

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Innolux Corporation

Petitioner,

v.

Phenix Longhorn LLC

Patent Owner.

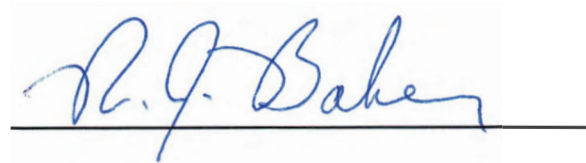
Case No. IPR2025-00044
U.S. Patent No. 7,557,788

**EXPERT DECLARATION OF R. JACOB BAKER, PH.D., P.E., IN
SUPPORT OF PETITION FOR *INTER PARTES* REVIEW OF
U.S. PATENT NO. 7,557,788**

I declare under penalty of perjury that the following is true and correct. I declare that all statements made herein of my knowledge are true, and that all statements made on information and belief are believed to be true, and that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

Executed on October 15, 2024

Las Vegas, NV



R. Jacob Baker, Ph.D., P.E.

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I. Introduction

1. My name is R. Jacob Baker, Ph.D., P.E. I am an emeritus professor of electrical and computer engineering at the University of Nevada, Las Vegas. I have prepared this declaration as an expert witness on behalf of the Petitioner. I submit this declaration in support of a Petition for *Inter Partes* Review of United States Patent No. 7,557,788 (“the ’788 Patent”), owned by Phenix Longhorn LLC (“Phenix” or “Patent Owner”). I have been retained in this matter by Baker Botts LLP (“Counsel”) on behalf of Innolux Corporation (“Innolux” or “Petitioner”).

2. This declaration contains statements of my opinions formed to date and the bases and reasons for those opinions. I may offer additional opinions based on further review of materials in this case, including opinions and/or testimony of other expert witnesses.

3. I make this declaration based upon my personal knowledge. I am over the age of 21 and am competent to make this declaration.

4. The statements herein include my opinions and the bases for those opinions, which are provided in the Exhibit List to the attached Petition.

5. The materials I considered in forming my opinions herein included at least those documents. In forming the opinions expressed in this declaration, I relied upon my knowledge, skill, experience, training, and education in the relevant field of the art, and have considered the viewpoint of a person of ordinary skill in

the art at the time of the alleged invention (“POSITA”), i.e., a POSITA as of January 28, 2004.

6. I am being compensated for my time in connection with this IPR at my standard consulting rate for consulting services. My compensation is not affected by the outcome of this matter. Although I am being compensated for my time in preparing this declaration, the opinions herein are my own.

II. Qualifications

7. My qualifications generally are set forth in my Curriculum Vitae, which has been submitted as Exhibit 1004, also includes a list of the publications I have authored and a list of the other cases in which I have testified during the last four years.

A. Educational Background

8. I received a B.S. degree and a M.S. degree in electrical engineering from the University of Nevada, Las Vegas (“UNLV”) in 1986 and 1988, respectively. I received my Ph.D. in Electrical Engineering from the University of Nevada, Reno, in 1993.

9. My doctoral research, culminating in the award of a Ph.D. in Electrical Engineering in 1993, investigated the use of power MOSFETs (metal oxide semiconductor field effect transistors) in the design of very high peak power, and high-speed, instrumentation. I developed techniques to reliably stack power

MOSFETs to switch higher voltages, that is, greater than 1,000 V at near 100 Amps of current with nanosecond switching times. This work was reported in the paper entitled “Transformerless Capacitive Coupling of Gate Signals for Series Operation of Power MOSFET Devices,” published in the IEEE Transactions on Power Electronics. The paper received the 2000 Best Paper Award from the Power Electronics Society.

B. Industry Experience

10. I have done technical and expert witness consulting for over 200 companies and their subsidiaries since I started working as an engineer in 1985. From 1985 to 1993, I worked for EG&G Energy Measurements and the Lawrence Livermore National Laboratory designing nuclear diagnostic instrumentation for underground nuclear weapon tests at the Nevada test site. During this time, I designed, and oversaw the fabrication of, over 30 electronic and electro-optic instruments, including high-speed cable and fiber-optic receiver/transmitters, PLLs, frame and bit-syncs, data converters, streak-camera sweep circuits, Pockel’s cell drivers, micro-channel plate gating circuits, charging circuits for battery backup of equipment for recording test data, and analog oscilloscope electronics.

11. I am a licensed Professional Engineer and have extensive industry experience in circuit design, fabrication, and manufacture of Dynamic Random Access Memory (DRAM) semiconductor integrated circuit chips, Phase-Change

Random Access Memory (PCRAM) chips, and CMOS Image Sensors (CISs) at Micron Technology, Inc. (“MTI”) in Boise, Idaho. I am a named inventor on 150 U.S. patents in integrated circuit design including Flash memory, DRAM, and CMOS image sensors. I spent considerable time working on the development of flash memory chips while at MTI. My efforts resulted in more than a dozen patents relating to flash memory. One of my projects at MTI included the development, design, and testing of circuit design techniques for a multi-level cell (MLC) flash memory using signal processing. This effort resulted in higher-density memories for use in solid-state drives and flash memory cards having an ATA interface that are ubiquitous in consumer electronics, including cameras and data storage systems. Further, the use of higher-density memory can result in fewer changes in the flash translation layer for logical-to-physical addressing, less need for garbage collection, and larger data segments that can improve a computing system’s performance. Another project I worked on at MTI focused on the design of buffers for high-speed double-data rate DRAM, which resulted in around 10 U.S. patents in buffer design. Among many other experiences, I led the development of the delay locked loop (DLL) in the late 1990s so that MTI DRAM products could transition to the DDR memory protocol, used in mobile and non-mobile (server, desktop, cell phones, tablets, etc.) computing systems as main computer memory, for addressing and controlling accesses to memory via interprocess

communications (IPC) with the memory controller (MC). In addition to work developing these high-speed digital communication systems, I've supervised a half dozen or so master's Theses in high-speed digital communications with focuses ranging from calibration to eliminating slack in digital timing. Further, I provided technical assistance with MTI's acquisition of Photobit during 2001 and 2002, including transitioning the manufacture of CIS products into MTI's process technology. Further, I did consulting work at Sun Microsystems and then Oracle on the design of memory modules during 2009 and 2010. This work entailed the design of low-power, high-speed communications, and wide interconnection methods with the goal of transmitting data to/from the memory module and the MC at higher speeds.

12. I have extensive experience in the development of instrumentation and commercial products in a multitude of areas including: integrated electrical/biological circuits and systems, array (memory, imagers, and displays) circuit design, CMOS analog and digital circuit design, diagnostic electrical and electro-optic instrumentation for scientific research, CAD tool development and online tutorials, low-power interconnect and packaging techniques, design of communication/interface circuits (to meet commercial standards such as USB, firewire, DDR, PCIe, SPI, etc.), circuit design for the use and storage of renewable energy, and power electronics. For example, a part of my research at Boise State,

for many years, focused on the use of Thru-Silicon-Vias (TSVs), aka Thru-Wafer Vias (TWVs), for high-density 3D packaging. These packaging techniques were utilized in the memory module development work I did with Sun Microsystems and Oracle. As another example, I designed circuitry for use in implementing Universal Serial Bus (USB) interface circuits while I did consulting at Tower Semiconductor. I designed PCI communication circuits for IPC between a Graphics Processor Unit (GPU) and memory while consulting for Rendition, Inc. From 1994 to 1996, I worked on the design of displays at Micron Display and Micron Technology, Inc. ("Micron") in Boise, Idaho. This work was at a time when cathode ray tubes (CRTs) were still the dominant type of display. Flat panel displays were being developed with the hope of replacing CRTs in the consumer market. I worked on flat panel displays which resulted in 5 patents: 5,598,156, 5,638,085, 5,818,365, 5,894,293, and 5,909,201. I worked on the design of the pixels, both active and passive, as well as the supporting electronics for processing video signals. I was involved with the evaluation of display technologies including liquid crystal displays (LCDs), light-emitting diodes, plasma displays, and organic light emitting diode (OLED) displays; the display technologies that were looking to displace CRTs in the consumer market. I was also involved with the packaging of the displays including the vacuum sealing and deposition of the phosphors for

light wavelength conversion. I also taught display design as a topic in my courses and did display design consulting again in industry for Cirque in 2013.

13. Further, I did consulting work in 2009 and 2010 at Sun Microsystems and then Oracle on the design of memory modules. This work entailed the design of low-power, high-speed, and wide interconnection methods with the goal of transmitting data to/from the memory module at higher speeds.

14. My current research work is focused in part on the design of integrated circuits for wireless sensing using LIDAR (Light Detection And Ranging). I have worked with several companies in the development of these circuits and systems including Freedom Photonics, Aeries Photonics, and FLIR. In the early 1990s, I worked on wireless systems for wideband impulse radar while at Lawrence Livermore Laboratory. Further, part of my research for several years focused on the digitization of IQ channels using delta-sigma modulation. The knowledge and experience gained from this effort are reflected in my textbook CMOS Mixed-Signal Circuit Design and a presentation, which I have presented at several universities and companies,

C. Academic Experience

15. I have been teaching electrical engineering since 1991. From 1991-1993, I was an adjunct faculty member in the electrical engineering department of the University of Nevada, Las Vegas and University of Nevada, Reno. From 1993

to 2000, I served on the faculty at the University of Idaho as an Assistant Professor and then as a tenured Associate Professor of Electrical Engineering. In 2000, I joined a new electrical and computer engineering program at Boise State University (“BSU”) where I served as department chair from 2004 to 2007. At BSU I helped establish graduate programs in electrical and computer engineering including, in 2006, the university’s second Ph.D. degree. In 2012, I re-joined the faculty at UNLV where I am currently a Professor of Electrical and Computer Engineering. Over the course of my career as a professor, I have advised over 100 graduate students.

16. I have been recognized for my contributions as an educator and researcher in electrical and computer engineering. While at Boise State University, I received the President’s Research and Scholarship Award (2005), Honored Faculty Member recognition (2003), and Outstanding Department of Electrical Engineering Faculty recognition (2001). In 2007, I received the Frederick Emmons Terman Award (the “Father of Silicon Valley”). The Terman Award is bestowed annually upon an outstanding young electrical/computer engineering educator in recognition of the educator’s contributions to the profession. In 2011 I received the IEEE Circuits and Systems Education Award. I have also received the Tau Beta Pi Outstanding Electrical and Computer Engineering Professor Award each year I have been at UNLV.

17. I have authored several books and papers in the electrical and computer engineering area. My published books include CMOS Circuit Design, Layout, and Simulation (Baker, R. J., Wiley-IEEE, ISBN: 978-0470881323 (3rd ed., 2010)) and CMOS Mixed-Signal Circuit Design (Baker, R. J., Wiley-IEEE, ISBN: 978-0470290262 (2nd ed., 2009) and ISBN: 978-0471227540 (1st ed., 2002)). I co-authored DRAM Circuit Design: Fundamental and High-Speed Topics (Keeth, B., Baker, R. J., Johnson, B., and Lin, F., Wiley-IEEE, ISBN: 978-0-470-18475-2 (2008)), DRAM Circuit Design: A Tutorial (Keeth, B. and Baker, R. J., Wiley-IEEE, ISBN: 0-7803-6014-1 (2001)), and CMOS Circuit Design, Layout and Simulation (Baker, R. J., Li, H.W., and Boyce, D.E., Wiley-IEEE, ISBN: 978-0780334168 (1998)). I contributed as an editor and co-author on several other electrical and computer engineering books.

D. Other Relevant Experience

18. I have performed technical and expert witness consulting for more than 200 companies and their subsidiaries and given more than 50 invited talks at conferences, companies, and universities. I am the author and co-author of more than 100 papers and presentations in the areas of solid-state circuit design and packages. A list of my publications and patents are on my curriculum vitae in Appendix B.

19. I currently serve, or have served, as a volunteer on: the IEEE Press Editorial Board (1999-2004); as editor for the Wiley-IEEE Press Book Series on Microelectronic Systems (2010-2018); as the Technical Program Chair of the 2015 IEEE 58th International Midwest Symposium on Circuits and Systems (MWSCAS 2015); on the IEEE Solid-State Circuits Society (SSCS) Administrative Committee (2011-2016); as a Distinguished Lecturer for the SSCS (2012-2015); the Technology Editor (2012-2014) and Editor-in-Chief (2015-2020) for IEEE Solid-State Circuits Magazine; IEEE Kirchhoff Award Committee (2020-2023); and advisor for the student branch of the IEEE at UNLV (2013-present). These meetings, groups, and publications are intended to allow researchers to share and coordinate research. In addition to the above, I am an IEEE Fellow and a member of the honor societies Eta Kappa Nu and Tau Beta Pi.

20. My active participation in these meetings, groups, and publications allowed me to see what other researchers in the field have been doing.

21. During the past several years, I have provided expert testimony, depositions, reports, or declarations in the cases shown in Appendix B.

III. Person Of Ordinary Skill In The Art

22. I have been informed by counsel that the content of a patent (including its claims) and prior art should be interpreted the way a POSITA would have interpreted the material at the time of invention. I understand from counsel

that the person of ordinary skill is a hypothetical person who is assumed to be aware of all the pertinent information that qualifies as prior art. In addition, the POSITA is a person of ordinary creativity who makes inferences and takes creative steps.

23. I have been informed by counsel that the “time of invention” I should use for purposes of this declaration is the date that the applicant for the ’788 Patent filed the earliest parent application in the United States Patent and Trademark Office, namely, June 11, 2003. I have not provided an opinion as to whether the claims of the ’788 Patent are entitled to that priority date.

24. It is my opinion that a POSITA at the time of the alleged invention would have had at least a bachelor of science degree in physics, electrical engineering, or the equivalent thereof and three (3) years of experience in circuit design or display technologies. Such a POSITA would have had knowledge of integrated circuits, gamma correction, and storage of gamma correction voltage values within memory, and would have understood how to search available literature for relevant publications.

25. In addition to my testimony as an expert, I am prepared to testify as someone who actually practiced in the field from 1985 to present, who actually possessed at least the knowledge of a POSITA in that time period, and who

actually worked with others possessing at least the knowledge of a POSITA in that time period.

IV. Legal Understanding

26. I have a general understanding of validity based on my experience with patents and my discussions with counsel.

27. I have a general understanding of prior art and priority date based on my experience with patents and my discussions with counsel.

28. I understand from my discussions with counsel that inventors may be entitled to a priority date earlier than the date of filing to the extent that they can show complete possession of particular claimed inventions at such an earlier priority date and reasonable diligence to reduce the claims to practice between such an earlier priority date and the date of filing of the patent. I understand from my discussions with counsel that if the patent holder contends that particular claims are entitled to an earlier priority date than the date of filing of the patent, then the patent holder has the burden to prove this contention with specificity.

