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UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE PATENT TRIAL AND APPEAL BOARD
APTIV SERVICES US, LLC,) Case No. IPR2024-00646
)
Petitioner,)
)
vs.)
)
MICROCHIP TECHNOLOGY INC.,)
)
Patent Owner.)
_____)

VIDEOTAPED DEPOSITION OF GREG TAYLOR
Menlo Park, California
Thursday, March 27, 2025

REPORTED BY: Derek L. Hoagland
CSR No. 13445

1 UNITED STATES PATENT AND TRADEMARK OFFICE 2 BEFORE THE PATENT TRIAL AND APPEAL BOARD 3 APTIV SERVICES US, LLC,) Case No. IPR2024-00646 4) 4 Petitioner,) 5) 5 vs.) 6) 6 Microchip TECHNOLOGY INC.,) 7) 7 Patent Owner.) _____) 8 9 10 11 Videotaped Deposition of GREG TAYLOR, taken before Derek 12 L. Hoagland, a Certified Shorthand Reporter for the 13 State of California, commencing at 9:18 a.m., Thursday, 14 March 27, 2025, at Orrick Herrington & Sutcliffe, 15 1000 Marsh Road, Menlo Park, California 94025. 16 17 18 19 20 21 22 23 24 25 Page 2	1 I N D E X 2 WITNESS PAGE 3 GREG TAYLOR 4 Examination by Mr. Liu 7 5 Examination by Mr. Jensen 105 6 7 QUESTIONS WITH INSTRUCTIONS NOT TO ANSWER 8 PAGE LINE 19 5 20 2 9 10 11 E X H I B I T S 12 EXHIBIT DESCRIPTION MARKED 13 Exhibit 1 US Patent IPR2024-00646 9 14 Exhibit 2 LM2990 58 15 Exhibit 3 LM78xxAB, L78MccAC 75 16 Exhibit 4 TC1300 85 17 18 19 20 21 22 23 24 25 Page 4
1 APPEARANCES: 2 3 COUNSEL FOR PETITIONER MORRISON FOERSTER 4 755 Page Mill Road Palo Alto, California 94304-1018 5 BY: STEPHEN J. H. LIU, ESQ. 6 650.813.6493 7 sliu@mofo.com 7 -- AND -- 8 MORRISON FOERSTER 707 Wilshire Boulevard 9 Los Angeles, California 90017 BY: ALEX YAP, ESQ. (Remote Appearance) 10 213.892.5688 ayap@mofo.com 11 COUNSEL FOR PATENT OWNER 12 Orrick Herrington & Sutcliffe 1000 Marsh Road 13 Menlo Park, California 94025 BY: TRAVIS JENSEN, ESQ. 14 tjensen@orrick.com 15 16 ALSO PRESENT MICHAEL CHEN, PHD 17 REILLY LEET, VIDEOGRAPHER 18 19 20 21 22 23 24 25 Page 3	1 9:18 A.M. P R O C E E D I N G S 2 09:18:41 3 THE VIDEOGRAPHER: All right. Good morning. We 09:18:41 4 are going on the record at 9:18 a.m. on 09:18:45 5 March 27th, 2025. Please note that the microphones are 09:18:51 6 sensitive and may pick up whispering and private 09:18:54 7 conversations. Please mute your phones at this time. 09:18:57 8 Audio and video recording will continue to take place 09:19:02 9 unless all parties agree to go off the record. 09:19:05 10 This is media unit 1 of the video-recorded 09:19:09 11 deposition of Dr. Greg Taylor taken by counsel for 09:19:12 12 petitioner in the matter of Aptive Services US LLC 09:19:18 13 Versus Microchip Technology, Inc., filed in the 09:19:24 14 United States Patent and Trademark Office before the 09:19:30 15 Patent Trial and Appeal Board, inter Partes Review 09:19:33 16 Number IPR2024-00646. The location of the deposition is 09:19:38 17 1000 Marsh Road, Menlo Park, California 94025. 09:19:49 18 My name is Reilly Leet, representing Veritext 09:19:57 19 Legal Solutions, and I am the videographer. I'm not 09:20:01 20 related to any party in this action, nor am I 09:20:04 21 financially interested in the outcome. 09:20:07 22 Counsel and all present will now state their 09:20:10 23 appearances and affiliations for the record, beginning 09:20:12 24 with the noticing attorney. 09:20:15 25 MR. LIU: Stephen Liu from Morrison Foerster on 09:20:17 Page 5

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1 behalf of Petitioner Aptive. And with me here today is 09:20:20 2 petitioner's expert, Dr. Chen. 09:20:25 3 MR. JENSEN: This is Travis Jensen from Orrick 09:20:27 4 Herrington & Sutcliffe on behalf of patent owner 09:20:32 5 Microchip Technology, Inc. 09:20:36 6 THE VIDEOGRAPHER: Thank you. Will the court 09:20:37 7 reporter please introduce yourself and administer the 09:20:40 8 oath to the witness. And then counsel may proceed. 09:20:42 9 THE REPORTER: Yes. My name is Derek Hoagland, 09:20:44 10 and my CSR is 13445. 09:20:46 11 (Whereupon, the deponent is duly sworn by the 09:21:01 12 court reporter.) 09:21:04 13 THE REPORTER: May we go off the record? 09:21:04 14 THE VIDEOGRAPHER: Going off the record. The 09:21:07 15 time is 9:21 a.m. 09:21:09 16 (A recess transpires.) 09:24:30 17 THE VIDEOGRAPHER: Going back on the record. 09:45:55 18 The time is 9:46 a.m. 09:46:05 19 MR. JENSEN: Yeah, and I wanted to mention one 09:46:08 20 thing that we brought up during the break, which is that 09:46:10 21 Dr. Taylor has an insulin pump that may, you know, beep 09:46:16 22 or flash a message on his watch from time to time, and 09:46:19 23 that's simply his insulin pump. There is no 09:46:23 24 communication going on between, you know, me and the 09:46:26 25 witness if that -- if that happens. 09:46:28 Page 6	1 A. I am running a consulting business, yes. 09:47:16 2 Q. And 25, 30 years ago, you would have -- would 09:47:17 3 you have been at Intel? 09:47:22 4 A. I was a manager at Intel and it was a human 09:47:23 5 resources lawsuit. It was not a patent case. 09:47:27 6 Q. Okay. So -- and no tech involved? 09:47:28 7 A. No tech -- well, none of this tech was involved 09:47:31 8 and the issues were not technology based. 09:47:35 9 Q. Okay. And was it just one deposition? 09:47:37 10 A. It was just one deposition. 09:47:40 11 Q. And I understand you've served as an expert in 09:47:41 12 some previous matters. Right? 09:47:51 13 A. That is correct. 09:47:53 14 Q. So I will ask about those in a second, but I 09:47:53 15 noticed you have a document in front of you. 09:47:56 16 A. I do. 09:47:59 17 Q. Can you explain what that is? 09:47:59 18 A. So this is my deposition. It's a relatively 09:48:00 19 clean copy. There are three typos that I annotated in 09:48:05 20 it. 09:48:11 21 Q. Okay. And I -- you said "deposition," but I 09:48:11 22 think you meant your declaration? 09:48:16 23 A. I meant my declaration. I'm sorry. 09:48:17 24 Q. And it was submitted as Exhibit 2021 to this 09:48:19 25 proceeding? 09:48:22 Page 8
1 MR. LIU: Okay. Thank you. 09:46:29 2 And on that note, Dr. Taylor, I should first 09:46:33 3 say, good morning. 09:46:36 4 THE DEPONENT: Good morning. 09:46:37 5 MR. LIU: Thanks for sitting for this 09:46:38 6 deposition. 09:46:39 7 8 GREG TAYLOR, 9 having first been duly sworn, 10 was examined and testified as follows: 11 12 EXAMINATION 09:46:39 13 BY MR. LIU: 09:46:39 14 Q. Just on that note, is there any medications 09:46:40 15 you're on or any other factors that might affect your 09:46:45 16 testimony today? 09:46:49 17 A. No. 09:46:49 18 Q. And you understand you are under oath? 09:46:50 19 A. I understand that I am under oath. 09:46:55 20 Q. Have you been deposed before? 09:46:59 21 A. Yes. 09:47:00 22 Q. How long ago was that? 09:47:01 23 A. 25, 30 years. 09:47:04 24 Q. Okay. So that was -- right now you're -- are 09:47:07 25 you running a consulting business or? 09:47:14 Page 7	1 A. It is Exhibit 2021, yes. 09:48:22 2 Q. Can you walk us through what the three typos you 09:48:24 3 mentioned are? 09:48:30 4 A. So the first one is in paragraph 84. 09:48:30 5 Q. Actually, I'm sorry. 09:48:37 6 MR. LIU: Can we first mark Dr. Taylor's copy of 09:48:39 7 his declaration as Exhibit 1? 09:48:44 8 (Exhibit No. 1 marked for identification.) 09:48:45 9 THE REPORTER: So marked. Go ahead. 09:49:10 10 MR. LIU: Thank you. 09:49:11 11 BY MR. LIU: 09:49:11 12 Q. So you were mentioning paragraph 84? 09:49:12 13 A. Paragraph 84, page 45, there's text that says: 09:49:14 14 "Error: Reference source not found." 09:49:19 15 In the Word document I reviewed, that is a 09:49:22 16 reference to paragraph 70. 09:49:27 17 BY MR. LIU: 09:49:28 18 Q. Okay. 09:49:28 19 A. Somehow in the PDF version, it got changed. 09:49:28 20 Q. Okay. 09:49:32 21 A. And in the next paragraph, paragraph 85, there 09:49:33 22 is a reference to, again, it says: 09:49:38 23 "Error: Reference source not found." 09:49:41 24 It should have been paragraph 69 to 71. 09:49:43 25 Q. Okay. 09:49:46 Page 9

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1 A. And the third one is -- I believe it's paragraph 09:49:52 2 107 on page 63, and again it's -- the text says: 09:49:56 3 "Error: Reference source not found." 09:50:05 4 The actual reference is to paragraphs 77 through 09:50:08 5 81. 09:50:12 6 Q. Okay. Thanks. So other than those three 09:50:15 7 corrections? 09:50:19 8 A. Other than those three corrections, it's a clean 09:50:21 9 copy. 09:50:24 10 Q. Okay. So when I reference your -- your 09:50:24 11 declaration, and I may ask you to reference yours, you 09:50:33 12 will be looking at that copy that's, you know, exactly 09:50:37 13 what was submitted, other than -- are they hand 09:50:41 14 corrections? 09:50:45 15 A. Those are Post-It Notes. 09:50:45 16 Q. So other than Post-It Note corrections to 09:50:46 17 those -- those broken paragraph numbers? 09:50:49 18 A. Yeah. 09:50:51 19 Q. Okay. So -- and we were just talking about your 09:50:52 20 previous expert work, and I noticed that you list some 09:50:59 21 matters under paragraph 3 of the declaration. 09:51:06 22 Do you see that? 09:51:06 23 A. I see that, yes. 09:51:13 24 Q. And you have noted: 09:51:14 25 "During the past five years, I submitted 09:51:17 Page 10	1 Q. So you list four IPR matters in this paragraph, 09:52:36 2 correct? 09:52:45 3 A. Mm-hmm. 09:52:45 4 Q. Three. I believe the first one, IPR2021-01531 09:52:45 5 was a matter between Mercedes Benz and Arigna. Does 09:52:55 6 that sound right? 09:52:55 7 A. I recognize Arigna. I don't know who the 09:53:04 8 counterparty was. 09:53:06 9 Q. Okay. Do you recall a patent that was called 09:53:07 10 "circuit and method for adjusting an offset output 09:53:13 11 current for an input current amplifier"? 09:53:16 12 A. That sounds familiar, yes. 09:53:19 13 Q. Did you submit a declaration in that proceeding? 09:53:20 14 A. I believe I did. 09:53:24 15 Q. Okay. And as we discussed before, you didn't 09:53:26 16 provide any testimony? 09:53:31 17 A. I did not provide any testimony. 09:53:31 18 Q. Do you recall whether that case had anything to 09:53:33 19 do with voltage regulators? 09:53:38 20 A. I don't believe voltage regulators were 09:53:41 21 explicitly a part of that case. 09:53:46 22 Q. And why do you specify explicitly? 09:53:48 23 A. All of these analog circuits depend on voltage 09:53:51 24 regulators for their correct operation in some other 09:53:56 25 way, provide -- providing power supplies, but the matter 09:53:59 Page 12
1 declarations in the following matters, but otherwise 09:51:20 2 have not testified in any cases." 09:51:22 3 Right? 09:51:23 4 A. That is correct. 09:51:24 5 Q. And so this is covering the past five years as 09:51:24 6 of the date you submitted this declaration? 09:51:30 7 A. Yes, it is. 09:51:34 8 Q. Is there any other expert work you've done 09:51:35 9 that's not shown -- that's not listed here? 09:51:41 10 A. I have done expert work. I consult, and I do 09:51:43 11 not strictly do patent work. 09:51:50 12 Q. I will be more precise, yeah. 09:51:51 13 So is there any -- are there any other legal 09:51:54 14 matters in which you have served as an expert that are 09:51:59 15 not identified in this paragraph? 09:52:02 16 A. There is one other matter that is not and was 09:52:03 17 not a court case, and I was asked to be confidential 09:52:09 18 with respect to that, to not -- 09:52:14 19 Q. Okay. Was it an arbitration? 09:52:16 20 A. It was an arbitration. 09:52:19 21 Q. And how long ago was that? 09:52:20 22 A. It spanned probably close to two years, ended, I 09:52:22 23 don't know, three months ago. 09:52:30 24 Q. Okay. And did you testify in the arbitration? 09:52:32 25 A. I did not testify. 09:52:35 Page 11	1 in question basically abstracts that and assumes you've 09:54:03 2 got a good voltage power supply coming in. 09:54:07 3 Q. So you don't recall voltage regulators ever 09:54:10 4 being expressly discussed -- 09:54:16 5 A. I don't recall that. 09:54:20 6 Q. -- in that proceeding? 09:54:21 7 A. No. 09:54:22 8 Q. Next one, you've listed IPR2022-00481. Do you 09:54:23 9 recall that being a matter between BMW and Arigna? 09:54:31 10 A. Again, Arigna, I recognize. 09:54:35 11 Q. And in both of these, you were -- you served as 09:54:38 12 an expert for Arigna? 09:54:43 13 A. That is correct. 09:54:45 14 Q. Do you recall that proceeding relating to a 09:54:45 15 patent called "level shifter"? 09:54:49 16 A. I remember one of them involving a level 09:54:50 17 shifter, yes. 09:54:56 18 Q. What is a level shifter? 09:54:56 19 A. It's a term that covers a lot of area, and 09:54:57 20 analogs, the basic concept is you're trying to move a 09:55:05 21 signal from one voltage range to another voltage range. 09:55:09 22 Both digital and analog guys use the same terminology, 09:55:14 23 but they mean different circuits. But the general 09:55:19 24 concept is, I'm trying to shift the voltage without 09:55:21 25 losing the information content. 09:55:24 Page 13

