**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

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|---|---|
| In re *Inter Partes* Review of: | ) |
| U.S. Patent No. 9,100,604 | ) |
| Issued: August 4, 2015 | ) |
| Application No.: US 14/264,243 | ) |
| Filed: April 29, 2014 | ) |
| For: **Electric Camera** | |

**FILED VIA E2E**

**DECLARATION OF DR. ELI SABER, PH.D. IN SUPPORT OF PETITION FOR *INTER PARTES* REVIEW OF U.S. PATENT NO. 9,100,604**

# APPENDICES – PART 2

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# New Products & Developments

*Further information about these items can be obtained direct from the addresses given. As in the case of technical papers, the Society is not responsible for manufacturers' statements, and publication of these items does not constitute endorsement of the products or services.*

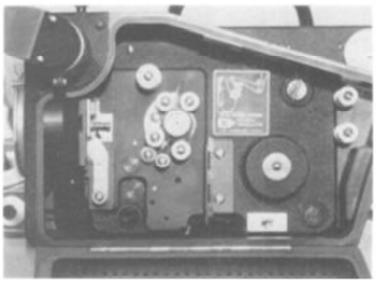


**The MV-201 miniature television camera,** a third-generation charge-coupled device (CCD), offering improved resolution over earlier models, has been announced by Fairchild Camera and Instrument Corp., Imaging Systems Div., 300 Robbins Lane, Syosset, NY 11791. The MV-201 has 244-line resolution and a bandwith of 1.86 MHz compared with resolution of 100 lines and a bandwith of 1 MHz for the MV-101, its immediate predecessor. The MV-201 incorporates a CCD sensor developed by Fairchild Memory and Logic Group. The sensor contains more than 46,000 photoresistive elements. The new camera is reported to be sensitive to as little as 0.000125 fc of illumination at the CCD elements with sensitivity extending into the near infrared range. The camera weighs 12 oz and is 2 in high, 2.5 in wide and 3.75 in long. A 25mm *f*/1.4 C mount lens is standard. Designed especially for military and industrial low-light applications, the camera may be used in law enforcement, remote inspection, industrial monitoring, process control and medical instrumentation.

The MV-201 interfaces directly with conventional TV receivers. Power required is 4 W at 12 V and battery operation is possible. The MV-201 is priced at $4000.

**The BCC-2,** a new handheld color broadcast camera designed for studio use as well as for on-location coverage of live news events and production video requirements, has been announced by Ampex Corp., 401 Broadway, Redwood City, CA 94063. The camera is 13 in long, 4 in wide and 8 in high. The camera head weighs 15 lb and comes with a shoulder support, 19-lb backpack, and harness. It has a weather-resistant head housing to provide easy and safe assembly, disassembly and transport of the camera for use on location. Designed for remote use, the BCC-2 is equipped with a battery pack that provides 1.5 h of operation and an ac-operated power supply. With a special cigarette lighter adapter it can also work from a standard 12-V automobile battery. The camera has a 10× zoom lens and tiltable mount. The viewfinder has external controls for contrast and brightness and a high-frequency peaking switch. External controls on the BCC-2 are located on the camera head. They include automatic/manual iris, intercom level, power switch, VTR stop/record, master video gain, auto white balance and encoder-video/bars. The camera incorporates three 1-in Plumbicons including an extended red. The optical system allows a large reduction of 50%. The BCC-2 system is priced at under $50,000.

Ampex Corp. also announced the BCC-3 color broadcast camera designed for educational, industrial and professional applications. An optional Interface Backpack (IB) is offered which allows the user to integrate the Ampex BCC-2 portable camera into the BCC-3 system. Designed to tie the BCC-2 to the separate camera control unit of the BCC-3, the IB transforms a portable backpack recording unit into an on-line camera for studio productions or remotes. The BCC-3 utilizes three 1-in Plumbicons including an extended red. A Schneider *f*/2.5 10:1 zoom lens is standard with 15:1 and 20:1 zoom lenses optional. The camera control unit has plug-in printed circuit cards for easy maintenance accessibility. Other features include a small diameter camera cable which can be run as far as 1000 ft with no timing adjustments necessary. The BCC-3 is priced at about $55,000.



**The CP-16R/DS,** a new double system sound reflex 16-mm camera, has been announced by Cinema Products Corp., 2037 Granville Ave., Los Angeles, CA 90025. The new camera is identical to the standard CP-16R reflex camera except that the flywheel and film-threading rollers needed for single-system sound recording have been removed making the new camera simpler and considerably faster to thread. Also it is about three quarters of a pound lighter than the 10-lb (body only) CP-16R. The new camera is designed especially for the cinematographer who shoots double-system sound only; however, if required, it can be easily converted to single/double-system sound capability.

**The Cooke Varo-Kinetal** 16mm zoom lens produced by Rank Optics in the United Kingdom and introduced in the United States by



BlackBerry Corporation Exhibit 1004, pg. 381

**Sponsoring Editor:** George Z. Kuredjian
**Editing Supervisor:** Larry Goldberg
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**Text Designer:** Sharkey Design
**Cover Type Designer:** Renée Kilbride
**Cover Illustrator:** John Weiman
**Technical Studio:** Fine Line, Inc.

Library of Congress Cataloging in Publication Data

Grob, Bernard.
Basic television and video systems.

Rev. ed. of: Basic television, principles and servicing.—
4th ed.— . . . 1975.
Includes bibliographical references and index.
1. Television. I. Title.
TK6630.G75 1984 621.388 83-5476
ISBN 0-07-024933-4

**Basic Television and Video Systems, Fifth Edition**

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1 2 3 4 5 6 7 8 9 0 DOCDOC 8 9 0 9 8 7 6 5 4 3

ISBN 0-07-024933-4

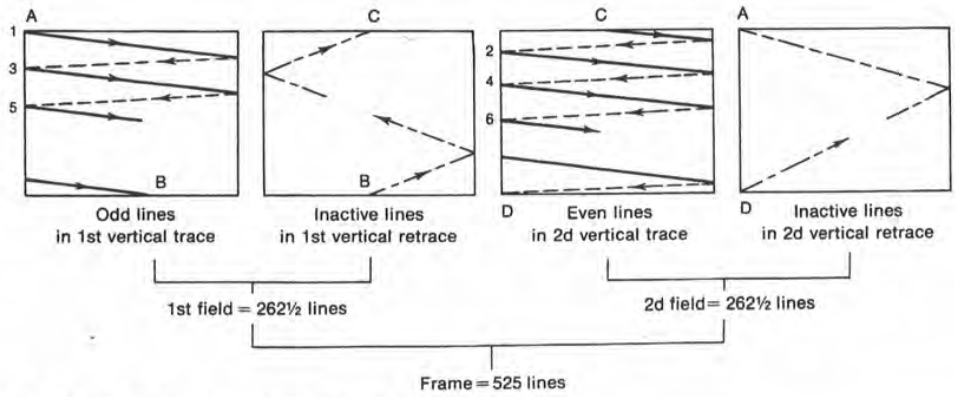



**Fig. 6-5** Details of odd-line interlacing with two fields in one frame.

even lines are skipped. After this vertical scanning cycle, a rapid vertical retrace causes the electron scanning beam to return to the top of the frame. Then all the even lines that were omitted in the first scanning are scanned from top to bottom.

Each frame becomes divided into two fields. The first and all the following odd fields contain the odd lines in the frames. The second and all the even fields include the even scanning lines. Given two fields per frame and 30 complete frames scanned per second, the field repetition rate is 60 per second and the vertical scanning frequency is 60 Hz. In fact, doubling the vertical scanning frequency from the 30-Hz frame rate to the 60-Hz field rate is what makes the beam scan every other line in the frame.

**ODD-LINE INTERLACING** The geometry of the standard odd-line interlaced scanning pattern is illustrated in Fig. 6-5. Actually, the electron gun aims the beam at the center, which is where the scanning starts. For convenience, however, we can follow the motion by starting at the upper left corner of the frame at point A. For this line 1, the beam sweeps across the frame with uniform velocity to cover all the picture elements in one horizontal line. At the end of this trace, the beam retraces rapidly to the left side of the frame, as shown by the dashed line, to begin scanning the next horizontal line.

Note that the horizontal lines slope downward in the direction of scanning because the vertical deflection signal simultaneously produces a vertical scanning motion, which is very slow compared with horizontal scanning. Also note that the slope of the horizontal trace from left to right is greater than the slope during retrace from right to left. The reason is that the faster retrace does not allow the beam as much time to be deflected vertically.

After line 1 is scanned, the beam is at the left side, ready to scan line 3, omitting the second line. This line skipping is accomplished by doubling the vertical scanning frequency from 30 to 60 Hz. Deflecting the beam vertically at twice the speed necessary to scan 525 lines produces a complete vertical scanning period for only 262½ lines, with alternate lines left blank. The electron beam scans all the odd lines, then, finally reaching a position, such as point B in Fig. 6-5, at the bottom of the frame.

At time B the vertical retrace begins because of flyback on the vertical sawtooth deflection sig-



BlackBerry Corporation Exhibit 1004, pg. 383

# NTSC Signal Specifications*

There is presented here the technical signal specifications formulated by the National Television System Committee and approved by the Federal Communications Commission on December 17, 1953 as the technical transmission standards for commercial color television broadcasting in the United States.—*The Editor*

## I. General Specifications

### *A. Channel*

The color television signal and its accompanying sound signal shall be transmitted within a 6 mc channel.

### *B. Picture Signal Frequency*

The picture signal carrier, nominally 1.25 mc above the lower boundary of the channel, shall conform to the frequency assigned by the FCC for the particular station.

### *C. Polarisation*

The radiated signals shall be horizontally polarized.

### *D. Vestigial Sideband Transmission*

Vestigial sideband transmission in accordance with Fig. 2 shall be employed.

### *E. Aspect Ratio*

The aspect ratio of the scanned image shall be four units horizontally to three units vertically.

### *F. Scanning and Synchronization*

1. The color picture signal shall correspond to the scanning of the image at uniform velocities from left to right and from top to bottom with 525 lines per frame interlaced 2:1.

2. The horizontal scanning frequency shall be 2/455 times the color subcarrier frequency; this corresponds nominally to 15,750 cycles per second (with an actual value of 15,734.264 ± 0.047 cycles per second). The vertical scanning frequency is 2/525 times the horizontal scanning frequency: this corresponds nominally to 60 cycles per second (the actual value is 59.94 cycles per second).

3. The color television signal shall consist of color picture signals and synchronizing signals, transmitted successively and in different amplitude ranges except where the chrominance penetrates the synchronizing region, and the burst penetrates the picture region.

4. The horizontal, vertical, and color synchronizing signals shall be those specified in Fig. 1, as modified by vestigial sideband transmission specified in Fig. 2 and by the delay characteristic specified in III.B.

* Decimal classification: R583×R020. Approved by Panel 13, July 8, 1953, and the NTSC, July 21, 1953. Reprinted from Appendix A of the NTSC petition to the FCC.

### *G. Out-of-Channel Radiation*

The field strength measured at any frequency beyond the limits of the assigned channel shall be at least 60 db below the peak picture level.

## II. Sound

### *A. Sound Signal Frequency*

The frequency of the unmodulated sound carrier shall be 4.5 mc ± 1,000 cycles above the frequency actually in use for the picture carrier.

### *B. Sound Signal Characteristics*

The sound transmission shall be by frequency modulation, with maximum deviation of ±25 kc, and with pre-emphasis in accordance with a 75 μsec time constant.

### *C. Power Ratio*

The effective radiated power of the aural-signal transmitter shall be not less than 50 per cent nor more than 70 per cent of the peak power of the visual signal transmitter.

## III. The Complete Color Picture Signal

### *A. General Specifications*

The color picture signal shall correspond to a luminance (brightness) component transmitted as amplitude modulation of the picture carrier and a simultaneous pair of chrominance (coloring) components transmitted as the amplitude modulation sidebands of a pair of suppressed subcarriers in quadrature having the common frequency relative to the picture carrier of +3.579545 mc ±0.0003 per cent with a maximum rate of change not to exceed 1/10 cycle per sec per sec.

### *B. Delay Specification*

A sine wave, introduced at those terminals of the transmitter which are normally fed the color picture signal, shall produce a radiated signal having an envelope delay, relative to the average envelope delay between 0.05 and 0.20 mc, of zero μsecs up to a frequency of 3.0 mc; and then linearly decreasing to 4.18 mc so as to be equal to −0.17 μsecs at 3.58 mc. The tolerance on the envelope delay shall be ±0.05 μsecs at 3.58 mc. The tolerance shall increase linearly to ±0.1 μsec, down to

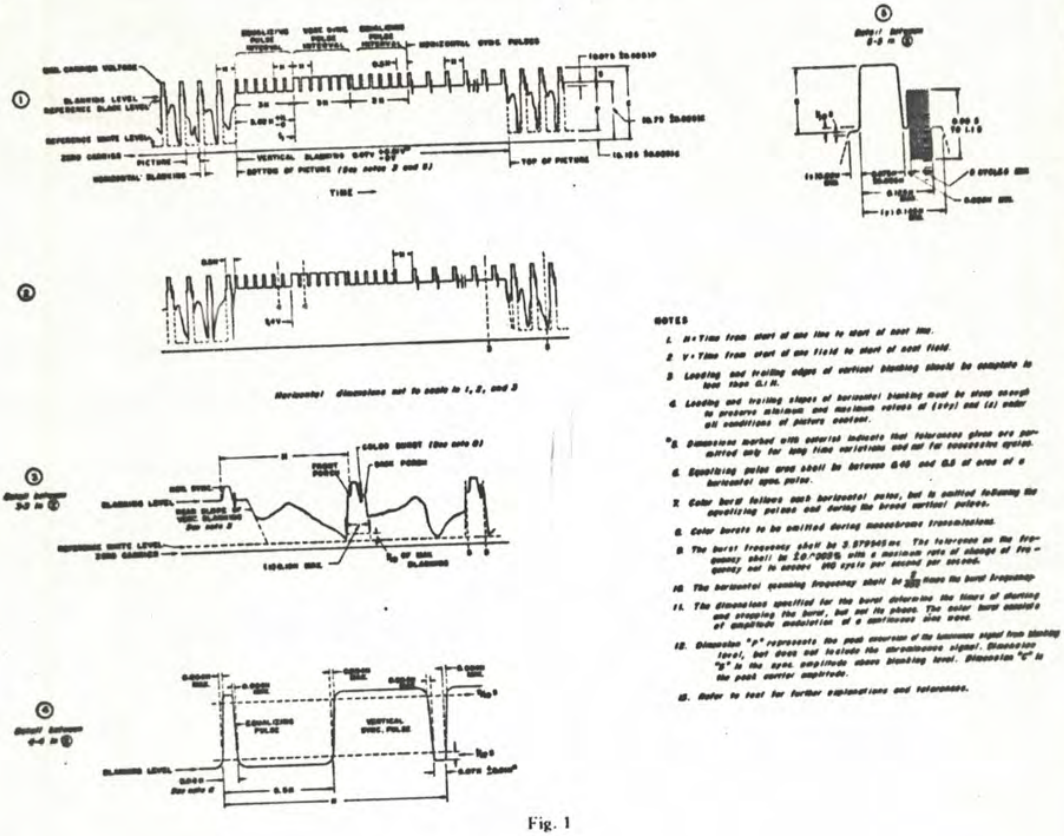


Fig. 1

2.1 mc, and remain at ±0.1 μsec down to 0.2 mc.[1] The tolerance shall also increase linearly to ±0.1 μsec at 4.18 mc.

### C. The Luminance Component

1. An increase in initial light intensity shall correspond to a decrease in the amplitude of the carrier envelope (negative modulation).

2. The blanking level shall be at (75 ± 2.5) per cent of the peak amplitude of the carrier envelope. The reference white (luminance) level shall be (12.5 ± 2.5) per cent of the peak carrier amplitude. The reference black level shall be separated from the blanking level by the setup interval, which shall be (7.5 ± 2.5) per cent of the video range from the blanking level to the reference white level.

3. The over-all attenuation versus frequency of the luminance signal shall not exceed the value specified by the FCC for black-and-white transmission.

[1] Tolerances for the interval of 0.0 to 0.2 mc should not be specified in the present state of the art.

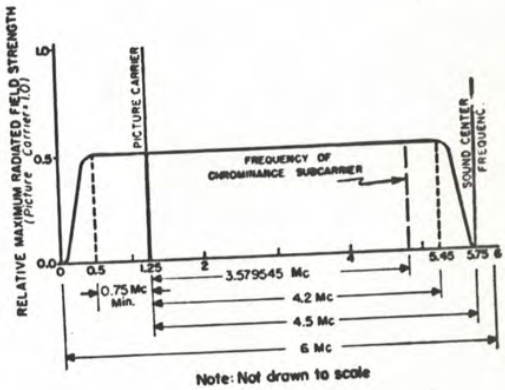



Fig. 2

### D. Equation of Complete Color Signal

1. The color picture signal has the following composition:

$$E_M = E_Y' + \{E_Q' \sin(\omega t + 33°) + E_I' \cos(\omega t + 33°)\}$$

where

$$E_Q' = 0.41(E_B' - E_Y') + 0.48\,(E_R' - E_Y')$$
$$E_I' = -0.27(E_B' - E_Y') + 0.74\,(E_R' - E_Y')$$
$$E_Y' = 0.30E_R' + 0.59E_G' + 0.11\,E_B'.$$

The phase reference in the above equation is the phase of the (color burst +180°), as shown in Fig. 3. The burst corresponds to amplitude modulation of a continuous sine wave.

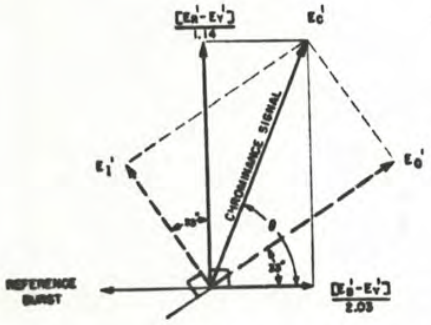



Fig. 3

Notes: For color-difference frequencies below 500 kc, the signal can be represented by

$$E_M = E_Y' + \left\{\frac{1}{1.14}\left[\frac{1}{1.78}\,(E_B' - E_Y')\sin \omega t + (E_R' - E_Y')\cos \omega t\right]\right\}.$$

In these expressions the symbols have the following significance:

$E_M$ is the total video voltage, corresponding to the scanning of a particular picture element, applied to the modulator of the picture transmitter.

$E_Y'$ is the gamma-corrected voltage of the monochrome (black-and-white) portion of the color picture signal, corresponding to the given picture element.[1]

$E_R'$, $E_G'$, and $E_B'$ are the gamma-corrected voltages corresponding to red, green, and blue signals during the scanning of the given picture element.

The gamma corrected voltages $E_R'$, $E_G'$, and $E_B'$ are suitable for a color picture tube having primary colors with the following chromaticities in the CIE system of specification:

| | $x$ | $y$ |
|---|---|---|
| Red ($R$) | 0.67 | 0.33 |
| Green ($G$) | 0.21 | 0.71 |
| Blue ($B$) | 0.14 | 0.08 |

and having a transfer gradient (gamma exponent) of 2.2[2] associated with each primary color. The voltages $E_R'$, $E_G'$, and $E_B'$ may be respectively of the form $E_R^{1/\gamma}$, $E_G^{1/\gamma}$, and $E_B^{1/\gamma}$ although other forms may be used with advances in the state of the art.

$E_Q'$ and $E_I'$ are the amplitudes of two orthogonal components of the chrominance signal corresponding respectively to narrow-band and wide-band axes, as specified in paragraph *D*.

The angular frequency $\omega$ is $2\pi$ times the frequency of the chrominance subcarrier.

The portion of each expression between brackets represents the chrominance subcarrier signal which carries the chrominance information.

1. The chrominance signal is so proportioned that it vanishes for the chromacity of CIE illuminant *C* ($x = 0.310$, $y = 0.316$).

2. $E_Y'$, $E_Q'$, $E_I'$ and the components of these signals shall match each other in time to 0.05 μsecs.

3. A sine wave of 3.58 mc introduced at those terminals of the transmitter which are normally fed the color picture signal shall produce a radiated signal having an amplitude (as measured with a diode on the RF transmission line supplying power to the antenna) which is down (6 ± 2) db with respect to a radiated signal produced by a sine wave of 200 kc. In addition, the amplitude of the radiated signal shall not vary by more than ±2 db between the modulating frequencies of 2.1 and 4.18 mc.

4. The equivalent bandwidths assigned prior to modulation to the color-difference signals $E_Q'$ and $E_I'$ are given by Table I.

TABLE I

| |
|---|
| *Q-channel bandwidth* |
| at 400 kc less than 2 db down |
| at 500 kc less than 6 db down |
| at 600 kc at least 6 db down |
| *I-channel bandwidth* |
| at 1.3 less than 2 db down |
| at 3.6 mc at least 20 db down |

5. The angles of the subcarrier measured with respect to the burst phase, when reproducing saturated primaries and their complements at 75 per cent of full amplitude, shall be within ±10° and their amplitudes shall be within ±20 per cent of the values specified above. The ratios of the measured amplitudes of the subcarrier to the luminance signal for the same saturated primaries and their complements shall fall between the limits of 0.8 and 1.2 of the values specified for their ratios. Closer tolerances may prove to be practicable and desirable with advance in the art.

[1] Forming of the high frequency portion of the monochrome signal in a different manner is permissible and may in fact be desirable in order to improve the sharpness on saturated colors.

[2] At the present state of the art it is considered inadvisable to set a tolerance on the value of gamma and correspondingly this portion of the specification will not be enforced.


Panasonic
Pocket Watch
CT-301E/302B
3″ diagonal LCD Color TV
Pocket Watch
Panasonic LIQUID CRYSTAL DISPLAY
CT-301E
CT-302B
Picture simulated

# CT-301E/302B Pocket Watch™ 3″ diagonal LCD Color TV

LCD Technology. Once the province of pocket calculators and digital watches...now, a growing force in the television industry. Panasonic proudly presents Pocket Watch; the next generation of portable TV's. The result of pioneering research in the LCD field, the Pocket Watch by Panasonic is a 3″ diagonal Color TV with remarkable picture clarity. Thanks to its TFT Active Matrix System, the Pocket Watch is able to deliver even subtle variations in color not found in earlier, Simple Matrix formats. What's more, in addition to the internal backlight, a pop-up display panel makes use of ambient light to ensure a high-contrast picture under almost any lighting condition.

The end result is the convenience of viewing TV programs anywhere at any time, on a picture worthy of the Panasonic name.




## Quality Features for Quality Performance

**3″ Diagonal LCD Screen...Just 7/8″ Thin**
The Pocket Watch boasts a 3″ LCD (Liquid Crystal Display) screen. Large enough to deliver fine detail and crisp image clarity, yet housed in an ultra-compact frame that measures less than an inch from front to back. What's more, a wide viewing angle (±40° horizontal and ±30° vertical) allows flexibility of placement, helping to ensure comfortable viewing.

**Internal Backlight and Pop-up Display Panel**
For outdoor use, a pop-up display panel filters environmental lighting through the screen. Indoors, an internal backlight can be used when ambient light is insufficient to generate a bright picture. Both indoors and out, day or night, it's always the right time for the Pocket Watch by Panasonic.

**TFT Active Matrix System**
A technical breakthrough called TFT (Thin Film Transistor) Active Matrix is responsible for the brilliant color reproduction of the Pocket Watch by Panasonic. Employing 89,280 individual picture elements (240 x 372 pixels), this system produces the intermediate colors that were difficult to obtain with earlier LCD screens. The color filter technology of the Pocket Watch features Triangle Color Formation and Black Matrix to help improve contrast and overall picture quality.

**4-Way Operation**
In addition to the AC adaptor provided for indoor use, you can enjoy up to 5.5 hours of continuous viewing with alkaline batteries* (when using external illumination). The Pocket Watch can also operate on an optional Ni-Cd rechargeable battery. Or, if you prefer, an optional car adaptor cord makes use of your car's cigarette-lighter. Ideal for picnics, or for use in campers and trailers.

* Alkaline batteries not included.

**Audio/Video Input Jack**
Thanks to its Audio/Video Input jack, the Pocket Watch can function as a quality color monitor for a camera or VCR. Watch instant color playback of camera-recorded material to help ensure that the desired scene was properly filmed.

**Standard Accessories**
- AC Adaptor
- Earphone
- Handstrap
- Antenna Matching Unit
- Soft Case
- Detachable Stand

**Optional Accessories**
- Ni-Cd Rechargeable Battery (TY-BT49P)
- Car Adaptor Cord (TY-RC49P)
- A/V Connection Cord (TY-SC49P)

**Other Features**
- VHF/UHF unipotential antenna helps assure strong TV broadcast reception under most conditions. An external antenna terminal is also provided.
- Independent controls for VHF/UHF band selection, slide rule tuning, volume, color, tint, and brightness.
- Detachable stand lets you select the most desirable viewing angle.

Note: Avoid exposing this unit to high temperatures and direct sunlight for prolonged periods.

## Technical Specifications

| | |
|---|---|
| Viewing Area: | 4.3 sq. inches (3″ diagonal) |
| Number of Pixels: | 89,280 (240 vertical x 372 horizontal) |
| Contrast: | more than 30 : 1 |
| Viewing Angle: | ±40° (horizontal), ±30° (vertical) |
| Channels: | UHF 56<br>VHF 12 |
| Power Source: | 4-way operation (AC/Dry cell battery/ Car battery/ Rechargeable battery) |
| Power Consumption: | 3.0 W (with backlight)<br>1.7 W (without backlight) |
| Continuous Battery Usage Time: 6 "AA" size alkaline batteries; | 3.0 hours (with backlight)<br>5.5 hours (without backlight) |
| Terminals: | Audio/video input jack<br>External antenna terminal<br>Earphone jack |
| Speaker: | 1 7/16″ round |
| Antenna: | VHF/UHF unipotential antenna |
| Dimensions (H x W x D): | 6 7/16″ x 3 9/16″ x 7/8″ |
| Weight: | 15/16 lbs. (including 6 "AA" batteries) |
| Cabinet Color: | Black (CT-301E)<br>Wine Red (CT-302B) |

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Specifications subject to change without notice. Printed in Japan

US005751261A

# United States Patent [19]

Zavracky et al.

[11] Patent Number: 5,751,261

[45] Date of Patent: May 12, 1998

[54] **CONTROL SYSTEM FOR DISPLAY PANELS**

[75] Inventors: **Matthew Zavracky**, North Attleboro; **Vic Odryna**, Acton; **Barry Mansell**, Groton, all of Mass.

[73] Assignee: **Kopin Corporation**, Taunton, Mass.

[21] Appl. No.: **106,416**

[22] Filed: **Aug. 13, 1993**

**Related U.S. Application Data**

[63] Continuation-in-part of Ser. No. 971,399, Nov. 4, 1992, abandoned, which is a continuation-in-part of Ser. No. 944,207, Sep. 11, 1992, which is a continuation-in-part of Ser. No. 823,858, Jan. 22, 1992, abandoned, and Ser. No. 872,297, Apr. 22, 1992, which is a continuation-in-part of Ser. No. 839,241, Feb. 20, 1992, abandoned, which is a continuation-in-part of Ser. No. 636,602, Dec. 31, 1990, Pat. No. 5,206,749.

[51] **Int. Cl.**[6] ..... **G09G 3/20**

[52] **U.S. Cl.** ..... **345/55**; 345/99

[58] **Field of Search** ..... 345/207, 55, 58, 345/87, 89, 101, 63, 99, 100, 102, 132, 127; 348/777, 776

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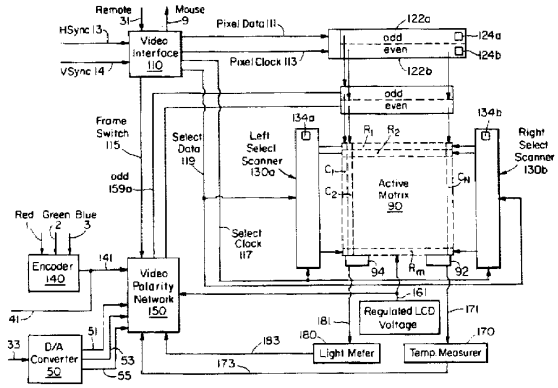
(List continued on next page.)

*Primary Examiner*—Curtis Kuntz
*Assistant Examiner*—Vivian Chang
*Attorney, Agent, or Firm*—Hamilton, Brook, Smith & Reynolds, P.C.

[57] **ABSTRACT**

A control apparatus for an active matrix liquid crystal display device is fabricated with the active matrix as a single integrated SOI circuit. The control apparatus and the active matrix are lifted from a silicon substrate and transferred to a glass substrate as a single piece. The control apparatus comprises a video interface, a column driver, and dual row drivers. The video interface operates the active matrix as a multiple-frequency scanning display device. The polarities of the display pixels are reversed on every frame by a polarity switch coupled to a video signal amplifier. The control apparatus further comprises sensors for generating a gray-scale feedback signal to adjust the gain of the video amplifier. User control of the display is provided by a user interface.

**20 Claims, 14 Drawing Sheets**



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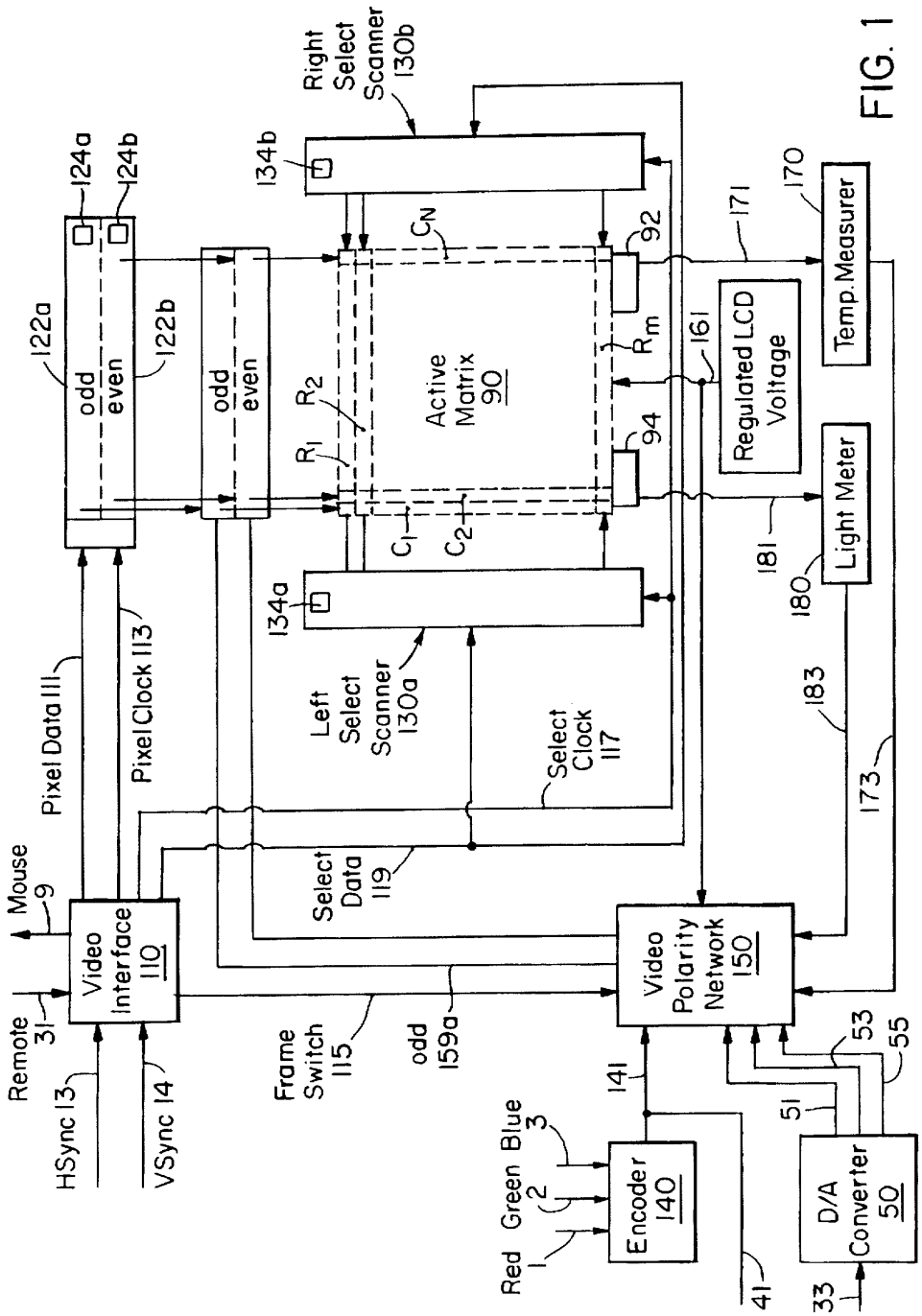



FIG. 1

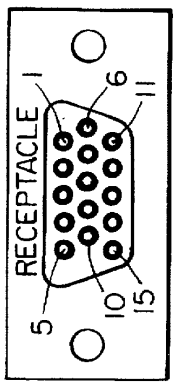



FIG. 2A

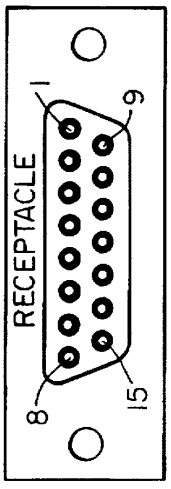



FIG. 2C

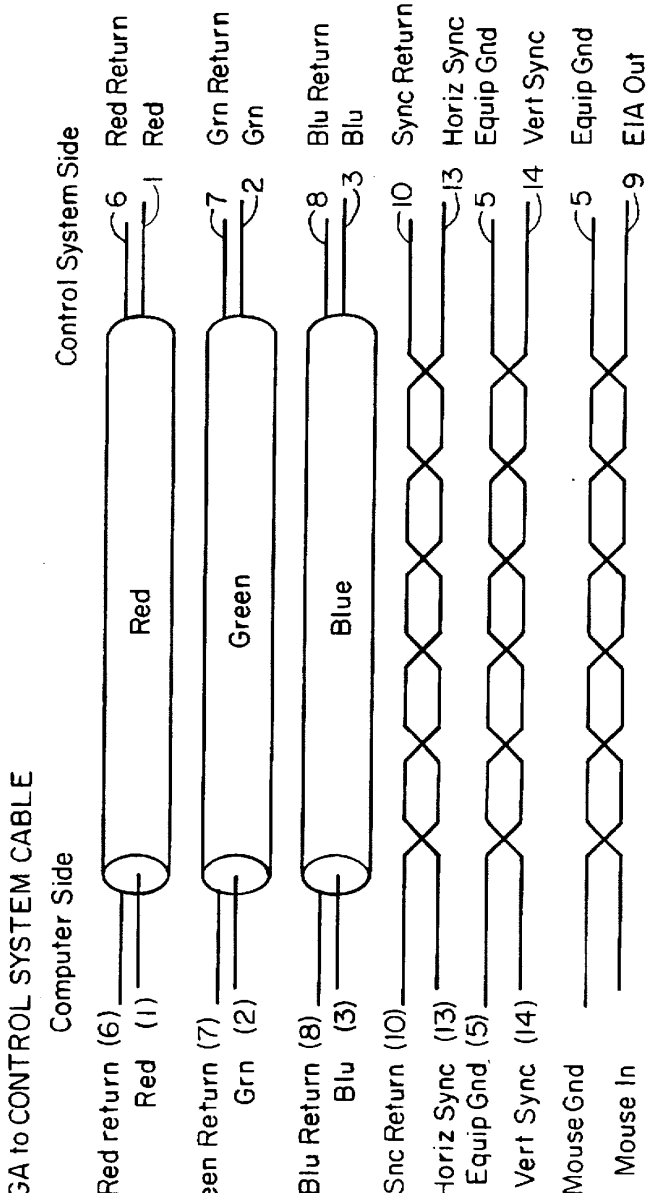



FIG. 2B

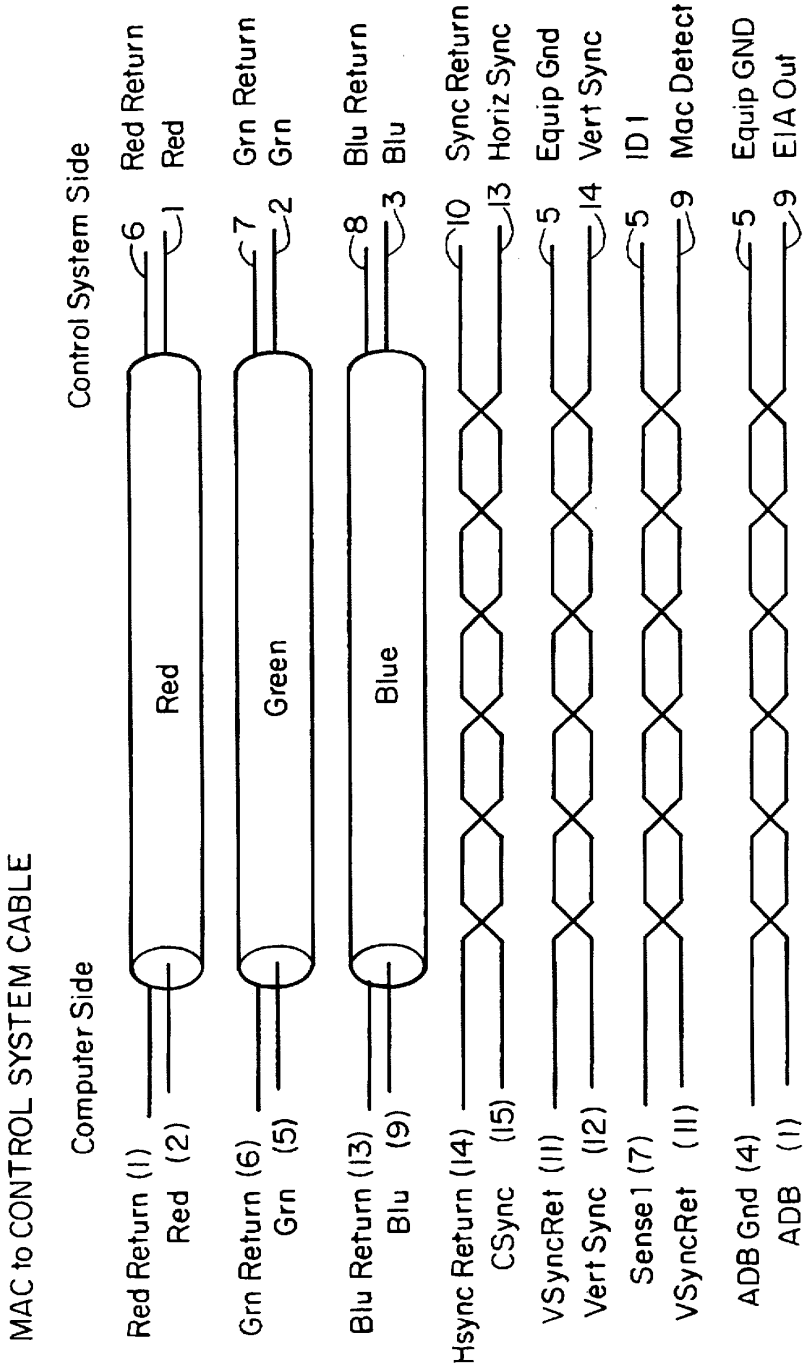

MAC to CONTROL SYSTEM CABLE
Computer Side
Control System Side
Red Return (1)
Red (2)
Red
6
Red Return
1
Red
Grn Return (6)
Grn (5)
Green
7
Grn Return
2
Grn
Blu Return (13)
Blu (9)
Blue
8
Blu Return
3
Blu
Hsync Return (14)
CSync (15)
10
Sync Return
13
Horiz Sync
VSyncRet (11)
Vert Sync (12)
5
Equip Gnd
14
Vert Sync
Sense1 (7)
VSyncRet (11)
5
ID 1
9
Mac Detect
ADB Gnd (4)
ADB (1)
5
Equip GND
9
EIA Out

FIG. 2D

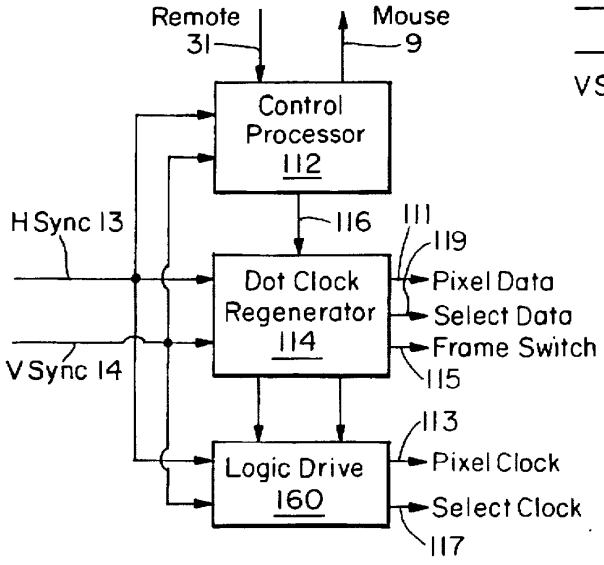



FIG. 3A

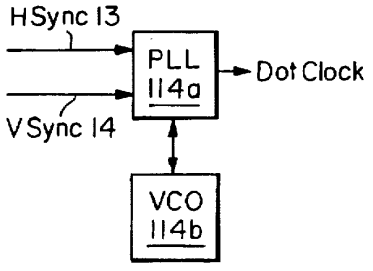



FIG. 3B

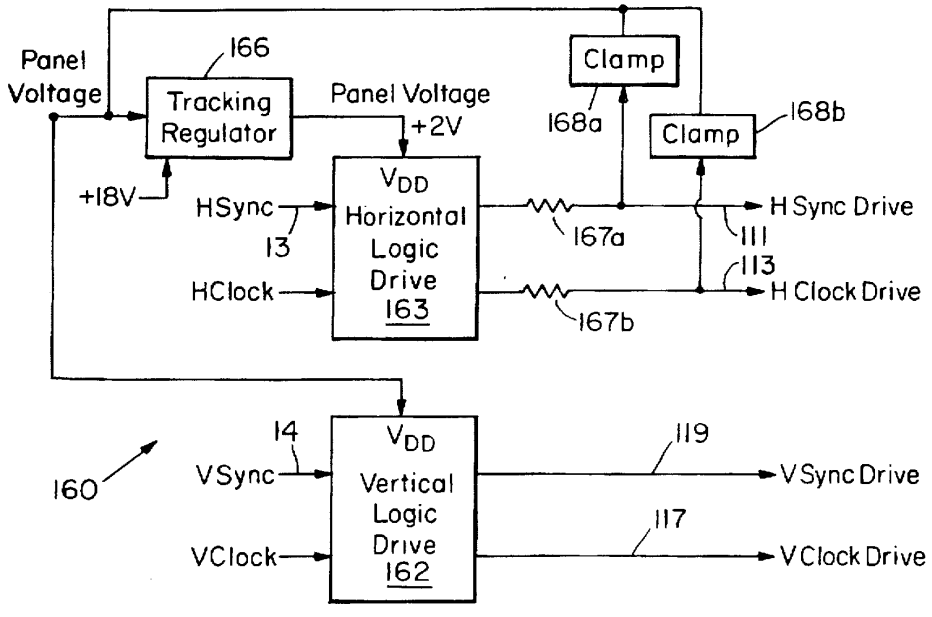



FIG. 3C

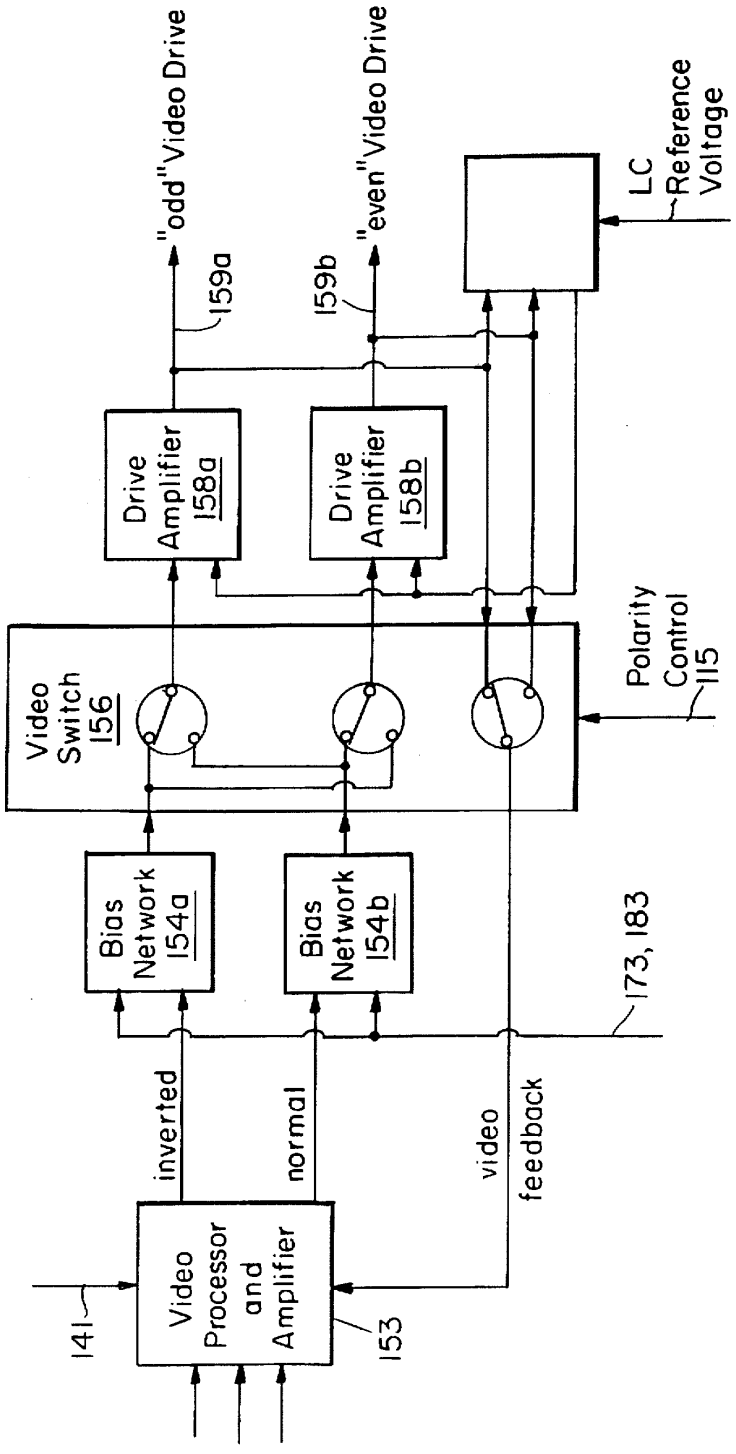

"odd" Video Drive
"even" Video Drive
159a
159b
LC Reference Voltage
Drive Amplifier 158a
Drive Amplifier 158b
Video Switch 156
Polarity Control 115
Bias Network 154a
Bias Network 154b
173, 183
inverted
normal
video feedback
Video Processor and Amplifier
141
153

FIG. 4

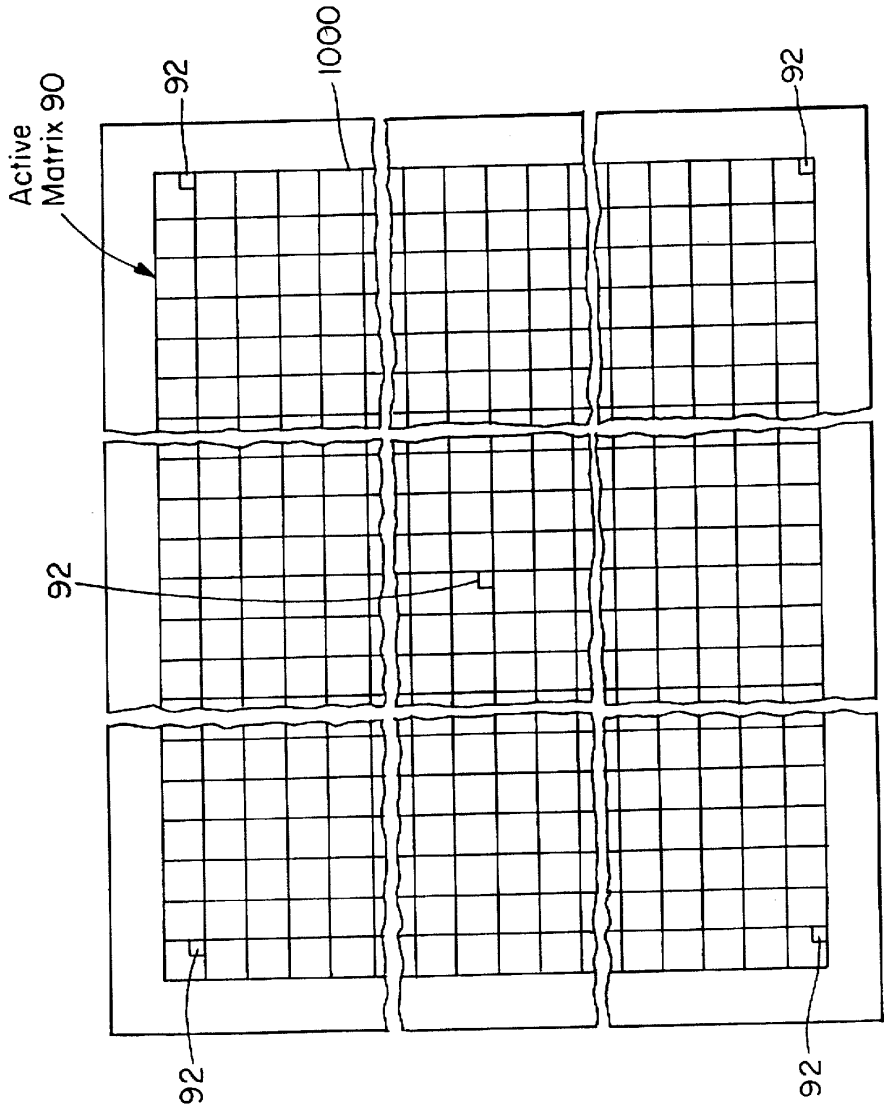



FIG. 5

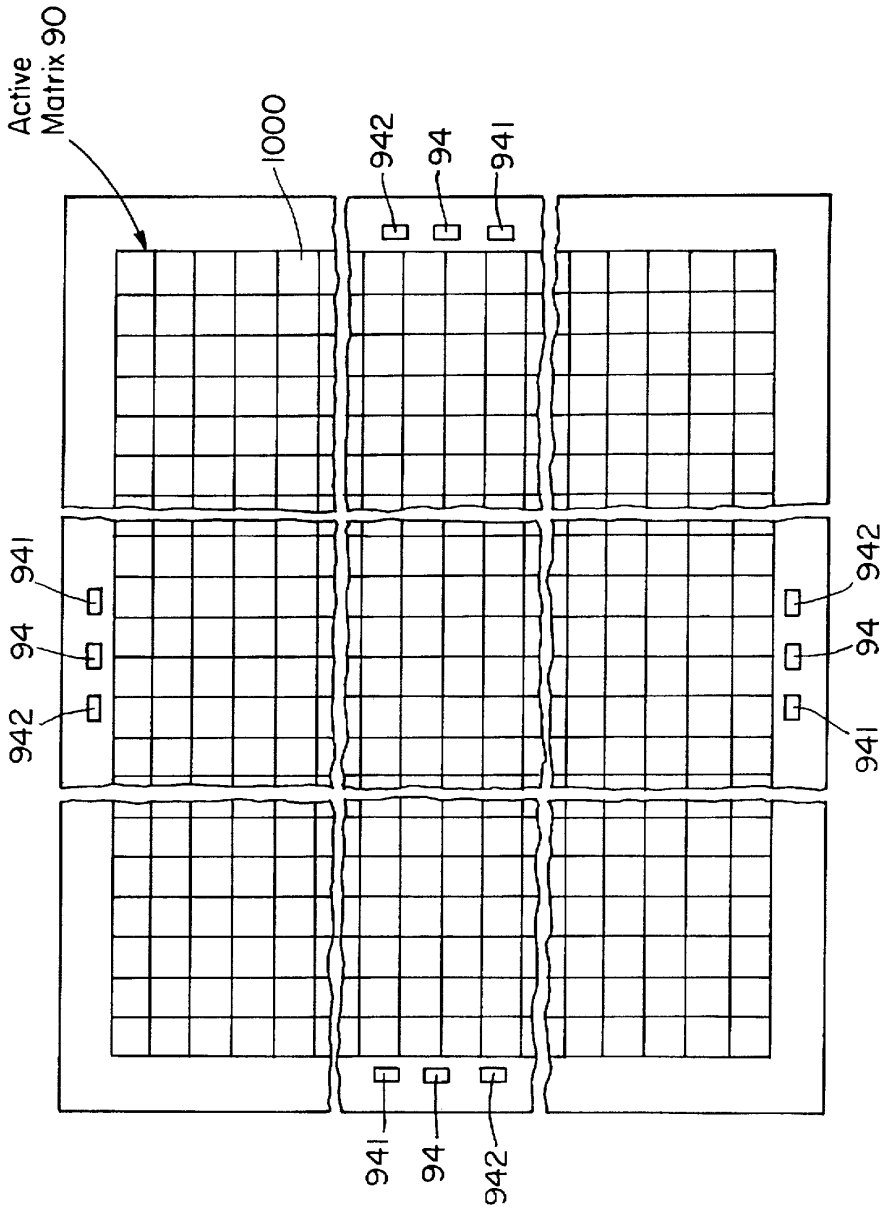

Active Matrix 90
1000
942
94
941
941
94
942
942
94
941
941
94
942

FIG. 6A

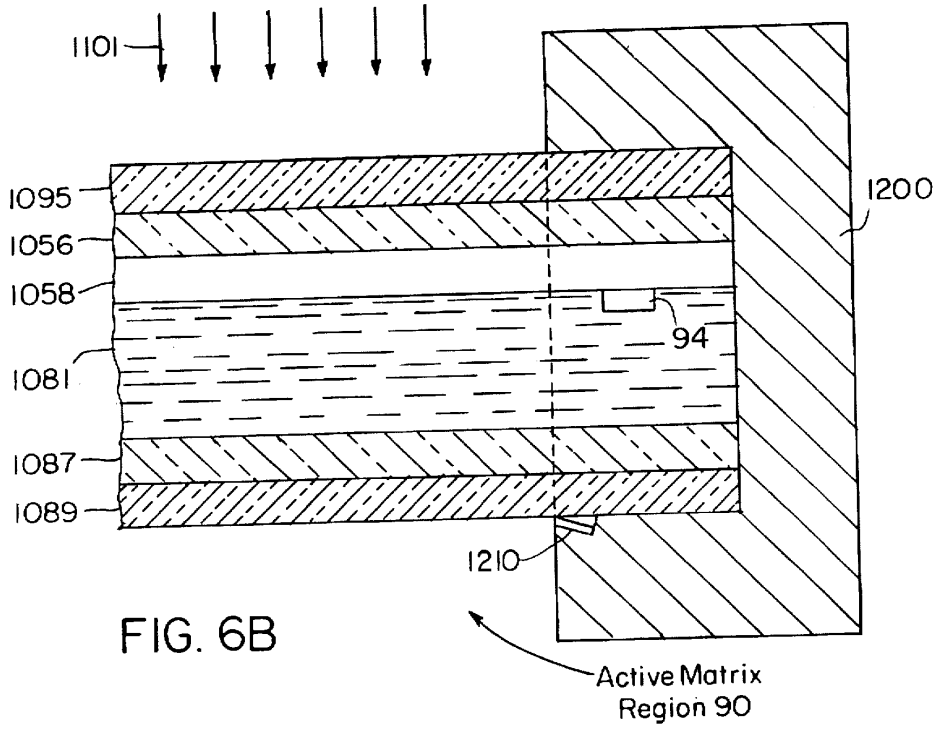

1101
1095
1056
1058
1081
1087
1089
94
1200
1210
Active Matrix Region 90

FIG. 6B

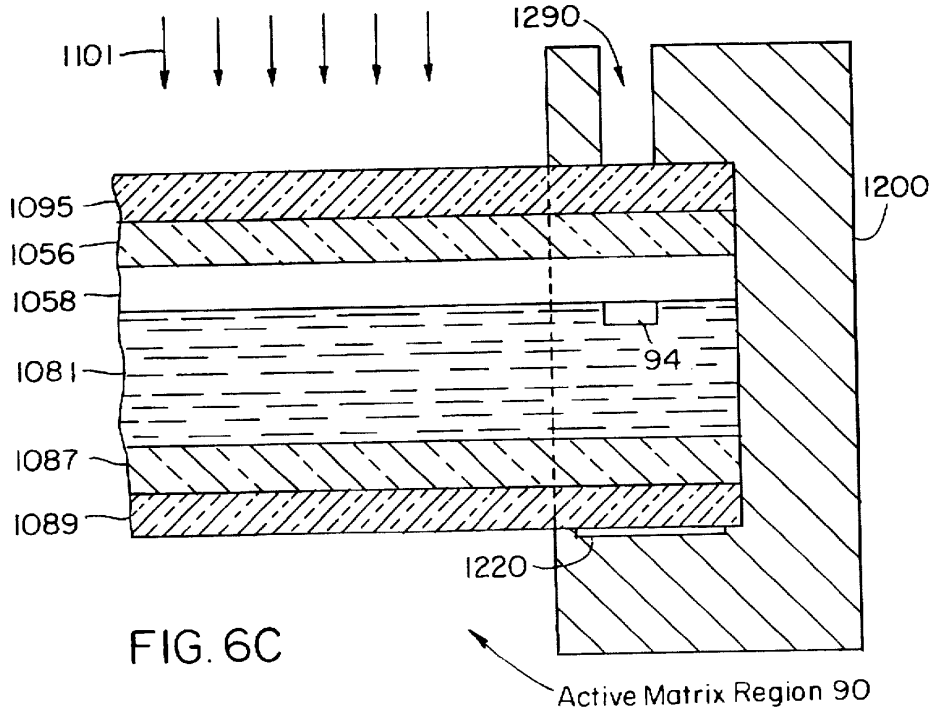

1101
1290
1095
1056
1058
1081
1087
1089
94
1200
1220
Active Matrix Region 90

FIG. 6C

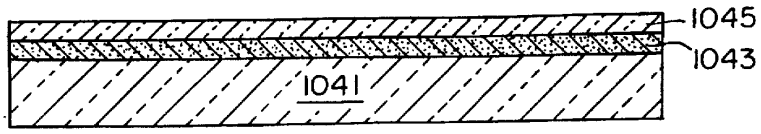



FIG. 7A

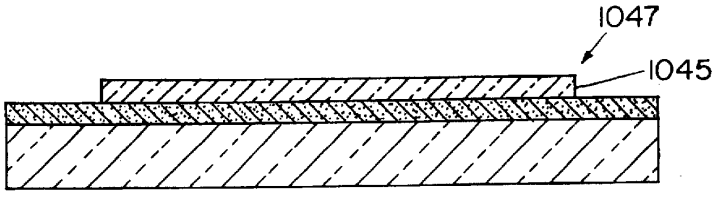



FIG. 7B

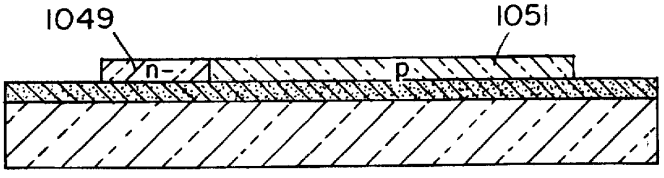



FIG. 7C

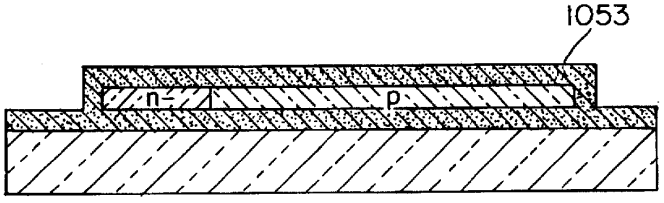



FIG. 7D

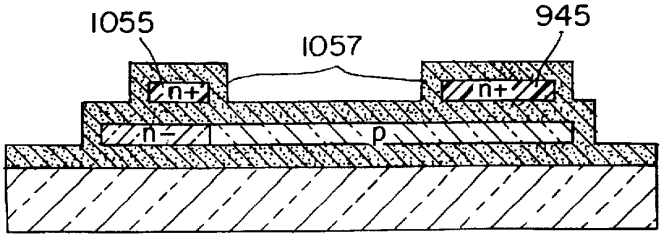



FIG. 7E

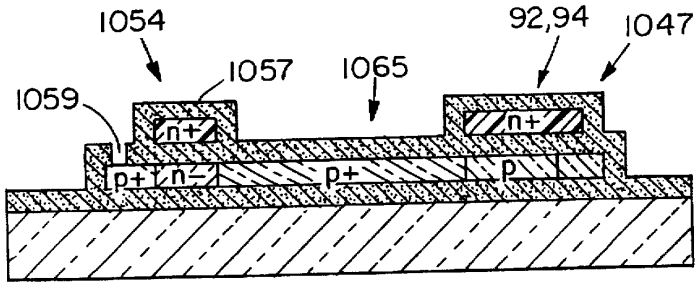



FIG. 7F

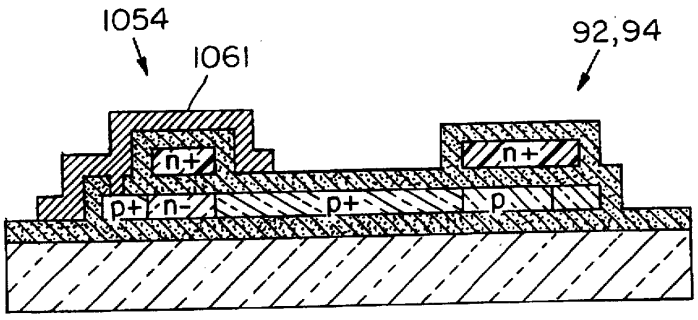



FIG. 7G

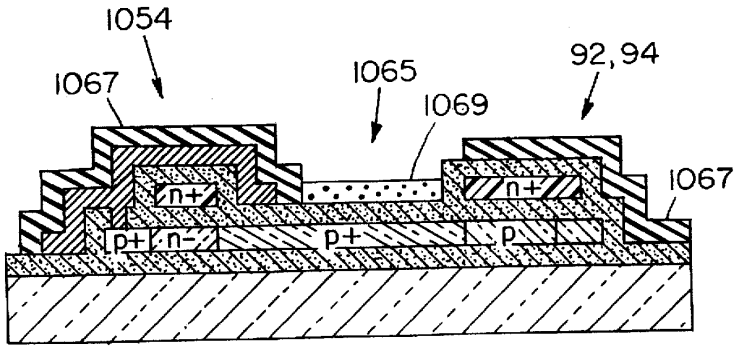



FIG. 7H

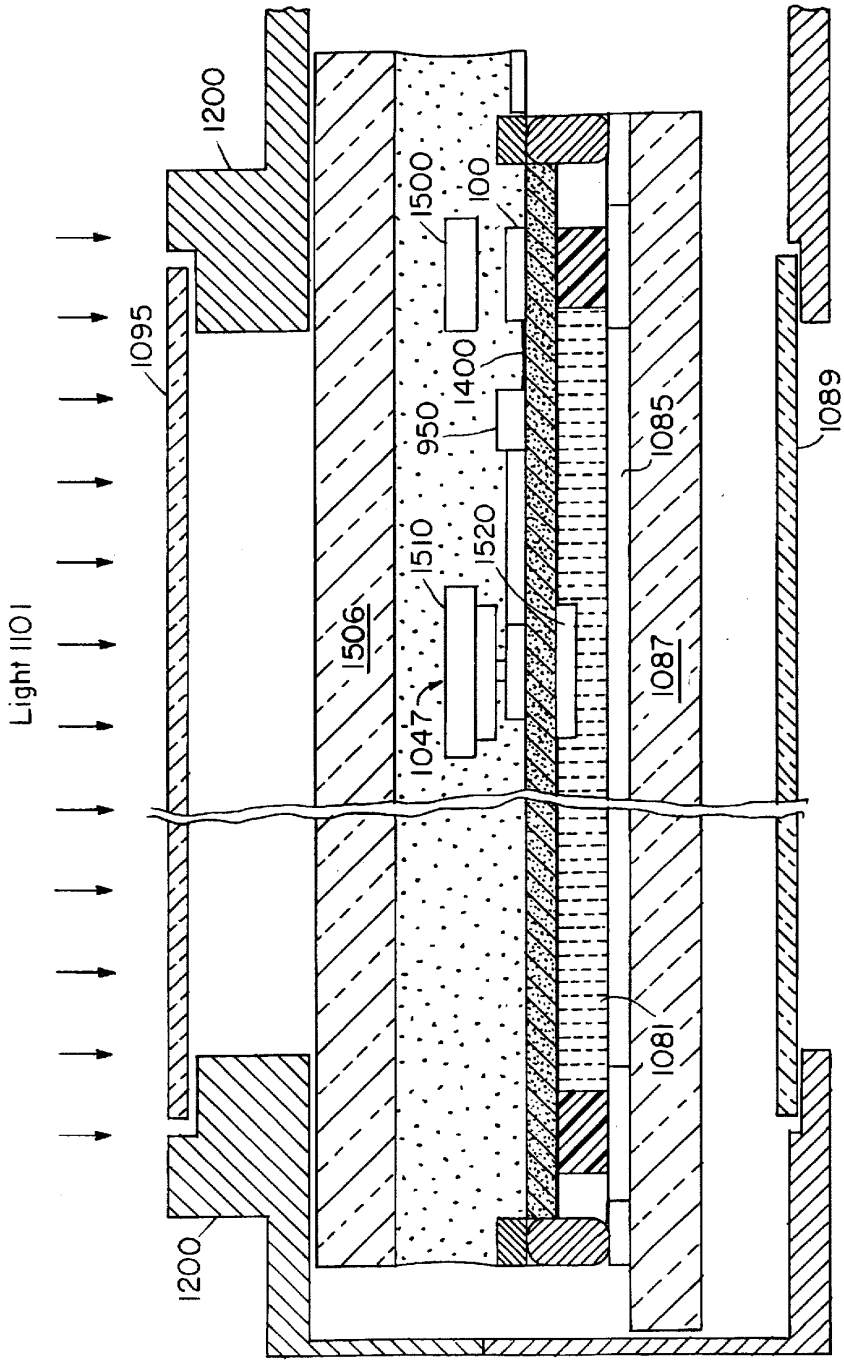

Light 1101
1200
1095
1500
100
1400
950
1510
1520
1506
1047
1085
1089
1087
1081
1200

FIG. 8

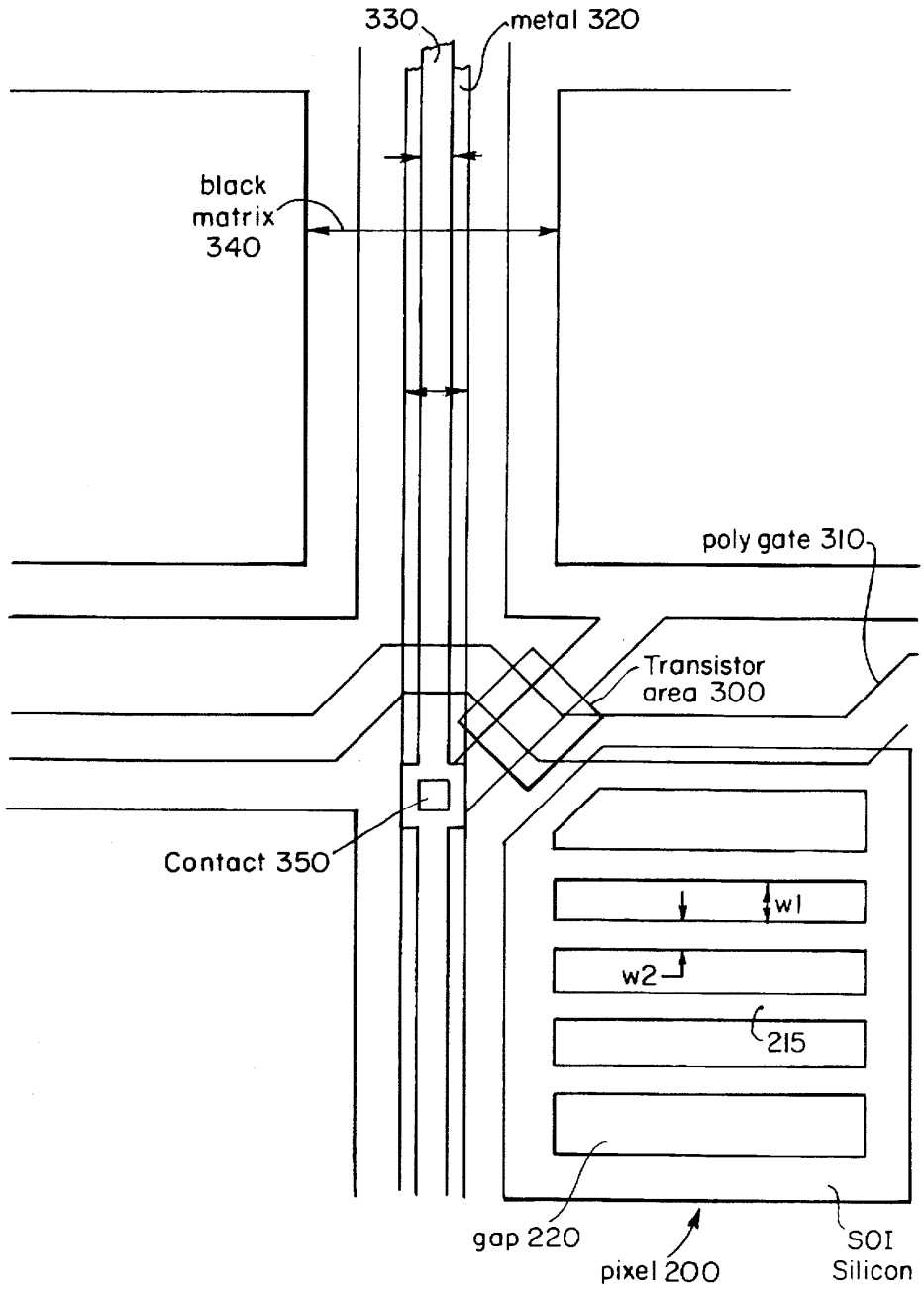

330
metal 320
black
matrix
340
poly gate 310
Transistor
area 300
Contact 350
w1
w2
215
gap 220
pixel 200
SOI
Silicon

FIG. 9

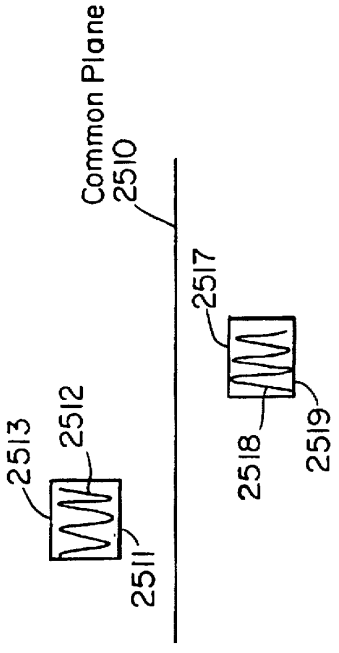



FIG. 11A

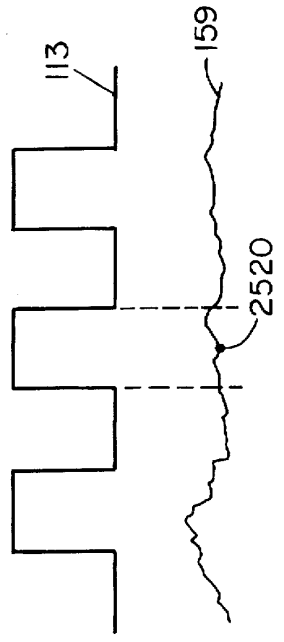



FIG. 11B

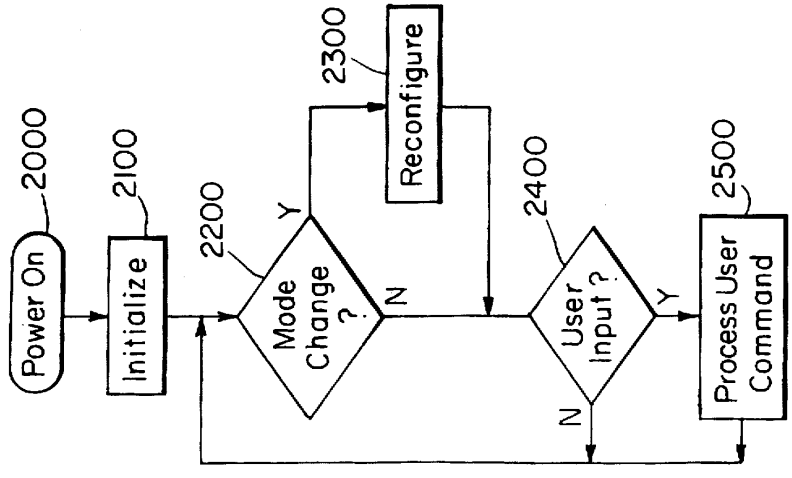



FIG. 10

FIG. 12A

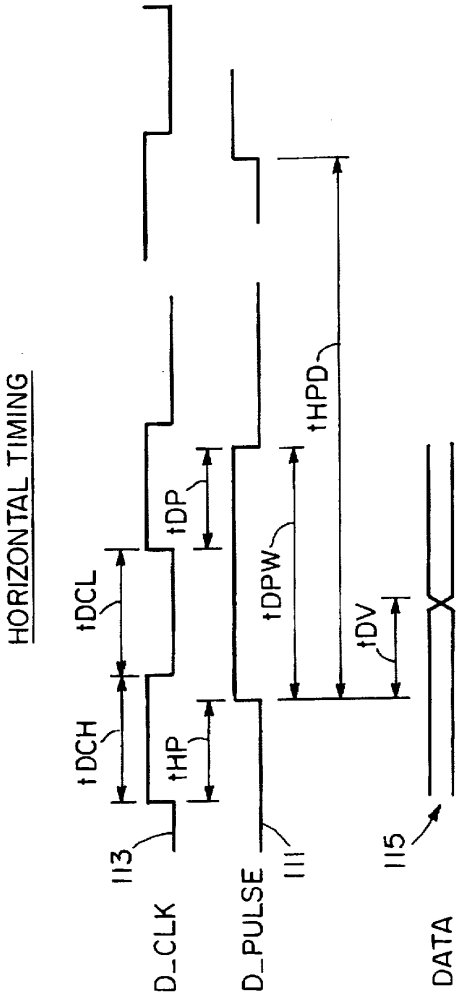
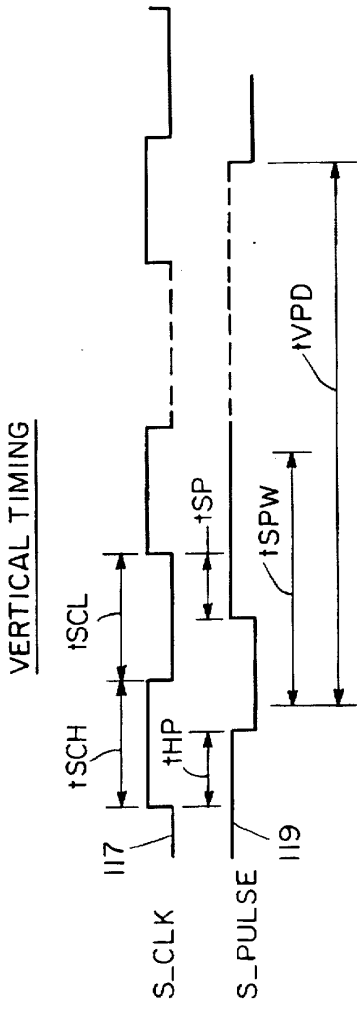



FIG. 12B



# CONTROL SYSTEM FOR DISPLAY PANELS

## RELATED APPLICATION

This application is a Continuation-In-Part of U.S. patent application, Ser. No. 07/971,399 filed Nov. 4, 1992, now abandoned, which is a Continuation-In-Part of U.S. patent application, Ser. No. 07/944,207 filed on Sep. 11, 1992, now allowed, which is also a Continuation-In-Part of Ser. No. 07/823,858 filed on Jan. 22, 1992, now abandoned, and of Ser. No. 07/872,297, filed Apr. 22, 1992, now allowed which is a Continuation-In-Part of U.S. patent application, Ser. No. 07/839,241 filed Feb. 20, 1992, now abandoned, which is a Continuation-In-Part of U.S. patent application, Ser. No. 07/636,602 filed Dec. 31, 1990, now U.S. Pat. No. 5,206,749, all of which are incorporated herein by reference.

## BACKGROUND OF THE INVENTION

Flat-panel displays are being developed which utilize liquid crystals or electroluminescent materials to produce high quality images. These displays are expected to supplant cathode ray tube (CRT) technology and provide a more highly defined television picture. The most promising route to large-scale high-quality liquid crystal displays (LCDs), for example, is the active-matrix approach in which thin-film transistors (TFTs) are co-located with LCD pixels. The primary advantage of the active matrix approach using TFTs is the elimination of cross-talk between pixels, and the excellent gray scale that can be attained with TFT-compatible LCDs.

Flat panel displays employing LCDs generally include five different layers: a white light source, a first polarizing filter that is mounted on one side of a circuit panel on which the TFTs are arrayed to form pixels, a filter plate containing at least three primary colors arranged into pixels, and finally a second polarizing filter. A volume between the circuit panel and the filter plate is filled with a liquid crystal material. This material will rotate the polarization of light when an electric field is applied across the liquid crystal material between the circuit panel and a ground affixed to the filter plate. Thus, when a particular pixel of the display is turned on, the liquid crystal material rotates polarized light being transmitted through the liquid crystal material so the rotated polarized light will pass through the second polarizing filter.

The primary approach to TFT formation over the large areas required for flat panel displays has involved the use of amorphous silicon, which has previously been developed for large-area photovoltaic devices. Although the TFT approach has proven to be feasible, the use of amorphous silicon compromises certain aspects of the panel performance. For example, amorphous silicon TFTs lack the frequency response needed for large area displays due to the low electron mobility inherent in amorphous material. Thus the use of amorphous silicon limits display speed, and is also unsuitable for the fast logic needed to drive the display.

Owing to the limitations of amorphous silicon, other alternative materials include polycrystalline silicon, or laser recrystallized silicon. These materials are limited as they use silicon that is already on glass, which generally restricts further circuit processing to low temperatures.

A continuing need exists for systems and methods of controlling pixel of panel displays having the desired speed and providing for ease, and reduced cost, of fabrication.

## SUMMARY OF THE INVENTION

The invention is a control system for an active matrix liquid crystal display panel. A control apparatus is fabricated



with the active matrix as a monolithic SOI structure. After the SOI structure is fabricated in a thin film layer of single crystal or substantially single crystal silicon on a silicon substrate, the structure is removed from the silicon substrate using a lift-off process and transferred to a glass substrate as a single substrate. The single structure provides improved processing speeds and the fabrication process reduces the difficulty and cost of manufacturing display panels. In a particular preferred embodiment, the display panel is adapted for use in a standard 35 mm slide projector.

In a preferred embodiment, a control apparatus for a liquid crystal display device comprises a video interface, a left select scanner, a right select scanner, a video polarity network, a data scanner, and a transmission gate. The video interface converts video signals from a video source into active matrix control signals. In response to the active matrix control signals, the left and right select scanners simultaneously drive opposite sides of the matrix select lines. The video polarity network inverts the polarity of the video signals on each successive video frame. A preferred embodiment employs either column inversion or frame inversion techniques. In particular, a column inversion technique is used where the polarity of the even columns is opposite to the polarity of the odd columns on any given video frame. In response to the active matrix control signals, the data scanner triggers the transmission gate to drive the active matrix columns with the even and the odd column signals.

The data scanner comprises an odd-column shift register array and an even-column shift register array. The odd column array triggering an odd column array of the transmission gate and the even column array triggering an even column array of the transmission gate. The odd and even column arrays of the transmission gate drive respective columns of the active matrix.

An encoder may be coupled between the video source and the video polarity network. The encoder generating a superposed analog video signal from a video source Red-Green-Blue (RGB) data signal. The RGB data signal can be mapped to a superposed color analog signal. The RGB data signal can also be mapped to a gray-scale analog signal. Preferably, the encoder can map to either of the color or gray-scale signal in response to a control signal.

In a preferred embodiment, the control apparatus adjusts the gray-scale video signal level to compensate for changes in the transmittance of the liquid crystal material. At least one sensor is fabricated within the SOI structure. A temperature sensor can be used to generate a data signal in response to the temperature of the active matrix. A light sensor can be used to generate a data signal in response to the light transmittance of the liquid crystal material. The sensor can include at least one real-time light sensor at least one real-time temperature sensor, or a combination of light sensors and temperature sensors. The sensor data is processed by a light meter or temperature measurer, which generates a feedback signal in response to the sensor data. An amplifier gain is adjusted by the feedback signal, the amplifier amplifying the video signal by the gain. The gain may be linear or nonlinear.

If light sensors are used, a light transmittance curve for the liquid crystal material must be established. A light sensor is provided that generates a signal representing light transmittance through a black pixel. Another light sensor is provided that generates a signal representing light transmittance through a white pixel. The black and white pixel signals can be generated by permanently connecting one pixel light sensor to a DC voltage and the other pixel light

sensor to ground. The black and white pixel light sensors define the end points of the active matrix transmittance curve.

In a preferred embodiment, the video source generates a video signal having variable synchronization frequencies. The active matrix display has a fixed pixel resolution. The video interface generates a dot clock signal from the variable synchronization frequencies for driving the display at the fixed resolution. The video interface allows the display panel to function as a multiple-frequency scanning display device.

The video interface comprises a control processor and dot clock regenerator. The control processor is responsive to video mode changes on the video signal as reflected by changes in the synchronization signals. In response to mode changes, the control processor signals the dot clock regenerator. The dot clock regenerator is responsive to the control processor signal. The dot clock regenerator comprises a digitally programmable phase-locked loop that tracks changes on the synchronization frequencies such that the dot clock signal is centered over the correct pixel and does not drift. The video interface providing compatibility with Video Graphics Array (VGA) adapter and Apple™ video signals.

## BRIEF DESCRIPTION OF THE DRAWINGS

The above, and other features of the invention including various novel details of construction and combination of parts, will now be more particularly described with reference to the accompanying drawings. It will be understood that the particular display device and the methods used in fabricating the display device which embody the invention are shown by way of illustration only and not as a limitation of the invention. The principle features of this invention can be employed in various embodiments without departing from the scope of the invention.

FIG. **1** is a schematic block diagram of a preferred embodiment of the invention.

FIGS. **2***a*–**2***d* illustrate preferred video signal connections to a computer video source.

FIGS. **3***a*–**3***c* an schematic block diagrams of a preferred video interface **110** of FIG. **1**.

FIG. **4** is a schematic block diagram of a preferred video polarity network **150** of FIG. **1**.

FIG. **5** is a view of the display device showing a preferred temperature sensor arrangement.

FIGS. **6***a*–**6***c* are views of the display device showing a preferred light sensor arrangement.

FIGS. **7***a*–**7***h* illustrate a preferred processed flow sequence illustrating the fabrication of a transmissive active matrix display with a sensor.

FIG. **8** is a partial cross-sectional view of a preferred active matrix display device.

FIG. **9** is a partial cross-sectional view of a preferred active matrix display device illustrating a preferred shielding approach.

FIG. **10** is a flowchart of the processing steps of the control processor of FIG. **3**A.

FIGS. **11***a*–**11***b* a timing diagrams for driving the active matrix **90**.

FIGS. **12**A–**12**B are timing diagrams for a particular preferred embodiment of the invention.

## DETAILED DESCRIPTION OF THE INVENTION

A preferred embodiment is shown in FIG. **1**. A video signal source (not shown) provides video signals to an active



matrix display device (shown in phantom). The video signal source can be any analog or digital video signal source including a Video Graphics Array (VGA) adaptor, the Apple™ Macintosh™ family of computers, a National Television Systems Committee (NTSC) composite video source, a high-resolution professional display adapter, a Charge-Coupled-Device (CCD), or other similar sources. In a particular preferred embodiment, the active matrix display device is adapted as a computer-controlled light valve that substitutes for a positive photographic slide in a standard 35 mm slide projector. A detailed description of the particular preferred active matrix display device can be found in the patent application U.S. Ser. No. 08/106,071 by Matthew Zavracky et al., entitled "Slide Projector Mountable Light Valve Display," filed on Aug. 13, 1993, and incorporated herein by reference.

Horizontal and vertical synchronization signals from the video signal source are provided to a video interface **110** on data lines **13** and **14**, respectively. Red-Green-Blue (RGB) video signal components, if supplied by the video signal source, are provided to an encoder **140** on respective data lines **1**, **2**, **3**. If discrete color (e.g., RGB) signals are not supplied by the video source (e.g., NTSC composite video signal), then a single encoded video signal **41** must be supplied by the video source. The appropriate video signal is supplied to a video polarity network **150** on data line **141**, the operation of which is described in greater detail below.

The active matrix **90** (shown in phantom) operates as a multi-frequency display device. Typically, video signals from the video signal source will not be synchronized to a fixed frequency. A change in the video mode can change the resolution of the data, measured in pixels. For example, a VGA adaptor generates synchronization signals that vary depending on the particular video mode in which the adaptor is operating. A standard VGA adaptor can generate a vertical synchronization frequency between about 56 and 70 Hz and a horizontal synchronization frequency between about 15 and 35 Khz. For professional display purposes (e.g., CAD/CAM) the vertical and horizontal synchronization frequency can be higher than described. To handle current high resolution display applications, the display device can preferably adapt to vertical synchronization frequencies up to about 100 Hz and horizontal synchronization frequencies up to about 66 Khz. In addition, a change in the video mode can also invert the polarities of the synchronization signals. Consequently, a preferred embodiment of the invention adapts to changes in the synchronization signals caused by changes in the video mode.

The video interface **110** is used to interface the active matrix display device with the horizontal and vertical synchronization signals from the video signal source. In a preferred embodiment, the video interface **110** interfaces with a standard VGA display adapter to display the video image at a horizontal resolution of 640 pixels and a vertical resolution of 480 pixels (640H×480V). In another preferred embodiment, the display resolution is 1024H×768V. In yet another preferred embodiment, the display resolution is 2048H×2048V. The video interface **110** adjusts to changes in the input synchronization frequencies by detecting polarity, frequency, or phase changes in the input signals.

A preferred embodiment of the invention for use with video signals for a VGA adaptor supports 720H×400V text mode, 640H×480V graphics mode, 640H×400V graphics mode and 640H×350V graphics mode. Table I summarizes video rates and resolutions associated with these supported VGA modes. It will be understood that other video modes

having different video rates and resolutions can be supported as well, with minor modifications.

TABLE I

TYPICAL VGA RATES AND RESOLUTIONS

| Mode | Graphics | Graphics | Graphics | Text |
|---|---|---|---|---|
| Resolution | 640 H × 480 V | 640 H × 400 V | 640 H × 350 V | 720 H × 400 V |
| Pixel Rate | 25.175 MHz | 25.175 MHz | 25.175 MHz | 28.322 MHz |
| Horizontal Rate | 31.47 KHz | 31.47 KHZ | 31.47 KHz | 31.47 KHZ |
| Vertical Rate | 59.94 HZ | 70.08 Hz | 70.08 Hz | 70.08 Hz |
| Hsync Polarity | Negative | Negative | Positive | Negative |
| Vsync Polarity | Negative | Positive | Negative | Positive |

HORIZONTAL

| | Time | Pixels | Time | Pixels | Time | Pixels | Time | Pixels |
|---|---|---|---|---|---|---|---|---|
| Active Scan | 25.42 uS | 640 | 25.42 uS | 640 | 25.42 uS | 640 | 25.42 uS | 720 |
| Front Porch | 0.64 uS | 16 | 0.64 uS | 16 | 0.64 uS | 16 | 0.64 uS | 18 |
| Sync Width | 3.81 uS | 96 | 3.81 uS | 96 | 3.81 uS | 96 | 3.81 uS | 108 |
| Back Porch | 1.91 uS | 48 | 1.91 uS | 48 | 1.91 uS | 48 | 1.91 uS | 54 |
| Back Porch | 1.91 uS | 48 | 1.91 uS | 48 | 1.91 uS | 48 | 1.91 uS | 54 |

VERTICAL

| | Time | Lines | Time | Lines | Time | Lines | Time | Lines |
|---|---|---|---|---|---|---|---|---|
| Active Scan | 15.25 mS | 480 | 12.71 mS | 400 | 11.12 mS | 350 | 12.71 mS | 400 |
| Front Porch | 0.35 mS | 11 | 0.38 mS | 12 | 0.18 mS | 37 | 0.38 mS | 12 |
| Sync Width | 0.06 mS | 2 | 0.06 mS | 2 | 0.06 mS | 2 | 0.06 mS | 2 |
| Back Porch | 1.02 mS | 32 | 1.11 mS | 35 | 1.91 mS | 60 | 1.11 mS | 35 |
| Total Period | 16.68 mS | 525 | 14.27 mS | 449 | 14.27 mS | 449 | 14.27 mS | 449 |

Connection to a VGA adapter is through a traditional 15-pin, 3 row connector. The pin connections for the VGA receptacle are illustrated in FIG. **2A**. Table II defines the pinouts for a typical VGA adapter. Table III lists the pinouts for the receptacle in FIG. **2A**. Video signals are carried on pin **1**, **2**, **3**, **5**, **6**, **7**, **8**, **10**, **13** and **14**. These pins are identical between the VGA connection and the control system connection. Pin **9** is used by a preferred embodiment of the invention as an EIA mouse out signal line. Pin **9** together with the equipment ground (pin **5**) are provided to a mouse port on the receiving computer through an appropriate connector. In addition, pin **15** is used to receive a Mac detect signal to help detect Apple machines. FIG. **2B** is a schematic diagram illustrating a VGA to video control system cable. Note that the computer end has two connections: a 15-pin, 3-row plug for the video information, and an appropriate plug for the mouse connector. To connect to a standard COM port, a 9-pin DSUB plug connector is used as the mouse connector.

TABLE II

VGA PINOUTS

| Pin | Function | Pin | Function | Pin | Function |
|---|---|---|---|---|---|
| 1 | Red | 6 | Red Return | 11 | ID0 |
| 2 | Green | 7 | Green Return | 12 | ID1 |
| 3 | Blue | 8 | Blue Return | 13 | Horiz Sync |
| 4 | ID2 | 9 | No Pin | 14 | Vert Sync |
| 5 | Equip Gnd | 10 | Sync Return | 15 | No Connect |

TABLE III

CONTROL SYSTEM PINOUTS

| Pin | Function | Pin | Function | Pin | Function |
|---|---|---|---|---|---|
| 1 | Red | 6 | Red Return | 11 | EIA In |
| 2 | Green | 7 | Green Return | 12 | ID1 |
| 3 | Blue | 8 | Blue Return | 13 | Horiz Sync |
| 4 | TTL ADB | 9 | EIA Mouse Out (PC) | 14 | Vert Sync |
| 5 | Equip Gnd | 10 | Sync Return | 15 | Mac Detect |

A preferred embodiment of the invention for use with Apple™ MAC-II computers, including the Powerbook™ series, supports 640H×480V resolution. In particular, the computer is informed that the active matrix display **90** is a 13-inch, 640H×480V Apple™ monitor. This does not imply that the same video timing is used on all Apple™ computers. If the correct timing cannot be determined, differences may manifest as centering offsets, which can be adjusted to zero. Table IV summarizes video rates and resolutions associated with an Apple™ MAC-II computer.

TABLE IV

TYPICAL MAC-II RATES AND RESOLUTIONS

| | |
|---|---|
| Monitor | 13 inch |
| Resolution | 640 × 480 |
| Pixel Rate | 30.24 MHz |
| Horizontal Rate | 35.00 KHZ |

TABLE IV-continued

| TYPICAL MAC-II RATES AND RESOLUTIONS | | |
|---|---|---|
| Vertical Rate | 66.67 HZ | |
| CSync Polarity | Negative | |
| HORIZONTAL | | |
| | Time | Pixels |
| Active Scan | 21.16 uS | 640 |
| Front Porch | 2.12 uS | 64 |
| Sync Width | 2.12 uS | 64 |
| Back Porch | 3.18 uS | 96 |
| Total Period | 28.57 uS | 864 |
| VERTICAL | | |
| | Time | Lines |
| Active Scan | 13.71 Ms | 480 |
| Front Porch | 0.09 Ms | 3 |
| Sync Width | 0.09 mS | 3 |
| Back Porch | 1.11 mS | 39 |
| Total Period | 15.00 mS | 525 |

Connection to an Apple MAC-II computer is through a 15-pin, 2 row connector. The Macintosh video connector is illustrated in FIG. **2C**. The Macintosh video pinout definitions are provided in Table V. The video control system pin definitions are the same as defined in Table III. FIG. **2D** is a schematic diagram illustrating a Macintosh computer to video control system cable.

TABLE V

| MAC PINOUTS | | |
|---|---|---|
| Pin Function | Pin Function | Pin Function |
| 1 Red Return | 6 Green Return | 11 VSync/CSync Return |
| 2 Red | 7 Sense 1 | 12 Vert Sync |
| 3 Composite Sync | 8 No Connect | 13 Blue Return |
| 4 Sense 0 | 9 Blue | 14 Horiz Sync Return |
| 5 Green | 10 Sense 2 | 15 Horiz Sync |

Preferably, a preferred embodiment of the invention also supports the Apple™ MAC-LC video family. The MAC-LC computer can generate signals to drive either a 13-inch 640H×480V Apple™ monitor or a VGA monitor, using a special monitor adaptor available from Apple Computer, Inc. When connected directly to the MAC-LC computer, the video control system functions as a 13-inch 640H×480V Apple™ monitor. When the monitor adaptor is installed, the video control system receives quasi-VGA signals. The video control system detects the actual video mode sent by the computer. Unfortunately, the timing of the Apple™ quasi-VGA signal is not identical to the VGA specification. This timing difference results in the horizontal centering being four pixels off, which can be adjusted using centering controls. Table VII summarizes video rates and resolutions associated with an Apple™ MAC-LC product.

TABLE VI

| TYPICAL MAC-LC RATES AND RESOLUTIONS | | |
|---|---|---|
| Monitor | 13 inch | VGA |
| Resolution | 640 H × 480 V | 640 H × 480 V |
| Pixel Rate | 31.3344 MHZ | 25.175 MHz |
| Horizontal Rate | 34.97 KHz | 31.47 KHz |

TABLE VI-continued

| TYPICAL MAC-LC RATES AND RESOLUTIONS | | | | |
|---|---|---|---|---|
| Vertical Rate | 66.61 Hz | | 59.94 HZ | |
| Hsync Polarity | Negative | | Negative | |
| Vsync Polarity | Negative | | Negative | |
| HORIZONTAL | | | | |
| | Time | Pixels | Time | Pixels |
| Active Scan | 20.43 uS | 640 | 25.42 uS | 640 |
| Front Porch | 2.55 uS | 80 | 0.48 uS | 12 |
| Sync Width | 2.04 uS | 64 | 3.81 uS | 96 |
| Back Porch | 3.57 uS | 112 | 2.07 uS | 52 |
| Total Period | 28.59 uS | 896 | 31.78 uS | 800 |
| VERTICAL | | | | |
| | Time | Lines | Time | Lines |
| Active Scan | 13.73 mS | 480 | 15.25 mS | 480 |
| Front Porch | 0.09 mS | 3 | 0.32 mS | 10 |
| Sync Width | 0.09 mS | 3 | 0.06 mS | 2 |
| Back Porch | 1.11 mS | 39 | 1.05 mS | 33 |
| Total Period | 15.01 mS | 525 | 16.68 mS | 525 |

Video signal from the appropriate video connector are fed to the video control system. FIGS. **3A–3C** are block diagrams of a preferred video interface **110** for VGA signals.

Referring to FIG. **3A**, horizontal and vertical synchronization signals are provided at TTL levels on respective incoming data lines **13**, **14** from a VGA adapter or similar video source. A control processor **112** examines the incoming video stream and tracks mode changes, which provide for variable frequency multi-scanning capability. Upon detecting a mode change, the control processor **112** signals the mode change to a dot clock regenerator **114** over data line **116**. Optionally, the control processor **112** interprets input signals from a remote control device over a remote signal line **31** and either controls hardware or provides remote mouse functionality over a mouse signal line **9** to the computer, as required. Preferably, a non-volatile Editable Erasable Programmable Read-Only Memory (EEPROM) is used to store setup and adjustment parameters. The program for the processor is contained within a Erasable Programmable Read-Only Memory (EPROM) which simplifies upgrading the functionality of the program. Most digital logic is contained within Field Programmable Gate Arrays (FPGAs), which are also programmed from the same EPROM. Upgrading the EPROM allows functionality to be changed, added or repaired, all with little manufacturing cost. The dot clock regenerator **114** provides a pixel data signal on line **111**, a pixel clock signal on line **113**, a frame switch signal on line **115**, a select clock signal on line **117**, and a select data signal on line **119**.

As illustrated in FIG. **3B**, the dot clock regenerator **114** recreates the pixel dot clock used by a computer to output pixels. The regeneration must be accurately controlled because it is very important to provide a clock that is centered over each pixel and does not drift. Thus, a clock must be recreated that can be used to sample a pixel and move to the next pixel. The dot clock regenerator **114** includes a phase locked loop (PLL) network **114*a*** and Voltage Controlled Oscillator (VCO) **114*b***. The PLL **114*a*** and VCO **114*b*** are responsive to the mode change signal over data line **116**. There is no standard for the frequency of the incoming video signal, which can range from 20 Mhz to over 30 Mhz, depending on the source.

An analog RGB signal is not quantized because CRTs do not require the analog signal to have a notion of screen

position. Unlike CRTs, flat panel displays have quantized pixels. Hence, the analog RGB signal must be quantized to each pixel. For the quantization to be accurate, each scan line of the analog RGB signal must be divided into discrete values. That task is performed by the dot clock regenerator **114**. As summarized in Table I, the VGA 640H×480V modes include 800 pixels per horizontal scan. Unfortunately, only one timing signal (i.e., the horizontal sync) is received per scan line. Thus, the PLL **114***a* must operate with a divider multiplication ratio of 800:1. Typical phase-lock loop circuits become unstable at divider multiplication ratios over about 8:1. PixelVision, Inc. of Acton, Mass. manufactures and sells video processing circuitry containing a preferred dot clock regenerator **114**, under Part Nos. PV-CIFK-xxxx. Other suitable dot clock regenerators **114** may be available from other sources. The dot clock regenerator **114** preferably permits a user to fine tune the position of the reconstructed dot clock, through the control processor **112**.

Although the active matrix **90** is an analog device, video signals must be "massaged" before being presented to the active matrix **90**. In general, the video signal is to be presented to the active matrix **90** through two inputs, each a mirror of the other. Both signals are to be biased on a nine-volt reference, with the video having a six volt, peak-to-peak swing. At least 50 Mhz bandwidth must be maintained, into a 100 pf load. The voltages and currents required in this particular embodiment are detailed in Table VII.

TABLE VII

| Center Voltage (volts) | Range (volts) | Drive (milliamps) |
|---|---|---|
| +3 | 2.5 to 4.5 | 70 (Sink) |
| +9 | 7 to 11 | +/−2 |
| +15 | 11.5 to 16 | 75 (Source) |

FIG. **3**C is a schematic block diagram of the logic drive **160** for the active matrix **90**. Overall, the logic drive **160** receives common logic level inputs, preferably CMOS or TTL and translates them to the drive levels required by the active matrix **90**.

A tracking regulator **166** provides a DC voltage approximately two volts higher than the panel voltage supply to the active matrix **90**. The panel voltage itself is adjustable, to allow operation with different liquid crystal types. The tracking regulator **166** is a small linear regulator, with an emitter follower output to supply the needed current.

A horizontal logic drive **163** provides the synchronizing pulse (i.e., pixel data **111**) and clock (i.e., pixel clock **113**) for the horizontal axis of the active matrix **90**. This is the fast axis, where the video data is clocked into the display. A MOSFET driver is used, to provide the needed fifteen-volt logic swing into the 30 pF load at speeds commensurate with a maximum pixel rate (e.g., 31.5 Mhz). The clock is half the pixel rate, with each edge being used to enter pixels. Another reason for the output voltages to quickly reach near the panel voltage, or ground, is to limit power dissipation in the active matrix circuitry. This is especially important for the clock, because the edge rate is high. Another reason for fast edge rates is sampling jitter; slow edges lead to timing uncertainty. To increase the positive-going edge rate, the voltage from the tracking regulator **166** is used to provide some overdrive. In the negative-going direction there is already overdrive, because the negative panel supply is a nominal three volts.

With the overdrive from the driver, there would be some danger of overloading the input clamp to the active matrix **90**. This is prevented by, first, including a small current limiting resistor **167***a*, **167***b* in series with each output. There is also a diode clamp **168***a*, **168***b* to the panel voltage. The current limiting resistor **167** together with the diode clamp **168** prevents the input clamp to the active matrix **90** from being overly stressed.

A vertical logic drive **162** provides the synchronizing pulse (i.e., select data **119**) and clock(s) (i.e., select clock **117**) for the vertical axis of the active matrix **90**. This is the slow axis, where a clocking edge occurs every scanline. A MOSFET driver is used here, as with the horizontal axis, except without overdrive.

Returning to FIG. **1**, the video interface **110** converts the synchronization signals from the video signal source into pixel timing information for the pixel columns and select line timing information for the pixel rows of the active matrix. The video interface **110** provides control registers to adjust and delay the pixel clock **113**, pixel data **111**, select clock **117**, and select data **119** so the image generated by the video source (e.g. VGA) can be precisely mapped to the active matrix 90 pixel resolution (e.g., 640H×480V). The video interface **110** provides a pixel data signal and a pixel clock signal to a data scanner **120** on respective data lines **111.113**. The video interface **110** also provides a select line data signal and a select line clock signal to select scanners **132.136** on respective data lines **117.119**. Preferred embodiments of the invention supply one or four clocks on each clock signal line **113.117**. By supplying four clock signals on each clock signal line **113.117**, the circuitry of the scanners **120.130** can be simplified. This is especially important if the scanners **120.130** are fabricated on the SOI structure with the active matrix **90** and the video interface **110** is a discrete component. Finally, the video interface **110** provides a frame switch signal to the video polarity network **150** on data line **115**.

Encoder **140** may be a gray-scale encoder or a color encoder. The RGB signal is provided from the pinout connectors on signal lines **1.2.3**. The encoder converts the RGB signal into a mapped analog signal. A gray-scale encoder employs a colored mapper to convert the RGB signal into a gray-scale equivalent. In a preferred embodiment, each color from the RGB signal is weighted and then summed together to form a gray-scale signal. The gray-scale mapper uses the equation

$$V_o = W_R V_R + W_G V_G + W_B V_B, \quad (1)$$

where $V_o$ is the gray-scale output signal; $W_R$, $W_G$, and $W_B$ are the respective weighting for the red, green and blue signals; and $V_R$, $V_G$, and $V_B$ are the respective signal strengths for the red, green and blue signals. In a preferred embodiment of the invention, $W_R$=0.3, $W_G$=059 and $W_B$=0.11 to result in a weighting function approximately equal to the human eye's relative response. However, other weighting values can be obtained by changing resistor values in the circuit. If the video source supplies a monochrome signal, that signal is preferably applied at the green input **2**. In addition, other mapping techniques may be employed without affecting the scope of the invention (e.g., digital mapping). A color encoder employs a multiplexer to multiplex the RGB signal into a mixed color equivalent. In a preferred embodiment, the encoder **140** provides either one of gray-scale or color encoding, as required. The encoded analog signal from either the gray-scale mapper or color encoder is provided to the video polarity network **150** via an encoder line **141**.

In a further embodiment, the video source can provide an NTSC composite video signal on signal line **123**. In an

NTSC composite video signal, the RGB signals and the synchronization signals are superposed as a single analog video signal. Because the RGB signals are already encoded in a NTSC composite video signal, no separate encoding is necessary. Instead, the superposed RGB data is extracted from the NTSC composite video signal. The superposed RGB data from an NTSC composite video source is provided to the video polarity network **150** on line **141**.

The video polarity network **150** generates odd and even video driven signals **159** from the frame switch data on line **115** and the analog video signal on line **141**. The video drive signal **159** is adjusted by a contrast control signal **51**, a back porch clamp signal **53**, a brightness control signal **55**, the liquid crystal reference voltage **161**, and feedback signals **173**, **183** from a temperature measurer **170** or light meter **180**. As shown in FIG. **4**, the video polarity network **150** incorporates a video amplifier **152**, bias network **154**, a video switch **156**, drive amplifiers **158** and a DC level control servo **155**.

The analog video signal from line **141** is provided to the video amplifier **152**. The video input **141** is amplified by an amount determined by the contrast (gain) control voltage **51** generated by a digital-to-analog (D/A) converter **50**. Because the video input is AC coupled, the DC restore function is done by a back porch clamp (not shown). The Brightness (level) control **55** is the reference voltage for the clamp which is obtained from the D/A converter **50**. The feedback for the clamp is taken from the main video outputs, which closes the loop around the full video path. In a preferred embodiment, this block is implemented by a National Semiconductor LM1201 amplifier, although other suitable amplifiers can be used.

One important feature is that there are two complementary outputs from the video amplifier **152**. The normal output **153*b*** is positive-white from a (clamped) level a few volts above ground. The inverted output **153*a*** is negative white from a few volts below the positive supply voltage (12V). These two outputs **153*a***, **153*b*** are inherently in phase, and have the same gain because they are preferably taken from the same output transistor. Alternatively, the amplifier gain can be nonlinear (e.g., gamma functions). The normal and inverted amplifier signals **153*a***, **153*b*** are fed to a bias network **154**.

The bias network **154** is an RC network that biases the two outputs of the video amplified **152** toward each other. Those outputs can never reach the same voltage, due to the nature of the output stage. But the inputs to the drive amplifiers **158** should be capable of crossing over in some cases, to allow a full range of contrast and brightness adjustment. The output signals from the bias network **154** are fed to the video polarity switch **156**.

To provide the AC component of the required active matrix drive signal, video switches select either the normal or the inverted video signals. These video signals are supplied alternately to an odd drive amplifier **158*a***, with an even drive amplifier **158*b*** receiving the opposite signal. Preferably, the switches change every video field (every vertical sync). The switch could occur more or less often, as might be desirable for crosstalk or other purposes; a preferred switching rate allows switching every scanline. The switches used are FET-based "T" switches, which provide good isolation and fairly low "on" resistance. A switch is also used to select between the outputs, to always provide a "normal" feedback signal for clamping comparison. The video polarity switch **156** is synchronized to the frame rate provided over the frame switch line **115**.

In a preferred embodiment, a column inversion technique is used to reduce crosstalk between select lines to reduce or avoid the production of a DC offset voltage. The video switch **156** provides an alternating opposite polarity for the column pixels. The even column pixels are operated at the opposite polarity of the odd column pixels. The polarities of the column pixels are switched on each sequential frame. For example, on one frame even column pixels operate at a positive polarity and odd column pixels operate at a negative polarity. On the next sequential frame, the switch **156** switches the polarities of the odd and even columns. As a result, the even column pixels operate at a negative polarity and the odd column pixels operate at a positive polarity. The odd column polarity is provided to the active matrix on line **159*b*** and the even column polarity is provided to the active matrix on line **159*a***.

Another preferred embodiment of the invention uses a frame inversion technique instead of column inversion. Using frame inversion, each column during any one frame has the same polarity. On alternating frames, as clocked by the frame switch **115**, the polarity of each column is reversed. In that way, the polarity of the entire active matrix **90** is inverted on each successive frame. Note that this frame inversion embodiment would not require the use of distinct odd and even data registers **122**.

The video drive to the active matrix **90** is preferably implemented with current feedback operational amplifiers **158**. These amplifiers **158** can drive the high load capacitance while remaining stable and retaining adequate frequency response. Two amplifiers **158*a***,**158*b*** are provided, for the odd and even pixel inputs of the active matrix **90**. Both inputs receive the full video signal, with correct pixel data selected by the clock inputs discussed above. The operational amplifiers **158** are used in a non-inverting configuration, with the feedback networks referenced to the output of the DC-level control servo **155**. There is a small output resistor, to limit peaking and overshoot. Alternatively, an RC snubber can be coupled to ground. The nominal gain of this stage is preferably 2.3.

The DC level control servo **155** adjusts the operating level of the drive amplifiers **158** so there is a minimal overall DC voltage applied across the liquid crystal material. A significant DC voltage could damage the liquid crystal material. A regulated LCD voltage **161** is supplied to the servo **155** as a center reference voltage of the liquid crystal material. The servo **155** filters the two video outputs **159**, to establish their average level. The difference between this average and the reference voltage is integrated, with the result providing a feedback voltage for the drive amplifiers **158**. Thus, the loop is closed, and drives to "zero" error. The integrator output stage has a discrete emitter follower to handle the current required by the drive amplifiers **158**. With fixed 1% resistors, the residual error should be less than 100 mV. With a potentiometer as well, as used in a preferred embodiment, the DC level error can be further adjusted as needed.

The data scanner **120** provides for double storage of pixel data. The data scanner **120** interfaces with the pixel data signal on line **111** and the pixel clock signal on line **113** via interface component **125**. The data scanner **120** uses an odd shift register array **122*a*** and an even shift register array **122*b*** to store data for each scan. The odd shift register array **122*a*** stores data to odd column pixels and the even shift register array **122*b*** stores data to even column pixels. To facilitate fabrication testing, an odd test pad **124*a*** is fabricated on the odd shift register array **122*a*** and an even test pad **124*b*** is fabricated on the even shift register array **122*b***.

A transmission gate **126** transmits pixel actuation signals to the active matrix **90**. The transmission gate **126** is partitioned into odd column gate **128*a*** and even column gate

128*b*, which are registered to respective columns of the data scanner shift registers 122*a*,122*b*. A serial data stream of a video drive signal is provided to the odd and even column pixels on respective signal lines 159*a*,159*b*. An appropriate signal level is transmitted by the transmission gate 126 to the correct pixel as triggered by the output from the shift registers 122.

To reduce signal loss across the active matrix, the select lines are driven from both sides by select scanners 130. As viewed in FIG. 1, left select scanner 130*a* and right select scanner 130*b* are connected to the select data line 119 and the select clock line 117. The left select scanner 130*a* provides a select line signal at the end of the select line nearest the lowest-valued pixel column ($C_1$) and right select scanner 130*b* provides a select line signal at the end of the select line nearest the highest-valued pixel column ($C_N$). Thus, an identical select line signal is supplied at both ends of the select line. To facilitate fabrication testing, a left scanner test pad 134*a* is fabricated on the left select scanner 130*a* and a right scanner test pad 134*b* is fabricated on the right select scanner 130*b*.

The shift registers of the data scanner 120 and the select scanners 130 are dynamic shift registers. The dynamic shift registers rely on capacitor storage without leakage. However, dynamic shift registers are susceptible to leakage, especially when they are exposed to light. Hence, light shields are needed to protect the scanners 120,130 from exposure to light.

In a further preferred embodiment, at least one sensor 92, 94 is integrated into the active matrix 90 for gray-scale adjustments. The sensor may be a temperature diode, a photo transistor or diode, or combinations thereof. Returning to FIG. 1, a preferred embodiment employs at least one temperature sensor 92 and at least one light sensor 94. The signals from the sensors provide feedback signals, to the video polarity network 150. In response to the feedback signal, the video amplifier 152 adjusts the gray-scale signal strength.

In a preferred embodiment, the sensors 92,94 are uniformly distributed throughout the active matrix. For example, each pixel element, or a selected group of pixel elements can have an associated sensor 92,94. The sensor to pixel ratio need not be one-to-one however. In another material embodiment, the sensors 92,94 are distributed around the perimeter of the active matrix.

FIG. 5 shows a preferred temperature sensor arrangement. The active matrix 90 comprises a plurality of pixels 1000 arranged in columns and rows. Ideally, heat will be absorbed substantially uniformly throughout the liquid crystal material. Thus, only one temperature sensor 92 is necessary to measure the temperature of the active matrix 90. However, there will be local temperature variations due to the nature of the image being displayed. In addition, a plurality of temperature sensors can be used to provide redundancy. In the figure, temperature sensors 92 are distributed throughout the active matrix region 90. As shown, temperature sensors 92 are distributed around the perimeter of the active matrix 90. In particular, the temperature sensors 92 are located at corner pixels 1000 of the active matrix 90. In addition, a temperature sensor 92 is disposed near the center of the active matrix 90. Of course, more or less temperature sensors 90 may be used.

FIG. 6A shows a preferred light sensor arrangement. Light sensors are used to construct a transmittance curve for the liquid crystal material. The light sensors 94 are distributed around the active matrix region 94. In addition, there are sensors 941 to indicate a permanently dark pixel reading. There are also sensors 942 that represent permanently white pixel readings. The permanent readings are provided by either connecting the sensors 94 to either a DC supply voltage or to ground. The permanent-valued sensors 941,942 map the end points of the liquid crystal material's transmittance curve. The light sensor 94 measures the transmission of light through the liquid crystal material in real time. The transmittance of the liquid crystal material varies with the temperature of the material.

Because all light between the polarizes 1095,1089 is polarized, a light sensor 94 located within the active matrix 90 cannot measure changes in the transmission of light through the liquid crystal material. To measure changes in the intensity of light, the light transmitted through the liquid crystal material 1081 must be measured after exiting the second polarizer 1089. Although a light sensor may be mounted outside the second polarizer 1089, a preferred embodiment of the invention fabricates the light sensor 94 as part of the SOI circuit 1058.

FIG. 6B–6C are partial cross-sectional views of the display area having a light sensor 94. In both figures, the light sensor 94 is located outside of the active matrix region 90. A preferred embodiment is shown in FIG. 6B. A reflector 1210 is mounted on a mechanical frame 1200. The reflector 1210 is inclined such that light that has passed through the liquid crystal material 1081 is reflected toward the light sensor 94. Light sensor 94 only measures relative change in light transmission. Therefore, only a minute quantity of light, such as collateral light, needs to be reflected toward the sensor 94.

An alternative embodiment is shown in FIG. 6C, where an aperture 1290 is provided through the mechanical frame 1200. The incident light 1101 enters the structure through the aperture 1290 and passes through the liquid crystal material. After passing through the liquid crystal material, the light 1101 is reflected by a reflector 1220 mounted on the mechanical frame 1220. The reflected light is thus reflected back to the light sensor 94, where the light intensity is measured. Although the light does not pass through the active matrix region 90, the transmittance can be calculated because the temperature of the liquid crystal material is essentially constant throughout. Therefore, the measurement by light sensor 94 is sufficiently accurate to determine the liquid crystal's relative position on the transmittance curve.

FIGS. 7A–7H illustrates a preferred fabrication process for fabricating the sensors 92,94 into the active matrix. Referring to FIG. 7A, an SOI structure includes a silicon substrate 1041 and an insulating oxide layer 1043 (such as, for example, one micron of $SiO_2$) that is grown or deposited on the substrate 1041. A thin (i.e. 0.3 micron) single crystal layer 1045 of silicon is formed over the oxide 1043. The oxide is thus buried beneath the silicon surface layer, such that higher speed devices can be fabricated. However, it is noted that any number of techniques can be employed to provide a thin film of single crystal silicon.

As shown in FIG. 7B, the film 1045 is patterned into islands to define each pixel elements 1047. As explained below, the pixel elements are then processed to form a transistor, an electrode, and sensors 92,94. To that end, the pixel elements are masked (not shown) and subjected to deep and shallow implants to form an n-well region 1049 (FIG. 7C). Another masked is formed over the pixel elements, and the elements are subjected to deep and shallow implants to form an p-well region 1051.

Referring to FIG. 7D, an $SiO_2$ layer 1053 having a thickness on the order of 0.07 micron is formed over each silicon island 1047. A layer of polysilicon having a thickness

of about 0.5 micron is formed on the oxide layer **1053**, doped to provide an n+ region and patterned to form a transistor gate **1055** and a diode junction **945** (FIG. **7**E). Another oxide layer **1057** having a thickness of about 0.07 micron is formed over the polysilicon.

The pixel elements **1047** are masked (not shown) and doped with $2*10^{15}$ of phosphorous to provide an n+ source/drain implantation (FIG. **7**F). After the mask is removed, the pixel elements are again masked and doped with $4*10^{15}$ of boron to provide a p+ source/drain implantation. As such, a transistor **1054**, a pixel electrode **1065**, and a sensor **92**, **94** have been formed for pixel element **1047**.

A portion **1059** of the oxide layer is then removed to form a contact for the transistor **1054**. Referring to FIG. **7**G, a metallization deposition is then performed to form a layer **1061** over the transistor **1054**. The layer can comprise aluminum and has a thickness of about one micron. The layer **1061** serves as a pixel light shield as well as a contact for the transistor **1054**.

Referring to FIG. **7**H, the entire pixel can be coated with a thin (about 0.15 micron) layer of silicon nitride (not shown). Next, a layer of amorphous silicon having a thickness of about 0.5 micron is deposited over each pixel element. The layer is then patterned to provide a matrix of black elements **1067**, each black element associated with a transistor. A color filter element **1069** may be formed over the pixel electrode **1065**. The color filter elements can be formed by processing an emulsion or a photoresist carrier, or by processing conventional filter materials. The individual color filter elements can be processed to provide an arrangement of three or four different color pixel elements in any of the previously described geometries.

FIG. **8** shows a partial cross sectional view of a preferred active matrix display device. The display device comprises polarizers **1089**,**1095**, cover glass **1087**, glass substrate **1056**, counter electrode **1085**, and liquid crystal **1081**. Integrated into the active matrix is a monolithic integrated circuit **100**. In a preferred embodiment, the data scanner **120**, the transmission gate **126**, and the select scanners **130** are integrated onto the integrated circuit **100**. In an alternative embodiment, the video interface **110**, encoder **140**, video polarity switch **150**, temperature measurer **160**, and light meter **170** are also integrated onto the integrated circuit **100**. In addition, a sensor **950** (shown in phantom) can be integrated into the active matrix adjacent to the pixel electrode **1065**.

For reasons to be explained below, the integrated circuit **100** is connected to the end pixel elements **1047** of each row of pixels by an aluminum interconnect **1400**. In a preferred embodiment, the aluminum interconnect **1400** is 750 microns long.

Because the integrated circuit **100** comprises dynamic shift registers and other optically sensitive components, the integrated circuit **100** must be shielded from exposure to light **1101**. A mechanical frame **1200** functions to shield the integrated circuit **100** from direct exposure to light **1101**. The integrated circuit **100** must be formed far enough away from the active matrix region **90** so the mechanical frame **1200** is guaranteed to shield the integrated circuit **100**. The **15** distance between the integrated circuit **100** and the active matrix region is dependent on the machined tolerances of the frame **1200** and mounting hole, and the tolerance of the glass size. A distance of about 750–1000 microns has been found to be sufficient.

Because of the relatively large distance between the integrated circuit **100** and the active matrix, an interconnect is required. The interconnect **1400** must also be shielded from incident light **1101**. A shield layer **1500** formed by metallization deposition functions to shield substantially all of the interconnect **1400** from incident light **1101**. In a preferred embodiment, the shield is formed a black matrix. The black matrix shield **1500** also functions to shield the integrated circuit **100** from exposure to collateral directed incident light.

FIG. **9** is a schematic diagram of a partial pixel array of the active matrix. Generally, four pixel areas **1047** are shown. The silicon material is patterned to form an array of pixel electrodes and each electrode is further patterned into a grid, serpentine, or other suitable geometry to reduce transmission loss through the pixel electrode. The individual pixel electrode **210** initially comprises a solid layer of single crystal silicon. However, the element is processed such that areas **220** of silicon are removed and strips **215** of silicon remain. As such, the resulting pixel electrode **210** resembles a grid. The open areas **220** have a width (W1) of about 6 microns and the strips have a width (W2) of about 3 microns. In a preferred embodiment, there are four strips **215** and five removed areas **220** on the pixel electrode **210**.

The grid provides an aperture through each pixel electrode **210** that improves transmission of light by reducing interference effects and also reducing reflection, absorption, and scattering caused by the pixel material. One advantage of the grid-shaped pixels is the increased light transmission through the active matrix, which results in brighter displayed images. Another advantage is that grid-shaped pixels minimize thickness variations in the single crystal silicon layer. These thickness variations cause light absorption or interference, which reduces the light transmission through the active matrix. By minimizing thickness variations, brighter displayed images can be provided.

FIG. **10** is a flow chart of the processing steps of the control processor **112**. The control processor is activated when the power is turned on as step **2000**. Control then flows to step **2100**, where the control processor performs initializations. These initializations include loading initial data into the FPGAs. Preferably, the initial settings are factory defaults. When configured with a VGA video connector, the factory default setting is 640H×480V graphics mode. When configured with a Macintosh™ video connector, the default settings are 640H×480V. The initialization procedure **2210** may also include a diagnostic self-test. After initialization is complete, control flows to a loop beginning at step **2200**.

At step **2200**, a check is performed on the video signal inputs to determine whether a mode change has occurred. If a mode change has occurred, control flows to step **2300**. At step **2300**, the FPGAs are reconfigured to reflect the current video mode. If there is no mode change at step **2200** or after reconfiguring at step **2300**, control flows to step **2400**.

At step **2400**, a check is performed to determine whether there are any user inputs. If there are user inputs, control flows to step **2500**. At step **2500**, the user commands are processed. The user inputs can include mouse functions, brightness adjustments, contrast adjustments, tuning adjustments, frame adjustments, configuration saves, configuration resets, and a graphics/text mode selection (VGA modes only). After the user commands are processed at step **2500**, or if there were no user input pending at step **2400**, control flows back to the beginning of the loop at step **2200**.

The brightness and contrast adjustments are provided to a digital-to-analog converter **50**. The digital to analog converter **50** provides the contrast signal on signal line **51** and the brightness signal on signal line **53**. The operation of the brightness and contrast adjustments will now be described with reference to FIG. **11**A, which illustrates two columns of select data.

The video image is computed relative to a common plane voltage **2510**, which is +9 volts in a preferred embodiment of the invention. The video signal **2512**, **2518** is bounded by a white level **2511**, **2517** and a black level **2513**, **2519**. As illustrated, the display is a drive-to-black active matrix display. The operation of a drive-to-white active matrix display is similar. The normal signal **2512** is centered about +15 volts with a range from 11.5 volts to 16 volts. The inverted signal **2518** is centered about +3 volts with a range extending from 2.5 volts to 4.5 volts.

Contrast is a direct control of the video input amplifier **152**. When contrast is increased, the difference between the black signal level and the white signal level is increased such that there is less resolution per video data bit. When contrast is decreased, the difference between the black signal level and the white signal level is decreased such that he resolution per video data bit is increased.

Brightness controls the video input stage and determines the overall saturation of the data in a drive-to-black active matrix display. An increase in brightness decreases the difference between the common plane voltage **2510** and the white signal levels **2511**, **2519** such that the center voltages are driven nearer to the common plane voltage **2510**. A decrease in brightness separates the center voltages further from the common plane voltage **2510**. The opposite is true in a drive-to-white active matrix display.

The operation of the pixel fine tuning adjustment will be described referring to FIG. **11B**. The fine tuning adjustment adjusts the sampling point to provide for a stable, locked display. The analog signal **159** must be aligned with the pixel clock **113** such that the portion of the analog signal representing the pixel value **2520** is centered on the pixel clock **113**. The fine tuning adjustment shifts the pixel clock forward or backward in time by fractions of a pixel.

The graphics/test mode switch toggles between graphics and text mode in VGA-based computers. In VGA-based computers, it is impossible to distinguish between text mode (740H×400V), which is typically used whenever the user is at a MS-DOS prompt, and the 640H×400V graphics mode. The video signals appear identical, although they are not. Unfortunately, the display must be informed of which mode the VGA is operating so data may be sampled correctly. When toggled to text mode, every ninth pixel is dropped so the 720 horizontal pixels can be represented in a 640 pixel display. The graphics/text mode button is only active when operating in either of the two applicable video modes.

The frame adjustment moves the display left or right by whole pixels or up and down by one scan line. The delay between scanner data and the horizontal sync and vertical sync signals is changed by the frame adjustment control. In a preferred embodiment of the invention, the available range is ±32 pixels horizontally and ±75 lines vertically.

The reset command causes the control system to be re-initialized to factory presets. The save command causes the currently active user configuration to be saved for the current video mode.

FIGS. **12A–12B** are timing diagrams for a particular preferred embodiment of the invention.

FIG. **12A** is a horizontal signal timing diagram illustrating the pixel clock signal **113**, the pixel data signal **111**, and the video data signal **159**. The pixel clock signal **113** has a clock high width tDCH and a low width tDCL. The pixel data signal **111** has a pulse width tDPW that is triggered by the rising edges of the pixel clock signal **113**. The rising edge of the pixel data pulse is delayed a time tHP from a rising edge of the pixel clock signal **113**. The falling edge of the pixel data pulse is delayed a time tDP from the next rising edge of the pixel clock signal **113**. The pixel data pulses have a horizontal pulse period tHPD. The time from the pixel data pulse to the first data valid is defined as tDV. Table VIII provides horizontal timing parameters.

TABLE VIII

HORIZONTAL TIMING

| Parameter | Meaning | Min | Typical | Max |
|---|---|---|---|---|
| tDCH | Clock High Width | 30 ns | | |
| tDCL | Clock Low Width | 30 ns | | |
| tDPW | DPulse Width | 60 ns | | |
| tHP | Clock to Pulse High | tDCH - 16 ns | tDCH | tDCH + 16 ns |
| tDP | Clock to Pulse Low | tDCH - 16 ns | tDCH | tDCH + 16 ns |
| tHPD | Horizontal Pulse Period | 19.2 μSecs | | |
| tDV | Pulse to first data valid | | 60 ns | 75 ns |

FIG. **12B** is a vertical signal timing diagram, illustrating the select clock signal **117** and the select data signal **119**. The select clock signal **117** has a clock high width tSCH and a clock low width tSCL. Table IX provides vertical timing parameters.

TABLE IX

VERTICAL TIMING

| Parameter | Meaning | Min | Typical | Max |
|---|---|---|---|---|
| tSCH | Clock High Width | 5 μS | 32 μS | |
| tSCL | Clock Low Width | 5 μS | 32 μS | |
| tSPW | SPulse Width | 5 μS | | |
| tHP | Clock to Pulse High | 14 nS | | 40 μS |
| tSP | Clock to Pulse Low | 14 nS | | 40 μS |
| tVPD | Vertical Pulse Period | 10.0 mS | 16.7 mS | |

Equivalents

While this invention has been particularly shown and described with reference and preferred embodiments thereof, it will be understood by those skilled in the art that various changes on form and details may be made therein without departing from the spirit and scope of the invention as defined by the appended claims.

What is claimed is:

**1**. A control apparatus for displaying a video signal from a video source using an active matrix liquid crystal display, the video source generating a select horizontal synchronization frequency from a plurality of selectable horizontal synchronization frequencies and a select vertical synchronization frequency from a plurality of selectable vertical synchronization frequencies, comprising

a Silicon-on-Insulator (SOI) structure having a silicon device layer bonded to a transparent substrate by an adhesive layer, the active matrix liquid crystal display including an active matrix circuit formed in the SOI structure;

a video interface coupled between the video source and the display, the video interface generating a dot clock signal for driving the display at a fixed resolution in response to the select synchronization frequencies;

an active matrix interface circuit formed within the SOI structure and coupled to the video interface for actuating pixels of the active matrix circuit in response to the dot clock signal; and

a user interface coupled between the video source and the video interface for enabling user control of the display.

2. The control apparatus of claim 1 wherein the video interface comprises a control processor and a dot clock regenerator, the control processor detecting a mode change in the video signal in response to a change in the select synchronization frequencies and signaling the mode change to the dot clock regenerator, the dot clock regenerator tracking changes in the select synchronization frequency in response to the mode signal from the control processor, the dot clock regenerator converting the select synchronization frequencies into the dot clock signal.

3. The control apparatus of claim 2 wherein the dot clock regenerator comprises a digitally programmable phase-locked loop for generating a dot clock that tracks changes in the select horizontal synchronization frequency, the mode change signal providing the digital programming.

4. The control apparatus of claim 3 wherein the digitally programmable phase-locked loop operates with a divider multiplication ratio substantially over 8:1.

5. The control apparatus of claim 4 wherein the divider multiplication ratio is about 800:1.

6. The control apparatus of claim 1 wherein the video interface is responsive to a select vertical synchronization frequency between about 56 and 70 Hz and a select horizontal synchronization frequency between about 15 and 35 Khz, and the fixed display resolution is 640H×480V pixels.

7. The control apparatus of claim 1 wherein the video interface is responsive to a select vertical synchronization frequency between about 56 and 100 Hz and a select horizontal synchronization frequency between about 15 and 66 Khz, and the fixed display resolution is 1024H×768V pixels.

8. A control apparatus for displaying an image encoded as a cathode ray tube (CRT) video drive signal from a video source using a transmissive active matrix display panel, the CRT video drive signal having a select vertical synchronization frequency from a group of selectable vertical frequencies, the apparatus comprising:

a silicon-on-insulator (SOI) structure including an active matrix circuit and an active matrix interface circuit within the display panel, the SOI structure being bonded to a transmissive substrate with an adhesive layer;

a video interface coupled between the video source and the active matrix interface circuit of the display panel, the video interface receiving the CRT video drive signal and in response generating an active matrix drive signal to actuate the display panel that generates the image.

9. The apparatus of claim 8 wherein the select vertical synchronization frequency is over 56 Hz.

10. The apparatus of claim 8 wherein the CRT video drive signal has a select horizontal synchronization frequency from a group of selectable horizontal frequencies.

11. The apparatus of claim 8 wherein the video source is a computer.

12. The apparatus of claim 8 wherein the video source includes a video port and the video interface includes a connector for coupling to the video port.

13. The apparatus of claim 8 wherein the display panel is a light transmissive light valve display panel.

14. A control apparatus for a projection display system, the display system displaying an image encoded as a cathode ray tube (CRT) video drive signal from a video source using a transmissive active matrix liquid crystal display panel, the CRT video drive signal having a select vertical synchronization frequency from a group of selectable vertical frequencies, the apparatus comprising:

a silicon-on-insulator (SOI) structure including an active matrix circuit an active matrix interface circuit within the display panel, the SOI structure being bonded to a transmissive substrate with an adhesive layer;

a video interface coupled between the video source and the display panel, the video interface receiving the CRT video drive signal and in response generating an active matrix drive signal to actuate the display panel to generate an image; and

a light source that is optically coupled to the display panel to project the image onto a viewing surface.

15. The apparatus of claim 14 wherein the select vertical synchronization frequency is over 56 Hz.

16. The apparatus of claim 14 wherein the CRT video drive signal has a select horizontal synchronization frequency from a group of selectable horizontal frequencies.

17. The apparatus of claim 14 wherein the video source is a computer.

18. The apparatus of claim 14 wherein the video source includes a video port and the video interface includes a connector for coupling to the video port.

19. The apparatus of claim 14 wherein the CRT video drive signal is Red-Green-Blue encoded signal.

20. The apparatus of claim 14 wherein the CRT video drive signal is an analog signal.

* * * * *

## Sharp History

### 1993 : LCD ViewCam a Huge Hit Debut of the Zaurus PDA

#### LCD ViewCam a Huge Hit

In October 1992, the debut of the LCD ViewCam introduced a whole new concept in video cameras. Its ease of use gave Sharp an immediate share increase in the video camera market. The ViewCam was chosen one of just 16 products from among approximately 13,000 nominated for Nikkei Product and Service Excellence Awards. It was also chosen for the Nikkan Kogyo Shimbun's (Japan's leading industrial daily) 10 Best New Products Awards. The LCD ViewCam became the flagship product that showed the world that "LCD is Sharp" and contributed to boosting the company image.



The VL-HL1 LCD ViewCam, loaded with world-firsts.

#### Debut of the Zaurus, a New PDA

Based on Sharp's PI2T (personal information and intelligent tool) concept, Sharp developed the LCD Pencom Zaurus Personal Information Tool, which changed the way people communicate and work.
Released in September, the PI-3000 (nicknamed the Zaurus), continued to progress by incorporating new features: facsimile transmission, PC linking, handwriting recognition and multimedia. The Zaurus created whole new markets and joined the ViewCam as one of Sharp's flagship products.



The PI-3000 Zaurus.

#### SMCA of the US Surpasses the 20-Million Mark

In September, US manufacturing base SMCA reached the 20-million mark for both color TVs and microwave ovens, just 14 years after establishment.
With a high ratio of local parts procurement, manufacturing that emphasizes quality, the top share of the US microwave oven market, and a dedication to making products that meet the needs of Americans, SMCA has become a model company in the state of Tennessee.



SMCA of the US celebrates 20 million color TVs.

#### Copier Manufacturing Company Established in China

In December in Changshu, Jiangsu Province, China, Sharp established Sharp Office Equipments (Changshu) Co., Ltd. (SOCC), a 100%-owned subsidiary for the manufacture of copiers. The company's copiers are exported around the world to Japan, the US and Europe. In July 1996, SOCC began selling copiers in China and by that time had become Sharp's largest copier production base.

#### Sharp Voted Among Top Companies of 1993

Weekly Diamond, an influential business magazine, published a ranking of the best companies and products of the year in its December 11 issue. Diamond put Sharp at the top of the list of companies. Products like the Zaurus and ViewCam created whole new markets and reinforced the image that Sharp is a good corporate citizen and that "LCD is Sharp." The company was also close to the top of rankings put out by other newspapers and magazines.



SOCC in Jiangsu, China.

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The informants say earnings from operations will rise 8% to ¥82 bln, some ¥12 bln above the earlier projection, with volume gain and exchange profit taking an equal share.

For the full year, the sources forecast, pretax profit will rise 20% to around ¥150 bln ($1.30 bln), a record high for the third straight year, provided the ¥115 per dollar exchange rate stays put over the second half. Likewise, sales are expected to hit ¥1,520 bln ($13.21 bln), up 9%, on the continuing boom in copying machine and laser-beam printer segments.

## JVC Adds Smallest Digital Camcorder with Autoflash Function

Victor Company of Japan (JVC) has announced the second generation model to add to its digital camcorder lineup which is characterized by the built-in "autoflash" which enables recording of still image in low light conditions.



The GR-DVX is claimed to be the world's smallest and lightest camcorder mounted with built-in LCD monitor. Measurements (W.H.D.): 49 x 131 x 93mm. Weight: 500g w/o battery, 590g w/battery & tape.

JVC in its news release states that in development of the new digital camcorder it aimed at 1) making it even smaller and lighter to create a basic portable tool, 2) Expansion of its still image applications by bolstering its function as still camera. 3) Easier editing of pictures taken and uploading to personal computers.

The digital camcorder features 1/3-inch 330K-pix CCD sensor; f4.5-45mm/f1.6 zoom lens (digitally enhanced to 100X); 2.5-inch TFT color LCD monitor; and is capable of 90-minute recording on a M-DV60ME digital cassette.

Switched to the 'souvenir picture' mode, the DVX produces still images, and automatically triggers the 'autoflash' electronic flash at the lower left of the taking lens when ambient light is insufficient. It further makes a fake click sound of the shutter release when taking a still image.

The new digital camcorder, list-priced at ¥230,000, will hit the shelves of local dealers on July 20.

JVC simultaneously introduced the GV-DS2 video capture docking station, an application tool to upload the still image data captured by a GR-DVX camcorder onto a personal computer, list-priced at ¥48,800. The camcorder is just placed on the station to establish necessary connection to the computer.

## Sony's First Notebook PC Unveiled

Sony Corp. said June 3 it will start selling its first notebook computers under its own brand name next month. The company re-entered the computer market only last year. The two notebook computers of its VAIO series, which offer integrated video and audio, use Intel Corp.'s Pentium processors running at 166 and 150 MHz and come with removable 14.5X speed CD-ROM players. Sony hopes the new computers, designed to work with digital audiovisual equipment, will attract consumers who want to capture video images and make customized video clips using video recorders or digital cameras.

The mobile duo will become available on July 1 and the desktop sister will follow two weeks later, selling for ¥400,000 to ¥500,000 ($3,478-$4,378), company officials said. Similar models also will be put on sale in the United States. The Minitower desktop model runs at 266 MHz with a Pentium II processor and is mounted with a recordable CD-R drive, a television tuner and MPEG-1 encoder board, the officials said. The new computers also include digital imaging software such as Picture Gear and Adobe Photo Deluxe. Sony provisionally set the monthly output at a modest 3,000 for notebook and 1,000 for desktop units, to keep away from the price war raging on the home market.

After a brief, unsuccessful effort to sell computers in the 1980s, Sony withdrew from that market. It continued, however, to make key parts for other manufacturers, such as monitors and CD-ROM drives, and made Apple Computer Inc.'s first notebook computer, the

# United States Patent [19]

**Gal et al.**

[11] **Patent Number: 4,717,958**

[45] **Date of Patent: Jan. 5, 1988**


[54] **POSITION-STABILIZED IMAGE CONVERTER SYSTEM**


[75] Inventors: **Eliyahu Gal**, Ramat-Gan; **Naftaly Fontyn**, Necher, both of Israel

[73] Assignee: **Elbit Computers Ltd.**, Haifa, Israel



[21] Appl. No.: **866,752**

[22] Filed: **May 27, 1986**

[30] **Foreign Application Priority Data**

Jul. 5, 1985 [IL] Israel ..... 75728

[51] **Int. Cl.**[4] ..... **H04N 5/21**

[52] **U.S. Cl.** ..... **358/222**

[58] **Field of Search** ..... 358/222; 350/500



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*Assistant Examiner*—Stephen Brinich
*Attorney, Agent, or Firm*—Benjamin J. Barish



[57] **ABSTRACT**

An image converter system comprises an image sensor producing an electrical signal corresponding to the sensed light intensity; a change-in-position sensor physically coupled to the image sensor so as to be moved therewith and to produce output signals corresponding to the changes in position of the image sensor; and a control cirucit for shifting the electrical signals produced by the image sensor according to the changes in position of the image sensor as sensed by the change-in-position sensor, to compensate for the changes in position and thereby to position-stabilize the electrical output of the image sensor.


**19 Claims, 4 Drawing Figures**

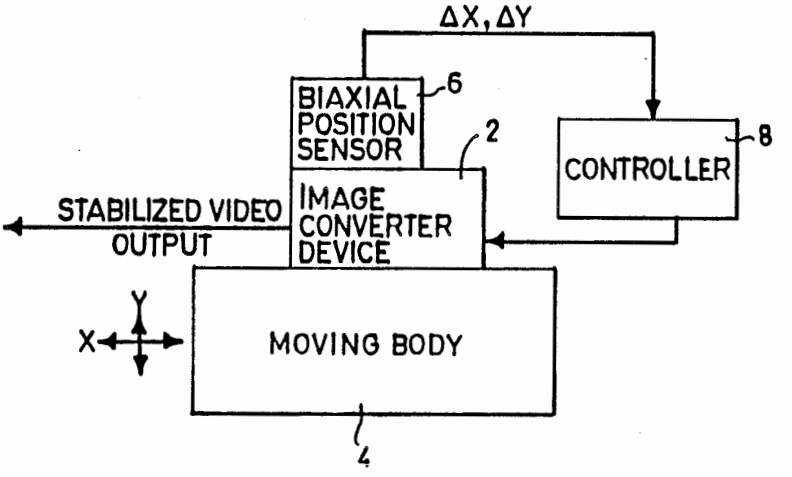


FIG. 1

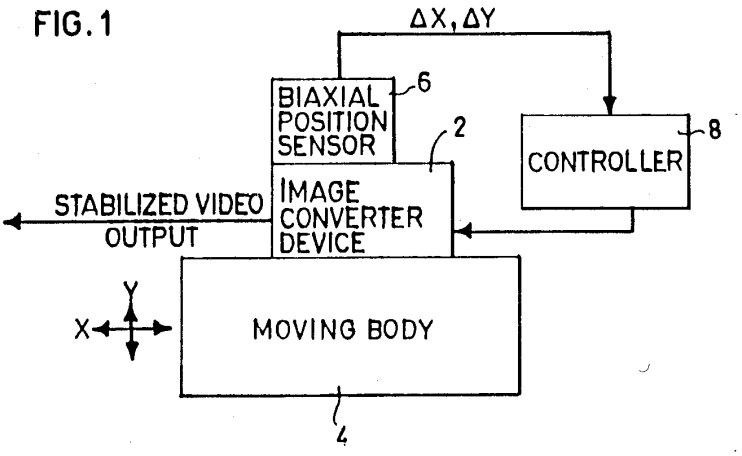

ΔX, ΔY
BIAXIAL POSITION SENSOR
6
2
CONTROLLER
8
STABILIZED VIDEO OUTPUT
IMAGE CONVERTER DEVICE
Y
X
MOVING BODY
4

FIG 3

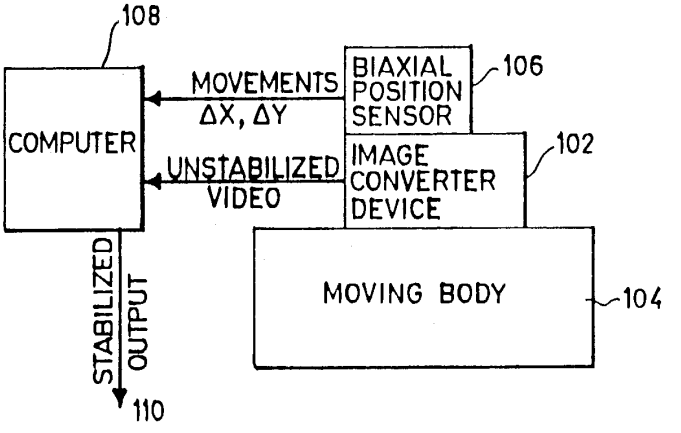

108
COMPUTER
MOVEMENTS ΔX, ΔY
BIAXIAL POSITION SENSOR
106
UNSTABILIZED VIDEO
IMAGE CONVERTER DEVICE
102
STABILIZED OUTPUT
110
MOVING BODY
104

FIG. 2

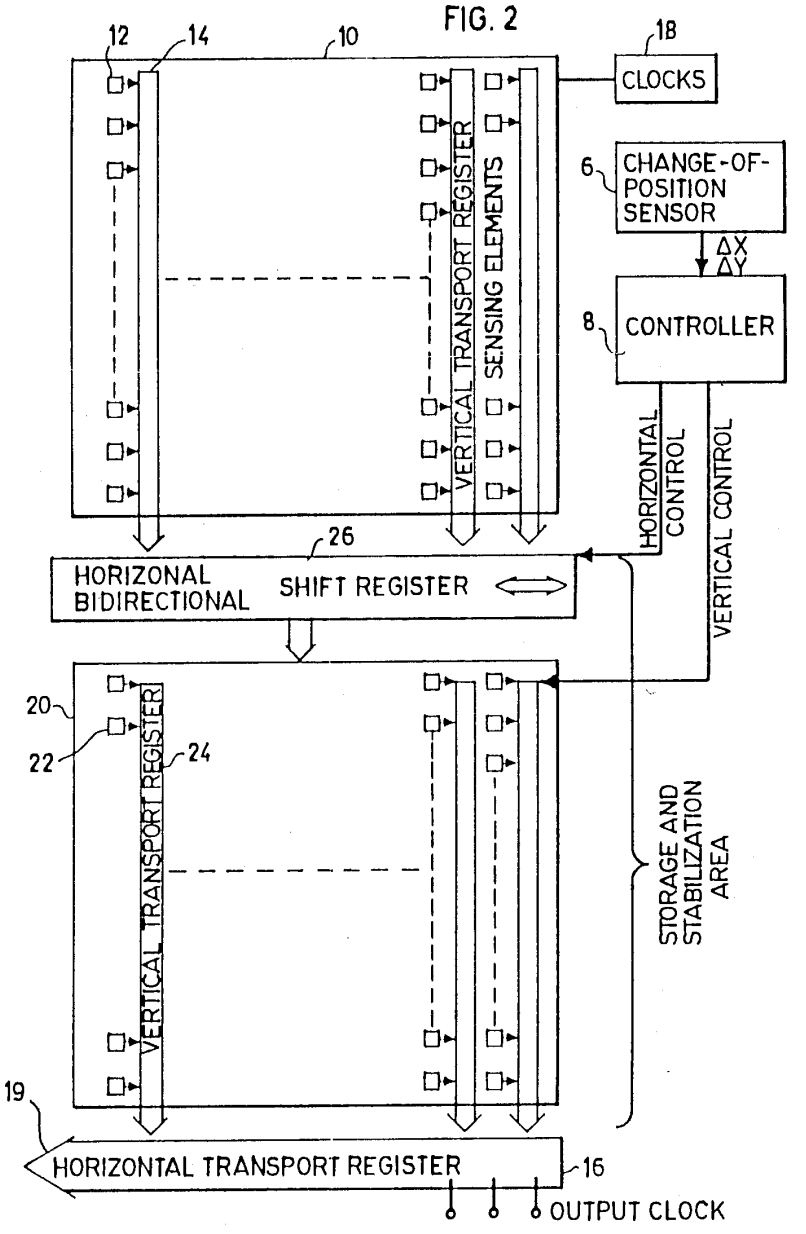
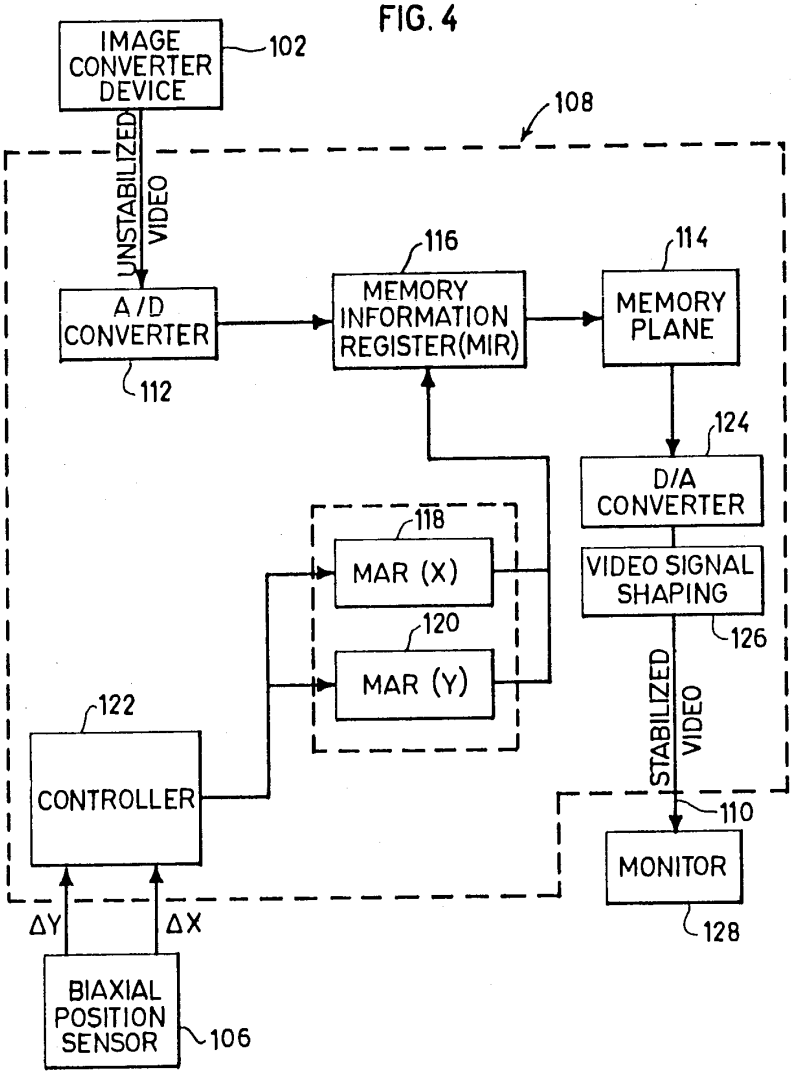

12
14
10
18
CLOCKS
6
CHANGE-OF-POSITION SENSOR
ΔX
ΔY
8
CONTROLLER
VERTICAL TRANSPORT REGISTER
SENSING ELEMENTS
HORIZONTAL CONTROL
VERTICAL CONTROL
26
HORIZONAL BIDIRECTIONAL SHIFT REGISTER
20
22
24
VERTICAL TRANSPORT REGISTER
STORAGE AND STABILIZATION AREA
19
HORIZONTAL TRANSPORT REGISTER
16
OUTPUT CLOCK

FIG. 4


IMAGE CONVERTER DEVICE
102
108
UNSTABILIZED VIDEO
A/D CONVERTER
112
116
MEMORY INFORMATION REGISTER(MIR)
114
MEMORY PLANE
124
D/A CONVERTER
VIDEO SIGNAL SHAPING
126
118
MAR (X)
120
MAR (Y)
122
CONTROLLER
STABILIZED VIDEO
110
MONITOR
128
ΔY
ΔX
BIAXIAL POSITION SENSOR
106

# POSITION-STABILIZED IMAGE CONVERTER SYSTEM

## BACKGROUND OF THE INVENTION

The present invention relates to image converter systems, for converting a light image into electrical signals. Such electrical signals may be used for reproducing the image at a remote location, or may be stored or further processed.

If the image sensor in such a system is on a moving body, for example located on a moving vehicle . or carried by a moving person, a problem arises in stabilizing the image with respect to changes in position of the image sensor. One way of doing this is to stabilize the image sensor itself, e.g. by mounting it on a stabilized platform, but such an arrangement would be complicated, costly and bulky.

## SUMMARY OF THE INVENTION

An object of the present invention is to provide an image converter system having means for electronically stabilizing the image against changes in position.

According to a broad aspect of the present invention, there is provided an image converter system, comprising: an image sensor mountable on a moving body and including an array of light sensing elements each producing an electrical signal corresponding to the light intensity sensed thereby, and means for producing an electrical output corresponding to the light image sensed by said image sensor; a change-in-position sensor physically coupled to said image sensor and mountable therewith on the moving body so as to directly sense movements in space of said moving body, and thereby of said image sensor, and to produce output signals corresponding to the changes in position of said image sensor; and control means for shifting the electrical signals produced by said image sensing elements according to the changes in position of said image sensor as sensed by said change-in-position sensor, to compensate for said changes in position and thereby to position-stabilize the electrical output of said image sensor.

According to a more specific aspect of the present invention: the image sensor is an area image sensor; the light sensing elements are arranged in a matrix array including a plurality of vertical columns and horizontal rows; the change-in-position sensor produces output signals corresponding to the changes in position of the area image sensor in both the vertical and horizontal axes; and the control means shifts the electrical signals produced by the light sensing elements according to the changes in position of the area image sensor in both the vertical and horizontal axes.

The invention is particularly useful when the area image sensor is a charge-coupled device in which the light sensing elements generate charge packets proportional to the light intensity received by them, the area image sensor further including a set of vertical transport registers, a horizontal transport register, and clock means for controlling the transport registers to produce the electrical output in the form of a series of pulses modulated according to the light sensed by the light sensing elements.

Two embodiments of the invention are described below for purposes of example.

In one described embodiment, the control means comprises: a matrix buffer including an array of storage elements corresponding to the array of light sensing elements in the area image sensor; a horizontal shift register receiving the electrical signals of the light sensing elements and the horizontal-axis change-in-position signals from the change-in-position sensor for compensating the electrical signals of the light sensing elements according to changes in position of the area image sensor along the horizontal axis; and a plurality of vertical shift registers receiving the electrical signals of the light sensing elements and the vertical-axis change-in-position signals from the change-in-position sensor for compensating the electrical signals of the light sensing elements according to changes in position of the area image sensor along the vertical axis before transferring same to the horizontal transport registers for producing the position-stabilized output.

In this embodiment, the control means may be integrated in the same integrated circuit chip with the light sensing elements and other elements of the charge-coupled device, or the control means may be constructed in a separate chip from the charge-coupled. device containing the light sensing elements.

A second embodiment of the invention is described wherein the control means comprises: a memory plane having a matrix of memory elements aranged in vertical columns and horizontal rows corresponding to the matrix of light sensing elements in the area image sensor; an analog-to-digital converter converting the electrical signals from the light sensing elements to digital form; memory read-in means shifting the digital electrical signals from the light sensing elements according to the changes-in-position of the area image sensor in both the vertical and horizontal axes as sensed by the change-in-position sensor, and then storing the shifted electrical signals in the memory plane; and read-out means for outputting the shifted electrical signals from the memory plane to produce a series of pulses modulated according to the light sensed by the light sensing elements but shifted to compensate for changes-in-position of the area image sensor in both the vertical and horizontal directions.

Further features and advantages of the invention will be apparent from the description below.

## BRIEF DESCRIPTION OF THE DRAWINGS

The invention is herein described, by way of example only, with reference to the accompanying drawings, wherein:

FIG. 1 is a block diagram illustrating one form of position stabilized image converter system constructed in accordance with the present invention;

FIG. 2 is a block diagram more particularly illustrating one implementation of the system of FIG. 1;

FIG. 3 is a block diagram illustrating a second image converter system constructed in accordance with the present invention; and

FIG. 4 is a block diagram more particularly illustrating one implementation of the system of FIG. 3.

## DESCRIPTION OF A PREFERRED EMBODIMENT

With reference to FIG. 1, there is illustrated a system including an image converter device which converts a light image to electrical signals, e.g., for reproducing the light image at a remote location. The image converter device 2 is mounted on a moving body 4, such as a moving vehicle, which may change the position of the image converter device 2 along both the horizontal and

vertical axes. These movements of body **4** are transmitted to the image converter device **2** so that its output will reflect the movements. In order to stabilize the output of image converter device, a bi-axial position sensor **6** is mounted on the image converter device and produces electrical outputs ($\Delta X$, $\Delta Y$) corresponding to the changes in position of device **2** along both the horizontal and vertical axes. These output signals from the change-in-position sensor **6** are transmitted to a controller **8** which controls the image converter device **2** in order to compensate for these changes in position, which thereby position-stabilizes the electrical output from the image converter device **2**.

FIG. **2** illustrates one implementation of the system illustrated in FIG. **1**.

In the system illustrated in FIG. **2**, the image converter device includes an area image sensor in the form of a charge-coupled device having a matrix array **10** of light sensing elements **12** arranged in a plurality of vertical columns and horizontal rows. As well known, these light sensing elements generate charge packets proportional to the light intensity received by them. As also well known in such charge-coupled devices, they include a set of vertical transport registers, generally designated **14**, a horizontal transport register, generally designated **16**, and clock means, generally designated **18**, controlling the transport registers to produce an electrical output at **19** in the form of a series of pulses modulated according to the light sensed by the light sensing elements **12**.

Such charge-coupled devices have been known since about 1970 and are thoroughly described in a large number of publications, for example the publication titled "Charge-Coupled Devices: Technology and Applications", edited by Roger Melen and Dennis Buss, the Institute of Electrical and Electronic Engineers, Inc., New York, 1976. In addition, a large number of such devices are now available on the market. Accordingly, further details of their construction and operation are not described herein.

The system illustrated in FIG. **2** further includes the two-axes position sensor **6** which produces the $\Delta X$ and $\Delta Y$ output signals representing the changes in position of the moving body **4**, and thereby of the image converter device **2**. These signals are outputted to controller **8** which, as mentioned earlier, shifts the electrical signals produced by the light sensing elements **12** according to the change-in-position signal $\Delta X$, $\Delta Y$, to compensate for these changes in position and thereby to position-stabilize the electrical output **19**.

In the embodiment illustrated in FIG. **2**, the latter control means include, in addition to controller **8**, a matrix buffer **20** including an array of storage elements **22** arranged in a matrix of vertical columns and horizontal rows corresponding to the matrix of light sensing elements **12** of the area image converter **10**. Each vertical column of memory elements **22** is separated by a vertical shift register **24**. The control means further includes a horizontal, bi-directional shift register **26**.

Controller **8** produces, as a result of the change-in-position signals received from the position sensor **6**, horizontal control signals which are applied to the horizontal shift register **26**, and vertical control signals which are applied to the vertical shift registers **24**. Thus, the horizontal control signals applied to the horizontal shift register **26** compensate the outputs of the light sensing elements **12** for any changes in position in the horizontal direction, and the vertical control signals applied to the vertical shift registers **24** compensate the output signals of the light sensing elements **12** for any changes in position in the vertical direction. Accordingly, the output from the horizontal transport register **16** will be in the form of a series of pulses modulated according to the light sensed by the light sensing elements **12** but compensated for both vertical and horizontal displacements of these sensing elements so that these signals, appearing at output **19**, will be electronically stabilized with respect to these positional changes.

The capability of the known charge-coupled devices for manipulating information in the form of discrete charge packets makes them ideally suited for use in the image converter system of the present invention. Preferably, the matrix buffer **20**, including the matrix of storage element **22** and the vertical shift registers **24**, and also the bi-directional horizontal shift register **26**, are incorporated into the same integrated circuit chip as the light sensing elements **12** of the area image sensor **10**, including its vertical transport registers **14** and horizontal transport register **16**. However, for systems requiring lower resolution and/or lower frame rates, lhe matrix buffer **20**, including its vertical shift registers **24** and horizontal shift register **26**, may be embodied in one or more chips separate from that of the area image sensor **10**.

FIG. **3** illustrates another embodiment of the invention, and FIG. **4** illustrates one implementation of the embodiment of FIG. **3**. This embodiment also includes an image converter device **102** mounted on a moving body **104** and coupled to a bi-axial position sensor **106** producing output signals corresponding to the changes in position of device **102** in both the horizontal and vertical directions. The outputs of both the image converter device **102** and the position sensor **106** are inputted into a computer **108** which compensates the unstabilized electrical signals received from the image converter device **102** for positional changes, the computer producing the stabilized output at **110**.

As shown more particularly in FIG. **4**, computer **108** includes an analog-to-digital converter **112** converting the analog information from the light sensing elements of the image converter device **102** to digital form. Image converter **102** is preferably a charge-coupled device similar to image converter **2** in FIG. **1** but of conventional construction that is, it does not include the electronic compensation for positional changes, since such compensation is performed in computer **108** in the embodiment of FIGS. **3** and **4**.

Computer **108** further includes a memory plane **114** having a matrix of memory elements arran9ed in vertical columns and horizontal rows corresponding to the matrix of light sensing elements **12** in the FIGS. **1**, **2** embodiment. The input of the digital signals from converter **112**, as derived from the light sensing elements of the image converter device **102**, is controlled by a Memory Instruction Register (MIR) **116**: MIR **116** is in turn controlled by two further registers, namely Memory-Address-Register-X, (MAR-X) **119**, and Memory-Address-Register-Y, (MAR-Y) **120**. These latter registers are presettable counters and are preset by the outputs of the position sensor **106** via controller **122** so as to control the input of the information stream from MIR **116** into the proper places in the memory plane **114** such as to compensate for the positional displacements sensed by sensor **106**.

This information is read out of memory plane **114** into a digital-to-analog converter **124** which converts the

information back to analog form. The analog information is then shaped by a video-signal shaping circuit **126** and outputted via output **110** in the form of position-stabilized video information. This output may be transmitted to a monitor **128** for reproducing the image but in position-stabilized form. Alternatively, the stabilized output **110** may be stored or further processed.

Following are examples of presently-available components which may be used in the above-described systems:

Among the may known area image sensors which may be used for sensor **10** in FIG. **2** or **102** in FIG. **4**, is the Fairchild CCD 222, but modified to include another horizontal bi-directional shift register and another set of vertical shift registers controlled by the change-in-position sensor for positional displacement of the area image sensor to stabilize the pictures. Another area image sensor that may be used is the RCA SID 51232, or the Thompson-CSF TH7851, both of which have separate areas for image and storage.

Also commercially available and usable in the described system, particularly that of FIG. **4**, is MATROX MIP512 containing an analog-to-digital converter, MIR, memory plane, digital-to-analog converter, and video signal shaping circuit, corresponding to blocks **112, 114, 116, 124** and **126**, respectively in FIG. **4**. For the MAR-X and MAR-Y, blocks **118** and **120**, respectively, in FIG. **4**, there may be used two presettable counters Texas Instruments 74195 or Fairchild 74195; two such units are needed for each direction since each of the above units is of four-bit precision, whereas eight-bit precision is desired in the system.

For the change-in-position sensor **6** (FIGS. **1, 2**) or **106** (FIGS. **3, 4**), a large number of such sensors are known and commercially available, for example rate gyros, and accelerometer.

While the invention has been described with respect to two preferred embodiments, it will be appreciated that many other variations, modifications and applications of the invention may be made.

What is claimed is:

**1.** An image converter system comprising:

an image sensor mountable on a moving body and including an array of light sensing elements each producing an electrical signal corresponding to the light intensity sensed thereby, and means for producing an electrical output corresponding to the light image sensed by said image sensor;

a change-in-position sensor physically coupled to said image sensor and mountable therewith on the moving body so as to directly sense movements in space of said moving body and thereby of said image sensor, and to produce output signals corresponding to the changes in position in space of said image sensor;

and control means for shifting the electrical signals produced by said image sensing elements according to the changes in position of said image sensor as sensed by said change-in-position sensor, to compensate for said changes in position and thereby to position-stabilize the electrical output of said image sensor.

**2.** The system according to claim **1** wherein:

said image sensor is an area image sensor;

said light sensing elements are arranged in a matrix array including a plurality of vertical columns and horizontal rows,

said change-in-position sensor produces output signals corresponding to the changes in position of the area image sensor in both the vertical and horizontal axes,

and said control means shifts the electrical signals produced by said light sensing elements according to the changes in position of said area image sensor in both the vertical and horizontal axes.

**3.** The system according to claim **2**, wherein said area image sensor is a charge-coupled device in which said light sensing elements generate charge packets proportional to the light intensity received by them, said area image sensor further including a vertical transport register, a horizontal transport register, and clock means for controlling said transport registers to produce said electrical output in the form of a series of pulses modulated according to the light sensed by said light sensing elements.

**4.** The system according to claim **3**, wherein said control means comprises:

a matrix buffer including an array of storage elements corresponding to the array of light sensing elements in the area image sensor;

a horizontal shift register receiving the electrical signals of the light sensing elements and horizontal-axis change-in-position signals from the change-in-position sensor for compensating the electrical signals of the light sensing elements according to changes in position of the area image sensor along the horizontal axis;

and a plurality of vertical shift registers receiving the electrical signals of the light sensing elements and the vertical-axis change-in-position signals from the change-in-position sensor for compensating the electrical signals of the light sensing elements according to changes in position of the area image sensor along the vertical axis before transferring same to the horizontal transport registers for producing said position-stabilized output.

**5.** The system according to claim **4**, wherein said light sensing elements, vertical and horizontal transport registers of the charge-coupled device, and said vertical and horizontal shift registers of the control means, are all included in a common integrated circuit chip.

**6.** The system according to claim **4**, wherein said light sensing elements, and vertical and horizontal transport registers of the charge-coupled device are included in one integrated circuit chip, and said vertical and horizontal shift registers of the control means are included in a separate integrated circuit chip.

**7.** The system according to claim **3**, wherein said control means comprises:

a memory plane having a matrix of memory elements arranged in vertical columns and horizontal rows corresponding to the matrix of light sensing elements in said area image sensor;

an analog-to-digital converter converting the electrical signals from the light sensing elements to digital form;

memory read-in means shifting the digital electrical signals from the light sensing elements according to the changes-in-position of said area image sensor in both the vertical and horizontal axes as sensed by said change-in-position sensor, and then storing said shifted electrical signals in said memory plane

and read-out means for outputting said shifted electrical signals from said memory plane to produce a series of pulses modulated according to the light

sensed by said light sensing elements but shifted to compensate for changes-in-position of the area image sensor in both the vertical and horizontal directions.

**8.** The system according to claim **7**, wherein said memory read-in means comprises:

a Memory-Address-Register-X (MAR-X), and a Memory-Address-Register-Y (MAR-Y) receiving the changes-in-position signals from the change-in-position sensor in the horizontal and vertical axes, respectively;

and a Memory-Instruction-Register (MIR) temporarily storing the output from said analog-to-digital converter;

said MIR being controlled by said MAR-X and MAR-Y to read into the memory plane the digital electrical signals from said analog-to-digital converter in the shifted positions of the memory plane as controlled by said MAR-X and MAR-Y.

**9.** The system according to claim **1**, wherein said change-in-position sensor is a rate gyro.

**10.** The system according to claim **1**, wherein said change-in-position sensor is an accelerometer.

**11.** An image converter system comprising:

an area image sensor including an array of light sensing elements each producing an electrical signal corresponding to the light intensity sensed thereby, and means for producing an electrical output corresponding to the light image sensed by said image sensor;

a change-in-position sensor physically coupled to said image sensor so as to be moved therewith and to produce output signals corresponding to the changes in position of said image sensor;

and control means for shifting the electrical signals produced by said image sensing elements according to the changes in position of said image sensor as sensed by said change-in-position sensor, to compensate for said changes in position and thereby to position-stabilize the electrical output of said image sensor; said control means comprising:

a memory plane having a matrix of memory elements arranged in vertical columns and horizontal rows corresponding to the matrix of light sensing elements in said area image sensor;

an analog-to-digital converter converting the electrical signals from the light sensing elements to digital form;

memory read-in means shifting the digital electrical signals from the light sensing elements according to the changes-in-position of said area image sensor in both the vertical and horizontal axes as sensed by said change-in-position sensor, and then storing said shifted electrical signals in said memory plane;

and read-out means for outputting said shifted electrical signals from said memory plane to produce a series of pulses modulated according to the light sensed by said light sensing elements but shifted to compensate for changes-in-position of the area image sensor in both the vertical and horizontal directions.

**12.** The system according to claim **11**, wherein:

said light sensing elements are arranged in a matrix array including a plurality of vertical columns and horizontal rows,

said change-in-position sensor produces output signals corresponding to the changes in position of the area image sensor in both the vertical and horizontal axes,

and said control means shifts the electrical signals produced by said light sensing elements according to the changes in position of said area image sensor in both the vertical and horizontal axes.

**13.** The system according to claim **12**, wherein said area image sensor is a charge-coupled device in which said light sensing elements generate charge packets proportional to the light intensity received by them, said area image sensor further including a vertical transport register, a horizontal transport register, and clock means for controlling said transport registers to produce said electrical output in the form of a series of pulses modulated according to the light sensed by said light sensing elements.

**14.** The system according to claim **13**, wherein said control means comprises:

a matrix buffer including an array of storage elements corresponding to the array of light sensing elements in the area image sensor;

a horizontal shift register receiving the electrical signals of the light sensing elements and horizontal-axis change-in-position signals from the change-in-position sensor for compensating the electrical signals of the light sensing elements according to changes in position of the area image sensor along the horizontal axis;

and a plurality of vertical shift registers receiving the electrical signals of the light sensing elements and vertical-axis change-in-position signals from the change-in-position sensor for compensating the electrical signals of the light sensing elements according to changes in position of the area image sensor along the vertical axis before transferring same to the horizontal transport registers for producing said position-stabilized output.

**15.** The system according to claim **14**, wherein said light sensing elements, vertical and horizontal transport registers of the charge-coupled device, and said vertical and horizontal shift registers of the control means, are all included in a common integrated circuit chip.

**16.** The system according to claim **14**, wherein said light sensing elements, and vertical and horizontal transport registers of the charge-coupled device are included in one integrated circuit chip, and said vertical and horizontal shift registers of the control means are included in a separate integrated circuit chip.

**17.** The system according to claim **11**, wherein said memory read-in means comprises:

a Memory-Address-Register-X (MAR-X), and a Memory-Address-Register-Y (MAR-Y) receiving the changes-in-position signals from the change-in-position sensor in the horizontal and vertical axes, respectively;

and a Memory-Instruction-Register (MIR) temporarily storing the output from said analog-to-digital converter;

said MIR being controlled by said MAR-X and MAR-Y to read into the memory plane the digital electrical signals from said analog-to-digital converter in the shifted positions of the memory plane as controlled by said MAR-X and MAR-Y.

**18.** The system according to claim **11**, wherein said change-in-position sensor is a rate gyro.

**19.** The system according to claim **11**, wherein said change-in-position sensor is an accelerometer.

* * * * *

US005502484A

# United States Patent [19]

Okada

[11] Patent Number: 5,502,484

[45] Date of Patent: Mar. 26, 1996

[54] **VIDEO CAMERA AND VIDEO SIGNAL REPRODUCING APPARATUS WITH SHAKE DETECTION AND CORRECTION OPERATION**

[75] Inventor: **Miyuki Okada**, Kanagawa, Japan

[73] Assignee: **Sony Corporation**, Tokyo, Japan

[21] Appl. No.: **502,584**

[22] Filed: **Jul. 14, 1995**

**Related U.S. Application Data**

[63] Continuation of Ser. No. 187,058, Jan. 27, 1994, abandoned.

