

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

MIANYANG BOE OPTOELECTRONICS TECHNOLOGY CO., LTD.; WUHAN
CHINA STAR OPTOELECTRONICS SEMICONDUCTOR DISPLAY
TECHNOLOGY CO., LTD.; TIANMA MICROELECTRONICS CO. LTD.; AND
VISIONOX TECHNOLOGY, INC.
Petitioner,

v.

SAMSUNG DISPLAY CO., LTD.
Patent Owner.

Case No. IPR2023-00941
U.S. Patent No. 7,414,599

PETITIONER'S REPLY BRIEF

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LISTING OF EXHIBITS

Exhibit	Description
EX1001	U.S. Pat. 7,414,599 (Chung)
EX1002	U.S. Pat. Pub. 2003/0132931 (Kimura)
EX1003	Expert Declaration of Dr. Daniel Foty
EX1004	U.S. Pat. 6,362,798 (Kimura '798)
EX1005	File History for U.S. Pat. 7,414,599
EX1006	U.S. Pat. Pub. 2001/0022565
EX1007	U.S. Pat. Pub. 2003/0030603
EX1008	Excerpts from <i>Analog Integrated Circuit Design</i> , David A. Johns et al., John Wiley & Sons, Inc., 1997.
EX1009	<i>Modeling and Simulation of Insulated-Gate Field-Effect Transistor Switching Circuits</i> , Harold Shichman et al., IEEE Journal of Solid-State Circuits, Vol. SC-3, No. 3, September 1968.
EX1010	Excerpts from <i>Physics and Technology of Semiconductor Devices</i> , A. Grove, John Wiley & Sons, 1967.
EX1011	Excerpts from <i>CMOS Digital Integrated Circuits: Analysis and Design</i> , (third edition), S. Kang et al., McGraw-Hill, 2003.
EX1012	U.S. Pat. 6,229,506 ("Dawson")
EX1013	U.S. Pat. 5,666,046 ("Mietus")
EX1014	<i>TFT AMOLED Pixel Circuits and Driving Methods</i> , J. Stanford, SID 03 Digest, pp. 10-13 (2003))
EX1015	<i>A New Pixel Circuit for Active Matrix Organic Light Emitting Diodes</i> , J. Goh, IEEE Electron Device Letters vol. 23, pp. 544-546 (2002)

Exhibit	Description
EX1016	<i>A Novel Pixel Circuit for Active-Matrix Organic Light-Emitting Diodes</i> , J. Goh et al., SID 03 Digest, pp. 494-497 (2003)
EX1017	<i>Current-Writing Active-Matrix Circuit for Organic Light-Emitting Diode Display Using a-Si:H Thin-Film-Transistors</i> , R. Hattori et al., IEICE Transactions on Electronics vol. E83-C, pp. 779 – 782 (2000).
EX1018	Declaration of Thomas L. Credelle
EX1019	Reserved
EX1020	Reserved
EX1021	Reserved
EX1022	<i>Certain Active Matrix Organic Light-Emitting Diode Display Panels & Modules for Mobile Devices</i> , ITC Inv. No. 337-TA-1351, Staff’s Prehearing Brief (Public Version) (Excerpt) (Jan. 12, 2024)
EX1023	LinkedIn Profile of Dr. Andrew Wolfe
EX1024	Profile of Dr. Andrew Wolfe on Santa Clara University website
EX1025	Curriculum Vitae of Dr. Andrew Wolfe on Santa Clara University website
EX1026	<i>CMOS Circuits for Peripheral Circuit Integrated Poly-Si TFT LCD Fabricated at Low Temperature Below 600C</i> , Masaru Takabatake et al., IEEE Transactions on Electron Devices, Vol. 38, No. 6, pp. 1303-1309, June 1991
EX1027	<i>Polysilicon TFT Circuit Design and Performance</i> , Alan G. Lewis et al., IEEE Journal of Solid-State Circuits, Vol. 27, No. 12, pp. 1833-1842, December 1992
EX1028	Deposition Transcript of Dr. Andrew Wolfe (May 17, 2024)
EX1029	Supplemental Expert Declaration of Dr. Daniel Foty

Exhibit	Description
EX1030	Google patent search results
EX1031	<i>Current Copier Cells</i> , S.J. Daubert et al., Electronics Letters, Vol. 24, No. 25, December 8, 1988
EX1032	<i>Characteristics of Field-Induced-Drain (FID) Poly-Si TFTs with High On/Off Current Ratio</i> , K. Tanaka et al., IEEE Transactions on Electron Devices, Vol. 39, No. 4, pp. 916 – 920, April 1992
EX1033	<i>A Self-Aligned Offset Polysilicon Thin-Film Transistor Using Photoresist Reflow</i> , J. Han and C. Han, IEEE Electron Device Letters, Vol. 20, No. 9, pp. 476 – 477, September 1999
EX1034	Declaration of Johannes Hsu

I. INTRODUCTION

Samsung's three nonobviousness arguments fail. **First**, Samsung baselessly persists in asserting that Kimura's PMOS and NMOS switching transistors are not interchangeable. POR, 9-26. This runs directly contrary to Kimura's express and pervasive disclosure (Kimura, [0396], [0434], [0438], [0445], [0649], [0670]) and the basic knowledge/skill of a POSITA.

Second, Samsung asserts Kimura does not render obvious a shared light-emitting signal because bodily incorporation into Fig. 33 would render the circuit inoperable. POR, 4, 38-44. This is a red herring because Petitioner expressly relied on **Kimura Fig. 36**, which has no "inoperability" issue. *See, e.g.*, Pet., 62-63 ("[T]he all-PMOS version of Kimura Fig. 36, discussed below, renders claim 13 obvious."); EX1028, 197:17-198:1, 200:7-11 (no opinion on Fig. 36).

Third, Samsung argues against a universally recognized and well-known circuit function—performing initialization/reset. But Kimura Figs. 16A/17A expressly disclose attaching a reset/initialization transistor directly to the capacitor it discharges, which performs exactly the same function when placed in exactly the same location in Kimura Fig. 33/36. This is the epitome of obviousness. *See KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 417 (2007) ("[I]f a technique has been used to improve one device, and a [POSITA] would recognize that it would improve similar devices in the same way, using the technique is obvious unless its actual

application is beyond his or her skill.”).

Samsung’s secondary-considerations arguments fail collectively for lack of nexus, and individually on the merits. Even if credited, Samsung’s secondary considerations cannot overcome Petitioner’s strong prima facie obviousness case.

II. LEVEL OF SKILL IN THE ART

Samsung and its expert manufacture a POSITA dispute where one does not, and should not, exist. The experts agree a POSITA would have had a Bachelor’s degree in electrical engineering or similar field. EX1003, ¶31; EX2008, ¶46. And they agree 2-3 years is the appropriate length of work experience. EX1003, ¶31; EX1028,73:19-74:1.

Dr. Foty expressly stated the ’599 patent “pertains generally to the field of OLED displays, and more particularly to the circuitry used to drive and control the pixels that comprise the light-generating elements of the display,” and a POSITA would thus have “2-3 years of circuit design/analysis experience.” EX1003, ¶31. Plainly, this refers to circuit design/analysis experience relevant to the type of circuitry (*e.g.*, mixed-signal analog/digital circuits) used in OLED displays.

Samsung ignores Dr. Foty’s contextual statement to setup a strawman argument. This is most apparent from Dr. Wolfe’s testimony, which erroneously contends that Petitioner’s definition qualifies someone with “experience in battery chargers or radio transmitters” as a POSITA. EX1028, 73:5-6, *see also id.*, 70:18-

71:7, 72:17-73:7; *see also* POR, 7-9. Neither Dr. Foty nor Petitioner said any such thing.

Dr. Wolfe was silent regarding Mr. Credelle's declaration, which focused exclusively on the level of skill in the art. *See, e.g.*, EX1018, ¶32 ("Experience in active-matrix display design is not necessary to understanding the '599 patent. While set in the context of OLED displays, the '599 patent and the relevant prior art are directed to transistor circuits."); EX1028, 28:3-5. And he rendered no opinion on Dr. Foty's or Mr. Credelle's qualifications.¹ *Id.*, 47:5-11. The Board should reject Samsung's manufactured POSITA dispute. *See* EX1029, ¶¶11-17.