1 Q. And the definition you just gave with the 09:55:26	1 A. I think all three of them were, yes. 09:58:38
2 explanation you just gave, was that what was at issue in 09:55:33	2 Q. And did you provide declarations in those 09:58:44
3 IPR2022-00481? 09:55:39	3 proceedings? 09:58:50
4 A. It's been a while, and so which specific one, 09:55:42	4 A. I provided declarations in two of them. I don't 09:58:50
5 you know, cir -- but I believe this was -- had to do 09:55:53	5 think I did a third. 09:58:55
6 with a multistage level shifter rather than a 09:55:56	6 Q. Okay. Do you recall whether those proceedings 09:58:58
7 single-stage level shifter. 09:56:01	7 involved three of the same patents as the IPR 09:59:02
8 Q. Do you recall voltage regulators being relevant 09:56:06	8 proceedings that you listed above? 09:59:07
9 to that proceeding? 09:56:09	9 A. I'm not certain. I believe two of them 09:59:08
10 A. Again, voltages are a key part of the 09:56:10	10 overlapped with the IPRs, and one did not. 09:59:13
11 litigation. Voltage regulators were not the center of 09:56:17	11 Q. Okay. Besides patent owner Microchip and 09:59:17
12 the circuit, but they were peripheral actors. They were 09:56:20	12 Arigna, and not counting the arbitration, have you 09:59:24
13 not part of the discussions that I remember. 09:56:24	13 served as a -- an expert in any -- on behalf of any 09:59:29
14 Q. Next, you list IPR2022-00285. Do you see that? 09:56:26	14 other party in a legal proceeding? 09:59:34
15 A. I do see that. 09:56:33	15 A. No. 09:59:36
16 Q. And my understanding is that that was a 09:56:34	16 Q. And we skipped over the first bullet, but it 09:59:36
17 proceeding between Unified Patents and Arigna. 09:56:39	17 says: 09:59:41
18 Do you recall that? 09:56:39	18 "The co-pending district court litigation 09:59:41
19 A. I worked on several for Arigna, yes. 09:56:45	19 between the same parties"? 09:59:43
20 Q. The patent there was called "semiconductor 09:56:50	20 A. Mm-hmm. 09:59:45
21 device with a voltage-detecting device to prevent 09:56:52	21 Q. What exactly do you mean by the co-pending 09:59:46
22 shoot-through phenomenon in first and second 09:56:56	22 district court litigation? 09:59:50
23 complementary switching devices." 09:57:00	23 A. There's a litigation over the claims 09:59:51
24 Does that sound familiar? 09:57:01	24 construction in this patent and another one that was 10:00:00
25 A. The title sounds familiar. It was not the most 09:57:03	25 held in front of the district court. 10:00:05
Page 14	Page 16
1 descriptive patent title I've ever run across, and I'm 09:57:07	1 Q. And you submitted declarations in support of 10:00:06
2 trying to place exactly what it was. But, yeah. 09:57:13	2 microchip's position on claim construction in that 10:00:11
3 Q. Okay. What about the next, IPR2023-00453, do 09:57:15	3 proceeding, correct? 10:00:14
4 you recall that being a case between Apple and Arigna? 09:57:26	4 A. I submitted declarations in that -- 10:00:15
5 A. I know one of the cases was between those two 09:57:29	5 Q. And there -- 10:00:18
6 parties, yes. 09:57:34	6 A. -- proceeding. 10:00:19
7 Q. And the patent there was called "semiconductor 09:57:34	7 Q. -- are two declarations that were -- 10:00:20
8 device which realizes a short circuit protection 09:57:37	8 A. There were two, yes. There's a declaration and 10:00:22
9 function without shock resistor in semiconductor device 09:57:40	9 a late-found mistake that resulted in a correction and a 10:00:26
10 module." 09:57:45	10 second declaration. 10:00:31
11 Does that sound familiar to you? 09:57:45	11 Q. Okay. I'm sorry. What do you mean by 10:00:31
12 A. It does sound familiar. 09:57:46	12 late-found mistake? 10:00:33
13 Q. Did that case involve voltage regulators? 09:57:48	13 A. The -- we found a mistake the day after the 10:00:34
14 A. Again, I don't recall explicit discussion of 09:57:52	14 declaration was submitted that actually, to be perfectly 10:00:42
15 voltage regulators. I'm a little fuzzy on exactly what 09:57:59	15 honest, the expert on the other side raised a question 10:00:47
16 the issues were there. 09:58:03	16 that -- about an interpretation and it -- he was 10:00:53
17 Q. Okay. So you -- I'll restart my question. 09:58:04	17 pointing to a mistake that I had made, and I didn't see 10:00:58
18 So just to confirm, in none of these IPRs, you 09:58:10	18 that until after submitting the declaration, and so I 10:01:02
19 provided live testimony? 09:58:20	19 corrected the wording. 10:01:06
20 A. That's correct. 09:58:22	20 Q. Do you recall what the mistake was? 10:01:07
21 Q. And but you did submit reports in each of them, 09:58:22	21 A. No, I do not. 10:01:08
22 or declarations in each of them? 09:58:27	22 Q. So I -- so you're refer -- are you referring to 10:01:09
23 A. I did submit declarations. 09:58:29	23 two different versions you submitted of essentially the 10:01:15
24 Q. And then were the three ex parte reexaminations 09:58:32	24 same declaration, just with the correction? 10:01:18
25 listed in paragraph 3 also on behalf of Arigna? 09:58:36	25 A. Where there was a small correction in there -- 10:01:20
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1 well, there was a correction. Whether someone 10:01:22	1 that were leading to that. 10:04:20
2 considered it small or not, I suppose is up to them. 10:01:25	2 MR. JENSEN: Yeah, I'm going to object this is 10:04:21
3 Q. Do you -- and you don't recall submitting a 10:01:28	3 calling for privileged information. 10:04:22
4 second declaration that was sometime later? 10:01:31	4 Don't answer. 10:04:24
5 A. No. And now I think about, the dates were a 10:01:35	5 It's not in his declaration. You can ask him 10:04:24
6 month apart or something. I'm -- but, yeah, there were 10:01:40	6 about the declaration you're here to depose him on, but 10:04:27
7 two declarations I had -- but there was a correction in 10:01:43	7 trying to explore, you know, district court infringement 10:04:30
8 there as well. I don't know if that was the second one 10:01:46	8 issues and any work he may have done on that is clearly 10:04:34
9 or -- I'm a little confused on that at this point. 10:01:48	9 privileged. 10:04:37
10 Q. Yeah, I'm referring to, like, they wouldn't 10:01:52	10 BY MR. LIU: 10:04:38
11 share the same paragraph text, like it would be -- 10:01:55	11 Q. Are you following your attorney's instruction? 10:04:39
12 A. Okay. 10:01:58	12 A. I will follow his instruction. 10:04:41
13 Q. -- a different document, not correcting the 10:01:58	13 Q. Do the positions that -- I'm sorry. I will 10:04:43
14 first, but -- 10:02:02	14 restart. 10:05:02
15 A. I would -- I believe that there were two 10:02:03	15 You've provided certain opinions in your 10:05:02
16 separate ones and a correction to the first one. 10:02:07	16 declaration that support claim construction or claim 10:05:15
17 Q. Okay. Have you been involved with other 10:02:10	17 interpretation positions that patent owner has taken in 10:05:19
18 portions of the district court litigation besides claim 10:02:15	18 its patent owner's response. Is that right? 10:05:24
19 construction? 10:02:18	19 A. So I -- in my declaration, I supported some of 10:05:27
20 A. No. 10:02:19	20 the claim construction terms that were advocated by 10:05:34
21 Q. All right. So you haven't, for example, 10:02:19	21 Microchip, yes. 10:05:39
22 reviewed Microchip's infringement contentions in that 10:02:24	22 Q. And I just want to be clear. I'm not taking 10:05:39
23 proceeding? 10:02:27	23 about this inter partes review proceeding. 10:05:43
24 MR. JENSEN: I will say object to form and 10:02:28	24 A. No, in the district court. 10:05:48
25 object on the grounds of privilege. Asking what he's 10:02:31	25 Q. Okay. Okay. 10:05:49
Page 18	Page 20
1 done in the other litigation, I think, raises questions 10:02:35	1 A. And the declaration refers to some of those 10:05:50
2 about attorney-client privileged information. 10:02:37	2 interpretations. 10:05:53
3 MR. LIU: Are you instructing him not to answer 10:02:42	3 Q. I will restate my question. 10:05:54
4 the question? 10:02:44	4 In the declaration that's in front of you now -- 10:05:55
5 MR. JENSEN: I will instruct him not to answer, 10:02:45	5 A. Mm-hmm. 10:05:59
6 to make it easy. 10:02:46	6 Q. -- that you submitted in this inter partes 10:06:00
7 BY MR. LIU: 10:02:48	7 review proceeding, you -- do you provide certain 10:06:03
8 Q. Are you're following your attorney's advice? 10:02:48	8 opinions that support claim construction positions that 10:06:08
9 A. I am following my attorney's advice, yes. 10:02:50	9 patent owner Microchip has taken in this inter partes 10:06:10
10 Q. Are you aware of any infringement positions that 10:03:16	10 review proceeding? 10:06:14
11 Microchip has taken in the district court litigation? 10:03:20	11 A. There are -- there's a section in here on claims 10:06:15
12 MR. JENSEN: Object to form. 10:03:22	12 construction, yes. 10:06:24
13 THE DEPONENT: I know that there are 10:03:23	13 Q. Have you ever viewed the patent owner's 10:06:24
14 infringement positions. 10:03:30	14 response? 10:06:30
15 BY MR. LIU: 10:03:33	15 A. To the district court? To the -- 10:06:30
16 Q. Do you know what those positions are, or have an 10:03:33	16 Q. No. So -- so the cover page of your declaration 10:06:32
17 understanding of what they are? 10:03:36	17 says "Declaration of Dr. Greg Taylor in Support of 10:06:35
18 A. I have seen them. I don't know if I saw final 10:03:37	18 Patent Owner's Response," right? 10:06:38
19 versions that were submitted, but. 10:03:44	19 A. Mm-hmm. 10:06:40
20 Q. What do you mean by -- by then? When you say 10:03:50	20 Q. So I'm referring to that patent owner's 10:06:40
21 you've seen them, what do you mean? 10:03:53	21 response? 10:06:44
22 A. I've seen documents that were leading to that. 10:03:54	22 A. Oh. 10:06:44
23 I don't know if I saw the final versions or not. I saw 10:04:01	23 Q. Have you reviewed that? 10:06:45
24 attorney-client work product, I guess it would be. 10:04:09	24 A. I have seen it. 10:06:46
25 Q. I'm a little unclear what you mean by documents 10:04:11	25 Q. And do you agree with the claim construction 10:06:47
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1 positions taken in that document? 10:06:50 2 MR. JENSEN: I object to form. 10:06:52 3 THE DEPONENT: I would have to look at it and -- 10:06:53 4 and see. 10:06:59 5 BY MR. LIU: 10:07:01 6 Q. Okay. Let's look at paragraph 4 of your 10:07:30 7 declaration. 10:07:32 8 A. Mm-hmm. 10:07:32 9 Q. And just for clarity's sake, whenever I refer to 10:07:33 10 declaration during this deposition and I don't specify 10:07:39 11 that it's a declaration other than the one in front of 10:07:43 12 you, it -- I'm talking about, you know, Exhibit 2021 10:07:46 13 that you submitted for this inter partes review 10:07:53 14 proceeding. 10:07:57 15 A. I understand. 10:07:57 16 Q. So at paragraph 4, you mentioned that when you 10:07:57 17 were an employee of Bipolar Integrated Technology, you 10:08:08 18 helped develop the world's only formal verification tool 10:08:14 19 for bipolar circuits. 10:08:17 20 Do you see that? 10:08:18 21 A. I see that. 10:08:19 22 Q. Can you explain a little bit what that formal 10:08:19 23 verification tool for bipolar circuits was? 10:08:25 24 A. So at the time, bipolar technology was 10:08:27 25 delivering emitter-coupled logic circuits. They 10:08:32 Page 22	1 Q. And did that formal verification tool or 10:10:25 2 developing that formal verification tool involve voltage 10:10:32 3 regulators? 10:10:34 4 A. It did not. It involved voltages, but not the 10:10:35 5 creation of voltage regulators. 10:10:40 6 Q. In paragraph 6 on the next page, you note that 10:10:41 7 you were -- so I think now you're talking about your 10:10:56 8 time at Intel. Is that correct? 10:10:59 9 A. This is at Intel, yes. 10:11:01 10 Q. And you note that when you were at Intel, your 10:11:03 11 team successfully developed a 100-megahertz on-chip 10:11:07 12 switching regulator technology that took a high-voltage 10:11:11 13 input supply twice what any transistor on the chip could 10:11:15 14 survive and delivered a high-efficiency, clean, 10:11:19 15 low-voltage output without using any board-level passive 10:11:23 16 components. 10:11:26 17 Do you see that? 10:11:26 18 A. I do see that. 10:11:26 19 Q. Why do you highlight this particular achievement 10:11:27 20 in paragraph 6? 10:11:34 21 A. It was a significant achievement. It's in the 10:11:35 22 realm of voltage regulation. This is -- there's a 10:11:40 23 20-year span between the two achievements you just 10:11:47 24 outlined, and I started my career very much working on 10:11:50 25 logic and architecture and moved towards circuits 10:11:57 Page 24
1 actually had built a chip, and it almost worked. There 10:08:44 2 was one gate in it where the gate was supposed to be an 10:08:51 3 AND gate and it wasn't, and they discovered this about a 10:08:55 4 week before I showed up to work. And so the problem I 10:08:58 5 was faced with was, how do you determine whether the 10:09:02 6 circuits, the emitter-coupled logic circuits, match the 10:09:08 7 logic that they supposedly implement. 10:09:12 8 And the technique they were using at the time 10:09:15 9 was, you run simulations, but if you have complex 10:09:16 10 circuits, if you've got 20 inputs, you've got a million 10:09:22 11 combinations to test. Simulation just can't do that. 10:09:25 12 With formal verification, you extract mathematically 10:09:29 13 Boolean algebra, the function, the function from the 10:09:35 14 circuits, the function from the logic description, and 10:09:38 15 see do they match or not match. In CMOS, this is, and 10:09:43 16 even at the time was, a fairly well-used technique. But 10:09:47 17 an emitter-coupled logic, nobody had, to my knowledge, 10:09:53 18 even attempted this approach and ultimately was 10:09:57 19 successful and avoided a lot of errors. 10:09:59 20 Q. And is this a technique that you use with 10:10:04 21 physical chips, or is it still done on the computer? 10:10:06 22 A. This is done on the design database. So it's a 10:10:09 23 pre-tape-out, pre-manufacturing check you run to make 10:10:15 24 sure that the chip you have designed is the chip you 10:10:18 25 intended to design. 10:10:23 Page 23	1 throughout that time. In this case, switching 10:12:01 2 regulators were 100-kilohertz circuits that were on 10:12:06 3 boards and they were huge and were an essential part of 10:12:12 4 these systems. So going from 100 kilohertz to 10:12:14 5 100 megahertz was a very dramatic shift. It brought the 10:12:22 6 regulator much closure to the chip. It improved the 10:12:24 7 quality of regulation. It improved the efficiency of 10:12:28 8 the overall system. 10:12:30 9 Q. This -- 10:12:30 10 A. And this is the way it's done now. 10:12:31 11 Q. Does the 2008 to 2011 timeframe sound right for 10:12:33 12 when you were developing this technology? 10:12:37 13 A. It sounds right. 2008 is when I switched from a 10:12:41 14 very product focus to Intel Labs, and this originally 10:12:48 15 started in Intel Labs. 10:12:51 16 Q. And at the end of your declaration is actually 10:12:53 17 your CV, right? 10:12:55 18 A. Yes. 10:12:56 19 Q. Starting at page -- at least according to the 10:13:02 20 stamps, page 89? 10:13:05 21 A. Yes, it looks like it starts on page 89. 10:13:07 22 Q. And on page 90, which is, I guess, the actual 10:13:16 23 first page of your CV, you identified a period from 2008 10:13:20 24 to 2011 you were director of the circuit research lab at 10:13:27 25 Intel, correct? 10:13:30 Page 25

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1 A. In Intel Labs, yes. 10:13:32 2 Q. And that's the same -- that's what you're 10:13:33 3 referencing in paragraph 6 when you say you were leading 10:13:40 4 the circuit research lab? 10:13:42 5 A. That is the same circuit research lab, yes. The 10:13:45 6 voltage regulator work was not the only work done in 10:13:49 7 that lab. 10:13:53 8 Q. Is that -- you mentioned, I think, that before 10:13:53 9 you worked on this technology, the regulators are 10:14:04 10 running at 100 kilohertz? 10:14:08 11 A. The switching regulators. 10:14:11 12 Q. Switching regulators. So that's a 1,000-volt 10:14:12 13 improvement, right? 10:14:23 14 A. It's a 1,000-fold increase. 10:14:25 15 Q. Increase? 10:14:27 16 A. Depending on what your goals are, you might view 10:14:28 17 it as improvement, you might not. 10:14:30 18 Q. Mm-hmm. In the next sentence, you mention your 10:14:32 19 team also worked on LDO regulators producing reference 10:14:45 20 17 of Al-Shyukh, his only reference with the figure of 10:14:50 21 merit close to his own. 10:14:53 22 Do you see that? 10:14:53 23 A. I do see that. 10:14:55 24 Q. Was that in 2005? 10:14:56 25 A. So the -- that was the team did that work. At 10:14:59 Page 26	1 small steps here. And so this was a very large jump all 10:17:14 2 at once because in order to go to those frequencies, you 10:17:18 3 needed to use very high-frequency components. 10:17:24 4 Microprocessors have those in abundance. Most 10:17:28 5 processors used on those versions of switching 10:17:31 6 regulators do not. And so this was a very non-linear 10:17:37 7 change. This was not simple. If you looked at the 10:17:42 8 trend line over the previous decade, you would have 10:17:44 9 gotten there at that time. This was dramatically ahead 10:17:47 10 of that. 10:17:49 11 Q. Is there any relation between the 100-megahertz 10:17:50 12 on-chip switching regulator you describe in this 10:18:00 13 paragraph and the LDO regulators that you describe in 10:18:04 14 the -- that next sentence? 10:18:08 15 A. Any relation. I mean, they're both used for 10:18:13 16 voltage regulation. There's fairly little overlap 10:18:15 17 inside the circuits themselves. There were some efforts 10:18:21 18 to hybrid the two, but they're fairly disconnected. 10:18:26 19 Q. Were they -- were they both intended for the 10:18:34 20 same chip or line of chips? 10:18:39 21 A. So both of these when developed were developed 10:18:43 22 as research projects. There was not a specific product 10:18:51 23 in mind. The work was actually introduced on different 10:18:56 24 products, but also introduced at different times. 10:18:59 25 Q. Do you know why they were not used on the same 10:19:04 Page 28
1 that point in time, I was not their manager, but I was 10:15:08 2 someone they worked with to make sure their work was 10:15:12 3 aligned with what the products needed. 10:15:14 4 Q. And the reference 17 you're referring to, does 10:15:16 5 2005 sound like the right publication year for that? 10:15:24 6 A. Well, it's listed here towards the back. 2005 10:15:31 7 seems about right. 90 nanometers. 10:15:40 8 Q. Is there a reason why, you know, you go out of 10:15:43 9 chronological order here and you list the 2008 to '11 10:15:56 10 achievement before the 2005 one? 10:16:02 11 A. I have a 30-year career here, and I'm not 10:16:08 12 necessarily strictly in chronological order. It's as 10:16:10 13 things come to mind. 10:16:15 14 Q. How quickly was the switching regulator 10:16:16 15 technology changing at the time you were working on the 10:16:24 16 100 megahertz? 10:16:28 17 A. So prior to that regulator switching tech -- 10:16:31 18 switching regulators, I'm sure they were evolving, but 10:16:36 19 they were very much a board-level structure. They 10:16:42 20 required physically large inductors, physically large 10:16:46 21 capacitors. And so one of the reasons to go to high 10:16:51 22 frequencies is the component sizes can become 10:16:57 23 equivalently smaller, and that enables you to integrate 10:17:02 24 the entire thing in the package. 10:17:08 25 So it's all tied together. You can't take these 10:17:11 Page 27	1 product? 10:19:16 2 A. They were developed at different times. 10:19:17 3 Q. Okay. And just to clarify, the -- you mentioned 10:19:18 4 that they were both eventually used in different 10:19:31 5 products, right? 10:19:35 6 A. They were introduced in different products, one 10:19:35 7 first, one second. 10:19:41 8 Q. And those two products were not part of the same 10:19:42 9 line or family? 10:19:46 10 A. No. They were different vintages. Could they 10:19:49 11 both have been on the same project? It may have been. 10:19:54 12 Q. In paragraph 8, as just the -- it's the only 10:19:57 13 paragraph under the compensation section. You're being 10:20:13 14 compensated at your usual hourly rate for your work on 10:20:16 15 this case? 10:20:18 16 A. Mm-hmm. 10:20:19 17 Q. Do you know what that rate is? 10:20:19 18 A. Yes, I know how much I get paid. 10:20:24 19 Q. Yeah. What is it? 10:20:25 20 A. I'm charging \$400 per hour. 10:20:27 21 Q. Do you have a sense of how much time you've 10:20:29 22 billed to this case? 10:20:35 23 MR. JENSEN: Object to form. 10:20:38 24 THE DEPONENT: I'm not sure what you mean by 10:20:39 25 this case. 10:20:42 Page 29

1 BY MR. LIU: 10:20:46 2 Q. I guess I'm referring to what you mean this 10:20:46 3 case. 10:20:51 4 A. Well, if this case is the IPR, right, I do have 10:20:51 5 an idea, not terribly precise, but, you know, 100 hours. 10:20:55 6 Could be half, could be twice that. 10:21:01 7 Q. And was most of that time -- I'll restart. 10:21:03 8 Do you know how much of those -- and I won't 10:21:10 9 hold you to exactly 100 hours, but roughly 100 hours was 10:21:13 10 spent in preparing this -- the declaration that's in 10:21:17 11 front of you? 10:21:26 12 A. Most of that time went into preparing the 10:21:26 13 declaration, and that was the main involvement I had in 10:21:30 14 the IPR. 10:21:37 15 Q. When did you first review the petition in this 10:21:55 16 IPR? 10:21:57 17 A. I don't recall precisely when. 10:21:58 18 Q. Do you recall whether it was this year? 10:22:06 19 A. 2025. No. I'm confident it was earlier than 10:22:12 20 that. It was somewhere in 2024. 10:22:16 21 Q. Do you recall whether it was before when this 10:22:18 22 IPR was instituted? 10:22:27 23 A. I don't know when the IPR was instituted, so I 10:22:27 24 have a hard time answering that. 10:22:32 25 Q. I'm sorry. I'm just going to grab a date for 10:22:34 Page 30	1 additional power states have been added to systems." 10:25:06 2 And then you say: 10:25:08 3 "Sometimes these are explicitly visible to the 10:25:09 4 user, e.g., the sleep and hibernate states supported by 10:25:11 5 many computers. More often, they're present but 10:25:20 6 invisible to the user. 10:25:23 7 Do you see that? 10:25:23 8 A. I do see that. 10:25:25 9 Q. What do you mean by sleep and hibernate states? 10:25:25 10 A. The -- it looks like you have a Windows computer 10:25:28 11 in front of you. It supports sleep and hibernate 10:25:32 12 states, and they are different power states that are 10:25:36 13 available in the machine. They have different power 10:25:39 14 levels and they have different wake-up times. 10:25:43 15 Q. So are they the same thing, sleep and hibernate? 10:25:48 16 A. They are not the same thing. They are two 10:25:52 17 different states. 10:25:54 18 Q. What's the difference? 10:25:55 19 A. In sleep, the processor is stopped, but the 10:25:56 20 image -- the contents of memory are retained. And since 10:26:03 21 it's in dynamic random access memory, there's some power 10:26:08 22 consumed in retaining it. In hibernate, all of that 10:26:11 23 content is pushed out to your permanent storage, either 10:26:16 24 a hard drive or a solid state drive, and all power is 10:26:20 25 shut off. But in either case, it wakes up looking 10:26:23 Page 32
1 you. 10:22:34 2 Have you read the decision on Institution? 10:23:04 3 A. Well, perhaps relevance. That is when I first 10:23:06 4 was involved. I was presented with Dr. Chen's 10:23:10 5 declaration. 10:23:15 6 Does that answer your question as to was it 10:23:16 7 after or before institution? 10:23:19 8 Q. Unfortunately, no, but -- so I believe it was 10:23:24 9 September 25th, 2024, was the institution decisions. Do 10:23:35 10 you recall whether it was -- I will -- 10:23:39 11 A. It could well have been in that timeframe. I -- 10:23:42 12 I don't know. 10:23:45 13 Q. So the first document submitted by petitioner in 10:23:45 14 this IPR that you reviewed was Dr. Chen's declaration? 10:23:55 15 A. No. What I said was, when I was first involved, 10:23:59 16 I was presented with Dr. Chen's declaration. 10:24:03 17 Q. Can we go to paragraph 42? It's under a section 10:24:07 18 heading Power Management. 10:24:47 19 Do you see that? 10:24:47 20 A. I do see that. 10:24:48 21 Q. And in paragraph 42, the second sentence, you 10:24:49 22 note -- I will start with the first sentence. You say: 10:24:53 23 "For some systems, on and off are the only power 10:24:57 24 states. But as energy efficiency and the use of 10:24:59 25 batteries to power systems have become more common, 10:25:02 Page 31	1 pretty much like it looked when you put it to sleep. 10:26:28 2 Q. Both sleep and hibernate states are -- I think 10:26:30 3 you were alluding to this, but they're things that are 10:26:41 4 observable to the user, right? 10:26:45 5 A. They are observable to the user, yes. And, in 10:26:46 6 fact, you have settings that allow you to enable and 10:26:49 7 disable them and use them. 10:26:52 8 Q. And that's why you say that these are explicitly 10:26:53 9 visible to the user? 10:27:00 10 A. That is why I say that, yes. 10:27:01 11 Q. And you also allude to states that are present 10:27:04 12 but invisible to the user, right? 10:27:16 13 A. There are also those states, yes. 10:27:18 14 Q. All right. And then you give an example, which 10:27:20 15 is auto halt capability that was integrated into Intel 10:27:25 16 processors in the 1990s, where the CPU clock would stop 10:27:29 17 whenever the CPU would become idle, often between 10:27:33 18 keystrokes while the user typed, but be capable of 10:27:36 19 restarting in a small fraction of a microsecond, right? 10:27:39 20 A. Yes. 10:27:42 21 Q. Are there other invisible states you can think 10:27:46 22 of? 10:27:50 23 A. There are other invisible states. Auto hold is 10:27:54 24 the last one I was explicitly involved in, and I know 10:27:57 25 there are others, but I can't enumerate them for you. 10:28:00 Page 33

