

IN THE 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.
Petitioners,

v.

POLARIS POWERLED TECHNOLOGIES, LLC
Patent Owner.

IPR2023-00771
U.S. Patent No. 7,259,521

ZOOM DEPOSITION OF THOMAS L. CREDELLE,
(Reported Remotely via Web videoconference)
Powell Butte, Oregon (Deponent's location)
Thursday, April 18, 2024
Volume 1

STENOGRAPHICALLY REPORTED BY:
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JOB NO. 9011

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6 LTD.; and SAMSUNG ELECTRONICS AMERICA, INC.
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8 v.

9 POLARIS POWERLED TECHNOLOGIES, LLC
10 Patent Owner.
11 _____

12 IPR2023-00771
13 U.S. Patent No. 7,259,521
14 _____
15

16 DEPOSITION OF THOMAS L. CREDELLE, taken
17 on behalf of the Petitioners, with the deponent
18 located in Powell Butte, Oregon, commencing at
19 9:00 a.m., Thursday, April 18, 2024, remotely
20 reported via Web videoconference before
21 REBECCA L. ROMANO, a Certified Shorthand Reporter,
22 Certified Court Reporter, Registered Professional
23 Reporter.
24
25

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I N D E X

DEPONENT	EXAMINATION
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THOMAS L. CREDELLE	PAGE
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VOLUME 1	
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By Mr. Williams	8
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DESCRIPTION

NUMBER	PAGE
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Exhibit 1100	Declaration of Thomas L. Credelle;	132
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PREMARKED EXHIBITS

Exhibit 1001	U.S. Patent No. 7,259,521;
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Exhibit 1002	Kattamis IPR Declaration;
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Exhibit 1006	U.S. Patent Pub No. 2005/0190128 A1;
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Exhibit 1007	U.S. Patent Pub No. 2005/0140600 A1;
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Exhibit 1008	International Patent App. No. WO 2004/034365 A1;
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PREMARKED EXHIBITS(cont'd)

NUMBER

PAGE

Exhibit 2001 Credelle Declaration;

Exhibit 2011 Second Credelle Declaration;

/////

1 Powell Butte, Oregon; Thursday, April 18, 2024

2 9:00 a.m.

3 ---000---

4
5 THOMAS L. CREDELLE,

6 having been administered an oath, was examined and
7 testified as follows:

8
9 EXAMINATION

10 BY MR. WILLIAMS:

11 Q. Good morning, Mr. Credelle. My name is
12 Eliot Williams, and I will be asking you some
13 questions today.

14 Where are you located --

15 A. Good morning.

16 Q. Good morning.

17 Where are you located today?

18 A. Powell Butte, Oregon, which is near Bend.

19 Q. Okay. And what's your full name?

20 A. Thomas Credelle.

21 Q. Okay. Any middle initial or middle name?

22 A. L.

23 I'm sorry, L.

24 Q. You've been deposed before, correct?

25 A. Yes, that's correct.

1 Q. Okay. Do you recall when the last time
2 you were deposed was?

3 A. I think it was about a month ago.

4 Q. Okay. Do you have an estimate for how
5 many times you have been deposed?

6 A. More than 20, maybe more than 30. I
7 don't have an exact tally.

8 Q. Okay. Fair to say you have done this
9 more than once, so I'm going to skip over some of
10 the preliminaries here.

11 Is there any reason you couldn't testify
12 truthfully or accurately today?

13 A. No.

14 Q. Okay. If at any point you don't
15 understand one of my questions, let me know.
16 Otherwise, I am going to assume that you understood
17 the question.

18 Does that make sense?

19 A. Yes, it does.

20 Q. Okay. Let's talk about logistics for a
21 second.

22 Do you have any hard copy materials with
23 you in the room today?

24 A. Yes.

25 I did print out clean copies of my

1 declaration, the '521 patent and three references.
2 Sometimes it's easier to refer to these than
3 on-screen, but they are unmarked.

4 Q. Okay. The declaration that you printed
5 out, does that have an exhibit number at the
6 bottom?

7 A. Yes, it says Exhibit 2011.

8 Q. Okay. And then the other materials that
9 you just mentioned, do they have exhibit numbers?

10 A. Let me check. Yeah, Kim is 1007; Steer
11 is 1008; Hayafuji is 1006; and Assent -- where did
12 that go? -- I know I have it -- 1001.

13 Q. Okay. That Exhibit 1001, is that
14 U.S. Patent No. 7,259,521?

15 A. Yes.

16 Q. Okay. And if at any point today I refer
17 to the '521 patent, will you understand that that's
18 the document I'm talking about?

19 A. Yes, I will.

20 Q. Okay. Other than the materials you
21 mentioned, do you have any hard copies of any other
22 materials with you today?

23 A. Actually, yes.

24 I did print out -- I printed out
25 earlier -- it was some -- some excerpts from my

1 claim construction declaration. I don't think that
2 will be relevant today, but I do have a few pages
3 copied. No exhibit number.

4 I can put that away if we are not going
5 to use it.

6 Q. When you say your claim construction
7 declaration, are you talking about a declaration
8 filed in the PTAB or a declaration filed in a
9 district court proceeding?

10 A. This was -- I don't have the title
11 page -- district court.

12 Q. Okay. All right. So other than the
13 district court claim construction declaration and
14 the materials you mentioned, are there any other
15 hard copy materials in front of you today?

16 A. No, there are not.

17 Q. Okay. Are you on a computer right now?

18 A. Yes, I am.

19 Q. Okay. Do you have any windows open
20 besides the Zoom meeting?

21 A. I have the Zoom meeting, and I have my
22 browser. But the browser just has the Zoom -- or
23 actually -- no, I did have my emails open, but
24 they're closed now.

25 So it just has the Zoom; and I have a

1 folder that I downloaded the files in the chat, so
2 I have a folder that has those available
3 electronically. My copies are black and white, so
4 sometimes the color is useful, so I can use either.

5 Q. Okay. So other than the Zoom window, you
6 said you've got a folder of the materials for this
7 case.

8 Is there anything else you have open?

9 A. No.

10 Q. Okay. All right. Let me ask about
11 preparing for today's deposition.

12 Is there anything you did to prepare for
13 the deposition today?

14 A. Yes.

15 Q. What was that?

16 A. I reviewed the patent, my declaration,
17 the prior art references. I reviewed primarily
18 those documents.

19 Let's see.

20 I had some telephone calls with my
21 attorney, Mr. Hamill.

22 MR. HAMILL: I will caution the witness
23 not to disclose the substance of any communications
24 with counsel.

25 THE DEPONENT: Got it.

1 Q. (By Mr. Williams) Other than reviewing
2 the materials you mentioned, telephone calls with
3 counsel, did you do anything else to prepare for
4 today's deposition?

5 A. No, I think that's primarily it.

6 There was a call with -- actually, there
7 was call with another attorney whose name is Peter.
8 I forget his last name. But that was just for some
9 background on the IPR.

10 MR. HAMILL: I will caution the witness
11 not to disclose the substance of any
12 communications --

13 THE DEPONENT: Okay.

14 MR. HAMILL: -- with counsel.

15 THE DEPONENT: Okay. It was related
16 to -- related to the case.

17 Q. (By Mr. Williams) Okay. And do you know
18 Peter's last name?

19 A. Andrew?

20 I don't remember.

21 Q. Do you know what law firm he was with?

22 A. You know, I wrote it down. It was a
23 short call. I think -- yeah, maybe I will let
24 Mr. Hamill answer that.

25 MR. HAMILL: Yeah, we don't need to get

1 into that.

2 THE DEPONENT: Okay.

3 Q. (By Mr. Williams) How long was that call
4 with the lawyer named Peter?

5 A. Maybe 30 -- 30 minutes to an hour. I
6 don't exactly remember.

7 Q. Okay. These phones call that you
8 mentioned either -- with counsel, when did they
9 take place?

10 A. They took -- we had actually a few calls.
11 The first one was, I believe, last Friday; and then
12 we had one Monday; and then we had some short
13 conversations yesterday.

14 So over the span of the last week.

15 Q. Okay. The prior art that you mentioned
16 having reviewed, are those the three exhibits that
17 you mentioned earlier that you have printed out,
18 Exhibit 1006, 1007 and 1008?

19 A. Yes, that's correct.

20 Q. Is there any other prior art you recall
21 reviewing in preparation for today's deposition?

22 A. No, I don't think there was any other.

23 Q. Did you see in Chat that I had uploaded
24 an Exhibit No. 2001?

25 A. Yes.

1 Q. Okay. Do you have access to that
2 document?

3 A. I do.

4 Q. Okay. Can you open that for me.

5 A. Okay.

6 Q. Let me know when you see it.

7 A. Okay. It's on my screen.

8 Q. Can you tell me what it is.

9 A. This is a copy of my declaration for this
10 case before the PTAB.

11 Q. Okay. And can you turn to the end where
12 there's a date.

13 A. I see that.

14 Q. And what date do you see there?

15 A. July 17th, 2023.

16 Q. Okay. Is that your signature below the
17 date?

18 A. Yes. Yes.

19 Q. Okay. And this document is entitled
20 declaration of Thomas L. Credelle, correct?

21 A. Yes.

22 Q. Okay. And then there's -- you have
23 printed out, I think, in front of you, you said,
24 Exhibit 2011?

25 A. Yes, that's what it is marked.

1 Q. Okay. Can you turn to the date on that
2 document towards the end.

3 A. Yes, I see that.

4 This is dated January 29th, 2024.

5 Q. Okay. And is that your signature below
6 the date?

7 A. Yes, it is.

8 Q. Generally, do you have an understanding
9 of the difference between that document and
10 Exhibit 2001 that I asked you to look at a moment
11 ago that was dated July 2023?

12 A. Yes, I believe the -- the earlier one was
13 in support of the preliminary petition response;
14 and the second one was submitted more recently as
15 my declaration for the case as it stands now, the
16 more current document. But they are quite similar.

17 Q. Yeah, that's what I wanted to talk about,
18 the similarities, for just a moment.

19 Have you had a chance to review
20 Exhibit 2001 in preparation for today's deposition?

21 A. Yes, as a matter of fact, I did -- I did
22 review it briefly. Not in much detail, but I did
23 review it.

24 Q. Okay. And is there anything -- I guess
25 the question I want to ask is, do you stand behind

1 everything that was in Exhibit 2001?

2 A. I think that's a fair statement.

3 Q. Okay. So there's nothing -- in other
4 words, this is -- what's in Exhibit 2001 is your
5 testimony, correct?

6 A. Well, my declaration is encompassed in
7 that document as well as the document that I
8 printed from January.

9 Q. Sure.

10 A. There was -- and there was -- the content
11 was explained somewhat differently, but no
12 difference in actual opinions, I would say, but --

13 Q. Okay.

14 A. -- maybe some clarity that was added in
15 that document.

16 Q. Okay. Fair enough.

17 We're going to turn to Exhibit 2011 in a
18 few moments, but I guess I just wanted -- what I'm
19 curious about is whether there's anything that's in
20 Exhibit 2001 that you would want to recant at this
21 point.

22 A. Not that I can -- not that I can remember
23 or recall.

24 Q. Okay. So the best of your recollection,
25 the -- the testimony that's -- that's in

1 Exhibit 2001 is accurate and correct; is that fair?

2 MR. HAMILL: Objection. Misstates
3 testimony.

4 THE DEPONENT: To the best -- I'm sorry,
5 Andrew. I spoke too quick.

6 Go ahead, Andrew. You said something.
7 I --

8 MR. HAMILL: Yeah.
9 Objection. Misstates testimony.

10 THE DEPONENT: What -- what -- to the
11 best of my recollection, and I haven't reviewed it
12 in great detail, I believe the opinions expressed
13 there are consistent with the opinions I expressed
14 in the later document from January. I don't recall
15 any differences.

16 So I stand by those opinions as modified
17 or expanded in the second document.

18 Q. (By Mr. Williams) Okay. Is there
19 anything in particular in Exhibit 2001 that you
20 think was incorrect?

21 A. Not that I recall, but as I say, I didn't
22 review in great detail. I -- I noted when I
23 reviewed it that was consistent with the later
24 document, which added some explanatory content. I
25 don't believe there was any discrepancy.

1 Q. Okay. So then turning -- I want to ask a
2 couple process questions about the two
3 declarations.

4 So Exhibit 2001 is the declaration you
5 prepared earlier in time, correct?

6 A. 2001, yes -- yes, that was -- obviously,
7 the date was last summer, July. So the other
8 document was maybe six months later.

9 Q. Okay. So focusing for a moment, then, on
10 the time period leading up to the first declaration
11 last summer, can you describe for me the process of
12 creating that document.

13 A. I'm sorry, which one?

14 Q. 2001, Exhibit 2001.

15 A. 2001.

16 It's -- it's my opinions about these
17 three prior arts that were proposed by -- by
18 Samsung -- no, by -- I'm sorry -- yeah, by Samsung.

19 And I reviewed those prior arts, I
20 formulated some concepts, I had discussions with
21 attorneys, we drafted the report, we made edits,
22 and finally came up with the document that I signed
23 in July.

24 Q. And you reviewed the document before you
25 signed it, correct?

1 A. Yes.

2 Q. Did you -- so other than the attorneys
3 that were assisting you in that process, was there
4 anyone else who assisted you in preparing this
5 declaration, Exhibit 2001?

6 A. I have to -- no -- no, nobody else. This
7 is my document.

8 Q. All right. Okay. Did you have any other
9 assistants or employees helping you with your
10 analysis in this case?

11 A. I did not personally have any -- like
12 assistants helping with this case.

13 Q. Okay. Now, in terms of the text of the
14 declaration, are those words that you yourself
15 created, or did someone else create them?

16 A. As I said earlier, it was a collaborative
17 process. And some were created by me, some were
18 edits, and some were created by attorney.

19 So I couldn't point to any particular
20 phrases that -- that I could identify one way or
21 the other.

22 Q. Okay. When the time came to prepare
23 Exhibit 2011, can you describe the process for
24 creating that document.

25 A. Similar -- similar process.

1 Q. And when you say "similar process,"
2 meaning it was a collaborative process between you
3 and the patent owner's attorneys?

4 A. Yes.

5 Q. Okay. Did you -- did you compare the
6 second declaration, Exhibit 2011, to Exhibit 2001
7 at any point?

8 A. As I went through the process, it was
9 certainly, I will call it, a blueprint. But there
10 is -- as I said earlier, you know, my intent was to
11 expand and explain some points that were maybe
12 not -- maybe not -- not as clear as they could be,
13 you know, based on some feedback from the
14 institution decision.

15 Q. And other than addressing some points you
16 noticed in the institution decision, were there any
17 other changes you were trying to make between
18 Exhibit 2001 and Exhibit 2011?

19 A. Not -- not that I can put a finger on.
20 As I said, it was more about explaining
21 points that might have been not as clearly stated.
22 I don't believe there are any inconsistencies in
23 the explanation.

24 Q. Okay. And did you read all of
25 Exhibit 2011 before you signed it?

1 A. Yes.

2 Q. Okay. And did you believe it to be
3 truthful and accurate when you signed it?

4 A. Yes.

5 Q. Okay. Do you still believe it to be
6 truthful and accurate?

7 A. Yes.

8 Q. Okay. Is there anything in Exhibit 2011
9 that you would like to change before we start
10 asking questions about it?

11 A. In my recent review, I didn't note
12 anything that needed changing. I certainly could
13 have missed something small, but nothing came to
14 mind.

15 Q. How many times have you been retained as
16 an expert witness for a patent case?

17 Do you have happen to know that number?

18 A. It is in my CV; I should probably have
19 the number. Maybe 20, 30 times, maybe, over the
20 years. I have been doing this since about 2008.

21 Q. When you say, "this," you mean testifying
22 as an expert in patent cases?

23 A. Yes.

24 Q. Okay. Do you recall if any of your prior
25 cases where you have been an expert involved you

1 testifying to the effect that a patent was invalid?

2 A. Yes, I -- I work for both plaintiffs and
3 defendants on patent cases.

4 Q. And do you recall which -- which cases
5 you were on the defense side?

6 A. No, I would have to go back to my CV,
7 which I can do. But I made it clear in my CV which
8 were which.

9 Q. Okay. Let me ask you, so you have a
10 Exhibit -- you have a hard copy of Exhibit 2011,
11 right?

12 A. Yes.

13 Q. Okay. If you could turn to page 9.
14 And there's a section there called
15 "Person of Ordinary Skill in the Art."

16 Do you see that?

17 A. I do.

18 Q. And you abbreviate that term to
19 P-O-S-I-T-A, correct?

20 A. That is correct.

21 Q. All right. Do you have a preferred
22 pronunciation for that word?

23 A. "POSITA."

24 Q. "POSITA."

25 A. What I usually say.

1 Q. That's fine.

2 You would be surprised the diversity of
3 opinion on how to pronounce that word.

4 Okay. For purposes of the -- this
5 proceeding, you had -- according to paragraph 24,
6 you have applied the definition of a POSITA that
7 that petitioner was relying on; is that correct?

8 A. Yes, and Dr. Kattamis.

9 That's a name I don't know how to
10 pronounce. "Kattamis"? "Kattamis"?

11 Q. That's a good question.

12 A. Okay. His -- his deposition.

13 Q. Yeah, fair enough.

14 Okay. Do you have happen to have a
15 copy -- do you know what his definition is?

16 A. I don't -- I do not.

17 I didn't put that out.

18 It's in -- obviously, in the petition and
19 also in his -- in his definition. I probably
20 should have just copied it into this document but
21 did not.

22 Q. Okay. I put Exhibit 1002 in Chat. Just
23 going to have maybe one or two questions about that
24 if you want to open it.

25 And let me know when you have that open.

1 A. Okay. Got it.

2 Q. You can turn to paragraph 44, which is on
3 page 19, using the numbers at the bottom of the
4 page.

5 A. Okay. Let me read that.

6 Okay. I now remember that.

7 Q. Okay. You read paragraph 44?

8 A. Yes.

9 Q. Okay. And so that's the definition of
10 POSITA that you were applying in this case,
11 correct?

12 A. Yes.

13 Q. Okay. Do you have any disagreement with
14 that definition?

15 A. No, I think it's -- it's -- it's -- it
16 covers what I believe a POSITA would have in this
17 time frame.

18 Q. Okay. And the time frame we're talking
19 about here is around August of 2006, correct?

20 A. Yes, right.

21 Q. Okay. And would you yourself have had at
22 least this level of expertise in August of 2006?

23 A. Yes.

24 Q. Okay. So one of the criteria here is
25 "academic or industry experience in OLED display

1 engineering or comparable industry."

2 Can you describe for me what your
3 experience would have been in that field at the
4 time?

5 A. Sure.

6 As you may or may not know from my CV, I
7 have been involved with flat-panel technology for
8 most of my career. And part of that was related to
9 LCDs, which use active matrix technology. And so
10 that is -- that's relevant to display engineering
11 of OLED displays to the extent that they both use a
12 thin-film transistor technology to drive pixels.

13 Regarding OLEDs, I had extensive
14 experience with OLED display engineering during my
15 time at Clairvoyant Laboratories, which was around
16 2001 to 2006. More than half of that time was
17 related to applying the Clairvoyant technology to
18 OLED circuitry and displays.

19 And we actually worked quite closely with
20 a number of manufacturers of OLEDs, including
21 Samsung and LG and others, to adapt the technology
22 that we had developed to their OLED designs.

23 And that involved a very close
24 collaboration with the engineers at those companies
25 to engineer the new pixel layout, structure and

1 software processing to operate the new technology
2 that actually is -- is used widely now by Samsung.

3 Q. What was the -- what was it that
4 Clairvoyant was in the business of at that time?

5 A. Clairvoyant invented a novel pixel
6 arrangement of the RGB dots to allow reduced power
7 consumption, improve color performance and higher
8 resolution displays by rearranging the dots in a
9 novel way. It's called a PenTile matrix, was the
10 term we used initially.

11 And that allowed the manufacturer to
12 reduce the number of thin-film transistors on the
13 array and make the array more dense, a higher --
14 higher pixel density.

15 So we, in implementing that, had many
16 challenges as it related to changing the TFT design
17 to match this new pixel structure. So myself and
18 my team had extensive meetings and conversations
19 with suppliers in Asia, primarily Samsung but also
20 LG and some Japanese companies, who were interested
21 in using our new technology.

22 The business model of Clairvoyant was to
23 license the technology to the manufacturers.

24 Q. So you mentioned TFTs. Is that a
25 thin-film transistor?

1 A. Yes, I apologize for using that jargon.
2 But, yes, thin-film transistor is abbreviated
3 "TFT."

4 Q. Are thin-film transistors used in LCD
5 displays at that time?

6 A. Most certainly, yes.

7 Q. In an LCD display, what was -- what was
8 the purpose for which the thin-film transistor
9 would have been used at that time?

10 A. Actually, it's used in two ways.

11 Fundamentally, a thin-film transistor was
12 used at every pixel of the display to store data
13 that would be -- that would just be used to create
14 the pixel luminance, if you will.

15 LCD doesn't have any light-emitting
16 capabilities, but it does allow to change the
17 transmission of light through a pixel that's
18 controlled by a thin-film transistor and a storage
19 capacitor.

20 There is one at every pixel. In some
21 cases now, there's two at every pixel, but around
22 2006, primarily one.

23 A thin-film transistors are also used,
24 around this time frame, in creating some
25 gate-driving circuitry, although it could be done

1 externally or internally. The same thin-film
2 transistors can be used to create some very limited
3 circuitry on the panel itself.

4 Q. I want to -- when you say "external" or
5 "internal," you mean external or internal to the
6 panel itself, or something else?

7 A. In -- what I mean by that is integral
8 with the glass, integral with the active matrix
9 substrate that is used in the fabrication of the
10 display.

11 Instead of using external gate drivers,
12 the technology is advanced enough by this time to
13 start using internal -- I call internal or integral
14 gate-driver circuits directly on the glass or
15 substrate.

16 Q. Okay. What's the -- can you explain what
17 you mean by "substrate" in that context.

18 A. In this context, I am referring to the
19 lower substrate of a LCD or OLED which contains the
20 active matrix circuitry and, usually, the
21 connections to the outside world and some other
22 functions. But primarily, it's that substrate.

23 In an LCD, there's also another glass
24 substrate which usually contains the color filters
25 to make a color display. But the substrate or the

1 transistors are fabricated as the lower substrate,
2 or I referred to it as "glass substrate."