[30] **Foreign Application Priority Data**

Feb. 12, 1993 [JP] Japan ..... 5-047434
Feb. 16, 1993 [JP] Japan ..... 5-050029

[51] **Int. Cl.**[6] ..... **H04N 5/232**

[52] **U.S. Cl.** ..... **348/208**; 348/240

[58] **Field of Search** ..... 348/208, 240, 348/358, 347; H04N 5/232

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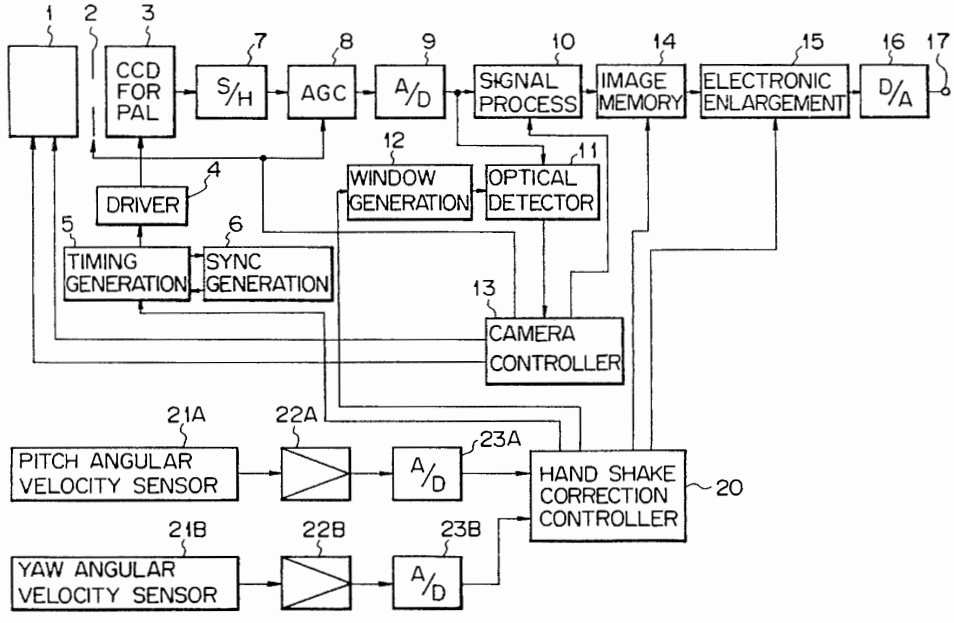
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*Primary Examiner*—Wendy R. Greening
*Attorney, Agent, or Firm*—Jay H. Maioli

[57] **ABSTRACT**

A video camera includes a lens for collecting a light from an object to be photographed; an image pickup device for converting the light collected by the lens into an electric signal; an analog to digital converting circuit for converting the electric signal from the image pickup device into a digital signal; a memory circuit for storing the digital signal obtained by the analog to digital conversion; a shake detector for detecting a shake of the video camera; calculating unit for obtaining a correction amount from an output signal of the shake detector; a correcting unit for correcting a shake of an image accompanied with a slight shake of a body of the video camera on the basis of an output signal of the calculating means; a zoom system for enlarging or reducing the object to be photographed; and a control unit for changing the correcting unit in accordance with a change of zoom of the zoom system.

**29 Claims, 9 Drawing Sheets**



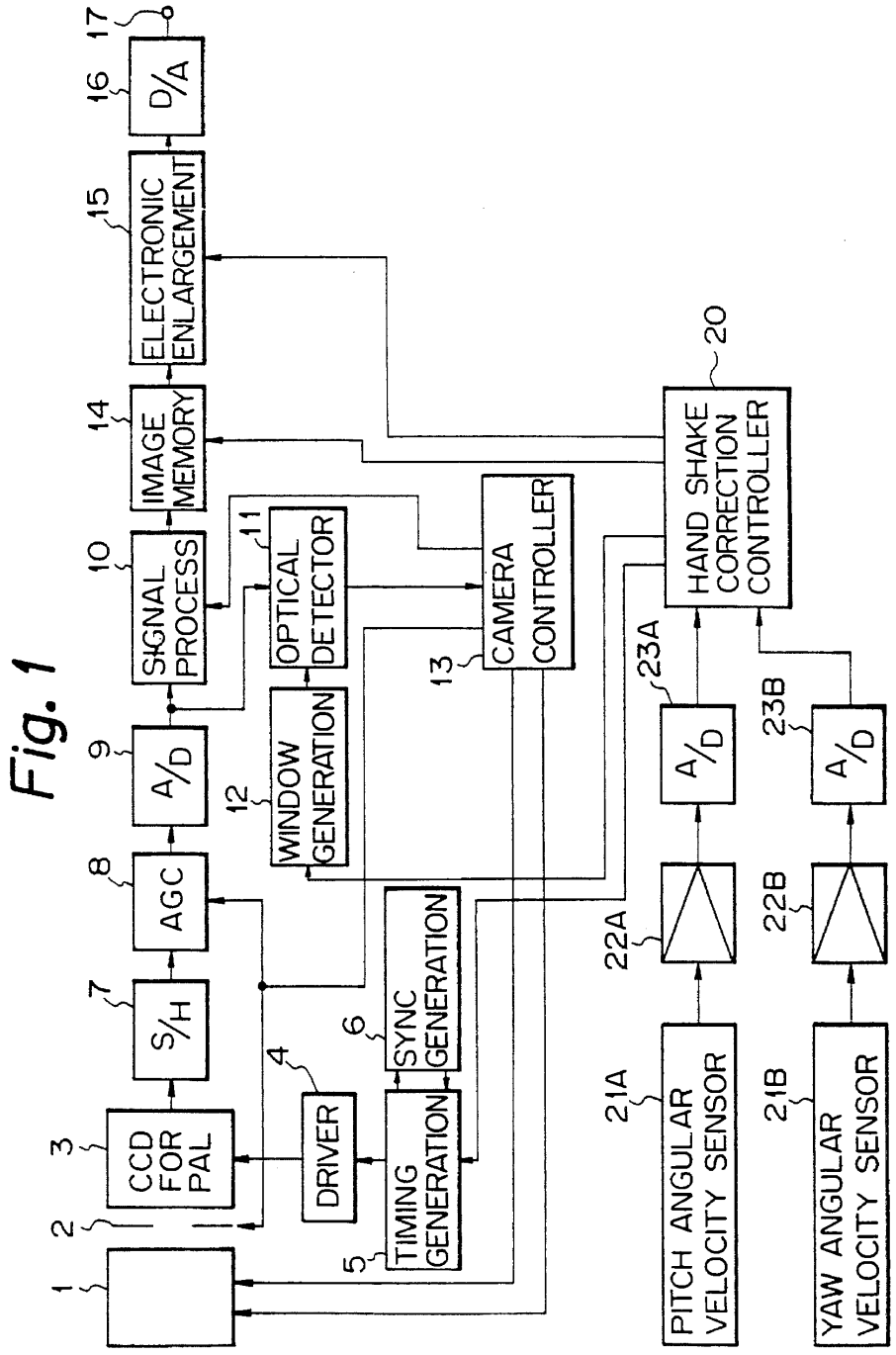

1
2
3
CCD FOR PAL
4
DRIVER
5
TIMING GENERATION
6
SYNC GENERATION
7
S/H
8
AGC
9
A/D
10
SIGNAL PROCESS
11
OPTICAL DETECTOR
12
WINDOW GENERATION
13
CAMERA CONTROLLER
14
IMAGE MEMORY
15
ELECTRONIC ENLARGEMENT
16
D/A
17
20
HAND SHAKE CORRECTION CONTROLLER
21A
PITCH ANGULAR VELOCITY SENSOR
21B
YAW ANGULAR VELOCITY SENSOR
22A
22B
23A
A/D
23B
A/D

Fig. 1

Fig. 2

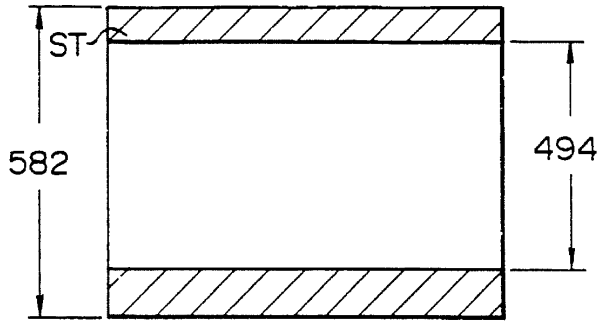



Fig. 3

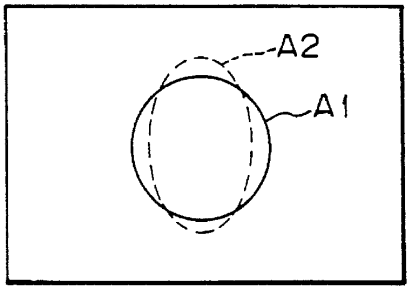



Fig. 4A

Fig. 4B

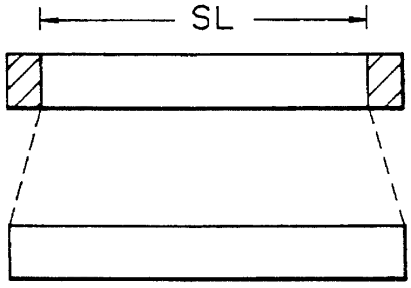


Fig. 5B

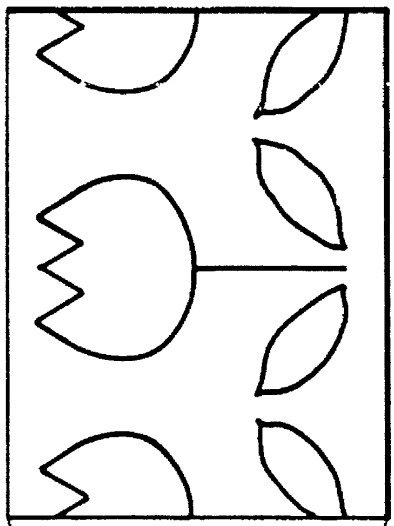


Fig. 5A

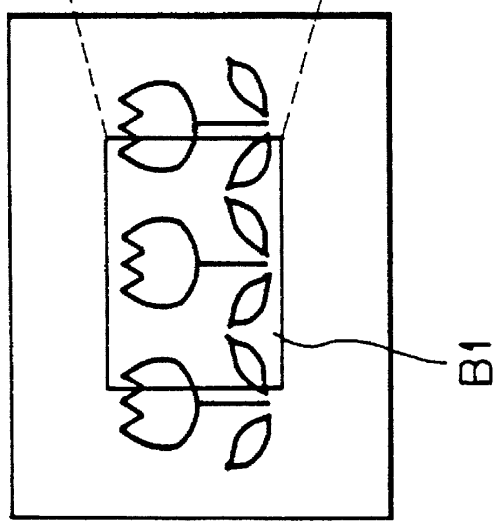
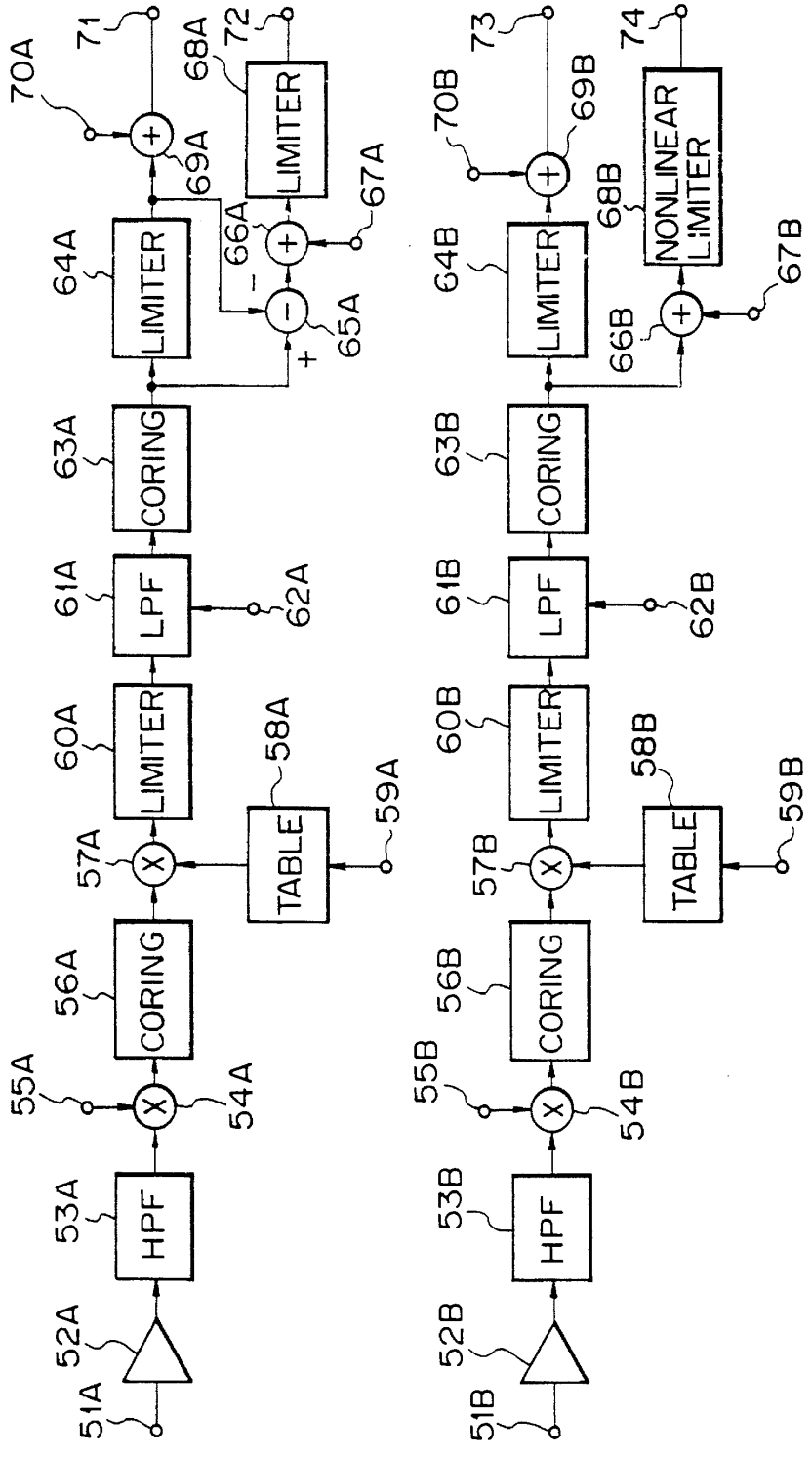


Fig. 6


51A
52A
HPF
53A
55A
54A
56A
CORING
57A
TABLE
58A
59A
60A
LIMITER
61A
LPF
62A
63A
CORING
64A
LIMITER
66A
65A
67A
LIMITER
68A
72
69A
70A
71
51B
52B
HPF
53B
55B
54B
56B
CORING
57B
TABLE
58B
59B
60B
LIMITER
61B
LPF
62B
63B
CORING
64B
LIMITER
66B
67B
NONLINEAR LIMITER
68B
74
69B
70B
73

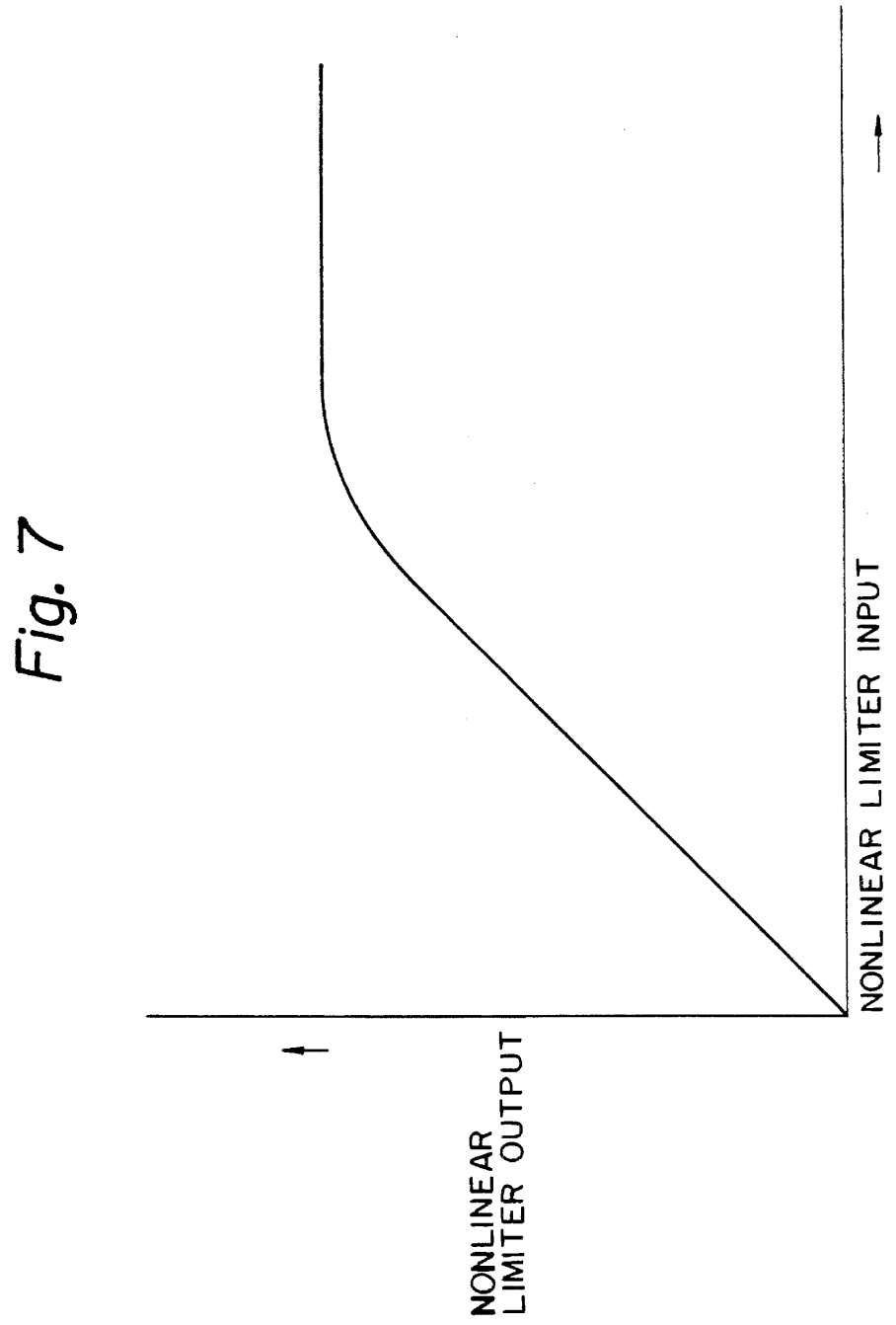



Fig. 7

Fig. 8A

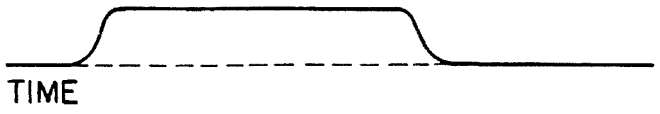



Fig. 8B

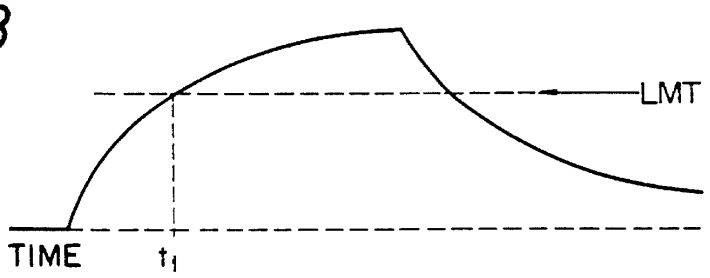



Fig. 8C

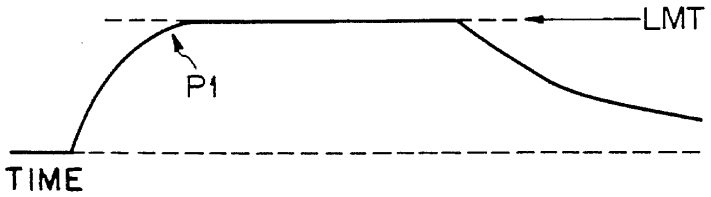


Fig. 9A

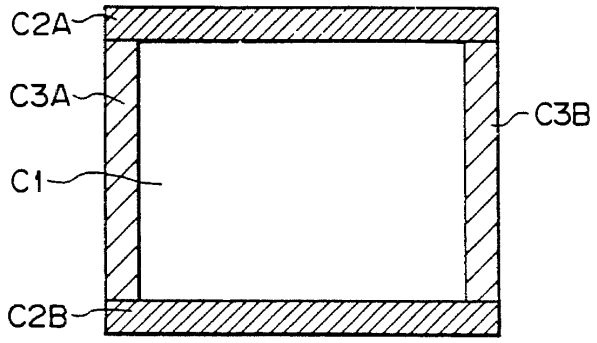



Fig. 9B

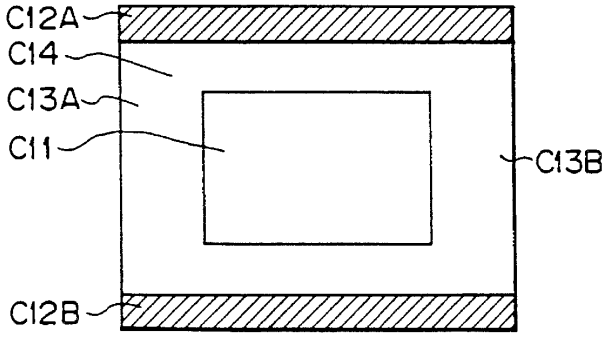


Fig. 10

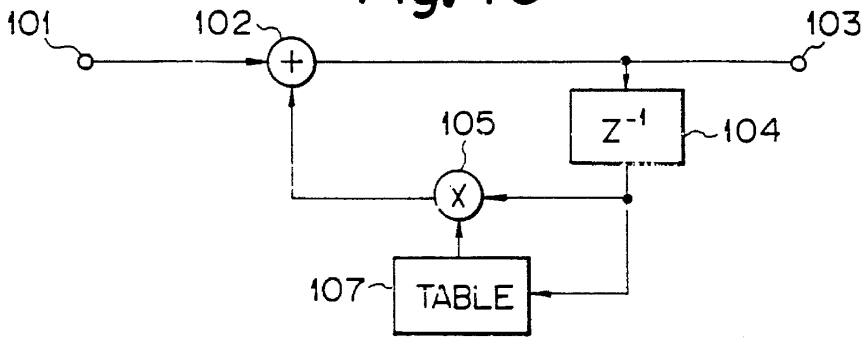



Fig. 11

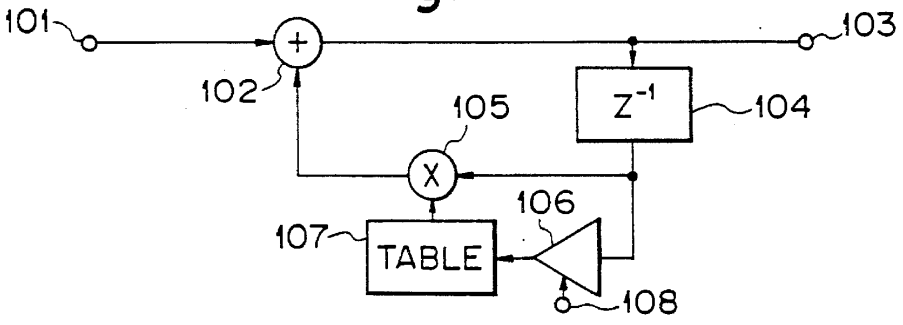



Fig. 12

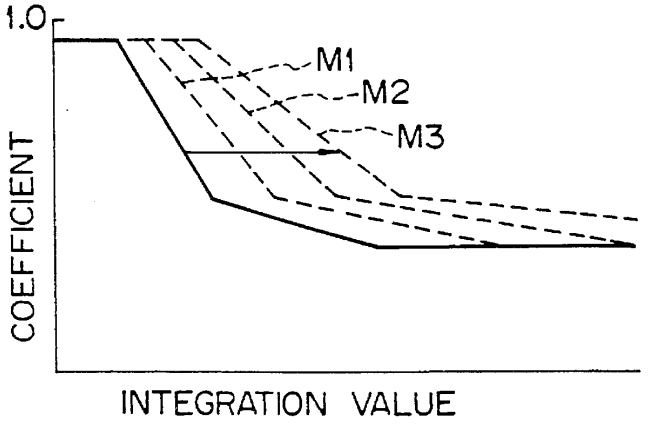


Fig. 13A

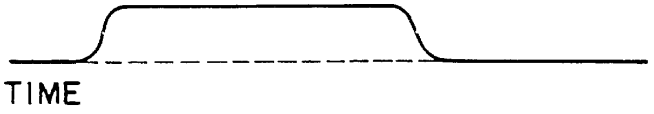



Fig. 13B

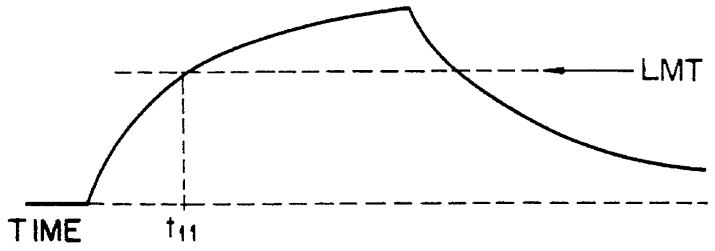
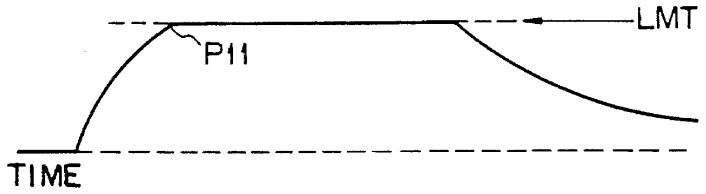



Fig. 13C



# VIDEO CAMERA AND VIDEO SIGNAL REPRODUCING APPARATUS WITH SHAKE DETECTION AND CORRECTION OPERATION

This is a continuation of application Ser. No. 08/187,058 filed Jan. 27, 1994 now abandoned.

## BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a video camera and a video signal reproducing apparatus, each having a hand shake correcting function.

2. Description of the Related Art

In recent years, in association with the miniaturization and light weight of video cameras, a problem of hand shake has come to easily occur. Therefore, a video camera having a hand shake correcting function has been put into practical use.

As a hand shake correcting method of such a video camera, there has been known a method whereby a shake of the camera is detected by an angular velocity sensor and a cut-out position in an image memory is shifted in accordance with an output of the angular velocity sensor.

In such a hand shake correcting method of the video camera, the output of the angular velocity sensor is integrated by a low pass filter, and is converted from an angular velocity into an angle, thereby obtaining a correction amount. On the basis of the correction amount, an image plane is shifted. A limiter to set a correction limit value of an output of the low pass filter is provided so that the correction amount does not exceed the limit value.

The video camera having the image memory can enlargedly interpolate the image plane stored in the image memory. Such a function is called an electronic zoom. On the other hand, a zoom in which a zoom lens is moved is called an optical zoom.

In case of the hand shake correcting method such that a movement of the camera is detected by the angular velocity sensor and the correction is performed in accordance with the cut-out position in the image memory (for example, European Patent Application Publication No. 0498730), the shake of the image plane enhances with an increase in zoom magnification in the optical zoom region. It is, therefore, necessary to increase the correction amount in proportion to the zoom magnification.

On the other hand, in an electronic zoom region, it is sufficient to set the correction gain constant. This is because in the electronic zoom region, for example, in case of the electronic zoom of the double magnification, when there is a hand shake of (n) lines, the reading position in the image memory is shifted by (n) lines. Then, the content of the image memory is interpolated by two times and is read out. When the image data is shifted by (n) lines and is interpolated by two times and is read out, the correction of ($2n$) lines is executed.

Such a hand shake correcting apparatus has a low pass filter to convert from an angular velocity based on the shake of the camera detected by the angular velocity sensor into an angle. Since it is sufficient that the correction gain is constant in the electronic zoom region, hitherto, the gain of the low pass filter is set to the same as that in the control in the telescopic end of the zoom lens in the electronic zoom region.



However, when such a hand shake correcting function is added, a problem such that an image pickup plane becomes unnatural upon panning photographing has conventionally occurred. Namely, upon panning photographing, the camera is suddenly moved at the start of the panning. Due to this, the integration value of the angular velocity sensor rapidly increases and suddenly the value exceeds the correction limit. Accordingly, the image pickup plane becomes unnatural.

Namely, when the panning photographing is executed, a detection signal is outputted from the angular velocity sensor as shown in FIG. **13**A. The detection signal is integrated by a low pass filter. The integration value reaches a correction limit LMT at a time point $t_{11}$ as shown in FIG. **13**B. Hitherto, as shown in FIG. **13**C, the integration value is suddenly limited from a point P11 at the time point $t_{11}$ at which the integration value reaches the correction limit LMT.

On the other hand, when the electronic zoom magnification rises, the portion which is not read out from the image memory is widened, so that the hand shake correction ability inherently increases. However, conventionally, the low pass filter which integrates the output of the angular velocity sensor is controlled in a manner similar to the control in the telescopic end of the zoom lens in the electronic zoom region. Therefore, the hand shake correcting function cannot be effectively utilized even at a position of a high electronic zoom magnification where the hand shake correction ability is high.

## OBJECTS AND SUMMARY OF THE INVENTION

Therefore, it is an object of the invention to provide a video camera and a video signal reproducing apparatus which can prevent an unnatural movement of an image plane upon panning photographing.

It is another object of the invention to provide a video camera and a video signal reproducing apparatus, in which the correction amount in the electronic zoom region can be effectively used and the correction ability is improved.

According to an aspect of the invention, there is provided a video camera comprising:

- a lens for collecting a light from an object to be photographed;
- an image pickup device for converting the light collected by the lens into an electric signal;
- an analog to digital converting circuit for converting the electric signal from the image pickup device into a digital signal;
- a memory circuit for storing the digital signal obtained by the analog to digital conversion;
- shake detecting means for detecting a shake of the video camera;
- calculating means for obtaining a correction amount from an output signal of the shake detecting means;
- correcting means for correcting a shake of an image accompanied with a slight shake of a body of the video camera on the basis of an output signal of the calculating means; and
- a limiter circuit for limiting a correction amount in the correction limit for an output signal of the calculating means.

According to another aspect of the invention, there is provided a video signal reproducing apparatus comprising:

an analog to digital converting circuit for converting an input video signal into a digital signal;

a memory circuit for storing the digital signal obtained by the analog to digital conversion;

shake detecting means for detecting a shake of an image plane generated by the video signal;

calculating means for obtaining a correction amount from an output signal of the shake detecting means;

correcting means for correcting a shake of an image accompanied with a slight shake of a body of the video camera on the basis of an output signal of the calculating means; and

a limiter circuit for limiting a correction amount in the correction limit for an output signal of the calculating means.

The shake of the video camera or the video signal reproducing apparatus is detected and integrated, thereby obtaining a control amount. A limiter which sets a limit value in the control is set to a nonlinear limiter, thereby limiting that the value suddenly reaches the correction limit upon panning and making an image plane upon panning natural.

According to still another object of the invention, there is provided a video camera comprising:

a lens for collecting a light from an object to be photographed;

an image pickup device for converting the light collected by the lens into an electric signal;

an analog to digital converting circuit for converting the electric signal from the image pickup device into a digital signal;

a memory circuit for storing the digital signal obtained by the analog to digital conversion;

shake detecting means for detecting a shake of the video camera;

calculating means for obtaining a correction amount from an output signal of the shake detecting means;

correcting means for correcting a shake of an image accompanied with a slight shake of a body of the video camera on the basis of an output signal of the calculating means;

zoom means for enlarging or reducing the object to be photographed; and

control means for changing the correcting means in accordance with a change of zoom of the zoom means.

According to yet another object of the invention, there is provided video signal reproducing apparatus comprising:

an analog to digital converting circuit for converting an input video signal into a digital signal;

a memory circuit for storing the digital signal obtained by the analog to digital conversion;

shake detecting means for detecting a shake of an image plane generated by the video signal;

calculating means for obtaining a correction amount from an output signal of the shake detecting means;

correcting means for correcting a shake of an image accompanied with a slight shake of the image plane on the basis of an output signal of the calculating means;

zoom means for enlarging or reducing the object to be photographed; and

control means for changing the correcting means in accordance with a change of zoom of the zoom means.

The shake of the video camera or the video signal reproducing apparatus is detected by the angular velocity sensor. The correction amount of the image is calculated from the detection result and the zoom magnification. In this instance, by using the electronic enlargement magnification, a coefficient of the low pass filter to convert from the angular velocity into the angle is changed. Thus, the correction amount in the electronic zoom region can be effectively used and the correction ability is improved.



According to the invention, by using a nonlinear limiter as a limiter to set the limit value of the control, it is prevented that the value suddenly reaches the correction limit upon panning and the image plane upon panning can be made natural.

According to the invention, the coefficient of the low pass filter which converts the angular velocity into the angle can be set in correspondence to the electronic zoom magnification. Therefore, as the electronic zoom magnification is increased, a larger correction range can be obtained, so that the hand shake correction ability is improved.

The above, and other, objects, features and advantage of the present invention will become readily apparent from the following detailed description thereof which is to be read in connection with the accompanying drawings.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a block diagram showing a whole construction of a video camera to which the invention is applied;

FIG. **2** is a schematic diagram which is used for explanation of an embodiment of the invention;

FIG. **3** is a schematic diagram which is used for explanation of a hand shake correction of an embodiment of the invention;

FIGS. **4**A and **4**B are schematic diagrams which are used for explanation of a hand shake correction of an embodiment of the invention;

FIGS. **5**A and **5**B are schematic diagrams which are used for explanation of an electronic zoom of an embodiment of the invention;

FIG. **6** is a functional block diagram of a hand shake correction controller of an embodiment of the invention;

FIG. **7** is a graph showing an example of a table of a nonlinear limiter in an embodiment of the invention;

FIGS. **8**A, **8**B, and **8**C are waveform diagrams which are used for explanation of an embodiment of the invention;

FIGS. **9**A and **9**B are schematic diagrams which are used for explanation of a hand shake correction of an embodiment of the invention;

FIG. **10** is a block diagram which is used for explanation of a low pass filter of an embodiment of the invention;

FIG. **11** is a block diagram which is used for explanation of a low pass filter of an embodiment of the invention;

FIG. **12** is a graph which is used for explanation of a low pass filter of an embodiment of the invention; and

FIGS. **13**A, **13**B, and **13**C are waveform diagrams which are used for explanation of conventional limiter.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

An embodiment of the invention will be explained hereinbelow with reference to the drawings. FIG. **1** shows a whole construction of a video camera to which the invention is applied. In FIG. **1**, an object image light obtained through a lens group **1** forms an image onto a photosensitive surface of a CCD image pickup device **3** through an iris **2**. The video

camera records by the NTSC system. In order to correct the hand shake, however, the number of lines of the CCD image pickup device **3** corresponds to the number of lines of the PAL system instead of the number of lines of the NTSC system.

The CCD image pickup device **3** is driven by a driver **4** on the basis of a timing signal from a timing generating circuit **5**. A sync signal is supplied to the timing generating circuit **5** from a sync signal generating circuit **6**. An output from a hand shake correction controller **20** is supplied to the timing generating circuit **5**. A high speed transfer clock is supplied to the CCD image pickup device **3** within a vertical blanking period according to the shake in the vertical direction of the camera.

The output of the CCD image pickup device **3** is supplied to an A/D converter **9** through a sampling and holding circuit **7** and an AGC circuit **8**. The image pickup signal is converted into the digital signal by the A/D converter **9**. An output of the A/D converter **9** is supplied to a signal processing circuit **10** and also to an optical detector **11**.

The signal processing circuit **10** executes a necessary camera signal process and forms a luminance signal and a chrominance signal which correspond to the NTSC system from the image pickup signal of the CCD image pickup device **3**. An output of the signal processing circuit **10** is supplied to an image memory **14**.

The optical detector **11** is provided to obtain information necessary for optical control such as exposure control, focusing control, white balance control, and the like. A window is set by the optical detector **11** and a light amount level in the window is detected. The light amount level is supplied to a camera controller **13**.

The camera controller **13** controls a gain of the AGC circuit **8** and an opening degree of the iris **2** in accordance with the light amount level. Due to this, the automatic exposure control is executed. A window is set in the optical detector **11** and an edge component level of the image pickup signal in the window is detected. The edge component level is supplied to the camera controller **13**. The camera controller **13** controls the position of the focusing lens in the lens group **1** so as to maximize the edge component. Due to this, the automatic focusing adjustment is executed.

The position of the window of the optical detector **11** is movable in the horizontal direction by a window generating circuit **12**. The position of the window is changed in accordance with the hand shake correction amount.

The image memory **14** is provided for executing the electronic zoom and is also used for executing a hand shake correction of a big shake. An output of the image memory **14** is supplied to an electronic enlarging circuit **15**. The electronic enlarging circuit **15** executes a hand shake correction in the horizontal direction of the camera by shifting the reading position of one line. The hand shake in the vertical direction of one line or less is also corrected by the electronic enlarging circuit **15**.

An output of the electronic enlarging circuit **15** is supplied to a D/A converter **16**. The D/A converter **16** outputs an analog video signal. The analog video signal is outputted from an output terminal **17**.

The shake of the camera is detected by a pitch angular velocity sensor **21**A and a yaw angular velocity sensor **2**1B. That is, the shake in the vertical direction is detected by the pitch angular velocity sensor **21**A. An output of the pitch angular velocity sensor **21**A is supplied to an A/D converter **23**A through an amplifier **22**A. An output of the A/D converter **23**A is supplied to the hand shake correction controller **20**. An output of the yaw angular velocity sensor **2**1B is supplied to an A/D converter **23**B through an amplifier **22**B. An output of the A/D converter **23**B is supplied to the hand shake correction controller **20**.

The hand shake correction controller **20** allows the CCD image pickup device **3** to transfer the charges at a high speed on the basis of the shake in the vertical direction detected by the pitch angular velocity sensor **21**A, thereby executing the hand shake correction in the vertical direction. Shifting operation is executed in the horizontal direction on the basis of the shake in the horizontal direction detected by the yaw angular velocity sensor **21**B. Due to this, the hand shake correction in the horizontal direction is executed.

As shown in FIG. **2**, according to the embodiment of the invention, a device having the number of lines of the PAL system, for example, the number of effective lines equal to **582** is used as a CCD image pickup device **3**. **0**n the other hand, the number of effective lines of the NTSC system is equal to **494**. Therefore, **494** lines among the **582** effective lines of one image plane of the CCD image pickup device **3** are used. As shown in the hatched regions in FIG. **2**, outputs of the other lines are not used. The image plane can be moved in the vertical direction by changing the start position ST. Therefore, by moving the start position ST so as to eliminate the shake in the vertical direction of the image plane, the hand shake correction in the vertical direction can be executed.

Accordingly, when the charges of the lines as many as the number of lines in the NTSC system in the CCD image pickup device **3** having the lines as many as the number of lines of the PAL system are transferred at an ordinary speed, and the charges of the remaining lines are transferred at a high speed, as shown in FIG. **3**, for example, a circular object A**1** is displayed as a circular object A**2** which is elongated vertically.

As shown in FIG. **4**A, a signal SL of one line is fetched into the line memory and as shown in FIG. **4**B, the signal is read out while changing the time base. Thus, an aspect ratio of the image which is displayed is corrected and also the image plane in the horizontal direction is enlarged. The reading position in the line memory is shifted in accordance with the shake of the video camera in the horizontal direction, thereby enabling the hand shake correction in the horizontal direction to be executed.

In the video camera to which the invention is applied, by moving the zoom lens, the optical zoom photographing can be executed and by using the image memory **14**, the electronic zoom photographing can be also executed. That is, when it is assumed that the image pickup plane as shown in FIG. **5**A has been stored in the image memory **14**, by cutting out the portion shown by the region B**1** and by enlargedly interpolating the cut-out portion, the image plane can be doubled in size as shown in FIG. **5**B.

The hand shake correction controller **20** executes a filtering process to the outputs of the pitch angular velocity sensor **21**A and the yaw angular velocity sensor **2**1B, thereby calculating correction amounts in the vertical and horizontal directions.

FIG. **6** is a functional block diagram of the processes in the hand shake correction controller **20**. First, the process on the pitch side will be explained. In FIG. **6**, an output of the angular velocity sensor **21**A in the pitch direction is supplied to an input terminal **51**A through the amplifier **22**A and the A/D converter **23**A (FIG. **1**). A signal from the input terminal **51**A is supplied to a high pass filter **53**A through a multi-

plying circuit **52**A for an adjustment of the whole gain. The high pass filter **53**A eliminates a DC offset included in the angular velocity sensor **21**A.

An output of the high pass filter **53**A is supplied to a multiplying circuit **54**A for a variation adjustment of the angular velocity sensor. A gain corresponding to a variation is supplied to the multiplying circuit **54**A from an input terminal **55**A. An output of the multiplying circuit **54**A is supplied to a coring circuit **56**A for noise removal. An output of the coring circuit **56**A is supplied to a multiplying circuit **57**A.

A coefficient is given to the multiplying circuit **57**A from a table **58**A. A position of an optical zoom is given to the table **58**A from a terminal **59**A. The hand shake needs to be largely corrected as the optical zoom magnification is large. Accordingly, the coefficient is set by the table **58**A so that a bigger correction is executed when the zoom lens is located on the telescopic side.

An output of the multiplying circuit **57**A is supplied to a low pass filter **61**A through a limiter **60**A. The low pass filter **61**A executes a conversion from an angular velocity to an angle. The low pass filter **61**A is constructed by an IIR filter as will be described in detail hereinlater. A coefficient in the low pass filter **61**A is set in accordance with the electronic zoom magnification from a terminal **62**A, thereby enabling the effective correction to be also executed even in the electronic zoom region.

An output of the low pass filter **61**A is supplied to a coring circuit **63**A. An output of the coring circuit **63**A is supplied to a limiter **64**A. An output of the limiter **64**A is outputted from an output terminal **71** through an offset adding circuit **69**A and is also supplied to a subtracting circuit **65**A. According to an output from the output terminal **71**, the reading position of the CCD image pickup device **3** for the PAL is shifted and the hand shake correction in the vertical direction is executed.

A correction amount exceeding an offset is obtained by the subtracting circuit **65**A. An output of the subtracting circuit **65**A is supplied to an adding circuit **66**A. An electronic zoom control data is supplied to the adding circuit **66**A from a terminal **67**A. An output of the adding circuit **66**A is outputted from an output terminal **72** through a limiter **68**A. According to the output from the output terminal **72**, the reading position in the image memory **14** is shifted and the hand shake correction in the vertical direction exceeding the correction range is executed. An output of the output terminal **72** is supplied to the electronic enlarging circuit **15** and the hand shake correction in the vertical direction of 0.5 line or less is executed.

The process in the yaw direction will now be explained. The process in the yaw direction is substantially the same as the process in the pitch direction. That is, the output of the angular velocity sensor **21** in the yaw direction is supplied to an input terminal **51**B through the amplifier **22**B and the A/D converter **23**B. The signal from the input terminal **51**B is supplied to a high pass filter **53**B for a DC offset removal through a multiplying circuit **52**B for an adjustment of the whole gain.

An output of the high pass filter **53**B is supplied to a multiplying circuit **54**B for a variation adjustment of the angular velocity sensor. A gain corresponding to the variation is supplied to the multiplying circuit **54**B from an input terminal **55**B. An output of the multiplying circuit **54**B is supplied to a coring circuit **56**B for a noise removal. An output of the coring circuit **56**B is supplied to a multiplying circuit **57**B. A coefficient is given to the multiplying circuit **57**B from a table **58**B. The position of the optical zoom is given to the table **58**B from a terminal **59**B. The coefficient is set by the multiplying circuit **57**B and the table **58**B so that bigger correction is executed when the zoom lens is located on the telescopic side.

An output of the multiplying circuit **57**B is supplied to a low pass filter **61**B through a limiter **60**B. The low pass filter **61**B converts the angular velocity into the angle. An electronic zoom magnification is supplied to the low pass filter **61**B from a terminal **62**B. An output of the low pass filter **61**B is supplied to a coring circuit **63**B. An output of the coring circuit **63**B is supplied to a limiter **64**B. An output of the limiter **64**B is outputted from an output terminal **73** through an offset adding circuit **69**B and is also supplied to an adding circuit **66**B. An offset is supplied to the adding circuit **69**B from a terminal **70**B. Electronic zoom control data is supplied to the adding circuit **66**B from a terminal **67**B. An output of the adding circuit **66**B is outputted from an output terminal **74** through a nonlinear limiter **68**B.

An output from the output terminal **73** is supplied to the window generating circuit **12** and the window position of the optical detector **11** is shifted in accordance with the output from the output terminal **73**. An output of the output terminal **74** is supplied to the electronic enlarging circuit **15** and the reading position of the electronic enlarging circuit **15** is shifted in accordance with an output from the output terminal **74** and the hand shake correction in the horizontal direction is executed.

As mentioned above, the low pass filters **61**A and **61**B convert from the angular velocity to the angle and obtain a correction amount. In order to set a limit of the correction amount, limiters **64**A, **68**A, **64**B, and **68**B are provided. Among these limiters, the limiter **68**B is a nonlinear limiter so as to prevent that an image pickup plane becomes unnatural upon panning photographing.

Namely, upon panning photographing, since the camera is rapidly moved at the start of the panning, the integration value of the angular velocity sensor rapidly increases and suddenly exceeds the limit value. Therefore, when an ordinary limiter is used, the integration value suddenly reaches the correction limit from a state of the image plane such that the motion of the panning is suppressed at the start of the panning. An unnatural image pickup plane is obtained.

On the other hand, according to an embodiment of the invention, as shown in FIG. **7**, a nonlinear limiter such that the correction amount gradually approaches the limit is used. FIG. **7** shows a table of a nonlinear limiter **68**B. In FIG. **7**, an axis of abscissa shows input values of the nonlinear limiter **68**B and an axis of ordinate indicates output values. The input corresponds to the output of the low pass filter **61**B.

As mentioned above, according to the embodiment of the invention, since the nonlinear limiter **68**B is used, even when the camera is rapidly moved at the start of the panning, the value doesn't suddenly reach the correction limit and the image pickup plane upon panning is not unnatural.

Namely, when the panning photographing is executed, a detection signal as shown in FIG. **8**A is outputted from the angular velocity sensor. The detection signal is integrated by the low pass filter. The integration value reaches the correction limit LMT at a time point $t_1$ as shown in FIG. **8**B. Since the characteristics of the nonlinear limiter **68**B are nonlinear, as shown at a point P1 in FIG. **8**C, the value gradually reaches the correction limit LMT. Due to this, the image pickup plane upon panning is not unnatural.

Although the characteristics of the nonlinear limiter **68**B can be fixed, the nonlinear characteristics can be also

changed according to the speed of the panning or the zoom ratio. For instance, limiter characteristics such that the faster the panning speed is, or the bigger the zoom magnification is, the curve which reaches the correction limit becomes more gentle are set.

According to the embodiment mentioned above, a nonlinear limiter is provided only for a hand shake correction system in the horizontal direction. However, it is also possible to provide a nonlinear limiter for a hand shake correction system in the vertical direction.

FIG. **9**A shows an image plane in the optical zoom region. In such an optical zoom region, an image of the region shown by C**1** is used. The hand shake correction in the vertical direction is executed within a region shown by C**2**A and C**2**B and the hand shake correction in the horizontal direction within a region shown by C**3**A and C**3**B is executed. The hand shake correction in the range shown by C**2**A and C**2**B is achieved by shifting the reading position of the CCD image pickup device **3**. The hand shake correction in the horizontal direction in the range shown by C**3**A and C**3**B is achieved by shifting the reading position in the horizontal direction by the electronic enlarging circuit **15**.

FIG. **9**B shows an image plane which is stored in the image memory **14** in the electronic zoom region. In such an electronic zoom region, an image in the region shown by C**11** is used. The hand shake correction in the vertical direction is executed by shifting the reading position of the CCD image pickup device **3** within a range shown by C**12**A and C**12**B. The hand shake correction in the horizontal direction is executed within a range shown by C**13**A and C**13**B. Further, an unused region C**14** occurs in the image memory. The unused region C**14** can be used for the hand shake correction.

FIGS. **10** and **11** show constructions of the low pass filters **61**A and **6**lB. FIG. **10** shows a construction in the optical zoom region and FIG. **11** shows a construction in the electronic zoom region. In FIGS. **10** and **11**, a signal from an input terminal **101** is supplied to an adding circuit **102**. An output of the adding circuit **102** is outputted from an output terminal **103** and is also supplied to a delay circuit **104**.

In the optical zoom region, as shown in FIG. **10**, an output of the delay circuit **104** is supplied to a multiplying circuit **105** and also to a table **107**. A coefficient is read out by the table **107** and the coefficient is set to the multiplying circuit **105**. An output of the multiplying circuit **105** is supplied to the adding circuit **102**.

In the electronic zoom region, as shown in FIG. **11**, an output of the delay circuit **104** is supplied to the multiplying circuit **105** and also to an attenuator **106**. An electronic zoom magnification (k) is supplied to the attenuator **106** from an input terminal **108**. A coefficient is read out by the table **107** and the coefficient is set to the multiplying circuit **105**. An output of the multiplying circuit **105** is supplied to the adding circuit **102**.

A signal corresponding to the shake of the video camera is supplied to the input terminal **101**. And the signal is added to the feedback component by the adding circuit **102** and outputted and is also multiplied with a proper coefficient by the multiplying circuit **105** and is fed back.

The coefficient is obtained by referring to the table **107** by the output of the delay circuit **104** in the optical zoom region as shown in FIG. **10**. In the electronic zoom region, as shown in FIG. **11**, the coefficient is obtained by supplying the output of the delay circuit **104** to the table **107** through the attenuator **106** and by referring to the table **107**. An attenuation of the attenuator **106** is set so as to be inversely proportional to the electronic zoom magnification (k).

FIG. **12** shows the relation between the integration value in the electronic zoom region and the coefficient. In FIG. **12**, an axis of abscissa shows the integration value and an axis of ordinate shows the coefficient. Since the attenuation of the attenuator **106** is set so as to be inversely proportional to the electronic zoom magnification (k), as the electronic zoom magnification is raised, the line showing the relation between the integration value and the coefficient is changed such that M**1**, M**2**, M**3**, . . . . Therefore, as the electronic zoom magnification increases, the correction range can be largely set.

The invention is not limited to the video camera but can be also similarly used in a video reproducing apparatus having a hand shake correcting function. Namely, the shake of the image plane due to the hand shake not only can be corrected on the video camera side upon recording, but also can be corrected on the reproducing apparatus side upon reproduction. That is, upon reproduction, the hand shake is detected, and the image plane is shifted according to the hand shake amount. Thus, in case of executing the hand shake correction upon reproduction, the hand shake can be detected by detecting the motion vector of the reproduction video signal. A low pass filter is used for obtaining an actual correction amount from the motion vector.

In such a video reproducing apparatus, a nonlinear limiter can be used in a manner similar to the embodiment mentioned above.

The invention is not limited to a video camera but can be also applied to a video signal reproducing apparatus having the hand shake correction function. Namely, the shake of the image plane by a hand shake can be corrected not only by executing the correction on the video camera side upon recording but also on the reproducing apparatus side upon reproduction. That is, the hand shake is detected upon reproduction and the image plane is shifted according to the hand shake amount. Thus, in case of executing the hand shake correction upon reproduction, the hand shake is detected by detecting the motion vector of the reproduction video signal. A low pass filter is used in order to obtain an actual correction amount from the motion vector. An image memory is used to execute the correction. An electronic enlarging image plane can be formed by using the image memory. In case of forming an electronic enlarging image plane as mentioned above, by changing the coefficient of the low pass filter according to the magnification, a wide correction range can be obtained.

What is claimed is:

**1**. A video camera comprising:

lens means for collecting light from an object to be photographed;

an image pickup device for converting the light collected by said lens means into an electric signal;

an analog to digital converting circuit for converting the electric signal from said image pickup device into a digital signal;

a memory circuit for storing the digital signal produced by said analog to digital converting circuit;

shake detecting means for detecting a shake of the video camera;

calculating means for obtaining a correction amount from an output signal of said shake detecting means and for generating an optical control signal and an electronic control signal;

optical correcting means responsive to said optical control signal for correcting a shake of an image caused by the shake of the video camera up to a predetermined limit;

optical zoom means included in said lens means for enlarging or reducing the object to be photographed; and

electronic zoom means for enlarging or reducing the object to be photographed represented by said digital signal from said analog to digital converting circuit and for correcting a portion of the shake that exceeds the predetermined limit in response to said electronic control signal.

**2**. The video camera according to claim **1**, wherein said optical zoom means comprises a lens and said electronic zoom means performs an electrical process on signals output from said memory circuit.

**3**. The video camera according to claim **1**, wherein said optical zoom means and said electronic zoom means are controlled so that said optical zoom means executes a zooming operation first and said electronic zoom means executes a zooming operation when a zoom amount by said optical zoom means reaches a maximum zoom.

**4**. The video camera according to claim **1**, wherein a window for a predetermined focus adjustment is set in said image pickup device and the window is moved in response to operation of said optical zoom means.

**5**. The video camera according to claim **1**, wherein the output of said memory circuit is supplied to said electronic zoom means for performing hand shake correction.

**6**. The video camera according to claim **1**, wherein said electronic zoom means performs a hand shake correction in the horizontal direction by shifting a read-out position in one line of said memory circuit.

**7**. The video camera according to claim **1**, wherein said image pickup device has an image pickup area larger than an image display area, and said optical correcting means performs a hand shake correction in the horizontal and vertical directions by changing a read-out position in the horizontal and vertical directions in the image pickup area.

**8**. The video camera according to claim **1**, wherein said shake detecting means comprises angular sensors which detect motion of the video camera in the vertical and horizontal directions.

**9**. The video camera according to claim **8**, wherein said calculating means comprises a gain adjusting circuit for performing a negative adjustment of gain for output signals obtained from said angular sensors.

**10**. The video camera according to claim **9**, wherein said gain adjusting circuit comprises a multiplying circuit for adjusting a variation in the output of said angular sensors.

**11**. The video camera according to claim **10**, wherein said gain adjusting circuit further comprises a coring circuit for eliminating noise in an output signal of said multiplying circuit.

**12**. The video camera according to claim **11**, wherein said gain adjusting circuit further comprises a low pass filter circuit for converting angular velocity information of an output signal of said coring circuit into angular information.

**13**. The video camera according to claim **12**, wherein said gain adjusting circuit further comprises a limiter circuit for limiting an amplitude of an output signal of said low pass filter.

**14**. A video camera comprising:

lens means for collecting light from an object to be photographed;

an image pickup device for converting the light collected by said lens means into an electric signal;

an analog to digital converting circuit for converting the electric signal from said image pickup device into a digital signal;



a memory circuit for storing the digital signal produced by said analog to digital converting circuit;

shake detecting means for detecting a shake of the video camera;

calculating means for obtaining a correction amount from an output signal of said shake detecting means and for generating an optical control signal and an electronic control signal;

optical correcting means responsive to said optical control signal for correcting a shake of an image caused by the shake of the video camera up to a predetermined limit;

optical zoom means included in said lens means for enlarging or reducing the object to be photographed; and

electronic zoom means for enlarging or reducing the object to be photographed and for correcting a portion of the shake that exceeds the predetermined limit in response to said electronic control signal;

wherein said calculating means comprises a first limiter circuit that limits the correction amount in accordance with the predetermined limit.

**15**. The video camera according to claim **14**, wherein said first limiter circuit performs a nonlinear process for changing a limiting amount.

**16**. The video camera according to claim **14**, wherein said shake detecting means generates a panning speed signal that controls said first limiter circuit so that the limiting amount is changed in response thereto.

**17**. The video camera according to claim **14**, wherein said first limiter circuit is controlled so that the limiting amount is changed in response to zoom amounts of said optical and electronic zoom means.

**18**. The video camera according to claim **17**, wherein said electronic zoom means performs an electrical process on signals output from said memory circuit.

**19**. The video camera according to claim **18**, wherein said zoom means is controlled so that said optical zoom operates first and said electronic zoom operates when a zoom amount by said optical zoom reaches its maximum.

**20**. The video camera according to claim **14**, wherein a window for a predetermined focus adjustment is set in said image pickup device and the window is moved in response to operation of said optical zoom means.

**21**. The video camera according to claim **18**, wherein the output of said memory circuit is supplied to said electronic zoom means for performing hand shake correction.

**22**. The video camera according to claim **18**, wherein said electronic zoom means performs a hand shake correction operation in the horizontal direction by shifting a read-out position in one line of said memory circuit.

**23**. The video camera according to claim **18**, wherein said image pickup device has an image pickup area larger than an image display area, and said optical correction means performs a hand shake correction in the horizontal and vertical directions by changing a read-out position in the horizontal and vertical directions in the image pickup area.

**24**. The video camera according to claim **14**, wherein said shake detecting means comprises angular sensors which detect motion of the video camera in the vertical and horizontal directions.

**25**. The video camera according to claim **24**, wherein said calculating means comprises a gain adjusting circuit for

performing a negative adjustment of gain for output signals obtained from said angular sensors.

**26**. The video camera according to claim **25**, wherein said gain adjusting circuit comprises a multiplying circuit for adjusting a variation in the output of said angular sensors.

**27**. The video camera according to claim **26**, wherein said gain adjusting circuit further comprises a coring circuit for eliminating noise in an output signal of said multiplying circuit.



**28**. The video camera according to claim **27**, wherein said gain adjusting circuit further comprises a low pass filter circuit for converting angular velocity information of an output signal of said coring circuit into angular information.

**29**. The video camera according to claim **28**, wherein said gain adjusting circuit further comprises a second limiter circuit for limiting an amplitude of an output signal of said low pass filter.

* * * * *

# United States Patent [19]

**Kojima et al.**

[11] **Patent Number: 4,951,125**

[45] **Date of Patent: Aug. 21, 1990**


## [54] IMAGE PICKUP APPARATUS


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[73] Assignee: **Matsushita Electric Industrial Co., Ltd.**, Kadoma, Japan



[21] Appl. No.: **336,490**

[22] Filed: **Apr. 12, 1989**

[30] **Foreign Application Priority Data**

Apr. 12, 1988 [JP] Japan ..... 63-89827
Jul. 22, 1988 [JP] Japan ..... 63-184320
Nov. 16, 1988 [JP] Japan ..... 63-289297

[51] **Int. Cl.**[5] ..... **H04N 5/14**
[52] **U.S. Cl.** ..... **358/22**; 358/160; 358/180
[58] **Field of Search** ..... 358/21 R, 22, 160, 166, 358/180, 185, 209, 213.11, 213.37, 227



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63-185286 7/1988 Japan .



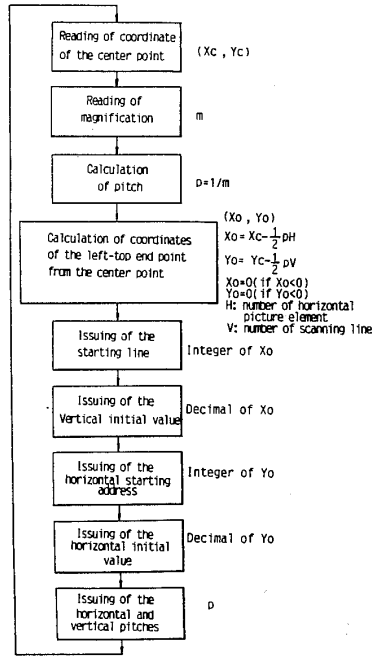
*Primary Examiner*—Tommy P. Chin
*Attorney, Agent, or Firm*—Cushman, Darby & Cushman



[57] **ABSTRACT**

An image pickup apparatus has only a few line memories (**5, 6, 7**), a change-over switch (**4, 104**) for selectively supplying input signals to the line memories and a selector (**8, 108**) for selectively taking data stored in the line memories and stores data of a desired part of the picture to be enlarged or reformed in accordance with a predetermined procedure, and interpolation of the stored data of the scanning lines is sequentially performed, thereby enlarging or reforming the desired part of the picture without lowering quality of the image.


**9 Claims, 25 Drawing Sheets**



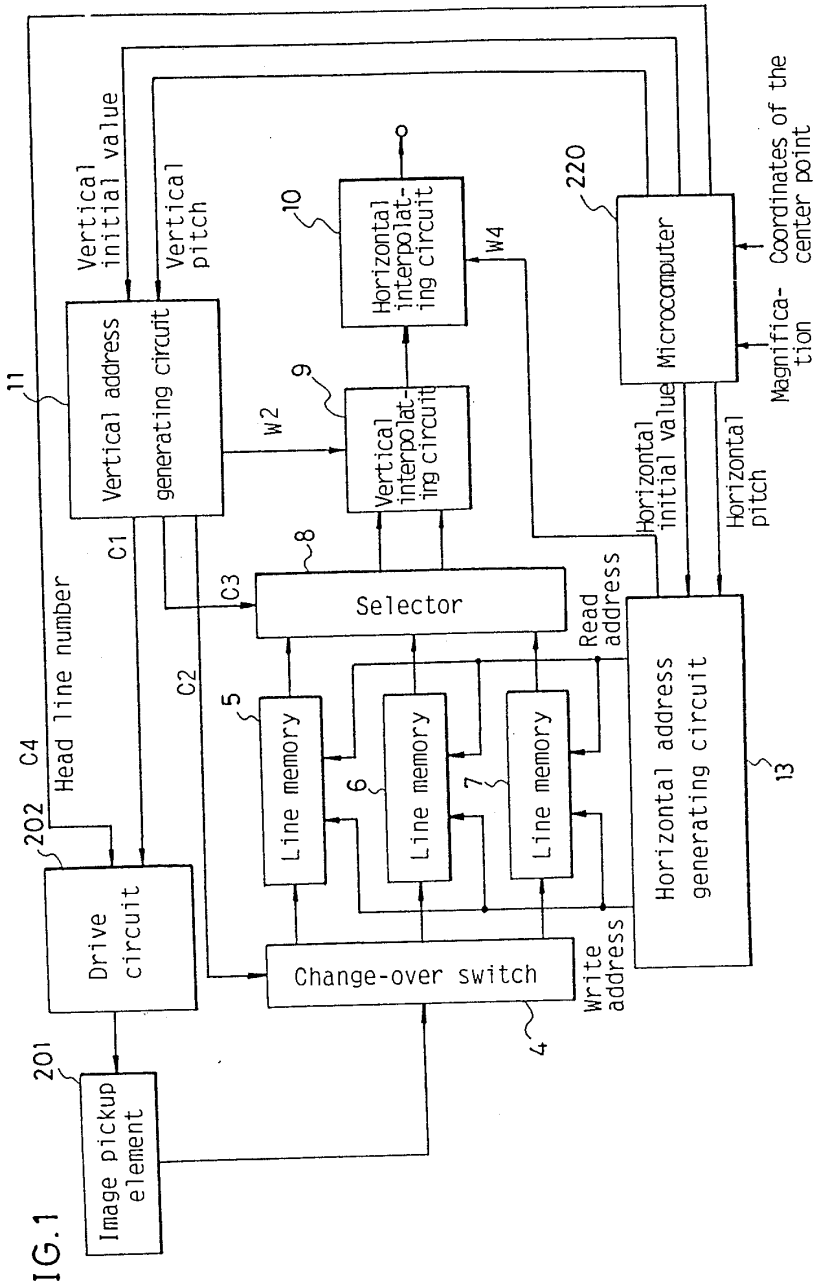

Vertical initial value
Vertical pitch
Horizontal interpolating circuit
10
W4
220
Microcomputer
Coordinates of the center point
Magnification
11
Vertical address generating circuit
W2
9
Vertical interpolating circuit
Horizontal initial value
Horizontal pitch
C1
8
C3
Selector
Read address
C2
5
Line memory
6
Line memory
7
Line memory
Horizontal address generating circuit
13
C4
Head line number
202
Drive circuit
Change-over switch
Write address
4
201
Image pickup element

FIG. 1

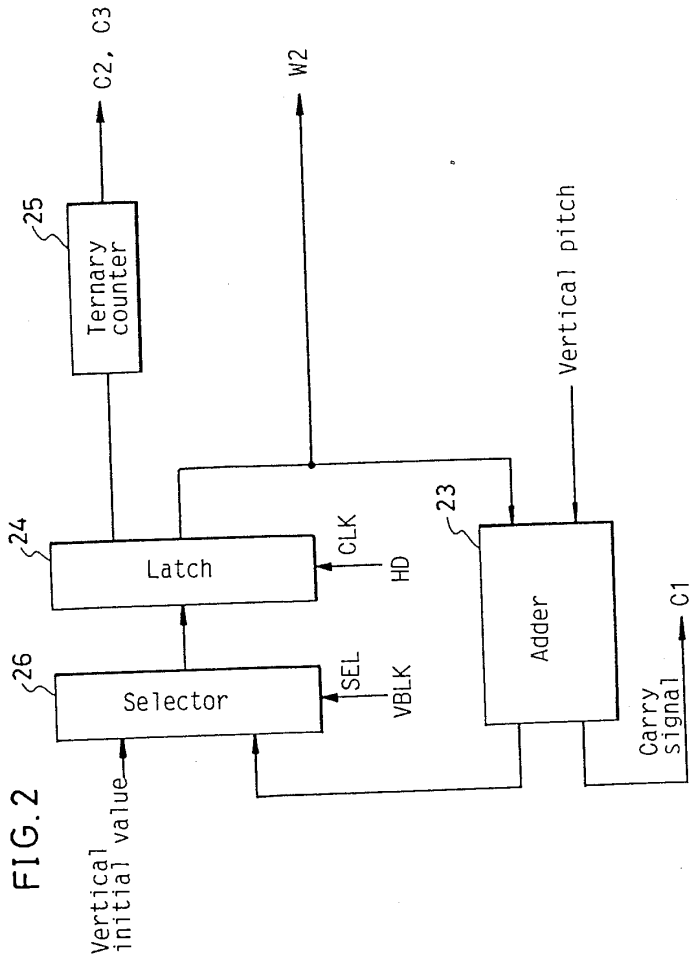

C2, C3
W2
25
Ternary counter
Vertical pitch
24
Latch
CLK
HD
23
Adder
C1
26
Selector
SEL
VBLK
Carry signal
Vertical initial value

FIG. 2

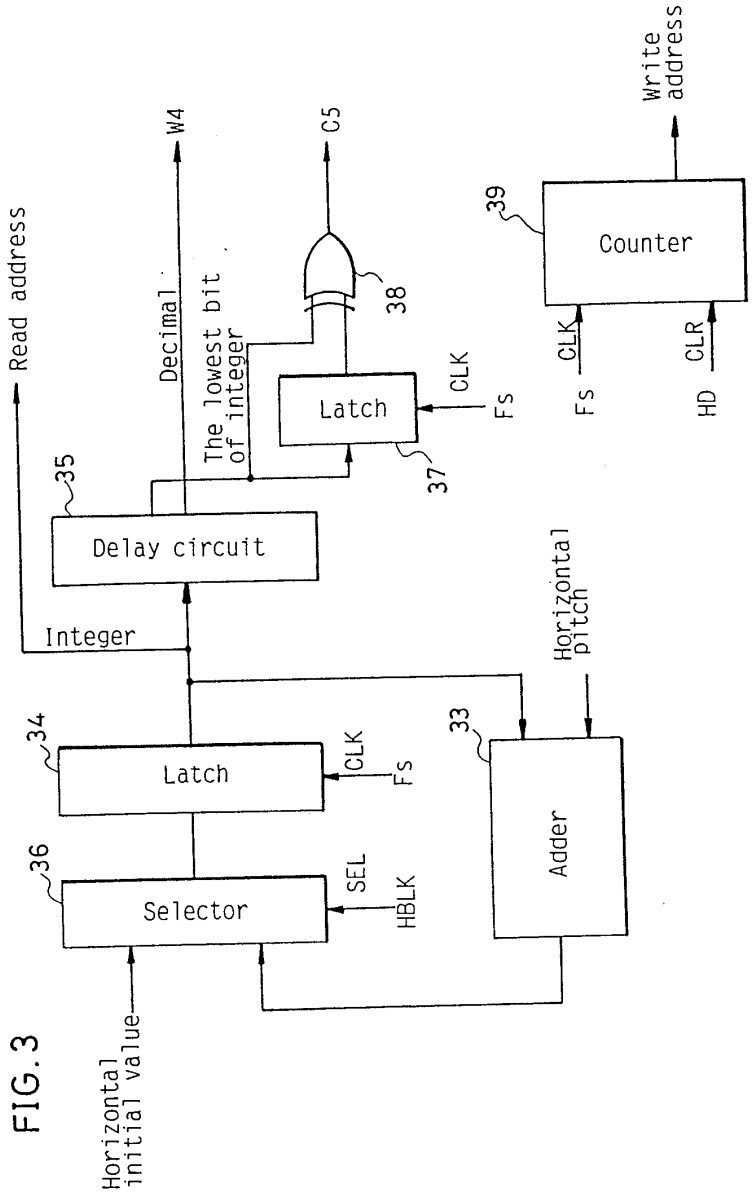

Write address
W4
C5
39
Counter
Read address
Decimal
The lowest bit of integer
38
CLK
Fs
CLK
CLR
Fs
HD
Latch
35
37
Delay circuit
Integer
Horizontal pitch
34
33
Latch
CLK
Fs
Adder
36
Selector
SEL
HBLK
Horizontal initial value

FIG. 3

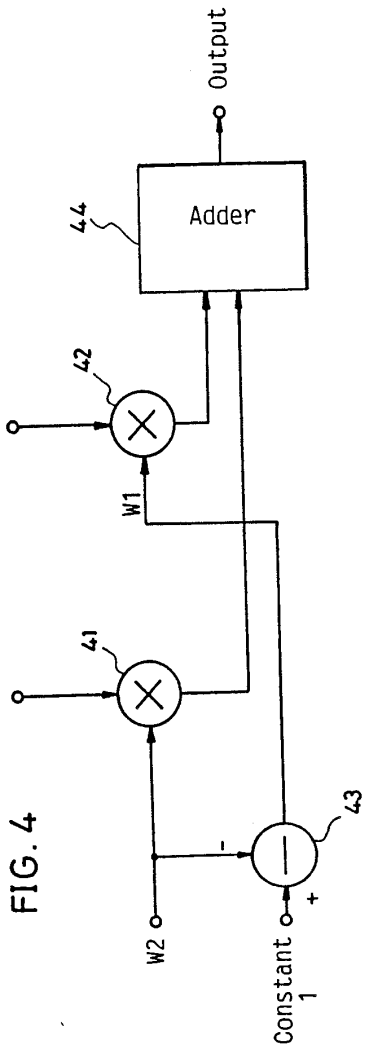



FIG. 4

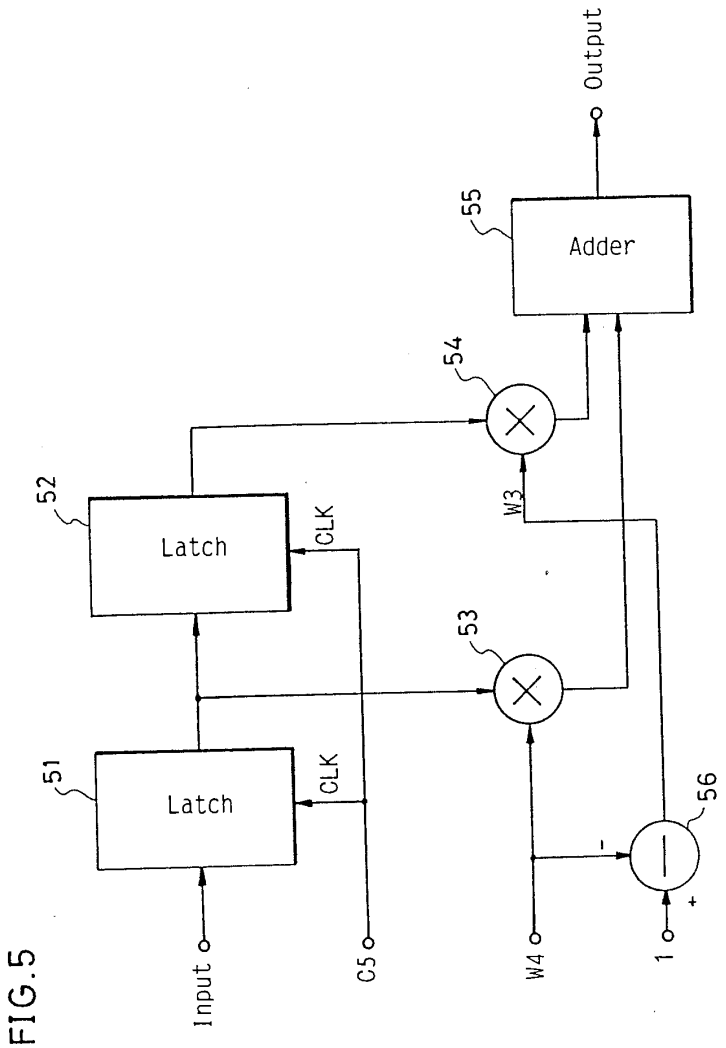

Output
55
Adder
54
W3
52
Latch
CLK
53
51
Latch
CLK
56
-
+
Input
C5
W4
1

FIG.5

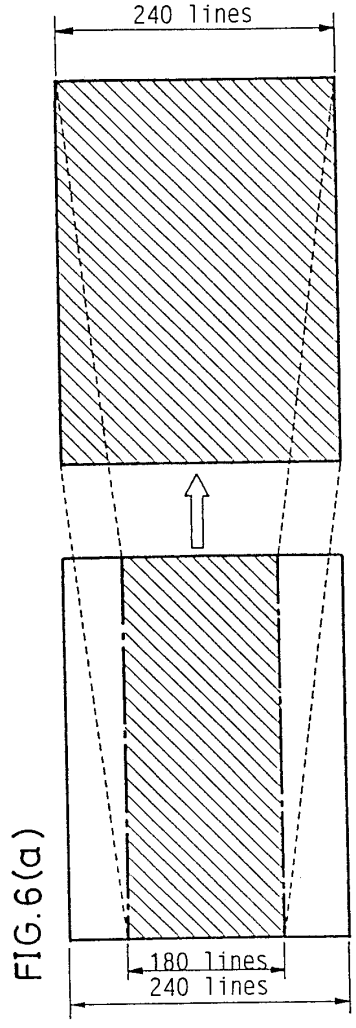



FIG. 6(a)

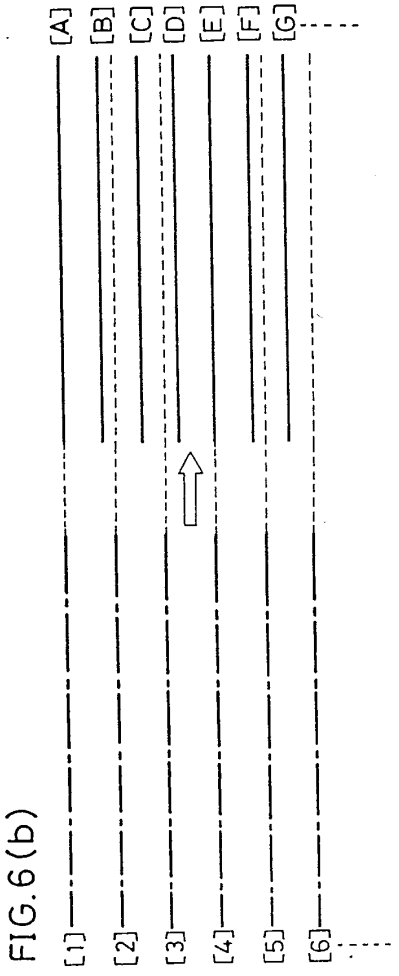
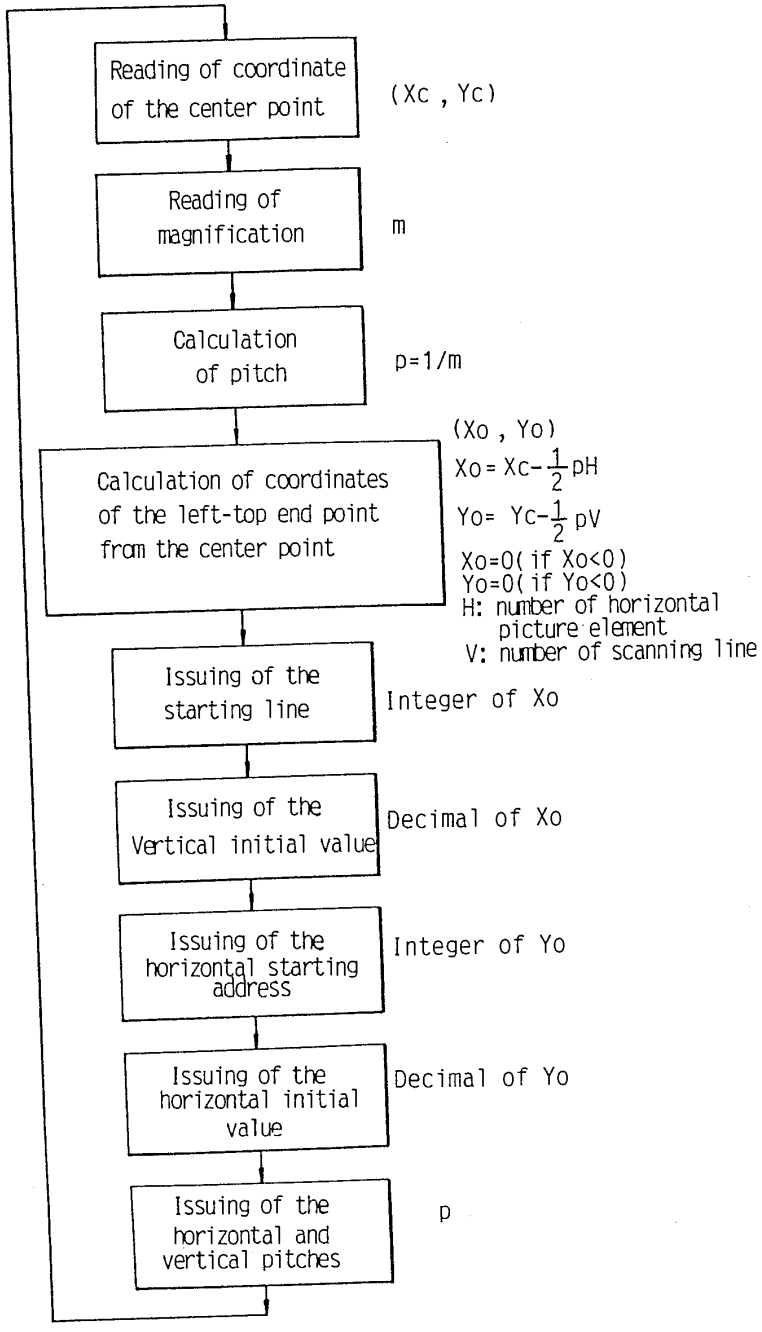



FIG. 6(b)

FIG.7


Reading of coordinate of the center point
(Xc , Yc)
Reading of magnification
m
Calculation of pitch
p=1/m
Calculation of coordinates of the left-top end point from the center point
(Xo , Yo)
Xo = Xc - 1/2 pH
Yo = Yc - 1/2 pV
Xo=0( if Xo<0)
Yo=0( if Yo<0)
H: number of horizontal picture element
V: number of scanning line
Issuing of the starting line
Integer of Xo
Issuing of the Vertical initial value
Decimal of Xo
Issuing of the horizontal starting address
Integer of Yo
Issuing of the horizontal initial value
Decimal of Yo
Issuing of the horizontal and vertical pitches
p

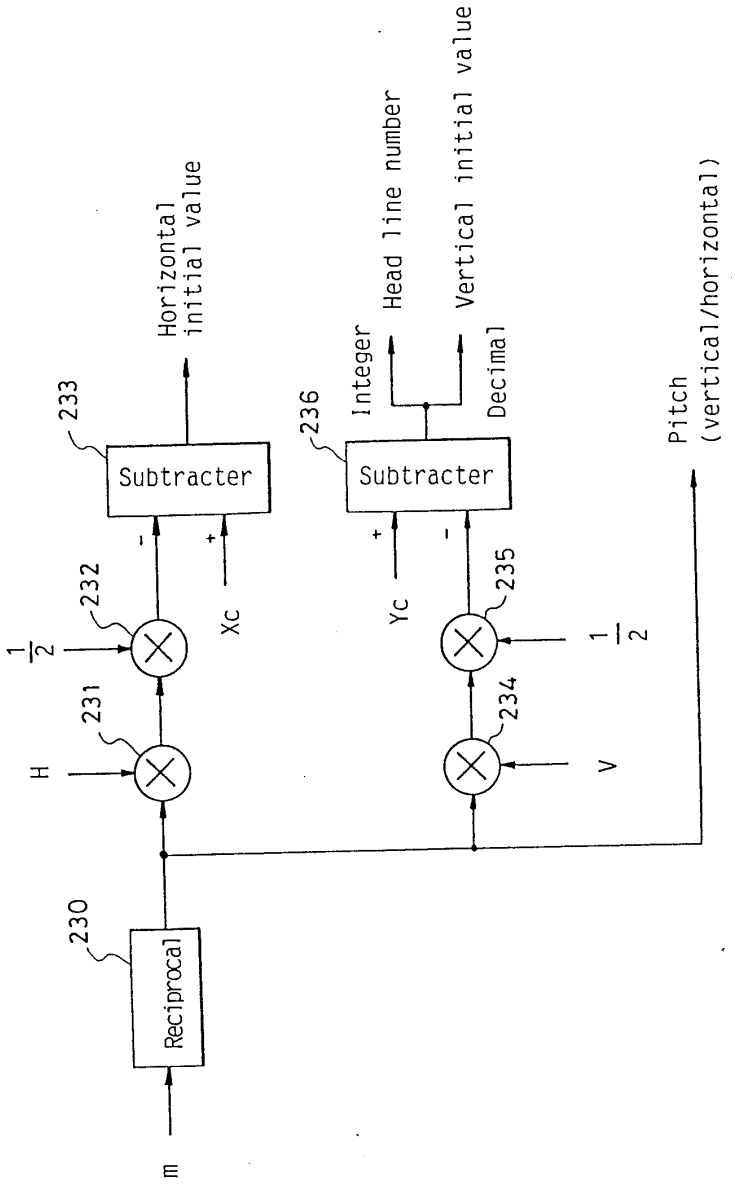

Horizontal initial value
Head line number
Vertical initial value
Integer
Decimal
Pitch (vertical/horizontal)
233
Subtracter
236
Subtracter
232
231
235
234
230
Reciprocal
1/2
H
Xc
Yc
V
m

FIG. 8

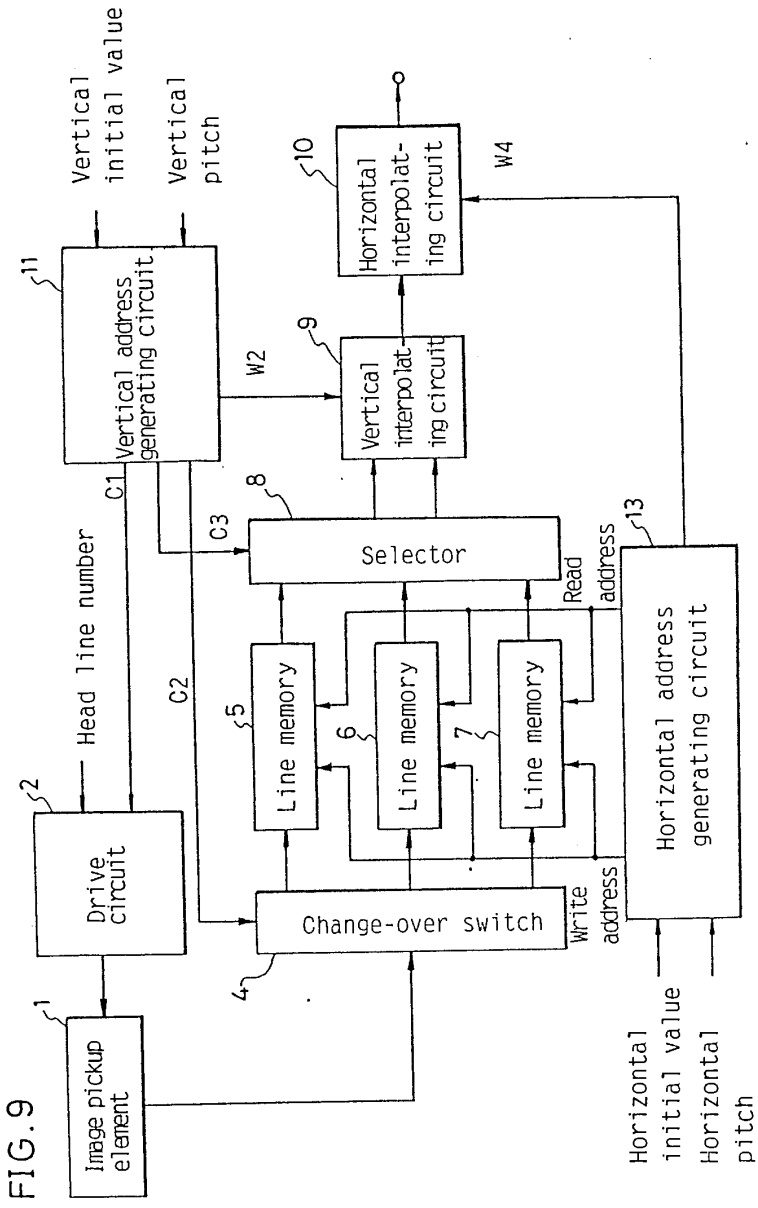

Vertical initial value
Vertical pitch
Horizontal interpolating circuit
10
W4
11
Vertical address generating circuit
W2
9
Vertical interpolating circuit
C1
8
C3
Selector
Read address
13
Head line number
C2
5
Line memory
6
Line memory
7
Line memory
Horizontal address generating circuit
2
Drive circuit
Change-over switch
Write address
4
1
Image pickup element
Horizontal initial value
Horizontal pitch

FIG. 9

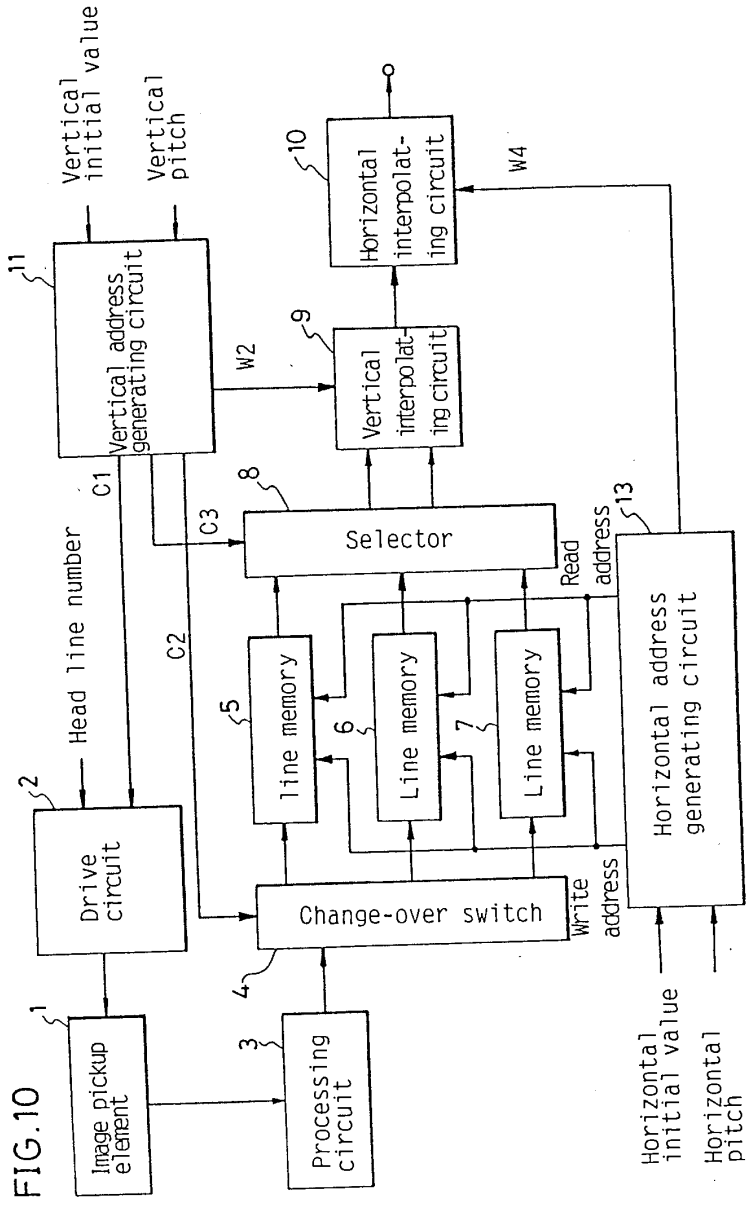

Vertical initial value
Vertical pitch
11
Vertical address generating circuit
W2
9
Vertical interpolating circuit
10
Horizontal interpolating circuit
W4
C1
C3
8
Selector
13
Read address
Head line number
C2
5
line memory
6
Line memory
7
Line memory
Horizontal address generating circuit
2
Drive circuit
Change-over switch
Write address
4
1
Image pickup element
3
Processing circuit
Horizontal initial value
Horizontal pitch

FIG. 10

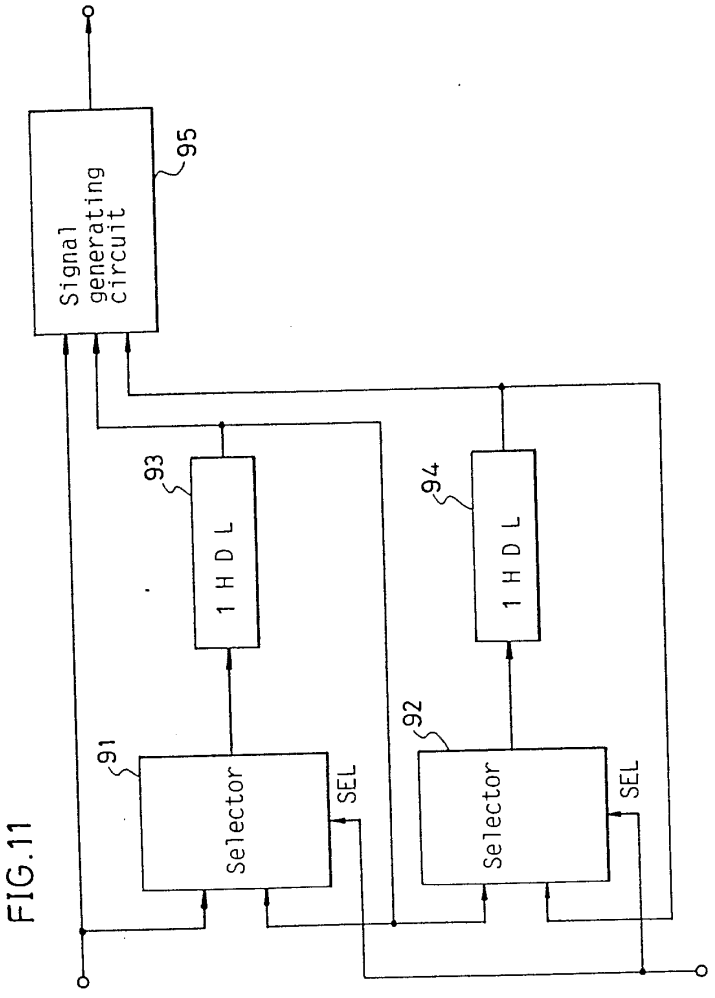

Signal generating circuit
95
93
1 H D L
94
1 H D L
91
Selector
SEL
92
Selector
SEL

FIG.11

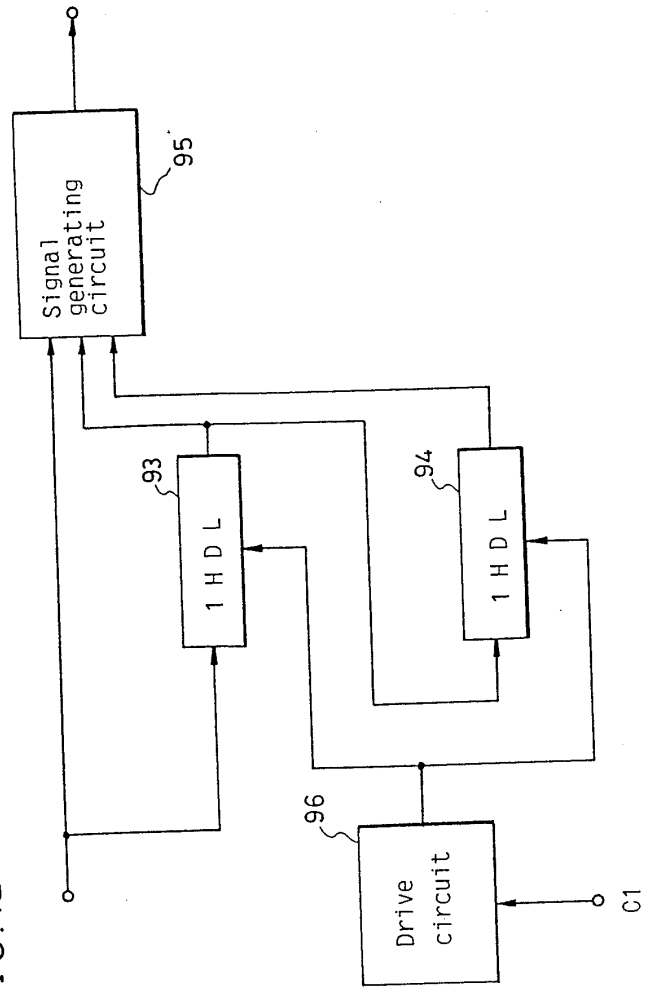

Signal generating circuit
95
93
1 H D L
94
1 H D L
96
Drive circuit
C1

FIG. 12

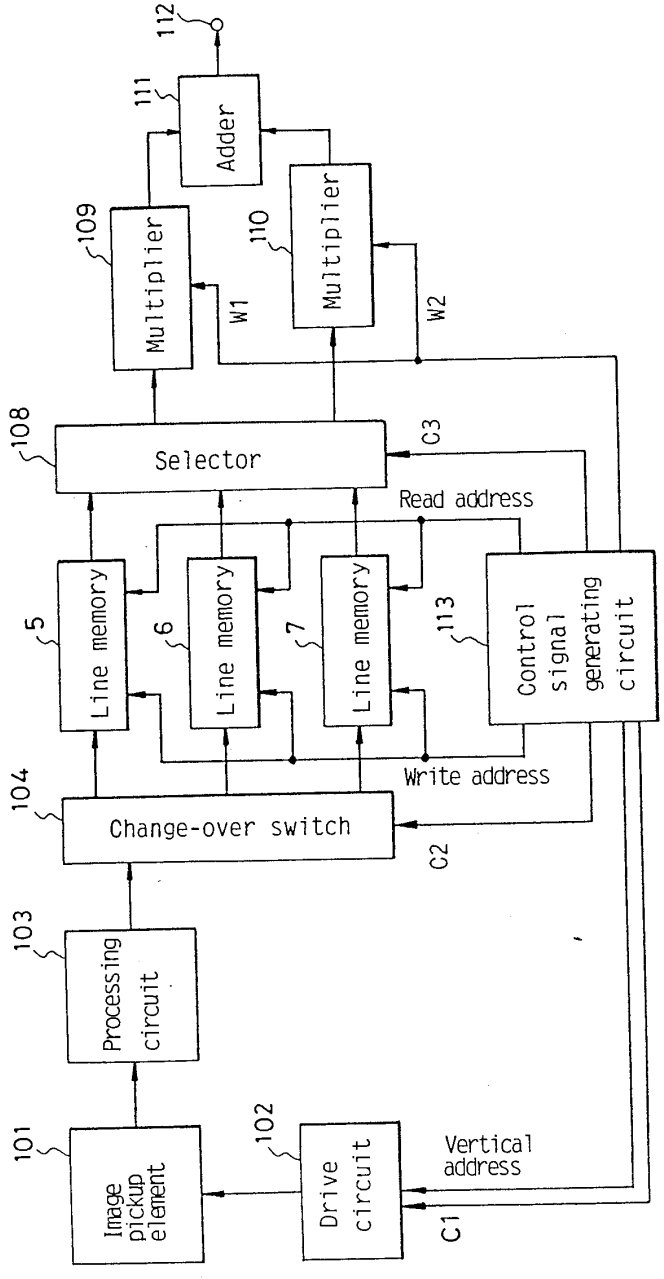

112
111
Adder
109
Multiplier
110
Multiplier
W1
W2
108
Selector
C3
Read address
5
Line memory
6
Line memory
7
Line memory
113
Control signal generating circuit
Write address
104
Change-over switch
C2
103
Processing circuit
101
Image pickup element
102
Drive circuit
Vertical address
C1

FIG.13

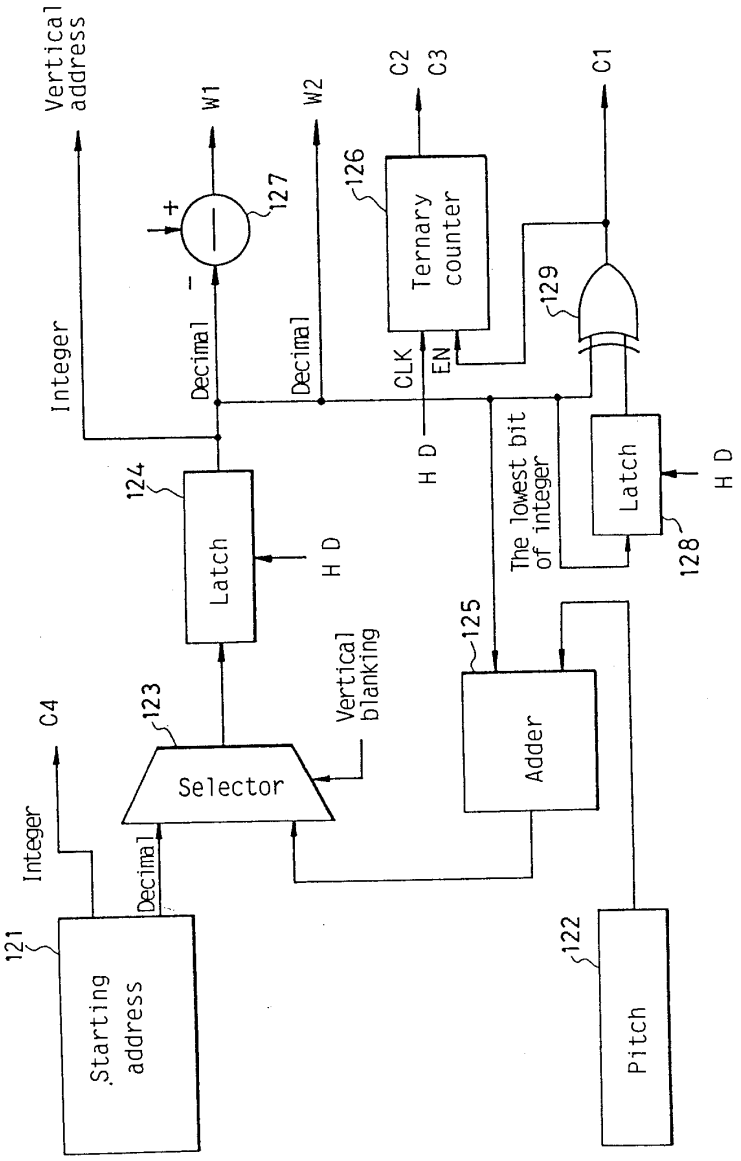

Vertical address
W1
W2
C2
C3
C1
126
Ternary counter
127
+
-
129
Integer
Decimal
Decimal
CLK
EN
H D
The lowest bit of integer
Latch
H D
124
Latch
H D
128
125
Vertical blanking
C4
123
Selector
Adder
Integer
Decimal
121
Starting address
122
Pitch

FIG. 14

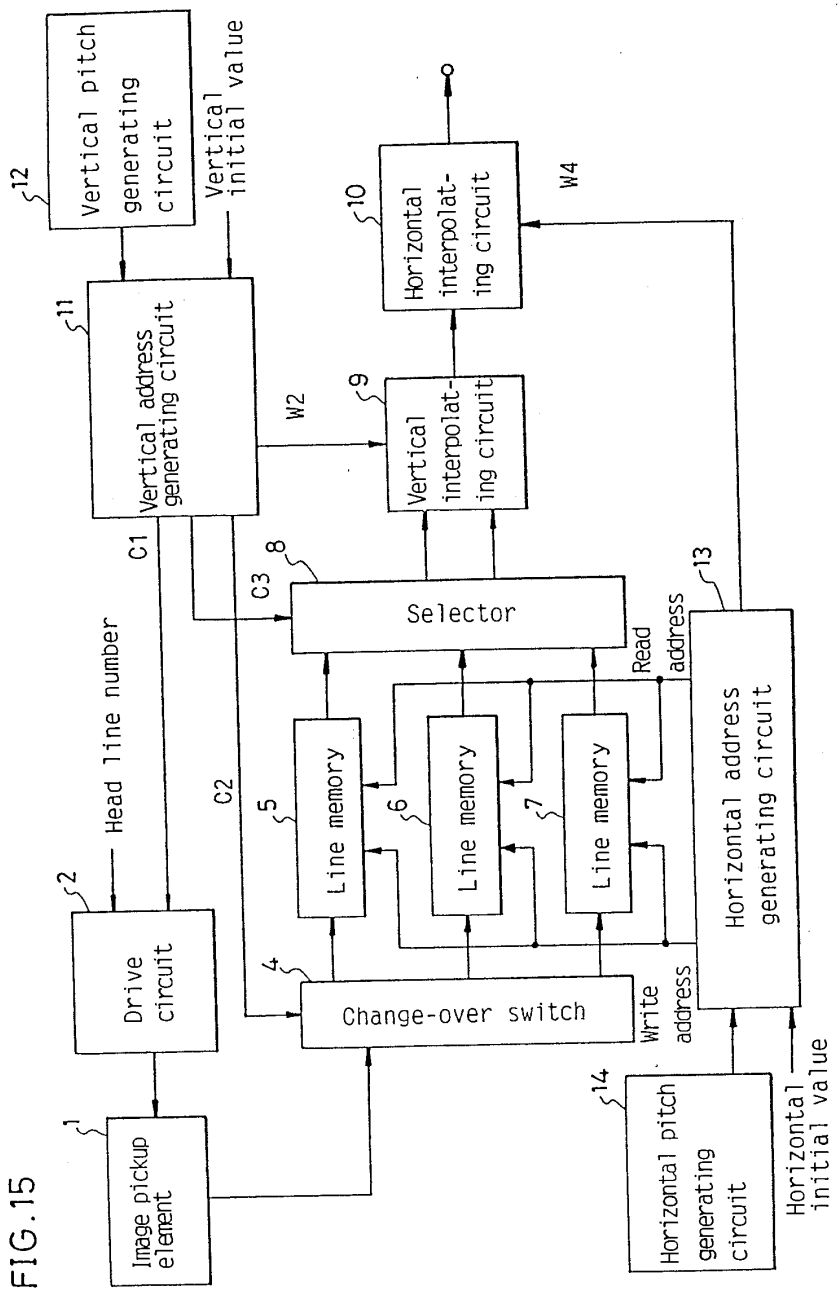

12
Vertical pitch generating circuit
Vertical initial value
11
Vertical address generating circuit
W2
9
Vertical interpolating circuit
10
Horizontal interpolating circuit
W4
C1
C3
8
Selector
13
Read address
Head line number
C2
5
Line memory
6
Line memory
7
Line memory
Horizontal address generating circuit
2
Drive circuit
4
Change-over switch
Write address
14
Horizontal pitch generating circuit
Horizontal initial value
1
Image pickup element

FIG. 15

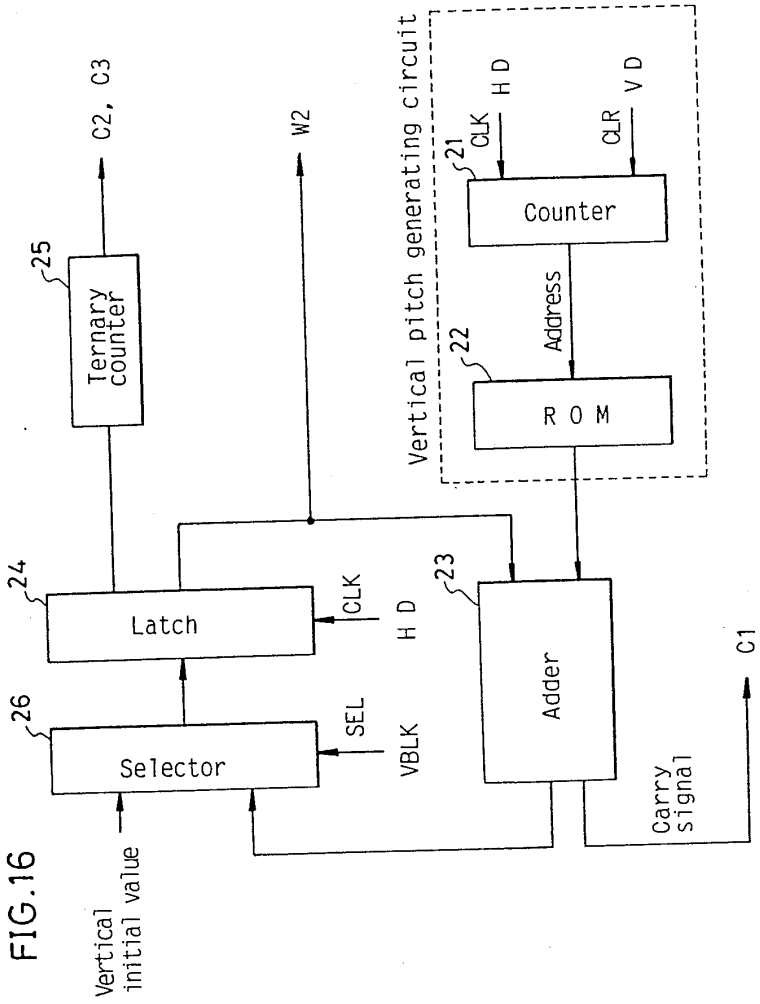

Vertical pitch generating circuit
H D
V D
CLK
CLR
21
Counter
Address
22
R O M
C2, C3
W2
25
Ternary counter
24
Latch
CLK
H D
23
Adder
C1
26
Selector
SEL
VBLK
Carry signal
Vertical initial value

FIG.16

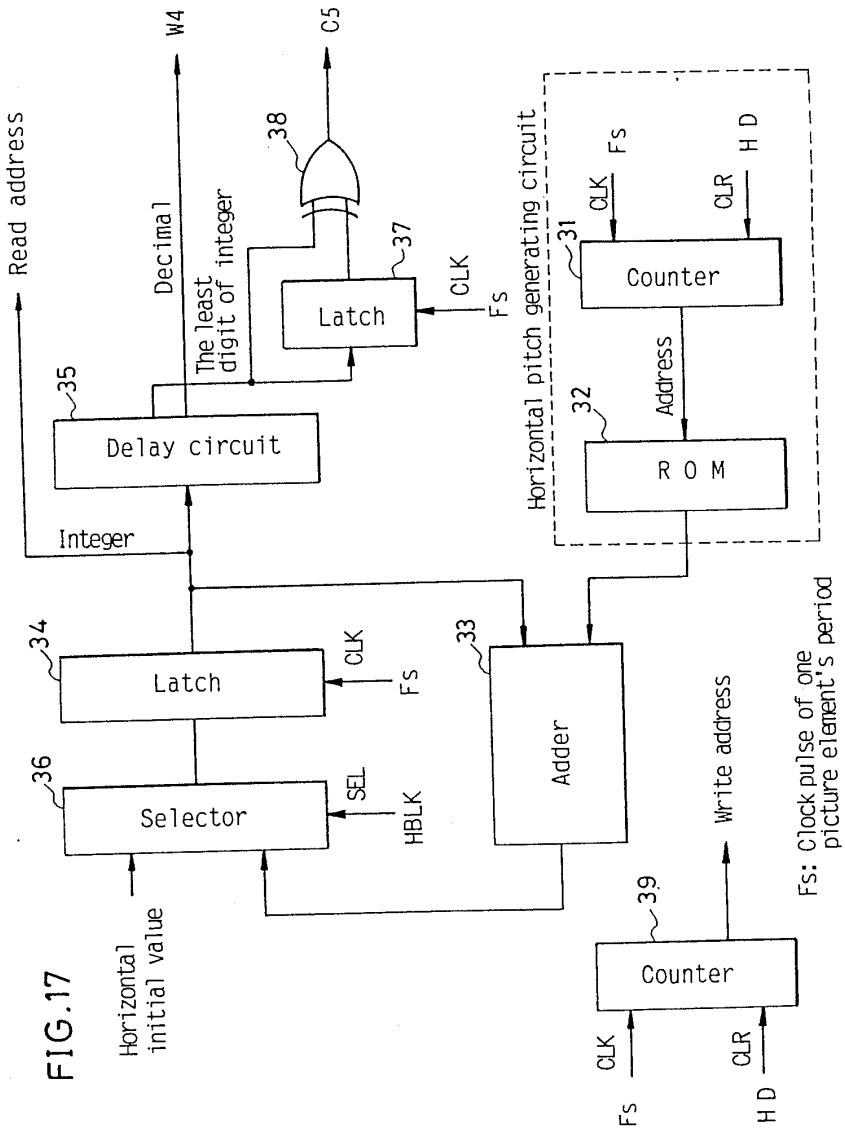

W4
C5
Read address
Decimal
38
The least digit of integer
37
Latch
CLK
Fs
Horizontal pitch generating circuit
CLK
Fs
CLR
H D
31
Counter
Address
32
R O M
35
Delay circuit
Integer
34
Latch
CLK
Fs
33
Adder
Write address
36
Selector
SEL
HBLK
39
Counter
CLK
Fs
CLR
H D
Horizontal initial value
Fs: Clock pulse of one picture element's period

FIG.17

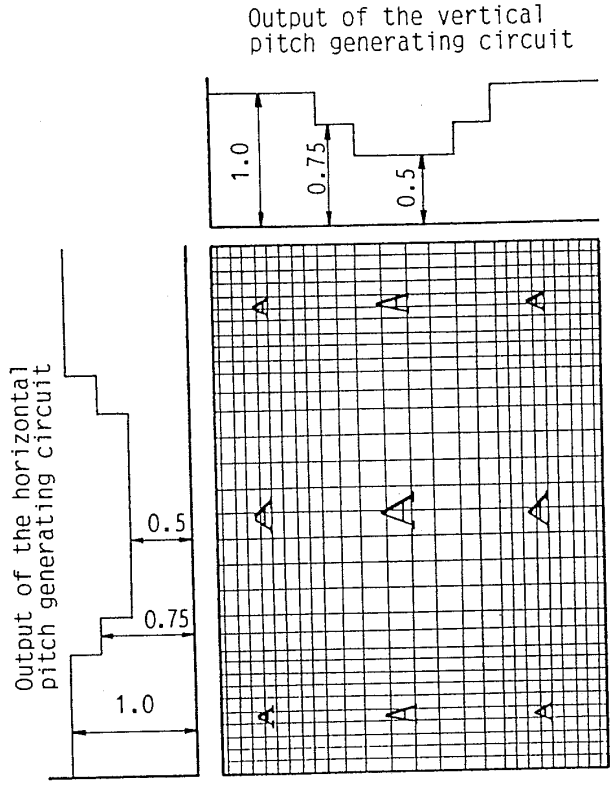

Output of the vertical pitch generating circuit
1.0
0.75
0.5
Output of the horizontal pitch generating circuit
0.5
0.75
1.0
A

FIG.18

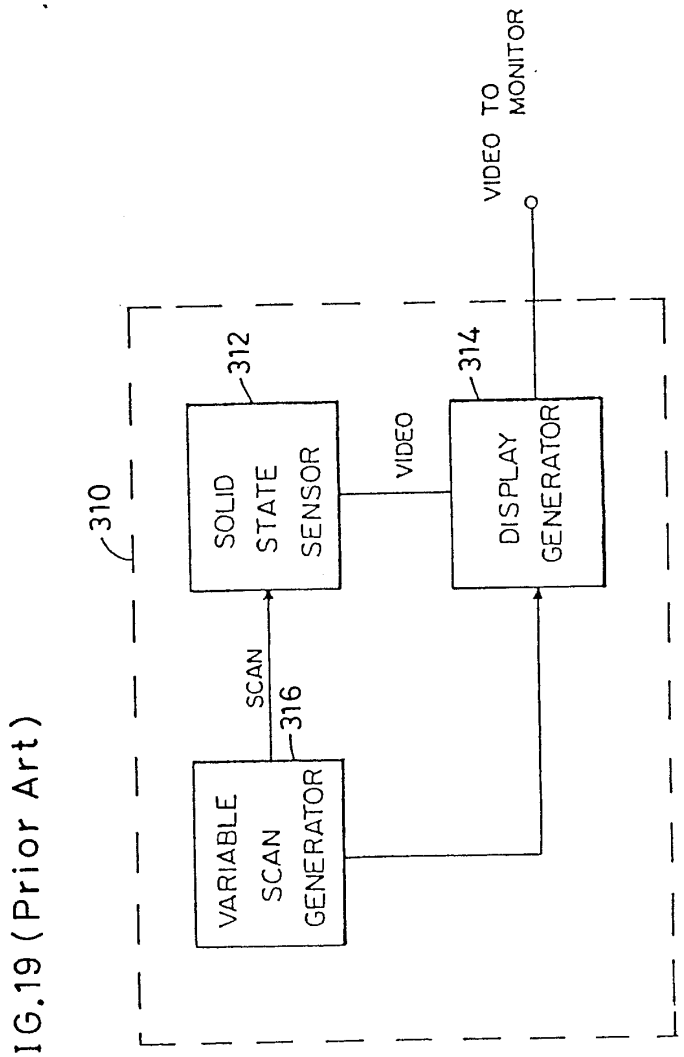



FIG.19 (Prior Art)

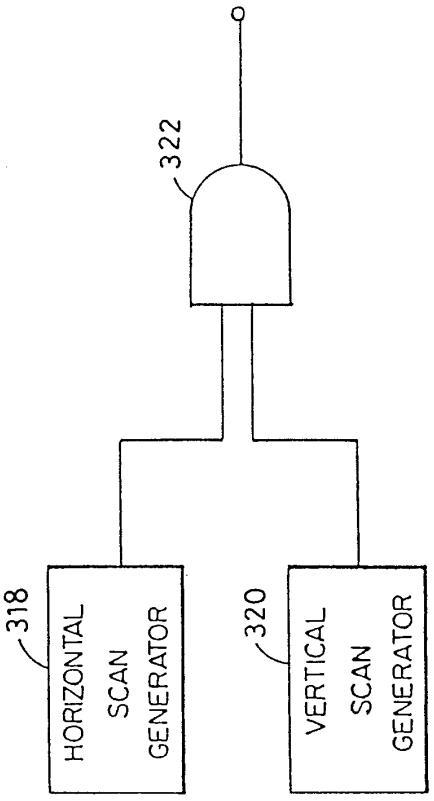



FIG.20 (Prior Art)

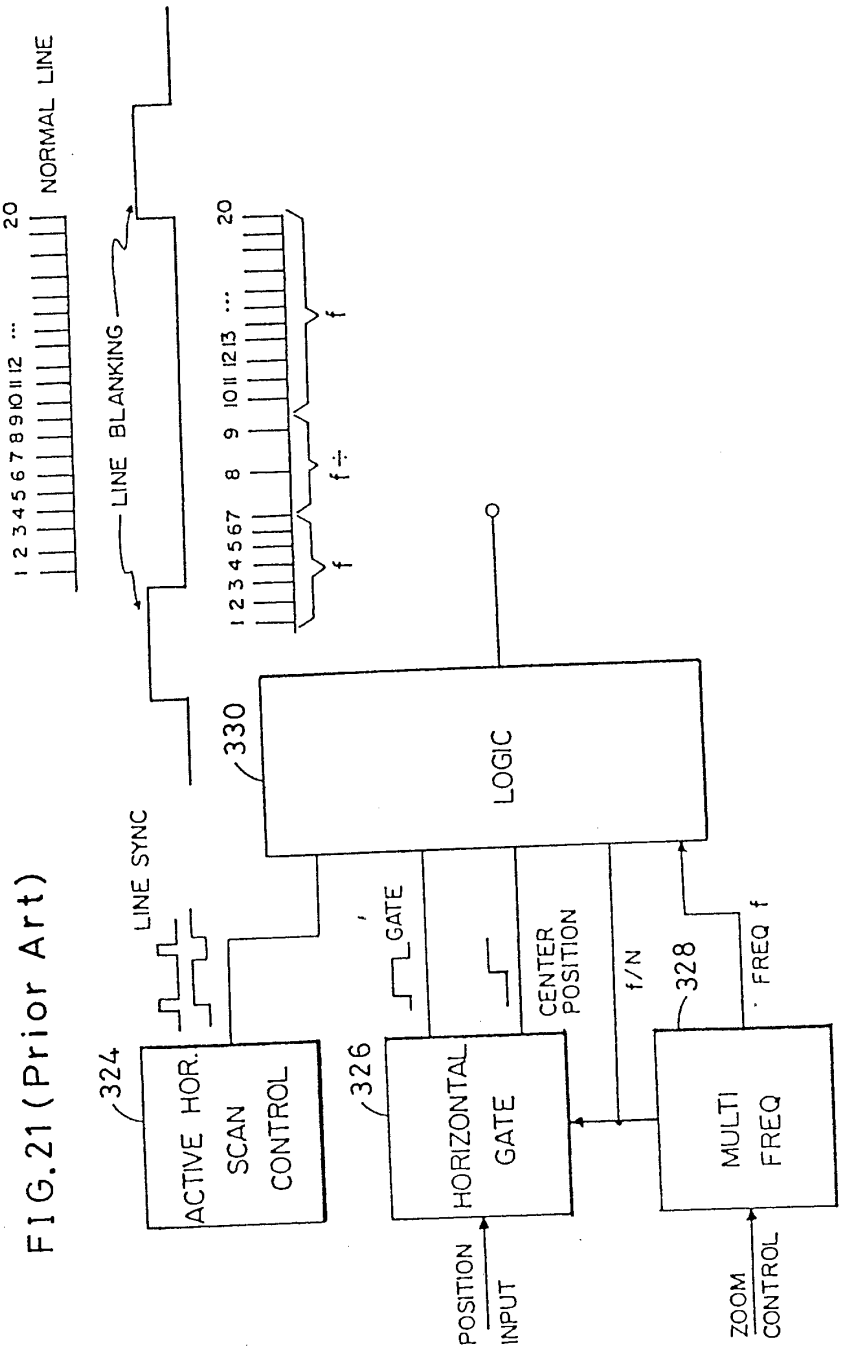



FIG. 21 (Prior Art)

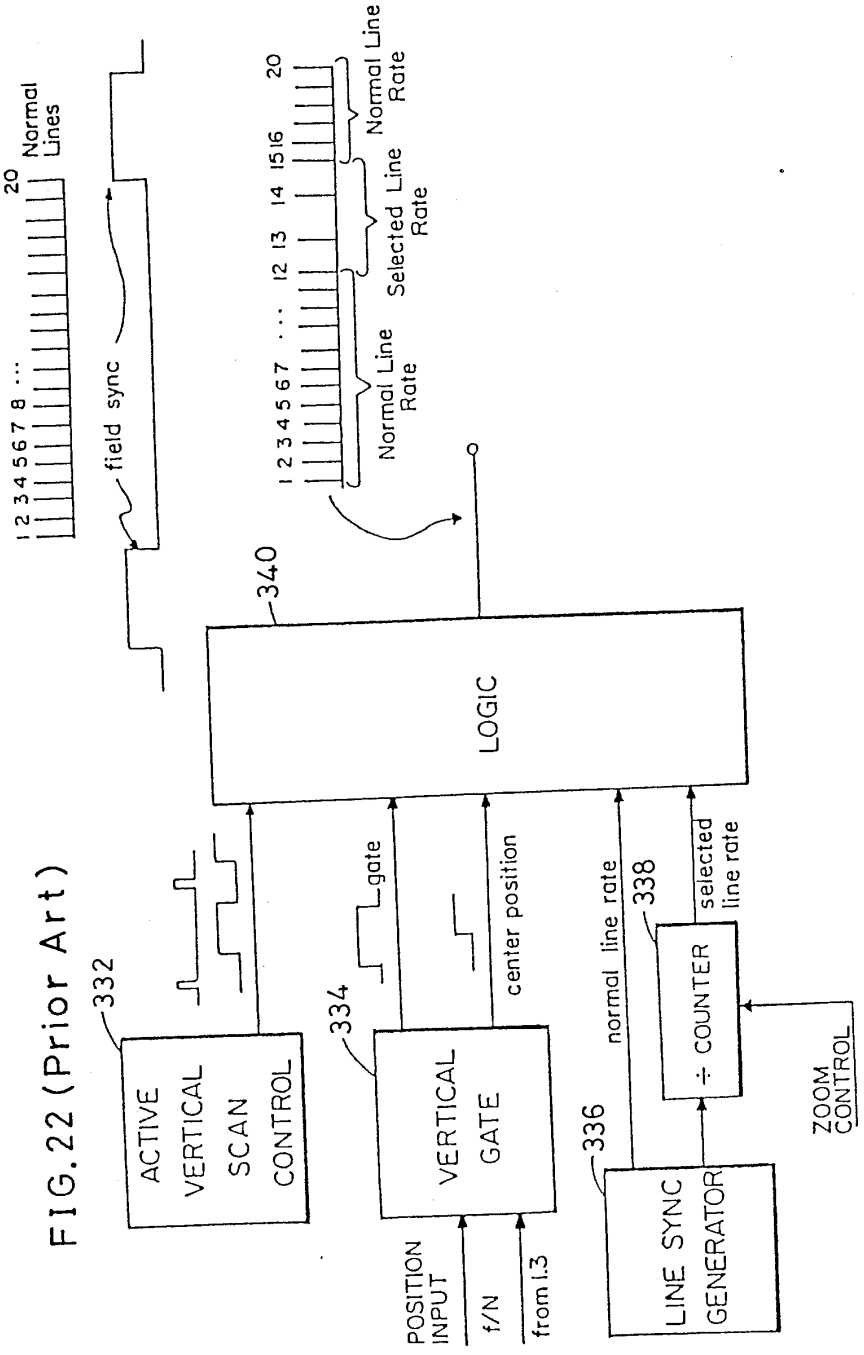



FIG. 22 (Prior Art)

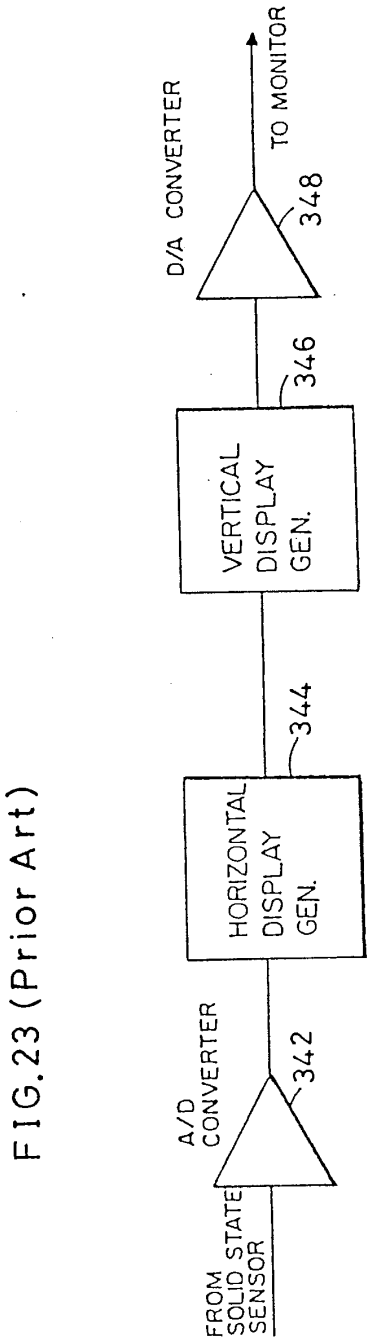



FIG. 23 (Prior Art)

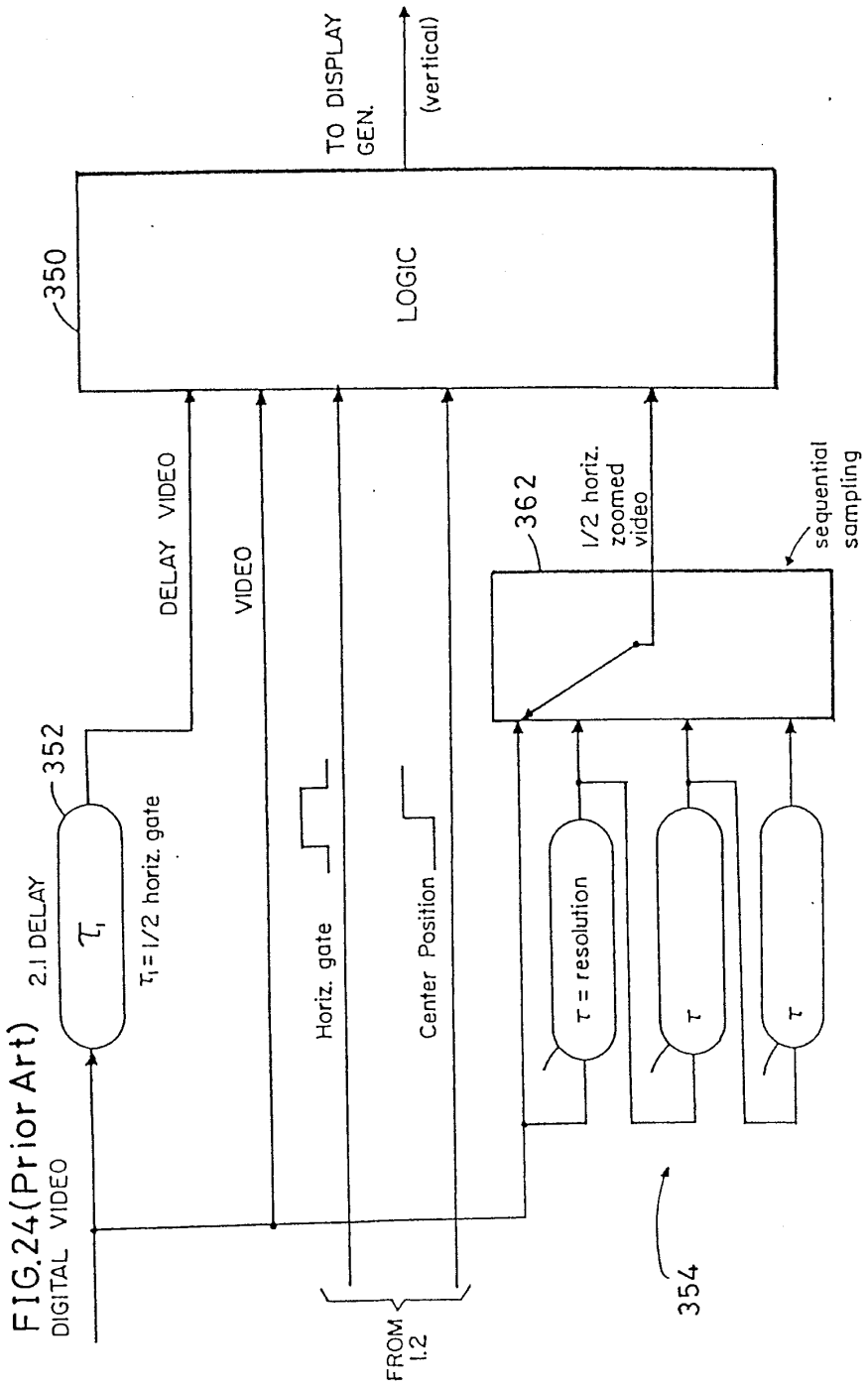



FIG.24(Prior Art)

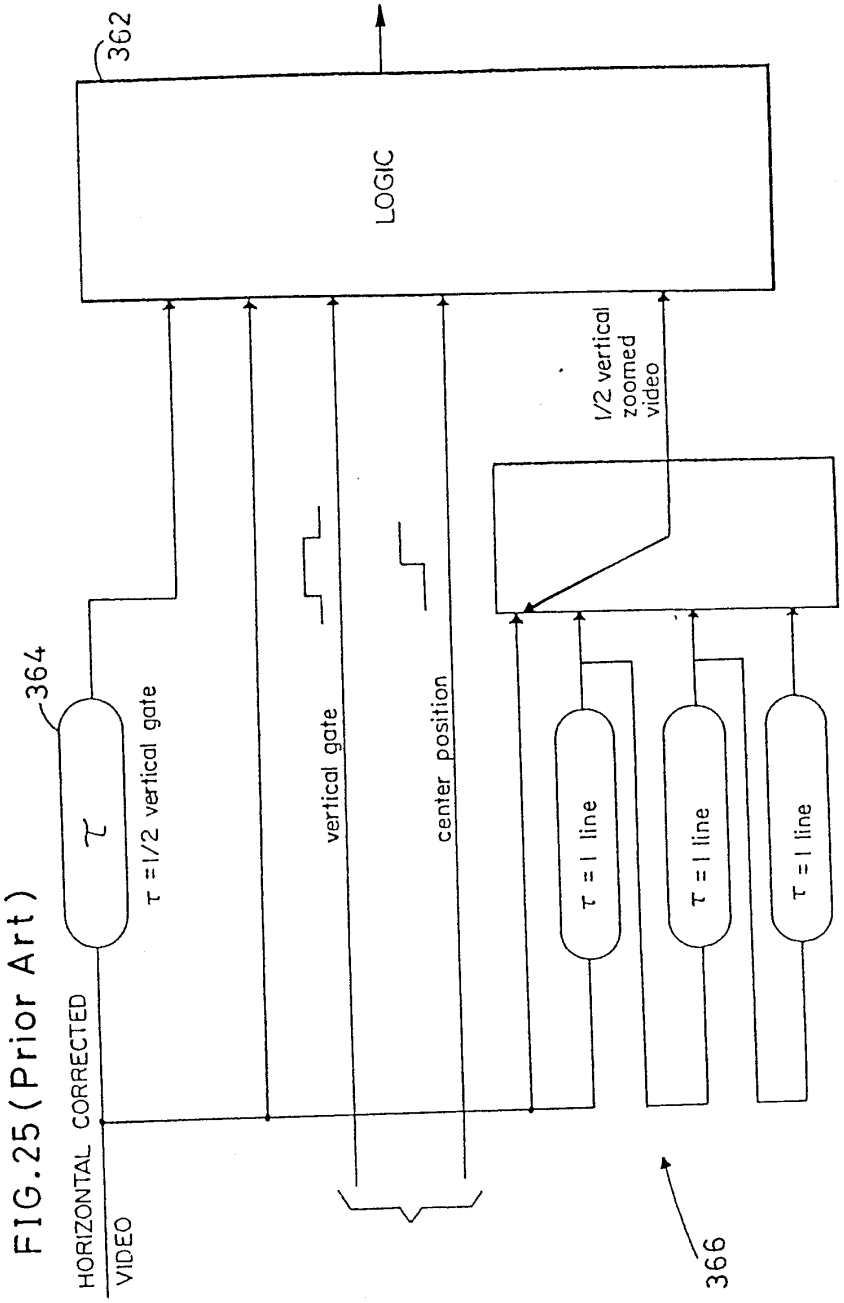



FIG. 25 (Prior Art)

# IMAGE PICKUP APPARATUS

## FIELD OF THE INVENTION AND RELATED ART STATEMENT

1. Field of the Invention

The present invention relates to an image pickup apparatus such as a video camera and to a process, for instance to enlarge or reform, images taken by the image pickup apparatus.

2. Descripton of the Related Art

In the conventional image pickup apparatus such as disclosed in the U.S. Pat. No. 4,002,824, a frequency of a clock for driving an image pickup element is lowered in response to magnifications of enlargement, thereby to read video signals, and these signals are interpolated by use of delay lines.

Referring now to FIG. **19** which is the generalized block diagram, there is shown a select zoom camera **310** that includes a solid state sensor **312** which may be of the charged coupled device type providing a video output to a display generator **314** when scanned by variable scan generator **316**. Variable scan generator **316** produces the clock pulses to control the scanning of the solid state sensor **312**. The resultant video signal from the sensor **312** is controlled by the display generator **314** so that the output display will be a combined magnified subject area and its normal surroundings in a single TV picture.

The variable scan generator **316** of FIG. **19** consists of a horizontal scan generator **318** and a vertical scan generator **320**. The outputs of these two generators are combined in an AND gate **322** to produce the variable scan for the solid state sensor of FIG. **19**.

As shown in FIG. **21**, a horizontal scan generator **18** comprises an active horizontal scan control **324**, a horizontal gate **326**, a multi-frequency generator **328** and a logic circuit **330**.

The active horizontal scan generator **324** determines the time at which the clock pulses are allowed to start to scan the sensor **312**. In the example waveforms shown the active scan control allows the horizontal scan to start three resolution bit time earlier than the normal horizontal scan. The horizontal gate **326** determines the horizontal area where the subject image is to be magnified. In the example shown by the waveforms, for a 2:1 magnification, the horizontal scan rate during first half of this gate is at one-half of the normal scan rate. After the first half of the gate, normal scan rate is resumed. The examples of normal horizontal scan and variable scan pulses into waveforms shown are with respect to the line blanking signal.

FIG. **22** shows the vertical scan generator and comprises an active vertical scan control **332**, a vertical gate generator **334**, a line sync, generator **336**, divide by an N counter **338** and a logic circuit **340**. The active vertical scan control **332** determines how far in advance the vertical scan is required to start. In the example waveforms shown the vertical scan control allows the vertical scan to start three lines earlier than the normal vertical scan. The vertical gate determines the vertical position in which the subject picture is to be magnified. During the first half of the gate scan rate was one-half the normal scan rate for a 1:2 magnification. The scan rate will be one-third the normal scan rate of a 1:3 magnification. These different scan rates are supplied from the multi-scan gate generator comprises of the line sync. generator **336** and divided by the N counter **338**. The



counter **338** counts downs from the normal scan rate. A logic circuit **340** selectively combines the normal and variable line rates to produce the vertical scan which is combined with the horizontal scan and thus the select zoom variable scan is generated.

FIG. **23** shows the display generator in block diagram form. The signal from the solid state sensor is fed to an analog to a digital converter **342** for converting the analog video into digital video signal. The output of analog to the digital converter **342** is fed to a horizontal display generator **344**. The output from the horizontal display generator **344** is fed to a vertical display generator **346** which provides both horizontally and vertically corrected video output that is fed to digital to an analog converter **348**.

Referring now to FIG. **24** which shows the horizontal display generator in more detail, the digital video signals from analog to the digital converter **342** are fed directly to a logic circuit **350** and through a first delay circuit **352** and through a second delay circuit **354**. A delay circuit **354** consisits of three delay lines **356**, **358** and **360**. The output from the delay circuit **354** goes from 0 delay to $3\tau$ delay means of a sequence sampling switch **362**. The delay $\tau$ in the delay line **352** is one-half a horizontal gate width so that the number of lines in the delay circuit **354** equals one-half of the vertical gate width. The output from the horizontal corrected video out of the logic circuit **350** is fed directly to the logic circuit **362** (FIG. **25**) and though horizontal delay circuits **364** and **366**. Logic circuits **350** and **362** are controlled by the horizontal and vertical gates and center position signals respectively from the vertical gate generator **334** (FIG. **22**). The delay circuits **354** and **366** consist of a number of a plurality of delay elements which should equal one-half the vertical gate width. In the example shown there are three delay elements.

In the conventional image pickup apparatus as constructed above, clock pulses corresponding to enlarging magnification are generated in the variable scan generator **316**, and reading of signal from the solid state sensor **312** is thereby controlled to execute or stop. When signal is taken from the sensor **312**, the display generator **314** generates the signal, and when signal is not taken therefrom, the display generator **314** issues a signal which is delayed by the delay line.

However, in the above-mentioned construction, interpolation between neighboring two picture elements is performed by successively issuing the previous one (or several) signal(s) of picture element or the previous one (or several) signal(s) of line(s). Therefore, the quality of the enlarged picture is deteriorated like a mosaic state. Besides, horizontal transferring of the sensor, which is generally executed with very high speed, is not easily controlled to execute or stop at every time period of the picture element. It may result in deterioration of quality of the image by the reason such as imperfect transferring of data of the CCD.

## OBJECT AND SUMMARY OF THE INVENTION

The object of the present invention is to offer an image pickup apparatus which can enlarge or reform the image without declining quality of the image through optimum memory means.

In order to achieve the above-mentioned object, the image pickup apparatus in accordance with the present invention comprises:

a solid-state image pickup element;

a drive circuit which controls to execute and stop vertical scanning of the image pickup element in response to a control signal C1;

n pieces of line memories (M1–Mn) for storing data of scanning lines;

change-over means for selectively giving an output signal S0 of the image pickup element to the line memories in response to a control signal C2;

a selector for selecting output signals of m pieces of the line memories in response to a control signal C3;

at least one multiplier for multiplying output signals S1–Sm of the selector by weight signals W1–Wm, respectively;

an adder for adding output signals of the multiplier each other; and

a control signal generating circuit which issues the control signals C1, C2, C3 and W1–Wm and controls the change-over means to execute vertical transferring of the image pickup element, thereby to supply a new line's signal SON ans write the new lines's signal SON to a line memory Mx selected from among the line memories M1–Mn, wherein signal stored in the line memory Mx is the oldest one among signals stored in the line memories M1–Mn; wherein

n,m and x hold the relations:

$$n \geqq 3,$$
$$2 \leqq m < n,$$
$$1 \leqq x \leqq n,$$

wherein

n, m and x are integers.

The above-mentioned image pickup apparatus realized special functions such as enlargement or reform of the picture by using only several line memories without lowering quality of the image.

While the novel features of the invention are set forth particularly in the appended claims, the invention, both as to organization ad content, will be better understood and appreciated, along with other objects and features thereof, from the following detailed description taken in conjunction with the drawings.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a block diagram showing an image pickup apparatus of a first embodiment of the present invention.

FIG. **2** is a block diagram showing a vertical address generating circuit of the first embodiment.

FIG. **3** is a block diagram showing a horizontal address generating circuit of the first embodiment.

FIG. **4** is a block diagram showing a vertical interpolating circuit of the first embodiment.

FIG. **5** is a block diagram showing a horizontal interpolating circuit of the first embodiment.

FIG. **6**(*a*) and FIG. **8**(*b*) are illustrations showing concept of magnification of a picture.

FIG. **7** is a flow-chart showing a process of a microcomputer **220** in accordance with the first embodiment.

FIG. **8** is a block diagram showing a circuit which is constructed by logic circuit to follow the flow-chart of FIG. **7**.

FIG. **9** is a block diagram showing the image pickup apparatus of a second embodiment of the present invention.

FIG. **10** is a block diagram showing the image pickup apparatus of a third embodiment of the present invention.

FIG. **11** is a block diagram showing a processing circuit of the image pickup apparatus of a fourth embodiment in accordance with the present invention.

FIG. **12** is a block diagram showing a processing circuit of the image pickup apparatus of a fifth embodiment in accordance with the present invention.

FIG. **13** is a block diagram showing the image pickup apparatus of a sixth embodiment of the present invention.

FIG. **14** is a block diagram showing a control signal generating circuit **113** of the sixth embodiment.

FIG. **15** is a block diagram showing the image pickup apparatus of a seventh embodiment of the present invention.

FIG. **16** is a block diagram showing a vertical pitch generating circuit and a vertical address generating circuit of the seventh embodiment.

FIG. **17** is a block diagram showing a horizontal pitch generating circuit and a horizontal address generating circuit of the seventh embodiment.

FIG. **18** is a graph showing an example of partially enlarged image and data of ROM **22** and ROM **23**.

FIG. **19** is the block diagram showing the conventional image pickup apparatus.

FIG. **20** is the block diagram showing the variable scan generator of the conventional image pickup apparatus.

FIG. **21** is the block diagram showing the horizontal scan generator of the conventional image pickup apparatus.

FIG. **22** is the block diagram showing the vertical scan generator of the conventional image pickup apparatus.

FIG. **23** is the block diagram showing the display generator of th conventional image pickup apparatus.

FIG. **24** is the block diagram showing the horizontal display generator of the conventional image pickup apparatus.

FIG. **25** is the block diagram showing the vertical display generator of the conventional image pickup apparatus.

It will be recognized that some or all of the Figures are schematic representations for purposes of illustration and do not necessarily depict the actual relative sizes or locations of the elements shown.

## DESCRIPTION OF THE PREFERRED EMBODIMENT

Hereafter, preferred embodiments of the present invention are described with references to the accompanying drawings.

### [First Embodiment]

FIG. **1** is block diagram showing the image pickup apparatus of a first embodiment. The following description is based upon a case such that a CCD type image pickup element, which has a vertical transferring part comprising a construction of shift register, is employed as a solid-state image pickup element **201** and continuous zooming is carried out by means of a microcomputer **220**. A drive circuit **202** controls to execute or stop vertical-transferring of the solid-state image pickup element **201** in accordance with a control signal C1. Electric charge for unnecessary scanning lines is swept by the drive circuit **202** in accordance with a control signal C4. Output signal of the image pickup element **201** is selectively given to line memories **5**, **6** and **7** through a change-over switch **4** in response to a control

signal C2. A selector 8 selects two of the line memories and issues data in response to a control signal C3. Output signal of the selector 8 is sent to a vertical interpolating circuit 9 and a horizontal interpolating circuit 10. A vertical address generating circuit 11 receives a vertical initial value and a vertical pitch signal from the microcomputer 220 as input signals. The vertical address generating circuit 11 generates the control signal C1 for controlling vertical transferring of the solid-state image pickup element 201, the control signals C2 and C3 for respectively controlling the change-over switch 4 and the selector 8, and a weight signal W2 for the vertical interpolating circuit 9. A horizontal address generating circuit 13 receives a horizontal initial value and a horizontal pitch signal from the microcomputer 220 as input signals. The horizontal address generating circuit 13 generates write address and read address for the line memories 5, 6 and 7 and weight signal W4 for the horizontal interpolating circuit 10. The vertical address generating circuit 11 and the horizontal address generating circuit 13 constitute a control signal generating circuit. According to random magnification and coordinates of the center of the partial image to be enlarged, the microcomputer 220 calculates to issue signals of the vertical initial value and the horizontal initial value, a vertical pitch and a horizontal pitch, and position of transferring head line of the solid state image pickup element 201.

FIG. 2 is a block diagram showing the vertical address generating circuit 11. Initial value is set in a selector 28 during time period of vertical blanking (VBLK), and thereafter an adder 23 adds vertical pitch signals given thereto, at every line. Decimal processed in the adder 23 is issued through a latch 24 as the weight signal W2 for the vertical interpolating circuit 9. Carry signal of the adder 23 is issued as the control signal C1 and sent to a ternary couter 25. The lowest two bits of number processed in the ternary counter 25 are issued as the counter signals C2 and C3.

FIG. 3 is a block diagram showing the horizontal address generating circuit 13. Initial value is set in a selector 38 during time period of horizontal blanking (HBLK), and thereafter an adder 33 adds horizontal pitch signals given thereto, at every picture element. Integer processed in the adder 33 is issued through a latch 34 as a read address signal for the line memories 5, 6 and 7 (FIG,. 1), and decimal of that is issued through a delay circuit 35 as the weight signal W4 for the horizontal interpolating circuit 10. The lowest bit of the integer is inputted to an exclusive OR gate 38 together with signal passed through a latch 37. The control signal C5 is issued from the exclusive OR gate 38 to the horizontal interpolating circuit 10 (FIG. 1). Write addresses for the line memories 5, 6 and 7 are issued from a counter 39.

FIG. 4 is a block diagram showing the vertical interpolating circuit 9. The circuit 9 comprises multipliers 41 and 42, a substracter 43 and an adder 44. Two picture element's signals weighed by the multipliers 41 and 42 are added each other by the adder 44 and issued therefrom.

FIG. 5 is a block diagram showing the horizontal interpolating circuit 10. The circuit 10 comprises latches 51 and 52, multipliers 53 and 54, an adder 55 and a subtracter 56. Signals of picture elements, which are mutually neighboring signals in the horizontal direction, are taken by the latches 51 and 52. Signals of two picture elements, which are weighted by the multiplier 53 and 54, are added to each other by the adder 55 and issued therefrom.

Next, operation of the above-mentioned image pickup apparatus is described with reference to FIG. 6(*a*), FIG. 6(*b*) and FIGS. 1-5. For instance, proportional enlargement of 4/3 times in the vertical direction is shown. In the microcomputer 220, magnification of 4/3 and a central coordinates (Xc, Yc) are predetermined. In accordance with a flow-chart as shown in FIG. 7, the microcomputer 220 calculates a scanning starting line of the solid-state image pickup element 201 and vertical/horizontal initial values and pitches from the given magnification and the central coordinates, and the microcomputer 220 issues outputs to the drive circuit 202 for the image pickup element 201, the vertical address generating circuit 11 and the horizontal address generating circuit 13. A pitch of 0.75 is given to the vertical address generating circuit 11 in response to the magnification.

In the line memories 5, 6 and 7, data of scanning lines [2], [3], and [4], which are issued from the solid-state image pickup element 201, are stored, respectively. Firstly, interpolating of a scanning line D in described. Decimal of data which means vertical position of the scanning line D is held by the latch 24. To interpolate the scanning line D, a pair of scanning lines [3] and [4], which are upper line and lower line across the scanning line D, are utilized. The selector 8 operates to issue signal of the line memory 6 and signal of the line memory 7 to the multiplier 42 of the vertical interpolating circuit 9 and the multiplier 41 thereof, respectively. If decimal value of the vertical address of the scanning line D, which is held by the latch 24, is 0.25, value of W1 is set to be 0.75 and value of W2 is 0.25, in the vertical interpolating circuit 9. The multipliers 41 and 42 multiply weights into the scanning lines [3] and [4], respectively, and the weighted signals are added each other in the adder 44, thereby outputting interpolated signals of the scanning line D. At that time, adding of the next address is executed in the adder 23, and the vertical pitch 0.75 is added to the output 0.25 of the latch 24. Since sum is 1.00 (0.75+0.25), a carry signal C1 becomes 1, and this signal C1 is supplied to the drive circuit 202. Decimal 0.00 is written to the latch 24 by a next horizontal pulse HD. When the carry signal C1 becomes 1, the drive circuit 202 operates to vertically transfer the solid-state image pickup element 201, and a new signal of the scanning line [5] is issued from the solid-state image pickup element 201. A signal of the scanning line [2] stored in the line memory 5 is the oldest one among the signals of the scanning lines [2], [3] and [4]. It has already been unnecessary for interpolating after the scanning line D. Therefore, the change-over switch 4 selects the line memory 5 and operates to write the signal of the scanning line [5] issued from the solid-state image pickup element 201. Both the writing to the line memory and the reading from that, that is, reading of the scanning lines [3] and [4] and writing of the scanning line [5], are simultaneously executed.

Next, interpolating of the scanning line E is described. Since the data held by the latch 24 is 0.00, the signal of the scanning line [4] can be used as that of the scanning line E. At this time, the weight signal W1 supplied to the multiplier 42 is 1, and the weight signal W2 supplied to the multiplier 41 is zero, thereby operating to supply the multiplier 42 and 41 with signals of the scanning line [4] and [5], respectively. That is, the selector 8 issues the signal of the line memory 7 to the multi-

plier **42** and the signal of the line memory **5** to the multiplier **41**. The signal of the scanning line [4], namely the scanning line E is therefore issued from the adder **44**. At that time, adding of the next address is executed in the adder **23**, and the vertical pitch 0.75 is added to the output 0.00 of the latch **24**. Since sum is 0.75 (0.75+0.00), the carry signal **C1** becomes zero, and this signal **C1** is supplied to the drive circuit **202**. Decimal 0.75 is written to the latch **24** by the next horizontal pulse HD. When the carry signal **C1** becomes zero, the drive circuit **202** does not operate to vertically transfer the solid-state image pickup element **201**, and nothing is issued from the solid-state image pickup element **201**. Therefore, each of the line memories **5**, **6** and **7** stores the present data.

The following Table 1 shows the above-mentioned selection of read/writing of the line memories **5**, **6** and **7** and control of transferring of the solid-state image pickup element **201**.

TABLE 1

| Present data of scanning line stored in the line memories | | | Scanning line to be | Scanning line to be read | Transferring of the | Next scanning | Line memory to be |
|---|---|---|---|---|---|---|---|
| 5 | 6 | 7 | interpolated | for interpolation | CCD | line | written |
| [2] | [3] | [1] | [C] | [2], [3] | ON | [4] | 7 |
| [2] | [3] | [4] | [D] | [3], [4] | ON | [5] | 5 |
| [5] | [3] | [4] | [E] | [4], [5] | OFF | — | — |
| [5] | [3] | [4] | [F] | [4], [5] | ON | [6] | 6 |
| [5] | [6] | [4] | [G] | [5], [6] | ON | [7] | 7 |
| [5] | [6] | [7] | [H] | [6], [7] | ON | [8] | 5 |
| [8] | [6] | [7] | [I] | [7], [8] | OFF | — | — |
| [8] | [6] | [7] | [J] | [7], [8] | ON | [9] | 6 |

The following Table 2 shows another selection of reading/writing of the line memories **5**, **6** and **7** and another control of transferring of the solid-state image pickup element. In this operation shown by Table 2, the control signal **C1** is delayed with one line against the operation of Table 1.

TABLE 2

| Present date of scanning line stored in the line memories | | | Scanning line to be | Scanning line to be read | Transferring of the | Next scanning | Line memory to be |
|---|---|---|---|---|---|---|---|
| 5 | 6 | 7 | interpolated | for interpolation | CCD | line | written |
| [2] | [3] | [1] | [C] | [2], [3] | ON | [4] | 7 |
| [2] | [3] | [4] | [D] | [3], [4] | ON | [5] | 5 |
| [5] | [3] | [4] | [E] | [4], [5] | ON | [6] | 6 |
| [5] | [6] | [4] | [F] | [4], [5] | OFF | — | — |
| [5] | [6] | [4] | [G] | [5], [6] | ON | [7] | 7 |
| [5] | [6] | [7] | [H] | [6], [7] | ON | [8] | 5 |
| [8] | [6] | [7] | [I] | [7], [8] | ON | [9] | 6 |
| [8] | [9] | [7] | [J] | [7], [8] | OFF | — | — |

By repeating the operation shown in Table 1 or 2 in the same way, vertical enlargement is peformed only by the line memories **5**, **6** and **7**.

Next, an example for horizontal enlargement is described. Outputs from the horizontal address generating circuit shown by FIG. **3** are used as read addresses for the lines memories **5**, **6** and **7**. Output signal from the vertical interpolating circuit **9** is supplied to the horizontal interpolating circuit shown by FIG. **5**. Interpolation between two picture elements in the horizontal direction is executed by using the horizontal weight signal **W4** generated by the horizontal address generating circuit shown by FIG. **3**. This operation is very similar to that of vertical direction. By the latch **37** and the exclusive OR gate **38**, change of the read address is detected. When the change is detected, the control signal **C5** becomes 1, and the next picture element's signals are taken into the latches **51** and **52** of the horizontal interpolating circuit **10**. Other operation is the same as that of the vertical enlargement.

As mentioned above, the image pickup apparatus of this embodiment can offer an electronic zoom image pickup apparatus which realizes special functions such as enlargement or reform of the picture by means of several line memories without lowering quality of the image. Besides, by changing the magnification given to the microcomputer **220** with lapse of time, continuous zooming like that of an optical zoom lens is obtained. Also, by changing the center of coordinates given to the microcomputer **220** as time lapses, continuous movement of pickup angle, e.g. pan or tilt of the image pickup apparatus, is realized.

It is possible to equivalently replace the microcomputer **220** with a logical circuit-unit as shown in FIG. **8**. This circuit-unit comprises a circuit **230** for obtaining reciprocal, multipliers **231**, **232**, **234** and **235** and subtractor **233** and **236**. The circuit **230** finds a reciprocal p of the magnification m and issues the reciprocal p as vertical/horizontal pitches. The multiplier **231** multiplies the pitch p and a number H of the horizontal picture element together, and the multiplier **232** makes output of the multiplier **231** ½ times. The subtracter **233** subtracts the output of the multipliers **232** from a horizontal coordinates Xc of the central coordinates given thereto, and output signal of the substacter **233** is issued as a horizontal initial value. The multiplier of **234** multiplies the pitch p by a number V of the scanning lines in one field, and the multiplier **235** makes output of the multiplier **234** ½ times. The subtracter **236** subtracts output of the multiplier **235** from a vertical coordinates Yc of the central coordinates given thereto. Integer of output signal of the subtracter **236** is issued as a starting line number of vertical scanning, and decimal of that is issued as a vertical initial value.

Although above-mentioned description is made with respect to the same magnification of vertical and horizontal directions, different magnifications to each may be employed.

Also, in the above-mentioned construction, although there are three lines memories and the interpolation is executed by using two scanning lines in the vertical direction, higher order interpolation can be executed by increasing the scanning lines to be used for the interpolation. At that time, number of the line memories is required to be at leased one more than the number of the scanning lines to be used for the interpolation. When a dual port memory is employed to simultaneously write/read data, number of the line memories may be one fewer than that of the above-mentioned case. However, crossfire may occur in the output image at a certain read/write timing of the line memories.

Further, although there is not provided in this embodiment, a processing circuit (not shown) is generally provided between the image pickup element **201** and the change-over switch **4** or at the next step of the block diagram shown by FIG. **1** in order to obtain luminance signal and chrominance signal.

[Second Embodiment]

FIG. **9** is a block diagram showing the image pickup apparatus of a second embodiment. The following description is based upon a case such that a CCD type image pickup element, which has a vertical transferring part comprising a construction of shift register, is employed as a solid-state image pickup element **1**. A drive circuit **2** controls to execute or stop vertical-transferring of the solid-state image pickup element **1** in accordance with a control signal C1. Electric charge for unnecessary scanning lines is swept by the drive circuit **2** in accordance with a control signal C1. Output signal of the solid-state image pickup element **1** is selectively give to line memories **5**, **6** and **7** through a change-over switch **4** in response to a control signal C2. A selector **8** selects two of the line memories and issues data in response to a control signal C3. Output signal of the selector **8** is sent to a vertical interpolating circuit **9** and a horizontal interpolating circuit **10**. A vertical address generating circuit **11** recevices a vertical initial value and a vertical pitch signal as input signals. The vertical address generating circuit **11** generates the control signal C1 for controlling vertical transferring of the solid-state image pickup element **1**, the control signals C2 and C3 for respectively controlling the change-over switch **4** and the selector **5**, and a weight signal W2 for the vertical interpolating circuit **9**. A horizontal address generating circuit **13** receives a horizontal initial value and a horizontal pitch signal as input signals. The horizontal address generating circuit **13** generates write address and read address for the line memories **5**, **6** and **7** and weight signal W4 for the horizontal interpolating circuit **10**. The vertical address generating circuit **11** and the horizontal address generating circuit **13** constitute a control signal generating circuit.

FIG. **2** is a block diagram showing the vertical address generating circuit **11**. FIG. **3** is a block diagram showing the horizontal address generating circuit **13**. FIG. **4** is a block diagram showing the vertical interpolating circuit **9**. FIG. **5** is a block diagram showing the horizontal interpolating circuit **10**. Description concerning these circuits are the same as described in the first embodiment.

Next, operation of the above-mentioned image pickup apparatus is described with reference to FIG. **6**(*a*), FIG. **6**(*b*) and FIGS. **1**–**5**. For instancce, proportional enlargement of 4/3 times in the vertical direction is shown. In the vertical address generating circuit **11**, a pitch of 0.75 corresponding to magnification is predetermined. In the line memories **5**, **6** and **7**, data of scanning lines [2], [3], and [4], which are issued from the solid-state image pickup element **1**, are stored, respectively. First, interpolation of a scanning line D is described. Decimal of data which means vertical position of the scanning line D is held by the latch **24**. To interpolate the scanning line D, a pair of scanning lines [3] and [4], which are upper line and lower line across the scanning line D, are utilized. The selector **8** operates to issue signal of the line memory **6** and signal of the line memory **7** to the multiplier **42** of the vertical interpolating circuit **9** and the multiplier **41** thereof, respectively. If decimal value of the vertical address of the scanning line D, which is held by the latch **24**, is 0.25, value of W1 is set to be 0.75 and value of W2 is 0.25, in the vertical interpolating circuit **9**. The multipliers **41** and **42** multiply weights on the scanning lines [3] and [4], respectively, and the weighted signals are added each other in the adder **44**, thereby outputting interpolated signals of the scanning line D. At that time, adding of the next address is executed in the adder **23**, and the verical pitch 0.75 is added to the output of 0.25 of the latch **24**. Since sum is 1.00 (0.75+0.25), a carry signal C1 becomes 1, and this signal C1 is supplied to the drive circuit **2**. Decimal 0.00 is written to the latch **24** by a next horizontal pulse HD. When the carry signal C1 becomes 1, the drive circuit **2** operates to vertically transfer the solid-state image pickup element **1**, and a new signal of the scanning line [5] is issued from the solid-state image pickup element **1**. A signal of the scanning line [2] stored in the line memory **5** is the oldest one among the signals of the scanning lines [2], [3] and [4]. After the scanning of the line D, it has already been unnecessary for interpolation. Therefore, the change-over switch **4** selects the line memory **5** and operates to write the signal of the scanning line [5] issued from the solid-state image pickup element **1**. Both writing to the line memory and reading from that, namely reading of the scanning lines [3] and [4] and writing of the scanning lines [5], are simultaneously executed.

Next, interpolation of the scanning line E is described. Since the data held by the latch **24** is 0.00, the signal of the scanning line [4] can be used as that of the scanning line E. At this time, the weight signal W1 supplied to the multiplier **42** is 1, and the weight signal W2 supplied to the multiplier **41** is zero, thereby operating to supply the multiplier **42** and **41** with signals of the scanning line [4] and [5], respectively. That is, the selector **8** issues the signal of the line memory **7** to the multiplier **42** and the signal of the line memory **5** to the multiplier **41**. The signal of the scanning line [4], namely the scanning line E is therefore issued from the adder **44**. At that time, adding of the next address is executed in the adder **23**, and the vertical pitch 0.75 is added to the output 0.00 of the latch **24**. Since sum is 0.75 (0.75+0.00), the carry signal C1 becomes zero, and this signal C1 is supplied to the drive circuit **2**. Decimal 0.75 is written to the latch **24** by the next horizontal pulse HD. When the carry signal C1 becomes zero, the drive circuit **2** does not operate to vertically transfer the solid-state image pickup element **1**, and nothing is issued from

the solid-state image pickup element 1. Therefore, each of the line memories 5, 8 and 7 stores the present data.

The above-mentioned selection of reading/writing of the line memories 5, 6 and 7 and control of transferring of the solid-state image pickup element 1 are shown in Table 1 and Table 2 in the same way as the first embodiment. In the operation shown by Table 2, the control signal C1 is delayed with one line against the operation of Table 1.

By repeating the operation shown in Table 1 or 2 in the same way, vertical enlargement is performed only by the line memories 5, 6 and 7.

Next, an example for horizontal enlargement is described. Outputs from the horizontal address generating circuit shown by FIG. 3 are used as read addresses for the line memories 5, 6 and 7. Output signal from the vertical interpolating circuit 9 is supplied to the horizontal interpolating circuit shown by FIG. 5. Interpolation between two picture elements in the horizontal direction is executed by using the horizontal weight signal W4 generated by the horizontal address generating circuit shown in FIG. 3. This operation is very similar to that of vertical direction. By the latch 37 and the exclusive OR gate 38, change of the read address is detected. When the change is detected, the control signal C5 becomes 1 , and the next picture element's signals are taken into the latches 51 and 52 of the horizontal interpolating circuit 10. Other operation is the same as that of the vertical enlargement.

As mentioned above, the image pickup apparatus of this embodiment can offer an electronic zoom image pickup apparatus which realizes special functions such as enlargement or reform of the picture by means of several line memories without declining quality of the image.

[Third Embodiment]

FIG. 10 is a block diagram showing the image pickup apparatus of a third embodiment. The image pickup apparatus has an electronic zooming function and is characterized by providing a processing circuit 3 which generates luminance signal andd chrominance signal from output of an image pickup element 1.

The image pickup element 1 has a vertical transferring part comprising a construction of shift register such as CCD. A drive circuit 2 controls to execute or stop vertical-transferring of the solid-state image pickup element 1 in accordance with a control signal C1. Electric charge for unnecessary scanning lines is swept by the drive circuit 2 in accordance with a control signal C4. The luminance signal and the chrominance signal or a chromiance-difference signal are obtained from the output signals of the solid state image pickup element 1 by means of the processing circuit 3. Output signal of the processing circuit 3 is selectively given to line memories 5, 6 and 7 through a change-over switch 4 in response to a control signal C2. A selector 8 selects two of the line memories and issues data in response to a control signal C3. Output signal of the selector 8 is sent to a vertical interpolating circuit 9 and a horizontal interpolating circuit 10. A vertical address generating circuit 11 receives a vertical initial value and a vertical pitch signal which are preset. The vertical address generating circuit 11 generates the control signal C1 for controlling vertical transferring of the image pickup element 1, the control signals C2 and C3 for respectively controlling the change-over switch 4 and the selector 8, and weight signal W2 for the vertical interpolating circuit 9. A horizontal address generating circuit 13 receives a horizontal initial value and a horizontal pitch signal and generates write address and read address for the line memories 5, 6 and 7 and weight signal W4 for the horizontal interpolating circuit 10.

In FIG. 10, construction except the processing circuit 3 is the same one as that of the second embodiment (FIG. 9). Therefore, electronic enlargement or reform of the luminance signal and the chrominance signal which are obtained by the processing circuit 3 are carried out in the same way as that of the second embodiment.

[Fourth Embodiment]

In the embodiment, there is further provided a delay line in the processing circuit 3 shown in FIG. 10 of the third embodiment. Corresponding parts and components to the third embodiment are shown by the same numerals and marks, and the description thereon made in the third embodiment similarly applies. FIG. 11 is a block diagram showing the processing circuit 3 of the image pickup apparatus in accordance with the fourth embodiment.

In FIG. 11, a pair of selectors 91 and 92 select input signals of a pair of delay lines 93 and 94 in response to the control signal C1 issued from the vertical address generating circuit 11. Each of the delay lines (hereinafter is referred as 1HDL) 93 and 94 delays signal of one horizontal scanning time period. A signal generating circuit 95 generates the luminance signal or the chrominance signal by utiilizing output signals of the 1HDL 93 and 94 and the solid-state image pickup element 1. The selectors 91, 92, the 1HDL 93, 94 and the signal generating circuit 95 constitute the process circuit 3.

Next, operation of the above-mentioned image pickup apparatus is described. The operation of this embodiment is similar to that of the second embodiment. When the control signal C1 operates to execute transferring of solid-state image pickup element 1, each of the selector 91 and 92 issues output signal for writing signal of the next scanning line in each of the 1HDL 93 and 94. When the control signal C1 operates to stop transferring of the solid-state image pickup element 1, each of the selector 91 and 92 issues output signal for writing the same signal again in each of the 1HDL 93 and 94. Operation of other parts is the same as that of the second embodiment. Thus, the similar effect to that of the second embodiment are also obtainable as to signal processing method which generates the luminance signal and the chrominance signal by using vertical correlation with the delay line such as a three-image sensors camera or a two or one image sensor camera.

[Fifth Embodiment]

In this embodiment, there is further provided a delay line of the CCD or digital in the processing circuit 3 shown in FIG. 10 of the third embodiment. Corresponding parts and components to the third embodiment are shown by the same numerals and marks, and the description thereon made in the third embodiment similarly applies. FIG. 12 is a block diagram showing the processing circuit 3 of the image pickup apparatus in accordance with the fifth embodiment.

In FIG. 12, a drive circuit 96 controls to drive or stop a pair of delay lines 93 and 94 in response to the control signal C1 issued from the vertical address generating circuit 11. Each of the delay lines (hereinafter is referred as 1HDL) 93 and 94 delays signal of one horizon-

tal scanning time period. A signal generating circuit **95** generates the luminance signal or the chrominance signal by utilizing output signals of the 1HDL **93** and **94** and the solid-state image pickup element **1**. The drive circuit **98**, the 1HDL **93**, **94** and the signal generating circuit **95** constitute the processing circuit **3**.

Next, operation of the above-mentioned image pickup apparatus is described. The operation of this embodiment is similar to that of the second embodiment. When the control signal C1 operates to execute transferring of solid-state image pickup element **1**, the drive circuit **96** issues output signal for writing signal of the next scanning line in each of the 1HDL **93** and **94**. When the control signal C1 operates to stop transferring of the solid-state image pickup element **1**, the drive circuit **96** stops driving of each of the 1HDL **93** and **94**. Operation of other parts is the same as that of the second embodiment. Thus, the similar effects to that of the second embodiment are also obtainable as to signal processing method which generates the luminance signal and the chrominance signal by using vertical correlation with the delay line such as a three-image sensors camera or a two or one image sensor camera.

[Sixth Embodiment]

FIG. **13** is a block diagram showing the image pickup apparatus of a sixth embodiment. A solid-state image pickup element **101** is of a type which is scanned with X-Y address like a MOS type. A drive circuit **102** supplies vertical and horizontal scanning pulses to drive the solid-state image pickup element **101**. Vertical scanning of the image pickup element **101** is executed or stopped in response to a control signal C1, and a head line number of vertical scanning is determined by a control signal C4. Luminance signal and chrominance signal are obtained from output signal of the solid-state image pickup element **101** by means of a processing circuit **103**. Output signal of the procssing circuit **103** is selectively given to the line memories **5**, **6** and **7** through a change-over switch **104** in response to a control signal C2. A selector **108** selects two of the line memories and issues data in response to a control signal C3. Multipliers **109** and **110** multiply output signal of the selector **108** by weight signals W1 and W2, respectively. Scanning line's signal of an upper side of the picture is supplied to the multiplier **109**, and scanning line's signal of a lower side of the picture is supplied to the multiplier **110**. An adder **111** addes output signals of the multipliers **109** and **110** each other and issues output signal to an output terminal **112**. A control signal generating circuit **113** supplies the control signals and the weight signal to each part and also supplies the addess signals to the line memories **5**, **6** and **7**.

FIG. **14** is a block diagram showing the control signal generating circuit **113**. A starting address register **121** specifies a starting position of the scanning lines for a desired part of the picture to be enlarged. For example, interval between the scanning lines in respective fields is selected to be 1. Integer of the starting address is issued as a starting line number C4 of vertical scanning, and decimal of the starting address is issued to a selector **123**. A pitch register **122** specifies a value which is converted from interval of the scanning lines of an enlarged picture to that of an original picture. When the picture is enlarged, the above-mentioned value is below 1. The selector **123** issues the initial value from the starting address **121** during the vertical blanking, and issues the signal from the adder **125** except the time of vertical blanking, thereby to form a looped circuit by the selector **123**, the latch **124** and the adder **125**. A latch **124** latches input signal once at each line. An adder **125** adds output of the latch **124** with output of the pitch resistor **122**. A carry signal is issued as C1 and other lower digits of the signal is issued to the selector **123**. A ternary counter **126** counts HD only at the time when value of C1 is 1, thereby issuing counting value as C2 and C3. Output signal of the latch **124** is used as a weight signal W2 ($0 \leqq W2 < 1$). A subtracter **127** executes subtracting of ($1-W2(=W1)$) and issues output signal as a weight signal W1 ($0 < W1 \leqq 1$).

Next, operation of the above-mentioned image pickup apparatus is described with reference to FIG. **8**(*a*), FIG. **6**(*b*), FIG. **13** and FIG. **14**. For instance, proportional enlargement of 4/3 times in the vertical direction is shown. A pitch of 0.75 is given to the pitch resistor **122** in response to the magnification. In the line memories **5**, **6** and 7, data of scanning lines [2], and [3] and [4], which are issued from the solid-state image pickup element **101**, are stored respectively. Firstly, interpolation of a scanning line D is described. Decimal of data which means vertical position of the scanning line D is held by the latch **124**. To interpolate the scanning line D, a pair of scanning lines [3] and [4], which are upper line and lower line across the scanning line D, are utilized. The selector **108** operates to issue signal of the line memory **8** and signal of the line memory 7 to the multiplier **109** and the multiplier **110**, respectively. If decimal value of the vertical address of the scanning line D, which is held by the latch **124**, is 0.25, value of W1 is set to be 0.75 and value of W2 is 0.25, in the control signal generating circuit **113**. The multipliers **109** and **110** multiply weights on the scanning lines [3] and [4], respectively, and the weighted signals are added each other in the adder **111**, thereby outputting interpolated signals of the scanning line D. At that time, adding of the next address is executed in the adder **125**, and the pitch 0.75 of the pitch register **122** is added to the output 0.25 of the latch **124**. Since sum is 1.00 (0.75+0.25), a carry signal C1 becomes 1, and this signal C1 is supplied to the drive circuit **102**. Decimal 0.00 is written to the latch **124** by a next horizontal pulse HD. When the carry signal C1 becomes 1, the drive circuit **102** operates to scan the next line of the solid-state image pickup element **101**, and a new signal of the scanning line [5] is issued from the solid-state image pickup element **101**. A signal of the scanning line [2] stored in the line memory **5** is the oldest one among the signals of the scanning lines [2], [3] and [4]. It has already been unnecessary for interpolation after the scanning line D. Therefore, the change-over switch **104** selects the line memory **5** and operates to write the signal of the scanning line [5] issued from the solid-state image pickup element **101**. Both writing to the line memory and reading from that, namely reading of the scanning lines [3] and [4] and writing of the scanning line [5], are simultaneously executed.

