

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Hisense USA Corporation
Petitioner

v.

Phenix Longhorn LLC
Patent Owner

Patent No. 7,557,788
Filing Date: May 1, 2007
Issue Date: July 7, 2009
Title: Gamma Reference Voltage Generator

Inter Partes Review No. IPR2025-01004

Ex. 1003 -- Declaration of Rafael J. Betancourt

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I, Rafael J. Betancourt, declare as follows:

I. Introduction

1. I am an independent consultant. I am over eighteen years of age, and I would otherwise be competent to testify as to the matters set forth herein if I am called upon to do so.

2. I have prepared this Declaration for consideration by the Patent Trial and Appeal Board in the *Inter Partes* Reviews of U.S. Patent No. 7,557,788 (“the ’788 Patent”).

3. I provide this Declaration at the request of and have been retained by Kilpatrick Townsend & Stockton, LLP, which represents Hisense USA Corporation (“Hisense”) in connection with the above-captioned *Inter Partes* Review. I have been informed and understand that Hisense contends that claims 1-3 and 5-6 of the ’788 Patent are invalid.

4. I am being compensated at an hourly rate of \$750 per hour. My compensation is not dependent on the outcome of or any issue in relation to the above-captioned *Inter Partes* Review, and I have no interest in either party.

5. In forming my opinions, I relied on my knowledge, education, experience, and training in the field and on documents and information referenced in this Declaration.

II. Qualifications

6. My curriculum vitae (“CV”) is attached hereto as Ex. 1004 and provides an accurate identification of my background and experience.

7. I hold the title of President of Betasoft Consulting, Inc., where I specialize in Analog Mixed-signal (“AMS”) architecture, debugging, modeling, and verification. Since 2019, I have worked with many major clients, including Applied Materials Inc., Palo Alto Electron, Inc., Scientific Analog Inc., Vidatronic, Inc., and zGlue Inc., to provide them with R&D engineering services and tools for AMS architecture, design, and verification of silicon integrated circuits.

8. I received a B.S. (1987) in Electrical Engineering from the University of Puerto Rico; an M.S. (1989) in Electrical Engineering from the University of Southern California; and an Engineers Degree in Electrical Engineering (2005) from Stanford University.

9. From 2002 to 2018, I worked at Synaptics, Inc., a leading manufacturer of human interface sensing devices. From 2014 to 2018, I held the title of Director of Analog Mixed-Signal Systems and Verification at Synaptics, Inc., where I was responsible for a global team that performs AMS verification of complex capacitive touch controllers, as well as integrated touch and LCD display controllers (TDDI) for mobile and automotive applications. While at Synaptics, Inc., I also worked as a technical lead for touchscreen CMOS controllers for

mobile, tablet, and notebook PCs and as a technical lead for various touch controller ASICs.

10. From 1998 to 2001, I worked as a Senior Mixed-Signal IC Design Engineer at Innovative Semiconductors, Inc. During that time, I designed a 480Mb/s analog transceiver for USB 2.0 in TSMC's 0.25um and 0.18um CMOS processes. I also wrote specifications for a 480MHz PLL clock synthesizer and interfaced with a PLL design contractor for post-layout verification and performance characterization. I also performed analog verification of a 400Mb/s serial transceiver 1394 PHY chip in TSMC's 0.35um CMOS, bench-tested, troubleshot, and characterized 1394 PHY, and assisted with porting of IEEE-1394 PHY to UMC's 0.18um CMOS.

11. I am currently an IEEE Senior Member and a member of IEEE Solid-State Circuits and Circuits & Systems societies, and I have held the following professional memberships and affiliations:

- IEEE Silicon Valley Chapter of the Technology and Engineering Management Society ("TEMS"): 2020-21 Chair; 2018-19, 2025 Vice-Chair; 2022-24/2017 Secretary; Reviewer for 2019 TEMSCON.
- IEEE Santa Clara Valley Section: 2020 Vice-Chair.
- Volunteer at IEEE Global Humanitarian Technology Conference 2018
- Volunteer Judge at International Science & Engineering Fair (ISEF), 7 times

12. I have authored over six (6) publications including:

- 1-GHz and 2.8-GHz CMOS Injection-locked Ring Oscillator Prescalers, *Symposium on VLSI Circuits, June 14-16, 2001, Kyoto, Japan.*
- CMOS VCOs for Frequency Synthesis in Wireless Biotelemetry, *International Symposium on Low Power Electronics and Design, August 10-12, 1998, Monterey, California.*
- Low Phase Noise CMOS Ring Oscillator VCOs for Frequency Synthesis, *2nd International Workshop on Design of Mixed-Mode Integrated Circuits, July 27-29, 1998, Guanajuato, Mexico.*
- A Low Power Frequency Synthesizer for Wireless Biotelemetry, *33rd. International Telemetering Conference, October 27-30, 1997, Las Vegas, Nevada.*
- A 1.5mW, 200MHz CMOS VCO for Wireless Biotelemetry, *First International Workshop on Design of Mixed-Mode Integrated Circuits and Applications, July 28-30, 1997, Cancun, Mexico.*
- A High-speed GaAs Transversal Filter Circuit for Clutter Rejection Systems, *SPIE's Tech. Symp. Optical Eng. & Photonics in Aerospace Sensing, April 1990.*

13. I am a named inventor on several issued patents: U.S. Pat. No. 9,778,804; U.S. Pat. No. 9,740,351; and U.S. Pat. No. 8,058,884. I have previously testified in multiple cases, including those concerning capacitive touch sensors, and circuits used in capacitive touch and display controllers as well as LCD touch screens. My CV (attached as Exhibit 1004) contains a list of cases in which I have testified in the last five years.

III. Summary of Legal Issues

14. I am not a lawyer. Thus, in expressing my opinions and considering the subject matter of the claims of the '788 Patent, I am relying upon certain legal principles that counsel has explained to me.

A. Obviousness

15. First, I understand that for an invention claimed in a patent to be found patentable, it must be, among other things, new and not obvious from what was known before the invention was made.

16. I understand the information that is used to evaluate whether an invention is new and not obvious is generally referred to as “prior art” and generally includes patents and printed publications (e.g., books, articles, product manuals, company publications, etc.).

17. I understand that in this proceeding Hisense has the burden of proving that the claims of the patents-at-issue are obvious in view of the prior art by a preponderance of the evidence. I understand that “a preponderance of the evidence” is evidence sufficient to show that a fact is more likely true than it is not true.

18. I understand that in this proceeding, the information that may be evaluated is limited to patents and printed publications. My analysis below compares the claims to patents and printed publications that I understand are prior art to the patents-at-issue.

19. I have been informed and understand that a claim is obvious in light of the prior art if the difference or differences between the claimed subject matter 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 having ordinary skill in the art. I have been informed and understand that the Supreme Court provided an outline for analyzing obviousness in which it rejected an earlier test in favor of an “expansive and flexible approach” using “common sense.” I have also been informed and understand that the Supreme Court explained that under the correct analysis, any need or problem known in the field of endeavor at the time of invention and addressed by the patent can provide a reason for combining the elements in the manner claimed. I have also been informed and understand that the Supreme Court explained that “[t]he combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results.” I further have been informed and understand that the Court pointed to other factors that may show obviousness. These factors included the following principles:

- a. combination that unites old elements with no change in their respective functions is unpatentable. As a result, the combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results,
- b. a predictable variation of a work in the same or a different field of endeavor is likely obvious if a person of ordinary skill would be able to implement the variation,

- c. an invention is obvious if it is the use of a known technique to improve a similar device in the same way, unless the actual application of the technique would have been beyond the skill of the person of ordinary skill in the art. In this case, a key inquiry is whether the improvement is more than the predictable use of prior art elements according to their established functions,
- d. an invention is obvious if there existed at the time of invention a known problem for which there was an obvious solution encompassed by the patent's claims,
- e. inventions that were “obvious to try” — chosen from a finite number of identified, predictable solutions, with a reasonable expectation of success — are likely obvious,
- f. known work in one field of endeavor may prompt variations of it for use in either the same field or a different one based on design incentives or other market forces if the variations would have been predictable to one of ordinary skill in the art, and
- g. an explicit teaching, suggestion, or motivation in the art to combine references, while not a requirement for a finding of obviousness, remains “a helpful insight” in determining upon which a finding of obviousness may be based.

B. Claim Construction

20. I have been informed and understand that in an *inter partes* review claim terms are construed according to their ordinary and customary meaning as understood by one of ordinary skill in the art in view of the specification and the prosecution history of the patent.

21. I further understand that the Patent Owner and Petitioner have proposed certain claim constructions in a litigation involving those parties. For purposes of my analysis, I interpreted the claim terms from a perspective of one of ordinary skill in the art as one would understand their plain and ordinary meaning. To the extent there were additional interpretations, or alternative ones, I analyzed the prior art in light of those additional interpretations. Such interpretations include those identified below that I understand may be construed according to a particular legal principle – i.e., construction under paragraph 6 of section 112, which addresses terms structured as a means plus a function. I understand such constructions include identifying the function claimed and identifying the structure that corresponds to the means from the specification, or equivalents thereof. Under all of these claim interpretations, I identified herein the various claimed steps and elements in the prior art.

22. The term “gamma reference control capability,” to the extent not indefinite, should be construed according to 35 U.S.C. § 112, ¶6. This term’s

function is programming and storing gamma reference voltage values in storage cells that are used to generate gamma reference voltage outputs and switching between different gamma settings to implement dynamic gamma correction. The corresponding structure is disclosed in Figs. 2, 3, and 5, or Figs. 6 and 5, or equivalents thereof.

23. The term “control circuit,” to the extent not indefinite, should be construed according to 35 U.S.C. § 112, ¶6. This term’s function is varying gamma reference voltage levels on columns of a display. The corresponding structure is Figs. 2 and 3, or Fig. 6, or equivalents thereof.

24. The term “means for executing a predetermined algorithm according to a predetermined criteria and data sensed by said at least one sensor” recited in claims 1 and 5, to the extent not indefinite, should be construed according to 35 U.S.C. § 112, ¶6. This term’s function is the execution of an algorithm that optimizes gamma reference voltage levels based on (1) data sensed by at least one sensor and (2) the application that is being displayed, external environment such as temperature and ambient light, or the personal preference of the user. Corresponding structure is Fig. 2 or Fig. 6, or the structure disclosed in col. 6:57-64, or equivalents thereof. The same “means for executing one or more optimization criteria algorithms based on optical emission corresponding to said

selected columns” recited in claim 3 should be similarly construed according to 35 U.S.C. § 112, ¶6.

25. The term “gamma reference voltage level” would be understood to include both analog and digital signals. To the extent such understanding is supported by the specification, the prior art discloses this claim term.

C. Level of Skill in the Art

26. I am informed and understand that a person of ordinary skill in the art is a hypothetical person who is presumed to have known the relevant art at the time of the alleged invention. I am informed and understand that factors that may be considered in determining the level of ordinary skill in the art may include: (A) the type of problems encountered in the art; (B) prior art solutions to those problems; (C) the rapidity with which innovations are made; (D) the sophistication of the technology; and (E) the educational level of active workers in the field.

IV. The '788 Patent

27. The '788 Patent is entitled “GAMMA REFERENCE VOLTAGE GENERATOR” and was filed on May 1, 2007. I am informed that the earliest claimed priority date of the '788 Patent is June 11, 2003. Each of the prior art references I address herein was available prior to June 11, 2003, thus I have not analyzed whether each claim of the '788 Patent is entitled to that priority date.

A. Person of Ordinary Skill in the Art of the '788 Patent

28. The '788 Patent relates to liquid crystal displays and gamma correction.

29. Upon consideration of this and the factors outlined in Section III.C above, in my opinion a person of ordinary skill in the art as of June 11, 2003, the earliest claimed priority date of the '788 Patent, 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 technology, and 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.

30. As I explain above, I have the relevant educational background and I have worked in the technical area of the '788 Patent for many years. As of June 11, 2003, which I understand to be the time of the alleged invention, I possessed at least such experience and knowledge of a person of ordinary skill in the art.

B. Construction of Claim Terms of the '788 Patent

31. As explained in further detail below, under any reasonable construction, the claims are obvious in view of the prior art I address herein. Thus, I do not separately offer an opinion with respect to the proper construction of the terms of the claims of the '788 Patent. However, as I discussed in Section III(B)

above, I understand that certain claim terms may be construed under paragraph 6 of section 112, which includes identifying the function claimed and identifying corresponding structure from the specification, or equivalents thereof. Each of these terms are identified in the table below:

Term	Function	Corresponding Structure in the Specification of the '788 Patent
“gamma reference control capability,”	programming and storing gamma reference voltage values in storage cells that are used to generate gamma reference voltage outputs and switching between different gamma settings to implement dynamic gamma correction	Figs. 2, 3, and 5, or Figs. 6 and 5, or equivalents thereof
“control circuit,”	varying gamma reference voltage levels on columns of a display	Figs. 2 and 3, or Fig. 6, or equivalents thereof
“means for executing a predetermined algorithm according to a predetermined criteria and data sensed by said at least one sensor” “means for executing one or more optimization criteria algorithms based on optical emission corresponding to said selected columns”	the execution of an algorithm that optimizes gamma reference voltage levels based on (1) data sensed by at least one sensor and (2) the application that is being displayed, external environment such as temperature and ambient light, or the personal preference of the user	Fig. 2 or Fig. 6, or the structure disclosed in col. 6:57-64, or equivalents thereof

V. Materials Considered

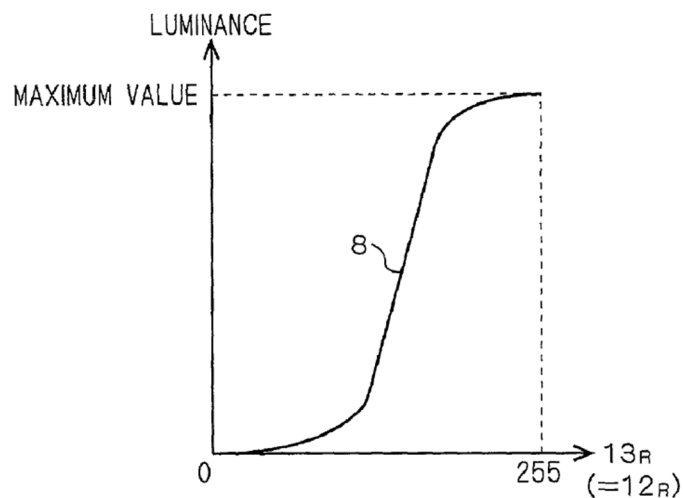
32. In forming my opinions, in addition to my knowledge and experience, I have considered the following documents and things that I have obtained, or that have been provided to me:

Exhibit	Description
1001	U.S. Patent No. 7,557,788 (“the ’788 Patent”)
1002	Prosecution History of U.S. Patent No. 7,557,788
1003	Declaration of Rafael Betancourt
1004	Curriculum Vitae of Rafael Betancourt
1005	JP H06217239 to Nonomura (“Nonomura”)
1006	Certified Translation of Nonomura
1007	U.S. 2002/0063666 to Kang (“Kang”)
1008	JP H07152347 to Uehara (“Uehara”)
1009	Certified Translation of Uehara
1010	U.S. 2002/0036646 to Tobiya (“Tobiya”)
1011	<i>Phenix Longhorn, LLC v. AU Optronics Corporation et al.</i> , No. 2:23-cv-00477, Dkt. 67 (E.D. Tex.) – Docket Control Order
1012	<i>Phenix Longhorn, LLC v. AU Optronics Corporation et al.</i> , No. 2:23-cv-00477, Dkt. 120 (E.D. Tex.) – Joint Claim Construction and Prehearing Statement and Associated Exhibits

33. In addition to the documents above, in forming the opinions expressed below, I have also considered my own knowledge and experience based upon my education and work in the field, as described above and in my *curriculum vitae* (Ex. 1004).

VI. State of the Art as of June 11, 2003.

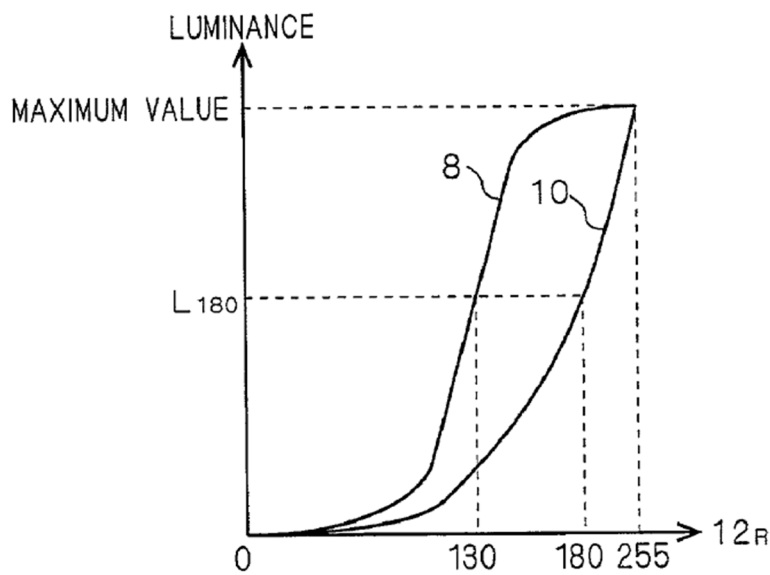
34. As of June 11, 2003, gamma correction is well-known. Liquid Crystal Displays (“LCD”) have a nonlinear relationship between input voltage and transmittance (i.e., “V-T” display characteristic or “gamma curve”), which characterizes how well the LCD panel allows light to pass through it. Ex. 1009, ¶¶4. Human eyes also have a similar but opposite nonlinear sensitivity curve when perceiving brightness.



