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UNITED STATES DISTRICT COURT
EASTERN DISTRICT OF TEXAS
MARSHALL DIVISION

ACORN SEMI, LLC,)	
)	
Plaintiff,)	
)	
VS.)	CASE NO.
)	2:19-cv-000347-JRG
SAMSUNG ELECTRONICS CO., LTD.,)	
SAMSUNG ELECTRONICS AMERICA,)	
INC., SAMSUNG SEMICONDUCTOR,)	
INC., and SAMSUNG AUSTIN)	
SEMICONDUCTOR, LLC,)	
)	
Defendants.)	

REPORTER'S RECORD

TRANSCRIPT OF JURY TRIAL (VOLUME 3)

BEFORE THE HONORABLE JAMES RODNEY GILSTRAP

May 17, 2021; 8:31 a.m.

MARSHALL, TEXAS

Proceedings recorded in realtime via machine shorthand.

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08:31AM

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I N D E X

(JURY TRIAL - VOLUME 3)

May 17, 2021

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1 ***** PROCEEDINGS *****

2 THE COURT: Are the parties prepared to read
3 into the record those items from the list of preadmitted
4 exhibits from use during the preceding Friday's portion
08:31AM 5 of the trial?

6 MR. DIXON: We are, your Honor.

7 THE COURT: Please proceed.

8 MR. ANDERSON: Good morning, your Honor.

9 On behalf of Acorn Semi, I would like to read
08:32AM 10 into the record the following exhibits: PTX-594,
11 PTX-650, PTX-1298, PTX-373, PTX-265, PTX-702, PTX-696,
12 PTX-870, PTX-201, PTX-875, PTX-744, PTX-404, PTX-202,
13 PTX-510, PTX-1285, PTX-733, PTX-199, PTX-1092, PTX-160,
14 PTX-159, PTX-161, PTX-157, PTX-156, PTX-955, PTX-282.

08:33AM 15 And, in addition, I would like to correct, for
16 the record, and add two additional exhibits that were
17 actually introduced in trial on Thursday, May 15th; and
18 those two exhibits are PTX-182 and PTX-90.

19 THE COURT: You said May 15th? May 15th was
08:33AM 20 Saturday.

21 MR. ANDERSON: I believe May -- May 13th.

22 THE COURT: All right. Any objection from
23 Defendants?

24 MS. DEGNAN: No, your Honor.

08:33AM 25 THE COURT: Do defendants have a similar

1 rendition?

2 MS. DEGNAN: Yes, your Honor.

3 THE COURT: Please proceed.

4 MS. DEGNAN: The Defendants move into the
08:34AM 5 record DTX-307 and 318, as well as PTX-1094.

6 THE COURT: All right. Any objection from
7 Plaintiff?

8 MR. ANDERSON: No, your Honor.

9 THE COURT: All right. Thank you, Counsel.

08:34AM 10 All right. We ended Friday with
11 cross-examination ongoing, regarding Dr. Edwin Piner.

12 Dr. Piner, if you'll return to the witness
13 stand. I'll remind you remain under oath.

14 Mr. Cordell, you may go to the podium or you
08:34AM 15 may position yourself at the podium, preparing to
16 continue.

17 And while they are doing that, let's bring in
18 the jury.

19 (Whereupon, the jurors enter the courtroom.)

08:35AM 20 THE COURT: Good morning, ladies and gentlemen.
21 Welcome back. Please be seated.

22 All right. We ended our day last Friday with
23 the cross-examination of Dr. Piner by defense counsel,
24 Mr. Cordell. That was ongoing, and we will pick back up
08:35AM 25 and continue with the Defendants' cross-examination of

1 the witness.

2 Mr. Cordell, you may proceed.

3 MR. CORDELL: Thank you, your Honor.

4 THE COURT: Good morning, Dr. Piner.

08:35AM

5 EDWIN PINER (continued),
6 having been previously duly sworn, testified as follows:

7 CROSS-EXAMINATION

8 BY MR. CORDELL:

9 A. Good morning.

08:35AM

10 Q. I'd like to start with one of your slides.

11 MR. CORDELL: Can I have Dr. Piner's Slide 52.

12 Q. This is one of the slides you showed the jury on
13 Friday, right?

14 A. That's correct.

08:35AM

15 Q. And you labeled it an actual Samsung transistor,
16 right?

17 A. That's correct.

18 Q. And you show a bunch of layers on the right-hand
19 side of the slide, correct?

08:36AM

20 A. That is correct.

21 Q. And you have tungsten, titanium nitride, a gray
22 region, and then silicon; is that right?

23 A. Yes, that's correct.

08:36AM

24 Q. Okay. So the claims in this case require an
25 interface between the metal and the semiconductor,

1 right?

2 A. Correct.

3 Q. And the metal, you would say, is the tungsten and
4 the titanium nitride, correct?

08:36AM 5 A. Yes, that's correct.

6 Q. And the semiconductor, you would say, is the
7 silicon, right?

8 A. Correct.

9 Q. So I take it the -- what you would say the interface
08:36AM 10 region is is that gray area; is that fair?

11 A. Yes, that's fair.

12 Q. Okay. And you think that gray area is about
13 7.5 nanometers wide; is that right?

14 A. Approximately, correct.

08:36AM 15 Q. Okay. How big is the titanium nitride?

16 A. So it's thicker, looking at this image.

17 Q. Well, looking at this image, I understand, sir; but
18 do you recall how big, in the actual Samsung transistor,
19 the titanium nitride is?

08:37AM 20 A. As I recall, I think there was a target specified of
21 5 or 5.2 nanometers.

22 Q. Okay. But that would be smaller than the 7.5 you
23 say the gray region is supposed to occupy, right?

24 A. That's correct.

08:37AM 25 Q. Okay. Now, you fill in that -- you fill in that

1 gray region with two things: Silicon dioxide and
2 Ti silicon oxide, right?

3 A. No, that's not correct.

08:37AM

4 Q. Well, you fill in that gray region, I guess, to be
5 precise, with silicon oxide and Ti silicon oxide, right?

6 A. That's correct.

7 Q. And you call out two separate layers for that
8 purpose, right?

9 A. Yes.

08:37AM

10 Q. Okay. And let's look at some of your analysis.

11 MR. CORDELL: Can I have --

12 Q. Well, before we do that, let me go to one of the
13 documents that you admitted on Friday. This is PTX-594.
14 Do you remember that?

08:38AM

15 A. Yes, I do.

16 Q. Okay. And let's go -- let's go back here in the
17 document at Page 21. I think you have a copy of this in
18 your binder, if you need to refer to it.

08:38AM

19 And Samsung shows the interface between the
20 metal and the semiconductor in this drawing, right?

21 A. Yes, it does.

22 Q. And that's the figure, for the record, in the upper
23 right-hand -- upper left-hand corner?

08:38AM

24 MR. CORDELL: And, your Honor, I apologize.

25 May I ask that the courtroom be closed?

1 THE COURT: All right. I'll order, at
2 Counsel's request, the courtroom to be sealed. Those
3 present, not subject to the protective order that's been
4 entered in this case, should excuse themselves and
5 remain outside until the courtroom is reopened and
6 unsealed.

08:38AM

7 [REDACTED]

8 [REDACTED]

9 [REDACTED]

08:39AM

10 [REDACTED] [REDACTED] [REDACTED]

11 [REDACTED] [REDACTED]

12 [REDACTED] [REDACTED]

13 [REDACTED] [REDACTED]

14 [REDACTED]

08:39AM

15 [REDACTED] [REDACTED]

16 [REDACTED] [REDACTED] [REDACTED]

17 [REDACTED]

18 [REDACTED] [REDACTED]

19 [REDACTED] [REDACTED]

08:39AM

20 [REDACTED]

21 [REDACTED] [REDACTED]

22 [REDACTED] [REDACTED]

23 [REDACTED] [REDACTED]

24 [REDACTED] [REDACTED]

08:39AM

25 [REDACTED]

1 [REDACTED]

2 [REDACTED]

3 [REDACTED]

4 [REDACTED]

09:16AM 5 [REDACTED] [REDACTED]

6 [REDACTED]

7 [REDACTED]

8 [REDACTED]

9 [REDACTED] [REDACTED]

09:16AM 10 [REDACTED]

11 Your Honor, I think we can reopen the

12 courtroom.

13 THE COURT: All right. Based on that

14 representation from Counsel, I'll order the courtroom

09:16AM 15 reopened and unsealed and direct the court security

16 officer to invite the public to return.

17 MR. CORDELL: All right. Can I have --

18 THE COURT: Just a minute, counsel.

19 MR. CORDELL: Sorry, your Honor.

09:17AM 20 (Proceedings now unsealed.)

21 THE COURT: All right. We're unsealed.

22 Please proceed.

23 Q. Now, one of the analyses you did --

24 MR. CORDELL: Can I have Piner Document 80 at

09:17AM 25 Page 19.

1 Q. One of the line scans that you did in this case was
2 for the Samsung 7885 chip, right?

3 A. That's correct.

09:17AM

4 Q. Okay. And this is one of the ones that you did as
5 part of your expert report, right?

6 A. Yes, that's correct.

7 Q. And this is one of the ones where you multiplied the
8 oxygen level by 15, right?

9 A. That's correct.

09:17AM

10 Q. Somebody asked me after court on Friday that wanted
11 to know if I was a Cowboy fan. Are you a Cowboy fan?

12 A. Not particularly, no.

13 Q. Well, but if we multiply the Cowboys score by 15,
14 they would win every game, right?

09:18AM

15 A. Maybe.

16 Q. Even the Cowboys.

17 A. Depends on which season.

18 Q. All right. Well, the one that we can agree on is
19 that this multiplying by 15 made the oxygen line move

09:18AM

20 way up on the graph, right?

21 A. Correct.

22 Q. And you told us on Friday you did that because it
23 was a light element, right?

24 A. As is nitrogen, that's correct.

09:18AM

25 Q. Okay. And so you multiply both the oxygen and the

1 nitrogen by 15 because they were light elements, right?

2 A. That's correct.

3 Q. And I think your testimony is that they are light
4 elements because that's the way nature made them.

09:18AM

5 They're lighter than, like a -- like iron. Iron would
6 be a heavier element, right?

7 A. Correct. And light elements do not have as intense
8 signal.

9 Q. Okay. And then -- but you put a warning on here.

09:18AM

10 You put a label, "Intensity (arbitrary)," right on the
11 side of the drawing, right?

12 A. Correct.

13 Q. And you meant that as a warning that, you know,
14 maybe the data had been multiplied here, right?

09:19AM

15 A. Well, when I multiplied the data, the scale is now
16 on two different levels.

17 Q. Well, more than that, sir. The reason why you
18 wrote, "Intensity (arbitrary)," is that you knew you had
19 shifted the curve, correct?

09:19AM

20 A. Correct.

21 Q. But then in court on Friday, when you showed us the
22 same data, let me bring that slide up on Slide 102.

23 There we go.

24 When you showed us that data on Friday, you

09:19AM

25 took the warning label off, right?

1 A. It is not present here, that's correct.

2 Q. So now we don't even have the warning label saying,
3 "You know, maybe these curves have been changed," right?

4 A. The legend indicates they have been changed.

09:19AM

5 Q. Well, and -- but you didn't put the, "Intensity
6 (arbitrary)" warning label on the slide you showed to
7 this jury, right?

8 A. It has been removed here, that's correct.

09:20AM

9 Q. And instead, at the top, you call it "Elemental
10 analysis of Exynos 7885," right?

11 A. That's correct.

12 Q. You meant to suggest that you had actually figured
13 out how much of each element was present, and it's
14 represented in the these curves, right?

09:20AM

15 A. No. These are intensity line scans. That's what
16 it's indicating.

17 Q. Well, so let's look at another one. Now, you also
18 analyzed the Exynos 7884 at Slide 103, right?

19 A. That's correct.

09:20AM

20 Q. It's in the same family as the 7885.

21 MR. CORDELL: Can I go back to 102, Mr. Sayres.

22 Q. But instead of Exynos 7885, we go to 7884, correct?

23 A. That's correct.

09:20AM

24 Q. But this time, Dr. Piner, you only multiplied the
25 oxygen by 5, right?

1 A. That's correct.

2 Q. You only multiplied them by 5, right?

3 A. That's correct.

09:21AM

4 Q. You still multiplied the oxygen -- I mean, the
5 nitrogen by 15, right?

6 A. Yes, that's correct.

7 Q. But here, you didn't multiply the oxygen by 15
8 because, if you had, this oxygen curve would have been
9 way up here, right?

09:21AM

10 A. Approximately, yes.

11 Q. You would have looked right across the top here and
12 people would have said, "Wow, that chip is made out of
13 oxygen," right?

14 A. Perhaps.

09:21AM

15 MR. CORDELL: But -- Mr. Sayres, can I have
16 those two put side by side, Slides 102 and 103.

17 Q. So in the 7885 chip, oxygen is so light you had to
18 multiply by 15, but when you went to the 7884 chip,
19 oxygen somehow became heavier, and now you only had to
20 multiply it by 5, right?

09:21AM

21 A. That's not correct.

22 Q. Oxygen, in your view, had its atomic weight changed
23 when they went to make the 7884 chip, right?

24 A. That is not correct.

09:22AM

25 Q. You understand how somebody might be misled by these

1 charts, correct?

2 A. No, I don't see a misleading aspect here.

3 Q. Thank you.

4 MR. CORDELL: Pass the witness, your Honor.

09:22AM

5 THE COURT: Redirect by the Plaintiff?

6 Please proceed with redirect when you're ready,

7 Ms. Rayburn.

8 MR. RAYBURN: Thank you, your Honor. May I

9 have a moment? I left something at my desk.

09:22AM

10 THE COURT: That's fine.

11 REDIRECT EXAMINATION

12 BY MS. RAYBURN:

13 Q. Good morning, Dr. Piner.

14 A. Good morning.

09:23AM

15 Q. Dr. Piner, based on your exhaustive review of the

16 evidence, is there any doubt in your mind that the

17 Samsung-accused devices comprise a layer of

18 silicon oxide and a distinct layer of an oxide of

19 titanium?

09:23AM

20 A. I have no doubt, no; that is correct.

21 Q. Is your data showing near trace levels of oxygen?

22 A. No. They're substantially higher amounts of oxygen

23 than any trace, as that term is typically used in the

24 art or in science.

09:23AM

25 Q. Dr. Piner, opposing counsel made the suggestion on

1 cross that you have been attempting to mislead the jury.

2 Do you recall that?

3 A. I do.

4 Q. Dr. Piner, did you manipulate your data in an effort
09:23AM 5 to mislead the jury?

6 A. Absolutely not, no.

7 Q. Did you hand the jury your slides without any
8 explanation of what they meant?

9 A. No. I went through testimony and explained in
09:24AM 10 detail on Friday, you know, what's meant in the slides,
11 as well as all my notes and commentary in the report
12 itself.

13 Q. And let's pull up Slide 74 of your slide deck. What
14 were you showing the jury with this slide?

09:24AM 15 A. So there are some key features. Here again would
16 be -- so first and foremost, if you start at the bottom,
17 would be the elemental analysis, as I've discussed
18 frequently and that I've highlighted for -- to make sure
19 we're all looking at the same thing.

09:24AM 20 The peaks in the oxygen signal, in the
21 silicon oxide or the Ti silicon oxide, interface layer
22 regions. And then above all that, I'm showing the
23 corresponding TEM image and showing the relationship
24 between the contrast we're seeing in the TEM image to
09:25AM 25 the elemental analysis and how this corresponds between

1 that, as well, between the contrast, the different
2 contrast throughout the structure and the elemental
3 analysis.