Next, interpolation of the scanning line E is described. Since the data held by the latch **124** is 0.00, the signal of the scanning line [4] can be used as that of the scanning line E. At this time, the weight signal W1 supplied to the multiplier **109** is 1, and the weight signal W2 supplied to the multiplier **110** is zero, thereby operating to supply the multiplier **109** and **110** with signals of the scanning line [4] and [5], respectively. That is, the selector **108** issues the signal of the line memory 7 to the multiplier **109** and the signal of the line memory **5** to the

multiplier 110. The signal of the scanning line [4], namely the scanning line E is therefore issued from the adder 111. At that time, adding of the next address is executed in the adder 125, and the pitch 0.75 of the pitch register 122 is added to the output 0.00 of the latch 124. Since sum is 0.75 (0.75+0.00), the carry signal C1 becomes zero, and the signal C1 is supplied to the drive circuit 102. Decimal 0.75 is written to the latch 124 by the next horizontal pulse HD. When the carry signal C1 becomes zero, the drive circuit 102 does not operate to scan the next line of the solid-state image pickup element 101, and reading of the same scanning line as aforeread is executed but nothing to use is issued from the solid-state image pickup element 101. Therefore, each of the lne memories 5, 6 and 7 stores the present data.

The above-mentioned selection of reacting/writing of the line memories 5, 6 and 7 and control of transferring of the solid-state image pickup element 101 are shown in Table 1 in the same way as the first embodiment.

By repeating operation shown in Table 1 in the same way, vertical enlargement is performed only by the line memories 5, 6 and 7 even in the image pickup element of X-Y address.

Horizontal enlargement is carried out by the similar procedure to the aforementioned embodiments. [Seventh Embodiment]

FIG. 15 is a block diagram showing the image pickup apparatus of a seventh embodiment.

The following description is based upon a case such that a CCD type image pickup element, which has a vertical transferring part comprising a construction of shift register, is employed as a solid-state image pickup element 1. A drive circuit 2 controls to execute or stop vertical-tranferring of the solid-state impage pickup element 1 in accordance with a control signal C1. Output signal of the solid-state image pickup element 1 is selectively given to line memories 5, 6 and 7 through a change-over switch 4 in response to control signal C2. A selector 8 selects two of the line memories and issues data in response to a control signal C3. Output signal of the selector 8 is sent to a vertical interpolating circuit 8 and a horizontal interpolating circuit 10. A vertical address generating circuit 11 receives a vertical initial value and a vertical pitch signal given from the vertical pitch generating circuit 12 at every line as input signals. The vertical address generating circuit 11 generates the control signal C1 for controlling vertical transfering of the solid-state image pickup element 1, the control signals C2 and C3 for respectively controlling the change-over switch 4 and the selector 8, and a weight signal W2 for the vertical interpolating circuit 9. A horizontal address generating circuit 13 receives a horizontal initial value and a horizontal pitch signal given from the horizontal pitch generating circuit 14 at every picture element as input signals. The horizontal address generating circuit 13 generates write address and read address for the line memories 5, 6 and 7 and weight signal W24 for the horizontal interpolating circuit 10. The vertical address generating circuit 11 and the horizontal address generating circuit 13 constitute a control signal generating circuit.

FIG. 16 is block diagram showing the vertical pitch generating circuit 12 and the vertical address generating circuit 11. A counter 21 counts up at every line and is reset during a time period of vertical blanking. Output of the counter 21 is supplied to a ROM 22 as address signals. Data of vertical pitches are stored in the ROM 22 in correspondence with each line of the picture, and the data of vertical pitches are issued in response to the address signal. Initial value is set in an adder 23 by a selector 26 during the time period of vertical blanking, and thereafter vertical pitch signal, which is supplied from the ROM 22, is added at every line. Decimal processed in the adder 23 is issued through a latch 24 as a weight signal W2 for the vertical interpolating circuit 8. Carry signal of the adder 23 is issued as a control signal C1 and sent to a ternary counter 25. The lowest two bits of number processed in the ternary counter 25 are issued as control signals C2 and C3.

FIG. 17 is a block diagram showing the horizontal pitch generating circuit 14 and the horizontal address generating circuit 13. A counter 31 counts up at every picture element and is reset during a time period of horizontal blanking. Output of the counter 31 is supplied to a ROM 32 as address signals. Horizontal pitches are stored in the ROM 32 in correspondence with each picture element on the scanning line of the picture, and the horizontal pitches are issued in response to the address signal. Initial value is set in an adder 33 by a selector 36 during the time period of horizontal blanking, and thereafter horizontal pitch signal, which is supplied from the ROM 32, is added at every picture element. Integer processed in the adder 33 is issued through the latch 34 as read address signals for the line memories 5, 6 and 7, and decimal processed in the adder 33 is issued through a delay circuit 35 as the weight signal W4 for the horizontal interpolating circuit 10. The lowest bit of the integer is inputted to an exclusive OR gate 38 together with signal passed through a latch 37, thereby issuing a control signal C5 to the horizontal interpolating circuit 10. A counter 39 has the similar function to that of the counter 31 and generates write addresses for the line memories 5, 6 and 7.

Next, operation of the above-mentioned image pickup apparatus is described with reference to FIG. 6(*a*). FIG. 6(*b*) and FIGS. 15–17. For instance, proportional enlargement of 4/3 times in the vertical direction is shown. A pitch of 0.75 is given to all address of the ROM 22 shown in FIG. 16 in response to the magnification. In the line memories 5, 6 and 7, data of scanning lines [2], [3] and [4], which are issued from the solid-state image pickup element 1, are stored respectively. Firstly, interpolation of a scanning line D is described. Decimal of data which means vertical position of the scanning line D is held by the latch 24. To interpolate the scanning line D, a pair of scanning lines [3] and [4], which are upper line and lower line across the scanning line D, are utilized. The selector 8 operates to issue signal of the line memory 6 and signal of the line memory 7 to the multiplier 42 of the vertical interpolating circuit 9 and the multiplier 41 thereof, respectively. If decimal value of the vertical address of the scanning line D, which is held by the latch 24, is 0.25, value of W1 is set to be 0.75 and value of W2 is 0.25, in the vertical interpolating circuit 9. The multipliers 41 and 42 multiply weights on the scanning lines [3] and [4], respectively, and the weighted signals are added each other in the adder 44, thereby outputting interpolated signals of the scanning line D. At that time, adding of the next address is executed, and the output value 0.75 of the ROM 22 is added to the output 0.25 of the latch 24. Since sum is 1.00 (0.75+0.25 ), a carry signal C1 becomes 1, and this signal C1 is supplied to the drive circuit 2. Decimal 0.00 is written to the latch 24 by a

next horizontal pulse HD. When the carry signal C1 becomes 1, the drive circuit 2 operates to vertically transfer the solid-state image pickup element 1, and a new signal of the scanning line [5] is issued from the solid-state image pickup element 1. A signal of the scanning line [2] stored in the line memory 5 is the oldest one among the signals of the scanning lines [2], [3] and [4]. After the scanning of the line D, it has already been unnecessary for interpolation. Therefore, the change-over switch 4 selects the line memory 5 and operates to write the signal of the scanning line [5] issued from the solid-state image pickup element 1. Both the writing to the line memory and the reading from that, that is, reading of the scanning lines [3] and [4] and writing of the scanning line [5], are simultaneously executed.

Next, interpolating of the scanning line E is described. Since the data held by the latch 24 is 0.00, the signal of the scanning line [4] can be used as that of the scanning line E. At this time, the weight signal W1 supplied to the multiplier 42 is 1, and the weight signal W2 supplied to the multiplier 41 is zero, thereby operating to supply the multiplier 42 and 41 with signals of the scanning line [4] [5], respectively. That is, the selector 8 issues the signal of the line memory 7 to the multiplier 42 and the signal of the line memory 5 to the multiplier 41. The signal of the scanning line [4], namely the scanning line E is therefore issued from the adder 44. At that time, adding of the next address is executed in the adder 23, and the output value 0.75 of the ROM 22 is added to the output 0.00 of the latch 24. Since sum is 0.75 (0.75+0.00), the carry signal C1 becomes zero, and this signal C1 is supplied to the drive circuit 2. Decimal 0.75 is written to the latch 24 by the next horizontal pulse HD. When the carry signal C1 becomes zero, the drive circuit 2 does not operate to vertically transfer the solid-state image pickup element 1, and nothing is issued from the solid-state image pickup element 1, and nothing is issued fromt the solid-state image pickup element 1. Therefore, each of the line memories stores the present data.

The above-mentioned selection of reading/writing of the line memories 5, 6 and 7 and control of transferring of the solid-state image pickup element 1 are shown in Table 1 in the same way as the first embodiment.

By repeating the operation shown in Table 1 in the same way, vertical enlargement is performed only by the line memories 5, 6 and 7.

Next, an example for horizontal enlargement is described. Outputs from the horizontal address generating circuit shown by FIG. 3 are used as read addresses for the line memories 5, 6 and 7. Output signal from the vertical interpolating circuit 9 is supplied to the horizontal interpolating circuit shown by FIG. 5. Interpolation between two picture elements in the horizontal direction is executed by using the horizontal weight signal W4 generated by the horizontal address generating circuit shown by FIG. 3. This operation is very similar to that of vertical direction. By the latch 37 and the exclusive OR gate 38, change of the read address is detected. When the change is detected, the control signal C5 becomes 1, and the next picture element's signals are taken into the latches 51 and 52 of the horizonal interpolating circuit 10. Other operation is the same as that of the vertical enlargement.

Although the above-mentioned description is made on the basis that stored data of the ROM 22 and 32 are constant, other data can be stored. For instance, in a case that pitch data as shown in FIG. 18 are stored in the ROM 22 and the ROM 32, a part of the picture can be partially enlarged as shown in FIG. 18 by issuing corresponding pitch signals to every lines by the ROM 22 and every picture elements by the ROM 32. By changing data of the ROM 22 and the ROM 23, reform of the picture is freely executed.

Also, the ROM, which is used for the vertical/horizontal pitch generating circuit, can be replaced by a RAM etc. When the RAM is used, various reforming patterns can be easily realized by changing data stored therein. Of course, the vertical/horizontal pitch generating circuit can be constructed by many logical components.

As mentioned above, the image pickup apparatus of this embodiment can offer an electronic zoom image pickup apparatus which realizes special functions such as enlargement or reform of the picture by means of several line memories without lowering quality of the image.

Although the invention has been described in its preferred form with a certain degree of particularity, it is understood that the present disclosure of the preferred form has been changed in the details of construction and the combination and arrangement of parts may be resorted to without departing from the spirit and the scope of the invention as hereinafter claimed.

What is claimed is:

1. An image pickup apparatus comprising:

a solid-state image pickup element;

a drive circuit which controls to execute and stop vertical scanning of said image pickup element in response to a control signal C1;

n pieces of line memories (M1–Mn) for storing data of scanning lines;

change-over means for selectively giving an output signal SO of said image pickup element to said line memories in response to a control signal C2;

a selector for selecting output signals of m pieces of said line memories in response to a control signal C3;

at least one multiplier for multiplying output signals S1—Sm of said selector by weight signals W1—Wm, respectively;

an adder for adding output signals of said multiplier to each other; and

a control signal generating circuit which issues said control signals C1, C2, C3 and W1–Wm and controls said change-over means to execute vertical transferring of said image pickup element, thereby to supply a new line's signal SON and write said new line's signal SON to a line memory Mx selected from among said line memories M1–Mn, wherein signal stored in said line memory Mx is the oldest one among signals stored in said line memories M1–Mn; wherein

said n, m and x hold the relations:

$n \geqq 3$,

$2 \leqq m < n$,

$1 \leqq x \leqq n$,

wherein

n, m and x are integers.

2. An image pickup apparatus in accordance with claim 1, further comprising:

a processing circuit for generating luminance signal or chrominance/chrominance-difference signal, which are used as input signals of said change-over means, from said output signal S0.

3. An image pickup apparatus in accordance with claim 2, wherein

said processing circuit has a delay line whereto output signal is inputted again at the time when vertical transferring of said image pickup element stops and said signal SO is not issued.

4. An image pickup apparatus in accordance with claim 2, wherein

said processing circuit has a delay line, driving of which stops and holds present signal at the time when vertical transferring of said image pickup element stops and said signal SO is not issued.

5. An image pickup apparatus in accordance with claim 1, wherein

said image pickup element comprises a vertical transferring part constructed by a shift register.

6. An image pickup apparatus in accordance with claim 1, wherein

said image pickup element is of X–Y address type

7. An image pickup apparatus comprising:

a solid-state image pickup element;

a drive circuit which controls to execute and stop vertical scanning of said image pickup element in response to a control signal C1;

n pieces of line memories (M1–Mn) for storing data of scanning lines;

change-over means for selectively giving an output signal SO of said image pickup element to said line memories in response to a control signal C2;

a selector for selecting output signals of m pieces of said line memories in response to a control signal C3;

at least one multiplier for multiplying output signals S1–Sm of said selector by weight signals W1—Wm, respectively;

an adder for adding output signals of said multiplier to each other;

a pitch generating circuit for issuing pitch signals of a predetermined pattern, said pitch signals corresponding to each of scanning lines of a picture; and

a control signal generating circuit which issues said control signals C1, C2, C3 and W1–Wm and controls said change-over means to execute vertical transferring of said image pickup element, thereby to supply a new line's signal SON and write said new line's signal SON to a line memory Mx selected from among said line memories M1–Mn, wherein signal stored in said line memory Mx is the oldest one among signals stored in the line memories M1–Mn; wherein

said n, m and x hold the relations:

$$n \geqq 3,$$
$$2 \leqq m < n,$$
$$1 \leqq x \leqq n,$$

wherein

n, m and x are integers.

8. An image pickup apparatus comprising:

a solid-state image pickup element;

a drive circuit which controls to execute and stop vertical scanning of said image pickup element in response to a control signal C1;

n pieces of line memories (M1–Mn), for storing data of scanning lines;

change-over means for selectively giving an output signal SO of said image pickup element to said line memories in response to a control signal C2;

a selector for selecting output signals of m pieces of said line memories in response to a control signal C3;

at least one multiplier for multiplying output signals S1–Sm of said selector by weight signals W1–Wm, respectively;

an adder for adding output signals of said multiplier to each other;

a mircrocomputer for generating pitch signals in response to magnification signal which is predetermined and changes with lapse of time; and

a control signal generating circuit which issues said control signals C1, C2, C3 and W1–Wm and controls said change-over means to execute vertical transferring of said image pickup element, thereby to supply a new line's signal SON and write said new line's signal SON to a line memory Mx selected from among said line memories M1–Mn, wherein signal stored in said line memory Mx is the oldest one among signals stored in said line memories M1–Mn; wherein

said n, m and x hold the relations:

$$n \geqq 3,$$
$$2 \leqq m < n,$$
$$1 \leqq x \leqq n,$$

wherein

n, m and x are integers.

9. An image pickup apparatus comprising:

a solid-state image pickup element which has a vertical transferring part constructed by a shift register;

a drive circuit which controls to execute and stop vertical scanning of said image pickup element in response to a control signal C1;

a processing circuit for generating luminance signal or chrominance/chrominance-difference signal from an output signal SO of said image pickup element;

n pieces of line memories (M1–Mn) for storing data of scanning lines;

change-over means for selectively giving output signal of said processing circuit to said line memories in response to a control signal C2;

a selector for selecting output signal of m pieces of said line memories in response to a control signal C3;

at least one multiplier for multiplying output signals S1–Sm of said selector by weight signals W1—Wm, respectively;

an adder for adding output signals of said multiplier to each other;

a mircrocomputer for generating pitch signals in response to magnification signal which is predetermined and changes with lapse of time; and

a control signal generating circuit which issues said control signals C1, C2, C3 and W1–Wm and controls said change-over means to execute vertical transferring of said image pickup element, thereby to supply a new line's signal SON and write said new line's signal SON to a line memory Mx selected from among said line memories M1–Mn, wherein signal stored in said line memory Mx is the oldest one among signals stored in said line memories M1–Mn; wherein

said n, m and x hold the relations:

$$n \geqq 3,$$
$$2 \leqq m < n,$$
$$1 \leqq x \leqq n,$$

wherein

n, m and x are integers.

* * * * *

US005177698A

# United States Patent [19]

Parulski

[11] Patent Number: 5,177,698

[45] Date of Patent: Jan. 5, 1993

[54] SELECTABLE POWER OF TWO COEFFICIENT SIGNAL COMBINING CIRCUIT

[75] Inventor: Kenneth A. Parulski, Rochester, N.Y.

[73] Assignee: Eastman Kodak Company, Rochester, N.Y.

[21] Appl. No.: 895,434

[22] Filed: Jun. 5, 1992

Related U.S. Application Data

[63] Continuation of Ser. No. 549,846, Jul. 9, 1990, abandoned.

[51] Int. Cl.[5] ..... G06F 7/38

[52] U.S. Cl. ..... 364/723

[58] Field of Search ..... 364/723, 754, 715.01; 358/21 R

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*Primary Examiner*—Long T. Nguyen
*Attorney, Agent, or Firm*—Edward Dugas

[57] ABSTRACT

An interpolation circuit multiplexes inputs prior to one or more additions during an interpolation operation, thereby reducing the number of components implementing the interpolation circuit. The multiplexers apply shifted inputs to adders in a sequence that produces the desired binary based interpolated values. The interpolation circuit can be used to programmably produce filter coefficients.

17 Claims, 8 Drawing Sheets

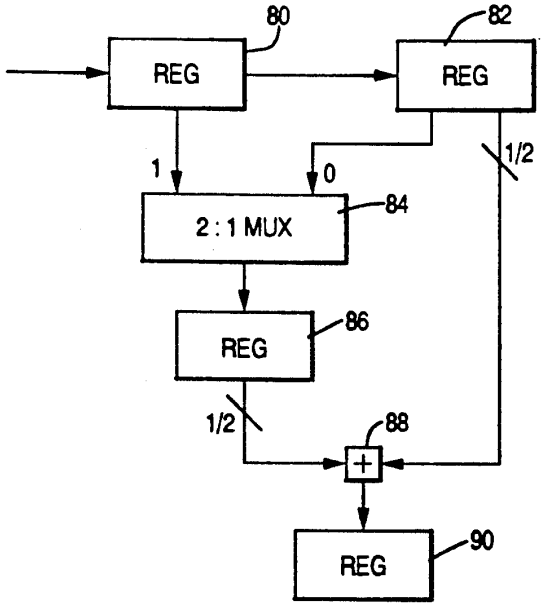


FIG. 1

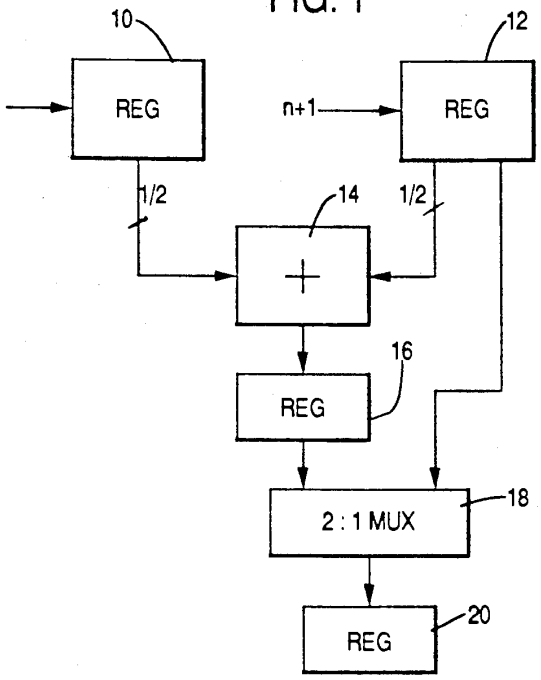

10
12
REG
n+1
REG
1/2
14
1/2
16
REG
2 : 1 MUX
18
REG
20

FIG. 2

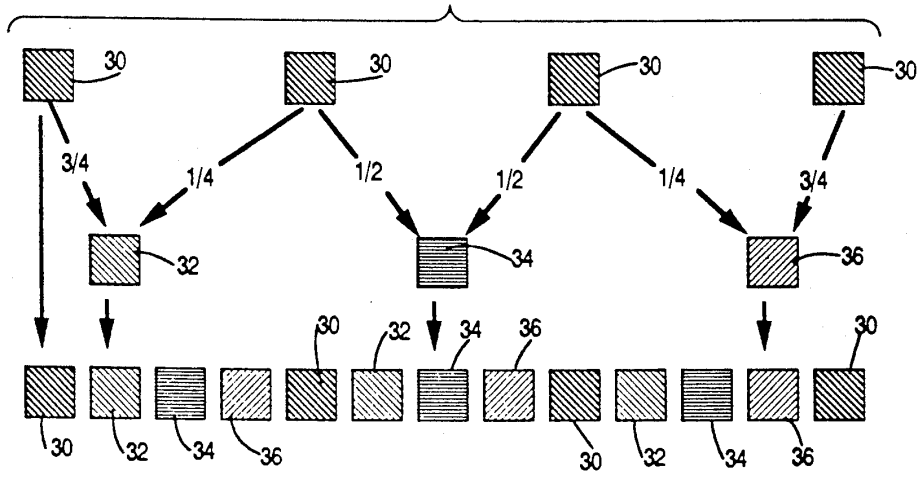

30
30
30
30
3/4
1/4
1/2
1/2
1/4
3/4
32
34
36
30
32
34
36
30
32
34
36
30
32
34
36

FIG. 3A

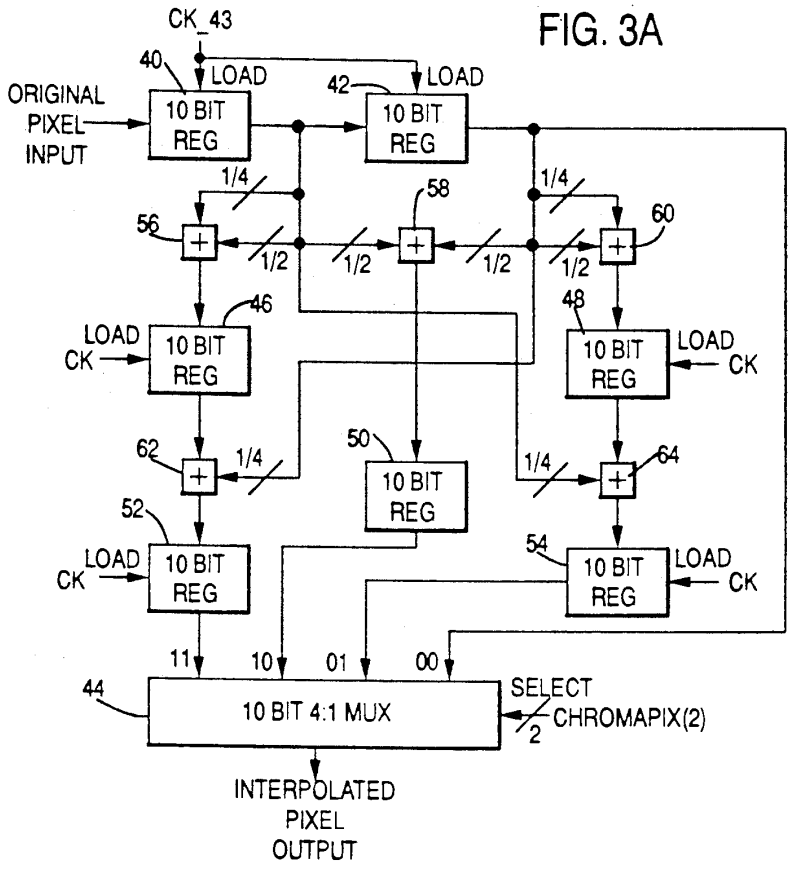



FIG. 3B

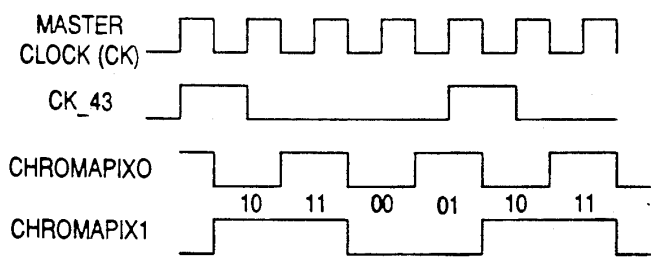



FIG. 3C

| CHROMAPIXO | | | | CHROMAPIX1 | | |
|---|---|---|---|---|---|---|
| LEFT | | | | RIGHT | | |
| 3/4 | X | X | X | 1/4 | 1 | 1 |
| 1/2 | X | X | X | 1/2 | 1 | 0 |
| 1/4 | X | X | X | 3/4 | 0 | 1 |
| 0 | X | X | X | 1 | 0 | 0 |

FIG. 4

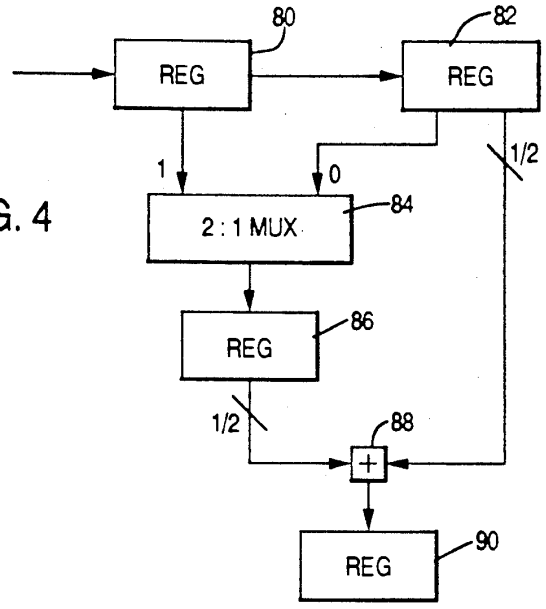

80
82
REG
REG
1
0
1/2
2 : 1 MUX
84
REG
86
1/2
88
+
REG
90

FIG. 5A

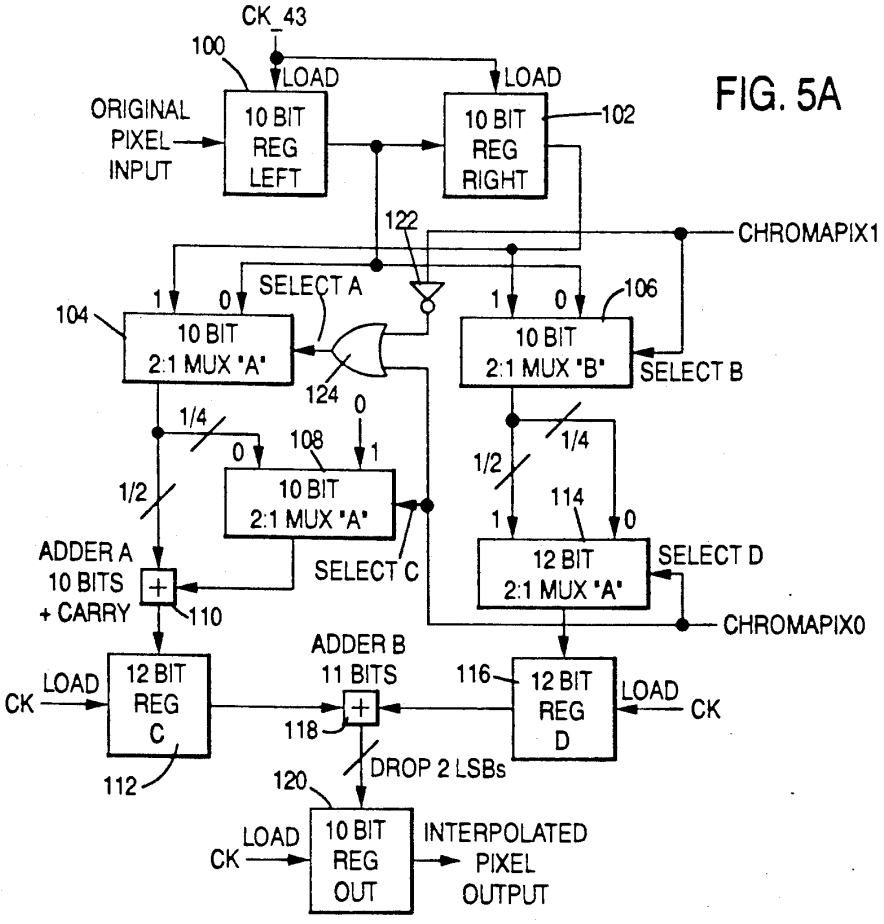

CK_43
100
LOAD
LOAD
ORIGINAL PIXEL INPUT
10 BIT REG LEFT
10 BIT REG RIGHT
102
122
CHROMAPIX1
SELECT A
1
0
104
10 BIT 2:1 MUX "A"
124
1
0
106
10 BIT 2:1 MUX "B"
SELECT B
1/4
0
108
1
10 BIT 2:1 MUX "A"
1/2
1/4
1/2
1
114
0
12 BIT 2:1 MUX "A"
SELECT D
ADDER A 10 BITS + CARRY
+
110
SELECT C
CHROMAPIX0
ADDER B 11 BITS
LOAD
CK
12 BIT REG C
112
+
118
116
12 BIT REG D
LOAD
CK
DROP 2 LSBs
120
LOAD
CK
10 BIT REG OUT
INTERPOLATED PIXEL OUTPUT

FIG. 5B

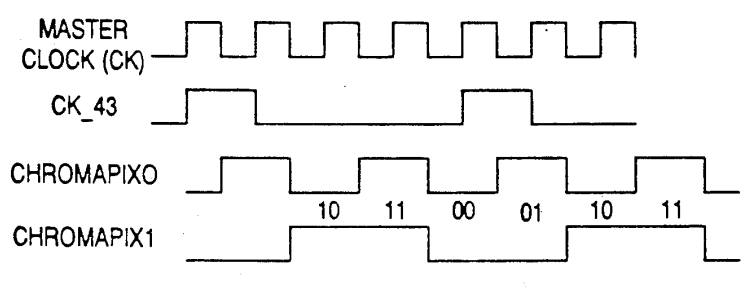



FIG. 5C

CHROMAPIXO
CHROMAPIX1

| LEFT | | | | RIGHT | SELECT | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | X | X | X | 1 | A | B | C | D | 1 | 1 |
| 1/4 | X | X | X | 3/4 | A | B^ | C^ | D^ | 0 | 0 |
| 1/2 | X | X | X | 1/2 | A | B^ | C | D | 0 | 1 |
| 3/4 | X | X | X | 1/4 | A^ | B | C^ | D^ | 1 | 0 |

D = CHROMAPIX0
C = CHROMAPIX0
B = CHROMAPIX1
A = CHROMAPIX0 + CHROMAPIX1^
X = LOCATION OF INTERPOLATED PIXEL

FIG. 6A

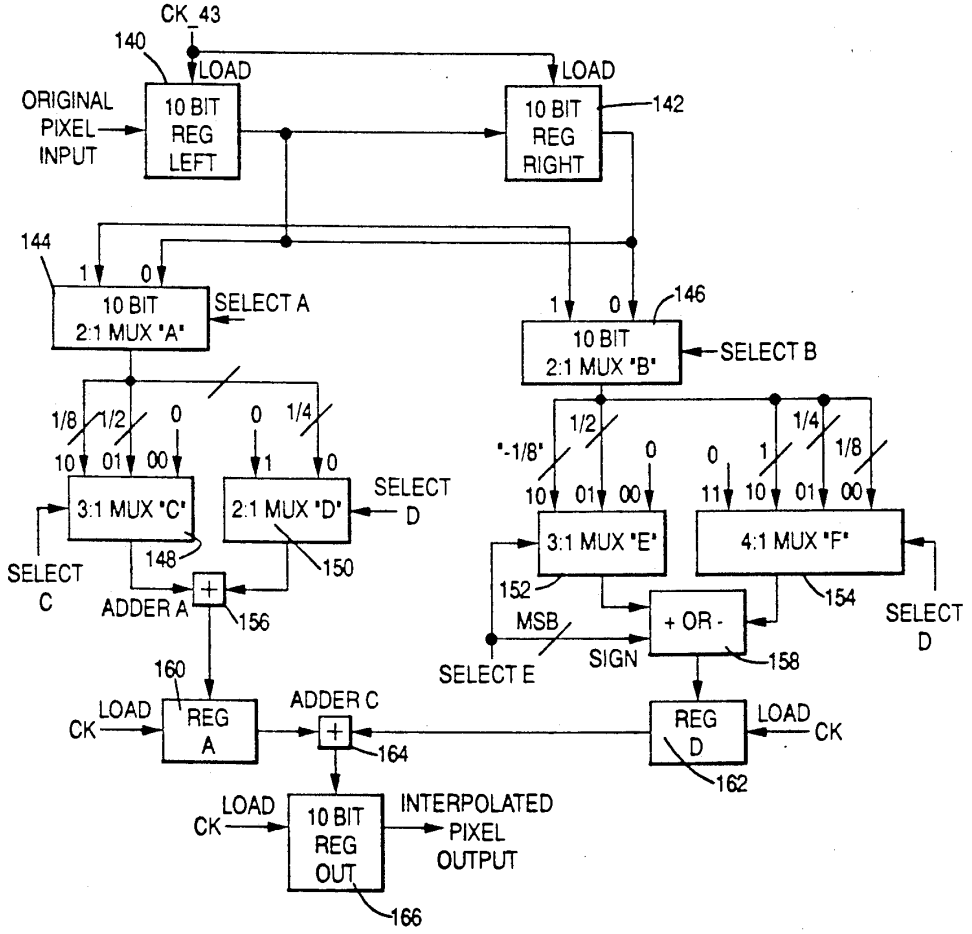

CK 43
140
LOAD
LOAD
ORIGINAL PIXEL INPUT
10 BIT REG LEFT
10 BIT REG RIGHT
142
144
1
0
10 BIT 2:1 MUX "A"
SELECT A
1
0
146
10 BIT 2:1 MUX "B"
SELECT B
1/8
1/2
0
0
1/4
10
01
00
1
0
3:1 MUX "C"
2:1 MUX "D"
SELECT D
SELECT C
148
150
ADDER A
156
"-1/8"
1/2
0
0
1
1/4
1/8
10
01
00
11
10
01
00
3:1 MUX "E"
4:1 MUX "F"
152
154
SELECT D
MSB
SIGN
+ OR -
158
SELECT E
160
LOAD
CK
REG A
ADDER C
164
REG D
LOAD
CK
162
LOAD
CK
10 BIT REG OUT
INTERPOLATED PIXEL OUTPUT
166

FIG. 6B

| INTERPOLATION FILTER | | | | | | | | | MULTIPLEXER SELECT CONTROL VALUES | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LEFT | | | | | | | | RIGHT | A | B | C | D | E | F |
| 0 | X | X | X | X | X | X | X | 1 | 0 | 1 | 00 | 1 | 00 | 10 |
| 1/8 | X | X | X | X | X | X | X | 7/8 | 0 | 1 | 10 | 1 | 10 | 10 |
| 2/8 | X | X | X | X | X | X | X | 6/8 | 0 | 1 | 00 | 0 | 01 | 01 |
| 3/8 | X | X | X | X | X | X | X | 5/8 | 0 | 1 | 10 | 0 | 01 | 00 |
| 4/8 | X | X | X | X | X | X | X | 4/8 | 1 | 0 | 01 | 1 | 01 | 11 |
| 5/8 | X | X | X | X | X | X | X | 3/8 | 1 | 0 | 00 | 0 | 01 | 00 |
| 6/8 | X | X | X | X | X | X | X | 2/8 | 1 | 0 | 10 | 0 | 01 | 01 |
| 7/8 | X | X | X | X | X | X | X | 1/8 | 1 | 0 | 10 | 1 | 10 | 10 |

X = LOCATION OF INTERPOLATED PIXEL

FIG. 7B

| | INTERPOLATION FILTER | | | | | SELECT CONTROL VALUES | | |
|---|---|---|---|---|---|---|---|---|
| LEFT 2 | LEFT 1 | | | RIGHT 1 | RIGHT 2 | AB | C | DE |
| 0 | 1/8 | X | X | X | 3/4 | 1/8 | 0 | 00 | 10 |
| 0 | 1/4 | X | X | X | 5/8 | 1/8 | 0 | 00 | 01 |
| 0 | 1/2 | X | X | X | 1/2 | 0 | 1 | 10 | 00 |
| 1/8 | 5/8 | X | X | X | 1/4 | 0 | 1 | 01 | 01 |

X = LOCATION OF INTERPOLATED PIXEL

FIG. 7A

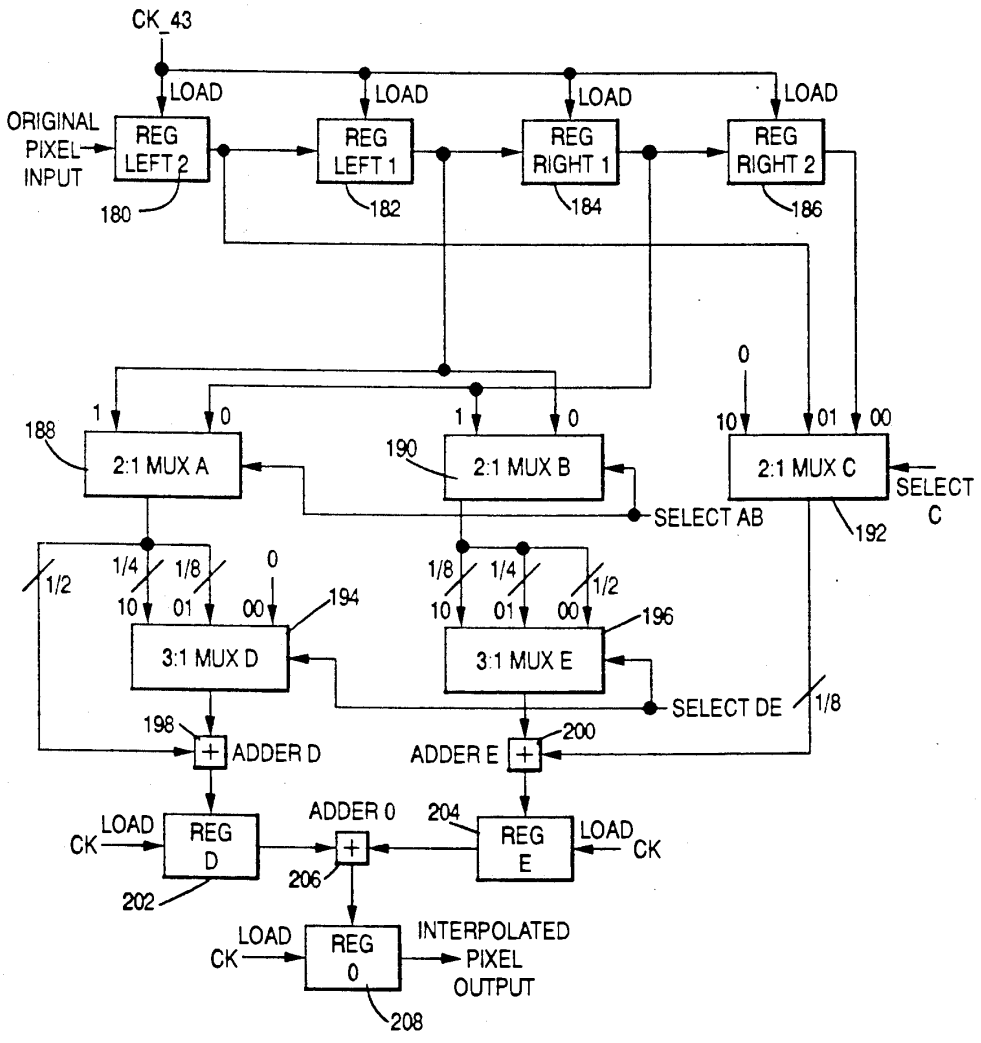

CK_43
LOAD
LOAD
LOAD
LOAD
ORIGINAL PIXEL INPUT
REG LEFT 2
REG LEFT 1
REG RIGHT 1
REG RIGHT 2
180
182
184
186
188
2:1 MUX A
190
2:1 MUX B
2:1 MUX C
SELECT C
SELECT AB
192
1/2
1/4
1/8
0
10
01
00
194
3:1 MUX D
196
3:1 MUX E
SELECT DE
1/8
198
ADDER D
200
ADDER E
ADDER 0
204
LOAD
CK
REG D
REG E
206
202
REG 0
INTERPOLATED PIXEL OUTPUT
208

FIG. 8A

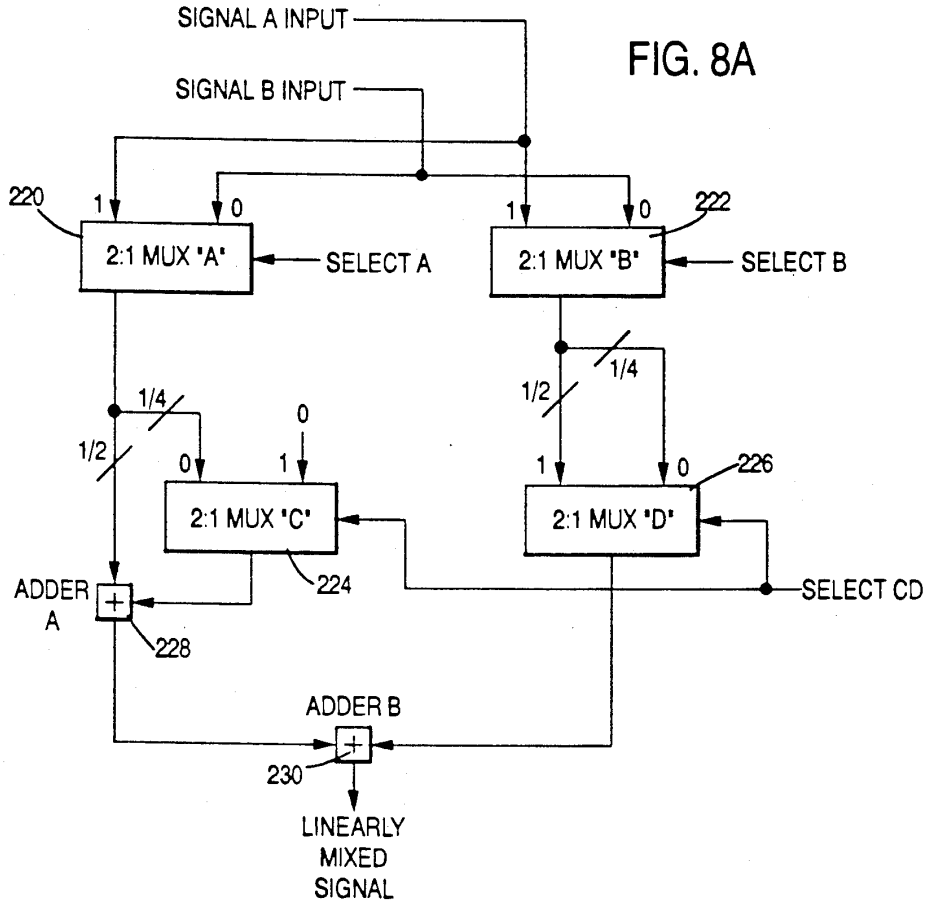



FIG. 8B

| SIGNAL MIXING FUNCTION | SELECT CONTROL VALUES A | B | CD |
|---|---|---|---|
| 1 SIGNAL A + 0 SIGNAL B | 1 | 1 | 1 |
| 3/4 SIGNAL A + 1/4 SIGNAL B | 1 | 0 | 0 |
| 1/2 SIGNAL A + 1/2 SIGNAL B | 1 | 0 | 1 |
| 1/4 SIGNAL A + 3/4 SIGNAL B | 0 | 1 | 0 |
| 0 SIGNAL A + 1 SIGNAL B | 0 | 0 | 1 |

# SELECTABLE POWER OF TWO COEFFICIENT SIGNAL COMBINING CIRCUIT

This application is a continuation of application Ser. No. 07/549,846, filed Jul. 9, 1990, now abandoned.

## CROSS REFERENCE TO RELATED APPLICATION

This application is related to U.S. Pat. No. 5,008,739, filed Feb. 13, 1989 entitled Real Time Digital Signal Processor For Producing Full Resolution Color Signals From A Multi-Color Image Sensor by Parulski et al., incorporated by reference herein.

## BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention is directed to a circuit which selectably combines power of two coefficients for interpolation and filter control and, more particularly, to a circuit capable of producing a linear interpolation commonly used in digital signal processing of color signals where the invention reduces the integrated circuit chip area used by the interpolation circuit.

2. Description of the Related Art

Linear interpolation circuits are commonly used in digital signal processing systems, and particularly in image processing systems. The simplest form of linear interpolation is 1 to 2 interpolation. For example, an original image from a CCD camera might have 500 lines of pixels, while the printer or display may require 1,000 lines. The simplest way to obtain a 1000 line image is to simply replicate each camera line twice when displaying or printing. However, a preferred technique is to set the values of every second output line equal to the values of the original lines from the camera, and to set the values of "interpolated" lines in between the original lines equal to the average of the values from the two vertically adjacent original lines from the camera. This technique, referred to as 1 to 2 linear interpolation, can be implemented in hardware very easily using an adder, a hardwired bit shift to divide by **2**, and a multiplexer, as illustrated in FIG. **1**. In this figure the original pixel values from two adjacent original lines (line n and line n+1) from the camera are loaded into registers **10** and **12**. Each register outputs $\frac{1}{2}$ the original value by hardwired shifting. For example, if the input signal is a ten bit signal then the most significant nine bits are passed to the adder as the least significant bits of the 10 bit adder input and the most significant bit of the adder input is set to zero. In this divide by shifting type operation, if a $\frac{1}{4}$ value is needed, the two most significant bits of the next stage are set to zero and the eight most significant bits are supplied to the least significant bits of the next stage, if a $\frac{1}{8}$ value is needed, the three most significant bits of the next stage are set to zero and only the seven most significant bits are supplied to the least significant bits of the next stage, and so on for other binary divisions. The adder **14** stores the result of the addition in a register **16**. A multiplexer **18** then alternately stores either the original pixel values or the linearly interpolated values into an output register **20** depending on whether the output line number is even or odd. In this operation, the addition of the shifted original pixel values is performed before the multiplex operation.

A 1 to 4 linear interpolation is a common operation in many image processing applications. Two such circuits are used in a digital signal processor chip produced by



Eastman Kodak Company as described in the U.S. Patent previously mentioned. The general operation of a 1 to 4 interpolation technique is illustrated in FIG. **2**. For each original pixel **30** in the input image, the circuit computes four "output" pixel values. One of the output pixel values **30** equals the original pixel **30**. The other three output pixel values **32**, **34** and **36** are linearly weighted combinations of the values of the nearest original pixels on the left and the right, if horizontal interpolation is being performed or top and bottom if vertical interpolation is being performed. The weights are $\frac{3}{4}$ times the left pixel plus $\frac{1}{4}$ times the right pixel for the first produced pixel **32**, $\frac{1}{2}$ times the left pixel plus $\frac{1}{2}$ times the right pixel for the second produced pixel **34**, and $\frac{1}{4}$ times the left plus $\frac{3}{4}$ times the right for the third produced pixel **36**.

FIG. **3A** shows one of the two identical "horizontal chroma interpolator" circuits shown as FIG. **7** of the Patent mentioned above. The two "original" pixel values are loaded into the top two registers **40** and **42** every fourth master clock cycle (See FIG. **3B**). A 4 to 1 multiplexer **44** which is actually composed of three 2 to 1 multiplexers, is used to set the output equal to one of four values (See FIG. **3C**). When CHROMAPIX(2)=00, the value in register **42** is used. When CHROMAPIX(2)=01, the output is set equal to $\frac{3}{4}$ of the register **42** pixel value plus $\frac{1}{4}$ of the register **40** pixel value. When CHROMAPIX(2)=10, the output equals $\frac{1}{2}$ of the register **42** pixel value plus $\frac{1}{2}$ of the register **40** pixel value. When CHROMAPIX(2)=11, the output equals $\frac{3}{4}$ of the register **40** pixel value plus $\frac{1}{4}$ of the register **42** pixel value. The implementation shown in FIG. **3A** is the simplest prior art 1 to 4 interpolation circuit known and includes seven registers **40**, **42**, **46**, **48**, **50**, **52** and **54**, five adders **56**, **58**, **60**, **62** and **64**, and a 4 to 1 multiplexer or three 2 to 1 multiplexers.

Another method of performing a linear interpolation is to use multipliers and interpolation coefficients stored in registers. This approach uses even more chip area than the approach discussed above.

## SUMMARY OF THE INVENTION

It is an object of the present invention to reduce the number of circuit components necessary to produce an interpolation circuit.

It is another object of the present invention to reduce the integrated circuit chip space used by the interpolation circuit.

It is also an object of the present invention to minimize the number of adders/subtractors used in an interpolation circuit.

It is a further object of the present invention to reduce the space used on an integrated circuit for an interpolation circuit by substituting multiplexers for adders.

It is an additional object of the present invention to provide an improved interpolation circuit capable of interpolation, filter coefficient programming and programmable interpolation circuit setting.

It is still another object of the present invention to produce a signal or coefficient combining circuit which is capable of producing binary combinations while reducing the necessary number of circuit components to a minimum.

The above objects can be attained by an interpolation circuit that multiplexes inputs prior to one or more additions during the interpolation operation. The multiplexers select among different divide shifted inputs and apply the shifted inputs to adders in a sequence that

produces the desired binary based combined or interpolated values.

These together with other objects and advantages which will be subsequently apparent, reside in the details of construction and operation as more fully hereinafter described and claimed, reference being had to the accompanying drawings forming a part hereof, wherein like numerals reference to like parts throughout.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** illustrates a conventional 1 to 2 interpolation circuit;

FIG. **2** illustrates a 1 to 4 interpolation operation;

FIG. **3A** depicts a conventional 1 to 4 interpolation circuit;

FIG. **3B** is a timing diagram of the control signals for the circuit of FIG. **3A**;

FIG. **3C** is a control signal state diagram showing the interpolation coefficients of the circuit of FIG. **3A**;

FIG. **4** depicts a 1 to 2 interpolation or signal combining circuit in accordance with the present invention;

FIG. **5A** illustrates a 1 to 4 interpolation circuit in accordance with the present invention;

FIG. **5B** is a timing diagram of the control signals for the circuit of FIG. **5A**;

FIG. **5C** is a control signal state diagram showing the interpolation coefficients of the circuit of FIG. **5A**;

FIG. **6A** depicts a 1 to 8 interpolation circuit in accordance with the present invention;

FIG. **6B** is a state diagram of the control signals and interpolation coefficients for the circuit of FIG. **6A**;

FIG. **7A** is a spline interpolation circuit in accordance with the present invention;

FIG. **7B** is a control signal state diagram for the circuit of FIG. **7A**;

FIG. **8A** illustrates a linear signal mixer in accordance with the present invention; and

FIG. **8B** illustrates the control signal state diagram for the circuit of FIG. **8A**.

## DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention is based on the observation that each adder shown in the circuit of FIG. **3A** is used only once every four master clock cycles, even though the adders are designed to complete an operation every master clock cycle. Therefore, the adders are essentially sitting idle 75% of the time. Furthermore, at most two adders are required to compute any of the interpolated output values. One adder is needed to sum $\frac{1}{2}$ and $\frac{1}{4}$ of a first original pixel value and a second adder is needed to sum this result with $\frac{1}{4}$ of the second original pixel value.

The principle behind the present invention is to select different divide shifted signals using multiplexers before the addition operation is performed. As a result, the key to the present invention is in determining how to properly multiplex the inputs to the adders. The principle of the present invention is illustrated in FIG. **4** where two registers **80** and **82** feed a multiplexer **84** which selects one of the two registers. In a first master clock cycle, multiplexer **84** selects register **80** and stores that value in register **86**. The contents of register **86** are shift divided by two and added to a shift divided output from register **82** and stored in register **90** producing the interpolated value. In the next master clock cycle multiplexer **84** selects the contents of register **82** and, as a result, register **90** receives the sum of $\frac{1}{2}$ of the value in register **82** from multiplexer **84** and $\frac{1}{2}$ of the value in register **82**. This circuit performs the multiplex operations prior to the addition operation, which is in contrast to the sequence illustrated in FIG. **1**. A comparison of FIG. **1** with FIG. **4** indicates that the number of circuit components for a one to two interpolation circuit in accordance with the present invention is the same as in the conventional circuit. However, the number of circuit components necessary in the present invention begins dropping with respect to the number of circuit components required in the conventional circuit, when the number of interpolated values increases, as illustrated in FIG. **5A**.

A 1 to 4 interpolation circuit in accordance with the present invention shown in FIG. **5A** requires only two adders, compared to five for the conventional circuit of FIG. **3A**, and only five rather than six registers. The circuit needs four, rather than three, 2 to 1 multiplexers, one OR gate, and one invertor. Since the adders require by far the most chip area, this new circuit takes less than one-half of the area of the conventional circuit of FIG. **3A**. Yet the present invention takes the same amount of time to perform the interpolation as the conventional circuit.

The circuit of FIG. **5A** operates using the same clocking signals required by the conventional circuit of FIG. **3A** and is a drop-in replacement for the prior art circuit. The original pixels are latched into the left and right registers **100** and **102** every four master clock (CK) cycles and four pixels are produced for every clock cycle of CK**43**. The A and B multiplexers **104** and **106** determine whether the left or right inputs are routed to the A and B adder inputs. The 0 and 1 values next to the inputs of the multiplexers indicate which input is selected based on the value of the select signal, for example, when select A is 1 the content of register **102** is selected and when select A is 0 the content of register **100** is selected. To set the output equal to the register **102** (right) pixel value, multiplexers A and B (**104** and **106**) both select (select A = 1 and select B = 1) the right register **100** output. Multiplexer C, **108** selects (select C = 0) zero as one of the adder A (**110**) inputs, so that the adder A (**110**) output to register C(**112**) equals $\frac{1}{2}$ the right register (**100**) value, while multiplexer D(**114**) selects (select D = 1) $\frac{1}{2}$ the right register (**100**) value. Thus, adder B (**118**) outputs to output register **120** a value which equals $\frac{1}{2}$ the value in the right register **102** plus $\frac{1}{2}$ the value in the right register **102**. Of course, it is possible to just route the right register **102** directly to the output register **120**, but this would require an additional multiplexer and a select line decoding circuit.

To obtain the $\frac{3}{4}$ left register value plus $\frac{1}{4}$ the right register value, multiplexer A (**104**) selects the left register **100** while multiplexer B (**106**) selects the right register **102**. At the same time multiplexer C (**108**) selects the $\frac{1}{4}$ input, so that the register C (**112**) value equals $\frac{3}{4}$ left, while Multiplexer D (**114**) selects the $\frac{1}{4}$ input, so that the register D (**116**) value equals $\frac{1}{4}$ right. This gives the proper output. To obtain $\frac{1}{4}$ left plus $\frac{3}{4}$ right, the multiplexer A (**104**) and multiplexer B (**106**) selection is simply reversed. To obtain $\frac{1}{2}$ left plus $\frac{1}{2}$ right, multiplexer A (**104**) selects right **102** while multiplexer B (**106**) selects left **100**. Multiplexer C (**108**) sets one adder A input to 0, so the output equals $\frac{1}{2}$ right, while multiplexer D (**114**) selects $\frac{1}{2}$, so the second adder B (**118**) input equals $\frac{1}{2}$ left.

FIG. **5B** illustrates the clock signals applied to the circuit of FIG. **5A** to accomplish the above-described operation. However, as can be seen by comparing the timing signal diagrams of FIG. **3B** with the correspond-

ing diagrams in FIG. 5B, the phases of the chromapix signals needs to be adjusted, a task within the ordinary skill in the art. By making such an adjustment the output arrives at the same phase relative to CK43 as in the conventional circuit. FIG. 5C illustrates the translation of the two control signals chromapix 1 and chromapix 0 into the multiplexer selection signals A, B, C and D. As shown in FIG. 5A the present invention includes an invertor 122 along with an OR gate 124 which produces the select A signal from the control signals chromapix (2). The remaining selection signals B, C and D are unmodified control signals. The map illustrated in FIG. 5C also depicts the interpolation coefficients produced as a result of the particular state of the control signals where X is the location in the pixel stream of the produced pixel, for example, when chromapix (2)=00 the pixel adjacent to the original right pixel is produced.

As can be seen from the above discussion, the present invention can be used to advantage any time a hardware implementation of a 1 to 4 interpolation is required. The basis of the present invention is to count the minimum number of adders needed to obtain the most adder intensive interpolated output value and then develop a circuit using this many adders along with multiplexers to appropriately provide the bit shifted or zero inputs to the adders. This approach can be extended to any other size interpolation circuit. However, a 1 to 3 interpolation circuit does not benefit from the present invention, since the $\frac{1}{3}$ plus $\frac{2}{3}$ terms are best implemented with multiplexers which have programmable coefficients instead of bit shifted additions. A 1 to 6 or 1 to 8 interpolator benefits considerably from the present invention since these interpolators would normally be implemented with multipliers. FIG. 6A illustrates how the present invention can be applied to a 1 to 8 interpolator.

As illustrated in FIG. 6A, a 1 to 8 interpolator circuit in accordance with the present invention also includes two registers 140 and 142, the contents of which are selected by multiplexers 144 and 146 in a first stage. A set of second stage multiplexers 148, 150, 152 and 154 select from appropriately shifted outputs from the first stage multiplexers, or from zero values, and supply the selected values to adder 156 and adder/subtractor 158. The second stage multiplexer 152 shows a "$-\frac{1}{8}$" input value. During actual operation only a $\frac{1}{8}$ value is transferred through multiplexer 152 and the sign input to the adder/subtractor 158 is set to produce a negative input. Adders 156 and 158 supply stage storage registers 160 and 162 which feed an adder 164 that produces the output stored in register 166. The control signals, the resulting interpolation coefficients and the pixel being produced are illustrated in FIG. 6B. It is possible to produce the control signals using a logic circuit with appropriate AND, OR and inverter gates, however, with a complicated control signal set such as illustrated in FIG. 6B it would also be appropriate to provide these values from a memory storage device such as a ROM or a RAM which can be sequentially addressed by a counter incremented by a master clock signal. With the use of a programmable RAM to control the circuit of FIG. 6 it is of course possible to provide even more complicated signal combination control.

FIG. 7A illustrates the present invention when applied to a spline interpolation circuit which produces four new pixels for each pixel input by using the nearest four pixels for interpolation. The filter coefficients produced by this circuit are approximations of the "Cubic-B Spline" interpolation shown in FIG. 4 of "Comparisons of Interpolating Methods For Image Resampling" by Parker et al., IEEE Transactions on Medical Imaging Vol. MI-2, No. 1, Mar. 1983. As illustrated in FIG. 7A, input storage registers 180, 182, 184 and 186 feed a first stage of multiplexers 188, 190 and 192. The outputs of the first stage of multiplexers are selected, in various divide by shift combinations, by a second stage of multiplexers 194 and 196 to be combined by adders 198 and 200 and stored in corresponding registers 202 and 204. The contents of these registers are added by adder 206 and stored in output register 208. FIG. 7B illustrates the control signal values necessary to produce the filter interpolation coefficients shown therein.

FIG. 8A illustrates the present invention being used as a linear signal mixer which could for example be combining images from two different image sensors or from two different sound or pressure transducers. In this embodiment first stage multiplexers 220 and 222 feed second stage multiplexers 224 and 226 which supply shift divided input signals to adders 228 and 230 which produce the linearly mixed output signal. FIG. 8B illustrates the control signal values which produce the indicated linear combinations of the input signals. Once again this can be a programmable set of control signals stored in a ROM or RAM or implemented as an appropriate logic circuit.

The many features and advantages of the invention are apparent from the detailed specification and thus it is intended by the appended claims to cover all such features and advantages of the invention which fall within the true spirit and scope of the invention. Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation illustrated and described, and accordingly all suitable modifications and equivalents may be resorted to, falling within the scope of the invention.

What is claimed is:

1. A combining circuit for combining input signals, comprising:

means for bit shifting the input signals, said means for bit shifting comprising hardwired bit lines providing a pair of hardwired signals, the pair selected from among one of a first pair of bit shifted input signals and a second pair of a bit shifted input signal and a bit input signal unshifted;

means, connected to said hardwired bit lines, for selecting the hardwired signals to produce selected outputs; and

means, connected to said means for selecting, for adding the selected outputs to produce an output signal.

2. A combining circuit as recited in claim 1, wherein:

said circuit further comprises input registers connected to said means for bit shifting;

said means for adding comprises adders having inputs receiving the selected outputs; and

said means for selecting comprises multiplexers connected to said adders and said means for bit shifting.

3. A circuit as recited in claim 1, wherein:

said circuit further comprises first and second input registers connected to said means for bit shifting;

said means for adding comprises first and second adders where an output of said first adder is provided to said second adder; and

said means for selecting comprises multiplexers connected to said adders and said means for bit shifting

provides, through said means for selecting, a bit shifted output of said input registers to one of said adders.

4. A circuit as recited in claim 1, wherein:

said circuit further comprises input registers connected to said means for bit shifting;

said means for adding comprises first, second and third adders, outputs of said first and second adders being connected to inputs of said third adder; and

said means for selecting comprising multiplexers connected to said adders and said means for bit shifting provides, through said means for selecting, a first bit shifted output of a first one of said input registers to said first adder and providing a second bit shifted output of a second one of said input registers to said second adder.

5. A circuit as recited in claim 1, wherein:

said means for adding comprises adders having inputs receiving the divided outputs; and

said means for selecting comprises multiplexers connected to said means for bit shifting, and said means for bit shifting provides, though said means for selecting, a bit shifted output comprised of one of said input signals to one of said adders.

6. A circuit as recited in claim 1, wherein said means for bit shifting passes most significant bits from the input signals as less significant bits of the hardwired signals.

7. A combining circuit for combining input signals, comprising:

input registers connected in series;

means for multiplexing the input signals to produce multiplexed outputs;

means for shift dividing the multiplexed outputs to produce divided outputs; and

means for adding the divided outputs to produce an output signal, said adder means comprising adders receiving the divided outputs and said multiplex means comprising multiplexers connected between said input registers and said adders and at least one of said multiplexers providing a bit shifted output of one of said input registers to one of said adders.

8. A combining circuit for combining input signals, comprising:

first and second input registers connected in series;

means for multiplexing the input signals to produce multiplexed outputs, said means for multiplexing comprising:

a 2 to 1 multiplexer connected to said first and second input registers; and

a storage register connected to said multiplexer;

means for shift dividing the multiplexed outputs to produce divided outputs; and

means for adding the divided outputs to produce an output signal, said means for adding comprising an adder connected to said second input register and said means for shift dividing.

9. A combining circuit for combining input signals, comprising:

first and second input registers connected in series;

means for multiplexing the input signals to produce divided shifted outputs, said means for multiplexing comprising:

first and second multiplexers each connected to both said first and second registers;

a third multiplexer connected to said first multiplexer; and

a fourth multiplexer connected to said second multiplexer; and

means for adding the divide shifted outputs to produce an output signal, said means for adding comprising:

a first adder connected to said first and third multiplexers; and

a second adder connected to said fourth multiplexer and said first adder.

10. A combining circuit for combining input signals, comprising:

means for multiplexing the input signals to produce divide shifted outputs, said means for multiplexing comprising:

first and second multiplexers each receiving the input signals;

a third multiplexer connected to said first multiplexer; and

a fourth multiplexer connected to said second multiplexer; and

means for adding the divide shifted outputs to produce an output signal, said means for adding comprising:

a first adder connected to said first and third multiplexers; and

a second adder connected to said fourth multiplexer and said first adder.

11. A binary 1 to 4 linear interpolation circuit, comprising:

a first register receiving an input signal;

a second register connected in series to said first register;

a first multiplexer connected to said first and second registers and producing a first output;

a second multiplexer connected to said first and second registers and producing a second output;

a third multiplexer connected to said first multiplexer, receiving the first output left shifted by two bits and receiving a zero input;

a fourth multiplexer connected to said second multiplexer and receiving the second output left shifted by two bits and left shifted by one bit;

a first adder connected to said third multiplexer and to said first multiplexer and receiving the first output left shifted by one bit; and

a second adder connected to said first adder and said fourth multiplexer.

12. A combining circuit for combining input signals, comprising:

first and second input registers connected in series;

means for multiplexing the input signals to produce divide shifted outputs, said means for multiplexing comprising:

first and second multiplexers each connected to both said first and second registers;

third and fourth multiplexers connected to said first multiplexer; and

fifth and sixth multiplexers connected to said second multiplexer; and

means for adding the divide shifted outputs to produce an output signal, said means for adding comprising:

a first adder connected to said third and fourth multiplexers;

an adder/subtractor connected to said fifth and sixth multiplexers; and

a second adder connected to said first adder and said adder/subtractor.

13. A combining circuit for combining input signals, comprising:

first through fourth registers connected in series;

means for multiplexing the input signals to produce divide shifted outputs. sand means for multiplexing comprising:

a first multiplexer connected to said second and third registers;

a second multiplexer connected to said second and third registers;

a third multiplexer connected to said first and fourth registers;

a fourth multiplexer connected to said first multiplexer; and

a fifth multiplexer connected to said second multiplexer; and

means for adding the divide shifted outputs to produce an output signal, said means for adding comprising:

a first adder connected to said first and fourth multiplexers;

a second adder connected to said third and fifth multiplexers; and

a third adder connected to said first and second adders.

**14**. A binary 1 to 8 linear interpolation circuit, comprising:

a first register receiving an input signal;

a second register connected in series with said first register;

a first multiplexer connected to said first and second registers and producing a first output;

a second multiplexer connected to said first and second registers and producing a second output;

a third multiplexer connected to said first multiplexer. receiving the first output left shifted three bits and one bit. and receiving a zero input;

a fourth multiplexer connected to said first multiplexer. receiving the first output left shifted two bits and receiving a zero input;

a fifth multiplexer connected to said second multiplexer. receiving the second output left shifted one bit and three bits. and receiving a zero input;

a sixth multiplexer connected to said second multiplexer and receiving the second output left shifted two bits and three bits. and receiving a zero input;

a first adder connected to said third and fourth multiplexers;

an adder/subtractor connected to said fifth and sixth multiplexers; and

a second adder connected to said first adder and said adder/subtractor.

**15**. A binary spline interpolation circuit, comprising:

first through fourth register connected in series;

a first multiplexer connected to said second and third registers and producing a first output;

a second multiplexer connected to said second and third registers and producing a second output;

a third multiplexer connected to said first and fourth registers and receiving a zero input;

a fourth multiplexer connected to said first multiplexer, receiving the first output left shifted two and three bits, and receiving a zero input;

a fifth multiplexer connect to said second multiplexer and receiving the second output left shifted one, two and three bits;

a first adder connected to said first and fourth multiplexers and receiving the first output left shifted one bit;

a second adder connected to said third and fifth multiplexers; and

a third adder connected to said first and second adders.

**16**. A binary linear signal mixing circuit, comprising:

a first multiplexer connected to receive input signals and producing a first output;

a second multiplexer connect to receive the input signals and producing a second output;

first means for left shifting the first output by two bits to produce a first left shifted first output;

a third multiplexer connected to said first means, receiving the first left shifted first output, and receiving a zero input;

second means for left shifting the second output by two bits and one bit to produce a first left shifted second output and a second left shifted second output;

a fourth multiplexer connected to said second means and receiving the first and second left shifted second outputs;

third means for left shifting the first output by one bit to produce a second left shifted first output;

a first adder connected to said third multiplexer and to said third means and receiving the second left shifted first output; and

a second adder connected to said first adder and said fourth multiplexer.

**17**. A combining circuit, comprising:

means for providing input signals;

an adder having first and second inputs; and

means for shifting the input signals. said means for shifting comprising a hardwired connection positioned between said means for providing input signals and the first and second inputs of said adder, and simultaneously providing a first bit shifted input signal to the first input shifted by a first amount and a second bit shifted input signal to the second input shifted by a second amount greater than the first amount.

* * * * *

# United States Patent [19]

**Dillon et al.**

[11] **4,176,373**

[45] **Nov. 27, 1979**


[54] **SIGNAL PROCESSING FOR DISCRETE-SAMPLE-TYPE-COLOR-VIDEO SIGNAL**


[75] Inventors: **Peter L. P. Dillon**, Pittsford; **Bryce E. Bayer**, Greece, both of N.Y.

[73] Assignee: **Eastman Kodak Company**, Rochester, N.Y.



[21] Appl. No.: **813,377**

[22] Filed: **Jul. 6, 1977**

[51] **Int. Cl.**[2] ..... **H04N 5/14**

[52] **U.S. Cl.** ..... **358/37**; 358/12; 358/21 R; 358/41; 358/138

[58] **Field of Search** ..... 358/37, 12, 21, 138, 358/141



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*Primary Examiner*—Richard Murray
*Attorney, Agent, or Firm*—T. H. Close



[57] **ABSTRACT**

Processing circuitry for discrete-sample-type-color-video signals performs an interpolation along a scan row or line to define intermediate signal levels between signal "updates" for the individual primary colors. In a preferred implementation, using green, red, and blue as primary colors, green samples occur more frequently than red or blue and interpolated green samples are specially combined to produce a "slow" green signal that is matched to the frequency ranges of the red and blue signals. The difference between the full green signal and the slow green signal is then used for producing a signal to represent high frequency luminance detail.


**7 Claims, 6 Drawing Figures**

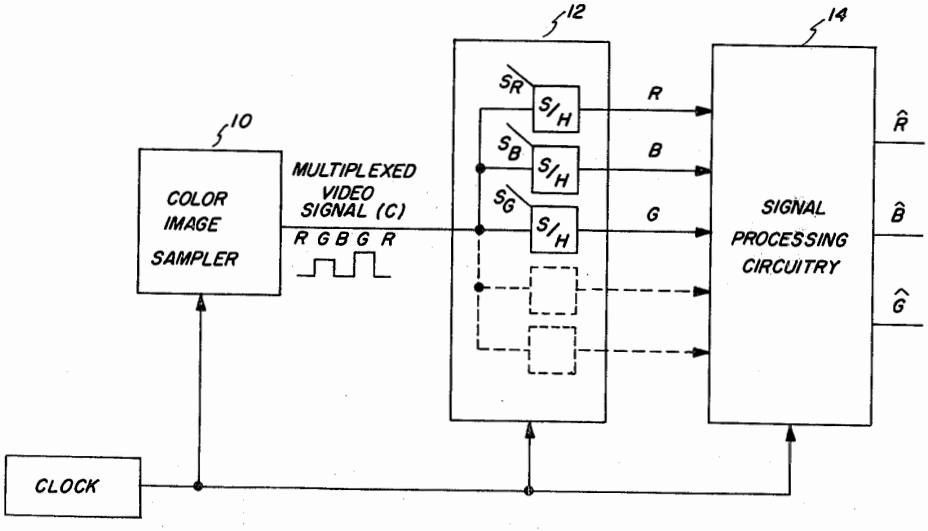


FIG. 1

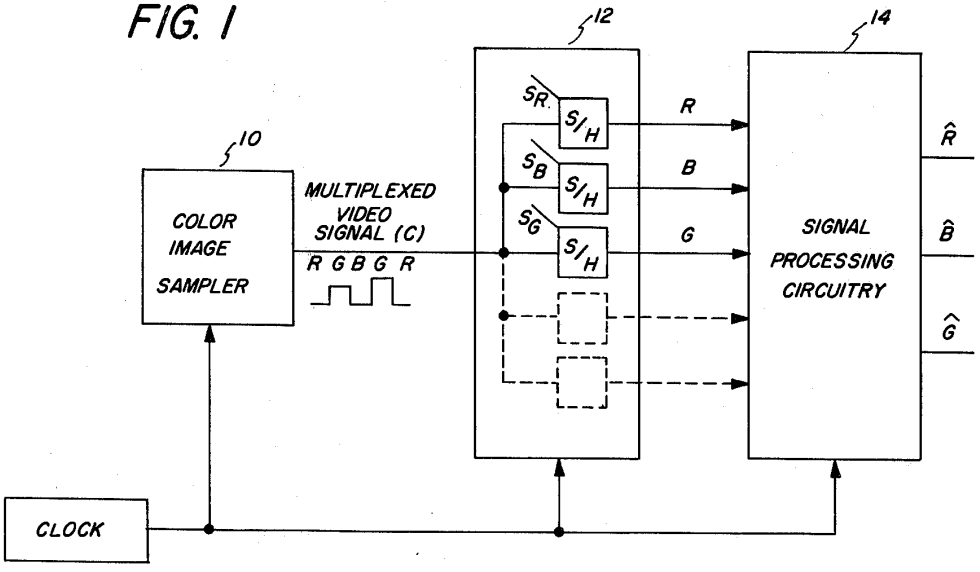

12
14
10
$S_R$
S/H
$S_B$
S/H
$S_G$
S/H
R
B
G
COLOR IMAGE SAMPLER
MULTIPLEXED VIDEO SIGNAL (C)
R G B G R
SIGNAL PROCESSING CIRCUITRY
$\hat{R}$
$\hat{B}$
$\hat{G}$
CLOCK

FIG. 2

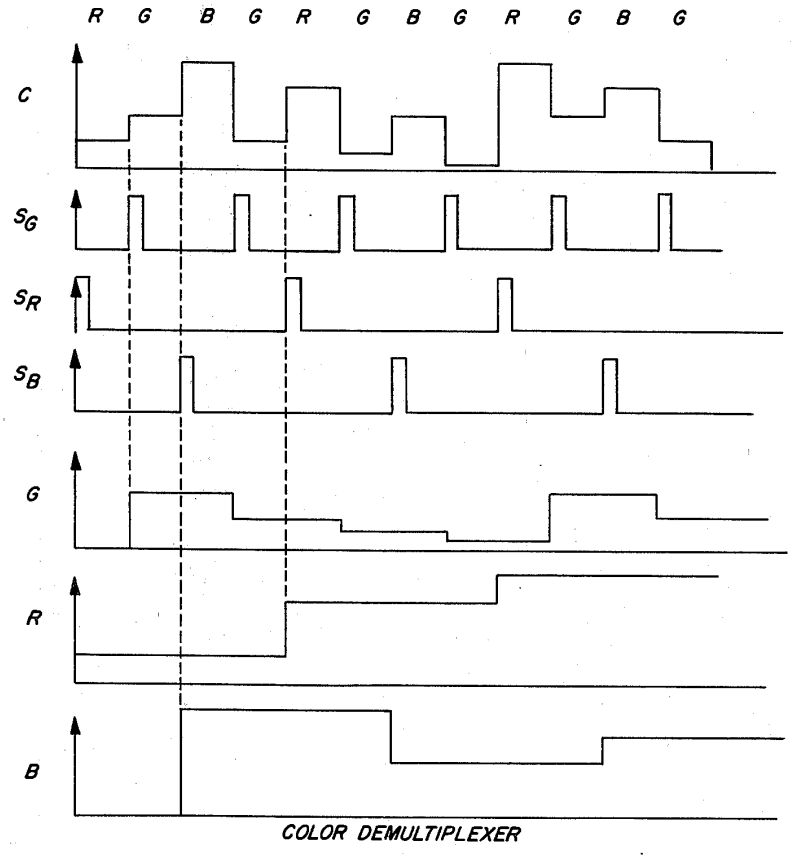

R G B G R G B G R G B G
C
$S_G$
$S_R$
$S_B$
G
R
B
COLOR DEMULTIPLEXER

FIG. 3

IMAGER. SAMPLING PATTERN

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| G | R | G | B | G | R | G | B | G |
| R | G | B | G | R | G | B | G | R |
| G | R | G | B | G | R | G | B | G |

G = GREEN
R = RED
B = BLUE

FIG. 5a

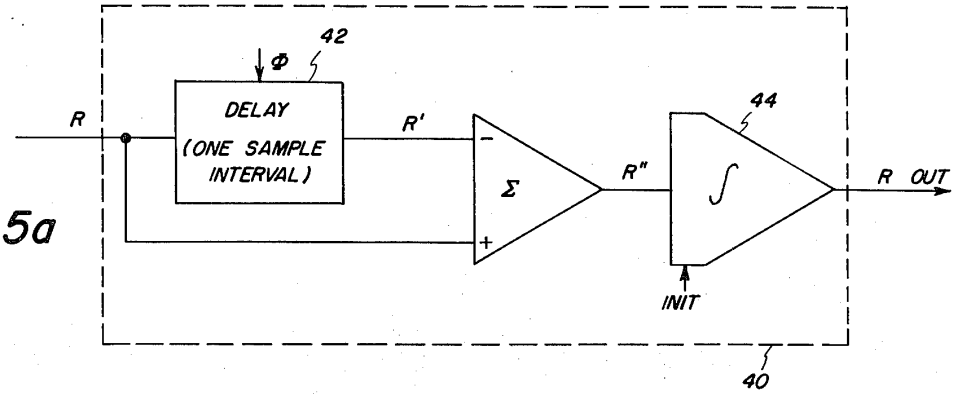
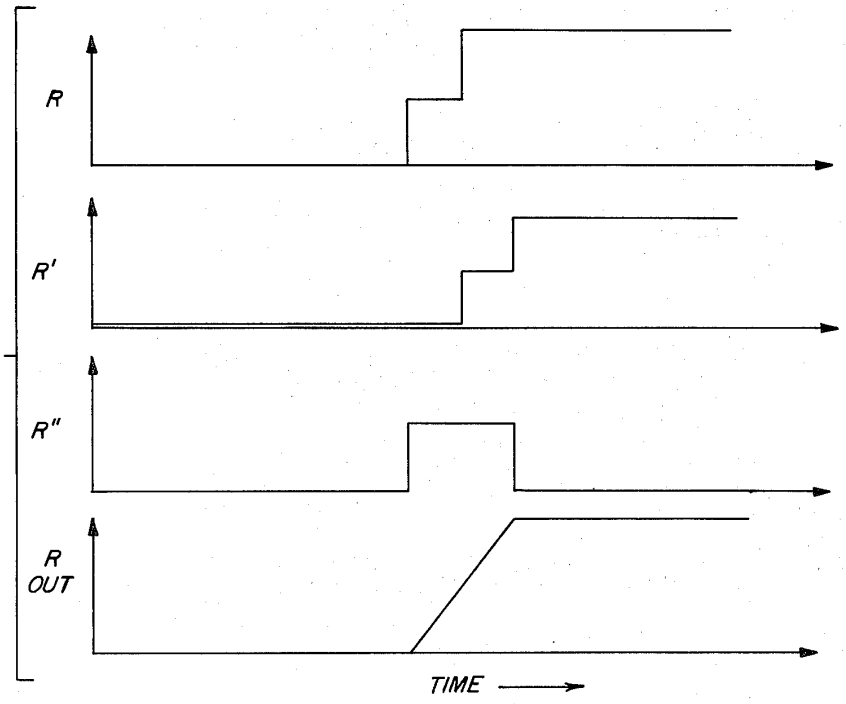



FIG. 5b



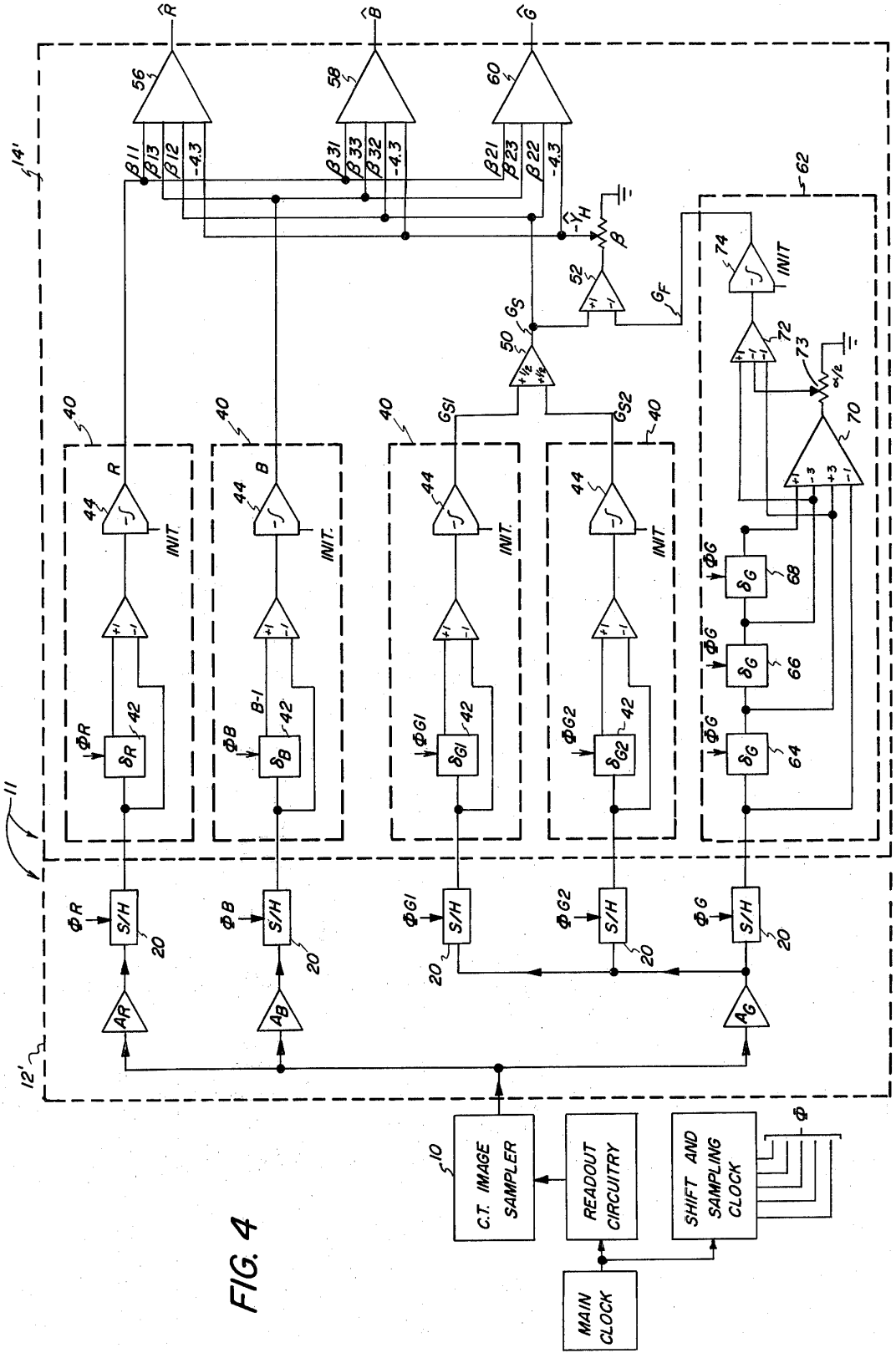

R
B
G
56
58
60
B11
B13
B12
-4.3
B31
B33
B32
-4.3
B21
B23
B22
-4.3
-Y_H
β
52
G_F
G_S
50
+½
+½
74
INIT
72
73
-½
70
62
14'
40
44
INIT.
G_S1
G_S2
ΦR
ΦB
ΦG1
ΦG2
ΦG
δR
δB
δG1
δG2
δG
42
B-1
68
66
64
11
12'
S/H
20
A_R
A_B
A_G
10
C.T. IMAGE SAMPLER
READOUT CIRCUITRY
SHIFT AND SAMPLING CLOCK
Φ
MAIN CLOCK

FIG. 4

# SIGNAL PROCESSING FOR DISCRETE-SAMPLE-TYPE-COLOR-VIDEO SIGNAL

## CROSS-REFERENCE TO RELATED APPLICATIONS

Reference is made to commonly assigned, copending U.S. patent application Ser. No. 685,824, filed in the name of Peter L. P. Dillon on May 12, 1976 issued as U.S. Pat. No. 4,047,203, Sept. 6, 1977.

## BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to processing circuitry for discrete-sample-type-color-video signals and more particularly to such circuitry which reduces artifacts of sampling and improves, at least apparently, the image detail of images resulting from such video signals.

2. Description Relative to the Prior Art

The conversion of a color image to an electrical signal representation by a color video imager typically involves either an elemental spot that scans continuously along a raster pattern or a grid of elemental areas that detect image information. In either case, the finite character of the sensing aperture results in a loss of image information. Because the image information that is successfully extracted by an imaging device is typically rather limited, specialized signal processing techniques are employed to maintain and to enhance, insofar as is possible, the quality of image representation.

For example, when image-representative signals are generated using a line scan process, as in a vidicon, it is known that certain degradation occurs as a result of the finite diameter of the scanning beam. Considering as an example a vertical edge in an image, only the leading portion of the beam initially "sees" the edge. Eventually the entire beam sweeps past the edge and is influenced by the edge transition. As a consequence of such operation, an abrupt edge transition tends to have a gradual influence on the scanning beam and, in effect, the edge is blurred. A somewhat similar effect, it will be appreciated, results with any image detail in the size range of the scanning beam.

To counteract this blurring effect, various "aperture correction circuits" (see e.g. U.S. Pat. No. 3,789,133) have been developed which function to amplify selectively high frequency scene information. By such boosting of high frequencies, these correction circuits reduce the undesirable loss of sharpness, albiet with some risk of amplifying noise inherent in the scanning device. It is also known in image signal processing that the green signal is closely related to the luminance response of the human visual system and may be aperture corrected, and used as the sole source of information regarding high-spatial-frequency image detail (see U.S. Pat. No. 3,732,360).

While such aperture correction techniques have been effective in upgrading the image-representative signals in line-scan-type systems such as single- and multi-tube color vidicons, they encounter problems when applied to the signals of elemental-area-type imagers, such as charge-transfer imaging devices, where image information is extracted as discrete samples. Such imagers provide discrete "updates," typically along respective element rows, rather than provide continuous line scan signals. The contrast in signal characteristics is even more significant where color imaging is performed on a



"single chip" (see U.S. Pat. No. 3,971,065 and "Integral Color Filter Arrays for Solid State Imagers," Dillon et al, IEEE Int'l. Elec. Dev. Mtg. Conference Papers, Washington, D.C., 1976), because signal updates are staggered among the colors, and even the sampling frequency may vary with color.

As a result of the discrete sampling of such solid-state imagers, the color signals tend to exhibit sharp transitions at the boundaries of picture elements and mere amplification of high frequencies would only serve to worsen the artifacts of discrete sampling. Hence, known aperture correction techniques are not directly applicable to discrete area imaging devices and only tend to degrade the signals from such devices.

## SUMMARY OF THE INVENTION

Video signal processing apparatus according to the invention interpolates to define intermediate levels between adjacent "updating events" (e.g. between successive green sample levels derived along a row of imager elements) of a discretely-updated color signal, such interpolation being preferably performed across a row by integrating differences between adjacent signal levels. Such integration is preferably implemented on a continuous basis by delaying the color signal for a sample period, subtracting the delayed signal from an undelayed version of that same color signal, and then integrating the resulting difference signal. By so modifying a discretely-updated color signal, a generally continuous signal is produced for which the artifacts resulting from sampling discontinuities prove to be significantly less noticeable. Furthermore, the preferred type of interpolation, which is essentially a linear interpolation, is more conservative of image detail than would be mere smoothing of the signal by more conventional low pass filtering.

To improve, furthermore, the representation of high frequency image detail, the signal for the primary color corresponding most closely to the luminance response characteristic of the human visual system, green—for a green, red and blue set of primary colors—is first processed to produce a slow-changing version corresponding to a fraction of the actual sampling rate (e.g. samples are alternately omitted). The fraction is preferably chosen to match the frequency range of the "slow" green signal to that for the red and blue signals. Such slow green signal, in interpolated form (see discussion above), is then differenced from an interpolated version of the full sampling rate signal for that color to produce a signal for representing high frequency luminance detail. This "high frequency luminance" difference signal is then added to each of the interpolated signals for the various primary colors to produce an augmented set of generally continuous primary color signals. By so producing the augmented signals, high frequency detail is retained but is effectively driven to neutral so that color banding problems are not introduced at sharp image transitions. Note in this regard it is possible to render an edge accurately in a neutral monochrome with less high frequency information than would be necessary to render the same edge in color and human eye response is such that the difference is typically not noticeable.

In a presently preferred implementation, green image detail is, on average, sampled at twice the rate of red or blue (i.e. in the incoming video signal green is updated twice as frequently as red and blue; see U.S. patent application Ser. No. 685,824 filed May 12, 1976 issued as

U.S. Pat. No. 4,047,203). Two slow green signals are generated by omitting signal updates on an alternating basis. These slow green signals are interpolated and then averaged to provide a signal representative of low-frequency green image information. The averaged slow green signal is then differenced from an interpolated full-sampling-rate green signal to provide a signal representative of high frequency luminance, which is added to interpolated versions of the red and blue signals, and to the averaged slow green signal. Hence, for improved representation of detail as mentioned above, the high frequency information for all three color signals is derived from the same set of samples . . . the green samples which correspond to the highest individual color sampling rate, and hence the broadest bandwidth image information.

In a further refinement, according to the invention, the full sampling rate green signal is enhanced as a source of information regarding high frequency detail by producing a weighted average of adjacent green samples. Such weighted average is produced using selectively delayed versions of such green signal (the delays being matched to the sample period) as is discussed more fully below.

The invention will now be described in detail with reference to the drawings wherein:

FIG. **1** is a simplified block diagram illustrating signal processing according to the invention;

FIG. **2** is a timing diagram indicating the operation of a demultiplexer used in practicing the invention;

FIG. **3** indicates a presently preferred color sampling pattern of an elemental area imager (image sampler for use with the invention;

FIG. **4** is a diagram in block form of a presently preferred signal processing apparatus;

FIG. **5A** is a block diagram of a circuit for use in practicing the invention; and

FIG. **5B** is a set of graphical representations indicating the operation of an interpolator circuit for use with the invention.

Referring to FIG. **1** for a simplified overview of a progression of video signal modifications according to the invention, a discrete area image sampler **10**, which may for example, include one or more charge-transfer-type imagers, produces a video signal set c. Assuming, as is presently preferred, a time-division-multiplexed set of signals for green, red, and blue (denoted G, R and B, respectively) a demultiplexer **12** is employed to produce individual pulse or "box car" type signals for such colors (dashed lines serve to indicate additional channels for "partial sample population demultiplexing" as is discussed below). The demultiplexer may comprise a series of sample-and-hold circuits as is well known; and a simplified timing diagram for such circuits is indicated in FIG. **2**, $S_G$, $S_R$, $S_B$ denoting "sample green," "sample red," and "sample blue," etc. The separated color signals (see the last three plots of FIG. **2**) are supplied to a signal processor **14** where the signals are modified according to the invention to afford improved image representation. A preferred imager sampling pattern for use in providing the video signal set c is indicated in FIG. **3**. Such pattern, it should be noted, includes green elements at twice the rate of red or blue elements; and a technique according to the invention for exploiting the resulting nonuniform color sample rates is explained below.

Referring to FIG. **4**, in a presently preferred implementation of the invention, a signal processing apparatus **11** cooperates with an image sampler **10** (See FIG. **3**) which produces a time-division-multiplexed signal having green, red and blue image sample information intermixed.

A demultiplexer **12'** (primes are used to indicate particular implementations of elements already discussed generally) receives the image sample signal and using sample-and-hold circuits **20** generates a set of discrete-time color signals. For the presently preferred implementation, five such color signals are produced: a full green signal based on all of the green samples ($G_F$); a red signal based on all of the red samples (R); a blue signal based on all of the blue samples (B); a first slow green signal based on every other green sample ($G_{S1}$); and a second slow green signal ($G_{S2}$) based on the green samples omitted for the first slow green signal. Synchronization of the sampling is achieved using clocking pulses along the lines indicated in FIG. **2**.

The discrete-time color signals are supplied to a signal processing circuit **14'** which produces output color signals $\hat{R}$, $\hat{B}$, and $\hat{G}$. Signal upgrading according to the invention involves an interpolation, which is preferably performed by integrating differences between adjacent samples for the respective discrete color signals as mentioned above. It is contemplated, however, that a higher order interpolation may be employed to advantage. An interpolating apparatus **40** is included in each of the signal channels except the full green channel where interpolation is combined with another operation as is discussed below. A presently preferred form for apparatus **40** (see FIG. **5A**) utilizes a delay device **42**, the delay of which corresponds to the period for the respective discrete-time color signal. An analog shift register may be used for the delay device **42** and a clocking signal input $\Phi$ has accordingly been indicated.

An integrator **44** produces a signal representing the integrated difference between the delayed and a relatively undelayed version of the discrete-time color signal. At the end of each row of signal image information, the integrator **44** is initialized to a zero level. By integrating sample-to-sample differences along a row in this manner the output signal of integrator **44** is caused to represent a first order linear interpolation between color sample levels (see FIG. **5B**).

The slow green signals $G_{S1}$ and $G_{S2}$ are averaged at a summing device **50** and the average slow green signal is differenced from the full green signal $G_F$ at a summing device **52** to produce a signal $\hat{Y}_H$ for representing high-frequency luminance. Such signal ($\hat{Y}_H$) is added to the red and blue and slow green signals at summers **56**, **58** and **60**, respectively. By sampling green (the primary color most like luminance) at a higher rate, as was mentioned above, a detailed high frequency luminance signal is provided for addition to all three primary color signals. It will be appreciated that for the high frequency component of all three color signals the highest sampling rate information is used whereas the low sampling rate information for the respective colors is used to develop the low frequency color signal components. By adding the luminance signal to all three color signals and hence driving the high frequency detail to be neutral, undesirable color banding effects at edges are reduced or obviated as was mentioned above. While the full green channel might have been used as the output signal $\hat{G}$, the use of the summer **60** advantageously facilitates the introduction of color matrixing at the bank of summers **56**, **58**, **60**, matrixing coefficients ($\beta$) being indicated for the signal inputs to those summers.

In a refinement for the invention the full-green signal is made more effective as the signal for representing high frequency detail by producing a weighted average of adjacent samples. An enhancement circuit **62** which incorporates an interpolation of the type provided by the apparatus **40** discussed above is indicated in the full-green signal channel in FIG. **4**. Preferred enhancement circuitry includes delays **64**, **66** and **68** which are matched to the sampling period for the full green signal. (Again, analog shift registers may be used to provide the delays and clocking signals $\Phi$ have been indicated.) The objective of processing by the circuit **62** is to multiply the relatively undelayed signal and the doubly delayed signal by a weighting coefficient $-\alpha/2$ and to multiply the single delayed signal by $1+\alpha$. Such weighting coefficient $\alpha$ is empirically chosen to provide the best apparent picture quality. However, for the presently preferred implementation, a weighting of adjacent samples to enhance high frequencies and an interpolation (along the lines provided by the circuit **40**) are combined in the circuit **62** using the gains shown at a summing device **70** and a summing device **72**, in conjunction with the scaling of a potentiometer **73**. The output of device **72** is supplied to an integrator **74** which produces the enhanced full-green signal. The preferred configuration for circuit **62** has the special advantage of concentrating adjustment of the empirical coefficient $\alpha$ at a single point, namely the potentiometer.

The invention has been described in detail with reference to the figures; however, it will be appreciated that variations and modifications are possible which are within the spirit and scope of the invention. For example, a color corresponding closely to the luminance response of the human eye could be used as a primary color rather than green, and respective color sampling rates other than those indicated for the presently preferred implementation might be used. Further, an imaging apparatus with separate imagers for each color might serve to produce the color video signal, i.e., act as the image sampler. Also, a record/playback step could be inserted, say, between any of the various elements indicated in FIG. **1**. Furthermore, while interpolation and enhancement have been described by use of only adjacent elements within a single line, both of these functions could be carried out with potential advantage using a greater number of elements within a single line and also elements from neighboring lines.

What is claimed is:

**1**. For use with a video camera having imaging apparatus for producing a discrete-sample-type-multicolor video signal representative of elemental areas of an image for a set of primary colors, such areas being arranged based on a predefined row-by-row scanning pattern to define respective sampling frequencies and periods for such primary colors, said multicolor video signal representing discrete, periodic updates of said set of primary colors, said updates being staggered among the colors of said set, signal processing apparatus comprising:

(A) means for decoding such video signal to produce a corresponding set of discrete-sample-type-single-color-signals for the respective primary colors, which discrete-sample-type-single-color-signals represent periodic updates of respective primary colors at intervals determined by the corresponding color sampling frequency; and

(B) interpolating means for producing generally continuous primary-color signals in accordance with said discrete-sample-type-single-color-signals, said interpolating means including

(1) respective color signal delay means for receiving the discrete-sample-type-single-color signals, said means having a time delay characteristic matched to the sampling period for the corresponding primary color, and

(2) respective integrating means cooperative with said signal delay means for producing a continuous color signal by integrating the difference between the delayed version and the relatively undelayed version of the corresponding discrete-sample-type-single-color signal.

**2**. Signal processing apparatus for a video signal of a type representing red, blue and green image samples in a repeating sequence which defines sampling rates for the respective colors, said apparatus comprising:

(A) decoding means for producing a set of pulse-type signals based, respectively, on such red, blue and green samples, said signals having pulse frequencies corresponding to the respective color sampling rates, said decoding means including sampler means for producing at least one relatively slow-changing-green pulse-type signal based on a fraction of the green samples of the sequence thereof; and

(B) processing means for receiving said pulse-type signals and for producing based thereon generally continuous image-representative signals for red, blue and green, said processing means including

(1) respective pulse-type signal interpolating means for smoothing the red, blue, green and slow-changing green signals to remove abrupt level transitions;

(2) differencing means for subtracting the slow-changing green signal from the other green signal to produce a luminance-estimating signal for relatively high spatial frequencies; and

(3) means for adding the luminance-estimating signal to the interpolated red, blue and slow-changing green-representative signals to produce red, blue and green signal outputs, whereby the interpolated red, blue and green signal outputs share a signal component for representing high frequency luminance detail.

**3**. Signal processing apparatus for a video signal of a type representing red, blue and green image samples in a repeating sequence wherein the green sample rate is twice that for red and blue, said apparatus comprising:

(A) decoding means for producing a set of pulse-type signals based, respectively, on such red, blue and green samples, said signals having pulse frequencies corresponding to the respective color sampling rates, said decoding means including sampler means for producing at least one relatively slow-changing-green pulse-type signal based on a fraction of the green samples of the sequence thereof; and

(B) processing means for receiving said pulse-type signals and for producing based thereon generally continuous image-representative signals for red, blue and green, said processing means including

(1) respective pulse-type signal interpolating means for smoothing the red, blue, green and slow-changing green signals to remove abrupt level transitions;

(2) differencing means for subtracting the slow-changing green signal from the other green sig-

nal to produce a luminance-estimating signal for relatively high spatial frequencies; and

(3) means for adding the luminance estimating signal to the interpolated red, blue and slow-changing green representative signals to produce red, blue and green signal outputs, whereby the interpolated red, blue and green signal outputs share a signal component for representing high frequency luminance detail.

4. Apparatus according to claim 3 wherein said interpolating means respectively include a delay means for delaying the corresponding signal by a period sufficient to match the sampling period for that signal, and means for integrating the difference between the delayed signal and the relatively undelayed signal, thereby to produce an interpolated output signal, and wherein said sampler means for producing at least one slow-changing green signal includes means for producing two slow-changing green signals by alternately allocating green samples to the one signal and then the other.

5. Video camera apparatus comprising:

(A) an elemental-area-type imaging device having rows of elements with predefined repeating patterns of color sensitivities for three primary colors, which patterns define sampling rates for such respective primary colors;

(B) readout means for interrogating the elements of said imaging device on a row-by-row basis to produce one or more sample information signals representing sample levels for the respective primary colors;

(C) decoding means for receiving said sample information signals and for producing based thereon image representative pulse-type signals for the respective primary colors, such signals having individual pulse rates in accordance with the corresponding color sampling rate; and

(D) means for producing continuous-type signal outputs for the respective primary colors based on a polynomial interpolation between adjacent pulse levels of the corresponding pulse-type signals.

6. Apparatus according to claim 5 wherein:

(A) said imaging device includes green-sensitive elements at every other position along a row and blue- or red-sensitive elements are dispersed in the remaining row positions;

(B) said decoding means includes sampler means for producing at least one relatively slow-changing-green signal based on very other green sample;

(C) said apparatus includes differencing means including means for interpolating said relatively slow-changing-green signal to produce a continuous-type slow-changing-green signal, and for producing an augmenting signal based on the difference between the continuous-type-green signal and the continuous-type slow-changing-green signal; and

(D) said apparatus includes summing means for adding the augmenting signal to the red, blue, and slow-changing-green continuous-type-color-signals.

7. Apparatus according to claim 6 wherein said interpolating means includes delay means matched to the sample period for the corresponding signal and integrating means for integrating the difference between the output of said delay means and a signal corresponding to the input to said delay means to produce a continuous-type output signal.

* * * * *

US005414811A

# United States Patent [19]

Parulski et al.

[11] Patent Number: 5,414,811

[45] Date of Patent: May 9, 1995

[54] **METHOD AND APPARATUS FOR CONTROLLING RAPID DISPLAY OF MULTIPLE IMAGES FROM A DIGITAL IMAGE DATABASE**

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[73] Assignee: **Eastman Kodak Company,** Rochester, N.Y.

[21] Appl. No.: **202,853**

[22] Filed: **Feb. 25, 1994**

**Related U.S. Application Data**

[63] Continuation of Ser. No. 796,207, Nov. 22, 1991, abandoned.

[51] **Int. Cl.**[6] ..... **G06F 15/00**

[52] **U.S. Cl.** ..... **395/162;** 395/164; 395/137; 382/296

[58] **Field of Search** ..... 395/162, 164–166, 395/600, 157, 137, 133; 360/27, 35.1, 133; 396/29; 382/45–47; 358/448, 450, 453, 302; 345/10, 27, 55, 112, 119, 127, 120, 126, 185, 201

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| WO90/04302 | 4/1990 | WIPO | H04N 1/387 |

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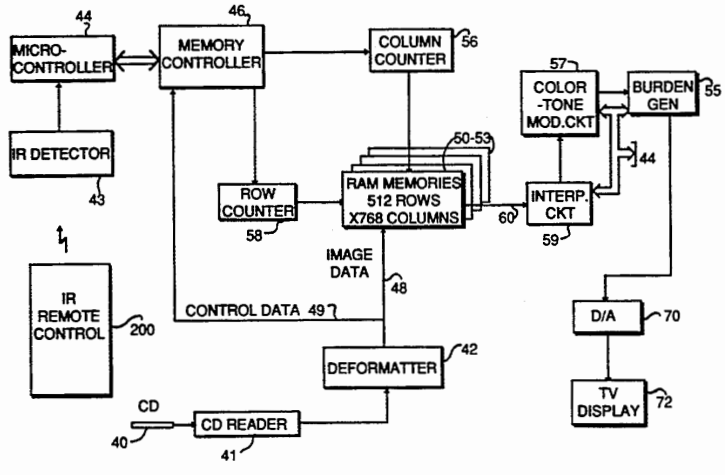
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*Primary Examiner*—Mark R. Powell
*Assistant Examiner*—Kee M. Tung
*Attorney, Agent, or Firm*—David M. Woods

[57] **ABSTRACT**

A digital image processing system for displaying digitized images on a screen of a display unit includes a data base such as a compact disc on which the digitized images are stored, a plurality of image memories for holding the digitized images for display, and a display unit having a screen including a two-dimensional array of pixels. The screen is divided into sections by designating subsets of the screen pixels by row and column, and the images stored in the image memories are allocated to the sections of the screen by mapping image data pixels to the screen pixels. Under user control, different images may be displayed on different sections of the screen. The number of images, and the specific images from the data base, are user selectable and independently manipulable. To reduce a latency time for displaying images responsive to user commands, the images may be arranged in a sequence. Responsive to a user command to load a first image into an image memory and display it, one or more other images adjacent to the first image in the sequence are read from the data base and held in other image memories, otherwise unused. Thus, if a subsequent user command directs the system to display one of the adjacent images, the latency time for reading that image from the data base and holding it in another image memory is reduced.

**20 Claims, 5 Drawing Sheets**



U.S. Patent May 9, 1995 Sheet 1 of 5 5,414,811

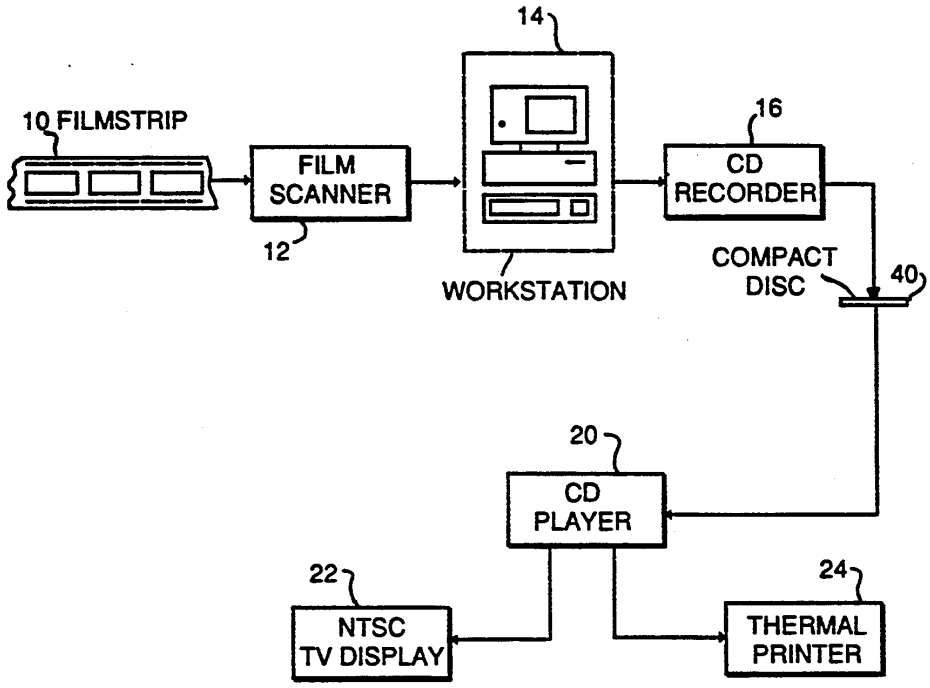



FIG. 1

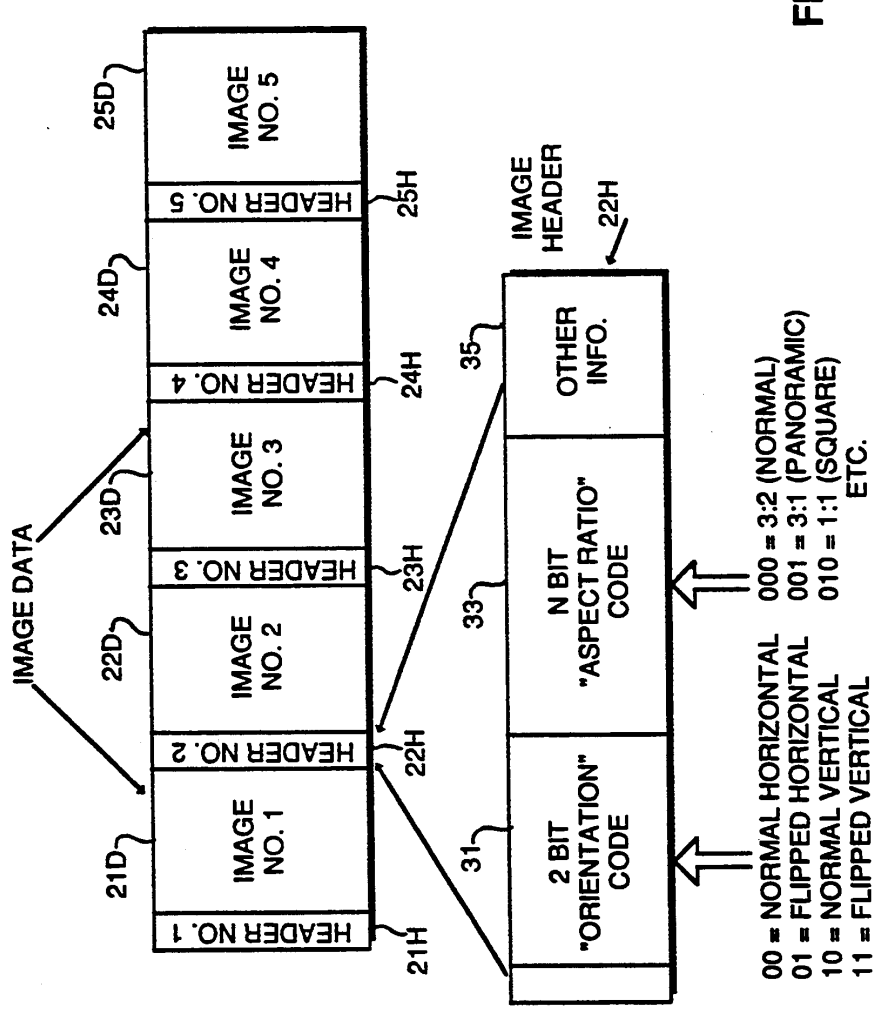

IMAGE DATA
21D
IMAGE NO. 1
HEADER NO. 1
21H
22D
IMAGE NO. 2
HEADER NO. 2
22H
23D
IMAGE NO. 3
HEADER NO. 3
23H
24D
IMAGE NO. 4
HEADER NO. 4
24H
25D
IMAGE NO. 5
HEADER NO. 5
25H
IMAGE HEADER
22H
35
OTHER INFO.
33
N BIT "ASPECT RATIO" CODE
31
2 BIT "ORIENTATION" CODE
00 = NORMAL HORIZONTAL
01 = FLIPPED HORIZONTAL
10 = NORMAL VERTICAL
11 = FLIPPED VERTICAL
000 = 3:2 (NORMAL)
001 = 3:1 (PANORAMIC)
010 = 1:1 (SQUARE)
ETC.

FIG. 2

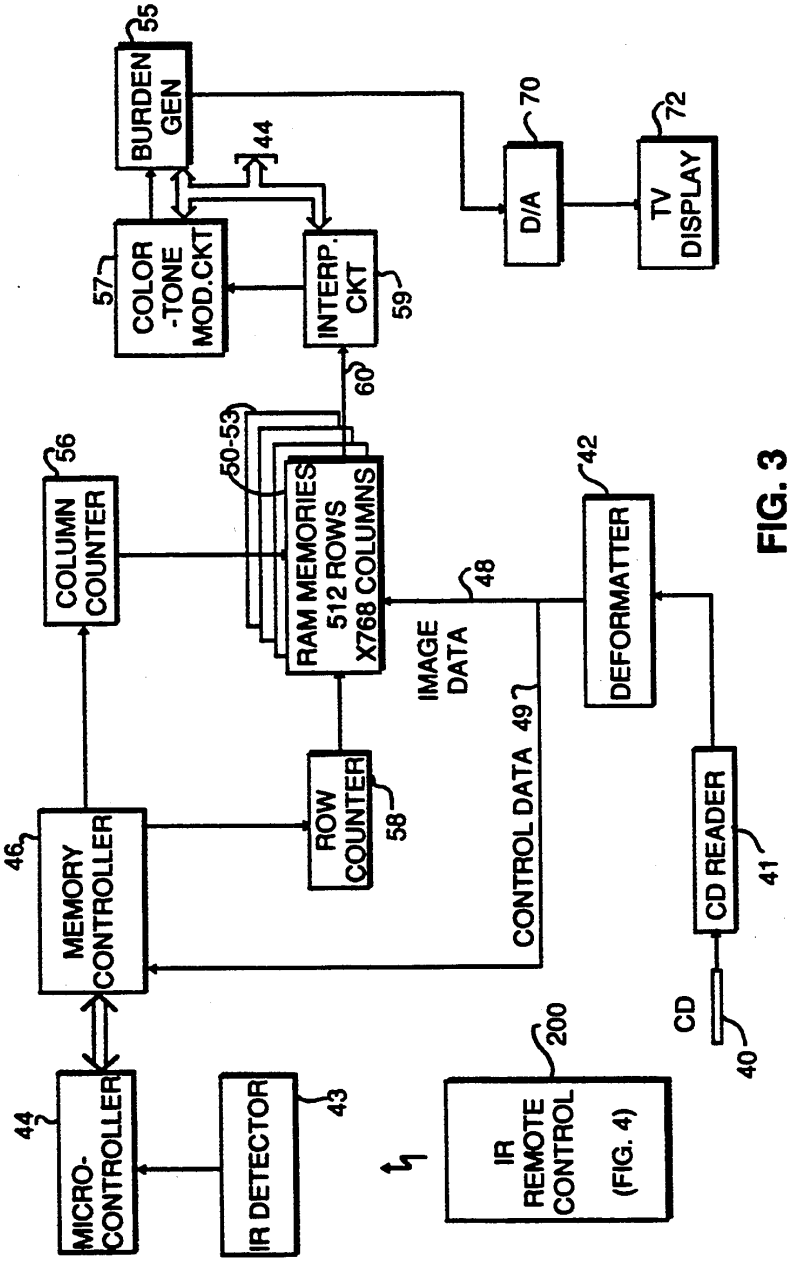

BURDEN GEN
55
44
D/A
70
TV DISPLAY
72
COLOR -TONE MOD.CKT
57
INTERP. CKT
59
60
50-53
RAM MEMORIES 512 ROWS X768 COLUMNS
COLUMN COUNTER
56
42
DEFORMATTER
48
IMAGE DATA
ROW COUNTER
58
CONTROL DATA 49
CD READER
41
MEMORY CONTROLLER
46
CD
40
MICRO-CONTROLLER
44
IR DETECTOR
43
IR REMOTE CONTROL (FIG. 4)
200

FIG. 3

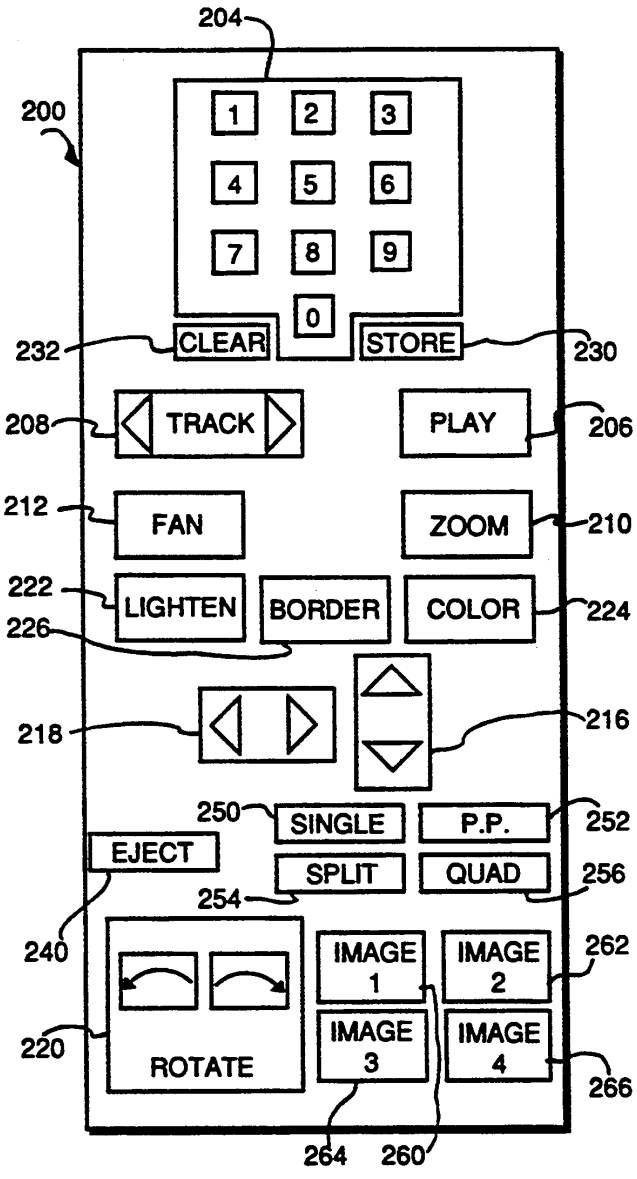

204
200
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4
5
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CLEAR
STORE
230
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TRACK
PLAY
206
212
FAN
ZOOM
210
222
LIGHTEN
BORDER
COLOR
224
226
218
216
250
SINGLE
P.P.
252
EJECT
SPLIT
QUAD
256
254
240
IMAGE 1
IMAGE 2
262
220
ROTATE
IMAGE 3
IMAGE 4
266
264
260

FIG. 4

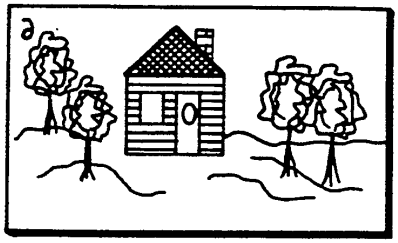


FIG. 5

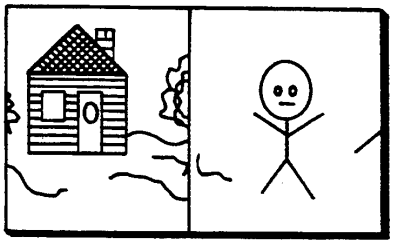


FIG. 6

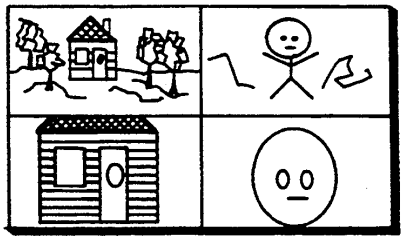


FIG. 7

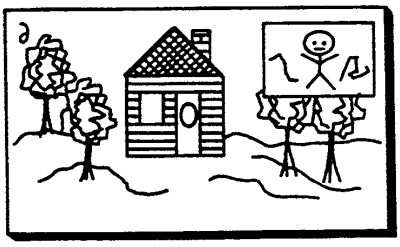


FIG. 8

# METHOD AND APPARATUS FOR CONTROLLING RAPID DISPLAY OF MULTIPLE IMAGES FROM A DIGITAL IMAGE DATABASE

This is a Continuation of application Ser. No. 07/796,207, filed Nov. 22, 1991, now abandoned.

## FIELD OF THE INVENTION

The present invention generally relates, to systems for storing and reproducing digitized sound and images, and, in particular, to a system for displaying digitized images responsive to user commands with minimum time delay and for displaying multiple images simultaneously.

## BACKGROUND OF THE INVENTION

Copending application Ser. No. 582,305, filed Sep. 14, 1990, entitled "Multiresolution Digital Imagery Photofinishing System", by S. Kristy, assigned to the assignee of the present application and the disclosure of which is herein incorporated, describes a digital image processing system wherein photographic still images, such as those captured by way of a 35 mm camera, are digitized and recorded on an optical compact disc (CD), for subsequent playback on a CD player. Image data files are created by scanning the images on a roll of developed photographic film to produce digitized pixel data for the images, and storing the pixel data as image data files. A relatively permanent digital storage medium, such as an optical disc readable by a laser pickup, is then produced. A user having such a disc loads the disc into a disc player coupled to a display unit such as a video monitor or television. Then, by entering suitable commands into the disc player or a separate control unit, such as an IR remote (hand-held) device, the user displays selected images on the display unit.

A low cost, reduced complexity frame store/data retrieval architecture, incorporated into a CD player and which provides for rapid call-up of images stored as digitized image data and display of the images on a consumer television color monitor, is described in a copending U.S. patent application Ser. No. 583,265, filed Sep. 14, 1990, entitled "Mechanism for Controlling Presentation of Displayed Image", by K. Parulski et al, assigned to the assignee of the present application, and the disclosure of which being herein incorporated.

As described in the above-referenced applications, each captured image is digitized by the scanner and stored 'as is', regardless of its orientation on the film. Annexed to each image file is a header file which contains orientation, aspect ratio and other minilab operator-generated information that is readable by the data retrieval microcontroller of a CD player, to control the coupling of the image data to a reproduction device (e.g. TV display). Images are displayed by providing image data residing in an image memory to an output of the apparatus at which a display device is to be coupled. The apparatus maps image data pixels to pixels of a display screen of the display device for correct orientation and aspect ratio.

Now, although the above-referenced photo compact disc schemes provide a number of photographic image processing and playback capabilities not heretofore available, it would be desirable to provide additional convenience and flexibility to the user. First, there is inevitably a certain latency time between the time the user enters a command by way of an I/O device (e.g. keyboard, IR remote control unit) to view a selected image, and the time that image actually appears on the display screen. This latency time is largely due to the time required for locating the image data file on disc, reading the image data from the disc, and then loading the read-out image data into the image memory or frame store in the CD player. Typically, this latency time is about 1 to 4 seconds, long enough to be noticeable and inconvenient to the user. It would be desirable to reduce this latency time to a time short enough not to be noticeable to the user.



Secondly, some user applications of image display systems involve displaying multiple images, for instance for side-by-side comparison. Medical imaging applications and slide presentations are two applications in which display of two or more images in a side-by-side format is useful. Also, consumers may want to compare images side-by-side, for instance to select a preferred one of several portrait photos of the same person. In addition, the user may wish to browse through a library of images stored on the CD and select plural images for display.

One possible mechanism for displaying multiple images involves redundant playback and display. Unfortunately, the constant complexity of such a scheme would be prohibitive for a consumer or for other users who have budgetary or equipment space limitations. A user of a system which does not support multiple images has to switch back and forth between the images to be displayed and compared, and must repeatedly enter a display command for the images to be played back. The fact that such playback/display commands must be repeatedly entered and that the images are not simultaneously on display are inconvenient to the user. Accordingly, it would be desirable to save the user the inconvenience of entering repeated commands by allowing for simultaneous display of multiple images.

## SUMMARY OF THE INVENTION

In order to provide the enhancements discussed above, and to provide additional convenience and flexibility to the user, the present invention provides a multiple memory frame store for storing respective ones of a plurality of images to be displayed on a display device. The invention additionally includes a programming capability for dividing the screen of the display device into two or more display regions or sections, allocating the screen sections to respective ones of the image memories of the frame store, displaying the images stored in the memories on the respective screen sections, and independently controlling the display of each image, all under user control responsive to user commands. The invention also includes a programming capability for arranging the images stored on the disc in a predetermined sequence, reading image data for a first image, storing the image data in a first image memory, and displaying the first image responsive to a user command, and for reading image data for a second image next to the first image in a sequence of images and storing the second image data in a second image memory responsive to the same user command. Thus, if the user subsequently enters a command for displaying the second image, the second image is accessed from the second image memory, whereby the latency time normally required for reading the image data for the second image from the disc is avoided.

Images to be displayed are preferably stored in a high resolution digital image data base such as an optically

encoded digital compact disc. The disc includes a plurality of image data files containing image data corresponding with a plurality of images. The images may be originally captured on an image medium such as photographic film. A digitizing scanner scans the images on the film to produce digitized image data. A photofinisher controls the operation of a photofinishing workstation to write respective image data files onto a photo compact disc, each image data file corresponding to each of the images on the film. The photo compact disc is preferably programmed at the time the film is developed, i.e., a customer delivers the exposed film to a photo lab having equipment for developing the film, scanning the developed film images, and storing the digitized images on the disc. Afterward, the customer pays for and picks up the developed film and the programmed disc. The customer then inserts the disc into his own compact disc player, the player being coupled to a television or other image display device, and views the images by entering commands into a control panel of the player or through a remote control device.

The improved playback apparatus in accordance with the invention includes a multifile frame store comprised of a plurality of image memories, each image memory including a random access memory (RAM) of sufficient size to hold pixel data for all pixels of an image. The memory is addressed to access image data in a manner consistent with the arrangement of the pixels in the image or in the screen of the display unit. Preferably, the image data in a memory is addressed in terms of rows and columns of the pixel matrix. A given pixel is uniquely addressed in terms of a given row value and a given column value. Data for a respective pixel is either a grey code value, or, for a color image, a digital value of some number of bits per color for each of a plurality of primary colors. The total capacity of each memory is thus determined by the number of rows and columns, and the number of bits of the encoded digital value for each pixel.

An image is displayed by mapping pixels of the image data in an image memory, by row and column, to pixels of the display device. For correct orientation, rows of image data pixels are mapped to rows or columns of the display screen pixels in accordance with orientation information programmed onto the disc. Similarly, for a correct aspect ratio, rows or columns of image data pixels may be decimated, and neutral border pixels generated, as necessary to make the image fit onto the screen, in accordance with aspect ratio information also programmed onto the disc.

Multiple images are read from the disc and loaded into various ones of the plurality of image memories. This may be effected both automatically and in response to a user command. In accordance with a first aspect of the invention, the image data files are arranged in a specified sequence, preferably corresponding to the sequence through which images on the film were scanned to produce the image data files. When a user inputs a command for displaying a selected one of the images, the image data for the next image in the sequence is also read from the disc and loaded into another image memory. If the user subsequently commands that this next image be displayed, the image data is already stored in the frame store. As a result, instead of a 1 to 4 second latency time before the next image is displayed, the latency time is reduced to about 1/30 second. Of course, if some other image, out of sequence, is to be displayed, the image data must be read from the disc requiring the 1 to 4 second display latency time. However, given that in many instances the images are viewed in sequence, the multiple memory frame store allows the taking of an "educated guess" as to the next image that will be viewed so as to reduce the average latency time.

In accordance with a second aspect of the invention, image data from multiple images on the disc are loaded into different ones of the plurality of image memories and displayed simultaneously. This is accomplished by dividing up the pixel array of the display screen into adjacent regions or sections, and mapping different images in different image memories to respectively different areas of the display screen. Preferably, the display screen is treated as having n rows and m columns of pixels. In order to display two images, the screen is divided into two sections comprised of a first section containing columns 1 through m/2, and a second section containing columns m/2+1 through m. Similarly, the screen is divided into quadrants in order to display four images by similarly dividing the columns, and further by dividing the rows into 1 through n/2 and n/2+1 through n.

When a display screen is divided into two or more sections in this manner, the image data for each image which to be displayed is mapped by row and column to its section. Since fewer total rows and columns will be available for each image, a greater degree of decimation will be required than for a single image displayed on the entire screen. However, each image is controllable independently of the others. On the other hand, the system allows for selecting a plurality of the sections, so that a given command for manipulating the image will apply equally to two or more of the selected images. This feature is useful if several images are to be manipulated in the same way, for instance if corresponding sections of different images are to be magnified or zoomed, e.g. for closer comparison.

The display screen may be divided into any suitable number of sections for displaying different images. It is anticipated that dividing the display matrix into two equal halves by column and into four equal quadrants by row and column, is useful for many applications. Two images may be compared, side-by-side, by dividing the screen in half by column, providing a relatively fine detail and resolution for each of the two images. Displaying four images may be useful, for instance, in medical applications. As an example, two X-ray images may be displayed in their entirety in the upper left and right quadrants of the screen, while corresponding sections of these two images may be magnified or otherwise manipulated in the lower left and right quadrants of the screen.

The latency time for accessing, reading, and displaying an image on all or part of a screen may be reduced, in some cases. Image data files may be written into a data base, such as a compact disc, in a predetermined sequence, by writing the files into a sequence of contiguous addresses of the disc or by writing the files and a utility table including file IDs appearing in the utility file in a sequence corresponding with the file sequence. In addition, a utility table including file IDs in a modified file sequence may be stored in an EEPROM memory in the disc player, as described in co-pending patent application Ser. No. 582,72, filed Sep. 14, 1990, entitled "Auxiliary Removable Memory for Storing Image Parameter Data," by K. A. Parulski et al, assigned to the assignee of the present application and the disclosure of

which is herein incorporated. In response to a user command, a file to be displayed is read out and loaded into a first image memory for display. The next image file is read out in sequence and loaded into a second image memory, with the image data maintained in a stand-by mode until the next user command is entered. If the next command is to display that image, the data stored in the second image memory is displayed. If a command to display some other image is entered, then the data is discarded or, if there are enough otherwise unused image memories available, it is maintained in memory in the event yet another user command calls for displaying that image.

The display screen is divided into a user-selectable number of sections by dividing the rows and columns of pixels in the screen. The images to be displayed concurrently are allocated to respective ones of the sections. The rows and columns of pixels of image data in the image memories are mapped to the rows and columns of display screen pixels in the screen sections corresponding to the images. To provide proper orientation of the image, rows of pixels of image data may be mapped to columns of screen pixels. The rows and columns of image data are decimated as necessary to fit into the screen sections. Borders are generated as necessary to accommodate various image aspect ratios. The displayed images may be independently manipulated, such as by zooming, panning, etc., independently in response to user commands. However, different ones of the images may be selected to respond to a single command for image manipulation under user control.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a simplified block diagram showing a compact disc data base storage medium, along with a system for generating image data files from images and storing the image data files on the disc, and a system for reading the image data files and displaying the images;

FIG. **2** is a partial memory map of the data base of FIG. **1**, showing an image data file format including image data and a header;

FIG. **3** is a detailed block diagram of the system for reading and displaying an image stored on disc by the system of FIG. **1**;

FIG. **4** is a front view of a user command input apparatus for use with the system for reading of FIG. **3**; and

FIGS. **5** through **8** are examples of display unit screens showing various images which are provided in accordance with the invention.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. **1** diagrammatically illustrates a photographic color film processing system, such as a photofinishing minilab, for producing a compact disc encoded with image files containing digitized image data. The disc constitutes a data base which is inserted into a compact disc player having the multiple memory storage and access capability in accordance with the invention. It should be observed, however, that the color film processing system of FIG. **1** and described here is merely an example of one type of system with which the invention may be used and is not to be considered limitative of the invention.

In accordance with the digital image processing system of FIG. **1**, photographic images, such as a set of twenty-four or thirty-six 36 mm×24 mm image frames of a 35 mm film strip **10**, are scanned by a high resolution opto-electronic film scanner **12**, such as a commercially available Eikonix Model 1435 scanner. High resolution scanner **12** outputs digitally encoded data (e.g. a 3072×2048 pixel matrix) representative of the internal electronic scanning of a high resolution image sensing array onto which a respective photographic image frame of film strip **10** is projected. This digitally encoded data (digitized image) is coupled in the form of an imaging pixel array-representative bit map to an attendant image processing workstation **14**, which contains a frame store and image processing application software through which the digitized image is processed (e.g. enlarged, cropped, subjected to a scene balance correction, etc.) to achieve a desired image appearance. Once an image file has been prepared, it is stored on a transportable data base storage medium, such as a write-once optical compact disc **40**, using compact disc recorder **16**. The disc **40** may then be inserted into a compact disc player **20** and, via the operation of selector switches of a cabinet-resident control panel or an (IR) remote control unit **200** shown in FIG. **4**, a selected image file is accessed for display on a display device shown as a television set **22**. The CD player may also be coupled to a high resolution thermal printer **24** for obtaining a hard copy of a selected image.

In accordance with the image processing system described in the above-referenced Kristy application, each digitized high resolution image is stored as a respective "image pack" data file containing a low (or base) resolution image bit map file, and a plurality of higher resolution residual image files associated with respectively increasing degrees of image resolution. By iteratively combining the higher resolution residual image file data with the low resolution image bit map file data, successively increased resolution images may be recovered from the base resolution image.

As an example, spatial data values representative of a high resolution (3072×2048) image scan of a 36 mm-by-24 mm image frame of a 35 mm film strip **10** are stored as a respective image data file including a base resolution image bit map file containing data values associated with a spatial image array of 512 rows and 768 columns of pixels and an associated set of residual image files to be stored on the disc. Within the workstation itself, the base resolution image may be further sub-sampled to derive an even lower resolution sub-array of image values (e.g. on the order of 128×192 pixels) for display on a segment of the system operator's workstation for the purpose of identifying image orientation and specifying aspect ratio.

Preferably, as described in the above-referenced Parulski et al application, a header file is associated with each digitized image for the purpose of specifying how the image was captured on film and has been correspondingly digitized and stored on disc. The information in the header file is used by the playback device to insure that the image will have an upright orientation and the correct aspect ratio for the reproduction device. In addition, a master header file is recorded which includes a unique ID number for each disc recorded by CD recorder **16** in FIG. **1**, in order to uniquely identify each disc.

When a film strip is originally scanned in the photoprocessing minilab, each picture is digitized as though it were horizontally oriented, irrespective of its actual orientation on the film. The digitized image is stored in the workstation's frame store, as is, and a lower resolution version of the digitized image is displayed on the

display monitor of workstation **14**, so that the image may be viewed by the operator. As each image is digitized and stored on the disc, the photofinishing minilab operator, using a workstation input device, enters a set of 'presentation' control codes that are incorporated within the header file associated with a respective image file to indicate how the image has been stored, so that, when subsequently accessed by a reproduction device, the image will be played back in an upright orientation at the correct aspect ratio.

Referring now to FIG. **2**, there is shown an example of the data file arrangement of the data base produced as described above. A memory map of the data base contains a series of image data files. Each image data file includes a header followed by a block of image data. For instance, a first image data file includes a header **21H** and image data **21D**, a second image data file adjacent to the first image data file includes a header **22H** and image data **22D**, etc. A preferred format for the headers is shown as a magnification of the header **22H**.

The header includes several fields, each field containing a designated piece of information. A first field **31** includes an orientation code. In a two-dimensional image, essentially rectangular in shape, any of the four sides could be the bottom. When the film image on the film strip **10** is scanned by the scanner **12**, the scan proceeds sequentially through the images on the film strip, without regard to the orientation of the images. However, when recording digital images on the disc, the workstation operator enters a command representative of the orientation of the image, which is stored in an orientation field **31**.

A second field **33** contains an aspect ratio code. The aspect ratio, or ratio of the height to width of the image, is used to determine what image data decimation or border generation is necessary to make the image fit onto the screen, or what the portion of the screen is allocated for display of the image. Again, an aspect ratio code is entered by the workstation operator at the time the disc is recorded.

FIG. **3** is a more detailed block diagram of the signal processing architecture of the image retrieval mechanism shown in FIG. **1**, which allows multiple images to be combined for viewing on a single video display. As in the above-referenced Parulski et al application, the playback device itself is preferably a commercially available compact optical disc player, which accesses digital image files that have been stored on disc and supplies video signals to a user's color television monitor. The contents of the digital image data file read from an optical compact disc **40** by a reader **41**, such as a laser pickup, are coupled to a deformatter **42**, wherein the file is deformatted into a digitized image and its associated header field, under the control of a resident microcontroller **44**. Four image memories, or frame stores, **50** through **53** are shown in the illustrated embodiment of the invention, although a different number of image memories are also usable in accordance with the invention. A respective image is stored in one of the four frame stores **50–53**, while the contents of its header field are coupled to a memory access control circuit **55**. Memory access control circuit **55** includes a memory controller **46**, a column counter **56**, and a row counter **58**, and controls the transfer of the image data from the disc into one of the frame stores **50–53** and the read-out of the contents of a frame store to associated circuitry including interpolation circuit **59**, color and tone modification circuit **57**, border generator **55** and a digital-to-analog (D/A) converter **70** for driving a color television display **72**.

Depending upon the aspect ration code **33** in FIG. **2**, the memory access control circuitry adjusts the aspect ratio and size of the image eventually supplied by the frame store to the television display. Details of the memory access control architecture are presented in the previously referenced Parulski et al application Ser. No. 583,265.

Turning now to FIG. **4**, the command key layout of a user-operated I/O command unit **200** is shown in the form of a hand-held remote control unit which produces an infrared (IR) beam for communicating user commands to the system. To receive the IR commands from the remote control unit **200**, the player (FIG. **3**) includes an IR detector **43**. Remote control unit **200** is used for entering user commands for selecting images to be displayed, and determining how many images are to be displayed simultaneously. Preferably, unit **200** is of conventional construction and preferably comprises a commercially available infrared remote control transmitter Model No. SAA 3007 manufactured by N. A. Philips Corporation that has a large command programming capacity (e.g. the Model SAA 3007 can accommodate 1280 commands). The key layout may be tailored as desired and in the embodiment shown in FIG. **4** includes function keys for multiple memory access in accordance with the invention. The remote control unit microcontroller reads these additional function keys in the same manner as other function keys.

In order to facilitate an understanding of the multiple image control feature of the present invention, the following discussion will explain both the operation and the data structure used to assemble respective images and associated parameter fields that are defined in the course of customizing one or a plurality of images.

When an optical compact disc onto which digitized image files have been recorded is inserted into the playback device **20** in FIG. **1**, the presentation of images on the NTSC display **22** is controlled by the user via the IR remote control unit **200**, the function key layout of which is shown in greater detail in FIG. **4**. Individual images are viewed by entering the image number using numerical digit buttons **204** and then pressing a play button **206**, or by pressing either a track forward or a track backwards arrow, shown together as **208**, to move on to the next or back to the previous image of the sequence of images on the disc **40**. The image sequence is preferably a numerical order, such as the order in which the images appeared on the film **10**. Therefore, after photofinishing, the numerical sequence on the film and the disc match. The image sequence may alternately be provided from a list of image numbers programmed by the user employing the remote control unit of shown in FIG. **4** and stored in an electrically erasable memory contained within the player or located in a removable unit, as described for example in the above-referenced '727 Parulski et al patent application.

In accordance with the invention, an initial command for viewing a user selected image causes the image data file for that image to be read from the disc **40**, and the image data to be loaded into one of the image memories **50–53**. Also responsive to that command, one or more other image data files for images sequentially adjacent to the user selected image are read, and the image data are loaded into one or more other image memories. Accordingly, a subsequent command to display the next or previous image causes the system to display the

image already loaded into the other image memory. Latency time is reduced, because the image data is not being read from the disc. In response to the command for the next or previous image, another image prior or subsequent to the image being displayed is read from the disc and loaded into another image memory, where it is ready to be displayed if another command is entered.

While there is no way to perfectly predict which image the user will want to display next, in many cases the user scans through the images in sequence, forward or backward. The arrangement discussed here provides an "educated guess" which in many cases accommodates the user's commands while reducing the latency time. The system thus has a better "feel" to the user.

As the image data is read from the disc **40**, the presentation control data described in the Parulski et al application is used to control the memory access control circuit **46**, so that the correctly oriented image is read from framestores **50** through **53**. Specifically, image data pixels are mapped to display screen pixels, by row and column numbers. The image is rotated zero degrees by mapping rows of data pixels to rows of screen pixels and columns of data pixels to columns of screen pixels. The image is rotated 90 degrees by mapping rows of data pixels to columns of screen pixels and columns of data pixels to rows of screen pixels in reverse order. The image is inverted or rotated 180 degrees by mapping rows of data pixels to rows of screen pixels in reverse order, and columns of data pixels to columns of screen pixels in reverse order. The image is rotated 270 degrees by mapping rows of data pixels to columns of screen pixels in reverse order, and columns of data pixels to rows of screen pixels in correct order. The images are displayed in accordance with the orientation information in the presentation control file. However, should the orientation code in the presentation control data be in error, due for example to an operator erroneously programming the presentation control data for the particular image in the course of recording the image onto the disc via CD recorder **16** (FIG. **1**), then the user re-orients the image via rotate buttons **220**.

The rows and columns of data pixels are decimated as necessary to map the image to the rows and columns of the display screen. The image is cropped by selecting upper and lower intermediate pixel data row and column numbers to define a subset of the image data, and mapping to the screen only those data pixels which fall between the selected intermediate row and column numbers.

The user may also zoom in or out to display only a portion of the image in enlarged form by pressing the zoom button **210** followed by either the up/down arrow keys **216**, which instruct the memory control circuit **46** to read out the proper portion of the image stored in the appropriate frame store memory (**50–53**) which is processed by interpolation circuit **59**, to provide the pixels of the enlarged image. To zoom the image for greater magnification, the subset is gradually reduced in size by increasing and decreasing the upper and lower intermediate row and column numbers, respectively, incrementally over a period of time during which the user operates the control. To zoom for lesser magnification, the upper and lower row and column numbers are decreased and increased, to increase the size of the subset.

The user may also pan through an image in a manner similar to zooming. Panning is either vertical or horizontal. Upper and lower intermediate rows and columns are defined. For horizontal panning, the intermediate row numbers remain constant, and the intermediate column numbers both increase, for left-to-right panning, or decrease, for right-to-left panning, incrementally over the time period in which the user operates the control. In vertical panning, the column numbers remain constant, and the row numbers increase or decrease incrementally.

Further, the user may alter the appearance of any displayed image by pressing the 'lighten' button **222** followed by either the up/down arrow key **216**, which cause the supply of control codes for increasing or decreasing the contrast of the image, respectively, or the left/right arrow key **218**, which increase or decrease the brightness of the image, respectively, by properly operating a color and tone modification circuit **57** to alter the brightness, or contrast of the digitized image as desired. This is done by performing a suitable mathematical transformation on the image data values from the appropriate image memory (**50–53**), such as increasing all values to increase brightness, increasing or decreasing values for certain colors to change color balance, etc. These transformations are facilitated through the use of digital lookup tables.

The user may also alter the color of the displayed image. For this purpose, the user depresses a color button **224**, followed by either the up/down arrow key **216**, which cause the generation of control codes to increase or decrease the color saturation of the image, or the left/right arrow key **218**, which alter the color balance of the image, by instructing the color and tone modification circuit **57** to alter the color of the digitized image by means of a digital $3\times3$ color correction matrix circuit (not shown).

The user also creates a colored border in the image via a color border generator and text generator **55**, by first pressing the border button **226** followed by the arrow keys **216** and **218** which allow the border to be properly positioned. The color of the border is changed by pressing the color button **224** and the border button **226** simultaneously, and then pressing the keys **216** to alter the color saturation, or the keys **218** to alter the color hue. A border may be used for filling a portion of the display screen if the preferred aspect ratio of a magnified and panned image differs from that of the display screen. If, for instance, the recomposed image has a preferred width-to-height ratio of 3:1 and the display has a 4:3 ratio, to fit the entire image onto the screen, the image is decimated such that the image width matches the screen width. The height of the image is then less than the screen height. The image pixels are mapped to a subset of the screen, leaving a blank portion of the screen above an upper intermediate row, or below a lower intermediate row. The border, comprising the portion of the screen above the upper intermediate row or below the lower intermediate row, is filled in with the border color.

In response to additional user commands, the invention divides the screen into two or more sections, in which different images are simultaneously displayed. Each image within each screen section is independently controllable as described above. In the illustrated system having four image memories **50–53**, up to four images may be displayed. The number of images displayed on TV display **72** is controlled by control keys labelled "single" **250**, "picture in picture" (P-P) **252**, "split" **254** and "QUAD" **256**. The display of each individual image is controlled by control keys **260**, **262**, **264** and **266** in FIG. **4**, labelled IMAGE **1** through IMAGE

4. In operation, the user depresses one of the four control keys **250**, **252**, **254**, **256** and then depressed the IMAGE **1** key **260** and selects an image as described above. Depending upon which of the control keys **250**, **252**, **254** and **256** have been pressed, the user may next depress the IMAGE **2** key **262**, of the IMAGE **2** key, IMAGE **3** key **264**, and IMAGE **4** key **266** to select the desired images.

In alternative embodiments of the invention, there could be a larger number of image memories may be employed, where having separately numbered keys would be impracticable. In such embodiments, the control device (FIG. **4**) has a multiple image key. The user depresses this key, keys in an image number in the numerical keypad, and then proceeds as described above.

Turning now to FIGS. **5** through **8**, there are shown four examples of a display screen for the display of multiple images in accordance with the invention. For the purpose of discussion, the display unit is a two-dimensional array of pixels arranged as 512 rows×768 columns. The upper left corner is row 1 and column 1. The upper right corner is row 1 and column 768. The lower left corner is row 512 and column 1. The lower right corner is row 512 and column 768.

In FIG. **5**, a single image takes up all 512 rows and all 768 columns. The display mode is used when the "single" key **250** is depressed. Rows and columns of image data pixels in a first image memory are mapped to the pixels of the display. If the image data includes more than 512 rows or more than 768 columns, then rows or columns of image data are decimated in a suitable ratio to the total number of rows or columns such that 512 rows and 768 columns remained.

In FIG. **6**, the user has depressed "split" key **254**, which splits the screen into two halves. This is accomplished by establishing a first screen section including columns 1 through 384, and a second section including columns 385 through 768. The image shown in FIG. **5** is shown, in part, in the first screen section of FIG. **6**. Of course, the number of columns in the first screen section is less than that of the full screen, so the first image does not fit exactly as in FIG. **5**. The image is cropped to fit. Specifically, columns 1 through 192 and 577 through 768 are truncated, leaving columns 193 through 576, the middle portion of the image. The second section of the screen displays a second image.

The system also provides other ways of fitting an image into a screen section. For instance, if only the columns of the image are decimated, for instance by 50%, then the image of FIG. **5** would appear to have been distorted (squashed) to fit into the first screen section, which is half as wide. Alternatively, if both rows and columns of the image of FIG. **5** are decimated by 50%, then the image is reduced in size, but is not distorted. Upper and lower borders are visible in the first screen section, above and below the reduced size image. As described above, these border regions are colored in, under user control.

Turning now to FIG. 7, the user has depressed "QUAD" key **256**, which divides the screen into four quadrants. The screen is divided by column, into columns 1 through 384, and columns 385 through 768, as before. In addition, the screen was divided by row into rows 1 through 256, and rows 257 through 512. Each quadrant has the same relative dimensions as the full screen, so the image of FIG. **5** fits in its entirety, except for row and column decimation to reduce size, into the upper left quadrant. The upper right quadrant contains a second image, which also fits the relative dimensions of the quadrant. The image in the right half of FIG. **6** is a middle section of the image of the upper right quadrant of FIG. **7**. The image was originally the same size as that of FIG. **5**. It was cropped, as the first image was, to fit into the right half of FIG. **6**, and then row and column decimated to fit into the upper right quadrant of FIG. 7. The lower left and right quadrants of the screen each show magnified subsets of the images on the upper left and right quadrants, respectively. In accordance with the invention, each image on each screen section may be manipulated independently by user command, or a plurality of the sections are selected such that a single user command manipulates each of the selected sections the same way. In the illustrated example, central portions of each of the upper images are magnified in the respective lower images. This includes the lower part of the house on the left, and the head of the figure on the right. Magnification includes cropping of the portions of the image not of interest. Also, since a smaller part of the overall image is displayed, less decimation of rows or columns within the portion of interest results in greater detail and finer resolution of the portion of interest.

As discussed above, this feature of the invention may be used in medical applications. The upper quadrants may be used to display two X-ray films of a patient taken at different times, between which a tumor developed and grew. To monitor the growth of the tumor, the particular portion of each X-ray film showing the tumor, which would be in the same portion of each film, is magnified by a single user command directed to the lower left and right images. Thus, the two images of the tumor taken at two different times are easily compared, and the context of each image is seen by comparing upper and lower respective images.

Turning now to FIG. **8**, there is shown another example of how a display screen may be divided to display multiple images. Rather than dividing the screen equally, a small window is inserted near a corner of the display. This is accomplished by selecting a window based on row and column numbers. For instance, in the 512 row by 768 column display shown, the window comprises pixel rows 64 through 192 and pixel columns 512 through 704. The rectangular region defined thus is a window for a more highly decimated secondary image, while the remainder of the screen, including narrow strips above and to the right of the secondary window, are devoted to a primary image. The portion of the primary image data which would fit into the area of the window is simply discarded. The primary and secondary images may be manipulated independently of each other by changing the way in which the image data pixels are mapped to the relevant portions of the screen. This feature is useful, for instance, for finding a first image of interest (displayed as the primary image) and then examining the remaining images one by one (in the secondary window) to locate an image to be viewed concurrently with the primary image. Once the secondary image is located, the user enters commands to change from a primary/secondary display format, as in FIG. **8**, to a side-by-side format, such as FIG. **6**, and the two images are then compared easily.

The steps through which a user may independently display and adjust multiple images will now be described using the QUAD mode in FIG. 7. The user first depresses the QUAD control button **256**, which divides

the display screen into four quadrants as described above.

The user next depresses one of the image controls: IMAGE 1 260, IMAGE 2 262, IMAGE 3 264, or IMAGE 4 266. After IMAGE 1 260 is depressed, the user next selects the desired image to be displayed in the upper left display quadrant using controls 204 or 208, as described earlier. Once the desired image 1 is displayed, the user may alter the composition of image 1 using the PAN button 212, ZOOM button 210 or the ROTATE button 220 or may alter the tone or color of the image using the LIGHTEN button 222 or COLOR button 224. These control buttons instruct tone and color modification circuit 57 to alter the tone and color reproduction for only the upper left quadrant image.

The user proceeds to press the IMAGE 2 control 262 and selects the desired image for the upper right quadrant. The user may alter the composition, tone, or color of the upper right image using the controls described earlier. The user proceeds in a similar fashion by pressing the IMAGE 3 button followed by the appropriate controls to obtain the desired image in the lower left quadrant, and finally presses the IMAGE 4 button followed by the appropriate controls to obtain the desired image in the lower right quadrant.

The user may also press two or more of the IMAGE 1, 260, IMAGE 2 262, IMAGE 3 264 and IMAGE 4 266 controls in sequence. This applies the subsequent image composition and tone and color operations to the two or more images selected. In the example described earlier relative to FIG. 7, the displayed images of the house and person may be generated as follows.

The user first depresses the IMAGE 1 control 260 followed by the IMAGE 3 control 264, and then employs controls 204 or 208 to locate and display the house image in both the upper left and lower left quadrants. Next, the user depresses the IMAGE 2 control 262 followed by the IMAGE 4 control 266, and again employs controls 204 or 208 to locate and display the image of the person in both the upper right and lower right quadrants. Finally, the user depresses the IMAGE 3 control 264 followed by the IMAGE 4 control 266, and then uses the zoom control 210 and the pan control 212 to enlarge the same section of the two lower quadrant images by the same amount.

While I have shown and described an embodiment in accordance with the present invention, it is to be understood that the invention is not limited thereto, but is susceptible to numerous changes and modifications as known to a person skilled in the art. I therefore do not wish to be limited to the details shown and described herein, but rather intend to cover all such changes and modifications as are obvious to one of ordinary skill in the art.

What is claimed is:

1. A method, for use with a digital image processing system including a digital database having a plurality of images digitized as image data and stored in respective image data files therein, a plurality of image memories, and an output for coupling thereto an image display device having a screen for display of images, for controlling the display of the images, the method comprising the steps of:

defining the screen to contain a plurality of sections;

selecting a plurality of image data files;

reading image data from the selected plurality of image data files and loading the image data into respective image memories;

allocating at least two image memories containing image data to at least two sections of the screen, respectively;

displaying the image data from the at least two image memories on the respective screen sections;

selecting a plurality of the images displayed on the screen sections for manipulation; and

manipulating each of the selected images responsive to a single user command so that each selected image is manipulated in the same way at the same time.

2. A method as recited in claim 1 wherein:

the screen includes a two-dimensional array of screen pixels arranged in rows and columns; and

the step of defining includes selecting a plurality of subsets of the screen pixels, by row and column.

3. A method as recited in claim 2 wherein the image data includes a plurality of image data pixels, each pixel datum having a row and a column associated therewith, and the step of displaying includes mapping the image data pixels to the screen pixels of the respective screen section, by row and column.

4. A method as recited in claim 3 wherein the step of manipulating the displayed images comprises changing the mapping of the image data pixels to the screen pixels of the respective screen sections.

5. A method as recited in claim 3 wherein the step of manipulating includes decimating the image data.

6. A method as recited in claim 3 wherein the step of manipulating includes cropping the image data.

7. A method as recited in claim 3 wherein the step of manipulating includes zooming the image.

8. A method as recited in claim 4 wherein the step of manipulating includes panning the image.

9. A method as recited in claim 3 wherein the step of mapping includes one of:

mapping rows of image data to rows of screen pixels of the section and columns of image data to columns of screen pixels of the section, thereby orienting the image at a 0° angle to the screen;

mapping rows of image data to columns of screen pixels of the section and columns of image data to rows of screen pixels of the section in reverse order, thereby orienting the image at a 90° angle to the screen;

mapping rows of image data to rows of screen pixels of the section in reverse order and columns of image data to columns of screen pixels of the section in reverse order, thereby orienting the image at a 180° angle to the screen; and

mapping rows of image data to columns of screen pixels of the section in reverse order and columns of image data to rows of screen pixels of the section, thereby orienting the image at a 270° angle to the screen.

10. An apparatus, useful with a system including a digital database that stores sequentially adjacent image data files containing digitized image data corresponding to input images, for controlling the manner in which the digitized image data is accessed from the image data files in the digital database and provided to an output of the apparatus for display on an image display device, said apparatus comprising:

a plurality of image memories for storing digitized image data read from the database;

user command means for registering user commands, including a particular read command to read and display a selected image data file from the database

and a subsequent user command to read and to display a sequentially adjacent image data file; and

control means responsive to the particular read command for reading the selected image data file and storing the corresponding image data in one of the image memories for subsequent display on the display device, wherein said control means is further responsive to said particular read command for reading one or more image data files sequentially adjacent to the selected image data file and storing the corresponding one or more sequentially adjacent digitized image data in one or more of the remaining image memories without displaying said sequentially adjacent data files until said subsequent user command is registered, whereby access time to display the sequentially adjacent image file pursuant to said subsequent user command is shortened because the sequentially adjacent image file has already been read from the database into one of said image memories.

**11**. An apparatus as recited in claim **10** wherein a plurality of sections are defined in the image display device and wherein said control means associates the image data in the image memories with respective ones of the sections.

**12**. An apparatus as recited in claim **11** wherein the image display device includes a television display having a two-dimensional array of pixels arranged in rows and columns; and wherein said control means defines sections of the image display device in terms of pixel rows and columns, and maps pixels of the image data in the respective memory devices to the respective sections of the array by row and column.

**13**. An apparatus as recited in claim **12** wherein the mapping performed by said control means includes decimating the image data.

**14**. An apparatus as recited in claim **12** wherein the mapping performed by said control means includes cropping the image data.

**15**. A method, for use with a digital image processing system including a digital database having a plurality of images digitized as image data and stored in respective image data files therein, said image data including a plurality of image data pixels, each image data pixel having a row and column associated therewith, a plurality of image memories, and an output for coupling thereto an image display device having a screen for display of images, such display including a two-dimensional array of screen pixels arranged in rows and columns, the method comprising the steps of:

defining the screen to contain a plurality of sections, each section including a plurality of subsets comprising rows and columns of screen pixels;

selecting a plurality of image data files;

reading image data from the selected plurality of image data files and loading the image data into respective image memories;

allocating at least two image memories containing image data to at least two sections of the screen, respectively;

displaying the image data from the at least two image memories on the respective screen sections by mapping the image data pixels onto the screen pixels of the respective screen section, by row an column;

selecting a plurality of the images displayed on the screen for manipulation; and

manipulating each of the selected images in response to a single user command so that all of the selected images are manipulated in the same way at the same time, said manipulating step comprising the step of zooming the image by defining, by minimum and maximum row and minimum and maximum column, a subset of the image data, redefining the subset by one of (a) increasing the minima and decreasing the maxima, and (b) decreasing the minima and increasing the maxima, incrementally over a period of time responsive to a user command, and displaying the subset, in accordance with the changing definition of the minima and maxima of the subset, concurrently with the time period over which the minima and maxima are redefined.

**16**. A method, for use with a digital image processing system including a digital database having a plurality of images digitized as image data and stored in respective image data files therein, said image data including a plurality of image data pixels, each image data pixel having a row and column associated therewith, a plurality of image memories, and an output for coupling thereto an image display device having a screen for display of images, such display including a two-dimensional array of screen pixels arranged in rows and columns, the method comprising the steps of:

defining the screen to contain a plurality of sections, each section including a plurality of subsets comprising rows and columns of screen pixels;

selecting a plurality of image data files;

reading image data from the selected plurality of image data files and loading the image data into respective image memories;

allocating at least two image memories containing image data to at least two sections of the screen, respectively;

displaying the image data from the at least two image memories on the respective screen sections by mapping the image data pixels onto the screen pixels of the respective screen section by row an column;

selecting a plurality of the images displayed on the screen for manipulation; and

manipulating each of the selected images in response to a single user command so that all of the selected images are manipulated in the same way at the same time, said manipulating step comprising the step of panning the image by defining, by minimum and maximum row and minimum and maximum column, a subset of the image data, redefining the subset by one of (a) increasing the row minimum and maximum, (b) decreasing the row minimum and maximum, (c) increasing the column minimum and maximum, and (d) decreasing the column minimum and maximum, incrementally over a period of time responsive to a user command, and displaying the subset, in accordance with the changing definition of the minima and maxima of the subset, concurrently with the time period over which the minima and maxima are redefined.

**17**. An apparatus, useful with a system including a digital database that stores sequentially adjacent image data files containing digitized image data corresponding to input images, for controlling the manner in which the digitized image data is accessed from the image data files in the digital database and provided to an output of the apparatus for display on an image display device, said apparatus comprising:

a plurality of image memories for storing digitized image data read from the database;

user command means for registering user commands, including a particular read command to read and display a selected image data file from the database and a subsequent user command to read and to display a sequentially adjacent image data file;

control means responsive to the particular read command for reading the selected image data file and storing the corresponding image data in one of the image memories for subsequent display on the display device, wherein said control means is further responsive to said particular read command for reading one or more image data files sequentially adjacent to the selected image data file and storing the corresponding one or more sequentially adjacent digitized image data in one or more of the remaining image memories, whereby access time to display the sequentially adjacent image file pursuant to said subsequent user command is shortened because the sequentially adjacent image file has already been read from the database into one of said image memories; and

means for controllably generating border image signals representative of image characteristics of at least one border region to be combined with the image data, and for coupling the border image signals to the image display device so that the image reproduced thereby is bound by the at least one border region.

**18**. An apparatus, useful with a system including a digital database that stores sequentially adjacent image data files containing digitized image data corresponding to input images, for controlling the manner in which the digitized image data is accessed from the image data files in the digital database and provided to an output of the apparatus for display on an image display device, said apparatus comprising:

a plurality of image memories for storing digitized image data read from the database;

user command means for registering user commands, including a particular read command to read and display a selected image data file from the database and a subsequent user command to read and to display a sequentially adjacent image data file; and

control means responsive to the particular read command for reading the selected image data file and storing the corresponding image data in one of the image memories for subsequent display on the display device, wherein said control means is further responsive to said particular read command for reading one or more image data files sequentially adjacent to the selected image data file and storing



the corresponding one or more sequentially adjacent digitized image data in one or more of the remaining image memories, whereby access time to display the sequentially adjacent image file pursuant to said subsequent user command is shortened because the sequentially adjacent image file has already been read from the database into one of said image memories, and wherein said control means comprises means for controllably reading image data files from the database in a first selected order; and means for loading image data from the thus read image data files into respective ones of the plurality of image memories in a second selected order.

**19**. An apparatus as recited in claim **18** wherein said control means further includes:

means for arranging the image data files in the database into a predetermined sequence which defines the selected order in which the image data files are to be read.

**20**. A method for controlling the manner in which digitized image data is accessed from a plurality of image data files in a digital database in order to display such digitized image data on an image display device, said database containing image data files representing a plurality of sequentially adjacent input images, said method comprising the steps of:

providing a plurality of image memories for storing digitized image data read from the database;

in response to a read command signaling a desire to display a selected input image on the display device, reading a selected image data file representing such input image from the digital data base, storing the corresponding digitized image data in one of the image memories, and displaying the input image represented by the so stored digitized image data on the display device; and

in response to the same read command, reading one or more additional image files representing input images that are sequentially adjacent to the input image represented by the selected image data file and storing the corresponding digitized image data in one or more of the remaining image memories without displaying the sequentially adjacent input images until a subsequent user command is registered, whereby access time to display a sequentially adjacent input image pursuant to a subsequent user command is shortened because the corresponding sequentially adjacent image file has already been read from the database and stored in one of the additional image memories.

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US005414811C1

(12) **EX PARTE REEXAMINATION CERTIFICATE** (9302nd)

**United States Patent**
**Parulski et al.**

(10) **Number: US 5,414,811 C1**
(45) **Certificate Issued: Sep. 18, 2012**

(54) **METHOD AND APPARATUS FOR CONTROLLING RAPID DISPLAY OF MULTIPLE IMAGES FROM A DIGITAL IMAGE DATABASE**

(76) Inventors: **Kenneth A. Parulski**, Rochester, NY (US); **David L. Funston**, Rochester, NY (US)

**Reexamination Request:**
No. 90/009,590, Oct. 2, 2009

**Reexamination Certificate for:**

| | |
|---|---|
| Patent No.: | **5,414,811** |
| Issued: | **May 9, 1995** |
| Appl. No.: | **08/202,853** |
| Filed: | **Feb. 25, 1994** |

**Related U.S. Application Data**

(63) Continuation of application No. 07/796,207, filed on Nov. 22, 1991, now abandoned.

(51) **Int. Cl.**
***G06F 15/00*** (2006.01)

(52) **U.S. Cl.** ..... **345/501**; 345/536; 345/543; 345/557; 382/296; 382/304; 382/305

(58) **Field of Classification Search** ..... 395/162
See application file for complete search history.

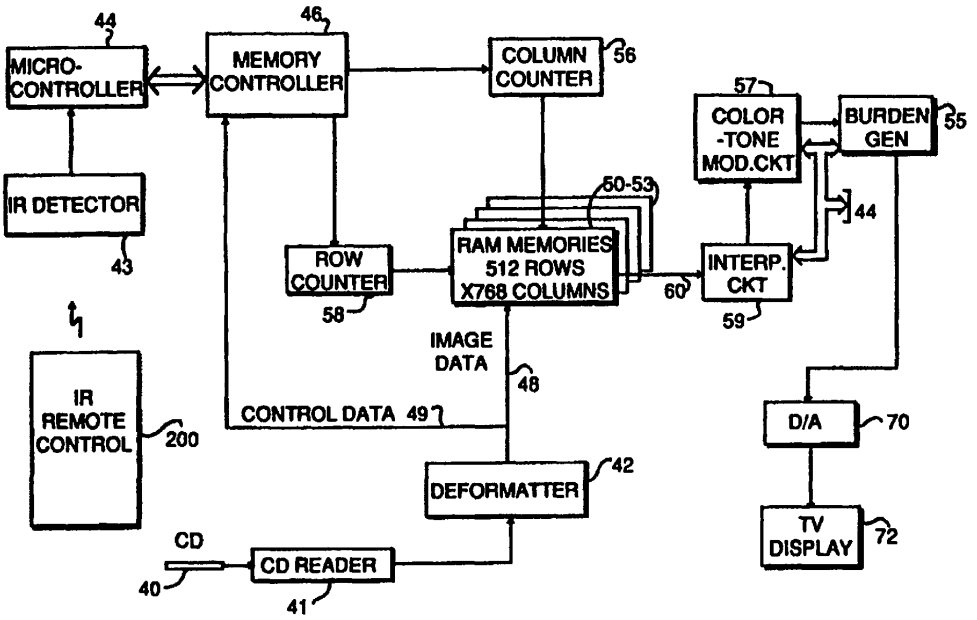
(56) **References Cited**

To view the complete listing of prior art documents cited during the proceeding for Reexamination Control Number 90/009,590, please refer to the USPTO's public Patent Application Information Retrieval (PAIR) system under the Display References tab.

*Primary Examiner*—Dennis Bonshock

(57) **ABSTRACT**

A digital image processing system for displaying digitized images on a screen of a display unit includes a data base such as a compact disc on which the digitized images are stored, a plurality of image memories for holding the digitized images for display, and a display unit having a screen including a two-dimensional array of pixels. The screen is divided into sections by designating subsets of the screen pixels by row and column, and the images stored in the image memories are allocated to the sections of the screen by mapping image data pixels to the screen pixels. Under user control, different images may be displayed on different sections of the screen. The number of images, and the specific images from the data base, are user selectable and independently manipulable. To reduce a latency time for displaying images responsive to user commands, the images may be arranged in a sequence. Responsive to a user command to load a first image into an image memory and display it, one or more other images adjacent to the first image in the sequence are read from the data base and held in other image memories, otherwise unused. Thus, if a subsequent user command directs the system to display one of the adjacent images, the latency time for reading that image from the data base and holding it in another image memory is reduced.



**EX PARTE**
**REEXAMINATION CERTIFICATE**
**ISSUED UNDER 35 U.S.C. 307**

THE PATENT IS HEREBY AMENDED AS INDICATED BELOW.



AS A RESULT OF REEXAMINATION, IT HAS BEEN DETERMINED THAT:

The patentability of claims **1-9** and **15-17** is confirmed.

Claims **10-14** and **18-20** are cancelled.

* * * * *

US005448372A

# United States Patent [19]

**Axman et al.**

[11] **Patent Number: 5,448,372**

[45] **Date of Patent: Sep. 5, 1995**

[54] **STORAGE AND RETRIEVAL OF DIGITIZED PHOTOGRAPHIC IMAGES**

[75] Inventors: **Michael S. Axman**, W. Henrietta; **Michael J. Barry**; **Michael S. Mathieu**, both of Rochester, all of N.Y.; **Jozef Timmermans**, Bilsen, Belgium; **Norman Richards**, Horsham, England

[73] Assignee: **Eastman Kodak Company**, Rochester, N.Y.

[21] Appl. No.: **809,365**

[22] Filed: **Dec. 18, 1991**

[51] **Int. Cl.**[6] ..... **H04N 5/781**

[52] **U.S. Cl.** ..... **358/342**; 358/311; 358/335; 358/403; 358/488; 360/13; 348/96

[58] **Field of Search** ..... 358/342, 335, 214, 311, 358/403, 488; 360/33.1, 13; 348/97, 96

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| 5,218,455 | 6/1993 | Kristy | 358/403 |
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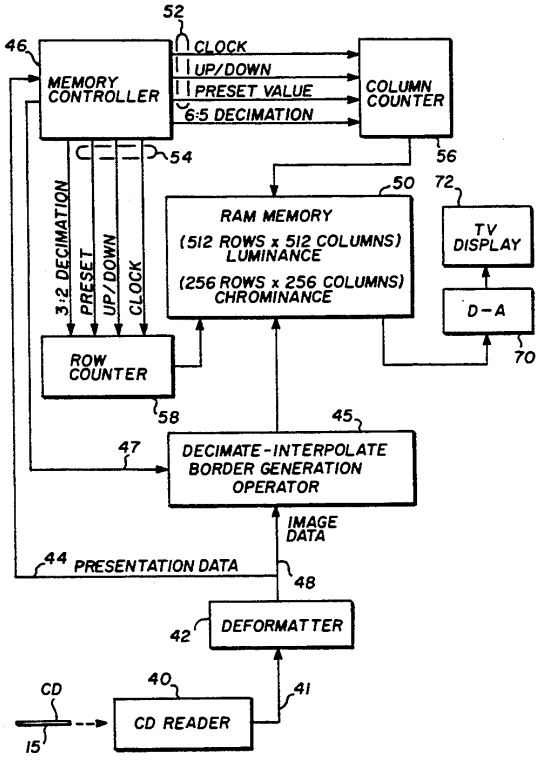
61-80695 4/1986 Japan .

*Primary Examiner*—Howard W. Britton
*Assistant Examiner*—Khoi Truong
*Attorney, Agent, or Firm*—Edward Dugas

[57] **ABSTRACT**

A storage and retrieval mechanism for a digital image processing system employs a reduced capacity frame store in the playback device. A plurality of photographic images captured on a photographic recording medium are digitized for processing and subsequent display. Digitized images are stored on a compact disc. When the disc is inserted into a playback device for driving a color TV monitor, the playback device decodes header information representative of image orientation, so that the image will be read from the disc and stored in the reduced capacity frame store for subsequent read out and display in an upright orientation. A memory control mechanism employs a decimation/interpolation operator to interface the imagery data from the disc to the frame store.