29. I understand that, subject to the next paragraph, the asserted “priority date” of a patent is the earlier of: (a) the date on which a patent application is filed; or (b) the date on which an earlier-filed patent application is filed if the patent holder claims the benefit of priority to that earlier-filed patent application.

30. I understand that it is not enough for a patent to merely claim the benefit of an earlier-filed application, but that additional criteria must be met. In particular, the prior application itself must describe the claimed invention, and must do so in sufficient detail that one skilled in the art can clearly conclude that the inventor invented the claimed invention as of the filing date sought. First, I understand that a priority-date analysis is on a claim-by-claim basis. Second, I understand that, in order for a patent claim to be entitled to the filing date of an earlier patent application, a “Section 112 analysis” must be conducted. I am informed that a “Section 112” analysis encompasses looking to the earlier patent application, and ascertaining whether that earlier patent application meets both the written-description and enablement requirements as of the filing date of the earlier application. I understand that it is not enough that the claim would have been obvious from the earlier application, but that application itself must describe the claimed invention.

31. I understand that in order to satisfy the written description requirement the earlier application must reasonably convey to those skilled in the art that the inventors had possession of the subject matter of the patent as of the filing date of the earlier application. I have been informed that it is the disclosure of the earlier patent application that counts, and that while the meaning of terms, phrases, or diagrams in the earlier patent application must be interpreted from the

vantage point of one skilled in the art, all of the claimed limitations must appear in the specification. Further, I understand that this analysis is not a question of whether one skilled in the art might be able to construct the claimed invention from the teachings of the disclosure. The question is not whether a claimed invention is an obvious variant of that which is disclosed in the specification; rather, I understand that an earlier application must itself describe each of the claim limitations.

32. I also understand that in order to satisfy the enablement requirement, the earlier application must enable a POSITA to practice the claimed invention without undue experimentation.

33. I understand from my discussions with counsel that an invention by another must be made before the priority date of a particular patent claim in order to qualify as “prior art” under 35 U.S.C. § 102 or § 103, that a printed publication or a product usage must be publicly available before the date of invention of a particular patent claim in order to qualify as “prior art” under 35 U.S.C. § 102(a), that a printed publication or a product usage or offer for sale must be publicly available more than one year prior to the date of the application for patent in the United States in order to qualify as “prior art” under 35 U.S.C. § 102(b), or that the invention by another must be described in an application for patent filed in the United States before the priority date of a particular patent claim in order to qualify

as “prior art” under 35 U.S.C. § 102(e). I understand from my discussions with counsel that the Petitioner has the burden of proving that any particular reference or product usage or offer for sale is prior art.

34. I have a general understanding of anticipation based on my experience with patents and my discussions with counsel.

35. I understand that anticipation analysis is a two-step process. The first step is to determine the meaning and scope of the asserted claims. Each claim must be viewed as a whole, and it is improper to ignore any element of the claim. For a claim to be anticipated under U.S. patent law: (1) each and every claim element must be disclosed, either explicitly or inherently, in a single prior art reference; (2) the claim elements disclosed in the single prior art reference must be arranged in the same way as in the claim; and (3) the invention must be disclosed in the single prior art reference, in as complete detail as set forth in the claim. Where even one element is not disclosed in a reference, the anticipation contention fails. Moreover, to serve as an anticipatory reference, the reference itself must be enabled, i.e., it must provide enough information so that a POSITA can practice the subject matter of the reference without undue experimentation.

36. I have a general understanding of obviousness based on my experience with patents and my discussions with counsel.

37. I understand that a patent claim is invalid under 35 U.S.C. § 103 as being obvious only if the differences between the claimed invention and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person of ordinary skill in that art. An obviousness analysis requires consideration of four factors: (1) scope and content of the prior art relied upon to challenge patentability; (2) differences between the prior art and the claimed invention; (3) the level of ordinary skill in the art at the time of the invention; and (4) the objective evidence of non-obviousness, such as commercial success, unexpected results, the failure of others to achieve the results of the invention, a long-felt need which the invention fills, copying of the invention by competitors, praise for the invention, skepticism for the invention, or independent development.

38. I understand that a prior art reference is proper to use in an obviousness determination if the prior art reference is analogous art to the claimed invention. I understand that a prior art reference is analogous art if at least one of the following two considerations is met. First, a prior art reference is analogous art if it is from the same field of endeavor as the claimed invention, even if the prior art reference addresses a different problem and/or arrives at a different solution. Second, a prior art reference is analogous art if the prior art reference is reasonably

pertinent to the problem faced by the inventor, even if it is not in the same field of endeavor as the claimed invention.

39. I understand that it must be shown that a POSITA at the time of the invention would have had a reasonable expectation that a modification or combination of one or more prior art references would have succeeded. Furthermore, I understand that a claim may be obvious in view of a single prior art reference, without the need to combine references, if the elements of the claim that are not found in the reference can be supplied by the knowledge or common sense of one of ordinary skill in the relevant art. However, I understand that it is inappropriate to resolve obviousness issues by a retrospective analysis or hindsight reconstruction of the prior art and that the use of “hindsight reconstruction” is improper in analyzing the obviousness of a patent claim.

40. I further understand that the law recognizes several specific guidelines that inform the obviousness analysis. First, I understand that a reconstructive hindsight approach to this analysis, i.e., the improper use of post-invention information to help perform the selection and combination, or the improper use of the listing of elements in a claim as a blueprint to identify selected portions of different prior art references in an attempt to show that the claim is obvious, is not permitted. Second, I understand that any prior art that specifically teaches away from the claimed subject matter, i.e., prior art that would lead a POSITA to a

specifically different solution than the claimed invention, points to non-obviousness, and conversely, that any prior art that contains any teaching, suggestion, or motivation to modify or combine such prior art reference(s) points to the obviousness of such a modification or combination. Third, while many combinations of the prior art might be “obvious to try,” I understand that any obvious-to-try analysis will not render a patent invalid unless it is shown that the possible combinations are: (1) sufficiently small in number so as to be reasonable to conclude that the combination would have been selected; and (2) such that the combination would have been believed to be one that would produce predictable and well understood results. Fourth, I understand that if a claimed invention that arises from the modification or combination of one or more prior art references uses known methods or techniques that yield predictable results, then that factor also points to obviousness. Fifth, I understand that if a claimed invention that arises from the modification or combination of one or more prior art references is the result of known work in one field prompting variations of it for use in the same field or a different one based on design incentives or other market forces that yields predictable variations, then that factor also points to obviousness. Sixth, I understand that if a claimed invention that arises from the modification or combination of one or more prior art references is the result of routine optimization, then that factor also points to obviousness. Seventh, I understand that

if a claimed invention that arises from the modification or combination of one or more prior art references is the result of a substitution of one known prior art element for another known prior art element to yield predictable results, then that factor also points to obviousness.

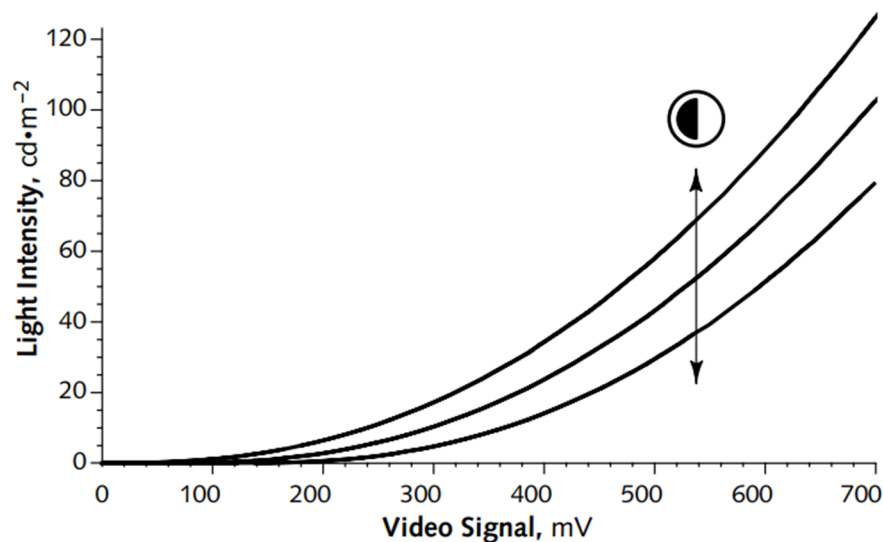
41. I understand from my discussions with counsel that the obviousness analysis should further consider evidence of “secondary considerations” such as commercial success, long-felt but unresolved needs, copying of the invention by competitors, and failures of others.

42. I understand that a dependent claim incorporates each and every limitation of the claim from which it depends. Thus, my understanding is that if a prior art reference fails to anticipate an independent claim, then that prior art reference also necessarily fails to anticipate all dependent claims that depend from the independent claim. Similarly, my understanding is that if a prior art reference or combination of prior art references fails to render obvious an independent claim, then that prior art reference or combination of prior art references also necessarily fails to render obvious all dependent claims that depend from the independent claim.

V. Background

A. Gamma Correction

43. Gamma correction is an important concept in display technology that ensures that images are faithfully rendered on display devices. (EX1009, at 92-93). Gamma correction addresses a mismatch between how electronic devices create images and how our eyes perceive them (EX1009, at 91). Traditional cathode ray tube (CRT) displays are known to have a nonlinear relationship between the input signal and display brightness - when you increase the input signal linearly, the brightness does not increase linearly. (EX1009, at 91). Instead, it follows a curved path (EX1009, at 913). This curve is described by a parameter called “gamma” (EX1009, at 92-93).

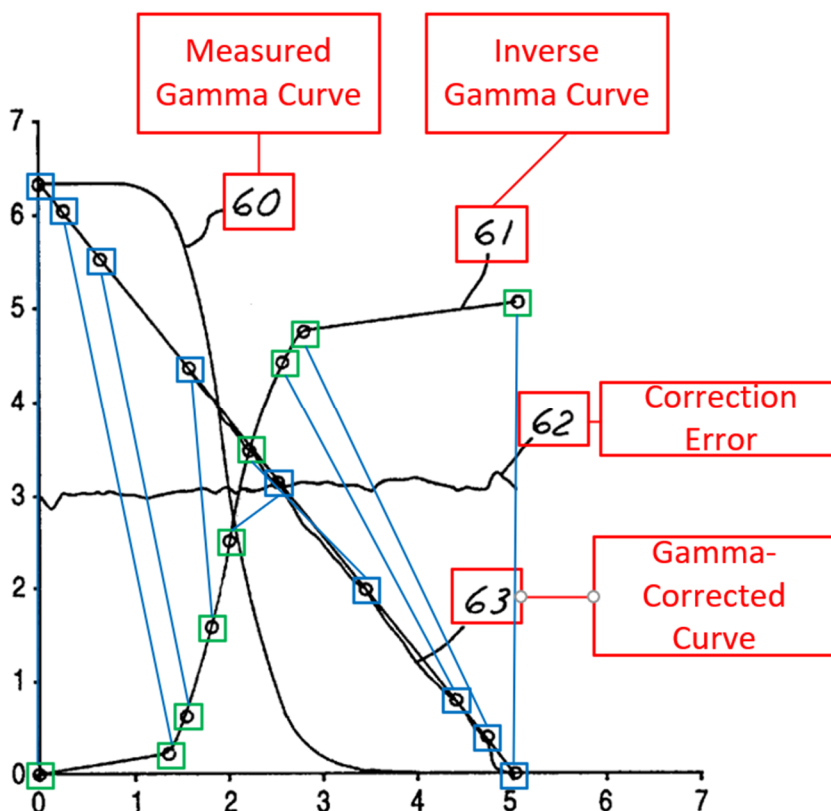


(EX1009, at 93). Human eyes have a similar but opposite curve when perceiving brightness (EX1009, at 93). By applying a gamma correction to adjust the signal

before it reaches the display, the final image matches what our eyes expect to see (EX1009, at 101).

44. Liquid Crystal Display (“LCD”) screens have a similar nonlinear relationship between input voltage and transmittance – how well the LCD panel allows light to pass through it. (EX1011, at 1:10-35). In order to correct this nonlinearity, the voltage-to-transmittance curve for a specific display must be determined, and an inverse transformation applied to accommodate for this nonlinearity (EX1011, at 1:36-60).

45. This is typically done by selecting a number of points (sometimes referred to as channels) on the measured gamma curve, and providing corrections for each of those points to produce an inverse gamma curve. (EX1011, at 3:63-4:16). When that inverse gamma curve is applied to inputs to the display, a linear relationship between input voltage and transmittance can be obtained. (EX1011, at 3:63-4:16). This is illustrated in the figure below, which shows a measured gamma curve 60 for a display, an inverse gamma curve 61 defined by nine points (highlighted in green), and the gamma-corrected curve 63. The annotations further illustrate how the nine points (in green) in the inverse gamma curve 61 map to nine points on the gamma corrected curve 63 (in blue).



(EX1011, at 4:17-23, Fig. 6). As described in EX1011, a common approach to gamma correction in LCD displays in 1997 was to store these nine points in high-speed digital memory, and to use a set of digital to analog converters (DAC's) to apply these gamma correction values to a display. (EX1011, at 4:43-65).

