

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

**SAMSUNG ELECTRONICS CO., LTD, and
SAMSUNG ELECTRONICS AMERICA, INC.,**

Petitioners,

v.

CELLECT, LLC,

Patent Owner.

**DECLARATION OF DEAN P. NEIKIRK, PH.D. IN SUPPORT OF
PETITION FOR *INTER PARTES* REVIEW OF
U.S. PATENT NO. 6,982,742**

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I, Dean P. Neikirk, Ph.D., hereby declare under penalty of perjury:

I. INTRODUCTION

1. I have been retained on behalf of Samsung to provide assistance regarding U.S. Patent No. 6,982,742 (“the ’742 patent,” Ex. 1001) in connection with Samsung’s Petition for *Inter Partes* Review.¹ Specifically, I have been asked to consider the validity of claims 22, 42, 58, and 66 of the ’742 patent (the “Challenged Claims”). I have personal knowledge of the facts and opinions set forth in this declaration, and, if called upon to do so, I would testify competently thereto.

2. I am being compensated for my time at my standard rate of \$600/hr. My compensation is based solely on the amount of time that I devote to activity related to this case and is in no way contingent on the nature of my findings, the presentation of my findings in testimony, or the outcome of this or any other proceeding. I have no other financial interest in this proceeding. My opinions are based on my years of education, research and experience, as well as my investigation and study of relevant materials, including those cited herein.

3. I may rely upon these materials, my knowledge and experience, and/or additional materials to rebut arguments raised by the Patent Owner. Further, I may

¹ Where appropriate, I refer to exhibits that I understand are filed with the Petition for *Inter Partes* Review of the ’742 Patent.

also consider additional documents and information in forming any necessary opinions, including documents that may not yet have been provided to me.

4. My analysis of the materials produced in this proceeding is ongoing and I will continue to review any new material as it is provided. This declaration represents only those opinions I have formed to date. I reserve the right to revise, supplement, and/or amend my opinions stated herein based on new information and on my continuing analysis of the materials already provided.

II. BACKGROUND AND QUALIFICATIONS

5. All of my opinions stated in this declaration are based on my own personal knowledge and professional judgment. In forming my opinions, I have relied on my knowledge and experience in designing, developing, researching, and teaching image sensor technology.

6. I received a Bachelor of Science degree from Oklahoma State University, in physics and mathematics, in 1979.

7. Following my undergraduate studies, I attended the California Institute of Technology, where I earned a Master's degree and Doctorate degree in Applied Physics, in 1981 and 1984, respectively.

8. Each of my academic degrees involved significant studies in sensors, including image sensors; optical systems; solid state physics; semiconductor devices; electrical engineering; electronic systems; electromagnetics; radio frequency

systems; and antennas. For example, courses relating to these fields that I took include two years of study in electromagnetics and optics, one year of study in solid state and semiconductor physics, as well as four years of graduate research in electronic devices, antenna design, antenna fabrication, and optical systems.

9. My Ph.D. thesis was on the design and fabrication of high frequency electromagnetic detectors and quasi-optical imaging antenna arrays, including research on integrated-circuit fabrication, semiconductor devices, integrated circuits, antennas, sensors, and IC packaging. I designed and fabricated the first monolithic integrated-circuit imaging antenna array for use in an electronic camera operating at wavelengths in the far infrared (sometimes referred to as the terahertz) region of the electromagnetic spectrum. For this work on the first high resolution focal plane array for use at wavelengths between 0.1 mm and 1 mm, I was awarded the 1984 Marconi International Fellowship Young Scientist Award “for contributions to the development of millimeter wave integrated circuits especially in the area of detectors and imaging arrays.”

A. Research and Teaching Experience

10. My work as a professor began in 1984, when I joined the University of Texas at Austin as an assistant professor. In 1988, I became an associate professor, and in 1992 became a full professor. Today, I continue to be a full professor in the Department of Electrical and Computer Engineering at the University of Texas.

11. Over the years, I have taught a variety of electrical engineering courses at the University of Texas. These include Integrated Circuit Fabrication, VLSI Fabrication Techniques, Ultra Large Scale Integrated Circuit Fabrication Techniques, Integrated Circuit Nanomanufacturing Techniques, Electromagnetics in Packaging, Simulation Methods in CAD/VLSI, Micro-Electromechanical Systems, Electromagnetic Engineering, and Microwave and Radio Frequency Engineering. I have also taught several continuing education courses in these fields.

12. I currently conduct research with students and research scientists in the Microelectromagnetics Research Group in the Microelectronics Research Center at The University of Texas at Austin. My research areas include the fabrication and modeling of electromagnetic micro-machined sensors and actuators. I am also involved in research relating to integrated circuit processing and the high frequency properties of transmission lines. Over the years, I conducted research in the area of wireless sensors for identifying failing bridges and improving the safety of new bridges. I have also conducted research in the areas of electromagnetics, optical devices for use in electronic cameras, manufacturing systems engineering, and solid-state electronics.

13. For over ten years, I served as the Graduate Advisor for the Department of Electrical and Computer Engineering at the University of Texas at Austin, as well as serving for over five years as an Associate Chairman of the Electrical and

Computer Engineering Department. In addition to my current position as a professor in the Electrical and Computer Engineering Department at The University of Texas at Austin, I am also an Associate Dean of Graduate Studies at The University of Texas at Austin.

14. I have also devoted a significant portion of my time at the University to contributing to various technical journals and other publications. My work has been included in 93 referenced archival journal publications, 165 referenced conference proceedings, and 24 published abstracts. I have also contributed to book chapters and technical reports relating to various electrical engineering topics. My publications have addressed technologies such as chemical sensors, integrated circuits for antenna arrays, determining conductor loss in transmission lines, optical and electromagnetic devices for infrared detection, multilayer interconnection lines for high speed digital integrated circuits, RF oscillator circuits, memory-switching double-barrier quantum-well diodes circuits, RF and infrared detection circuits, and other topics related to sensors and optical systems.

15. More information on my research and teaching experience, and my contribution to technical publications, is included in my *curriculum vitae* (Appendix A).

B. Patents Awarded

16. Through my work on sensors and electronic systems, I have been named an inventor on seventeen U.S. patents. These are summarized in my *curriculum vitae* attached as Appendix A.

17. My issued patents include, for example, U.S. Patent No, 5,408,107, titled “Semiconductor Device Apparatus Having Multiple Current-Voltage Curves and Zero-Bias Memory.” This patent is directed to a semiconductor device that can be switched between current-voltage curve settings at higher positive or negative voltages and can be read at lower voltages. As another example, U.S. Patent No. 9,291,586, titled “Passive Wireless Self-Resonant Sensor,” relates to a sensor for detecting materials, including a substrate, a passivation layer formed on the substrate, a high surface area material disposed on the passivation layer, and a self-resonant structure that includes a planar spiral inductor and a plurality of planar interdigitated capacitor electrodes disposed within the passivation layer.

18. Many of my patents are related to sensor arrays used for chemical testing. These include, for example, U.S. Patent 6,589,779: “General signaling protocol for chemical receptors in immobilized matrices,” U.S. Patent 6,602,702: “Detection system based on an analyte reactive particle,” U.S. Patent 7,316,899, “Portable sensor array system,” and U.S. Patent 8,105,849, “Integration of fluids and reagents into self-contained cartridges containing sensor elements.” These patents

resulted from research by my group and my collaborators into new sensor arrays with the capability to use optical effects to perform multi-analyte chemical analysis.

19. Two companies have been founded based on technology developed and patented by my research group and collaborators in the area of chemical sensing arrays. In both cases the technology was developed at The University of Texas at Austin and licensed to start-ups. In one case LabNow, Inc. received \$14 million in first-round venture investment for its point-of-care diagnostic system from the Soros Group, Austin Ventures and other investors to develop the company's technology and to launch its initial product, CD4NowTM, a point-of-care diagnostic tool for HIV/AIDS patients.

C. Other Awards

20. My work as a professor of electrical engineering, and my scholarship in various fields relating to sensors and electronic systems, have been recognized through several awards I have received over the years. As noted in my curriculum vitae (Appendix A), these include the Marconi International Fellowship Young Scientist Award, the Engineering Foundation Faculty Award from the University of Texas at Austin, the General Motors Foundation Centennial Teaching Fellowship, the IBM Corporation Faculty Development Award, the National Science Foundation Presidential Young Investigator, the Lockheed Martin Aeronautics Company Award for Excellence in Engineering Teaching, and various other academic awards.

D. Industry Experience

21. While the majority of my professional experience in electrical engineering has involved research and teaching, I have also provided technical consulting to numerous companies and been involved in academic-industry partnerships. For example, I have provided consulting to Teltech Resource Network, Ardex, Inc., E.P. Hamilton Associates, Burnett Company, Microelectronics and Computer Technology Corporation, and Baker-Hughes. In addition, my work on electro-chemical sensors was selected as a commercialization venture between the University of Texas and LabNow, Inc. Further, my work together with a graduate student relating to actuator stacked microbolometer arrays for multispectral infrared detection was selected for sponsorship by Coventor, Inc., a company that provides software tools for developing microelectromechanical systems, microfluidics, and semiconductor process applications.

E. Professional Society Involvement

22. I have been a Senior Member of the Institute of Electrical and Electronics Engineers (“IEEE”) for more than fifteen years. From March 1991 to October 1994, I served as an Associate Editor for the IEEE publication called “IEEE Transactions on Education.” I also served as a member of the Editorial Board on the IEEE Transactions on Microwave Theory and Techniques in the 1990-2000 timeframe.

23. A detailed description of my professional qualifications, including a listing of my specialties/expertise and professional activities, are contained in my *curriculum vitae* (Appendix A).

III. BASIS OF MY OPINIONS AND MATERIALS CONSIDERED

24. In reaching the conclusions described in this declaration, I have relied on the documents and materials cited herein as well as those identified in Appendix B attached to this declaration. These materials comprise patents, related documents, and printed publications. Each of these materials is a type of document that experts in my field would have reasonably relied upon when forming their opinions and would have had access to either through the applicable patent offices and/or well-known libraries, conferences, publications, organizations and websites in the field as further discussed herein.

25. My opinions are also based upon my education, training, research, knowledge, and personal and professional experience.

IV. LEGAL STANDARDS

A. Priority Dates and Priority Claims

26. I was informed and understand that for a patent to claim the benefit of the filing date of a prior application, the prior application must comply with the written description requirement of 35 U.S.C. § 112. To satisfy the written description requirement, the specification of the prior application must contain a

written description of the invention and the manner and process of making and using it, in such full, clear, concise, and exact terms to enable an ordinarily skilled artisan to practice the invention claimed in the later patent application. Additionally, the priority application must describe the later claimed invention in sufficient detail that a person having ordinary skill in the art can clearly conclude that the inventor invented the claimed invention as of the filing date sought.

B. Obviousness Under 35 U.S.C. §103(a)

27. I understand that a claim may be invalid under 35 U.S.C. § 103(a) if the subject matter described by the claim as a whole would have been obvious to a hypothetical person of ordinary skill in the art in view of a prior art reference or in view of a combination of references at the time the claimed invention was made. Therefore, I understand that obviousness is determined from the perspective of a hypothetical person of ordinary skill in the art and that the asserted claims of the patent should be read from the point of view of such a person at the time the claimed invention was made. I further understand that a hypothetical person of ordinary skill in the art is assumed to know and to have all relevant prior art in the field of endeavor covered by the patent in suit.

28. I have also been advised that an analysis of whether a claimed invention would have been obvious should be considered in light of the scope and content of the prior art, the differences (if any) between the prior art and the claimed invention,

and the level of ordinary skill in the pertinent art involved. I understand as well that a prior art reference should be viewed as a whole.

29. I have also been advised that in considering whether an invention for a claimed combination would have been obvious, I may assess whether there are apparent reasons to combine known elements in the prior art in the manner claimed in view of interrelated teachings of multiple prior art references, the effects of demands known to the design community or present in the market place, and/or the background knowledge possessed by a person having ordinary skill in the art. I understand that other principles may be relied on in evaluating whether a claimed invention would have been obvious, and that these principles include the following:

- A combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results;
- When a device or technology is available in one field of endeavor, design incentives and other market forces can prompt variations of it, either in the same field or in a different one, so that if a person of ordinary skill can implement a predictable variation, the variation is likely obvious;
- If a technique has been used to improve one device, and a person of ordinary skill in the art would recognize that it would improve similar devices in the same way, using the technique is obvious unless its actual application is beyond his or her skill;

- An explicit or implicit teaching, suggestion, or motivation to combine two prior art references to form the claimed combination may demonstrate obviousness, but proof of obviousness does not depend on or require showing a teaching, suggestion, or motivation to combine;
- Market demand, rather than scientific literature, can drive design trends and may show obviousness;
- In determining whether the subject matter of a patent claim would have been obvious, neither the particular motivation nor the avowed purpose of the named inventor controls;
- One of the ways in which a patent's subject can be proved obvious is by noting that there existed at the time of invention a known problem for which there was an obvious solution encompassed by the patent's claims;
- Any need or problem known in the field of endeavor at the time of invention and addressed by the patent can provide a reason for combining the elements in the manner claimed;
- "Common sense" teaches that familiar items may have obvious uses beyond their primary purposes, and in many cases a person of ordinary skill will be able to fit the teachings of multiple patents together like pieces of a puzzle;

- A person of ordinary skill in the art is also a person of ordinary creativity, and is not an automaton;
- A patent claim can be proved obvious by showing that the claimed combination of elements was “obvious to try,” particularly when there is a design need or market pressure to solve a problem and there are a finite number of identified, predictable solutions such that a person of ordinary skill in the art would have had good reason to pursue the known options within his or her technical grasp; and
- One should be cautious of using hindsight in evaluating whether a claimed invention would have been obvious.

30. I further understand that, in making a determination as to whether or not the claimed invention would have been obvious to a person of ordinary skill, the Board may consider certain objective factors if they are present, such as: commercial success of products practicing the claimed invention; long-felt but unsolved need; teaching away; unexpected results; copying; and praise by others in the field. These factors are generally referred to as “secondary considerations” or “objective indicia” of nonobviousness. I understand, however, that for such objective evidence to be relevant to the obviousness of a claim, there must be a causal relationship (called a “nexus”) between the claim and the evidence and that this nexus must be based on a novel element of the claim rather than something in the prior art. I also understand

that even when they are present, secondary considerations may be unable to overcome primary evidence of obviousness (such as motivation to combine with predictable results) that is sufficiently strong.

31. I have been asked to consider the validity of the Challenged Claims. I understand that for *inter partes* reviews, invalidity must be shown under a preponderance of the evidence standard. I have concluded that each of the Challenged Claims is invalid at least under 35 U.S.C. § 103 based on the references described below and as explained herein.

C. Claim Construction

32. I have been informed that patent claims are construed from the viewpoint of a person of ordinary skill in the art of the patent at the time of the invention. I have been informed that patent claims generally should be interpreted consistent with their plain and ordinary meaning as understood by a person of ordinary skill in the art in the relevant time period (*i.e.*, at the time of the purported invention, or the so called “effective filing date” of the patent application), after reviewing the patent claim language, the specification and the prosecution history (*i.e.*, the intrinsic record).

33. I have further been informed that a person of ordinary skill in the art must read the claim terms in the context of the claim itself, as well as in the context of the entire patent specification. I understand that in the specification and

prosecution history, the patentee may specifically define a claim term in a way that differs from the plain and ordinary meaning. I understand that the prosecution history of the patent is a record of the proceedings before the U.S. Patent and Trademark Office, and may contain explicit representations or definitions made during prosecution that affect the scope of the patent claims. I understand that an applicant may, during the course of prosecuting the patent application, limit the scope of the claims to overcome prior art or to overcome an examiner's rejection, by clearly and unambiguously arguing to overcome or distinguish a prior art reference, or to clearly and unambiguously disavow claim coverage.

34. In interpreting the meaning of the claim language, I understand that a person of ordinary skill in the art may also consider "extrinsic" evidence, including expert testimony, inventor testimony, dictionaries, technical treatises, other patents, and scholarly publications. I understand this evidence is considered to ensure that a claim is construed in a way that is consistent with the understanding of those of ordinary skill in the art at the time of the claimed invention. This can be useful for a technical term whose meaning may differ from its ordinary English meaning. I understand that extrinsic evidence may not be relied on if it contradicts or varies the meaning of claim language provided by the intrinsic evidence, particularly if the applicant has explicitly defined a term in the intrinsic record.

35. I understand that there is a “means-plus-function” type of claim interpretation that may be argued to apply to certain terms, pursuant to 35 U.S.C. §112(6). For these terms, if the term is determined to be a “means-plus-function” term under §112(6), I understand that there must be a corresponding structure disclosed in the specification in a way that a person of ordinary skill in the art would understand what structure would perform the claimed function. I understand the disclosure may be implicit in the specification if it would have been clear to a person of ordinary skill in the art what structure corresponds to the claimed function. With respect to a computer-implemented function, an algorithm must be disclosed in the specification.

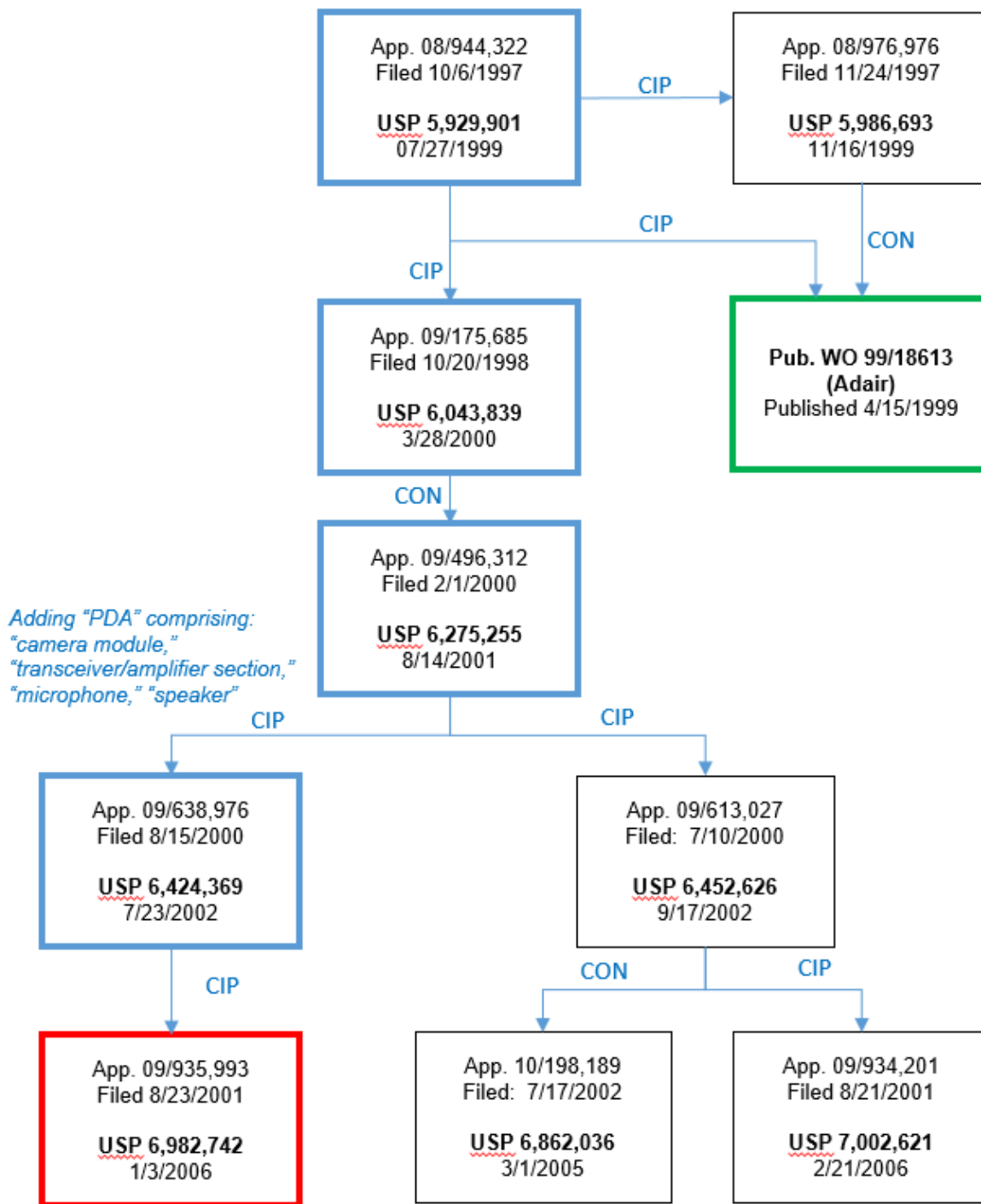
V. PRIORITY DATE AND A PERSON OF ORDINARY SKILL

A. Priority Claims and the Relevant Timeframe of the '742 Patent

36. The '742 patent issued from U.S. Patent Application No. 09/935,993 filed August 23, 2001 (the “'993 Application”), and claims priority to four applications: (1) U.S. Application 09/683,976 (the “'976 Application”) (Ex. 1076) which was filed August 15, 2000 and later matured into U.S. Patent No. 6,424,369; (2) U.S. Application 09/496,312 (the “'312 Application”) (Ex. 1074) which was filed on February 1, 2000 and later matured into U.S. Patent 6,275,255; (3) U.S. Application 09/175,685 (the “'685 Application”) (Ex. 1073) which was filed on October 20, 1998 and later matured into U.S. Patent 6,043,839; and (4) U.S.

Application 08/944,322 (the “322 Application”) (Ex. 1072) which was filed on October 6, 1997 and later matured into U.S. Patent 5,929,901. *See* ’742 patent, 1:5-17.

37. The relationship between these different patent applications is illustrated in the chart below:



38. I have carefully reviewed the '742 patent. I have also carefully reviewed the disclosures made in the '322, '685, '312, and '976 Applications, as

well as the patents and patent publications incorporated therein by reference. In addition, I had a redline run of the '976 application against the '312 application to identify the new features added in the '976 application (which issued as the '369 patent, the parent of the '742 patent) (*see* Ex. 1079), as well as a redline of the '993 application against the '976 application to identify the new features added in the '312 application (which issued as the '742 patent) (*see* Ex. 1086).

39. Based on my review of the materials, certain terms in the Challenged Claims are not described in the '312 Application or any patents or patent publications that it incorporates by reference (or any of the parent patents of the '742 patent). As discussed in greater detail in Sections VIII, the asserted claims of the '742 patent recite a “PDA ... comprising” the following elements:

- “PDA ... comprising ... a camera module” (Claims 22, 42, 58, 66)
- A PDA comprising:
 - “transceiver/amplifier section ... for amplifying and further transmitting ... and for receiving, and amplifying video and audio signals” (Claim 66)
 - “microphone ... for receiving sound” (Claim 66)
 - “speaker ... for broadcasting audio signals” (Claim 66)
 - “transceiver [radio] element/module” for transmitting/receiving converted pre-video signal between the camera module and PDA

(Claims 22, 42, 58, 66)

The '312 application does not describe any of these limitations, and a person of ordinary skill would not have reasonably concluded that the inventor had possession of the claimed invention at the time that these applications were filed. Instead, these limitations were first added to the '976 application that issued as the '369 patent, or the '993 application that issued as the '742 patent. Ex. 1079; Ex. 1086.

40. For example, each of the Challenged Claims requires a “PDA ... comprising ... a camera module.” But the '312 application does not describe a PDA, let alone a PDA including a camera module, a transceiver/amplifier section for transmitting, receiving and amplifying video and audio signals, and transceiver elements for wirelessly communicating video signals between the camera module and the PDA. A camera module is only described in the '312 application as a component included in an endoscope, which is not a PDA. '312 application (Ex. 1074), 10, 13, 15, 26-27. A person of ordinary skill in the art would understand that an endoscope is a medical device with a camera used to view hard to reach areas in a human body, while a PDA is a personal organizer that provides computer functionality.

41. Moreover, challenged claim 66 requires a “microphone ... for recording and receiving audio signals” and a “speaker ... for broadcasting audio

signals.” The ’312 application does not describe a “microphone” or “speakers” for receiving or broadcasting an audio signal.

42. As a result, the ’742 patent’s parent applications fail to provide written description support for the Challenged Claims. Instead, these features were either first added on August 15, 2000 to the ’976 application (which issued as the ’369 patent), as seen in the redlined comparison of the ’976 application with its parent ’312 application (*see* Ex. 1079), or added on August 23, 2001 to the ’993 application (which issued as the ’742 patent), as seen in the redlined comparison of the ’993 application with its parent ’976 application (*see* Ex. 1086). I have been informed that because the ’312 and/or ’976 application fails to describe these features, the ’742 patent cannot claim priority to any of the earlier applications.

43. Moreover, I have been informed that Patent Owner has asserted in a parallel litigation that the ’322 application (which is the oldest application, filed on October 6, 1997, to which the ’742 patent claims priority) discloses “PDAs and wireless telephones” with cameras by disclosing that its camera can be applied to “industrial fields.” Ex. 1017, 6-7. As an initial matter, the language that Patent Owner is referring to identifies only one specific application in industrial fields to which its camera is applicable: “boroscopes,” and does not recite PDAs or telephones. ’322 Application, 3:22-4:2 (“Additionally, while the foregoing invention has application with respect to the medical and dental fields, it will also

be appreciated by those skilled in the art that the small size of the imaging device set forth herein can be applied to other functional disciplines wherein the imaging device can be used to view difficult to access locations for industrial equipment and the like. Therefore, the imaging device of this invention could be used to replace many industrial boroscopes.”). There is no specific reference to phones or PDAs as a particular industrial application. Moreover, this reference to a potential application of the disclosed camera to “industrial fields” does not describe specific features that could be (but are not necessarily) found in a PDA, such as a camera module, a wireless RF transceiver, a microphone, and a speaker.

44. As a result, a person of ordinary skill in the art would understand that the '993 application filed on August 23, 2001 is the first priority document that could satisfy the written description requirement for the “PDA ... comprising ... a camera module,” “transceiver/amplifier section ... for transmitting, receiving, and amplifying video and audio signals,” “microphone ... for recording and receiving audio signals,” “speaker ... for broadcasting audio signals,” “transceiver [radio] element/module ... for transmitting/receiving said converted pre-video signal” limitations recited by the Challenged Claims of the '742 patent. Therefore, the Challenged Claims are not entitled to the benefit of a priority date before August 23, 2001.

B. The Person of Ordinary Skill in the Relevant Timeframe

45. In rendering the opinions set forth in this declaration, I was asked to consider the patent claims and the prior art through the eyes of a person of ordinary skill in the art at the time of the alleged invention. I understand that Patent Owner may argue that the Challenged Claims should be entitled to a filing date as early as October 6, 1997.

46. I understand that the factors considered in determining the ordinary level of skill in a field of art include the level of education and experience of persons working in the field; the types of problems encountered in the field, the teachings of the prior art, and the sophistication of the technology at the time of the alleged invention. I understand that a person of ordinary skill in the art is not a specific real individual, but rather is a hypothetical individual having the qualities reflected by the factors above. I understand that a person of ordinary skill in the art would also have knowledge from the teachings of the prior art, including the art cited below.

47. Taking these factors into consideration, in my opinion, on or before August 23, 2001, a person of ordinary skill in the art relating to the technology of the '742 patent would have had a minimum of a Bachelor's degree in Electrical Engineering, Physics, or a related field, and approximately two years of professional experience in the field of imaging devices. Additional graduate education could substitute for professional experience, or significant experience in the field could substitute for formal education.

48. Well before August 23, 2001, my level of skill in the art was at least that of a person of ordinary skill. I am qualified to provide opinions concerning what a person of ordinary skill would have known and understood at that time, and my analysis and conclusions herein with respect to Grounds 1 and 2 are from the perspective of a person of ordinary skill in the art as of August 23, 2001.

49. Even if the claims are entitled to a priority date as early as October 6, 1997 as I understand Patent Owner claims, my analysis would not change. On or before October 6, 1997, a person of ordinary skill would still have had a minimum of a Bachelor's degree in Electrical Engineering, Physics, or a related field, and approximately two years of professional experience in the field of imaging devices. Additional graduate education could substitute for professional experience, or significant experience in the field could substitute for formal education.

50. Well before October 6, 1997, my level of skill in the art was at least that of a person of ordinary skill. I am qualified to provide opinions concerning what a person of ordinary skill would have known and understood at that time, and my analysis and conclusions herein with respect to Grounds 3 through 8 are from the perspective of a person of ordinary skill as of October 6, 1997.

VI. BACKGROUND ON THE STATE OF THE ART

51. As discussed in Section VII, the '742 patent is generally directed to a reduced area imaging device with a pixel array, timing and control circuitry, and

processing circuitry for use with a personal digital assistant (“PDA”). As discussed in the subsequent sections, each of these components was well-known in the prior art, and the claims of the ’742 patent are generally directed to simple combinations of these prior art elements.

52. As further discussed in the sections below, a personal digital assistant with a camera was well-known in the art. For example, as shown by Harris (Ex. 1052), it was known to include a camera in a personal digital assistant. *See, e.g.*, Harris, 1:43-45, 5:45-47.

53. Moreover, cameras with various structural arrangements were known. For example, as shown by Adair (Ex. 1018) (a related patent to the ’369 that I understand is prior art), it was known to configure a CMOS imaging device with an image sensor on a first plane and circuitry for converting a pre-video signal to a post-video signal on a circuit board in a second plane. *See, e.g.*, Adair, 11:7-12, Claim 1, Figure 2b. In addition, multiple arrangements of placing timing and control circuitry for the image sensor were known. For example, the timing and control could be placed 1) with an image sensor, 2) with video processing circuitry or 3) separate from both an image sensor and video processing circuitry.

54. For example, Adair discloses timing and control circuitry together with an image sensor. *See, e.g.*, Adair, 5:19-22, Figure 4a. Adair also discloses “the timing and control circuits can be placed remote from the pixel array.” *See, e.g.*,

Adair, 4:21-25). And Adair discloses “plac[ing] the timing and control circuits onto video processing board.” *See, e.g.*, Adair, 16:14-17.

55. Other prior art from other, prior inventors, also discusses examples of: (1) an imager array grouped with the timing and control circuitry and separate from the processing circuitry (Ackland (Ex. 1006), Fig. 6 (*e.g.*, depicting an array and timing and control circuitry separate from the processing circuitry)); (2) timing and control circuitry grouped with the processing circuitry but separate from the array (Hurwitz (Exs. 1042, 1046, 1047), 120, Fig. 1) (*e.g.*, depicting a single ASIC for the timing and control and processing circuitry); Ricquier (Exs. 1038, 1033), 2-3 (*e.g.*, discussing “off-chip” timing and control relative to the pixel array)); or (3) the array, timing and control circuitry, and processing circuitry each being separate from one another (Ricquier (Exs. 1038, 1033), 2-3 (*e.g.*, discussing “off-chip” timing and control); Stam (Ex. 1043), 6:25-28, Fig. 5 (*e.g.*, illustrating “Timing and Control” 203 as separate from “Image Array Sensor” chip 106 and “Microprocessor” 204)). All of these various combinations were known in the art, and a person of ordinary skill would have known that components could be placed apart from each other or placed in different locations based on the design needs and intended applications of a given device.

56. Similarly, the prior art discloses various physical arrangements of an image sensor relative to the other components. For example, the prior art discloses:

(1) an imager that is positioned parallel or perpendicular to a circuit board on which the processing circuitry is mounted (Swift (Ex. 1005), 8:33-9:21, Fig. 2 (*e.g.*, depicting image sensor 51 and circuit board 52 and 53)); (2) three stacked circuit boards or chips that can contain the various components (Suzuki (Ex. 1015), 2:51-55, 3:15-19, Fig. 2 (*e.g.*, depicting “chip-connecting board 226,” “circuit board 227,” and “connector board 228” arranged in a stacked configuration) , Fig. 3c; Chamberlain (Ex. 1044), 5:47-50, 6:21-35, Fig. 2, Fig. 17 (*e.g.*, depicting “driver board 13,” “logic board 16,” and “option boards 19” arranged in a stacked configuration)); (3) an image sensor stacked on a circuit board, which is offset from another circuit board (Wakabayashi (Ex. 1027), Fig. 3, Fig. 7 (*e.g.*, depicting “circuit board 39” offset from the “imager device 27” stacked on “circuit board 29”)); or (4) a circuit board with processing circuitry that is placed in a control box remote from the image sensor (Monroe (Ex. 1007), 3:57-62, 8:8-11, Fig. 3 (*e.g.*, depicting “power supply and lighting unit 14,” having “video processing circuitry,” remote from “video otoscope 12” having “solid state imager 36”)). All of these various combinations were known in the art, and a person of ordinary skill would have known that components could be placed on a number of circuit boards and arranged in any number of different “planes” based on the design needs and intended applications of a given device.

57. Further, it 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 common design consideration for portable devices, and the components will work as expected. Textbook on PCB Board Design (1984) (Ex. 1045), 15, 20.

A. Personal Digital Assistants

58. As the '742 explains in the background discussion, personal digital assistants (“PDAs”) were well known devices. *See, e.g., '742*, 1:23-25 (“miniature computer systems known as palm top computers, personal digital assistants (PDA), or hand-held computers/organizers”); 3:46-47 (“Recently, devices known as palm top computers, PDA(s), or hand-held computers have become very popular items.”) The '742 also acknowledges that it was known to combine cameras with PDAs. *See e.g., '742*, 3:59-63 (“One such device ... is known as the ‘Hand Spring Visor Deluxe.’ This device will soon be available which allows a user to accommodate pagers, MP3 players, still digital cameras and other devices.”).

B. CMOS Imager Arrays

59. As set forth in the “Background Art” section of the '742 patent, solid state imaging technology typically employs one of three types of sensors including charged coupled devices (CCD), charge injection devices (CID), and photo diode

arrays (PDA). '742 patent, 1:30-38. The '742 further admits that “[i]n the mid-1980s, complementary metal oxide semiconductors (CMOS) were developed for industrial use.” '742 patent, 1:30-34.

60. In general, each pixel in a solid-state imager (including CMOS based imagers) will convert the light it receives into an electrical charge proportional to the amount of light that it receives. After a certain amount of time has elapsed, the signal produced by the charge accumulated by the pixel is measured, and this measured information from all the pixels is combined together and processed to create a single digital image. This process (*i.e.*, measuring the signal produced by charge on each of the pixels over time) is traditionally controlled by “timing and control” circuitry connected to the pixel array, and the output from the pixel array is communicated to the rest of the device through “read out circuitry” where it can be processed into a convenient data format.

61. As explained by the '742 patent, “active pixel-type CMOS imagers” and “passive pixel-type CMOS imagers” were already well known in the art. *See, e.g.*, '742 patent, 1:54-56; 2:8-10. These types of CMOS based imagers had various advantages over other types of solid-state imagers. For example, the '742 patent states that it was well known that “[o]ne advantage of active pixel-type imagers is that the amplifier placement results in lower noise levels [than CCDs].” *See, e.g.*, '742 patent, 1:57-58. It was also known, as recognized in the '742 patent, that

“[a]nother major advantage is that these CMOS imagers can be mass produced on standard semiconductor production lines.” *See, e.g.,* ’742 patent, 1:58-60. In addition, it was known that CMOS imagers “can incorporate a number of other electronic controls that are usually found on multiple circuit boards of much larger size”—“[f]or example, timing circuits, and special functions such as zoom and anti-jitter controls can be placed on the same circuit board containing the CMOS pixel array without significantly increasing the overall size of the host circuit board.” *See, e.g.,* ’742 patent, 1:63-2:3. Further, it was known in the art that CMOS imagers require significantly less power (*e.g.*, 100 times less power) than a CCD-type imager. *See, e.g.,* ’742 patent, 2:3-6.

62. The ’742 patent itself is replete with examples of prior art systems that make use of CMOS pixel arrays and the accompanying timing, control, and readout circuitry required to operate the array. *See e.g.,* ’742 1:60-2:6 (discussing that “the CMOS imager described in U.S. Pat. No. 5,471,515 to Fossum, et al. ... can incorporate a number of other different electronic controls that are usually found on multiple circuit boards”); 2:13-18 (“One example of a manufacturer who has developed a passive pixel array with performance nearly equal to known active pixel devices and being compatible with the read out circuitry disclosed in the U.S. Pat. No. 5,471,515 is VLSI Vision, Ltd., 1190 Saratoga Avenue, Suite 180, San Jose, Calif. 95129”); 2:23-30 (“In addition to the active pixel-type CMOS imager which is

disclosed in U.S. Pat. No. 5,471,515, there have been developments in the industry for other solid state imagers which have resulted in the ability to have a “camera on a chip.” For example, Suni Microsystems, Inc. of Mountain View, Calif., has developed a CCD/CMOS hybrid which combines the high quality image processing of CCDs with standard CMOS circuitry construction”); 17:1-6 (“A further discussion of the timing and control circuitry which may be used in conjunction with an active pixel array is disclosed in U.S. Pat. No. 5,471,515 and is also described in an article entitled ‘Active Pixel Image Sensor Integrated With Readout Circuits’ appearing in NASA Tech Briefs, October 1996, pp. 38 and 39.”).

C. Image Processing Circuitry

63. The data produced by an imager/image sensor will generally need to be processed further in order to convert the data into a standard video format. In the context of the '742 patent, this is described as converting the “pre-video” signal produced by the imager into a “post-video” signal that is suitable for a standard video device. *See, e.g., '742 patent, 9:53-10:4* (“Once the pre-video signal has been transmitted from the image sensor ... [v]ideo processing board 50 then carries out all the necessary conditioning...so that it may be viewed directly on a remote video device such as a television or standard computer video monitor.... This video signal produced by board 50 can be further defined as a post-video signal”).

64. These video processing circuits (*e.g.*, for doing white balancing and/or converting the single into a standard format) were well known prior to the '742 patent. For example, as discussed in greater detail in Section VIII.D, U.S. 4,700,219 (Ex. 1009, "Tanaka") was published in October of 1987 and discloses a functionally identical circuit as the preferred embodiment of the "video processing circuitry" disclosed in the '742 patent. The '742 patent itself also concedes that video processing circuitry was already known in the art, stating that the detailed "example of circuitry which may be used in the video processing board ... is very similar to the circuitry which is found in a miniature quarter-inch Panasonic camera, Model KS-162." '742 patent, 18:11-23.

VII. ANALYSIS OF THE '742 PATENT

A. Overview of the '742 Patent

65. The '742 describes PDAs with small and compact image sensors with an off-the-shelf solid state imager. '742 patent, 1:21-26. The '742 states that this camera applies to a "standard PDA." '742 patent, 3:64-4:4. Furthermore, the '742 explains that there were various solid state image sensor known at the time, such as charged coupled devices (CCD) and complementary metal oxide semiconductors (CMOS). '742 patent, 1:30-2:22, 3:46-63. In addition, the '742 further states that it was known for a CMOS imager to combine in one circuit board a number of other different electronic controls (*e.g.*, timing circuits) that typically resides on multiple

66. The '742 allegedly improves on the “camera on a chip” concepts by “reducing its profile area, and incorporating such a reduced area imaging device within a PDA such that minimal size and weight is added to the PDA, and further that the imaging device can be used to image selected targets by the user.” '742 patent., 4:36-40. Figures 7, 8 and 8a depict an example of such a PDA including the camera.

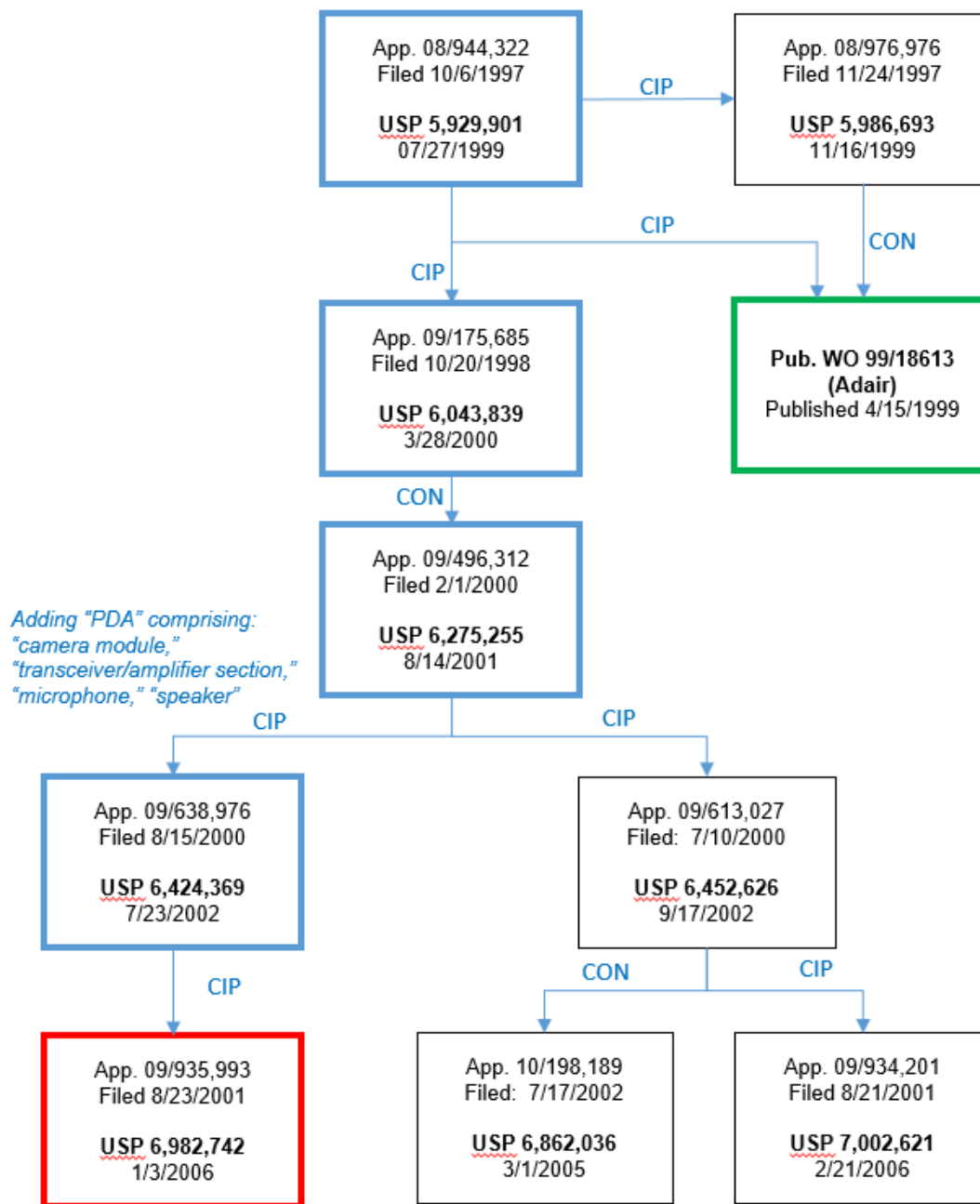


67. As shown in Figure 2 above, the PDA includes a camera module housing an image sensor. The image sensor captures images and converts them into electrical signals. '742 patent, 8:26-31. The camera module wirelessly transmits the captured images to the main component of the PDA. '742 patent, 12:61-13:9. Video processing circuitry is placed on a video processor board 50 to convert the pre-video signal into a form that can be viewed directly on a standard video device. '742 patent, 9:58-10:48, *see also*, 14:47-15:3, Figure 1a. In order to control the timing of the image sensor, timing and control circuitry is placed either on the video processor board 50, on the image sensor 40 itself, or separate from both the video processor board and the image sensor. '742 patent, 15:46-56.

68. The PDA also includes a “digital signal processor 72,” “transceiver/amplifier 70,” “speaker 76,” “microphone 78,” and “battery 62,” as shown in Figure 4 above.

B. Prosecution History

69. The '742 patent issued from U.S. Patent Application 09/935,993, filed August 23, 2001. For convenience, the chart from Section V.A showing the relationship between these various priority documents is reproduced below:



70. In the parent '976 application, the Examiner rejected certain claims based on Harris. The applicant overcame this rejection based on arguments related to another reference called Upton raised in the rejection. The applicant argued over Harris's disclosure by arguing that the '976 claims required a "flexible cable

connection” between “the camera and the housing of the PDA,” but that Harris instead discloses “a wireless infrared communication between the camera and the housing 108.” ’369 File History (Ex. 1077), 134-36. The Challenged Claims do not require a “flexible cable connection.”

71. The examiner never raised Harris in a rejection of the Challenged Claims, which recite a camera module communicating wirelessly with the PDA. Instead, the Examiner allowed claims 1-77 (which correspond to issued claims 1-77, including all Challenged Claims) in a first Office Action. The examiner rejected only claims other than the Challenged Claims. ’742 File History, 114-121. When the Examiner explained his reasons for allowance of claims 1-77 in the first Office Action, he quoted the following claim language, focused on the location of components specific to the camera:

a camera module housing an image sensor therein, said image sensor including an array of pixels for receiving images thereon, said image sensor further including circuitry means on said first plane and coupled to said array of pixels for timing and control of said array of pixels, said image sensor producing a pre-video signal, a first circuit board mounted in said camera module adjacent said image sensor and electrically coupled to said image sensor, said first circuit board including circuitry means for converting said pre-video signal to a desired video format, said camera module further including a transceiver radio element mounted therein and electrically communicating with said first circuit board to transmit said converted pre-video signal ...

'742 File History, 120. Harris does not expressly disclose all of the recited camera components. After the First Office Action, the Examiner allowed the Challenged Claims based on the same features. *See*, '742 File History, 198.

C. Claim Construction

72. I understand that for purposes of this *Inter Partes* Review, the standard for claim construction is the same as the standard used in federal district court litigation: claim terms should generally be given their ordinary and customary meaning as understood by one of ordinary skill in the art at the time of the invention and after reading the patent and its prosecution history.

73. I understand that Patent Owner has not identified any terms as being subject to “means-plus function” terms in district court. I have been asked to apply Patent Owner’s apparent constructions and the plain and ordinary meaning of the terms consistent with the specification. I have been instructed to not consider the issue of indefiniteness, but, where a term may be indefinite, to instead apply all reasonable interpretations of the term. With respect to the terms listed below, to the extent that these terms are interpreted under 35 U.S.C. §112(6), I have been asked to apply the following constructions:

“[C]ircuitry means ... for timing and control of said array of pixels” (Claims 22, 58 and 66)/“circuitry means ... for timing and control of said pixels” (Claim 42):

74. To the extent it is found that §112(6) applies, I have been asked to apply the following construction. The function is “timing and control of the array of pixels,” and the structure of the ‘742 specification linked to this function is the “Timing and Control Circuits” box 92 shown in Figure 4a. *See, e.g.,* ’742 patent, 5:2-5, 15:4-6, 16:9-44 (“The timing and control circuits 92 are used to control the release of the image information or image signal stored in the pixel array.”), Fig. 9a. I note that when discussing the timing and control circuitry, the ’742 “incorporated by reference” U.S. Patent 5,471,515 and *NASA Tech Briefs*, October 1996, pp. 38-39 (’742, 17:1-6). I am informed that any structures in these documents cannot be relied upon as being the corresponding structure.

“[C]ircuitry means for converting said pre-video signal to a desired video format” (Claims 22, 42 and 58)/“circuitry means for processing and converting said pre-video signal to a desired video format” (Claim 42)

75. To the extent it is found that §112(6) applies, I have been asked to apply the following construction. The function is “converting said pre-video signal to a desired video format” for the claim 1 term and “receiving said pre-video signal from said image sensor and for converting said pre-video signal to a desired video format” for the claim 13 term. The corresponding structure of the specification linked to these functions is the “processing circuitry which ... converts the pre-video signal to a post-video signal which may be accepted by a standard video device,” as shown

in Figure 4b. *See, e.g., '742 patent, 4:65-5:2 (“‘processing circuitry’ as used herein refers to the electronic components within the imaging device which receive the image signal from the image sensor and ultimately place the image signal in a usable format.”), 8:7-12 (“FIG. 9b 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.”), 17:8-44, 18:11-23, Fig. 9b.*

VIII. THE CHALLENGED CLAIMS ARE INVALID

76. It is my opinion that the Challenged Claims of the '742 patent are unpatentable as explained below.

Ground	Obviousness Basis	Claims
1	Harris in view of Adair	22, 42, 58, 66
2	Harris in view of Adair and Tran	66
3	Harris in view of Swift and Ackland	22
4	Harris in view of Swift, Ackland and Tanaka	
5	Harris in view of Swift and Ricquier	42, 58, 66
6	Harris in view of Swift, Ricquier and Tanaka	
7	Harris in view of Swift, Ricquier and Tran	66
8	Harris in view of Swift, Ricquier, Tran and Tanaka	

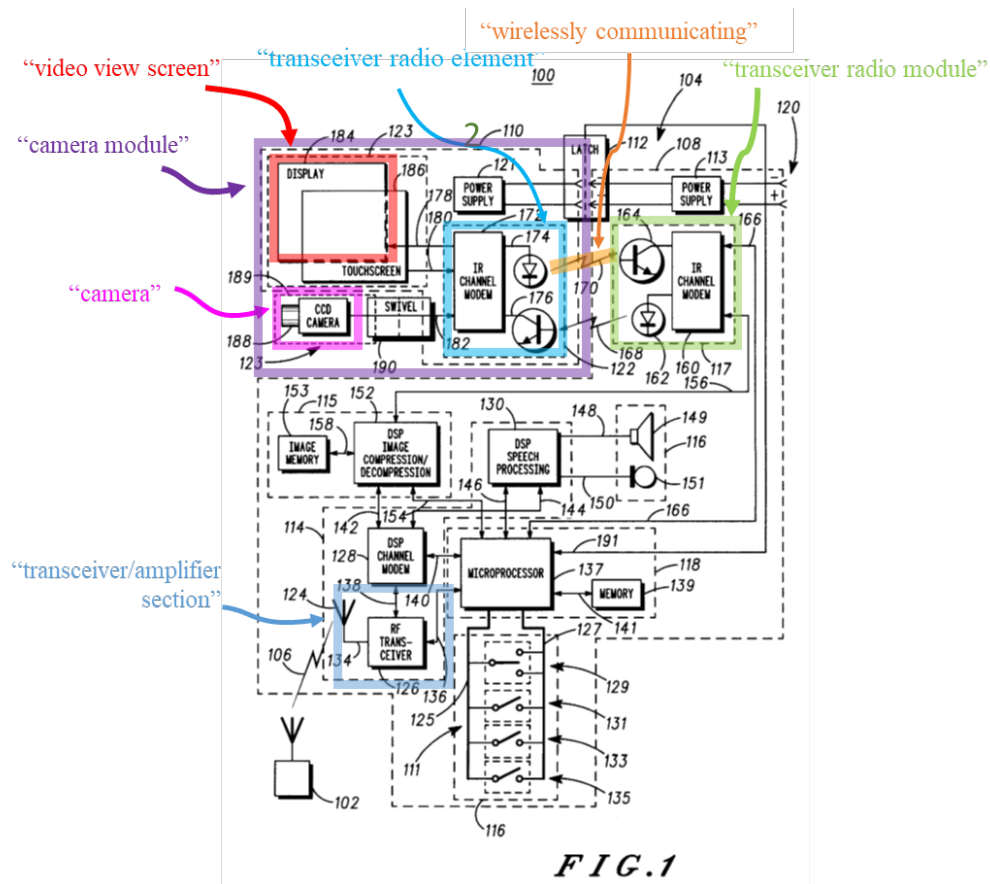
A. Claims 22, 42, 58 and 66 are rendered obvious by Harris in view of Adair (Ground 1)

1. Overview of Harris

77. Harris (Ex. 1052) was filed on July 10, 1996, and I understand is prior art to the '742 patent based on the '742 patent's priority date of October 6, 1997.

78. Harris describes a PDA with a camera module with a solid-state image sensor. *E.g.*, Harris, 1:43-45, Fig. 1. A display of the PDA displays video captured by the PDA's camera or video received over a wireless channel. *E.g.*, Harris, 5:45-54, 6:63-67, 9:44-55, 11:43-48, Figs. 1-2, 8. The PDA provides videoconferencing functionality, and allows a user to select whether to display video produced by the camera or video received from the other party. This selection is performed by changing the position of the switches in a latch between the camera module and the main PDA housing. Harris, 7:41-53, 9:36-55, 11:43-48, 11:61-65, Fig. 1. The camera produces "full motion video," which a wireless data transceiver 122 of the camera module exchanges over a wireless RF link with a wireless data transceiver 117 included in the PDA's main housing. *E.g.* Harris, 5:38-44, Fig. 1. While Harris discloses in an embodiment that an "IR channel modem" is used, Harris explains that an RF channel modem is alternatively used instead. Harris, 5:38-44 ("Although the illustrated communication between the housings 108 and 110 is accomplished via a wireless IR link, it will be recognized that the wireless data transceivers 117

and 122 can alternatively communicate via a wireless RF link or any other suitable means.”). A third “transceiver 126” of the PDA communicates over a wireless “communications link 106” to exchange video and audio data with another “communication device,” such as a computer. *E.g.*, Harris, 2:55-3:8, 3:40-50.



Harris, Fig. 1 (annotated²).

² Language annotated in figures from prior art references generally tracks the language of the Challenged Claims.

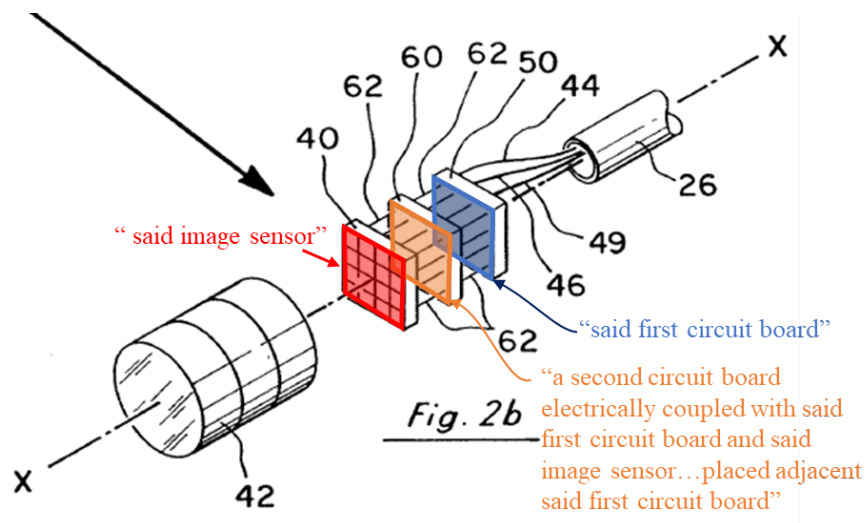
79. Harris also discloses a digital signal processor (“DSP”) that has three digital signal processing functions for videoconferencing. In particular, the DSP conditions video from the camera module and video and audio received from another party, processes audio signals received from a microphone and transmitted to a speaker, and encodes and decodes two-way video and audio data exchanged with another party through a “transceiver 126.” Harris, 3:30-43, 4:4-11, 4:25-42, Figure 1. Each of the PDA and camera module includes a “power supply.” Harris, 3:25-32, Fig. 1.

2. Overview of Adair

80. Adair (Ex. 1018) was published on April 15, 1999, and I understand, is prior art to the ’742 patent based on the ’742 patent’s priority date of August 23, 2001 (or even the earlier potential priority date of August 15, 2000). *See* Section V.

81. Similar to the ’742 patent, Adair describes compact solid state imaging technology. *See, e.g.,* Adair, 1:21-25 (“...solid state imaging technology which enables the image sensor to be placed at the distal tip of the investigating device”). Adair names the same inventors as the ’742 patent (*i.e.*, Edwin Adair, Jeffrey Adair, and Randall Adair), and Adair and the ’742 patent have substantial amounts of overlapping disclosure. I had a redline run of the specification and claims of the ’742 patent against the specification and claims of Adair, which shows the substantially overlapping disclosure. *See* Ex. 1067.

82. For example, as shown in the annotated version of Figure 2b reproduced below, in a first embodiment Adair teaches a reduced area imaging device with an “image sensor 40” lying in a first plane, and a first circuit board (*i.e.*, “video processing board 50”) lying behind the image sensor in a second plane that contains processing circuitry for converting a pre-video signal to a post-video signal. *See e.g.*, Adair, 11:6-15 (“Once the pre-video signal has been transmitted from image sensor 40..., it is received by video processing board 50. Video processing board 50 then carries out all the necessary conditioning of the pre-video signal and places it in a form so that it may be viewed directly on a standard video device.”).



83. As noted above, there are three possible locations for timing and control circuitry in a camera with a separate image sensor and image processing circuitry. Adair discloses all three of these possibilities. In the first configuration, the timing and control circuitry is located in the image sensor in the first plane, while the video

processing board is in a second plane. *See e.g.*, Adair, 4:22-24 (“the timing and control circuits can ... be placed on the same planar substrate as the pixel array and the image sensor can therefore also be defined as an integrated circuit”), 12:6-7 (“the video processing board 50 may be placed directly behind image sensor 40”). In the second configuration, the image sensor is in a first plane, the timing and control circuitry is in a second plane, and the video processing board is in a third plane. *See e.g.*, Adair, 4:24-25 (“the timing and control circuits can be placed remote from the pixel array”), 12:6-7 (“the video processing board 50 may be placed directly behind image sensor 40”). In the third configuration, the image sensor is by itself on a first plane, and the timing and control circuitry is on the video processing board in the second plane. *See e.g.*, Adair, 16:15-17 (“it is possible to separate the timing and control circuits from the pixel array and place the timing and control circuits onto video processing board 50.”).

84. Adair uses an “active pixel-type CMOS imager,” which includes “randomly accessible pixels with an amplifier at each pixel site.” *See e.g.*, Adair, 2:6-8. Adair further discloses that “a supplementary processing board 60 may be provided to further enhance the pre-video signal.” *See, e.g.*, Adair, 16:4-7. As shown in Figure 2b, the supplementary board 60 is electrically coupled with both the video processing board 50 and image sensor 40. *See e.g.*, Adair, 12:6-24 (“...one or more supplementary boards 60 may be provided which further contain processing circuitry

to process the image signal...”), 21:3-15 (“...The connection between image sensor 40 and board 60 may simply be the conductor 48.... Once the pre-video signal has been digitally enhanced on supplementary board 60, it is then sent to the video processor board 50 by means of another conductor 51”), Figure 2b, Figure 4.

3. Motivation to Combine Harris and Adair

85. A person of ordinary skill in the art would have been motivated and found it obvious and straightforward to employ Adair’s express teachings of a reduced area CMOS imaging device in implementing Harris’s camera.

86. While Harris discloses a CCD camera 188, Adair discloses a “reduced area imaging device” including an “active pixel-type CMOS imager[.]” *See, e.g.,* Adair, 2:6-8 (“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”). This is depicted as “image sensor 40” in Fig. 2b. *See, e.g.,* Adair, 4:14-21 (“The term ‘image sensor’ as used 20 herein describes the CMOS pixel array which captures images and stores them within the structure of each of the pixels in the array.”), 12:6-7 (“the video processing board 50 may be placed directly behind image sensor 40”). The ’742 patent expressly recognizes CMOS cameras were well-known. *See* Section VI.B.

87. Harris and Adair are in the same field of art, and are analogous art to the ’742 patent, as they all relate to compact solid-state image sensors for use in

space-constrained devices. For example, the '742 patent is directed towards a wireless/cellular telephone with an "imaging device," Harris discloses a "Hand-Held Radiotelephone" of minimal size with a camera, and Adair discloses an endoscope with a camera. See, e.g., '742 patent, Abstract ("A reduced area imaging device is provided for use with a miniature hand-held computer referred to in the industry as a PDA."), 1:21-26 ("This invention relates to solid state image sensors and associated electronics, and more particularly, to solid state image sensors which are configured to be of a minimum size and used within miniature computer systems known as palm top computers, personal digital assistants (PDA),s."), 4:44-46 ("In accordance with the present invention, reduced area imaging devices are provided in combination with a handheld computer or PDA."); Harris, Title ("Hand-Held Radiotelephone Having a Detachable Display"), 1:4-6 ("The present invention relates generally to a communication device and more specifically to a multi-mode communication device."), 1:9-12 ("In response, manufacturers have proposed giving traditional audio telephones video capability."), 1:23-28 ("To accommodate the video capability, it has been proposed to...mount a camera, such as a charge coupled device (CCD) camera, on the single housing in proximity to the display."), 1:59-63 ("what is needed is a multi-mode communication device that permits a user to communicate in privacy and employs a single user interface having components carried on multiple surfaces of the device so as to minimize the size and cost of the

device.”), 2:57-65 (“The communication device 104 can be a wireless device, such as a cellular radiotelephone, a cordless telephone, a two-way radio, a modem, or the like ... The communication device 102 is any device compatible with the communication device 104, such as a dispatch center, a cellular base station, a cordless base, another telephone, a computer, or the like.”); Adair, Abstract (“A reduced area imaging device is provided for use in medical or dental instruments such as an endoscope...”), 2:14-16 (“CMOS imager can incorporate a number of other different electronic controls that are usually found on multiple circuit boards of much larger size.”).

88. Moreover, Harris and Adair are also reasonably pertinent to the alleged problem(s) identified in the '742 patent, including arranging the circuitry of a camera (such as an image sensor and supporting circuitry) to minimize the size or profile area of the device. Because each of the references relates to a small, handheld device with a camera, there is a need in each to provide a compact camera that will fit into these devices. *See, e.g.,* '742 patent, 4:12-17 (“It is another object of this invention to provide a reduced area imaging device incorporated within a PDA which takes advantage of "camera on a chip" technology, but to rearrange the video processing circuitry in a selective stacked relationship so that the camera module has a minimum profile..”); Harris, 1:59-63 (“Therefore, what is needed is a multi-mode communication device that permits a user to communicate in privacy and employs a

single user interface having components carried on multiple surfaces of the device so as to minimize the size and cost of the device.”); Adair, 3:7-11 (“It is one object of this invention to provide surgical instruments with reduced area imaging devices which take advantage of the CMOS-type imagers of Fossum, et al., or passive pixel-type CMOS imagers, but rearrange the accompanying circuitry in a stacked relationship so that there is a minimum profile presented when used within the surgical instrument.”).

