

1 UNITED STATES PATENT AND TRADEMARK OFFICE
2 BEFORE THE PATENT TRIAL AND APPEAL BOARD
3
4 _____
5 QSC AUDIO PRODUCTS, INC.,)
6 Petitioners,)
7 vs.) Case No. IPR2014-00131
8 CREST AUDIO, INC.,) U.S. Patent 5,652,544
9 Patent Owner.)
10 _____)

11

12

13

14 VIDEO DEPOSITION OF DANIEL P.W. ELLIS, Ph.D.

15 Seattle, Washington

16 Friday, June 27, 2014

17

18

19

20

21 Reported by:

22 Donald W. McKay, RMR, CRR, CCR 3237

23

24 Job No. 54823

25

CREST 2002

1 UNITED STATES PATENT AND TRADEMARK OFFICE
2 BEFORE THE PATENT TRIAL AND APPEAL BOARD
3
4 _____
5 QSC AUDIO PRODUCTS, INC.,)
6 Petitioners,)
7 vs.) Case No. IPR2014-00131
8 CREST AUDIO, INC.,) U.S. Patent 5,652,544
9 Patent Owner.)
10 _____)

11
12
13
14
15
16
17
18
19
20
21
22
23
24
25

Video deposition of DANIEL P.W. ELLIS, Ph.D.,
taken on behalf of Patent Owner, at 1201 Third Avenue,
Suite 4900, Seattle, Washington, beginning at 9:00 a.m.
and ending at 6:02 p.m., on Friday, June 27, 2014,
before Donald W. McKay, RMR, CRR, CCR No. 3237.

1 A P P E A R A N C E S

2

3 FOR THE PETITIONERS:

4 KAUSTUV M. DAS, ESQ.

5 RODNEY C. TULLETT, ESQ.

6 Perkins Coie LLP

7 1201 Third Avenue

8 Suite 4900

9 Seattle, Washington 98101

10 206.359.8000

11 kmdas@perkinscoie.com

12 rtullett@perksinscoie.com

13

14 FOR THE PATENT OWNER:

15 N. ANDREW CRAIN, ESQ.

16 VIVEK A. GANTI, ESQ.

17 ROBERT D. GRAVOIS, ESQ. (by telephone)

18 Thomas Horstemeyer LLP

19 400 Interstate Parkway SE

20 Suite 1500

21 Atlanta, Georgia 30339

22 770.933.9500

23 andrew.crain@thomashorstemeyer.com

24 vivek.ganti@thomashorstemeyer.com

25 robert.gravois@thomashorstemeyer.com

1 A P P E A R A N C E S (continued)

2

3 ALSO PRESENT:

4 SPENCER MEAD (by telephone)

5 Technical Advisor

6 Thomas Horstemeyer LLP

7

8 PATRICK NORTON

9 Videographer

10

11

12

13

14

15

16

17

18

19

20

21

22

23

24

25

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25

I N D E X

EXAMINATION BY	PAGE
MR. CRAIN.....	7
MR. DAS.....	226
MR. CRAIN.....	233

E X H I B I T S

NUMBER	DESCRIPTION	PAGE
Exhibit 11	Patent Owner's Notice of Deposition of Dr. Daniel Ellis	11
Exhibit 12	Corrected Petition for Inter Partes Review of U.S. Patent No. 5,652,544	19
Exhibit 13	Expert Declaration of Daniel Ellis, Ph.D.	19
Exhibit 14	United States Patent No. 5,652,544, dated July 29, 1997	20
Exhibit 15	Document titled TMS320 Second Generation Digital Signal Processors	50
Exhibit 16	United States Patent No. 5,822,775, dated October 13, 1998	141
Exhibit 17	International Application Published Under the Patent Cooperation Treaty, Application No. PCT/N090/00178	204

1 Seattle, Washington; Friday, June 27, 2014

2 9:00 a.m.

3

4 THE VIDEOGRAPHER: We're on the record.

5 This is the beginning of Media No. 1 in the
6 deposition of Dr. Daniel Ellis, in the matter of QSC
7 Audio Products, Inc., versus Crest Audio, Inc.,
8 Case No. IPR2014-00131.

9 Today's date is June 27, 2014 and the time is
10 9:00 a.m.

11 My name is Patrick Norton and I am the
12 videographer. The court reporter is Donald McKay. We
13 are here with Huseby Court Reporting.

14 Counsel please introduce yourselves, after which
15 the court reporter will swear in the witness.

16 MR. CRAIN: This is Andrew Crain and Vivek Ganti
17 for the patent owner, Crest Audio.

18 MR. GRAVOIS: This is Robert Gravois and Spencer
19 Mead, on behalf of the patent owner, Crest Audio.

20 MR. DAS: Kaustuv M. Das, on behalf of
21 petitioner, QSC Audio Products LLC. Along with me,
22 Rodney Tullett.

23 ///

24 ///

25 ///

1 DANIEL P.W. ELLIS, Ph.D. called as a witness in the
2 above-entitled cause, being
3 first duly sworn, testified
4 as follows:

6 EXAMINATION

7 BY MR. CRAIN:

8 Q. Good morning, Dr. Ellis.

9 A. Good morning.

10 Q. I just want to run through some of the same type
11 of housekeeping-type issues that we did yesterday. I'll
12 try to do it more quickly since this is day two of our
13 time together in deposition.

14 A. Okay.

15 Q. As you know, my name is Andrew Crain. Just for
16 this record, would you go ahead and introduce yourself
17 and give your name and address.

18 A. Daniel Ellis, 456 Riverside Drive, Apartment 8B,
19 New York, New York. Did you want my telephone number as
20 well?

21 Q. That's fine.

22 I think I asked you yesterday, had you ever been
23 deposed before, and you said no.

24 A. That's right.

25 Q. So now the answer to that would be yes.

1 A. That's right.

2 Q. From yesterday, obviously.

3 As you'll know, just like yesterday, I will ask
4 you questions. Your answers will be recorded by the
5 court reporter to your left, and also recorded across
6 the way by the videographer. To that end, please
7 remember that we need to have verbal responses to
8 questions so that our court reporter can record yeses
9 and nos.

10 A. Yes.

11 Q. I think we did run into a couple of instances
12 yesterday where we need to speak clearly --

13 A. Right.

14 Q. -- so that we can get to that.

15 They will certainly remind us if we have any
16 troubles. Are you okay with that?

17 A. Yes.

18 Q. Okay. Very good.

19 I'm sure yesterday, I think I probably asked a
20 few questions that I probably didn't state very well.
21 Much like yesterday, if I do that today, I ask that you
22 please let me know that a question is unclear to you for
23 any reason --

24 A. Yes.

25 Q. -- and I will do my best to try to address the

1 point of unclarity for you.

