

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SAMSUNG DISPLAY CO., LTD, SAMSUNG ELECTRONICS CO., LTD,
and SAMSUNG ELECTRONICS AMERICA, INC.,
Petitioner,

v.

POLARIS POWERLED TECHNOLOGIES, LLC,
Patent Owner.

IPR2023-00771
Patent 7,259,521 B1

Before JON M. JURGOVAN, DANIEL J. GALLIGAN, and
KARA L. SZPONDOWSKI, *Administrative Patent Judges*.

SZPONDOWSKI, *Administrative Patent Judge*.

DECISION
Granting Institution of *Inter Partes* Review
35 U.S.C. § 314

I. INTRODUCTION

Samsung Display Co., Ltd., Samsung Electronics Co., Ltd., and Samsung Electronics America, Inc. (collectively, “Petitioner”) filed a Petition (Paper 4, “Pet.”) to institute an *inter partes* review of claims 1–5 and 7 of U.S. Patent 7,259,521 B1, issued on August 21, 2007 (Ex. 1001, “the ’521 patent”). Polaris PowerLED Technologies, LLC (“Patent Owner”) filed a Preliminary Response (Paper 8, “Prelim. Resp.”). With our authorization, Petitioner filed a Preliminary Reply (Paper 10, “Prelim. Reply”), and Patent Owner filed a Preliminary Sur-reply (Paper 11, “Prelim. Sur-reply”).

Institution of an *inter partes* review is authorized when “the information presented in the petition . . . and any response . . . shows that there is a reasonable likelihood that the petitioner would prevail with respect to at least 1 of the claims challenged in the petition.” 35 U.S.C. § 314(a). Based on the current record, and for the reasons explained below, we determine that Petitioner has established a reasonable likelihood that it would prevail with respect to at least one challenged claim, and we institute an *inter partes* review.

II. BACKGROUND

A. *Real Parties-in-Interest*

The parties identify themselves as the real parties-in-interest. Pet. 1; Paper 6, 1 (Mandatory Notices of Patent Owner).

B. *Related Matters*

The parties identify *Polaris PowerLED Technologies, LLC v. Samsung Electronics America, Inc.*, Case No. 2:22-cv-00469 (E.D. Tex.) as

a related case. Pet. 1; Paper 6, 1. Patent Owner also states that Petitioner has filed petitions for *inter partes* review of U.S. Patent Nos. 8,740,456 (IPR2023-00479) and 8,217,887 (IPR2023-00484). Paper 6, 1.

C. The '521 Patent (Ex. 1001)

The '521 patent is titled “Video Driver Architecture for AMOLED Displays” and is generally directed to a video driver for an active matrix organic light emitting diode (AMOLED) display that “is capable of isolating the pixel circuit from power supply voltage variations.” Ex. 1001, code (54), 1:6–9, 13.

The '521 patent explains that, in conventional AMOLED displays, because “[t]he current provided by the current driver is proportional to the difference between the voltage level of the video drive signal and the positive power supply voltage of the display panel . . . any variations in the power supply voltage will modulate the brightness of the AMOLED display.” Ex. 1001, 1:22–26. “Since the power supply voltage variations are likely to be nonsynchronous with the video scan rate, the net result is flickers that can be observed on the display panel and are objectionable to the viewer.” *Id.* at 1:29–32. In addition, “[t]he direct relationship between the drive current and the power supply voltage renders AMOLED displays extremely sensitive to power supply voltage noise,” so “the brightness level of an AMOLED display will tend to drift with power supply voltage variations.” *Id.* at 1:32–39. “The power supply voltage VDD . . . will have variations due to voltage glitches, noise or drifts.” *Id.* at 2:38–41. Thus, variations in the current driver voltage “due to the power supply voltage noise and drifts result in variations of the brightness level of the display,

negatively impacting the display quality of the AMOLED display panel.”

Id. at 2:67–3:4.

Accordingly, the ’521 patent describes

a video driver for an AMOLED display system [that] generates a video drive signal that is referenced to the positive power supply voltage of the display panel. When the video drive signal is re-referenced to the positive power supply voltage, instead of to the ground voltage as in the conventional systems, the current driver in the AMOLED display panel will generate a drive current that is indicative of the video signal but independent of the power supply voltage. In this manner, the AMOLED display system is thus made to be immune to power supply voltage variations and provides display images that are free from undesired flickers and brightness variations.

Id. at 3:56–67.

Figure 1, reproduced below, is a schematic diagram of an exemplary AMOLED display system in the prior art, i.e., in a conventional system.

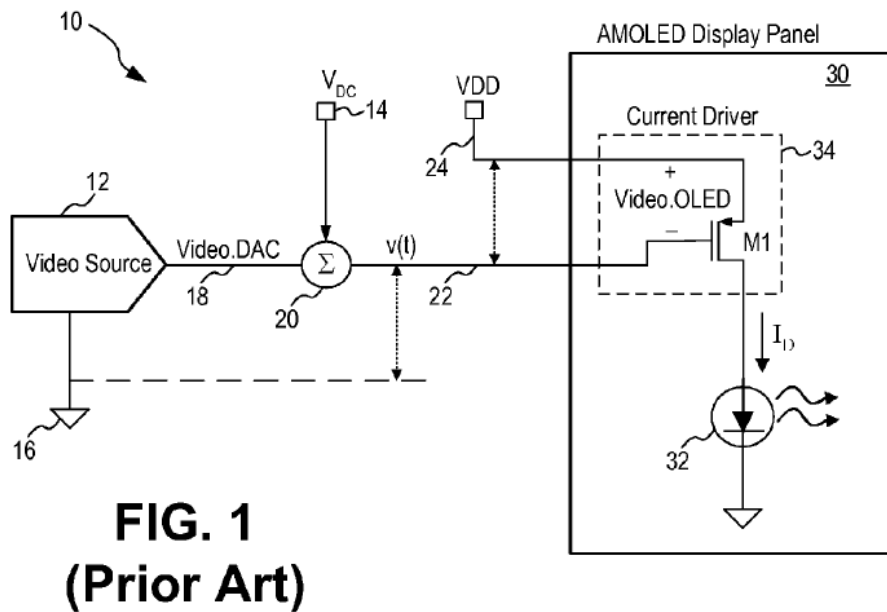


Figure 1, above, depicts video source **12** providing video signals to AMOLED display panel **30** for display. Ex. 1001, 1:57–59. Video source **12** converts digital video signals to analog signals Video.DAC on output bus **18**. *Id.* at 1:64–65. “Video.DAC is summed with a DC voltage V_{DC} (node **14**) at a summer **20** to generate the video drive signal $v(t)$ for driving the AMOLED display panel.” *Id.* at 1:65–2:1. In this system, “video drive signal $v(t)$ is a signal that is referenced to the ground voltage (node **16**) and has a voltage value given as $v(t) = \text{Video.DAC} + V_{DC}$.” *Id.* at 2:2–6. V_{DC} “is related to the power supply voltage VDD .” *Id.* at 2:7–8. “Video.DAC is referenced to ground and the V_{DC} voltage level is added to offset the video signal to the power supply voltage VDD .” *Id.* at 2:11–14.

“At the AMOLED display panel **30**, the video drive signal $v(t)$ is coupled to drive a current driver **34** for providing a drive current I_D to an OLED **32**.” *Id.* at 2:15–17. “[T]he current driver **34** is referenced to the

positive power supply voltage VDD (node **24**) of the display system **10**.” *Id.* at 2:21–23. Here, “current driver **34** includes a PMOS transistor M1 having it’s [sic] drain terminal connected to the VDD power supply voltage (node **24**) and it’s [sic] gate terminal connected to receive the video drive signal $v(t)$.” *Id.* at 2:23–27. “The source terminal of transistor M1 is coupled to the OLED **32** to provide the drive current I_D .” *Id.* at 2:27–28. “The drive current I_D is a function of a voltage Video.OLED across the drain-to-gate terminals of PMOS transistor M1.” *Id.* at 2:28–30. “Current driver voltage Video.OLED is the voltage applied to the current driver **34** and determines the value of drive current I_D to be applied to the OLED pixel element of the display panel.” *Id.* at 2:32–34. The ’521 patent explains that “[v]oltage Video.OLED is referenced to the power supply voltage VDD and is given as: $\text{Video.OLED} = VDD - v(t)$.” *Id.* at 2:34–37.

According to the ’521 patent, the power supply voltage VDD “will have variations due to voltage glitches, noise[,] or drifts . . . [and] can be characterized as the sum of an ideal power supply voltage $VDDI$ and drift and noise components given as $VDD = VDDI + V_{drift} + V_{noise}$.” *Id.* at 2:38–45. Substituting $v(t)$ and VDD from the equations above, the current drive voltage signal Video.OLED is given as $\text{Video.OLED} = V_{drift} + V_{noise} - \text{Video.DAC}$. *Id.* at 2:47–60. Therefore, “the noise and drift components of the power supply voltage VDD appear directly in the current driver voltage signal Video.OLED which determines the drive current I_D for the OLED pixel element . . . result[ing] in variations of the brightness level of the display, negatively impacting the display quality of the AMOLED display panel.” *Id.* at 2:63–3:4.

122) providing the video drive signal $v(t)$.” *Id.* at 4:37–41. “The positive input terminal **109** of opamp **104** is coupled to a resistor **107** where the other terminal of resistor **107** is connected to the ground voltage.” *Id.* at 4:41–43. “A resistor **108** is coupled between the positive input terminal **109** of opamp **104** and the power supply voltage VDD (node **124**) of the AMOLED display system **100**.” *Id.* at 4:43–46.

Therefore, “the positive input terminal **109** of opamp **104** is connected through resistor **108** to the power supply voltage VDD instead of the ground voltage so as to realize the re-referencing function of video driver **102**.” *Id.* at 4:56–60. “By connecting the positive input terminal **109** to the power supply voltage VDD, when the power supply voltage varies, the output signal of the instrumentation amplifier circuit, that is, the video drive signal $v(t)$ on node **122**, will vary in such a way as to track the power supply voltage variations.” *Id.* at 4:60–65. “As a result, the video drive signal $v(t)$ becomes the difference between the video signal Video.DAC and the power supply voltage VDD and give as: $v(t) = VDD - Video.DAC$.” *Id.* at 4:65–5:1. Therefore, “[i]nstead of being referenced to the ground voltage, the video drive signal $v(t)$ is now made to be referenced to the power supply voltage VDD.” *Id.* at 5:3–5. Accordingly, “when the video drive signal $v(t)$ is applied to the current driver **34** for the OLED pixel element **32**, the current drive voltage signal Video.OLED at the current driver **34** is given as: $Video.OLED = VDD - v(t)$,” and replacing $v(t)$ with the foregoing equation results in $Video.OLED = Video.DAC$. *Id.* at 5:6–15. The ’521 patent states, “as can be observed from [this equation], the current drive voltage signal Video.OLED is made to be independent of the power supply voltage VDD.

Thus, any noise or DC drifts in the power supply voltage VDD (node **124**) will not disturb the current drive signal Video.OLED and will not affect the brightness of the AMOLED display.” *Id.* at 5:18–23.

Figure 4, reproduced below, is a schematic diagram of a video driver for an AMOLED display system according to a third embodiment.

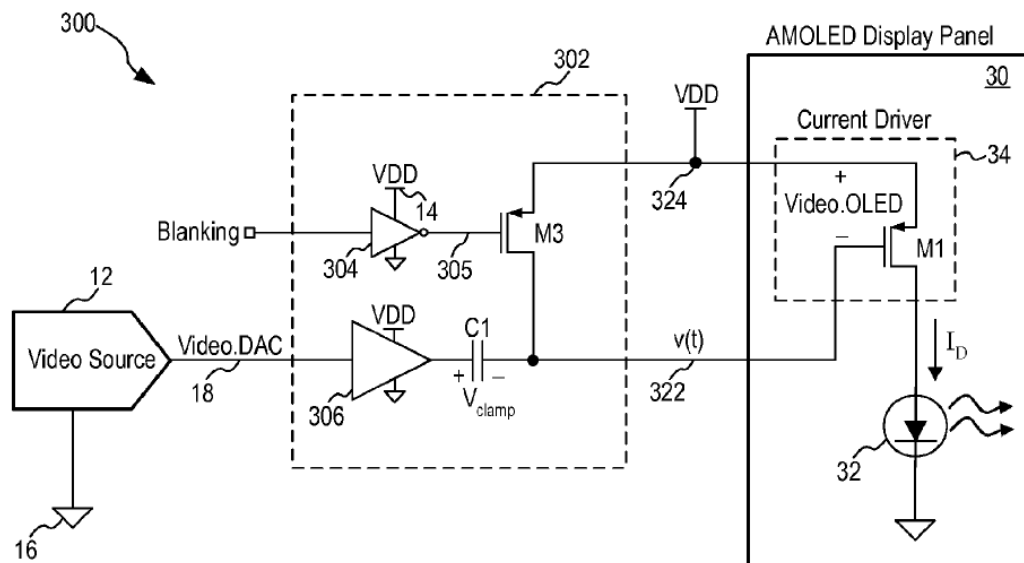


FIG. 4

In the third embodiment depicted above in Figure 4, video driver **302** “is implemented using a video clamp circuit to reference the video drive signal to the power supply voltage VDD.” Ex. 1001, 6:47–50. “The video clamp circuit is implemented using an amplifier **306** coupled to receive the video signal Video.DAC and driving one plate of a capacitor C1.” *Id.* at 6:50–53. “The other plate (node **322**) of capacitor C1 is the video drive signal v(t).” *Id.* at 6:53–54. “Video driver **302** also includes an inverter **304** receiving the video blanking signal and driving a PMOS transistor M3.” *Id.* at 6:54–56. “PMOS transistor M3 has a source terminal connected to the power supply

VDD voltage (node **324**) and a drain terminal connected to the left plate (node **322**) of capacitor C1 providing the video drive signal $v(t)$.” *Id.* at 6:56–60. In this configuration, power supply voltage VDD, including any voltage drift, is stored on capacitor C1 as the clamping voltage V_{clamp} . *Id.* at 6:65–67. “[T]he video signal Video.DAC is applied through amplifier **306** and is added to the clamping voltage V_{clamp} ,” which results in the video drive signal $v(t)$ being referenced to the power supply voltage. *Id.* at 7:1–8. In this configuration, “voltage drifts in the power supply voltage VDD are removed from the current drive signal Video.OLED but noise in the power supply voltage may remain to impact the current drive voltage Video.OLED.” *Id.* at 7:46–51.

D. Illustrative Claim

Independent claim 1 is reproduced below, with Petitioner’s identifiers in brackets.