Regardless, to the extent Samsung advocates for a *higher* level of skill than Petitioner, doing so renders the Challenged Claims even more obvious. *Trs. of Columbia Univ. v. Illumina, Inc.*, 620 F. App'x 916, 922 (Fed. Cir. 2015).

¹ Dr. Wolfe's CV (EX2048), LinkedIn profile (EX1023), and university bio (EX1023) show expertise in computer architecture, not active-matrix displays or circuit design. EX1028, 54:1-55:4, 56:9-12. Dr. Wolfe never designed an active-matrix display or pixel circuit, nor published on the subject (*id.*, 67:12-68:17), and his purported active-matrix design experience was "lumped [in] with video research" and "multimedia" (*id.*, 60:5, 61:8-13).

III. KIMURA RENDERS ALL CHALLENGED CLAIMS OBVIOUS

A. An All-PMOS Pixel Circuit Was Obvious

Some (but not all) Challenged Claims require PMOS transistors. ID, 19. Petitioner used “all-PMOS” implementations of Kimura Fig. 33/36 to meet such requirements and presented multiple rationales for doing so. *See, e.g.*, Pet., 19-23. To streamline proceedings, Petitioner focuses its reply on the “general interchangeability” rationale.² ID, 23-31.

First, Samsung argues that three purported “material differences” (*i.e.*, carrier mobility, transistor size, and leakage) between NMOS/PMOS transistors make an all-PMOS pixel circuit nonobvious. POR, 13-17. These red-herring arguments are belied by the ’599 patent itself, Kimura, and Samsung’s own exhibits.

Some Challenged Claims allow NMOS or PMOS transistors to be used, but the ’599 patent’s only embodiment is all-PMOS. *See* EX1001, Figs. 3 and 5-7. The ’599 specification identifies no benefits (or drawbacks) of PMOS versus NMOS transistors. Rather, it simply states “the pixel circuit can be configured of a NMOS transistor, a CMOS transistor or the like other than the PMOS transistor.” *Id.*, 8:36-38. This passing statement reflects that a POSITA would have known

² Petitioner maintains its “second theory” (ID, 31) for all-PMOS circuits is sound.

about PMOS/NMOS interchangeability; otherwise the claims lack enablement and/or written description. *See In re Paulsen*, 30 F.3d 1475, 1481 n.9 (Fed. Cir. 1994) (specification would not be enabling if held to the same standard urged for the reference); EX1029, ¶¶18-20. At deposition, Dr. Wolfe could provide no reason why purported NMOS/PMOS “leakage,” “mobility,” or “size” mattered in Kimura, but not the ’599 patent. EX1028, 110:3-113:13, *especially* 112:6-11.

Here, of course, Kimura contains far more disclosure than the ’599 patent regarding NMOS/PMOS interchangeability. Indeed, there is *repeated, express disclosure* for multiple Kimura embodiments that NMOS/PMOS switching transistors³ are interchangeable. *See* Pet., 4, 19-23, *especially* 20 (citing Kimura, [0438], [0649], [0670], and [0434], all confirming interchangeability of switching transistors). The Board recognized that Kimura’s “interchangeability teaching is described generically for all ‘switching transistors’ and transcends any particular embodiment of the pixel circuit.” ID, 23-24. That remains true. And Dr. Wolfe’s own exhibits demonstrate a POSITA’s knowledge/skill in using all-PMOS transistors. *See* EX2008, ¶¶114, 117, 119 (showing all-PMOS pixels); EX1029, ¶¶21-32.

³ Dr. Wolfe admitted switching transistors simply perform a digital on/off function. EX1028, 160:18-161:1.

Dr. Wolfe undermined Samsung's PMOS mobility argument when he testified faster displays "use more power" and "it is often commercially preferable to increase the number of pixels rather than to increase the refresh rate" because "a typical person would not be able to perceive the difference" of a faster display.⁴ EX1028, 101:13-102:18. In other words, relative NMOS/PMOS mobility simply did not matter because PMOS switching transistors operated faster than needed for common refresh rates, which Dr. Wolfe testified were between 15 and 60 Hz in 2003.⁵ *Id.*, 99:3-17; *see also* EX1026 and EX1027 (showing MHz switching speeds in early 1990s); EX1029, ¶¶33-37.

Concerning leakage, Samsung asserts that replacing Kimura's "third transistor" (3309) with a PMOS transistor was nonobvious because it "could alter

⁴ Moreover, Samsung's exhibits confirm polysilicon PMOS transistors were over 100 times faster than NMOS transistors in amorphous silicon, which was a suitable display material. EX2010, 27-28; EX1029, ¶¶38-40.

⁵ Samsung asserts NMOS switching transistors are "smaller than comparable PMOS TFTs," which can improve aperture ratio. POR, 14. Because relative NMOS/PMOS speed was unimportant, PMOS transistors could be the same size as NMOS transistors without perceptibly impacting refresh rate. EX1028, 96:16-99:17, 101:13-102:18; EX1029, ¶¶41-43.

the stored brightness level” during light emission due to higher PMOS leakage. POR, 14. First, neither the ’599 patent (EX1001, EX1028, 174:8-10) nor Kimura (EX1002) say anything about leakage, reflecting it wasn’t a meaningful concern. Second, Dr. Wolfe admitted that leakage does “not necessarily” affect pixel brightness “in a perceptible manner.” EX1028, 173:21-174:3. Moreover, Samsung omits that the capacitor is intentionally discharged and then recharged *every cycle* during initialization and programming. See Kimura, Figs. 33B/36B, 33C/36C, [0655]; EX1001, Figs. 5-6, 7:15-48; EX1028, 176:2-178:18. Thus, the capacitor need not hold charge for an extended time, making modest leakage unimportant. EX1029, ¶¶44-54.

Second, Samsung argues an all-PMOS pixel circuit would “require[] extensive modifications” to “drive circuitry, signaling, and the pixel circuit’s timing.” POR, 17-19. This assertion is baseless. At institution, the Board noted that “Patent Owner does not assert that implementing a switching transistor by a pMOS transistor exceeds the level of ordinary skill in the art.” ID, 29; *see also* EX1003, ¶57 (easy to implement active-high signaling). That remains true as Dr. Wolf admitted “[i]t certainly would have been within [a POSITA’s] ability to make the [PMOS/NMOS] substitution.” EX1028, 108:3-7; *see generally* EX2008, ¶¶58-78; EX1028, 161:8-18 (admitting Kimura discloses manufacturing single-species

pixels); EX1004, 12:30-49 (“every TFT [in the pixel circuit] can be [NMOS] or all TFTs can be [PMOS].”).

Samsung argues all-PMOS circuits are nonobvious because there are “sixteen [or even thirty-two] distinct permutations” available. POR, 18. But the Board already observed Samsung “made the issue more complicated than it is or needs to be. Kimura already discloses that either p-type or n-type transistors can be used for switching transistors.” ID, 26. Samsung’s POR changes nothing.

Samsung asserts “Kimura does not teach any embodiment of its invention that includes an all-PMOS design.” POR, 19. This is disingenuous at best. Kimura Fig. 22/23 is plainly all-PMOS. And Dr. Wolfe’s statement that “none of Kimura’s embodiments of its invention teach ... any single-species configuration” is likewise misleading. EX2008, ¶59. As Dr. Wolfe eventually admitted, Kimura Figs. 32 and 38-40 are single-species pixels. EX1028, 130:16-135:14.

Dr. Wolfe further admitted Kimura teaches replacing multiple NMOS switching transistors with PMOS in Fig. 1A to create an all-PMOS circuit. EX1028, 143:2-144:21. Dr. Wolfe testified Kimura “hint[s] towards [an all-PMOS] modification” where “the drive transistor is already PMOS.” *Id.*, 144:22-145:9. That is precisely the case in Kimura Fig. 33/36 where drive transistor 3308 in Fig. 33 (and 3609 in Fig. 36) *is already PMOS*, confirming obviousness under Dr. Wolfe’s own logic. *See* Kimura, [0657].