2 A. Thank you.

3 Q. If you answer the question without doing that,
4 then I'll just understand that you understood the
5 question.

6 A. Right.

7 Q. Is that fair?

8 A. Yes.

9 Q. Just like yesterday, we'll plan to go for
10 periods of about an hour, an hour and 15 minutes or so.
11 If you need a break at any time, that's fine, please let
12 me know. We'll do our best to accommodate that as
13 quickly as possible. My only request to you, like
14 yesterday, is if there is a question pending, that you
15 go ahead and answer the question as fully and completely.
16 The only caveat to that would be if there is an issue of
17 privilege. It's not my desire to get into issues that
18 are truly protected by an applicable privilege, but to
19 the extent you can answer the question without doing
20 that, I would like to go ahead and try to do that and
21 we'll take the break. Is that okay?

22 A. That's great.

23 Q. Certainly, if you need to speak with one of the
24 attorneys that are present in the room, you're more than
25 welcome to do that. If there is a question outstanding,

1 those same instructions. Let's try to answer the
2 question to the extent we can, without getting into the
3 substance of any privilege content that you may feel is
4 potentially invoked by the question. Is that okay?

5 A. Yes.

6 MR. DAS: Just to clarify, if you're not sure if
7 privilege applies and you need to speak with Mr. Tullett
8 or me, feel free to do that before responding to the
9 question.

10 THE WITNESS: Okay.

11 BY MR. CRAIN:

12 Q. Each situation will be fact specific or it will
13 be unique unto itself. So I'm sure we can work through
14 it. I don't think we had a problem with it yesterday.

15 A. No.

16 Q. I don't think it came up yesterday. But again,
17 I want to remind you, if you happen to recall
18 information that may be responsive to an earlier
19 question that you didn't share with me when the earlier
20 question was posed to you, what I would like for you to
21 do is stop the question or just stop us wherever we are,
22 and go back and address whatever the prior information
23 that's come to your mind may be. Once we feel like --
24 once you feel like we've exhausted that information and
25 you've provided a full and complete response, based upon

1 your remembering new information, then we'll jump back
2 to wherever we were. Is that okay?

3 A. That's great.

4 Q. Much like yesterday, we'll probably be talking
5 about some documents. If you feel like there is a
6 document that may help you frame a response, please let
7 me know. I may have it. But I mean if you -- there
8 were a couple times yesterday where maybe we don't have
9 a document, but if you can at least identify it, that
10 can be helpful to the process as well, to the best you
11 can.

12 Dr. Ellis, do you happen to be taking any
13 medications or can you think of any other reasons that
14 might make it difficult for you to answer my questions
15 today?

16 A. No.

17 Q. Can you think of any reason, Dr. Ellis, why you
18 may not be able to answer my questions truthfully today?

19 A. No.

20 Q. Do you understand that you're under oath?

21 A. Yes.

22 (Exhibit 11 marked for identification.)

23 BY MR. CRAIN:

24 Q. I'm going to hand to you what we've marked as
25 Exhibit 11. Would you please take a moment to review it

1 and let me know when you have completed your review.

2 A. Okay.

3 Q. Are you able to identify what appears to be
4 Exhibit 11?

5 A. It appears to be the notice of this deposition.

6 Q. Do you recall if you've ever seen a document
7 like Exhibit 11 before?

8 A. I think I have. Yeah, I've seen a document like
9 it. I think I've seen this one before.

10 Q. Or a copy of it.

11 Do you have any understanding of whether or not
12 Exhibit 11 is why you're here today?

13 A. I understand that's why I'm here today.

14 Q. I know we talked about some of these issues
15 yesterday. I want to walk through some of them again.
16 To the extent there is any differences, then we can talk
17 about that. There may not be. That may help us move
18 things along.

19 Dr. Ellis, can you describe for me what you did
20 in preparation for today's deposition.

21 A. I reviewed some documents relating to my
22 declaration, and I had discussions with my attorneys.
23 So the attorneys.

24 Q. Do you recall what documents you reviewed in
25 relation to your declaration?

1 MR. DAS: I'm going to object on privilege and
2 work product grounds and instruct the witness not to
3 respond.

4 MR. CRAIN: Let me see if I understand. You're
5 not going to let him answer what documents he reviewed
6 in preparation for his deposition?

7 MR. DAS: Yes.

8 MR. CRAIN: Under what basis?

9 MR. DAS: On the basis that that can go to our
10 strategy and what documents we are showing him. Again,
11 what documents he relied on in preparing his opinion,
12 that's fair game, but what documents we have elected to
13 show him to prepare for his deposition is not fair game.

14 MR. CRAIN: I didn't ask him what documents you
15 showed him. I asked him what documents he reviewed.

16 MR. DAS: And the --

17 MR. CRAIN: So you're construing it to be that
18 he reviewed no documents other than what you showed him?

19 MR. DAS: If you can respond to that question
20 without getting into documents that were given to you by
21 QSC's attorneys, then you can answer that question. But
22 I would instruct you not to get into documents that were
23 given to you to review by QSC's attorneys.

24 MR. CRAIN: All right. I disagree with that
25 instruction, but let's see if we can -- what we can

1 parse out. Then we're going to come back to that issue.

2 MR. DAS: Sure.

3 MR. CRAIN: Because that objection was not
4 lodged yesterday. And we got into, I think, a number of
5 documents in the transcript. But we'll see.

6 BY MR. CRAIN:

7 Q. What documents did you review in preparation for
8 your deposition?

9 A. I reviewed my declaration and the references
10 that I -- the references that I make reference to in the
11 declaration and the patent at issue.

12 MR. DAS: Who just joined?

13 MR. CRAIN: Robert, are you still there?

14 MR. GRAVOIS: I'm still here. I don't know what
15 that was.

16 BY MR. CRAIN:

17 Q. When you reference -- that's a bad word -- when
18 you reviewed the references that you make reference
19 to -- if you can follow me there -- does that include
20 all references that are recited or listed in your
21 declaration?

22 MR. DAS: Objection, form.

23 THE WITNESS: I think so. If you want to show
24 me the declaration, I can check.

25 BY MR. CRAIN:

1 Q. Well, it's at least your belief that you
2 reviewed all of the documents that are referenced in
3 your declaration?

4 A. Yes. I mean, the ones that I'm using as the
5 basis for my -- for my points.

6 Q. When did you review the references that are
7 identified in your declaration?

8 A. I reviewed them earlier this week.

9 Q. Was that on Tuesday?

10 A. That includes Tuesday.

11 Q. Again, to the extent we can streamline this from
12 our discussion yesterday, I will try to do that, because
13 I think it could help us conclude earlier. I understand,
14 from your testimony yesterday, that you met with your
15 attorneys on Wednesday, and then you did some review on
16 Tuesday, if I understood you correctly.