1 Q. What other invisible states were you involved 10:28:08 2 with? 10:28:10 3 A. Probably just auto halt. 10:28:10 4 Q. Are there any examples, like just one other 10:28:15 5 example you can think of? 10:28:28 6 A. Well, if you compare, many people think of ARM 10:28:37 7 processors as being very low power versus the Windows 10:28:41 8 Intel ecosystem. They come from fundamentally different 10:28:45 9 backgrounds. In Windows, there's this 1970s paradigm 10:28:51 10 that everything is always available all the time. ARM 10:28:56 11 is a somewhat later development and it assumes that when 10:29:01 12 you want new resources, you will go and ask for them, 10:29:04 13 and you will release them when you're done. And so this 10:29:07 14 means there are states embedded therein that changes the 10:29:11 15 behavior of the system, makes it easier to deliver lower 10:29:17 16 power, by that system having these hidden states. I 10:29:20 17 have never worked on them, but I know they are there. 10:29:24 18 Q. Was auto halt integrated into all Intel 10:29:26 19 processors in the early 1990s? 10:29:40 20 A. Auto halt was introduced into P54C, the second 10:29:42 21 generation Pentium product in -- before 1995 and was 10:29:50 22 introduced into all processors sub -- subsequent to 10:29:58 23 that. It resulted in something like a 90 percent 10:30:03 24 reduction in power for no noticeable user impact, so it 10:30:05 25 was significant. 10:30:12 Page 34	1 system? 10:32:10 2 A. The response to someone striking a key is fairly 10:32:10 3 long in computer terms, and that was significant because 10:32:20 4 it was possible for the operating system to show that 10:32:25 5 response in spite of having been halted and restarted. 10:32:29 6 User expectations were met, and that's essentially why 10:32:36 7 this was viewed as invisible. Other responses to things 10:32:40 8 demand much more timely responses, if a disk drive says 10:32:46 9 I've got data available, if, you know, there are 10:32:52 10 features in the UBS interface that have very strict 10:32:56 11 timelines and that constrains what can be done. And in 10:32:58 12 later non-invisible power management features I worked 10:33:05 13 on, that was critical. 10:33:11 14 Q. So here when you say the user typing on the 10:33:24 15 keyboard, are you referring back to paragraph 42 where 10:33:27 16 you say the CPU became idle often between keystrokes 10:33:30 17 while the user typed? 10:33:35 18 A. Yes. It's the same feature set. 10:33:36 19 Q. Can you clarify what you mean by external events 10:33:38 20 in the -- that last sentence of paragraph 43? 10:33:57 21 A. So the optimization that is happening in 10:34:03 22 paragraph 43 was done within the CPU, the central 10:34:05 23 processing unit, and so there are events in a system 10:34:10 24 that happen that are not inherently inside the CPU. 10:34:15 25 Some are typing on a keyboard, a device plugged into the 10:34:20 Page 36
1 Q. And did the auto halt capability affect the 10:30:12 2 voltage regulators in the processors? 10:30:21 3 A. As implemented, auto halt did not affect voltage 10:30:24 4 regulators. Other power states do. And they are -- 10:30:34 5 there's a gray line here. They're semi visible. 10:30:38 6 Q. So the function you describe here where the CPU 10:30:41 7 clock would stop whenever the CPU became idle, you're 10:30:49 8 not saying that's something the Intel voltage regulators 10:30:52 9 were -- I'm sorry. I'll rephrase. 10:30:56 10 That wasn't causing the Intel voltage regulators 10:31:03 11 to stop, right? 10:31:05 12 A. It did not shut down the voltage regulators. 10:31:06 13 That would have made for a slower startup and not been 10:31:10 14 invisible. 10:31:16 15 Q. In the next paragraph, paragraph 43, do you see 10:31:34 16 the last sentence? You say: 10:31:40 17 "Responding to external events, the user typing 10:31:42 18 on the keyboard, a device needing attention to input or 10:31:45 19 output data were significantly slower than the operating 10:31:49 20 system and could be handled without needing to make the 10:31:53 21 user or device aware that auto halt was saving power." 10:31:55 22 Do you see that? 10:31:58 23 A. I do see that. 10:31:59 24 Q. Why do you say that responding to external 10:32:00 25 events were significantly slower than the operating 10:32:07 Page 35	1 computer says, here I am. Anything external to the chip 10:34:23 2 was an external event. It was not under the control of 10:34:29 3 the designers of the chip. 10:34:32 4 Q. Would -- let's say if my computer enters sleep 10:34:36 5 mode and then I press a key to wake it back up. Would 10:34:43 6 that be an external event? 10:34:47 7 A. That would be an external event, yes. 10:34:48 8 Q. And on paragraph 46, now we're in a section 10:34:50 9 called Biocircuits. 10:35:21 10 A. Mm-hmm. 10:35:23 11 Q. You provide a dictionary definition for biasing? 10:35:23 12 THE REPORTER: Sing, S-i-n-g? 10:35:34 13 MR. LIU: Yeah, like bias, i-n-g. 10:35:35 14 THE DEPONENT: This is the definition from the 10:35:40 15 LaPlante Electrical Engineering Dictionary. 10:35:43 16 BY MR. LIU: 10:35:45 17 Q. And that definition reads: 10:35:45 18 "Biassing, the technique of applying a direct 10:35:48 19 current voltage to a transistor or an active network to 10:35:50 20 establish the desired operating point." 10:35:54 21 Right? 10:35:56 22 A. I see that. 10:35:57 23 Q. What -- what does direct current voltage mean 10:35:57 24 here? 10:36:05 25 A. Direct current, as opposed to alternating 10:36:05 Page 37

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1 current, direct current is a steady, stable, in this 10:36:09 2 case voltage. Alternating would be like the power 10:36:14 3 coming out of the wall socket that is continuously 10:36:17 4 varying. And this explicitly says voltage. 10:36:21 5 Q. Can you explain why you clarified that this 10:36:33 6 explicitly says voltage? 10:36:43 7 A. Because you specified direct current voltage and 10:36:44 8 I realized I only responded to the direct current 10:36:47 9 portion of your question. 10:36:49 10 Q. So -- 10:36:51 11 A. You can have a DC voltage. You can have a DC 10:36:57 12 current. It just sounds redundant when you say direct 10:37:00 13 current current. 10:37:05 14 Q. So biasing has to be a DC voltage specifically? 10:37:06 15 A. This -- this definition says voltage, but no. 10:37:10 16 Biasing can be currents or voltages. 10:37:13 17 Q. Okay. 10:37:15 18 A. But the intent is still -- the biasing is done 10:37:21 19 to make sure a transistor or the active network of a 10:37:24 20 circuit is at a desired operating point. 10:37:28 21 Q. And I think you described or defined operating 10:37:31 22 point in the next paragraph. So if we could look at 10:37:36 23 that, you note that: 10:37:39 24 "When analyzing and designing a circuit, it's 10:37:47 25 easier to consider linear operations, so engineers will 10:37:48 Page 38	1 A. If the voltage increases -- 10:39:08 2 Q. Yes. 10:39:09 3 A. -- a lot. 10:39:09 4 You're saying on the far right-hand side of the 10:39:10 5 figure. 10:39:13 6 Q. Yeah. Then we'll no longer be at the same 10:39:13 7 operating point, right? 10:39:16 8 A. That's a fair statement, yes. 10:39:18 9 Q. And is this -- is the blue curve meant to be 10:39:20 10 part of a parabola? 10:39:26 11 A. So if you look at the ideal behavior of a 10:39:29 12 transistor in the domain, yes, it's a squared law 10:39:34 13 function. 10:39:38 14 Q. And you give that square law function in 10:39:39 15 paragraph 47, right, the equation I_{DS} equals K times 10:39:41 16 $(V_{GS} - V_T)$ squared? 10:39:50 17 A. That's correct. 10:39:54 18 Q. In the sentence where you give that square law, 10:39:55 19 you note that this is the saturation current? 10:40:09 20 A. This is the saturation current, yes. 10:40:15 21 Q. And what does saturation current mean? 10:40:17 22 A. So transistors can operate in one of several 10:40:20 23 states, one of which is saturation. In saturation, you 10:40:25 24 have a -- the V_{GS} minus V_T is greater than zero, or V_{GS} 10:40:33 25 is greater than V_T, and the philosophy of the carriers 10:40:41 Page 40
1 consider an operating point," which is the orange dot 10:37:50 2 shown in Figure 1 included under this paragraph, "and 10:37:54 3 linearize the system, assume that it is operating along 10:38:00 4 the orange line rather than the blue curve." 10:38:04 5 Do you see that? 10:38:04 6 A. I do see that. 10:38:06 7 Q. So is an operating point a specific current and 10:38:07 8 voltage? 10:38:17 9 MR. JENSEN: Object to form. 10:38:18 10 THE DEPONENT: So the word "operating point" 10:38:19 11 here is referring to a specific current than voltage, 10:38:23 12 but it's -- it's not a statement that the circuit 10:38:28 13 operates only at that exact voltage and current, but 10:38:31 14 rather that it operates close to that and you're looking 10:38:34 15 at what -- how does it behave when you're close to that 10:38:39 16 operating point. 10:38:43 17 BY MR. LIU: 10:38:43 18 Q. And that's what you mean by linearizing the 10:38:43 19 system? 10:38:46 20 A. Essentially. 10:38:46 21 Q. So, for example, if the voltage were -- and now 10:38:48 22 I'm referring to the figure where you show the orange 10:38:54 23 line and the blue curve. 10:38:56 24 If the voltage were to, let's say, be at -- on 10:38:58 25 the right-hand -- the far right-hand side of the figure. 10:39:05 Page 39	1 saturate, and you follow this law. If you're operating 10:40:46 2 at lower voltages, you get a different response. 10:40:49 3 I'm sorry. And the -- the drain to source 10:41:00 4 voltage affects whether you're in saturation or not, if 10:41:02 5 the drain to source is greater than the gate to source 10:41:05 6 minus V_T. 10:41:09 7 Q. So it -- would that mean the square law 10:41:10 8 relationship only applies above the voltage where you 10:41:16 9 would consider the transistor to be saturated? 10:41:25 10 A. This applies when you're saturated and this 10:41:28 11 applies to an ideal model of a transistor. All 10:41:31 12 transistors are not necessarily ideal, but it's a good 10:41:36 13 approximation. 10:41:41 14 Q. And you said the -- did you say velocity of the 10:41:41 15 carriers saturate? I'm trying to -- it says velocity, 10:42:00 16 and I don't think that's what you said? 10:42:05 17 A. Oh, velocity. Speed. 10:42:06 18 Q. Okay. Yeah. What does it mean for the velocity 10:42:08 19 to saturate? 10:42:12 20 A. When carriers, electrons and holes, inside a 10:42:12 21 transistor experience an electric field, they move. And 10:42:21 22 free electrons and holes have some freedom to move. As 10:42:28 23 the electric field goes up, they move faster, but they 10:42:32 24 also bump into atoms along the way. And so at some 10:42:37 25 point, you're bumping into atoms often enough, you don't 10:42:40 Page 41

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1 make them go any faster. 10:42:43 2 Q. And is that velocity directly related to the 10:42:45 3 current through the transistor? 10:42:53 4 A. No. 10:42:54 5 Q. So what's the -- is there -- 10:42:55 6 A. It's related to the electric field in the region 10:42:58 7 in which they are going and the -- the mean free path, 10:43:02 8 the average distance that an electron travels before 10:43:08 9 bumping into the atom in the lattice. 10:43:12 10 Q. I will -- I should rephrase my question, so -- 10:43:15 11 because I understand an electric current to involve 10:43:21 12 electrons moving. 10:43:25 13 A. Yeah. 10:43:26 14 Q. Is that movement different from this mean free 10:43:26 15 path movement you're referring to? 10:43:31 16 A. They are different attributes of the current 10:43:33 17 movement. The other thing is, when you're talking about 10:43:36 18 current in a macroscopic sense, it doesn't really make 10:43:41 19 sense to talk about the velocity of the current. It's 10:43:44 20 when you're looking at the microscopic, the quantum 10:43:49 21 mechanical view, that you look at that. But it's not 10:43:52 22 something you can discover with your volt meter, your 10:43:56 23 ammeter. 10:44:00 24 Q. For purposes of your opinions in this -- in your 10:44:00 25 declaration you've -- you've assumed that that square 10:44:11 Page 42	1 exist. 10:45:29 2 BY MR. LIU: 10:45:30 3 Q. Why have you applied this model as opposed to 10:45:34 4 one of the other models you just mentioned? 10:45:36 5 A. It's straightforward, it's simple, it's very 10:45:41 6 usable, and it's relatively accurate. 10:45:45 7 Q. In the next paragraph, paragraph 48, you 10:45:49 8 describe Figure 2, which you've included in this 10:46:02 9 paragraph, and you say: 10:46:06 10 "It shows an example of an NMOS source follower, 10:46:08 11 which is a simple transconductance amplifier biased by a 10:46:13 12 current source connected to the transistor source 10:46:17 13 terminal." 10:46:19 14 Do you see that? 10:46:19 15 A. I see those words, and on the next page there's 10:46:20 16 a figure, yes. 10:46:23 17 Q. What is -- what is a source follower? 10:46:23 18 A. So a follower in -- in this terminology is a 10:46:29 19 level shifter, something we alluded to much, much 10:46:39 20 earlier. But it changes the level of a signal. It 10:46:42 21 changes the voltages through which a signal operates. 10:46:47 22 And in a follower, it also buffers the signal, I'll say, 10:46:50 23 in that if you have higher loading on the output, the 10:46:56 24 input doesn't necessarily suffer from all of the ill 10:47:01 25 effects of that loading. So it is both a level shifter 10:47:05 Page 44
1 law relationship shown in paragraph 47 applies to the 10:44:13 2 transistors you analyzed, correct? 10:44:19 3 A. I've -- 10:44:23 4 MR. JENSEN: Object to form. 10:44:24 5 THE DEPONENT: My assumption is that the 10:44:25 6 transistors are operating in the saturation regime and 10:44:27 7 the design is designed to keep them in that regime and 10:44:34 8 they approximately follow this law. 10:44:37 9 BY MR. LIU: 10:44:39 10 Q. There isn't some other law that you've applied 10:44:42 11 somewhere in your declaration, right? 10:44:45 12 MR. JENSEN: Objection to form. 10:44:47 13 THE DEPONENT: There are many design principles 10:44:47 14 that I have applied in my declaration, not all of them 10:44:54 15 related to transistors. 10:44:57 16 BY MR. LIU: 10:44:59 17 Q. Yeah. I'll be more specific. There isn't a 10:45:00 18 different law giving the relationship between the 10:45:01 19 current through an ideal MOSFET and its gate-to-source 10:45:06 20 voltage that you've applied in your declaration, 10:45:12 21 correct? 10:45:14 22 MR. JENSEN: Objection to form. 10:45:15 23 THE DEPONENT: So I have not applied a different 10:45:19 24 than square law model to the saturation behavior of a 10:45:21 25 transistor in the declaration, though such models do 10:45:23 Page 43	1 and a buffer. And that's true whether it's a source 10:47:10 2 follower or an emitter follower. 10:47:23 3 Q. And is emitter follower, that's -- that would be 10:47:25 4 a type of bi -- 10:47:28 5 A. Bipolar. 10:47:29 6 Q. -- polar? 10:47:31 7 And you mentioned that it buffers the signal in 10:47:37 8 that if you have a higher loading on the output, the 10:47:43 9 input doesn't necessarily suffer from all of the ill 10:47:46 10 effects of that loading, and I wanted to ask, what do 10:47:49 11 you mean by the ill effects of that loading? 10:47:52 12 A. If you have some signal source and you put more 10:47:54 13 loading, a large capacitor on it, in general, it tends 10:48:01 14 to slow down the rate at which the signal transitions. 10:48:04 15 If you put this buffer in between the input signal, it 10:48:09 16 is not as affected by the increase in loading by the 10:48:14 17 output signal as if it were directly loaded, and so, 10:48:18 18 ultimately, this can help you deliver the signal more 10:48:24 19 quickly. 10:48:26 20 Q. So in the second sentence to this paragraph 48, 10:48:26 21 you say: 10:48:42 22 "Here the NMOS transistor provides the path from 10:48:42 23 input in to output out while the current source ensures 10:48:46 24 that the DC current flowing through the source follower 10:48:49 25 is at an appropriate level." 10:48:52 Page 45