Third, Samsung argues an all-PMOS pixel circuit eliminates Kimura’s “benefits of using CMOS.” POR, 19-20. This is incorrect given Kimura’s disclosure of CMOS peripheral control circuitry that is “formed on the same substrate” as the pixels. Kimura, [0502]; *see also id.* [0547], Fig. 14D; EX1004, 13:38-48 (disclosing common substrate for peripheral circuitry and pixels). Thus, Kimura’s CMOS manufacturing process provides maximum flexibility to make single-species pixels while still allowing CMOS logic for peripheral control circuits. *See* EX2008, ¶77; EX1029, ¶¶22-26.

Samsung’s argument that utilizing PMOS transistors does not solve Kimura’s “light output at undesired times”⁶ (POR, 25-26) is a red herring. No requirement exists in the patent law on obviousness that a simple substitution must solve a particularized shortcoming. *See KSR*, 550 U.S. at 405 (approving “simple substitution of one known element for another”).

B. Kimura Renders Obvious a Shared Light-Emitting Signal

Various claims require a shared light-emitting signal (*i.e.*, a shared gate signal controlling the “fourth” and “fifth” transistors in claim 13-18, and the “fifth”

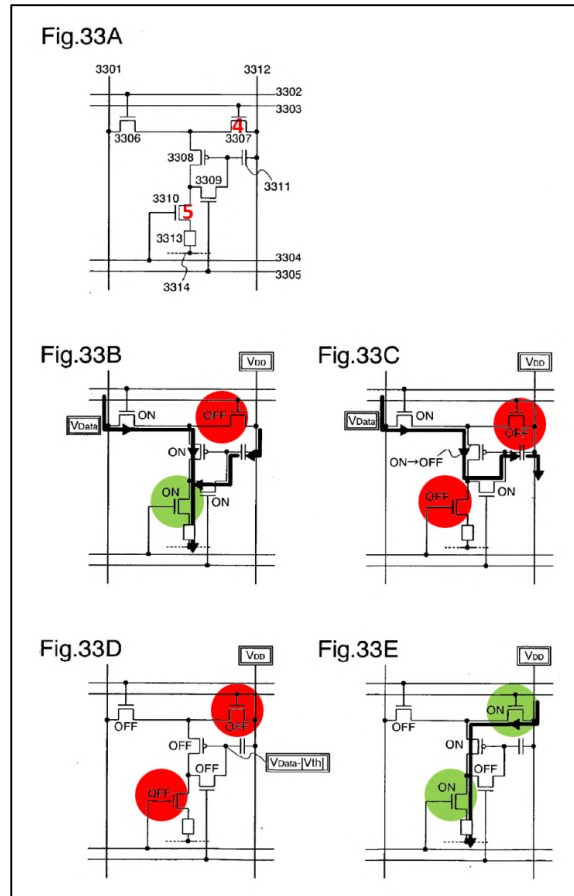
⁶ Kimura’s reset/initialization transistor in Fig. 16 solves this drawback. *See* §III.C.

and “sixth” transistors in claims 1-6). This requires both transistors to always have the same ON/OFF state.

Samsung’s sole argument against a shared light-emitting signal is that bodily incorporation into Fig. 33 renders the circuit inoperable. POR, 38-44.⁷ That is true, but irrelevant because Petitioner never proposed such a change. In fact, the Petition acknowledged unmodified Fig. 33 did not permit a shared light-emitting signal because the two relevant transistors have different ON/OFF states during initialization, as Fig. 33B shows below.⁸ Pet., 64.

⁷ Dr. Wolfe rendered no opinion Fig. 36 was inoperable. EX1028., 197:17-198:1, 200:7-11.

⁸ Adding the initialization/reset transistor to Fig. 33 solves this incompatibility and enables a shared light-emitting signal similar to Fig. 36. EX1003, ¶¶223, 228.



Accordingly, Petitioner relied on Kimura Fig. 36⁹ where the ON/OFF states of both transistors are identical in every phase, including Fig. 36B (initialization). Pet., 64-65. Kimura Fig. 36 (below) shows this, and Dr. Wolfe admitted as much at deposition. EX1028, 190:1-192:3.

⁹ The Petition explicitly stated “the all-PMOS version of *Kimura Fig. 36* [] renders claim 13 obvious.” Pet., 62-63; *see also* EX1003, ¶¶261, 263.

Fig.36B

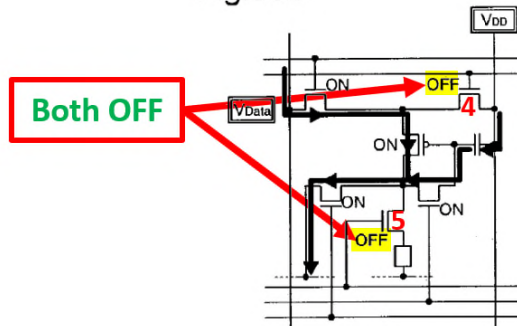


Fig.36C

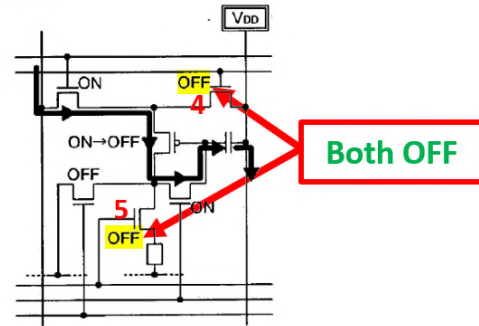


Fig.36D

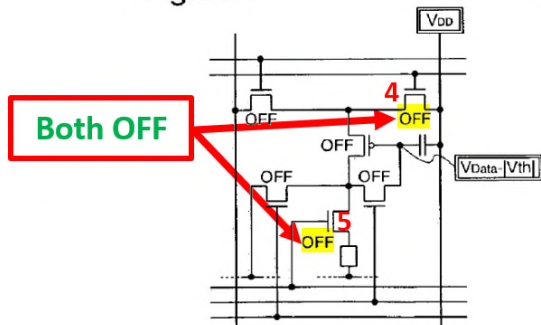
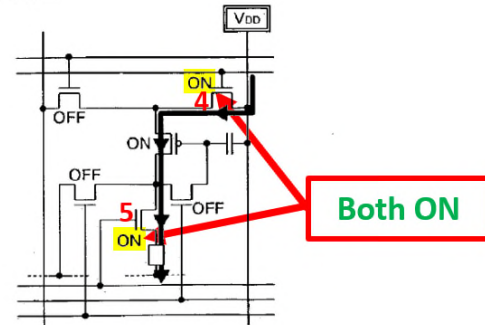
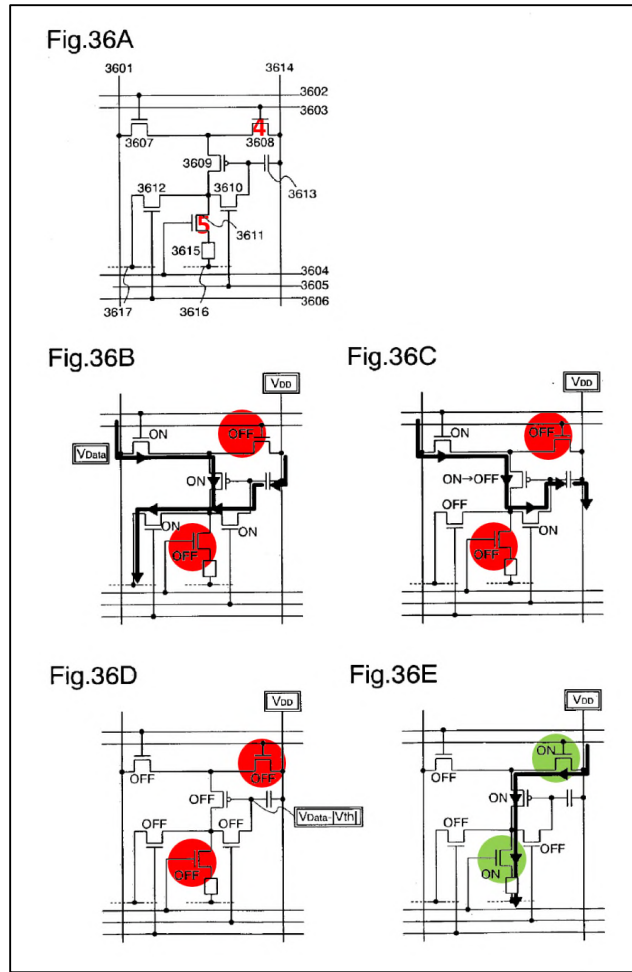


Fig.36E





Thus, as the Petition stated, “a POSITA would have understood (or at least found it obvious) that Kimura uses a shared light-emitting signal to control [both transistors]” in Fig. 36. Pet., 65; EX1003, ¶¶256-259, 263-265. And Dr. Wolfe testified as follows:

Q. How, if at all, would the operational states depicted in Figure 36B, C, D and E be any different if transistors 3608 [fourth transistor] and 3611 [fifth transistor] were controlled by a shared light-emitting signal?