**71 Claims, 3 Drawing Sheets**



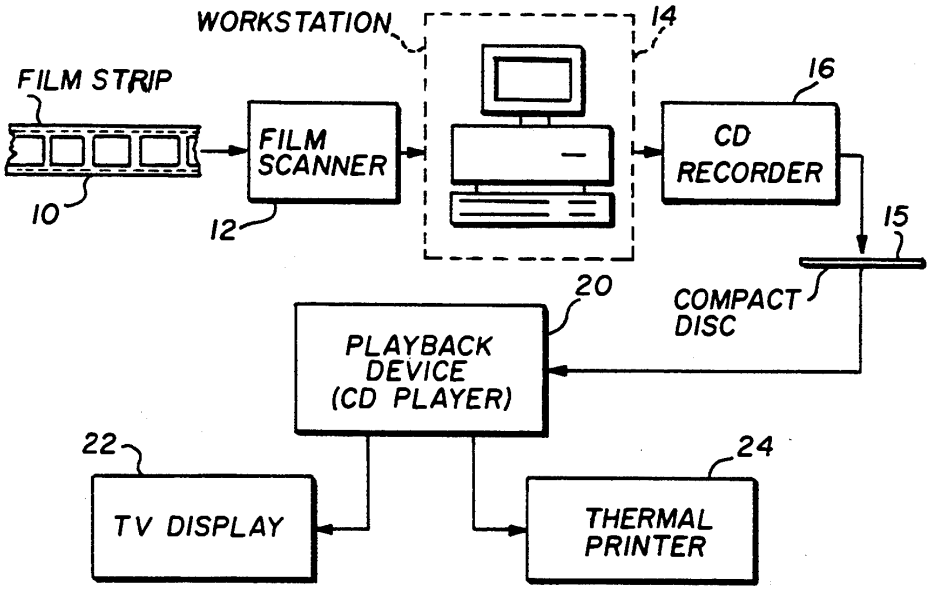



FIG. 1
PRIOR ART

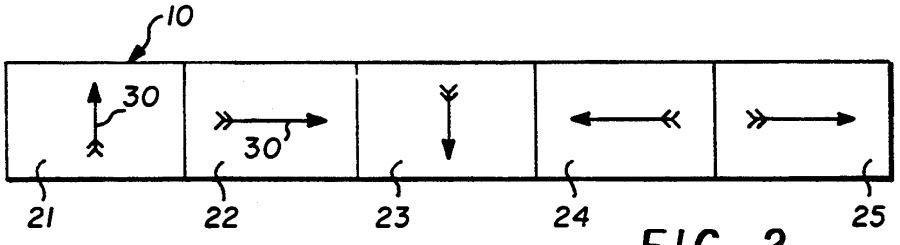



FIG. 2

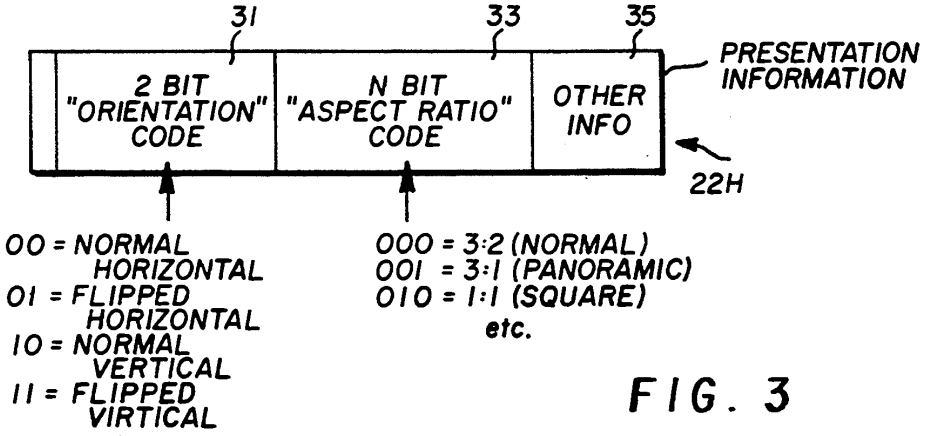



FIG. 3

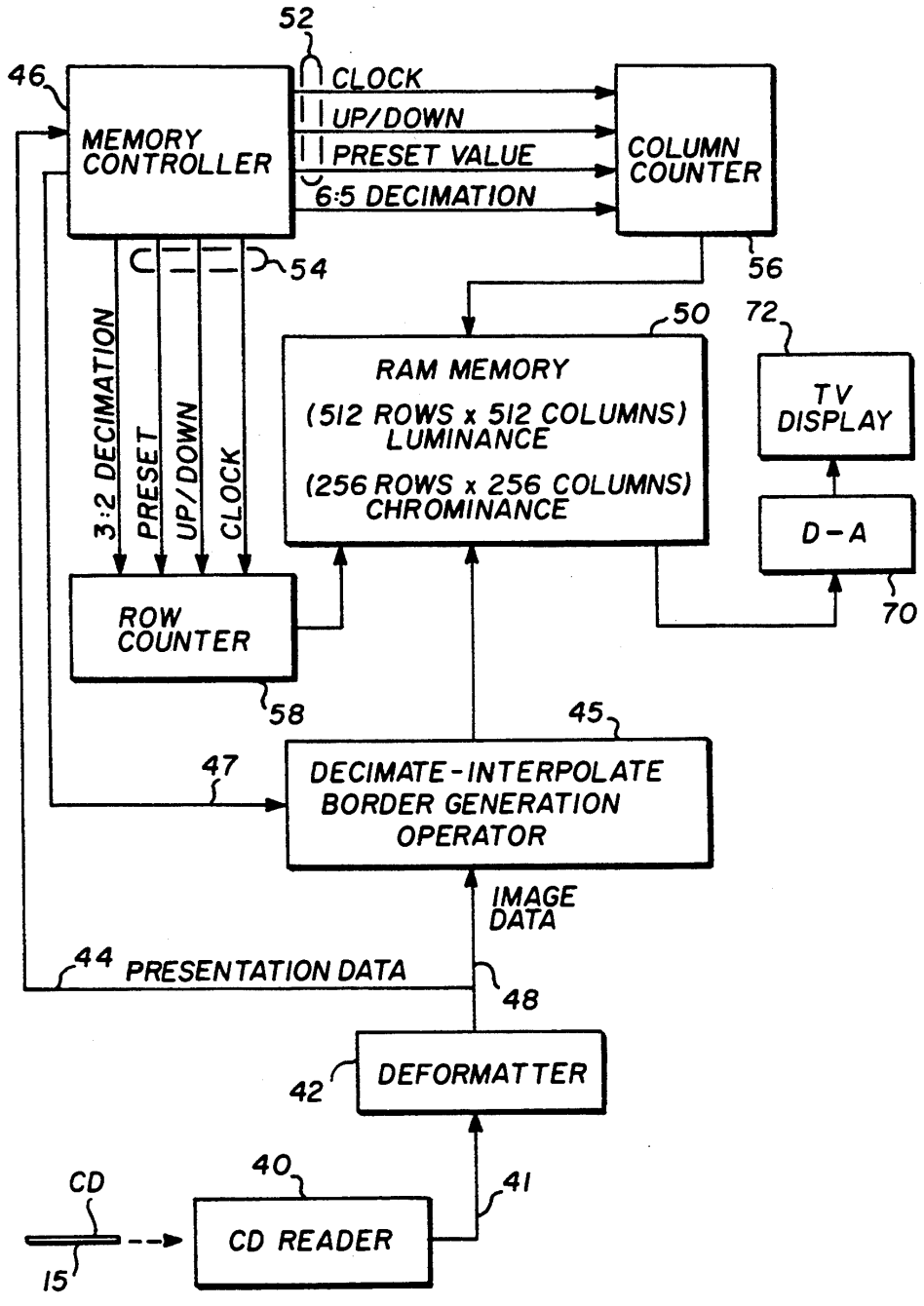

52
46
MEMORY CONTROLLER
CLOCK
UP/DOWN
PRESET VALUE
6:5 DECIMATION
COLUMN COUNTER
54
56
50
72
RAM MEMORY
(512 ROWS x 512 COLUMNS) LUMINANCE
(256 ROWS x 256 COLUMNS) CHROMINANCE
TV DISPLAY
D-A
70
3:2 DECIMATION
PRESET
UP/DOWN
CLOCK
ROW COUNTER
58
45
47
DECIMATE-INTERPOLATE BORDER GENERATION OPERATOR
IMAGE DATA
44
PRESENTATION DATA
48
42
DEFORMATTER
CD
40
41
CD READER
15

FIG. 4

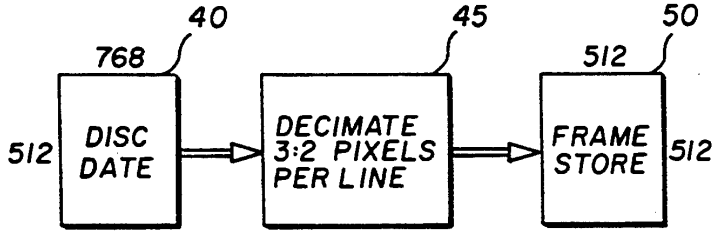



FIG. 5

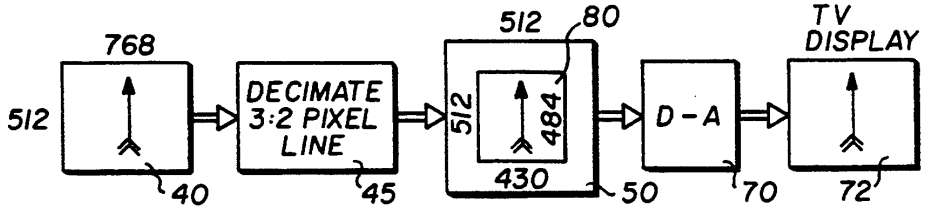



FIG. 6

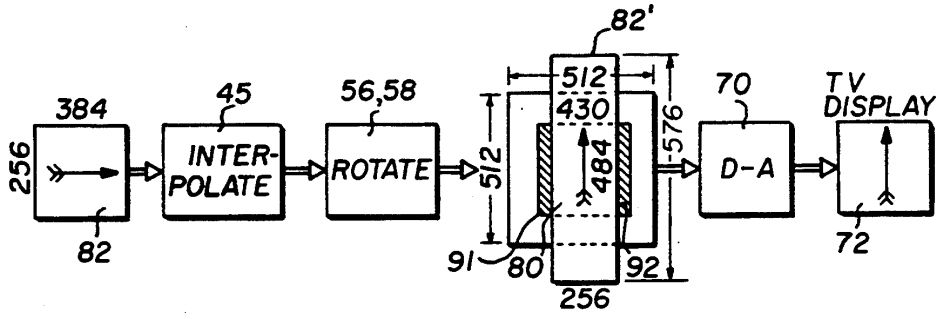



FIG. 7

# STORAGE AND RETRIEVAL OF DIGITIZED PHOTOGRAPHIC IMAGES

## FIELD OF THE INVENTION

The present invention relates in general to digitized image data processing systems and is particularly directed to a mechanism for controlling the manner in which digitized images are stored in and retrieved from a playback apparatus' frame store (random access memory), the storage capacity of which is less than the resolution of the digitized image.

## BACKGROUND OF THE INVENTION

Digital imaging systems, such as those employed for converting still color photographic film (e.g. 35 mm) images into digital format for storage in a digital database and subsequent playback, as by way of a color television monitor, customarily encode the output of an electronic film scanning device, such as a digital color camera, to some prescribed resolution and store the encoded image in an associated database as a respective image file. When it is desired to display a particular stored image, the contents of the respective addresses of the database in which the digitized image has been stored are read out and coupled to display driver circuitry for energizing corresponding pixels on the TV monitor.

Because each frame of a typical roll of 35 mm film has different horizontal and vertical frame dimensions, for example a dimension of 36 mm in the horizontal direction, parallel to the lengthwise direction of the film, and a dimension of 24 mm in the vertical direction, orthogonal to the lengthwise direction of the film (a horizontal:-vertical aspect ratio of 3:2), a photographer often rotates the camera ninety degrees about the lens axis in order to capture a subject in what is conventionally referred to as a 'vertical' orientation. 'horizontally shot' image, then, when a 'vertically shot' image is displayed, it will be rotated unless the recording and playback system has been designed to accommodate vertical images.

One conventional approach to handle the problem, similar to that described in the Ohta U.S. Pat. No. 4,641,198, is to rotate those film frames which contain vertical images by ninety degrees before scanning and to fill in the left and right sides of the image with a uniform 'border' color (e.g. black). Although this scanning method will provide the proper orientation of the displayed image, it suffers from two drawbacks. First, the actual scanning mechanism must be modified to effect an orthogonal scan of a vertical image. This is traditionally accomplished by physically reorienting the film by ninety degrees and changing the lens magnification of the scanning device by an amount related to the frame aspect ratio. Secondly, since side borders, which contain no useful information in terms of the captured image, are also recorded, some of the information storage capacity of the recording medium is wasted. A second solution to the problem is to rotate the display device, which is obviously impractical in many applications.

A third solution is to allow for different image orientations to be stored, together with digital control data indicating the orientations of the images, and to use an image playback device designed to read the orientation control data to properly orient the images on playback. Some prior art computer image file formats, for example the Tag Image File Format (TIFF), Revision 5.0, developed jointly by Aldus Corporation, Seattle, Wash., and Microsoft Corporation, Redmond, Wash., and described in "An Aldus/Microsoft Technical Memorandum:8/8/88," include the provision for an optical "tag" which can be used to indicate the orientation of the image. Page 25 of the above-mentioned TIFF document, described the TIFF "Orientation" tag, which can have eight different values indicating whether the zeroth row and zeroth column of the pixel data matrix represents the top and left, the top and right, the bottom and right, bottom and left, left and top, right and top, right and bottom, of left and bottom of the visual image. However, the above-mentioned memo further states that this field is recommended for private (non-interchange) use only. The default condition, where the zeroth row represents the visual top of the image, and zeroth column of the pixel data matrix represents the visual left hand side of the image, is recommended for all "non-private" applications, including those involving importing and printing. Thus, the TIFF orientation tag is never used to re-orient for display images which have been stored in different orientations in an image database.



In addition to the problem of different image orientations, captured images may have different aspect ratios. For example, dedicated use panoramic cameras, such as the Kodak Stretch (Trademark) camera, have an aspect ratio of 3:1, which is considerably wider than the above-referenced 3:2 aspect ratio of conventional 35 mm cameras. Other camera types, such as those which employ 126 type film also have aspect ratios other than 3:2.

In accordance with the invention described in co-pending patent application Ser. No. 022,603, filed Sep. 14, 1990, entitled "Mechanism for Controlling Presentation of Displayed Image," by K. Parulski et al, assigned to the assignee of the present application, and the disclosure of which is incorporated herein, rather than employ a complex and costly hardware arrangement that physically rotates the film scanner relative to the film for non-upright horizontal images (e.g. vertical images), each image is digitized and stored on a digital data storage medium, such as a 'write once' compact disc, in the same orientation as it is captured on film. In addition, a 'presentation' header is annexed to each image file. This header, which is prepared by a photofinishing minilab operator who views the output of the film scanner, is formatted to contain a set of orientation and aspect ratio codes that indicate how the image has been captured on film and, correspondingly, how it is stored on the disc. Subsequently, when the disc is inserted into a playback device, such as a CD player, which drives an output display such as a color TV monitor, the playback device decode presentation control file information, and controls the presentation of the image such that the image is displayed in an upright orientation and at the correct aspect ratio for the display.

FIG. **1** diagrammatically illustrates a digital image system for a photoprocessing mini-lab, in which photographic images, such as a set of twenty-four or thirty-six 36 mm×24 mm image frames of a 35 mm film strip **10**, are scanned by a high resolution opto-electronic film scanner **12**, such as a commercially available Eikonix 1435 scanner. High resolution scanner **12** outputs digitally encoded data representative of the response of each of the pixels of its high resolution imaging sensor pixel array (e.g. a 3072×2048 pixel matrix). Typically,

the color response of each pixel may be resolved into eight bits per color, so that, for a three color sensor array, the response of each sensor pixel is encoded into twenty-four bits. This digitally encoded data, or 'digitized' image, is coupled in the form of an imaging pixel array-representative bit map to an attendant photofinishing workstation **14**, which contains a frame store and image processing application software through which the digitized image may be processed (e.g. enlarged, cropped, subjected to a scene balance correction mechanism, etc.) to achieve a desired base image appearance. Once the base image has been prepared, it is to be written onto a transportable medium, such as a write once optical compact disc **15**, using an optical compact disc recorder **16**, for subsequent playback by a disc player **20**, which allows the image to be displayed, for example, on a television set **22**, or printed as a finished color print, as by way of a high resolution thermal color printer **24**.

Advantageously, the imaging system described in the above referenced co-pending application takes advantage of the imaging mechanism described in U.S. Pat. No. 4,969,204, entitled "Hybrid Residual-Based Hierarchical Storage and Display Method for High Resolution Digital Images in a Multiuse Environment, " by Paul W. Melynchuck et al, assigned to the assignee of the present application and the disclosure of which is herein incorporated. Pursuant to that system, each high resolution captured image is stored as a respective image data file containing a low, or base, resolution image bit map file and a plurality of higher resolution residual images associated with respectively increasing degrees of image resolution. By iteratively combining these higher resolution residual images with the base resolution image, successively increased resolution images may be recovered from the base resolution image for application to a high resolution reproduction device.

In order to accommodate data values representative of a scanned 36 mm-by-24 mm image frame of a 35 mm film strip, an original high resolution (3K×2K) image may be decimated into an image data file made up of a base resolution digitized image of 768×512 pixels of luminance information (and an associated 384×256 pixels of two records of chrominance information, set of residual image files). Pursuant to a preferred image processing operator, the base resolution file is formatted to consist of luminance and chrominance information interleaved in the following manner. Since there are twice as many lines of luminance as chrominance, one line of chrominance is interleaved with two lines of luminance, such that the resulting file has the structure of 768 pixels of luminance, 384 pixels of chrominance record one, 384 pixels of chrominance record two, and 768 pixels of luminance.

For the above-referenced file, the total memory capacity required for the base image is 0.5625 megabytes, so that the frame store and its associated read/write circuitry (including the need for separate line and pixel clocks) within the playback device becomes a significant cost item in the overall architecture of the CD player.

## SUMMARY OF THE INVENTION

In accordance with the present invention, the size and cost of the digitized imagery data storage and retrieval scheme described above can be reduced by employing, within the playback device, a frame store that has both a smaller capacity and employs a common address clock to play back both horizontally and vertically oriented images. For example, rather than employ a 512×768 luminance capacity memory (which is more than sufficient to fully utilize the bandwidth of a typical NTSC TV display), the playback mechanism uses a frame store the storage capacity of which corresponds to a 'square' pixel array (e.g. a 512×512 luminance resolution), so that the same address clock can be used for both pixel and line scans. To accommodate differences among frame store capacity, disc resolution and display resolution, during memory write operations imagery data values are controllably subjected to an interpolation/decimation operator.

Just as in the above-referenced Parulski et al invention, the present invention incorporates, within a presentation control file associated with each digitized image, additional orientation and aspect ratio information to indicate how the image was captured on film and has been correspondingly digitized and stored on the disc, so that, when played back, the image may have an upright orientation and the correct aspect ratio for the display device. However, unlike the Parulski et al system, because the present invention employs a reduced capacity frame store within the playback end of the system, the manner in which it responds to the presentation control data to control the interfacing of the image data file between the disc and the frame store is different and involves the use of an orientation-dependent decimation/interpolation operator.

More particularly, just as in the Parulski et al application, the present invention is directed to an improved storage and retrieval mechanism for a digital image processing system wherein a plurality of photographic images that have been captured on a photographic recording medium (film strip) are digitized for processing and subsequent reproduction. The film strip can be expected to include both horizontally-shot (whether upright or inverted) and vertically-shot (in either a right or left hand rotation) images. Digitized images are stored on a digital data storage recording medium, such as an optical compact disc, which is capable of being coupled to an image playback device (CD player) for reproduction (e.g. displayed on a color TV monitor).

In a photoprocessing workstation (photofinishing minilab), each (36 mm×24 mm) frame on the (35 mm) film strip is scanned and digitized as though the image were horizontally oriented, irrespective of its actual orientation within the frame. The digitized image is entered into a workstation frame store and displayed on a display monitor, so that the image may be viewed by the operator. Using an input device (e.g. keyboard, mouse) the operator may then enter a set of 'presentation' control codes that are incorporated within a presentation control file associated with a respective image file. These control codes preferably include a first digital code representative of the orientation in which the image is currently displayed (corresponding to its orientation as digitized from the film strip). Once all control information relative to the image has been defined, both the digitized image and its header file are written to a portable storage medium, such as a write once optical compact disc. When the disc is inserted into a playback device (CD player) for driving an output display such as a color TV monitor, the playback device decodes the presentation control information in the course of reading out the digitized image, so that the image will be displayed in an upright orientation.

As explained above, because the storage and retrieval scheme of the present invention employs a playback frame store the capacity of which is less than the digitized image resolution, a prescribed decimation/interpolation operator is employed in the course of interfacing imagery data between the compact disc and the frame store.

Pursuant to a preferred embodiment of the present invention, the reduced capacity frame store has a (512×512) luminance storage capacity which is less than the resolution of the 768×512 pixel array of the base image. A 'boundary address' image window is centered within the (512×512) array of pixels associated with the respective storage locations of the frame store to define which pixels may be used to form an output or reproduction image.

In response to the contents of a presentation file being representative of a vertical image, a (384×256) luminance image is read from the disc, and data values for the vertical dimension of that interlaced image field are interpolated, so as to effectively increase its vertical-to-horizontal aspect ratio. The resulting increased vertical-to-horizontal aspect ratio image is written into the frame store in such a manner as to effectively produce an orthogonal rotation of the increased vertical-to-horizontal aspect ratio image.

When accessing the contents of the frame store to drive an associated reproduction device such as a TV display, those interpolated image values that fall within the address boundary window are accessed and coupled to the image reproduction device (TV display).

On the other hand, when the presentation file identifies a horizontal imagery data file, the entire 768×512 base resolution luminance imagery data file is read out from the disc.

In order to store the 768×512 file in the (512×512) luminance frame store, data values for the horizontal dimension of the 768×512 pixel array are decimated, so as to effectively decrease its horizontal-to-vertical aspect ratio. Those image values that fall within the address boundary window are then read out and coupled to the image reproduction device (e.g. TV monitor).

As in the above-referenced Parulski et al application, the playback device may also employ a border generator to controllably 'frame' or crop a played back image.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** diagrammatically illustrates a photographic color film processing system in which the present invention may be employed;

FIG. **2** diagrammatically illustrates a portion of a film strip that contains a plurality of successive image frames on each of which an image of an arrow has been recorded;

FIG. **3** shows the format of a presentation information file;

FIG. **4** diagrammatically illustrates the signal processing architecture of an image retrieval mechanism in accordance with the present invention;

FIG. **5** is a memory load process flow diagram for horizontal images;

FIG. **6** illustrates the process flow through which memory controller controls the generation of address signals for loading data from the disc into the frame store and for reading out data from the frame store for application to an NTSC system television monitor for a 'horizontal' image; and

FIG. **7** illustrates the process flow through which memory controller controls the generation of address signals for loading data from the disc into the frame store and for reading out data from the frame store for application to an NTSC system television monitor for a 'vertical' image.

## DETAILED DESCRIPTION

Before describing in detail the particular improved digital image storage and retrieval mechanism in accordance with the present invention, it should be observed that the present invention resides primarily in a novel structural combination of conventional signal processing circuits and components and not in the particular detailed configurations thereof. Accordingly, the structure, control and arrangement of these conventional circuits and components have been illustrated in the drawings by readily understandable block diagrams which show only those specific details that are pertinent to the present invention, so as not to obscure the disclosure with structural details which will be readily apparent to those skilled in the art having the benefit of the description herein. Thus, the block diagram illustrations of the Figures do not necessarily represent the mechanical structural arrangement of the exemplary system, but are primarily intended to illustrate the major structural components of the system in a convenient functional grouping, whereby the present invention may be more readily understood.

FIG. **1** diagrammatically illustrates a photographic color film processing system (photofinishing minilab) with which the present invention may be employed and, as pointed out above, for purposes of the present description such a system may be of the type described in co-pending patent application Ser. No. 582,305, filed Sep. 14, 1990, by S. Kristy entitled "Multi-resolution Digital Imagery Photofinishing System, " now U.S. Pat. No. 5,218,455, issued Jun. 8, 1993, assigned to the assignee of the present application and the disclosure of which is herein incorporated. It should be observed that the system described in the co-pending Kristy application is merely an example of one type of system in which the invention may be used and is not to be considered limitative of the invention. In general, the invention may be incorporated in any digitized imagery processing system.

In accordance with the digital image processing system of FIG. **1**, photographic images, such as a set of twenty-four or thirty-six 36 mm×24 mm image frames of a 35 mm film strip **10**, are scanned by an opto-electronic film scanner **12**, such as the previously referenced, commercially available Eikonix 1435 high resolution scanner. Scanner **12** outputs digitally encoded data representative of the internal electronic scanning of a high resolution imaging sensor pixel array (e.g. a 3072×2048 pixel matrix) onto which a respective photographic image frame of film strip **10** is projected. This digitally encoded data, or 'digitized' image, is coupled in the form of an imaging pixel array-representative bit map to an attendant image processing workstation **14**, which contains a frame store and image processing application software through which the digitized image may be processed (e.g. enlarged, cropped, subjected to a scene balance correction mechanism, etc.) to achieve a desired base image appearance and configuration. Once image file has been prepared, it is stored on a transportable medium, such as an optical compact disc **15**, using an optical compact disc recorder **16**, for subse-

quent playback on playback device (CD player) **20** to drive a reproduction device, for example a consumer television set **22** or thermal printer **24**.

In accordance with the imagery data processing system described in the above referenced Kristy patent, each high resolution captured image is stored as a respective image data file containing a low, or base resolution (768×512) luminance image bit map file, a plurality of higher resolution residual images associated with respectively increasing degrees of image resolution, and a 384×256 luminance-hierarchical lower resolution image. By iteratively combining the higher resolution residual images with the base resolution image, successively increased resolution images may be recovered from the base resolution image.

As an example, spatial data values representative of a high resolution (3K×2K) image scan of a 36 mm-by-24 mm image frame of a 35 mm film strip **10** may be stored as a respective image data file including a base resolution image bit map file containing data values associated with a spatial image array or matrix of 512 rows and 768 columns of pixels and an associated set of residual image files to be stored on the disc. Within the workstation itself, the base resolution image may be further sub-sampled to derive an even lower resolution sub-array of image values (e.g. on the order of 192×128 pixels) for display on a segment of the system operator's workstation for the purpose of identifying image orientation.

As pointed out above and as described in the above-referenced co-pending Parulski application, a presentation information file is associated with each digitized image for the purpose of specifying how the image was captured on film and has been correspondingly digitized and stored on disc, so that, when played back, the image will have an upright orientation and the correct aspect ratio for the display device.

FIG. **2** diagrammatically illustrates a portion of a film strip **10** that contains a plurality of successive image frames **21** . . . **25**, on each of which an image of an arrow **30** has been recorded. While not every strip of film will necessarily contain images at each of the orientations shown in FIG. **2**, a typical film strip can be expected to include both horizontally-shot (whether upright or inverted) and vertically-shot (either right or left hand rotation) images. In frame **21** the arrow has been recorded with the camera held by the photographer in its normal horizontal position. In frame **22** the arrow has been recorded with the camera held by the photographer in its normal vertical position, rotated counterclockwise 90° relative to its normal horizontal position. In frame **23** the arrow has been recorded with the camera held by the photographer in its flipped (or inverted) horizontal position, rotated 180° relative to its normal horizontal position. In frame **24** the arrow has been recorded with the camera held by the photographer in its flipped vertical position, rotated clockwise 90° relative to its normal horizontal position. In frame **25** the arrow has been recorded with the camera held by the photographer in its normal vertical position.

Each image on the film strip is scanned and digitized as though it were horizontally oriented, irrespective of its actual orientation on the film. The digitized image is then stored in the workstation's frame store, as is, and a lower resolution version of the digitized image is then displayed on the display monitor of workstation **14**, so that the image may be viewed by the operator. Then, as each image is digitized and stored, the photofinishing minilab operator, using a workstation input device (e.g. keyboard, mouse) enters a set of 'presentation' control codes that are incorporated within a presentation information file associated with a respective image file.

The format of the presentation information is shown in FIG. **3** as comprising an M-bit orientation field **31**, an N-bit aspect ration field **33**, and a supplemental field **35**, in which additional information, such as title, date, etc. may be inserted by the operator in the course of formatting a digitized image for storage on the disc. For the four possible image orientations described above and depicted in FIG. **2**, M=3 bits are required for the orientation field **31**. For the N-bit aspect ratio field **33**, three bits are shown by way of example. It should be observed that the parameters and field formats given here are merely for purposes of illustration and are not to be considered limitative of the invention. As in any data processing application what is required is that the actual coding structure and data format of the header field be capable of being read and interpreted by the underlying control mechanism in the playback device. Rather than describe the coding details of that mechanism, the description to follow will set forth the architecture of the storage and retrieval mechanism and the manner in which it processes images having both horizontal and vertical orientations.

FIG. **4** diagrammatically illustrates the signal processing architecture of an image retrieval mechanism in accordance with an embodiment of the present invention, which may be incorporated in a commercially available digital data storage and retrieval device, such as a compact disc player, for supplying image generation control signals to an associated display device, such as a color television monitor. As shown in the figure, data read by a CD reader **40** from a disc **15** is coupled over input bus **41** to a deformatter **42**, which separates the presentation information from the (768×512) imagery array field. The presentation information data field is coupled over link **44** to a memory controller **46**, while the imagery data is coupled over link **48** to a selectively enabled decimation/interpolation and border generation (dec/int/bg) operator **45**. Operator **45** is controllably enabled, via link **47** from memory controller **46** to effect a 3:2 decimation of respective lines of a 768×512 frame of imagery data for horizontal images, and a 2:3 interpolation of respective lines of a 384×256 sub-frame of imagery data for vertical images, and generates the appropriate border information.

For this purpose, operator **45** contains a zero insertion circuit cascaded with a digital convolution filter, and operates to fill in zeros at those pixel locations where a border image is to be produced. As a result, a prescribed number of input pixel values per line (e.g. 768 for a horizontal image or 384 for a vertical image) are converted into a predetermined number of output pixels per line (e.g. 512 for a horizontal image and 576 for a vertical image). The output of operator **45** is coupled over link **49** to a frame store (random access memory) **50**, the storage capacity of which is less than the 768×512 resolution of the luminance base image file stored on the disc and preferably corresponds to a 'square' frame of imagery data (e.g. an array of 512×512 luminance pixels). Thus, for a three color space/pixel value scheme quantized to eight bits per pixel, the 576 Kbyte requirements of a 768×512 luminance and 384×256 chrominance frame store are reduced to 384 Kbytes.

Memory controller **46**, which controls the clocking of imagery data from disc **15** into frame store **50** may be

incorporated as part of the CD player's microcontroller or may be a separate dedicated combinational logic circuit driven by the microcontroller for controlling the generation of address/clock signals which are supplied over respective address bus links **52** and **54** to a set of associated column and address counters **56** and **58**, respectively, for controlling the rate and order in which addresses of memory **50** are accessed.

As pointed out previously, each field of imagery data is stored and read from the disc **15** as though the image were a normal 768×512 pixel horizontal image. The manner in which the imagery data is downloaded from the disc and written into frame store **50** will depend upon its associated presentation information data, which includes an orientation code (**31**, FIG. **3**) specifying whether the image is a horizontal image or a vertical image. For horizontal images, memory controller **46** enables operator **45** to effect a 3:2 decimation of each line of 768 values down to 512 values, thereby effectively converting the 768×512 base resolution image into a 512×512 image, data values for which are stored in the 512×512 address memory locations of frame store **50**, as illustrated in the process flow diagram of FIG. **5**.

When imagery data is read out from memory **50**, it is coupled over link **60** to a digital-to-analog converter **70** for application to a display device, such as a color TV monitor **72**, so that a reproduction of the original 35 mm image will be presented to the viewer.

The manner in which memory controller **46** controls the generation of address signals for loading data from the disc into the frame store will be described below with reference to FIGS. **6** and **7**.

More particularly, FIG. **6** illustrates a frame store load, or write-in, processing sequence for normal 'horizontal' images depicted in FIG. **5** and an overlay of a rectangular 'address boundary' window **80** 'centered' on the 512×512 pixel array represented by the contents of frame store **50**. For an inverted horizontal image, the same window of addresses is accessed except that the order of read-out of the successive 484 lines is reversed from that of a normal horizontal image.

FIG. **7** illustrates a frame store load processing sequence for normal 'vertical' images, together with an overlay of a rectangular address boundary window **80** centered on the 512×512 pixel array represented by the contents of frame store **50**.

More particularly, as described previously, when a vertical imagery data file is accessed from the disc, only one of its four 384×256 interlaced image fields of which its 768×512 base resolution image file is comprised is read out from the disc. One of these files is diagrammatically shown in FIG. **7** as a 384×256 pixel image **82**. Because the data file is that of a vertically oriented image, the image is effectively rotated by controllably 'swapping' the inputs to column and row counters **56** and **58** during the strobing of the address inputs of frame store **50**. When the image field (which undergoes a 90° rotation as a result of the swapping the inputs to address counters **56** and **58**) is loaded into frame store **50**, it is effectively centered relative to address boundary window **80**, so that there is a small amount of cropping of the image at a top portion **85** and a bottom portion **86**. For an inverted vertical image the same 576×256 data values are used except that the order of write-in of the successive 576 lines is reversed from that of a normal vertical image.

Because the imagery data stored in frame store **50** has undergone a 90° rotation prior to the 2:3 interpolation of the vertical dimension of the image in the course of loading the vertical image file into frame store **50**, the effective vertical:horizontal aspect ratio of the stored image is 9:4.

As will be appreciated from the foregoing description of the present invention, the size and cost of the digitized imagery data storage and retrieval scheme disclosed in the above-referenced Parulski et al application can be reduced by the use of a playback frame store that has both a smaller capacity and employs a common address clock for both horizontal and vertical scans of memory. Since the playback mechanism uses a frame store the storage capacity of which corresponds to a 'square' pixel array (e.g. a 512×512 pixel resolution), the same address clock can be used for both pixel and line scans. To accommodate the differences between the memory capacity and the disc and display resolutions, during memory write operations, imagery data values are controllably subjected to an interpolation/-decimation operator.

While we have shown and described an embodiment in accordance with the present invention, it is to be understood that the same is not limited thereto but is susceptible to numerous changes and modifications as known to a person skilled in the art, and we therefore do not wish to be limited to the details shown and described herein but intend to cover all such changes and modifications as are obvious to one of ordinary skill in the art.

What is claimed:

**1**. For use with a digitized image processing system in which images that have been captured on an image recording medium are converted into digital format and stored as digitized image data files on a transportable digital data storage medium, a method of controlling the manner in which digitized images are accessed therefrom for storage comprising the steps of:

(a) causing a digital data recording device to store, on said transportable digital data storage medium, respective data files associated with each of the images that have been digitized from images captured on said image recording medium, each of said data files containing digitized imagery data representative of its associated image as captured on said image recording medium;

(b) for each of said respective data files, causing said digital data recording device to store, on said transportable digital data storage medium, a presentation file, the contents of which represent the manner in which its associated digitized imagery data has been captured, on said image recording medium;

(c) providing an image retrieval device, which contains a digital data memory having a storage capacity which is different from the resolution of the image represented by the contents of a digitized image data file stored on said transportable digital data storage medium;

(d) transporting said transportable digital data storage medium on which digital data files and presentation files have been stored in steps (a) and (b) to said image retrieval device and coupling said transportable digital data storage medium to said image retrieval device; and

(e) causing said image retrieval device to read out, from said transportable digital data storage me-

dium, the digitized imagery data of a respective data file stored in step (a) and to write the read out digitized imagery data into said digital data memory of said image retrieval device in a manner that depends upon the contents of its associated presentation file stored on said transportable digital data storage medium in step (b).

2. A method according to claim 1, wherein said image retrieval device is coupled to an image reproduction device and further comprising the step of:

(f) controllably causing said image retrieval device to read out digitized imagery data that has been written into said digital data memory and to couple the read out data to said image reproduction device such that the reproduced image is reproduced by said image reproduction device in an upright orientation.

3. A method according to claim 1, wherein the digitized image of a respective image file corresponds to an MXN array of pixels and said digital data memory has a storage capacity associated with an MXP array of pixels, where P is less than N.

4. A method according to claim 2, wherein the resolution of said reproduction device is different than the storage capacity of said digital data memory.

5. A method according to claim 2, wherein the resolution of said reproduction device is greater than the storage capacity of said digital data memory.

6. A method according to claim 1, wherein step (e) comprises causing said image retrieval device to controllably decimate digitized image data stored on said transportable digital data storage medium that has been coupled thereto and to write the decimated data into said digital data memory.

7. A method according to claim 1, wherein step (e) comprises causing said image retrieval device to controllably interpolate digitized image data stored on said transportable digital data storage medium that has been coupled thereto and to write the interpolated data into said digital data memory.

8. A method according to claim 2, wherein step (e) comprises controllably causing said image retrieval device to decimate or interpolate digitized image data stored on said transportable digital data storage medium that has been coupled thereto and to write the decimated or interpolated data into said digital data memory of said image retrieval device.

9. A method according to claim 1, wherein step (e) comprises, in response the contents of said presentation file indicating that said image has a first orientation, controllably causing said image retrieval device to decimate a first portion of the digitized image data stored on said transportable digital data storage medium and to write the decimated image data from said transportable digital data storage medium into said digital data memory of said image retrieval device.

10. A method according to claim 9, wherein step (e) comprises, in response the contents of said presentation file indicating that said image has a second orientation, controllably causing said image retrieval device to interpolate a second portion of the digitized image data stored on said transportable digital data storage medium and to write the interpolated image data into said digital data memory of said image retrieval device.

11. A method according to claim 1, wherein step (b) comprises causing said digital data recording device to store, within a respective presentation file, first data representative of the orientation of its associated image as captured on said image recording medium.

12. A method according to claim 2, wherein said image reproduction device comprises a television display.

13. A method according to claim 1, wherein said transportable digital data storage medium comprises a photo compact disc and said image retrieval device comprises a photo compact disc player.

14. A method according to claim 1, wherein step (e) comprises causing said image retrieval device to write digitized imagery data into said digital data memory using a common clock for both pixel and line scan directions of a digital image.

15. A method according to claim 14, wherein said step (f) comprises causing said image retrieval device to read digitized imagery data from said digital data memory using a common clock for both pixel and line scan directions of a digital image.

16. A method according to claim 2, wherein said digital data memory has a capacity of an equal number of lines of pixels and pixels per line of a digital image storable therein, and wherein each of steps (e) and (f) comprises causing said image retrieval device to access said digital data memory using a common clock for both pixel and line scan directions.

17. For use with a digital image processing system wherein a plurality of images that have been captured on a photographic recording medium, said images being (and may include horizontally and vertically oriented images) oriented along one of a plurality of orientation axes, including vertical and horizontal axes, said images being (, are) digitized into respective digital imagery data files, each digital imagery data file containing data values associated with an array of pixels corresponding to a prescribed resolution representation of a respective one of said plurality of images, a method of controlling (the manner in which said) access to said digital imagery data files (may be accessed) for storage comprising the steps of:

(a) digitizing each of said plurality of images in accordance with a prescribed orientation, irrespective of its actual orientation on said photographic recording medium, and causing a digital data recording device to store each digitized image in a respective digital imagery data file on a transportable digital data storage medium;

(b) for each digital imagery data file stored in step (a), causing said digital data recording device to store on said transportable digital data storage medium a presentation data file, the contents of which are associated with the actual orientation of its image on said photographic recording medium;

(c) providing a digital image retrieval device having a digital data memory, the storage capacity of which is different from the resolution of the image represented by the contents of a digitized image data file stored on said transportable digital data storage medium;

(d) transporting said transportable digital data storage medium on which digital data files and presentation files have been stored in steps (a) and (b) to said image retrieval device and coupling said transportable digital data storage medium to said image retrieval device; and

(e) causing said image retrieval device to read out, from said transportable digital data storage medium that has been coupled to said image retrieval

device, the digitized imagery data of a respective data file stored in step (a) and to write the read out digitized imagery data into said digital data memory, in a manner that depends upon the contents of its associated presentation file stored in step (b).

**18.** A method according to claim **17**, further comprising the step of:

(f) causing said image retrieval device to controllably read out digitized imagery data that has been written into said digital data memory and to couple the read out data to an image reproduction device such that the reproduced image is reproduced by said image reproduction device in an upright orientation.

**19.** A method according to claim **17**, wherein said transportable digital data storage medium comprises a photo compact disc and said digital image retrieval device comprises a photo compact disc player.

**20.** A method according to claim **17**, wherein step (e) comprises causing said image retrieval device to write digitized imagery data into said digital data memory using a common clock for both pixel and line scan directions of a digital image.

**21.** A method according to claim **20**, wherein said step (f) comprises causing said image retrieval device to read digitized imagery data from said digital data memory using a common clock for both pixel and line scan directions of a digital image.

**22.** A method according to claim **18**, wherein said digital data memory has a capacity of an equal number of lines of pixels and pixels per line of a digital image storable therein, and wherein each of steps (e) and (f) comprises causing said image retrieval device to access said digital data memory using a common clock for both pixel and line scan directions.

**23.** For use with a digital image processing system wherein a plurality of photographic images that have been captured on a photographic recording medium are digitized and stored on a transportable digital data storage medium, said transportable digital data storage medium being capable of being coupled to an image playback device for display of an image, a method of controlling the displayed presentation of said image by said playback device comprising the steps of:

(a) digitizing each of said plurality of images on said photographic recording medium and storing each digitized image on said transportable digital data storage medium in the orientation in which the image was captured on said photographic recording medium;

(b) for each digitized image stored in step (a), causing a digital data recording device to store on said transportable digital data storage medium at least one digital code respectively representative of the orientation of the image;

(c) providing, with said image playback device, a digital data memory(,) having a (the) storage capacity (of) which is different from the resolution of the image represented by the contents of a digitized image stored on said transportable digital data storage medium;

(d) transporting said transportable digital data storage (device) medium to said image playback device;

(e) causing said image playback device to read out, from said transportable digital data storage medium that has been transported thereto in step (d), a respective digitized image stored in step (a) and to write the read out digitized image into said digital data memory in a manner that depends upon the contents of its associated at least one digital code stored in step (b); and

(f) causing said image playback device to read out a digitized image that has been written into said digital data memory and to couple the read out digitized image to an image reproduction device such that the reproduced image is reproduced by said image reproduction device in an upright orientation.

**24.** A method according to claim **23**, wherein said transportable digital data storage medium comprises a photo compact disc and said image playback device comprises a photo compact disc player.

**25.** A method according to claim **23**, wherein step (e) comprises causing said image playback device to write digitized imagery data into said digital data memory using a common clock for both pixel and line scan directions of a digital image.

**26.** A method according to claim **25**, wherein said step (f) comprises causing said image playback device to read digitized imagery data from said digital data memory using a common clock for both pixel and line scan directions of a digital image.

**27.** A method according to claim **23**, wherein said digital data memory has a capacity of an equal number of lines of pixels and pixels per line of a digital image storable therein, and wherein each of steps (e) and (f) comprises causing said image playback device to access said digital data memory using a common clock for both pixel and line scan directions.

**28.** For use with a digital image processing system wherein a plurality of images that have been captured on a photographic recording medium, said images being (and may include horizontally and vertically oriented images, are) oriented along one of a plurality of orientation axes, including vertical and horizontal axes, Said images being digitized into respective digital imagery data files and stored on a transportable digital data storage medium, each digital imagery data file containing a base resolution image associated with an MXN pixel array and formatted as a plurality of interlaced image fields each of which is associated with a respective JXK pixel subarray within said MXN pixel array, a method of controlling (the manner in which) access to a digital imagery data file (may be accessed) for application to an image reproduction device, so that a reproduced image (may be) is capable of being viewed in an upright orientation comprising the steps of:

(a) causing a digital data recording device to store, within each of said data files, digitized imagery data representative of its associated image as captured on said (image) photographic recording medium;

(b) for each respective data file, causing said digital data recording device to store, on said transportable digital data storage medium, a presentation file the contents of which represent the manner in which its associated digitized imagery data has been captured on said photographic recording medium;

(c) providing an image retrieval device having a digital data memory(, the) with a storage capacity (of) which is less than the resolution of said MXN pixel array, but greater than the resolution of said JXK pixel sub-array;

(d) transporting said transportable digital data storage medium and coupling said transportable digital

data storage medium with said image retrieval device;

(e) defining an image window within the array of pixels associated with the respective storage locations of said digital data memory;

(f) for a vertical imagery data file, causing said image retrieval device to read out, from said transportable digital data storage medium, digitized image data associated with one of its interlaced image fields, to interpolate data values for the vertical dimension of said one interlaced image field so as to effectively increase its vertical-to-horizontal aspect ratio, and to store the (resulting) increased vertical-to-horizontal aspect ratio of said one interlaced image field in storage locations of said digital data memory that effectively produce an orthogonal rotation of said increased vertical-to-horizontal aspect ratio interlaced image field; and

(g) causing said image retrieval device to read out from said digital data memory those image values stored in step (f) that fall within said image window and to couple the read-out image to said image reproduction device, such that the read-out image is reproduced by said image reproduction device in an upright orientation.

**29**. A method according to claim **28**, wherein said transportable digital data storage medium comprises a photo compact disc and said image retrieval device comprises a photo compact disc player.

**30**. A method according to claim **28**, wherein step (f) comprises causing said image retrieval device to write digitized imagery data into said digital data memory using a common clock for both pixel and line scan directions of a digital image.

**31**. A method according to claim **30**, wherein said step (g) comprises causing said image retrieval device to read digitized imagery data from said digital data memory using a common clock for both pixel and line scan directions of a digital image.

**32**. A method according to claim **28**, wherein said digital data memory has a capacity of an equal number of lines of pixels and pixels per line of a digital image storable therein, and wherein each of steps (f) and (g) comprises causing said image retrieval device to access said digital data memory using a common clock for both pixel and line scan directions.

**33**. For use with a digital image processing system wherein a plurality of images that have been captured on a photographic recording medium, said images being (and may include horizontally and vertically oriented images,) oriented along one of a plurality of orientation axes, including vertical and horizontal axes, said images being (are) digitized into respective digital imagery data files and stored on a transportable digital data storage medium, each digital imagery data file containing a base resolution image associated with an MXN pixel array, a method of controlling (the manner in which) access to a digital imagery data file (may be accessed) for application to an image reproduction device, so that a reproduced image (may be) is capable of being viewed in an upright orientation comprising the steps of:

(a) causing a digital data storage device to store on said transportable digital data storage medium, within each of said data files, digitized imagery data representative of its associated image as captured on said photographic recording medium;

(b) for each respective data file, causing said digital data storage device to store, on said transportable digital data storage medium, a presentation file the contents of which represent the manner in which its associated digitized imagery data has been captured on said (image recording) transportable digital data storage medium;

(c) providing an image retrieval device having a digital data memory(, the) with a storage capacity (of) which is less than the resolution of said MXN pixel array;

(d) transporting said transportable digital data storage medium and coupling said transportable digital data storage (device) medium to said image retrieval device;

(e) defining an image window within the array of pixels associated with the respective storage locations of said digital data memory;

(f) for a horizontal imagery data file, causing said image retrieval device to read out, from said transportable digital data storage medium that has been coupled thereto, digitized image data associated with said MXN pixel array, to decimate data values for the horizontal dimension of said MXN pixel array so as to effectively decrease its horizontal-to-vertical aspect ratio, and to store the (resulting) decreased horizontal-to-vertical aspect ratio (image) in storage locations of said digital data memory; and

(f) causing said image retrieval device to read out from said digital data memory those image values stored in step (f) that fall within said image window and to couple the read-out image to said image reproduction device.

**34**. A method according to claim **33**, wherein said transportable digital data storage medium comprises a photo compact disc and said image retrieval device comprises a photo compact disc player.

**35**. A method according to claim **33**, wherein step (f) comprises causing said image retrieval device to write digitized imagery data into said digital data memory using a common clock for both pixel and line scan directions of a digital image.

**36**. A method according to claim **35**, wherein said step (g) comprises causing said image retrieval device to read digitized imagery data from said digital data memory using a common clock for both pixel and line scan directions of a digital image.

**37**. A method according to claim **33**, wherein said digital data memory has a capacity of an equal number of lines of pixels and pixels per line of a digital image storable therein, and wherein each of steps (f) and (g) comprises causing said image retrieval device to access said digital data memory using a common clock for both pixel and line scan directions.

**38**. For use with a digitized image processing system in which images that have been captured on an image recording medium are converted into digital format and stored as digitized image data files on a transportable digital data storage medium, an apparatus for controlling the manner in which digitized images are accessed therefrom for playback comprising, in combination:

a digitized image recording device, which is operative to store, on said transportable digital data storage medium, respective data files associated with each of the images that have been digitized from images captured on said (transportable) image recording medium, each of said data files containing digitized imagery data representative of its associated image as captured on said image recording

medium, and a presentation file for each of said respective data files, the contents of said presentation file being representative of (the manner in which) its associated digitized imagery data (has been) as captured on said image recording medium and stored as a digitized image on said transportable digital data storage medium; and

a playback device including a digital data memory, the storage capacity of which is different from the resolution of the image represented by the contents of a digitized image data file stored on said digital data storage medium, and being operative to read from said transportable digital data storage medium, that has been transported from said digitized image recording device and coupled to said playback device, the digitized imagery data of a respective data file and writes the read out digitized imagery data from said transportable digital data storage medium into said digital data memory in a manner that depends upon the contents of its associated presentation file, and controllably reads digitized imagery data that has been written into said memory and couples the read out data to an image reproduction device such that the reproduced image is reproduced by said image reproduction device in an upright orientation.

**39**. An apparatus according to claim **38**, wherein the digitized image of a respective image file corresponds to an MXN array of pixels and said digital data memory has a storage capacity associated with an MXP array of pixels, where P is less than N.

**40**. An apparatus according to claim **38**, wherein the resolution of said reproduction device is greater than the storage capacity of said digital data memory.

**41**. An apparatus according to claim **38**, wherein said playback device is operative to controllably decimate digitized image data stored on said transportable digital data storage medium that has been coupled thereto and to write the decimated data into said digital data memory.

**42**. An apparatus according to claim **38**, wherein said playback device is operative to controllable interpolate digitized image data stored on said transportable digital data storage medium that has been coupled thereto and to write the interpolated data into said digital data memory.

**43**. An apparatus according to claim **38**, wherein said playback device is operative, in response to the contents of said presentation file indicating that said image has a first orientation, to controllably decimate a first portion of the digitized image data stored on said transportable digital data storage medium and to write the decimated image data into said digital data memory.

**44**. An apparatus according to claim **38**, wherein said digitized image recording device is operative to store, within a respective presentation file, first data representative of the orientation of its associated image as stored on (transportable) said transportable digital data storage medium.

**45**. An apparatus according to claim **44**, wherein said image reproduction device comprises a television display.

**46**. An apparatus according to claim **45**, wherein said television display contains an array of pixels the resolution of which is greater than the resolution of a respective data file.

**47**. An apparatus according to claim **38**, wherein said transportable digital data storage medium comprises a photo compact disc and said playback device comprises a photo compact disc player.

**48**. A method according to claim **38**, wherein step (f) comprises causing said image retrieval device to write digitized imagery data into said digital data memory using a common clock for both pixel and line scan directions of a digital image.

**49**. A method according to claim **48**, wherein said step (g) comprises causing said image retrieval device to read digitized imagery data from said digital data memory using a common clock for both pixel and line scan directions of a digital image.

**50**. A method according to claim **38**, wherein said digital data memory has a capacity of an equal number of lines of pixels and pixels per line of a digital image storable therein, and wherein each of steps (f) and (g) comprises causing said image retrieval device to access said digital data memory using a common clock for both pixel and line scan directions.

**51**. For use with a digital image processing system wherein a plurality of images that have been captured on a photographic recording medium, said images being (and may include horizontally and vertically oriented images) oriented along one of a plurality of orientation axes, including vertical and horizontal axes, said images being (, are) digitized into respective digital imagery data files, each digital imagery data file containing data values associated with an array of pixels corresponding to a prescribed resolution representation of a respective one of said plurality of images, an apparatus for controlling (the manner in which said) access to said digital imagery data files (may be accessed) for presentation to a reproduction device, so that a reproduced image (may be) is capable of being viewed in an upright orientation comprising, in combination:

a digitized image recording device which is operative to digitize each of said plurality of images in accordance with a prescribed orientation, irrespective of its actual orientation on said photographic recording medium, and stores each digitized image in a respective digital imagery data file on a transportable digital data storage medium and stores on said transportable digital data storage medium, for each digital imagery data file, a presentation data file the contents of which are associated with the actual orientation of its image on said photographic recording medium; and

a playback device including a digital data memory having a storage capacity which is different from the resolution of the image represented by the contents of a digitized image data file stored on said transportable digital data storage medium, said playback device being operative to read out, from said transportable digital data storage medium, the digitized imagery data of a respective data file and to write the read out digitized imagery data into said digital data memory in a manner that depends upon the contents of its associated presentation file, and to controllably read out digitized imagery data that has been written into said digital data memory and to couple the read out data to said image reproduction device such that the reproduced image is reproduced by said image reproduction device in an upright orientation.

**52**. An apparatus according to claim **51**, wherein said transportable digital data storage medium comprises a photo compact disc and said playback device comprises a photo compact disc player.

53. An apparatus according to claim 51, wherein said playback device is operative to write digitized imagery data into said digital data memory using a common clock for both pixel and line scan directions of a digital image.

54. An apparatus according to claim 53, wherein said playback device is operative to read digitized imagery data from said digital data memory using a common clock for both pixel and line scan directions of a digital image.

55. An apparatus according to claim 51, wherein said digital data memory has a capacity of an equal number of lines of pixels and pixels per line of a digital image storable therein, and wherein said playback device is operative to access said digital data memory using a common clock for both pixel and line scan directions.

56. For use with a digital image processing system wherein a plurality of photographic images that have been captured on a photographic recording medium are digitized and stored on a transportable digital data storage medium, said transportable digital data storage medium being transported to and coupled to an image playback device for display of an image, an apparatus for controlling the displayed presentation of said image by said playback device comprising, in combination:

a digitized image recording device which is operative to digitize each of said plurality of images on said photographic recording medium and to store each digitized image on said transportable digital data storage medium in the orientation in which the image was captured on said photographic recording medium, and, for each digitized image, to store at least one digital code respectively representative of at least one of the aspect ratio and orientation of the image;

a digitized image playback device including a digital data memory, said digital data memory having a storage capacity which is different from the resolution of the image represented by the contents of a digitized image stored on said transportable digital data storage medium, and is operative to read out, from said transportable digital data storage medium that has been transported from said digitized image recording device and coupled to said digitized image playback device, a respective digitized image and to write the read out digitized image into said digital data memory in a manner that depends upon the contents of its associated at least one digital code, and controllably reads out a digitized image that has been written into said digital data memory and couples the read out digitized image to said image reproduction device such that the reproduced image is reproduced by said image reproduction device in an upright orientation.

57. An apparatus according to claim 56, wherein said transportable digital data storage medium comprises a photo compact disc and said digitized image playback device comprises a photo compact disc player.

58. An apparatus according to claim 56, wherein said digitized image playback device is operative to write digitized imagery data into said digital data memory using a common clock for both pixel and line scan directions of a digital image.

59. An apparatus according to claim 58, wherein said digitized image playback device is operative to read digitized imagery data from said digital data memory using a common clock for both pixel and line scan directions of a digital image.

60. An apparatus according to claim 56, wherein said digital data memory has a capacity of an equal number of lines of pixels and pixels per line of a digital image storable therein, and wherein said digitized image playback device is operative to access said digital data memory using a common clock for both pixel and line scan directions.

61. For use with a digitized image processing system in which images that have been captured on an image recording medium are converted into digital format and stored as digitized image data files on a transportable digital data storage medium, each of said data files containing digitized imagery data representative of its associated image as captured on said image recording medium, and a presentation file for each of said respective data files, the contents of said presentation file being representative of the manner in which its associated digitized imagery data has been captured on said image recording medium and stored as a digitized image on said transportable digital data storage medium, a playback apparatus for controlling (the manner in which) access to said digitized images (are accessed) from said transportable digital data (recording) storage medium for presentation by an image reproduction device comprising, in combination:

a transportable digital data (recording) storage medium interface to which said transportable digital data (recording) storage medium is transported and coupled;

a digital data memory coupled to said transportable digital data (recording) storage medium interface and having a storage capacity which is different from the resolution of the image represented by the contents of a digitized image data file stored on said transportable digital data storage medium that has been transported and coupled to said interface;

first means for reading from said transportable digital data storage medium the digitized imagery data of a respective data file and writing the read out digitized imagery data into said digital data memory in a manner that depends upon the contents of its associated presentation file; and

second means for controllably reading out digitized imagery data that has been written into said digital data memory from said transportable digital data storage medium coupled to said interface and coupling the read out data to an image reproduction device such that the reproduced image is reproduced by said image reproduction device in an upright orientation.

62. An apparatus according to claim 61, wherein the digitized image of a respective image file corresponds to an MXN array of pixels and said digital data memory has a storage capacity associated with an MXP array of pixels, where P is less than N.

63. An apparatus according to claim 61, wherein the resolution of said reproduction device is greater than the storage capacity of said digital data memory.

64. An apparatus according to claim 61, wherein said first means includes means for controllably decimating digitized image data stored on said transportable digital data storage medium and writing the decimated data into said digital data memory.

65. An apparatus according to claim 61, wherein said first means includes means for controllably interpolating digitized image data stored on said transportable digital data storage medium and writing the interpolated data into said digital data memory.

66. An apparatus according to claim 61, wherein said first means includes means, responsive to the contents of said presentation file indicating that said image has a first orientation, for controllably decimating a first portion of the digitized image data stored on said transportable digital data storage medium and writing the decimated image data into said digital data memory.

67. An apparatus according to claim 61, wherein said first device includes means, responsive to the contents of said presentation file indicating that said image has a second orientation, for controllably interpolating a second portion of the digitized image data stored on said transportable digital data storage medium and writing the interpolated image data into said digital data memory.

68. A playback apparatus according to claim 61, wherein said transportable digital data storage medium comprises a photo compact disc.

69. An apparatus according to claim 61, wherein said first means includes means for writing digitized imagery data into said digital data memory using a common clock for both pixel and line scan directions of a digital image.

70. An apparatus according to claim 69, wherein said second means includes means for reading digitized imagery data from said digital data memory using a common clock for both pixel and line scan directions of a digital image.

71. An apparatus according to claim 61, wherein said digital data memory has a capacity of an equal number of lines of pixels and pixels per line of a digital image storable therein, and wherein each of said first and second means is operative to access said digital data memory using a common clock for both pixel and line scan directions.

* * * * *

US006181836B1

(12) **United States Patent**
**Delean**

(10) **Patent No.: US 6,181,836 B1**
(45) **Date of Patent: *Jan. 30, 2001**

(54) **METHOD AND SYSTEM FOR NON-DESTRUCTIVE IMAGE EDITING**

(75) Inventor: **Bruno Delean**, Labege (FR)

(73) Assignee: **MGI Software Corporation**, Richmond Hill (CA)

( * ) Notice: Under 35 U.S.C. 154(b), the term of this patent shall be extended for 0 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **08/933,798**

(22) Filed: **Sep. 19, 1997**

**Related U.S. Application Data**

(63) Continuation of application No. 08/327,421, filed on Oct. 21, 1994, now Pat. No. 5,790,708, which is a continuation of application No. 08/085,534, filed on Jun. 30, 1993, now abandoned.

(30) **Foreign Application Priority Data**

Mar. 25, 1993 (FR) ..... 93 03455

(51) **Int. Cl.**[7] ..... **G06K 9/54**; G06K 9/60

(52) **U.S. Cl.** ..... **382/302**; 382/305; 382/311; 345/428; 345/501; 345/507

(58) **Field of Search** ..... 382/276, 232, 382/302, 305, 311, 244, 309; 345/418, 419, 433, 435, 436, 439, 501, 508, 511, 507, 428

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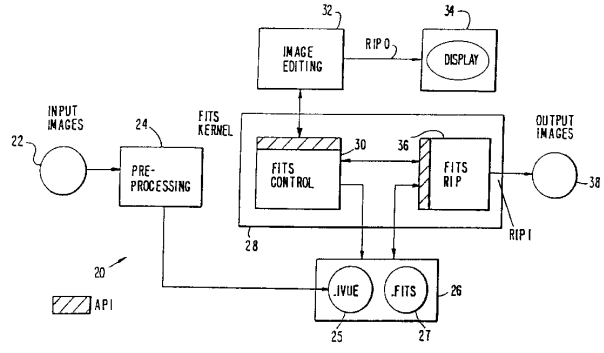
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*Primary Examiner*—Bhavesh Mehta
(74) *Attorney, Agent, or Firm*—Blakely, Sokoloff, Taylor & Zafman

(57) **ABSTRACT**

A method for non-destructive, selectably reversible image compositing, including providing a displayed image including at least a region of an original image, modifying the displayed image to produce a modified displayed image, and producing a modified image file including at least the displayed image and not including the modified displayed image and also including resolution independent parameters operative for modifying the displayed image to produce the modified displayed image. A system is also described and claimed.

**16 Claims, 10 Drawing Sheets**



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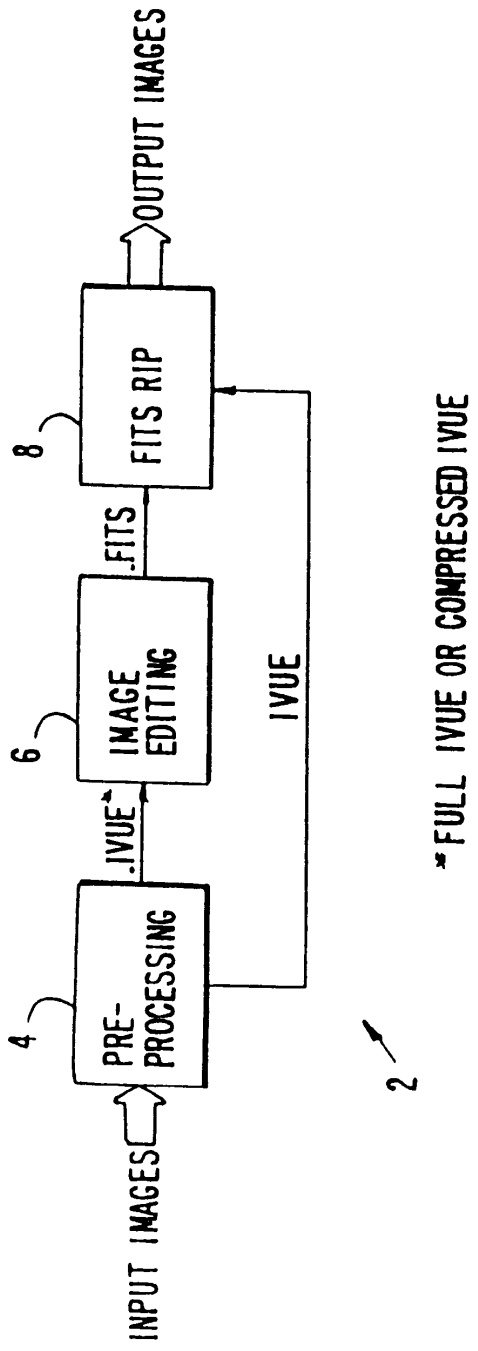
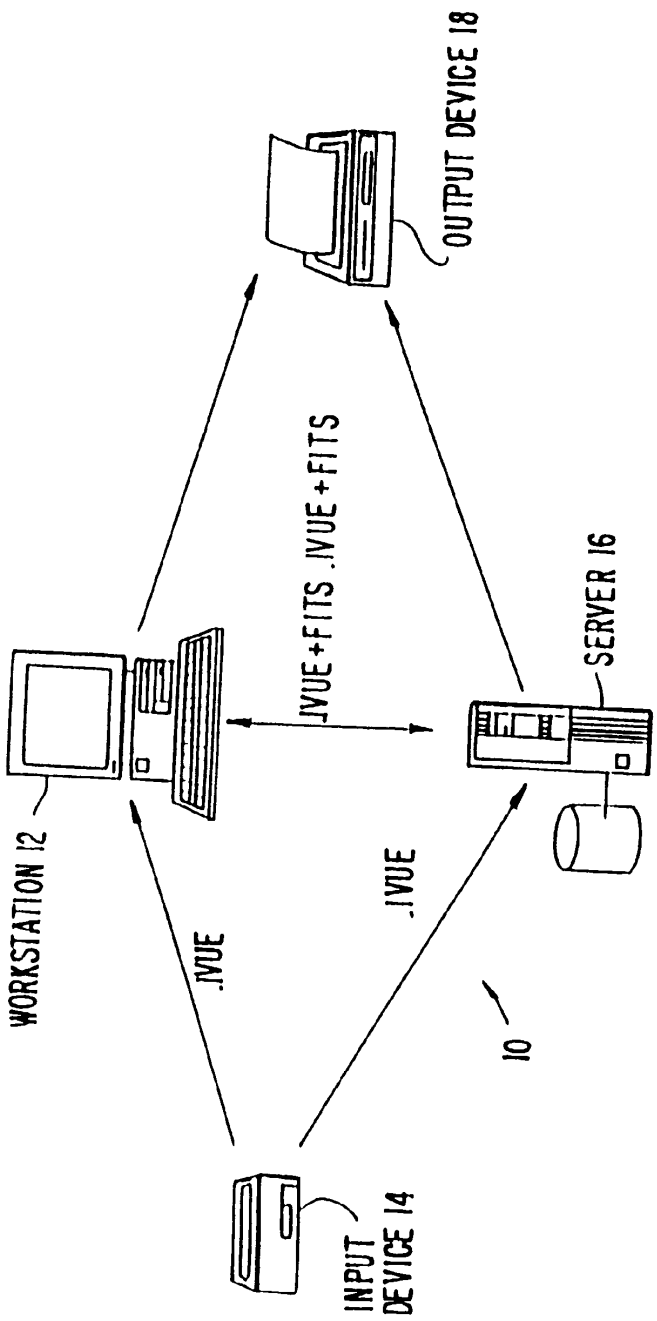

INPUT IMAGES
4
PRE-PROCESSING
.IVUE*
6
IMAGE EDITING
.FITS
8
FITS RIP
OUTPUT IMAGES
IVUE
*FULL IVUE OR COMPRESSED IVUE
2

FIG. 1

FIG. 2


OUTPUT DEVICE 18
.IVUE+FITS .IVUE+FITS
SERVER 16
WORKSTATION 12
.IVUE
.IVUE
10
INPUT DEVICE 14

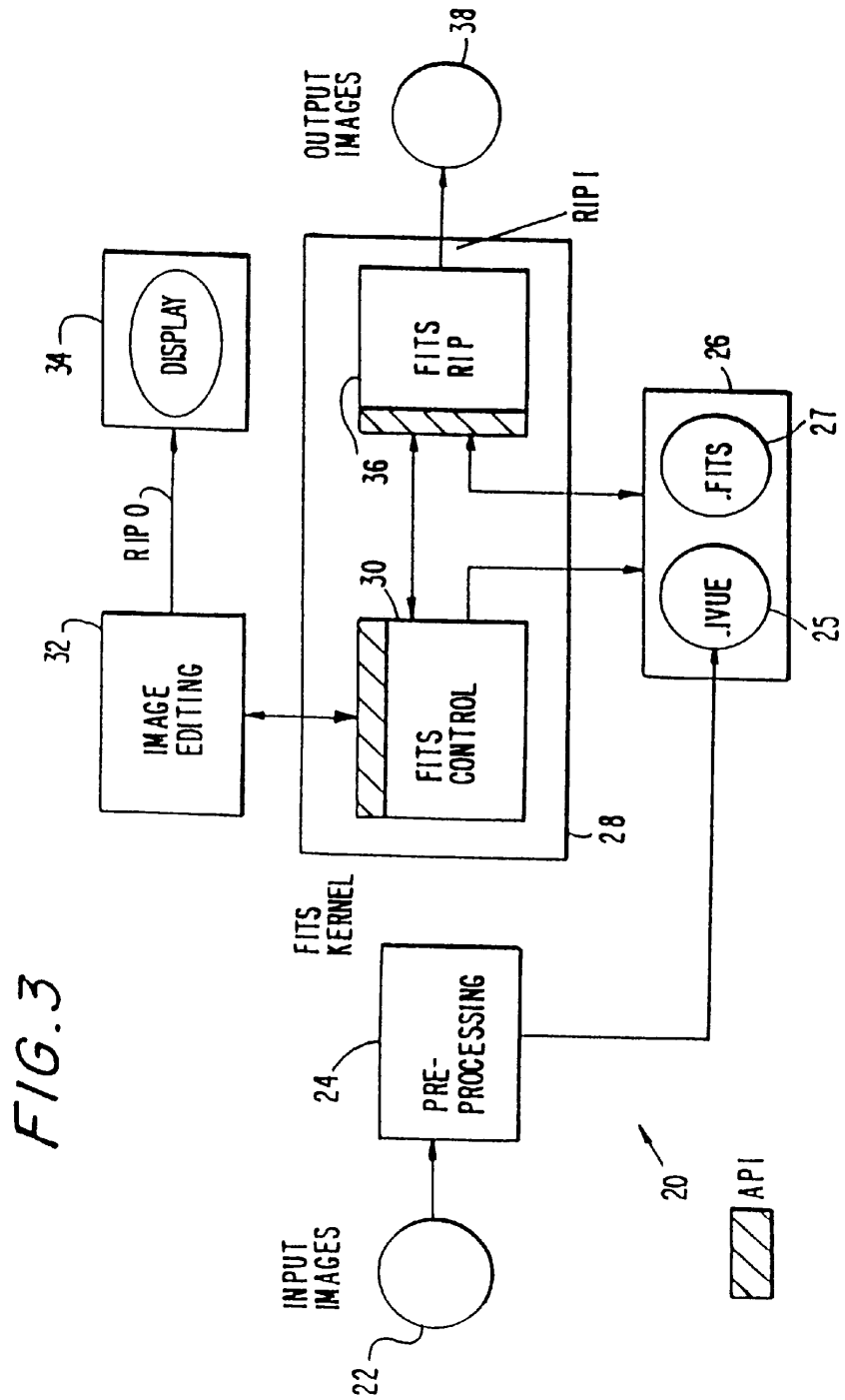
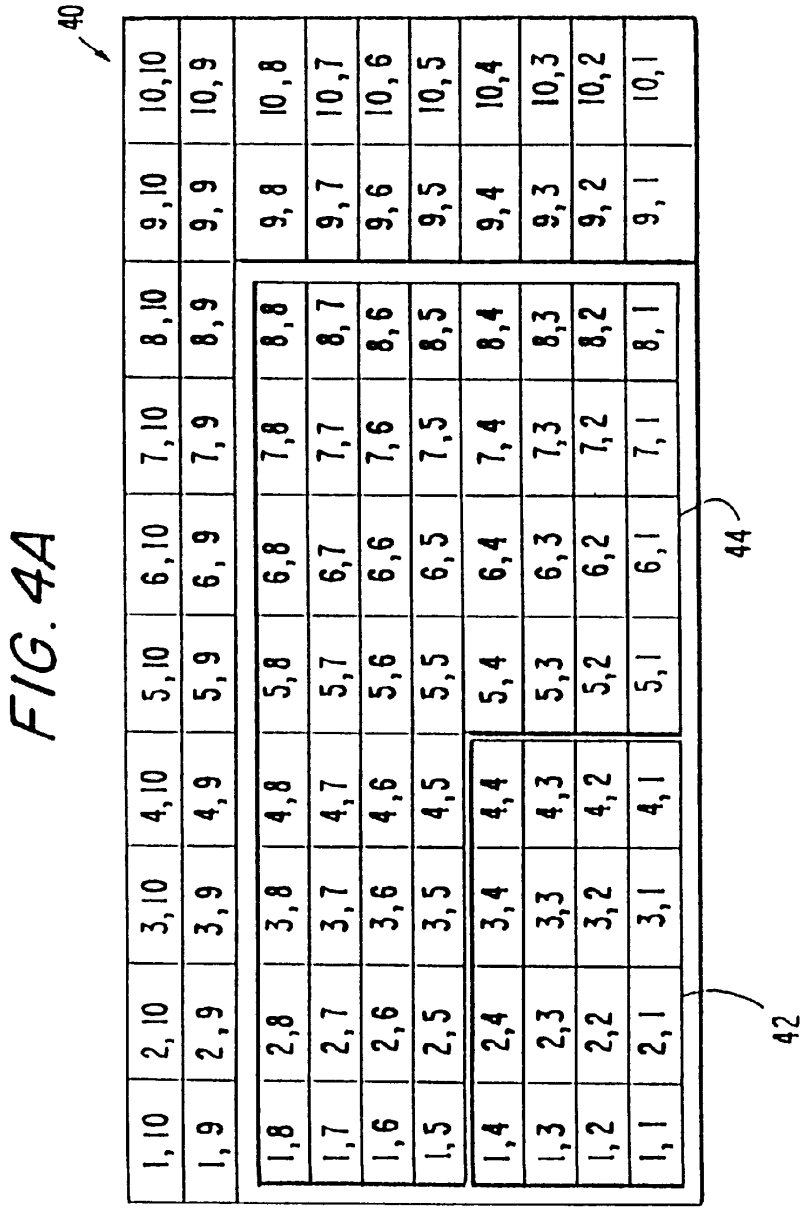

OUTPUT IMAGES
38
RIP 1
FITS RIP
36
DISPLAY
34
RIP 0
IMAGE EDITING
32
30
FITS CONTROL
28
26
.FITS
27
.IVUE
25
FITS KERNEL
PRE-PROCESSING
24
INPUT IMAGES
22
20
API

FIG. 3

FIG. 4A


40
1,10 2,10 3,10 4,10 5,10 6,10 7,10 8,10 9,10 10,10
1,9 2,9 3,9 4,9 5,9 6,9 7,9 8,9 9,9 10,9
1,8 2,8 3,8 4,8 5,8 6,8 7,8 8,8 9,8 10,8
1,7 2,7 3,7 4,7 5,7 6,7 7,7 8,7 9,7 10,7
1,6 2,6 3,6 4,6 5,6 6,6 7,6 8,6 9,6 10,6
1,5 2,5 3,5 4,5 5,5 6,5 7,5 8,5 9,5 10,5
1,4 2,4 3,4 4,4 5,4 6,4 7,4 8,4 9,4 10,4
1,3 2,3 3,3 4,3 5,3 6,3 7,3 8,3 9,3 10,3
1,2 2,2 3,2 4,2 5,2 6,2 7,2 8,2 9,2 10,2
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42
44

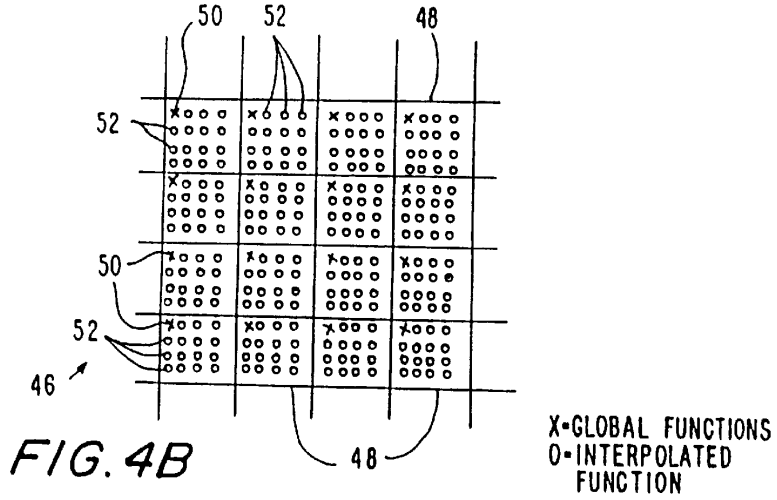

50
52
48
52
50
52
46
48
X-GLOBAL FUNCTIONS
O-INTERPOLATED FUNCTION

FIG. 4B

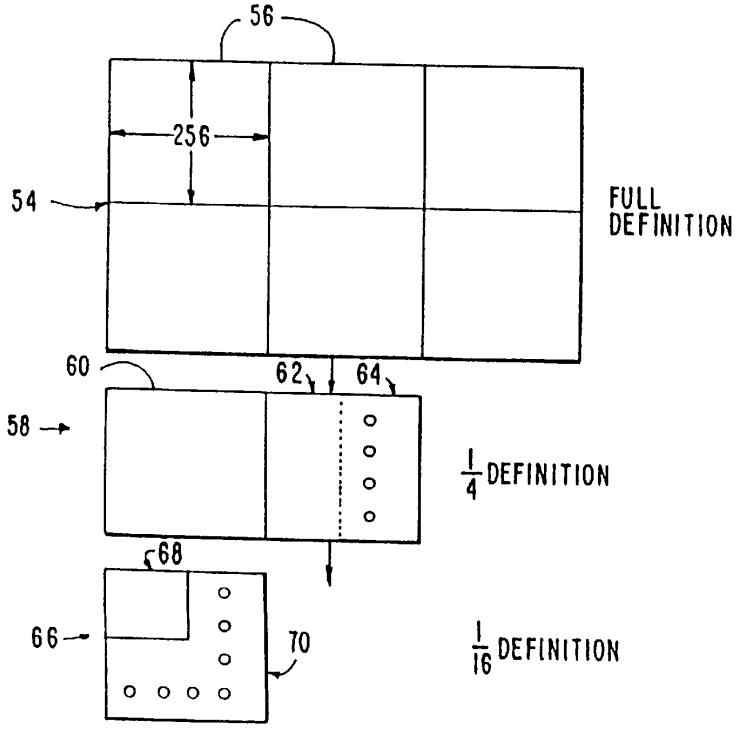

56
256
54
FULL DEFINITION
60
62
64
58
1/4 DEFINITION
68
66
70
1/16 DEFINITION

FIG. 5

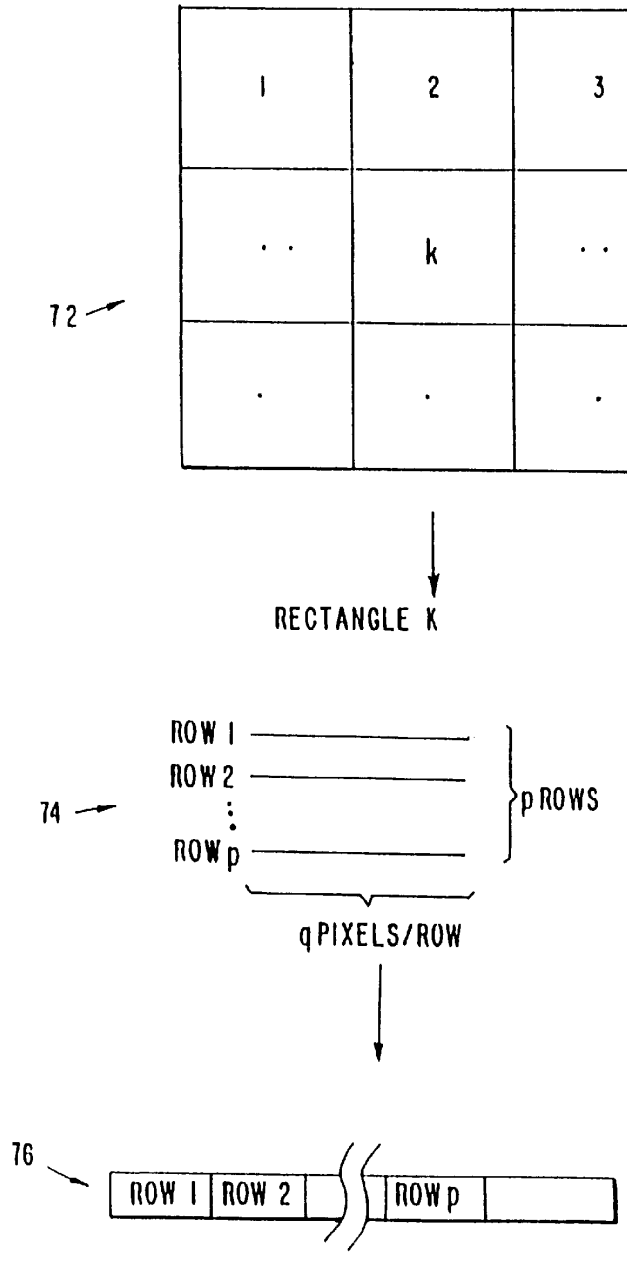

1
2
3
k
72
RECTANGLE K
ROW 1
ROW 2
ROW p
74
p ROWS
q PIXELS/ROW
76
ROW 1
ROW 2
ROW p

FIG. 6

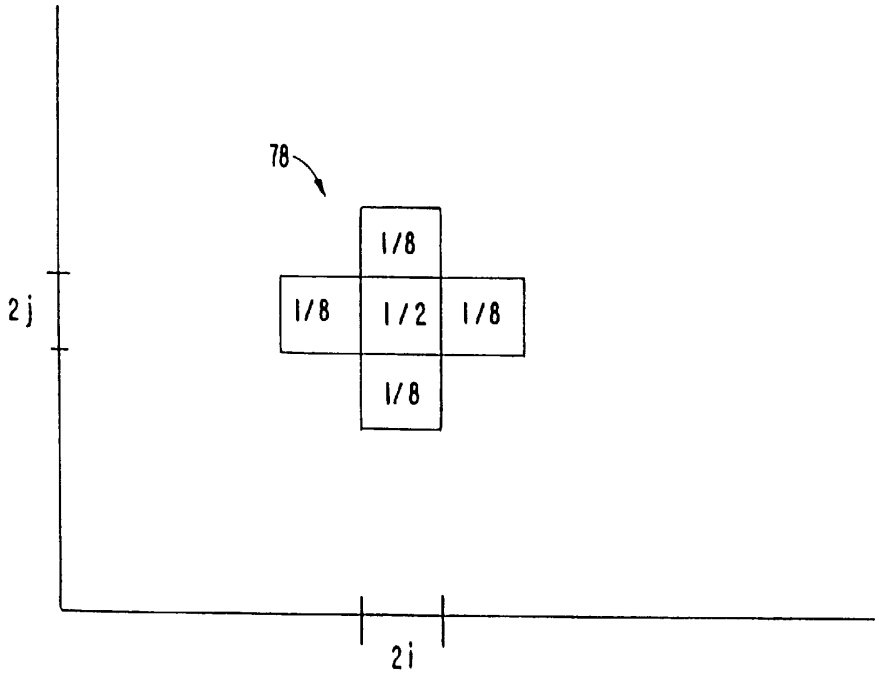



FIG. 7

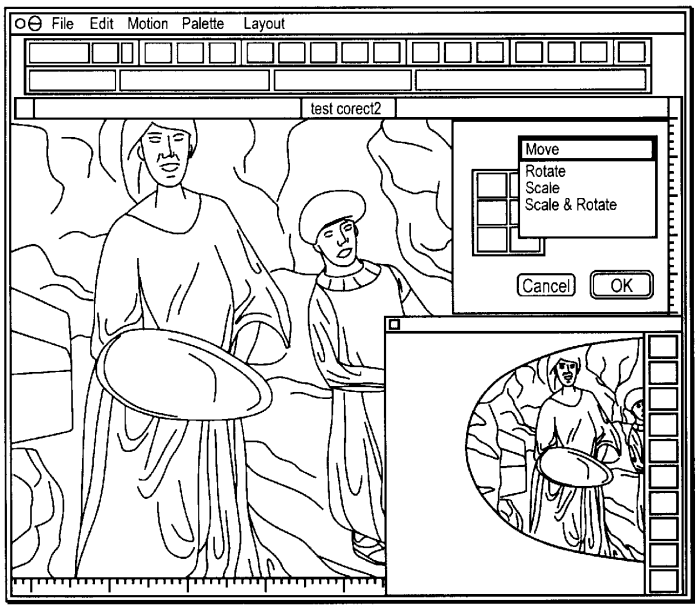

File Edit Motion Palette Layout
test corect2
Move
Rotate
Scale
Scale & Rotate
Cancel
OK

FIG. 8A

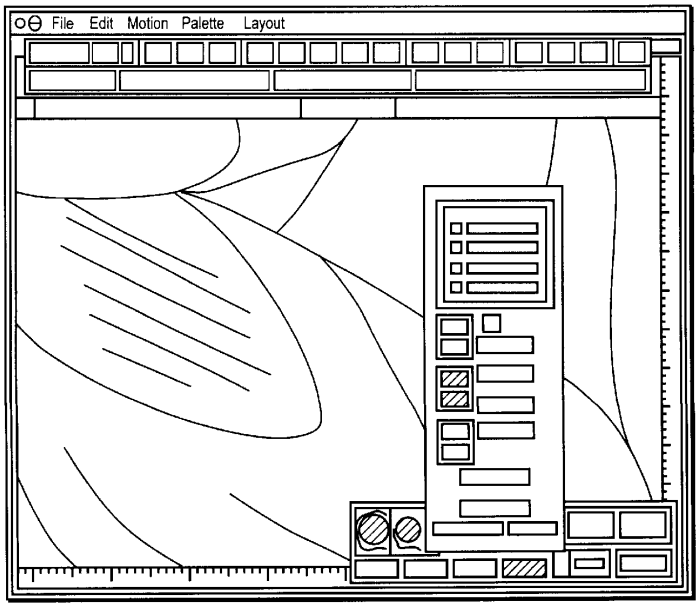

File Edit Motion Palette Layout

FIG. 8B

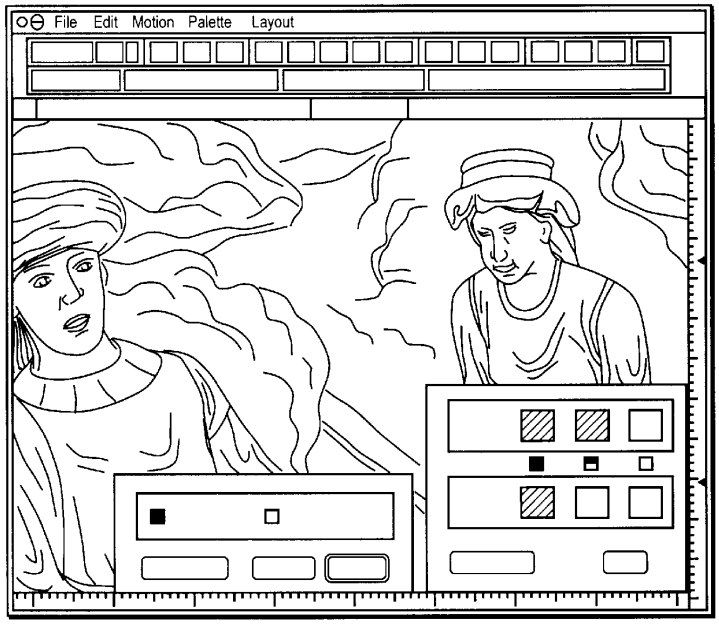

File Edit Motion Palette Layout

FIG. 8C

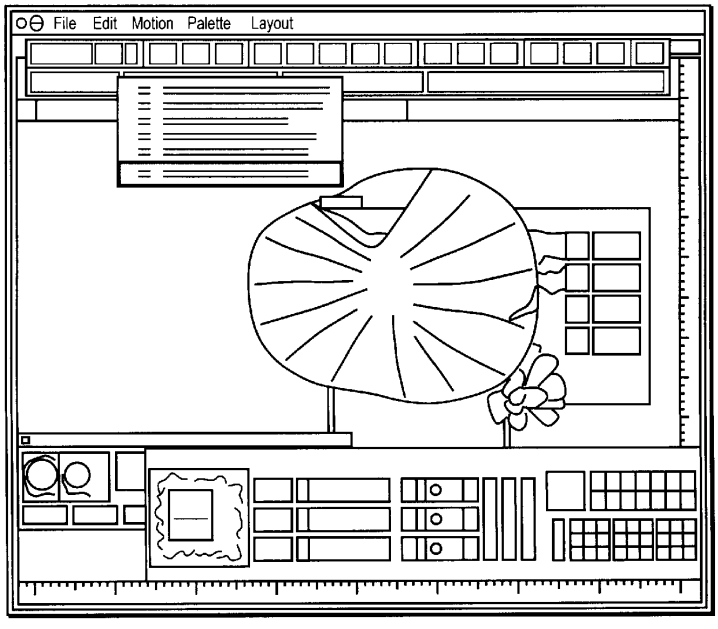

File Edit Motion Palette Layout

FIG. 8D

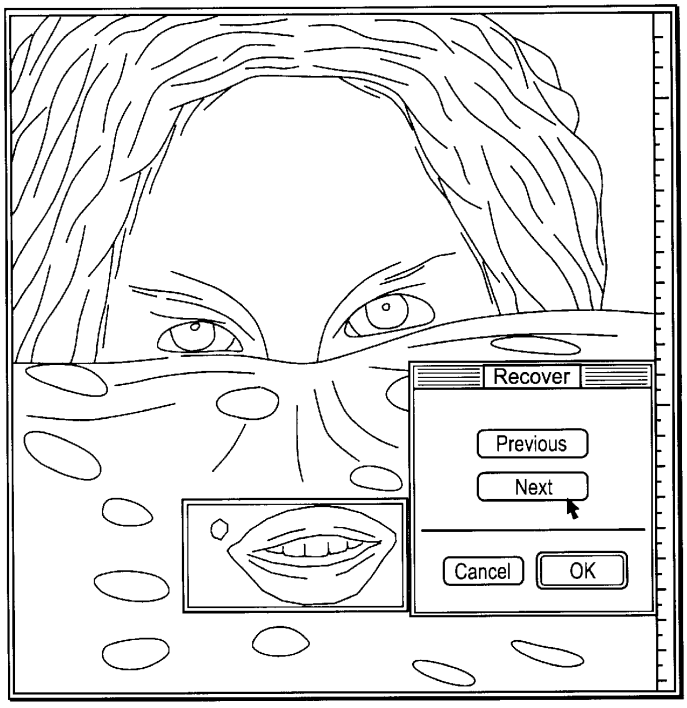

Recover
Previous
Next
Cancel
OK

FIG. 8E

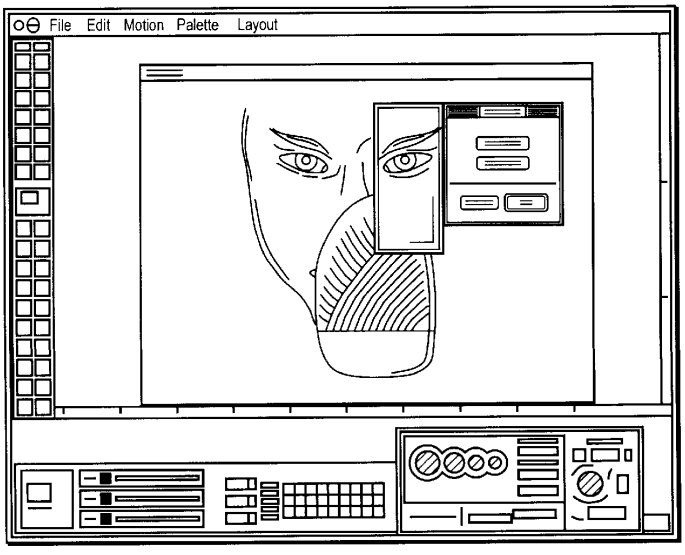

File Edit Motion Palette Layout

FIG. 8F

# METHOD AND SYSTEM FOR NON-DESTRUCTIVE IMAGE EDITING

## CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation of U.S. application Ser. No.08/327,421, filed on Oct. 21, 1994, now U.S. Pat. No. 5,790,708, which in turn is a continuation of U.S. application Ser. No. 08/085,534, filed on Jun. 30, 1993, now abandoned. The contents of both cited applications are hereby incorporated by reference into the present disclosure.

## BACKGROUND OF THE INVENTION

This invention relates to computer processing in general, and more particularly to a method and system for image processing. The patent application claims priority of French patent application No. 93.03455, filed Mar. 25, 1993, the contents of which are herein incorporated by reference.

The present invention was created in response to the shortcomings of the current generation of image retouching systems. Other retouching systems use one of two methods for handling images: (1) high resolution/low resolution (high res/low res), and (2) virtual image. Each of these two approaches overcomes some major obstacles, however neither fully responds to the needs of today's color professionals for high quality, and fast response at an affordable price.

In the high res/low res approach, the complete scanned image (referred to as the "high res" image) is subsampled to yield a much smaller image (referred to as the "low res" image). Because previous image retouching systems did not yield "real time" performance when handling large images (over 10M or 10 million bytes), it was necessary to invent an approach to allow the retouching system work on a smaller, i.e. low res image that would yield acceptable response times for the operator. Using this approach, retouching actions are stored in a script. When retouching is complete, the script is typically passed to a more powerful, and expensive, server and "executed." That is, the actions contained in the script are applied to the high res image, which results in a high quality final image. The disadvantage of this approach is that the operator does not work with the actual image or at highly detailed levels (particularly for a magnified "close-up" of a portion). As a result, it is not always possible to perform highly detailed retouching actions such as silhouetting and masking. Moreover, unpleasant surprises may occur upon execution.

The virtual image approach, commonly used by desktop image editing packages (e.g. MacIntosh or Windows types), manipulates a copy of the actual image held in memory. In some cases, one or more copies; or intermediate drafts are held, enabling the user to revert to at previous copy if an error is introduced. Using the virtual image approach, the image itself is transformed as retouching effects are applied.

The virtual image approach suffers two important shortcomings: first, large amounts of memory are required; and second, each effect is applied immediately to the entire image so that complex manipulation, such as large airbrushing, scaling and rotation, incur long processing delays.

Prior image retouching systems have used large mainframe computers or work stations and proprietary hardware. For example, U.S. Pat. No. 5,142,616, issued Aug. 25, 1992 to Kellas, et al., teaches an electronic graphic system. In this system, data relating to a user-defined low resolution image functions to control an image by the combining other image



data with data defining a low resolution representation of the initial image. Once desired modifications have been achieved, the image is displayed on a display monitor so that a low resolution control image is converted to a high resolution representation. Stapleton, et al., U.S. Pat. No. 4,775,858, issued Oct. 4, 1988, also teaches the use of a large frame store to produce an image of higher resolution than that found on a television screen.

Due to the high amount of memory required for processing, personal computers have proven very slow and marginally acceptable. Moreover, even with larger mainframe systems, there is not always a good correlation between the monitor and the printed image since there is not always a way to visualize the final image on the display device. Thus, discrepancies can be introduced due to differences between screen resolution and print resolution. Other relevant patents include: U.S. Pat. No. 5,179,651 issued Jan. 12, 1993 to Taaffe, et al., U.S. Pat. No. 5,065,346, issued Nov. 12, 1991 to Kawai, et al., U.S. Pat. No. 4,656,467, issued Apr. 7, 1987 to Strolle, U.S. Pat. No. 4,833,625, issued May 23, 1989 to Fisher, et al., U.S. Pat. No. 4,288, 821, issued Sep. 8, 1991 to Lavallee, et al., and U.S. Pat. No. 4,546,385, issued Oct. 8, 1985 to Anastassiou.

Numerous image processing procedures currently exist. Common to all procedures is modification of an image through recalculation operations to irreversibly rearrange dots or picture elements ("pixels") of an original image (or those resulting from the most recent modification) into a new arrangement.

Perhaps the greatest disadvantage of known procedures stems from the image that is displayed on the monitor not being identical to the image that will eventually be printed, rendering the operator unable to see the work as it will actually appear in print. Anomalies and discrepancies can therefore occur in the printed image. Known procedures cannot resolve the fact that the image displayed on the operator's monitor screen is in most cases vastly less defined than the scanned image held in the computer's memory. (This is untrue only in the case of small, low resolution images.) Resolution (as measured in dots per inch) of modern display monitors is far less than the resolution of printed color images.

A second and perhaps equally important disadvantage of known image processing techniques is that the image editing effects are applied sequentially, i.e. step-by-step. This incurs a severe degradation in the quality of the original image if many image editing effects are applied to the same portion of an image.

Operations carried out on an image usually require a high degree of processing power. If processing power is unavailable, then the time required to carry out the operation becomes unacceptably long, thus reducing the scope and sophistication of possible operations to be carried out on the image. For example, airbrush strokes are currently extremely limited in size as a result of the extreme processing power needed to calculated image changes.

The irreversible nature of image processing using known procedures precludes the operator from easily implementing any second thoughts. Presently, the only way to correct an airbrush stroke which does not achieve a desired effect is to superimpose a new stroke (instead of merely erasing the unsuccessful stroke). Alternatively, computers equipped with large memory can save intermediate steps. However, this requires a huge amount of memory (e.g., a single 8½"×11"×300 dots per inch (dpi) figure requires over 33 million bytes).

The present invention overcomes these shortcomings and permits rapid and powerful editing functions even on less powerful desktop computers, by employing at least one, more preferably two and most preferably three new and independent processes: preprocessing, image editing, and raster image processing.

The subject invention advantageously uses what I call a Functional Interpolating Transfer System (FITS) to greatly speed editing of an image on standard microcomputers, thus eliminating the need for expensive workstations or special hardware. FITS breaks down image processing into three steps: preprocessing, image editing and FITS raster image processing. This results in a virtually instantaneous response and eliminates waiting for file saving or processing updates. With this technique, limits on file size and resolution disappear.

Preprocessing in the invention (brand name "FITS") involves creating a specially formatted version of an image which allows image editing to progress at rapid speed.

Image editing refers to the process of retouching, combining or otherwise modifying images, to create the final desired image. Image editing involves, in the broadest sense, all processing operations performed on an original image. This includes the combining of images, effects such as sharpening, blurring, brightening, darkening, distortion, and include modifications to the color or appearance of all or part of a original image.

Color changes may be achieved in a variety of ways including global changes to the chromatic range of the image, or selective change to individual colors, e.g. changing blue to red.

Raster image processing ("RIP") is performed in two instances: (1) each time a new screen view is generated for display on a monitor, and (2) when an output page is generated for the purpose of printing or incorporated into another system such as a desktop publishing system. FITS raster image processing combines the input images with the modifications generated in the second stage (image editing) to create either a screen or print image. The output image generated by the FITS RIP can have any resolution; thus it is said to be resolution independent.

FITS raster image processing ("FITS RIP") involves taking the ensemble of image manipulations (the various steps or "layers" of changes) that are performed during the image editing process and computing a single image for purposes of printing or display on a monitor. Modifications to the image, made during image editing, are characterized in a manner that is independent of the resolution of the input images or final output image. During a FITS RIP, layers are first combined mathematically for each pixel or selected pixels in the desired image, rather than by applying each layer successively to the original images. For each final pixel, a single mathematical function is generated that describes the color, in an arbitrary color space, at that point. If as preferred, only a sample of pixels are fully computed for each layer of change, the color values of intermediate pixels are computed by averaging the mathematical functions of the neighboring pixels and applying that function average to the original pixel's color, rather than simply averaging the color values of the surrounding pixels. This approach results in a time savings in overall image handling and a higher quality resulting image.

In the FITS approach, the image editing actions are characterized by parameters to mathematical functions and these are stored layer-by-layer in a file separate from the original image(s). Each intermediate modification to the image is effectively saved in a layer and each layer can be independently modified, deleted or reordered. The parameters can be stored for points in a grid that is itself independent of the "dots-per-inch" resolution (dpi) of either the original imported images, or the final output images. As a result, images for display or print can be generated at an arbitrary resolution.



Substantially less memory is required during image editing than with the virtual image approach since only the changes to each layer are stored, not entire image each time. As a result, a sophisticated, heavily retouched new image consisting of over 10 layers can be described in a FITS file of 2–5 megabytes (2–5M), as compared with over 30M (megabytes) for existing virtual image systems to store a 1 page new image (at 300 dpi resolution). Thus, the FITS approach yields a 10 to 1 average savings per page of image, and substantially more for larger images or higher resolutions. Note that 600 dpi images are now quite common for high quality publishing, and this is likely to increase in the future.

To sum up, current computerized image processing for obtaining a high definition image suffers from the dual disadvantages of requiring extremely high processing power, a limitation of productivity and creativity for the operator due to the irreversibility of image editing steps, and the quality restrictions inherent in a pixel-based approach.

The subject invention, on the other hand, provides a computerized image processing procedure which enables the operator to rapidly carry out advanced graphic operations, and to reverse decisions as required—without in any way affecting the definition or precision of the final image.

## SUMMARY OF THE INVENTION

The invention provides an image processing system for the creating and editing images that are resolution independent and characterized by a series of layers, or image objects, that can be combined together to yield an output image, at any resolution, for display or print. The new method of image processing in a computerized system creates a high performance image representation, that yields much faster image processing by supplying data defining an original image into the system and reorganizing the original image data.

One aspect of this method (pre-processing, which I call "IVUE" format) comprises the following steps: (1) supplying data defining the original image into the system, (2) assigning pixels from the original image to pixels in the new image format in such a way that the new image is organized in groups (preferably rectangles and most preferably squares), each of which can be individually compressed (using JPEG or another compression algorithm) to yield reduced image size and faster access over a network, (3) creating a second, lower resolution, image by averaging groups of pixels falling within a first predetermined area (or neighborhood) into an averaged pixel, and performing this computation across the entire original image; this second image is also organized in groups, e.g. squares, (4) repeating the previous step, and thereby creating succession of decreasing resolution images, which are stored adjacent to the first two, until a number of pixels less than or equal to a preselected number of pixels remain, and (5) saving the resulting image representation on a storage device.

Also provided is a method for image processing in a computerized system that involves applying changes to one or more original images as a series of "layers" in which the

changes are recorded as resolution-independent mathematical functions. This approach has the property that only the final result of the retouching effects in a layer needs to be calculated or characterized and the effects are wholly or partially reversible. The layers themselves are independent and may at any time be modified, deleted, or reordered. The changes in each layer are generally characterized in a way that is independent of resolution.

This aspect of the method comprises the following steps: (1) for a layer 1, 2, 3, etc., generally number "i", displaying the results; of the image processing up to and including all effects applied and original effects inserted for the "i−1"th layer (e.g. 5th layer) (2) recording all effects applied in the ith layer (e.g. 6th layer) as parameters to mathematical functions that define the effect, so that for each pixel in the displayed image that is modified there is a single function that describes the resulting modification, (3) when the operator terminates processing of the ith layer these parameters are saved along with the parameters that describe changes to the preceding i−1 layers.

Also provided is a method for image processing in a computerized system that enables a raster image to be computed, either with the ability of displaying the image on a computer monitor or for printing the image.

This method involves: (1) sampling an original image to be processed with a definition grid so as to retain a predetermined number of dots from all of the dots contained within the original image, the predetermined number being equal to or less than the number required to either display the result on a computer monitor or to generate an output file destined to be printed; and (2) for each dot in the grid to generate a single mathematical function that represents the cumulative effect of all the layers in the image at that point. This is done by processing the resulting image into elementary recurrent operations each broken down into three parts and providing, based on the result of the previous elementary operation, these three parts added to each other, (3) filling in sufficient additional dots, or pixels, within the grid to reach the required resolution for screen or print by interpolating the functions at the surrounding gridpoints to obtain a single function that can be applied to intermediate pixels and will yield an interpolated color value for that pixel, (4) computing the color value results for each pixel, and (5) either printing or displaying the result, or storing the result on a computer storage device.

The invention may use a method of image processing in a computerized system, comprising: (a) supplying data defining an original image into the system, (b) assigning pixels from the original image to pixels in a new first image format so that the first image is organized into groups of pixels, each of the groups being individually compressible to yield a reduced size image, and (c) reducing the number of assigned pixels to form a reduced resolution image by averaging (preferably using a Gaussian function to weight the average for pixel proximity) a particular number of adjacent pixels falling within a first (preferably predetermined) area into a first averaged pixel, organized by the groups of pixels, and performing this computation across the entire first image format, to form a reduced definition image.

This method may (and preferably does) further comprise reducing the number of the first averaged pixels by averaging groups of pixels falling within a second predetermined area into a second averaged pixel, organized by the groups of pixels, performing this computation across the entire second image format, and (preferably) repeating this step until a preselected or lower number of pixels remain, the remaining pixels forming a reduced definition image. Data defining the reduced definition image may be modified by a user to obtain a desired result and the system or user may save a copy of the data or mathematical functions defining the pixels that form the desired result. Moreover, the data defining the original image may be added to the data defining the pixels forming the desired result, and forming an image from the added data.

The invention may also include a method of raster image processing which includes: (a) adding data defining an original image to data defining modifications to a reduced definition image, and (b) forming an image from the added data. Preferably, this is accomplished by a computerized system which comprises: (a) means for adding data defining pixels forming an original image to data defining modifications to a reduced definition image, and (b) means for forming an image from the added data.

The invention may also include a computerized system for image processing, comprises: (a) means for assigning pixels from an original image to pixels in a new first image format so that the first image is organized into compressible groups of pixels, and (b) means for reducing the number of assigned pixels to form a reduced resolution image by averaging a particular number of adjacent pixels falling within a first (preferably predetermined) area into a first averaged pixel, organized across the entire first image format, to form a reduced definition image. Preferably, means are provided for reducing the number of the first averaged pixels by averaging groups of pixels falling within a second predetermined area into a second averaged pixel, organized by the groups of pixels, performing this computation across the entire image format, and repeating this step until a preselected number of pixels remain, the remaining pixels forming a final reduced definition image.

## BRIEF DESCRIPTION OF THE FIGURES

FIG. **1**—A schematic representation of processing steps of the invention.

FIG. **2**—A schematic representation of interconnections between system hardware.

FIG. **3**—A schematic representation of software architecture.

FIG. **4**A—A numerical/graphic illustration of a pixel reduction grid.

FIG. **4**B—A schematic illustration of a pixel reduction grid.

FIG. **5**—A schematic illustration of the IVUE format.

FIG. **6**—A schematic illustration of the FITS reduction.

FIG. **7**—A schematic illustration of **2**i×**2**j density functions.

FIGS. **8**A–F—Depictions of computer monitors showing the invention in use.

## DETAILED DESCRIPTION OF THE INVENTION

To aid in understanding the invention, the following overview is provided:

The subject invention was created in response to the shortcomings of the current generation of image retouching systems. The current common personal computer approach, often referred to as virtual image, manipulates a copy of the actual image, which is held in memory.

Functional interpolating transformation system (FITS) takes a radically different approach in which the underlying

image is preserved, and changes are recorded in separate layers in a file, named FITS. By processing only changes to the current screen, FITS computes only what is needed, when needed. Further, all modifications are resolution independent and can be used to generate output images at any level of resolution (commonly measured in dots per inch or dpi). FIG. **1** shows an overview of the FITS model, FIG. **2** depicts the interaction of hardware involved, and FIGS. **8**A–F show the system in use.

When image editing is complete, the operator initiates a computation which applies the changes across the entire image. This final processing is termed FITS raster image processing (RIP) and is vaguely analogous to Postscript raster image processing (a system for generating the raster image that corresponds; to pages of printed information described using the Postscript language).

Unlike many high-end and mid-range color systems that oblige the operator to work with a low-resolution image, FITS operates in high-resolution, i.e., the operator may at any time access any information contained in the original image(s) without being limited by the FITS processing approach.

The subject invention will now be described in terms of its preferred Embodiments. These embodiments are set forth to aid understanding the invention, but are not to be construed as limiting. Moreover, the invention includes using only some aspects, or indeed, only one aspect, of the most preferred method.

The new image processing system is for creating and editing images that are resolution independent where the images are characterized by a series of layers that can be combined together to yield an output image, at any resolution, for display or print. Note that the term "layers" can also refer to image objects that are managed independently and combined in pixel format for purposes of output.

The general expression for characterizing an image, using this approach, is as follows:

$f_n(x,y)$=a combination of one or more of such components as:

external image(s)
position independent terms
position dependent terms
$f_{n-1}(x,y)$ or prior layers

Where $f_n(x,y)$ is the color value of a point of an image, in an arbitrary color space (e.g. RGB, or CMYK), at a layer n.

External image—may be any external image. In FITS, these images are preferably transformed into IVUE format for fast processing. Generally, however, the images may be in any format.

Position independent terms—these are modifications which do not depend on the position of the image element. For example, a color applied in a layer to the entire image.

Position dependent terms—these are geometric transforms, color modifications, etc. supplied selectively to different regions of the image. $f_{n-1}(x,y)$—the function that describes the color in the preceding layer.

The color value of a point (x,y) in layer n may be defined by a single mathematical function which combines an external image or images, position dependent terms, position independent terms, and the function defining the point (x,y) for the preceding layer.

THREE STEPS

FITS comprises three independent processes: preprocessing, image editing, and FITS raster image processing (FITS RIP). FITS is overviewed in FIGS. **1** and **6**. FIG. **3** illustrates the software architecture.

Prepossessing. Initially, the input image, in TIFF or another standard format (such as Postscript), is reorganized to create a specially formatted new file, termed IVUE. The IVUE file is used during image editing and also during the FITS RIP. It is reorganized in such a way that a new screen full of image data may be quickly constructed. The screen's best resolution can be used, both for the full image and for close-up details. As an option, a second IVUE file may be created that is compressed using conventional methods, such as JPEG, or by other methods. The IVUE file contains all of the original image data.

The image is divided into squares. Each of the squares in each of the various image representations within the IVUE file may be individually compressed (see FIG. **5**). This is a unique approach since other image processing systems compress the entire image. The resulting file, termed .IVUE/C, is considerably smaller than the original file. The actual size of the file depends on the compression level used to generate the IVUE file. Average compression will yield an 8 to 1 average reduction in the size of the image. In a first product to be based on this invention, to be called Live Picture, for example, three compression levels may be selected when creating the IVUE file.

Saving the IVUE sampled files together with the original file takes up only about 30% more space than the original alone. For example, for ¼ sampling with the original being assigned 1, the memory required is $1+¼+1/16+1/64+1/256$ . . . or approximately 1.3 times the original file size.

FIG. **4**A shows a 10×10 pixel box in which each of the pixels are identified by a column, row number. The smaller enclosed box is a 4×4 matrix which is reduced to a single point. One way to complete the reduction, or apply the FITS layer to do the RIP, is to select an origin point (in this case, 1,1, is selected). Two points are then selected outside of the box along the column and row, as depicted, point 1,5 and 5,1. By knowing these three pixels, each of the pixels in the box can be identified by a simple division by two. For example, pixel 1,3 can be determined by averaging 1,1 and 1,5. By thinking of column 1,1–1,5 as a vector and row 1,1–5,1 as another vector, each of the pixels can be identified and reconstructed. Another advantage to this system of picking two points outside of the 4×4 pixel square is that a redundancy exists. Returning to FIG. **4**A, pixel 1,5 acts as the origin for the 4×4 box above the initial box described. Again, the 5,1 pixels serves as the origin for the next 4×4 pixel box. Turning now to the larger black line square, (having corner points 1,1, 1,8, 8,8, and 8,1, this 16×16 square will after the first set of reductions, be a 4 pixel square which can be handled in much the manner described above. Once the 256 pixel square remains, or some other predetermined sized square or area, the next step of image editing can occur. Alternatively, the IVUE sampling to make a lower resolution image can average 4 pixels to make 1, or sample a large group using weighting (e.g. Gaussian) to achieve any desired ratio or compression.

A compressed image can be stored either on the operator's workstation or on a network file server. This approach greatly reduces the disk requirement. In addition, when the IVUE/C file is held on a file server, network delay in accessing the image is minimized since FITS accesses the IVUE file one screen at a time.

There are two principal advantages of using this compression: (1) only the IVUE file is used during image editing; thus, use of a compressed file decreases the disk requirement on the retouching station, and (2) during image editing, FITS accesses the IVUE file one screen at a time; thus if the image is on a network image server use of the

compression option will greatly reduce operator wait times induced by network delay.

The JPEG (or the like) compressed image is used only during the screen editing step, where the quality of the compressed image is perfectly acceptable. However, the full image, also in IVUE format, is used during the FITS RIP, in order to obtain the highest quality image. So while JPEG may be used to improve speed and memory, it does not lessen the quality of image. This last point is key because many people incorrectly assume that the use of JPEG will degrade image quality.

Preprocessing to IVUE format is fast; for example an A4 image takes approximately 1½ minutes on a Mac Quadra. Generally, a TIFF image is reprocessed at the rate of ½ megabyte per second.

The following method may be used to generate an IVUE image, which comprises a succession of reduced resolution images each of which is stored as a rectangle.

1) The original image, in a standard or proprietary image format is opened (i.e., accessed on a storage device).

2) The original image is used to create the first, full resolution image in the IVUE file. It is preferably stored as a succession of p pixel×q pixel rectangles. Each rectangle then contains p×q pixels, that is each rectangle can be considered as a series of p rows, each containing q pixels. The rectangles are stored sequentially on disk and for each square (to simplify further) the rows are stored sequential (row 1, row 2, row 3, . . . row p). (See FIGS. **4**A, **4**B and **5** for organization of rectangles). Each rectangle may be encoded using JPEG or another compression scheme.

3) A subsequent, reduced resolution image is created from the previous image, if there are more than p×q pixels in the previous image. Essentially, a neighborhood of pixels in the original image are averaged to provide a single pixel in the second image. The image is reduced in each dimension, x and y, by a factor of 2 (or whatever is selected) yielding a 4 to 1 reduction in size for the subimage.

The general computation for computing $f_{n+1}(i,j)$, the pixel at point i,j in the n+1st subimage is:

$$f_{n-1}(i,j)=\int \xi(x,y)\cdot f_n(x,y)\ dxdy$$

in which:

- $\xi(x,y)$ is an arbitrary probability density function intergrating over the entire space of real numbers, i.e. a weighting function, that takes into account the contribution of the neighboring area. Thus we may consider $\xi(x,y)\ \epsilon v(2i,2j)$ or a selection of elements in the vicinity.
- $\epsilon$ is an element of.
- v is a neighborhood of, and thus v(i,j) is the neighboring area of the point i,j.

As a density function, $\xi(x,y)$ satisfies the following:

$$1=\int \xi(x,y)\ dxdy$$

$$0<\xi(x,y)<1 \text{ for all } (x,y)$$

The presently preferred weighting function is a Gaussian density function . However, other functions may be used as well.

As an example, the neighboring weighted average has been implemented on a computer as depicted in FIG. **7**. In this case:

$$f_{n+1}(i,j)=\tfrac{1}{2}(f_n(2i,2j))+\tfrac{1}{8}(f_n(2i-1,2j))+\tfrac{1}{8}(f_n(2i+1,2j))+\tfrac{1}{8}(f_n(2i,2j-1))+\tfrac{1}{8}(f_n(2i,2j+1))$$

Alternatively, an equation which may be used for computing $f_{n+1}(i,j)$, the pixel at point i,j in the n+1st subimage is:

$$f_{n+1}(i,j)=\int \xi_{2i2j}(x,y)\cdot f_n(x,y)\ dxdy$$

where

- $\xi_{ij}(x,y)$ is the probability density function for pixel (i,j) at point (x,y). Usually, (x,y) is near to the origin point (i,j), that is in the "neighborhood." Thus E is the weight (such as 50% for near points, 20% for more distant points) of any particular neighbor point x,y relative to the "home base" or origin of i,j. The weights are set up to total 100%, and so that E is positive (not zero) in the defined radius of the neighborhood (which can but need not include the whole image). Once E goes to zero, there goes the neighborhood, that is, points at or beyond that distance are not weighted in. Thus

$$1=\int \xi_{ij}(x,y)\ dxdy \text{ for all } (i,j) \text{ and}$$

$$0<\xi_{ij}(x,y)<1 \text{ for all } (x,y)$$

This new, reduced image may be stored in rectangles of p×q pixels as well.

4) The third step may be repeated, creating a succession of images, each (say) ¼ the size of the last, until a subimage of less than p×q pixels is created. This is the last subimage. If this last subimage contains less than p×q pixels, the remaining pixels may be filled from the neighboring squares or may be set to 0.

5) The entire image format is saved on a storage device.

Image editing. Image editing refers to the process of retouching, creation and composition of images. The operator successively applies effects such as blur, smooth, and transformations such as rotation and scaling. Additional images can be inserted at any time and, if desired, with transparency and masking.

Each editing action is represented by a mathematical function and recorded in a file named FITS. The FITS file can be considered as a database of commands or layers, and is a very compact representation.

FITS implements types of layers, referred to as FITS modes. For each mode a set of actions are available and can be freely applied. In Live Picture, the operator will be able opt to initiate a new layer at any time, and when a new mode is selected, a new layer is automatically created and all subsequent actions are contained within this new layer (until a new layer is created).

FITS modes include: image insertion (insertion of a scanned image), painting, pattern, filters, lighting effects, mirror, linework and plug-in (i.e. a layer defined by an arbitrary application). Text is treated as a special case of linework, since it can be composed of Bezier curves. In fact, there are two types of image insertion modes: standard and advanced. The advanced mode offers the opportunity to distort the image at the price of additional processing and a slight decrease in response time.

With FITS, each image editing action is represented by a mathematical function. When the operator finishes working on a layer, the parameters of these functions are recorded in a file named FITS. Only the resulting aggregate modifications to the underlying image are recorded. If, for example, the operator applies an effect and then erases it then nothing is stored. Or, an artist may use hundreds of brush strokes to create a complex painting, yet the FITS representation describes the resulting painting and not the sequence of brush strokes used to create it.

Thus, FITS typically only records the final effect and not necessarily each image editing action. This saves processing time and also results in a very compact representation of the image editing session within a FITS file. For example, if an A4 image, stored in a 35 Mbyte file is heavily retouched, in (ten or more layers), the FITS file will only grow about 2–5 MB.

The FITS retouching file may be saved at any time, and may later be reused or modified. At any time, either during the image editing session, each layer can be accessed and re-edited.

FITS Raster Image Processing (FITS RIP).

The invention provides a computerized procedure for creating a raster image. This procedure is used both to create a new view of the image on a computer monitor and to create a high resolution output image. The procedure preferably has the following characteristics:

Based on the area of the image to be raster image processed (IZIP'ed), which is generally determined by the operator, a definition grid is constructed in such a way as to retain, from all the pixels to be processed, points equal at the most to the number that can be displayed on the monitor screen, For fast processing, a ratio of 1 dot to 16 pixels can be used. The area to be RIP'ed refers to a portion or all of the image to be displayed or processed for printing. The objective is to compute the color value resulting from the superposition of a series of layers. The color value is in an arbitrary color space. Commonly, this is in either the color-space named RGB, defined by the three primaries red, green, blue, or in CMYK, defined by the three colors cyan, magenta, yellow and an additional value for black.

For one point in each definition grid, the general expression for the color value of that point is computed. In practice, a simplified form of the general expression is generally used that can describe most image editing actions. This form is termed "elementary operation" and it has the advantage of being relative simple to compute.

The elementary operations are broken down in turn into three stages and when combined a new result (layer i), based on the result of the previous elementary operation (layer i–1). The three stages are:

- first, the adoption in the new layer (i) of a color dot (x,y) from the previous layer (i–1) with a weighing ($\alpha_i$) ranging from –100% to 100% (i.e., margins from +1 to –1 and including positive and negative value),
- second, the importing of an external image ($I_i$) into the layer i, that is, the importing of a color dot from the image (Ii), after chromatic and geometric transformation ($P_i(x,y)$) of this dot to add it to the color dot (x,y) of the layer (i), the degree of replacement of the dot of the layer (i) by the dot imported from the image ($I_i$) being defined by a scalar $\beta(x,y)$ with values from –100% to 100%.
- third, an additional color term $\gamma i(x,y)$ applied to the dot (x,y) of the layer (i). This term may take into account painting or other chromatic effects.
- each elementary operation (i) being defined by the equation taking account of the previous layer or operation (i–1):

in which:

$$\phi_i(x,y)=\alpha_i(x,y)\cdot\phi_{i-1}(x,y)+\beta_i(x,y)\ I_i[P_i(x,y)]+\gamma_i(x,y)$$ or alternatively:

where

$$\phi_i(x,y)=\alpha_i(x,y)\cdot\phi_{i-1}(x,y)+I_i[P_i(x,y)]+\gamma_i(x,y)$$

$\alpha_i(x,y)$ is; a scalar function of the dot (x,y) corresponding to the presence at this dot of the image resulting from the previous elementary operation $\phi_{i-1}(x,y)$,

$\phi_{i-1}(x,y)$ is a function representing the previous elementary operation,

$\beta_i(x,y)$ is scalar function corresponding to the presence at dot (x,y) of a clot corresponding to the imported image,

$I_i$ represents the imported image made up of a set of dots,

$P_i(x,y)$ represents geometric transforms, including rotation, scaling, distortion and may also include chromatic transforms of imported dot x,y,

$\gamma_i(x,y)$ is an additional position dependent term that can affect the color value of pixel (x,y),

Each of the terms $\beta_i(x,y)I_i[Pi(x,y)]$ and $\gamma i(x,y)$ may be nil, while the term $\alpha_i(x,y)\ \phi_{i-1}(x,y)$ should generally never be nil for all the dots (x,y). There is generally no part in observing all of the prior image.

Due to the form of the elementary operations, they can be combined to yield a global function that has a simple structure. The global function, defined below, defines the color value at point x,y for an image composed of a number of layers:

$$\left(\sum_{j=1}^{j=q}[\alpha_j(x,y)\cdot I_j[P_j(x,y)]\right)+\gamma(x,y)$$

or alternatively

$$\sum_{j=1}^{j=q}[\alpha_j(x,y)\cdot I_j[P_j(x,y)]+\gamma(x,y)$$

or alternatively

$$\sum_{j=1}^{j=q}\alpha_j(x,y)\cdot I_j[P_j(x,y)]+\gamma(x,y)$$

q=number of imported images that make a visible contribution at point x,y,

in this global function:

$\alpha_j(x,y)$ is a scalar analogous to the scalar $\alpha_i(x,y)$ of a elementary function and $\alpha_j(x,y)$ .neq. 0(not equal to zero at at least one point).

$I_j$ represents an image or layer j to import

$P_j(x,y)$ is $P_i$ an import function analogous to the previous import functions $P_i(x,y)$

$\gamma(x,y)$ is a chromatic function analogous to chromatic functions $\gamma_i(x,y)$,

in this procedure, the global function can be generated, but not yet computed, for one point within each grid (depicted in FIG. **4**).

since the grid represents a subset of the pixels required for the RIP, it is necessary to generate the remaining points, within each grid. For each additional point in the grid a new function is created by interpolating the function between the two nearest points where the global function has been computed. This process is termed functional interpolation. The simplest form of the function is to created a weighted average based on distance.

As an example, assume the grids are 16×16 and the global function has been created for dots (1,1) and (1,17). Further, that the global function at dot (1,1) yields cos(x,y) when simplified and the global function at dot (17,1) yields sin(x,y) when simplified. Then the interpolated function at point (1,8) will be (9/16)cos(x,y)+(7/16)sin(x,y). If the use of a 4×4 box is employed, and points 1 and 5 computed, the

computer is very fast. Point 3 is a simple add and divide by 2 of points 1 and 5. Point 2 is the same average of points 1 and 3. See FIG. **4A**.

the functions that have been obtained for each pixel, some being global functions and some being interpolated functions, are calculated for each pixel.

The subject method is particularly efficient for image processing for two reasons: the global function has a relatively simple form and thus can be easily computed, and very little computation is required to generate the interpolated functions. Use of functional interpolation provides a major time saving. For example, when 4×4 grids of 16 pixels are used the global function is generated only for 1/16 of the total pixels. It is because of this that high speed, real-time, image processing can be achieved.

The changes to the image caused by the operator actions are carried out and displayed almost instantaneously, i.e. in real time. The operator may, at any moment return and redo a elementary operation. This is because different actions and their results (i.e., the layers) are defined by simple elementary equations. These can be easily modified.

In this way, the invention allows for any image effect, such as airbrushing, blurring, contrasting, dissolving effects, color modifications, in short any operation concerning image graphics and color. The invention also enables geometrical transformations or modifications, such as rotation, changes of scale, etc. Using FITS, a microcomputer system can follow the actions of the operator, using input means such as in general a mouse or light pen on an interactive tracing table, in real time.

This input (e.g. pen) provides two types of command signals: one is a position signal giving the coordinates (x,y) of the dot concerned, and if necessary its environment (for example the path of an airbrush stroke); the other uses the pressure of the pen on the table to create a second type of signal. In the airbrush example, it would govern the density of the color being "sprayed".

The parameters for each elementary operation are constantly updated as the work evolves. To save space and time, only the parameters for dots in the definition grid that have a value or which are show a variation relative to their neighbors are stored. In this way the operator can access, at any moment, either the present overall result of all the operations, or intermediate results corresponding to one or several layers. Thus, the operator can intervene and modify a layer without affecting other layers. The link between the layers is only at the level of recurrence and are taken into account during the RIP stage.

When all the necessary operations are finished, and the operator wishes to produce the final image or an intermediate image at a given definition, the operator orders a raster image processing (RIP) at the required image definition. The RIP computes only those pixels necessary to update the screen, taking into account the portion of the image being displayed and the zoom factor.

The number of dots for which the global function should be generated during image editing within a layer are, in general, relatively small because function evolves with little variation (its second derivative is generally very low for most of the dots in the image). Function only varies substantially at dots corresponding to a large color change.

The grid chosen for the definition of elementary functions may have an equal mesh at all points. Alternatively, it may be constructed using a different sized mesh at various points, depending on whether the image zone covers an area of small or great variation to facilitate processing and correction.

Even if the final image is unsatisfactory, e.g. the control run has been carried out and a proof image printed, it is still possible to go back and correct any intermediate stage to yield a better result.

An alternative method for processing image data in a computerized system, which comprises:

(a) sampling an original image to be processed with a definition grid so as to retain a predetermined number of dots from all of the dots contained within the original image, the predetermined number being approximately equal to the number that can be displayed on a monitor screen to obtain a resulting image; and

(b) processing the resulting image into elementary recurrent operations each broken down into three parts and providing, based on the result of the previous elementary operation, these three parts added to each other representing:

first, adopting color dot at position coordinates (x,y) in the new layer (i) from previous layer (i−1) with a weighing ($\alpha_i$) ranging from 0 to ±100%,

second, importing a color dot from external image (Ii) into the layer i, after any desired chromatic and geometric transformation ($P_i(x,y)$) of this dot to add it to the color dot (x,y) of the layer (i), the degree of replacement of the dot of the layer (i) by the dot imported from the image (Ii) being defined by a scaler ($\beta_i(x,y)$) with values from 0 to ±100%, and

third, chromatically modifying ($\gamma_i(x,y)$) on dot (x,y) of layer (i),

each elementary operation (i) being defined by the equation

$$\phi_i(x,y)=\alpha_i(x,y)\cdot\phi_{i-1}(x,y)+\beta_i(x,y)\cdot I_i[P_i(x,y)]+\gamma_i(x,y)$$

taking account of the previous operation (i−1),

wherein:

$\alpha_i(x,y)$ is a scaler function of the dot (x,y) corresponding to the presence at this dot of the image resulting from the previous elementary operation $\phi_{i-1}(x,y)$,

$\phi_{i-1}(x,y)$ is a function representing the previous elementary operation,

$\beta_i(x,y)$ is scaler function corresponding to the presence at dot (x,y) of a dot corresponding to the imported image,

$I_i$ represents the imported image made up of a set of dots,

$P_i(x,y)$ is the function of image import representing the chromatic geometric transfer of one of the set of dots in the image towards the layer (i), to which is applied the elementary operation $\phi_i(x,y)$,

$I_i[P_i(x,y)]$ is the function corresponding to the import of the image,

$\gamma_i(x,y)$ is a chromatic function representing a color transformation function carried out on a dot (x,y),

each of the terms $\beta_i I_i pP_i(x,y)]$ and $\gamma_i(x,y)$ can be zero while the term $\alpha_i(x,y)\ \phi_{i-1}(x,y)$ is normally never zero for all the dots (x,y);

the elementary operations are effected to obtain a function representing i first elementary operations to obtain a function whose parameters are defined at all the dots of the definition grid

$$\sum_{j=1}^{j=q} \alpha_j(x, y) \cdot I_j[P_j(x, y)] + \gamma(x, y)$$

wherein,

q=number of imported images,

$\alpha_j(x,Y)$ is; a scaler analogous to the scaler $\alpha_i(x,y)$ of a elementary function,

$I_j$ represents an image j to import,

$P_j(x,y)$ is an import function analogous to the previous import functions $P_i(x,y)$,

$\gamma(x,y)$ is a chromatic function analogous to chromatic functions $\gamma_i(x,y)$,

the global function being defined by interpolating it at the intermediate dots between the dots of the definition grid, these intermediate dots depending on the definition required for the final image, the pixels being calculated for each dot to be obtained.

A system for using this method generally comprises: (a) means for sampling an original image to be processed with a definition grid so as to retain a predetermined number of dots from all of the dots contained within the original image, the predetermined number being approximately equal to the number that can be displayed on a monitor screen to obtain a resulting image, and (b) means for processing the resulting image into elementary recurrent operations each broken down into three parts and providing, based on the result of the previous elementary operation, these three parts added to each other representing the old image, a new imported image and a color change, as above.

The elementary operations are effected to obtain a function representing i first elementary operations to obtain a function whose parameters are defined at all the dots of the definition grid, using the summation function above.

The global function is defined by interpolating it at the intermediate dots between the dots of the definition grid, these intermediate dots depending on the definition required for the final image, the pixels being calculated for each dot to be obtained.

## EXAMPLES

1) Airbrushing:

This involves in making a line with a color. As this line imitates that made by an airbrush, it can be treated as a succession of colored dots created by the airbrush spray. The distribution of the color density in a airbrush dot is a Gaussian function. This means that the intensity of the color is at its greatest in the center of the dot, diminishing towards the edges as a Gauss function. In a real airbrush, the intensity depends on the pressure exerted on the trigger, which widens or otherwise changes the ink spray within the air jet. Such a pressure can be simulated in a computerized system by representing (as explained above) a dot by a circle of color with a density variation between the center and edge expressed as a Gauss function. The saturation at the center can vary between 0 and 1 (or zero and 100%).

To sum up, the line of an aerograph is a succession of colored disks, of which it is possible to modify the path (the location of the disk centers), and the color density.

Based on the general equation (1) and the airbrush characteristics,

this equation becomes the following:

$$\begin{cases} \varphi_i(x, y) = \alpha_i(x, y)\varphi_{i-1}(x, y) + \gamma_i(x, y) \\ \beta_i(x, y) = 0 \forall (x, y) \\ \gamma_i(x, y) = [1 - \alpha_i(x, y)] \cdot C \\ C = \text{color constant of the "projected material"} \end{cases}$$

and the general equation becomes the following:

$$\phi_i(x,y)=\alpha_i(x,y)\phi_{i-1}(x,y)+[1-\alpha_i(x,y)]\cdot C$$

As there is no imported image in the path of the airbrush, the coefficient of presence $\beta_i$ of an external image is nil at all points of the layer.

The application of the airbrush consists in replacing partially or totally the previous shade of a dot by the shade of the color "projected" by the airspray. Because of this, the chromatic function $\gamma_i(x,y)$ is expressed as a function of the color C and as a complement 1 to the coefficient of presence of the previous image, that is

$$\overline{\alpha}_i=1-\alpha_i$$

The choice of scaler $\alpha_i(x,y)$ at each dot translates the density of ccolor left by the airbrush.

The function of color presence $\alpha_i(x,y)$ or $[1-\alpha_i(x,y)]$, i.e. $\overline{\alpha}_i$, can be represented by a Gauss function centered on one dot, limited for example to 10% at the edge of the disk. In other words, the two extreme ends of the Gaussian curve beyond 10% (or any other value which may be selected) are suppressed. This means that the Gauss function will not be applied beyond the disk radius chosen.

2) Image fusion:

This operation imports an external image into an existing one. Based on the general equation, this importation operation is defined as; follows:

In the general equation (1) to which are applied the particular conditions relating to this operation:

$$\begin{cases} \varphi_i(x, y) = \alpha_i(x, y)\varphi_{i-1}(x, y) + \beta_i(x, y)I_iP_i(x, y) \\ \gamma_i(x, y) = 0 \\ \beta_i(x, y) = [1 - \alpha_i(x, y)] = \overline{\alpha}_i \end{cases}$$

The chromatic function $\gamma_i$ is zero and the coefficients $\alpha_i$ and $\beta_i$ are complementary coefficients (their sum is equal to one).

In fact, as a hypothesis for this type of operation, a dot of the imported image replaces, more or less, or even completely, a dot of the previous image. This corresponds in the first instance to a more or less pronounced dissolve and in the second to the replacement of the part of the previous image within the contour of the imported one.

The equation below can be simplified and thus gives the equation for image fusion:

$$\phi_i(x,y)=\alpha_i(x,y)\phi_{i-1}(x,y)+\overline{\alpha}_i(x,y)\ I_iP_i(x,y)$$

3) Lightening/darkening

It should be noted that in the general equation of a layer i, the scaler $\alpha_i$ should never be zero at all points of the layer. On the other hand, if there is no image importation, the scaler $\beta_i$ should be zero at every point (x,y).

To lighten or darken an image, it is necessary to use the chromatic function $\gamma_i(x,y)$. As explained above, the general function $\phi_i(x,y)$ should not be limited to only the chromatic

function, for this would mean suppressing all the images in layers 1 to i−1(disappearance of $\phi_{i-1}$), that is, the recurrence.

The darken/lighten function therefore assists in adding a color to the color at the previous dot x,y (function of $\phi_{i-1}$).

Based on the general equation, as follows:

$$\phi_i(x,y)=\alpha_i(x,y)\cdot\phi_{i-1}(x,y)+\beta_i(x,y)\ I_i(P_i(x,y))+\gamma_i(x,y)$$

in which:

$$\begin{cases}\alpha_i(x,\ y)=1\forall\ (x,\ y)\\ \beta_i(x,\ y)=0\forall\ (x,\ y)\end{cases}$$

We obtain:

$$\phi_i(x,y)=\phi_{i-1}(x,y)+\gamma_i(x,y)$$

4) Deformation/anamorphosis:

This operation can be applied to an existing or image. In fact, if it is desired to transform part of the image of the layer (i−1), this part of the image is considered as an imported image to be treated as described below.

The deformation/anamorphosis of an image consists of linking to each node a vector of deformation with a direction and size corresponding to the desired deformation. If deformation is uniform over all the relevant part of the image, each node will have attached to it vectors of the same size and direction, which will move the dot corresponding to each node as defined by each vector. The same sampling for the RIP can be used to limit the vector calculation for a group of pixels (e.g. 4×4) by computing only the origin and points just outside the 4×4 grid, and the functionally interpolating, thus speeding computation time.

To achieve such a deformation, the general function of the layer i becomes as follows through the use of the equation defining image import:

$$\phi_i(x,y)=\alpha_i(x,y)\phi_{i-1}(x,y)+\overline{\alpha}_i(x,y)\ I_iP_i(x,y)$$

The deformation or anamorphosis consists in working on the import function $P_i(x,y)$.

5) Levelling:

Levelling a color in part of an image, as an example, in a portrait, enables the operator to remove local skin defects, such as birthmarks. To achieve this, the average intensity of the color is calculated in a disk centered on each node of the part of the image to be processed. Depending on the radius selected, the color will be made more or less uniform. This operation combines the normal image with another which has been averaged out.

6) Contrasting:

Opposite to the previous type of processing, contrasting involves accentuating the fineness of the lines in a drawing or photograph. In a portrait, for example, it would bring out individual hairs of a hairstyle. This would also be useful for surveilance photography.

To achieve this, it is necessary to increase the high-frequency wavelength harmonics without touching the low frequency ones (near the average). The local average would be substituted from individual pixels, accentuating all changes, in the opposite manner from leveling.

The subject invention has been described in terms of its preferred embodiments. Upon reading the disclosure, various alternatives will become obvious to those skilled in the art. These variations are to be considered within the scope and spirit of the subject invention, which is only to be limited by the claims which follow and their equivalents.

What is claimed is:

**1**. A method for non-destructive, selectably reversible image compositing, comprising:

providing a displayed image comprising at least a region of an original image;

modifying said displayed image to produce a modified displayed image;

producing a modification file including resolution independent parameters operative for selectively modifying said displayed image to produce said modified displayed image and not including said modified displayed image, without destroying the original image; and

storing the modification file within a database of images.

**2**. A method according to claim **1** further comprising:

modifying said modified displayed image to produce a further modified displayed image, after said storing the modification file;

producing a further modification file including resolution independent parameters operative for modifying said displayed image to produce said further modified displayed image and not including said modified displayed image or said further modified displayed image; and

storing the further modification file within the database of images.

**3**. A method according to claim **2** wherein said further modification file and said modification file each include a modification parameter portion, and wherein said modification parameter portion of said further modification file differs from the modification parameter portion of said modification file.

**4**. A method according to claim **3** wherein the modification parameter portion of said further modification file includes the modification parameter portion of said modification file and an additional modification parameter portion and wherein the modification parameter portion of said modification file may be readily accessed in the further modification file with or without the additional modification parameter portion.

**5**. A method according to claim **1** wherein said original image is a previously modified image.

**6**. A method according to claim **1** wherein said original image is a non-previously modified image.

**7**. A method according to claim **1** also comprising rendering a composited image by:

applying at least some of said resolution independent parameters to at least a portion of said original image to produce composited image data; and

supplying said composited image data to a display device for rendering said composited image thereon.

**8**. A method for rendering a composited image comprising:

providing a database of images including a modification file, the modification file including resolution independent parameters operative for modifying at least one image which is not said composited image to produce said composited image;

selecting at least some of the resolution independent parameters;

applying the selected resolution independent parameters to at least a portion of said at least one image to produce composited image data; and

supplying said composited image data to a display device for rendering said composited image thereon.

9. A system for non-destructive, selectably reversible image compositing, comprising:

a display providing a displayed image comprising at least a region of an original image;

an image modifying user interface modifying said displayed image without destroying the original image, to produce a modified displayed image; and

a database of images storing a modification file, the modification file including resolution independent parameters operative for selectively modifying said displayed image to produce said modified displayed image and not including said modified displayed image.

10. A system according to claim 9 wherein said image modifying user interface is also operative for modifying said modified displayed image to produce a further modified displayed image, after said modification file is stored in said database of images, and wherein said database of images is also operative for storing a further modification file, the further modification file including resolution independent parameters operative for modifying said displayed image to produce said further modified displayed image and not including said modified displayed image or said further modified displayed image.

11. A system according to claim 10 wherein said further modification file and said modification file each include a modification parameter portion, and wherein said modification parameter portion of said further modification file differs from the modification parameter portion of said modification file.

12. A system according to claim 11 wherein the modification parameter portion of said further modification file includes the modification parameter portion of said modification file and an additional modification parameter portion and wherein the modification parameter portion of said modification file may be readily accessed in the further modification file with or without the additional modification parameter portion.

13. A system according to claim 9 wherein said original image is a previously modified image.

14. A system according to claim 9 wherein said original image is a non-previously modified image.

15. A system according to claim 9 for rendering a composited image further comprising a renderer applying at least some of said resolution independent parameters to at least a portion of said displayed image to produce composited image data and a display device for using said composited image data to render said composited image thereon.

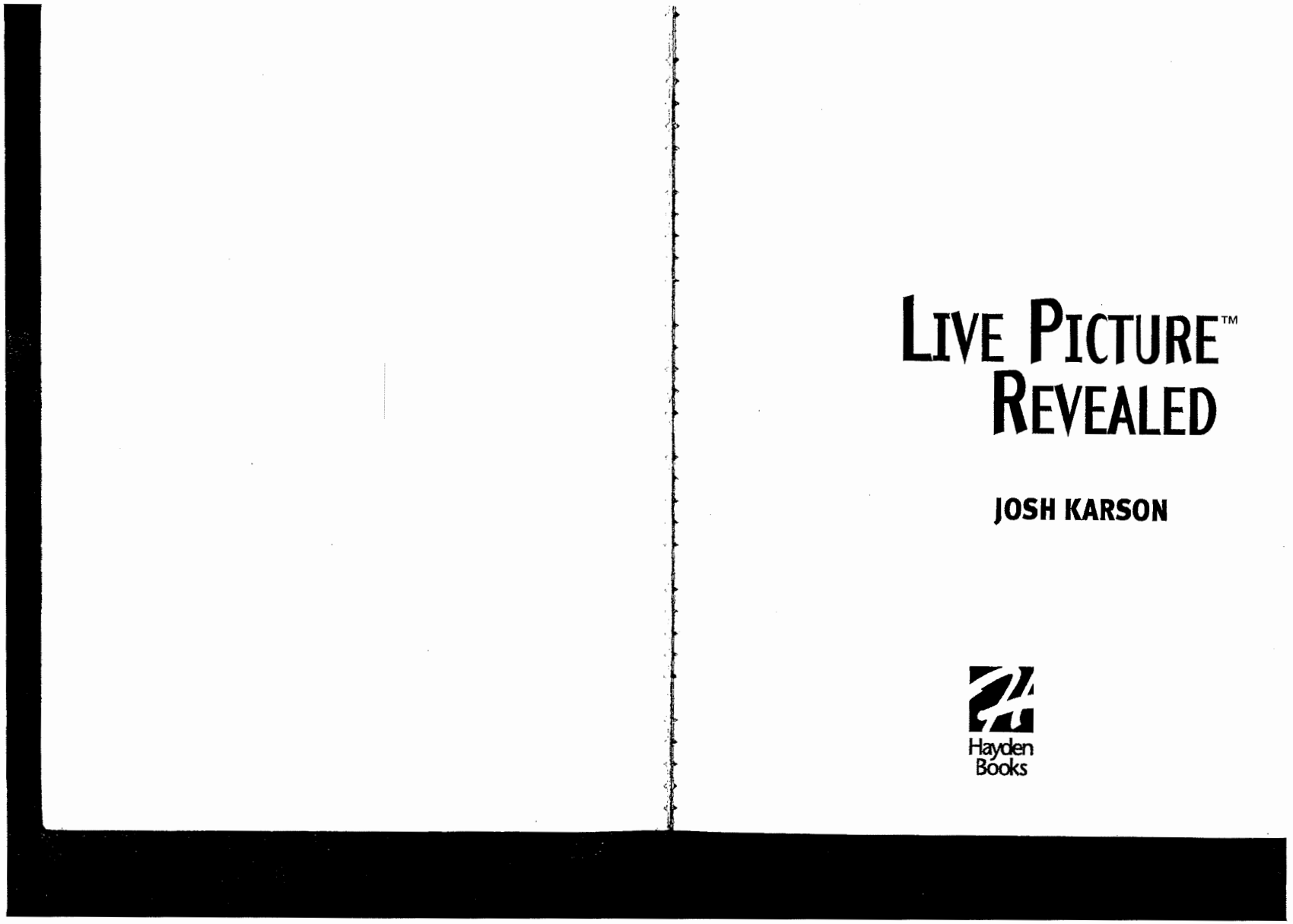
16. A system for rendering a composited image comprising:

a database of images including a modification file, the modification file including resolution independent parameters operative for modified at least one image which is not said composited image to produce said composited image;

an image processor selecting at least some of the resolution independent parameters and applying the selected resolution independent parameters to at least a portion of said at least one image to produce composited image data; and

a display device for rendering said comaposited image thereon.

* * * * *



# LIVE PICTURE™ REVEALED

JOSH KARSON

Hayden Books

**Live Picture Revealed**

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Library of Congress Catalog Number: 95-81210
ISBN: 1-56830-272-X

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Printed in the United States of America 1 2 3 4 5 6 7 8 9 0

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TO ISABELLE AND SAMUEL,
FOR THEIR PATIENCE AND UNDERSTANDING,
AND TO LENA, WHOSE 3 AM BOTTLE-FEED
GAVE ME THE IDEA TO WRITE THIS BOOK.

One of the unique aspects of Live Picture, the application, is that it contains several breakthrough technologies. The principal technologies are IVUE, which is about fast imaging off disk, CD-ROM and especially across networks and FITS, which stands for Flexible Image Transformation System, which is a resolution independent system for describing and rendering photo documents.

Last year we licensed the IVUE technology to Eastman Kodak Company. Working with Kodak and several other partner companies, we are enhancing this technology to become what a growing number of companies believe will be the next big imaging standard. The great advantage is that people will now have the ability to browse, crop, scale, rotate, and postition images in real time. Until Live Picture, that hasn't been possible with high-resolution images—at least not without spending hundreds of thousands of dollars on special purpose workstations. The technology is also ideal for sending images over networks because only the image data required to fill the display window needs to be transmitted, and it can be compressed. So, you're only sending over the network what is being displayed on the monitor rather than the entire image file. We believe that this will become a well-adopted industry standard, because Kodak has already succeeded in recruiting many other companies to join with them in supporting this new image file format.

So when you use Live Picture, you're way ahead because you're working with new technology that will soon become an adopted standard. Of course, in many ways the real magic is the FITS technology. It is this technology that lets you apply a 1 million pixel, perfect quality airbush in real time, or apply distortion with a brush and then progresively modify and even undo that distortion. Today leading photographers, graphic artists, and prepress professionals throughout the world are using Live Picture. Many of the top images for magazines, posters, album and CD-ROM covers, and even Web pages are being created in Live Picture. And while Live Picture is unique in its capability to let you work effortlessly with large files, in fact it is being used more broadly. Live Picture is being used by creative professionals to make complex or very creative images. It increases their range of visual expression and lets them create a new distinctive look. Live Picture users are doing things that that would be very hard or even impossible with any other application.

We've found that most Live Picture users already have and use Adobe Photoshop. So its important to understand that Live Picture works well with Photoshop, as well as independently from it. With our newest release, 2.5, we've made it even easier to take images from Photoshop and move them into Live Picture to do compositing and to apply special effects. It's also possible to work from scan to print entirely inside Live Picture. So Live Picture fits in with Photoshop but also stands out.

No company before us has developed resolution-independent photographic quality tools for creative professionals. This is a new domain and one that we will continue to explore. We aren't aiming Live Picture at existing products like Photoshop. We want to take imaging professionals in a new, fertile direction.

*John Sculley*

# INTRODUCTION

Something big is happening in digital imaging—a new, powerful, and highly creative software package called Live Picture. If you are already involved in digital imaging, or if you are just getting interested in creating or manipulating photographic images on a computer, this is one piece of technology you should know about and experience first-hand.

My own contact with Live Picture goes back almost three years. I witnessed the development of the software from its beginnings and watched it grow to maturity. Writing the greater part of the software's first user guide, I worked closely with the engineers and Live Picture's French inventor, Bruno Delean.

Over these three years, I've given dozens of training courses on Live Picture. Some of the people I teach have never used an imaging program. Some have never used a Macintosh. Others are experienced users of pixel-editing programs, such as Adobe Photoshop. Yet others are Live Picture users in search of more advanced skills.

Through all this writing and teaching, two things have become apparent. First, people often have all kinds of ideas about what Live Picture can do. But once they actually start using the program, it's as if they're entering a whole new world. They may be reasonably impressed, astounded, or disappointed (rarely), but almost every time there's a realization that they're in contact with something drastically new. Second, I noticed that during the training courses, the same questions are asked, and the same areas and concepts require clarification.

And as with all software, many current Live Picture users are always in search of a new method or tip that will carry their ideas and creativity yet further. Something to help them to probe deeper into the software.

This book hopes to address these three areas. If *Live Picture Revealed* succeeds in revealing the magic of Live Picture to a larger number of people, and if it helps reveal some of its better-kept secrets to current users, then its goal will be realized.

great interest to photographers and anyone else interested in modifying and controlling color in photographic images.

**Important:** All the images and composites contained on this CD-ROM can be used freely for the purpose of learning Live Picture. The images and composites cannot be redistributed, sold, or used for commercial purposes.



CHAPTER 1

# WHAT'S SPECIAL ABOUT LIVE PICTURE?

Throughout this book, you'll have the opportunity to experience Live Picture first-hand. But before you actually begin to use the software, it's interesting to know the capabilities and features that make Live Picture something truly special. This chapter summarizes those features in "A Revolution in Digital Imaging."

This chapter also contains one section devoted to digital imaging newcomers, Adobe Photoshop users, and Live Picture users, respectively. In these sections, Live Picture is dealt with from each perspective.

## A REVOLUTION IN DIGITAL IMAGING

In product literature, magazine articles, or trade show conversations, you may have heard the term revolutionary associated with Live Picture. Why?

Live Picture is based on two new file formats: IVUE, and more importantly, FITS. IVUE is an extremely efficient file format that lends itself to FITS in terms of file handling, and contributes to speed. FITS is the first technology capable of describing composite images in resolution-independent form. As an analogy, PostScript was the first language to describe text and line art in resolution-independent form. FITS could be considered to images what PostScript was to text and drawings—a revolution.

The following items listed are possible only because of FITS, IVUE, and resolution independence.

### Unlimited image size

You can open and manipulate images of any size with 18 MB of application RAM. The image can be 5 MB or 500 MB, all it takes is 18 MB of RAM.

### Speed

The speed of most operations is close to instantaneous. This is true no matter what the size of the image. Almost all effects can be applied with a brush, in real-time, no matter what the size of the brush.

### Unlimited number of images

You can insert an unlimited number of images to create a composite (though it helps to have more than the minimum RAM for a large number of images).

### Unlimited brush size

The brushes are resolution-independent. By adjusting the size of the image on the screen, you can brush one pixel or 500 MB in a single stroke.

### Unlimited number of layers

This lends to a truly flexible editing environment. You can create and manipulate dozens of layers with ease. Some users purposely create additional layers to maintain complete control over even subtle details.

### Unlimited undo

The original images are never modified. All edits are stored in separate layers. You can therefore remove any edit at any time, partially or completely. Nothing is permanent if you don't want it to be.

### New networking possibilities

Several users can manipulate the same image simultaneously over a network to create different composites. Likewise, each user can work on a different part of the same composite, and then merge the parts. Compressed images can be read over a network without decompressing the entire image. Manipulating large images over a network can be as fast, or faster than working on a single Mac.



## TO THE DIGITAL-IMAGING NEOPHYTE

Live Picture is a great way to break into working with images on a computer for several reasons.

First, for people used to working with brushes, paper, or film, Live Picture comes as close to direct painting or airbrushing as you can on a computer. Its real-time, pressure-sensitive brushes respond like traditional brushes. Because you can experiment and undo indefinitely, your ideas will emerge and develop as you work.

Second, the resolution-independent masks and 48-bit color allow you to produce high-quality, photorealistic composite images. If you're a designer, photographer, or artist, Live Picture on your computer means no compromises when it comes to quality.

Third, this software allows real-time image creation. Waits are rarely more than a few seconds. Like a pencil on paper, you'll see the result of your work instantly. Because the computer can keep up with your creative impulses, you will have more time to try new ideas.

## TO THE PHOTOSHOP USER

Live Picture and Photoshop are complements. This is the case because Photoshop does not do everything that Live Picture does, and vice versa.

The differences in possibilities are mainly due to the differences in technology. Photoshop edits image pixels directly. Live Picture creates a mathematical description of the edits and re-creates the image afterward. Many operations are faster or easier to perform in Live Picture. However, you may sometimes find that a simple operation in Photoshop is more complex, or even impossible to do, in Live Picture. It usually all boils down to the difference in technology.

At the risk of oversimplifying things, Photoshop excels in pixel editing, while Live Picture excels in image creation and compositing. In reality, there is an area where the two applications overlap. In that area, use the software or features you feel most comfortable with.

Live Picture is a creative tool and a productivity tool. You can experiment in real time with multiple high-resolution images, because of its speed, coupled with its unlimited undo. Some of the images shown in the Live Picture Gallery illustrate its creative potential.

In Live Picture, the original images are never modified. The whole image is there all the time, even after it has been silhouetted and the background appears to be permanently gone. Furthermore, effects such as sharpening and color corrections sit in layers by themselves.

Live Picture doesn't use selections in the Photoshop sense of the term (except to apply Photoshop-compatible filter plug-ins). There are several ways to constrain an image, color correction, or effect to a specific area, but it's not a selection.

Finally, the resolution-independent brushes can be used to apply anything, from sharpening to image ghosting to distortion. These pressure-sensitive tools offer new possibilities in image creation.

To summarize, there are two leading, yet distinct, imaging tools on the Macintosh. Having both of these tools will give you unprecedented power, flexibility, and creative freedom.

## TO THE LIVE PICTURE USER

This book provides clear explanations on most of the tools and concepts. It also contains numerous tips and descriptions of some of Live Picture's lesser known features. Furthermore, the Live Picture Gallery and other illustrations throughout the book demonstrate how other digital artists are using Live Picture.

To those who have just bought Live Picture, to the early adopters who began using it before it was sold in any store, and to all the other users, I wish you many hours of fast imaging and creative explorations.

CHAPTER 2

# AN OVERVIEW

The information contained in this chapter is very general. You don't need to read it to start using Live Picture, so if you're just not in the mood, read it later. However, the Live Picture technology and "approach" are quite different from those used by any other existing software. A full grasp of this technology and approach will help you use Live Picture to its full potential.

You will find in this chapter:

- A description of the file formats and technology used in Live Picture
- An introduction to the user interface
- An explanation of *layer logic*, or what it means to work with layers in Live Picture

## THE THREE TYPES OF FILES

You will be dealing with three types of file formats when working with Live Picture: IVUE, FITS, and a standard format for the finished output file: TIFF, EPS, DCS, Photoshop 3.0, PICT, Scitex CT, or IVUE. Figure 2.1 illustrates the Live Picture work flow.

### IVUE




A *pixel* is a picture element in digital images. It is the basic building block. IVUE is a pixel-based format, much like a TIFF or a PICT. It contains a fixed number of pixels. Each pixel describes a color in the original image. While other standard pixel-based formats are of a single resolution, for example 300 dpi, IVUE contains the 300 dpi image, plus a series of subimages at lower resolutions. For that reason, IVUE is termed a "multiple-resolution" format.




**Figure 2.1** The Live Picture work flow

How does this benefit you? Pixel-based applications, such as Adobe Photoshop, load the entire image into memory (RAM). This is time consuming. In Live Picture, however, only the amount of information needed to fill your screen is extracted from the file and loaded into memory. This is called working at *screen resolution*. Because computer monitors only display around 72 dots per inch (dpi), there's no point in loading the entire image into RAM. Because an IVUE file already contains a series of precalculated subimages, it quickly extracts the necessary data.

### QUESTIONS/ANSWERS

**So am I always working on a low-resolution image?**

Definitely not. If you were working on a low-res image or substitute (sometimes called a *proxy*), as soon as you zoomed, you would see pixels because the image contains such little information. This is a serious handicap for doing quality retouching. When you zoom in Live Picture, the screenful of data currently loaded into RAM is replaced by a new screenful of data extracted from the IVUE. So you are always working with *all* the data of the high-res image, except that you only load a screenful at a time instead of loading all the data into RAM at once. The advantage—speed.

**What happens if I zoom and the data needed is not contained in any of the precalculated subimages?**

Live Picture interpolates. It goes to the subimage immediately above the resolution needed and calculates a screen image based on the two closest subimages at the resolution needed.

**Is the quality of the screen display as good as that obtained in pixel-based software?**

As good, and in some cases better. You have access to all the information of the high-res image. For instance, when you view an image at a ratio of 1:4 in pixel-based software, the screen displays 1 pixel out of 4. This means the display is somewhat rough. By interpolating between the subimages, the Live Picture screen render is recalculated each time you zoom; so the display is much closer to the actual output, even at low viewing ratios.

Additionally, Live Picture offers an antialiasing option for the highest screen-viewing quality. This option smoothes jagged edges resulting from the relatively low resolution of the screen. No matter how far you zoom in, you never see a pixel. Screen antialiasing is useful for displaying hard edges, such as text, especially when your client wants to view the image on-screen.

**If I'm always working with a 72 dpi screen representation, won't there be a quality loss in the final output?**

This would be the case if you were actually modifying the full IVUE image based on the 72 dpi screen display. Though the image on the screen is dynamically linked to the



original IVUE, Live Picture uses the IVUE only to extract or read data. It doesn't write or record on to the IVUE. IVUE is a read-only format.

**So if Live Picture doesn't modify the original image, and doesn't work on a low-res image, how does it record what I've done on the screen?**

See "FITS" in the following section.

To summarize what we've covered so far:

- An image must be in IVUE format to be used in Live Picture (with the exception of EPS files, which can be inserted directly).
- IVUE allows you to open and edit high-resolution images in near-real time.
- The original image is unaltered.
- Quality loss associated with low-resolution proxies does not occur.

To obtain IVUE images, you can do the following:

- Scan directly into IVUE using Photoshop-compatible scanner plug-ins.
- Convert other formats to IVUE using the Converter menu in Live Picture or the Image Vue application supplied with Live Picture.

For more information on scanning and converting images to the IVUE format, see Chapter 7, "Inserting Images."

## FITS



FITS

The document is the workspace where you'll be compositing IVUE images, resizing and creating perspectives, making color corrections, sharpening, distorting and creating text, or just removing a wrinkle. When you save the document, or composite, you save it as a FITS file.

You do not actually modify the high-res IVUE images used when you composite in a FITS file. Nor do you modify a low-res proxy. Your work is recorded at no resolution because FITS is resolution-independent.

What does resolution independence mean? It means that changes, or edits, made to images have no resolution—they are not affected by the resolution of your original image. Masking, positioning, color corrections, distortion, and so on are expressed in purely mathematical terms in a FITS file.

The mathematical description of your edits is applied to each screenful of data. When you rotate an image you see it rotate on the screen, because the algorithm describing that rotation is applied to the current screenful of data. And when you zoom, the algorithm is reapplied to the new screenful of data. Because these modifications only go "screen-deep," a great amount of time is saved.

So when are the edits applied to the full, high-res IVUE files? That takes us to our next step: building the output file.

But first, let's summarize what we've learned so far:

- With the IVUE format, Live Picture creates a screen representation of each image used, at each level of zoom.
- With the FITS resolution-independent tools, you use that screen display to create a composite.

## Output file

As you create your composite, the FITS algorithms are recalculated for each new screenful of data. This calculation is called the *screen render*, or *screen RIP*. The screen render only involves a screenful of data at a time.

When you finish the composite, you need to apply the FITS algorithms to the full IVUE file. This operation is also a render, or RIP. But because this RIP actually builds a new image, it's called the *build*.

When you build your image, you choose the resolution and format of the output file. The outcome is a standard image format such as TIFF, EPS, DCS, or Photoshop 3.0.

The build, or RIP, was the missing link between the full-resolution IVUE images and the edits that you performed on the screen. RIP stands for Raster Image Processing. Note that RIPs are nothing new. PostScript uses a RIP for text. It's called a PostScript RIP. Now Live Picture has one for composite images, and it's called a FITS RIP.

### QUESTIONS/ANSWERS

**When I build my output image, am I modifying the original IVUE images?**

No, you never modify the original IVUEs. When you build an output, you create yet a third file (after IVUE and FITS).

**What happens to the FITS file after the build?**

Nothing. It remains just as it was before the build, fully editable, with all its layers intact.

**Can I modify my composite, or FITS file, and build another output file?**

Absolutely. You can use a single FITS file to build several output images. If you make significant changes, you can save the FITS file under another name. FITS files are very small.

**Can I throw away my IVUE files and keep just the FITS file?**

If you do, you won't be able to build another output file. To build, you need both the original images (IVUE) and the FITS file. If you inserted EPS files directly in a FITS file, you also need the EPS files. However, if your original images were in a format such as TIFF, and you converted them to IVUE, you don't need to keep the original TIFFs.



**Does resolution independence mean that I can scan at low resolution and output my final image at a high resolution?**

No. Resolution independence refers only to the edits contained in the FITS file. IVUE is a pixel-based format. If you scan at a given resolution and output at a higher resolution, interpolation occurs as it would in any pixel-based software. However, tests with Live Picture have shown that in most cases you can safely interpolate up to twice the original size of the file.

**Does the FITS RIP replay all the edits performed up to that time?**

No, that would be a script. In Live Picture, each time a FITS RIP occurs, whether on the screen or during the build, the composite is recalculated and expressed in its simplest form. This approach avoids cumulative errors and quality loss in the final output. For instance, if you extensively distort and undistort an image and finally leave just a bit of distortion, that bit of distortion will be applied to the image as if that's all you'd ever done.

## Advantages to the IVUE/FITS approach

- You can work much faster. The time it takes to open or edit a 5 MB image is the same as for a 300 MB image. In both cases you're loading only a screenful of data into memory.
- You never alter the original IVUE images. But the edits you perform are always based on the full-resolution of the originals.
- The FITS file and all its layers remain fully editable after you build your output. You can go back and output a similar composite without having to redo the whole thing; and FITS files are small. No need to keep multiple copies of large images on your hard disk.
- Because of the resolution-independent FITS file, you can output the same composite at several different sizes and resolutions.
- The FITS RIP does not cumulate operations, it recalculates. This ensures maximum quality.
- The IVUE approach requires much less RAM: you can open and manipulate a 300 MB image with just 18 MB of application RAM. You are loading the equivalent of a 72 dpi file into memory.

For a full discussion of these advantages, see Chapter 27, "The Most Flexible Software You've Ever Seen." Other advantages are discussed in Chapter 3, "The Tools Revealed," and Chapter 30, "Compression, CD-ROMs, and Networking."

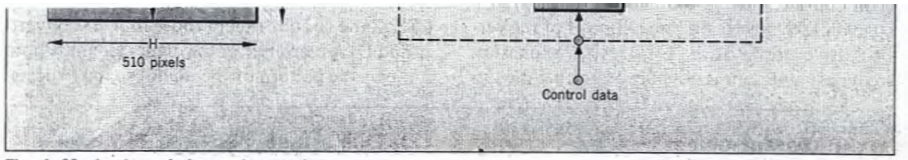



Fig. 4: Mechanism of electronic zooming.

ing LSI. The chip is very small (8.5 × 8.5mm), but comprises 30,000 gate logic circuits and a 14-bit memory (DRAM) for video signal storage of two scanning lines: it is designed for a low-voltage power supply of 5V. The LSI package is put together in a QSP format of 100-pins.

With this single-chip LSI and a 9-bit A/D converter, the number of components was reduced from 460 to 220 compared with the conventional analog signal processing circuit. In addition, power consumption was reduced 25 percent from 1.9W to 1.5W, leading to a smaller battery. Photo 3 compares the traditional analog signal processing circuit in an 8mm AM-E10 camcorder camera section and the new digital signal processing circuit. The photo clearly shows the compactness of the new chip.

Photo 4 shows an experimental, small 1/3-inch CCD with 250,000 effective pixels and an ultra compact video camera with 41 × 44 × 79mm weighing 90g, combined with this digital signal processing circuit.

Hitachi produced a compact VHS camcorder, the VM-5400A, by combining a 1/3-inch small CCD and the digital signal processing LSI. The camcorder, in addition to digital signal processing such as 8× electronic zoom function, features AI high-picture-quality control, autowhite balancing to accommodate color temperature, automatic backlight compensation and program AE.



Photo 5: The VM-5400A compact VHS camcorder combines a miniature 1/3-inch CCD and a digital signal processing circuit.



Photo 3: Comparison of digital signal processing circuit and conventional analog signal processing circuit in the VM-E10 8mm camcorder.



Photo 4: Hitachi prototype supercompact video camera combines a miniature 1/3-inch CCD and a digital signal processing circuit.

## Sony Also Develops One-Chip LSI for Digital Signal Processing

In the February ISSCC held in San Francisco, California in the United States, Sony announced a digital signal processing LSI containing a line memory for two scanning lines and digital signal processing circuits as well as two 8-bit D/A converters, which contain 120,000 transistors in an 8.4 × 8.7mm LSI chip. Sony already has introduced an ultraminiature 8mm camcorder and a Hi8 camcorder incorporating the digital signal processing LSI. Innovative products are expected in the near future.

## Matsushita First to Successfully Use Digital Signal Processing in Camcorders

Matsushita first introduced digital signal processing in its Super VHS-C compact camcorder. Figure 6 shows the digital signal processing circuit system of the camera section. The

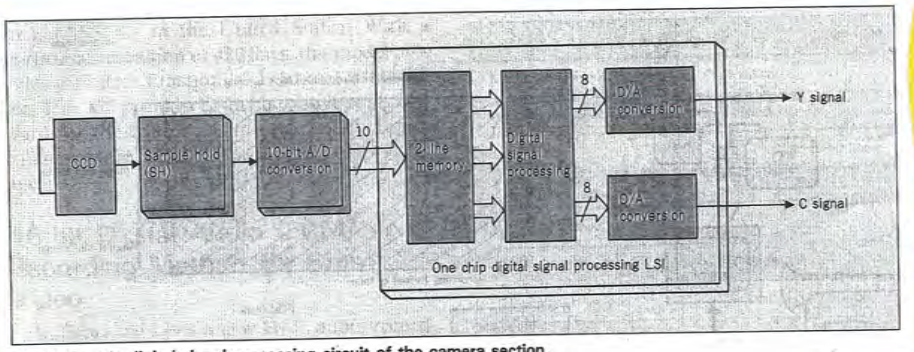



Fig. 5: Sony's digital signal processing circuit of the camera section.

digital camera circuit has a newly developed fuzzy gyro circuit, which has succeeded in correcting the deterioration of the picture quality because of operator-caused shake.

First, the signal obtained from the CCDs is sampled and held. After AGC and gamma compensation using analog bipolar ICs, the signal is A/D converted to 8-bit digital signals. The digital signal processing section has one chip for line memory of two scanning lines and the Y-signal processing IC containing logic circuits; the chip measures 7.53 × 7.76mm. It separates Y signals and makes a horizontal and vertical aperture adjustment. One LSI chip does C signal processing (the chip measures 7.68 × 7.50mm and performs separation of C signals, compensation of white balancing, removal of running, etc.). Two LSI chips for detecting motion or hand shaking and interpolation processing in the fuzzy gyro circuit compensate for hand unsteadiness. There are two units of 1M-bit field memory and two 8-bit microcomputers for signal processing and additional functions.

In the fuzzy gyro circuit, signals of two consecutive pictures are stored in two field memories and the motion is compared. After comparing and examining the motion, the system shifts the picture frame in response to the motion to obtain stationary pictures. Accordingly, it is not possible to read out all picture signals for all CCDs. As shown in Fig. 8, the cutout picture is about 85 percent smaller than normal pictures. Therefore, the small pictures are enlarged to normal size by electronic zooming and the output generated.

Because the camcorder uses a 1/3-inch compact CCD, the pictures compensated for hand unsteadiness decrease in the number of pixels, become less clear and the quality deteriorates. Other makers are developing methods to compensate for hand unsteadiness that do not cause picture quality to deteriorate.

## New Camcorder with Newly Developed Digital LSIs

This spring, Hitachi announced two new experimental camcorders that contain a new, digital processing, one-chip LSI.

*Digital Snap 8mm camcorder*

Recently, both camcorders and film cameras have been used to record various family events, including trips. Therefore, a combination camcorder and film camera eliminates the burden of carrying two separate cameras. Developed based on such a philosophy of a product, Digital Snap Hi8 camcorders contain a digital electronic still camera. With this camcorder, the desired picture can be digitally stored as a high-quality still image simply by pressing the shutter button. Incidentally, the recording track of 8mm camcorders has a space for recording digital sound (PCM) signals, in addition to space for recording the video signals. This camcorder has

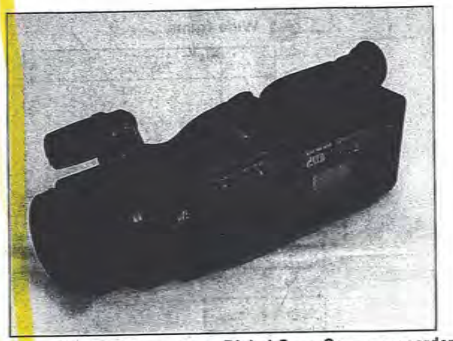


Photo 6: Hitachi prototype Digital Snap 8mm camcorder.



processing IC containing logic circuits; the chip measures 7.53 × 7.76mm. It separates Y signals and makes a horizontal and vertical aperture adjustment. One LSI chip does C signal processing (the chip measures 7.68 × 7.50mm and performs separation of C signals, compensation of white balancing, removal of running, etc.). Two LSI chips for detecting motion or hand shaking and interpolation processing in the fuzzy gyro circuit compensate for hand unsteadiness. There are two units of 1M-bit field memory

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**Photo 6: Hitachi prototype Digital Snap 8mm camcorder.**

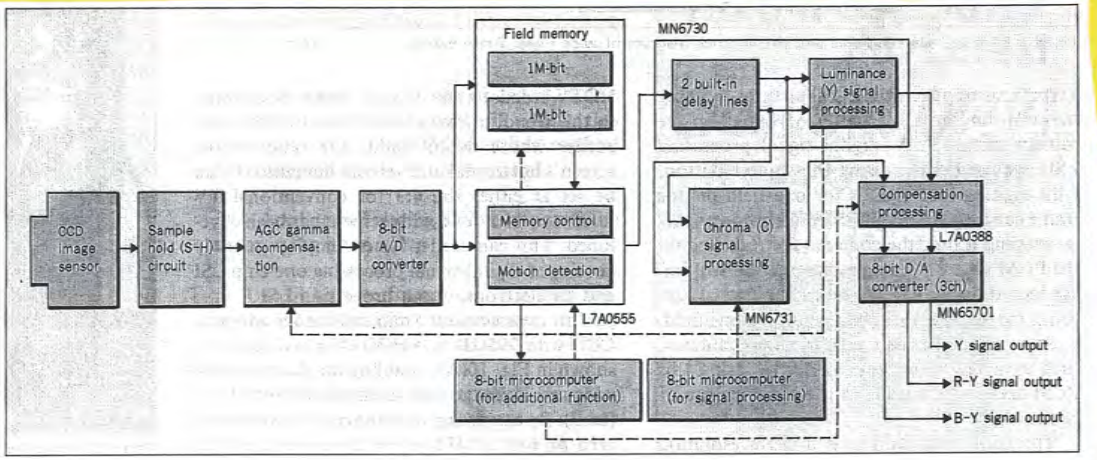



**Fig. 6: Block diagram of digital signal processing circuit in camera section**

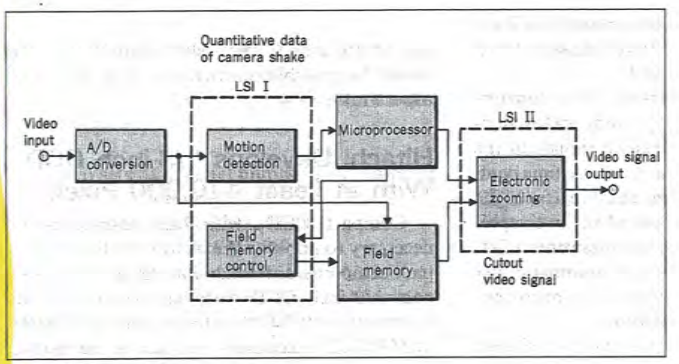



**Fig. 7: Diagram of fuzzy gyro system**

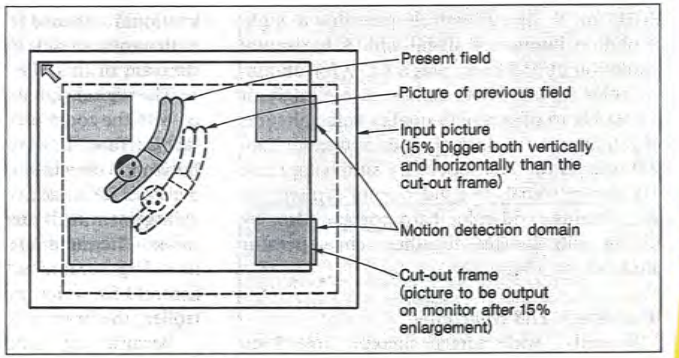



**Fig. 8: Motion detection field fuzzy gyro**



BlackBerry Corporation Exhibit 1004, pg. 564

# Latest Advances in Camcorder Technology

YUKIO KUBOTA, YOSHIO NISHI, KENJI SHINTANI, TETSUO URABE, KEIICHIRO SHIMADA, AND TORU KATSUMOTO

*Invited Paper*

*Camcorders have been developed to be compact with high performance. Latest advancement of key technologies and devices such as digital signal processing LSI, six-layer printed circuit board with micro chips, high-speed power lens with linear motor, 103K pixels 0.7-in LCD electronic viewfinder, and high-energy Li-ion battery are described. High-band format is also explained.*

## I. Introduction

Since the first introduction of camcorders around 1985, the evolution of camcorders has proceeded. Technologies for making camcorders smaller, lighter, and easier to use with high performance have been developed.