Ex. 1010, FIG. 3 – Exemplary LCD Gamma Curve

35. To address the nonlinearity and mismatch between display images and human perception, we must determine the gamma curve for the display and apply an inverse transformation (i.e., “gamma correction”). Ex. 1009, ¶¶4-5. Applying gamma correction to the input signal, before it reaches the display, aligns the final

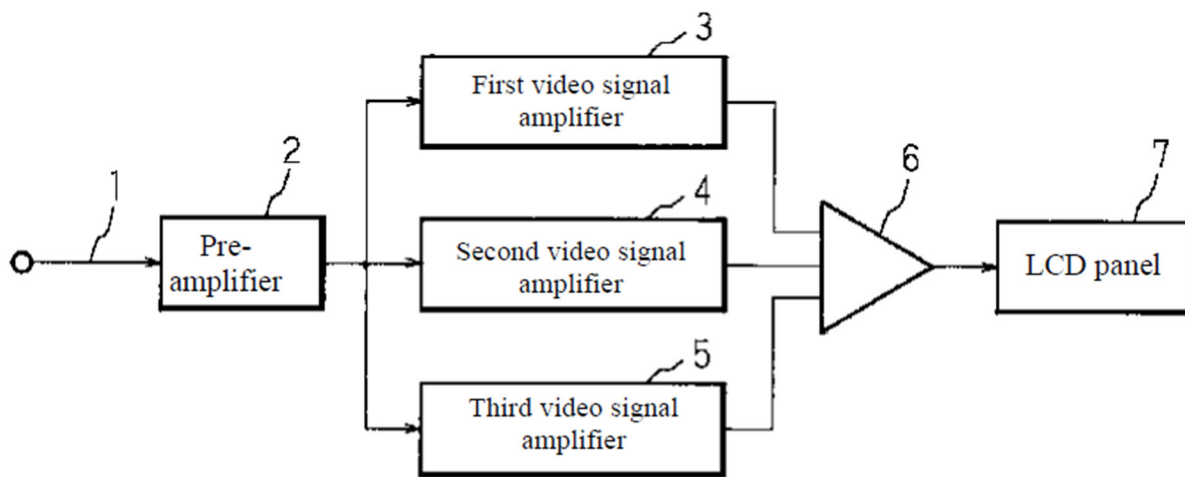
image with human visual expectations. Manufacturing variability requires gamma correction on a per-device basis to render images accurately. Ex. 1009, ¶2. Gamma correction is typically done by selecting a number of points on the measured gamma curve (the curve 8, as shown in the figure below) and providing corrections for each of those points to produce an inverse gamma curve. Ex. 1010, ¶49. Applying this inverse curve to display inputs ensures the end-to-end V-T transfer function matches with the desired luminance target.



Ex. 1010, Fig. 6 – Exemplary Gamma Curve Correction

36. Analog gamma correction is conventional. Ex. 1006, ¶6. In the example shown below, the video signal input 1 is input into the pre-amplifier 2 and amplified to the appropriate level, and the video signals amplified by the video

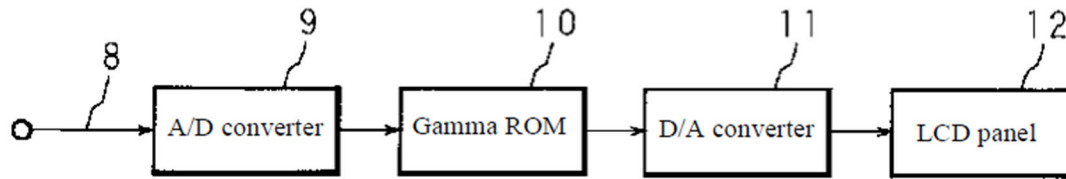
amplifiers 3-5 with different operating regions and gains are regenerated as signals having polygonal line characteristics in the synthetic circuit 6 and amplified to the appropriate level for input into the LCD panel. Ex. 1006, ¶7. However, this conventional analog gamma correction configuration needs an increased circuit size in order to obtain more detailed characteristics. Ex. 1006, ¶8.



Ex. 1006, Fig. 2 – Exemplary Analog Gamma Correction Configuration

37. The digital gamma correction approach can address the deficiencies of the configuration above. Ex. 1006, ¶9. ADC 9, gamma ROM 10, DAC 11, and LCD panel 12 are connected in series, and the gamma ROM 10 uses the digital value that was input as the address and outputs the stored data corresponding to the address. Ex. 1006, ¶10. Fine characteristics can be achieved by increasing the

resolution of the ADC and DAC and the capacity of the gamma ROM. Ex. 1006, ¶11.



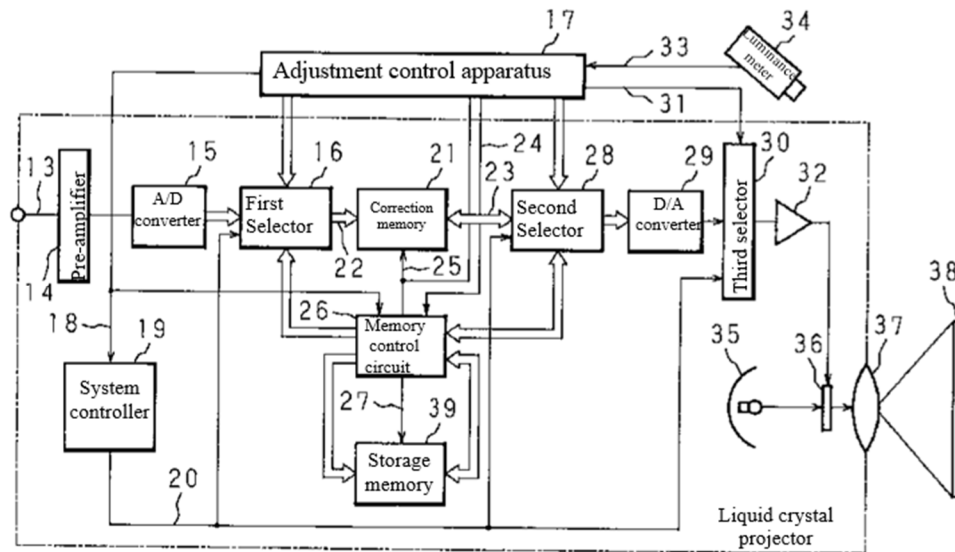
Ex. 1006, Fig. 3 – Exemplary Digital Gamma Correction Configuration

38. Thus, this proves that both analog gamma correction and digital gamma correction are known in the art before January 15, 1993, more than a decade ahead of the priority date (June 11, 2003) of the '788 Patent. Indeed, analog and digital are simply two common implementations of gamma correction, depending on the available technical capabilities and cost-effectiveness. The concept of gamma correction is well known in the display industry.

A. Nonomura

39. Nonomura is a publication of a Japanese Application, and I am informed that Nonomura is prior art to the '788 Patent. Nonomura relates to “a liquid crystal projector, and more specifically, it relates to a liquid crystal projector having a gamma correction function.” Ex. 1006, ¶1.

40. Nonomura depicts a liquid crystal projector having a gamma correction function that performs gamma correction according to the correction data based on the results of the measurement of the applied voltage-transmittance characteristics. Ex. 1006, ¶14. Nonomura describes an LCD panel 36 and a screen 38, where the image displayed on the LCD panel 36 is projected by a light source 35 and enlarged by projection lens 37 for projection onto screen 38. Ex. 1006, ¶20, FIG. 1.



Ex. 1006, Fig. 1.

41. Nonomura explains that the applied voltage-transmittance characteristics of LCD panels depend on various factors such as the birefringence of the liquid crystal, the thickness of the liquid crystal layer, and the wavelength of

light source, and a fixed gamma correction conversion data is not able to deal with this panel-to-panel variance. Ex. 1006, ¶¶12-13.

42. Nonomura describes three operation modes, namely the first mode being a display mode, the second mode being a gamma correction mode using stored gamma correction data, the third mode being a gamma correction data writing mode. Ex. 1006, ¶¶16. Depending on the specific mode adopted, the third selector 30 selects either an analog video signal output by the D/A converter 29 or the DC level voltage signal 31. Ex. 1006, ¶22.

43. The memory control circuit 26 is able to exchange data with the non-volatile storage memory 39, and data can be written to or read from the non-volatile storage memory. Ex. 1006, ¶25. The non-volatile storage memory 39 can retain correction data even if the power supply is turned off. Ex. 1006, ¶34. The correction data stored in the non-volatile storage memory 39 is read according to the address for transfer to the correction memory 21 via the second selector 28, and the data is then written to the correction memory 21 according to the address. Ex. 1006, ¶34. The adjustment control apparatus 17 is connected to the luminance meter 34, which measures the luminance of the image on the screen 38 and inputs the measurement data 33 to the adjustment control apparatus 17 for calibrating the LCD panel 36. Ex. 1006, ¶23.

44. In addition, the range enclosed by the dashed line in FIG. 1 is a basic circuit that is used for a liquid crystal projector, and the adjustment control apparatus 17 and the luminance meter 34 “have been added to this circuit.” Ex. 1006, ¶19.

45. The DC level voltage signal 31 is sent from the adjustment control apparatus 17 to the third selector 30, and at the same time the system control signal 18 is sent to the system controller 19 to provide instructions for a change in mode switching signal 20. Ex. 1006, ¶26. Then third selector 30 then selects the DC level voltage signal 31 according to the mode switching signal 20 and outputs it to the LCD panel 36 as a video signal via the buffer 32. Ex. 1006, ¶26. The adjustment control apparatus 17 then causes the luminance of the screen to be projected onto screen 38 at each voltage to be measured by luminance meter 34 while changing the voltage of DC level voltage signal 31 in a predetermined procedure, and the adjustment control apparatus 17 receives the measurement data 33. Ex. 1006, ¶27.

46. The adjustment control apparatus 17 multiplies the received measurement data 33 by a gamma count that is specific to the LCD panel 36 in order to determine the applied voltage-transmittance characteristics of the LCD panel 36. Ex. 1006, ¶27. The adjustment control apparatus 17 prepares the correction data for the output data in relation to the input data to ensure that the video signal will undergo gamma correction corresponding to the measurement

data 33. Ex. 1006, ¶28. For instance, if the A/D conversion value of the video signal input 13 is n , and the desired correction is m , the data of the value m should be written to address n of the correction memory 21. Ex. 1006, ¶28.

47. The adjustment control apparatus 17 is operated to adjust the gamma correction data, which will then be written to the correction memory 21. Ex. 1006, ¶32. After the gamma correction data adjustment optimization process, the adjustment control apparatus 17 sends the store signal 24 to the memory control circuit 26, and the memory control circuit 26 provides the address signal to the correction memory 21 to read the gamma correction data and provides the address signal and the second memory control signal 27 to the non-volatile storage memory 39 to write the gamma correction data to the non-volatile storage memory 39. Ex. 1006, ¶33.

48. Nonomura also discloses that the video signal input 13 is converted according to the gamma correction data in the correction memory 21 before being converted back to an analog signal by the D/A converter 29, which is input into the LCD panel 36 via the buffer 32. Ex. 1006, ¶31.

49. Nonomura further describes that the adjustment of gamma correction data may be “repeated until operator believes that there is no need for further correction.” Ex. 1006, ¶32.

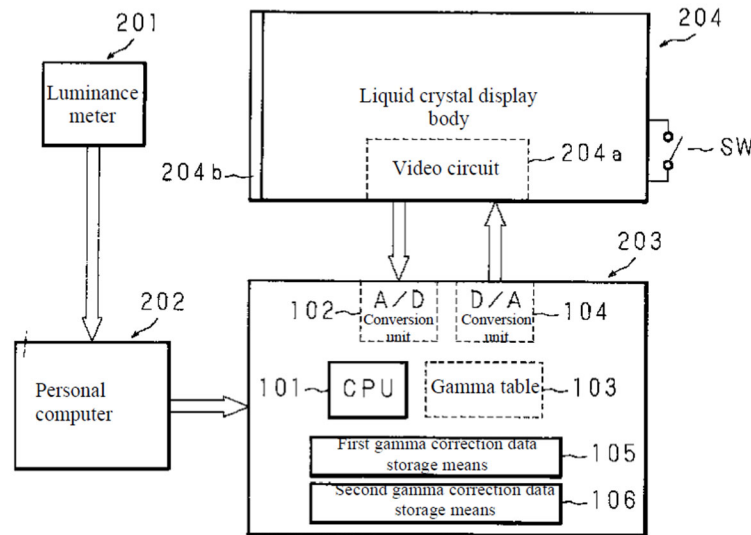
B. Uehara

50. Uehara is a publication of a Japanese Application, and I am informed that Uehara is prior art to the '788 Patent. Uehara relates to “a gamma correction method for a liquid crystal display and a liquid crystal display.” Ex. 1009, ¶1.

51. Uehara explains that the light transmittance of an LCD panel to which voltage is applied is measured, and the gamma characteristics of the LCD panel are then determined based on the measured light transmittance. Ex. 1009, ¶7. The gamma characteristics are then corrected. Ex. 1009, ¶7. Uehara states that the light transmittance in relation to the input voltage is called the “V-T characteristic,” which is appropriately corrected by the gamma correction data. Ex. 1009, ¶4.

52. Uehara highlights that the purpose of gamma correction is to “correct the non-linearity and manufacturing variability of the voltage-light transmission characteristics of the liquid crystal elements.” Ex. 1009, ¶2.

53. Uehara describes a liquid crystal display that includes an LCD body 204 and a gamma correction circuit 203. Ex. 1009, ¶¶11-12. The LCD body 204 includes a liquid crystal panel 204b and a video circuit 204a built into the LCD body 204. Ex. 1009, ¶11.

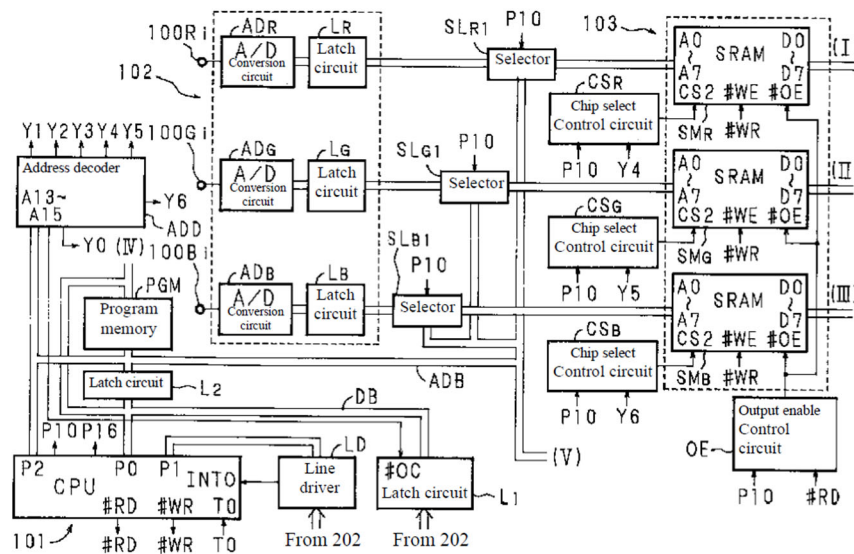


Ex. 1009, Fig. 1.