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1 Do you see that? 10:48:53 2 A. I do see that. 10:48:54 3 Q. What do you mean by appropriate level? 10:48:55 4 A. When designing this circuit, the engineer has 10:48:57 5 some operating point in mind, and you want to make sure 10:49:04 6 you're operating at that point. As I say, there is a 10:49:12 7 level shift between input and output. If you look back 10:49:15 8 at Figure 1, you can see that as the current varies, the 10:49:18 9 voltage gate to source minus VT varies. Most likely 10:49:23 10 the -- whoever is designing this circuit has a voltage 10:49:30 11 in mind by which they're shifting the signal. You have 10:49:32 12 to pick the right current to get the right voltage. If 10:49:36 13 you don't pay attention to the current, then you're not 10:49:43 14 paying attention to the voltage. 10:49:46 15 Q. Oh. So is that what you mean in the first 10:49:47 16 sentence by the phrase biased by a current source, the 10:49:55 17 NMOS source follower is biased by a current source? 10:50:00 18 A. What I'm saying is that the source of the NMOS 10:50:03 19 transistor is tied to a current source, the intent being 10:50:06 20 that the transistor operates at that current. So this 10:50:11 21 works best if the output is a purely capacitive output, 10:50:17 22 so there is no DC current going into the occupant, all 10:50:21 23 the DC, all the steady-state current, flows through the 10:50:24 24 follower. 10:50:29 25 Q. Okay. So in the third and fourth -- fourth 10:50:29 Page 46	1 the intended -- or the intention of the person designing 10:51:57 2 a circuit. There may be cases where it is intended, but 10:52:02 3 you're not really operating as a source follower in that 10:52:04 4 case. 10:52:08 5 BY MR. LIU: 10:52:11 6 Q. And that's why you -- you bias the source 10:52:12 7 follower with a current source connected to the 10:52:17 8 transistor's source terminal? 10:52:20 9 A. Yes. That gives you a predictable operating 10:52:22 10 point for the transistor. 10:52:27 11 Q. How do you decide what operating point you want 10:52:29 12 to use? What would that depend on? 10:52:33 13 A. It's very context dependent. For example, 10:52:36 14 there's rarely one source follower in an entire circuit. 10:52:45 15 There are usually other things it's interacting with. 10:52:49 16 If you have multiple followers and you want them to 10:52:52 17 cause the same shift in voltage, you need to make sure 10:52:56 18 they have -- are operating with the same VGS. Easiest 10:52:59 19 way to do that is make the transistors identical and 10:53:04 20 make the currents identical. But there are other 10:53:06 21 reasons as well. 10:53:13 22 Q. Can you explain a little bit more about -- you 10:53:22 23 described the source follower as a level shift er. Can 10:54:00 24 you explain how -- how it shifts the level? 10:54:07 25 A. Well, if you look at the voltage on in and the 10:54:12 Page 48
1 sentences, you go on to say: 10:50:35 2 "This is important because the transconductance 10:50:39 3 GM of the source follower is proportional to the current 10:50:42 4 flowing through it. If this current source is removed 10:50:45 5 from the circuit and N is stable, not changing, then 10:50:47 6 voltage out will rise until the current and the 10:50:52 7 source" -- I think you meant follower -- "shuts off, 10:50:55 8 reducing GM to zero, almost certainly not the intended 10:50:58 9 transconductance. 10:51:04 10 Do you see that? 10:51:04 11 A. I do see that. 10:51:05 12 Q. Can you explain that last sentence, why -- you 10:51:05 13 know, what the mechanism you're describing in that 10:51:11 14 sentence is? 10:51:13 15 MR. JENSEN: Object to form. 10:51:15 16 THE DEPONENT: So if there is no current source 10:51:16 17 in a circuit, if all I have is a transistor and a 10:51:20 18 capacitor hanging off of it, then let's say the signal 10:51:25 19 rises, the input signal rises. The source follower will 10:51:29 20 conduct current. That current will flow through the 10:51:34 21 capacitor and it will charge up. If you remain in that 10:51:37 22 state, the capacitor will continue charging until the 10:51:40 23 current and the source follower shuts off. At that 10:51:43 24 point, GM drops to zero. So the instantaneous response 10:51:48 25 at that point is rather slow, and that is unlikely to be 10:51:52 Page 47	1 voltage on out at any given point in time, they are 10:54:17 2 different. So it's shifting level. If the current 10:54:23 3 through the transistor is constant, then the VGS will be 10:54:25 4 constant in the steady state and the amount of the shift 10:54:30 5 will be constant, so out will tend to stay the same 10:54:32 6 distance away from in. 10:54:36 7 Q. So in a steady state, you have a constant 10:54:38 8 voltage shift? 10:54:41 9 A. In the steady state, you -- yeah, if you 10:54:42 10 maintain the current constant, the temperature con -- 10:54:46 11 yes, you undergo the steady offset. 10:54:49 12 Q. And what exactly do you mean by steady state? 10:54:55 13 A. By steady state, I mean when things are not 10:55:00 14 changing. So I say there's no DC current going into a 10:55:07 15 capacitive load, and there isn't. But if I were to 10:55:10 16 change the voltage, it requires current to change the 10:55:14 17 voltage of the load. That means that although I have a 10:55:18 18 current source that is constant, when things are 10:55:24 19 changing, when the input voltage is slowing up or 10:55:26 20 slowing down, some of the current is diverted, charging 10:55:29 21 the load. And in that case, the current through the 10:55:32 22 transistor is not absolutely precisely equal to the 10:55:38 23 current and the current source at all times. It's only 10:55:41 24 when things are not moving that the -- those currents 10:55:44 25 are -- are the same. 10:55:48 Page 49

1 Q. Would another way to describe it be, if you let 10:55:49 2 the circuits sit for a long time, until it settles, that 10:56:01 3 that would be the steady state? 10:56:05 4 A. That is -- steady state is a technical term in 10:56:07 5 this case, saying, yes, when you let things settle, when 10:56:12 6 you let things stop changing, it takes time before you 10:56:18 7 reach the steady state because there may be delays in 10:56:21 8 things responding. But yes, if all of the inputs of a 10:56:24 9 circuit stop changing and you wait an appropriate amount 10:56:27 10 of time, you achieve the steady state. 10:56:30 11 Q. At the end of this section on bias circuits, so 10:56:32 12 this would be paragraph 52, you -- in the last sentence, 10:56:48 13 you say: 10:56:59 14 "Shutting off a reference generation circuit is 10:56:59 15 not the same thing as shutting off the bias distribution 10:57:02 16 within an amplifier." 10:57:05 17 And I wanted to ask, what do you mean by bias 10:57:09 18 distribution within an amplifier? 10:57:14 19 A. Well, if I look at Figure 2, I have a source 10:57:15 20 follower, presumably a component with an amplifier 10:57:25 21 somewhere, and to org -- to bias that transistor to have 10:57:31 22 it operate at the correct operating point, I need to 10:57:37 23 deliver the right bias current. There's a path that 10:57:39 24 goes from somewhere. You're probably generating a 10:57:44 25 reference, a voltage or current reference. If the 10:57:47 Page 50	1 worried about how well does your regulator reject 10:59:51 2 variation on that input power supply voltage. So if 10:59:55 3 you're doing that kind of analysis, it is not staying 10:59:58 4 constant. But to the first order, we tend to assume 11:00:01 5 that's a relatively constant power supply. 11:00:05 6 Q. At the end of the paragraph, you note that: 11:00:09 7 "The use of an external reference voltage allows 11:00:12 8 the design of regulators to have variable or 11:00:16 9 controllable outputs, and also allows a single reference 11:00:20 10 generator to drive multiple voltage regulators." 11:00:23 11 Do you see that? 11:00:23 12 A. I do see that. 11:00:27 13 Q. Why would you have multiple voltage regulators? 11:00:27 14 A. Many systems have multiple voltages. 11:00:30 15 Q. What do you mean by that? 11:00:40 16 A. They have more than one voltage. Not every 11:00:41 17 system operates from a single power supply to a single 11:00:47 18 ground. Some of them have more than one. In fact, most 11:00:50 19 of them have more than one. 11:00:53 20 Q. And you're saying here, you could use the same 11:01:09 21 external voltage reference to drive each of those 11:01:11 22 multiple voltage regulators? 11:01:14 23 A. Yes. 11:01:17 24 Q. In the next paragraph, do you see the third 11:01:18 25 sentence, where you say: 11:01:40 Page 52
1 voltage reference, maybe you use a resister to convert 10:57:52 2 it to a current later. You have to deliver that 10:57:55 3 reference to the actual active device, the source 10:57:57 4 follower in this case. So there is both generation and 10:58:01 5 distribution of bias voltages that has to be understood 10:58:08 6 to make things work correctly. 10:58:15 7 Q. Paragraph 53. So now we are in section called 10:58:16 8 "Voltage Regulators." 10:58:40 9 A. Mm-hmm. 10:58:44 10 Q. Starting on the top of the next page, do you see 10:58:45 11 the sentence beginning "Each voltage regulator"? 10:58:47 12 A. Yes. 10:58:52 13 Q. And you say -- you describe an input power 10:58:53 14 supply voltage. Where does that voltage come from? 10:58:56 15 A. Somewhere that is external to the regulator. It 10:59:01 16 can be coming from, you know, a wall plug, another 10:59:10 17 regulator, a switcher. But whenever you're describing 10:59:16 18 something, you have some external environment you're 10:59:21 19 working in, that is part of the external environment 10:59:23 20 you're working in. 10:59:26 21 Q. And does that stay constant? 10:59:27 22 A. For some definition of that word, yes. In the 10:59:35 23 reality, when you're designing a voltage regulator, you 10:59:42 24 tend -- whether you're looking at line regulation or 10:59:45 25 load regulation, you're -- in line regulation, you're 10:59:48 Page 51	1 "The excess voltage or the amount that the power 11:01:41 2 supply voltage exceeds the output voltage is dropped in 11:01:45 3 the regulator with this excess power being wasted as 11:01:50 4 heat"? 11:01:54 5 A. I see that. 11:01:54 6 Q. What do you mean by excess power? 11:01:54 7 A. So a voltage regulator takes an input voltage 11:01:57 8 and, using the reference voltage to make appropriate 11:02:05 9 decisions, delivers an output voltage. The input 11:02:09 10 voltage is not equal to the output voltage. If it were, 11:02:13 11 you would probably just tie the two together and skip 11:02:17 12 the regulator. 11:02:20 13 As current flows from one voltage to the other, 11:02:23 14 power is dissipated. Power is voltage times current. 11:02:27 15 And so when the current goes through, for example, an 11:02:30 16 output transistor in a low dropout regulator and it 11:02:36 17 drops from the input voltage to the output voltage, heat 11:02:40 18 is generated, energy is conserved, and so the power 11:02:44 19 represented by the difference in voltage times the 11:02:50 20 current flowing through the device shows up as heat in 11:02:55 21 the transistor. 11:02:57 22 Q. You were saying that if the input voltage is 11:03:01 23 equal to the output voltage, then you would probably 11:03:04 24 just tie the two together and skip the regulator. Isn't 11:03:07 25 a low dropout regulator supposed to, you know, 11:03:14 Page 53

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1 essentially have input and output be the same? 11:03:19 2 A. A low dropout regulator never delivers input 11:03:21 3 equal to output. It delivers output voltages strictly 11:03:27 4 lower than the input. 11:03:31 5 Q. But isn't the goal to keep that difference as 11:03:33 6 small as possible? 11:03:38 7 A. Certainly you want to keep the -- well, a goal 11:03:39 8 might be to keep that difference as small as possible. 11:03:44 9 If you want to have the minimum wasted energy, you would 11:03:48 10 make that difference as small as possible. But you may 11:03:52 11 find there are other constraints that get in the way of 11:03:56 12 that, the output impedance requirements on the 11:03:58 13 regulator, the ability to reject noise on the input. 11:04:03 14 For example, if you want to eject noise that's 100 11:04:07 15 millivolts tall in the input, you better keep the output 11:04:10 16 at least 100 millivolts below the output so you have 11:04:13 17 work -- you know, room to respond with. 11:04:17 18 So, no. There's always a difference, even 11:04:22 19 though you would like to make it small. 11:04:26 20 Q. I'm just trying to understand why you would -- 11:04:27 21 you're saying you would skip the regulator if -- if you 11:04:41 22 want input and output voltage to be the same. 11:04:46 23 A. If the voltage that the application wants is the 11:04:48 24 input voltage, use the input voltage. It costs area, 11:04:54 25 power, design effort, work to create a regulator, so why 11:05:00 Page 54	1 BY MR. LIU: 11:07:21 2 Q. Was the highlighting meant to hide parts of the 11:07:28 3 circuit or? 11:07:31 4 A. Essentially parts of it are invisible, yes. 11:07:32 5 Q. Okay. So by highlight, you don't mean 11:07:35 6 emphasizing -- 11:07:41 7 A. Maybe it's low lighting. 11:07:41 8 Q. Yeah. And then you have -- did you create this 11:07:43 9 figure? 11:07:47 10 A. I did not create this figure. 11:07:47 11 Q. Do you know who did? 11:07:49 12 A. I don't know. But it would have been someone 11:07:50 13 who I received it from through my counsel. 11:07:58 14 Q. But you do agree, you know, that element 16 is 11:08:02 15 an amplifier, and the transistor, that's not -- the 11:08:09 16 transistor shown there is an output transistor? 11:08:18 17 A. That is an output transistor, and yes, 11:08:20 18 Figure 16. It is not a source follower, but it is an 11:08:23 19 output transistor. 11:08:27 20 Q. And so if you take out -- let's say you have 11:08:29 21 a -- an LDO -- or let's say you have a linear regulator 11:09:05 22 that only consisted of the components that are shown in 11:09:12 23 black. 11:09:14 24 A. Mm-hmm. 11:09:14 25 Q. Would that still operate as a linear regulator? 11:09:15 Page 56
1 create a regulator that does nothing. 11:05:07 2 Q. So are you saying that the dropout voltage -- 11:05:09 3 are you saying that a low dropout voltage regulator is 11:05:53 4 not necessarily better because the dropout voltage is 11:05:57 5 smaller? 11:06:02 6 A. I'm not saying that. 11:06:03 7 MR. JENSEN: Object to form. 11:06:04 8 BY MR. LIU: 11:06:04 9 Q. It just depends on what you're trying to achieve 11:06:07 10 and what noise tolerance. 11:06:10 11 A. As in all engineering, you know, better depends 11:06:11 12 on what your goals are, what is your target market, what 11:06:16 13 are you trying to achieve. 11:06:22 14 Q. On paragraph 55, you begin by saying: 11:06:32 15 "A simplified example of a linear regulator is 11:06:51 16 shown on Figure 2 from Rincon-Mora? 11:06:55 17 Do you see that? 11:06:55 18 A. I do see that. 11:06:58 19 Q. And it looks like you've reproduced Figure 2 by 11:06:59 20 Rincon-Mora with some modifications? 11:07:06 21 MR. JENSEN: Object to form. 11:07:08 22 THE DEPONENT: This is a reproduction of 11:07:09 23 Figure 2 with some highlighting, although it's rather 11:07:11 24 extreme, so you -- you -- it's hard to see what is 11:07:14 25 de-emphasized. 11:07:20 Page 55	1 A. It would still operate as a linear regulator, 11:09:19 2 yes. 11:09:24 3 Q. So what's shown here in black is a -- is a 11:09:24 4 functioning regulator? 11:09:28 5 A. Yeah. It's a bare bones functioning regulator. 11:09:29 6 MR. JENSEN: Whenever is convenient, Stephen, it 11:09:58 7 might be a good time to take a short morning break. 11:10:00 8 MR. LIU: Okay. Yeah. We've been going for a 11:10:03 9 while. Let me just think if I have one more question on 11:10:05 10 this figure. 11:10:07 11 We can take a break now. 11:10:16 12 MR. JENSEN: Okay. 11:10:18 13 THE VIDEOGRAPHER: This marks the end of media 11:10:19 14 unit 1. We are going off the record. The time is 11:10:21 15 11:10 a.m. 11:10:25 16 (A recess transpires.) 11:10:26 17 THE VIDEOGRAPHER: This marks the beginning of 11:23:29 18 media unit 2. We are going back on the record. The 11:23:31 19 time is 11:23 a.m. 11:23:35 20 MR. LIU: So I would like to introduce as 11:23:44 21 Exhibit 2, Exhibit 2 to the deposition, but previously 11:23:46 22 filed by patent owner as Exhibit 2011 to the IPR, a 11:24:20 23 document called "LM2990 Negative Low Dropout Regulator." 11:24:28 24 BY MR. LIU: 11:24:28 25 Q. Dr. Taylor, you have a copy of that document 11:24:35 Page 57

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1 before you. Do you recognize this? 11:24:37 2 (Exhibit No. 2 marked for identification.) 11:24:39 3 (Discussion off the record.) 11:25:03 4 THE DEPONENT: Yes, I have seen this data -- 11:25:05 5 well, a data sheet. There are many data sheets for the 11:25:08 6 LM2990, but this is certainly one of them, and I suspect 11:25:11 7 I've seen it before. 11:25:19 8 BY MR. LIU: 11:25:19 9 Q. Is this the data sheet that is included in the 11:25:19 10 table you provide in your declaration at -- 11:25:23 11 A. Let's see. 11:25:27 12 Q. -- paragraph 9? 11:25:28 13 A. Revised April 2013. I suspect it's the same 11:25:28 14 one. 11:25:32 15 Q. And what is this document? 11:25:33 16 A. This is a data sheet. 11:25:42 17 Q. What's a data sheet? 11:25:44 18 A. Chips are designed by companies and typically 11:25:46 19 used by other companies to build products that they're 11:25:55 20 going to sell. And so a data sheet is the communication 11:25:59 21 tool that those companies use, the company making, in 11:26:05 22 this case, a regulator is trying to describe the 11:26:11 23 expected behavior and range of behaviors of the 11:26:15 24 regulator so that those others who are trying to use 11:26:18 25 that product know what to expect of it and know how to 11:26:23 Page 58	1 regulator? 11:28:06 2 A. Created a data sheet for a voltage -- I have 11:28:06 3 created pieces of them, yes. In this case, it would be 11:28:11 4 Intel interacting with outside providers, and we didn't 11:28:18 5 necessarily like exactly what we saw, so we tried to 11:28:22 6 help them deliver something that would work better for 11:28:26 7 Intel's purposes. 11:28:30 8 Q. So you wouldn't have directly written portions 11:28:31 9 of the data sheet, but you would -- you're saying you 11:28:38 10 contributed to the content? 11:28:41 11 A. I -- yes, I contributed to the content. 11:28:42 12 Q. What about LDL regulators specifically, have you 11:28:49 13 ever created or contributed to a data sheet for an LDL 11:28:59 14 regulator? 11:29:04 15 A. At Intel, or at least the portions of Intel I've 11:29:04 16 worked in, did not sell low dropout voltage regulators. 11:29:08 17 We used them. And so we might have internal data sheets 11:29:13 18 would not be precisely equivalent, but -- so we would 11:29:18 19 not have produced a document quite in the same detail as 11:29:21 20 this for those. But we did worry about communicating 11:29:25 21 the behavior of our LDO to those who were using it. 11:29:30 22 Q. And what periods -- I will refer you to your -- 11:29:34 23 the CBU included in your declaration. 11:29:42 24 What periods identified in your CV for your 11:29:44 25 employment at Intel involved reviewing voltage regulator 11:29:52 Page 60
1 use it. 11:26:27 2 Q. Would those others include, for example, 11:26:27 3 customers? 11:26:34 4 A. If customers mean end user, probably not. But 11:26:34 5 the direct customers of the company selling the chip 11:26:39 6 would be among those users, yes. 11:26:42 7 Q. When you were at Intel, was reviewing data 11:26:44 8 sheets a typical component of your day-to-day 11:26:52 9 responsibilities? 11:26:56 10 A. Creating data sheets was a typical day-to-day 11:26:57 11 activity. Reviewing others' data sheets was probably 11:27:02 12 not day to day, but was quite frequent. 11:27:07 13 Q. So you personally created data sheets? 11:27:10 14 A. I have personally created data sheets. 11:27:12 15 Q. What types of devices or components did you 11:27:17 16 create data sheets for? 11:27:20 17 A. Mostly microprocessors, occasionally other 11:27:22 18 components that Intel desired from other companies. 11:27:29 19 Q. And who -- what types of companies would have 11:27:31 20 been the direct -- the intended direct customers for 11:27:41 21 those microprocessors? 11:27:44 22 A. You're all using them. These were commercial 11:27:46 23 commodity microprocessors that appeared in, you know, 11:27:52 24 desktops, laptop computers, widely used in the industry. 11:27:55 25 Q. Have you ever created a data sheet for a voltage 11:27:59 Page 59	1 data sheets? 11:30:00 2 A. Reviewing voltage regulator data sheets was 11:30:04 3 never an explicit item on my list of responsibilities. 11:30:07 4 It was, you know, one of many, many tasks. But in most 11:30:13 5 of this, where I am at Intel, I'm dealing with analog 11:30:20 6 circuits, starting in '92, or '93. And so voltage 11:30:28 7 regulators became a part of what is happening there, and 11:30:37 8 I was continuing doing product design through 2008 and 11:30:40 9 past 2008, until I retired. I was looking at analog 11:30:47 10 circuits across the company, including voltage 11:30:53 11 regulators. At that point in time, I probably would not 11:30:58 12 have been creating any, but I still was seeing them and 11:31:00 13 mentoring people who were working on them. 11:31:11 14 Q. You mentioned you were doing product design 11:31:21 15 through 2008. What were you doing after that, if -- 11:31:23 16 until the time you retired? 11:31:32 17 A. From two thousand -- well, in late 2008, I 11:31:34 18 transitioned into Intel Labs. But as I said, I 11:31:37 19 continued to lead the group of people that was trying to 11:31:42 20 ensure consistency and coherency across products, so I 11:31:49 21 was not officially responsible for product design, but 11:31:52 22 the product designers told me, no I could not escape 11:31:56 23 from that product responsibility, and I continued to do 11:31:59 24 it. For my last two years, I actually went back into 11:32:05 25 the product design world again and continued still in 11:32:08 Page 61