09:25AM

4 Q. And the "x15" on both the oxygen and the nitrogen,
5 did you hide those indications from the jury?

6 A. No. I pointed them out in the legend, and I
7 discussed that at length in my testimony.

8 Q. And tell us again, why did you apply an x15 to both
9 the oxygen and the nitrogen signals for this graph?

09:25AM

10 A. As I indicated, they are both light elements, and
11 because of that, they have a weak intensity. They do
12 not exhibit as many x-rays specifically as silicon or
13 titanium or tungsten would, and that's a well-understood
14 feature in the science of how this is conducted.

09:25AM

15 And so what I was doing was helping visually
16 show, in a graph, the correspondence between these five
17 elements; and that was the sole reason why I did the
18 multiplication.

09:26AM

19 Q. So was it an attempt to help the jury see what your
20 expert eyes see?

21 A. For the jury and everyone, yes.

22 Q. Let's explore that. Let's pull up the top graph of
23 PTX-373-65. Now, opposing counsel showed you this
24 graph, right?

09:26AM

25 A. That's correct.

1 Q. And what is this document?

2 A. So this is a document -- or, excuse me. This is a
3 graph that was provided as a part of this analysis from
4 EAG to me in a graphable form that corresponded to the
5 data that came with it.

09:26AM

6 Q. And opposing counsel was pointing out that the
7 oxygen signal in this graph looks very, very small,
8 right?

9 A. I believe that was what they were indicating,
10 correct.

09:26AM

11 Q. And that's the green line bumping along near the
12 bottom, I think was the language used?

13 A. That's correct.

14 Q. And the nitrogen signal also looks very, very small,
15 doesn't it?

09:27AM

16 A. So the nitrogen here would be the dark blue and,
17 yes, it's low counts, as clearly indicated in these
18 data.

19 Q. But we actually know how much nitrogen is in that
20 region of this sample, don't we?

09:27AM

21 A. At least in certain parts of this sample, we do,
22 yes.

23 Q. And how much nitrogen is at around the 18- to
24 19-nanometer point in this sample?

09:27AM

25 A. So around 18 to 19 nanometers in this graph, we're

1 looking in the titanium nitride part of the structure;
2 and generally speaking, titanium nitride is one part
3 titanium, one part nitrogen, or 50 percent titanium, 50
4 percent nitrogen, in terms of the atomic percentages.

09:27AM

5 Q. So that tiny -- or the low blue line bumping along
6 the bottom indicates 50 percent of nitrogen, right?

7 A. Corresponding to the light blue line above it, which
8 is the titanium signal; but, yes, that's correct.

09:28AM

9 Q. So let's zoom back out of the top graph and look at
10 the entirety of the page. Now let's zoom into the
11 bottom graph on the same page. And this is another
12 graph that EAG provided to you, right?

13 A. That's correct.

14 Q. And what does this graph show?

09:28AM

15 A. So this graph is the same data as was shown above
16 it, except if you focus on the vertical axis, the Y
17 axis, what's indicated there is that we're zooming in
18 now on the bottom part of the upper graph, and so the
19 scales are the same. We're just, again, focusing on
20 those lighter elements specifically and more clearly
21 here.

09:28AM

22 Q. And so where is the nitrogen in this graph?

23 A. So the legend is the same, so the nitrogen will be
24 the dark blue.

09:29AM

25 Q. And where is the oxygen?

1 A. The oxygen is the same, as indicated previously,
2 which is the green.

3 Q. So --

09:29AM

4 A. And I'll also point out here that the titanium, the
5 light blue, the silicon, and the tungsten, you can see
6 parts of those on this scale, but they are going way
7 above that. They are going off scale here, so it's hard
8 to visualize those when they're above this particular
9 region.

09:29AM

10 Q. So let's turn back to the graph that you presented
11 to the jury, and that would be Slide 74. And this shows
12 the peaks of light elements and the heavy elements in
13 correspondence together; is that fair?

14 A. That's fair.

09:29AM

15 Q. And when you zoom in, or multiply something by 15,
16 you're not creating something out of nothing, right?

17 A. That's correct.

18 Q. There needs to be something there to get multiplied;
19 is that fair?

09:30AM

20 A. There's the raw data, and then that raw data is
21 having a multiple assigned to it.

22 Q. And you didn't only multiply the amount of oxygen at
23 right around the 12-nanometer or right around the
24 18-nanometer point, did you?

09:30AM

25 A. No.

1 MR. CORDELL: Objection. Leading, your Honor.

2 THE COURT: Sustained.

3 A. No, I multiplied --

09:30AM

4 THE COURT: Just a minute. I sustained the
5 question. She needs to ask you a new question.

6 THE WITNESS: Thank you, your Honor.

7 THE COURT: I sustained the objection. I'm
8 sorry. Ask a new question.

09:30AM

9 Q. How did your multiplication apply to the oxygen and
10 the nitrogen signals, Dr. Piner?

11 A. So when I applied the 15x multiple for the oxygen
12 and the nitrogen, I did that for the entirety of the
13 oxygen and nitrogen intensity data, not just particular
14 parts of it.

09:30AM

15 Q. And now that you have multiplied the nitrogen and
16 the oxygen both by 15, how do the nitrogen and the
17 titanium line up?

18 A. They are closer in terms of their relative locations
19 in this data set.

09:31AM

20 Q. And will you please remind the jury approximately
21 how much nitrogen and titanium are in that region
22 located?

23 A. So in titanium nitride, as I indicated before, the
24 expectation, as the stoichiometry indicates, is 50
09:31AM 25 percent titanium, 50 percent nitrogen on that basis.

1 MR. CORDELL: Your Honor, I'm going to move to
2 strike that as outside his report.

3 THE COURT: What's your response, Ms. Rayburn?

4 MR. RAYBURN: I'll withdraw it, your Honor.

09:31AM

5 THE COURT: All right. That's struck as being
6 withdrawn. Please continue.

7 Q. Dr. Piner, I'm going to show you something I think
8 you will be familiar with.

09:32AM

9 MR. CORDELL: Your Honor, I hate to interrupt,
10 but I'm going to object on the same basis.

11 THE COURT: You're going to object to showing
12 the periodic table as outside his report?

13 MR. CORDELL: I am.

09:32AM

14 THE COURT: Well, let's wait until we get a
15 question.

16 MR. CORDELL: Okay. Thank you.

17 THE COURT: I'll overrule the objection at this
18 time.

09:32AM

19 Q. Dr. Piner, is this a document with which you are
20 familiar?

21 A. Yes, I'm very familiar with this document.

22 Q. And what is it?

23 A. This is a representation of the periodic table.

09:32AM

24 Q. Would this document help you illustrate your opinion
25 that you have given about what are low-weight elements

1 and what are high-weight elements?

2 A. Yes, it would.

3 Q. And can you show the jury where the low-weight
4 elements that you have identified as oxygen and nitrogen
09:33AM 5 are?

6 MR. CORDELL: Objection, your Honor. Outside
7 the report.

8 THE COURT: Does he discuss the weight of the
9 elements in relation to the periodic table in his
09:33AM 10 report, Ms. Rayburn?

11 MR. RAYBURN: No, he does not. He just
12 discusses the weight of the elements.

13 THE COURT: All right. I'll sustain the
14 objection.

09:33AM 15 Q. Dr. Piner, when you multiplied both the nitrogen and
16 the oxygen signals by 15, were you misrepresenting the
17 actual amount of nitrogen and oxygen there?

18 A. No, not at all.

19 Q. And, Dr. Piner, when you multiplied both the oxygen
09:33AM 20 and the nitrogen signals by 15, were you creating bumps
21 that weren't already there?

22 A. No. Again, that was just helping visually observe
23 the data. It was not changing any of the structure
24 within the data itself.

09:34AM 25 Q. Is it typical to, as you did, chart the elements in

1 a way that magnifies some of them, to better show how
2 the elements work together in a material analysis like
3 this?

09:34AM 4 A. Yes. I mean, it's always helpful when you're
5 publishing or presenting data to make sure that the
6 audience can visually observe it and be able to see what
7 you're pointing out, and that's particularly true with
8 these EDS analysis, which as I've indicated, lighter
9 elements have a lower intensity naturally.

09:34AM 10 Q. In fact, have you seen Samsung represent their own
11 data in arbitrary units of intensity?

12 A. I have.

13 Q. Let's call up Exhibit 744-1, Page 6. Is this one of
14 those examples, Dr. Piner?

09:34AM 15 A. That is one example, yes. And so what's shown are a
16 couple of cases. So the top graph, which is labeled
17 "Core Loss EELS Analysis" is in "intensity (counts),"
18 and then directly below that would be an analysis, and
19 that's a reference -- excuse me. That's in the
09:35AM 20 amorphous interface layer.

21 Then directly below that, when a comparison is
22 being made between the amorphous interlayer and the eSD,
23 it's labeled red and black in the bottom, or the second
24 from the left, that's correct. The intensity there is
09:35AM 25 labeled, "(a.u.)," or arbitrary unit.

1 Q. Am I circling that correctly?

2 A. That's correct.

3 Q. And that a.u. stands for?

4 A. So "a.u." is short for arbitrary units.

09:35AM

5 Q. Dr. Piner, I'm going to show now a document that
6 puts side by side two figures you discussed during your
7 direct testimony. Can you describe what we are seeing
8 here?

09:36AM

9 A. Sure. So on the left would be -- excuse me -- would
10 be the analysis that I conducted for this Samsung part,
11 and -- which I've already reviewed just a few moments
12 ago, again.

09:36AM

13 And on the right would be an analysis that
14 Samsung did of this same type part and showing the same
15 type of characterization methodology specific to EDS
16 analysis in a line scan form.

17 Q. Is your analysis showing some amount of oxygen
18 that's wildly different from Samsung's own internal
19 analysis?

09:36AM

20 A. No. In fact, as I described on Friday, looking at
21 their analysis and looking at my analysis, they are very
22 comparable.

09:36AM

23 Q. Now, we heard on Friday some suggestion that
24 your analysis of Samsung's internal documents relied on
25 failed devices. Do you recall that?

1 A. I do.

2 Q. And we heard that again today, didn't we?

3 A. We did.

09:37AM

4 Q. Now, is the line scan you're showing here, is that
5 showing a failed transistor?

09:37AM

6 A. No. This would be for the reference, or what
7 Samsung had identified as something that's associated
8 with what they would expect in this device; and, in
9 fact, it's highlighted in the top left corner of the
10 right-hand graph where "Ref." is called out in the
11 Samsung document.

12 Q. And so for clarity, this line scan of a transistor
13 is in a failure analysis document, right?

09:37AM

14 A. This came from an internal Samsung failure analysis
15 report, correct.

16 Q. And what is the purpose of a reference transistor in
17 a failure analysis document?

09:37AM

18 A. So as I talked about Friday in some detail, in
19 brief, they are looking to do a comparison of what
20 they -- other devices that they have observed failing to
21 ones that look as they would expect, or a reference
22 structure, to understand exactly what was going wrong in
23 the failed devices.

09:38AM

24 Q. And in your experience, Samsung cares when a
25 device -- when a transistor fails, right?

1 A. Oh, absolutely. If it fails, they can't sell it.
2 It's a wasted part and a lot of money going into a
3 product that they can't sell.

09:38AM

4 Q. And Samsung then has an incentive to investigate
5 what went wrong with the failed device?

6 A. Absolutely.

7 Q. In your view, would Samsung then, use as a reference
8 transistor, a transistor that was not a true reference
9 transistor?

09:38AM

10 A. No. Again, the point of the reference transistor is
11 to help look at and compare to what failed and then,
12 "Okay. What went wrong in the failed -- what's
13 different in the failed device to the reference device?"

09:38AM

14 And the reference, again, is something that is
15 looking like or is exhibiting the performance that they
16 would expect and has been produced according to the
17 process of record of Samsung also.

18 Q. Has --

19 A. So it would be a known good device.

09:39AM

20 Q. Is your view impacted by the fact that the reference
21 transistor came from a spot next to the failed
22 transistor?

23 A. No, not at all.

09:39AM

24 Q. In your view, would it have made more sense for
25 Samsung to go break a chip that actually had all

1 transistors working perfectly in order to evaluate those
2 transistors?

09:39AM

3 A. It's -- no. It is very rare that you would want to
4 go cut into a device that you know is operating, because
5 once you cut into it, it doesn't operate anymore. You
6 can't sell it.

09:39AM

7 Q. Do you have any reason to believe that Samsung would
8 choose anything that was not a gold standard reference
9 to use as a reference when investigating problems with
10 its other transistors?

09:40AM

11 A. That seems like a gold standard or something that
12 you can rely on as is representing your standard process
13 is exactly what you are looking for. Otherwise, the
14 comparison, the failure that you are trying to
15 understand would not be completely appreciated, and you
16 may be misled into your understanding of exactly what
17 failed. So you need to have a good reference to be able
18 to do that comparison.

09:40AM

19 Q. And why did you choose to rely on a failure analysis
20 document for your purposes in evaluating the nature of
21 the accused devices?

09:40AM

22 A. Well, again, failure analysis documents are the
23 source of reports, the source of analysis that failure
24 engineers, reliability engineers, the process engineers
25 do routinely, especially when they have major failure

1 events, to really dig into and understand their process
2 and to fix it.

3 And the goal of this is not just to analyze
4 something that failed, but they want to be able to fix
09:40AM 5 that so that it doesn't continue to recur and they
6 continue to lose devices. And so, again, there are
7 reports of known good die or known good parts that have
8 been cut into, because as soon as you cut it, it's
9 failed. I mean, it's -- it doesn't operate anymore and
09:41AM 10 you can't sell it; and so these types of reports are
11 very typical when looking at a die that has failed and
12 then doing the comparative analysis within that die or
13 within that part itself.

14 Q. Is Samsung more likely to do deep, detailed
09:41AM 15 elemental analyses like this in a failure analysis or on
16 a good chip?

17 A. This sort of analysis would typically, if not
18 always, occur on a fail-type part. A good chip, what
19 they would typically measure would be those things that
09:41AM 20 are not destroying the device, the resistances, the
21 amount of voltage it takes to operate the different
22 devices, those sorts of data they can collect on all the
23 chips, and that's actually how we ascertain if it's a
24 good device, performing correctly, or if it's not
09:42AM 25 performing correctly in that it's failed. And so that's

1 the only testing they would do on the good parts, would
2 be some electrical characterization to confirm it's
3 operating properly.

09:42AM

4 Q. Dr. Piner, in your -- to what extent, if any, do you
5 believe that Samsung's engineers, conducting failure
6 analysis investigations, are aware of oxide
7 contamination issues?

09:42AM

8 A. Well, I find it interesting that in this document
9 where, as was indicated in the failure analysis report,
10 the concern that they had in the parts or the regions
11 that had failed was something about titanium and, yet,
12 they took the time, they were motivated to not only
13 investigate the titanium and the nitrogen but also the
14 oxygen.

09:42AM

15 And so this, to me, indicates that this is
16 something that Samsung would typically look for and
17 observe in this particular part and, yet, you know, it
18 seems to me like it's a standard process -- a standard
19 characterization that's conducted in these source/drain
20 regions by Samsung.

09:43AM

21 Q. Dr. Piner, I'd like to show you Slide 50 of your
22 deck. You didn't manipulate the information shown here
23 in any way, did you?

24 A. Not at all.

09:43AM

25 MR. CORDELL: Objection. Leading.

1 THE COURT: Sustained.

2 Avoid leading, counsel.

3 MR. RAYBURN: Yes, your Honor. Thank you.

09:43AM

4 Q. To what extent, if any, did you manipulate the
5 information in these maps?

6 A. These are the raw data, as in its raw form,
7 color-coded to make it visually distinct from one
8 component to the next.

9 Q. Now I'd like to show you Slide 67 of your deck.

09:43AM

10 A. And I should point out, Counsel, that the
11 color-coding is also done automatically.

12 THE COURT: Just a minute, Dr. Piner. She
13 asked you did you manipulate it, and she didn't ask you
14 any of the rest of what you are now trying to explain to
15 the jury.