[1-PRE] An active matrix organic light emitting diode (AMOLED) display system comprising an AMOLED display panel receiving a video signal to be displayed on the AMOLED display panel, the AMOLED display panel comprising a plurality of organic light emitting diode (OLED) pixel elements, the AMOLED display system comprising:

[1-A] a video driver receiving the video signal and generating a video drive signal indicative of the video signal and referenced to a positive power supply voltage of the AMOLED display panel; and

[1-B] a current driver coupled to at least one OLED pixel element, the current driver receiving the video drive signal and the positive power supply voltage and providing a drive current to the at least one OLED pixel element, [1-C] the drive current being proportional to a current drive voltage being indicative of the video signal and independent of the positive power supply voltage.

Ex. 1001, 8:47–64.

E. Prior Art and Asserted Challenges to Patentability

Petitioner asserts that claims 1–5 and 7 are unpatentable on the following challenges (Pet. 6):

Claims Challenged	35 U.S.C. §¹	Basis/References
1, 2, 7	102	Kim ²
1, 2, 7	103(a)	Kim ³
1, 2	102	Hayafuji ⁴
1–3, 5	103(a)	Hayafuji
1–4	103(a)	Steer ⁵

¹ Because the '521 patent issued from a patent application that was filed before March 16, 2013, patentability is governed by the versions of 35 U.S.C. §§ 102 and 103 preceding the Leahy-Smith America Invents Act (“AIA”), Pub L. No. 112–29, 125 Stat. 284 (2011).

² Kim et al., US 2005/0140600 A1, published June 30, 2005 (Ex. 1007). Petitioner contends Kim is prior art under at least 35 U.S.C. § 102(b). Pet. 16.

³ In the obviousness grounds, Petitioner separately references the knowledge of a person of ordinary skill in the art. Pet. 6. When analyzing whether claims would have been obvious and whether it would have been obvious to modify prior art, it is always from the perspective of an ordinarily skilled artisan and one must consider knowledge generally available to one of ordinary skill in the art. *See KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 418 (2007) (one considers “the background knowledge possessed by a person having ordinary skill in the art”). The knowledge of a person of ordinary skill in the art is, therefore, always a consideration and is not a separate basis in an obviousness challenge.

⁴ Hayafuji, US 2005/0190128 A1, published Sept. 1, 2005 (Ex. 1006). Petitioner contends Hayafuji is prior art under at least 35 U.S.C. §§ 102(a) and (e). Pet. 15.

⁵ Steer, WO 2004/034365 A1, published Apr. 22, 2004 (Ex. 1008). Petitioner contends Steer is prior art under at least 35 U.S.C. § 102(b). Pet. 17.

In support of its proposed challenges, Petitioner relies on the Declaration of Alex Z. Kattamis, Ph.D. *See* Ex. 1002. Patent Owner relies on the Declaration of Thomas L. Credelle in response. *See* Ex. 2001.

III. ANALYSIS

A. *Legal Standards*

A claim is unpatentable under 35 U.S.C. § 103(a) if “the differences between the subject matter sought to be patented 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 to which said subject matter pertains.” *KSR*, 550 U.S. at 406. The question of obviousness is resolved on the basis of underlying factual determinations, including (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of skill in the art; and (4) objective evidence of nonobviousness, i.e., secondary considerations. *See Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

“In an [*inter partes* review], the petitioner has the burden from the onset to show with particularity why the patent it challenges is unpatentable.” *Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016) (citing 35 U.S.C. § 312(a)(3)); *see also Intelligent Bio-Sys.*, 821 F.3d at 1369. At this preliminary stage, we determine whether the information presented in the Petition shows there is a reasonable likelihood that Petitioner would prevail in establishing that at least one of the challenged claims would have been obvious.

B. Level of Ordinary Skill in the Art

Petitioner asserts a person of ordinary skill in the art “would have [had] a B.S. in Electrical Engineering or equivalent field, with 3–5 years of academic or industry experience in OLED display engineering or comparable industry.” Pet. 12 (citing Ex. 1002 ¶¶ 44–45). Petitioner further asserts that “[a]dditional education could compensate for less practical experience and vice versa.” *Id.*

At this stage of the proceeding, Patent Owner does not dispute the level of ordinary skill in the art, and “applies Petitioner’s definition.” Prelim. Resp. 12.

We find Petitioner’s proposal is consistent with the level of ordinary skill in the art reflected by the prior art of record, and, therefore, adopt Petitioner’s proposed level of ordinary skill in the art for purposes of this Decision.

C. Claim Construction

Petitioner contends that two terms require construction, and interprets any other terms according to their plain and ordinary meaning. Pet. 12.

1. Petitioner’s Contentions

a) “referenced to”

Claim 1 recites, *inter alia*, “generating a video drive signal indicative of the video signal and *referenced to* a positive power supply voltage of the AMOLED display panel.” Ex. 1001, 8:53–55 (emphasis added). Petitioner contends that “*referenced to*” is not defined in the ’521 patent, but the Specification describes several different relationships where a signal may be “*referenced to*” a voltage. Pet. 12. For example, Petitioner contends that, in

accordance with the intrinsic record, a person of ordinary skill in the art would understand “*referenced to*” to include a direct connection between a component and a voltage signal, an indirect connection between multiple voltage signals, a voltage differential’s minuend value, and a driver functionality. *Id.* at 12–13 (citing Ex. 1001, 2:1–14, 2:20–23, 2:34–37, 3:55–58, 4:55–56, 5:63–65).

b) “independent of the . . . power supply voltage”

Claim 1 recites, *inter alia*, “the drive current being proportional to a current drive voltage being indicative of the video signal and *independent of the positive power supply voltage*.” Ex. 1001, 8:61–64 (emphasis added). Petitioner contends that, consistent with the Specification, a person of ordinary skill in the art would understand this to mean that “noise or DC drifts in the power supply voltage . . . will not disturb the current drive signal . . . and will not affect the brightness” of the display and, “[v]ariations in the power supply voltage VDD will no longer adversely affect the” display. Pet. 13–14 (citing Ex. 1001, 6:6–7, 5:18–23, 2:63–65, Fig. 2; Ex. 1002 ¶¶ 48, 49).

2. Patent Owner’s Contentions

Patent Owner states that “Patent Owner agrees with Petitioner that the terms of the Challenged Claims should be given their plain and ordinary meaning.” Prelim. Resp. 12. Aside from that, Patent Owner does not explicitly respond to Petitioner’s contentions.⁶

⁶ We note that in connection with limitation 1-C of the Kim grounds, Patent Owner states that “[i]n the context of the ’521 patent, the drive current is independent of the positive power supply voltage if the power supply

3. *Analysis*

At this stage of the proceeding, only terms that are in controversy need to be construed, and then only to the extent necessary to determine whether to institute *inter partes* review. *See Realtime Data, LLC v. Iancu*, 912 F.3d 1368, 1375 (Fed. Cir. 2019) (“The Board is required to construe ‘only those terms . . . that are in controversy, and only to the extent necessary to resolve the controversy.’” (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999))). After reviewing the parties’ arguments and evidence, and on this record, we do not observe a dispute over the meanings of these terms. Accordingly, we determine that we do not need to expressly construe any term for purposes of this Decision.

D. Grounds 1 and 2: Alleged Anticipation or Obviousness Over Kim

Petitioner contends claims 1, 2, and 7 were anticipated by or would have been obvious in view of Kim. Pet. 19–45. Patent Owner disputes Petitioner’s contentions. Prelim. Resp. 24–44. Having considered the arguments and evidence before us, we find that the record establishes a

voltage is not a factor in calculating the drive current and at least unwanted voltage drift is removed from the current drive voltage,” and that in connection with limitation 1-A of the Hayafuji grounds, Patent Owner states that “[i]n the context of the ‘521 patent, a video drive signal is referenced to the positive power supply when the positive power supply is used as a baseline to measure the voltage.” Prelim. Resp. 41, 46 (citing Ex. 1001, 5:6–15, 6:20–29, 7:36–43; Ex. 2001 ¶ 104); *see also* Prelim. Resp. 48 (similar statement in connection with limitation 1-C of the Hayafuji grounds), 58 (similar statement in connection with limitation 1-A of the Steer ground). We interpret these statements as Patent Owner’s position on the plain and ordinary meaning of these terms. If there is a dispute over the plain and ordinary meaning of these terms, the parties should address those issues during trial.

reasonable likelihood that Petitioner would prevail on at least one claim in these asserted grounds of unpatentability. However, we recognize that the issues in dispute are fact-intensive and implicate issues of fact more appropriately resolved on a fully developed record at trial.

1. *Kim (Ex. 1007)*

Kim is titled “Light Emitting Display, Display Panel, and Driving Method Thereof” and is generally directed to an organic EL element (OLED) display, where “a current that flows to the OLED of a pixel circuit in a light emitting display is substantially prevented from being influenced by a power supply voltage.” Ex. 1007, code (54), ¶¶ 7, 14.

Figure 3 of Kim, reproduced below, shows an organic EL (electroluminescent) display.

FIG.3

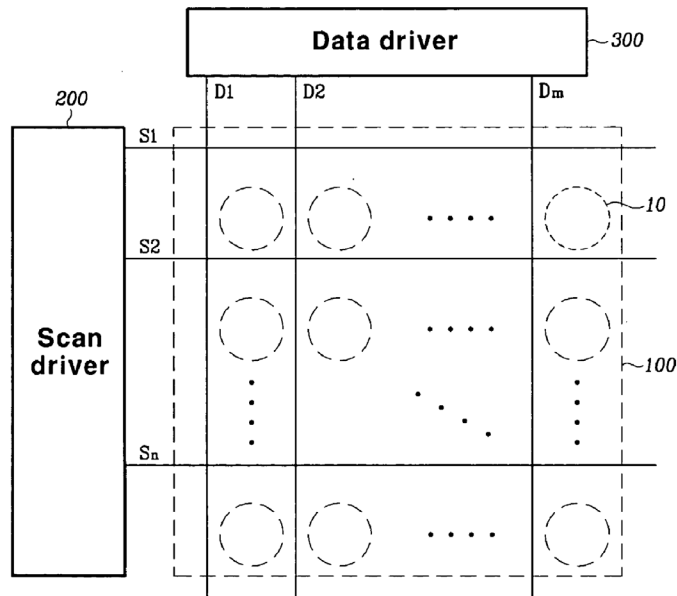


Figure 3, above, depicts an organic EL display with organic EL display panel **100**, scan driver **200**, and data driver **300**. Ex. 1007 ¶ 45. Display

panel **100** “includes a plurality of data lines D_1 through D_m each extending in a column direction, a plurality of scan lines S_1 through S_n , each extending in a row direction, and a plurality of pixel circuits **10**.” *Id.* ¶46. The data lines transmit voltages that correspond to video signals to the pixel circuits, and the scan lines transmit select signals for selecting the pixel circuits. *Id.* Scan driver **200** sequentially applies select signals to the scan lines, and data driver **300** applies the data voltage that corresponds to video signals to the data lines. *Id.* ¶47.

Figure 10, reproduced below, shows a pixel circuit according to a fourth embodiment.

FIG.10

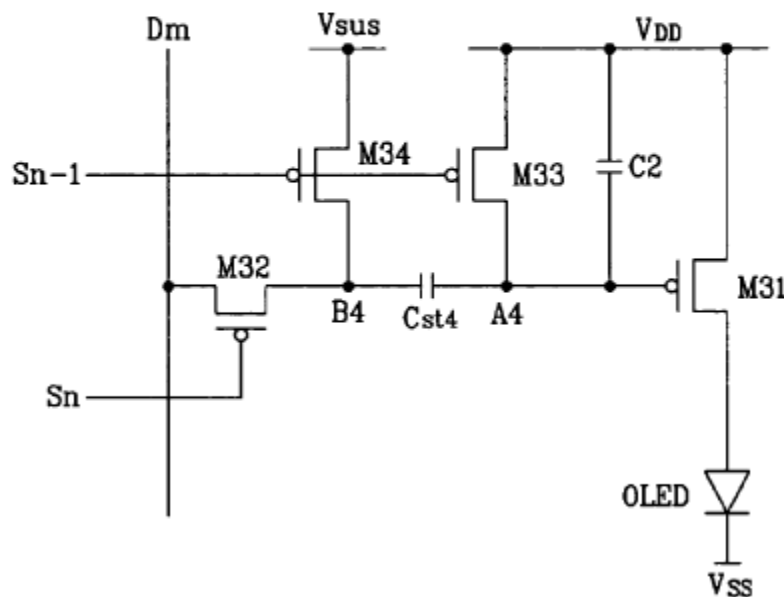


Figure 10, above, shows a pixel circuit with “transistors **M31**, **M32** and a capacitor C_{st4} are connected together in substantially the same relationship as

the transistors **M1**, **M2** and the capacitor C_{st1} of **FIG. 6A**.”⁷ Ex. 1007 ¶ 105. Figure 10 also includes electrodes **A4** and **B4**, where electrode **A4** is coupled to the gate of transistor **M31**, and electrode **B4** is coupled to the drain of transistor **M32**. *Id.* ¶¶ 57, 105. Transistor **M33** is coupled between power supply voltage V_{DD} and electrode **A4**. *Id.* ¶¶ 58, 105. Transistor **M34** is coupled between a compensation voltage V_{SUS} and electrode **B4**. *Id.* ¶¶ 59, 105. The pixel circuit in Figure 10 further includes capacitor **C2** coupled between power supply voltage V_{DD} and a gate of the driving transistor **M31**. *Id.* ¶ 105.

The operation of the pixel circuit in Figure 10 is described as follows:

When the select signal from the previous scan line S_{n-1} becomes low level, the transistors **M33** and **M34** are turned on, the power supply voltage V_{DD} is applied to the first electrode **A4** of the capacitor C_{st4} , and the compensation voltage V_{SUS} is applied to the second electrode **B4** thereof.

Id. ¶ 107.

Next, the select signal from the present scan line S_n , becomes low level, and the transistor **M32** is turned on. Therefore, the

⁷ In connection with Figure 6A, Kim describes a pixel circuit that includes transistors **M1** and **M2** that are P-type transistors, and voltage compensator 11. Ex. 1007 ¶ 51. “[T]ransistor **M1** is a driving transistor for controlling the current that flows to the OLED, and it has a source coupled to the power supply voltage V_{DD} , and a drain coupled to an anode of the OLED.” *Id.* ¶ 52. “A cathode of the OLED is coupled to a reference voltage V_{SS} and emits light that corresponds to the current applied from the transistor **M1**.” *Id.* “The reference voltage V_{SS} is a voltage lower than the power supply voltage V_{DD} .” *Id.* “By way of example, the ground voltage can be used as the reference voltage V_{SS} .” *Id.*

voltage of the second electrode **B4** of the capacitor C_{st4} is changed to the data voltage, and the voltage of the first electrode **A4** of the capacitor C_{st4} is changed by a voltage variation of the second electrode **B4** of the capacitor C_{st4} . The voltage of the first electrode **A4** of the capacitor C_{st4} is given as Equation 11.