A. Gamma Correction Circuits

46. Many years later, in 2003 – the time of the alleged invention, the state of the art in display technology included sophisticated systems for gamma correction to optimize image quality. Display devices commonly incorporated integrated circuits with dedicated gamma correction functionality, including nonvolatile memory for storing correction data, control circuitry for applying

corrections, and driver circuits for outputting adjusted signals to display pixels. (EX1008, Fig. 1, 3:30-37, 6:10-28) These integrated designs, with components formed on a single substrate, enabled high-speed operations and efficient switching between different gamma correction data sets. (EX1008, 19:56-65)

47. The art recognized the importance of providing independent gamma correction for different color channels to improve overall image quality. Advanced data drivers could generate separate gamma reference voltages for red, green, and blue colors, allowing for optimized color reproduction. (EX1005, 1:61-2:3, Fig. 1) These systems typically employed digital-to-analog converters to transform stored digital gamma data into analog reference voltages, which were then used to convert image data into appropriate driving voltages for the display. (EX1005, 3:15-32, Fig. 1)

48. Flexibility in gamma correction was a key focus, with systems designed to store and apply multiple sets of correction data to accommodate varying display conditions. (EX1005, 2:25-28; EX1006, 2:29-35, 8:58-67) This adaptability was achieved through the use of reprogrammable nonvolatile memory arrays organized in rows and columns, allowing for efficient storage and retrieval of correction values. (EX1006, 4:11-25, 5:19-28, Fig. 3)

49. The art also taught sophisticated memory architectures to enable on-chip programming and flexible data management. Microcomputers with embedded

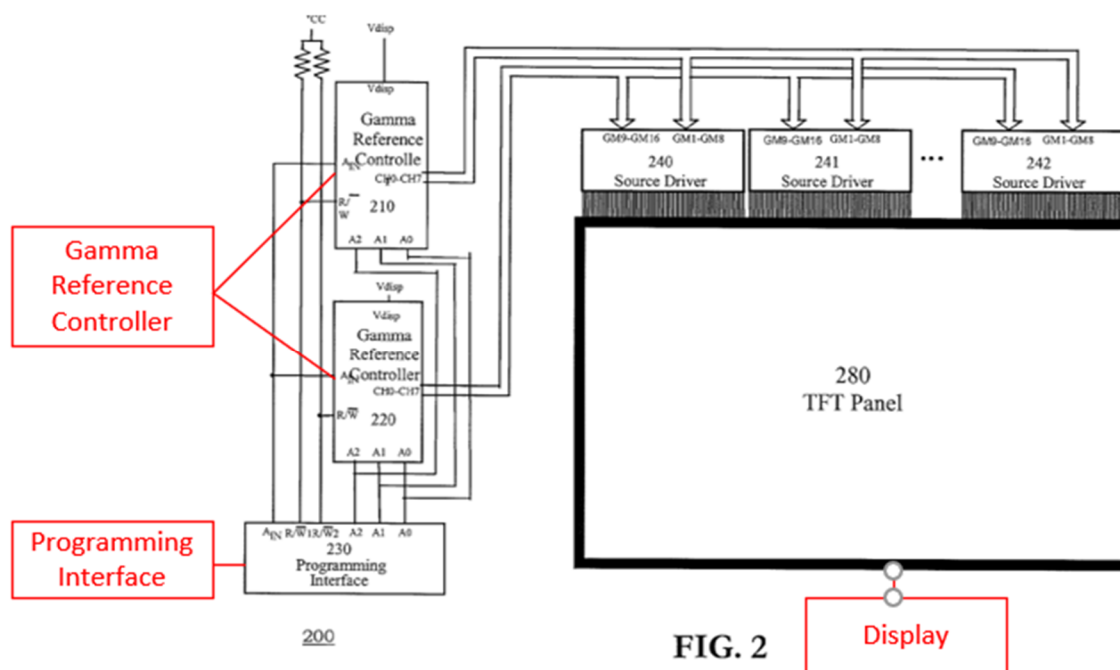
flash memory could partition storage into separate blocks for loader programs and application data, with shared I/O circuitry and bus multiplexing to efficiently switch between execution and programming modes. (EX1007, 3:5-13, 7:49-67, Fig. 3) This approach allowed for dynamic updating of stored data, including gamma correction values, without the need for external programming tools. (EX1007, Abstract, 2:38-43).

50. Overall, the state of the art demonstrated a clear trend towards integrated, flexible, and dynamically adjustable gamma correction systems in display devices, leveraging advances in memory technology and circuit design to optimize image quality across various operating conditions.

VI. The '788 Patent

51. U.S. Patent 7,557,788 ("the '788 patent") discloses a method for calibrating a liquid crystal display to achieve a desired gamma curve and compensate for manufacturing variations between display panels. (EX1001, Abstract). The method involves providing the display with gamma reference control capability that is electrically reprogrammable and non-volatile. (EX1001, 2:17-28). This capability allegedly allows for automated assembly and testing of display panels, as well as reprogrammable settings to provide different gamma correction curves for various applications. (EX1001, 2:29-35).

52. The '788 patent describes testing the display using at least one optical sensor separate from the display. (EX1001, 6:38-56, Fig. 2). Gamma reference voltage levels on display columns are varied by a control circuit separate from the display. (EX1001, 3:6-12, Fig. 2). The method optimizes these gamma reference voltage levels using means for executing a predetermined algorithm based on sensor data and predetermined criteria. (EX1001, 6:48-56, Fig. 2). The optimized gamma reference voltage levels are then stored in the gamma reference control capability. (EX1001, 3:24-28).



53. The '788 patent notes that the calibration method can be repeated under different ambient display conditions to generate multiple sets of gamma reference voltage levels. (EX1001, 6:52-7:10). These stored sets allow for

optimized gamma correction curves for different user or application requirements. (EX1001, 2:24-28). The patent acknowledges that gamma correction has long been a problem for TFT flat panel display manufacturers, particularly as display resolutions increase. (EX1001, 1:21-29).

A. Priority Date of the '788 Patent

54. I have been informed by counsel that the priority date that I should use for purposes of this declaration is the date that the applicant for the '788 Patent filed the earliest parent application in the United States Patent and Trademark Office, namely, June 11, 2003. I have not provided an opinion as to whether the claims of the '788 Patent are entitled to that priority date.

VII. Claim Construction

55. I understand that claim terms are typically given their ordinary and customary meaning, as would have been understood by a POSITA, at the time of the alleged invention. In considering the meaning of the claims, however, I understand that one must consider the language of the claims, the specification, the prosecution history of record, and the knowledge of a POSITA at the relevant time. I have followed these principles in my analysis.

A. “operating means for executing one or more optimization criteria algorithms based on optical emission corresponding to said selected columns” (Claim 3)

56. In my opinion, this phrase appears to be a means-plus-function claim. Counsel has informed me that means-plus-function claims are construed by first

identifying the claimed function and then determining the corresponding structure disclosed in the specification that performs that function. The scope of the claim is limited to the structure disclosed in the specification and its equivalents, rather than covering all means for performing the claimed function.

57. When a means-plus-function claim recites an algorithm, I understand that the specification must disclose an algorithm or structure for performing the claimed function to be definite. Simply disclosing a general-purpose computer as the structure for performing the claimed function is insufficient; the specification must disclose the specific algorithm that transforms the general-purpose computer into a special-purpose computer programmed to perform the claimed function.

58. In my opinion, the term “operating means for executing one or more optimization criteria algorithms . . .” is indefinite because the ’788 Patent does not disclose any specific algorithms. Further, the term “operating” is not used within the ’788 Patent specification *at all* except to refer to an “operating current” (EX1001, at 5:34). Thus, there is no corresponding structure recited in the ’788 Patent.

59. Nonetheless, and solely for the purposes of this Petition, in the event the Board does not determine that Claim 3 is indefinite, I will assume that the term be construed to refer to a “programming interface which executes an optimization algorithm”.

60. I do not believe that any other terms are necessary to be construed.

VIII. State of the Art

61. At the time of the alleged invention of the '788 Patent, the field of liquid crystal display (LCD) technology was already highly advanced, particularly in the area of gamma correction techniques. The prior art demonstrates that key features of the target patent were well-known and widely implemented.

62. Programmable gamma reference control capabilities were a standard feature in LCD systems. For example, Da Costa (EX1007) disclosed a smart controller chip with programmable registers for storing digital gamma reference values, which could be reprogrammed via external PROM or internal flash memory. (EX1007, 7:66-8:3, Fig. 7A) This approach provided non-volatile, electrically reprogrammable gamma control, allowing for flexible adjustment of display characteristics to compensate for manufacturing variations and environmental changes. (EX1007, 11:34-46)

63. Automated calibration processes using optical sensors were also well-established. Liaw taught a system with sensors to measure voltage-to-luminance characteristics, a programmable gamma voltage generating means, and a main controller with a CPU to optimize gamma voltages. (EX1005, 5:62-6:56, Fig. 7A) This enabled automatic testing, variation of gamma reference voltages, and optimization using predetermined algorithms. (EX1005, 9:6-12, Fig. 14)

64. The ability to store and utilize multiple sets of gamma reference voltages for different ambient conditions was known in the art. Matsui disclosed automatically adjusting luminance based on detected external light intensity and display tilt, indicating that the gamma correction method was repeated as ambient conditions changed. (EX1008, 10:53-11:6, Figs. 4-5)

65. Column-specific gamma correction was also a recognized technique. Greene taught using luminance scaler/adder means to adjust drive signals for each column of pixels, effectively varying gamma reference voltage levels on a per-column basis. (EX1006, 10:59-11:11, Fig. 5)

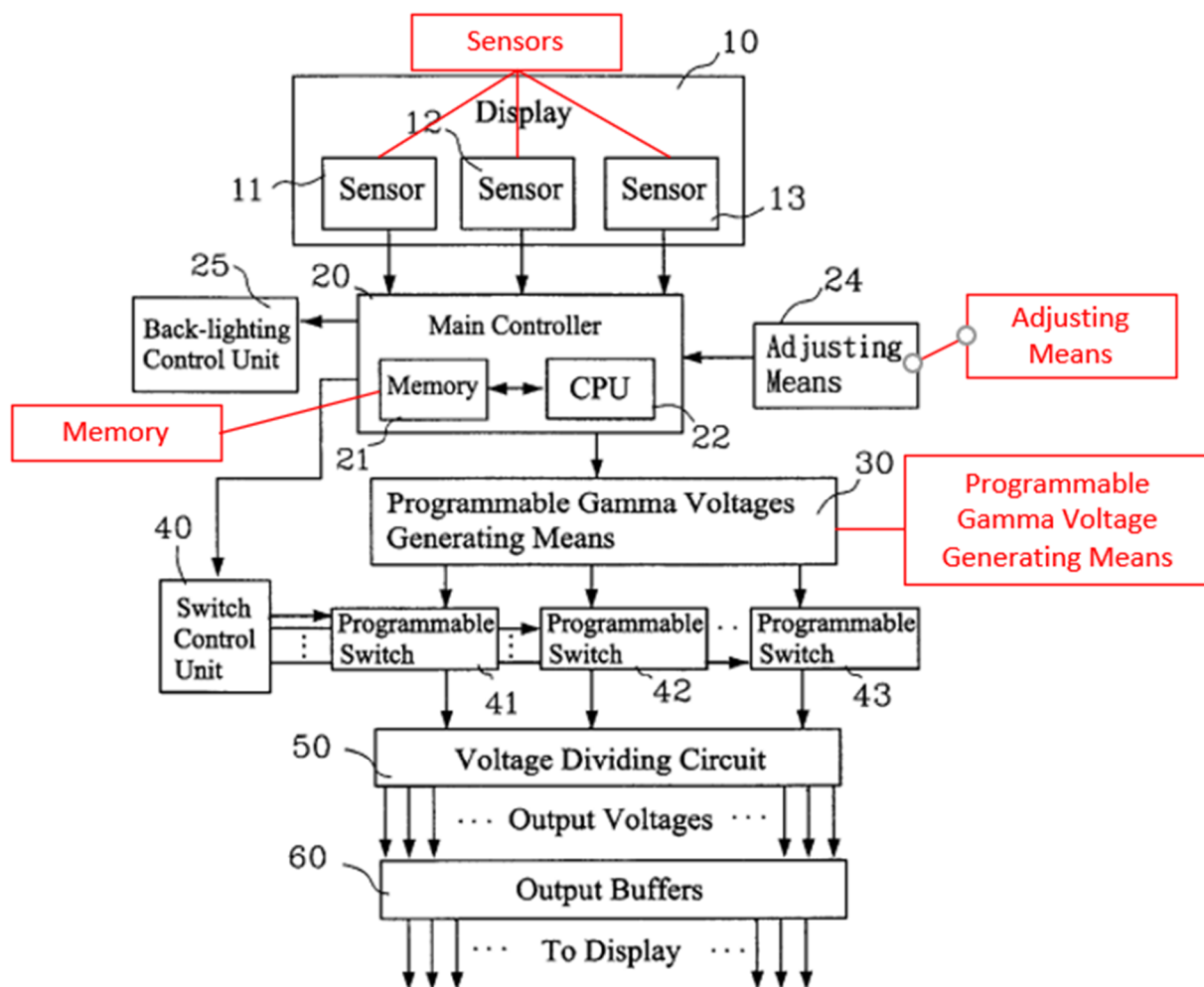
IX. The Prior Art

A. Liaw (EX1005)

66. The Liaw reference discloses an automatic gamma correction system for liquid crystal displays that addresses panel-to-panel manufacturing variations. (EX1005, 1:15-34). The system includes sensors to measure voltage-to-luminance characteristics, a programmable gamma voltage generating means to output adjustable reference voltages, and a main controller with a CPU to optimize the gamma voltages. (EX1005, 5:62-6:56, Fig. 7A) Liaw's method involves testing the display with sensors, varying gamma reference voltages on display columns, optimizing those voltages using predetermined algorithms, and storing the optimized values for future use. (EX1005, 9:6-12, Fig. 14)

67. The system can calibrate under different ambient conditions by adjusting luminance, contrast, and color temperature. (EX1005, 3:5-8).

Importantly, Liaw's gamma voltage generating means uses a digital-to-analog converter, allowing for electrical reprogramming of gamma voltages. (EX1005, 8:29-34, Fig. 11). This reference was selected because it demonstrates known techniques for calibrating LCD gamma curves to compensate for manufacturing variations, a key aspect of the challenged patent claims.



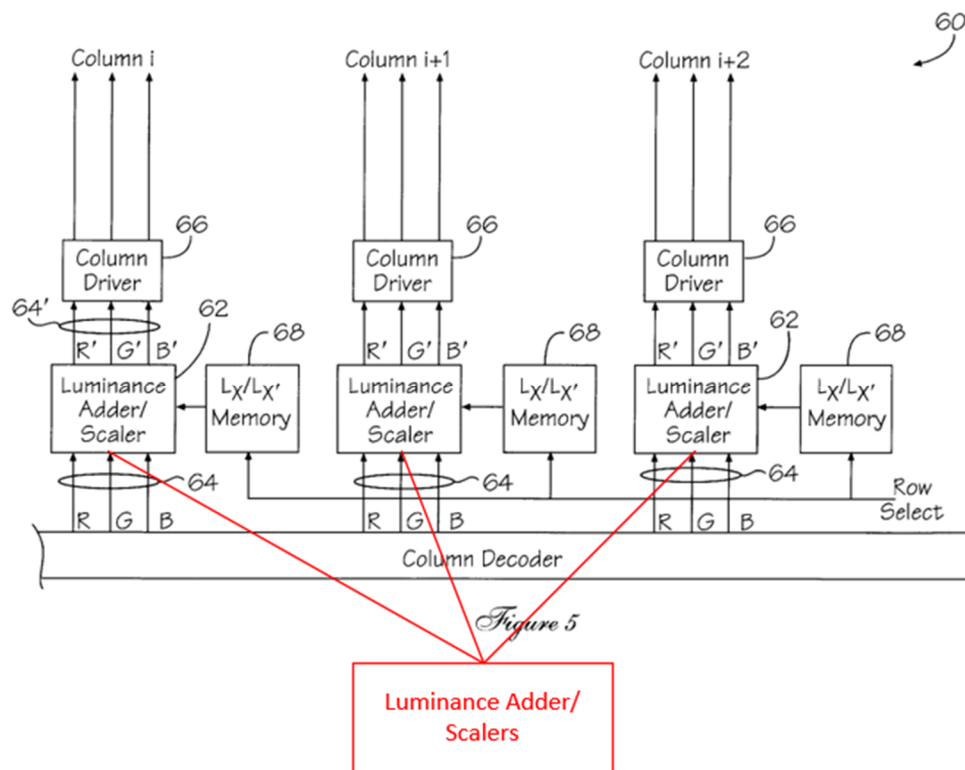
(EX1005, at Fig. 7A).