09:43AM

16 She will ask you individual questions, but
17 answer her questions as asked and let her ask the next
18 follow-up question, all right?

19 THE WITNESS: Yes, your Honor.

09:44AM

20 THE COURT: Let's proceed.

21 Q. I'd like to take you to Slide 67 of your deck,
22 Dr. Piner. To what extent, if any, did you manipulate
23 the information shown on this slide?

09:44AM

24 A. Again, this is the intensity data by, in this case,
25 EELS, the other chemical analysis that I conducted.

1 This is the data in its raw form.

2 THE COURT: Dr. Piner, does that mean you did
3 not manipulate this?

09:44AM

4 THE WITNESS: That's correct, your Honor, I did
5 not manipulate this.

6 THE COURT: Then just give a straight answer,
7 please.

8 THE WITNESS: Okay.

9 THE COURT: Let's continue.

09:44AM

10 Q. Dr. Piner, we've heard a lot today and Friday about
11 signal intensity charts and atomic percentage charts.
12 Do you recall that?

13 A. I do.

09:44AM

14 Q. Can you please describe how those two different
15 methods of charting data are prepared?

16 A. So signal intensity and -- I'm sorry. What was
17 the -- the mapping?

18 Q. Atomic percentage information.

09:45AM

19 A. So in brief, signal intensity is the data in its raw
20 form. That's how it's collected from the samples. The
21 atomic percents, when that is of interest, there is a
22 modeling of the raw data that occurs that then converts
23 that into an atomic percent, and then it can be
24 displayed in that form.

09:45AM

25 Q. And you decided that signal intensity amount -- and

1 which one did you choose to perform in this case,
2 Dr. Piner?

3 A. I chose signal intensity.

09:45AM

4 Q. But did you also evaluate atomic percentage
5 information in your analysis?

6 A. To the extent that Samsung provided it, yes, I did.

7 Q. Let's show PTX-702, Page 22 again. Is this one of
8 the Samsung internal documents that you reviewed that
9 recorded oxygen in atomic percentage data?

09:45AM

10 A. It is.

11 Q. And what do you conclude from this document?

12 A. Again, as I've indicated, this is -- excuse me --

13 Samsung's analysis of their parts that showed two
14 distinct oxide layers present in the interface region of
15 the source/drain structures.

09:46AM

16 Q. Let's pull up Slide 131 from your deck, which shows
17 PTX -- images from PTX-874.

18 What did you conclude from these images?

19 A. Similarly that there is a significant oxygen signal
20 in the interface region between the titanium nitride and
21 the silicon source/drain. That also indicates the
22 similar or the same sort of structure, meaning the oxide
23 layer is present in the interface layer.

09:46AM

24 Q. Dr. Piner, you testified that a molecule of silicon
25 monoxide has 50 percent silicon and 50 percent oxygen,

09:46AM

1 right?

2 A. That's correct.

3 Q. And why is that?

09:46AM

4 A. Well, atomically speaking, silicon monoxide, one
5 part silicon, one part oxygen, if you break that down,
6 it's half silicon, half oxygen, or 50 percent silicon,
7 50 percent oxygen, and that would be silicon monoxide.

8 Q. Does that mean that a layer of an oxide of silicon
9 has to have 50 percent oxygen in it?

09:47AM

10 A. No, it does not.

11 Q. Let me show you Slide 25 of your deck.

12 MR. CORDELL: Your Honor, I'm going to move to
13 strike that last answer. It's outside the scope of his
14 report.

09:47AM

15 THE COURT: What's your response, Ms. Rayburn?

16 MR. RAYBURN: Your Honor, it's the exact same
17 answer that opposing counsel elicited from him on cross
18 on Friday.

09:47AM

19 THE COURT: I'll overrule the objection. Let's
20 proceed.

21 Q. What is this slide showing, Dr. Piner?

22 A. So, in brief, this slide is showing the different
23 claim elements for the '395 Patent, specifically
24 Claims 17 and 20, that are being alleged as infringement
25 by Acorn.

09:47AM

1 Q. Is there any reference on this slide to 50 percent
2 of oxygen?

3 A. No, there is not.

09:48AM

4 Q. And you see the words, "Comprising an oxide of
5 titanium and an oxide of the semiconductor," right?

6 A. I do.

7 Q. And can you please remind the jury what "comprising"
8 means?

09:48AM

9 A. So the best way to think about "comprising" is it
10 means it includes those elements that come after the
11 term.

12 Q. Dr. Piner, there was discussion today about whether
13 the samples that you analyzed were impacted by being
14 exposed to air before analysis. Do you recall that? Or
15 perhaps Friday.

09:48AM

16 A. I do.

17 Q. In your experience, is oxygen contamination
18 something that you understand and account for in your
19 work?

09:48AM

20 A. I do, yes.

21 Q. In your opinion, did oxygen contamination impact the
22 results of your analysis that you presented to the jury?

23 A. No, it did not impact them at all.

09:49AM

24 Q. Dr. Piner, you were asked questions about how clean
25 the environment is in the fab, right?

1 A. I was, right, correct.

2 Q. But that clean environment still has oxygen in it,
3 doesn't it?

4 A. For sure, yes. It must.

09:49AM

5 Q. Dr. Piner, you were asked questions about test
6 wafers. Do you recall that this morning?

7 A. Yes, I do.

09:49AM

8 Q. And can you please explain why you found test wafers
9 appropriate to analyze for the purposes of your
10 infringement opinion?

11 A. Yes. Test wafers are wafers that Samsung produces,
12 as a part of their normal experimentation, to understand
13 their process.

09:49AM

14 If there's something that they are looking to
15 change, especially, as I've already indicated, the RF
16 etch step, then you need to do experimentation before
17 you transfer that to the production process; and those
18 experimentations are what is contained substantially in
19 the reports that I analyzed by Samsung.

09:49AM

20 MS. RAYBURN: Let's pull up PTX-744-1.

21 Actually, let's pull up your slide deck, Slide 104. I'm
22 still not at the right -- can we go to 106, please.

23 Q. And this page represents Wafer 4; is that right,
24 Dr. Piner?

09:50AM

25 A. That is correct. That's how its indicated at the

1 top in the title of the slide.

2 Q. And what was the difference between Wafer 4, this
3 test Wafer 4, and the actual wafers that were being
4 produced at the time?

09:50AM

5 A. So as I recall, Wafer Number 4 was including the
6 RF etch step, and then a later wafer, they removed it
7 from the process and a comparative analysis was being
8 conducted.

09:51AM

9 Q. Well, actually let's go back to 744-1 because -- and
10 do you see the reference to the number --

11 THE COURT: Just a minute.

12 Counsel, if you are going to discuss things
13 to defense counsel, do it quietly so that I can't hear
14 you up here, okay?

09:51AM

15 All right. Please continue, Ms. Rayburn.

16 Q. Do you see the reference to, "Number 4," in this
17 e-mail, Dr. Piner?

09:51AM

18 A. Yes. So this is indicating what I was just
19 testifying to, that Wafer Number 4 includes the RF etch
20 and then Wafer Number 5 is where the RF etch has been
21 removed from the process flow, or it's been skipped, to
22 use Samsung's technology.

23 MR. CORDELL: Your Honor, can I ask the
24 courtroom be sealed?

09:51AM

25 THE COURT: All right. Based on counsel's

10:09AM
10:09AM
10:10AM
10:10AM
10:10AM

1 A. [REDACTED]

2 [REDACTED]

3 [REDACTED]

4 [REDACTED]

5 [REDACTED]

6 [REDACTED]

7 [REDACTED]

8 [REDACTED]

9 [REDACTED]

10 [REDACTED]

11 [REDACTED]

12 [REDACTED]

13 [REDACTED]

14 [REDACTED]

15 [REDACTED]

16 [REDACTED]

17 [REDACTED]

18 [REDACTED]

19 [REDACTED]

20 [REDACTED]

21 [REDACTED]

22 [REDACTED]

23 [REDACTED]

24 I'm going to order the courtroom unsealed at

25 this time and direct the court security officer to

1 invite the public to return.

2 (Proceedings unsealed.)

3 THE COURT: As I said, ladies and gentlemen,
4 we're going to take a recess at this time. If you'll
10:10AM 5 simply leave your notebooks in your chairs. Please
6 follow all my instructions, and we'll be back shortly to
7 continue with the next witness called by the Plaintiff.

8 Jury's excused for recess.

9 (Whereupon, the jurors exit the courtroom.)

10:11AM 10 THE COURT: The court stands in recess.

11 (Recess from 10:11 a.m. to 10:28 a.m.)

12 THE COURT: All right. Plaintiff, call your
13 next witness -- wait a minute. Jury's not in the room,
14 are they?

10:29AM 15 MR. DIXON: I learned that lesson at the
16 beginning of trial.

17 THE COURT: Okay. Dr. Park is your next
18 witness?

19 MR. DIXON: Yes, your Honor.

10:29AM 20 THE COURT: All right. I'm going to ask the
21 interpreter to meet Dr. Park in the well of the
22 courtroom so that you can assist him in getting sworn
23 in, and then you and he can come back to the witness
24 stand, and we'll put him behind the microphone and then
10:29AM 25 you can sit next to him, all right?

1 Now let's bring in the jury.

2 (Whereupon, the jurors enter the courtroom.)

3 THE COURT: Please be seated.

4 Plaintiff, call your next witness.

10:30AM

5 MR. DIXON: Thank you, your Honor. Acorn calls
6 Samsung engineer Dr. Hong-Lae Park.

7 THE COURT: All right. Dr. Park will be
8 testifying with the aid of interpreter, who's previously
9 been sworn, ladies and gentlemen.

10:30AM

10 (Whereupon, the witness was duly sworn.)

11 THE COURT: Thank you. Please come around to
12 be seated at the witness table.

13 Let me ask the witness to remove his mask while
14 he testifies -- well, you are going to testify and
15 interpret for him. If you'll just make sure that you're
16 heard through the microphone, please.

10:31AM

17 THE WITNESS: Thank you, your Honor.

18 THE COURT: All right. Counsel, proceed with
19 your direct examination.

10:31AM

20 MR. REITER: Thank you, your Honor.

21 HONG-LAE PARK,

22 having been first duly sworn, testified through the duly
23 sworn interpreter as follows:

24 DIRECT EXAMINATION

10:31AM

25 BY MR. REITER:

1 Q. Could you please state your full name for the
2 record, Mr. Park.

3 A. My name is Hong-Lae Park.

4 Q. Good morning, Dr. Park. My name is Joseph Reiter.

10:31AM 5 I represent Acorn in this case. We've never met before,
6 correct?

7 A. Good morning. Probably not.

8 Q. And where do you work, Mr. Park?

9 A. I work for Samsung Electronics in Korea.

10:32AM 10 Q. How long have you worked for Samsung Electronics?

11 A. I've worked there for about ten years now.

12 Q. And what is your current job title?

13 A. I'm a principal engineer.

14 Q. Sir, I'd like to start by asking you about contact
10:32AM 15 resistance. That's a concept you're familiar with,
16 right?

17 A. Yes.

18 Q. And contact resistance, that can decrease the
19 performance of Samsung's products, correct?

10:32AM 20 A. That's right. If you're talking about high contact
21 resistance, the higher it is, the lower the performance.

22 Q. And over time, contact resistance has become a
23 greater and greater issue for Samsung, correct?

24 A. Yes.

10:33AM 25 Q. Okay. And in 2014, contact resistance was an

1 essential issue that Samsung needed to solve, right?

2 A. Well, it was always an issue for us to solve.

3 Q. Okay. And so what Samsung did is they formed a task
4 force in 2014 to research ways to lower contact

10:34AM 5 resistance, right?

6 A. That's right.

7 Q. Okay. And that task force lasted approximately ten
8 months, right?

9 A. If you're talking about the first year on a
10:34AM 10 full-time basis, yes, that's about right.

11 Q. Okay. And you and five other individuals worked on
12 that task force, correct?

13 A. No, I think it was a bit more than that.

14 Q. How many individuals worked on the task force?

10:35AM 15 A. Not that I remember exact number, but it was about
16 ten.

17 Q. And Samsung requested that all ten of those Samsung
18 employees spend the majority of their time researching
19 ways to reduce contact resistance, correct?

10:35AM 20 A. Precisely speaking. It might be a little bit
21 different because the reason why this contact task force
22 was formed, the fundamental reason for that or purpose
23 for that is to research the contact-related issues as
24 the fundamental issue that we needed to deal with, and
10:36AM 25 then it was to -- the next task that we were tasked with

1 was to use the contact resistance in that regard.

2 MR. REITER: Okay. I'll object as
3 nonresponsive, your Honor.

4 THE COURT: Overruled. Next question.

10:36AM

5 Q. Sir, as part of the task force research, the task
6 force studied metal-insulator-semiconductor technology,
7 right?

8 A. Yes. It was very --

9 THE INTERPRETER: Withdrawn.

10:37AM

10 A. It was one of many technologies in that regard.

11 Q. And you were the particular person who studied MIS
12 technology, correct?

13 A. Yes.

10:37AM

14 Q. And, sir, you understand that in this case what
15 we've been talking about is Acorn's MIS technology,
16 right?

17 A. Yes.

18 Q. Okay. And when the task force finished its
19 research, it published a report with its findings,
20 correct?

10:37AM

21 A. It was not published to the public to be publicly
22 available, but we issued a report that is to be reviewed
23 within the company.

10:38AM

24 Q. Right. There was an internal Samsung report that
25 was circulated internally, correct?

1 A. Yes.

2 MR. REITER: At this time, your Honor, I'll
3 have to ask to have the courtroom sealed.

4 THE COURT: All right. Based on Counsel's
5 request, I'll issue the courtroom sealed. All persons
6 present who are not subject to protective order in this
7 case should excuse themselves until the courtroom is
8 reopened and unsealed.

10:38AM

9 [REDACTED]

10:38AM

10 [REDACTED]

11 [REDACTED]

12 [REDACTED] [REDACTED] [REDACTED]

13 [REDACTED]

14 [REDACTED] [REDACTED]

10:39AM

15 [REDACTED]

16 [REDACTED] [REDACTED]

17 [REDACTED]

18 [REDACTED] [REDACTED] [REDACTED]

19 [REDACTED]

10:39AM

20 [REDACTED] [REDACTED] [REDACTED]

21 [REDACTED]

22 [REDACTED] [REDACTED]

23 [REDACTED] [REDACTED] [REDACTED]

24 [REDACTED]

10:39AM

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[REDACTED]

(Proceedings unsealed.)

THE COURT: As I was saying, ladies and gentlemen, we're going to recess at this time for lunch. If you will take your notebooks with you to the jury room. I'm told by Ms. Clendening your lunch is there waiting on you.
Please follow all my instructions about your conduct, including, of course, you would expect me to

1 remind you not to discuss the case among yourselves, and
2 we'll be back in approximately an hour to continue with
3 the witnesses in this case.

4 So with that, the jury's excused for lunch.

12:16PM

5 (Whereupon, the jurors exit the courtroom.)

6 THE COURT: Be seated, please.

7 Counsel, the Court's timekeeping records

8 indicate that Plaintiff has 3 hours and 10 minutes

9 remaining. Defendant has 6 hours and 30 minutes

12:16PM

10 remaining.

11 Also, am I correct that Plaintiff wishes to

12 read an interrogatory question and answer into the

13 record, but other than that, it's prepared to rest?