17 A. Yes.

18 Q. So I'm just trying to understand, is this
19 contemporaneous with that or not?

20 A. Yes.

21 MR. DAS: Objection to form.

22 BY MR. CRAIN:

23 Q. Approximately how much time do you recall
24 spending on Tuesday with respect to your declaration or
25 any of the references contained or referenced in it?

1 MR. DAS: Objection, form.

2 THE WITNESS: So on Tuesday, I was traveling out
3 here for both yesterday and today's deposition. I was
4 reviewing documents relevant to both events. The total
5 time spent was eight to ten hours.

6 BY MR. CRAIN:

7 Q. Are you able to parse the amount of time that
8 you spent reviewing the declaration and references
9 related to the '544 patent in comparison to the '542
10 patent and its documents that you may have reviewed?

11 A. Not easily.

12 Q. Are you able to give me an approximation?

13 A. A first approximation would be that I spent
14 equal time on both.

15 Q. Okay. What other documents did you review in
16 preparation for your deposition?

17 MR. DAS: Again, if you can answer that question
18 without getting into privileged issues, feel free to do
19 so.

20 THE WITNESS: I don't recall any other
21 documents.

22 BY MR. CRAIN:

23 Q. Are you testifying that you don't recall any
24 other documents with the exception of any documents that
25 may have been presented to you from your attorneys?

1 That's a yes or no question.

2 A. The only yes or no part is like -- I want to
3 know if there is a privilege risk or waive the
4 privilege --

5 MR. DAS: No, you can say --

6 THE WITNESS: But the answer is -- tell me the
7 question again. I would like to answer the question.

8 BY MR. CRAIN:

9 Q. Sure. Are you testifying that you do not recall
10 reviewing any documents other than what you've told me,
11 with the exception of any documents that may or may not
12 have been presented to you by your attorneys?

13 A. In the matter of the '544 patent --

14 Q. Correct.

15 A. -- I'm saying that there are no other documents.

16 Q. Including any documents that may or may not have
17 been presented by your attorneys.

18 A. Sorry. Which one?

19 Q. Let's just try it this way: Yes or no, did your
20 attorneys present documents for you to review in
21 preparation for today's deposition?

22 A. Am I allowed to answer that?

23 MR. DAS: Yes.

24 THE WITNESS: They gave me -- when I met with
25 them on Wednesday, they gave me a folder with the

1 documents that are referenced in my declaration. But I
2 had already reviewed them on Tuesday. Because like I
3 had my own copies.

4 BY MR. CRAIN:

5 Q. Were there any documents given to you by your
6 attorneys that were not documents that you had already
7 reviewed on Tuesday?

8 A. Not that I recall.

9 Q. Are you able to indicate how long you met with
10 attorneys of QSC in preparation for today's deposition
11 regarding the '544 patent?

12 A. So I met with the attorneys on Tuesday for --
13 from about 8:30 until 4:30, something like that. That
14 was discussing both depositions. So some of it was
15 spent -- some of it was relevant to this deposition.

16 Q. Now, you said Tuesday. Do you mean Wednesday?

17 A. I mean Wednesday. Thank you.

18 I also met with them this morning before we came
19 in.

20 Q. Do you recall speaking to anyone else, other
21 than QSC's attorneys, with respect to today's deposition?

22 A. I've spoken -- you know, I've mentioned to my
23 family and friends incidentally that I'm coming out here
24 to do this, but that's all.

25 Q. Did you bring any documents with you today?

1 A. No.

2 Q. You seemed to pause with that. So you did not
3 bring any documents to today's deposition?

4 MR. DAS: Objection, asked and answered.

5 MR. CRAIN: Go ahead.

6 THE WITNESS: Yes. That's right. I didn't
7 bring any documents with me today.

8 MR. CRAIN: Okay.

9 (Exhibit 12 marked for identification.)

10 (Exhibit 13 marked for identification.)

11 BY MR. CRAIN:

12 Q. Dr. Ellis, I'm going to give you two documents
13 that we'll be referencing, I'm sure, throughout the day,
14 marked Exhibit 12 and Exhibit 13. Go ahead and just
15 take a few moments and let's look at both of them and
16 see if we can identify them. That way, we can maybe be
17 more efficient with our time.

18 A. Okay.

19 Q. Would you go ahead, please, if you're able, and
20 identify Exhibit 12.

21 A. Exhibit 12 is the Corrected Petition for Inter
22 Partes Review in the case of the patent, 5,652,544.

23 Q. Do you recall if you've ever seen Exhibit 12
24 before?

25 A. I'm not sure. I think I probably have seen it.

1 Q. Do you recall when you may have first seen it?

2 A. If I've seen it, it would have been, you know,
3 in late 2013, probably -- or if I hadn't -- maybe I
4 didn't see it then and maybe -- maybe I saw it first
5 more recently.

6 Q. Do you recall if Exhibit 12 was one of the
7 documents you reviewed in preparation for your
8 deposition?

9 A. It was not.

10 Q. If you'll take a look at Exhibit 13.

11 A. Yep. This is my declaration.

12 Q. The answers may be similar to yesterday. But
13 when were you first engaged with respect to your
14 involvement in this matter on the '544 patent?

15 A. According to my recollection, it was sometime
16 during the summer of 2013, late summer of 2013, I think.

17 MR. CRAIN: Let's go ahead and do one more
18 document so that we're --

19 (Exhibit 14 marked for identification.)

20 BY MR. CRAIN:

21 Q. I'll give you that one, too.

22 A. Thank you.

23 Q. Dr. Ellis, you have what has now been marked as
24 Exhibit 14.

25 A. Yes.

1 Q. When you're able, would you please identify it.

2 A. This appears to be the patent at issue,
3 No. 5,652,544.

4 Q. Who contacted you in regard to your potential
5 involvement in this matter?

6 A. As I recall, I was contacted by the -- I don't
7 remember whether the initial contact was by phone or by
8 e-mail, but by Attorney Tullett.

9 Q. Sometime in the summer or late summer of 2013?

10 A. That's my recollection.

11 Q. Did you enter into a written engagement
12 agreement with QSC Audio with respect to your efforts to
13 provide a declaration in this case?

14 A. I entered into a written agreement. I couldn't
15 tell you for sure exactly who it was with. Obviously,
16 my interaction was with the attorneys.

17 Q. When did you enter into this written agreement?

18 A. Shortly -- you know, within a few days or weeks
19 of the initial contact.

20 Q. Could you describe for me your efforts from --
21 let me start again.

22 Would you describe for me your efforts that you
23 engaged in after your initial contact from QSC Audio
24 with respect to the '544 patent. Again, I'm not asking
25 you for any communications you may have had with them,

1 but I'd like a description of your efforts.