THE WITNESS: If you start from Figure 36 and you combine them and you only have the illustrated operations, then I don't think there would be a difference.

EX1028, 201:22-202:9. Apart from the PMOS/NMOS substitution discussed (*supra* §III.A), no changes are needed.

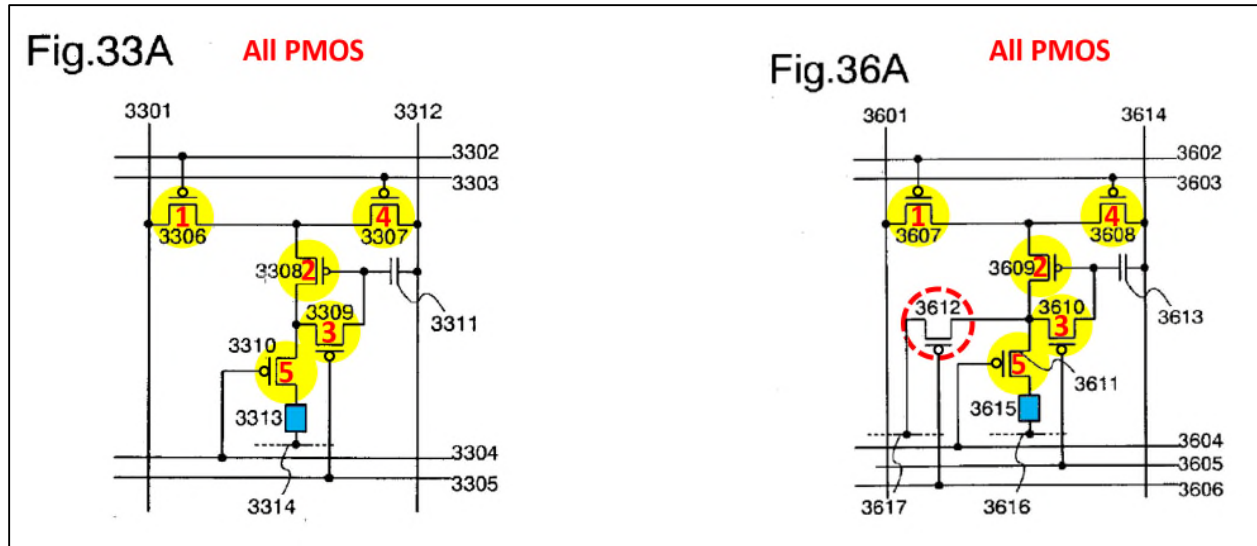
Moreover, Kimura itself provides a rationale for sharing a light-emitting signal—doing so reduces the number of control lines, which improves aperture ratio. *See* Pet., 65 (citing Kimura, [0429], [0421]-[0422], and [0659]. Moreover, Dr. Wolfe admits a POSITA would have independently known that sharing control signals could improve aperture ratio. EX1028, 246:3-15.

At institution, the Board agreed but observed that Fig. 36 “[uses] six transistors, not five as in the case of the Figure 33 embodiment,” and invited the parties to develop the record on whether the “Figure 36 embodiment, would still meet all the requirements of the first, second, third, fourth, and fifth transistor” in base claim 7. ID, 51-52. The unequivocal answer is “yes.”

The Petition expressly stated “Kimura Fig. 36 is merely an extension of Fig. 33 and discussion of one applies equally to the other unless noted.” Pet., 15, fn.3; *see also* EX1003, ¶130 (“It is important to note at the outset that Kimura Figure 36 is just an extension of Kimura Figure 33, and that (unless noted) the analysis and discussion of one figure applies equally to the other.”). Petitioner cited Fig. 33 for claim 7 instead of Fig. 36 because Kimura itself used Fig. 33 to explain circuit

operation and simply noted differences when describing subsequent figures, like Fig. 36, that build off Fig. 33. *See* Kimura, [0652]-[0668].

Accordingly, Petitioner’s claim 7 analysis applies in all relevant respects to claim 13. A side-by-side comparison of Fig. 33A and Fig. 36A shows all five transistors in Fig. 33 (and their respective connections) are the same in Fig. 36. The only structural difference in Fig. 36 is the addition of transistor 3612, but all Challenged Claims are “comprising” claims that permit additional elements.



As shown below, no functional or operation differences exist in transistors one, two, three, four or five in Figs. 33C-E versus Figs. 36C-E.

Programming

Fig.33C

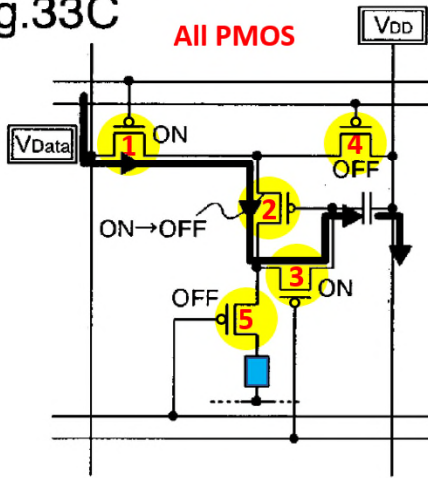
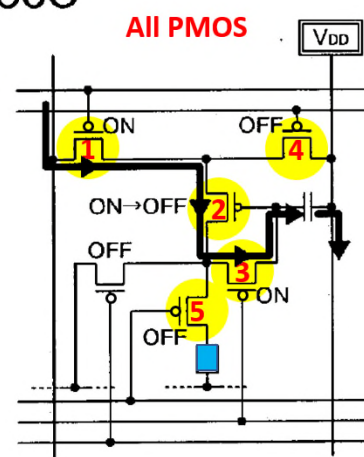


Fig.36C



Programming Completed

Fig.33D

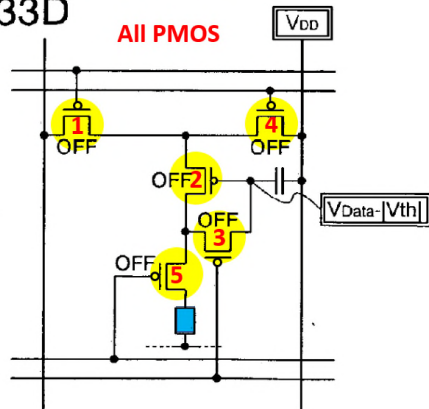
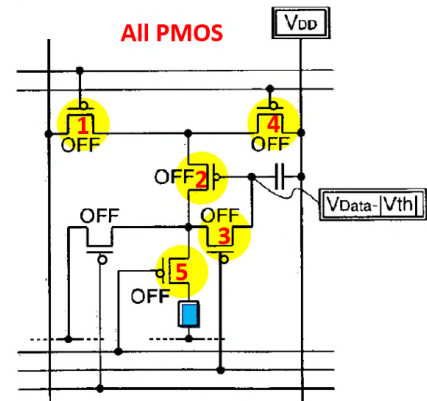


Fig.36D



Light Emission

Fig.33E

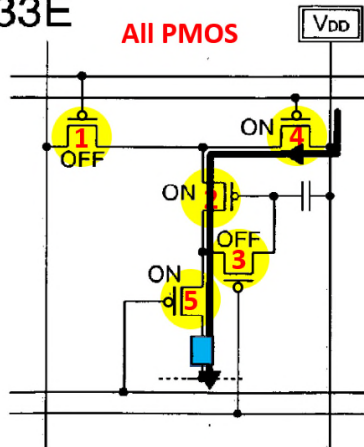
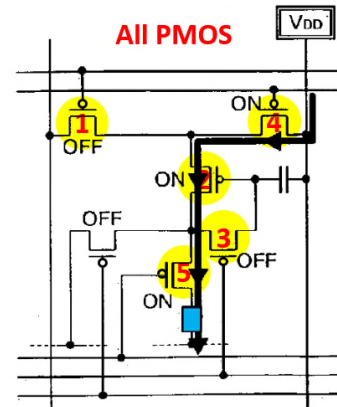


Fig.36E



Only Figs. 33B and 36B differ, and only with respect to the ON/OFF state of transistor 5 (*i.e.*, transistors 1-4 all match). In this phase, transistor 5 is “ON” in Fig. 33B, but “OFF” in Fig 36B.