14 MR. DIXON: You are correct, your Honor.

12:17PM

15 THE COURT: Okay. And am I also correct that

16 Defendants will begin their case-in-chief with

17 Dr. Reifsnider?

18 MR. CORDELL: Yes, your Honor.

19 THE COURT: Also, in reviewing what's

12:17PM

20 previously been submitted, the Court is persuaded at

21 this juncture that it would benefit by a new effort on

22 your part jointly with regard to a proposed final jury

23 instruction and verdict in this case, verdict form in

24 this case. Consequently, I'm directing the parties to

12:17PM

25 jointly prepare and submit, by 3:00 tomorrow afternoon,

1 a revised proposed final jury instruction and verdict
2 form, using either different highlighting or different
3 fonts so that, in any area where you are not in
4 agreement and have competing submission, the Court can
12:18PM 5 easily review those. That should be delivered to the
6 Court by e-mail to my staff, and it should be presented
7 in Word format.

8 Any questions?

9 MR. DIXON: No, your Honor.

12:18PM 10 MR. CORDELL: Not from Defendant, your Honor.
11 Thank you.

12 THE COURT: All right. We'll reconvene at or
13 shortly after 1:00. The Court stands in recess for
14 lunch.

12:18PM 15 (Recess from 12:18 p.m. to 1:16 p.m.)

16 THE COURT: Counsel, we talked in chambers this
17 morning about an issue raised by Samsung asserting that
18 the door had been open in opening statement regarding a
19 prior limine order concerning efforts outside of this
01:17PM 20 trial and this court to attack the validity of
21 patents-in-suit.

22 I heard from both sides and instructed you to
23 communicate with each other to continue to meet and
24 confer in hopes of working out either an agreed
01:17PM 25 instruction or some other resolution.

1 I understand communications are ongoing, but
2 there's been no resolution reached at this time; is that
3 accurate?

4 MR. CORDELL: That's accurate, your Honor.

01:17PM

5 THE COURT: All right. Well, my instruction is
6 that Samsung's not to go there until either I've been
7 informed that there is an agreement and approved the
8 agreement or I've been informed, despite best efforts,
9 no agreement is going to be reached and there's an
10 impasse, and the issues come back to me for instruction.

01:17PM

11 MR. CORDELL: Excellent. Thank you, your
12 Honor.

13 THE COURT: Keep me posted, please.

01:17PM

14 Do I understand the exact wording of what's
15 going to be read into the record on this interrogatory
16 and the corresponding answer is all worked out between
17 you?

18 MR. DIXON: Yes, your Honor.

01:18PM

19 THE COURT: Okay. And that's what we should
20 expect to have happen next, Mr. Dixon?

21 MR. DIXON: Yes, your Honor, that is correct.

22 THE COURT: All right. Is there anything else
23 that we need to discuss before I bring the jury back in.

01:18PM

24 MR. McKEON: Just one preliminary matter, your
25 Honor. I'm going to be putting on Dr. Reifsnider and --

1 THE COURT: I'm aware of that.

2 MR. McKEON: At some point, we're going to get
3 into the Samsung process flows, and he's going to
4 describe them in some detail. And we've been closing
01:18PM 5 the courtroom, and I appreciate that; but at that point,
6 when we get into the process flows, we would make the
7 request that Mr. Horgan be asked to leave, given the
8 highly sensitive nature of the process flows and the
9 description by the witness.

01:18PM 10 THE COURT: All right. Have you had a
11 discussion with Plaintiff's counsel about that?

12 MR. McKEON: Yes, we have.

13 THE COURT: Any problems I need to know about?

14 MR. DIXON: No, your Honor.

01:18PM 15 THE COURT: Okay. Let's bring in the jury.

16 (Whereupon, the jurors enter the courtroom.)

17 THE COURT: Welcome back from lunch, ladies and
18 gentlemen. Please have a seat.

19 We recessed for lunch after Dr. Park stepped
01:19PM 20 down at this point.

21 Plaintiff, call your next witness.

22 MR. DIXON: Thank you, your Honor.

23 Acorn will now read into the record Samsung's
24 response to Interrogatory Number 5.

01:19PM 25 THE COURT: Go to the podium and proceed.

1 MR. DIXON: This is from PTX-917.
2 Interrogatory Number 5 asks Samsung: "For the asserted
3 patents, state with particularity the circumstances
4 surrounding your first awareness of each asserted
01:20PM 5 patent, any application from which any of the asserted
6 patents issued and/or any related patent application,
7 including the date when you first became aware of the
8 patent and/or patent application, the persons involved
9 in your first becoming aware of the patent and/or patent
01:20PM 10 application, the identity and content of any
11 communications or documents relating to your awareness
12 of the patent and/or patent application, and all actions
13 taken by you relating to, or as a result of, your
14 becoming aware of the patent and/or patent application."

01:20PM 15 Answer: "Samsung became aware of each of the
16 asserted patents shortly after Plaintiff filed its
17 complaint in this matter on or about October 23rd,
18 2019."

19 THE COURT: All right. Thank you, Mr. Dixon.
01:21PM 20 Now, if you will, call your next witness.

21 MR. DIXON: With that, your Honor,
22 Plaintiff Acorn rests.

23 THE COURT: All right. Plaintiff has rested
24 its case-in-chief, ladies and gentlemen. We'll proceed
01:21PM 25 with the Defendants' case-in-chief.

1 Defendants, call your first witness.

2 MR. CORDELL: Thank you, your Honor. On behalf
3 of Samsung, we call Dr. Jason Reifsnider.

01:21PM

4 THE COURT: All right. If you'll come forward,
5 Dr. Reifsnider, and be sworn.

6 (Whereupon, the witness was duly sworn.)

7 THE COURT: Please come around, sir. Have a
8 seat on the witness stand.

9 If you'll take your mask off, please.

01:22PM

10 THE WITNESS: Habit.

11 THE COURT: All right, Mr. McKeon, you may
12 proceed with direct examination.

13 MR. McKEON: Thank you, your Honor.

01:22PM

14 DR. JASON REIFSNIDER,
15 having been first duly sworn, testified as follows:

16 DIRECT EXAMINATION

17 BY MR. McKEON:

18 Q. Well, good afternoon, Dr. Reifsnider.

19 A. Good afternoon.

01:22PM

20 Q. Would you please introduce yourself to the members
21 of the jury.

22 A. Sure. My name's Jason Reifsnider. I live just down
23 the way, about five hours from here, in Austin, Texas,
24 where I live with my wife of about 30 years, and I'm a
01:22PM 25 proud employee of Samsung Austin Semiconductor.

1 Q. And how long have you lived in Austin?

2 A. I've lived in Austin almost 30 years, as well.

3 Q. And where did you go to school?

4 A. Not surprisingly, University of Texas at Austin.

01:22PM 5 Q. And what did you get your degree in?

6 A. I have a bachelor's degree, a master's degree, and a
7 doctorate in electrical engineering.

8 Q. And when did you join Samsung Austin Semiconductor?

01:23PM 9 A. I joined about June of 1999. Coming up on -- what
10 is that -- 22 years now.

11 Q. And sometimes is that referred to as SAS?

12 A. Yeah. Samsung Austin Semiconductor can be a bit of
13 a mouthful every now and then, so we just call it SAS,
14 or S-A-S.

01:23PM 15 Q. And what is SAS?

16 A. SAS is a high-volume manufacturing arm of
17 Samsung Electronics.

18 Q. When you say, "High-volume," what do you mean?

01:23PM 19 A. Well, it's -- it's all we do. It's a lot of -- it's
20 a big plant. We manufacture a lot of wafers.

21 Specifically, that plant is, I believe, one of the
22 biggest single plants in the U.S.

23 Q. And is it sometimes referred to as a fab?

01:23PM 24 A. Yes, you'll hear me use the term, "Fab." That just
25 means fabrication facility or a fabrication line.

1 Q. And what is your job at SAS?

2 A. I'm the director of manufacturing engineering.

3 Q. And do you have a team?

4 A. I do.

01:23PM

5 Q. And could you describe that team?

6 A. Sure. It's several departments. I have a defect
7 team, I have a materials team, and an analysis team.

8 Q. And how many people are on your team?

9 A. Total is about two -- a little over 280 people.

01:24PM

10 Q. And how long has SAS been in Texas?

11 A. SAS has been in Texas about 25 years now.

12 Q. Okay. And when -- was that 1996? Is that whenever?

13 A. Yeah, 1996.

14 Q. And was it sort of a big deal with SAS came to
15 Texas?

01:24PM

16 A. Yeah. I was in school in town, and I remember
17 hearing about it. It was a massive deal. Governor Bush
18 came and talked. We had a lot of press coverage. It
19 was an exciting day.

01:24PM

20 Q. And how is it -- well, let me ask you this question:
21 What was it like when you first joined 22 years ago?

22 A. Honestly, it was pretty small. When I first joined,
23 there were about a thousand people, which doesn't sound
24 that small, but in comparison. And it was nice because
01:24PM 25 you sort of knew everybody. It was nice.

1 Q. And how has it changed over the years?

2 A. Well, truly, it's grown quite a bit. We've invested
3 a lot of money year in and year out. Now there's over
4 3,000 employees directly. There's another 3,000 or more
01:25PM 5 that are contractor and vendor. So it's got a really
6 big footprint now.

7 Q. Now, have you prepared some demonstratives to
8 facilitate your testimony, Dr. Reifsnider?

9 A. I have.

01:25PM 10 Q. So let's get those pulled up here and go to your
11 first demonstrative here. And describe what you show
12 here.

13 A. Sure. We'll start in the picture in the top left
14 labeled, "1996." So February, that's when
01:25PM 15 groundbreaking began. It's also when we started working
16 on this site. You can tell from the picture there's not
17 a whole lot around there. As a matter of fact, we had
18 to build a road out to the site to begin construction
19 because there wasn't even a road out there at that point
01:25PM 20 in time. And that was for the main -- the first main
21 fab building.

22 Moving on to the bottom left picture, that's in
23 June 2007. We made another big investment. We added
24 that sort of large, white-roofed building there. We
01:26PM 25 expanded the size of the clean room. And that

1 corresponds to where we shifted some products.

2 And then in 2017, the bigger picture here on
3 the right, we added that L-shaped building there on the
4 bottom right-hand side. My office is actually in that
5 building, so I'm sort of partial to it.

01:26PM

6 Q. And what type of products was SAS making back in
7 1996 time frame, when the fab was getting up and
8 running?

9 A. 1996, we were making DRAM chips. These are the
10 chips that go into your computer, the memory, you know,
11 the main thing for your computer.

01:26PM

12 Q. And has that changed over the years?

13 A. Yes. In about the time we did the big expansion in
14 2007, we moved on to flash memory chips. Those are the
15 ones that are in, like, your camera, camera flash memory
16 or, you know, a memory stick. That's the flash memory,
17 and we went to those.

01:26PM

18 Q. Okay. And at some point in time, did you evolve
19 from there?

20 A. Yes. So about 2012, we moved from memory into logic
21 chips.

01:27PM

22 Q. And is that sometimes called processor chips?

23 A. Yeah. Processor chips are definitely a big, very
24 obvious component of those, the ones that are, like, in
25 your phones, also in things like TVs and cars and lots

01:27PM

1 of places.

2 Q. Thank you, Dr. Reifsnider. Now let's fast forward.
3 What do you show here in Slide 53?

01:27PM

4 A. Yeah, this is sort of a nicer recent picture of the
5 two main buildings. So I'll start with the building on
6 the right, the white-roofed building. And then you'll
7 see the sort of brown-roofed building on the left. So
8 those are the two big parts of the clean room.

01:27PM

9 The area underneath that clean room is about
10 eight football fields in size. That gives you some
11 size. It's really big in there.

12 Q. And are there any plans on expanding the fab in the
13 future?

01:28PM

14 A. Yeah. There have been some news articles batting
15 around. We are hopeful that coming in another -- I
16 don't know -- week or month or who knows, but hopefully
17 soon, we're going to put a brand-new fab off to the left
18 on the far left of that picture where there's a big --
19 you see that big parking lot area with all the cars? If
20 we're lucky, we're going to have a new fab there at some
21 point in time soon, seven -- yeah, a really big number
22 for investment.

01:28PM

23 Q. All right. Thank you, Dr. Reifsnider. Now I want
24 to talk about what's inside the fab. And in reference
25 to your Slide 54, can you describe to the members of the

01:28PM

1 jury what's going on inside the fab?

2 A. Sure. This is a picture of just one -- one of the
3 bays in the fab. There is about a hundred bays like
4 this, so this is just one of many.

01:28PM

5 We'll start with the main corridor aisle there.
6 You can see, just from the depth and the scale that
7 shrinks down how, sort of long that is. That gives you
8 some perspective. Everything on the floor level that's
9 on the left and the right, those are all the process
10 tools.

01:29PM

11 In the -- well, you see in the very center, you
12 see two people down there in clean room garb. And then
13 in the foreground, up at the top and on the top left and
14 the top right, you see these two boxes labeled "VT299"
15 and "VT140," those are cars, not like the road cars, but
16 they are things that we use that transport the wafers
17 around. They're wheeled upon rails. We just call them
18 cars.

01:29PM

19 Q. Now, you mentioned a couple times already in your
20 testimony, "Clean room." What's a clean room?

01:29PM

21 A. Well, not to be, you know, redundant, but it is a
22 very clean room. So we go out of our way to really try
23 and get rid of all the particles and any kind of
24 contaminants that are in the room. It's done via --
25 they're called HEPA filters, but they're these super,

01:29PM

1 super awesome filters that are actually out of the
2 picture above the ceiling in this picture, and the air
3 is circulated through those filters, down -- straight
4 down past this pictured level and into some area below.

01:30PM

5 So the floor actually -- you can't tell,
6 but it's got lots of little holes in it, believe it or
7 not; so it makes the air go straight past. The goal is
8 to blow all the particles and all the things that we
9 don't want down below the level where the wafers live,
10 and then it gets circulated back up and around.

01:30PM

11 And, you know, in COVID time period, we're all
12 very familiar with air circulation. Well, we do it a
13 lot. It's very quick. So we keep that circulation
14 going so we can get all the air through these really,
15 really good filters as much as possible.

01:30PM

16 Q. Now, how many machines do you have in the factory?

17 A. Yeah, there's close on to 2,000 tools in that fab.

18 Q. And is there a machine that you can identify here in
19 the slide?

01:30PM

20 A. Sure. If you want to look, send your attention down
21 to the bottom right-hand side there, that right corner.
22 Thank you for circling that. That is one of the tools.
23 You can see it's labeled, "DULS06."

01:31PM

24 Q. And why are there so many machines, or tools, in
25 there?

1 A. Well, again, it's a very big fab. We produce a lot
2 of wafers, and we want to try and do it as fast as
3 possible. It's also -- it's a really complex process,
4 as we're going to get to a little bit later on. There's
5 thousands of steps.

01:31PM

6 And so if you have a lot of steps and a lot
7 of wafers you are trying to make, that ends up a lot of
8 tools. That's why we've got eight football fields of
9 space just packed with tools.

01:31PM

10 Q. And you described the cars. Can you describe how
11 the cars are moving around, and then also what are they
12 doing? What are they moving?

13 A. Yeah. The cars are moving the wafers around. So
14 they actually have that extension reaching down and
15 grabs the wafer off the tool, pulls it up, and then it
16 goes zipping around the fab. We're going to show you a
17 video of that here in a bit. But you go zipping around,
18 because it's not like a Dodge assembly line or it's like
19 A to B to C and you're done at the left-hand side, right
20 to left. The tools are all over this area, so the cars
21 take the wafers and move them all around, and so they
22 have a very convoluted pattern and going all over this
23 area, and that's how we get it done fast.

01:31PM

01:32PM

24 Q. And prior to cars, when you had these cars, how did
25 you get the wafers around the factory?

01:32PM

1 A. Human power. We had a whole army of people whose
2 job it was to walk up and grab them off the tool and put
3 them in a box and walk that box to where it needed to go
4 next, hopefully to the right exact spot, put it down,
01:32PM 5 open it up, put it on the tool, and keep going.