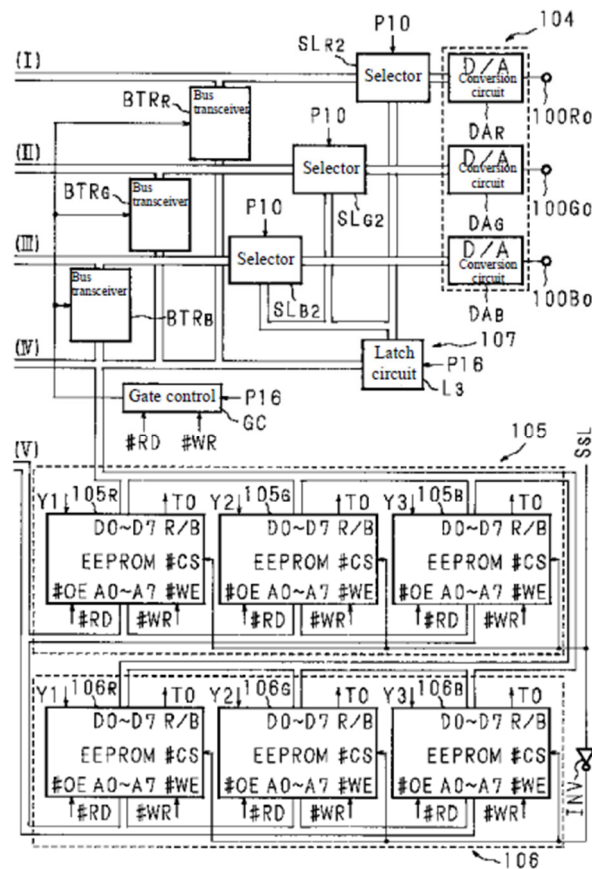
54. The light transmittance of the liquid crystal panel 204b is measured by a luminance meter 201 and sent to a personal computer 202. Ex. 1009, ¶11. The output signal of the personal computer is sent to the gamma correction circuit 203. Ex. 1009, ¶12. The gamma correction circuit 203 includes, among other components, the A/D conversion unit 102, the D/A conversion unit 104, the CPU 101, the gamma table 103, the first gamma correction data storage means 105, and the second gamma correction data storage means 106. Ex. 1009, ¶12.

55. An example of detailed structures of the gamma correction circuit 203 is shown in FIGS. 2-3. Ex. 1009, ¶13. As shown in FIG. 3, the image signals output from the A/D converters (AD_R , AD_G , AD_B) are sent to address terminals of the gamma table 103, and the image signals output from the gamma table 103 are sent to D/A converters (DA_R , DA_G , DA_B). Ex. 1009, ¶¶13-14. The first gamma

correction data storage means 105 stores gamma correction data (image signals not gamma-corrected) and includes, among other components, EEPROMs 105_R, 105_G, and 105_B corresponding to the R, G, and B image signals. Ex. 1009, ¶17. Similarly, the second gamma correction storage means 106 stores gamma correction data (image signals gamma corrected) and includes EEPROMs 106_R, 106_G, and 106_B corresponding to the R, G, and B image signals. Ex. 1009, ¶17.



Ex. 1009, Fig. 2.



Ex. 1009, Fig. 3.

56. In one operation, after storing the gamma correction data, the control command signal from the personal computer 202 is sent to the gamma correction circuit 203, thus the address signal and write signal #WR from the CPU 101 are provided to EEPROMs 105_R, 105_G, 105_B, 106_R, 106_G, and 106_B. Ex. 1009, ¶28. The personal computer 202 writes the gamma correction data (image signals gamma not corrected) to EEPROMs 105_R, 105_G, 105_B. Ex. 1009, ¶28. After selecting the EEPROM 106_R, 106_G, and 106_B by switching the switch SW, the

personal computer 202 similarly writes the gamma correction data (image signals gamma corrected) to EEPROM 106_R, 106_G, 106_B. Ex. 1009, ¶28.

57. The light transmittance of the liquid crystal panel 204b is measured by a luminance meter 201 and sent to a personal computer 202. Ex. 1009, ¶¶11, 23. The output signal of the personal computer is sent to the gamma correction circuit 203. Ex. 1009, ¶12. The signal coming out of the gamma correction circuit 203 is sent to the LCD body 204. Ex. 1009, ¶12.

58. During a gamma correction process, the personal computer 202 outputs the test signal data, the mode switching signal, the gate control signal, and other control command signals for generating test signals in response to the voltage applied to the liquid crystal panel 204b, and the gamma correction circuit 203 receives these signals. Ex. 1009, ¶21. The test signal data is then inputted into the gamma correction circuit 203 and the latch circuit L₃ and the CPU 101 of the gamma correction circuit 203 via the latch circuit L₁. Ex. 1009, ¶21. As a result of these signals from the personal computer 202, the latch circuit L₃ generates a test signal based on the test signal data, and the test signal is converted to the analog voltage by the D/A conversion unit 104. Ex. 1009, ¶22. The converted analog voltage is sent to the LCD body 204 via output terminals 100R₀, 100G₀, and 100B₀. Ex. 1009, ¶22.

59. The luminance meter 201 repeatedly measures the light transmittance (luminance) of the liquid crystal panel 204b, as the test signal data is “changed by the personal computer 202.” Ex. 1009, ¶23. The same operation is “repeated in order to sequentially change the applied voltage of liquid crystal panel 204b from, for example, a black level to a white level.” Ex. 1009, ¶23. By measuring all of the light transmission from the black level to the white level, it becomes “possible to determine the gamma characteristics of liquid crystal panel 204b.” Ex. 1009, ¶24.

60. The personal computer 202 then reads the measurements values of the light transmission that have been stored in the memory and calculates the inverse function of the gamma characteristics of the liquid crystal and 204b. Ex. 1009, ¶24. The personal computer 202 then calculates the gamma correction data in order to correct the gamma characteristics of liquid crystal panel 204b. Ex. 1009, ¶24. The gamma correction data calculated in this way is temporarily stored in the personal computer 202. Ex. 1009, ¶24.

61. The gamma correction data calculated in this way is temporarily stored in the personal computer 202. Ex. 1009, ¶24. The gamma correction data temporarily stored in the personal computer 202 is written directly to EEPROMs 105_R, 105_G, 105_B, 106_R, 106_G, and 106_B. Ex. 1009, ¶30. Moreover, after storing the gamma correction data, the control command signal from the personal computer 202 is sent to the gamma correction circuit 203, thus the address signal and write

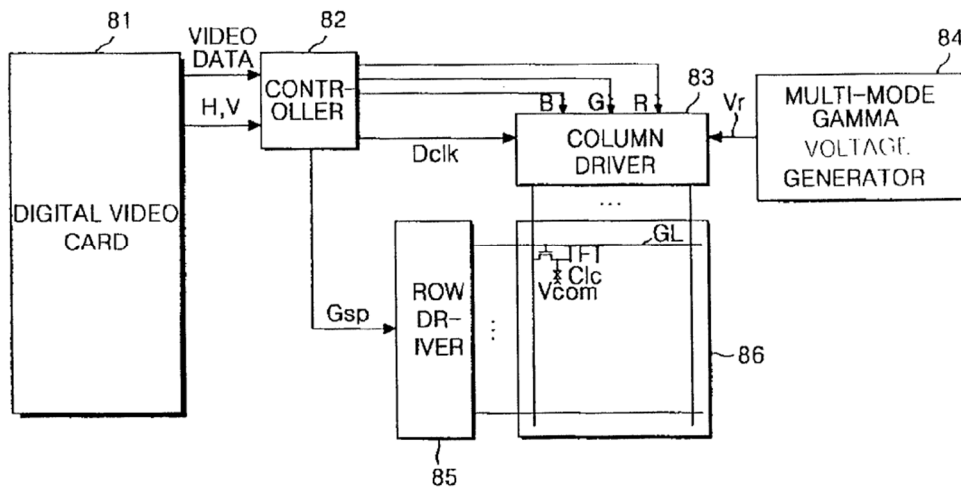
signal #WR from the CPU 101 are provided to EEPROMs 105_R, 105_G, 105_B, 106_R, 106_G, and 106_B. Ex. 1009, ¶28. The personal computer 202 writes the gamma correction data (image signals gamma not corrected) to EEPROMs 105_R, 105_G, 105_B. Ex. 1009, ¶28. After selecting the EEPROM 106_R, 106_G, and 106_B by switching the switch SW, the personal computer 202 similarly writes the gamma correction data (image signals gamma corrected) to EEPROM 106_R, 106_G, 106_B. Ex. 1009, ¶28.

C. Kang

62. Kang is a publication of a U.S. Application, and I am informed that Uehara is prior art to the '788 Patent. Kang relates to “an apparatus and method for correcting a gamma voltage and a video data in a liquid crystal display that is capable of improving a display quality of the liquid crystal display.” Ex. 1007, ¶1.

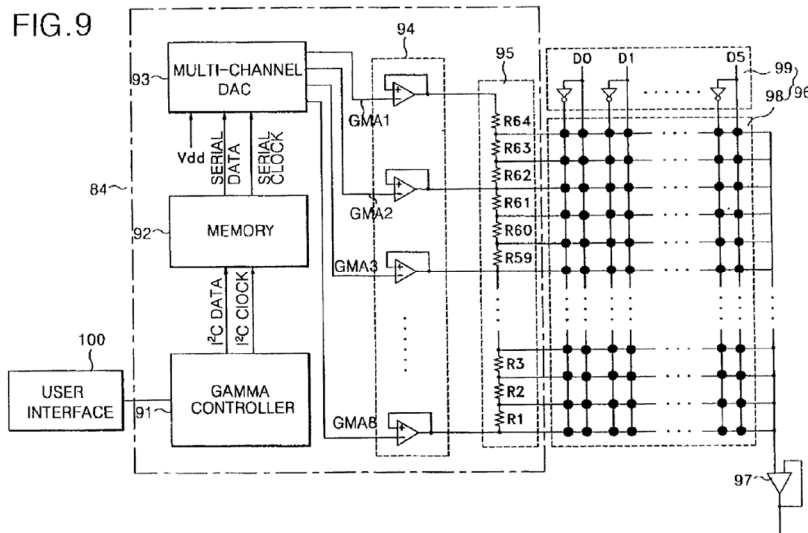
63. Kang describes an LCD that includes the digital video card 81, the multi-mode gamma voltage generator 84, the column driver 83 for supplying data to data lines of the liquid crystal panel 86, the row driver 85 for sequentially driving gate lines of the liquid crystal panel 86, and the controller 82 for controlling the column driver 83 and the row driver 85. Ex. 1007, ¶48. The multi-mode gamma voltage generator 84 stores therein gamma data and divides, by utilizing the selected gamma data, a gamma voltage into a gray level range to be displayed and applies it to the column driver 83. Ex. 1007, ¶49. The column

driver 83 latches the R, G and B digital video data received from the controller 82 in synchronization with the dot clock signal and thereafter corrects the latched data in accordance with a gamma voltage from the gamma voltage generator 84. Ex. 1007, ¶50. The column driver 83 then converts the data corrected by the gamma voltage into analog data to apply it to the data lines. Ex. 1007, ¶50.



Ex. 1007, Fig. 8.

64. As shown in FIG. 9, the gamma voltage output 95 is connected between the gamma controller 91 and the DAC 96 of the column driver 83. Ex. 1007, ¶51.



Ex. 1007, Fig. 9.

D. Tobiya

65. Tobiya is a publication of a U.S. Application, and I am informed that Tobiya is prior art to the '788 Patent. Tobiya relates to “controlling the gray level of an image that s displayed in response to an input signal.” Ex. 1010, ¶1.

66. Tobiya describes a display characteristic correction system that includes a liquid crystal display 100 and a means for correcting the gray level thereof. Ex. 1010, ¶36. Tobiya explains that the gray level relates to luminance or light transmittance. Ex. 1010, ¶4. The value of the signal inputted to the display device and the value of the gray level associate with a characteristic (the “ γ -characteristic” or the “display characteristic”) inherent to the display device. Ex. 1010, ¶4. Converting the input signal by using another characteristic (the

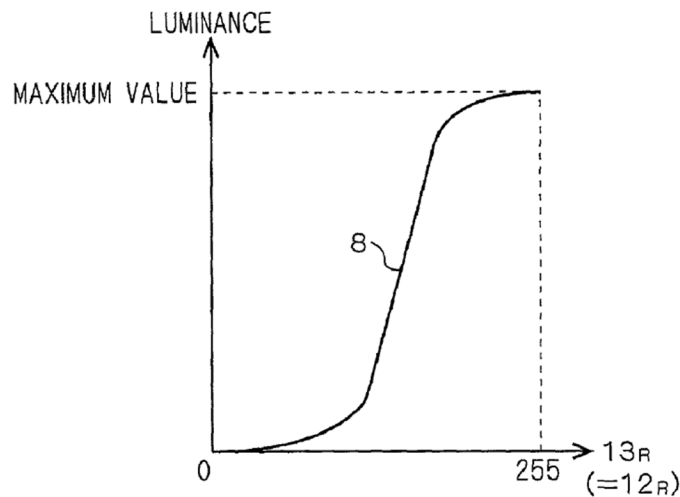
“correction characteristic”) allows the display device to display with a gray level that has a linear relationship with the value of the input signal. Ex. 1010, ¶4.

67. The display characteristic correction system includes, among other components, the signal source 3, the analog/digital converter (ADC) 4, the LUT memory means 5, the liquid crystal panel 6, the computer 2, and the luminance meter 1. Ex. 1010, ¶¶36-37, 39-40. The ADC 4 carries out an analog/digital conversion on a group of analog RGB signals 11 input thereto from outside and generates a group of digital RGB signals 12. Ex. 1010, ¶37. The LUT memory means 5 carries out a conversion on the group of RGB signals 12 based upon a predetermined conversion characteristic and generates a group of digital RGB signals 13 as conversion signals. Ex. 1010, ¶37. The computer 2 stores the resulting conversion characteristic 16 in the LUT memory means 5. Ex. 1010, ¶40. The application of a rewritable memory (e.g., a RAM and an EEPROM) as the LUT memory means 5 makes it possible to cancel individual differences in the display characteristic of the liquid crystal panels 6, and consequently to obtain a desired gray level. Ex. 1010, ¶40.

68. The signal source 3 generates a group of analog RGB signals 11 corresponding to various gradients, based upon a control signal 21 from the computer 2 for setting the LUT memory means 5 and gives them to the ADC 4. Ex. 1010, ¶39. Based on the control signal 21 from the computer 2, the signal 11R

having various amplitudes is outputted from the signal source 3 to the ADC 4. Ex. 1010, ¶43. The ADC 4 subjects it to a quantization process with the greatest amplitude being set at 255 to generate a signal 12R, and outputs the resulting signal to the LUT memory means 5. Ex. 1010, ¶43.

69. Since the LUT memory means 5 stores the conversion characteristic 16R that allows the signals 12R and 13R to have the same value at the very beginning, the value of the signal 12R is inputted to the liquid crystal panel 6. Ex. 1010, ¶44. The liquid crystal panel 6 emits light with a luminance corresponding to the value of the signal 12R, and the luminance meter 1 measures the luminance 14 at this time and sends data 15 indicating the results to the computer 2. Ex. 1010, ¶44. This process continues on all the values 0 to 255 of gradients, and the display characteristic of the red color of the liquid crystal panel 6 is obtained. Ex. 1010, ¶45. FIG. 3 shows an exemplary display characteristic 8 of the liquid crystal panel 6. Ex. 1010, ¶45.



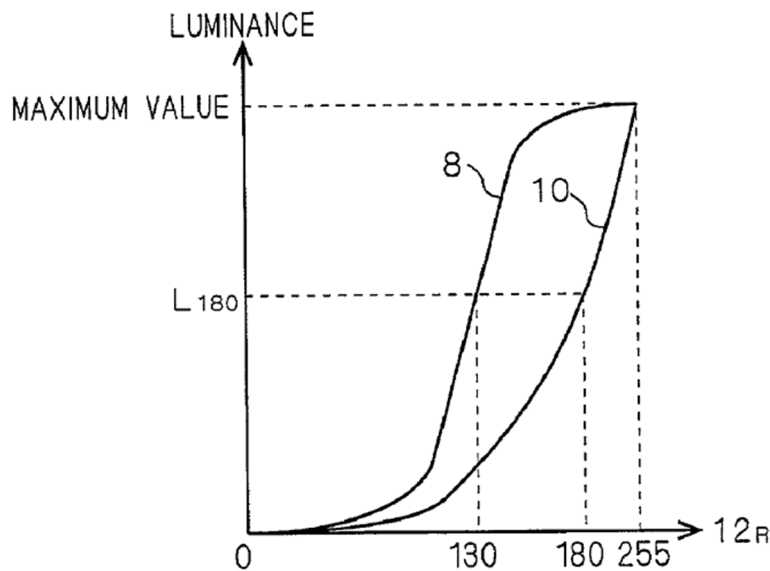
Ex. 1010, Fig. 3.

70. The luminance meter 1 measures the gray level (e.g., the luminance 14) displayed by the liquid crystal panel 6, and the data 15 corresponding to the luminance 14 measured by the luminance meter 1 is supplied to the computer 2.

Ex. 1010, ¶39.

71. Once the display characteristic has been obtained, the conversion characteristic can be obtained accordingly. Ex. 1010, ¶47. By comparing the actual luminance target characteristic 10 with the actually measured display characteristic 8 of the liquid crystal panel 6, a conversion characteristic is obtained, and the conversion characteristic makes the display characteristic covering the entire liquid crystal display 100 coincident with the actual luminance target characteristic 10. Ex. 1010, ¶48.