89. A person of ordinary skill in the art would have been further motivated to apply Adair’s teachings in implementing Harris’s camera because of the various advantages that CMOS cameras have relative to other solid-state options (such as CCD). For example, CMOS cameras have “lower noise levels than CCDs or other solid state imagers.” *See, e.g.*, Adair, 2:8-10. When there is less noise, the video quality is improved. CMOS technology also enables “mass produc[tion] on standard semiconductor lines.” *See, e.g.*, Adair, 2:10-12. This ability for mass production results in lower costs. Furthermore, “CMOS imager requires 100 times less power than a CCD-type imager.” *See, e.g.*, Adair, 2:20-22; *see also* NASA (Ex. 1060) (“low power-consumption,” “small size,” “made on standard semiconductor production lines,” “cost[s] much less than CCDs,” and can tolerate lower material quality); *see also* Umeda (Ex. 1069, which was filed on January 30, 1998, and I understand is prior art), 1:22-58 (advantages of CMOS over CCD include lower

power consumption with a simpler power supply). In addition to reducing the cost of operating the device, the ability to operate with less power would have been known to be particularly important to the camera in Harris's handheld device because battery life was (and still is) a key feature of portable devices. In fact, reducing the size and cost of operating the device addresses the two main objectives of Harris's communication device. Harris, 1:59-63.

90. In addition to CMOS sensors being known to provide benefits over CCD sensors, Adair discloses that its miniature camera requires less space than other CMOS cameras. This is particularly important when addressing Harris's desire to reduce overall size and cost of a communication device. *See, e.g.,* Adair, 3:7-11 ("It is one object of this invention to provide ... reduced area imaging devices which take advantage of the CMOS-type imagers of Fossum, et al. ... but rearrange the accompanying circuitry in a stacked relationship so that there is a minimum profile presented..."); Harris, 1:59-63 ("what is needed is a multi-mode communication device that permits a user to communicate in privacy and employs a single user interface having components carried on multiple surfaces of the device so as to minimize the size and cost of the device"). Indeed, as evidenced by textbooks available at the time, it was known that products like "personal phones" and "handsets" require that the available space be considered in implementing features in the device. Printed Circuit Board Assembly (Ex. 1049) at 17 ("Running through

the above applications are considerations of space of the end product, i.e. is it required to fit any particular environment (and here we might refer back to personal phones for example).”), 22 (“In many cases the printed circuit board shape and layout is not controlled by the designer of the electronics of the board, but by the mechanical constraints of the final product. In the majority of cases the board will be rectangular but in some applications boards can be peculiar shapes to fit handsets”). In addition, a person of ordinary skill in the art would have been motivated to apply Adair’s teachings of a CMOS image sensor to Harris because, as admitted by the ’742, CMOS imagers produce less noise than CCD or other solid state imagers, can be mass produced on standard semiconductor production lines, and can incorporate a number of other different electronic controls on a single circuit board. ’742, 1:53-2:5.

91. Moreover, Adair discloses that “it will also be appreciated by those skilled in the art that the small size of the imaging device set forth herein can be applied to other functional disciplines ... for industrial equipment and the like.” *See, e.g.,* Adair, 3:27-4:12. In arguing for a 1997 priority date, Patent Owner has noted in the district court litigation that, from this same language found in a patent application at the time (the patent application for the ’901 patent to which the ’742 patent claims priority), “[a] person skilled in the art would understand this ... disclosure to be describing various existing devices which could incorporate [patent

owner's allegedly] inventive reduced area imaging device.” Collect Supplemental Response to Interrogatory No. 2 (Ex. 1017), 6-7. I disagree with Patent Owner's assertion that this disclosure supports its priority claim. *See* Section V. Regardless, while this disclosure does not specify any particular applications beyond the endoscope and boroscope identified in Adair, a person of skill in the art would have understood from this disclosure that it would have been obvious to look to other applications for the camera in Adair. Moreover, it was well known in the art that CMOS sensors were being used in various other devices and fields, including in both phones and medical devices. *See, e.g.*, Kozlowski (Ex. 1054, a U.S. patent filed on April 24, 2000, which I understand is prior art to the 742 patent), 2:12-26 (disclosing “CMOS video imagers can be implemented in widely-used consumer products” including “digital cellular/PCS telephone systems” and “medical instrumentation”), 2:44-3:10 (disclosing “CMOS image sensors are expected to gradually replace CCDs in many digital imaging applications and account for nearly 50 percent of digital imagers over the next five years”); Silicon Eyes (Ex. 1061, published in 1998, and which I understand is prior art to the '369 patent), 94-95, 97-98, 100 (explaining CMOS imagers, are expected in “cellular telephones and personal digital assistants” as well as disposable “[e]ndoscopic surgical devices”).

92. In light of the above, a person of ordinary skill in the art would have found it routine, straightforward and advantageous to apply Adair's teachings of

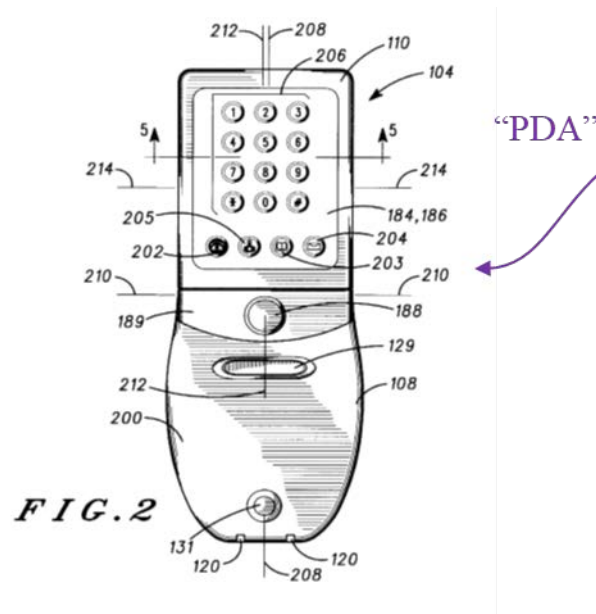
CMOS active pixels in an image sensor and outputting the video signal in implementing Harris's solid-state camera 188. A person of ordinary skill in the art would have had a reasonable expectation of success that applying these teachings would predictably work and provide the expected functionality for the reasons discussed above.

4. Invalidity of Claims 22, 42, 58 and 66 Over Harris in view of Adair

a. Element [22.pre]

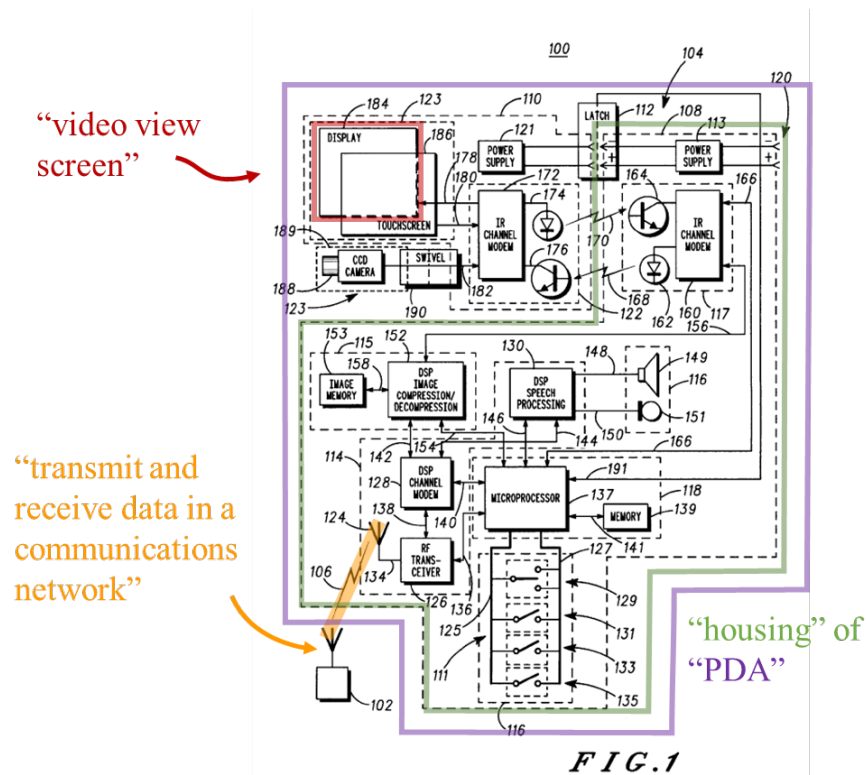
93. **Element [22.pre] recites “In a PDA having capability to transmit and receive data in a communications network, the PDA having a housing, and a video view screen for viewing the data which includes video signals.”** To the extent the preamble is limiting, Harris discloses a PDA (*e.g.*, “communication device 104” serving as a “personal digital assistant”) having capability to transmit and receive data in a communications network (*e.g.*, “data communications between the communication devices 102 and 104”), the PDA having a housing (*e.g.*, “first housing 108”), and a video view screen for viewing the data which includes video signals (*e.g.*, “display 184” for displaying “receive” and “transmit” “decompressed image data,” “video”).

94. For example, Harris discloses a PDA, and more specifically, “a multi-mode communication device 104” that combines “a portable radiotelephone with a personal digital assistant.” Harris, 1:4-6, 1:43-50, Fig. 2.



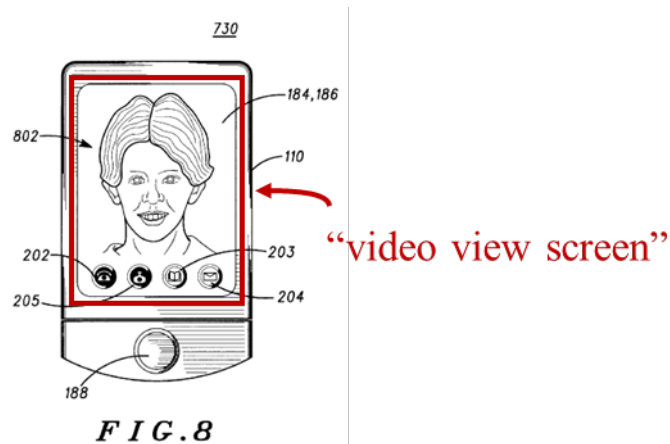
95. Further, Harris discloses that this PDA has the capability to transmit and receive data in a communications networks. Specifically, “multi-mode communication device 104” is a part of “communication system 100,” as shown in annotated Figure 1 below, wherein “communication devices 102 and 104...communicate over a communication link 106 [that] supports data communications between the...devices.” Harris, 2:55-3:6, 9:36-41 (“the controller 118 configures the communication device in a video conferencing mode 730 of FIG. 7.”), Figure 1. Harris teaches that data communications over “communication link 106” include transmit “image data” that has been compressed, encoded, and

modulated into “electrical transmit signals” and “electrical receive signals” that are demodulated, decoded, and decompressed into “image data.” Harris, 3:41-4:3, 4:27-50.



96. Harris discloses “the communication device 104” includes “a first housing 108” as shown in green above in Figure 1, as well as a “display 184” as shown in red above in Figure 1. Harris, 3:9-18, Fig. 1. Further, Harris teaches that “the display 184 displays receive decompressed image data,” including “full motion video,” received over “communication link 106,” and “transmit decompressed image data.” *See, e.g., Harris, 5:32-34, 5:38-44 (“[W]ireless data transceivers 117 and 122 can alternatively communicate via a wireless RF link or any other suitable*

wireless means. The wireless IR link transmits data at a rate of approximately 1 Mbit/sec to enable full motion video.”), 5:45-64, 9:44-55, Fig. 8.



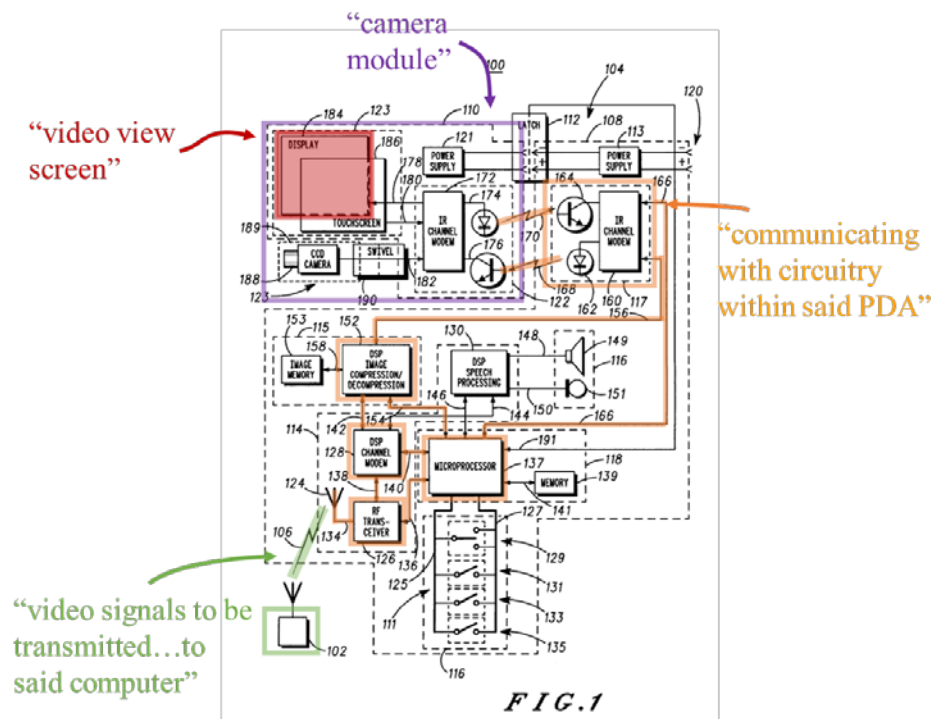
b. Element [22.a]

97. Element [22.a] recites “a camera module for taking video images, said camera module communicating with circuitry within said PDA enabling viewing on said video view screen and enabling video signals to be transmitted from said camera module to said computer.” Harris discloses element [22.a]. Harris discloses a camera module for taking video images (*e.g.*, “second housing 110” and “third housing 189” including “camera 188” for “captur[ing]” “video” “image data”), said camera module communicating with circuitry within said PDA (*e.g.*, as shown in Figure 1) enabling viewing on said video view screen (*e.g.*, displaying “video” “image data” from “camera 188” on “display 184”) and enabling

video signals to be transmitted from said camera module to said computer³ (*e.g.*, “image data” from “camera 188” “emi[tted] by the antenna 124” to “communication device 102” “computer”).

98. For example, Harris discloses a “second housing 110” and “third housing 189” that house a “CCD camera 188” and together make up a camera module. Harris, 5:60-65, Fig. 1. The “CCD camera 188 captures an image and outputs the image as receive decompressed image data on bus 182,” as shown in annotated Figure 1, below. Harris, 5:60-6:2, Fig. 1.

³ I note that the term “said computer” does not have an antecedent basis. I have been asked to assume that the claimed “computer” refers to either circuitry within the PDA itself or a separate device with which the PDA is communicating. As I explain, Harris discloses this limitation regardless of whether “computer” in the claim refers to a component on the PDA (*e.g.*, “IR channel modem 117) or a separate device with which the PDA is communicating (*e.g.*, “computer” “communication device 104”).

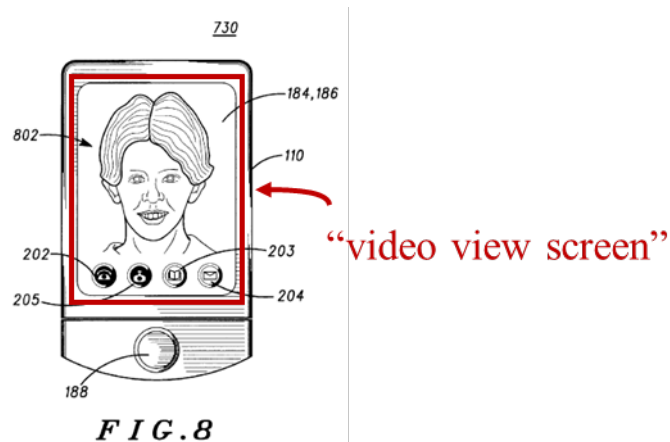


99. As shown in Figure 1 above, the “second housing 110” and “third housing 189” that make up the camera module communicate with “a first portion of circuitry housed in a first housing 108” of the PDA, via a “forward communication signal 168” and “backward communication signal 170.” Harris, 3:9-18, 5:18-44, Fig. 1. Harris discloses that “forward communication signal 168” includes encoded and modulated “forward control data received on bus 166” from the “controller 118” within the PDA, as outlined in orange in Figure 1 above. Harris, 4:66-5:5, 6:41-43, Fig. 1.

100. This communication between the camera module and the circuitry within the PDA enables video to be displayed on the display 184. For example, circuitry within the “second housing 110” and “third housing 189” that make up the

camera module is responsive to the “forward control data” from the PDA to “route transmit decompressed image data” captured by “CCD camera 188” “directly from bus 182 to [display 184]”. Harris, 4:66-5:11, 5:22-37, 11:43-47 (“the controller 118 controls the wireless data transceiver 122 of housing 110 to route image data captured by the CCD camera 188 directly to the display 184”), 12:12-17.

101. Further, Harris discloses that the output of the camera 188 can be encoded and modulated into “backward communication signal 170.” Harris, 4:66-5:11. The “backward communication signal 170” is transmitted as a “full motion video” to “wireless transceiver 117” in the PDA from the camera module and is demodulated and decoded into “transmit decompressed image data.” Harris, 5:8-11, 5:22-37, 5:42-44. The “transmit decompressed image data” is compressed by “image DSP 152” into “transmit compressed image data” and routed to “image memory 153” within the PDA for later retrieval and viewing on “display 184.” Harris, 4:36-43, 4:51-60, 5:47-51, Fig. 1, Fig. 2.



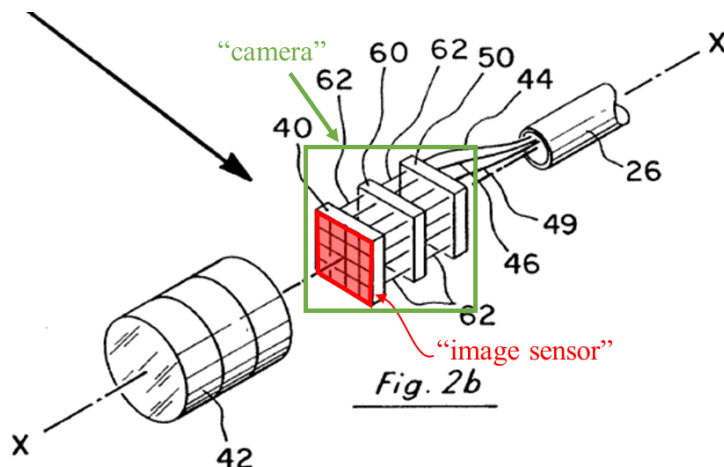
102. In addition, the communication between the camera module (the combination of “second housing 110” and “third housing 188) and the circuitry in the PDA allow video signals to be transmitted from the camera to the computer. For example, after the video signal from the camera is converted into “transmit compressed image data,” it can be modulated by a “channel modem DSP 128” and routed to “RF transceiver 126” to be filtered and amplified into “electrical transmit signals” for transmission to “communication device 102” over “communication link 106.” Harris, 3:40-58 (“The antenna 124 receives incoming RF signals of the communication link 106.... Electrical transmit signals on wire 134 are emitted by the antenna 124 as outgoing RF signals of the communication link 106.”), 3:65-4:3, 4:36-42, Fig 1. Harris further discloses that “communication device 102 is any device compatible with the communication device 104, such as a dispatch center, a cellular base station, a cordless base, another telephone, a computer, or the like.” Harris, 2:61-65, 2:55-57.

c. Element [22.b]

103. **Element [22.b]** recites “**said camera module including an image sensor housed therein.**” Harris in view of Adair renders obvious element [22.b]. Harris discloses said camera module housing a camera (*e.g.*, “second housing 110” and “third housing 189” including “camera 188”). Adair discloses a camera (*e.g.*, as shown in Fig. 2b) including an image sensor (*e.g.*, “image sensor 40”).

104. As discussed in [22.a], Harris discloses the camera module housing a camera. *See* Section VIII.A.4.b.

105. While Harris discloses said camera module including a camera housed therein, it does not disclose the components within said camera. Adair discloses a “reduced area imaging device” including an “active pixel-type CMOS imager[.]” *See* Adair, 2:6-9 (“... the active pixel-type CMOS imagers which consist of randomly accessible pixels with an amplifier at each pixel site...”), 4:14-21 (“... The term “image sensor” as used herein describes the CMOS pixel array which captures images and stores them within the structure of each of the pixels in the array”), 12:6-7 (“As shown in Figure 2b, the video processing board 50 may be placed directly behind image sensor 40”), Fig. 2b. An annotated copy of Figure 2b, highlighting the CMOS imager as “image sensor 40” is reproduced below:



106. As explained in Section VIII.A.3, a person of ordinary skill in the art would have been motivated and found it obvious and straightforward to apply

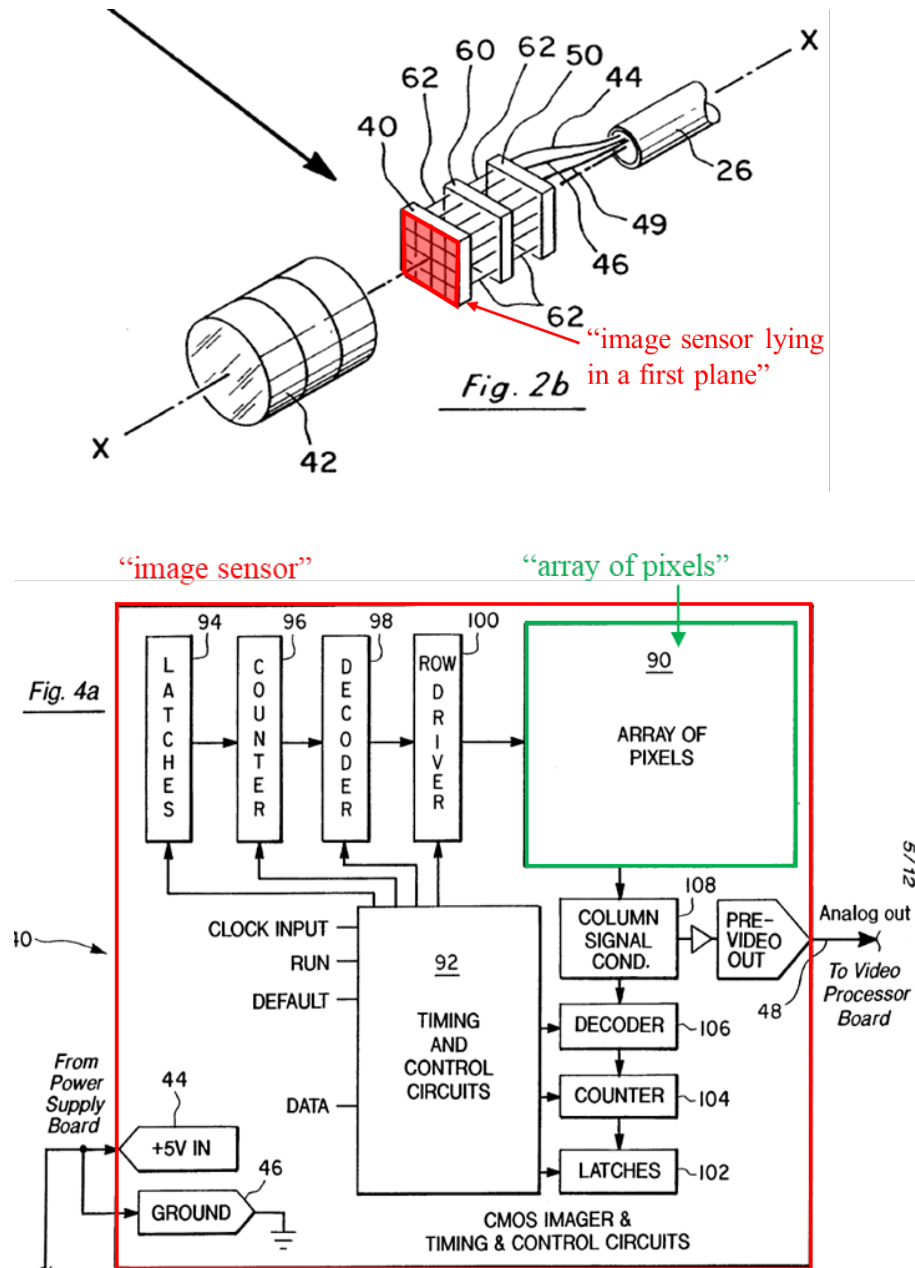
Adair's teachings of a reduced area CMOS imaging device in implementing Harris's camera such that Harris's camera module houses an image sensor therein. For example, Adair's camera system teachings would be applied to Harris's camera module because of various advantages that CMOS cameras have relative to other solid-state options (such as CCD), as discussed in Section VIII.A.3.

d. Element [22.c]

107. **Element [22.c] recites “said image sensor lying in a first plane and including an array of pixels for receiving images thereon.”** Adair discloses element [22.c]. Adair discloses said image sensor (*e.g.*, “image sensor 40”) lying in a first plane (*e.g.*, as shown in Fig. 2b) and including an array of pixels for receiving images thereon (*e.g.*, the “array of pixels making up the image sensor captures images”).

108. While Harris does teach a camera, it does disclose a CMOS imager in the camera. Adair discloses a “CMOS image sensor 40” lying on a “planar structure” and including a “CMOS pixel array.” Adair, 4:19-21 (“... image sensor’ *as used herein describes the CMOS pixel array* which captures images...”), 10:13-14 (“Image sensor 40 is illustrated as *being a planar* and square shaped *member*.”), 15:6-9 (“... the CMOS image sensor 40 may include the timing and control circuits *on the same planar structure*”), Fig. 4a. The first plane, defined by the image sensor

40, is also shown in Figure 2b. Annotated copies of Figures 2b and 4a are reproduced below:



109. Moreover, Adair’s claim 1 recites, “[a] reduced area imaging device comprising: a first circuit board defining a profile area and lying in a first plane,

said first circuit board including an array of CMOS pixels on said first plane for receiving images thereon.” See Adair, 8:7-14 (“... The array of pixels making up the image sensor captures images”), Claim 1, Claim 8.

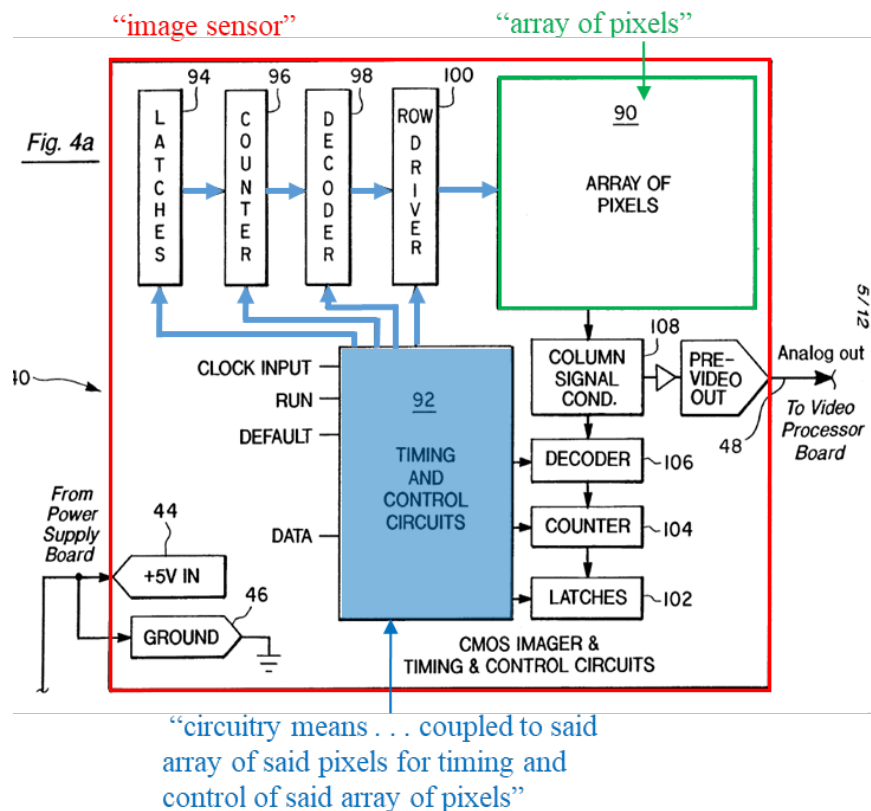
110. As discussed in Section VIII.A.3, a person of ordinary skill in the art would have been motivated to apply Adair’s teachings of a reduced area CMOS imaging device in implementing Harris’s camera.

e. Element [22.d]

111. **Element [22.d] recites “said image sensor further including circuitry means on said first plane and coupled to said array of said pixels for timing and control of said array of pixels.”** Adair discloses element [22.d]. Adair discloses said image sensor further including circuitry means on said first plane and coupled to said array of said pixels for timing and control of said array of pixels (*e.g.*, “the CMOS image sensor 40 may include the timing and control circuits on the same planar structure”).

112. While Harris does not expressly disclose its camera performs timing and control of the imaging array, Adair discloses circuitry means for timing and control of the CMOS pixels that is included on the CMOS image sensor and resides on the same plane as the array of CMOS pixels. Adair, 5:6-8 (“[T]iming and control circuits or circuitry’ as used herein refer to the electronic components which control the release of the image signal from the pixel array.”). For example, Adair discloses

“the CMOS image sensor 40 may include the timing and control circuits on the same planar structure.” Adair, 5:19-22, 15:7-9. Additionally, as shown in Figure 4a of Adair, the “timing and control” circuitry is coupled to the array of pixels. An annotated copy of Figure 4a is reproduced below:



113. Moreover, Adair's claim 1 recites, "[a] reduced area imaging device comprising: a first circuit board defining a profile area and lying in a first plane, said first circuit board including an array of CMOS pixels on said first plane for receiving images thereon and wherein individual CMOS pixels within said array of CMOS pixels each include an amplifier, *said first circuit board further including*

circuitry means on said first plane and coupled to said array of CMOS pixels for timing and control of said array of CMOS pixels, said first circuit board producing an analog pre-video signal.” See Adair, Claim 1.

114. A person of ordinary skill in the art would have been motivated and found it obvious and straightforward to apply Adair’s teaching of “placing the timing and control circuits on the same planar structure as the image sensor” in implementing Harris’s camera. For example, this configuration advantageously minimizes the number of connections between the image sensor and rest of the imaging device and to reduce the noise level in the pre-video signal (*see* Section VIII.A.4.f), without significantly increasing the size of the image sensor. See Adair, 16:14-17:5 (“The advantage in placing the timing and control circuits on the same planar structure as the image sensor is that only three connections are required between image sensor 40 and the rest of the imaging device, namely, conductors 44, 46 and 48. Additionally, placing the timing and control circuits on the same planar structure with the pixel array results in the pre- video signal having less noise. Furthermore, the addition of the timing and control circuits to the same planar structure carrying the image sensor only adds approximately .25 millimeters to one dimension of the planar structure 40.”). Further, a person of ordinary skill in the art would have recognized this combination (yielding the claimed limitation) would work as expected.

115. Furthermore, as discussed in Section VIII.A.3, a person of ordinary skill in the art would have been motivated to apply Adair’s teachings of a reduced area CMOS imaging device in implementing Harris’s camera.

116. To the extent that the “circuitry means ... for timing and control” limitation is construed under 35 U.S.C. §112(6) (*see* Section VII.C, above), as discussed above, Adair’s “timing and control circuits 92” perform the same function of timing and control of the array of CMOS pixels and has the same structure as “timing and control circuits 92,” which control the release of the image signal from the CMOS pixel array, disclosed in the ’742. A table showing a comparison between the disclosure in the ’742 and equivalent disclosure in Adair is shown below (the redline between the 742 patent and Adair that I had prepared (Ex. 1067) also generally shows the overlap in disclosure between the two):

<u>'742 Patent</u>	<u>Adair</u>
“The terms “timing and control circuits” or “timing and control circuitry” as used herein refer to the electronic components which control the release of the image signal from the pixel array.” 5:2-5	“The terms “timing and control circuits” or “circuitry as used herein refer to the electronic components which control the release of the image signal from the pixel array.” 5:6-8
“FIG. 9a is a more detailed schematic diagram of image sensor 40 which contains an array of pixels 90 and the timing and control circuits 92.” 15:4-6	“FIG. 4a is a more detailed schematic diagram of image sensor 40 which contains an array of pixels 90 and the timing and control circuits 92” 17:6-7
“The timing and control circuits 92 are used to control the release of the image information or image signal stored in	“The timing and control circuits 92 are used to control the release of the image information or image signal stored in

the pixel array. In the image sensor of Fossum, et al., the pixels are arranged in a plurality of rows and columns.... The whole process is repeated, based upon the timing sequence that is programmed. When the row driver 100 has accounted for each of the rows, the row driver reads out each of the rows at the desired video rate.” 16:9-44

the pixel array. In the preferred image sensor of Fossum, et al., the pixels are arranged in a plurality of rows and columns.... The whole process is repeated, based upon the timing sequence that is programmed. When the row driver 100 has accounted for each of the rows, the row driver reads out each of the rows at the desired video rate.” 18:3-19:3

Fig. 9a:

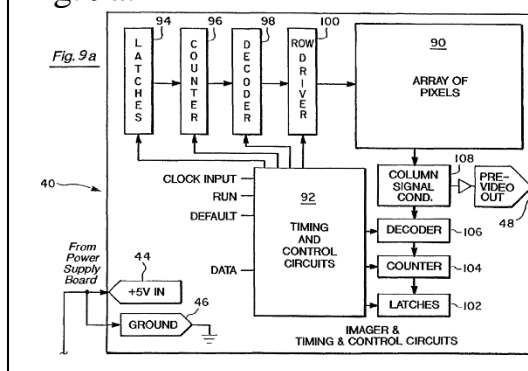
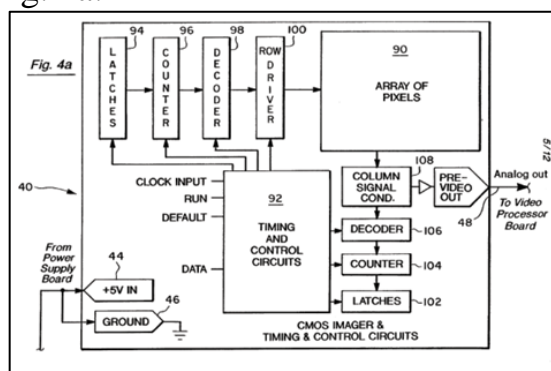


Fig. 4a:

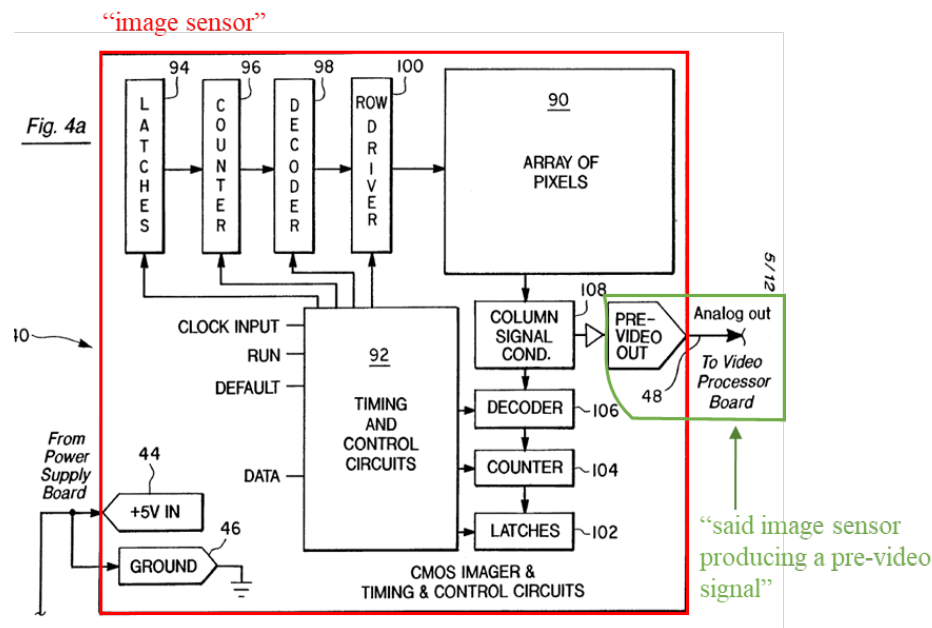


f. Element [22.e]

117. Element [22.e] recites “said image sensor producing a pre-video signal.” Adair discloses element [22.e]. Adair discloses said image sensor producing a pre-video signal (e.g., “image sensor 40” “produce[s]” “pre-video signal”).

118. For example, Adair discloses that “output from image sensor 40 in the form of the pre-video signal is input to video processor board 50 by means of the conductor 48.” See Adair, 15:12-14, Fig. 4a; see also Adair, 11:6-9 (“The image signal transmitted from the image sensor through conductor 48 is also herein”

referred to as a pre-video signal. Once the pre-video signal has been transmitted from image sensor 40 by means of conductor 48, it is received by video processing board 50.”), 20:3-4 (“Once image sensor 40 has created the pre-video signal, it is sent to the video processing board 50 for further processing.”), 21:3-5.



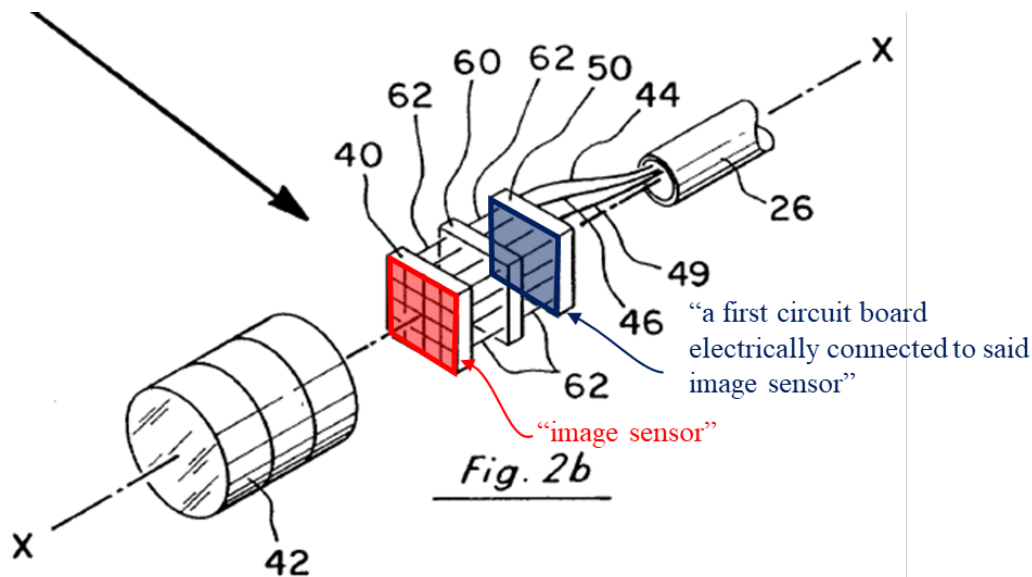
119. Moreover, Adair’s claim 1 recites, “first circuit board including an array of CMOS pixels on said first plane for receiving images ... said first circuit board producing an analog pre-video signal.” See Adair, Claim 1.

120. As discussed in Section VIII.A.3, a person of ordinary skill in the art would have been motivated to apply Adair’s teachings of a reduced area CMOS imaging device in implementing Harris’s camera.

g. Element [22.f]

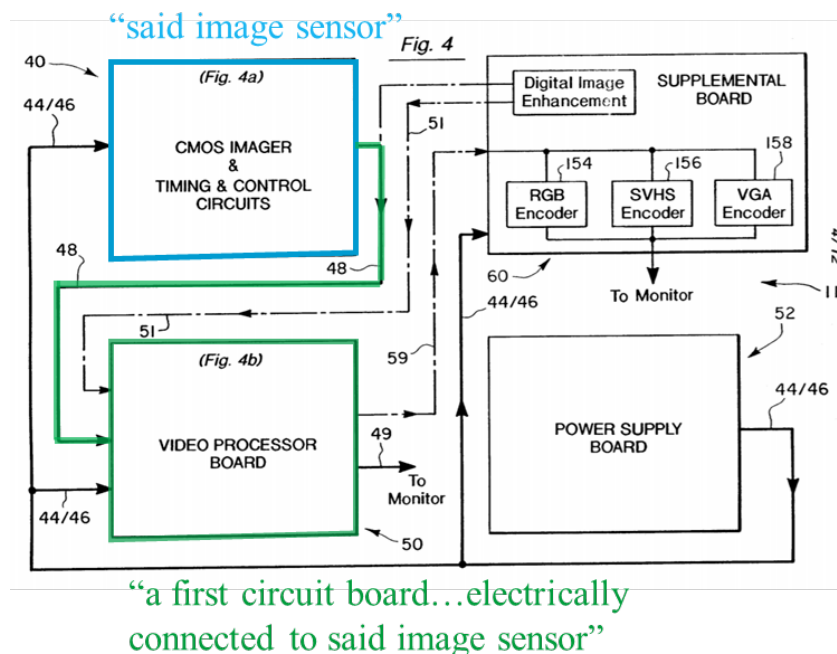
121. Element [22.f] recites “a first circuit board electrically connected to said image sensor, said first circuit board including circuitry means for converting said pre-video signal to a desired video format.” Adair discloses element [22.f]. Adair discloses a first circuit board (*e.g.*, “video processing board 50”) electrically connected to said image sensor (*e.g.*, “output from image sensor 40 ... is input to video processor board 50 by means of the conductor 48.”; “A plurality of pin connectors 62 serve to electrically couple image sensor 40 with video processing board 50”), said first circuit board including circuitry means for converting said pre-video signal to a desired video format (*e.g.*, “processing circuitry which ... converts the pre-video signal to a post-video signal which may be accepted by a standard video device,” as shown in Figure 4b.).

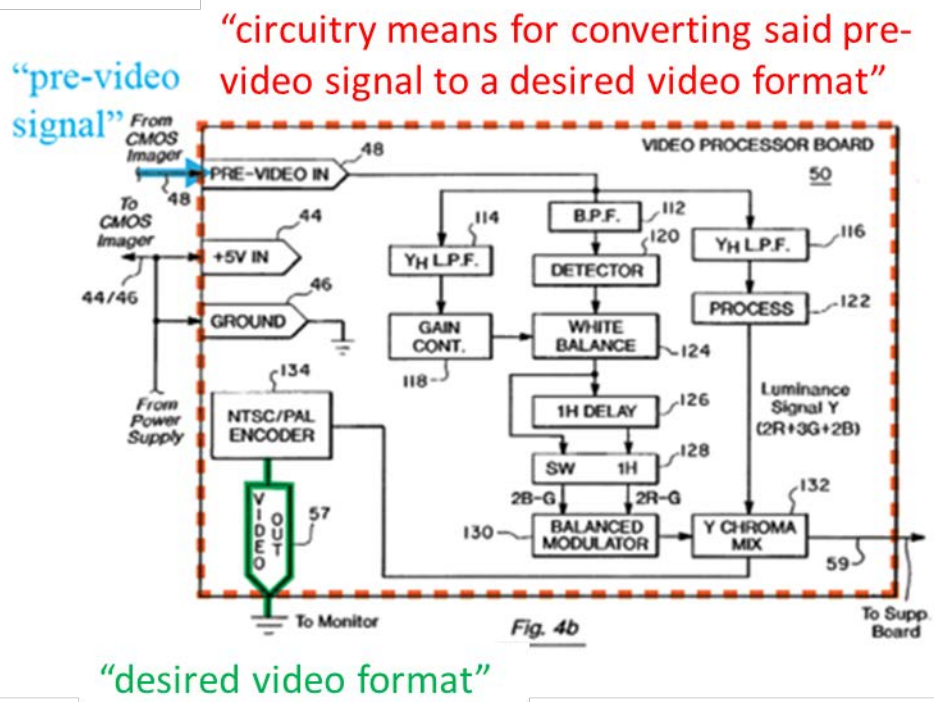
122. For example, Adair discloses, “output from image sensor 40 in the form of the pre-video signal is input to video processor board 50 by means of the conductor 48.” Adair, 15:12-14, 11:6-15. In Figure 2b, Adair discloses that “image sensor 40” is lying in a first plane, and the “video processing board 50 may be placed directly behind image sensor 40” in a second plane. *See* Adair, 12:6-7. An annotated copy of Figure 2b showing the relationship between the image sensor 40 and the video processor board 50 (i.e., a “first circuit board”) is reproduced below:



123. Furthermore, Adair discloses, “[o]nce image sensor 40 has created the pre-video signal, it is sent to the video processing board 50 for further processing.” Adair, 20:3-6. Once the pre-video signal is received, “[v]ideo processing board 50 then carries out all the necessary conditioning of the pre-video signal and places it in a form so that it may be viewed directly on a standard video device.” See Adair, 11:7-19. Additionally, Adair explicitly discloses that “the signal produced by the video processing board 50 can be further defined as a post-video signal which can be accepted by a standard video device.” See Adair, 11:13-19. Adair discloses that, “[t]he term ‘processing circuitry’ as used herein refers to the electronic components within the imaging device which receive the image signal from the image sensor and ultimately place the image signal in a usable format.” See Adair, 5:3-6, 7:23-27 (“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.”), 12:6-12, 15:12-19. Figure 4b of Adair is also an exemplary “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.” See Adair, 7:23-27. Annotated Figures 4 and 4(b) are reproduced below:





124. Adair teaches that “[t]he composite frequencies are added to the signal leaving the Y chroma mixer 132 in encoder 134 to produce the post-video signal which may be accepted by a television.” See Adair, 20:25-21:2. Adair further discloses that, “Figures 5a-5e illustrate in more detail one example of circuitry which may be used in the video processing board 50 in order to produce a post-video signal which may be directly accepted by a video device such as a television.” See Adair, 22:14-23.

125. Moreover, Adair’s claim 1 recites, “circuitry means for converting said pre-video signal to a post-video signal for reception by a standard video device.” See Adair, Claim 1.

126. Furthermore, as discussed in Section VIII.A.3, a person of ordinary skill in the art would have been motivated to apply Adair's teachings of a reduced area CMOS imaging device in implementing Harris's camera.

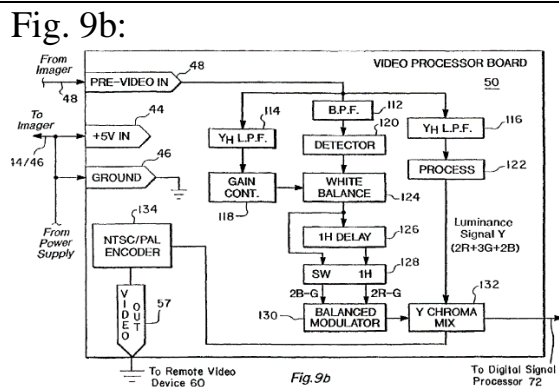
127. To the extent that the "circuitry means for converting said pre-video signal to a desired video format" limitation is construed under 35 U.S.C. §112(6) (see Section VII.C, above), as discussed above, Adair's processing circuitry that converts the pre-video signal to a post-video signal, which may be received by a standard video device as shown in Fig. 4b, performs the same function of "converting said pre-video signal to a desired video format" and has the same structure as "processing circuitry ... which converts the pre-video signal to a post-video signal which may be accepted by an NTSC/PAL compatible video device" disclosed in the '742. A table showing a comparison between the disclosure in the '369 and equivalent disclosure in Adair is shown below (the redline between the '742 patent and Adair that I had prepared (Ex. 1067) also generally shows the overlap in disclosure between the two):

<u>'742 Patent</u>	<u>Adair</u>
"The term "processing circuitry" as used herein refers to the electronic components within the imaging device which receive the image signal from the image sensor and ultimately place the image signal in a usable format." 4:65-5:2	"The term "processing circuitry" as used herein refers to the electronic components within the imaging device which receive the image signal from the image sensor and ultimately place the image signal in a usable format." 5:3-6.

“FIG. 9b is an enlarged schematic diagram of a video processing board/planar structure 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 an NTSC/PAL compatible video device” 8:7-12

“Once image sensor 40 has created the pre-video signal, it is sent to the video processing board 50 for further processing. At board 50, as shown in FIG. 6b, the pre-video signal is passed through a series of filters. One common filter arrangement may include two low pass filters 114 and 116, and a band pass filter 112....” 17:8-29

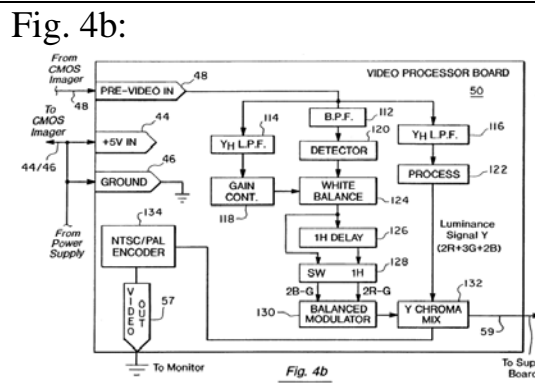
“FIGS. 8a-8 e illustrate in more detail one example of circuitry which may be used in the video processing board 50 in order to produce a post-video signal which may be directly accepted by a NTSC/PAL compatible video device such as a television. The circuitry disclosed in FIGS. 8a-8 e is very similar to circuitry which is found in a miniature quarter-inch Panasonic camera, Model KS-162.” 18:11-23



“Figure 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.” 7:23-27

“Once image sensor 40 has created the pre-video signal, it is sent to the video processing board 50 for further processing. At board 50, as shown in Figure 4b, the pre-video signal is passed through a series of filters. One common filter arrangement may include two low pass filters 114 and 116, and a band pass filter 112....” 20:3-19

“Figures 5a-5e illustrate in more detail one example of circuitry which may be used in the video processing board 50 in order to produce a post-video signal which may be directly accepted by a video device such as a television. The circuitry disclosed in Figures 5a-5e is very similar to circuitry which is found in a miniature quarter-inch Panasonic camera, Model KS-162....” 22:14-23



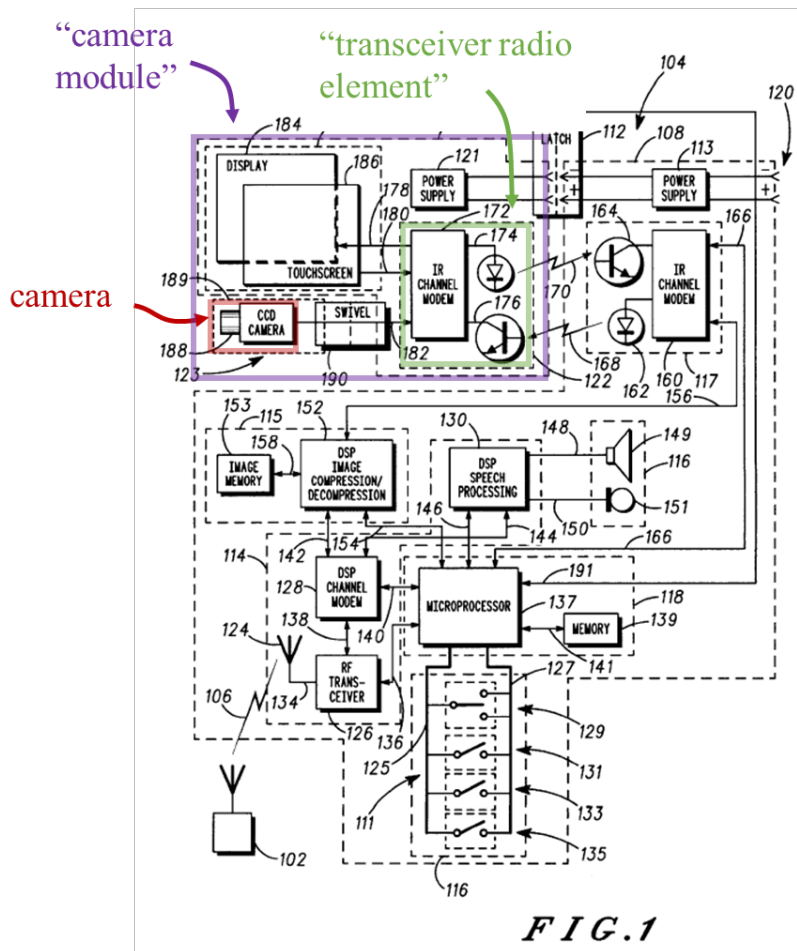
128. In addition, a person of ordinary skill in the art would have recognized that applying Adair's teachings of its processing circuitry to Harris's camera would have predictably yielded the claim element. A person of ordinary skill in the art would have known found it straightforward to convert the output of Adair's video processing circuitry to a digital signal in order to supply the output signal to Harris's DSP and/or camera. Thus, a person of ordinary skill in the art would have recognized this combination (yielding the claimed limitation) would work as expected.

h. Element [22.g]

129. **Element [22.g] recites “a transceiver radio element housed within said camera module and electrically coupled to said first circuit board for transmitting said converted pre-video signal.”** Harris in view of Adair renders obvious element [22.g]. Harris discloses a transceiver radio element (*e.g.*, “RF” “wireless data transceiver 122”) housed within said camera module (*e.g.*, housed in “second housing 110” portion of camera module) and electrically coupled to said camera (*e.g.*, “camera 188 ... electrically coupled to” “wireless data transceiver 122”) for transmitting a converted pre-video signal (*e.g.*, for transmitting “backward communication signal 170,” containing “decompressed image data” “video”). Adair discloses electrically coupling said first circuit board with external circuitry (*e.g.*,

“The output signal from the video processor board 50 ... may be carried by conductor 49”).

130. For example, Harris discloses its “second housing 110” and “third housing 189,” which make up a camera module, includes a radio frequency transceiver, “wireless data transceiver 122,” housed within the “second housing 110.” Harris, 3:13-18, 5:38-42 (“[T]he wireless data transceivers 117 and 122 can alternatively communicate via a wireless RF link or any other suitable wireless means.”). As shown in annotated Figure 1 below, “wireless data transceiver 122” is electrically coupled to the “camera 188” via “bus 182.” Harris, 5:18-21 (“The wireless data transceiver 122 includes an IR channel modem 172”), 5:60-61 (“The CCD camera 188 of FIG. 1 is electrically coupled to the IR channel modem 172 via bus 182.”), Fig. 1.



Further, Harris discloses that the circuitry of “wireless data transceiver 122...encodes and modulates transmit decompressed image data” in the form of “full motion video” captured by “camera 188” into a “backward communication signal 170” for further transmission. Harris, 5:18-21; 5:26-30, 5:5-44 (“IR channel modem 172 drives the IR emitter 162 to transmit the backward communication signal 170”).

131. While Harris discloses electrical coupling between its wireless transceiver radio element and camera, Adair discloses electrically coupling the

output of video processing board 50 with external circuitry via “conductor 49.” *See* Adair, 11:13-17 (“The signal produced by the video processing board 50 can be further defined as a post- video signal which can be accepted by a standard video device. As shown in Figure 1a, a conductor 49 is provided which transmits the post-video signal to an output connector 58 on the exterior surface of control box 30.”), 15:17-19 (disclosing “The output signal from the video processor board 50 is in the form of the post-video signal and which may be carried by conductor 49 which can also be a 50 ohm conductor”). Figures 2b, 4, and 4b, show the video processing board 50’s external connections, including the connection through conductor 49 to external circuitry.

132. As discussed in Section VIII.A.3, a person of ordinary skill in the art would have been motivated to apply Adair’s teachings of a reduced area CMOS imaging device in implementing Harris’s camera.

133. Furthermore, a person of ordinary skill in the art would have understood that, when applying Adair’s CMOS camera teachings in implementing Harris, the transceiver 122 is electrically coupled to the video processing board 50.

i. Element [22.h]

134. **Element [22.h] recites “a transceiver radio module housed in the PDA and wirelessly communicating with said transceiver radio element for receiving said converted pre-video signal, and said transceiver radio element**

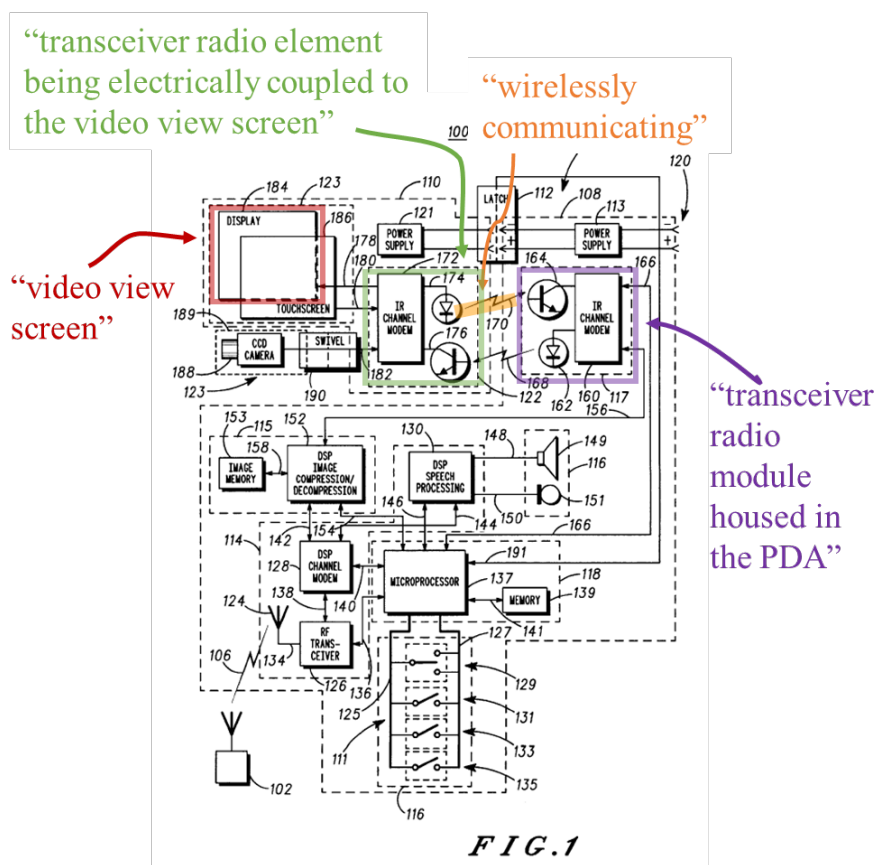
being electrically coupled to the video view screen of the PDA enabling viewing of the converted pre-video signals.” Harris discloses element [22.h]. Harris discloses a transceiver radio module (*e.g.*, “RF” “wireless data transceiver 117”) housed in the PDA (*e.g.*, in “first housing 108” of “communication device 104”) and wirelessly communicating with said transceiver radio element (*e.g.*, communicating with “wireless data transceiver 122” over “wireless RF link”; see Figure 1) for receiving said converted pre-video signal (*e.g.*, receiving “decompressed image data” “video”), and said transceiver radio element being electrically coupled to the video view screen of the PDA (*e.g.*, “wireless data transceiver 122” coupled to the “display 184” via “bus 178”) enabling viewing of the converted pre-video signals (*e.g.*, “rout[ing] ... image data directly from” “camera 188” to “display 184”).

135. Harris discloses “a first wireless data transceiver 117” housed in “a first housing 108” of the PDA, as shown in Figure 1. Harris, 3:9-18. Harris further discloses that the “wireless data transceiver 122” of the “second housing 110” in the camera module “is compatible with the wireless data transceiver 117” and “can ...communicate via a wireless RF link or any other suitable wireless means.” Harris, 5:18-23; 5:32-44.

136. Further, Harris discloses circuitry within “wireless data transceiver 117” receives a “backward communication signal 170”—the converted pre-video signal in the form of “full motion video”—from “wireless data transceiver 122” and further

“demodulates and decodes the backward communication signal 170 into transmit decompressed image data” captured by “camera 188.” Harris, 4:61-64 (“The wireless data transceiver 117 includes an infrared (IR) channel modem 160”), 5:5-11, 5:18-23 (“The wireless data transceiver 122 includes an IR channel modem 172”), 12:12-17, Figure 1.

137. Harris also discloses that circuitry within “wireless data transceiver 122” is electrically coupled to “display 184,” as shown in Figure 1. Harris, 5:18-21 (“The wireless data transceiver 122 includes an IR channel modem 172,”); 5:47-48 (“The display 184 is coupled to the IR channel modem 172 via bus 178.”), Figure 1. Harris further discloses that “the display 184 displays receive decompressed image data ... received on bus 178” which may include “image data captured by the CCD camera 188.” Harris, 5:45-54; 11:43-47. In particular, “forward control data” transmitted to the transceiver radio element (“transceiver 122”) causes “the wireless data transceiver 122 of housing 110 to route image data captured by the CCD camera 188 directly to the display 184.” Harris, 4:66-5:11, 5:22-37, 11:43-48.



j. Element [42.pre]

138. Element [42.pre] recites “In a PDA having capability to transmit and receive data in a communications network.” To the extent the preamble is limiting, as discussed in connection with [22.pre], Harris discloses a PDA (*e.g.*, “communication device 104” serving as a “personal digital assistant”) having capability to transmit and receive data in a communications network (*e.g.*, “data communications between the communication devices 102 and 104”).

139. My analysis of [22.pre] with respect to similar claim language is equally applicable to [42.pre]. *See* Section VIII.A.4.a.

k. Element [42.a]

140. **Element [42.a]** recites “**a video system integral with said PDA for receiving and transmitting video images, and for viewing said images.**” Harris discloses element [42.a]. Harris discloses a video system integral with said PDA (*e.g.*, “communication device 104” with “video conferencing”) for receiving and transmitting video images (*e.g.*, “receives” and “transmit[s]” “RF signals” containing “video” “image data” over “communication link 106”), and for viewing said images (*e.g.*, displaying “video” “image data” received from “communication link 106” and “camera 188” on “display 184”).

141. Harris discloses its PDA—communication device 104—has “video capability” for displaying “transmit decompressed image data” and “receive decompressed image data” from a “second user...with which the instant user is telephonically communicating, on the display 184.” *See* Harris, 1:9-12 (“manufacturers have proposed giving traditional audio telephones video capability.”), 2:18-20, 5:32-34 (“The IR channel modem 172 may alternatively route transmit decompressed image data directly from bus 182 to bus 178 in response to forward control data.”), 5:50-54 (“the display 184 displays receive decompressed image data and forward control data received on bus 178.”), 9:44-55 (“In the video conferencing mode 730...[t]he controller 118 displays a second user 802, with which the instant user is telephonically communicating, on the display 184.”).