Id. ¶ 108.

Equation 11 is:

$$V_{A4} = V_{DD} + \Delta V_{B4} = V_{DD} + V_{DATA} - V_{SUS}$$

Id. ¶ 109. Kim states “[t]herefore, the power supply voltage V_{DD} and the voltage of the first electrode **A4** of the capacitor C_{st4} are applied to both electrodes of the capacitor **C2**, and the capacitor **C2** is charged.” *Id.* ¶ 110.

The voltage charged in capacitor **C2** is given in Equation 12:

$$V_{C2} = V_{DD} - (V_{DD} + V_{DATA} - V_{SUS}) = V_{DATA} - V_{SUS}$$

Ex. 1007 ¶¶ 111–112. Kim provides the current flowing to the OLED in Equation 13:

$$\begin{aligned} I_{OLED} &= \beta/2 (V_{GS31} - V_{TH31})^2 \\ &= \beta/2 ((V_{DATA} - V_{SUS}) - V_{TH31})^2 \end{aligned}$$

Id. ¶ 113. Kim states “[a]s can be seen from Equation 13, the current flowing to the OLED is substantially not influenced by the power supply voltage V_{DD} .” *Id.* ¶ 114.

2. Analysis of Independent Claim 1

Petitioner contends that Kim teaches each limitation of independent claim 1. Pet. 19–45. In support, Petitioner identifies certain passages and figures in the references and explains their significance with respect to the corresponding claim limitation. *Id.*

- a) *[1-Pre]: An active matrix organic light emitting diode (AMOLED) display system comprising an AMOLED display panel receiving a video signal to be displayed on the AMOLED display panel, the AMOLED display panel comprising a plurality of organic light emitting diode (OLED) pixel elements, the AMOLED display system comprising:*

Petitioner contends that Kim “discloses ‘a light emitting **display** and a driving method’ for ‘an organic EL (electroluminescent) display’ consisting of multiple pixel circuits ‘for driving an organic EL element (**OLED**)’ and which can use an ‘**active matrix**’ method.” Pet. 19–20 (citing Ex. 1007 ¶¶ 5–7). Petitioner relies on Figure 3 of Kim and its corresponding description, including organic EL display panel **100** and pixel circuits **10**, to contend that Kim’s “data voltage from the data line D_m” teaches the claimed “*video signal to be displayed on the AMOLED display panel.*” Pet. 20–21. Petitioner contends that, if not anticipated, a person of ordinary skill in the art “would find it obvious that the Kim system could receive a video signal, and use that signal as the source for the ‘video signals’ explicitly discussed in Kim.” *Id.* at 21 (citing Ex. 1002 ¶¶ 93–104).

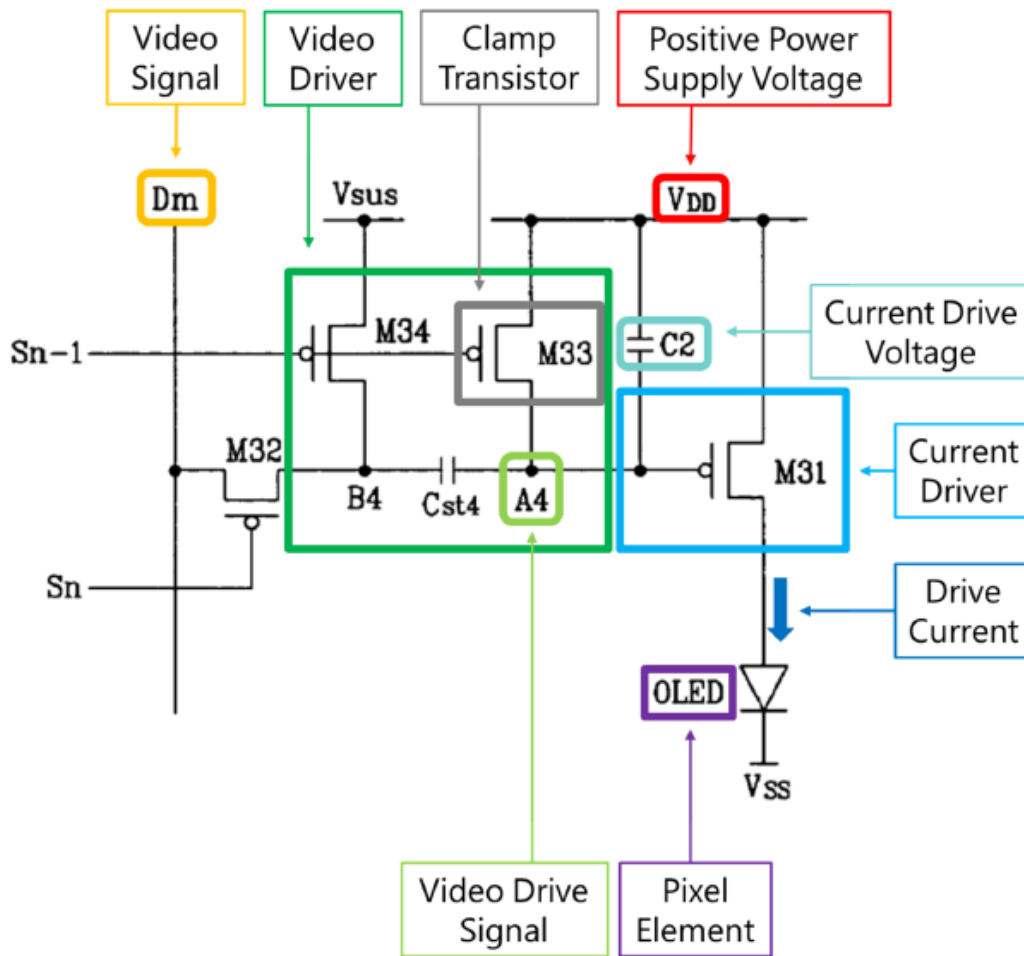
Petitioner’s analysis is primarily directed to Kim’s fourth embodiment corresponding to Figure 10, and Petitioner asserts that “the concepts and discussions of Figures 1–6A are generally pertinent to the fourth embodiment.” Pet. 22. However, Petitioner asserts, “[t]o the extent these disclosures are found to be distinct embodiments, it would be obvious to combine these disclosures in view of Kim’s teachings and suggestions, which provide motivation to use the disclosures together in implementing variations of Kim’s teachings.” *Id.* at 23 (citing Ex. 1002 ¶¶ 105–106).

At this stage, Patent Owner does not dispute Petitioner's contentions. *See Prelim. Resp.* Based on our review and consideration of the current record, we determine that Petitioner has sufficiently shown that Kim teaches the recited elements for purposes of institution, whether under anticipation or obviousness.⁸

- b) [1-A] a video driver receiving the video signal and generating a video drive signal indicative of the video signal and referenced to a positive power supply voltage of the AMOLED display panel;*

Petitioner contends that Kim's fourth embodiment discloses the claimed **video driver** in a similar way as the '521 patent's third embodiment, depicted in Figure 4. Pet. 25–27. Specifically, and referring to circuitry in Kim's Figure 10, Petitioner contends that Kim's capacitor C_{st4} and transistor M33 correspond to capacitor C1 and transistor M3 in the '521 patent. *Id.* at 27. Petitioner provides an annotated version of Kim's Figure 10, reproduced below, depicting in various colors where Petitioner contends Kim discloses the claim elements.

⁸ Petitioner does not argue that the preamble limits claim 1. Although we find that the evidence supports that the prior art teaches the preamble, we make no determination at this stage of the proceeding whether the preamble of claim 1 is limiting.



Ex.[1007], Fig. 10 (annotated).

Pet. 28. Petitioner’s annotated Figure 10, above, identifies in dark green, circuitry including C_{st4} , A4, B4, M33 and M34 as the recited “video driver.” Petitioner also identifies D_m as the “video signal” in yellow; A4 as the “video drive signal” in light green; V_{DD} as the “positive power supply voltage” in red; C2 as the “current drive voltage” in light blue; circuitry including “M31” as the current driver in dark blue; and OLED as the “pixel element” in purple. Petitioner states that a person of ordinary skill in the art “would recognize or find obvious that ‘data voltage from the data line D_m ’

corresponds to the relevant portion of the claimed **video signal**.” *Id.* (citing Ex. 1007 ¶¶ 9, 62; Ex. 1002 ¶ 110).⁹

Petitioner further contends that, similar to the ’521 patent’s third embodiment, Kim’s “fourth embodiment similarly discloses voltage at node **A4** being supplied to the gate of transistor **M31** driving the organic light emitting diode **OLED** by the video driver circuitry including Capacitor **C_{st4}** and clamp transistor **M33**.” Petitioner states that a person of ordinary skill in the art “would thus recognize that *Kim*’s ‘voltage of the first electrode **A4**’ corresponds to the claimed **generated video drive signal**.” *Id.* at 29 (citing Ex. 1002 ¶¶ 111–113).

Petitioner also relies on Kim’s Equation 11:

$$V_{A4} = V_{DD} + \Delta V_{B4} = V_{DD} + V_{DATA} - V_{SUS}$$

Pet. 29. Petitioner asserts that a person of ordinary skill in the art would recognize from Equation 11 that Kim “discloses a **video drive signal** (voltage of the first electrode **V_{A4}**) indicative of the video signal (voltage **V_{DATA}**) because voltage **V_{A4}** explicitly depends on data voltage **V_{DATA}**.” *Id.* (citing Ex. 1007 ¶¶ 108, 109; Ex. 1002 ¶¶ 111–113).

Petitioner contends that **V_{A4}** is referenced to positive power supply voltage **V_{DD}** based upon Kim’s disclosure that “[w]hen . . . the transistors **M33** and **M34** are turned on, the power supply voltage **V_{DD}** is applied to the first electrode **A4** of the capacitor **C_{st4}**,” as well as Equation 11, in which

⁹ Petitioner contends that a person of ordinary skill in the art would understand “the ‘data voltage **V_{DATA}**’ transmitted along ‘data line **D_m**’ is the relevant portion of the claimed **video signal** destined for the addressed pixel.” Pet. 21 n.4 (citing Ex. 1002 n.1).

V_{A4} is a function of power supply voltage V_{DD} . Pet. 30 (citing Ex. 1007, Fig. 10, ¶¶ 107, 109; Ex. 1002 ¶¶ 114–117).

Petitioner concludes that, consistent with annotated Figure 10, a person of ordinary skill in the art would recognize that Kim “discloses *a video driver* (circuitry in green Video Driver annotation including Capacitor C_{st4} and clamp transistor **M33**) *receiving the video signal* (voltage V_{DATA}) *and generating a video drive signal* (voltage of the first electrode V_{A4}) *indicative of the video signal* (voltage V_{DATA}) *and referenced to a positive power supply voltage* (PPS voltage V_{DD}) *of the AMOLED display panel.*” Pet. 30–31 (citing Ex. 1007, Fig. 10; Ex. 1002 ¶¶ 107–117).

Patent Owner argues that Kim does not teach a video driver as claimed. Prelim. Resp. 25–40. First, Patent Owner argues that Kim’s alleged video driver (i.e., the circuitry in green in Petitioner’s annotated Figure 10) is part of the display panel, even though it is required to be a distinct component. *Id.* at 25. According to Patent Owner, the ’521 patent “states that the invention is for a video driver that functions to isolate the pixel circuit from power supply variations.” *Id.* (citing Ex. 1001, 1:5–10). Therefore, Patent Owner argues, “the claimed video driver of the ’521 patent is necessarily separate and distinct from the pixel circuit, which is consistent with the general usage of these terms in the field.” *Id.* (citing Ex. 2001 ¶ 71). Patent Owner further contends that “each of the ’521 patent’s embodiments disclose a system with a video driver distinct from the AMOLED display panel and its pixel circuits.” *Id.* at 32–33 (citing Ex. 1001, Figs. 2–4). Moreover, Patent Owner argues, “the ’521 patent

claims the ‘video driver’ and ‘display panel’ as separate and distinct elements.” *Id.* at 34–35.

Patent Owner argues Kim’s Figure 10 discloses a “pixel circuit,” and Petitioner is identifying a portion of a “pixel circuit” rather than a “video driver,” and therefore, improperly conflating the “pixel circuit” and “video driver.” Prelim. Resp. 26. According to Patent Owner, Kim’s “pixel circuit” is part of the display panel, which “is consistent with the common understanding in the art that pixel circuits are part of AMOLED displays.” *Id.* at 31–32 (citing Ex. 1007 ¶¶ 18–21, 46; Ex. 2001 ¶ 78). Therefore, argues Patent Owner, “Ppetitioner’s allegation that part of the ‘display panel’ (i.e., a portion of a ‘pixel circuit’) is the ‘video driver’ in the challenged claims is contrary to the plain language of the claims and Federal Circuit precedent, which both require the ‘video driver’ and ‘display panel’ to be separate and distinct structures.” *Id.* at 35–36.

In Reply, Petitioner argues that Patent Owner’s contention that the “video driver” must be separate and distinct is expressly contradicted by the Specification of the ’521 patent. Prelim. Reply 1. First, Petitioner contends that the Specification refers to electrical isolation, not physical isolation. *Id.* Second, Petitioner contends that the Specification expressly states that “[t]he embodiments in FIGS. 2-4 are illustrative only and are ***not intended to require the video driver to be formed outside of the AMOLED display panel.***” *Id.* at 2 (citing Ex. 1001, 7:62–66). Third, regarding the claim language, Petitioner contends that claim 1 recites “the AMOLED display system comprising . . . a video driver . . . **and a current driver,**” but the current driver is not separate and distinct from the display panel according to

Patent Owner’s own annotated figures. *Id.* at 1–2 (citing Prelim. Resp. 33–34).

In Sur-reply, Patent Owner argues that Kim’s approach “is to attempt to mitigate power supply voltage variations *within* the pixel circuit,” whereas the approach of the ’521 patent is to re-reference “the video signal in the video driver *before* it reaches the pixel circuit.” Prelim. Sur-reply 1 (citing Prelim. Resp. 14–17, 5–31; Ex. 1001, Figs. 2–4, 1:6–9, 3:8–21) (first emphasis added). Patent Owner further argues that the “video driver being distinct from the pixel circuit is consistent with the current driver being part of the display’s pixel circuit” because the “video driver provides a video drive signal to the current driver in the display’s pixel circuit.” *Id.* at 1–2 (citing Ex. 1001, 1:6–9, 4:17–25). Patent Owner argues that “the current driver is distinct from the OLED pixel element.” *Id.* at 2 (citing Ex. 1001, Fig. 2, elements 32, 34). Patent Owner further contends that “even if [the] video driver circuitry is incorporated into the same integrated circuit as the current driver and pixel circuit, the components of the video driver on the chip would be physically and logically distinct from those of the pixel circuit.” *Id.* (citing Ex. 2001 ¶ 54).