6 So this is much more automated. We don't
7 have anybody having to carry wafers all the time. It's
8 much better.

9 Q. Okay. Let's focus, if we can, on the two people
01:32PM 10 that are there in their fab there. Can you describe
11 what they are wearing?

12 A. Yeah. They're in a clean-room suit, commonly called
13 a bunny suit. I guess that's because they look like
14 little white bunnies. Yeah, that's sort of standard
01:33PM 15 garb for the clean room for everybody.

16 Q. And why are they wearing these bunny suits?

17 A. Well, it's actually to protect the clean room from
18 the people, not the other way around, for example.

19 So as we sit here, I think everybody in COVID
01:33PM 20 knows this, we're breathing out, we're breathing out
21 particles, right? We've got, regrettably, hair falling
22 off, some of us more than others, and maybe you're
23 shedding some skin flakes; all those things can cause
24 defects on the wafer.

01:33PM 25 So the clean room gown is actually there

1 to try and protect all that from standing as close to
2 you as possible and not getting out into the clean room
3 and causing problems.

4 Q. Now, how many hours a day is the fab operating?

01:33PM

5 A. It operates 24 by 7, 365. I mean, with the
6 exception of things like natural disasters. Like, y'all
7 are in Texas. In February, when we had that bad polar
8 vortex storm; that threw us for a curve and had us down
9 for a while. So, yeah, but other than that, for our

01:34PM

10 normal operation it's 24 by 7, 365.

11 Q. Is that the one that was all over the national and
12 international news?

13 A. Yeah, that was a bad time.

01:34PM

14 MR. McKEON: All right. Now, you mentioned a
15 video. So why don't we have -- Mr. Sayres, will you
16 pull up the video, Dr. Reifsnider's video.

17 Q. Before we start the video, Dr. Reifsnider, could you
18 describe what you are going to be showing here in your
19 video?

01:34PM

20 A. Absolutely. So it showed those two cars in the top,
21 in the foreground of the picture a minute ago. Well, in
22 this video, we actually put a camera to go through on
23 one of those cars, and we ran it around the fab. So
24 this is just an excerpt of that to show you sort of what
01:34PM 25 a better impression of what the fab sort of looks like.

1 It can go everywhere. We just drove it around a little
2 bit to show it to you.

3 Q. All right. Mr. Sayres, can you start playing that.

01:34PM

4 A. Here you see we're moving on to the main corridor,
5 and then we're going to turn left so you can get a feel
6 for the depth of the fab here. We're passing people and
7 some other bays. You see bays on the left and bays on
8 the right, some cars going by, some with wafers. There
9 we are, here's another car going on a different track.

01:35PM

10 You can see there's a couple different tracks up on the
11 roof so we can move wafers around. Here it's just
12 heading back, and now we're going to head back down.
13 So, again, more bays on the left, bays on the right,
14 heading down. Back where we started.

01:35PM

15 Q. Thank you, Dr. Reifsnider. Now, I know you brought
16 with you today one of your wafers, and could you take
17 that out and --

18 A. Sure.

19 Q. -- show that to members of the jury?

01:35PM

20 A. So this is a fully completed wafer from our fab.
21 I'll hold it up pretty high. I know it's hard to see in
22 the back row. Wafer starts like this. So when
23 you're -- sorry. When you start off the process, this
24 is actually the back of the wafer. That's what the
01:35PM 25 front looks like when you start. Right, it's just

1 polished silicon. The whole front and back looks like
2 that.

3 When you're done, you have -- trying to get
4 ahold of this. There you go. You have this on the
01:36PM 5 front side now. You've got a bunch of chips. So this
6 is, I believe, a little bit over 200 chips on this. I
7 don't know if you can see the grid pattern, but each one
8 of those grids -- it is, in fact, one of the chips
9 happens to be a wafer that we made for Tesla, and those
01:36PM 10 are the self-driving car chips. So that's 200
11 self-driving car chips right there.

12 Q. And you say that was made in your fab in Austin?

13 A. Yep. This is a 14-nanometer wafer made in our fab
14 in Austin.

01:36PM 15 Q. Thank you, Dr. Reifsnider. Now, as you put that
16 away, how many transistors are on a single wafer?

17 A. Each of those chips that you can see on that wafer,
18 if you cover it, has, you know, billions of chips.

19 Billions, multiply that by 220, whatever or so. So
01:36PM 20 there's trillions of wafers on that -- sorry, trillions
21 of transistors on that wafer.

22 Q. That sounds like a lot.

23 A. That's a big number.

24 THE COURT: Would you mind slowing down just a
01:37PM 25 little bit, Dr. Reifsnider?

1 THE WITNESS: My apologies.

2 THE COURT: Okay. Let's continue.

3 MR. McKEON: Thank you, your Honor.

01:37PM

4 Q. So to get that many transistors on that wafer, I
5 mean, how small are they?

01:37PM

6 A. So I believe we've covered they're 14-nanometer in
7 size. That's sort of the feature size of the fin
8 itself. I think the hair comparison has been used
9 before, but I just like it. So, again, take one of your
10 hairs, you cut it crosswise; that's about, you know, 100
11 microns. And so a fin is on the order of, let's say,
12 8,000 times smaller than that. So it's very small.

13 Q. And how do you make them so small?

01:37PM

14 A. Yeah, the challenge is that. We have, you know,
15 trillions of transistors on that one wafer, and we're
16 doing a high volume of wafers every day. So the answer
17 to that question is precision. We have to be precise
18 and repeatable with our process. There's a lot of
19 tools, and they have got to run just perfectly every
20 time.

01:38PM

21 Q. Now, what does Samsung do when a chip on a wafer
22 doesn't meet performance standards?

01:38PM

23 A. Yeah, so we check them at the end of the line, as
24 been discussed, right? We do some electrical testing or
25 some performance testing, and if the chip doesn't work,

1 then that chip gets marked to be not sold.

2 The problem is if enough chips don't work, you
3 end up with a wafer like this one, where the whole wafer
4 had to be thrown out because there were too many chips
01:38PM 5 that didn't work.

6 So even the ones that were good, still can't
7 use them.

8 Q. And that sounds like a bad thing?

9 A. Yeah. I wish that were as extremely rare -- excuse
01:38PM 10 me. I wish that was as extremely rare as has been
11 recorded, but it happens more often than I would like,
12 that's for sure.

13 Q. Now, are there any size process nodes? You
14 mentioned 14-nanometer. Are there any other sizes that
01:39PM 15 you do at fab?

16 A. Yeah, 14-nanometer is maybe the biggest runner in
17 the fab right now, but we also have a 28-nanometer
18 planar process and we also have a 65-nanometer planar
19 process.

01:39PM 20 Q. And who does SAS manufacturer wafers for?

21 A. Sort of by definition, as a foundry, whomever really
22 wants us to, if we have space. And so it's -- you've
23 heard testimony that there were, you know, the four big
24 foundries. Foundry means that we don't have any
01:39PM 25 internal customers. Everybody is an external customer

1 to us, even the Samsung LSI group that designs the chips
2 we've been talking about, the Exynos chips, they are not
3 internal to us. They are an external customer the same
4 way anybody else is. So we have quite a few, dozens of
5 customers.

01:39PM

6 Q. And I guess one of them ultimately is Tesla; is that
7 right?

8 A. Yep. Tesla is one of our customers. It's
9 automotive, so maybe not as much volume because they
10 don't need to make billions of cars, unlike headphones,
11 maybe; but, yeah, they are definitely one of our good
12 customers.

01:40PM

13 Q. Now, when did SAS start manufacturing devices using
14 the 14-nanometer FinFET technology?

01:40PM

15 A. We started production of devices in the first
16 quarter of 2015.

17 Q. And did you play any role in implementing the
18 14-nanometer process in the Austin fab?

19 A. Very much so.

01:40PM

20 Q. And could you describe that?

21 A. Sure. So when the decision was made to transfer
22 this technology from headquarters to Austin, I was the
23 process integration leader; and so I was selected by the
24 company to be the transfer team lead head. I was
25 responsible for the entire 14-nanometer transfer from

01:40PM

1 headquarters to Austin.

2 Q. And when did that process begin?

3 A. That began in January of 2014.

01:41PM

4 Q. And as technology transfer leader, what were you
5 required to do?

01:41PM

6 A. The short answer would be everything. So, I mean,
7 as the leader, the buck stopped with me, so I had to
8 have final technical authority on any problems; I had to
9 be concerned about the schedule, the tools. If it
10 touched 14-nanometer during that first year and change,
11 it was my problem, and I was responsible for it.

12 Q. Now, did the teams from Korea come over and assist
13 in the implementation in the fab?

01:41PM

14 A. Absolutely. We had about -- I believe it was about
15 two dozen people that came from Korea because they had
16 been working on 14-nanometer. They joined our team. We
17 had about, I think, 80 local people, all told, working
18 on the project.

01:41PM

19 You can imagine our Korean wasn't as great as
20 theirs. So their English was actually quite good. So
21 they were the liaisons and helped us, you know, stay
22 coordinated with headquarters.

01:42PM

23 Q. And what kind of effort went into developing the
24 process technology to make Samsung's 14-nanometer FinFET
25 at SAS?

1 A. So the process wasn't fully baked, I guess would be
2 the best way to describe it; it was still being
3 developed in Korea; it was still being developed at
4 Austin. We were all working in tandem trying to make
01:42PM 5 improvements, find problems, fix problems, communicate
6 those problems to Korea, get information back from them
7 on what they had found, and stay synchronized, all while
8 trying to move as quickly as possible. So it was --
9 yeah, it was a huge amount of work.

01:42PM 10 Q. So was some of the development of the 14-nanometer
11 technology done here in Austin?

12 A. Quite a bit. Again, when we got the process in
13 2014, it was not production-capable. It was not meeting
14 its performance targets. Yeah, there was a lot to be
01:42PM 15 done before we could actually sell a product in that
16 node.

17 Q. Well, why was it such a big effort to do that?

18 A. Well, I use analogy that it's like trying to rebuild
19 a car while you are trying to race the car. It's just
01:43PM 20 that we had so many issues adapting, like, the process
21 and the recipes to our tools. Our tools weren't an
22 exact match to what the headquarters site -- sending
23 site was from, so we had to figure out how to make all
24 that work.

01:43PM 25 And it's just, I think one of the bigger

1 challenges was the fact that we had those two teams
2 trying to work in tandem, geographically separated by an
3 ocean, and trying to get stuff ready for production.

01:43PM

4 Q. Can you give me an example of some of the process
5 technology that was totally new with the 14-nanometer at
6 the fab?

01:43PM

7 A. I think first and foremost was the fin, right.
8 Until then, we had been working with planar transistors,
9 flat -- you know, they were on a flat surface, if you
10 will; and now we had this fin to deal with and getting
11 that the right shape and keeping it from falling over, I
12 mean, all sorts of problems. That was some of the
13 bigger problems.

01:44PM

14 And we were fortunate we were able to reuse
15 some of the other information, some of the other
16 processes, but yeah.

01:44PM

17 Q. Okay. So some of the stuff that you already had
18 going in the fab, you were able to use that?

19 A. Yeah. You have actual growth. We were able to use
20 a lot of the back-end metals that make everything up.
21 We knew how to do that from the previous technology.
22 So, yeah, there were some things that we already could
23 just reuse that made it -- that was helpful.

01:44PM

24 Q. Now, after the technology transfer began in, you
25 said, January 2014, how long did it take until SAS began

1 actual commercial production of 14-nanometer?

2 A. Yeah, that was the over-one-year period. So we
3 started January 2014; and then Q1 in 2015, we went into
4 production.

01:44PM

5 Q. And was commercial production maybe a milestone for
6 you, Dr. Reifsnider?

7 A. Yes, I'd say so. That was after a long hard year of
8 work, having the yield to the point where we could
9 actually put in a production wafer that we were going to
10 sell and start getting some, you know, reward for all of
11 our hard work, yeah, that was a big day.

01:45PM

12 Q. All right. Now, during the fabrication of the
13 wafers at the factory, is there some sort of process,
14 guide, or reference source that's used to do that?

01:45PM

15 A. Yeah. You've probably heard, so far we've talked
16 about process flows. So, yeah, we have a very detailed
17 process flow that directs the tools how to make the
18 product.

19 Q. And what is the process flow?

01:45PM

20 A. The process flow is an ordered, carefully controlled
21 list of steps, top to bottom. It's, again, several
22 thousand steps long, and it tells you, in order, what to
23 do next and, again, in a very controlled and hopefully
24 very precise fashion.

01:45PM

25 Q. Is there something called a recipe?

1 A. So these steps are what is sort of the call-out to
2 what's to be done, but the actual tools themselves need
3 to know how to execute that. So the tools have a recipe
4 that is linked to each step. So each step says, "Ah,
5 run this recipe"; the tool goes off and does that and
6 makes the actual changes to the product.

01:46PM

7 Q. And where do these flows and recipes, where do they
8 come from?

9 A. Sort of a mix. Obviously we get -- we got the
10 initial revisions from HQ when we started in 2014
11 January, but a lot of that had to be updated and
12 modified and adjusted. So, again, we worked on that in
13 a sort of co-development period throughout the point up
14 to production.

01:46PM

15 Q. So that would be Samsung flows and recipes?

01:46PM

16 A. Yes, they are all Samsung internal information.

17 Q. You're not going on, making a 1-800 number call and
18 getting a recipe?

19 A. There is no external source that we can use for
20 that.

01:46PM

21 Q. And are these recipes and flows, are they important
22 to Samsung and SAS?

23 A. Extremely. They are most highly classified material
24 that we have in the fab. They are -- I mean, the very
25 lifeblood of what our company does is reflected in those

01:47PM

1 process flows and the recipes that are associated with
2 them.

3 Q. Could your fab, Dr. Reifsnider, build the wafers
4 without the process flows?

01:47PM 5 A. Not at all.

6 Q. And would your competitors like to get their hands
7 on them?

8 A. From my industry experience, yes, absolutely.

9 Q. All right. Let's see if we can get the slides back
01:47PM 10 up. And turning to the next slide, Dr. Reifsnider, what
11 are you showing here?

12 A. So these are the 14-nanometer process flows used to
13 make 14-nanometer products at our fab.

14 Q. And, just for the record, we have on the slide
01:47PM 15 DTX-310 to DTX-318.

16 Now, Dr. Reifsnider, as director of
17 engineering, are you familiar with these process flows.

18 A. Yes, I am.

19 Q. And could you just generally describe, generically
01:48PM 20 across the flows, the types of steps that are included?

21 A. Sure. Every one of these nine flows has steps that
22 are categorized in two parts. So there is the process
23 steps; that's the ones -- the tools that actually do
24 something and make a change on the wafer.

01:48PM 25 And then there's what I'll call metrology,

1 also known as measurement steps, or measurement and
2 inspection steps basically, and those are the ones that
3 are inspecting some test structures of the wafer to
4 ensure that everything's running right.

01:48PM 5 Q. And why do you have these inspection steps?

6 A. Well, again, you can see in the middle that we have
7 a large number of rows. As I said, it's a very complex
8 process. We've got almost 2,000 tools.

9 The inspection steps are really there to make
01:48PM 10 sure that the tools and the process is running
11 accurately. I mean, these are tools; tools can, on
12 occasion, break down; they can, on occasion,
13 malfunction. So we have all these things to make sure
14 we are doing it right every time.

01:49PM 15 Q. Thank you, Dr. Reifsnider.

16 MR. McKEON: And with that, your Honor, we'd
17 like to go ahead and seal the courtroom because we're
18 going to get into the process flow at this time.

19 THE COURT: All right. Based on Counsel's
01:49PM 20 request and representations, I'll order the courtroom
21 sealed. Those present, not subject to the protective
22 order in this case, should exit the courtroom and remain
23 outside until it's reopened and unsealed.