In the latest camcorder, state-of-the-art technologies of a six-layer printed circuit board, 1.0 × 0.5 mm$^2$ micro surface mount chips, a 0.7-in 103K picture element LCD, a linear actuator drive lens, a lithium-ion battery, and a cassette-size tape transport are incorporated, making the camcorder palm-size.

By introducing a metal-evaporated tape and an advanced metal powder tape, the minimum wavelength of recording has reached to 0.5 $\mu$m, which realized a high-band format [1]. VCR can record a horizontal luminance resolution of 400 lines in this high-band format.

The digitalization of signal processing for camera [2] brought automatic operation of auto-focus, auto-exposure, auto-white balance, and an electric image stabilizer.

In this paper we describe the technologies of high-band recording, a high-density mounting, a high integrated LSI, a 0.7-in LCD, a linear motor drive lens, and a lithium-ion battery.

Manuscript received July 12, 1993; revised September 20, 1993.

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IEEE Log Number 9215840.

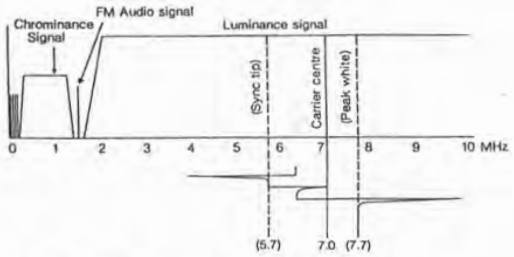



**Fig. 1.** Frequency allocation of high-band 8 mm video format.

## II. High-Band Recording

Two-hour recording with a smaller size cassette comparable to the audio compact cassette was made possible by introducing a metal powder tape to 8 mm video [3].

Camcorders are used to take pictures of family or travel scenes. Pictures taken by a camcorder may well be edited. To have a good picture even after editing, the initial quality is expected to be as high as possible. To extend the horizontal luminance resolution from 250 lines of a normal band to 400 lines of a high band, the carrier frequency of the frequency-modulated luminance signal was shifted from 5.0 to 7.0 MHz (Fig. 1).

As a result, the minimum wavelength of recording was shortened from 0.8 to 0.5 $\mu$m. The shorter wavelength causes losses of output and carrier-to-noise ratio ($C/N$). To compensate these losses a Metal Evaporated tape (ME tape) and an advanced metal-powder tape (MP tape) have been developed.

A high-magnetic-remanance tape with a smooth surface and a narrow gap length head makes it possible to have a high output at 0.5 $\mu$m, which is comparable or higher than the output of a conventional Metal-Powder tape at 0.8 $\mu$m (Fig. 2).

The noise level was reduced by using a fine crystal in column for the ME tape and a fine magnetic powder for

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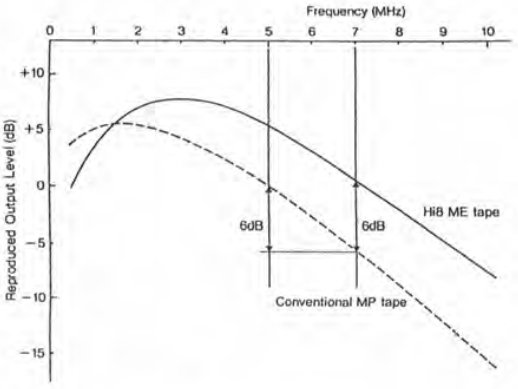



Fig. 2. Frequency response.

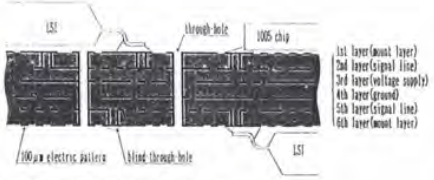



Fig. 3. Six-layer PCB configuration.

the MP tape, which affords an increase in $C/N$ of 4 dB for the ME tape and 2 dB for the MP tape.

## III. High-Density Mount

The volume of the circuit board, which is a product of area and height, is a very important factor to miniaturize in a camcorder. In 1989, a four-layer printed circuit board (PCB) was introduced for the first time in the CCD-TR55. In the four-layer PCB, top and bottom surfaces are used not only to mount 1.6 × 0.8 mm$^2$ (1608) chips, but also to print the electric pattern of 150-$\mu$m pitch and width. The inner two layers are used for voltage supply and ground.

To increase the mount density, we needed to separate the mount layer and the electric-pattern layer. As a result, a six-layer PCB was developed and introduced in the CCD-TR1 in 1992 (Fig. 3). In this six-layer PCB, we incorporated a blind-through hole, 100-$\mu$m pitch and width electric pattern, and microchips of 1.0 × 0.5 mm$^2$ (1005). To connect the first and the second layer, and the fifth and the sixth layer without connecting the other layers, we developed this blind-through-hole technology.

Using this technology, the first and sixth layers can be used fully for mounting components. We also developed a machine which prints cream solder and places 1005 chips accurately on a fine electric pattern with a parts per million order error.

Because the circuit for the camera is based on digital LSI, and the PCB mainly works for connecting pins in LSI, the fine pattern of 100 $\mu$m in the second and fifth layers are effective in reducing the area of PCB. The pattern area in



Fig. 4. Six-layer PCB photo-picture.

the second and fifth layers reaches 70% of PCB. In contrast, the circuit for video is based on analog LSI and there are many small components outside the LSI, the fine pattern of 100 $\mu$m, the microchips of 1005, and mount layers of the first and sixth layers made it possible to reduce the area of the PCB.

As a result, the mount density reached to 15 parts/cm$^2$ and the volume of circuit board was reduced to 50 cm$^3$, which is 1/3 of that of the CCD-TR55 (Fig. 4).

## IV. LSI System

### A. CCD Image Sensor

In today's market, compact camcorders require a smaller size and a better picture quality. To meet these requirements, a 1/3-in IT-CCD image sensor with 380K effective pixels has been developed. The pixel size of the 1/3-in CCD is 6.35 $\mu$m (H) × 7.40$\mu$m (V), which is 57% of the size of the 1/2-in CCD. The improvement of the charge detector and the incorporating micro lenses achieved +3 dB higher sensitivity than that of the conventional 1/2-in CCD. The smear level and dark current are as good as those of the 1/2-in CCD.

### B. Digital Signal Processing

In recent years, camera signal processing has been rapidly converted to digital technology. Employing this digital signal processing, reduction in external parts, adjusting points, and power consumption can be achieved. Low power consumption is one of the most important items for realizing the compact camcorder. Furthermore, as the size of the camcorder becomes small, total power consumption per unit cubic volume (mW/cc) increases and its value seems to reach the limit. We found that in order to solve this difficult problem, we would have to reduce the supplied voltage of the LSI's including peripheral circuits from 5 to 4 V.

Progress in the semiconductor manufacturing process rule has contributed to the low power consumption of LSI's. The second-phase camera DSP (Digital Signal Processor) using 1.0-$\mu$m CMOS technology has been developed. The power consumption of this LSI at 14.3-MHz operating mode is 270 mW, which is 54% of the first-phase DSP using 1.4-$\mu$m CMOS technology.



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### C. Intelligent Control

Another advantage of employing digital signal processing is its suitability for automatic control systems with MCU (Micro Control Unit), such as auto-exposure and electric image stabilizer.

An advanced auto-exposure system based on fuzzy logic, which can perform well even in the case of backlighting or excessive frontlighting, has been developed [4]. This system has a compensation value for exposure that ranges from a maximum of +9 dB in backlighting to a minimum of −3 dB in excessive frontlighting. To achieve this compensation, we introduced a histogram as a new criterion parameter and fuzzy logic is applied to determine the amount of compensation. An example of such a histogram is shown in Fig. 5.

This system has the following advantages:

1) The compensation value is not influenced by the position of objects.
2) It has quite a natural response even for panning, tilting, and zooming.

As camcorders become smaller and lighter, the demand for stable shooting has become strong. There are two systems which have realized an electric image stabilizer.

One is to expand the frame size by 20% by using a field memory, and the camera compensates the mechanical fluctuation electrically. This technique has the disadvantage of sacrificing picture quality.

The other is to tilt the optical axis by using a variable fluid prism, and the camera compensates the mechanical fluctuation optically [5]. This system realizes image stabilization with good picture quality, but needs a bigger lens and higher power consumption.

Recently, we introduced a third system which produces good picture quality with a compact size [6]. A PAL CCD image sensor has 20% more pixels than that of NTSC. By applying the PAL CCD image sensor to an NTSC camera, we can compensate for the mechanical fluctuation electrically on the CCD image sensor. This system uses only a line memory, so we think, it is the best system for a compact camera (Fig. 6).

## V. Color EVF

There has been an increasing demand for camcorder electronic view finders (EVF) with color display. LCD is the most suitable display device for this application, and has already been used as an EVF of camcorders.

However, color LCD's used for the EVF in the past have had only 50 ~ 70K pixels. This corresponds to a horizontal resolution of less than 200 TV lines which is not satisfactory for high-quality use such as in high-band VCR's.

In order to achieve high-resolution LCD within a limited display area such as 0.7-in diagonal, the following problems have to be solved:

1) The integration of $H$ and $V$ driver circuits on the LCD substrate is imperative in order to eliminate the huge number of interconnections with external drivers.

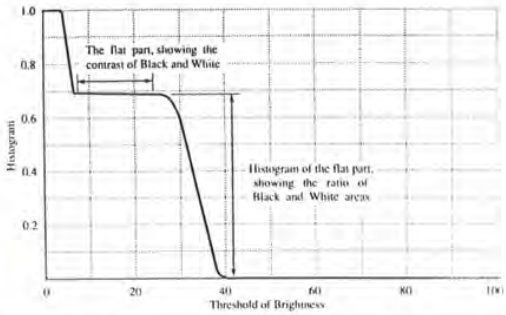



Fig. 5. Example of histogram for auto-exposure.

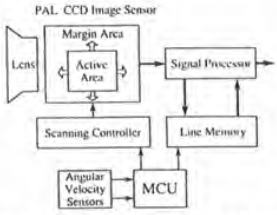



Fig. 6. Electric image stabilizer by using PAL CCD image sensor.

2) The pixel pitch has to be reduced without reducing the aperture ratio.

We have developed a polycrystalline-silicon TFT active matrix LCD, LCX 003, to solve these problems and have realized 0.7-in diagonal color LCD with 103 k pixels which is able to display a more than 240-TV-line image [7].

This LCD is based on Sony's proprietary polycrystalline-silicon thin-film transistor technology, Super thin Film Transistor (SFT) [8].

SFT has a very large field-effect mobility (100 cm/V·s and 50 cm/V·s for n-channel and p-channel transistors, respectively), so that high-speed shift registers can be integrated on the display panel. Fig. 7 shows the block diagram of LCD panel. A CMOS shift register of SFT is used for $H$ and $V$ drivers. RGB simultaneous sampling was adopted for the first time, so that R, G, and B video signals are sampled at the same time. This driving method enables a reduction of the number of stages of the $H$ shift register by 1/3, resulting in a reduction of LCD chip size and power consumption.

Thanks to the high field-effect mobility, the size of pixel transistors can be reduced to $W/L = 3\mu m/5\ \mu m$ which contributes to a high aperture ratio of 30%. Table 1 summarizes the specifications of a color LCD for the EVF of CCD-TR1.

A high contrast ratio, 120 (TYP), is realized due to the following three factors:

1) High on/off ratio of the pixel transistor. LDD (Lightly Doped Drain) structure is adopted for pixel transistors. The LDD structure suppresses leakage current in the reversed gate bias voltage region, so that on/off ratio of 108 is obtained.



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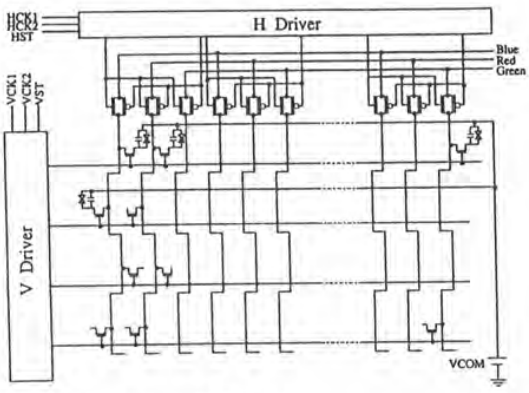



Fig. 7. Block diagram of LCD panel.

Table 1 Panel Specifications

| | |
|---|---|
| Chip size | 18.44 mm (H) × 18 mm (V) |
| Display area | 14.22 mm (H) × 10.68 mm (V) |
| Number of dots | 103 114 (473 H× 218 V) |
| Frequency of H driver | 1.67 MHz |
| Frequency of V driver | 7.865 kHz |
| Aperture ratio | 30% |
| Resolution | 240 TV lines |
| Contrast ratio | 120 |
| Transparency | 2.1% |
| Flicker | −45 dB |

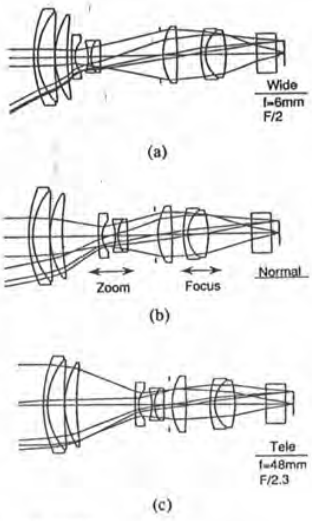



Fig. 8. Lens configuration.

Table 2 Optical Specifications of a Lens

| | |
|---|---|
| Zoom magnification | × 8 |
| Focal length | 6–48 mm |
| $F$ number | $F/1.4$–$2.2$ |
| Optical length | 60.0 mm (in air) |
| Front lens diameter | 22 mm |
| Volume | 60 cc |
| Weight | 60 g |

2) High-voltage-retaining characteristics of liquid-crystal materials.
3) High capacitance of the storage capacitor of each pixel.

The LCD has to be driven by ac voltage to prevent deterioration of the liquid crystal. Image sticking occurs when a dc component of the applied voltage to the liquid crystal exists. If stray capacitance ($C_1$) exists between the gate and the drain of pixel transistors, the actual center voltage of the video signal at the drain of the pixel transistors changes by $\Delta V$ with respect to the original center voltage of the video signal. $\Delta V$ is determined by $C_1/(C_1+C_2+C_3)$, where $C_2$ is the capacitance of the storage capacitor and $C_3$ is the capacitance of the liquid crystal. Since the capacitance of the liquid crystal changes with respect to the video signal level, it causes image sticking. LCX003 has a very low $C_1$ because of the LDD structure of pixel transistors, and a very high $C_2$ because of the ONO (Oxide–Nitride–Oxide) structure of the storage capacitor, so that $\Delta V$ is small (0.3 V) and almost constant. This is why LCX003 has extremely good image sticking characteristics.

Since the leakage current of pixel transistors has a temperature dependence, degradation of the displayed image, such as contrast ratio and bright point defect, in the high-temperature region might be a problem. The SFT with LDD structure has extremely low leakage current, less than $10^{-13}$ A. As a result, a high-quality image can be retained up to 70-nA low leakage current which also contributes to obtaining an excellent flicker level (typically −45 dB).

## VI. Lens System

### A. Optical System

The development of a new zoom lens system is motivated by the needs of high-speed Auto Focus (AF) and high-speed zoom as well as compactness. The main parameters of the optical specifications are presented in Table 2. The four-component rear-focus zoom system is designed using nine glass elements including two aspheric glass mold lenses (Fig. 8). The second (variator) and fourth (master) components are movable for zooming and focusing, respectively. The fourth component also functions to compensate for defocus caused by the movement of the second component. The relationship between these two components is called "Zoom Tracking." This function is controlled electronically and is called "Electronic Cam" instead of the conventional mechanical cam.



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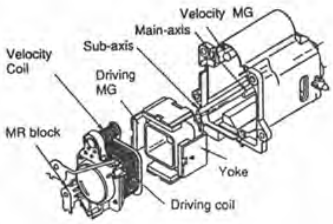



Fig. 9. Linear actuator configuration.

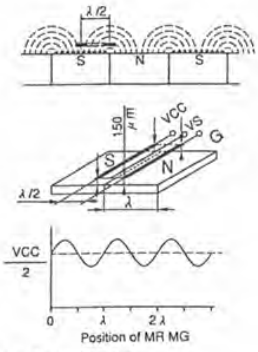



Fig. 10. Principle of thin-film MR sensor.

### B. Realization of Linear Motor Auto Focus

*1) Linear motor:* In the conventional zoom lens, a stepping motor is used for the focus lens actuator. The focus lens speed is typically 1 s/5 mm, and is limited by vibration and noise. We have developed a new linear actuator as illustrated in Fig. 9. The focus lens is mounted on a moving block surrounded by a voice coil and a magnetic circuit. The driving force is generated along the optical axis in the center of gravity. The moving block is supported by a pair of shafts and a metal bushing which minimizes friction loss. The velocity (damping) coil and the MR sensor are mounted on the moving block.

The developed linear motor realizes 0.1 s/5 mm, 3 G thrust/3.3 V, and 50-mW power consumption (1/8 that of a conventional stepping motor).

*2) Precision three-phase MR sensor:* Magneto-resistive (MR) sensors are widely used in the FG (frequency generator) of capstan motors. The principle of a thin-film MR sensor is illustrated in Fig. 10. The electric resistance of the ferromagnetic film varies depending on the direction of magnetization [7]. Two magneto-sensitive patterns are separated by $\lambda/2$ and are serially connected. The variation of the mid-point ($V_s$) is the output signal of the MR sensor.

We have developed a new three-phase MR sensor to improve the resolution. $A$-, $B$-, and $C$-phase MR sensors are laid out by $l/3$ and $2l/3$ separation, respectively, as shown in Fig. 11. The magnetic pole width $l$ is designed as 264 $\mu$m to secure the gap distance (MR sensor to magnet air gap). The output signal of the three-phase MR sensor is electronically interpolated (8-b A/D and processed by a microprocessor). This MR sensor realizes submicrometer

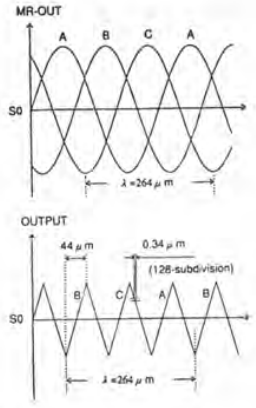



Fig. 11. Three-phase MR sensor.

resolution and ± 5-$\mu$m accuracy which is sufficient for the lens position control.

*3) Lens control system* As part of the camera system a microprocessor (8 b) is used to control the zoom and linear motors. This lens system achieves 1.3-s zoom speed (×8) and high-speed AF.

## VII. Lithium-Ion Battery

The CCD-TR1 camcorder is powered by an NP-500 battery pack which comprises newly developed lithium-ion secondary batteries, and in this section some features and properties of these batteries will be described. Portable electronic equipments such as audio–video devices, lap-top computers, and pocket phones have been designed smaller and smaller, and the need for lighter, smaller, and longer lasting rechargeable batteries has grown. While significant improvement of both Ni–Cd and sealed lead–acid batteries has been made in order to fulfill this requirement, energy characteristics have reached their technological limits. Moreover, Cd and Pb have received increasing attention from environmentalists. These are the reasons for the development of novel electrochemical cells.

A secondary electrochemical cell with a metallic lithium anode has attracted much attention as a candidate for high-energy batteries, and has been investigated worldwide for a long time. The unusual characteristics of the lithium electrode during cycling, however, have prevented rechargeable lithium batteries from coming onto the market. For example, the cycle life of the cells is decreased significantly by the lower discharge currents or the higher charge currents.

To overcome the weakness of the metallic lithium anode, we have studied some lithium-storing materials as an anode, and cells with carbonaceous anodes have proved to be most promising.

Certain carbonaceous materials can be intercalated with various atoms or atomic groups between their layers to form so-called Carbon Intercalation Compounds (CIC). There exist various classes of CIC's and it is well known that carbonaceous materials are electrochemically reduced in an aprotic organic electrolyte containing lithium ions to



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Table 3 Specifications of Li-Ion Battery

| | |
|---|---|
| Volume | 16.5 cm |
| Weight | 40 g |
| Nominal voltage | 4.2 V |
| Average operating voltage | 3.6 V |
| Capacity at 700 mA | 1030 mA· h |
| Energy density | 225 W· h/l<br>95 W· h/kg |
| Self-density | 10%/M |
| Cycle life | > 500 cycles |

form a Li–C Intercalation Compound (Li-CIC). Li-CIC can be charged and discharged as a rechargeable anode for nonaqueous cells according to the reaction [1].

$$\mathrm{LiaC\ Lia} - dx\mathrm{C} + dx\mathrm{Li} + +e. \quad (1)$$

From the battery manufacturing standpoint, lithium-containing compounds would be desirable as cathode materials, because the Li-CIC anode can be prepared inside cells by the first charging even when the anode material is constructed with pure carbon without containing lithium. In this case, it is necessary for lithium ions to be extracted by electrochemical oxidation from the cathode compounds during charging, and $LiCoO_2$ has been found to be most satisfactory. The composition of the $LiCoO_2$ cathode reversibly changes during charging and discharging as indicated in (2).

$$\mathrm{LiCoO_2\ Li_1} - dx\mathrm{CoO_2} + dx\mathrm{Li} + +e. \quad (2)$$

The overall cell reaction is as follows.

$$\mathrm{LiCoO_2} + \mathrm{Lia} - dx\mathrm{C} \qquad \mathrm{Li_1} - dx + \mathrm{LiaC}. \quad (3)$$

Equation (3) indicates that no metallic lithium is present in the system. To make a distinction from conventional lithium batteries, the name "Lithium-Ion Rechargeable Battery" was given to this battery because a special ionic bond compound is used as a cathode and only lithium of an ionic state is found in the anode.

The use of special lithium compounds in both electrodes has resulted in a product with such an extremely improved level of safety that the U.S. Department of Transportation (DOT) and the International Air Transport Association (IATA) have decided that the lithium-ion rechargeable battery would not be subject to their Hazardous Materials Regulations.

In 1991, we completed the development of lithium-ion rechargeable batteries through intensive investigations and brought them into the market. The basic performance of a 18650 $LiCoO_2$/LiaC cell (diameter: 18 mm, height: 65 mm) is summarized in Table 3. The battery performance including energy density (both volumetric and gravimetric), drain capability, and self-discharge characteristics meets the performance requirements for the battery for camcorders.

An NP-500 battery pack comprises two 18650 lithium-ion cells. An elaborately tailored electronic device is used in a pack in order to protect cells against overcharging, overdischarging, and excess current flow.

## VIII. Conclusion

Camcorders consist of a wide range of technologies. Advancement of technologies such as magnetic recording, small components and mounting, signal processing, control, image and display devices, optics, and chemistry have made camcorders small with high performance.

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**Yukio Kubota** received the B.S. and M.S. degrees in physics from Waseda University, Tokyo, Japan, in 1972 and 1974, respectively.

He joined Sony Corporation in 1974 and has participated in the development of a variety of video systems. During 1979–1980, he was at the California Institute of Technology, Pasadena, doing research in the area of optical data processing. After returning to Sony, he has been engaged in the development of video-recording technology. He is General Manager of DC Products Division Personal Video Group at Sony.





**Yoshio Nishi** received the B.S. degree in applied chemistry from KEIO University, Tokyo, Japan, in 1966.

In 1966 he joined the Research Center, Sony Corporation, where he was engaged in the research and development of fuel cells. In 1974 he began research on materials for electro-acoustic transducers in the Audio Research Laboratory at Sony. Since 1987, he has been involved in developmental research on nonaqueous electrolyte batteries and currently is a General Manager of the Technocal Department of Sony Energytec Inc. He has presented six papers and communications and published two books.

Mr. Nishi is a member of TAPPI, the Chemical Society of Japan, and the Society of Polymer Science of Japan.




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# United States Patent [19]

**Kinugasa et al.**

[11] **Patent Number: 5,060,074**

[45] **Date of Patent: Oct. 22, 1991**


[54] **VIDEO IMAGING APPARATUS**


[75] Inventors: **Toshiro Kinugasa**, Hiratsuka; **Takuya Imaide**, Yokohama; **Naoki Yamamoto**, Yokohama; **Hiroyuki Komatsu**, Yokohama, all of Japan

[73] Assignees: **Hitachi, Ltd.**, Tokyo; **Hitachi Video Engineering, Inc.**, Yokohama, both of Japan



[21] Appl. No.: **595,364**

[22] Filed: **Oct. 10, 1990**

[30] **Foreign Application Priority Data**

Oct. 18, 1989 [JP] Japan ..... 1-268898
Nov. 6, 1989 [JP] Japan ..... 1-287453
Dec. 22, 1989 [JP] Japan ..... 1-331350

[51] **Int. Cl.**[5] ..... **H04N 5/228**
[52] **U.S. Cl.** ..... **358/224**; 358/222
[58] **Field of Search** ..... 358/224, 222, 105, 108



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*Primary Examiner*—Stephen Brinich
*Attorney, Agent, or Firm*—Antonelli, Terry, Stout & Kraus



[57] **ABSTRACT**

A video imaging apparatus changes an area of an imaging element (CCD or MOS type) from which a signal is read out as a TV signal. A normal transfer speed is used to read out the signal from the area as the TV signal and a high transfer speed is used to read out a signal from other area so that smooth movement of an image can be attained.

Further, when movement of a video camera occurs, the movement can be judged by observation through a view finder, that is, which partial area of the whole area of the imaging element is produced as the TV signal can be recognized.


**22 Claims, 22 Drawing Sheets**

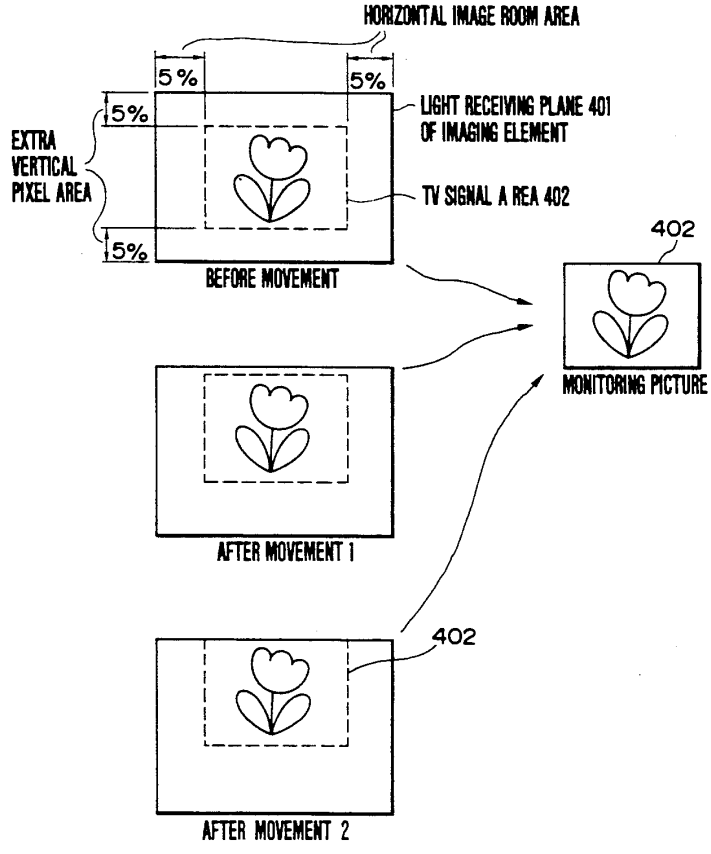


FIG. 1A

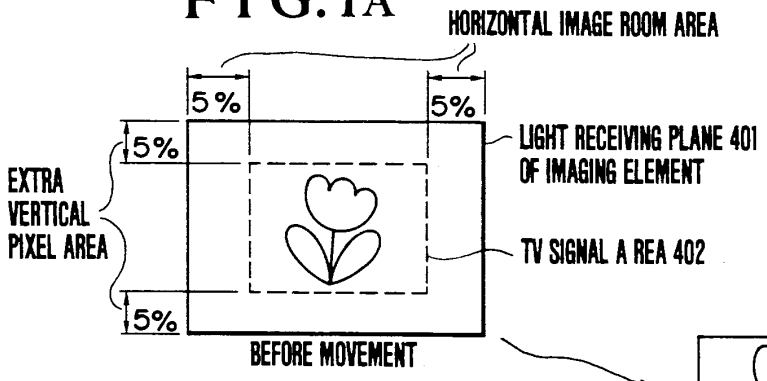



FIG. 1B

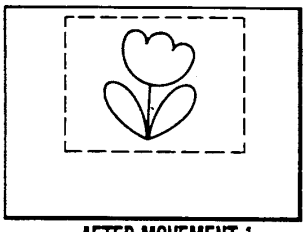
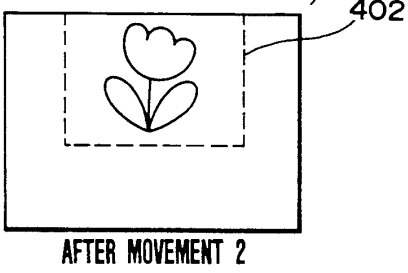



FIG. 1C



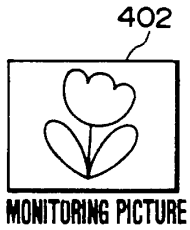




FIG. 1D

FIG.2

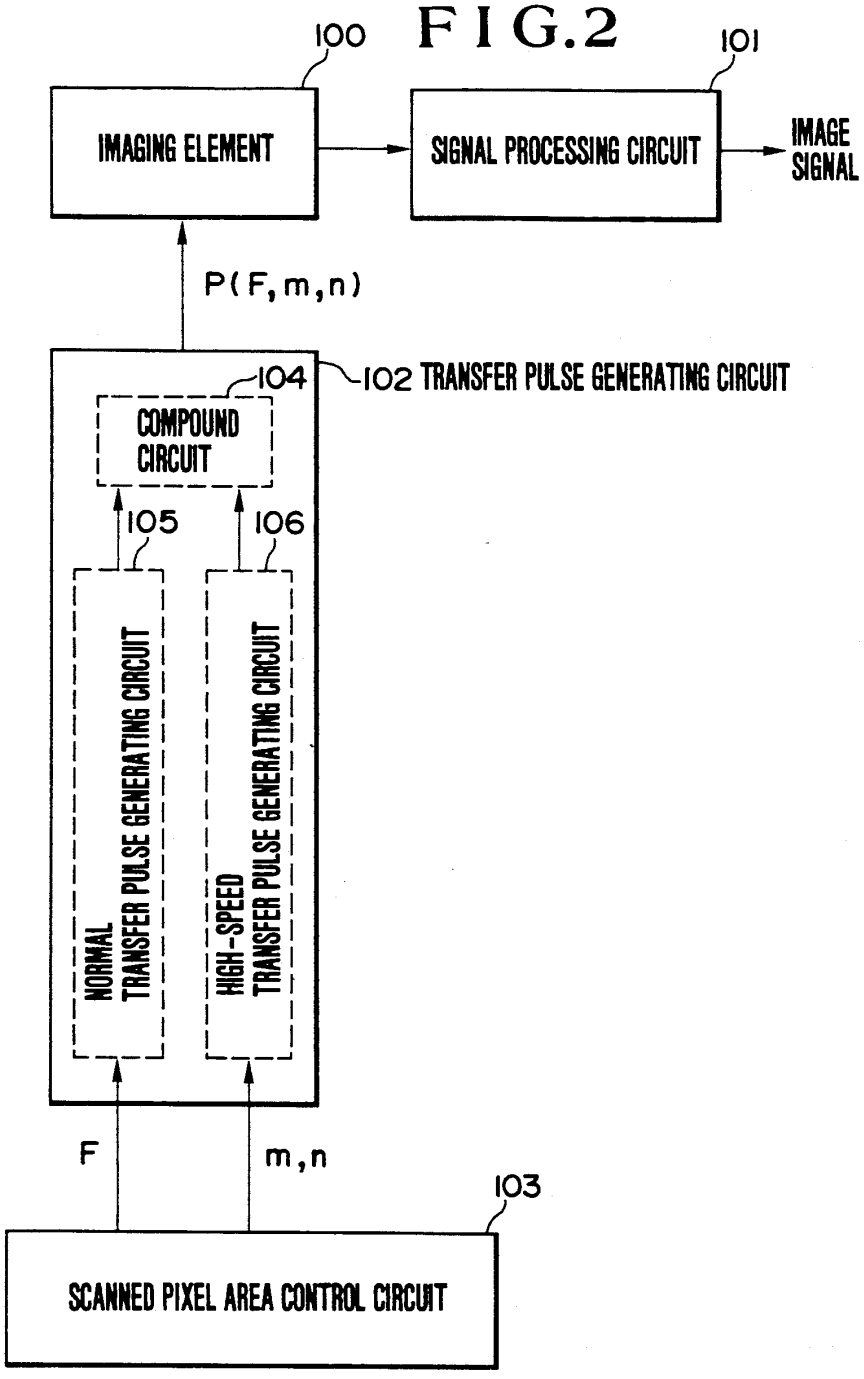
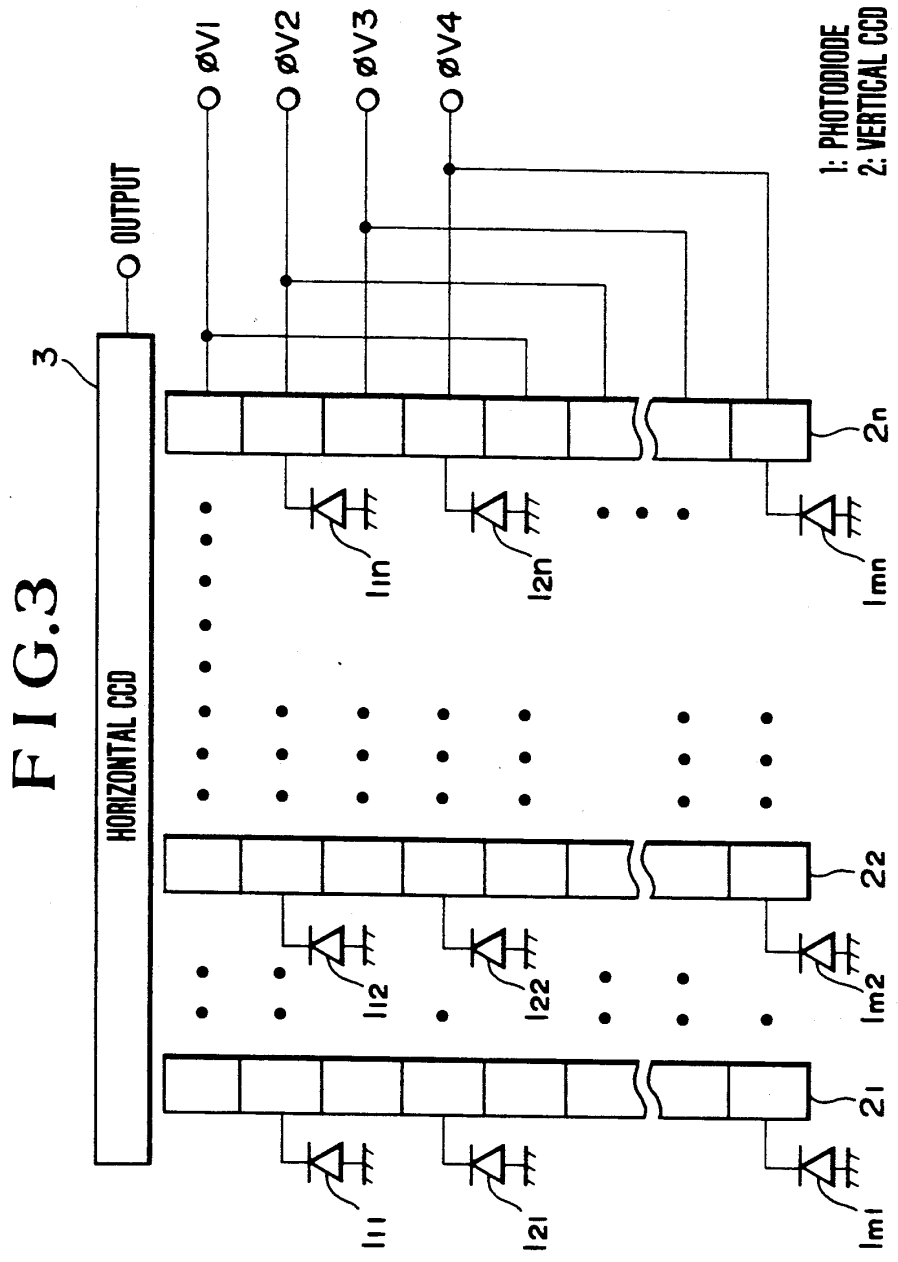

100
101
IMAGING ELEMENT
SIGNAL PROCESSING CIRCUIT
IMAGE SIGNAL
P(F,m,n)
104
102 TRANSFER PULSE GENERATING CIRCUIT
COMPOUND CIRCUIT
105
106
NORMAL TRANSFER PULSE GENERATING CIRCUIT
HIGH-SPEED TRANSFER PULSE GENERATING CIRCUIT
F
m,n
103
SCANNED PIXEL AREA CONTROL CIRCUIT

FIG.3


ØV1
ØV2
ØV3
ØV4
1: PHOTODIODE
2: VERTICAL CCD
OUTPUT
3
HORIZONTAL CCD
2n
22
21
l1n
l2n
lmn
l12
l22
lm2
l11
l21
lm1

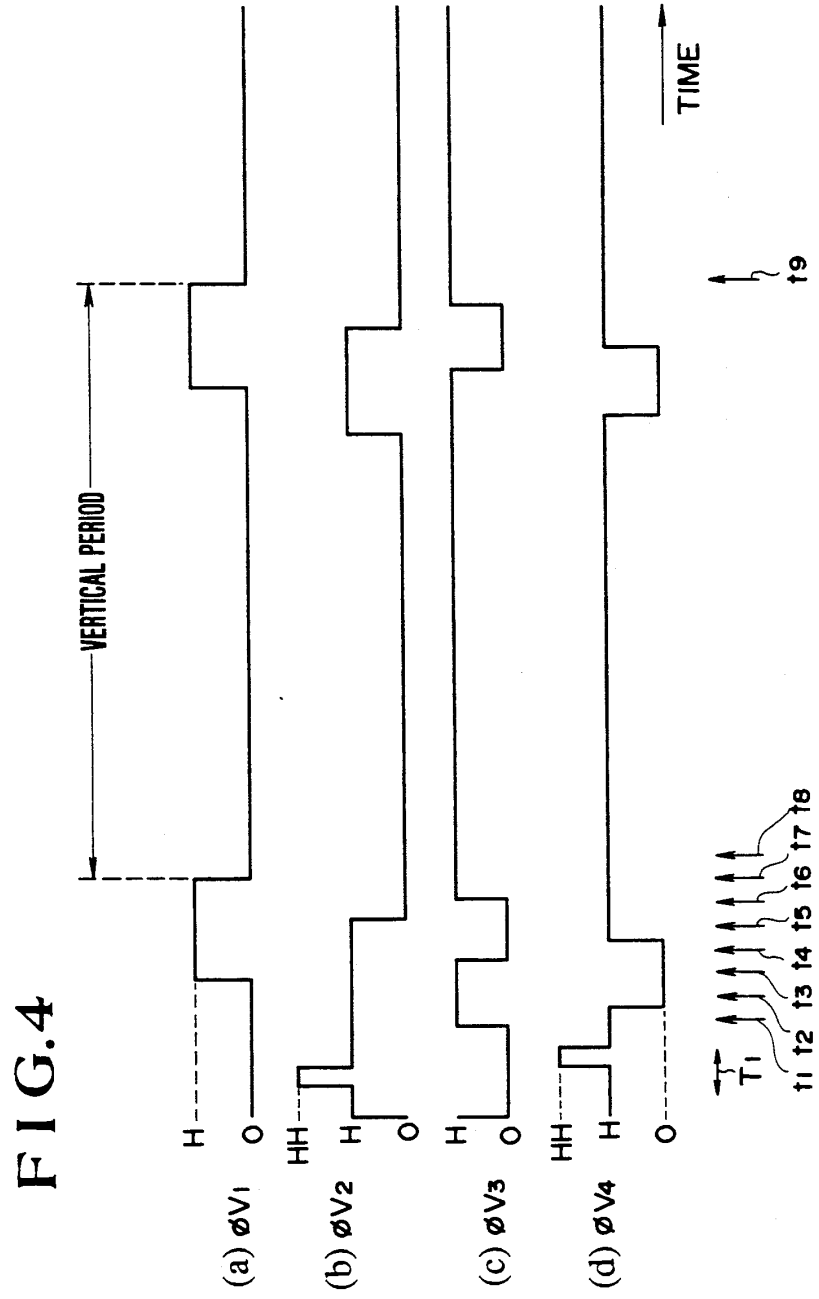

VERTICAL PERIOD
TIME
t9
T1
t1 t2 t3 t4 t5 t6 t7 t8
(a) øV1
(b) øV2
(c) øV3
(d) øV4
HH
H
O

FIG.4

FIG.5

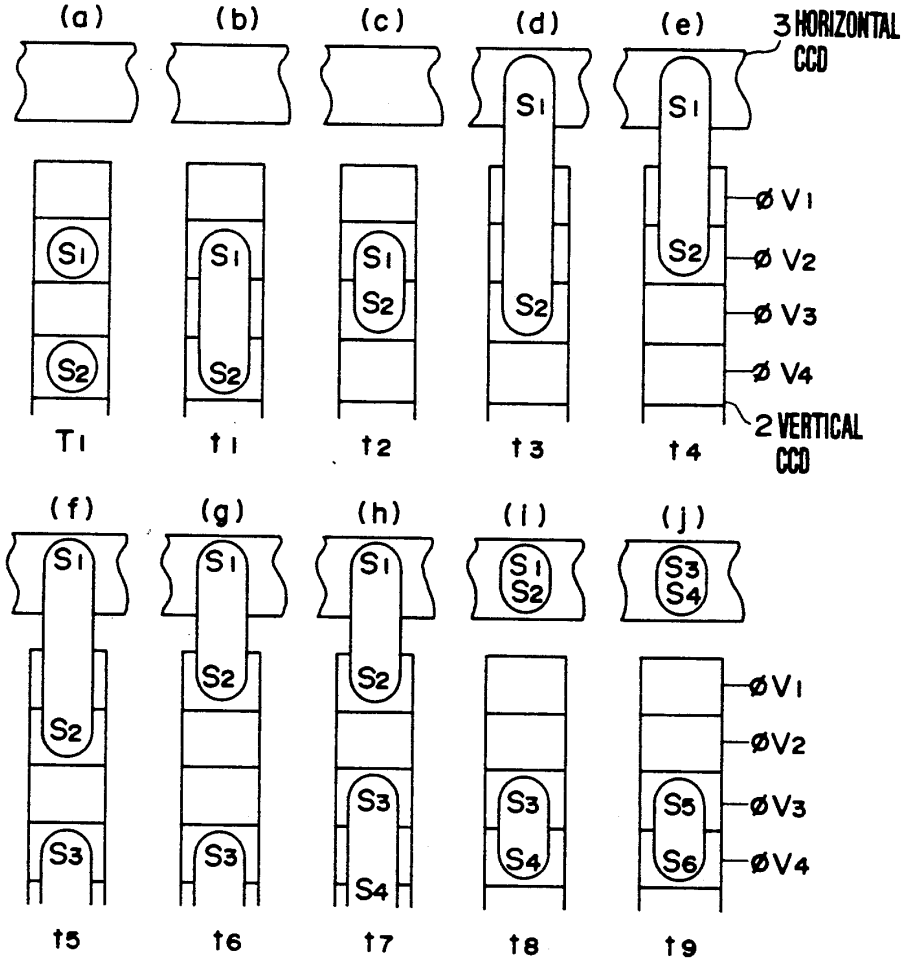

(a)
(b)
(c)
(d)
(e)
3 HORIZONTAL CCD
S1
S2
ØV1
ØV2
ØV3
ØV4
2 VERTICAL CCD
T1
t1
t2
t3
t4
(f)
(g)
(h)
(i)
(j)
S3
S4
S5
S6
t5
t6
t7
t8
t9

FIG.6

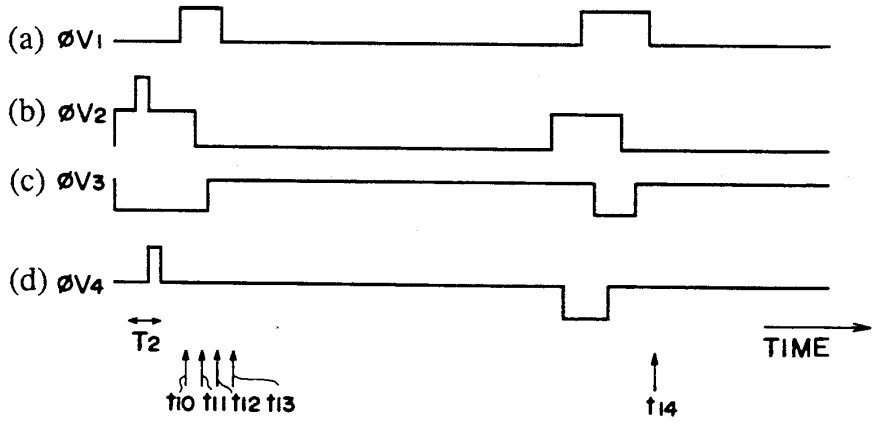

(a) øV1
(b) øV2
(c) øV3
(d) øV4
T2
TIME
t10 t11 t12 t13
t14

FIG.7

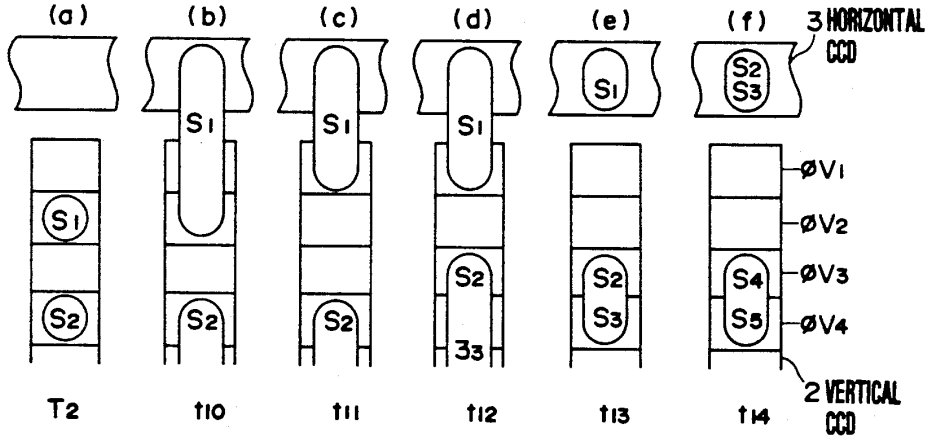

(a)
(b)
(c)
(d)
(e)
(f)
3 HORIZONTAL CCD
S1
S2
S3
S4
S5
øV1
øV2
øV3
øV4
33
2 VERTICAL CCD
T2
t10
t11
t12
t13
t14

FIG.8

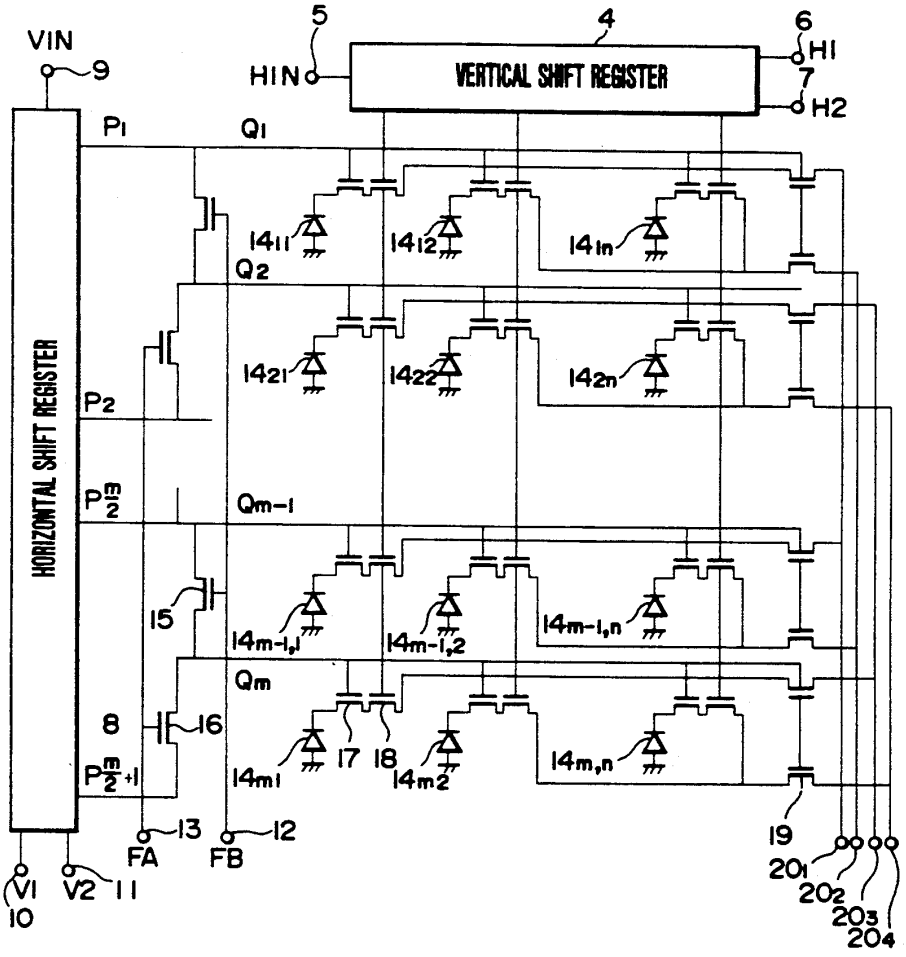

VIN
9
HIN
5
4
VERTICAL SHIFT REGISTER
6
HI
7
H2
HORIZONTAL SHIFT REGISTER
P1
Q1
Q2
P2
Pm/2
Qm-1
Qm
Pm/2+1
8
15
16
17
18
19
FA
13
FB
12
V1
10
V2
11
201
202
203
204

FIG.9

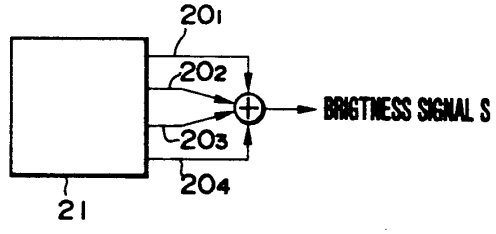

201
202
203
204
21
BRIGTNESS SIGNAL S

FIG.10

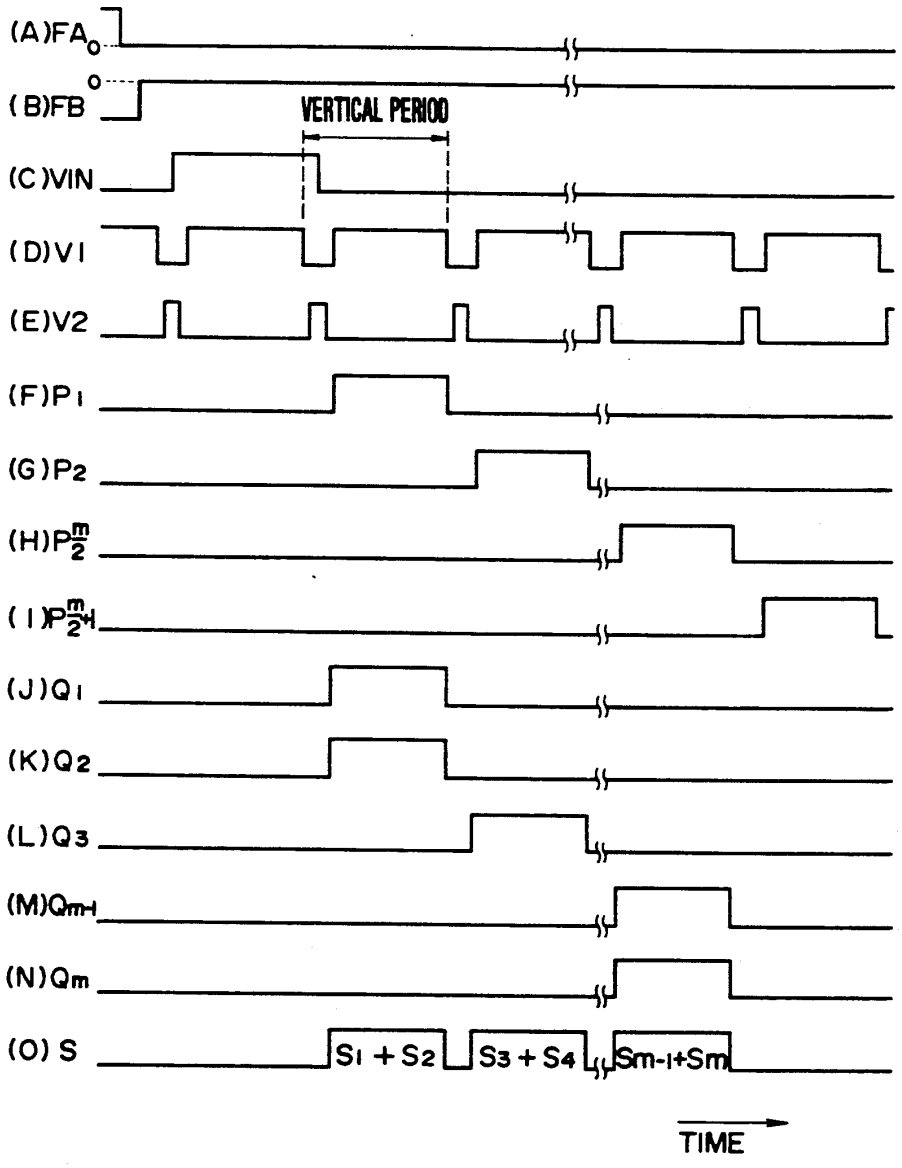

(A)FA0
(B)FB
VERTICAL PERIOD
(C)VIN
(D)V1
(E)V2
(F)P1
(G)P2
(H)Pm/2
(I)Pm/2+1
(J)Q1
(K)Q2
(L)Q3
(M)Qm-1
(N)Qm
(O) S
S1 + S2
S3 + S4
Sm-1+Sm
TIME

FIG.11

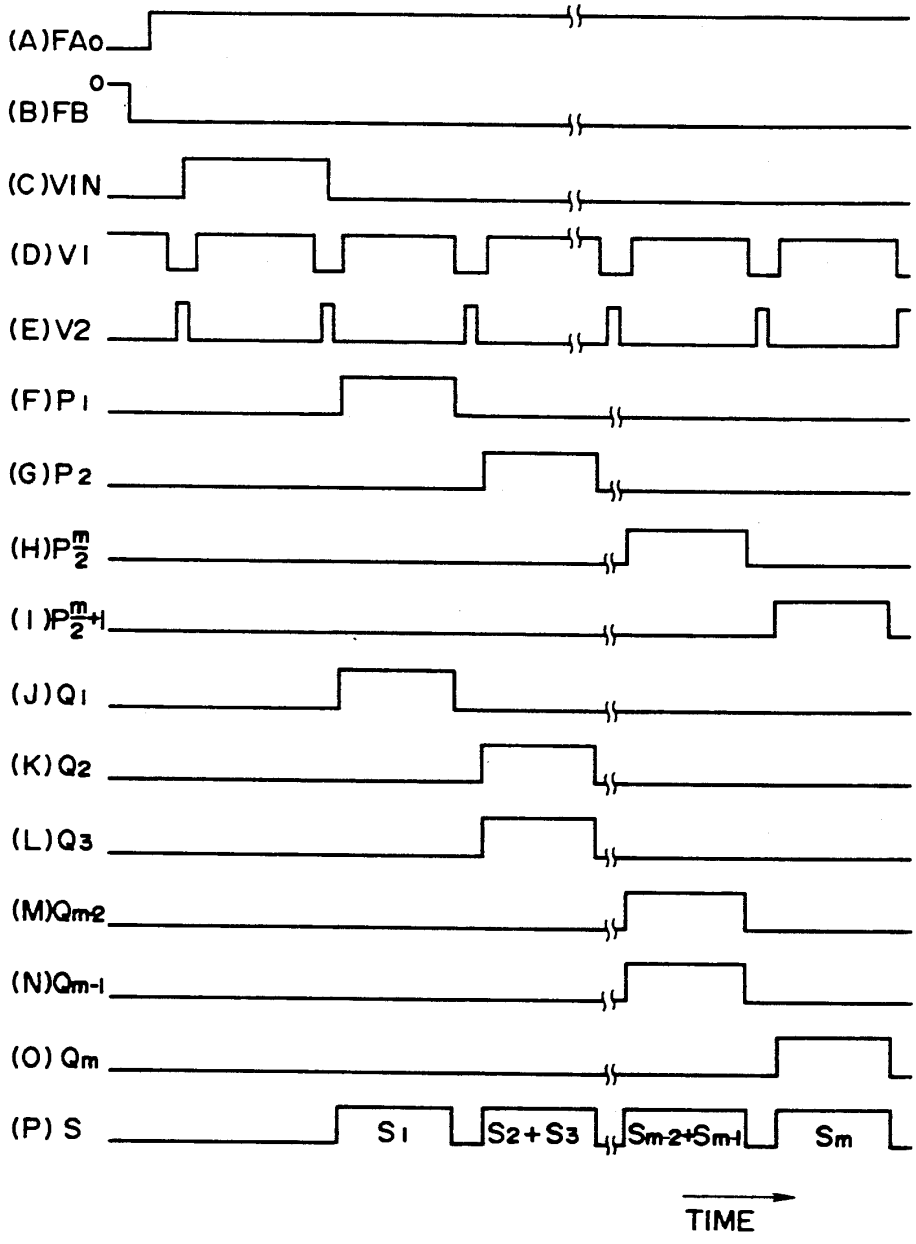

(A)FAo
(B)FB o
(C)VIN
(D)V1
(E)V2
(F)P1
(G)P2
(H)P m/2
(I)P m/2+1
(J)Q1
(K)Q2
(L)Q3
(M)Qm-2
(N)Qm-1
(O) Qm
(P) S
S1
S2+S3
Sm-2+Sm-1
Sm
TIME

FIG.12

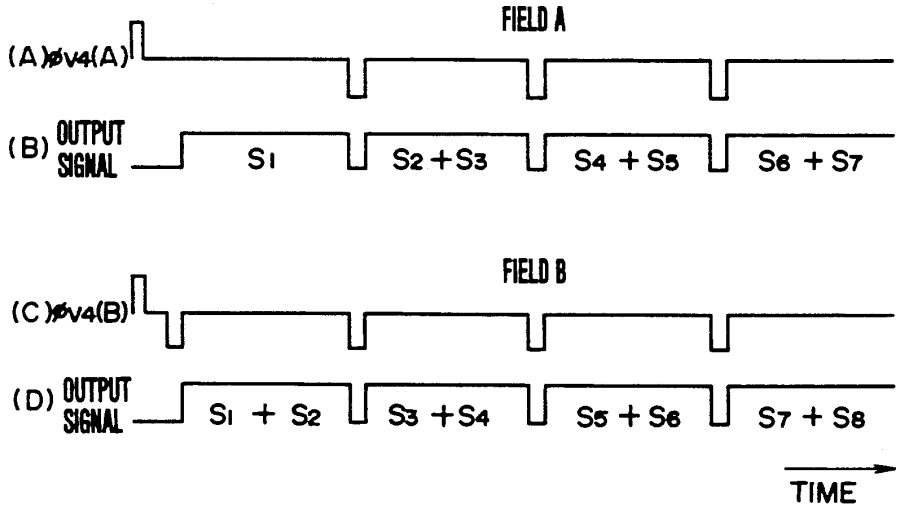

FIELD A
(A) øV4(A)
(B) OUTPUT SIGNAL
S1
S2 + S3
S4 + S5
S6 + S7
FIELD B
(C) øV4(B)
(D) OUTPUT SIGNAL
S1 + S2
S3 + S4
S5 + S6
S7 + S8
TIME

FIG.13

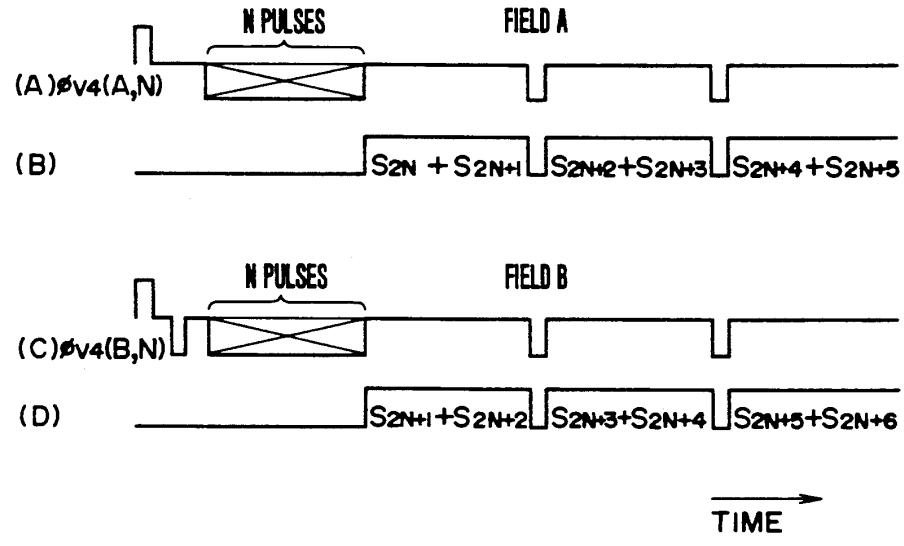

N PULSES
FIELD A
(A) øV4(A,N)
(B)
S2N + S2N+1
S2N+2+S2N+3
S2N+4+S2N+5
N PULSES
FIELD B
(C) øV4(B,N)
(D)
S2N+1+S2N+2
S2N+3+S2N+4
S2N+5+S2N+6
TIME

FIG.14

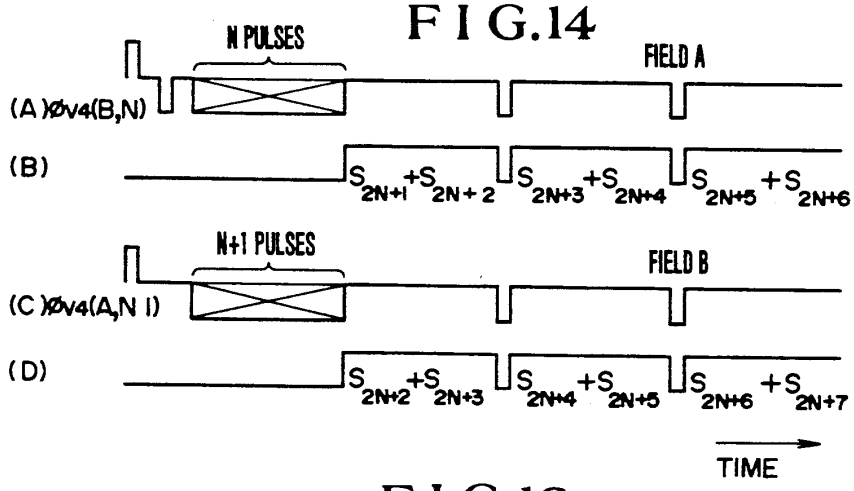

N PULSES
FIELD A
(A) ØV4(B,N)
(B)
S2N+1 +S2N+2 S2N+3 +S2N+4 S2N+5 +S2N+6
N+1 PULSES
FIELD B
(C) ØV4(A,N I)
(D)
S2N+2 +S2N+3 S2N+4 +S2N+5 S2N+6 +S2N+7
TIME

FIG.16

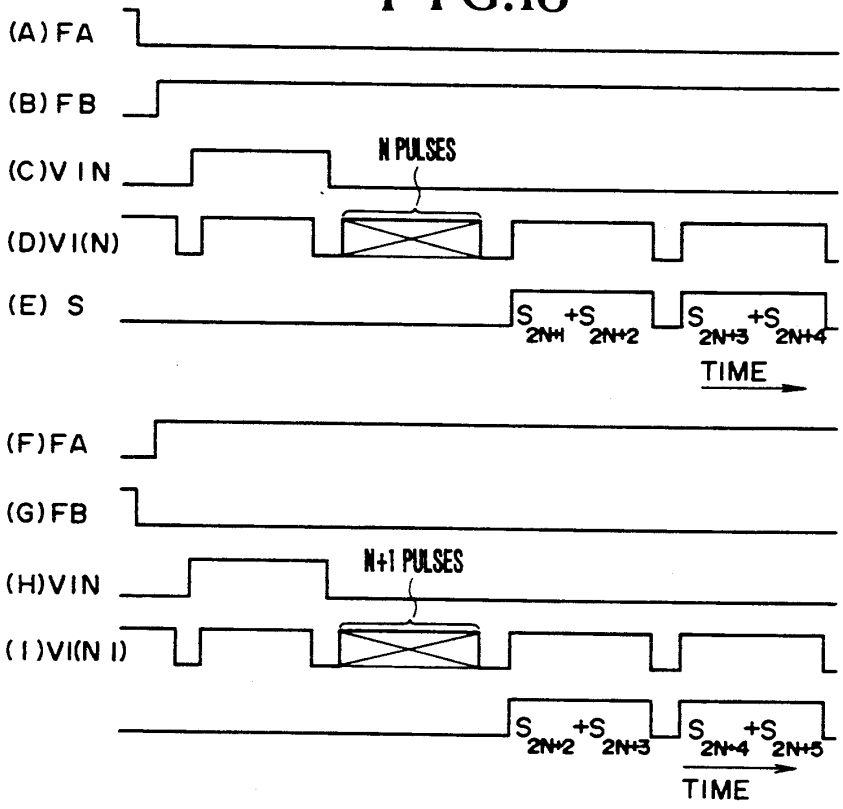

(A) FA
(B) FB
N PULSES
(C) V I N
(D) VI(N)
(E) S
S2N+1 +S2N+2 S2N+3 +S2N+4
TIME
(F) FA
(G) FB
N+1 PULSES
(H) VIN
(I) VI(N I)
S2N+2 +S2N+3 S2N+4 +S2N+5
TIME

FIG.15

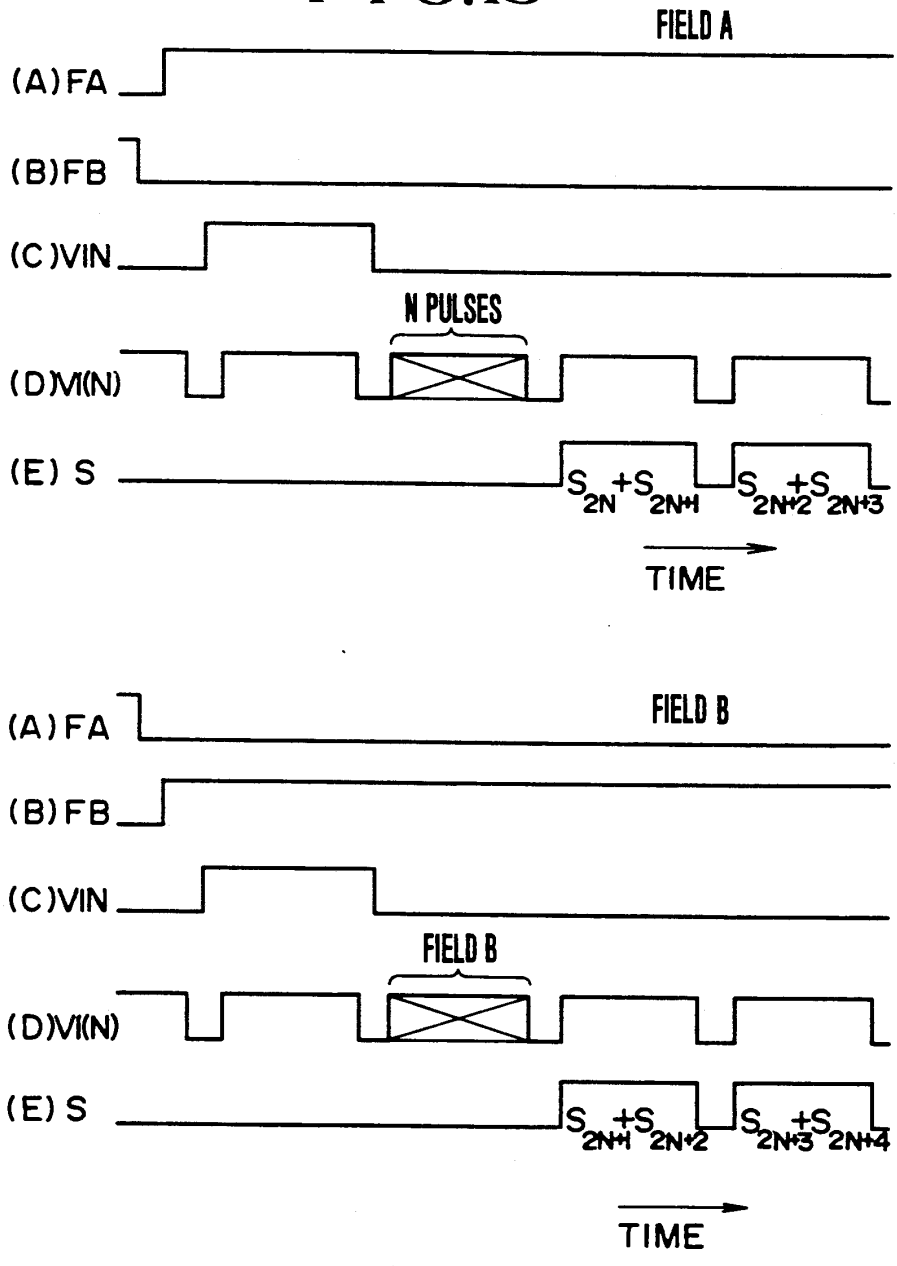

FIELD A
(A) FA
(B) FB
(C) VIN
N PULSES
(D) VI(N)
(E) S
$S_{2N}+S_{2N+1}$
$S_{2N+2}+S_{2N+3}$
TIME
FIELD B
(A) FA
(B) FB
(C) VIN
FIELD B
(D) VI(N)
(E) S
$S_{2N+1}+S_{2N+2}$
$S_{2N+3}+S_{2N+4}$
TIME

FIG.17

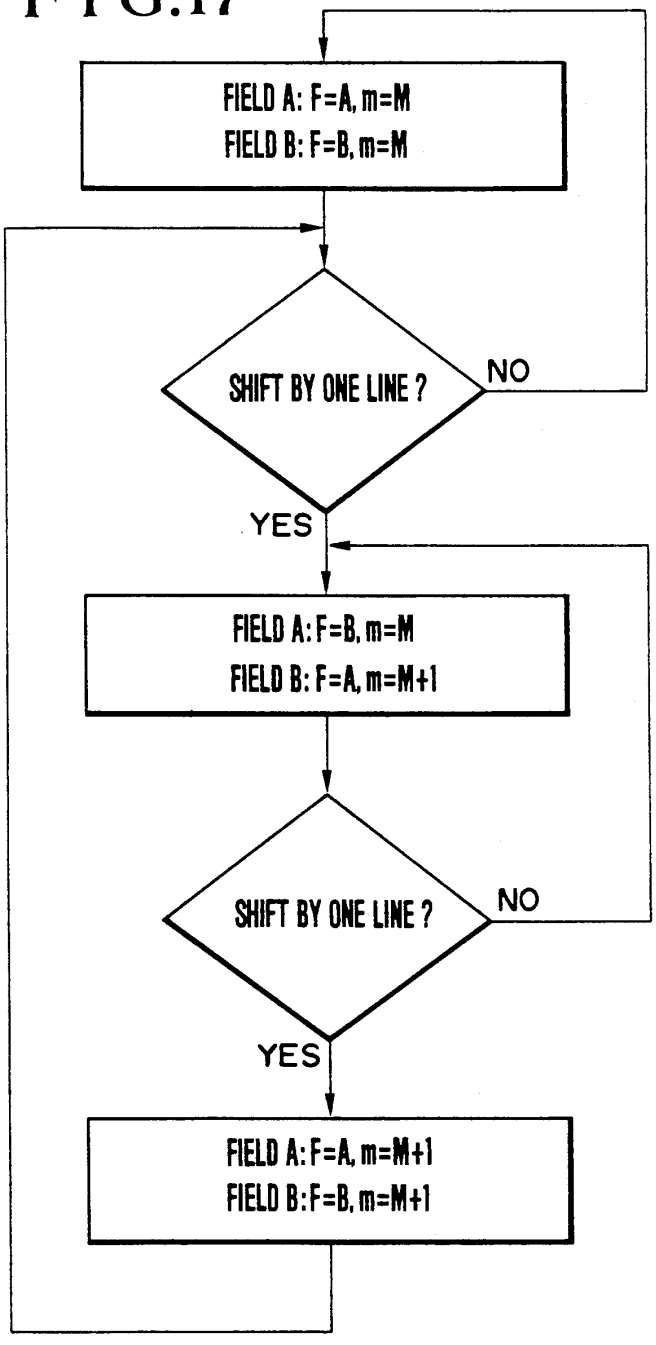

FIELD A: F=A, m=M
FIELD B: F=B, m=M
SHIFT BY ONE LINE ?
NO
YES
FIELD A: F=B, m=M
FIELD B: F=A, m=M+1
SHIFT BY ONE LINE ?
NO
YES
FIELD A: F=A, m=M+1
FIELD B: F=B, m=M+1

FIG.18

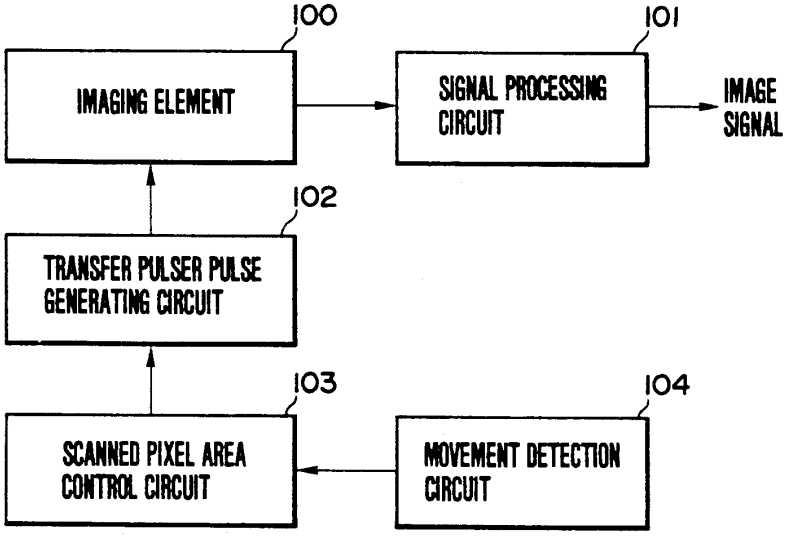
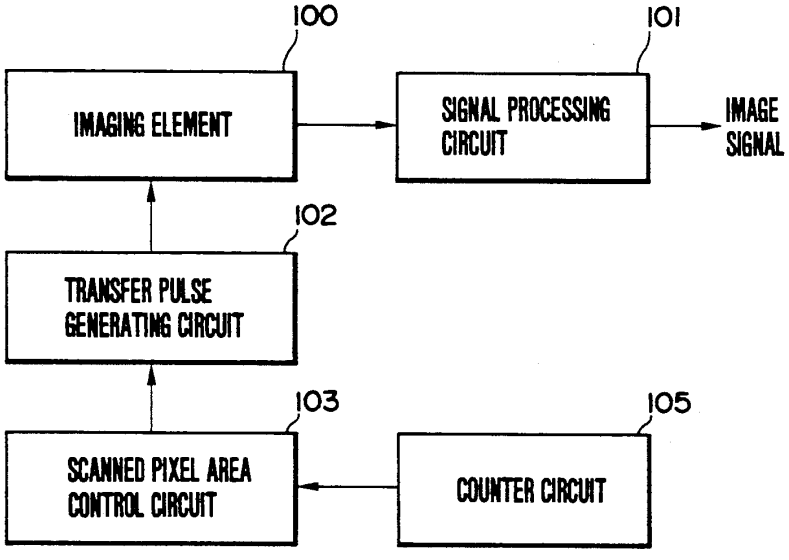

100
IMAGING ELEMENT
101
SIGNAL PROCESSING CIRCUIT
IMAGE SIGNAL
102
TRANSFER PULSER PULSE GENERATING CIRCUIT
103
SCANNED PIXEL AREA CONTROL CIRCUIT
104
MOVEMENT DETECTION CIRCUIT

FIG.19


100
IMAGING ELEMENT
101
SIGNAL PROCESSING CIRCUIT
IMAGE SIGNAL
102
TRANSFER PULSE GENERATING CIRCUIT
103
SCANNED PIXEL AREA CONTROL CIRCUIT
105
COUNTER CIRCUIT

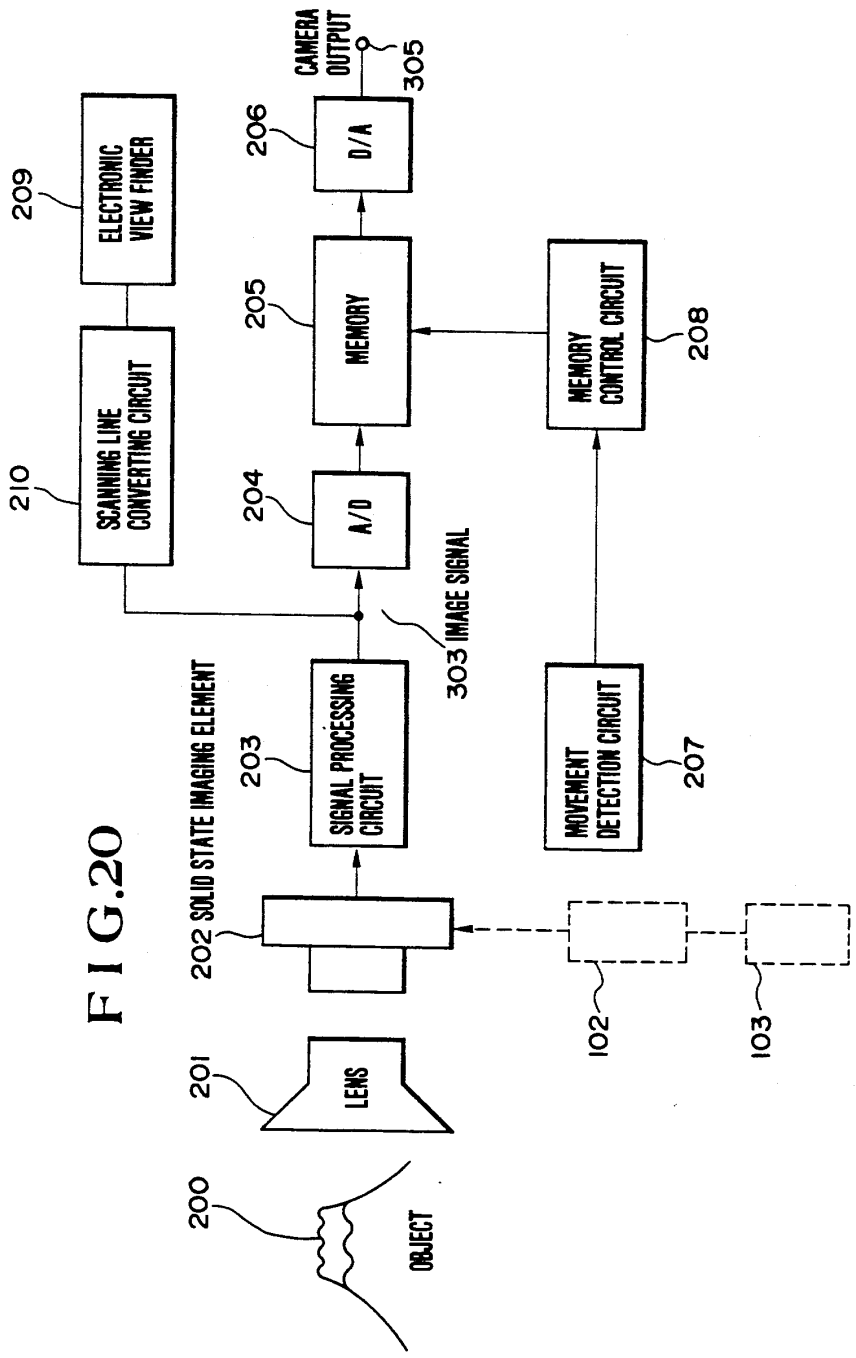

CAMERA OUTPUT
305
206
D/A
209
ELECTRONIC VIEW FINDER
205
MEMORY
208
MEMORY CONTROL CIRCUIT
210
SCANNING LINE CONVERTING CIRCUIT
204
A/D
303 IMAGE SIGNAL
203
SIGNAL PROCESSING CIRCUIT
207
MOVEMENT DETECTION CIRCUIT
202 SOLID STATE IMAGING ELEMENT
102
103
201
LENS
200
OBJECT

FIG.20

FIG.21A

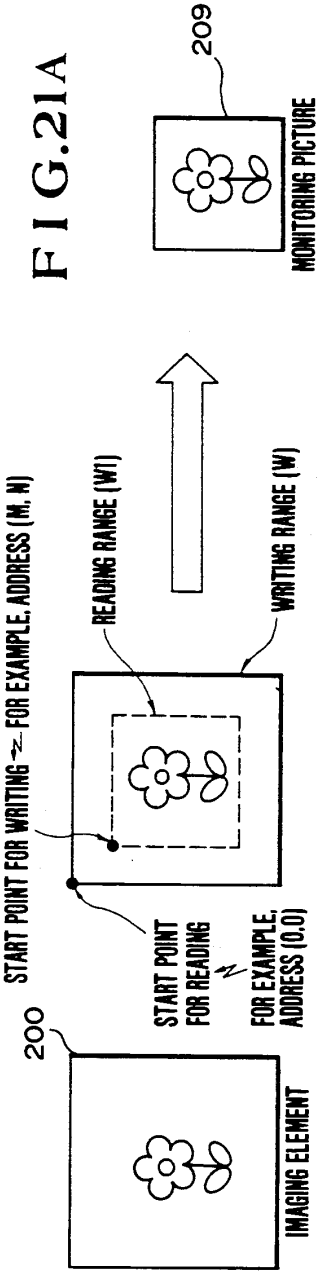



FIG.21B

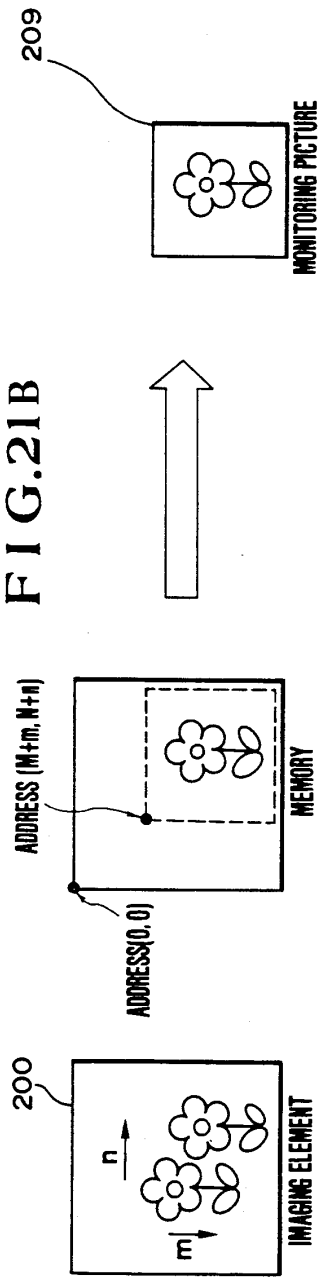


FIG.22A

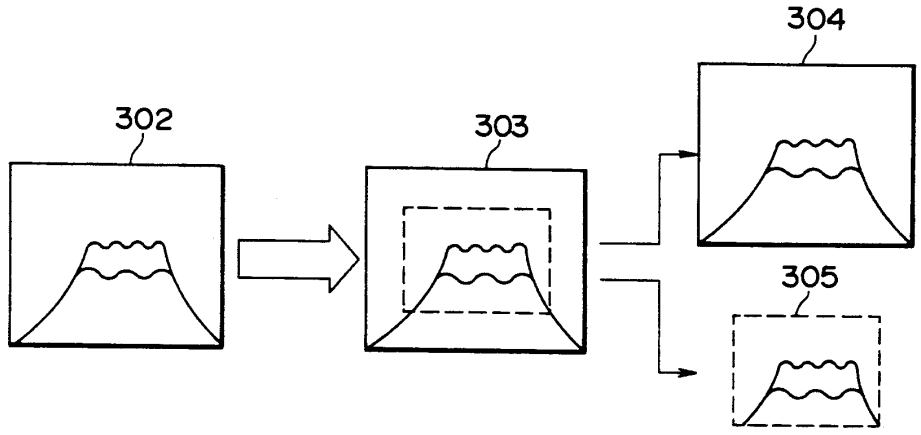
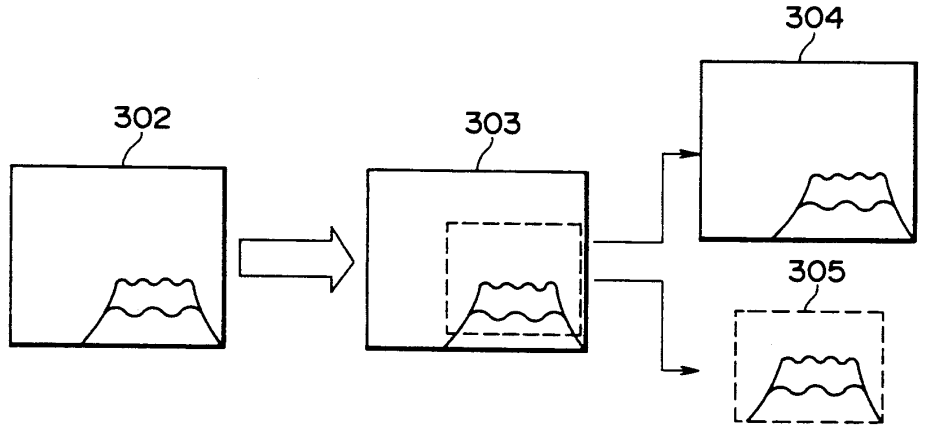



FIG.22B



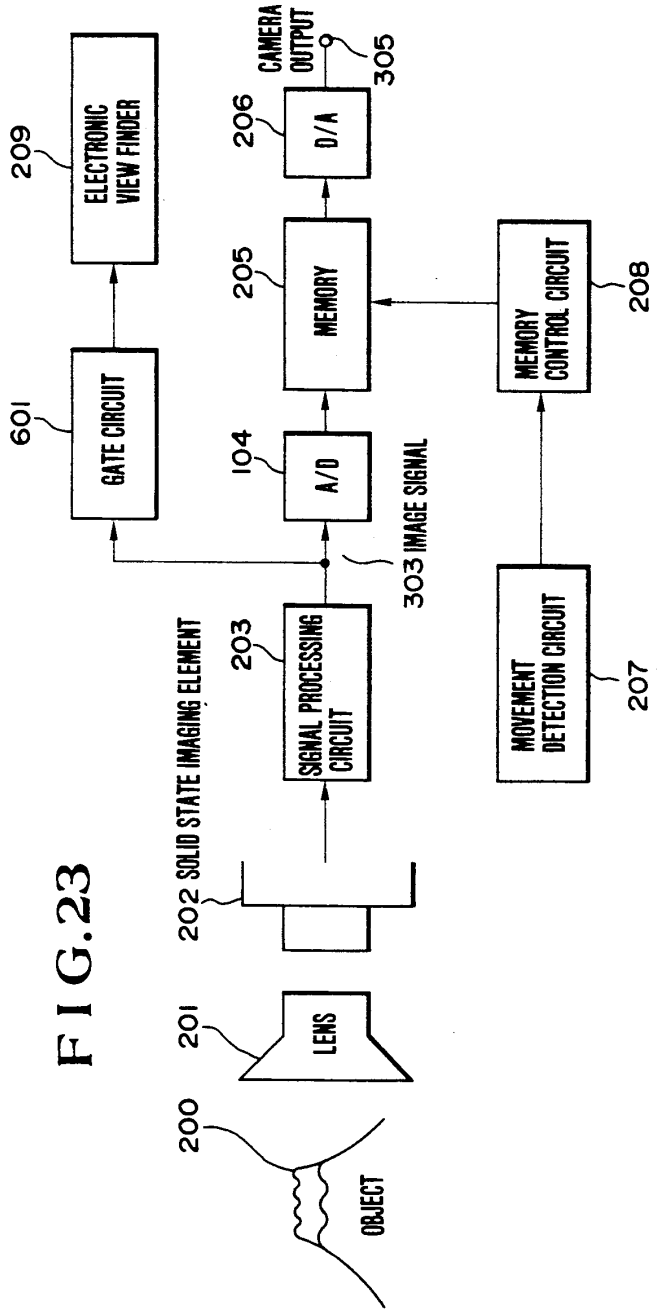

200
OBJECT
201
LENS
202 SOLID STATE IMAGING ELEMENT
203
SIGNAL PROCESSING CIRCUIT
303 IMAGE SIGNAL
104
A/D
205
MEMORY
206
D/A
CAMERA OUTPUT
305
209
ELECTRONIC VIEW FINDER
601
GATE CIRCUIT
208
MEMORY CONTROL CIRCUIT
207
MOVEMENT DETECTION CIRCUIT

FIG.23

FIG.24A

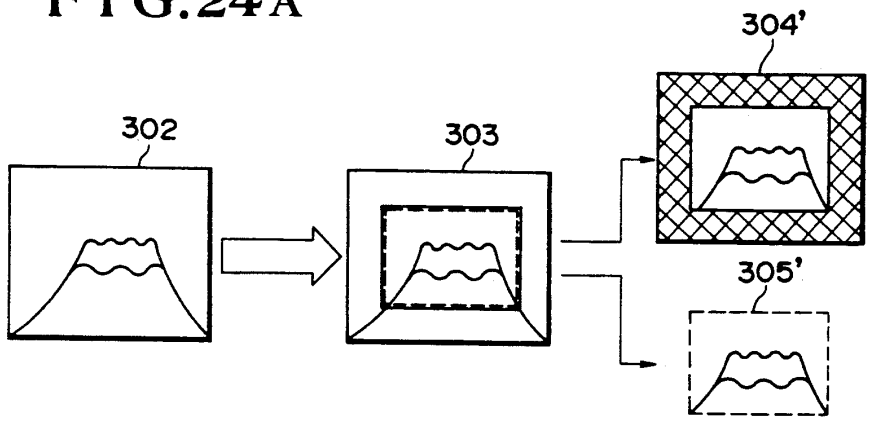
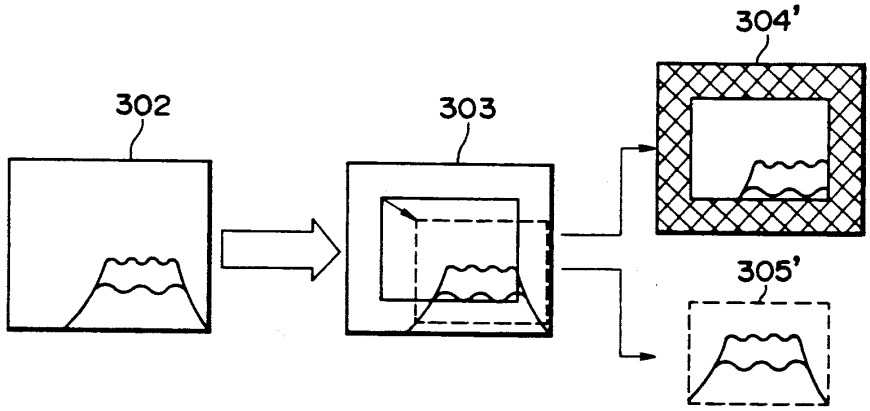



FIG.24B



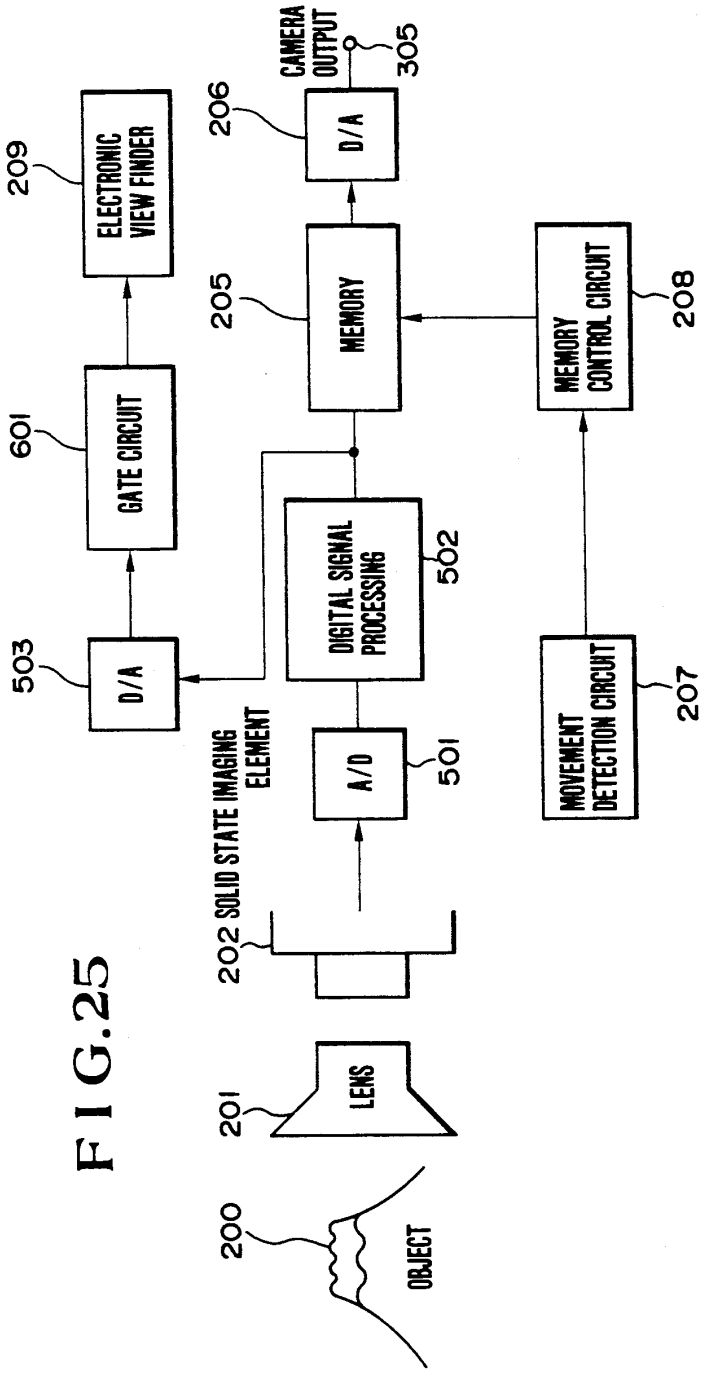

OBJECT
200
LENS
201
SOLID STATE IMAGING ELEMENT
202
A/D
501
DIGITAL SIGNAL PROCESSING
502
D/A
503
GATE CIRCUIT
601
ELECTRONIC VIEW FINDER
209
D/A
206
CAMERA OUTPUT
305
MEMORY
205
MEMORY CONTROL CIRCUIT
208
MOVEMENT DETECTION CIRCUIT
207

FIG.25

FIG.26

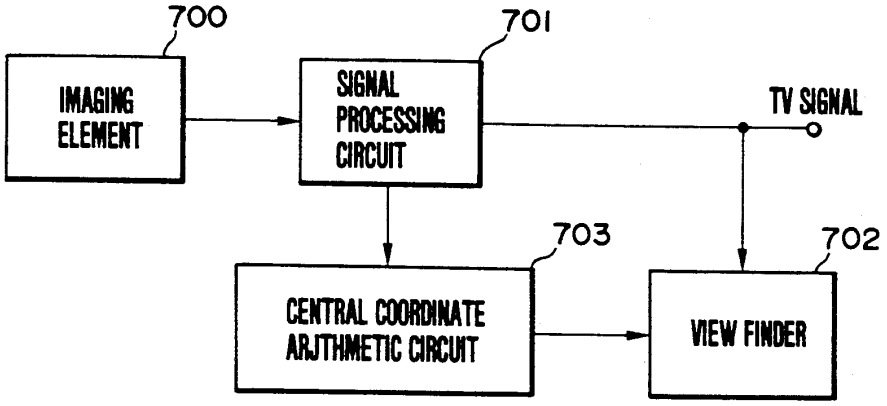

700
701
IMAGING ELEMENT
SIGNAL PROCESSING CIRCUIT
TV SIGNAL
703
702
CENTRAL COORDINATE ARJTHMETIC CIRCUIT
VIEW FINDER

FIG.27

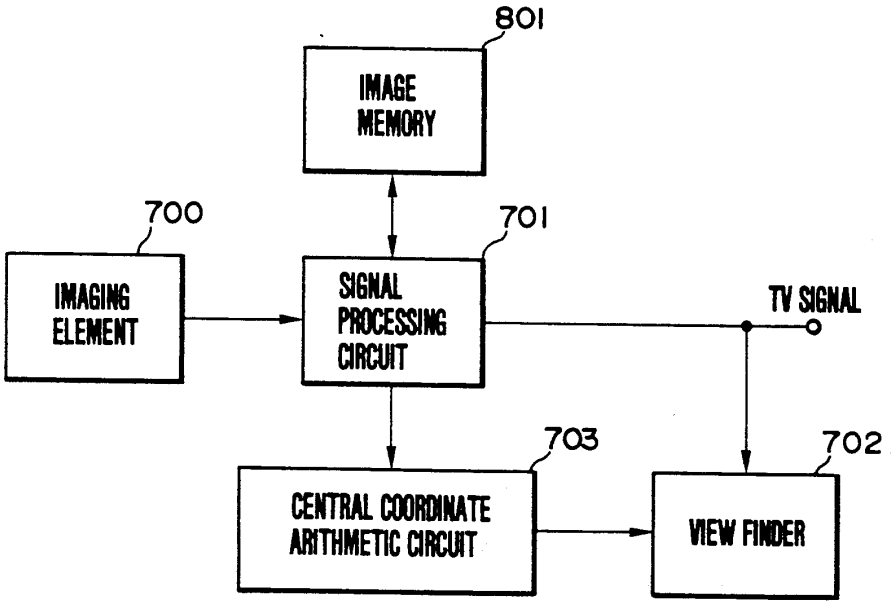
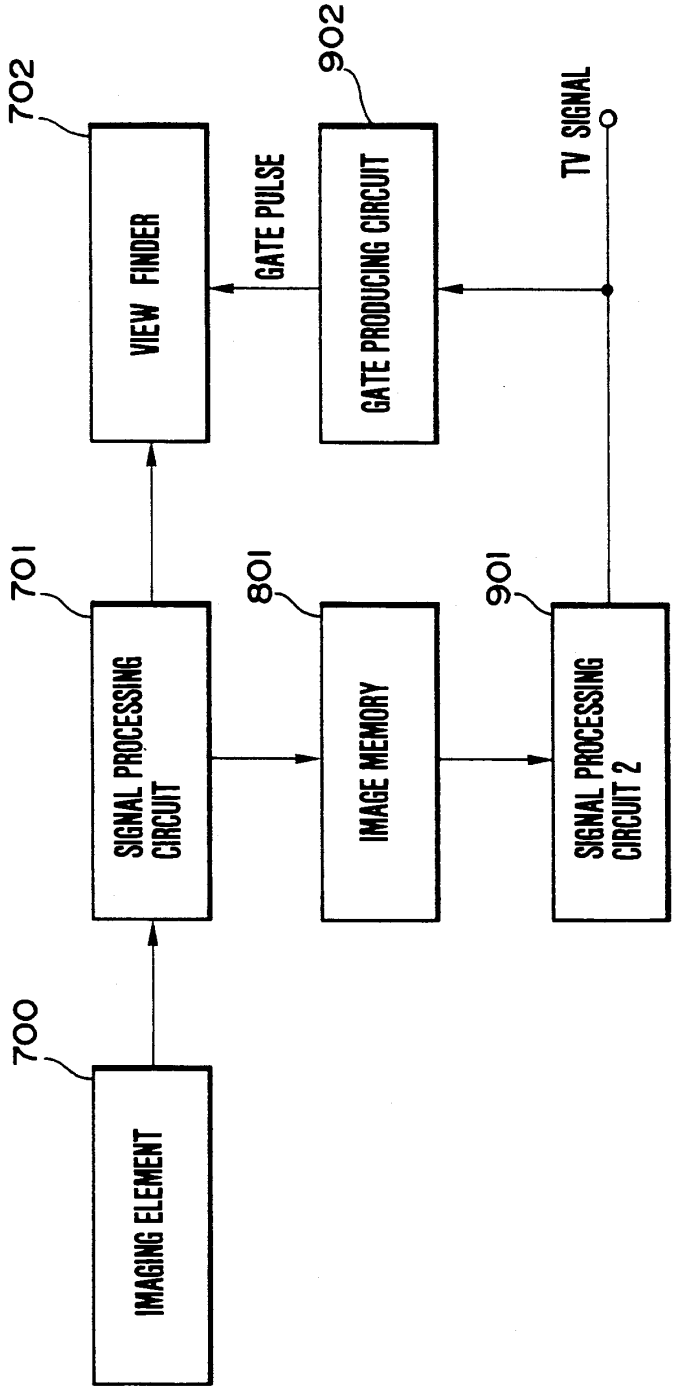

801
IMAGE MEMORY
700
701
IMAGING ELEMENT
SIGNAL PROCESSING CIRCUIT
TV SIGNAL
703
702
CENTRAL COORDINATE ARITHMETIC CIRCUIT
VIEW FINDER

FIG.28


700
IMAGING ELEMENT
701
SIGNAL PROCESSING CIRCUIT
702
VIEW FINDER
801
IMAGE MEMORY
901
SIGNAL PROCESSING CIRCUIT 2
902
GATE PRODUCING CIRCUIT
GATE PULSE
TV SIGNAL

# VIDEO IMAGING APPARATUS

## BACKGROUND OF THE INVENTION

The present invention relates to a video imaging apparatus, and more particularly to an imaging apparatus characterized by varying an area from which a signal of an imaging element is read out.

Further, the present invention relates to a video camera using a solid state imaging element, and more particularly to a method of monitoring a current imaging condition when movement of a camera is prevented electronically.

Recently, an imaging apparatus is made small in size and light in weight and the magnification of a zoom lens tends to be increased. Thus, when a picture is taken by hand, the picture tends to be blurred by movement of the hands. As a prior art for suppressing the movement of the picture, there is known a method described in Japanese Patent Publication Nos. 1-53957 and 2-32831. In this prior art method, a movement of an imaging apparatus is detected by a rotating gyroscope. An optical system including from a lens to the imaging apparatus is moved on the basis of the detected result, or a transfer of a signal from an imaging apparatus is divided into a high speed transfer and a normal transfer to control the number of signals to be transferred in the high speed transfer. The latter is characterized in that an apparatus therefor can be made small in size.

However, the above prior art method does not considered that two pixels in the vertical direction of the imaging element are read out simultaneously. This simultaneous reading of two rows is an indispensable method necessary to eliminate a remaining image of a frame. When the number of signals to be transferred is increased or decreased while reading two pixels simultaneously, the transfer can be usually made only in a unit of two-pixel pitch even if an area of pixels to be transferred is minimum. Accordingly, a picture having a suppressed movement of an image is moved awkwardly.

In addition, recently, with the development of small and light household video cameras and high magnification of lenses, a video camera having less movement of an image without use of a tripod is highly desired.

As means for correcting the movement of the image, a method using an image memory is known, for example, as described on pages 377 to 378 in a collection of preprints for Lectures in a National Convention of the Institute of Television Engineers of Japan (1987). In this method, movement and vibration of a picture due to movement of a camera are detected as a parallel movement amount of the picture to calculate a correction amount on the basis of an amount and a direction of the parallel movement, that is, a vector so that the image is moved by the correction amount through the image memory to correct the movement and vibration of the picture.

As methods of correcting (preventing) the movement of the hands in the photography by a camera, there are the mechanical method using the gyroscope or the like as described in Japanese Patent Unexamined Publication No. 60-14330 described above and the electrical method of correcting the movement of the hands by using the image memory to devise the special processing of signals and the reading method of an imaging element. The latter has an image memory or an imaging element providing an image signal for a wider area than



an area from which a TV signal is produced and selects a proper area in the whole area to produce the image signal in the selected area as the TV signal. Accordingly, even if movement of the hands occurs and the angle of field of the image memory or the imaging element is varied, the image signal in the same area as that before the occurrence of the movement of the hands is produced as the TV signal so that the TV signal having the same angle of field before and after the movement of the hands is obtained to thereby correct the movement of the hands.

In a camera which corrects movement of the hands electrically, for example, as shown in FIG. **1A**, when an area of a light receiving plane **401** of an imaging element has an image room of 10% in the vertical and horizontal directions as compared with an area from which the TV signal is produced, movement of the hands up to 5% in the vertical and horizontal directions can be corrected as shown in FIG. **1B** (in the case where the center of the TV signal before the movement of the hands is the same as the optical center of the imaging element).

As shown in FIG. **1C**, when the TV signal area **402** is deviated or moved up due to the movement of the hands to come into contact with an upper edge of the light receiving plane **401**, there is no room for correcting the upward movement of the hands and the upward movement of the hands can not be corrected.

As described above, even if the movement of the hands occurs as shown in FIGS. **1B** and **1C**, the image in the TV signal area **402** is not changed by the correction of the movement.

The area **402** is observed through a view finder as a monitoring picture. Accordingly, there is an disadvantage that it is impossible to determine whether the movement of a camera occurs or not as far as the area is observed through the view finder.

## SUMMARY OF THE INVENTION

It is an object of the present invention to move in a pitch of one pixel an area of pixels to be normally transferred while reading out two rows simultaneously so that an image is moved smoothly.

In order to achieve the above object, there are provided an imaging element, a scanning pulse generating circuit for supplying a scanning pulse for transfer of a signal to the imaging element and a scanned pixel area control circuit for supplying a control signal to the scanning pulse generating circuit, whereby a combination of two pixels adjacent to each other in the vertical direction which are read out simultaneously by the control signal is gradually shifted in a pitch of one pixel.

When the combination of two pixels adjacent to each other in the vertical direction which are read out simultaneously is gradually shifted, the area of the pixels to be normally transferred can be moved in a pitch of one pixel and accordingly the image is moved smoothly.

It is another object of the present invention to provide a video camera apparatus having a correction function of movement of a camera which solves the problems in the prior art and is used and operated easily and simply by producing an image, which is not subjected to correction, to an electronic view finder upon photographing and producing an image signal, which is subjected to correction, to a VTR.

The above object is achieved by using a solid state imaging element with pixels having a row in the number thereof in the horizontal and vertical direction and

providing means for reading out the whole pixels and extracting only necessary portion of the image signal which has been subjected to signal processing and does not pass through an image memory to produce the extracted image signal to the electronic view finder.

Observation of uncorrected image can correct the movement of a camera while monitoring a natural image so that a camera work having reduced movement of the image without use of a tripod can be attained.

It is a further object of the present invention to reduce an error in correction of movement of the hands by giving information as to which portion in the whole area of an image memory or imaging elements is produced as a TV signal to a photographer.

The above object is achieved by the provision of a circuit for calculating an optical center in a light receiving plane of the image memory or imaging elements to display it.

Further, the above object is also achieved by displaying the whole area in a view finder and superposing information such as a boundary line between a portion produced as the TV signal and a portion not produced as the TV signal.

The optical center of the whole area of the image memory or the imaging elements is calculated and displayed in the finder in which a portion of the whole area of the image memory or the imaging elements is displayed. Thus, since the photographer can move the center of the angle of field of an object in the finder to the center of the whole area of the image memory or the imaging elements consciously, the movement of the hands in the vertical and horizontal directions can be corrected uniformly and a correction error can be reduced. Further, the whole area of the image memory or the imaging elements is displayed in the finder and the boundary line is provided between the portion produced as the TV signal and the portion not produced as the TV signal to thereby attain the same effect.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIGS. **1A** to **1D** are drawings for explaining a conventional correction method of movement of the hands in a video camera;

FIG. **2** is a block circuit diagram illustrating a transfer pulse generating system of the present invention;

FIGS. **3**, **4**, **5**, **6** and **7** are waveform diagrams and element configuration diagrams for explaining operation of transferring an image signal in a CCD type imaging element;

FIGS. **8**, **9**, **10**, and **11** are waveform diagrams and element configuration diagrams for explaining operation of transferring an image signal in an MOS type imaging element;

FIGS. **12** to **17** are waveform diagrams and a flow chart for explaining the transfer operation of FIG. **2**;

FIGS. **18** and **19** are block circuit diagrams for explaining operation of other embodiments of the present invention, respectively;

FIG. **20** is a block circuit diagram of a video camera apparatus showing another embodiment of the present invention;

FIGS. **21A**, **21B**, **22A** and **22B** illustrate states of image signals in each portion of the embodiment of FIG. **20**;

FIG. **23** is a block circuit diagram showing other embodiment different from the embodiment shown in FIG. **20**;

FIGS. **24A** and **24B** illustrate states of image signals in each portion of the embodiment of FIG. **23**;

FIG. **25** is a block circuit diagram of other embodiment different from the embodiments shown in FIGS. **20** and **23**; and

FIGS. **26**, **27** and **28** are block diagram showing other embodiments of the present invention, respectively.

## DESCRIPTION OF THE PREFERRED EMBODIMENT

An embodiment of the present invention is now described with reference to FIG. **2**. In FIG. **2**, reference numeral **100** denotes an imaging element, **101** a signal processing circuit, **102** a transfer pulse generating circuit, and **103** a scanned pixel area control circuit. Further, the transfer pulse generating circuit comprises a compound circuit **104**, a normal transfer pulse generating circuit **105** and a high-speed transfer pulse generating **106** as shown by broken line.

Operation of the imaging element **100** is now described. The imaging element is classified into a CCD type and an MOS type. A representative CCD type imaging element is shown in FIG. **3**. In FIG. **3**, reference numeral **1** denotes a photodiode, **2** a vertical CCD, and **3** a horizontal CCD. The photodiodes **1** are arranged into m rows and n columns and suffixes of the numeral **1** for the photodiodes represent the numbers of the row and the column. Electric charges of signals stored in the photodiodes **1** are transferred to the vertical CCD's **2** in response to transfer pulses $\phi_{V1}$ to $\phi_{V4}$ and further transferred to the horizontal CCD **3** to be produced in response to horizontal transfer pulses not shown. The transfer operation of signals in the case where two rows of the photodiodes are read out simultaneously is described with reference to FIGS. **4** to **7**. FIG. **4** is a timing chart of transfer pulses in the case where a signal $S_{2i-1}$ of a photodiode in the (2i-1)th row and a signal $S_{2i}$ of a photodiode in the (2i)th low are read out simultaneously, i represents a natural number. A signal Si is transferred from the photodiodes **1** to the vertical CCD **2** in a period $T_1$ and transferred to the horizontal CCD **3** at time $t_1$ to $t_8$. This operation is shown in FIG. **5**. The signals $S_{2i-1}$ and $S_{2i}$ are combined at time $t_1$ and the signals $S_1$ and $S_2$ are transferred to the horizontal CCD **3** until time $t_8$ and read out successively. The transfer is made in the same manner in the next horizontal period and signals $S_3$ and $S_4$ are transferred to the horizontal CCD **3** at time $t_9$. FIG. **6** is a timing chart of transfer pulses in the case where a signal $S_{2i}$ of the photodiode in the (2i)th row and a signal $S_{2i+1}$ of the photodiode in the (2i+1)th row are read out simultaneously. As shown in FIG. **7**, the signals are transferred in a combination shifted by one row in respect to the operation of FIGS. **4** and **5** and read out. Normally, the signal transfer shown in FIGS. **4** and **5** are made in an odd field and the signal transfer shown in FIGS. **6** and **7** are made in an even field so that the interlacing operation is made.

A representative MOS type imaging element is shown in FIG. **8**. In FIG. **8**, reference numeral **4** denotes a horizontal shift register, **5** a horizontal start pulse (HIN) input terminal, **6** and **7** horizontal clock (H1 and H2) input terminals, **8** a vertical shift register, **9** a vertical start pulse (VIN) input terminal, **10** and **11** vertical clock (V1 and V2) input terminals, **12** and **13** field pulse (FA and FB) input terminals, **14** a photodiode, **15-19** MOS switches, and **20** signal output termi-

nals. A brightness signal is obtained by adding respective output signals as shown in FIG. **9**.

Referring to FIGS. **10** and **11**, reading of signals is described. When the vertical start pulse VIN is applied, pulses Pi are produced from the vertical shift register **8** successively in a period of the vertical clocks V1 and V2. The pulses Pi are distributed by the MOS switches **15** and **16** in response to the polarity of the field pulses FA and FB to produce pulses Qi so that the photodiodes **14** in the (2i-1)th row and the (2i)th row are selected simultaneously and signals $S_{2i-1}$ and $S_{2i}$ of the photodiodes **14** in the (2i–l)th row and the (2i)th row are produced out successively in response to pulses (not shown) of the horizontal shift register **4**. As shown in FIG. **11**, when the polarity of the field pulses FA and FB is reversed, a combination of rows selected by the pulses Qi is shifted by one row so that signals $S_{2i}$ and $S_{2i+1}$ of the photodiodes in the (2i)th row and the (2i+1)th row are produced simultaneously. In the normal reading of the signal, the reading of the signal in FIG. **10** is made in the odd field and the reading of the signal in FIG. **11** is made in the even field so that the interlacing operation is made.

Operation is the case where the high-speed transfer is combined is now described. FIG. **12** shows output signals for the transfer pulse $\phi_{V4}$(A) of the field A and the transfer pulse $\phi_{V4}$(B) of the field B in the case where the transfer pulse $\phi_{V4}$ is representative in FIGS. **4** and **5**. With transfer pulses $\phi_{V4}$(A, N) and $\phi_{V4}$(B, N) obtained by adding N high-speed transfer pulses to the above transfer pulses $\phi_{V4}$(A) and $\phi_{V4}$(B), the signals are read out in the normal transfer while shifted by 2N rows as shown in FIG. **13**. The scanned pixel area at this time is begun from the 2N'th row. FIG. **14** shows a case where the scanned pixel area is shifted by one row. In the field A of FIG. **14**, the same transfer pulses $\phi_{V4}$(B, N) as those of the field B of FIG. **13** is used to read out signals in a combination shifted by one row. In the field B of FIG. **14**, transfer pulses $\phi_{V4}$(A, N+1) obtained by adding one high-speed transfer pulse to the transfer pulses $\phi_{V4}$(A, N) of FIG. **13** is used to read out signals in a combination shifted by one row.

Description is now made to the case of the MOS type imaging element. FIG. **15** shows waveforms in reading of the signals in the case where N high-speed pulses are added while pulses FA, FB, VIN and V1 are representative in FIGS. **10** and **11**. The scanned pixel area is begun from the 2N'th row by addition of the N high-speed pulses in the same manner as in the CCD type imaging element. FIG. **16** shows a case where the scanned pixel area is shifted by one row. In the field A of FIG. **16**, signals are read out in a combination shifted by one row by using pulses of the field B of FIG. **15**. In the field B of FIG. **16**, signals are read out in a combination shifted by one row by adding one high-speed pulse to the pulses of FIG. **15**.

The interlacing operation is not made for the horizontal operation. Accordingly, it is sufficient to simply change the number of pulses to be transferred at a high speed and thus description thereof is omitted.

The foregoing is summarized as follows. The normal transfer pulse control signal F shown in FIG. **2** controls the field in which the normal transfer pulses are supplied to the imaging element **100** and the number of high-speed pulses control signals m and n control the number of high-speed pulses in the vertical and horizontal directions. FIG. **17** shows a flow chart in the case where one row is shifted in one vertical direction. The transfer pulse generating circuit **102** produces the transfer pulses p (F, m and n) in accordance with the flow chart. F represents whether the normal transfer pulse is for the field A or B, and m and n represent the numbers of the high-speed pulses in the vertical and horizontal directions, respectively. In the above description, the case where one row is shifted in one vertical direction has been described, while the shift operation in the opposite direction or by several rows can be made in the case manner. Further, as apparent from the foregoing description, when the scanned pixel area is varied over two fields successively, the normal transfer pulses for the field A or B are supplied to the imaging elements **100** successively.

The changeover of the normal transfer pulses and the changeover of the number of the high-speed transfer pulses are made during the vertical retrace period so that disturbance of an image signal is prevented and accordingly it is desirable that change of the control signals F, m and n are made during the vertical retrace period.

FIG. **18** illustrates an embodiment of suppression of movement of an image. In FIG. **18**, reference numeral **104** denotes a movement detection circuit. The movement detection circuit may use an angular velocity sensor to detect the movement of an imaging apparatus, or may detect the movement on the base of the image signal. The movement detection circuit supplies a movement detection signal representative of the direction of movement of the image and the number of pixels over which the image moved to the scanned pixel area control circuit to control the scanned pixel area on the basis of the detection signal.

FIG. **19** illustrates an embodiment in which a picture is scrolled. In FIG. **19**, reference numeral **105** denotes a counter circuit. The counter circuit can supply a control signal having a value which is gradually increased or decreased to the scanned pixel area control circuit so that the scrolling that the image gradually goes up and down on a monitoring picture or is gradually moved right and left can be attained smoothly.

As described above, according to the embodiment of the present invention, the area of pixels to be normally transferred, that is, the scanned pixel area can be moved in a pitch of one pixel and accordingly smooth movement of the image can attained.

Another embodiment of the present invention is now described with reference to drawings.

FIG. **20** is a block diagram showing an embodiment of a video camera apparatus according to the present invention. In FIG. **20**, reference numeral **201** denotes a lens, **202** a solid state imaging element (hereinafter referred to as an imaging element), **203** a signal processing circuit, **204** an A/D converter, **205** an image memory (hereinafter referred to as a memory), **206** a D/A converter, **207** a movement detection circuit, **208** a memory control circuit for controlling the reading of the memory, **209** an electronic view finder, and **210** a scanning line converting circuit.

The scanning line converting circuit **210** operates as follows. The solid state imaging element **202** has sufficient pixels having a room in the number and accordingly all of pixel signals can not be displayed in the electronic view finder **209** by the scanning line for the standard TV signal (conversely speaking, only part of the pixel signals can be displayed). Thus, for example, TV signals for n lines are produced from the pixel signals for m lines, where m > n (the image is contracted).

The memory control circuit **208** operates as follows. The memory control circuit **208** controls the memory **205** so that all of signals (produced from pixels in the whole area (W)) produced from the solid state imaging element **202** are written int he memory **205** and part (W1) of the written signals is read out form the memory **205** and controls addresses of the memory **205** so that a range of the signals to be read is varied to correct "movement" of a camera.

More particularly, as shown in FIG. **21**B, when the image is moved by a m and n in the vertical and horizontal directions, respectively, the starting point of the reading for the memory can be changed from an address (0, 0) to an address (M+m, N+n) to correct the movement of the camera. FIG. **21**A shows a case in which there is no movement.

FIGS. **22**A and **22**B illustrate an image signal **303** after the light receiving plane **302** of the imaging element **202** and the signal processing circuit **203** of FIG. **20**, an image **304** of the electronic view finder, and a camera output **305** which is an output after correction of movement of the camera.

In FIG. **20**, a light image of an object **200** focused on a light receiving plane of the imaging element **202** through the lens **201** is converted into an electronic signal which is processed by the signal processing circuit **203** which produces an image signal **303**. Since the imaging element **202** has sufficient pixels having a room in the number in the horizontal and vertical directions as described above, the image signal **303** has a room in the periphery of the image or the image frame as compared with the standard camera output **305**. On the other hand, the movement detection circuit **207** monitors the movement of the camera to supply the movement information to the memory control circuit **208** which produces a memory reading control signal. THe memory control circuit **208** supplies to the memory **205** the memory reading controls signal for moving the start point of the memory reading by the movement opposite to the movement information obtained by the movement detection circuit **207** to correct the movement of the camera.

Further, the image signal **303** produced form the signal processing circuit **203** is supplied to the scanning line converting circuit **210** for converting the number of the scanning lines to be equal to the number of the scanning lines of the standard television signal. The circuit **210** produces the scanning line converted signal to supply it to the electronic view finder **209** to produce an image **304** (refer to FIGS. **22**A and **22**B).

FIG. **22**A illustrates images int he standard state of the present embodiment. The image **304** of the electronic view finder **209** and the camera output **305** have the same image but have different image frames as shown in FIG. **22**A. Thereafter, when movement of the camera occurs and the focused image of the object **200** on the light receiving plane **302** of the imaging element is shifted as shown in FIG. **22**B, the memory control circuit **208** changes the start point of the reading of the memory on the basis of the movement information from the movement detection circuit **207** to coincide with the image before one field so that the camera output **305** as showing broken line is produced. On the other hand, the electronic view finder **209** is supplied with an uncorrected image signal **303** having the converted number of scanning lines and produces an image shifted in parallel by the same mount as the movement of the camera as shown in solid line by **304** of FIG. **22**B.

Thus, the same image as that in the standard state, that is the image having the corrected and small movement of the camera is obtained in the camera output **305** and the image having the uncorrected movement of the camera is obtained in the image **304** of the electronic view finder.

The imaging element **202** is required to have the number of extra pixels which is at least **30** percent larger than the number of the standard pixels.

FIG. **23** is a block diagram of a further embodiment of the present invention. The embodiment constitutes a video camera apparatus which can produce a monitoring image having the same image frame as that of the camera output **305** when an image having uncorrected movement of the camera is monitored.

The embodiment of FIG. **23** has the same configuration as that of the embodiment shown in FIG. **20** except that a gate circuit **601** is provided between the signal processing circuit **203** and the electronic view finder **209**.

FIG. **24** illustrates the image on the light receiving plane **302** of the imaging element **202**, the image signal **303**, and the image **304'** of the electronic view finder and the camera output **305'** of the electronic view finder and the camera output **3-5'** in the same manner as in FIGS. **22**A and **22**B.

Referring to FIGS. **23**, **24**A and **24**B, operation is now described.

The image output **303** produced from the signal processing circuit **203** has a room in the horizontal and vertical direction in the same manner as in the abovementioned embodiment and is supplied to the gate circuit **601** in which the image output **303** is subjected top the gating process so that the image thereof is equal to that of the camera output **305'**. The image signal gated by the gate circuit is supplied to the electronic view finder **209** so that the image having the same image frame as that of the camera output **305'** can be produced as shown by **304'** of FIGS. **24**A and **24**B.

As described above, according to the embodiment the uncorrected image having the same image frame as that of the corrected camera output can be monitored by the electronic view finder **209** while correcting the movement of the camera. As shown in FIGS. **24**A and **24**B, an outer peripheral portion of the view finder **304'** marked with double-hatching is not quite viewed by an observer.

FIG. **25** is a block diagram illustrating a further embodiment of the present invention. The embodiment constitutes a video camera apparatus which monitors an image in correction of movement of the hands in a video camera which obtains an image signal using a digital signal processing.

In FIG. **25**, reference numeral **501** denotes an A/D converter, **502** a digital signal processing circuit, and **503** a D/A converter.

In the case manner as in the embodiments, an image signal produced from the imaging element **202** is supplied to the A/D converter **501** to be converted into a digital signal which is supplied to the digital signal processing circuit **502**. The digital image signal processed by the digital signal processing circuit **502** is supplied through the memory **205** and the D/A converter **503** tot he gate circuit **601**. Thus, the embodiment digitizes the signal processing of the video camera apparatus and performs the same operation as that of the circuit of the embodiment of FIG. **23**.

In the embodiment of FIG. 20, the transfer pulse generating circuit 102 and the scanned pixel area control circuit 103 described in FIG. 2 can be combined into the solid state imaging element 203 (FIG. 20) (refer to blocks 102 and 103 shown by broken line of FIG. 20).

As described above, according tot he present invention, in the video camera apparatus having the correction function of the movement of the camera, the imaging can be attained while directly monitoring uncorrected image, instead of imaging while monitoring image having corrected movement of the camera. Thus, there can be provided the video camera apparatus having the excellent function that a photographer can make imaging without preventing correction of the movement of the camera and the effect of correction of the movement of the camera can be attained effectively.

FIG. 25 illustrates a further embodiment of the present invention. In FIG. 26, reference numeral 700 denotes an imaging element, 701 a signal processing circuit, 702 a view finder, and 703 a center coordinate arithmetic circuit which calculates coordinates of an optical center in the whole area of the light receiving portion of the imaging element. An image signal of part in the whole area converted into an electric signal version by the imaging element 700 is supplied to the signal processing circuit 701 to be produced as an TV signal and displayed int he view finder 702. Simultaneously, the center coordinate arithmetic circuit 703 calculates the coordinates of the optical center of the whole light receiving portion of the imaging element 700 to display it in the view finder. According to the present invention, the photographer can move the center of the object near a mark of the optical center displayed in the view finder so that the imaging element 700 has extra pixels which are uniform in the vertical and horizontal directions and error in correction of the movement of the hands can be reduced.

FIG. 27 illustrates a further embodiment of the present invention. In FIG. 27, reference numerals 700 to 703 denote the same elements as those in the embodiment shown in FIG. 26, the numeral 801 denotes an image memory. THe image signal of the whole area converted into an electric signal version by the imaging element 700 is once registered in the image memory 801 through the signal processing circuit 701. Thereafter, part of contents stored in the memory is read out to be produced as a TV signal and displayed in the view finder 702. Simultaneously, the center coordinate arithmetic circuit 703 calculates central coordinates of the whole area of the image memory 801 and displays it in the view finder 702. This embodiment can attain the same effects as the above-mentioned embodiments.

FIG. 28 illustrates a further embodiment of the present invention. In FIG. 28, reference numerals 700 to 703 and 801 denote the same elements as those of the embodiment shown in FIG. 27, numeral 901 denotes a second signal processing circuit different from the signal processing circuit 701 and numeral 902 denotes a gate producing circuit. THe image signal of the whole area converted into an electric signal version by the imaging element 700 is displayed in the view finder 702 through the signal processing circuit 701. Simultaneously, all of the image signal from the signal processing circuit 701 is once stored in the image memory 801 and then part of contents stored in the memory is read out to be produced as the TV signal. THe gate producing circuit 902 produces a gate from the TV signal portion produced from the second signal processing circuit 901 and superposes a gate pulse on the image signal of the whole area in the view finder 702. According to the present invention, the whole area of the imaging element 700 is displayed in the view finder 702 and a boundary line is provided between a portion produced as the TV signal and other portion, or a boundary is provided by changing the brightness therebetween. Accordingly, the photographer can consciously pan and tilt the camera so that the center of the TV signal portion enclosed by the boundary line comes near the center of the view finder. This embodiment can attain the same effects as in the embodiments of FIGS. 26 and 27.

According to the present invention, since the photographer of a camera can recognize which part of the whole area of the imaging element can be produced as the TV signal and can always bring the TV signal portion into the central portion of the whole area of ht imaging element, error int eh correction of movement of the hands is reduced.

We claim:

1. An imaging apparatus comprising:
an imaging element;
a signal processing circuit for processing a signal produced from said imaging element to produce an image signal;
a transfer pulse generating circuit for supplying a transfer pulse for reading out the signal from said imaging element to said imaging element; and
a scanned pixel area control circuit for supplying a control signal for controlling a scanned pixel area of said imaging element to said transfer pulse generating circuit;
whereby signals of pixels arranged in said imaging element and adjacent in the vertical direction are read out simultaneously and the scanned pixel area is varied in a pitch of one pixel at a minimum.

2. An imaging apparatus according to claim 1, wherein said transfer pulse generating circuit comprises:
a normal transfer pulse generating circuit;
a high-speed transfer pulse generating circuit; and
a compound circuit for compounding a normal transfer pulse produced from said normal transfer pulse generating circuit and a high-speed transfer pulse produced from said high-speed transfer pulse generating circuit;
whereby a signal is read out in the scanned pixel area in response to said normal transfer pulse.

3. An imaging apparatus according to claim 1, wherein change of said scanned pixel area or a period of change-over of said transfer pulse is equal to a period of a field or a multiple of the period of the field.

4. An imaging apparatus according to claim 2, wherein change of said scanned pixel area or a period of change-over of said transfer pulse is equal to a period of a field or a multiple of the period of the field.

5. An imaging apparatus according to claim 1, wherein said transfer pulse is changed over during a vertical blanking period.

6. An imaging apparatus according to claim 2, wherein said transfer pulse is changed over during a vertical blanking period.

7. An imaging apparatus according to claim 1, comprising a movement detection circuit for detecting movement of the image signal and means for correcting the movement.

8. An imaging apparatus according to claim 2, comprising a movement detection circuit for detecting movement of the image signal and means for correcting the movement.

9. An imaging apparatus according to claim 1, comprising a counter circuit and means for scrolling an image in the vertical and horizontal directions.

10. An imaging apparatus according to claim 1, comprising a counter circuit and means for scrolling an image in the vertical and horizontal directions.

11. An imaging apparatus according to claim 2, comprising a counter circuit and means for scrolling an image in the vertical and horizontal directions.

12. An image apparatus comprising:

an imaging element;

a signal processing circuit for processing a signal produced from said imaging element to produce an image signal;

a transfer pulse generating circuit for supplying a transfer pulse for reading out the signal from said imaging element to said imaging element; and

a scanned pixel area control circuit for supplying a control signal for controlling a scanned pixel area of said imaging element to said transfer pulse generating circuit;

whereby signals of pixels arranged in said imaging element and adjacent in the vertical direction are read out in response to said transfer pulse simultaneously, and when said control signal is not changed said transfer pulse generating circuit produces a transfer pulse for an odd field and a transfer pulse for an even field alternately, while when a predetermined change occurs in said control signal said transfer pulse generating circuit produces a transfer pulse for the odd field or even field successively.

13. An imaging apparatus according to claim 12, wherein said transfer pulse generating circuit comprises:

a normal transfer pulse generating circuit;

a high-speed transfer pulse generating circuit; and

a compound circuit for compounding a normal transfer pulse produced from said normal transfer pulse generating circuit and a high-speed transfer pulse produced from said high-speed transfer pulse generating circuit;

whereby a signal is read out in the scanned pixel area in response to said normal transfer pulse.

14. An imaging apparatus according to claim 12, wherein change of said scanned pixel area of a period of change-over of said transfer pulse is equal to a period of a field or a multiple of the period of the field.

15. An imaging apparatus according to claim 12, wherein said transfer pulse is changed over during a vertical blanking period.

16. An imaging apparatus according to claim 12, comprising a movement detection circuit for detecting movement of the image signal and means for correcting the movement.

17. An imaging apparatus according to claim 13, comprising a movement detection circuit for detecting movement of the image signal and means for correcting the movement.

18. An imaging apparatus according to claim 13, comprising a counter circuit and means for scrolling an image in the vertical and horizontal directions.

19. A video camera apparatus comprising a solid state imaging element including pixels in the horizontal and vertical directions, memory means for storing a first image signal produced from said solid state imaging element, movement detection means for detecting movement of a camera, control means for controlling a timing of reading out a second image signal rom said memory means by said movement detection means, means for monitoring said first image signal, and image signal recording means, whereby said second image signal is produced in said image signal recording means upon photographing and simultaneously said first image signal is produced in said monitoring means.

20. A video camera apparatus according to claim 19, wherein a ratio of the number of extra pixels provided to accommodate camera movement to the total number of pixels of said solid state imaging element is 30 or more percent.

21. A video camera apparatus including an imaging element, a first signal processing circuit for converting only a certain area of a light receiving area of said imaging element into a TV signal and a view finder for displaying the TV signal produced from said first signal processing circuit, comprising an arithmetic circuit for calculating an optical center of the light receiving plane of said imaging element to display it in said view finder.

22. A video camera apparatus including an imaging element, a first signal processing circuit for converting only a certain area of a light receiving area of said imaging element into a TV signal and a second signal processing circuit provided separately from said first signal processing circuit for converting the whole area of a light receiving plane of said imaging element into a TV signal to display it in a view finder, wherein an area for signal processing in said first signal processing circuit is displayed in said view finder.

* * * * *

APPENDIX TT



# ELECTRONIC IMAGE STABILIZER FOR VIDEO CAMERA USE

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## ABSTRACT

A compact electronic image stabilizer was realized by developing two main techniques; (1) scanning area selection of the imager, and (2) motion vector detection. The stabilization rate we obtained is 18 dB at 1 Hz. This system is very suitable for recent compact video cameras, but the stabilization rate becomes poor at high frequency. So, an advanced system was also designed.

## INTRODUCTION

Recent video cameras for consumer use are tending toward compactness and high zoom ratio. So the reproduced images recorded by those cameras are apt to swing even if users handle the video cameras carefully. As the unexpected image swing degrades the quality of reproduced image so much, we tried to stabilize the image swing by an electronic compact system.

In order to realize the system, the methods for image swing suppression and motion detection is required as shown in Table 1. The methods we examined for image swing suppression are "imager scanning", "memory read/write", and "movable lens block"[1]. And the methods for motion detection are "signal correlation", and "motion sensor". According to Table 1, 6 kinds of systems (A~F) are available for the image stabilizer. System A is most compact because it is composed of electronic circuits which are able to be integrated into an LSI. System F is not suitable for the compact video cameras because it needs the movable mechanism and motion sensor in addition to an LSI. The order of compactness is A,B,C,D,E,F.

In order to compose the image stabilizer in a compact system, system A was chosen and two main techniques mentioned above were developed.

Table 1 Necessary Main Parts for Respective Method

| | | Image swing suppression | | |
|---|---|---|---|---|
| | Method | Imager scanning | Memory R/W | Movable lens block |
| Motion detection | Signal correlation | Base* (A) | +Memory (B) | +Movable Mechanism (E) |
| | Motion sensor | +Motion sensor (C) | +Memory +Motion sensor (D) | +Movable Mechanism +Motion sensor (F) |

* Custom LSI only

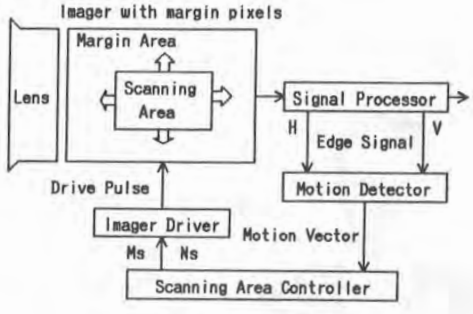



Fig.1 System Block Diagram

## TOTAL SYSTEM

Fig.1 shows the developed system. The imager has margin pixels in addition to scanning pixels.

Manuscript received June 8, 1990

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Both pixels are available for photo-electron conversion. The charge accumulated in scanning pixels is read out, and the charge accumulated in margin pixels is swept out. The scanning area which contains the scanning pixels is movable in horizontal and vertical direction by means of drive pulse control. In addition that, the image swing is detected by the motion detector in the form of motion vector which is composed of horizontal and vertical motion vector.

According to the detected motion vector, the scanning area controller controls the imager driver, and the scanning area moves so as to offset the image swing.

The high speed signal transfer, mentioned above, is possible by changing the frequency of the drive pulse for high frequency, and the starting pixel to be read out normally is selectable by changing the number of high frequency drive pulse.

The margin area is able to be prepared by developing an imager which has margin pixels, and also can be prepared by using the electronic zoom.

Ms and Ns shown in Fig.1,2 are the address of the starting pixel in vertical and horizontal direction respectively, and Ns is shown as follows.

$$Ns = n+1 \qquad \cdots (1)$$

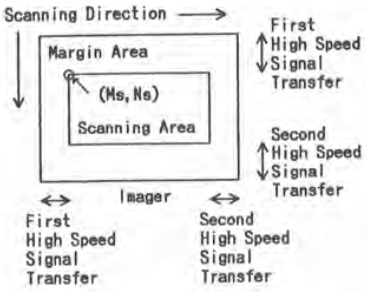



Fig. 2 Imager Signal Readout

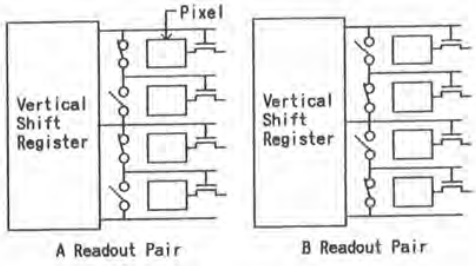



Fig. 3 Signal Transfer (MOS Imager)

## SCANNING AREA SELECTION

A popular method to move a displayed video image is memory read/write control. But that system is not suitable for the compact video camera because it needs the field memory (about 1.5 Mbits to memorize one field), A/D, and D/A.

From a standpoint to pursue the compactness, scanning area selection of the imager was contrived as shown in Fig.2. The signal charge accumulated in margin area is swept out quickly in the horizontal and vertical blanking period by the high speed signal transfer. The signal charge in scanning area is read out normally in the horizontal and vertical scanning period.

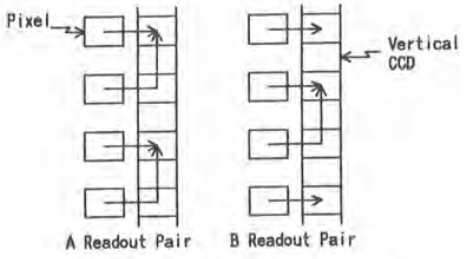



Fig. 4 Signal Transfer (CCD Imager)

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Table 2 Scanning Area Selection

| Vertical location of scanning area | Odd field | | Even field | | Address of the starting pixel Ms |
|---|---|---|---|---|---|
| | Number of drive pulse* | Readout pair | Number of drive pulse* | Readout pair | |
| : | : | : | : | : | : |
| Up by 3-pixel pitch | m-2 | B | m-1 | A | 2m-3 |
| Up by 2-pixel pitch | m-1 | A | m-1 | B | 2m-2 |
| Up by 1-pixel pitch | m-1 | B | m | A | 2m-1 |
| (Starting point) | m | A | m | B | 2m |
| Down by 1-pixel pitch | m | B | m+1 | A | 2m+1 |
| Down by 2-pixel pitch | m+1 | A | m+1 | B | 2m+2 |
| Down by 3-pixel pitch | m+1 | B | m+2 | A | 2m+3 |
| : | : | : | : | : | : |

* Vertical high frequency drive pulse

where, n is the number of horizontal high frequency drive pulse at the first high speed signal transfer. So the scanning area is selectable by one-pixel pitch in the horizontal direction. In the vertical direction, as the pixels are scanned by two-pixel pitch, the image movement by scanning area selection becomes stiff if the scan method mentioned above was used. The scanning area becomes selectable by one-pixel pitch even in the vertical direction by using the following selection, and the image movement becomes smooth.

$$Ms = 2m+(F-P) \quad \cdots (2)$$

$$F = \begin{cases} 1 : \text{odd field} \\ 0 : \text{even field} \end{cases}$$

$$P = \begin{cases} 1 : \text{A readout pair} \\ 0 : \text{B readout pair} \end{cases}$$

where, m is the number of vertical high frequency drive pulse at the first high speed signal transfer. P symbolizes the readout pairs shown in Fig.3 and Fig.4, and A,B readout pairs are selectable by controlling the normal drive pulse.

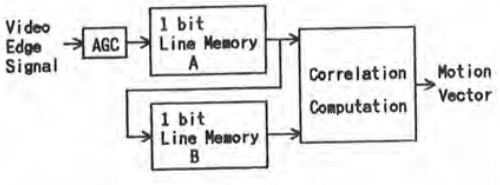



Fig.5 Motion Detector

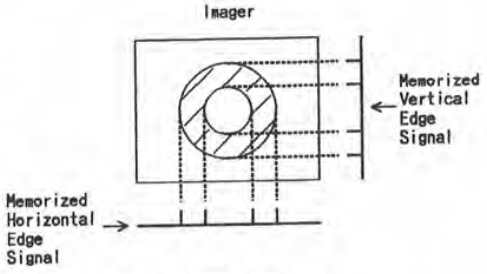



Fig.6 Signal Projection

This scanning area selection is based on the interlaced scanning of the imager and the display. The concrete combination of the readout pair and the number of vertical high frequency drive pulse is shown in Table 2.

## MOTION VECTOR DETECTION

Fig.5 shows our contrived motion detection. The horizontal and vertical video edge signals are memorized in the one bit line memory A separately so as to project a two dimentional image on one dimentional reduced edge data as shown in Fig.6. The reduced edge data is delayed for one field period by the line memory B, and the motion vector is detected by computing the correlation between non-delayed edge data and delayed edge data.

By setting the sampling frequency of the memory A,B equal to that of the imager scanning, the horizontal motion vector is detect-

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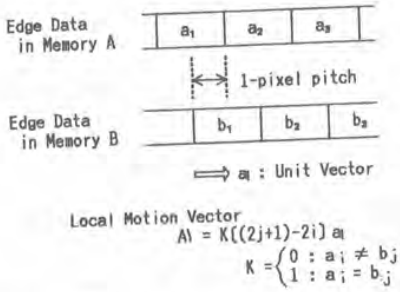



Fig. 7 Correlation Computation for Motion Vector

able by one-pixel pitch. The vertical motion vector is also detectable by one-pixel pitch by taking the imager scanning, mentioned above, into consideration as shown in Fig.7.

There is a spatial shift by one-pixel pitch between the edge data in memory A and B according to the interlaced scanning of the imager. So, as for one edge data, the local motion vector is obtained by the correlation computation shown in Fig.7, and general motion vector is calculated by investigating the distribution of the local motion vectors.

## RESULT

Several image stabilizers were manufactured using an MOS and a CCD imagers. The MOS imager is suitable for the scanning area selection because the pixels are scanned by the shift registers [2], but the MOS imager is not suitable for the image stabilizer because the pixels are scanned in sequence. All pixels are scanned at different time respectively, so the reproduced images are bent with the scanning area selection.

The specification of the CCD imager we used is shown in Table 3, and the image stabilization rate obtained by the trial video camera is shown in Fig.8. The obtained stabilization rate is 18 dB, 9 dB, 3 dB at 1 Hz, 3Hz, 6Hz respectively.

Table 3 Specification of Used Imager

| | | |
|---|---|---|
| Number of Pixels | Scanning Area | 660 (H) × 485 (V) |
| | Margin Area | 135 (H) × 99 (V) |
| Imager Type | IL-CCD | |

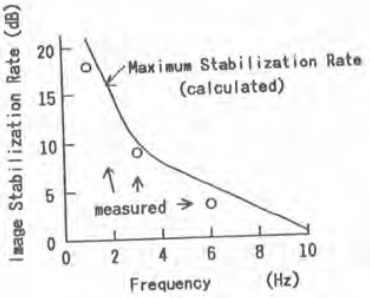



Fig. 8 Image Stabilization Rate

The system shown in Fig.1 has feedback loop, and when the movement of the images is detected, the movement has already been displayed. So the stabilization rate becomes poor when the frequency of the image swing becomes high. In order to improve the frequency responce, an advanced system was also designed.

## IMPROVEMENT OF STABILIZATION RATE

The advanced system is shown in Fig.9. In addition to the stabilization by the feedback loop, the feedforward loop stabilizes the image swing. ( we call this system Double Image Stabilizer; DIS ) The signals from the scanning area are memorized in the buffer memory, and the signals from the displaying area are read out. The displaying area is selectable by controlling the memory read/write address.

In the DIS, the heavy image swing is stabilized roughly by the feedback loop, and the remained image swing is stabilized correctly by the feedforward loop. The frequency of the heavy image swing is generally low enough for the feedback loop to stabilize the image. And

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the amplitude of the remained image swing is small enough for the feedforward loop to detect the motion vectors by the correlation computation with not so large circuits. The reason of that is as follows. The local motion vectors are able to be obtained by the correlation computation in a small area because the amplitude of the remained image swing is small.

Because the movement of the images is also stabilized by the feedforward loop, the movement of the images is not displayed before the motion detection. So the stabilization rate at high frequency is to be improved.

The timing chart of the memory control is shown in Fig.10. The delay time by the buffer memory is selectable from 1 H ( H : horizontal period ) to 1 field period, and by that time, the motion detector completes the correlation computation for the feedforward loop.

That motion detection becomes to able to detect the whole image movement and the stabilizable amplitude becomes to increase according as the delay time increases, but at the same time, the required capacity of the buffer memory increases. Taking the efficiency of the image stabilization and the scale of the system into consideration, the delay time and the capacity of the buffer memory are set to be equal to the vertical blanking period. So, about 20 line memories are required for the buffer memory.

Using the recent submicron process for an LSI, that line memories are able to be integrated into an LSI chip with other circuits - signal processor or memory controller and so on -, so the system maintains the compactness.

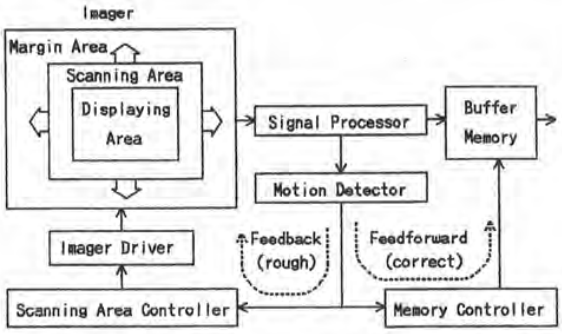



Fig.9 Double Image Stabilizer (DIS) System

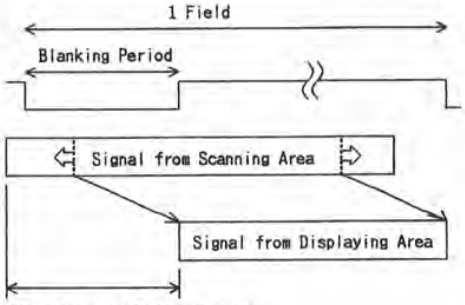



Fig.10 Displaying Area Control by Buffer Memory

## CONCLUSION

A compact electronic image stabilizer was realized. We manufactured several video cameras by way of trial and exhibited a compact video camera at the Japan Electronics Show `89.

The obtained stabilization rate is 18 dB at 1 Hz. The developed system is very suitable for the compact video cameras, but the stabilization rate becomes poor at high frequency. The frequency responce is to be improved by the DIS which has the feedforward control, and the compactness of the system is to be maintained.

## ACKNOWLEDGEMENT

The authors wish to express their sincere thanks to many Hitachi people in Tokai Works, Mobara Works, Central Research Laboratory, and Consumer Products Research Center for their advices and contributions.

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# AN ELECTRONIC ZOOM VIDEO CAMERA USING IMAGER SCANNING CONTROL

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ABSTRACT

An electronic zoom system for video camera use was developed. Zoom ratioes were designed to be smoothly changed vertically and horizontally by controlling imager scanning and line memory scanning respectively.

## 1. INTRODUCTION

Recent progress of digital LSI technology has enabled a new digital feature to be taken in consumer video cameras because several ten kilo-gate digital LSIs have become possible for consumer use. For one of new digital features, a compact electronic zoom system was developed in order to realize more powerful zooming.

The technical points of the developed system shown in Fig.1 are as follows.

(1) Charge sweep ··· Unnecessary charge accumulated in photo diodes which is outside of scanning area must be swept out quickly in vertical blanking period.

(2) Signal interpolation ··· In order to reduce the number of logic gates for interpolation, interpolated signals must be calculated in a simple way.

## 2. CHARGE SWEEP

The CCD imager shown in Fig.1 has M(vertical)×N (horizontal) photo diodes. The charge accumulated in the scanning area which has $M/M_V$ photo diodes in vertical direction is read out during vertical scanning period, when $M_V$ is selected for vertical zoom ratio. So, the unnecessary charge accumulated in $(M-M/M_V)\times N$ photo diodes must be swept out in vertical blanking period as shown in Fig.2.

Signal charge accumulated in M×N photo diodes is simultaneously transfered to vertical CCD at the timing $T_{PD\Rightarrow VCCD}$. After that and before the beginning of vertical scanning period, the frequency of vertical transfer pulse becomes high to sweep unnecessary charge accumulated in $(M-M/M_V)\times N/2$ photo diodes. Signal charge accumulated in $(M/M_V)\times N$ photo diodes is transferred $m=(M/M_V)/2$ times and read out in vertical scanning period. [Ref.1] Remaining unnecessary charge is also quickly transferred $m_e$ times and swept out after the end of vertical scanning period.

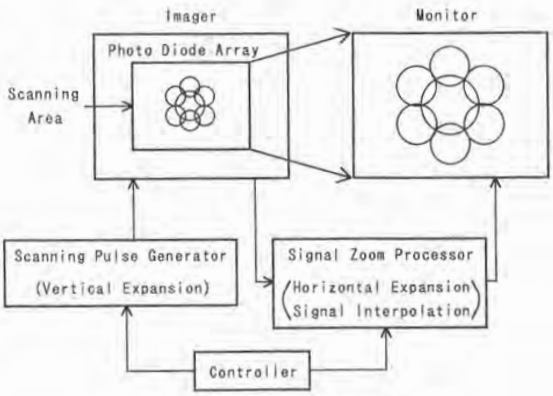
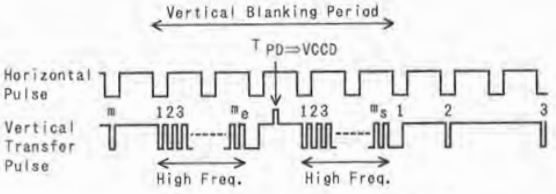



Fig.1 Developed Electronic Zoom Method




$$\text{Zoom Ratio in Vertical Direction} = \frac{m + m_s + m_e}{m}$$

Fig.2 Vertical Transfer for Electronic Zoom

Manuscript received June 7, 1991

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According to the increase of vertical zoom ratio, unnecessary charge increases and becomes so excess in amount that horizontal CCD overflows with unnecessary charge. For example, when a bright object is focused on photo diodes which is outside of the scanning area, overflowed charge appears in picture just like a white curtain as shown in Fig. 3.

Fig. 4 shows the saturation of imager signal output. The differences between normal horizontal transfer and developed horizontal transfer are as follows. (1) When the frequency of vertical transfer pulse is high, horizontal transfer pulse is fixed to low level. (2) After that, the frequency of horizontal transfer pulse becomes high.

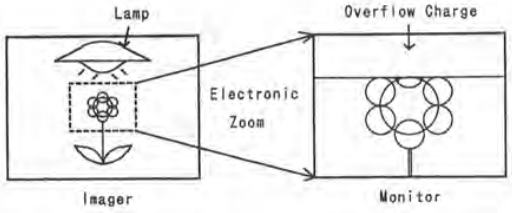



Fig. 3 Horizontal CCD Saturation caused by High Frequency Transfer

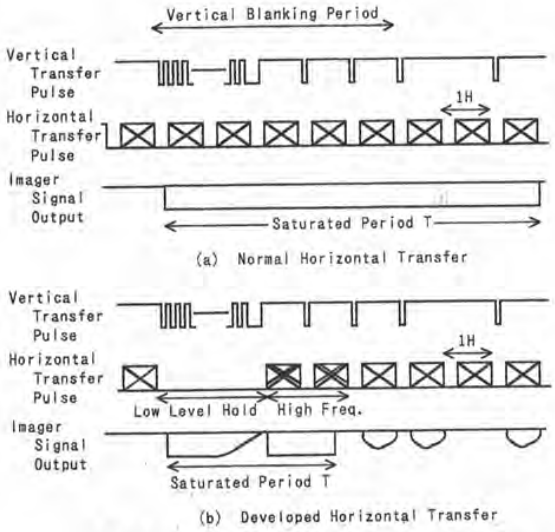



Fig. 4 Timing Chart in Vertical Blanking Period

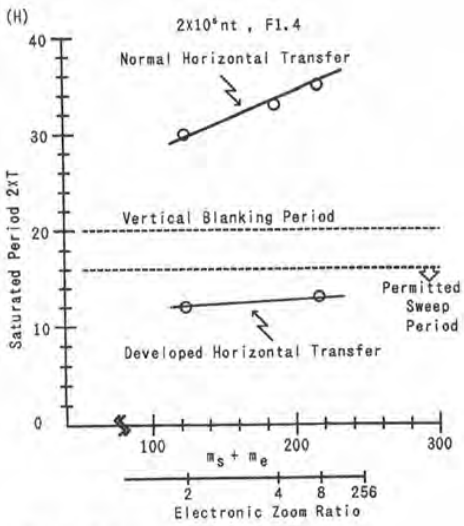



Fig. 5 Reduction of Saturated Period

By stopping horizontal transfer pulse and by making the potential of horizontal CCD high, the majority of unnecessary charge becomes able to be swept out quickly because the potential gradient in horizontal CCD is large enough to move to reset drain. When the potential gradient becomes small and the signal level of imager output becomes small, remaining unnecessary charge is swept out quickly by making the frequency of horizontal transfer pulse high. Fig. 5 shows the effect of above new horizontal transfer. By using above method, imager scanning becomes to be able to complete the charge sweep in vertical blanking period.

## 3. SIGNAL INTERPOLATION

Fig. 6 shows the spatial distribution of interpolated signals. Sm, n and Si, j are imager output signal and interpolated signal respectively. The interpolated signals are calculated as follows.

$$Si,j = \frac{(Sm,n \times Di,m+1)+(Sm+1,n \times Di,m)}{Di,m + Di,m+1} \times \frac{Dj,n+1}{Dj,n + Dj,n+1} + \frac{(Sm,n+1 \times Di,m+1)+(Sm+1,n+1 \times Di,m)}{Di,m + Di,m+1} \times \frac{Dj,n}{Dj,n + Dj,n+1}$$

where, $D_{x,y}$ is the spatial distance between interpolated signal $S_x$ and imager output signal

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$S_V$. As above calculation uses linear approximation, only two line memories are required for the calculation. Moreover, the quality of picture is sufficient for consumer use. In order to reduce the number of logic gates, the calculation is simplified by using vertical and horizontal zoom ratioes $M_V, M_H$.

$$Di,m = FRAC\left[\frac{1}{Mv} \times i\right] \qquad Dj,n = FRAC\left[\frac{1}{M_H} \times j\right]$$

$$Di,m+1 = 1 - Di,m \qquad Dj,n+1 = 1 - Dj,n$$

$$m = INT\left[\frac{1}{Mv} \times i\right] \qquad n = INT\left[\frac{1}{M_H} \times j\right]$$

where, INT[A] means integer term of A, FRAC[A] means fraction term of A, and Di,m Di,m+1 Dj,n Dj,n+1 are normalized by the distance between imager output signals ($\beta_V$, $\beta_H$).

As 'i' indicates the number of interpolated signal row in vertical direction, signal charge stored in vertical CCD is transfered to horizontal CCD and is read out when 'm' is renewed by the calculation INT[1/$M_V$×i] as shown in Table 1. On the other hand, 'j' indicates the number of interpolated signal row in horizontal direction. As Sm,n is memorized in line memories, memory read/write is able to control the horizontal zoom ratio with the calculation INT[1/$M_H$×j] in the similar way shown above.

Table 1 Imager Scanning and Signal Interpolation (Vertical)

| i | ··· | i-1 | i | i+1 | ··· |
|---|---|---|---|---|---|
| m | ··· | m-1 | m | m | ··· |
| Di,m | ··· | $d_1$ | $d_2$ | $d_3$ | ··· |
| Vertical Transfer | ··· | Undo | Do | Undo | ··· |
| Imager Output Signal | ··· | — | $S_m$ | — | ··· |
| Memorized Signal | ··· | $S_{m-2}$ $S_{m-1}$ | $S_{m-1}$ $S_m$ | $S_{m-1}$ $S_m$ | ··· |
| Interpolated Signal | ··· | $S_{m-2}\times d_1 + S_{m-1}\times(1-d_1)$ | $S_{m-1}\times d_2 + S_m\times(1-d_2)$ | $S_{m-1}\times d_3 + S_m\times(1-d_3)$ | ··· |

## 4. DEVELOPED LSIs

Fig. 7 shows the block diagram of developed system. As shown in Fig. 7, imager output signal is led to signal processor and is converted into Y/C-Y signals. [Ref. 2] Vertical and horizontal scanning areas are independently calculated by the micro computer according to zoom ratioes $\alpha_V/\beta_V$ ($=M_V$) and $\alpha_H/\beta_H$ ($=M_H$). Control signal for vertical scanning area is converted into (9+8) bit serial data. Control signal for horizontal scanning area and zoom ratioes $\alpha_V/\beta_V$, $\alpha_H/\beta_H$ are also converted into (44+9+9) bit serial data. As mentioned above, signal zoom processor stops the vertical transfer of CCD imager by setting 'STOP' signal at high level.

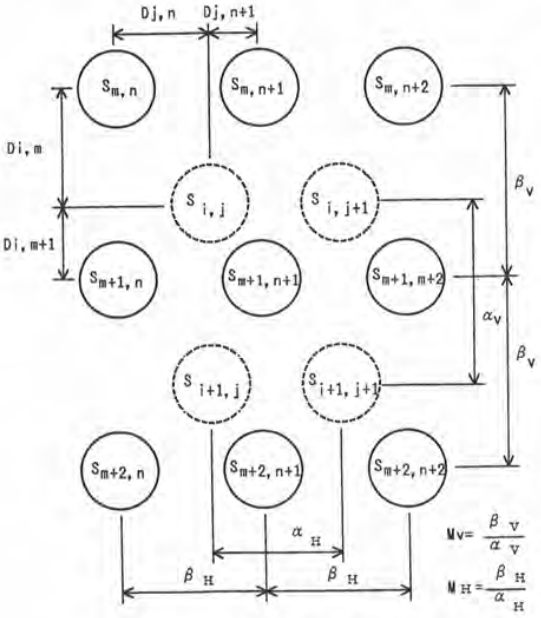



Fig. 6 Spatial Distribution of Interpolated and Non-interpolated Signals

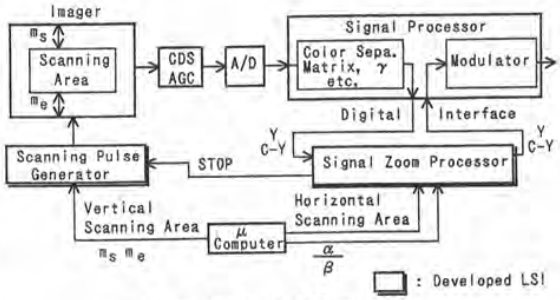



Fig. 7 System Block Diagram

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Fig. 8 shows the block diagram of the scanning pulse generator. In order to be available for many kind of imagers, same phase comparator as described in Ref. 3 is used. Vertical scanning pulse is stopped when control pulse "STOP" is high level, and is changed to high frequency pulse during charge sweep period. Horizontal scanning pulse is set at low level when the frequency of vertical scanning pulse is high, and then, is changed to high frequency pulse as shown in Fig. 4.

Fig. 9 shows the block diagram of signal zoom processor. Y/C-Y signals are memorized in two line memories and are expanded in horizontal direction by the R/W controller. The expanded signals Sm,g and Sm-1,g are led to multipliers and adders. The coefficient $C_1$ and $C_2$ are calculated according to above mentioned formula. In this signal zoom processor, $\alpha_V$ and $\alpha_H$ are fixed to 256, and $\beta_V$, $\beta_H$ are selectable from 1 to 256 by 256 steps. So, zoom ratioes $\alpha_V/\beta_V$, $\alpha_H/\beta_H$ are smoothly changed from X1 to X256 (256/256, 256/255, ···, 256/1).

## 5. CONCLUSION

An electronic zoom system was developed. The zoom ratioes in vertical and horizontal direction are independently controllable. Two CMOS digital LSIs, scanning pulse generator and signal zoom processor for this electronic zoom system were developed. The specifications of developed LSIs are shown in Table 2.

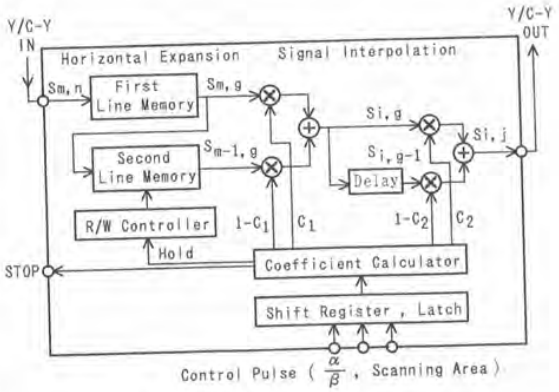



Fig. 9 Block Diagram of Signal Zoom Processor

Table 2 Specifications of Developed LSIs

| | Scanning Pulse Generator | Signal Zoom Processor |
|---|---|---|
| Function | Vertical Expansion (Imager Scanning) | Horizontal Expansion Signal Interpolation |
| Process | 1.2 μm CMOS | 1 μm CMOS |
| Gate Number | 2.5 k | 10 k |
| RAM Capacity (bit) | — | 22 k |
| Power Dissipation | 120 mW | 150 mW |
| Package | 80 pin TQFP | 100 pin QFP |

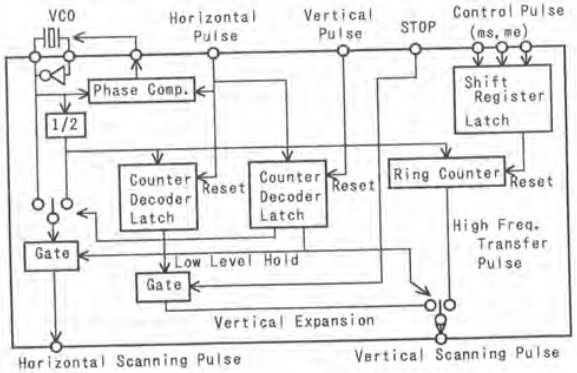



Fig. 8 Block Diagram of Scanning Pulse Generator

## 6. ACKNOWLEDGEMENT

The authors wish to express their sincere thanks to many Hitachi people in Tokai Works, Mobara Works, Central Research Laboratory, and Image and Media System Laboratory for their advices and contributions.

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## BIOGRAPHIES

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Naoki Yamamoto received the B.S. degree from Meiji University in 1987, when he joined Image and Media System Laboratory, Hitachi Ltd., where he has been engaged in the research and development of solid-state color video cameras. He is a member of the ITEJ.

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Junji Kamimura was graduated from Hamamatsu Technical High School in 1986, when he joined Image and Media System Laboratory, Hitachi Ltd., where he has been engaged in the research and development of solid-state color video cameras.

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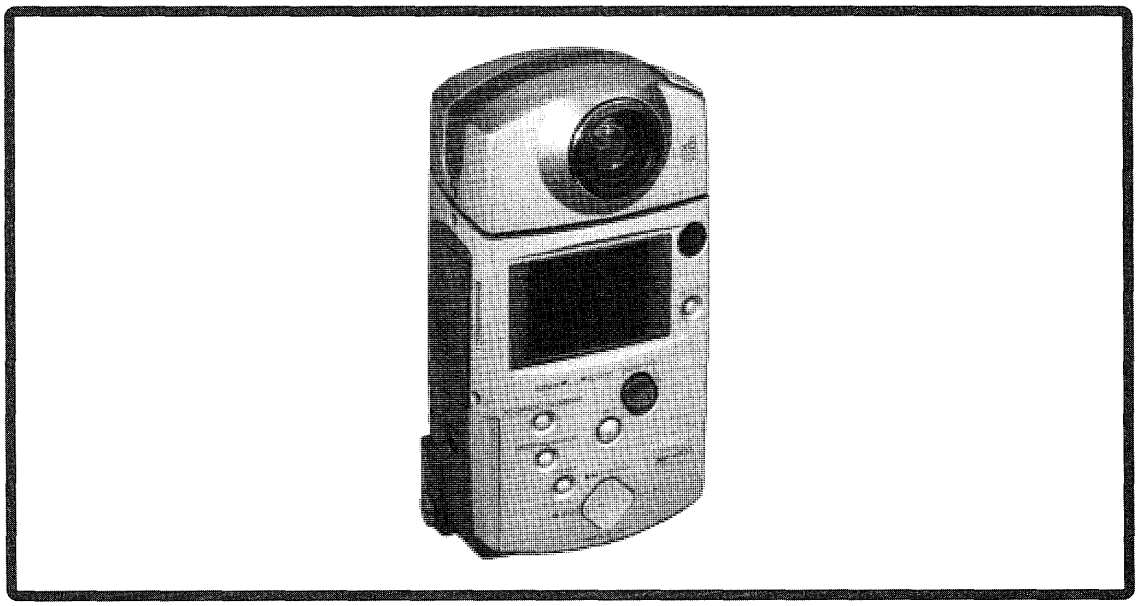
HITACHI

V28522

# MPEGCAM™

## MP-EG1A

ENGLISH



**Instruction Manual**

To obtain the best performance and ensure years of trouble-free use, please read this instruction manual completely.

## *Precaution*

■ **No water, dust or sand**

Be careful that no water, dust or sand enters the MP-EG1A because it may cause trouble and accidents.

■ When you shoot at a scene which contains an extremely bright object such as the sun or a light source, a bright vertical bar may appear in the picture.
Your MP-EG1A is functioning properly, but the solid-state pickup device (C.C.D) usually causes this as an inherent characteristic. Try to avoid shooting an excessive bright object directry.

**The liquid crystal display (LCD) panel is made by highly precise technology. More than 99.99% of its picture elements (pixels) are effective, but some (less than 0.01%) may appear as coloured bright dots. This does not indicate a fault as the LCD panel stretches the limits of current technology.**

**Stored data:**
- It is recommended that you store valuable data in your personal computer or other storage devices after each recording.

**WARNING:** To prevent risk of injury or damage to youpr MP-EG1A and the AC adapter/charger, use only the specified battery and AC adapter/charger.

Battery: MP-BP1A

AC adapter/charger: MP-AC1E

**BE SURE NOT TO LEAVE THE MP-EG1A IN A PLACE AT HIGH TEMPERATURE EXCEEDING 60˚C, OR ITS INTERNAL PARTS MAY DETERIORATE. BE CAREFUL NOT TO LEAVE THE UNIT IN THE FOLLOWING PLACES:**

* **Inside a car with the window closed and in direct sunshine.**
* **Near heating appliances.**
* **In direct sunshine in summer.**

**WARNING:** It is permissible to record television programmes only in the event that third party copyrights and other rights are not violated.

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Intel® and Pentium® are registered trademarks of Intel Corporation.
SoftPEG is a registered trademarks of CompCore Multimedia Inc.
IBM®, IBM PC/AT® and PowerPC™ are registered trademark of International Business Machines Corporation.
SoundBlaster is a registered trademark of Creative Technology Ltd.
Other company names and product names listed are trademarks or brand names belonging to each company.



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# *Read This First*



## To guide you, we've included following eight chapters.

- Chapter 1, "Introduction", gives you how to use your MP-EG1A efficiently, and explains the overview of your MP-EG1A.
- Chapter 2, "Set-up", explains how to set up your MP-EG1A for recording.
- Chapter 3, "Recording", explains how to record moving pictures, still pictures, etc. Read thoroughly before starting to record.
- Chapter 4, "Playback", explains how to play back recorded pictures and sound, and search for files you want to play back.
- Chapter 5, "Operating files", explains how to use Media Navigation for arranging recorded files, editing folder for auto play, etc.
- Chapter 6, "Using the MP-EG1A with Other Equipment", explains how to use the MP-EG1A with a TV(NTSC 3.58MHz only) or a personal computer.
- Chapter 7, "Menu Settings", explains how to operate the on-screen menu for desired settings.
- Chapter 8, "Subsidiary Information", shows various information, including what to do when you are in trouble. Refer to each item as needed.

## Get to know your MP-EG1A by using this manual, and get to know Hitachi. We appreciate your business.

- The MPEG1 standard is used for the MP-EG1A to handle moving pictures. The playback picture will be slightly rougher, but this does not indicate a fault.
- The MP-EG1A mechanism is configured so the PC card cannot be removed when hot. Wait until it cools down to remove.
- Do not set the CAM/OFF/PLAY switch to OFF when the ACCESS indicator is flashing.
- Be sure to set the CAM/OFF/PLAY switch to OFF once before switching it between CAM (REC) and PLAY.



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# *Quick Index*

**We want this manual to be as helpful as possible, so it includes two easy ways to find the information you need:**

- A quick index for the information you use most often (this page).
- A detailed table of contents directing you to specific information quickly (page 7).

Charging Battery Pack ..... 18
Recording Moving Pictures ..... 29
Playing Back the File Just Recorded ..... 38
Connecting to TV and Viewing Playback Pictures ..... 66
Connecting to Your Personal Computer ..... 68





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# Cautions When Using

**Any problems that occur as a result of any of the following conditions will not be covered by our warranty.**



**Handle the LCD screen with care:**
- Do not apply force to the screen surface, as this could cause cracks, scratches or unevenness in display. Any unevenness in display will disappear on its own when power is turned off, and then on again after a brief wait.
- Do not place the MP-EG1A with its LCD screen down.