On the current record, we agree with Petitioner. Patent Owner essentially presents an issue of claim construction. However, on this record, the Specification of the ’521 patent does not support that the “video driver” and “display panel” must be structurally distinct components. Specifically, the ’521 patent states:

The video driver circuit of the present invention described above with reference to FIGS. 2-4 can be implemented using discrete components. Alternately, the video driver circuit of

the present invention can be implemented as an integrated circuit to be incorporated in the AMOLED display system. Furthermore, the video driver circuit of the present invention can be integrated with other circuitry of the AMOLED display panel into a single integrate[d] circuit. For instance, the video driver of the present invention can be integrated on the same integrated circuit with the current driver and the OLED pixel elements of the AMOLED display panel. *In FIGS. 2-4, the video drivers are shown as being formed outside of the AMOLED display panel 30. The embodiments in FIGS. 2-4 are illustrative only and are not intended to require the video driver to be formed outside of the AMOLED display panel. The video driver of the present invention can be integrated with the AMOLED display panel when desired to reduce the component count and size of the PC board space used.*

Ex. 1001, 7:52–8:2 (emphasis added). This disclosure indicates that the video driver need not be a separate and distinct component from the display panel. Moreover, although the “display panel” and “video driver” are separately claimed, we are not persuaded, on this record, and in light of the disclosure set forth above, that the “video driver” may not be integrated with the “display panel.” Petitioner has not identified the “video driver” and “display panel” as the *same* components. Petitioner identifies Kim’s organic EL display panel **100**, which includes a plurality of pixel circuits **10**, as the “display panel.” See Pet. 20 (citing Ex. 1007, Fig. 3). Kim’s Figure 10 “*shows a pixel circuit* according to a fourth exemplary embodiment,” and Petitioner identifies circuitry in this pixel circuit including C_{st4}, **A4**, **B4**, **M33** and **M34** as the recited “video driver.” Pet. 26–28; Ex. 1007 ¶ 104. Thus, on this record, the video driver Petitioner identifies in Kim is integrated with EL display panel **100**, as described in the ’521 patent. The parties may wish

to further develop the record as to whether the “video driver” and “display panel” should be construed as structurally distinct elements during trial.

Second, Patent Owner argues that Kim’s alleged video driver does not generate a video drive signal. Prelim. Resp. 27–31. Specifically, Patent Owner contends that “the pixel circuit of Figure 10 lacks the necessary components of a video driver that are responsible for generating a video drive signal.” *Id.* at 27 (citing Ex. 2001 ¶ 73). According to Patent Owner, Kim’s alleged video driver includes only switching transistors **M33** and **M34** and capacitor C_{st4} , which are not capable of generating a video signal. *Id.* (citing Ex. 2001 ¶ 73). Rather, Patent Owner contends, with supporting testimony from Mr. Credelle, that an amplifier, among other components, is used to generate a video drive signal. *Id.* Patent Owner further argues that Kim’s fourth embodiment merely modifies an existing video signal, but does not generate a video signal. *Id.* (citing Ex. 2001 ¶ 74). According to Patent Owner, one of ordinary skill in the art would understand that switching transistors **M33** and **M34** and capacitor C_{st4} , as described in Kim, adjust, but do not generate, the video drive signal. *Id.* at 27–28 (citing Ex. 1007 ¶¶ 107, 108; Fig. 4; Ex. 2001 ¶ 74). Patent Owner asserts that “the only component in Kim that generates a drive signal with video data is data driver 300, as illustrated in Kim’s Figure 3.” *Id.* at 29 (citing Ex. 2001 ¶ 75).

In Reply, Petitioner argues that claim 1 does not recite an “amplifier,” but dependent claims 3, 4, 6, and 8 do recite an “amplifier.” Prelim. Reply 3. According to Petitioner, requiring the “video driver” to include an “amplifier” would render the “amplifier” recited in claims 3, 4, 6, and 8

superfluous. *Id.* Petitioner also contends that the Specification states that an amplifier is not required. *Id.* (citing Ex. 1001, 5:30–36, 6:38–44).

In Sur-reply, Patent Owner argues that dependent claims 3, 4, and 6 “specify exactly *how* an amplifier is configured in the circuit that references the video drive signal to the positive power supply voltage.” Prelim. Sur-reply 2. Patent Owner further argues that a person of ordinary skill in the art would understand that a video driver must include an amplifier, and that every embodiment in the ’521 patent includes an amplifier. *Id.* at 3 (citing Ex. 2001 ¶¶ 28–30, 73; Ex. 1001, Figs. 2–4).

Patent Owner’s arguments may have merit, but are better evaluated on a full record at trial. The claim language recites “a video driver receiving the video signal and generating a video drive signal.” Ex. 1001, 8:53–55. We recognize Mr. Credelle’s testimony that “[w]ithout an amplifier, the alleged video driver is unable to generate the claimed video drive signal,” (Ex. 2001 ¶ 73), but observe that neither Patent Owner nor Mr. Credelle elaborates on what it means to “generate” a video drive signal, and why that excludes “modifying” or “adjusting” the received video signal in some manner. *See, e.g.*, Ex. 1001, 1:65–67 (“[t]he analog video signal Video.DAC is summed with a DC voltage V_{DC} (node **14**) at a summer **20** to generate the video drive signal $v(t)$. . .”); *id.* at 4:9–14 (“[A] video driver **102** is incorporated in an AMOLED display system **100** for receiving input video signals Video.DAC from a video source **12** and *providing a modified video drive signal $v(t)$* for driving the current driver **34** in the AMOLED display panel **30**.”) (emphasis added). Moreover, as Petitioner points out, an “amplifier” is not recited in the language of claim 1, and, on this record, we

decline to read in unclaimed features of embodiments in the '521 patent. *See SuperGuide Corp. v. DirecTV Enterprises, Inc.*, 358 F.3d 870, 875 (Fed. Cir. 2004) (citing *Electro Med. Sys. S.A. v. Cooper Life Sci., Inc.*, 34 F.3d 1048, 1054 (Fed. Cir. 1994)) (“[A] particular embodiment appearing in the written description may not be read into a claim when the claim language is broader than the embodiment.”); *see also Thorner v. Sony Computer Ent. Am. LLC*, 669 F.3d 1362, 1366 (Fed. Cir. 2012) (“It is likewise not enough that the only embodiments, or all of the embodiments, contain a particular limitation. We do not read limitations from the specification into claims; we do not redefine words.”). Again, the parties may wish to further develop the record as to these issues during trial.

Third, Patent Owner argues that Kim’s alleged video driver is not referenced to the power supply voltage. Prelim. Resp. 36–40. Specifically, Patent Owner argues that “due to variations in VDD over time, the value of VDD used to calculate VA4 is not the same value of VDD that is applied to the drive transistor,” so VA4 is not referenced to the positive power supply voltage.” *Id.* at 36 (citing Ex. 1001, 1:32–55; Ex. 2001 ¶ 82). Patent Owner argues that “the positive power supply voltage VDD is not constant with time.” *Id.* at 37 (citing Ex. 2001 ¶ 84). Patent Owner rewrites Kim’s Equations 11 and 12 to reflect this alleged variation in time:

$$VA4 = VDD(t1) + \Delta VB4 = VDD(t1) + V_{DATA} - V_{sus}$$

$$VC2 = VDD(t) - (VDD(t1) + V_{DATA} - V_{sus})$$

Id. at 38 (citing Ex. 2001 ¶ 86). According to Patent Owner, “[t]he value of VA4 is therefore not referenced to the relevant power supply voltage that is applied to the source terminal of drive transistor M31 while current is supplied to the pixel, which is VDD(t),” and “[i]nstead, VA4 is referenced to the value of VDD at earlier time t1, VDD(t1).” *Id.* at 39 (citing Ex. 2001 ¶ 86). Thus, argues Patent Owner, “VA4 is referenced to the value of VDD at earlier time t1, VDD(t1).” *Id.* Patent Owner further contends that Kim’s fourth embodiment is not similar to the third embodiment of the ’521 patent because amplifier 306 receives the power supply voltage VDD, which varies over time like the voltage VDD that is applied to the drive transistor in the pixel circuit. *Id.* (citing Ex. 2001 ¶ 88).

Here, again, Patent Owner’s arguments may have merit, but are better evaluated on a full record at trial. We note that, in connection with the Hayafuji grounds, Patent Owner argues that “[i]n the context of the ’521 patent, a video drive signal is referenced to the positive power supply when the positive power supply is used as a baseline to measure the voltage,” and asserts that “each embodiment of the ’521 patent uses power supply voltage VDD as a baseline to measure the voltage of the video drive signal.” Prelim. Resp. 46.¹⁰ In particular, Patent Owner states that in the third embodiment of the ’521 patent, $v(t) = VDD + \text{Video.DAC}$, depicts using the power supply voltage VDD as a baseline to measure the voltage of the video drive signal. *Id.* As discussed above, Petitioner relies, in part, in Kim’s Equation

¹⁰ We note that this does not appear to be inconsistent with Petitioner’s understanding of the term “referenced to,” set forth above in Section III.C.1.

11 to disclose that the voltage V_{A4} is referenced to power supply voltage V_{DD} :

$$\begin{aligned} V_{A4} &= V_{DD} + \Delta V_{B4} \\ &= V_{DD} + V_{DATA} - V_{SUS} \end{aligned}$$

See Pet. 29. Kim's Equation 11 appears consistent with Patent Owner's description above, and appears to use positive power supply signal V_{DD} as a baseline to measure the voltage.¹¹ This disclosure appears to sufficiently support Petitioner's contention that Kim teaches a video drive signal that is referenced to the positive power supply voltage, even under Patent Owner's own interpretation.

Further, Patent Owner's contentions that the value of V_{DD} used to calculate V_{A4} is not the same value of V_{DD} that is applied to the drive transistor and Patent Owner's modifications of Kim's Equations 11 and 12 to incorporate such alleged variations in time raise factual disputes that are best resolved on a full record at trial.

Based on our review and consideration of the current record, we determine that Petitioner has sufficiently shown that Kim teaches limitation [1-A] for purposes of institution, whether under anticipation or obviousness.

- c) *[1-B] a current driver coupled to at least one OLED pixel element, the current driver receiving the video drive signal and*

¹¹ Petitioner states that Equation 11 shows that " V_{A4} is explicitly a function of power supply voltage V_{DD} ." Pet. 30 (citing Ex. 1007 ¶ 109; Ex. 1002 ¶¶ 114–117). As discussed in footnote 1, if there is a dispute as to the plain and ordinary meaning of "referenced to," the parties should address those issues during trial.

the positive power supply voltage and providing a drive current to the at least one OLED pixel element,

Petitioner contends that Kim “has a current driver (e.g. **M31**) receiving the video drive signal generated at node **A4**, and the driver is coupled to a pixel element (OLED) and power supply (V_{DD}).” Pet. 32. Petitioner contends that a person of ordinary skill in the art “would recognize that *Kim* discloses **a current driver** (circuitry in blue Current Driver annotation including transistor **M31/M1**) ***coupled to at least one OLED pixel element*** (organic light emitting diode **OLED**), ***the current driver receiving the video drive signal*** (voltage of the first electrode V_{A4} or node **A**) ***and the positive power supply voltage*** (V_{DD}).” *Id.* at 33–34 (citing Ex. 1002 ¶¶ 118–125). Petitioner identifies Kim’s transistor current I_{OLED} as the recited “drive current.” *Id.* at 34.

At this stage, Patent Owner does not dispute Petitioner’s contentions. *See* Prelim. Resp. Based on our review and consideration of the current record, we determine that Petitioner has sufficiently shown that Kim teaches limitation [1-B] for purposes of institution.

d) [1-C] the drive current being proportional to a current drive voltage being indicative of the video signal and independent of the positive power supply voltage

Petitioner relies on Kim’s Equations 12 and 13 in support of this limitation. Pet. 35–36. Petitioner asserts that Kim explains that “the voltage charged in the capacitor **C2** is given as Equation 12, and the corresponding current flows to the **OLED**.” *Id.* at 35 (citing Ex. 1007 ¶¶ 111–112).

Equation 12 follows:

$$V_{C2} = V_{DD} - (V_{DD} + V_{DATA} - V_{SUS}) = V_{DATA} - V_{SUS}$$

Ex. 1007 ¶ 112. “The current flowing to the OLED is given as Equation 13”:

$$\begin{aligned} I_{OLED} &= \beta/2(V_{GS31}-V_{TH31}) \\ &= \beta/2((V_{DATA}-V_{SUS})-V_{TH31}) \end{aligned}$$

1007 ¶ 113.

Petitioner contends that “[a]s illustrated in *Kim*’s Figure 10 (annotated), the voltage across the gate and source (V_{GS}) of transistor **M31** that drives organic light emitting diode **OLED** is also the same voltage across capacitor **C2** (i.e., $V_{C2}=V_{GS31}$). Thus, the voltage across capacitor **C2** ($V_{C2}=V_{GS31}$) corresponds to the claimed *current drive voltage*.” Pet. 36. (citing Ex. 1002 ¶¶ 131–138). Therefore, asserts Petitioner, a person of ordinary skill in the art would “recognize that *Kim*’s voltage across the gate and source (V_{GS}) of the transistor **M31** corresponds to the claimed *current drive voltage*, and that *Kim*’s current I_{OLED} corresponds to the claimed *drive current*.” *Id.* (citing Ex. 1002 ¶¶ 131–138). Petitioner again compares *Kim*’s **M31** transistor with the **M1** transistor in the ’521 patent, and asserts that both are P-channel MOSFETS, so a person of ordinary skill in the art would understand that *Kim*’s current I_{OLED} is “proportional” to the gate and source (V_{GS}) in the same manner as it is “proportional” in the ’521 patent. *Id.* at 36 (citing Ex. 1002 ¶¶ 131–138). Petitioner further contends that *Kim* “discloses *the video drive signal* (voltage of the first electrode V_{A4}) being *indicative of the video signal* (voltage V_{DATA}),” so a person of ordinary skill in the art would understand that since V_{GS31} is calculated based on voltage V_{A4} , it must also be “indicative” of voltage V_{DATA} . *Id.* at 37 (citing Ex. 1002 ¶¶ 139–140).

Petitioner contends that Kim's drive current I_{OLED} is independent of the positive power supply voltage (V_{DD}) because Kim states "[a]s can be seen from Equation 13, the current flowing to the OLED is substantially **not influenced** by the power supply voltage V_{DD} ," and a person of ordinary skill in the art would understand that because Kim's drive current is "not influenced" by the positive power supply voltage V_{DD} , it is therefore "independent of" the positive power supply voltage V_{DD} . Pet. 38–39 (citing Ex. 1007 ¶ 114, Fig. 10; Ex. 1002 ¶¶ 141–147).

