# Petitioner's Demonstrative Slides

***Samsung Electronics Co., LTD. v. Cellect, LLC***

***Inter Partes* Review of**

**U.S. Patent No. 9,186,052**

**May 26, 2021**

IPR2020-00475, IPR2020-00512
Patent Trial and Appeal Board
United States Patent and Trademark Office

# Table of Abbreviations

| Abbreviation | Description |
|---|---|
| '052 | IPR2020-00475/IPR2020-00512, Ex. 1001, U.S. Patent No. 9,186,052 |
| [-00475/-00512] Neikirk | IPR2020-00475/IPR2020-00512, Ex. 1004, Declaration of Dr. Dean Neikirk |
| [-00475/-00512] Neikirk Reply | IPR2020-00475/IPR2020-00512, Ex. 1086, Reply Declaration of Dr. Dean Neikirk |
| Wakabayashi | Ex. 1027, U.S. Patent No. 5,903,706 |
| Ackland | Ex. 1006, U.S. Patent No. 5,835,141 |
| Swift | Ex. 1005, WO Application Publication No. 95/34988 |
| Monroe | Ex. 1007, U.S. Patent No. 5,919,130 |
| Suzuki | Ex. 1016, U.S. Patent No. 5,233,426 |
| Ricquier | Ex. 1038, "CIVIS sensor: a flexible smart imager with programmable resolution," Charge-Coupled Devices and Solid State Optical Sensors IV. Vol. 2172. International Society for Optics and Photonics, 1994. |
| Dierickx | Ex. 1041, U.S. Patent Publication No. 2001/0010551 |
| [-00475/-00512] Pet. | IPR2020-00475, Paper 2/IPR2020-00512, Paper 2 (Petition) |
| [-00475/-00512] POPR | IPR2020-00475, Paper 6/IPR2020-00512, Paper 6 (Patent Owner's Preliminary Response) |
| [-00475/-00512] DI | IPR2020-00475, Paper 15/IPR2020-00512, Paper 15 (Decision on Institution) |
| [-00475/-00512] POR | IPR2020-00475, Paper 18/IPR2020-00512, Paper 18 (Patent Owner's Response) |
| [-00475/-00512] Reply | IPR2020-00475, Paper 21/IPR2020-00512, Paper 21 (Petitioner's Reply to Patent Owner's Response) |
| [-00475/-00512] POSR | IPR2020-00475, Paper 24/IPR2020-00512, Paper 24 (Patent Owner's Sur-Reply) |

All citations within quotations omitted herein, and emphasis added unless otherwise indicated

# '052, Claim 1

- Claim 1 of the '052 recites:

[1.pre] An imaging device comprising:

[1.a] a housing;

[1.b] an image sensor mounted in said housing, said image sensor including a first circuit board having a length and a width thereto, wherein said length and width of said first circuit board define a first plane, said first circuit board including an array of CMOS pixels thereon, [1.c] wherein a plurality of CMOS pixels within said array of CMOS pixels each include an amplifier, [1.d] said first circuit board further including timing and control circuitry thereon, said timing and control circuitry being coupled to said array of CMOS pixels, [1.e] said image sensor producing a pre-video signal;

[1.f] a second circuit board mounted in said housing, said second circuit board being electrically coupled to said first circuit board, said second circuit board having a length and a width thereto, wherein said length and width of said second circuit board define a second plane, said second circuit board including circuitry thereon to convert said pre-video signal to a post-video signal, said second circuit board being offset from said first circuit board, said second plane of said second circuit board being substantially parallel to said first plane of said first circuit board;

[1.g] a lens mounted in said housing, said lens being integral with said imaging device, said lens focusing images on said array of CMOS pixels of said image sensor;

[1.h] a video screen, said video screen being electrically coupled to said second circuit board, said video screen receiving said post-video signal and displaying images from said post-video signal; and

[1.i] a power supply mounted in said housing, said power supply being electrically coupled to said first circuit board to provide power to said array of CMOS pixels and said timing and control circuitry, said power supply also being electrically coupled to said second circuit board to provide power thereto;

[1.j] wherein said image sensor has a generally square shape along said first plane; and

[1.k] wherein a largest dimension of said image sensor along said first plane is between 2 and 12 millimeters.

# '052, Claim 2

- Claim 2 of the '052 recites:

[2.pre] An imaging device comprising:

[2.a] a housing;

[2.b] an image sensor mounted in said housing, said image sensor including a first circuit board having a length and a width thereto, wherein said length and width of said first circuit board define a first plane, said first circuit board including an array of CMOS pixels thereon, [2.c] wherein a plurality of CMOS pixels within said array of CMOS pixels each include an amplifier, [2.d] said first circuit board further including timing and control circuitry thereon, said timing and control circuitry being coupled to said array of CMOS pixels, [2.e] said image sensor producing a pre-video signal;

[2.f] a second circuit board mounted in said housing, said second circuit board being electrically coupled to said first circuit board, said second circuit board having a length and a width thereto, wherein said length and width of said second circuit board define a second plane, said second circuit board including circuitry thereon to convert said pre-video signal to a post-video signal, said second circuit board being positioned in a stacked arrangement with respect to said first circuit board, said second plane of said second circuit board being substantially parallel to said first plane of said first circuit board;

[2.g] a lens mounted in said housing, said lens being integral with said imaging device, said lens focusing images on said array of CMOS pixels of said image sensor;

[2.h] a video screen, said video screen being electrically coupled to said second circuit board, said video screen receiving said post-video signal and displaying images from said post-video signal; and

[2.i] a power supply mounted in said housing, said power supply being electrically coupled to said first circuit board to provide power to said array of CMOS pixels and said timing and control circuitry, said power supply also being electrically coupled to said second circuit board to provide power thereto;

[2.j] wherein a largest dimension of said image sensor along said first plane is between 2 and 12 millimeters.

# '052, Claim 3

- Claim 3 of the '052 recites:

[3.pre] An imaging device comprising:

[3.a] a housing;

[3.b] an image sensor mounted in said housing, said image sensor including a planar substrate having a length and a width thereto, wherein said length and width of said planar substrate define a first plane, said planar substrate including an array of CMOS pixels thereon, [3.c] wherein a plurality of CMOS pixels within said array of CMOS pixels each include an amplifier, [3.d] said image sensor further including a first circuit board having a length and a width thereto, wherein said length and width of said first circuit board define a second plane, said first circuit board including timing and control circuitry thereon, said timing and control circuitry being coupled to said array of CMOS pixels, [3.e] said first circuit board being positioned in a stacked arrangement with respect to said planar substrate, said second plane of said first circuit board being substantially parallel to said first plane of said planar substrate, [3.f] said image sensor producing a pre-video signal;

[3.g] a second circuit board mounted in said housing, said second circuit board being electrically coupled to said planar substrate and to said first circuit board, said second circuit board having a length and a width thereto, wherein said length and width of said second circuit board define a third plane, said second circuit board including circuitry thereon to convert said pre-video signal to a post-video signal, said second circuit board being offset from said first circuit board and from said planar substrate, said third plane of said second circuit board being substantially parallel to said second plane of said first circuit board and to said first plane of said planar substrate;

[3.h] a lens mounted in said housing, said lens being integral with said imaging device, said lens focusing images on said array of CMOS pixels of said image sensor;

[3.i] a video screen, said video screen being electrically coupled to said second circuit board, said video screen receiving said post-video signal and displaying images from said post-video signal; and

[3.j] a power supply mounted said housing, said power supply being electrically coupled to said planar substrate to provide power to said array of CMOS pixels, said power supply also being electrically coupled to said first circuit board to provide power to said timing and control circuitry, said power supply also being electrically coupled to said second circuit board to provide power thereto;
[3.k] wherein a largest dimension of said image sensor along said first plane is between 2 and 12 millimeters.

# Grounds

| Claims | Ground |
|---|---|
| '052, claim 1 | Wakabayashi in view of Ackland |
| '052, claim 1 | Wakabayashi in view of Ackland and Suzuki |
| '052, claims 3 and 7 | Wakabayashi in view of Ricquier and Dierickx |
| '052, claim 2 | Swift in view of Ricquier and Suzuki |
| '052, claim 2 | Larson in view of Swift, Ricquier, and Suzuki |

-00475 Pet. at 9; -00512 Pet. at 9.

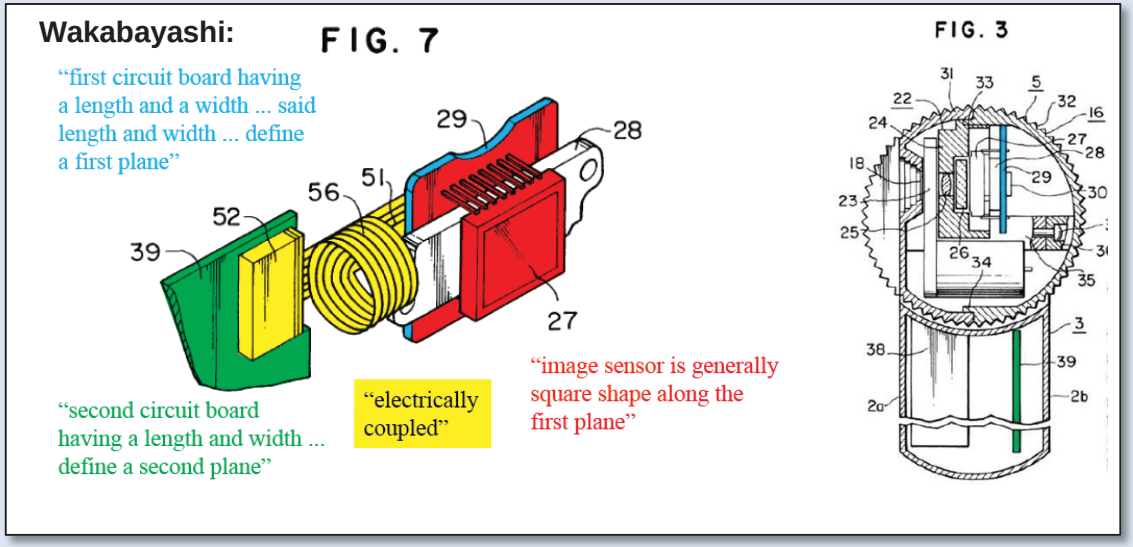
## Key Limitations of '052 Claims 1-3

| | CMOS Array: | Circuitry: | Arrangement: |
|---|---|---|---|
| **Claim 1** | • CMOS Pixel Array<br>• Each Pixel Includes an Amplifier (First Circuit Board) | • Timing and Control Circuitry (First Circuit Board)<br>• Video Conversion Circuitry (Second Circuit Board) | • Second Circuit Board Offset from and Parallel to First Circuit Board |
| **Claim 2** | • CMOS Pixel Array<br>• Each Pixel Includes an Amplifier (First Circuit Board) | • Timing and Control Circuitry (First Circuit Board)<br>• Video Conversion Circuitry (Second Circuit Board) | • Second Circuit Board Stacked with First Circuit Board |
| **Claim 3** | • CMOS Pixel Array<br>• Each Pixel Includes an Amplifier (Planar Substrate) | • Timing and Control Circuitry (First Circuit Board)<br>• Video Conversion Circuitry (Second Circuit Board) | • First Circuit Board Stacked with Substrate<br>• Second Circuit Board Offset from and Parallel to First Circuit Board and Substrate |

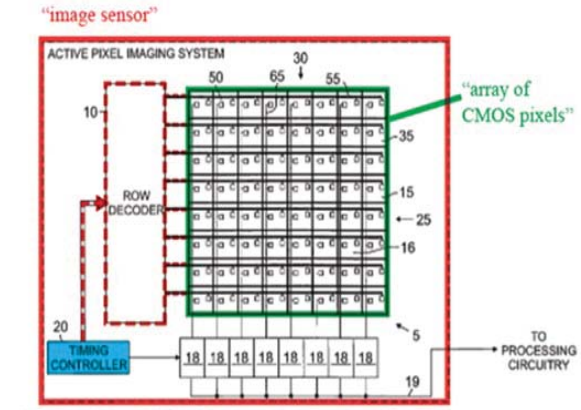
# Key Limitations of '052 Claims 1-3

| | CMOS Array: | Circuitry: | Arrangement: |
|---|---|---|---|
| Claim 1 | **Wakabayashi in view of Ackland**<br>• CMOS Pixel Array<br>• Each Pixel Includes an Amplifier (First Circuit Board) | **Wakabayashi in view of Ackland**<br>• Timing and Control Circuitry (First Circuit Board)<br>**Wakabayashi**<br>• Video Conversion Circuitry (Second Circuit Board – obvious) | **Wakabayashi**<br>• Second Circuit Board offset from First Circuit Board |

**Wakabayashi:**




**Ackland:** "A CMOS active pixel …, and pixel arrays based on such a pixel are disclosed."




Ackland, 2:19-23, Figs. 2, 6; -00475 Neikirk ¶¶107-110; -00475 Pet. 39.

- A POSITA would have been motivated to locate Wakabayashi's video conversion circuitry on circuit board 39 instead of board 29

**Dr. Neikirk:** "A person of ordinary skill in the art would have been motivated and found it obvious and straightforward to locate the processing circuitry to convert the pre-video signal to a post-video signal on Wakabayashi's circuit board 39 [which] includes a signal processing circuit…, a driver circuit…, a system circuit, a power supply circuit, and so on' because it is the larger of two circuit boards .... [T]he size of circuit board 29 is advantageously reduced and the video camera unit that rotates is made smaller…."

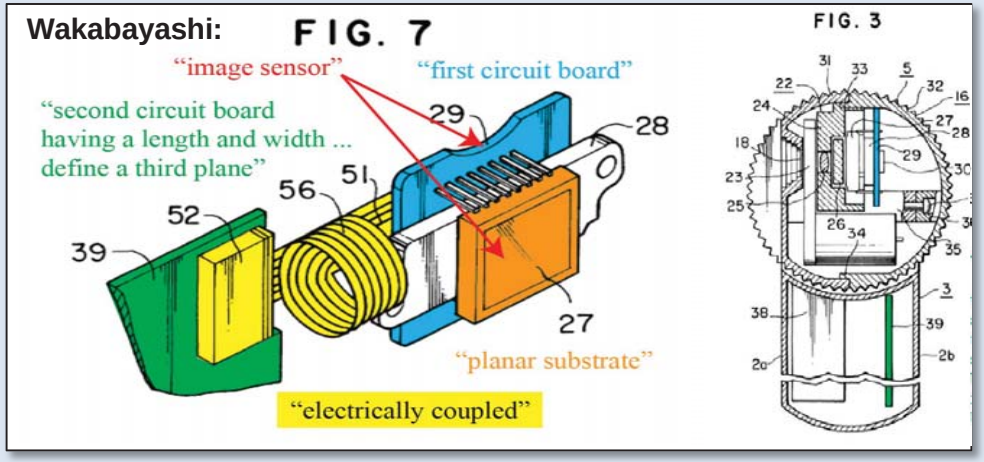
-00475 Neikirk ¶¶73-77; -00475 Pet. 23-25.

## Key Issues

# Wakabayashi in view of Ricquier & Dierickx Renders Obvious Claim 3

| | CMOS Array: | Circuitry: | Arrangement: |
|---|---|---|---|
| Claim 3 | **Wakabayashi in view of Ricquier & Dierickx**<br>• CMOS Pixel Array<br>• Each Pixel Includes an Amplifier (Planar Substrate) | **Wakabayashi in view of Ricquier**<br>• Timing and Control Circuitry (First Circuit Board)<br>**Wakabayashi**<br>• Video Conversion Circuitry (Second Circuit Board – obvious) | **Wakabayashi**<br>• First Circuit Board stacked with Substrate<br>• Second Circuit Board offset from First Circuit Board and Substrate |

**Wakabayashi:**




Wakabayashi, Figs. 7, 3; -00475 Neikirk ¶¶180-185, 192-209; -00475 Pet. 58- 84.

- A POSITA would have been motivated to locate Wakabayashi's video conversion circuitry on circuit board 39 instead of board 29 (*see* Slide 8)

**Ricquier:**"The pixel array consists of 256 by 256 square pixels arranged on a pixel pitch of 19 µm and realised in a 1.5 µm n-well CMOS technology."

"Based on X-Y addresses and control pulses generated by an external driving unit, two decoders drive one particular row selection and column selection signal."

"In order to limit the complexity of the timing controller (realised in an off-chip driving unit) only timing configurations of some very common patterns are provided…."

Ricquier, 2-6; -00475 Neikirk ¶¶163-165, 169, 184, 195-197; -00475 Pet. 59-60, 66-67, 71-72.

**Dierickx:** "Of the image sensors implemented in a CMOS- or MOS-technology, CMOS or MOS image sensors with passive pixels and CMOS or MOS image sensors with active pixels are distinguished. An active pixel is configured with means integrated in the pixel to amplify the charge that is collected on the light sensitive element…."

Dierickx, ¶6; -00475 Neikirk ¶¶167-168, 189-190; -00475 Pet. 62-63, 69.

# Swift in view of Ricquier & Suzuki Renders Obvious Claim 2

| | CMOS Array: | Circuitry: | Arrangement: |
|---|---|---|---|
| Claim 2 | **Swift in view of Ricquier**<br>• CMOS Pixel Array<br>• Each Pixel Includes an Amplifier (First Circuit Board) | **Swift in view of Ricquier**<br>• Timing and Control Circuitry (First Circuit Board)<br>**Swift**<br>• Video Conversion Circuitry (Second Circuit Board) | **Swift in view of Suzuki**<br>• Second Circuit Board stacked with First Circuit Board |

**Swift:**

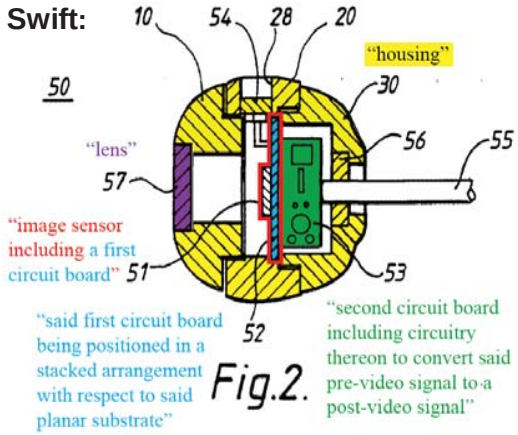


Fig.2.

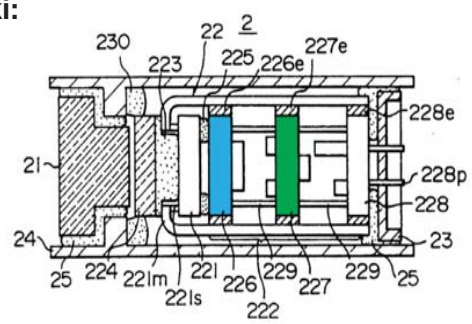
"The image sensor 51 is preferably of a CMOS/APS (Active Pixel Sensor) type"

"In this specification, terms of absolute orientation are used conveniently to denote the usual orientation of items in normal use and/or as shown in the accompanying drawings. However, such items could be disposed in other orientations…."