2 MR. DAS: Objection, form. And again, just to
3 clarify, don't get into privileged communications.

4 THE WITNESS: I reviewed some relevant documents
5 and I discussed with the attorneys.

6 BY MR. CRAIN:

7 Q. Do you recall what the relevant documents were?

8 A. I recall the documents that I've mentioned in my
9 declaration, that I've used in the declaration. There
10 may have been others, but I don't recall any.

11 Q. Of the documents that are recited in your
12 declaration that we have, do you recall which one or
13 ones you would have reviewed subsequent to your initial
14 contact? What I'm asking for is, do you remember
15 specifically which ones you may have reviewed then? If
16 it was all of them, it was all of them. If it was one
17 or more, which ones do you remember? Does that make
18 sense to you?

19 MR. DAS: Objection to form.

20 MR. CRAIN: Let me ask you the question again.

21 BY MR. CRAIN:

22 Q. Do you recall the specific documents from your
23 declaration that you may have reviewed shortly after
24 your initial contact from QSC's attorneys?

25 MR. DAS: Objection, form.

1 THE WITNESS: Let me think. Obviously, I
2 certainly remember, you know, seeing the actual '544
3 patent. I don't remember the -- any particular details
4 of the sequence or timing of the other documents.

5 BY MR. CRAIN:

6 Q. I'm sorry? What were you saying?

7 A. I don't recall any details about the precise
8 sequence of the other documents.

9 Q. Well, let's walk through, as systematically as
10 we can, with a description of your activities that
11 commence with your involvement in the matter to your
12 declaration. Okay? So would you explain your
13 activities from the time from which you were engaged,
14 and walk me all the way through when you completed your
15 declaration.

16 MR. DAS: And I caution you not to get into
17 privileged communications in that explanation.

18 THE WITNESS: I had some discussions with the
19 attorneys. I reviewed some documents on my own, the
20 documents we've discussed. I had further discussions
21 and further review. And then I wrote my declaration.

22 BY MR. CRAIN:

23 Q. Are you being compensated for your efforts --

24 A. I am.

25 Q. -- with respect to your service in this case?

1 A. Yes.

2 Q. By whom are you being compensated?

3 A. My impression is I'm being paid by the
4 attorneys' law firm. Presumably, ultimately I'm being
5 paid by the petitioner.

6 MR. DAS: Dr. Ellis, I'm just going to caution
7 you to let Mr. Crain finish his question before you
8 start answering.

9 THE WITNESS: I'm sorry. Thank you.

10 BY MR. CRAIN:

11 Q. Have you ever spoken with anyone that is
12 employed by the petitioner?

13 MR. DAS: Again, I would caution you not to get
14 into privileged communications.

15 THE WITNESS: I don't know whether the attorneys
16 representing the petitioner count as being employed by
17 them.

18 BY MR. CRAIN:

19 Q. Let's exclude them.

20 A. No.

21 Q. How much are you being compensated with respect
22 to your efforts on the '544 patent?

23 A. I'm being paid \$250 an hour.

24 Q. Is there any adjustment in your rate depending
25 upon the type of activity?

1 A. No.

2 Q. How many hours do you believe that you've worked
3 with respect to your efforts on the '544 patent to date?

4 A. My recollection is that the work that I
5 performed preparing the declaration, both for the '544
6 patent and the '542 patent, was a total of 20 hours,
7 which was completed in 2013. This week, I've been
8 engaged in additional work, which is now three long days
9 worth, and then today.

10 Q. So, if I understand you correctly, approximately
11 20 hours of your time was spent in preparation of
12 declarations on the '542 patent and the '544 patent.

13 A. Yes.

14 Q. And you may have mentioned it yesterday, but
15 let's ask it again with respect to the '544 patent. Are
16 you able to break out the 20 hours in any way to let us
17 know how much of that time may have been devoted
18 strictly to the '544 patent and your declaration for it?

19 A. It's not easy for me to do that, but it's
20 reasonable to say that it's evenly split between the
21 two.

22 Q. Did you tell me that you spent approximately --
23 was it eight to ten hours on Tuesday, in preparation for
24 this deposition?

25 A. Yes. Well, in preparation for both depositions.

1 Q. Thank you for the correction.

2 Then, I think on Wednesday, it was pretty much
3 an all-day effort with the QSC attorneys as well, in
4 preparation for the '542 and the '544 depositions.
5 Correct?

6 A. That's right.

7 Q. So is that approximately 20 hours or so,
8 according to your estimation?

9 A. Yes.

10 Q. So, of that 20 hours, again, split roughly
11 evenly between the '542 and '544 patents?

12 A. I think that's the most -- if we had to split
13 them, that would be the way to do it.

14 Q. Like the '542 patent, have you invoiced your
15 time with respect to the '544 patent in preparation for
16 the declaration?

17 A. Have I invoiced the time spent preparing the
18 declaration? Is that what you're asking?

19 Q. Yes, that's a better question.

20 A. I haven't invoiced them separately. I've made a
21 single invoice for my work on both declarations.

22 Q. Right. And I think it was around \$5,000, if I
23 recall yesterday. So again, \$2,500 or so would have
24 been invoiced with respect to the preparation of your
25 declaration in the '544 patent?

1 A. As I said, I didn't -- as I recall, I don't
2 remember breaking it down. It's like there is a single
3 invoice for the total work. It doesn't specify a
4 breakdown.

5 Q. Have you received payment on the invoice
6 associated with your services preparing the declaration
7 on the '544 patent?

8 MR. DAS: Objection, relevance.

9 THE WITNESS: I've received payment for my
10 single invoice for the work I conducted in 2013 in
11 preparing the two declarations.

12 BY MR. CRAIN:

13 Q. With respect to the '544 patent and your
14 preparation of a declaration in the '544 patent, did
15 QSC's attorney identify any facts or data, which could
16 include documents, to you that you considered in forming
17 your opinions expressed in your declaration?

18 MR. DAS: Objection to form.

19 THE WITNESS: So what are you asking? Did they
20 specify any facts that --

21 BY MR. CRAIN:

22 Q. Did QSC identify any documents to you associated
23 with the preparation of your declaration for you to
24 consider?

25 MR. DAS: Objection, privilege. I would

1 instruct the witness not to respond to that question.

2 MR. CRAIN: That's clearly allowed by
3 Rule 26(b)(5)(ii). Facts and data provided by the
4 party's attorney that the expert considered.

5 MR. DAS: That's not the question you asked. So
6 you might want to reconsider asking your question.

7 MR. CRAIN: I believe it's the exact same thing.

8 MR. DAS: I instruct the witness not to answer
9 that question.

10 BY MR. CRAIN:

11 Q. Dr. Ellis, please identify any facts or data --
12 and that would include documents -- that QSC's attorneys
13 provided and that you considered in forming the opinions
14 that are expressed in your declaration. And before you
15 answer, considered would include documents even if
16 they're not listed in your declaration.