Initialization

Fig.33B

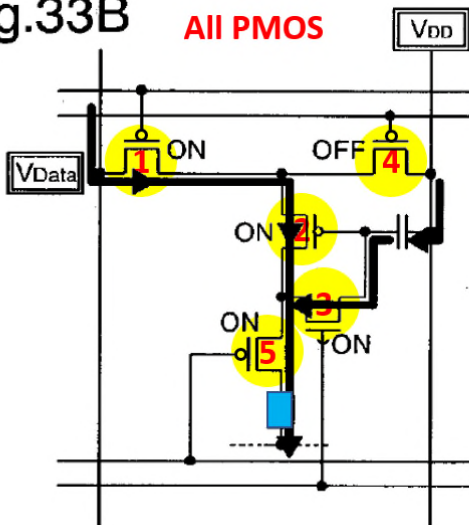
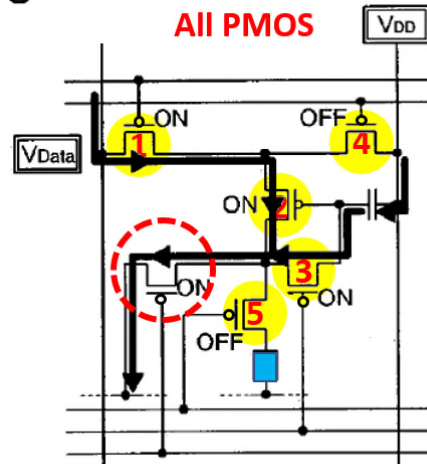


Fig.36B



Dr. Wolfe admits the “extra” transistor (circled in red) in Fig. 36B is ON to drain current so transistor 5 can be OFF. EX1028, 191:4-11. Thus, the ON/OFF states of transistors 4 and 5 in Fig. 36 always match and can be controlled by a shared light-emitting signal. This in no way violates claim 7, and Petitioner’s analysis of transistors 1-5 for claim 7 fully applies to claim 13. Pet., 15, fn.3. The same is true for claims 1-6 and 14-18. EX1029, ¶¶55-71.

C. Attaching Kimura’s Initialization/Reset Transistor to the Capacitor It Discharges Is Obvious

Various claims require an “initialization transistor” (controlled by the “scan signal” of the prior cycle) that “discharge[es]” (*i.e.*, resets) the storage capacitor’s voltage before programming. *See, e.g.*, EX1001, cl. 2; EX1028, 90:6-20.

Dr. Wolfe admitted “some embodiments” of Kimura disclose a transistor that initializes (*viz.*, discharges/charges) the capacitor before programming. EX1028, 240:19-241:1. And Samsung does not dispute Kimura Figs. 16/17 discloses a transistor (1607) whose sole purpose is to reset/initialize the capacitor (1610) which it is connected to. *See generally* POR, 26-38; EX1028, 237:14-238:4. Nor does Samsung dispute the previous row’s scan signal controls this transistor. POR, 26-38; *see also* Pet., 51-52 (citing Kimura, [0429] (“gate signal line of the previous row [controls] TFT 1607.”), [0426] (similar)); EX1028, 230:4-10.

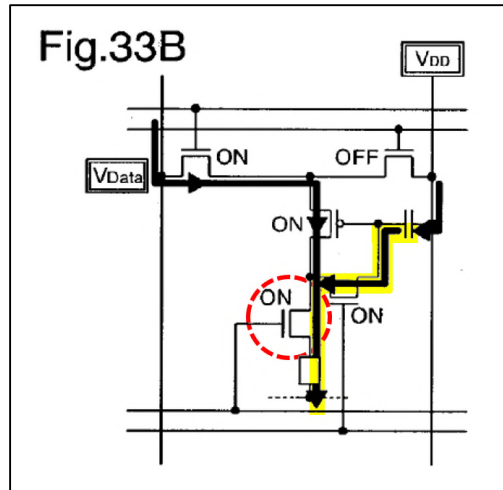
Petitioner applied Kimura’s reset/initialization transistor 1607 to Kimura Figs. 33/36 as the claimed “initialization transistor” that discharges the capacitor. *See* Pet., 51-56. Petitioner provided numerous reasons for doing so. *See id.*, 54-55 (“simplicity of the solution and ease of implementation”; “[i]nitializing/resetting circuits (including OLED drivers) was a common and well-known practice at the relevant time”; “there were limited options/locations for initialization transistor placement”; “[a]dding the initialization transistor as described in Fig. 16-17 does not require any additional control signals”; “Kimura’s express teachings about the flexible location of the [reset] transistor” and “[e]xtensive discussion of the dedicated initialization transistor approach in Figs. 16-17, including detailed control signal/timing waveforms”;¹⁰ “a dedicated initialization transistor solves a known drawback in Fig. 33 (i.e., spurious light emission during initialization)”). Since the initialization/reset transistor discharges the capacitor, connecting it thereto would have been an obvious design choice (and is expressly taught by Figs. 16/17). *Id.* Moreover, a direct connection lowers drainage path resistance (traversing only one transistor instead of two). EX1029, ¶¶72-80.

¹⁰ For example, Petitioner explained Kimura Fig. 16B’s timing diagram for initialization/reset “would directly apply to the modified embodiment” of Kimura Figs. 33/36. EX1003, ¶142; *see also* Pet., 16, 55-56.

Samsung responds to ***only one*** of these reasons, mistakenly asserting “Petitioner’s flawed reading of ‘erasure’ is the ***sole*** premise” for “combin[ing] Figures 16-17 with Figure 33.” POR, 28-29. Accordingly, the Board has ample un rebutted reasons to find the initialization/reset transistor obvious, and the inquiry can—and should—end there. Nevertheless, Petitioner addresses Samsung’s flawed “erasure” argument.

Samsung contends that Kimura’s teaching that “TFT 3310 can also be used as an erasure TFT” and “can be placed in any location” (Kimura, [0658]) does not support connecting the reset/initialization transistor to the capacitor. POR, 31-32. Samsung’s only argument for this assertion is that “erasure” and “initialization” are “separate and distinct operations.” POR, 27. Samsung’s argument fails for two independent reasons: (1) it is undisputed that TFT 3310 in Fig. 33 and TFT 3612 in Fig. 36 (like TFT 1607 in Fig. 16A) discharge (*i.e.* reset/initialize) the capacitor; and (2) the relevant timing diagram (*viz.*, from Figs. 16/17) confirm that “initialization” occurs during the “erasure” period.

First, by arguing that “erasure” and “initialization” are “separate and distinct operations,” (POR, 27), Samsung wishes to draw the inference that those functions are necessarily performed by “separate and distinct” transistors. That is plainly not the case—Fig. 33B shows the capacitor discharging through “erasure” TFT 3310 (circled in red). *See* EX1028, 203:2-22, 205:15-206:2.

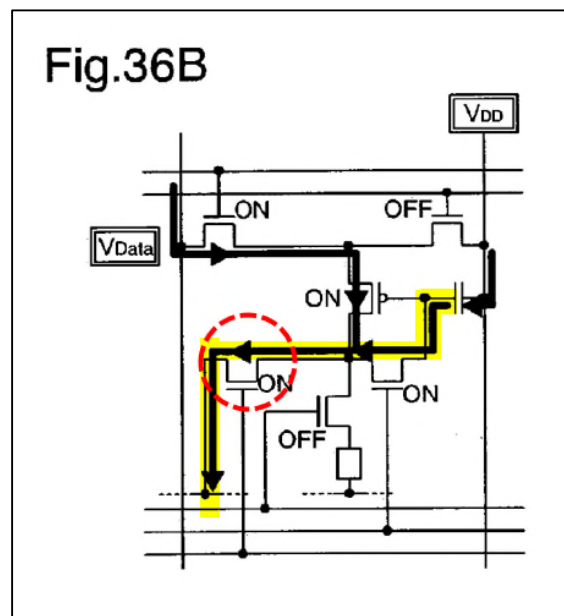


Even assuming “erasure” and “initialization” are separate operations in *other embodiments*, it makes no difference to Petitioner’s argument because the “erasure” transistor discharges the capacitor, which is the function required by the claims. See, e.g., claim 8 (“sixth initialization transistor *for discharging the data signal voltage stored in the capacitor*”). That is exactly what TFT 3310 does. It simply does not matter whether TFT 3310 also performs other functions.