**Do not allow dust or sand to enter the unit!**
- Store the batteries in a place beyond the reach of children.
- Be careful that no sand splashes on the unit when using it on a beach. This could cause malfunctions.
- Be careful that no dust or sand enters the unit when using it outdoors on windy days. This could cause malfunctions.
- Do not place the unit directly on sand, as this could cause malfunctions

**Do not point directly at the sun:**
- Handle the unit with care so that sunlight does not enter the lens directly. This could cause malfunctions
- Do not leave the unit with the LCD screen exposed to direct sunlight. This could cause malfunctions.

**Do not wipe unit case with benzene or thinner:**
- The coating of case could peel off or the case could deteriorate.
- Use chemical cleaning cloth, following the instructions for use.

**Do not use the unit near an operating radio or TV:**
Noise could appear on the TV screen or noise could enter the radio sound.

**Do not use unit in extremely hot or cold places:**
- Be sure not to leave the MP-EG1A in a place where the temperature exceeds 60°C, or the pickup device may be damaged.
- Normal recording or playback may not be possible if you use it at temperatures over 40°C or under 0°C

**Do not apply shocks:**
- Take care that you do not strike the unit against anything or drop it. This could cause malfunctions.
- When you are using the unit on the provided stand, do not depress unit with force from top, as the stand could break.
- Do not expose the unit to shocks during recording, or the file being recorded will not be stored.

**Do not use the unit near strong radio waves or magnetism:**
Do not use the unit near objects generating radio waves or electric appliances with motors. This could cause malfunctions.

**Do not use the unit for a long uninterrupted period of time:**
This unit is designed and produced for home-use recording and playback. Do not use it for a long time continuously as a surveillance camera/monitor, as this could cause malfunctions. If you use it for a prolonged time, the temperature at unit surface will rise, but this does not indicate a fault.

**No water!**
This unit does not have a water-resistant structure. Be careful that it is not exposed to rain or water splash. This could cause malfunctions.

**Also read the instructions attached with optional accessories.**
When you use optional accessories with this unit, follow the cautions on them and the instruction manuals attached.

**Loading Batteries**

**NOTES:**
- When replacing the battery, use 3V micro lithium battery CR2025.
- Danger of explosion if battery is incorrectly replaced.

This product uses the lithium battery which contains dangerous chemicals. Handle and dispose of with great care.

**WARNING:**
- Keep the battery away from children and pets. If swallowed consult a physician immediately for emergency treatment.
- Keep the battery in a dark, cool, dry place.
- Do not throw the battery in a fire.
- Do not short circuit the battery.
- Do not disassemble the battery.
- Do not hold the battery with the metallic tweezers.
- Do not re-charge the battery.
- Wipe the battery with dry cloth and set properly confirming ends (+,-).
- After use please bring back to retail shop.

**Warning for disposal in U.K: Place in a plastic bag and put in waste bin.**



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# *Before Using*

## Compensation for recorded contents:

If the unit or PC card becomes faulty during use and no recording is possible on PC card or playback from it, we will not be responsible for compensation for your lost recordings.

## Make a trial recording before recording important events:

If recorded data is erased because the unit malfunctions, the data cannot be restored.

## Copyrights:

You cannot use recordings of copyrighted materials for purposes other than for your private enjoyment, without permission of their rightful owner.



# Be careful of Moisture Condensation

## Condensation:

When a heater is used in your room in a cold season, windowpanes will be frosted. This is because vapour in air indoors is cooled rapidly and moisture is formed. This is referred to as condensation.

## Condensation occurs:

When you move unit from a cold place to a warm place abruptly, such as when you enter a lodge from a ski slope; When you place the unit in a room in which heating has just begun or in a place where cool air strikes unit directly; When you move the unit outside from a cooled room or vehicle in a hot season.

## When condensation occurs:

Leave unit in a place as dry as possible for about one hour before using it.
When moisture condenses on the lens, a clear picture cannot be recorded. Start recording after condensation of the lens has been removed.



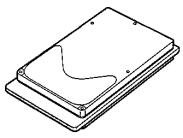
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ENGLISH

## *Checking the Provided Accessories*

**Make sure you have following :**

**PC Card**
(MP-HD260)



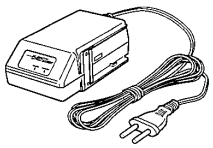
A 260MB hard disk. This stores video and audio data

**Battery pack × 2**
(MP-BP1A)



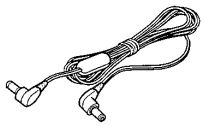
The portable power supply of the MP-EG1A Charge before use (See page 18)

**AC adapter/charger**
(MP-AC1E)



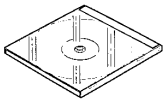
To charge battery pack, etc (See page 18)

**DC power cord**



Connect this to the AC adapter/charger to power the MP-EG1A from AC outlet (See page 20)

**CD-ROM**



Stores various applications, etc

**Remote control**
(MP-RM1A)



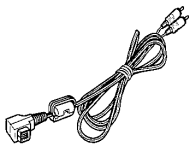
(See page 25)

**Lithium battery**
for remote control (CR2025)



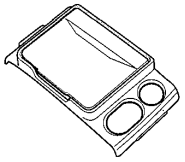
**WARNING** Keep this battery away from children. If swallowed, consult a physician immediately for emergency treatment.

**Audio/video cable**



To connect the MP-EG1A to TV (NTSC 3 58MHz only).

**Sunshade for LCD screen**



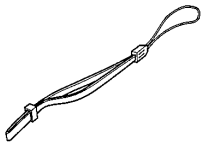
Attach this to the MP-EG1A so that you can see the LCD screen easily.

**Stand**

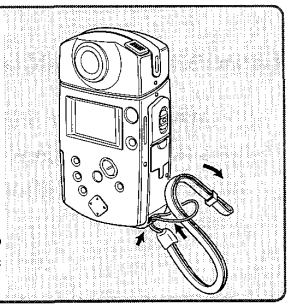


Used when connecting the MP-EG1A to another device and operating it.

**Wrist strap**



Attach to the MP-EG1A to hold it as shown in the figure on right.





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# Chapter 1
# Introduction

**This section gives you how to use your MP-EG1A efficiently, and explains the overview of your MP-EG1A. Before using it, read this section thoroughly.**


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# *Features*

## A Variety of Recordings

One MP-EG1A allows you to record in three ways - moving picture (with audio), still picture, and still picture with audio. Your recordings are stored in PC card*3 instead of videotape or film, as a video file*1 and audio file*2. Usual operation is similar to a usual camcoder.

ENGLISH

### Recording moving pictures:

You can record joyful events and sports as you use a usual camcorder.

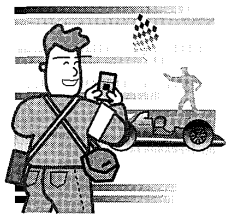
MPEG1 Format



### Recording a still picture or consecutive still pictures:

You can record a still picture just as you would use an ordinary still camera. If you record moving subjects in consecutive still picture made, you will not miss a crucial chance.

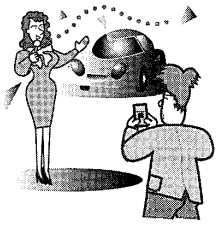
JPEG Format



### Recording a still picture with audio:

You can add narration to a still picture for JPEG and MPEG Audio. This function is useful if you want to attach voice to a still picture.

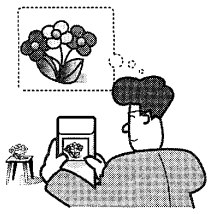
JPEG + MPEG Audio



## Playback to View Recordings

### Viewing on the LCD screen:

You can immediately see the video just recorded on the built-in 1.8" liquid crystal display (LCD) screen.



*1: MPEG 1 format, JPEG format
*2: MPEG Audio
*3: PC card (MP-HD260), exclusively for MP-EG1A



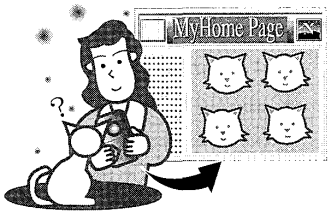
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# A Variety of Uses

## Presentation by using application software:

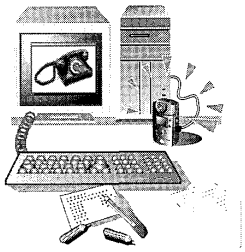
Microsoft® Office 97 (PowePoint® 97, Word 97, Excel 97), Microsoft® Access etc.

## For creating multimedia contents and materials for Internet homepage or Intranet Lan:



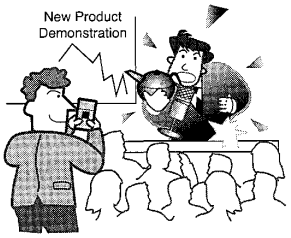

Because being stored in file, it is easy to send files in a personal computer. This is most suitable for creating multimedia contents and materials for Internet home page. You can use the stored video file in a variety of joyful ways such as wallpaper for your computer.

## Playback and edit the files on your personal computer:



Transfer files to your computer (see page 69), and you can view them with computer software and edit the files with the bundled software.

## For gathering materials:




You can choose the recording mode to suit the material, such as recording moving subjects with a motion picture mode adding a narrative with recording still picture when recording commodities, etc.

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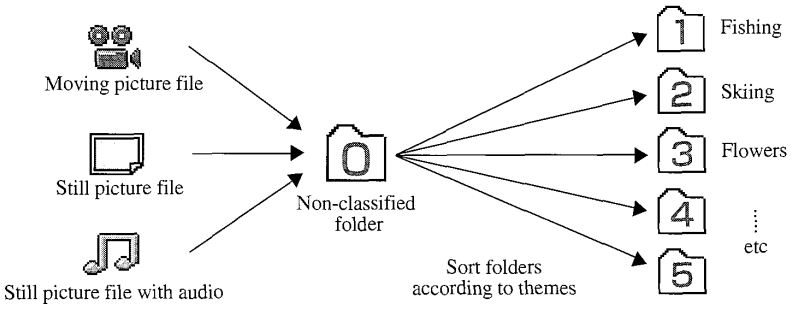
# *Operating Files*

**In PLAY mode, you can use the file management function, Media Navigation, which is provided with the MP-EG1A, to operate files. Here is a brief explanation of Media Navigation:**



## File and folder

The MP-EG1A records moving pictures, still pictures and a still picture with audio, and stores each as gathering of data. Gathering of data is referred to as a file.
Files are stored in a folder to be managed. Media Navigation provides six folders with numbers 0-5, and recorded file is securely stored in any of the folders ( 🗀 ). Folder 0 is referred to as "non-identified folder" and all recorded files are stored in this folder temporarily.
Folders 1-5 have no files at first. You can use Folder 1-5 to arrange files.
* To move files to another folder, refer to "Transferring Files to Another Folder" ( see page 48).




* Folder names (fishing, Skiing, etc ) shown in the above figure will not appear on the Media Navigation screen.

## Arranging files in folders with themes

When you have decided the theme of each folder, move the file from non-identified folder (folder 0) to designated folder and arrange (see page 48). Delete unnecessary files (see pages 50 and 51).
If you arrange files in folders this way, you can easily locate desired files.

## Editing files for auto play

The MP-EG1A can automatically play back files collected in a folder in your designated (See page 58) order, like the program play with a CD player. Collect a moving picture, still picture and a still picture with audio in a folder under a theme you want (see page 48), and sort them (see page 56). Now, you can automatically play back the folder as a completed work.




* Titles (Winter in New York, etc ) shown in the above figure will not appear on the Media Navigation screen.

**The section "File Management (Media Navigation)" on page 43 will describe the method for performing the above procedures, etc., using Media Navigation.**

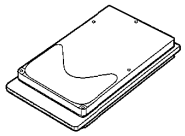


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# *PC Card*

## What is a PC card?

The MP-EG1A stores video and audio data in a hard disk, which is referred to as a PC card in this text.



MP-HD260 PC card



## Maximum time and number of pictures PC card can store

The MP-HD260 can store:

Moving picture: approx. 20 minutes
Still pictures: approx. 3,000 shots
Still picture with audio: approx. 1,000 shots with each 10sec. audio

* The number of still pictures that can be stored may decrease as their video scene contents become more complicated. The recordable time of still picture with audio is the maximum time when one still picture and audio only are stored. Use the above storable time and number of stills only as a reference.
* MP-HD260 is already formated. It is not necessary to format.

# Cautions When Using PC Card

For safety, be careful of the following:

**CAUTION**

- **Do not bring PC card near fire or throw it into fire; it may explode, causing injury or burns.**
- **Do not disassemble or modify the unit by yourself. This could cause fire or electric shock.**
- **To prevent damage by static electricity, touch metal (door knob, windows frame, etc.) with your hand to discharge it, before handling the unit. Static electricity from the human body could damage the unit.**

### Generally available PC cards:

Do not use PC cards other than the MP-HD260. We cannot guarantee their operation.

### Handle PC card with care as follows to prevent malfunctions or erasure of data :

- Do not bend the PC card, apply force, allow it to be subject to shocks or drop it
- Do not use or store in a place where static electricity or magnetic or electric noise is likely to occur.
- Do not use or store where temperature and/or humidity are high, in a dusty place, or under highly corrosive environments.
- Be careful that no dust or foreign object enters through the connector
- Do not pull out the PC card, unplug the DC power cord or remove battery during recording or playback. The file being recorded will not be stored, or the stored file could be destroyed.

### Removing the PC card:

- Lay the unit on its back, with the LCD screen facing up, then remove the PC card from the bottom. Do not put the bottom face down to remove; you could drop the PC card.
- When the unit is continuously used for a long time, the PC card will generate heat and its temperature will increase. For safety, the PC card eject lever is locked when the temperature of PC card exceeds the specified one, and it cannot be removed. If the lever is locked, set the CAM/OFF/PLAY switch to OFF and wait for a while. After the temperature drops, the lever will unlock, and you can remove the PC card.
- When the CAM/OFF/PLAY switch is set to CAM or PLAY, the eject lever will not work. To remove the card, check to see if the switch is set to OFF, with the unit powered by the charged battery in it or the AC adapter/charger connected to AC outlet.
- When the unit is powered by the AC adapter/charger, do not unplug the DC cord from unit or AC adapter/charger from AC outlet, with the CAM/OFF/PLAY switch set to CAM or PLAY; you cannot remove PC card. Before unplugging them, make sure that the switch is set to OFF.
- When the PC card eject lever does not work because the unit is not powered by the battery or AC adapter/charger, turn on the unit, set the CAM/OFF/PLAY switch to OFF and then unlock the lever.

### Stored data:

- It is recommended that you store valuable data in your personal computer or other storage devices after each recording.
- The recorded data may be erased when the PC card is affected by electric noise or becomes faulty or is repaired, or if you or your friends make a mistake in using the unit. We cannot accept any responsibility of compensating for damages due to erasure of recorded data.

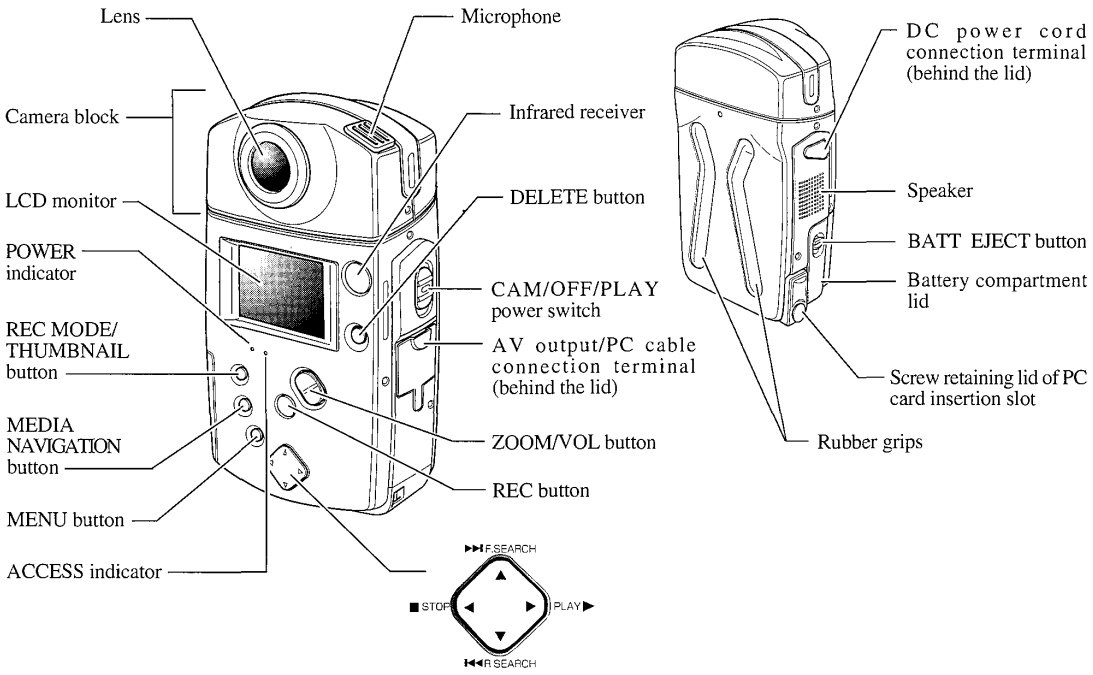


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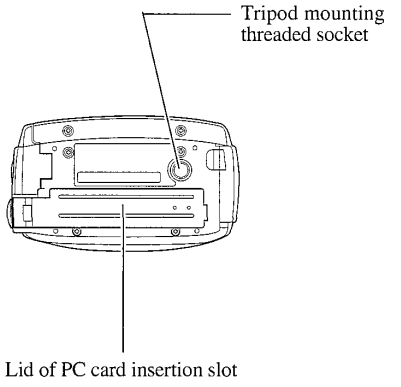
ENGLISH

# *Names of Each Part*

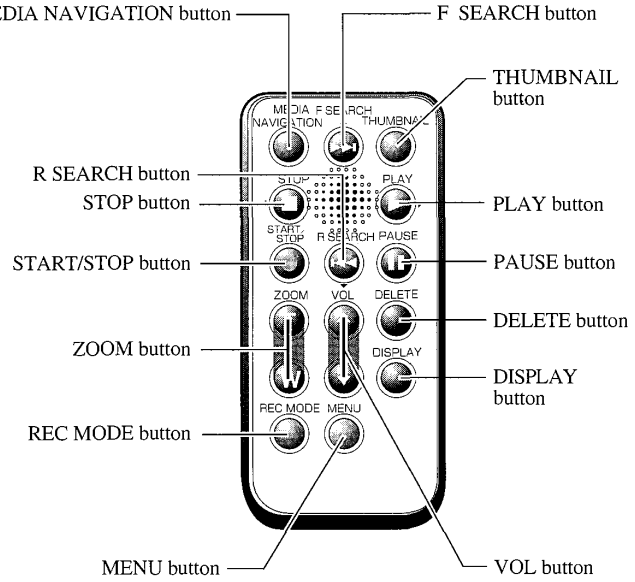
## Front View




## Bottom View




## Remote Control






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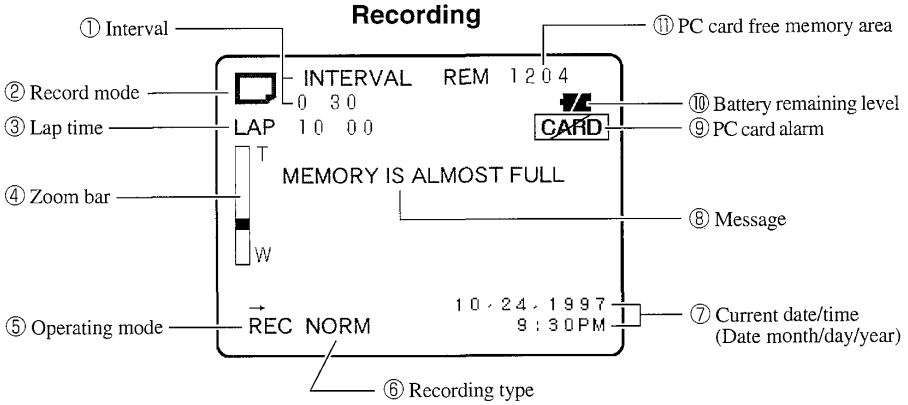
# *Viewing the On-Screen Display*

**Various types of information appear on the LCD monitor. Here are meaning of each indication and how to interpret them.**

* Note that all the following indications do not appear at the same time.
* Although a colour text appears on the built-in LCD monitor, a white text appears on the TV screen.

## [REC MODE]

### On-Screen Display during Recording




① **INTERVAL:** Appears during still picture recording mode if the interval has been set (see page 74). This indicates the interval at which still pictures are recorded and can be set to 30 seconds, 1 minute or 5 minutes (see page 32). If this indicator does not appear, normal still picture recording will be engaged.

② **Record mode:** This indicates the current recording file type which can be switched by pressing the REC MODE/THUMBNAIL button. You can select one of four modes.

: Moving picture (MPEG1 Format)
· Still picture (JPEG Format)
: Consecutive recording of still pictures
(JPEG Format, 2 pictures/sec. and 5shots)
· Still picture with audio
(JPEG Format and MPEG Audio)

③ **Lap time :** This appears when you select moving pictures or still picture with audio, and indicates the elapsed time since the REC button was pressed.

④ **Zoom bar :** This appears when the ZOOM/VOL button is pressed during recording, and indicates how the zoom is engaged in 10 settings from W (wide) to T (tele). The magnification in the optical zoom range is shown in white and that in the digital zoom in yellow.

If zoom is pressed, the zoom bar will be displayed for three seconds even when the indicator "OFF" appears in the on-screen display (see page 78).

⑤ **Operating mode :** This indicates what mode the MP-EG1A is in currently - recording, playback, etc. - with letters and symbols. See "Operating Mode Indicators" (on page 16) for details.

⑥ **Recording type :** This indicates the function of the REC button during recording.

NORM : Recording starts when REC is pressed and stops when it is pressed again.

CLIP : Recording continues while REC is held and stops when it is released.

The REC button function is set to NORM at the factory. You can switch it to CLIP with the menu (see page 72)

⑦ **Current date/time :** The current date and time appear during recording If incorrect date and time appear, correct them (see page 22).

⑧ **Message :** Appears as required

⑨ **PC card alarm :** This appears when a PC card is not inserted or non-usable card is inserted.

⑩ **Battery remaining level :** This indicates the battery remaining level with graphics.

: Full charge (lights white)
: Middle level (lights white)
: Low level (flashes white)

Charge the battery in the low level (see page 18).

Connecting the AC adapter/charger causes the middle indicator to light. ( )

⑪ **PC card free memory area :** This indicates the free memory area on PC card for recording in terms of recording time left or the number of recordable still pictures.

ENGLISH

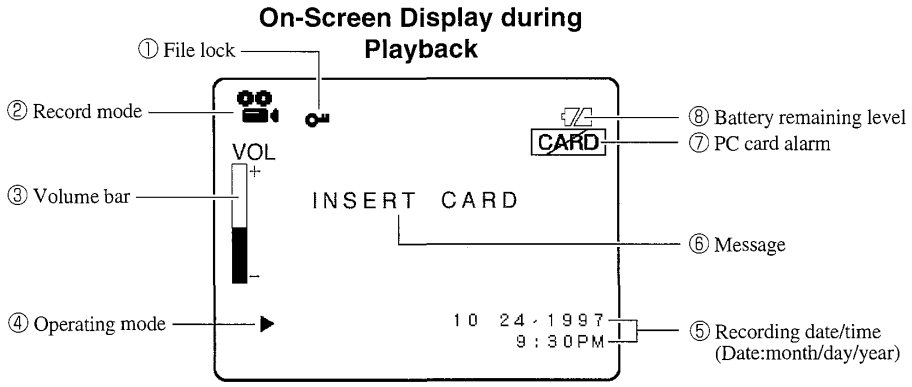


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ENGLISH

## [PLAY MODE]

* Note that all the follwing indications do not light at the same time.
* Although a colour text appears on the built-in LCD monitor, a white text appears on the TV screen.




① **File lock :** Appears when the file being played back is set to the inhibit state of deletion (see page 54).

② **Record mode :** This indicates the type of file which is being played back.

③ **Volume bar :** Appears when the ZOOM/VOL button is pressed during playback and indicates the current volume level.

⑤ **Recording date/time :** This indicates the recording date/time of the file being played back. The displayed date/time cannot be updated during playback.

⑧ **Battery remaining level :** During playback this appears only in the low level graphic flashes.

# Operating Mode Indicators

**The operating modes are displayed with the following letters and symbols and in colours, indicating the MP-EG1A operations:**

| Letters/symbols indicated | Colour | Operation |
|---|---|---|
| REC | Red | Recording (shooting) |
| PAUSE | Green | Recording pause |
| ▶ | Green | Playback (disappears after 5 seconds) |
| AUTO▶ | Green | Auto play |
| II | Green | Play pause |
| ▶I | Green | Location of start: Forward search |
| I◀ | Green | Location of start: Reverse search |
| ■ | Green | Stop (disappears after 5 seconds) |



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# Chapter 2
# Set-up

**This section explains how to set up your MP-EG1A for recording. Before you start to record, be sure to read the section thoroughly.**


Charging battery pack ..... 18
Loading the battery pack ..... 19
Using power supply from AC outlet ..... 20
Loading the PC card ..... 21
Setting the date and time ..... 22
Inserting battery into the remote control ..... 25
Tips for skillful use of the MP-EG1A ..... 26




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# *Charging Battery Pack*

**The battery pack is the portable power supply of the MP-EG1A. Charge before use.**

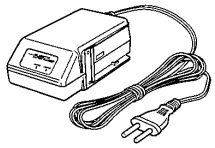
When the battery remaining level indicator ⍁ flashes white, you need to re-charge the battery pack. See "Removing the battery pack" instruction (on page 19 ). A fully charged battery pack powers the MP-EG1A for about 40 minutes.



**Battery pack**
(MP-BP1A)



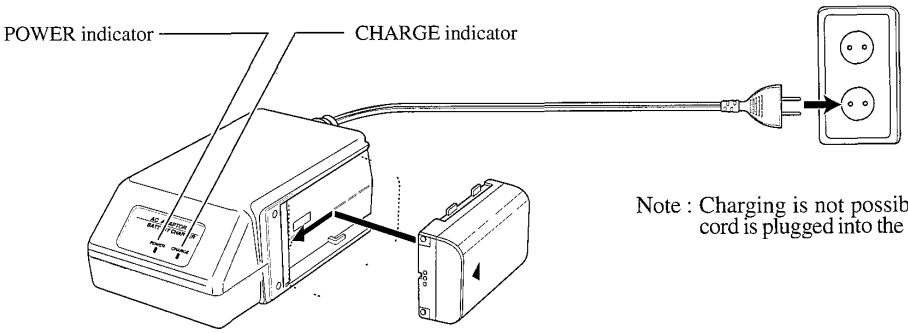
**AC adapter/charger**
(MP-AC1E)



**Caution** : Be sure to use the specified MP-AC1E AC adapter/charger to charge the battery pack.
If you use AC adapter/chargers other than the MP-AC1E, heat generation, damage, fire, leakage of liquid, etc. could result.

## 1 Plug the AC adapter/charger into an AC outlet.

The red POWER indicator will light.




Note : Charging is not possible if the DC power cord is plugged into the AC adapter/charger.

## 2 Attach the battery pack.

The green CHARGE indicator will light and charging will start. Continue charging the battery pack until the indicator goes out. Charging will be finished in about 100 minutes. After charging is finished, unplug the AC adapter/charger from the AC outlet, and then remove the battery pack from the AC adapter/charger.

See the bottom of the AC adapter/charger. The rating label is located on the bottom of the AC adapter/charger.

***Skillful use of battery pack***

See "Tips on Battery Pack" on page 86.



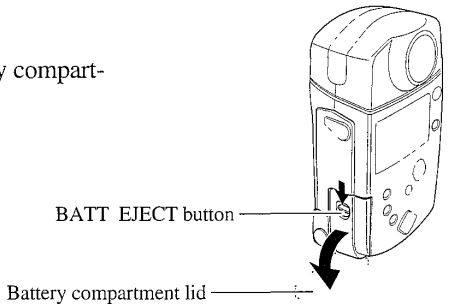
BlackBerry Corporation Exhibit 1004, pg. 629

## *Loading the Battery Pack*

**Load the battery pack in the MP-EG1A by the following procedure:**

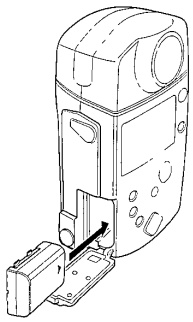
### 1 Open the battery compartment lid.

Press the BATT. EJECT button downward. The battery compartment lid will open.



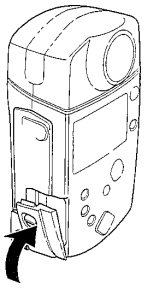

### 2 Load the battery pack.

Load the battery pack in the direction of the arrow until it is fixed securely.



### 3 Close the battery compartment lid.

* If the battery pack is not inserted correctly, the lid will not close completely. If this happens, re-insert the battery pack correctly.

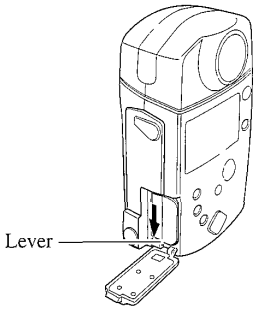


***Removing the battery pack***

Press the BATT. EJECT button downward to open the lid and push the lever in the direction of the arrow. The battery pack will be ejected by spring force.

* Do not drop the battery pack when removing it; this could result in malfunction.

* Do not remove the battery pack during recording or playback. If it is removed during recording, file will not be recorded.



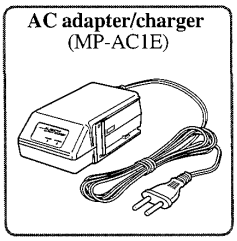

ENGLISH

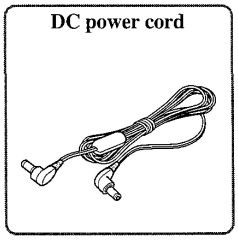


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## *Using Power Supply from AC Outlet*

**You can also use power supply from any AC outlet.**

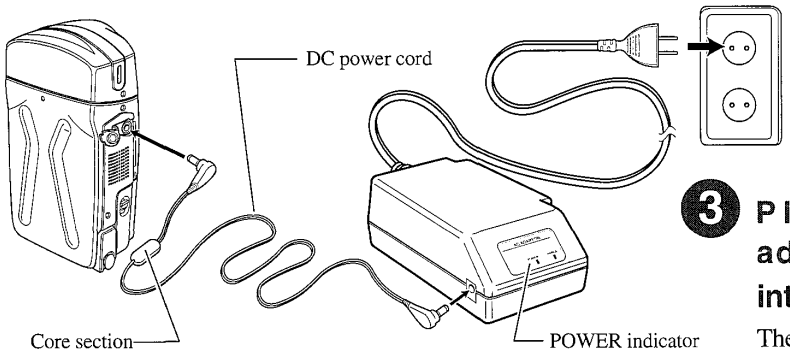



**Caution** : Be sure to use the specified MP-AC1E AC adapter/charger to use power supply from AC outlet. If you use AC adapter/chargers other than the MP-AC1E, fire or electric shock could result.



**1 Set the CAM/OFF/PLAY switch to OFF, and connect one end of the DC power cord to the DC IN jack of the MP-EG1A.**




**2 Connect the other end of the DC power cord to the DC output jack of the AC adapter/charger.**

See the bottom of the AC adapter/charger. The rating label is located on the bottom of the AC adapter/charger.

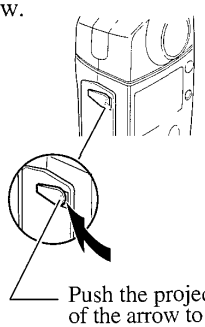
**3 Plug the AC adapter/charger into an AC outlet.**

The red POWER indicator will light.

***If the POWER indicator does not light :***

If the POWER indicator of the AC adapter/charger does not light, unplug the AC adapter/charger from the AC outlet. Wait about 30 seconds, and try again to plug it into the AC outlet. If the POWER indicator still does not light, it is possible that the AC adapter/charger is faulty. Unplug the AC adapter/charger from the AC outlet and consult the store where you purchased the MP-EG1A.

After use, close the lid for DC power cord connection terminal, referring to the figure below.






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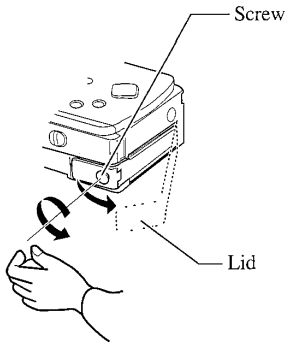
# *Loading the PC Card*

**Set the CAM/OFF/PLAY switch to OFF before inserting or removing the PC card.**

* Do not use PC cards other than that specified (MP-HD260).
* Do not attempt to attach an adhesive tag, etc. to the PC card to remove it easily. If the PC card is removed while the MP-EG1A is operating, it could result in malfunction.

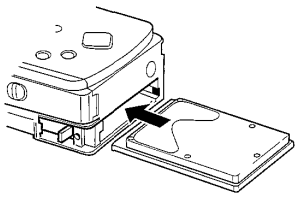
## 1 Open the lid of the PC card insertion slot.

Loosen the screw and remove the lid.



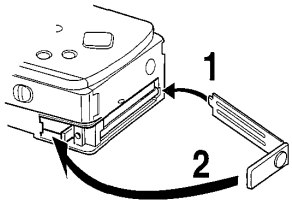

## 2 Insert the PC card.

With the card surface up, insert the PC card until it is fixed securely into the slot.



## 3 Close the lid of the PC card slot.

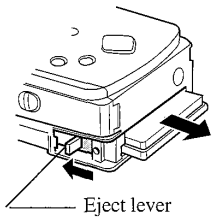
Attach the lid over the slot and screw up.
(Use fingers to screw up when you close the lid of the PC card slot.)




### *Removing the PC card*

Set the CAM/OFF/PLAY switch to OFF and loosen the screw to remove the lid. Lay the MP-EG1A on its side in a horizontal place and push the eject lever. The PC card will be removed.

* Be careful not to drop the PC card as this could damage it.




### *When the eject lever does not move.*

See "Troubleshooting Guide" on page 91, or check the following two items:

- If the CAM/OFF/PLAY switch is set to CAM or PLAY, the eject lever will not move. Set it to OFF, and power the MP-EG1A from the charged battery pack or AC adapter/charger.
- If the PC card becomes hot after the MP-EG1A is used for a long time, the eject lever will not work even if the CAM/OFF/PLAY switch is set to OFF, for safety reasons. In this case, leave the MP-EG1A as it is for 10-20 minutes to cool the PC card. When the temperature is low enough, the eject lever can be operated.





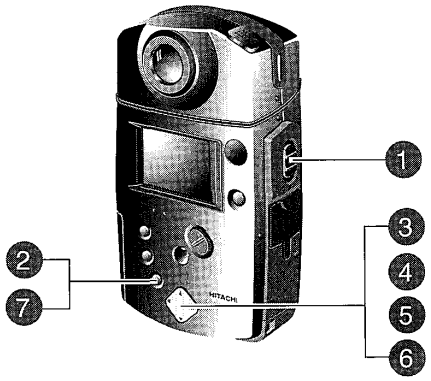
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## *Setting the Date and Time*

**The recorded video/audio data management will be performed with the date and time you set when you started to record.**
**Use the following procedure to set the MP-EG1A's internal clock to the current date and time correctly:**

* You can also use the remote control to set the date and time.





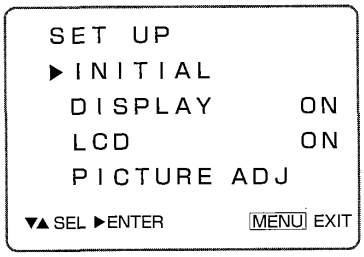

### 1 Set the CAM/OFF/PLAY switch to CAM.

Hold the red button at the centre of switch, and then set the switch to CAM.

* When the switch is set to PLAY, the LCD and INITIALIZE CARD parameters will not appear.
* When the AV cable is connected, the PICTURE ADJ parameter will not appear

### 2 Press the MENU button.

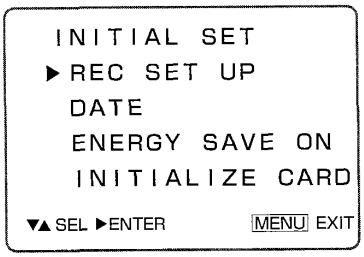
The SET UP menu will appear on the LCD monitor.
The INITIAL parameter will be displayed in green.
* The menu does not appear during recording.




### 3 Display the INITIAL SET screen.

Press the ▶ (PLAY) button.
The INITIAL SET screen will appear.

Initial Setting Screen

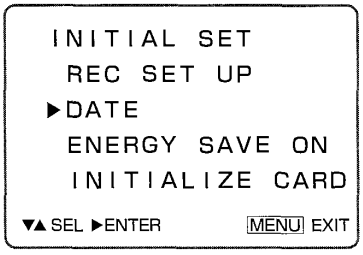





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## 4 Select DATE.

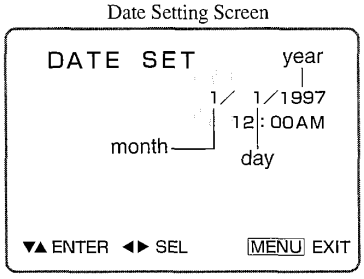
Press the ▼ (R.SEARCH) button to select DATE.




## 5 Display the DATE SET screen.

Press the ▶ (PLAY) button.
The DATE SET screen will appear.

Date Setting Screen




## 6 Set the correct date and time.

Press the ▶ (PLAY) or ◀ (STOP) button until the digit you want to set flashes, then press the ▲ (F.SEARCH) or ▼ (R.SEARCH) button to increase or decrease the number.

## 7 Finish the date/time setting.

Press the MENU button.
The date/time setting will be completed and the DATE SET menu will disappear, after which the original picture will be restored.
As soon as MENU is pressed, the clock will start counting from the set date and time.

ENGLISH



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ENGLISH

### *Charging the MP-EG1A's Built-in battery :*

The MP-EG1A incorporates a battery to power the memory which stores the date/time and various settings. This built-in battery will discharge after about two months, even if the MP-EG1A is not used. When the battery will discharge, "—/—/—" will flash in the date/time digits. If you record in this state, the file will be stored with the "—/—/—" date/time display, and the settings entered in various setting menus (see pages 71 - 81) will also be cleared and reset to the initial status, when you purchased the MP-EG1A.

To avoid loosing entered data, charge the built-in battery once about every two months.

Use one of the following two ways to charge the battery:

- Connect the AC adapter/charger to the MP-EG1A, and leave the MP-EG1A for about 24 hours with the CAM/OFF/PLAY switch set to OFF.
- Load a charged battery pack and leave the MP-EG1A for about 24 hours with the CAM/OFF/PLAY switch set to OFF.

### *If the date and time are incorrect :*

When the incorrect recording date and time appear on the screen, charge the built-in battery by the procedure above, and correct the date and time on the DATE SET screen.

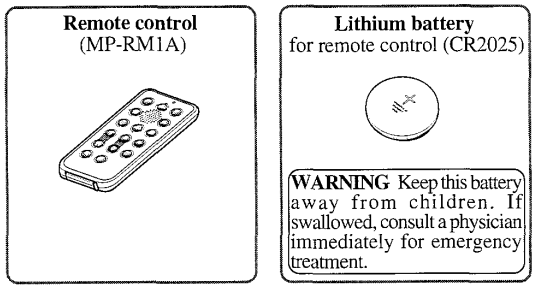
If the recording date and time are displayed incorrectly, the video data will be stored with the incorrect date and time. To correct the date/time data, see "Correcting File Recording Date/Time" on page 62.



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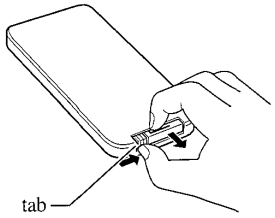
## *Inserting Battery into the Remote Control*

**Insert the provided CR2025 lithium battery into the remote control.**

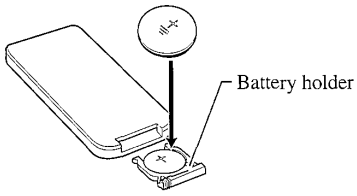



### 1 Pull out the battery holder.

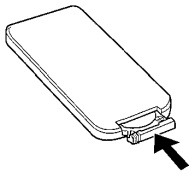
Push the tab in the direction of the arrow and hold it, then pull out the battery holder.




### 2 Insert the battery with the (+) terminal up.




### 3 Replace the battery holder.



***Life of lithium battery***

The life of the lithium battery is about one year.

**NOTES:**

- When replacing the battery, use 3V micro lithium battery CR2025.
- Danger of explosion if battery is incorrectly replaced.

This product uses the lithium battery which contain dangerous chemicals. Handle and dispose of with great care

**WARNING:**

- Keep the battery away from children and pets. If swallowed consult a physician immediately for emergency treatment.
- Keep the battery in a dark, cool, dry place.
- Do not throw the battery in a fire.
- Do not short circuit the battery.
- Do not disassemble the battery.
- Do not hold the battery with the metallic tweezers.
- Do not re-charge the battery.
- Wipe the battery with dry cloth and set properly confirming ends (+,-).
- After use please bring back to retail shop.

**Warning for disposal in U.K: Place in a plastic bag and put in waste bin.**

ENGLISH



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# *Tips for Skillful Use of the MP-EG1A*

## Use the PC card efficiently.

The PC card to be used with the MP-EG1A corresponds to film of a still camera or videotape of a camcorder, but it is a more expensive medium when compared with film and videotape. If the PC card is used as a storage for video and audio files, you will need a lot of PC cards, and this is not economical.

Instead, it is recommended that you transfer necessary files to the hard disk of your computer or other storage devices and store them. After transferring files, edit the files and delete the files from the PC card for new recording.

* To store data in your computer, see "Connecting to your personal computer" on page 68.



## Watch the PC card's free memory area.

It is recommended that you occasionally check the free memory area of PC card, especially when you start to record. If you notice that the free memory will be insufficient for scheduled recording, delete unnecessary files to increase the free memory area.

* To check the free memory area: See "Checking free memory area of PC card" on page 60.
* To delete unnecessary files: See "Deleting files" on page 50.



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# Chapter 3
# Recording

**This section explains how to record moving pictures, still pictures, etc. Read thoroughly before starting to record.**

Rotating the camera block and attaching the sunshade ..... 28
Recording moving pictures ..... 29
Recording still pictures ..... 31
Recording still pictures at intervals ..... 32
Recording consecutive still pictures ..... 33
Recording a still picture with audio ..... 34
Recording image of your portrait using the remote control ..... 35

**Do not expose the MP-EG1A to shocks during recording. The file being recorded will not be stored.**

**Be sure you first set the switch to OFF even if you want to set it to PLAY immediately.**
**If you don't , the MP-EG1A could malfunction.**



BlackBerry Corporation Exhibit 1004, pg. 638

# *Rotating the Camera Block and Attaching the Sunshade*

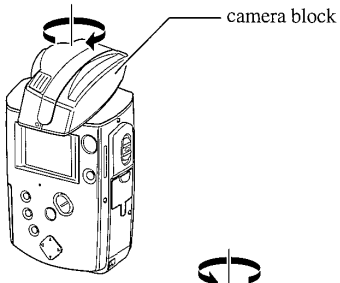
**The camera block is turned to record an image of yourself when the MP-EG1A has been shipped. Rotate it before recording subjects other than yourself.**
**If the LCD screen is difficult to see during shooting outdoors, etc., attach the sunshade (provided) to the LCD screen.**



## Rotating the camera block

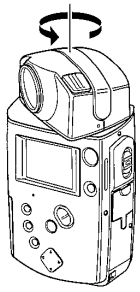
Hold the camera block at both sides and turn it clockwise, with the lens facing forward.

* The camera block cannot be turned over limit. Do not use force, since it could cause malfunctions.



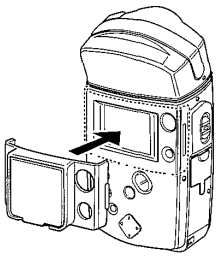

When you want to record yourself or house the MP-EG1A in its carrying case, turn the camera block counterclockwise so that the lens faces you.

* Take care that you do not touch the lens when holding the camera block.

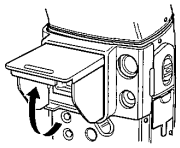


## Attaching the sunshade

Align the convex sections on both sides of sunshade with the concave sections on the MP-EG1A, and fit in the sunshade.

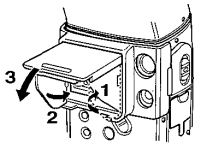


**To open the sunshade:**



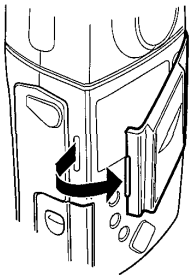
**To close the sunshade:**

When not using, fold the segments as shown in the figure on right.




## Detaching the sunshade

Close the sunshade and release the concave side on the left as shown in the figure on right to detach it.



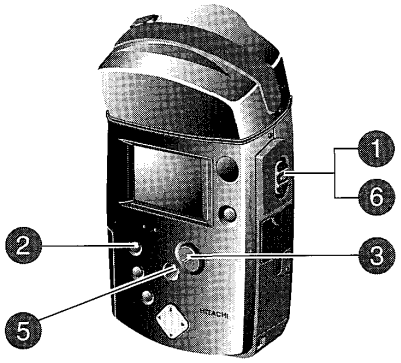


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# *Recording Moving Pictures*

**The MP-EG1A records moving pictures and audio.**

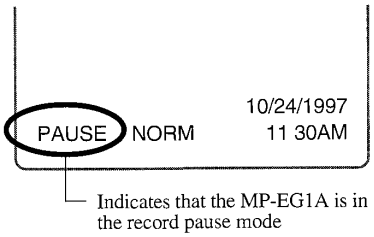
* The illustrations used in the following text may be different from the actual pictures.





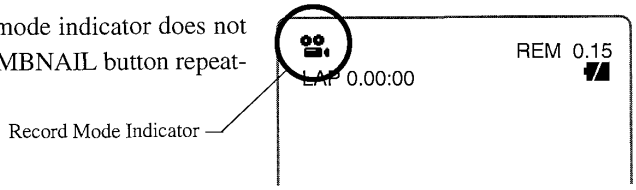

## 1 Set the CAM/OFF/PLAY switch to CAM.

Hold down the red button at the centre of the switch and set the switch to CAM. The image from the lens will appear on the LCD monitor, and the MP-EG1A will enter the record pause mode ("PAUSE" will appear).




## 2 Check that the "📹" record mode indicator appears.

If the " 📹 " moving picture record mode indicator does not appear, press the REC MODE/THUMBNAIL button repeatedly until it does.



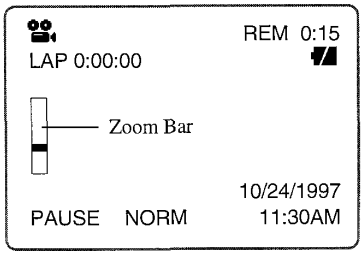

## 3 Adjust the image size of subject.

Press the ZOOM/VOL button to adjust the image size of subject. Pressing T (tele) magnifies the image, and pressing W (wide) makes it smaller.

* When the ZOOM/VOL button is pressed, the zoom bar will appear on the left end of the LCD monitor.

### *Zooming*

The MP-EG1A can zoom in on a subject and enlarge it up to 6 times, 3 times the optical zoom multiplied by 2 times the digital zoom. When the MP-EG1A enters the digital zoom area, the zoom bar will change from white to yellow on the LCD monitor, and the picture will be slightly rough in this area.



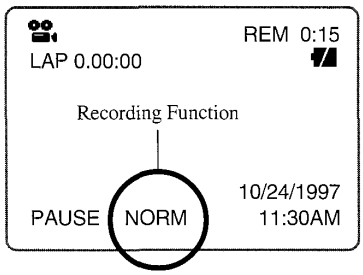



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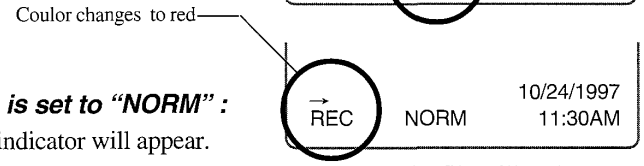
ENGLISH

## 4 Check the recording type.

The way you record varies depending on the recording type. Check to see whether the recording function is set to "NORM" or "CLIP".




## 5 Record.




- ***When the recording function is set to "NORM" :***
  Press the REC button, the "REC" indicator will appear.
  Recording will start. When the REC button is pressed again, recording of the file will end.
- ***When the recording function is set to "CLIP" :***
  Hold down the REC button.
  Recording will continue while the button is held. When the button is released, recording of the file will end.

Sound is always recorded with moving pictures: You cannot record pictures without sound. During recording, the "REC" indicator lights (red Colour), and " → " indicates on the LCD monitor. When recording is finished, it will change to "PAUSE" (green Colour).

* For switching between NORM and CLIP, see "Switching the Recording Function Type" on page 72.

## 6 Set the CAM/OFF/PLAY switch to OFF.

After recording is finished, set the switch to OFF to turn power off.

**Do not turn power off when the ACCESS indicator is flashing: This could destroy the stored data.**

**Be sure you first set the switch to OFF even if you want to set it to PLAY immediately. If you don't, the MP-EG1A could malfunction.**

### *Minimum distance recording*

The MP-EG1A can record a subject as close as 28 cm. If you bring the MP-EG1A nearer than 28 cm to a subject, or set the zoom in the telephoto direction during minimum distance recording, the image will be out of focus.

### *Auto power off (ENERGY SAVE ON)*

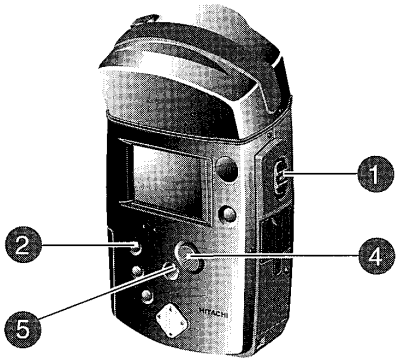
The MP-EG1A has an "auto power off (in 5 minutes)" function to prevent battery from going dead. When the recording pause mode (during recording) or playback stop mode (during playback) or playback pause mode (during playback) or start Media Navigation (during playback) continues for 5 minutes or more, the MP-EG1A will turn off automatically. Press the PLAY or REC button on the MP-EG1A to turn the MP-EG1A on again. The original operation mode will be restored.
You can disable the auto power off function. See "Switching Auto Power Off Setting" on page 76 for details.



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# *Recording Still Pictures*

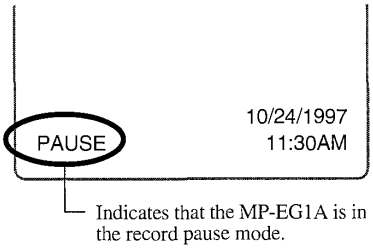
* If a still picture has been recorded, the remaining number of storable still pictures (REM) which appears in the on-screen display may not decrease. See "Remaining number indicator of storable still pictures" on page 33





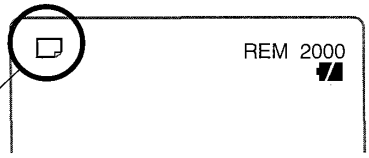

## 1 Set the CAM/OFF/PLAY switch to CAM.

Hold down the red button at the centre of the switch and set the switch to CAM. The image from the lens will appear on the LCD monitor, and the MP-EG1A will enter the record pause mode ("PAUSE" will appear).



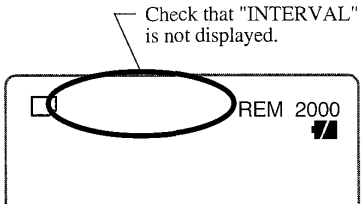

## 2 Set the record mode indicator to "□".

Press the REC MODE/THUMBNAIL button repeatedly until the "□" still picture record mode indicator appears on the LCD monitor.




## 3 Check that the interval indicator is off.

If "INTERVAL" appears on the monitor, interval recording will be made at the displayed "INTERVAL".




## 4 Adjust the image size of subject.

Press the ZOOM/VOL button to adjust the image size of subject. Pressing T (tele) magnifies the image, and pressing W (wide) makes it smaller.

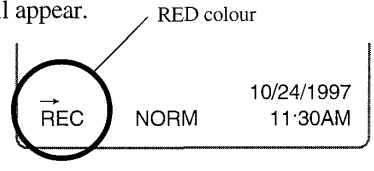
* See "Zooming" on page 29 for details of zoom.

* When the ZOOM/VOL button is pressed, the zoom bar will appear on the left end of the LCD monitor.

## 5 Record.

Press the REC button to start recording. The REC indicator will appear. The image at the moment the button is pressed will be recorded as a still picture.

* The shutter speed varies from 1/4 to 1/800 second automatically, according to the brightness of subject. If the subject is dim, the shutter speed will be a maximum of 1/4 second, so be careful of camera movement.



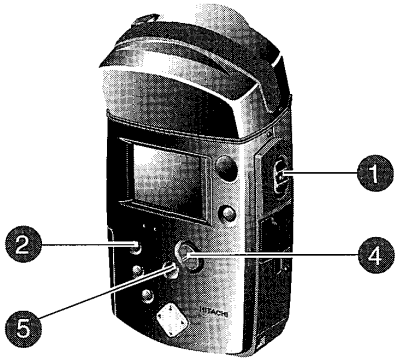



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# *Recording Still Pictures at Intervals*

**If the interval recording has been set (see page 74), you can automatically record still pictures at a specified interval.**

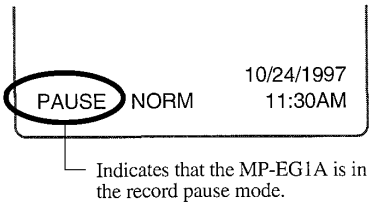
* Check the free memory area on PC card and battery remaining level.
* It is recommended that you use AC power supply.




ENGLISH

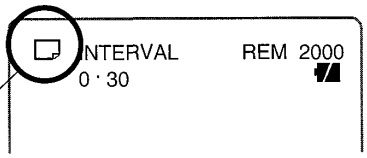
## 1 Set the CAM/OFF/PLAY switch to CAM.

Hold down the red button at the centre of the switch and set the switch to CAM. The image from the lens will appear on the LCD monitor, and the MP-EG1A will enter the record pause mode ("PAUSE" will appear).




## 2 Set the record mode indicator to "□".

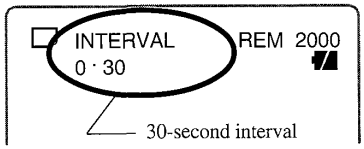
Press the REC MODE/THUMBNAIL button repeatedly until the "□" still picture record mode indicator appears on the LCD monitor.




## 3 Check the interval.

Check that the INTERVAL setting time (30 seconds, 1 minute or 5 minutes) appears in the on-screen display.
If "INTERVAL" does not appear, the MP-EG1A will not operate at interval (see page 31).

* See "Setting Recording Interval" on page 74 for switching the interval.



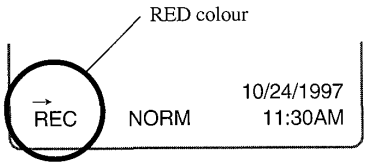

## 4 Adjust the image size of subject.

Press the ZOOM/VOL button to adjust the image size of subject. Pressing T (tele) magnifies the image, and pressing W (wide) makes it smaller.

* See "Zooming" on page 29 for details of zoom.
* When the ZOOM/VOL button is pressed, the zoom bar will appear on the left end of the LCD monitor.

## 5 Record.

Press the REC button to start recording.
The image at the moment the button is pressed will be recorded as a still picture, and the interval counter will count down. Each time the interval counter is reset to 0, still pictures will be recorded automatically.
Pressing the REC button again stops interval recording.




* When the CAM/OFF/PLAY switch is set to OFF, the interval recording will be released.

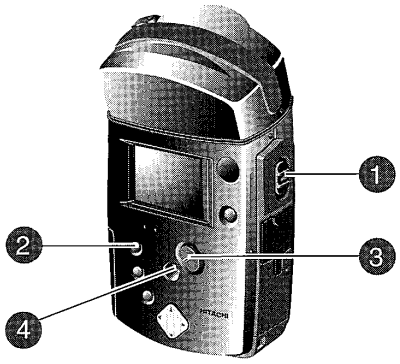


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# *Recording Consecutive Still Pictures*

**This record mode allows you to automatically record five consecutive still pictures at a speed of about two pictures per second.**

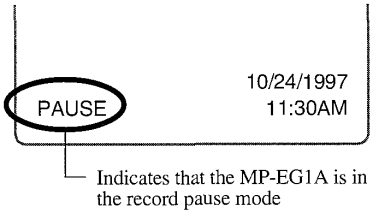
* If the brightness of subject changes abruptly during consecutive recording, it could result in overexposure or underexposure.





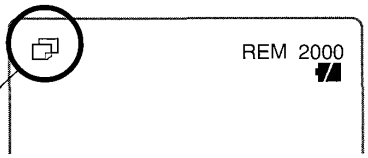

## 1 Set the CAM/OFF/PLAY switch to CAM.

Hold down the red button at the centre of the switch and set the switch to CAM. The image from the lens will appear on the LCD monitor, and the MP-EG1A will enter the record pause mode ("PAUSE" will appear).




## 2 Set the record mode indicator to "🗗".

Press the REC MODE/THUMBNAIL button repeatedly until the "🗗" consecutive record mode indicator appears on the LCD monitor.




## 3 Adjust the image size of subject.

Press the ZOOM/VOL button to adjust the image size of subject. Pressing T (tele) magnifies the image, and pressing W (wide) makes it smaller.

* See "Zooming" on page 29 for details of zoom.

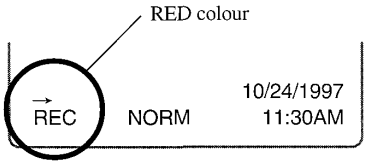
* When the ZOOM/VOL button is pressed, the zoom bar will appear on the left end of the LCD monitor

## 4 Record.

Hold down the REC button.

Five consecutive still pictures will be recorded at a speed of about two pictures per second, after which recording will stop.

If you release the REC button during consecutive recording, recording will stop at the moment you release the button.




* If you are recording a dark scene or a subject with complicated patterns, the consecutive recording speed may be one picture per second.

***Remaining number indicator of storable still pictures :***

If a still picture whose size is little has been recorded, the remaining number indicator may not change. Please understand in advance that this does not indicate a fault.

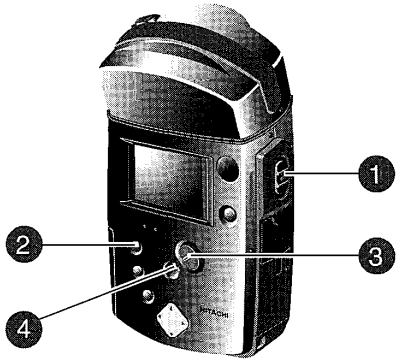


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ENGLISH

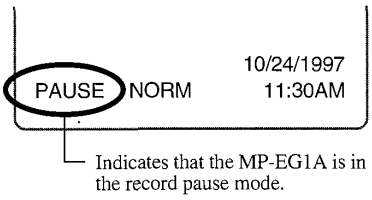
# *Recording a Still Picture with Audio*

**The MP-EG1A can record a still picture, followed by recording of audio.**



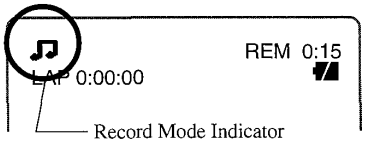

## 1 Set the CAM/OFF/PLAY switch to CAM.

Hold down the red button at the centre of the switch and set the switch to CAM. The image from the lens will appear on the LCD monitor, and the MP-EG1A will enter the record pause mode ("PAUSE" will appear).




## 2 Set the record mode indicator to "♫".

Press the REC MODE/THUMBNAIL button repeatedly until the "♫" still with audio record mode indicator appears on the LCD monitor.




## 3 Adjust the image size of subject.

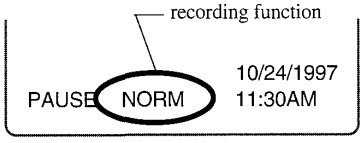
Press the ZOOM/VOL button to adjust the image size of subject. Pressing T (tele) magnifies the image, and pressing W (wide) makes it smaller.

* See "Zooming" for details of zoom.

* When the ZOOM/VOL button is pressed, the zoom bar will appear on the left end of the LCD monitor.

## 4 Start recording.

The way you record varies depending on the recording type you set. (See page 72 for switching between "NORM" and "CLIP".)




- ***When the recording function is set to "NORM" :***
  Press the REC button. The still image at the moment the button is pressed will be recorded. After the recorded picture appears on the screen, audio can also be recorded.
  When the REC button is pressed again, recording of the file will end.
- ***When the recording function is set to "CLIP" :***
  Hold down the REC button. The still image at the moment the button is pressed will be recorded. After the recorded picture appears on the screen, audio can also be recorded.
  When the button is released, recording of the file will end.

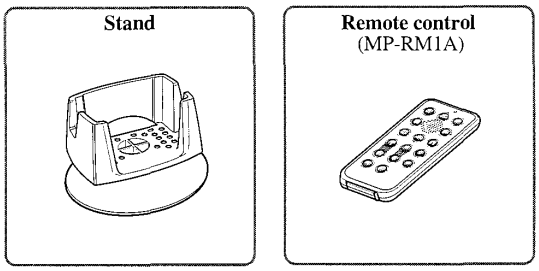
* See "Switching the Recording Function Type" on page 72 for switching between NORM and CLIP.



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## *Recording Image of Your Portrait Using the Remote Control*

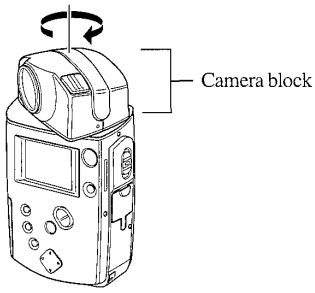
**Place the MP-EG1A on the stand and turn the camera block so the lens faces you. You can record yourself using the remote control.**






### 1 Turn the camera block.

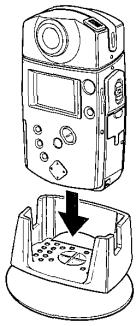
Turn the camera block so the lens faces the same direction as the LCD monitor does.




### 2 Install the MP-EG1A.

Place the stand in a flat, stable position, and install the MP-EG1A on the stand as shown in the figure.

* Select a place where there are no obstacles between you and the MP-EG1A. If there is an obstacle between the remote control and MP-EG1A's infrared receiver, you cannot operate the MP-EG1A with the remote control.
* Be sure to select a stable installation place. Installing the MP-EG1A in an unstable place is dangerous.
* You can use a generally available tripod for a still camera instead of the stand.
* The stand can be tilted, but cannot be rotated. Do not force to turn it.



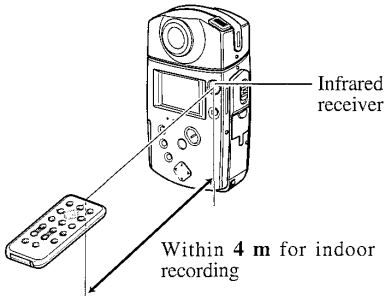
### 3 Set the CAM/OFF/PLAY switch to CAM and adjust the angle.

Hold down the red button at the centre of the switch and set the switch to CAM. Viewing the LCD monitor screen, adjust the angle of the stand.

### 4 Use the remote control to record.

Point the remote control at the MP-EG1A's infrared receiver to operate.

* A lithium battery must be inserted into the remote control (see page 25).
* Be careful that strong light does not strike the infrared receiver. The remote control distance may be extremely small or no operation can be done.



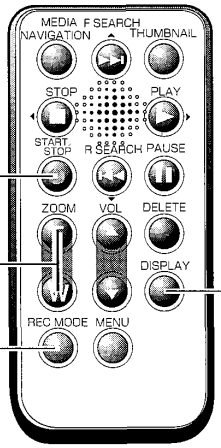



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ENGLISH

### *Buttons on the remote control*

The following shows the buttons on the remote control used for recording, and their functions:




**START/STOP :**
To start or stop recording This corresponds to the REC button on the MP-EG1A.

**ZOOM :**
To adjust zoom.

**REC MODE :**
To switch the record mode.

**DISPLAY :**
To turn on or off the on-screen display (characters and symbols). (See page 78)



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*Chapter4*

# *Playback*

**This section explains how to play back recorded pictures and sound, and search for files you want to play back. Before you start to play back, be sure to read the section thoroughly.**

**Playing back the file just recorded ..... 38**
**Locating files to be played by skipping start pictures ..... 39**
**Order of files to be played ..... 40**
**Playback using the remote control ..... 41**

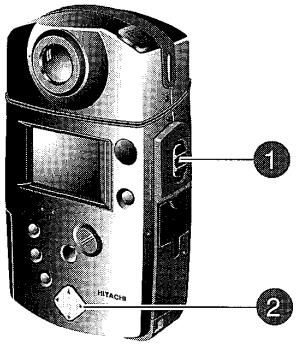


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## *Playing Back the File Just Recorded*

**If you want to play back the file just recorded, perform the following procedure:**

* The displayed date and time during playback are fixed to the date and time on which you started recording. The date and time dose not change even as moving picture playback progresses.






### 1 Set the CAM/OFF/PLAY switch to PLAY.

Hold down the red button at the centre of the switch and set the switch to PLAY. The picture you recorded just before (in case of moving pictures, the start picture of the file) will appear on the LCD monitor.

* If you have played back some file immediately before, the picture played back last will appear.

* If the menu for Media Navigation appears (see page 45), press the MEDIA NAVI GATION button.



### 2 Press the PLAY button.

The pictures and sound will be played back.

- ***In case of moving picture :***
  Both picture and sound will be played back. When playback reaches the end, the start picture of the file will be displayed and playback will stop.
- ***In case of a still picture :***
  The picture will be displayed as it is.
- ***In case of consecutive still pictures:***
  The last still picture will be displayed.
- ***In case of still picture with audio:***
  The still picture will be displayed and sound will be played back.

#### *Adjusting the volume*

When you hear the sound from the built-in speaker, use the ZOOM/VOL button to adjust the volume. Pressing + increases the volume, and pressing - decreases the volume. When this button is pressed, the volume bar will appear on the left end of the LCD monitor.

* When you connect the MP-EG1A to a TV, be sure to adjust the volume on the TV.

#### *Pausing*

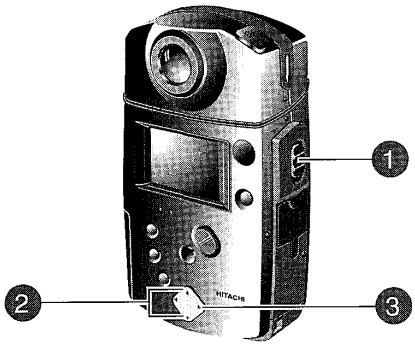
Press the REC button to pause the playback of moving pictures or a still picture with audio. Press the REC button again to resume playback.



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# *Locating Files to be Played by Skipping Start Pictures*

**You can search for files you want to play by displaying the start pictures of the files in sequence.**






## 1 Set the CAM/OFF/PLAY switch to PLAY.

Hold down the red button at the centre of the switch and set the switch to PLAY. The picture you recorded last or played last (in case of moving pictures, the start picture of the file) will appear on the LCD monitor.

* If the menu for Media Navigation appears (see page 45), press the MEDIA NAVIGATION button.



## 2 Press the F.SEARCH or R.SEARCH button to search for the file.

Pressing R.SEARCH once displays the start picture of the file recorded one before the current file. Hold down R.SEARCH to skip files continuously.

Press F.SEARCH when you want to skip files in reserve. If you press R.SEARCH while the oldest file is being displayed, the start picture of the newest file will appear. If you press F.SEARCH while the newest file is being displayed, the start picture of the oldest file will appear.

## 3 Press the PLAY button.

The pictures and sound (moving picture or still picture with audio) will be played back.

After playback of a file ends, the next file will be played back. To stop playback, press the STOP button.

### *Searching for files during playback*

Each time F.SEARCH or R.SEARCH is pressed during file playback, the files are scanned forward or backward one by one, and playback will start from the located file. Holding down the button causes continuous search (visual scanning).



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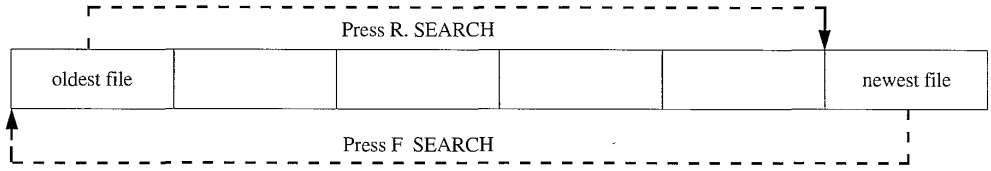
## *Order of Files to be Played*

**When the file just recorded has played back to its end, playback will stop. If you locate an object file by skipping others and press PLAY, the file will play to its end, and the next files will also play.**

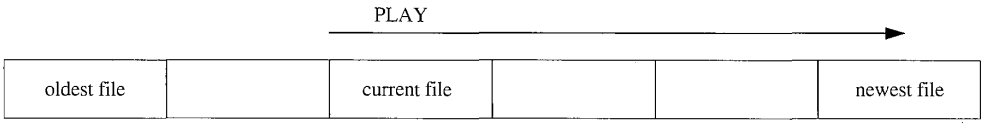
**The order of files is below:**

ENGLISH

If you press R.SEARCH while the oldest file is displayed, the start picture of the newest file will appear. If you press F.SEARCH while the newest file is displayed, the start picture of the oldest file will appear.




If you press PLAY when the MP-EG1A is at the current file shown below, the files will play in order as shown by the arrow. When playback reaches the end of the newest file, the start picture of the newest file will be displayed. (Still pictures will show for about three seconds each.)




***Changing playback order***

Arrange the display order of files with Media Navigation (See page 56) and start auto play (see page 58). You can play files regardless of the order of recordings.

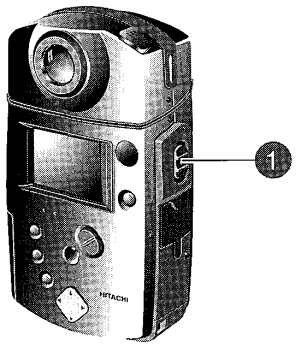


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# *Playback Using the Remote Control*

**You can use the remote control to operate playback.**

* Insert the lithium battery into the remote control in advance. (See page 25)




ENGLISH

## 1 Set the CAM/OFF/PLAY switch to PLAY.

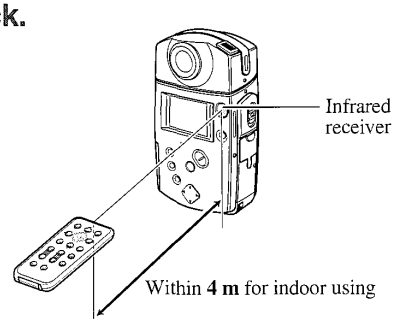
Hold down the red button at the centre of the switch and set the switch to PLAY. The picture you recorded last or played back last (in case of moving pictures, the start picture of the file) will appear on the LCD monitor.

* If the menu for Media Navigation appears (see page 45), press the MEDIA NAVIGATION button.

## 2 Use the remote control to operate playback.

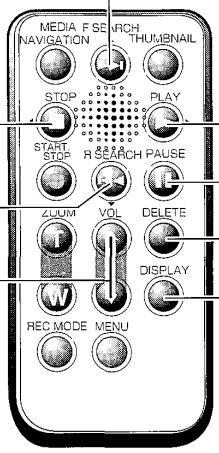
Point the remote control at the MP-EG1A's infrared receiver and perform playback operation (see pages 38-40).

* Be careful that strong light does not strike the infrared receiver. The remote control distance may be extremely small or no operation can be done.




### *Buttons on the remote control*

The following shows the buttons on the remote control used.




**F.SEARCH :**
Press this in the stop mode to display the start pictures of each file in sequence

**STOP :**
To stop playback

**PLAY :**
To play pictures and sound.

**R.SEARCH :**
Press this in the stop mode to display the start pictures of each file in reverse order

**PAUSE :**
Press during playback to stop pictures and sound temporarily

**DELETE :**
To delete the displayed file (See page 50)

**VOL button**
To increse (▲) or decrease (▼) the volume.

**DISPLAY :**
To turn on or off the on-screen display (characters and symbols) (See page 78)



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*Chapter 5*

# *File Management (Media Navigation)*

**This section explains how to use Media Navigation for arranging recorded files, editing folder for auto play, etc. Also, see "Operating Files" on page 12.**

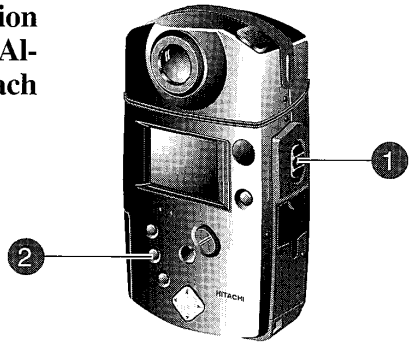

Starting Media Navigation ..... 44
On-screen display and basic operation of Media Navigation ..... 45
Selecting the file and playing it back ..... 47
Transferring files to another folder (CHG FOLD# menu item) ..... 48
Deleting the file ..... 50
Deleting all files in folder ..... 53
Protecting files (LOCK/UNLOCK menu item) ..... 54
Changing the display order of files (CHG ORD menu item) ..... 56
Auto play of desired files ..... 58
Checking free memory area of PC card (REMAIN) ..... 60
Switching thumbnail display on or off ..... 61
Correcting file recording date/time (CHG TIME menu item) ..... 62




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## *Starting Media Navigation*

**The following describes how to start Media Navigation used for management of recorded files (see page 12). Always start Media Navigation before performing each operation on pages 47-49 and on pages 51-63.**






### 1 Set the CAM/OFF/PLAY switch to PLAY.

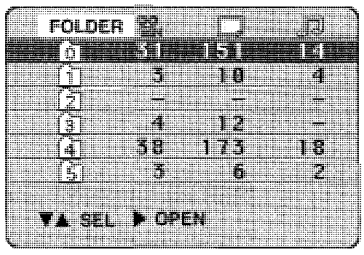
Hold down the red button at the centre of the switch and set the switch to PLAY. The picture you recorded last or played last (in case of moving pictures, the start picture of the file) or the Media Navigation screen will appear on the LCD monitor.

### 2 Start Media Navigation.

If the Media Navigation screen does not appear in step 1, press the MEDIA NAVIGATION button.
The FOLDER select screen or file select screen (see page 46) will appear. In the following text, the explanation will be started from the FOLDER select screen.

* If the file select screen is displayed, press the ◀ button to return to the FOLDER select screen.

FOLDER Select Screen




***Exiting Media Navigation.***

If you press the MEDIA NAVIGATION button during the media navigation operation, Media Navigation will end where the button is pressed, and the picture you played last (in case of moving pictures, the start picture of the file) will appear.

If the MP-EG1A is turned off when the Media Navigation screen appears, Media Navigation will automatically start when the CAM/OFF/PLAY switch is set to PLAY, and the FOLDER select screen or file select screen (see page 46) will appear.
If the CAM/OFF/PLAY switch is set to CAM after the MP-EG1A is turned off, Media Navigation will not start.



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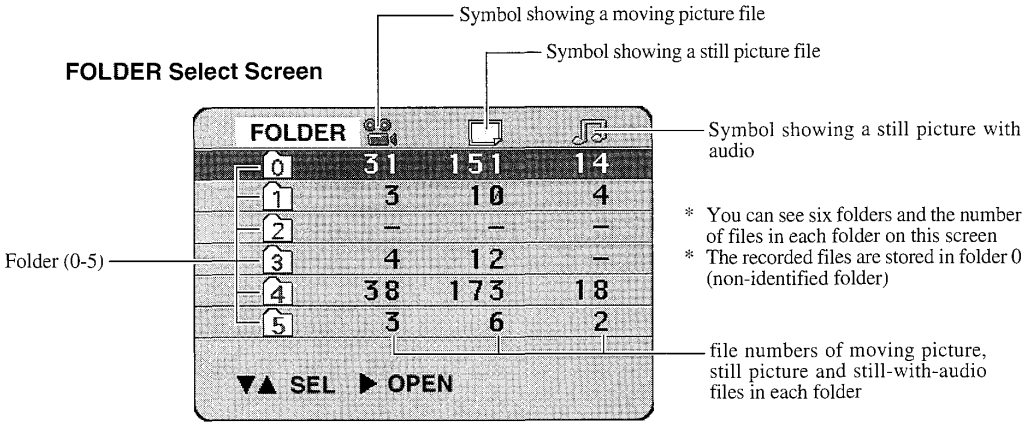
# *On-Screen Display and Basic Operation of Media Navigation*

**There are two basic screens for Media Navigation - the FOLDER select screen, which displays file number list in folders, and the file select screen, which displays a list of files.**
**Following are details of the displays on these screens and the basic operation methods.**

## Details of display on FOLDER select screen

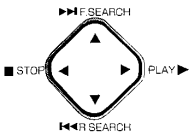
This screen allows you to select a folder which contains the files you want to operate, or to select a folder you want to operate (to delete all files in folder).

**FOLDER Select Screen**




## Basic operation on folder select screen

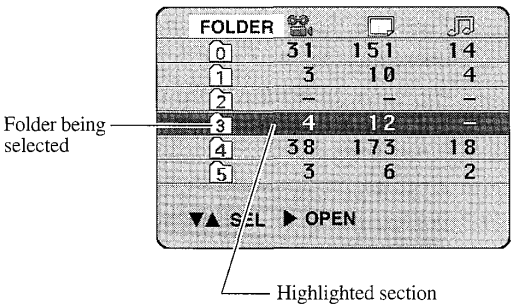
Use the buttons shown below corresponding to ▼,▲, ▶ and ◀ in the following text. You can use the remote control to operate in the same way.




**▼ : R.SEARCH button**
**▶ : PLAY button**
**▲ : F.SEARCH button**
**◀ : STOP button**

### To select a folder:

Press ▲ or ▼ to move the highlighted section up or down and select a folder.



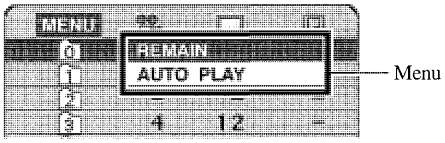

### To open the folder:

Press ▶ to open the selected folder, and the file select screen will appear (see page 46).

### To display the menu:

Press the MENU button, and the menu will appear. To switch off the menu, press the button again.

* A menu item displayed in gray text cannot be operated.



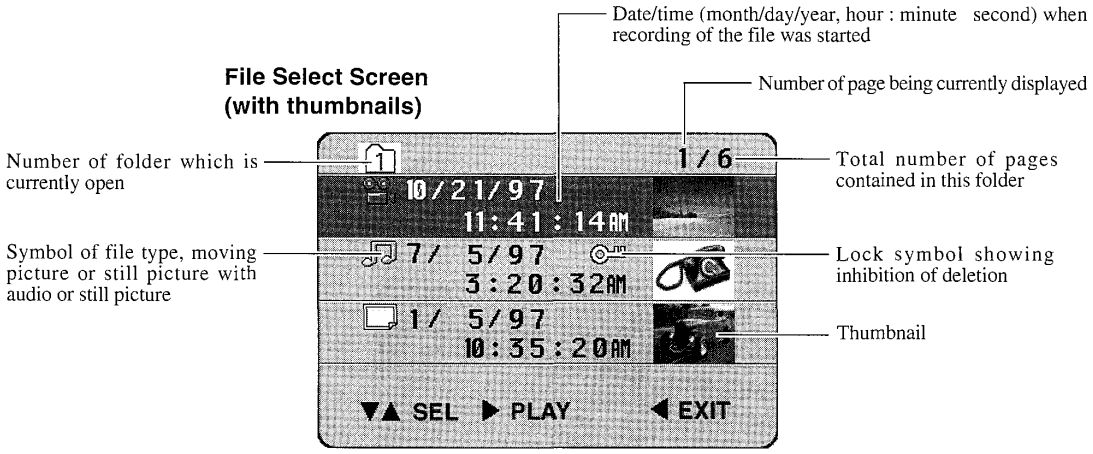



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## Details of display on File select screen

This screen allows you to select a file and operate it in various ways, including playback, deletion, change of folder that contains files, change of display order, protection of files, auto play, free (remaining) memory, etc.




* The seconds of the date when recording of file was started are always displayed in an even number.

* See "Switching Thumbnail Display On or Off" on page 61.

## Basic operation on file select screen

Use the buttons shown below corresponding to ▼, ▲, ▶ and ◀ in the following text. You can use the remote control to operate in the same way.




**▼ : R.SEARCH button**
**▶ : PLAY button**
**▲ : F.SEARCH button**
**◀ : STOP button**

### To select a file :

Press ▲ or ▼ to move the highlighted section up or down and select a file. When the folder contains more files than can be displayed on one screen, hold ▼ or ▲; the next screen will appear.

### To play :

Press ▶ , and the selected file will play. When playback is finished, the final picture of the file will appear and playback will stop.

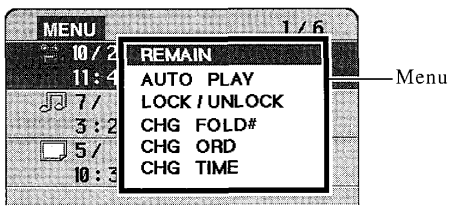
### To return to the FOLDER select screen :

Press ◀ , and the folder select screen will be restored.

### To display the menu :

Press the MENU button, and the menu for operating files will appear. To switch off the menu, press the MENU button again.

* A menu item displayed in gray text cannot be operated.

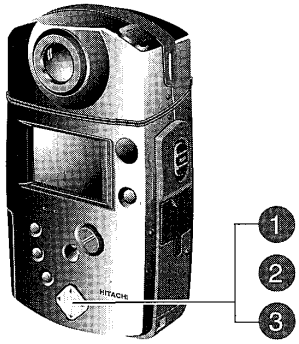





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## *Selecting the File and Playing It Back*

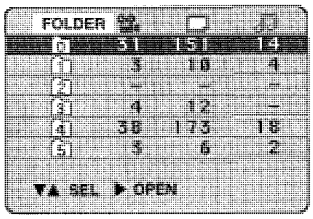
**If you know the recording date/time of the file you want and the folder containing the file, you can select the file and play it back.**




* Start Media Navigation (see page 44) and display the FOLDER select screen to start.

* You can also use the remote control to operate.

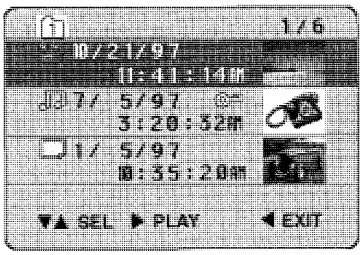
FOLDER Select Screen




### 1 Display the file select screen.

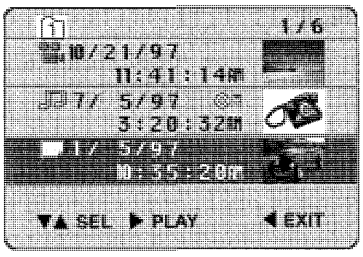
Press ▼ or ▲ with the FOLDER select screen to select the folder containing the file you want to play back, and then press ▶ .
The file select screen will appear.

File Select Screen (with thumbnails)




### 2 Select the file to be played back.

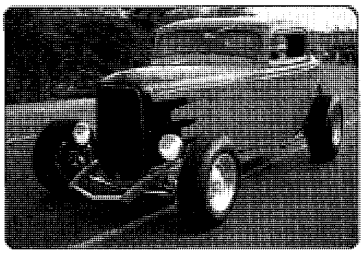
Press ▼ or ▲ to select the file you want to play back and highlight it.




### 3 Play back the file

Press ▶ . The selected file will play back. When playback of the file is finished, it will stop at the final picture of the file.

* The displayed date and time during playback are fixed at those on which you started recording. The date and time will not change even as picture playback progresses.



Stops at final picture.

***To select another file :***

Press ◀ .
The file select screen will be restored. Perform steps 2 and 3 again.

- If 'FILE ERROR' appears:
  If you attempt to play back a file that the MP-EG1A cannot play back, the message 'FILE ERROR' will appear. In this case, the MP-EG1A operation may be malfunctioning. Delete the file to prevent future malfunction.

ENGLISH

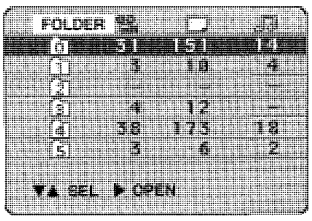


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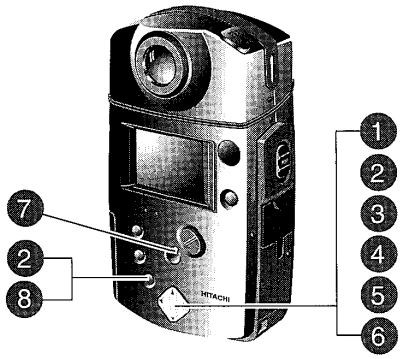
## *Transferring Files to Another Folder (CHG FOLD# menu item)*

**You can transfer the files in a non-identified folder (folder 0) to folders 1- 5 and gather files for auto play.**

FOLDER Select Screen




* Start Media Navigation (see page 44) and display the FOLDER select screen to start.
* You can also use the remote control to operate.

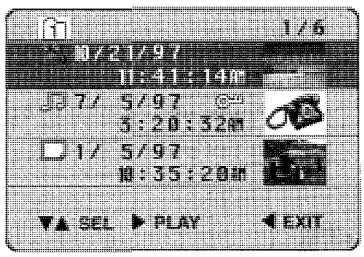





### 1 Display the file select screen.

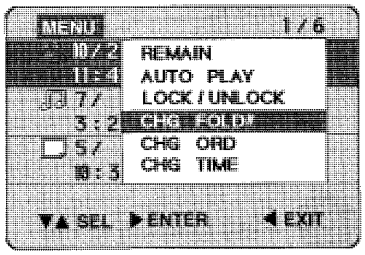
Press ▼or ▲ in the FOLDER select screen to select the folder containing the file you want to transfer, and then press ▶ .
The file select screen will appear.

File Select Screen (with thumbnails)



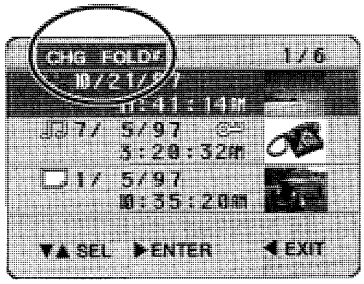

### 2 Display the menu and select CHG FOLD#.

Press the MENU button to display the menu, and press ▼or ▲ to select CHG FOLD #.




### 3 Display the screen for changing folder number.

Press ▶ .
The menu will disappear and the CHG FOLD# screen will appear.



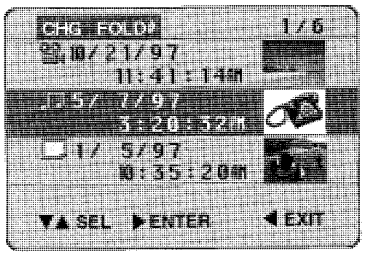



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## 4 Select the file you want to transfer.

Press ▼ or ▲ to select the file you want to transfer.

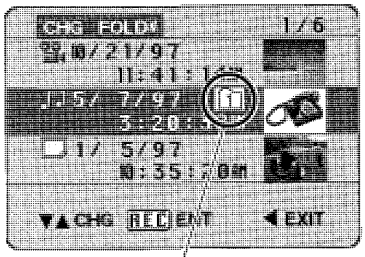
* You can also change the folder for files with a lock symbol ( ).




## 5 Enter the selected file.

Press ▶ .

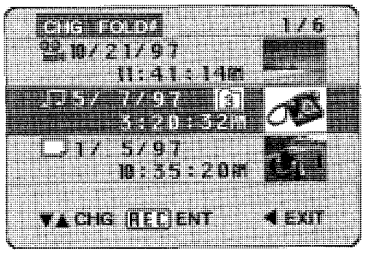
The folder symbol will be displayed with the selected file.




## 6 Designate the folder to which you want to transfer the file.

Press ▼ or ▲ to change the folder number to that of the folder to which you want to transfer the file.

Change to the number of the folder you want to transfer the file to.




## 7 Decide the transfer.

Press the REC button (or the START/STOP button on the remote control).

The transfer has been decided and the screen for selecting the file to transfer (the screen in step 4) will be restored. The transferred file has now disappeared from this select screen.

You can continue to change folders of other files by repeating steps 4-7.

* If the folder is empty after all the files are transferred, the message "NO FILES" will appear.

* To cancel the file transfer, press the ◀ button before pressing REC. The transfer will be cancelled and the file select screen to transfer (the screen in step 4) will be restored.

## 8 Exit the CHG FOLD# menu item.

Press the MENU button.

The folder change will end and the file select screen (the screen in step 1) will be restored.

* A transferred file will be displayed at the top of the list of the folder to which the file has been transferred.





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## *Deleting Files*

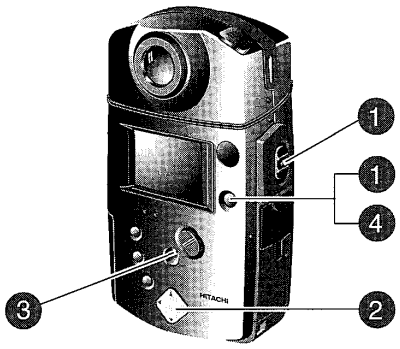
**It is recommended that you delete as many unnecessary files as possible to expand the free memory area of PC card.**
**There are two ways of deleting the file - deletion while playing back the file and deletion by selecting the file.**

* You can also use the remote control to delete files.
* If you repeat recording and deleting of a large file, interference may enter the recorded moving pictures. It is recommended that you create backup copy earlier and initialize the PC card (see page 82).



## Deleting a file being played back:

* Take great care when deleting files, since the files you have deleted once cannot be restored.

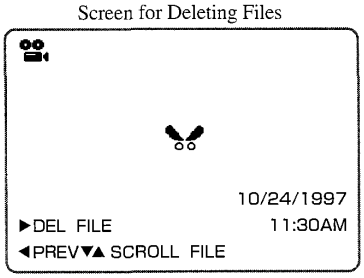



### 1 Set the CAM/OFF/PLAY switch to PLAY, and then press the DELETE button.

When you press the DELETE button during playback, the MP-EG1A will enter the pause mode, and the Screen for Deleting Files will appear.

* If the file is locked and protected against accidental deletion, a red lock symbol will flash on the LCD monitor, indicating the file cannot be deleted. See page 54 to erase the lock and release the file.

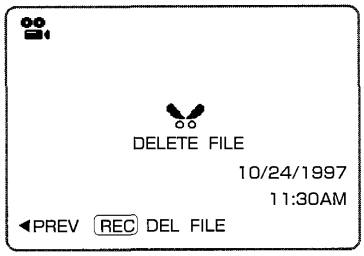
Screen for Deleting Files




### 2 Press the ▶ button.

The message which asks you to permit deletion will appear.

* To cancel deletion, press the ◀ button.
* Make sure you want to delete the file before pressing the REC button.




### 3 Execute deletion.

Press the REC button.
The file being displayed will be deleted and the screen in step 1 will be re stored.

* If you use the remote control to delete, press the START/STOP button.
* To delete another file, perform steps 2 and 3 again.

### 4 Finish deletion.

Press the DELETE button or ◀ button.
Deletion of files will be finished and the playback picture will be restored.

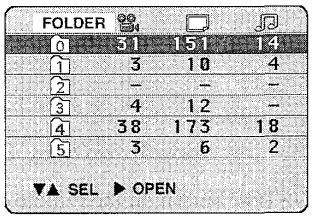


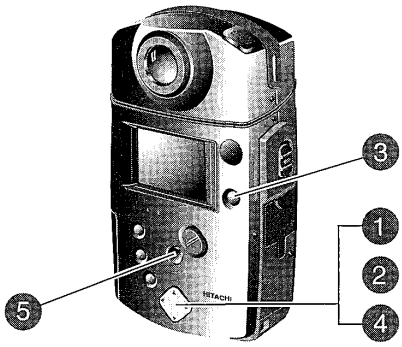
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## Select the file and deleting it:

* Start Media Navigation (see page 44) and display the FOLDER select screen to start.

FOLDER Select Screen



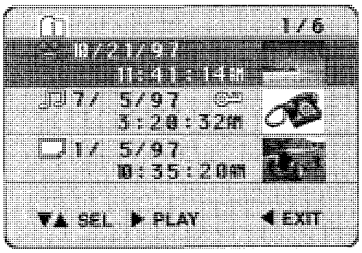



### 1 Display the file select screen.

Press ▼ or ▲ with the FOLDER select screen to select the folder containing the file you want to delete, and then press ▶.

The file select screen will appear.

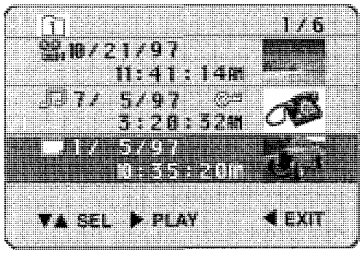
File Select Screen (with thumbnails)




### 2 Select the file to be deleted.

Press ▼ or ▲ to select the file you want to delete.

* You cannot delete a file with the lock symbol (see page 54).



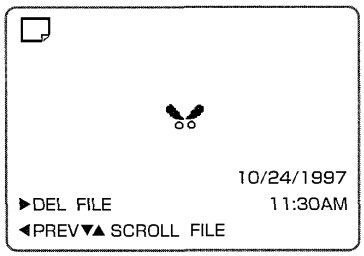

### 3 Display the screen for deleting files.

Press the DELETE button.

The screen for deleting files will appear, and the start picture of the selected file and recording start date/time will appear.

* If you have specified DISPLAY OFF (see page 78), the marks indicating the record mode and the recording date/time of files will not appear

Screen for Deleting Files



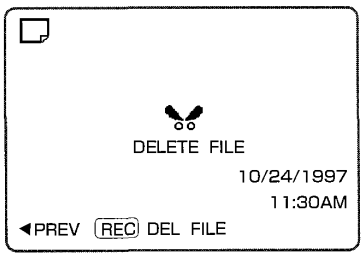



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## 4 Check the file to be deleted.

Check again, and if it is the file you want to delete, press the ▶ button.

* To cancel deletion, press the ◀ button.




## 5 Execute deletion.

Press the REC button (or the START/STOP button on the remote control).

The selected file will be deleted and the screen in step 3 will be restored.

* To finish deletion, press the ◀ button.

* To delete another file, perform steps 3-5 again.

* If the folder is empty after all the files are deleted, message "NO FILES" will appear. When you press the ◀ button in this case, the FOLDER select screen will be restored.



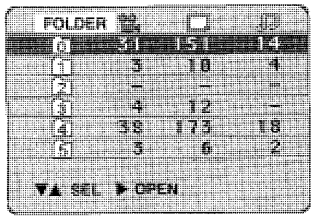
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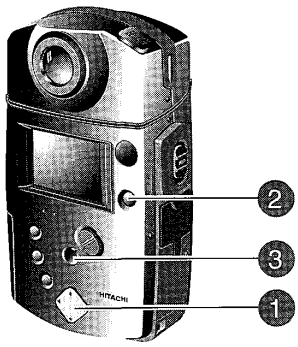
# *Deleting All Files in Folder*

**You can delete all files in a folder at one time.**

* It is recommended that you use AC power supply.
* Start Media Navigation (see page 44) and display the FOLDER select screen to start.
* Take great care when deleting files, since the files you have deleted once cannot be restored.
* You can also use the remote control to operate.

FOLDER Select Screen



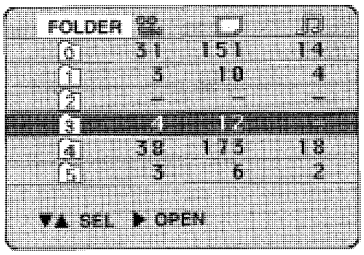






## 1 Select a folder.

Press ▼ and ▲ to select the folder you want to clear.

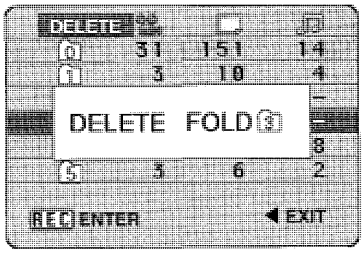
File Select Screen (with thumbnails)




## 2 Press the DELETE button.

The message "DELETE FOLD (selected folder number)" will appear.

* To cancel deletion, press the ◀ button or DELETE button




## 3 Execute deletion.

Press the REC button (or the START/STOP button on the remote control) and deletion will be executed.

When deletion is completed, the FOLDER select screen will be restored.

* All files which have been locked will remain. See page 54 to unlock the protection of file.
* Make sure you want to delete all files in the folder before pressing the REC button



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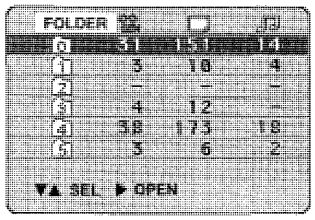
ENGLISH

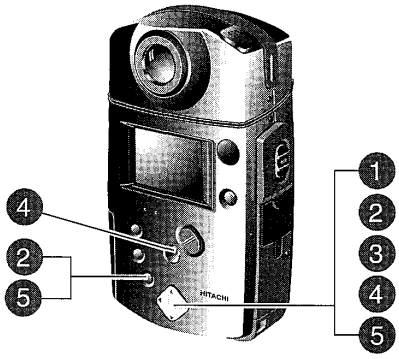
## *Protecting Files (LOCK/UNLOCK menu item)*

**You can lock files to protect them from accidental deletion. The protected file can be unlocked by the same procedure as locking.**

* Start Media Navigation (see page 44) and display the FOLDER select screen to start.

FOLDER Select Screen

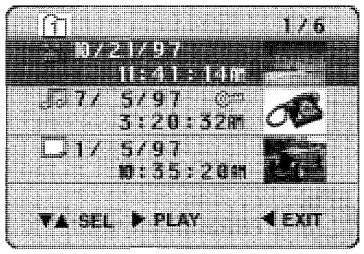



### 1 Display the file select screen.

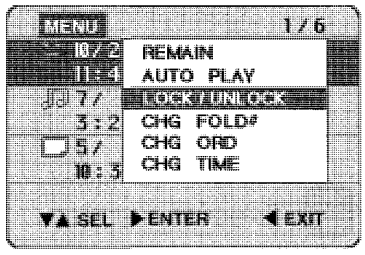
Press ▼ or ▲ with the FOLDER select screen to select the folder containing the file you want to lock, and then press ▶ . The file select screen will appear.

File Select Screen (with thumbnails)



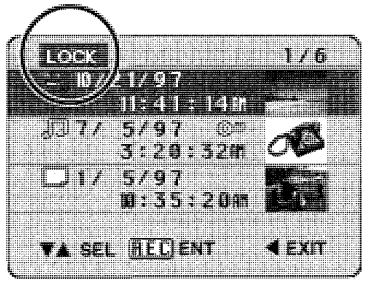

### 2 Display the menu and select LOCK/UNLOCK.

Press the MENU button to display the menu, and press ▼or ▲ to select LOCK/UNLOCK.




### 3 Display the LOCK/UNLOCK setting screen.

Press ▶ .
The menu will disappear and the LOCK/UNLOCK setting screen will appear.

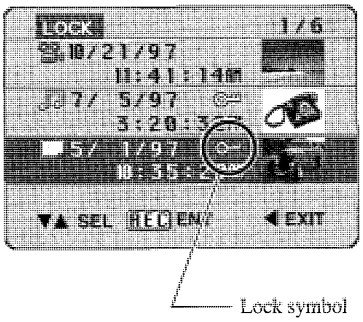





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## 4 Select a file and lock or unlock it.

Press ▼ or ▲ to select the file you want to lock or unlock, and then press the REC button.
Pressing the REC botton switches between locking and unlocking of the file and switches the lock symbol on or off.
You will be able to lock or unlock another file by performing steps 4 - 5.




## 5 Exit the LOCK/UNLOCK menu item.

Press the ◀ button or MENU button.
Pressing ◀ exits the LOCK/UNLOCK setting and restores the file function setting menu (the screen in step 2).
Pressing MENU exits the LOCK/UNLOCK setting and restores the file select screen (shown in step 1).

ENGLISH



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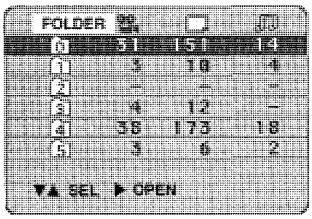
ENGLISH

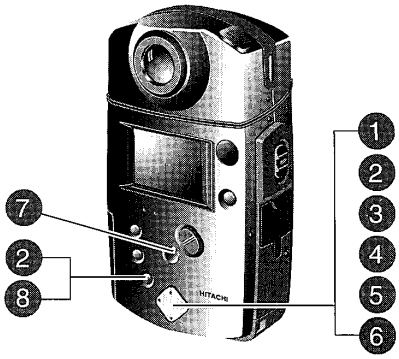
## *Changing the Display Order of Files (CHG ORD menu item)*

**You can rearrange files in a folder: to move a file you frequently play to the top of file list, change the display order in a folder for auto play, etc.**

* Start Media Navigation (see page 44) and display the FOLDER select screen to start.
* You can also use the remote control to operate.

FOLDER Select Screen

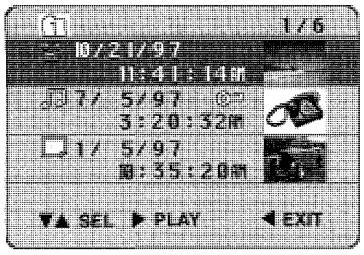



### 1 Display the file select screen.

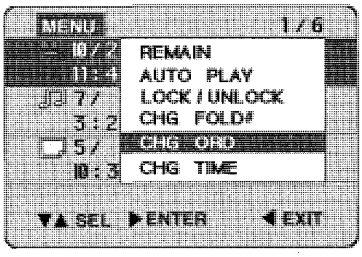
Press ▼ or ▲ with the FOLDER select screen to select the folder containing files whose display order you want to change, and then press ▶ .
The file select screen will appear.

File Select Screen (with thumbnails)



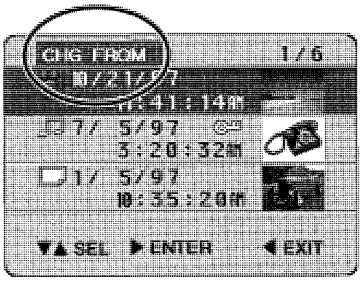

### 2 Display the menu and select CHG ORD.

Press the MENU button to display the menu, and press ▼ or ▲ to select CHG ORD.




### 3 Display the screen for changing display order of files.

Press ▶ .
The menu will disappear and the screen for changing display order of files will appear.



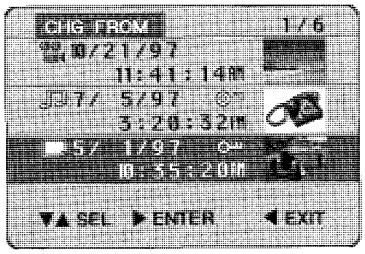



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## 4 Select the file whose display order you want to change.

Press ▼ or ▲ to select the file whose display order you want to change.

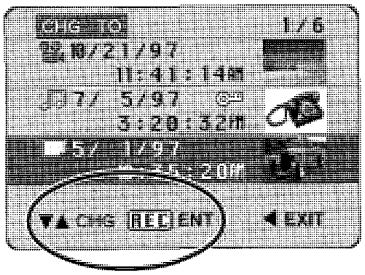
* You can also change the display order for files with lock symbol (🔒).




## 5 Display the screen for selecting the location where you want to move the file.

Press ▶ .

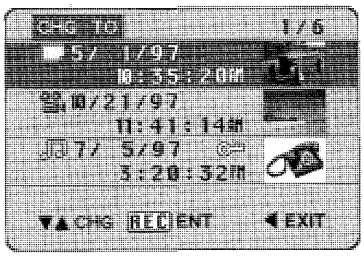
The screen will change to that for deciding the location where the file is to be moved.




## 6 Move the file to your designated location.

Press ▼ or ▲ .

Each time ▼ or ▲ is pressed, the display position of the selected file will change.




## 7 Execute the change of the file display order.

Press the REC button (or the START/STOP button on the remote control).

The change of display order has been decided. You can continue to change the display order of other files by repeating steps 4-7

.

## 8 Exit the CHG ORD menu item.

Press the ◀ button or MENU button.

Pressing ◀ exits the display order change menu item and restores the file function setting menu (the screen in step 2).

Pressing MENU exits the display order change menu item and restores the file select screen (shown in step 1).





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# *Auto Play of Desired Files*

**You can automatically play desired files in sequence after gathering them in one folder. There are two ways of auto play: playing all files in a folder or only specified files in it.**

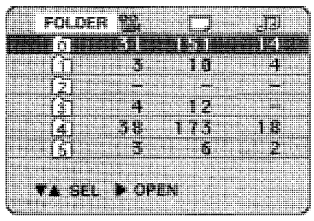
* Still pictures are displayed for about three seconds during auto play, and the next file will follow.

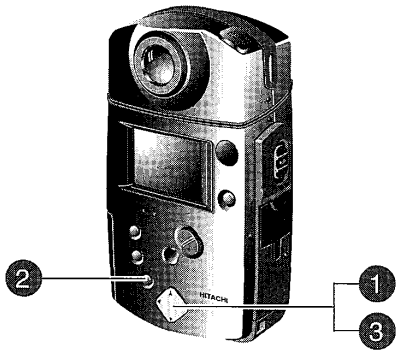
## Auto play of all files in a folder

ENGLISH

* Start Media Navigation (see page 44) and display the FOLDER select screen to start.
* You can also use the remote control to operate.

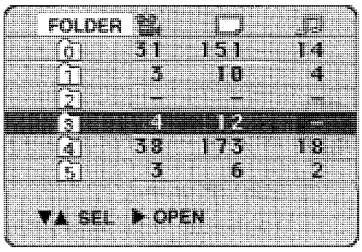
FOLDER Select Screen



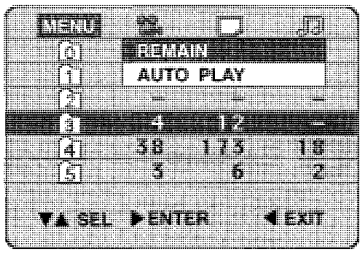

### 1 Select a folder.

Press ▼and ▲ to select the folder whose files you want to play automatically.




### 2 Display the menu.

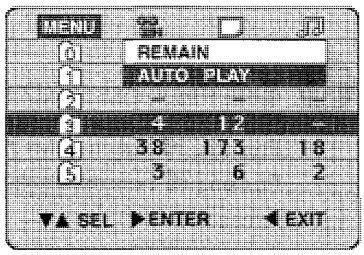
Press the MENU button to display the menu.




### 3 Select AUTO PLAY.

Press ▼ or ▲ to select AUTO PLAY, and then press ▶ .
The files in the selected folder will be played in sequence, starting from the file at the end of list. When auto play of all files is finished, the FOLDER select screen will be restored.

* You can change the order of files in a folder. (See "Changing the Display Order of Files" on page 56.)




***To cancel auto play midway***

Press ◀ .
Auto play will be interrupted and the FOLDER select screen will be restored.

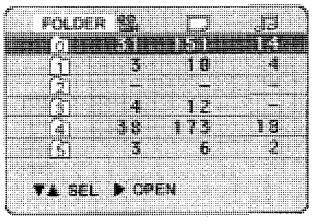


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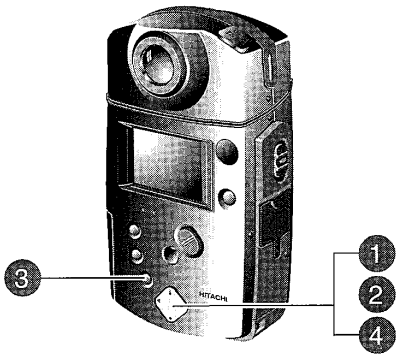
## Auto play specifying files in folder

**You can specify a file in the folder and start auto play from that file, followed by all files listed above that file.**

FOLDER Select Screen




* Start Media Navigation (see page 44) and display the FOLDER select screen to start.
* See "Changing the Display Order of Files" on page 56 when you want to rearrange files in a folder.
* You can also use the remote control to operate.

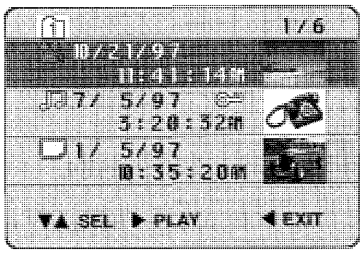





### 1 Select a folder.

Press ▼ or ▲ with the FOLDER select screen to select the folder containing the files for auto play, and then press ▶ .
The file select screen will appear.

File Select Screen (with thumbnails)



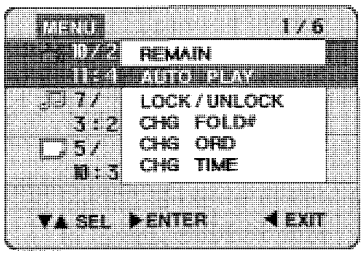

### 2 Select the file.

Press ▼ or ▲ to select the file from which you want to start auto play.




### 3 Display the menu.

Press the MENU button to display the menu.




### 4 Select AUTO PLAY.

Press ▼ or ▲ to select AUTO PLAY, and then press ▶ .
Auto play will start from the selected file, which will be followed by files listed above this one in sequence. When auto play of the top file in the list is finished or press ◀ , the file select screen will be restored.



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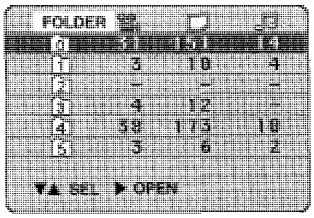
ENGLISH

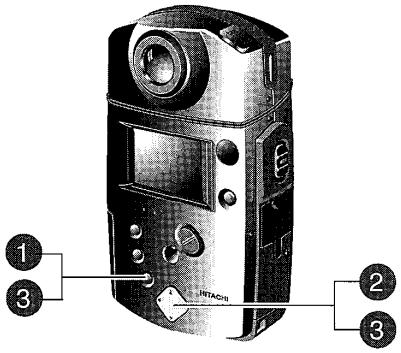
# *Checking Free Memory Area of PC Card (REMAIN)*

**Check the remaining free memory area of PC card before you start to record. You can do this by the following procedure:**

* Start Media Navigation (see page 44) and display the FOLDER select screen to start.
* You can also use the remote control to operate.

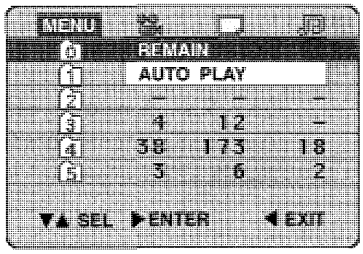
FOLDER Select Screen




## 1 Display the menu.

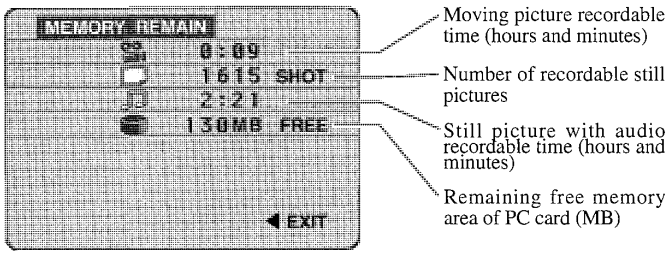
Press the MENU button.
The following menu will appear.




## 2 Select REMAIN.

Make sure that REMAIN is highlighted, and then press ▶ .
The screen showing the remaining memory area will appear as shown below.

* The REMAIN screen shows the recordable time of moving pictures (), or number of still pictures () or time of still picture with audio (), when you use only one of 3 kinds of record mode. Therefore, you cannot store all of these time lengths and numbers. Also, remember that the values displayed on this screen are reference only and may be different from actual ones.

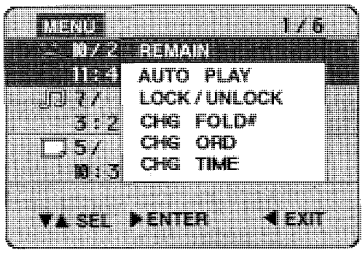



## 3 Exit the REMAIN screen.

Press the ◀ button or MENU button.
Pressing ◀ exits the REMAIN screen and restores the menu (screen in step 1).
Pressing MENU exits the REMAIN screen and restores the FOLDER select screen.

***Reviewing the remaining memory screen from the file select screen.***

You can also review the remaining memory area of PC card when the file select screen is displayed.
Press the MENU button with the file select screen. The following menu will appear: Select REMAIN and press ▶ .

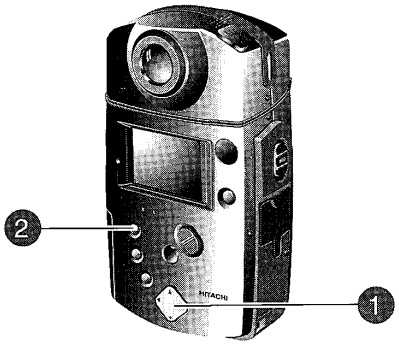





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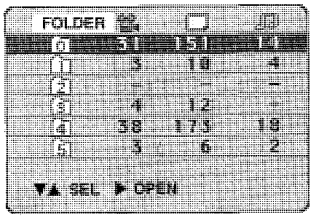
## *Switching Thumbnail Display On or Off*

**You can switch the thumbnail display on and off with the file select screen. If thumbnail display is switched off, you can display six files on the screen at a time.**




* Start Media Navigation (see page 44) and display the FOLDER select screen to start.
* You can also use the remote control to operate.

FOLDER Select Screen

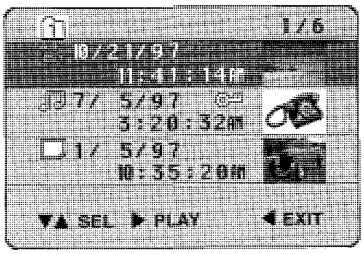



### 1 Display the file select screen.

Press ▼ or ▲ with the FOLDER select screen to select a folder with files, and press ▶ .

* When you switch off a thumbnail, no thumbnails will be displayed no matter which folders you select.

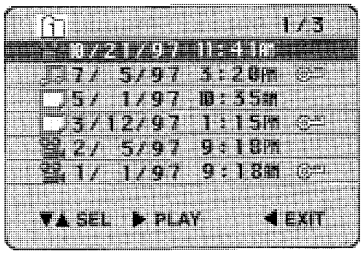
File Select Screen (with thumbnails)




### 2 Press the REC MODE/THUMBNAIL button.

Thumbnails will disappear and six files will be displayed on one screen. Pressing the button again switches on the thumbnails display.

* When using the remote control, press the REC MODE/THUMBNAIL button
* You cannot switch on or off the thumbnail display while the menu is displayed, a folder is being changed (see page 48), or the recording date/time are being changed (see page 62).




File Select Screen (without thumbnails)

If the thumbnail display is not possible with files recorded by equipment other than MP-EG1A, [?] will appear in place of thumbnails.

ENGLISH



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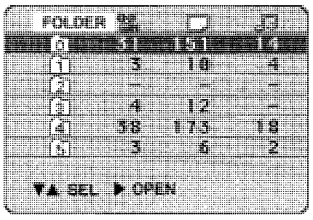
ENGLISH

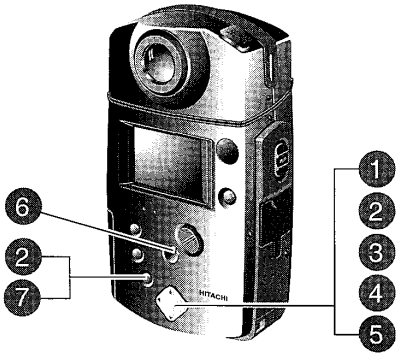
## *Correcting File Recording Date/Time (CHG TIME menu item)*

**When the internal clock goes wrong because of consumption of the built-in battery, the date and time on which you start to record will not be recorded correctly. In this case, charge the built-in battery, correct the clock, and also correct the file recording date/time by the following procedure.**

* Start Media Navigation (see page 44) and display the FOLDER select screen to start.
* You can also use the remote control to operate.

FOLDER Select Screen

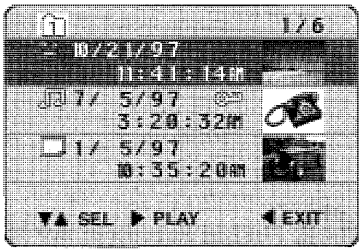



### 1 Display the file select screen.

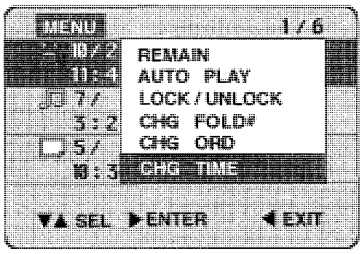
Press ▼ or ▲ with the FOLDER select screen to select the folder containing the file where you want to correct the recording date/time, and then press ▶ .
The file select screen will appear.

File Select Screen (with thumbnails)



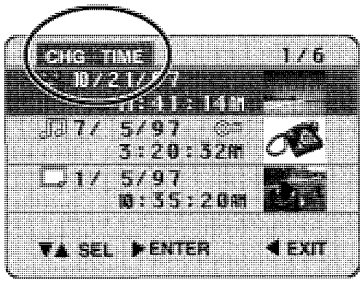

### 2 Display the menu and select CHG TIME.

Press the MENU button to display the menu, and press ▼or ▲ to select CHG TIME.




### 3 Display the screen for correcting the recording date/time.

Press ▶ .
The menu will disappear and the screen for correcting the recording date/time will appear.

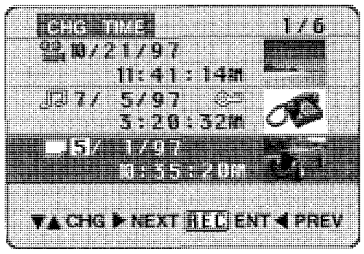





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## 4 Select the file where you want to correct the recording date/time.

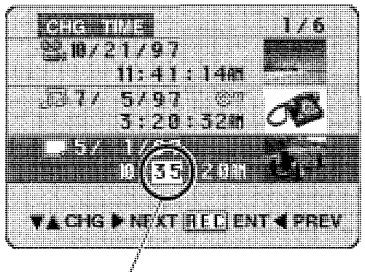
Press ▼ or ▲ to select the file whose recording date/time you want to correct, and then press ▶ .
The month displayed in the selected file will be highlighted.
The date will appear in this order : month, day, year.




## 5 Correct the recording date/time.

Press ▶ or ◀ to highlight the number you want to correct, and then press ▲ or ▼ to increase or decrease it.

* The seconds display counts up or down in 2-second units




## 6 Enter the corrected date/time.

After correcting all the incorrect numbers, press the REC button (or the START /STOP button on the remote control).
You can continue to change file recording date/time by repeating steps 4 - 7.

* To cancel change of recording date/time, press the MENU button before pressing REC. The recording date/time will not change, and recording time/date change menu will finish.

## 7 Exit the CHG TIME menu item.

Press the ◀ button or MENU button.
Press ◀ exits the recording date/time correct menu item and restores the file function setting menu (the screen in step 2).
Pressing MENU exits the recording date/time correct menu item and restores the file select screen (shown in step1).

ENGLISH



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ENGLISH



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*Chapter 6*

# *Using the MP-EG1A with Other Equipment*

**This section explains how to use the MP-EG1A with a TV or a personal computer. Read it thoroughly before connecting the MP-EG1A to a TV or personal computer.**
**The MP-EG1A output signal is in the NTSC 3.58MHz format only.**

**Connecting to TV and viewing playback pictures ..... 66**
**Personal computers to which MP-EG1A can be connected ..... 67**
**Connecting to your personal computer ..... 68**
**Transferring files to your personal computer ..... 69**
**Personal computers to which files can be transferred directly ..... 70**



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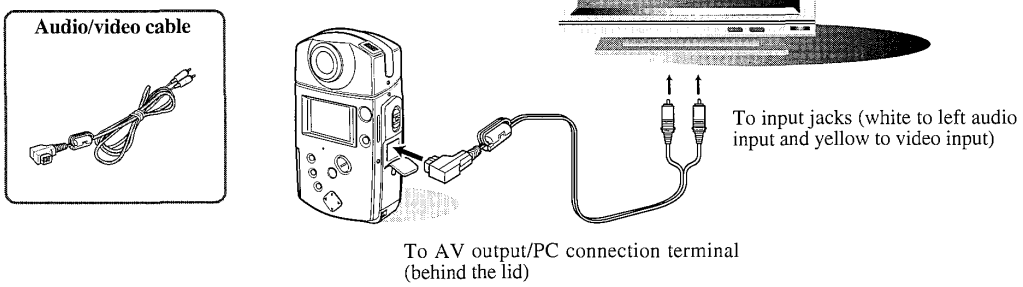
# *Connecting to TV and Viewing Playback Pictures*

**Connecting the MP-EG1A to your TV, you can view the recorded pictures and the pictures being recorded on your large TV screen.You need the AV cable provided.**
**The MP-EG1A output signal is in the NTSC 3.58MHz format only.**



## Connecting to TV

See the following figure and use the AV cable to connect the MP-EG1A to your TV.




## Viewing Playback Pictures on TV

**1 Set the input selector of your TV (with NTSC 3.58MHz) to the VCR position.**

**2 Start recording or playback with the MP-EG1A.**

**3 You can view the pictures, with sound, on the TV screen.**

Adjust the audio volume on the TV.

* When you connect the AV cable, the MP-EG1A's LCD monitor goes off, and no sound is output from the speaker even if power is supplied. However, the volume buttons on the MP-EG1A are functioning meantime. Do not set the volume setting too high : the sound at set volume will be output from the speaker when the AV cable is taken off.
* The quality of moving pictures is less than that of still pictures. This is because the resolution of each picture is different. When an image with fine patterns is recorded and played back in the moving picture mode, some imperfections may be seen in the picture, since the MP-EG1A uses the video compression system. These may be conspicuous when viewing on the connected TV screen, but their phenomenon does not indicate a fault.

***Using the remote control***

You can use the remote control to record or play back while you monitor the pictures on the TV screen.

* Recording: See "Recording Your Portrait Using the Remote Control"on page 35.
* Playback: See "Playback Using the Remote Control" on page 41.



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## *Personal Computers to which the MP-EG1A Can Be Connected*

**A personal computer which is to be connected to the MP-EG1A should have the following:**

| | |
|---|---|
| Computer | IBM® PC/AT® Compatible machine |
| OS | Microsoft® Windows® 95 Operating System |
| CPU | Pentium® at least 100MHz (133MHz or more is recommended) |
| Display | 640 x 480 or more, 256 colours (which appear simultaneously) or more |
| Slot | Should have an empty ISA bus slot or PC card typeIII slot. |
| Sound source | SoundBlaster compatible sound source (it may not be possible to play moving pictures and still picture with audio on computers without SoundBlaster installed) |
| Built-in memory | At least 16MB (32MB or more is recommended) |
| Free memory area of HDD | 80MB or more (including Windows® 95 swap memory area) when you install all application software packed with the MP-EG1A. |
| Miscellaneous | CD-ROM drive (4-times speed is recommended) |
| | 1.44 MB 3.5" floppy disk drive |
| | Speaker |





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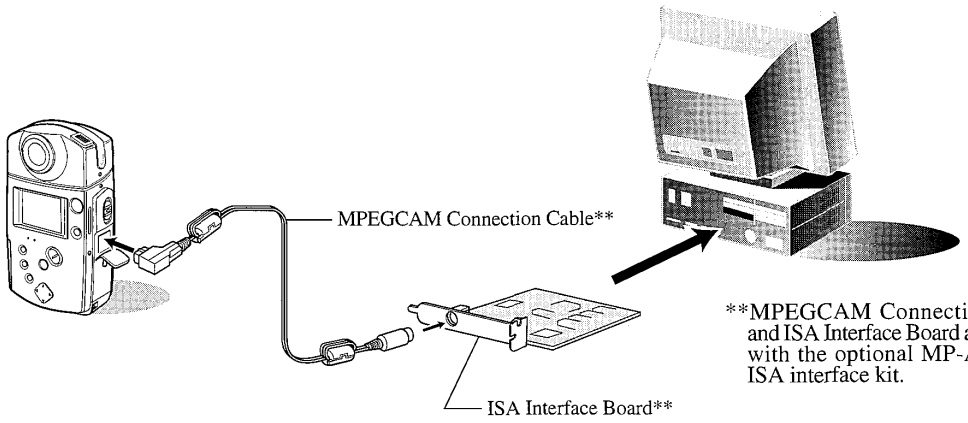
# *Connecting to Your Personal Computer*

## Connection with an exclusive ISA board:

For connection to an IBM® PC/AT® compatible desktop personal computer, you need the ISA interface kit. See "Available Accessories" on page 95.

* The exclusive transfer application software PureVi is stored in the CD-ROM packed with the MP-EG1A.
* The ISA communication driver is packed with the ISA interface kit.






**MPEGCAM Connection Cable and ISA Interface Board are packed with the optional MP-ADI1AW ISA interface kit.

**WARNING :** MPEGCAM Connection Cable must be connected to ISA Interface Board . If MPEGCAM Connection Cable is connected to another jack, MP-EG1A and personal computer may be broken down.



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# *Transferring Files to Your Personal Computer*

## How to transfer files when the MP-EG1A is connected to an exclusive ISA board:

* Power the MP-EG1A using the AC adapter/charger during connection to a computer.
* Do not operate the files in the MP-EG1A with applications other than the PureVi transfer application software. Operating another transfer application software is in danger of malfunctions.
* Make sure that the PC card is in the MP-EG1A.



### 1 Set the power switch to PC.

Hold down the red button at the centre of the switch and set the switch to PC.

* Before turning power on, make sure that the MP-EG1A is connected to the computer correctly. (See page 68)

### 2 Run PureVi on the computer.

See the PureVi help menu for operation that follows.

* No buttons on the MP-EG1A can be operated during this connection (except ZOOM/VOL button).



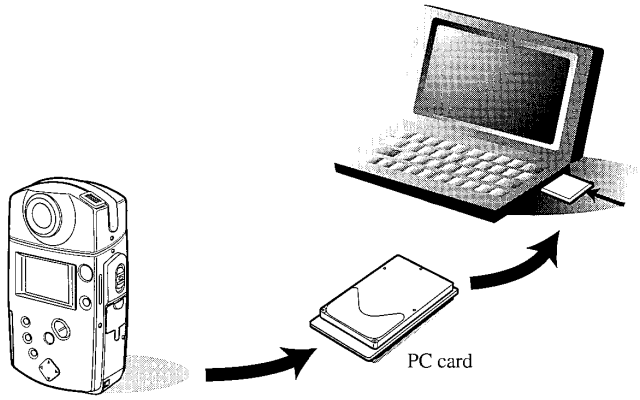
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## *Personal Computers to which Files Can Be Transferred Directly*

**If your notebook-sized personal computer has a PC card type III slot, or your personal computer has a PC card reader, insert the PC card into the computer to transfer data directly to the computer.**

* Use the PureVi exclusive transfer application software when transferring files on PC card to the computer.
* The PureVi transfer application software is stored in the CD-ROM packed with the MP-EG1A.
* Do not use the PC card as a storage device for a personal computer If you do so, we cannot guarantee the fidelity of the stored data and subsequent MP-EG1A operation.








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# Chapter 7
# Menu Settings

**This section explains how to operate the on-screen menu for desired settings. Refer to each item necessarily.**

**Switching the recording function type (REC SET UP)** ..... **72**
**Setting recording interval (INTERVAL)** ..... **74**
**Switching auto power off setting (ENERGY SAVE ON)** ..... **76**
**Switching on-screen display on and off (DISPLAY ON/OFF)** ..... **78**
**Switching off LCD monitor (LCD)** ..... **79**
**Adjusting picture on LCD monitor (PICTURE ADJ)** ..... **80**
**Initializing the PC card** ..... **82**

* See "Setting the date and time" on page 22 for setting the internal clock.

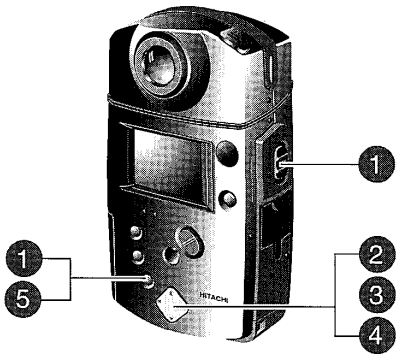


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# *Switching the Recording Function Type (REC SET UP)*

**You can switch the recording function type between NORM and CLIP when recording (see page 30).**

* You can also use the remote control to set this.




ENGLISH

## 1 Display the SET-UP screen and select INITIAL.

Set the CAM/OFF/PLAY switch to CAM or PLAY and press the MENU button.

Make sure that you select INITIAL.

* If you have started Media Navigation, terminate it.

* If the CAM/OFF/PLAY switch is set to PLAY, LCD ON will not be displayed.

SET-UP screen

```
SET UP
▶INITIAL
 DISPLAY        ON
 LCD            ON
 PICTURE ADJ
▼▲ SEL ▶ENTER   MENU EXIT
```

## 2 Display the INITIAL SET screen and select REC SET UP.

Press ▶ to display the INITIAL SET screen.

Make sure that you select REC SET UP.

* If the CAM/OFF/PLAY switch is set to PLAY, INITIALIZE CARD will not be displayed.

INITIAL SET screen

```
INITIAL SET
▶REC SET UP
 DATE
 ENERGY SAVE ON
 INITIALIZE CARD
▼▲ SEL ▶ENTER   MENU EXIT
```

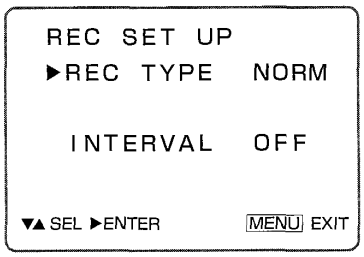


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## 3 Display the REC SET UP screen.

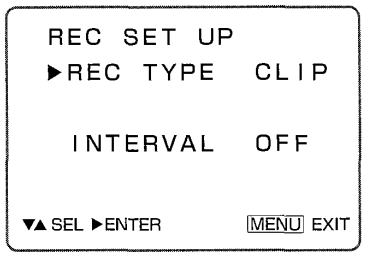
Press ▶ . The screen for setting up for recording will appear.

REC SET UP screen




## 4 Switch the REC TYPE setting.

Press ▼ or ▲ to select REC TYPE and then press ▶ .
Pressing ▶ alternates REC TYPE between NORM and CLIP.




## 5 Finish the setting.

Press the MENU button.
The REC SET UP setting has finished, and the SET-UP screen will disappear.

* Even when you do not press MENU, the setting will be finished automatically 60 seconds after the setting is completed, and the SET-UP screen will disappear

***The REC button works as follows.***

- ***When set to NORM :***
  When the button is pressed, recording starts, and when it is pressed again, recording stops.
- ***When set to CLIP :***
  When the REC button is held down, recording continues while the button is held ; when the button is released, recording stops.

ENGLISH

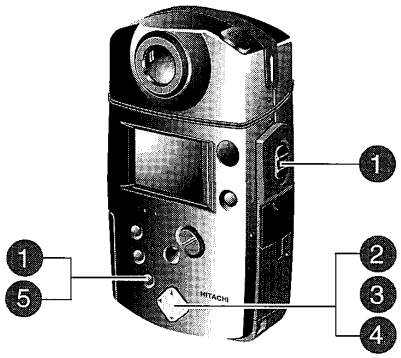


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## *Setting Recording Interval (INTERVAL)*

**You can automatically record still pictures at an interval specified with this setting.**

* You can also use the remote control to set this.






### 1 Display the SET-UP screen and select INITIAL.

Set the CAM/OFF/PLAY switch to CAM and press the MENU button.
Make sure that you select INITIAL.

SET-UP screen

```
SET UP
▶INITIAL
 DISPLAY        ON
 LCD            ON
 PICTURE ADJ
▼▲ SEL ▶ENTER   MENU EXIT
```

### 2 Display the INITIAL SET screen and select REC SET UP.

Press ▶ to display the INITIAL SET screen.
Make sure that you select REC SET UP.

INITIAL SET screen

```
INITIAL SET
▶REC SET UP
 DATE
 ENERGY SAVE ON
 INITIALIZE CARD
▼▲ SEL ▶ENTER   MENU EXIT
```

### 3 Display the REC SET UP screen.

Press ▶ .
The screen for setting up for recording will appear.

REC SET UP screen

```
REC SET UP
▶REC TYPE   NORM

 INTERVAL   OFF

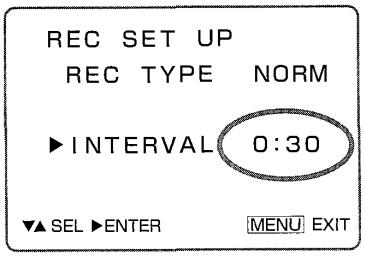
▼▲ SEL ▶ENTER   MENU EXIT
```



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## 4 Set the interval time.

Press ▼ or ▲ to select INTERVAL, and then press ▶ to set the interval time.
Each time ▶ is pressed, the interval time will change from OFF to 0:30 (30 seconds), 1:00 (1 minute), 5:00 (5 minutes) and back to OFF.




## 5 Finish the setting.

Press the MENU button.
The interval setting has finished, and the SET-UP screen will disappear.

* Even when you do not press MENU, the setting will be finished automatically 60 seconds after the setting is completed, and the SET-UP screen will disappear.

***Details of each setting***

- ***OFF :***
  Still pictures are recorded normally.
- ***0:30, 1:00, 5:00 :***
  Still pictures are automatically recorded at intervals of 30 seconds, 1 minute, 5 minutes each. (See "Recording still pictures at intervals" on page 32.)

ENGLISH

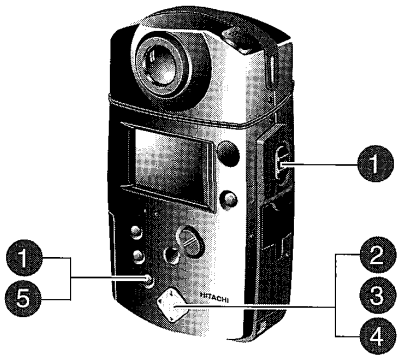


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## *Switching Auto Power Off Setting (ENERGY SAVE ON)*

**The auto power off function automatically turns the MP-EG1A off when it is left unoperated for 5 minutes after power is on. The auto power off setting is initially set for on, but you can change it.**

* You can also use the remote control to set it.




ENGLISH

### 1 Display the SET-UP screen.

Set the CAM/OFF/PLAY switch to CAM or PLAY and press the MENU button.

* If you have started Media Navigation, terminate it.

* If the CAM/OFF/PLAY switch is set to PLAY, LCD ON will not be displayed.

SET-UP screen

```
SET UP
▶INITIAL
 DISPLAY        ON
 LCD            ON
 PICTURE ADJ
▼▲ SEL ▶ENTER   MENU EXIT
```

### 2 Display the INITIAL SET screen.

Press ▶ .

The INITIAL SET screen will appear.

* If the CAM/OFF/PLAY switch is set to PLAY, INITIALIZE CARD will not be displayed

INITIAL SET screen

```
INITIAL SET
▶REC SET UP
 DATE
 ENERGY SAVE ON
 INITIALIZE CARD
▼▲ SEL ▶ENTER   MENU EXIT
```

### 3 Switch to ENERGY SAVE setting.

Press ▼ or ▲ to select ENERGY SAVE, and then press ▶ .

Pressing ▶ alternates between ENERGY SAVE ON and OFF.

```
INITIAL SET
 REC SET UP
 DATE
▶ENERGY SAVE ON
 INITIALIZE CARD
▼▲ SEL ▶ENTER   MENU EXIT
```



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### 4 Finish the setting.

Press the MENU button.

The ENERGY SAVE ON/OFF setting has finished, and the SET-UP screen will disappear.

* Even when you do not press MENU, the setting will be finished automatically 60 seconds after the setting is completed, and the SET-UP screen will disappear.



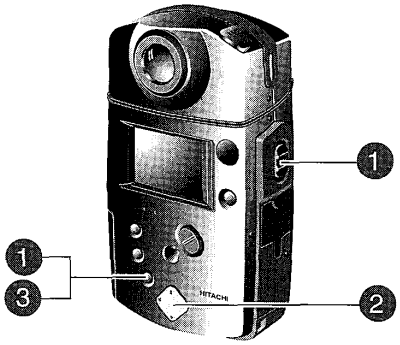


BlackBerry Corporation Exhibit 1004, pg. 688

ENGLISH

## *Switching ON-Screen Display On and Off (DISPLAY ON/OFF)*

**You can switch on or off the information displayed on the LCD monitor. (See page 15)**



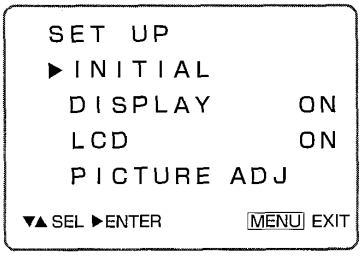

### 1 Display the SET-UP screen.

Set the CAM/OFF/PLAY switch to CAM or PLAY and press the MENU button.

* If you have started Media Navigation, terminate it.

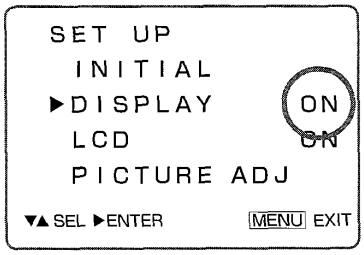
* If the CAM/OFF/PLAY switch is set to PLAY, LCD ON will not be displayed

SET-UP screen




### 2 Switch DISPLAY between ON and OFF.

Press ▼ or ▲ to select DISPLAY, and then press ▶ .
Pressing ▶ alternates between DISPLAY ON and OFF.




### 3 Finish the setting.

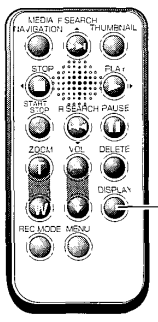
Press the MENU button.

The DISPLAY ON/OFF setting is finished, and the SET-UP screen will disappear.

* Even when you do not press MENU, the setting will be finished automatically 60 seconds after the setting is completed, and the SET-UP screen will disappear.

***Using the remote control to switch to the on-screen display directly:***

Press the DISPLAY button on the remote control. Pressing it alternates between on and off of the on-screen display.



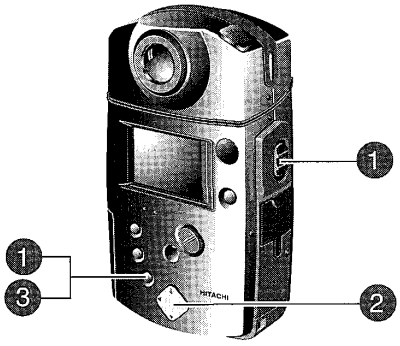



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## *Switching Off LCD Monitor (LCD)*

**To save battery power, you should switch off the LCD monitor when you are not viewing the LCD screen such as recording of audio with still picture.**

* You can also use the remote control to set this.

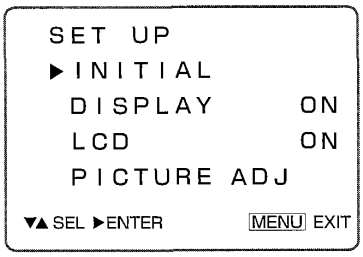





### 1 Display the SET-UP screen.

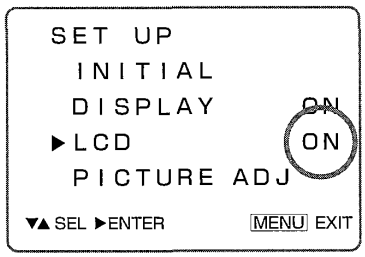
Set the CAM/OFF/PLAY switch to CAM and press the MENU button.

SET-UP screen




### 2 Switch LCD between ON and OFF.

Press ▼ or ▲ to select LCD, and then press ▶ .
Pressing ▶ alternates between LCD ON and OFF.




### 3 Finish the setting.

Press the MENU button.
If you have specified LCD OFF, the picture will disappear by pressing MENU. When you have specified LCD ON, the LCD ON/OFF setting has finished and the SET-UP screen will disappear.

* Even when you do not press MENU, the setting will be finished automatically 60 seconds after the setting is completed.

***To switch on the LCD monitor.***

The LCD monitor will turn on, when you press the MENU button. LCD ON will set automatically when power is turned on again after it has been off.

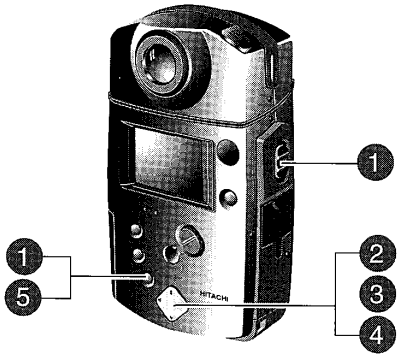


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# *Adjusting Picture on LCD Monitor (PICTURE ADJ)*

**You can adjust brightness, colour density and tint of the picture on the LCD screen.**

* You can also use the remote control to adjust.
* When the AV cable is connected, the LCD monitor switches off, and you cannot adjust the picture.



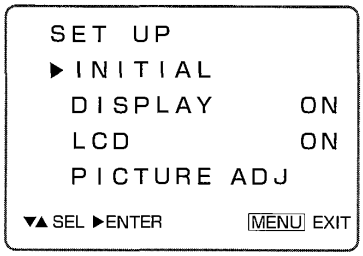

ENGLISH

## 1 Display the SET-UP screen.

Set the CAM/OFF/PLAY switch to CAM or PLAY and press the MENU button.

* If you have started Media Navigation, terminate it.
* If the CAM/OFF/PLAY switch is set to PLAY, LCD ON will not be displayed.

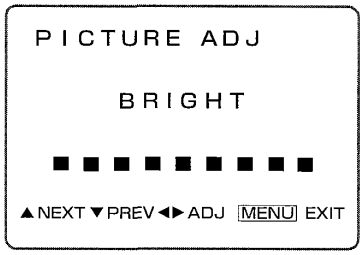
SET-UP screen




## 2 Display the LCD picture adjustment screen.

Press ▼ or ▲ to select PICTURE ADJ, and then press ▶ .
The LCD picture adjustment screen will appear.

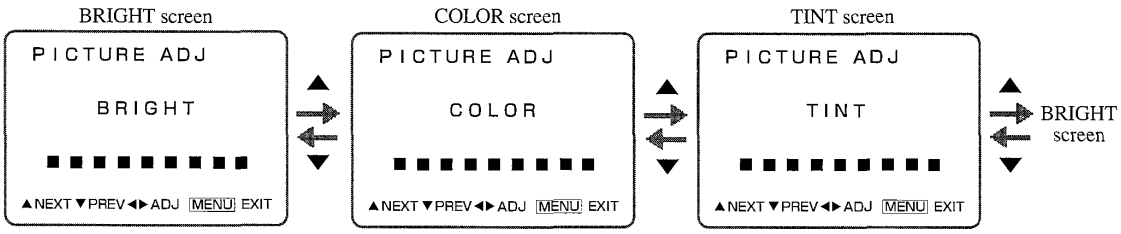
PICTURE ADJ screen




## 3 Switch to the screen for the adjustment item.

Press ▲, and the COLOR adjustment screen will appear. Press ▲ again, and the TINT adjustment screen will appear.
Pressing ▼ switches to the previous adjustment screen.
Use ▲ and ▼ to display the adjustment screen you want.

BRIGHT screen / COLOR screen / TINT screen






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### 4 Adjust.

Press ▶ and ◀ to adjust.
As you adjust each item, the picture displayed on the LCD monitor will change.

Perform steps 3 and 4 to adjust necessary items.

### 5 Finish PICTURE ADJ.

Press the MENU button.
The LCD picture adjustment is finished, and the SET-UP screen will disappear.

* Even when you do not press MENU, adjustment will be finished automatically 60 seconds after each adjustment screen is left displayed, and the SET-UP screen will disappear.

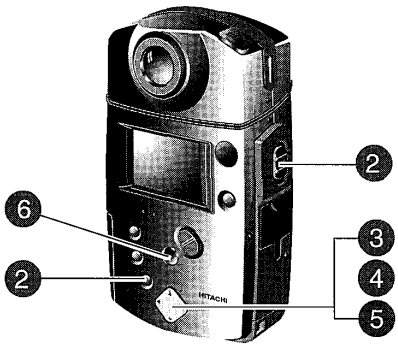




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# *Initializing the PC Card*

**If you want to erase all files stored on the PC card, initialize the PC card by the following procedure:**

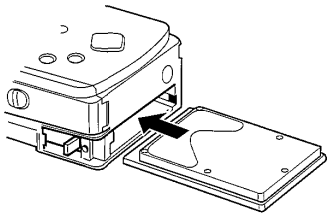



* It takes about 10 minutes to initialize the PC card, use the AC adapter/charger (MP-AC1E) to power the MP-EG 1A.
* During initializing the PC Card, do not vibrate the MP-EG1A and never turn power off.
* You can initialize a used PC card to return it to unused state. However, take great care when doing so because all data recorded on the PC card, including locked files, will be erased.
* Initializing the PC card is done in a roon temperature. If not, a fault could result.
* Be sure to initialize the PC card by inserting it into the MP-EG1A. If a personal computer, etc is used to initialize it, a fault could result.



## 1 Insert the PC card into the MP-EG1A.

Turn power off and insert the PC card to be initialized.
Connect the MP-EG1A to the AC adapter/charger, plugged into AC outlet, to power the MP-EG1A. (See page 20)



## 2 Display the SET UP screen and select INITIAL.

Set the CAM/OFF/PLAY switch to CAM and press the MENU button.
Make sure that INITIAL has been selected.
* The PC card cannot be initialized in the PLAY mode.

SET-UP screen

```
SET UP
▶INITIAL
 DISPLAY        ON
 LCD            ON
 PICTURE ADJ
▼▲ SEL ▶ENTER   MENU EXIT
```

## 3 Display the INITIAL SET screen.

Press ▶ , and the INITIAL SET screen will appear.

INITIAL SET screen

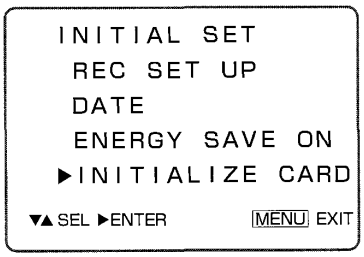
```
INITIAL SET
▶REC SET UP
 DATE
 ENERGY SAVE ON
 INITIALIZE CARD
▼▲ SEL ▶ENTER   MENU EXIT
```



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## 4 Select INITIALIZE CARD.

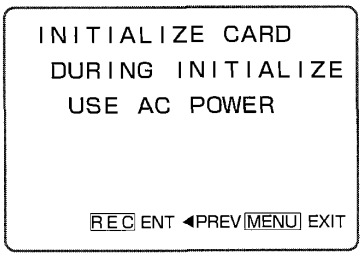
Press ▼ or ▲ to select the INITIALIZE CARD.




## 5 Display the INITIALIZE CARD screen.

Press ▶ .
The INITIALIZE CARD screen will appear.

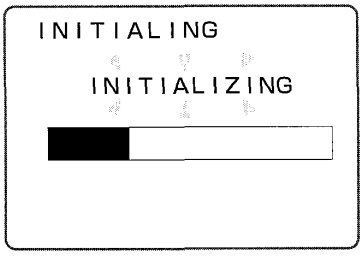
INITIALIZE CARD screen




## 6 Execute the initialization.

Press REC button.
The screen showing that initialization is being executed will appear.
When initialization is finished, the original screen will be restored.

* It takes about 10 minutes for the initialization to finish.
* Initializing cannot be cancelled midway.




***Are you certain about "yes" for initializing this PC card?***

Make absolutely sure before initializing.
Once the PC card has been initialized, all files including locked ones will be erased, and you cannot restore them.

ENGLISH



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ENGLISH



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*Chapter 8*

# *Subsidiary Information*

**This section shows various information, including what to do when you are in trouble. Refer to each item as needed.**


**Tips on battery pack** ..... **86**

**Cleaning** ..... **88**

**When trouble messages appear** ..... **88**

**Troubleshooting guide** ..... **89**

**Terminology** ..... **92**

**Index** ..... **93**

**Major specifications** ..... **94**

**Accessories add excitement** ..... **95**




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# *Tips on Battery Pack*

**The MP-EG1A uses a lithium-ion rechargeable battery pack. Make sure you understand the performance and characteristics of this battery for skillful and safe use.**



## Charging

Always charge the battery just before using the MP-EG1A.
If you store the battery after charging without using the MP-EG1A, the battery will discharge on its own. Therefore, it is recommended that you do not charge immediately after using the MP-EG1A, but immediately before using it. It is not necessary to discharge the battery or use it up.
Charge the battery where the ambient temperature is 10-30°C. The lower the temperature, the more difficult the charging.
To ensure good battery performance, the MP-AC1E exclusive adapter/charger has a protection circuit which stops charging automatically when the temperature is too low. Therefore, the battery cannot be charged at a temperature of 5°C or less.

## Storing

Remove the battery from the MP-EG1A and store it in a cool place.
Storing it at a high temperature could shorten the life of the battery.

## Usable time

A fully charged battery can power the MP-EG1A to continuously record moving picture for about 40 minutes at normal temperature. However, if you use the zoom and start/stop operation frequently in actual recording, the usable time will be half to one-third of the above. The battery will also discharge in the following cases :
· When the CAM/OFF/PLAY switch is set to CAM (recording pause);
· When the CAM/OFF/PLAY switch is set to PLAY.
Remember that the usable time is reduced when using the MP-EG1A in a cold place.

## Battery remaining level indicator

When the remaining battery level is low during recording or recording pause, the message, low battery level, will appear.
A short time after " ▭ " flashes, the MP-EG1A will turn off automatically to prevent the battery from over-discharging.
When " ▭ " is displayed, the battery may be near full charge " ▬ " or low charge " ▭ ".



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## Cautions when using the battery pack

- ***The battery cannot be charged when the CHARGE indicator of the AC adapter/charger is flashing:***
  If you try to charge the battery which has been left unused for a long time, the CHARGE indicator of the AC adapter/charger may flash. In this case, remove the battery and re-attach it. If the CHARGE indicator continues to flash, the battery may be defective or dead, and you need a new battery.
- You cannot charge the battery, if the DC power cord is connected to the AC adapter/charger. Before charging the battery, be sure to unplug the DC power cord from the AC adapter/charger.
- ***Remove the battery after using the MP-EG1A:***
  When the battery is left in the MP-EG1A, a minute level current will flow even when the CAM/OFF/PLAY switch is set to OFF, and the battery will discharge.



## Battery life

- ***If you repeat nearly complete charging at normal temperature, you can use the battery to power the MP-EG1A 500 times:***
  The life of battery will vary greatly depending on the ambient temperature and how often it is used. If the usable time is very short even when the battery is fully charged, it is going dead.

## Disposal of battery

Do not dispose of a dead battery with ordinary garbage, or throw it into fire.

**Do not use AC adapter/chargers or batteries other than those specified.**
**Prohibition** : Even if they are the same shape, the performance will be different, and leakage of liquid or generation of heat could result.
**With the MP-EG1A:**
- Use the MP-AC1E AC adapter/charger.
- Use the MP-BP1A battery.

**Be sure not to disassemble, modify (solder, etc.), heat or throw the battery into fire.**
**Prohibition** : This could cause leakage of liquid, generation of heat, or explosion.

**Do not allow metal (a necklace, a bobby pin, etc.) to contact the battery terminals (+ and -).**
**Prohibition** : This could cause leakage of liquid, generation of heat, or explosion.
- Do not put the battery into a vinyl bag with metallic objects.

## Leakage of liquid from battery

- ***If the liquid leaked from the battery adheres to your hand, clothes, rinse it away immediately with tap water.***
- ***If the liquid gets in your eye, you could lose the eyesight. Do not rub it, but immediately rinse it with clean water and see a doctor.***



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## *Cleaning*

**Be sure to turn the MP-EG1A off before cleaning it.**

### If dirt adheres to the LCD screen or lens :

Wipe it off with a soft, dry cloth. When cleaning the LCD screen, do not use force or strike it.

### Do not wipe case with benzene or thinner :

The coating of case could peel off or the case could deteriorate. When using a chemical cleaning cloth, follow the instructions for use.
Wipe off dirt on the case with a moist cloth which has been completely wrung out.



## *When Trouble Messages Appear*

**Various messages may appear when you are operating the MP-EG1A. Perform troubleshooting accordingly.**

| Message | Cause | Troubleshooting |
|---|---|---|
| **MEMORY IS ALMOST FULL** | Free memory area of PC card is small. | Stop recording, and delete unnecessary files to increase free memory area, or replace the PC card. |
| **END OF MEMORY** | No free memory area of PC card | |
| **INSERT CARD** | PC card is not inserted, or PC card that cannot be used with the MP-EG1A is inserted. | Insert PC card, or replace it with the MP-HD260 PC card. |
| **INVALID CARD TYPE** | PC card that cannot be used with the MP-EG1A is inserted. | Replace it with the MP-HD260 PC card. |
| **INITIALIZE CARD** | PC card which is not initialized has been inserted. | Initialize it (see page 82). |
| **—/—/——<br>—:—AM<br>(date/time digits flash)** | The clock has not been set or the built-in battery has discharged. | Charge the built-in battery (see page 24) and set the date and time (see page 22). |
| **CARD LOCK (flashes)** | The temperature of PC card is too high, because of extended use. | Turn the MP-EG1A off, leave it for 10-20 minutes and wait until the message disappears. |



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# *Troubleshooting Guide*

**Check to following. If the suggested solutions still cannot restore MP-EG1A to normal, do not attempt to repair yourself, but consult the video store where you purchased it.**

| | Symptom | Check to see | Correction | Reference page |
|---|---|---|---|---|
| Power supply | Power goes off immediately after being turned on. | Is battery pack discharged? | Charge it. | 18 |
| | Power goes off midway. | Have you continued pause during recording for 5 minutes or more? The auto power off function has operated. | Press the PLAY or REC button. (You can disable auto power off (see page 76) | 30 |
| | | Have you continued stop or pause during playback for 5 minutes or more? The auto power off function has operated and power has turned off automatically. | Press the PLAY or REC button. (You can disable auto power off (see page 76) | 30 |
| | Battery weakens fast or its usable time is short. | Are you using MP-EG1A where the temperature is extremely low? | The usable time is much shorter in cold places. Prepare extra batteries. | 87 |
| | | The battery may be dead. | Replace it. | 87 |
| | Battery cannot be charged. | You cannot charge battery when the CHARGE indicator of AC adapter/charger is flashing. Charging may not be possible where the temperature is lower than 5°C. | When the CHARGE indicator flashes, remove the battery and re-attach it. If it continues to flash, the battery may be dead. | 87 |
| | | Is DC power cord plugged into the AC adapter/charger? | Unplug it. | 18 |
| | | Is battery inserted correctly? | Make sure of the orientation. | 18 |
| During recording | Recording does not start if you press the REC button. | Is CAM/OFF/PLAY switch set to PLAY? | Set it to CAM. | 29 |
| | Recording stops after you press the REC button. | Is recording function type set to CLIP? CLIP setting allows recording only when REC is held. | Switch it to NORM. | 72 |
| | | Does the record mode indicator for recording of still pictures or consecutive still pictures light? | Recording does not continue if the record mode is set to still picture or consecutive still pictures. | 15 |

ENGLISH

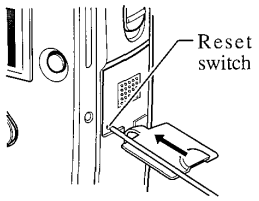


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| | Symptom | Check to see | Correction | Reference page |
|---|---|---|---|---|
| During recording | Even when recorded files are few, the number of recordable still pictures is small or audio recordable time is short. | Do many of the recorded files have complicated patterns? | The number of recordable still pictures or the time of recordable audio varies depending on the pattern complication of recorded pictures. | 13 |
| | Audio recordable time is short. | Are you recording audio, repeating recording pause? | Since still pictures are recorded during every recording pause, the audio recordable time is short. The audio recordable time also varies depending on audio content. | |
| | No picture appears on the LCD monitor. | Has LCD OFF been specified? | Press the MENU button to display the SET UP screen, and specify LCD ON. | 79 |
| | | Is AV cable connected? | Unplug it. | 66 |
| | LCD screen is difficult to see. | Is LCD screen adjusted properly? | Press the MENU button to display the SET UP screen, and the adjust the picture with the PICTURE ADJ screen. | 80 |
| | | Is the MP-EG1A being used outdoors? The LCD screen is difficult to see in a bright place. | Attach the provided sunshade. | 28 |
| | Subject cannot be focused. | Is the MP-EG1A too near to the subject? | The MP-EG1A allows minimum distance recording as close as 28 cm to the subject at W position of zoom. If it is brought much nearer, the subject cannot be focused. | 30 |
| | Recording cannot be done. | Are you using the specified PC card? | Use the MP-HD260 PC card. | 13 |
| During Playback | Playback cannot be done if you press the PLAY button. | Is CAM/OFF/PLAY switch set to CAM? | Set it to PLAY. | 38 |
| | | Was the MP-EG1A subjected to force or shocks? | The MP-EG1A has possibly been destroyed. | |
| | | Was the file recorded by other equipment? | It may be impossible to play the file recorded by other equipment (MPEG file, etc. transferred from computer). Play the file recorded by the MP-EG1A. | |
| | | Did you operate the file with software (explorer, etc.) other than that provided? | Operating the file in PC card with software other than the one provided could destroy the file. | |
| | No picture appears on the LCD monitor. | Has LCD OFF been specified? | Press the MENU button to display the SET UP screen, and specify LCD ON. | 79 |



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| | Symptom | Check to see | Correction | Reference page |
|---|---|---|---|---|
| During Playback | No picture appears on the LCD monitor. | Is AV cable connected? | Unplug it. | 66 |
| | No playback picture appears on TV and no sound is heard from TV. | Is the TV input selector set correctly? | Set it to VCR. | 66 |
| | | Is MP-EG1A connected to the TV correctly? | Correct the connection. | |
| Miscellaneous | Power does not come on. No button operation is accepted. |  | Remove the battery. After about one minute, press the reset switch with a fine tip rod. Then re-attach the battery and try to operate MP-EG1A. Since the internal clock is initialized to the value at the factory, set the date and time (see page 22). | |
| | The date and time are incorrect. | Was MP-EG1A left unused for a long time? | The built-in battery may have discharged Charge it, and then set the date and time (see page 22). | 24 |
| | PC card cannot be ejected. | Is CAM/OFF/PLAY switch set to OFF? | Set it to OFF, and then remove the PC card. | 13 • 21 |
| | | Have you removed battery or unplugged DC cord before setting the CAM/OFF/PLAY switch to OFF? | Power MP-EG1A from battery or DC cord, and then set the CAM/OFF/PLAY switch off. | |
| | | Is the bottom of MP-EG1A hot? | If the PC card is hot after MP-EG1A is used for a long time, the eject lever will not work for safety reasons. Leave MP-EG1A off for approx. 10-20 minutes. | |
| | The remote control cannot operate MP-EG1A. | Are you pointing the remote control to the MP-EG1A's infrared receiver? | Point it to the infrared receiver. | 35 • 41 |
| | | Is fluorescent light or sunlight directly striking the infrared receiver? | The remote control cannot operate MP-EG1A if strong light strikes the infrared receiver. Adjust the location or angle of MP-EG1A so that light does not strike the infrared receiver. | |
| | | Is the litium battery inserted into the remote control? | Insert it. | 25 |
| | | Is the remote control battery discharged? | If so, the remote control distance will be short. Replace the battery. | |

ENGLISH



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# *Terminology (As of July 1997)*



### Application software

Software which is run by users on an OS. Typical are word processing software, spreadsheet program, painting software, etc.

### CD-ROM (Compact Disk Read-Only Memory)

Large-capacity read-only memory. A compact disc in which files are stored. It is possible to read data at high speed.

### CPU (Central Processing Unit)

A component that is the centre of computer. It receives data from an input device, computes and stores it, then transfers resultant data to an output device.

### Driver software

Software which provides OS with a specified device. Once installed, user need not be concerned about use.

### Hard disk

Conventionally, a fixed storage of personal computer. Although it is not as handy as a floppy disk or MO disk, it can store mass data at high speed. Recently, detachable and card type hard disks has been marketed.

### Homepage

Introduction for information to be provided on Internet, which can be created using still pictures, audio and moving pictures.

### ISA (Industry Standard Architecture)

16-bit bus interface standard used with IBM® PC/AT® compatible machines.

### Initialization

A task done so that hard disk, MO disk, floppy disk, etc. can be used with personal computers. This is also referred to as formatting.

### Internet

More advanced network of computer networks. In this system, computers in the world are connected to one network.

### JPEG (Joint Photographic coding Experts Group)

One of the national standards for colour still picture compression system. This system has become popular worldwide and is used to create Internet homepage, etc. The file extension is generally ".jpg".

### MO disk (Magnetic Optical disk)

A storage device, from/to which data is read and written using the magnet-optical system. It is able to store much more data.

### MPEG 1 (Moving Picture Experts Group 1)

One of the international standards for colour moving picture compression system. This is one of the most efficient moving picture compression systems, as of July, 1997. An MPEG 1 decoding hardware or MPEG 1 decoding software is necessary to play back pictures. The file extension is generally ".mpg".

### Multimedia Contents

Electronic publications configured by various types of data, including characters, moving pictures, still pictures, audio, etc.

### OS (Operating System)

Software that manages other programs, data, hardware, etc., to process the task given to computer.

### PC card

A credit-card sized card that can be easily inserted into personal computer from outside. PC card is the formal name for cards conforming to the PCMCIA (personal computer memory card international association) standard. PC cards are divided into type I, II and III, depending on their thickness.

### Pentium®

The 32-bit CPU developed by Intel Corporation.

### RAM (Random Access Memory)

The memory, from/to which data can be read and written at random.

### Thumbnail

A small still picture, used with many types of image indexing software.

### Windows® 95 (Microsoft® Windows® 95 Operating System)

The OS developed by Microsoft Corporation, which is very popular as an OS for personal computers.



BlackBerry Corporation Exhibit 1004, pg. 703

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BlackBerry Corporation Exhibit 1004, pg. 704

## *Major Specifications*

| | |
|---|---|
| **Model** | MP-EG1A |
| **Power supply** | 7.2 V DC |
| **Power consumption** | 6.5 W |
| **Weight** | approx. 385 g (MP-EG1A only)<br>approx. 540 g (with MP-BP1A battery pack and MP-HD260 PC card) |
| **I/O terminals** | Video out (NTSC 3.58MHz), audio out (monaural), PC (special serial port) |
| **Compression systems** | Moving pictures : MPEG1<br>Still picture : Conforming to JPEG<br>Audio : Conforming to MPEG Audio |
| **Battery usable time** | approx. 40 minutes (when recording moving pictures continuously at normal temperature) |
| **Storage device** | MP-HD260 PC card |
| **Speaker output** | 200 mW |
| **Permissible operating temperature/humidity** | 0-40°C / 80% or less |
| **Image sensor** | 1/4" CCD Total number of pixels: approx. 390,000<br>Effective number of pixels: approx. 360,000 |
| **Built-in microphone** | Monaural |
| **Automatic sensitivity adjustment range** | 20-100,000 lux |
| **Minimum required illumination** | 14 lux for moving pictures<br>5 lux for still pictures |
| **Liquid crystal display panel** | Image size: 1.8" Number of dots: 61,380 |
| **Lens** | 6x zoom lens (when 2x digital zoom is used concurrently)<br>F2.4f = 3.6-10.8mm |
| **Minimum distance recording** | Possible as close as 28 cm (at W position of zoom) |
| **Maximum recording time*** | Moving pictures: approx. 20 minutes<br>Still picture with audio: approx. 4 hours (with MP-HD260 PC card) |
| **Maximum number of recordable still pictures** | approx. 3,000 (with MP-HD260 PC card) |
| **External dimensions** | 83 (W) x 143.5 (H) x 56 (D) mm |

* See "PC card" on page 13 for details.
Specifications are subject to change without notice.
There are pixels which always light on the LCD monitor, but this does not indicate a fault

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BlackBerry Corporation Exhibit 1004, pg. 705

# Accessories Add Excitement

We know that once you discover how much your Hitachi MP-EG1A can add to your life you will want to use these accessories for even more excitement. Hitachi takes you to wherever your imagination leads.

## Available Accessories

| PARTS NO. | Accessories |
|---|---|
| **MP-BP1A** | Battery pack  |

| PARTS NO. | Interface Kit |
|---|---|
| **MP-ADI1AW** | ISA Interface kit<br>Use this kit to connect the MP-EG1A to a IBM® PC/AT® compatiblel desktop personal computer.<br><br>Components provided in the kit :<br>· ISA interface board<br>· MPEGCAM connection cable<br>· ISA communications driver (3.5" floppy disk)<br>· Instruction manual<br>· Warranty<br>(· Warranty for USA/Canada) |

ENGLISH



BlackBerry Corporation Exhibit 1004, pg. 706

ENGLISH



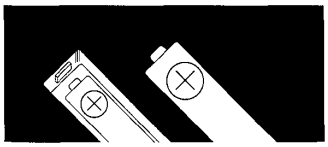
# BATTERY SAFETY GUIDELINES

**PLEASE PHPTOCOPY AND DISPLAY**

USed correctly, domestic batteries are a safe and dependable source of portable power. Problems can occur if they are misused or abused- resulting leakage or, in extreme cases, fire or explosion.

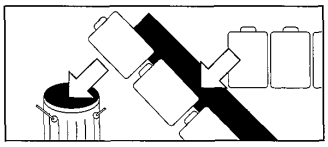
Here are some simple guidelines to safe battery use designed to eliminate any such problems.

## ALWAYS



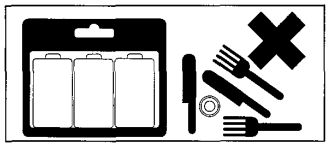
Take care to fit your batteries correctly, observing the *plus* and *minus* marks on the battery and appliance Incorrect fitting can cause leakage or, in extreme cases, fire or even an explosion

## ALWAYS



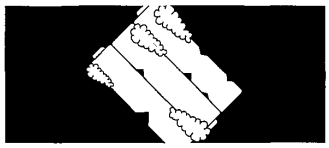
Replace the whole set of batteries at one time, taking care not to mix old and new batteries or batteries of different types, since this can result in leakage or, in extreme cases, fire or even an explosion

## ALWAYS



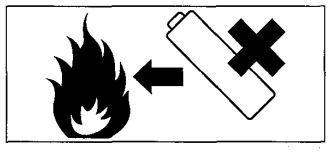
Store unused batteries in their packaging and away from metal objects which may cause a short-circuit resulting in leakage or, in extreme cases, fire or even an explosion

## ALWAYS



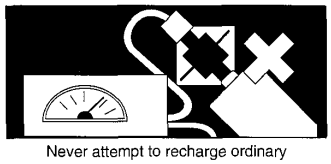
Remove dead batteries from uquipment and all batteries from equipment you know you are not going to use for a long time Otherwise the batteries may leak and cause damage

## NEVER



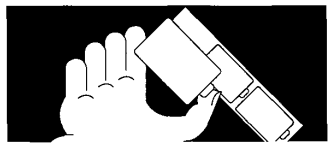
Never dispose of batteries in fire as this can cause them to explode Please put dead batteries in with the normal household waste

## NEVER



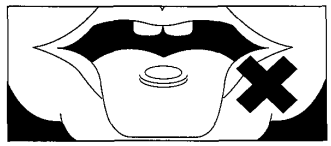
Never attempt to recharge ordinary batteries, either in a charger or by applying heat to them They may leak, cause fire or even explode There are special rechargeable batteries which are clearly marked as such

## ALWAYS



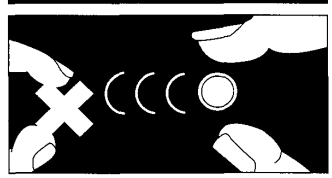
Supervise children if they are replacing batteries themselves in order to ensure these guidelines are followed

## ALWAYS



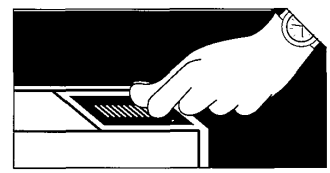
Remember that small button cell batteries such as used in some hearing aids, toys, games and other appliances, are easily swallowed by young children and this can be dangerous

## ALWAYS



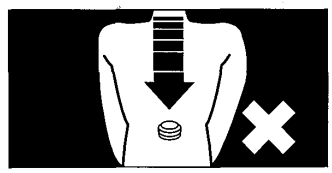
Keep loose button cells away from young children

## ALWAYS



Make sure battery compartments are secure

## ALWAYS



Seek medical advice if you believe a cell has been swallowed

**PUBLISHED BY THE BRITISH BATTERY MANUFACTURERS ASSOCIATION** 7 BUCKINGHAM GATE, LONDON SW1E6JS



BlackBerry Corporation Exhibit 1004, pg. 707

***SOME DO'S AND DON'TS ON THE SAFE USE OF EQUIPMENT***

This equipment has been designed and manufactured to meet international safety standards but, like any electrical equipment, care must be taken if you are to obtain the best results and safety is to be assured.