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1 that role of overseeing all the analog product design. 11:32:10	1 probably start in the back where the mechanical 11:35:31
2 Q. So that was in your role as hard IP group chief 11:32:16	2 information usually is. If you want to know what pins 11:35:33
3 architect? 11:32:20	3 are there, there's probably a signal list with more 11:35:36
4 A. That is correct. 11:32:20	4 details. It depends on what you're looking for. But in 11:35:39
5 Q. You actually list in that line item in your CV 11:32:27	5 general, there're an objective in mind when you're 11:35:43
6 for 2014 to 2016: 11:32:33	6 looking at these things. 11:35:47
7 "Intel fellow hard IP group chief architect, 11:32:36	7 Q. And would you say there's a certain level of 11:35:59
8 leading the worldwide circuit architecture teams for IO 11:32:42	8 expertise or familiarity that's required to fully 11:36:02
9 analog and linear supply regulator design"? 11:32:45	9 understand a data sheet like the one we've marked as 11:36:05
10 A. Mm-hmm. 11:32:48	10 Exhibit 2 to the deposition? 11:36:11
11 Q. Are these linear supply regulators voltage 11:32:48	11 MR. JENSEN: Object to form. 11:36:12
12 regulators? 11:33:01	12 THE DEPONENT: I believe that data sheets are 11:36:16
13 A. Yes. 11:33:01	13 generally written for the understanding of engineers who 11:36:18
14 Q. And -- 11:33:01	14 will be using the parts in question. They're an aid in 11:36:21
15 A. But they're linear regulators, not necessarily 11:33:05	15 that process. And so if you have no concept of what is 11:36:28
16 switching regulators. 11:33:08	16 involved in that, this is probably not meant to be 11:36:34
17 Q. And they were intended for use in Intel chips? 11:33:09	17 readable to you. 11:36:37
18 A. They were intended for use inside of Intel 11:33:11	18 BY MR. LIU: 11:36:40
19 chips, yes. They were not provided as external 11:33:15	19 Q. If you could look at page 3 of the Texas 11:36:44
20 products. 11:33:17	20 Instruments LM2990 data sheet -- 11:36:50
21 Q. Did you create -- did you or the organization 11:33:26	21 A. Mm-hmm. 11:36:52
22 you were leading create data sheets for those linear 11:33:33	22 Q. -- do you see a table of electrical 11:36:52
23 supply regulators? 11:33:35	23 characteristics? 11:36:56
24 A. Conceptually, yes. Did we produce publicly 11:33:37	24 A. I do. 11:36:56
25 available data sheets for the commons? Not at all. 11:33:42	25 Q. And does the data sheet define what each of 11:36:56
Page 62	Page 64
1 (Reporter clarification.) 11:33:42	1 these characteristics are? 11:37:04
2 THE DEPONENT: For these common products. 11:33:51	2 A. I would have to read the data sheet in more 11:37:05
3 BY MR. LIU: 11:33:51	3 depth. Sometimes they define characteristics quite 11:37:09
4 Q. Can you walk me through your general process of 11:34:02	4 well, and sometimes they don't. 11:37:13
5 reviewing a voltage regulator data sheet? 11:34:05	5 Q. On page 5, for example, it looks like they 11:37:17
6 MR. JENSEN: Object to form. 11:34:10	6 defined some terms. 11:37:31
7 BY MR. LIU: 11:34:12	7 A. Well, it depends on what you mean by definition. 11:37:37
8 Q. Or how do you go about understanding what's on 11:34:13	8 For example, if you read the definition of line 11:37:40
9 the page? 11:34:15	9 regulation, it says it's the change in output voltage 11:37:44
10 A. Okay. I interpret that as very different than 11:34:16	10 for change in input voltage. That qualitatively 11:37:46
11 reviewing. Typically, I would start by looking at 11:34:19	11 describes what's there, but I don't think that 11:37:51
12 circuit diagrams to get an idea of the structure that is 11:34:25	12 definition would tell you how do you measure line 11:37:54
13 represented, what inputs and outputs are available. 11:34:32	13 regulation. For some parameters, they actually include 11:37:57
14 Look at the description, typically, and you see here in 11:34:37	14 diagrams showing how the parameters are measured. So 11:38:03
15 the upper right-hand corner of the first page, there's a 11:34:39	15 depending on what you mean by definition, yeah, there 11:38:08
16 high-level description that, you know, outlines the 11:34:46	16 are definitions there. They are not sufficiently 11:38:13
17 major capabilities of what's there, the idea being that 11:34:48	17 precise to know how to go down to the lab and measure 11:38:15
18 between those two you -- it gives you an idea of what is 11:34:53	18 things. 11:38:19
19 the intended functionality and the intended feature set. 11:34:57	19 Q. Is that knowledge required to understand the -- 11:38:20
20 And this is a pile of paper. Most of it is then in the 11:35:03	20 the line regulation item on page 3? 11:38:28
21 details of that functionality. And so I would start by 11:35:11	21 MR. JENSEN: Object to form. 11:38:34
22 understanding big picture and then proceed down, 11:35:15	22 THE DEPONENT: It -- that knowledge, could you 11:38:35
23 depending on what I'm looking for, and I proceed in 11:35:19	23 be more specific? 11:38:38
24 different fashions. If you're interested in information 11:35:24	24 BY MR. LIU: 11:38:39
25 on how is it packaged, how is it on the board, you 11:35:27	25 Q. You described -- you noted that the definition 11:38:54
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1 provided on page 5 doesn't tell you how to measure line 11:38:59 2 regulation, and for some parameters they actually 11:39:04 3 include diagrams showing how the parameters are 11:39:07 4 measured. So depending on what you mean by definition, 11:39:11 5 yeah, there are definitions there, but they are not 11:39:15 6 sufficiently precise to be -- I think you said something 11:39:17 7 about going to the lab and measuring things? 11:39:26 8 A. And so for -- for some parameters, when you're 11:39:27 9 talking about output transition time, the way you 11:39:35 10 measure it affects the number you measure, and so it's 11:39:38 11 very important to be much more precise in the definition 11:39:40 12 of the term to fully understand it. Line regulation is 11:39:45 13 not the most constraining in that regard, but it varies 11:39:49 14 by parameter. There isn't a simple rule of everything 11:39:54 15 is described in the way you measure in a lab and -- or 11:39:59 16 not. 11:40:04 17 Q. On page 5, they define quiescent current as that 11:40:04 18 part of the positive input current that does not 11:40:14 19 contribute to the positive load current, the regulator 11:40:17 20 ground lead current. 11:40:20 21 Do you see that? 11:40:20 22 A. I do see that. 11:40:22 23 Q. Is that enough information to understand the 11:40:23 24 quiescent current characteristics shown on page 3? 11:40:32 25 A. If you look at page 2, you can see that this 11:40:36 Page 66	1 in the output voltage, you see changes in the 11:43:16 2 characteristics. 11:43:23 3 Q. So do you under -- are those -- do you 11:43:27 4 understand each column to refer to a different product? 11:43:33 5 A. So I would interpret the pair of limits 11:43:36 6 underneath LM2990-5.0 to refer to the LM2990-5.0 11:43:41 7 product. And so we're actually looking at four 11:43:48 8 different products in these two different tables. 11:43:51 9 Q. Okay. So for LM2990-5.0 shown on page 3, the 11:43:57 10 data sheet reports a -- several -- four different 11:44:05 11 quiescent current values, 1 milliamp, 5 milliamps, 11:44:12 12 9 milliamps and 50 milliamps. 11:44:19 13 Do you see that? 11:44:19 14 A. I see that. 11:44:22 15 Q. Do you know what -- what -- why there are four 11:44:23 16 different values given? 11:44:29 17 A. The data sheet is providing four different 11:44:30 18 operating conditions. 11:44:33 19 Q. And what are those operating conditions? 11:44:36 20 A. So, for example, if you look at the value of 1, 11:44:37 21 that is when the IO, the output current, is less than or 11:44:42 22 equal to 1 amp. It's saying typically, as in your 11:44:47 23 mileage may vary, don't expect that you're going to see 11:44:51 24 all your units behave this way, you have 1 microamp -- 1 11:44:54 25 milliamp, sorry. Next to it is the 5, and you see 11:44:58 Page 68
1 particular part has three pens. And so when you talk 11:40:44 2 about the -- let's turn -- the part of the positive -- 11:40:51 3 the input current that does not contribute to the load 11:40:58 4 current, meaning the output current, the difference 11:41:01 5 between those two is the ground lead current. That 11:41:03 6 description is very -- is adequate, but very specific to 11:41:08 7 this part. That description might not be an adequate 11:41:13 8 description for all voltage regulators that you could 11:41:16 9 come across, but for this one it is a sufficient 11:41:20 10 description. 11:41:22 11 Q. So when page 3 -- actually, first let me ask, do 11:41:22 12 you see there's another table of electrical 11:41:36 13 characteristics on page 4? 11:41:37 14 A. Mm-hmm. 11:41:40 15 Q. What -- do you know what the difference is 11:41:40 16 between these two tables or -- and why two different 11:41:43 17 tables are given? 11:41:46 18 A. So if you look at the top line of the table, in 11:41:47 19 the third and fourth columns, you can see it says 11:42:36 20 "LLM2990-5.0 and LM2990-5.2. My speculation would be, 11:42:41 21 those are, one is a 5.0 volt regulator, the other is a 11:42:48 22 5.2 volt regulator, 5.0 being common in TTL systems, 5.2 11:42:54 23 in ECL systems. On the next page, you see LLM2990-12 11:43:02 24 and LM990-15. My guess would be those are 12- and 11:43:07 25 15-volt regulators. And so with that significant change 11:43:14 Page 67	1 that's also measured when the output current is less 11:45:03 2 than or equal to 1 amp. But in that case, it says 11:45:06 3 "limit," meaning they are promising you that you won't 11:45:10 4 see more than 5 milliamps. So there is variation from 11:45:14 5 product to product, die to die. 11:45:20 6 And so as -- as an engineer, I would often 11:45:23 7 ignore the typical column and just focus on the limit 11:45:27 8 because I know that's what the behavior is. 11:45:30 9 And then when the output current -- that the 11:45:31 10 second line interestingly overlaps the first line. It 11:45:37 11 says, when the output current is 1 amp and VN is equal 11:45:40 12 to VO, nominal, those are the quiescent currents, and 11:45:46 13 they're quite a bit higher. And what's interesting 11:45:53 14 is -- to me at least an interesting thing, the first 11:45:55 15 column says IO is less than or equal to 1 amp. And so I 11:45:57 16 would argue that the second row is a subset of the first 11:46:04 17 row because IO equal 1 amp is contained within IO less 11:46:07 18 than or equal to 1 amp. 11:46:17 19 Q. Does the quiescent current depend on the output 11:46:21 20 current? 11:46:26 21 THE DEPONENT: In -- 11:46:26 22 MR. JENSEN: Object to form. 11:46:29 23 THE DEPONENT: Well, what -- what is interesting 11:46:30 24 to me here is, typically quiescent current is defined as 11:46:34 25 in the absence of a load, but their definition of 11:46:39 Page 69

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1 quiescent current was something else. They just said 11:46:44 2 it's this minus that. And so their quiescent current is 11:46:46 3 actually what is the current dissipated in the 11:46:52 4 regulator, and yes, that often is a function of the load 11:46:57 5 current. 11:47:01 6 BY MR. LIU: 11:47:16 7 Q. And I think you -- you were talking about the 11:47:17 8 second line item being a subset of the first? 11:47:22 9 A. I'm saying that IO equals 1 amp is contained 11:47:28 10 within IO less than or equal to 1 amp, and yet from the 11:47:34 11 values assigned to it, that clearly isn't the case. So 11:47:39 12 I'm pointing to what seems to be a point of ambiguity in 11:47:42 13 what they presented. I'm sure there's some question 11:47:49 14 that they're trying to outline in the second line that 11:47:53 15 is not fully clear to me. Okay? 11:47:58 16 So if you look at the very top of the chart, 11:48:07 17 underneath the words "electrical characteristics," it 11:48:09 18 says: 11:48:13 19 "VN equals minus 5 volts plus VO nom." 11:48:13 20 And so in that second line, it says "VN equals 11:48:18 21 VO nom." So essentially, the first line could be 11:48:24 22 appended by VN equals minus 5 volts plus VO nom. 11:48:28 23 Q. I'm sorry. I'm not quite following you. 11:48:38 24 A. So underneath the words "electrical 11:48:40 25 characteristics" at the top of the table, it has several 11:48:43 Page 70	1 the regulator creates minus 5 volts. Very typical 11:50:42 2 operating conditions for an LDO. In that second line, 11:50:46 3 you're actually taking minus 5 volts in and using it to 11:50:52 4 create minus 5 volts, and you can see that the quiescent 11:50:54 5 current becomes quite large. And so they are pointing 11:50:58 6 out that there's a hazard here. If you squeeze the 11:51:03 7 dropout voltage too far, one of the behaviors you will 11:51:09 8 start to see is you will start wasting a lot of power 11:51:12 9 inside the regulator. 11:51:14 10 Q. Is there a way to verify, using the information 11:51:35 11 in this data sheet, that these reported quiescent 11:51:37 12 currents are accurate? 11:51:46 13 A. You could buy a lot of parts and measure them, 11:51:47 14 but in general you're trusting the vendor to be honest 11:51:57 15 with you. 11:52:00 16 Q. Has there ever been an instance in your career 11:52:00 17 where you found that maybe not necessarily quiescent 11:52:09 18 current, but some parameter reported on a data sheet was 11:52:13 19 not actually, in practice, what -- what it was reported 11:52:16 20 to be? 11:52:20 21 A. Oh, absolutely. But generally, these are not 11:52:21 22 malfeasance on the part of the vendor. I have never 11:52:27 23 found a reason to not trust a vendor. They're defective 11:52:30 24 parts that somehow escape through test. 11:52:33 25 Q. I see. So it was the specific part that was 11:52:36 Page 72
1 statements, and the default assumption is that these 11:48:48 2 characteristics apply unless otherwise specified. If we 11:48:53 3 look at the second line of quiescent current, we see 11:48:57 4 something is otherwise specified. 11:49:01 5 Q. I see. So you're saying that the VN conditions 11:49:06 6 from these two lines are different? 11:49:11 7 A. So VN in the first line is minus 5 volts plus VO 11:49:13 8 nom, and the second one, VN is precisely equal to VO 11:49:19 9 nom. So yes, the conditions are different. 11:49:25 10 Q. And what difference does the minus 5 volts make 11:49:33 11 it, which is -- I guess what I'm trying to ask is, why 11:49:46 12 would they report different -- why would they report 11:49:53 13 separate quiescent currents for each of those 11:49:56 14 conditions? 11:49:59 15 A. Because they're different. The first case is 11:50:02 16 the nominal situation where the input voltage is 11:50:04 17 different than the output voltage. And one thing I 11:50:09 18 should point out here, this is a negative regulator. In 11:50:15 19 the LDOs we were discussing earlier, the presumption was 11:50:19 20 you had some high in voltage you're dropping down to 11:50:22 21 create some smaller input voltage. In this case, you're 11:50:26 22 providing a very negative voltage and regulating it to a 11:50:29 23 less negative voltage. 11:50:34 24 And, you know, for the 5-volt regulator, the 11:50:35 25 default assumption is VN is minus 10 volts, from which 11:50:37 Page 71	1 off, not the -- 11:52:41 2 A. Not a systematic -- 11:52:41 3 Q. The data sheet wasn't wrong? 11:52:43 4 A. I have not experienced a case where the vendor 11:52:45 5 was lying in their data sheet. 11:52:47 6 Q. But, I mean, the data sheet could be wrong even 11:52:48 7 if you don't intend to lie about it, right? 11:52:55 8 A. Well, from that perspective, yes. When you have 11:52:56 9 this amount of information -- I mean, this particular 11:52:59 10 data sheet says "revised April 2013, SNVSO93D. I'm 11:53:03 11 going to guess that "D" is saying this is at least the 11:53:13 12 fourth revision. That's on page 1. Some of them even 11:53:16 13 include revisions. I don't know if this one includes 11:53:20 14 revisions, but yes, data sheets do get revised. Yes, 11:53:25 15 mistakes happen, which is why sometimes you do measure a 11:53:28 16 part. 11:53:34 17 Q. Besides correcting mistakes, are there other 11:53:34 18 reasons why a data sheet would get revised? 11:53:37 19 A. People might change the part. They may change 11:53:40 20 the manufacturing process and tighten up distributions, 11:53:45 21 which means the difference between the typical and the 11:53:49 22 limit may come closer together. Yeah, there are many 11:53:53 23 reasons it can be done. 11:53:55 24 Q. Wouldn't that get confusing if you change the 11:53:57 25 part and just call it a different -- a revised version 11:54:04 Page 73

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1 of the same data sheet? 11:54:11 2 A. I'm not quite sure I understood what you're 11:54:12 3 asking. 11:54:17 4 Q. Yeah. I guess I'm asking -- maybe it's not 11:54:18 5 confusing in the industry. I guess I'm trying to get at 11:54:25 6 is, it -- is it still considered the same part even when 11:54:30 7 parameters get changed and you have to update the data 11:54:35 8 sheet to reflect that? 11:54:37 9 MR. JENSEN: Objection to form. 11:54:38 10 THE DEPONENT: I'm still not sure that I 11:54:44 11 under -- that your presumptions are correct. But in 11:54:46 12 some senses, a data sheet is a contract, and I'm 11:54:52 13 promising you the part is somewhere in this giant box, 11:54:54 14 and if I find a way to make it fit within a much smaller 11:54:57 15 box, but that's still within the same giant box, I'm 11:55:02 16 still meeting the contract. Now, over time, someone may 11:55:07 17 say, I really need the small box, and someone may revise 11:55:13 18 the data sheet because they're already building the 11:55:19 19 small box. And sometimes as technology moves forward, 11:55:22 20 we find ways to tighten distributions that actually save 11:55:28 21 costs. You may create a new data sheet, but you may 11:55:33 22 just confuse the market, so more likely you just go with 11:55:36 23 it because you're still meeting your contract to the 11:55:42 24 customer. 11:55:45 25 /// 11:55:45 Page 74	1 Q. Do you recognize this? 11:57:27 2 A. LM -- or L78MX -- 11:57:31 3 THE REPORTER: I'm sorry. You have to go 11:57:34 4 slower. 11:57:36 5 THE DEPONENT: I'm sorry. 11:57:36 6 Yes. This is the L78MxxAB and L78MxxAC data 11:57:37 7 sheet. Yes, I have seen this before. 11:57:46 8 BY MR. LIU: 11:57:49 9 Q. Do you know why there are two different, I 11:57:52 10 guess, names for this data sheet? 11:57:56 11 A. I don't know. But if you look lower down on 11:58:06 12 page 1, I see a list of part numbers, and those part 11:58:09 13 numbers all end in AB or AC. So I suspect that's part 11:58:13 14 of it. And if you look higher up, you see output 11:58:22 15 voltages of 5, 6, 8, 9, 10, 12, 15, 24, all in the first 11:58:26 16 page. Clearly, we are talking about a family of 11:58:33 17 regulators. And so while you comment that there are two 11:58:38 18 different line items on the title, the L78Mxx -- 11:58:41 19 actually, there are probably -- there are a multitude of 11:58:48 20 products described by this one data sheet. It looks 11:58:53 21 like 11 different products. 11:58:59 22 Q. And it looks like those voltages you were just 11:59:00 23 reading, are they part of the -- 11:59:03 24 A. They are listed in the second line of features 11:59:06 25 on page 1. 11:59:08 Page 76
1 BY MR. LIU: 11:55:45 2 Q. Is it generally expected that the customers 11:55:45 3 would keep up with data sheet revisions so they know 11:55:48 4 what they're continuing to purchase? 11:55:51 5 MR. JENSEN: Object to form. 11:55:54 6 THE DEPONENT: Well, the general expectation is 11:55:55 7 that when you revise data sheets, you are making the 11:55:56 8 space available for the customer to use bigger. If you 11:56:00 9 were to revise a data sheet a way that made some portion 11:56:06 10 of the operating space illegal, unusable, you would 11:56:11 11 really have to highlight this to your customers and make 11:56:14 12 sure they were aware of it. That is not something to be 11:56:17 13 taken lightly. 11:56:19 14 BY MR. LIU: 11:56:21 15 Q. You can set that one aside. 11:56:30 16 MR. LIU: So I would like to introduce as 11:56:51 17 Exhibit 3 to the deposition a document that was 11:56:52 18 previously submitted by patent owner as Exhibit 2012 to 11:56:57 19 the IPR proceeding, which is appears to be a data sheet 11:57:02 20 for certain ST regulators. 11:57:10 21 (Exhibit No. 3 marked for identification.) 11:57:10 22 BY MR. LIU: 11:57:10 23 Q. Dr. Taylor, do you have that document in front 11:57:25 24 of you? 11:57:26 25 A. I do. 11:57:27 Page 75	1 Q. Yeah. Are -- and it looks like they might 11:59:09 2 correspond to the part numbers that -- the XX -- where 11:59:14 3 the XX is filled in? 11:59:17 4 A. The XX is presumably the voltage, and so 11:59:19 5 L78M05AB, the very first part number, is most likely a 11:59:25 6 5-volt regulator. How that differs from the next part, 11:59:29 7 the L78M05AC, is not obvious. They're probably both 11:59:35 8 5-volt regulators, but of some different specification. 11:59:42 9 Q. And so if an engineer were reviewing this data 11:59:46 10 sheet, the expectation would be that unless otherwise 11:59:53 11 specified, the descriptions in this data sheet apply to 11:59:57 12 all 11 parts? 12:00:02 13 A. Unless called out specifically, I would assume 12:00:03 14 that, yes, these all share many common characteristics. 12:00:06 15 Q. And this is a data sheet that you rely on in 12:00:16 16 your declaration, correct? 12:00:18 17 A. It is a data sheet that is referenced in the 12:00:19 18 declaration. 12:00:25 19 Q. Was this data sheet provided to you or did you 12:00:25 20 find it yourself? 12:00:32 21 A. Yes. Some of the data sheets I found myself. 12:00:33 22 Some were provided to me. I believe I found this one, 12:00:38 23 but I could be mistaken. 12:00:42 24 Q. And do you recall how you found it? Like, were 12:00:46 25 you running searches or? 12:00:49 Page 77