142. Harris also explicitly discloses that the communication device can be configured in a “video conferencing mode 730.” Harris, 9:39-41. In this mode, the PDA can transmit video images to other users. For example, the video signal is routed to “RF transceiver 126” to be filtered and amplified into “electrical transmit signals” for transmission to “communication device 102” over “communication link 106.” Harris, 3:6-6 (“data is communicated via the wireless communication link 106 as radio frequency (RF) signal energy”), 3:40-58, 3:65-4:3, 4:36-42, Figure 1. And the PDA can also receive video images from other users. Harris, 9:44-55 (“In the video conferencing mode 730...[t]he controller 118 displays a second user 802, with which the instant user is telephonically communicating, on the display 184.”).

143. Moreover, the display 184 displays video received from a second user. Harris, 9:44-49 (“the controller 118 displays a second user 802, with which the instant user is telephonically communicating, on the display 184.”), Fig. 8.

144. In addition the display 184 displays the output of the camera. Harris, 11:39-47 (“the controller 118 controls the wireless data transceiver 122 of housing 110 to route image data captured by the CCD camera 188 directly to the display...”).

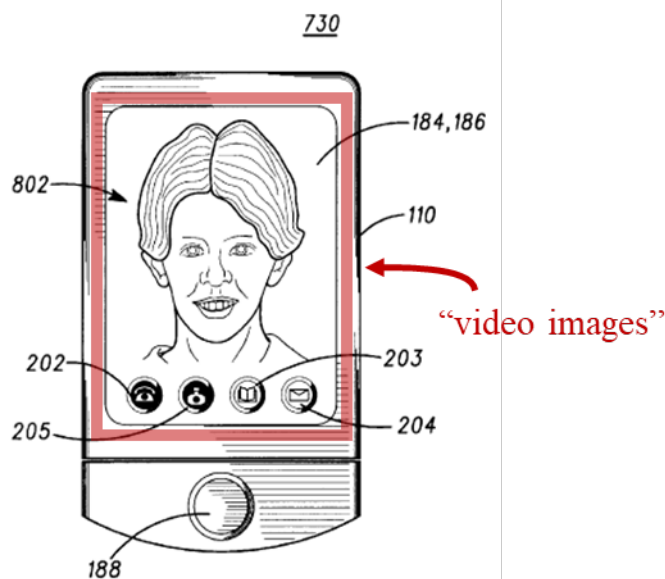


FIG. 8

I. Element [42.b]

145. **Element [42.b]** recites “a camera module housing an image sensor **therein.**” Harris in view of Adair renders obvious element [42.b]. As discussed in connection with [22.b], Harris discloses said camera module including a camera housed therein (*e.g.*, “second housing 110” and “third housing 189” including “camera 188” for “captur[ing]” “video” “image data”). Adair discloses a camera (*e.g.*, as shown in Fig. 2b) including an image sensor (*e.g.*, “image sensor 40”).

146. My analysis of [22.b] with respect to similar claim language is equally applicable to [42.b]. *See* Section VIII.A.4.c.

147. As discussed in Section VIII.A.3, a person of ordinary skill in the art would have been motivated to apply Adair’s teachings of a reduced area CMOS imaging device in implementing Harris’s camera.

m. Element [42.c]

148. **Element [42.c]** recites “**said image sensor lying in a first plane and including an array of pixels for receiving images thereon.**” Adair discloses element [49.c]. As discussed in relation to claim element [22.c], Adair discloses said image sensor (*e.g.*, “image sensor 40”) lying in a first plane (*e.g.*, as shown in Fig. 2b) and including an array of CMOS pixels for receiving images thereon (*e.g.*, the “array of [CMOS] pixels making up the image sensor captures images”).

149. My analysis of [22.c] with respect to similar claim language is equally applicable to [49.c]. *See* Section VIII.A.4.d. As discussed in Section VIII.A.3, a person of ordinary skill in the art would have been motivated to apply Adair’s teachings of a reduced area CMOS imaging device in implementing Harris’s camera.

n. Element [42.d]

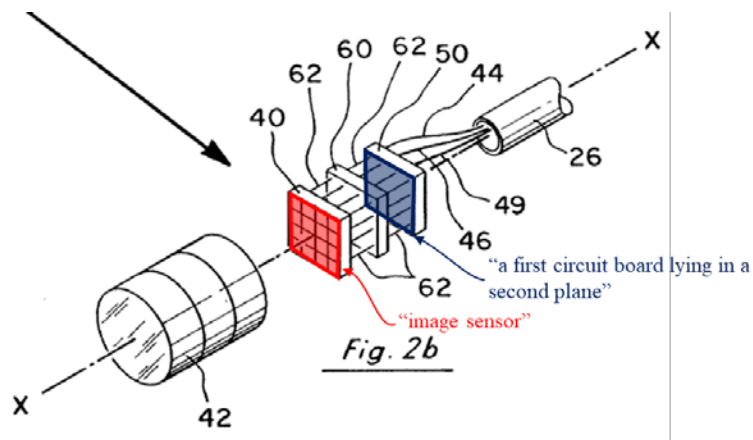
150. **Element [42.d]** recites “**said image sensor producing a pre-video signal.**” Adair discloses element [42.d]. As discussed in relation to claim element [22.e], Adair discloses said image sensor producing a pre-video signal (*e.g.*, “image sensor 40” “produce[s]” “pre-video signal”).

151. My analysis of [22.e] with respect to similar claim language is equally applicable to [42.d]. *See* Section VIII.A.4.f. As discussed in Section VIII.A.3, a person of ordinary skill in the art would have been motivated to apply Adair’s teachings of a reduced area CMOS imaging device in implementing Harris’s camera.

o. Element [42.e]

152. **Element [42.e]** recites **“a first circuit board lying in a second plane and electrically coupled to said image sensor.”** Adair discloses element [42.e]. Adair discloses a first circuit board lying in a second plane (*e.g.*, “video processing board 50... placed directly behind image sensor 40”) and electrically coupled to said image sensor (*e.g.*, “output from image sensor 40 ... is input to video processor board 50 by means of the conductor 48.”; “A plurality of pin connectors 62 serve to electrically couple image sensor 40 with video processing board 50”).

153. For example, Adair discloses, “output from image sensor 40 in the form of the pre-video signal is input to video processor board 50 by means of the conductor 48.” Adair, 15:12-14, 11:6-15. In Figure 2b, Adair discloses that “image sensor 40” is lying in a first plane, and the “video processing board 50 may be placed directly behind image sensor 40” in a second plane. *See* Adair, 12:6-7. An annotated copy of Figure 2b showing the relationship between the image sensor 40 and the video processor board 50 (i.e., a “first circuit board”) is reproduced below:



154. As discussed in Section VIII.A.3, a person of ordinary skill in the art would have been motivated to apply Adair’s teachings of a reduced area CMOS imaging device in implementing Harris’s camera.

p. Element [42.f]

155. **Element [42.f] recites “said first circuit board including circuitry means for timing and control of said array of pixels and circuitry means for processing and converting said pre-video signal to a desired video format.”** Adair discloses element [42.f]. Adair discloses said first circuit board including circuitry means for timing and control of said array of pixels (*e.g.*, “place the timing and control circuits onto video processing board 50”) and circuitry means for processing and converting said pre-video signal to a desired video format (*e.g.*, “processing circuitry ... converts the pre-video signal to a post-video signal which may be accepted by a standard video device”).

156. For example, Adair discloses that “video processing board 50” (which includes circuitry means for processing and converting said pre-video signal to a desired video format as discussed above in Section VIII.A.4.g) may also include “timing and control circuits.” *See* Adair, 16:14-17.

157. Moreover, claim 3 recites “...said circuit board including circuitry means for timing and control of said array of CMOS pixels, said timing and control means producing an analog pre-video signal, said circuit board further including circuitry means for receiving said analog pre-video signal from said timing and control means and converting said pre-video signal to a post-video output signal for reception by a video device...” *See* Adair, Claim 3.

158. As discussed in connection with element [22.d], Adair discloses circuitry means for timing and control. *See* Section VIII.A.4.e. In addition, my analysis of [22.f] with respect to similar claim language is equally applicable to element [42.f], since the processing circuitry disclosed by Adair for “converting said pre-video signal to a desired video format” also performs the function of “processing and converting said pre-video signal to a desired video format.” *See* Section VIII.A.4.g.

159. As discussed in Sections VIII.A.3 and VIII.A.4.g, a person of ordinary skill in the art would have been motivated to apply Adair’s teachings of a reduced area CMOS imaging device in implementing Harris’s camera.

q. Element [42.g]

160. **Element [42.g] recites “a transceiver radio element communicating with said first [sic] circuit board for transmitting said converted pre-video signal.”** Harris in view of Adair renders obvious element [42.g]. As explained in connection with element [22.g], Harris discloses a transceiver radio element (*e.g.*, “RF” “wireless data transceiver 122”) communicating with said camera (*e.g.*, “camera 188 ... electrically coupled to” “wireless data transceiver 122”) for transmitting said converted pre-video signal (*e.g.*, for transmitting “backward communication signal 170,” containing “decompressed image data” “video”). Adair discloses said first circuit board communicating with external circuitry (*e.g.*, “The output signal from the video processor board 50 ... may be carried by conductor 49”).

161. My analysis of [22.g] with respect to similar claim language is equally applicable to [42.g]. *See* Section VIII.A.4.h.

162. As discussed in Sections VIII.A.3 and VIII.A.4.g, a person of ordinary skill in the art would have been motivated to apply Adair’s teachings of a reduced area CMOS imaging device in implementing Harris’s camera. Furthermore, a person of ordinary skill in the art would have understood that, when applying Adair’s CMOS camera teachings in implementing Harris, the transceiver 122 is communicating with the video processing board 50.

r. Element [42.h]

163. **Element [42.h] recites “a transceiver radio module mounted in said PDA for wirelessly receiving said converted pre-video signal.”** Harris discloses element [42.h]. As explained in connection with element [22.h], Harris discloses a transceiver radio module (*e.g.*, “wireless data transceiver 117” “communicat[ing] via ... RF”) mounted in the PDA (*e.g.*, in “first housing 108” of “communication device 104”) for wirelessly receiving said converted pre-video signal (*e.g.*, receiving “decompressed image data” “video” over “wireless RF link”; see Figure 1).

164. My analysis of [22.h] with respect to similar claim language is equally applicable to [42.h]. *See* Section VIII.A.4.i.

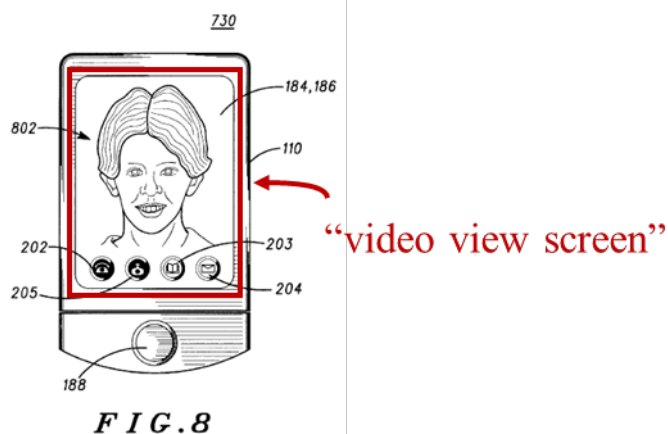
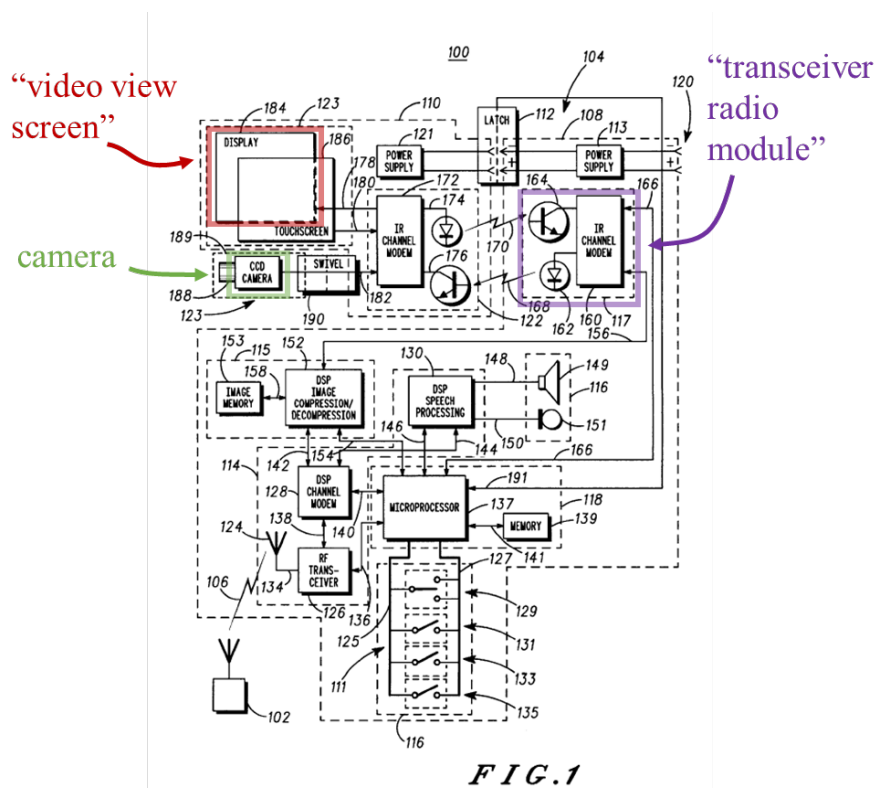
s. Element [42.i]

165. **Element [42.i] recites “a video view screen attached to said PDA for viewing said video images, said video view screen communicating with said transceiver radio module, and displaying video images processed by said first circuit board.”** Harris in view of Adair renders obvious element [42.i]. Harris discloses a video view screen (*e.g.*, “display 184”; *see* [22.pre]) attached to said PDA (*e.g.* on “the front surface 200” of the PDA) for viewing said video images (*e.g.*, viewing “decompressed image data” “video”; *see* [22.pre]), said video view screen communicating with said transceiver radio module (*e.g.*, via “bus[es] 178” and “180” and “wireless RF link” between “data transceiver[s] 117” and “122”; *see*

[22.h]), and displaying video images processed by said camera (*e.g.*, displaying “video” “image data” from “camera 188”; see [22.a]). Adair discloses a video view screen communicating with said first circuit board, and displaying video images processed by said first circuit board (*e.g.*, “The signal produced by the video processing board 50 ... accepted by a standard video device” as shown in Fig. 4b).

166. As discussed in [22.pre], [22.a], and [22.h] Harris discloses a video view screen for viewing said video images, said video view screen displaying video images from said camera. *See* Sections VIII.A.4.a, VIII.A.4.b, VIII.A.4.i. As discussed in [42.f], Adair discloses said camera outputting video images processed by said first circuit board. *See* Section VIII.A.4.p.

167. In addition, Harris discloses that a video view screen, the “display 184,” is attached to the PDA on “the front surface 200,” and communicates with “wireless data transceiver 117” over “bus 178” and the wireless RF link between transceivers 117 and 122, as illustrated in Figures 1 and 8. *See, e.g.*, Harris, 2:55-65, 3:9-18, 4:61-5:11, 5:23-27, 5:45-51, 5:60-65, 6:63-67, Figure 1, Figure 8.



168. To the extent it is argued that “communicating with said transceiver radio module” requires communication *from* the video view screen *to* the transceiver radio module, Harris also discloses that its video view screen has a “touchscreen 186” (shown in Figure 8) that transmits “control signals” *to* “data transceiver 117” via bus

180 and the “wireless RF link.” Harris, 4:61-64, 5:5-11, 5:18-21, 5:26-32, 5:38-42, 5:48-50, 5:54-56.

169. As discussed in Section VIII.A.3, a person of ordinary skill in the art would have been motivated and found it obvious and straightforward to apply Adair’s teachings of a camera producing video images on the first circuit board in implementing Harris’s camera, and the output video images of the first circuit board would be provided to Harris video screen for displaying.

t. Element [58.pre]

170. **Element [58.pre] recites “In a PDA having capability to transmit and receive data in a communications network, the PDA including a video view screen for viewing the video images.”** To the extent the preamble is limiting, as explained in connection with [22.pre], Harris discloses a PDA (*e.g.*, “communication device 104” serving as a “personal digital assistant”) having capability to transmit and receive data in a communications network (*e.g.*, “data communications between the communication devices 102 and 104”), the PDA including a video view screen for viewing the video images (*e.g.*, “display 184” for displaying “receive” and “transmit” “decompressed image data,” “video”).

171. My analysis of [22.pre] with respect to similar claim language is equally applicable to [58.pre]. *See* Section VIII.A.4.a.

u. Element [58.a]

172. **Element [58.a] recites “a camera module for taking video images, said camera module communicating with circuitry within said PDA enabling viewing of said video images on said PDA and enabling video signals to be transmitted from said camera module to the personal computer.”** Harris discloses element [58.a]. As explained in connection with [22.a], Harris discloses a camera module for taking video images (*e.g.*, “second housing 110” and “third housing 189” including “camera 188” for “captur[ing]” “video” “image data”), said camera module communicating with circuitry within said PDA (*e.g.*, as shown in Figure 1) enabling video signals to be transmitted from said camera module to said computer.

173. My analysis of [22.a] with respect to similar claim language is equally applicable to [58.a]. *See* Section VIII.A.4.b.

v. Element [58.b]

174. **Element [58.b] recites “said camera module including an image sensor housed therein, said image sensor lying in a first plane and including an array of pixels for receiving images thereon.”** Harris in view of Adair renders obvious element [58.b]. As explained in connection with [22.b], Harris discloses said camera module including a camera housed therein. As explained in connection with [22.c], Adair discloses said image sensor (*e.g.*, “image sensor 40”) lying in a first plane (*e.g.*, as shown in Fig. 2b) and including an array of CMOS pixels for

receiving images thereon (*e.g.*, the “array of [CMOS] pixels making up the image sensor captures images”).

175. As discussed in connection with [22.b], Harris discloses the camera module housing a camera. *See* Section VIII.A.4.c. As discussed in connection with [22.c], Adair discloses said image sensor lying in a first plane and including an array of CMOS pixels for receiving images thereon. *See* Section VIII.A.4.d.

176. As discussed in Section VIII.A.3, a person of ordinary skill in the art would have been motivated to apply Adair’s teachings of a reduced area CMOS imaging device in implementing Harris’s camera.

w. Element [58.c]

177. **Element [58.c] recites “said image sensor further including circuitry means electrically coupled to said array of said pixels for timing and control of said array of pixels.”** Adair discloses element [58.c]. As discussed in relation to claim element [22.d], Adair discloses said image sensor further including circuitry means electrically coupled to said array of said pixels for timing and control of said array of pixels (*e.g.*, “the CMOS image sensor 40 may include the timing and control circuits on the same planar structure”).

178. My analysis of [22.d] with respect to similar claim language is equally applicable to element [58.c]. *See* Sections VIII.A.4.e. As discussed in Section VIII.A.3, a person of ordinary skill in the art would have been motivated to apply

Adair's teachings of a reduced area CMOS imaging device in implementing Harris's camera.

x. Element [58.d]

179. **Element [58.d] recites “said circuitry means for timing and control placed remote from said array of pixels on a second plane.”** Adair discloses element [58.d]. Adair discloses said circuitry means for timing and control (*e.g.*, “timing and control circuitry”) placed remote from said array of pixels (*e.g.*, “placed remote from the pixel array”) on a second plane (*e.g.*, “placed on ... other circuit board[]” defining a second plane”).

180. For example, Adair discloses that “the timing and control circuits can be placed remote” from “the CMOS pixel array.” Adair, 4:21-25, *see also*, Adair 5:16-19. Moreover, Harris explains that, when placed remote from the pixel array, “the timing and control circuits are incorporated onto other circuit boards.” Adair, 6:16-20, *see also*, Adair 16:14-16. Because the accompanying timing and control circuits are “in a stacked relationship so that there is a minimum profile,” the circuit board with the timing and control circuitry is in a second plane. *See, e.g.*, Adair, 3:9-11, Fig. 2b.

181. As discussed in Section VIII.A.3, a person of ordinary skill in the art would have been motivated to apply Adair's teachings of a reduced area CMOS imaging device in implementing Harris's camera.

y. Element [58.e]

182. **Element [58.e] recites “said image sensor producing a pre-video signal.”** Adair discloses element [58.e]. As discussed in relation to claim element [22.e], Adair discloses said image sensor producing a pre-video signal (*e.g.*, “image sensor 40” “produce[s]” “pre-video signal”).

183. My analysis of [22.e] with respect to similar claim language is equally applicable to [58.e]. *See* Section VIII.A.4.f. As discussed in Section VIII.A.3, a person of ordinary skill in the art would have been motivated to apply Adair’s teachings of a reduced area CMOS imaging device in implementing Harris’s camera.

z. Element [58.f]

184. **Element [58.f] recites “a first circuit board electrically connected to said image sensor and lying in a third plane, said first circuit board including circuitry means for processing and converting said pre-video signal to a desired video format.”** Adair discloses element [58.f]. As discussed in relation to claim element [22.f], Adair discloses a first circuit board (*e.g.*, “video processing board 50”) electrically connected to said image sensor (*e.g.*, “output from image sensor 40 ... is input to video processor board 50 by means of the conductor 48.”; “A plurality of pin connectors 62 serve to electrically couple image sensor 40 with video processing board 50”) and lying in a third plane (*e.g.*, as shown in Figure 2b), said first circuit board including circuitry means for processing and converting said pre-

video signal to a desired video format (*e.g.*, “processing circuitry which ... converts the pre-video signal to a post-video signal which may be accepted by a standard video device,” as shown in Figure 4b.).

185. My analysis of [22.f] and [42.f] with respect to similar claim language is equally applicable to element [58.f], where the video processor board 50 would now be lying in the third plane, since the first plane is defined by the image sensor and the second plane is defined by the timing and control circuitry. *See* Sections VIII.A.4.g and VIII.A.4.p. As discussed in Section VIII.A.3, a person of ordinary skill in the art would have been motivated to apply Adair’s teachings of a reduced area CMOS imaging device in implementing Harris’s camera.

aa. Element [58.g]

186. **Element [58.g] recites “a radio transceiver element communicating with said first circuit board for wirelessly transmitting said converted pre-video signal.”** Harris in view of Adair discloses element [58.g]. As explained in connection with [42.g], Harris discloses a radio transceiver element (*e.g.*, “RF” “wireless data transceiver 122”) communicating with said camera (*e.g.*, “camera 188 ... electrically coupled to” “wireless data transceiver 122”) for wirelessly transmitting said converted pre-video signal (*e.g.*, for transmitting “backward communication signal 170,” containing “decompressed image data” “video”), and Adair discloses electrically coupling said first circuit board with external circuitry

(*e.g.*, “The output signal from the video processor board 50 ... may be carried by conductor 49”).

187. My analysis of [42.g] with respect to similar claim language is equally applicable to [58.g]. *See* Section VIII.A.4.q.

188. As discussed in Section VIII.A.3, a person of ordinary skill in the art would have been motivated and found it obvious and straightforward to apply Adair’s teachings of a reduced area CMOS imaging device in implementing Harris’s camera.

bb. Element [66.pre]

189. **Element [66.pre] recites “A PDA having capability to transmit and receive data in a communications network.”** To the extent the preamble is limiting, as explained in connection with [22.pre], Harris discloses a PDA (*e.g.*, “communication device 104” serving as a “personal digital assistant”) having capability to transmit and receive data in a communications network (*e.g.*, “data communications between the communication devices 102 and 104”).

190. My analysis of [22.pre] with respect to similar claim language is equally applicable to [66.pre]. *See* Section VIII.A.4.a.

cc. Element [66.a]

191. **Element [66.a] recites “an image sensor lying in a first plane including an array of pixels for receiving images thereon, said image sensor**

producing a pre-video signal.” Adair discloses element [66.a]. As discussed in relation to claim element [22.c], Adair discloses said image sensor (*e.g.*, “image sensor 40”) lying in a first plane (*e.g.*, as shown in Fig. 2b) and including an array of CMOS pixels for receiving images thereon (*e.g.*, the “array of [CMOS] pixels making up the image sensor captures images”). As discussed in relation to claim element [22.e], Adair discloses said image sensor producing a pre-video signal (*e.g.*, “image sensor 40” “produce[s]” “pre-video signal”).

192. My analysis of [42.c] and [42.d] with respect to similar claim language is equally applicable to [66.a]. *See* Sections VIII.A.4.m and VIII.A.4.n.

193. As discussed in Section VIII.A.3, a person of ordinary skill in the art would have been motivated and found it obvious and straightforward to apply Adair’s teachings of a reduced area CMOS imaging device in implementing Harris’s camera.

dd. Element [66.b]

194. **Element [66.b] recites “a first circuit board electrically communicating with said image sensor, said first circuit board including circuitry means for timing and control of said array of pixels and circuitry means for processing and converting said pre-video signal to a desired video format.”** Adair discloses element [66.b]. Adair discloses said first circuit board including circuitry means for timing and control of said array of pixels (*e.g.*, “place

the timing and control circuits onto video processing board 50”) and circuitry means for processing and converting said pre-video signal to a desired video format (*e.g.*, “processing circuitry ... converts the pre-video signal to a post-video signal which may be accepted by a standard video device”).

195. My analysis of [22.f] and [42.f] with respect to similar claim language is equally applicable to [66.b]. *See* Sections VIII.A.4.g and VIII.A.4.p.

196. As discussed in Sections VIII.A.3 and VIII.A.4.g, a person of ordinary skill in the art would have been motivated to apply Adair’s teachings of a reduced area CMOS imaging device in implementing Harris’s camera.

ee. Element [66.c]

197. **Element [66.c] recites “a radio transceiver element communicating with said first circuit board for wirelessly transmitting said converted pre-video signal.”** Harris in view of Adair renders obvious element [66.c]. As discussed in connection with [42.g], Harris discloses a radio transceiver element (*e.g.*, “RF” “wireless data transceiver 122”) communicating with said camera (*e.g.*, “camera 188 ... electrically coupled to” “wireless data transceiver 122”) for wirelessly transmitting said converted pre-video signal (*e.g.*, for transmitting “backward communication signal 170,” containing “decompressed image data” “video”). Adair discloses said first circuit board communicating with external circuitry (*e.g.*, “The

output signal from the video processor board 50 ... may be carried by conductor 49”).

198. My analysis of [42.g] with respect to similar claim language is equally applicable to [66.c]. *See* Section VIII.A.4.q.

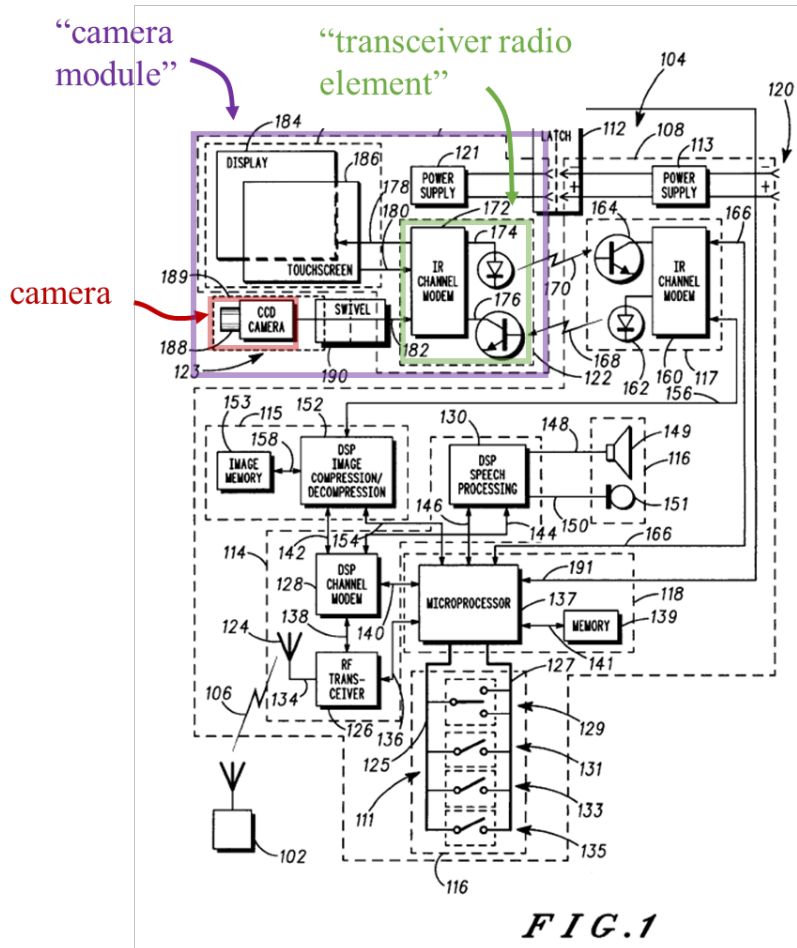
199. As discussed in Sections VIII.A.3 and VIII.A.4.h, a person of ordinary skill in the art would have been motivated to apply Adair’s teachings of a reduced area CMOS imaging device in implementing Harris’s camera. Furthermore, a person of ordinary skill in the art would have understood that, when applying Adair’s CMOS camera teachings in implementing Harris, Harris’s transceiver 122 communicates with to Adair’s video processing board 50.

ff. Element [66.d]

200. **Element [66.d] recites “a camera module housing said image sensor, said first circuit board, and said transceiver radio element therein.”** Harris in view of Adair renders obvious element [66.d]. As explained in connection with [42.b], Harris discloses a camera module housing said camera and said transceiver radio element therein (*e.g.*, a “second housing 110” and a “third housing 189” collectively housing “CCD camera 188” and RF “data transceiver 122”). As explained in connection with [42.e], Adair discloses a camera (*e.g.*, as shown in Fig. 2b) including said image sensor (*e.g.*, “image sensor 51”) and said first circuit board (*e.g.*, “circuit board 53”) therein.

201. As discussed in [22.a] and [42.b], Harris discloses a camera module housing said camera. *See* Sections VIII.A.4.b and VIII.A.4.1. As discussed in [42.e], Adair discloses a camera including said image sensor and said first circuit board. *See* Section VIII.A.4.o.

202. In addition, Harris discloses a camera module, including a “second housing 110” and a “third housing 189,” that houses the “wireless data transceiver 122” therein. *See* Harris, 11:45-46 (“wireless data transceiver 122 of housing 110”). Harris discloses “[t]he CCD camera 188 captures an image and outputs the image as receive decompressed image data on bus 182. The CCD camera 188 is housed in a third housing 189 coupled to the housing 110 via a swivel 190.” Harris, 5:60-6:2. Placement of the camera and transceiver radio element in the camera module is shown below in the annotated Figure 1 of Harris:



203. As discussed in Section VIII.A.3, a person of ordinary skill in the art would have been motivated to apply Adair’s teachings of a reduced area CMOS imaging device in implementing Harris’s camera, such that Harris’s camera module houses the image sensor, the first circuit board, and the transceiver radio element therein.

gg. Element [66.e]

204. Element [66.e] recites “a radio transceiver module housed within the PDA for wirelessly communicating with said radio transceiver element and

receiving said converted pre-video signal.” Harris discloses element [66.e]. As explained in connection with [22.h], Harris discloses a radio transceiver module (*e.g.*, “RF” “wireless data transceiver 117”) within the PDA (*e.g.*, in “first housing 108” of “communication device 104”) for wirelessly communicating with said transceiver radio element (*e.g.*, communicating with “wireless data transceiver 122” over “wireless RF link”; see Figure 1) and receiving said converted pre-video signal (*e.g.*, receiving “decompressed image data” “video”).

205. My analysis of [22.h] with respect to similar claim language is equally applicable to [66.e]. *See* Sections VIII.A.4.i.

hh. Element [66.f]

206. **Element [66.f] recites “a transceiver/amplifier section electrically coupled to said transceiver radio module for amplifying and further transmitting the converted pre-video signal, and for receiving, and amplifying video and audio signals transmitted by another party.”** Harris discloses element [66.f]. Harris discloses a transceiver/amplifier section (*e.g.*, “RF transceiver 126” and “antenna 124”) electrically coupled to said transceiver radio module (*e.g.*, “RF transceiver 126” coupled to “wireless data transceiver 117,” as shown in Figure 1) for amplifying and further transmitting the converted pre-video signal (*e.g.*, “RF transceiver 126 ... filter[s] and amplif[ies] electrical transmit signals...for emission by the antenna 124”), and for receiving, and amplifying video and audio signals

transmitted by another party (*e.g.*, “antenna 124 receives incoming RF signals”, which “RF transceiver 126 ... filters and steps down”).

207. Harris discloses that its PDA, “communication device 104,” includes a “video conferencing mode,” in which “communication device 104” displays “full motion video” of “a second user 802, with which the instant user is telephonically communicating, on the display 184” and transmits “full motion video” to the second user’s “communication device 102.” *See e.g.*, Harris, 2:18-20, 5:42-44, 9:36-41, 9:44-59. To communicate in “videoconferencing mode,” Harris discloses a transceiver/amplifier section including an “antenna 124” and an “RF transceiver 126” that is electrically coupled to the “wireless data transceiver 117” via busses 140 and 156, as shown in purple in Figure 1, and the DSP. *See e.g.*, Harris, 3:8-18 (“The wireless data transceiver 117 is for communicating with a second portion of circuitry primarily housed in a second housing 110.”), 3:40-49, 3:50-58, 3:59-65, 4:26-30, 4:61-67, Figure 1.

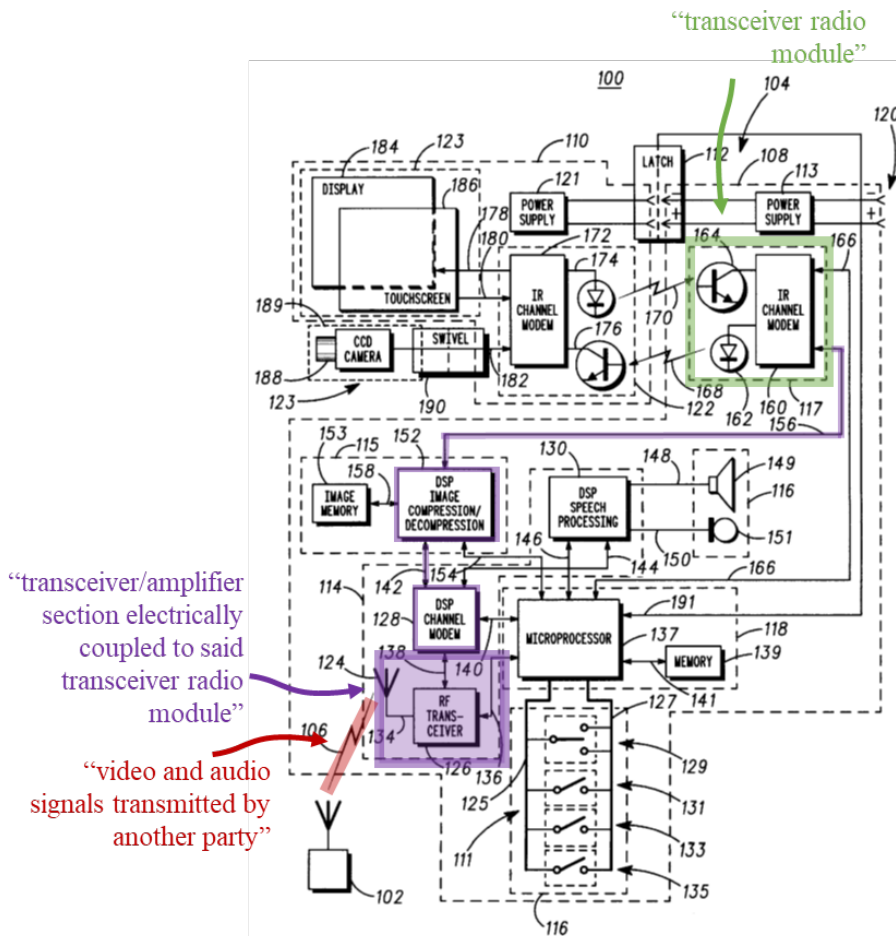


FIG. 1

208. Harris discloses the “antenna 124” and “RF transceiver 126” in the transceiver/amplifier section is for amplifying and further transmitting the video signals produced by the camera. For example, after the “transmit compressed image data” containing image data captured by “camera 188” has been encoded and modulated by the DSP into an “electrical transmit signal[]”, the “RF transceiver 126” filters and amplifies the electrical transmit signals for emission by the antenna 124. Harris, 3:40-49 (“The radio circuitry 114 of the housing 108 includes an antenna 124, a RF transceiver 126, a channel modem digital signal processor (DSP) 128, and a

speech processing DSP 130... Electrical transmit signals on wire 134 are emitted by the antenna 124 as outgoing RF signals of the communication link 106.”) 3:50-58 (“The RF transceiver 126 is coupled to the antenna via wire 134 and the controller 118 via bus 136...The RF transceiver 126 is responsive to control signals on bus 136 to filter and amplify electrical transmit signals on bus 138 for emission by the antenna 124 via wire 134”), 3:65-4:3.

209. Harris further discloses the “antenna 124” and “RF transceiver 126” in the transceiver/amplifier section for receiving and converting video and audio signals from other users in the videoconference. For example, the “antenna 124 receives and converts incoming RF signals” transmitted by another party over the “communication link 106” into “electrical receive signals.” Harris, 3:40-49 (“The antenna 124 receives incoming RF signals of the communication link 106 and converts the incoming RF signals into electrical receive signals output on wire 134.”). The “RF transceiver 126” further “filters and steps down the electrical receive signals.” Harris, 3:50-58 (“The RF transceiver 126...filters and steps down the electrical receive signals on wire 134 into electrical receive signals output on bus 138.”). A person of ordinary skill in the art would have understood that the strength of signals received by the antenna 134 can be very small. Thus, when filtering and stepping down the electrical receive signals received on wire 134, the RF transceiver 126 needs to amplify the electrical receive signals before outputting “electrical

receive signals ... on bus 138.” Harris, 3:59-65. To the extent further disclosure is required, it would have been obvious to a person of ordinary skill in the art for RF transceiver 126 to amplify signals received by antenna 124 to reduce noise, thus improving the quality of the signal received by the DSP 128, and helping to ensure that the DSP 128 correctly “demodulates and decodes electrical receive signals on bus 138....” Harris, 3:59-65.

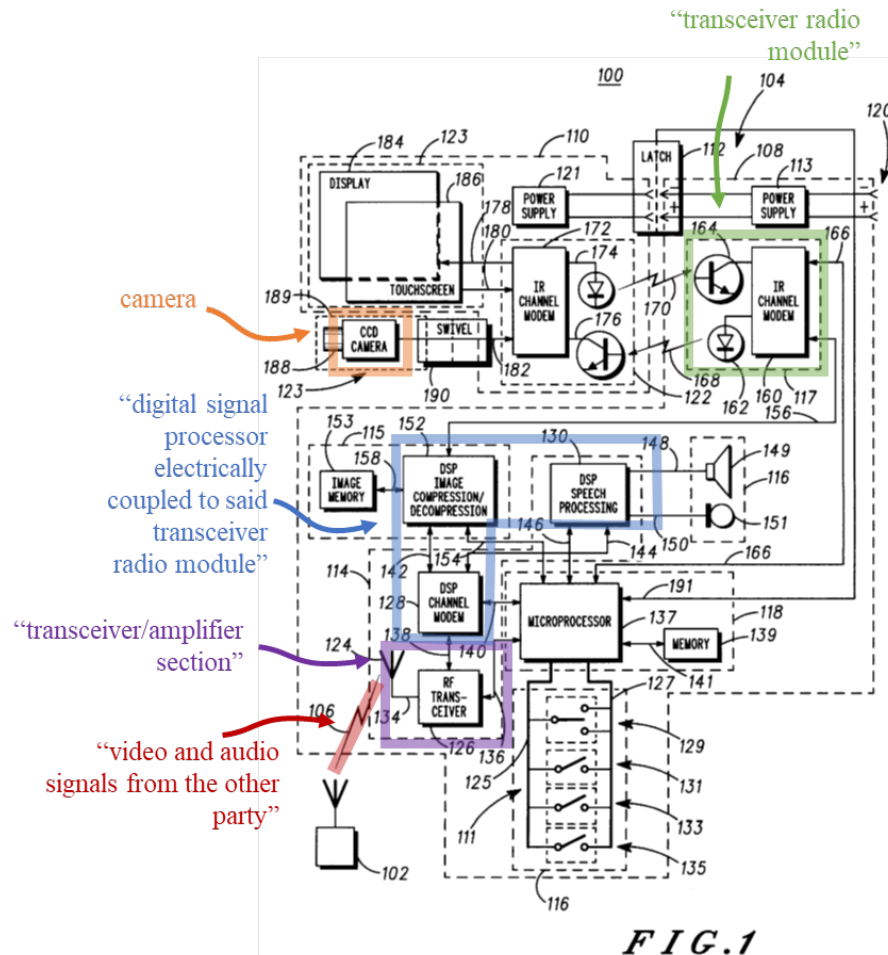
ii. Element [66.g]

210. **Element [66.g] recites “a digital signal processor electrically coupled to said transceiver radio module and said transceiver/amplifier section, said digital signal processor further conditioning said pre-video signal which is first conditioned by said first circuit board, and also for conditioning video and audio signals received by said transceiver/amplifier section from the other party.”** Harris in view of Adair renders obvious element [66.g]. Harris discloses a digital signal processor (*e.g.*, “image DSP 152” “channel modem DSP 128” and “speech processing DSP 130” “implemented using one ... DSP[.]”) electrically coupled to said transceiver radio module (*e.g.*, coupled to “wireless” RF “data transceiver 117” via “bus 156”) and said transceiver/amplifier section (*e.g.*, coupled to “RF transceiver 126” by “bus 138”), said digital signal processor further conditioning said pre-video signal which is first conditioned by said camera (*e.g.*, “compress[es] ... image data” received from “camera 188”), and also for

conditioning video and audio signals received by said transceiver/amplifier section from the other party (*e.g.*, “demodulates and decodes electrical receive signals” into “image data” and “speech data”). Adair discloses electrically coupling said first circuit board with external circuitry (*e.g.*, “The output signal from the video processor board 50 ... may be carried by conductor 49”) and said first circuit board first conditioning said pre-video signal (“processing circuitry ... converts the pre-video signal to a post-video signal which may be accepted by a standard video device”).

211. Harris discloses implementing the “image DSP,” “channel modem DSP” and a “speech processing DSP” as “one” “digital signal processor (DSP)” for further conditioning of “image data” captured by “camera 188” and conditioning of “image data” and “speech data” received from another party via the transceiver/amplifier section. *See e.g.*, Harris, 3:59-61, 3:65-4:3, 4:36-42, 4:46-50. Harris discloses that the “channel modem DSP 128, the speech processing DSP 130, and the image DSP 152 can be implemented using one...DSP[]” is electrically coupled to the “RF transceiver 126” of the transceiver/amplifier section via “bus 138” and the “wireless data transceiver 117” via “bus 156”, as shown in annotated Figure 1 below. Harris, 3:59-61 (“The channel modem *DSP 128 is coupled to the RF transceiver 126 via bus 138*”), 4:46-50, 4:61-66 (“*The wireless data transceiver 117* includes an infrared

(IR) channel modem 160... The IR channel modem 160 is coupled to the image DSP 152 via bus 156.”), Figure 1.



212. Harris discloses the single DSP compresses, encodes, and modulates the video signal captured by and received from the “camera 188” on bus 156 into “electrical transmit signals,” thereby further conditioning the video signal after the camera first conditions the signal. Harris, 3:65-4:3 (“The channel modem DSP 128 is responsive to control signals on bus 140 to *encode and modulate transmit compressed image data, transmit speech data,* and/or transmit control data on busses

142, 144, 140, respectively, into electrical transmit signals on bus 138.”), 4:36-42 (“The image DSP 152 is responsive to control signals on bus 154 to compress transmit decompressed image data on bus 156 into transmit compressed image data on bus 142”), 12:12-17 (“[W]ireless data transceivers 117 and 122 ... initiate coupling of transmit image data captured by the CCD camera 188 to the image DSP 152...”). The image DSP 152 portion of the single DSP “compress[es] transmit decompressed data” received from “CCD camera 188” using “a conventional algorithm, such as the Motion Picture Experts Group (MPEG) algorithm.” Harris, 4:43-46.

213. Further, Harris discloses the single DSP processes, demodulates decodes and decompresses “electrical receive signals” including “receive speech data” and “receive compressed image data” received by the transceiver/amplifier section from the other party into “receive decompressed image data” and “electrical speech signals,” thereby conditioning the audio and video signals from the other user. Harris, 3:59-65 (“The channel modem DSP 128...demodulates and decodes electrical receive signals on bus 138 into receive compressed image data, receive speech data...output on busses 142, 144”), 4:4-11 (“The speech processing DSP 130...processes the receive speech data on bus 144 into electrical speech signals on wire 148.”), 4:25-33 (“The image DSP 152, in response to control signals on bus 154, decompresses receive compressed image data on bus 142 into receive

decompressed image data on bus 156....”), 4:36-42 (“The image DSP 152...compress[es] transmit decompressed image data on bus 156 into transmit compressed image data on bus 142....”).

214. As discussed in relation to elements [42.f] and [42.g], while Harris discloses electrical coupling between its digital signal processor and camera, Adair discloses electrically coupling the output of video processing board 50 (which first conditions the pre-video signal) with external circuitry via “conductor 49.” See Sections VIII.A.4.p and VIII.A.4.q.

215. As discussed in Sections VIII.A.3 and VIII.A.4.g, a person of ordinary skill in the art would have been motivated to apply Adair’s teachings of a reduced area CMOS imaging device in implementing Harris’s camera.

216. Furthermore, a person of ordinary skill in the art would have understood that, when applying Adair’s CMOS camera teachings in implementing Harris’s camera, the video processing board 50 that first conditions the pre-video signal is electrically coupled to the digital signal processor 23 and to the wireless transceiver 31.

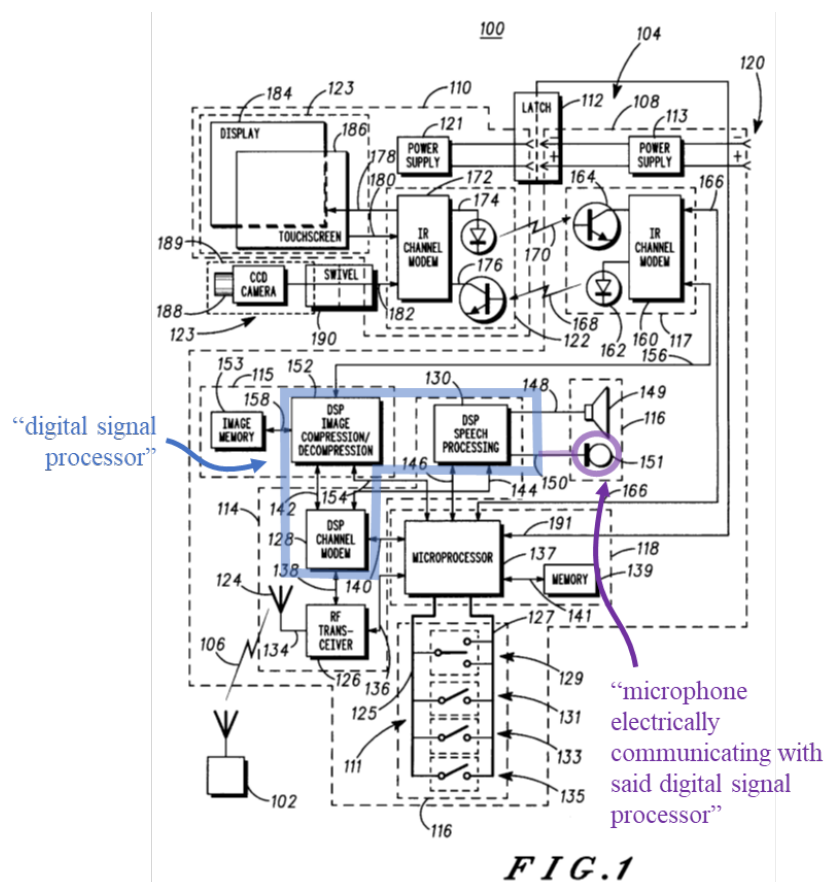
jj. Element [66.h]

217. **Element [66.h] recites “a microphone electrically communicating with said digital signal processor for receiving sound and converting the sound to audio signals.”** Harris discloses element [66.h]. Harris discloses a microphone

(*e.g.*, “microphone 151”) electrically communicating (*e.g.*, over “wire 150”) with said digital signal processor (*e.g.*, DSPs 152, 128, 130 “implemented using one ... DSP[.]”) for receiving sound (*e.g.*, “receive audible voice signals”) and converting the sound to audio signals (*e.g.*, “transduces audible voice signals into electrical speech signals”).

218. Harris discloses a “microphone 151 [that] transduces audible voice signals into electrical speech signals on wire 150.” Harris, 4:17-23. The “microphone 151 is coupled to the speech processing DSP 130” portion of the “one ... DSP” “for conversion into speech data for transmission.” Harris, 4:8-11, 4:17-23⁴, Figure 1, Claim 15.

⁴ “[W]ire 148” at Harris, 4:10, is a typo that instead refers to wire 150 as shown in Figure 1.

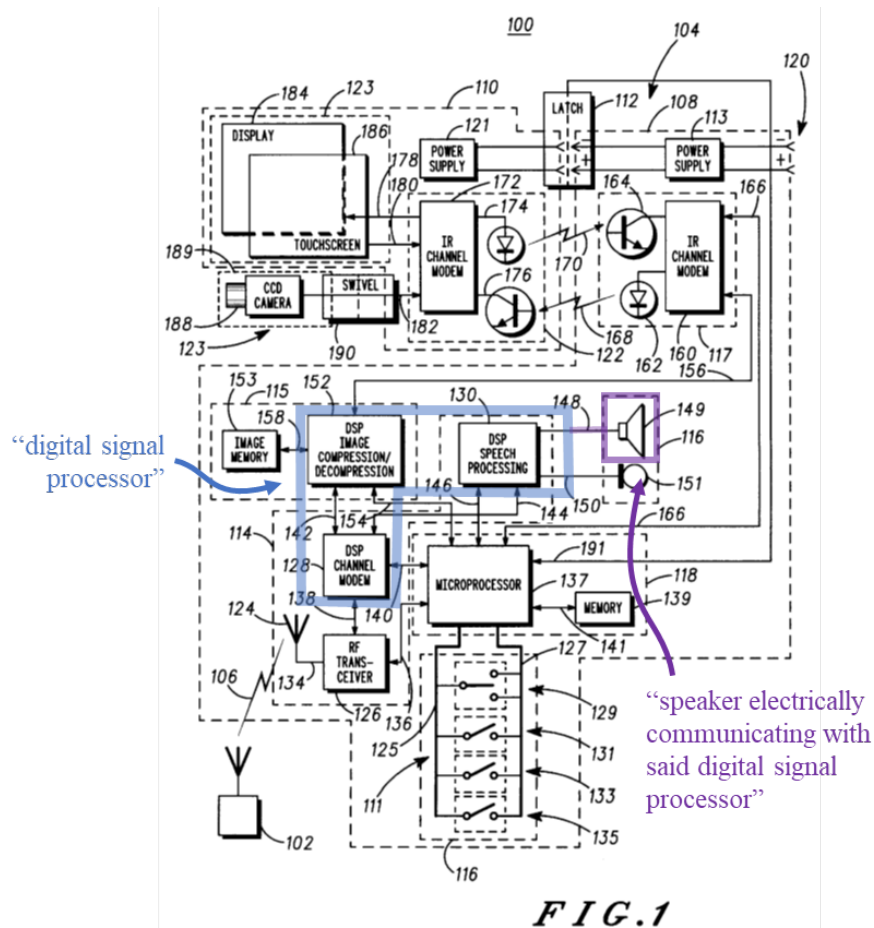


kk. Element [66.i]

219. Element [66.i] recites “a speaker electrically communicating with said digital signal processor for broadcasting audio signals.” Harris discloses element [66.i]. Harris discloses a speaker (e.g., “speaker 149”) electrically communicating (e.g., “via wire 148”) with said digital signal processor (e.g., DSPs 152, 128, 130 “implemented using one ... DSP[.]”) for broadcasting audio signals (e.g., “transduces electrical speech signals on wire 148 into audible voice signals”).

220. Harris discloses a “speaker 149 is coupled to the speech processing DSP 130” of the “one...DSP”, as shown in Figure 1. Harris, 4:12-17, Figure 1. Harris

further discloses the “speaker 149 transduces electrical speech signals...into audible voice signals.” Harris, 4:12-17.



II. Element [66.j]

221. Element [66.j] recites “a video view screen attached to said PDA, said video view screen for selectively displaying images from said imaging device, and for selectively displaying video images received by said transceiver/amplifier section.” Harris discloses element [66.j]. Harris discloses a video view screen attached to said PDA (*e.g.* on “the front surface 200” of the PDA;

see [42.i]), said video view screen for selectively displaying images from said imaging device (e.g., selectively “route...image data” “video” from “camera 188” to “display 184”), and for selectively displaying video images received by said transceiver/amplifier section (e.g., selectively route “image data” “video” received by “RF transceiver 126” and “antenna 124” to “display 184”).

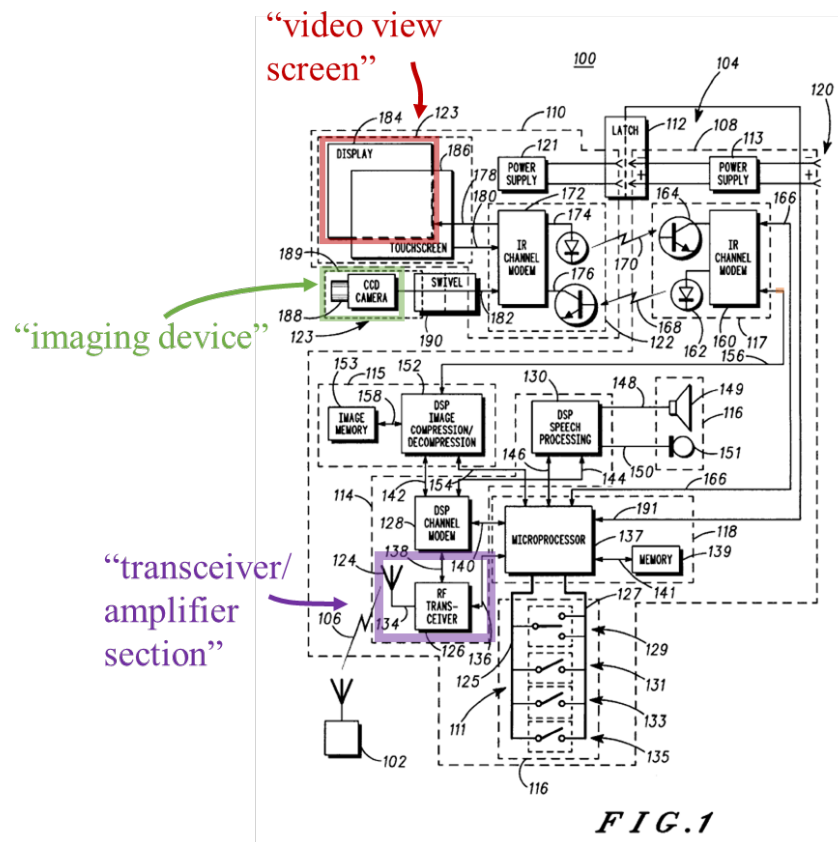
222. As discussed in [42.i], Harris discloses a video view screen attached to said PDA. See Section VIII.A.4.s.

223. In addition, Harris discloses that a “microprocessor 137 configures the display 184...with forward control signals” to selectively display the video signal output from imaging device—camera 188. Harris, 5:23-26 (“The IR channel modem 172 demodulates and decodes the forward communication signal 168 ... into receive decompressed image data and forward control data on busses 178 and 182.”), 5:32-34 (“The IR channel modem 172 may alternatively route transmit decompressed image data directly from bus 182 to bus 178 in response to forward control data”), 5:50-54 (“The display 184 and the touchscreen 186 are configured by forward control data received on bus 178. Once configured, the display 184 displays receive decompressed image data and forward control data received on bus 178.”).

224. Harris also discloses selectively displaying video images received by said transceiver/amplifier section. After the single DSP has demodulated and decoded the “electrical receive signals” received by the “RF transceiver 126” of the

transceiver/amplifier section into “receive decompressed image data,” wireless transceiver 117 encodes and modulates the “receive decompressed image data” and “forward control data” from the microprocessor into “a forward communication signal 168.” Harris, Fig. 1, 3:50-58 (“The RF transceiver 126 is coupled to the antenna via wire 134 and the controller 118 via bus 136. The RF transceiver 126, in response to control signals on bus 136, filters and steps down the electrical receive signals on wire 134 into electrical receive signals output on bus 138.”), 3:61-4:3 (“The channel modem DSP 128, in response to control signals on bus 140, demodulates and decodes electrical receive signals on bus 138 into receive compressed image data...receive control data output on busses 142... and 140, respectively.”), 4:64-5:5 (“The IR channel modem 160, in response to control signals on bus 166, encodes and modulates receive decompressed image data received on bus 156 and forward control data received on bus 166 into a forward communication signal 168.”). The “forward communication signal 168” is received, demodulated, and decoded into “receive decompressed image data and forward control data” by “wireless data transceiver 122,” and output onto busses 178 and 180 to be selectively viewed on “display 184” in response to “forward control signals.” 5:23-26 (“The IR channel modem 172 demodulates and decodes the forward communication signal 168 received...into receive decompressed image data and forward control data on busses 178 and 182.”), 5:50-54 (“The display 184 and the touchscreen 186 are

configured by forward control data received on bus 178. Once configured, the display 184 displays receive decompressed image data and forward control data received on bus 178.”), 6:41-49 (“The microprocessor 137 configures the display 184...with forward control signals output on bus 166.”).



mm. Element [66.k]

225. Element [66.k] recites “a video switch communicating with said first circuit board and said digital signal processor for switching video images to be viewed on said video view screen.” Harris in view of Adair renders obvious element [66.k]. Harris discloses a video switch (e.g., “the sensors 512, 514, 604, and 606” of the “latch 112”) communicating with said camera and said digital signal

processor (*e.g.*, “microprocessor 137” generates “forward control signals” to “camera 188” and DSPs 152, 128, 130 “implemented using one ... DSP[],” in response to the “logic ... level signal” from the sensors of “latch 112”) for switching video images to be viewed on said video view screen (*e.g.*, “controller 118 transitions operation of the communication device 104” to display “video” “image data captured by the []camera 188 directly to the display 184” or to “display[] a second user 802, with which the instant user is telephonically communicating” based on the “signal from the sensor[s]” of “latch 112”). As explained in connection with [22.g], Adair discloses said first circuit board communicating with external circuitry (*e.g.*, “The output signal from the video processor board 50 ... may be carried by conductor 49”).

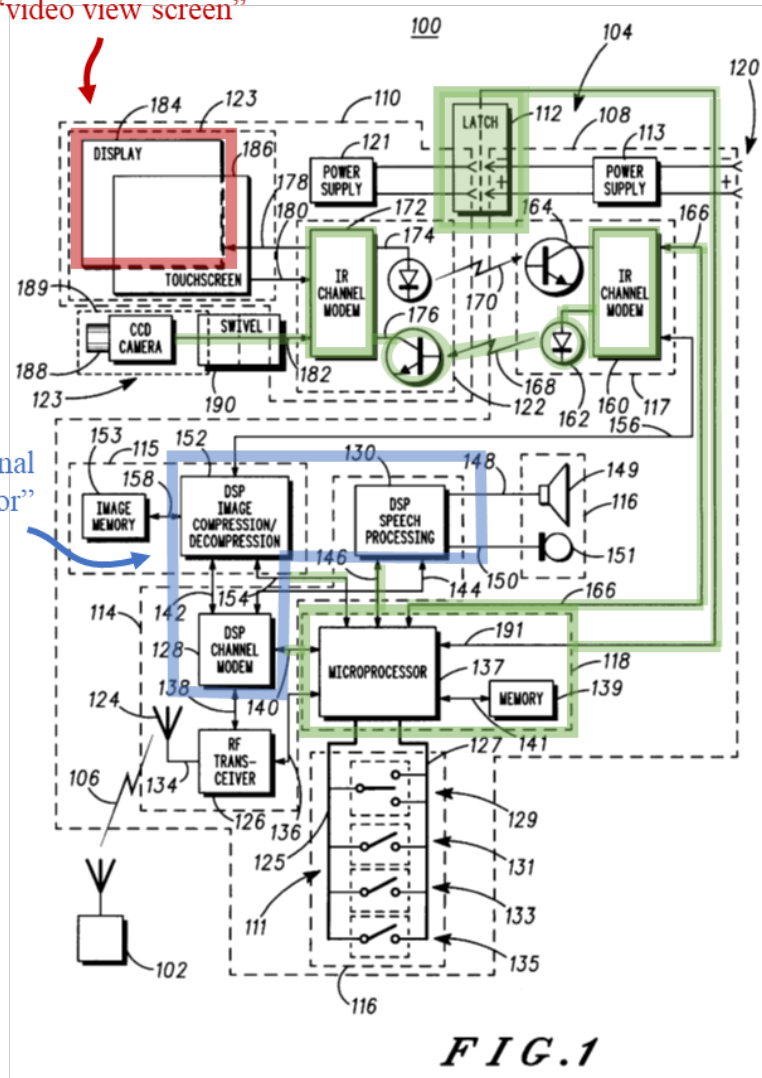
226. Harris discloses a “latch 112” that works as a video switch by communicating with “camera 188” and digital signal processor via a “logic level signal” to “controller 118” on “bus 191.” As a result of this communication, “latch 112” causes the “display 184” to display either the output of the “camera 188” or the video images received from the second user.