72. As shown in FIG. 6, supposing that the display characteristic of the liquid crystal panel 6 is in conformity with the actual luminance target characteristic 10, a signal 11_R having a value of gradient 180 is supplied, the luminance of the liquid crystal panel 6 is represented by L₁₈₀. Ex. 1010, ¶49. In this case, when the value of gradient of the signal 13_R, which gives the luminance L₁₈₀ in accordance with the display characteristic 8 that is the actual display characteristic of the liquid crystal panel, is found, a value of gradient 130 is obtained. Ex. 1010, ¶49.



Ex. 1010, Fig. 6.

73. This process is carried out by the computer 2 with respect to all the values of gradients so as to obtain a conversion characteristic 16 with respect to the red color as well as the green color and the blue color. Ex. 1010, ¶49.

74. The signal source 3 generates a group of analog RGB signals 11 corresponding to various gradients, based upon a control signal 21 from the computer 2 for setting the LUT memory means 5 and gives them to the ADC 4. Ex. 1010, ¶39.

75. Based on the control signal 21 from the computer 2, the signal 11R having various amplitudes is outputted from the signal source 3 to the ADC 4, and the ADC 4 subjects it to a quantization process with the greatest amplitude being set at 255 to generate a signal 12R, and outputs the resulting signal to the LUT memory means 5. Ex. 1010, ¶43.

76. Tobiya also highlights that the setting of the conversion characteristic 16 is also carried out on each of the green and blue colors individually in actual cases. Ex. 1010, ¶40.

VII. Nonomura and Kang in View of the Knowledge of a Person of Ordinary Skill in the Art Renders Obvious Claims 1-3 and 5-6 of the '788 Patent.

77. A person of ordinary skill in the art would have been motivated to combine Nonomura and Kang.

78. Both Nonomura and Kang are in the same field of endeavor, i.e., gamma correction. Consequently, a POSITA would have had a reasonable expectation of success in combining their various disclosures to achieve, for

example, (i) desired gamma correction in the real state in which an LCD panel has been mounted and (ii) improved display quality.

79. Furthermore, it was well within the technical ability of a POSITA at the time to incorporate the column driver and corresponding column configuration described in Kang into the liquid crystal projector described in Nonomura because a POSITA knows how to arrange an LCD into columns and rows for accessing individual pixels, which allows for various benefits such as individual pixel control, high resolution, efficient addressing, scalability, simplified wiring, and the like. Also, the column-row arrangement aligns well with the way the integrated circuit (IC) drivers (including column drivers and row drivers, which are designed to efficiently manage the signals for activating the columns and rows of the pixels) are designed.

80. It was also well within the technical ability of a POSITA to incorporate the multi-mode gamma voltage generator for generating a gamma voltage using Kang's multi-mode gamma data set into Nonomura's liquid crystal projector because (i) using multiple modes is well-known in the gamma correction field to accommodate different display conditions and use cases and (ii) a POSITA would be motivated to do so to achieve versatility and functionality within the display. Different types of content (e.g., video games, movies, photos, documents) can benefit from different gamma settings. Additionally, the perceived brightness

and contrast of a display can change depending on the ambient lighting conditions.

A higher gamma setting might help to maintain image contrast and prevent the image from looking washed out, while a lower gamma might be preferable to avoid overly dark shadows and reveal more subtle details. Multi-mode gamma allows users to adjust the display to suit their environment. Moreover, various display standards and color spaces have different recommended gamma values.

81. It was well within the technical ability of a POSITA to design a display where Nonomura's non-volatile cells correlate to appropriate columns using Kang's teachings of column drivers, which a POSITA would understand correlates non-volatile cells with their corresponding columns. Thus, combining Nonomura and Kang would have been obvious to a POSITA.

82. In my opinion, a person of ordinary skill in the art would have recognized that each element of claims 1-3 and 5-6 was obvious in view of the combination of Nonomura in view of Kang. This is further demonstrated by the claim chart below.

Claims of the '788 Patent	Prior Art
Claim 1	
[1 Preamble] A method of calibrating a liquid crystal display to a desired gamma curve to compensate for panel	[1].Nonomura describes a liquid crystal projector having a gamma correction function that will perform gamma correction according to the correction data based on the results of the measurement of the applied voltage-transmittance characteristics. Ex. 1006, ¶14. As explained in Nonomura and known by a POSITA,

Claims of the '788 Patent	Prior Art
to panel manufacturing variations comprising the steps:	the non-linear processing of the applied voltage-transmittance characteristics is generally referred to as gamma correction. Ex. 1006, ¶¶3-4. [2]. The applied voltage-transmittance characteristics of LCD panels depend on various factors such as the birefringence of the liquid crystal, the thickness of the liquid crystal layer, and the wavelength of light source, and a fixed gamma correction conversion data is not able to deal with this panel-to-panel variance. Ex. 1006, ¶¶12-13. Thus, Nonomura stresses the need for performing gamma correction “according to the individual characteristics in the state in which the LCD panel has actually been mounted.” Ex. 1006, ¶13. A POSITA would understand that such individualized gamma correction is to compensate “for panel to panel manufacturing variations comprising the steps.”
[1A] a. providing said display with gamma reference control capability which is electrically reprogrammable and non-volatile;	[3]. Nonomura describes an LCD panel 36 and a screen 38, where the image displayed on the LCD panel 36 is projected by a light source 35 and enlarged by projection lens 37 for projection onto screen 38. Ex. 1006, ¶20, FIG. 1. A POSITA would comprehend that the underlying operation principles of the system in Nonomura remain the same, whether the projection is used or not.

Claims of the '788 Patent	Prior Art
Ex. 1006, Fig. 1.	
[4]. The memory control circuit 26 is able to exchange data with the non-volatile storage memory 39, and data can be written to or read from the non-volatile storage memory. Ex. 1006, ¶25. The non-volatile storage memory 39 can retain correction data even if the power supply is turned off. Ex. 1006, ¶34. The correction data stored in the non-volatile storage memory 39 is read according to the address for transfer to the correction memory 21 via the second selector 28, and the data is then written to the correction memory 21 according to the address. Ex. 1006, ¶34.	[5]. Therefore, a POSITA would understand that Nonomura discloses “providing said display with gamma reference control capability” (the basic circuit comprising the non-volatile storage memory 39, the correction memory 21, the memory control circuit 26, and optionally the D/A converter 29 and the buffer 32), and such gamma reference control capability is electrically reprogrammable (being able to write data to the memory) and non-volatile (being able to retain data without power).

Claims of the '788 Patent	Prior Art
[1B] b. testing said display with at least one sensor with optical input, wherein said sensor is separate from said display;	[6].Nonomura describes that the adjustment control apparatus 17 is connected to the luminance meter 34, which measures the luminance of the image on the screen 38 and inputs the measurement data 33 to the adjustment control apparatus 17 for calibrating the LCD panel 36. Ex. 1006, ¶23. A POSITA would understand that the luminance meter 34 is a type of available sensors and the luminance of the image is an optical input to be detected by the sensor. [7].Nonomura further states that the range enclosed by the dashed line in FIG. 1 is a basic circuit that is used for a liquid crystal projector, and the adjustment control apparatus 17 and the luminance meter 34 “have been added to this circuit.” Ex. 1006, ¶19. In other words, Nonomura discloses that said sensor (the luminance meter 34) is separate from said display (outside the range enclosed by the dashed line).
[1C] c. varying gamma reference voltage levels on columns of said display by a control circuit, wherein said control circuit is separate from said display;	[8].Nonomura describes three operation modes. Ex. 1006, ¶16. In one mode, the adjustment control device 17 changes the voltage of the DC level voltage signal 31 in a predetermined manner while having the luminance of the screen measured, as the measurement data 33, with the luminance meter 34 at each voltage. Ex. 1006, ¶27. Consequently, the applied voltage-transmittance characteristics of the LCD panel 36 is obtained by the adjustment control device 17. Ex. 1006, ¶27. A POSITA would comprehend that this mode is a “display characterization mode” where the applied voltage-transmittance characteristics of the LCD panel is obtained. [9].In another mode, the adjustment control apparatus 17 prepares the correction data for the output data corresponding to the input data to ensure that the video signal is gamma-corrected based on the measurement

Claims of the '788 Patent	Prior Art
	data 33. Ex. 1006, ¶28. A POSITA would comprehend that this mode is a “gamma correction mode” where the input video signal is gamma-corrected according to the measured applied voltage-transmittance characteristics in the previous “display characterization mode” and the measurement data 33. [10]. The adjustment control device 17 sends the system control signal 18 to the system controller 19, which generates the mode switching signal 20 to control the operation of the selectors 16, 28, and 30 accordingly. Ex. 1006, ¶¶22-23. During the gamma correction operation, the correction memory 21 and the adjustment control apparatus 17 are connected, and the address signal 22 and the data signal 23 are written in the correction memory 21 according to the first memory control signal 25 received from the adjustment control apparatus 17. Ex. 1006, ¶29. Accordingly, a POSITA would understand that Nonomura discloses a “control circuit” (the adjustment control apparatus 17, which interacts with the system controller 19, sends the system control signal 18, and controls the correspondence between the address signal 22 and the data signal 23). [11]. When the writing of the correction data corresponding to each address in the correction memory 21 is completed in this way, the adjustment control device 17 outputs the system control signal 18 to change the mode switching signal 20. Ex. 1006, ¶30. The video signal input 13 is converted according to the gamma correction data in the correction memory 21 before being converted back to an analog signal by the D/A converter 29, which is input into the LCD panel 36 via the buffer 32. Ex. 1006, ¶31. Accordingly, a POSITA would appreciate that Nonomura discloses “varying gamma reference

Claims of the '788 Patent	Prior Art
	voltage levels” (varying, across various addresses, the analog signal output by the D/A converter 29) “on ... said display” (applied to the LCD panel via the buffer 32). The gamma-corrected data in the correction memory 21 (and/or the non-volatile storage memory 39), the analog signal output by the D/A converter 29, and the analog signal in the buffer 32 are different representations of the same gamma reference voltage level, which exist in different locations within the basic circuit. [12]. To the extent that Nonomura fails to disclose “on columns of said display,” Kang discloses applying gamma reference voltage levels on columns of the display. [13]. Kang describes an LCD that includes the digital video card 81, the multi-mode gamma voltage generator 84, the column driver 83 for supplying data to data lines of the liquid crystal panel 86, the row driver 85 for sequentially driving gate lines of the liquid crystal panel 86, and the controller 82 for controlling the column driver 83 and the row driver 85. Ex. 1007, ¶48. The multi-mode gamma voltage generator 84 stores therein gamma data and divides, by utilizing the selected gamma data, a gamma voltage into a gray level range to be displayed and applies it to the column driver 83. Ex. 1007, ¶49. The column driver 83 latches the R, G and B digital video data received from the controller 82 in synchronization with the dot clock signal and thereafter corrects the latched data in accordance with a gamma voltage from the gamma voltage generator 84. Ex. 1007, ¶50. The column driver 83 then converts the data corrected by the gamma voltage into analog data to apply it to the data lines. Ex. 1007, ¶50.

Claims of the '788 Patent	Prior Art
	Ex. 1007, Fig. 8. [14]. FIG. 9 shows that the gamma voltage output 95 is connected between the gamma controller 91 and the DAC 96 of the column driver 83. Ex. 1007, ¶51. FIG. 9 Ex. 1007, Fig. 9. [15]. Thus, Kang teaches applying gamma reference voltage levels on columns of the display (the liquid crystal panel 86) by using the column driver 84. A POSITA would be motivated to modify the teachings of Nonomura by applying the gamma reference voltage levels, which are varied by the adjustment control apparatus 17, to the columns of the LCD panel 36, considering the teachings of Kang. It is

Claims of the '788 Patent	Prior Art
	common knowledge in the display industry to arrange an LCD panel into columns and rows for accessing individual pixels, and corresponding row drivers and column drivers are in engineers' regular toolbox.
[1D] 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	[16]. As explained above, in the “gamma correction mode,” the adjustment control apparatus 17 prepares the correction data for the output data corresponding to the input data to ensure that the video signal is gamma-corrected based on the measurement data 33. Ex. 1006, ¶¶14, 28. The input data signal 23 is sent from the correction memory 21 to the D/A converter 29. A POSITA would comprehend the gamma correction process in the “gamma correction mode” is “optimizing said gamma reference voltage levels” (optimizing the output signal of the D/A converter 29). Again, the gamma-corrected data in the correction memory 21 (and/or the non-volatile storage memory 39) and the analog signal output by the D/A converter 29 are different but equivalent representations in different domains (digital v. analog). [17]. A POSITA would appreciate that this optimization process is “using means for executing a predetermined algorithm according to a predetermined criteria and data sensed by said at least one sensor” because (i) the luminance meter 34 is used and (ii) the “gamma count specific to the LCD panel 36” is a predetermined criteria. Ex. 1006, ¶27. It is well-known in this field that the optimization process involves “a predetermined algorithm” (the matching/fitting to a certain desired gamma curve) for the algorithm/software aspect and at least one sensor for the hardware aspect. It is also common knowledge of a POSITA that the “predetermined algorithm” must be executed by “means for executing a predetermined algorithm according to a predetermined criteria and

Claims of the '788 Patent	Prior Art
	data sensed by said at least one sensor” such as the adjustment control apparatus 17. [18]. Additionally, Nonomura states that the range enclosed by the dashed line in FIG. 1 is a basic circuit, and the adjustment control apparatus 17 and the luminance meter 34 “have been added to this circuit.” Ex. 1006, ¶19. Similarly, a POSITA would understand that the “means for executing said predetermined algorithm” (e.g., the adjustment control apparatus 17) is “separate from said display to achieve the desired gamma curve.”
[1E] e. storing said gamma reference voltage levels in said gamma reference control capability.	[19]. Nonomura describes that the adjustment control apparatus 17 adjusts the gamma correction data, which is then written to the correction memory 21. Ex. 1006, ¶32. The correction data may be modified and rewritten to the correction memory as needed. Ex. 1006, ¶32. After the “gamma correction mode,” the adjustment control apparatus 17 sends the store signal 24 to the memory control circuit 26, and the memory control circuit 26 provides the address signal to the correction memory 21 to read the gamma correction data and provides the address signal and the second memory control signal 27 to the non-volatile storage memory 39 to write the data to the non-volatile storage memory 39. Ex. 1006, ¶33. Thus, a POSITA would understand that Nonomura discloses storing the “gamma reference voltage levels” (storing the gamma correction data is equivalent to storing the output signal of the D/A converter 29 as they are simply different representations of the same signal) in the “gamma reference control capability” (the basic circuit comprising, among other components, the non-volatile storage memory 39 where the gamma correction data is stored). Indeed, A/D conversion (sampling and encoding analog signals in essence) and D/A

Claims of the '788 Patent	Prior Art
	conversion (the reverse process of the A/D conversion in essence) have become well-known in electronics and signal processing since 1940s, and storing the digital representation is equivalent to storing the analog representation. [20]. Alternatively, paragraph 31 of Nonomura discloses storing the “gamma reference voltage levels” (the output signal of the D/A converter 29 transferred to the buffer 32 via the selector 32) in the “gamma reference control capability” (the basic circuit comprising both the non-volatile storage memory 39 and the buffer 32 where the transferred analog signal is stored). A POSITA would understand the buffer 32 can be viewed as a part of the “gamma reference control capability” by redrawing the line, which a POSITA is well-equipped to achieve.
Claim 2	
[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.	[21]. Nonomura teaches that the adjustment of gamma correction data may be “repeated until operator believes that there is no need for further correction.” Ex. 1006, ¶32. A POSITA would appreciate that Nonomura discloses that the adjustment of gamma correction data may be repetitive as needed. This process typically ends when certain predetermined criteria are met, for example, when the operator believes that there is no need for further correction based on visual feedback. Because of such repetitive operations, a POSITA would understand that at least one different set of gamma reference voltage levels can be generated “under different ambient display conditions” and stored in the gamma reference control capability because different ambient conditions result in different gamma correction setting. As such, the display can accommodate various ambient conditions.