"An image sensor 51 is mounted on a circular printed circuit board 52…. A further printed circuit board 53 is mounted on the first printed circuit board 52, substantially at right angles thereto. Various circuitry components are mounted on the circuit board 53, to provide power to the image sensor 51, process image signals received therefrom, …."

Swift, Fig. 2, 10:1-6, 18:25-33, 4:11-13, 8:33-9:13; -00512 Neikirk ¶¶229-230, 232, 252-254, 268-270; -00512 Pet. 15-16, 29-31, 38-39.

**Suzuki:**




"The chip-connecting board 226, the circuit board 227 and the connector board 228 are arranged in such a manner that their side electrodes 226e, 227e and 228e are disposed in registry with one another, and these three boards are aligned with each other."

Suzuki, 3:15-25; -00512 Neikirk ¶¶271-272; -00512 Pet. 24, 41-43.

**Ricquier:** "This square 256*256 imager was fabricated in a standard 1.5 um CMOS technology. … the timing controller (realised in an off-chip driving unit) …."

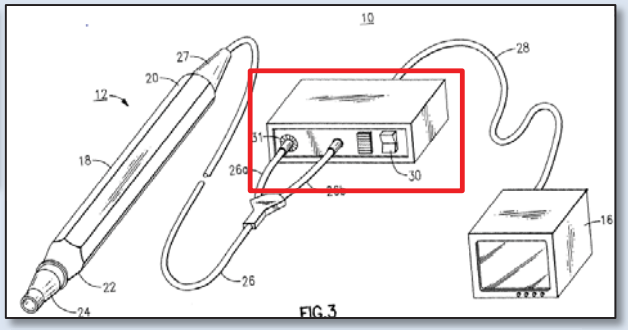
Ricquier, 2-4; -00512 Neikirk ¶¶163-165, 238-239, 261-262; -00512 Pet. 20-22, 34-36.

# CMOS Imagers that Were Not Camera-On-A-Chip Were Well-Known

- In addition to the disclosures of Swift, Ackland and Ricquier (*see* Slides 8-10):

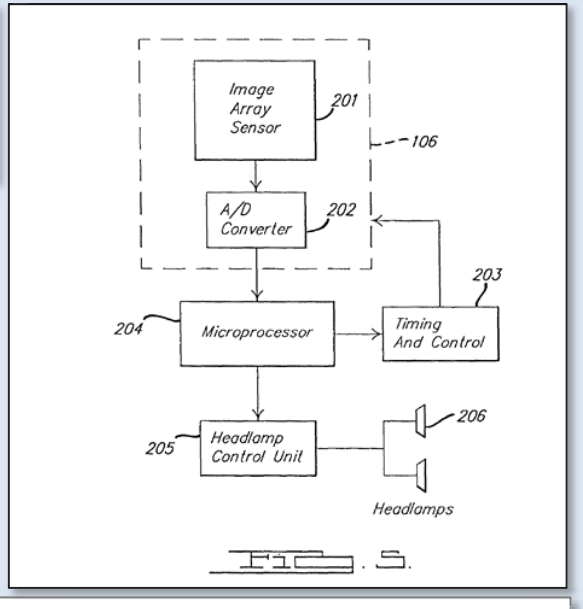
**Monroe (Ex. 1007, filed 3/17/1997):** "[T]he processing circuitry [for the CMOS imager] should not be limited to the plug-in connector, for example, circuitry could be contained within the peripheral device 16 or the combined light box/power supply 14."

Ex. 1007 (Monroe), 8:8-11, 3:36-62, Fig. 3; -00475 Neikirk ¶¶40, 77, 299-300; -00475 Pet. 25, 84.




**Stam (Ex. 1043, filed 4/2/1997):** "The image array sensor 106 may be CMOS active pixel image sensor array for example, as disclosed in U.S. Pat. No. 5,471,515 [Fossum, Ex. 2034], hereby incorporated by reference and available from Photobit LLC of La Crasenta, Calif."

Ex. 1043 (Stam), Fig. 5, 4:66-5:2, 6:25-28; -00475 Neikirk ¶39; -00512 Neikirk ¶39; -00475 Pet. 4-5; -00512 Pet. 4-5.




**1997 BYTE Magazine review:** "The key to this camera is its CMOS sensor, developed with VLSI Vision (Edinburgh, Scotland). …. The SVmini-209's four color sensor produces a native resolution of 1000 by 800 pixels (10 bits per color). A Texas Instruments TMS-320C209 digital signal processor extrapolates the image to 2000 by 1600, a truly impressive 3.2-megapixel image."

Ex. 1087 (Nov. 7, 1997 BYTE Magazine review); -00475 Neikirk Reply ¶29; -00475 Reply 7.

# Conventional CMOS Image Sensors Were Not Camera-On-A-Chip

- As PO admits, "conventional CMOS image sensors" did not "integrate much of the camera timing, control and signal processing circuitry onto the same silicon die":

> **Cellect**: "As noted by Dr. Bryan Ackland, an AT&T engineer working on CMOS retinal pixel arrays and also the named inventor on the Ackland Patent asserted by Petitioner: '[a]rguably the most important advantage of the CMOS APS approach ... is the ability to integrate much of the camera timing, control and signal processing circuitry onto the same silicon die.' Ex. 2050 at 3. This allow both a higher performance than that of CCDs and conventional CMOS image sensors and versatile functions that cannot be achieved with conventional image sensors.' *Id.*; Ex. 2069 at 20."

-00475 POR 14-15.

- As PO's evidence demonstrates, CMOS provided the ability to integrate circuitry—not a requirement

> **Johannes (Ex. 2060, dated 8/21/1998):** "Here's how the [CMOS] chips work… Each cell generates a minute electric charge that carries the information needed to generate a picture made up of black, red, green and blue dots. After this image is relayed to processing and memory chips inside the camera, the sensor chip is wiped clean to record the next picture."
>
> "CMOS sensors cost an average of less than $14, about 15% to 20% cheaper than CCDs. ... **If** additional image-processing functions are crammed onto the chip, the savings can reach 50%. …"

Ex. 2060 (8/21/1998 Wall Street Journal Article), 2, 3; -00475 POR 33, 40, 40; -00475 POSR 20; -00475 Lebby ¶130; *see also* -00475 Neikirk Reply ¶35; -00475 Reply 13.

> **Ackland & Dickinson Article (Ex. 2050, dated 1996):** "Arguably the most important advantage of the CMOS APS approach, however, is the ability to integrate much of the camera timing, control and signal processing circuitry onto the same silicon die."

Ex. 2050 (Ackland & Dickinson Article), 3; -00475 Neikirk Reply ¶12, 32-33; -00475 Reply 3, 10; -00512 Neikirk Reply ¶¶11, 25, 51; -00512 Reply 4, 26.

> **Ohta (Ex. 2069, dated 2008):** "CMOS image sensors are fabricated based on standard CMOS large scale integration (LSI) fabrication processes, while CCD image sensors are based on a specially developed fabrication process. This feature of CMOS image sensors makes it possible to integrate functional circuits to develop smart CMOS image sensors and to realize both a higher performance than that of CCDs and conventional CMOS image sensors and versatile functions that cannot be achieved with conventional image sensors."

Ex. 2069 (Ohta), 20; -00475 Neikirk Reply ¶¶12, 60; -00512 Neikirk Reply ¶¶11, 25, 51; -00475 Reply 3, 38-39; -00512 Reply 4, 26.

> **Zarnowski (Ex. 2007, dated 6/1997):** "Increased functionality offered by CMOS imagers now includes **partial** or complete integration of electronics, random access, variable integration time, video processing, background subtraction, and digitization."

Ex. 2007 (Zarnowski), 129-130; -00512 Neikirk Reply ¶¶12, 25; -00512 Reply 4.

# It Was Well-Known to a POSITA to Move Circuitry between Circuit Boards

**Dr. Neikirk:** "The number of circuit boards and configuration of circuitry across the circuit boards was a well-known engineering consideration guided by the dimensions of the intended housing …. Even with respect to circuitry to convert pre-video signals to post-video signals, it was a well-known engineering consideration to move the circuitry from a circuit board directly attached to the image sensor chip to one that is remote to the image sensor chip."

-00475 Neikirk ¶¶75-76; -00475 Pet. 24-25.

**Dr. Neikirk:** "A person of ordinary skill in the art would have been further motivated to apply Ricquier's known teachings in implementing Swift's image sensors because of Ricquier's advantages of using an 'timing controller' that can be located off-chip, which adds flexibility in selecting from the several design choices for 'fitting … the components into the available space' and 'plac[ing]' circuitry on 'various layers' arranged 'stackwise' to 'allow for a more compact camera head.'"

-00512 Neikirk ¶239 (citing Ricquier, 3-4; Ex. 1016 (Tanuma), 4-5; Suzuki, Fig. 2; Ex. 1045 (A Guide to Printed Circuit Board Design), 15, 20); -00512 Pet. 22-23.

**Roustaei (Ex. 1030):** "[T]he number of printed circuit boards is a design choice,.. all the hardware could be contained on one board or … whatever quantity [of boards] permits the device's components to be fitted into the dimensions of the intended housing."

Ex. 1030, 43:38-44; *see also id*., 54:7-11; -00475 Neikirk ¶75; -00512 Neikirk ¶233; -00475 Pet. 24; -00512 Pet. 18.

**Cotton (Ex. 1031):** "[T]he fact that certain of the I/O devices are included on the CPU board of FIG. 6, and others are included on the video board of FIGS. 7 and 8, is merely a matter of design choice and one which allows for modification and expansion of the preferred embodiment."

Ex. 1031, 13:30-35 ; -00475 Neikirk ¶75; -00512 Neikirk ¶233; -00475 Pet. 24; -00512 Pet. 18.

**Crosetto (Ex. 1032):** "[T]he placement and arrangement of processors and connectors upon the PCB is a matter of design choice…."

Ex. 1032, 15:35-46; -00475 Neikirk ¶75; -00512 Neikirk ¶233; -00475 Pet. 24; -00512 Pet. 18.

# Disputed Issues for Wakabayashi Grounds

| Cellect's Arguments | | Slides |
|---|---|---|
| **"said first circuit board including an array of CMOS pixels thereon …" ('052, claim 1);<br>"said planar substrate including an array of CMOS pixels thereon …" ('052, claim 3)** | -00475 POR 19, 22, 28, 32-37, 44-45, 54;<br>-00475 POSR 2, 4-6, 9-10, 13-19 | Slides 15-29 |
| **"said first circuit board including timing and control circuitry thereon, said first circuit board being positioned in a stacked arrangement with respect to said planar substrate" ('052, claim 3)** | -00475 POR 23-24, 57-58;<br>-00475 POSR 23 | Slides 30-33 |
| **"said second circuit board including circuitry thereon to convert said pre-video signal to a post-video signal, said second circuit board being offset from said first circuit board [and from said planar substrate]" ('052, claims 1 and 3)** | -00475 POR 48-49, 58 | Slides 34-39 |
| **"wherein a plurality of CMOS pixels within said array of CMOS pixels each include an amplifier" ('052, claim 3)** | -00475 POR 55-57 | Slides 40-43 |
| **"wherein a largest dimension of said image sensor along said first plane is between 2 and 12 millimeters" ('052, claims 1 and 3)** | -00475 POR 23, 50-51;<br>-00475 POSR 21 | Slides 44-47 |
| **No Evidence of Secondary Indicia of Non-Obviousness** | -00475 POR 58-67;<br>-00475 POSR 24-26 | Slides 71-76 |

**"said first circuit board including an array of CMOS pixels thereon …" ('052, claim 1);**

**"said planar substrate including an array of CMOS pixels thereon …" ('052, claim 3)**

# Wakabayashi in View of Ackland Renders Obvious "said first circuit board including an array of CMOS pixels thereon" (claim 1)

## Wakabayashi:

"[T]he imager device 27 is electrically connected to the camera circuit board 29 by soldering with the mounting plate 28 interposed therebetween."

"[A] solid-state imager device, a circuit for driving the solid-state imager device, and so on, generates an opto-electrically converted signal 101 which is inputted to a camera circuit 102."

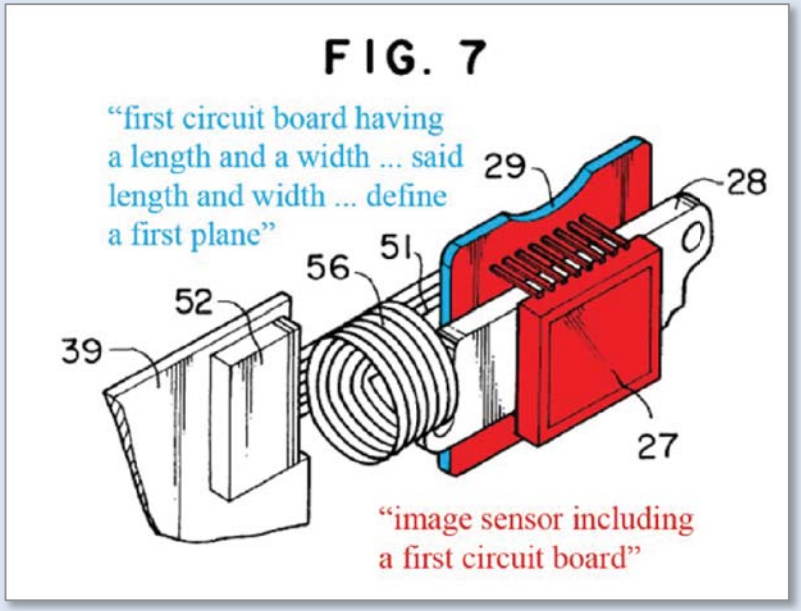
Wakabayashi, 6:46-48, 9:10-14; -00475 Neikirk ¶105; -00475 Pet. 36.

## Ackland:

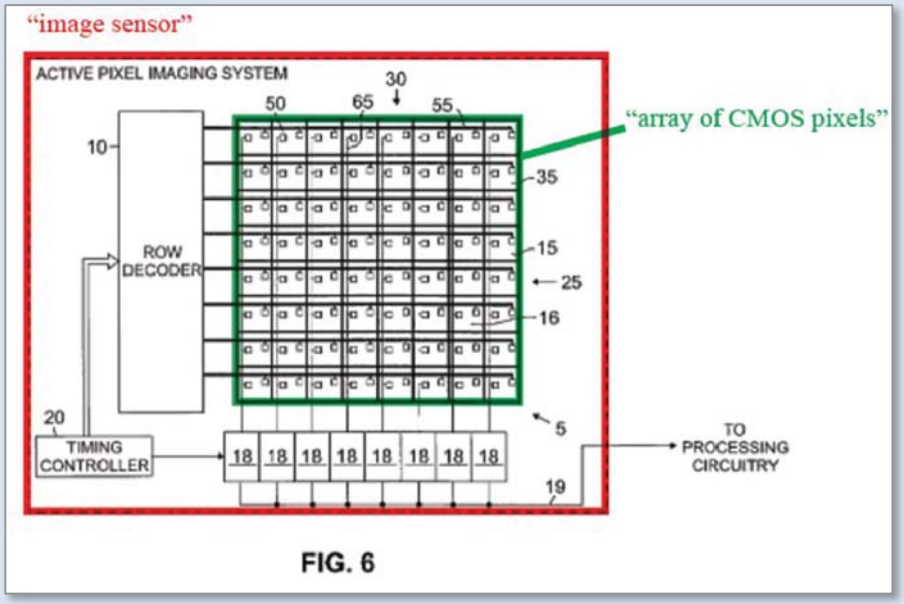
A "class of solid state image sensors is a CMOS active pixel array."

"A CMOS active pixel characterized by a single layer of polysilicon for forming the photo gate and the transfer gate ('single-polysilicon active pixel'), a method for operating the pixel, and pixel arrays based on such a pixel are disclosed."

Ackland, Abstract, 2:19-23; -00475 Neikirk ¶108; -00475 Pet. 39.




Wakabayashi, Fig. 7; -00475 Neikirk ¶¶103-106; -00475 Pet. 37.




Ackland, Fig. 6; -00475 Neikirk ¶¶107-110; -00475 Pet. 40.

# A POSITA Would Have Been Motivated to Apply Ackland's CMOS Active Pixel Image Sensor Teachings in Implementing Wakabayashi

- As the '052 patent admits:

> **'052:** "One advantage of active pixel-type imagers is that the amplifier placement results in lower noise levels than CCDs or other solid state imagers. Another major advantage is that these CMOS imagers can be mass produced on standard semiconductor production lines."

'052, 1:66-2:6; *see also* -00475 Neikirk ¶¶48, 90; -00475 Pet. 10, 29-30.
*See also* Ex. 1060 (NASA), 54; -00475 Neikirk ¶90.

- Ackland teaches:

> **Ackland:** "[A]n active pixel using a process wherein only one polysilicon deposition is required. This simple process would result in lower per chip fabrication cost. … The structure of the single-polysilicon active pixel allows for charge transfer, from the photosite to the pixel amplifier, with no active drive signal applied to the gate of the transfer transistor. This eliminates the need for a separate bias supply or clocking circuitry, as found in a double-polysilicon active pixels and photodiode pixel designs. Image lag is typically not observed in the single-polysilicon active pixel when operating it in this manner….."

Ackland (Ex. 1006), 2:10-15; 2:34-45.
*See also* -00475 Neikirk ¶95; -00475 Pet. 31.

- As Dr. Neikirk further explained:

> **Dr. Neikirk**: "While Wakabayashi discloses that the image sensor uses a 'solid-state imager device' and a 'circuit for driving the solid-state imager device' to 'generate[] an opto-electrically converted signal'…, Wakabayashi does not expressly state that its 'imager device 27 [] electrically connected to the camera circuit board 29' includes an array of CMOS pixels. Ackland expressly provides this additional implementation detail for 'an imaging system…used as a solid-state camera,' which includes a 'CMOS … pixel array' for receiving images thereon—a feature the '052 patent recognizes was well known. … Similarly, while Wakabayashi does not detail the timing and control circuitry of its 'imager device 27 [] electrically connected to the camera circuit board 29,' Ackland describes circuitry including a 'timing controller 20 provid[ing] timing signals' that control the imaging system 'to achieve a desired frame rate'—another feature the '052 patent recognizes was well known."

-00475 Neikirk ¶¶85-87; -00475 Pet. 26-29.

# A POSITA Would Have Been Motivated to Apply Ackland's CMOS Active Pixel Image Sensor Teachings in Implementing Wakabayashi

- As PO's exhibits admit:

> **Johannes:** "CMOS sensors cost an average of less than $14, about 15% to 20% cheaper than CCDs.... If additional image-processing functions are crammed onto the chip, the savings can reach 50%...."

Ex. 2060 (Johannes), 3; -00475 Lebby ¶130;
*see also* -00475 Neikirk Reply ¶35; -00475 Reply 13.

- As PO's expert admits:

> **Dr. Lebby:** "Despite poorer image quality, CMOS image sensors had unique advantages over CCD, including (1) integration of CMOS pixels with circuitry on chip (e.g., camera-on-a-chip) such as timing and control, A/D conversion, and signal processing, lowering total manufacturing costs; (2) lower power requirements; (3) increased resistance to radio frequency interference (RFI) and electromagnetic interference (EMI); and (4) flexible readout of the signal charge without destroying the accumulated charge providing key advantages for postsignal processing.