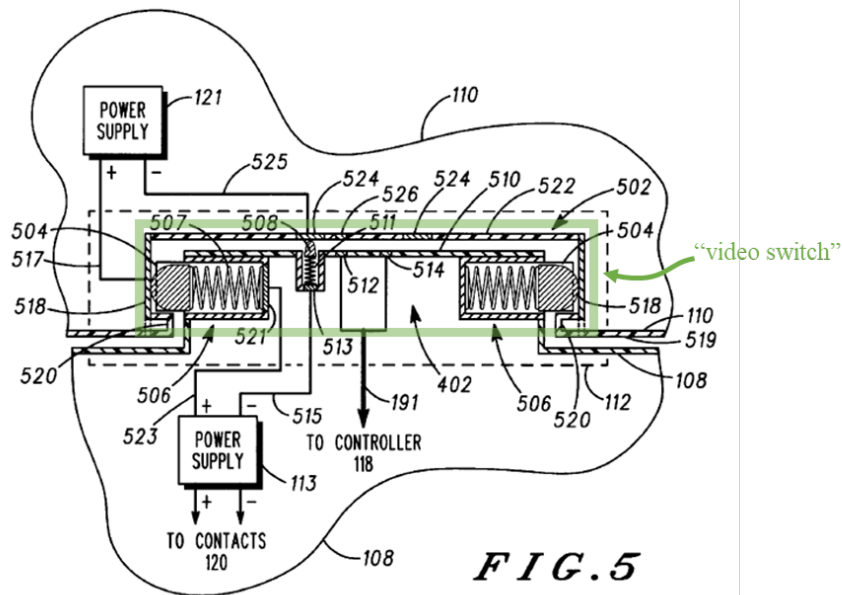
227. Specifically, “latch 112” is connected to the “microprocessor 137” of “controller 118” via a wired connection, as shown in Figures 1 and 8 below, to switch video images on the “display 184.” Harris, 3:61-65, 4:8-11, 4:27-30, 5:23-26, 6:41-49, 7:23-25, Fig. 1, Fig. 8.

“video view screen”

“digital signal processor”

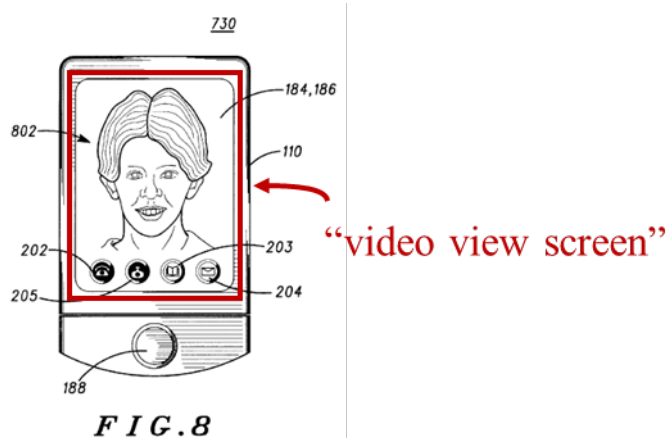
“video switch communicating with said...digital signal processor”





228. The signal from the “sensor[s]” of “latch 112” configures the “operation of the communication device.” Harris, 7:23-25 (“FIGS. 5 and 6 illustrate that the turret 402 of the latch 112,”), 7:41-53 (“The turret 402 also includes sensors 512, 514, 604, and 606 positioned along a circular path 602 in the top surface 510.”), 9:9-14, 9:36-41, 10:42-46, 11:3-7, 11:34-38. Specifically, the sensors of “latch 112” output a logic level signal onto bus 191; if the logic level signal is low, the microprocessor 137 outputs a “forward control signal” on bus 166 to operate the device in a “video conferencing mode” and “display[] a second user 802”; and if the logic level is high, the microprocessor 137 controls the device to operate in “camera mode” and display “image data captured by” the “camera 188.” Harris, 6:41-43 (“The microprocessor 137 configures the display 184 and the touchscreen 186 with

forward control signals output on bus 166.”), 8:50-52 (“The sensor 604 ...outputs the high logic level signal to the controller 118 via its respective wire of the bus 191.”), 9:9-14 (“Once detached, all of the sensors 512, 514, 604, and 606 are untriggered and all wires of the bus 191 are at the logic low level.”), 9:36-55 (“Upon detection... from the logic low level on all wires of the bus 191... the controller 118 configures the communication device in a video conferencing mode 730”), 10:42-49 (“Upon detection of the logic high level signal from the sensor 604 or 606 via bus 191, the controller 118 transitions operation of the communication device 104...to the camera mode 706”), 11:39-48 (“In the camera mode 706... the controller 118 controls the wireless data transceiver 122 of housing 110 to route image data captured by the CCD camera 188 directly to the display 184”), 11:61-65 (“Upon detection of the logic high level signal from the sensor 514 via bus 191, the controller 118 controls the wireless data transceiver 122 of housing 110 to route image data captured by the CCD camera 188 directly to the display 184”).



229. The “forward control signal” is sent from “microprocessor 137” to “camera 188” and DSP and carries “forward control data.” Specifically, the “forward control signal” is sent from “microprocessor 137” to “camera 188” through wireless data transceiver 117 (which includes modem 160), wireless data transceiver 122, and bus 182. *See, e.g., Harris, 4:61-5:4* (“The wireless data transceiver 117 includes an infrared (IR) channel modem 160...The IR channel modem 160 ... encodes and modulates...forward control data received on bus 166 into a forward communication signal 168.”), 5:23-26 (“The IR channel modem 172 demodulates and decodes the forward communication signal 168 received via the IR detector 176 into receive decompressed image data and forward control data on busses 178 and 182.”), 5:65-67 (“The swivel 190 permits passage of the bus 182 therethrough so as to electrically connect the CCD camera 188 and the IR channel modem 172.”), 6:28-33 (“The microprocessor 137 is coupled to... the wireless data transceiver 117...via bus[] 166,”), 6:41-43 (“The microprocessor 137 configures the display 184 ... forward control signals output on bus 166.”). In response to receipt of the “forward control signal” from microprocessor 137, modem 160 “encodes and modulates receive[d] decompressed image data ... and forward control data received on bus 166 into forward communication signal 168.” *Harris, 4:66-5:3.* Modem 172 “demodulates and decodes the forward communication signal 168...into... forward

control data on busses 178 and 182.” Harris, 5:23-26. Bus 178 goes to the display 184 and bus 182 goes to camera 188. *See, e.g.*, Harris, Figure 1.

230. The “forward control signal” is also sent from “microprocessor 137” to the DSP over busses 154 and 140. *See, e.g.*, Harris, 3:65-4:3 (“The channel modem DSP 128 is responsive to control signals on bus 140”), 4:36-42 (“The image DSP 152 is responsive to control signals on bus 154”). The DSP “is coupled to ... the controller 118 [which includes microprocessor 137] via bus 140.” Harris, 3:59-61 (“The channel modem DSP 128 is coupled to ... the controller 118 via bus 140.”), 4:24-26 (“The image DSP 152 is coupled to...the controller 118 via bus 154.”).

231. Harris teaches that “[t]he display 184 and the touchscreen 186 are configured by forward control data received on bus 178,” which, as discussed above, originated at microprocessor 137. Harris, 5:50-51.

232. Circuitry within the “wireless data transceiver 122” demodulates and decodes “forward communication signal 168” into “forward control data on bus[] 178” to configure, or switch, video images displayed on video view screen “display 184.” Harris, 5:50-51 (“The display 184 and the touchscreen 186 are configured by forward control data received on bus 178.”). Thus, the logic level signal output from latch 112 causes the microprocessor 137 to configure the communication device in “camera mode” to display “image data captured by” the “camera 188” (logic high)

or in “video conferencing mode” to “display[] a second user” (logic low) on display 184.

233. While Harris discloses electrical coupling between its latch and camera, Adair discloses “conductor 49” for the output of video processing board 50 communicating with external circuitry. *See* Section VIII.A.4.h.

234. As discussed in Sections VIII.A.3 and VIII.A.4.h, a person of ordinary skill in the art would have been motivated to apply Adair’s teachings of a reduced area CMOS imaging device in implementing Harris’s camera. Furthermore, a person of ordinary skill in the art would have understood that, when implementing Adair’s CMOS camera teachings in implementing Harris’s camera, Adair’s video processing board 50 communicates with Harris’s latch.

nn. Element [66.l]

235. **Element [66.l] recites “a power supply mounted to said PDA for providing power thereto.”** Harris discloses element [66.l]. Harris discloses a power supply mounted to said PDA (*e.g.*, “the communication device 104 includes power supplies” 113 and 121) for providing power thereto (*e.g.*, “supplies power to the circuitry of the housing 108” and “supplies power to the circuitry of the housing 110”).

236. For example, Harris discloses power supplies in the PDA that provide power to the PDA, as shown in Figure 1. Harris, 3:25-32 (“The communication

device 104 includes power supplies 113 and 121.... [P]ower supply 113 supplies power to the circuitry of the housing 108...The power supply 121 supplies power to the circuitry of the housing 110.”), Figure 1.

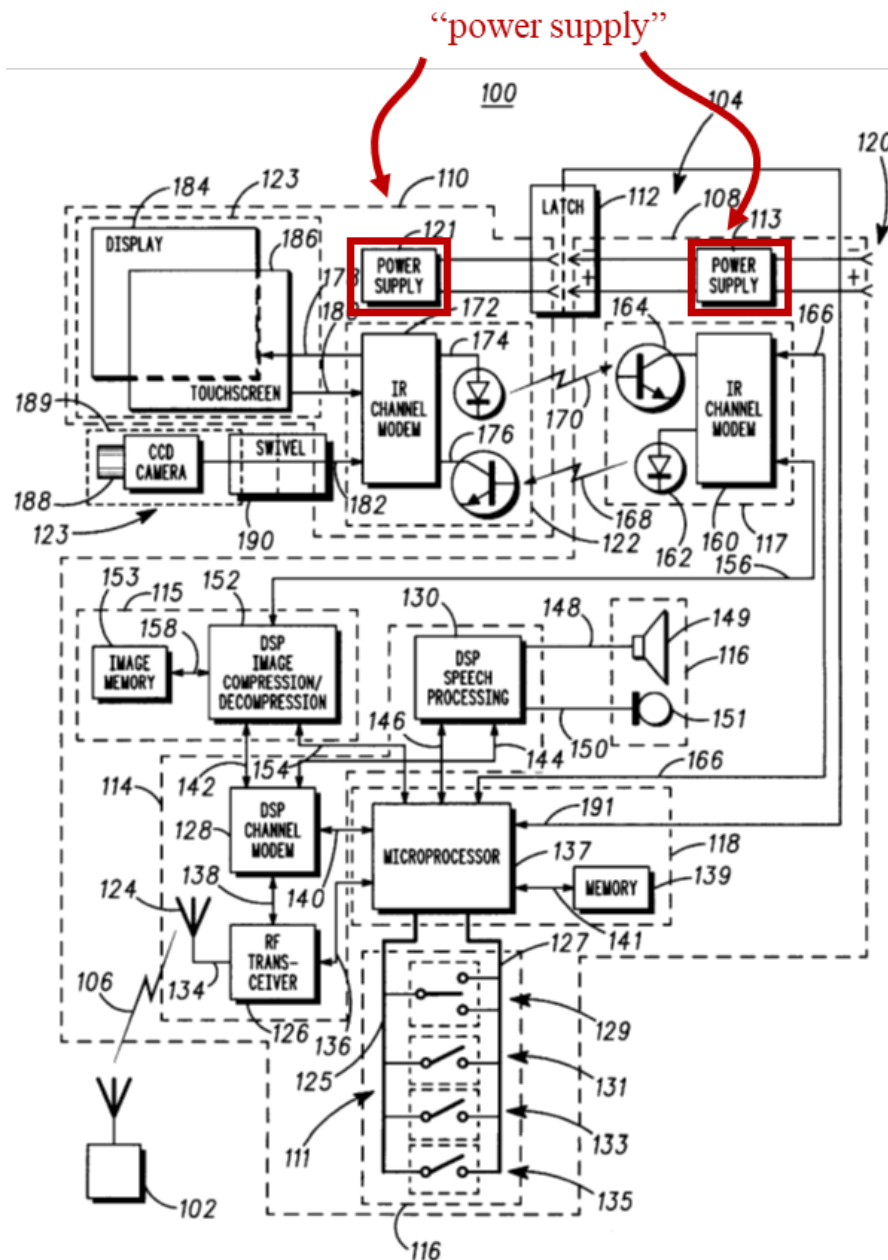


FIG. 1

B. Claim 22 is rendered obvious by Harris in view of Swift and Ackland (Ground 3)

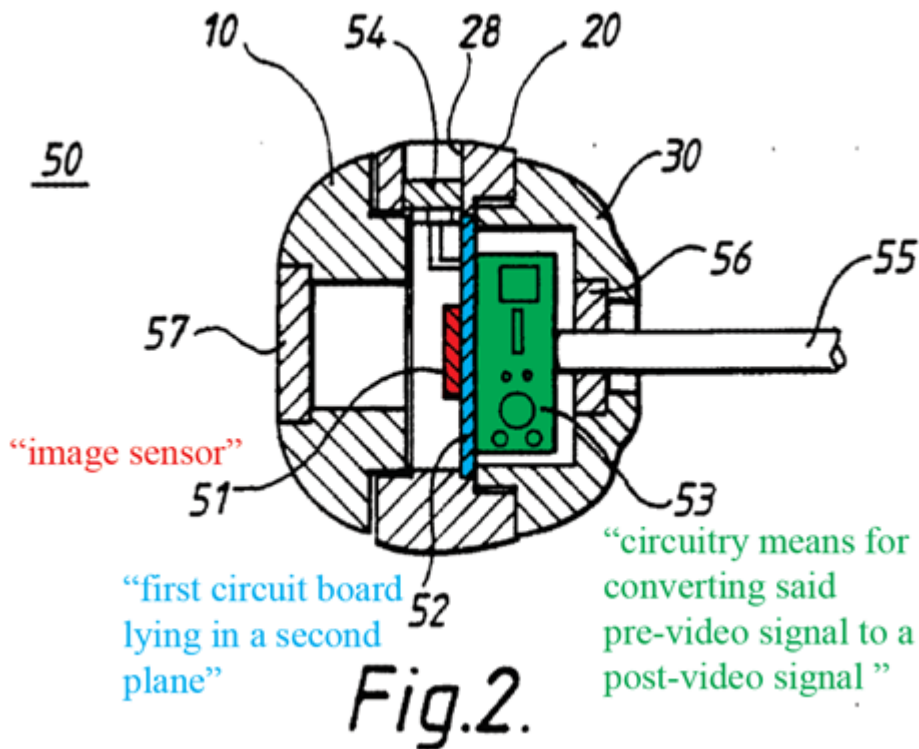
1. Overview of Swift

237. Swift (Ex. 1005) was published on December 21, 1995, and as I understand, is prior art to the '742 patent.

238. Swift describes a miniature camera suitable for purposes such as surveillance and security systems, and automated inspection apparatuses, among others. *See, e.g.*, Swift, 1:2-13. Swift discloses that “[i]n such systems, it is often desirable for a camera to be as small as possible” and describes its disclosed cameras as “small and compact.” Swift, 1:3-16, 9:30-34. Swift’s miniature video camera includes a CMOS image sensor and, specifically, of a CMOS/APS (Active Pixel Sensor) type. Swift, 4:11-15, 10:1-6.

239. As shown in Figure 2, Swift discloses an image sensor 51, lying in a first plane, mounted on a circular printed circuit board 52, lying in a second plane, and a rectangular circuit board 53, which includes various circuitry components “to provide power to the image sensor 51,” and “process image signals received therefrom,” including a video processor for converting the pre-video signal generated by the image sensor to a post-video signal. *See, e.g.*, Swift, 8:31-9:13, 3:32-4:4. Swift also discloses a “cable 55 is connected to the printed circuit board

53, and passes through the rear 15 bores 32, 33, to provide a connection between the miniature video camera 50 and external processing circuitry.” Swift, 9:13-17.



Swift, Fig. 2 (annotated).

240. Swift discloses that to power the sensor, Swift’s miniature camera uses a battery and a voltage regulator that provide power to the components on the printed circuit board(s) and the image sensor. *See, e.g.,* Swift, 3:31-4:4 (“image sensor assembly for a miniature camera, the assembly comprising a printed circuit board and, mounted thereon, the image sensor, a video processor, ... and a voltage regulator to accept a plurality of different input voltages and provide a substantially constant supply voltage to components on the printed circuit board”), 4:21-22

(“camera ... may incorporate a battery...”), 9:7-13 (“Various circuitry components are mounted on the circuit board 53, to provide power to the image sensor 51...”). Swift’s battery and voltage regulator provide power to (and thus are electrically coupled to and drive) the “image sensor 51” (including its pixels) and the alternatives of the “single circuit board” and circuit boards 52 and 53.

2. Motivation to Combine Harris and Swift

241. A person of ordinary skill in the art would have been motivated and found it obvious and straightforward to apply Swift’s teachings of a miniature camera module housing a CMOS image sensor, compactly arranging circuitry components associated with a CMOS image sensor, electrically coupling the “circuit board 53” to external circuitry to output the video signal, and the implementation details described above in implementing Harris’ camera.

242. While Harris discloses a CCD camera, Swift discloses a CMOS camera including a CMOS “image sensor 51.” *See, e.g.,* Swift, 3:32-34 (“there is provided an image sensor assembly for a miniature camera, the assembly comprising a printed circuit board and, mounted thereon, the image sensor, a video processor,”), 8:33-9:1 (“An image sensor 51 is mounted on a circular printed circuit board 52, which engages within the intermediate bore 23 in the central housing portion 20...”), 10:1-2 (“The image sensor 51 is preferably of a CMOS/APS (Active Pixel Sensor) type.”).

The '742 patent expressly recognizes CMOS cameras were well known. '742 patent, 1:30-2:2.

243. Similarly, while Harris does not expressly disclose how it converts image data to a desired video format for display, Swift expressly provides processing circuitry in its CMOS camera. Swift, 9:5-15 (“ Various circuitry components are mounted on the circuit board 53, to ... process image signals received [from image sensor 51]”), 17:34-18:3 (“With the video signals provided from the camera 152 as ...video ...signals, viewing of an image from the camera 152 may be selected on the television at will”), 18:8-11 (“Any of the cameras mentioned above may be connected to such a terminal box, in order to distribute the video signals from the camera(s)...”), Fig. 6.

244. And while Harris does not expressly disclose what components within its camera connect with external circuitry, Swift discloses that its “circuit board 53” for processing image signals output by its CMOS image sensor is electrically coupled to external circuitry. Swift, 9:5-21 (“[a] cable 55 is connected to the printed circuit board 53...to provide a connection between the miniature video camera 50 and external processing circuitry.”), Fig. 2.

245. A person of ordinary skill in the art would have been motivated to apply Swift’s teachings of a miniature camera module housing a CMOS image sensor, compactly arranging circuitry components associated with a CMOS image sensor,

electrically coupling the “circuit board 53” to external circuitry to output the video signal, and the implementation details described above in implementing Harris’ camera.

246. Harris and Swift are both in the same field of art and are analogous art to the ’742 patent—all are in the field related to compact solid-state image sensors for use in space-constrained devices. For example, the ’742 patent is directed towards a PDA with an “imaging device,” Harris discloses a “Hand-Held Radiotelephone” of minimal size with a camera, and Swift discloses a “miniature camera” for placement in small locations. *E.g.*, ’742 patent, Abstract (“A reduced area-imaging device is provided for use with a miniature hand-held computer referred to in the industry as a PDA... The camera module is small enough that it can be stored within the housing of the PDA.”), 1:21-26 (“This invention relates ...particularly, to solid state image sensors which are configured to be of a minimum size and used within miniature computer systems known as...personal digital assistants (PDA), or handheld computers/organizers.”), 4:44-46 (“In accordance with the present invention, reduced area imaging devices are provided in combination with a handheld computer or PDA.”); Harris, Title (“Hand-Held Radiotelephone Having a Detachable Display”), 1:4-6 (“The present invention relates generally to a communication device and more specifically to a multi-mode communication device.”), 1:23-28 (“To accommodate the video capability, it has

been proposed to...mount a camera, such as a charge coupled device (CCD) camera, on the single housing in proximity to the display.”), 1:59-63 (“what is needed is a multi-mode communication device that permits a user to communicate in privacy and employs a single user interface having components carried on multiple surfaces of the device so as to minimize the size and cost of the device.”); Swift, Abstract (“A miniature camera (80) is fitted to a door...Cameras of other configurations are disclosed in the specification.”), 1:7-10 (“Miniature cameras are finding increasing application...for incorporation in other devices...[I]t is often desirable for a camera to be as small as possible”), 4:11-15 (“said image sensor is preferably a CMOS sensor.”).

247. In addition, Harris and Swift are also reasonably pertinent to the alleged problems identified in the '742 patent of arranging the circuitry of a camera (such as an image sensor and supporting circuitry) to minimize the size or profile area of the device. Because each of the references relates to a small, handheld device with a camera, there is a need in each to provide a compact camera that will fit into these devices. *E.g.*, '742 patent, 3:64-4:4 (“It is one general object of this invention to provide a video found in the form of electrons which have been placed in a system in combination with a standard PDA enabling a user to take video images by a very small camera module incorporated within the PDA,”), 4:12-17 (“It is another object of this invention to provide a reduced area imaging device incorporated within a

PDA which takes advantage of "camera on a chip" technology, but to rearrange the video processing circuitry in a selective stacked relationship so that the camera module has a minimum profile."); Harris, 1:59-63 ("what is needed is a multi-mode communication device that permits a user to communicate in privacy and employs a single user interface having components carried on multiple surfaces of the device so as to minimize the size and cost of the device."); Swift, 1:7-18.

248. A person of ordinary skill in the art would have been motivated to apply Swift's teachings in implementing Harris's camera because, relative to other solid-state options (which include CCD cameras), CMOS cameras (such as Swift's CMOS miniature camera) have "low power-consumption," have "small size," do not need "a custom manufacturing process," "cost much less than CCDs," and can tolerate lower material quality. *See, e.g.*, "Nasa's Tiny Camera has a Wide-Angle Future" (Ex. 1060, which was published on March 6, 1995 and I understand is prior art) at 55. In addition to reducing the cost of operating the device, the ability to operate with less power would have been known to be particularly important to the camera in Harris's handheld device because battery life was (and still is) a key feature of portable devices. Moreover, the ability to manufacture devices without a custom manufacturing process helps reduce production costs. Swift's disclosure of a miniature camera relative to other CMOS cameras reduces the amount of space required by the camera in Harris' communication device 104. This is particularly

important when addressing Harris's desire to reduce overall size and cost of a communication device. *See, e.g.,* Swift, 1:10-18 ("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. Preferred embodiments of the present invention aim to provide miniature cameras which can be so constructed as to be particularly small and compact, and may find application in fields as mentioned above."), 3:32-34 ("there is provided an image sensor assembly for a miniature camera,"); Harris, 1:59-63 ("what is needed is a multi-mode communication device that permits a user to communicate in privacy and employs a single user interface having components carried on multiple surfaces of the device so as to minimize the size and cost of the device"). In addition, a person of ordinary skill in the art would have been motivated to apply Swift's teachings of CMOS active pixel image sensor to Harris because, as admitted by the '742, active pixel sensor imagers produce less noise than CCD or other solid state imagers, can be mass produced on standard semiconductor production lines, and can incorporate a number of other different electronic controls on a single circuit board. '742, 1:54-2:7.

249. Moreover, a person of ordinary skill would have reasonably expected the combination of Swift's CMOS camera to work in Harris's mobile device. Swift explains that its output video signal can be made to operate with one of many different types of devices, including televisions and monitors. Swift, 15:7-9 ("A

video monitor or TV 154 is provided, to display a signal received from the camera 152.”). A person of skill in the art would have known, when applying Swift’s teaching of video processing circuitry in the camera, to place the output of the video processing circuitry in the format of the display receiving the output of the camera so that the output video could be routed directly to the display as disclosed in Harris. Harris, 11:43-48 (“the controller 118 controls the wireless data transceiver 122 of housing 110 to route image data captured by the CCD camera 188 directly to the display”). In addition, a person of skill in the art would have understood that, because the wiring for control signaling and power supply is more complex for CCD image sensors than for CMOS image sensors, the overall size of a CMOS camera is smaller than a CCD camera, resulting in CMOS cameras having a smaller overall form factor, making them suitable for placement in a small camera device. Indeed, Swift discloses that its camera is a miniature camera, and a person of ordinary skill in the art would have understood its teachings of a “miniature” CMOS camera would work as expected in a handheld devices at the time. Swift, 1:7-10 (“Miniature cameras are finding increasing application...for incorporation in other devices...[I]t is often desirable for a camera to be as small as possible”).

250. In light of the above, a person of ordinary skill in the art would have found it routine, straightforward and advantageous to apply Swift’s teachings of a CMOS active pixel camera and outputting a video signal in implementing Harris’s

solid-state camera, and would have known that such a combination (yielding the claimed limitations) would predictably work and provide the expected functionality.

3. Overview of Ackland

251. Ackland (Ex. 1006) was filed July 3, 1996 and issued November 10, 1998, and I understand, is prior art to the '742 patent.

252. Ackland describes an active pixel imaging system using a “CMOS active pixel array” that may be used as a solid-state camera. *See, e.g.*, Ackland, 1:35-38, 7:62-63.

253. Ackland describes circuitry for timing and control of the array of CMOS pixels to generate a pre-video signal that is sent over a pre-video conductor. *See, e.g.* Ackland, 8:24-35, 8:45-52, Fig. 6. As shown in the exemplary active pixel image sensor shown in Figure 6 below, Ackland discloses a timing controller coupled to the CMOS pixel array through row decoder 10. Ackland discloses that “[i]n operation, a timing controller 20 provides timing signals to the row decoder 10” and “[i]n response, the decoder 10 sequentially activates each row 25 of active pixels 35 via the control lines 55 to detect light intensity and to generate corresponding output voltage signals during each frame interval.” Ackland, 8:24-35. The output voltage signals are amplified by amplifiers 18 and “[o]utput signals from the amplifiers 18 are provided to the common output line 19 in serial fashion

based on timing control signals from the timing controller 20.” Ackland, 8:45-52, 7:59-8:9, Fig. 6.

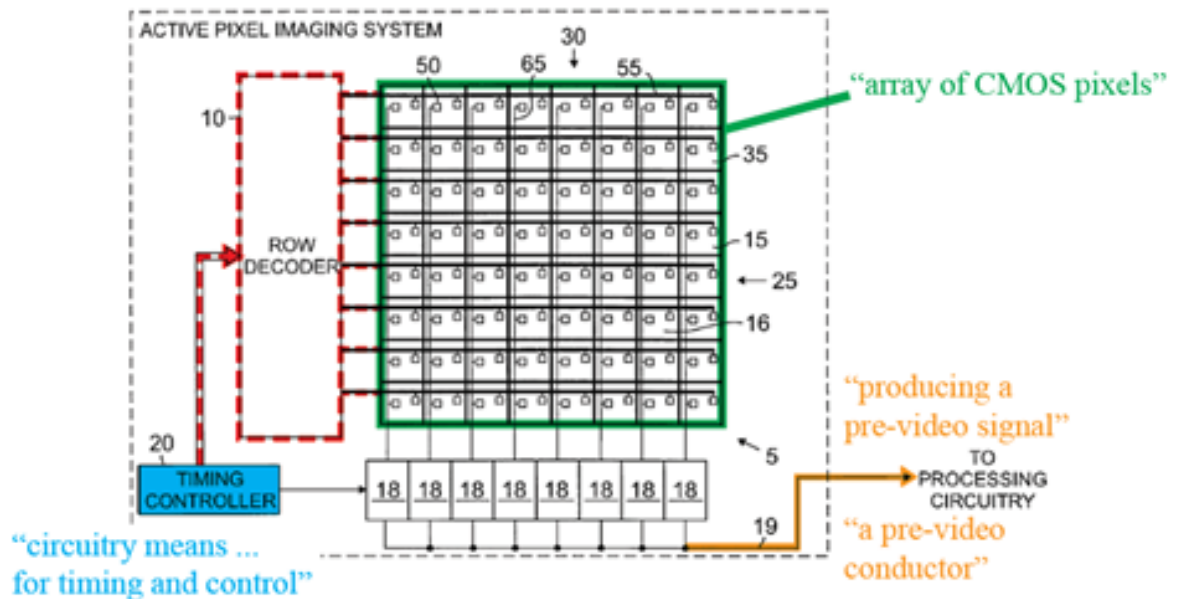


FIG. 6

Ackland, Fig. 6 (annotated).

4. Motivation to Combine Harris, Swift and Ackland

254. A person of ordinary skill in the art would have been motivated and found it obvious and straightforward to employ Ackland’s express teachings of an array of CMOS active pixels including its timing controller in implementing Swift’s image sensor 51 in Harris’s camera 288.

255. While Swift does not expressly state that its CMOS active pixels for receiving images thereon are configured in an array, Ackland expressly provides this additional implementation detail for an “active pixel imaging system,” which

includes a “CMOS ... pixel array” for receiving images thereon. *See, e.g.*, Ackland, 1:35-38 (“CMOS active pixel array”), 2:19-23, 7:44-47, 7:59-65 (“[a] plurality of single polysilicon active pixels...”), Fig. 6. The ’742 patent recognizes CMOS active pixel imaging systems were well known. ’742 patent, 1:60-63 (“... area of CMOS imagers including active pixel-type arrays ...”).

256. Similarly, while Swift does not expressly disclose how the timing of its pixels is controlled other than referring to sensor “selection and readout” circuitry (Swift, 10:2-4), Ackland describes circuitry including a “timing controller 20 providing timing signals” that control the imaging system “to achieve a desired frame rate.” *See, e.g.*, Ackland, 8:24-35. The ’742 patent admits that such timing circuitry was well known. ’742 patent, 1:63-2:6 (“This [prior art] CMOS imager can incorporate a number of other different electronic controls...timing circuits...”), 17:1-7 (“A further discussion of the timing and control circuitry which may be used in conjunction with an active pixel array is disclosed in U.S. Pat. No. 5,471,515 and is also described in an article entitled ‘Active Pixel Image Sensor Integrated With Readout Circuits’ appearing in NASA Tech Briefs, October 1996, pp. 38 and 39.”). As shown in Figure 6 in red, Ackland’s timing controller 20 is coupled to the CMOS pixel array for timing and control of the pixels.

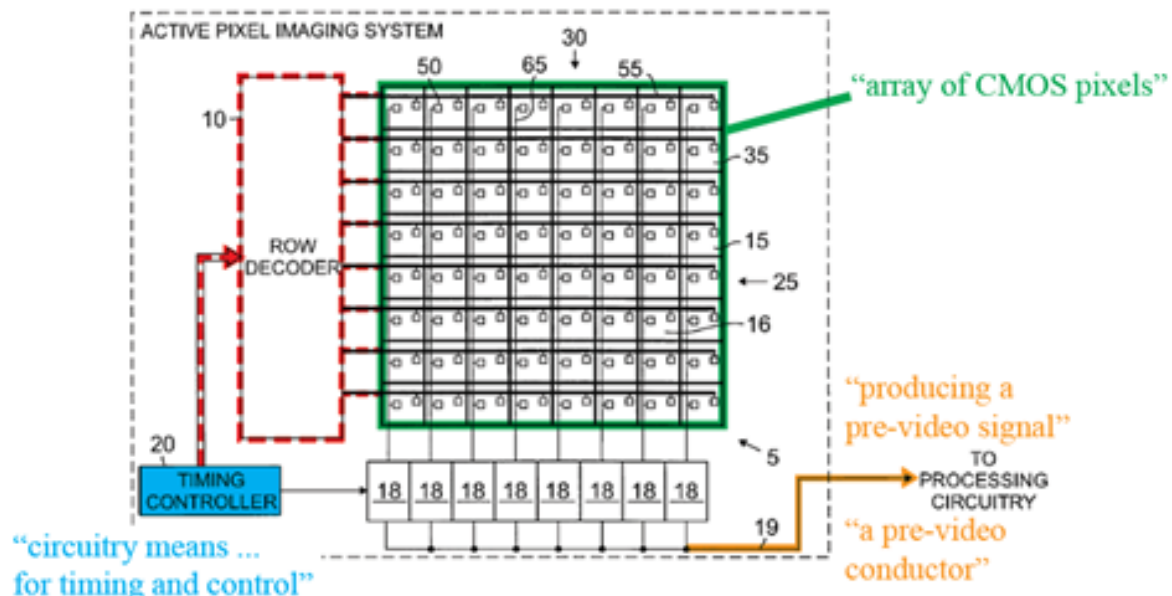


FIG. 6

Ackland, Fig. 6 (annotated).

257. In addition, while Swift discloses communicating an “image signal” from its image sensor to its image processor (*see* Swift, 9:5-10), Swift does not expressly disclose that the pre-video signal is sent over a pre-video conductor. Ackland describes how the active pixel imaging system produces an output signal and a common output line 19 along which the output signals are transmitted from the active pixel imaging system (the image sensor) on the first end of the line to the second end. *E.g.*, Ackland, 8:45-52 (“The output voltage signals generated by the activated row 35 are simultaneously provided to the corresponding amplifiers 18 via the column output line 65” and “[o]utput 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.”), 7:59-8:9, Fig. 6.

258. A person of ordinary skill in the art would have been motivated to apply Ackland’s explicit teachings described above in implementing Swift’s “image sensor 51.” Both Swift and Ackland are in the same field of art and are analogous art to the ’742—all are in the same field related to solid-state image sensors (*e.g.*, active CMOS image sensors) for use in cameras. *See, e.g.*, ’742 1:20-26 (“...solid state image sensors and associated electronics...”), 16:64-67 (“CMOS type active pixel array”); Swift, Abstract (“miniature camera”), 4:11-15 (“image sensor is preferably a CMOS sensor”); Ackland, 1:35-38, 3:27-29, 7:59-65. In addition, Swift and Ackland are also reasonably pertinent to the alleged problem(s) identified in the ’742 of arranging the circuitry of an image sensor, including to minimize the size of the device and for the device to be “low cost.” *See, e.g.*, ’742, 4:12-17 (“It is one object of this invention to provide reduced area imaging devices ...”); Swift, 1:7-18 (“Preferred embodiments of the present invention aim to provide miniature cameras which can be so constructed as to be particularly small and compact...”); Ackland, 2:10-15 (“...lower per chip fabrication cost”).

259. A person of ordinary skill in the art would have been further motivated to apply Ackland’s teachings in implementing Swift’s image sensors because, relative to other APS options, Ackland’s teachings of an array of single-polysilicon

active pixels requires no active drive signal for charge transfer. *See, e.g., Ackland, 2:34-43.* This advantageously allows the image sensor to operate without requiring a “separate bias supply or clocking circuitry.” *See, e.g., Ackland, 2:34-43* (“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.”), Abstract. In addition, through the use of single-polysilicon active pixels, a simpler fabrication process is possible, which lowers costs. *Ackland, 2:10-15* (“It would be desirable to form an active pixel using a process wherein only one polysilicon deposition is required” as “[t]his simple process would result in lower per chip fabrication cost.”). Such a design also reduces image lag that “is observed in a double-polysilicon active pixel.” *See, e.g., Ackland, 2:34-45* (“Image lag is typically not observed in the single-polysilicon active pixel when operating it in this manner.”). In addition, a person of ordinary skill in the art would have been motivated to apply Ackland’s teachings of an array of CMOS active pixels because, as the ’742 admits, it was known that CMOS active pixel sensor imagers result in “lower noise levels than CCDs or other solid state imagers,” can be “mass produced on standard semiconductor productions lines,” “can incorporate a number of other different electronic controls that are usually found on multiple circuit boards of

much larger size,” and require *less power* than CCD imagers. ’742 patent, 1:54-2:7. In addition, a person of ordinary skill in the art would have been motivated to apply Ackland’s teachings of an array of CMOS active pixels each including an amplifier in implementing Swift’s image sensor because it is able to advantageously amplify the “video signal” in order to “*overcome the relatively large load offered by the common output conductor 65.*” Ackland, 5:7-10.

260. In light of the above, a person of ordinary skill in the art would have found it routine, straightforward and advantageous to apply Ackland’s teachings of an array of CMOS active pixels together with a timing controller in an image sensor in implementing Swift’s image sensor 51 of a CMOS/APS type (as further applied to Harris’s camera 288), and would have known that such a combination (yielding the claimed limitations) would work as expected.

5. Invalidity of Claim 22 Over Harris in view of Swift and Ackland

a. Element [22.pre]

261. Element [22.pre] recites “**In a PDA having capability to transmit and receive data in a communications network, the PDA having a housing, and a video view screen for viewing the data which includes video signals.**” To the extent the preamble is limiting, as discussed in connection with Ground 1, Harris discloses a PDA (*e.g.*, “communication device 104” serving as a “personal digital

assistant”) having capability to transmit and receive data in a communications network (*e.g.*, “data communications between the communication devices 102 and 104”), the PDA having a housing (*e.g.*, “first housing 108”), and a video view screen for viewing the data which includes video signals (*e.g.*, “display 184” for displaying “receive” and “transmit” “decompressed image data,” “video”).

262. My discussion of Harris’s disclosure of this claim language is in Section VIII.A.4.a.

b. Element [22.a]

263. **Element [22.a] recites “a camera module for taking video images, said camera module communicating with circuitry within said PDA enabling viewing on said video view screen and enabling video signals to be transmitted from said camera module to said computer.”** Harris discloses element [22.a]. As discussed in connection with Ground 1 for this limitation, Harris discloses a camera module for taking video images (*e.g.*, “second housing 110” and “third housing 189” including “camera 188” for “captur[ing]” “video” “image data”), said camera module communicating with circuitry within said PDA (*e.g.*, as shown in Figure 1) enabling viewing on said video view screen (*e.g.*, displaying “video” “image data” from “camera 188” on “display 184”) and enabling video signals to be transmitted

from said camera module to said computer⁵ (*e.g.*, “image data” from “camera 188” “emi[tted] by the antenna 124” to “communication device 102” “computer”).

264. My discussion of Harris’s disclosure of this claim language is in Section VIII.A.4.b.

c. Element [22.b]

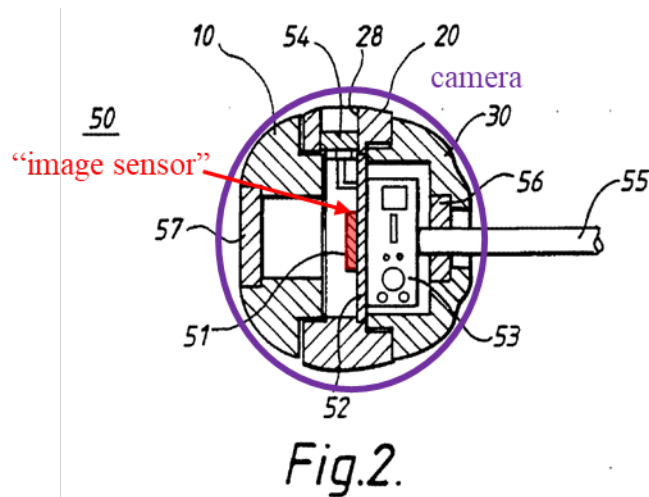
265. **Element [22.b] recites “said camera module including an image sensor housed therein.”** Harris in view of Swift renders obvious element [22.b]. Harris discloses said camera module housing a camera (*e.g.*, “second housing 110” and “third housing 189” including “camera 188”; *see* [22.a]). Swift discloses a camera including an image sensor (*e.g.*, “miniature camera 50” with “image sensor 51” as shown in Figure 2).

266. My discussion of Harris’s disclosure of said camera module housing a camera is in Section VIII.A.4.c.

⁵ I note that the term “said computer” does not have an antecedent basis. I have been asked to assume that the claimed “computer” refers to either circuitry within the PDA itself or a separate device with which the PDA is communicating. As I explain, Harris discloses this limitation regardless of whether “computer” in the claim refers to a component on the PDA (*e.g.*, “IR channel modem 117) or a separate device with which the PDA is communicating (*e.g.*, “computer” “communication device 104”).

267. While Harris discloses said camera module including a camera housed therein, it does not disclose the components within said camera. Swift discloses a miniature camera including a CMOS image sensor housed therein. Swift, 3:32-34, Fig. 2.

268. For example, Swift discloses *“an image sensor assembly for a miniature camera,”* where the *“image sensor is preferably a CMOS sensor.”* Swift, 3:32-34; 4:11-13. Further, Swift discloses *“[t]he miniature camera 50 that is shown in Figure 2 comprises a housing made of a front portion 10, centre portion 20 and rear portion 30,”* wherein *“three housing portions 10, 20 and 30 engaged with one another, to make up the housing, which is generally ovoid, or egg-shaped. An image sensor 51 is mounted on a circular printed circuit board 52, which engages within the intermediate bore 23 in the central housing portion 20...”* Swift, 7:10-12; 8:31-9:19.



269. As discussed in Section VIII.B.2, a person of ordinary skill in the art would have been motivated and found it obvious and straightforward to apply Swift's teachings of a CMOS camera in implementing Harris's camera.

d. Element [22.c]

270. **Element [22.c] recites “said image sensor lying in a first plane and including an array of pixels for receiving images thereon.”** Swift in view of Ackland renders obvious element [22.c]. Swift discloses said image sensor (*e.g.*, “image sensor 51”) lying in a first plane (*e.g.*, as shown in Figure 2). Ackland discloses an image sensor (*e.g.*, “active pixel imaging system”) including an array of pixels for receiving images thereon (*e.g.*, “CMOS ... pixel array”).

271. While Harris does not teach the components within its camera, Swift discloses the miniature camera includes a CMOS “image sensor 51” in a first plane, as shown in Figure 2. Swift, 8:31-9:18.

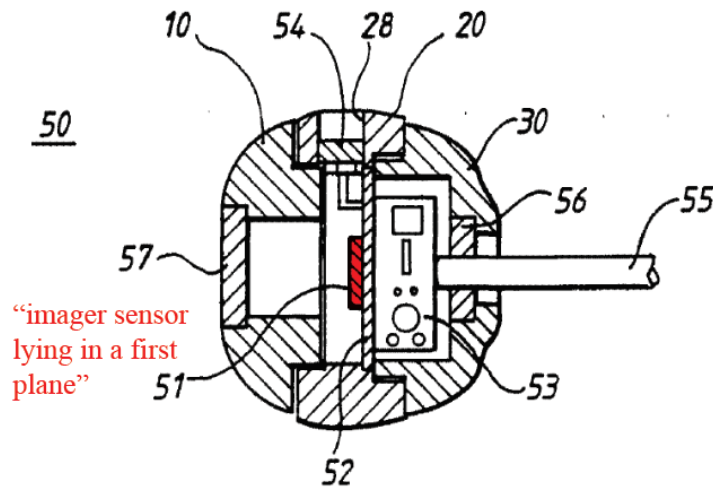


Fig.2.

272. Swift discloses that “image sensor 51 is preferably a CMOS/APS (Active Pixel Sensor) type,” where “each pixel contains its own selection and readout transistor.” Swift, 10:1-6, 4:11-13. Swift also discloses that additional information on “APS-type sensors may be found in the publication ‘Laser Focus World’, June 1993, Page 83.” Swift, 10:1-6.

273. While Swift does not expressly state that its CMOS active pixels for receiving images thereon are in an array, Ackland provides additional implementation detail for an “active pixel imaging system,” which includes a “CMOS ... pixel array” for receiving images thereon. *See, e.g.*, Ackland, 1:35-38.

274. Ackland’s discloses 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.” Ackland, 2:19-23. Ackland’s “CMOS active pixel 36 ... may be comprised of the same elements that are used in a double polysilicon active pixel for providing read-out, reset and buffering functions.” Ackland, 7:44-47.

275. For example, Ackland discloses an “*active pixel imaging system*, such as the exemplary imaging system 1 shown in FIG. 6,” which “may be used as a solid-state camera.” Ackland, 7:59-65. Ackland’s active pixel imaging system, as shown in Figure 6 below, for example, “includes *an array 5 of active pixels*, a row decoder 10 and a plurality of output amplifiers 18.” Ackland, 7:59-65.

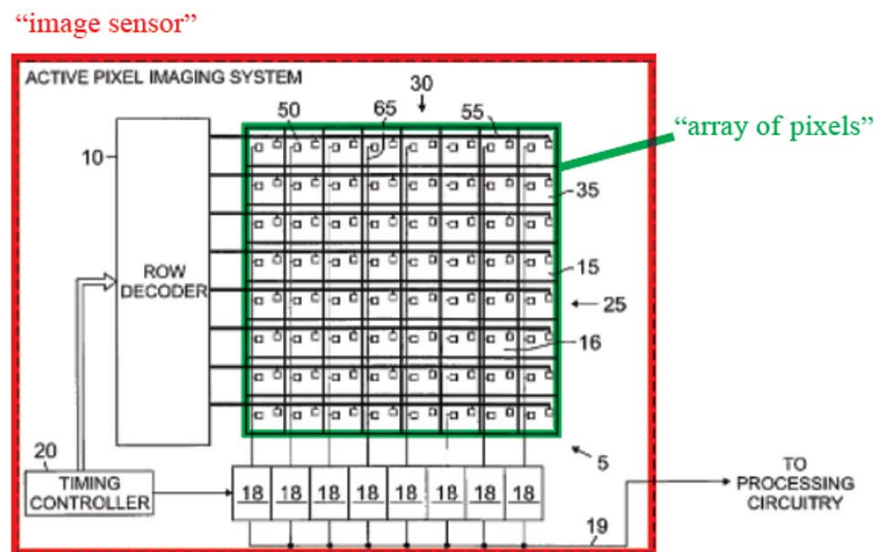


FIG. 6

Ackland, Figure 6 (annotated).

276. As discussed in Section VIII.B.4, a person of ordinary skill in the art would have been motivated and found it obvious and straightforward to apply Ackland’s teachings of an image sensor with an array of CMOS active pixels in

implementing Swift's image sensor 51 (which teachings are applied to Harris's camera).

e. Element [22.d]

277. **Element [22.d]** recites “said image sensor further including circuitry means on said first plane and coupled to said array of said pixels for timing and control of said array of pixels.” Swift in view of Ackland renders obvious element [22.d]. Swift discloses said image sensor (*e.g.*, “image sensor 51”; *see* [22.a]) on said first plane (*e.g.*, as shown in Figure 2; *see* [22.a]). Ackland discloses said image sensor (*e.g.*, “active pixel imaging system”) further including circuitry means (*e.g.*, “timing controller 20”) coupled to said array of said pixels for timing and control of said array of pixels (*e.g.*, “timing controller 20” coupled to the “CMOS ... pixel array” through “row decoder 10” in the “exemplary active pixel image sensor” shown in Figure 6).

278. As discussed in [22.c], Swift discloses the image sensor on the first plane. *See* Section VIII.B.5.d.

279. While Swift does not expressly teach how the timing of its image sensor is controlled, Ackland describes circuitry including a “timing controller 20 provides timing signals” that control the imaging system “to achieve a desired frame rate.” Ackland, 8:24-35. As shown in Figure 6, the timing controller 20 is coupled to the pixel array for timing and control of the pixels. Ackland, 2:19-23, 3:6-7, Fig. 6.

20” controls the timing of the imaging system “to achieve a desired frame rate, such as 30 frames per second.” Ackland, 8:24-35.

281. Ackland discloses that the signals output from the amplifiers 18, shown in Figure 6, “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.” Ackland, 8:47-52. See also Ackland, 3:39-54, 4:45-49.

282. To the extent “circuitry means ... for timing and control” limitation is construed under §112(6) (see Section VII.C, above), Ackland’s “timing controller 20” performs the same function of timing and control of the array of pixels and has the same structure as “timing and control circuits 92,” which control the release of the image signal from the pixel array disclosed in the ’742. See Section VII.C; ’742 patent, 5:2-5 (“The terms ‘timing and control circuits’ or ‘circuitry’ as used herein refer to the electronic components which control the release of the image signal from the pixel array”), 15:4-6, 16:9-44, Fig. 9a (disclosing “timing and control circuits 92”).

283. To the extent further disclosure is required, for the reasons discussed above, Ackland’s “timing controller 20,” at minimum, discloses the equivalent of the corresponding ’742 patent structure by performing the substantially same function (timing and control of the array of pixels), in substantially the same way

(using electronic components), to achieve the same result (outputting images from the pixel array at a desired frame rate).

284. Specifically, Ackland's timing controller 20 performs substantially the *same function* as the "timing and control circuits 92" of the '742 patent as both control the timing and control of the array of pixels. '742 patent, 5:2-5 ("The terms 'timing and control circuits' or 'circuitry' as used herein refer to the electronic components which control the release of the image signal from the pixel array"), 16:9-44 ("the timing and control circuits 92 are used to control the release of the image information or images stored in the pixel array"); Ackland, 8:24-35 ("...a timing controller 20 provides timing signals to the row decoder 10..."), 8:47-52 ("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"), Fig. 6.

285. Ackland's timing controller 20 performs this function in substantially the *same way* as the '742 by using electronic components. '742 patent, 5:2-5 ("The terms 'timing and control circuits' or 'circuitry' as used herein refer to the electronic components which control the release of the image signal from the pixel array"), 15:4-6 ("FIG. 9a is a more detailed schematic diagram of image sensor 40 which contains an array of pixels 90 and the timing and control circuits 92"); Ackland, 8:24-35 ("...a timing controller 20 provides timing signals to the row

decoder 10...”), 8:47-52 (“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”), Fig. 6.

286. And, Ackland’s timing controller 20 produces the *same result* as the “timing and control circuits 92” of the ’742 patent—outputting images from the pixel array at a desired frame rate. ’742 patent, 5:2-5 (“The terms ‘timing and control circuits’ or ‘circuitry’ as used herein refer to the electronic components which control the release of the image signal from the pixel array”), 16:9-44 (“the timing and control circuits 92 are used to control the release of the image information or images stored in the pixel array”); Ackland, 4:46-55 (“The signal timing controller 190 generates reset, select and photo gate control signals.... The integration time is dictated by the frame rate, or in other words, the number of times per second an image is updated...”), 8:24-35 (“...a timing controller 20 provides timing signals to the row decoder 10...”), 8:47-52 (“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”).

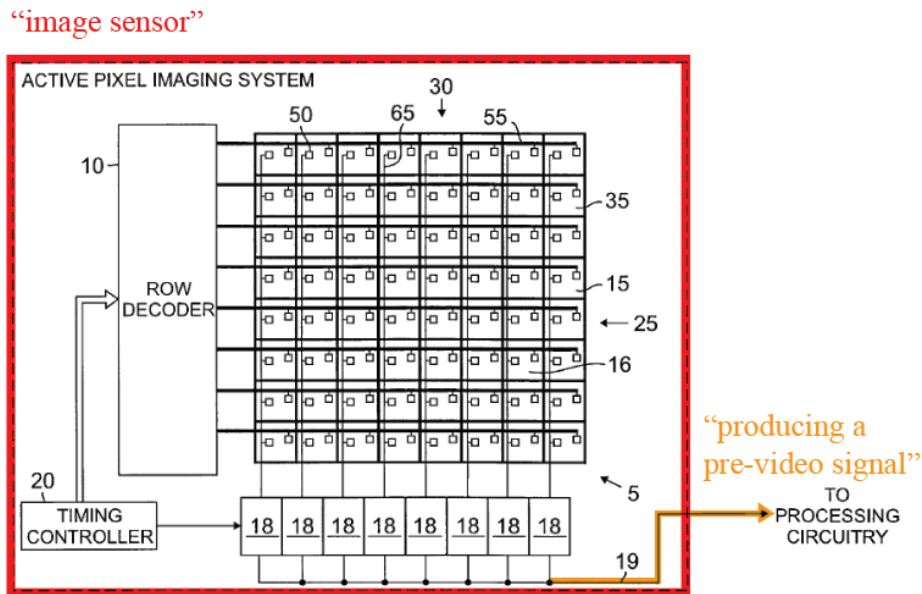
287. As discussed in Section VIII.B.4, a person of ordinary skill in the art would have been motivated and found it obvious and straightforward to apply Ackland’s teachings of an image sensor with an array of CMOS active pixels and

timing and control circuitry in implementing Swift's image sensor 51 (which teachings are applied to Harris's camera).

f. Element [22.e]

288. **Element [22.e]** recites “**said image sensor producing a pre-video signal.**” Ackland discloses element [22.e]. Ackland discloses said image sensor producing a pre-video signal (*e.g.*, “output signal” produced by the “active pixel imaging system”).

289. While Swift discloses communicating an “image signal” from its image sensor to its image processor (*see e.g.*, Swift, 9:5-18, Fig. 2), Ackland describes how the active pixel imaging system produces an output signal, which is a pre-video signal. For example, Ackland discloses that “[t]he output voltage signals generated by the activated row 35 are simultaneously provided to the corresponding amplifiers 18 via the column output line 65” and the “[o]utput signals from the amplifiers are provided to the common output line 19 in serial fashion.” Ackland, 8:45-52, 7:59-8:9. These output signals are “routed to suitable processing circuitry.” Ackland, 8:45-52.



Ackland, Fig. 6 (annotated).

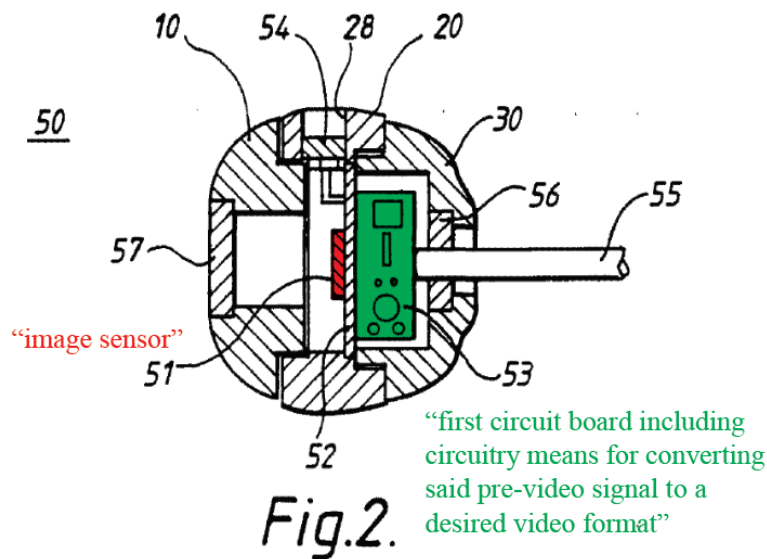
290. As discussed in Section VIII.B.4, a person of ordinary skill in the art would have been motivated and found it obvious and straightforward to apply Ackland’s teachings of an image sensor with an array of CMOS active pixels producing a pre-video signal in implementing Swift’s image sensor 51 (which teachings are applied to Harris’s camera).

g. Element [22.f]

291. Element [22.f] recites “a first circuit board electrically connected to said image sensor, said first circuit board including circuitry means for converting said pre-video signal to a desired video format.” Swift discloses element [22.f]. Swift discloses a first circuit board (*e.g.*, “circuit board 53”)

electrically connected to said image sensor (*e.g.*, “provide power to the image sensor 51 [and] process image signals received therefrom”), said first circuit board including circuitry means for converting said pre-video signal to a desired video format (*e.g.*, “video processor”; “circuitry components are mounted on the circuit board 53, to ... process image signals received [from image sensor 51]” into a “video signal” for a “video monitor or TV 154” to “display”).

292. Swift discloses a “printed circuit board 53 is mounted on the first printed circuit board 52, substantially at right angles thereto.” Swift, 9:5-7.



293. Additionally, Swift discloses that “circuit board 53” is electrically connected to and receives the “image signals” (pre-video signal) from “image sensor 51.” For example, Swift explains that the “circuitry components ... mounted on the

circuit board 53” “provide power to the image sensor 51, process image signals received therefrom....” Swift, 9:5-13.

294. Swift discloses that its “circuit board 53” receives image signals from image sensor 51 and includes a “video processor” and “circuitry components” that convert the received signal into a signal that may be received by a monitor or television. For example, Swift discloses “an image sensor assembly for a miniature camera, ... comprising a printed circuit board and, mounted thereon, the image sensor, a video processor,” Swift, 3:31-4:4. Swift further discloses that this video processor is part of the “circuitry components [that] are mounted on circuit board 53,” or, alternatively, the single circuit board, and is used “to process image signals received from [image sensor].” Swift, 9:5-13. The processed video signals are converted to a desired video format for reception by a standard video device, as Swift discloses “[a] video monitor or TV 154 is provided, to display a signal received from the camera 152.” Swift, 15:7-8, 15:13-14 (“The camera 152 and monitor 154 are connected by means of a cabling system 160.”), 17:34-18:3, 18:8-11.

295. To the extent the “circuitry means for converting said pre-video signal to a desired video format” limitation is construed under §112(6) (*see* Section VII.C, above), as discussed above, Swift’s “circuit board 53” that includes a “video processor”/“circuitry components” performs the same function of “converting said pre-video signal to a desired video format” and has the same structure as “processing

circuitry which ... converts the pre-video signal to a post-video signal which may be accepted by a standard video device” disclosed in the ’742 at least to the extent Patent Owner has interpreted the structure in the ’742 patent.⁶ See Section VII.C; ’742 patent, 4:65-5:2, 8:7-12 (“FIG. 9b 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.”), 17:8-44, 18:11-23, Fig. 9b (disclosing “video processing board 50”).

296. To the extent further disclosure is required, for the reasons discussed above, Swift’s “circuit board 53” that includes a “video processor”/“circuitry components” at minimum discloses the equivalent of the corresponding ’742 structure by performing substantially the same function (converting said pre-video signal to a desired video format), in substantially the same way (using electronic components), to achieve the same result (outputting a signal in a desired video

⁶ Patent Owner has asserted in litigation against Samsung that products have this structure because “[t]he pre-video signal received from the image sensor is sent to a processor on the first circuit board, which converts the pre-video signal to a post-video signal that can be viewed on the [accused product] LCD screen.” Ex. 1040, 9.

format “accepted by a standard video device”), at least as Patent Owner has interpreted the equivalent structure.⁷

297. Specifically, Swift’s “circuit board 53” that includes a “video processor”/“circuitry components” performs substantially the *same function* as the “processing circuitry” in ’742 patent—converting said pre-video signal to a desired video format. *See, e.g.,* ’742 patent, 4:65-5:2 (“The term “processing circuitry” as used herein refers to the electronic components within the imaging device which receive the image signal from the image sensor and ultimately place the image signal in a usable format.”), 9:58-63 (“Video processing board 50 then carries out all the necessary conditioning of the pre-video signal and places it in a form, also referred to herein as a video ready signal, so that it may be viewed directly on a remote video device such as a television or standard computer video monitor.”); Swift, 15:7-8 (“A video monitor or TV 154 is provided, to display a signal received from the camera

⁷ Patent Owner has asserted in litigation that the accused products perform the function of the disclosed structure in the same way because “algorithms embedded in a memory of the [accused product], upon receiving an instruction such as an user input (for example, pressing a button, touching screen), will be executed and cause the processor to convert the pre-video signal into a signal that can be accepted by a standard video device (for example accepted by its display).” Ex. 1040, 11.

152.”), 17:34-18:3 (“...With the video signals provided from the camera 152 as either video or UHF signals, viewing of an image from the camera 152 may be selected on the television at will...”), 18:8-11.

298. Swift’s “circuit board 53” that includes a “video processor”/“circuitry components” performs this function in substantially the **same way** as the ’742 patent by using electronic components. ’742 patent, 4:65-5:2 (“The term ‘processing circuitry’ as used herein refers to the electronic components within the imaging device which receive the image signal from the image sensor and ultimately place the image signal in a usable format.”), 17:8-44; Swift, 3:31-4:4 (“image sensor assembly ... comprising a printed circuit board and, mounted thereon, ... a video processor...”), 9:5-13 (“Various circuitry components are mounted on the circuit board 52, to ... process image signals received [from image sensor 51].”).

299. Swift’s “circuit board 53” that includes a “video processor”/“circuitry components” achieves the **same result** as the ’742 patent of outputting a signal in a video format “accepted by a standard video device.” ’742 patent, 4:46-50 (“The term “imaging device” as used herein describes the imaging elements and processing circuitry which is used to produce a video signal which may be accepted by a standard video device”), 9:58-63 (“Video processing board 50 then carries out all the necessary conditioning of the pre-video signal and places it in a form, also referred to herein as a video ready signal, so that it may be viewed directly on a

remote video device such as a television or standard computer video monitor.”); Swift, (“A video monitor or TV 154 is provided, to display a signal received from the camera 152.”), 17:34-18:3 (“...With the video signals provided from the camera 152 as either video or UHF signals, viewing of an image from the camera 152 may be selected on the television at will....”), 18:8-11.

300. As discussed in Section VIII.B.2, a person of ordinary skill in the art would have been motivated and found it obvious and straightforward to apply Swift’s teachings of a CMOS camera in implementing Harris’s camera.

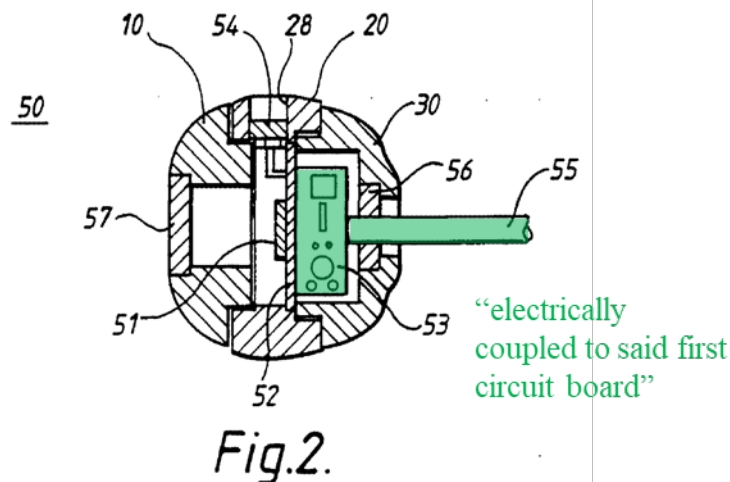
h. Element [22.g]

301. **Element [22.g] recites “a transceiver radio element housed within said camera module and electrically coupled to said first circuit board for transmitting said converted pre-video signal.”** Harris in view of Swift renders obvious element [22.g]. As discussed in connection with Ground 1 for this limitation, Harris discloses a transceiver radio element (*e.g.*, “RF” “wireless data transceiver 122”) housed within said camera module (*e.g.*, housed in “second housing 110” portion of camera module) and electrically coupled to said camera (*e.g.*, “camera 188 ... electrically coupled to” “wireless data transceiver 122”) for transmitting a converted pre-video signal (*e.g.*, for transmitting “backward communication signal 170,” containing “decompressed image data” “video”). Swift discloses said first circuit board (*e.g.*, “circuit board 53”) in said camera (*e.g.*,

“miniature camera 50”) electrically coupled to external circuitry (e.g., communicating the “process[ed] image signals” to “external ... circuitry” via “cable 55”).

302. My discussion of Harris’s disclosure of a transceiver radio element housed within said camera module and electrically coupled to said camera is in Section VIII.A.4.h.