1 A. I went to a distributor website to look for 12:00:50	1 quiescent current when they're saying it's 6 -- 12:04:24
2 voltage regulators and tried to find ones that had very 12:00:57	2 A. Some people -- 12:04:27
3 old publication dates. 12:01:01	3 MR. JENSEN: Object to form. 12:04:28
4 Q. By very old, do you mean before the priority 12:01:04	4 THE DEPONENT: Some people do have different 12:04:28
5 date? 12:01:10	5 definitions. As we saw on the earlier three-pin 12:04:31
6 A. Precisely. 12:01:10	6 regulator, their definition of quiescent current was 12:04:36
7 Q. Okay. 12:01:11	7 simply everything that's left over. In other places, 12:04:40
8 A. My assumption was that data sheets for parts 12:01:13	8 quiescent current means there is no output, it is 12:04:45
9 made in 2020 really were not relevant to this 12:01:15	9 quiescent. 12:04:48
10 proceeding. 12:01:19	10 BY MR. LIU: 12:04:49
11 Q. Do you recall which distributor's website you 12:01:19	11 Q. And this one has a -- another item for quiescent 12:04:49
12 found this on? 12:01:35	12 current change. 12:04:55
13 A. I do not. 12:01:36	13 Do you see that? 12:04:55
14 Q. Were there different -- among the data sheets 12:01:44	14 A. I do see that. 12:04:55
15 that you found, were they sourced from different 12:01:49	15 Q. Do you know what that means? 12:04:56
16 distributor websites or all the same one? 12:01:56	16 A. So it says -- for example, take the first line 12:04:59
17 A. I believe they were all -- I looked at a couple 12:01:58	17 there -- "quiescent current change." And it says "I0 12:05:01
18 different distributors, but one of them was easier to 12:02:03	18 equals 5 to 350 milliamps. I take that to mean that if 12:05:06
19 isolate the search in the way I wanted to, and so I 12:02:07	19 you measure quiescent current at 5 milliamps and then 12:05:10
20 believe they all came from the same distributor, but I 12:02:09	20 you measure quiescent current at 350 milliamps, the 12:05:14
21 don't recall which distributor it was. 12:02:12	21 difference between the two is half a milliamp. So 12:05:18
22 Q. It looks like this particular data sheet 12:02:13	22 clearly, their definition of quiescent current does not 12:05:24
23 L78MxxAB, L78MxxAC, provides the electrical 12:02:25	23 mean I output equals 0. 12:05:26
24 characteristics on pages 7 -- or I should say -- yeah, 12:02:30	24 Q. So you interpret this to mean they measured 12:05:38
25 pages, 7, 8, 9, 10, 11, 12 -- I'll skip ahead here. 7 12:02:42	25 quiescent current at 5 milliamp output and 350 milliamp 12:05:41
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1 through 14. Do you agree with me? 12:02:58	1 output and just took the difference? 12:05:46
2 A. That looks right, yes. Each page has a 12:03:02	2 A. Yes. 12:05:47
3 different target voltage. 12:03:10	3 Q. And then the second item, would you interpret 12:05:52
4 Q. And this time, they actually use the -- xx is 12:03:11	4 that to mean that I output was held constant, but they 12:05:54
5 for AB and AC, right? 12:03:13	5 changed the input voltage from 8 to 25 volts? 12:05:59
6 A. So presumably, the difference between the AB and 12:03:15	6 A. Yes. 12:06:03
7 the AC is not relevant to most of these characteristics, 12:03:18	7 Q. Do you have a sense of why only the maximum 12:06:03
8 because it does say "unless otherwise specified." 12:03:25	8 values are reported for quiescent current? 12:06:24
9 Q. And can you tell from this what quiescent 12:03:27	9 A. Because that's the number that's interesting to 12:06:28
10 current means? 12:03:36	10 the customer, meaning if I tell you it's typically 3, 12:06:30
11 A. Can I tell what it means? No. I can tell what 12:03:37	11 I'm making no promise whatsoever there. So typically, 12:06:34
12 they think it is. 12:03:43	12 min and max are the more interesting numbers. They 12:06:39
13 Q. I'm not sure I understand the nuance there that 12:03:50	13 could potentially have specified a minimum, but they 12:06:42
14 you're articulating. 12:03:53	14 chose not to, and very few designers would complain that 12:06:45
15 A. What it means, I interpret it to mean, what does 12:03:54	15 the power is too low. So this was acceptable. 12:06:47
16 the two-word -- what do the two words "quiescent 12:03:57	16 Q. You can set that one aside, too. If you could 12:06:51
17 current" mean. That is not specified here. What I can 12:04:00	17 turn back to your declaration, and at paragraph 65. 12:07:14
18 see here is what are they promising the quiescent 12:04:03	18 A. Okay. 12:07:34
19 current to be. 12:04:07	19 Q. Which goes on to the next page. It starts at 12:07:35
20 Q. I see. So -- so you do understand that they're 12:04:08	20 33. You note: 12:07:39
21 reporting the quiescent current to be 6 milliamps? 12:04:12	21 "Voltage regulators have been around for many 12:07:40
22 A. I do understand that to be a maximum of 6 -- 12:04:17	22 years, including the 2013 timeframe and much earlier." 12:07:43
23 Q. A maximum. 12:04:19	23 Do you know, at least ballpark, how much 12:07:46
24 A. -- milliamps. 12:04:20	24 earlier? 12:07:53
25 Q. But you're not sure exactly they mean by 12:04:21	25 A. Voltage regulators? My father started work in 12:07:55
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1 1952, and he worked on voltage regulators. I don't know 12:07:59 2 if he did in the very first year he worked, but they go 12:08:06 3 way back. 12:08:08 4 Q. Yeah. Do you know how far back linear 12:08:10 5 regulators go? 12:08:14 6 A. Probably about the same. 12:08:15 7 Q. Is -- are switching regulators a later 12:08:18 8 development than linear? 12:08:22 9 A. Switching regulators are a later development, 12:08:22 10 yes. 12:08:24 11 Q. What about LDO regulators, do you know how far 12:08:25 12 back they go? 12:08:28 13 A. LDOs are a descriptive term applied to linear 12:08:29 14 regulators with certain characteristics, and so there is 12:08:36 15 not a crisp definition where a linear becomes an LDO. 12:08:39 16 Consequently, there's not an easy way to answer the 12:08:47 17 question. You could perhaps come up with when the term 12:08:51 18 LDO was first created. I don't know. But there is no 12:08:53 19 technical definition that would say LDOs started here. 12:08:56 20 Q. In that case, in the next sentence you say: 12:09:05 21 "Various companies manufactured and sold voltage 12:09:07 22 regulators. Some companies I was personally aware of 12:09:09 23 circa 2013 included Texas Instruments, 12:09:12 24 SD Microelectronics, Fairchild, and Microchip." 12:09:17 25 Do you see that? 12:09:17 Page 82	1 Did you personally draft this declaration? 12:10:47 2 A. I created most of it. I did not create the 12:10:49 3 initial draft of the legal definitions portion of the 12:10:57 4 data sheet, but -- or the declaration. But I did create 12:11:01 5 the first draft and the rest. There were others who 12:11:04 6 helped me clarify my writing. It's always 12:11:10 7 understandable to me, but sometimes not everybody 12:11:12 8 understands it the way I meant it. 12:11:18 9 Q. And you noted earlier that one of the figures 12:11:20 10 that -- that Rincon-Mora figured had been annotated. 12:11:23 11 You hadn't created that figure yourself? 12:11:29 12 A. I did not create that figure myself. 12:11:31 13 Q. What about the -- did you create the figure 12:11:37 14 shown on -- I will say paragraph 76, but it's probably 12:11:44 15 easiest if you just go to page 42. 12:11:50 16 A. So it depends on what you mean by the word 12:11:58 17 "creation." I did the annotation. The underlying 12:12:01 18 fixture or figure is a copy made from the '074 patent. 12:12:07 19 Q. Right. Right. So the -- the different colored 12:12:14 20 currents shown here, you -- you made these annotations? 12:12:17 21 A. I -- I chose those colors, so, yeah, that's my 12:12:20 22 fault. 12:12:24 23 MR. LIU: So I will mark as Exhibit 4 to this 12:12:53 24 deposition a document that was previously submitted by 12:12:58 25 patent owner as Exhibit 2019 to the IPR, which appears 12:13:07 Page 84
1 A. I do see that. 12:09:21 2 Q. And we looked at a Texas Instruments regulator 12:09:21 3 and an SD Micro regulator, right? 12:09:25 4 A. Yes. 12:09:28 5 Q. And Microchip is the patent owner? 12:09:28 6 A. And so one of their -- one of the data sheets 12:09:30 7 was provided by them. 12:09:35 8 Q. Next you say: 12:09:38 9 "These companies adhered to the common practice 12:09:46 10 of publishing public data sheets describing their 12:09:49 11 products offerings, including voltage regulators." 12:09:51 12 Do you see that? 12:09:51 13 A. I do see that. 12:09:54 14 Q. "And these companies make data sheets and 12:09:55 15 product descriptions readily available, e.g., on their 12:09:57 16 websites and via distributor websites, for the obvious 12:10:01 17 reason that the companies were attempting to sell their 12:10:04 18 products, including to PHOSITAs doing design work." 12:10:06 19 Do you see that? 12:10:06 20 A. I do see that. 12:10:10 21 Q. And so was it one of the distributor websites 12:10:10 22 you're describing in this sentence where you found that 12:10:15 23 SD Micro -- 12:10:20 24 A. Yes. 12:10:21 25 Q. -- data sheet? 12:10:22 Page 83	1 to be a data sheet for a Microchip product called 12:13:12 2 TC1300. 12:13:30 3 THE DEPONENT: I see it. 12:13:30 4 (Exhibit No. 4 marked for identification.) 12:13:31 5 BY MR. LIU: 12:13:32 6 Q. Was this the Microchip data sheet you mentioned 12:13:32 7 earlier that patent owner provided? 12:13:34 8 A. I believe so, yes. 12:13:38 9 Q. Did you speak to anyone at Microchip about this 12:13:39 10 data sheet? 12:13:43 11 A. I did not speak to anyone at Microchip about 12:13:45 12 this data sheet, no. 12:13:46 13 Q. But you felt that given your background and 12:13:52 14 experience, you were equipped to interpret this data 12:13:57 15 sheet, at least as far as your opinions about this data 12:14:03 16 sheet, in your declaration? 12:14:06 17 A. I felt I am equipped to understand it and see 12:14:07 18 how it fits. And it -- I don't have any reason to 12:14:14 19 disbelieve the truthfulness of the information here. 12:14:19 20 Q. And this -- if you look on pages 2 and 3 of this 12:14:21 21 data sheet, actually, 2, 3, and 4, it looks like there's 12:14:34 22 a table or several tables showing electrical 12:14:40 23 characteristics. 12:14:46 24 Do you see that? 12:14:47 25 A. I see them, yes. 12:14:48 Page 85

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1 Q. And I'm sorry. Is there a quiescent current 12:14:49 2 characteristic in these tables? 12:15:21 3 A. I'm sorry. You're asking me to read the data 12:15:24 4 sheet? 12:15:27 5 Q. I'm just wondering if you see one in these three 12:15:29 6 tables. 12:15:32 7 MR. JENSEN: Object to form. 12:15:46 8 THE DEPONENT: I do not see something labeled 12:15:46 9 quiescent current. 12:15:50 10 BY MR. LIU: 12:15:52 11 Q. Do you see -- 12:15:53 12 A. But other labels might apply. 12:15:54 13 Q. Do you see any labels that might be describing 12:15:57 14 something you understand to be quiescent current? 12:15:59 15 A. Well, I see supply current, and certainly 12:16:06 16 quiescent current should be smaller than the supply 12:16:07 17 current. But that's not a very tight limit. 12:16:10 18 Q. What does supply current mean? 12:16:21 19 A. So I would interpret supply current to mean the 12:16:23 20 current that this particular -- that the regulator 12:16:30 21 consumes from the supply, not to be confused with the 12:16:34 22 current that the regulator supplies to its own load. 12:16:40 23 Q. And how is that different from quiescent 12:16:47 24 current? 12:16:49 25 A. The word "quiescent" means quiet. So in some 12:16:51 Page 86	1 "Shut down supply current"? 12:18:59 2 A. Yes. 12:19:00 3 Q. Do you have a sense of what that is referring 12:19:00 4 to? 12:19:02 5 A. If you look at the front page, there's a signal, 12:19:02 6 SHDN, shutdown. And so I would interpret that when it 12:19:11 7 says shutdown supply current, you can see on the 12:19:15 8 right-hand side, it says that that signal, SHDN with an 12:19:17 9 overstrike, is zero volts. So when the regulator is in 12:19:22 10 shutdown mode, you can see that the supply current drops 12:19:27 11 by 100 microamps. Not a stunning change. 12:19:32 12 Q. Is the shutdown supply current measured when 12:19:36 13 there is a load? 12:19:48 14 A. When the regulator is shut down, its not going 12:19:49 15 to matter whether there's a load or not. The regulator 12:19:53 16 is not regulating. 12:19:56 17 Q. Do you know how they measured the supply 12:19:57 18 current? 12:20:14 19 A. I would have to search through the data sheet 12:20:16 20 and see if they specify how they do that. 12:20:21 21 Q. Okay. Can you take a moment to see if there is 12:20:22 22 anything? 12:20:26 23 A. No, I don't see a precise definition of what 12:23:22 24 they mean by it. I -- I know what I would assume, but I 12:23:25 25 don't believe they have defined it. 12:23:31 Page 88
1 usages of quiescent current, quiescent would mean what 12:16:55 2 is the power drawn by the regulator when there's no 12:17:01 3 load. In the usage we saw in the 2990, quiescent 12:17:04 4 current had nothing to do with it being quiescent, but 12:17:09 5 was simply the power -- the current dissipated in the 12:17:12 6 regulator. And so this use of supply current is 12:17:15 7 consistent with the 2990 quiescent current. It's not 12:17:19 8 consistent with the usage of quiescent current in 12:17:23 9 Rincon-Mora and Al-Shyoukh. 12:17:28 10 Q. I see. It -- so is this supply current assuming 12:17:35 11 that there is a load or? 12:17:39 12 A. If we look at the top, it says "VN equals V" -- 12:17:46 13 (Reporter clarification.) 12:17:46 14 THE DEPONENT: VN equals V, subscript, out plus 12:17:55 15 1 volt, and it also assumes ILI load equals 0.1 12:17:57 16 milliamp, CL, C, subscript, L, equals 3.3 microfarads, 12:18:05 17 and shutdown is greater than VIH. TA ambient 12:18:14 18 temperature is 25 degrees C. 12:18:20 19 Q. So it -- I was asking, does that mean there is a 12:18:31 20 load? 12:18:36 21 A. So that would imply there is a load of 0.1 12:18:38 22 milliamps. 12:18:43 23 Q. The "L" stands for load? 12:18:45 24 A. The L subscript to UI is for load, yes. 12:18:47 25 Q. And do you see that below that, it says: 12:18:57 Page 87	1 Q. And I'm sorry to switch exhibits again. If you 12:23:32 2 could go back to the SD Micro, Exhibit 3. I think I 12:23:43 3 forgot to ask whether you knew how SD Micro measured the 12:23:49 4 quiescent current. 12:23:58 5 A. Again, I would have to look through the data 12:24:09 6 sheet. 12:24:13 7 Q. Yeah, please go ahead. 12:24:14 8 A. So in this case, there isn't a clear definition. 12:24:18 9 However, this is a three-pin regulator. If we look at 12:26:11 10 Figure 13 on page 15, you can see the vertical axis. 12:26:18 11 The figure is labeled quiescent current versus junction 12:26:29 12 temperature. The vertical axis is ID -- presumably that 12:26:32 13 is the quiescent current ranges -- from 4 to 5 12:26:38 14 milliamps. The conditions in the bottom of the table 12:26:42 15 say output current is 200 milliamps. So clear they're 12:26:44 16 not measuring output current. Input current is 12:26:49 17 presumably greater than 200 milliamps. 12:26:52 18 And so from this, I would presume by quiescent 12:26:55 19 current they are measuring the current through the 12:26:58 20 ground pin. But that is not -- they have not explicitly 12:27:00 21 stated what they're doing, but implicitly, I can't see 12:27:04 22 another way that they could be defining it. 12:27:08 23 Q. And in terms of the actual test they're 12:27:11 24 performing, do you know how they would have generated 12:27:16 25 this -- this curve shown on Figure 13? 12:27:20 Page 89