Similarly, TFT 3612 in Fig. 36B (circled in red below) discharges the capacitor. EX1003, ¶223. Dr. Wolfe admitted the capacitor discharges through TFT 3612, which is the “erase transistor.” EX1028, 216:6-16, 189:14-22. And Kimura expressly teaches “the erasure TFT can be placed in any location, provided that it is a location at which electric current supplied to the [LED] can be cut off at an arbitrary timing.” EX1002, [0658]. This would include directly connecting the “erase transistor” to the capacitor it initializes. EX1003, ¶¶215-230. Notably, this maintains the circuit’s ability to arbitrarily cut off LED current because Kimura

teaches that the “electric current path to the [LED can be] cut off by a TFT 3611 [when turned ‘OFF’],” as Fig. 36B shows.¹¹ Kimura, [0666]. The same holds true for TFT 3310 in Fig. 33. EX1029, ¶¶81-85.

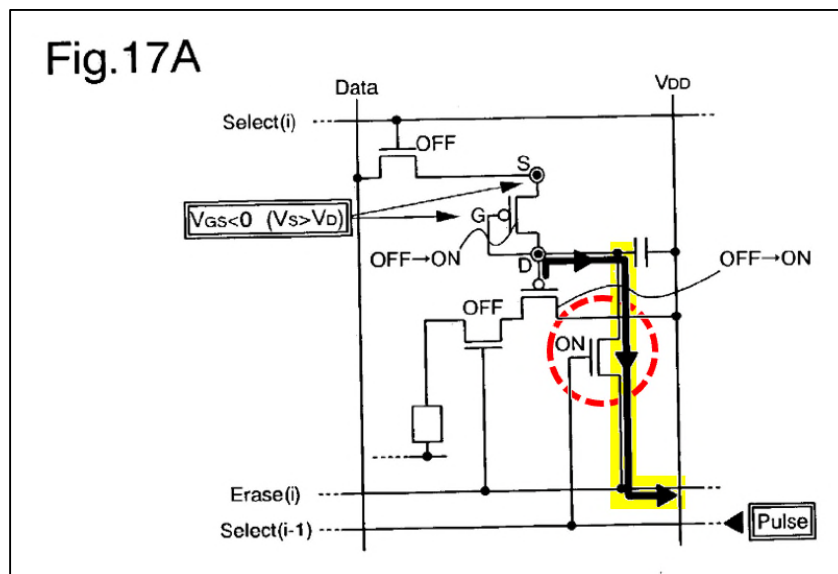
Regardless, even if TFT 3612 plays some role in preventing current flow through the LED, that does not make TFT 3612 any less of an “initialization transistor,” because it still discharges the storage capacitor before programming.



And it is undisputed the sole purpose of TFT 1607 (circled in red below) in Kimura Figs. 16-17 is to discharge (*i.e.*, reset/initialize) the capacitor, as Fig. 17A

¹¹ If TFT 3611 is the “erase” TFT (under Samsung’s definition), the initialization/reset TFT 3612 can be placed elsewhere because 3611 cuts off LED current. EX1029, ¶88.

shows. See Kimura, [0425]-[0426].



Petitioner's primary point is that Figs. 16/17 and 33/36 perform the claimed function of "discharging the data signal voltage stored in the capacitor" (see, e.g., cl. 8), regardless of whether such function is called "initialization," "reset," or "erasure." Dr. Wolfe admitted that Kimura's "Vreset" voltage is "intended to initialize the voltage on the capacitor prior to programming." EX1028, 243:3-7. That is sufficient for obviousness. *ADASA Inc. v. Avery Dennison Corp.*, 55 F.4th 900, 913 (Fed. Cir. 2022) (reversing finding of no anticipation where the prior art and claims discuss same concept using different terminology). Further, attaching the reset/initialization transistor to the capacitor in Fig. 33/36 solves Kimura's stated problem of unwanted light emission and provides motivation for doing so. See Kimura, [0666].

If Samsung contends Figs. 33/36 must maintain “erasure” capability as Samsung defines it (*i.e.*, cutting off LED at any time), that is already accomplished by TFT 3310 (Fig. 33) or TFT 3611 (Fig. 36). Regardless, Kimura shows Samsung is wrong that the “erasure” transistor must be “along the current path to the [LED]” (POR, 32). For example, “erasure” TFTs 914 and 2106 in Kimura Figs. 9 and 21 respectively, are plainly not in the LED current path. *See* Kimura, [0407], [404].¹²

Fig.9A

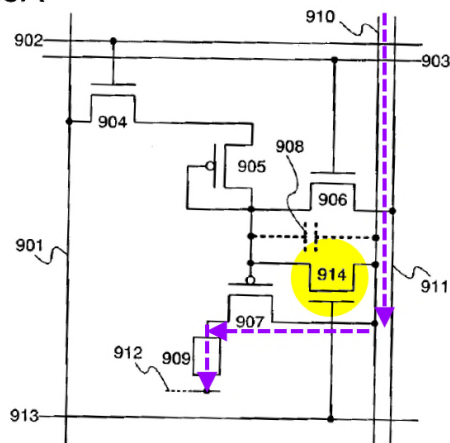
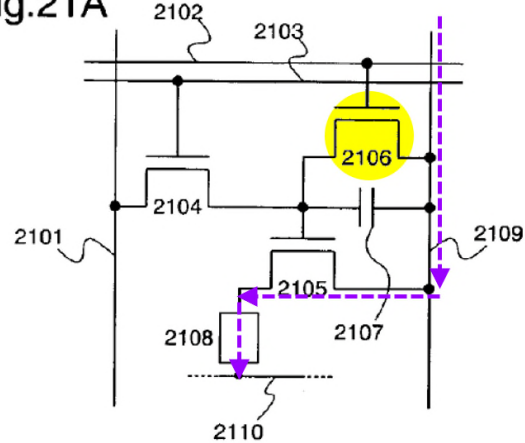


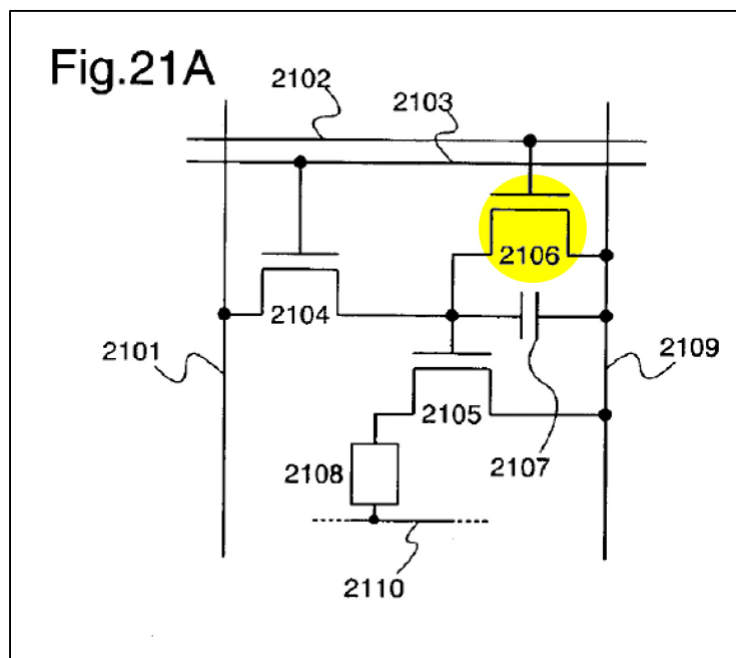
Fig.21A



Second, Samsung asserts Petitioner “improper[ly] confla[es]” Kimura’s “initialization” and “erasure” operations. POR, 4; *see also* EX2008, ¶85. Samsung argues that “[i]n Kimura, ‘erasure’ means ‘forcibly plac[ing] [the EL