3 Q. Okay. Thank you.

4 So at this time -- I guess the question I
5 was getting to a moment ago about the use of
6 thin-film transistors in LCD displays at the time
7 you were at Clairvoyant, were you also then using
8 that technology in OLED displays at Clairvoyant?

9 A. So to be -- to be clear, Clairvoyant
10 didn't manufacture any products. We worked with
11 manufacturers in Asia to build prototypes.

12 And we worked with LCD manufacturers, and
13 we adapted our technology to the LCD design. And
14 there are certain different constraints about LCDs
15 and OLEDs, so the design of the transistor
16 substrate required changes. And we worked closely
17 with manufacturers to do that.

18 And then with respect to OLED, the same.
19 We would propose a design and work with the
20 engineers to -- to create prototypes, and then we
21 would -- we could demonstrate the capability of our
22 technology and provide the appropriate software
23 required to adjust the video signal data such that
24 it would provide the right information at the right
25 pixel.

1 Q. So do you recall working around the 2006
2 time period, then, on any type of OLED display
3 panel?

4 A. Yes.

5 As I just described, at Clairvoyant -- I
6 was there for about five years, up to around 2006,
7 as I recall. And over that span of time, we worked
8 with, probably, a dozen manufacturers of LCDs and
9 OLEDs. But the primary partner was Samsung.

10 Q. Okay. Is there a difference between an
11 OLED display and a nonOLED display?

12 In other words, is an OLED a type of an
13 LED display, or are they different things?

14 MR. HAMILL: Objection. Form. Compound.

15 THE DEPONENT: An OLED display, "O"
16 stands for "organic," and "LED" is "light-emitting
17 display." So the OLED is a display that
18 incorporates pixels that have OLEDs in every pixel.

19 The OLEDs can be red, green and blue
20 light emitters, or they can be white emitters with
21 a color filter. But fundamentally, they are
22 light-emitting display.

23 An LCD is a passive display in that
24 sense. It doesn't create light. It modulates
25 light from a backlight source and -- instead of

1 color filters to create a color display.

2 The -- unfortunately, the TV industry has
3 bastardized the names of TV displays, and they call
4 them QLEDs or OLEDs. And that actually -- in the
5 sense of an LCD, that refers to the LED backlight.
6 It doesn't refer to actual pixel-using LEDs. So
7 the so-called QLED displays are LCDs with LED
8 backlights.

9 OLED displays don't have a backlight.
10 They generate light individually at each pixel,
11 with a circuitry that has a number of transistors
12 to store and display the data.

13 Q. (By Mr. Williams) One of the things you
14 mentioned in your answer about LCD displays a
15 moment ago was to discuss active matrix.

16 Can you explain what that is, what an
17 "active matrix" means?

18 A. That's -- that's a terminology that
19 started, you know, way back in the, probably, '80s.

20 Displays were broken into two categories:
21 so-called passive matrix displays, where all the
22 signals to drive the pixels were provided at the
23 row and column edging -- in the case of either
24 OLEDs or LCDs, that worked fairly well for
25 low-resolution applications; but for

1 high-resolution applications, such as laptops or
2 monitors, the performance of the passive matrix
3 wasn't good enough to provide a good picture.

4 So the active matrix was -- was
5 developed -- actually, the active matrix concept --
6 concept goes back to the -- to the late '50s or
7 early '60s. The idea is to put an active
8 transistor at every pixel, or even an active diode,
9 but a nonlinear element at every pixel that can
10 better control the signal from the pixel to
11 achieve, for example, higher contrast ratio or more
12 brightness.

13 So the industry has adopted the term
14 "active matrix LCD," meaning thin-film transistors
15 or even transistors themselves are added to each
16 pixel to create a better picture.

17 Q. Can you turn to -- I am going to ask some
18 questions about your declaration, so that's
19 Exhibit 2011.

20 A. Okay.

21 Q. And I am at paragraph 32.

22 A. Okay.

23 Q. Which is under a heading of "Active
24 Matrix architecture."

25 Do you see that?

1 A. Yes.

2 Q. Okay. The first sentence, you said
3 "Display elements can be driven directly to create
4 illumination or driven passively."

5 What does it mean "driven directly"?

6 A. So by that I mean, for example, take an
7 LED, a regular, inorganic LED you buy at a store,
8 or it's in your flashlight. Those operate by
9 applying a voltage directly to the leads of the
10 diode.

11 And one can contemplate making a display
12 by that manner, but you would have millions of
13 wires. So that would -- but each LED is directly
14 driven from a power supply controlled by some,
15 you know, switch.

16 A passive matrix is a -- is a design
17 where, as I said, the driving signals are provided
18 on the rows and columns of a display.

19 So a display has columns. Usually the
20 data comes in the column by -- by convention. The
21 rows are -- are switching electrodes. And so by
22 providing voltages on the rows and columns, you can
23 create a -- a signal at a pixel to -- to drive it.

24 But as I said, the performance is
25 somewhat limited. And it's good for low-resolution

1 displays, and it's still used for very
2 low-resolution signage applications.

3 But if you want to have high resolution
4 like we are now used to with our -- our products,
5 you need an active matrix, which has these
6 additional nonlinear elements to better control the
7 signal, the voltage, as I said, on the either LCD
8 or OLED.

9 Q. You alluded to the need for millions of
10 wires. I'm just trying to understand a
11 hypothetical -- what you mean there.

12 So you would need a wire for each pixel;
13 is that the million that you were talking about?

14 A. What I said is, if you are going to
15 directly drive each LED, each LED has two leads.
16 One has -- you know, one can be ground, but the
17 other one has to go to a switch, to a control
18 point, if you will. And that, you know, can be
19 done.

20 And to some extent, the billboard
21 displays that we see around the highways, which are
22 very low resolution, do use some kind of direct
23 drive, although there's some minor multiplexing.
24 They are not active matrix. Actually, they're more
25 of a passive design with driver chips.

1 But that's the idea. If you had a
2 million-pixel display, you would have to have an
3 individual wire coming out from every pixel to
4 control it, which would certainly not be
5 cost-effective.

6 Q. So how do active matrix displays avoid
7 the problem of, you know, millions of wires that
8 you just alluded to?

9 A. So an active matrix display, as -- as
10 I -- I think, you know, there's figure in my report
11 that describes the basic design.

12 Whether it's an LCD or an OLED, there is
13 a transistor that controls either the transmission
14 of light or the generation of light at each pixel.
15 And by having an array of rows and columns -- and
16 that is really the "matrix" part of the word
17 "active matrix" -- the basic operation is that the
18 rows are turned on one by one, sequentially, and
19 the data is supplied from a driver onto the columns
20 in parallel.

21 So if you have a 1920-by-1080 display,
22 like an HDTV, you would have 1920 columns of
23 information that comes from a -- your video source
24 and is converted to the right format and impedance
25 for each column.

1 When you switch on a row -- so, for
2 example, row 1 switches a transistor to an "on"
3 position, and the data from the columns can flow to
4 a storage capacitor within the pixel. And that
5 analog voltage is -- is -- is -- is saved, if you
6 will.

7 It's -- it's kind of like a dynamic RAM.
8 You save the data. When you turn off the row, the
9 pixel is floating. So if the resistance is high
10 enough to its surrounds, that -- that voltage will
11 stay on the pixel for -- for -- until you refresh
12 it. And you refresh them roughly every -- 60 times
13 a second, or 120 times a second. So the data is
14 written, if you will, to the pixel.

15 And if it's an LCD, it's controlling the
16 amount of transmission of light for that pixel.

17 And if it's an OLED, it's controlling the
18 amount of current that will flow during the -- the
19 entire frame time. And then it's refreshed a 60th
20 of a second later with new data.

21 I'm greatly simplifying the way an OLED
22 works, but that's the basic concept, you know, of
23 an active matrix.

24 Q. Okay. That's helpful.

25 The -- the -- you mentioned a particular

1 resolution of 1920-by-1080. And that, I guess, was
2 understood to be kind of a standard HDTV resolution
3 at the time; is that correct?

4 A. Yeah, it was certainly known in 2006.

5 I think, you know, in 2006 time frame, I
6 can't recall, you know, for -- certainly monitors
7 and laptops had resolution even much higher than
8 that. But it's really just a representation of the
9 number of columns and the number of rows.

10 Back in the old days, there was something
11 called XGA resolution or VGA resolution, and that
12 referred to how many columns and how many rows.

13 And I didn't mention, but in either case,
14 if you have a color display, you need three times
15 as many transistors as black and white.

16 Q. Okay. You would need three transistors
17 per pixel for a color display; is that what you are
18 saying?

19 A. Yes.

20 They -- unfortunately, our industry uses
21 the word "pixel" to mean sometimes just an
22 individual pixel; and it's -- sometimes they are
23 called subpixels if you have three or four pixels
24 to make up, you know, one resolution element.

25 So in the case of HDTV, that's

1 1920-by-1080. But there could actually be three
2 times as -- the number of subpixels to make up that
3 number of -- sometimes you call them "logical
4 pixels" or just "pixels."

5 So that's just something our industry
6 never really cemented a clear definition. But it's
7 well-understood, certainly, by a person of skill in
8 the art.

9 Q. Okay. Thank you.

10 So then getting back to this notion of
11 the matrix -- direct drive involving -- you know,
12 you would need a connection to every one of these
13 pixels, versus the -- the matrix.

14 So you could -- so in the case of HDTV,
15 you mentioned -- I'm not going to do this math, so
16 let's call it 2000-by-1000 pixels. That would
17 be --

18 A. Right.

19 Q. -- essentially 2 million pixels we are
20 talking about, then. Or potentially 6 million if
21 we need three for every resolution element.

22 Am I following you correctly?

23 A. Yes, that's right.

24 Q. Okay. So worst-case scenario there, it
25 seems like you might -- you would -- if you are

1 going to drive each of those directly, you would
2 need 6 million wires coming out of that panel to
3 some other control function; is that right?

4 A. Yes.

5 Q. Okay.

6 A. Yes.

7 Q. And with an active matrix, then, we can
8 reduce that to, what, I guess 6000-by-1000, so
9 7,000 wires?

10 A. Yes, that's -- you did the math right.

11 Q. Okay. All right. Thank you.

12 On the next page of your declaration,
13 which this is still, I think, paragraph 32, there's
14 a picture there.

15 Do you see that?

16 A. Yeah, yup.

17 Q. That's Figure 2.3 from -- I think it's --
18 well, it's Exhibit 2011, which is a textbook, I
19 think --

20 A. Yeah.

21 Q. -- is that right?

22 A. Den Boer -- den Boer is the author, yes.

23 Q. And you have reviewed that --

24 A. Yes.

25 Q. You've reviewed portions of that textbook

1 here?

2 A. I have reviewed that textbook.

3 Q. Okay. Were you familiar with that
4 textbook before this case, or do you remember?

5 A. Yes, I've used it in other cases. It's a
6 good reference, because it's dated back more in the
7 time frame of the old patents.

8 But, yes, I have used that before.

9 Q. Okay. And you are relying on it on
10 occasion in your declaration as evidence of what a
11 person of ordinary skill in the art would have
12 understood in this field at the time, correct?

13 A. That's fair.

14 Q. Okay. Can you just briefly explain what
15 it is that is shown in this Figure 2.3 on the page
16 here?

17 A. Sure. So this is for an LCD, and it's
18 showing just four pixels. And it shows data lines
19 going vertically and what's called select lines
20 going horizontally. So you can imagine the select
21 lines to be the rows and the data lines to be the
22 columns.

23 And so as I described just a moment ago,
24 data from the -- the -- the driver comes down the
25 data lines. And if a select line is chosen, for

1 example, the select line shown in the middle -- the
2 middle horizontal line, it switches a transistor, a
3 thin-film transistor. That allows the data signal,
4 which is analog, to be stored on that capacitor
5 that's shown in the pixel.

6 And then the select line is turned off,
7 and that TFT goes to a "off" state, and that
8 capacitor is floating. In other words, it can't --
9 the charge stays on that point.

10 Now, for the rest of the frame, until
11 it's refreshed, that will provide a voltage to the
12 liquid crystal, which is effectively a capacitor,
13 and it will switch the molecules of the liquid
14 crystal to some level to cause light to -- to be
15 modulated as it flows through that pixel.

16 And this is a very simple display with
17 four pixels. So pretty simple. You probably could
18 do this with direct wiring.

19 But you can see that the -- the data is
20 coming from the -- the source, the data driver, the
21 source driver, that's been properly formatted to
22 match the needs of the liquid crystal in term of
23 its voltage, its impedance, its analog levels.
24 That's all done in the driver.

25 Whereas the select line is just an on/off

1 switch.

2 Q. Okay. Thank you.

3 So then in practice, in this case or -- I
4 guess two pixels per row are shown; is that right?

5 A. In this one, yes.

6 Actually, on the next -- Figure 2.17, it
7 shows some driving waveforms that shows what I just
8 said about selecting and nonselecting rows.

9 Q. Okay. So let me ask a question about
10 that figure then.

11 This is Figure 2.17; is that right?

12 A. Yes, yes.

13 Q. All right. So is the operation here any
14 different than what you were describing with
15 respect to Figure 2.3?

16 A. No.

17 The only minor difference is they
18 actually show that there would be three pixels for
19 a color to -- to achieve color, there would be red,
20 green and blue signals coming from the data driver
21 to create red, green and blue dots on the screen.

22 Q. Okay. And then what is the select --
23 what is the waveform shown on the select pulses
24 meant to indicate?

25 A. As I mentioned, the rows in an active

1 matrix are selected one by one. And in the case of
2 these transistors in this illustration, a positive
3 voltage would turn the transistor on.

4 So think of that as a switch. You close
5 the switch, and now the data signals can flow to
6 that capacitor that I mentioned. And it happens
7 in -- in parallel.

8 So these three signals shown here, red,
9 green and blue, data only goes to that row. All
10 the other transistors are turned off, so the data
11 only is written to the rows that's activated by the
12 select pulses.

13 Q. Okay. I have a couple follow-up
14 questions.

15 So then, just focusing on the first row
16 of pixels, then, when that row is active, does
17 that -- does that imply that the data is coming in
18 in parallel in each of those -- each of those
19 vertical lines, I guess?

20 A. Yes, that's correct.

21 That's normal operation of an active
22 matrix.

23 Q. Okay. So you would send in the data for
24 the entire row at one time, run the data lines.

25 A. Yes, that's correct.

1 And in the industry, we call that
2 line-at-a-time "addressing."

3 Q. Got it. Then I wanted to understand, so
4 what -- and maybe you explained this already, just
5 like the 2.3.

6 But in Figure 2.17, I see each of these
7 pixels has, it looks like, two things that are
8 shown as capacitors. One -- they have different
9 orientations, I guess. One is pointing up and
10 down; one is pointing left and right.

11 What are those two different capacitors
12 meant to indicate?

13 A. The -- these are meant to indicate
14 storage capacitors. And I forget the -- the text
15 description for this figure, but I believe it
16 pointed that -- pointed out that the capacitor that
17 is needed to store the information could either be
18 a capacitor attached to adjacent gate line as a
19 reference ground; or it could go to what's referred
20 to as a common connection, which would be another
21 electrode, if you will, of the capacitor that will
22 store the data.

23 Actually, not shown is, the liquid
24 crystal itself is a capacitor. But basically, it
25 was found back in this time frame and before that

1 maybe that capacitance wasn't good enough or the
2 resistance, the leakage resistance, was too high,
3 and you needed a larger capacitor.

4 The goal of the capacitor is to hold the
5 voltage on the pixel for 1/60th of a second. So
6 the time constant, R times C, has to be greater
7 than -- than 1/60th of a second.

8 So additional capacitance is almost
9 always added by one or both of these methods.

10 Q. Okay. Understood.

11 So just turning back to page 12 for a
12 second.

13 In paragraph 33, you say "A driving
14 circuitry principle for AMLCDs is illustrated below
15 for a two row by three column section of an AMLED."

16 What do you mean by "AMLED" there?

17 A. That's a typo.

18 This paragraph is about LCD.

19 Q. Okay. So that should be AMLCD at the end
20 of that first sentence I just read?

21 A. Yes, that would be --

22 Q. Okay.

23 A. Yeah, that's just a typo.

24 Q. That's fine.

25 MR. WILLIAMS: We have been going about

1 an hour. If this is good for you, why don't we
2 take a short break.

3 THE DEPONENT: Okay.

4 MR. WILLIAMS: Off the record.

5 (Recess taken.)

6 MR. WILLIAMS: Let's go back on the
7 record.

8 Q. (By Mr. Williams) During the break, did
9 you discuss the substance of your testimony with
10 anyone?

11 A. No.

12 Q. So getting back to this discussion we
13 were having around paragraph 33 of your
14 declaration.

15 I see -- I recognize now that you
16 indicated there's a typo now in terms of AMOLED
17 versus AMLCD.

18 The next question I am going to have has
19 to do with OLED displays.

20 So how does the discussion we've been
21 having differ for OLED displays as opposed to LCD
22 displays, if at all?

23 A. Well, I did describe it later on in my
24 report.

25 For example, on paragraph 42, I show the

1 basic pixel architecture for an AMOLED display.
2 And this is the -- probably the kind of simplest
3 pixel structure you could have for an AMOLED
4 display.

5 It shows a pixel circuit which now has
6 two transistors and one capacitor as a minimum for
7 active matrix operation.

8 The transistor -- one transistor is
9 basically the same as the LCD version. It's
10 basically a transistor -- it's an on/off switch
11 that allows data signals to be stored on a
12 capacitor.

13 But the OLED is a light-emitting device,
14 so it has a second transistor on the figure on
15 page 21, labeled "MP2." That's often called the
16 drive transistor.

17 And when that transistor is turned on,
18 it's basically a transistor that works in an analog
19 manner, allowing current to flow from the -- in
20 this circuit diagram, VDD through the OLED to
21 ground, and that OLED will light up. And that OLED
22 will stay lit at a level set by the capacitor for
23 the entire frame until it's refreshed.

24 So like, for example, a 60th of a second
25 later, new data is written to the capacitor, and

1 new current will flow from that OLED to create a
2 light -- a spot of light. And that could be red
3 OLED, green OLED and blue OLED, or there's other
4 versions.

5 But the idea is that that driving
6 transistor is required with the connection to a
7 power supply.

8 Q. You used the word "frame" there, and I
9 want to make sure I understand what you mean.

10 Can you explain what a "frame" is in the
11 context of a display panel?

12 A. Sure.

13 The frame is -- I think its roots are
14 probably in television. But it refers to one
15 snapshot of data that's going to be displayed
16 across the entire screen, and it's refreshed fast
17 enough so you could have motion video.

18 If you have static images, you can have a
19 frame time that's longer than the 1/60th of a
20 second; but for any kind of motion, you need to
21 refresh the data periodically.

22 And it's -- the whole screen is called a
23 frame of data. As I say, the roots are back from
24 cathode ray tubes. But anyway, that's -- that's
25 the terminology generally used, whereas a line of

1 data would just be one row of data.

2 And so there's a frame time, which is
3 usually about a 60th of a second.

4 There's also a line time that has --
5 depends on the frame time and the number of rows
6 that you have to address. It's actually a much
7 shorter amount of time, obviously.

8 Q. So above the figure you were pointing to
9 on page 21 of your declaration, above that, you say
10 "Because the drive TFT must handle higher current
11 than TFTs in AMLCDs, higher mobility devices are
12 required."

13 Can you explain why the -- and maybe you
14 just did, but can you explain that sentence to me?

15 What is the drive -- the TFT -- why does
16 "the drive TFT must handle higher current" than in
17 an LCD panel?

18 A. Sure.

19 The -- the LCD panel, the only current
20 that's flowing, you know, from the data driver
21 section is enough current to charge a capacitor.
22 And that's a very small amount of current.

23 And there are two kinds of transistors
24 used in active matrix, generally. There's the
25 so-called amorphous silicone and poly silicone.

1 There are others.

2 But amorphous silicon is a very low
3 mobility, meaning a fairly poor transistor as
4 transistors go. But that transistor has enough
5 current capability to charge the capacitor.

6 For poly -- for AMOLEDs, there's a much
7 more significant current that has to flow through
8 the OLED to create light. And so that requires a
9 higher-mobility transistor, and that's what I am
10 referring to in that paragraph. It's a
11 higher-mobility transistor that can handle the
12 current to light the pixel to the appropriate
13 brightness.

14 It's -- it's only nanoamps or -- or maybe
15 tens of nanoamps of current, but it's much more
16 than the picoamps that you need to charge an LCD
17 pixel.

18 And so you need these higher-mobility
19 transistors, and the industry generally uses what's
20 called polycrystalline thin-film transistors for
21 that purpose.

22 Q. Okay. That's helpful.

23 The capacitor that you mentioned in this
24 circuit, which is labeled "C1," I believe, did you
25 describe that as a storage capacitor?

1 A. Yes, it basically performs that function.
2 It -- the circuitry in a pixel can have other
3 capacitors and other -- other more complex circuits
4 than this basic circuit. But in this case, it is
5 storing the voltage that will be applied to the
6 gate of the driving transistor.

7 So the gate to source, which the
8 capacitor is from gate to source on -- on the
9 transistor, that will set the -- the amount of
10 current that flows through that transistor.

11 Q. And so does that capacitor then have the
12 same function it did in the LCD panels we looked at
13 before the break?

14 MR. HAMILL: Objection. Form.

15 THE DEPONENT: I would say at -- at -- at
16 a high level, they perform a similar function but
17 actually act differently in the circuit, clearly.
18 But they are -- in both cases, there is data stored
19 on the capacitor and held until refreshed or until
20 it decays.

21 Q. (By Mr. Williams) This circuit that
22 you've included here in -- in your declaration,
23 where did it -- where did this figure come from?

24 A. Well, it came from Exhibit 12. Let's
25 see.

1 It's from an article by Han. It looks
2 like that's Exhibit 12 -- 1012 at page 54.

3 Q. Okay. So in your view, this figure from
4 Han is an accurate depiction of what a typical
5 AMOLED pixel circuit would have looked like
6 around -- around the time of the invention?

7 A. No, that's not what I said.

8 I said this is a simplified pixel circuit
9 that performs the necessary functions.

10 But unfortunately, transistors aren't
11 exactly uniform. And there's real-world effects
12 like resistance and other factors which generally
13 require additional transistors in a circuit that
14 would be used practically today.

15 So there may be four or five or six
16 transistors within a pixel instead of two. But
17 there is always a driving a transistor. There's
18 always a switching transistor. But there's
19 additional transistors that can perform other
20 functions in circuits that are actually fabricated
21 today, or even probably contemplated back in the
22 time frame of this, you know, patent.