B. Greene (EX1006)

68. The Greene reference (EX1006) discloses methods for correcting spatial non-uniformities in brightness arising from manufacturing variations in electronic displays, including liquid crystal displays (LCDs). (EX1006, Abstract, 1:8-13, 4:8-22). Greene teaches measuring luminance variations across pixels using a photodetector, determining correction parameters, and storing these parameters in non-volatile memory. (EX1006, 10:14-36, 11:30-33, Fig. 6). The stored parameters are used to adjust drive signals in real-time, effectively providing gamma reference control for LCDs. (EX1006, 4:45-58, 10:59-11:4).

69. Greene describes a column-based correction approach, integrating luminance scalers/adders into column driver circuits. (EX1006, 11:5-19, Fig. 5). This allows for precise adjustment of gamma voltages on a per-column basis. The correction process can be repeated to account for display aging and changing ambient conditions. (EX1006, 11:20-24, 2:56-3:2).

70. Greene's methods are directly applicable to calibrating LCD gamma curves to compensate for panel-to-panel variations. While not using the term "gamma reference voltage levels," a POSITA would have understood Greene's drive signal adjustments to be functionally equivalent for LCDs.



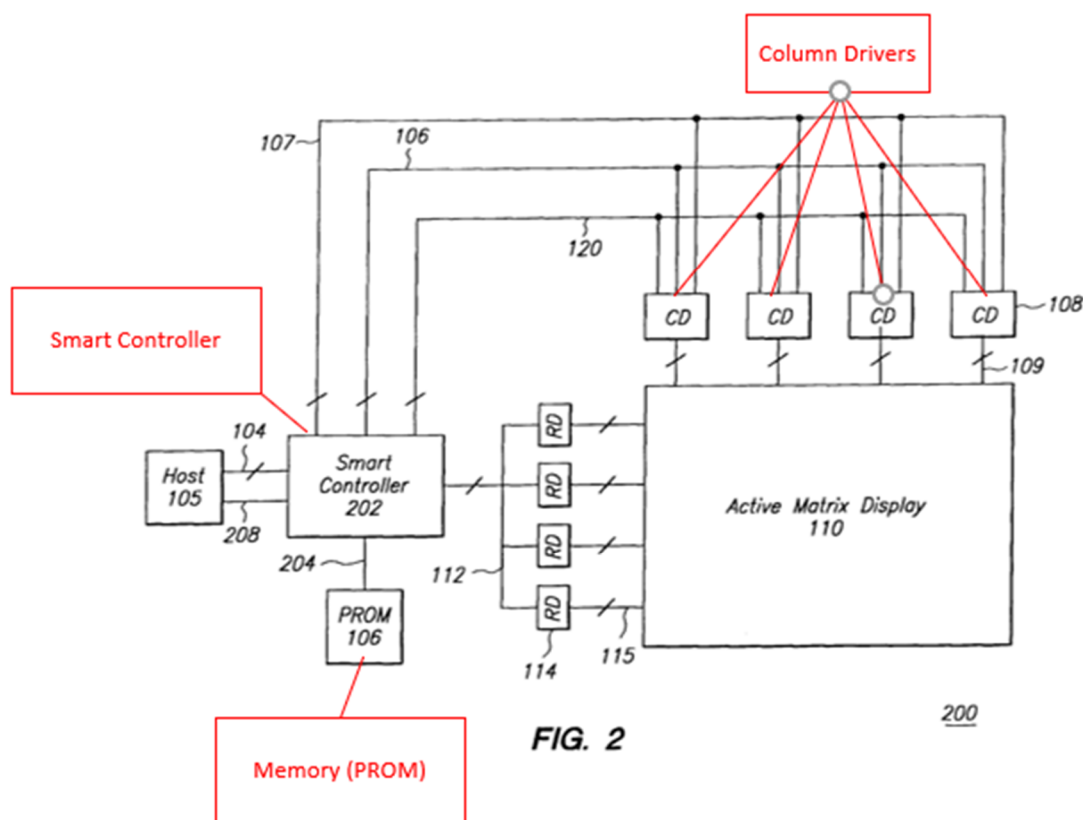
(EX1006, Fig. 5).

C. Da Costa (EX1007)

71. The Da Costa reference discloses a system and method for controlling an active matrix liquid crystal display using a “smart” controller chip that integrates both digital and analog control capabilities. (EX1007, 2:31-34, Fig. 2). This controller allows for flexible and dynamic adjustment of display characteristics, including gamma correction, to compensate for manufacturing variations and environmental changes. (EX1007, 11:15-33, 11:34-46)

72. The smart controller chip contains programmable registers for storing digital values corresponding to gamma reference voltages. (EX1007, 7:51-56, Fig.

7A) These registers can be programmed via an external PROM or internal flash memory, providing non-volatile and electrically reprogrammable gamma reference control. (EX1007, 4:57-67, 6:45-50). The stored digital values are converted to analog reference levels by integrated D/A converters and sent to the column drivers to control the display output. (EX1007, 7:22-27, 8:12-23, Fig. 2)



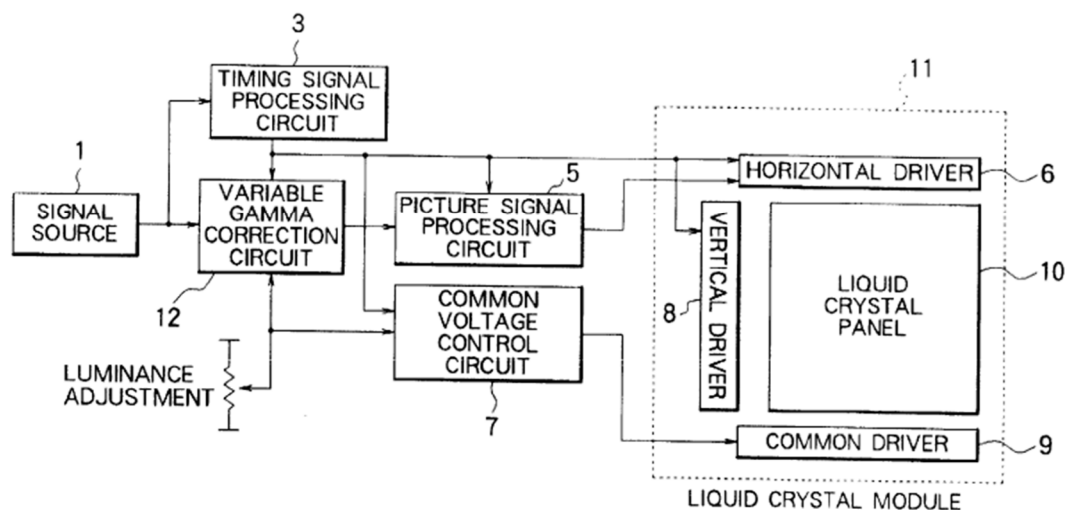
(EX1007, Fig. 2)

73. This integrated approach enables real-time optimization of display gamma, allowing for improved image quality across various applications and environmental conditions. (EX1007, 2:60-3:8, 11:15-33)

D. Matsui (EX1008)

74. The Matsui reference discloses a luminance adjusting apparatus for liquid crystal displays that addresses the need to optimize gamma correction for individual panels. (EX1008, Abstract, 1:7-10). Matsui teaches a variable gamma correction circuit that can change inflection points of a gamma correction curve by adjusting voltage levels. (EX1008, 6:6-14, Fig. 1). This circuit includes components for setting multiple reference voltages as inflection points, allowing for precise control of the display's luminance characteristics. (EX1008, 13:18-34, Fig. 1).

FIG. 3



(EX1008, Fig. 3).

75. Matsui's apparatus synchronously adjusts the common electrode voltage along with the gamma correction curve, enabling luminance adjustment within a narrow dynamic range. (EX1008, 9:39-45, Fig. 2). This approach reduces

the required output voltage range of the picture signal processing section, potentially decreasing the cost of the horizontal driver. (EX1008, 5:64-6:3). Matsui also describes automatic adjustment based on ambient light and display tilt, suggesting the ability to store and retrieve multiple gamma correction settings. (EX1008, 10:53-11:6, Figs. 4-5).

X. Motivations to Combine

76. A POSITA would have been motivated to combine each of the asserted combinations here to arrive at the challenged claims. Each of Liaw, Greene, Da Costa, and Matsui relate to the field of integrated circuits for producing corrections to voltages used to drive a display. Thus, all the references asserted here are analogous art, because they are in the same field of endeavor. Even if they were not in the same field of endeavor, they are all reasonably pertinent to the problem addressed by the '788 Patent – the calibration of LCD displays. The specific rationales to combine these references, along with more specific similarities of each, are further provided below through Section IX.

XI. Ground 1: Claims 1-3, 5-6 Are Invalid Over Liaw in view of Greene

77. As discussed above, Liaw was applied by the Examiner to reject the claims that ultimately issued as Claims 1-3, 5-6 in the '788 Patent. However, each and every limitation argued by Applicant that was apparently missing in Liaw is in

fact present in Liaw, Greene, or both. A POSITA would have been motivated to combine Liaw with Greene to arrive at the claimed features.

78. Liaw discloses a method for calibrating a liquid crystal display to a desired gamma curve. (EX1006, Abstract). Greene teaches using a separate, movable photodetector to test the display and optimize luminance uniformity. (EX1007, 11:30-38, Fig. 6). A POSITA would have been motivated to incorporate Greene's separate photodetector into Liaw's system as a simple substitution of one known testing method for another, yielding the predictable result of more flexible and precise display calibration. (EX1007, 11:25-29).

79. Furthermore, a POSITA would have been motivated to apply Greene's teaching of repeating the calibration process under different ambient conditions to Liaw's method. Greene explicitly states that ambient illumination affects image contrast and that correction methods can adjust for different lighting conditions. (EX1007, 2:56-3:2). Implementing this feature in Liaw's system would be an obvious application of a known technique to improve a similar device, allowing the display to maintain optimal performance across various usage scenarios. (EX1006, 3:5-8).

80. Regarding the optimization process, Greene's disclosure of using stored parameters to scale and interpolate drive signals in real-time (EX1007, 4:45-58) would motivate a POSITA to enhance Liaw's optimization algorithm. This

modification would be an obvious use of a known technique to improve a similar device, as it would allow for more efficient and precise gamma curve calibration in Liaw's system.

81. Finally, a POSITA would have been motivated to incorporate Greene's teaching of integrating correction circuitry into column driver circuits (EX1007, 11:12-15, Fig. 5) into Liaw's system. This modification would be obvious to try, as it represents one of a finite number of identified, predictable solutions for implementing the gamma correction hardware, with the expected benefit of improved performance and reduced complexity in the overall display system.

A. Claim 1

1. Limitation 1[0]: A method of calibrating a liquid crystal display to a desired gamma curve to compensate for panel to panel manufacturing variations comprising the steps:

a) Liaw (EX1005)

82. Liaw expressly discloses a method of calibrating a liquid crystal display to a desired gamma curve to compensate for panel to panel manufacturing variations. Liaw describes an automatic gamma correction system and method for displays to correct for non-linearity between gray-scale values, signal voltages, and luminance. (EX1005, 1:15-34). The system aims to provide individual correction of gamma parameters for each display to account for inevitable process unreliability and differences between displays. (EX1005, 1:28-34). Liaw's method

involves determining parameters, measuring voltage-to-luminance curves, optimizing gamma reference voltages, and building a gray-scale-to-voltage curve to achieve a desired gamma curve. (EX1005, 10:14-25, Fig. 14).

b) Greene (EX1006)

83. Greene discloses a method of calibrating a liquid crystal display to compensate for manufacturing variations, which a POSITA would have understood achieves a desired gamma curve. Greene describes methods for correcting spatial non-uniformities in brightness arising from materials, manufacturing, and operational parameter variations in electronic color displays, including liquid crystal displays. (EX1011, Abstract, 1:15-17, 4:8-22). While Greene focuses on brightness/luminance correction, a POSITA would have understood this is directly related to gamma curve calibration, as gamma characterizes the display's brightness response. Greene's goal of correcting manufacturing variations to achieve uniform brightness across the display (EX1011, 1:41-54) is conceptually equivalent to calibrating to a desired gamma curve from a POSITA's perspective.

2. Limitation 1[1]: a. providing said display with gamma reference control capability which is electrically reprogrammable and non-volatile;

a) Liaw (EX1005)

84. Liaw discloses providing the display with gamma reference control capability that is electrically reprogrammable and non-volatile. The system includes a programmable gamma voltage generating means (30) that generates

adjustable gamma reference voltages. (EX1005, 5:62-7:5, Fig. 7A). These gamma reference voltages are stored in memory (21) of the main controller (20), which is described as storing parameters for data storage. (EX1005, 6:21-36, Fig. 7A).

While Liaw does not explicitly state the storage is non-volatile, a POSITA would have understood that storing calibration parameters for future use would require non-volatile storage to retain the values when power is removed from the display.

b) Greene (EX1006)

85. Greene discloses providing the display with gamma reference control capability that is electrically reprogrammable and non-volatile. Greene describes storing correction parameters in non-volatile random-access memory (NV-RAM). (EX1011, 10:14-36). These stored parameters are used to scale and/or interpolate drive signals in real time to correct for brightness non-uniformities. (EX1011, 4:45-58). A POSITA would have understood that the stored correction parameters effectively serve as gamma reference controls, as they adjust the brightness response of the display. The use of NV-RAM indicates this control capability is both electrically reprogrammable and non-volatile. (EX1011, 10:14-36).