★★★★★★★★★★

***DO*** read the operating instructions before you attempt to use the equipment.
***DO*** ensure that all electrical connections (including the mains plug, extension leads and interconnections between pieces of equipment) are properly made and in accordance with the manufacturer's instructions. Switch off and withdraw the mains plug when making or changing connections.
***DO*** consult your dealer if you are ever in doubt about the installation, operation or safety of your equipment.
***DO*** be careful with glass panels or doors on equipment.

★★★★★★★★★★

***DON'T*** continue to operate the equipment if you are in any doubt about it working normally, or if it is damaged in any way – switch off, withdraw the mains plug and consult your dealer.
***DON'T*** remove any fixed cover as this may expose dangerous voltages.
***DON'T*** leave equipment switched on when it is unattended unless it is specifically stated that it is designed for unattended operation or has a standby mode. Switch off using the switch on the equipment and make sure that your family know how to do this. Special arrangements may need to be made for infirm or handicapped people.
***DON'T*** use equipment such as personal stereos or radios so that you are distracted from the requirements of traffic safety. It is illegal to watch television whilst driving.
***DON'T*** listen to headphones at high volume, as such use can permanently damage your hearing.
***DON'T*** obstruct the ventilation of the equipment, for example with curtains or soft furnishings. Overheating will cause damage and shorten the life of the equipment.
***DON'T*** use makeshift stands and ***NEVER*** fix legs with wood screws – to ensure complete safety always fit the manufacturer's approved stand or legs with the fixings provided according to the instructions.
***DON'T*** allow electrical equipment to be exposed to rain or moisture.
***ABOVE ALL***

- ***NEVER*** **let anyone especially children push anything into holes, slots or any other opening in the case – this could result in a fatal electrical shock;**
- ***NEVER*** **guess or take chances with electrical equipment of any kind**
- **it is better to be safe than sorry!**

★★★★★★★★★★

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BlackBerry Corporation Exhibit 1004, pg. 708

# HITACHI - YOUR GUARANTEE OF EXCELLENCE (for UK only)

For the period of **12 MONTHS** from the date of purchase your product has the benefit of our **FULL PARTS AND LABOUR GUARANTEE** as detailed below.
We undertake to replace or repair any part of the product which fails due to manufacturing defect within 12 months of the date of purchase provided that:

1) The product has been installed and used only in accordance with the instructions supplied with the product.
2) The product has not been repaired, maintained, or modified by any person other than our authorised Engi neer.
3) The product serial number is not removed or altered.

This guarantee does not apply to products acquired secondhand or for commercial or communal use.
This guarantee does not extend to user control adjustments, battery replacement and aerial adjustment.
Any parts replaced under guarantee shall become the property of Hitachi Home Electronics (Europe) Ltd.
Please note that evidence of the date of purchase will be required before service under guarantee is carried out.
This guarantee does not affect your statutory rights. In all cases of difficulty consult your Hitachi dealer.

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Printed in Japan KN-Y(CN)

# First Looks

DIGITAL CAMERAS

## The Digital Chameleon

*Hitachi's MP-EG1 captures full-motion video, stills, and audio.—By Daniel Grotta and Sally Wiener Grotta*

The $2,500 (street) Hitachi MP-EG1 is the first all-digital device capable of capturing up to 20 minutes of full-motion video, 3,000 still images, 1,000 still images with 10-second audio annotations, or 4 hours of audio. It's an elegant, well-constructed, and remarkably easy-to-use camera.

Although the MP-EG1 has a few quirks, its unique features and affordability will appeal to users who shoot hundreds or even thousands of stills in a single session and to Web content creators who want the speed and convenience of direct digital MPEG-1 footage.

### BRIGHT AND LIGHT

Smaller and lighter than most standard camcorders, the MP-EG1 is designed to be used one-handed. It's as easy to operate as a camcorder or an auto-everything point-and-shoot still camera. Just turn it on, select the image type, line up the subject in the viewfinder, and press Record. There's a 6X power-zoom button for framing or following the subject. Although the camera doesn't feature a true macro mode, it can capture objects as close as 11.2 inches.

The MP-EG1 has an automatic white balance that adjusts to different types of lighting. Its lens diaphragm also adjusts quickly to changing brightness levels, and the electronic shutter can capture extreme low-light situations by exposing the CCD for up to 16 seconds. The camera lacks a built-in flash, exposure-compensation capability, a backlight switch, and a provision for manually selecting f-stops or shutter speeds. All data is saved to the camera's 260MB Type III PC-Card hard disk.

Hitachi comes close to solving the problem of viewing a color LCD in bright light, thanks to three tactics: a snap-on collapsible hood that shields the LCD; an upwardly angled, 180-degree swivel lens that gives you some latitude in positioning the LCD; and the ability to adjust the brightness as well as the tint and color of the LCD (this is the only digital camera that does all this).



**ALL-IN-ONE CAMERA:** *The Hitachi MP-EG1 excels at recording three types of media.*

### PUSHING THE RIGHT BUTTONS

There are eight buttons and switches: Off/Camera/Playback, Zoom/Volume level, Recording Mode/Thumbnail, Media/Navigation, Menu (setup), Delete, Record, and a four-way diamond rocker switch for file searches and navigating through pull-down menus. The small remote control can access all controls and functions via the infrared port from up to 22 feet away, although it doesn't work in bright light and must be in a direct line of sight.

Video and audio images are recorded as MPEG-1 files at 30 frames per second, at a resolution of 352-by-240 per frame. Even with compression rates reaching 100:1, every 4 seconds of data consumes approximately 1MB of hard disk space. The camera captures still images at a 704-by-480 resolution and saves them in JPEG format. Each JPEG file occupies 40K to 65K of disk space, depending upon the image's complexity. And depending upon the mode selected, the camera can record one image every two seconds, in a burst mode of five images in 2.5 seconds or a time-lapse mode of one shot every 30 seconds, one minute, or five minutes.




**HARD CARD:** *Image and sound data is stored on this 260MB Type III PC Card.*

Files can be organized and saved to a series of folders and may be displayed in various formats on the LCD. This makes it comparatively easy for retrieval and playback.

### IMAGE TRANSFER

There are two ways to transfer images to your PC: Either swap the PC Card drive into a PC Card reader, or attach the camera to the kit's dedicated high-speed ISA serial board, which Hitachi claims offers data-transfer rates of up to 2 MBps. That's marginally faster than a Type III PC Card disk transfer.

Hitachi bundles comprehensive programs for viewing and editing video, still, and audio files. Unfortunately, they are not well integrated or bug-free. It wouldn't matter so much if Hitachi provided documentation of any sort.

### GREAT VIDEO

The MP-EG1's video quality is outstanding. When viewed at a resolution of 1,024-by-768 on a 17-inch monitor, playback is at 30 fps and displays in a window that's about 3-by-4.25 inches. This is more than adequate for most Web displays. Colors are accurate and vibrant, motion is clear and continuous, and audio is flawless.

Still-image quality is average, and it outputs as a continuous-tone print at sizes up to 3.5-by-5 inches without pixelizing. Nevertheless, aliasing is apparent on oblique angles, and the lack of a flash, exposure compensation, or a backlight switch often translates into subpar illumination.

The MP-EG1's zoom lens is a combination 3X optical zoom with an enhanced 2X digital boost. Although you have a seamless 6X zoom capability, going to telephoto interpolates the images, thus reducing picture quality.

What we liked most about the Hitachi MP-EG1 is that it's really fun to use. You can effortlessly mix and match video with stills and audio, get instant-replay feedback, and transfer images to your PC in standard file formats. And you don't need an engineering degree to do it, either.

**MP-EG1:** Street price: $2,500. Requires: 100-MHz Pentium or better, 16MB of RAM (32MB recommended), Microsoft Windows 95, 80MB of hard disk space, 4X CD-ROM drive, empty ISA slot or PC Card drive, speaker and Sound Blaster–compatible audio card. Hitachi Home Electronics (America) Inc. Norcross, GA, 30093; 800-448-2244, 770-279-5600; www.mpegcam.net. *Circle 404 on reader service card.*

US006226449B1

(12) **United States Patent**
**Inoue et al.**

(10) **Patent No.: US 6,226,449 B1**
(45) **Date of Patent: *May 1, 2001**

(54) **APPARATUS FOR RECORDING AND REPRODUCING DIGITAL IMAGE AND SPEECH**

(75) Inventors: **Hisashi Inoue**, Kashiwa; **Keiji Nagayama**; **Tomishige Yatsugi**, both of Hitachinaka, all of (JP)

(73) Assignee: **Hitachi, Ltd.**, Tokyo (JP)

( * ) Notice: This patent issued on a continued prosecution application filed under 37 CFR 1.53(d), and is subject to the twenty year patent term provisions of 35 U.S.C. 154(a)(2).

Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **08/838,286**

(22) Filed: **Apr. 17, 1997**

(30) **Foreign Application Priority Data**

Apr. 17, 1996 (JP) ..... 8-095498
Feb. 17, 1997 (JP) ..... 9-032200

(51) **Int. Cl.**[7] ..... **H04N 5/225**
(52) **U.S. Cl.** ..... **386/120**; 348/231
(58) **Field of Search** ..... 386/38, 69, 70, 386/120, 121, 97, 95; 348/220, 232, 231, 233, 234, 222; 360/72.2; 358/296; 345/328

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(57) **ABSTRACT**

A digital image and speech recording and reproducing apparatus is arranged to quickly and simply retrieve, classify, and erase a great deal of data for improving the operativity in small-sized equipment. The apparatus includes a recording and reproducing unit for a moving image signal, a recording and reproducing unit for a still image signal, a recording and reproducing unit for a digital speech signal operated in synchronous to the image, a display for displaying the image for said moving image signal or said still image signal, a recording condition recording unit for recording recording conditions containing data information about recorded data for distinguishing said moving image from said still image and recording time information for recording an image or a speech. The recording conditions consisting of at least the data information and the recording time information about the recorded data are graphically and literarily displayed on the display, so that the recorded data item may be selected on the display screen.

**31 Claims, 13 Drawing Sheets**

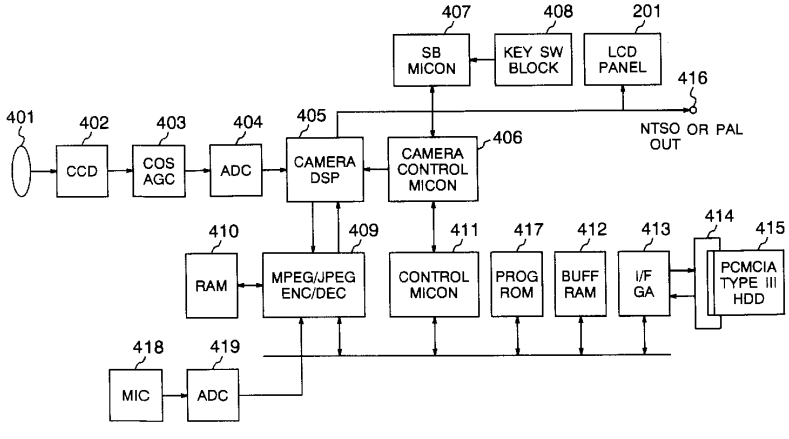


FIG. 1

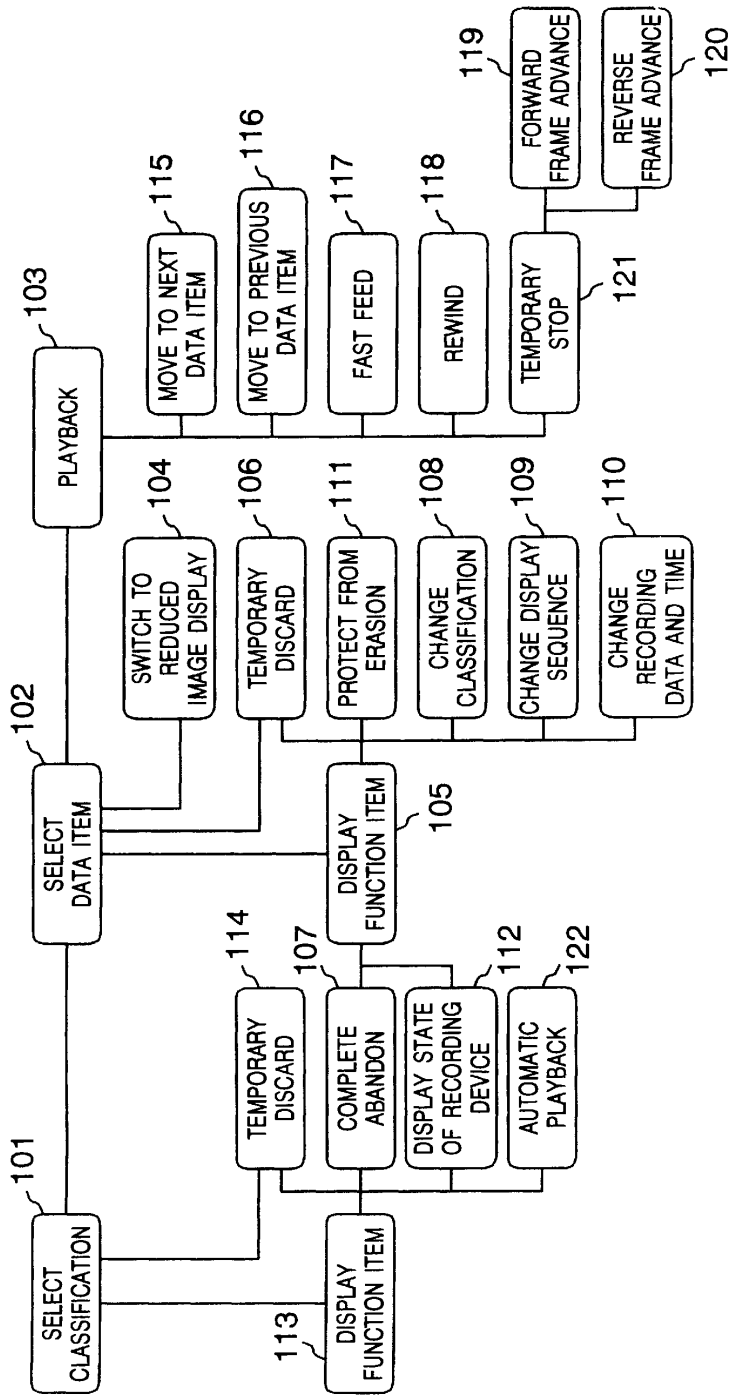

SELECT CLASSIFICATION
101
SELECT DATA ITEM
102
PLAYBACK
103
SWITCH TO REDUCED IMAGE DISPLAY
104
TEMPORARY DISCARD
106
PROTECT FROM ERASION
111
CHANGE CLASSIFICATION
108
CHANGE DISPLAY SEQUENCE
109
CHANGE RECORDING DATA AND TIME
110
DISPLAY FUNCTION ITEM
105
MOVE TO NEXT DATA ITEM
115
MOVE TO PREVIOUS DATA ITEM
116
FAST FEED
117
REWIND
118
TEMPORARY STOP
121
FORWARD FRAME ADVANCE
119
REVERSE FRAME ADVANCE
120
TEMPORARY DISCARD
114
COMPLETE ABANDON
107
DISPLAY STATE OF RECORDING DEVICE
112
AUTOMATIC PLAYBACK
122
DISPLAY FUNCTION ITEM
113

FIG. 2

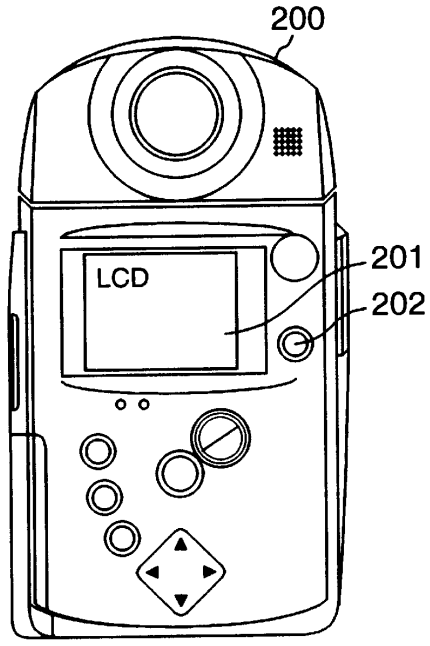

200
LCD
201
202

FIG. 3

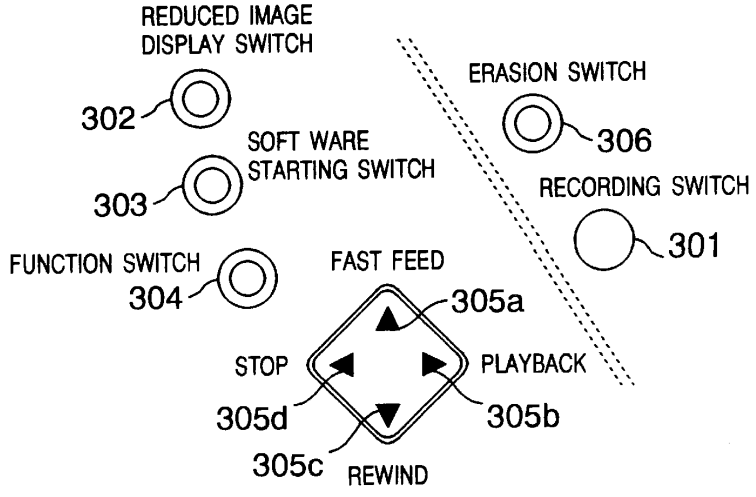

REDUCED IMAGE DISPLAY SWITCH
302
SOFT WARE STARTING SWITCH
303
FUNCTION SWITCH
304
ERASION SWITCH
306
RECORDING SWITCH
301
FAST FEED
305a
STOP
305d
PLAYBACK
305b
305c
REWIND

FIG. 4

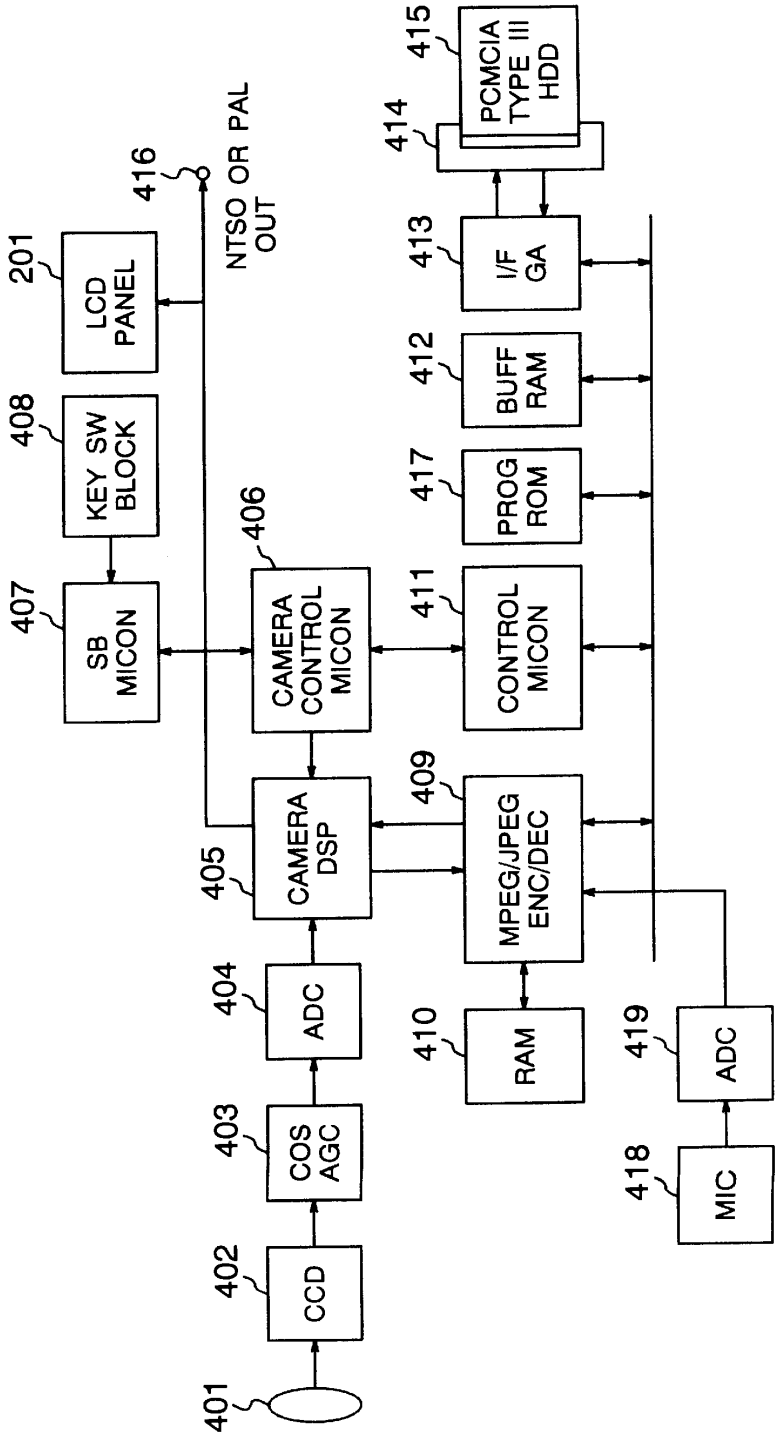

401
CCD
402
COS AGC
403
ADC
404
CAMERA DSP
405
CAMERA CONTROL MICON
406
SB MICON
407
KEY SW BLOCK
408
LCD PANEL
201
NTSO OR PAL OUT
416
MPEG/JPEG ENC/DEC
409
CONTROL MICON
411
PROG ROM
417
BUFF RAM
412
I/F GA
413
PCMCIA TYPE III HDD
414
415
RAM
410
ADC
419
MIC
418

FIG. 5

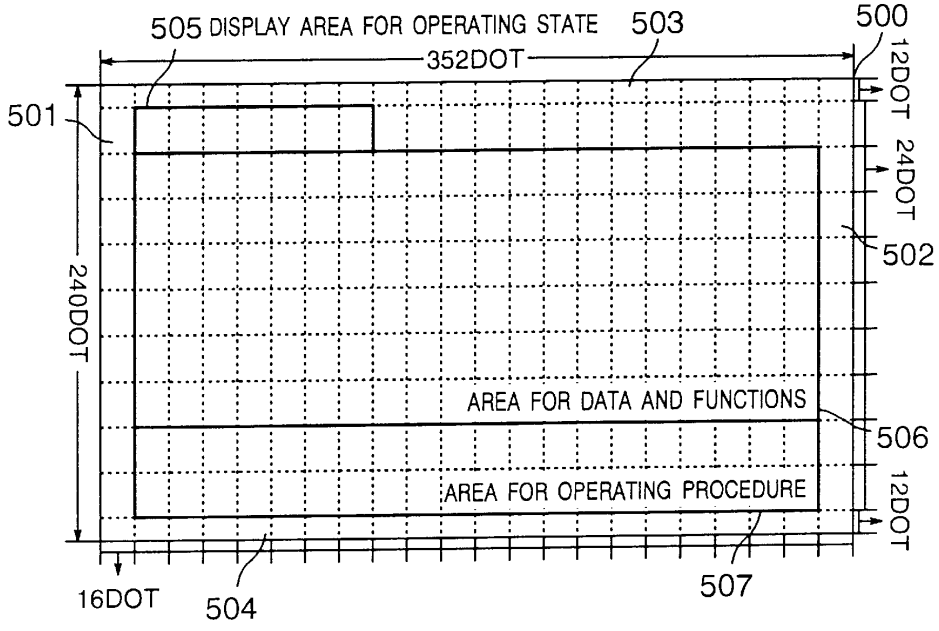

505 DISPLAY AREA FOR OPERATING STATE
503
500
352DOT
12DOT
24DOT
501
240DOT
502
AREA FOR DATA AND FUNCTIONS
506
AREA FOR OPERATING PROCEDURE
12DOT
16DOT
504
507

FIG. 6

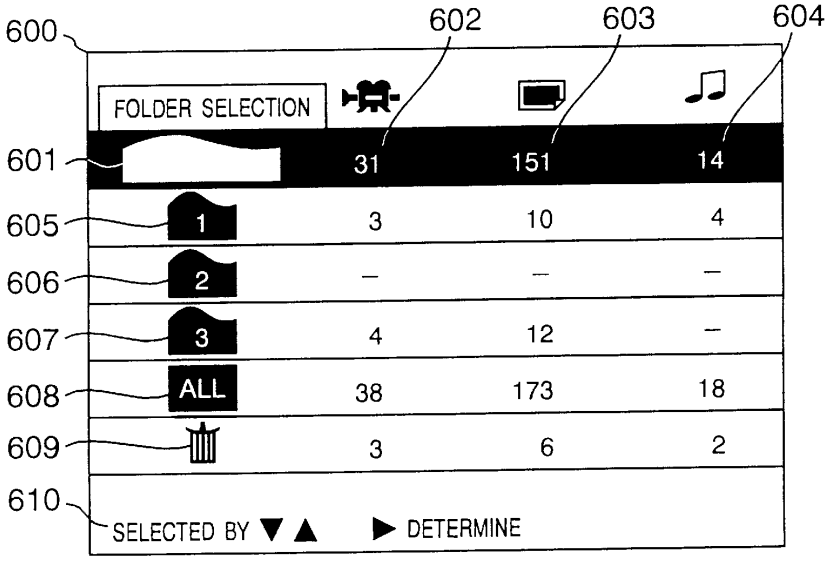

600
602
603
604
FOLDER SELECTION
601
31
151
14
605
1
3
10
4
606
2
–
–
–
607
3
4
12
–
608
ALL
38
173
18
609
3
6
2
610
SELECTED BY ▼ ▲
▶ DETERMINE

FIG. 7

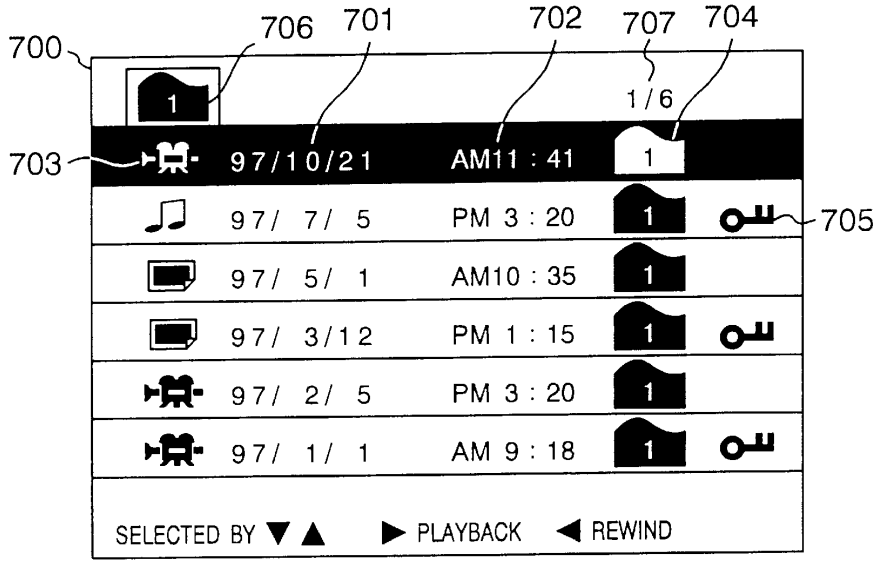

700
706
701
702
707
704
1
1/6
703
97/10/21
AM11 : 41
1
97/ 7/ 5
PM 3 : 20
1
705
97/ 5/ 1
AM10 : 35
1
97/ 3/12
PM 1 : 15
1
97/ 2/ 5
PM 3 : 20
1
97/ 1/ 1
AM 9 : 18
1
SELECTED BY ▼ ▲
▶ PLAYBACK
◀ REWIND

FIG. 8

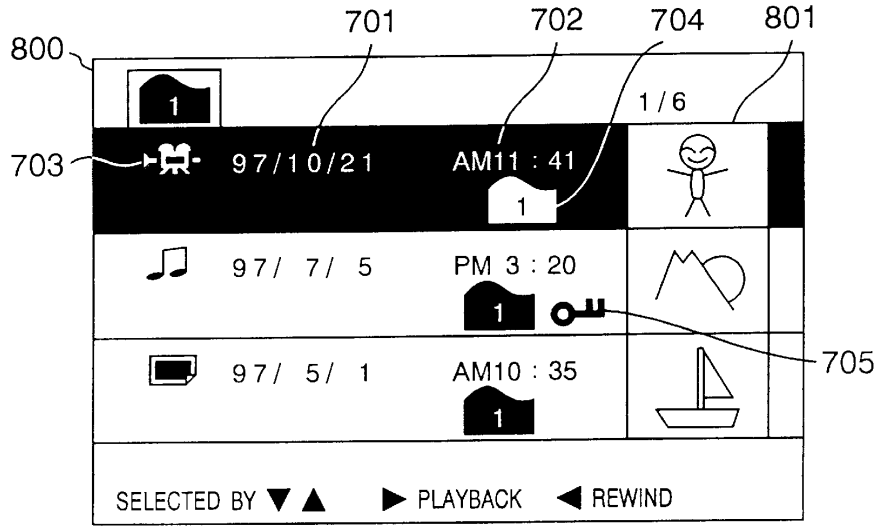

800
701
702
704
801
1
1/6
703
97/10/21
AM11 : 41
1
97/ 7/ 5
PM 3 : 20
1
705
97/ 5/ 1
AM10 : 35
1
SELECTED BY ▼ ▲
▶ PLAYBACK
◀ REWIND

FIG. 9

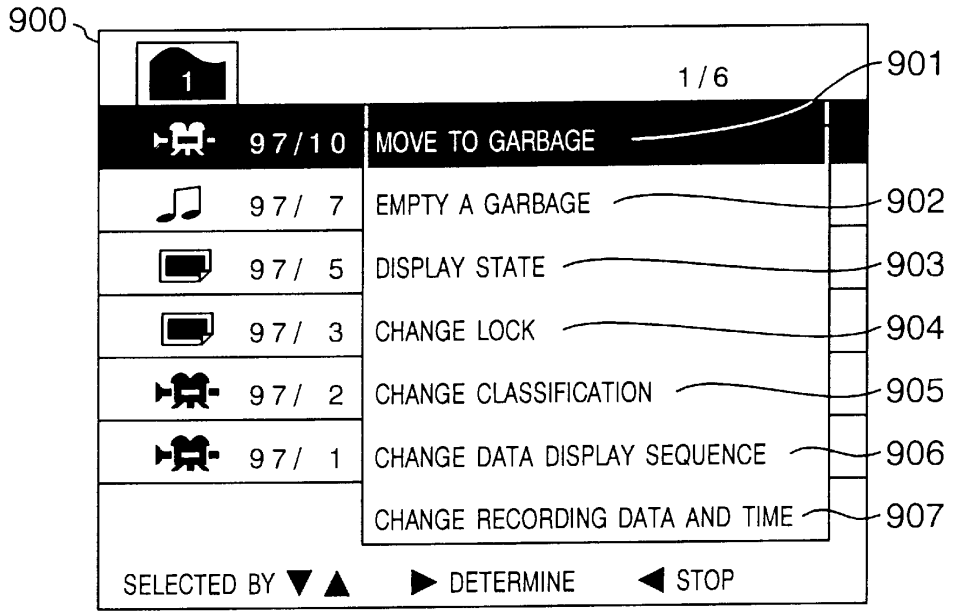

900
1
1/6
901
97/10
MOVE TO GARBAGE
97/ 7
EMPTY A GARBAGE
902
97/ 5
DISPLAY STATE
903
97/ 3
CHANGE LOCK
904
97/ 2
CHANGE CLASSIFICATION
905
97/ 1
CHANGE DATA DISPLAY SEQUENCE
906
CHANGE RECORDING DATA AND TIME
907
SELECTED BY ▼ ▲
▶ DETERMINE
◀ STOP

FIG. 10

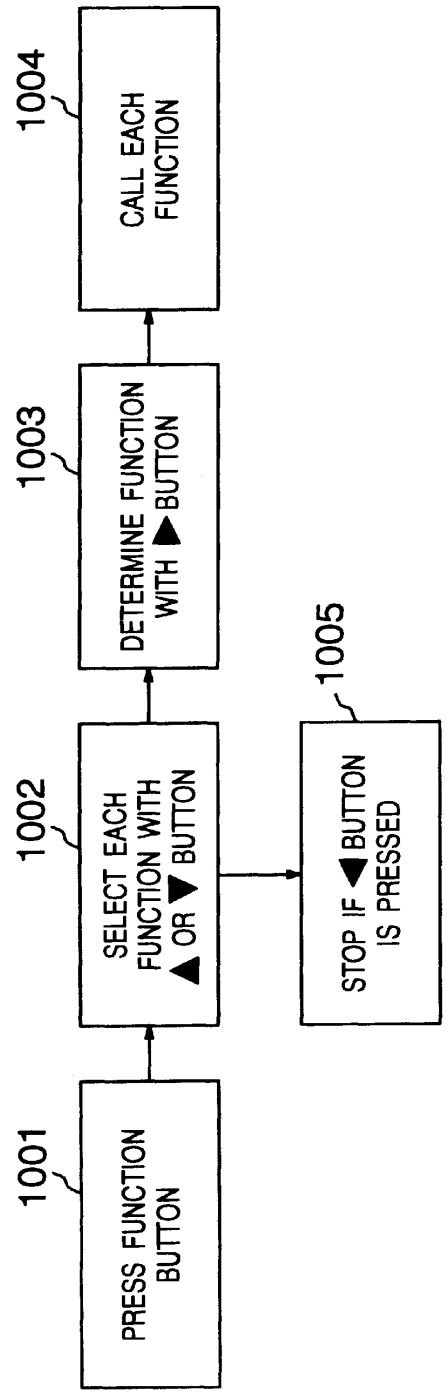

1001
PRESS FUNCTION BUTTON
1002
SELECT EACH FUNCTION WITH ◀ OR ▼ BUTTON
1003
DETERMINE FUNCTION WITH ▲ BUTTON
1004
CALL EACH FUNCTION
1005
STOP IF ◀ BUTTON IS PRESSED

FIG. 11

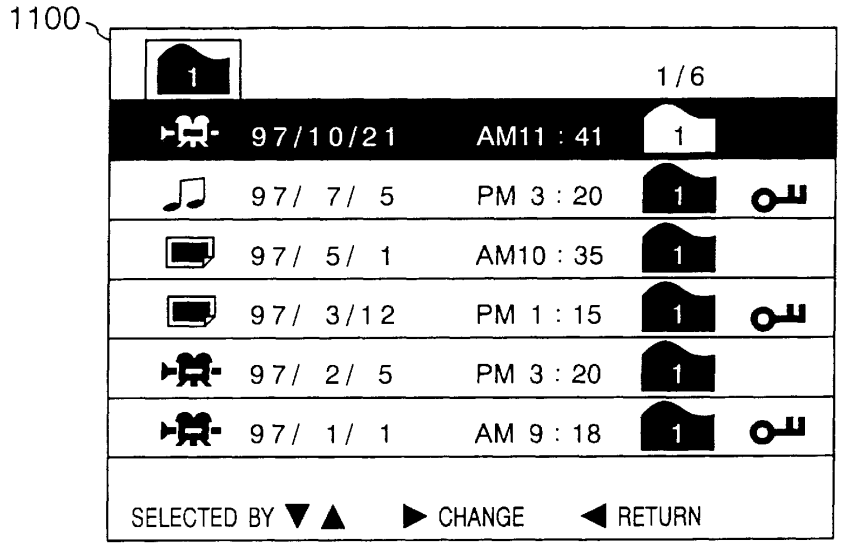

1100
1
1/6
97/10/21 AM11 : 41 1
97/ 7/ 5 PM 3 : 20 1
97/ 5/ 1 AM10 : 35 1
97/ 3/12 PM 1 : 15 1
97/ 2/ 5 PM 3 : 20 1
97/ 1/ 1 AM 9 : 18 1
SELECTED BY ▼ ▲ ▶ CHANGE ◀ RETURN

FIG. 12

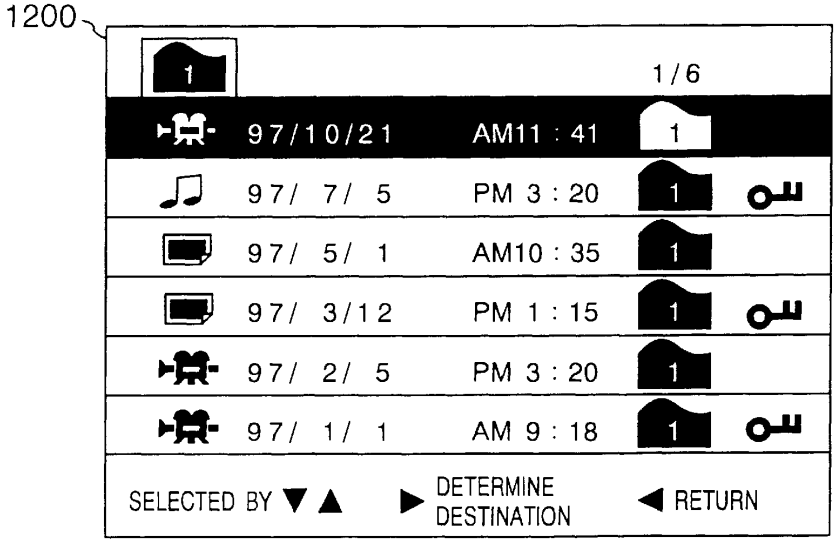

1200
1
1/6
97/10/21 AM11 : 41 1
97/ 7/ 5 PM 3 : 20 1
97/ 5/ 1 AM10 : 35 1
97/ 3/12 PM 1 : 15 1
97/ 2/ 5 PM 3 : 20 1
97/ 1/ 1 AM 9 : 18 1
SELECTED BY ▼ ▲ ▶ DETERMINE DESTINATION ◀ RETURN

FIG. 13

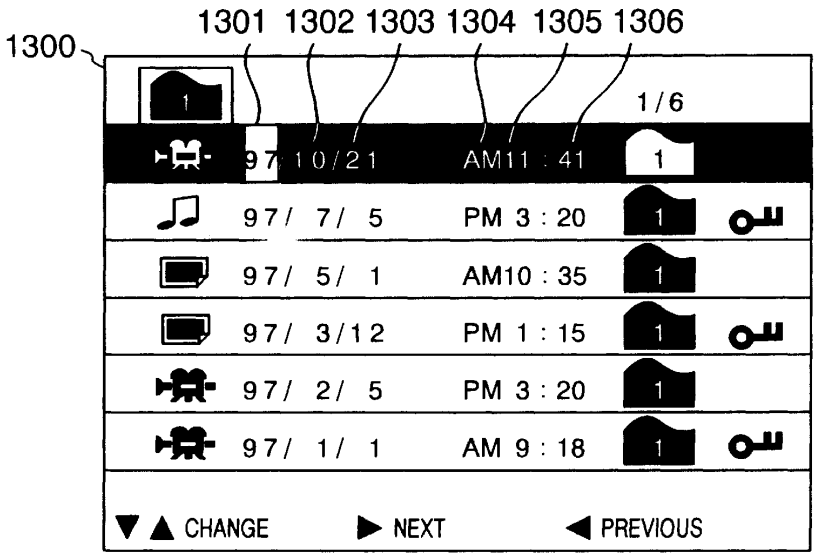

1300
1301 1302 1303 1304 1305 1306
1/6
97/10/21 AM11 : 41 1
97/ 7/ 5 PM 3 : 20 1
97/ 5/ 1 AM10 : 35 1
97/ 3/12 PM 1 : 15 1
97/ 2/ 5 PM 3 : 20 1
97/ 1/ 1 AM 9 : 18 1
▼ ▲ CHANGE ▶ NEXT ◀ PREVIOUS

FIG. 14

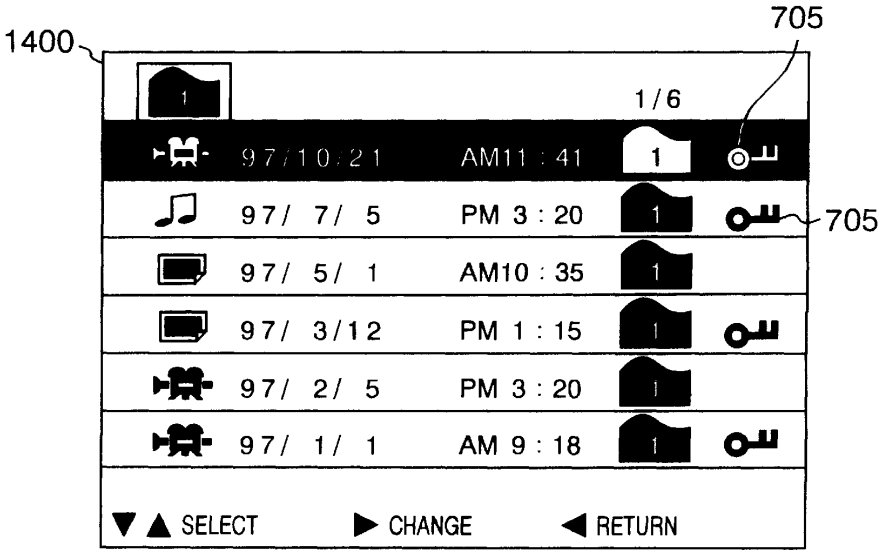

1400
705
1/6
97/10/21 AM11 : 41 1
97/ 7/ 5 PM 3 : 20 1
705
97/ 5/ 1 AM10 : 35 1
97/ 3/12 PM 1 : 15 1
97/ 2/ 5 PM 3 : 20 1
97/ 1/ 1 AM 9 : 18 1
▼ ▲ SELECT ▶ CHANGE ◀ RETURN

FIG. 15

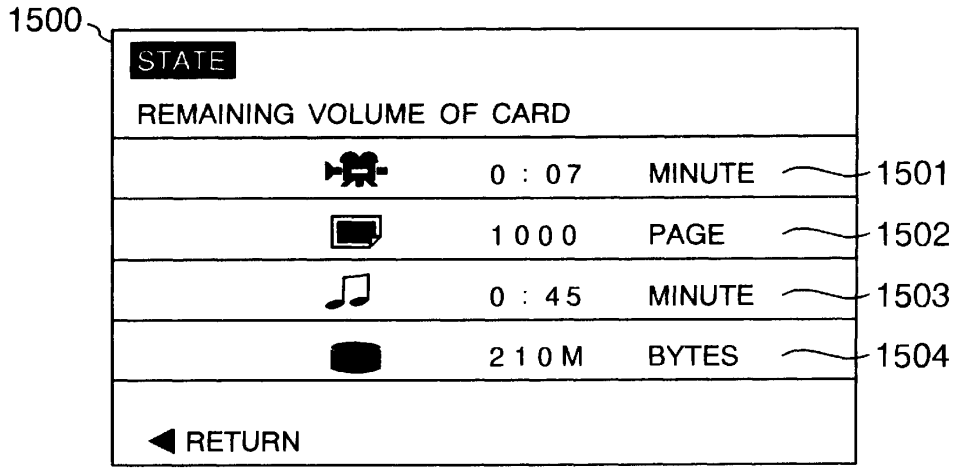

1500
STATE
REMAINING VOLUME OF CARD
0 : 07 MINUTE
1501
1000 PAGE
1502
0 : 45 MINUTE
1503
210M BYTES
1504
RETURN

FIG. 16

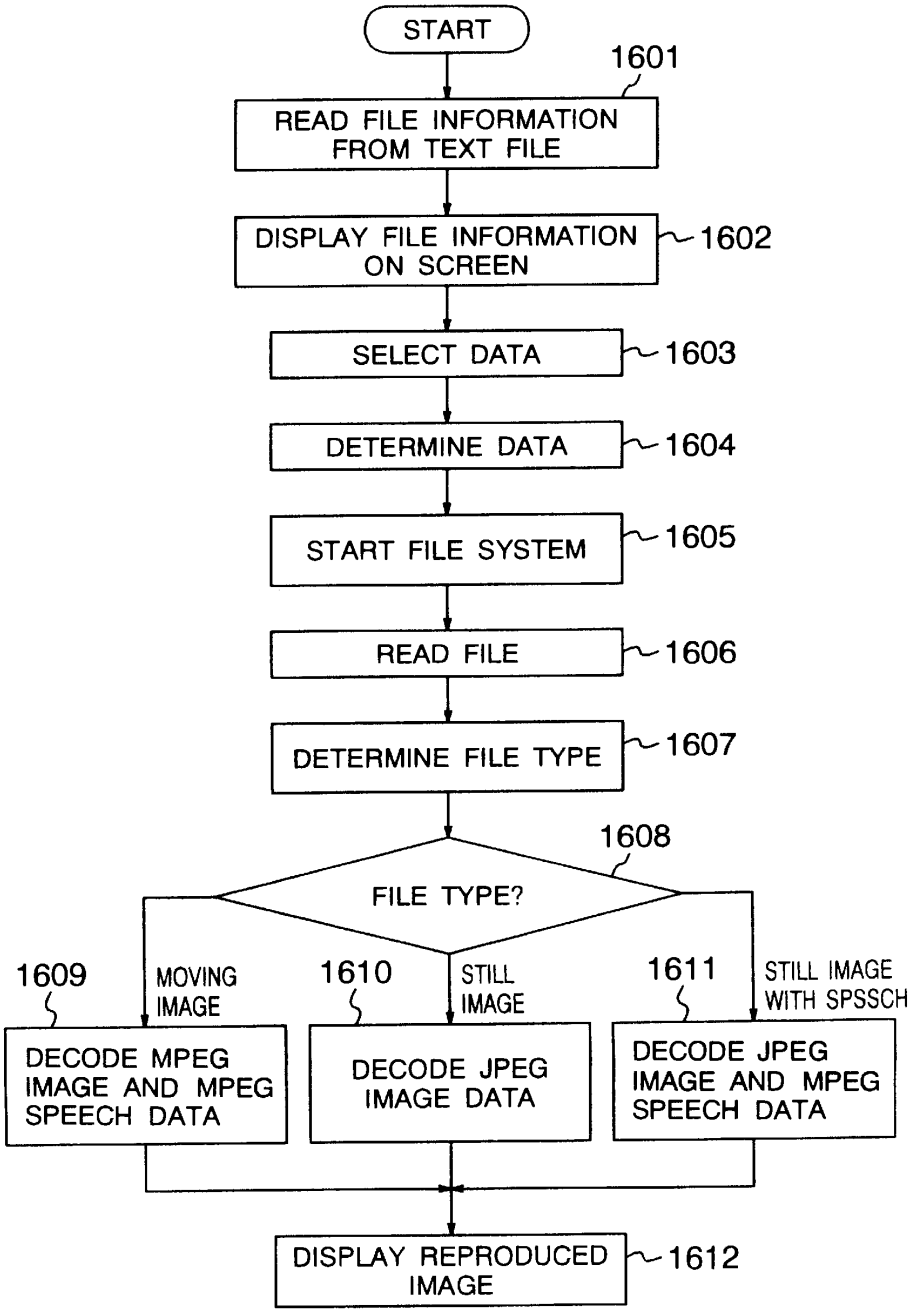

START
1601
READ FILE INFORMATION FROM TEXT FILE
DISPLAY FILE INFORMATION ON SCREEN
1602
SELECT DATA
1603
DETERMINE DATA
1604
START FILE SYSTEM
1605
READ FILE
1606
DETERMINE FILE TYPE
1607
1608
FILE TYPE?
1609
MOVING IMAGE
1610
STILL IMAGE
1611
STILL IMAGE WITH SPSSCH
DECODE MPEG IMAGE AND MPEG SPEECH DATA
DECODE JPEG IMAGE DATA
DECODE JPEG IMAGE AND MPEG SPEECH DATA
DISPLAY REPRODUCED IMAGE
1612

FIG. 17

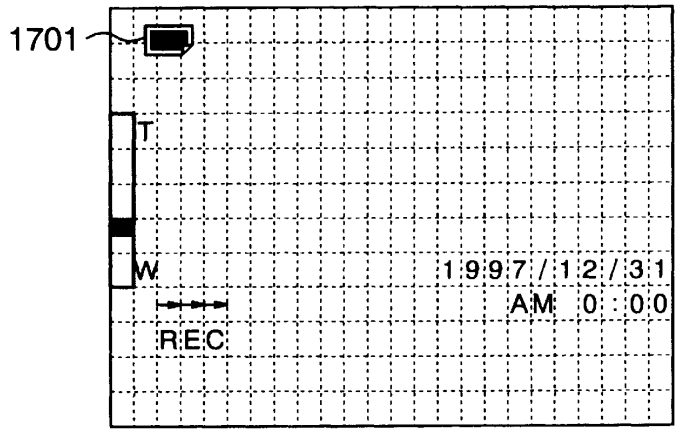
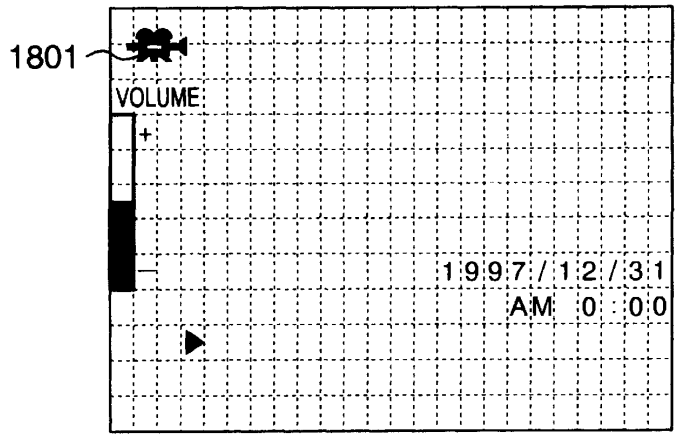



FIG. 18



# FIG. 19

| RECORDING MODE | MODE SYMBOL |
|---|---|
| MOVING IMAGE |  |
| STILL IMAGE |  |
| SERIAL STILL IMAGE |  |
| STILL IMAGE WITH SPEECH |  |

# APPARATUS FOR RECORDING AND REPRODUCING DIGITAL IMAGE AND SPEECH

## BACKGROUND OF THE INVENTION

The present invention relates to operativity of a portable digital camcorder.

The prior art relevant to the portable digital comcorder has been published as an electronic photograph system, that is, the so-called electronic still camera that is arranged to record a still image signal as a video signal in a memory composed of a semiconductor (termed as a semiconductor memory or simply a memory) as disclosed in JP-A-2-292974. With recent prevail of personal computers, recording mediums such as semiconductor memories and harddisks are progressively made lower in cost, smaller in size, and greater in capacity. At a time, the advance of signal compressing technology such as JPEG or MPEG allows even the small-sized equipment to record greater number of still images and moving ones. Taking a harddisk drive as an example, the resulting harddisk drive is kept as small as a card and has as great a capacity as about 300 Mbytes.

This type of harddisk drive enables to record about 3000 still images through the use of the JPEG compression and about 20-minutes moving picture through the use of the MPEG compression. It is thus necessary to improve the operativity of the portable equipment for retrieving, grouping, and deleting a great deal of recording data. The technique disclosed in JP-A-2-292974, however, does not provide means for retrieving a great deal of recording data quickly and easily. In actual, therefore, the technique does not have any means except the method of retrieving the great deal of recorded data as checking all images reproduced on screen from the recorded data.

In case that 3000 JPEG still images are recorded on a feasible media such as the aforementioned harddisk drive and then are retrieved as expanding those images on the screen one by one, about one second for expanding one JPEG still image is required. It means that the expansion of 3000 images needs about one hour. This method lacks in practicability. In order to retrieve a great deal of data, therefore, it is necessary to enhance the operating speed of the system.

## SUMMARY OF THE INVENTION

It is an object of the present invention to provide an apparatus which is arranged to overcome the foregoing shortcoming and enhance the operativity even if the apparatus is small-sized.

In carrying out the object, for improving the operativity of a small-sized apparatus, the present invention is achieved by an apparatus which comprises recording means for recording both imaging time information and imaging mode information for distinguishing moving images from still images at a time when taking the still image or moving image, display means for displaying as a list the informations as well as expanded images on a liquid crystal display screen built in the main body of the apparatus itself, and keying means for retrieving, classifying, and erasing the recorded data.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a diagram showing a state transition of a program used in an apparatus according to the present invention;



FIG. **2** is a view showing an outer appearance of a portable digital camcorder in which the program of FIG. **1** is executed;

FIG. **3** is an expanded view showing an operating switch portion provided in the portable digital camcorder in which the program of FIG. **1** is executed;

FIG. **4** is a circuit diagram showing an arrangement of a portable digital camcorder in which the program of FIG. **1** is executed;

FIG. **5** is a view showing a display screen provided in the portable digital camcorder in which the program of FIG. **1** is executed;

FIG. **6** is a view showing a display screen on which the recorded data is classified;

FIG. **7** is a view showing a display screen on which the recorded data is selected;

FIG. **8** is a view showing a display screen with expanded images in which the recorded data is selected;

FIG. **9** is a view showing a display screen on which the function details of the recorded data are selected;

FIG. **10** is a flowchart showing a method for selecting the function details;

FIG. **11** is a view showing a display screen on which the classifications of the recorded data are changed;

FIG. **12** is a view showing a display screen on which the displaying sequence of the recorded data is changed;

FIG. **13** is a view showing a display screen on which each date of the recorded data is changed;

FIG. **14** is a view showing a display screen on which each erasing attribute of the recorded data is changed;

FIG. **15** is a view showing a display screen on which a remaining state of the recording medium is displayed;

FIG. **16** is a flowchart showing a method for reading recorded data from a harddisk driver and reproducing it;

FIG. **17** is a view showing an imaged screen appearing if a still image recording mode is selected when recording an image;

FIG. **18** is a view showing an imaged screen appearing if a moving image recording mode is selected when recording an image; and

FIG. **19** is a view showing marks for modes;

## DESCRIPTION OF THE PREFERRED EMBODIMENTS

Later, the description will be oriented to the embodiments of the present invention with reference to FIGS. **1** to **19**.

FIG. **1** shows a flow of a software program according to an embodiment of the present invention.

The software program shown in FIG. **1** flows through the process of selecting a classification containing data to be played back or handled (**101**) and reaches the process of playing back the data (**103**) or flows to a function selecting items (**105**) in which a temporary discard (**106**), a complete abandon (**107**), a state display (**112**) of a storage unit, setting of protection from erasion (**111**), change of a display list (**109**), or change of a record date and hour (**110**) is selected. Moreover, when selecting a classification (**101**), the flow goes to the function selecting items (**105**) in which a temporary discard (**106**), a complete abandon (**107**), a state display of a storage unit (**112**), or automatic playback is selected. In the playback (**103**), a move to next data (**115**), a move to previous data (**116**), a fast playback (**117**), a rewind playback (**118**), or a temporary stop (**121**) is selected.

In the temporary stop (**121**), a forward frame advance (**119**) or reverse frame advance (**120**) is selected.

FIG. **2** shows an example of an outer appearance of a portable digital comcorder **200** in which the software program shown in FIG. **1** is executed. This camcorder **200** provides a capability of recording and reproducing an NTSC or PAL TV system signal.

FIG. **3** is an expanded view showing an operating switch portion of the portable digital camcorder shown in FIG. **2**. In the portable digital camcorder **200** shown in FIG. **2**, with the operating switches, a digital moving signal obtained from the camera system is compressed to one MPEG (Moving Picture Expert Group) format and then is recorded on a harddisk storage medium sized to a memory card. In the playback, with the operating switches, the MPEG1 format signal recorded in a memory card is expanded and then displayed on a display unit **201** built in the camcorder itself. The display unit may be connected to the outside of the comcorder **201**. The portable digital camcorder **200** shown in FIG. **2** may recorded the MPEG moving image data as well as the JPEG data for the still images and the MPEG speech format for the speech data.

FIG. **4** schematically shows a circuit arrangement of the portable digital comcorder **200**. At first, the description will be oriented to the procedure of recording the moving image through the portable digital comcorder **200**. When a user presses a recording switch **301**, an image of an object obtained through a lens **401** is converted into the corresponding electric signal through the effect of a CCD sensor **402**. The signal read out of a sensor is electrically processed through a CDS (Correlated Double Sampling) circuit for suppressing the low-frequency noises of the signal and a circuit **403** integrated with a AGC circuit for controlling an automatic gain of the signal for stabilizing the signal level. Then, the processed signal is converted into a digital signal through an ADC **404** and then is applied to a camera signal processing circuit **405**.

A camera signal processing circuit (camera DSP) **405** is configured of a function of converting a digital pixel signal from the sensor into a luminance signal Y and color difference signals U and V, a function of adding a synchronous signal, a function of controlling relation between an iris and a shutter speed, a function of adjusting a white balance, and a function of digitally zooming in or out the signal. Though not illustrated in detail in FIG. **4**, the camera DSP **405** is operated to feed a horizontal and a vertical driving signal pulses to the CCD sensor **402** and read the signal from the CCD sensor **402** as adjusting the timing between the synchronous signal and the pulses. Moreover, a camera control microcomputer **406** is operated to feed operating parameters for the DSP **405** to the camera DSP **405** in order to control the overall camera system.

On the other hand, the digital luminance signal Y and the digital color difference signals U and V obtained by the camera DSP **405** are sent to an MPEG1 encoder **409** through a digital bus line. The MPEG1 is a standard compression format for the digital signal for a moving image. The encoder **409** operates to compress the data according to the MPEG1 format and then convert it into the digital data. A numeral **410** denotes a working memory used in encoding the data according to the MPEG1 format. The data converted into the MPEG1 format is sent to a microcomputer **411** for controlling a transmission rate of the digital output data. The MPEG1 encoder **409**, the working memory **410** and the microcomputer **411** compose the overall system for compressing the moving image.



The microcomputer **411** for controlling the transmission rate stores a constant amount of MPEG1-formatted data in a buffer memory **412**. The formatted data is passed through an interface circuit **413** and a card connector **414** and reaches a harddisk drive **415**. The card connector **414** is configured on the PCMCIA standards and thus contains 68 pins. The harddisk drive **415** is sized to a memory card and subject to the PC card standards defined by the PCMCIA (Personal Computer Memory Card International Association).

The foregoing description has concerned with the method for recording the moving image. In case the still image recording mode is selected by the user, the MPEG encoder **409** is switched to a JPEG compressing circuit. Then, a still image data is generated at the encoder **409** and then transferred to the microcomputer **411** for doing the same operation as described above. The MPEG compression data process and the JPEG compression data process have the same common points, so that the use of both the data formats may effectively save the circuit scale. This is a well-known method for saving the circuitry.

Further, the speech signal is converted into an analog electric signal through a microphone **418**. The analog electric signal is sent to a speech ADC **419** for converting the analog electric signal into the corresponding digital data. The digital speech data is applied into the data bus through the effect of the MPEG encoder **409**. Then, the microcomputer **411** performs the MPEG-format-based compression through the program run therein so that the digital speech data is added to the moving image data or the still image data in precise time sequences.

According to this embodiment, the portable digital comcorder **200** is arranged to record the MPEG1-formatted data, the JPEG-formatted data, and the MPEG1-formatted speed data.

In recording the data, the microcomputer **411** also enables to record a data, a time, and a symbol for representing any one of the MPEG1-formatted data, the JPEG-formatted data, and the MPEG1-formatted data on a time when the recording switch **301** is pressed. At a time, the microcomputer **411** enables to record a symbol for representing a classification for retrieving the recorded data and a symbol for representing whether or not the operation of erasing the recorded data is prohibited. In recording the data, the classification symbol is recorded as "not classified" and the deletion symbol is recorded as "erasable".

In the general disk operating system, the symbol for indicating the imaging mode is discriminated using a code for a data type. The symbol for representing the classification and the symbol for representing if the data is erased are recorded in the corresponding files.

On the other hand, when recording the data, a digital signal applied to the camera DSP **405** as a monitoring signal is converted into an analog TV signal through the effect of an NTSC or PAL encoder built in the circuit **405** and then is fed at an output terminal **416** and the built-in display unit **201**. The foregoing description has concerned with the MPEG1-formatted moving image data with the speech. In actual, the JPEG-formatted data or the MPEG1-formatted speech data may be solely processed in the similar manner to the above operation.

When the system stays at the playback mode, the signal flows in an opposite manner to the flow at the recording mode. FIG. **16** is a flowchart showing the reproduction of the signal. Text data indicating information of data is read from the harddisk drive **415** (step **1601**). Next, the user retrieves data from a list of data displayed on the built-in display unit

201 and specifies the data to be played back with the operating switch **408** (step **1604**). The list of the recorded data displayed on the display unit **201** is a feature of the invention. With the specification, a file system is started (step **1605**) so that the data is read out of the harddisk drive **415** and then sent to the microcomputer **411** (step **1606**).

Then, the data type is discriminated (steps **1607** and **1608**). If the recorded data is the moving image, the MPEG-formatted moving image data and the MPEG-formatted speech data are both decoded (step **1609**). If the recorded data is the still image, the JPEG-formatted still image data is decoded (step **1610**). If the recorded data is the still image with the speech, the JPEG-formatted still image data and the MPEG-formatted speech data are both decoded (step **1611**). Then, the decoded image and the decoded speech if any are displayed on the screen (step **1612**).

An indication signal issued by the operating switch **408** is read by a sub-microcomputer **407** and then is sent to the microcomputer **411** through a camera-controlling microcomputer **406**. The software program according to this embodiment is read out of a ROM **417** (Read-only Memory) for storing a program and then is executed. In this embodiment, the program is stored in the ROM **417**. In place of the ROM **417**, another storage unit such as a flash RAM or a harddisk drive may be used for the purpose.

Next, the data is transferred to the buffer memory **412** through the PCMCIA connector **414** and the interface circuit **413**. The timing of the data stored in the buffer memory **412** is controlled by the microcomputer **411**. Then, the data whose timing is adjusted is sent to the MPEG1 decoder **409**. The decoder **409** switches the MPEG1 coding to the MPEG1 decoding or vice versa.

The data decoded by the MPEG1 decoder **409** is sent to the camera DSP circuit **405** through the digital path line. The decoded data is converted into an analog video signal through the effect of an NTSC or PAL encoder and a DAC built in the circuit **405** and then is led at an output terminal **416** and from the built-in display unit **201** to the outside of the apparatus. The foregoing description has concerned with the MPEG1-formatted moving picture data with the speech. The JPEG-formatted still image data or the MPEG1-formatted speech data may be solely processed in the same manner as described above.

The portable comcorder of this embodiment is arranged to use a harddisk unit of 260 MB for the harddisk drive **415**. In case that only the JPEG-formatted still image data is recorded, about 3000 still images may be recorded. In actual, the portable comcorder of this invention enables to retrieve 3000 items of data quickly and easily using the classifying function.

FIG. **4** shows a circuit arrangement about the moving image. The corresponding circuit arrangement to that of FIG. **4** is required for the still images and the speech. That is, the portable comcorder of this embodiment is arranged to have a general-purpose means for imaging a moving object/a still object, a microphone, means for digitally converting a moving image/a still image, means for digitally converting speech, and means for digitally recording a moving image, a still image, and a speech signal.

FIG. **5** shows the screen of the built-in display unit **201** used in the embodiment of the invention, in which the diagonal length is 1.8 inch (45.7 mm), the horizontal length is 36.6 mm, and the vertical length is 27 mm. The illustrated screen arrangement uses a liquid crystal consisting of 352 pixels and 240 pixels. In order to reduce the power consumption and the size of the portable digital camcorder **200**, the 1.8-inch liquid crystal is used for the built-in display unit **201**. This built-in display unit **201** shows an imaging screen formed by a monitoring signal when recording the signal, a retrieval screen formed by the program when retrieving the data, and a playback screen formed by the decoded data when playing back the data.

In recording the data, the moving image recording mode (MPEG compression recording mode) or the still image recording mode (JPEG compression recording mode) may be switched each time the mode selecting button is pressed. As the user can select the recording mode with this button, as shown in FIGS. **17** and **18**, the mark for each mode located in the upper left portion of the imaging screen is switched each time the mode is switched.

FIG. **17** shows the imaging screen appearing when the still image recording mode is selected when recording data. In FIG. **17**, a numeral **1701** denotes a mark representing a still image mode. FIG. **18** shows the imaging screen appearing when the moving image recording mode is selected when recording data. In FIG. **18**, a numeral **1801** denotes a mark representing the moving image mode. The mark for each mode appears on the screen so that the user can visually recognize the current imaging mode as he or she is pushing the mode selecting button. This mark allows the user to handle the comcorder without having to keep his eyes out of the imaging screen. It means that the digital comcorder offers convenient operativity to the user.

The mark for each mode is displayed on the retrieving screen through the effect of the program sent from a data containing unit. The retrieving screen will be discussed in detail together with the display of the mode mark. FIG. **19** shows the concrete mark for each mode. In actual, however, the marks are not limited to the illustrative ones. Any mark may be used if it can distinguish the modes from each other.

In FIG. **5**, the display screen **500** consists of 20×9 characters at maximum, each character consisting of 16 and 24 pixels. The character size consisting of 16×24 pixels keeps the maximum recognizable size compatible with efficient digitizing of the character data. The blanks of a left side **501**, a right side **502**, an upper side **503**, and a lower side **504** of the screen are secured because the display unit or the built-in display unit **201** connected to an output terminal **416** disables to display the overall area of the main screen.

A numeral **505** denotes an operating state display area where the operating state of the program of this embodiment is displayed. A numeral **506** denotes an area where the information of the recorded data and the functions to be operated for specifying the data details of the data by pressing a function switch **304** are displayed as individual items in partitioned sub-screens. A numeral **507** denotes an area where an operating procedure suggests the operating method to the user.

FIG. **6** shows a display screen **600** appearing when a program starting switch **303** is pressed by the user for starting the program of this embodiment. The display screen **600** corresponds to a classifying selection **101** of FIG. **1** for indicating the state transition of the operation. As mentioned earlier, the data recorded by the user is unconditionally recorded "unclassified" when recording the data. The figure (number of files) displayed on the "unclassified" row stands for the number of MPEG1-formatted moving image data items with the speech **602**, the number of JPEG-formatted still image data pieces **603**, and the number of MPEG1-formatted speech **604**.

Likewise, the figure displayed on each row of a mark **605** for indicating the first classification, a mark **606** for indi-

cating the second classification, and a mark **607** for indicating the third classification indicate the numbers of data items arbitrarily classified by the user, respectively. A mark **608** for indicating all data items at a batch indicates the total number of the data items on the "unclassified" row **601**, the "first classified" row **605**, the "second classified" row **606**, and the "third classified" row **607**.

A mark **609** for indicating the "temporary discard" means a classification for temporarily discarding the data items so that the user cannot erroneously erase the data items. With the mark **609**, the user can temporarily move the "unclassified", "first classified", "second classified", and "third classified" data items to the "temporary discard" row. The figure represented on the row of the mark **609** does not contain a figure represented on the row of the mark **608** for indicating all data items at a batch.

In FIG. **6**, the row of the mark **601** for indicating the unclassification is reversed to the rows of the other marks. It indicates that the mark **601** for indicating the unclassification is the selected item. In place of the reversing, another kind of way may be used such as change of a color. The software program is executed by the user so that the recorded data items whose classifying destinations are not changed are contained in the row of the mark **601** for indicating the unclassification.

When the upper arrow switch **305***a* of FIG. **3** is pressed by the user, the selected item is shifted upward by one row, while the lower arrow switch **305***c* is pressed, the selected item is shifted downward by one row.

In case that the selected item is an item on the first row of the display area **506**, that is, on the mark **601** for indicating the unclassification, when the user presses the upper arrow switch **305***a,* the selected item is shifted to the item on the sixth row of the display area **506**, that is, on the mark **609** for indicating the temporary discard. In case that the selected item is an item on the sixth row of the display area **506**, that is, on the mark **609** for indicating the temporary discard, when the user presses the lower arrow arrow **503***c,* the selected item is shifted to the item on the first row of the display area **506**, that is, on the mark **601** for indicating the unclassification.

When the user presses the right arrow switch **305***b,* the display screen is shifted into the screen on which the content of the classification of the selected row is represented.

Moreover, the guide indication **610** for the operating procedure is displayed so as to remind the user of the operation.

As an example, FIG. **7** shows a display screen **700** on which the mark **605** for indicating the first classification is selected so that the data items on the row of the mark **605** appear as ones to be selected if the right arrow switch **305***b* is pressed by the user. This function corresponds to the data selection **102** shown in FIG. **1**.

The display screen **700** is a screen on which a data item is to be retrieved from a data list and played back. The data list is a feature of the present invention. On the screen **700**, the data items recorded by the portable digital comcorder **200** may be listed using a mark **703** for representing a sort of data content of a recording start time **702**, a moving image, a still image, and a speech, a classifying mark **704**, and a mark **705** for protecting data from being erased by the erroneous operation.

The data items displayed on the screen **700** are ranged from the top to the down in the sequence of the recording year/month/day **701** and the recording start time **702**. Hence, the latest recorded data is listed on the topmost row, so that the user can effectively retrieve the data. The number of the pages of the displayed lists is checked, so that the lists are displayed as pages as indicated by a numeral **707**. In the page display **707**, a denominator indicates all the list pages, while a numerator indicates the current one of the list pages.

The imaging status of the user such as the recording date and time and the data type are automatically recorded as the aforementioned information, so that the user can manually record these pieces of information. Since the user may optionally change the classifying destination according to his or her purpose, the user's retrieval work for the destination data is made simpler and more efficient.

These pieces of information are all composed of a list represented in characters. This does not need a time consumed in expanding the compressed image data recorded on the media. Further, if the user selects a data item using the operating button, the screen can be rewound quickly, so that the quick retrieval is made possible.

This list retrieving operation may offer comfortable operativity without having to impose stress on the user who wants to quickly select the recorded image.

The selecting classification **706** indicates a classification selected by a display screen **600**. This embodiment has concerned with the user's selection of the first classification **605** on the display screen **600**.

The display list of the data items on the display screens **700** and **800** is arranged in the sequence of recording the data on the harddisk drive **415**, that is, in the sequence that the latest data item comes to the topmost row. Since the user may change the sequence of recording the data items on the harddisk driver **415**, he or she may change the display sequence. The data immediately after imaging is recorded on the topmost row (**701** of FIGS. **7** and **8**) of the display area **506** on the unclassified data selecting screen. If the user makes sure of the just imaged data, he or she only reproduces the data and makes sure of the topmost row of the display area **506** on the unclassified data selecting screen.

Like the display screen **600**, when the user presses the upper arrow switch **305***a,* the selected data item is shifted upward by one row. When the user presses the lower arrow switch **305***c,* the selected data item is shifted downward by one row. In this embodiment, the six rows of the data items are displayed on one screen. In case the user selects the sixth data item, if the lower arrow switch **305***c* is pressed, the seventh data item is displayed on the first row of the display area **506**. It means that the seventh data item is the selected item. The eighth, the ninth and the following data items are displayed on the second, the third, and the following rows, respectively.

On the other hand, for example, in case the seventh data item is selected, if the upper arrow switch **305***a* is pressed, the seventh data item is displayed on the first row of the display area **506**. The second, the third, the fourth, the fifth, and the sixth data items are respectively displayed on the rows after the first one, so the selected data item is changed to the sixth data item.

That is, the n-th data item is displayed on a remainder-th row on the display area **506**, in which the remainder is obtained by dividing n by 6.

In case the head data item or the tail one is selected, if the upper arrow switch **305***a* or the lower arrow switch **305***c* is pressed, like the display screen **600**, the data items containing the head and the tail items are displayed as a list so that the head or the tail data item is selected. Though FIG. **6** shows the one-page screen on which the number of folders is fixed, FIGS. **7** and **8** show the screen on which the pages

are increased or decreased in number according to the number of data items.

If the user selects the upper arrow switch **305***a* and the lower arrow switch **305***c* shown in FIG. **3** and depresses the right arrow switch **305**, the selected data is fed out of the output terminal **416** and is played back on the built-in display unit **201**.

While the data is being played back, the upper arrow switch **305***a,* the lower arrow with **305***c,* and the left arrow switch **30**, as shown in FIG. **3**, are served as fast feed, rewind, and stop, respectively. While the data is being played back, if the left arrow switch **305***d* served as a stop switch is pressed by the user, the playback is stopped, and the display screen **700** is displayed again. The state transition during the data playback is denoted by a numeral **103** of FIG. **1**.

Next, the description will be oriented to the display content on which reduced images are added to the recording date and time so that the content of the data may be easily recognized. In the state of the display screen **700**, if the user presses the reduced image display switch **302**, a reduced image **801** of the first frame of the data listed on the subject row is displayed on the display screen **800** shown in FIG. **8**. This makes it possible to surprisingly enhance the retrieval of the data. The state transition in the reduced image display function is denoted by a numeral **104** of FIG. **1**.

For example, in case that the viewable area of the 1.8-inch built-in LCD display unit **201** consists of 379 dots in horizontal and 220 dots in vertical, the reduced image **801** is adjusted to consist of 64 dots in horizontal and 48 dots in vertical. (if the LCD panel consists of 352 and 240 dots, the reduced image **801** consists of 240/48=5 dots in vertical and 352/5=70.4 in horizontal. From a vertical viewpoint, the reduced image is one-fifth and from a horizontal viewpoint, the reduced image is one-fifth with a slight margin.) In this reduction, three reduced images, the recording starting year month day **701**, the recording starting time **702**, the mark **703** representing the content type of the data indicating the moving image, the still image, and the speech, the classification mark **704**, and the mark **705** for protecting the data from being erroneously erased can be all displayed on one screen. This screen arrangement makes it possible to secure more visible reduced images on the display. Like the display screen **700**, on this display screen **800**, the data may be played back by pressing the operating button **305** and the like.

In this state, if the reduced image display switch **302** is pressed again, the display screen is returned to the display screen **600** for displaying the data classification. The reduced image is depicted in the RAM **410** shown in the circuit block of FIG. **4** through the effect of the control microcomputer **411** and the MPEG encoder **409**.

In turn, the description will be oriented to a function selecting display screen **900** for easily changing the display state from the data selecting display screen **700**. The function selecting display screen **900** includes the reduced number of operation switches and function items displayed thereon so that the ease of use in operation may be improved as viewing the screen. The operating switches **304**, **305***a,* **305***b,* **305***c,* and **305***d* shown in FIG. **3** implement the operating system for selectively operating the function. The state transition on the display screen **900** is denoted by a numeral **105** of FIG. **1**.

On the reduced image display screen **800**, the function selecting display screen **900** is displayed by the same procedure. On the display screen **600**, the display screen having the necessary functions such as "empty a garbage", "move to a garbage", "display a state", and "auto play" shown in FIG. **1** is displayed by the same procedure. In this case, the function items on the display screen **900** are not required to be identical with the function items on the data classifying display screen **600**.

The flow of operation on the display screen **900** is shown in FIG. **10**. The display screen **900** is displayed when the user pressed the function switch **304** on the display screen **700** (step **1001**). The selective movement of each item is indicated by the upper arrow switch **305***a* and the switch lower arrow switch **305***c*. If the user pressed the upper arrow switch **305***a,* the selected data item is moved upward by one row. If the lower arrow switch **305***c* is pressed, the selected data item is moved downward by one row (step **1002**). If the user presses the right arrow switch **305***b* (step **1003**), the function of the selected data item is executed (step **1004**). If the left arrow function switch **305***d* is pressed, the display screen **900** is returned to the data selecting display screen **700** (step **1005**).

As mentioned earlier, in this embodiment, the erasion of the data is realized by moving the data to the temporary discard location and then erase the data contained in the temporary discard location. The state transition of this function is denoted by a numeral **106** of FIG. **1**.

The procedure of erasing the data will be described below.

If the data is erased, the data is moved to the temporary discard location. In this case, the procedure for selectively executing "move the data to a garbage" will be described with reference to FIG. **9**.

At first, on the display screen **700**, the user selects the data item to be temporarily discarded with the upper arrow switch **305***a* and the lower arrow operating switch **305***c* and then depresses the function switch **304**. Then, the display screen **700** is changed to the display screen **900**. The user selects the "move data to a garbage" **901** with the upper arrow operation switch **305***a* and the lower arrow function switch **305***c* and then depresses the right arrow switch **305***b*. Then, the selected data item is moved to the garbage that is the temporary discard location. If the user presses the switch **306**, the similarly selected data is moved to the garbage.

When the user selects the "empty a garbage" **902** on the display screen **900**, all the data items left in the garbage are erased. The state transition of this function is denoted by a numeral **107** of FIG. **1**.

In the operating system, the user is required to do two operations for erasing the data. The two operations protect the data from the user's erroneous erasion.

As mentioned earlier, when recording the data, the classifying symbol to be allocated to each data item is an unclassified one. When playing back the data, the classification may be changed by the user's operation. This classifying function is used for classifying the data item. Hence, since the user classifies the data item for each destination, the ease of use of the retrieval may be surprisingly enhanced. The state transition of this function is denoted by a numeral **108** of FIG. **1**.

Later, the description will be oriented to the procedure for changing the data classification. On the display screen **700**, the user selects the data item whose classification is to be changed with the upper arrow switch **305***a* or the lower arrow operation switch **305***c* and then presses the function switch **304**. Then, the display screen is changed to the display screen **900**. The user selects the "change a group" **905** that is a function of changing the classification with the upper arrow operation switch **305***a* and the lower arrow

operation switch **305***c* and then presses the right arrow switch **305***b*. Then, a display screen **1100** is displayed on which the classification of the selected data shown in FIG. **11** is changed.

If the right arrow switch **305***b* is pressed on the display screen **1100**, the classification is cyclically changed from "unclassification" to 1 to 2 to 3 to "unclassification". In this embodiment, the update of the symbol for the classification according to the display screen is executed by the control microcomputer **411** at a time when the user presses the left arrow switch **305***d* and the display screen **600** appears. This is intended for enhancing the processing speed and retrying the user's operation.

As described earlier, unless the user does the following operation, the list indicated on the display screen **700** is arranged in the recording sequence of the recorded data. When playing back the data, the sequence may be changed so as to implement a simple editing function. The state transition of this function is denoted by a numeral **109** of FIG. **1**.

The procedure of changing the data displaying sequence will be described below. At first, on the display screen **700**, the user selects the data item whose displaying sequence is to be changed with the upper arrow switch **305***a* and the lower arrow switch **305***c*. Then, if the function switch **304** is pressed, the display screen **900** is displayed.

The user selects the "change a data display sequence" **906** that is a function of changing the display sequence with the lower arrow switch **305***c* and depresses the right arrow switch **305***b*. Then, the display screen **1200** shown in FIG. **12** is displayed, so that the display sequence of the selected data item may be changed. Next, the user specifies the location where the selected data is to be inserted with the upper arrow switch **305***a* and the lower arrow switch **305***c*. Then, if the right arrow switch **305***b* is pressed, the selected data item is inserted to the specified location. In this case, the sequence of the data item located after the specified location is shifted lower by one.

The portable digital camcorder **200** of this embodiment incorporates an internal clock for displaying on the display screen **700** the date and the time when the data is recorded. However, if failure such as run-down of a battery takes place while imaging an object, the recorded data and time may not be correctly displayed on the display screen **700**. In this embodiment, the user may operate to optionally change the date and time when the data is recorded. The state transition of this function is denoted by a numeral **110** of FIG. **1**.

Later, the description will be oriented to the procedure for changing the date and time. The user selects the data whose recording date and time are to be changed using the upper arrow switch **305***a* and the lower arrow switch **305***c*. Then, if the function switch **304** is pressed, the display screen **900** is displayed. The user selects the "change a recording date and time" **907** that is a function of changing the displaying sequence with the upper arrow switch **305***a* and the lower arrow switch **305***c*. Next, if the right arrow switch **305***b* is pressed, the display screen **1300** shown in FIG. **13** is displayed where the recording date and time of the selected data are to be changed.

In this state, when the user pressed the upper arrow switch **305***a,* the year figure **1301** is increased by 1, while the lower arrow switch **305***c* is pressed, the year figure **1301** is decreased by 1. When the right arrow switch **305***b* is pressed, the year figure **1301** is determined as a numeric value represented at the time point. Next, the user may specify the increment or decrement of the numeric value of a month figure **1302**.

Likewise, if the upper arrow switch **305***a* is pressed, the month figure **1302** is increased by 1, while if the lower arrow switch **305***c* is pressed, the month figure **1302** is decreased by 1. If the right arrow switch **305***b* is pressed, the month figure **1302** is determined as a numerical value displayed at the time point. Next, the user may specify the increment or decrement of a numerical value of a day figure **1303**.

Further, when the left arrow switch **305***d* is pressed, the year figure **1301** may be retried. The similar operation may be executed to set the day figure **1303**, an a.m or p.m. indication **1304**, a time figure **1305**, and a minute figure **1306**. After adjusting a value of the minute figure **1306**, if the right arrow switch **305***b* is pressed, the change of the recording date and time is terminated and the date and time of the data is changed to a new numeric value.

In the case of specifying an numeric value that does not exist in the calendar such as February 30, the numeric value is changed to the nearest date (that is, March 1) to the value.

In this embodiment, though the user can freely erase the data, the user may provide the data with an attribute of prohibiting the erasion for preventing the data from being erased. The state transition of this function is denoted by a numeral **111** of FIG. **1**.

Later, the description will be oriented to the procedure for adding the attribute of protecting the data from the erasion to the data. At first, on the display screen **700**, the user selects the data whose erasing attribute is to be changed with the upper arrow switch **305***a* or the lower arrow switch **305***c*. Then, the function switch **304** is pressed, so that the display screen **700** is changed to the display screen **900**. The user selects the "change a lock" **904** that is a function of changing the erasing attribute with the upper arrow switch **305***a* or the lower arrow switch **305***c*. Then, if the right arrow switch **305***b* is pressed, the display screen **1400** is displayed where the erasing attribute of the selected data shown in FIG. **14** is changed.

When the user pressed the right arrow switch **305***b,* the erasing attribute is cyclically changed from "disabled" to "enabled" to "disabled". The protecting mark **705** is displayed or not displayed according to the erasing attribute.

In this embodiment, the user can know the remaining volume of the harddisk drive **415**. The state transition of this function is denoted by a numeral **112** of FIG. **1**.

Hereafter, the description will be oriented to the procedure for checking the remaining volume of the harddisk drive **415**. On the display screen **700**, if the user presses the function switch **304**, the display screen **700** is changed to the display screen **900**. The user selects the "display a state" **903** that is a function of changing the displaying sequence with the upper arrow switch **305***a* or the lower arrow switch **305***c*. Then, if the right arrow switch **305***b* is pressed, the display screen **1500** is displayed where the remaining volume of the harddisk drive **415** shown in FIG. **15** is shown.

On the display screen **1500**, a remaining time **1501** left if only the MPEG1-formatted moving image data with the speech is recorded on the harddisk drive **415**, a remaining pages left if only the JPEG-formatted still image data is recorded, a remaining time **1503** left if only the MPEG1-formatted speech data is recorded, and a remaining volume **1504** represented in bytes are all displayed as a list. Since the remaining volume of the harddisk drive is listed with respect to each recordable data type, the user can more easily grasp the remaining volume of the harddisk drive **415**.

In this embodiment, when playing back the data, the user needs to use only the switches **305***a,* **305***d,* **305***c* and **305***d* for playing back the data. It is epoch-making that the

minimum number of operating switches are just required for playing back the data.

Another epoch-making point is the increase of the functions without increasing the operating buttons by using the functional selecting screen **900**.

In this embodiment, as shown in FIG. **6**, the classified number of data items is four including "unclassified". The classified number of data may take any value. On the data selecting display screen **700**, the data items may be displayed as a list independently of the types of the moving image, the still image, and the speech. This embodiment may apply to the function of automatically classifying the data according to the data type with the user's specification.

Moreover, the control microcomputer **411** is operated to automatically select the data according to the imaging modes such as the moving image and the still image. For example, the user can select only the imaging mode for the still image, pick up only the image type of the still image, and reproduce it.

The foregoing description has been concerned with the specific embodiments of the invention. The present invention may apply to the following arrangement.

For example, the present invention may be achieved by an image recording apparatus which includes converting means for converting a video signal into a digital signal, a codec unit for selectively performing a MPEG system or a JPEG system compression about the digital signal, for generating the compressed data, a recording unit for recording the compressed data, and a selective indicating means for a compression mode, for selectively indicating the MPEG system compression or the JPEG system compression.

This image recording apparatus may be applicably arranged to switch the compressing system of the codec unit according to the indication given by the selective indicating means.

Further, the image recording apparatus may be applicably arranged to add a code for indicating the compression system to the compressed data according to the indication given by the selective indicating means.

Further, the image recording apparatus may be applicably arranged so that the codec unit may be a circuit for performing the MPEG system and the JPEG system processing at one process.

Moreover, the image recording apparatus may be applicably arranged so that the video signal is obtained from an imaging element and the recording unit is a harddisk drive.

The present invention may be also achieved by the image reproducing apparatus which includes a recording unit for receiving compressed data generated according to the MPEG system or the JPEG system and recording the compressed data, specifying means for specifying a data item to be reproduced of the compressed data recorded in the recording unit, readout means for retrieving and reading out the compressed data specified by the specifying means from the recording unit, a codec unit for selectively performing the MPEG system or the JPEG system expansion about the compressed data and generating the digital signal, and converting means for converting the digital signal generated by the codec unit into a video signal.

Moreover, the image reproducing apparatus may be applicably arranged so that the expanding system of the codec unit may be switched according to the compressed data read out of the readout means.

Further, the image reproducing apparatus may be applicably arranged so that the compressed data of the recording unit pre-contains the code indicating the compressing system and the expanding system of the codec unit may be switched according to the code for indicating the compressing system added to the compressed data read out of the readout means.

Further, the image reproducing apparatus may be applicably arranged so that the codec unit may be a circuit for performing the MPEG system and the JPEG system expansion at one process, the video signal is output to the built-in display unit, and the recording unit may be a harddisk drive.

The present invention may be achieved by the image recording and reproducing apparatus for converting a video signal into a digital signal, recording the digital signal, converting the digital signal into the video signal, and reproducing the video signal, which includes a codec unit for selectively performing the MPEG system or the JPEG system compression about the digital signal for generating the compressed data in recording the data and selectively performing the MPEG system or the JPEG system expansion about the compressed data for generating the digital signal in reproducing the data, a recording unit for recording the compressed data, selective indicating means for the compressing mode for selectively indicating the MPEG system compression or the JPEG system compression, specifying means for specifying the data to be reproduced of the compressed data recorded in the recording unit, and readout means for retrieving and reading the compressed data specified by the specifying means from the recording unit.

Moreover, the image recording and reproducing apparatus may be applicably arranged so that the codec unit may switch the compressing system according to the indication given by the selective indicating means in recording the data or the expanding system according to the compressed data read out of the readout means in reproducing the data.

Further, the image recording and reproducing apparatus may be applicably arranged so that in recording the data, the recording unit adds the code for indicating the compressing system to the compressed data according to the indication given by the selective indicating means and records the compressed data and in reproducing the data, the codec unit switches the expanding system according to the code for indicating the compressing system added to the compressed data read out of the readout means.

Moreover, the image recording and reproducing apparatus may be applicably arranged so that the codec unit may be a circuit for performing the MPEG system and the JPEG system processing at one process, the video signal to be recorded is obtained from an imaging element, the video signal to be reproduced is output to the built-in display unit, and the recording unit is a harddisk drive.

As described above, as keeping the capacity of the recording medium larger and advancing the compressing technology, the data items to be recorded on one recording medium are increased in number. This embodiment, however, makes it possible to do the recording and the reproducing operations with quite few keys. Hence, this embodiment offers the below-indicated effects, so that it may improve the operativity even if it is applied to the small-sized apparatus with a limited space prepared for the operation buttons or switches.

This embodiment may display the recording date and time information and the marks for modes such as the moving image, the still image, and the still image with the speech as a list. Hence, the user can efficiently and quickly retrieve the data as grasping the content of the data. In recording the

data, the marks are switchably displayed on the imaging screen each time the mode is switched so that the user can grasp the current imaging mode. Hence, the user can focus his or her attention onto the imaging screen at any mode when recording the data.

The display list is composed of a date and a time. The apparatus of this embodiment may automatically create the overall list and at once output the reduced images, so that the user can more easily grasp the content of the data.

The imaged data may be classified to the predetermined locations. Hence, the imaged data may be classified on the mode information and the date and time information according to the imaging statue and the object. This classification makes it easier for the user to retrieve the data.

Further, the displaying sequence of the list and the generating sequence of the data are allowed to be replaced depending on the mode information and the date and time information. Hence, the optimal reproducing effect can be obtained without having to depend on the recording sequence.

Then, the classification of "temporary discard" is provided for preventing the erasion of the data resulting from the user's erroneous operation and reusing the unnecessary data if it is made necessary after being deleted.

As described above, if the operation on the relatively simple graphic screen is executed to record a great deal of data, the function of this embodiment enables to offer quicker retrieval than the conventional function of reproducing the data as expanding all image screens.

What is claimed is:

**1**. A digital camera comprising:

a lens,

an imaging device which converts an optical image into an analog signal;

an A/D converter which converts the analog signal from said imaging device to a digital signal;

a compressor which compresses said digital signal outputted from said A/D converter, and generates compressed data by using a different compressing method for moving image signals than for still image signals;

a recording circuit which records compressed data, said compressed data including a moving image signal, and a still image signal;

a decompressor which decompresses said compressed data by using a different decompressing method according to whether said recorded compressed data is a moving image signal or a still image signal;

a reproducing circuit which reproduces a moving image signal, a sound signal in synchronous to said moving image signal, and a still image signal; and

a display which displays moving image signals and still image signals outputted from said reproducing circuit, and a list of said moving image signals and still image signals in a search mode;

wherein said recording circuit records recording information data for distinguishing a moving image signal from a still image signal and recording time data for indicating when an image is recorded, and said list of image signals displayed by said display in a search mode includes a plurality of marks for distinguishing a moving image signal from a still image signal and said recording time data corresponding to each displaying mark.

**2**. A digital camera comprising:

a lens,

an imaging device which converts an optical image into an analog signal;

an A/D converter which converts the analog signal from said imaging device to a digital signal;

a compressor which compresses said digital signal outputted from said A/D converter, and generates compressed data by using a different compressing method for moving image signals than for still image signals;

a recording circuit which records compressed data, said compressed data including a moving image signal, and a still image signal;

a decompressor which decompresses said compressed data by using a different decompressing method according to whether said recorded compressed data is a moving image signal or a still image signal;

a reproducing circuit which reproduces a moving image signal, a sound signal in synchronous to said moving image signal, and a still image signal; and

a display which displays said moving image signals and still image signals outputted from said reproducing circuit, a list of said moving image signals and still image signals in a search mode, and a list of classifications in a classification mode;

wherein said recording circuit records an image signal with classification data and information data for distinguishing a moving image signal from a still image signal, and recording time data for indicating when an image is recorded, and

said display displays a plurality of classifications and a number of moving image signals, still image signals, still image with sound signals, distinguishably, belonging to each classification in said classification mode,

after selecting one classification in said classification mode by a user, said search display displays a list of a plurality of image signals belonging to the selected classification with a mark for distinguishing a moving image signal from a still image signal and a recording time corresponding to each mark.

**3**. A digital camera according to claim **1**, wherein said recording information data includes recording time data for indicating when a image is recorded, and said display displays said recording time information corresponding to each displaying image signals.

**4**. A digital camera according to claim **1**, wherein said recording time data indicates recording start date and recording start time.

**5**. A digital camera according to claim **1** or **2**, said recording circuit records a sound signal in synchronous to said moving image signal and a sound signal in synchronous to said still image signal and recording information data for distinguishing a still image signal with a sound signal from a still image signal without a sound signal, and said display displays a mark for distinguishing a still image signal with still image signal with a sound signal from a still image signal without a sound signal corresponding to each displaying image signals.

**6**. A digital camera according to claim **1**, wherein said recording information data includes reduced image data.

**7**. A digital camera according to claim **2**, wherein said recording information data includes reduced image data, and said display displays plurality of said reduced image signal.

**8**. A digital camera according to claim **1**, wherein said displays the information data recorded later on higher locations of the display screen.

9. A digital camera according to claim 2, wherein said displays the image recorded later on higher locations of the display screen.

10. A digital camera according to claim 8, wherein the display sequence may be changed by a user's direction.

11. A digital camera according to claim 7, wherein the display sequence may be changed by a users direction.

12. A digital camera according to claim 1, wherein said display displays said mark and said recording time corresponding to each displaying mark on same row as graphic and literary notation.

13. A digital camera according to claim 2, wherein said display displays said image and said mark and said recording time corresponding to each displaying mark on same row as graphic and literary notation.

14. A digital camera according to claim 1, wherein said recording information data includes information indicating preventing erasion, and said display displays a mark indicating preventing erasion.

15. A digital camera according to claim 2, wherein said recording information data includes information indicating preventing erasion, and said display displays a mark indicating preventing erasion.

16. A digital camera according to claim 1, wherein said displays at least one of function buttons which representatives moving recorded data to a temporary discard area, erasing all data to a temporary discard area, changing a retrieving classification, changing display sequences, changing an erasing attribute, displaying a remaining volume.

17. A digital camera according to claim 2, wherein said displays at least one of function buttons which representatives moving recorded data to a temporary discard area, erasing all data to a temporary discard area, changing a retrieving classification, changing display sequences, changing an erasing attribute, displaying a remaining volume.

18. A digital camera according to claim 1, further comprising a storage medium; wherein display displays remaining volume of said storage medium.

19. An image recording and reproducing apparatus according to claim 1, wherein after one data of the plurality of data displayed in a search display is selected by an user, said display displays plurality of said image signal belonging to selected data.

20. A digital camera according to claim 2, wherein said recording circuit records image signal with classification data, and said display displays plurality of classification and a number of image belonging to each classification as a classification screen mode, and after directing one classification on said classification screen mode said by an user, said display displays plurality of said image signal belonging to selected classification with a mark for distinguishing a moving image signal from a still image signal.

21. A digital camera according to claim 2, wherein said display displays a number of each moving image, still image, still image with sound, distinguishably, belonging to each classification.

22. A digital camera according to claim 2, wherein said classification is able to change by a direction of a user.

23. A digital camera according to claim 2, wherein said display said classification including image without a direction of a user higher of a screen.

24. A digital camera according to claim 2, further comprising:

a button for changing the display screen from said classification screen mode to a mode displaying said plurality of image,

a button for selecting each recording data from a list of the recording data,

a button for indicating a function of playing back stopping, fast feeding, and rewinding said image,

a button for changing said display screen for indicating the functions into display screen for indicating a recording mode,

wherein said buttons integrated same one button.

25. A digital camera comprising:

a lens,

an imaging device which converts an optical image into an analog signal;

an A/D converter which converts said analog signal from said imaging device to a digital signal;

a compressor which compresses said digital signal outputted from said A/D converter, and generates compressed data by using a different compressing method for moving image signals and for still image signals;

a recording circuit which records compressed data, said compressed data including a moving image signal, and a still image signal;

a decompressor which decompresses said compressed data by using a different decompressing method according to whether said recorded compressed data is a moving image signal or a still image signal;

a reproducing circuit which reproduces a moving image signal, a sound signal in synchronous to said moving image signal, and a still image signal; and

a display which displays said moving image signals and still image signals outputted from said reproducing circuit, and a list of said moving image signal and still image signal as a search mode, and a list of classifications as a classification mode;

wherein said recording circuit records each one of said plurality of image signals with classification data, and

said display lists a plurality of classifications and a number of images belonging to each classification.

26. A digital camera according to claim 25,

wherein said display displays a number of each moving image, still image, still image with sound, distinguishably, belonging to each classification.

27. A digital camera according to claim 25,

wherein said classification is able to change by a direction of a user.

28. A digital camera according to claim 25,

wherein said display said classification including image without a direction of a user higher of a screen.

29. A digital camera comprising:

a lens,

an imaging device which converts an optical image into an analog signal;

an A/D converter which converts said analog signal from said imaging device to a digital signal;

a compressor which compresses said digital signal outputted from said A/D converter, and generates compressed data by using a different compressing method for moving image signals and for still image signals;

a recording circuit which records compressed data, said compressed data including a moving image signal, and a still image signal;

a decompressor which decompresses said compressed data by using a different decompressing method according to whether said recorded compressed data is a moving image signal or a still image signal;

a reproducing circuit which reproduces a moving image signal, a sound signal in synchronous to said moving image signal, and a still image signal to a storage medium;

a display which displays said moving image signal and still image signal outputted from said reproducing circuit;

wherein said recording circuit records recording information data for distinguishing a moving image signal from a still image signal to said storage medium, and said display displays a remaining time if only compressed moving image data is recorded to said storage medium, a remaining pages if only compressed still picture image data is recorded to said storage medium, and a remaining volume of said storage medium as a remaining volume displaying mode.

**30**. A digital camera according to claim **2**, wherein after one data of the plurality of data displayed in a search display is selected, said display displays said image signal belonging to the selected data.

**31**. A digital camera according to claim **25**, wherein after one data of the plurality of data displayed in a search display is selected, said display displays said image signal belonging to the selected data.

* * * * *

# *KODAK DIGITAL SCIENCE™*
## DC210 Plus Zoom/DC200 Cameras




# User's Guide

***for the cameras, KODAK Installation Software, KODAK DC200/DC210 Mounter Software, and KODAK Acquire/TWAIN Software.***

***Visit Kodak on the World Wide Web at www.kodak.com***

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The FlashPix format is defined in a specification and test suite developed and published by Kodak in collaboration with Microsoft, Hewlett-Packard, and Live Picture. Only products that meet the specification and pass the test suite may use the FlashPix name and logo.

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# Getting Started

Congratulations on your purchase of the new *KODAK DIGITAL SCIENCE*™ DC210 Plus Zoom (DC210) or *KODAK DIGITAL SCIENCE*™ DC200 Camera (DC200). The cameras that capture pictures digitally, without the use of film.



The DC200 camera features:

- ✓ built-in flash with red-eye reduction
- ✓ an easy to use status display of camera settings
- ✓ removable memory card
- ✓ video out capabilities which allow you to connect and run a slide show on your TV
- ✓ color LCD to immediately see or preview your pictures
- ✓ software to easily transfer pictures from the camera to your computer
- ✓ a mode dial to activate one of four different functions on the camera:

  **Capture—**takes, previews, or deletes a picture and adjusts the exposure

  **Review—**review or delete pictures

  **Preference—**adjust camera settings

  **Connect—**camera communicates with your computer

The DC210 has all of the features of the DC200 plus:

- ✓ infrared remote connection to compatible devices
- ✓ 2X zoom lens (29 to 58mm) to zoom in on subjects and a close up option to set the focus at 8in. (20cm)

The pictures used in this manual were captured with a Kodak digital camera. This user's guide includes operating instructions for the DC200/DC210 cameras and detailed information on the KODAK Installation Software (chapter 5), Mounter Software (chapter 7), and TWAIN Software (chapter 8). Instruction manuals for the additional software packages included on the DC200/DC210 CD are included in the camera package.



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## Package Contents

- ✓ DC200/DC210 camera with handstrap
- ✓ user's guide
- ✓ quick setup guide(s)
- ✓ four AA batteries
- ✓ registration cards
- ✓ DC200/DC210 software CD
- ✓ video output cable
- ✓ PC serial cable
- ✓ *KODAK DIGITAL SCIENCE* Picture Card
- ✓ AC adapter (available in some DC210 camera outfits)

## Camera Specifications

**Picture Pixel Resolution—**
**High—**1152 x 864 = 995,328
**Standard—**640 x 480 = 307,200

**CCD Resolution—**
1160 x 872 = 1,011,520

**Flash Range—**
**DC200—**2.23 ft. to 9.84 ft. (0.7 to 3.0 m)
**DC210—**
**wide—**1.6 to 9.84 ft.(0.5 to 3.0 m)
**telephoto—**3.2 to 8.8 ft. (1.0 to 2.7 m)

**Color—**24-bit, millions of colors

**Storage—**external memory only
ATA Compatible Compact Flash Card

**Power—** 4 AA batteries

**Shutter Speed—**1/2 to 1/362 sec

**File Format—**FlashPix or JPG

**Lens—**optical quality glass

**Weight—**without batteries
**DC200—**11.64oz. (330 g)
**DC210—**11 oz. (320 g)

**Video Out—**NTSC or PAL

**Operating Temperature—**
40 to 104° F (4.4 to 40° C)

**Focus Distance—**
**DC200—**
**fixed—**2.23 ft. (.68 m) to infinity
**DC210—**
**wide—**1.64 ft. (0.5 m) to infinity
**telephoto—**3.28 ft. (1 m) to infinity
**close up—**8 in. (20 cm)

**Sensitivity—**ASA/ISO rating equivalent to 140

**Accessary Lens Thread—**
37 mm—DC200 only

**Viewfinder—**Real image

**Tripod Socket—**.25 in.

**Focal Length—**
**DC200—**6.0 mm
Actual is 39mm
**DC210—**2X zoom lens-4.4 to 8.8 mm
Actual is 29 to 58 mm
Equivalent for 35 mm camera

**Aperture—**
**DC200—**f/4 to f/13.5
**DC210—**
**wide—**f/4 to f/13.5
**telephoto—**f/4.7 to f/16

**Dimensions—**5.15 X 1.87 X 3.20 in. (131 X 48 X 82 mm)

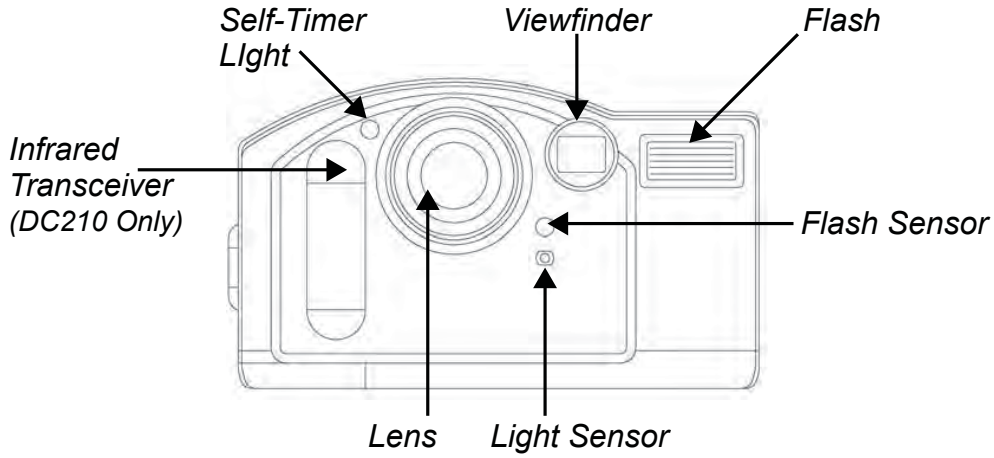


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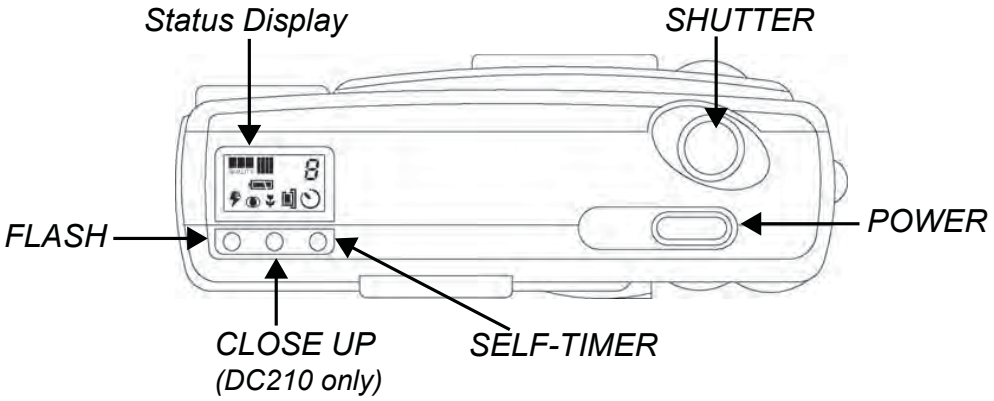
# Your DC200/DC210 Camera

☞ The illustrations throughout this user's guide are of the DC210 unless otherwise stated.

## Camera Front




## Camera Top

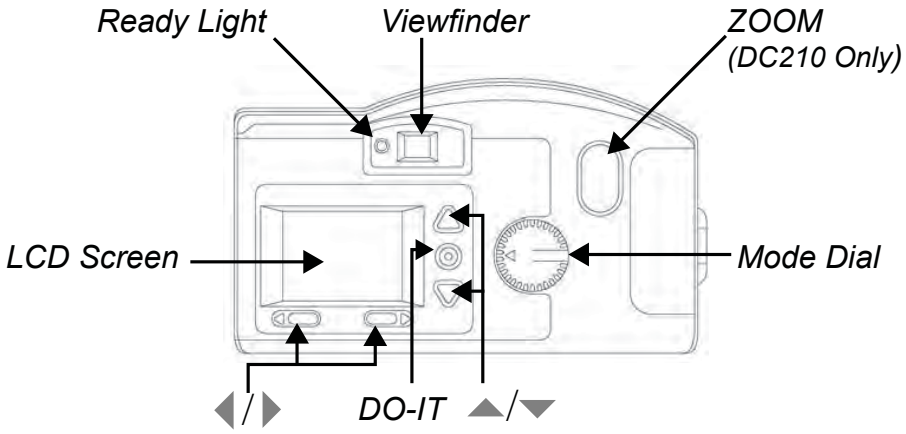




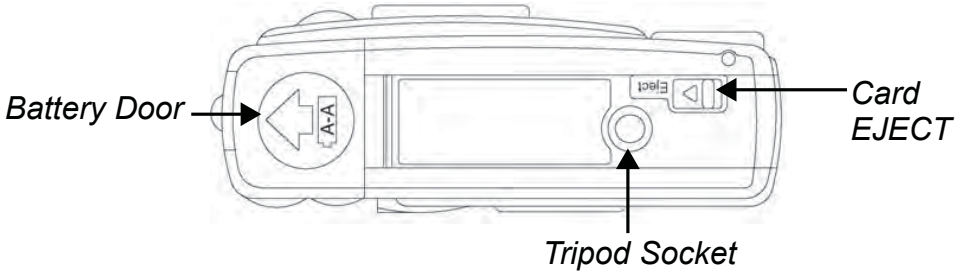



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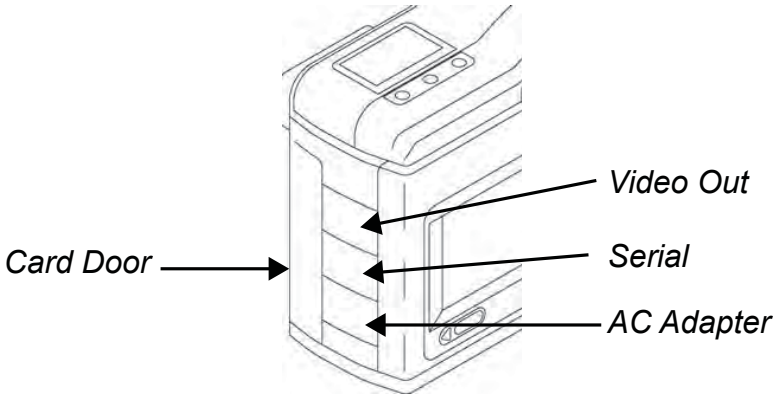
## Camera Back




## Camera Bottom




## Camera Side






BlackBerry Corporation Exhibit 1004, pg. 745

# 2 Capturing a Picture

When the Mode dial is set to Capture, the camera can perform the following functions:

- ✓ capture a picture
- ✓ preview pictures on the Liquid Crystal Display (LCD)
- ✓ delete a picture just taken
- ✓ adjust the exposure
- ✓ adjust some camera settings using the Status Display



## Camera Power

**To turn the camera on/off:**



Press the POWER button.

*The green Ready light, on the back of the camera, and the Status Display screen turns on or off.*

☞ If the camera is turned off while a picture is being processed, the camera will finish processing the picture before turning off.

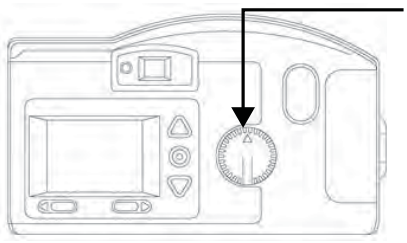
If you are not using an AC power adapter and your camera is idle for approximately 5 minutes, it automatically turns off. To turn the camera on again, press the camera's power button.



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## Take a Picture

**To take a picture:**



1. Set the Mode dial to Capture.
2. Turn the camera on.
3. Center subject in the viewfinder.
4. Press the SHUTTER button.

*The green Ready light, Memory Card icon, Pictures Remaining number on the Status Display blink rapidly, as the camera processes the picture.*

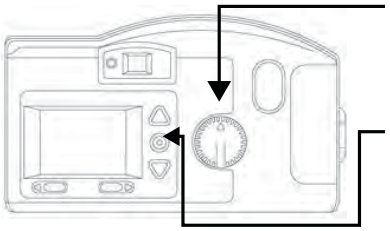
☞ You do not need to hold the camera still while the green Ready light is blinking, but you will not be able to take another picture until it stops.

## Preview

You may also use the LCD as a live viewfinder while in Capture mode. This allows you to preview your picture before it is taken.

☞ Using the Preview option significantly shortens battery life.

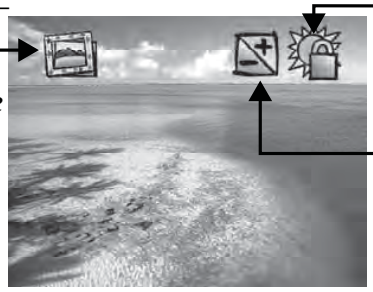
**To activate Preview:**



1. Set the Mode dial to Capture.
2. Turn the camera on.
3. Press the DO-IT button.

   *The LCD displays the subject that is viewed from the viewfinder with the icons of activated camera features.*

***Template icon**—appears if the template option is activated. See "Template" on page 4-4 for details.*



***Exposure Lock icon**—appears if the exposure lock option is activated. See "Exposure Lock" on page 2-5 for details.*

***Exposure Compensation icon**—appears if the exposure value is adjusted. See "Exposure Compensation" on page 2-4 for details.*

**To exit:** press the DO-IT button again to turn Preview off. The Preview setting automatically turns off when the camera is turned off.



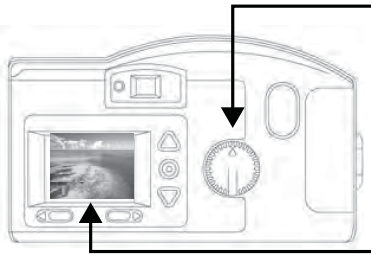
BlackBerry Corporation Exhibit 1004, pg. 747

## Delete One Picture

You may delete the picture that was just taken without leaving Capture mode.

☞ This delete feature is only available when the picture is shown on the LCD and the Quickview option is activated. See “Quickview” on page 4-7.

**To delete the most recent picture taken in Capture mode:**

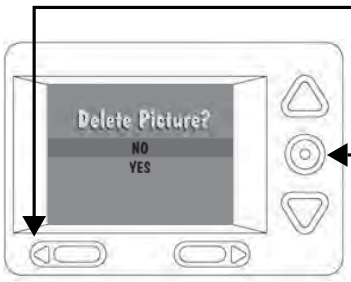


**1** Set the Mode dial to Capture.

**2** Turn the camera on.

**3** Take a picture.

*The picture is displayed on the LCD.*




**4** Press the ◀ button.

*The delete screen appears in the LCD.*

☞ The picture must be showing on the LCD screen to activate the delete screen.

**5** Press a ▲/▼ button until the correct delete option is highlighted.

**6** Press the DO-IT button.

*The picture is deleted from the memory card.*

**To exit:** press a ▲/▼ button until NO is highlighted and then press the DO-IT button.





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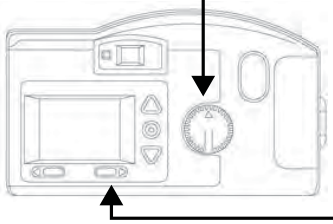
## Exposure Compensation

The camera's exposure value (EV) can be adjusted from -2.0 to +2.0 EV in 0.5 EV increments while in Capture mode. A +1.0 adjustment in EV, in effect doubles the amount of light allowed to reach the CCD (charge coupled device) in your camera. A -1.0 adjustment in EV, halves the amount the light allowed to reach the CCD in your camera. Below shows how changes in EV can effect your pictures.

If your pictures are too:

- ✓ **dark—**increase (+) the exposure compensation setting
- ✓ **light—**decrease (-) the exposure compensation setting

**To change Exposure Compensation:**

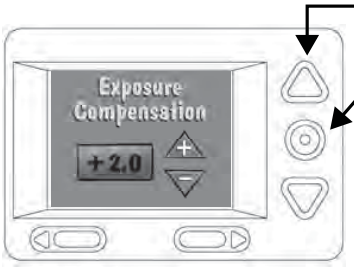


**1** Set the Mode dial to Capture.

**2** Turn the camera on.

**3** Press the ▶ button.

*The LCD displays the Exposure Compensation screen.*




**4** Use the ▲/▼ buttons to adjust the exposure.

**5** Press DO-IT to select the Exposure setting.

**To reset:** the Exposure setting automatically resets to 0.0 EV when the camera is turned off.

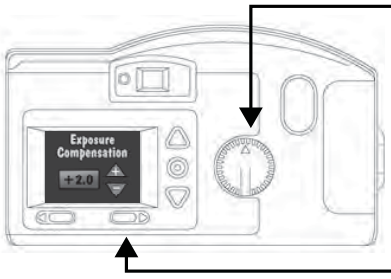


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## Exposure Lock

Use the Exposure Lock to take a sequence of pictures that require the same exposure. When this setting is activated, the camera maintains a constant exposure setting.

**To turn on Exposure Lock:**



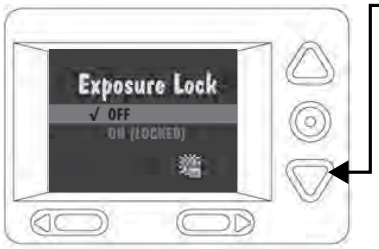

**1** Set the dial to Capture.

**2** Turn the camera on.

**3** Press the ▶ button two times.

*The Exposure Compensation screen appears, followed by the Exposure Lock screen.*

☞ Press the ▶ button a third time to exit the exposure menu.




**4** Press a ▲/▼ button until ON is highlighted.

**5** Press the DO-IT button.

*The Take a Picture screen appears.*

**6** Center the area you want to lock the exposure on in the viewfinder

**7** Press the SHUTTER button to lock in the exposure setting.

**To Reset:** The Exposure Lock setting automatically resets when the camera is turned off.



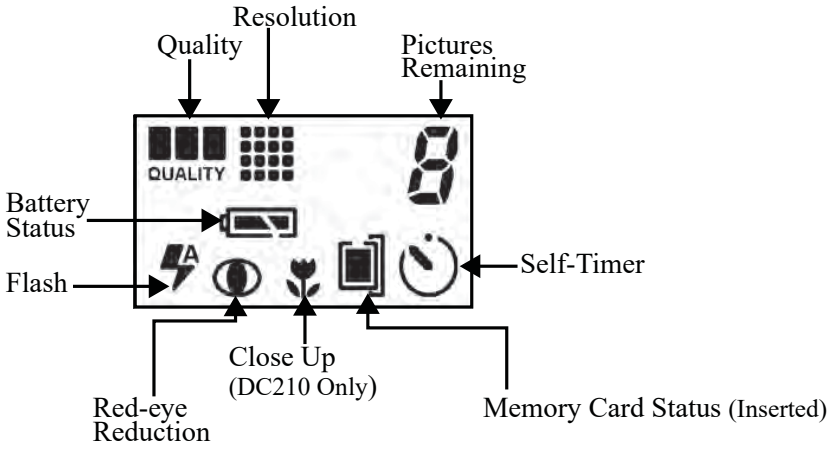


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## Status Display

The Status Display, located at the top of your camera, allows you to view and change some camera settings. The following sections offer detailed descriptions of Status Display settings.

☞ The DC200/DC210 must be turned on to view the Status Display.




### Pictures Remaining 

The Pictures Remaining icon changes automatically to indicate the remaining number of pictures which can be stored at the current quality and resolution setting. You may not select or change the Pictures Remaining icon.

When the card's memory is full the Status Display indicates **Full**. You must delete existing pictures or change memory cards to capture additional pictures. To save pictures, transfer them to your computer before deleting them. For more information on how to move or delete pictures, see "Delete One Picture" on page 2-3, "Delete One or All Pictures" on page 3-2, or the software chapters.

☞ The Pictures Remaining number does not always change by one when a picture is taken if the picture content is easily compressed.

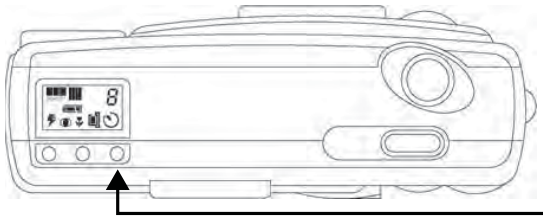


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## Self-Timer

Activating the Self-Timer option creates a 10-second delay between the time you press the SHUTTER button and when the picture is taken. This allows you to include yourself in the picture.

**To activate the Self-Timer:**



1. Set the Mode dial to Capture.
2. Turn the camera on.
3. Press the SELF-TIMER button.

   *The Self-Timer icon appears on the Status Display.*
4. Place the camera on a flat, steady surface or tripod.
5. Press the SHUTTER button.

   *The red Self-Timer light, located on the front of the camera, turns on and stays lit for 8 seconds. The Self-Timer light flashes for 2 additional seconds just before the picture is taken. The Self-Timer returns to the off setting once the picture is taken.*

**To stop the Self-Timer:** press the SELF-TIMER button again before the picture is taken.

## Memory Card

The DC200/DC210 comes equipped with a *KODAK DIGITAL SCIENCE* Picture Card (memory card). The reusable memory card is used to store the pictures taken with the camera. The camera does not have an internal memory and will not operate without a memory card. The Card Status icon changes automatically to indicate if there is a memory card inserted in the camera. You may not select or change this icon.

**No card inserted**—pictures cannot be taken.

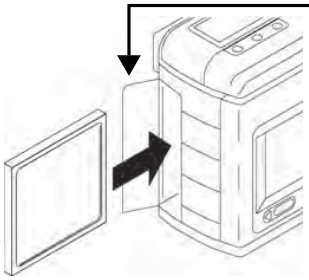
**Card inserted**—pictures are saved to the card's memory.





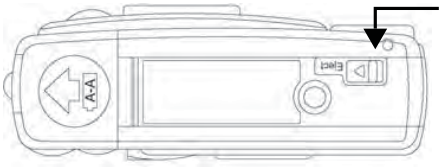
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**To insert a memory card:**



1. Open the card door.
2. Hold the memory card with the connecting end pointed at the camera.
3. Push the card all of the way into the card slot and close the card door.

**To remove a memory card:**




1. Open the card door.
2. Press the EJECT button

   *The card partially slides out of the slot.*
3. Take hold of the card, carefully remove it from the slot, and close the card door.

WARNING: Do not insert or eject a card when the Ready light is blinking. This may damage your pictures or camera.

CompactFlash™

Use only certified memory cards in your camera that carry the CompactFlash logo.

## Close Up —*DC210 Only*

The DC210 offers a Close Up setting which allows you to set the camera's focus distance at 8 in. (20 cm).

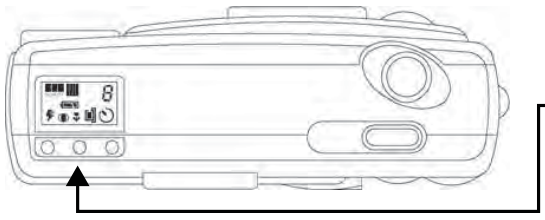
The red-eye reduction option for the Flash setting is not available when Close Up is on.

☞ To accurately capture the picture in Close Up, the Preview option automatically starts when the CLOSE UP button is pressed. See "Preview" on page 2-2 for detailed information. To deactivate the Preview option, press the DO-IT button.



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**To turn on the Close Up setting:**



1. Set the Mode dial to Capture.
2. Turn the camera on.
3. Press the CLOSE UP button.

   *The Close Up icon appears on the Status Display.*
4. View the subject on the LCD display to accurately capture the picture.

**To cancel Close Up:** press the CLOSE UP button again and the Close Up icon disappears from the Status Display. The Close Up setting is automatically turned off when the camera is turned off.

## Flash

The DC200/DC210 is equipped with a built-in flash that offers an optional red-eye reduction feature. The flash has an effective range of approximately 2.23 to 9.84 ft. (0.7 to 3 m) for the DC200, and 1.6 to 9.8 ft. (0.5 to 3 m) for the DC210. There are five Flash settings:

**Auto**—flash fires automatically when the SHUTTER button is pressed and the camera determines that there is not enough light. This is the default setting.

**Auto Red-eye**—works the same as auto flash except the flash fires once before the picture is taken to reduce the chance of red-eye and then flashes a second time when the picture is taken.

**Fill**—flash fires every time you press the SHUTTER button. Use this setting when the lighting is poor or when your subject is lit from behind.

**Fill Red-eye**—works the same as fill flash except the flash fires once before the picture is taken to reduce the chance of red-eye and then flashes a second time when the picture is taken.

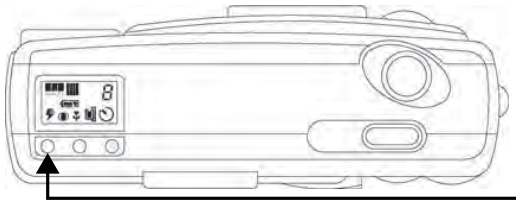
**Off**—flash is turned off and will not fire.





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**To change the Flash setting:**



1 Set the Mode dial to Capture.

2 Turn the camera on.

3 Press the FLASH button to scroll through and select the appropriate Flash settings.

**To cancel the Flash setting:** Flash setting returns to the default setting when the camera is turned off.

## Resolution

Resolution indicates the size of the picture in pixels. The camera can be set to capture pictures in a High or Standard resolution. Your pictures include more detail with high resolution, but they will use more memory on the card than at the standard resolution setting.

You can switch freely between the two settings when taking pictures. The number of pictures the DC200/DC210 is able to store will vary accordingly.

The Resolution setting is indicated on the Status Display using the following icons:

**High**—the picture size is 1152 x 864 pixels. This is the default setting. Use this setting when your pictures are to be printed.

**Standard**—the picture size is 640 x 480 pixels. Use this setting when the pictures are for email or on-line use.

The Resolution setting is changed using the Preferences mode. See “Resolution” on page 4-3 for more information.



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## Quality 


You may set your camera to capture pictures in a Good, Better, or Best quality setting. The Quality setting indicates how much the picture is compressed to save space on the memory card. Your pictures include more detail with the Best or Better setting, but they will use more memory on the card than with the Good setting.

You may switch freely between the three settings when taking pictures. The number of pictures the DC200/DC210 is able to store will vary accordingly.

The Quality setting is indicated on the Status Display using the following icons:




**Best—**you can store approximately 4 pictures per 1 MB of storage at this Quality setting and when the Resolution is set to High. Use this setting when image quality is very important for maximum picture quality, especially for larger sized or zoom prints.




**Better—**you can store approximately 6 pictures per 1 MB of storage at this Quality setting and when the Resolution is set to High. Use this setting for a good picture quality and to store a large number of pictures. This setting is good for general picture taking.




**Good—**you can store approximately 9 pictures per 1 MB of storage at this Quality setting and when the Resolution is set to High. Use this setting to maximize the number of pictures stored.

The Quality setting is changed using the Preferences mode. See “Quality” on page 4-2 for more information.





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## Batteries

The DC200/DC210 comes with four AA batteries. Standard 1.5V alkaline, 1.5V lithium, or rechargeable 1.2V Ni-Cd or Ni-MH batteries may be used.

The battery power icon changes automatically. You may not select or change this icon.

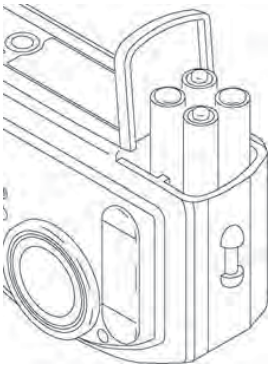
**Full—**batteries are fully charged.

**Low—**batteries need to be replaced.

**Blinking—**batteries are insufficient to run camera and need to be replaced.

☞ Pictures on memory cards are not lost if batteries are depleted.

**To install the batteries:**



1. Place your thumb on the battery door.
2. Slide the battery door away from the camera.
3. Insert the batteries as indicated on the battery cover and close the battery door.

☞ Remove the batteries if the camera will not be used for an extended period of time. This extends battery life and prevents camera damage from battery leaks or corrosion. If the batteries are removed from the camera for more than a few minutes the date and time will be deleted and must be reset.



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*Battery Usage Guidelines*

Always follow your battery manufacturer's directions fully. Do not attempt to disassemble, recharge, short circuit, or subject the battery to high temperature or fire. When removing, batteries may be hot, allow them to cool before touching.

Dispose of batteries according to Federal and Local Regulations.

Failure to replace the batteries when they are low may cause the DC210 to shut down with the camera lens extended.

Your camera has been designed to operate correctly using a variety of AA-size batteries currently available. These include 1.5-volt alkaline, 1.5-volt lithium, or 1.2-volt Nickel Metal Hydride (Ni-MH) and Nickel Cadmium (Ni-Cd) batteries.

NOT ALL BATTERIES ARE CREATED EQUAL! Battery life depends significantly on age, usage conditions, type and brand. Digital camera requirements are very demanding on batteries. Not all battery brands perform well under these challenging conditions. In Kodak lab tests, Ni-MH rechargeable batteries delivered the best results in a variety of conditions. Ni-MH batteries are designed for high demand devices like digital cameras, and do not exhibit the "memory" effects seen with other rechargeable technologies. Kodak offers Ni-MH rechargeable batteries (with charger) as an optional accessory. Refer to catalog number 152 7068 (U.S. and Canada), 852 2344 (Europe), 867 9953 (UK), 870 8141 (Asia), 910 7632 (Japan).

If you elect to use alkaline batteries in your camera, you will obtain better performance from "photo-flash grade" alkaline batteries, such as KODAK PHOTOLIFE Alkaline Batteries. These types of batteries last more than twice as long in digital cameras as ordinary alkaline batteries.

Ni-Cd batteries work well in digital cameras, but typically have the shortest "duty cycle," or usable power provided between charges.

Lithium batteries typically provide the longest overall battery life, but carry a higher cost-per-picture than other non-rechargeable battery types.

When using your camera on battery power, we recommend you limit continuous LCD "Preview" or "Review" to less than 20-minutes per session. If you anticipate using your camera for longer periods in these modes, it is recommended that you do so with the camera powered by the AC adapter.





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## Zoom *—DC210 Only*

The DC210 comes equipped with a 2X zoom lens that allows you to zoom in on your subject from Wide Angle (29mm) to TelePhoto (58mm).

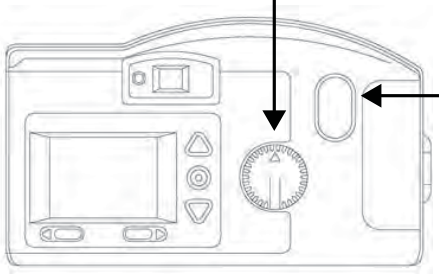
***Wide Angle***



***TelePhoto***



**To activate the zoom:**



1. Set the Mode dial to Capture.
2. Turn the camera on.
3. Press the ZOOM button.

   *The subject will appear closer or farther away when you look through the viewfinder and press the ZOOM button.*

The camera's default lens position is Wide Angle. All other lens positions are considered TelePhoto settings.



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## General Maintenance and Safety

- ✓ To keep from damaging your DC200/DC210, avoid exposing it to moisture and extreme temperatures.
- ✓ Clean the outside of the DC200/DC210 by wiping with a clean, dry cloth. Never use harsh or abrasive cleaners or organic solvents on the camera or any of its parts.
- ✓ Never disassemble or touch the inside of the DC200/DC210. This could result in electrical shock.
- ✓ If you notice smoke or a strange smell coming from the DC200/DC210, immediately turn the camera off, wait a few minutes until the camera cools, and then remove the batteries.
- ✓ Cleaning the lens and back LCD screen:

  1. Blow gently on the lens or LCD screen to remove dust and dirt.
  2. Moisten the lens or LCD screen by breathing lightly on it.
  3. Wipe the lens or LCD screen gently with a soft, lint-free cloth or an untreated lens-cleaning tissue.

     ☞ Do not use cleaning solutions unless they are designed specifically for camera lenses. Do not wipe the camera lens or LCD screen with chemically treated eyeglass lens tissue as it may scratch the lens.

- ✓ Service agreements are available in some countries. Please contact your Kodak dealer for more information.





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APPENDIX YY

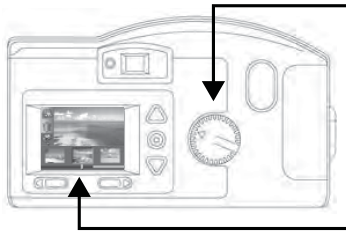
# 3 Review

When the Mode dial is set to Review, you may use the LCD to view the pictures stored on the *KODAK DIGITAL SCIENCE* Picture Card (memory card). Using the Overlay screen the camera can perform the following functions:

- ✓ view the amount of unused memory left on the memory card
- ✓ view thumbnails of the pictures
- ✓ delete one or all pictures from the memory card
- ✓ view pictures, and run a slide show from the camera on your TV

## View Pictures

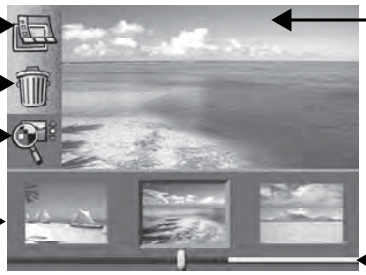
**To view pictures:**



**1** Set the Mode dial to Review.

**2** Turn the camera on.

*The Overlay screen appears on the LCD screen with the last picture taken.*




☞ Use the ◀/▶ buttons to scroll through pictures. To continuously scroll, hold down a ◀/▶ button.

**To exit:** press the ▲/▼ buttons to highlight the Overlay icon. Press DO-IT to turn off the Overlay screen. The main Review screen reappears.



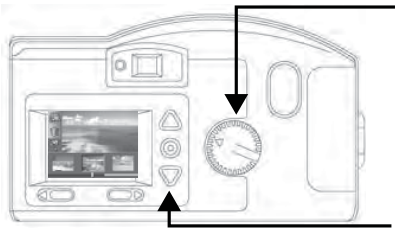


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## Delete One or All Pictures

You can delete one or all of the pictures on the memory card when in the Review mode.

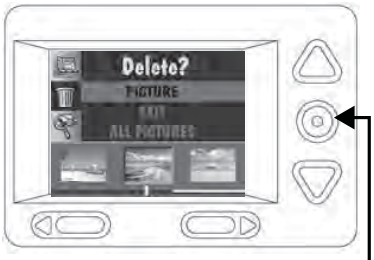
**To delete a picture in Review mode:**



1. Set the Mode dial to Review.
2. Turn the camera on.

   *The last picture taken appears on the LCD screen. The Overlay screen is turned on.*
3. Press a ▲/▼ button until the Delete icon is highlighted.
4. Press the DO-IT button.

   *The delete screen appears on the LCD.*




5. Press a ◀/▶ button until the appropriate picture is highlighted on the filmstrip.

   ☞ To delete all the pictures on the memory card, press a ▲/▼ button until ALL PICTURES is highlighted and then press the DO-IT button.
6. Press the DO-IT button.

   *That picture is deleted from the memory card.*

**To exit:** press a ▲/▼ button until Exit is highlighted and then press the DO-IT button. The main Review screen reappears.

☞ Memory cards containing images captured from other digital cameras will have less memory space available when used in the DC200/ DC210 cameras. To free-up memory space on the memory card you must delete the images in the model of camera that captured those images.

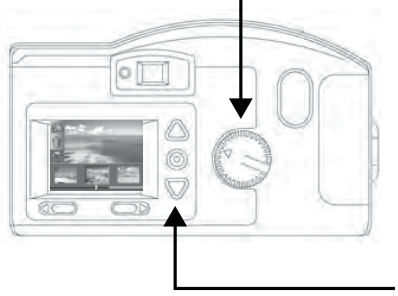


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## Magnify Pictures

The magnify feature allows you to view the current picture at 2x size on the LCD screen when in Review mode.

**To magnify a picture in Review mode:**



1. Set the Mode dial to Review.
2. Turn the camera on.

   *The last picture taken appears on the LCD screen. The overlay screen is turned on.*
3. Press a ◀/▶ button until the appropriate picture is highlighted on the filmstrip.
4. Press a ▲/▼ button until the Magnify icon is highlighted.



5. Press the DO-IT button.

   *The LCD displays a magnified view of the selected picture.*

   ☞ Use the ▲/▼ and ◀/▶ buttons to scroll to different parts of the picture.

**To exit:** press the DO-IT button to cancel the Magnify feature. The magnify feature stops and the Overlay screen reappears.





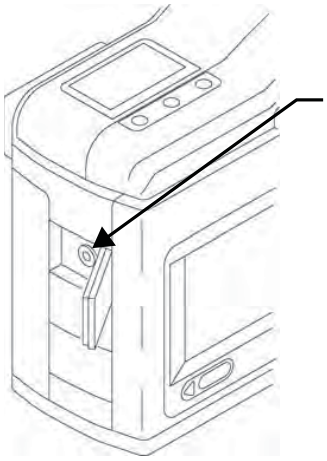
BlackBerry Corporation Exhibit 1004, pg. 764

## Video Out

The video out feature on the DC200/DC210 allows you to connect the camera to a TV and view or run a slide show of the pictures from the memory card on your TV! This is especially useful when sharing pictures with family and friends.

☞ The camera's LCD is disabled when the camera is attached to the video cable.

**To view pictures on a TV:**



1. Turn your TV and the DC200/DC210 camera off.
2. Insert the video output cable into the video out connection on the side of your camera.
3. Connect the other end of the cable to the video in connection on your TV.
4. Turn on the camera and TV.
5. Set the Mode dial to Review.
6. Set the TV to the correct video setting.

   *The pictures that are stored on the memory card appear on the TV screen.*

   ☞ You may need to adjust the Video Out preference on the camera. See "Format Memory Card" on page 4-10 for details.

7. Press a ◀ / ▶ button on the camera to scroll through the pictures on the TV.

   ☞ To run a slide show, press the DO-IT button. The slide show starts, and the pictures change every five seconds for a period of five minutes. If you are using an AC adapter, the slide show runs indefinitely.

**To cancel Slide Show:** press the DO-IT button to stop the slide show. The slide show stops and the main Review screen reappears.



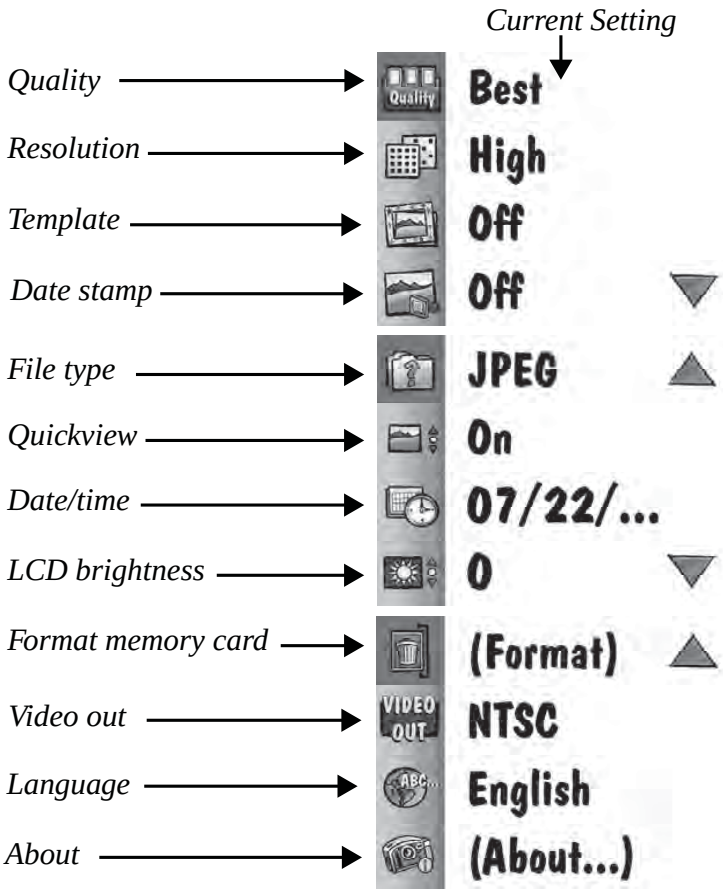
BlackBerry Corporation Exhibit 1004, pg. 765

# 4 Preferences

When the Mode dial is set to Preferences, the main Preferences screen appears on the LCD. Using the Preferences screen the following settings can be adjusted or activated:

- ✓ Quality
- ✓ Resolution
- ✓ Template
- ✓ Date stamp
- ✓ File type
- ✓ Quickview
- ✓ Date/Time
- ✓ LCD brightness
- ✓ Format memory card
- ✓ Video out
- ✓ Language
- ✓ About

The Preferences screens, illustrated below, display the current setting of each icon.



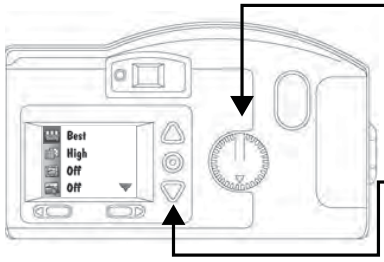



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# Quality

The Quality screen is used to set the picture quality to Best, Better, or Good. See “Quality” on page 2-11 for more information on picture quality.

**To set quality:**




1. Set the Mode dial to Preferences.
2. Turn the camera on.

   *The LCD displays the Preferences screen.*
3. Press a ▲/▼ button until the Quality icon is highlighted.
4. Press the DO-IT button.

   *The LCD displays the main Quality screen. The current setting is checked (✓).*




5. Press a ▲/▼ button until the appropriate option is highlighted.
6. Press the DO-IT button.

   *The main Preferences screen reappears.*

**To reset:** the Quality setting is maintained until another setting is selected. This setting **does not** change when the camera is turned off.

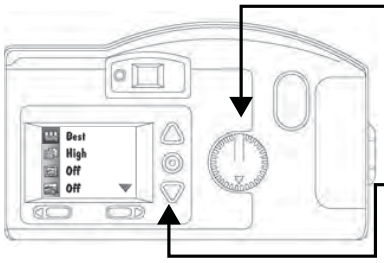


BlackBerry Corporation Exhibit 1004, pg. 767

## Resolution

The Resolution screen is used to set the picture resolution to High (1152x864) or Standard (640x480). See “Resolution” on page 2-10 for more information on picture resolution.

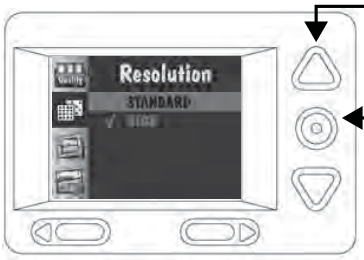
**To set resolution:**




1. Set the Mode dial to Preferences.
2. Turn the camera on.

   *The LCD displays the Preferences screen.*
3. Press a ▲/▼ button until the Resolution icon is highlighted.
4. Press the DO-IT button.

   *The LCD displays the main Resolution screen. The current setting is checked (✓).*




5. Press a ▲/▼ button until the appropriate option is highlighted.
6. Press the DO-IT button.

   *The main Preferences screen reappears.*

**To reset:** the Resolution setting is maintained until another setting is selected. This setting **does not** change when the camera is turned off.



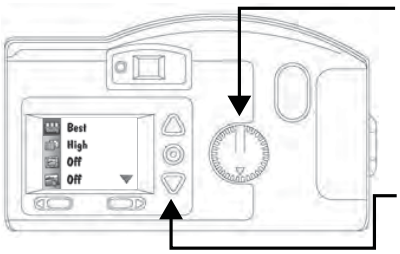
BlackBerry Corporation Exhibit 1004, pg. 768

## Template

The Template screen is used to select a creative border and/or logo that is added to your picture when the picture is captured. Once a picture is captured with the template feature activated, the template cannot be removed from the picture. The templates are stored on your memory card, and you can store up to eight templates per memory card, depending on the cards size. The memory card supplied with your camera comes with some templates already pre-loaded.

☞ For more information on using templates with your DC200/DC210 camera, refer to the readme file on the DC200/DC210 software CD.

**To select a template:**




**1** Set the Mode dial to Preferences.

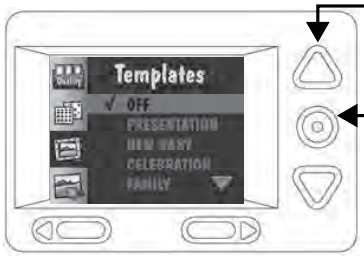
**2** Turn the camera on.

*The LCD displays the Preferences screen.*

**3** Press a ▲/▼ button until the Template icon is highlighted.

**4** Press the DO-IT button.

*The LCD displays the main Template screen. The current setting is checked (✓).*




**5** Press a ▲/▼ button until the appropriate option is highlighted.

**6** Press the DO-IT button.

*The main Preferences screen reappears.*

☞ The template is only visible after the picture has been taken with the camera in either Review mode, or in Capture mode with Quickview activated. See "Quickview" on page 4-7, or chapter 3 "Review" on page 3-1 for details.

**To cancel Template:** press a ▲/▼ button until OFF is highlighted, and then press the DO-IT button. The Template setting is maintained until another setting is selected. This setting **does not** change when the camera is turned off.

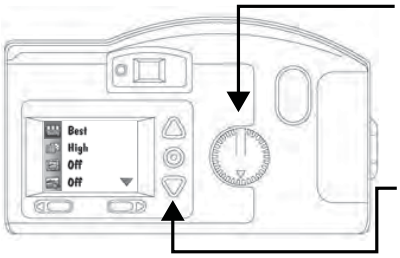


BlackBerry Corporation Exhibit 1004, pg. 769

## Date Stamp

The Date Stamp screen is used to record the date on your pictures.

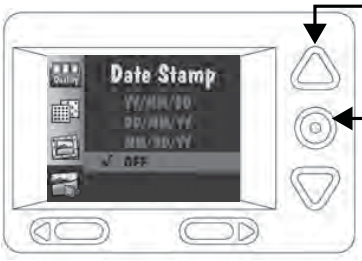
**To turn on the Date Stamp:**




1. Set the Mode dial to Preferences.
2. Turn the camera on.

   *The LCD displays the Preferences screen.*
3. Press a ▲/▼ button until the Date Stamp icon is highlighted.
4. Press the DO-IT button.

   *The LCD displays the main Date Stamp screen. The current setting is checked (✓).*




5. Press a ▲/▼ button until the appropriate date stamp order is highlighted.
6. Press the DO-IT button.

   *The main Preferences screen reappears.*

   *The next time you take a picture the Date Stamp will appear in the lower right hand corner of the picture on the LCD screen.*

☞ The date stamp is only visible after the picture has been taken with the camera in either Review mode, or in Capture mode with Quickview activated. See “Quickview” on page 4-7, or chapter 3, “Review” on page 3-1 for details.

**To cancel Date Stamp:** press a ▲/▼ button until OFF is highlighted, and then press the DO-IT button. The Date Stamp setting is maintained until another setting is selected. This setting **does not** change when the camera is turned off.

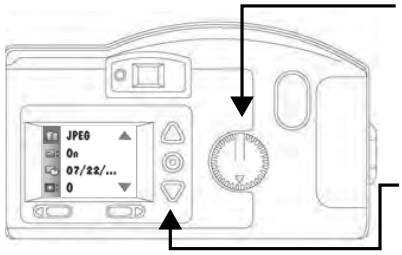


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## File Type

The File Type screen is used to select how the picture file is saved, in a FlashPix or JPG (default setting) format. Select a format that is compatible with the software you use on your computer.

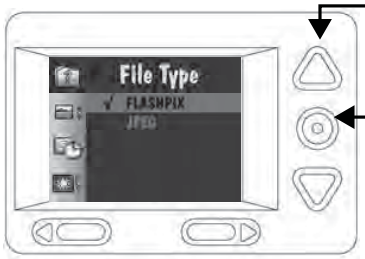
**To set the file type:**




1. Set the Mode dial to Preferences.
2. Turn the camera on.

   *The LCD displays the Preferences screen.*
3. Press a ▲/▼ button until the File Type icon is highlighted on the second Preferences screen.
4. Press the DO-IT button.

   *The LCD displays the main File Type screen. The current setting is checked (✓).*




5. Press a ▲/▼ button until the appropriate option is highlighted.
6. Press the DO-IT button.

   *The main Preferences screen reappears.*

**To reset:** the File Type setting is maintained until another setting is selected. This setting **does not** change when the camera is turned off.



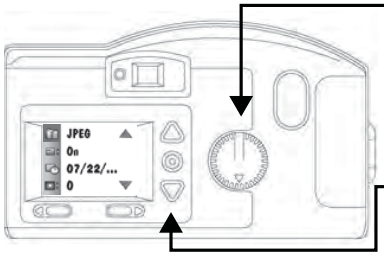
BlackBerry Corporation Exhibit 1004, pg. 771

## Quickview 

The Quickview screen is used to turn the camera's Quickview setting on or off. When you take a picture with Quickview on, the picture momentarily appears on the LCD seconds after the picture is taken!

☞ The Quickview option must be activated to use the delete feature available in Capture mode. See "Delete One Picture" on page 2-3 for more details.

**To turn on Quickview:**




**1** Set the Mode dial to Preferences.

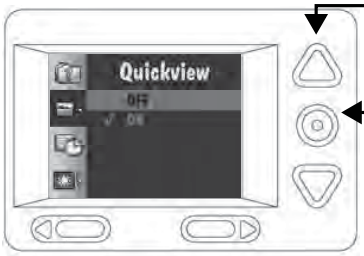
**2** Turn the camera on.

*The LCD displays the Preferences screen.*

**3** Press a ▲/▼ button until the Quickview icon is highlighted on the second Preferences screen.

**4** Press the DO-IT button.

*The LCD displays the main Quickview screen.The current setting is checked (✓).*




**5** Press a ▲/▼ button until ON is highlighted.

**6** Press the DO-IT button.

*The main Preferences screen reappears.*

*The next time you take a picture, it will appear for a moment on the LCD screen.*

**To cancel Quickview:** press a ▲/▼ button until OFF is highlighted and then press the DO-IT button. The Quickview setting is maintained until another setting is selected. This setting **does not** change when the camera is turned off.

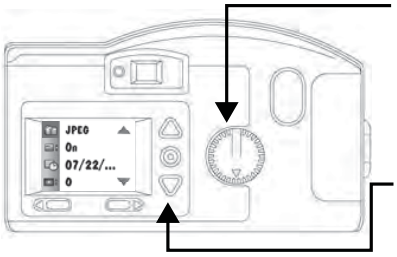


BlackBerry Corporation Exhibit 1004, pg. 772

## Date and Time

The Date and Time screen is used to set the camera's date and time.

**To set the date and time:**




1. Set the Mode dial to Preferences.
2. Turn the camera on.

   *The LCD displays the Preferences screen.*
3. Press a ▲/▼ button until the Date/Time icon is highlighted on the second Preferences screen.
4. Press the DO-IT button.

   *The LCD displays the main Date/Time screen with the current date and time listed.*




5. Press a ◀/▶ button to highlight the day, month, year, hour, or minute setting.
6. Press a ▲/▼ button to adjust the setting.
7. Repeat steps 5 and 6 until the information is correct.
8. Press the DO-IT button.

   *The main Preferences screen reappears.*

**To reset:** the Date and Time setting is maintained until another setting is selected. This setting **does not** change when the camera is turned off.

☞ If batteries are removed from the camera for more than a few minutes, the Date/Time will be deleted and must be reset.

☞ If batteries are removed from the camera when the camera is on, the Date/Time may be deleted and must be reset.

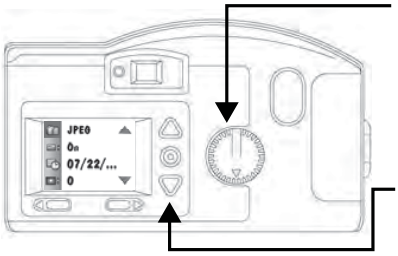


BlackBerry Corporation Exhibit 1004, pg. 773

## LCD Brightness

The LCD Brightness screen is used to adjust the brightness of the LCD screen.

**To adjust the LCD brightness:**



1. Set the Mode dial to Preferences.
2. Turn the camera on.

   *The LCD displays the Preferences screen.*
3. Press a ▲/▼ button until the LCD Brightness icon is highlighted on the second Preferences screen.
4. Press the DO-IT button.

   *The LCD displays the main LCD Brightness screen.*




5. Press a ▲/▼ button to adjust the brightness of the LCD screen to the appropriate level.

   *The brightness of the LCD screen changes as the setting is adjusted.*
6. Press the DO-IT button.

   *The main Preferences screen reappears.*

**To reset:** the LCD Brightness setting is maintained until another setting is selected. This setting **does not** change when the camera is turned off.

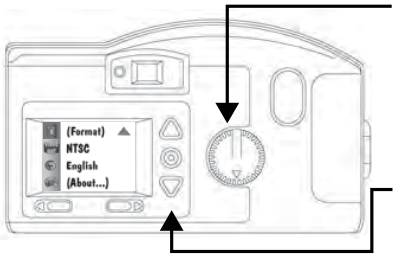


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## Format Memory Card

The Format Memory Card screen formats the memory card while it is in the camera. When a memory card is formatted it erases everything, including any templates on the card, and sets up new directories and pointers on the memory card.

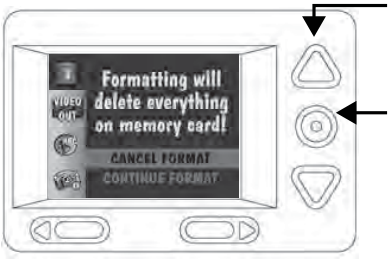
**To format a memory card:**




1. Set the Mode dial to Preferences.
2. Turn on the camera.

   *The LCD displays the Preferences screen.*
3. Press a ▲/▼ button until the Format Memory Card icon is highlighted on the third Preferences screen.
4. Press the DO-IT button.

   *The LCD displays the main Format Memory Card screen.*




5. Press a ▲/▼ button until CONTINUE FORMAT is highlighted.
6. Press the DO-IT button.

   *The card is formatted and the main Preferences screen reappears.*

**To cancel format:** press a ▲/▼ button until CANCEL FORMAT is highlighted and then press the DO-IT button. The card is not formatted and the main Preferences screen reappears.

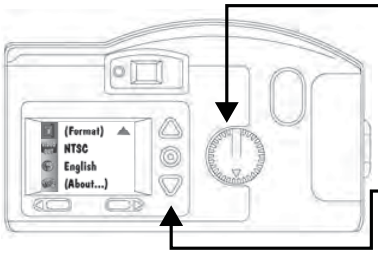


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## Video Out

The Video Out screen is used to set the camera's video output format to NTSC or PAL. The video out format selected depends on your TV or video monitor. In most cases European countries use PAL, other countries use NTSC.

**To set the video out format:**




1. Set the Mode dial to Preferences.
2. Turn on the camera.

   *The LCD displays the Preferences screen.*
3. Press a ▲/▼ button until the Video Out icon is highlighted on the third Preferences screen.
4. Press the DO-IT button.

   *The LCD displays the main Video Out screen. The current setting is checked (✓).*




5. Press a ▲/▼ button until the appropriate option is highlighted.
6. Press the DO-IT button.

   *The main Preferences screen reappears.*

**To reset:** the Video Out setting is maintained until another setting is selected. This setting **does not** change when the camera is turned off.

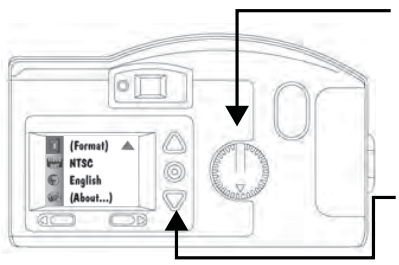


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## Language

The Language screen is used to select a language interface for the camera. When a specific language is selected, the LCD screens on the back of the camera will change to reflect the language selected.

**To select a language**:




1. Set the Mode dial to Preferences.
2. Turn the camera on.

   *The LCD displays the Preferences screen.*
3. Press a ▲/▼ button until the Language icon is highlighted on the third Preference screen.
4. Press the DO-IT button.

   *The LCD displays the main Language screen. The current setting is checked (✓).*




5. Press a ▲/▼ button until the appropriate language is highlighted.
6. Press the DO-IT button.

   *The main Preferences screen reappears.*

**To change Language:** press a ▲/▼ button until another language is highlighted and then press the DO-IT button. The Language setting is maintained until another is selected. This setting **does not** change when the camera is turned off.



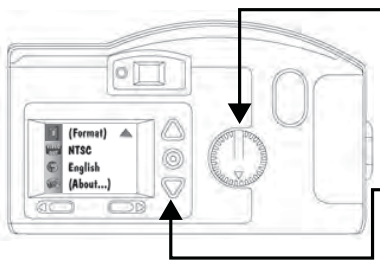
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## About 

The About screen is a view only screen that keeps a record of the camera's use. While viewing the About screen, you can look-up the following information:

- ✓ firmware version
- ✓ total number of pictures taken over the lifetime of the camera
- ✓ total number of flashes fired over the lifetime of the camera

**To view the About screen**:

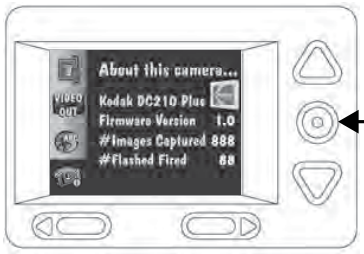



**1** Set the Mode dial to Preferences.

**2** Turn the camera on.

*The LCD displays the Preferences screen.*

**3** Press a ▲/▼ button until the About icon is highlighted on the third Preferences screen.




**4** Press the DO-IT button.

*The LCD displays the About screen*

**5** Press the DO-IT button to return to the main Preferences screen.



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APPENDIX YY



# Installation Software

KODAK Installation Software (Installation software) quickly and easily installs the software included on the DC200/DC210 CD to your computer.



## WINDOWS System Requirements

- ✓ WINDOWS 95, WINDOWS 98, or WINDOW NT System Software
- ✓ Personal computer with 486/66MHz microprocessor minimum, PENTIUM Processor recommended
- ✓ 8 MB or more of RAM available, 16 MB recommended
- ✓ available serial port and CD-ROM drive

## Installing the Software

While the Installation software is automatically loading your software, take a few minutes to fill out and send in the DC200/DC210 product registration card. This allows you to receive information regarding software updates and registers some of the products included with the camera.

Close all other applications before starting the Installation software.

1. Place the DC200/DC210 CD into your CD-ROM drive.

   ☞ If Auto Run is turned on in WINDOWS 95, WINDOWS 98, or WINDOWS NT, the first install window automatically appears. Proceed to step 4. If the first install window does not automatically appear proceed to step 2.

2. Choose Run from the Start menu.
3. Type the path to the drive that contains the CD and then type *\setup.exe*

   *For example:* ***d:\setup.exe***



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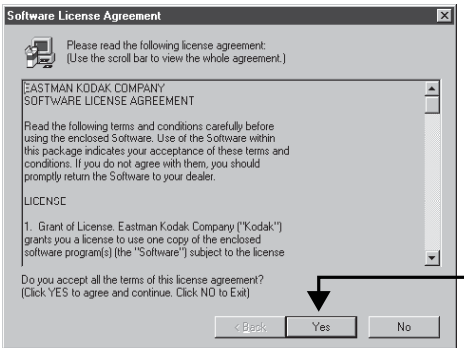



*The install window appears.*

**4** Select the language you want to install.

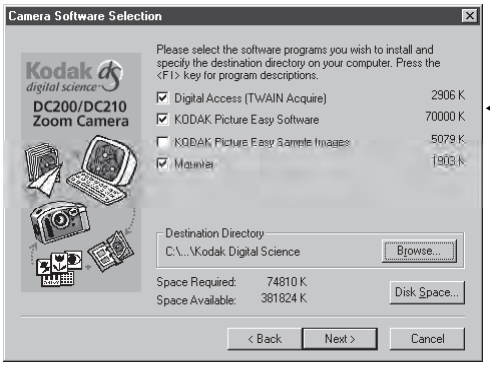
*The Welcome window appears.*

**5** Click on the NEXT button.

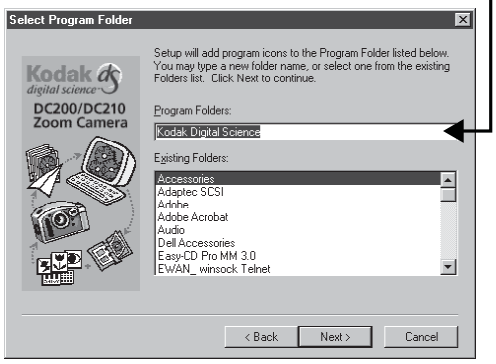



**6** Read the agreement and click on the YES button to accept the software license agreement.

☞ If you do not accept the license you will not be able to install the software.




**7** Select which software you wish to install and click on the NEXT button.

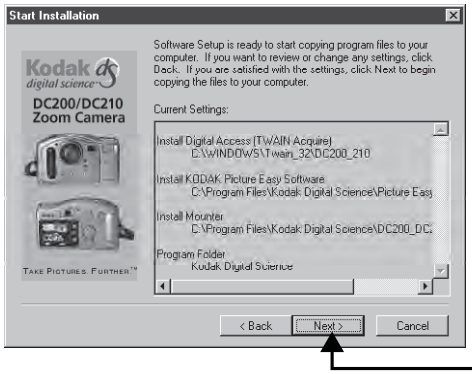



**8** Select the name of the Program Folder and click on the NEXT button.

☞ If necessary, type a new folder name or select from the Existing Folders list.

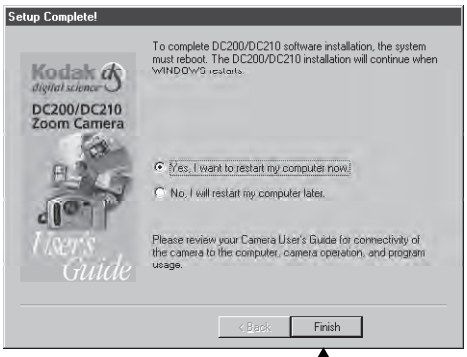


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**9** Verify the settings and then click on the NEXT button.

*A progress screen appears while the software is installed.*




**10** Select the preferred restart option and click on the FINISH button.

☞ If you have installed the KODAK DC200/DC210 Mounter Software you must restart your computer.

5 Installation

You are now ready to run the newly installed software. Detailed information on KODAK DC200/DC210 Mounter Software (chapter 7) and TWAIN Software (chapter 8) are included in this user manual. Instruction manuals for the additional software packages that were installed are included in the camera package.

When using DC200/DC210 software, if your computer does not recognize that the camera is attached and turned on, you may need to adjust the serial port and speed settings. Use the software's Preferences or Properties window to adjust the camera communications settings.



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# Connect

When the Mode dial is set to Connect, the camera can communicate with your computer using a serial cable or infrared transceiver (DC210 only).

The camera automatically detects if it is attached to the computer via the serial cable or an infrared transceiver. While in Connect mode the camera is controlled by the computer. Except for the Mode dial and POWER button, all other camera buttons are ignored. The Ready light indicates when the camera is on.

Once the camera is connected to a computer and the DC200/DC210 software is installed, you are now ready to transfer the pictures from the camera to your computer. Refer to the appropriate chapters of this user's guide, or the software's quick setup guides, for more information on the software programs.

## Checking Serial Port Availability

If your computer cannot communicate with the DC200/DC210 you may need to adjust the serial port and speed settings. Adjust the settings using the KODAK Mounter Software (chapter 7) or KODAK TWAIN Software (Chapter 8), or follow the instructions on the Kodak Web site at http://www.kodak.com.

## Infrared Connection —*DC210 Only*

The camera can connect to a computer using an infrared transceiver connection.Your computer must be set up with an infrared connection before the camera's infrared transceiver can be used.

Refer to the instructions included with your computer's infrared connection package for more details on setting up an infrared transceiver connection. Additional information is available in the README file on the DC200/DC210 software CD.

☞ If you are using the camera's infrared transceiver to connect to the computer, and the camera automatically turns off because of inactivity, you need to press the camera's POWER button to turn the camera back on.





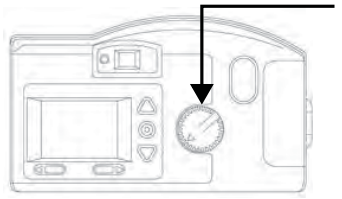
BlackBerry Corporation Exhibit 1004, pg. 784

## Serial Cable Connection

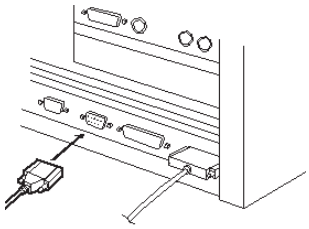
The camera can connect to a computer using the serial cable included in your camera package. In order to connect the DC200/DC210, you need to find an available serial (COM) port on your PC. Most PCs come configured with two serial communication ports labeled COM1 and Com2, or A and B. These COM ports are usually labeled on the back of your PC. If they are not labeled, see your computer's user guide for a diagram that illustrates all your external ports on the back of your PC.

☞ For more information on serial cable connection, refer to "Resolving COM Port Connectivity problems for IBM-Type PCs, with KODAK Digital Cameras" section in the readme file on the DC200/DC210 software CD, or click "Service and Support" on the Kodak Web site at http://www.kodak.com.

**To connect to your computer with a serial cable:**



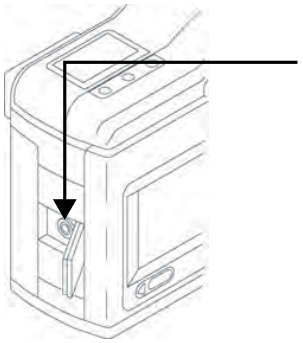
**1** Set the Mode dial to Connect.



**2** Plug one end of the serial cable into a COM port on the back of your PC.

☞ If your computer has a 25-pin port, you need to use an optional 9-pin adapter (available at your local computer store) and attach it to the port before attaching the serial cable to the computer.

**3** Open the serial port on the side of your camera.



**4** Plug the other end of the serial cable into the camera's serial port.

**5** Turn on the camera.

**To cancel connection:** turn the Mode dial to another setting or turn the camera off.



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# Mounter Software

KODAK DC200/DC210 Mounter Software (Mounter software) is an easy way to view, transfer, or delete pictures stored on the memory card using your PC and WINDOWS 95, WINDOW 98, or WINDOWS NT software.

Using Mounter software, the DC200/DC210 camera icon appears in the My Computer window, and within file browsers included in many software applications.

Mounter software extends WINDOWS 95, WINDOWS 98, or WINDOWS NT to present the camera contents as though it were an extension of your hard drive. For more detailed information on working with WINDOWS 95,WINDOWS 98, or WINDOWS NT, refer to that Software's user guide.

## Installation

If you accepted the default installation settings when you installed the software from the DC200/DC210 CD (see Chapter 5 - *Installation Software)*, Mounter software is already installed. If it is not installed, complete the instructions in Chapter 5 and select the Mounter software option.

## Camera Communication Settings

If your computer does not recognize that the camera is attached and turned on, you may need to adjust the serial port and speed settings. See "Communication Settings" on page 7- 8 for details or follow the instructions on the Kodak Web site at http://www.kodak.com.





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## Overview

Mounter software uses the following icons:



**Camera icon—**displays the DC200/DC210 camera.



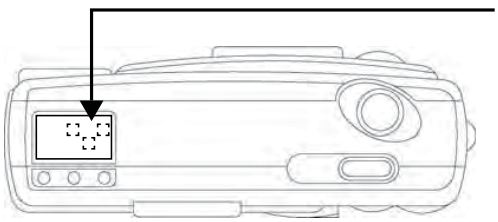
**Memory Card icon—**displays picture files stored on the memory card.



**Picture File icon—**displays picture files with FlashPix (FPX) or JPEG (JPG) extensions when appropriate viewing option is selected. If the picture file has been registered by another application this icon may be different.

## Using Mounter Software

Mounter software allows you to open picture files into a software application, transfer, or delete picture files and adjust the camera settings. You may not copy picture files **into** the memory card using Mounter software. The camera needs to be connected to your computer and turned on to access your picture files.



When the camera is correctly connected to your computer the camera's Status Display is replaced with the following screen. 

### Opening Picture Files

Mounter software allows you to open picture files into a registered software application. Simply double-click on the Camera icon and then double-click on the Memory Card icon to view the picture files. Double-click on a picture file to open it into a registered software application.

### Transferring Pictures to your Computer

Mounter software allows you to transfer picture files from the memory card to a new location on your computer using the drag and drop method.



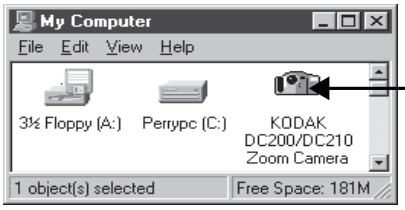
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**To transfer files:**

**1** Double-click on the My Computer icon.

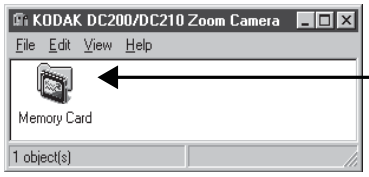



*The My Computer window appears.*



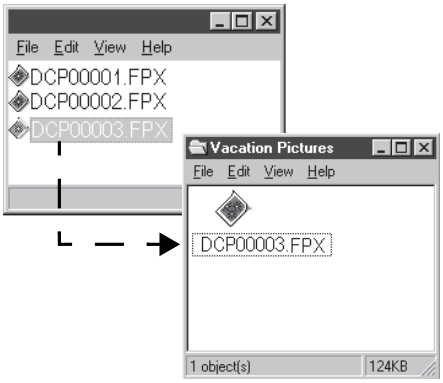

**2** Double-click on the Camera icon.

*The Memory Card icon appears.*




**3** Double-click on the Memory Card icon.

*The Memory Card window appears listing individual picture files.*




**4** Open the folder that the picture files will be dragged into.

**5** Click on the picture file to highlight it and while holding the mouse button down, drag the picture file to the new location.

*The picture file appears in the new location.*

☞ To select and move multiple pictures, hold down the Control key and click on additional files.

**To exit Mounter software:** select Close from the File menu. The Mounter Camera icon remains in the My Computer folder even when the camera is not accessed.





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# Setting and Viewing Properties

Mounter software displays memory card, picture file, or camera information from the Properties window.

## Memory Card Properties

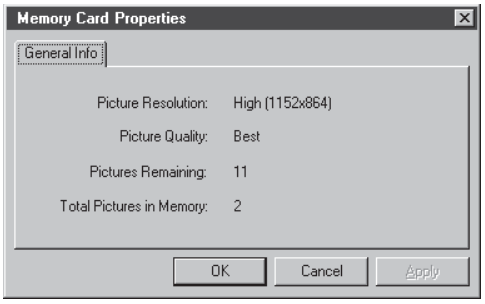
The General Info tab on the Camera Card Memory Properties window displays the current setting for the memory card. You cannot change settings on this window.

☞ You must have a memory card inserted to view the properties window.

**To open the Camera Memory Card Properties window:**

1. Double-click on the Camera icon in the My Computer window.
2. Click on the Memory Card icon with the right mouse button.
3. Select Properties from the pop-up menu.

   *The Memory Card Properties window appears and displays:*




- ✓ Resolution setting (High or Standard)
- ✓ Quality setting (Good, Better, or Best)
- ✓ Remaining number of pictures that can be stored on the memory card at the current settings
- ✓ Number of pictures currently stored on the memory card

**To exit:** click on the OK or CANCEL button.



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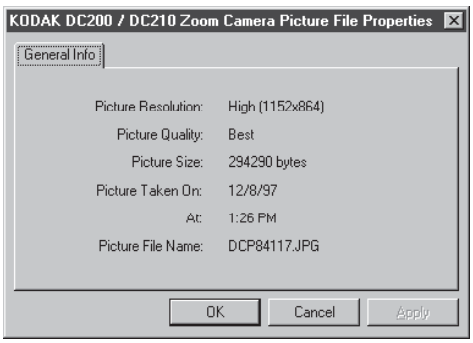
## Picture File Properties

The General Info tab on the Picture File Properties window displays information about the current picture file. You cannot change any settings on this window.

**To open the Picture File Properties window:**

1. Double-click on the Camera icon in the My Computer window.
2. Double-click on the Memory Card icon.
3. Click on the Picture File icon with the right mouse button.
4. Select Properties from the pop-up menu.

*The Picture File Properties window appears and displays*:




- ✓ Resolution setting (High or Standard)
- ✓ Quality setting (Good, Better, or Best)
- ✓ Picture size, in bytes
- ✓ Date and time the picture was taken
- ✓ Name of the picture file

**To exit:** click on the OK or CANCEL button.





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## Camera Properties

The Camera Properties window displays the Camera Settings and Capture tab cards.

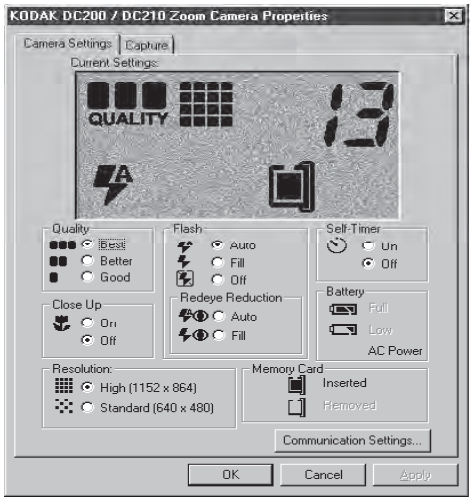
### *Camera Settings Tab*

The Camera Settings tab on the Camera Properties window is used to view and change the camera's current settings, and open to the Communication Settings window.