303. While Harris does not expressly disclose the components of its camera, Swift discloses “[a] cable 55 is connected to the printed circuit board 53, and passes through the rear bores 32, 33, to provide a connection between the miniature video camera 50 and external processing circuitry (not shown).” Swift 9:7-18, Fig. 2.



304. As discussed in Section VIII.B.2, a person of ordinary skill in the art would have been motivated and found it obvious and straightforward to apply Swift’s teachings of a CMOS camera in implementing Harris’s camera. In applying

these teachings a person of ordinary skill in the art would have understood that the output of circuit board 53 is the output of the camera, thus the circuit board 53 is electrically coupled to wireless data transceiver 122—the transceiver radio element—such that the converted pre-video signal is received from the circuit board 53 and transmitted by the transceiver 122.

i. Element [22.h]

305. **Element [22.h] recites “a transceiver radio module housed in the PDA and wirelessly communicating with said transceiver radio element for receiving said converted pre-video signal, and said transceiver radio element being electrically coupled to the video view screen of the PDA enabling viewing of the converted pre-video signals.”** Harris discloses element [22.h]. As discussed in connection with Ground 1 for this limitation, Harris discloses a transceiver radio module (*e.g.*, “RF” “wireless data transceiver 117”) housed in the PDA (*e.g.*, in “first housing 108” of “communication device 104”) and wirelessly communicating with said transceiver radio element (*e.g.*, communicating with “wireless data transceiver 122” over “wireless RF link”; see Figure 1) for receiving said converted pre-video signal (*e.g.*, receiving “decompressed image data” “video”), and said transceiver radio element being electrically coupled to the video view screen of the PDA (*e.g.*, “wireless data transceiver 122” coupled to the “display 184” via “bus 178”) enabling

viewing of the converted pre-video signals (*e.g.*, “rout[ing] ... image data directly from” “camera 188” to “display 184”).

306. My discussion of Harris’s disclosure of this claim language is in Section VIII.A.4.i.

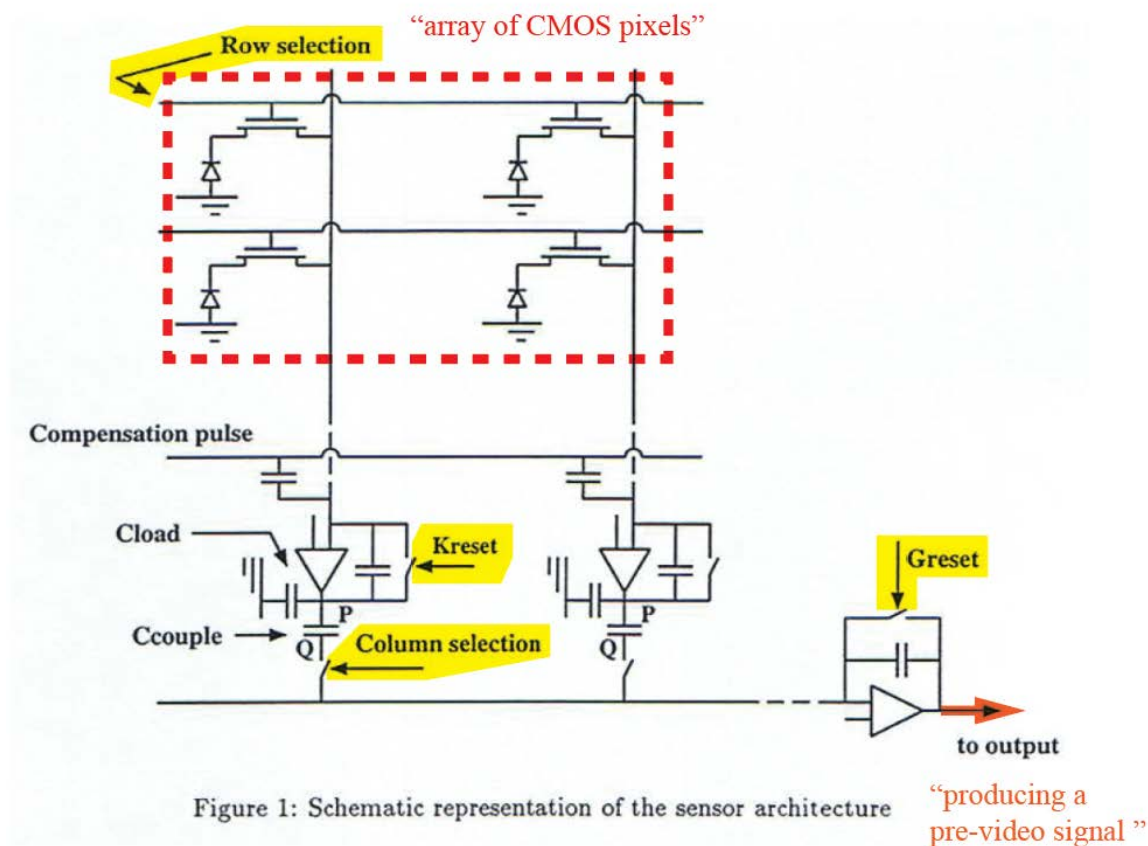
C. Claims 42, 58, and 66 are rendered obvious by Harris in view of Swift and Ricquier (Ground 5)

1. Overview of Ricquier

307. Ricquier (Exs. 1038, 1033) is a paper presented at the Proceedings of SPIE – The International Society of Optical Engineering in May 1994, and I understand, is prior art to the ’742 patent.

308. Ricquier describes a dedicated imager for a camera programmed to operate in several resolutions. *See, e.g.*, Ricquier, 2.

309. Ricquier’s imager includes a CMOS photodiode array of 256*256 pixels that are addressable by column and row (*i.e.*, “X-Y addressable”) using a timing controller implemented on an off-chip driving unit. *See, e.g.*, Ricquier, 1, 3, 5, 9, Figure 1. Figure 1 is a schematic representation of 2*2 of the 256*256 CMOS pixel array:



310. Ricquier teaches that the “256*256 X-Y addressable photodiode array” acquires image data by sequentially driving row selection signals to “transfer[] in parallel a row of 256 charges to 256 charge sensitive amplifiers” and coupling these “signals ... to a single output amplifier.” *See, e.g., Ricquier, 2-3.* For each row of pixels, the “charges are converted simultaneously to a voltage at the output[s] of ... amplifiers located at the end of the column readout lines.” *See, e.g., Ricquier, 3.*

311. A person of ordinary skill in the art would have understood Ricquier’s “output” at “a single output amplifier” is a pre-video signal produced by Ricquier’s timing and control circuitry. *See, e.g., Ricquier, 2-4.* Ricquier teaches that the

readout of the X-Y addressable photodiode array is done by “controlling the clocking scheme” using a “timing controller” on “an off-chip driving unit” for driving the “row selection,” “column selection,” and reset signal inputs (highlighted in Figure 1 above). *See, e.g.*, Ricquier, 3-4.

2. Motivation to Combine Harris, Swift, and Ricquier

312. A person of ordinary skill in the art would have been motivated to apply Ricquier’s explicit teachings when implementing Swift’s CMOS solid-state imager (as these teachings are applied in implementing Harris’s PDA). While Swift does not expressly state that its CMOS active pixels are in an array, Ricquier provides this additional implementation detail of the “acquisition of image data” using a “256*256 X-Y addressable photodiode array ... realised in a 1.5 μm standard CMOS technology.” *See, e.g.*, Ricquier, 9. Similarly, while Swift does not expressly disclose how the timing of its pixels is controlled other than referring to sensor “selection and readout” circuitry, Ricquier discloses that the readout from the “256*256 imager” is driven by a “timing controller (realised in an off-chip driving unit),” by “transferring ... charges of different pixels” “to a single output amplifier.” *See, e.g.*, Ricquier, Abstract, 3, 4, 9. Like Harris and Swift, Ricquier is also in the same field of art and is analogous art to the ’742—all are in the same field related to solid-state image sensors for use in cameras. *See, e.g.*, Ricquier, 2-3 (“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.”), 5, 9. In addition, like Harris and Swift, Ricquier is also reasonably pertinent to the alleged problem(s) identified in the ’742 of arranging the circuitry of a CMOS image sensor, including to minimize the size or profile area of the device, for the device to be “low cost,” for application in “industrial” applications, and to reduce image noise in CMOS sensors. *See, e.g.,* Ricquier, 2-3 (referring to use in “industrial applications”), 8 (noise reduction). A person of ordinary skill in the art would have been further motivated to apply Ricquier’s teachings in implementing Swift’s CMOS solid-state imager because of Ricquier’s express advantages of “selective addressability” and “multiple resolutions ... [and] data rates upto 10 MHz.” *See, e.g.,* Ricquier, 1. 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. The need for and placement of timing and control circuitry is not affected by whether the pixels are active pixels with amplifiers or passive pixels without amplifiers, since both types of image sensors need to have the time during which they collect light be controlled, and that control is going to be generally the same for both types. 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. A person of ordinary skill in the art would have been further motivated to apply Ricquier’s teachings in implementing Swift’s image sensor 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." Ricquier, 3, 4; Guide to Printed Circuit Board Design, 15, 20; *see also* Tanuma (Ex. 1016), 2-3 (placing circuit components on opposite side of circuit board from image sensor results in "compact camera head"), Fig. 2.

313. Ricquier does not specify the location of the timing controller other than specifying it is "off-chip" from the array of pixels. *E.g.*, Ricquier, 3, 4. A person of ordinary skill in the art would have been motivated to place Ricquier's timing and control circuitry in a second plane on either of Swift's two circuit boards 52 and 53 to minimize the overall size of the camera, or on a separate circuit board altogether to minimize the profile area of the camera. For example, a person of ordinary skill in the art would have been motivated to place Ricquier's timing and control circuitry on the opposite side of Swift's "circuit board 52" to "image sensor 51" to decrease the circumference of Swift's circuit board 52 and the number of lead wires while increasing reliability and matching characteristics. It was understood that there are benefits to mounting an image sensor chip on one side of a circuit board and other circuit components on the opposite side of the circuit board, including that this arrangement "does not require many lead wires, so there is a high degree of reliability, and excellent matching characteristics...[and] allow[s] for a more

compact camera head.” *See* Tanuma (Ex. 1016), 3-4. Alternatively, a person of ordinary skill in the art would have also been motivated to place Ricquier’s timing and control circuitry on Swift’s “circuit board 53.” This arrangement would minimize the number of components on Swift’s “circuit board 52” and would consolidate timing and control circuitry with processing and converting circuitry in a single location, which would reduce complexity in the system and avoid duplicate supporting circuitry. Further demonstrating that a person of skill in the art would have had a reasonable expectation of success in doing so, Hurwitz discloses a single “ASIC/DSP” performing both timing and control and image processing of video signals for a CMOS image sensor. Hurwitz (Ex. 1046), 120, Figure 1. Thus, when applying Ricquier’s teachings of placing timing and control circuitry on a separate chip from an image sensor in implementing Swift’s teachings, a person of ordinary skill in the art would have been motivated to locate video processing circuitry on circuit board 53, image sensor 51 on circuit board 52, and the timing controller either on the opposite side of circuit board 52 from image sensor 51 or along with Swift’s video processing circuitry on circuit board 53 to minimize the overall size of the device. As another alternative, a person of ordinary skill in the art would have been motivated to place Ricquier’s timing and control circuitry on a separate circuit board from both circuit boards 52 and 53 to reduce the profile area of the device. For example, it was understood that the use of a stacked arrangement of circuit boards

improves compactness, and provides a simpler arrangement for adding additional functionality as needed. *See, e.g.,* Chamberlain (Ex. 1044), 5:46-50, 1:61-66, 4:3-8, 7:52-62, 1:44-50, Figs. 17, 2 (depicting separate “driver board” with an “image sensor,” “logic board” that controls the “timing for the image sensor,” and option boards in stacked relationship for “a compact, electronically expandable camera”). A person of ordinary skill in the art would have had a reasonable expectation of success with each of these arrangements because “fitting of the components into the available space” and “placement” of circuitry is a common design consideration for portable devices. *Guide to Printed Circuit Board Design*, 15, 20.

314. Moreover, a person of ordinary skill in the art would have understood that there is a finite number of known, predictable solutions to the placement of timing and control circuitry in a system with a separate image sensor and image processing circuitry as disclosed in Swift, including: on the same side of circuit board 52 as “image sensor 51”; on the opposite side of circuit board 52 as “image sensor 51”; on either side of “circuit board 53”; or on another board. *See* Section VI. Thus, it would have at least been obvious to a person of skill in the art to try placing Ricquier’s timing and control circuitry either on the opposite side of “circuit board 52” from “image sensor 51” (see my discussion of ’742 claim 58 below) or on “circuit board 53” (see my discussion of ’742 claims 42 and 66 below).

315. In light of the above, a person of ordinary skill in the art would have found it routine, straightforward and advantageous to apply Ricquier’s teachings of arranging CMOS pixels in an array and an off-chip timing controller in implementing Swift’s image sensor (which teachings would have been obvious to apply in implementing Harris’s camera 188 as discussed in Section VIII.B.2), and would have known that such a combination (yielding the claimed limitations) would predictably work and provide the expected functionality.

3. Invalidity of Claims 42, 58 and 66 Over Harris in view of Swift and Ricquier

a. Element [42.pre]

316. **Element [42.pre]** recites **“In a PDA having capability to transmit and receive data in a communications network.”** To the extent the preamble is limiting, as discussed in connection with Ground 1 for this limitation, Harris discloses a PDA (*e.g.*, “communication device 104” serving as a “personal digital assistant”) having capability to transmit and receive data in a communications network (*e.g.*, “data communications between the communication devices 102 and 104”).

317. My discussion of Harris’s disclosure of this claim language is in Section VIII.A.4.j.

b. Element [42.a]

318. **Element [42.a]** recites “**a video system integral with said PDA for receiving and transmitting video images, and for viewing said images.**” Harris discloses element [42.a]. As discussed in connection with Ground 1 for this limitation, Harris discloses a video system integral with said PDA (*e.g.*, “communication device 104” with “video conferencing”) for receiving and transmitting video images (*e.g.*, “receives” and “transmit[s]” “RF signals” containing “video” “image data” over “communication link 106”), and for viewing said images (*e.g.*, displaying “video” “image data” received from “communication link 106” and “camera 188” on “display 184”).

319. My discussion of Harris’s disclosure of this claim language is in Section VIII.A.4.k.

c. Element [42.b]

320. **Element [42.b]** recites “**a camera module housing an image sensor therein.**” Harris in view of Swift renders obvious element [42.b]. As discussed in connection with Ground 1 for this limitation, Harris discloses said camera module including a camera housed therein (*e.g.*, “second housing 110” and “third housing 189” including “camera 188” for “captur[ing]” “video” “image data”). Swift discloses a camera including an image sensor (*e.g.*, “miniature camera 50” with “image sensor 51” as shown in Figure 2).

321. My discussion of Harris's disclosure of said camera module including a camera housed therein is in Section VIII.A.4.1.

322. Moreover, as discussed in [22.b], Swift discloses a camera including an image sensor. *See* Section VIII.B.5.c.

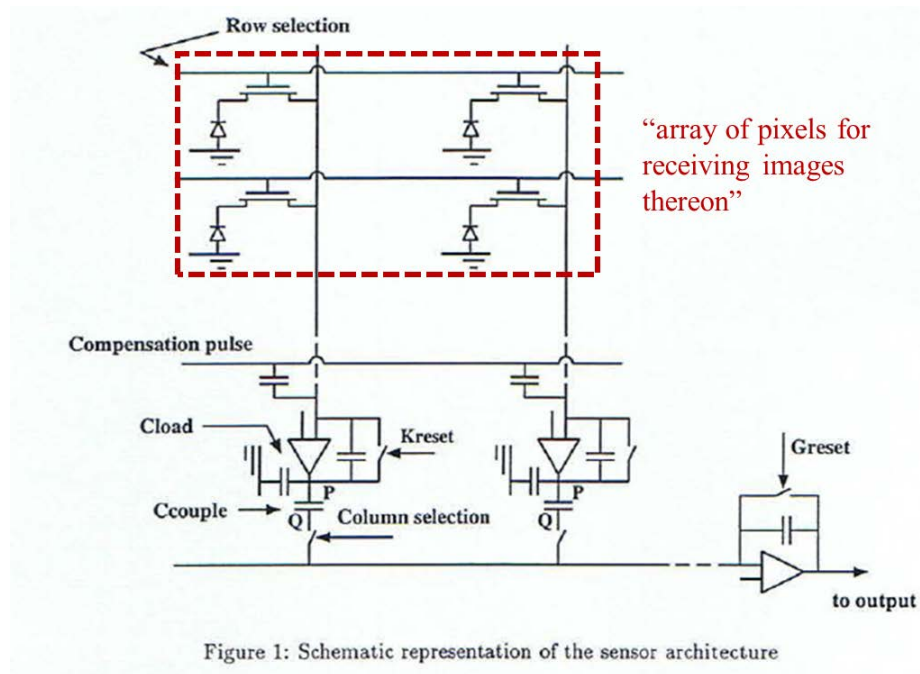
323. As discussed in Section VIII.B.2, a person of ordinary skill in the art would have been motivated and found it obvious and straightforward to apply Swift's teachings of a CMOS camera in implementing Harris's camera.

d. Element [42.c]

324. **Element [42.c] recites “said image sensor lying in a first plane and including an array of pixels for receiving images thereon.”** Swift in view of Ricquier renders obvious element [42.c]. Swift discloses said image sensor (*e.g.*, “image sensor 51”; *see* [22.b]) lying in a first plane (*e.g.*, as shown in Figure 2 of [22.c]; *see* [22.c]). Ricquier discloses an image sensor (*e.g.*, “image sensor”; “imager”) including an array of pixels for receiving images thereon (*e.g.*, “pixel array” “[t]o realise the acquisition of image data” “images are formed on the sensor plane”).

325. As discussed in [22.b] and [22.c], Swift discloses an image sensor including CMOS active pixels lying in a first plane. *See* Sections VIII.B.5.c and VIII.B.5.d.

326. In addition, while Swift does not expressly state that its CMOS active pixels for receiving images thereon are in an array, Ricquier provides additional implementation detail for the “acquisition of image data” in an “image sensor,” which includes a “256*256 X-Y addressable photodiode array ... realised in a 1.5 μm standard CMOS technology.” Ricquier, Abstract, 1, 9, Fig. 1. In addition, Ricquier discloses that “To realise the acquisition of image data ...an X-Y addressable architecture was selected,” and “images are formed on the sensor plane.” Ricquier, 3, 6.



327. As discussed in Section VIII.C.2, a person of ordinary skill in the art would have been motivated and found it obvious and straightforward to apply Ricquier’s teachings of arranging pixels in an array in implementing Swift’s image

sensor 51 (which teachings are applied to Harris's camera) such that the active pixels in Swift's image sensor are arranged in an array.

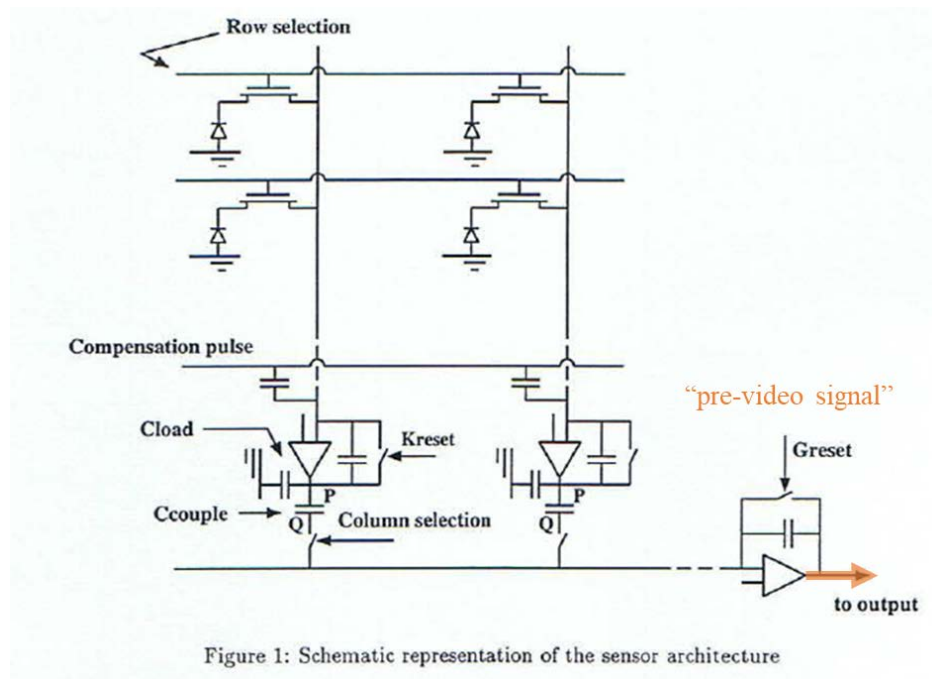
e. Element [42.d]

328. **Element [42.d] recites “said image sensor producing a pre-video signal.”** Ricquier discloses element [42.d]. Ricquier discloses said image sensor producing a pre-video signal (*e.g.*, “image data” “output,” as shown in Figure 1).

329. While Swift does not expressly teach how the timing of its image sensor is controlled, Ricquier discloses that the readout from the “256*256 imager” is “output” from the array and driven by a “timing controller (realised in an off-chip driving unit),” by “transferring ... charges of different pixels” “to a single output amplifier.” Ricquier, Abstract, 3, 4. A person of ordinary skill in the art would have understood Ricquier's “output” at “a single output amplifier” as shown in Figure 1 is a pre-video signal produced by Ricquier's timing and control circuitry.

330. For example, Ricquier discloses that “[*t*]he readout occurs in two phases”—“[a]fter transferring in parallel a row of charges to 256 charge sensitive amplifiers, these signals are coupled to a single output amplifier.” Ricquier, Abstract. Ricquier teaches that “[*t*]he readout of the charge packets that are accumulated during the integration time, proceeds as follows”—“[a]fter selecting one particular row of pixels, these charges are converted simultaneously to a voltage at the output of the different charge sensitive amplifiers located at the end of the

column readout lines.” Ricquier, 4. Such readout is controlled by “the timing controller (realised in an off-chip driving unit).” Ricquier, 4, Figure 1.



331. As discussed in Section VIII.C.2, a person of ordinary skill in the art would have been motivated and found it obvious and straightforward to apply Ricquier’s teachings of outputting a pre-video signal from a CMOS image sensor in implementing Swift’s image sensor 51 (which teachings are applied to Harris’s camera).

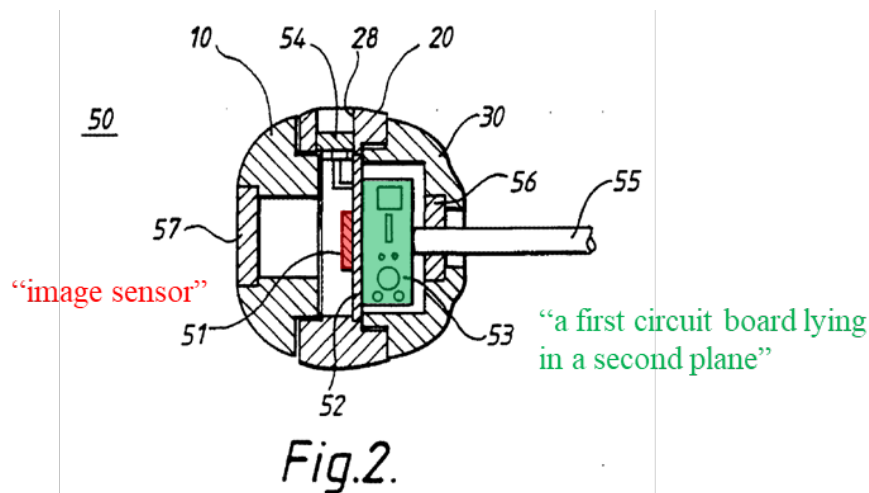
f. Element [42.e]

332. Element [42.e] recites “a first circuit board lying in a second plane and electrically coupled to said image sensor.” Swift discloses element [42.e].

Swift discloses a first circuit board (*e.g.*, “circuit board 53”; see [22.f]) lying in a second plane (*e.g.*, plane defined by “circuit board 53,” as shown in Figure 2) and electrically coupled to said image sensor (*e.g.*, “provide power to the image sensor [and] process image signals received therefrom”; see [22.f]).

333. As discussed in [22.f], Swift discloses a first circuit board electrically coupled to said image sensor. *See* Section VIII.B.5.g.

334. In addition, Swift discloses placing video processing circuitry on “circuit board 53,” which is “substantially at right angles [to image sensor 51],” in a second plane, as shown in Figure 2. Swift, 9:5-13; Figure 2.



335. As discussed in Section VIII.B.2, a person of ordinary skill in the art would have been motivated and found it obvious and straightforward to apply Swift’s implementation teachings of a CMOS camera in implementing Harris’s camera.

g. Element [42.f]

336. Element [42.f] recites “said first circuit board including circuitry means for timing and control of said array of pixels and circuitry means for processing and converting said pre-video signal to a desired video format.”

Swift in view of Ricquier renders obvious element [42.f]. As explained in connection with element [22.f], Swift discloses said first circuit board including circuitry means for processing and converting said pre-video signal to a desired video format (*e.g.*, “video processor”; “circuitry components are mounted on the circuit board 53, to ... process image signals received [from image sensor 51]” into a “video signal” for a “video monitor or TV 154” to “display”; *see* [22.f]). Ricquier discloses circuitry means for timing and control of said array of pixels (*e.g.*, “timing controller” “controlling the sequence of addresses and reset pulses of” “photodiode array”) separate from the pixel array (*e.g.*, “timing controller” is “realised ... off-chip” from the “photodiode array” in an “external driving unit”).

337. My analysis of [22.f] with respect to similar claim language is equally applicable to element [42.f], since the “video processor”/“circuitry components” disclosed by Swift for “converting said pre-video signal to a desired video format” also performs the function of “processing and converting said pre-video signal to a desired video format.” *See* Section VIII.B.5.g.

338. While Swift does not expressly disclose how the timing of its CMOS sensor is controlled, Ricquier discloses a “timing controller” that generates the “X-Y addresses and control pulses” and uses “decoders [to] drive ... row selection and column selection signal,” but is “off-chip” from the “X-Y addressable photodiode array.” Ricquier, 3, 4, 9. A person of ordinary skill in the art would have understood that Ricquier’s Figure 1 (annotated below) depicts timing and control signals (yellow) from the off-chip timing controller applied to the read-out circuitry of the array.

Ricquier, Fig. 1.

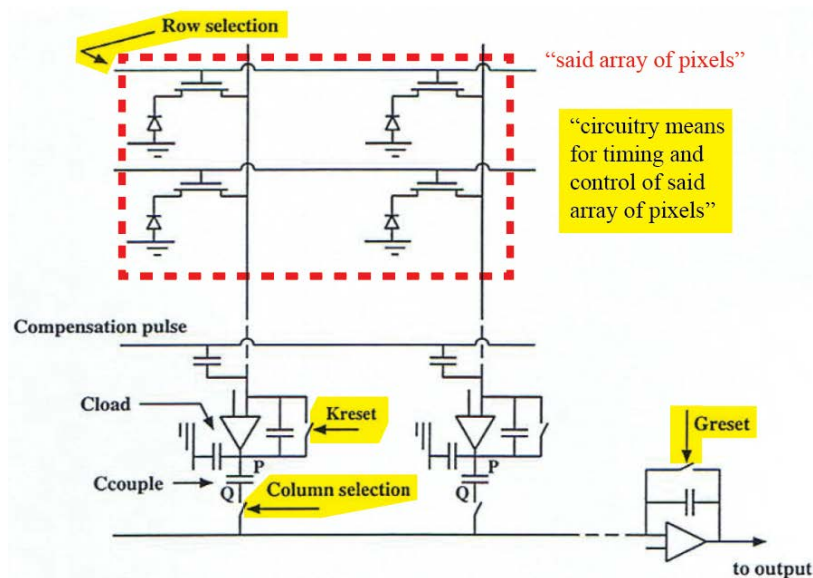


Figure 1: Schematic representation of the sensor architecture

339. For example, Ricquier explains that “[b]y controlling the sequence of addresses and reset pulses of the amplifiers, charges of different pixels are accumulated.” Ricquier, Abstract. Control pulses generated by “two decoders drive one particular row selection and column selection signal” based on “X-Y addresses.”

Ricquier, 3. Ricquier teaches that “[a]fter selecting one particular row of pixels, these charges are converted simultaneously to a voltage at the output of the different charge sensitive amplifiers located at the end of the column readout lines.” Ricquier, 3. Then, “[b]ased on the column selection signals, these nodes Q are again discharged to their starting value, at the same time creating a voltage variation at the output amplifier proportional to the charges at that column.” Ricquier, 3. Every column selection is “followed by a reset pulse on the Kreset switch bringing back the output amplifier into its initial state” and “after that, another charge packet can be received.” Ricquier, 3. After reading out a particular row of pixels, “the Kreset switch is closed causing the integration capacitor to discharge.” Ricquier, 3. Ricquier further teaches that “[b]y using the Kreset switches and the Greset switch in an appropriate way, it is possible to accumulate charge packets of different pixels or of different column amplifiers on the integration capacitors according to different patterns.” Ricquier, 3. By “controlling the clocking scheme, the resolution of the imager can be altered and it is even possible to create rectangular pixel patterns with a resolution varying across the rows. 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: apart from the normal resolution (1 *1) also the addition of pixel charges in 2*2, 4*4 and 8*8 neighbourhoods was foreseen.” Ricquier, 4, Fig. 1.

340. Furthermore, to the extent that the “timing and control means” limitation is construed under §112(6) (*see* Section VII.C, above), Ricquier’s “timing controller” performs the same function of timing and control of the array of CMOS pixels and has the same structure as the “timing and control circuits 92,” which control the release of the image signal from the pixel array disclosed in the ’742. *See* Section VII.C; ’742 patent, 5:2-5 (“The terms ‘timing and control circuits’ or ‘circuitry’ as used herein refer to the electronic components which control the release of the image signal from the pixel array”), 15:4-6, 16:9-11, Fig. 9a (disclosing “timing and control circuits 92”).

341. To the extent further disclosure is required, for the reasons discussed above, Ricquier’s “timing controller,” at minimum, discloses the equivalent of the corresponding ’742 structure by performing substantially the same function (timing and control of the array of pixels), in substantially the same way (using electronic components), to achieve the same result (outputting images from the pixel array at a desired frame rate).

342. Specifically, Ricquier’s “timing controller,” performs substantially the ***same function*** as the “timing and control circuits 92” of the ’742 patent as both control the timing and control of the array of CMOS pixels. ’742 patent, 5:2-5 (“The terms ‘timing and control circuits’ or ‘circuitry’ as used herein refer to the electronic components which control the release of the image signal from the pixel array.”),

16:9-11 (“The timing and control circuits 92 are used to control the release of the image information or image signal stored in the pixel array”); Ricquier, 3 (“The readout of the charge packets that are accumulated during the integration time, proceeds as follows. After selecting one particular row of pixels, these charges are converted simultaneously to a voltage at the output of the different charge sensitive amplifiers located at the end of the column readout lines. ... Based on the column selection signals these nodes Q are again discharged to their starting value, at the same time creating a voltage variation at the output amplifier proportional to the charges at that column. Every column selection is followed by a reset pulse on the Kreset switch bringing back the output amplifier into its initial state. After that, another charge packet can be received. After reading out a particular row of pixels, the Kreset switch is closed causing the integration capacitor to discharge.”), 4 (“By using the Kreset switches and the Greset switch in an appropriate way, it is possible to accumulate charge packets of different pixels or of different column amplifiers on the integration capacitors according to different patterns. So by controlling the clocking scheme, the resolution of the imager can be altered and it is even possible to create rectangular pixel patterns with a resolution varying across the rows. 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 : apart

from the normal resolution (1*1) also the addition of pixel charges in 2*2, 4*4 and 8*8 neighbourhoods was foreseen”), 9.

343. Ricquier’s “timing controller” performs this function in substantially the *same way* as the ’742 by using electronic components. ’742 patent, 5:2-5 (“The terms ‘timing and control circuits’ or ‘circuitry’ as used herein refer to the electronic components which *control the release of the image signal from the pixel array.*”), 15:4-6 (“FIG. 4a is a more detailed schematic diagram of image sensor 40 which contains an array of pixels 90 and the timing and control circuits 92.”); Ricquier, 4 (“In order to limit the complexity of the timing controller (realised in an off-chip driving unit)...”)

344. And, Ricquier’s “timing controller” produces the *same result* as the “timing and control circuits 92” of the ’742 patent—outputting images from the CMOS pixel array at a desired frame rate. ’742 patent, 5:2-5 (“The terms ‘timing and control circuits’ or ‘circuitry’ as used herein refer to the electronic components which *control the release of the image signal from the pixel array.*”), 16:9-11 (“The timing and control circuits 92 are used to control the release of the image information or image signal stored in the pixel array.”); Ricquier, 4 (“By using the Kreset switches and the Greset switch in an appropriate way, it is possible to accumulate charge packets of different pixels or of different column amplifiers on the integration capacitors according to different patterns. So by controlling the

clocking scheme, the resolution of the imager can be altered and it is even possible to create rectangular pixel patterns with a resolution varying across the rows. 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 : apart from the normal resolution (1*1) also the addition of pixel charges in 2*2, 4*4 and 8*8 neighbourhoods was foreseen.”)

345. As discussed in Section VIII.C.2, 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 Swift’s image sensor 51 (which teachings are applied to Harris), and would have been motivated to place the “timing controller” on Swift’s circuit board 53 with the video processor. A person of ordinary skill in the art would have recognized this combination (yielding the claimed limitation) would work as expected.

h. Element [42.g]

346. **Element [42.g] recites “a transceiver radio element communicating with said firs [sic] circuit board for transmitting said converted pre-video signal.”** Harris in view of Swift renders obvious element [42.g]. As discussed in connection with Ground 1 for this limitation, Harris discloses a transceiver radio element (*e.g.*, “RF” “wireless data transceiver 122”) communicating with said

camera (*e.g.*, “camera 188 ... electrically coupled to” “wireless data transceiver 122”) for transmitting said converted pre-video signal (*e.g.*, for transmitting “backward communication signal 170,” containing “decompressed image data” “video”). Swift discloses said first circuit board (*e.g.*, “circuit board 53”) in said camera (*e.g.*, “miniature camera 50”) electrically coupled to external circuitry (*e.g.*, communicating the “process[ed] image signals” to “external ... circuitry” via “cable 55”).

347. My discussion of Harris’s disclosure of a transceiver radio element communicating with said camera for transmitting said converted pre-video signal is in Section VIII.A.4.q.

348. Moreover, as explained in [22.g], Swift discloses said first circuit board in said camera electrically coupled to external circuitry. *See* Section VIII.B.5.h.

349. As discussed in Section VIII.B.2, a person of ordinary skill in the art would have been motivated and found it obvious and straightforward to apply Swift’s teachings of a CMOS camera in implementing Harris’s camera, and would have understood that Swift’s circuit board 53 would communicate with Harris’s transceiver 122.

i. Element [42.h]

350. **Element [42.h] recites “a transceiver radio module mounted in said PDA for wirelessly receiving said converted pre-video signal.”** Harris discloses

element [42.h]. As explained in connection with element [22.h], Harris discloses a transceiver radio module (*e.g.*, “wireless data transceiver 117” “communicat[ing] via ... RF”) mounted in the PDA (*e.g.*, in “first housing 108” of “communication device 104”) for wirelessly receiving said converted pre-video signal (*e.g.*, receiving “decompressed image data” “video” over “wireless RF link”; see Figure 1).

351. My discussion of Harris’s disclosure of this claim language is in Section VIII.A.4.r.

j. Element [42.i]

352. **Element [42.i] recites “a video view screen attached to said PDA for viewing said video images, said video view screen communicating with said transceiver radio module, and displaying video images processed by said first circuit board.”** Harris in view of Swift renders obvious element [42.i]. As discussed in connection with Ground 1 for this limitation, Harris discloses a video view screen (*e.g.*, “display 184”; see [22.pre]) attached to said PDA (*e.g.* on “the front surface 200” of the PDA) for viewing said video images (*e.g.*, viewing “decompressed image data” “video”; see [22.pre]), said video view screen communicating with said transceiver radio module (*e.g.*, via “bus[es] 178” and “180” and “wireless RF link” between “data transceiver[s] 117” and “122”; see [22.h]), and displaying video images processed by said camera (*e.g.*, displaying “video” “image data” from “camera 188”; see [22.a]). Swift discloses video images

processed by said first circuit board (*e.g.*, “circuitry components are mounted on the circuit board 53, to...process image signals”; *see* 42.f) of said camera (*e.g.*, “miniature camera 50”; *see* 42.f).

353. My discussion of Harris’s disclosure of a video view screen attached to said PDA for viewing said video images, said video view screen communicating with said transceiver radio module, and displaying video images processed by said camera is in Section VIII.A.4.s. As discussed in [42.f], Swift discloses said camera outputting video images processed by said first circuit board. *See* Section VIII.C.3.g.

354. As discussed in Section VIII.B.2, a person of ordinary skill in the art would have been motivated and found it obvious and straightforward to apply Swift’s teachings of a camera producing video images on the first circuit board in implementing Harris’s camera, and would have recognized this combination (yielding the claimed limitation) would work as expected.

k. Element [58.pre]

355. **Element [58.pre] recites “In a PDA having capability to transmit and receive data in a communications network, the PDA including a video view screen for viewing the video images.”** To the extent the preamble is limiting, As discussed in connection with Ground 1 for this limitation, Harris discloses a PDA (*e.g.*, “communication device 104” serving as a “personal digital assistant”) having capability to transmit and receive data in a communications network (*e.g.*, “data

communications between the communication devices 102 and 104”), the PDA including a video view screen for viewing the video images (*e.g.*, “display 184” for displaying “receive” and “transmit” “decompressed image data,” “video”).

356. My discussion of Harris’s disclosure of this claim language is in Section VIII.A.4.t.

I. Element [58.a]

357. **Element [58.a] recites “a camera module for taking video images, said camera module communicating with circuitry within said PDA enabling viewing of said video images on said PDA and enabling video signals to be transmitted from said camera module to the personal computer.”** Harris discloses element [58.a]. As discussed in connection with Ground 1 for this limitation, Harris discloses a camera module for taking video images (*e.g.*, “second housing 110” and “third housing 189” including “camera 188” for “captur[ing]” “video” “image data”), said camera module communicating with circuitry within said PDA (*e.g.*, as shown in Figure 1) enabling video signals to be transmitted from said camera module to said computer.⁸

⁸ As with claim 22, claim 58 also recites “said computer” without antecedent basis. For the reasons I explain in connection with element [22.a], Harris discloses this limitation regardless of whether “computer” in the claim refers to a component on

358. My discussion of Harris’s disclosure of this claim language is in Section VIII.A.4.u.

m. Element [58.b]

359. **Element [58.b] recites “said camera module including an image sensor housed therein, said image sensor lying in a first plane and including an array of pixels for receiving images thereon.”** Harris in view of Swift and Ricquier renders obvious element [58.b]. As discussed in connection with Ground 1 for this limitation, Harris discloses said camera module including a camera housed therein. As explained in connection with [22.c], Swift discloses a camera including an image sensor (*e.g.*, “miniature camera 50” with “image sensor 51” as shown in Figure 2, *see* [22.b]) lying in a first plane (*e.g.*, as shown in Figure 2 of [22.c]; *see* [22.c]). Ricquier discloses an image sensor (*e.g.*, “image sensor”; “imager”) including an array of pixels for receiving images thereon (*e.g.*, “pixel array” “[t]o realise the acquisition of image data” “images are formed on the sensor plane”).

360. My discussion of Harris’s disclosure of the camera module housing a camera is in Section VIII.A.4.v.

the PDA (*e.g.*, “IR channel modem 117) or a separate device with which the PDA is communicating (*e.g.*, “computer” “communication device 104”), the two interpretations I have been asked to assume.

361. As discussed in connection with [22.c], Swift discloses a camera including said image sensor lying in a first plane. *See* Section VIII.B.5.d. As discussed in connection with [42.c], Ricquier discloses an image sensor including an array of pixels for receiving images thereon. *See* Section VIII.C.3.d.

362. As discussed in Section VIII.C.2, a person of ordinary skill in the art would have been motivated and found it obvious and straightforward to apply Ricquier's teachings of arranging pixels in an array in implementing Swift's image sensor 51 (which teachings are applied to Harris's camera) such that the active pixels in Swift's image sensor are arranged in an array.

n. Element [58.c]

363. **Element [58.c] recites “said image sensor further including circuitry means electrically coupled to said array of said pixels for timing and control of said array of pixels.”** Ricquier discloses element [58.c]. Ricquier discloses said image sensor further including circuitry means electrically coupled to said array of pixels (*e.g.*, “off-chip” “timing controller” to “drive ... row selection and column selection signal[s]” of “X-Y addressable photodiode array”) for timing and control of said array of pixels (*e.g.*, “controlling the sequence of addresses and reset pulses of” “photodiode array”).

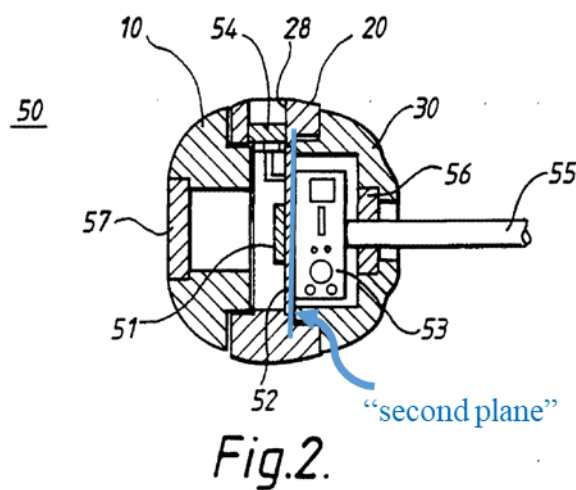
364. My analysis of [42.f] with respect to similar claim language is equally applicable to [58.c]. *See* Section VIII.C.3.g.

365. As discussed in Section VIII.C.2, 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 Swift's image sensor 51 (which teachings are applied to Harris), and would have recognized this combination (yielding the claimed limitation) would work as expected.

o. Element [58.d]

366. **Element [58.d] recites "said circuitry means for timing and control placed remote from said array of pixels on a second plane."** Swift in view of Ricquier renders obvious element [58.d]. To the extent "remote from said array of pixels on a second plane" encompasses different circuits on the same circuit board, Swift discloses a second plane (*e.g.*, "circuit board 52"). Ricquier discloses said circuitry means for timing and control placed remote from said array of pixels (*e.g.*, "timing controller" is "realised ... off-chip" from the "photodiode array" in an "external driving unit").

367. For example, Swift discloses a "circuit board 52" on a separate plane from "image sensor 51." Swift, 8:33-34, 9:5-10, Fig. 2.



368. In addition, as explained in connection with [42.f], Ricquier discloses circuitry means for timing and control of said array of pixels separate from the pixel array. *See* Section VIII.C.3.g.

369. As discussed in Section VIII.C.2, 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 Swift’s image sensor 51 (which teachings are applied to Harris), and would have been motivated to place the “timing controller” on Swift’s circuit board 52. A person of ordinary skill in the art would have recognized this combination (yielding the claimed limitation) would work as expected.

370. As an alternative, to the extent “remote from said array of pixels on a second plane” does not encompass different circuits on the same circuit board, a person of ordinary skill in the art would have also been motivated to place the timing

and control circuitry on a separate circuit board from both circuit boards 52 and 53 in the back housing of Swift's camera to reduce the profile area of the device, as I explain in Section VIII.C.2. As a result, the image sensor would be on the circuit board 52, the video processing circuitry would be on the circuit board 53, and the timing and control circuitry would be on a third board, where the circuit board 52 defines a first plane and the board with the timing and control circuitry defines a second plane.

p. Element [58.e]

371. **Element [58.e]** recites “said image sensor producing a pre-video signal.” Ricquier discloses element [58.e]. Ricquier discloses said image sensor producing a pre-video signal (*e.g.*, “image data” “output,” as shown in Figure1 in [42.d]).

372. My analysis of [42.d] with respect to similar claim language is equally applicable to [58.e]. *See* Section VIII.C.3.e.

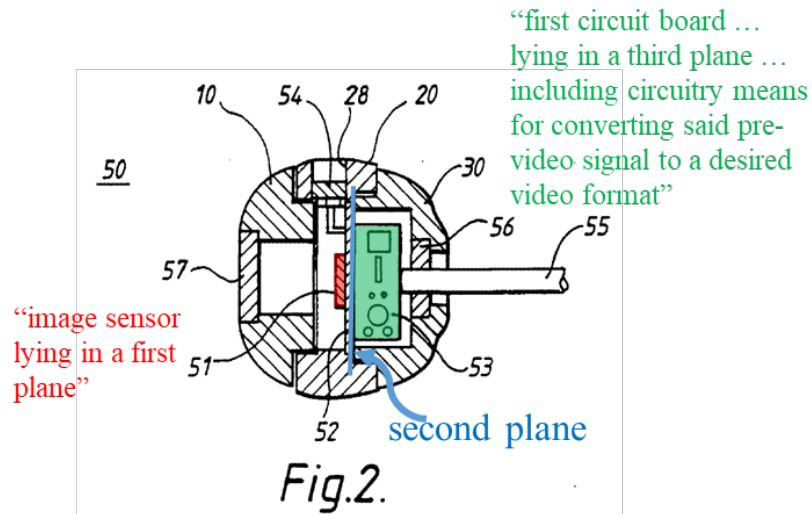
373. As discussed in Section VIII.C.2, a person of ordinary skill in the art would have been motivated and found it obvious and straightforward to apply Ricquier's teachings of arranging pixels in an array in implementing Swift's image sensor 51 (which teachings are applied to Harris's camera) such that the active pixels in Swift's image sensor are arranged in an array.

q. Element [58.f]

374. **Element [58.f] recites “a first circuit board electrically connected to said image sensor and lying in a third plane, said first circuit board including circuitry means for processing and converting said pre-video signal to a desired video format.”** Swift discloses element [58.f]. Swift discloses a first circuit board electrically connected to said image sensor (“circuit board 53” “provide[s] power to the image sensor 51 [and] process image signals received therefrom”; *see* [22.f]) and lying in a third plane (*e.g.*, plane defined by “circuit board 53,” which is “substantially at right angle[]” to “circuit board 52” and the “image sensor” as shown in Figure 2), said first circuit board including circuitry means for processing and converting said pre-video signal to a desired video format (*e.g.*, “video processor”; “circuitry components are mounted on the circuit board 53, to ... process image signals received [from image sensor 51]” into a “video signal” for a “video monitor or TV 154” to “display”; *see* [22.f]).

375. As discussed in [22.f] and [42.f], Swift discloses a first circuit board electrically connected to said image sensor, said first circuit board including circuitry means for processing and converting said pre-video signal to a desired video format. *See* Sections VIII.B.5.g, VIII.C.3.g.

376. In addition, Swift discloses that relative to the “image sensor 51” on a first plane and “circuit board 52” in a second plane, “circuit board 53” is on a third plane, as shown in Figure 2 below.



377. Alternatively, in the arrangement in which the timing and control circuitry is on a separate board from both the circuit boards 52 and 53 (See Section VIII.C.3.e), the image sensor is in a first plane on board 52, the timing and control circuitry is in a second plane on the separate board, and the circuitry means for converting the pre-video signal is in a third plane on the circuit board 53.

378. As discussed in Section VIII.B.2, a person of ordinary skill in the art would have been motivated and found it obvious and straightforward to apply Swift's teachings of a CMOS camera in implementing Harris's camera.

r. Element [58.g]

379. **Element [58.g] recites “a radio transceiver element communicating with said first circuit board for wirelessly transmitting said converted pre-video signal.”** As discussed in connection with Ground 1 for this limitation, Harris discloses a radio transceiver element (e.g., “RF” “wireless data transceiver 122”)

communicating with said camera (*e.g.*, “camera 188 ... electrically coupled to” “wireless data transceiver 122”) for wirelessly transmitting said converted pre-video signal (*e.g.*, for transmitting “backward communication signal 170,” containing “decompressed image data” “video”). As explained in connection with [42.g], Swift discloses said first circuit board (*e.g.*, “circuit board 53”) in said camera (*e.g.*, “miniature camera 50”) electrically coupled to external circuitry (*e.g.*, communicating the “process[ed] image signals” to “external ... circuitry” via “cable 55”).

380. My discussion of Harris’s disclosure of a radio transceiver element communicating with said camera for wirelessly transmitting said converted pre-video signal is in Section VIII.A.4.aa.

381. As discussed in [42.g], Swift discloses said first circuit board in said camera electrically coupled to external circuitry. *See* Section VIII.C.3.h.

382. As discussed in Section VIII.B.2, a person of ordinary skill in the art would have been motivated and found it obvious and straightforward to apply Swift’s teachings of a CMOS camera in implementing Harris’s camera, and would have understood that Swift’s circuit board 53 would communicate with Harris’s transceiver 122.

s. Element [66.pre]

383. **Element [66.pre] recites “A PDA having capability to transmit and receive data in a communications network.”** To the extent the preamble is limiting, as discussed in connection with Ground 1 for this limitation, Harris discloses a PDA (*e.g.*, “communication device 104” serving as a “personal digital assistant”) having capability to transmit and receive data in a communications network (*e.g.*, “data communications between the communication devices 102 and 104”).

384. My discussion of Harris’s disclosure of this claim language is in Section VIII.A.4.bb.

t. Element [66.a]

385. **Element [66.a] recites “an image sensor lying in a first plane including an array of pixels for receiving images thereon, said image sensor producing a pre-video signal.”** Swift in view of Ricquier renders obvious element [66.a]. As explained in connection with [42.c], Swift discloses an image sensor (*e.g.*, “image sensor 51”) lying in a first plane (*e.g.*, as shown in Figure 2), and Ricquier discloses an image sensor (*e.g.*, “image sensor”; “imager”) including an array of pixels for receiving images thereon (*e.g.*, “pixel array” “[t]o realise the acquisition of image data” “images are formed on the sensor plane”). And as explained in connection with [42.d], Ricquier discloses said image sensor producing a pre-video signal (*e.g.*, “image data” “output,” as shown in Figure 1 in [42.d]).

386. My analysis of [42.c] and [42.d] with respect to similar claim language is equally applicable to [66.a]. *See* Sections VIII.C.3.d and VIII.C.3.e.

387. As discussed in Section VIII.C.2, a person of ordinary skill in the art would have been motivated and found it obvious and straightforward to apply Ricquier's teachings of outputting a pre-video signal from a CMOS image sensor in implementing Swift's image sensor 51 (which teachings are applied to Harris's camera).

u. Element [66.b]

388. **Element [66.b] recites “a first circuit board electrically communicating with said image sensor, said first circuit board including circuitry means for timing and control of said array of pixels and circuitry means for processing and converting said pre-video signal to a desired video format.”** Swift in view of Ricquier renders obvious element [66.b]. As discussed in connection with [22.f], Swift discloses a first circuit board (*e.g.*, “circuit board 53”) electrically communicating with said image sensor (*e.g.*, “provide power to the image sensor [and] process image signals received therefrom”), said first circuit board including circuitry means for converting said pre-video signal to a desired video format (*e.g.*, “video processor”; “circuitry components are mounted on the circuit board 53, to ... process image signals received [from image sensor 51]” into a “video signal” for a “video monitor or TV 154” to “display”). As discussed in

connection with [42.f], Ricquier discloses circuitry means for timing and control of said array of pixels (*e.g.*, “timing controller” “controlling the sequence of addresses and reset pulses of” “photodiode array”) separate from the pixel array (*e.g.*, “timing controller” is “realised ... off-chip” from the “photodiode array” in an “external driving unit”).

389. My analysis of [22.f] and [42.f] with respect to similar claim language is equally applicable to [66.b]. *See* Sections VIII.B.5.g and VIII.C.3.g.

390. As discussed in Section VIII.C.2, a person of ordinary skill in the art would have been motivated and found it obvious and straightforward to apply Ricquier’s teachings of placing a “timing controller” “off-chip” in implementing Swift’s image sensor 51, and to place the timing and control circuitry on Swift’s circuit board 53 (which teachings are applied to Harris’s camera), and would have been motivated to place the “timing controller” on Swift’s circuit board 53 with the video processor. A person of ordinary skill in the art would have recognized this combination (yielding the claimed limitation) would work as expected.

v. Element [66.c]

391. **Element [66.c] recites “a radio transceiver element communicating with said first circuit board for wirelessly transmitting said converted pre-video signal.”** Harris in view of Swift renders obvious element [66.c]. As discussed in connection with Ground 1 for this limitation, Harris discloses a radio transceiver

element (*e.g.*, “RF” “wireless data transceiver 122”) communicating with said camera (*e.g.*, “camera 188 ... electrically coupled to” “wireless data transceiver 122”) for wirelessly transmitting said converted pre-video signal (*e.g.*, for transmitting “backward communication signal 170,” containing “decompressed image data” “video”). Swift discloses external circuitry electrically coupled to said first circuit board (*e.g.*, “circuit board 53” coupled to “external ... circuitry” via “cable 55”) of said camera (*e.g.*, “miniature camera 50”).

392. My discussion of Harris’s disclosure of a radio transceiver element communicating with said camera for wirelessly transmitting said converted pre-video signal is in Section VIII.A.4.ee.

393. As discussed in [42.g], Swift discloses said first circuit board in said camera electrically coupled to external circuitry. *See* Section VIII.C.3.h.

394. As discussed in Section VIII.B.2, a person of ordinary skill in the art would have been motivated and found it obvious and straightforward to apply Swift’s implementation teachings of a CMOS camera in implementing Harris’s camera. Furthermore, a person of ordinary skill in the art would have understood that, when applying Swift’s CMOS camera teachings in implementing Harris, Harris’s transceiver 122 communicates with Swift’s circuit board 53.

w. Element [66.d]

395. **Element [66.d] recites “a camera module housing said image sensor, said first circuit board, and said transceiver radio element therein.”**

Harris in view of Swift renders obvious element [66.d]. As discussed in connection with Ground 1 for this limitation, Harris discloses a camera module housing said camera and said transceiver radio element therein (*e.g.*, a “second housing 110” and a “third housing 189” collectively housing “CCD camera 188” and RF “data transceiver 122”). As explained in connection with [42.e], Swift discloses a camera (*e.g.*, “miniature camera 50”) with said image sensor (*e.g.*, “image sensor 51”) and said first circuit board (*e.g.*, “circuit board 53”) therein.

396. My discussion of Harris’s disclosure of a camera module housing said camera and said transceiver radio element therein is in Section VIII.A.4.ff. As discussed in [42.e], Swift discloses a camera housing said image sensor and said first circuit board. *See* Section VIII.C.3.f.

397. As discussed in Section VIII.B.2, a person of ordinary skill in the art would have been motivated and found it obvious and straightforward to apply Swift’s implementation teachings of a CMOS camera in implementing Harris’s camera.

x. Element [66.e]

398. **Element [66.e] recites “a radio transceiver module housed within the PDA for wirelessly communicating with said radio transceiver element and**

receiving said converted pre-video signal.” Harris discloses element [66.e]. As discussed in connection with Ground 1 for this limitation, Harris discloses a radio transceiver module (*e.g.*, “RF” “wireless data transceiver 117”) within the PDA (*e.g.*, in “first housing 108” of “communication device 104”) for wirelessly communicating with said transceiver radio element (*e.g.*, communicating with “wireless data transceiver 122” over “wireless RF link”; see Figure 1) and receiving said converted pre-video signal (*e.g.*, receiving “decompressed image data” “video”).

399. My discussion of Harris’s disclosure of this claim language is in Section VIII.A.4.gg.

y. Element [66.f]

400. **Element [66.f] recites “a transceiver/amplifier section electrically coupled to said transceiver radio module for amplifying and further transmitting the converted pre-video signal, and for receiving, and amplifying video and audio signals transmitted by another party.”** Harris discloses element [66.f]. As discussed in connection with Ground 1 for this limitation, Harris discloses a transceiver/amplifier section (*e.g.*, “RF transceiver 126” and “antenna 124”) electrically coupled to said transceiver radio module (*e.g.*, “RF transceiver 126” coupled to “wireless data transceiver 117,” as shown in Figure 1) for amplifying and further transmitting the converted pre-video signal (*e.g.*, “RF transceiver 126 ...

filter[s] and amplif[ies] electrical transmit signals...for emission by the antenna 124”), and for receiving, and amplifying video and audio signals transmitted by another party (*e.g.*, “antenna 124 receives incoming RF signals”, which “RF transceiver 126 ... filters and steps down”).

401. My discussion of Harris’s disclosure of this claim language is in Section VIII.A.4.hh.

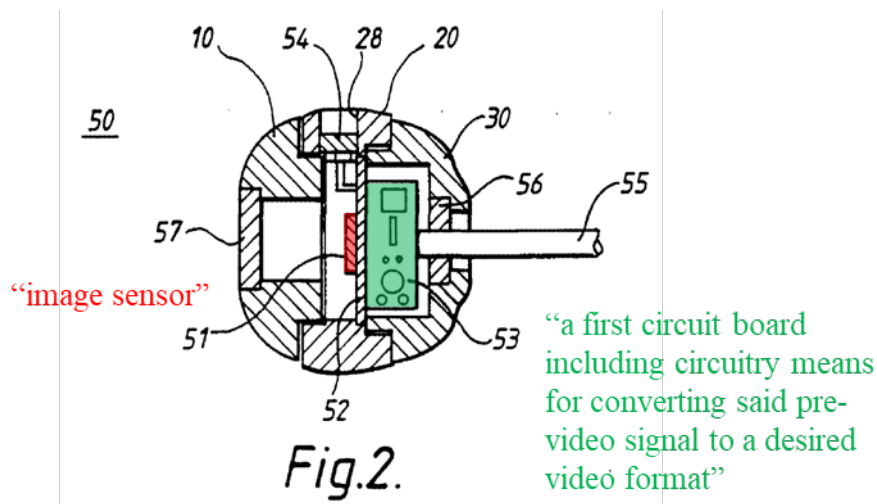
z. Element [66.g]

402. **Element [66.g] recites “a digital signal processor electrically coupled to said transceiver radio module and said transceiver/amplifier section, said digital signal processor further conditioning said pre-video signal which is first conditioned by said first circuit board, and also for conditioning video and audio signals received by said transceiver/amplifier section from the other party.”** Harris in view of Swift renders obvious element [66.g]. As discussed in connection with Ground 1 for this limitation, Harris discloses a digital signal processor (*e.g.*, “image DSP 152” “channel modem DSP 128” and “speech processing DSP 130” “implemented using one ... DSP[.]”) electrically coupled to said transceiver radio module (*e.g.*, coupled to “wireless” RF “data transceiver 117” via “bus 156”) and said transceiver/amplifier section (*e.g.*, coupled to “RF transceiver 126” by “bus 138”), said digital signal processor further conditioning said pre-video signal which is first conditioned by said camera (*e.g.*, “compress[es]

... image data” received from “camera 188”), and also for conditioning video and audio signals received by said transceiver/amplifier section from the other party (e.g., “demodulates and decodes electrical receive signals” into “image data” and “speech data”). Swift discloses said pre-video signal is first conditioned by said first circuit board (e.g., “video processor”; “circuitry components are mounted on the circuit board 53, to ... process image signals received [from image sensor 51]” into a “video signal” for a “video monitor or TV 154” to “display”).

403. My discussion of Harris’s disclosure of a digital signal processor electrically coupled to said transceiver radio module and said transceiver/amplifier section, said digital signal processor further conditioning said pre-video signal which is first conditioned by said camera, and also for conditioning video and audio signals received by said transceiver/amplifier section from the other party is in Section VIII.A.4.ii.

404. While Harris discloses the single DSP further conditioning video signals received from the camera, it does not specify what components in its camera first condition its video signal. Swift discloses its “miniature camera 50”, as shown in Figure 2, includes “circuit board 53, to...process image signals received [from image sensor 51].” Swift, 9:5-13, Figure 2. Swift further discloses that “video signals [are] provided from the camera 152.” Swift, 17:34-18:3.



405. As discussed in Section VIII.B.2, a person of ordinary skill in the art would have been motivated and found it obvious and straightforward to apply Swift’s teachings of a CMOS camera in implementing Harris’s camera.

aa. Element [66.h]

406. **Element [66.h] recites “a microphone electrically communicating with said digital signal processor for receiving sound and converting the sound to audio signals.”** Harris discloses element [66.h]. As discussed in connection with Ground 1 for this limitation, Harris discloses a microphone (*e.g.*, “microphone 151”) electrically communicating (*e.g.*, over “wire 150”) with said digital signal processor (*e.g.*, DSPs 152, 128, 130 “implemented using one ... DSP[.]”) for receiving sound (*e.g.*, “receive audible voice signals”) and converting the sound to audio signals (*e.g.*, “transduces audible voice signals into electrical speech signals”).

407. My discussion of Harris’s disclosure of this claim language is in Section VIII.A.4.jj.

bb. Element [66.i]

408. **Element [66.i] recites “a speaker electrically communicating with said digital signal processor for broadcasting audio signals.”** Harris discloses element [66.i]. As discussed in connection with Ground 1 for this limitation, Harris discloses a speaker (*e.g.*, “speaker 149”) electrically communicating (*e.g.*, “via wire 148”) with said digital signal processor (*e.g.*, DSPs 152, 128, 130 “implemented using one ... DSP[.]”) for broadcasting audio signals (*e.g.*, “transduces electrical speech signals on wire 148 into audible voice signals”).

409. My discussion of Harris’s disclosure of this claim language is in Section VIII.A.4.kk.

cc. Element [66.j]

410. **Element [66.j] recites “a video view screen attached to said PDA, said video view screen for selectively displaying images from said imaging device, and for selectively displaying video images received by said transceiver/amplifier section.”** Harris discloses element [66.j]. As discussed in connection with Ground 1 for this limitation, Harris discloses a video view screen attached to said PDA (*e.g.* on “the front surface 200” of the PDA; *see* [42.i]), said video view screen for selectively displaying images from said imaging device (*e.g.*,

selectively “route...image data” “video” from “camera 188” to “display 184”), and for selectively displaying video images received by said transceiver/amplifier section (*e.g.*, selectively route “image data” “video” received by “RF transceiver 126” and “antenna 124” to “display 184”).