-00475 Lebby ¶83 (citing Ex. 2007 (Zarnowski), 7; Ex. 2065 (Nakamura), 1).

> **Dr. Lebby:** "During the mid-1990s, wireless, mobile consumers drove the need for a low resolution, increased functionality of a camera on a chip for wireless mobile applications. Despite poorer image quality, CMOS image sensors had certain advantages over CCD, primarily in lower power consumption, more flexible readout circuitry, and increased resistance to electromagnetic interference (EMI) and radio frequency interference (RFI)."

-00475 Lebby ¶89.

# Wakabayashi in View of Ricquier Renders Obvious "said planar substrate including an array of CMOS pixels" (claim 3)

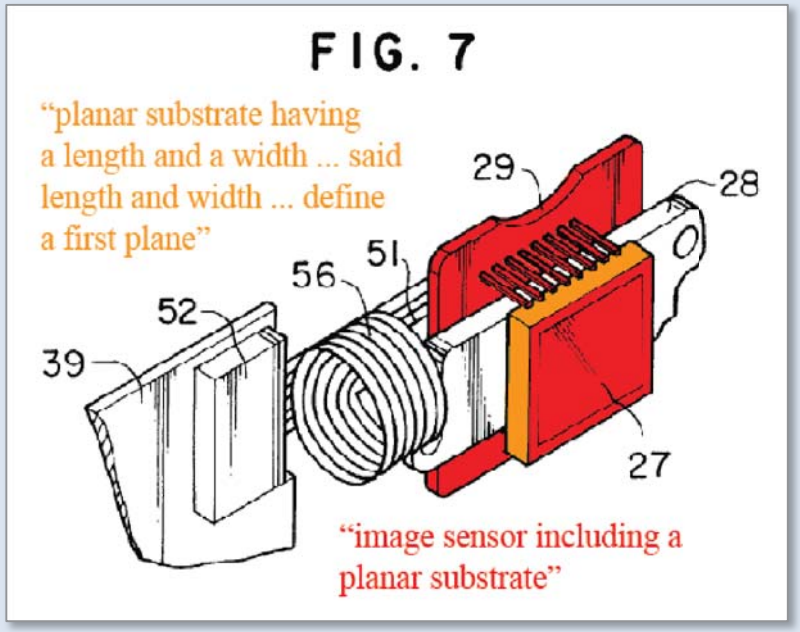
## Wakabayashi:

"[T]he imager device 27 is electrically connected to the camera circuit board 29 by soldering with the mounting plate 28 interposed therebetween."

Wakabayashi, 6:46-48; -00475 Neikirk ¶105; -00475 Pet. 36.

"[A] solid-state imager device, a circuit for driving the solid-state imager device, and so on, generates an opto-electrically converted signal 101 which is inputted to a camera circuit 102."

Wakabayashi, 9:10-14; -00475 Neikirk ¶¶182, 194; -00475 Pet. 30, 36.




Wakabayashi, Fig. 7; -00475 Neikirk ¶¶180-182; -00475 Pet. 66.

## Ricquier:

"The pixel array consists of 256 by 256 square pixels arranged on a pixel pitch of 19 µm and realised in a 1.5 µm n-well CMOS technology. … [I]mages are formed on the sensor plane…."

Ricquier, 5-6; -00475 Neikirk ¶¶183-185; -00475 Pet. 66-68.

"A CMOS technology was chosen because it offers the selective addressability…."

Ricquier, 2; -00475 Neikirk ¶170; -00475 Pet. 61.

"This square 256*256 imager was fabricated in a standard 1.5 µm CMOS technology. The readout occurs in two phases. … By controlling the sequence of addresses and reset pulses of the amplifiers, charges of different pixels are accumulated. This way multiple resolutions can be programmed. The imager is operated at data rates upto 10 MHz providing about 125 full images per second. At lower resolution, even higher frame rates are obtained."

Ricquier, 2; -00475 Neikirk ¶¶170; -00475 Pet. 61.

"[A]t a given illumination level, the resolution of the sensor can be changed on the fly, while still respecting the limited voltage range in which the charge sensitive amplifiers have a linear behaviour."

Ricquier, 4; -00475 Neikirk ¶¶170; -00475 Pet. 61.

# A POSITA Would Have Been Motivated to Apply Ricquier's Teachings of an X-Y Addressable CMOS Photodiode Array in Implementing Wakabayashi

- As PO's exhibits and expert admit, CMOS image sensors had numerous advantages (*see* Slides 17-18)

- And, as Dr. Neikirk testified:

> **Dr. Neikirk: "**A person of ordinary skill in the art would have been motivated to apply Ricquier's known teachings described above in implementing Wakabayashi's portable imager apparatus. … A person of ordinary skill in the art would have been further motivated to apply Ricquier's teachings in implementing [Wakabayashi's] imager teachings because of Ricquier's advantages of using a 'timing controller' located off-chip, which adds flexibility in selecting from the several design choices for "fitting … the components into the available space" and 'placement' of circuitry to 'allow for a more compact camera head.'"

-00475 Neikirk ¶170 (citing Ricquier, 3, 4; Ex. 1045 (A Guide to Printed Circuit Board Design), 15, 20; Ex. 1016 (Tanuma), 4-5, Fig. 2); -00475 Pet 61.

# Wakabayashi's "Solid-State Imager Device" is Not Limited to a CCD Imager

***Cellect argues:*** "[T]he fact ***that Wakabayashi[']s digital camera] includes an off-chip signal processing circuit*** separate from the imager pixel array ***tells a POSITA that Wakabayashi describes a CCD imaging sensor***."

-00475 POR 28; -00475 POSR 2, 4, 13.

- But, Wakabayashi discloses:

**Wakabayashi: "**FIG. 22 shows a block diagram of a circuit used in the first-third embodiments of the present invention. A camera head 100, which includes a light receiving lens, a solid-state imager device, a circuit for driving the solid-state imager device, and so on, generates an opto-electrically converted signal 101 which is inputted to a camera circuit 102."

Wakabayashi, 9:9-15; -00475 Neikirk ¶¶72, 85, 104-105; -00475 Pet. 22, 27, 36.

- As PO admits:

"The term 'solid-state imagers' refers broadly to image sensors that were developed during the latter-half of the twentieth century and perform 'four important functions'—'light-detection, accumulation of photo-generated signals, switching from accumulation to readout, and scanning.' Ex. 2069 at 21. As shown in the figure below, several types of solid-state imagers have been developed, each with their own unique characteristics in design and performance, including metal-oxide semiconductor (MOS), charge-coupled device (CCD), and complementary metal-oxide semiconductor (CMOS) image sensors. *Id.* at Fig. 1.1; Ex. 2053 at 5."

00475 POR 9-10.
*See also* -00475 Neikirk Reply ¶10 (citing Wakabayashi, 9:9-14; -00475 POR 9-10; -00475 Lebby, ¶¶56-57, n.2; Ackland, 1:34-35); -00475 Neikirk, ¶85 (citing Wakabayashi, 9:11-15).

- As Dr. Neikirk testified:

**Dr. Neikirk:** "Off-chip signal processing is not limited to non-CMOS image sensors."

-00475 Neikirk Reply ¶12; *see also* -00475 Neikirk ¶77; -00475 Neikirk Reply ¶¶13-20; -00475 Pet. 24-25; -00475 Reply 2-10; Swift (Ex. 1005), 8:33-9:21, Fig. 2; Monroe (Ex. 1007), 3:36-62, 8:8-11, Fig. 3.

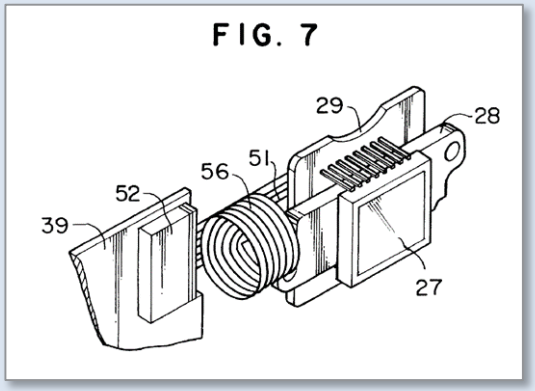
- As PO admits and its evidence demonstrates, CMOS provided the ability to integrate circuitry, but did not require such integration (*see* Slide 12)

# Wakabayashi's Mounting Plate 28 Is Not a Heat Sink and Is Not Indicative of a CCD Sensor

***Lebby opines: "Another indicator that the Wakabayashi camera architecture was design to use a CCD image sensor is*** reflected by ***the need for mounting plate 28***. A POSITA would have been understood plate 28 provide both support and a mechanism ***to dissipate heat (e.g., a heat sink)***. It was known that CCD have high-power-consumption characteristic and generate heat."

-00475 Lebby ¶118; -00475 POSR 13-14; -00475 POR 19 (citing -00475 Lebby ¶¶101-102, 115-122, 124, 125).

- But, as Wakabayshi discloses, element 28 is simply a "mounting plate":




Wakabayashi, Fig. 7.

**Wakabayashi:** "The video camera 22 includes the shutter 23, the lens case 24, the mounting plate 28, and the camera circuit board 29. … The mounting plate 28 is also secured to the lens case 24 with a screw 44."

"The flexible board 51 is electrically connected to the camera circuit board 29 by soldering, while the imager device 27 is electrically connected to the camera circuit board 29 by soldering with the mounting plate 28 interposed therebetween."

Wakabayashi, 6:12-19, 6:45-49; -00475 Neikirk ¶59; -00475 Pet. 15-16.

- As Dr. Neikirk testified:

**Dr. Neikirk:** "Nowhere in Wakabayashi is part 28 referred to as anything other than a 'mounting plate' and nowhere is the word 'heat' ever mentioned. … A person of ordinary skill in the art would not have understood mounting plate 28 to act as a heat sink for image device 27. … Mounting image sensors to a heatsink was a well-known design implementation that does not indicate whether one type of imager or another is used."

-00475 Neikirk Reply ¶17; -00475 Reply 3-4.

# Petitioner's Proposed Combination Would Not Require Substantial Redesign or Change the Operation of Wakabayashi

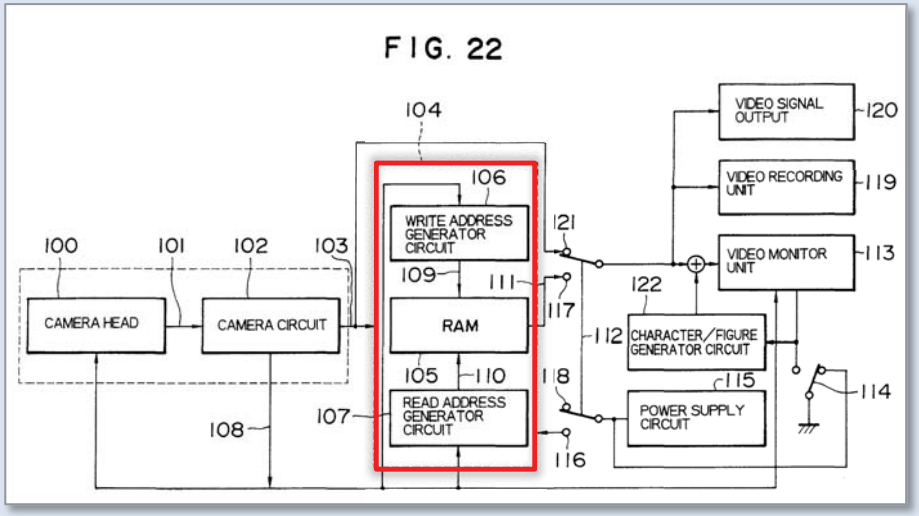
***Cellect argues:*** "Accordingly, the apparatus of ***Wakabayashi*** is directed to the image arrangement convertor circuit 104 that ***relies on the one-directional flow*** of image signal ***expected from*** the readout mechanism of ***CCD*** image sensors ... As such, changing the imaging apparatus of Wakabayashi in the manner proposed by Petitioner, which would use ***a CMOS APS pixel array*** that ***can be selectively addressed and read out...would significantly change the principle of operation of Wakabayashi***."

-00475 POSR 14-17 (citing -00475 Lebby ¶¶132-134).

- But, as Dr. Neikirk testified:

**Dr. Neikirk:** "[T]he type of image sensor used is not determined by the particular methods of inverting the captured image signal disclosed by Wakabayashi. Because these methods operate on the captured image after they are read out from the image sensor, a person of ordinary skill in the art would have understood that these methods can be advantageously employed by a user to correct the orientation of the image. Both methods for inverting the image taught in Wakabayashi would work on an image signal captured from a CCD or CMOS solid-state image sensor."

-00475 Neikirk Reply ¶20; -00475 Reply 3-4.




Wakabayashi, Fig. 22.

# CMOS Image Sensors Were Used In Digital Cameras In 1997

***Cellect argues:*** "The unsuitability of CMOS image sensors for digital cameras is confirmed by ***a review of all major digital cameras released in 1997***, which ***showed all digital cameras having CCD sensors and not CMOS sensors***."

-00475 POR 33.

- But, the evidence shows the opposite was true:

**June 16, 1997 Toshiba PDR-2 Press Release (Exhibit 1096):** "Our pocket-sized digital still camera - "Allegretto" (*1) (model name: PDR-2), can transfer at high speed pictures you have taken, simply by plugging the camera unit into the PC card slot. … [¶] … In terms of its image sensor, in place of the previous CCD image sensor, it uses a "CMOS image sensor," eliminating the LCD monitor that has high battery consumption, and with its thorough low power consumption design, it is capable of taking over 500 pictures with just one battery."

Ex. 1096 (Toshiba PDR-2 Press Release).

**Sept. 1997 ELECTRONICS Australia article (Exhibit 1088):** "Unlike most other digital cameras the Allegretto also uses a CMOS image sensor, whose power consumption level is around 1/10 that of CCD image sensors currently in widespread use. Further, the camera's ultra-low power consumption design means that one battery provides enough power for shooting more than 500 pictures."

Ex. 1088 (Sept. 1997 ELECTRONICS Australia article).

**1997 BYTE Magazine review:** "The key to this camera is its CMOS sensor, developed with VLSI Vision (Edinburgh, Scotland). The model I tested is Sound Vision's second-generation camera. The first, sold as the Vivitar ViviCam 3000 and Umax Sharpset 8000, was the first digital still camera on the market to use a CMOS sensor instead of a charge-coupled device (CCD) sensor. High-resolution CMOS sensors are less expensive than comparable CCDs, and they also require considerably less power and support circuitry, which means dramatically increased battery life. [¶] The SVmini-209's four color sensor produces a native resolution of 1000 by 800 pixels (10 bits per color). A Texas Instruments TMS-320C209 digital signal processor extrapolates the image to 2000 by 1600, a truly impressive 3.2-megapixel image."

Ex. 1087 (Nov. 7, 1997 BYTE Magazine review).
*See also* -00475 Neikirk Reply ¶29; -00475 Reply 6-8.

# Ackland's CMOS Pixel Array Is Not for a Camera-On-a-Chip Design

***Cellect argues:*** "***Ackland discloses a CMOS camera-on-a-chip, evidenced by*** Ackland's CMOS APS disclosure and Ackland's own ***contemporaneous article entitled 'Camera on a Chip' [Ex. 2050]*** directed to his work on CMOS APS image sensors. POR 34-37, Ex. 2050."

-00475 POR 22, 34-37, 48-49; -00475 POSR 2, 4-6, 9-10, 18.

- But, as Ackland discloses:

**Ackland:** "Output signals from the amplifiers 18 are provided to the common output line 19 in serial fashion based on timing control signals from the timing control 20. The output signals are routed to suitable processing circuitry, not shown."

Ackland, 8:47-52, Fig. 6; -00475 Neikirk ¶¶83, 89, 120-121; -00475 Neikirk Reply, ¶30; -00475 Pet. 27, 29, 44; -00475 Reply 9.

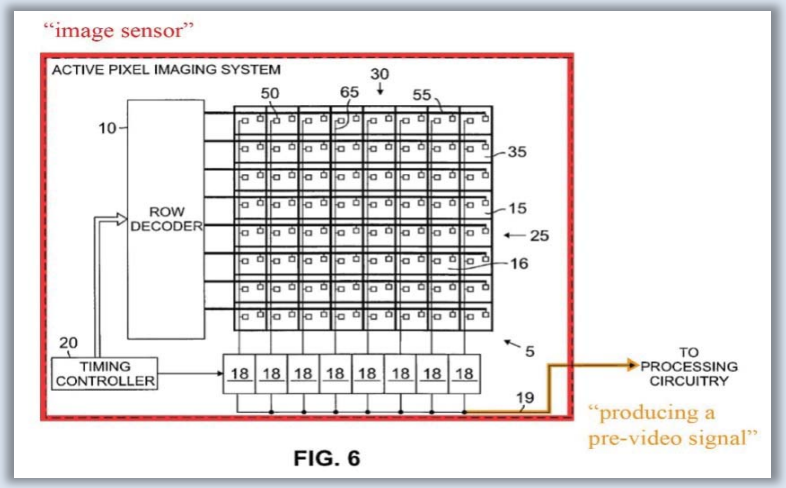


FIG. 6

- As Dr. Neikirk testified:

**Dr. Neikirk:** "Ackland has no disclosure or suggestion that its intended purpose is integration within a camera-on-a-chip. Ackland teaches a 'CMOS active pixel array' within an 'active pixel imaging system,' but never mentions designing a 'camera-on-a-chip' or integrating its video processing circuitry on the same chip as the pixel array. Ackland, 1:35-38, 7:62-63."

"Neither Exhibit 2050 nor Ackland reference each other. Their only connection is that Exhibit 2050 is authored by two of the four named inventors of Ackland. Indeed, [Exhibit 2050] makes no reference to a "[s]ingle-polysilicon CMOS active pixel sensor"—Ackland's title and field of invention. See generally Ex. 2050 (ISSCC96 "Camera on a Chip" paper); Ackland, Title, 1:10-11, 2:19-23."

-Neikirk Reply ¶30, ¶32 (citing Ex. 2050; Ackland, Title, 1:10-11, 2:19-23); -00475 Reply 9-10.

# Petitioner Does Not Rely on Hindsight Even the Admitted Benefits Would Have Motivated a POSITA to Use a CMOS Array

***Cellect argues:*** "Petitioner re-iterates in its Reply that ***the benefits of CMOS image sensors discussed in the '052 Patent***, such as 'lower noise, mass-producibility, ability to incorporate electronic control on smaller circuit boards, and less power consumption,' provide the necessary motivation to modify Wakabayashi with Ackland. Reply 2 (citing 1:66-2:19 of the '052 Patent); Pet. 29-30. These disclosures, however, ***are directed to the CMOS camera-on-a-chip designs*** known at the time of the invention."

-00475 POSR 9-10 (citing -00475 Reply 2; -00475 Pet. 29-30).