23 Q. Okay. You said there's always the two
24 transistors, and there would be always be the
25 diode, I assume, correct?

1 A. Yes.

2 Q. And what about the capacitor?

3 Would that always be present as well?

4 A. There always is a capacitor. It's wired
5 in the circuit in different ways.

6 But there has to be some method to store
7 information that can control the driving transistor
8 during -- what's called the emission period. So
9 you have kind of the -- sometimes called a
10 programming period and emission period. So during
11 that emission period, you have to have light.

12 And so that's all built into the
13 circuitry that is used.

14 And, you know, later on in my background
15 section, I show a couple examples of more
16 complicated circuitry that's used to basically make
17 the image more uniform and account for some of
18 these nonuniformities in either like threshold
19 voltage, resistance of lines, et cetera.

20 Q. Yeah, we'll come to that, obviously. I
21 want to talk more about those nonuniformities in a
22 few minutes.

23 But can you explain that distinction used
24 here between programming and emission time in an
25 AMOLED panel?

1 A. Sure.

2 In this -- in this simplified circuit,
3 there are actually -- they kind of merge together,
4 but the -- the concept is the same.

5 The concept is, during some period of
6 time, which is a line time -- which is a fraction
7 of the whole frame, you know, one thousandths of
8 the frame, maybe, if there's a thousand rows --
9 data has to be written to the capacitor.

10 And in this simple circuit, as data is
11 written to the capacitor, some light will be
12 emitted because there's nothing to switch it off or
13 on. It's continually connected.

14 But once that row is turned off and the
15 data is stored in the capacitor, that will control
16 the current flowing in the drive transistor to the
17 OLED.

18 So that would -- in more complicated
19 circuits, the -- the time where you're writing data
20 is separated from the time you are lighting up the
21 panel in a way to improve the performance. And
22 some -- sometimes it's called the programming time
23 and the emission time.

24 It's not a rigid definition, but there's
25 a distinction between those two phases, if you

1 will.

2 Q. Yeah.

3 Okay. I think I understand that.

4 So this circuit doesn't show anything to
5 prevent the LED from emitting while it's being
6 programmed, correct?

7 A. Correct.

8 Q. And then -- so I think what that implies
9 is that the LED would need to emit for longer than
10 it takes this -- the entire panel to program that
11 line; is that correct?

12 MR. HAMILL: Objection. Form.

13 THE DEPONENT: Basically, the programming
14 of the pixel occurs in -- in, as I mentioned, a
15 row-by-row sequential manner.

16 So if there are thousand rows, and you
17 have a 16 millisecond refresh, you have a 16
18 microsecond window where you are writing data; and
19 the rest of the frame time, light is being emitted
20 by the OLED.

21 Q. (By Mr. Williams) Right, and I'm trying
22 to remember what you said the frame time was. So
23 it would be about 1/60th of a second; is that
24 right?

25 A. Yes, that's, you know, 16.7 milliseconds,

1 if I remember right. And then if you had a
2 thousand, that means that you have one thousandths
3 of that time, or 16 microseconds, available to
4 provide the data to each row. And so that would be
5 a predivation [phonetic] in the brightness, if you
6 will, of a very small amount if you have this very
7 simplified circuit.

8 But it would work. And there may have
9 even been some simple products that -- that utilize
10 that, that only had a hundred rows or maybe some
11 lower resolution.

12 But it would cause some kind of a small
13 error in the performance. So it's -- it's not done
14 in any practical AMOLED displays that I am aware of
15 aware, certainly not today.

16 Q. So can you explain -- that's fine, thank
17 you.

18 Can you explain, then, the transistor
19 MP1, what its role is during the programming period
20 versus what you described as the emission period?

21 A. Sure.

22 As I described for the AMLCD, it is
23 basically an on/off switch. So it connects the
24 data signal, indicated here as Vdata, to the
25 capacitor by closing the switch when it's turned

1 on.

2 And then when it's turned off, it
3 disconnects the data line from that pixel.

4 You don't want to write data from another
5 row into the previous row, so you need to isolate.
6 So it performs the same function. It's basically
7 isolating the data line from the pixel circuit
8 during the rest of the time when light is being
9 emitted.

10 Q. Okay. So in this case, the data line is
11 the vertical line on the left, correct?

12 A. Yes.

13 Q. Okay. So then that transistor, during
14 the programming period, would connect the capacitor
15 to that data line; and then when the programming
16 period has ended, it will disconnect the capacitor
17 from that data line.

18 Have I got that right?

19 A. You do.

20 Q. Okay. Great.

21 Is that the waveform -- is that what is
22 being shown by the "Select" waveform below the
23 figure or -- and if not, can you just explain what
24 that "Select" waveform is supposed to be
25 indicating.

1 A. That is the -- it indicates the "Select"
2 line goes along the rows, the -- across the page,
3 the horizontal connecting, to the gate of MP1.

4 This happens to be a PMP transistor, so a
5 low voltage turns it on, and a high voltage turns
6 it off.

7 And the video is some analog level. It's
8 just shown as a flat line, but it's a varying
9 parameter based on the image, you know, content.

10 Q. Got it.

11 Let's talk about that for a second.

12 The image content on Vdata would
13 correspond -- would be a voltage of some sort that
14 corresponds to what -- the intensity that the pixel
15 should be emitting during that frame?

16 MR. HAMILL: Objection. Form.

17 THE DEPONENT: Yes -- yes, the -- the --
18 the data coming from the driver has been set with
19 the right impedance to drive the -- the column and
20 provide a signal at each -- you know, along the
21 row, along every row as needed. And that is an
22 analog voltage for an OLED.

23 That voltage is set to be the right level
24 to operate the transistor. So it has to be set
25 with the appropriate voltage and current capability

1 to drive that pixel within 16 microseconds, as we
2 were saying. You have to have a strong enough
3 driver that can do that.

4 So that's why the video driver has
5 amplifiers in it, so you could actually create
6 enough -- the right voltage and charge up the
7 capacitance of the column line fast enough so the
8 voltage can appear on the capacitor that's correct
9 during that short period of time.

10 Q. (By Mr. Williams) And then how -- so
11 what is the -- then what is the -- so what does the
12 signal you are describing to -- what does the
13 signal correspond to in terms of what the image
14 would appear to be to the user?

15 MR. HAMILL: Objection. Form.

16 THE DEPONENT: The -- the signal that
17 comes from the video driver for this particular
18 circuit, a low -- it will be an analog voltage that
19 will be properly set for that transistor to go from
20 black to white; in other words, no -- no brightness
21 to full brightness.

22 So, you know, it's one -- one voltage --
23 since this is a PMP transistor, a more -- a more
24 negative voltage will be darker; a higher voltage
25 will be brighter. So it's a range of voltages,

1 maybe 2 to 3 volts for a typical OLED, between
2 black and white. There's a delta-v, if you will,
3 that sits -- stored on the capacitor.

4 Q. (By Mr. Williams) Okay. So then that
5 range of voltages on the capacitor you just
6 mentioned would then correspond to a range of
7 brightnesses of the OLED; is that right?

8 A. Yes.

9 Q. Okay. Can you go to paragraph 46 of your
10 declaration.

11 A. Okay. Got it.

12 Q. So the heading of this section D is Video
13 (Data) Drivers; is that right?

14 A. Yes.

15 Q. And then the first paragraph -- sorry,
16 the first sentence of paragraph 46 includes this
17 term "video data drive circuit."

18 Do you see that?

19 A. Uh-huh, yes.

20 Q. Can you explain what you mean by "video
21 data drive circuit"?

22 A. As we were just discussing, the data
23 driver provides the -- the proper signals in terms
24 of voltage and current that is supplied to the
25 panel. That's the data. It can go black to white

1 or anywhere in between. And it's refreshed at a
2 certain refresh rate.

3 And it's -- the term "video" is used is
4 sort of generically to indicate moving data. But
5 obviously, it doesn't to have to be video. It
6 could be a still image. But the terminology is
7 usually "video" to -- to imply that the signal is
8 changing and refreshing at some rate. So they are
9 called data drivers or video drivers.

10 And it is circuitry, which I -- you know,
11 the later pages, I show some examples of what's
12 actually in the data driver. It has a lot of
13 functionality to get the signal generated with the
14 right current, voltage, et cetera, that matches the
15 actually signal coming from the computer or the
16 CPU.

17 Q. Thank you.

18 The -- just turning back a few pages,
19 there's a figure at the top of page 20.

20 Let me know when you see that.

21 A. Yup.

22 Q. Okay. It's titled Figure 4.31; is that
23 correct?

24 A. Yes.

25 Q. So in that figure, is the -- is the thing

1 that you just described as the "video data drive
2 circuit," is that the box of the top?

3 A. Yes.

4 Q. Okay. And what is the box on the left
5 side of the page?

6 The one that is labeled -- I think it's
7 "Scan driver." I can't really read it.

8 A. The scan driver is the functionality that
9 I mentioned that turns each row on sequentially.
10 They are sometimes called gate drivers, scan
11 drivers, select drivers. But in -- in active
12 matrix LCDs or OLEDs, there's no data on those
13 lines. It's purely a switching circuit much like a
14 shift register would be, that sequentially, each
15 row is returned on one by one with signals from
16 come from that scan driver.

17 Q. Got it.

18 Okay. We can maybe move up to page 35 of
19 your declaration now.

20 A. Okay.

21 Q. And this is -- the top of this page says
22 "Background of the '521 Patent."

23 Do you see that?

24 A. Yes.

25 Q. Okay. If you turn to the next page, page

1 36. At the bottom, there's a section labeled
2 "Prior Art."

3 Do you see that section?

4 A. Yes.

5 Q. So here, I think you are describing what
6 the '521 patent characterizes as prior art; is that
7 right?

8 A. Yes, I am.

9 Q. Okay. And that's -- there's a Figure 1
10 from the patent that is shown on the next page.

11 Do you see that figure?

12 A. Yes.

13 Q. So what -- what's your understanding of
14 what this figure was intended to be depicting in
15 the '521 patent?

16 MR. HAMILL: Objection. Form.

17 THE DEPONENT: This -- this -- this
18 description in the patent is talking about how the
19 video data driver section would be architected, if
20 you will, at a -- at a very high level.

21 There's a video source that is data that
22 goes into the circuit in the dotted box -- I
23 added -- added the dotted box -- which creates a
24 digital/analog signal that, in this example, is --
25 is -- is level-shifted to a VDC to get the -- the

1 signal to the correct voltage level for the circuit
2 to operate.

3 And that -- that video signal is
4 referenced to ground. That goes into the -- the
5 display as $v(t)$. And as I showed earlier, the OLED
6 pixel is referenced to a voltage called VDD, or
7 positive power supply.

8 And so that VDD appears at the source of
9 the driving transistor, and the gate receives the
10 $v(t)$ signal, and a certain amount of current will
11 flow through the OLED.

12 Q. (By Mr. Williams) Okay. And this --
13 this structure that's shown here, then, is meant to
14 reflect what was happening in the prior art at the
15 time of the invention of the '521; is that your
16 understanding?

17 A. Yes, this -- this was -- excuse me.

18 This would be a typical kind of
19 architecture for a video driver that provides a
20 signal to the -- to the display and operates the
21 pixel, in -- in this case, a very simplified
22 illustration of the pixel circuit of the AMOLED
23 display.

24 This particular example, you know,
25 represents just a single pixel. It doesn't show

1 any additional circuitry like we have just been
2 discussing: Capacitors, switching transistors.
3 It's simply looking at the current flow relative to
4 the signal generated by the driver and the power
5 supply that will -- that will light up the OLED.

6 Q. Understood.

7 Okay. And if you turn to page 40 of your
8 declaration, where you should see Figure 2 of the
9 '521 patent.

10 A. Yes.

11 Q. And this is one of the embodiments that's
12 described as an embodiment of the invention of the
13 '521 patent, correct?

14 A. Yes, this is one of the embodiments.

15 Q. Okay. So in what ways does this differ
16 from what was shown in the prior art figure we just
17 looked at?

18 A. Well, the -- the key difference, as I'm
19 sure you know, is that in this new circuit, the
20 circuit of this embodiment, the video driving
21 circuit, labeled "Video Driver" in the dotted box,
22 has an additional op amp that will provide a
23 reference to the -- the $v(t)$ that is not ground but
24 is now referenced to VDD. So that is done by the
25 circuitry.

1 And that's in contrast to the Figure 1
2 prior art, where the video signal is referenced to
3 ground.

4 And as the patent explains, by
5 referencing to VDD, it -- it makes a more uniform
6 image.

7 Q. The pixel -- is there a pixel circuit
8 that is shown in the figure?

9 A. Again, this figure uses the very basic
10 core of the pixel, which is just the drive
11 transistor, and doesn't show additional pixel
12 circuitry.

13 Q. So in -- well, in the view of a person of
14 ordinary skill in the art reading the patent in
15 this figure, would they have believed that there
16 was a -- for instance, a storage capacitor in the
17 pixel circuit of Figure 2?

18 A. Certainly, the person of skill of the art
19 would understand that the video driver's
20 architecture has changed and that there's a
21 different reference for that signal.

22 And that would be applied to an actual
23 pixel circuit as the drive signal, which would then
24 eliminate the problems that the inventor realized
25 regarding voltage variations due to mobile products

1 that have, you know, batteries and real-world
2 effects.

3 But certainly, a person of skill in the
4 art would know that there is additional circuitry
5 within the pixel.

6 Q. How would -- when you say "additional
7 circuitry," what additional circuitry would they
8 understand to be present in pixel?

9 A. Well, as a minimum, there would be a
10 switching transistor, like we saw in the previous
11 discussion.

12 And there would be some storage means,
13 like a capacitor, that would store the information.

14 And there would be -- there could be
15 other transistors to do other functions in an
16 actual circuit used for AMOLEDs.

17 Q. And if this is a -- the box on the right
18 there is labeled "AMOLED Display Panel."

19 Do you see that?

20 A. Yes.

21 Q. Okay. And does that -- I can't recall.

22 Is it your opinion that that would
23 suggest to a person of ordinary skill in the art
24 that everything to the left of that is separate and
25 distinct from the display panel?

1 A. Everything to the left is separate and
2 distinct from the display panel.

3 Q. Okay.

4 A. I -- it -- everything to the left of
5 the -- well, let me rephrase.

6 The -- the -- the stuff to the left is
7 the -- is the video driving circuitry, if you will,
8 for this invention. And it provides signals to --
9 that will go out of those data columns that we
10 talked about earlier.

11 And they would see the clear distinction
12 between that AMOLED active matrix as -- as pixel
13 circuitry, more complicated than what's shown here,
14 but that would be pixel circuitry.

15 And it would show the video driver --
16 they would understand this is what is happening in
17 the video driver to change the voltage reference
18 for the signal coming from the computer.

19 Q. So what would be the relationship, then,
20 between the video driver that you have drawn in, I
21 guess, the dotted line around here and the data
22 columns that you just mentioned?

23 A. Well, the -- the data in this very
24 simplified diagram, where it shows $v(t)$ going into
25 a box labeled "AMOLED Display Panel," that would be

1 equivalent to the signal on the data column.

2 So an analog signal is generated by the
3 driver and provided to the pixel, the pixel array.
4 The active matrix array's job is to take that data
5 and store it and display it.

6 Q. So in this -- in this figure, where would
7 a person of ordinary skill in the art have
8 understood the -- let me withdraw that question.

9 Could this -- in your view, would a
10 person of ordinary skill of the art have believed
11 that this circuit, the video driver circuit, they
12 believed that could have been used in a display
13 system that had a data driver and a scan driver
14 like the architecture we looked at earlier on -- on
15 paragraph 20 of your declaration?

16 MR. HAMILL: Objection. Form.

17 THE DEPONENT: Yeah, I am not sure I
18 understand your question.

19 Can you -- are you asking about the --
20 about the block that's labeled "Video Driver"?

21 And maybe --

22 Q. (By Mr. Williams) I will withdraw the
23 question. Let me ask it this way.

24 Turning back to page 20 of your
25 declaration for a moment, we looked -- at the top,

1 there's a Figure 4.31.

2 Do you see that?

3 A. Right.

4 Okay.

5 Q. So that figure shows an OLED display with
6 a data driver and a scan driver connected to
7 various pixel circuits, correct?

8 A. Right.

9 Q. So I guess my question, then, is, then
10 turning back to page 40 of your declaration and
11 considering Figure 2, how -- how would a person of
12 ordinary skill of the art have understood this
13 video driver to relate to the architecture we just
14 saw in Figure 4.31?

15 A. Okay. So the -- the video driver
16 circuitry shown in Figure 2 would be incorporated
17 into the data driver. It would be part of the
18 circuitry that's in the data driver shown.

19 The data driver has other functions, such
20 as timing and voltage adjustment and many other,
21 you know, factors. But this would be the -- the --
22 the circuitry that relates to handling the voltage
23 from digital to analog domain.

24 And we skipped over my background, but I
25 showed several examples of data drivers. And --

1 and the relevant portion would be, for example, any
2 of the output buffers or amplifiers in the video
3 driver circuits that I -- that I described that
4 this circuitry would be added to that function
5 to -- to reference the video signal to VDD, in this
6 case, the -- the power supply voltage. That would
7 be done in that -- in that section.

8 And then that generated signal would go
9 down the data columns and be stored on the pixels.

10 Q. That answer you just gave talked about
11 output buffers.

12 Are you referring to, for instance, the
13 figure on page 27 of your declaration?

14 A. I have several figures here.

15 On page 26, it shows buffers. On
16 figure -- on page 27, it shows buffers which are
17 basically amplifiers. You know, different
18 architectures for different chips. Page 28 shows
19 output buffers. Page 29 shows output buffers.

20 So these are all meant to show what the
21 architecture of -- of data drivers or video data
22 drivers incorporate into the circuit. It's usually
23 an integrated circuit, you know, made out of
24 silicone that is attached to the display by some
25 means to provide these signals to all those 2,000

1 columns.

2 Q. Okay. So you had a figure on page 26
3 that you just alluded to. That's Figure 6.15; is
4 that correct?

5 A. Yes, and this is actually for an AMLCD,
6 but the architecture is very similar to that of a
7 AMOLED. Levels are different, there's other
8 factors that are different, but the architecture is
9 similar.

10 And, in fact, the industry at the time,
11 when OLEDs were first being developed, did their
12 best to try to use as much of the LCD technology as
13 they could so they wouldn't have to completely
14 redesign driver ICs.

15 But anyway, that -- this idea of taking
16 data that's timed properly and latching it and
17 shifting it and all the functions that are shown
18 here are quite similar for either LCD and/or OLED.

19 Q. Okay. Are -- what about the figure shown
20 on page 27?

21 Is that -- is that also an LCD driver?

22 A. Let me see.

23 Yes, I believe it is. It's from the same
24 reference around the same page numbers.

25 So this is showing -- this is a showing a

1 feature of data drivers that we haven't discussed.
2 But all of the voltage needs -- need to be
3 precisely determined, the analog voltage, so that
4 the picture represents what was intended by the
5 creator of the picture.

6 That relationship between brightness and
7 voltage is called gamma. And so that gamma
8 correction is done in all of these driver ICs with
9 either resistor strings or other circuits so that
10 the voltages can be set properly so that the gray
11 levels match what we expect: They are not washed
12 out; they are not compressed gray scales.

13 So this is showing that part of the
14 circuitry, and then, finally, buffers that take
15 those voltages and generate the proper signal that
16 goes to the -- to the source drivers on the panel.

17 Q. And then figure -- on page 28, there's a
18 figure from the same reference, 6.19.

19 Again, is this a -- is this an LCD driver
20 or an OLED driver being depicted here?

21 A. I believe this is still from the LCD
22 domain, but the functionality is -- is exactly the
23 same as it relates to these particular amplifiers
24 and buffers.

25 In both cases, that signal has to be set

1 to the right level and has to be amplified such
2 that there will be enough current and voltage to --
3 to operate the display.

4 And that's primarily to drive the
5 capacitance of the column with whatever its
6 resistance is. You need to have a -- a properly
7 generated signal that will charge up the capacitor
8 in the short time you have available. So that's
9 all done in the driver.

10 And it's really not that different
11 between LCDs and AMOLEDs, except for the voltage
12 levels are different for driving the pixel.

13 And sometimes the polarity is different.
14 So with LCDs, there's also polarity adjustments
15 that are done in the -- in the driver circuitry.
16 And it's -- it's all timed, you know, according to
17 the signal coming in from the computer.

18 Q. The last figure you mentioned on page 29,
19 this one is from a different reference. And I
20 think this one is an AMOLED driver; is that
21 correct?

22 A. I believe so.

23 Just a moment.

24 MR. HAMILL: Sorry, which page you are on
25 now?

1 MR. WILLIAMS: I am on page 29 of
2 Exhibit 1011 [sic].

3 THE DEPONENT: Yes, this -- this is a --
4 from a Kim reference. It is for an AMOLED.

5 And it shows, again, the same
6 functionality, including what's called linear R
7 strings, which are part of the gamma adjustment,
8 and it shows the output buffers that connect to, in
9 this case, 1,620 panels. So whatever the
10 resolution of this display is, there are 1,620
11 channels on this chip. And it shows the basic
12 functionality.

13 Q. (By Mr. Williams) Which -- just so I
14 understand, which component here is the buffer you
15 just referred to?

16 A. There are buffers indicated by the
17 triangles.

18 And the linear R-string, those are shown
19 as -- as amplifies at that point.

20 There's RGB gamma data going into the
21 upper circuitry, the shift registers and latches,
22 level shifters.

23 This is just one proposed column driver
24 architecture. It isn't necessarily how they are
25 all architected these days.

1 But my intention to show this was that
2 the architecture is similar. And so the LCD
3 references are a good guide to a person of skill in
4 the art how the -- the video data driver is
5 architected to take video data and to organize it
6 so all the data could go onto the -- the columns at
7 one time, properly amplified and adjusted so that
8 the voltages are correct.

9 And there's -- there's a low enough
10 impedance to drive the capacitance, as I mentioned,
11 and you get the right signal stored on the pixel.

12 Q. You said there were 1,620 channels, which
13 I see in the figure.

14 What does that correspond to in terms of,
15 you know, the matrix or the data lines?

16 Explain that to me.

17 A. Those would be the signals provided to
18 the data lines. So I would have to look at the
19 reference specifically to see the resolution.

20 I think this might be a single driver
21 chip, and you can always have multiple driver chips
22 on your display. So these are the column drivers,
23 column data drivers, with proper signals that send
24 to, in this case, in parallel, 1,620 channels.