17 MR. DAS: Objection, form.

18 THE WITNESS: So I'm confused, because it seems
19 like you're asking me about the documents that were
20 shown to me that were provided to me by the attorneys.
21 It seems like that's an issue of privilege. And I
22 understand there is some legal technical stuff going on
23 about exactly which question you can ask and which you
24 can't.

25 MR. DAS: Do you want to take a break and

1 discuss? We can do that.

2 MR. CRAIN: That's fine. If you need to. I
3 mean, I'm going to stand on this. We're going to get
4 through this. Because this is clearly allowed by the
5 rules. If we need to, we can call the board.

6 MR. DAS: He's expressed confusion.

7 MR. CRAIN: That's fine. That's fine. If you
8 need to take a break, sure.

9 THE VIDEOGRAPHER: We're going off the record.
10 The time is 9:37 a.m.

11 (Recess taken from 9:37 to 9:44.)

12 THE VIDEOGRAPHER: We're back on the record at
13 9:44 a.m.

14 BY MR. CRAIN:

15 Q. Dr. Ellis, did you have an opportunity to speak
16 with your attorneys during the break?

17 A. Yes.

18 Q. I understand that we took the break so that we
19 could assess whether or not there may be an applicable
20 privilege that may apply with respect to the questions
21 that were asked before the break.

22 A. Yes.

23 Q. So let's ask the question again and see where we
24 can get with it.

25 Dr. Ellis, please identify the facts or data

1 that QSC provided and that you considered in forming the
2 opinions to be expressed in your declaration.

3 A. So you're asking specifically facts and data.
4 Is that right?

5 Q. That's right. And as we said before, I believe
6 that includes any documents that would be provided to
7 you as well.

8 A. Okay. So the only material -- the only thing
9 that's coming to mind that I used -- you know that I
10 considered in forming my declaration is the documents
11 that I refer to in my declaration. I think that's what
12 I've said before. Although, I've just remembered
13 another one.

14 Q. Okay. What's the other one?

15 A. There was a document describing an early
16 experimental digital audio signal processing device
17 manufactured at BBC Research in the mid 1980s. I
18 remember seeing -- reviewing a document describing that.

19 Q. This document was provided to you by QSC's
20 attorneys?

21 A. Not as I recall.

22 Q. We'll come back to that.

23 A. Yes.

24 Q. Again, seeking to focus on any documents that
25 were provided to you that you considered. You should

1 understand, when I say considered, even if it's not
2 referenced in your declaration, that you may have
3 reviewed, then I take the position that that also
4 includes considered.

5 MR. DAS: Objection, asked and answered.

6 BY MR. CRAIN:

7 Q. So are there any other documents that --

8 A. Not that I can recall. There are no other
9 documents that I considered which would -- yeah. That's
10 what I said.

11 Q. Dr. Ellis, would you identify for me any
12 assumptions that QSC counsel provided and that you
13 relied on in forming the opinions expressed in your
14 declaration.

15 A. I can't think of any assumptions that I relied
16 on in forming my declaration. But I, you know -- you
17 could possibly help me by explaining what that counts --
18 what counts.

19 Q. Do you understand what an assumption would be?

20 A. I understand the common usage of the term,
21 assumption.

22 Q. Based on your understanding of the common usage,
23 applying it to my question with regard to any
24 assumptions that QSC's attorneys may have provided to
25 you, are you able to answer the question with that

1 understanding?

2 MR. DAS: Objection. Again, clarifying, the
3 question is not assumptions that were provided to you;
4 the question, I believe, is assumptions that you relied
5 on. I just want to make sure that's the question.
6 Because assumptions that were provided to you is
7 privileged.

8 BY MR. CRAIN:

9 Q. I think the question -- just so your clear --
10 identify, please, any assumptions that QSC's attorneys
11 provided and that you relied upon in forming the
12 opinions expressed in your declaration.

13 A. I can't think of anything that would fit that
14 description.

15 Q. I think yesterday, in talking about the '542
16 patent, you indicated that you were familiar with the
17 concept of invalidity contentions.

18 A. Yes.

19 Q. Do you recall, as part of your efforts in
20 forming your declaration, ever reviewing any invalidity
21 contentions with respect to the '544 patent?

22 MR. DAS: Again, I instruct you not to answer
23 that on privilege grounds.

24 MR. CRAIN: So let's play this out. If he
25 reviewed QSC's invalidity contentions, and they were

1 provided by you, QSC, you're taking the position that he
2 cannot tell me that?

3 MR. DAS: Yes.

4 MR. CRAIN: Under what basis?

5 MR. DAS: Because it could be work product. You
6 can ask him what opinions and what assumptions he relied
7 on in forming his opinions. You can ask him about what
8 documents he relied on in forming his opinions. You
9 can't ask him about what documents we may otherwise have
10 provided him. Rule 26 doesn't allow you this broad
11 fishing into what documents or what facts were provided
12 to the expert unless the expert relied on it or
13 considered it in forming his opinion.

14 MR. CRAIN: And I don't see how you could
15 possibly contend that he would not have considered the
16 content in QSC's invalidity contentions in forming the
17 nature of his opinions.

18 MR. DAS: It doesn't matter what I contend.

19 MR. CRAIN: Is that your contention?

20 MR. DAS: No. My contention is the question
21 you've asked seeks privileged information.

22 You can reask the question and not have it be
23 privileged, but the question you've asked seeks
24 privileged information.

25 BY MR. CRAIN:

1 Q. Let's try it this way, just to make sure:

2 Did you consider QSC's invalidity contentions in
3 forming the opinions expressed in your declaration?

4 MR. DAS: Objection, lacks foundation, but you
5 can answer.

6 THE WITNESS: I don't -- I don't really know
7 what you're talking about as QSC's invalidity
8 contentions. I'm not aware of being -- you know, of
9 that specific concept.

10 BY MR. CRAIN:

11 Q. Have you ever seen a document identified as
12 QSC's invalidity contentions? Yes or no?

13 A. Not as I recall.

14 Q. To be clear, have you ever seen a document
15 pertaining to QSC's invalidity contentions related to
16 the '544 patent in any venue?

17 MR. DAS: Again, I would caution you, yes or no
18 response to that.

19 THE WITNESS: Not as I recall.

20 BY MR. CRAIN:

21 Q. Do you recall ever having the occasion to review
22 or consider QSC's invalidity contentions prior to today?

23 MR. DAS: Objection, form. Objection,
24 privilege.

25 BY MR. CRAIN:

1 Q. Yes or no.

2 A. No.

3 Q. Did you do any research into the '544 patent as
4 part of your efforts to prepare your declaration?

5 MR. DAS: Objection, form.

6 THE WITNESS: Yes.

7 BY MR. CRAIN:

8 Q. Describe the research that you did with respect
9 to the '544 patent in preparing your declaration.

10 A. I was interested to see what contemporary
11 digital audio signal processing devices there were and I
12 tried to find some documents describing them.