411. My discussion of Harris’s disclosure of this claim language is in Section VIII.A.4.11.

dd. Element [66.k]

412. **Element [66.k] recites “a video switch communicating with said first circuit board and said digital signal processor for switching video images to be viewed on said video view screen.”** Harris in view of Swift renders obvious element [66.k]. As discussed in connection with Ground 1 for this limitation, Harris discloses a video switch (*e.g.*, “the sensors 512, 514, 604, and 606” of the “latch 112”) communicating with said camera and said digital signal processor (*e.g.*, “microprocessor 137” generates “forward control signals” to “camera 188” and DSPs 152, 128, 130 “implemented using one ... DSP[,]” in response to the “logic level ... signal” from the sensors of “latch 112”) for switching video images to be viewed on said video view screen (*e.g.*, “controller 118 transitions operation of the communication device 104” to display “video” “image data captured by the []camera 188 directly to the display 184” or to “display[] a second user 802, with which the instant user is telephonically communicating” based on the “signal from the

sensor[s]” of “latch 112”). As explained in connection with [22.g], Swift discloses external circuitry communicating with said first circuit board (*e.g.*, “circuit board 53” coupled to “external ... circuitry” via “cable 55”) of said camera (*e.g.*, “miniature camera 50”).

413. My discussion of Harris’s disclosure of a video switch communicating with said camera and said digital signal processor for switching video images to be viewed on said video view screen is in Section VIII.A.4.mm.

414. As discussed in [22.g], Swift discloses external circuitry communicating with said first circuit board in said camera. *See* Section VIII.B. 5.h.

415. As discussed in Section VIII.B.2, a person of ordinary skill in the art would have been motivated and found it obvious and straightforward to apply Swift’s teachings of a CMOS camera in implementing Harris’s camera. Moreover, a person of ordinary skill in the art would have understood that, when applying Swift’s CMOS camera teachings in implementing Harris, Harris’s latch 112 (*i.e.*, video switch) is communicating with Swift’s circuit board 53 to allow the output video signal to be selectively displayed.

ee. Element [66.l]

416. **Element [66.l] recites “a power supply mounted to said PDA for providing power thereto.”** Harris discloses element [66.l]. As discussed in connection with Ground 1 for this limitation, Harris discloses a power supply

mounted to said PDA (*e.g.*, “the communication device 104 includes power supplies” 113 and 121) for providing power thereto (*e.g.*, “supplies power to the circuitry of the housing 108” and “supplies power to the circuitry of the housing 110”).

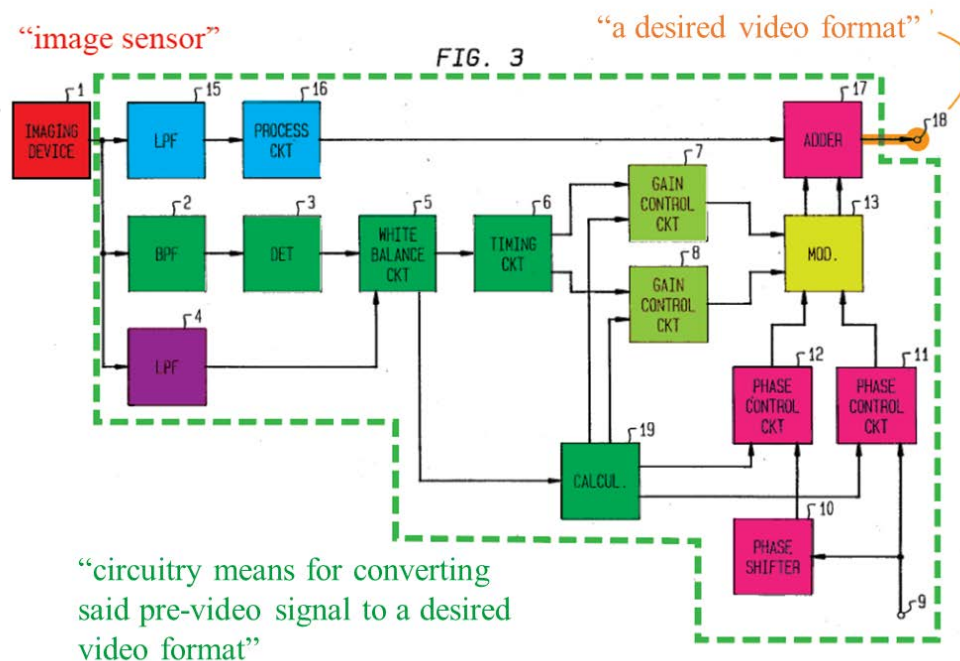
417. My discussion of Harris’s disclosure of this claim language is in Section VIII.A.4.nn.

D. Tanaka Grounds (Grounds 4, 6 and 8)

418. U.S. Patent 4,700,219 (“Tanaka”) (Ex. 1009) is a patent titled “Color Imaging Apparatus” issued on October 13, 1987, and I understand, is prior art to the ’742 patent.

419. Tanaka provides implementation details for a video processor, including a “white-balancing circuit” that converts the “output signal of an imaging device” into a “composite color video signal.” Tanaka discloses white-balancing circuitry that receives the output from an “imaging device 1,” and processes it into “composite color video signal whose color reproduction characteristics has been compensated.” *See e.g.*, Tanaka, Abstract, 1:66-2:6 (“...a luminance signal and two color difference-signals are derived from an output signal of an imaging device...”), 2:65-3:6 (“... In the NTSC color television system, the signal B-Y corresponds to the color sub-carrier having a phase of 0°, and the signal R-Y to that having a phase of 90°.”), 3:48-53 (“...the output signal from the imaging device 1 is supplied to a band-

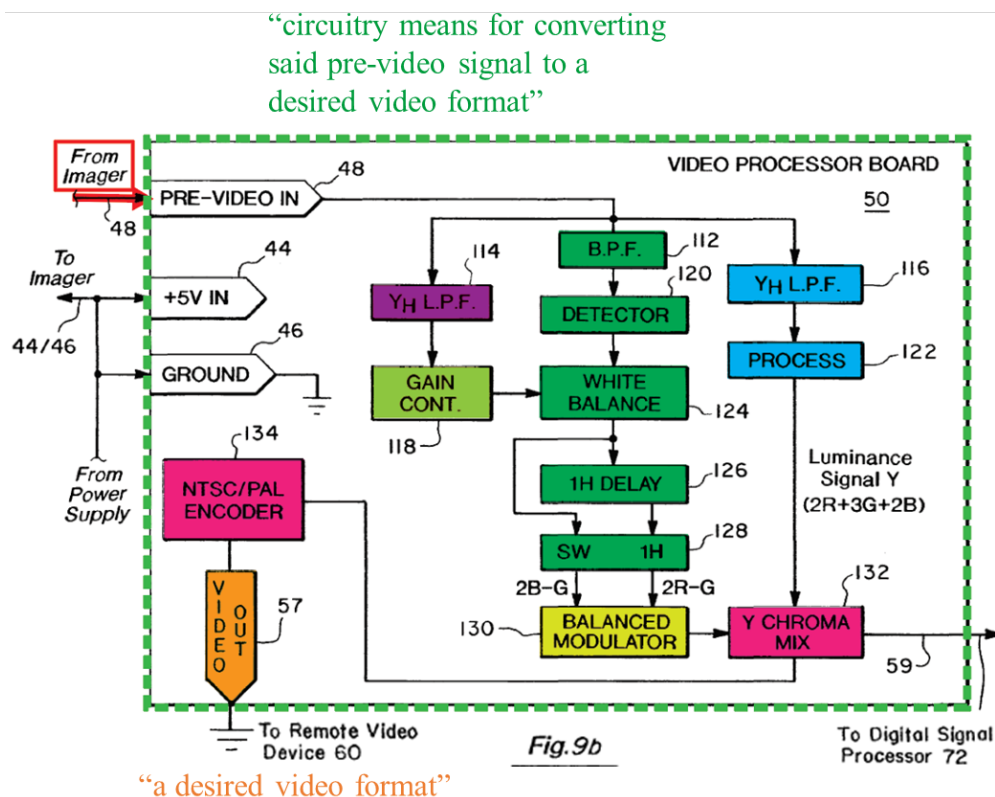
pass-filter 2...”), 4:40-53 (“...to obtain at an output terminal 18 the composite color video signal whose color reproduction characteristic has been compensated.”). In particular, as shown in Figure 3 below, Tanaka describes circuitry to convert a pre-video signal to a desired video format, including band-pass/low-pass filters, processing blocks, white balance circuitry, timing elements, modulators, and mixers/adders to convert the output received from the imager into a composite color video signal.



Tanaka, Figure 3 (annotations added).

420. To the extent the “circuitry means for converting said pre-video signal to a desired video format” (Claims 22, 58 and 66)/“circuitry means for processing

and converting said pre-video signal to a desired video format” (Claim 42)) limitations are construed under §112(6), the Tanaka Figure 3 teachings disclose and/or render obvious the same structures and processing techniques as the “processing circuitry which ... converts the pre-video signal to a desired video format” disclosed in the ’742. Compare Tanaka Figure 3 with ’742, Fig. 9b (disclosing a functionally identical arrangement of components, as shown by the color-coding of Tanaka Figure 3 above and ’742 Figure 9b below, to convert the output received from the imager into a final video signal), 8:7-12, 17:10-44.



’742 patent, Figure 9b (annotations added).

421. Specifically, Tanaka and the '742 patent both disclose a low-pass-filter followed by a process circuit (blue); a second low-pass-filter (purple); a band-pass filter, detector, white balance circuit, delay/timing circuits (dark green); gain control (light green); modulator (yellow); and mixer/adder/encoders (magenta) that convert the pre-video signal from the imager into a post-video signal which may be accepted by a television. *See e.g.*, Tanaka, 3:32-4:56, Figure 3; '742 patent, 17:8-44, Figure 9b. The '742 describes that the NTSC/PAL encoder 134 adds "composite frequencies" to produce the post-video signal. '742, 17:8-44 ("...the output from the Y chroma mixer 132 is sent to the NTSC/PAL encoder 134, commonly known in the art as a "composite" encoder. The composite frequencies are added to the signal leaving the Y chroma mixer 132 in encoder 134 to produce the post-video signal which may be accepted by a television"). Similarly, Tanaka describes the output of "Adder 17" as "the composite color video signal whose color reproduction characteristic has been compensated," for output to a NTSC color television. *E.g.*, Tanaka, 4:35-47 ("The carrier chrominance signals are supplied to an adder ..., thereby to obtain at an output terminal 18 the composite color video signal whose color reproduction characteristic has been compensated"), 1:66-2:6, 5:34-37, 2:65-3:47 ("... In the NTSC color television system, the signal B-Y corresponds to the color sub-carrier having a phase of 0°, and the signal R-Y to that having a phase of 90°."). Thus, Tanaka discloses and/or renders obvious the same function of

“converting said pre-video signal to a desired video format” using the same or equivalent structure disclosed in the ’742.

422. While Swift does not describe its “video processor” and “circuitry components” that “process image signals received [from image sensor 51]” into a “video signal” in extensive detail, Tanaka provides additional implementation details for such a video processor, including a “white-balancing circuit” that converts the “output signal of an imaging device” into a “composite color video signal.” *See e.g., Swift*, 9:5-13 (“Various circuitry components are mounted on the circuit board, to ...process image signals received...”); 15:7-8 (“[a] video monitor or TV 154 is provided, to display a signal received from the camera 152.”); Tanaka, Figure 3, 3:48-53 (“...the output signal from the imaging device 1 is supplied to a band-pass-filter 2...”), 4:40-53 (“...to obtain at an output terminal 18 the composite color video signal whose color reproduction characteristic has been compensated.”).

423. A person of ordinary skill in the art would have been motivated to apply Tanaka’s known teachings of the video processing circuitry, in implementing the imaging device disclosed by Swift in order to improve the quality of the images, including production of higher-quality video with truer colors. *See, e.g., Tanaka*, 3:25-31, 4:28-34, 4:40-47. Both Swift and Tanaka are in the same field of art and are analogous to the ’742—all are in the same field related to imaging apparatuses. *See, e.g., ’742 patent*, Abstract (“A reduced area-imaging device is provided...”),

1:21-25 (“This invention relates to solid state image sensors and associated electronics...”), 18:56-58 (“Microprocessor 146 may also control other functions of the imaging device such as white balance.”); 5:39-42; Swift, Abstract (“miniature camera”), 4:11-15 (“image sensor is preferably a CMOS sensor”); Tanaka, Abstract (“A color imaging apparatus which produces a luminance signal and a plurality of chrominance signals in order to generate a composite color video signal...”), 1:61-65 (“It is, therefore, an object of this invention to provide a color imaging apparatus capable of compensating a deterioration of a color reproduction characteristic”), 3:48-53 (“...the output signal from the imaging device 1 is supplied to a band-pass-filter 2...”), 4:40-53 (“...to obtain at an output terminal 18 the composite color video signal whose color reproduction characteristic has been compensated.”). In addition, Swift and Tanaka are also reasonably pertinent to the alleged problem(s) identified in the ’742 of arranging the circuitry of a CMOS image sensor. See, e.g., ’742 patent, 4:12-17 (“It is another object of this invention to provide a reduced area imaging device incorporated within a PDA which takes advantage of ‘camera on a chip’ technology, but to rearrange the video processing circuitry in a selective stacked relationship so that the camera module has a minimum profile.”); Swift, 1:7-18 (“Preferred embodiments of the present invention aim to provide miniature cameras which can be so constructed as to be particularly small and compact...”); Tanaka, 2:25-48 (“...However, in the single-chip imaging device in which the color

difference signals are derived directly from the imaging device, in order to separately gain-control three primary color signals... is complicated and not practical”). Tanaka expressly discloses that through its use of a luminance signal and two color difference signals derived from the output of the imaging device, a higher quality video with more accurate colors is obtained.

424. A person of ordinary skill in the art would have been further motivated to apply Tanaka’s known teachings in implementing the imaging device disclosed by Swift because Tanaka expressly discloses that through its use of a luminance signal and two color difference signals derived from the output of the imaging device, this technique advantageously compensates for the variations of the color temperature of the light. *See e.g.*, Tanaka, 1:66-2:6 (“...a luminance signal and two color difference-signals are derived from an output signal of an imaging device...”), 3:25-31 (“... the phase variation of the two color difference signals is compensated by phase-controlling the color sub-carriers in response to the color temperature of the light.”), 4:28-34 (“...color sub-carriers are controlled in response to the color temperature of the light so as to compensate for the deterioration of the [] color reproduction characteristic...”), 4:40-47 (“The carrier chrominance signals are supplied to an adder ..., thereby to obtain at an output terminal 18 the composite color video signal whose color reproduction characteristic has been compensated.”).

425. To the extent it is argued that Tanaka's teachings are limited to CCD image sensors, a person of ordinary skill in the art would have understood that systems and methods for processing the output of a CCD camera would be equally applicable to the output of other types of solid-state imaging devices, including CMOS imagers, or could be adapted for use with other types of solid-state imaging devices with minimal effort. This is confirmed in the prior art, which describes CCD and CMOS imaging technology as interchangeable components within the overall system.

426. For example, Martin (Ex. 1010) was filed on January 17, 1995, and I understand, is prior art to the '742 patent. Martin discloses methods for capturing and filtering a captured image using a "directly addressable CMOS APS, CID or a CCD camera array 22." Martin, 6:10-25; *see also* 6:42-52, 8:25-37, Fig. 1, Fig. 2. Regardless of the particular imager technology used, a "video dewarping engine" is disclosed that "accepts video data input by whatever means and corrects any predetermined distortion introduced by the imaging system." Martin, 12:11-38, Fig. 9. Afterwards, additional processing is done, and the signal can be converted into a standard video format such as "NTSC, PAL, SECAM, etc." Martin, 13:10-15. In other words, no matter how the video signals initially generated (e.g., using CMOS, CID, or CCD imagers), a person of ordinary skill would have understood that the same general techniques can be used to process the signals and convert them

into a standard video format. Accordingly, Martin describes itself as providing a method “for directly addressing an image captured using a CCD camera array, a CMOS APS sensor or CID array and outputting a signal for displaying a selected portion of that image in real time.” Martin, 13:15-31.

427. As another example, Olmstead (Ex. 1011) was filed on December 21, 1995, and I understand, is prior art to the '742 patent. Olmstead generally describes a bar-code reader that captures an image and extracts information from it. *See* Olmstead, Abstract. Although Olmstead generally describes the use of a CCD imager in order to capture the image, Olmstead also explicitly states that the apparatus may be constructed “with CMOS active pixel sensor arrays in place of CCD arrays without fundamentally changing the inventive concept ... namely, methods and apparatus for reading a bar code under ambient illumination.” Olmstead, 49:38-50. Once again, person of ordinary skill would have understood that the same general techniques for processing and extracting information from the video data can be applied, regardless of the specific type of image sensor used.

428. As yet another example, Rapa (Ex. 1012) was filed June 12, 1997, and I understand, is prior art to the '742 patent. Rapa generally describes a dental imaging apparatus that can be used to capture images with an image sensor located at the end of a handpiece, and convert the images into a standard video signal. *See* Rapa, Abstract, 2:15-18, 5:26-33, Fig. 1, Fig. 7. Similar to the other example

discussed above, Rapa is agnostic to the precise type of image sensor used, saying that “[t]he image sensor 23 is preferably either a CCD (charge coupled device) or an APS (active pixel sensor array).” Rapa, 3:24-26. Once again, a person of ordinary skill would have understood that similar techniques could be applied to retrieve and output video data from the array, regardless of the specific type of image sensor used.

429. In light of the above, a person of ordinary skill in the art would have found it routine, straightforward and advantageous to apply the teachings of the white-balancing circuitry disclosed in Tanaka in implementing the camera disclosed by Swift (as modified by the teachings of Ackland and Ricquier and applied to Harris’s communication device, discussed in Sections VIII.B.4 and VIII.B.2), and would have known that such a combination (yielding the claimed limitations) would predictably work and provide the expected functionality.

E. Tran Grounds (Grounds 7 and 8)

430. Tran (Ex. 1051), is a patent titled “Data Management System” was filed on October 29, 1996, I understand, is prior art to the ’742 patent.

431. Tran, through its incorporation by reference of co-pending U.S. Application No. 08/461,646 (“’646”) (Ex. 1057), discloses an amplifier section (*e.g.*, “RF amplifier 140” of “RF receiver portion 132”) for amplifying video and audio signals transmitted by another party (*e.g.*, “amplifier 140” “increases the low-level DPQSK RF signal [voice and video data] to a workable range”).

432. Tran discloses a “wireless transceiver 31” using “a cellular telephone, whose block diagram and operation are discussed in detail in a co-pending U.S. application Ser. No. 08/461,646, hereby incorporated-by-reference.” Tran, 7:59-63. A person of skill in the art would have understood from this statement that Tran is specifically referring to the U.S. patent application number 08/461,646, and that the portions of the ’646 application that describe a cellular telephone, including description in the ’646 application of the cellular telephone’s structure and operation, are specifically incorporated by reference into Tran.

433. The material in the ’646 application that is incorporated by reference discloses a “RF amplifier 140” portion of “radio frequency (RF) transmitter/receiver 112” that “increases” received signals. Ex. 1057 (“’646”), 10:34-11:10, Figs. 10-12. A person of ordinary skill in the art would have understood that when an “RF amplifier” “increases” a signal, it is amplifying that signal. The output of “receiver portion 132,” which is “coupled to the antenna 76” is “fed to a receiver RF amplifier 140, which increases the low-level DPQSK RF signal to a workable range before feeding it to the mixer section.” ’646, 11:11-18; *see also*, 10:24-11:18. The ’646 further discloses that “RF amplifier 140 is a broadband RF amplifier, which preferably has a variable gain control....” ’646, 11:14-16. Here, a “gain” is the amount of amplification applied to the signal.

434. A person of ordinary skill in the art would have been motivated to apply Tran's explicit teachings (including those incorporated in from the '646 application) of an RF amplifier for increasing received voice and video data signals in implementing Harris's communication device. Like Harris, Tran is also in the same field of art and is analogous art to the '742—both are in the same field related to compact solid-state image sensors for use in space-constrained devices. For example, Tran discloses a “portable computer” shaped like a phone that includes a camera. *E.g.*, Tran, Abstract (“A portable computer system manages data conveniently for a user. The system has a processor, a program storage device coupled to the processor ... and a computer readable code embodied in the program storage device for storing and processing the data.”), 1:4-6 (“The present invention relates to a data management system, and more particularly, to a data management system for a mobile computer.”), 4:67-5:1 (“The computer system is preferably housed in a small, rectangular portable enclosure.”), 6:26-48 (“Via the PCMCIA bus 26, the computer system can acquire visual information via a charged coupled device (CCD) or a CIS unit 27.... The CCD/CIS unit 27 thus can be either a digital camera or a page scanner, as shown in more detail in FIG. 2. Images scanned via the CCD/CIS unit 27 can be compressed and transmitted via a suitable network such as the Internet, via cellular telephone channels or via facsimile to a remote site”). Additionally, like Harris, Tran is also reasonably pertinent to the alleged problem(s) identified in the '742 of

arranging the circuitry of a camera (such as an image sensor and supporting circuitry), including to minimize the size or profile area of the device. Because each of the references relates to a small, handheld device with a camera, there is a need in each to provide a compact camera that will fit into these devices. *E.g.*, Tran, 4:67-5:1 (“The computer system is preferably housed in a small, rectangular portable enclosure.”).

435. A person of ordinary skill in the art would have been motivated to apply Tran’s wireless transceiver with the incorporated ’646 teachings of an RF amplifier for amplifying received signals in implementing Harris’s “RF transceiver 126” to advantageously reduce noise. By reducing noise, this will increase the likelihood that the DSP 128 correctly “demodulates and decodes electrical receive signals on bus 138....” Harris, 3:59-65. A person of ordinary skill in the art would have had a reasonable expectation of success because both Harris and Tran disclose RF transceivers for communicating video and voice data over a cellular network. Harris, 3:1-8; Tran, 40-63.

436. In light of the above, a person of ordinary skill in the art would have found it routine, straightforward and advantageous to apply Tran’s teachings of an RF amplifier in a wireless transceiver in implementing Harris’s RF transceiver and would have known that such a combination (yielding the claimed limitations) would predictably work and provide the expected functionality.

IX. SECONDARY CONSIDERATIONS

437. The Challenged Claims of the '742 are obvious based on the references presented herein.

438. Patent Owner submitted a declaration from the inventor in related prosecution (prosecution of the '839 patent—related to the '742 patent through multiple continuation and continuation-in-part applications) ('839 Patent File History (Ex. 1003), 83-95) that argued an unexpected result of decreased interference. Specifically, when image processing circuitry is removed from the same board or plane as the pixel array, decreased interference was argued as an unexpected result. In particular, inventor Jeffrey Adair asserted that:

CCD devices cannot be used near an electrical surgical generator without requiring significant shielding for the CCD device. Such shielding requires intense grounding techniques for the CCD camera cables/conductors which trail the CCD imager, and also grounding for the actual CCD pixel array. These shielding techniques not only add significantly to the size of the CCD device, but also to the overall cost of the CCD camera system. Even when such shielding is incorporated, RFI levels are only brought to a reasonable level which may still result in an obstructed view of the surgical area.

'839 Patent File History, 85.

439. The Patent Owner further asserted that, “Even with standard CMOS devices which have processing circuitry on chip with the CMOS pixel array, at least some shielding is required to prevent RFI in order to optimize the image.” '839

Patent File History, 86. It does not appear that the examiner relied upon this argument in finding patentability, nonetheless, I have been asked to address this Patent Owner argument.

440. My understanding of these noise benefits is that they were not unexpected, but were instead predictable. For example, as the declaration notes, they were using endoscopic cameras around an “electrosurgical generator” that was used to “cut or cauterize” tissue. ’839 File History, 85. It would have been understood by a person of ordinary skill in the art that such an electrosurgical generator would create a large amount of electromagnetic (“EM”) radiation. 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. Moreover, while the declaration does not specify what the structure of the processing circuitry was that was removed from the plane with the image sensor, it would have been understood that removing processing circuitry from the image sensor would further reduce interference for various reason, depending on the circuitry removed. As but one example, it was well understood that interference would be caused by placing analog and digital circuitry too close to each other, and that a way to reduce interference was to place analog and digital circuitry on separate circuit boards. *See* Phillips (Ex. 1085) (“The PCRM 100 handles internal EMI between analog and digital circuitry using separate circuit boards, shielding and isolation.”). Thus, it was known that EMI/RFI could be further reduced by removing the processing circuitry from the image sensor.

441. Importantly, because, as explained above, Swift and Adair disclose placing the processing circuitry on a separate circuit board placed closely adjacent the CMOS pixel array (*see* Sections VIII.A and VIII.B-C) and Monroe discloses removing the processing circuitry from the image sensor and placing it in a remote control box (*see, e.g.,* Monroe, 3:57-62, 8:8-11, Fig. 3), 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.

442. In addition, the benefits of using CMOS image sensors instead of CCD image sensors, including reduced cost, low noise, small size, easier manufacturing process and a higher tolerance of lower quality material, were not unexpected, and were explicitly noted by those in the field at the time, as well as their applicability to medical devices. *See, e.g.*, '052 patent, 1:60-2:19; NASA (Ex. 1060) (describing benefits of active pixel image sensor over CCD sensors, including lower power consumption, smaller size, no need for a custom manufacturing process, and can tolerate lower material quality); Monroe (Ex. 1007), 1:7-17, 7:59-65 (describing a medical otoscope (similar to an endoscope) with a CMOS image sensor with separate video processing circuitry).

443. Patent Owner did not present any other evidence of secondary considerations during prosecution and the clear teachings. In light of the above, to the extent this aspect of the prosecution history can be considered “secondary considerations,” such would not change my opinions expressed herein.

X. PUBLIC ACCESSIBILITY OF RICQUIER (EXS. 1033, 1038)

444. I have been informed that a reference is publicly accessible if it has been disseminated or otherwise made available to the extent that persons interested

and ordinarily skilled in the subject matter or art exercising reasonable diligence, can locate it.

445. I have been informed that Ricquier is a conference paper that was presented at the Charge-Coupled Devices and Solid State Optical Sensors IV 1994 conference, which was a part of the Electronic Imaging 1994 symposium, and published in volume 2172 of the Proceedings of SPIE. In the 1990s, SPIE's journals, conferences, and conference proceedings were among the most prominent sources of information on optics, photonics, optoelectronics, lasers, and electronic imaging, and this remains true today. The Proceedings of SPIE contained papers presented at SPIE conferences, and these papers were known to be especially useful because they represented recent advances in their respective fields. The Proceedings of SPIE was a known source of research in the area of digital imaging in the 1990s. Since 1982, I have personally attended over thirty SPIE Conferences and have published more than sixty papers in the Proceedings of SPIE. By 1997, I had read hundreds of papers published in the Proceedings of SPIE.

446. Persons of ordinary skill would have known that in the late 1990s the full set of the Proceedings of SPIE was available in libraries or available for purchase from SPIE, whether as a single volume or as part of a subscription service for all volumes and would have further known that individual articles within the

Proceedings were available for purchase from SPIE. In this timeframe, I regularly accessed the Proceedings of SPIE from the libraries at Caltech and UT Austin.

447. The International Symposium on Electronic Imaging: Science and Technology, 1994, and the Charge-Coupled Devices and Solid State Optical Sensors IV 1994 conference within the symposium, was a well-known, respected conference in the area of solid-state imaging. Persons of ordinary skill and other members of the public with an interest in advances in the area of digital imaging would have attended this conference.

448. Exs. 1033 and 1038 confirm that Ricquier was included on pages 2-10 of volume 2172 of the Proceedings of SPIE, which served as the record of the Charge-Coupled Devices and Solid State Optical Sensors IV 1994 conference.

449. Ex. 1038 at Pages 3 of 16, as marked by the exhibit labels, confirms that volume 2172 of the Proceedings was available at the University of Wisconsin library as of May 27, 1994.

450. Ex. 1033 at Page 1 of 18, as marked by the exhibit labels, confirms that SPIE published Volume 2172 by April 4, 1994 and began shipping Volume 2172 of the Proceedings of SPIE as of April 5, 1994. According to the declaration, I am informed that SPIE shipped 100-120 print copies of Volume 2172 to library customers by May 1, 1994, which is consistent with the availability date at the University of Wisconsin library as of May 27, 1994.

451. Based on its inclusion in the Proceedings of SPIE, Ricquier was disseminated by SPIE and made readily available to persons of ordinary skill in the art at libraries, including the University of Wisconsin library, and through distribution by SPIE, at least one year prior to the earliest October 6, 1997 priority date.

XI. CONCLUSION

452. In summary, I have concluded that each of the Challenged Claims is unpatentable as obvious under 35 U.S.C. § 103 in light of the prior art references as discussed above and the knowledge of one of ordinary skill in the art, as described above.

453. Specifically, in my opinion, for at least the reasons above, the Challenged Claims are rendered obvious as shown in the chart below:

Ground	Obviousness Basis	Claims
1	Harris in view of Adair	22, 42, 58, 66
2	Harris in view of Adair and Tran	66
3	Harris in view of Swift and Ackland	22
4	Harris in view of Swift, Ackland and Tanaka	
5	Harris in view of Swift and Ricquier	42, 58, 66
6	Harris in view of Swift, Ricquier and Tanaka	
7	Harris in view of Swift, Ricquier and Tran	66
8	Harris in view of Swift, Ricquier, Tran and Tanaka	

454. To the extent it is argued that any further disclosure is required for a limitation in claims 22, 42, 58, and 66 that I have identified as being disclosed (explicitly or inherently) by Harris, Adair, Swift, Ackland, Ricquier, Tran and/or Tanaka, a person of ordinary skill in the art would certainly have found that limitation obvious to include based on the same explicit disclosure or inherent disclosures and analysis I have identified above.

455. I reserve the right to supplement my opinions in the future to respond to any arguments that Patent Owner or its expert(s) may raise and to take into account new information as it becomes available to me.

I hereby declare under penalty of perjury under the laws of the United States of America that the foregoing is true and correct, and that all statements made of my

own knowledge are true and that all statements made on information and belief are believed to be true.

Sworn to this 15th day of February, 2020 in Austin, Texas.

A handwritten signature in black ink, appearing to read "Dean Neikirk", written over a horizontal line.

Dean P. Neikirk, Ph.D.

APPENDIX A (CURRICULUM VITAE)

Dean P. Neikirk

Professor, Cullen Trust for Higher Education Professorship in Engineering (No. 7)
Department of Electrical and Computer Engineering
Cockrell School of Engineering
The University of Texas at Austin
The Graduate School
110 Inner Campus Dr Stop G0400
Austin, TX 78712

Education:

Oklahoma State University (Physics and Mathematics; with Honors)	B.S.	1979
California Institute of Technology (Applied Physics)	M.S.	1981
California Institute of Technology (Applied Physics)	Ph.D.	1984

Professional Experience:

Assistant Professor, University of Texas at Austin, Jan. 1984 - Aug. 1988
Associate Professor, University of Texas at Austin, Sept. 1988- Aug. 1992
Full Professor, University of Texas at Austin, Sept. 1992-present
Associate Dean of Graduate Studies, August 2014 - present

Honors and Awards:

- 1984 Marconi International Fellowship Young Scientist Award "for contributions to the development of millimeter wave integrated circuits especially in the areas of detectors and imaging arrays."
- Listed in the Second Edition of Who's Who in Frontiers of Science and Technology, 5th Edition of Who's Who in Technology Today, 1994 American Men & Women of Science; 1985 Outstanding Young Man of America, 1989 Outstanding Young Man of America; 7th Edition of Who's Who in Technology.
- 1984-85 Engineering Foundation Faculty Award, University of Texas at Austin Engineering Foundation Advisory Council.
- 1985-90 General Motors Foundation Centennial Teaching Fellowship, University of Texas at Austin.
- 1985-86 IBM Corporation Faculty Development Award
- 1986 National Science Foundation Presidential Young Investigator.

- 1987 Award for Outstanding Engineering Teaching by an Assistant Professor, College of Engineering, University of Texas at Austin.
- 1990-1992 Temple Foundation Endowed Faculty Fellowship (No. 1), University of Texas at Austin.
- 1992-present Cullen Trust for Higher Education Professorship in Engineering (No. 7), University of Texas.
- 1997 College of Engineering Award for Outstanding Teaching in the Department of Electrical and Computer Engineering, University of Texas at Austin.
- 2003 Department of Electrical and Computer Engineering Gordon T. Lepley IV Endowed Memorial Teaching Award, University of Texas at Austin.
- 2007 Lockheed Martin Aeronautics Company Award for Excellence in Engineering Teaching
 - each year since 1956, Lockheed Martin and its predecessor, has sponsored an award for excellence in engineering teaching to reward one College of Engineering faculty member for exceptional teaching. This prestigious award is given to a faculty member dedicating time and energy in abundance to teaching undergraduate and graduate students. As a result, his or her work leaves a mark of excellence on the entire College of Engineering. Nominations for this award are made by The University of Texas at Austin engineering students and faculty. Final selection is made by a committee composed the five most recent faculty recipients of the award and the student presidents of the Student Engineering Council (SEC) and the Graduate Engineering Council (GEC).
- 2015 Civitatis Award: The University of Texas at Austin Civitatis Award was established in 1997 to recognize outstanding faculty citizenship. The Civitatis Award is conferred upon a member of the faculty in recognition of dedicated and meritorious service to the University above and beyond the regular expectations of teaching, research, and writing. The award is made by the President upon the recommendation of the Faculty Council Executive Committee. Prof. Neikirk was nominated for the award for his “extensive, effective and distinguished service record to his department, college and [the] University of Texas.”

Vita for Dean P. Neikirk:

Dean P. Neikirk was born in Oklahoma City, Oklahoma, on October 31, 1957. He received the B.S. degree (1979) in physics from Oklahoma State University, and the M.S. (1981) and Ph.D. (1984) degrees in applied physics from the California Institute of Technology. He joined the faculty of The University of Texas at Austin in 1984, and is currently a Professor in the Department of Electrical and Computer Engineering, holding the Cullen Trust for Higher Education Professorship in Engineering (No. 7). Dr. Neikirk developed the first monolithic, high resolution focal plane detector array for use at wavelengths between 0.1 mm and 1 mm, and in 1984 received the Marconi International Fellowship Young Scientist Award "for contributions to the development of millimeter

wave integrated circuits especially in the area of detectors and imaging arrays." He has also been named a 1986 National Science Foundation Presidential Young Investigator.

Dr. Neikirk's current research interests concentrate on the fabrication and modeling of electromagnetic and micromachined sensors and actuators. His work also includes projects involving integrated circuit processing and the high frequency properties of transmission lines. His work concentrates on the use of advanced fabrication techniques, including silicon micromachining, for new device and sensor development. Dr. Neikirk developed the teaching laboratory for semiconductor device fabrication at The University of Texas at Austin, and is an active member of The University of Texas at Austin Microelectronics Research Center. Recently Dr. Neikirk's research project related to the development of new chemical sensors (an "electronic taste" sensor) was selected for a commercialization venture between the University of Texas and LabNow, Inc. Dr. Neikirk has also served as the Graduate Advisor of the Department of Electrical and Computer Engineering at UT-Austin, an Associate Chairman of the ECE Department, the Chair of the UT-Austin Graduate Assembly, the Chair of the UT-Austin Faculty Council, the Secretary of the General Faculty at UT-Austin, and is currently Associate Dean of the University of Texas at Austin Graduate School.

Professional Societies:

Senior Member, Institute of Electrical and Electronics Engineers

- Associate Editor for Solid State and VLSI Electronics, **IEEE Transactions on Education** (March 1991- Oct. 1994)

Commercialization of Technology:

Two companies have been founded based on technology developed by Dr. Neikirk's research group. In both cases the technology was developed at The University of Texas at Austin and licensed to start-ups.

From a University of Texas news release:

Firm commercializing University of Texas technology rounds up \$14 million venture capital investment (October 1, 2004)

AUSTIN, Texas—LabNow Inc. has received \$14 million in first-round venture investment for its point-of-care diagnostic system from the Soros Group, Austin Ventures and other investors.

The money will be used to develop the company's technology and to launch its initial product, CD4Now™, a point-of-care diagnostic tool for HIV/AIDS patients.

The device, which is based on technology developed at The University of Texas at Austin, quickly and accurately analyzes complex fluids such as blood.

Patents

1. US Patent 5,080,870: "Sublimating and Cracking Apparatus," Jan. 14, 1992; Inventors: B. G. Streetman, T. J. Mattord, D. P. Neikirk
2. US Patent 5,408,107: "Semiconductor Device Having Multiple Current-Voltage Curves and Zero-Bias Memory," April 18, 1995; Inventors: Dean P. Neikirk and Kiran Kumar Gullapalli
3. US Patent 6,589,779: "General signaling protocol for chemical receptors in immobilized matrices," July 8, 2003; Inventors: McDevitt; John T.; Anslyn; Eric V.; Shear; Jason B.; Neikirk; Dean P. Assignee: Board of Regents, The University of Texas System (Austin, TX)
4. US Patent 6,602,702: "Detection system based on an analyte reactive particle," August 5, 2003; Inventors: McDevitt; John T. (Austin, TX); Anslyn; Eric V. (Austin, TX); Shear; Jason B. (Austin, TX); Neikirk; Dean P. (Austin, TX)

Assignee: The University of Texas System (Austin, TX)

5. US Patent 6,649,403: "Method of preparing a sensor array," November 18, 2003
Inventors: McDevitt; John T. (Travis, TX); Anslyn; Eric V. (Austin, TX); Shear; Jason B. (Austin, TX); Neikirk; Dean P. (Travis, TX)
Assignee: Board of Regents, The University of Texas Systems (Austin, TX)
6. US Patent 6,680,206, "Sensor arrays for the measurement and identification of multiple analytes in solutions," January 20, 2004
Inventors: McDevitt; John T. (Travis, TX); Anslyn; Eric V. (Austin, TX); Shear; Jason B. (Austin, TX); Neikirk; Dean P. (Travis, TX)
Assignee: Board of Regents, The University of Texas Systems (Austin, TX)
7. US Patent 6,713,298, "Method and apparatus for the delivery of samples to a chemical sensor array," March 30, 2004
Inventors: McDevitt; John T. (Travis, TX); Anslyn; Eric V. (Travis, TX); Shear; Jason B. (Travis, TX); Neikirk; Dean P. (Travis, TX)
Assignee: Board of Regents, The University of Texas System (Austin, TX)
8. US Patent 6,908,770, "Fluid based analysis of multiple analytes by a sensor array," June 21, 2005
Inventors: McDevitt; John T. (Austin, TX); Anslyn; Eric V. (Austin, TX); Shear; Jason B. (Austin, TX); Neikirk; Dean P. (Austin, TX)
Assignee: Board of Regents, The University of Texas System (Austin, TX)
9. US Patent 7,022,517, "Method and apparatus for the delivery of samples to a chemical sensor array," April 4, 2006, filed: July 14, 2000
Inventors: McDevitt; John T. (Austin, TX); Anslyn; Eric V. (Austin, TX); Shear; Jason B. (Austin, TX); Neikirk; Dean P. (Austin, TX); Borich; Damon V. (Austin, TX)
Assignee: Board of Regents, The University of Texas System (Austin, TX)
10. US Patent 7,316,899, "Portable sensor array system," January 8, 2008, filed: January 31, 2001
Inventors: McDevitt; John T. (Austin, TX); Anslyn; Eric V. (Austin, TX); Shear; Jason B. (Austin, TX); Neikirk; Dean P. (Austin, TX)
Assignee: Board of Regents, The University of Texas System (Austin, TX)
11. US Patent 7,491,552, "Fluid based analysis of multiple analytes by a sensor array," February 17, 2009, filed: January 20, 2005
Inventors: McDevitt; John T. (Austin, TX); Anslyn; Eric V. (Austin, TX); Shear; Jason B. (Austin, TX); Neikirk; Dean P. (Austin, TX)
Assignee: Board of Regents, The University of Texas System (Austin, TX)
12. United States Patent 7,651,868, "Method and system for the analysis of saliva using a sensor array," January 26, 2010, Filed: December 13, 2004

Inventors: McDevitt; John T. (Austin, TX), Anslyn; Eric V. (Austin, TX), Shear; Jason B. (Austin, TX), Neikirk; Dean P. (Austin, TX), Christodoulides; Nick J. (Austin, TX)

Assignee: The Board of Regents of The University of Texas System (Austin, TX)

13. United States Patent 8,101,431, "Integration of fluids and reagents into self-contained cartridges containing sensor elements and reagent delivery systems," January 24, 2012, Filed: December 22, 2004

Inventors: McDevitt; John T. (Austin, TX), Ballard; Karri L. (Pflugerville, TX), Floriano; Pierre N. (Austin, TX), Christodoulides; Nick J. (Austin, TX), Neikirk; Dean (Austin, TX), Anslyn; Eric (Austin, TX), Shear; Jason (Austin, TX)

Assignee: Board of Regents, The University of Texas System (Austin, TX)

14. United States Patent 8,105,849, "Integration of fluids and reagents into self-contained cartridges containing sensor elements," January 31, 2012, Filed: December 22, 2004

Inventors: McDevitt; John T. (Austin, TX), Ballard; Karri L. (Pflugerville, TX), Floriano; Pierre N. (Austin, TX), Christodoulides; Nick J. (Austin, TX), Neikirk; Dean (Austin, TX), Anslyn; Eric (Austin, TX), Shear; Jason (Austin, TX)

Assignee: Board of Regents, The University of Texas System (Austin, TX)

15. United States Patent 8,257,967, "Method and system for the detection of cardiac risk factors," September 4, 2012, Filed: April 28, 2003

Inventors: McDevitt; John T. (Austin, TX), Anslyn; Eric V. (Austin, TX), Shear; Jason B. (Austin, TX), Neikirk; Dean P. (Austin, TX), Christodoulides; Nick J. (Austin, TX)

Assignee: Board of Regents, The University of Texas System (Austin, TX)

16. United States Patent 9,291,586, "Passive wireless self-resonant sensor," March 22, 2016, Filing Date: May 5, 2013

Inventors: Neikirk, Dean P. (Austin, TX, US), Pasupathy, Praveenkumar (Austin, TX, US), Zhang, Sheng (Austin, TX, US), Leonhardt, Brad (Austin, TX, US), Ekerdt, John G. (Austin, TX, US), Korgel, Brian A. (Austin, TX, US), Holmberg, Vincent C. (Seattle, WA, US), Shipman, Catherine D. (Reston, TX, US), Bogart, Timothy D. (Oxford, GB), Chockla, Aaron (Chicago, IL, US)

Assignee: Board of Regents, The University of Texas System (Austin, TX, US)

17. United States Patent 9,581,559, "Corrosion detection sensor embedded within a concrete structure with a diffusion layer placed over the sacrificial transducer," February 28, 2017, Filing Date: August 14, 2014

Inventors: Neikirk; Dean P. (Austin, TX), Wood; Sharon L. (Austin, TX), Pasupathy; Praveenkumar (Austin, TX), Yosef; Ali Abu (Austin, TX)

Assignee: Board of Regents, The University of Texas System (Austin, TX)

Publications:

A: Refereed archival journal publications

1. D. P. Neikirk and R. C. Powell, "Laser Time-Resolved Spectroscopy of Host-Sensitized Energy Transfer in $\text{Bi}_4\text{Ge}_3\text{O}_{12}:\text{Er}^{3+}$ Crystals," **J. Lumin.**, vol. 20, 1979, pp. 261-270.
2. R. C. Powell, D. P. Neikirk, J. M. Flaherty, and J. G. Gualtieri, "Lifetime Measurements, Infrared and Photoacoustic Spectroscopy of $\text{NdP}_5\text{O}_{14}$," **J. Phys. Chem. Solids**, vol. 41, 1980, pp. 345-350.
3. R. C. Powell, D. P. Neikirk, and D. Sadar, "Radiationless Decay Processes of Nd^{3+} Ions in Solids," **J. Opt. Soc. Am.**, vol. 70 (5), May 1980, pp. 486-490.
4. D. P. Neikirk, D. B. Rutledge, M. S. Muha, H. Park, and C. X. Yu, "Far-Infrared Imaging Antenna Arrays," **Appl. Phys. Lett.**, vol. 40 (3), 1 February 1982, pp. 203-205.
5. D. P. Neikirk, D. B. Rutledge, M.S. Muha, H. Park, and C. X. Yu, "Progress in Millimeter-Wave Integrated-Circuit Imaging Antenna Arrays," **Proc. Soc. Photo-Opt. Instr. Eng.**, vol. 317, 1981, pp. 206-211.
6. D. P. Neikirk, D. B. Rutledge, P.P. Tong, H. Park, and P. E. Young, "Imaging Antenna Array at $119\mu\text{m}$," **Appl. Phys. Lett.**, vol. (41), 15 August 1982, pp. 329-331.
7. D. P. Neikirk and D. B. Rutledge, "Self-Heated Thermocouples for Far-Infrared Detection," **Appl. Phys. Lett.**, vol. 41, (5), 1 September 1982, pp. 400-402.
8. P.P. Tong, D. P. Neikirk, D. Psaltis, D. B. Rutledge, K. Wagner, and P. E. Young, "Tracking Antenna Arrays for Near- Millimeter Waves," **IEEE Trans. Antennas Propagat.**, vol. AP- 31, May, 1983, pp. 512-515.
9. D. P. Neikirk and D. B. Rutledge, "Air-Bridge Microbolometer for Far-Infrared Detection," **Appl. Phys. Lett.** **44**, 15 Jan. 1984, pp. 153-155.
10. P.P. Tong, D. P. Neikirk, D. B. Rutledge, P. E. Young, W. A. Peebles, N. C. Luhmann, Jr., "Imaging Polarimeter Arrays for Near-Millimeter Waves," **IEEE Trans. Microwave Theory Tech. MTT-32**, March 1984, pp. 507-512.
11. D. P. Neikirk, D. B. Rutledge, and W. Lam, "Far-Infrared Microbolometer Detectors," **Int. J. Infrared and Millimeter Waves** **5**, March 1984, pp. 245-277.
12. D. P. Neikirk and D. B. Rutledge, "Far-Infrared Imbedding Impedance Measurements,"

Int. J. Infrared and Millimeter Waves **5**, July 1984, pp. 1017-1026.

13. P. E. Young, D. P. Neikirk, P.P. Tong, D. B. Rutledge, and N. C. Luhmann, Jr., "Multichannel far-infrared phase imaging for fusion plasmas," **Rev. Sci. Instrum.** **56**, Jan. 1985, pp. 81-89.

14. P. E. Young, N. C. Luhmann, Jr., R. J. Taylor, D. P. Neikirk, and D. B. Rutledge, "Far-infrared imaging of tokamak plasma," **Rev. Sci. Instrum.** **56**, May 1985, pp. 903-904.

15. Y. Fukuoka, Q. Zhang, D. Neikirk, and T. Itoh, "Analysis of multilayer interconnection lines for a high speed digital integrated circuit," **IEEE Trans. Microwave Theory Tech. MTT-33**, June 1985, pp. 527-532.

16. N. Song, D. P. Neikirk, and T. Itoh, "Modeling of Ion-implanted GaAs MESFETs by the Finite Element Method," **IEEE Electron Device Lett. EDL-7**, April 1986, pp. 208-210.

17. V. P. Kesan, D. P. Neikirk, B. G. Streetman, and P. A. Blakey, "A New Transit Time Device Using Quantum Well Injection," **IEEE Electron Device Lett. EDL-8**, April 1987, pp. 129-131.

18. A. C. Cambell, V. P. Kesan, G. E. Crook, C. M. Maziar, D. P. Neikirk, and B. G. Streetman, "Impedance Switching Effects in GaAs/AlAs Barrier Structures," **Electronics Letters** **23**, Aug 27, 1987, pp. 926-927.

19. Y. D. Lin, D. P. Neikirk, and T. Itoh, "Coplanar Waveguide Phase Shifter Controlled by a Spatially Periodic Optical Illumination," **Int. J. Infrared and Millimeter Waves** **8**, Sept. 1987, pp. 1027-1036.

20. C. W. Farley, G. E. Crook, V. P. Kesan, T. R. Block, H. A. Stevens, T. J. Mattord, D. P. Neikirk, and B. G. Streetman, "Substrate Rotation and Carbon Generation in a Molecular Beam Epitaxy System," **J. Vac. Science Tech. B**, Sept./Oct. 1987, pp. 1374-1376.

21. V. P. Kesan, D. P. Neikirk, T. D. Linton, P. A. Blakey, and B. G. Streetman, "Influence of Transit Time Effects on the Optimum Design and Maximum Oscillation Frequency of Quantum Well Oscillators," **IEEE Trans. Electron Devices ED-35**, April 1988, pp. 405-413.

22. A. C. Campbell, V. P. Kesan, G. E. Crook, C. M. Maziar, D. P. Neikirk, and B. G. Streetman, "Capacitive Hysteresis Effects in 5.0 nm Single and Double Barrier AlAs Tunneling Structures Grown by MBE," **J. Vac. Science Tech. B** **6**, Mar/Apr 1988, pp. 651-656.

23. V. P. Kesan, A. Mortazawi, D. P. Neikirk, and T. Itoh, "Monolithic Millimeter-Wave Oscillator using a Transmission Line Periodically Loaded by QWITT Diodes," **Electronics Letters**, May 26, 1988, pp. 666-667.

24. T. J. Mattord, V. P. Kesan, G. E. Crook, T. R. Block, A. C. Campbell, D. P. Neikirk, and B. G. Streetman, "Baffle-free Refractory Dimer Source for Molecular Beam Epitaxy," **J. Vac Sci. Technol. B** **6**, Nov./Dec. 1988, pp. 1667-1670.
25. V. P. Kesan, A. Dodabalapur, D. P. Neikirk, and B. G. Streetman, "Growth and Rapid Thermal Annealing of AlGaAs/InGaAs Pseudomorphic Modulation-doped Structures," **Appl. Phys. Lett.** **53**, 22 Aug. 1988, pp. 681-683.
26. T. J. Mattord, V. P. Kesan, D. P. Neikirk, and B. G. Streetman, "A Single-filament Effusion Cell with Reduced Thermal Gradient for Molecular Beam Epitaxy," **J. Vac Sci. Technol. B** **7**, Mar/Apr 1989, pp. 214-216.
27. A. Dodabalapur, V. P. Kesan, T. R. Block, D. P. Neikirk, and B. G. Streetman, "Optical and Electrical Characterization of Pseudomorphic AlGaAs/InGaAs/GaAs Modulation-doped Structures Processed by Rapid Thermal Annealing," **J. Vac Sci. Technol. B** **7**, March/April 1989, pp. 380-383.
28. V. P. Kesan, A. Mortazawi, D. R. Miller, T. Itoh, B. G. Streetman, and D. P. Neikirk, "Microwave Frequency Operation of the Quantum Well Injection Transit Time (QWITT) Diode," **Electronics Letters** **24**, 24 Nov. 1988, pp. 1473-1474.
29. C. S. Kyono, V. P. Kesan, D. P. Neikirk, C. M. Maziar, and B. G. Streetman, "Dependence of Apparent Barrier Height on Barrier Thickness for Perpendicular Transport in AlAs/GaAs Single Barrier Structures Grown by MBE," **Appl. Phys. Lett.** **54**, 6 Feb. 1989, pp. 549-551.
30. R. L. Rogers and D. P. Neikirk, "Use of Broadside Twin Element Antennas to Increase Efficiency on Electrically Thick Dielectric Substrates," **Int. J. Infrared and Millimeter Waves** **9**, Nov. 1988, pp. 949-969.
31. R. L. Rogers and D. P. Neikirk, "Radiation Properties of Slot and Dipole Elements on Layered Substrates," **Int. J. Infrared and Millimeter Waves** **10**, June 1989, pp. 697-728.
32. A. Dodabalapur, V. P. Kesan, D. R. Hinson, D. P. Neikirk, and B. G. Streetman, "Photoluminescence Studies of Pseudomorphic modulation-doped AlGaAs/ InGaAs/ GaAs Quantum Wells," **Appl. Phys. Lett.** **54**, 24 April 1989, pp. 1675-1677.
33. A. C. Campbell, V. P. Kesan, T. R. Block, G. E. Crook, D. P. Neikirk, and B. G. Streetman, "Influence of MBE Growth Temperature on GaAs/AlAs Resonant Tunneling Structures," **Journal of Electronic Materials** **18**, 1989, pp. 585-588.
34. S. M. Wentworth, D. P. Neikirk, and C. R. Brahce, "The High Frequency Characteristics of Tape Automated Bonding (TAB) Interconnects," **IEEE. Trans. Components, Hybrids, and Manufacturing Tech.** **12**, Sept. 1989, pp. 340-347.

35. V. P. Kesan, A. Mortazawi, D. R. Miller, V. K. Reddy, D. P. Neikirk, and T. Itoh, "Microwave and Millimeter Wave QWITT Diode Oscillators," **IEEE Trans. Microwave Theory Tech. MTT-37**, Dec. 1989, pp. 1933-1941.
36. P. Cheung, D. P. Neikirk, and T. Itoh, "A Schottky-Biased, Optically-Controlled Coplanar Waveguide Phase Shifter," **Electronics Letters** **25**, Sept. 14, 1989, pp. 1301-1302.
37. S. M. Wentworth and D. P. Neikirk, "Far Infrared Microbolometers made with Tellurium and Bismuth," **Electronics Letters** **25**, Nov. 9, 1989, pp. 1558-1560.
38. A. Dodabalapur, V. P. Kesan, D. P. Neikirk, and B. G. Streetman, "Photoluminescence and Electoreflectance Studies of Modulation-Doped Pseudomorphic AlGaAs/ InGaAs/ GaAs Quantum Wells," **Journal of Electronic Materials** **19**, 1990, pp. 265-270.
39. P. Cheung, D. P. Neikirk, and T. Itoh, "Optically Controlled Coplanar Waveguide Phase Shifters," **IEEE Trans. Microwave Theory Tech. MTT-38**, May 1990, pp. 586-595.
40. S. M. Wentworth, R. L. Rogers, J. G. Heston, D. P. Neikirk, and T. Itoh, "Millimeter Wave Twin Slot Antennas on Layered Substrates," **Int. J. Infrared and Millimeter Waves** **11**, Feb. 1990, pp. 111-131.
41. J. G. Heston, J. M. Lewis, S. M. Wentworth, and D. P. Neikirk, "Twin slot antenna structures integrated with microbolometer detectors for 94 GHz imaging," **Microwave and Optical Technology Letters** **4**, no. 1, Jan. 5, 1991, pp. 15-19.
42. R. L. Rogers, S. M. Wentworth, D. P. Neikirk, and T. Itoh, "A twin slot antenna on a layered substrate coupled to a microstrip feed line," **Int. J. Infrared and Millimeter Waves** **11**, no. 10, October 1990, pp. 1225-1249.
43. T. Y. Chu, D. P. Neikirk, and B. G. Streetman, "Properties and Applications of $\text{Al}_x\text{Ga}_{1-x}\text{As}$ Grown at Low Temperatures," **J. Crystal Growth** **111**, 1991, pp. 26-29.
44. V. K. Reddy, A. J. Tsao, and D. P. Neikirk, "High Peak-to-Valley Current Ratio AlGaAs/AlAs/GaAs Double Barrier Resonant Tunneling Diodes," **Electronics Letters** **26**, Oct. 11, 1990, pp. 1742-1744.
45. A. J. Tsao, V. K. Reddy, and D. P. Neikirk, "Epitaxial Liftoff of AlAs/GaAs Double Barrier Resonant Tunneling Diodes," **Electronics Letters** **27**, March 14, 1991, pp. 484-486.
46. D. R. Miller and D. P. Neikirk, "Simulation of Intervalley Mixing in Double Barrier Diodes Using the Lattice Wigner Function," **Appl. Phys. Lett.** **58**, 17 June 1991, pp. 2803-2805.

47. M.S. Islam, A. J. Tsao, V. K. Reddy, and D. P. Neikirk, "GaAs on Quartz Coplanar Waveguide Phase Shifter," **IEEE Microwave and Guided Wave Letters** **1**, Nov. 1991, pp. 328-330.
48. S. M. Wentworth and D. P. Neikirk, "Composite Microbolometers with Tellurium Detector Elements," **IEEE Trans. Microwave Theory Tech. MTT-40**, no. 2, Feb. 1992, pp. 196-201.
49. T. D. Linton, Jr., P.A. Blakey, and D. P. Neikirk, "The impact of three-dimensional effects on EEPROM cell performance," **IEEE Trans. Electron Devices** **39**, April 1992, pp. 843-850.
50. V. K. Reddy and D. P. Neikirk, "Influence of Growth Interruption on I - V Characteristics of AlAs/GaAs Double Barrier Resonant Tunneling Diodes," **J. Vac. Sci. Technol. B** **10**, Mar/Apr 1992, pp. 1045-1047.
51. A. J. Tsao, V. K. Reddy, D. R. Miller, K. K. Gullapalli, and D. P. Neikirk, "The effect of barrier thickness asymmetries on the electrical characteristics of AlAs/GaAs double barrier resonant tunneling diodes," **J. Vac. Sci. Technol. B** **10**, Mar/Apr 1992, pp. 1042-1044.
52. T. R. Block, D. P. Neikirk, and B. G. Streetman, "Photoluminescence study of the effects of growth interruption on integer and fractional monolayer AlGaAs/GaAs quantum wells," **J. Vac. Sci. Technol. B** **10**, Mar/Apr 1992, pp. 832-834.
53. Emre Tuncer and Dean P. Neikirk, "Highly Accurate Quasi-Static Modeling of Microstrip Lines Over Lossy Substrates," **IEEE Microwave and Guided Wave Letters** **2**, Oct. 1992, pp. 409-411.
54. S. Javalagi, V. Reddy, K. Gullapalli, and D. Neikirk, "High efficiency microwave diode oscillators," **Electronics Letters** **28**, 27 August 1992, pp. 1699-1701.
55. K. K. Gullapalli, A. J. Tsao, and D. P. Neikirk, "Multiple self-consistent solutions at zero bias and multiple conduction curves in quantum tunneling diodes containing $N^- - N^+$ - N^- spacer layers," **Appl. Phys. Lett.** **62**, 7 June 1993, pp. 2971-2973.
56. K. K. Gullapalli, A. J. Tsao, and D. P. Neikirk, "Experimental observation of multiple current - voltage curves and zero-bias memory in quantum well diodes with $N^- - N^+$ - N^- spacer layers," **Appl. Phys. Lett.** **62**, 31 May 1993, pp. 2856-2858.
57. V. K. Reddy and D. P. Neikirk, "High breakdown voltage AlAs/InGaAs quantum barrier varactor diodes," **Electronics Letters** **29**, 4 March 1993, pp. 464-466.
58. T. R. Block, D. P. Neikirk, and B. G. Streetman, "Molecular-beam epitaxial growth condition dependence of reflection high-energy electron diffraction dampening and quantum well photoluminescence," **J. Vac. Sci. Technol. B** **11**, May/June 1993, pp. 791-

59. Y. C. Albert Shih, D. P. Neikirk, B. G. Streetman, and C. W. Magee "Effects of As flux on Si δ -doped GaAs," **J. Vac. Sci. Technol. B** **11**, May/June 1993, pp. 905-907.
60. T. J. Mattord, K. Sadra, A. Srinivasan, A. Tang, T. R. Block, Y. C. Albert Shih, D. P. Neikirk, and B. G. Streetman, "Real-time flux monitoring and feedback control of a valved arsenic source," **J. Vac. Sci. Technol. B** **11**, May/June 1993, pp. 1050-1052.
61. M. Saiful Islam, Emre Tuncer and Dean P. Neikirk, "Calculation of Conductor Loss in Coplanar Waveguide using Conformal Mapping," **Electronics Letters** **29**, 24 June 1993, pp. 1189-1191.
62. Emre Tuncer and Dean P. Neikirk, "Efficient Calculation of Surface Impedance for Rectangular Conductors," **Electronics Letters** **29**, 25 Nov. 1993, pp. 2127-2128.
63. K. Sadra, A. Srinivasan, D. P. Neikirk, and B. G. Streetman, "Speed and Efficiency in Multiple p-i-n Photodetectors," **IEEE J. Lightwave Technol.** **11**, December 1993, pp. 2052-2056.
64. K. K. Gullapalli, D. R. Miller, and D. P. Neikirk, "Simulation of quantum transport in memory-switching double-barrier quantum-well diodes," **Phys. Rev. B (Condensed Matter)** **49**, 15 January 1994, pp. 2622-2628.
65. M. Saiful Islam, Emre Tuncer and Dean P. Neikirk, "Accurate Model for Schottky-Contacted Coplanar Waveguide Including Finite Epilayer Resistance Effects," **Electronics Letters** **30**, 28 April 1994, pp. 712-713.
66. Emre Tuncer, B.-T. Lee, M. S. Islam, and D. P. Neikirk, "Quasi-Static Conductor Loss Calculations in Transmission Lines using a New Conformal Mapping Technique," **IEEE Trans. Microwave Theory Tech.** **42**, September 1994, pp. 1807-1815.
67. Youngmin Kim and D. P. Neikirk, "Micromachined Fabry-Perot Cavity Pressure Transducer," **IEEE Photonics Technology Letters** **7**, Dec. 1995, pp. 1471-1473.
68. Youngmin Kim and Dean P. Neikirk, "Design for Manufacture of Micro Fabry-Perot Cavity-based Sensors," **Sensors and Actuators A** **50**, Jan. 1996, pp. 141-146.
69. I. Busch-Vishniac, C. S. Chu, S. Flagg, V. Gupta, C. Hearn, Y. Kim, P. Koeneman, W. Maddox, D. Masser, D. Neikirk, W. Weldon, H. Wells, and K. Wood, "Smart Hydrodynamic Bearings with Embedded MEMS Devices," *Journal of Tribology*, submitted 3/96, 1996.
70. John J. Lavigne, Steve Savoy, Marvin B. Clevenger, Jason E. Richie, Bridget McDoniel, Seung-Jin Yoo, Eric V. Anslyn, John T. McDevitt, Jason B. Shear, and Dean Neikirk, "Solution-Based Analysis of Multiple Analytes by a Sensor Array: Toward the

Development of an 'Electronic Tongue'," *Journal of the American Chemical Society*, vol. 120, July, 1998, pp. 6429-6430.

71. K. L. Wood, D. Neikirk, I. Busch-Vishniac, W. Weldon, C.-S. Chu, Y. Kim, V. Gupta, W. Maddox, and D. Masser, "MEMs hydrodynamic bearings: Applications to and implications for machine failure prevention," *TriboTest*, vol. 4, pp. 275-288, 1998.