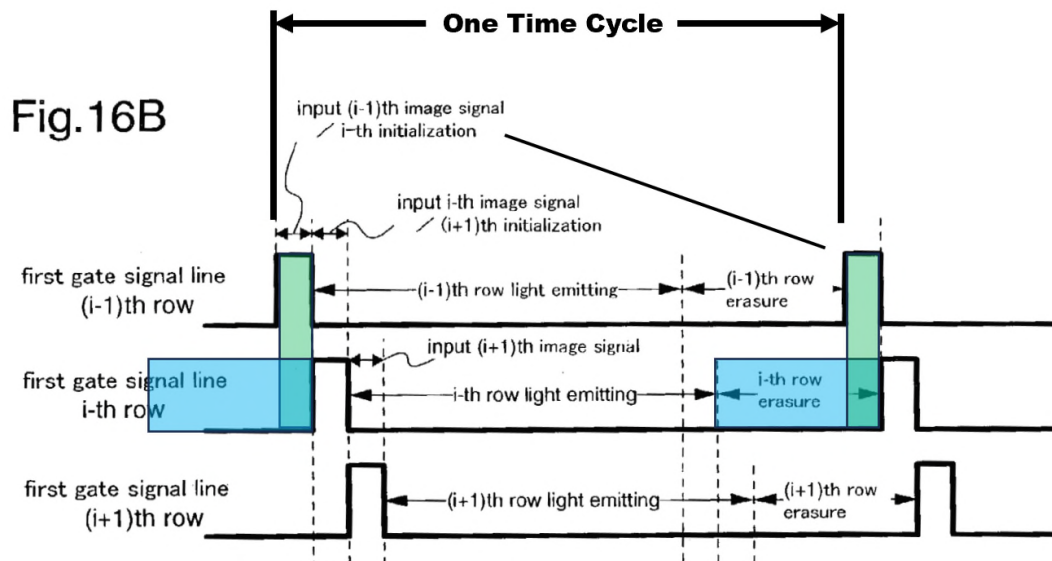
¹² Moreover, “erasure” TFT 2106 in Fig. 21 does **not** turn off the LED (*i.e.*, cutoff current), but can **turn it on**. EX1028, 221:17-223:12.

device] in a non-light-emitting state.” POR, 28. Samsung further asserts “Kimura does not use ‘erasure’ to refer to ‘reset[ting] the capacitor voltage to a default initialization value.” *Id.* Both statements are demonstrably incorrect, as shown by Kimura Fig. 21, and Dr. Wolfe’s discussion of it. Kimura expressly identifies TFT 2106 as “an erasure TFT” (Kimura, [0404]), and Dr. Wolfe testified that “[TFT] 2106 is described as an erasure TFT, and I believe that *its role is to discharge the capacitor.*” EX1028, 221:11-16; *id.*, 225:12-226:3. *See also* EX1029, ¶¶86-87.



Samsung previously color-coded the timing diagram of Kimura Fig. 16B (see POPR, 18) and led the Board to conclude Kimura’s “initialization period in green and the erasure period in blue ... do not overlap” (ID, 49). Samsung’s POR abandons this argument. And for good reason—Dr. Wolfe admitted they do

overlap. EX1028, 231:16-232:20. In fact, as shown below, they overlap so much that initialization (green) occurs entirely within the erasure period (blue). EX1029, ¶¶89-98; *see also* EX1028, 232:2-233:6, 182:19-183:1.



Accordingly, Kimura itself demonstrates “initialization” and “erasure” are not entirely “distinct” from one another. Moreover, Kimura links erasure/reset/initialization together in Fig. 17A when it explains that “Vreset” is the voltage placed on the erase(i) line for initializing the capacitor. Kimura, [0425]-[0426].

In summary, given the many reasons to connect the initialization/reset transistor of Figs. 16/17 to the capacitor of Fig. 33/36 (including a POSITA’s knowledge, the limited placement locations, Kimura’s various descriptions of “erasure” and “initialization,” and Kimura’s express disclosure of directly connecting a reset/initialization transistor to the capacitor), a POSITA would have

found it obvious to connect a transistor (regardless of whether it is called a “reset,” “initialization,” or “erasure” transistor) to the capacitor in Kimura Fig. 33/36 it is intended to discharge. *Intel Corp. v. PACT XPP Schweiz AG*, 61 F.4th 1373, 1380 (Fed. Cir. 2023).

Samsung makes one secondary argument, asserting that “the Petition’s proposed modification would also require adding at least one additional signal line connected to the drain of the [reset/initialization transistor].” POR, 33-34. Not so. *See* Pet., 79; EX1003, ¶321. As Dr. Foty’s original declaration explained, “[t]he actual voltage used for VReset is simply a design choice for the circuit designer” and that “[one] obvious option is disclosed in connection with Kimura Figures 16 and 17 where the drain of the reset transistor is connected to the light emitting signal (i.e., the second gate signal labeled 1604).” EX1003, ¶321. By using an existing signal (*viz.*, the light-emitting signal which is low during reset/initialization), no additional signals are required.¹³ *See also* Kimura, [0430] (teaching this flexibility); EX1029, ¶¶99-100.

¹³ Samsung alleges “Dr. Foty admitted in deposition that [the reset modification] would require at least one additional signal line.” POR, 27 (citing Ex. 2050,

IV. SAMSUNG’S SECONDARY CONSIDERATIONS FAIL

Samsung’s secondary considerations (POR, 46-65) fail for lack of nexus and on the merits. Undeterred by a lack of evidence (*see* Paper 30, order denying discovery), Samsung continues to allege “failure of others, long-felt need, skepticism, praise, and copying” support nonobviousness. POR, 46. They do not.

A. Samsung Fails to Establish Nexus

Samsung’s failure to establish nexus is dispositive. For “secondary considerations to be relevant, there must be a nexus between the merits of the claimed invention and the objective evidence.” *Volvo Penta of the Ams., LLC v. Brunswick Corp.*, 81 F.4th 1202, 1210 (Fed. Cir. 2023). “A showing of nexus can be made in two ways: (1) via a presumption of nexus, or (2) via a showing that the evidence is a direct result of the unique characteristics of the claimed invention.” *Id.* Samsung shows neither.

1. Samsung is Not Entitled to a Presumption of Nexus

Samsung does not assert entitlement to a presumption of nexus. *See* POR, 63 (relying instead on “unique characteristics” test). “A presumption of nexus

117:21-118:14). Dr. Foty said no such thing. *See* Ex. 2050, 117:21-118:14.

Rather, his testimony confirmed the explanation in his declaration. EX2050, 126:20-127:11.

requires both that the product embodies the invention and is coextensive with it.” *Volvo*, 81 F.4th at 1211. Samsung shows neither. Purportedly, Samsung’s “Galaxy S21 product practices all challenged claims,” but Samsung punts to claim charts and its expert to “explain[] that this pixel circuit for the Galaxy S21 product includes [the claim elements].” POR, 54-55. This is improper incorporation by reference (*see* 37 C.F.R. § 42.6(a)(3) and Papers 37 and 39), and is too cursory to establish nexus, as confirmed by the case Samsung cites. *See Volvo*, 81 F.4th at 1211 (no presumption of nexus where POR argument “amounts to a single sentence [citing] its expert’s declaration.”).

Samsung does not assert co-extensiveness, nor could it. The Galaxy S21—and similar Galaxy products—are smartphones. The ’599 patent is directed to a pixel circuit, not a smartphone. *Fox Factory, Inc. v. SRAM, LLC*, 944 F.3d 1366, 1374-75 (Fed. Cir. 2019) (no nexus when claims embraced mere “component”). Moreover, even if smartphone screens were the “product,” making a TFT display involves driver/control circuitry, materials selection, fabrication processes and considerations, circuit layout, etc., as confirmed by the 72 U.S. patents Samsung has with “AMOLED” *in the claims*. EX1030 (search results).

In IPRs on *unrelated patents*, Samsung asserts that “long-felt need, failure of others, skepticism, praise, and copying” of its Galaxy displays (including the S21) is “the direct result of the unique characteristics of [practicing the ’803 patent

claims related to pixel layout].” *E.g.*, IPR2023-00987, Paper 19 at 58, 72-74.