Patent Owner argues that "the drive current is independent of the positive power supply voltage if the power supply voltage is not a factor in calculating the drive current and at least unwanted voltage drift is removed from the current drive voltage." Prelim. Resp. 41 (citing Ex. 1001, 5:6–15, 6:20–29, 7:36–43).¹² According to Patent Owner, "[d]ue to changes over time of unwanted voltage variations such as noise and drift, these voltage variations are not removed from the current drive voltage in Kim." *Id.* (citing Ex. 2001 ¶ 91). Patent Owner asserts that Kim's "Equation 13 ignores the variations in V_{DD} over time." *Id.* at 43 (citing Ex. 2001 ¶ 96). Patent Owner argues that " V_{DD} includes a constant ideal voltage component as well as undesirable voltage variation components such as noise and drift that vary with time:

¹² We note that this appears consistent with Petitioner's interpretation. *E.g.*, Pet. 38 ("none of the parameters in [Equation 13] are dependent on V_{DD} "), 92 ("Since the first V_{SUPPLY} will be eliminated in equation (4A) via subtraction of the second V_{SUPPLY} , the gate-to-source voltage V_{GS} on drive transistor 22 (i.e., the claimed ***current drive voltage***) is ***independent of the positive power supply voltage*** as shown in equation (4B)."

$$VDD = VDD(t) = V_{DC} + V_{drift}(t) + V_{noise}(t)$$

Id. Patent Owner rewrites Kim's Equation 13 as follows:

$$IOLED = \beta/2 * (V_{GS31} - V_{TH31})^2$$

$$IOLED = \beta/2 * (VDD(t) + V_{DATA} - V_{sus} - VDD(t1) - V_{TH1})^2$$

$$= \beta/2 * (V_{DC} + V_{drift}(t) + V_{noise}(t) + V_{DATA} - V_{sus} - V_{DC} - V_{drift}(t1) - V_{noise}(t1) - V_{TH1})^2$$

$$= \beta/2 * (V_{drift}(t) + V_{noise}(t) + V_{DATA} - V_{sus} - V_{drift}(t1) - V_{noise}(t1) - V_{TH1})^2$$

Id. at 44 (citing Ex. 2001 ¶ 97). Patent Owner argues that “t1 is the time before new data is written and t is the time after data is written and when current is flowing to the OLED (the majority of time).” *Id.* (citing Ex. 2001 ¶ 98). Patent Owner argues that “the differences in undesirable voltage variations between VDD(t1) and VDD(t) do not” cancel out, and the Petition “completely ignores these voltage fluctuations that are present during the period in which current flows to the pixel.” *Id.* Therefore, Patent Owner argues, “the drive current in Kim's Figure 10 is not independent of the power supply voltage.” *Id.*

On this record, we determine that Petitioner has sufficiently shown that Kim teaches limitation [1-C] for purposes of institution. Specifically, we are persuaded by Kim's disclosure that Equation 13 shows that “the current flowing to the OLED is substantially not influenced by the power supply voltage V_{DD} .” Ex. 1007 ¶ 114. On this record, Patent Owner has not persuasively addressed why this disclosure does not support that the drive current is independent of the power supply voltage. As discussed above for limitation [1-A], Patent Owner's contentions as to the variations of VDD

over time and modification of Kim's Equation 13 are best resolved on a full record at trial.

e) Conclusion for Independent Claim 1

Based on our review and consideration of the current record, we determine that Petitioner has adequately shown that Kim describes the limitations in claim 1 for purposes of institution. Accordingly, we determine, on the current record and for purposes of this Decision, that the information presented in the Petition demonstrates a reasonable likelihood that claim 1 is unpatentable under 35 U.S.C. § 102 or § 103(a) over Kim.

3. Dependent Claims 2 and 7

Petitioner contends that dependent claims 2 and 7, which depend from claim 1, were anticipated by or would have been obvious over Kim. Pet. 40–45. In support, Petitioner identifies certain passages and figures in the references and explains their significance with respect to the corresponding claim limitations. *Id.*

Patent Owner does not separately challenge Petitioner's analysis of these claims in its Preliminary Response. *See* Prelim. Resp. Based on our review and consideration of the current record, Petitioner has sufficiently shown that Kim describes the limitations in claims 2 and 7 for purposes of institution. *Id.* We are persuaded that, at this stage, Petitioner demonstrates a reasonable likelihood of prevailing in showing that claims 2 and 7 are unpatentable over the asserted prior art.

4. *Summary of Grounds 1 and 2*

We find that Petitioner has demonstrated a reasonable likelihood that claims 1, 2, and 7 are unpatentable under 35 U.S.C. § 102 or § 103(a) over Kim.

E. Ground 3: Alleged Anticipation by Hayafuji

Petitioner contends claims 1 and 2 were anticipated by Hayafuji. Pet. 45–65. Patent Owner disputes Petitioner’s contentions. Prelim. Resp. 45–52. Because we determine above that Petitioner demonstrated a reasonable likelihood of prevailing in its challenge to at least one claim of the ’521 patent, we institute *inter partes* review on all claims and grounds, including Ground 3. See 37 C.F.R. § 42.108(a) (“When instituting . . . review, the Board will authorize the review to proceed on all of the challenged claims and on all grounds of unpatentability asserted for each claim.”). In this section, therefore, we will provide observations on the parties’ positions where relevant. We note that, as in Grounds 1 and 2, the parties’ arguments raise fact-intensive issues that are best resolved on a complete record.

1. Hayafuji (Ex. 1006)

Hayafuji is titled “Drive Device and Drive Method of Light Emitting Display Panel,” and is generally directed to “a drive device and a drive method of a display panel in which display quality of an image which is caused by a ripple component superimposed onto the drive power source of the light emitting elements can be prevented from deteriorating.” Ex. 1006, code (54), ¶ 2.

Figure 6, reproduced below, shows a first embodiment of a drive device.

FIG. 6

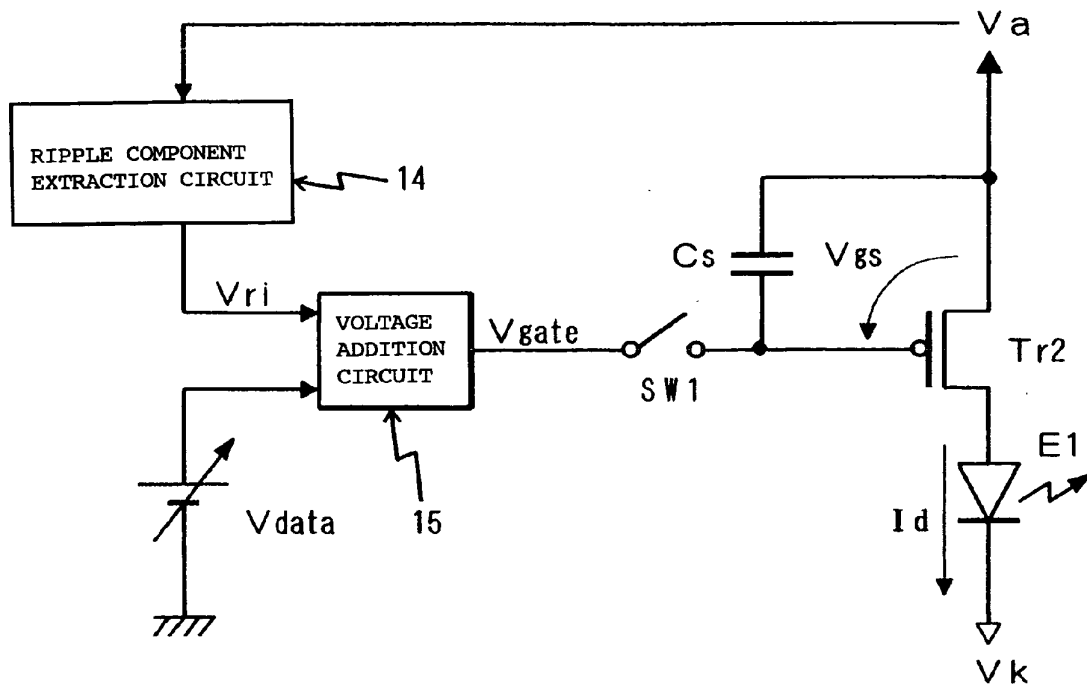
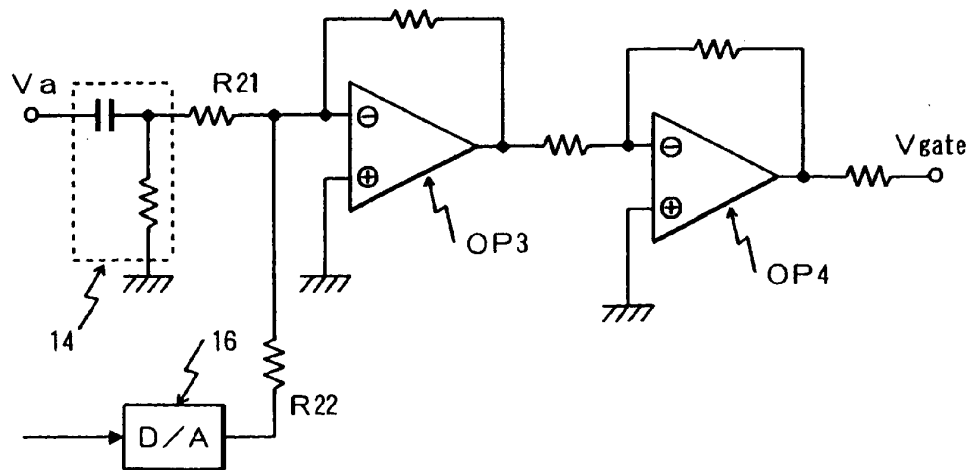


Figure 6, above, depicts ripple component extraction circuit **14** and voltage addition circuit **15**. Ex. 1006 ¶¶ 47–48. “The ripple component extraction circuit **14** extracts a ripple component included in a drive voltage V_a generated by the . . . DC-DC converter, and a ripple component V_{ri} extracted by this ripple component extraction circuit **14** is supplied to one input terminal of the voltage addition circuit **15**.” *Id.* ¶ 48. “The data voltage V_{data} transmitted via . . . data line **B1** is input to the other input terminal of the voltage addition circuit **15**.” *Id.* “[I]n the voltage addition circuit **15**, treating the data voltage V_{data} as a base, the ripple component V_{ri} extracted by the ripple component extraction circuit **14** is added to the base.” *Id.* ¶ 49. “The output thereof as V_{gate} is supplied to a scan selection transistor $Tr1$ represented by reference character $SW1$, and the V_{gate} is

supplied to the gate of a light emission drive transistor Tr2 by the turning on of the transistor Tr1 during the addressing time and is written in a capacitor Cs.” *Id.*

Figure 7, reproduced below, is a connection diagram showing a specific example of the circuits employed in the structure shown in Figure 6.

FIG. 7



In Figure 7 above, “a capacitor and a resistor enclosed by the dashed line constitute a bypass filter, and by this filter, the ripple component extraction circuit **14** extracting the ripple component included in the drive voltage V_a is formed.” *Id.* ¶ 50. “The output thereof is supplied to a negative feedback type voltage buffer circuit constituted by an operational amplifier **OP3** via a resistor **R21**.” *Id.*

2. Analysis of Independent Claim 1

- a) [1-Pre]: An active matrix organic light emitting diode (AMOLED) display system comprising an AMOLED display

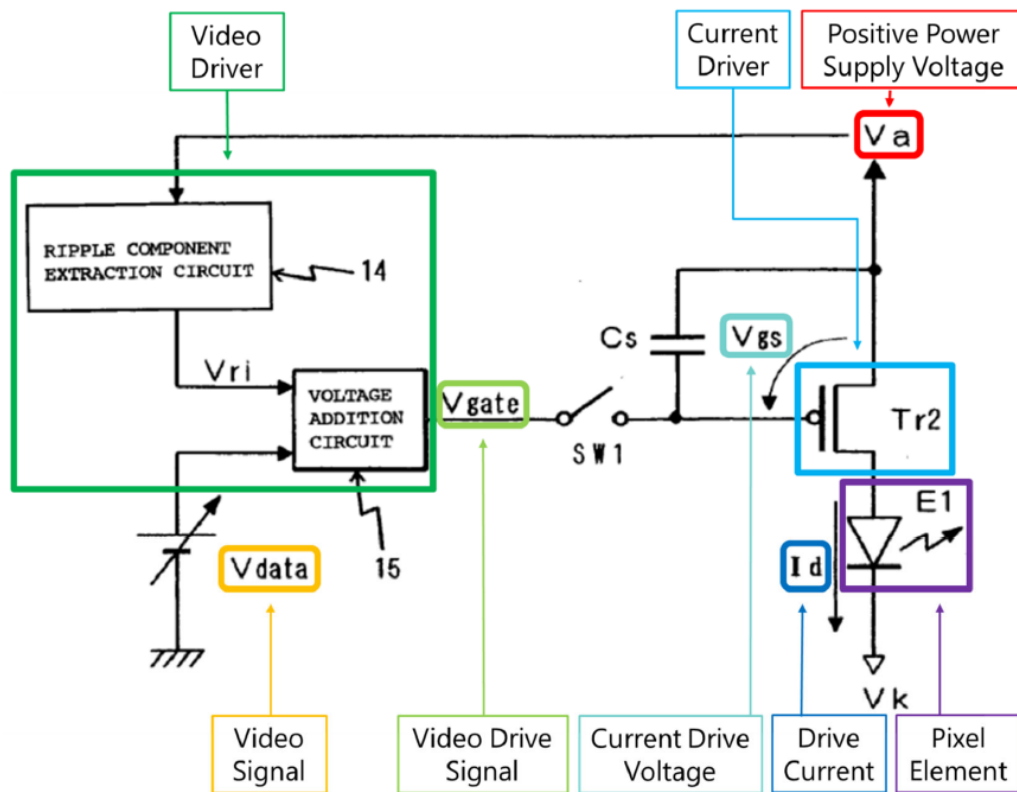
panel receiving a video signal to be displayed on the AMOLED display panel, the AMOLED display panel comprising a plurality of organic light emitting diode (OLED) pixel elements, the AMOLED display system comprising:

Petitioner compares Hayafuji's disclosure to that of the first embodiment of the '521 patent, depicted in Figure 2. Pet. 45. Petitioner contends that Hayafuji discloses "'a display panel constructed by arranging light emitting elements in a matrix pattern,' including 'an organic EL (electroluminescent) element in which an organic material is employed in a light emitting layer.'" *Id.* at 46 (citing Ex. 1006 ¶ 4). Petitioner contends that these organic EL elements, which are depicted as E1 in Figures 2 and 6 of Hayafuji, "'are employed as light emitting elements'" and "'constitut[e] [sic] pixels.'" *Id.* (citing Ex. 1006 ¶¶ 2, 6, 10, 29, 30, 47; Ex. 1002 ¶¶ 162–172). Citing to Hayafuji's Figures 1, 6, and 7, Petitioner contends that Hayafuji's analog signal Vdata that is output from the D/A converter corresponds to the Video.DAC in the '521 patent, i.e., the recited "video signal." Pet. 47–50.