24

01:49PM 25

1 [REDACTED]

2 [REDACTED]

3 [REDACTED]

4 [REDACTED]

5 [REDACTED]

6 [REDACTED]

7 [REDACTED]

8 [REDACTED]

9 [REDACTED]

03:00PM

03:01PM

03:01PM

03:01PM

03:23PM

10 Ladies and gentlemen of the jury, we're going

11 to take a short recess at this juncture before the next

12 witness is called. If you will simply leave your

13 notebooks closed and in your chairs. Please follow all

14 my instructions about your conduct, including not to

15 discuss the case among each other, and we'll be back

16 shortly to continue with the next witness.

17 The jury's excused for recess.

18 I'll order the courtroom unsealed.

19 (Proceedings unsealed.)

20 (Whereupon, the jurors exit the courtroom.)

21 THE COURT: Court stands in recess.

22 (Recess from 3:01 p.m. to 3:22 p.m.)

23 THE COURT: Defendants are prepared to call the

24 next witness?

25 MR. CORDELL: We are, your Honor.

1 THE COURT: Let's bring in the jury.
2 (Whereupon, the jurors enter the courtroom.)

3 THE COURT: Please have a seat, ladies and
4 gentlemen.

03:23PM 5 Defendants, call your next witness.

6 MR. CORDELL: Thank you, your Honor.
7 Defendants at this time call Dr. Jeffrey Bokor.

8 THE COURT: All right. Dr. Bokor, if you'll
9 come forward and be sworn, please.

03:24PM 10 (Whereupon, the witness was duly sworn.)

11 THE COURT: Please come around, sir. Have a
12 seat at the witness stand.

13 All right. Counsel, you may proceed with
14 direct examination.

03:24PM 15 MR. CORDELL: Thank you, your Honor.

16 JEFFREY BOKOR,
17 having been first duly sworn, testified as follows:

18 DIRECT EXAMINATION

19 BY MR. CORDELL:

03:24PM 20 Q. Good afternoon, Dr. Bokor.

21 A. Good afternoon, Mr. Cordell.

22 Q. Could you please introduce yourself to the ladies
23 and gentlemen of the jury.

24 A. My name is Jeffrey Bokor. I live in El Cerrito,
03:24PM 25 California.

1 Q. All right. And what do you do for a living?

2 A. I'm a professor at the University of California in
3 Berkeley.

4 Q. All right. Well, what's -- what do you teach?

03:25PM 5 A. In electrical engineering.

6 Q. Okay. Well, let's talk a little bit about your
7 background. Did you go to college?

8 A. Yes, I did.

9 Q. Where did you go?

03:25PM 10 A. Massachusetts Institute of Technology.

11 Q. Did you get a degree?

12 A. Got a bachelor's degree in electrical engineering.

13 Q. Okay. And what year was that?

14 A. 1975.

03:25PM 15 Q. Let's see if I can get the slides up here. All
16 right. 1951. And did you get a master's degree after
17 that?

18 A. Yes, I did.

19 Q. Where from?

03:25PM 20 A. Stanford University.

21 Q. And what about your Ph.D.?

22 A. Same thing in Stanford, in electrical engineering.

23 Q. All right. What was your thesis for your Ph.D.?

24 A. Something about laser physics.

03:25PM 25 Q. Okay. Was it complicated?

1 A. I think so.

2 Q. All right. Well, then I'll just give everybody a
3 break and move on.

4 So have you had a fair number of jobs over your
5 career?

03:26PM

6 A. Well, only a couple.

7 Q. Okay. Well, you said that you were currently a
8 professor; is that right?

9 A. That's right.

03:26PM

10 Q. And tell us about that.

11 A. I'm currently on the faculty in the department of
12 electrical engineering and computer science at
13 University of California, UC Berkeley. I currently
14 serve as the chairman of the department. I've been
15 there since about 1993, so 28 years. And --

03:26PM

16 Q. How much longer are you going to serve as chairman?

17 A. Not much longer. My term is almost up. I'm looking
18 forward to a nice little break from that. It's been
19 quite a demanding job.

03:26PM

20 Q. Now, you list AT&T and Bell Laboratories. When did
21 you work for Bell Labs?

22 A. As soon as I graduated from Stanford in 1980, I
23 started at AT&T Bell Labs in New Jersey and I worked
24 there about 13 years.

03:27PM

25 Q. And what kinds of things did you do at Bell Labs?

1 A. I worked on a number of different kinds of
2 technologies. I did basic research in lasers, laser
3 physics, solid-state physics, device technology. Later
4 on in the latter part of my career there, the last four
03:27PM 5 years or so, I worked directly on this technology that
6 we're talking about generally. That means integrated
7 circuit devices and fabrication technologies.

8 Q. And you also list the Center For Energy Efficient
9 Electronics Science. What's all that about?

03:27PM 10 A. I thought that might be interesting to the jury and
11 the rest of the court. That is a large-scale
12 collaboration that I colead that's headquartered
13 Berkeley. It has collaborators from a number of other
14 universities: MIT, Stanford, UT-El Paso, Florida
03:28PM 15 International University, about 12 or 15 faculty working
16 together with a smaller army of graduate students to
17 investigate the reduction of the energy use by
18 electronics.

19 So at the academic level, what we're looking at
03:28PM 20 are technologies that might go into products 15 years
21 from now; so we're looking way out beyond what the
22 industry is looking at to try to make electronics that
23 are going to continue to give us more computing and more
24 intelligence for less power. That's what that center's
03:28PM 25 about.

1 Q. Okay. And you also --

2 A. Funded by the -- by the way, sponsored by the
3 National Science Foundation of the U.S. government.

4 Q. What's an IEEE fellow?

03:28PM

5 A. Well, IEEE is the professional society for
6 electrical engineers. It's an international society;
7 that's the I. And a small percentage of the members of
8 the IEEE get elected to the grade of fellow, in
9 recognition of achievement.

03:29PM

10 Q. Okay. Have you been published in this field?

11 A. Quite a bit.

12 Q. Okay. So in Slide 3, you've got a bunch of
13 publications. How many times have you been published?

03:29PM

14 A. I have well over 300 publications. I think it's
15 pushing over 350 now.

16 Q. Now, in this case, we seem to have gotten into how
17 many people cite articles. Do you know how many times
18 your articles have been cited?

03:29PM

19 A. I haven't checked lately, but it's somewhere in the
20 up -- north of 16,000.

21 Q. Would you believe 27,494?

22 A. I won't argue.

23 Q. Okay. And have you published a lot in the
24 semiconductor device field, like FinFET transistors?

03:29PM

25 A. Quite a bit.

1 Q. And have those been pretty well received?

2 A. I believe so.

3 Q. I'd like to focus on one of those papers, if I can.

4 And before I do that, can you tell the jury what the

03:30PM

5 defense -- or what DARPA is?

6 A. So DARPA is a U.S. -- is an agency of the U.S.

7 government. They are actually part of the U.S.

8 Department of Defense. It stands for Defense Advanced

9 Research Projects Agency. They are listed on this slide

03:30PM

10 because they were the sponsor for the research that led

11 to the publication that you're showing here. DARPA

12 researches, sponsors research. They don't do any

13 research. They fund research that goes on in a variety

14 of academic and industry laboratories, with a goal of

03:30PM

15 providing a leading edge to the United States military

16 in national security technologies.

17 So they're famous, for example, for having been

18 the agency that sponsored the invention of the Internet,

19 as well as a number of other really well-known

03:31PM

20 technologies like stealth aircraft, GPS, and many, many

21 other important national security technologies. And

22 they've sponsored the research that was done and

23 reported in that paper that you've got up on the slide.

24 Q. All right. And this paper's entitled: "FinFET, a

03:31PM

25 self-aligned double-gate MOSFET scaleable to 20

1 nanometers."

2 Did I read that right?

3 A. You did.

4 Q. Okay. And why is this significant?

03:31PM

5 A. Well, we're here to talk about FinFETs. And
6 actually this team, there's a list of coauthors there,
7 three faculty leaders. I was one of the three faculty
8 members who led this team of graduate students and
9 postdoctoral researchers, and we published the first
10 paper reporting our invention of the FinFET, and that's
11 the technology that Samsung uses today.

03:31PM

12 This paper was published in 2000. We were a
13 little conservative. We didn't know that we would
14 actually get all the way to 14 nanometers with it.

03:32PM

15 Q. And were you the folks that came up with the name
16 "FinFET"?

17 A. We're generally recognized -- this paper's generally
18 recognized as the paper that announced, first
19 demonstrated, and named the FinFET.

03:32PM

20 Q. Okay. Now, have you done a lot of work in this
21 case, Dr. Bokor?

22 A. On this case, I put in a fair bit of time on this
23 case, yes, I have.

03:32PM

24 Q. Are you being compensated for your time in this
25 case?

1 A. Yes, I am.

2 Q. At what rate?

3 A. \$650 an hour.

4 Q. And have you had occasion to study the four patents
03:32PM 5 in this case?

6 A. I certainly have.

7 Q. And what other kinds of information have you looked
8 into as part of your work on this case?

9 A. Well, besides studying the patents and what's called
03:32PM 10 the prosecution history for those patents, I studied
11 what's shown on this slide. A lot of documents from
12 Samsung; those process flows that we just saw from
13 Dr. Reifsnider; lots of other Samsung documents
14 regarding the 14-nanometer FinFET process and the
03:33PM 15 devices.

16 I sampled some Samsung devices and did some
17 testing using this company EAG. I studied some of the
18 deposition testimony of the Samsung witnesses. Of
19 course, I've read a lot of technical literature
03:33PM 20 specifically related to this case.

21 Some of the papers that have been talked about
22 as having been published by the Acorn inventors, I read
23 those and many other papers. And, of course, I have my
24 40 years of professional experience in this game that I
03:33PM 25 also draw on in making my analysis and coming to my

1 opinion.

2 Q. Do you feel qualified to offer opinions about the
3 infringement issues that we've been talking about in
4 this case?

03:33PM 5 A. I do.

6 Q. Okay.

7 MR. CORDELL: Your Honor, Samsung offers
8 Dr. Bokor as an expert in semiconductor design and
9 technology.

03:34PM 10 THE COURT: Is there objection?

11 MS. RAYBURN: No, your Honor.

12 THE COURT: Without objection the Court will
13 recognize this witness as an expert in those designated
14 fields.

03:34PM 15 Please continue.

16 MR. CORDELL: Thank your Honor.

17 Q. So, Dr. Bokor, we talk a lot about transistors in
18 this case. Can you tell the ladies and gentlemen of the
19 jury a little bit more about what a transistor does?

03:34PM 20 A. Sure. I think you heard a little bit this already.
21 The transistors in the context of this application are
22 used simply as an on/off switch.

23 Q. And what do you mean just on and off? Just like a
24 light switch?

03:34PM 25 A. That's why we have this -- that's why I prepared

1 this slide with this simple demonstration. It's just
2 like a light switch. It's either on and the current
3 from the battery can flow around what's called a
4 circuit. The circuit has to be complete. The current
03:35PM 5 flows; lights up the light bulb when the switch is
6 closed. When the switch is open, the light bulb doesn't
7 light up. That's just what the transistors does.

8 Q. Well, now, when you put these switches in a
9 computer, does it get more complicated?

03:35PM 10 A. Gets a lot more complicated. You've heard over and
11 over that these chips have billions of these transistors
12 that are scaled down to an unbelievably small scale.
13 I'm sure it's very difficult for any of us really in the
14 real world to even imagine the size, except for those of
03:35PM 15 us that work on this all the time. And what I'm trying
16 to illustrate here is, in a very simple way, to try to
17 give you a little bit of a taste for how a computer
18 works to calculate numbers.

19 We have these large numbers of transistors that
03:35PM 20 are switches, and if you close just the right set of
21 switches, that's basically equivalent to asking a
22 question of the computer and that's why the transistors
23 are wired up in, you know, a very unique and special way
24 to make a string like you see here on this slide.

03:36PM 25 If you close all the right switches, the light

1 bulb goes on and the computer comes up with an answer.
2 That's basically what it does. And the point I'm trying
3 to illustrate here is that inside this chip with
4 billions of transistors, they're wired up in strings
03:36PM 5 like this, and when you have a whole lot of them wired
6 up in a string, the resistance of every transistor adds
7 up. If the resistance is too high, the light bulb will
8 just be very dim and it really won't operate.

9 So the resistance, that's why the resistance is
03:36PM 10 so important. The resistance of one transistor doesn't
11 make a whole lot of difference, but in the chip they are
12 strung in thousand -- there's strings of them thousands
13 and thousands long and they have all got to work and
14 they have all got to have low resistance so that the
03:36PM 15 light bulb, by analogy, will actually light up and be
16 bright and the chip works.

17 Q. How many times a second do these switches open and
18 close in one of these Samsung chips?

19 A. Another unimaginable number. I'm sure you've been
03:37PM 20 bombarded with a lot of those.

21 The switches in these chips switch on and off
22 multiple billions of times per second, billions.

23 Q. All right. Well, so obviously we don't put the
24 old-timey switches into the chip, so tell us -- tell us
03:37PM 25 how those functions make it into the modern FinFET.

1 A. Okay. So transistors, obviously we can't stick our
2 fingers in there and operate billions of transistors at
3 a time. It wouldn't be any good. But transistors are
4 made to -- they are switched to open and close by
5 another electrical device. That's called the gate.

03:37PM

6 So the gate is like your finger to open and
7 close the switch. If you put a voltage, elect- -- if
8 you put electricity on the gate, the switch will close;
9 and if you remove the electricity or the voltage, turn
10 the -- if the voltage which is coming from another
11 transistor -- that's why they swing up together -- if
12 the voltage on the transistor is -- if there is no
13 voltage, zero, the transistor is open.

03:38PM

14 So you can control whether this transistor will
15 be on or off by putting the voltage on the gate. That's
16 the way all these transistors can wire up and control
17 each other and in an incredibly complicated way that it
18 finally computes.

03:38PM

19 Q. So you also label a fin with the old transistor.

03:38PM

20 Where is the fin in the modern FinFET?

21 A. The fin I think you've heard quite a few times now.
22 You can see in this diagram that gray fin that's under
23 the gate is only showing the mushroom contact on top.
24 But the thing underneath there and where it's -- the key
25 thing about the fin is right under the gate, where the

03:39PM

1 gate is controlling it, it's a very narrow fin and that
2 was a big innovation and a big surprise when we first
3 came up with this idea.

4 Dr. Reifsnider talked about the earlier

03:39PM

5 generations of transistors, which are just flat; and
6 when we came up with this idea to make it a fin, that
7 was actually pretty radical and a major breakthrough.

8 And you can get a -- kind of get an idea, at least a
9 flavor of the idea of why the fin is a good idea by

03:39PM

10 looking at the old-timey switch. That bar is kind of
11 like the shape of a fin, and if you need to run a lot of
12 current through your circuit, you want a big fat bar
13 like that.

14 And the previous generation of transistors were

03:39PM

15 just, you know, more like a wire, just sort of flat on
16 the surface. By bringing that fin up, we can get more
17 current, but it didn't take up any extra space on the
18 chip. To get more current in the same space, we could
19 cram more transistors in there, continue to make them

03:40PM

20 smaller and smaller but keep carrying the current.

21 And actually, the more current that flows --

22 this is another detail -- the more current, the faster
23 they go. They make the transistors go faster if you can
24 put more current through.

03:40PM

25 Q. Let me ask you about this thing. It looks like a --

1 looks like a home plate, but it's kind of long. What's
2 that?