- But, the '052 provides:

**'052:** "One particular advance in CMOS technology has been in the active pixel-type CMOS imagers which consist of randomly accessible pixels with an amplifier at each pixel site. One advantage of active pixel-type imagers is that the amplifier placement results in lower noise levels than CCDs or other solid state imagers. Another major advantage is that these CMOS imagers can be mass produced on standard semiconductor production lines.' One particularly notable advance in the area of CMOS imagers including active pixel-type arrays is the CMOS imager described in U.S. Pat. No. 5,471,515 to Fossum, et al. … In short, the CMOS imager disclosed in Fossum, et al. has enabled the development of a 'camera on a chip.'"

'052, 1:66-2:19; *see also* -00475 Neikirk ¶¶48, 90; -00475 Pet. 10, 29-30.

**Federal Circuit:** "[I]t is appropriate to rely on admissions in a patent's specification when assessing whether that patent's claims would have been obvious."

*Koninklijke Philips N.V. v. Google LLC*, 948 F.3d 1330, 1339 (Fed. Cir. 2020).

**Federal Circuit:** "Admissions in the specification regarding the prior art are binding…."

*PharmaStem Therapeautics, Inc. v. ViaCell, Inc.*, 491 F.3d 1342, 1362 (Fed. Cir. 2007).

- *See also* Slides 17-18 (citing additional evidence/admissions from PO)

# Petitioner's Proposed Combinations Would Not Result in Higher Noise

> ***Cellect argues: "Petitioner's proposed combination*** would make Wakabayashi's digital camera ***unsuitable for*** its intended purpose as a ***consumer digital video camera because*** a POSITA would have understood such ***a modification from a CCD to CMOS pixel array would provide lower image quality as well as not obtain the reduced cost and size benefits*** of on-chip integration of timing, control and image processing that were recognized advantages of using a CMOS pixel array."

-00475 POSR 17-18; POR 32-34.

- But, Petitioner does not propose "modification from a CCD to CMOS" (*see* Slides 21-23)
- And consumer digital video CMOS cameras were available in 1997 (*see* Slide 24)
- As the '052 admits:

> **'052 Background of the Invention:** "One particular advance in CMOS technology has been in the active pixel-type CMOS imagers which consist of randomly accessible pixels with an amplifier at each pixel site. One advantage of active pixel-type imagers is that the amplifier placement results in lower noise levels than CCDs or other solid state imagers. Another major advantage is that these CMOS imagers can be mass produced on standard semiconductor production lines."

'052, 1:66-2:6; -00475 Neikirk ¶¶48, 90; -00475 Pet. 10, 29-30.

- And, as Dr. Neikirk testified:

> **Dr. Neikirk:** "[A] greater noise threshold is acceptable for cameras in the consumer market as the images do not need to be as precise as they do in medical or aerospace applications."

-00475 Neikirk Reply ¶26 (citing Ex. 2076 (9/30/20 Neikirk Dep. Tr.), 44:2-49:13; -00475 POR 14); -00475 Reply 5-6.
*See also* -00475 Neikirk Reply ¶27 (citing Ackland, 7:59-63; Swift, 1:3-5, 10:1-20, Figs. 2-3; -00475 Neikirk ¶¶81, 84, 91); -00475 Reply 6.

# Petitioner's Proposed Combinations Would Not Result in Higher Costs

***Cellect argues:*** "Petitioner does not address Patent Owner's argument that Petitioner's own exhibit (Ex. 1060) indicates that replacing the CCD array with a ***CMOS array would not yield much cost savings***; such savings required using a CMOS camera-on-a-chip."

-00475 POSR 19; -00475 POR 44-45.

- But, both parties' evidence instead shows:

**Business Week, March 6, 1995:** "Since it's made on standard semiconductor production lines, it taps into enormous economies of scale and should cost much less than CCDs. One chip can incorporate all manner of electronic controls that are usually on multiple chips, from timing circuits to zoom and antijitter controls."

Ex. 1060 at 1; -00475 Neikirk ¶90; -00475 Pet. 29-30.

**Ackland and Dickinson:** "One advantage of APS sensors is that they can be powered from a single 3.3V (or lower) supply and do not require external multiphase clock generators. This leads to reduced system costs and significantly reduced power dissipation. … Silicon processing costs are also reduced because of the huge volumes associated with generic digital CMOS production. Another advantage is the flexibility that is provided by a random access sensor addressing. No longer is one constrained to access pixels in serial order determined by the architecture of the CCD pipeline. This simplifies introduction of alternate forms of pixel access, such as that required for electronic pan & zoom."

Ex. 2050, 23-24; -00475 Neikirk Reply ¶33; -00475 Reply 10.

**Johannes:** "CMOS sensors cost an average of less than $14, about 15% to 20% cheaper than CCDs. ... If additional image-processing functions are crammed onto the chip, the savings

Ex. 2060 (Johannes), 3; -00475 Lebby ¶130;
*see also* -00475 Neikirk Reply ¶35; -00475 Reply 13.

- As Dr. Neikirk testified:

**Dr. Neikirk:** "[T]he cost advantage of CMOS imagers is not entirely due to adding circuitry to the chip. [¶] The fabrication facilities used to make the pixels themselves, those fabrication facilities by this point in time were very standardized. ... People who wanted to build CCDs had to have a dedicated line to do that. ... But the CMOS opportunity to the domestic silicon fabrication companies was that they wouldn't have to make that new investment. Even if they incorporate no extra circuitry on-chip, they still garner that advantage."

Ex. 2076 (9/30/20 Neikirk Dep. Tr.), 193:7-194:20, 44:6-47:10; -00475 Neikirk Reply ¶¶35-36.
-00475 Neikirk ¶¶93-95; -00475 Pet. 30-31; -00475 Reply 13; *see also In re Farrenkopf*, 713 F.2d 714, 718 (Fed. Cir. 1983); -00475 Reply 7.

# A POSITA Would Have Been Motivated to Apply Ricquier's Teachings to Wakabayashi

***Cellect argues:*** "Ricqu[i]er's purported advantages of 'selective addressability' and 'multiple resolutions' cannot support a finding that a POSITA would be motivated to combine the teachings of Wakabayashi and Ricquier because a POSITA would understand that ***the imaging apparatus of Wakabayashi would not benefit from these purported advantages***."

-00475 POR 54; -00475 Lebby ¶¶151-152, 161-163.

- However, Cellect admits:

**Cellect:** "[Ricquier] chose to use CMOS technology "because "it offers the selective addressability" and the ability to program "multiple resolutions" required to meet the design goals. … Critically for purposes of Petitioner's motivation to combine argument, however, the X-Y addressability and multiple resolution capability disclosed in Ricquier is a feature of **all** CMOS imagers and is the reason CMOS was chosen over CCD in the first instance."

-00512 POR 33 (citing Ricquier, 10-11; -00512 Lebby, ¶120); -00475 Neikirk Reply ¶48; -00475 Reply 23.

- And, as Dr. Neikirk testified:

**Dr. Neikirk:** "A person of ordinary skill in the art would have been further motivated to apply Ricquier's known teachings in implementing Wakabayashi's solid state imager device because of Ricquier's express advantages of 'selective addressability' and 'multiple resolutions…[and] data rates upto 10 MHz.' *See, e.g.*, Ricquier, 2. By implementing Ricquier's teachings, an electronic shutter and the ability to change the captured resolution and frame rate were realized. *See, e.g.*, Ricquier, 9. As a result of this ability to change resolution, the frame rate of the image sensor can be advantageously be changed on the fly. Ricquier, 4."

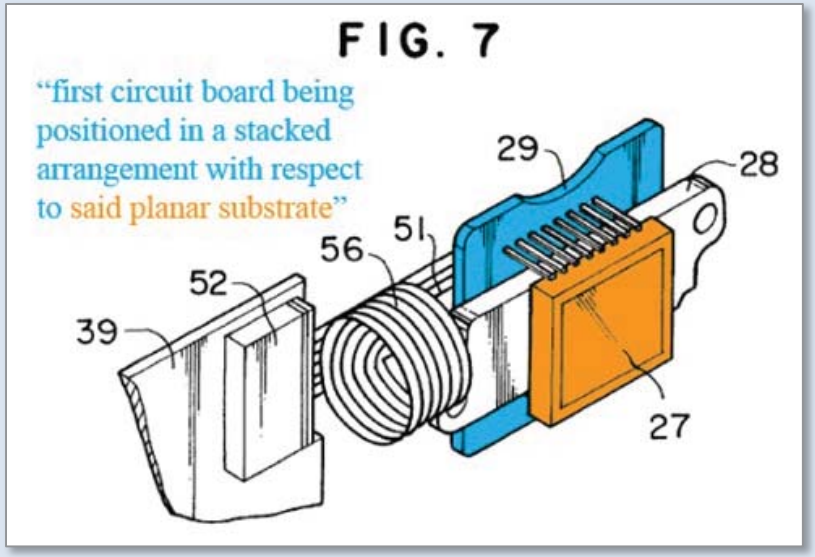
-00475 Neikirk ¶170; -00475 Pet. 61-62; -00475 Neikirk Reply ¶48; -00475 Reply 23-24.

- Moreover, '052 admits numerous advantages of CMOS images (*see* Slide 17)
- Ricquier's "off-chip" "timing controller" also would have provided added flexibility to reduce camera size (*see* Slide 20)

**“said first circuit board including timing and control circuitry thereon, said first circuit board being positioned in a stacked arrangement with respect to said planar substrate” (’052, claim 3)**

# Wakabayashi in View of Ricquier Renders Obvious a First Circuit Board Including Timing and Control Circuitry

**Wakabayashi:**




Wakabayashi, Fig. 7; -00475 Neikirk ¶200; -00475 Pet. 74.

**Ricquier:**

**Ricquier:** "In order to limit the complexity of the timing controller (realised in an off-chip driving unit) only timing configurations of some very common patterns are provided…."

Ricquier, 4; -00475 Neikirk ¶196; -00475 Pet. 72.

**Ricquier:** "Based on X-Y addresses and control pulses generated by an external driving unit, two decoders drive one particular row selection and column selection signal."

Ricquier, 3; -00475 Neikirk ¶195; -00475 Pet. 71.

- As Dr. Neikirk testified:

**Dr. Neikirk:** "[A] person of ordinary skill in the art would have been motivated and found it obvious and straightforward to apply Ricquier's known teachings of placing a 'timing controller' 'off-chip' in implementing Wakabayashi's imager apparatus such that the timing controller is located on the circuit board 29—i.e., off-chip from imager device 27, and would have recognized this combination (yielding the claimed limitation) would work as expected."

-00475 Neikirk ¶198; -00475 Pet. 71.

## A POSITA Would Have Been Motivated to Apply Ricquier's Teachings of a CMOS Photodiode Array with an Off-Chip Timing Controller in Implementing Wakabayashi

- A POSITA would have been motivated to apply Ricquier's teachings of an X-Y addressable CMOS photodiode array in implementing Wakabayashi (*see* Slide 20)

- Moreover, as Dr. Neikirk testified:

> **Dr. Neikirk:** "[I]t was well-known that '[f]itting of the components into the available space' while maintaining 'orientation of the components relative to one another,' including 'placement' of circuitry on 'various layers' arranged 'stackwise,' is a mere design choice. Ex. 1045 (A Guide to Printed Circuit Board Design, 1984), 15, 20."

-00475 Neikirk ¶41.

> **Ex. 1045 (A Guide to Printed Circuit Board Design):** "Also worth mentioning at this stage are 'multi-layer' circuits. These occur when a large number of tracks and components have to be made and assembled on a PCB to the extent that the surface area available becomes 'over-dense'. By making a series of individual PCBs and then joining them, stackwise, one on top of the other, a multi-layer board results."

Ex 1045 (A Guide to Printed Circuit Board Design) 15, 20; -00475 Neikirk ¶¶41, 170; Pet. 4-5, 61.

> **Ex. 1016 (Tanuma):** "In this practical application example, glass filter 3a for color correction and quartz filter 3a (which is used as a space-reduction filter) overlap with the surface of solid state imaging element chip 1, which is loaded onto package mount 2, and are secured by an adhesive for optical components. I/O lead 9 (9a, 9b, etc.) is installed to the underside of package mount 2, to which solid state element chip 1 is mounted. A portion of the chip components 6a that make-up the matching circuit that are also on the underside of package mount 2 are directly secured by solder. … [¶] [T]his application example does not require many lead wires, so there is a high degree of reliability, and excellent matching characteristics because of the matching circuit board forming a single unit, allowing for a more compact camera head."

Ex. 1016 (Tanuma), 4-5; -00475 Neikirk ¶170; Pet. 61.

# Ricquier Discloses a CMOS Image Sensor with an Off-Chip Timing Controller

> ***Cellect argues:*** "[A] POSITA would understand that since ***Ricquier is describing a proof of concept prototype***, the 'driving unit' was externally located while they experimented to see if it would work, ***with the expectation that the 'driving unit' feature would be integrated on-chip*** in any actual CMOS imager having this feature as explained on the first page of the article ('further co integration of processing electronics on the same chip')."

-00475 POR 23-24, 57-58; -00475 POSR 23; -00475 Lebby ¶¶20, 110, 160.

- But, as Dr. Neikirk testified:

> **Dr. Neikirk:** "There is no disclosure in Ricquier that suggests its teachings are for a 'proof-of-concept prototype,' a 'bench-testing device,' or that it is 'intended to be…a camera-on-a-chip.'"

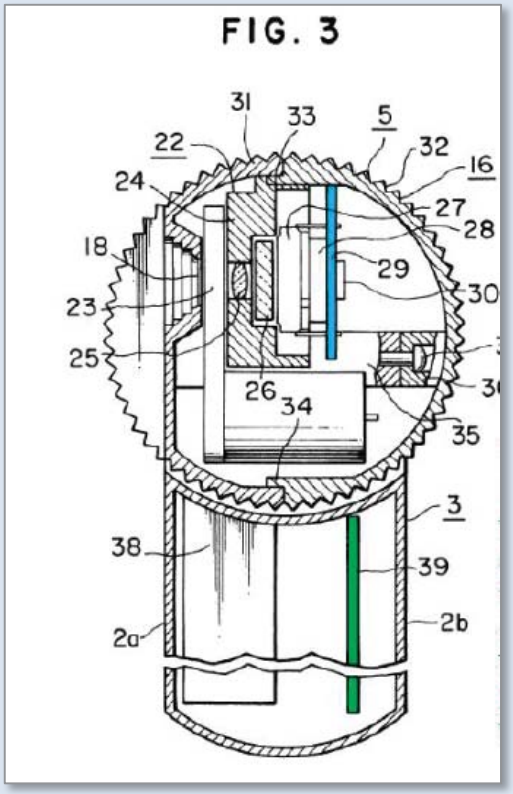
-00475 Neikirk Reply ¶52; -00475 Reply 24.

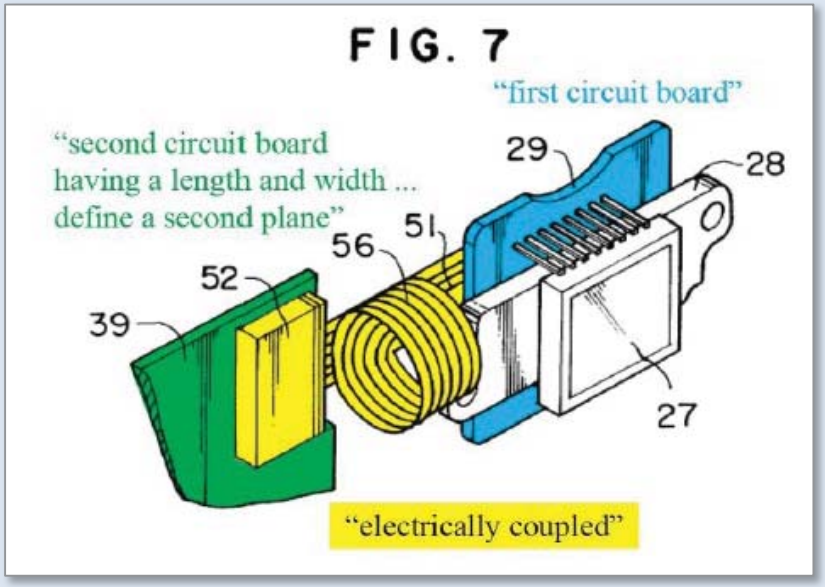
- And CMOS is not limited to a camera-on-a-chip (*see* Slides 11-12)
- A POSITA would have been motivated to apply Ricquier's off-chip teachings (*see* Slides 32)

**“said second circuit board including circuitry thereon to convert said pre-video signal to a post-video signal, said second circuit board being offset from said first circuit board [and from said planar substrate]” (’052, claims 1 and 3)**

# Wakabayashi Renders Obvious the Claimed Arrangement

- Wakabayashi discloses that board 39 is offset from board 29 and from the planar substrate of imager device 27

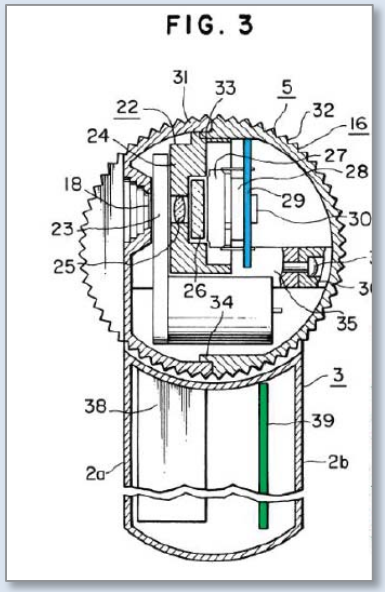



Wakabayashi, Figs. 3, 7; -00475 Neikirk ¶¶125-126; -475 Pet. 45-49.

# Wakabayashi Renders Obvious the Claimed Arrangement

- Wakabayashi discloses that the video conversion circuitry in camera circuit 102 is located on board 29

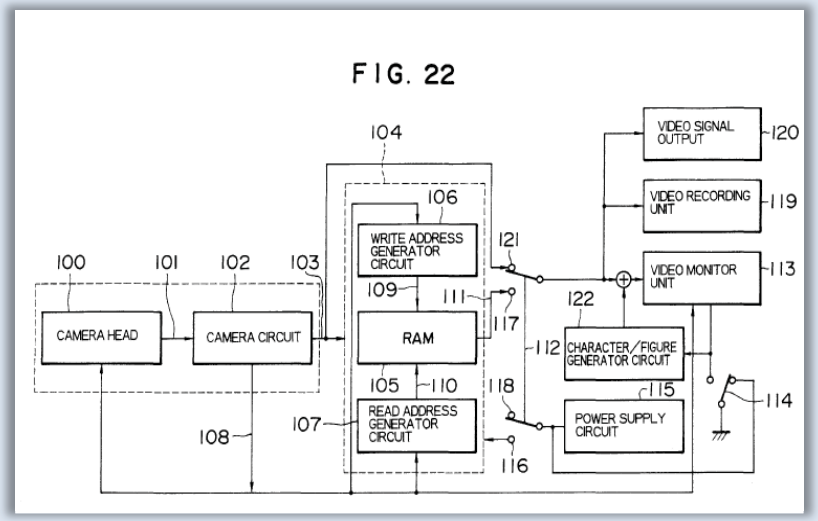



**Wakabayashi:** "video camera unit 5"

Wakabayashi, 6:8, 5:1-2, 5:38, Figs. 3, 22.