At this stage, Patent Owner does not dispute Petitioner's contentions. See Prelim. Resp.

- b) [1-A] a video driver receiving the video signal and generating a video drive signal indicative of the video signal and referenced to a positive power supply voltage of the AMOLED display panel;*

Petitioner provides an annotated version of Hayafuji's Figure 6 in connection with limitation [1-A], reproduced below:



Ex.[1006], Fig. 6 (annotated).

Petitioner’s annotated Figure 6 of Hayafuji, above, identifies in dark green circuitry including Hayafuji’s ripple component and extraction circuit 14 and voltage addition circuit 15 as the “video driver”; identifies in light green V_{gate} as the “video drive signal”; identifies in yellow V_{data} as the “video signal”; identifies in light blue V_{gs} as the “current drive voltage”; identifies in light blue circuitry including light emission drive transistor **Tr2** as the “current driver”; identifies in dark blue I_d as the “drive current”; identifies in red V_a as the “positive power supply voltage”; and identifies in purple **E1** as the “pixel element.” See Pet. 50–51.

Petitioner contends that a person of ordinary skill in the art would understand that V_a represents the “positive power supply voltage” because

Va is depicted in Figure 1 as the voltage output by the power supply and present on power line P1. *Id.* at 52 (citing Ex. 1006 ¶¶ 17, 18, 21, Fig. 1; Ex. 1002 ¶¶ 173–182).

Petitioner contends that Hayafuji generates a video drive signal (Vgate). Pet. 54. According to Petitioner “because the output of [voltage addition] circuit 15 (V_{gate}) is the sum of (1) the relevant portion of the video signal [(Vdata)] and (2) the ripple component of the supply voltage [(Vri)], V_{gate} is both indicative of the video signal and referenced to the supply voltage.” *Id.* at 54–55 (citing Ex. 1002 ¶¶ 173–182).

Patent Owner argues that Vgate does not disclose the claimed video drive signal because it is not referenced to the positive power supply voltage Va. Prelim. Resp. 45–48. According to Patent Owner, “[i]n Hayafuji, the power supply voltage Va is delivered to a ripple component extraction circuit that extracts *only* the ripple component, Vri, of power supply voltage Va.” *Id.* at 46 (citing Ex. 1006 ¶¶ 48–49, Fig. 6). Patent Owner contends that “[t]he ripple component Vri is then supplied to an addition circuit where it is added to the video signal Vdata to produce Vgate.” *Id.* Patent Owner argues that, “[i]n the context of the ’521 patent, a video drive signal is referenced to the positive power supply when the positive power supply is used as a baseline to measure the voltage.” *Id.* (citing Ex. 2001 ¶ 104). Patent Owner argues that because only the ripple component Vri, not power supply voltage Va, is combined with the video signal Vdata in the addition circuit, the alleged video drive signal Vgate is not referenced to the positive power supply voltage. *Id.* at 47. Patent Owner argues that Vgate is the sum of ripple component Vri and video signal Vdata: $V_{gate} = V_{ri} + V_{data}$, so

power supply voltage V_a does not even appear in the calculation for V_{gate} .
Id. (citing Ex. 1006 ¶ 49).

Patent Owner further argues that Figure 7 of Hayafuji further demonstrates that V_{gate} is not referenced to V_a because the positive input terminal of each operational amplifier (i.e., OP3 and OP4) is connected directly to ground (referenced to ground) rather than to the positive power supply. Prelim. Resp. 47–48 (citing Ex. 2001 ¶ 106).

Hayafuji states that “[t]he ripple component extraction circuit 14 extracts a ripple component included in a drive voltage V_a .” Ex. 1006 ¶ 48. On this record, Patent Owner does not explain why combining the ripple component V_{ri} , which is *included in* power supply voltage V_a with the relevant portion of the video signal V_{data} , is not sufficient to show that the video drive signal V_{gate} is referenced to the power supply voltage V_a . Further, Patent Owner’s arguments as to Figure 7 may have merit, but are better resolved on a full record at trial.

- c) *[1–B] a current driver coupled to at least one OLED pixel element, the current driver receiving the video drive signal and the positive power supply voltage and providing a drive current to the at least one OLED pixel element,*

Relying on annotated Figure 6 of Hayafuji (reproduced above) and the associated description of Figure 6, Petitioner contends that Hayafuji “discloses a current driver (circuitry including light emission drive transistor $Tr2$. . . ***coupled to at least one OLED pixel element*** (organic EL element E1), ***the current driver receiving the video drive signal*** (gate voltage V_{gate}) ***and the positive power supply voltage*** (drive voltage V_a) ***and providing a***

drive current (drain current I_d) ***to the at least one OLED pixel element.***”

Pet. 55–57 (citing Ex. 1006, Fig. 6; Ex. 1002 ¶¶ 183–189).

At this stage, Patent Owner does not dispute Petitioner’s contentions.

See Prelim. Resp.

d) [1-C] the drive current being proportional to a current drive voltage being indicative of the video signal and independent of the positive power supply voltage

Petitioner contends that Hayafuji’s drain current I_d (the recited “drive current”) is determined by the gate-to-source voltage V_{gs} of transistor Tr2, so V_{gs} corresponds to the recited “current drive voltage.” Pet. 57 (citing Ex. 1006 ¶ 21; Ex. 1002 ¶¶ 190–201). According to Petitioner, as shown in Figure 6, gate-to-source voltage V_{gs} is the difference between positive power supply voltage V_a and gate voltage V_{gate} , i.e., $V_{gs} = V_a - V_{gate}$. *Id.* Petitioner contends that V_{gate} is the sum of the relevant portion of the video signal (V_{data}) and the ripple component of the power supply voltage (V_{ri}), i.e., $V_{gate} = V_{data} + V_{ri}$. *Id.* (citing Ex. 1006 ¶ 49). Therefore, Petitioner contends, V_{gs} is indicative of the video signal (V_{data}) and is supplied to transistor Tr2 to create a corresponding drive current (I_d). *Id.* at 58 (citing Ex. 1006, Fig. 6; Ex. 1002 ¶¶ 190–201).

Petitioner further contends that Hayafuji teaches that the current drive voltage (V_{gs}) is independent of the positive power supply voltage (V_a) because variations in the power supply (V_{ri}) are removed from the current drive voltage. Pet. 59–60 (citing Ex. 1002 ¶¶ 190–201); Ex. 1006 ¶¶ 53–54. Petitioner contends that a person of ordinary skill in the art would understand V_a is composed of DC power $V_{DC} + V_{ri}$. *Id.* at 59. Therefore, Petitioner contends that current drive voltage V_{gs} is as follows:

$$\begin{aligned} V_{gs} &= V_a - V_{gate} \\ &= V_{DC} + V_{ri} - V_{data} - V_{ri} \\ &= V_{DC} - V_{data} \end{aligned}$$

Id. That is, Petitioner contends the variations in power supply voltage (V_{ri}) are removed from the current drive voltage. *Id.* at 59–60 (citing Ex. 1002 ¶¶ 190–201; Ex. 1006 ¶¶ 53–54).

In addition, Petitioner contends that Hayafuji’s drive current (I_d) is proportional to the current drive voltage (V_{gs}) because the drive current is “determined by” the current drive voltage. Pet. 60 (Ex. 1006 ¶¶ 7, 21; Ex. 1002 ¶¶ 190–201). Petitioner also compares Hayafuji’s Tr2 transistor with the M1 transistor in the ’521 patent, and asserts that both are P-channel MOSFETS, so a person of ordinary skill in the art would understand that Hayafuji’s drive current I_d is “proportional” to the gate-to-source voltage (V_{gs}) in the same manner as it is “proportional” in the ’521 patent. *Id.* (citing Ex. 1002 ¶¶ 190–201).

Patent Owner argues that “positive power supply voltage V_a does not drop out of the equation for the current drive voltage signal that determines the drive current for the OLED pixel.” Prelim. Resp. 49. Patent Owner argues that “[t]he current flowing through drive transistor Tr2 to the pixel element is determined by the gate-source voltage (i.e., current drive voltage), described by the following equation: $V_{gs} = V_a - (V_{data} + V_{ri})$.” *Id.* (citing Ex. 2001 ¶ 111). According to Patent Owner, “[b]ecause V_a is part of the equation for the current drive voltage, the drive current is not independent of the power supply voltage.” *Id.* at 50.

Patent Owner contends that Petitioner's argument that the drive current is independent of the power supply voltage because the ripple component voltage V_{ri} is not included in the current drive voltage equation is incorrect. Prelim. Resp. 50. First, Patent Owner contends that V_{DC} , the main component of the positive power supply voltage is part of Petitioner's equation for current drive voltage, i.e., $V_{gs} = V_{DC} - V_{data}$. Second, Patent Owner argues that Petitioner "ignores the undesirable voltage drift that each embodiment of the '521 patent removes from the current drive voltage." *Id.* at 51 (citing Pet. 59; Ex. 1001, 5:18–23, 6:33–37, 7:46–51). According to Patent Owner, Hayafuji "remov[es] only the ripple component of the power supply voltage introduced by a DC-DC converter, which is distinct from [the] voltage drift and noise addressed by the '521 patent's teachings." *Id.* (citing Ex. 1006 ¶ 22; Ex. 1001, 1:40–55, 2:38–46, 2:67–3:4, 5:18–23, 6:33–37, 7:46–51; Ex. 2001 ¶ 114). Therefore, Patent Owner asserts, a more accurate equation for current drive voltage V_{gs} is as follows:

$$\begin{aligned} V_{gs} &= V_{DC} + V_{ri} + V_{drift} + V_{noise} - V_{data} - V_{ri} \\ &= V_{DC} + V_{drift} + V_{noise} - V_{data} \end{aligned}$$

Id. (citing Ex. 2001 ¶ 114).

The parties present competing equations for calculation of the current drive voltage, which creates a factual issue that is best evaluated on a full record at trial. However, we make the following observations on the parties' arguments. We note that neither party explains what a "ripple component" is, or how (or if) it differs from "noise" or "drift." Although Mr. Credelle testifies that the "ripple component" is "distinct from voltage drift and noise," he does not provide further elaboration. Ex. 2001 ¶ 114. Moreover,

although Patent Owner contends that Hayafuji relates only to removing the ripple component of the power supply voltage, “which is distinct from voltage drift and noise addressed by the ’521 patent’s teachings,” we note that voltage drift and noise are not recited in claim 1. On this record, we also agree with Patent Owner that Petitioner appears to acknowledge that V_{DC} is part of the V_a ($V_a = V_{DC} + V_{ri}$). As a result, we observe that Petitioner’s contentions that V_{gate} is referenced to the positive power supply ($V_{gate} = V_{data} + V_{ri}$) appears inconsistent with Petitioner’s contentions that V_{gs} is independent of the positive power supply ($V_{gs} = V_{DC} - V_{data}$).

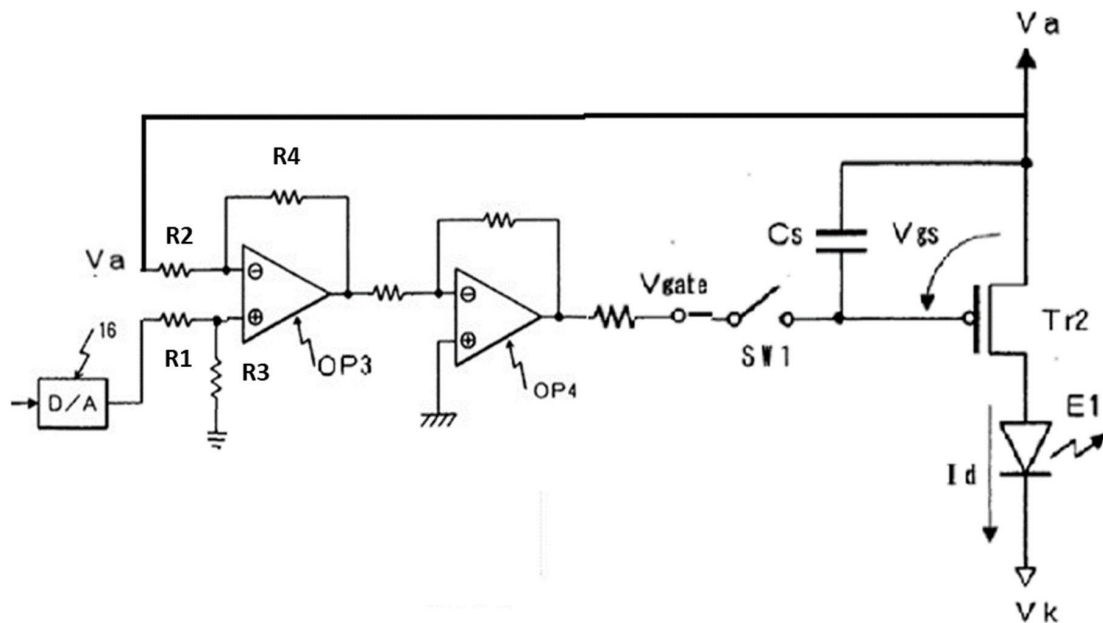
F. Ground 4: Alleged Obviousness by Hayafuji

Petitioner contends claims 1–3 would have been obvious in view of Hayafuji. Pet. 64–79. Patent Owner disputes Petitioner’s contentions. Prelim. Resp. 52–58. Because we determine above that Petitioner demonstrated a reasonable likelihood of prevailing in its challenge to at least one claim of the ’521 patent, we institute *inter partes* review on all claims and grounds, including Ground 4. See 37 C.F.R. § 42.108(a). In this section, therefore, we will provide observations on the parties’ positions where relevant. We note that, as in Grounds 1–3, the parties’ arguments raise fact-intensive issues that are best resolved on a complete record.

For independent claim 1, Petitioner essentially relies on its contentions for Ground 3, but asserts that it would have been obvious to modify Hayafuji “such that ***video drive signal*** (gate voltage V_{gate}) is configured such that ***video drive signal*** (gate voltage V_{gate}) is output as ***the difference between the positive power supply voltage*** (drive voltage V_a) ***and the video signal*** (data voltage V_{data}).” Pet. 68 (citing Ex. 1002 ¶¶ 213–234).