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1 A. Well, if -- the only thing that makes sense to 12:27:22 2 me is they are defining quiescent current to mean the 12:27:25 3 current through the ground pin. So in terms of a test, 12:27:28 4 you would simply operate the part with an input voltage 12:27:30 5 of 10 volts and an output voltage set to 5 volts, with a 12:27:34 6 200-milliamp load on it, or some resistor that given 5 12:27:40 7 volts draws 200 milliamps, and then measure how much 12:27:43 8 ground current is drawn. 12:27:45 9 Q. It looks like there's a schematic diagram of 12:27:47 10 this part on page 4, Figure 3. 12:27:55 11 Do you see that? 12:27:55 12 A. I do. 12:28:01 13 Q. And do you understand this to show various 12:28:01 14 transistors and resistors? 12:28:08 15 A. And diodes. 12:28:09 16 Q. And diodes. Diodes being the triangular the -- 12:28:11 17 the black triangles? 12:28:16 18 A. D1 and D2, yes. There's also a capacitor in 12:28:17 19 there. 12:28:20 20 Q. Oh, I see. C1? 12:28:21 21 A. Yes. 12:28:24 22 Q. Which of these components would you expect to 12:28:31 23 contribute to quiescent current? 12:28:35 24 A. Well, the definition of quiescent current here 12:28:37 25 is current through the ground pin, which is that 12:28:41 Page 90	1 or parameters that would affect quiescent current? 12:30:10 2 A. Yes. 12:30:13 3 Q. And what are those? 12:30:14 4 A. The precise values of the resistors, the leakage 12:30:17 5 in the transistors. We talked earlier about operating 12:30:23 6 points. And so the resistors are here to establish 12:30:29 7 operating points on the transistors, so the precise 12:30:32 8 operating point, you establish the temperature, the 12:30:35 9 value of VN. Many things contribute to quiescent 12:30:42 10 current. 12:30:49 11 Q. But here -- sorry. 12:30:49 12 By precise values of the resistors, did you -- 12:31:10 13 do mean the resistance of the -- 12:31:13 14 A. A resistor has resistance, and although there 12:31:15 15 are a bunch of things, at least 20 of them, labeled R 12:31:19 16 something that I'm assuming are resistors. 12:31:22 17 Q. Mm-hmm. 12:31:25 18 A. I'm not assuming they're all identical to one 12:31:25 19 another. 12:31:27 20 Q. Do the -- the sizes of the transistors affect 12:31:30 21 quiescent current? 12:31:35 22 A. Yes. 12:31:35 23 Q. And you're not assuming all the transistors are 12:31:39 24 the same size? 12:31:43 25 A. I know they're not. Some of the transistors are 12:31:44 Page 92
1 horizontal black line at the bottom. So all of the 12:28:45 2 components that lead down to that could be contributing 12:28:49 3 to quiescent current, which leads to pretty much 12:28:52 4 everything. 12:28:56 5 Q. Does -- do the -- do the components individually 12:28:59 6 contribute to quiescent current or? 12:29:06 7 A. Quiescent current is the sum of current drawn by 12:29:09 8 the part. So would you measure the current through 12:29:12 9 every component added together to get quiescent current? 12:29:16 10 No. 12:29:19 11 Q. Is it, for example, because you -- you 12:29:22 12 wouldn't -- you would be double or triple counting 12:29:24 13 things that are in a series? 12:29:27 14 A. Yes. And, you know, if you look at the 12:29:28 15 relationship between R16 and Q11, some of the current 12:29:31 16 through R16 also flows through Q11, some does not. 12:29:37 17 Q. Sorry. Where -- I'm trying to find the -- 12:29:42 18 A. It's in the bottom right quadrant. 12:29:44 19 Q. Oh, I see. Okay. 12:29:47 20 A. And so it -- you're not constrained strictly to 12:29:49 21 parallel and serial topologies here. But yes, you would 12:29:52 22 be double counting if you added the current through 12:29:57 23 every individual component, or triple or quadruple 12:29:59 24 counting. 12:30:04 25 Q. And are there certain component characteristics 12:30:04 Page 91	1 PNPs. Some of them are NPNs. They're not equivalent to 12:31:48 2 one another. 12:31:52 3 Q. Does the data sheet report the sizes of -- or -- 12:31:58 4 A. The purpose of a data sheet is to sell parts to 12:32:04 5 a customer. It is not to enable a competitor to make an 12:32:07 6 identical part. 12:32:11 7 Q. But they were -- all of these parameters would 12:32:12 8 be fixed at point of sale, right? 12:32:20 9 MR. JENSEN: Object to form. 12:32:22 10 THE DEPONENT: The dimensions of devices would 12:32:22 11 be fixed when you make the mask set. The reality is, 12:32:27 12 manufacturing of these tiny components is not infinitely 12:32:32 13 precise, and so even with the same mask set, there is 12:32:36 14 variation in the result. And furthermore, they may 12:32:39 15 depend on temperature. They may even depend on 12:32:47 16 operating voltage. 12:32:51 17 MR. LIU: I'm happy to break for lunch now. 12:33:01 18 THE VIDEOGRAPHER: Okay. This marks the end of 12:33:04 19 media unit 2. We are going off the record. The time is 12:33:07 20 12:33 p.m. 12:33:11 21 (A recess transpires.) 12:33:13 22 THE VIDEOGRAPHER: This marks the beginning of 13:25:20 23 media unit 3. We are going back on the record. The 13:25:23 24 time is 1:25 p.m. 13:25:27 25 /// 13:25:29 Page 93

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1 BY MR. LIU: 13:25:29	1 in Figure 8, which is above, and VGS is the gate to 13:28:50
2 Q. Welcome back, Dr. Taylor. 13:25:31	2 source voltage and VT is the threshold voltage of the 13:28:54
3 A. Thank you. 13:25:32	3 transistor." 13:28:59
4 Q. At any point today, have you spoken to your 13:25:33	4 Do you see that? 13:28:59
5 counsel about this deposition? 13:25:38	5 A. I see that. 13:29:00
6 A. About this deposition, no. 13:25:40	6 Q. Do you understand this to be -- is it a 13:29:00
7 Q. And that would include anything, any of the 13:25:42	7 derivative of the square law that we were looking at 13:29:05
8 topics we've been covering in this deposition, right? 13:25:52	8 earlier? 13:29:10
9 A. That's correct, yes. 13:25:56	9 MR. JENSEN: Object to form. 13:29:11
10 Q. Could you turn back to your declaration and take 13:25:57	10 THE DEPONENT: It relates to the square -- 13:29:12
11 a look at paragraph 60? It's on page 30. 13:26:11	11 the -- to that law, yes. 13:29:15
12 A. 30, 31. Yeah. Okay. 13:26:34	12 BY MR. LIU: 13:29:15
13 Q. And so you start this paragraph by saying that: 13:26:39	13 Q. How -- is this just a -- how did you arrive at 13:29:22
14 "The other term that matters to the efficiency 13:26:44	14 this -- this formula here? 13:29:27
15 of the LDO quiescent current." 13:26:46	15 A. I -- it's a classic formula. I mean, I first 13:29:30
16 A. I see that. 13:26:53	16 ran across it in my undergraduate education. But if you 13:29:35
17 (Reporter clarification.) 13:26:55	17 look at it, it is relating VGS, MOS VT, and IDS, which 13:29:40
18 Q. And then you end the paragraph by saying: 13:26:55	18 are the axes of the equation that you were talking about 13:29:48
19 "I note, however, that the relative importance 13:26:59	19 and that operating point, and yes, from that you can 13:29:51
20 of power efficiency highly depends on the application 13:27:01	20 derive this slope. 13:29:54
21 and is frequently not a design consideration." 13:27:05	21 Q. So I -- maybe I should clarify. 13:29:57
22 Do you see that? 13:27:05	22 Would you arrive at this equation by taking a 13:30:03
23 A. I see that. 13:27:10	23 derivative of the square law? 13:30:13
24 Q. Was quiescent current a significant design 13:27:11	24 MR. JENSEN: Object to form. 13:30:14
25 consideration for the -- the regulators in the data 13:27:16	25 THE DEPONENT: Yes. Applying differential 13:30:16
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1 sheets we have been looking at? 13:27:22	1 calculus leads you to this path. 13:30:18
2 MR. JENSEN: Object to form. 13:27:24	2 BY MR. LIU: 13:30:20
3 THE DEPONENT: I have no main -- no basis on 13:27:24	3 Q. And in paragraph 66, you provide a different 13:30:23
4 which to answer that question. 13:27:29	4 formula for GM. Do you see that? 13:30:30
5 BY MR. LIU: 13:27:31	5 MR. JENSEN: Object to form. 13:30:34
6 Q. And why is that? 13:27:32	6 THE DEPONENT: I see an alternative writing. If 13:30:36
7 A. You're asking what were the factors that the 13:27:35	7 you're familiar with differential calculus, you will 13:30:40
8 people who design -- the engineers who design these 13:27:40	8 recognize that the derivative is the delta with the 13:30:43
9 products evaluated and what they emphasize and didn't 13:27:44	9 delta approaching zero. They are strongly related. 13:30:49
10 emphasize. I don't know. 13:27:50	10 BY MR. LIU: 13:30:59
11 Q. There's nothing you would infer from the fact 13:27:54	11 Q. Can you explain what you mean by delta 13:31:01
12 that they reported quiescent currents in the data sheet? 13:27:58	12 approaching zero? 13:31:04
13 A. They reported operating temperature. 13:28:03	13 A. Are you familiar with differential calculus? 13:31:05
14 MR. JENSEN: Object to form. 13:28:05	14 Q. Somewhat, but let's start from -- 13:31:12
15 THE DEPONENT: They report lots of things. 13:28:05	15 A. So the -- 13:31:18
16 Quiescent current is unlikely to be something that they 13:28:08	16 Q. Let's assume that I have no familiarity 13:31:18
17 completely ignored, but you have to consider all the 13:28:10	17 with it -- 13:31:20
18 factors. 13:28:14	18 A. So -- 13:31:22
19 BY MR. LIU: 13:28:19	19 Q. -- for the record. 13:31:24
20 Q. If you could go to paragraph 68. 13:28:20	20 A. -- back to -- was it Figure 1? 13:31:24
21 A. Mm-hmm. 13:28:30	21 What you see there is a curve. And the question 13:31:31
22 Q. And you state that: 13:28:30	22 is, what's the slope of the curve. Well, you can draw 13:31:35
23 "In general, GM of a MOSFET is given by a GM 13:28:33	23 this orange line, which is a tangent, meaning it 13:31:42
24 equal to two times IDS divided by AGS, minus VT, where 13:28:37	24 intersects the curve at precisely at one point. One way 13:31:46
25 IDS is the drain to source current, the output current 13:28:46	25 to calculate the slope is you take the delta. You take 13:31:53
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1 the IDS at one point minus the IDS at another point, 13:31:55 2 divide it by the VGS minus VT at one point, another. 13:32:00 3 And if you look at the delta, what you see is, if you 13:32:05 4 move along the blue curve as you approach the operating 13:32:09 5 point, is that that delta approaches the same one you 13:32:13 6 would achieve you were using the orange line, the linear 13:32:18 7 approach, so that in the limit where the size of the gap 13:32:21 8 between the operating point and the point you're 13:32:27 9 measuring approaches zero, there is no difference 13:32:32 10 between the delta and the slope of the line. And 13:32:35 11 differential calculus is all about as you approach 13:32:38 12 the -- as your difference approaches zero. And there's 13:32:41 13 a footnote somewhere that talks about notation of delta 13:32:46 14 derivatives and partial derivatives. For the purposes 13:32:51 15 of this deposition, they're all equivalent definitions. 13:32:55 16 For the purposes of high-order mathematics, they're not 13:32:59 17 equivalent. 13:33:03 18 Q. So is it fair to say that the formula, or 13:33:04 19 equation, if you prefer, shown in paragraph 66, which 13:33:11 20 says "GM equals delta I out divided by delta VN," that 13:33:14 21 would only be valid for very small values of delta I 13:33:26 22 out? 13:33:29 23 A. It Will be more accurate as the deltas are made 13:33:29 24 smaller. But since it's a ratio, you can have a ratio 13:33:33 25 to small numbers that's not necessarily poorly defined. 13:33:39 Page 98	1 THE DEPONENT: So the relay -- the reason for 13:36:16 2 the division there is because both of those transistors 13:36:21 3 have the same VGS minus VT, and I'm assuming they have 13:36:25 4 the same length. If not, that would have to be 13:36:30 5 accounted for. And so then the current flowing in M25 13:36:33 6 is directly related to the current in MP, and the size 13:36:37 7 ratio. 13:36:41 8 BY MR. LIU: 13:36:42 9 Q. Okay. And then do you see a -- there's a -- an 13:36:42 10 annotation in red in the figure that Dr. Chen had made? 13:36:54 11 A. I see that. 13:36:57 12 Q. Do you understand that current to be going down 13:36:59 13 to M23? 13:37:04 14 A. I do. 13:37:05 15 Q. And then, so does the additional factor of M22 13:37:06 16 divided by M23 come from that current then being 13:37:11 17 mirrored from M23 to M22? 13:37:17 18 MR. JENSEN: Object to form. 13:37:20 19 THE DEPONENT: So that current flows into the 13:37:21 20 current mirror, and so again, assuming the same channel 13:37:25 21 length in M22 and M23, you get that ratio between the 13:37:29 22 input and output of the current mirror. 13:37:34 23 BY MR. LIU: 13:37:36 24 Q. And we're just talking about the red current, 13:37:36 25 right, not -- 13:37:39 Page 100
1 Q. Okay. And if you could go to paragraph 118 of 13:34:03 2 the declaration. There's another mathematical 13:34:35 3 expression you give there which I wanted to ask about. 13:34:40 4 So you're -- do you see there's a 13:34:49 5 fraction you've provided in that paragraph that says 13:34:54 6 "M25 times M22 divided by MP times M23"? 13:34:56 7 A. I do see that. 13:35:01 8 Q. And does that relate to the figure shown above 13:35:03 9 this paragraph? 13:35:07 10 A. Figure 28? 13:35:09 11 Q. Yes. You've labeled it Figure 28, "Al-Shyoukh 13:35:10 12 Figure 8 as annotated by Dr. Chen"? 13:35:15 13 A. Yes. 13:35:17 14 Q. So I just wanted to understand where this -- the 13:35:20 15 math is coming from. So I'll try to walk through it, 13:35:25 16 and you let me know if this is what you meant. 13:35:30 17 So I think -- you have MP. Does -- you have MP 13:35:34 18 and then M25 that are both connected at their gates, 13:35:54 19 right? 13:35:58 20 A. They're both connected at their gates, yes. 13:35:58 21 Q. And that's labeled node N2? 13:36:01 22 A. I -- it's labeled node N2. 13:36:03 23 Q. Based on that connection, are you applying a 13:36:08 24 factor of M25 divided by MP? 13:36:11 25 MR. JENSEN: Object to form. 13:36:15 Page 99	1 A. The -- 13:37:43 2 MR. JENSEN: Object to form. 13:37:43 3 THE DEPONENT: The current mirrors whatever 13:37:44 4 current comes into it, but the red current component 13:37:48 5 would appear, multiplied by that ratio in the drain M22. 13:37:52 6 (Reporter clarification.) 13:38:02 7 BY MR. LIU: 13:38:02 8 Q. So would you agree that -- do you see a blue 13:38:04 9 current as well? 13:38:07 10 A. I do. 13:38:07 11 Q. Would you agree that the blue current and the 13:38:08 12 red current would sum to the purple current? 13:38:11 13 MR. JENSEN: Object to form. 13:38:15 14 THE DEPONENT: So the current that flows into 13:38:16 15 the current mirror annotated in purple is the sum of the 13:38:19 16 current annotated I22 and the current coming out of the 13:38:25 17 drain of M25. 13:38:29 18 BY MR. LIU: 13:38:31 19 Q. But the -- the blue current marked I22, that 13:38:33 20 doesn't get a factor of M25 over MP, right? 13:38:38 21 A. It does not. 13:38:44 22 Q. And I'm sorry. If we could go to paragraph 68, 13:38:44 23 where we were looking at that MOSFET GM formula. 13:39:31 24 A. Okay. 13:39:47 25 Q. So in the middle of this paragraph, you state 13:39:49 Page 101

1 that there are three different ways that the GM of a 13:39:54 2 source follower can be raised? 13:39:58 3 A. Mm-hmm. 13:39:59 4 Q. And then you list the three, right? 13:40:00 5 A. Yes. 13:40:02 6 Q. And then I think in paragraph 69 through 71, 13:40:06 7 each of those paragraphs is dedicated to elaborating on 13:40:08 8 one of those three ways. Right? 13:40:13 9 A. I believe that's correct, yes. 13:40:15 10 Q. And so in the first paragraph -- now I'm talking 13:40:18 11 about 69 -- that says first, you say you can make the 13:40:21 12 source follower wider without changing the current 13:40:26 13 through it, and that's a way of raising GM, right? 13:40:28 14 A. Yes. 13:40:36 15 Q. Can you explain to me -- and then you say that's 13:40:36 16 because it reduces the denominator of GM, which the 13:40:39 17 denominator being VGS minus VT, correct? 13:40:44 18 A. And so if you make the transistor wider, the 13:40:50 19 current density drops and so you're changing VGS minus 13:40:53 20 VT. 13:40:58 21 Q. And then -- oh, I'm sorry. So it affects both 13:41:01 22 VGS and VT? 13:41:09 23 A. It affects the difference. 13:41:10 24 Q. I see. And then in the in -- paragraph 70, you 13:41:11 25 say that, second, raising the current through the source 13:41:23 Page 102	1 current IDS is flowing through both current sources? 13:43:24 2 A. Yes. 13:43:28 3 Q. So why -- why have you -- is it necessary for 13:43:53 4 both those current sources to have the same magnitude of 13:44:00 5 current to explain this third approach? 13:44:06 6 THE DEPONENT: The third -- 13:44:16 7 MR. JENSEN: Object to form. 13:44:17 8 THE DEPONENT: There are a large number of 13:44:17 9 approaches that -- a lot of ways you can add more 13:44:19 10 transistors. But the embodiment from the '074 patent 13:44:25 11 looks source of like this, and so that's why I chose 13:44:30 12 this description of an available technique. 13:44:39 13 MR. LIU: I think I might be close to done, so 13:46:38 14 can we just take a short break to see if I have more 13:46:40 15 questions? And -- okay. 13:46:43 16 THE VIDEOGRAPHER: Going off the record. The 13:46:47 17 time is 1:46 p.m. 13:46:48 18 (A recess transpires.) 13:46:50 19 THE VIDEOGRAPHER: Going back on the record. 13:56:18 20 The time is 1:56 p.m. 13:56:28 21 BY MR. LIU: 13:56:35 22 Q. Dr. Taylor, did you -- during the last break, 13:56:35 23 did you speak with your counsel about this deposition or 13:56:37 24 the substance of this deposition? 13:56:39 25 A. No, I did not. 13:56:40 Page 104
1 following increases the numerator of that formula 13:41:25 2 because the numerator is just 2 IDS, right? 13:41:28 3 A. Yes. 13:41:32 4 Q. And you're saying I -- I -- IDS increases so GM 13:41:34 5 increases? 13:41:38 6 A. Yep. 13:41:38 7 Q. And in the third paragraph, I noticed you don't 13:41:38 8 use this formula. And so now are you -- when you 13:41:46 9 describe the third approach to raising GM, are you no 13:41:52 10 longer referring to the GM of a MOSFET? 13:41:56 11 A. I am no longer referring to a source follower. 13:42:00 12 Q. Okay. 13:42:04 13 A. I'm saying that you -- you add more transistors, 13:42:06 14 you change the circuit topology, so the equation for a 13:42:09 15 GM source follower is not telling you what the GM of the 13:42:21 16 overall circuit is. 13:42:26 17 Q. Do you have an equation for a -- I'm just now 13:42:26 18 seeing an equation for the GM of the overall circuit in 13:42:39 19 paragraph 71. 13:42:43 20 A. That's because without knowing what specific 13:42:44 21 circuit topology you're talking about, there isn't such 13:42:48 22 an equation. 13:42:51 23 Q. Okay. And I just wanted to understand the 13:42:51 24 Figure 10 that's included in paragraph 71. So the first 13:43:13 25 question I have for you is, you state that the same 13:43:19 Page 103	1 MR. LIU: So I don't have further questions for 13:56:44 2 now, so pass the witness. 13:56:46 3 MR. JENSEN: Thank you. I would like to ask a 13:56:48 4 few follow-up questions, Dr. Taylor. 13:56:54 5 EXAMINATION 13:56:58 6 BY MR. JENSEN: 13:56:58 7 Q. Let me begin by asking you to pull out 13:56:58 8 Exhibit 2012. 13:57:09 9 A. The L70MxxAB, AC data sheet? 13:57:10 10 Q. That is the one, yes. 13:57:17 11 A. Okay. 13:57:20 12 Q. And do you recall being asked some questions 13:57:20 13 about the electrical characteristics in the -- this data 13:57:24 14 sheet? 13:57:32 15 A. Yes. 13:57:33 16 Q. And in particular, about the quiescent current? 13:57:35 17 A. Yes. 13:57:38 18 Q. And I believe you were asked some questions 13:57:38 19 about your understanding of what the quiescent current 13:57:42 20 referred to in this data sheet. Is that right? 13:57:46 21 A. Yes. We had questions about what does the term 13:57:49 22 mean and what is the value of it. 13:57:54 23 Q. And I believe you had identified Figure 13 in 13:57:55 24 the data sheet as providing additional information that 13:58:06 25 related to the measurement of the quiescent current. Is 13:58:10 Page 105