3. Limitation 1[2]: b. testing said display with at least one sensor with optical input, wherein said sensor is separate from said display;

a) Liaw (EX1005)

86. Liaw expressly discloses testing the display with at least one sensor with optical input, wherein the sensor is separate from the display. Liaw's system

includes sensors (11-13) that can be disposed inside or outside the display to obtain voltage-to-luminance curves. (EX1005, 5:62-6:12, Fig. 7A). These sensors can be light sensors used to measure luminance parameters of the display. (EX1005, 6:13-20). The sensors are separate components from the display itself, connected to the main controller to provide sensed data for gamma correction. (EX1005, 6:21-36, Fig. 7A).

b) Greene (EX1006)

87. Greene expressly discloses testing the display with at least one sensor with optical input that is separate from the display. Specifically, Greene describes using “a photodetector 72 movably mounted (on an x-y arm assembly 74, for example) [that] provides the measured data when scanned over the surface of the screen 76.” (EX1011, 11:30-33, Fig. 6). The photodetector is clearly separate from the display, as Greene states it “can be parked inside the housing of the display, not shown, away from the viewable area of the screen, when the self-calibration function is not in use.” (EX1011, 11:33-38). This arrangement allows for automated testing and correction of display non-uniformities arising from manufacturing variations. (EX1011, 11:25-29).

4. Limitation 1[3]: c. varying gamma reference voltage levels on columns of said display by a control circuit, wherein said control circuit is separate from said display;

a) Liaw (EX1005)

88. Liaw expressly discloses varying gamma reference voltage levels on columns of said display by a control circuit, wherein said control circuit is separate from said display. The system includes a programmable gamma voltage generating means (30) that generates adjustable gamma reference voltages output to programmable switches (41-43) connected to columns of the display. (EX1005, 5:62-7:5, Fig. 7A). This gamma voltage generating means is controlled by the main controller (20), which is a separate control circuit from the display itself. (EX1005, 6:21-36, Fig. 7A). The system varies these gamma reference voltages during the optimization process to achieve the desired gamma curve. (EX1005, 9:22-42, Fig. 14).

b) Greene (EX1006)

89. Greene discloses varying gamma reference voltage levels on columns of the display by a control circuit separate from the display. Greene describes using luminance scaler/adder means to adjust drive signals for each column of pixels. (EX1011, 10:59-11:11, Fig. 5). While Greene does not explicitly use the term “gamma reference voltage levels,” a POSITA would have understood that adjusting the drive signals effectively varies the gamma reference voltage levels, as these drive signals control the brightness response of the display. The luminance scaler/adder means and associated control circuitry are depicted as separate from the display itself in Figure 5. (EX1011, Fig. 5).

5. Limitation 1[4]: d. optimizing said gamma reference voltage levels using means for executing a predetermined algorithm according to a predetermined criteria and data sensed by said at least one sensor, wherein said means for executing said predetermined algorithm is separate from said display to achieve the desired gamma curve; and

a) Liaw (EX1005)

90. Liaw expressly discloses optimizing said gamma reference voltage levels using means for executing a predetermined algorithm according to predetermined criteria and data sensed by said at least one sensor, wherein said means for executing said predetermined algorithm is separate from said display to achieve the desired gamma curve. The main controller (20) includes a CPU (22) that executes optimization algorithms to determine gamma reference voltages based on sensed voltage-to-luminance data from the sensors and predetermined criteria like desired luminance and contrast. (EX1005, 6:38-56, 7:46-8:4, Fig. 7A). This optimization process aims to fit the transfer curve to a desired gamma curve. (EX1005, 7:46-8:4). The main controller and CPU are separate components from the display itself, as clearly shown in Figure 7A. (EX1005, Fig. 7A).

b) Greene (EX1006)

91. Greene discloses optimizing gamma reference voltage levels using means for executing a predetermined algorithm according to predetermined criteria and sensed data, wherein the means is separate from the display. Greene describes using stored parameters to scale and interpolate drive signals in real time to correct

brightness non-uniformities. (EX1011, 4:45-58). This scaling and interpolation process constitutes a predetermined algorithm for optimizing the drive signals (effectively gamma reference voltage levels) based on previously measured brightness characteristics. (EX1011, 4:34-44). While not explicitly stated, a POSITA would have understood the electronic signal processing means performing these computations would likely be implemented separately from the display itself. (EX1011, 10:48-58, Fig. 5). The optimization achieves a desired gamma curve by correcting manufacturing variations to produce uniform brightness across the display. (EX1011, 1:41-54).

6. Limitation 1[5]: e. storing said gamma reference voltage levels in said gamma reference control capability.

a) Liaw (EX1005)

92. Liaw expressly discloses storing said gamma reference voltage levels in said gamma reference control capability. The main controller (20) includes a memory (21) for parameter calculation and data storage. (EX1005, 6:21-24, Fig. 7A). The memory can store at least one gray-scale-to-luminance destination curve and the Gamma reference voltages evaluated by the central process unit. (EX1005, 6:24-27). While Liaw does not explicitly state the storage is non-volatile, a POSITA would have understood that storing calibration parameters for future use would require non-volatile storage to retain the values when power is removed

from the display. This ensures the optimized gamma reference voltages are preserved for subsequent use in driving the display with the desired gamma curve.

b) Greene (EX1006)

93. Greene expressly discloses storing the gamma reference voltage levels in the gamma reference control capability. Greene describes storing correction parameters in non-volatile random-access memory (NV-RAM). (EX1011, 10:14-36). These stored parameters are used to scale and interpolate drive signals in real time, which a POSITA would have understood effectively serve as gamma reference voltage levels. (EX1011, 4:45-58). The use of NV-RAM ensures the storage is both electrically reprogrammable and non-volatile, as required by the gamma reference control capability described in limitation 1[1]. (EX1011, 10:14-36).

B. Claim 2: The method of claim 1 wherein the method is repeated more than once under different ambient display conditions to generate at least one different set of gamma reference voltage levels stored in said gamma reference control capability.

1. Liaw (EX1005)

94. Liaw renders obvious repeating the method more than once under different ambient display conditions to generate multiple sets of gamma reference voltage levels stored in the gamma reference control capability. Liaw discloses the system can be used with adjusting means for luminance, contrast, and color temperature and a back-lighting control unit. (EX1005, 3:5-8). This indicates the

ability to calibrate under different ambient conditions. The memory can store “at least one gray-scale-to-luminance destination curve”, suggesting multiple curves for different conditions. (EX1005, 2:65-67). A POSITA would have understood the calibration process could be repeated for different ambient settings (e.g. luminance, color temperature) to generate and store multiple optimized gamma reference voltage sets, allowing optimal display performance across various usage scenarios.

2. Greene (EX1006)

95. Greene discloses repeating the calibration method under different conditions to generate multiple sets of correction parameters. Greene teaches that the measurement of primary luminance variations can be repeated after a period of usage to compensate for display aging. (EX1006, 8:16-24). This implies repeating the method under different conditions, as the display characteristics change over time. Greene further discloses that the correction methods can address non-uniformities from uneven aging (EX1006, 4:45-58), and describes a self-calibrating function that can be initiated periodically (EX1006, 4:59-63). A POSITA would have understood these teachings to disclose repeating the calibration process multiple times as the display ages to generate updated correction parameters stored in the non-volatile memory. (EX1006, 7:41-8:4).

C. Claim 3

1. Limitation 3[0]: A method of programming one or more gamma reference voltage generator integrated circuits attached to a liquid crystal display comprising the steps:

a) Liaw (EX1005)

96. Liaw discloses a method of programming one or more gamma reference voltage generator integrated circuits attached to a liquid crystal display. The system includes a programmable gamma voltage generating means (30) composed of a digital-to-analog converter (DAC) and buffers that generates adjustable gamma reference voltages for a liquid crystal display. (EX1005, 1:7-13, 1:62-2:8, 6:57-7:5, Fig. 7A). While not explicitly stated as “attached,” a POSITA would have understood the gamma voltage generating means must be connected to the display to provide the reference voltages, which is equivalent to being attached. The method comprises steps for optimizing and programming these gamma reference voltages, as detailed in the subsequent limitations. (EX1005, 9:6-12, Fig. 14).

b) Greene (EX1006)

97. Greene discloses a method of programming one or more gamma reference voltage generator integrated circuits attached to a liquid crystal display. While Greene does not explicitly use the term “gamma reference voltage generator integrated circuits,” it describes luminance scaler/adder circuitry that performs an equivalent function of adjusting pixel drive signals to correct for non-uniformities in liquid crystal displays. (EX1011, 1:8-13, 2:43-55, 10:59-11:4, Fig. 4). This

circuitry is attached to the display and programmed with correction values stored in memory, analogous to programming gamma reference voltage generators. (EX1011, 4:14-24, 10:14-36). A POSITA would have understood the luminance correction circuitry of Greene to be functionally equivalent to gamma reference voltage generators for LCDs, as both serve to adjust the brightness response of the display to achieve desired uniformity.

2. Limitation 3[1]: a. selecting one or more columns on said liquid crystal display;

a) Liaw (EX1005)

98. Liaw discloses selecting one or more columns on said liquid crystal display. The system includes programmable switches (41-43) connected to a switch control unit (40) that interconnects the switches and voltage dividing circuit with corresponding gray-scale values. (EX1005, 6:57-7:5, Fig. 7A). The switch control unit applies gamma reference voltages to specific divided voltage points according to gray-scale signals from the CPU. (EX1005, 7:6-12). While Liaw does not explicitly use the term “columns”, a POSITA would have understood that applying voltages to specific points in the voltage dividing circuit is equivalent to selecting columns, as these voltage points correspond to columns in the display.

b) Greene (EX1006)

99. Greene discloses selecting one or more columns on the liquid crystal display. Greene explicitly describes applying luminance scaling/correction to

columns of pixels, stating “luminance scalers/adders 62 are placed into a pixel stream 64 associated with each column driver 66.” (EX1006, 11:5-7, Fig. 5). This indicates that columns of the display are selected for correction. The column-based correction is further evidenced by Greene’s description of parallel implementation where “scalers/adders 62 and memories 68 can be integrated into the column driver circuit 66.” (EX1006, 11:12-15, Fig. 5).

3. Limitation 3[2]: b. applying one or more different gamma voltages to said liquid crystal display columns;

a) Liaw (EX1005)

100. Liaw expressly discloses applying one or more different gamma voltages to said liquid crystal display columns. The programmable gamma voltage generating means (30) generates a set of gamma reference voltages that are output to the programmable switches (41-43). (EX1005, 5:39-6:5, Fig. 7A). These gamma reference voltages are then applied to corresponding divided voltage points in the voltage dividing circuit (50) by the switch control unit (40) according to gray-scale signals. (EX1005, 7:6-16, Fig. 7A). A POSITA would have understood that applying different voltages to different points in the voltage dividing circuit is equivalent to applying different gamma voltages to different columns of the display, as the voltage dividing circuit outputs correspond to display columns. (EX1005, 8:5-16, Fig. 13).

b) Greene (EX1006)

101. Greene discloses applying different gamma voltages to liquid crystal display columns. While Greene does not explicitly use the term “gamma voltages”, it describes adjusting drive signals applied to pixels in columns to correct for luminance non-uniformities. (EX1006, 1:41-54, 10:59-11:4, Fig. 5). A POSITA would have understood these drive signals in an LCD to be gamma voltages that control pixel brightness. Greene states “the drive voltage administered to each color element may be adjusted” (EX1006, 9:59-10:3), which directly corresponds to applying different gamma voltages to display columns. The column-based nature of the correction is evident from Greene’s description of “luminance scalers/adders 62 are placed into a pixel stream 64 associated with each column driver 66.” (EX1006, 11:5-7, Fig. 5).

4. Limitation 3[3]: c. storing said applied gamma voltages in reprogrammable, nonvolatile cells in said gamma reference voltage generator integrated circuits appropriate to said selected columns;

a) Liaw (EX1005)

102. Liaw does not expressly disclose storing the applied gamma voltages in reprogrammable, nonvolatile cells in the gamma reference voltage generator integrated circuits. However, a POSITA would have found it obvious to modify Liaw’s system to store the gamma voltages in such memory within the gamma voltage generating means (30). Liaw discloses storing gamma reference voltages in memory (21) (EX1005, 5:39-46, Fig. 7A), and a POSITA would have recognized

the benefits of using reprogrammable, nonvolatile memory in the gamma voltage generator itself to retain calibrated voltages when powered off and allow easy updates. This modification would predictably improve Liaw's system by enabling persistent storage of optimized gamma voltages directly in the voltage generation circuitry.

b) Greene (EX1006)

103. Greene discloses storing applied correction values in reprogrammable, nonvolatile cells for selected columns. Greene describes storing correction values for each pixel in non-volatile random-access memory (NV-RAM) after measuring luminance. (EX1006, 10:14-36). While not explicitly called "gamma reference voltage generator integrated circuits," a POSITA would have understood the stored correction values to be equivalent to gamma voltages, and the NV-RAM storing these values for each pixel to function as reprogrammable, nonvolatile cells. The column-specific nature is evident from Greene's description of integrating memories into column driver circuits. (EX1006, 11:5-19, Fig. 5).

5. Limitation 3[4]: d. operating means for executing one or more optimization criteria algorithms based on optical emission corresponding to said selected columns, wherein said means for executing said one or more optimization criteria algorithms is separate from said liquid crystal display;

a) Liaw (EX1005)

104. Liaw expressly discloses operating means for executing one or more optimization criteria algorithms based on optical emission corresponding to said

selected columns, wherein said means for executing said one or more optimization criteria algorithms is separate from said liquid crystal display. The main controller (20) includes a CPU (22) that executes optimization algorithms to determine gamma reference voltages based on voltage-to-luminance data from optical sensors (11-13). (EX1006, 6:38-56, 5:62-6:12, Fig. 7A). This optimization process aims to fit the transfer curve to a desired gamma curve for the selected display columns. (EX1006, 7:46-8:4). The main controller and CPU are clearly separate components from the display itself, as shown in Figure 7A. (EX1006, Fig. 7A). While Liaw does not use the exact phrase “optimization criteria algorithms”, a POSITA would have understood the described optimization process to be equivalent to executing such algorithms.

b) Greene (EX1006)

105. Greene discloses operating means for executing optimization criteria algorithms based on optical emission from selected columns, wherein the means is separate from the liquid crystal display. Greene describes using photo-sensing means to measure luminance variations across pixels (EX1006, 8:7-9). These measurements are used in algorithms to determine correction values, as Greene states: “The correction methods incorporate the measurement of the brightness characteristics of the display” (EX1006, 4:34-36). The algorithms are executed by control circuitry separate from the display, as evidenced by the luminance

scaler/adder means depicted apart from the LCD array in Figure 4 (EX1006, Fig. 4, 7:41-8:4).