In particular, Petitioner contends that a person of ordinary skill in the art would modify Hayafuji's Figure 7 configuration "by connecting the **positive power supply voltage** (drive voltage V_a) to the inverting input of operational amplifier **OP3** rather than the non-inverting input." *Id.* (citing Ex. 1002 ¶¶ 213–234).

Petitioner provides a combination of Hayafuji's Figure 6 and 7 that illustrates the modification, which is reproduced below:



In Petitioner's combination of Figure 6 and Figure 7, above, positive power supply drive voltage V_a "(and accompanying voltage dividing resistors) are coupled to the negative terminal such that the output of the operational amplifier **OP3** would be the desired result of a control signal based on the data voltage V_{data} entering via **R1**, referenced against the drive voltage V_a ." Pet. 69 (citing Ex. 1002 ¶¶ 213–234).

According to Petitioner, this "would be an obvious design choice and would simplify material needs and cost because as modified, the capacitor of

the high pass filter of the disclosed ripple component extraction circuit **14** would be unnecessary.” *Id.* at 68–69 (citing Ex. 1002 ¶¶ 213–234). Petitioner contends that this is a “simpler design” that “eliminates the need for and the cost to include the additional ripple component extraction circuit **14** module.” *Id.* at 69–70 (citing Ex. 1002 ¶¶ 213–234). Petitioner also argues that the modification would have been obvious to a person of ordinary skill in the art because (1) it was well-known that in conventional differential instrumentation amplifier circuits, the positive input terminal is the reference voltage (often ground) to which the negative terminal is compared; 2) it is merely a trivial design change that would also accomplish the purpose of Hayafuji; and 3) it would provide improved immunity to power source noises. *Id.* at 70 (citing Ex. 1002 ¶¶ 213–226; Ex. 1006 ¶ 28). Petitioner contends that a person of ordinary skill in the art would have had a reasonable expectation of success when making the modification “because implementing a differential amplifier circuit in this manner is a well-known and fundamental op amp configuration.” *Id.* (citing Ex. 1002 ¶¶ 213–234); Ex. 1010, 181.

Patent Owner argues that a person of ordinary skill in the art would not have been motivated to modify the circuits in Figures 6 and 7 in the manner proposed by Petitioner for three reasons. Prelim. Resp. 52–57.

First, Patent Owner argues that the ripple component extraction circuit is central to the teachings of Hayafuji, so it would not have been obvious to a person of ordinary skill in the art to remove it, “as that would be contrary to the operating principles of Hayafuji and would have rendered it

inoperable for its intended purpose.” Prelim. Resp. 55 (citing Ex. 1006 ¶¶ 28, 48, Figs. 6, 7; Ex. 2001 ¶ 122).

Second, Patent Owner argues that modifying amplifier **OP3** in the manner proposed by Petitioner transforms what was a summing amplifier circuit into a differential amplifier. Prelim. Resp. 56. Patent Owner further argues, “summing the ripple component V_{ri} extracted by the ripple component extraction circuit with the video signal V_{data} was necessary for eliminating the undesirable ripple component of the power supply voltage, which is the entire purpose of Hayafuji.” *Id.* (citing Ex. 2001 ¶ 123; Ex. 1006 ¶¶ 28–30). Therefore, Patent Owner argues that the modification would be “contrary to the operating principles of Hayafuji and would have rendered it inoperable for its intended purpose.” *Id.* (citing Ex. 2001 ¶ 123).

Third, Patent Owner argues that the modifications are the result of impermissible hindsight bias because the teachings of Hayafuji relate to a different problem than the ’521 patent and propose a different solution. Prelim. Resp. 57 (citing Ex. 2001 ¶ 124).

Patent Owner’s contentions may have merit and we have some doubt that Petitioner ultimately will establish sufficient motivation to make the modification proposed. Specifically, on the current record, we tend to agree with Patent Owner that the “ripple component extraction circuit” appears to be “central to the teachings of Hayafuji.” Prelim. Resp. 55 (citing Ex. 2001 ¶ 122); *see, e.g.*, Ex. 1006 ¶ 47 (Figure 6 “shows a first embodiment of a drive device according to the present invention and shows a structure which is allowed to have ripple component supply means that the present invention

is characterized[by]”); *see id.* ¶¶ 27–30 (“SUMMARY OF THE INVENTION”).

We note that even if a person of ordinary skill in the art “could” modify Hayafuji to remove the ripple component extraction circuit, that does not inform us that a person of ordinary skill in the art “would” make these changes. *Belden Inc. v. Berk-Tek LLC*, 805 F.3d 1064, 1073 (Fed. Cir. 2015) (stating that “obviousness concerns whether a skilled artisan not only *could have made* but *would have been motivated to make* the combinations or modifications of prior art to arrive at the claimed invention”); *see also Personal Web Techs., LLC v. Apple, Inc.*, 848 F.3d 987, 993–94 (Fed. Cir. 2017) (“[T]hat reasoning seems to say no more than that a skilled artisan, once presented with the two references, would have understood that they could be combined. And that is not enough: it does not imply a motivation to pick out those two references and combine them to arrive at the claimed invention.”).

G. Ground 5: Alleged Obviousness Over Steer

Petitioner contends claims 1–4 would have been obvious in view of Steer. Pet. 79–94. Patent Owner disputes Petitioner’s contentions. Prelim. Resp. 58–64. Because we determine above that Petitioner demonstrated a reasonable likelihood of prevailing in its challenge to at least one claim of the ’521 patent, we institute *inter partes* review on all claims and grounds, including Ground 5. *See* 37 C.F.R. § 42.108(a). In this section, therefore, we will provide observations on the parties’ positions where relevant. We note that, as in Grounds 1–4, the parties’ arguments raise fact-intensive issues that are best resolved on a complete record.

1. *Steer (Ex. 1008)*

Steer is titled “Electroluminescent Display Devices” and is generally directed to “an active matrix electroluminescent display device in which current feedback is used during pixel programming so that any effects of differences between characteristics of the drive transistor of different pixels are avoided.” Ex. 1008, code (54), 7.

Figure 1, reproduced below, “shows a known pixel circuit for an active matrix addressed electroluminescent display device.” Ex. 1008, 2:3–4.

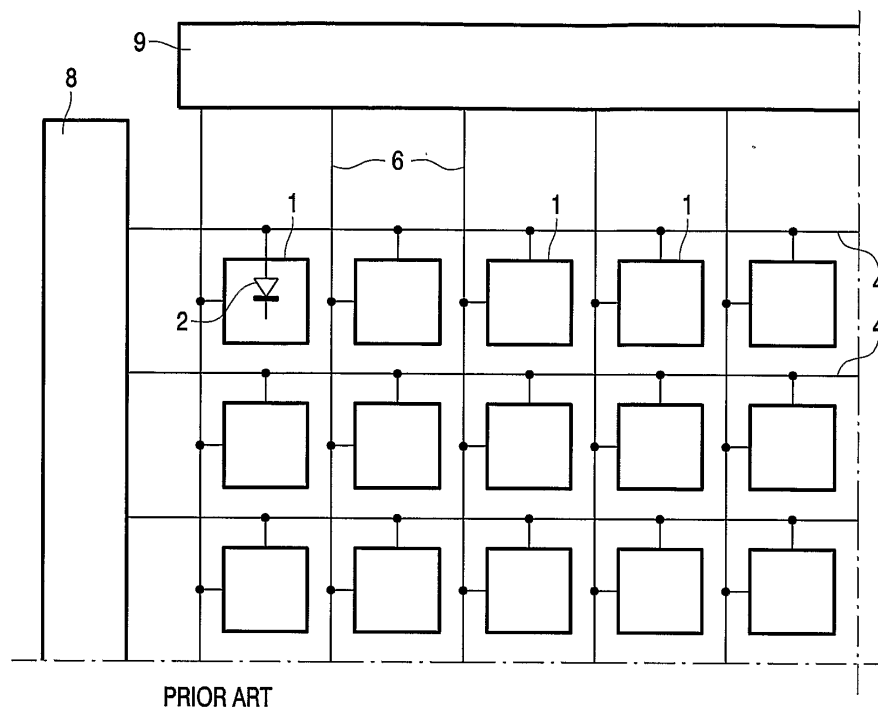


FIG.1

Figure 1, above, depicts “a panel having a row and column matrix array of regularly-spaced pixels, denoted by the blocks 1 and comprising electroluminescent display elements 2 together with associated switching

means.” Ex. 1008, 2:4–9. “The pixels 1 are addressed via the sets of row and column address conductors by a peripheral drive circuit comprising a row, scanning, driver circuit 8 and a column, data, driver circuit 9 connected to the ends of the respective sets of conductors.” *Id.* at 2:10–13.

Figure 4, reproduced below “shows one example of a possible feedback system to be provided in the column driver.” Ex. 1008, 8:27–29.

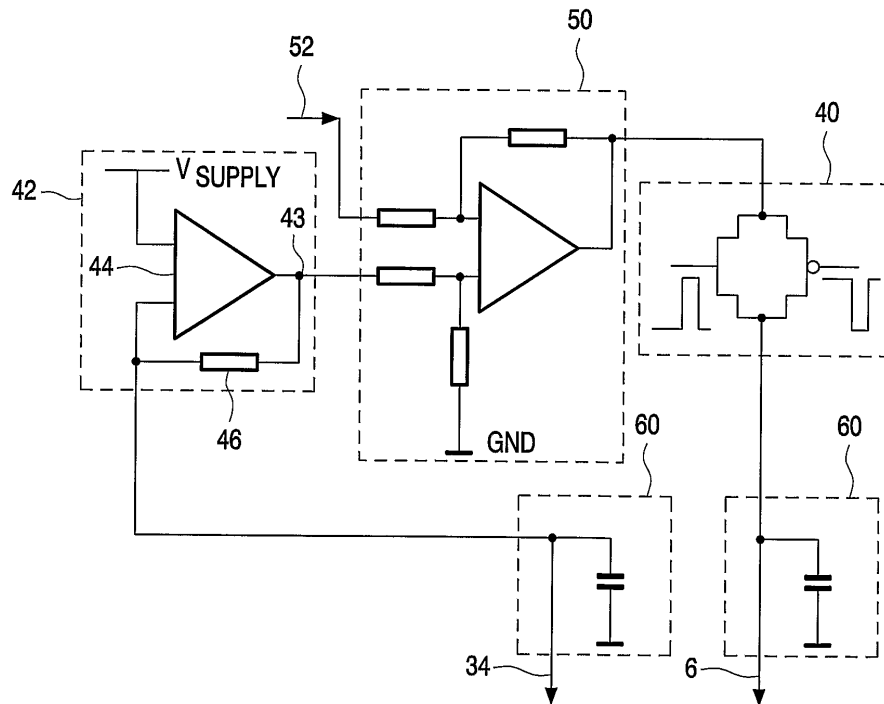


Fig.4

Figure 4, above, depicts, *inter alia*, current-to-voltage converter section 42, comparator section 50, and transmission gate 40. Ex. 1008, 9–10.

Current-to-voltage converter section 42 “provides a voltage at node 43 depending on the current being provided down the current-measurement supply line 34.” Ex. 1008, 9:4–6. “The current-to-voltage converter section 42 has a high open loop gain amplifier 44 so that the current-measurement

supply line, connected to the virtual earth amplifier input, is held at the voltage V_{SUPPLY} on the other input of the amplifier 44.” *Id.* at 9:6–9. “This is the same supply voltage as for the power supply line 26.” *Id.* at 9:9–10. “The voltage at node 43 differs from this supply voltage by a value $R \times I$, where R is the resistance of the feedback resistor 46 and I is the current flowing.” *Id.* at 9:10–12. “Thus, the output voltage is a function of the current drawn from the current-measurement supply line.” *Id.* at 9:12–13.

“[C]omparator section 50 compares the voltage at node 43 with an input voltage at input 52 representing the desired current.” Ex. 1008, 9:14–15. “The amplified output of the comparator section 50 is provided to the column conductor through the gate 40.” *Id.* at 9:17–18. “The comparator section 50 thus also acts as the driver for providing the column conductor voltage.” *Id.* at 9:18–19.

2. Analysis of Independent Claim 1

- a) [1-Pre]: An active matrix organic light emitting diode (AMOLED) display system comprising an AMOLED display panel receiving a video signal to be displayed on the AMOLED display panel, the AMOLED display panel comprising a plurality of organic light emitting diode (OLED) pixel elements, the AMOLED display system comprising:

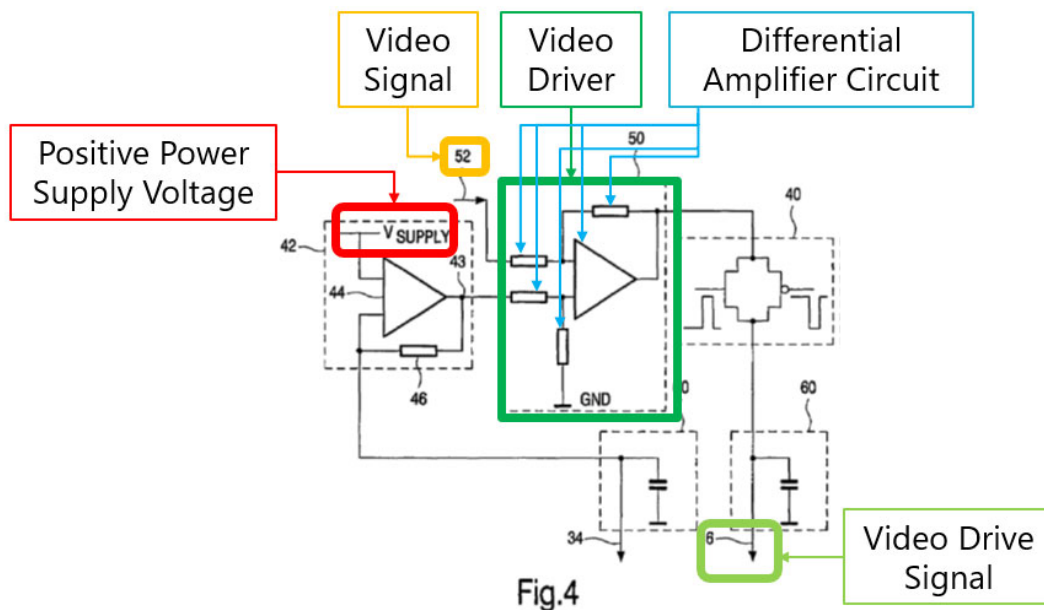
Petitioner contends that Steer discloses a substantially similar structure to Figure 2 of the ’521 patent. Pet. 79. Petitioner contends that Steer’s active matrix electroluminescent display device with organic thin film electroluminescent elements, for example, light emitting diodes, teaches the preamble. Pet. 80–81 (citing Ex. 1008, code (57), 1:11–12, 2:4–14, Fig. 1; Ex. 1002 ¶ 263. Petitioner further contends that Steer’s “input

voltage at input 52 representing the desired current” corresponds to the recited video signal. *Id.* at 81–82 (citing Ex. 1008, 9:14–15).