13 Q. Where did you go to try to find the documents?

14 A. I used a web search.

15 Q. Do you remember the search that you ran or
16 searches that you ran?

17 A. No.

18 Q. Was this a Google search?

19 A. Probably.

20 Q. What other searching mechanisms might you have
21 used if it wasn't a Google search?

22 A. There is a search interface to the AES. AES has
23 an interface for searching their publications.

24 Q. Did you use the AES search interface with regard
25 to --

1 A. I think so.

2 MR. DAS: Again, Dr. Ellis, please let Mr. Crain
3 finish his questions.

4 THE WITNESS: Yes.

5 BY MR. CRAIN:

6 Q. What documents did you discover through the AES
7 interface search that you ran?

8 A. I don't recall. I don't recall any -- I don't
9 recall any important documents coming out of that.

10 Q. Do you recall any documents coming out of that?

11 A. Yes.

12 Q. Are you able to describe or identify them?

13 A. I cannot identify them, but I can tell you the
14 sort of things they were.

15 Q. Okay.

16 A. Which were -- the sort of things I was looking
17 for were papers that discuss or relate to digital audio
18 signal processing devices in the years leading up to
19 the -- to this patent.

20 Q. Do you recall how many documents you discovered
21 in your AES search, even though you deemed them to be
22 unimportant?

23 A. I have a recollection of going through several
24 screens of titles. So maybe -- maybe dozens of
25 documents. But only a small number of those would I

1 have actually taken the extra step to look at the
2 document.

3 Q. Do I understand you correctly that you're not
4 able to identify any of the documents from the AES
5 search, even the small number that you had actually
6 taken the extra step to look at?

7 MR. DAS: Objection, form.

8 THE WITNESS: I recall looking at one document
9 from the AES site that was an overview paper of then
10 current developments in digital audio signal processing.
11 I don't recall any more detail, but if I had to find it
12 again, maybe I could.

13 BY MR. CRAIN:

14 Q. Sorry?

15 A. If I had to identify which one it was again.

16 Q. How would you go about trying to identify it
17 again?

18 A. I would attempt to go through the process of
19 trying to recall the kinds of search terms I would have
20 used and looking at the results and seeing if one
21 reminded me of that one.

22 Q. Do you remember any authors of any of these
23 documents?

24 A. No.

25 Q. Was the AES interface the only resource that you

1 sought to find documents related to the '544 patent?

2 MR. DAS: Objection, form.

3 THE WITNESS: I also -- I think I -- I think I
4 also used the Google search interface.

5 BY MR. CRAIN:

6 Q. I thought you did, but I wasn't sure. So I had
7 to get there.

8 Do you remember the search or searches you ran
9 on Google?

10 MR. DAS: Objection, asked and answered.

11 THE WITNESS: Not in any detail.

12 BY MR. CRAIN:

13 Q. Do you remember any documents that may have been
14 returned to you from your Google search or searches?

15 A. I remember one document which described an early
16 digital audio signal processor developed by the BBC.

17 Q. That was the one you referred to maybe ten or
18 fifteen minutes ago?

19 A. Correct.

20 Q. Do you remember the author of that BBC paper?

21 A. No. I think it may have been, you know,
22 corporate author, BBC Research.

23 Q. Why did you not reference the BBC Research paper
24 in your declaration?

25 A. It was not -- it didn't provide anything

1 particularly useful over my other references.

2 Q. Are there any other efforts that you can
3 describe with regard to researching the '544 patent that
4 you've not already shared with me?

5 A. I thought about my own experience in that period
6 of working with digital audio signal processing devices.

7 Q. Did you speak with anyone -- not attorneys of
8 QSC -- with regard to research on the '544 patent?

9 A. Not as I recall.

10 Q. I understand that you have -- your department at
11 Columbia has some very talented and well-informed people
12 in some of these areas from your testimony yesterday.
13 Why didn't you speak with some of them with respect to
14 your efforts to research the '544 patent?

15 A. In this material, I would consider myself the
16 most relevant expert among my colleagues at Columbia.

17 Q. Dr. Ellis, why would you consider yourself the
18 most relevant expert among your colleagues at Columbia
19 with respect to the teachings of the '544 patent?

20 A. The patent is about digital audio signal
21 processing. That's -- I'm the person who does that at
22 Columbia.

23 Q. So not only did you not speak to anyone at
24 Columbia, but I take it then that you really didn't
25 communicate with anyone else with regard to your

1 research; again, excluding the attorneys?

2 A. I can't think of anyone.

3 Q. As a result of any of your efforts to research
4 the '544 patent, did you find anything that you would
5 consider to be prior art?

6 MR. DAS: Objection, form.

7 THE WITNESS: You know, forgive me that I'm
8 not -- I'm not as well versed in the strict definition
9 of a term like prior art as you would be. But I
10 mentioned this BBC digital audio signal processor. That
11 is a very similar device or a relevant device that
12 precedes this patent, as are the other -- you know, some
13 of the contents of the other references I've described.

14 BY MR. CRAIN:

15 Q. Thank you for bringing up the issue with regard
16 to prior art.

17 A. Yeah.

18 Q. Would you share with me what your understanding
19 of prior art is.

20 A. My understanding is that it's something that has
21 already been disclosed or that is known that is relevant
22 to the -- relevant to the content of the patent.

23 Q. Using your definition of prior art --

24 A. Yeah.

25 Q. -- did you identify any documents that are in

1 your opinion -- or your declaration, that is?

2 A. Yes. I identified all the documents, those
3 being relevant in terms of prior art.

4 Q. What I'm asking is, how did you come to discover
5 the documents that are referenced in your declaration?

6 A. Does this get into issues of privilege?

7 MR. DAS: No.

8 THE WITNESS: These documents were shared with
9 me by the attorneys. I think. Let me see.

10 BY MR. CRAIN:

11 Q. It may be helpful for you, Dr. Ellis --

12 A. Sorry.

13 Q. No. Go ahead. We can probably get there a
14 couple different ways. Go ahead.

15 A. I'm not sure about the TMS320 data sheet. That
16 may have been -- I'm not sure about the TMS320 data
17 sheet which I referenced. That may have been something
18 that I discovered in the course of the research that
19 we've been discussing.

20 Q. Before you move on, what makes you unsure about
21 that?

22 A. Well, I -- I own a copy of it.

23 Q. Of the TMS320 second generation digital signal
24 processors --

25 A. Yes. I mean, I'm not sure if it's that exact,

1 but I own documentation relating to that device.