Claims of the '788 Patent	Prior Art																																													
	[22]. To the extent that one would argue Nonomura fails to disclose this element, Kang discloses the same. Kang discloses the multi-mode gamma voltage generator 84 for generating a gamma voltage using multi-mode gamma data set. Ex. 1007, ¶48. The memory 92 stores a multi-mode gamma data set, and such gamma data is input to the multi-channel DAC 93 to indicate a gamma reference voltage for each mode. Ex. 1007, ¶53. Notably, an example of gamma reference voltages for each mode is shown in Table 1. Ex. 1007, ¶59. TABLE 1 <table><tr><th>Mode Gamma</th><th>Mode A</th><th>Mode B</th><th>Mode C</th><th>Mode D</th></tr><tr><td>GMA 1</td><td>0.1875</td><td>0.3750</td><td>0.5625</td><td>0.7500</td></tr><tr><td>GMA 2</td><td>1.8750</td><td>2.0625</td><td>2.2500</td><td>2.4375</td></tr><tr><td>GMA 3</td><td>3.3750</td><td>3.5625</td><td>3.7500</td><td>3.9375</td></tr><tr><td>GMA 4</td><td>5.0625</td><td>5.2500</td><td>5.4375</td><td>5.6250</td></tr><tr><td>GMA 5</td><td>6.7500</td><td>6.9375</td><td>7.1250</td><td>7.3125</td></tr><tr><td>GMA 6</td><td>8.4375</td><td>8.6250</td><td>8.8125</td><td>9.0000</td></tr><tr><td>GMA 7</td><td>10.1250</td><td>10.3125</td><td>10.5000</td><td>10.6875</td></tr><tr><td>GMA 8</td><td>11.8125</td><td>11.6250</td><td>11.4375</td><td>11.2500</td></tr></table> Ex. 1007, Table 1. [23]. Therefore, a POSITA would understand that Kang discloses “at least one different set of gamma reference voltage levels” (e.g., four different sets of gamma correction data corresponding to four different modes, namely Mode A, Mode B, Mode C, and Mode D) under different ambient display conditions. Such multi-mode arrangement is well-known in the gamma correction space to accommodate different display conditions (e.g., dark, bright, sunlight) and use cases (e.g., reading, gaming, cinema). A POSITA would be motivated to introduce Kang’s multi-mode gamma voltage generator 84 into the system in Nonomura to achieve versatility and functionality within the display.	Mode Gamma	Mode A	Mode B	Mode C	Mode D	GMA 1	0.1875	0.3750	0.5625	0.7500	GMA 2	1.8750	2.0625	2.2500	2.4375	GMA 3	3.3750	3.5625	3.7500	3.9375	GMA 4	5.0625	5.2500	5.4375	5.6250	GMA 5	6.7500	6.9375	7.1250	7.3125	GMA 6	8.4375	8.6250	8.8125	9.0000	GMA 7	10.1250	10.3125	10.5000	10.6875	GMA 8	11.8125	11.6250	11.4375	11.2500
Mode Gamma	Mode A	Mode B	Mode C	Mode D																																										
GMA 1	0.1875	0.3750	0.5625	0.7500																																										
GMA 2	1.8750	2.0625	2.2500	2.4375																																										
GMA 3	3.3750	3.5625	3.7500	3.9375																																										
GMA 4	5.0625	5.2500	5.4375	5.6250																																										
GMA 5	6.7500	6.9375	7.1250	7.3125																																										
GMA 6	8.4375	8.6250	8.8125	9.0000																																										
GMA 7	10.1250	10.3125	10.5000	10.6875																																										
GMA 8	11.8125	11.6250	11.4375	11.2500																																										
Claim 3																																														

Claims of the '788 Patent	Prior Art
[3 Preamble] A method of programming one or more gamma reference voltage generator integrated circuits attached to a liquid crystal display comprising the steps:	[24]. Nonomura discusses a liquid crystal projector having a gamma correction function that will perform gamma correction according to the correction data based on the results of the measurement of the applied voltage-transmittance characteristics. Ex. 1006, ¶14. A POSITA would understand that the non-linear processing of the applied voltage-transmittance characteristics is generally referred to as gamma correction and the corresponding apparatus is generally referred to as a gamma reference voltage generator. Ex. 1006, ¶¶3-4. [25]. Nonomura describes an LCD panel 36 and a screen 38, Ex. 1006, ¶20, FIG. 1. The basic circuit used for the liquid crystal projector is enclosed by the dashed line in FIG. 1. Ex. 1006, ¶19. Hence, a POSITA would comprehend that the basic circuit, which includes the “gamma reference voltage generator integrated circuits,” can be attached to the liquid crystal display as a natural design choice. Such an attaching design may shorten the wiring between the basic circuit and the display. Ex. 1006, Fig. 1.

Claims of the '788 Patent	Prior Art
	[26]. The memory control circuit 26 is able to exchange data with the non-volatile storage memory 39, and data can be written to or read from the non-volatile storage memory 39. Ex. 1006, ¶25. The correction data stored in the non-volatile storage memory 39 is read according to the address for transfer to the correction memory 21 via the second selector 28, and the data is then written to the correction memory 21 according to the address. Ex. 1006, ¶34. A POSITA would understand that Nonomura discloses “programming” (by writing data to the memory) the “gamma reference voltage generator integrated circuits” (a portion of the “basic circuit” shown in FIG. 1, which includes, among other components, the non-volatile storage memory 39, the correction memory 21, the memory control circuit 26, the system controller 19, and probably the A/D converter 15, the D/A converter 29, the first selector 16, the second selector 28, the third selector 30, and the buffer 32).
[3A] a. selecting one or more columns on said liquid crystal display;	[27]. To the extent that someone would argue that Nonomura fails to disclose selecting columns on the LCD, Kang discloses the same. [28]. Kang describes an LCD that includes the digital video card 81, the multi-mode gamma voltage generator 84, the column driver 83 for supplying data to data lines of the liquid crystal panel 86, the row driver 85 for sequentially driving gate lines of the liquid crystal panel 86, and the controller 82 for controlling the column driver 83 and the row driver 85. Ex. 1007, ¶48. The multi-mode gamma voltage generator 84 stores therein gamma data and divides, by utilizing the selected gamma data, a gamma voltage into a gray level range to be displayed and applies it to the column driver 83. Ex. 1007, ¶49. The column

Claims of the '788 Patent	Prior Art
	driver 83 latches the R, G and B digital video data received from the controller 82 in synchronization with the dot clock signal and thereafter corrects the latched data in accordance with a gamma voltage from the gamma voltage generator 84. Ex. 1007, ¶50. The column driver 83 then converts the data corrected by the gamma voltage into analog data to apply it to the data lines. Ex. 1007, ¶50. Ex. 1007, Fig. 8. [29]. FIG. 9 shows that the gamma voltage output 95 is connected between the gamma controller 91 and the DAC 96 of the column driver 83. Ex. 1007, ¶51. FIG. 9 [30]. Ex. 1007, Fig. 9.

Claims of the '788 Patent	Prior Art
	[31]. Thus, Kang discloses selecting one or more columns on the liquid crystal display (the liquid crystal panel 86) by using the column driver 84 and the controller 82. A POSITA would be motivated to modify the teachings of Nonomura to apply the gamma reference voltage levels, which are varied by the adjustment control apparatus 17, to the columns of the LCD panel 36, considering the teachings of Kang. It is common knowledge in the display industry to arrange an LCD panel into columns and rows for accessing individual pixels, and corresponding row drivers and column drivers are in engineers' regular toolbox.
[3B] b. applying one or more different gamma voltages to said liquid crystal display columns;	[32]. As described in relation to Element [1C], Nonomura teaches “varying gamma reference voltage levels on” and Kang discloses “columns of said display.” Nonomura also describes that if the A/D conversion value of video signal input 13 is n, and the desired corrected value is m, the data of the value m is written to address n of correction memory 21. Ex. 1006, ¶28. A POSITA would comprehend this process establishes a look-up table (video signal input n as address, desired corrected value m as data/result). [33]. As explained above, Kang discloses applying gamma reference voltage levels on columns of the display. A POSITA would be motivated to modify the teachings of Nonomura to apply the gamma reference voltage levels, which are varied by the adjustment control apparatus 17, to the columns of the LCD panel 36, considering the teachings of Kang because the row-column arrangement is common in the display field. [34]. Thus, the combination of Nonomura and Kang discloses “applying one or more different

Claims of the '788 Patent	Prior Art
	gamma voltages” (applying the A/D conversion value of the video signal input 13, which is n in the example above) to “said liquid crystal display columns” (columns of the liquid crystal panel 86).
[3C] c. storing said applied gamma voltages in reprogrammable, nonvolatile cells in said gamma reference voltage generator integrated circuits appropriate to said selected columns;	[35]. As explained above, Nonomura discloses reprogrammable, nonvolatile cells (in relation to Element [1A]) in said gamma reference voltage generator integrated circuits (in relation to Element [3PRE]). Nonomura describes that the A/D conversion value of the video signal input 13 (n in the example above) is input into the correction memory 21 as address signal 22. Ex. 1006, ¶20. A POSTIA would appreciate that the correction memory 21, as a memory device designed to store information, at least temporarily stores the A/D conversion value of the video signal input 13. It is well-known that a (non-volatile) memory device is divided into multiple cells, as the minimum storage unit, and different cells are “appropriate to said selected columns.”
[3D] 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;	[36]. As explained above in relation to Element [1D], Nonomura discloses this element.

Claims of the '788 Patent	Prior Art
[3E] e. modifying said one or more different applied gamma voltages based on said one or more optimization criteria algorithms;	[37]. As described in relation to Element [3B], Nonomura describes that if the A/D conversion value of video signal input 13 is n , and the desired corrected value is m , the data of the value m is written to address n of correction memory 21. Ex. 1006, ¶28. A POSITA would comprehend Nonomura discloses “modifying said one or more different applied gamma voltages” (modifying/transforming from the A/D conversion value of video signal input 13 (n in the example above) to the desired corrected value (m in the example above)). The modification process is the gamma correction process as a result of Element [3D].
[3F] f. programming said applied gamma voltages in storage cells in said gamma reference voltage generator integrated circuits appropriate to said selected columns; and	[38]. As described in relation to Element [1E], Nonomura teaches “programming said applied gamma voltages” (storing the corrected A/D conversion value of video signal input 13, which is the desired corrected value) “in storage cells in said gamma reference voltage generator integrated circuits” (in memory device). [39]. As explained above, such storage cells are “appropriate to said selected columns.”
[3G] g. repeating steps (d) through (f) until said one or more optimization criteria have been satisfied.	[40]. Nonomura teaches that the adjustment of gamma correction data may be “repeated until operator believes that there is no need for further correction.” Ex. 1006, ¶32. Therefore, a POSITA would understand that Nonomura discloses that steps (d) through (f) are being repeated “until said one or more optimization criteria have been satisfied.” The optimization criteria may include various criteria, including the operator’s judgement that the correction is good enough based on, for example, visual effects.
Claim 5	

Claims of the '788 Patent	Prior Art
[5 Preamble] A method for a liquid crystal display, comprising:	[41]. As explained in claim element [1 Preamble], Nonomura discloses this element.
[5A] providing said liquid crystal display with gamma reference control capability which is electrically reprogrammable and non-volatile;	[42]. As explained in claim element [1A], Nonomura discloses this element.
[5B] calibrating said liquid crystal display comprising: a. testing said liquid crystal display with at least one sensor with optical input;	[43]. As explained in claim element [1B], Nonomura discloses this element.
[5C] b. varying gamma reference voltage levels on columns of said liquid crystal display;	[44]. As explained in claim element [1C], Nonomura discloses this element.
[5D] 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;	[45]. As explained in claim element [1D], Nonomura discloses this element.
[5E] d. storing said gamma reference	[46]. As explained in claim element [1E], Nonomura discloses this element.

Claims of the '788 Patent	Prior Art
voltage levels in said gamma reference control capability;	
[5F] retrieving said gamma reference voltage levels from said gamma reference control capability; and	[47]. Nonomura describes that the video signal input 13 is converted according to the gamma correction data in the correction memory 21 before being converted back to an analog signal by the D/A converter 29, which is input into the LCD panel 36 via the buffer 32. Ex. 1006, ¶31. A POSITA would appreciate that Nonomura discloses that the gamma reference voltage levels are retrieved “from said gamma reference control capability” (read from the correction memory 21).
[5G] displaying an image on said liquid crystal display based on said gamma reference voltage levels.	[48]. Nonomura describes that the video signal input 13 is converted according to the gamma correction data in the correction memory 21 before being converted back to an analog signal by the D/A converter 29, which is input into the LCD panel 36 via the buffer 32. Ex. 1006, ¶31. A POSITA would understand that Nonomura discloses displaying an image on said liquid crystal display (the LCD panel 36) based on said gamma reference voltage levels (gamma correction data stored in the correction memory). After the LCD panel receives the buffered analog video signal, an image is certainly displayed on the LCD.
Claim 6	
[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	[49]. As explained in claim element [2], Nonomura discloses this element.

Claims of the '788 Patent	Prior Art
different set of gamma reference voltage levels stored in said gamma reference control capability.	

VIII. Uehara and Kang in View of the Knowledge of a Person of Ordinary Skill in the Art Renders Obvious Claims 1-3 and 5-6 of the '788 Patent.

83. A person of ordinary skill in the art would have been motivated to combine Uehara and Kang.

84. Both Uehara and Kang are in the same field of endeavor, i.e., gamma correction. Therefore, a POSITA would have had a reasonable expectation of success in combining their various disclosures to achieve, for example, (i) desired gamma correction that takes into consideration the gamma characteristics of the image signal for which gamma correction has been performed and (ii) improved display quality.

85. Furthermore, it was well within the technical ability of a POSITA at the time to incorporate the column driver and corresponding column configuration described in Kang into the LCD described in Uehara because a POSITA knows how to arrange an LCD into columns and rows for accessing individual pixels, which allows for various benefits such as individual pixel control, high resolution, efficient addressing, scalability, simplified wiring, and the like. Also, the column-

row arrangement aligns well with the way the integrated circuit (IC) drivers (including column drivers and row drivers, which are designed to efficiently manage the signals for activating the columns and rows of the pixels) are designed.

86. It was also well within the technical ability of a POSITA to incorporate the multi-mode gamma voltage generator for generating a gamma voltage using multi-mode gamma data set described in Kang into Uehara's LCD because (i) multi-mode arrangements are well-known in the gamma correction field to accommodate different display conditions and use cases and (ii) a POSITA would be motivated to do so to achieve versatility. Different types of content (e.g., video games, movies, photos, documents) can benefit from different gamma settings. Additionally, the perceived brightness and contrast of a display can change depending on the ambient lighting conditions. A higher gamma setting might help to maintain image contrast and prevent the image from looking washed out, while a lower gamma might be preferable to avoid overly dark shadows and reveal more subtle details. Multi-mode gamma allows users to adjust the display to suit their environment. Moreover, various display standards and color spaces have different recommended gamma values

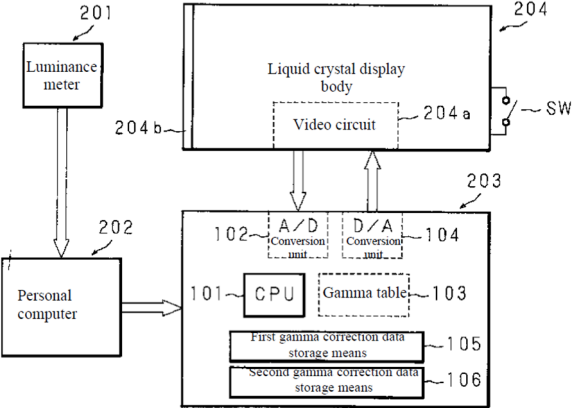
87. It was well within the technical ability of a POSITA to incorporate the buffer unit that stabilizes the gamma reference voltages discussed in Kang into the gamma correction circuit discussed in Uehara to stabilize the gamma reference

voltage levels for a stable image. The introduction of a buffer provides various advantages including stable and accurate gamma performance, improved transient response, reduced crosstalk and image artifacts, consistent brightness and color across the display.

88. It was well within the technical ability of a POSITA to correlate the storage cells of Uehara’s EEPROMs to appropriate columns based on Kang’s teachings of using column drivers to correspond non-volatile cells, gamma reference signals, and columns.

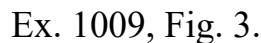
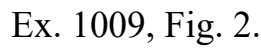
89. In my opinion, a person of ordinary skill in the art would have recognized that each element of claims 1-3 and 5-6 was obvious in view of the combination of Uehara in view of Kang. This is further demonstrated by the claim chart below.