25 As I said, you could have multiple column

1 drivers, so there could be more required if the
2 resolution is higher.

3 Q. And just so I understand what you just
4 said there, meaning, I guess, if you had a panel
5 with more columns of pixels than your driver could
6 support, you would just add additional driver chips
7 to support those additional columns?

8 A. Yes, that's correct.

9 Q. Okay. Okay. Just focusing on this
10 figure for a second, you said earlier that a person
11 of ordinary skill in the art would have understood
12 that that Figure 2 driver would be integrated into
13 this architecture.

14 Can you just tell me where, for instance,
15 in this Figure 4 you would -- a POSA would have
16 known to integrate that Figure 2 driver?

17 MR. HAMILL: Objection to form.

18 THE DEPONENT: Sure.

19 The -- the Figure 2 architecture could be
20 implemented in -- in a variety of areas.

21 But they would look to the output buffer
22 stage, either modifying that output buffer or
23 adding an additional circuitry in the driver chip
24 itself that does that Figure 2 summing or
25 re-referencing, if you will. So the design of the

1 driver IC could be modified.

2 Certainly, one could have an additional
3 IC with buffer amplifiers as shown in Figure 2.
4 They don't have to be integrated, although I think
5 even the patent says one can integrate that
6 functionality into the driver IC, which certainly
7 would be done for practical reasons.

8 So that's how a person of skill in the
9 art would understand what to do and how to apply
10 the Figure 2 design to a typical driver IC.

11 Q. (By Mr. Williams) Can you turn back to
12 page 15 for a second, of your declaration.

13 A. Okay.

14 Q. Do you see the Figure 6.1 on page 15?

15 A. Yes, I do.

16 Q. All right. And this -- this from
17 Exhibit 2006; is that correct?

18 A. Yes, it is.

19 Q. Do you recall what that is?

20 A. I think that's the den Boer reference. I
21 would have to check 2006 -- oh, Cristaldi. I
22 apologize.

23 "Liquid Crystal Display Drivers" by
24 Cristaldi.

25 Q. Okay. This is an exhibit that you

1 introduced with your declaration, correct?

2 A. Yes, I don't think it was used by the
3 other expert.

4 Q. Okay. And what you are trying -- I mean,
5 what you are trying to depict?

6 What's the point you are trying to make
7 in this paragraph 35 with this Figure 6.1?

8 MR. HAMILL: Objection. Form.

9 THE DEPONENT: What -- what I was trying
10 to indicate is that there's various levels of
11 integration used in creating products, specifically
12 AMOLED or AMLCD products. And as time has evolved,
13 more and more integration is done.

14 But this is an illustration of the basic
15 building blocks, if you will, and how they can be
16 integrated into basically fewer and fewer pieces of
17 silicone.

18 So in the upper left, it shows the
19 functional blocks to drive a TFT pixel matrix.
20 There's a gate driver section, a source driver
21 section, a gray scale decoder, a timing controller.
22 There's RAM. There's DC-to-DC power supplies.

23 And they all can be individual
24 components, as they were in the early days. I can
25 speak from experience.

1 But then, it shows an evolution to an
2 improved design, where all of the functions except
3 for the gate drivers are integrated onto a data
4 driver. So now, DC-to-DC voltage adjustments,
5 storage, RAM, gray scale, digital/analog converters
6 and timing controllers are all on a single chip.
7 So that's a more simplified design.

8 It still has a gate driver for -- for the
9 row select, but now all the data driver functions,
10 plus other functions, are on one silicone chip.

11 That evolved into what is shown on the C,
12 where all the functions are included on this piece
13 of silicone, including, if there are a thousand
14 rows, there are a thousand leads coming from the
15 chip going to the gate driver section.

16 For small displays, this -- this was
17 done. Maybe for small mobile phone displays when
18 they first came out. The resolution was quite low.

19 And -- and -- and by eliminating the
20 piece of the silicone that is called the gate
21 driver, you can shrink the border of the display.
22 And especially for cell phones, that was important
23 to get the screen bigger and not have a bunch of
24 dead space on the edges. But it did require a lot
25 traces on the glass, you know, on the LCD glass.

1 And then the industry evolved to, we --
2 we figured out how to make gate drivers out of
3 amorphous silicon, which was the technology used
4 for LCDs. And it -- it involves a handful of
5 transistors, seven or eight or ten transistors,
6 that are fast enough to provide the gate signal
7 for -- for the row select.

8 And now the gate drivers are integrated
9 onto the glass. We talked about this earlier this
10 morning. And the only signals that come from that
11 chip at the bottom are timing signals. Basically,
12 what is required is a start pulse and an index
13 pulse. Since it's a shift register, you have to
14 tell it when to start and when to change.

15 So that circuitry is now on -- on the
16 lower substrate, the TFT substrate. In the case of
17 the LCDs, that's glass. In the case of OLEDs, it's
18 sometimes plastic. But that functionality is on --
19 on the substrate, whereas the data driver functions
20 are still on the piece of silicone that is shown in
21 the lower box.

22 So this is meant to show an evolution and
23 to show functionally what is happening in each
24 block.

25 Q. (By Mr. Williams) So the -- the gate

1 drivers in that box D in the -- on -- that are part
2 of the substrate, those -- do those correspond,
3 then, to the scan drivers we spoke about earlier?

4 A. That's correct.

5 Q. Okay. Then coming back to -- I know we
6 are getting close to a break, so I will try to be
7 quick with this.

8 A. I'm fine, go ahead.

9 Q. And we are, I think, ready to move on to
10 a new topic, so let me just try to finish this up.

11 So back to page 40. I guess what I want
12 to -- of your declaration.

13 I guess what I want to understand, how
14 would a POSITA know that that video driver would be
15 part of the gate driver functionality and not part
16 of the pixel circuit.

17 MR. HAMILL: Objection to form.

18 THE DEPONENT: Well, it wouldn't -- it
19 wouldn't be the gate driver circuit. It would be
20 the data driver circuit.

21 Q. (By Mr. Williams) I'm sorry, I misspoke.

22 A. That's what you meant.

23 Okay.

24 Q. Correct, I apologize.

25 A. Okay.

1 Q. Let me rephrase the question.

2 How would a POSITA know that the video
3 driver shown in Figure 2 on page 40 would be part
4 of the data driver as opposed to part of the pixel
5 circuit?

6 A. So a person of skill in the art would
7 look at this block and say, Oh, okay; it's taking
8 video data, and it's creating and formatting and
9 generating a signal that will go to the panel.

10 And they would understand clearly that
11 the additional circuitry that is shown would be
12 part of the generated video signal and would be
13 separate from the pixel circuit, which its function
14 that we discussed at its core is to -- to sample --
15 to store the data that's appropriate to drive the
16 pixel.

17 The pixel circuit is a -- that's its
18 function. And I discuss that later in my report,
19 as I am sure we will get to.

20 And that's separate from the generation
21 of the signal that's used. That generation is
22 basically generating signals for all the rows. And
23 the pixel job -- the job of the pixel circuit is
24 just to transfer that information to a storage
25 capacitor so it could be used to draw current, in

1 the case of an OLED.

2 Q. Is there anything in the '521 patent
3 itself that would have led a person of ordinary
4 skill in the art to that understanding that you
5 just described?

6 MR. HAMILL: Objection to form.

7 THE DEPONENT: The -- the '521 patent, I
8 mean, describes op amps. I mean, there's various
9 versions and circuitry in the three embodiments.

10 But it -- it describes functions that
11 would not be on the pixel array, nor would you ever
12 think to build these kind of circuits on the pixel
13 array to generate the proper drive signal that, in
14 the case of the '521 invention, is referencing to
15 the VDD power supply.

16 But that -- that signal generation is
17 part of the driver. It's the way it's described.
18 The patent actually doesn't -- doesn't really
19 describe the pixel circuitry much.

20 But a person of skill in the art would
21 understand that there's, you know, driver chips
22 that generate signals, and then you have pixels
23 circuits that store that information.

24 Now, the pixel circuit can do other
25 things. We haven't talked about other functions

1 that the pixel circuit could accomplish, like level
2 shifting or correction for voltage errors. That's
3 separate from the generation of the signal and its
4 reference.

5 MR. WILLIAMS: Okay. Why don't we take a
6 short break.

7 THE DEPONENT: Okay.

8 MR. WILLIAMS: Off the record.

9 (Recess taken.)

10 MR. WILLIAMS: Back on the record.

11 THE DEPONENT: Mr. Williams, I have a
12 little comment to make. During the break, I sort
13 of scanned through my old -- the older declaration.
14 I actually found a typo, so I thought I would just
15 point that out.

16 Q. (By Mr. Williams) Sure.

17 A. On page 73, paragraph 129, where it says
18 "Third embodiment," I wrote "VDD plus V" --
19 "Video.DAC."

20 It should be Vclamp plus Video.DAC.

21 Not that that's -- changes any of my
22 opinions, but I realized in a quick scan that that
23 didn't look right, so I checked it.

24 Q. This is in paragraph 129, you say, right?

25 A. Yeah, sort of top of page 73. There's

1 three embodiments listed, and the third embodiment,
2 I checked the patent. It didn't look right.

3 V(t) is Vclamp plus Video.DAC, is what it
4 should say.

5 Q. Okay. Is that an error that is only in
6 the third embodiment formula?

7 A. Yes.

8 Q. Okay.

9 A. I noticed -- I believe the other ones are
10 correct.

11 Q. Okay.

12 A. But anyway, since I saw it, I thought I
13 would at least mention it.

14 Q. Thank you.

15 Did you discuss the substance of your
16 testimony with anyone during the break?

17 A. I did not.

18 Q. Okay. Sorry, that got me off of the page
19 I was on, so I will take a second.

20 A. I apologize.

21 Q. No, no, no.

22 All right. Let me ask you about
23 paragraph 63 again, or maybe I haven't.

24 Let me ask you about paragraph 63 of your
25 declaration, 1011 [sic].

1 Here again, we were talking about how the
2 '521 patent talks about this prior art example
3 Figure 1.

4 A. Yes.

5 Q. Let me know when you get there.

6 At the bottom of page 37, you say "The
7 result is that the video drive signal $v(t)$ is
8 referenced to the ground voltage."

9 Do you see that?

10 A. Yes.

11 Q. So how -- this is what I want to
12 understand.

13 How does a person of ordinary skill in
14 the art know that that voltage is referenced to a
15 ground voltage?

16 A. Well, I would look at the circuit and
17 where it shows video source referenced to ground.

18 And let me look at the actual picture.

19 It shows a dotted line from ground
20 referencing $v(t)$, so that a person of skill in the
21 art would clearly see that that signal is
22 referenced to ground.

23 And it's been shifted in voltage. I
24 think the words used in the patent is to adjust the
25 voltages to that required for driving the

1 transistor, M1 in this case, VDC, summed to that
2 voltage.

3 So it would be clear to a person of skill
4 in the art that it's referenced to ground.

5 Q. In your declaration, do you provide a
6 definition of what "referenced to" means in the
7 context of the '521 patent?

8 A. Not -- I don't think I did specifically,
9 because -- no, I don't think I discussed that.

10 It just means -- referenced to ground
11 means referenced to ground.

12 Q. Do you have the '521 patent nearby?

13 A. Yes.

14 Q. Just turn to claim 1 of that patent,
15 please.

16 A. Okay.

17 Q. So one of the elements, one -- one of the
18 elements of this claim begins "a video driver
19 receiving."

20 Do you see that?

21 A. Yes.

22 Q. And then in that -- other than that text,
23 there's a -- some language that reads "referenced
24 to a positive power supply voltage."

25 Do you see that?

1 A. Yes.

2 Q. So as the term "referenced to" is used in
3 there, what definition did you give that language,
4 "referenced to," in the context of your analysis in
5 this case?

6 MR. HAMILL: Objection. Form.

7 THE DEPONENT: Basically -- basically,
8 the -- I use the plain meaning, just as we
9 discussed that in the prior art, the video signal
10 is referenced to ground, and it's indicated,
11 you know, in Figure 1.

12 In the case of -- it's referenced to a
13 positive power supply. That means that the $v(t)$
14 voltage is referenced to a positive power supply
15 instead of ground.

16 Q. (By Mr. Williams) So are you using
17 "referenced to" there in the metrology sense of
18 this is a reference datum against which that
19 voltage is measured?

20 Is that what you are meaning?

21 MR. HAMILL: Objection. Form.

22 THE DEPONENT: I think what I mean is
23 what the patent describes as the -- the signal, the
24 $v(t)$, which is normally referenced to ground -- and
25 that would be typical for a data driver; for most

1 circuitry, in fact -- has been, through the action
2 of, for example, the opamp in Figure 2, has now
3 been referenced to $v(t)$.

4 And the equation is given, I believe, in
5 the patent that now the -- the $v(t)$ is Video.OLED
6 minus VDD, if I got that -- if I have that right.

7 So it's referencing -- it -- it is a
8 sense -- you could think of it as metrology. But
9 in the video driver where you're generating this
10 signal, you've now shifted the reference so that
11 the errors in VDD can be eliminated from the actual
12 AMOLED display, as taught by this patent, that that
13 allows one to achieve better performance.

14 Q. (By Mr. Williams) So what equation were
15 you looking at?

16 A. I think we were describing the first
17 embodiments.

18 Q. So the Figure 2 embodiment, I think the
19 equations are at the top of column 5 of the patent.

20 Do you see that?

21 A. Yeah, right, right.

22 So Video.OLED -- so the $v(t)$ -- well,
23 $v(t)$ is VDD minus Video.OLED if you swap the -- the
24 equation.

25 But it said the Video.OLED is VDD minus

1 v(t), so that when put into the transistor, the
2 driving transistor, the VDD will be -- will drop
3 out of the equation. And it's independent of the
4 positive power supply, as -- as explained in the
5 claims.

6 Q. Sure.

7 Let's focus on the "referenced to" part
8 of that for a second.

9 So equation 5 at the top of column 5
10 has -- well --

11 A. Yeah, there's -- there's --

12 Q. I think that's supposed to say $v(t)$
13 equals VDD minus Video.DAC; is that right?

14 A. I think it does.

15 Q. Okay.

16 A. On my copy.

17 Q. It looks like a minus sign for me here.
18 Maybe it's --

19 A. No, it's equal.

20 Q. Okay. So $v(t)$ equals VDD minus
21 Video.DAC, correct?

22 That's the equation?

23 A. That's the equation.

24 Q. Okay. So is -- and the specification
25 says, like maybe the next line, " $v(t)$ is now made

1 to be referenced to the power supply voltage VDD,"
2 correct?

3 A. That's what it says.

4 Q. Yeah. So how does that equation tell
5 to -- tell you, as a person of ordinary skill in
6 the art, that $v(t)$ is now referenced to VDD?

7 MR. HAMILL: Objection. Form.

8 THE DEPONENT: Well, you know, $v(t)$
9 starts out being just Video.DAC. But, you know,
10 and now it's -- now it's referenced to VDD because
11 it's in the equation. So that's -- that's -- it's
12 a different reference point for the Video.DAC
13 signal.

14 Q. (By Mr. Williams) I have a couple
15 questions about the -- the second embodiment here,
16 which is on -- I think it's your declaration at
17 page 42.

18 Sorry, it starts on your declaration
19 page 42.

20 A. Okay. Yes.

21 Okay. The second embodiment uses a --
22 what they call a "current mode isolator circuit."

23 Q. Yeah, and that's -- I want to ask you
24 about that term.

25 Is that a term that you have seen before,

1 "current mode isolator circuit," prior to this
2 case?

3 A. Possibly.

4 I mean, it -- it didn't surprise me as a
5 term. I mean, it was described very clearly
6 what -- what it is and what it does.

7 Sometimes electrical engineers, you know,
8 call things differently.

9 But it -- isolates the current. It's --
10 it's a circuit that has that mode. So I understood
11 what it meant, and I think a person of skill in the
12 art would understand that it's just another way to
13 generate the referencing within the generated drive
14 signal such that it has the same characteristics as
15 the first embodiment.

16 Q. And when you say the first
17 characteristics, do you mean the $v(t)$ -- the
18 equation for $v(t)$ is the same as the first
19 embodiment?

20 A. Well --

21 MR. HAMILL: Objection. Form.

22 THE DEPONENT: The equation -- I'm sorry,
23 I spoke over you. Let me back up.

24 The equation is the same; is that what
25 you asked?

1 Q. (By Mr. Williams) Yeah.

2 Well, I meant -- what I was trying to ask
3 is what you meant by the same characteristics as --
4 of the first embodiment.

5 So does that have to do with the equation
6 for $v(t)$, or are you talking about something else?

7 A. Basically the equation.

8 You know, equation 7 in the patent shows
9 $v(t)$ is equal to V_{DD} minus $V_{\text{Video.DAC}}$.

10 Q. Correct.

11 And that's the same as the equation 5 we
12 just looked at for the first embodiment, correct?

13 A. Yes.

14 Q. Okay. So is that what you meant by
15 the -- by the same characteristics as the first
16 embodiment?

17 A. The generated video signal by this
18 circuitry, results are the same, referencing of the
19 voltage with the same equation.

20 Q. This annotated version of Figure 3 that
21 appears on page 42, what components correspond to
22 the current mode isolator circuit?

23 A. Well, it's generally the additional
24 circuits of the M2 transistor and the two Rs, 206
25 and 207, added to the opamp, and then the

1 feedback -- the feedback circuit.

2 So it's -- it's -- it's that circuit.

3 It's -- it's a different circuit. It still has the
4 amplifier, but the current is measured or created
5 differently, and the reference is done differently
6 than the first simplified embodiment. But the
7 result is the same.

8 Q. When you say "the result is same," what
9 do you mean?

10 A. Well, as we just discussed, the -- the
11 $v(t)$ that comes out of this driver chip, the video
12 drive signal is -- that takes the form VDD minus
13 $Video.DAC$ that's shown in Figure 7. And the -- the
14 patent in column 5 describes how this current mode
15 isolator circuit works.

16 Q. Okay. Let's just flip back a second to
17 Figure 2 on page 40.

18 Are you there?

19 A. Yup.

20 Q. Okay. The -- the video driver box is
21 surrounding, it looks like, an opamp and four
22 resistors; is that right?

23 A. Yes.

24 Q. Do you have -- this would probably be
25 easier if you had the patent in front of you. I

1 want to ask about column 5, around line 31 or so,
2 of the '521 patent.

3 A. Okay. Let me read it, excuse me.

4 Okay.

5 Q. So what did you just read, from 30 to --
6 lines 30 to 36 of column 5?

7 A. That one paragraph.

8 Q. Yeah.

9 Okay. There's a reference in there to a
10 "differential instrumentation amplifier."

11 Do you see that?

12 A. Yes.

13 Q. And is that a term of art -- or is that a
14 term that you'd seen prior to this case?

15 A. Yes, that's -- that term used in opamps
16 was not -- not -- not an unfamiliar term.

17 Q. What is the word "instrumentation"
18 intending to convey in that phrase?

19 A. I think that just comes from the
20 historical description of opamps, whether they're
21 summing or differential or their purpose, their --
22 I'm not even sure of the history, but it was called
23 an "instrumentation amplifier" because it performed
24 some function.

25 There's no significance to its use here.

1 It's a common term.

2 Q. Okay. So would you consider there a
3 difference between a differential amplifier and a
4 differential instrumentation amplifier?

5 A. Not in my mind.

6 There may be some subtle differences
7 in -- but it was the same.

8 Q. Okay. Now, that section you just read --
9 so what is the -- is the differential
10 instrumentation amplifier that's referred to there,
11 does that correspond to the video driver in
12 Figure 2?

13 A. It corresponds to that portion of the
14 video driver.

15 As we said, there's -- as I said in my
16 report, there's other functions of the video
17 driver, data driver chip. But this is the
18 functionality that's effectively added to the --
19 the Video.DAC signal which is generated by the
20 chip. So this like an add-on to the video driver.

21 Q. Okay. Yeah, I understood that.

22 I guess I just want to understand this
23 language and what it corresponds to in Figure 2.

24 So, you know, the box that you've got,
25 you've annotated -- I think there was a dotted line

1 there before, but you've drawn a green dotted line
2 around and labeled it "Video Driver" at the top of
3 page 40.

4 Do you see that?

5 A. Yeah, I have a black-and-white copy, but
6 I -- I'll take it your word for it. I get it.

7 Q. Okay. Yeah.

8 So does that -- what's inside that box,
9 is that the differential instrumentation amplifier?

10 A. That would be the circuitry that's
11 referred to in the patent that is that amplifier
12 that does this referencing to VDD by the action of
13 those resistors.

14 And, of course, it does comment that you
15 have could have gain or not in -- depending on the
16 values of those resistors.

17 Q. So the resistors here are labeled --
18 well, they have an "R," I guess, in the box.

19 Are those the resistors?

20 A. The resistors are 105 through -- 105,
21 107, 108, 106. Yeah, those resistors are labeled
22 "R."

23 Q. Okay. What does it mean by "unity gain,"
24 when it describes that the amplifier can have
25 "unity gain" in that section of the patent?

1 A. Some amplifiers are strictly designed to
2 not amplify the signal but provide lower impedance
3 for driving a certain circuit. So it isn't
4 necessary to have gain, but the patent says you
5 could have gain or not, depending on the values of
6 the resistors.

7 But the important -- so it really depends
8 on the Video.DAC signal. If it needs to be
9 amplified in addition to referencing to VDD, it can
10 be; or it can just be passed through with a lower
11 impedance, perhaps to drive the columns.

12 But it's -- it's function is to do the
13 referencing to VDD as shown.

14 Q. Can you explain -- just quickly explain
15 what you mean by "lower impedance" of a signal in
16 that context?

17 A. As often the case, and the buffers in
18 the -- in the data drivers do this, you know,
19 without this additional feature, there has to be a
20 low enough impedance so that the -- the column
21 line -- I talked about the column capacitance, that
22 that line is a capacitor -- that the RC time
23 constant is fast enough to be able to charge up the
24 pixel to the appropriate voltage.

25 And sometimes there may not be enough

1 impedance. There's not enough current. You don't
2 have to change the voltage, but you have to --
3 you know, to lower the impedance so you can drive a
4 heavier load.

5 So depending on the design of the panel
6 and how large it is -- some small panels have low
7 capacitance, big panels have high capacitance, so
8 you need to adjust the driver appropriately. And
9 that's done with the buffers, and that -- that
10 constitutes the generated video signal of the
11 system.