72. R. J. Friar and D. P. Neikirk, "Limitations on the Extraction of Loss Tangent from Submicron Transmission Line Test Structures," *IEEE TRANSACTIONS ON ADVANCED PACKAGING*, vol. 23, p. 393, August 2000.

73. T. Curey, A. Goodey, A. Tsao, J. Lavigne, Y. Sohn, J. McDevitt, E. Anslyn, D. Neikirk, and J. Shear, "Characterization of multicomponent monosaccharide solutions using an enzyme-based sensor array," *ANALYTICAL BIOCHEMISTRY*, vol. 293, June 15, pp. 178-184, 2001.

74. Goodey, Adrian; Lavigne, John J.; Savoy, Steve M.; Rodriguez, Marc D.; Curey, Theodore; Tsao, Andrew; Simmons, Glen; Wright, John; Yoo, Seung-Jin; Sohn, Youngsoo; Anslyn, Eric V.; Shear, Jason B.; Neikirk, Dean P.; McDevitt, John T., "Development of multianalyte sensor arrays composed of chemically derivatized polymeric microspheres localized in micromachined cavities," *JOURNAL OF THE AMERICAN CHEMICAL SOCIETY* 123 (11): pp. 2559-2570 MAR 21 2001.

75. N. Christodoulides, M. Tran, P. Floriano, N. Pierre, M. Rodriguez, A. Goodey, M. Ali, D. Neikirk, and J. McDevitt, "A novel Microchip-based Multi-Analyte Assay System for the Assessment of Cardiac Risk," *Analytical Chemistry* 74 (13), July 1, 2002, pp. 3030-3036.

76. L. Vardapetyan, L. Demkowicz, and D. Neikirk, "hp-Vector finite element method for eigenmode analysis of waveguides," *Comput. Methods Appl. Mech. Engrg.*, vol. 192, Jan. 3, 2003, pp. 185-201.

77. Ali, Mehnaaz F.; Kirby, Romy; Goodey, Adrian P.; Rodriguez, Marc D.; Ellington, Andrew D.; Neikirk, Dean P.; McDevitt, John T.; "DNA hybridization and discrimination of single-nucleotide mismatches using chip-based microbead arrays," *Analytical Chemistry*, v 75, n 18, Sep 15, 2003, p 4732-4739.

78. Sohn, Young- Soo; Goodey, Adrian; Anslyn, Eric V.; McDevitt, John T.; Shear, Jason B.; Neikirk, Dean P., "A micromachined fluidic structure for capillary-based sample introduction into a microbead array chemical sensor," *Sensor Letters*, vol. 2, No. 1, March 1, 2004, pp. 69-72.

79.. Kirby, Romy; Cho, Eun Jeong; Gehrke, Brian; Bayer, Travis; Park, Yoon Sok; Neikirk, Dean P.; McDevitt, John T.; Ellington, Andrew D.; "Aptamer-based sensor arrays for the detection and quantitation of proteins," *Analytical Chemistry*, v 76, n 14, Jul 15, 2004, p 4066-4075.

80. Sang-Wook Han, Jun-Wan Kim, Young-Soo Sohn, and Dean P. Neikirk "Design of Infrared Wavelength-Selective Microbolometers Using Planar Multimode Detectors," IEE Electronics Letters, vol. 40, No. 22, October 28, 2004, pp. 1410-1411.
81. Young-Soo Sohn, Adrian Goodey, Eric V. Anslyn, John T. McDevitt, Jason B. Shear and Dean P. Neikirk, "A microbead array chemical sensor using capillary-based sample introduction: toward the development of an 'electronic tongue'," Biosensors and Bioelectronics, Vol. 21, Aug. 8, 2005, pp. 303-312.
(<http://www.sciencedirect.com/science/article/B6TFC-4DXT7XR-2/2/63c4b30ed5019368cbf0daa18e961915>).
82. Shifeng Li, Pierre N. Floriano, Nicolaos Christodoulides, David Y. Fozdar, Dongbing Shao, Mehnaaz F. Ali, Priya Dharshan, Sanghamitra Mohanty, Dean Neikirk, John T. McDevitt and Shaochen Chen, "Disposable polydimethylsiloxane/silicon hybrid chips for protein detection," Biosensors and Bioelectronics, Vol. 21, No. 4, Oct. 15, 2005, pp. 574-580.
(<http://www.sciencedirect.com/science/article/B6TFC-4F9MTDX-1/2/8723de52f98adafl1e55f417c04de29cb>)
83. Han, S. W., Park, Y. S., Neikirk, D. P., "Broadband infrared detection using Jaumann absorbers with genetic algorithm," Electronics Letters, v 41, n 24, Nov 24, 2005, pp. 1307-1308.
84. Abu Yousef, A., Wood, S.L., Pasupathy, P., and Neikirk, D.P., "Resonant Sensors for Detecting Corrosion in Concrete Bridges," *Transportation Research Record*, Transportation Research Board, No. 2201, December 2010, pp. 19-26.
85. Sheng Zhang, Praveenkumar Pasupathy, and Dean Neikirk, "Microfabricated self-resonant structure as a passive wireless dielectric constant and conductivity sensor," *Microsystem Technologies*, Springer Berlin / Heidelberg, Issn: 0946-7076, pp. 1-7, <http://dx.doi.org/10.1007/s00542-011-1403-y> , Doi: 10.1007/s00542-011-1403-y.
86. Jong Yeon Park, Praveen Pasupathy and Dean P. Neikirk, "Wavelength Selective Microbolometers with Low Deformation Membranes Using a Planar Self-aligned Process," submitted to be considered for publication in the Journal of Micro/Nanolithography, MEMS, and MOEMS (JM3), April 2012.
87. Jeremiah Fasl, Todd Helwig, Sharon L. Wood, Praveen Pasupathy, Dean P. Neikirk, Frank Raffaelli, "Factors Affecting Wireless Network Communication in Monitoring Systems for Steel Bridges," Journal of Civil Structural Health Monitoring, Volume 2, Issue 2, September 2012, pp. 87-95.
88. Joo-Yun Jung, Jong Yeon Park, Sangwook Han, Aniruddha Weling, and Dean P. Neikirk, "Wavelength-selective infrared Salisbury screen absorber," APPLIED OPTICS, Vol. 53, No. 11, 10 April 2014, pp. 2431-2436

89. Ignacio F. Gallardo, Praveenkumar Pasupathy, Maxwell Brown, Carol M. Manhart, Dean P. Neikirk, Eric Alani, and Ilya J. Finkelstein, "High-Throughput Universal DNA Curtain Arrays for Single-Molecule Fluorescence Imaging," *Langmuir*, Vol. 31 (37), pp 10310–10317, Sept. 1, 2015. doi: 10.1021/acs.langmuir.5b02416.
90. Shixuan Yang, Ying-Chen Chen, Luke Nicolini, Praveenkumar Pasupathy, Jacob Sacks, Su Becky, Russell Yang, Sanchez Daniel, Yao-Feng Chang, Pulin Wang, David Schnyer, Dean Neikirk and Nanshu Lu, " 'Cut-and-Paste' Manufacture of Multiparametric Epidermal Sensor Systems," *Advanced Materials*, Vol. 27, No. 41, 11/1/2015, pp. 6423-6430.
91. Praveen Pasupathy, Tanuj Trivedi, Brad Leonhardt, Sheng Zhang, John G. Ekerdt, and Dean P. Neikirk, "Miniature Passive Wireless Resonant Platform for Chemical Memory based Threshold Sensing," *IEEE Sensors Journal*, Volume: 17, Issue: 5, March 1, 1 2017, pp. 1209 - 1210; DOI: 10.1109/JSEN.2016.2646686
92. Jung, Joo-Yun; Song, Kyungjun; Choi, Jun-Hyuk; Lee, Jihye; Choi, Dae-Geun; Jeong, Jun-Ho; Neikirk, Dean P., "Infrared broadband metasurface absorber for reducing the thermal mass of a microbolometer," *Scientific Reports*, Vol. 7, No. 430, March 27, 2017, 8 pages, 10.1038/s41598-017-00586-x.
93. Tanuj Trivedi, Anupam Roy, Hema C. P. Movva, Emily S. Walker, Seth R. Bank, Dean P. Neikirk, and Sanjay K. Banerjee, "Versatile Large-Area Custom-Feature van der Waals Epitaxy of Topological Insulators," *ACS Nano*, 2017, 11 (7), pp 7457–7467, DOI: 10.1021/acsnano.7b03894, Publication Date (Web): July 10, 2017.
94. Brad Leonhardt, Praveen Pasupathy, Tanuj Trivedi, Sheng Zhang, Dean P. Neikirk, and John G. Ekerdt, "Functionalized Polycyclic Aromatic Polymers for High Temperature Wireless Chemical Memory Threshold Sensors," submitted to *ACS Ind. Eng. Chem. Res.*, 2017, 56 (19), pp 5479–5482, DOI: 10.1021/acs.iecr.6b04541, Publication Date (Web): May 2, 2017.

B. Refereed Conference Proceedings

1. D. P. Neikirk, D. B. Rutledge, M.S. Muha, H. Park, and C.-X. Yu, "Progress in Millimeter-Wave Integrated-Circuit Imaging Arrays," *SPIE Conf. on Integrated Optics and Millimeter and Microwave Integrated Circuits*, Huntsville, Alabama, November, 1981.
2. D. P. Neikirk, D. B. Rutledge, M.S. Muha, H. Park, and C.-X. Yu, "Imaging Antenna Arrays," 6th Int. Conf. on Inf. and Millimeter Waves, Miami Beach, Florida, December, 1981, p. Th-4-1.
3. D. P. Neikirk, D. B. Rutledge, H. Park, C.-X. Yu, W. A. Peebles and N. C. Luhmann,

Jr., "Development of Imaging Arrays for Poloidal Field Determination and Holographic Imaging of Plasmas," Proc. of U.S.A. - Japan Workshop on Submillimeter Diagnostic Techniques, Nagoya, US-J FRC-006, p. 60, January, 1982.

4. D. P. Neikirk, D. B. Rutledge, P. E. Young, N. C. Luhmann, Jr., H. Park, W. A. Peebles, and C.-X. Yu, "Far-Infrared Imaging Systems for the Determination of Fusion Plasma Density and Magnetic Field Distributions," Department of Energy Workshop on Magnetic Field Measurements, Oak Ridge, Tennessee, April, 1982.

5. P. Young, Q.-X. Yu, W. A. Peebles, N. C. Luhmann, Jr., D. P. Neikirk, D. B. Rutledge, and P. Tong, "Far-Infrared Imaging," Digest 7th Int. Conf. on Inf. and Millimeter Waves, Marseille, France, February, 1983, p. J3-4.

6. D. P. Neikirk, P.P. Tong, D. B. Rutledge, and P. E. Young, "Progress in Far-Infrared Imaging Arrays," 7th Int. Conf. on Inf. and Millimeter Waves, Marseille, France, February, 1983, p. J3-3.

7. P. E. Young, W. A. Peebles, N. C. Luhmann, Jr., R. J. Taylor, D. P. Neikirk, D. B. Rutledge, and P.P. Tong, "Simultaneous FIR Interferometry/Polarimetry in the UCLA Microtor Plasma," 8th Int. Conf. on Infrared and Millimeter Waves, Miami, Florida, December, 1983.

8. P. E. Young, W. A. Peebles, N. C. Luhmann, Jr., D. P. Neikirk, D. B. Rutledge, and P.P. Tong, "Interferometric FIR Phase Imaging of a Tokamak Plasma," 8th Int. Conf. on Infrared and Millimeter Waves, Miami, Florida, December, 1983.

9. D. P. Neikirk and D. B. Rutledge, "Advances in Microbolometers," 8th Int. Conf. on Infrared and Millimeter Waves, Miami, Florida, December, 1983.

10. P.P. Tong, D. B. Rutledge, and D. P. Neikirk, "Polarization- sensitive imaging arrays," IEEE MTT-S International Microwave Symposium, San Francisco, Ca., May 29- June 1, 1984, pp. 542-544.

11. Y. Fukuoka, Q. Zhang, D. Neikirk, and T. Itoh, "Analysis of multilayer interconnection lines for a high speed digital integrated circuit," IEEE VLSI Multilevel Interconnection Conference, June 21-22, 1984, pp. 246-251.

12. P. Young, D. Neikirk, C. Domier, P. Tong, W. Peebles, D. Rutledge, and N. Luhmann, "Near-millimeter wave imaging," 9th Int. Conf. on Infrared and Millimeter Waves, Takarazuka, Japan, Oct. 22-26, 1984, pp. 250-251.

13. P. Cheung, D. Fun, D. Miller, C.-K. C. Tzuang, D. P. Neikirk, and T. Itoh, "Optically Controlled Coplanar Waveguide Millimeter Wave Phase Shifter," Tenth International Conference on Infrared and Millimeter Waves, Lake Buena Vista, FL, Dec. 9-13, 1985, pp. 303-304.

14. N. U. Song, D. P. Neikirk, and T. Itoh, "Device Modeling and Characterization of Ion-Implanted GaAs MESFET's by the Finite Element Method," 8th Colloquium on Microwave Communication, Budapest, Hungary, August 26-29, 1986.
15. C.-K. Tzuang, P. Cheung, D. P. Neikirk, and T. Itoh, "Analysis of an Optically Controlled CPW Phase Shifter Containing Laterally Non-uniform Lossy Layers, Eleventh International Conference on Infrared and Millimeter Waves, Pisa, Italy, Dec., 1986, pp. 127-129.
16. V. Kesan, D. P. Neikirk, and B. G. Streetman, "A Proposed Quantum Well Injection Transit Time Device (QWITT)," Second Topical Meeting on Picosecond Electronics and Optoelectronics, Jan., 1987, pp. 66-68.
17. C.-K. Tzuang, D. Miller, T.-H. Wang, D. P. Neikirk, T. Itoh, P. Williams, and M. Downer, "Picosecond Response of an Optically Controlled Millimeterwave Phase Shifter," Second Topical Meeting on Picosecond Electronics and Optoelectronics, Jan., 1987, pp. 182-184.
18. Y.-D. Lin, D. P. Neikirk, and T. Itoh, "Periodically Illuminated CPW Phase Shifter," 12th International Conference on Infrared and Millimeter Waves, Dec. 14-18, 1987, pp. 93-94.
19. V. P. Kesan, D. P. Neikirk, T. D. Linton, P.A. Blakey, and B. G. Streetman, "Influence of Transit Time Effects on the Optimum Design and Maximum Oscillation Frequency of Quantum Well Oscillators," 12th International Conference on Infrared and Millimeter Waves, Dec. 14-18, 1987, pp. 12-13.
20. P. Cheung, D. P. Neikirk, and T. Itoh, "Measurements of an Optically Controlled Coplanar Waveguide Phase-Shifter," 12th International Conference on Infrared and Millimeter Waves, Dec. 14-18, 1987, pp. 91-92.
21. R. L. Rogers, D. P. Neikirk, and H. Ling, "Planar Matching of Antennas on Electrically Thick Dielectric Substrates," 12th International Conference on Infrared and Millimeter Waves, Dec. 14-18, 1987, pp. 288-289.
22. V. P. Kesan, T. D. Linton, C. M. Maziar, D. P. Neikirk, P.A. Blakey, and B. G. Streetman, "Power-optimized design of quantum well oscillators," 1987 IEEE International Electron Devices Meeting, Dec. 6-9, 1987, pp. 62-65.
23. S. M. Wentworth, D. P. Neikirk, and C. R. Brahce, "High Frequency Characterization of Tape-Automated Bonding (TAB) Interconnects," SPIE Advances in Semiconductors and Superconductors: Physics and Device Applications, Conf. 947: Interconnection of High Speed and High Frequency Devices and Systems, Newport Beach, CA, March 13-18, 1988. pp. 81-84.

24. D. R. Miller, V. P. Kesan, R. L. Rogers, C. M. Maziar, and D. P. Neikirk, "Time Dependent Simulation of the Quantum Well Injection Transit Time Diode," 13th International Conference on Infrared and Millimeter Waves, R. J. Temkin, Editor, SPIE Vol. 1039, Dec. 5-9, 1988, pp. 5-6.
25. P. Cheung, D. P. Neikirk, and T. Itoh, "Experimental Performance of a Periodically Illuminated Optically Controlled Coplanar Waveguide Phase Shifter," 13th International Conference on Infrared and Millimeter Waves, R.J. Temkin, Editor, SPIE Vol. 1039, Dec. 5-9, 1988, pp. 63-64.
26. R. L. Rogers, D. P. Neikirk, H. Ling, and T. Itoh, "Antennas on Electrically Thick Multilayered Substrates," 13th International Conference on Infrared and Millimeter Waves, R. J. Temkin, Editor, SPIE Vol. 1039, Dec. 5-9, 1988, pp. 33-34.
27. A. Mortazawi, V. P. Kesan, D. P. Neikirk, and T. Itoh, "Periodic Monolithic Millimeter-Wave Quantum Well Oscillator," 13th International Conference on Infrared and Millimeter Waves, R. J. Temkin, Editor, SPIE Vol. 1039, Dec. 5-9, 1988, pp. 47-48.
28. V. P. Kesan, A. Mortazawi, D. P. Neikirk, and T. Itoh, "Microwave and Millimeterwave QWITT Diode Oscillator," IEEE MTT-S International Microwave Symposium Digest, Vol. 1, June 13-15, 1989, pp. 487-489.
29. P. Cheung, D. P. Neikirk, and T. Itoh, "An Optically Controlled Coplanar Waveguide Phase-Shifter," IEEE MTT-S International Microwave Symposium Digest, Vol. 1, June 13-15, 1989, pp. 307-309.
30. A. Mortazawi, V. P. Kesan, D. P. Neikirk, and T. Itoh, "A Self Oscillating QWITT Diode Mixer," 19th European Microwave Conference, London, Engl., Sept. 4-7, 1989, pp. 715-718.
31. R. L. Rogers, D. P. Neikirk, and T. Itoh, "Impedance Measurements and Calculations of a Microstrip-fed Slot Antenna on a Multilayered Electrically Thick Dielectric Substrate," 19th European Microwave Conference, London, Engl., Sept. 4-7, 1989, pp. 167-171.
32. S. M. Wentworth, R. L. Rogers, D. P. Neikirk, and T. Itoh, "A Twin Slot Antenna Structure on a Layered Substrate for Millimeter Wave Imaging Arrays," 14th International Conference on Infrared and Millimeter Waves, M. von Ortenberg, Editor, SPIE Vol. 1240, Oct. 2-6, 1989, pp. 399-400.
33. S. M. Wentworth, R. L. Rogers, J. G. Heston, and D. P. Neikirk, "Twin-slot multi-layer substrate-supported antennas and detectors for terahertz imaging," First International Symposium on Space Terahertz Technology, University of Michigan, Ann Arbor, Mich., March 5-6, 1990, pp. 201-213.
34. D. R. Miller, V. K. Reddy, and D. P. Neikirk, "Realistic Band Structure Effects of

GaAs/AlAs Quantum Well Diodes: Theory and Experiment," Proceedings of the SPIE Symposium on Advances in Semiconductors and Superconductors: High Speed Electronics and Device Scaling, SPIE Vol. 1288, San Diego, CA, March 17-21, 1990, pp. 167-176.

35. P. Cheung, M.S. Islam, D. P. Neikirk, and T. Itoh, "Circuit Model of Coplanar Waveguide Phase Shifters on GaAs Substrates," Gallium Arsenide Applications Symposium '90, Rome, Italy, April 19-20, 1990.

36. P. Cheung, D. P. Neikirk, and T. Itoh, "Measurements of an Optically Controlled Coplanar Waveguide Phase Shifter," Microwaves and Optronics Conference and Exhibition on Ultra High Frequency Engineering (MIOP 90), Stuttgart, West Germany, April 24-26, 1990.

37. S. M. Wentworth and D. P. Neikirk, "A Transition Edge Microbolometer (TREMBOL) for Far-Infrared Detection," SPIE Conference on Superconductivity Applications for Infrared and Microwave Devices, SPIE Proceedings Vol. 1292, Orlando, FL, April 19-20, 1990.

38. M.S. Islam, P. Cheung, C.-Y. Chang, D. P. Neikirk, and T. Itoh, "Optically-Controlled Tunable CPW Resonators," IEEE MTT-S International Microwave Symposium Digest, Vol. II, May 8-10, 1990, pp. 949-950.

39. S. M. Wentworth and D. P. Neikirk, "Far-Infrared Composite Microbolometers," IEEE MTT-S International Microwave Symposium Digest, Vol. III, May 8-10, 1990, pp. 1309-1310.

40. J. G. Heston, S. M. Wentworth, R. L. Rogers, D. P. Neikirk, and T. Itoh, "MM Wave /FIR Twin Slot Antenna Structures," AP-S International Symposium and URSI Radio Science Meeting, May, 1990.

41. T. Y. Chu, D. P. Neikirk, and B. G. Streetman, "Properties and Applications of $\text{Al}_x\text{Ga}_{1-x}\text{As}$ Grown at Low Temperatures," Proceedings of the Sixth International Conference on Molecular Beam Epitaxy, Aug. 27-31, 1990, La Jolla, CA, Journal of Crystal Growth, vol. 111, n 1-4, May 2, 1991..

42. A. Mortazawi, D. Miller, D. P. Neikirk, and T. Itoh, "Small Signal Measurements of the Microwave Impedance of QWITT Diodes," 20th European Microwave Conference, Budapest, Hungary, Sept. 10-14, 1990, pp. 715-718.

43. V. K. Reddy, A. J. Tsao, S. Javalagi, D. R. Miller, and D. P. Neikirk, "Quantum Well Injection Transit Time (QWITT) Diode Oscillators," 15th International Conference on Infrared and Millimeter Waves, Richard J. Temkin, Editor, SPIE vol. 1514, Dec. 10-14, 1990, pp. 88-90.

44. M. S. Islam, P. Cheung, D. P. Neikirk, and T. Itoh, "Microwave response of a coplanar

waveguide phase shifter to pulsed optical illumination," 15th International Conference on Infrared and Millimeter Waves, Richard J. Temkin, Editor, SPIE vol. 1514, Dec. 10-14, 1990, pp. 484-486.

45. J. M. Lewis, D. P. Neikirk, and S. M. Wentworth, "Low growth temperature GaAs microbolometers," 15th International Conference on Infrared and Millimeter Waves, Richard J. Temkin, Editor, SPIE vol. 1514, Dec. 10-14, 1990, pp. 398-400.

46. C. S. Kyono, P. Cheung, C. J. Pinzone, N. D. Gerrard, T. Bustami, C.M. Maziar, D. P. Neikirk, and R.D. Dupuis, "High gain, high speed InGaAs/InP heterojunction bipolar transistors," 1990 IEEE International Electron Devices Meeting, San Francisco, CA, Dec. 9-12, 1990, pp. 677-680.

47. Nanda Gopal, Dean P. Neikirk, and Lawrence T. Pillage, "Evaluating RC-Interconnect using Moment-Matching Approximations," 1991 IEEE International Conference on Computer-Aided Design Digest of Technical Papers, Conference on Computer-Aided Design - ICCAD-91, Santa Clara, CA, Nov. 10-14, 1991, pp. 74-77.

48. K. K. Gullapalli, D. R. Miller, and D. P. Neikirk, "Hybrid Boltzmann Transport - Schrödinger Equation Model for Quantum Well Injection Transit (QWITT) Diodes," 1991 IEEE International Electron Devices Meeting, Washington, DC, Dec. 8-11, 1991, pp. 18.5.1-18.5.4.

49. Douglas R. Miller and D. P. Neikirk, "Lattice Wigner simulations of double barrier resonant tunneling devices," Third International Symposium on Space Terahertz Technology, The University of Michigan, Ann Arbor, Mich., March 24-26, 1992, pp. 560-574.

50. Youngmin Kim, Wanjun Wang, Dean P. Neikirk, and Ilene J. Busch-Vishniac, "Fabrication and characterization of a clover type position sensitive photodetector," IEEE Instrumentation / Measurement Technology Conference, New York NY, May 12-14, 1992.

51. Nanda Gopal, Emre Tuncer, Dean P. Neikirk, and Lawrence T. Pillage, "Non-uniform lumping models for transmission line analysis," IEEE Topical Meeting on Electrical Performance of Electronic Packaging, Tucson, AZ, April 22-24, 1992, pp. 119-121.

52. K. K. Gullapalli and D. P. Neikirk, "Evaluating space charge resistance in resonant tunneling diodes," 11th Annual Symposium on Electronic Materials, Processing, and Characterization, Richardson, TX, June 1-2, 1992.

53. D. R. Miller and D. P. Neikirk, "Realistic Lattice Wigner simulations of double barrier resonant tunneling devices," 11th Annual Symposium on Electronic Materials, Processing, and Characterization, Richardson, TX, June 1-2, 1992.

54. V. K. Reddy, S. Javalagi, and D. P. Neikirk, "Molecular beam epitaxial growth and characterization of double barrier resonant tunneling diodes for microwave oscillator

applications," 11th Annual Symposium on Electronic Materials, Processing, and Characterization, Richardson, TX, June 1-2, 1992.

55. Alwin J. Tsao, M. S. Islam, and D. P. Neikirk, "Epitaxial liftoff of GaAs/AlGaAs thin film device structures for hybrid integration on silicon and quartz substrates," 11th Annual Symposium on Electronic Materials, Processing, and Characterization, Richardson, TX, June 1-2, 1992 (Best Student Paper Award).

56. A. J. Tsao, K. K. Gullapalli, and D. P. Neikirk, "Effect of barrier asymmetries in AlAs/GaAs double barrier resonant tunneling diodes: experiment and numerical simulation," 11th Annual Symposium on Electronic Materials, Processing, and Characterization, Richardson, TX, June 1-2, 1992.

57. K. K. Gullapalli, A. J. Tsao, and D. P. Neikirk, "Observation of zero-bias multi-state behavior in selectively doped two-terminal quantum tunneling devices," 1992 IEEE International Electron Devices Meeting, San Francisco, CA, Dec. 13-16, 1992, pp. 479-482.

58. D. R. Miller and D. P. Neikirk, "Lattice Wigner Simulations of Quantum Devices," 1992 IEEE International Electron Devices Meeting, San Francisco, CA, Dec. 13-16, 1992, pp. 561-564.

59. J. M. Lewis and D. P. Neikirk, "HiTc composite microbolometers using YBCO," 17th International Conference on Infrared and Millimeter Waves, Richard J. Temkin, Editor, SPIE vol. 1929, Dec. 14-17, 1992, pp. 202-203.

60. V. K. Reddy and D. P. Neikirk, "AlAs/InAs heterojunction barrier varactors," 17th International Conference on Infrared and Millimeter Waves, Richard J. Temkin, Editor, SPIE vol. 1929, Dec. 14-17, 1992, pp. 358-359.

61. A. J. Tsao, M. Saiful Islam, and D. P. Neikirk, "Hybrid integration of millimeter wave devices using the epitaxial lift-off (ELO) technique," 17th International Conference on Infrared and Millimeter Waves, Richard J. Temkin, Editor, SPIE vol. 1929, Dec. 14-17, 1992, pp. 421-422.

62. M. Saiful Islam, Emre Tuncer and Dean P. Neikirk, "Accurate Quasi-Static Model for Conductor Loss in Coplanar Waveguide," 1993 IEEE MTT-S International Microwave Symposium Digest, Vol. II, pp. 959-962.

63. V. K. Reddy, S. Javalagi, and D. P. Neikirk, "AlAs/InGaAs Single Barrier Diodes," 12th Annual Symposium on Electronic Materials, Processing, and Characterization, Austin, TX, June 7-8, 1993.

64. Y. Kim and D. P. Neikirk, "Monolithically integrated optical pressure microsensor," 12th Annual Symposium on Electronic Materials, Processing, and Characterization, Austin, TX, June 7-8, 1993.

65. K. K. Gullapalli and D. P. Neikirk, "Memory Switching Phenomena in Quantum Well Diodes," 12th Annual Symposium on Electronic Materials, Processing, and Characterization, Austin, TX, June 7-8, 1993.
66. E. Tuncer, S. Y. Kim, L. T. Pillage and D. P. Neikirk, "A new, efficient circuit model for microstrip lines including both current crowding and skin depth effects" IEEE 2nd Topical Meeting on Electrical Performance of Electronic Packaging, Monterey, CA, Oct. 20-22, 1993, pp. 85-88.
67. S. Y. Kim, E. Tuncer, R. Gupta, B. Krauter, D. P. Neikirk, and L. T. Pillage, "An Efficient Methodology for Extraction and Simulation of Transmission Lines for Application Specific Electronic Modules," IEEE/ACM International Conference on Computer-Aided Design - 93, Santa Clara, CA, Nov. 7-11, 1993, pp. 58-65.
68. K. K. Gullapalli, D. R. Miller, and D. P. Neikirk, "Wigner-Poisson simulation of memory switching heterostructure tunneling diodes," 1993 IEEE International Electron Devices Meeting, Washington, DC, Dec. 5-8, 1993, pp. 109-112.
69. T. R. Block, K. G. Eyink, D. P. Neikirk, and B. G. Streetman, "Diffraction condition dependence of RHEED dampening during MBE growth," Epitaxial Growth Processes, Proc. SPIE Conf. on Optics, Electro-optics, and Laser Applications, SPIE Vol. 2140, Los Angeles, CA, Jan. 26-27, 1994, pp. 10-24.
70. K. K. Gullapalli and D. P. Neikirk, "Incorporating spatially varying effective-mass in the Wigner-Poisson model for AlAs/GaAs resonant-tunneling diodes," Proceedings of the Third Annual International Workshop on Computational Electronics, Portland, OR, May 18-20, 1994, pp. 171-174.
71. E. Tuncer, Beom-Taek Lee, and D. P. Neikirk, "Interconnect Series Impedance Determination Using a Surface Ribbon Method" IEEE 3rd Topical Meeting on Electrical Performance of Electronic Packaging, Monterey, CA, Nov. 2-4, 1994, pp. 250-252.
72. C. Hearn, W. Maddox, Y. Kim, V. Gupta, D. Masser, P. Koeneman, C. S. Chu, I. Busch-Vishniac, D. Neikirk, W. Weldon, and K. Wood, "Smart Mechanical Bearings Using MEMS Technology," ASME Energy and Environment EXPO '95: Tribology Symposium 1995, editor: H. Masudi, Houston, TX, Jan. 29 - Feb. 1, 1995, pp. 1-10.
73. Y. Kim and D. P. Neikirk, "Fabry Perot Pressure Sensor," *AVS 14th Annual Symposium on Electronic Materials, Processing, and Characterization*, Austin, Texas, June 6-7, 1995.
74. O. Hartin and D. P. Neikirk, "Memory Switching in RTDs," *AVS 14th Annual Symposium on Electronic Materials, Processing, and Characterization*, Austin, Texas, June 6-7, 1995.

75. V. Gupta and D. P. Neikirk, "Design and Fabrication of an Inductive Proximity Sensor using a Two-Coil Planar Transformer on a Micromachined Membrane," *AVS 14th Annual Symposium on Electronic Materials, Processing, and Characterization*, Austin, Texas, June 6-7, 1995.
76. D. P. Neikirk, E. Tuncer, and B.-T. Lee, "The Use of Effective Internal Impedance Approximations in Lossy Transmission Line Modeling," *Progress in Electromagnetics Research Symposium PIERS 95*, The University of Washington, Seattle, Washington, July 24-28, 1995, p. 955.
77. D. P. Neikirk, M. S. Islam, and E. Tuncer, "Accurate Quasi-Static Modeling of Transmission Lines on Semiconducting Substrates," *Progress in Electromagnetics Research Symposium PIERS 95*, The University of Washington, Seattle, Washington, July 24-28, 1995, p. 929.
78. B. Krauter, D. P. Neikirk, and L. T. Pillage, "Sparse Partial Inductance Matrix Formulation," *Progress in Electromagnetics Research Symposium PIERS 95*, The University of Washington, Seattle, Washington, July 24-28, 1995, p. 957.
79. O. Hartin, D. P. Neikirk, A. Anselm, and B. Streetman, "Design and Fabrication of a Three Terminal Quantum Storage Device," *Proceedings of the 1995 IEEE/Cornell Conference on Advanced Concepts in High Speed Semiconductor Devices and Circuits*, Cornell University, Ithaca, NY, USA, August 7-9, 1995, p. 209-218.
80. K. L. Wood, I. Busch-Vishniac, D. Neikirk, and W. Weldon, "Smart Hydrodynamic Bearing Applications of Micro-Electro-Mechanical Systems," *American Society of Mechanical Engineers' 1995 International Mechanical Engineering Congress and Exposition*, San Francisco, Nov. 12-17, 1995.
81. B.-T. Lee, E. Tuncer, and D. P. Neikirk, "Efficient 3-D Series Impedance Extraction using Effective Internal Impedance," *IEEE 4th Topical Meeting on Electrical Performance of Electronic Packaging*, Portland, OR, October 1-4, 1995, pp. 220-222.
82. V. Gupta and D. P. Neikirk, "Design of an Eddy-Current Proximity Sensor using a Two-Coil Planar Transformer," in *Micromachined Devices and Components*, Ray Roop, Kevin Chau, Editors, Proc. SPIE 2642, pp. 173-182, Austin, Texas, USA, 23-24 October, 1995.
83. Y. Kim and D. P. Neikirk, "Micromachined Fabry-Perot Pressure Transducer with Optical Fiber Interconnects," in *Micromachined Devices and Components*, Ray Roop, Kevin Chau, Editors, Proc. SPIE 2642, pp. 242-249, Austin, Texas, USA, 23-24 October, 1995.
84. Kristin L. Wood, Dean Neikirk, Ilene Busch-Vishniac, and William Weldon, "MEMS Hydrodynamic Bearings: Applications and Implications to Machine-Failure Prevention," *Proceedings of a Joint Conference on Integrated Monitoring, Diagnostics*

and Failure Prevention, Joint Oil Analysis program Technical Support Center, University of Wales, Swansea, Mobile, AL, April 22-26, 1996, pp. 363-372.

85. S. Kim and D. P. Neikirk, "Compact Equivalent Circuit Model for the Skin Effect," 1996 IEEE-MTT-S International Microwave Symposium, San Francisco, California, June 17-21, 1996, pp. 1815-1818.

86. J. Han, D. P. Neikirk, M. Clevenger, and J. T. McDevitt, "Fabrication and characterization of a Fabry-Perot based chemical sensor," SPIE Microelectronic Structures and MEMS for Optical Processing II, M. E. Motamedi and W. Bailey, editors, Proc. SPIE 2881, Austin, Texas, USA, 14-15 October, 1996, pp. 171-178.

87. J. Han and D. P. Neikirk, "Deflection behavior of Fabry-Perot pressure sensors having planar and corrugated membrane," SPIE's Micromachining and Microfabrication '96 Symposium: Micromachined Devices and Components II, R. Roop and K. Chau, Proc. SPIE 2882, Austin, Texas, USA, 14-15 October, 1996, pp. 79-90.

88. B.-T. Lee and D. P. Neikirk, "Minimum Segmentation in the Surface Ribbon Method for Series Impedance Calculations of Microstrip Lines," *IEEE 5th Topical Meeting on Electrical Performance of Electronic Packaging*, Napa, CA, October 28-30, 1996, pp. 233-235.

89. S. -J. Yoo, J. Lavigne, S. Savoy, J. B. McDoniel, E. V. Anslyn, J. T. McDevitt, D. P. Neikirk, J. B. Shear, "Micromachined storage wells for chemical sensing beads in an 'artificial tongue'," SPIE's Micromachining and Microfabrication '96 Symposium: Micromachined Devices and Components III, K. Chau and P. J. French, editors, Proc. SPIE 3224, Austin, Texas, USA, 29-30 September, 1997.

90. Sangwoo Kim and Dean P. Neikirk, "Time Domain Multiconductor Transmission Line Analysis Using Effective Internal Impedance," *IEEE 6th Topical Meeting on Electrical Performance of Electronic Packaging*, San Jose, CA, October 27 - 29, 1997, pp 255-258.

91. S.-J. Yoo, R. Friar, and D. P. Neikirk, "Analytic modeling of monolithic inductors on semiconductor substrates," *IEEE Topical Meeting on Electrical Performance of Electronic Packaging*, , Oct 26-28, 1998, pp. 219-222.

92. S. Savoy, J. J. Lavigne, J. S.-J. Yoo, J. Wright, M. Rodriguez, A. Goodey, B. McDoniel, J. T. McDevitt, E. V. Anslyn, J. B. Shear, A. Ellington, and D. P. Neikirk, "Solution-based analysis of multiple analytes by a sensor array: toward the development of an electronic tongue," *SPIE Chemical Microsensors and Applications*, Vol. 3539, Boston, MA, Nov. 4, 1998, pp. 17-26.

93. J. J. Lavigne, A. Metzger, K. Niikura, L. A. Cabell, S. M. Savoy, J. S. Yoo, J. T. McDevitt, D. P. Neikirk, J. B. Shear, and E. V. Anslyn, "Single-analyte to multianalyte fluorescence sensors," *SPIE Advances in Fluorescence Sensing Technology IV*, S. A.

Soper and R. B. Thompson, Vol. 3602, Boston, MA, May, 1999, pp. 220-231.

94. R. J. Friar and D. P. Neikirk, "Experimental Determination of the Importance of Inductance in Sub-Micron Microstrip Lines," IEEE 1999 International Interconnect Technology Conference, San Francisco, May 24-26, 1999, pp. 176-177.

95. Eames, Sara J.; Yoo, J. Seung-Jin; Warner, John C.; Neikirk, Dean P.; McDevitt, John Thomas, "Lithographically patterned superconductor bolometer detectors for visible and near-infrared radiation incorporating wavelength-selective light-absorbing elements," Proc. SPIE-Int. Soc. Opt. Eng. (1999), 3790 (Engineered Nanostructural Films and Materials), pp. 160-168, July 23, 1999.

96. R. Friar and D. P. Neikirk, "Limitations due to systematic phase errors on the extraction of loss tangent from micron-sized transmission line test structures," IEEE Topical Meeting on Electrical Performance of Electronic Packaging, San Diego, CA, October 25-27, 1999, p. 67-70.

97. Youngsoo Sohn, John Levigne, Dr. Yi Deng, Adrian Goodey, Marc Rodriguez, Andrew Tsao, Theodore E. Curey, Dean P. Neikirk, Eric Anslyn, John McDevitt, and Jason Shear, "Micromachined multi-analyte sensors: towards an 'electronic tongue'," NASA NanoSpace 2000, International Conference on Integrated Nano/Microtechnology for Space Applications, League City, TX, Jan. 23-28, 2000.

98. Y.-S. Sohn, A. Tsao, E. Anslyn, J. McDevitt, J. B. Shear, and D. P. Neikirk, "Liquid Flow through an Array-based Chemical Sensing System," Proc. SPIE-Int. Soc. Opt. Eng. (2000), 4177 (Microfluidic Devices and Systems III), Sept. 18-21, 2000, pp. 212-219.

99. Young-Soo Sohn, Adrian P. Goodey, Eric V. Anslyn, John T. McDevitt, Jason B. Shear, and Dean P. Neikirk, "MEMS Based Microfluidic Structure for Biological and Chemical Sensor Array," TEX MEMS III, Dallas, TX, June 7, 2001, p. 23.

100. S. C. McCleskey, A. P. Goodey, M. D. Rodriguez, J. T. McDevitt, E. V. Anslyn, and D. P. Neikirk, "Development of a multi-component sensor array for the simultaneous detection of various analytes in solution," presented at 222nd ACS National Meeting,, Chicago, IL, 2001.

101. D. Neikirk, Y. Sohn, S. Yoo, B. Park, Y. Park, B. Woo, and S. Wood, "From medical to structural health monitoring: electronic taste chips to electronic structural surveillance tags," presented at International Sensor Conference 2001 (ISC 2001), Seoul, Korea, 2001.

102. Y.-S. Sohn, A. P. Goodey, E. Anslyn, J. McDevitt, J. Shear, and D. P. Neikirk, "Development of a Micromachined Fluidic Structure for a Biological and Chemical Sensor Array," presented at Fifth International Conference on Miniaturized Chemical and Biochemical Analysis Systems, μ TAS 2001, Monterey, California, 2001.

103. S. Wood and D. Neikirk, "Development of a passive sensor to detect cracks in welded steel construction," presented at US-Japan Joint Workshop and Third Grantees Meeting, US-Japan Cooperative Research in Urban Earthquake Disaster Mitigation, Seattle, 2001.
104. T. Postlethwaite, T. Spain-Santanta, P. Zhang, R. Priest, J. McDevitt, J. Shear, D. Neikirk, E. Anslyn, S. McCleskey, and P. Floriano, "Electronic taste chip sensor for the detection of chemical and biological targets," presented at SPIE AeroSense 2002: Conference 4722 Chemical and Biological Sensing III, Orlando, Florida, 2002.
105. Wiskur, Sheryl L.; Metzger, Axel; Lavigne, John J.; Schneider, Stephen E.; Anslyn, Eric V.; McDevitt, John T.; Neikirk, Dean; Shear, Jason B.; "Mimicking the mammalian sense of taste through single-component and multicomponent analyte sensors," ACS Symposium Series, v 825, 2002, p 276-288.
106. Novak, Lisa J.; Grizzle, Kristi M.; Wood, Sharon L.; Neikirk, Dean P., "Development of state sensors for civil engineering structures," Proceedings of SPIE's Vol. 5057 8th Annual International Symposium on NDE for Health Monitoring and Diagnostics: Smart Systems and NDE for Civil Infrastructures, March 3-6, 2003, pp. 358-363.
107. J. W. Kim and D. P. Neikirk, "Infrared wavelength selective micromachined microbolometers," Proceedings of SPIE Vol. 5116 Smart Sensors, Actuators, and MEMS, SPIE's First International Symposium on Microtechnologies for the New Millennium 2003, Maspalomas, Gran Canaria (Canary Islands), Spain, May 19-21, 2003, pp. 514-522.
108. B. H. Park, Y. S. Park, Y.-S. Sohn, and D. P. Neikirk, "Fabrication of bead size sorting chip for chemical array sensor," Proceedings of SPIE Vol. 5116 Smart Sensors, Actuators, and MEMS, SPIE's First International Symposium on Microtechnologies for the New Millennium 2003, Maspalomas, Gran Canaria (Canary Islands), Spain, May 19-21, 2003, pp. 303-313.
109. B. H. Park, Y.-S. Sohn, and D. P. Neikirk, "Development of micro bead size selection chip for a chemical array sensor," μ TAS2003 / microTAS2003: The 7th International Conference on Miniaturized Chemical and BioChemical Analysis Systems, Squaw Valley, California USA, October 5-9 2003, pp. 631-634.
110. Jooyong Kim; Neikirk, D.P.; "Experimental characterization of copper/low-k transmission line interconnects through microwave measurements," IEEE Electrical Performance of Electrical Packaging (IEEE Cat. No. 03TH8710), Princeton, NJ, USA, Oct. 27-29, 2003, p. 93-96.
111. J. T. Simonen, M. M. Andringa, K. M. Grizzle, S. L. Wood, and D. P. Neikirk, "Wireless sensors for monitoring corrosion in reinforced concrete members," Proceedings of SPIE Smart Structures/NDE Joint Conference Vol. #5391, 15-18 March 2004, San

Diego, CA, 2004, pp. 587-596.

112. M. M. Andringa, D. P. Neikirk, and S. L. Wood, "Unpowered wireless analog resistance sensor," Proceedings of SPIE Smart Structures/NDE Joint Conference Vol. 5391, 15-18 March 2004, San Diego, CA, 2004, pp. 356-367.

113. Shifeng Li, David Fozdar, Dongbing Shao, Shaochen Chen, Pierre N. Floriano, Nicolaos Christodoulides, Mehnaaz F. Ali, Priya Dharshan, John T McDevitt, Dean Neikirk, "Disposable Polydimethylsiloxane/Silicon Hybrid Chips for Protein Detection," IMECE2004-62170, Proceedings of IMECE: International Mechanical Engineering Congress and Exposition, November 13-19, 2004, Anaheim, California

114. J. W. Kim, Y. Sohn, and D. P. Neikirk, "Microfabrication of a multichannel microfluidic system for use with microbead reagent sources and detectors," SPIE MOEMS-MEMS 2005, MICROFLUIDICS, BIOMEMS AND MEDICAL MICROSYSTEMS III, Proceedings of SPIE Vol. #5718, 25-27 January 2005, pp. 265-271.

115. Nathan P. Dickerson, Jarkko T. Simonen, Matthew M. Andringa, Sharon L. Wood, and Dean P. Neikirk, "Wireless low-cost corrosion sensors for reinforced concrete structures," SPIE: Smart Structures/NDE Joint Conference, Proceedings of SPIE Vol. 5765, 7-10 March 2005, pp. 493-503.

116. S.-W. Han and D. P. Neikirk, "Design of infrared wavelength-selective microbolometers using planar multimode detectors," presented at Proceedings of the SPIE Vol. 5836 Smart Sensors, Actuators, and MEMS II, Microtechnologies for the New Millennium 2005, Seville, Spain, May 9-11, 2005, pp. 549-557.

117. B. Park, Y. S. Park, J. W. Kim, Y.-S. Sohn, and D. P. Neikirk, "MEMS-based method of polymer bead handling for chemical array sensors," Proceedings of the SPIE Vol. 5836 Smart Sensors, Actuators, and MEMS II, Microtechnologies for the New Millennium 2005, Seville, Spain, May 9-11, 2005, pp. 625-633.

118. Sang-Wook Han and D. P. Neikirk, "Design of broadband or wavelength selective planar multi-mode microbolometer infrared detectors," The Joint 30th International Conference on Infrared and Millimeter Waves and 13th International Conference on Terahertz Electronics, IRMMW-THz 2005 Volume 2, 19-23 Sept. 2005, pp. 650 – 651.

119. Sang-Wook Han, Yoon Sok Park, and D. P. Neikirk, "Multilayer Fabry-Perot microbolometers for infrared detection," The Joint 30th International Conference on Infrared and Millimeter Waves and 13th International Conference on Terahertz Electronics, IRMMW-THz 2005 Volume 2, 19-23 Sept. 2005, pp. 646 - 647.

120. Matthew M. Andringa, Dean P. Neikirk, Nathan P. Dickerson, Sharon L. Wood, "Unpowered wireless corrosion sensor for steel reinforced concrete", 4th IEEE International Conference on Sensors, Irvine, Ca, Nov. 1-3, 2005, pp. 155-158.

121. Andringa, Matthew M.; Puryear, John M.; Neikirk, Dean P.; Wood, Sharon L., "Low-cost wireless corrosion and conductivity sensors," Proceedings of SPIE - The International Society for Optical Engineering, v 6174 I, Smart Structures and Materials 2006 - Sensors and Smart Structures Technologies for Civil, Mechanical, and Aerospace Systems, March 2006, p 61740X.
122. Byungki Woo, Matthew Andringa, Sharon Wood, and Dean P. Neikirk, "Development of a Resonant Repeater Tag for the Enhancement of Sensitivity and Specificity in a Wireless Eddy Current Sensing Scheme" Proceedings of SPIE - The International Society for Optical Engineering, v 6174 I, Smart Structures and Materials 2006 - Sensors and Smart Structures Technologies for Civil, Mechanical, and Aerospace Systems, March 2006 [6176-54].
123. Dickerson, Nathan P., Andringa, Matthew M.; Puryear, John M.; Wood, Sharon L.; Neikirk, Dean P., "Wireless threshold sensors for detecting corrosion in reinforced concrete structures," Proceedings of SPIE - The International Society for Optical Engineering, v 6174 I, Smart Structures and Materials 2006 - Sensors and Smart Structures Technologies for Civil, Mechanical, and Aerospace Systems, March 2006, p 61741L.
124. Sangwook Han, Jooyong Kim, and Dean P. Neikirk, "RF Measurement, Characterization, and Verification of Cu/low-k Transmission Line Interconnects," IEEE International Conference on Microelectronic Test Structures, March 6-9, 2006 Hyatt Regency on Town Lake Austin, Texas USA.
125. S. Han and D. P. Neikirk, "Multilayer Fabry-Perot microbolometers for 2-color infrared detection," Proceedings of SPIE - The International Society for Optical Engineering, v 6206 I, Infrared Technology and Applications XXXII, Orlando, Florida, April 17-21, 2006, p 62061G.
126. A. Weling, P. F. Henning, D. P. Neikirk, and S. Han, "Antenna-coupled microbolometers for multispectral infrared imaging," Proceedings of SPIE - The International Society for Optical Engineering, v 6206 I, Infrared Technology and Applications XXXII, , Orlando, Florida, April 17-21, 2006, p 62061F
127. Dean P. Neikirk, Archie Holmes, Eric V. Anslyn, "Point and Stand-off Sensors for Explosives Detection," The 7th International Symposium on Technology and the Mine Problem, Naval Postgraduate School, Monterey, CA, May 2-5, 2006.
128. Sangwook Han, Rubin Sidhu, Archie Holmes, and Dean P. Neikirk, "Wavelength selective mid and long wave infrared sensor design," 2006 International Symposium on Spectral Sensing Research (ISSSR-2006), organized by the US Army Edgewood Chemical & Biological Center, Bar Harbor, Maine, 29 May – June 2, 2006.
129. Yoon Park, Dean P. Neikirk, and Eric V. Anslyn, "Micromachined Chemiluminescent System for Explosives Detection," Proceedings of SPIE Vol. 6398, Optically-Based

Biological and Chemical Detection for Defence III, Monday-Wednesday 11-13 September 2006, Stockholm.

130. Michael D. Engelhardt, Sharon L. Wood, and Dean P. Neikirk, "Challenges for Performance-Based Fire Safety Design of Steel Structures and Opportunities for Sensor Technologies," US-Korea Workshop on Smart Structures Technology for Steel Structures, Prima Hotel, Seoul, Korea, 16-18 November 2006.

131. Yoon S. Park, Matthew M. Andringa, Dean P. Neikirk, Himali S. Hewage, and Eric V. Anslyn, "Smart microplates: integrated photodiodes for detecting bead-based chemiluminescent reactions," 5th IEEE International Conference on Sensors, paper # B1L-E-4, Daegu, Korea, October 22 – 25, 2006.

132. M. M. Andringa, J. M. Puryear, D. P. Neikirk, S. L. Wood, "In situ measurement of conductivity and temperature during concrete curing using passive wireless sensors," SPIE's 14th Annual International Symposium on Smart Structures and Materials & Nondestructive Evaluation and Health Monitoring, Proceedings of SPIE vol 6529 Sensors and Smart Structures Technologies for Civil, Mechanical, and Aerospace Systems, March 2007.

133. J. M. Puryear, M. M. Andringa, S. L. Wood, D. P. Neikirk, "Low-cost wireless sensors for civil infrastructure," SPIE's 14th Annual International Symposium on Smart Structures and Materials & Nondestructive Evaluation and Health Monitoring, Proceedings of SPIE vol 6529 Sensors and Smart Structures Technologies for Civil, Mechanical, and Aerospace Systems, March 2007.

134. J. Jung, S. Han, D. P. Neikirk, A. S. Weling, J. H. Goldie, P. D. Willson, "Wavelength-selective infrared detectors based on patterned resistive sheets," SPIE Defense and Security Symposium 2007, Conference 6542, Infrared Technology and Applications XXXIII, April 9-13, 2007, paper [6542-47].

135. Y. S. Park, H. S. Hewage, D. P. Neikirk, E. V. Anslyn, "Micromachined microfluidic chemiluminescent system for explosives detection," SPIE Defense and Security Symposium 2007, Conference 6554, Chemical and Biological Sensing VIII, April 11-12, 2007, paper [6554-02].

136. Yoon S. Park, P. Pasupathy, and Dean P. Neikirk, "Resonant chemical surveillance tags," SPIE Europe Symposium on Security and Defence, Florence, Italy, 17 - 20 September 2007, Proceedings of SPIE vol. 6739, Electro-Optical Remote Sensing, Detection, and Photonic Technologies and Their Applications, 2007, p. 673916, paper [6739B-43].

137. Joo-Yun Jung, Sangwook Han, Dean P. Neikirk, "Wavelength-selective infrared detectors," SPIE Europe Symposium on Security and Defence, Florence, Italy, 17 - 20 September 2007, Proceedings of SPIE vol. 6737, Electro-Optical and Infrared Systems: Technology and Applications IV, 2007, p. 67370Z, paper [6737-35].

138. Y. Park, M. Andringa, D. Neikirk, H. Hewage, and E. Anslyn, "Smart microplates: Photodiode Within Silicon Pyramidal Cavity for Detecting Bead-Based Chemiluminescence and AC Characterization for RFID-Type Readout," 6th IEEE Conference on Sensors, Atlanta, Georgia, Oct 28-31, 2007, pp. 1189-1192.
139. P. Pasupathy, Dean P. Neikirk, and Sharon L. Wood, "Improved reading techniques for electronic structural surveillance tags," Proc. SPIE Volume 6932 / Wireless Sensors/Networks, Sensors and Smart Structures Technologies for Civil, Mechanical, and Aerospace Systems, March 2008, San Diego, California, USA, 2008693214 (2008), DOI:10.1117/12.776522.
140. Yoon Seok Park, Praveenkumar Pasupathy, Dean P. Neikirk, Eric V. Anslyn, "Micromachined platform for chemiluminescent and phosphorescent vapor detection" (Invited Paper), SPIE Europe Symposium on Security and Defence, Cardiff, Wales, 15 - 18 September 2008, Proceedings of SPIE vol. 7116, Optically Based Biological and Chemical Detection for Defence, paper [7116-27].
141. Puryear, J.M.H., Dickerson, N.P., Wood, S.L., and Neikirk, D.P., "Low-Cost Wireless Sensors for Concrete Bridges," NDE/NDT for Highways and Bridges: Structural Materials Technology, American Society for Nondestructive Testing, Oakland, CA, September 2008.
142. Pasupathy, P., Zhuzhou, M., Neikirk, D.P., Wood, S.L., "Unpowered resonant wireless sensor nets for structural health monitoring," 2008 IEEE Conference on Sensors, Lecce, Italy, Oct 26-29, 2008, pp. 697-700, ISBN: 978-1-4244-2580-8.
143. Wood, S.L. and Neikirk, D.P., "Passive Sensors for Infrastructure Monitoring," Proc. of SPIE Vol. 7292, keynote paper, Sensors and Smart Structures Technologies for Civil, Mechanical, and Aerospace Systems 2009, International Society for Optical Engineering, San Diego, California, 9 March 2009, pp. 729202-1 to 729202-11.
144. Joo-Yun Jung, Jong Yeon Park, and Dean P. Neikirk, "Wavelength-selective infrared detectors based on cross patterned resistive sheets," Proc. SPIE 7298, 72980L (2009), DOI:10.1117/12.818638, SPIE Defense and Security Symposium 2009, Infrared Technology and Applications XXXV, April 13-17, 2009.
145. Praveen Pasupathy, Shasi Munukutla, Dean P. Neikirk, and Sharon L. Wood, "Versatile wireless sacrificial transducers for electronic structural surveillance sensors," 2009 IEEE Conference on Sensors, Christchurch, New Zealand, Oct 25-28, 2009, paper B3L-C2, Oct. 27, IEEE Catalog Number: CFP09SEN-CDR, ISBN: 978-1-4244-5335-1, pp. 979-983.
146. Jun Wan Kim, Praveen Pasupathy, Sheng Zhang, and Dean P. Neikirk, "Measurement of liquid complex dielectric constants using non-contact sensors," 2009 IEEE Conference on Sensors, Christchurch, New Zealand, Oct 25-28, 2009, paper C5L-

C5, Oct. 28, IEEE Catalog Number: CFP09SEN-CDR, ISBN: 978-1-4244-5335-1, pp. 2017-2020.

147. Ali Abu Yousef, Praveenkumar Pasupathy, Sharon L. Wood, and Dean P. Neikirk, "Embedded Passive Sensors for Detecting Corrosion in Concrete Bridge Decks," 89th Annual Meeting, Transportation Research Board, Washington, DC, January 2010, Paper #10-3483.

147. Ye Chen, Praveenkumar Pasupathy, Dean P. Neikirk, Sharon L. Wood, "Magneto-inductive waveguide as a passive wireless sensor nets for structural health monitoring," Sensors and Smart Structures Technologies for Civil, Mechanical, and Aerospace Systems, Conference 7647 - Proceedings of SPIE Volume 7647, Date: Thursday 11 March, 2010, San Diego, California, USA.

148. Joo-Yun Jung, Jong Yeon Park, Dean P. Neikirk, Aniruddha S. Weling, William T. Hafer, James H. Goldie, Paul D. Willson, "Skin depth effects in wavelength-selective infrared microbolometers based on lossy frequency selective surfaces," Proceedings of SPIE, Vol. 7660, Infrared Technology and Applications XXXVI, Orlando, Florida, Monday-Friday 5-9 April 2010, paper number 7660-38.

149. Jong Yeon Park, Joo-Yun Jung, Dean P. Neikirk, Aniruddha S. Weling, William T. Hafer, James H. Goldie, Paul D. Willson, "Fabrication of wavelength selective germanium dielectric supported microbolometers," Proceedings of SPIE, Vol. 7660, Infrared Technology and Applications XXXVI, Orlando, Florida, Monday-Friday 5-9 April 2010, paper number 7660-139.

150. Ali Abu Yousef, Praveenkumar Pasupathy, Sharon L. Wood, and Dean P. Neikirk, "Passive Sensors for Detecting Corrosion in Concrete Structures," 3rd Congress of the International Federation for Structural Concrete, Washington, DC, May 2010.

151. Ali Abu Yousef, Praveenkumar Pasupathy, Sharon L. Wood, and Dean P. Neikirk, "Passive Sensors for Detecting Corrosion in Concrete Structures," 5th International Conference on Bridge Maintenance, Safety and Management, Philadelphia, PA, July 2010.

152. Ali Abu Yousef, Praveenkumar Pasupathy, Sharon L. Wood, and Dean P. Neikirk, "Passive Sensors for Detecting Corrosion in Concrete Bridge Decks," 7th International Bridge Engineering Conference Improving Reliability and Safety - Restoration, Renewal and Replacement, San Antonio, Texas, December 2010.

153. JinYoung Kim, Praveenkumar Pasupathy, Chih-Chieh Chou, Sharon L. Wood, and Dean P. Neikirk, "Embedded passive wireless sensors for detecting conductivity within RC structures," Proc. SPIE 7983, 79832L (2011); doi:10.1117/12.880412, SPIE Conference on Nondestructive Characterization for Composite Materials, Aerospace Engineering, Civil Infrastructure, and Homeland Security 2011 Monday 7 March 2011, San Diego, California.

154. Ali E. Abu-Yousef, Praveenkumar Pasupathy, Sharon L. Wood, and Dean P. Neikirk, "Low-Cost, Passive Sensors for Monitoring Corrosion in Concrete Structures," Proc. SPIE 7983, 79831Q (2011); doi:10.1117/12.879893, SPIE Conference on Nondestructive Characterization for Composite Materials, Aerospace Engineering, Civil Infrastructure, and Homeland Security 2011 Monday 7 March 2011, San Diego, California.
155. P. Pasupathy, A. Abu Yousef, D. P. Neikirk, and S. L. Wood, "Wireless Electronic Structural Surveillance Sensors Using Inductively Coupled Sacrificial Transducers," Progress in Electromagnetics Research Symposium, PIERS 2011, Marrakesh. Morocco, March 20-23, 2011, PIERS Online Vol. 7 No. 6 2011 pp: 511-515
156. Ye Chen, Praveen Pasupathy, and Dean P. Neikirk, "The Effects of Defects on Magneto-inductive Waveguide," Progress in Electromagnetics Research Symposium, PIERS 2011, Marrakesh. Morocco, March 20-23, 2011, PIERS Online Vol. 7 No. 6 2011 pp: 506-510
157. Sheng P. Zhang, Praveenkumar Pasupathy, Dean P. Neikirk, "Microfabricated self-resonant structure as a passive wireless chemical sensor," Proc. SPIE 8066, 80661L (2011); doi:10.1117/12.886895, SPIE International Symposium on Microtechnologies, Conference 8066 Smart Sensors, Actuators and MEMS (EMT101), Prague, Czech Republic, 18-20 April 2011, Paper 8066-57.
158. Joo-Yun Jung, Jong Yeon Park, Dean P. Neikirk, Aniruddha S. Weling, Will Hafer, James H. Goldie, and Paul D. Willson, "Experimental LWIR spectral characterization of wavelength selective microbolometers," SPIE Defense, Security, and Sensing, Infrared Technology and Applications XXXVII Proceedings of SPIE, paper number 8012-38, 25-29 April 2011, Orlando, Florida.
159. Jong Yeon Park, James E. Gardner, Praveen Pasupathy, Ji Won Suk, Rodney S. Ruoff, and Dean P. Neikirk, "Fabrication and Characterization of Wavelength Selective Microbolometers using a Planar Self-aligned Process for Low Deformation Membranes," in MOEMS and Miniaturized Systems XI, part of SPIE MOEMS-MEMS, San Francisco, California, 25 Jan 2012, SPIE Paper Number 8252-33, Proc. SPIE 8252, 82520Y (2012); <http://dx.doi.org/10.1117/12.906290> , 7 pages.
160. Ye Chen, Praveen Pasupathy, Tanuj Trivedi, Dean P. Neikirk and Sharon L. Wood, "Improved magneto-inductive waveguide as wireless sensor net for structural health monitoring," Nondestructive Characterization for Composite Materials, Aerospace Engineering, Civil Infrastructure, and Homeland Security 2012, San Diego, California, USA, Proc. SPIE 8347, 83472H (2012); <http://dx.doi.org/10.1117/12.915227>, Monday 12 March 2012, 8 pages.
161. Ali E. Abu-Yosef, Praveen Pasupathy, Sharon L. Wood and Dean P. Neikirk, "Detection of multiple corrosion thresholds in reinforced concrete structures using

passive sensors,” Nondestructive Characterization for Composite Materials, Aerospace Engineering, Civil Infrastructure, and Homeland Security 2012, San Diego, California, USA, Proc. SPIE 8347, 83470J (2012); <http://dx.doi.org/10.1117/12.915164> , Monday 12 March 2012, 7 pages.