Claims of the '788 Patent	Prior Art
Claim 1	
[1 Preamble] A method of calibrating a liquid crystal display to a desired gamma curve to compensate for panel to panel manufacturing variations comprising the steps:	[1]. Uehara describes a gamma correction method for a liquid crystal display. Ex. 1009, ¶1. The light transmittance of an LCD panel to which voltage is applied is measured, and the gamma characteristics of the LCD panel are then determined based on the measured light transmittance. Ex. 1009, ¶7. The gamma characteristics are then corrected. Ex. 1009, ¶7. Uehara explains that the light transmittance in relation to the input voltage is called the “V-T characteristic,” which is appropriately corrected by the gamma correction data. Ex. 1009, ¶4. A POSITA would understand that correcting the

Claims of the '788 Patent	Prior Art
	V-T characteristic using the gamma correction data is a process of “calibrating a liquid crystal display to a desired gamma curve.” [2]. Uehara further highlights that the purpose of gamma correction is to “correct the non-linearity and manufacturing variability of the voltage-light transmission characteristics of the liquid crystal elements.” Ex. 1009, ¶12. Therefore, a POSITA would appreciate that Uehara discloses that the method of calibrating is “to compensate for panel to panel manufacturing variations.”
[1A] a. providing said display with gamma reference control capability which is electrically reprogrammable and non-volatile;	[3]. Uehara describes a liquid crystal display that includes an LCD body 204 and a gamma correction circuit 203. Ex. 1009, ¶¶11-12. The LCD body 204 includes a liquid crystal panel 204b and a video circuit 204a built into the LCD body 204. Ex. 1009, ¶11.  Ex. 1009, Fig. 1. [4]. The light transmittance of the liquid crystal panel 204b is measured by a luminance meter 201 and sent to a personal computer 202. Ex. 1009, ¶11. The output signal of the personal computer is sent to the gamma correction circuit 203. Ex. 1009, ¶12. The

Claims of the '788 Patent	Prior Art
	gamma correction circuit 203 includes, among other components, the A/D conversion unit 102, the D/A conversion unit 104, the CPU 101, the gamma table 103, the first gamma correction data storage means 105, and the second gamma correction data storage means 106. Ex. 1009, ¶12. A POSITA would understand that the gamma correction circuit 203 is the “gamma reference control capability” due to (i) the components included in the gamma correction circuit 204 and (ii) the feedback loop that includes the liquid crystal panel 204b, the luminance meter 201, the personal computer 202, and the gamma correction circuit 203. [5]. An example of detailed structures of the gamma correction circuit 203 is shown in FIGS. 2-3. Ex. 1009, ¶13. As shown in FIG. 3, the first gamma correction data storage means 105 stores gamma correction data (image signals not gamma-corrected) and includes, among other components, EEPROMs 105_R, 105_G, and 105_B corresponding to the R, G, and B image signals. Ex. 1009, ¶17. Likewise, the second gamma correction storage means 106 stores gamma correction data (image signals gamma corrected) and includes EEPROMs 106_R, 106_G, and 106_B corresponding to the R, G, and B image signals. Ex. 1009, ¶17.

Prior Art



[6]. In one operation, after storing the gamma correction data, the control command signal from the personal computer 202 is sent to the

Claims of the '788 Patent	Prior Art
	gamma correction circuit 203, thus the address signal and write signal #WR from the CPU 101 are provided to EEPROMs 105_R, 105_G, 105_B, 106_R, 106_G, and 106_B. Ex. 1009, ¶28. The personal computer 202 writes the gamma correction data (image signals gamma not corrected) to EEPROMs 105_R, 105_G, 105_B. Ex. 1009, ¶28. After selecting the EEPROM 106_R, 106_G, and 106_B by switching the switch SW, the personal computer 202 similarly writes the gamma correction data (image signals gamma corrected) to EEPROM 106_R, 106_G, 106_B. Ex. 1009, ¶28. A POSITA would appreciate that the “gamma reference control capability” is electrically reprogrammable (being able to write data to the EEPROMs) and non-volatile (EEPROM is well-known as non-volatile).
[1B] b. testing said display with at least one sensor with optical input, wherein said sensor is separate from said display;	[7]. Uehara describes the light transmittance of the liquid crystal panel 204b is measured by a luminance meter 201 and sent to a personal computer 202. Ex. 1009, ¶¶11, 23. A POSITA would comprehend that the luminance meter 201 is a sensor and the luminance of the liquid crystal panel 204b is optical input. [8]. FIG. 1 shows the configuration for gamma correction, while FIG. 4 shows the configuration for image displaying. Ex. 1009, Brief Description of Drawings. Thus, a POSITA would know that Uehara discloses that said sensor (the luminance meter 201) “is separate from said display” because the liquid crystal panel 204b operates without the luminance meter 201 in FIG. 4.

Claims of the '788 Patent	Prior Art
	Ex. 1009, Fig. 4.
[1C] c. varying gamma reference voltage levels on columns of said display by a control circuit, wherein said control circuit is separate from said display;	[9]. Uehara describes that the output signal of the personal computer is sent to the gamma correction circuit 203. Ex. 1009, ¶12. The signal coming out of the gamma correction circuit 203 is sent to the LCD body 204. Ex. 1009, ¶12. [10]. During a gamma correction process, the personal computer 202 outputs the test signal data, the mode switching signal, the gate control signal, and other control command signals for generating test signals in response to the voltage applied to the liquid crystal panel 204b, and the gamma correction circuit 203 receives these signals. Ex. 1009, ¶21. The test signal data is then inputted into the gamma correction circuit 203 and the latch circuit L₃ and the CPU 101 of the gamma correction circuit 203 via the latch circuit L₁. Ex. 1009, ¶21. [11]. As a result of these signals from the personal computer 202, the latch circuit L₃

Claims of the '788 Patent	Prior Art
	generates a test signal based on the test signal data, and the test signal is converted to the analog voltage by the D/A conversion unit 104. Ex. 1009, ¶22. The converted analog voltage is sent to the LCD body 204 via output terminals 100R₀, 100G₀, and 100B₀. Ex. 1009, ¶22. The personal computer 202 modifies the test signal data and inputs it to the latch circuit L3 in order to change the voltage applied to the liquid crystal panel 204b, which changes its light transmittance. Ex. 1009, ¶23. The test signal generation step will sequentially change the voltage to be applied to the liquid crystal panel based on the test signal data. Ex. 1009, ¶41. [12]. Therefore, a POSITA would comprehend that the personal computer 202, working in conjunction with the CPU 101 of the gamma correction circuit 203, effectively varies the “gamma reference voltage levels” by sending a group of signals, including the test signal data, the mode switching signal, the gate control signal, and other control command signals for generating test signals in response to the applied voltage. [13]. Similarly, FIG. 1 shows the configuration for gamma correction, while FIG. 4 shows the configuration for image displaying. Ex. 1009, Brief Description of Drawings. Thus, a POSITA would comprehend that Uehara discloses that said control circuit (the personal computer 202, or alternatively the personal computer 202 in conjunction with the CPU 101) “is separate from said display” because the liquid crystal panel 204b operates without the personal computer 202 in FIG. 4.

Claims of the '788 Patent	Prior Art
	[14]. To the extent that Uehara fails to disclose “on columns of said display,” Kang discloses applying gamma reference voltage levels on columns of the display, as explained above. [15]. A POSITA would be motivated to modify the teachings of Uehara to apply the gamma reference voltage levels, which are varied by the personal computer 202 (in conjunction with the CPU 101), to the columns of the liquid crystal panel 204b, considering the teachings of Kang. It is common knowledge in the display industry to arrange an LCD panel into columns and rows for accessing individual pixels, and corresponding row drivers and column drivers are in engineers’ regular toolbox.
[1D] 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	[16]. Uehara describes that the luminance meter 201 repeatedly measures the light transmittance (luminance) of the liquid crystal panel 204b, as the test signal data is “changed by the personal computer 202.” Ex. 1009, ¶23. The same operation is “repeated in order to sequentially change the applied voltage of liquid crystal panel 204b from, for example, a black level to a white level.” Ex. 1009, ¶23. By measuring all of the light transmission from the black level to the white level, it becomes “possible to determine the gamma characteristics of liquid crystal panel 204b.” Ex. 1009, ¶24. [17]. The personal computer 202 then reads the measurements values of the light transmission that have been stored in the memory and calculates the inverse function of the gamma

Claims of the '788 Patent	Prior Art
	characteristics of the liquid crystal and 204b. Ex. 1009, ¶24. The personal computer 202 then calculates the gamma correction data in order to correct the gamma characteristics of liquid crystal panel 204b. Ex. 1009, ¶24. The gamma correction data calculated in this way is temporarily stored in the personal computer 202. Ex. 1009, ¶24. [18]. Therefore, a POSITA would understand that the gamma correction data is the “gamma reference voltage levels” and is optimized using this feedback loop (i.e., changing the test signal data, generating light transmission accordingly, measuring the light transmission, calculating the gamma correction data). [19]. A POSITA would comprehend that this optimization process is “using means for executing a predetermined algorithm according to a predetermined criteria and data sensed by said at least one sensor” because (i) the luminance meter 201 is used; (ii) the applied voltage is changed in a predetermined manner (e.g., from a black level to a white level); and (iii) the gamma correction data is calculated using a predetermined algorithm (e.g., calculating the inverse function of the gamma characteristics). It is also well-known in the gamma correction space that the optimization process involves “a predetermined algorithm” for the software aspect and at least one sensor for the hardware aspect. A POSITA would also comprehend that the optimization process typically involves matching/fitting to a certain desired gamma curve, which is “according to a predetermined criteria.” It is also common knowledge of a POSITA that the

Claims of the '788 Patent	Prior Art
	“predetermined algorithm” must be executed by “means for executing a predetermined algorithm” such as the personal computer 202, which interacts with, among other things, the CPU 101. [20]. As explained above, a POSITA would appreciate that Uehara discloses that said means for executing said predetermined algorithm (the personal computer 202 or the personal computer 202 in conjunction with the CPU 101) “is separate from said display” because the liquid crystal panel 204b operates without the personal computer 202 in FIG. 4.
[1E] e. storing said gamma reference voltage levels in said gamma reference control capability.	[21]. As explained above, the gamma correction data calculated in this way is temporarily stored in the personal computer 202. Ex. 1009, ¶24. The gamma correction data temporarily stored in the personal computer 202 is written directly to EEPROMs 105_R, 105_G, 105_B, 106_R, 106_G, and 106_B. Ex. 1009, ¶30. [22]. After storing the gamma correction data, the control command signal from the personal computer 202 is sent to the gamma correction circuit 203, thus the address signal and write signal #WR from the CPU 101 are provided to EEPROMs 105_R, 105_G, 105_B, 106_R, 106_G, and 106_B. Ex. 1009, ¶28. The personal computer 202 writes the gamma correction data (image signals gamma not corrected) to EEPROMs 105_R, 105_G, 105_B. Ex. 1009, ¶28. After selecting the EEPROM 106_R, 106_G, and 106_B by switching the switch SW, the personal computer 202 similarly writes the gamma correction data (image signals gamma

Claims of the '788 Patent	Prior Art
	corrected) to EEPROM 106_R, 106_G, 106_B. Ex. 1009, ¶28. [23]. Hence, a POSITA would comprehend that Uehara discloses storing the “gamma reference voltage levels” (the gamma correction data) in the “gamma reference control capability” (the gamma correction circuit 203). [24]. To the extent that the “gamma reference voltage levels” is interpreted as analog gamma reference voltage levels, Uehara discloses it as well. [25]. The gamma correction circuit 203 includes, among other components, the D/A conversion unit 104. Ex. 1009, ¶12. The analog version of the gamma reference voltages, which interfaces with the real world, must exist in the system, and a POSITA is well-equipped to include, for example, a D/A converter and a buffer in the “gamma reference control capability.” The broad concept of “gamma reference control capability” justifies redrawing the line to include such components as needed. Indeed, A/D conversion (sampling an encoding analog signals in essence) and D/A conversion (the reverse process of the A/D conversion in essence) have become well known in electronics and signal processing since 1940s. Digital gamma correction and analog gamma correction are simply two common implementations of gamma correction, depending on the available technical capabilities and cost-effectiveness.

Claims of the '788 Patent	Prior Art
	[26]. In addition, Kang discloses that the buffer unit 94 stabilizes the eight gamma reference voltages GMA1 to GMA8 and applies them to the gamma voltage output 95. Ex. 1007, ¶54. Therefore, a POSITA would be motivated to introduce the buffer unit 94 discussed in Kang to stabilize the gamma reference voltage levels for a stable image.
Claim 2	
[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.	[27]. Uehara describes that the same operation is “repeated in order to sequentially change the applied voltage of liquid crystal panel 204b from, for example, a black level to a white level.” Ex. 1009, ¶23. Therefore, a POSITA would understand that Uehara discloses that the adjustment of gamma correction data may be repetitive as needed. Because of such repetitive operations, a POSITA would understand that at least one different set of gamma reference voltage levels can be generated “under different ambient display conditions” and stored in the gamma reference control capability because different ambient conditions result in different gamma correction setting. As such, the display can accommodate various ambient conditions. [28]. To the extent that one would argue Uehara fails to disclose this element, Kang discloses the same. Kang discloses the multi-mode gamma voltage generator 84 for generating a gamma voltage using multi-mode gamma data set. Ex. 1007, ¶48. The memory 92 stores a multi-mode gamma data set, and such gamma data is input to the multi-channel DAC 93 to indicate a gamma reference voltage for each mode. Ex. 1007, ¶53. Notably, an example

Claims of the '788 Patent	Prior Art																																													
	of gamma reference voltages for each mode is shown in Table 1. Ex. 1007, ¶59. TABLE 1 <table><tr><th>Mode Gamma</th><th>Mode A</th><th>Mode B</th><th>Mode C</th><th>Mode D</th></tr><tr><td>GMA 1</td><td>0.1875</td><td>0.3750</td><td>0.5625</td><td>0.7500</td></tr><tr><td>GMA 2</td><td>1.8750</td><td>2.0625</td><td>2.2500</td><td>2.4375</td></tr><tr><td>GMA 3</td><td>3.3750</td><td>3.5625</td><td>3.7500</td><td>3.9375</td></tr><tr><td>GMA 4</td><td>5.0625</td><td>5.2500</td><td>5.4375</td><td>5.6250</td></tr><tr><td>GMA 5</td><td>6.7500</td><td>6.9375</td><td>7.1250</td><td>7.3125</td></tr><tr><td>GMA 6</td><td>8.4375</td><td>8.6250</td><td>8.8125</td><td>9.0000</td></tr><tr><td>GMA 7</td><td>10.1250</td><td>10.3125</td><td>10.5000</td><td>10.6875</td></tr><tr><td>GMA 8</td><td>11.8125</td><td>11.6250</td><td>11.4375</td><td>11.2500</td></tr></table> Ex. 1007, Table 1. [29]. Therefore, a POSITA would understand that Kang discloses “at least one different set of gamma reference voltage levels” (e.g., four different sets of gamma correction data corresponding to four different modes, namely Mode A, Mode B, Mode C, and Mode D) under different ambient display conditions. Such multi-mode arrangement is well-known in the gamma correction space to accommodate different display conditions (e.g., dark, bright, sunlight) and use cases (e.g., reading, gaming, cinema). A POSITA would be motivated to introduce Kang’s multi-mode gamma voltage generator 84 into the system in Uehara to achieve versatility and functionality within the display.	Mode Gamma	Mode A	Mode B	Mode C	Mode D	GMA 1	0.1875	0.3750	0.5625	0.7500	GMA 2	1.8750	2.0625	2.2500	2.4375	GMA 3	3.3750	3.5625	3.7500	3.9375	GMA 4	5.0625	5.2500	5.4375	5.6250	GMA 5	6.7500	6.9375	7.1250	7.3125	GMA 6	8.4375	8.6250	8.8125	9.0000	GMA 7	10.1250	10.3125	10.5000	10.6875	GMA 8	11.8125	11.6250	11.4375	11.2500
Mode Gamma	Mode A	Mode B	Mode C	Mode D																																										
GMA 1	0.1875	0.3750	0.5625	0.7500																																										
GMA 2	1.8750	2.0625	2.2500	2.4375																																										
GMA 3	3.3750	3.5625	3.7500	3.9375																																										
GMA 4	5.0625	5.2500	5.4375	5.6250																																										
GMA 5	6.7500	6.9375	7.1250	7.3125																																										
GMA 6	8.4375	8.6250	8.8125	9.0000																																										
GMA 7	10.1250	10.3125	10.5000	10.6875																																										
GMA 8	11.8125	11.6250	11.4375	11.2500																																										
Claim 3																																														
[3 Preamble] A method of programming one or more gamma reference voltage generator integrated circuits attached to a liquid crystal display comprising the steps:	[30]. Uehara describes a gamma correction method for a liquid crystal display. Ex. 1009, ¶1. The light transmittance of an LCD panel to which voltage is applied is measured, and the gamma characteristics of the LCD panel are then determined based on the measured light transmittance. Ex. 1009, ¶7. The gamma characteristics are then corrected. Ex. 1009, ¶7. Uehara explains that the light transmittance in																																													

Claims of the '788 Patent	Prior Art
	relation to the input voltage is called the “V-T characteristic,” which is appropriately corrected by the gamma correction data. Ex. 1009, ¶4. [31]. Uehara describes a liquid crystal display that includes an LCD body 204 and a gamma correction circuit 203. Ex. 1009, ¶¶11-12. The LCD body 204 includes a liquid crystal panel 204b and a video circuit 204a built into the LCD body 204. Ex. 1009, ¶11. The gamma correction circuit 203 includes, among other components, the A/D conversion unit 102, the D/A conversion unit 104, the CPU 101, the gamma table 103, the first gamma correction data storage means 105, and the second gamma correction data storage means 106. Ex. 1009, ¶12. A POSITA would appreciate that the gamma correction circuit 203 is the “one or more gamma reference voltage generator integrated circuits” because of (i) the components included in the gamma correction circuit 204 and (ii) the feedback loop comprised of the liquid crystal panel 204b, the luminance meter 201, the personal computer 202, and the gamma correction circuit 203. [32]. A POSITA would also appreciate that the gamma correction circuit 203 can be attached to the liquid crystal display as a natural design choice. Such an attaching design may shorten the wiring between the basic circuit and the display.
[3A] a. selecting one or more columns on said liquid crystal display;	[33]. To the extent that someone would argue that Uehara fails to disclose selecting columns on the LCD, Kang discloses the same.