12 Q. So would an amplifier with unity gain be
13 a buffer, in your view?

14 A. Yes, it could be -- it acts as a buffer.

15 Q. Okay. And if you are in the -- if you
16 have the patent in front of you still, now turn
17 to -- okay. I guess we should just put -- put this
18 in context so you see what's happening in the
19 patent here.

20 The paragraph you just read is sort of
21 the end of the discussion of Figure 2.

22 And then the next paragraph, which begins
23 around line 37, starts with the Figure 3.

24 Do you see that?

25 A. Yes.

1 Q. So then I want to ask you about the next
2 column, Figure 6 -- sorry, column 6, around line 38
3 to 44.

4 A. Okay. Let me read that.

5 Okay.

6 Q. Okay. And so this -- this section of the
7 patent is discussing that Figure 3 embodiment that
8 is depicted on page 42 of your declaration,
9 correct?

10 A. Yes, it shows 206 and 207 resistors.

11 Q. Okay. Yeah, yeah.

12 And for this embodiment, the -- rather
13 than calling this a "differential instrumentation
14 amplifier," the patent describes those circuit
15 components as the "current mode isolator circuit,"
16 correct?

17 A. Yes, the -- the input current to the
18 circuit is -- is isolated from the circuit being
19 drawn through those resistors and through that
20 transistor M2. So it's a way to separate the
21 current sources.

22 That's sometimes done for noise reasons.
23 There's other reasons to isolate the current
24 flowing to the OLED from the input Video.DAC
25 signal. But -- so this a different circuit that

1 accomplishes that.

2 Q. When you say the input current is
3 isolated, what -- what would that correspond to in
4 Figure 3?

5 I'm sorry, I mean, what would the input
6 current correspond to in Figure 3?

7 A. Well, the -- the input current would be,
8 there's -- there's an analog signal on the
9 Video.DAC going into the amplifier. There's a
10 feedback circuit, and there's this output current
11 that flows to $v(t)$. It's a function of those
12 resistors we just talked about.

13 But that -- that current is isolated from
14 the input current, which only goes to the plus
15 terminal of the opamp.

16 Q. Okay. So the input current you're
17 talking about is the Video.DAC signal; is that
18 correct?

19 A. Well, I was referring to that input
20 signal, yes.

21 Q. Okay. And again, the patent describes
22 that this current mode isolator circuit can have
23 unit gain; is that right?

24 A. It does so state.

25 Q. And again, that means that it could -- it

1 could be that there's no actual amplification to
2 the signal, but just what you described as being a
3 change to the impedance of the signal; is that
4 right?

5 A. That's -- that's a possible result;
6 that's correct.

7 Q. Okay. Then turning to the next page of
8 your declaration.

9 You start at the bottom of that page
10 talking about a third embodiment of the
11 '521 patent.

12 Do you see that?

13 A. Yeah. What page -- what page -- oh,
14 there we are.

15 Q. Sorry, I'm on page 43.

16 A. Yeah.

17 Okay. I'm there now.

18 Q. Okay. And then I think that's depicted
19 on the next page. Figure 4 is on the top of
20 page 44?

21 A. That's right.

22 Q. Okay. Can you -- I think you called this
23 the "Video Clamp Circuit" in the heading for this
24 section.

25 Can you just explain what you meant by

1 "Video Clamp Circuit"?

2 A. I was -- I was using the words of the
3 patent. I think they call it a "video clamp
4 circuit."

5 And this particular circuit performs the
6 same function of referencing the video signal to
7 VDD. However, it's done with an additional signal
8 called "Blanking" in Figure 4.

9 And that controls a transistor M3, so
10 that the Video.DAC signal is on one side of the
11 capacitor, the VDD is on the other side, and then
12 $v(t)$ becomes -- wait for it -- video clamp plus
13 Video.DAC.

14 So that circuit is a different kind of
15 circuit that has this clamping function. And the
16 patent describes, you know, why they do that, but
17 that would be the difference in these two
18 approaches between embodiments 1 and 2 and
19 embodiment 3.

20 Q. Okay. So is the clamp -- again, is the
21 clamping circuit, then, the combination of the
22 components shown in the box labeled "Video Driver"?

23 A. Yes, those are the added components that
24 allow this blanking function to take place in the
25 video driver itself.

1 Q. What does that blanking input correspond
2 to?

3 A. I want to see what they -- what they
4 said.

5 The term "blanking signal" is one that
6 refers to turning something off and on. Probably
7 goes back to blanking signals that are used in
8 video processing back before LCDs.

9 But it -- it is a period that is done
10 basically at -- before you write data to a column.
11 And so it would be synchronized with the -- the
12 clocking signals of the display.

13 So it saves the value -- as it describes
14 in the patent, it saves the value of -- of the
15 voltage on the capacitor that's used by the
16 circuit.

17 Q. Okay. And is the -- is this a -- so as
18 with the other two embodiments we looked at, is it
19 your view that a person of skill in the art would
20 have understood that this video driver circuit --
21 or I should say, the video clamp circuit in this
22 embodiment is something that could be incorporated
23 into the panel data driver?

24 A. Yes, I think they explicitly say that.

25 And that would be obvious, because this

1 is a function added to the video driver with
2 additional amplifiers to do the different
3 functions. So it's part of the video generation
4 signal, and re-referencing to VDD -- or to the
5 power supply, I should say, periodically instead of
6 continuously.

7 Q. When you say "periodically instead of
8 continuously," what are you distinguishing there?

9 MR. HAMILL: Objection. Form.

10 THE DEPONENT: There is -- there is a
11 blanking signal. It says this -- just a moment.

12 It would be, probably, column 6, around
13 line 61.

14 The patent describes that "the Blanking
15 signal is asserted at the beginning of each video
16 line to re-establish the black reference of the
17 video display," using transistor M3. Right?

18 Transistor M3.

19 And the result of that is that the
20 voltage is saved or sampled at that point in time.
21 And then that voltage Vclamp is stored on the
22 capacitor.

23 And it goes on to say that in this
24 manner, Vclamp is added to the Video.DAC for the
25 rest of the video line.

1 So that explains what the blanking is
2 doing and the operation of this circuit. And it
3 results in $v(t)$, the correction I made at the
4 beginning of this session, is V_{clamp} plus
5 Video.DAC.

6 Q. (By Mr. Williams) Yeah.

7 And I want to come back down to that
8 correction to see why you think that that
9 correction is needed.

10 So is it your view in this embodiment
11 that V_{clamp} and VDD are different?

12 A. The patent actually describes that.
13 V_{clamp} is equal to VDD, but -- it's VDD, but VDD --
14 is VDC plus V_{drift} , shown in equation 8.

15 Q. Right.

16 But, I mean, the patent says they are
17 equivalent, doesn't it?

18 Doesn't it say V_{clamp} equals VDD, which
19 equals those two things?

20 A. Yeah, that's correct.

21 VDD is made of up of several components,
22 but the main ones here on the -- the VDC, which is
23 kind of the ideal voltage that is supplied to the
24 panel, plus V_{drift} , which is a consequence of other
25 factors in the cell phone or the product that

1 caused the voltage to vary, that's -- that's a slow
2 variation of -- of voltages.

3 But it shows that those are the two
4 components that are sampled by this clamp so that
5 the display will not be affected by changes.

6 Q. Got it.

7 Now if you turn -- I don't know if you're
8 on column 7 already, but I want to talk to you
9 about column 7.

10 A. I am on 7.

11 Q. Yeah.

12 So the patent at column 7, line 9 -- been
13 talking about this embodiment -- mentions -- well,
14 what it says -- I will just read what it says.

15 "More specifically, video driver 302 is
16 effective in removing voltage drifts in the power
17 supply voltage but does not necessarily remove
18 noise or glitches in the power supply voltage from
19 impacting the video drive signal."

20 Do you see that?

21 A. Yes.

22 Q. What is your understanding of what the
23 patent means when it talks about noise or glitches
24 in the power supply voltage?

25 A. So the -- the power supply in -- in

1 real-world systems, it will be made up of -- it's a
2 power source with a certain characteristic.

3 And as the patent describes, the -- the
4 power supply can -- can vary slowly with things
5 that happen. Within like the cell phone, for
6 example, the battery starts getting used up. These
7 are all slow variations that occur over time or
8 through some use pattern.

9 And this particular circuit will -- will
10 sample the voltage, the VDD, which is the ideal VDC
11 plus any drift, and it samples that voltage.

12 Now, noise and glitches would be random
13 occurrences that could happen aperiodically. And
14 for a -- an instant of time, it temporarily --
15 you know, something could happen between -- between
16 times when the blanking period -- the blanking
17 happens. So that's while light is being emitted.

18 It could cause a minor glitch, sometimes
19 a little flash or something, to the operation. But
20 it's aperiodic.

21 That's what they're referring to as
22 noise, I think, is a good example in this case for
23 glitches.

24 But that the circuit itself creates an
25 output that is independent of the -- the VDD, but

1 it includes the potential for a noise signal that
2 could happen.

3 Q. So the next paragraph, beginning on
4 line 21, says "Again, assume that the power supply
5 voltage VDD is the sum of an ideal power supply
6 voltage VDC and noise and voltage drift."

7 Do you see that?

8 A. Yes, yes.

9 Q. So as I understand that, the inventor is
10 telling us that the power supply is producing a
11 voltage that is composed of, I guess, three
12 components that -- a DC voltage, a drift and noise.

13 Is that -- have I understood that
14 correctly?

15 MR. HAMILL: Objection. Form.

16 THE DEPONENT: Yeah, that's what it is
17 indicating in that sentence, that there is drift,
18 which is discussed in -- in a lot of detail in this
19 specification as a problem to be solved, and --
20 but -- but -- but this sentence says there could
21 also be noise.

22 So that VDD power supply can be made up
23 of ideal voltage, a drift voltage and a noise
24 element.

25 Q. (By Mr. Williams) Okay. And then it

1 tell us in equation 8 that the voltage at V_{clamp}
2 would involve the DC component and the drift
3 component but not the noise component; is that
4 correct?

5 A. That -- that's what is indicated, the
6 assumption being that the noise is aperiodic and
7 random.

8 And I suppose it's possible it could
9 catch a noise glitch; but generally speaking, it's
10 catching the -- the drift, which a slow-moving
11 voltage change. A person of skill of the art would
12 certainly understand that. But noise is aperiodic,
13 so it's not in the equation.

14 Q. I understand.

15 So the reason this happens is because
16 V_{clamp} voltage is set the time that you transition
17 that blanking signal, is that right, that moment in
18 time?

19 MR. HAMILL: Objection. Form.

20 THE DEPONENT: The -- the voltage is
21 captured, if you will, during the blanking time.
22 So that -- and this says that's at the beginning of
23 the frame or the beginning of -- of the refresh,
24 and I think they use the term.

25 So that's the point at which that voltage

1 is -- is sampled and put into this circuit. And
2 it's sampling the -- the -- the actual VDD power
3 supply for the -- for the whole panel. It's
4 sampling that voltage at the driver chip and then
5 re- -- doing this reset in embodiment 3.

6 Q. (By Mr. Williams) Okay. And then -- so
7 as a result of that, it tell us in the equation
8 shown between line 30 and 34 that $v(t)$ is going to
9 be equal to the DC component and the drift
10 component plus the Video.DAC signal, correct?

11 A. Correct.

12 Q. Okay. The noise -- the noise component
13 doesn't show up in that -- in that equation for the
14 reasons we just talked about; is that right?

15 A. Right.

16 Q. Okay. And the patent, you agree -- do
17 you agree that the $v(t)$ signal there is referenced
18 to the power supply voltage?

19 MR. HAMILL: Objection. Form.

20 THE DEPONENT: The -- the $v(t)$ is -- is
21 referenced to -- the Video.OLED is VDC minus $v(t)$,
22 and that says it's -- the VDC and the drift drop
23 out of the equation. That means it is referenced
24 to that positive power supply, because it does --
25 it is referenced to the -- to the VDD.

1 And since noise is aperiodic, it's not --
2 it would be considered part of the power supply
3 voltage in terms of this referencing; that's
4 correct.

5 Q. (By Mr. Williams) And the patent
6 actually, at line 4 -- sorry, no -- line 6 to 8
7 tell us that the drive signal $v(t)$ is now
8 referenced to the power supply voltage VDD in this
9 embodiment, correct?

10 A. Which column are you on?

11 I'm sorry.

12 Q. Column 7. It's the top of --

13 A. Oh, top.

14 Q. -- the -- top of this place where you're
15 reading.

16 A. Okay.

17 Q. Column 7, line -- maybe line 7 to 8.

18 A. All right. Yes, you're right, that's
19 what it says.

20 Q. Okay. And you agree that's true, right,
21 that as a result of these equations and what's
22 described here, a signal $v(t)$ is referenced to the
23 power supply voltage?

24 A. $V(t)$ is referenced to the power supply
25 voltage, as described in the math below.

1 Q. Can you -- maybe you did this already,
2 and I apologize. I don't want you to have to chew
3 on the same cabbage here.

4 But can you just briefly explain what
5 "voltage drift" means in the context of a power
6 supply here?

7 A. The -- the patent describes a situation
8 that's a good example of drift.

9 A drift could be caused by different
10 factors, but they describe drift as being caused,
11 perhaps, by battery voltage change, DC power source
12 change, such factors that would occur in a
13 real-life product that cause a problem for the
14 display if not compensated.

15 And so this patent discloses a way to
16 reference the voltage in the video driver such that
17 these problems won't show up in the actual display.

18 It's sampling the power supply, and it's
19 sampling the drift, and it's sampling the actual
20 voltage, and so it can produce a display that has
21 less variation.

22 Q. Okay. Can you turn to page 51 of your
23 declaration, please.

24 A. Okay.

25 Q. Just let me know when you're -- are you

1 there now?

2 A. Yeah, starting -- you can tell me which
3 paragraph on the page.

4 Q. 85, paragraph 85.

5 A. Okay.

6 Q. Do you see that paragraph?

7 A. Yeah, I'm looking at it now.

8 Q. Okay. Great.

9 The question I have here is about the
10 second sentence.

11 You say "The portion of the pixel circuit
12 identified by Petitioner does not 'generate a video
13 drive signal.'"

14 Do you see that?

15 A. Yes.

16 Q. Okay. What portion of the pixel circuit
17 are you talking about?

18 A. Let's see.

19 I think -- I have a -- I have a figure --
20 I guess the -- on page 50 -- no, see, that's my
21 annotation.

22 Somewhere in here, I thought I had the
23 petitioner's identification of video drive signals.
24 And they identified -- if my recollection is
25 correct, they identified the M33 and M34

1 transistors and capacitor as being part of the --
2 generating the video signal circuit.

3 And I said that that portion of the pixel
4 circuit does not generate a video drive signal, as
5 we discussed. It performs other functions, but it
6 does not generate the video signal, which is done
7 by the data driver.

8 Q. So that function, in your view, is done
9 by Kim's data driver and not by those transistors
10 you just mentioned; is that right?

11 A. Yes, that -- what I said is that portion
12 of the pixel circuit -- I apologize for not
13 including that; I thought I did somewhere.

14 But that -- the petition argument was
15 related to those transistor circuits, M33 and M34,
16 do not generate video drive signal. They do some
17 compensation and level shifting for other problems
18 within the display itself.

19 Remember, this is actually a more
20 practical pixel circuit.

21 But it's my opinion that they are not
22 part of the video drive signal generation.

23 Q. Okay. Do you dispute that there's a
24 video drive signal in Kim?

25 A. What I say in Kim is that the video drive

1 signal is what's shown on the -- the data line
2 coming into the circuit 10. We are looking at
3 Figure 10, for example. That there is a video
4 drive signal generated by the drive -- the data
5 driver. That shows on Dm -- shown as Dm, data
6 line.

7 So I am not saying it doesn't have one.
8 I am saying that's where it happens.

9 Q. I understand.

10 Can you turn to paragraph 88 for a
11 second. It's on page 53.

12 A. I'm looking at it. Just -- just a
13 moment.

14 Q. Okay. The question I want to ask is, the
15 second sentence on paragraph 88 says "For example,
16 the video driver disclosed in den Boer."

17 Do you see that?

18 A. Yes.

19 Q. And -- okay. So den Boer is that
20 textbook we talked about earlier?

21 It's exhibit, I think, 1011; is that
22 right?

23 A. Yes, yes.

24 Q. Okay. What -- where does -- do you
25 recall seeing den Boer use the word "video driver"

1 somewhere?

2 A. I -- I don't have the book memorized.

3 They are talking about the video data driver
4 architecture. They may have called it source
5 driver, data driver, video -- video driver.

6 But it's referring to the circuitry to
7 generate the video signal that's going to be --
8 that's going to be imposed on the data lines of the
9 display.

10 And that's -- regardless of whether it's
11 LCD or OLED, those functions are in the data driver
12 or video driver.

13 Q. Okay. But if -- would it surprise you to
14 learn that the word -- the phrase "video driver"
15 doesn't appear in den Boer anywhere?

16 MR. HAMILL: Objection. Form.

17 THE DEPONENT: You know, you may have
18 done the search, and it may not use that
19 terminology precisely.

20 But it -- I would -- I would bet that
21 it's describing the function of a video driver,
22 even if it actually tends to use the word that was
23 common for him when he wrote this book to be maybe
24 "data driver" or "source driver."

25 But the functionality and the

1 architecture is well-described, and it does take a
2 video signal to generate an analog output that goes
3 to the display.

4 Q. (By Mr. Williams) Well, what does that
5 in den Boer?

6 A. Well, I'd have to go back and look at
7 den Boer to see what he precisely called it.

8 I think the figure I have on page 52,
9 it's called "source driver IC."

10 Q. Okay.

11 A. That's synonymous with -- with a data
12 driver, or it has the functionality of a video
13 driver circuitry within it.

14 Q. What was your basis for equating the word
15 "video driver" to den Boer's "source driver"?

16 A. Basically, the architecture -- the video
17 driver function described in -- in the
18 '521 patent -- they use the term "video driver" --
19 creates a video signal, an analog signal. It's
20 been buffered so it has the right impedance. That
21 outputs a signal to the data columns. The -- the
22 authors of this patent called it a "video driver."

23 The functionality within the source
24 driver IC described by den Boer has the same
25 capability of taking digital data and creating

1 analog signals that are appropriately shifted to
2 match the voltage requirements of the panel.

3 So that's why I equate the two.

4 Q. Okay. Let me ask you about -- to turn to
5 page -- sorry, page 57.

6 A. I just see -- by the way, on page 56, I
7 think, is the annotated alleged video driver, the
8 petition, with a box. So I was correct in pointing
9 to those transistors.

10 All right. So page 57?

11 Q. Well, hang on. Let me make sure I
12 understood what you just said.

13 So the figure on page 56, the solid box,
14 that's -- that's the portion of the pixel circuit
15 that you were talking about in that section I was
16 asking about earlier?

17 A. Yes.

18 The petition and the expert declaration
19 pointed to that section as the alleged video
20 driver. So when I said "alleged video driver," I
21 was -- I was pointing to that portion of the
22 circuit.

23 I could look -- we could look at
24 Kattamis' declaration, but that's -- I believe this
25 came from that -- from him, or from the petition.

1 Q. Okay. Yeah.

2 In paragraph 91, you say -- I think,
3 again, you're talking about this portion, what you
4 call the "alleged video driver."

5 And you say "It does not generate, but
6 rather merely makes minor adjustments to an
7 existing video drive signal."

8 Do you see that?

9 A. Yes.

10 Q. So what, in your view, is the line
11 between generating a signal and adjusting a signal?

12 A. So first of all, Kim's -- Kim's -- Kim's
13 circuit, Kim's invention, if you will, is about
14 adding additional components to the pixel circuit
15 that can compensate for factors such as AR drop,
16 the threshold voltage changes.

17 These are all what I would consider, you
18 know, local changes to the pixel array that create
19 problems for the display.

20 So they do compensation -- the word
21 mostly used by Kim is "compensation" for errors
22 that happen at the pixel level. They are not doing
23 any adjustment of the video driver signal that's
24 generated by the driver, to reference to a voltage
25 such as the power supply.

1 So the minor adjustments I'm referring to
2 are voltage adjustments. They have a feature
3 called V_{sus} that can reduce the charge on the
4 capacitor. So these are adjustments that are made
5 at the pixel level to create a better display. So
6 those -- those -- those happen in the pixel. I
7 would not consider those circuits to be part of the
8 generation of the video signal by the driver.

9 And any referencing that might occur at
10 that point where the voltage being sampled for the
11 video driver is the video power supply, the VDD
12 power supply, that's -- I will call it kind of a
13 global sampling and adjustment of the signal so
14 that the display will operate better, Kim is adding
15 additional level shifting and compensation to
16 correct for the errors I mentioned.

17 Q. So in that sense, how does Kim's pixel
18 circuit differ from what's shown, for instance, as
19 the video driver in the '521 patent Figure 2?

20 MR. HAMILL: Objection. Form.

21 THE DEPONENT: Well, they are -- they are
22 quite different.

23 Kim discloses a pixel circuit with three
24 transistors, two capacitors -- I'm sorry, one, two,
25 three -- four transistors, two capacitors, a

1 sustained voltage. And it shows a Dm, which is
2 where the actual generated video signal comes from.

3 And the purpose of all of these
4 transistors is to adjust for errors in stored --
5 stored charge on capacitors, or adjusting the
6 voltage to compensate for local variations, such as
7 IR voltage drop or threshold voltage changes, which
8 the embodiment 3 doesn't describe.

9 Embodiment 3 -- I think we are talking
10 about the embodiment 3 -- samples a voltage, and
11 stores that, and then modifies the video drive
12 signal, the generated video drive signal, and
13 references it to that new value.

14 So those are completely different
15 circuits.

16 Q. (By Mr. Williams) Yeah.

17 And let's focus on Figure 2 of the '521
18 for a minute.

19 A. Okay. Figure 2.

20 Okay.

21 Q. Which is the first embodiment, I think.

22 My question to you is, does what is shown
23 in box 102, which is a video driver, does it
24 satisfy your definition of what "generating" means?

25 MR. HAMILL: Objection. Form.

1 THE DEPONENT: Box 102 is part of the
2 video driver. It generates a signal based on the
3 Video.DAC signal. It's also -- it's part of the
4 video driver for sure.

5 But this is -- this is functionality in
6 the video driver that does the re-referencing in
7 Figure 2.

8 Q. (By Mr. Williams) Right.

9 So what that box does in Figure 2 is
10 adjust the voltage from -- to re-reference it to
11 VDD, correct?

12 A. It does more than that. It also provides
13 the gain or -- it provides gain or -- or
14 attenuation, and it provides impedance changing
15 through the opamp to provide the right signal to --
16 to the display.