6. Limitation 3[5]: e. modifying said one or more different applied gamma voltages based on said one or more optimization criteria algorithms;

a) Liaw (EX1005)

106. Liaw expressly discloses modifying said one or more different applied gamma voltages based on said one or more optimization criteria algorithms. The CPU (22) optimizes and evaluates gamma reference voltages using predetermined algorithms, then delivers signals representing these optimized gamma voltages to the programmable gamma voltage generating means (30). (EX1005, 6:48-56, Fig. 7A). This process of optimizing and then delivering new gamma voltages to the voltage generating means modifies the applied gamma voltages based on the optimization algorithms. The voltage generating means (30) then outputs these modified gamma voltages to the programmable switches (41-43) for application to the display columns. (EX1005, 6:57-7:5, Fig. 7A).

b) Greene (EX1006)

107. Greene discloses modifying the applied gamma voltages based on optimization criteria algorithms. Specifically, Greene describes adjusting drive signals (equivalent to gamma voltages in LCDs) based on measured luminance variations and calculated correction values. (EX1006, 1:41-54, 10:59-11:4). This adjustment process utilizes optimization criteria to reduce luminance non-

uniformities below a detection threshold. (EX1006, 4:45-58). A POSITA would have understood that the luminance scaler/adder means (56) in Greene's system performs this modification by applying the stored correction parameters to the input video signal in real-time, effectively modifying the gamma voltages applied to the display columns. (EX1006, Fig. 4, 10:59-11:4).

7. Limitation 3[6]: f. programming said applied gamma voltages in storage cells in said gamma reference voltage generator integrated circuits appropriate to said selected columns; and

a) Liaw (EX1005)

108. A POSITA would have found it obvious to modify Liaw's system to program the applied gamma voltages in storage cells in the gamma reference voltage generator integrated circuits appropriate to the selected columns. While Liaw discloses delivering optimized gamma voltages to the programmable gamma voltage generating means (30), it does not explicitly state these voltages are programmed into storage cells within the means itself. (EX1005, 6:48-56, Fig. 7A). However, a POSITA would have recognized the benefits of storing the optimized voltages locally in the gamma voltage generator, such as retaining calibrated values when powered off and allowing quick access during display operation. This modification would predictably improve Liaw's system by enabling persistent, efficient storage of optimized gamma voltages directly in the voltage generation circuitry.

b) Greene (EX1006)

109. Greene discloses programming applied gamma voltages in storage cells in gamma reference voltage generator integrated circuits for selected columns. While not using those exact terms, Greene describes storing correction values (equivalent to gamma voltages) in non-volatile random-access memory (NV-RAM) for each pixel/column. (EX1011, 10:14-18). A POSITA would have understood this process of storing correction values in NV-RAM to be functionally equivalent to programming gamma reference voltage generators for the selected columns, as these stored values are used to adjust drive signals (gamma voltages) in real-time. (EX1011, 4:45-58, 10:59-11:4, Fig. 5). The column-specific nature is evident from Greene's description of integrating memories into column driver circuits. (EX1011, 11:12-15, Fig. 5).

8. Limitation 3[7]: g. repeating steps (d) through (f) until said one or more optimization criteria have been satisfied.

a) Liaw (EX1005)

110. Liaw discloses repeating steps (d) through (f) until said one or more optimization criteria have been satisfied. Liaw describes that the process of optimizing gamma voltages, modifying the voltages, and applying the new voltages can be repeated until reaching "the determined value". (EX1005, 5:5-7, Fig. 15A). While Liaw does not use the exact phrase "optimization criteria," a POSITA would have understood that reaching "the determined value" is equivalent

to satisfying optimization criteria. The iterative process shown in Figure 15A, where steps are repeated until reaching determined values, further illustrates this concept of repeating optimization steps until criteria are met. (EX1005, Fig. 15A).

b) Greene (EX1006)

111. Greene discloses repeating steps (d) through (f) until optimization criteria are satisfied. Greene describes an iterative process of measuring, calculating corrections, and adjusting drive signals until luminance non-uniformities are reduced below a detection threshold. (EX1006, 4:45-58). This corresponds to repeating the optimization, modification, and programming steps. Greene also explicitly describes repeating the measurement and correction process to compensate for aging of the display over time (EX1006, 11:20-24), further evidencing the iterative nature of the calibration method.

D. Claim 5

1. Limitation 5[0]: A method for a liquid crystal display, comprising:

a) Liaw (EX1005)

112. Liaw expressly discloses a method for a liquid crystal display. Liaw describes an automatic gamma correction system and method specifically for liquid crystal displays (LCDs). (EX1005, 1:7-13, 1:15-34). The method involves providing gamma reference control capability, calibrating the display using sensors and optimization algorithms, and storing optimized gamma reference voltages.

(EX1005, 5:62-7:5, 9:6-12, Fig. 7A). These stored gamma reference voltages are then used to display images on the LCD with corrected gamma characteristics.

(EX1005, 8:29-34, 9:47-10:3). While Liaw does not explicitly use the term “method,” a POSITA would have understood the disclosed system and process steps constitute a method for calibrating and operating an LCD.

b) Greene (EX1006)

113. Greene discloses a method for a liquid crystal display. While Greene does not explicitly state the display is a liquid crystal display, Greene indicates the methods apply to all electronic gray-tone and color displays, irrespective of their construction, including liquid crystal displays (LCDs). (EX1011, 1:8-13, 1:55-2:15). A POSITA would have understood Greene’s methods to be directly applicable to and usable with liquid crystal displays, as LCDs are a common type of electronic color display that suffers from brightness non-uniformities due to manufacturing variations, which Greene’s methods aim to correct. (EX1011, 1:41-54, 4:8-22).

2. Limitation 5[1]: providing said liquid crystal display with gamma reference control capability which is electrically reprogrammable and non-volatile;

a) Liaw (EX1005)

114. Liaw expressly discloses providing said liquid crystal display with gamma reference control capability which is electrically reprogrammable. Liaw’s system includes a programmable gamma voltage generating means (30) that

generates adjustable gamma reference voltages based on values from the main controller. (EX1005, 5:62-6:12, Fig. 7A). This gamma voltage generating means is implemented using a digital-to-analog converter (DAC) connected to buffers, allowing it to be electrically reprogrammed. (EX1005, 8:29-34, Fig. 11). While Liaw does not explicitly state the storage is non-volatile, the system includes memory (21) for storing gamma reference voltages (EX1005, 6:21-36, Fig. 7A). A POSITA would have understood that storing calibration parameters for future use would require non-volatile storage to retain the values when power is removed from the display.

b) Greene (EX1006)

115. Greene discloses providing the liquid crystal display with gamma reference control capability that is electrically reprogrammable and non-volatile. Greene describes storing correction parameters in non-volatile random-access memory (NV-RAM) to adjust pixel luminances. (EX1006, 4:3-6). These stored parameters are used to scale and interpolate drive signals in real-time, effectively providing gamma reference control for an LCD. (EX1006, 4:34-44). The storage is reprogrammable, as Greene indicates measurements and adjustments can be repeated to compensate for display aging. (EX1006, 11:20-24). While Greene does not use the term “gamma reference control,” a POSITA would have understood the

luminance adjustment based on stored values to be functionally equivalent for an LCD.

3. Limitation 5[2]: calibrating said liquid crystal display comprising:

a) Liaw (EX1005)

116. Liaw expressly discloses calibrating said liquid crystal display. The entire system and method described by Liaw focuses on automatic gamma parameter correction for LCDs. (EX1005, 1:7-13, 8:29-34). This gamma correction process involves testing the display with sensors (11-13), varying gamma reference voltages using the programmable gamma voltage generating means (30), optimizing those voltages using the CPU (22), and storing the optimized values. (EX1005, 5:62-6:12, Fig. 7A). This comprehensive process of measuring, adjusting, and optimizing gamma parameters to achieve a desired gamma curve constitutes calibrating the liquid crystal display. (EX1005, 9:6-12, Fig. 14).

b) Greene (EX1006)

117. Greene discloses calibrating the liquid crystal display. The entire method described by Greene is a calibration process for correcting spatial non-uniformities in luminance across the display. (EX1011, 1:41-54). This process involves measuring luminance variations, determining and storing associated correction values, and using those values to adjust pixel luminances in real-time. (EX1011, 1:55-3:2, 4:45-58). A POSITA would have understood this luminance

correction process to be equivalent to calibrating the gamma response of an LCD, as it adjusts the brightness characteristics to achieve a desired uniform output across the display.

4. Limitation 5[3]: a. testing said liquid crystal display with at least one sensor with optical input;

a) Liaw (EX1005)

118. Liaw expressly discloses testing said liquid crystal display with at least one sensor with optical input. Liaw's system includes sensors (11-13) that can be disposed inside or outside the display to obtain voltage-to-luminance curves. (EX1005, 5:62-6:12, Fig. 7A). These sensors can be light sensors used to measure luminance parameters of the display. (EX1005, 6:13-20). A POSITA would have understood that light sensors inherently have optical input to detect light emitted by the display. The sensors are used to test the display by measuring its optical output characteristics during the gamma correction process. (EX1005, 9:47-10:3, Fig. 14).

b) Greene (EX1006)

119. Greene expressly discloses testing the liquid crystal display with at least one sensor with optical input. Greene describes using "photo-sensing means" to measure luminance variations across pixels of the display. (EX1011, 7:55-8:4, 11:20-24). A POSITA would have understood this photo-sensing means to be an optical sensor used to test the display's output. Greene further elaborates on this

sensor, describing “a photodetector 72 movably mounted (on an x-y arm assembly 74, for example) [that] provides the measured data when scanned over the surface of the screen 76.” (EX1011, 11:30-33, Fig. 6). This photodetector clearly constitutes a sensor with optical input used for testing the display.

5. Limitation 5[4]: b. varying gamma reference voltage levels on columns of said liquid crystal display;

a) Liaw (EX1005)

120. Liaw expressly discloses varying gamma reference voltage levels on columns of said liquid crystal display. The system uses programmable switches (41-43) connected to a voltage dividing circuit (50) to apply gamma reference voltages to divided voltage points corresponding to display columns. (EX1005, 7:6-31, Fig. 7A). The programmable gamma voltage generating means (30) outputs adjustable gamma reference voltages to the switches, which are then applied to specific points in the voltage dividing circuit under control of the switch control unit (40). (EX1005, 6:57-7:23, Fig. 7A). A POSITA would have understood that applying different voltages to different points in the voltage dividing circuit is equivalent to varying gamma voltages on display columns, as the voltage dividing circuit outputs correspond to display columns. (EX1005, 7:24-28, Fig. 13).

b) Greene (EX1006)

121. Greene discloses varying gamma reference voltage levels on columns of the liquid crystal display. While Greene does not explicitly use the term

“gamma reference voltage levels,” it describes adjusting drive signals, including voltages, for pixels to correct luminance non-uniformities. (EX1011, 2:1-3, 9:41-48). For an LCD, these drive voltages correspond to gamma reference voltage levels. Greene indicates the corrections can be applied to columns of pixels, stating “luminance scalers/adders 62 are placed into a pixel stream 64 associated with each column driver 66.” (EX1011, 11:5-7, Fig. 5). This column-based correction is further evidenced by Greene’s description of integrating correction circuitry into column driver circuits. (EX1011, 11:12-15, Fig. 5).

6. Limitation 5[5]: c. optimizing said gamma reference voltage levels using means for executing a predetermined algorithm according to a predetermined criteria and data sensed by said at least one sensor; and

a) Liaw (EX1005)

122. Liaw expressly discloses optimizing said gamma reference voltage levels using means for executing a predetermined algorithm according to predetermined criteria and data sensed by said at least one sensor. The main controller (20) includes a CPU (22) that executes optimization algorithms to determine gamma reference voltages based on the voltage-to-luminance data from the sensors (11-13) and predetermined criteria like desired luminance and contrast. (EX1005, 5:62-6:12, 8:17-28, Fig. 7A). This optimization process aims to fit the transfer curve to a desired gamma curve for the display. (EX1005, 5:39-61). While Liaw does not use the exact phrase “predetermined algorithm”, a POSITA would

have understood the described optimization process to be equivalent to executing such an algorithm to achieve the desired gamma characteristics.

b) Greene (EX1006)

123. Greene discloses optimizing gamma reference voltage levels using means for executing a predetermined algorithm according to predetermined criteria and data sensed by the sensor. Greene describes using luminance scaler/adder means to modify input signals based on stored correction parameters derived from sensor measurements. (EX1011, 2:33-55, 10:59-11:4, Fig. 4). This process optimizes the drive signals (corresponding to gamma reference voltage levels) according to predetermined criteria to correct luminance non-uniformities below a detection threshold. (EX1011, 4:45-58). The luminance scaler/adder 56 in Figure 4 executes this predetermined optimization algorithm using the stored parameters and input video signal to generate normalized output signals. (EX1011, Fig. 4, 10:59-11:4).

7. Limitation 5[6]: d. storing said gamma reference voltage levels in said gamma reference control capability;

a) Liaw (EX1005)

124. Liaw expressly discloses storing said gamma reference voltages in said gamma reference control capability. The main controller (20) includes a memory (21) for parameter calculation and data storage. (EX1005, 5:57-59, Fig. 7A). The memory (21) can store the Gamma reference voltages evaluated by the

central process unit. (EX1005, 6:2-4). While Liaw does not explicitly state the storage is non-volatile, a POSITA would have understood that storing calibration parameters for future use would require non-volatile storage to retain the values when power is removed from the display. This ensures the optimized gamma reference voltages are preserved for subsequent use in driving the display with the desired gamma curve.

b) Greene (EX1006)

125. Greene expressly discloses storing the gamma reference voltage levels in the gamma reference control capability. Greene describes storing correction parameters in non-volatile random-access memory (NV-RAM) for each pixel/column. (EX1011, 10:14-36). For a liquid crystal display, these stored correction parameters correspond to gamma reference voltage levels, as they are used to adjust drive signals (gamma voltages) in real-time to correct luminance non-uniformities. (EX1011, 4:45-58, 10:59-11:4). The use of NV-RAM ensures the storage is both electrically reprogrammable and non-volatile, as required by the gamma reference control capability. (EX1011, 10:14-36).