Similar facts in *Fox Factory* led the Federal Circuit to reverse a Board finding that a presumption of nexus existed. 944 F.3d at 1374-78 (reversing presumption of nexus because of “the patentee’s own assertions about the significance of the unclaimed features”). In sum, the facts here are the opposite of a situation where the patent and product are “co-extensive” with one another. EX1029, ¶¶101-104.

2. Samsung Fails to Show its Secondary Considerations Directly Result from the Unique Characteristics of the Claimed Invention

As a proxy for the claims, Samsung focuses on two purported “benefits”: (1) “display uniformity”; and (2) “aperture ratio.” *See, e.g.*, POR, 63; *see also id.*, 49-50 (uniformity), 51 (aperture ratio), 57-58.

Display Uniformity (V_{th} Compensation). Samsung asserts the claimed diode-connected transistor configuration “provide[s] for display uniformity by self-compensating for threshold voltage deviations in the driving transistor.” POR, 63. But Samsung does not dispute that prior art—including Kimura—disclose exactly this. *See generally* POR (no challenge that Kimura discloses V_{th} compensation); Kimura, [0654]-[0655], Fig. 33/36; EX1003, ¶¶77-78 (discussing four references disclosing V_{th} compensation); EX1028, 212:8-11 (admitting Kimura discloses diode-connected TFT configuration). Indeed, it was known since at least 1988 to use diode-connected transistors to “mak[e] practically identical copies of [a circuit]

without the need for accurately matched components.” EX1031, 1; EX1028, 213:9-12 (conceding that diode-connected configuration in ’599 patent was known in the prior art). This known technique cannot provide the necessary nexus. *See Yita LLC v. MacNeil IP LLC*, 69 F.4th 1356, 1364 (Fed. Cir. 2023) (“[O]ur case law makes clear that objective evidence of nonobviousness lacks a nexus if it exclusively relates to a feature that was *known* in the prior art—not necessarily well-known.”) (emphasis original; cites omitted). Nor is *Volvo* helpful for Samsung (POR, 63) because the Federal Circuit was procedurally barred from considering this argument since “the Board did not rely on [it] in reaching its decision.” *Volvo*, 81 F.4th at 1212.

Aperture Ratio (Shared Signals). Samsung asserts “the ’599 Patent allows high aperture ratios to be achieved in AMOLED displays by requiring fewer control or scan lines.” POR, 64. Initially, neither the ’599 claims nor specification reference “aperture ratio,” let alone explain, quantify, or otherwise describe this purported benefit. Accepting, *arguendo*, that some relationship exists, Samsung attributed the Galaxy aperture ratio to ***practicing other, unrelated patents*** concerning pixel layout. *See, e.g.*, IPR2023-00987, Paper 19 at 72-74 (“[T]he ’803 Patent’s ‘Diamond Pixel’ arrangement [is used in] every Samsung Galaxy [AMOLED display]” and is “what enabled ... improving the aperture ratio”); *see also* IPR2023-00988, Paper 18 at 68-71 (similar); IPR2023-00988, Paper 18 at 68-

71 (similar); EX2015 at 3 (attributing aperture ratio to “design rule in LTPS TFT fabrication process” rather than the pixel circuit that Samsung asserts to embody the alleged invention). Samsung cannot have it both ways.

Samsung points to a shared “scan signal” for controlling the first and third TFTs. POR, 64. This is the only shared signal in claims 7-12, and Samsung does not dispute Kimura discloses it. *See* Kimura, Fig. 34B; Pet., 36. Nor can Samsung dispute that Kimura repeatedly teaches sharing other control lines to improve aperture ratio. *See, e.g.*, Kimura, [0429] (“a high aperture ratio[] can be obtained” by keeping “[t]he number of signal lines [] to a minimum”); *id.*, [0421]-[0422] (similar), [0659] (“signal line for controlling a TFT can be shared among a plurality of TFTs”).

Only claims 2, 8, 16, and 18 require re-using an existing scan signal for initialization, but Kimura, Figs. 16A-B and 17A discloses this too. *See* Pet., 55 (previous scan signal used for initialization).

In summary, Samsung’s reliance on known threshold-voltage compensation techniques and shared signals cannot and does not establish the “direct result” nexus required to afford any meaningful weight to its purported secondary considerations. EX1029, ¶¶105-107.

B. Samsung's Secondary Considerations Individually Fail

Long-felt Need, Skepticism, and Failure of Others. See POR, 48-56. As purported *objective* indicia of “long-felt need,” Samsung cites itself. POR, 52 (citing EX2015 (a Samsung publication) and the ’599 patent); *id.*, 47 (citing EX2009, Samsung saying its own displays are “transformative technology”). Self-citation is not *objective* indicia of nonobviousness, and should be given no weight.

Samsung’s reliance on EX2010 (POR 48-49) to show long-felt need is self-defeating. The book post-dates the ’599 patent by 5 years but ignores the ’599’s purported solution when discussing display uniformity. EX2010, 30-31. Samsung asserts the ’599 patent “used only PMOS transistors, [which] went against the grain.” POR, 52. But Kimura itself and multiple pixel circuits in Samsung’s own exhibits which plainly disclose all-PMOS prior art pixel circuits. See, e.g., Kimura, Fig. 22; EX2008, ¶¶114, 117, 119.

Industry Recognition. Samsung asserts its “patented pixel circuit[] has been validated by specific industry recognition *for the inventors.*” POR, 56. But praise “for the inventors” is not a secondary consideration. Samsung’s cited article (EX2021) refers to “310 domestic patents and 418 overseas patents” the inventor holds, without identifying the ’599 patent or any product(s). Samsung’s other articles are similarly deficient. See EX2022, 2 (referencing Kwon’s “545 papers and ... 700 [patents and applications]”); EX2023 (generic praise for unspecified

“technical development”). Moreover, Dr. Wolfe was unaware of any ’599 licenses showing industry acceptance. EX1028, 41:15-42:6.

Copying. Samsung rampantly speculates when it accuses numerous manufacturers of “slavish copying.” POR, 47. Indeed, Dr. Wolfe did not know whether any of the seventeen “manufacturers” he accused of copying even manufactured or designed displays. *See* EX1028, 260:10-262:10. When confronted, Dr. Wolfe admitted the companies were “display distributors,” and that all the displays could be “sourced from a small number or even a single manufacturer.” EX1028, 264:7-15. This is not evidence of widespread copying. Moreover, Dr. Wolfe did no teardown work himself, did not request or supervise any such work, and did not know Dr. Silzars who did. EX1028, 29:22-30:2, 254:12-19. Lacking firsthand knowledge, Dr. Silzars merely “understands” the provenance of the products he purportedly photographed. EX2043, ¶2.

Regarding BOE (which does design and manufacture displays), Dr. Wolfe relied on a single image from a district court Complaint prepared by Samsung lawyers he did not know for a case where he had no involvement. EX2008, ¶¶157-158; EX1028, 16:16-18, 254:20-255:4, 255:12-256:6. From this specious trail, Dr. Wolfe concludes BOE “apparently [copied]” Samsung. EX2008, ¶158; EX1028, 258:6-12. This is precisely the type of speculation the Federal Circuit has rejected as evidence of “copying.” *See, e.g., Wyers v. Master Lock Co.*, 616 F.3d 1231,

1246 (Fed. Cir. 2010); EX1029, ¶¶108-114.

Any weight afforded Samsung’s purported secondary considerations “simply cannot overcome [Petitioner’s] strong prima facie case of obviousness.” *Id.*

V. **CONCLUSION**

The Board should find all Challenged Claims obvious.

Dated: May 31, 2024

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CERTIFICATE OF WORD COUNT

The undersigned certifies that the foregoing Reply with the word count limits set forth in 37 C.F.R. §42.24(c)(1). Excluding the parts of the Reply exempted by 37 C.F.R. §42.24(a)(1), this Reply contains 5,600 words as determined using the word count feature in Microsoft Word, which was used to prepare this Reply.

Dated: May 31, 2024

Respectfully submitted,

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CERTIFICATE OF SERVICE

The undersigned certifies that on May 31, 2024, a copy of the following was served in its entirety via electronic mail, upon the following attorneys of record for the Patent Owner:

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