17 Q. Okay. Is that the difference, is that
18 Kim's pixel circuits, although they re-reference
19 the voltages, they don't do the impedance shifting?

20 Is that why Kim does not meet your
21 definition of "generating"?

22 MR. HAMILL: Objection. Form.

23 THE DEPONENT: Certainly, that's --
24 that's an important part of -- of generating a
25 signal. Generating a signal means creating a

1 signal that is appropriately -- has the right
2 voltages, has the right references, that has the
3 right impedance.

4 Once that is done, these two transistors
5 in Figure 10 will just do some level shifting to
6 compensate for something different from the VDD
7 lines, compensating for errors in threshold voltage
8 or IR drop. Other things that could affect the
9 voltage are taking place locally within the pixel
10 circuit.

11 And I would not consider that to be
12 generating a video signal, nor -- it's my opinion
13 that a POSITA would not consider that to be
14 generating a signal, but adjusting voltages that
15 happened to be Vsus and VDD to compensate for
16 problems in the pixel circuit.

17 Q. (By Mr. Williams) So what is it that
18 box 102 in Figure 2 does that -- that would
19 convince a person of ordinary skill in the art that
20 that circuit is doing generating?

21 MR. HAMILL: Objection. Form.

22 THE DEPONENT: The clearest evidence that
23 a person of skill in the art would look at this
24 circuit to say this has an opamp, this has a gain
25 or attenuation, and it also has a reference imposed

1 on the signal $v(t)$ that includes VDD, that all of
2 that is generating a new video signal that will go
3 into the panel and create the desired result.

4 Q. (By Mr. Williams) Okay. So let me start
5 with what you said about the opamp.

6 What do you mean by there is an opamp?

7 A. The -- the -- I think the patent called
8 it a differential -- what is that? I forget the
9 words.

10 104 in Figure 2, it's an opamp.

11 Q. Okay. And the patent also says that
12 Figure 5 is -- well, let's just see what it says
13 about Figure 5. Let's turn to that.

14 So I am looking at column 3, line 47. It
15 says "Figure 5 is a transistor level circuit
16 diagram for implementing the video driver of
17 Figure 2."

18 Do you see that?

19 A. Yes, yes.

20 Q. And do you have in Figure 5 in front of
21 you?

22 A. Yes, it's a circuit diagram.

23 Q. It's a circuit diagram.

24 Is there an opamp shown in Figure 5?

25 A. I believe it's the -- it's the

1 circuit-level implementation of what is shown in
2 Figure 2. I believe that's -- let me -- let me
3 find the -- the description.

4 "Figure 5 is the transistor level circuit
5 diagram for implementing the video driver of
6 Figure 2."

7 The patent explains that you don't have
8 to physically use a separate opamp if you are
9 designing this new type of driver, that you can
10 implement that circuitry.

11 And Figure 2, I believe, is where they
12 use the term "amplifier."

13 "Differential instrumentation amplifier
14 circuit."

15 So the -- the '521 is describing a, as I
16 said, component-level example of that differential
17 amplifier, so that depending on the values in that
18 circuit, you will have gain or no gain or
19 attenuation and/or impedance changing by that
20 circuit.

21 Q. And the circuit shown in Figure 5, you
22 agree, would perform the step of generating, as you
23 understand that term, correct?

24 A. I -- I -- I didn't really tear apart
25 Figure -- the circuit diagram. I just go by what

1 the -- the -- what is stated in the patent.

2 So as an example of what could be --
3 could represent what's in Figure 2, it does have
4 the four resistors and other transistors.

5 So, yes, I -- I believe that would --
6 would match what's shown in Figure 2.

7 Q. Okay. So why does this circuit shown in
8 Figure 5 perform generating, but the circuit in Kim
9 does not?

10 A. Well, they are completely different
11 circuits. I mean, this is a circuit that
12 represents what is shown in Figure 2, which is an
13 amplifier, a differential transconductance --
14 instrumentation amplifier circuit. And as I said,
15 I didn't do a circuit analysis of Figure 5, but it
16 performs those functions.

17 In the pixel circuit in Kim, it's
18 actually looking at fixing two completely different
19 issues, namely, some stored -- stored voltage on a
20 capacitor, and a level shift to compensate for
21 other pixel variations within the array.

22 So I would not call them part of a video
23 generation circuit.

24 Q. Okay.

25 A. Or his.

1 Q. Okay. But are you saying Figure 5
2 doesn't do a level shift?

3 Figure 5 in the '521 patent doesn't do
4 level shifting?

5 A. No, I -- I'm not saying that. I mean,
6 the Figure -- the Figure 2 is referencing the video
7 signal $v(t)$ to VDD. You can call that level
8 shifting. It's establishing a new reference.

9 The details of what happens within the
10 circuit, I didn't analyze, but it is not doing the
11 simple change in voltage of a generated signal.

12 Q. How do you know that?

13 A. Well, because it doesn't -- that's what
14 the circuit does. The Kim circuit shifts the
15 voltage of the gate of the transistor, the drive
16 transistor, to a sample value of VDD, I believe
17 it's called in Kim, to compensate for issues such
18 as IR drop or V threshold changes within the pixel
19 array, basically making local corrections to the
20 data coming from the actual video generator, the
21 data driver.

22 It's doing these -- as I say, it's doing
23 compensation or it's doing adjustments on a
24 pixel-by-pixel basis. And that would not be
25 considered to be part of a video -- generated video

1 signal, which I -- I -- my opinion is that a person
2 of skill in the art would see that as two distinct
3 functions.

4 MR. WILLIAMS: I am getting a message
5 that I guess we have been going about an hour; is
6 that right?

7 MR. HAMILL: A little more, and it's
8 getting close to lunchtime, so --

9 MR. WILLIAMS: All right. Let's go off
10 the record.

11 (Recess taken.)

12 MR. WILLIAMS: Back on the record.

13 Q. (By Mr. Williams) The first thing I want
14 to do is, you had -- actually, the first thing I
15 want to do is ask if you discussed your testimony
16 with anyone over the break?

17 A. I did not.

18 Q. Okay. The next thing I want to do is
19 come back to something you said about your prep for
20 today.

21 I think you said that you had reviewed a
22 claim construction declaration that you had
23 submitted in the District Court case; is that
24 right?

25 A. Yeah, it was in the -- in the group of

1 documents that I -- I did review. But not -- not
2 with any, you know, close intent, but just look at
3 it.

4 Q. Okay. I am just going to -- I put into
5 Chat a document. I want you to just -- can you
6 open that up and let me know if that's the document
7 you're alluding to.

8 A. Sure.

9 MR. WILLIAMS: And just for the record,
10 I've marked that document as Samsung Exhibit 1100.

11 (Exhibit 1100 was marked for
12 identification by the Court Reporter and is
13 attached hereto.)

14 THE DEPONENT: Yes, that does look like
15 the document that I reviewed.

16 Q. (By Mr. Williams) Okay. And that is
17 your signature on page 32?

18 A. Yeah, that it is.

19 Q. Okay. Was there anything in here in
20 your -- that you noticed during your review for
21 today's deposition that you disagreed with?

22 A. No.

23 Q. Okay. Great.

24 Just turning back to the '521 patent for
25 a moment. And we can look at the Figure 2

1 embodiment for purpose of this question.

2 And let me know when you have that in
3 front of you.

4 A. I do.

5 Q. Okay. On the bottom left of that figure,
6 from the video source, is a signal labeled
7 "Video.DAC."

8 Do you see that?

9 A. Yes, I do.

10 Q. Is that -- and the patent describes that
11 as being an analog signal, correct?

12 A. Yes, I believe it does, coming out of a
13 D-to-A converter.

14 Q. Is there a D-to-A converter shown in this
15 figure?

16 A. No, just the abbreviation. I can't
17 remember if the patent said what that was.

18 Q. When you say "that," what are you talking
19 about?

20 A. Yeah, I'm just seeing if it actually said
21 what they meant by "DAC." I don't think they
22 really did.

23 Q. Yeah, I mean, you're free to look
24 wherever you want. I noticed at column 4, line 18,
25 there's a mention of it.

1 A. Yes -- oh, the definition.

2 They say analog video signals. So, yes,
3 I would agree that they are analog signals
4 represented by the words "Video.DAC."

5 Q. Okay. Great.

6 Turning to paragraph 86 of your
7 declaration.

8 Let me know when you get to that
9 paragraph.

10 A. Okay. I have reviewed that paragraph.

11 Q. Okay. You say in this paragraph that
12 "One of ordinary skill in the art would understand
13 that generating a video drive signal requires
14 taking a usually digital video signal and shifting,
15 converting to analog, and amplifying the voltage so
16 that it can properly drive the transistors in the
17 display panel's pixel circuits," correct?

18 A. Correct.

19 Q. So turning to the patent Figure 2, which
20 of those functions are performed by the video
21 driver 102?

22 MR. HAMILL: Objection. Form.

23 THE DEPONENT: Sorry for the shifting of
24 papers.

25 So of those functions, they would be the

1 amplification -- amplification of the voltages.
2 The conversion of -- to analog is actually taking
3 place in the Video.DAC. This particular added
4 circuit 102 does the re-referencing of the video
5 signal to VDD and potentially provides data
6 attenuation to the output, so it acts as an
7 additional buffer compared to the buffers shown
8 in -- the figure on page 52, which has output
9 buffers after the D-to-A converter.

10 So that would be examples of what that
11 video driver adds to the existing video driver.

12 Q. (By Mr. Williams) Right.

13 Okay. So the circuits shown in box 102
14 of Figure 2, they -- you agree with me that they --
15 they take, as an input, an analog signal, correct?

16 A. Actually, it's shown as a digital data
17 input to that driver.

18 Q. Okay. So you think that line 18
19 Video.DAC is digital?

20 A. No, I -- line 18, what I was referring to
21 is that the data come into this source driver IC as
22 digital data. That is then converted with a
23 digital/analog converter and then goes to an output
24 buffer.

25 Maybe we're saying the same thing.

1 Q. I don't think we are.

2 So looking at the dotted line 102. Do
3 you see that dotted line?

4 A. I guess I am missing -- which figure are
5 you looking at?

6 Q. I am looking at Figure 2 of the '521
7 patent.

8 A. Oh, I thought you were looking at the
9 den Boer schematic.
10 I'm sorry.

11 Q. Yeah, I knew we weren't communicating,
12 and I couldn't figure out why.

13 A. Okay. So line 102 is -- is what's
14 identified as video driver.

15 Q. Yup. So I want to focus on that.
16 What's inside that dotted-line box?

17 A. An amplifier circuit that also
18 re-references the voltage to VDD.

19 Q. Yes.
20 So do you agree with me that what's
21 inside that box takes as an input an analog signal?

22 A. That's the way it is described, yes.

23 Q. Okay. And does it convert that signal to
24 analog?

25 A. The signal is analog, and it amplifies

1 that signal, makes it -- changes -- that would
2 happen in the amplifier, as well as re-referencing
3 the signal to VDD instead of ground.

4 So it's doing two steps.

5 Q. And that amplification step you
6 mentioned, as we talked about earlier this morning,
7 the patent says that amplification could be with a
8 unity gain, correct?

9 A. It does mention that it can be unity
10 gain. It doesn't go into any more details about
11 the function of that, except the addition -- the
12 re-referencing of VDD.

13 But it would be well-known that that kind
14 of a buffer can amplify or change impedance of the
15 output.

16 Q. Does that circuit in box 102 increase the
17 voltage from the logical level of the video source
18 to the level of the display?

19 MR. HAMILL: Objection. Form.

20 THE DEPONENT: Presumably the video
21 source could be either analog or digital, but
22 it's -- the step within the 102 box is primarily
23 the -- taking that signal and potentially
24 amplifying or attenuating the signal, changing its
25 impedance, and re-referencing the voltage to VDD

1 through that opamp.

2 Q. (By Mr. Williams) Let me ask you to turn
3 to paragraph 93.

4 A. Okay.

5 Q. The first sentence of that paragraph
6 reads "One of ordinary skill would also understand
7 that" an AMO -- sorry -- "in AMOLED displays there
8 is a one-to-many relationship between drivers and
9 pixel circuits."

10 Do you see that?

11 A. Yes.

12 Q. Is that relationship that you are
13 referring there to shown anywhere in the
14 '521 patent?

15 A. The '521 patent describes the video
16 driver. That was modified with an additional
17 circuit. And it makes a global change to all of
18 the signals coming from that driver.

19 So it doesn't go into any details about
20 the architecture of the data driver other than
21 showing this additional circuit, which is the
22 subject of the invention.

23 But clearly, that -- that change in
24 voltage and potentially amplification is done at
25 the column driver level. It applies it to all the

1 columns equally, without regard to what's going on
2 in the pixel circuit. And it outputs that value as
3 of $v(t)$ -- one could say $v(t)$ of N , pertinent to N
4 being the column number, so it's actually a
5 multitude of outputs.

6 So that's -- that's what this circuit is
7 doing and why I say that there's a relationship --
8 there's a one-to-many relationship. It's the
9 driver with multiple outputs, as shown in the
10 figure above, certainly well-known to a person of
11 skill in the art and, I am sure, to the inventors
12 of this patent; and that that change, suggested and
13 disclosed by the '521, happens at the column driver
14 level, and that applies to many columns.

15 So that's the one-to-many relationship
16 that exists in -- in an active matrix LCD, which
17 the patent certainly disclosed that his invention
18 applies to an active matrix LCD with many rows and
19 columns.

20 Q. So other than the patent's reference to
21 this happening in an active matrix, is there any
22 other place in the patent that a person of ordinary
23 skill in the art would have learned that there's a
24 one-to-many relationship between the claim drivers
25 and the pixel circuits?

1 A. I think the disclosure in the patent is
2 clear that it's -- applies to an active matrix LCD.

3 And I believe they talk about, you know,
4 many thousand of pixels or -- you know, I forget
5 the exact wording, and that this circuit is added
6 between the video source and the display panel, as
7 is certainly shown as part of the video driver --
8 the generated video signal section.

9 That would be clear to a person of skill
10 in the art that that's the teaching of this patent.

11 Q. All right. Let me ask you to turn now to
12 paragraph 103.

13 A. Okay.

14 Q. Did you find paragraph 103?

15 A. I just got there.

16 Q. Okay. This is the beginning of a section
17 of your declaration where you are talking about
18 whether or not Kim is referenced to the -- whether
19 Kim's video drive signals reference to the power
20 supply voltage; is that correct?

21 A. Yes, that's correct.

22 Q. Your conclusion is that it -- in Kim, the
23 video drive signal is not referenced to the
24 positive power supply voltage; is that right?

25 A. Yes.

1 Q. Okay. And as part of that analysis on
2 paragraph 107, you have some equations.

3 Do you see those?

4 A. Yes, I give an example of, yeah, some
5 equations about voltages.

6 Q. Yeah, and I want to talk about these for
7 a second.

8 So in this equation -- or, sorry, in
9 these two equations shown in paragraph 107, you
10 have a term of $VDD(t)$ and $VDD(t_1)$.

11 Do you see that?

12 A. Yes.

13 Q. Can you explain to me the difference
14 between those two terms?

15 A. Certainly.

16 The -- the " t_1 " refers to the time when
17 the circuit, pixel circuit, is being reset or
18 programmed to a new value. And " t " refers to the
19 time that the -- basically, that the OLED is
20 emitting light.

21 So it's the -- there's two time intervals
22 that I tried to indicate in my analysis.

23 Q. So then " t_1 " comes before " t ." Is that
24 how it works?

25 A. Let me just confirm that.

1 Yes, that's -- that was my assumption.

2 Q. Okay. And you -- as I understand it, you
3 conclude that because those two values could be
4 different, Kim doesn't satisfy the claim
5 limitation.

6 Have I understood this correctly?

7 A. Essentially, yes.

8 Kim -- Kim talks about changes to the
9 voltage that are caused by current flow to the
10 pixel, basically IR drop; they talk about threshold
11 voltage changes to the pixel, which occur locally
12 at each pixel individually; and that both of those
13 terms change throughout -- I'm sorry, they don't --
14 the current drop changes based on what is happening
15 in the display.

16 The threshold voltage change is a
17 pixel-by-pixel difference, so they are different
18 across the display. So they -- they are different
19 then what was -- what was measured or what is
20 measured at t1.

21 Q. So, yeah, I'm trying -- when you "they
22 are different," are you talking the VDD value, the
23 value -- the voltage being produced by the positive
24 power supply?

25 MR. HAMILL: Objection. Form.

1 THE DEPONENT: Yeah, the -- just to be
2 clear, the -- the voltage measured at the pixel --
3 the voltage that exists at the pixel -- it's not
4 only measured, but the voltage at the pixel will be
5 influenced by IR drop and threshold voltage changes
6 that occur within the panel across the pixel array.

7 Q. (By Mr. Williams) Okay. But are
8 these -- these equations, VA4, for instance,
9 that's -- that's a voltage measured at the pixel,
10 isn't it?

11 A. Yeah, VA4 is indeed the voltage measured
12 at what is shown in the figure on page 68, A4 on
13 the right side of the capacitor, and B4 is the
14 voltage on the left side of the capacitor.

15 Q. And VC2 is the voltage across
16 capacitor 2; is that right?

17 A. That's the voltage at the capacitor --
18 essentially the gate of the transistor M31.

19 Q. Okay. So this VC of 2, which is the
20 voltage at the gate of the transistor M31, I mean,
21 that's being measured at one particular pixel,
22 correct?

23 MR. HAMILL: Objection. Form.

24 THE DEPONENT: The voltage VC2 is
25 measured at every pixel, and it's different for

1 every pixel, most likely, or it's -- it's not the
2 same.

3 Q. (By Mr. Williams) Okay. Fair enough.

4 So just focusing on one particular pixel,
5 then, would VDD(t) be different than VDD(t1)?

6 A. It certainly can be.

7 Q. Can you explain why?

8 A. VDD(t), which is basically the voltage
9 that exists on that -- on the VDD line, can
10 fluctuate based on what's happening within the
11 display: what current is being drawn, what
12 luminous levels there are for the entire array that
13 would cause the voltage to change from the t1 time
14 frame.

15 Q. And, again, the V1 -- sorry, the t1 time
16 frame here is the time that that particular pixel
17 was programmed; is that right?

18 A. Eventually, yes, that's the -- the time
19 element when the data is being written, and other
20 things are happening during that time frame.

21 But yes, that -- that's the -- sometimes
22 referred as the programming phase.

23 Q. Can you turn to Figure 2 of the patent
24 for me.

25 A. Okay. I got it.

1 Q. So this issue you're identifying in VDD
2 and how it changes over time, why is that not an
3 issue that would be present in Figure 2?

4 A. The -- the patents in Figure 2, as an
5 example an embodiment, is -- is concerned only
6 about changes in VDD that happen globally due to
7 such effects like drift or other impact on the
8 power supply that -- that are actually equally
9 applied to all pixels.

10 The patent doesn't describe what happens
11 locally at every pixel. That's not the invention
12 of the '521.

13 So the '521 is fixing a problem that
14 occurs when the power supplies vary or drift or are
15 affected by other factors within the product and
16 reference the VDD to that value so that when it's
17 displaying light, it will be correct.

18 To be clear, though, the patent doesn't
19 describe or concern itself with what happens
20 locally, which is exactly opposite of what Kim's
21 circuit is attempting to do, is to fix problems
22 that happen locally throughout the array to make a
23 better picture.

24 Q. Earlier, we looked at the embodiment of
25 this patent that is shown in Figure 3 -- I'm sorry,

1 Figure 4.

2 A. Okay.

3 Q. And we discussed how, in that embodiment,
4 variations in VDD due to noise would not be
5 eliminated from the display.

6 Do you remember that?

7 A. What I recall is we -- we discussed that
8 the -- the VDD and the drift would be -- would be
9 compensated for by that circuit, but not the noise.

10 Q. All right. And is there -- I don't
11 recall in the patent there being a discussion of
12 that distinction with respect to Figures 2 or 3.

13 Do you?

14 A. I'm sorry, which distinction?

15 MR. HAMILL: Objection. Form.

16 Q. (By Mr. Williams) The distinction
17 between eliminating noise or eliminating other
18 variations in VDD.

19 A. The patent does -- with respect to
20 embodiment 3, the patent indicates that drift --
21 drift -- VDD and drift are part of the clamping
22 signal and, therefore, subtracted.

23 But the noise, which is, as I said
24 earlier, aperiodic would not be subtracted. It
25 would happen as a glitch. I think that's the word

1 they used.

2 I distinguish that dramatically from the
3 pixel variations that are going on in a Kim
4 circuit, where every pixel can have a different
5 adjustment of voltage based on the properties of
6 the transistors in those areas, as well as the IR
7 drop and influence on the local value of VDD at any
8 one point.

9 And so that is why I concluded that Kim
10 doesn't -- doesn't reference the video drive signal
11 to the power supply, because of these additional
12 changes.

13 Q. So what is it that -- what is -- what is
14 it that Figure -- the embodiments in the 3 --
15 sorry, in the '521 patent eliminate that Kim does
16 not?

17 A. The -- first of all, the '521 eliminates
18 changes in the power supply that occur in the
19 system.

20 And, again, it measures -- it references
21 to the value of VDD, whichever embodiment it is,
22 and applies that to the driver circuit. And after
23 that, it's -- it's moot to any other changes.

24 Kim, on the other hand, doesn't do that.
25 It supplies the video signal. It's referenced to

1 ground into a pixel array and has additional
2 compensation transistors, M3 -- M33 and M34, which
3 makes local adjustments to the voltage of VDD
4 across the array.

5 And those will be different depending on
6 the conditions of the array, depending on the
7 luminance of the signal being given, because all
8 those factors affect the value of VDD.

9 And since VDD is varying, it is
10 referencing to a positive power supply voltage, is
11 my conclusion.

12 Q. Does Kim eliminate variations in drift in
13 the power supply voltage?

14 A. Kim doesn't consider that factor.

15 But drifts in your power supply is a
16 global feature, if you will. And to the extent
17 it's the same everywhere, then Kim's referencing of
18 the voltage within the pixel would reference to --
19 to that drift, if it was present.

20 But again, I am certain it doesn't
21 identify in the event.

22 The Kim circuit talks about a voltage
23 drop; it talks about threshold voltage changes that
24 are presumably solved by the use of their circuit.

25 Q. Would -- let's just focus on

1 embodiment 1, for instance -- for the moment in the
2 '521 patent.

3 Would that embodiment eliminate
4 variations caused by noise in the positive power
5 supply voltage from the drive current?