**To adjust the camera settings:**

1. Click on the Camera icon with the right mouse button.
2. Select Camera Properties from the pop-up menu.

   *The Camera Properties window appears with the Camera Setting tab open.*




3. Click on the appropriate button to adjust the following settings:
   - ✓ Quality setting
   - ✓ Flash
   - ✓ Self-Timer
   - ✓ Close Up (DC210 only)
   - ✓ Red-eye Reduction
   - ✓ Resolution

   ☞ The Battery Level and Memory Card information cannot be adjusted.

☞ Select the COMMUNICATIONS SETTINGS button to adjust the serial port and speed. See "Communication Settings" on page 7- 8 for more details.

**To exit:** click on the OK button to apply the changes and exit the window. To exit the window without making any changes, click on the CANCEL button.



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*Capture*

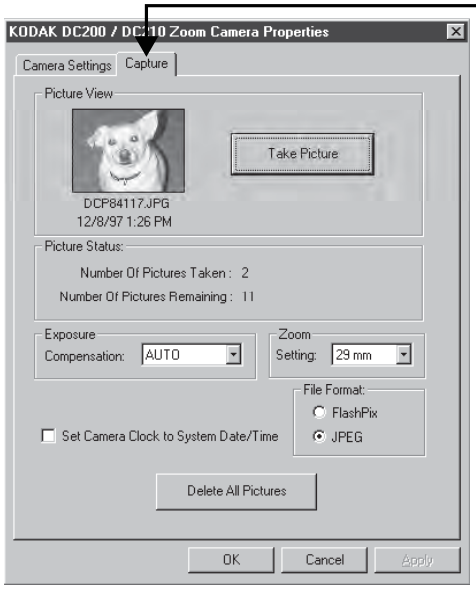
The Capture tab on the Camera Properties window allows you to take a picture, and adjust the exposure and zoom settings, and adjust the file format while the camera is attached to the computer.

**To open the Capture tab:**

**1** Click on the Camera icon with the right mouse button.

**2** Select Camera Properties from the pop-up menu.

*The Camera Properties window appears.*




**3** Click on the Capture tab.

*The Capture tab appears.*

**4** If necessary click on the buttons to adjust the:

- ✓ Exposure compensation
- ✓ Zoom (DC210 only)
- ✓ File format

**5** Click on the TAKE A PICTURE button to take a picture while the camera is attached to computer.

*The picture appears in the Picture View Area.*

☞ Select the DELETE SELECTED PICTURES or DELETE ALL PICTURES button to delete picture files. See “Delete” on page 7- 9 for more details.

**To exit:** click on the OK button to apply the changes and exit the window. To exit the window without making any changes, click on the CANCEL button.





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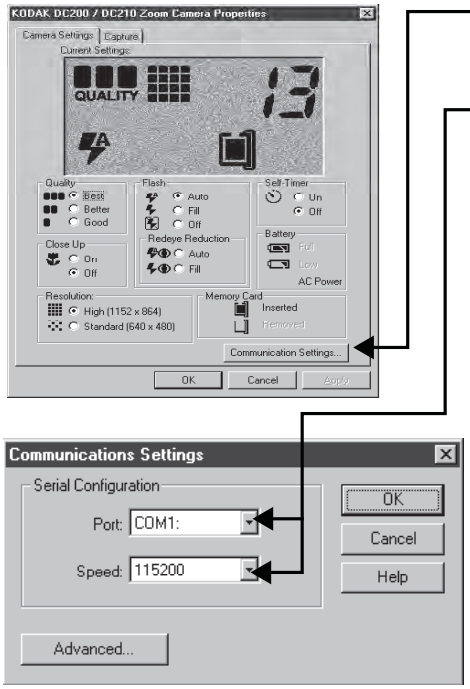
*Communication Settings*

The Communications Settings window allows you to view and change the serial port and port speed settings while the camera is attached to your computer. See “Camera Communication Settings” on page 7- 1 for more detailed information.

**To open the Communication Setting window:**

1 Click on the Camera icon with the right mouse button.

2 Select Camera Properties from the pop-up menu.







3 Click on the COMMUNICATIONS SETTINGS button.

4 If necessary, click on the arrows to adjust the:

- ✓ port, if your computer does not recognize the camera
- ✓ speed, to optimize picture transfer time

☞ If your computer is faster than 166 MHz you can click on the ADVANCED button and adjust the serial speed.

☞ If the software does not recognize the camera, continue to adjust the serial port speed on COM1, and the other COM ports, until it is recognized. Once your computer can communicate with your camera, gradually increase speed to optimize transfer picture time.

**To exit:** click on the OK button to apply the changes and exit the window.To exit the window without making any changes, click on the CANCEL button.



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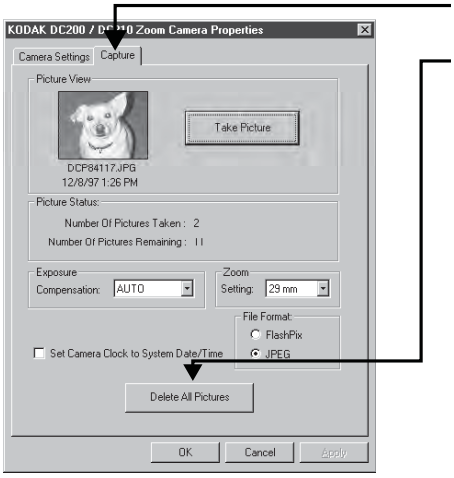
*Delete*

The Delete window allows you to delete the pictures from the memory card.

**To delete a picture:**

1 Click on the Camera icon with the right mouse button.

2 Select Camera Properties from the pop-up menu.




3 Click on the Capture tab.

4 Click on the DELETE ALL PICTURES button to delete all the pictures from the memory card.

☞ You may also delete individual picture files using the Camera icon. Simply double-click on the Camera icon, then double-click on the Memory Card icon. Click once on the picture file that you wish to delete. From the File pulldown menu, select Delete.

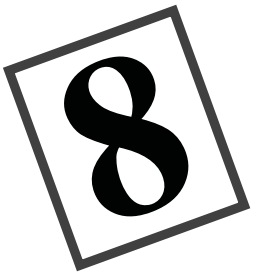
**To exit:** click on the OK button to apply the changes and exit the window.To exit the window without making any changes, click on the CANCEL button.





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APPENDIX YY



# TWAIN Software



KODAK DC200/DC210 Digital Access TWAIN Acquire Software (TWAIN) for WINDOWS 95, WINDOWS 98, or WINDOWS NT is a special industry-standard interface that allows the DC200/DC210 camera to transfer pictures from your camera directly to your favorite TWAIN-compliant software, such as ADOBE PHOTODELUXE.

## Installation

If you accepted the default installation settings when you installed the software from the DC200/DC210 CD (see Chapter 5 - *Installation Software)*, TWAIN software is already installed. If it is not installed, complete the instructions in Chapter 5 and select the TWAIN software option.

## Camera Communication Settings

If your computer does not recognize that the camera is attached and turned on, you may need to adjust the serial port and speed settings. See “Preferences Settings” on page 8-5 for details or follow the instructions on the KODAK Web site at http://www.kodak.com.



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## Starting TWAIN Software

1 Connect the DC200/DC210 camera to your computer.

*See "Connect" on page 8-1.*

2 Open a TWAIN-compliant software (for example, Adobe PhotoDeluxe).

3 Pull down the File menu and select TWAIN Source.

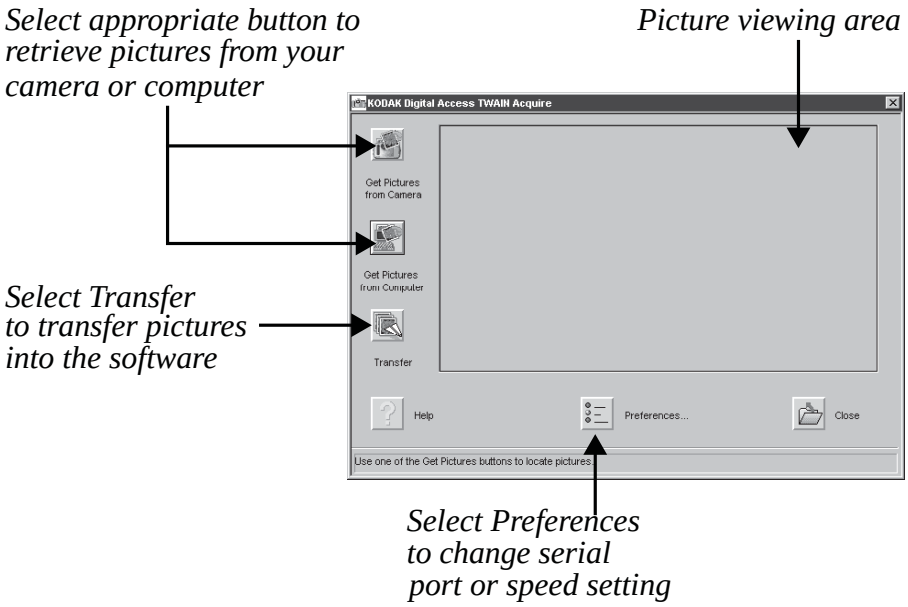
4 Select Kodak DC200/DC210 Zoom Acquire TWAIN.

5 Pull down the File menu and select TWAIN Acquire.

*The TWAIN software main window appears.*

## Overview

The following is the main window of TWAIN software. More detailed information is offered in the following sections.






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# Transferring Pictures from DC200/DC210

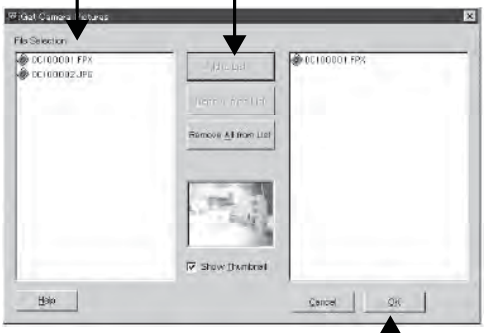
The DC200/DC210 needs to be turned on and connected to your computer to transfer pictures from the camera.



**1** Click on the GET PICTURES FROM CAMERA button.

*The Get Camera Pictures window appears.*

☞ Select Get Pictures from Computer to transfer pictures from an existing folder on your computer.



**2** Select the picture file from the File Selection area.

*The picture file is highlighted. To select multiple files at one time, hold down the CONTROL or SHIFT key and click on the picture files.*

☞ Check Show Thumbnail to preview the picture file.

**3** Click on the ADD TO LIST button.

*The picture file is listed in the transfer window.*

☞ You may also select:

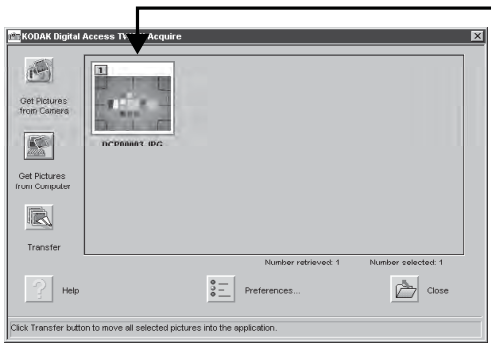
- ✓ Remove from List to remove a picture file from the transfer list.
- ✓ Remove All from List to remove all the picture files from the transfer list.

**4** Click on the OK button.



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*The main TWAIN software window reappears with a thumbnail of your picture.*




5 Click on a picture to select it.

☞ To select multiple pictures, hold down the Control or Shift key and click on the pictures.

6 Click on the TRANSFER button.

*The picture is displayed in the previously opened TWAIN-compliant software window.*

**To exit:** click on the CLOSE button.

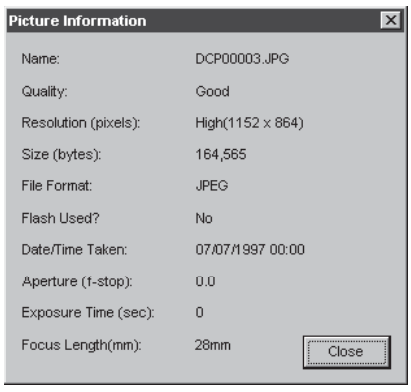
## Picture Information

The Picture Information window displays information about the picture and camera settings when the picture was taken. You may not select or change any settings on the window.

**To display picture information**:

Click on the [i] in the upper left corner of the picture to open the Picture Information window.

*The Picture Information window appears and displays:*




- ✓ Name of the picture file
- ✓ Quality setting
- ✓ Resolution setting
- ✓ Size (in bytes)
- ✓ File Format
- ✓ Flash information
- ✓ Date and time picture was taken
- ✓ Aperture information
- ✓ Exposure Time, in seconds
- ✓ Focal Length

**To exit:** click on the CLOSE button.



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## Preferences Settings

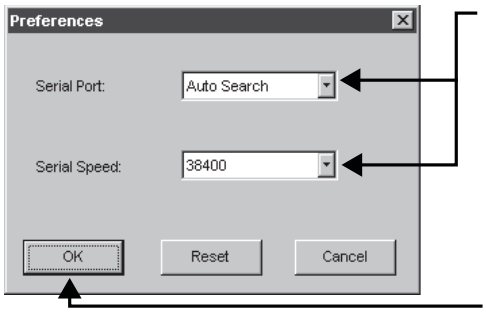
The Preferences window allows you to change serial port and speed settings.

If your computer does not recognize that the camera is attached and turned on, you may need to adjust the serial port and speed setting.

**To change serial port or speed setting:**

**1** Click on the PREFERENCES button.

*The Preferences window appears.*




**2** If necessary, click on the arrows and adjust the:

- ✓ serial port, if your computer does not recognize the camera
- ✓ port speed, to optimize picture transfer time

**3** Click on the OK button.

☞ To reset the values to the default settings click the RESET button.

☞ If the software does not recognize the camera, continue to adjust the serial port speed on the appropriate COM port until it is recognized. Once your computer can communicate with your camera, gradually increase speed to optimize transfer picture time.

**To exit:** click on the OK button. To exit the window without making any changes, click the CANCEL button.



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# 9 Tips and Troubleshooting



## Communicating with the Computer

If your computer cannot communicate with the camera you may need to adjust the serial port and speed settings. Adjust the settings using the KODAK Mounter Software (chapter 7) or KODAK TWAIN Software (Chapter 8), or follow the instructions on the Kodak Web site at http://www.kodak.com

## Monitor Adjustment

Your monitor display settings may need to be adjusted to view pictures from the camera.

1. Double-click on the My Computer icon.
2. Double-click on the Control Panel icon.
3. Double-click on the Display icon and click on the Settings tab.
4. From the Color Palette field, select the highest available setting {256, High (16-bit), or True (32-bit) color} and click the OK button.



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## Printing

You may notice that the colors on your computer screen do not always match those in your documents or prints. This is because monitors and printers use different color systems.

You may be able to achieve more predictable results in your printed documents by:

- ✓ improving the quality of your paper. Copier paper may not offer the same results as coated paper or paper made especially for ink jet printers.
- ✓ adjusting your printer software settings.
- ✓ using fresh ink cartridges. Do not use ink cartridges beyond their life expectancy.

☞ If you need extreme precision in matching printed output to your computer screen, you may want to consider purchasing a calibration system. The aim of a calibration system is to match, as close as possible, the printed image to the image on your computer screen. Please consult your local computer dealer for more information.

Remember these few tips when it comes time to print your document:

- ✓ color printing takes more time. The more complex your document is increases the printing and drying time.
- ✓ color printing is more memory intensive than black and white. If your computer gives you an insufficient memory message, you may need to close some applications, change some settings, or add additional memory.
- ✓ color prints may not photocopy as clearly as black and white. If you plan to photocopy documents, you may consider printing the document in gray scale. This setting is usually changed from the Print menu.
- ✓ resizing the picture to a smaller size or printing the picture on glossy paper may increase the quality of the print.

To improve the quality of your prints, you may want to print your pictures on *KODAK DIGITAL SCIENCE* Inkjet Snapshot Paper (Snapshot Paper). Snapshot Paper is made to work with most inkjet printers to give you clearer, crisper, and more detailed images on your prints.



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# Troubleshooting

If you are experiencing difficulties with your camera, check the following table for possible solutions. If the difficulties persist, refer to Chapter 11 - *Where to Get Help*.

☞ Additional technical information is available in the ReadMe file located in the KODAK DC200/DC210 Folder.

| **Computer Monitor** | | |
|---|---|---|
| **Problem** | **Cause** | **Solution** |
| The image on your monitor is jagged or inappropriately colored. | Monitor is not set correctly. | Adjust your monitor display settings. See "Monitor Adjustment" on page 9-1. |
| **Memory Card** | | |
| **Problem** | **Cause** | **Solution** |
| The DC200/DC210 does not recognize your memory card. | The memory card may not be ATA compatible. | Memory cards must be ATA compatible to work with the camera. |
| | The memory card may contain compression or stacker software. | Reformat any memory cards that contain compression or stacker software. Refer to the memory card's user's guide or see "Format Memory Card" on page 4-10 for instructions on reformatting the card. |





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| Windows-DC200/DC210 Camera Communications | | |
|---|---|---|
| **Problem** | **Cause** | **Solution** |
| Computer cannot communicate with the camera. | Some Advanced Power Management utilities on laptops can turn off ports to save battery life. | See the Power Management section of your laptop's user guide to disable this feature. |
| | Conflict with another serial device, such as a modem. | Refer to the serial communication or corresponding section of your computer's modem, and/or operating system's user's guide. |
| | Camera power is off. | Turn the camera on. |
| | Camera is not connected to serial cable or cable is not connected to the computer's COM port. | Connect serial cable to camera and COM port. See "Serial Cable Connection" on page 6-2. |
| | Infrared port is not responding. | Check the computer's infrared connection. Be sure that the camera is on. |
| | Port settings in software's Acquire-Preferences may be set to the incorrect COM port. | Change the COM port settings to Auto-Search or to a specific COM port. |
| | The Mode dial is not set to Connect. | Set the camera's Mode dial to Connect. |



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| DC200/DC210 Camera | | |
|---|---|---|
| **Problem** | **Cause** | **Solution** |
| Ready light does not turn on and the camera does not work. | Batteries are low or empty. | Replace the batteries. Pictures remain in the camera's memory when the battery is removed. |
| | Camera is not turned on. | Turn the camera on and verify that the green Ready light turns on. |
| Shutter button does not work. | Camera is not turned on. | Turn the camera on and verify that the green Ready light turns on. |
| | Mode dial is not set to Capture. | Set the Mode dial to Capture. |
| | Ready light is blinking. Camera is processing picture. | Wait until Ready light stops blinking before attempting to take another picture. |
| | The Status Display reads **Full**. The memory card is full. | Transfer pictures to your computer or insert a memory card that has available memory. |
| | Camera is connected to the computer. | Disconnect camera from computer. |
| Camera does not turn on. | Batteries are not properly installed. | Remove the batteries and install them according to the directions on the outside of the battery door. |
| | Batteries are weak or dead. | Install new batteries. |





BlackBerry Corporation Exhibit 1004, pg. 806

| DC200/DC210 Camera | | |
|---|---|---|
| **Problem** | **Cause** | **Solution** |
| Part of the picture is missing. | Something was blocking the lens when the picture was taken. | Keep hands, fingers, or other objects away from the lens when taking pictures. |
| | Your eye or the picture was not centered correctly in the viewfinder. | Leave space around subject when centering picture in viewfinder. |
| Picture is too dark. | Flash is not on or did not go off. | Turn on the flash. See “Flash” on page 2-9. |
| | The subject is too far away for the flash to have an effect. | Move so there is no more than 10 feet (3 m) between the camera and the subject. |
| | The subject is in front of a bright light. | Change your position so the light is not behind the subject. |
| Picture is too light. | The flash is not needed. | Change to automatic flash. See“Flash” on page 2-9. |
| | The subject is too close when the flash was used. | Move so there is at least 1.6 ft. (0.5 m) between the camera and the subject. |
| | The light sensor is covered. | Hold the camera so your hands or other objects do not cover the light sensor. |
| Stored pictures are damaged. | The memory card was removed when the Ready light was blinking. | Make sure the Ready light is not blinking before removing the memory card. |



BlackBerry Corporation Exhibit 1004, pg. 807

| DC200/DC210 Camera | | |
|---|---|---|
| **Problem** | **Cause** | **Solution** |
| Pictures remaining number does not decrease. | The image resolution does not take up sufficient space to decrease the picture remaining number. | The camera is operating normally. Continue taking pictures. |
| Picture is not clear. | The lens is dirty. | Clean the lens. See "General Maintenance and Safety" on page 2-15. |
| | Subject too close when taking picture | Stand at least 2.23 ft. (.68m) with DC200; at least 8 in. (20 cm.) in close-up, 3.28 ft. (1m) in telephoto, 1.64 ft. (0.5 m) with DC210. |
| | Subject or the camera moved while the picture was taken. | Hold camera steady until the picture is taken. |
| | The subject is too far away for the flash to be effective. | Move so the subject is less than 10 ft. (3 m) away. |
| **LCD Messages** | | |
| **Message** | **Cause** | **Solution** |
| Memory Card is Full. | Memory card is full and cannot hold additional pictures | Transfer pictures to your computer or insert a memory card that has available memory. |





BlackBerry Corporation Exhibit 1004, pg. 808

| LCD Messages | | |
|---|---|---|
| **Message** | **Cause** | **Solution** |
| No Memory Card. | There is no memory card inserted in the camera. | Insert a memory card into the camera. |
| Cannot read memory card. | Memory card is corrupted. | Insert a new or reformat the memory card. |
| Cannot establish connection. | The camera cannot communicate with the computer. | Change the COM port settings to Auto-Search or to a specific COM port. See “Serial Cable Connection” on page 6-2. |
| Camera needs service. | The camera is malfunctioning. | Have the camera serviced. |



BlackBerry Corporation Exhibit 1004, pg. 809

# 10 Accessories

Several accessories for the DC200/DC210 cameras can be purchased from your Kodak or computer dealer.

## AC Adapter

An AC adapter allows you to connect your DC200/DC210 to a standard electrical outlet. This is especially useful when you are transferring pictures into your computer. The adapter powers the camera, but does not charge the batteries.

WARNING: Only use the AC adapter designed for the DC200/DC210. Use of any other adapter may void the warranty and can cause camera failure, fire, electric shock, or injury.



1. Insert the AC adapter into the AC power adapter connection on the side of your camera.
2. Connect the other end of the adapter into the power outlet.
3. Turn the camera on.

   ☞ The Battery icon does not appear on the Status Display when an AC adapter is used.





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## Memory Cards



*KODAK DIGITAL SCIENCE* Picture Cards, also known as memory cards or CompactFlash cards, allow you to expand the storage capability of your camera. These removable, reusable cards come in a variety of MB sizes that make storing, sharing, and manipulation of pictures easy. Used with card adapters, memory cards become compatible with PCMCIA slots on laptop computers

| Memory Card | Kodak Item Number | Number of Pictures* |
|---|---|---|
| 4 MB | 196-4956 | 14 |
| 4 MB card with adapter | 821-6822 | 14 |
| 10 MB card | 863-3828 | 36 |
| 10 MB card with adapter | 849-2399 | 36 |
| 20 MB card | 146-8628 | 74 |
| 20 MB card with adapter | 824-2026 | 74 |
| 32 MB card | 180-6900 | 100 |
| 32 MB card with adapter | 196-4840 | 100 |
| Card adapter only | 156-1596 | N/A |

*These figures are based on images captured in the best quality and highest resolution settings in JPEG format. The number of pictures are approximate numbers because the actual numbers are determined by the detail in the scene of each picture.

## Memory Card Reader

Memory card readers transfer pictures up to 10 times faster from your memory card to your computer than standard serial cable connections. The parallel port memory card reader connects easily to your PC computer, and works well with most printers. Using the memory card reader greatly reduces battery consumption during download, since the camera is not used, and is WINDOWS 95, WINDOWS 98, or WINDOWS NT compatible.



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## Inkjet Media

The *KODAK DIGITAL SCIENCE* Family of Inkjet Products provide consistently sharp, vivid color and text reproduction. All *KODAK DIGITAL SCIENCE* Inkjet Media works well with all popular color inkjet printers.

| ***KODAK DIGITAL SCIENCE* Injet Quality Products** | **KODAK Item Number** |
|---|---|
| Snapshot paper, 36 sheet, 4x6 in. | 145-6979 |
| Photographic quality paper, photo weight, 15 sheet, 8.5x11 in. | 158-5199 |
| Photo paper, photo weight, 50 sheet, 8.5x15 in. | 121-5904 |
| Photo paper, photo weight, 50 sheet, 11x17 in. | 877-0356 |
| Photographic quality paper, photo weight, 15 sheet, 210x297 mm | 134-2013 |
| Photo paper, photo weight, 50 sheet, 297x420 mm | 829-5370 |
| Photographic quality paper, letter weight, 15 sheet, 8.5x11 in. | 815-0443 |
| Photographic quality paper. photo weight, 15 sheet, 210x297 mm | 197-5937 |

## Serial Connection Kit for MACINTOSH Systems

The kit contains a serial cable and software that allow you to transfer pictures from your DC200/DC210 camera to your MACINTOSH Computer.

## Battery Charger




The KODAK Ni-MH/Ni-Cd Battery Charger is a great alternative to an AC adapter. This compact charger can charge four AA batteries in three hours or less. The four AA Ni-MH batteries included with the charger last longer than most alkaline batteries, and can be charged up to 500 times.





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## Camera Bag



The camera bag with adjustable shoulder strap, is specially designed to protect your new camera. This camera bag has an adjustable compartment with enough room to hold the camera, cables, and AC adapter. The inside pockets offer convenient storage for memory cards and batteries. Size: 5”h x 3”d x 8.5”w (12mm h x 77mm d x 216mm w)

## Infrared Connection *—DC210 Only*

The DC210 camera can connect to a computer using an infrared transceiver connection. An infrared connection can increase transfer speed dramatically depending on the capability of your computer’s IR options.

Your computer must be set up with an infrared transceiver before the camera’s infrared transceiver can be used. Consult your computer dealer for more information.

Refer to the instructions included with your computer’s infrared connection package for more details on setting up an infrared transceiver connection.

Additional information on accessories for your DC200/DC210 are available from:

- ✓ World Wide Web—http://www.kodak.com/go/accessories
  —http://www.kodak.com/go/shop (USA only)
- ✓ Faxed product information by calling:1-800-508-1531 (USA only)
- ✓ Your computer or Kodak dealer

☞ Not all accessories are available in all countries.



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# Where to Get Help

Help with your DC200/DC210 is available from a number of resources.

- ✓ in *Tips and Troubleshooting,* Chapter 9
- ✓ the software's manufacturer
- ✓ product information by fax
- ✓ your place of purchase
- ✓ World Wide Web
- ✓ technical support

## Software Help

Help with any **software** packaged with your DC200/DC210 can be obtained from the software instructions, the software's help screens, or by contacting the manufacturer of that product.

## Online Services

Contact Kodak via:

**World Wide Web—**http://www.kodak.com
**America Online—**(keyword) KODAK
**CompuServe—**GO KODAK
**Kodak Internet listserv—**photo-cd@info.kodak.com; or ftp.kodak.com

## Faxed Information

Kodak offers automated support for digital imaging products and services. Product information can be faxed to you by calling:

**U.S.—**1-800-508-1531
**Canada—**1-800-295-5531
**Europe—**44-131-458-6962
**U.K.—**44-0-131-458-6962





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## Customer Support

If you have questions concerning the operation of Kodak software, or the DC200/DC210, you may speak directly to a customer support representative. Have the camera connected to your computer, its serial number ready, and be at your computer when you call.

**U.S. and Canada—**call toll free, 1-888-375-6325, between the hours of 9:00 a.m. and 8:00 p.m. (Eastern Standard Time) Monday through Friday.

**Europe—**call the Kodak Digital Imaging Support Centre toll free number associated with your location, or the U.K. toll line, 44-131-458-6714, between the hours of 09.00 and 17.00 (GMT/CET) Monday through Friday.

**Outside the U.S., Canada, and Europe—**call the number on the following pages that is associated with your location.

| Country | Help number | Fax |
|---|---|---|
| Argentina | 54-1-808-300 | 54-1-808-3328 |
| Australia | 1-800-674-831 | 61-3-9353-2488 |
| Austria | 0-660-7348 | 44-131-458-6962 |
| Belgium | 0800-72247 | 44-131-458-6962 |
| Brazil | 0-800-15-0000 | 55-12-331-8571 |
| Caribbean | 78-7-757-5500 | 78-7-757-8760 |
| Chile | 56-2-697-2000 | 56-2-697-0310 |
| China–Shanghai | 8621-64720888 | 8621-64726582 |
| China–Beijing | 8610-63471155 | 8610-63475641 |
| Colombia | 57-1-629-0266 | 57-1-629-0673 |
| Denmark | 80-01-09-24 | 44-131-458-6962 |
| Dominican Republic | 809-563-1252 | 809-563-1264 |
| Egypt | 20-2-394-2205 | 20-2-393-1119 |
| France | 0800-90-6281 | 44-131-458-6962 |
| Finland | 0800-117056 | 44-131-458-6962 |
| Germany | 0130-82-54-02 | 44-131-458-6962 |
| Greece | 00800-44125605 | 44-131-458-6962 |
| Hong Kong | 852-2564-9777 | 852-2564-9753 |



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| Country | Help number | Fax |
|---|---|---|
| Hungary | 36-1-269-71-17 | 36-1-269-71-13 |
| India | 91-22-617-5823 | 91-22-617-6004 |
| Ireland | 1-800-409391 | 44-131-458-6962 |
| Italy | 1678-72-996 | 44-131-458-6962 |
| Japan | 81-3-5488-2390 | 81-3-5488-4512 |
| Korea | 82-2-708-5400 | 82-2-708-5500 |
| Latin America | 1-305-267-4700 | 1-305-267-4780 |
| Lebanon | 961-1-883822 | 961-1-881726 |
| Malaysia | 60-3-757-2722 | 60-3-755-5919 |
| Mexico | 52-5-449-4300 | 52-5-449-4400 |
| Middle East | 971-4-444-910 | 971-4-447-059 |
| Netherlands | 06-0224428 | 44-131-458-6962 |
| New Zealand | 0800-500-135 | 64-9-302-8637 |
| Norway | 800-1-1848 | 44-131-458-6962 |
| Panama | 52-3-678-6200 | 52-3-678-6210 |
| Peru | 51-1-224-8610 | 51-1-224-8605 |
| Philippines | 63-2-810-0331 | 63-2-816-6718 |
| Portugal | 351-1-4149-500 | 351-14194-321 |
| Russia | 7-095-929-9166 | 7-095-929-9170 |
| Singapore | 65-470-9875 | 65-479-8397 |
| South Africa | 27-11-804-2852 | 27-11-804-5013 |
| Spain | 900-98-4485 | 44-131-458-6962 |
| Sweden | 020-793169 | 44-131-458-6962 |
| Switzerland | 0800-551034 | 44-131-458-6962 |
| Taiwan | 886-2-893-8210 | 886-2-895-1069 |
| Thailand | 66-2-271-3040 | 66-2-279-5073 |
| Turkey | 90-216-342-3332 | 90-216-343-6743 |
| U.K. | 0800-281487 | 44-131-458-6962 |
| Uruguay | 59-2-92-0473 | 59-2-92-1796 |
| Venezuela | 58-2-903-1111 | 58-2-943-2081 |





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# *Warranty & Regulatory Information*



## Warranty Time Period

Kodak warrants the *KODAK DIGITAL SCIENCE* DC200 and *KODAK DIGITAL SCIENCE* DC210 cameras (excluding the batteries) to be free from malfunctions and defects in both materials and workmanship for one year from the date of purchase.

## Warranty Repair Coverage

This warranty will be honored within the geographical location that the product was purchased.

If the equipment does not function properly during the warranty period due to defects in either materials or workmanship, Kodak will, at its option, either repair or replace the equipment without charge, subject to the conditions and limitations stated herein. Such repair service will include all labor as well as any necessary adjustments and/or replacement parts.

If replacement parts are used in making repairs, these parts may be remanufactured, or may contain remanufactured materials. If it is necessary to replace the entire system, it may be replaced with a remanufactured system.

Kodak will also provide telephone assistance during the warranty period.



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## Limitations

WARRANTY SERVICE WILL NOT BE PROVIDED WITHOUT DATED PROOF OF PURCHASE. PLEASE RETURN THE WARRANTY REGISTRATION CARD WITHIN 30 DAYS OF PURCHASE.

THIS WARRANTY BECOMES NULL AND VOID IF YOU FAIL TO PACK YOUR DC200/DC210 CAMERA IN A MANNER CONSISTENT WITH THE ORIGINAL PRODUCT PACKAGING AND DAMAGE OCCURS DURING PRODUCT SHIPMENT.

THIS WARRANTY DOES NOT COVER: CIRCUMSTANCES BEYOND KODAK'S CONTROL; SERVICE OR PARTS TO CORRECT PROBLEMS RESULTING FROM THE USE OF ATTACHMENTS, ACCESSORIES OR ALTERATIONS NOT MARKETED BY KODAK; SERVICE REQUIRED AS THE RESULT OF UNAUTHORIZED MODIFICATIONS OR SERVICE; MISUSE, ABUSE; FAILURE TO FOLLOW KODAK'S OPERATING, MAINTENANCE OR REPACKAGING INSTRUCTIONS; OR FAILURE TO USE ITEMS SUPPLIED BY KODAK (SUCH AS ADAPTERS AND CABLES).

KODAK MAKES NO OTHER WARRANTIES, EXPRESS, IMPLIED, OR OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE FOR THIS EQUIPMENT OR SOFTWARE.

REPAIR OR REPLACEMENT WITHOUT CHARGE ARE KODAK'S ONLY OBLIGATION UNDER THIS WARRANTY. KODAK WILL NOT BE RESPONSIBLE FOR ANY SPECIAL, CONSEQUENTIAL OR INCIDENTAL DAMAGES RESULTING FROM THE PURCHASE, USE, OR IMPROPER FUNCTIONING OF THIS EQUIPMENT REGARDLESS OF THE CAUSE. SUCH DAMAGES FOR WHICH KODAK WILL NOT BE RESPONSIBLE INCLUDE, BUT ARE NOT LIMITED TO, LOSS OF REVENUE OR PROFIT, DOWNTIME COSTS, LOSS OF USE OF THE EQUIPMENT, COST OF ANY SUBSTITUTE EQUIPMENT, FACILITIES OR SERVICES, OR CLAIMS OF YOUR CUSTOMERS FOR SUCH DAMAGES.

Depending on your geographical location, some limitations and exclusions may not apply.



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## Application Support

For application specific support, contact your reseller, systems integrator, software manufacturer, or dealer.

## How to Obtain Service

Visit us on the Internet at http://www.kodak.com

Please refer to the Service and Support section of your user's guide for the support hotline designated to your location.

When returning a DC200/DC210 camera for repair, the unit shall be packed in its original packing materials. A problem report should also be enclosed with the equipment. If the original packaging has been discarded or is not available, packing will be at the owner's expense.

The repaired or replaced unit will be shipped from Kodak within five business days from the date of the camera receipt at the service center.

Unless a specific Kodak warranty is communicated to the purchaser in writing by a Kodak company, no other warranty or liability exists beyond the information contained above, even though defect, damage or loss may be caused by negligence or other act.

To obtain warranty repair service contact your local Kodak representative. For assistance, refer to the Service and Support information in the KODAK DC200/DC210 Camera User's Guide.



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# Regulatory Information

## FCC Compliance and Advisory

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:1) this device may not cause harmful interference, and 2) this device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation.

This equipment generates, uses, and can radiate radio frequency energy and, if not installed or used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures: 1) reorient or relocate the receiving antenna; 2) increase the separation between the equipment and the receiver; 3) connect the equipment to an outlet on a circuit different from that to which the receiver is connected; 4) consult the dealer or an experienced radio/TV technician for additional suggestions.

Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment. Where shielded interface cables have been provided with the product or specified additional components or accessories elsewhere defined to be used with the installation of the product, they must be used in order to ensure compliance with FCC regulation.

## Canadian DOC Statement

**DOC Class B Compliance—**This digital apparatus does not exceed the Class B limits for radio noise emissions from digital apparatus set out in the radio interference regulations of the Canadian Department of Communications.

**Obervation des normes-Class B—**Le présent appareil numérique n'émet pas de bruits radioélectriques dépassant les limites applicables aux appareils numériques de la Classe B prescrites dans les règlements sur le brouillage redioélectrique édictés par le Ministère des Communications du Canada.



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# *KODAK DIGITAL SCIENCE™*
## DC220 and DC260 Zoom Cameras



# User's Guide

***for the cameras, KODAK Installation Software, KODAK Camera Properties Software, KODAK Mounter Software, and KODAK Acquire/TWAIN Software***

***Visit Kodak on the World Wide Web at www.kodak.com***

Kodak, Digital Science, FlashPix, and the ds monogram are trademarks of Eastman Kodak Company.

Digita is a trademark of FlashPoint Technology, Incorporated.

The FlashPix format is defined in a specification and test suite developed and published by Kodak in collaboration with Microsoft, Hewlett-Packard, and Live Picture. Only products that meet the specification and pass the test suite may use the FlashPix name and logo.

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# Getting started

## So where is the film?

Of course there is no film, but you knew that already. The *KODAK DIGITAL SCIENCE*™ DC260 Zoom Camera (DC260) and the *KODAK DIGITAL SCIENCE*™ DC220 Zoom Camera (DC220) take great pictures without using film. Here are some of the things that you can do:

- ✔ take pictures and immediately view them on the color camera display, on your TV, or on your computer
- ✔ take burst and timelapse pictures
- ✔ add sound to a picture
- ✔ organize your pictures in electronic photo albums (DC260 only)
- ✔ transfer your pictures to your computer and do things like e-mail them to family and friends



## Camera features

The DC220/DC260 Camera features:

- ✔ built-in flash with red-eye reduction
- ✔ an easy to use status display of camera settings
- ✔ removable memory card
- ✔ infrared remote connection to compatible devices
- ✔ a 2X zoom lens (29 to 58mm) on the DC220 and a 3X zoom lens (38.4 to 115.2mm) on the DC260 to zoom in on subjects
- ✔ a close up option to set the focus at 8 in. (20 cm) (DC220 only)
- ✔ a mode dial to activate one of four functions on the camera:

  **Capture** —takes, previews, and adjusts the exposure of pictures

  **Review** —reviews, plays, or deletes pictures

  **Connect** —the camera communicates with your computer

  **Info** —displays information about the camera



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## Typical uses for your camera

So you bought this great new digital camera and now you want to know what to do with it. Here is a typical scenario:

| | |
|---|---|
| **1. Turn on your camera and put it in the Capture mode.** | A push of a button and a turn of the dial. See page 3-2. |
| **2. Take a picture and instantly review it.** | With your digital camera you can take single, burst, or timelapse pictures. See page 3-14. |
| **3. Add sound to your picture.** | Record a reminder to mail your insurance premium and attach it to the picture of your latest fender-bender. See page 3-16. |
| **4. Put the camera in the Review mode.** | The Review mode lets you view, edit, and organize your pictures. See page 4-1. |
| **5. Scroll through your pictures.** | One at a time, in a continuous scroll, or in a fast scroll. See page 4-5. |
| **6. Play back the picture's sound.** | You can also play a series of burst or timelapse pictures. See page 4-14. |
| **7. Magnify the picture on the LCD to see its detail.** | Get a close up view of your subject. See page 4-15. |
| **8. Connect your camera to your computer.** | You can use a serial, USB, or infrared connection. See page 6-1. |
| **9. Transfer the pictures to your computer.** | Choose from Mounter, TWAIN, or *KODAK DIGITAL SCIENCE* Picture Easy Software 3.0. See Chapters 7 and 8 in this Guide and the Picture Easy User's Guide. |

**Now the sky's the limit.**

With various software programs you can e-mail pictures to friends, place pictures in your documents and letters, manipulate your picture in image editing software...you name it. Try Picture Easy—it offers great ways to use your digital pictures.



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## DC220 and DC260 software

Included with your camera is a CD-ROM containing software that will help you use your digital pictures:

- ✔ Camera Properties which allows you to setup your digital camera through a graphical interface on your computer
- ✔ Mounter and TWAIN which allow you to move pictures from the camera to your computer
- ✔ Picture Easy which allows you to organize, enhance, share, and print your digital pictures

☞ This User's Guide describes the DC220/DC260 Camera operation and the operation of software for use on WINDOWS PC computer systems. For information about the Macintosh plug-in software, please refer to Appendix A.

### System Requirements

- ✔ PC with 486/66MHz microprocessor or PENTIUM Processor
- ✔ 16 MB or more of RAM (WINDOWS 95), 32 MB RAM (WINDOWS NT 4.0)
- ✔ 50 MB hard disk space available
- ✔ available serial port, IrDA connection, USB port or PC Card reader
- ✔ USB requires WINDOWS 95 4.00.950B and supporting hardware
- ✔ IrDA requires WINDOWS 95 and supporting hardware
- ✔ CD-ROM drive
- ✔ 256 colors (thousands of colors recommended)
- ✔ System Administrator privileges to install on a WINDOWS NT 4.0 system





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## Installing software

To install the software:

1. Close all other software programs before starting the DC220/DC260 software installation.
2. Place the DC220 or DC260 CD into your CD-ROM drive.
3. Select the language in which you want to view menus and install the software.

   *The CD Browser menu appears.*
4. Click the INSTALL DC220/DC260 SOFTWARE button.
5. Follow the instructions on your computer screen to complete the installation.

You are now ready to run the newly installed software. Detailed information on Camera Properties Software (Chapter 5), KODAK Mounter Software (Chapter 7), and TWAIN Software (Chapter 8) are included in this user manual. Instruction manuals for the additional software packages that were installed are included in the camera package.

# Accessories

The following accessories for the DC220 and DC260 Cameras can be purchased from your local Kodak dealer or computer dealer.

| Camera Accessories | Item Number |
|---|---|
| KODAK DIGITAL SCIENCE Premium Accessory Kit for DC200 Series Digital Camera | 190 6130 (US/Canada)<br><br>188 0459 (International) |
| KODAK DC200 Series Premium Camera Bag | 809 2710 |
| Lens Cap for DC220/DC260 Zoom Camera | 139 5185 |
| KODAK DIGITAL SCIENCE AC Adapter for DC200 Cameras | 122 0557 (US/Canada)<br>190 9282 (International)<br>974 2933 (Australia/NZ) |
| KODAK Ni-MH/Ni-Cd Battery Charger with 4AA NiMH Batteries | 807 6341 |



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| Camera Accessories | Item Number |
|---|---|
| Serial Interface Cable for DC220/DC260 Zoom Cameras and WINDOWS platforms | 804 4745 |
| USB Interface Cable for DC220/DC260 and WINDOWS | 811 2690 |
| Video/Audio Cable for DC220/DC260 Zoom Cameras | 812 6344 |



| COMPACTFLASH Card | Item Number | Number of Pictures * 220 | 260 |
|---|---|---|---|
| 10 MB Card | 863 3828 | 32 | 20 |
| 10 MB Card With Adapter | 849 2399 | 32 | 20 |
| 20 MB Card | 146 8628 | 65 | 40 |
| 20 MB Card With Adapter | 824 2026 | 65 | 40 |
| 32 MB Card | 180 6900 | 100 | 65 |
| 32 MB Card With Adapter | 196 4840 | 100 | 65 |
| Card Adapter only | 156 1596 | N/A | N/A |

*These figures are based on the best quality and highest resolution in a Still Picture JPEG format. These are approximate numbers because the actual numbers are determined by the detail in the scene of each picture.

.

| KODAK DIGITAL SCIENCE Inkjet Quality Products | Item Number |
|---|---|
| Snapshot Paper, 36 sheet, 4x6in. | 145 6979 |
| Photographic Quality paper, Photo Weight, 15 sheet, 8.5x11in. | 158 5199 |
| Photo Paper, Photo Weight, 50 sheet, 8.5x14in. | 121 5904 |
| Photo Paper, Photo Weight, 50 sheet, 11x17in. | 877 0356 |
| Photographic Quality Paper, Photo Weight, 15 sheet, 210x297mm | 134 2013 |
| Photo Paper, Photo Weight, 50 sheet, 297x420mm | 829 5370 |
| Photographic Quality Paper, Letter Weight, 15 sheet, 8.5x11in. | 815 0443 |



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| KODAK DIGITAL SCIENCE Inkjet Quality Products | Item Number |
|---|---|
| Photographic Quality Paper, Photo Weight, 15 sheet, 210 x 297mm | 197 5937 |
| Photo Paper, Perforated 2 up 5"x7", 15 sheet with Picture Easy Software CD, 8.5x11in. | 864 5491 |
| Photo Paper, Perforated 2 up 127x177mm, 15 sheet with Picture Easy Software CD, 210x297 mm | 888 5139 |
| Photo Paper, Perforated 6 up 2.25" x 3.5", 15 sheet with Picture Easy Software CD, 8.5x11in. | 870 2870 |
| Photo Paper, Perforated 6 up 57.1 x 88.9mm, 15 sheet with Picture Easy Software CD, 210x297 mm | 802 1172 |
| Photo Paper, Perforated 10 up 2" x 3.5", 20 sheet, 8.5 x 11in. | 877 8151 |
| Photo Paper, Perforated 10 up 50 x 90mm, 20 sheet, 210x297 mm | 863 9064 |
| Photo Stickers, Pre cut 6 up 3.75" x 3.25", 15 sheet with Picture Easy Software CD, 8.5 x 11 in. | 167 4647 |
| Photo Stickers, Pre cut 6 up 95.25 x 82.55mm, 15 sheet with Picture Easy Software CD, 210x297 mm | 114 2470 |
| Photo Stickers, Full Page, 15 sheet, 8.5x11in. | 847 2177 |
| Photo Greeting Card Paper, 1/2 Fold, 20 sheet with 20 envelopes, 28.5x11in. | 106 2330 |
| Photo Greeting Card Paper, 1/2 Fold, 20 sheet with 20 envelopes, 210x297 mm | 103 6540 |
| Premium Transparency Film, 15 sheet, 8.5x11in. | 182 0445 |
| Premium Transparency Film, 15 sheet, 210 x 297mm | 149 8369 |

Additional information on accessories is available from:

- ✔ the World Wide Web—http://www.kodak.com/go/accessories
- ✔ in the U.S., shop on-line at http://www.kodak.com/go/shop
- ✔ your computer or Kodak dealer

☞ Not all accessories are available in all countries.

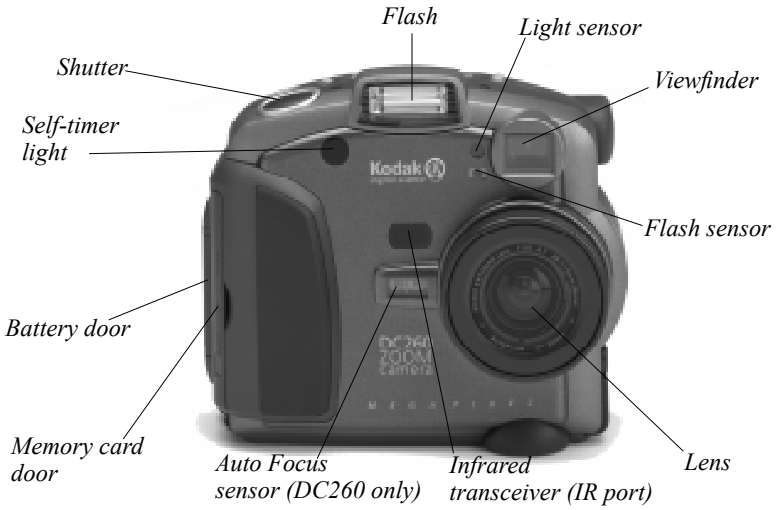


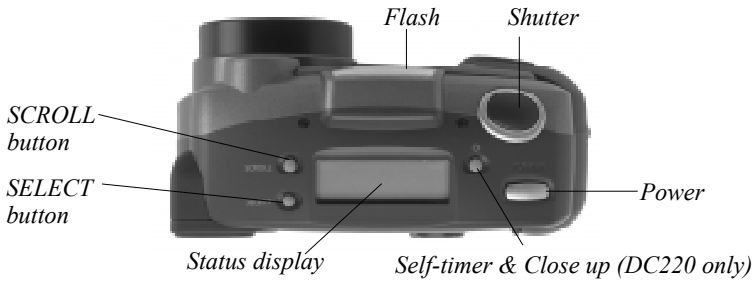
BlackBerry Corporation Exhibit 1004, pg. 839

# 2 Meet your camera

To take full advantage of your camera, it's important to familiarize yourself with your *KODAK DIGITAL SCIENCE*™ DC220 or DC260 Zoom Camera's buttons, displays, and hardware features.

## Your Digital Camera

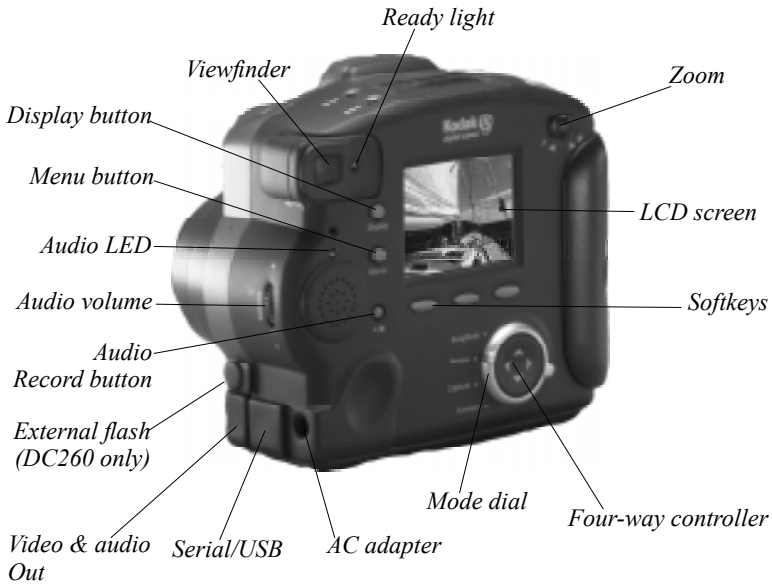







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☞ The camera shown is a DC260. In cases where the features differ from the camera shown, the User's Guide will note it.



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## Softkeys

Your camera has three “softkeys.” A softkey is a button whose function changes according to what is displayed above it. For example, in the Capture mode, the following screen can be displayed:




In this case, pressing the left softkey enters the Capture Preferences. When presented with a different screen display, pressing this softkey may perform an entirely different function.

## Mode dial

The camera’s mode dial allows you to choose from four camera modes:

- ✔ Capture—the mode you’ll use to take beautiful digital pictures
- ✔ Review—this mode allows you to view, edit, and organize your pictures
- ✔ Connect—the mode you’ll use to connect your camera to your computer. Once connected you can use Mounter, TWAIN, or *KODAK DIGITAL SCIENCE* Picture Easy Software to move your pictures from your camera to your computer.
- ✔ Info—this mode displays information about your camera’s firmware.

You can change modes without turning your camera off.

## Four-way controller

The four-way controller’s up, down, right, and left arrows allow you to move through the Camera’s menus and icons and to scroll through your pictures.



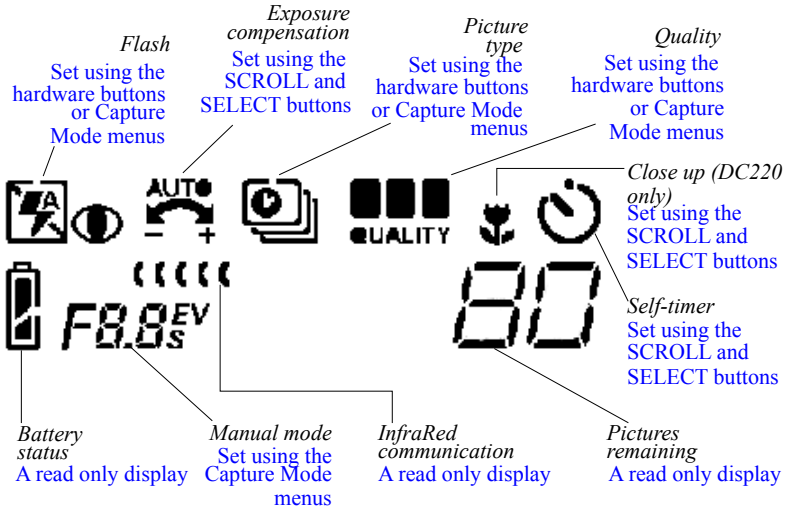


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## Your camera display

On the top of the camera a display shows the current settings. Take a minute to become familiar with the various entries on the display. The following subsections briefly describe each entry.

☞ The camera must be turned on to view the Status Display. You must also be in the Capture mode to view and interact with this display.




☞ For information on how to define settings through the Capture Mode menus and through the SCROLL and SELECT buttons, refer to Chapter 3.

### *Flash*

Your camera is equipped with a built-in flash that offers a red-eye reduction feature. The flash has an effective range of approximately 1.6 to 9.8 ft. (0.68 to 3 m). There are four Flash settings:

**Auto—** the flash fires automatically when you press the SHUTTER button and the camera determines that there is not enough light.

**Red-eye—** if the camera determines that there is not enough light**,** the flash fires once when you press the SHUTTER button to reduce the chance of red-eye and then flashes a second time, 600 milliseconds later, when the picture is taken.



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**Fill—** the flash fires every time you press the SHUTTER button. Use this setting when the lighting is poor or when your subject is lit from behind.

**Off—** the flash is turned off and will not fire. If you turn the flash off, the next time you turn the camera on, the camera defaults to the Auto flash setting.

### *Exposure Compensation*

The camera's exposure can be adjusted from -2.0 to +2.0 exposure value (EV) in 0.5 EV increments while in Capture mode.

If your pictures are:

- ✔ **correctly exposed** —maintain the AUTO default setting which will automatically choose the correct exposure for the lighting conditions.
- ✔ **too dark—** increase (+) the exposure compensation setting
- ✔ **too light—** decrease (-) the exposure compensation setting

### *Picture Type*

The Picture Type icon changes to indicate the type of picture you are taking. There are three picture types:

**Still—** a single still picture is taken. The Still picture type is the default; whenever you turn the camera on, Still pictures is the selected picture type.

**Burst—** a series of pictures are taken in quick succession.

**Timelapse—** a series of pictures are taken with a time delay between each picture. You can set the time delay through Capture Preferences.

☞ Refer to Chapter 5, "Setting camera properties" for more information about each picture type and their preference settings.





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## *Quality* 


You may set your camera to take pictures with a Good, Better, or Best Quality setting. The Quality setting indicates how much the picture is compressed to save space on the memory card.

*A brief detour to discuss quality and resolution...*

Keep in mind that with your DC220 and DC260 Cameras you're generally going to get beautiful digital pictures. But based on two factors, **resolution** and **compression** , some pictures will be of a higher quality than others.

It's basically quality versus quantity when it comes to pictures.

Instead of film, a digital camera places your pictures on a memory card. The pictures are made up of pixels. Stand really close to your TV—so close that your mother would yell at you if she saw you. Those little dots that make up the picture are pixels. It's the more the merrier when it comes to pixels and the quality of your digital pictures. But everything has its price. The more pixels you have (or the better the **resolution** in other words) the more space you use on the camera memory card.

To save space, you can compress each picture. When a picture is compressed, some color and detail information is discarded. More compression means a lower quality picture. Less compression means a better quality picture.

Together, compression (or **quality** ) and resolution dictate how many pictures you can fit on your memory card.

- ✔ If the quality of your pictures is most important, use high quality (which results in little compression) and high resolution. You may want to do this if you will be printing your pictures on a high quality printer.
- ✔ If space on your memory card is most important, use a lower quality (which results in more compression) and standard resolution. You may want to do this if you will be using your pictures in a Web page.

☞ Remember that Resolution and Quality are two different things. Resolution is the number of pixels in the picture. Quality is how much you compress them.



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*We now return to our Quality discussion....*

You may switch freely between the three settings when taking pictures. The number of pictures the camera is able to store will vary accordingly. The Quality and Resolutions settings combine to dictate how many pictures you can store on your memory card. Higher Quality and Resolution settings mean you save more picture information, making for higher quality pictures, but use more space of your memory card.

The three Quality setting icons are:




**Best—** use this setting when image quality is very important for maximum picture quality, especially for larger sized or zoom prints.




**Better—** use this setting for general picture taking, good quality pictures, and to store a large number of pictures.




**Good—** use this setting to store the greatest number of pictures.

## *Self-Timer*

Activating the Self-Timer option creates a 10-second delay between the time you press the SHUTTER button and when the picture is taken. This allows enough time for you to include yourself in the picture.

## *Close Up (DC220 only)*

The camera offers a Close Up setting which allows you to focus as close as 8 in. (20 cm).

☞ The viewfinder does not accurately display the subject in close up mode. To accurately capture the picture close up, the Preview option automatically starts when the CLOSE UP button is pressed.





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### *Batteries* 

☞ This is a display icon only. You cannot select or change this icon.

The camera comes equipped with four AA batteries. You can use standard 1.5V alkaline, 1.7V lithium, rechargeable 1.2 NiMH, or rechargeable 1.2V NiCad batteries. NiMH tend to give the best overall performance of rechargeable batteries.

☞ Battery life will be reduced when Preview, Review, or Close-up Mode are in use.

The battery power icon changes automatically.



**Full—** batteries are fully charged.



**Low—** batteries need to be replaced.



**Blinking—** batteries are insufficient to run the camera and need to be replaced.

☞ Pictures stored in the card's memory are not lost if the batteries are depleted.

### *Pictures Remaining* 

☞ This is a display icon only. You cannot select or change this icon.

The Pictures Remaining icon changes automatically to indicate the remaining number of pictures that can be stored at the current quality and resolution setting. You may not select or change the Pictures Remaining icon.

☞ The Pictures Remaining number does not always change when a picture is taken if the picture content is easily compressed.

When the card's memory is full, the Status Display indicates Full. You must delete existing pictures or change the memory card to take additional pictures. For more information on how to delete pictures, refer to the "Deleting pictures" section on page 4-13.



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## *Manual Mode* F8.8 EV s

The DC260 Camera supports two advanced capture modes—the external flash mode and the long time mode. The DC220 Camera supports only the long time mode.

The two manual mode icons are:

F8.8 **External flash mode—** the DC260 camera's built-in flash is disabled and the external flash sync is used to provide flash. You set the camera aperture setting (or f/stop). Choose from 1.8, 2.4, 4, 5.6, 8, 11, 16, or 22. The default value is 5.6 and provides an appropriate depth of field for many identification or portraiture applications.

8.8s **Long time mode—** The camera's flash is disabled as it is assumed that a long exposure time is necessary to obtain a proper exposure within the current ambient lighting environment. You set the exposure time between 0.5 and 4 seconds in 0.5 second increments.

## *Infrared Communication*

In a camera to camera connection in the Review mode, two cameras can communicate with each other through an infrared connection. The Infrared Communication icon appears and changes to indicate the state of the camera's communication with its infrared partner camera.

The infrared communication icons are:

IR **Initiating communication—** Infrared communication has been initiated.

**Searching for communication partner—** The camera is looking for an infrared communication partner.
**Blinking**

**Communicating—** The camera is communicating with its infrared partner. The alphanumeric display also indicates the number of pictures that have yet to be transmitted.
IR

**Communication timed out—** A problem has occurred that has caused the communication to time out. The icon continues to blink until you respond to the LCD dialog or turn the camera off.
IR
**Blinking**





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## Removable memory card

The DC220 and DC260 cameras use a removable *KODAK DIGITAL SCIENCE* Picture Card, also referred to as a CompactFlash or memory card, for storing your pictures. A memory card can be thought of as a roll of film. But unlike a roll of film, the picture data on the card can be erased and the card can be reused.

☞ The *KODAK DIGITAL SCIENCE* Picture Card is furnished with your camera. Additional removable memory cards can be obtained from a variety of sources. Visit **http://www.kodak.com/go/accessories** for ordering directly from Kodak, or visit the retail store where you purchased your camera. The memory cards can also be purchased at any computer store. Any standard CompactFlash card that is "CF" certified will function properly. A CF certified card will have the CF logo on its label.

The removable memory card contains no moving parts. It stores information in and maintains that data when removed from your camera. The memory card retains information until you either delete the data or re-format the card. Normal magnetic interference and airport x-rays will not harm the stored data.

### Reformatting the memory card

In order to communicate with the camera and the PC, the removable memory card requires the same standard DOS format that is used by floppy diskettes. The DC220 and DC260 offer you the format option if the camera doesn't recognize the format of the card when it is inserted into the camera.

If you suspect that the card requires formatting and the camera does not automatically provide you the option, you can format the card by placing it into a PCMCIA card adapter and placing the card adapter in your computer or in a card reader attached to a PC. (Refer to "Placing the memory card in your computer" on page 7-7 for more information.)

Follow the same procedures as you would for formatting a floppy diskette:

1. Double-click on the My Computer icon. 


   *The My Computer window appears.*
2. With the removable memory card inserted into your computer or card reader, highlight the icon representing the memory card.
3. Click the right mouse button and select FORMAT from the pop-up menu.



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☞ Reformatting a removable memory card deletes all information on the card. This deleted information cannot be recovered.

### Removing the memory card

Although your camera can't take pictures without the memory card, you may want to remove the card to use in another camera or to place in your computer.

To remove the memory card:



1. Open the memory card door.
2. Flip the memory card release button so it protrudes out from the side of the camera.

WARNING: Do not depress the release button if the red LED under the button is on or blinking. Ejecting the card while this LED is on may result in the loss of all data on the card.

3. Depress the release button to release the memory card from the camera.
4. Pull the memory card out of the camera.

☞ For a more detailed discussion of the memory card, the PCMCIA card, and the *KODAK DIGITAL SCIENCE* Picture Card Adapter, refer to "Placing the memory card in your computer" on page 7-7.

## Power management

You can use batteries or an AC adapter to power your camera. Refer to the following subsections for information about battery and AC adapter use.

To conserve power usage, the camera has a sleep mode. After a specified period of inactivity, the camera enters sleep mode by turning the LCD off. You can set the amount of time before entering sleep mode through the Capture menu settings. Refer to setting the Sleep Timeout preference on page 3-10. After 10 minutes of inactivity, the camera turns itself off.





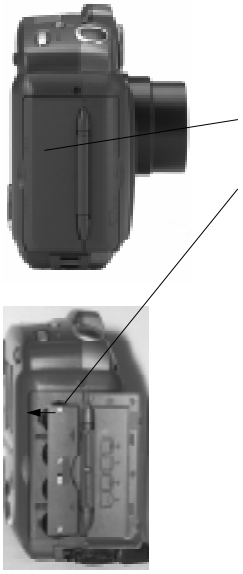
BlackBerry Corporation Exhibit 1004, pg. 850

To reactivate your camera from the sleep mode:

- ✔ In the Review mode, press the DISPLAY button.
- ✔ In the Capture mode, use the ZOOM or SHUTTER as you normally would to take a picture.

## Installing batteries

To install the batteries:



1. Open the battery door.
2. Slide the inside battery cover toward the back of the camera and then lift it away from the camera.
3. Insert the batteries as indicated on the battery cover.
4. Close and lock the inside battery cover and close the battery door.

WARNING: When using batteries, limit the continuous operation of the LCD for previewing pictures to less than 30 minutes. This is particularly true with Lithium batteries. Previewing pictures requires a significant electrical current, which over time could cause your batteries to heat up significantly. Should your camera become too hot inside, it is designed with protective circuitry to turn itself off. You should allow sufficient time for the camera to cool before turning it on again. Consider using an AC adapter when using preview mode for extended periods.

Always follow your battery manufacturer's directions fully.

Remove the batteries if the camera will not be used for an extended period of time. This extends the battery life and prevents camera damage from battery leaks or corrosion. If the batteries are removed from the camera for more than a few days, the date and time will be deleted and must be reset.

## Using the AC adapter

The AC adapter allows you to connect your camera to a standard electrical outlet. This is especially useful when you are transferring pictures into your computer. The adapter powers the camera, but does not charge the batteries.

WARNING: Only use the AC adapter designed for the DC220 or DC260. Use of any other adapter may void the warranty and can cause camera failure, fire, electric shock, or injury.



1. Insert the AC adapter into the AC power adapter connection on the side of your camera.
2. Connect the other end of the adapter into a power outlet.
3. Turn the camera on.

The Battery icon does not appear on the Status Display when an AC adapter is used.

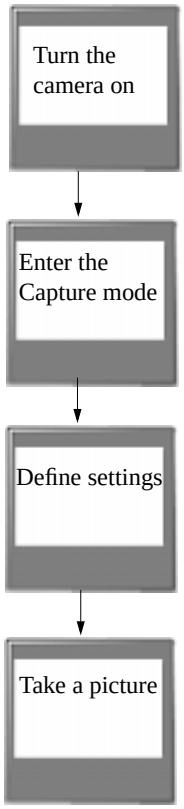




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# 3 Taking pictures

Here is a summary of the steps you'll likely follow to take pictures with your DC220 or DC260 Camera:




It doesn't work very well if you don't. Refer to the "Turning the camera on" section on page 3-2.

Make sure the Mode dial is pointing to CAPTURE. Refer to the "Entering the Capture mode" section on page 3-2.

Settings can be defined either through using the SCROLL and SELECT buttons or through the settings menus on the LCD. Refer to the "Defining settings" section on page 3-3.

You can take still, burst, or timelapse pictures. Refer to the "Taking pictures" section on page 3-14.





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## Turning the camera on




**1** Press the POWER button.

*The green Ready light on the back of the camera blinks for approximately 10 seconds until the camera is ready to take pictures and the Status Display on the top of the camera turns on.*

*To turn the camera off, press the POWER button again.*

☞ If the camera is turned off while a picture is being processed, the camera will finish processing the picture before turning off.

If your camera is idle for the time period you set in the Camera Properties Time-out Settings, it automatically turns off. To turn the camera on again, press the POWER button.

## Entering the Capture mode

You will use the Capture Mode to take pictures. To place the camera in the Capture Mode:



**1** Turn the Mode dial to the CAPTURE setting.

*The camera moves the lens to a point away from the camera.*

☞ You cannot take pictures without a memory card in the camera. If you enter the Capture mode without a memory card, the Status LCD flashes the message “NO CARD.”

If the camera goes into sleep mode to conserve power, the word “CARD” remains on the Status LCD.



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## Defining settings

You can define settings via the Capture mode menus and through the SCROLL and SELECT buttons on the top of the camera.

☞ Capture mode settings affect only future pictures—they cannot be used to alter pictures you have already taken.

### Defining settings via the Capture mode menus

The Capture mode preferences are divided into the following categories:

| | | |
|---|---|---|
| Picture Type | Album (DC260 only) | White Balance |
| Watermark | Advanced Exposure Modes | Advanced Focus Mode (DC260 only) |
| Preferences | | Script |

☞ The Script icon only appears when a script is present on your camera. It is possible for multiple script icons to appear in your menus.

As a first step in adjusting the Capture mode settings via the menus, you need to display the Capture Mode Settings screen on the LCD:



**1** Press the MENU button.

*The Capture Mode Settings screen appears with the Picture Type icon selected.*





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2 Press the left and right arrows to highlight the icon representing the settings you want to adjust.

*Some icons do not appear on the initial screen; continue to press the right arrow to display these additional icons.*

3 Refer to the following subsections for information about each setting category.

4 When you are satisfied with all your settings, press the DONE softkey.

☞ The following subsections assume that you have turned the camera on, entered the Capture mode, and pressed the MENU button to display the Capture Mode Settings on the LCD.

### *Picture Type settings*

Picture Type settings define the characteristics, including resolution, of your still, burst, and timelapse pictures.

- ✔ Still pictures are your normal digital photographs.
- ✔ Burst pictures are a series of photographs taken in quick succession.

☞ In Burst mode, Medium and Standard resolutions may appear less sharp than in a Still picture mode.

- ✔ Timelapse pictures are a series of photographs taken with a time delay between each picture.




☞ More information about Picture Type settings can be found in Chapter 5.

1 Press the down arrow to highlight the type of picture you want to define.

2 Press the ENTER softkey.

*The settings for the selected picture type appear.*

3 Use the up and down arrow keys to highlight the particular setting you want to specify.

4 Use the left and right arrow keys to scroll through the options for each individual setting.



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### *Album settings (DC260 only)*

Album settings specify the album into which pictures will be stored. All future pictures are stored in the selected album until you change the album setting.




☞ To remove an album, highlight it and then press the DISSOLVE softkey. The album is removed, but its pictures are retained outside the album.

1. Press the down arrow to select one of the following selections:
   - ✔ No Album—your pictures are not stored in an album.
   - ✔ New Album—allows you to create a new album. The New Album Name screen appears.

     Press the up and down arrows to select a character. Press the right arrow to add the selected character to the name. Add additional characters until you have spelled the name you want using a maximum of 8 characters. When you are satisfied with the name, press the DONE softkey to return to the Album Settings screen. Press the down arrow to select the new album.
   - ✔ An existing album name—your pictures are stored in the album you select.
2. Press the SELECT softkey.
3. Press the DONE softkey.

### *Script setting*

The Script setting allows you to run a predefined script that's been downloaded to the System folder on the camera's memory card. Scripts can be created to appear on any screen, not only the Script setting screen.

A script can prompt you for certain actions and define the behavior of the camera and its settings. For example, a script can set the camera to take burst pictures at a certain rate. The script can then prompt you, using text on the LCD, to take a picture and the camera waits for you to press the SHUTTER button.

☞ The DC220 and DC260 can run DIGITA-compatible scripts. These scripts add new selections to existing menus or can create new menus and choices





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to automate and extend camera operations. Visit **http://www.kodak.com** for information on how to obtain scripts for your camera.

To choose and run a script that has been placed on the camera:




1. Press the down arrow to choose the script you want to execute.
2. Press the START softkey.

   *Any steps that follow depend on the chosen script. The chosen script may begin running or a screen containing subscripts may appear.*

   ☞ To stop a script that is running, press the EXIT softkey which appears after you push the START softkey.

### *White Balance settings*

White Balance examines your pictures and tries to adjust the color balance to remove the color cast that the current lighting conditions add.




1. Press the down arrow to highlight the type of White Balance you want to use.

   ✔ Automatic—Use this setting when taking pictures under a variety of lighting conditions. This is the default.

   ✔ Daylight—Use this setting when taking pictures outdoors.

   ✔ Fluorescent—Use this setting when taking pictures under fluorescent light.

   ✔ Tungsten—Use this setting when taking pictures under normal incandescent light.

   ✔ Off—No White Balance adjustment is made.

2. Press the SELECT softkey to select the highlighted choice.



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### *Watermark settings*

You can choose to place a date, time, text, or logo watermark on the pictures you take. (Logo watermarks are available only on the DC260.)




1 Press the down arrow to select the type of watermark you want.

2 Press the SELECT softkey.

- ✔ None—No watermark appears.
- ✔ Date and Time—The Date & Time Stamp screen appears. In the Date & Time Stamp screen, you can specify to use the date, the time, or both.
- ✔ Text—The Text Stamp screen appears. When you select the text stamp, you can select the EDIT softkey to change the text.
- ✔ Logo—The Logo Stamp screen appears. When you select the logo stamp, you can select the EDIT softkey to change the logo.

3 Press the left and right arrows to set each of the following fields:

- ✔ Left offset—The distance in from the left side of the LCD to place the watermark.
- ✔ Top offset—The distance down from the top of the LCD to place the watermark.
- ✔ Transparency—The level of transparency for the watermark.
- ✔ Text color—The color of the text in the watermark.
- ✔ Background color—The color of the watermark's background.

4 When you are satisfied with the settings, press the DONE softkey.

☞ If you do not want a watermark, select None.

☞ If a logo watermark file (.lgo) exceeds 512 Kb, it will not appear as an option on the Logo Stamp screen.

☞ Remember that watermarks will only appear on future pictures.

☞ You can see watermarks on pictures in the Review mode when the full resolution picture appears. You cannot see watermarks on thumbnail pictures.





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### *Advanced Exposure Modes settings*

The Advanced Exposure Modes settings allow you to select one of the following modes:

- ✔ Programmed AE—the camera uses the programmed automatic exposure setting which selects the appropriate flash and aperture setting. This is the default.
- ✔ Long Time Exposure—the camera's flash is disabled as it is assumed that the long time exposure is necessary to obtain a proper exposure within the current ambient lighting environment. You set the exposure time between 0.5 and 4 seconds in 0.5 second increments.
- ✔ External Flash (DC260 only)—the camera's built in flash is disabled and the external flash sync is used to provide flash. You set the camera aperture (or f/stop). Choose from 3, 4, 5.6, 8, 11, 16, or 22. The default value is 5.6 which provides an appropriate depth of field for many identification or portraiture applications.

To select an Advanced Exposure mode:




1. Press the down arrow to choose the exposure mode you want to use.
2. Press the SELECT softkey.
   - ✔ Programmed AE—the programmed automatic exposure setting is used. This is the default.
   - ✔ External Flash—the External Flash Setup screen appears. Use the left and right arrows to set the aperture.
   - ✔ Long Time Exposure—the Long Time Setup screen appears. Use the left and right arrows to set the exposure time.
3. Press the DONE softkey.

   *If you set a new aperture or exposure time, it appears on the Status LCD on top of the camera.*



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### *Advanced Focus Mode settings (DC260 only)*

The Advanced Focus Mode settings allow you to select one of the following modes:

- ✔ Multi-Spot Auto Focus
- ✔ Single-Spot Auto Focus
- ✔ Manual Focus

To select the focus mode:




1. Press the down arrow to choose the focus mode you want to use.
2. Press the SELECT softkey.
   - ✔ Multi-Spot Auto Focus—the camera uses a multi-spot focus algorithm which determines the focus position using three positions on the lens.
   - ✔ Single-Spot Auto Focus—the camera uses a single-spot focus algorithm which determines the focus position using the subject in the center of the lens.
   - ✔ Manual Focus—the Manual Focus Setup screen appears which allows you to specify the focus position. Use the left and right arrows to set the focus distance.
3. Press the DONE softkey.

### *Preferences settings*

The Preferences settings include:

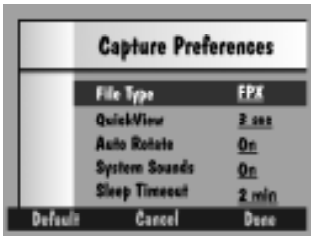
- ✔ Capture
- ✔ Date and Time
- ✔ Camera Name





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*Capture*




Pressing the DEFAULT softkey restores the default Capture Preference values.

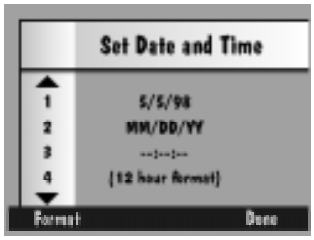
1. Press the down arrow to select the particular setting you want to change.
   - ✔ File Type—the format in which pictures are saved, either FlashPix (FPX) or JPEG (JPG).
   - ✔ Quickview—displays the picture just taken for a duration between 0.5 and 30 seconds.
   - ✔ Auto Rotate—rotates pictures automatically in response to a sensor that senses the orientation of the camera and rotates pictures to a vertical plane.

     The Auto Rotate sensor does not function well when you are above the subject with the lens perpendicular to the floor. In such cases, Auto Rotate should be OFF.
   - ✔ System sounds—plays shutter sounds when a picture is taken and alert sounds when an error occurs.
   - ✔ Sleep Timeout—the number of minutes the camera will sit inactive with the LCD on before it goes into the low power mode. In the “sleep” mode, the LCD turns off, the Status Display on the top of the camera remains on, and you can take a picture.
2. Press the left and right arrows to change each setting.
3. When you are satisfied with the settings, press the DONE softkey.



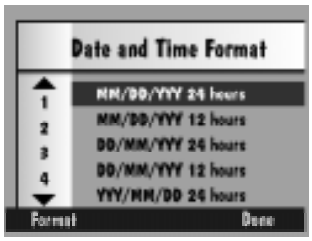
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*Date and Time*




1 Press the FORMAT softkey.

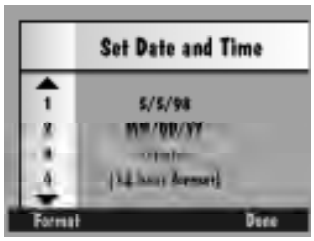
*The Format screen appears.*




2 Press the down arrow to select the date and time format you want to use.

3 Press the SELECT softkey.

*The Date and Time screen appears again.*




4 Press the up and down arrows to select a value for the highlighted field.

5 Press the left and right arrows to move from one field to another.

6 When you are satisfied with the settings, press the DONE softkey.





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*Camera Name*

When you name a camera, the name is included in the header of each picture file.




1. Press the left softkey to select the type of character set you want to choose from:
   - ✔ capital letters
   - ✔ lower case letters
   - ✔ numbers
   - ✔ symbols
2. Press the up and down arrows to select a character.
3. Press the right arrow to add the selected character to the name.

   ☞ Press the left arrow to backspace and press the center softkey to add a space to the name.
4. Add additional characters until you have spelled the name you want using a maximum of 32 characters.
5. When you are satisfied with the name, press the DONE softkey.



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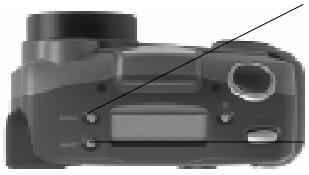
## Defining settings via the SCROLL and SELECT buttons

Its likely that you'll change these settings much more often than the settings that you define through the settings menus. The settings can change from picture to picture depending on the conditions that exist at the time.

☞ You must be in the Capture mode to change these settings.

### *Setting Flash, Exposure, Picture Type, and Quality*

To change the Flash, Exposure, Picture Type, and Quality Capture mode settings:

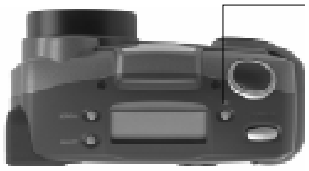


1. Press the SCROLL button to scroll through the first four functions on the Status display: Flash, Exposure, Picture Type, and Quality.
2. When the function you want to change is flashing, press the SELECT button to toggle through the choices for the active function.

   *The new selection takes affect if you press the SCROLL button again to move to another function or if you do not press a button for 5 seconds.*

### *Setting the Self-Timer and Close-up settings (DC220 only)*

To activate the Self-Timer and Close-up settings:



1. Press the TIMER button:
   - ✔ once to activate the self-timer
   - ✔ twice to activate the close-up setting
   - ✔ three times to activate both settings
   - ✔ four times to turn both settings off again

   ☞ On the DC260, activate the self-timer by pressing the TIMER button.





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## Taking pictures

Taking any kind of picture, still, burst, or timelapse is basically the same. The only difference is the amount of time you have to hold down the SHUTTER button.

☞ For best results when taking a picture, press and hold the SHUTTER button halfway down until the green Ready light illuminates. Then press the SHUTTER button the rest of the way.

To take a picture:



**1** Place the subject in the viewfinder.

☞ To view the subject in the LCD as well as the viewfinder, press the DISPLAY button.

**2** Press the SHUTTER button.

✔ If you are taking a still picture, press and release the SHUTTER button.

✔ If you are taking burst pictures, hold down the SHUTTER button for as long as you want the camera to fire. The camera stops firing when the available camera memory is used or when you release the SHUTTER button. The resolution and quality of your pictures, set in the burst picture settings, dictates how quickly camera memory is consumed. Refer to page 3-4 for more information on burst picture settings.

✔ If you are taking timelapse pictures, press and release the SHUTTER button. The camera fires at the interval set in the timelapse picture settings. The camera continues to fire until you press the SHUTTER button again, press the STOP softkey, or until the maximum number of pictures, set in the timelapse picture settings, is taken. Refer to page 3-4 for more information on timelapse picture settings.

☞ You do not need to hold the camera still while the green Ready light is blinking, but you will not be able to take another picture until it stops blinking.

☞ If you set a long interval between timelapse pictures, the camera may appear to turn itself off to save batteries. It will turn itself back on to take the next picture.



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*If you have the Quickview setting turned on, the camera displays the picture on the LCD and saves it to the memory card.*

☞ If you are taking burst or timelapse pictures, the LCD displays the picture after the last picture in the series is taken. You can only record sound when the picture sequence is complete and the last picture is displayed.

## Viewing the memory gauge

In the Capture mode, the Overlay bar displays a memory gauge that gives the status of working memory (DRAM) and memory on the memory card.




Working memory is the memory the camera uses to process pictures. The working memory gauge fluctuates as the camera processes pictures. When the camera has completely processed all pictures (by either saving them to the memory card or deleting them) the working memory gauge will be clear.

The memory card gauge shows used space on the memory card in red and available space as white. As the camera processes pictures and saves them to the memory card, more of the memory card gauge fills with red.

## Adding sound to a picture

After taking a picture with Quickview turned on, you can attach sound to the picture. Once the picture disappears from Quickview, you must enter the Review mode to record sound.

☞ You can switch to Review mode and attach sound to a picture at any time.




**1** When the LCD displays the picture you have taken, press and hold the RECORD button.

*The flashing microphone icon appears in the top overlay bar along with a timer indicating how long you have been recording sound.*





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If you lift your finger from the RECORD button before you have finished recording sound, delete the sound clip and record a new one.

**2** When you are done recording, release the RECORD button.

*Delete, Overlay, and Play softkeys appear on the bottom of the screen.*

If you press the RECORD button a second time, you are given the option to delete the existing sound and record new sound for the picture.

**3** Press a softkey.

- ✔ Delete—Gives the option of deleting the picture and sound or just the sound.
- ✔ Overlay—Turns the Overlay off.
- ✔ Play—Plays the recorded sound.



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## Zooming

The DC220 comes equipped with a 2X zoom lens that allows you to zoom in on your subject from Wide Angle (29mm) to TelePhoto (58mm). The DC260 comes equipped with a 3X zoom lens that allows you to zoom in from Wide Angle (38mm) to TelePhoto (115mm).

To activate the zoom:



1 Move the ZOOM button to adjust the lens.

- ✔ Move the button to the right (toward **T**elephoto) to zoom in on your subject.
- ✔ Move it to the left (toward **W**ide angle) to zoom away from your subject.

The camera's default lens position is Wide Angle. All other lens positions are considered TelePhoto settings.

### Digital zooming

Digital zooming allows you to zoom in on a subject beyond the range provided by the optical zoom lens. Digital zooming crops the center of the digital picture and resizes the new cropped picture to the size of the selected resolution.

☞ You may see some pixel interpolation effects with digital zooming.

The camera's viewfinder cannot accurately depict a subject that is digitally zoomed. You must use the LCD to preview the subject.





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To use digital zoom:



1. Turn the camera on in CAPTURE mode.

   *In this mode, you can access the full optical zoom range plus the additional digital zoom range.*

2. Press the DISPLAY button to turn on the LCD.
3. Move and hold the ZOOM switch all the way to the right (toward **T**) to zoom to the camera's maximum range.
4. View the subject through camera LCD.

   *The LCD displays an icon indicating that digital zoom is in effect.*

   ☞ Digital zoom is disabled when you turn the LCD off.

5. Press the SHUTTER button to take the picture.



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# Reviewing your pictures



Did you have your thumb over the lens? Did someone have their eyes closed? Should you take one more picture before you let your kids take those ties off? With film, you'll know as soon as you get your pictures processed. With the DC220 and DC260 Cameras in the Review mode, you'll know instantly.

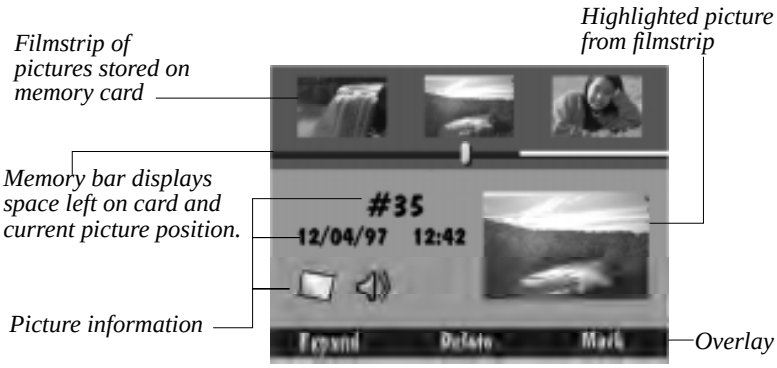
## Entering the Review mode



**1** Set the Mode dial to Review.

*The last picture taken appears on the LCD in a full screen view.*

*Pressing the DISPLAY button toggles between the thumbnail and full screen views.*



Reviewing allows you to:

- ✔ view pictures as thumbnails on a portion of the Camera LCD screen.
- ✔ view the amount of unused memory on the memory card
- ✔ delete one or all pictures from the memory card
- ✔ view pictures from the camera on your TV
- ✔ view and magnify pictures on the full LCD
- ✔ play back sound, bursts, and timelapse sequences

## Setting Review mode preferences

The Review mode preferences allow you to set global parameters for this mode. Review mode preferences include:

- ✔ overlay
- ✔ slideshow
- ✔ video
- ✔ play

As a first step in adjusting the Review mode settings, you need to display the Review Mode Settings screen on the LCD:



1 Press the MENU button.

*The Review Mode Settings screen appears.*



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2 Press the right arrow to highlight the Review Preference icon.

3 Press the down arrow to highlight the preference category you want to set.

4 Press the ENTER softkey to enter the selected preference category.

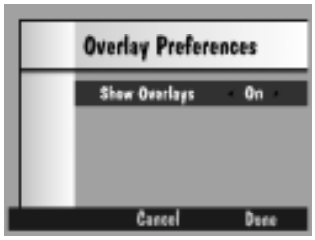
5 Refer to the following sections for information about each preference category.

6 When you are satisfied with all your settings, press the DONE softkey.

*The LCD returns to the thumbnail or full screen.*

### *Overlay preferences*

Through the Overlay preferences you can turn the overlay on or off. The overlay appears on the LCD and displays the softkey labels.




1 Use the left and right arrows to choose between ON and OFF.

2 Press the DONE softkey to save your settings.

*CANCEL takes you out of the menu without saving the changes you have made.*

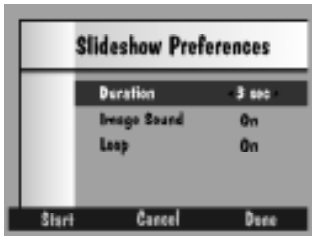
### *Slideshow preferences*

A slideshow displays each selected picture for a specified interval. Through the Slideshow preferences you can specify the duration each picture is displayed, turn sound on or off, and choose to continuously loop the pictures in the



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slideshow.



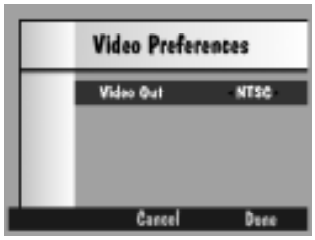

1. Use the left and right arrows to select a choice for each setting.
2. Press the START softkey to start the slideshow.

   *Press the DISPLAY or MENU button or the STOP softkey to stop the slideshow.*

☞ Pressing the DONE softkey saves your settings and takes you back to the Review Preferences menu.

### *Video preferences*

Through the Video preferences you can specify the type of video connection for connecting to a TV.




1. Use the left and right arrows to choose between PAL and NTSC.

   *NTSC is generally used in the United States and Japan, PAL in Europe.*
2. Press the DONE softkey to save your settings.

   *CANCEL takes you out of the menu without saving the changes you have made.*

### *Playback preferences*

Through the Playback preferences you can specify how quickly burst, timelapse, and album pictures are displayed during full screen playback.




1. Use the left and right arrows to select a choice for each setting.
2. Press the DONE softkey to save your settings.

   *CANCEL takes you out of the menu without saving the changes you have made.*



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## Viewing pictures

You can view your pictures in three ways on the Filmstrip screen:

- ✔ one picture at a time
- ✔ in a continuous scroll
- ✔ in a fast scroll

To review pictures:



1 Use one of the following methods to view your pictures:

- ✔ To review the pictures one at a time press and release the right or left arrow.
- ✔ To review the pictures in a continuous scroll, press and hold the right or left arrow.

  *The filmstrip scrolls until you release the arrow button.*
- ✔ To review the pictures in a fast scroll, press and hold the right or left arrow. After several pictures have scrolled by and the left softkey is labelled FASTER, hold the left softkey while still holding the arrow.

  *The filmstrip scrolls until you release the arrow button.*



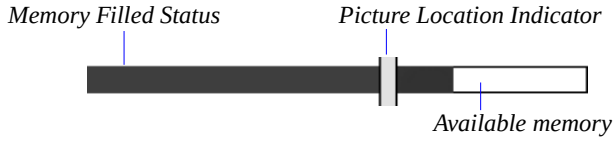

*The selected picture on the filmstrip is highlighted and is displayed as a thumbnail.*



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## Viewing the remaining memory

The Review screen displays a reminder of the amount of memory remaining on the memory card.




The memory bar gives two different indications about your camera's memory. The Memory Filled Status indicator shows the amount of used memory (in blue) and the amount of available memory (in white).

As you scroll through your pictures, the Picture Location Indicator moves to represent the position of the current picture in the list of pictures already on the camera. For example, if the selected picture is the first of 20 pictures on the camera, the indicator is all the way to the left. As you scroll through the pictures, the indicator moves to the right with each new picture. At picture 10, the indicator will be in the middle of the blue portion of the Memory Filled Status indicator. At picture 20, the indicator will be all the way to the right of the blue area.

## Marking pictures for an action

When you want to select a number of pictures and carry out an action on them, you must first mark each picture. Marked pictures can be deleted, copied from camera to camera, or moved from album to album (DC260 only).

To mark a picture:




1 Scroll to find the picture you want to select.

*Use any of the three methods described in the "Viewing pictures" section.*

2 Press the MARK softkey.

*The selected picture is marked, denoted by the notched lower right corner. It remains marked until you carry out an action on it.*

☞ When you have marked a picture, the softkey changes to UNMARK.

☞ To mark the entire contents of the memory card, hold down the MARK softkey for 2 seconds.



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## Placing marked pictures in an album (DC260 only)

You can place marked pictures in an existing or new album.




1. Press the MENU button.
2. Press the right arrow to highlight the Album icon.
3. Press the down arrow to select an existing album or New Album.

   *Refer to the next subsection for information about creating a new album.*
4. Press the MOVE softkey.

   *The marked pictures are moved to the selected album.*

### *Creating a new album*

To create a new album:

1. Display the Album screen as described in the "Placing marked pictures in an album" section above.
2. Press the down arrow to select New Album.
3. Press the MOVE softkey.

   *The New Album Name screen appears.*




4. Press the left softkey to select the type of character set you want to choose from:
   - ✔ capital letters
   - ✔ numbers
5. Press the up and down arrows to select a character.



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6 Press the right arrow to add the selected character to the name.

☞ Press the left arrow to backspace.

7 Add additional characters until you have spelled the name you want using a maximum of 8 characters.

8 When you are satisfied with the name, press the DONE softkey.

*The marked pictures are moved to the album you created and the Album screen appears.*

## Copying marked pictures from camera to camera

You can send marked pictures to or receive marked pictures from another camera in the Review mode:




1 Place the two cameras facing each other aligning their infrared transceivers.

*During Camera to Camera communication, the cameras communicate via infrared port.*

2 Make sure both cameras are in the Review mode.

3 Press the MENU button on the receiving camera.

4 Press the down arrow key to highlight RECEIVE.

5 Press the MENU button on the sending camera.

6 Press the down arrow key to highlight SEND.

7 Press the SEND softkey.

*The marked pictures are copied from one camera to the other.*



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## Opening albums

The Review screen shows you when pictures are grouped in an album and allows you to open the album to view the pictures. If the highlighted picture resides in an album, an album icon appears and the left softkey is labelled OPEN.

To open an album:




1 Scroll to view the picture you want to select.

*Use any of the three methods described in the "Viewing pictures" section on page 4-5.*

2 Press the OPEN softkey.

*The screen opens the album containing the selected picture and displays the other pictures that are stored in the album. The related pictures are linked by a colored background.*




☞ When you have opened an album, the OPEN softkey changes to CLOSE. Press this softkey to close the album.



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## Expanding and collapsing pictures

It is important to note that your camera treats burst and timelapse pictures as folders containing a series of individual pictures but displays them as a single picture until you press the EXPAND softkey. In the Review mode, you can expand the displayed burst or timelapse picture to view all the pictures in the series.

If the highlighted picture is a burst or timelapse picture, the appropriate icon appears and the left softkey is labelled EXPAND.

To expand a burst or timelapse picture:




1. Scroll to view the picture you want to select.

   *Use any of the three methods described in the "Viewing pictures" section on page 4-5.*

2. Press the EXPAND softkey.

   *The screen expands the selected burst or timelapse picture and displays its individual pictures on the filmstrip. The related pictures are linked by a colored dotted line.*




☞ When you have expanded a picture, the EXPAND softkey changes to COLLAPSE. Press this softkey to collapse the picture back to its original form.



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## Adding sound to pictures

You can attach sound to a selected picture at any time while reviewing your pictures from either the filmstrip or full screens.

☞ You can only add sound to or play sound associated with burst and timelapse pictures when the series is collapsed.






☞ If the camera's volume control is turned down, you will not be able to hear the sound you have recorded.

☞ The volume control adjusts the volume of sound clips attached to pictures only. You can turn off System Sounds through Capture Preferences on page 3-10.

1. Scroll to view the picture you want to select.

   *Use any of the three methods described in the "Viewing pictures" section on page 4-5.*

2. Press and hold the RECORD button.

   *The microphone icon appears on the screen along with how long you have been recording.*

   ☞ Each picture can have only one attached sound clip. If you attempt to attach a second sound clip to a picture, a message appears allowing you to delete the existing sound.

3. Speak into the microphone on the back of the camera.

4. Release the RECORD button.

   *A sound icon appears indicating the picture now has attached sound. If a picture has attached sound, pressing the DELETE softkey allows you to delete the sound alone or both the picture and sound.*

5. Press the softkey of your choice.

   ✔ DELETE—Deletes the sound.

   ✔ SAVE—Saves the sound.

   ✔ PLAY—Plays the sound. Refer to "Playing sound, bursts, and timelapse sequences" on page 4-14 for information on playing sound that has not been newly recorded.



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## Deleting one picture

To delete a picture:




1. Scroll until the picture you want to delete is highlighted in the center of the filmstrip.
2. Press the DELETE softkey.

   *Delete, Sound Only, and Cancel softkeys appear.*




3. Press the softkey of your choice.

   ✔ DELETE—Deletes the picture and any attached sound.

   ✔ SOUND ONLY—Deletes only the attached sound. (This softkey appears only if the picture contains an attached sound clip.)

   ✔ CANCEL—Cancels the delete operation.



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## Deleting multiple or all pictures

You can delete multiple pictures from your memory card:




1. Mark any pictures you want to delete.

   *Refer to the "Marking pictures for an action" section on page 4-6 for information on how to mark pictures.*

2. Press the DELETE softkey.

   ☞ Pressing and holding the DELETE softkey for 2 seconds will delete all the pictures on the memory card. It is not necessary to mark pictures if you want to delete all your pictures.




*A confirmation screen appears asking if you want to delete all the marked pictures.*

3. Press the softkey of your choice.

   ✔ DELETE—Deletes the pictures and any attached sound.

   ✔ CANCEL—Cancels the delete operation.



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## Playing sound, bursts, and timelapse sequences

To play sound, burst, and timelapse sequences you have to be viewing the picture on a full screen.



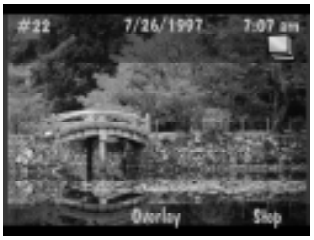

1 Scroll to highlight the picture sequence you want to play.

*You can scroll through your pictures while viewing them as thumbnails or on a full screen. If you scroll to the picture as a thumbnail, press the DISPLAY button to view it on a full screen.*

2 Press the PLAY softkey.

*If the highlighted picture is a still picture with sound, the camera plays the sound.*

☞ The softkeys remain DELETE, MAGNIFY, and PLAY when you play a sound clip.




*If the highlighted picture is a burst or timelapse picture, the camera plays back the sequence of pictures at the rate specified in the Review Mode preferences.*

☞ To stop playing the sequence, press the STOP softkey.



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## Magnifying pictures

You can magnify a picture while viewing it on a full screen:




**1** Scroll to view the picture you want to magnify.

*Use any of the three methods described in the "Viewing pictures" section on page 4-5.*

**2** Press the MAGNIFY softkey.

*The screen displays a magnified view of the selected picture.*



☞ Use the arrow keys to scroll to different parts of the picture.

**3** To return to a normal view, press the REDUCE softkey.

☞ If you use the arrow keys to move to different parts of the magnified picture, the REDUCE softkey label disappears. However, you can still press the middle softkey to reduce the picture to its normal view.



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## Viewing pictures on your TV

The video out feature on the camera allows you to show the pictures from the memory card on your TV.

☞ The camera's LCD is disabled when the camera is attached to the video cable.

To view pictures on a TV:



1. Turn your TV and the camera off.
2. Insert the video output cable into the video out connection on the side of your camera.
3. Connect the other end of the cable to the video in connection on your TV.

   ☞ To play sound on your TV, use a cable that has two connectors on the TV end. Connect the yellow connector to the video in connection and the white connector to the audio in connection.
4. Turn on the camera and TV.
5. Set the Mode dial to Review.
6. Set the TV to the correct channel for viewing video.

   *The pictures that are stored on the memory card appear on the TV screen as they appear on the LCD.*
7. Scroll through your pictures using any of the three methods described in the "Viewing pictures" section on page 4-5.

   ☞ If pictures do not appear on the TV, you may need try a different channel or adjust the Video preference on the camera. Refer to page 4-4.



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# Setting camera properties



Camera Properties allow you to program your digital camera through a graphical interface on your computer.

You may want to set these properties before you use your camera to take pictures. Or you may want to use the default properties that are already set on your camera. To use the default for each setting, click the Defaults button on the Camera Properties screen. To return to the previous settings, click Cancel.

We'll identify any properties that can also be set from the camera itself.

You can set camera properties for these categories:

- ✔ General
- ✔ Camera
- ✔ Picture Type
- ✔ Albums (DC260 only)

## You've got to connect first

Because you set the camera properties on your computer, you first have to connect your camera to your computer.

Refer to Chapter 6, "Connecting your camera to your computer" for instructions.

## Finding the Properties software

You can get to the Camera Properties software in a number of ways:

- ✔ Double-click the DC220 or DC260 Camera Properties icon on your desktop
- ✔ Select the Camera Properties menu item from the Mounter Software screen

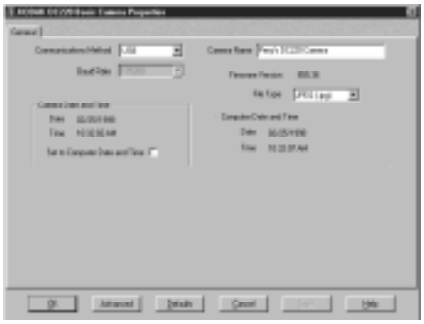


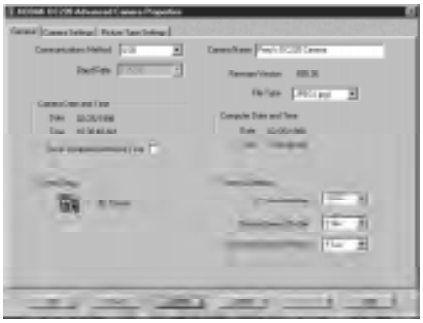
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- ✔ Select the Camera Properties button from the camera's TWAIN Software screen
- ✔ Select the Properties button from the *KODAK DIGITAL SCIENCE* Picture Easy Software 3.0 screen
- ✔ Select DC220 or DC260 Camera Properties from the Start Programs menu.

The remaining sections of this chapter assume that you have started the Camera Properties software and are viewing the first tab, General settings.

## Specifying General settings





The GENERAL settings tab is selected by default.

1. Specify the settings.

   *Refer to the following subsections for a brief description of each setting.*

2. If you want to see more settings, click the ADVANCED button.

   *Additional settings appear.*

3. To apply these settings to the camera, click the APPLY button.

☞ To revert to a screen's default settings, click the DEFAULTS button.

Communications Method—Defines the type of connection you want to use between the camera and your computer.

Baud Rate—Defines the rate at which the camera and the computer communicate. This field is greyed out if USB or IrDA is selected as the communication method.



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Camera Name—Why would you want to give a camera a name? Because it's so impersonal calling it "Hey, camera." Also, the camera name is included in every picture file. *You can also set this setting through the Capture mode settings on the camera.*

Firmware Version—A read-only field that displays the camera's firmware version number. *You can also view the camera firmware version on the LCD by turning the Mode Dial to INFO.*

File Type—The file format in which the camera will store all future pictures. You can choose JPEG (.jpg), which can be used by many software programs, or FLASHPIX (.fpx). FLASHPIX offers great benefits such as speed in displaying your pictures and the ability to undo and redo edits in software programs such as Picture Easy. *You can also set this setting through the Capture settings on the camera.*

Camera Date and Time—This date and time are assigned to each picture that you take. You can set it to the same date and time as on your computer by clicking the **Set to Computer Date and Time** checkbox. *You can also set this setting through the Capture mode settings on the camera.*

Computer Date and Time—A read-only display of the time and date as it is set on the computer to which the camera is connected.

☞ The remaining General Property settings are available only after you click the ADVANCED button.

Power status—The current power status. This field displays an AC Power icon when you are using the AC Adapter or an icon indicating the level of the camera's battery charge.

Time-out Settings—**AC Power Off After** turns the camera off after a period of inactivity when using AC power. **Battery Power Off After** turns the camera off after a period of inactivity when using battery power. **Quick View Display Off After** defines how long a newly captured picture is displayed before the LCD turns off.





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## Specifying Camera settings



1. Click the CAMERA SETTINGS tab.
2. Specify the settings.

   *Refer to the following subsections for a brief description of each setting.*
3. To apply these settings to the camera, click the APPLY button.

Picture type—Choose the type of picture—**Still** , **Burst** , or **Timelapse** —that you want to take. This field defaults to Still when you turn the camera off. *You can also set this setting through the Capture mode settings on the camera.*

White Balance—White Balance examines your pictures and tries to adjust the color balance to remove the color casts that the current lighting conditions add. Use **Automatic** when taking pictures under a variety of lighting conditions. Use **Daylight** when taking pictures outdoors. Use **Fluorescent** when taking pictures under fluorescent light. Use **Tungsten** when taking pictures under normal incandescent light. **Off** makes no white balance adjustment. *You can also set this setting through the Capture mode settings on the camera.*

Flash mode—The mode in which you want the camera's flash to operate. **Auto** causes the flash to fire only when there is not enough light. **Fill** causes the flash to fire for every picture. **Red-eye Reduction** causes the flash to fire twice—once 600 milliseconds before the picture is taken to constrict the subject's pupils, and once when the picture is taken. **Off** turns the flash off. *You can also set this setting through the Capture mode settings and through the SCROLL and SELECT buttons on the camera.*

Focus (DC260 only)—**Single spot** determines the focus position using the subject in the center of the lens. **Multi-spot** determines the focus position using three positions on the lens. **Manual** allows you to specify the focus position from the pull down menus. *You can also set this setting through the Capture mode settings on the camera.*

Macro (DC220 only)—**On** disables the zoom control and places the lens in



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the macro position. **Off** enables the zoom control and sets the lens position to 28mm. This is also known as Close-up mode. *You can also set this setting through the SCROLL and SELECT buttons on the camera.*

Advanced capture mode—**Programmed AE** automatically determines the appropriate shutter speed and aperture settings but allows you to choose an exposure compensation value from a drop down list. **Long time exposure** allows you to select the shutter speed setting from a drop down list. **External flash** (DC260 only) allows you select the aperture setting from a drop down list. *You can also set this setting through the Capture mode settings on the camera.*

Zoom—The position of the zoom lens. The DC220 ranges from 28mm to 58mm in four steps. The DC260 ranges from 38mm to 115mm in six steps.

## Specifying Picture Type settings



1. Click the PICTURE TYPE SETTINGS tab.
2. Specify the settings.

   *Refer to the following subsections for a brief description of each setting.*
3. To apply these settings to the camera, click the APPLY button.

Picture Capture State—Choose the type of picture—**Still** , **Burst** , or **Timelapse** —for which you want to set Picture Type settings. The other fields on the screen change depending on the type of picture.

Picture quality—**Best** compresses a picture the least and has the highest image quality. **Better** compresses a picture more and has a lower image quality. **Good** compresses a picture the most and has the lowest image quality. *You can also set this setting through the Capture mode settings and through the SCROLL and SELECT buttons on the camera.*

Resolution—The number of pixels that make up each picture, either **High** (1152 x 864 pixels DC220, 1536 x 1024 pixels DC260)**, Medium** (1152 x 768 pixels DC260 only), or **Standard** (640 x 480 pixels DC220, 768 x 512 pixels DC260). The more the merrier when it comes to pixels and the quality of your pictures. *You can also set this setting through the Capture*





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*mode settings on the camera.*

Approximate Picture Size (Still)—The approximate size of each picture based on your **Picture quality** and **Resolution** selections. The actual picture size can vary depending on the content of the picture.

Burst/Capture rate—The rate, in frames per second, at which pictures will be taken. *You can also set this setting through the Capture mode settings on the camera.*

Approximate Picture Size (Burst)—Based on the **Picture Quality** , **Resolution** , and **Burst/Capture rate** , the approximate size of the burst picture series. The actual burst size can vary depending on the content of the picture.

Interval (Timelapse)—The time between pictures, in hours and minutes. The minimum time between pictures is 60 seconds for both the DC220 and DC260. The maximum time between pictures is 1550 minutes for both cameras. *You can also set this setting through the Capture mode settings on the camera.*

Number of Pictures (Timelapse)—The total number of pictures to capture.

Approximate timelapse size—Based on the **Picture Quality** , **Resolution** , **Interval** , and **Number of Pictures,** the number of pictures that can be taken and the total size of the timelapse picture series. The actual timelapse size can vary depending on the content of the picture.

Storage status—Based on your current Picture Type settings, the number of pictures you have stored on your memory card and the number of pictures that can still be stored.



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## Specifying Albums settings (DC260 only)



1. Click the ALBUMS SETTINGS tab.
2. Specify the settings.

   *Refer to the following subsections for a brief description of each Albums setting.*
3. To apply these settings to the camera, click the APPLY button.

Camera Folder—The list of camera folders on the memory card. Multiple names exist if the memory card in question has pictures on it that were taken with 2 or more different DC260 Cameras.

Albums—A display of the albums on the memory card. You can create new albums, or rename or delete existing albums.





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# 6 Connecting your camera to your computer

A first step to using your digital pictures on your computer is to connect your camera to your computer. The camera can communicate with your computer using:

- ✔ an RS232 serial connection
- ✔ a Universal Serial Bus (USB) connection
- ✔ an infrared transceiver

☞ It is a good idea to use the AC Adapter when connecting to your computer to conserve battery power.

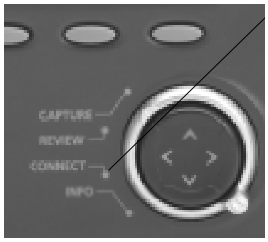
While in Connect mode the camera is controlled by the computer. Except for the Mode dial, POWER, SHUTTER, and ZOOM buttons, all other camera buttons are disabled. The Ready light indicates when the camera is on.

Once software is installed and the camera is connected to a computer, you are ready to transfer the pictures. Refer to the appropriate chapters of this User's Guide, or the software's quick setup guides, for more information on the software programs.



## Entering the Connect mode

To enter the Connect mode:




1 Set the Mode dial to Connect.



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## Which connection?

Which connection should you use to transfer pictures between your camera and computer? That depends on which connections your computer supports. The following sections will help you determine the connections that your PC supports.

You specify the type of connection you are using through the Camera Properties software. For information on how to choose a connection method, refer to Chapter 5, “Setting camera properties.”

| Operating System | Connection Option |
|---|---|
| WINDOWS 95<br>WINDOWS 95a | Serial, IrDA [1] |
| WINDOWS 95B (also known as OSR2) | Serial, IrDA, USB [2] |
| WINDOWS NT 4.0 | Serial |

[1]WINDOWS 95 and WINDOWS 95a require an IrDA Software Patch that is available from MICROSOFT’s Web site. Go to **http://www.microsoft.com** and then search for “irda.” (Please read and understand all the instructions provided by MICROSOFT before proceeding.)

[2]WINDOWS 95B requires the MICROSOFT USB Supplement. Contact your PC vendor or manufacturer for the Supplement.

The IrDA driver for WINDOWS 95B is either preloaded on your system or available on your original diskettes or CD-ROM.

To determine which version of WINDOWS 95 is installed on your PC:
1. Click **Start** -> **Settings** -> **Control Panel** .
2. Double-click the System icon.
3. View the top right of the General tab which indicates the installed operating system:
   4.00.950 indicates WINDOWS 95 (basic)
   4.00.950a indicates WINDOWS 95a
   4.00.950B indicates WINDOWS 95B

## RS-232 Serial

Although not fast (maximum data transfer rate of 115 kb/sec), an RS-232 serial connection is supported by the vast majority of PC computers. The serial port option is available on both the WINDOWS 95 and WINDOWS NT 4.0 Operating Systems.



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RS-232 connectors are the standard ports located on the back of the PC. They are usually labeled A and B. The typical computer user should use this method of communicating with the camera.

To determine if your computer supports an RS232 connection:

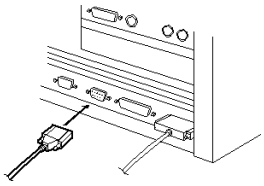
1. Click the right mouse button on the My Computer icon on your computer's desktop.
2. Click on Properties in the pop-up menu.
3. Click the Device Manager tab.
4. Double-click on the Ports device in the displayed list.
5. Verify that there is at least one Communication Port.

   *If at least one Communications Port is present, your computer supports an RS-232 Serial connection.*

## Connecting via a serial cable

The camera can connect to a computer using the serial cable included in your camera package.

To connect to your computer with a serial cable:



1. Plug one end of the serial cable into a COM port on the back of your PC.

   ☞ If your computer has a 25-pin port, you need to use a 9-pin adapter and attach it to the port before attaching the serial cable to the computer.



2. Open the serial port on the side of your camera.
3. Plug the other end of the serial cable into the camera's serial port.
4. Turn on the camera.





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## USB

The Universal Serial Bus (USB) is a relatively new method for your camera to communicate with the PC. A USB connection is faster than an RS-232 serial connection increasing the maximum data transfer rate to 12 Mb/sec.

USB requires special computer hardware and software features including a USB enabled motherboard, USB connections, and a version of WINDOWS 95 (called Win95B or OSR2). Most computers manufactured prior to January 1997 do not meet these requirements, but most computers manufactured since then often meet these requirements.

☞ USB is not currently supported in the WINDOWS NT 4.0 environment.

This method should only be used by the advanced computer user.

To determine if your computer supports a USB connection:

1. Verify that a USB connector is present.

   *This connector is normally on the back of the computer.*
2. Click the right mouse button on the My Computer icon on your computer's desktop.
3. Click on Properties in the pop-up menu.
4. Verify the operating system is 4.00.950b or greater.
5. Click the Device Manager tab.
6. Verify that the Universal Serial Bus Controller is present, without any yellow or red indicators.
7. Click on Universal Serial Bus Controller.
8. Verify that a controller and USB Root hub are listed.
9. Double-click on USB Root hub.
10. Verify that device status is "The device is working properly."
11. On your desktop, click **Start** → **Settings** → **Control Panel** .
12. Click the Add/Remove Programs entry.
13. Verify that USB Supplement to OSR2 is present.

    *If all of the above conditions are met, your computer supports a USB*



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*connection.*

*If your computer meets all the conditions except that no USB Supplement to OSR2 is present, refer to the README file for instructions on installing the USB Supplement.*

### Connecting via a USB cable

The camera can connect to a computer using the USB cable included in your camera package.

To connect to your computer with a USB cable:



1. Plug one end of the USB cable into the USB port on the back of your PC.



2. Open the serial port on the side of your camera.
3. Plug the other end of the USB cable into the camera's serial port.
4. Turn on the camera.



## Infrared transceiver

Infrared is invisible light that the camera uses to transfer pictures through the air without cables or wires. Like your television remote, the camera requires a clear line of sight between its infrared transceiver and the infrared port on the computer.

IrDA (Infrared Data Association) compliant devices use both a transmitting mode and a receiving mode which allows these devices to acknowledge the information was received, generate responses, and even automatically detect the presence of another infrared device.



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IrDA 1.0 has the same maximum data transfer rate of the serial port, 115 Kb per second.

☞ Remember that infrared communication usually requires system resources that are used by the serial port. On most computers you will have to disable the serial port and enable the infrared port for infrared communication to work and reverse these settings if you wish to use your serial port again.

☞ IrDA is not currently supported in the WINDOWS NT 4.0 environment.

To determine if your computer supports an infrared connection:

1. Click the right mouse button on the My Computer icon on your computer's desktop.
2. Click on Properties in the pop-up menu.
3. Click the Device Manager tab.
4. Verify that an "Infrared Devices" entry exists.
5. Double click on Infrared Devices.
6. Verify that the "Infrared port on laptops or desktop" is present.
7. On your computer, click **Start** → **Settings** → **Control Panel** .
8. Verify that the Infrared icon is present.
9. Double-click the Infrared icon.
10. Click the Options tab.
11. Verify that the "Enable infrared communication on Com X" and "Search for and provide status for device in range" checkboxes are selected.
12. Verify that you have an internal or external IrDA transceiver connected to your computer. Check your computer hardware manual for information on the IrDA transceiver location.

☞ If you are using the camera's infrared transceiver to connect to the computer, and the camera automatically turns off because of inactivity, you need to press the camera's POWER button to turn the camera back on.



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## Connecting via an infrared transceiver

Your camera automatically detects when a compatible infrared device is present.



1 Place the camera facing the computer's infrared transceiver.

*When the two infrared ports establish contact, the PC emits a beep.*

☞ While in the Review mode, you can transfer pictures from one camera to another using an infrared connection. Refer to "Copying marked pictures from camera to camera" on page 4-8.





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## Potential connection problems

Here are some issues that might come up when attempting to connect your camera to your computer and some ways to correct them:

| Windows/DC220 DC260 Camera Communications | | |
|---|---|---|
| **Problem** | **Cause** | **Solution** |
| Computer cannot communicate with the camera. | Camera power is off. | Turn the camera on. |
| | The Mode dial is not set to Connect. | Set the camera's Mode dial to Connect. |
| | Conflict with another serial device, such as a modem. | Refer to the serial communication or corresponding section of your computer's modem, and/or operating system's user's guide. |
| | Some Advanced Power Management utilities on laptops can turn off ports to save battery life. | See the Power Management section of your laptop's user guide to disable this feature. |
| | Camera is not connected to serial cable or cable is not connected to the computer's COM port. | Connect serial cable to camera and COM port. See "Connecting via a serial cable" on page 6-3. |
| | Infrared port is not responding. | Check the computer's infrared connection. Be sure that the camera is on. |
| | The BIOS has a different port assigned as the infrared port. | Change the port setting in Camera Properties to reflect the port value assigned in the BIOS. |



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# Accessing your pictures via computer

Now that you've taken some pictures with your digital camera, how do you get to them?

- ✔ By connecting your camera to your computer and using KODAK Mounter Software. Mounter software is an easy way to view, transfer, or delete pictures stored on the memory card using your PC and WINDOWS software.
- ✔ By placing your memory card in a PCMCIA card adapter and placing it in your computer or a memory card reader.

## Using the Mounter software

Using Mounter software, the DC220 or DC260 camera icon appears in the My Computer window, dialog boxes, and file browsers included in many software applications.

Mounter software presents the camera contents as though it were an extension of your hard drive. For more detailed information on working with WINDOWS, refer to your WINDOWS Software User's Guide.

### Installing Mounter software

If you have not installed the DC220/DC260 software, refer to the "Installing software" section on page 1-4.





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## Mounter software overview

With Mounter software you can:

- ✔ View pictures on the camera
- ✔ Transfer pictures from the camera to your computer
- ✔ Transfer pictures and scripts to the camera
- ✔ Save the audio portion of a picture file as a .wav file
- ✔ Set Mounter preferences

Mounter software uses the following icons:



**camera—** represent the DC220 and DC260 cameras.





**album—** represents an album on your memory card. (DC260 only)



**camera folders—** represents both the Camera Folder and the System folder. The Camera Folder holds your pictures or albums. The System folder holds scripts and camera firmware files.



**burst—** represents burst pictures with and without attached sound.



**timelapse—** represents timelapse pictures with and without attached sound.



**picture file—** represents picture files (with and without attached sound) with FLASHPIX (FPX) or JPEG (JPG) extensions when appropriate viewing option is selected.

If the picture file has been registered by another application this icon may be different.

## You've got to connect first

To use Mounter software to access your pictures, the camera needs to be



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connected to your computer and turned on. Refer to Chapter 6, “Connecting your camera to your computer” for detailed information.



When the camera is correctly connected to and communicating with your computer, the camera’s Status Display is replaced with the following screen.



If the connection times out, the Status Display returns.

## Viewing your pictures

Mounter software allows you to view your pictures as picture files or as thumbnails.

☞ To view your pictures as thumbnails, select View -> Thumbnail View. It will take longer to display pictures as thumbnails than as picture files.

To view your pictures:

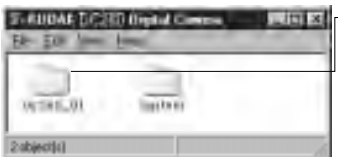
**1** Double-click on the My Computer icon. 


*The My Computer window appears.*



**2** Double-click on the Camera icon.

*The Camera Folder icon appears.*



**3** Double-click on the Camera Folder icon.

*A window appears showing the individual picture files or thumbnails.*

☞ To delete pictures from your memory card, either move them to the Recycle Bin or press the DELETE key.





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## Transferring pictures to your computer

Mounter software allows you to drag and drop pictures from the camera to your computer.

When you drag pictures from one place to another using Mounter software, the pictures are copied, not moved. To move pictures, you must hold down the SHIFT key while dragging and dropping.

Select multiple pictures by holding down the shift key and clicking to select adjacent pictures or the control key and clicking to select nonadjacent pictures.

To transfer pictures:

1. Double-click on the My Computer icon. 


   *The My Computer window appears.*



2. Double-click on the Camera icon.

   *The Camera Name and System folder icons appear.*



3. Double-click on the Camera Folder icon.

   *A window appears listing individual pictures.*

4. Double-click on the folder into which you'll be placing pictures.
5. Click on the pictures and while holding the mouse button down, drag the pictures to the folder.

   *The pictures appear in the new location.*

## Transferring pictures and scripts to your camera

Mounter software allows you to drag and drop pictures and scripts from your computer to your camera.



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A predefined script can prompt you for certain actions and define the behavior of the camera and its settings. For example, a script can set the camera to take burst pictures at a certain rate. The script can then prompt you, using text on the LCD, to take a picture and the camera waits for you to press the SHUTTER button.

☞ You can view transferred pictures on your camera only if they are FLASHPIX (.fpx) or JPEG (.jpg) formats in a resolution supported by the camera. Refer to page 5-5 for resolution information.

To transfer pictures and scripts to the camera:

**1** Double-click on the My Computer icon. 


*The My Computer window appears.*

**2** Double-click on the folder containing the pictures or scripts you want to write.



**3** Double-click on the Camera icon.

*The Camera Name and System folder icons appear.*

**4** Click on the picture or script to highlight it and while holding the left mouse button down, drag the file onto the appropriate folder icon:

- ✔ Drag picture files onto the Camera Folder icon. If you want to transfer pictures to a specific album on the camera, double-click the Camera Folder to open it and find the desired album.
- ✔ Drag script files onto the System folder icon.

### *Creating albums on the camera (DC260 only)*

You can create, rename and delete albums on your DC260 camera. Because your computer treats the camera like another drive, you can create, rename, and delete





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albums just like you would create, rename, and delete folders on any other drive.



1 Double-click on the Camera Folder icon.

*A window appears listing individual pictures.*

2 Perform one of the following operations:

- ✔ To create a folder select File -> New -> Folder or position the cursor in the folder window and click the right mouse button.
- ✔ To rename an existing folder click on the name beneath the folder to highlight it. Type a new name and press Enter.

☞ You should not rename the System, DC260_01, or DC220_01 folders because the camera looks for these names to locate pictures, scripts, and logo files.

- ✔ To delete a folder click on the folder to highlight it. Either move it to the Recycle Bin or press the DELETE key.

## Opening picture files in other software programs

Mounter software allows you to open picture files into a registered software program. Simply double-click on the Camera icon and then double-click on the Camera Folder icon to view the picture files. Double-click on a picture file to open it into a registered software program.

☞ You can also save FLASHPIX and JPEG pictures from other software programs to the Camera Folder.

## Saving sound

When you transfer pictures containing sound, Mounter software extracts the sound portion of the file. Through preferences, Mounter software can:

- ✔ Prompt you for a filename for each sound file
- ✔ Save the sound under the same filename as the picture with a .wav extension
- ✔ Save no sound



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## Setting preferences

Mounter software allows you to set preferences that govern how Mounter software notifies and prompts you for audio options.

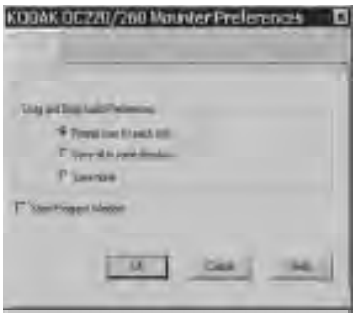
To set Mounter preferences:

1 Click the right mouse button on the Camera icon.




2 Select MOUNTER PREFERENCES from the pop-up menu.

*The Mounter Preferences screen appears.*




3 Specify the settings which include:

- ✔ How you want to be prompted when saving a picture's attached audio
- ✔ If you want to show the progress of the Mounter connection operations.

4 Click the OK button to apply the settings.

## Exiting Mounter software

To exit the Mounter software**,** select Close from the File menu. The Mounter Camera icon remains in the My Computer folder even when the camera is not accessed.

# Placing the memory card in your computer

As an alternative to connecting your camera to your computer, you can also access the pictures on the memory card by placing the card in a PCMCIA-ATA Card Adapter. You can then place the Adapter Card in a PCMCIA drive if your computer is so equipped or into a memory card reader.

PCMCIA is an acronym for **P**ersonal **C**omputer **M**emory **C**ard **I**nternational **A**ssociation. Using a PCMCIA card eliminates the need to have your camera tethered to your PC and provides a fast picture data transfer rate.





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☞ While using a PCMCIA card to access your pictures is generally faster than accessing the camera in the Connect mode, you lose some of the functionality you would have through the Mounter software. For example, when using MICROSOFT EXPLORER software and a PCMCIA card, you cannot extract and save audio from pictures that have attached sound. To access both a picture and its attached sound from the PCMCIA card, you must use KODAK TWAIN software or *KODAK DIGITAL SCIENCE* Picture Easy Software 3.0.

## Picture Card Adapter

The DC220 and DC260 use a removable memory card that complies with the CompactFlash standard. Due to the size of the CompactFlash card, most PCMCIA card readers do not accept the card as is, but require an adapter card. A *KODAK DIGITAL SCIENCE* Picture Card Adapter is available for your memory card to adapt the 50-pin Picture Card for use with 68-pin PCMCIA-ATA compatible devices.

☞ For information on ordering a Picture Card Adapter, refer to the "Accessories" section on page 1-4.

To transfer pictures via the PCMCIA card:



1. Remove the memory card from the camera.

   *Refer to "Removing the memory card" on page 2-10.*

2. Insert the memory card into the Picture Card Adapter.

3. Insert the Picture Card Adapter into your computer.

   *The Picture Card appears as a drive on your computer.*



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*Does my computer support a PCMCIA card?*

To determine if your computer supports a PCMCIA connection:

1. Click the right mouse button on the My Computer icon on your computer's desktop.
2. Click on Properties in the pop-up menu.
3. Click the Device Manager tab.
4. Verify that a "PCMCIA Socket" entry exists.
5. Double click on the PCMCIA socket.
6. Verify that the "PCIC or compatible PCMCIA controller" is present.
7. Double click on "PCIC or compatible PCMCIA controller."
8. Verify that device status is "The device is working properly."

*If the above conditions are met and you have a PCMCIA card for your camera, you can use a PCMCIA connection. A PCMCIA card is an optional accessory for the DC220/DC260 camera.*

## Memory Card Reader



A memory card reader allows you to transfer pictures faster from a CompactFlash or full size PCMCIA Flash Memory ATA card to your PC computer than with a cable connection.

Several models of memory card readers are available from computer dealers.





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# Transferring pictures via TWAIN software



You've used your digital camera to photograph your real estate agency's newest listings for the company Web page. Now you need to open your pictures in an image editing software program to touch up some peeling paint, add some text, and insert an asking price.

Using KODAK Access TWAIN Acquire Software (TWAIN) for WINDOWS, you can do just that. TWAIN is special industry-standard software that allows you to transfer pictures from your digital camera directly to TWAIN-compliant software, such as ADOBE PHOTODELUXE.

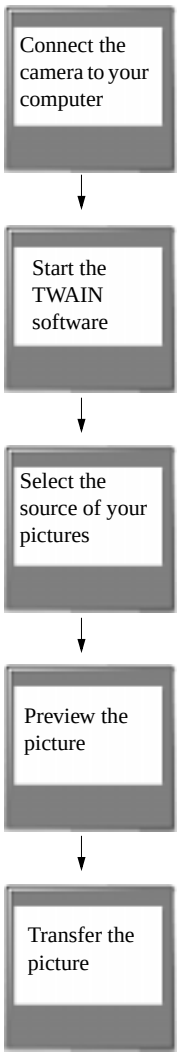
## Installing TWAIN software

If you have not installed the DC220/DC260 software, refer to the "Installing software" section on page 1-4.



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## TWAIN software workflow




Refer to page 8-2.
Refer to page 8-3.
Refer to page 8-4.
Refer to page 8-5.
Refer to page 8-7.

## Connecting the camera to your computer

To use TWAIN software to transfer your pictures, the camera needs to be connected to your computer and turned on. Refer to Chapter 6, “Connecting your



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camera to your computer" for detailed information.



When the camera is correctly connected to and communicating with your computer, the camera's Status Display is replaced with the following screen.



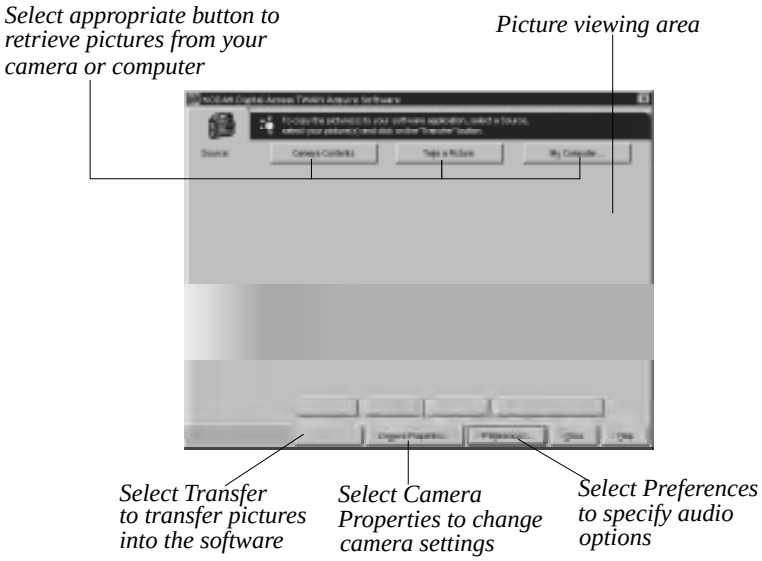
If the connection times out, the Status Display returns.

## Starting the TWAIN Software

1. Open a TWAIN-compliant software (for example, ADOBE PHOTODELUXE).
2. Select KODAK DC220/DC260 ZOOM ACQUIRE as the TWAIN source.
3. Select TWAIN ACQUIRE from the compliant software.

   *The TWAIN software main window appears.*

The following screen is the main window of TWAIN software. More detailed information is offered in the following sections.






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## Selecting the source of your pictures

TWAIN software allows you to transfer:

- ✔ the contents of the camera's memory card
- ✔ a picture that you take while your camera is connected to the computer
- ✔ pictures stored on your computer or your memory card

### Selecting the camera's contents



1. Click the CAMERA CONTENTS button on the TWAIN screen.

   *The TWAIN software displays the pictures stored on the camera's memory card.*

   If your DC260 Camera contains albums, the screen displays album icons. Click on an album to display its contents.

2. Click on the pictures you want to select for transfer.

   *Refer to "Previewing your pictures" on page 8-5.*

### Taking a picture



1. Frame the subject of your picture in the camera's viewfinder.
2. Click the TAKE PICTURE button on the TWAIN screen.

You can only take still pictures through the TWAIN software.

*The TWAIN software displays the picture in a full view.*

*Refer to "Previewing your pictures" on page 8-5.*



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## Selecting pictures on your computer

To select a picture that is stored on your computer or a picture that resides on a memory card that is in your computer:



1. Click the MY COMPUTER button on the TWAIN screen.

   *The TWAIN software displays a standard WINDOWS Open window.*

2. Navigate to find the pictures that you want to open.

3. Click on the pictures you want and click OPEN.

   *The TWAIN software displays the picture in either the list or thumbnail mode.*

   *Refer to the next section, "Previewing your pictures."*

# Previewing your pictures

While previewing your pictures using TWAIN software, you can view your pictures as files or as thumbnails which are smaller versions of your pictures.

☞ To view your pictures as thumbnails, click on the SHOW AS THUMBNAILS checkbox. Viewing pictures as thumbnails will be slower than viewing pictures as files.



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Refer to the following subsections for more information about each Preview function.




## Play a picture's attached sound

Pictures that have attached sound show a sound icon beneath the picture.

## Expanding and collapsing pictures

Burst pictures are a series of pictures taken in rapid succession. Timelapse pictures are a series of pictures taken at a specified interval. TWAIN software displays both as single thumbnails with an icon indicating if the picture is a burst or a timelapse picture.

When you have expanded a selected picture, the EXPAND button changes to a COLLAPSE button.

## Opening a picture in full view

You can also double-click a picture to open it.



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## Displaying picture information

The Picture Information window displays information about the picture and camera settings when the picture was taken. You may not select or change any settings on the window.

The Picture Information window displays:



☞ To play the picture's attached sound, click the PLAY icon.

- ✔ Name of the picture file
- ✔ Number of pictures (burst and timelapse only)
- ✔ Quality setting
- ✔ Resolution setting
- ✔ Size (in bytes)
- ✔ Date and time picture was taken
- ✔ Name of the album in which the picture is stored (DC260 only)
- ✔ Aperture information
- ✔ Exposure Time, in seconds
- ✔ Flash information
- ✔ Audio attachment

# Transferring pictures

When you have previewed your pictures and determined which ones you want to transfer:



1. Click on the pictures you want to transfer.
2. Click the TRANSFER button.

   *The picture is displayed in the previously opened TWAIN-compliant software window.*



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## Saving sound

When you transfer pictures containing sound, TWAIN software extracts the sound portion of the file. Through Preferences, TWAIN software can:

- ✔ Prompt you for a filename for each sound file
- ✔ Save the sound under the same filename as the picture with a .wav extension
- ✔ Save no sound



1. Click the PREFERENCES button on the TWAIN screen.

   *The Preferences screen appears.*

2. Specify how you want to save a picture's attached audio.
3. Click the OK button to apply the settings.



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# 9 Tips and troubleshooting



## General maintenance and safety

- ✔ To keep from damaging your camera, avoid exposing it to moisture and extreme temperatures.
- ✔ Clean the outside of the camera by wiping with a clean, dry cloth. Never use harsh or abrasive cleaners or organic solvents on the camera or any of its parts.
- ✔ Never disassemble or touch the inside of the camera. This could result in electrical shock.
- ✔ If you notice smoke or a strange smell coming from the camera, immediately turn the camera off, wait a few minutes until the camera cools, and then remove the batteries.
- ✔ Cleaning the lens:

1. Blow gently on the lens to remove dust and dirt.
2. Moisten the lens by breathing lightly on it.
3. Wipe the lens gently with a soft, lint-free cloth or an untreated lens-cleaning tissue.

☞ Do not use cleaning solutions unless they are designed specifically for camera lenses. Do not wipe the camera lens with chemically treated eyeglass lens tissue as it may scratch the lens.



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## Communicating with the computer

If your computer cannot communicate with the camera you may need to adjust the serial port speed setting. Adjust the settings using the Camera Properties (Chapter 5), or follow the instructions on the Kodak Web site at **http://www.kodak.com**

## Monitor adjustment

To get the best view of your pictures, you should optimize your monitor display. You can view the pictures on a monitor using 256 color and a 640 x 480 display setting, but these settings will not give a true representation of the pictures.

1. Double-click on the My Computer icon.
2. Double-click on the Control Panel icon.
3. Double-click on the Display icon and click on the Settings tab.
4. Make note of the settings for the Color Palette and Desktop areas.
5. From the Color Palette field, select the highest available setting {256, High (16-bit), or True (24-bit or 32-bit) color} and click the OK button.
6. From the Desktop Area, select 800 x 600 pixels.

☞ Changing these values may cause your monitor display to be offset. Consult your monitor's User's Guide for information on repositioning the display.

☞ If changing your settings makes your display unusable, shutdown your PC, reboot in the Safe mode and reset the settings to those recorded in Step 4. To boot up in Safe mode, press the F5 key when "Starting WINDOWS 95..." appears on the monitor.



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## Printing

You may notice that the colors on your computer screen do not always match those in your documents or prints. This is because monitors and printers use different color systems.

You may be able to achieve more predictable results in your printed documents by:

- ✔ improving the quality of your paper. Copier paper may not offer the same results as coated paper or paper made especially for ink jet printers.
- ✔ adjusting your printer software settings.
- ✔ using fresh ink cartridges. Do not use ink cartridges beyond their life expectancy.

☞ If you need extreme precision in matching printed output to your computer screen, you may want to consider purchasing a calibration system. The aim of a calibration system is to match, as closely as possible, the printed image to the image on your computer screen. Please consult your local computer dealer for more information.

Remember these few tips when it comes time to print your document:

- ✔ color printing takes more time. Increased complexity in your document increases the printing and drying time.
- ✔ color printing is more memory intensive than black and white. If your computer gives you an insufficient memory message, you may need to close some applications, change some settings, or add additional memory.
- ✔ color prints may not photocopy as clearly as black and white. If you plan to photocopy documents, you may consider printing the document in gray scale. This setting is usually changed from the Print menu.
- ✔ resizing the picture to a smaller size or printing the picture on glossy paper may increase the quality of the print.

To improve the quality of your prints, you may want to print your pictures on *KODAK DIGITAL SCIENCE* Inkjet Paper. InkJet Paper is made to work with most inkjet printers to give you clearer, crisper, and more detailed images on your prints.





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## Troubleshooting

If you are experiencing difficulties with your camera, check the following table for possible solutions. If the difficulties persist, refer to Chapter 10 - *Getting Help*.

☞ Additional technical information is available in the ReadMe file located in the KODAK DC220/DC260 folder.

| **Computer Monitor** | | |
|---|---|---|
| **Problem** | **Cause** | **Solution** |
| The image on your monitor is jagged or inappropriately colored. | Monitor is not set correctly. | Adjust your monitor display settings. See “Monitor adjustment” on page 9-2. |
| **Memory Card** | | |
| **Problem** | **Cause** | **Solution** |
| The camera does not recognize your memory card. | The memory card may not be ATA compatible or CompactFlash CF certified. | Memory cards must be ATA compatible and CompactFlash certified to work with the camera. |



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| Camera | | |
|---|---|---|
| **Problem** | **Cause** | **Solution** |
| Ready light does not turn on and the camera does not work. | Batteries are low or empty. | Replace the batteries or use the AC Adapter. Pictures remain in the camera's memory when the battery is removed. |
| | Camera is not turned on. | Turn the camera on and verify that the green Ready light turns on. |
| Ready light is red. | No memory card in camera or the memory card is full. | Insert a new memory card. |
| Shutter button does not work. | Camera is not turned on. | Turn the camera on and verify that the green Ready light turns on. |
| | Mode dial is not set to Capture. | Set the Mode dial to Capture. |
| | Ready light is blinking. Camera is processing picture. | Wait until Ready light stops blinking before attempting to take another picture. |
| | The Status Display reads **Full** . The memory card is full. | Transfer pictures to your computer or insert a memory card that has available memory. |
| Camera does not turn on. | Batteries are not properly installed. | Remove the batteries and install them according to the directions on the inside of the battery door. |
| | Batteries are weak or dead. | Install new batteries or use the AC Adapter. |





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| Camera | | |
|---|---|---|
| **Problem** | **Cause** | **Solution** |
| Part of the picture is missing. | Something was blocking the lens when the picture was taken. | Keep hands, fingers, or other objects away from the lens when taking pictures. |
| | Your eye or the picture was not centered correctly in the viewfinder. | Leave space around subject when centering picture in viewfinder. |
| Picture is too dark. | Flash is not on or did not go off. | Turn on the flash. See “Flash” on page 2-4. |
| | The subject is too far away for the flash to have an effect. | Move so there is no more than 10 feet (3 m) between the camera and the subject. |
| | The subject is in front of a bright light. | Change your position so the light is not behind the subject. |
| Picture is too light. | The flash is not needed. | Change to automatic flash. See “Flash” on page 2-4. |
| | The subject is too close when the flash was used. | Move so there is at least 1.6 ft. (0.5 m) between the camera and the subject. |
| | The light sensor is covered. | Hold the camera so your hands or other objects do not cover the light sensor. |
| Stored pictures are damaged. | The memory card was removed when the Ready light was blinking. | Make sure the Ready light is not blinking before removing the memory card. |
| Pictures remaining number does not decrease. | The image resolution does not take up sufficient space to decrease the picture remaining number. | The camera is operating normally. Continue taking pictures. |



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| Camera | | |
|---|---|---|
| **Problem** | **Cause** | **Solution** |
| Picture is not clear. | The lens is dirty. | Clean the lens. See “General maintenance and safety” on page 9-1. |
| | Subject too close when taking picture | Stand at least 8 in. (20 cm.) away when taking pictures using Close-up. |
| | Subject or the camera moved while the picture was taken. | Hold camera steady until the picture is taken. |
| | The subject is too far away for the flash to be effective. | Move so the subject is less than 10 ft. (3 m) away. |
| **LCD Messages** | | |
| **Message** | **Cause** | **Solution** |
| Memory Card is Full. | Memory card is full and cannot hold additional pictures | Transfer pictures to your computer or insert a memory card that has available memory. |
| No Memory Card. | There is no memory card inserted in the camera. | Insert a memory card into the camera. |
| Cannot read memory card. | Memory card is corrupted. | Insert a new or reformat the memory card. |
| Camera did not establish connection. | The camera cannot communicate with the computer. | See “Potential connection problems” on page 6-8. |
| Camera needs service. | The camera is malfunctioning. | Have the camera serviced. |
| The receiving camera does not have enough memory to receive the pictures. | In a camera to camera communication, the receiving camera’s memory card is full. | Transfer pictures to your computer or insert a memory card that has available memory. |





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| LCD Messages | | |
|---|---|---|
| **Problem** | **Cause** | **Solution** |
| Unable to receive picture. | An error has occurred while receiving pictures in a camera to camera transfer. | Try the camera to camera transfer again. |
| Transfer of pictures was interrupted. Not all pictures were sent. | An error has occurred before all pictures were transferred. | Try the transfer again. |
| Not enough memory | There is not enough memory on the card to store the selected timelapse picture sequence. | Transfer pictures to your computer or insert a memory card that has available memory. You can also change the timelapse sequence to one that requires less memory. |



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# 10 Getting help

Help with your camera is available from a number of resources.

- ✔ in *Tips and Troubleshooting*, Chapter 9
- ✔ the software's manufacturer
- ✔ product information by fax
- ✔ your place of purchase
- ✔ World Wide Web
- ✔ technical support

## Software help

Help with any **software** packaged with your camera can be obtained from the software instructions, the software's help screens, or by contacting the manufacturer of that product.

## Online services

Contact Kodak via:

**World Wide Web—** http://www.kodak.com
**America Online—** (keyword) KODAK
**CompuServe—** GO KODAK
**Kodak Internet listserv—** photo-cd@info.kodak.com; or ftp.kodak.com

## Faxed information

Kodak offers automated support for digital imaging products and services. Product information can be faxed to you by calling:

**U.S.—** 1-800-508-1531
**Canada—** 1-800-295-5531
**Europe—** 44-131-458-6962
**U.K.—** 44-0-131-458-6962





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## Customer support

If you have questions concerning the operation of KODAK software, or the DC220/DC260, you may speak directly to a customer support representative. Have the camera connected to your computer, its serial number ready, and be at your computer when you call.

**U.S.—** call toll free, 1-888-375-6325, between the hours of 9:00 a.m. and 8:00 p.m. (Eastern Standard Time) Monday through Friday.

**Canada—** call toll free, 1-800-375-6325, between the hours of 9:00 a.m. and 8:00 p.m. (Eastern Standard Time) Monday through Friday.

**Europe—** call the Kodak Digital Imaging Support Centre toll free number associated with your location, or the U.K. toll line, 44-131-458-6714, between the hours of 09.00 and 17.00 (GMT/CET) Monday through Friday.

**Outside the U.S., Canada, and Europe—** call the number on the following pages that is associated with your location.

| Country | Help number | Fax |
|---|---|---|
| Argentina | 54-1-808-300 | 54-1-808-3328 |
| Australia | 1-800-674-831 | 1-800-659-757 |
| Austria | 0-660-7348 | 44-131-458-6962 |
| Belgium | 0800-72247 | 44-131-458-6962 |
| Brazil | 0-800-15-0000 | 55-12-331-8571 |
| Caribbean | 78-7-757-5500 | 78-7-757-8760 |
| Chile | 56-2-697-2000 | 56-2-697-0310 |
| China–Shanghai | 8621-64720888 | 8621-64726582 |
| China–Beijing | 8610-63471155 | 8610-63475641 |
| Colombia | 57-1-629-0266 | 57-1-629-0673 |
| Denmark | 80-01-09-24 | 44-131-458-6962 |
| Dominican Republic | 809-563-1252 | 809-563-1264 |
| Egypt | 20-2-394-2205 | 20-2-393-1119 |
| France | 0800-90-6281 | 44-131-458-6962 |
| Finland | 0800-117056 | 44-131-458-6962 |
| Germany | 0130-82-54-02 | 44-131-458-6962 |
| Greece | 00800-44125605 | 44-131-458-6962 |
| Hong Kong | 852-2564-9777 | 852-2564-9753 |



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| Country | Help number | Fax |
|---|---|---|
| Hungary | 36-1-269-71-17 | 36-1-269-71-13 |
| India | 91-22-617-5823 | 91-22-617-6004 |
| Indonesia | 62-21-721-1060 | 62-21-725-3817 |
| Ireland | 1-800-409391 | 44-131-458-6962 |
| Italy | 1678-72-996 | 44-131-458-6962 |
| Japan | 81-3-5488-2390 | 81-3-5488-4512 |
| Korea | 82-2-708-5400 | 82-2-708-5500 |
| Latin America | 1-305-267-4700 | 1-305-267-4780 |
| Lebanon | 961-1-883822 | 961-1-881726 |
| Malaysia | 60-3-757-2722 | 60-3-755-5919 |
| Mexico | 52-5-449-4300 | 52-5-449-4400 |
| Middle East | 971-4-444-910 | 971-4-447-059 |
| Netherlands | 06-0224428 | 44-131-458-6962 |
| New Zealand | 0800-500-135 | 64-9-302-8637 |
| Norway | 800-1-1848 | 44-131-458-6962 |
| Panama | 52-3-678-6200 | 52-3-678-6210 |
| Peru | 51-1-224-8610 | 51-1-224-8605 |
| Philippines | 63-2-810-0331 | 63-2-816-6718 |
| Portugal | 351-1-4149-500 | 351-14194-321 |
| Russia | 7-095-929-9166 | 7-095-929-9170 |
| Singapore | 65-470-9875 | 65-479-8397 |
| South Africa | 27-11-804-2852 | 27-11-804-5013 |
| Spain | 900-98-4485 | 44-131-458-6962 |
| Sweden | 020-793169 | 44-131-458-6962 |
| Switzerland | 0800-551034 | 44-131-458-6962 |
| Taiwan | 886-2-893-8210 | 886-2-895-1069 |
| Thailand | 66-2-271-3040 | 66-2-616-1923 |
| Turkey | 90-216-342-3332 | 90-216-343-6743 |
| U.K. | 0800-281487 | 44-131-458-6962 |
| Uruguay | 59-2-92-0473 | 59-2-92-1796 |
| Venezuela | 58-2-903-1111 | 58-2-943-2081 |





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# KODAK Digital Access Software Plug-In Acquire

KODAK DC220/DC260 Digital Access Software (Plug-In Acquire) lets you use a PCMCIA-compatible card reader and a host application (ADOBE PHOTOSHOP version 3.0.5 or later, or ADOBE PhotoDeluxe version 2.0) to access pictures stored on the DC220 or DC260 camera memory card.

You use Digital Access software to

- ✔ View and select the pictures you want to transfer to the host application or save to your hard disk
- ✔ View high-resolution pictures in Preview view
- ✔ View burst and timelapse pictures as thumbnails on a contact sheet, as high-resolution pictures in Preview view, and in a slide show
- ✔ Play and save an audio attached to a picture
- ✔ Rotate and delete selected pictures
- ✔ View information on a selected picture, burst folder, or timelapse folder
- ✔ Export burst and timelapse pictures as an APPLE QuickTime movie

## System and Software Requirements

To use Digital Access software, you require the following system configuration and software:

- ✔ APPLE PowerMacintosh, PowerPC-equipped PowerBook, or PowerPC-equipped Macintosh-compatible computer, and a CD-ROM drive
- ✔ Display monitor with a minimum resolution of 640 by 400 (1024 by 768 preferred) and 8-bit color (16-bit or 24-bit preferred)
- ✔ 10 MB free disk space
- ✔ 32 MB random access memory (RAM)
- ✔ PCMCIA-compatible card reader and CompactFlash card adapter





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- ✔ MacOS 7.5.3 or later
- ✔ ADOBE PHOTOSHOP version 3.0.5 or later, or ADOBE PhotoDeluxe version 2.0 or later

## Installing Digital Access Software

To install Digital Access software

1. Close any applications that are running.
2. Place the software installation disc into the CD-ROM drive.
3. Double-click the KODAK Plug-In Installer icon.

   *The Install dialog box appears.*
4. From the Install Location pop-up menu, choose Select Folder.
5. In the Select Folder dialog box, navigate to one of the following application folders where you want to install the software.
   - ✔ PHOTOSHOP version 3.0.5 Plug-ins folder Acquire/Export folder
   - ✔ PHOTOSHOP version 4.0 Plug-ins folder Import/Export folder
   - ✔ PhotoDeluxe version 2.0 Plug-ins folder Acquire/Export folder
6. Follow the on-screen instructions to complete the installation.

   ☞ If you do not have APPLE QuickTime installed on your system, a message notifies you that you need to install it. The APPLE QuickTime version 3.0 installer is located on the installation disc.
7. When the software has been installed successfully, a message appears prompting you to restart your computer. Click Restart.

Digital Access software is installed in the folder KODAK DC220/DC260 Acquire in the selected folder. To also use Digital Access software with another supported application, Option-click the KODAK DC220/DC260 Acquire folder and then drag it to the Plug-ins folder for the application you want to use.

## Connecting the Card Reader

In order to retrieve pictures, you need to connect a PCMCIA-compatible card reader to your computer and use a PCMCIA card adapter to hold the camera memory card. For information, see the card reader User's Guide.



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## Digital Access Application Window

You use the Digital Access application window to view and select pictures, transfer them to the host application, or save them to your computer.




The application window contains the following elements:

- ✔ The **picture source pop-up menu** lets you select the source of the pictures you want to retrieve. Sources include the camera memory card or a folder on your computer.
- ✔ The **Album pop-up menu** lets you display the contents of a DC260 album in the viewing area.
- ✔ The **view graphic icon** indicates the source of the displayed pictures.


Indicates the picture source is the camera memory card.


Indicates the picture source is a DC260 camera album.


Indicates the picture source is a burst folder.


Indicates the picture source is a timelapse folder.





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Indicates the picture source is a folder on your computer.

- ✔ The **toolbar** provides icons that let you work with pictures.



Rotates selected pictures 90 degrees clockwise (right).



Rotates selected pictures 90 degrees counterclockwise (left).



Expands a burst or timelapse folder to display the pictures stored in the folder. The icon changes to the Collapse icon.



Collapses the folder so only the first picture in the folder is displayed.



Plays the audio attached to a selected picture.



Displays the Preferences dialog box, from which you can

- ✔ Select the picture transfer resolution
- ✔ Show or hide tooltips in the application window
- ✔ Set the unit of measure used in the Transfer Contact Sheet dialog box
- ✔ Specify the color for the background, slide mount frame, and text on a transferred contact sheet

- ✔ The **View menu** lets you display the contents of the selected picture source as a contact sheet in the viewing area or as high-resolution pictures in Preview view.
- ✔ The **viewing area** displays the contents of the selected picture source either as thumbnails on a contact sheet or as high-resolution pictures in Preview view.



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- The **navigation bar** provides controls to scroll through multiple-selected pictures. From left to right you can: view the first picture in the selection, display the previous picture, specify the exact picture you want to view, advance to the next picture, and view the last picture in the selection.
- Five **control buttons**
  - **Transfer** transfers the selected pictures to the host application.
  - **Save As** displays the Save As dialog box, from which you can save the selected pictures to your hard disk, save an attached audio, and export burst and timelapse pictures as APPLE QuickTime movies.
  - **Delete** erases the selected pictures from the picture source.
  - **Done** quits Digital Access software and returns you to the host application.
  - **Help** displays the help Contents window, from which you can view the books and pages in the help system, access an index of topics, and conduct a full-text search.
- **Transfer As radio buttons** let you select the way in which pictures are transferred to the host application. You can transfer pictures either as individual pictures or as thumbnails on a contact sheet.
- **Picture Information window** displays information on a selected picture, burst folder, or timelapse folder.
- The **status bar** includes the Select All icon when you are viewing a contact sheet and the Play Slide Show button in Preview view. The status bar also contains the Display Size pop-up menu and the following information:
  - The number of the selected picture and the total number of pictures displayed in the viewing area.
  - The cursor position when it is placed over a thumbnail or picture.
  - The RGB pixel values at the cursor position over a thumbnail or picture.

## Getting Pictures from the Camera Memory Card

To get pictures from the camera memory card

1. Start the host application and then start Digital Access software. If you are using





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- ✔ PHOTOSHOP version 3.0.5, choose File → Acquire → KODAK DC220/ DC260 Acquire.
- ✔ PHOTOSHOP version 4.0, choose File → Import → KODAK DC220/DC260 Acquire.
- ✔ PhotoDeluxe, click the Get Photo button in the application window. Click the Get Photo tab and then click the Other icon. Select KODAK DC220/ DC260 Acquire and click OK.

*The Open dialog box appears.*



2. Use the navigation pop-up menu to select the camera folder.
3. Click Select ["folder name"].

☞ The next time you start Digital Access software, the contents of the last selected folder are displayed automatically.



*Digital Access software starts. The application window shows thumbnails from the selected picture source on a contact sheet.*

☞ To display the contents of a DC260 album, select an album from the Album pop-up menu.

After the pictures are displayed in the viewing area, you can

- ✔ Select pictures to transfer to the host application or save to your computer
- ✔ Change the display size of thumbnails on the contact sheet or pictures displayed in Preview view
- ✔ View pictures at a higher resolution in Preview view



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- ✔ Expand burst and timelapse folders, and display the pictures as thumbnails on a contact sheet, as high-resolution pictures in Preview view, and in a slide show
- ✔ Rotate pictures
- ✔ Play an attached audio
- ✔ Delete pictures from the picture source
- ✔ View picture information

## Select Pictures

In order to work with pictures displayed on the contact sheet, you need to select them. To select pictures in a burst or timelapse folder, expand the folder and then select the pictures. To select

- ✔ **A single picture.** Click the thumbnail.
- ✔ **Multiple noncontiguous pictures.** Shift-click each thumbnail.
- ✔ **Multiple contiguous pictures.** Click outside the slide mount frame of the first thumbnail, hold down the mouse button, and drag the cursor across or down the contact sheet to the last thumbnail you want in the selection.
- ✔ **All the pictures.** Click the Select All icon on the status bar.

To deselect a picture, Shift-click it. To deselect all the pictures, click anywhere in the viewing area background but not on a picture.

## Change Thumbnail and Picture Display Size

You use the Display Size pop-up menu on the status bar to change the viewing size of thumbnails on the contact sheet or pictures in Preview view.

☞ The display size affects only the viewing size. You use the Preferences dialog box to specify the picture transfer size.

### *Contact Sheet*

You can display thumbnails on the contact sheet in two sizes:

- ✔ **Small** provides a thumbnail suitable for reference.
- ✔ **Large** provides a viewing-quality thumbnail.





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### *Preview View*

You can display pictures in Preview view in three sizes. The following tables show the picture display sizes for the DC220 camera and the DC260 camera:

| DC220 Camera | Percentage of Camera Resolution (pixels) | | |
|---|---|---|---|
| | **100%** | **50%** | **25%** |
| *High resolution* | *1152 by 864* | *576 by 432* | *288 by 216* |
| *Standard resolution* | *640 by 480* | *320 by 240* | *160 by 120* |



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| DC260 Camera | Percentage of Camera Resolution (pixels) | | |
|---|---|---|---|
| | 100% | 50% | 25% |
| *High resolution* | *1536 by 1024* | *768 by 512* | *384 by 256* |
| *Medium resolution* | *1152 by 768* | *576 by 384* | *288 by 192* |
| *Standard resolution* | *768 by 512* | *384 by 256* | *192 by 128* |

## View a High-resolution Picture

To display pictures at a higher resolution

**1** In the application window viewing area, select the pictures you want to view.

☞ To select pictures from a burst or timelapse folder, click the folder to select it and then click the Expand icon on toolbar.



**2** From the View pop-up menu, select Preview.

**3** To change the display size, choose an option from the Display Size pop-up menu.

*The actual display size depends on your camera model. See the table in "Change Thumbnail and Picture Display Size."*



*A single picture is displayed based on the selected display size and the original picture resolution.*

*The picture filename and file format extension are displayed below the picture. Icons indicate if an audio is attached to a picture or if the picture is in a burst or timelapse folder.*





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*Multiple pictures are displayed with a stack frame surrounding the pictures.*

*To scroll through the pictures, use the controls on the navigation bar. To view a specific picture, type the picture number in the text box and then press Return.*

## View Burst and Timelapse Pictures

You can view the pictures in a burst or timelapse folder as thumbnails on the contact sheet, as high-resolution pictures in Preview view, or in a slide show.

### *Contact Sheet*

To view burst and timelapse pictures on a contact sheet



1. In the application window viewing area, click the burst or timelapse folder to select it.
2. On the toolbar, click the Expand icon.

You can also double-click a burst or timelapse folder to expand it.



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*The folder expands and a thumbnail of each picture in the folder is displayed in the viewing area.*

*The Expand icon changes to the Collapse icon.*

*To collapse the expanded folder and redisplay the contact sheet, click the Collapse icon.*

### *Preview View*

To view burst and timelapse pictures in Preview view

**1** In the application window viewing area, expand the folder and then select the pictures you want to view.



*The pictures are displayed in Preview view with a stack frame surrounding them.*

**2** To change the display size, select an option from the Display Size pop-up menu.

*The actual display size depends on your camera model. See the table in "Change Thumbnail and Picture Display Size."*

**3** To scroll through the pictures, use the controls on the navigation bar. To view a specific picture, type its number in the text box and then press Return.

### *Slide Show*

To view burst or timelapse pictures in a slide show

**1** In the application window viewing area, click the burst or timelapse folder to select it and then click the Expand icon on the toolbar.

**2** From the View pop-up menu, select Preview.





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3 To change the display size for the slide show, select an option from the Display Size pop-up menu.

4 On the status bar, click the Play Slide Show icon.



*The slide show begins with the first picture in the folder and continues through the last picture. If an audio is attached, it begins when the first picture is displayed.*

☞ To stop the slide show, click the Stop Slide Show icon on the status bar.

## Play the Audio Attached to a Picture

To listen to an audio attached to a picture, do either of the following:

- ✔ **Contact sheet.** Click the thumbnail to select it and then click the Play Sound icon on the toolbar.
- ✔ **Preview view.** Advance to the picture with an attached audio and then click the Play Sound icon on the toolbar.

## Rotate Pictures

To rotate pictures

1 In the application window viewing area, select the pictures you want to rotate. To select multiple pictures, Shift-click each picture.

2 On the toolbar, click either the Rotate Clockwise (right) or Rotate Counterclockwise (left) icon. The picture is rotated 90 degrees in the selected direction.

## Delete Pictures

To delete pictures from the picture source

1 In the application window viewing area, select the pictures you want to delete from the picture source.



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☞ To delete pictures from a burst or timelapse folder, expand the folder and then select the pictures.

2 Click Delete.

3 In the resulting message, click Delete to erase the pictures from the picture source. To keep the pictures, click Cancel.

### View Picture Information

To view picture information, click the picture or burst or timelapse folder in the application window viewing area.

☞ To view information on pictures in a burst or timelapse folder, expand the folder and then select a picture.



Picture Information window

*The Picture Information window shows the following information for a single picture:*

- ✔ Width
- ✔ Height
- ✔ Date
- ✔ Time
- ✔ File type
- ✔ Aperture (f-stop)
- ✔ Exposure time (seconds)
- ✔ Flash on/off

*The Picture Information window shows the width, height, date, time, file type, and number of pictures in a burst or timelapse folder.*

## Getting Pictures from Your Computer

You can use Digital Access software to display FlashPix™ and JPEG pictures saved on your computer.

1 From the Source pop-up menu, select Change Folder.

*The Change Folder dialog box appears.*





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2 Use the navigation pop-up menu to select the folder on your computer where the pictures are saved.

3 Click Select [“folder name”].

*The pictures from the selected folder are displayed in the application window viewing area.*

## Transferring Pictures

You can transfer pictures to the host application either as individual pictures or as thumbnails on a contact sheet.

### Transfer Individual Pictures

To transfer individual pictures to the host application

1 In the application window viewing area, select the pictures you want to transfer. To transfer pictures in a burst or timelapse folder, expand the folder and then select the pictures. To transfer a single picture, double-click it.

☞ For information on exporting the folder, see “Export an APPLE QuickTime Movie” later in this appendix.



2 In the Transfer As section, click the Photo radio button.

3 Click Transfer.

4 To close Digital Access software, click Done.

### Transfer Thumbnails on a Contact Sheet

To transfer thumbnails on a contact sheet



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1 In the application window viewing area, do either of the following:

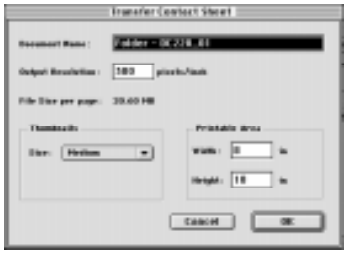
- ✔ To transfer a single picture, double-click it.
- ✔ To transfer multiple pictures, select the pictures you want to include on the contact sheet. To transfer pictures in a burst or timelapse folder, expand the folder and then select the pictures.

☞ For information on changing the color for the contact sheet background, slide mount frame, and text, see “Setting Preferences.”

2 In the Transfer As section, click the Contact Sheet radio button.

3 Click Transfer.

*The Transfer Contact Sheet dialog box appears.*



4 In the Transfer Contact Sheet dialog box, do the following:

- ✔ In the Document Name text box, type a filename.
- ✔ In the Output Resolution text box, type the output device resolution.
- ✔ From the Thumbnail Size pop-up menu, select the thumbnail slide mount frame size you want transferred on the contact sheet. The picture is sized to fit in the frame. A Small frame is 3/4-inch, a Medium frame is 1.5 inches, and a Large frame is 3 inches.
- ✔ In the Printable area, type the width and height of your output media. For information on setting the unit of measure for this section, see “Setting Preferences” later in this appendix.

5 Click OK.

*A progress indicator appears as the contact sheet is created. The contact sheet holds as many thumbnails as fit on a single page based on the specified dimensions. Multiple contact sheets are created if necessary.*

6 To close Digital Access software, click Done.

## Saving Pictures to Your Computer





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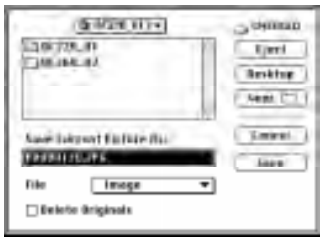
You can save pictures and audio files to your computer, and save burst and timelapse pictures as APPLE QuickTime movies.

## Save Individual Pictures

To save pictures to your computer

1. In the application window viewing area, select the pictures you want to save to your computer.
2. Click Save As.

   *The Save As dialog box appears.*



3. Use the navigation pop-up menu to select the folder where you want to save the pictures. To create a new folder, click New.
4. Optionally, in the Save Current Picture As text box, type a filename for a single picture. Multiple pictures use the camera filename.

   ☞ If you rename a single FlashPix™ picture, some applications may not recognize the renamed picture.

5. From the File pop-up menu, select Image (the default).
6. To delete the pictures from the camera memory card after they are saved to your computer, click the Delete Originals checkbox.
7. To save the pictures, click Save.

## Save the Audio Attached to a Picture

To save the audio attached to a picture

1. In the application window viewing area, select one or more pictures with an attached audio.
2. Click Save As.
3. In the Save As dialog box, use the navigation pop-up menu to select the folder where you want to save the pictures. To create a new folder, click New.



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4 From the File pop-up menu select Sound.

5 Optionally, in the Save Current Picture As text box, type a filename for a single audio.

If you are saving audio from multiple pictures, the filename of the picture is used with the file extension “sound.” For example: P0000023.JPG becomes P0000023 sound.

6 To save the audio, click Save.

## Export an APPLE QuickTime Movie

To save burst and timelapse pictures as an APPLE QuickTime movie

1 In the application window viewing area, click a burst or timelapse folder to select it.

2 Click Save As.

*The Save As dialog box appears.*



3 Use the navigation pop-up menu to select the folder where you want to save the movie. To create a new folder, click New.

4 From the File pop-up menu, select QuickTime.

5 Optionally, in the Save Current Picture As text box, type a filename.

6 Click Save





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*The QuickTime dialog box appears.*



7 In the Frame Interval section, click a radio button.

- ✔ **Real Time** uses the time delay specified when the pictures were taken.
- ✔ **Delay at Least x Seconds** lets you specify the interval between pictures.

*If an audio is attached, the frame interval may increase so the movie shows as long as the audio plays.*

8 From the Scaling pop-up menu, use the Up and Down arrows to specify the percentage you want the picture scaled from its original size. The default is 100%, the original picture size.

9 To create the movie, click OK.

*A progress indicator appears as the movie is created.*

## Setting Preferences

You use the Preferences dialog box to set picture transfer resolution, show or hide tooltips in the application window, set the unit of measure in the Transfer Contact Sheet dialog box, and customize display elements on a transferred contact sheet.

1 In the application window, click the Preferences icon on the toolbar.

*The Preferences dialog box appears.*



2 In the Transfer Resolution text box, type a resolution. The default is 300 pixels per inch (ppi).

3 To hide the tooltips displayed in the application window, deselect the Show Tooltips checkbox.

4 To display centimeters as the unit of measure in the Transfer Contact Sheet dialog box, click the Centimeters radio button.

5 In the Transferred Contact Sheet Layout section, do the following

- ✔ Click a display element color block (background, slide mount frame, or text).
- ✔ Use the Color Picker dialog box to select the color for the display element.

☞ If you do not want the slide mount frame or text displayed on the transferred contact sheet, click the checkbox preceding the element label.

6 To apply the preferences, click OK.





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# Warranty and regulatory information



## Warranty time period

Kodak warrants the *KODAK DIGITAL SCIENCE* DC220 Zoom Camera and the *KODAK DIGITAL SCIENCE* DC260 Zoom Camera (excluding the batteries) to be free from malfunctions and defects in both materials and workmanship for one year from the date of purchase.

## Warranty repair coverage

This warranty will be honored within the geographical location that the product was originally distributed and purchased.

If the equipment does not function properly during the warranty period due to defects in either materials or workmanship, Kodak will, at its option, either repair or replace the equipment without charge, subject to the conditions and limitations stated herein. Such repair service will include all labor as well as any necessary adjustments and/or replacement parts.

If replacement parts are used in making repairs, these parts may be remanufactured, or may contain remanufactured materials. If it is necessary to replace the entire system, it may be replaced with a remanufactured system.

Kodak will also provide telephone assistance during the warranty period.



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## Limitations

WARRANTY SERVICE WILL NOT BE PROVIDED WITHOUT DATED PROOF OF PURCHASE. PLEASE RETURN THE WARRANTY REGISTRATION CARD WITHIN 30 DAYS OF PURCHASE.

THIS WARRANTY BECOMES NULL AND VOID IF YOU FAIL TO PACK YOUR DC220/260 CAMERA IN A MANNER CONSISTENT WITH THE ORIGINAL PRODUCT PACKAGING AND DAMAGE OCCURS DURING PRODUCT SHIPMENT.

THIS WARRANTY DOES NOT COVER: CIRCUMSTANCES BEYOND KODAK'S CONTROL; SERVICE OR PARTS TO CORRECT PROBLEMS RESULTING FROM THE USE OF ATTACHMENTS, ACCESSORIES OR ALTERATIONS NOT MARKETED BY KODAK; SERVICE REQUIRED AS THE RESULT OF UNAUTHORIZED MODIFICATIONS OR SERVICE; MISUSE, ABUSE; FAILURE TO FOLLOW KODAK'S OPERATING, MAINTENANCE OR REPACKAGING INSTRUCTIONS; OR FAILURE TO USE ITEMS SUPPLIED BY KODAK (SUCH AS ADAPTERS AND CABLES).

KODAK MAKES NO OTHER WARRANTIES, EXPRESS, IMPLIED, OR OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE FOR THIS EQUIPMENT OR SOFTWARE.

REPAIR OR REPLACEMENT WITHOUT CHARGE ARE KODAK'S ONLY OBLIGATION UNDER THIS WARRANTY. KODAK WILL NOT BE RESPONSIBLE FOR ANY SPECIAL, CONSEQUENTIAL OR INCIDENTAL DAMAGES RESULTING FROM THE PURCHASE, USE, OR IMPROPER FUNCTIONING OF THIS EQUIPMENT REGARDLESS OF THE CAUSE. SUCH DAMAGES FOR WHICH KODAK WILL NOT BE RESPONSIBLE INCLUDE, BUT ARE NOT LIMITED TO, LOSS OF REVENUE OR PROFIT, DOWNTIME COSTS, LOSS OF USE OF THE EQUIPMENT, COST OF ANY SUBSTITUTE EQUIPMENT, FACILITIES OR SERVICES, OR CLAIMS OF YOUR CUSTOMERS FOR SUCH DAMAGES.

Depending on your geographical location, some limitations and exclusions may not apply.



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## Application support

For application specific support, contact your reseller, systems integrator, software manufacturer, or dealer.

## How to obtain service

Visit us on the Internet at http://www.kodak.com

Please refer to the Customer Support section in Chapter 10 for the support hotline designated to your location.

When returning a DC220/260 camera for repair, the unit shall be packed in its original packing materials. A problem report should also be enclosed with the equipment. If the original packaging has been discarded or is not available, packing will be at the owner's expense.

The repaired or replaced unit will be shipped from Kodak within five business days from the date of the camera receipt at the service center.

Unless a specific Kodak warranty is communicated to the purchaser in writing by a Kodak company, no other warranty or liability exists beyond the information contained above, even though defect, damage or loss may be caused by negligence or other act.

To obtain warranty repair service contact your local Kodak representative. For assistance, refer to the Service and Support information in the DC220/260 User’s Guide.



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# Regulatory information

## FCC compliance and advisory

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:1) this device may not cause harmful interference, and 2) this device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation.

This equipment generates, uses, and can radiate radio frequency energy and, if not installed or used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures: 1) reorient or relocate the receiving antenna; 2) increase the separation between the equipment and the receiver; 3) connect the equipment to an outlet on a circuit different from that to which the receiver is connected; 4) consult the dealer or an experienced radio/TV technician for additional suggestions.

Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment. Where shielded interface cables have been provided with the product or specified additional components or accessories elsewhere defined to be used with the installation of the product, they must be used in order to ensure compliance with FCC regulation.

## Canadian DOC statement

**DOC Class B Compliance—** This digital apparatus does not exceed the Class B limits for radio noise emissions from digital apparatus set out in the radio interference regulations of the Canadian Department of Communications.

**Obervation des normes-Class B—** Le présent appareil numérique n'émet pas de bruits radioélectriques dépassant les limites applicables aux appareils numériques de la Classe B prescrites dans les règlements sur le brouillage redioélectrique édictés par le Ministère des Communications du Canada.

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