**Wakabayashi:** "FIG. 22 shows a block diagram of a circuit used in the first-third embodiments of the present invention. A camera head 100, which includes a light receiving lens, a solid-state imager device, a circuit for driving the solid-state imager device, and so on, generates an opto-electrically converted signal 101 which is inputted to a camera circuit 102. The camera circuit 102, which includes a camera signal processing circuit, a synchronization signal generator circuit, and so on, generates a video signal 103 in a television signal format from the opto-electrically converted signal 101. The camera head 100 and the camera circuit 102 surrounded by dotted rectangles constitute the video camera of the present invention."

Wakabayashi, 9:9-21; -00475 Neikirk ¶72; -00475 Pet. 22.



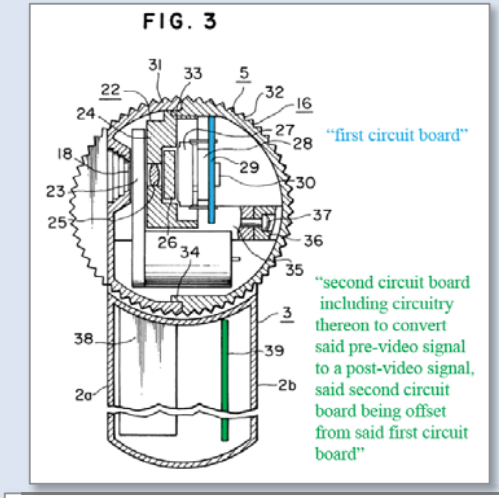

**Dr. Neikirk**: "In describing Figure 22, Wakabayashi explains that the camera circuit 102 converts the opto-electrically converted signal into a 'video signal 103 in a television signal format' and outputs the signal to the 'video monitor unit.' … Wakabayashi further explains that 'camera head 100' and 'camera circuit 102' constitute the 'video camera' unit of the imager apparatus."

-00475 Neikirk ¶¶72 (citing Wakabayashi, 9:10-21), 74; -00475 Pet. 22.

*See also* Ex. 2076 (9/30/20 Neikirk Dep. Tr.), 242:16-243:6, 235:20-237:17; -0475 Reply 17; -00475 Lebby ¶129.

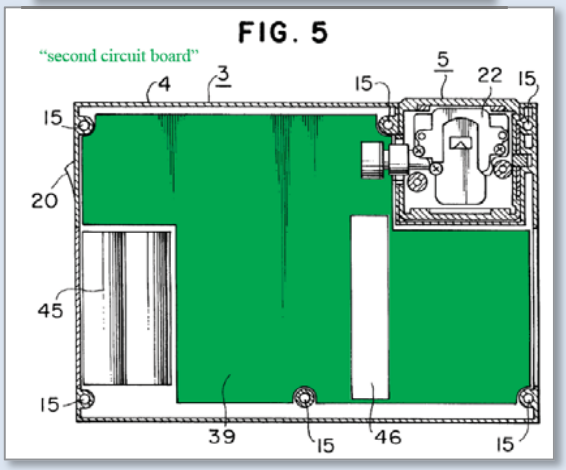
# Wakabayashi Renders Obvious the Conversion Circuitry on Board 39

- A POSITA would have been motivated to locate Wakabayashi's video conversion circuitry instead on circuit board 39




**Dr. Neikirk**: "A person of ordinary skill in the art would have been motivated and found it obvious and straightforward to locate the processing circuitry to convert the pre-video signal to a post-video signal on Wakabayashi's circuit board 39 [which] includes a signal processing circuit…, a driver circuit…, a system circuit, a power supply circuit, and so on' because it is the larger of two circuit boards in the imager apparatus and there is more space where circuit board 39 is mounted than in the camera head where circuit board 29 is mounted. … [T]he size of circuit board 29 is advantageously reduced and the video camera unit that rotates is made smaller…."

-00475 Neikirk ¶74; -00475 Pet. 23-24.




**Dr. Neikirk**: "Wakabayashi teaches one objective is to make 'the video camera unit… small,' 'composed of minimally necessary parts,' and 'compact to realize a reduction in weight of [the] … rotating mechanism,' so that 'less strength is required' for the 'rotatable joining portion' to 'join the video camera with the housing' portion of the imager apparatus. … Placement of the processing circuitry on circuit board 39 furthers this objective."

-00475 Neikirk ¶74 (quoting Wakabayashi, Abstract, 2:37-39, 3:40-44, 14:6-10); -00475 Pet. 26-27.

Wakabayashi, Figs. 3, 5; -00475 Neikirk ¶¶126-128; -00475 Pet. 47-49.

- It was well-known to a POSITA to move circuitry between circuit boards (*see* Slide 13)

*See also* Ackland, 8:48-52, Fig. 6; Swift, 9:13-17, 18:25-33, Fig. 2; Monroe (Ex. 1007), 3:36-62, 8:8-11, Fig. 3; -00475 Neikirk ¶¶73-77; -00475 Pet. 23-26.

# A POSITA Would Have Been Motivated to Locate Wakabayashi's Video Conversion Circuitry on Circuit Board 39

> ***Cellect argues: "Ackland's CMOS image sensor … teaches an on-chip design architecture including*** the pixel array, timing control and ***signal processing on-chip*** that contradicts, or ***teaches away from, Petitioner's proposed modification*** of Wakabayashi to have the second circuit board include the signal processing circuitry to convert pre-video signal to a post-video signal."

00475 POR 48-49.

- But, Ackland does not disclose video conversion circuitry on the same chip as the timing and control circuitry (*see* Slide 25)
- Rather, Ackland teaches locating video conversion circuitry separately by showing the "processing circuitry" outside the "active pixel imaging system" in Figure 6 (*see* Slide 25)
- Moreover, PO misunderstands what is required for teaching away:

> **Federal Circuit:** "A reference that 'merely expresses a general preference for an alternative invention but does not criticize, discredit, or otherwise discourage investigation into' the claimed invention does not teach away."

*Meiresonne v. Google, Inc.*, 849 F.3d 1379, 1382 (Fed. Cir. 2017); -00475 Reply 18.

# A POSITA Would Have Been Motivated to Locate Wakabayashi's Video Conversion Circuitry on Circuit Board 39

**Cellect argues: "*Following Petitioner's rationale further, a POSITA would also have moved the timing and control circuitry to the other circuit board 39, to make the video camera unit smaller*, which would result in the timing and control circuitry and the circuitry to convert pre-video signal to a post-video signal on the same circuit board 39, rather than on separate circuit boards as required by the Challenged Claims."**

-00475 POR 49, 58.

- But, as the Federal Circuit has held:

**Federal Circuit**: "[J]ust because better alternatives exist in the prior art does not mean that [the purportedly] inferior combination is inapt for obviousness purposes."

*In re Mouttet*, 686 F.3d 1322, 1334 (Fed. Cir. 2012); -00475 Reply 18-19.

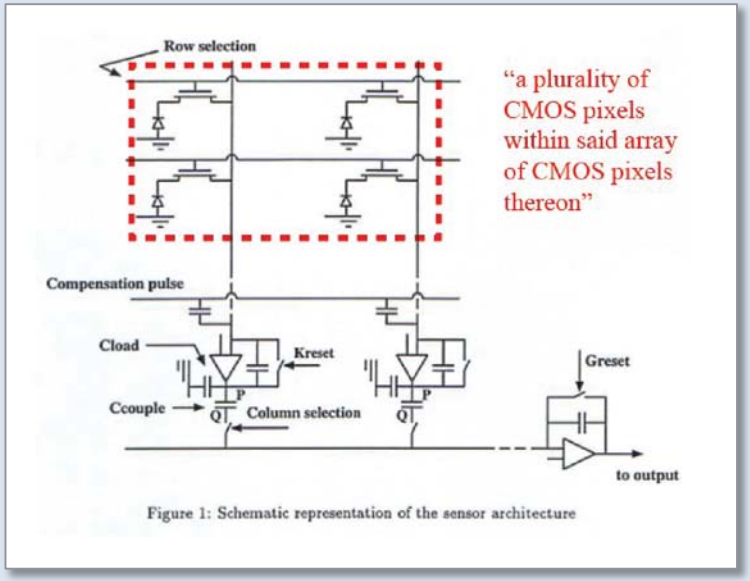
**Federal Circuit**: "[O]ur case law does not require that a particular combination must be the preferred, or the most desirable, combination…to provide motivation for the current invention."

*In re Fulton*, 391 F.3d 1195, 1200-01 (Fed. Cir. 2004); -00475 Reply 18-19.

**“wherein a plurality of CMOS pixels within said array of CMOS pixels each include an amplifier” (’052, claim 3)**

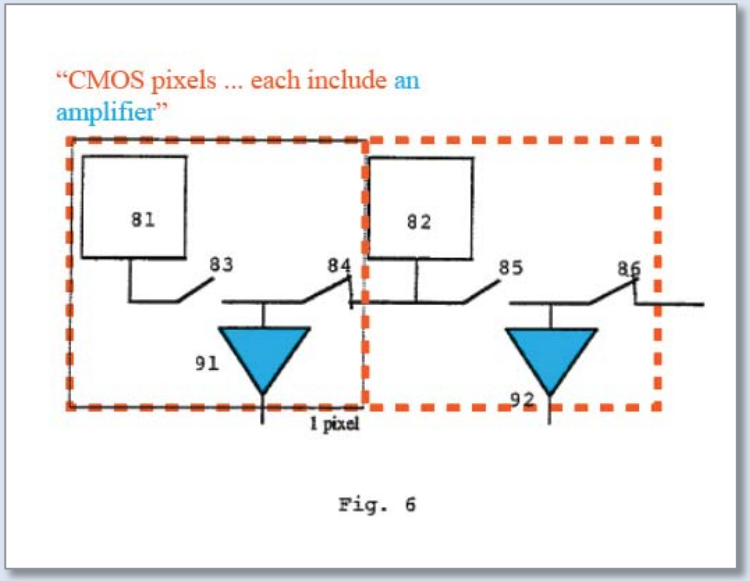
# Wakabayashi in view of Ricquier and Dierickx Renders Obvious a Plurality of CMOS Pixels Each Include an Amplifier

**Ricquier:**




Ricquier, Fig. 1; -00475 Neikirk ¶¶186-188; -00475 Pet. 68.

**Dierickx:**




Dierickx, Fig. 6; -00475 Neikirk ¶190; -00475 Pet. 69.

**Dierickx:** "Of the image sensors implemented in a CMOS- or MOS-technology, CMOS or MOS image sensors with passive pixels and CMOS or MOS image sensors with active pixels are distinguished. An active pixel is configured with means integrated in the pixel to amplify the charge that is collected on the light sensitive element…."

Dierickx, ¶6; -00475 Neikirk ¶189; -00475 Pet. 69.

**Dierickx:** "An active pixel…is shown in FIG. 6 in a most simple form. Two pixels of an array are shown, only relevant parts of the pixels are shown: (81), (82) are photo detectors, (91), (92) are schematic representations of the amplifying part of the pixel."

Dierickx, ¶53; -00475 Neikirk ¶190; -00475 Pet. 69.

# A POSITA Would Have Been Motivated to Apply Dierickx's Known Teachings in Implementing Wakabayashi's Imager Apparatus (as Modified by the Teachings of Ricquier):

- Dierickx discloses:

> **Dierickx:** "[A]ctive pixel image sensors are potentially less sensitive to noise fluctuations than passive pixels. Due to the additional electronics in the active pixel, an active pixel image sensor may be equipped to execute more sophisticated functions, which can be advantageous for the performance of the camera system. Said functions can include filtering, operation at higher speed or operation in more extreme illumination conditions."

Dierickx, ¶6; -00475 Neikirk ¶174; -00475 Pet. 63-64, 69.

- And, as Dr. Neikirk testified:

> **Dr. Neikirk:** "A person of ordinary skill in the art would have been motivated to apply Dierickx's known teachings of an array of active CMOS pixels, each including an amplifier, in implementing Wakabayashi's 'video camera' (as modified by the teachings of Ricquier) to advantageously provide 'high image quality' … improving the functionality of Wakabayashi's 'video camera' without 'lead[ing] to a larger size and increased weight'…."

00475 Neikirk ¶174 (citing Dierickx ¶19; Wakabayashi, 2:27-29, 3:39-45); -00475 Pet. 63-64.

# Wakabayashi in view of Ricquier and Dierickx Renders Obvious a Plurality of CMOS Pixels Each Include an Amplifier

> ***Cellect argues: "Dierickx discloses an active pixel array***—a subset of CMOS technology that a POSITA would understand to be ***distinct and separate from, and therefore not readily compatible with, the passive-pixel technology as disclosed in Ricquier***."
>
> -00475 POR 55.

- But, a POSITA would have been motivated to apply Dierickx's teachings of active pixels in implementing Ricquier's CMOS pixel array (*see* Slide 42)
- Moreover, the '052 admits:

> **'052:** "[T]he major difference between passive and active CMOS pixel arrays is that a passive pixel-type imager does not perform signal amplification at each pixel site."
>
> '052 patent, 2:22-25; -00475 Neikirk Reply ¶53; -00475 Reply 25.

> ***Cellect argues:*** "Dierickx admits that CCD-based camera systems have higher image quality compared to CMOS-based camera systems, which undermines ***Petitioner's argument that a POSITA would be motivated to replace the CCD-based imaging apparatus of Wakabayashi with a CMOS sensor*** to provide 'high image quality.' … ***Dierickx teaches away from Petitioner's proposed combination because*** a POSITA, upon reading ***Dierickx's disclosure that CCD-based systems are 'preferred,'*** would be discouraged from any modification using CMOS image sensors.
>
> -00475 POR 55-57.

- But, Wakabayashi's solid-state imager is not limited to CCD (*see* Slides 21-23) and Dierickx teaches a CMOS sensor (*see* Slides 41-42)
- Moreover, PO misunderstands what is required for teaching away:

> **Federal Circuit:** "A reference that 'merely expresses a general preference for an alternative invention but does not criticize, discredit, or otherwise discourage investigation into' the claimed invention does not teach away."

*Meiresonne v. Google, Inc.*, 849 F.3d 1379, 1382 (Fed. Cir. 2017); *see also In re Fulton*, 391 F.3d 1195, 1200-01; *In re Mouttet*, 686 F.3d 1332, 1334; -00475 Reply 25-26.

**“wherein a largest dimension of said image sensor along said first plane is between 2 and 12 millimeters” (‘052, claims 1 and 3)**

# Wakabayashi in View of Ackland Renders Obvious the Dimension Limitation

**Wakabayashi:** "The video camera unit is made small and pivoted on an edge of the housing for rotation about an axis parallel to the edge, so that a less strength is required for joining members and accordingly the joining members can be reduced in size and weight. This structure also allows the user to manipulate the video camera with a thumb or index finger for setting an imaging angle of the video camera unit."

Wakabayashi, 3:39-45; *see also* Wakabayashi 7:20-24, 4:58-5:2, Abstract; -00475 Neikirk ¶¶66, 148; -00475 Pet. 19, 55.

- As Dr. Neikirk testified:

**Dr. Neikirk:** "A person of ordinary skill in the art would have been motivated to use a circuit board having a largest dimension between 2 and 12 millimeters because it would further Wakabayashi's express desire that the 'video camera unit is made small' such that it may be 'manipulate[d] … with a thumb or index finger,'…."

-00475 Neikirk ¶148 (citing Wakabayashi, 3:39-45, 7:20-24, 4:58-5:2, Abstract); -00475 Pet. 55.

**Dr. Neikirk:** "[I]t would have been an obvious implementation choice to use a circuit board having a largest dimension between 2 and 12 millimeters because boards of such size were well-known at the time for mounting to an image sensor."

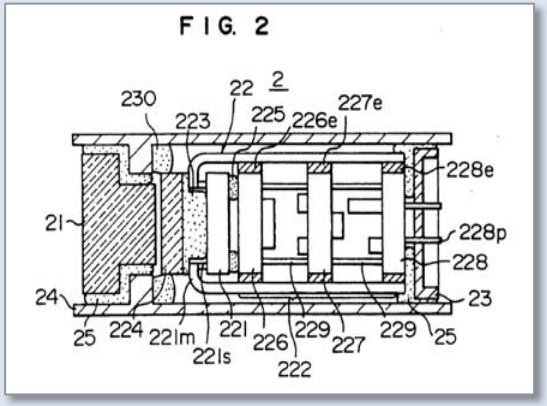
-00475 Neikirk ¶148 (citing Suzuki, 4:6-11, 4:58-65, 1:53-56, 4:58-61, Fig. 2); -00475 Pet. 55.

- Moreover, as the Federal Circuit has held:

**Federal Circuit:** where "difference[s] between the claimed invention and the prior art is some range or other variable within the claims…applicant must show the particular range is critical, generally by showing that the claimed range achieves unexpected results relative to the prior art range."

*In re Woodruff*, 919 F.2d 1575, 1578 (Fed. Cir. 1990); *see also Gardner v. TEC Systems*, 725 F.2d 1338, 1345-49 (Fed. Cir. 1984); MPEP § 2144.04 IV; -00475 Reply 20.

# Wakabayashi in View of Ackland and Suzuki Renders Obvious the Dimension Limitation




Suzuki, Fig. 2; -00475 Neikirk ¶152; -00475 Pet. 57.

**Suzuki:** "[I]n the case where the solid-state image pickup chip of 1/3 inch (8.5 mm) is used, the outer diameter of the camera head is about 10 mm, and therefore is smaller about 5 mm than that of the conventional camera head."

Suzuki, 4:6-11; -00475 Neikirk ¶153; -00475 Pet. 57.

**Suzuki:** "[T]he outer diameter of the camera head can be reduced to a small size close to the diagonal length of the solid-state image pickup chip. This provides an advantage that an image of a narrow portion, such as the interior of a pipe and the interior of a precision machine, can be picked up…."

Suzuki, 4:58-65; -00475 Neikirk ¶154; -00475 Pet. 57.

**Suzuki:** "With this arrangement, not only the solid-state image pickup chip but also the boards including the electric circuits parts can be sealed, and therefore the stability and reliability of the circuit are advantageously enhanced."

Suzuki, 4:30-45; -00475 Neikirk ¶158; -00475 Pet. 57.

- As Dr. Neikirk testified:

**Dr. Neikirk:** "A person of ordinary skill in the art would have been motivated to apply Suzuki's known teachings of an image sensor comprising a "chip-connecting board 226" between 8.5 and 10mm in implementing Wakabayashi's imager apparatus (as modified by Ackland's teachings) because, as Suzuki expressly discloses, this arrangement of its image sensor and circuit board allows for the 'camera head [to have] an outer diameter closer to a diagonal length of a solid-state image pickup chip'—thus realizing Wakabayashi's objective of making the camera unit "compact," and to improve the camera's "stability and reliability," as discussed further below."

00475 Neikirk ¶¶154-158; -00475 Pet. 57-58.

**Dr. Neikirk:** "Suzuki further discloses its arrangement of its image sensor and circuit board allows 'not only the solid-state image pickup chip but also the boards including the electric circuits parts can be sealed, and therefore the stability and reliability of the circuit are advantageously enhanced.'"