6 A. In the case of Figure 2, that -- that
7 would, because VDD is directly fed to the OLED
8 element as well as to the video driver section.

9 So as those vary, they will be referenced
10 out.

11 Q. Okay. Now, earlier this morning, we
12 talked about how, in reviewing this -- the
13 embodiments of this patent, a person of ordinary
14 skill in the art would understand that there would
15 be a storage capacitor in the pixel shown in
16 Figure 2.

17 So if there was such a storage capacitor,
18 is still your view that noise would be eliminated?

19 MR. HAMILL: Objection. Form.

20 THE DEPONENT: It's -- as we discussed
21 this morning, this circuit doesn't show any
22 switching transistors or capacitors.

23 It was only, I believe, shown as an
24 indication of the issue with current driving the
25 transistor and where the voltage comes from and

1 where it is referenced.

2 So if -- if you ask me what would happen
3 if there was a different circuit, I would have
4 to -- I haven't done that analysis. It would have
5 some impact, depending how that circuit actually
6 worked, that's not relevant to the invention of
7 the -- of Figure 2.

8 Q. (By Mr. Williams) All right. So you
9 haven't considered the question of whether noise
10 would be eliminated in the Figure 2 embodiment if
11 there were a storage capacitor at the pixel,
12 correct?

13 A. I haven't formed an opinion on that,
14 correct.

15 Q. Let me ask you to turn to paragraph 112
16 on page 71 of your declaration.

17 A. All right.

18 Q. I want to ask about the first sentence
19 there.

20 Do you see that?

21 A. Yeah.

22 Q. So in that first sentence, you say that
23 "In the context of the '521 patent, the drive
24 current is independent of the positive power supply
25 voltage if the power supply voltage is not a factor

1 in calculating the drive current and at least
2 unwanted voltage drift is removed from the current
3 drive voltage."

4 Do you see that?

5 A. Yes, and I'm talking about all three
6 embodiments to, more or less, different degrees.

7 Q. Yeah.

8 So are you saying that to be independent
9 of in the context of this patent, you have to at
10 least eliminate voltage drift?

11 MR. HAMILL: Objection. Form.

12 THE DEPONENT: The patent teaches that
13 the -- the voltage supplied to the array, to the
14 driving transistor, has been referenced to a value
15 such as VDD.

16 And if VDD is supplied to the drive
17 transistor, then the data source voltage would just
18 be the video signal, the video -- the analog video
19 signal.

20 So if the sampling of the voltage
21 accounts for drift, for example, then it will be --
22 what are my exact words -- "will not be a factor in
23 calculating the drive current."

24 The same could be said for noise in the
25 first two embodiments, because there are --

1 actually is no sampling or storage capacitor. It's
2 just a direct drive, if you will, pixel
3 description.

4 So in that case, any -- any variations in
5 VDD would be -- would be compensated for, or there
6 would -- the drive current would not be a factor.

7 My exact words -- yeah, "the power supply
8 voltage" -- the current wouldn't be a factor --
9 wouldn't be -- would be "independent of the
10 positive power supply voltage."

11 Q. (By Mr. Williams) Okay. So which
12 embodiment -- you talking about Figure 2 being
13 direct drive embodiment?

14 Is that what you just said?

15 A. Figure 2 and 3 effectively have no
16 sampling effect. The only embodiment that has a
17 sampling concept is the blanking concept in
18 embodiment 3.

19 But the -- the other two embodiments are
20 shown as directly driving the OLED pixel. So
21 literally, those two embodiments -- you know, any
22 variation in VDD would be -- would be reflected
23 and, therefore, would not affect the OLED current.

24 Q. Okay. So -- so would -- how would that
25 work in a -- in a matrix display panel?

1 Then you would need -- you would need one
2 wire going to every single pixel from your video
3 drivers, correct?

4 A. If one were to --

5 MR. HAMILL: Objection. Form.

6 THE DEPONENT: -- literally try to apply
7 the -- that concept to the display panel, that
8 would be correct. And clearly, that wasn't the
9 intention of the invention.

10 The -- the reason it was simplified, I
11 believe, to this figure is just to illustrate the
12 impact of the drive current on re-referencing the
13 video drive signal to VDD, therefore eliminating
14 the variations that could occur.

15 But, in fact, if you build a working
16 active matrix LCD, you would have additional
17 components, and you would have to -- you know, I
18 would make different statements about each one. I
19 did state that, for example, for embodiment 3, it's
20 different than embodiment 1 and 2.

21 Q. (By Mr. Williams) Okay. Turning back to
22 paragraph 112 for a second, I just wanted to see if
23 I understood your prior -- one of your prior
24 answers.

25 So the question I was asking you is

1 whether eliminating drift is -- well, I didn't ask.

2 Let me reask the question, and I am going
3 to ask it this way.

4 Is your view, is eliminating unwanted
5 voltage drift essential in order to practice the
6 claim of the '521 patent?

7 MR. HAMILL: Objection. Form.

8 THE DEPONENT: Let me reiterate what I
9 believe I said.

10 The '521 describes various embodiments
11 that track the VDD. It's -- the concept is fairly
12 straightforward.

13 You re-reference your video circuit using
14 this special added video driver, and it will track
15 VDD. And to the extent that there was drift or not
16 drift, it would still track VDD -- the actual VDC,
17 if you will, part of the signal. But it will also
18 compensate for or remove drift, because drift is
19 happening slowly.

20 So whether it's embodiment 1, 2 or 3, it
21 will all remove those variations.

22 As I said in my paragraph 112, the -- the
23 variations that occur in Kim's circuit, with the
24 voltage threshold changing and the IR drop changing
25 across the array, which is dependent on the signal,

1 it will not remove those variations because they
2 aren't constant, if you will, like the VDD and even
3 the Vdrift.

4 Q. (By Mr. Williams) Let me ask you to turn
5 to, I guess, the -- page 75 of your declaration.

6 THE DEPONENT: Can I ask -- request for a
7 five-minute break?

8 MR. WILLIAMS: Sure, that's fine.

9 We can take a break now.

10 THE DEPONENT: It's a new subject we're
11 getting to, it looks like, so I'll take my break
12 now.

13 MR. WILLIAMS: That's fine.

14 (Recess taken.)

15 MR. WILLIAMS: Okay. Back on the record.

16 Q. (By Mr. Williams) Did you discuss the
17 substance of your testimony with anyone during the
18 break?

19 A. No, I had other tasks at hand during the
20 break.

21 Q. Okay. Let's talk about the section
22 actually beginning of page 78 of your declaration.

23 Just let me know when you see that.

24 A. Yeah, I see -- I'm there.

25 Q. All right. And at the bottom of that

1 page, you begin an analysis of Hayafuji with
2 respect to this claim element involving the term
3 "referenced to a positive power supply voltage."

4 Do you see that?

5 A. Yes.

6 Q. Okay. Let me actually start with this
7 first question, which is, for the purposes of this
8 claim element, what is it that has to be referenced
9 to a positive power supply voltage?

10 A. The video drive signal is indicative of
11 the video signal in reference to a positive power
12 supply voltage on the panel.

13 Q. Okay. So it's the video drive signal
14 that needs to be referenced to the positive power
15 supply voltage, correct?

16 A. Yes, that's -- that's the video drive
17 signal that we've been discussing throughout the
18 morning.

19 Q. Yes.

20 Okay. So the term that Hayafuji uses for
21 the video drive signal is "Vgate"; is that correct?

22 A. Well, that's the output of this circuit.

23 I --

24 Q. Let me rephrase the question.

25 That's what -- the petition maps Vgate to

1 the video drive signal, correct?

2 A. Yes.

3 Q. That was your understanding too, correct?

4 A. Yes.

5 They call it -- well, there is a Vdata,
6 and they have a Vgate as the output of the circuit.
7 So that would be the video drive signal equivalent
8 to $v(t)$, I guess.

9 Q. So Vgate is the equivalent to $v(t)$; is
10 that right?

11 A. That's --

12 MR. HAMILL: Objection. Form.

13 Q. (By Mr. Williams) Is that what you meant
14 to say, is that those --

15 A. Yes.

16 Q. -- are the equivalent -- those are the
17 equivalent values?

18 A. Vgate is the signal that is going to the
19 gate of the drive transistor.

20 So that would be equivalent.

21 Q. Okay. So then turning to page 80, which
22 is where paragraph 128 begins.

23 A. Okay.

24 Q. The last full sentence on that page reads
25 "Vgate is therefore the sum of ripple component V_{ri}

1 and video signal Vdata: Vgate equals Vri plus
2 Vdata."

3 Do you see that?

4 A. I see that, and let me just check.

5 Yes, that's -- I just checked the patent,
6 and it is also shown in Figure 6 of the patent.

7 Q. Sorry, which patent are you talking
8 about?

9 A. Hayafuji.

10 Q. Okay. That's Exhibit 1006, correct?

11 A. Correct.

12 Q. All right. And you were looking at
13 Figure 6; is that right?

14 A. It's in my report on the previous page,
15 79.

16 Q. Okay. The next -- anyway, I was -- I am
17 going to read the next sentence in your paragraph
18 128, which reads "Because the positive power supply
19 voltage Va of Hayafuji does not even appear in the
20 calculation for Vgate, it is not referenced to the
21 positive power supply voltage."

22 Do you see that?

23 A. That's my opinion, yes.

24 Q. Yeah.

25 Why is that -- you agree that Vri is part

1 of the power supply voltage, correct?

2 A. So as described by Hayafuji, V_{ri} is
3 ripple component caused by, I believe they say, the
4 DC-to-DC power supply, which has a high ripple and
5 can effect the performance of the display, that
6 that -- that signal alone is filtered by the RC
7 filter and supplied to the circuit as V_{ri} , which
8 all the DC components have been removed.

9 So V_a or anything else that occurs on the
10 power supply line have been removed, and just the
11 r_i is extracted and added to the V_{data} to create
12 V_{gate} .

13 Q. Uh-huh.

14 A. So that's not referenced to the positive
15 power supply.

16 Q. Okay. The ripple extraction circuit --
17 so you were looking at Figure 6, correct?

18 A. Yeah, and the patent.

19 But, yes, it's shown in Figure 6.

20 Q. Yeah, right, which is on the page before
21 in your declaration as well.

22 Okay. That ripple extraction circuit 14
23 is connected to V_a , correct?

24 A. It's -- yes, it's connected to V_a -- V_a
25 is the input, and it extracts the AC component,

1 called ripple. And now it's a -- it's a
2 low-voltage signal that is completely independent
3 of V_a . And it sends that to the gate signal to
4 compensate for that ripple effect on brightness.

5 That's Hayafuji's invention, in my
6 opinion.

7 Q. You call -- you called "ripple" the -- an
8 AC signal; is that right?

9 A. Yes.

10 I call it that because I think it's
11 described as such in Hayafuji. I think they show
12 it in Figure 8, for example. There's a V_{ri} -- it's
13 kind of a sawtooth, repetitive signal, which would
14 be -- would be the type of noise you might see from
15 a DC-to-DC converter circuit.

16 Q. And did you say that Hayafuji uses the
17 term "AC" to describe that signal?

18 A. I don't recall if they used that term.

19 I think I might have said it is an AC
20 signal, because the RC filter filters out the DC or
21 any slow-changing components in the signal V_a .

22 Q. When you say "slow-moving components,"
23 what do you mean by "slow" in that context?

24 A. Slow in the context of the RC filter.

25 And judging by the -- I don't remember

1 the description in Hayafuji. Let me just see what
2 I said here.

3 They clearly are focused on ripple noise
4 caused by the power supply. And they extract the
5 ripple component from the power supply voltage and
6 feed it into the addition circuit. And they show
7 it, for example, in Figure 8.

8 Maybe they show it before that. Let's
9 see.

10 Well, they first of all show it in
11 Figure 3. They show a V_a voltage that's no longer
12 flat or constant as it should be. And opposed on
13 V_a is a ripple. And Figure 8 shows that ripple
14 being extracted, if you will. And then it shows it
15 being added to V_{data} .

16 So the magnitude of that signal is added
17 to V_{data} to get a -- a new gate signal that goes to
18 the drive transistor.

19 So the DC be component, the V_a component,
20 is totally filtered out. And it could change by a
21 volt or two, and this circuit would not know that.

22 Q. And by "a volt or two," do you mean a
23 volt or two over a microsecond, or are you talking
24 about something else?

25 A. I'm talking about V_a changing the -- the

1 patent, '521, is obviously about referencing the
2 output to VD -- to VDD, in this case Va, so that
3 the drive current will be dependent of that value.

4 The Hayafuji circuit focuses on only one
5 solution, which is to extract the ripple from the
6 DC-to-DC supply, or anything else that happens at
7 high frequency that could get through the RC
8 filter, and adds that, effectively, through an
9 addition circuit to the data signal so that it
10 generates a new gate voltage that will track, if
11 you will, that ripple effect, the ripple being a
12 brightness effect on the display.

13 Q. Okay. You mentioned in that answer "high
14 frequency."

15 Is there any indication of what "high
16 frequency" means in the context of Hayafuji?

17 A. I don't believe Hayafuji talked about any
18 specific frequencies. But they are -- and they're
19 describing a simple RC filter.

20 And they don't give the values, but the
21 purpose of that would be a high-pass filter that
22 would filter out DC components and only supply the
23 AC components.

24 And I think that's indicated by Figure 8
25 showing this dotted line, Vri, that is going to be

1 added to the data signal as being a kind of a
2 plus-and-minus signal around Vdata.

3 It tells me that it's a AC signal, and
4 it's been filtered by the RC circuit.

5 Q. So in your view, what would Hayafuji have
6 to eliminate in order to satisfy the limitation
7 that the video drive signal be referenced to a
8 positive supply power voltage?

9 MR. HAMILL: Objection. Form.

10 THE DEPONENT: Claim 1A states that video
11 drive signal is indicative of a video signal
12 referenced to a positive power supply voltage.

13 Hayafuji would have to show -- and he
14 doesn't; it does not -- that the video drive signal
15 has any relationship to what they call Va. It's
16 not in the equation.

17 As a matter of fact, Figure 7 in my
18 report shows that the video circuit is referenced
19 to ground.

20 Q. (By Mr. Williams) Which video circuit
21 are you talking about?

22 A. Figure 7 on page 78.

23 Well, the circuitry there is shown as a
24 reference to ground for the Vgate signal.

25 Q. And what makes you say that?

1 A. The little symbols that show ground on
2 the opamps and on the RC circuit.

3 Possible even in the -- another figure
4 that I didn't use. Let me check.

5 Figure 6 shows Vdata referenced to
6 ground. This voltage addition circuit in Figure 7
7 is referenced to ground; ergo, Vgate is referenced
8 to ground.

9 Q. So are you saying because this opamp has
10 a connection to ground, it can't practice the
11 invention?

12 MR. HAMILL: Objection. Form.

13 THE DEPONENT: I'm not saying -- I'm not
14 saying it cannot practice the invention. I am
15 saying it does not practice the invention.

16 There's no evidence that that Va -- that
17 the video data signal or the Vgate signal is
18 referenced to Va.

19 Q. (By Mr. Williams) Okay. But -- yeah, I
20 understood that part.

21 But I want to talk now about the answer
22 you just gave about being connected to ground,
23 because I didn't understand how that tells me that
24 this is not practicing the patent.

25 So what is it about the fact that there

1 is a ground that the opamp is connected to that has
2 led you to believe Hayafuji doesn't practice the
3 patent?

4 A. Well, each of these opamps are referenced
5 to ground on the plus terminal in the opamps. And
6 you can compare that to the '521 -- well, not
7 directly.

8 But there -- there is nowhere in this
9 circuit where Va even appears other than at the RC
10 circuit or -- RC circuit.

11 Therefore, if you look at the Hayafuji
12 disclosures, there is a Vdata signal that's
13 definitely referenced to ground. I think that we
14 have no -- should be no debate. That's in
15 Figure -- let me make sure I have the right patent
16 out here.

17 It's shown in Figure 10, may be shown in
18 other figures as well. Shown in Figure 2 as prior
19 art. It's shown in Figure 6, probably the most
20 relevant.

21 And these two opamps, if there was any --
22 any reference to Va, it would have to show up in
23 the circuit. It does not.

24 These are addition circuits that go
25 through to form the Vgate.

1 Q. Okay. What is it about the fact that the
2 Hayafuji -- the Vdata signals reference to ground
3 that is important to your analysis?

4 A. I will say it one more time; I don't know
5 how to say it any differently.

6 But when you look at Figure 6 and
7 Figure 7, and you look at the description of these
8 opamps, and you look at the description of the data
9 signal all being referenced to ground, there is
10 absolutely nowhere in the circuit that the signal,
11 the video drive signal, is referenced to a positive
12 power supply.

13 Q. Okay. Let me ask you to turn to the
14 '521 patent, Figure 2.

15 Do you agree with me that the VDAC signal
16 is referenced to ground, the Video.DAC?

17 (Simultaneously speaking.)

18 Q. (By Mr. Williams) Let me reask the
19 question.

20 Do you agree with me in Figure 2 of the
21 '521 patent that the Video.DAC signal is referenced
22 to ground?

23 A. Yeah, according to the figure, it does
24 appear to be referenced to ground. And I think
25 that's what the text says, but I would have to go

1 check it.

2 Q. Okay. And that's true in Figures 3 and 4
3 as well, right?

4 A. Yes.

5 Q. Figure 5 shows the circuits connected to
6 ground as well, correct?

7 A. Well, Figure 5 shows the circuit
8 connected to ground, but not the Video.DAC
9 necessarily.

10 But, yes, the little -- the little
11 triangles are ground.

12 Q. Okay.

13 A. So most importantly, $v(t)$, if you see
14 that -- anyway, it's referenced to ground.

15 Q. Okay. Now let me ask you about
16 paragraph 136 of your declaration.

17 And I should point out, we are here --
18 now we have moved into a section of your
19 declaration addressing element 1C.

20 A. Oh, I see that. Okay.

21 Okay. In paragraph 136?

22 Q. Yeah.

23 Do you see that paragraph?

24 A. Yes.

25 Q. What is your basis for saying Hayafuji's

1 circuit doesn't remove the voltage noise in the
2 power supply?

3 A. Well, let me think about that.

4 It clearly doesn't remove the voltage
5 drift, and it doesn't remove the DC. But depending
6 on the frequency of the noise, it may be removed or
7 it may not be removed.

8 So it really depends on the character of
9 the RC filter.

10 Q. Okay. Let me ask you to turn to
11 paragraph 139.

12 Do you have that?

13 A. I'm reading -- I'm reading -- just
14 reading back a couple paragraphs.

15 Q. Okay. Sure.

16 A. So I'm caught up now.

17 You wanted to focus on which paragraph?

18 Q. 139.

19 A. Got it.

20 Q. All right. And that paragraph alludes to
21 "Petitioner's admitted equation for the drive
22 current voltage." [as read]

23 Do you see that?

24 A. Yes.

25 Q. Do you recall what that equation is?

1 A. I think it's on page 1 -- page 86.

2 If I quoted this accurately, "The
3 Petition alleges that V_a can be expressed as the
4 sum of DC power and the ripple component V_{ri} : V_a
5 equals V_{DC} plus V_{ri} ." [as read]

6 So the petition and their expert is
7 saying that the -- the power supply is made up of
8 those two components. So V_a is made up of those
9 two components.

10 Q. Yeah, no, I understood that part.

11 I guess I was getting to the next part,
12 where you say the "admitted equation for the
13 current drive voltage," which I think was V_{GS} .

14 A. Oh, V_{GS} ; it was V_{GS} .

15 So V_{GS} has V_{ri} plus V_{DC} minus V_{data} minus
16 V_{ri} .

17 So what did Petitioner say here?

18 So I think -- so I think what this --
19 what the equation of the petition said for V_{GS} ,
20 which would determine the gate current and would
21 determine the current, is V -- V_{DC} plus V_{ri} , which
22 is the same as V_a , minus V_{data} minus V_{ri} , which
23 then simplifies to V_{DC} minus V_{data} .

24 So that's not independent of V_{DC} .

25 So that's -- I guess that's -- my

1 paragraph 139 is saying that, in fact, the drive
2 current is VDC minus Vdata. Just the ripple part
3 has been canceled.

4 Q. Okay. So now if you turn to the
5 '521 patent, column 7, line 44, for me.

6 A. Okay.

7 Q. It's this equation 9 that I want to ask
8 you about.

9 A. Equation 9.

10 So Video.OLED, right.

11 Okay.

12 Q. All right. Does this equation in
13 column 7 of the '521 patent satisfy the limitation
14 that the drive current is independent of power
15 supply voltage?

16 A. Yes.

17 Q. Okay. Well, and that equation has Vnoise
18 in it, still, right?

19 A. It does Vnoise, which we discussed before
20 is an aperiodic glitch.

21 So it's independent of the positive power
22 supply voltage. It's not independent of aperiodic
23 noise events.

24 That's quite different than the equation
25 on page 86, where the petitioner says it's directly

1 proportional to VDC, meaning a steady stated value
2 of VDC, and that is the positive power supply
3 voltage.

4 That is quite different than considering
5 a -- a glitch.

6 Q. Okay. So I think -- if I understand what
7 you just said correctly, then it is -- it is
8 sufficient to be independent of the positive power
9 supply voltage if you -- if you eliminate from the
10 drive current the DC component.

11 But it's not sufficient to be independent
12 of the positive power supply voltage if you
13 eliminate only the variations in the power supply
14 voltage.

15 Is that correct?

16 MR. HAMILL: Objection. Form.

17 THE DEPONENT: That's -- that's not what
18 I had indicated, and what we discussed in --
19 previously, that the -- the drift, for example,
20 these low-frequency changes in the power supply,
21 are part of the power supply voltage; the
22 embodiment 3 eliminates those variations to make
23 them independent of the positive power supply; and
24 that I assert that the random noise glitches don't
25 change my conclusion.

1 During those -- you know, those glitches,
2 there will be momentary moment when that affects
3 the voltage, but that is still quite different from
4 having the DC component of the voltage in the
5 equation, I think we both have to agree.

6 So we are -- we are eliminating all of
7 the DC and drift, which are -- are changing slowly.
8 The reference -- they are independent of those
9 voltages, of that voltage. When there's a noise
10 glitch, there's a temporary glitch.

11 A person of skill in the art wouldn't
12 consider that this is now dependent on the power
13 supply voltage because there's a glitch now and
14 again. That's just not the way you would interpret
15 this -- this -- these claims and this patent to
16 operate.