8. Limitation 5[7]: retrieving said gamma reference voltage levels from said gamma reference control capability; and

a) Liaw (EX1005)

126. A POSITA would have understood that Liaw implicitly discloses retrieving said gamma reference voltage levels from said gamma reference control

capability. While Liaw does not explicitly state that stored gamma values are retrieved, a POSITA would have recognized this step is inherently necessary to utilize the optimized values. Liaw discloses storing optimized gamma reference voltages in memory (21) for subsequent use in driving the display. (EX1006, 2:61-3:8, Fig. 7A). For these stored values to be applied to the display columns via the programmable gamma voltage generating means (30) and voltage dividing circuit (50), they must first be retrieved from memory. (EX1006, 3:9-23, Fig. 7A). Without retrieval, the stored optimized values could not be utilized to achieve the desired gamma correction, rendering the calibration process futile.

b) Greene (EX1006)

127. Greene inherently discloses retrieving the gamma reference voltage levels from the gamma reference control capability. While Greene does not explicitly describe a retrieval step, it discloses that the stored correction parameters are used by the luminance scaler/adder means to modify input signals in real-time. (EX1006, 4:34-44, 4:59-63, 10:59-11:4, Fig. 4). A POSITA would have understood that this real-time use of stored parameters necessarily involves retrieving them from the non-volatile memory where they are stored. The luminance scaler/adder (56) in Figure 4 could not apply the stored correction factors to modify the input video signal without first retrieving those values from memory.

9. Limitation 5[8]: displaying an image on said liquid crystal display based on said gamma reference voltage levels.

a) Liaw (EX1005)

128. Liaw expressly discloses displaying an image on said liquid crystal display based on said gamma reference voltage levels. The entire purpose of Liaw's gamma correction system is to improve image quality on liquid crystal displays. (EX1005, 1:7-13). After optimizing and storing the gamma reference voltages, the voltage dividing circuit (50) outputs voltages to output buffers (60) according to input gray-scale values of the image, using the optimized gamma reference voltages. (EX1005, 10:32-34, Fig. 7A). These output buffers then drive the display columns to produce the image with corrected gamma characteristics. (EX1005, 7:24-31, Fig. 7A). While not explicitly stated, a POSITA would have understood that applying these optimized voltages to the display columns results in displaying an image based on the calibrated gamma reference voltage levels.

b) Greene (EX1006)

129. Greene discloses displaying an image on the liquid crystal display based on the gamma reference voltage levels. Greene describes applying corrected drive signals to adjust primary luminances of color spaces associated with pixels in the display to match luminances and correct spatial non-uniformities (EX1006, 7:54-63). A POSITA would have understood that this process of applying corrected drive signals to ensure uniform brightness necessarily involves

displaying an image on the LCD using those corrected signals. Greene further explains that the correction methods are used to display moving images at a predetermined refresh rate (EX1006, 6:65-7:3). By applying the corrected drive signals to display moving images with uniform brightness, Greene inherently discloses displaying an image on the LCD based on the corrected gamma reference voltage levels.

E. Claim 6: The method of claim 5, wherein the calibrating step is repeated more than once under different ambient display conditions to generate at least one different set of gamma reference voltage levels stored in said gamma reference control capability.

130. Claim 6 is substantially identical to Claim 2, and the analysis provided above regarding Liaw and Greene at *supra*, § IX.B applies equally to Claim 6.

XII. Ground 2: Claims 1-3 and 5-6 Are Invalid Over Greene in view of Da Costa

131. A POSITA would have been motivated to combine Greene with Da Costa to arrive at the claimed features. Greene discloses a method for correcting spatial non-uniformities in brightness for electronic displays, including LCDs,. (EX1011, Abstract, 1:15-17). Da Costa teaches a smart controller chip with integrated analog and digital circuitry for flexible gamma control in active matrix displays. (EX1005, 2:35-46) A POSITA would have been motivated to incorporate Da Costa's programmable gamma reference control capability into Greene's system to achieve more precise and dynamic brightness correction.

132. Specifically, a POSITA would modify Greene's luminance scaler/adder circuitry to include Da Costa's programmable registers and D/A converters for storing and generating gamma reference voltages. (EX1005, 7:51-56, Fig. 7A) This modification would be a simple substitution of one known element (Greene's generic luminance scaling) for another (Da Costa's specific gamma voltage generation) to obtain predictable results of improved display uniformity. (EX1011, 10:59-11:4; EX1005, 8:12-23)

133. The combination would benefit from Da Costa's ability to store multiple gamma curves and dynamically switch between them, allowing for compensation of both manufacturing variations and environmental changes. (EX1005, 11:15-33) This aligns with Greene's goal of correcting both gradual and abrupt non-uniformities in displays. (EX1011, 4:8-22)

134. Furthermore, integrating Da Costa's host system interface into Greene's setup would enable software-controlled optimization of gamma reference levels. (EX1005, 5:1-12) This would enhance Greene's ability to perform iterative corrections and adapt to changing display conditions over time. (EX1011, 11:20-24)

135. The combined system would maintain Greene's optical sensing capabilities for measuring display output (EX1011, 11:30-33), but leverage Da Costa's programmable architecture to more efficiently implement the correction

algorithms. This integration represents an application of a known technique (Da Costa's programmable gamma control) to improve a similar device (Greene's display correction system) in the same way, yielding predictable improvements in display uniformity and adaptability.

136. A limitation-by-limitation analysis of Greene is provided *supra*, at § IX, and is not repeated here. Below is a limitation-by-limitation analysis of DaCosta.

A. Claim 1

1. Limitation 1[0]

137. Da Costa discloses a method of calibrating a liquid crystal display to a desired gamma curve to compensate for panel to panel manufacturing variations. The reference teaches a system and method for controlling an active matrix display that allows for flexible and dynamic adjustment of display characteristics such as gamma. (EX1007, 2:31-34, 11:15-33). Da Costa explicitly states that this capability enables “compensat[ing] for temperature changes which alter the transmission behavior of the display panel.” (EX1007, 11:34-37). A POSITA would have understood this to involve calibrating the display to desired gamma curves to account for panel-to-panel variations in manufacturing and environmental conditions. The method comprises steps for testing, varying gamma

voltages, optimizing, and storing gamma reference levels, as detailed in the following limitations.

2. Limitation 1[1]

138. Da Costa discloses providing the display with gamma reference control capability which is electrically reprogrammable and non-volatile. The smart controller chip contains programmable registers for storing digital values corresponding to gamma reference voltages. (EX1007, 7:66-8:3, Fig. 7A) These registers can be programmed via an external PROM or internal flash memory, both of which are non-volatile storage. (EX1007, 4:57-67, 6:45-50). The gamma reference values can be dynamically modified by software in the host system, enabling electrical reprogramming. (EX1007, 5:1-12, 11:15-33). This programmable, non-volatile gamma reference control capability allows for flexible adjustment of display characteristics to compensate for manufacturing variations and environmental changes. (EX1007, 11:34-46)

3. Limitation 1[2]

139. Da Costa mentions compensating for environmental changes (EX1007, 11:34-46), which suggests using an external optical sensor to test the display. A POSITA would have understood that some form of external testing or sensing capability could be used to detect environmental changes and optimize display parameters.

4. Limitation 1[3]

140. Da Costa discloses varying gamma reference voltage levels on columns of the display by a control circuit separate from the display. The smart controller chip (202 or 302) adjusts analog reference levels provided to the column drivers (108 or 354) of the display (110). (EX1007, Fig. 2, Fig. 3A, Fig. 3B) This adjustment is performed by multiplexer circuitry (413) and digital-to-analog converter circuitry (416 or 450) within the controller, which selects digital values from registers (410) and converts them to the necessary analog voltages for the display columns. (EX1007, 7:22-27, 8:12-23, Fig. 7A, Fig. 7B) The smart controller chip is clearly shown as a separate component from the display in the system diagrams. (EX1007, Fig. 2, Fig. 3A, Fig. 3B)

B. Claim 3

1. Limitation 3[0]

141. Da Costa discloses a method of programming gamma reference voltage generator integrated circuits attached to a liquid crystal display. The smart controller chip (202 or 302) contains programmable registers (410) for storing digital values corresponding to gamma reference voltages. (EX1007, 7:51-56, Fig. 7A) These registers can be programmed via an external PROM (206) or internal flash memory (303), allowing the gamma reference values to be set for the display. (EX1007, 5:30-39, 6:56-61) The stored digital values are used to generate analog

reference levels that drive the column drivers (108 or 354) of the attached liquid crystal display (110). (EX1007, 2:47-59, 8:12-23, Figs. 2, 3A, 3B).

2. Limitation 3[1]

142. Da Costa discloses selecting one or more columns on the liquid crystal display. The smart controller chip (202 or 302) generates column control signals and display data that are sent to the column drivers (108 or 354). (EX1007, Figs. 2, 3A, 3B) These column drivers are connected to and drive the column electrodes of the display (110). (EX1007, 4:38-49, Fig. 2). A POSITA would have understood that the process of sending specific control signals and data to particular column drivers inherently involves selecting which columns of the display to activate and program with certain voltage levels. This column selection is a fundamental aspect of how active matrix displays operate to create images by addressing individual pixels.

3. Limitation 3[2]

143. Da Costa discloses applying different gamma voltages to the liquid crystal display columns. The smart controller chip (202 or 302) generates analog reference levels using integrated digital-to-analog converters (416 or 450). (EX1007, 8:55-66, Figs. 4A, 4B) These reference levels are sent to the column drivers (108 or 354), which apply the corresponding voltages to the display columns. (EX1007, 4:38-56, 6:35-41, Figs. 2, 3A, 3B) The controller can store and

select from multiple gamma curves, allowing different voltages to be applied to optimize display characteristics. (EX1007, 9:12-16, 11:15-33)

4. Limitation 3[3]

144. Da Costa discloses storing digital values corresponding to analog reference levels in programmable registers (EX1007, 7:66-8:3, Fig. 7A). While it does not use the words “nonvolatile storage cells for gamma voltages,” it does disclose that the registers can be programmed via an external PROM or internal flash memory, which a POSITA would have recognized as “nonvolatile storage cells.” (EX1007, 4:57-67, 6:45-50).

C. Claim 5

1. Limitation 5[0]

145. Da Costa expressly discloses a method for a liquid crystal display. The reference describes a system and method for controlling an active matrix display, which includes liquid crystal displays, using a smart controller chip that integrates both digital and analog control capabilities. (EX1007, 1:10-28, 2:35-3:2). The smart controller manages column and row drivers to control the liquid crystal display panel. (EX1007, Figs. 2, 3A, 3B) This integrated approach allows for flexible and dynamic adjustment of display characteristics like gamma correction. (EX1007, 2:29-35, 11:15-33)

2. Limitation 5[1]

146. Da Costa expressly discloses providing the liquid crystal display with gamma reference control capability that is electrically reprogrammable and non-volatile. The smart controller chip contains programmable registers for storing digital values corresponding to gamma reference voltages. (EX1007, 4:50-56, Fig. 7A) These registers can be programmed via an external PROM or internal flash memory, both of which are non-volatile storage. (EX1007, 2:47-56, 4:45-50). The gamma reference values can be dynamically modified by software in the host system, enabling electrical reprogramming. (EX1007, 5:1-12, 11:15-33). This programmable, non-volatile gamma reference control capability allows for flexible adjustment of display characteristics to compensate for manufacturing variations and environmental changes. (EX1007, 11:34-46)

3. Limitation 5[2]

147. Da Costa discloses calibrating the liquid crystal display by adjusting gamma reference voltage levels. The smart controller chip allows for dynamic modification of analog reference levels through programmable registers, which can be updated by software in the host system. (EX1007, 6:26-33, 11:15-33). This process enables calibration to compensate for manufacturing variations and environmental changes, allowing the display characteristics to be optimized for particular applications or conditions. (EX1007, 2:19-27, 5:1-12). The ability to

reprogram the gamma reference values and immediately apply them to the display constitutes a calibration capability as claimed.

4. Limitation 5[4]

148. Da Costa expressly discloses varying gamma reference voltage levels on columns of the liquid crystal display. The smart controller chip (202 or 302) contains programmable registers (410) that store digital values corresponding to gamma reference voltages. (EX1007, 7:51-56, Fig. 7A) These digital values are converted to analog reference levels by D/A converters (416 or 450) and sent to the column drivers (108 or 354) to drive the display columns. (EX1007, 7:22-27, 8:12-23, Figs. 2, 3A, 3B) The system allows for dynamic modification of these levels by the host system software, enabling real-time adjustment of gamma reference voltages applied to the display columns. (EX1007, 5:1-12, 11:15-33)

5. Limitation 5[5]

149. Da Costa discloses optimizing gamma reference voltage levels using means for executing a predetermined algorithm according to predetermined criteria, though it does not explicitly mention using sensor data. The smart controller chip allows dynamic adjustment of gamma reference voltages through software in the host system. (EX1007, 5:1-12, 11:15-33). This capability enables optimizing display characteristics for specific applications or environmental conditions according to predetermined criteria. (EX1007, 5:1-12). While Da Costa

does not expressly mention using sensor data, a POSITA would have understood that environmental data could be input to the optimization process to achieve desired display performance.

6. Limitation 5[6]

150. Da Costa expressly discloses storing gamma reference voltage levels in the gamma reference control capability. The smart controller chip contains programmable registers for storing digital values corresponding to gamma reference voltages. (EX1007, 7:51-56, Fig. 7A) These registers can be programmed via an external PROM or internal flash memory, both of which are non-volatile storage. (EX1007, 4:57-67, 6:45-50). The stored digital values are then used to generate the analog reference levels that drive the column drivers, allowing the calibrated gamma settings to be retained and utilized by the display system. (EX1007, 2:47-59, 7:66-8:11)

7. Limitation 5[7]

151. Da Costa discloses retrieving gamma reference voltage levels from the gamma reference control capability. The smart controller chip uses programmable registers to store digital values corresponding to gamma reference voltages. (EX1007, 6:62-7:9, Fig. 7A) These stored values are necessarily retrieved and converted to analog reference levels by the D/A converters (416 or 450) to drive the column drivers (108 or 354). (EX1007, 7:22-27, 8:12-23, Figs. 2, 3A, 3B)

A POSITA would have understood that the controller must retrieve the stored digital values to generate the appropriate analog voltages for display operation, as this retrieval is fundamental to the controller's ability to dynamically adjust and utilize the stored gamma levels. (EX1007, 2:60-3:8, 11:15-33)

8. Limitation 5[8]

152. Da Costa discloses displaying an image on the liquid crystal display based on the gamma reference voltage levels. The smart controller chip (202 or 302) uses the stored gamma reference values to generate analog reference levels that are provided to the column drivers (108 or 354). (EX1007, 7:66-8:11, Figs. 2, 3A, 3B) These column drivers then apply the corresponding voltages to the display columns to produce the desired image. (EX1007, 1:19-28, 8:25-38). This process of using the programmed gamma reference levels to control the display output is fundamental to the operation of the active matrix display system described by Da Costa. (EX1007, 1:29-43, 10:65-11:14)

XIII. Ground 3: Claims 1-2, 5-6 Are Invalid Over Liaw, in view of Greene, in further view of Matsui

153. A POSITA would have been motivated to combine Liaw with Greene and Matsui to arrive at the claimed features. Specifically, a POSITA would have been motivated to incorporate Greene's separate optical sensor and optimization algorithm into Liaw's system to improve calibration accuracy. Greene teaches using "a photodetector 72 movably mounted (on an x-y arm assembly 74, for

example) [that] provides the measured data when scanned over the surface of the screen 76" (EX1007, 11:30-33). This separate sensor allows for precise measurement of display output, which a POSITA would have recognized as beneficial for Liaw's goal of correcting "spatial non-uniformities in brightness that arise from materials, manufacturing, operational and lighting parameter variations" (EX1006, Abstract). Incorporating Greene's separate sensor and optimization means would have been a simple substitution of one known element for another to obtain predictable improvements in calibration precision.