00475 Neikirk ¶158 (citing Suzuki,4:30-45); -00475 Pet. 57.

# Suzuki is not limited to CCD technology

***Cellect argues: "Suzuki*** refers to a solid-state imager and ***describes a conventional CCD device design*** used in 1991 (when Suzuki was filed). See supra Ex. 2092 at 8. The fact that Suzuki's circuit board 227 includes 'a circuit for ***driving*** the solid-state image pickup chip 221 and a circuit for ***amplifying*** the video signal from the solid-state image pickup chip 221' separate from the image pickup chip tells a POSITA that Suzuki describes a CCD imaging sensor."

-00475 POR 23, 50-51; -00475 POSR 21.

- But Suzuki teaches:

**Suzuki:** "[T]he solid-state image pickup chip of 1/3 inch (8.5 mm) is used…."

Suzuki, 4:6-11; -00475 Neikirk, ¶¶150-153; -00475 Pet. 56; *see also* -00512 Neikirk, ¶¶234, 245, 272; -00512 Pet. 26, 41-43.

- And, as Dr. Neikirk testified:

**Dr. Neikirk:** "Suzuki does not even mention CCDs."

-00475 Neikirk Reply ¶43; -00475 Reply 21; *see also* 00512 Neikirk Reply ¶33; -00512 Reply 16-17.

**Dr. Neikirk:** "Suzuki's off-chip driving and amplification circuits do not limit Suzuki to a CCD. … Suzuki provides a 'broad-based statement about putting driving circuitry on circuit board 227,' but is not 'providing any specific requirement.'"

-00475 Neikirk Reply ¶45 (citing Ex. 2075 (10/8/20 Neikirk Dep. Tr.), 23:3-25:25, 31:21-32:12; -00475 Neikirk ¶¶151-153); -00475 Reply 21; *see also* -00512 Neikirk Reply ¶34; -00512 Reply 16-17.

**Dr. Neikirk:** "Suzuki's off-chip 'circuit for amplifying the video signal' does not limit the type of image sensor that Suzuki can use since it amplifies the signal after it is output from the solid-state image pickup chip."

-00475 Neikirk Reply ¶45; -00475 Reply 21; *see also* -00512 Neikirk Reply ¶34; -00512 Reply 16-17.

- Moreover, CMOS imagers with off-chip circuitry were well-known (*see* Slides 11-12)

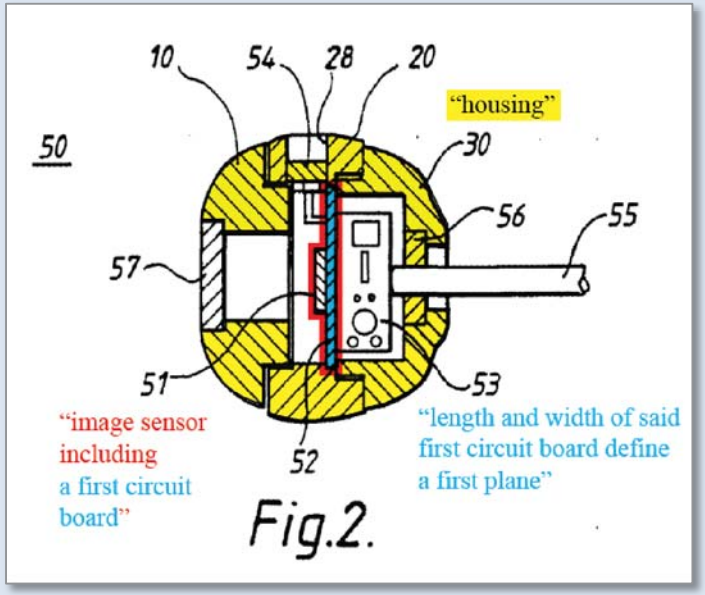
## Disputed Issues for Swift Grounds

| Cellect's Arguments | | Slides |
|---|---|---|
| **"said first circuit board including an array of CMOS pixels thereon, wherein a plurality of CMOS pixels within said array of CMOS pixels each include an amplifier" ('052, claim 2)** | -00512 POR 14-17, 24-28, 30, 33, 35-37;<br>-00512 POSR 3-4, 8-9, 11-12 | Slides 49-54 |
| **"said first circuit board further including timing and control circuitry thereon" ('052, claim 2)** | -00512 POR 28-30, 32-35;<br>-00512 POSR 4, 14-16 | Slides 55-59 |
| **"said second circuit board including circuitry thereon to convert said pre-video signal to a post-video signal, said second circuit board being positioned in a stacked arrangement with respect to said first circuit board" ('052, claim 2)** | -00512 POR 18, 24-25, 35-37;<br>-00512 POSR 12, 14, 18, 20-21 | Slides 60-64 |
| **"wherein a largest dimension of said image sensor along said first plane is between 2 and 12 millimeters" ('052 claim 2)** | -00512 POR 21-23 | Slides 65-67 |
| **No Evidence of Secondary Indicia of Non-Obviousness** | -00512 POR 39-47; -00512 POSR 23-25 | Slides 71-76 |

**“said first circuit board including an array of CMOS pixels thereon, wherein a plurality of CMOS pixels within said array of CMOS pixels each include an amplifier” (’052, claim 2)**

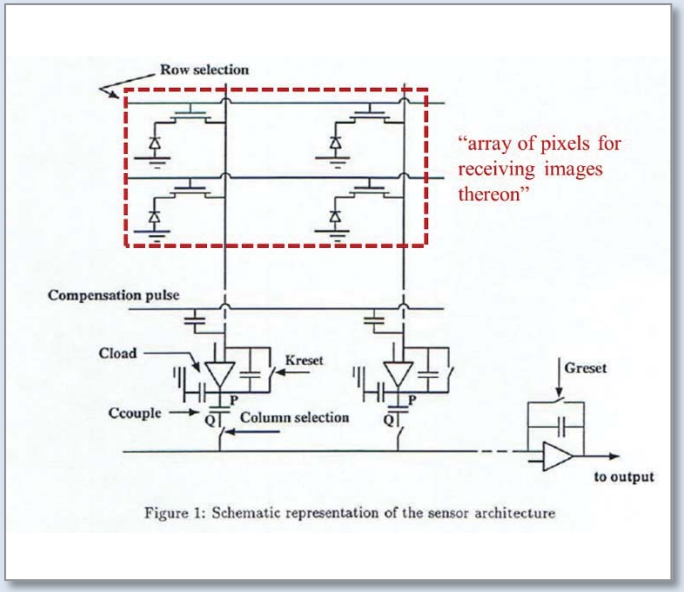
# Swift in View of Ricquier Renders Obvious a First Circuit Board Including an Array of CMOS Pixels, Each Including an Amplifier

**Swift:** "The image sensor 51 is preferably of a CMOS/APS (Active Pixel Sensor) type. An APS acts similarly to a random access memory (RAM) device, wherein each pixel contains its own selection and readout transistors. Further information on APS-type sensors may be found in the publication 'Laser Focus World', June 1993, Page 83."




Swift, 10:1-6, 4:11-13, Fig. 2;
-00512 Neikirk ¶252-254; -00512 Pet. 30-31.

**Ricquier** "The pixel array consists of 256 by 256 square pixels arranged on a pixel pitch of 19 µm and realised in a 1.5 µm n-well CMOS technology."




Ricquier, 5, Fig. 1;
-00512 Neikirk ¶¶255-256; -00512 Pet. 31-33.

- As Dr. Neikirk testified:

**Dr. Neikirk:** "While Swift does not expressly state that its CMOS active pixels are in an array, Ricquier provides this additional implementation detail of a "256*256 XY addressable photodiode array … realised in a 1.5 µm standard CMOS technology."

-00512 Neikirk ¶238; -00512 Pet. 22.

# Swift Does Not Disclose a Camera-On-A-Chip CMOS Image Sensor

***Cellect argues:*** "***Swift discloses a camera that uses the CMOS APS-type sensors*** disclosed in the *Laser Focus World* article referenced therein. … Petitioner has not demonstrated any known motivation for *deintegrating* various circuit components from *Swift's* ***camera on a chip*** in order to arrive at the invention claimed in the '052 Patent."

-00512 POR 25 (citing Swift, 10; Ex. 1048 (Laser Focus World)), 14-17, 24-28, 30, 33, 35-37; -00512 POSR 3-4.

- But, CMOS imagers that were not camera-on-a-chip were well-known (*see* Slides 11-12)
- Swift discloses:

**Swift** "Various circuitry components are mounted on the circuit board 53 … [to] process image signals received [from image sensor 51]."

Swift 9:7-13; -00512 Neikirk ¶279; -00512 Pet. 39.

**Swift:** "The image sensor 51 is preferably of a CMOS/APS (Active Pixel Sensor) type."

Swift, 10:1-6; -00512 Neikirk ¶257-258; -00512 Pet. 33-34.

**Swift** "Each feature disclosed in this specification (including any accompanying claims, abstract and drawings), may be replaced by alternative features serving the same, equivalent or similar purpose, unless expressly stated otherwise. Thus, unless expressly stated otherwise, each feature disclosed is one example only of a generic series of equivalent or similar features."

Swift, 19:15-21; -00512 Neikirk ¶270; -00512 Pet. 39.

- As Dr. Neikirk testified:

**Dr. Neikirk:** "While Swift mentions that '[f]urther information on APS-type sensors may be found in the publication 'Laser Focus World', June 1993, Page 83,' an article by Mr. Fossum, Swift does not suggest that, among the several CMOS APS sensors described, its image sensor must be the 'camera-on-chip' concept 'pursued by…JPL.'"

-00512 Neikirk Reply ¶¶11-12; -00512 Reply 4-5.

# Swift Does Not Disclose a CCD Image Sensor

> ***Cellect argues:*** "***Swift***'s description of its system architecture betrays the reality that the author ***merely contemplated placing a CMOS imager within the incompatible CCD system architecture***. … [W]hile Swift boasts that ***its 'miniature camera*** 50 may have very small dimensions,' it ***is many times larger than the CMOS imager disclosed in the '052 Patent***."

-00512 POR 14-16; -00512 POSR 11-12.

- But, Swift expressly discloses its image sensor is CMOS (*see* Slide 50).
- As Dr. Neikirk testified:

> **Dr. Neikirk:** "Swift expressly discloses its camera employs a CMOS/APS sensor, and not once does Swift suggest using a CCD image sensor."

-00512 Neikirk Reply 16 (citing Swift, Abstract, 4:11-15, 10:1-6, 12:30-32, claim 19; -00512 Neikirk ¶¶230, 254, 258).

> **Swift:** "[T]he miniature camera 50 may have very small dimensions. For example, the maximum diameter of the housing may be 38mm, and the overall length of the housing may be 38mm. [¶] … [T]here may be provided within the housing 50 sufficient room to house a battery, and/or a transmitter, and/or a converter in order to convert a video signal or combined video/audio signals into a UHF signal.

Swift 9:30-10:20; -00512 Neikirk Reply ¶17; -00512 Reply 6-7.

- And, as Dr. Neikirk testified:

> **Dr. Neikirk:** "Nothing about the size of the camera housing suggests that Swift is limited to a CCD, nor does it contradict Swift's express disclosure of a CMOS image sensor."

-00512 Neikirk Reply ¶17; -00512 Reply 6-7.

# Swift Does Not Disclose a CCD Image Sensor

***Cellect argues:*** "***Swift's multi-circuit-board system architecture is consistent with CCD*** imager architecture, not CMOS imagers."

-00512 POR 16; -00512 POSR 8-9.

- But, CMOS imagers with off-chip circuitry were well-known (*see* Slides 11-12).

***Cellect argues:*** "***The 12V power supply*** used in Swift ***is*** the range of voltages ***used for CCD imagers, not CMOS imagers***."

-00512 POR 15-16 (citing Swift, 15:28-31); -00512 POSR 8.

- But, Swift discloses:

**Swift:** "The power supply device 170 **may** comprise, **for example**, a low-voltage transformer in order to receive mains power and provide, as an output, a low (eg 12 volt) operating voltage **for the camera** 152."

Swift 15:28-31; -00512 Neikirk Reply ¶18; -00512 Reply 7.

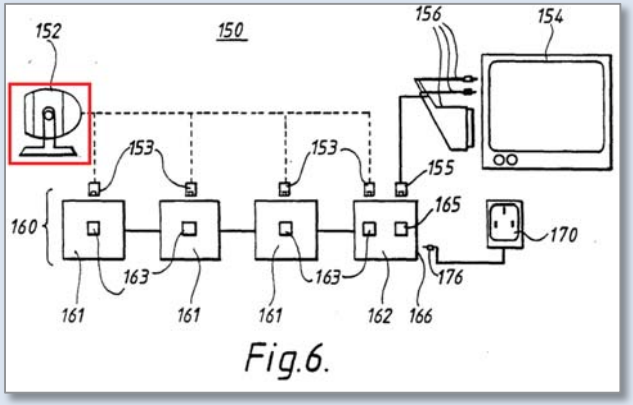


Fig.6.

Swift Fig. 6

- And, as Dr. Neikirk testified:

**Dr. Neikirk:** "An exemplary voltage for the entire camera does not limit operating voltages of individual components such that the explicitly disclosed CMOS sensor can be somehow transformed into a CCD imager that was nowhere described."

-00512 Neikirk Reply ¶18; -00512 Reply 7.

- And, as the '052 admits:

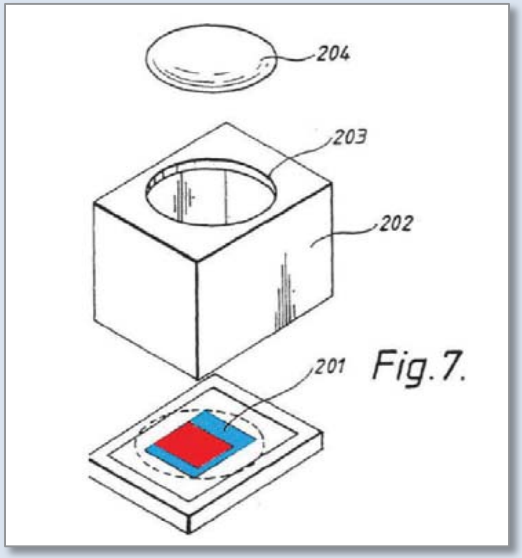
**'052:** "In the preferred imager incorporated in this invention, the power to the imaging device is simply a direct current which can be a 1.5 volt to a 12 volt source."

'052 9:44-47; -00512 Neikirk Reply ¶18; -00512 Reply 7.

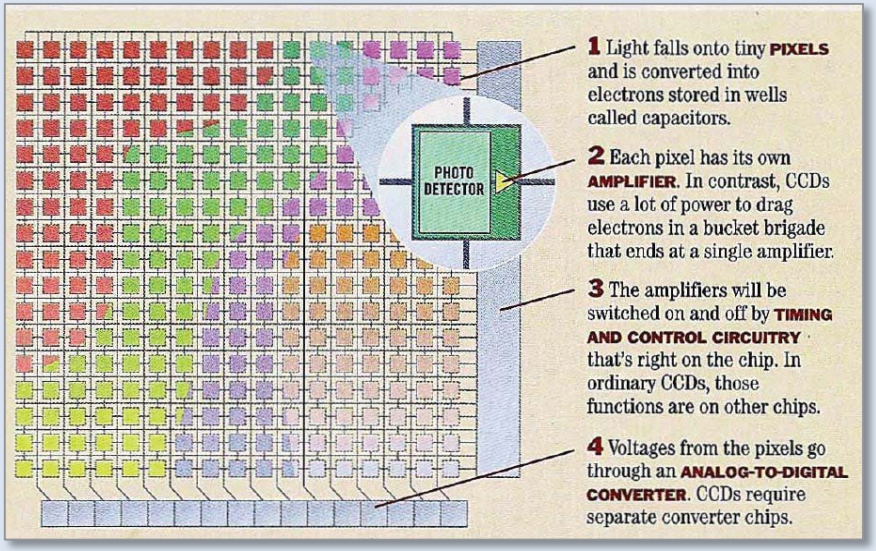
# Swift Does Not Disclose a CCD Image Sensor

***Cellect argues:*** "***Swift's CMOS imager***, with an asymmetrically positioned 'light-sensitive area,' ***is directly analogous to Dr. Fossum's CMOS camera on a chip***, which has integrated timing and control circuitry and an analog-to-digital converter and an asymmetrically located pixel array: … Ex. 1060 at 2."

00512 POR 26-27 (citing Swift, Fig. 7; Ex. 1060 (Armstrong), 2).




POR 26 (annotated Swift, Fig. 7).




Ex. 2039 (Ex. 1060, Armstrong), 55 (depicting Fossum's "active pixel sensor").

- But, Fossum cannot rewrite Swift nor does it depict the same configuration as Swift, and as Dr. Neikirk testified:

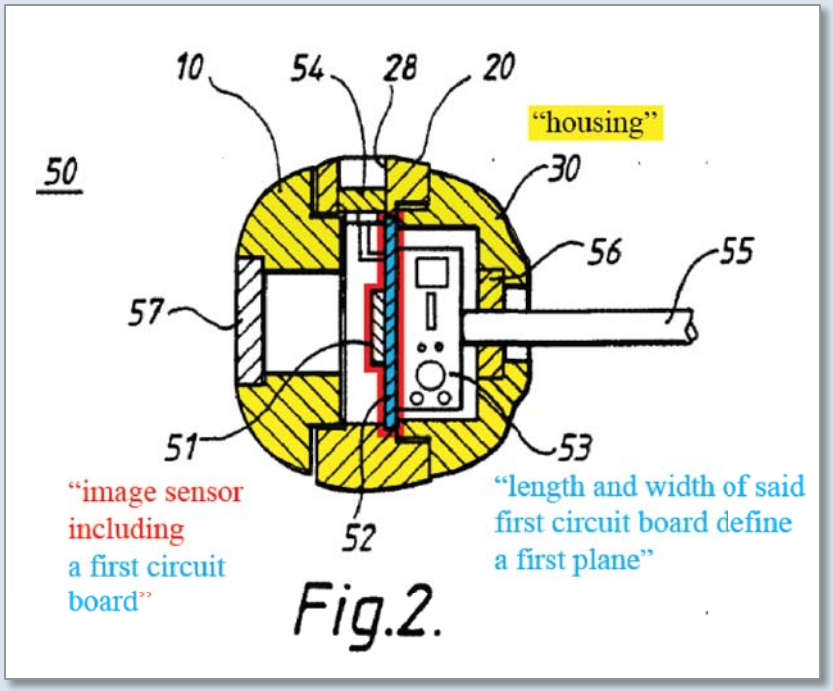
**Dr. Neikirk:** "There is no disclosure in Swift that describes what circuitry is included within 201."

-00512 Neikirk Reply ¶14; -00512 Reply 5-6.

**“said first circuit board further including timing and control circuitry thereon” (’052, claim 2)**

# Swift in View of Ricquier Renders Obvious a First Circuit Board Including Timing and Control Circuitry

**Swift:** "circuit board 52"




Swift, Fig. 2; -00512 Neikirk ¶253; -00512 Pet. 31.