2 Q. What is the purpose for why you own that
3 documentation?

4 A. It's of interest to me.

5 Q. Have you ever had occasion to work with the
6 digital signal processor that may be known as TMS320?

7 MR. DAS: Objection, form.

8 THE WITNESS: I'm not sure. I've worked with
9 several different digital signal processors. I can't
10 recall the exact ones.

11 BY MR. CRAIN:

12 Q. I'm just trying to understand why it is that you
13 happen to have that data sheet.

14 MR. DAS: Objection, relevance.

15 You can answer.

16 THE WITNESS: It's actually something of, you
17 know -- it's an interest of mine. I like -- it's a nice
18 historical artifact.

19 BY MR. CRAIN:

20 Q. What makes it such a nice historical artifact?

21 A. Because it -- you know, it's symbolic of the
22 dawn of the DSP revolution.

23 Q. That's interesting. What is the DSP revolution?

24 A. The DSP revolution is the -- the increasing --
25 you know, the transition to using digital signal

1 processors in practical applications.

2 Q. When did the DSP revolution begin?

3 A. I would say -- you know, it has its origins in
4 the 1960s.

5 Q. Walk me through that. Tell me about that.

6 MR. DAS: Objection, form.

7 THE WITNESS: So in -- to my knowledge, it was
8 not until the 1960s that people started actually
9 thinking about trying to process signals, including
10 audio signals in a digital form on a computer. But then
11 as those ideas developed over several decades and as the
12 technology became faster and cheaper, the kinds of
13 applications that were possible became broader and
14 broader, and the applications for which it made good
15 engineering sense to use a digital signal processor
16 rather than say the preceding analog technology also
17 became broader.

18 BY MR. CRAIN:

19 Q. What were some of the first applications for
20 digital signal processors that you can recall or have
21 knowledge about?

22 MR. DAS: Objection, form.

23 THE WITNESS: You're asking about digital signal
24 processors, which means hardware specialized for
25 calculating digital signal processing functions.

1 Correct?

2 BY MR. CRAIN:

3 Q. I don't know. Is that what digital signal
4 processors are?

5 MR. DAS: Objection, form.

6 THE WITNESS: That's one definition.

7 BY MR. CRAIN:

8 Q. What are the others?

9 A. Any computational device which is performing
10 digital signal processing function.

11 Q. So would you consider a central processing unit
12 also to be a digital signal processor?

13 MR. DAS: Objection, form.

14 THE WITNESS: If the central processing unit is
15 performing the arithmetic operations which are -- which
16 constitute signal processing, then it would be a very --
17 it would be a reasonable way to describe it.

18 BY MR. CRAIN:

19 Q. So my question to you was: What were some of
20 the first applications for digital signal processors
21 that you can recall or that you have knowledge about?

22 And then you stated: You're asking about
23 digital signal processors, which means hardware
24 specialized for calculating digital signal processing
25 functions. Correct?

1 Yes, I am.

2 A. Okay. I think one of the earliest applications
3 was the TI Speak & Spell, which was a voice synthesis
4 device that came out in the mid 1970s.

5 Q. That was a kids' toy?

6 A. That's correct.

7 Q. I remember that.

8 What others can you remember, moving forward in
9 time?

10 MR. DAS: Objection, form.

11 THE WITNESS: There are earlier ones. I mention
12 that one because it was maybe the first really mass
13 market application that I can think of. Certainly even
14 before that, I can think of instances where DSPs were
15 used for things like specialized speeding up and slowing
16 down of speech recordings, something I happen to know
17 about.

18 BY MR. CRAIN:

19 Q. Could you give me a specific example of that and
20 a time.

21 A. I have a recollection that there is a paper
22 discussing a box built, I think, by BBN, Bolt Beranek &
23 Newman, in maybe 1972 that does voice speed conversion.

24 Q. Do you have any understanding of what the
25 digital signal processors, the actual physical devices,

1 of their architecture in these devices that you're
2 discussing?

3 MR. DAS: Objection, form. Objection, compound.

4 THE WITNESS: I have some understanding of the
5 early implementations of digital signal processors,
6 special-purpose digital signal processors.

7 BY MR. CRAIN:

8 Q. Would you please try to describe these early
9 digital signal processors and perhaps their evolution
10 over time.

11 MR. DAS: Objection, form. Objection, compound.

12 THE WITNESS: The reason that digital signal
13 processor specialized hardware developed was because
14 digital signal processing specifies a number of
15 algorithms which can easily incorporate a large number
16 of multipliers and additions, even for just a relatively
17 simple function, in contrast to other applications that
18 computers may be used for which would not require so
19 many -- such a high density of these operations. So the
20 field of specifically developing digital signal
21 processors is concerned with the issues of building
22 specialized hardware to do just that limited task,
23 multiplication and addition of numbers, but to do it
24 rapidly and at a constant rate, typically.

25 The earliest -- as I understand, the earliest

1 implementations relied on so-called bit slice devices
2 which, as I understand, are digital logic devices, which
3 aren't quite a whole microprocessor, but kind of smaller
4 components that you can put together that will end up
5 giving you a more complete digital processing system.
6 These were very inflexible. So the development of
7 digital signal processor hardware is mainly about --
8 well, it's about two things -- well, three things.
9 Making them more flexible and easier to program, making
10 them faster, making them cheaper.

11 BY MR. CRAIN:

12 Q. Do I understand you correctly to say that
13 earlier DSPs were inflexible?

14 A. Yes.

15 Q. Is that because they were not as fast, they were
16 more expensive, and they were difficult to program?

17 MR. DAS: Objection, compound.

18 THE WITNESS: It doesn't relate to their speed
19 and cost. It only relates to their -- their
20 flexibility, which includes how difficult they are to
21 program.

22 BY MR. CRAIN:

23 Q. I was just giving you those three reasons back
24 to see.

25 A. Yeah.

1 Q. So the programming ease or difficulty, do I
2 understand you correctly that that has been a -- I don't
3 know if it's been an impediment or an issue in the
4 development of DSPs. That may not be the correct way to
5 say it.

6 MR. DAS: Objection, form.

7 THE WITNESS: In my understanding, when you're
8 working with a bit slice processor, a bit slice system,
9 it's not even really recognizable as programming. It's
10 more in a gray area between building hardware and
11 programming. So that's why I mean they were not very
12 flexible. By the end of the 1970s, as I recall, we had
13 devices that were more -- were much more recognizable as
14 more or less conventional microprocessors with
15 additional specialized multiply and accumulate hardware.

16 BY MR. CRAIN:

17 Q. Has the progression of digital signal processors
18 allowed for the inclusion of more components in what we
19 might today call a digital signal processor chip?