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1 that correct? 13:58:10 2 A. That is correct. 13:58:14 3 Q. I would like to direct your attention on the 13:58:14 4 next page to figure 16. 13:58:20 5 A. Okay. 13:58:24 6 Q. And what is the title of that figure? 13:58:24 7 A. Quiescent Current Versus Input Voltage. 13:58:27 8 Q. Does that provide any information to a PHOSITA 13:58:31 9 about the conditions that are used to measure the 13:58:37 10 quiescent current in this data sheet? 13:58:40 11 MR. LIU: Objection to form. 13:58:42 12 THE DEPONENT: Given that it specifies, you 13:58:43 13 know, the load current and input voltage, it -- it 13:58:51 14 provides hints there. Certainly the quiescent current 13:58:58 15 is not the load current, and so not the output current. 13:59:01 16 And so it's -- it's consistent with the prior diagram in 13:59:06 17 that the quiescent current seems very likely to be -- 13:59:12 18 the vertical axis ID to be the ground current on this 13:59:17 19 three-pin part. 13:59:20 20 BY MR. JENSEN: 13:59:24 21 Q. And more generally, you were asked about whether 13:59:24 22 various data sheets provided an express definition for 13:59:28 23 quiescent current. Do you recall that? 13:59:32 24 MR. LIU: Objection to form. 13:59:34 25 THE DEPONENT: I do recall that. 13:59:35 Page 106	1 in the art to a PHOSITA in the 2013 timeframe? 14:00:42 2 MR. LIU: Objection to form. 14:00:48 3 THE DEPONENT: The term would be known, yes. 14:00:49 4 The usage is not utterly unambiguous, but it's a term 14:00:52 5 they would have heard of and would have basic 14:01:00 6 understanding. 14:01:02 7 BY MR. JENSEN: 14:01:03 8 Q. If a data sheet did not provide an explicit 14:01:03 9 definition of quiescent current, would a PHOSITA use 14:01:06 10 their understanding of that term as it was generally 14:01:10 11 known in the art to interpret the data sheet? 14:01:13 12 MR. LIU: Objection to -- objection to form. 14:01:16 13 THE DEPONENT: Certainly. Certainly. 14:01:18 14 BY MR. JENSEN: 14:01:20 15 Q. Let me ask you to pull out Exhibit 2019. And 14:01:34 16 this is the data sheet for the TC1300 part. 14:01:44 17 Do you see that? 14:01:48 18 A. I see that. 14:01:49 19 Q. And you were asked some questions about the 14:01:51 20 parameter labeled supply current on page 3 of the data 14:01:54 21 sheet? 14:02:00 22 A. I was. 14:02:00 23 Q. And I believe you were asked to look at whether 14:02:01 24 this data sheet in Exhibit 2019 used the word "quiescent 14:02:10 25 current." 14:02:16 Page 108
1 BY MR. JENSEN: 13:59:37 2 Q. And I believe you said that not all the data 13:59:38 3 sheets did provide an expressed definition. Is that 13:59:40 4 correct? 13:59:45 5 MR. LIU: Objection to form. 13:59:45 6 THE DEPONENT: I think I probably used the word 13:59:45 7 "explicit definition," but yes. 13:59:48 8 BY MR. JENSEN: 13:59:50 9 Q. Explicit definition. Thank you. 13:59:50 10 I -- is it necessary for a PHOSITA to understand 13:59:52 11 the meaning of quiescent current in a data sheet for the 13:59:56 12 data sheet to provide an explicit definition? 14:00:00 13 MR. LIU: Objection to form. 14:00:03 14 THE DEPONENT: It -- I'm not entirely sure what 14:00:04 15 you're asking. But certainly a PHOSITA brings some 14:00:10 16 understanding of what matters to his reading, and so the 14:00:15 17 fact that there's not an explicit definition of 14:00:18 18 quiescent current, you know, is it measured at load 14:00:21 19 equals zero or -- or some other condition, is not a 14:00:24 20 fundamental barrier to a PHOSITA gaining the 14:00:27 21 understanding they need to use the part. 14:00:35 22 BY MR. JENSEN: 14:00:36 23 Q. Let me maybe take one step back and -- and ask 14:00:36 24 this question. 14:00:38 25 Is quiescent current a term that would be known 14:00:39 Page 107	1 Do you recall that? 14:02:16 2 A. I recall that, yes. 14:02:18 3 Q. And I believe your answer in the brief time you 14:02:19 4 had to review it was that you did not see the word 14:02:22 5 "quiescent current." Is that right? 14:02:24 6 A. That is correct. 14:02:26 7 Q. What relationship, if any, would a PHOSITA 14:02:27 8 understand there to be between what is labeled supply 14:02:32 9 current in Exhibit 2019 and quiescent current? 14:02:35 10 MR. LIU: Objection to form. 14:02:40 11 THE DEPONENT: Again, it depends on how you 14:02:40 12 define quiescent current. The definition that we saw 14:02:45 13 used earlier in the Texas Instrument part was a 14:02:48 14 quiescent current is literally the current consumed by 14:02:52 15 the regulator, whether the output is loaded or not. And 14:02:55 16 a PHOSITA would recognize that that definition fits very 14:03:00 17 nicely with this definition of supply current. That is 14:03:05 18 different than Rincon-Mora or the Al-Shyoukh definition, 14:03:09 19 which is quiescent current is measured when the load 14:03:13 20 current is zero. 14:03:16 21 BY MR. JENSEN: 14:03:17 22 Q. So I wanted to ask a follow-up question on that. 14:03:18 23 And first, I believe that you had testified on 14:03:25 24 cross-examination that the quiescent current or supply 14:03:34 25 current in the data sheets is not necessarily the exact 14:03:36 Page 109

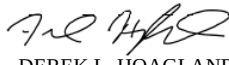
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1 same thing as the quiescent current definition used in 14:03:39 2 the Rincon-Mora reference or Al-Shyoukh. Is that 14:03:42 3 correct? 14:03:42 4 A. That's right. 14:03:48 5 MR. LIU: Object to -- objection to form. 14:03:49 6 BY MR. JENSEN: 14:03:52 7 Q. Let me ask you to turn in your declaration to 14:04:00 8 paragraph 134. 14:04:03 9 MR. LIU: And I will object. This is outside 14:04:20 10 the scope of the cross. 14:04:22 11 BY MR. JENSEN: 14:04:25 12 Q. And in paragraph 134, you include a table. 14:04:26 13 Do you see that? 14:04:30 14 A. I do. 14:04:33 15 Q. And in the table, you've highlighted a row IQ 14:04:34 16 with the units of milliamps. 14:04:41 17 Do you see that? 14:04:43 18 A. I see that. 14:04:44 19 Q. What does IQ refer to in that row? 14:04:44 20 MR. LIU: I'll object as outside the scope of 14:04:49 21 the cross. 14:04:52 22 THE DEPONENT: IQ was quiescent current with an 14:04:52 23 attempt to be the quiescent current as defined by 14:04:56 24 Rincon-Mora and Al-Shyoukh. For some products, that was 14:05:02 25 not available. 14:05:05 Page 110	1 MR. LIU: Counsel, he was never asked about 14:05:57 2 the -- 14:05:59 3 MR. JENSEN: You made your objection, Stephen. 14:05:59 4 You don't get to do a speaking objection. Your 14:06:01 5 objection is on the record. I'm going to continue with 14:06:04 6 the redirect. 14:06:06 7 MR. LIU: Then you're definitely going out of 14:06:07 8 the scope. This is improper. 14:06:10 9 MR. JENSEN: It's not improper at all. We have 14:06:12 10 a disagreement. 14:06:13 11 BY MR. JENSEN: 14:06:14 12 Q. Dr. Taylor, my question for you is: In the 14:06:15 13 table that you included in paragraph 134 of your 14:06:19 14 declaration, why did you think it was appropriate to 14:06:24 15 compare a quiescent current value from a data sheet that 14:06:29 16 may not necessarily have the exact same definition of 14:06:34 17 quiescent current as the Rincon-Mora or Al-Shyoukh 14:06:37 18 references used? 14:06:42 19 MR. LIU: Objection. Outside the scope. 14:06:43 20 Paragraph 134 was -- never came up during the cross. 14:06:45 21 THE DEPONENT: It was the best values that I 14:06:48 22 could use. This is a low current, but not a zero 14:06:53 23 current load, so it's not irrelevant, it's not utterly 14:07:00 24 different, but it's not precisely identical. 14:07:04 25 /// 14:07:06 Page 112
1 BY MR. JENSEN: 14:05:07 2 Q. And in this table, which is Figure 31, you've 14:05:07 3 added to the figure from Al-Shyoukh two columns on 14:05:13 4 the -- or I don't know how many columns. You added at 14:05:20 5 least one column. 14:05:23 6 A. One column. 14:05:24 7 Q. And that is highlighted in green? 14:05:24 8 A. And that is a product, yes. 14:05:26 9 Q. And that corresponds -- 14:05:27 10 MR. LIU: Objection. Outside the scope. 14:05:28 11 BY MR. JENSEN: 14:05:30 12 Q. That corresponds to a data sheet, correct? 14:05:30 13 A. It does correspond to a data sheet. 14:05:32 14 MR. LIU: Objection. Counsel, this product data 14:05:33 15 sheet, it was never discussed during the 14:05:37 16 cross-examination. 14:05:40 17 BY MR. JENSEN: 14:05:40 18 Q. Dr. Taylor, were you asked about various voltage 14:05:41 19 regulator data sheets during your cross -- during your 14:05:45 20 direct examination? 14:05:49 21 A. I was asked about data sheets. 14:05:49 22 Q. Were you asked about quiescent currents in those 14:05:51 23 data sheets? 14:05:54 24 A. I was asked about quiescent currents in the data 14:05:54 25 sheets. 14:05:57 Page 111	1 BY MR. JENSEN: 14:07:06 2 Q. During your cross-examination, Dr. Taylor, do 14:07:23 3 you recall being asked some questions that related to 14:07:28 4 the amount of leakage in transistors and how that 14:07:30 5 contributes to quiescent current? 14:07:36 6 MR. LIU: Objection to form. 14:07:39 7 THE DEPONENT: In one of these data sheets, yes. 14:07:40 8 BY MR. JENSEN: 14:07:44 9 Q. How, if at all, does the size of a transistor 14:07:56 10 bear on the amount of leakage current? 14:08:01 11 A. Specify size. 14:08:04 12 Q. The length and width of a transistor. 14:08:07 13 So I'll narrow my question. Let's start with 14:08:18 14 the length of a transistor. 14:08:19 15 A. In general, if you hold all other technology 14:08:20 16 parameters constant, as transistors get longer, the 14:08:26 17 drive current goes down and the leakage current goes 14:08:31 18 down. 14:08:33 19 Q. What units are typically used to identify the 14:08:33 20 length of a transistor? 14:08:49 21 MR. LIU: Objection to form. 14:08:51 22 BY MR. JENSEN: 14:08:52 23 Q. The channel length? 14:08:52 24 A. The transistor channel length is generally -- 14:08:52 25 well, measured at a length, microns or nanometers, 14:09:02 Page 113

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1 depending on technology generation. 14:09:06 2 Q. What do you mean by the term "technology 14:09:07 3 generation"? 14:09:10 4 A. Technology changes over time, and in 14:09:10 5 microelectronics in general, that has involved making 14:09:17 6 things smaller as you move to more advanced 14:09:19 7 technologies. And so it seems every year the technology 14:09:23 8 that is available is better than the older technologies. 14:09:30 9 And you tend to assign it to a length number, but it's 14:09:35 10 there are many attributes in technology that change. 14:09:37 11 Q. And in the 2013, 2014 timeframe, what were the 14:09:39 12 common and contemporaneous technology nodes used to 14:09:49 13 manufacture transistors? 14:09:54 14 A. There were -- 14:09:55 15 MR. LIU: Objection to form. 14:09:57 16 THE DEPONENT: There were a range of 14:09:57 17 technologies being used to make transistors, depending 14:10:02 18 on what applications were in question. So the bleeding 14:10:04 19 edge at that point, what I was working on at Intel, 14:10:10 20 would have been 14, 20 nanometers. Other products would 14:10:13 21 have been larger dimensions, possibly, you know, three 14:10:18 22 or five times larger. 14:10:24 23 BY MR. JENSEN: 14:10:33 24 Q. Do you recall what technology node was used in 14:10:34 25 connection with the Rincon-Mora design? 14:10:42 Page 114	1 contemporaneous manufacturing technology in 2013? 14:12:21 2 MR. LIU: Objection to form. This is outside 14:12:25 3 the scope. 14:12:27 4 THE DEPONENT: It would depend on the goals the 14:12:28 5 engineer is faced with. Are they trying to raise 14:12:36 6 performance? Are they trying to match performance? But 14:12:39 7 I would expect the engineer on the more advanced 14:12:44 8 technologies to have more freedom to move the design 14:12:47 9 where they wanted to, and if you just, you know, were 14:12:50 10 not trying to fundamentally change anything, I would 14:12:54 11 expect you would get lower leakage and higher 14:12:56 12 performance. 14:12:58 13 BY MR. JENSEN: 14:13:03 14 Q. When you say lower leakage, can you be any more 14:13:03 15 specific about that? 14:13:06 16 MR. LIU: Objection to form. Outside the scope. 14:13:06 17 THE DEPONENT: Given the differences in 14:13:11 18 technology, they're going to be significant. This is 14:13:12 19 not a 5 or 10 percent shift. You -- there is much more 14:13:15 20 freedom available to the designer, both in terms of 14:13:19 21 transistor performance and transistor budget. As you 14:13:22 22 make transistors smaller, you can use more transistors 14:13:26 23 to do the same function, and that gives you more design 14:13:29 24 flexibility. 14:13:33 25 /// 14:13:34 Page 116
1 A. Rincon-Mora was on a 2 micron technology, which 14:10:45 2 actually shows up on that table you were referring to. 14:10:49 3 Q. And do you recall what manufacturing technology 14:10:51 4 node was used and discussed in connection with the 14:10:56 5 Al-Shyoukh voltage regulator design? 14:11:00 6 MR. LIU: Objection to form. Outside scope. 14:11:03 7 THE DEPONENT: That is .35 micron, 350 14:11:05 8 nanometer, technology. 14:11:10 9 BY MR. JENSEN: 14:11:11 10 Q. How do those manufacturing technology nodes 14:11:12 11 compare, in terms of transistor size and leakage 14:11:16 12 current, to the manufacturing technologies that were 14:11:22 13 commonly in use in 2013 and 2014? 14:11:25 14 MR. LIU: Objection to form. Outside scope. 14:11:30 15 THE DEPONENT: Those technologies are -- they 14:11:33 16 are much older technologies than the ones widely used in 14:11:37 17 2013, which would mean lower GM, lower performance, 14:11:40 18 which means that if you were redesigning products, you 14:11:50 19 know, if you were to take Al-Shyoukh's work and produce 14:11:58 20 it in a more advanced technology, you would expect to 14:12:01 21 get better performance. 14:12:03 22 BY MR. JENSEN: 14:12:04 23 Q. What would you expect in terms of leakage 14:12:06 24 current if you were to implement the Rincon-Mora or 14:12:09 25 Al-Shyoukh voltage regulator designs in a 14:12:16 Page 115	1 BY MR. JENSEN: 14:13:34 2 Q. If someone were not familiar with the micron 14:13:35 3 and -- and nanometer units that -- that you use to 14:13:39 4 describe the channel lengths and the manufacturing 14:13:45 5 technology nodes, could you provide a relative 14:13:49 6 comparison of the size of a transistor in a 2-micron 14:13:52 7 process versus a 20-nanometer process? 14:13:59 8 MR. LIU: Objection to form. Outside scope. 14:14:03 9 THE DEPONENT: If you were to just look at the 14:14:04 10 numbers, you would say 2 nanometers is 100 times bigger. 14:14:09 11 But transistors take up area. They're a square. So in 14:14:15 12 terms of area, eh, ballpark of 10,000X difference. As 14:14:20 13 you push to the end, you know, it may not be quite that 14:14:28 14 much, but it's a very significant difference. 14:14:31 15 BY MR. JENSEN: 14:14:34 16 Q. And given that orders of magnitude difference in 14:14:35 17 size between 2-two micron design process and a 14:14:39 18 20-nanometer design process, how much improvement would 14:14:48 19 a PHOSITA expect to see in quiescent current in a 14:14:51 20 voltage regulator design like Rincon-Mora or Al-Shyoukh? 14:14:55 21 MR. LIU: Objection to form. Outside scope. 14:15:00 22 THE DEPONENT: There is such a vast difference 14:15:02 23 there that it's difficult to quantify. You're comparing 14:15:05 24 an antique to a really modern process, and you could see 14:15:13 25 orders of magnitude variation in any of these parameters 14:15:19 Page 117

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1 when you look at it coming up. I mean, I've seen 14:15:23 2 pictures that are just stunning when you make these 14:15:29 3 insane variations between technology, but you're talking 14:15:31 4 about what would be the size of a via, just a connection 14:15:34 5 between two metal wires in the 2-micron technology. You 14:15:39 6 might put the whole voltage regulator inside that one 14:15:42 7 little area. More realistically, you're spending a 14:15:45 8 little more area and you're going to do -- have 14:15:48 9 incredible freedom to change the results that you get. 14:15:52 10 BY MR. JENSEN: 14:16:06 11 Q. What impact, if any, would the improvements do 14:16:07 12 to the manufacturing process in terms of leakage and 14:16:12 13 quiescent current have on a PHOSITA's motivation to add, 14:16:15 14 enable, or disable functionality to either Rincon-Mora 14:16:20 15 or Al-Shyoukh's regulator design? 14:16:24 16 MR. LIU: Objection to form. Outside scope. 14:16:27 17 THE DEPONENT: In -- if you can find -- you 14:16:28 18 know, if you can reduce the leakage current without 14:16:35 19 adding the complexity of enable and disable, it's -- 14:16:38 20 it's a nicer way to go. It raises fewer validation 14:16:45 21 questions. It would reduce the motivation to do that. 14:16:49 22 MR. JENSEN: No further questions. 14:16:54 23 MR. LIU: Can you give me five minutes? 14:16:55 24 MR. JENSEN: Sure. 14:16:59 25 THE VIDEOGRAPHER: Going off the record. The 14:17:00 Page 118	1 I declare under penalty of perjury 2 under the laws that the foregoing is 3 true and correct. 4 5 Executed on _____, 20____, 6 at _____, _____. 7 8 9 10 11 _____ 12 SIGNATURE OF THE WITNESS 13 14 15 16 17 18 19 20 21 22 23 24 25 Page 120
1 time is 2:17 p.m. 14:17:03 2 (A recess transpires.) 14:17:05 3 THE VIDEOGRAPHER: Back on the record. 2:25 p.m. 14:25:01 4 MR. LIU: So Aptive objects to the lines of 14:25:12 5 questioning that were outside the scope of the 14:25:15 6 cross-examination. It's past 5:00 p.m. Eastern. We'll 14:25:18 7 take it up with the board by moving to strike. 14:25:24 8 But for now, I don't have any further questions 14:25:26 9 for you, Dr. Taylor. 14:25:29 10 MR. JENSEN: All right. And Microchip disagrees 14:25:31 11 with the objections, and I think that Aptive plainly 14:25:33 12 opened the door to the line of questioning on -- on 14:25:37 13 redirect. 14:25:42 14 And I will say, this is your opportunity to ask 14:25:42 15 any further questions. We're located in the Pacific 14:25:44 16 time zone. It's 2:25 p.m. The fact that it's after 14:25:47 17 5 o'clock in the Eastern Time zone is of no relevance 14:25:51 18 whatsoever. And we would oppose any motion to strike, 14:25:54 19 and we would -- patent owner would reserve the right to 14:26:02 20 read and sign as well. 14:26:06 21 THE VIDEOGRAPHER: We are off the record at 2:26 14:26:07 22 p.m., And this concludes today's testimony given by 14:26:10 23 Dr. Greg Taylor. The total number of media used was 14:26:17 24 three and will be retained by Veritext Legal Solutions. 14:26:20 25 (Proceeding Concludes at 2:26 p.m.) Page 119	1 REPORTER'S CERTIFICATE 2 3 STATE OF CALIFORNIA) ss. 4 I, DEREK L. HOAGLAND, CSR #13445, State of California, 5 do hereby certify: 6 That prior to being examined, the witness named in the 7 foregoing proceeding was by me sworn to testify to the 8 truth, the whole truth and nothing but the truth; 9 That said proceeding was taken down by me by stenotype 10 at the time and place therein stated and thereafter 11 transcribed under my direction into computerized 12 transcription. 13 I further certify that I am not of counsel nor attorney 14 for nor related to the parties hereto, nor am I in any 15 way interested in the outcome of this action. 16 In compliance with section 8016 of the Business and 17 Professions Code, I certify under penalty of perjury 18 that I am a certified shorthand reporter with license 19 number 13445 in full force and effect. 20 Witness my hand this March 28, 2025. 21 22 23  24 DEREK L. HOAGLAND, CSR #13445 25 Page 121

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