154. Furthermore, a POSITA would have been motivated to incorporate Matsui's teaching of repeating calibration under different ambient conditions into Liaw's system. Matsui discloses automatically adjusting luminance based on detected external light intensity (EX1008, 3:1-6). and display tilt (EX1008, 3:7-14). A POSITA would have recognized that combining this feature with Liaw's system would allow for dynamic optimization of display performance across various usage scenarios, addressing Liaw's concern with "ambient illumination affect[ing] the contrast of the displayed image" (EX1006, 2:56-3:2). This combination would have been obvious to try, as it would involve choosing from a finite number of identified, predictable solutions (i.e., static vs. dynamic calibration) to yield the predictable result of improved display performance under varying conditions.

155. The combination would yield a system that uses a separate optical sensor to measure display output, executes optimization algorithms based on that data, and repeats the calibration process under different ambient conditions - all features of the claimed invention. This combination would have been within the technical grasp of a POSITA and would have yielded predictable results, supporting a conclusion of obviousness.

156. A limitation-by-limitation analysis for Liaw and Greene is already provided *supra*, at § IX. Below is a limitation-by-limitation analysis of Matsui.

A. Claim 1

1. Limitation 1[0]

157. Matsui discloses a method of calibrating a liquid crystal display to a desired gamma curve to compensate for panel to panel manufacturing variations. Specifically, Matsui teaches a luminance adjusting apparatus for adjusting the gamma correction curve of a liquid crystal display to achieve a desired luminance output. (EX1008, Abstract, 1:7-10, 6:6-14). The gamma correction compensates for the nonlinear input voltage-luminance characteristic of liquid crystal panels. (EX1008, 1:15-33, Fig. 8). While Matsui does not explicitly state this is to compensate for manufacturing variations, a POSITA would have understood that adjusting the gamma curve for each individual display panel inherently compensates for panel-to-panel variations that occur during manufacturing.

2. Limitation 1[1]

158. Matsui discloses providing the display with gamma reference control capability which is electrically reprogrammable and non-volatile. Specifically, Matsui teaches a variable gamma correction circuit 12 that can change inflection points of a gamma correction curve. (EX1008, 10:7-11, Fig. 3). This gamma correction circuit includes transistors and other components that allow the gamma correction to be electrically adjusted. (EX1008, 11:10-26, Fig. 6). While Matsui does not explicitly state the gamma correction settings are non-volatile, a POSITA would have understood that the adjusted settings would need to be retained when power is removed for the adjustments to be useful, implying some form of non-volatile storage. This understanding is supported by Matsui's teaching that the gamma correction can be optimized for individual displays. (EX1008, 13:58-63).

3. Limitation 1[3]

159. Matsui discloses varying gamma reference voltage levels on columns of the display by a control circuit separate from the display. Specifically, the variable gamma correction circuit 12 changes inflection points of the gamma correction curve, which involves adjusting voltage levels applied to the display columns. (EX1008, 10:21-26, 9:39-45). Figure 3 shows the gamma correction circuit 12 as a separate component from the liquid crystal panel 10, and horizontal

drivers, which (in this orientation), a POSITA would have understood are column drivers. (EX1008, Fig. 3).

B. Claim 2

160. Matsui discloses repeating the method under different ambient display conditions to generate multiple stored gamma reference voltage sets. Specifically, Matsui teaches automatically adjusting luminance based on detected external light intensity (EX1008, 3:1-6, Fig. 4) and display tilt (EX1008, 3:7-14, Fig. 5). This indicates the gamma correction and voltage adjustment method is repeated as ambient conditions change, generating different gamma reference voltage sets. While not explicitly stated, a POSITA would have understood these different sets must be stored in the variable gamma correction circuit to enable automatic adjustment based on changing conditions. The adjustable power sources and reference voltages in Matsui's circuit allow for storing multiple voltage sets (EX1008, 11:35-13:63, Fig. 6).

Claim 3

a) Limitation 3[0]

161. Matsui discloses a method of programming one or more gamma reference voltage generator integrated circuits attached to a liquid crystal display. Specifically, Matsui describes a variable gamma correction circuit 12 that is part of a luminance adjusting apparatus for a liquid crystal display. (EX1008, 10:21-26, Fig. 3). This circuit includes multiple transistors, current sources, and resistances

that implement programmable gamma correction functionality. (EX1008, 11:10-13:36, Fig. 6). While not explicitly called an “integrated circuit”, a POSITA would have understood that this complex circuit would be implemented as an integrated circuit attached to the display. Matsui further describes methods of adjusting and programming this gamma correction circuit to achieve desired gamma characteristics for individual displays. (EX1008, 5:55-63, 9:17-26).

Limitation 3[1]

162. Matsui does not expressly disclose selecting one or more columns on the liquid crystal display. While Matsui describes adjusting gamma correction for the entire display (EX1008, 2:55-3:11), it does not specifically mention selecting individual columns for adjustment. However, a POSITA would have understood that the gamma correction could be applied selectively to columns if desired, as liquid crystal displays are typically driven on a column-by-column basis using source drivers. (EX1008, Fig. 3, showing horizontal driver 6 connected to liquid crystal panel 10). The ability to select and adjust individual columns would have been obvious to a POSITA as a way to fine-tune the gamma correction for different areas of the display.

Limitation 3[2]

163. Matsui discloses applying different gamma voltages to the liquid crystal display columns. Specifically, Matsui teaches changing inflection points of

a gamma correction curve by adjusting voltages in the variable gamma correction circuit. (EX1008, 6:6-14, Fig. 1). This process involves applying different gamma voltages to achieve the desired gamma correction characteristic. (EX1008, 9:17-13:63, Fig. 6). While Matsui does not explicitly mention applying these voltages to specific columns, a POSITA would have understood that the gamma voltages are inherently applied to drive the display columns via the horizontal driver 6 connected to the liquid crystal panel 10. (EX1008, Fig. 3). Applying different gamma voltages to the columns is necessary to implement the variable gamma correction described by Matsui.

2. Limitation 3[5]

164. Matsui discloses modifying the applied gamma voltages based on optimization criteria algorithms. Specifically, Matsui teaches automatically adjusting gamma correction parameters based on detected ambient light conditions or display tilt. (EX1008, 10:27-11:6, Figs. 4-5). This adjustment process inherently involves modifying the voltages applied in the variable gamma correction circuit 12 to achieve the desired gamma characteristics. (EX1008, 9:21-13:63, Fig. 6). A POSITA would have understood that implementing such automatic adjustments based on sensor inputs requires executing optimization algorithms to determine appropriate voltage modifications for the display columns.

C. Limitation 3[6]

165. Matsui discloses programming applied gamma voltages in storage cells in the gamma reference voltage generator circuits appropriate to selected columns. While not explicitly mentioning “storage cells,” Matsui teaches a variable gamma correction circuit for adjusting gamma correction parameters. (EX1008, 3:32-42, Fig. 6). A POSITA would have understood that implementing variable gamma correction requires programming voltage values into some form of memory within the gamma correction circuitry. Though Matsui does not explicitly discuss selected columns, a POSITA would have recognized that gamma voltages would be programmed for appropriate columns to implement the variable gamma correction described.

D. Claim 5

1. Limitation 5[0]

166. Matsui expressly discloses a method for a liquid crystal display. Specifically, Matsui teaches a luminance adjusting apparatus and method for adjusting the luminance of a liquid crystal display by changing gamma correction and common voltage. (EX1008, Abstract, 1:7-10). The method involves using a variable gamma correction circuit to adjust inflection points of a gamma correction curve and synchronously change the common electrode voltage to achieve desired luminance characteristics. (EX1008, 6:6-14, Fig. 3). This process allows for

calibrating and optimizing the gamma curve for individual liquid crystal displays. (EX1008, 7:15-24).

2. Limitation 5[1]

167. Matsui discloses providing the liquid crystal display with gamma reference control capability which is electrically reprogrammable and non-volatile. Specifically, Matsui teaches a variable gamma correction circuit 12 that can change inflection points of a gamma correction curve. (EX1008, 10:7-11, Fig. 3). This circuit includes components for setting multiple reference voltages as inflection points. (EX1008, 13:18-34, Fig. 1). While not explicitly stated, a POSITA would have understood that the ability to adjust the gamma correction via a manual dial or automatic sensors implies the gamma reference control is electrically reprogrammable. (EX1008, 10:21-26, 9:31-10:6). Though non-volatility is not expressly disclosed, a POSITA would find it obvious to implement non-volatile storage to maintain optimized settings when power is removed, as this would be necessary for the individual display optimization taught by Matsui. (EX1008, 13:58-63).

3. Limitation 5[2]

168. Matsui discloses calibrating the liquid crystal display. Specifically, Matsui teaches adjusting the gamma correction curve and common voltage to optimize the luminance characteristics of the display. (EX1008, 9:39-45, 10:21-

26). This adjustment process involves changing inflection points of the gamma correction curve using the variable gamma correction circuit 12 and synchronously adjusting the common electrode voltage. (EX1008, 10:21-26, 10:43-47, Fig. 3). A POSITA would have understood this process of optimizing the gamma curve and voltage levels for individual displays to be equivalent to calibrating the liquid crystal display. (EX1008, 5:64-6:3).

4. Limitation 5[4]

169. Matsui discloses varying gamma reference voltage levels on columns of the liquid crystal display. Specifically, Matsui teaches changing inflection points of the gamma correction curve by adjusting voltages in the variable gamma correction circuit 12. (EX1008, 6:6-14, Fig. 1). This process inherently involves varying gamma reference voltage levels applied to the display columns, as the gamma correction curve directly determines the voltage-luminance relationship for each column. (EX1008, 1:15-33, Fig. 8). While Matsui does not explicitly mention columns, a POSITA would have understood that the adjusted gamma voltages are applied to drive the display columns via the horizontal driver 6 connected to the liquid crystal panel 10. (EX1008, Fig. 3).

5. Limitation 5[6]

170. A POSITA would have understood that Matsui discloses storing the gamma reference voltage levels in the gamma reference control capability. While

not explicitly stated, Matsui teaches adjusting gamma correction parameters for individual displays (EX1008, p. 5, lines 29-34), which a POSITA would have recognized requires storing the optimized values to maintain calibration. The variable gamma correction circuit 12 changes inflection points by adjusting voltages (EX1008, p. 9, lines 21-26, Fig. 2), and these adjusted values must be retained to drive the display with the optimized gamma curve. Without storage, the carefully tuned gamma correction would be lost after each adjustment, defeating the purpose of Matsui's individualized display optimization.

6. Limitation 5[8]

171. Matsui discloses displaying an image on the liquid crystal display based on the gamma reference voltage levels. Specifically, Matsui teaches that the variable gamma correction circuit 12 processes input picture signals using the adjusted gamma correction curve to display images on the liquid crystal panel 10 with optimized luminance characteristics. (EX1008, 10:21-26, Fig. 3). The horizontal driver 6 applies the gamma-corrected voltages to the display columns to produce the image with the desired luminance response. (EX1008, 10:27-42, Fig. 3). While not explicitly stated, a POSITA would have understood that displaying images is the fundamental purpose of Matsui's liquid crystal display apparatus, and that the carefully optimized gamma reference voltages are used to achieve this purpose.

E. Claim 6

172. Claim 6 is substantially identical to Claim 2, and the analysis provided *supra*, at § XI.B shows where in Matsui these limitations are found.

XIV. Ground 4: Claims 1-3, and 5-6 Are Invalid Over Liaw in view of DaCosta

173. A POSITA would have been motivated to combine Liaw with Da Costa to arrive at the claimed features. Specifically, a POSITA would have been motivated to incorporate Da Costa's programmable registers and digital-to-analog conversion circuitry into Liaw's gamma correction system to provide more flexible and dynamic control over gamma reference voltages. Liaw discloses a gamma correction system with sensors and optimization algorithms, but lacks the detailed programmable architecture described in Da Costa. (EX1006, 5:62-7:5). Da Costa teaches storing digital gamma values in programmable registers and using D/A converters to generate analog reference voltages. (EX1005, 7:51-56, 8:55-66). This arrangement allows for easy reprogramming and dynamic adjustment of gamma curves. (EX1005, 11:15-33)

174. Combining Da Costa's programmable architecture with Liaw's optimization system would have been an obvious application of a known technique to improve a similar device, yielding predictable results. (EX1005, 2:35-46; EX1006, 1:55-65). The combination would enhance Liaw's ability to compensate for manufacturing variations and environmental changes by providing greater

flexibility in adjusting gamma reference voltages. (EX1005, 11:34-46; EX1006, 1:28-34)

175. Furthermore, a POSITA would have been motivated to implement Da Costa's non-volatile storage capability in Liaw's system to retain optimized gamma values when power is removed. (EX1005, 4:57-67). This modification would be a simple substitution of one known element (Liaw's unspecified memory) for another (Da Costa's non-volatile storage), providing the predictable benefit of preserving calibrated settings between power cycles. (EX1006, 6:21-27; EX1005, 2:47-56)

176. The combination would have been obvious to try, as it would involve choosing from a finite number of identified, predictable solutions (i.e., various programmable architectures for gamma correction) to address the known problem of display calibration and gamma adjustment. (EX1006, 1:21-39; EX1005, 2:19-27). A POSITA would have had a reasonable expectation of success in combining these elements, as both references relate to gamma correction in liquid crystal displays and aim to improve display quality through dynamic adjustment of gamma characteristics.

177. A limitation-by-limitation of Liaw is provided *supra*, at § IX and a limitation-by-limitation analysis of Da Costa is provided *supra*, at § X, and are not repeated here.

XV. CONCLUSION

178. In my opinion, claims 1-3, and 5-6 of the '788 Patent are invalid for at least the reasons stated above.

179. I reserve the right to supplement my opinions in the future to respond to any arguments raised by the owner of the '788 Patent and to take into account new information that becomes available to me.