17 Q. (By Mr. Williams) So why is drift
18 important but noise is not to this patent?

19 A. Well, as the patent teaches, the
20 rationale for the patent initially is that -- that
21 real-world products, like cell phones, have power
22 supplies that are designed to be at a certain
23 voltage, but then have to drift due to various
24 causes: Problems with the charging system,
25 problems with the battery, and such issues.

1 And those will cause the display, for
2 example, to get dark if you were to not compensate
3 for that.

4 So this patent references to the voltage
5 that's supplied to the -- to the panel itself.
6 Therefore, that cancels out, and the drive current
7 is independent of the voltage, except if there is a
8 noise glitch -- they -- they even admit for -- for
9 embodiment 3 -- that that glitch will cause an
10 error, but that doesn't change the opinion that
11 that circuit is independent of the positive power
12 supply voltage.

13 Q. And when you say "that glitch will cause
14 an error," it will cause an error in what is
15 displayed on the screen, correct?

16 A. It would cause a predivation in the
17 voltage, depending on the magnitude of the glitch.
18 So, yes, it would cause a change in luminance.

19 Q. And that could be visible to the user,
20 correct?

21 A. Yeah, in that incident time, it -- if
22 they were looking at the screen, it could be
23 visible. If it happened quickly, they may not have
24 even seen it.

25 But it's not -- you know, the patent is

1 more about the power supply itself varying and
2 drifting that will cause the deleterious problems,
3 you know, in use.

4 Q. Yeah.

5 And so would that drift, then -- would --
6 would problems with drift be visible to the user in
7 the display output?

8 A. Yes.

9 Q. In what kind of ways would that be
10 visible to the user?

11 A. It depends how the voltage drifts. It
12 usually drifts down, because power supplies and
13 batteries get used up. So you would have less
14 drive current -- less drive voltage, so the display
15 would get darker.

16 Q. And so, in your view, that phenomenon
17 that you're describing is eliminated by the
18 invention of the '521 patent; is that correct?

19 MR. HAMILL: Objection. Form.

20 THE DEPONENT: What's -- what's
21 eliminated is the DC variations and the drift
22 variations, yes. Those are eliminated by
23 embodiment 3.

24 All predivations are eliminated by
25 embodiments 1 and 2.

1 Q. (By Mr. Williams) Let's turn to Figure 5
2 of the '521 patent for a moment then.

3 And I don't know if you recall, but the
4 patent describes Figure 5 as a transistor level
5 implementation of --

6 A. Figure 2, I think.

7 Q. Figure 2 sounds right to me.

8 Yes, Figure 2.

9 Okay. So VDD is shown at the top of this
10 circuit diagram as an input into the circuit,
11 correct?

12 A. Yes.

13 Q. And at the bottom of the circuit,
14 eventually things start getting connected -- start
15 getting connected to ground, correct?

16 A. Yes, there's current sources and other
17 parts of the circuit that I said I didn't analyze
18 in any detail. But, yes, that -- those are
19 referenced to ground.

20 The Video.DAC is referenced to ground
21 according to the figure but not in the -- it's hard
22 to see from this drawing.

23 Q. Yeah, that's fine.

24 The current sources that you're alluding
25 to, are those the overlapping circles at the bottom

1 of the page, or are you referring to something
2 else?

3 A. Yes, they are; they are the overlapping
4 circles.

5 Q. Okay. So you don't know -- in this
6 figure, you can't tell how those current sources
7 are being powered, or can you?

8 A. I can't -- I don't have enough
9 information to determine that. I don't have the --
10 the values and properties of the transistors. I
11 don't have the R values. I don't have anything.

12 I -- I didn't even feel it was important
13 to pay much attention to this figure, as it states
14 that it's the equivalent to Figure 2. So we can
15 look to Figure 2.

16 So that's as far as I went.

17 Q. Okay. Well, all right. Let's -- we can
18 do this in Figure 2 then. That's fine.

19 VDD is an input on terminal 14 to the --
20 to the opamp 104, correct?

21 A. That's one place it's an input.

22 Q. Yeah.

23 Is there another place that it's input?

24 A. Yeah, it's input at -- next to the upper
25 resistor, it's directly connected to the resistor

1 which goes through that resistor chain to ground as
2 an input to the plus terminal of the opamp.

3 Q. Okay. Now, what would happen if VDD went
4 to the -- went to ground here?

5 Would the circuit still work?

6 A. Which -- which VDD?

7 All of the VDD?

8 Q. Well, I mean, that's an interesting
9 question.

10 Do you think that those VDDs are
11 different VDDs then?

12 A. The patent didn't put any description of
13 those. They just called them the same, so I assume
14 they are the same.

15 And if VDD went to ground, if VDD was
16 grounded, there would be no current in the circuit.

17 Q. Okay. And would there be -- there be
18 output on the display panel in that scenario?

19 A. No.

20 Q. Okay. At what -- how much drift could
21 this circuit handle in VDD before it could longer
22 produce an output current?

23 MR. HAMILL: Objection. Form.

24 THE DEPONENT: A VDD is made up of, as we
25 discussed, three components.

1 But let's focus on the VDC and the drift.

2 As the voltage drift is causing the
3 voltage to decrease, if it's a negative effect, VDD
4 will drop.

5 At some point, VDD will get too low, and
6 the threshold -- it may not overcome the threshold
7 voltage of the transistor M1. And then the circuit
8 would not operate.

9 That's certainly not the situation that's
10 being contemplated or -- or described in the
11 patent.

12 The opamp also draws its power from VDD,
13 which is probably -- you know, maybe this just a
14 circuit schematic. Often the input to the opamp is
15 a different voltage than the -- than the VDD. And
16 here, it's drawn as the same. So that will
17 eventually have some impact on the gain
18 characteristics of the opamp if it drops down too
19 low.

20 Q. (By Mr. Williams) So what -- sorry, hang
21 on one second.

22 Okay. I think that's -- we did that
23 already.

24 Okay. I want to ask you a question about
25 ground 4. You address that beginning at page 89 of

1 your declaration.

2 A. Okay. Okay. I'm with you.

3 Q. So --

4 MR. HAMILL: Excuse me.

5 If we are going to change gears, can we
6 take a break now?

7 MR. WILLIAMS: You want a break?

8 Sure, that's fine. Let's take a break.

9 (Recess taken.)

10 MR. WILLIAMS: Back on the record.

11 Q. (By Mr. Williams) During that break, did
12 you discuss your testimony with anybody?

13 A. I did not.

14 Q. All right. Super.

15 All right. So I am on page 89 of your
16 report, where you talk about your analysis of
17 ground 4.

18 Do you see that?

19 A. Yes.

20 Q. Okay. And on page 90, you show a figure,
21 I think from the petition, of what the combination
22 is that is being proposed; is that right?

23 A. Yes.

24 Yeah, that's right, by eliminating the RC
25 constant -- or filter, I should say.

1 Q. Yup.

2 Okay. And in paragraph 149, you note --
3 the end of that paragraph, which is on the next
4 page.

5 You note that "The result of the proposed
6 modifications is a circuit that outputs the
7 difference between power supply voltage V_a and
8 video signal V_{data} ."

9 Do you see that?

10 A. Yes.

11 Q. All right. And that -- so that would be
12 the voltage -- you are talking there about the
13 voltage at V_{gate} , correct?

14 A. The resulting voltage of V_{gate} .

15 The proposed modifications initially
16 takes V_a into the first opamp, compared to DA --
17 compared to the video signal V_{data} . And then that
18 eventually becomes V_{gate} .

19 Q. Okay. And then so on -- if you turn to
20 page 94, then, at the bottom, you get an equation
21 there from the petition: V_{gate} equals V_a minus
22 V_{data} .

23 Do you see that?

24 A. Yes.

25 Q. Okay. So I guess the question I want to

1 ask is, you don't disagree that the -- the circuit,
2 as shown on page 90 of your declaration, would --
3 would generate Vgate that has that -- according to
4 that formula, correct?

5 A. I -- I -- I did -- I didn't analyze
6 this -- all of this in -- pieces of the circuit in
7 detail. But, yes, it does have those two inputs
8 and would result in a modified re-referencing of
9 Vgate, much as the way the patent describes
10 re-referencing on that -- at that Vgate.

11 That really wasn't my argument, as you
12 know, but that would be the result.

13 Q. Okay. Yeah, no, I understand you have an
14 argument that -- as I understand your argument is
15 that a person of ordinary skill in the art
16 wouldn't -- wouldn't have done this, right?

17 That's what your argument is?

18 A. Pretty much in a nutshell, that this is
19 teaching -- this is hindsight.

20 Q. Okay. Yeah.

21 All right. But in that circuit, then,
22 the -- the -- according to the formula, then, that
23 you have on the bottom of page 94, the voltage
24 across -- well, the VGS voltage shown in -- in that
25 figure on page 90, that would just be Vdata,

1 correct?

2 A. Vdata.

3 MR. HAMILL: Objection. Form.

4 THE DEPONENT: If you looked at -- VGS
5 would be the -- the Va would cancel out and be plus
6 or minus Vdata.

7 Q. (By Mr. Williams) Okay. Fair enough.

8 So it's either -- one way or another, it
9 would be plus or minus. It just -- but that would
10 be the only term in the equation is Vdata, correct?

11 A. That follows from this hypothetical
12 design.

13 Q. Okay. And that hypothetical design,
14 then, the effect of that would be to eliminate
15 drift in the -- any component of drift in the power
16 supply from the output to the OLED, correct?

17 MR. HAMILL: Objection. Form.

18 THE DEPONENT: It -- again, this
19 circuit -- I didn't analyze this circuit in any
20 detail to that level.

21 But it does have a storage capacitor, so
22 it is sampling a voltage. And depending on how
23 the -- the changes are made, as we discussed with
24 respect to Kim, that there still can be errors
25 caused by the pixel circuit variations across the

1 array. Notwithstanding that, the first order of
2 this would take into account drift.

3 Q. (By Mr. Williams) Thank you.

4 All right. Just give me one more minute
5 here.

6 Do you have Steer?

7 A. I do.

8 Q. This is Exhibit 1008, I believe; is that
9 correct?

10 A. It looks so, yes.

11 Q. Okay. Just give me one second.

12 Okay. You have your declaration, and
13 turn to paragraph 161 for me.

14 A. Okay.

15 Q. In this paragraph, you are starting by
16 discussing a feedback circuit in Figure 4, which I
17 think is on the next page; is that right?

18 A. Yes.

19 This is the -- you know, the heart of the
20 Speer [sic] -- or Steer invention, to use a current
21 feedback system to sample the pixel characteristics
22 across the array to compensate for potential
23 voltage, other errors that may occur across the
24 array.

25 That's this type of a sensing circuit.

1 Q. And is the -- is the actual OLED or the,
2 you know, emitting device shown in this figure?

3 A. In Figure 3, it's shown. And Figure 3 is
4 connected to Figure 4 through, I guess you could
5 say, element 6, the data line.

6 Of course there are a multitude of data
7 lines, but that's one column.

8 Q. Okay. Got it.

9 Okay. And then I wanted to get you down
10 into -- within paragraph 161, in the -- on page 99,
11 you talk about the amplified output of
12 comparator 50.

13 Do you see that?

14 A. Yes.

15 Q. Is it your view -- so you've labeled the
16 resistors on comparator 50 as R1, R2, R3, R4; is
17 that right?

18 A. Yes.

19 That was not originally in the diagram, I
20 believe.

21 Q. Okay. Is it your view that those
22 resistors would need to be different values, or
23 could they all be the same?

24 A. The patent claims there is amplification;
25 therefore, they would be different to achieve

1 amplification.

2 And I focused on R4 and R3 for the ratio,
3 as in my analysis you have seen, I'm sure.

4 Q. R4 and R3.

5 Okay. So your view is that because the
6 patent says there's amplification done here that
7 these resistors must be different values; is
8 that -- do I understand that correctly?

9 A. Yes, that's what I indicated.

10 Q. Okay. Is it -- is it possible for an
11 amplifier to have unity gain?

12 A. An amplifier can have unity gain, but
13 then it wouldn't have amplification, which is
14 clearly indicated in the patent, even to the extent
15 that they say adding an additional opamp, you can
16 reduce the amplification of the first opamp.

17 That implies, certainly, there is
18 amplification in this circuit, even though it could
19 be designed with unity gain. But it's clearly not.

20 Q. Just explain that last part to me.

21 Why is it clearly not with unity gain?

22 A. Oh, I said it's not unity gain because
23 the patent describes there as being amplification
24 of the signal.

25 Q. So what we talked earlier about these

1 unity gain amplifiers in the context of the
2 '521 patent, you mentioned that an amplifier could
3 have unity gain whereby it reduces the impedance of
4 the signal.

5 Do you recall that?

6 A. Yes, I said the opamps can have unity
7 gain, and that's by setting the resistors equal.
8 There would not be amplification as described in
9 this patent, which is dealing specifically with the
10 voltages in the circuit.

11 Q. Okay. So your conclusion from reading
12 Steer, then, is that the output of this particular
13 amplifier has to change the voltage and not just
14 the impedance; is that right?

15 A. The disclosure indicates that that's what
16 Steer is teaching. Whether the impedance changes
17 or not is -- is not relevant.

18 I believe Steer does say -- let me find
19 the right wording.

20 So I guess -- yeah, I finally found it.
21 Paragraph 190.

22 Q. Sorry, of your declaration?

23 A. Yeah, my declaration. Paragraph 190,
24 page 111.

25 What Steer teaches, that there is

1 amplification of the signal, that's what we have
2 already discussed. And according to Steer, the
3 amplified output "is provided to the column
4 conductor through the gate 40... Steer also
5 explains that comparator 50 could employ a lower
6 gain if an 'integrating amplifier' that is 'not
7 shown in Figure 4' is added to the circuit."
8 [as read]

9 So this discussion implies that
10 comparator 50 employs some gain; otherwise, it
11 could not be lowered.

12 Additionally -- well, that's -- that's --
13 that's sufficient to teach a person of skill in the
14 art that the disclosures of Steer is that there is
15 amplification in their circuit that's used to drive
16 the current to the correct value for this
17 current-sensing circuit to fix for pixel errors,
18 and that gain can be lowered.

19 But clearly, there's gain by that phrase
20 I just read you from the exhibit.

21 Q. Can you turn to the -- your -- you were
22 just reading on Steer, line -- on page 9, I think,
23 line 20, is that right, of Steer?

24 A. I was reading paragraph 190.

25 Q. Yeah, but I think you were quoting from

1 Steer, page 9?

2 A. Oh, Steer, yes, 9:20-24.

3 Q. Yeah.

4 Okay. So can you turn to page 10 of

5 Steer.

6 You can read to yourself the section of

7 Steer from line 5 to line 17, that paragraph.

8 A. Just give me a moment.

9 Okay. So starting at line 5 through -- I
10 read up to 17.

11 Does that cover the --

12 Q. Yeah, I want to understand this a little
13 bit more.

14 And one way to do this if you could look
15 at your paragraph 187.

16 A. Okay. Okay. I have enough information
17 in my head to answer your question.

18 Q. Hopefully this won't be that hard.

19 Okay. The "I" that's in that equation in
20 paragraph 187, that's the "I" through resistor 46,
21 correct?

22 A. Yes, that's right.

23 Q. So I am looking at Figure 4, for
24 instance, of Steer, but we all agree that's what
25 the "I" is that's --

1 A. Yeah.

2 Q. Okay.

3 A. The figure might help you answer the
4 question.

5 Q. Yeah.

6 Okay. So then -- yeah, just if you --
7 maybe looking at the figure might help, because
8 this was what I wanted to get a little better
9 understanding about, what is going on here in
10 Steer.

11 So that section I just had you read of
12 Steer on page 10 is kind of talking about a pixel
13 programming mode; is -- is that right?

14 A. Actually, it's talking about half of the
15 pixel programming mode, which is when the current
16 sensing and adjustments through the comparator
17 takes place.

18 Q. Okay. Great.

19 So I guess the question is, this line --
20 this voltage that's on line 34 in Figure 4, which
21 is where that current we just looked at is flowing
22 through --

23 A. That's -- that's the current sensing
24 line.

25 Q. Yeah.

1 A. That's used during programming.

2 Q. Yeah.

3 So I guess the question is, is there a
4 voltage on that line after the pixel programming
5 mode that's held at Vsupply?

6 A. I mean -- yeah, it says that. I am just
7 trying to just see in the circuit.

8 It says that the potential on the current
9 measurement supply line is maintained at the power
10 supply voltage supply during pixel drive phase.

11 I am trying to understand why the circuit
12 schematic -- it didn't consider that important. So
13 let's see how that happens.

14 Q. Yeah.

15 Well, while you're considering that, the
16 next question I was going to ask is, does that mean
17 that the capacitor 60 there is charged to the
18 supply?

19 A. Capacitor 60?

20 Oh, that's the column -- the column --
21 that's the line 34 capacitance.

22 So basically, line 34 is out of the
23 circuit during the pixel phase. Once transistor 32
24 shuts off, there's no connection between line 34
25 and the pixel circuit. And the voltage on that is

1 indicated as maintained at the power supply line,
2 maybe through the capacitor 60, but I have to go
3 back and read that part.

4 Well, but -- ask your question again.
5 Maybe I don't need to study it.

6 What -- what is your question again?

7 Q. Well, the question I just asked I think
8 you weren't sure about, which was, does that mean
9 that capacitor 60 is charged to that Vsupply
10 voltage.

11 But I can ask a different question if you
12 want.

13 A. Well, I wanted to see what -- what the
14 patent says. I forget what it says about the
15 capacitor 60.

16 This is where an electronic copy might be
17 better for searching.

18 Q. So, yeah, I don't know if this is what
19 you're looking for, but on page 10, line 23,
20 there's a paragraph about that.

21 A. Oh, thank you.

22 Let me read that. I didn't go far
23 enough.

24 Okay. So that's -- that's what it claims
25 happens when the -- when the transmission gate

1 turns off. The voltage on the column is maintained
2 by the row parasitic capacitance -- actually,
3 there's two row parasitic capacitances, but the
4 line 6 is for the data line, and line 34 is the
5 current sensing line.

6 They are talking here specifically about
7 line 34 is maintained. So you are asking about
8 line 6 or line 34?

9 Q. Sorry, line 34.

10 A. Line 34, which is the current sensing
11 line. It's maintained at -- at Vsupply, but that's
12 out of the circuit.

13 So I -- I assume the last -- the last
14 state for the current sensing line -- well, I
15 haven't -- I haven't analyzed what happens on -- on
16 the capacitor of line 34. So I really --

17 Q. Okay.

18 A. I just -- I read what it says. I don't
19 have any -- I don't form an opinion whether that's
20 accurate or misleading, but that's what it says.

21 Q. Okay.

22 A. So what's your question?

23 Q. Okay. Well, then, I'll have one more
24 question, which maybe you don't have an answer for,
25 then, in view of that.

1 But the question is, when this circuit
2 then reenters the pixel programming mode, and
3 current is flowing through the pixel then, would
4 current be supplied from this capacitance until it
5 discharged below Vsupply?

6 A. You're right, I haven't -- I don't have
7 an opinion on the details of what happens when you
8 turn on -- with respect to the capacitance. I just
9 analyzed the circuit as it runs once the new data
10 is supplied to, you know, 52, which is where you
11 have new data, and then the current supply line is
12 activated and charge flows -- current flows.

13 There will always be non-zero current
14 because there's -- as long as the display is black.
15 So there will be current flowing in that line.

16 It may just charge the capacitor quickly.
17 I think it's irrelevant, just at first flush. But
18 I haven't formed a detailed opinion about how that
19 microsecond of activity -- what happens at that
20 exact turn-on point.

21 MR. WILLIAMS: If we could maybe just
22 take a two- or three-minute break. I just want to
23 take a look through my outline and caucus with my
24 brain trust.

25 And if I have any more questions, I will

1 ask them. Otherwise, I will be done.

2 THE DEPONENT: Okay. Five minutes, ten?

3 MR. WILLIAMS: Five minutes is plenty.

4 MR. HAMILL: So 32?

5 MR. WILLIAMS: Yes.

6 (Recess taken.)

7 MR. WILLIAMS: Back on the record.

8 We have no further questions.

9 THE DEPONENT: Okay.

10 MR. HAMILL: Okay. Could we take another
11 very short break. I don't expect anything, but I
12 just want to --

13 MR. WILLIAMS: Sure, that's fine.

14 We can go off the record.

15 (Recess taken.)

16 MR. HAMILL: Back on the record.

17 No questions on redirect.

18 MR. WILLIAMS: Okay. Off the record
19 then.

20 MR. HAMILL: Sorry, my audio was messing
21 up.

22 MR. WILLIAMS: We heard you, Andrew.

23 Can we go off the record?

24 MR. HAMILL: Yeah. No questions from
25 Polaris.

1 MR. WILLIAMS: Okay. Thank you,
2 Mr. Credelle.

3 THE DEPONENT: Well, thank you,
4 Mr. Williams.

5 MR. HAMILL: Regular delivery, and no
6 rough draft.

7 THE COURT REPORTER: Thank you.

8 (Deposition concluded at 3:39 p.m.)

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1 I, THOMAS L. CREDELLE, do hereby declare under
2 penalty of perjury that I have read the foregoing
3 transcript; that I have made any corrections as
4 appear notes; that my testimony as contained
5 herein, as corrected, is true and correct.

6 Executed this ____ day of _____,
7 2024, at _____, _____.

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11 _____
12 THOMAS L. CREDELLE
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12 direction; that the foregoing transcript is a true
13 record of the testimony given.

14 Further, that if the foregoing pertains to the
15 original transcript of a deposition in a Federal
16 Case, before completion of the proceedings, review
17 of the transcript [] was [X] was not requested.

18 I further certify I am neither financially
19 interested in the action nor a relative or employee
20 of any attorney or any party to this action.

21 IN WITNESS WHEREOF, I have subscribed my
22 name this 23rd day of April, 2024.

23

24

25

Rebecca L. Romano, RPR, CCR
CSR. No 12546

1 DEPOSITION ERRATA SHEET

2 Case Name: Samsung Display Co., Ltd., et al. vs.
Polaris Powerled Technologies, LLC.

3 Name of Deponent: Thomas L. Credelle

Date of Deposition: April 18, 2024

4 Job No.: 9011

Reason Codes: 1. To clarify the record.
5 2. To conform to the facts.
3. To correct transcript errors.

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22 _____ Subject to the above changes, I certify that
23 the transcript is true and correct
24 _____ No changes have been made. I certify that
25 the transcript is true and correct.

THOMAS L. CREDELLE

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