**Ricquier:** "In order to limit the complexity of the timing controller (realised in an off-chip driving unit) only timing configurations of some very common patterns are provided…."

Ricquier, 4; -00512 Neikirk ¶262; -00512 Pet. 36.

**Ricquier:** "Based on X-Y addresses and control pulses generated by an external driving unit, two decoders drive one particular row selection and column selection signal."

Ricquier, 3; -00512 Neikirk ¶262; -00512 Pet. 35.

**Dr. Neikirk:** **"**While Swift discloses that it's 'image sensor 51' is preferably a 'CMOS … Active Pixel Sensor' (Swift, 10:1-6), Swift does not expressly disclose … how the timing of its 'image sensor 51' is controlled other than referring to 'selection and readout circuitry.' Ricquier expressly provides this additional implementation detail and discloses that a 'timing controller' generates the 'X-Y addresses and control pulses' and uses 'decoders [to] drive … row selection and column selection signal' from the 'X-Y addressable photodiode array.'"

-00512 Neikirk ¶261; -00512 Pet. 34-.

# A POSITA Would Have Been Motivated to Apply Ricquier's Teachings to Swift

**Ricquier:** "This square 256*256 imager was fabricated in a standard 1.5 µm CMOS technology. The readout occurs in two phases. … By controlling the sequence of addresses and reset pulses of the amplifiers, charges of different pixels are accumulated. This way multiple resolutions can be programmed. The imager is operated at data rates upto 10 MHz providing about 125 full images per second. At lower resolution, even higher frame rates are obtained. ... [¶] … A CMOS technology was chosen because it offers the selective addressability…."

Ricquier, 2; -00512 Neikirk ¶239; -00475 Pet. 23-24.

- As Dr. Neikirk testified:

**Dr. Neikirk:** "A person of ordinary skill in the art would have been further motivated to apply Ricquier's known teachings in implementing Swift's image sensors because of Ricquier's advantages of using an 'timing controller' that can be located off-chip, which adds flexibility in selecting from the several design choices for 'fitting … the components into the available space' and 'plac[ing]' circuitry on 'various layers' arranged 'stackwise' to 'allow for a more compact camera head. … Specifically, a person of ordinary skill in the art would have been motivated to apply Ricquier's teachings of an off-chip timing and control circuitry in implementing Swift's image sensor by locating the timing and control circuitry on, for example, on the opposite side of Swift's 'circuit board 52' to 'image sensor 51' in order to minimize the camera's overall size."

-00512 Neikirk ¶239 (citing Ricquier, 2-4; Tanuma 4-5; Suzuki, Fig. 2, Ex. 1045 (PCB Design), 15, 20; -00512 Pet. 23-24; *see also* Suzuki 4:58-61; -00512 Neikirk ¶288.

- Locating circuitry on opposite sides of a circuit board was well-known:

**Ex. 1045 (A Guide to Printed Circuit Board Design):** "As the layout is being developed - and probably at a very early stage - the designer will be able to decide an important and fundamental feature of the PCB - namely whether the board material will be single- or double-sided."

Ex. 1045 (A Guide to Printed Circuit Board Design) 20; -00512 Neikirk ¶239; -00512 Pet. 23-24.

**Ex. 1016 (Tanuma):** "[S]olid state imaging element chip 1, which is loaded onto package mount 2…. A portion of the chip components 6a that make-up the matching circuit that are also on the underside of package mount 2 are directly secured by solder. … [¶] [T]his application example does not require many lead wires, so there is a high degree of reliability, and excellent matching characteristics because of the matching circuit board forming a single unit, allowing for a more compact camera head.

Ex. 1016 (Tanuma), 4-5; Fig. 2; -00512 Neikirk ¶239; -00512 Pet. 22-23.

*See also*, Suzuki, 4:58-61, Fig. 2; -00512 Neikirk ¶288; -00512 Neikirk Reply ¶22; -00512 Pet. 22-23,49; -00512 Reply 8-14.

# A POSITA Would Have Been Motivated to Apply Ricquier's Teachings to Swift

> ***Cellect argues:*** "***[A] POSITA*** at the time of the invention ***would not have modified Swift with Ricquier's off-chip driving unit if the goal was to 'minimize the device's size or profile area,'*** as asserted in the Petition."

-00512 POR 28-29; -00512 POSR 16.

> ***Cellect argues:*** "***Petitioner's argument that 'a POSITA would have been further motivated*** to apply Ricquier's known teachings in implementing Swift's CMOS solid-state imager ***because of Ricquier's express advantages*** of 'selective addressability' and 'multiple resolutions … [and] data rates up to 10 MHz' ***is*** also ***meritless***. Petition at 24. Because ***Swift*** discloses a camera based on Dr. Fossum's CMOS imager, its pixel array ***already enjoys that advantage***."

-00512 POR 33; -00512 POSR 15-16.

> ***Cellect argues:*** "[B]ecause ***a POSITA never would have moved Swift's timing and control circuitry off chip*** in the first place (absent the teachings of the '052 Patent), Petitioner's ***arguments directed to the alleged 'flexibility'*** afforded by the proposed modification ***are*** the product of ***hindsight***."

-00512 POR 30; -00512 POSR 4.

- But, Swift is not a camera-on-a-chip (*see* Slide 51) and does not teach the location of its timing and control circuitry (*see* Slide 56)
- And, in addition to Ricquier's express benefits, as Neikirk explained:

> **Dr. Neikirk:** "…Ricquier's advantages of using an 'timing controller' that can be located off-chip, which adds flexibility in selecting from the several design choices for 'fitting … the components into the available space' and 'plac[ing]' circuitry on 'various layers' arranged 'stackwise' to 'allow for a more compact camera head.' … Specifically, a person of ordinary skill in the art would have been motivated to apply Ricquier's teachings of an off-chip timing and control circuitry in implementing Swift's image sensor by locating the timing and control circuitry on, for example, on the opposite side of Swift's 'circuit board 52' to 'image sensor 51' in order to minimize the camera's overall size."

-00512 Neikirk ¶239 (citing Ricquier, 2-4; Tanuma 4-5; Suzuki, Fig. 2, Ex. 1045 (PCB Design), 15, 20; -00512 Neikirk Reply ¶¶22, 28-29; -00512 Pet. 22-24; -00512 Reply 8-14.

- And, locating circuitry on opposite sides of a circuit board was well-known (*see* Slide 57)

# Ricquier Discloses a CMOS Imager with an Off-Chip Timing Controller

***Cellect argues:*** "***Ricquier provides a proof-of-concept for using a CMOS imager*** for machine vision applications."

-00512 POR 32-33; -00512 POSR 14-15.

***Cellect argues:*** "***Ricquier*** explicitly ***teaches away from the off-chip driver*** utilized in its tests."

-00512 POR 34-35.

***Cellect argues:*** "***Petitioner*** selectively ***ignores*** that express ***statements in Ricquier regarding its goal to*** design a fully integrated system (*i.e.*, integration of all circuitry) for machine vision application to ***adopt the APS CMOS camera-on-a-chip design***."

-00512 POSR 14.

- But Ricquier instead teaches:

**Ricquier:** "A CMOS technology was chosen because it offers the selective addressability together with the possibility of further cointegration of processing electronics on the same chip."

Ricquier, 2; POR 34.

**Ricquier:** "Our work is closely related to this research, emphasizing the development of a multi-purpose flexible sensor architecture that can be used as a module in further sensor systems on a single chip."

Ricquier, 3; POR 34.

- And, as Dr. Neikirk testified:

**Dr. Neikirk:** "[C]ontrary to Patent Owner's assertion, Ricquier never characterizes its imager device as 'a test setup,' or a 'proof of concept,' nor does it characterize its imager device as 'a bench-test setup' as Dr. Lebby opined."

-00512 Neikirk Reply ¶30; -00512 Reply 14-15.

**Dr. Neikirk:** "[T]hese statements are directed toward possible future developments and do not suggest that using 'off-chip' architecture is discouraged. Ricquier 2-3; Neikirk Decl., ¶¶163-165. Moreover, these statements do not suggest that further cointegration of Ricquier is mandatory nor that such cointegration would necessarily include Ricquier's off-circuit driving unit."

-00512 Neikirk Reply ¶30; -00512 Reply 14-15.

- Moreover, as the Federal Circuit has held:

**Federal Circuit:** "A reference that 'merely expresses a general preference for an alternative invention but does not criticize, discredit, or otherwise discourage investigation into' the claimed invention does not teach away."

*Meiresonne v. Google, Inc.*, 849 F.3d 1379, 1382 (Fed. Cir. 2017); -00512 Reply 14.

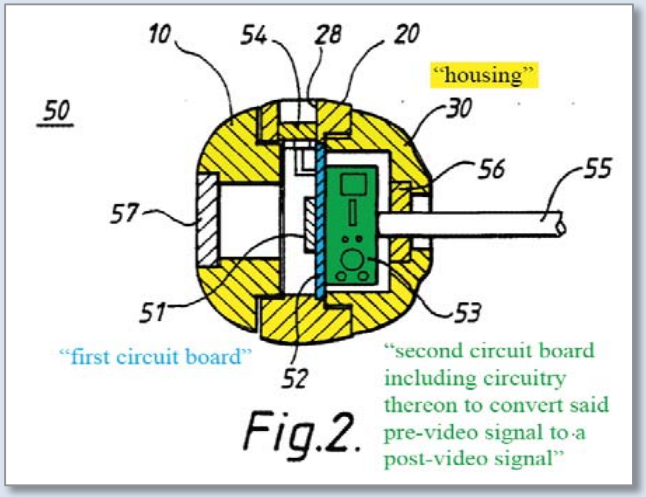
**“said second circuit board including circuitry thereon to convert said pre-video signal to a post-video signal, said second circuit board being positioned in a stacked arrangement with respect to said first circuit board” (’052, claim 2)**

# Swift Discloses the Claimed Arrangement

- Swift discloses that the conversion circuitry is located on "circuit board 53"

**Swift:** "An image sensor 51 is mounted on a circular printed circuit board 52…. A further printed circuit board 53 is mounted on the first printed circuit board 52, substantially at right angles thereto. Various circuitry components are mounted on the circuit board 53, to provide power to the image sensor 51, process image signals received therefrom, and also to process audio signals from a miniature microphone 54 which is mounted within the radially extending passage 28 and connected to the printed circuit board 52 and/or 53. A cable 55 is connected to the printed circuit board 53,…"

Swift, 8:33-9:18; -00512 Neikirk ¶¶231,269; -00512 Pet. 17, 39.




Swift, Fig. 2; -00512 Neikirk ¶269; -00512 Pet. 41.

- As Dr. Neikirk testified:

**Dr. Neikirk:** "[W]hile Swift shows circuit board 53 at a right angle to image sensor 51 in Figure 2, a person of ordinary skill in the art would have understood Swift to also teach circuit board 53 parallel to circuit board 52."

-00512 Neikirk ¶232; -00512 Pet. 18.

**Swift:** "In this specification, terms of absolute orientation are used conveniently to denote the usual orientation of items in normal use and/or as shown in the accompanying drawings. However, such items could be disposed in other orientations, and in the context of this specification, terms of absolute orientation, such as 'top', 'bottom', 'left', 'right', 'vertical' or 'horizontal', etc. are to be construed accordingly, to include such alternative orientations."

Swift, 18:25-33; -00512 Neikirk ¶232; -00512 Pet. 18.

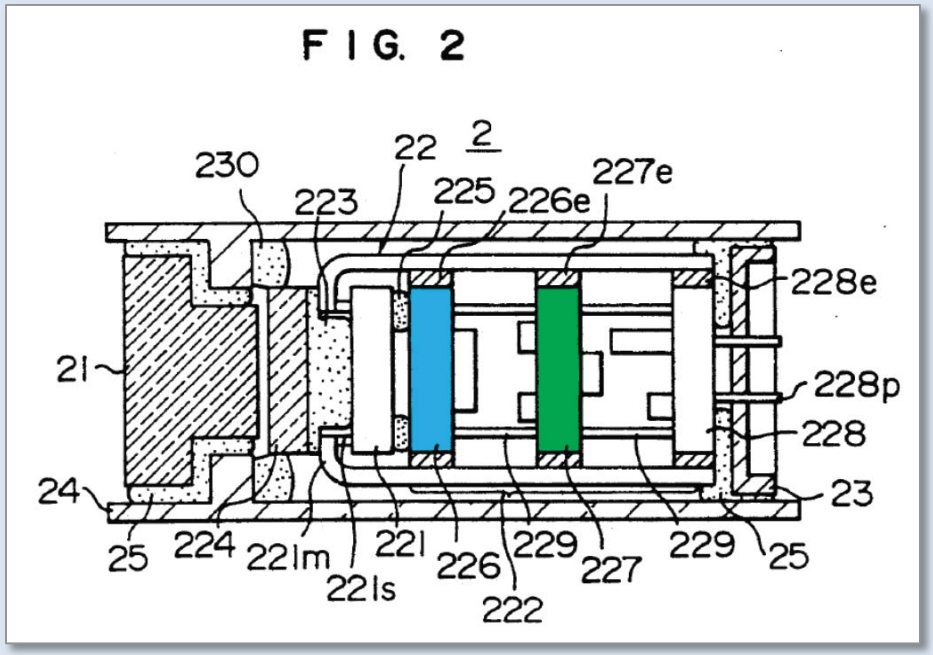
**Swift:** "If desired, the rear housing portion 30 may be replaced by another portion of different configuration, designed to accommodate additional components or different components of different configurations."

Swift, 10:12-16; -00512 Neikirk ¶¶232, 270; -00512 Pet. 18, 39.

**Dr. Neikirk:** "At minimum, a person of ordinary skill in the art would have been motivated to orient the circuit board 53 in this manner to allow the device to be more compact."

-00512 Neikirk ¶¶232, 270; -00512 Pet. 18, 38-39.

# Swift (as modified by Ricquier) in Further View of Suzuki Renders Obvious the Claimed Arrangement




Suzuki, Fig. 2; -00512 Neikirk ¶271; -00512 Pet. 43.

**Suzuki:** "The **chip-connecting board 226**, the **circuit board 227** and the connector board 228 are arranged in such a manner that their side electrodes 226e, 227e and 228e are disposed in registry with one another, and these three boards are aligned with each other."

Suzuki, 3:15-25; -00512 Neikirk ¶¶243-244, 271-273; -00512 Pet. 41-43.

- As Dr. Neikirk testified:

**Dr. Neikirk:** "By applying the above teaching of Suzuki in implementing Swift's teachings of a miniature camera (as modified by Ricquier's teachings) the camera's overall size would be reduced, furthering Swift's express objective of make the 'camera … as small as possible, so that it may be located discretely in such a way that it is not readily observed.'"

-00512 Neikirk ¶243 (quoting Swift, 1:10-13); -00512 Pet. 24-26.

# Swift Expressly Discloses the Claimed Circuitry on a Second Circuit Board to Convert the Pre-Video Signal to a Post-Video Signal

***Cellect argues:*** "***Swift never states*** that circuit board 53 includes 'circuitry… to convert said pre-video signal to a post-video signal.' Lebby, ¶ 124. The evidence cited in the Petition only states that Swift's camera outputs a signal that may be viewed on a monitor, not that ***the circuitry component mounted on circuit board 53 is responsible for converting a pre-video signal to a post-video signal***."

-00512 POR 36-37; -00512 POSR 12, 20-21.

- But, Swift discloses:

**Swift:** "Various circuitry components are mounted on the circuit board 53, to provide power to the image sensor 51, process image signals received therefrom, and also to process audio signals from a miniature microphone 54 which is mounted within the radially extending passage 28 and connected to the printed circuit board 52 and/or 53. A cable 55 is connected to the printed circuit board 53,…"

Swift, 9:7-18; -00512 Neikirk ¶¶236, 268-273; -00512 Neikirk Reply ¶43; -00512 Pet. 38-40; -00512 Reply 21.

**Swift:** "The camera 152 and monitor 154 are connected by means of a cabling system 160."

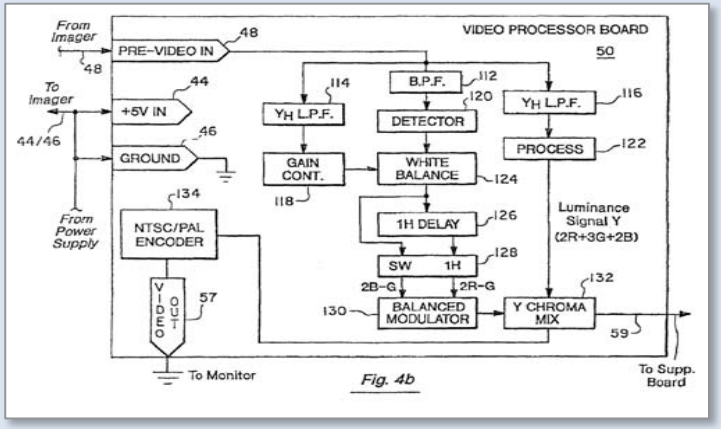
Swift, 15:13-14; -00512 Neikirk ¶¶236, 268-273; -00512 Neikirk Reply ¶43; -00512 Pet. 38-40; -00512 Reply 21.

***Cellect argues:*** "For example, as shown ***in Fig. 4b of the '052 Patent, the term video processing does not mean*** or even imply ***converting a 'pre-video signal to a post-video signal.'***" -00512 POR 37.

- But, the '052 explains:

**'052:** "FIG. 4b is an enlarged schematic diagram of a video processing board having placed thereon the processing circuitry which processes the pre-video signal generated by the array of pixels and which converts the pre-video signal to a post-video signal which may be accepted by a standard video device."

'052, 7:9-14, Fig. 4b; -00512 Neikirk Reply ¶44; -00512 Reply 22.




PETITIONER'S DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

# Suzuki is not limited to CCD technology

***Cellect argues:*** "***Suzuki*** refers to a solid-state imager and ***describes a conventional CCD device design*** used in 1991 (when Suzuki was filed). See supra Ex. 2092 at 8. The fact that Suzuki's circuit board 227 includes '***a circuit for driving the solid-state image pickup chip 221 and a circuit for amplifying the video signal*** from the solid-state image pickup chip 221' ***separate from the image pickup chip tells*** a POSITA ***that Suzuki describes a CCD*** imaging sensor. … Petitioner cites ***Suzuki*** for its disclosure of a stacked arrangement of circuit boards, which are ***incompatible with Swift's CMOS sensor embodiment***."

-00512 POR 18, 24-25, 35; -00512 POSR 14, 18.

- But Suzuki teaches a "solid-state image pickup chip" and does not limit the type to a CCD (*see* Slide 47)
- And, as Dr. Neikirk testified, "off-chip driving and amplification circuits do not limit Suzuki to a CCD" (*see* Slide 47)
- Moreover, CMOS imagers with off-chip circuitry were well-known (*see* Slides 11-12)

***Cellect argues:*** "***Suzuki claims priority to an application filed in 1990, prior to the introduction of CMOS imagers***…. Ex. 2092 at 8. A POSITA ***therefore*** recognizes that ***Suzuki's "solid-state image pickup device" uses CCD*** technology, not CMOS."