At this stage, Patent Owner does not dispute Petitioner’s contentions.
See Prelim. Resp.

- b) [1-A] a video driver receiving the video signal and generating a video drive signal indicative of the video signal and referenced to a positive power supply voltage of the AMOLED display panel;

Petitioner provides an annotated version of Steer’s Figure 4 in connection with limitation [1-A], reproduced below:



Petitioner’s annotated Figure 4, above, identifies in dark green, comparator section 50 as the recited “video driver”; identifies in yellow input video signal 52 as the recited “video signal”; identifies in red V_{SUPPLY} as the “positive power supply voltage”; and identifies in light green the output of comparator 50 (node 6) as the “video drive signal.” Pet. 84–86.

Petitioner contends that Steer’s “video driver also receives an input from ‘high open loop gain amplifier 44’ which itself is connected to ‘V_{SUPPLY}’ which is ‘the same supply voltage as for the power supply line 26.’” *Id.* at 84 (citing Ex. 1008, 9:4–12). According to Petitioner, “amplifier 44 outputs at node 43 a value that differs from V_{SUPPLY} ‘by a value R_XI, where R is the resistance of the feedback resistor 46 and I is the current flowing.’” *Id.* at 84–85 (citing Ex. 1008, 9:4–12). Thus, Petitioner asserts the voltage at node 43 is represented as:

$$V_{43} = V_{\text{SUPPLY}} + R \cdot I$$

Thus, Petitioner contends, a person of ordinary skill in the art would “recognize that voltage at node 43 is V_{SUPPLY} with an offset, and a comparison between voltage at node 43 (V₄₃) and input voltage at input 52 would result in an output signal indicative of voltage at input 52 (V₅₂ or *input(t)*) (*i.e.*, the claimed **video signal**) and referenced to V_{SUPPLY} (*i.e.*, the claimed **positive power supply voltage of the AMOLED display panel**).” *Id.* at 85–86. Petitioner contends that the output of the comparator 50 on node 6 (V₆, the recited **video drive signal**) is represented by the following equation, which shows the output of the comparison between V₄₃ and V₅₂:

$$V_6 = V_{\text{SUPPLY}} + R \cdot I - \text{input}(t)$$

Pet. 86 (citing Ex. 1008, 9:1–2; Ex. 1002 ¶ 281). Petitioner contends that this equation is “substantially identical” to the operation of the embodiments of the ’521 patent. *Id.* (citing Ex. 1001, 6:10–31 (Equation 5)).

Patent Owner argues that Steer does not disclose the claimed video signal because output V₆ is not referenced to the power supply voltage.

Prelim. Resp. 59–61. Patent Owner provides annotated Figure 4 from Steer, reproduced below:

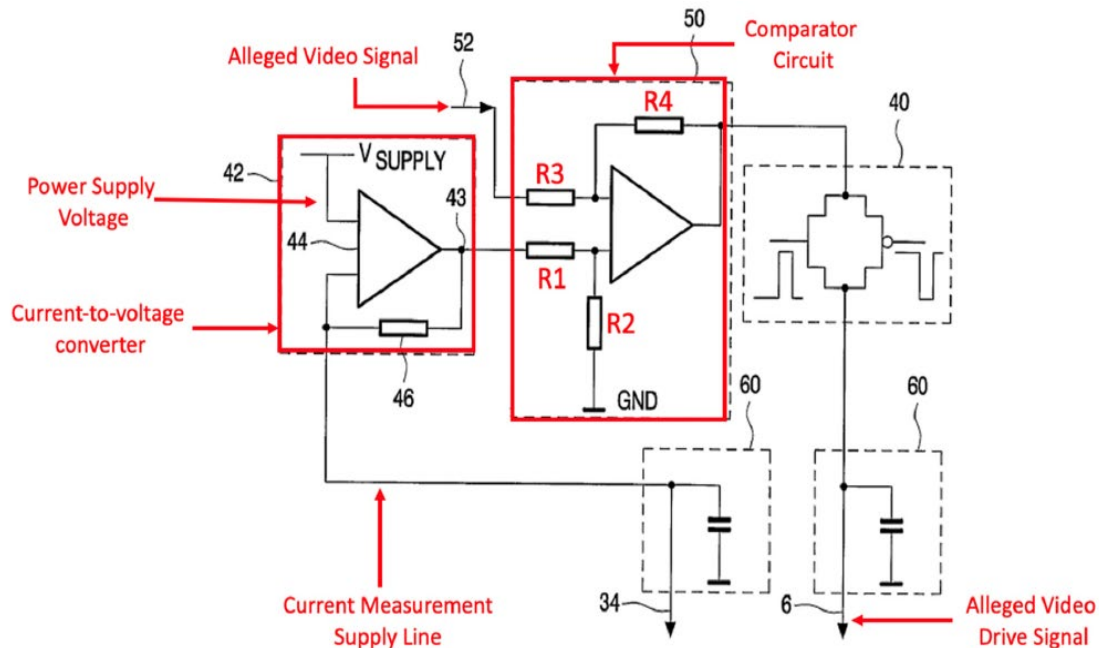


Fig.4

Id. at 60. Patent Owner’s annotated Figure 4, above, adds notations for R1, R2, R3, and R4 for the resistors located in comparator section 50. *Id.*

Patent Owner argues that “the value of V_6 also depends on the values of resistors R3 and R4 . . . which Petitioner ignored.” *Id.* at 61 (citing Ex. 2001 ¶ 133). Patent Owner, therefore, argues the equation for V_6 is as follows:

$$V_6 = (V_{43} - V_{52}) * R4/R3$$

$$= [V_{SUPPLY} + R46 * I - V_{52}] * R4/R3$$

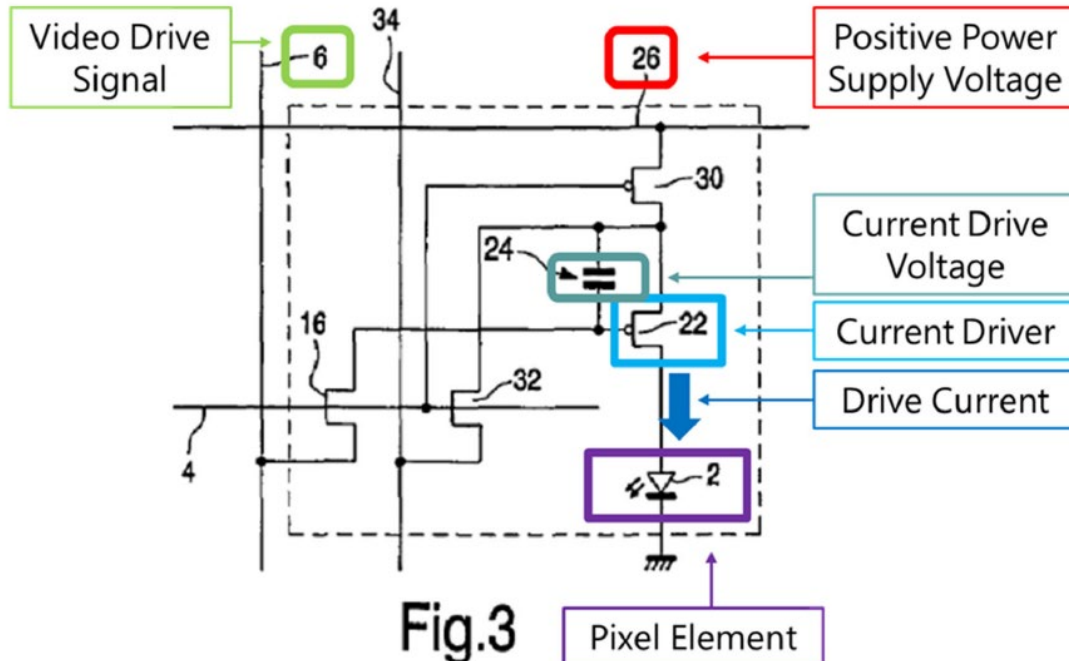
Id. According to Patent Owner, V_6 is not “referenced to the positive power supply voltage” because “the entire equation is multiplied by $R4/R3$. . . ,

resulting in a value for V_6 that is not an offset from V_{SUPPLY} .” *Id.* (citing Ex. 2001 ¶ 134).

Patent Owner’s contentions may have merit, and we welcome further briefing regarding the influence (if any) of resistors R1–R4 in comparator section 50 and the parties’ competing equations for calculation of the video drive signal, which raise factual issues that are best evaluated on a full record at trial.

- c) [1-B] a current driver coupled to at least one OLED pixel element, the current driver receiving the video drive signal and the positive power supply voltage and providing a drive current to the at least one OLED pixel element,

Petitioner provides an annotated version of Steer’s Figure 3 in connection with limitation [1-B], reproduced below:



Ex.[1008], Fig. 3 (annotated).

Petitioner’s annotated Figure 3, depicted above, identifies in light green node 6 as the “video drive signal”; identifies in red V_{SUPPLY} as the “positive power supply voltage”; identifies in blue drive transistor 22 as the “current driver”; identifies in teal circuitry including storage capacitor 24 as “current drive voltage”; and identifies in purple EL display element 2 as the “pixel element.” Pet. 87.

Petitioner contends that drive transistor 22 (current driver) is coupled to EL display element 2 (OLED pixel element) and receives drive signal 6 at its gate via address transistor 16 and power supply voltage from power supply line 26 via transistor 30. Pet. 87 (citing Ex. 1008, 2:30–3:9, 8:32–9:3, 9:25–26, 10:5–10). According to Petitioner, “[d]uring the pixel drive phase, line 26 corresponds to V_{SUPPLY} .” *Id.* (citing Ex. 1008, 10:5–10).

At this stage, Patent Owner does not dispute Petitioner’s contentions.
See Prelim. Resp.

d) [1-C] the drive current being proportional to a current drive voltage being indicative of the video signal and independent of the positive power supply voltage

Petitioner contends that drive transistor 22 (current driver) receives a “current drive voltage” comprising the gate-source voltage (the difference between the voltage at the source of drive transistor 22 and the voltage provided from the driver on line 6 on the gate of drive transistor 22).

Pet. 88. According to Petitioner, the voltage on line 6 “is ***indicative of the video signal*** because voltage [that] is generated on line 6 varies directly with the video signal input on line 52.” *Id.* (citing Ex. 1002 ¶¶ 293–297; Ex. 1008, Fig. 4). Petitioner, therefore, contends that a person of ordinary skill in the art “would understand that the gate-source voltage for drive transistor

22 is the claimed *current drive voltage*, and would further understand that the current flowing through drive transistor **22** and into EL element **2** is the claimed *drive current*.” *Id.* at 89 (citing Ex. 1002 ¶¶ 289–290, 292; Ex. 1008, Fig. 3).

Petitioner also compares Steer’s drive transistor 22 with the M1 transistor in the ’521 patent, and asserts that both are P-channel MOSFETS, so a person of ordinary skill in the art would understand that Steer’s current flowing through drive transistor 22 and into the EL element 2 is “*proportional*” to the gate-source voltage in the same manner as it is “proportional” in the ’521 patent. Pet. 90 (citing Ex. 1002 ¶¶ 291–292; Ex. 1008, Fig. 3).

Petitioner contends that the current drive voltage is independent of the positive power supply voltage because a change in voltage of V_{SUPPLY} will be recognized both at node 43 and at line 26. Pet. 91. According to Petitioner, “[a] mathematical representation of the voltages at each node shows that V_{SUPPLY} does not appear in the gate-to-source voltage over drive transistor **22**, and therefore, is independent of V_{SUPPLY} .” *Id.* Petitioner contends that the following equation represents the gate-to-source voltage:

$$V_{\text{GS}} = R * I - \text{input}(t)$$

Id. at 92 (citing Ex. 1002 ¶¶ 295–297).

Patent Owner argues that “the amplification introduced by the feedback system onto alleged video drive signal V_6 prevents V_{SUPPLY} from dropping out of the current drive voltage equation.” Prelim. Resp. 62. Using the equation for V_6 , set forth above for limitation [1-A], Patent Owner contends that the correct equation for V_{gs} is as follows:

$$\begin{aligned}V_{gs} &= V_6 - V_{26} \\&= [V_{\text{SUPPLY}} + R_{46} * I - \text{input}(t)] * R_4 / R_3 - V_{\text{SUPPLY}} \\&= V_{\text{SUPPLY}} * R_4 / R_3 + R_{46} * I * R_4 / R_3 - \text{input}(t) * R_4 / R_3 - V_{\text{SUPPLY}} \\&= V_{\text{SUPPLY}}(R_4 / R_3 - 1) + R_{46} * I * R_4 / R_3 - \text{input}(t) * R_4 / R_3\end{aligned}$$

Id. at 64 (citing Ex. 2001 ¶ 143). Patent Owner, therefore, contends that multiplier R_4/R_3 prevents V_{SUPPLY} from dropping out of the equation, and therefore, Steer does not disclose a drive current independent of the positive power supply voltage. *Id.*

Similar to limitation [1-A] above, Patent Owner's contentions regarding the influence (if any) of resistors R_1 – R_4 in comparator section 50 and the modification of the equation proposed by Petitioner raise factual issues that are best evaluated on a full record at trial.

IV. CONCLUSION

After considering the evidence and arguments presented in the Petition and the Preliminary Response, we determine Petitioner has established a reasonable likelihood of prevailing on its assertion that at least one claim of the '521 patent is unpatentable on at least one ground, and we institute an *inter partes* review on all the challenged claims and challenges presented in the Petition. *See* 37 C.F.R. § 42.108(a) ("When instituting *inter partes* review, the Board will authorize the review to proceed on all of the challenged claims and on all grounds of unpatentability asserted for each

claim”). At this stage of the proceeding, we have not made a final determination as to the patentability of the challenged claims.¹³

V. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that pursuant to 35 U.S.C. § 314, *inter partes* review is instituted as to the challenged claims of the ’521 patent and all challenges of unpatentability presented in the Petition; and

FURTHER ORDERED that *inter partes* review is commenced on the entry date of this Order, and pursuant to 35 U.S.C. § 314(c) and 37 C.F.R. § 42.4, notice is hereby given of the institution of a trial.

¹³ We remind Patent Owner that any arguments it does not raise in its Patent Owner Response are waived, even if the Board discusses them in this Decision. *See, e.g., Unified Patents Inc. v. Nonend Inventions N.V.*, IPR2016-00174, Paper 28, 3–4 (PTAB July 25, 2017) (arguments raised in a patent owner preliminary response but not reasserted in a patent owner response are waived). Nothing in this Decision authorizes Petitioner to supplement argument or evidence presented in the Petition on any ground in a manner not permitted by our rules.

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