Claims of the '788 Patent	Prior Art
	[34]. Kang discloses an LCD that includes the digital video card 81, the multi-mode gamma voltage generator 84, the column driver 83 for supplying data to data lines of the liquid crystal panel 86, the row driver 85 for sequentially driving gate lines of the liquid crystal panel 86, and the controller 82 for controlling the column driver 83 and the row driver 85. Ex. 1007, ¶48. The multi-mode gamma voltage generator 84 stores therein gamma data and divides, by utilizing the selected gamma data, a gamma voltage into a gray level range to be displayed and applies it to the column driver 83. Ex. 1007, ¶49. The column driver 83 latches the R, G and B digital video data received from the controller 82 in synchronization with the dot clock signal and thereafter corrects the latched data in accordance with a gamma voltage from the gamma voltage generator 84. Ex. 1007, ¶50. The column driver 83 then converts the data corrected by the gamma voltage into analog data to apply it to the data lines. Ex. 1007, ¶50.. [35]. As shown in FIG. 9, the gamma voltage output 95 is connected between the gamma controller 91 and the DAC 96 of the column driver 83. Ex. 1007, ¶51. [36]. Therefore, Kang discloses selecting one or more columns on the liquid crystal display (the liquid crystal panel 86) by using the column driver 84 and the controller 82. A POSITA would be motivated to modify the teachings of Uehara to apply the gamma reference voltage levels, which are varied by the personal computer 202, to the columns of the liquid crystal panel 204b, considering the

Claims of the '788 Patent	Prior Art
	teachings of Kang. It is common knowledge in the display industry to arrange an LCD panel into columns and rows for accessing individual pixels, and corresponding row drivers and column drivers are in engineers' regular toolbox.
[3B] b. applying one or more different gamma voltages to said liquid crystal display columns;	[37]. As described above in relation to Element [1C], Uehara discloses a gamma correction circuit that applies gamma correction to the liquid crystal display using a personal computer. [38]. Additionally, the image signals output from the A/D converters (AD_R, AD_G, AD_B) are sent to address terminals of the gamma table 103, and the image signals output from the gamma table 103 are sent to D/A converters (DA_R, DA_G, DA_B). Ex. 1009, ¶¶13-14. A POSITA would comprehend that this process is a gamma correction process (image signals output from the ADC as address, image signals output from the gamma table 103 as gamma-corrected data). [39]. Thus, a POSITA would comprehend that the personal computer 202, working in conjunction with the CPU 101 of the gamma correction circuit 203, effectively applies "one or more different gamma voltages to said liquid crystal display" by sending a group of signals, including the test signal data, the mode switching signal, the gate control signal, and other control command signals for generating test signals in response to the applied voltage. [40]. To the extent that Uehara fails to disclose on columns of said liquid crystal display, Kang

Claims of the '788 Patent	Prior Art
	discloses applying gamma reference voltage levels on columns of the display, as explained above. [41]. A POSITA would be motivated to modify the teachings of Uehara to apply the gamma reference voltage levels, which are varied by the personal computer 202 (in conjunction with the CPU 101), to the columns of the liquid crystal panel 204b, considering the teachings of Kang because the row-column arrangement is common in the display field.
[3C] c. storing said applied gamma voltages in reprogrammable, nonvolatile cells in said gamma reference voltage generator integrated circuits appropriate to said selected columns;	[42]. As described above in relation to element [1A], Uehara discloses storing applied gamma voltages in reprogrammable nonvolatile cells by discussing programming and storage into EEPROMs. A POSITA would appreciate that the “gamma reference control capability” is electrically reprogrammable (being able to write data to the EEPROMs) and non-volatile (EEPROM is known as non-volatile). [43]. A POSITA would appreciate that the gamma table 103, implemented as the memory device designed to store information, at least temporarily stores the image signals output from the ADC as address. Ex. 1009, ¶¶13-14. It is well-known that a (non-volatile) memory device is divided into multiple cells, as the minimum storage unit, and different cells are “appropriate to said selected columns.”
[3D] d. operating means for executing one or more optimization criteria algorithms based on optical emission corresponding to	[44]. As discussed in relation to element [1D], Uehara discloses this element.

Claims of the '788 Patent	Prior Art
said selected columns, wherein said means for executing said one or more optimization criteria algorithms is separate from said liquid crystal display;	
[3E] e. modifying said one or more different applied gamma voltages based on said one or more optimization criteria algorithms;	[45]. See element [1D] analysis. [46]. Moreover, as described in relation to Element [3B], Uehara discloses that the image signals output from the A/D converters (AD_R, AD_G, AD_B) are sent to address terminals of the gamma table 103, and the image signals output from the gamma table 103 are sent to D/A converters (DA_R, DA_G, DA_B). Ex. 1009, ¶¶13-14. This process is a gamma correction process (image signals output from the ADC as address, image signals output from the gamma table 103 as gamma-corrected data). Thus, a POSITA would comprehend that Uehara discloses “modifying said one or more different applied gamma voltages” (modifying/transforming from the image signals output from the ADC to the image signals output from the gamma table 103). Ex. 1009, ¶30. The modification process is the gamma correction process as a result of Element [3D].
[3F] f. programming said applied gamma voltages in storage cells in said gamma reference voltage generator integrated circuits appropriate to said selected columns; and	[47]. As explained above, the gamma correction data calculated in this way is temporarily stored in the personal computer 202. Ex. 1009, ¶¶13-14 and 24. The gamma correction data temporarily stored in the personal computer 202 is written directly to EEPROMs 105_R, 105_G, 105_B, 106_R, 106_G, and 106_B. Ex. 1009, ¶30.

Claims of the '788 Patent	Prior Art
	[48]. Additionally, after storing the gamma correction data, the control command signal from the personal computer 202 is sent to the gamma correction circuit 203, thus the address signal and write signal #WR from the CPU 101 are provided to EEPROMs 105_R, 105_G, 105_B, 106_R, 106_G, and 106_B. Ex. 1009, ¶28. The personal computer 202 writes the gamma correction data (image signals gamma not corrected) to EEPROMs 105_R, 105_G, 105_B. Ex. 1009, ¶28. [49]. Thus, a POSITA would understand that Uehara discloses “programming” (writing) “said applied gamma voltages” (writing the gamma correction data output from the gamma table 103) in “storage cells in said gamma reference voltage generator integrated circuits” (the EEPROMs 105_R, 105_G, 105_B, 106_R, 106_G, and 106_B, and the gamma table 103). Transferring data between different types of memory devices (e.g., EEPROMs and SRAMs) is well-known. Some information is stored in volatile memories for quick access, while other information is stored in nonvolatile memories for long-term storage. Transferring information between these two types of memories is readily and frequently implemented in IC design as needed. [50]. As explained above, such storage cells are “appropriate to said selected columns.”
[3G] g. repeating steps (d) through (f) until said one or more optimization criteria have been satisfied.	[51]. Uehara describes that the luminance meter 201 repeatedly measures the light transmittance (luminance) of the liquid crystal panel 204b, as the test signal data is “changed by the personal computer 202.” Ex. 1009, ¶23.

Claims of the '788 Patent	Prior Art
	The same operation is “repeated in order to sequentially change the applied voltage of liquid crystal panel 204b from, for example, a black level to a white level.” Ex. 1009, ¶23. By measuring all of the light transmission from the black level to the white level, it becomes “possible to determine the gamma characteristics of liquid crystal panel 204b.” Ex. 1009, ¶24. Accordingly, a POSITA would understand that Uehara discloses that steps (d) through (f) are being repeated “until said one or more optimization criteria have been satisfied.”
Claim 5	
[5 Preamble] A method for a liquid crystal display, comprising:	[52]. As explained in claim element [1 Preamble], Uehara discloses this element
[5A] providing said liquid crystal display with gamma reference control capability which is electrically reprogrammable and non-volatile;	[53]. As explained in claim element [1A], Uehara discloses this element.
[5B] calibrating said liquid crystal display comprising: a. testing said liquid crystal display with at least one sensor with optical input;	[54]. As explained in claim element [1B], Uehara discloses this element.
[5C] b. varying gamma reference voltage levels on columns of said liquid crystal display;	[55]. As explained in claim element [1C], Uehara discloses this element.
[5D] c. optimizing said gamma reference voltage levels using means for executing a predetermined algorithm according to a predetermined criteria and	[56]. As explained in claim element [1D], Uehara discloses this element

Claims of the '788 Patent	Prior Art
data sensed by said at least one sensor; and;	
[5E] d. storing said gamma reference voltage levels in said gamma reference control capability;	[57]. As explained in claim element [1E], Uehara discloses this element.
[5F] retrieving said gamma reference voltage levels from said gamma reference control capability; and;	[58]. Uehara describes that the gamma correction circuit 203 includes, among other components, the gamma table 103 configured to store the gamma correction data. Ex. 1009, ¶12. After storing the gamma correction data, the control command signal from the personal computer 202 is sent to the gamma correction circuit 203, thus the address signal and write signal #WR from the CPU 101 are provided to EEPROMs 105 _R , 105 _G , 105 _B , 106 _R , 106 _G , and 106 _B . Ex. 1009, ¶28. The personal computer 202 writes the gamma correction data (image signals gamma not corrected) to EEPROMs 105 _R , 105 _G , 105 _B . Ex. 1009, ¶28. When the liquid crystal display is turned ON, switching signal S _{SL} will change to the L level, selecting EEPROMs 105 _R , 105 _G , and 105 _B of first gamma correction data storage means 105. 1009, ¶32. When EEPROMs 105 _R , 105 _G , and 105 _B are provided with the address signal and read signal #RD, and EEPROM select signals Y1, Y2, and Y3 are provided from address decoder ADD, the gamma correction data will be read from EEPROMs 105 _R (105 _G , 105 _B), and this data will be sent to the SRAM SM _R (SM _G , SM _B). 1009, ¶34. Thus, a POSITA would understand that Uehara discloses retrieving said gamma reference voltage levels (selecting the EEPROMs 105 _R , 105 _G , and 105 _B and reading the gamma correction data stored therein) from said gamma reference control capability (the gamma correction circuit 203,

Claims of the '788 Patent	Prior Art
	which includes the EEPROMs 105 _R , 105 _G , and 105 _B).
[5G] displaying an image on said liquid crystal display based on said gamma reference voltage levels.	[59]. Uehara describes that the image signal that was read out will be sent to the D/A conversion circuits DA _R , DA _G , and DA _B , where the image signal is converted to analog image signal, which is applied to the liquid crystal panel 204b via output terminals 100R ₀ , 100G ₀ , and 100B ₀ in order to display the image on the liquid crystal panel 204b. A POSITA would understand that Uehara discloses displaying an image on said liquid crystal display (on the liquid crystal panel 204b) based on said gamma reference voltage levels because the analog image signal is based on gamma reference voltage levels (gamma correction data).
Claim 6	
[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.	[60]. As explained in element [2], Uehara discloses this element.

IX. Tobiya and Kang in View of the Knowledge of a Person of Ordinary Skill in the Art Renders Obvious Claims 1 and 3 of the '788 Patent.

90. A person of ordinary skill in the art would have been motivated to combine Tobiya and Kang.

91. Both Tobiya and Kang are in the same field of endeavor, i.e., gamma correction. Thus, a POSITA would have had a reasonable expectation of success in combining their various disclosures to achieve, for example, (i) a variable gamma correction in addition to a linear type gamma correction and (ii) improved display quality.

92. Furthermore, it was well within the technical ability of a POSITA at the time to incorporate the column driver and corresponding column configuration described in Kang into the LCD described in Tobiya because a POSITA knows how to arrange an LCD into columns and rows for accessing individual pixels. Again, this arrangement results in various benefits such as individual pixel control, high resolution, efficient addressing, scalability, simplified wiring, and the like. Also, the column-row arrangement aligns well with the way the integrated circuit (IC) drivers (including column drivers and row drivers, which are designed to efficiently manage the signals for activating the columns and rows of the pixels) are designed.

93. It was also well within the technical ability of a POSITA to incorporate the multi-mode gamma voltage generator for generating a gamma voltage using Kang's multi-mode gamma data set into Tobiya's LCD because (i) multi-mode arrangements are well-known in the gamma correction field to accommodate different display conditions and use cases and (ii) a POSITA would

be motivated to do so to achieve versatility. As explained above, a number of benefits can be achieved. Different types of content (e.g., video games, movies, photos, documents) can benefit from different gamma settings. Additionally, the perceived brightness and contrast of a display can change depending on the ambient lighting conditions. A higher gamma setting might help to maintain image contrast and prevent the image from looking washed out, while a lower gamma might be preferable to avoid overly dark shadows and reveal more subtle details. Multi-mode gamma allows users to adjust the display to suit their environment. Moreover, various display standards and color spaces have different recommended gamma values

94. It was well within the technical ability of a POSITA to incorporate the buffer unit that stabilizes the gamma reference voltages discussed in Kang into the gamma correction circuit discussed in Tobiya to stabilize the gamma reference voltage levels for a stable image. The introduction of a buffer provides various advantages including stable and accurate gamma performance, improved transient response, reduced crosstalk and image artifacts, consistent brightness and color across the display.

95. It was well within the technical ability of a POSITA to correspond the storage cells of the LUT memory means described in Tobiya to Kang's columns of the display because it is well-known that a (non-volatile) memory device is divided

into multiple cells, as the minimum storage unit, and different cells are appropriate to the selected columns.

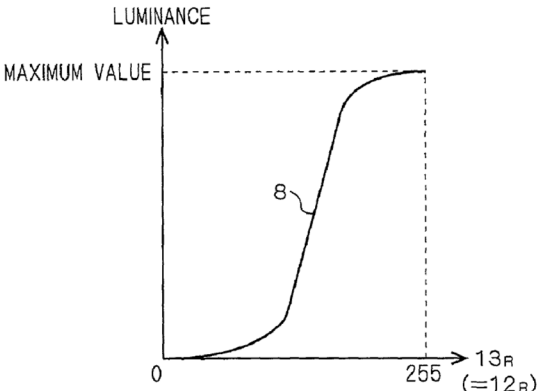
96. In my opinion, a person of ordinary skill in the art would have recognized that each element of claims 1 and 3 was obvious in view of the combination of Tobiya in view of Kang. This is further demonstrated by the claim chart below.

Claims of the '788 Patent	Prior Art
Claim 1	
[1 Preamble] A method of calibrating a liquid crystal display to a desired gamma curve to compensate for panel to panel manufacturing variations comprising the steps:	[1]. Tobiya describes a display characteristic correction system that includes a liquid crystal display 100 and a means for correcting the gray level thereof. Ex. 1010, ¶36. Tobiya explains that the gray level relates to luminance or light transmittance. Ex. 1010, ¶4. The value of the signal inputted to the display device and the value of the gray level associate with a characteristic (the “γ-characteristic” or the “display characteristic”) inherent to the display device. Ex. 1010, ¶4. Converting the input signal by using another characteristic (the “correction characteristic”) allows the display device to display with a gray level that has a linear relationship with the value of the input signal. Ex. 1010, ¶4. A POSTIA would appreciate that such a display characteristic correction system and the corresponding operation method is “a method of calibrating a liquid crystal display to a desired gamma curve” because converting the input signal by using the correction characteristic (also known as “gamma correction data”) is a process to calibrate the LCD to a desired gamma curve (called “display characteristic” in Tobiya).

Claims of the '788 Patent	Prior Art
	[2]. Tobiya further describes that the correction characteristic needs to be set for each of the display devices, and a look-up table ("LUT") is used so as to make the input signal and the conversion signal associated with each other because there are variations in the display characteristic depending on display devices. Ex. 1010, ¶5. The application of a rewritable memory (e.g., a RAM and an EEPROM) as the LUT memory means 5 makes it possible to cancel individual differences in the display characteristic of the liquid crystal panels 6, and consequently to obtain a desired gray level. Ex. 1010, ¶40. Hence, a POSITA would appreciate that Tobiya discloses "to compensate for panel to panel manufacturing variations" because Tobiya highlights the need for compensating for individual differences in the display characteristics.
[1A] a. providing said display with gamma reference control capability which is electrically reprogrammable and non-volatile;	[3]. Tobiya describes that the display characteristic correction system includes, among other components, the signal source 3, the analog/digital converter (ADC) 4, the LUT memory means 5, the liquid crystal panel 6, the computer 2, and the luminance meter 1. Ex. 1010, ¶¶36-37, 39-40.