-00512 POR 24.

- CMOS image sensors were known prior to 1990:

**Ex. 1090 (Renshaw) (dated May 3, 1990):** "This paper describes two image array sensors designed and fabricated using a standard 2 level metal ASIC CMOS process."

Ex. 1090 (Renshaw), 3038, Fig. 1; -00512 Neikirk Reply ¶35; -00512 Reply 18.

**Ex. 1089 (Shizukuishi) (granted June 20, 1989):** "[T]he present invention uses a CMOS IC manufacturing process to provide a solid state pickup device, comprising a photosensitive section having a plurality of charge accumulation regions respectively corresponding to picture elements, transfer means for transferring the signals accumulated in the charge accumulation regions therefrom, and a peripheral circuit integrally formed with the photosensitive section on one and the same semiconductor substrate."

Ex. 1089 (Shizukuishi), 2:47-68, Abstract; -00512 Neikirk Reply ¶35; -00512 Reply 18.

**“wherein a largest dimension of said image sensor along said first plane is between 2 and 12 millimeters” (‘052 claim 2)**

# Swift in View of Ricquier and Suzuki Renders Obvious the Dimension Limitation

**Suzuki:** "[I]n the case where the solid-state image pickup chip of 1/3 inch (8.5 mm) is used, the outer diameter of the camera head is about 10 mm, and therefore is smaller about 5 mm than that of the conventional camera head."

Suzuki, 4:6-11; -00512 Neikirk ¶¶243, 288; -00512 Pet. 24-26, 49.

**Suzuki:** "[T]he outer diameter of the camera head can be reduced to a small size close to the diagonal length of the solid-state image pickup chip. This provides an advantage that an image of a narrow portion, such as the interior of a pipe and the interior of a precision machine, can be picked up…."

Suzuki, 4:58-65; -00512 Neikirk ¶288; -00512 Pet. 49.

**Suzuki:** "With this arrangement, not only the solid-state image pickup chip but also the boards including the electric circuits parts can be sealed, and therefore the stability and reliability of the circuit are advantageously enhanced…."

Suzuki, 4:30-45; -00512 Neikirk ¶244; -00512 Pet. 26.

- As Dr. Neikirk testified:

**Dr. Neikirk:** "A person of ordinary skill in the art would have been motivated to apply Suzuki's known teachings of an image sensor comprising a 'chip-connecting board 226' between 8.5 and 10 mm in implementing Swift's teachings of a miniature camera (as modified by Ricquier's teachings) such that the miniature camera's overall size is reduced thus improving the camera device's 'stability and reliability.'"

-00512 Neikirk ¶¶244-245; -00512 Pet. 26-27.

- Moreover, as the Federal Circuit has held:

**Federal Circuit:** where "difference[s] between the claimed invention and the prior art is some range or other variable within the claims…applicant must show the particular range is critical, generally by showing that the claimed range achieves unexpected results relative to the prior art range."

*In re Woodruff*, 919 F.2d 1575, 1578 (Fed. Cir. 1990);
*see also Gardner v. TEC Systems*, 725 F.2d 1338, 1345-49 (Fed. Cir. 1984); MPEP § 2144.04 IV; -00512 Reply 20.

# Swift in View of Ricquier and Suzuki Renders Obvious the Dimension Limitation

> ***Cellect argues:*** "***Swift discloses a camera having far larger dimensions than*** either ***the imaging device*** recited ***in*** the '052 Patent or ***Suzuki***"

-00512 POR 21-23.

> ***Cellect argues:*** "[E]ven granting Petitioner's assertion that a POSITA would ***modify Swift such that 'circuit board 53 is oriented parallel to circuit board 52,'*** that modification ***would not change the dimensions of circuit board 52, which is far larger than 12mm***."

-00512 POR 22.

- But, Swift discloses:

> **Swift:** "[T]he miniature camera 50 may have very small dimensions. **For example**, the maximum diameter **of the housing** may be 38mm, and the overall length of the housing may be 38mm."

Swift, 9:30-34; -00512 Neikirk ¶245; -00512 Pet. 26.

- As Dr. Neikirk testified:

> **Dr. Neikirk:** "Swift's discloses an 'example' of the 'maximum' dimension of the camera's outer housing of 38 mm, but the maximum outer dimension of a camera does not determine the minimum size for the housing and, more specifically, [nor] does it suggest the size of the image sensor along said first plane within the housing (defined by the first circuit board as required by claim 2). Swift, 9:30-34. Indeed, a 'maximum' size of 38mm as disclosed by Swift only further confirms that Suzuki's teaching of a 'chip-connecting board 226' having a diagonal length between 8.5 and 10mm would be a practical choice that would fit when implementing Swift's miniature camera (as modified by Ricquier)—satisfying claim 2's size limitation."

-00512 Neikirk Reply ¶38; ; -00512 Reply 19; *see also* -00512 Neikirk ¶¶285-289; -00512 Pet. 24-27, 48-50.

- It would have been obvious to orient the circuit boards 52 and 53 parallel to one another (*see* Slides 61-62)
- And, a POSITA would have been motivated to apply Suzuki's teachings of a "chip-connecting board 226" between 8.5 and 10 mm in implementing Swift's teachings of a miniature camera (*see* Slide 62)

**“an imaging device comprising: … an image sensor mounted in said housing… a video screen” (‘052, claim 2)**

## To the Extent the Claims Require a Camera and Video Monitor in the Same Physical Housing, Larson in View of Swift, Ricquier, and Suzuki Renders This Limitation Obvious

**Larson:** "[T]he videophone … incorporates a flat panel liquid crystal display (LCD) for displaying images … [¶] For example, the LCD can be a 128×112 picture element (pixel) color LCD. … The images are transduced and digitized by a charge coupled device (CCD) chip video camera having a plastic lens. … The LCD and the CCD video camera are preferably mounted in a tilt and swivel housing for ease of positioning the video camera and viewing screen to facilitate use of the videophone in accordance with one embodiment of the invention. This also enables the videophone of the invention to be housed in a compact housing."

Larson, 7:8-27, Fig. 8B1; -005l2 Neikirk ¶291; -00512 Pet. 50.

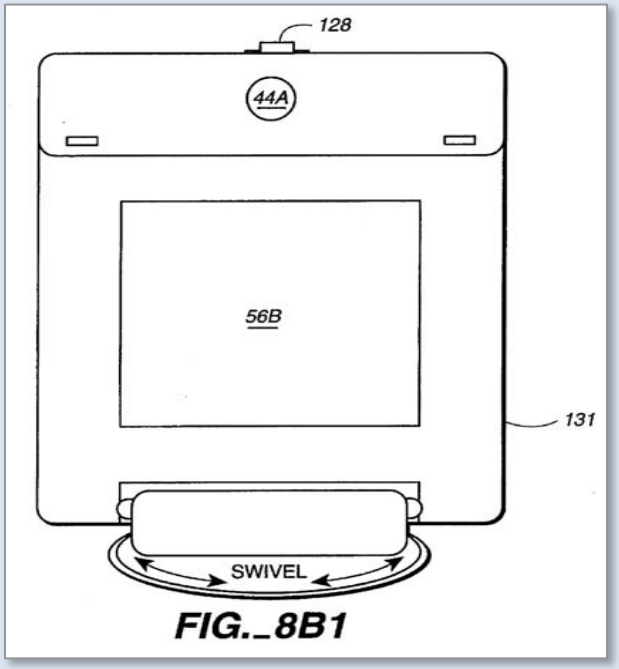


FIG._8B1

**Swift:** "Miniature cameras are finding increasing application in surveillance and security systems, and also in automated inspection apparatus, and for incorporation in other devices. In such systems, it is often desirable for a camera to be as small as possible, so that it may be located discretely in such a way that it is not readily observed.

Swift, 1:7-13; -005l2 Neikirk ¶294; -00512 Pet. 52.

- And, as Dr. Neikirk testified:

**Dr. Neikirk:** "[A] person of ordinary skill in the art would have been motivated and found it advantageous to apply the teachings of Swift's miniature camera (as modified by Ricquier's and Suzuki's teachings) … in implementing Larson's 'camera' in the 'videophone' with a 'compact housing.'"

-00512 Neikirk ¶¶295, 290-294; -00512 Pet. 52.

## To the Extent the Claims Require a Camera and Video Monitor in the Same Physical Housing, Larson in View of Swift, Ricquier, and Suzuki Renders This Limitation Obvious

***Cellect argues:*** "***A POSITA would not have replaced the CCD image sensor in Larson with a CMOS image sensor***, especially not a passive pixel sensor (in Ricquier) used for machine vision applications."

-00512 POR 38; -00512 POSR 21-23.

- The Petition sets forth motivations to apply the teachings of Swift's miniature camera (as modified by Ricquier's and Suzuki's teachings) in implementing Larson's "camera" in the "videophone" with a "compact housing." (*See* Slide 69)

- Moreover, the '052 admits numerous advantages of CMOS image sensors over CCDs (*see* Slide 17)

# No Evidence of Secondary Indicia of Non-Obviousness

# There Is No Nexus Between the Purported Secondary Considerations and the Claimed Invention

***Cellect argues:*** "The non-obviousness of the claims are also supported by ***strong secondary considerations of non-obviousness***, including ***long-felt need, unexpected results, industry praise, and commercial success*** of the patented invention."

-00475 POR 58; -00512 POR 39.

- But, as the Federal Circuit has held:

**Federal Circuit:** "For objective evidence to be accorded substantial weight, its proponent must establish a nexus between the evidence and the merits of the claimed invention."

*In re GPAC Inc.*, 57 F.3d 1573, 1580 (Fed. Cir. 1995).

**Federal Circuit:** "To be afforded substantial weight, the objective indicia of non-obviousness must be tied to the novel elements of the claim at issue."

*Institut Pasteur v. Focarino*, 738 F.3d 1337, 1347 (Fed. Cir. 2013).

**Federal Circuit:** "A nexus may not exist where, for example, the merits of the claimed invention were 'readily available in the prior art.'"

*ClassCo, Inc. v. Apple, Inc.*, 838 F.3d 1214, 1220 (Fed. Cir. 2016)

*See also* -00475 Neikirk ¶¶296-301; -00512 Neikirk ¶¶296-301; -00475 Neikirk Reply ¶¶57-61; -00512 Neikirk Reply ¶¶48-53; -00475 Pet. 84; -00512 Pet. 53; -00475 Reply 27-30; -00512 Reply 24-27.

# There Is No Evidence that '052 Led to Commercial Success or Licensing

***Cellect argues:*** "The fact that ***companies have taken a license to the '052 Patent*** is powerful evidence of non-obviousness."

-00475 POR 60; -00512 POR 41.

- But, as Dr. Neikirk testified:

**Dr. Neikirk:** "Patent Owner's evidence (Ex. 2074 (Micro Imaging Solutions' website)) simply contains generic statements that it has licensed its 'technology.' *See* POR 60-61. Patent Owner has presented no evidence on what product(s) or patents were allegedly licensed or that such product(s) practiced any Challenged Claims."

-00475 Neikirk Reply ¶58; -00512 Neikirk Reply ¶49.

**Federal Circuit:** "[T]he mere fact of licensing alone cannot be considered strong evidence of nonobviousness if it cannot also be shown that the licensees did so out of respect for the patent rather than to avoid the expense of litigation."

*In re Affinity Labs of Tex.*, 856 F.3d 883, 901 (Fed. Cir. 2017).
-00475 Reply 28; -00512 Reply 25.

# PO's Allegations of Long Felt But Unresolved Need Are Not Tied to the Challenged Claims

> ***Cellect argues: "Industry publications … recognized the contribution to the art by Patent Owner's reduced area imaging device*** as incorporated in an endoscope that ***addressed a long felt need for a smaller imaging device in endoscopes.***"

-00475 POR 62; -00512 POR 42; -00475 POSR 24-25; -00512 POSR 23-25.

- But, as the Federal Circuit has held:

> **Federal Circuit:** "[Where offered secondary consideration] results from something other than what is both claimed and novel in the claim, there is no nexus to the merits of the claimed invention."

*In re Huai-Hung Kao*, 639 F.3d 1057, 1068 (Fed. Cir. 2011).

- PO's evidence states:

> **Orthopaedic Product News in July 2007:** "A Denver-based company has developed and patented high resolution, sturdy and inexpensive CMOS sensors … built into the distal tip of arthroscopes, as well as other commonly used endoscopes…. [¶] It is evident that we have needed an appropriate and thoughtful improvement to the scope and video system as we currently know it. The development of the CMOS sensor has addressed the needs of the surgeon, surgical facility and the patient while addressing the important issues of video image, thoughtful design and cost-effectiveness. This disposable scope system represents a significant advancement for arthroscopists, cost-conscious hospitals and surgery centers."

Ex. 2089 (Orthopaedic Product News), 2-3.

- As Dr. Neikirk testified:

> **Dr. Neikirk:** "[T]he cited articles credit the development of CMOS sensors generally.... However, as the '052 patent itself admits, CMOS sensors were not novel."
>
> "[This] article[] do[es] not specify any particular product, but describe[s] the general development of disposable arthroscopes and endoscopes that use a CMOS sensor located at the distal tip of the scope. The praise for this 'disposable scope system' is directed primarily to the unclaimed feature of disposability. … The claims of the '052 patent do not require a disposable scope with a 'high resolution, sturdy and inexpensive CMOS sensor[] … built into the distal tip of arthroscopes [and] … endoscopes.' There is no nexus between these statements and the Challenged Claims…."

-00475 Neikirk Reply ¶59 (citing Ex. 2089, 2-3; '052, 1:57-3:23); -00512 Neikirk Reply ¶50. -00475 Pet. 84; -00512 Pet. 53; -00475 Reply 28; -00512 Reply 25-26.

# Cellect's Purported Industry Skepticism Is Not Tied to the Challenged Claims

***Cellect argues:*** "[T]he ***industry skepticism*** for the patented invention of the Challenged Claims, which is based on a claimed element of the Challenged Claim, ***is yet further evidence of nonobviousness.***"

-00475 POR 63 (citing Ex. 1003 at 85 (Adair Declaration)); -00512 POR 43-44.

***Adair (named inventor) declaration:*** "There has been great ***skepticism in the industry as to the capability to use CMOS technology in medical imaging applications***. CMOS imagers have been characterized as not being able of producing high quality images. Despite this skepticism, we were able to locate companies developing CMOS technology that might be useable within an imaging device ... [that] utilize[] a CMOS pixel array with timing and control placed together on one plane or circuit board, and remaining processing circuitry either placed in a remote control box, or on other circuit boards placed closely adjacent the CMOS pixel array."

-00475 POR 63 (citing Ex. 1003 at 85 (Adair Declaration)); -00512 POR 44-43.

- But, as Dr. Neikirk testified:

**Dr. Neikirk:** "Likewise, I have reviewed Mr. Adair's declaration (Ex. 1003 at 83-89) on which Patent Owner bases its allegations of industry skepticism and unexpected results. [-00475 POR 63/-00512 POR 43-45]. Again, there is no nexus between Patent Owner's purported industry skepticism and unexpected results and the Challenged Claims. With respect to industry skepticism, the declaration specifies that '[t]here has been great skepticism in the industry as to the capability to use CMOS technology in medical imaging applications' because 'CMOS imagers have been characterized as not being capable of producing high quality images.' Ex. 1003 at 84. The Challenged Claims, however, do not have any limitations specific to 'medical applications' or the improvement CMOS image quality."

-00475 Neikirk Reply ¶60; -00512 Neikirk Reply ¶51; -00475 Neikirk ¶¶287-289; -00512 Neikirk ¶¶287-289; -00475 Pet. 84; -00512 Pet. 53; -00475 Reply 28-29; -00512 Reply 26.

**Federal Circuit:** "[S]elf-serving statements from researchers about their own work do not have the same reliability [as praise from the industry]."

*In re Cree, Inc.*, 818 F.3d 694, 702 (Fed. Cir. 2016); *see also Stride Rite Children's Grp. v. Shoes by Firebug*, IPR2017-01810, Pap. 66, *51-52 (finding "self-serving testimony from a highly-interested witness" to be "very weak evidence").
-00475 Reply 29; -00512 Reply 26-27.

# It Was Well-Known to Locate Processing Circuitry Separate From a CMOS Image Sensor; CMOS Resistance to EMI/RFI Was Not Unexpected

***Cellect argues:*** "Prior to the '052 Patent, the ***accepted wisdom in the art was that CMOS imagers should be implemented in an on-chip integration manner***."

-00475 POR 66-67; -00512 POR 46-47.

***Cellect argues: "CMOS was unexpectedly more resistant to EMI/RFI*** and generated lower ***EMI/RFI noise*** in these environments. Ex. 1003 at 85 (¶ 10, 11); Ex. 2088 ¶ 17."

-00475 POSR 25, n. 4; -00512 POSR 24, n. 1; -00475 POR 64; -00512 POR 44-45.

- But, as PO admits, "conventional" CMOS image sensors did not implement "much of the timing, control, and signal processing circuitry on to the same silicon die" (*see* Slide 12)
- As Dr. Neikirk testified:

**Dr. Neikirk:** "Swift discloses placing the processing circuitry on a separate circuit board placed closely adjacent the CMOS pixel array … and Monroe discloses removing the processing circuitry from the image sensor and placing it in a remote control box…, it was already known to locate the processing circuitry away from the image sensor, and the results of doing so (*e.g.*, decreased interference) were already known and utilized in the field."

-00475 Neikirk ¶¶299 (citing Monroe, 3:57-62, 8:8-11, Fig. 3), 76-77 (citing Swift, 8:33-9:21, Fig. 2), 229-232; -00512 Neikirk ¶¶76-77, 229-232, 299; -00475 Neikirk Reply ¶61; -00512 Neikirk Reply ¶53; -00475 Pet. 24-25; -00512 Pet. 15-18, 29-31; -00475 Reply 29; -00512 Reply 26-27.

**Dr. Neikirk:** "My understanding of these noise benefits is that they were not unexpected, but were instead predictable. ... Moreover, while the declaration does not clearly state how many wires were in the CCD system at issue, a person of ordinary skill in the art would have understood that such EM radiation would cause radio frequency interference ('RFI') in a system, and would have a more significant adverse effect on a system with more wires than a system with fewer wires. It was also known that a CCD sensor could have many more wires than a CMOS sensor. For example, according to the declaration, the prior art CCD sensor identified in the declaration ('Pelchy') includes 'a large number of transmissions wires 33 which interconnect the circuit boards placed perpendicular to the pixel array with an external processor 13.' '839 File History, 92. Thus, in a CCD sensor with many wires, the radio frequency interference would have a relatively large effect on the quality of images produced by the image sensor. On the other hand, CMOS sensors require only a few wires to connect to the pixel array, and thus interference created in a CMOS image sensor would be much smaller than in such a CCD arrangement."

-00475 Neikirk ¶299; -00512 Neikirk ¶299; -00475 Neikirk Reply ¶61; -00512 Neikirk Reply ¶53; -00475 Pet. 84; -00512 Pet. 53; -00475 Reply 29; -00512 Reply 26-27.