03:40PM 3 A. Like home plate up on its side, right? We've heard
4 that structure discussed quite a bit over the last
5 couple of days that, some people have been calling it
6 the mushroom. And so what they do in the process is --
7 there's a special process. It's called epitaxial
8 growth. I think you heard Dr. Reifsnider use that
9 terminology, and they put the -- first they make the
03:40PM 10 fins and then they have another process where they just
11 have silicon come and expand and grow up from the fin to
12 make that bigger, fatter structure that's used to make
13 the contact.

03:41PM 14 Q. Okay. Well, you mentioned contact. Let's talk
15 about the contact. How do -- first of all, what's the
16 mech- -- how do we make contact with the old-timey
17 switch?

03:41PM 18 A. Yeah. So the analog, we're going to continue to
19 push this analog a little further. The switch needs to
20 have some wires connected to it so that it can be in a
21 circuit and do a function, and the contact is where the
22 wire on the left-hand side, these copper wires come in
23 and there's a little -- there's usually a screw terminal
24 there.

03:41PM 25 You'll wrap the wire around the screw and then

1 you use a screwdriver, or in this case looks like a nut
2 driver, and you screw the screw down and make a really
3 nice, tight contact to the wire. The wire's jammed in
4 there really good and it doesn't move, and it won't pull
5 off, and it carries the current.

03:41PM

6 And that's the thing that the contact that this
7 whole case is all about is trying to do on this
8 incredibly tiny scale. Got no screw, there's no
9 screwdriver to turn the screw, but what we're trying to
10 do is the equivalent of that screw terminal, make a
11 really good contact, make it solid, make it reliable,
12 and make it carry lots of current.

03:42PM

13 Q. All right. Well, show me, show the jury how that's
14 done with the FinFET.

03:42PM

15 A. Okay. So after we form that, what Mr. Cordell
16 called -- it's like a real thick home -- make a stack of
17 home plates.

18 Q. Let's go back to mushroom. I'm sorry. I don't know
19 why we got --

03:42PM

20 A. Okay. Good enough. So after that structure is
21 formed -- and that's what it looks like when it's first
22 formed. It's got that sharp peak kind of like a peak
23 roof. And then what they do, one of those process steps
24 that we saw in the presentation from Dr. Reifsnider is
25 they drill a hole into that mushroom to make a plug --

03:42PM

1 sorry, to make the socket for the plug to come in.

2 And so I'm mixing my analogy here a little bit,
3 but what we're going to do, I'm going to use
4 terminology. Where the wire comes in, that's the plug;
03:43PM 5 and the hole that's created there, I want to call that
6 the socket.

7 Q. Okay. Then what happens?

8 A. There you go. So now the plug comes down, plugs
9 into the socket; and the metal contacts there, what
03:43PM 10 we've heard is made out of tungsten in this process,
11 that's the wire that comes down, plugs into the
12 transistor to carry the current that comes from other
13 transistors that are other places on the chip. And
14 there's wires that go this way, in this direction to
03:43PM 15 wire the different transistors all up together to make
16 the computer.

17 Q. Okay. So what's the focus of this case, Dr. Bokor?

18 A. The focus of this case is the details of the nature
19 of that contact between the metal and the semiconductor.
03:44PM 20 That's called the interface.

21 Q. Okay. And you mentioned something about resistance.
22 What is contact resistance?

23 A. That's what we engineers use to describe how easy it
24 is for the current to flow from the wire into the
03:44PM 25 semiconductor or back in the other direction.

1 Q. And then --

2 A. You've seen that discussed a lot.

3 Q. Okay. And then contact area, what's that all about?

4 A. Well, the size of the contact is the contact area.

03:44PM

5 It's also very important for the performance. These

6 contacts are extremely small. There are about a

7 trillion of them -- if you put them all, just the

8 contacts, not the whole transistor, the contact area is

9 about a trillionth of a square inch. That means if I

03:44PM

10 just made the contacts, stacked them up side by side

11 over the area of about a postage stamp, which is about a

12 square inch, there would be a trillion of them. They're

13 tiny as all get-out.

14 Q. Now, we talked a lot about oxide in this case. What

03:45PM

15 are you showing us on Slide 13 -- 113, DDX-113?

16 A. So on these chips that have billions of transistors,

17 the name of the game is to try to make the transistors

18 as small as you can and then put them as close together

19 as you can, but it's important when you're making them

03:45PM

20 close together that they don't touch and they don't

21 contact each other, the current doesn't flow where it's

22 not supposed to and so that's what I'm showing here is

23 two transistors that are very close together.

24 And what you can see that's sort of

03:45PM

25 transparent, you can see through it, is the silicon

1 oxide. That's the insulator that's being used to keep
2 the transistors from touching each other. It's not a --
3 it's not an accident that you can actually see through
4 it.

03:46PM

5 Silicon oxide is essentially the constituency
6 of glass. Essentially, the silicon oxide here is much
7 purer than the glass, the glasses are in your window,
8 but it's the same chemical material and it's
9 transparent. You can see through it, but electricity

03:46PM

10 can't get through it.

11 Q. Is it a little bit like the plastic on the outside
12 of the toaster cord?

13 A. It's an insulator and so same function. The plastic
14 on your toaster cord is meant to keep other things from
15 touching it like your fingers or the counter or, you
16 know, another wire for the microwave. You want to keep
17 them from not -- from touching each other and shorting
18 out.

03:46PM

19 Q. Now, we've heard a lot about oxide. Is this the
20 oxide at the interface that you show here on DDX-113?

03:46PM

21 A. In my opinion, there is no oxide at the interface.

22 Q. Okay.

23 A. But this is a different oxide.

24 Q. Okay. Well, let's talk about -- let's talk about

03:46PM

25 the claims. What is it the Acorn patents tell us to do

1 in order to create the interface between the metal and
2 the semiconductor?

3 A. Well, as it's highlighted on the slide here, this is
4 kind of the nugget that really answers your question.

03:47PM

5 The -- this claim of this particular patent, Claim 1 of
6 the '167, the last part there says the interface layer
7 is comprising a metal oxide and an oxide of the
8 semiconductor. So they tell you to put an oxide in that
9 interface.

03:47PM

10 Q. Okay. And just one oxide, or is it more than one?

11 A. Actually, yeah, they tell you to put two, very
12 specifically. You need two oxides: A metal oxide -- a
13 layer, a metal oxide layer and a semiconductor oxide
14 layer at that interface.

03:47PM

15 Q. Okay. And what does Samsung do?

16 A. As we heard from Dr. Reifsnider, Samsung puts a
17 silicide material between the metal and the
18 semiconductor to form that contact.

19 Q. And is silicide a layer of metal oxide?

03:48PM

20 A. It is not.

21 Q. And is silicide a layer of semiconductor oxide?

22 A. It is not.

23 Q. All right. We'll take that in pieces. Let's --

03:48PM

24 have you formed an opinion as to whether or not Samsung
25 infringes any of the asserted claims of the four

1 patents-in-suit?

2 A. I have.

3 Q. And what is your opinion?

03:48PM

4 A. I just kind of tipped my hand there. None of these
5 claims of these patents are infringed by the Samsung
6 14-nanometer FinFET process in my opinion.

7 Q. Okay. Well, we'll take that in some more detail,
8 but are there any primary reasons you rely on for your
9 opinion that Samsung does not infringe?

03:48PM

10 A. It's really focused on these layers. So in my
11 opinion, my own independent analysis confirms that there
12 is no metal oxide layer and there is no semiconductor
13 oxide layer at the contacts in the Samsung 14-nanometer
14 FinFET products.

03:49PM

15 Q. Okay. Now, the judge gave us some definitions in
16 this case. Are you familiar with those?

17 A. I am.

18 Q. And have you applied the judge's definitions in your
19 analysis of this case?

03:49PM

20 A. I did.

21 Q. Okay. And just to confirm, those two -- those two
22 requirements that you just articulated, the no metal
23 oxide layer and no semiconductor oxide layer, did you
24 find those in all four of the patents in this case?

03:49PM

25 A. The requirement for those?

1 Q. Yes.

2 A. Yeah, I -- yes. I do see, essentially, that
3 requirement in all of the claims.

03:49PM

4 Q. Okay. So I put up '167, Claim 1. Do you see a
5 requirement for a layer of metal oxide and a requirement
6 for a distinct layer of a semiconductor oxide?

7 A. It's right there highlighted on the slide. That is
8 the -- that's the claim. Those are there.

03:50PM

9 Q. And we have a note here at the bottom: "Also
10 required by dependent Claim 6." What's that all about?

11 A. Right. The idea, there are independent claims of
12 the patent; there are dependent claims in the patent.
13 So Claim 6 depends from Claim 1, so it also requires --
14 Claim 6 also requires these same two layers.

03:50PM

15 Q. So anytime we see a dependent claim, does that
16 include the limitations, the requirements of the
17 independent claim?

18 A. That is my understanding of how these patents work.

03:50PM

19 Q. And what about the '395 Patent? Did you find the
20 same two requirements: a layer of metal oxide and a
21 layer of semiconductor oxide in the '395 Patent?

03:50PM

22 A. I did. Here there's a minor variation in the
23 language. It specifically calls out an oxide of
24 titanium, but titanium is a metal. So it's a metal
25 oxide, and also this claim requires the layer of a

1 semiconductor oxide.

2 Q. And what about the '691 Patent? Did you find the
3 same two requirements: a layer of metal oxide and a
4 layer of semiconductor oxide in that patent?

03:51PM 5 A. I do.

6 Q. And what about the '336? Did you find the same two
7 requirements here: a layer of metal oxide and a layer of
8 semiconductor oxide?

9 A. I do. The language again is a little bit different.
03:51PM 10 It's not ex- -- doesn't say the same exact words, but to
11 a person trying to read this claim and practice it,
12 reading what's written in blue, understanding what they
13 know, they would understand that to mean that you have
14 to have a semiconductor, a layer of semiconductor oxide.

03:51PM 15 Q. Now, we just heard from Dr. Reifsnider about
16 Samsung's process flows. Were you here for that
17 testimony?

18 A. I was.

19 Q. Okay. So maybe I'll just ask you a couple of
03:51PM 20 questions about that. Are you familiar with Samsung's
21 process flows?

22 A. I've looked at them in some detail, yes.

23 Q. Okay. And I think we can skip the fab and --

24 A. Oh, can't we watch the movie one more time?

03:52PM 25 Q. Nope.

1 So looking at DDX-125, tell the jury what we've
2 summarized on this slide.

03:52PM

3 A. This is very similar to a slide that you already saw
4 from Dr. Reifsnider. It lists the Samsung process
5 flows, nine of them. The Samsung code name designation
6 for these process flow is like an internal product name
7 like the LPSM_A and so forth.

03:52PM

8 To the right is some kind of evidence
9 designation code for this case, the DTX number. They
10 are listed from DT -- I'm told I should say that there
11 are DTX-310 to DTX-318 for the record, and those are the
12 process flows that I looked at.

13 Q. And did you study these process flows?

14 A. I did.

03:52PM

15 Q. And did you determine whether we can -- whether
16 there were any significant differences between, say, the
17 LPSM process flow and the LPRF process flow for the
18 purposes of this case?

03:53PM

19 A. For the purpose of this case, I focused my attention
20 on that question relating to this small number of steps
21 in the rightmost column, somewhere between 15 and 20
22 steps depending on the particular process flow; and in
23 terms of the particular issues involved in this case,
24 there's no significant differences between all of those
25 nine process flows, at least in this section of the

03:53PM

1 process.

2 Q. And tell us about the source/drain contact interface
3 step column. What does that represent?

03:53PM

4 A. Right. So we saw that in the previous witness
5 testimony, Dr. Reifsnider. There's a sequence of steps
6 that are the ones that form the source/drain contact
7 interface that's at issue in this case in each of the
8 process flow, and they're labeled in that right-hand
9 column. The number and actually exactly which lines in
10 that process flow document in each one.

03:54PM

11 MR. CORDELL: Your Honor, can I ask that we
12 seal the courtroom?

13 THE COURT: All right. Based on counsel's
14 request, I'll order the courtroom sealed. Those present
15 not subject to the protective order in this case should
16 excuse themselves until the courtroom is reopened and
17 unsealed.

03:54PM

18 [REDACTED]
19 [REDACTED]
20 [REDACTED]
21 [REDACTED] [REDACTED] [REDACTED] [REDACTED]
22 [REDACTED]
23 [REDACTED] [REDACTED]
24 [REDACTED] [REDACTED]
25 [REDACTED]

03:54PM

03:55PM

1 [REDACTED]

2 [REDACTED]

3 [REDACTED] [REDACTED]

4 [REDACTED]

04:27PM 5 [REDACTED]

6 [REDACTED]

7 [REDACTED]

8 [REDACTED]

9 [REDACTED] [REDACTED]

04:28PM 10 [REDACTED]

11 [REDACTED]

12 [REDACTED] [REDACTED]

13 [REDACTED]

14 [REDACTED]

04:28PM 15 [REDACTED]

16 [REDACTED] Your Honor, at this point, I
 17 think we can unseal the courtroom.

18 THE COURT: All right. Then, based on
 19 Counsel's representation, I'll order the courtroom
 04:28PM 20 unsealed and direct the court security officer to invite
 21 the public to return.

22 (Proceedings unsealed.)

23 THE COURT: All right. We're unsealed at this
 24 time. You may proceed.

04:28PM 25 MR. CORDELL: Thank you, your Honor.

1 Q. Okay. Dr. Bokor, did EAG give you a report?

2 A. Yes, they did.

3 Q. Okay. Did you use that report as part of your
4 analysis?

04:29PM 5 A. Yes, I did.

6 Q. I've got to ask you this: Did you change any part
7 of their report?

8 A. No.

9 Q. On Slide -- DDX-160, we've got Page 19 of DTX-241.
04:29PM 10 Was DTX-241 your EAG report for the Shannon chip?

11 A. That sounds right.

12 Q. And we're going to try to go through this carefully,
13 but just to remind everybody, what -- the top line,
14 squiggly line up here which is purple, what element does
04:29PM 15 that represent?

16 A. That represents the silicon.

17 Q. Okay. And then I see this bright green down here.
18 Do I go up and look for the letter that corresponds to
19 that?

04:29PM 20 A. That's the nitrogen.

21 Q. Okay. And that's generally how these reports work;
22 is that fair?

23 A. Correct.

24 Q. Okay. Now, in order to make this a little clearer,
04:30PM 25 I've added some labels to the picture on the left. Can

1 you verify that I did these right? It's tungsten, then
2 titanium nitride, then titanium silicide, and then
3 silicon?

4 A. Correct.

04:30PM

5 Q. Okay. All right. So looking at this, were you able
6 to use the EAG report to -- as part of your opinion
7 about whether or not Samsung infringes?

8 A. I did.

04:30PM

9 Q. And what was your conclusion based on the EAG
10 testing data?

11 A. What I saw in the EAG testing data was that there
12 was no evidence for a layer of metal oxide or a layer of
13 semiconductor oxide at the contact interface in the
14 Samsung 14-nanometer FinFET process.

04:31PM

15 Q. All right. Now, I don't want to fool around with
16 this graph, but at the same time, I can't read it. So
17 would it be okay if I blew up the numbers here on the
18 chart?

19 A. I think that would help everybody.

04:31PM

20 Q. So I'm going to have Mr. Sayres already do this. So
21 can you verify that those numbers are the same numbers;
22 they're just bigger?

23 A. Yes.

04:31PM

24 Q. Okay. Made my day, because they are more readable;
25 is that fair?

1 A. The numbers, the same numbers, just they are in a
2 bigger font so we can all read them, yes.

3 The way we got those charts from EAG, they
4 had those really tiny numbers on them.

04:31PM

5 Q. Okay. So I'd like to go through this. And I had
6 Mr. Sayres animate this to help us explain this. So let
7 me start it, and it will go all the way through, and
8 then we'll come back, if that's okay.