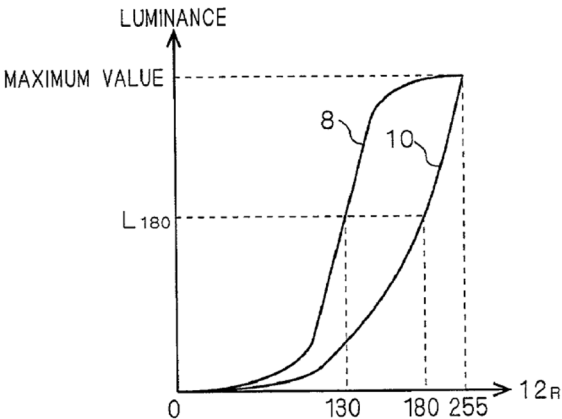
Claims of the '788 Patent	Prior Art
	The diagram illustrates a display system 100. A signal source 3 provides input signals 11 (11_B, 11_G, 11_R) to an ADC 4. The ADC 4 outputs digital signals 12 (12_R, 12_G, 12_B) to LUT memory means 5. The LUT memory means 5 outputs digital signals 13 (13_R, 13_G, 13_B) to a liquid crystal panel 6. A PC 2 is connected to the signal source 3, the ADC 4, and a luminance meter 1. The luminance meter 1 is also connected to the liquid crystal panel 6. A feedback loop 15 connects the luminance meter 1 to the PC 2, and a control line 16 connects the PC 2 to the LUT memory means 5. Ex. 1010, Fig. 1. [4]. The ADC 4 carries out an analog/digital conversion on a group of analog RGB signals 11 inputted thereto from outside and generates a group of digital RGB signals 12. Ex. 1010, ¶37. The LUT memory means 5 carries out a conversion on the group of RGB signals 12 based upon a predetermined conversion characteristic and generates a group of digital RGB signals 13 as conversion signals. Ex. 1010. Thus, a POSITA would appreciate that Tobiya discloses “providing said display with gamma reference control capability” because the LUT memory means 5 carries out a conversion on the RGB signals 12 based on a predetermined conversion characteristic to generate a group of RGB signals 13 as conversion signals. [5]. Additionally, the application of a rewritable memory (e.g., a RAM and an EEPROM) as the LUT memory means 5 makes it possible to cancel individual differences in the display characteristic of the liquid crystal panels 6, and consequently to obtain a desired gray level. Ex. 1010, ¶40. Therefore, a POSITA would appreciate that

Claims of the '788 Patent	Prior Art
	Tobiya discloses that the gamma reference control capability is “electrically reprogrammable” (rewritable) and “non-volatile” (EEPROM is well known as nonvolatile).
[1B] b. testing said display with at least one sensor with optical input, wherein said sensor is separate from said display;	[6]. Tobiya describes that the luminance meter 1 measures the gray level (e.g., the luminance 14) displayed by the liquid crystal panel 6. Ex. 1010, ¶39. The data 15 corresponding to the luminance 14 measured by the luminance meter 1 is supplied to the computer 2. Ex. 1010, ¶39. Thus, Tobiya discloses “testing said display with at least one sensor with optical input” because (i) the luminance meter 1 is the “at least one sensor” and (ii) the luminance 14 is the “optical input.” [7]. Further, FIG. 1 shows that the luminance meter 1 is separate from the LCD 100. Ex. 1010, FIG. 1. Hence, a POSITA would know that Tobiya discloses “said sensor is separate from said display.”
[1C] c. varying gamma reference voltage levels on columns of said display by a control circuit, wherein said control circuit is separate from said display;	[8]. Tobiya describes that the signal source 3 generates a group of analog RGB signals 11 corresponding to various gradients, based upon a control signal 21 from the computer 2 for setting the LUT memory means 5 and gives them to the ADC 4. Ex. 1010, ¶39. Based on the control signal 21 from the computer 2, the signal 11R having various amplitudes is outputted from the signal source 3 to the ADC 4. Ex. 1010, ¶43. The ADC 4 subjects it to a quantization process with the greatest amplitude being set at 255 to generate a signal 12R, and outputs the resulting signal to the LUT memory means 5. Ex. 1010, ¶43.

Claims of the '788 Patent	Prior Art
	[9]. The LUT memory means 5 carries out a conversion on the group of RGB signals 12 based upon a predetermined conversion characteristic and generates a group of digital RGB signals 13 as conversion signals. Ex. 1010, ¶37. Since the LUT memory means 5 stores the conversion characteristic 16R that allows the signals 12R and 13R to have the same value at the very beginning, the value of the signal 12R is inputted to the liquid crystal panel 6. Ex. 1010, ¶44. The liquid crystal panel 6 emits light with a luminance corresponding to the value of the signal 12R, and the luminance meter 1 measures the luminance 14 at this time and sends data 15 indicating the results to the computer 2. Ex. 1010, ¶44. This process continues on all the values 0 to 255 of gradients, and the display characteristic of the red color of the liquid crystal panel 6 is obtained. Ex. 1010, ¶45. FIG. 3 shows an exemplary display characteristic 8 of the liquid crystal panel 6. Ex. 1010, ¶45.  Ex. 1010, Fig. 3. [10]. Thus, a POSITA would comprehend that Tobiya discloses varying gamma reference voltage levels (changing the digital RGB

Claims of the '788 Patent	Prior Art
	signals 13 as conversion signals based on the control signal 21 and the conversion characteristic 16) applied to the display (the liquid crystal panel 6) by a control circuit (the computer 2 that sends the control signal 21 and the conversion characteristic 16). [11]. FIG. 1 shows that the computer 2 is separate from the LCD 100. Ex. 1010, FIG. 1. Thus, a POSITA would know that Tobiya discloses “said control circuit is separate from said display.” [12]. To the extent that Tobiya fails to disclose “on columns of said display,” Kang discloses applying gamma reference voltage levels on columns of the display, as explained above. A POSITA would be motivated to modify the teachings of Tobiya to apply the gamma reference voltage levels, which are varied by the computer 2, to the columns of the liquid crystal panel 6, considering the teachings of Kang. It is common knowledge in the display industry to arrange an LCD panel into columns and rows for accessing individual pixels, and corresponding row drivers and column drivers are in engineers’ regular toolbox.
[1D] 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	[13]. Tobiya describes that the signal source 3 generates a group of analog RGB signals 11 corresponding to various gradients, based upon a control signal 21 from the computer 2 for setting the LUT memory means 5 and gives them to the ADC 4. Ex. 1010, ¶39. [14]. Based on the control signal 21 from the computer 2, the signal 11R having various amplitudes is outputted from the signal source

Claims of the '788 Patent	Prior Art
separate from said display to achieve the desired gamma curve; and	3 to the ADC 4, and the ADC 4 subjects it to a quantization process with the greatest amplitude being set at 255 to generate a signal 12R, and outputs the resulting signal to the LUT memory means 5. Ex. 1010, ¶43. The LUT memory means 5 carries out a conversion on the group of RGB signals 12 based upon a predetermined conversion characteristic and generates a group of digital RGB signals 13 as conversion signals. Ex. 1010, ¶37. [15]. The luminance meter 1 measures the gray level (e.g., the luminance 14) displayed by the liquid crystal panel 6, and the data 15 corresponding to the luminance 14 measured by the luminance meter 1 is supplied to the computer 2. Ex. 1010, ¶39. This process continues on all the values 0 to 255 of gradients, and the display characteristic of the red color of the liquid crystal panel 6 is obtained. Ex. 1010, ¶45. [16]. Once the display characteristic has been obtained, the conversion characteristic can be obtained accordingly. Ex. 1010, ¶47. By comparing the actual luminance target characteristic 10 with the actually measured display characteristic 8 of the liquid crystal panel 6, a conversion characteristic is obtained, and the conversion characteristic makes the display characteristic covering the entire liquid crystal display 100 coincident with the actual luminance target characteristic 10. Ex. 1010, ¶48. [17]. As shown in FIG. 6, supposing that the display characteristic of the liquid crystal panel 6 is in conformity with the actual

Claims of the '788 Patent	Prior Art
	luminance target characteristic 10, a signal 11_R having a value of gradient 180 is supplied, the luminance of the liquid crystal panel 6 is represented by L₁₈₀. Ex. 1010, ¶49. In this case, when the value of gradient of the signal 13_R, which gives the luminance L₁₈₀ in accordance with the display characteristic 8 that is the actual display characteristic of the liquid crystal panel, is found, a value of gradient 130 is obtained. Ex. 1010, ¶49. A POSITA would appreciate that a gradient value of 130, instead of a gradient value of 180, should be used as the input to achieve the target luminance value of L₁₈₀, and a corresponding conversion (i.e., from 180 to 130) can be carried out.  The graph shows LUMINANCE on the vertical axis and 12_R on the horizontal axis. The horizontal axis has tick marks at 0, 130, 180, and 255. The vertical axis has tick marks for L₁₈₀ and MAXIMUM VALUE. Two curves, labeled 8 and 10, originate from (0,0) and approach the MAXIMUM VALUE. Curve 8 is steeper than curve 10. A horizontal dashed line at L₁₈₀ intersects curve 8 at 130 and curve 10 at 180. Vertical dashed lines connect these intersection points to the horizontal axis at 130 and 180 respectively. Ex. 1010, Fig. 6. [18]. This process is carried out by the computer 2 with respect to all the values of gradients so as to obtain a conversion characteristic 16 with respect to the red color as well as the green color and the blue color. Ex. 1010, ¶49. [19]. Therefore, a POSITA would understand that Tobiya discloses optimizing (comparing the actual luminance target

Claims of the '788 Patent	Prior Art
	characteristic 10 with the actually measured display characteristic 8 to obtain the conversion characteristic) said gamma reference voltage levels according to a predetermined criteria (carrying out the conversion based on the predetermined conversion characteristic) and data sensed by said at least one sensor (the luminance meter 1) to “achieve the desired gamma curve” (the desired/target display characteristic). [20]. A POSITA would also comprehend that “means for executing a predetermined algorithm” is needed to execute the predetermined algorithm, and the computer 2 is such “means for executing a predetermined algorithm.” [21]. FIG. 1 shows that the computer 2 is separate from the LCD 100. Ex. 1010, FIG. 1. Accordingly, a POSITA would conclude that Tobiya discloses “said means for executing said predetermined algorithm is separate from said display.”
[1E] e. storing said gamma reference voltage levels in said gamma reference control capability.	[22]. Tobiya describes that the computer 2 compares the values of the group of RGB signals 11 with the values of the data 15 and stores the resulting conversion characteristic 16 in the LUT memory means 5. Ex. 1010, ¶40. This process is realized by storing data corresponding to the value of the group of RGB signals 13 in addresses corresponding to the value of the group of RGB signals 12. Ex. 1010, ¶40. A POSITA would appreciate a lookup table (the value of the group of RGB signals 12 as address, the value of the group of

Claims of the '788 Patent	Prior Art
	RGB signals 13 as desired/target data) is established, and that's where the name "look-up table ("LUT") memory means" comes from. The application of a rewritable memory (e.g., a RAM and an EEPROM) as the LUT memory means 5 makes it possible to cancel individual differences in the display characteristic of the liquid crystal panels 6, and consequently to obtain a desired gray level. Ex. 1010, ¶40. [23]. Therefore, a POSITA would understand that Tobiya discloses storing said gamma reference voltage levels (storing the resulting conversion characteristic 16 is equivalent to storing the group of RGB signals 13) in said reference control capability (the LUT memory means 5 which is reprogrammable and nonvolatile). [24]. To the extent that the "gamma reference voltage levels" is interpreted as analog gamma reference voltage levels, Kang discloses this element. [25]. Kang discloses that (i) the gamma data is input to the multi-channel DAC 93 to be converted to eight gamma reference voltages GMA1 to GMA8 and (ii) the buffer unit 94 stabilizes the eight gamma reference voltages GMA1 to GMA8 and applies them to the gamma voltage output 95. Ex. 1007, ¶54. Thus, a POSITA would be motivated to introduce the multi-channel DAC 93 and the buffer unit 94 discussed in Kang to stabilize the gamma reference voltage levels for digital/analog conversion and image stability.

Claims of the '788 Patent	Prior Art
Claim 3	
[3 Preamble] A method of programming one or more gamma reference voltage generator integrated circuits attached to a liquid crystal display comprising the steps:	[26]. Tobiya describes “calibrating an LCD to a desired gamma curve” (as discussed in relation to element [1PRE]) and “storing said gamma reference voltage levels in said gamma reference control capability” (as discussed in relation to element [1E]). Thus, a POSITA would appreciate that Tobiya discloses “programming one or more gamma reference voltage generator integrated circuits” because (i) the LUT memory means 5 carries out a conversion on the RGB signals 12 based on a predetermined conversion characteristic to generate a group of RGB signals 13 as conversion signals and (ii) storing the resulting conversion characteristic 16 in the LUT memory means 5 is a process of programming.
[3A] a. selecting one or more columns on said liquid crystal display;	[27]. To the extent that someone would argue that Tobiya fails to disclose selecting columns on the LCD, Kang discloses the same. [28]. A POSITA would be motivated to modify the teachings of Tobiya to apply the gamma reference voltage levels to the columns of the liquid crystal panel 6 in light of the teachings of Kang because arranging an LCD into columns and rows for accessing individual pixels was well known to a POSITA as of the earliest claimed priority date.
[3B] b. applying one or more different gamma voltages to said liquid crystal display columns;	[29]. As described in relation to element [1C], Tobiya uses changing the digital RGB signals 13 as conversion signals to adjust the luminance of the display. Thus, a POSITA would comprehend that Tobiya discloses applying one or more different gamma voltage to said liquid crystal display.

Claims of the '788 Patent	Prior Art
	[30]. To the extent that Tobiya fails to disclose “said liquid crystal display columns,” Kang discloses applying one or more different gamma voltages to the columns of the display, as explained above. [31]. A POSITA would be motivated to modify the teachings of Tobiya to apply the one or more different gamma voltages to the columns of the liquid crystal panel in light of the teachings of Kang because arranging an LCD into columns and rows for accessing individual pixels was well known to a POSITA as of the earliest claimed priority date.
[3C] c. storing said applied gamma voltages in reprogrammable, nonvolatile cells in said gamma reference voltage generator integrated circuits appropriate to said selected columns;	[32]. Tobiya describes that the ADC 4 subjects it to a quantization process with the greatest amplitude (set at 255) to generate a signal 12R, and outputs the resulting signal to the LUT memory means 5. Ex. 1010, ¶40. A POSITA would understand the signal 12R is a non-programmed or non-corrected (haven’t been gamma-corrected) signal, and Tobiya discloses storing said applied gamma voltages (e.g., the signal 12R) in said gamma reference voltage generator integrated circuits (the LUT memory means 5 which is reprogrammable and nonvolatile). [33]. A POSITA would also understand that Tobiya discloses that the gamma reference voltage generator integrated circuits include “reprogrammable” (rewritable) and “non-volatile” (EEPROM is known as nonvolatile) cells. It is well-known that a (non-volatile) memory device is divided into multiple cells, as

Claims of the '788 Patent	Prior Art
	the minimum storage unit, and different cells are “appropriate to said selected columns.” [34]. To the extent that the “applied gamma voltages” are interpreted as analog gamma reference voltages, Kang discloses this element.
[3D] 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;	[35]. As explained above in relation to element [1D], Tobiya describes this element.
[3E] e. modifying said one or more different applied gamma voltages based on said one or more optimization criteria algorithms;	[36]. Tobiya discloses an optimization process for optimizing gamma reference voltage levels (<i>see</i> Section VII.C.[1D]) and storing the resultant gamma reference voltage levels (<i>see</i> Section VII.C.[1E]). For the same reasons, Tobiya discloses “modifying said one or more different applied gamma voltages based on said one or more optimization criteria algorithms” because the optimization process, as a trial and error process, involves modifying the applied gamma voltages repeatedly until the optimization criteria have been satisfied.
[3F] f. programming said applied gamma voltages in storage cells in said gamma reference voltage generator integrated circuits appropriate to said selected columns; and	[37]. As explained in relation to Element [1E], Tobiya discloses “programing said applied gamma voltages” (writing the resulting conversion characteristic 16 is equivalent to writing the group of RGB signals 13) “in storage cells in said gamma reference voltage

Claims of the '788 Patent	Prior Art
	generator integrated circuits” (in the LUT memory means 5). It is well-known that a (non-volatile) memory device is divided into multiple cells, as the minimum storage unit, and different cells are “appropriate to said selected columns.” [38]. As explained in relation to Element [1E], to the extent that the “gamma reference voltage levels” is interpreted as analog gamma reference voltage levels, Kang discloses it.
[3G] g. repeating steps (d) through (f) until said one or more optimization criteria have been satisfied.	[39]. Tobiya highlights that the setting of the conversion characteristic 16 is also carried out on each of the green and blue colors individually in actual cases. Ex. 1010, ¶40. [40]. A POSITA would comprehend that the optimization process is repetitive in essence to achieve “a gray level that has a linear relationship with the value of the input signal,” as stated in paragraph 4 of Tobiya.

I hereby declare that statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true. Should further information become available to me as this matter proceeds, I may revise my opinions accordingly as necessary. I declare under penalty of perjury that the foregoing Declaration is true and correct.

May 14, 2025

A handwritten signature in black ink, reading "Rafael Betancourt". The signature is written in a cursive style with a horizontal line underneath the name.

Rafael J. Betancourt