162. JinYoung Kim, Praveenkumar Pasupathy, Sharon L. Wood and Dean P. Neikirk, “Enhanced resolution of passive wireless conductivity sensors,” Sensors and Smart Structures Technologies for Civil, Mechanical, and Aerospace Systems 2012, San Diego, California, USA, Proc. SPIE 8345, 83451B (2012); <http://dx.doi.org/10.1117/12.916754> , Monday 12 March 2012, 7 pages.

163. Tanuj Trivedi, Frank Raffaeli, Praveen Pasupathy, Ali E. Abu-Yousef, Ye Chen, Dean Neikirk and Sharon Wood, “A reflectometer-based reader for passive wireless structural surveillance sensors,” Nondestructive Characterization for Composite Materials, Aerospace Engineering, Civil Infrastructure, and Homeland Security 2012, San Diego, California, USA, Proc. SPIE 8347, 83470I (2012); <http://dx.doi.org/10.1117/12.915223> Monday 12 March 2012, 7 pages.

164. Hoo Kim and Dean P. Neikirk, “Three Dimensional Dual-band Stacked Microbolometer Design using resistive dipoles and slots,” SPIE Infrared Technology and Applications XXXIX, edited by Bjørn F. Andresen, Gabor F. Fulop, Charles M. Hanson, Paul R. Norton, Proc. of SPIE Vol. 8704, 870419, 11 June 2013.

165. Dean P. Neikirk, Hoo Kim, Jong Yeon Park, Joo-Yun Jung, “Patterned resistive sheets for use in infrared microbolometers,” SPIE Security + Defence, 25 Sep 2013 4:00 PM - 4:20 PM.

C. Published Abstracts

1. P.E. Young, Q.-X. Yu, W. A. Peebles, N.C. Luhmann, Jr., D. P. Neikirk, and D. B. Rutledge, "Application of Far-Infrared Imaging Arrays to Plasma Density and Magnetic Field Measurements," 4th APS Topical Conference on High Temperature, 1982.

2. P.E. Young, Q.-X. Yu, W.A. Peebles, N.C. Luhmann, Jr., D. P. Neikirk, and D. B. Rutledge, "Demonstration of Far-Infrared Phase Imaging," 24th Annual Meeting, Division of Plasma Physics, New Orleans, La., November, 1982.

3. P. E. Young, W.A. Peebles, N.C. Luhmann, Jr., R.J. Taylor, D. B. Rutledge, D. P. Neikirk, and P.P. Tong, "Current Profile Measurements in a Tokamak Plasma," 25th Ann. APS Meeting, Div. of Plasma Physics, Nov., 1983.

4. D. B. Rutledge, D. P. Neikirk, P.P. Tong, P.E. Young, W.A. Peebles, N.C. Luhmann, Jr., and R.J. Taylor, "Demonstration of a FIR Imaging System as a Multi-Channel Interferometer," 25th Ann. APS Meeting, Div. of Plasma Physics, Nov., 1983.

5. P.E. Young, N.C. Luhmann, Jr., R.J. Taylor, D. P. Neikirk, and D. B. Rutledge, 26th Annual Meeting of the Division of Plasma Physics, Boston, MA, Oct 29- Nov 2, 1984.
6. D.L. Brower, W.A. Peebles, S. Kim, R.L. Savage, Jr., T. Lehecka, N.C. Luhmann, Jr., J. Wagner, D. B. Rutledge, D. P. Neikirk, P.E. Young, and H.K. Park, "Recent advances in multichannel far-infrared collective scattering and interferometry systems," Eleventh Symposium on Fusion Engineering, Austin, TX, Nov. 18-22, 1985.
7. A.C. Campbell, V.P. Kesan, G.E. Crook, C.M. Maziar, D. P. Neikirk, and B. G. Streetman, "Capacitive Hysteresis Effects in 5.0nm single and double barrier AlAs Tunneling Structures," 8th Molecular Beam Epitaxy Workshop, Los Angeles CA, September 9-11, 1987.
8. A.C. Campbell, V.P. Kesan, G.E. Crook, D. P. Neikirk, and B. G. Streetman, "Capacitance Transient Analysis of GaAs/AlAs Tunneling Structures," 1988 Electronics Materials Conference, University of Colorado, Boulder, Colorado, June 22-24, 1988.
9. V.P. Kesan, A. Dodabalapur, D. P. Neikirk, and B. G. Streetman, "Influence of MBE Growth and Rapid Thermal Annealing Conditions on the Electrical Properties of Normal and Inverted AlGaAs/InGaAs Pseudomorphic HEMT Structures," IEEE 46th Annual Device Research Conference, June 20-22, 1988, Boulder, CO.
10. A. Dodabalapur, V.P. Kesan, T.R. Block, D. P. Neikirk, and B. G. Streetman, "Optical and Electrical Characteristics of Normal and Inverted AlGaAs/InGaAs Pseudomorphic HEMT Structures Processed by RTA," 9th Molecular Beam Epitaxy Workshop, West Lafayette, Indiana, September 21-23, 1988.
11. A. Sharif, D. P. Neikirk, and D.R. Diller, "Design and Fabrication of a Multi-Sensor Cryomicroscope Stage using VLSI Technology," Cryo 89, Charleston, SC, June 1989, published in **Physics in Medicine and Biology** 33.
12. A. Dodabalapur, V.P. Kesan, D. P. Neikirk, B. G. Streetman, M.H. Herman, and I.D. Ward, "Photoluminescence and Electreflectance Characterization of Modulation-Doped Quantum Wells," Journal of Electronic Materials 18, July 1989, p. 51.
13. V.K. Reddy and D. P. Neikirk, "Influence of Growth Interruption on I - V Characteristics of AlAs/GaAs Double Barrier Resonant Tunneling Diodes," 11th Annual Molecular Beam Epitaxy Workshop, Austin TX, Sept. 16-18, 1991.
14. A.J. Tsao, V.K. Reddy, D.R. Miller, K.K. Gullapalli, and D. P. Neikirk, "The effect of barrier thickness asymmetries on the electrical characteristics of AlAs/GaAs double barrier resonant tunneling diodes," 11th Annual Molecular Beam Epitaxy Workshop, Austin TX, Sept. 16-18 1991.
15. T.R. Block, D. P. Neikirk, and B. G. Streetman, "MBE growth condition dependence

of RHEED dampening and QW photoluminescence," Twelfth North American Conference on Molecular Beam Epitaxy, Ottawa, Canada, Oct. 12-14, 1992.

16. T.J. Mattord, D. P. Neikirk, A. Srinivasan, A. Tang, K. Sadra, Y.C. Shih, and B. G. Streetman, "Real time flux monitoring and feedback control of a valved arsenic source" Twelfth North American Conference on Molecular Beam Epitaxy, Ottawa, Canada, Oct. 12-14, 1992.

17. Y.C. Shih, D. P. Neikirk, and B. G. Streetman, "Effects of As flux on Si δ -doped GaAs," Twelfth North American Conference on Molecular Beam Epitaxy, Ottawa, Canada, Oct. 12-14, 1992.

18. Y. Kim and D. P. Neikirk, "Monolithically integrated optically interrogated pressure microsensor," **J. Acoust. Soc. Am.**, Vol. 92, No. 4 (pt. 2), October 1992, p. 2353.

19. O. Hartin, D. P. Neikirk, A. Anselm, and B. Streetman, "Memory Switching Simulation in Resonant Tunneling Devices," 1997 American Physical Society March Meeting, Kansas City, MO, March 17-21, Bulletin of the American Physical Society, Vol. 42, No. 1, 1997, p. 548.

20. O. Hartin and D. P. Neikirk, "Tight Binding Simulation of Memory Switching in Resonant Tunneling Devices," 1997 American Physical Society International Conference on Computational Physics, University of California, Santa Cruz, Aug. 25, 1997.

21. D. Neikirk, "Embedded Passive Sensors for State Monitoring," presented at NSF Workshop on Exploring the Uses of Autoadaptive Media in Geotechnical Earthquake Engineering, Austin, TX, January 10-12 2001.

22. Lavigne, John J.; Savoy, Steve; Best, Michael; Anslyn, Eric V.; Shear, Jason B.; McDevitt, John T.; Neikirk, Dean, "Toward the development of an 'electronic tongue'," Book of Abstracts, 219th ACS National Meeting, San Francisco, CA, March 26-30, 2000 (2000), AGFD-193.

23. Wood, Sharon; Neikirk, Dean, "Development of a passive sensor to detect cracks in welded steel construction," US-Japan Joint Workshop and Third Grantees Meeting, US-Japan Cooperative Research in Urban Earthquake Disaster Mitigation, Monbu-Kagakusho and The National Science Foundation, Seattle, August 15-16, 2001.

24. McCleskey, Shawn C.; Goodey, Adrian P.; Rodriguez, Marc D.; McDevitt, John T.; Anslyn, Eric V.; Neikirk, Dean P., "Development of a multi-component sensor array for the simultaneous detection of various analytes in solution," Abstracts of Papers, 222nd ACS National Meeting, Chicago, IL, United States, August 26-30, 2001.

D. Other Major Publications

V. Kesan and D. P. Neikirk, "Quantum Well Devices," **Microwaves and RF**, vol. 25, July 1986, pp. 93-97.

D. P. Neikirk, P. Cheung, M.S. Islam, and T. Itoh, "Optically Controlled Coplanar Waveguide Phase Shifters," **Microwave Journal**, Dec. 1989, pp. 77-88.

D. P. Neikirk, "Quantum Wells and Other Deep Subjects," **Discovery**, Vol. 11, No. 3, 1989, pp. 5-8.

S. M. Wentworth, J. M. Lewis, and D. P. Neikirk, "Antenna-Coupled Thermal Detectors of mm-Wave Radiation," **Microwave Journal**, Jan. 1993, pp. 94-103.

E. Book Chapter

D. B. Rutledge, D. P. Neikirk, and D. Kasilingam "Integrated- Circuit Antennas," in **Infrared and Millimeter Waves**, vol. 11, editor K.J. Button, 1984.

Nicolaos Christodoulides, Priya Dharshan, Jorge Wong, Pierre N. Floriano, Dean Neikirk and John T. McDevitt, "A Microchip-Based Assay for Interleukin-6," In: *Methods in Molecular Biology*, Volume 385: Microchip-Based Assay Systems, Humana Press, ISBN 978-1-58829-588-0 (Print) 978-1-59745-426-1 (Online), Copyright 2008, pages 131-144.

F. Technical Reports

C-K Tzuang, D. P. Neikirk, and T. Itoh, "Finite Element Analysis of Slow-Wave Schottky Contact Printed Lines," Microwave Laboratory Report No. 87-P-2, AFOSR Grant 86-0036, Feb., 1987.

D. P. Neikirk and T. Itoh, "Monolithic Phase Shifter Study," Microwave Laboratory Report No. 87-P-3, AFOSR Grant 86-0036, Jan., 1987.

V. P. Kesan and D. P. Neikirk, "Quantum Well Devices," Electrical Engineering Research Laboratory Report No. 87-P-8, Joint Services Electronics Program Research Contract AFOSR F49620-86-C-0045, August 7, 1987.

Stuart M. Wentworth and D. P. Neikirk, "High Frequency Characteristics of Tape Automated Bonding (TAB) Interconnects," Microwave Laboratory Report No. 87-P-7, August 26, 1987.

Stuart M. Wentworth and D. P. Neikirk, "Characterization of Tape Automated Bonding (TAB) Interconnects at High Frequency ," Microwave Laboratory Report No. 87-P-9, October 23, 1987.

D. P. Neikirk and T. Itoh, "Monolithic Phase Shifter Study," Microwave Laboratory Report No. 90-P-1, Final Technical Report for AFOSR Grant 86-0036, Feb., 1990.

A. Mortazawi, D. Neikirk, and T. Itoh, "Microwave and millimeter wave oscillators and planar power combining structures for QWITT and Gunn diodes," Microwave Laboratory Report No. 90-P-4, Technical Report for ARO Grant DAAL03-88-K-0005 and JSEP Grant F49620-89-0044, Aug., 1990.

Oral Presentations

A. Professional Society Presentation

D. B. Rutledge and D. P. Neikirk, "Imaging Antenna Arrays," Invited Keynote Speakers, Sixth International Conference on Infrared and Millimeter Waves, Miami, Fl., Dec. 7-12, 1981.

D. P. Neikirk and D. B. Rutledge, "Advances in Microbolometers," Invited Keynote Speakers, Eighth International Conference on Infrared and Millimeter Waves, Miami, Fl., Dec. 12-17, 1983.

D. P. Neikirk, "Optically Controlled Coplanar Waveguide Millimeter Wave Phase Shifter," Tenth International Conference on Infrared and Millimeter Waves, Lake Buena Vista, Fl., Dec. 9-13, 1985.

D. P. Neikirk, "Picosecond Response of an Optically Controlled Millimeterwave Phase Shifter," Second Topical Meeting on Picosecond Electronics and Optoelectronics, Jan., 1987.

D. P. Neikirk, "Influence of Transit Time Effects on the Optimum Design and Maximum Oscillation Frequency of Quantum Well Oscillators," 12th International Conference on Infrared and Millimeter Waves, Dec. 14-18, 1987.

D. P. Neikirk, "Measurements of an Optically Controlled Coplanar Waveguide Phase-Shifter," 12th International Conference on Infrared and Millimeter Waves, Dec. 14-18, 1987.

D. P. Neikirk, "High Frequency Characterization of Tape-Automated Bonding Interconnects," 5th Annual Texas Regional Symposium, International Society of Hybrid Manufacturing, April 11, 1988.

D. P. Neikirk, "Time Dependent Simulation of the Quantum Well Injection Transit Time Diode," 13th International Conference on Infrared and Millimeter Waves, Dec. 5-9, 1988.

D. P. Neikirk, "Experimental Performance of a Periodically Illuminated Optically Controlled Coplanar Waveguide Phase Shifter," 13th International Conference on Infrared and Millimeter Waves, Dec. 5-9, 1988.

B. Invited Lectures

1. D. P. Neikirk, "Exotic Heterojunction Devices for Microwave Circuits," NSF Workshop on Future Research Opportunities in Electromagnetics, Arlington, TX., January 29-31, 1986.
2. D. P. Neikirk, "Optical Control of a Monolithic Millimeter Phase Shifter," ARO Workshop on Fundamental Issues in Millimeter and Submillimeter Waves, Los Angeles, Ca., Sept. 15-16, 1986.
3. Dean P. Neikirk, "Quantum Well Oscillators for Millimeter Wave Applications," 1987 Workshop on Compound Semiconductor Microwave Materials and Devices (WOCSEMMAD), Hilton Head Island, S.C., March 2-4, 1987.
4. S.M. Wentworth and D. P. Neikirk, "High Frequency Tape-Automated Bonding (TAB) Interconnect Characterization," IEEE 6th Annual VLSI and GaAs Packaging Workshop, Sept. 14-16, 1987.
5. D. P. Neikirk, "The quantum well injection transit time diode," Engineering Foundation Conference on Advanced Heterostructure Transistors, Keauhou-Kona, Hawaii, Dec. 5-10, 1988.
6. D. P. Neikirk, "The High Frequency Characteristics of Tape Automated Bonding (TAB) Interconnects," presented to the Microelectronics and Computer Technology Corporation, April 19, 1989.
7. Dean P. Neikirk, "Impedance measurements of quantum well diodes for millimeter wave applications," 1990 Workshop on Compound Semiconductor Microwave Materials and Devices (WOCSEMMAD), San Francisco, CA., Feb. 12-14, 1990.
8. Dean P. Neikirk, "Twin-slot multi-layer substrate-supported antennas and detectors for terahertz imaging," First International Symposium on Space Terahertz Technology, University of Michigan, Ann Arbor, Mich., March 5-6, 1990.
9. Dean P. Neikirk, "Microwave and Millimeterwave Oscillators using Quantum Well Diodes," Joint IEEE MTT/ED Dallas Chapter meeting, Sept. 27, 1990.
10. Dean P. Neikirk, "Quantum Transport Simulations of Resonant Tunneling Diodes," 1991 Workshop on Compound Semiconductor Microwave Materials and Devices (WOCSEMMAD), Ft. Lauderdale, FL., Feb. 18-20, 1991.

11. Dean P. Neikirk, "The Application of Physics in Electrical Engineering (or is it Engineering in Physics?): Electromagnetics in Very High Frequency Semiconductor Devices," Physics Colloquium, Oklahoma State University, March 5, 1992.
12. D. P. Neikirk and B. G. Streetman, "MBE growth of multilayer heterostructures for photonic and high-speed electronic devices," Engineering Foundation Conference on High Speed Optoelectronic Devices and Circuits II, Banff, Alberta, Canada, Aug. 9-13, 1992.
13. L. T. Pillage, D. P. Neikirk, and R. Mercer, "Design automation techniques and algorithms for application specific electronic modules (ASEMs)," ARPA Electronic Packaging & Interconnect Principle Investigator Meeting, Marina del Ray, CA, Feb. 14-18, 1994.
14. D. P. Neikirk, "Micro-sensors - What happens when you make classical devices small?: Integrated Bolometric Radiation Detectors," Texas Instruments, Dallas, Texas, Oct. 20, 1994.
15. Dean P. Neikirk, "Micromachined sensors," Motorola Sensors Steering Committee, Albuquerque, New Mexico, March 28, 1995.
16. D. P. Neikirk, E. Tuncer, and B.-T. Lee, "The Use of Effective Internal Impedance Approximations in Lossy Transmission Line Modeling," *Progress in Electromagnetics Research Symposium PIERS 95*, The University of Washington, Seattle, Washington, July 28, 1995.
17. D. P. Neikirk, M. S. Islam, and E. Tuncer, "Accurate Quasi-Static Modeling of Transmission Lines on Semiconducting Substrates," *Progress in Electromagnetics Research Symposium PIERS 95*, The University of Washington, Seattle, Washington, July 28, 1995.
18. D. P. Neikirk, "Impact of Finite Metal Conductivity on Inductance Extraction of Interconnects and Packages," Sematech meeting on Electrical Modeling Challenges Faced by Packaging Designers, Austin, Texas, Nov. 19, 1995.
19. D. P. Neikirk, "Micromachined Fabry-Perot Pressure Transducers," Hughes Research Laboratory, Malibu, California, Nov. 21, 1995.
20. D. P. Neikirk, "Classical Devices Made Small; or 'What's the big deal about little machines?'" , Manufacturing 2000, University of Texas at Austin, Feb. 23, 1996.
21. D. P. Neikirk, "Interconnect Inductance Modeling from DC to the Skin Effect Limit," Quad Designs, Camarillo, CA, July 10, 1996.
22. D. P. Neikirk, "Efficient Conductor Boundary Conditions in the dc to Skin Effect Limit," DARPA MAFET Program Review, Fairfax, VA, Oct. 27-31, 1997.

23. Micromachined Array-based Multi-analyte Chemical Sensors: Towards the Fabrication of an "Electronic Tongue" South, Texas Local Section of The Electrochemical Society Meeting, April 17, 1999.

24. D. P. Neikirk, "Resonant Chemical Surveillance Tags," IEEE Electron Device Chapter, Central Texas Section, September 25, 2008.

25. D.P. Neikirk, "Near Borehole Condition Sensing," Nanotechnology Conference and Trade Show - Nanotech 2009, Houston, TX May 3-7, 2009, Nanotech & Cleantech for Oil & Gas Session, (Session chair: Sean Murphy, Advanced Energy Consortium), May 5, 2009.

26. D.P. Neikirk, "Integrated Threshold Nanosensor Systems," Advanced Oil Consortium Microfabricated Sensors Workshop, Houston Research Center, Bureau of Economic Geology, University of Texas at Austin, September 8th-9th, 2010.

27. D. P. Neikirk, "Sensing systems for "harsh" environments," Engineering Challenges for Deepwater Drilling at the "U.S. Offshore Oil Exploration: Managing Risks to Move Forward," James A. Baker III Institute for Public Policy and PFC Energy, Rice University, Houston, TX, February 11, 2011.

C. Other Conference Presentations

Praveen Pasupathy, Mingxiang Zhuzhou, Shasi K. Munukutla, Dean P. Neikirk, and Sharon L. Wood, "Resonant Wireless Sensor Nets for Civil Infrastructure Health Monitoring," 2009 National Science Foundation Division of Civil, Mechanical and Manufacturing Innovation (CMMI) Engineering Research and Innovation Conference, Honolulu, Hawaii, June 22-25, 2009.

Technical Consulting

Teltech Resource Network (1985-1993)
Ardex, Inc. (1986-88)
University and Polytechnic Grants Committee, Consultancy to examine Equipment Requirements for the Hong Kong University of Science and Technology, July, 1989
E. P. Hamilton Associates, (1987-90)
Burnett Company, Microwave Heating for Secondary Oil Recovery, July, 1990
Microelectronics and Computer Technology Corporation, June, 1990
Microelectronics and Computer Technology Corporation, Oct., 1994 - Sept., 1996
Baker-Hughes

University Committee Assignments

Departmental:

Graduate Student Financial Aid, Sept. 1984- Sept. 1987
Faculty Recruiting, Sept. 1984- Aug. 1985
Microelectronics Jr. Faculty Recruiting, Sept. 1985- Sept. 1987 (chairman)
ECE Safety Committee, Sept. 1985- Aug. 1993 (chairman, 1985-89)
ECE Electronics Shop Coordinating Committee, March 1986- Aug. 1993
Solid State Electronics Area Graduate Advisor, Aug. 1986- Aug. 89
ECE Space Allocation Committee, Sept. 1989-Aug. 1993 (chairman)
ECE Facilities Committee, Sept. 1993- Aug. 1996 (chairman)
ECE Areas Committee, Electromagnetics/Acoustics, Sept. 1993-present
ECE Ad Hoc Committee to Review the Undergraduate Curriculum, Jan. 1995- Aug. 1995
ECE World Wide Web Home Page Committee, Sept. 1995-Aug. 1996
ECE Ad Hoc Committee to Review the Undergraduate Curriculum, Jan. 1997- Aug. 1997
ECE Areas Committee, Materials and Quantum Electronics, Sept. 1993-present; chairman, Sept. 1996-present
Chair of ECE Graduate Studies Committee, May 1998-August 2006
ECE Chair's council, November 1999-2010
ECE Graduate Advisor, Sept. 1999- 2010
ECE Associate Chair, Sept. 2001-Dec. 2010
ECE peer Faculty Annual Review Committee, Sept. 2012-Aug. 2013

College:

Engineering Scholastic Appeals, Sept. 1984- Aug. 1985
Engineering Safety Committee, Sept. 1985- Aug. 1994 (chairman, Sept. 1989-Aug. 1994)

Aerospace Engineering Machine Shop, Sept. 1989-Aug. 1993
College Annual Report Quality Team, Jan. 1994- Aug. 1994
College Multimedia Committee, Sept. 1995-Aug. 2000
Equal Opportunity in Engineering (EOE) Program, 1995-Dec. 1996
Graduate Fellowship Review Committee, Sept. 2011-Aug. 2013

University:

Presidential Ad Hoc Committee on Research Infrastructure Enhancement, Jan. 1988 - Aug. 1994
Research Safety Advisory Committee, Oct. 1991-present (chairman, Sept. 1996-1999)
Ad Hoc Consultative Committee for the Selection of a Dean of the College of Engineering, Nov. 1995-May 1996
Faculty Building Advisory Committee, Sept. 1995-Aug. 2000; Aug. 2003-Aug. 2004
Ad Hoc Project Committee for Parking Garage # 4A, Sept. 1996-Aug. 2000
Faculty Council, Sept. 1996-Aug. 2000; Sept. 2002 - Aug. 2004
Faculty Advisory Committee on the Budget, Sept. 99 - Aug. 2000; Sept. 2008 – Aug. 2011 (vice chair Sept. 2009- Aug. 2010)
Graduate Assembly, April 1997- Aug. 2000; Sept. 2001 - Aug. 2008
Administrative sub-committee of GA, Sept. 1997-Aug. 1998; Sept. 2006-Aug. 2007
Academic sub-committee of GA, Sept. 1998-Aug. 2000; Sept. 2001-Aug. 2006; Sept. 2007-Aug. 2008
Chair, Graduate Assembly, 2004-2005
Academy of Distinguished Teachers selection committee, academic year 1999-2000
Outstanding Graduate Adviser selection committee, academic year 1999-2000
Outstanding Graduate Coordinator selection committee, academic year 1999-2000
Faculty Council, Sept. 2008 – Aug. 2012; Chair-elect Sept. 2009- Aug. 2010; Chair Sept. 2010- Aug. 2011; past chair: Sept. 2011-Aug. 2012
Faculty Council Executive Committee, Sept. 2009 – Aug. 2012
General Faculty Rules and Governance Committee, Sept. 2010 – Aug. 2015 (Chair, Sept. 2011 – Aug. 2013)
Ad Hoc Consultative Committee for the Selection of a Dean of the Graduate School, Nov. 2012 – Sept. 2012
Secretary of the General Faculty and Faculty Council, Sept. 2013 – Aug. 2015
Committee on Undergraduate Degree Program review, Sept. 2013 – Aug. 2015
Faculty Council Executive Committee, Sept. 2013 – Aug. 2015
Faculty Committee on Committees, *ex officio* member, Sept. 2013 – Aug. 2015

UT System:

Task Force on Doctoral Programs and Post-Doctoral Experience, Spring-Fall 2006

University of Texas System Faculty Advisory Council, Sept. 2009- Aug. 2011

State of Texas:

Texas Higher Education Coordinating Board Graduate Education Advisory Committee (GEAC), September 1, 2015 - August 31, 2018.

Evidence of Teaching Effectiveness

Senior Design Projects:

Umer Yousafzai and Venuka Jayatilaka, Spring 1994

Chris Eiting and Sonny Gonzalez, Spring 1994

David Lee and David Onsongo, Fall 1996

Dave Pyle and Aruna Murthy, Spring 1999

Hitesh Mehta and Edward Zhu, Spring 1999, "Giving the electronic tongue a sense of good taste: image analysis tools and GUI"

Gus Espinosa and Donnie Garcia, Spring 1999, "Design and Implementation of a Computer Interfacing Circuit to Control LED's for use with a Chemical Sensor"

Natthanant Pon Skulkaew and Prem Nainani, Spring 2001, "PC-based data acquisition and wireless transmission system"

Matthew Andringa and Allen Hall, Spring 2001, "Non-Invasive RFID Weld Inspection"

Michael Amalfitano and Sapun Parekh, Spring 2002, "Output circuitry for a transmitter used in an Electronic Structural Surveillance system"

Kunal Patel and Jacy Little, Spring 2002, "Swept, high frequency oscillator to work in an Electronic Structural Surveillance (ESS) system"

Dong Pak, Spring 2002, "Automated image-processing software of an electronic chemical sensor"

Rajesh Nerlikar, Jonathan Solomon, Spring 2003, "Wireless Data Acquisition System for Bluetooth-enabled RFID Readers"

Nola Li, Judith Chen, Maria Huang, Fall 2003, "Design and build a tuning network for a swept frequency reader used in structural health analysis"

Tuenlap (Daniel) Chan, Imranul Islam, Derek Choi, Spring 2004, "Design and build an RFID Interrogator Receiver"

John McKee and Terence Man, Spring 2007, "Improved Corrosion Sensors"

Abdulaziz Beayeyz, Sravan Bhagavatula, Rahul Mitra, Shasi Munukutla, Spyder Spann, Fall 2009, "Portable Corrosion Detector"

Jonathan Pham, Po-Han Wu, Josh Schulte, Pritesh Solanki, Mesele Bedasa, Spring 2011- Fall 2011, "Multi-Sensor Robotics Platform"

Raymund Lee, Simon Chow, Connor Landy, Kevin Woo, and Anirudh Kashyap, Fall 2012-Spring 2013, "Variable Frequency RFID Tag and Reader"

Javier Chacon, Joshua Poncik, Joshua Orozco, Sebastian Salomon, Yongcong Zou, Fall 2013-Spring 2014, "Environmental Sensor Monitoring Network"

Organized Classes Taught:

EE 363M Introduction to Microwaves, Spring 1984, # 16455
EE 396K VLSI Fabrication Techniques, Fall 1984, # 16255
EE 379K Integrated Circuit Fabrication, Spring 1985, # 16055
EE 396K VLSI Fabrication Techniques, Fall 1985, # 16275
EE 379K Integrated Circuit Fabrication, Fall 1985, # 16070
EE 396K VLSI Fabrication Techniques, Spring 1986, # 17680
EE 379K Integrated Circuit Fabrication, Spring 1986, # 17450
EE 396K VLSI Fabrication Techniques, Fall 1986, # 15245
EE 379K Integrated Circuit Fabrication, Fall 1986, # 15020
EE 396K VLSI Fabrication Techniques, Spring 1987, # 15205
EE 379K Integrated Circuit Fabrication, Spring 1987, # 14970
EE 396K VLSI Fabrication Techniques, Fall 1987, # 15010
EE 440 Integrated Circuit Fabrication, Fall 1987, # 14545
EE 363M Introduction to Microwaves, Spring 1988, # 14535
EE 396K VLSI Fabrication Techniques, Spring 1988, # 14865
EE 440 Integrated Circuit Fabrication, Spring 1988, # 14390
EE 396K VLSI Fabrication Techniques, Fall 1988, # 15165
EE 440 Integrated Circuit Fabrication, Fall 1988, # 14705
EE 363M Introduction to Microwaves, Spring 1989, # 14525
EE 396K VLSI Fabrication Techniques, Spring 1989, # 14855
EE 396K VLSI Fabrication Techniques, Fall 1989, # 15165
EE 440 Integrated Circuit Fabrication, Fall 1989, # 14705
EE 363M Introduction to Microwaves, Spring 1990, # 14050
EE 396K VLSI Fabrication Techniques, Spring 1990, # 14355, 14360
EE 440 Integrated Circuit Fabrication, Spring 1990, # 13915, 13920
EE 396K VLSI Fabrication Techniques, Fall 1990, # 14630, 14635
EE 440 Integrated Circuit Fabrication, Fall 1990, # 14200, 14205
EE 363M Introduction to Microwaves, Spring 1991, # 14365
EE 396K VLSI Fabrication Techniques, Spring 1991, # 14660, 14665, 14670
EE 440 Integrated Circuit Fabrication, Spring 1991, # 14220, 14225, 14230
EE 396K VLSI Fabrication Techniques, Fall 1991, # 14865, 14860
EE 440 Integrated Circuit Fabrication, Fall 1991, # 14425, 14430
EE 363M Introduction to Microwaves, Spring 1992, # 14270
EE 396K VLSI Fabrication Techniques, Spring 1992, # 14545, 14550, 14555
EE 440 Integrated Circuit Fabrication, Spring 1992, # 14130, 14135
EE 396K VLSI Fabrication Techniques, Fall 1992, # 15095, 15100, 15105
EE 440 Integrated Circuit Fabrication, Fall 1992, # 14670, 14675
EE 397K Microwave Devices, Spring 1993, # 14805
EE 396K VLSI Fabrication Techniques, Fall 1993, # 14800, 14805, 14810
EE 440 Integrated Circuit Fabrication, Fall 1993, # 14385, 14390
EE 363M Introduction to Microwaves, Spring 1994, # 14370
EE 396K VLSI Fabrication Techniques, Fall 1994, # 14365

EE 440 Integrated Circuit Fabrication, Fall 1994, # 13870
 EE 397K Electromagnetics in Packaging, Spring 1995, # 14555
 EE 396K VLSI Fabrication Techniques, Fall 1995, # 14765
 EE 440 Integrated Circuit Fabrication, Fall 1995, # 14260
 EE 397K Electromagnetics in Packaging, Spring 1996, # 14695
 EE 382M Simulation Methods in CAD/VLSI, Spring 1996, # 14500
 EE 396K VLSI Fabrication Techniques, Fall 1996, # 14535
 EE 440 Integrated Circuit Fabrication, Fall 1996, # 14090
 EE 382M Simulation Methods in CAD/VLSI, Spring 1997, # 14325
 EE 363M Introduction to Microwaves, Spring 1997, # 14120
 EE 396K VLSI Fabrication Techniques, Fall 1997, # 15315
 EE 440 Integrated Circuit Fabrication, Fall 1997, # 14820
 EE 363M Introduction to Microwaves, Spring 1998, # 14530
 EE 397K Microwave Devices, Spring 1998, # 14950
 EE 396K VLSI Fabrication Techniques, Fall 1998, # 15475
 EE 440 Integrated Circuit Fabrication, Fall 1998, # 14965
 EE 363M Introduction to Microwaves, Spring 1999, # 14825
 EE 397K Microwave Devices, Spring 1999, # 15260
 EE 396K VLSI Fabrication Techniques, Fall 1999, # 15340
 EE 440 Integrated Circuit Fabrication, Fall 1999, # 14820
 EE 363M Introduction to Microwaves, Spring 2000, # 14755
 EE 396K VLSI Fabrication Techniques, Fall 2000, # 15600
 EE 440 Integrated Circuit Fabrication, Fall 2000, # 15100
 EE 397K Micro-electromechanical Systems (MEMS), Spring 2001, #15170
 EE 396K VLSI Fabrication Techniques, Fall 2001, # 15725
 EE 440 Integrated Circuit Fabrication, Fall 2001, # 15230
 EE 397K Micro-electromechanical Systems (MEMS), Spring 2002, #15330
 EE 396K VLSI Fabrication Techniques, Fall 2002, # 16050
 EE 440 Integrated Circuit Fabrication, Fall 2002, # 15485
 EE 397K Microwave Devices, Spring 2003, # 15110
 EE 396K VLSI Fabrication Techniques, Fall 2003, # 15580
 EE 440 Integrated Circuit Fabrication, Fall 2003, # 15095
 EE 325 Electromagnetic Engineering, Spring 2004, # 14345
 EE 396K VLSI Fabrication Techniques, Fall 2004, # 16250
 EE 440 Integrated Circuit Fabrication, Fall 2004, # 15715
 EE 396K 26-Microelectromechanical Systems, Spring 2005, # 15690
 EE 396K VLSI Fabrication Techniques, Fall 2005, # 16455
 EE 440 Integrated Circuit Fabrication, Fall 2005, # 15930
 EE 396K VLSI Fabrication Techniques, Fall 2006, # 17040
 EE 440 Integrated Circuit Fabrication, Fall 2006, # 16430
 EE 325 Electromagnetic Engineering, Spring 2007, # 15765
 EE 396K VLSI Fabrication Techniques, Fall 2007, # 17425
 EE 440 Integrated Circuit Fabrication, Fall 2007, # 16770
 EE 396K-26 Microelectromechanical Systems, Spring 2008, # 16815
 EE 396K VLSI Fabrication Techniques, Fall 2008, # 17380
 EE 325 Electromagnetic Engineering, Spring 2009, # 16000

EE 396K-24 Microwave Devices, Spring 2010, # 16975
 EE 396K VLSI Fabrication Techniques, Fall 2010, # 17075, 17080, 17085, 17090
 EE 440 Integrated Circuit Fabrication, Fall 2010, # 16540, 16545, 16550, 16555
 EE 396K VLSI Fabrication Techniques, Fall 2011, # 17295, 17300, 17305, 17310
 EE 440 Integrated Circuit Fabrication, Fall 2011# 16760, 16765, 16770, 16775
 EE 396K 26-Microelectromechanical Systems, Spring 2012, #17070
 EE 396K VLSI Fabrication Techniques, Fall 2012, # 17185, 17190, 17195, 17200
 EE 440 Integrated Circuit Fabrication, Fall 2012, # 16640, 16645, 16650, 16665
 EE 363M Introduction to Microwaves, Spring 2013, # 16605
 EE 396K Ultra Large Scale Integrated Circuit Fabrication Techniques, Fall 2013, # 17425, 17430, 17435, 17440
 EE 440 Integrated Circuit Nanomanufacturing Techniques, Fall 2013, # 16790, 16795, 16800, 16805
 EE 396K-24 Microwave Devices. Spring 2014, #17440
 EE 396K Ultra Large Scale Integrated Circuit Fabrication Techniques, Fall 2014, #17525, 17530, 17535, 17540
 EE 440 Integrated Circuit Nanomanufacturing Techniques, Fall 2014, #16960, 16965, 16970, 16975
 EE 363M Microwave and Radio Frequency Engineering, Spring 2015, #16355
 EE 396K Ultra Large Scale Integrated Circuit Fabrication Techniques, Fall 2015, #16965, 16970, 16975
 EE 440 Integrated Circuit Nanomanufacturing Techniques, Fall 2015, #16480, 16485, 16490
 EE 363M Microwave and Radio Frequency Engineering, Spring 2016, #16550
 EE 396K Ultra Large Scale Integrated Circuit Fabrication Techniques, Fall 2016
 EE 440 Integrated Circuit Nanomanufacturing Techniques, Fall 2016
 EE 396K 26-Microelectromechanical Systems, Spring 2017
 EE 363M Microwave and Radio Frequency Engineering, Spring 2018, #15890

Continuing Education Courses Taught

"Microelectronics Fabrication - Chemical Aspects," with Isaac Trachtenberg,
 Continuing Engineering Studies, College of Engineering, The University of
 Texas at Austin, June 1-4, 1987.
 "Integrated Circuit Process & Design," with M. R. Mercer, Motorola short course,
 Continuing Engineering Studies, College of Engineering, The University of

Texas at Austin:

- Aug.-Sept., 1987
- Nov.-Dec., 1987
- Nov.-Dec., 1988
- March-April, 1989
- Aug.-Sept., 1989
- Nov.-Dec., 1989
- Feb.-March, 1990
- April, 1990
- Aug., 1990

"Integrated Circuit Processing and Design," with L. T. Pillage, Advanced Micro Devices short course, Continuing Engineering Studies, College of Engineering, The University of Texas at Austin:

- Oct.-Nov., 1990
- June-July, 1991

"Microelectronics Fabrication," for the Fellows of the Senior Service College Fellowship Program, Continuing Engineering Studies, College of Engineering, The University of Texas at Austin, yearly 1993-2003.

Cases: Dean P. Neikirk

Trial experience: five jury trials (Federal District Court); two ITC bench trials; two California State Court trials (trade secrets)

Expert reports: over 40

Depositions: over 30

1. Jan. 2003-June 2003: Vinson & Elkins, counsel for International Rectifier, Patent infringement case: Hitachi Ltd., et. al. v. International Rectifier

Corporation, in the United States District Court for the Central District of California, Case No. CV-02-0077-R; [no testimony or depositions]

Semiconductor / IC processing

2. August 2003-August 2004: Wilmer Cutler Pickering Hale and Dorr LLP, counsel for Analog

Devices, patent infringement case: Motorola, Inc. v. Analog Devices, Inc. TX Eastern - Beaumont Civil Action No. 1:03-cv-131 (RHC); case settled [three depositions]

Semiconductor / IC processing

3. April 2004-March 2005: Fish & Richardson P.C., counsel for Micron, patent infringement case:

Micron Technology, Inc. adv. Motorola, Inc. USDC-W.D. TX (Austin) - Civil Action No. A04 CA 007; case settled [no testimony or depositions]

Semiconductor / IC processing

4. Jan 2004- July 2004: Howrey Simon Arnold & White, counsel for ASM in patent litigation with Applied Materials; case settled [no testimony or depositions]

Semiconductor processing equipment

5. May 2004-Dec. 2006: Vinson & Elkins, counsel for Advanced Micro Devices, patent infringement case: Advanced Micro Devices, Inc. v Oki America, Inc., et al.

Originally TX Eastern District Marshall, Civil action No. 2:03-CV-373, transferred to Northern California; case settled [depositions and expert reports]

Semiconductor / IC processing

6. April 2004-May 2006: Fish & Richardson P.C., counsel for AVID Identification Systems, patent

infringement case: Avid v. Crystal Import Corporation, et al., USDC-EDTX Marshall Div. Case No. 2:04-cv-183; [depositions and expert reports; jury trial May 2006]

RFID

7. November 2005 – 2006: Keker & Van Nest, LLP, counsel for Intel, patent infringement case:

Ohmi v. Intel Corp., et al.- 2:05CV-209 TJW [no testimony or depositions].

Semiconductor / IC processing

8. July 2006 – March 2007: Fish & Richardson P.C., counsel for Applied Materials, patent

infringement case: Semiconductor / IC processing SEZ Holdings AG, et al. vs. Applied Materials, Inc. USDC-D. Del. - C.A. No. 05-552-SL; case settled [expert report submitted, otherwise no

depositions or testimony]; case settled

Semiconductor / IC processing

9. July 2006 – May 2007: Kenyon & Kenyon, counsel for FCI; patent infringement case: FCI USA, Inc. v. Tyco Electronics, Case No. 2:06cv128; case settled [no testimony or depositions]

Printed circuit board connector design

10. January 2007 – Dec. 2007: Vinson & Elkins, counsel for Lutron Electronics Co., Inc. in ITC matter Lutron Electronics Co. vs. Leviton Manufacturing Co., Inc., United States International Trade Commission, Honorable Carl C. Charneski, Investigation No. 337-TA-599, In the matter of certain lighting control devices including dimmer switches and/or switches and parts thereof. [no testimony or depositions]; case closed

RF lighting controls

11. February 2007 – Dec. 2007: LATHAM & WATKINS LLP counsel for FLIR Systems, Inc and Indigo Systems Corp. (plaintiff) v. William Parrish, E. Timothy Fitzgibbons, Superior Court of the State of California, County of Santa Barbara, case no. 1220581. [expert report, deposition; trial testimony]

Infrared sensors

12. May 2007 – Feb. 2008: Vinson & Elkins L.L.P., on behalf of Silicon Labs ("SiLabs") in connection with Analog Devices, Inc., Plaintiff, v. Silicon Laboratories, Inc., Defendant, United States District Court, District of Massachusetts, Civil Action No. 06-12240 (WGY) [expert reports, deposition]; case settled

Digital isolators

13. November 2006 – January 2010: Jones Day, counsel for Sercel, Input/Output, Inc., et al. v. Sercel, Inc., Case No. 5:06-CV-236-DF/CMC, [deposition; trial testimony (jury trial)]; trial January 2010, July 2010.

MEMS sensors and fabrication

14. February 2007 – Dec 2008: Vinson & Elkins, counsel for Lutron Electronics Co., Inc. in *Lutron Electronics Co., Inc. vs. CONTROL4 Corp. Case No. 2:06-CV-00401 DAK, US District Court, District of Utah* ; case settled [deposition].

RF lighting controls

15. June 2007 – July 2011: Kirkland & Ellis LLP, counsel for AVID, in Allflex USA, Inc. v. AVID Identification Systems, Inc., UNITED STATES DISTRICT COURT CENTRAL DISTRICT OF CALIFORNIA Case No. EDCV-06-1109-SGL (OPx) [declaration, expert report]

RFID

16. January 2008 – May 2009: Gibbs & Bruns, L.L.P., counsel for LONESTAR INVENTIONS, L.P., Plaintiff, v. NINTENDO OF AMERICA, INC., Defendant, UNITED STATES DISTRICT COURT FOR THE EASTERN DISTRICT OF TEXAS, TYLER DIVISION, CASE NO. 6:07-CV-261-LED; case settled [deposition].

Semiconductor devices.

17. May 2008 – Dec 2009: Heller Ehrman LLP, counsel for Maxim Integrated Products, Inc. v. Freescale Semiconductor, Inc., United States District Court, Northern District of California, Case No.: 3:08-cv-00979-BZ [no depositions or testimony]
Semiconductor / IC processing / electronic packaging

18. January 2008 – November 2008: Gibbs & Bruns, L.L.P., counsel for LONESTAR INVENTIONS, L.P., Plaintiff, v. SANDISK CORPORATION, Defendant, UNITED STATES DISTRICT COURT FOR THE EASTERN DISTRICT OF TEXAS, TYLER DIVISION, CASE NO. 6:07-CV-374; LONESTAR INVENTIONS, L.P., Plaintiff, v. XILINX, INC., Defendant, UNITED STATES DISTRICT COURT FOR THE EASTERN DISTRICT OF TEXAS, TYLER DIVISION, CASE NO. 6:07-CV-0393-LED. Case settled.
Semiconductor devices.

19. November 2008 – April 2009: Wilson Sonsini Goodrich & Rosati, counsel for Luna Innovations, Incorporated, in Hansen Medical, Inc. v. Luna Innovations, Incorporated, Superior Court of the State of California County of Santa Clara Case No. 107 CV 088551.[expert report; deposition; trial testimony]
Optical devices.

20. February 2009 – Dec 2009: Finnegan, Henderson, Farabow, Garrett & Dunner, L.L.P., Fish & Richardson P.C., Howrey LLP, Kenyon & Kenyon, LLP, and Hartline, Dacus, Barger, Dreyer & Kern, L.L.P. (collectively, “Defendants’ Counsel”) representing Audi/VW, BMW, Hyundai/Kia, Isuzu, Nissan, Porsche, and Subaru (collectively, the “Defendant Companies”) in MHL TEK, LLC v. Nissan Motor Company, et al., Civil Action No. 2:07-cv-00289, U.S. District Court for the Eastern District of Texas. Summary judgment of non-infringement [two expert reports; one deposition]
Pressure sensors

21. January 2010 – April 2010: King & Spalding LLP, counsel for Spansion in Complaint in United States International Trade Commission Investigation No. 337-TA-664, respondents Samsung, Apple, Hon Hai Precision Industry, Asus, Kingston, Lenovo, PNY, Research In Motion, Sony, Beijing SE Putian Mobile Communication Co, Transcend, Verbatim. [one deposition]
Semiconductor devices.

22. December 2010-April 2011: Thompson & Knight LLP, counsel for STMicroelectronics, Inc. (ST) in ST v. Avago, Civil Action No. 3:10-cv-1460, United States District Court, Northern District of Texas, Dallas Division.
Semiconductor devices.

23. October 2010-June 2011: McDermott Will & Emery, counsel for Spansion in Spansion LLC v. Samsung Electronics Co. Civil Action No. 08-855 (D. Del.).
[Case settled]
Semiconductor devices.

24. October 2010-June 2011: McDermott Will & Emery, counsel for Spansion in Spansion, LLC, et al. v. Samsung Electronics Co., et al., Civil Action Nos. 3:10-cv-453 and 3:10-cv-685 (W.D. Wisc.).

[Case settled]

Semiconductor devices.

25. June 2007-July 2011: Kirkland & Ellis LLP, counsel for AVID in Allflex USA, Inc. v. AVID Identification Systems, Inc., UNITED STATES DISTRICT COURT CENTRAL DISTRICT OF CALIFORNIA Case No. EDCV-06-1109-SGL (OPx) [expert reports]

[Case settled]

RFID tags.

26. August 2011- September 2011: Patterson & Sheridan, LLP, counsel for Silicon Laboratories, Case No. 1:10-cv-0607-LY; Silicon Laboratories, Inc. v. Airoha Technology Corp.; In the United States District Court for the Western District of Texas

[case settled]

Semiconductor devices.

27. March-April 2012-: Fish & Richardson P.C., counsel for Cypress Semiconductor Corporation in Commonwealth Research Group, LLC v. Microchip Technology Incorporated, et al., USDC-D. Del. – C.A. No. 11-655-RGA

[case closed]

Semiconductor devices.

28. September 2010 – December 2013: Vinson & Elkins and Hatch, James, & Dodge, counsel for Lutron Electronics Co., Inc. in *Lutron v. Crestron, et al.*, Case No. 2:09cv707, pending in the United States District Court for Utah; [expert reports; two depositions].

[case settled]

RF lighting controls

29. March 2011-August 2012: SNR Denton US LLP, counsel for Kilopass Technology, Inc. in Kilopass Technology, Inc. v. Sidense Corporation -- Case No. 3:10-CV-02066-SI, Northern District of California (San Francisco Division). [three expert reports, one deposition]

[Summary judgment, case closed]

Semiconductor devices.

30. April 2011- August 2012: Alston & Bird counsel for X2Y Attenuators, LLC ("X2Y") in the Matter of CERTAIN MICROPROCESSORS, COMPONENTS THEREOF, AND PRODUCTS CONTAINING SAME, International Trade Commission Investigation No. 337-TA-781, X2Y v. Intel Corporation. [two expert reports; deposition; ITC trail August 2012]

Semiconductor packaging.

31. July 2012 – September 2013: Vinson & Elkins L.L.P. counsel for Silicon Laboratories, in SILICON LABORATORIES INC., Plaintiff, vs. MAXLINEAR, INC., Defendant Case No. 3:12CV1765-WQH-WVG UNITED STATES DISTRICT COURT SOUTHERN DISTRICT OF CALIFORNIA, SAN DIEGO. [expert report; deposition]

[case settled]

RF ICs

32. February 2012 – October 2013: Haynes and Boone, LLP, counsel for L-3, in L-3 COMMUNICATIONS CORPORATION, Plaintiff/Counterclaim Defendant, v. SONY CORPORATION, SONY ELECTRONICS INC. and SONY ERICSSON MOBILE COMMUNICATIONS (USA) INC., Defendants/Counterclaim Plaintiffs., C.A. No. 10-734-RGA IN THE UNITED STATES DISTRICT COURT FOR THE DISTRICT OF DELAWARE. [expert reports; depositions; jury trial October 2013]

Image sensors

33. February 2013-October 2013: McKool Smith, counsel for Ericsson, Inc., in the Matter of CERTAIN WIRELESS COMMUNICATIONS EQUIPMENT AND ARTICLES THEREIN, Investigation No. 337-TA-866 in UNITED STATES INTERNATIONAL TRADE COMMISSION. [expert reports; ITC trial October 2013]

Microwave amplifiers

34. January 2013-March 2013: Finnegan, Henderson, Farabow, Garrett & Dunner, L.L.P., counsel for Axis Communications AB and Axis Communications, Inc. in the case of patent infringement litigation and inter partes review proceedings, Network-I Security Solutions Inc. v. Alcatel-Lucent USA Inc., et al., No. 6:11-cv-00492-LED-JDL and Sony Corporation of America; Axis Communications AB; and Axis Communications, Inc. v. Patent of Network-I Security Solutions, Case IPR2013-00092. [case inactive pending IPR]

35. April 2013- August 2013: Alston & Bird LLP, counsel for AmTran, in the matter of Freescale v. Vizio (Defendants Amtran Technology Co., Ltd., Amtran Logistics, Inc., Vizio, Inc. , MediaTek, Inc., Zoran Corporation, CSR Technology, Inc. Sanyo Electric Co., Ltd., Sanyo North America Corporation, Sanyo Manufacturing Corporation, TPV Technology Limited TPV International (USA) Inc., Top Victory Electronics Co., Ltd., Envision Peripherals, Inc., Marvell Semiconductor, Inc.) Case No. A-12-CV-644-LY.

36. February 2013-February 2014: Quinn Emanuel, counsel for STMicroelectronics, in the matter of STMICROELECTRONICS, INC., Plaintiff, vs. INVENSENSE, INC., Defendant, UNITED STATES DISTRICT COURT NORTHERN DISTRICT OF CALIFORNIA SAN FRANCISCO DIVISION, CASE NO. 12-CV-2475-JSW [expert reports]

[case settled]

MEMS accelerometers

37. November 2012 – August, 2013: Haynes and Boone, LLP, counsel for Xilinx, Inc., in the matter of the Inter Partes Review of Patent 7,566,960 Title: INTERPOSING STRUCTURE, before the UNITED STATES PATENT AND TRADEMARK OFFICE BEFORE THE PATENT TRIAL AND APPEAL BOARD, INTELLECTUAL VENTURES MANAGEMENT, LLC, Petitioner, v. Patent of XILINX, INC., Patent Owner, Case IPR2012-00018. [expert report; deposition]

IC packaging

38. May 2014 – December 2014: Taylor Dunham and Rodriguez LLP, counsel for Andrew Katrinecz and David Byrd, in Civil Action No. 1:12-cv-235-LY, Andrew Katrinecz and David

Byrd v. Motorola Mobility LLC, in the United States District Court for the Western District of Texas, Austin Division, [expert reports, deposition] [expert report; deposition] [case settled].
Data entry devices

39. February 2015 – February 2016: Ropes & Gray, counsel for Samsung Electronics, in in Civil Action No. 4:14-cv-00371 (E.D. Tex.), Imperium IP Holdings (Cayman), Ltd. v. Samsung Electronics Co., Ltd., Samsung Electronics America, Inc., Samsung Telecommunications America, LLC, and Samsung Semiconductor, Inc. [expert report; deposition; jury trial]
Cell phone cameras

40. March 2015 – September 2015: Baker Botts LLP, on behalf of Dell, in Certain Electronic Products, Including Products with Near-Field Communication (“NFC”) System-Level Functionality and/or Battery Power-up Functionality, Components thereof, and Products Containing Same 337-TA-950 (International Trade Commission) and NXP B.V. v. Dell Inc., 1:14-cv-00146-UNA [case settled]
laptop power and data communications

41. March 2015 – September 2015: Baker Botts LLP, in Inter Partes Review of U.S. Patents 7412230, 6590365, 8065389, 8204959.

42. October 2015 – December 2015: Baker Botts LLP, in Inter Partes Review of U.S. Patent 7,926,978, “Light Set with Surface Mounted Light Emitting Components” by Kenneth Tsai, owned by Real Bonus Ltd. [declaration]
String LED lights

43. January 2013 – November 2017: Finnegan, Henderson, Farabow, Garrett & Dunner, L.L.P., on behalf of Axis Communications AB and Axis Communications, and McDermott Will & Emery on behalf of Hewlett-Packard, in Network-1 Technologies Inc. v. Alcatel-Lucent USA Inc., et al., No. 6:11-cv-00492-RWS-KNM and Network-1 Technologies Inc. v. Axis Communications AB., et al., No. 6:13-cv-00080-RWS-KNM. Trial 11/6/17 - 11/13/17. [jury trial]
Power over Ethernet

44. November 2015 – July 2016: DLA Piper LLP on behalf of Samsung Electronics Co., Ltd., Samsung Electronics America, Inc. and Samsung Telecommunications America, LLC, in UNITED STATES INTERNATIONAL TRADE COMMISSION, In the Matter of CERTAIN RF CAPABLE INTEGRATED CIRCUITS AND PRODUCTS CONTAINING THE SAME, Investigation No. 337-TA-982 [reports] [case settled]
RF mixers

45. February 2016: Baker & Hostetler on behalf of Sony, in Raytheon Company v. Sony Corporation, et al., C.A. No. 2:15-cv-342 (E.D. Tex.) and Raytheon Company v. Samsung Electronics Co., Ltd., et al., C.A. No. 2-15-cv-00341 (E.D. Tex.). [case closed]
Cell phone cameras

46. October-November 2016: Baker & McKenzie LLP on behalf of Continental Automotive, in IN THE UNITED STATES DISTRICT COURT FOR THE EASTERN DISTRICT OF MISSOURI,

WATLOW ELECTRIC MANUFACTURING COMPANY Plaintiff, v. CONTINENTAL AUTOMOTIVE SYSTEMS, INC. and CONTINENTAL AUTOMOTIVE SYSTEMS US, INC. Defendants. [case closed]

47. Sept. 2016 – May 2017: Alston & Bird on behalf of Nokia in ITC action In the Matter of Certain Electronic Devices, Including Mobile Phones, Tablet Computers and Components Thereof, Inv. No. 337-TA-1039. [case settled]

48. Dec. 2016 – August 2017: Jones Day on behalf of Bio-Rad Laboratories in Thermo Fisher Scientific Inc. v. Bio-Rad Laboratories, Inc. CIPR2017-00054 and IPR2017-00055, and Bio-Rad Laboratories, Inc. v. Thermo Fisher Scientific Inc. (1:17-cv-00469-RGA, USDC - Wilmington, DC). [declaration, deposition]

49. March 2017: Baker Botts L.L.P. on behalf of AMD. [related to ASETTEK DANMARK A/S, Plaintiff, VS. CMI USA, INC., fka COOLER MASTER USA, INC., Defendant]

50. April 2017 – present: Baker & Hostetler LLP, on behalf of Renesas Electronics Corp., in Lone Star Silicon Innovations LLC v. Renesas Electronics Corp., et al. (E.D. TX), and associated IPRs. [declarations and depositions]

51. October 2017: Dorsey & Whitney LLP on behalf of Global Foundries.

52. September 2017 – September. 2018: Bunsow De Mory Smith & Allison LLP on behalf of VLSI Technology LLC.

53. June 2018 – Nov. 2018: O'Melveny & Myers LLP on behalf of Samsung in Certain Wafer-Level Packaging Semiconductor Devices and Products Containing Same (Including Cellular Phones, Tablets, Laptops, and Notebooks) and Components Thereof, ITC No. 337-3262; Tessera Advanced Techs., Inc. v. Samsung Elecs. Co., Ltd., et al., No. 2:17-cv-00671 (E.D. Tex.); Tessera Advanced Techs., Inc. v. Samsung Elecs. Am., Inc., et al., No. 2:17-cv-07621 (D.N.J.); Invensas Corp. v. Samsung Elecs. Co., Ltd., et al., No. 2:17-cv-00670 (E.D. Tex.); Invensas Corp. v. Samsung Elecs. Co., Ltd., et al., No. 1:17-cv-01363 (D. Del.); Invensas Bonding Techs., Inc. v. Samsung Elecs. Am., Inc., et al., No. 1:17-cv-07609 (D.N.J.); FotoNation Ltd. et al. v. Samsung Elecs. Co., Ltd., et al., No. 2:17-cv-00669 (E.D. Tex.). [case settled]

54. October 2018 – present: Irell & Manella LLP on behalf of VLSI Technology LLC. [IPRs] [semiconductor devices, processing, and packaging]

55. March 2019 – present: Alston & Bird LLP, on behalf of Cellco Partnership d/b/a Verizon Wireless in FRACTUS, S.A., Plaintiff, v. AT&T MOBILITY LLC, Defendant. SPRINT COMMUNICATIONS COMPANY, L.P., ET AL., Defendants. T-MOBILE US, INC. ET AL., Defendants. VERIZON COMMUNICATIONS INC. ET AL., Defendants. [reports, deposition]

56. Dec. 2018- present: Fish & Richardson P.C., on behalf of Wasica Finance

GMBH and Bluearc Finance AG in WASICA FINANCE GMBH and BLUEARC FINANCE AG,
Plaintiffs, v. SCHRADER INTERNATIONAL, INC. and SCHRADER-BRIDGEPORT
INTERNATIONAL, INC., Defendants, C.A. No. 13-1353-LPS. [reports, deposition]
[TPMS]

APPENDIX B (LIST OF MATERIALS CONSIDERED)

Ex. 1001	U.S. Patent No. 6,982,742 (“’742 patent”)
Ex. 1002	File History of U.S. Patent No. 6,982,742 (“’742 File History”)
Ex. 1003	File History of U.S. Patent No. 6,043,839 (“’839 File History”)
Ex. 1005	WO Application Publication No. 95/34988 (“Swift”)
Ex. 1006	U.S. Patent No. 5,835,141 (“Ackland”)
Ex. 1007	U.S. Patent No. 5,919,130 (“Monroe”)
Ex. 1009	U.S. Patent No. 4,700,219 (“Tanaka”)
Ex. 1010	U.S. Patent No. 6,243,131 (“Martin”)
Ex. 1011	U.S. Patent No. 5,814,803 (“Olmstead”)
Ex. 1012	U.S. Patent No. 6,002,424 (“Rapa”)
Ex. 1015	U.S. Patent No. 5,233,426 (“Suzuki”)
Ex. 1016	JP Unexamined Patent Publication No. S62-104075 (“Tanuma”)
Ex. 1017	Plaintiff Collect LLC’s Amended and Supplemental Objections and Responses to Defendants Samsung Electronics Co., Ltd., and Samsung Electronics America, Inc.’s Interrogatory No. 2
Ex. 1018	WO Application Publication No. 99/18613 (“Adair”)
Ex. 1027	U.S. Patent No. 5,903,706 (“Wakabayashi”)
Ex. 1030	U.S. Patent No. 5,756,981 (“Roustaei”)
Ex. 1031	U.S. Patent No. 4,630,110 (“Cotton”)
Ex. 1032	European Patent Application Publication EP0610938 (“Crossetto”)
Ex. 1033	Ricquier, N., et al. “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. ("Ricquier SPIE")
Ex. 1038	Ricquier, N., et al. "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. ("Ricquier")
Ex. 1039	Excerpts from Plaintiff Collect's Infringement Contentions Cover Document ("PO's Infringement Contentions")
Ex. 1040	Exemplary chart from Collect's Infringement Contentions for the '742 patent
Ex. 1042	Hurwitz, et al., "An 800K-Pixel Color CMOS Sensor For Consumer Still Cameras" ("Hurwitz")
Ex. 1043	U.S. Patent No. 5,837,994 ("Stam")
Ex. 1044	U.S. Patent No. 5,221,964 ("Chamberlain")
Ex. 1045	Charles Hamilton, A Guide to Printed Circuit Board Design (1984)
Ex. 1046	Hurwitz, et al., "An 800K-Pixel Color CMOS Sensor For Consumer Still Cameras" ("Hurwitz Cornell")
Ex. 1047	Hurwitz, et al., "An 800K-Pixel Color CMOS Sensor For Consumer Still Cameras" ("Hurwitz SPIE")
Ex. 1049	P.J.W. Noble, Printed Circuit Board Assembly, Chapter 2 (1989)
Ex. 1051	U.S. Patent No. 6,202,060 ("Tran")
Ex. 1052	U.S. Patent No. 6,009,336 ("Harris")
Ex. 1054	U.S. Patent No. 7,009,647 ("Kozlowski")
Ex. 1057	U.S. Application 08/461646 File History Excerpt ("Tran '646")
Ex. 1060	"NASA's Tiny Camera Has A Wide-Angle Future," Business

	Week (March 6, 1995) (“NASA”)
Ex. 1061	“Silicon Eyes,” Business Week (October 12, 1998)
Ex. 1067	Redline comparison of ’742 patent specification and claims and Adair specification and claims
Ex. 1068	U.S. Patent No. 5,425,027 (“Baran”)
Ex. 1069	U.S. Patent No. 6,452,632 (“Umeda”)
Ex. 1072	U.S. Patent Application No. 08/944,322
Ex. 1073	U.S. Patent Application No. 09/175,685
Ex. 1074	U.S. Patent Application No. 09/496,312
Ex. 1076	U.S. Patent Application No. 09/638,976
Ex. 1077	U.S. Patent No. 6,424,369 File History
Ex. 1078	Butler Affidavit (Bluetooth 2)
Ex. 1079	Redline comparison of ’976 application with its parent ’312 application
Ex. 1085	U.S. Patent No. 5,859,878 (“Phillips”)
Ex. 1086	Redline comparison of ’993 application with its parent 09/638,976 application

* I also considered any additional materials referenced in my declaration.