9 A. Okay.

04:31PM

10 Q. Is that all right?

11 A. Yeah.

12 Q. All right. So there we go. So tell us why you put
13 a yellow bar on top of the arrow and a yellow bar moving
14 across the chart?

04:32PM

15 A. What I wanted to do was try to make it as clear as
16 possible because many people are not used to looking at
17 these kinds of scientific graphs. So I put this blue
18 arrow scanning up through the picture on the left, and I
19 put that yellow bar at the tip of the blue arrow to
20 indicate where, to help identify where in the picture
21 the data that's on the graph is coming from.

04:32PM

22 So as the blue arrow scans up, what we're
23 supposed to do is look along the horizontal direction of
24 the graph to see what the different atoms and what their
25 percentage is at that particular point where the tip of

04:32PM

1 the arrow is and where the yellow bar that's right at
2 the top of that arrow that corresponds to where the
3 yellow vertical bar is in the graph.

04:33PM 4 Q. Okay. Let's do that, and let's go through it a step
5 at a time. So I'm going to put it all the way to the
6 bottom, and the yellow bar is all the way to the left.
7 Is that all right?

8 A. Sure.

04:33PM 9 Q. All right. So I'm going to start it off and stop
10 it, okay? So tell us what's going on here.

11 A. So what we're doing now is the tip of the arrow is
12 right there. It's kind of right at the region where the
13 fin and the S/D, the mushroom, are joined. And in the
14 graph on the right, the vertical yellow bar is telling
04:33PM 15 us what was the concentration, or the atomic percent of
16 atoms, right along the horizontal yellow bar in the
17 picture in that vertical blue rectangle.

18 Q. Now, you used a funny word there, "Atomic percent."
19 What does that mean?

04:33PM 20 A. That's just the data that EAG was able to create for
21 me, and it tells, at that exact position in the picture,
22 what percentage of silicon, what percentage of nitrogen,
23 what percentage of oxygen, et cetera, they found exactly
24 at that point where the tip of the arrow is and that
04:34PM 25 horizontal yellow bar.

1 Q. So, for example, I guess, this top squiggly line,
2 that's the purple silicon; is that right?

3 A. That's the silicon.

4 Q. And that's somewhere about 95 percent?

04:34PM

5 A. Correct.

6 Q. And this bottom, sort of, pinkish line, that's the
7 oxygen?

8 A. That's the oxygen.

9 Q. And that's down around 5 percent?

04:34PM

10 A. Give or take.

11 Q. Can I go ahead and put labels on those so we can
12 quit looking back at the colors?

13 A. Yeah, that will help. Yes, that will help.

14 Q. All right. So if I advance the blue bar, what
15 happens next?

04:34PM

16 A. Okay. So now the blue bar's moved up a little
17 further, and the graph is now showing what the atomic
18 concentrations are right there where the horizontal
19 yellow bar is. Go over and look at the graph, and we
20 can see what the ingredients are right there at that
21 point in the picture.

04:35PM

22 Q. Well, I'm down still here in the middle of the
23 silicon, right?

24 A. That's right.

04:35PM

25 Q. But I see some oxygen. Why is that there?

1 A. So my interpretation of that is that there is no
2 oxygen in that silicon fin. That's very precisely known
3 that the silicon wafer that they started with is highly
4 purified. There's no oxygen there; we know that.

04:35PM

5 And where they grow that epi S/D, we also know
6 there's no oxygen there; that's very well studied and
7 very well understood.

04:36PM

8 The oxygen signal that we're seeing there is
9 coming from that contamination that I talked about that
10 happens because this sample has been exposed in the air,
11 so the oxygen is now coating the faces of that thin
12 sliver where the silicon was exposed.

13 Q. Okay. All right. Now, as that arrow moves up, what
14 happens next?

04:36PM

15 A. Well, the arrow is now crossed into the titanium
16 silicide layer, and sure enough, what you can see, if
17 you look at the graph right where the vertical yellow
18 bar is, the silicon has dropped down. That's the upper
19 purple, the lighter purple on the upper path has come
20 down to a little bit under 50 percent, and now we see
21 another line start to come up from nowhere, from zero.
22 That's the darker purple; that's the titanium.

04:36PM

23 The titanium has now come up to about 50
24 percent. So now we're -- I'm sorry, titanium and the
25 silicon. So we're at Ti silicide, and we've got equal

04:37PM

1 amount of titanium and silicon, very close to 50 percent
2 of each. That's the titanium silicide.

3 Q. And what was that green stuff that we saw back in
4 DTX-307 at that interface?

04:37PM 5 A. I'm sorry. Can we go back?

6 Q. Yeah, I should probably. Why don't I -- I'll use
7 PTX-594. Can you remind us what the engineers --

8 A. Oh, I see. You meant that green stuff?

9 Q. Yeah, yeah.

04:37PM 10 A. Well --

11 Q. Page 21 of 594 --

12 THE COURT: Let's talk one at a time,
13 gentlemen, please.

14 MR. CORDELL: My apologies.

04:37PM 15 THE WITNESS: Apologize.

16 Q. The green stuff on Page 21 of DTX-594, remind us of
17 what that material is, please.

18 A. That's the titanium silicide.

19 Q. And if that's titanium silicide, if I can go back to
04:37PM 20 the slides, and the arrow is in that region, what should
21 the chemical atomic percentages be at that point?

22 A. Should be pretty much 50 percent titanium and
23 50 percent silicon.

24 Q. And is that what the EAG data shows?

04:38PM 25 A. That is what it shows.

1 Q. Can I add a "titanium" label to that blank purple
2 line?

3 A. That would help.

04:38PM

4 Q. All right. So as I move the arrow up further, what
5 happens?

04:38PM

6 A. Well, now the arrow has moved into the region that's
7 labeled on the left in the picture, TiN, titanium
8 nitride. And sure enough, as we look now where that
9 vertical yellow bar is in the graph, you can see that
10 now a green line has jumped up. That, if you look over
11 on the right side there, that's the N; that's our
12 nitrogen, and it's jumped up to very close to 50.
13 Percent. The titanium is still pretty close to
14 50 percent. There's still a little bit of silicon
04:39PM 15 there, but it's mostly, primarily titanium nitride
16 because it's got titanium and nitrogen in it. So the
17 graph corresponds to the label in the micrograph on the
18 left.

19 Q. Can I add a label to that nitrogen curve?

04:39PM

20 A. Sure.

21 Q. And so if I had half -- roughly half nitrogen and
22 half titanium, I'm sorry, what layer does that tell me
23 I'm in?

24 A. That's titanium nitride.

04:39PM

25 Q. Okay. Now, in this case, we've been looking for

1 oxides, right?

2 A. Correct.

3 Q. And if I'm looking for an oxide, what percentage of
4 oxygen do I need to find with an element like silicon?

04:39PM 5 A. Should be at least 50 percent.

6 Q. I guess that depends a little bit on the flavor of
7 silicon oxide?

8 A. That's right. There is these, as they have been
9 called previously, flavors, different forms of silicon
10 oxide. One form of SiO , equal silicon and oxygen.

11 Another form is SiO_2 , so that's 66 percent oxygen,
12 two-thirds.

13 Q. So the minimum amount I've got to find is around
14 50 percent; is that right?

04:40PM 15 A. About, yes.

16 Q. Okay. So let's go back to our figure, and I'm going
17 to draw a 50 percent line across there. Now, does the
18 oxygen signal ever get anywhere close to that 50 percent
19 level, Dr. Bokor?

04:40PM 20 A. No. Just to remind you, the oxygen is that sort of
21 light pinkish line that's down very close to zero, bumps
22 around between a few percent and 5; once in a while, it
23 looks like it gets a little bit over 5 percent. That's
24 as high as it ever gets.

04:40PM 25 Q. So looking at the data from EAG, what material, in

1 your opinion, is it that creates that contact between
2 the metal and the semiconductor in the 14-nanometer
3 process?

04:41PM

4 A. Well, the EAG data confirms this picture, that on
5 top of the epi S/D, what you have is titanium silicide;
6 and on top of that, what you have is titanium nitride.

7 Q. All right. Now, the data you asked EAG to analyze,
8 I think you called it atomic percentage data; is that
9 right?

04:41PM

10 A. Yes.

11 Q. Okay. And did Dr. Piner present atomic percentage
12 data in his EAG analysis?

13 A. No.

04:41PM

14 Q. And I think you said a moment ago that we're kind of
15 concerned about whether we can find, for example, in
16 this region, half titanium and half nitrogen; is that
17 right?

18 A. Yes.

04:41PM

19 Q. And what role does the atomic percentage data play
20 in that kind of an analysis?

21 A. Well, it helps us to identify the actual chemical
22 composition, the real percentages of how much of each
23 element there are. If we're trying to confirm, for
24 example, in that region that what we have is a form of
25 silicon nitride with 50 percent silicon and 50 percent

04:42PM

1 nitrogen, then that's what this plot on the left helps
2 us to conclude.

3 MR. CORDELL: For the record, that's at about
4 the 52-nanometer spot on the --

04:42PM

5 A. We lost the big label.

6 Q. Yeah, DDX-177. I had to go back and look at it.

7 Now, Dr. Piner gave us a bunch of data, and I'm
8 not going to ask you to comment on his factoring here,
9 but let me ask you this, Dr. Bokor. When you look at

04:42PM

10 his line scans, the one I have on DDX-178, what is it
11 about his data that makes you think that maybe there's
12 something wrong with his oxygen scan?

13 A. Well, not -- I'm not exactly sure whether it's
14 wrong. It is what it is. You know, it's pretty -- it

04:43PM

15 kind of goes up and down, but I don't see it showing any
16 particularly strong information. It kind of goes up and
17 down more or less randomly, it seems to me.

18 Q. Is there any explanation as to why the oxygen

19 signal, whether it's multiplied or not, why the oxygen

04:43PM

20 signal is higher in this region, where it's supposed to
21 be semiconductor, than it is over here, where he says
22 you should have semiconductor oxide and titanium silicon
23 oxide?

24 A. Well, I think that what we're probably most -- what

04:43PM

25 we're probably looking at here is something that's

1 characteristic of that contamination effect I was
2 talking about.

3 Q. Okay. So from time to time, have you seen cases
4 where Samsung encounters some oxygen somewhere in their
5 parts?

04:44PM

6 A. Yes.

7 Q. And whenever Samsung finds oxygen around its
8 contact, what do they do?

9 A. All the documents that I saw that had anything to do
10 with oxygen in this region of the device identified it
11 as an issue that, one way or another, they at least
12 thought about or tried to figure out how to get rid of
13 it.

04:44PM

14 Q. Okay. Before I do that, let me ask you one other
15 question. Dr. Piner showed us some of these color maps.
16 Do you remember that?

04:44PM

17 A. Yeah.

18 Q. What do these color maps tell you?

19 A. So what the color map is is an effort to try to
20 communicate that, those signals, those atomic intensity
21 signals and show it to us not as a line graph but as an
22 image.

04:44PM

23 Q. And does that tell you what concentration of the
24 elements that you are looking at?

04:45PM

25 A. Well, it doesn't tell you the exact concentration.

1 It just sort of tells you what it -- how it varies
2 across the area that we're looking at, but it's kind of
3 just an arb -- sort of arbitrary. It's kind of like
4 those arbitrary units we've heard about.

04:45PM

5 Q. Did you rely on color maps as part of your atomic
6 percentage analysis?

7 A. No.

8 Q. So let's go back to the oxygen.

04:45PM

9 MR. CORDELL: And, your Honor, I'd ask that we
10 close the courtroom for this portion.

11 THE COURT: All right. Based on Counsel's
12 request, I'll order the courtroom sealed. Anyone
13 present, not subject to the protective order in this
14 case, should exit the courtroom and remain outside until
15 it's reopened.

04:45PM

16 [REDACTED]
17 [REDACTED]
18 [REDACTED]
19 [REDACTED] [REDACTED] [REDACTED]
20 [REDACTED] [REDACTED]
21 [REDACTED] [REDACTED]
22 [REDACTED] [REDACTED]
23 [REDACTED] [REDACTED]
24 [REDACTED] [REDACTED]
25 [REDACTED] [REDACTED]

04:46PM

04:46PM

1 THE COURT: All right. I'll order the
2 courtroom unsealed. I'll direct the court security
3 officer to invite the public to return.

4 (Proceedings unsealed.)

05:09PM

5 THE COURT: Ladies and gentlemen, we're going
6 to take a very short recess. If you'll simply leave
7 your notebooks in your chairs, follow all the
8 instructions I've given you, and I hope to have you back
9 in here shortly.

05:09PM

10 The jury's excused for recess at this time.

11 (Whereupon, the jurors exit the courtroom.)

12 THE COURT: Let me see Mr. Cordell, Mr. McKeon,
13 Ms. Smith, Mr. Fowler, along with Mr. Dixon, Mr. Hueston
14 and Ms. Rayburn in chambers.

05:09PM

15 Court stands in recess.

16 (Recess from 5:09 p.m. to 5:20 p.m.)

17 THE COURT: Let's bring in the jury, please.

18 (Whereupon, the jurors enter the courtroom.)

05:20PM

19 THE COURT: Please be seated. Ladies and
20 gentlemen, as you're aware, the Defendant has just
21 passed the witness, the witness being Dr. Jeffrey Bokor,
22 the Defendants' technical expert.

05:21PM

23 We would ordinarily move to cross-examination
24 by the Plaintiff now, but I'm told -- and the reason I
25 sent you out for recess is so I could consult with

1 counsel, and I'm told cross-examination is over an hour,
2 so we're going to stop for the day right now and pick up
3 with cross-examination first thing in the morning of
4 Dr. Bokor by the Plaintiff.

05:21PM

5 Sorry to get you out just to bring you back in,
6 but with the COVID situation, I don't get to bring the
7 lawyers up to the bench and have a quick conversation
8 with them. I have to send you out before I can talk to
9 them, and that just takes time.

05:21PM

10 If you-all will plan your evening and your
11 travel tomorrow morning so that you can be back,
12 assembled and ready to go by 8:30 as usual, I'd
13 appreciate it. Please follow all the instructions I've
14 given you about your conduct throughout the trial, of
05:21PM 15 course, including but not limited to not discussing the
16 case with anyone in any way. Have a good evening,
17 travel safe, and the jury's excused until tomorrow
18 morning.

19 (Whereupon, the jurors exit the courtroom.)

05:22PM

20 THE COURT: All right. Be seated.

21 Counsel, is there anything that needs to be
22 raised with the Court before we recess for the evening?

23 MR. DIXON: Not that Acorn's aware of, your
24 Honor.

05:22PM

25 THE COURT: How about from the Defendants?

1 MR. CORDELL: Not from Defendants, your Honor.
2 Thank you.

05:22PM

3 THE COURT: All right. I'll remind you to
4 continue your efforts to meet and confer and to minimize
5 any overnight disputes. I assume you are still talking
6 among yourselves about the issue we took up this morning
7 regarding opening the door to a limine issue?

8 MR. DIXON: We are, your Honor.

05:22PM

9 THE COURT: Well, I'll be available in the
10 morning by 7:30 if we need to continue that discussion
11 or take up other matters.

12 All right. We will stand in recess until
13 tomorrow morning.

05:23PM

14 (Proceedings adjourned for the day at
15 5:23 p.m.)

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CERTIFICATE OF OFFICIAL REPORTER

I, Dana Hayden, Deputy Official Realtime Court Reporter, in and for the United States District Court for the Eastern District of Texas, do hereby certify that pursuant to Section 753, Title 28, United States Code that the foregoing is a true and correct transcript of the stenographically reported proceedings held in the above-entitled matter and that the transcript page format is in conformance with the regulations of the Judicial Conference of the United States.

Dated this 17th of May, 2021.



Dana Hayden, CCR, RMR, CRR, CRC
Federal Deputy Court Reporter