20 MR. DAS: Objection, compound. Objection, form.

21 THE WITNESS: Normally, when we talk about
22 components in electronics, we're talking about
23 individual physical things. So the chip would just be
24 one component. It doesn't contain components.

25 BY MR. CRAIN:

1 Q. When I was thinking of components, I was
2 thinking more like logical, functional components.

3 A. Certainly the development of all digital logic
4 is an incessant increase in the number of gates
5 included, transistors.

6 Q. Did earlier DSPs, according to your
7 understanding, say include on-board memory, on the
8 chips?

9 MR. DAS: Objection, form.

10 THE WITNESS: I can't speak to bit slice
11 processors. It seems -- I can't -- it seems likely
12 that -- I'm having difficulty imagining a DSP chip that
13 doesn't have any on-board memory. They probably did
14 exist, but that would be something you would want to
15 incorporate.

16 BY MR. CRAIN:

17 Q. Memory, that is?

18 A. Yes.

19 Q. Well, and -- I'm just trying to gain an
20 understanding from you what earlier digital signal
21 processors looked like. You mentioned some devices
22 maybe in the '70s. I don't know if you have an
23 understanding of their architecture or design or not.
24 Maybe you do. What they would have looked like. Maybe
25 they would have had on-board memory or maybe they

1 wouldn't have. I don't know.

2 So let me see if I can ask it this way: You
3 mentioned a Speak & Spell device, I believe.

4 A. Yes.

5 Q. Do you have any understanding, just from your
6 experience, about the form or design of the DSP used in
7 that device?

8 A. Unfortunately, not any level of detail.

9 Q. Do you have any understanding with respect to
10 DSPs that may have existed in the 1970s?

11 A. Yes.

12 Q. Which ones would you feel most comfortable
13 talking about?

14 A. I can't recall the names, the designations of
15 any of these chips, but I have an idea of when -- you
16 know, the chips that I've discussed, which are -- more
17 or less look like my contemporary microprocessors with
18 additional hardware to make them specialized for DSP
19 operations. I think they emerged before 1980.

20 MR. CRAIN: Let me see if this helps our
21 discussion at all.

22 (Exhibit 15 marked for identification.)

23 BY MR. CRAIN:

24 Q. Dr. Ellis, you have Exhibit 15 in front of you.
25 I see you've taken a moment or two to review it. Are

1 you able to identify it?

2 A. It's some technical documentation describing the
3 Texas Instruments TMS320, some chips within that series.
4 The TMS320 is more of a brand than a particular device.

5 Q. I think you mentioned or seemed to express an
6 affinity for the TMS320 earlier, that it had a special
7 significance to you.

8 A. I said that I own one.

9 Q. What you're referring to about what you own, is
10 that also the same as what we see in Exhibit 15?

11 MR. DAS: Objection, form.

12 THE WITNESS: The device that I'm thinking of is
13 one of these devices, yes.

14 BY MR. CRAIN:

15 Q. And you mentioned something about maybe this
16 TMS320 has either broad application or is a name used
17 for many devices. Did I understand you correctly?

18 A. That's right. Yes.

19 Q. Does the name TMS320 second generation digital
20 signal processor mean anything to you?

21 A. It could mean a couple of things. It could mean
22 that this is the second generation of the TMS320. It
23 could mean that this is a second generation digital
24 signal processor. People in industry are fond of
25 labeling generations.

1 Q. Okay. Are you familiar with the various
2 generations that people consider with respect to digital
3 signal processors?

4 MR. DAS: Objection, form.

5 THE WITNESS: I'm not -- it's not that
6 interesting to me. That's more of a marketing
7 consideration.

8 BY MR. CRAIN:

9 Q. But I asked you if you had familiarity, even
10 though it may not be of interest to you.

11 A. Oh. I -- I -- I wouldn't be able to tell you
12 what the difference between a first generation and
13 second generation digital signal processor is.

14 Q. Why not?

15 A. As I say, you know, understanding the
16 generations is not that important to me.

17 Q. The TMS320 that you believe -- that you
18 indicated that you own, do you know if it's this TMS320
19 second generation digital signal processor?

20 A. Yes.

21 Q. And how do you happen to know that?

22 A. I believe it's a TMS320C25.

23 Q. In having the opportunity to review Exhibit 15,
24 does this refresh your memory on whether or not you may
25 have been the person to identify what we see in

1 Exhibit 15?

2 MR. DAS: Objection, form.

3 THE WITNESS: It doesn't -- no, it doesn't -- it
4 doesn't change my understanding, which is like I think I
5 may have been.

6 BY MR. CRAIN:

7 Q. So you remain uncertain?

8 A. Yeah.

9 Q. Can you give me any understanding, based on your
10 knowledge and experience with digital signal processors,
11 of how the DSP we see in Exhibit 15 may vary from the
12 digital signal processor in, for example, the Speak &
13 Spell device that you referred to earlier?

14 MR. DAS: Objection, form. Objection,
15 foundation.

16 THE WITNESS: I'm sure it's a faster device.
17 I'm sure this one represents a faster, able to perform
18 more computations in a fixed amount of time.

19 BY MR. CRAIN:

20 Q. So speed. What else?

21 A. I'm sure -- I expect it has both larger memory
22 on board and the ability to access larger external
23 memory. And it probably has -- I assume it has an
24 expanded instruction set. The Speak & Spell may not
25 have been -- it may not even make sense to talk about

1 its instruction set, but if so, then this is a much -- a
2 greatly expanded instruction set.

3 Q. Anything else that you can think of?

4 A. It's implemented using more advanced silicon --
5 you know, more -- a finer line width in the silicon chip
6 and probably more advanced chemistry to etch the chip.
7 The packaging is different. I'm sure they didn't have
8 these kinds of 68-pin devices in the Speak & Spell.

9 Q. What is an instruction set?

10 A. An instruction set is the -- it's the core set
11 of commands that a programmer can employ to instruct
12 the -- a microprocessor to do a particular task. It's
13 like the vocabulary of the program.

14 Q. Is that a standardized thing among DSPs?

15 MR. DAS: Objection, form.

16 THE WITNESS: That's an interesting question.
17 So if you're building a DSP chip, if you're the
18 manufacturer like Texas Instruments, part of that is you
19 get to design the instruction set. You get to define
20 it. And when you're doing that, you -- it's a
21 compromise between what you can feasibly implement in
22 your hardware and what's going to make it easier for a
23 programmer to write in what they want to use.

24 In the nature of this technology where new
25 chips, better-performing chips may come out every year

1 or two, on the one hand, you want to give the programmer
2 the opportunity to exploit the added capabilities of
3 your new device. On the other hand, you want to try and
4 retain whatever audience or constituency of developers
5 are already using your devices. So that means that you
6 want to maintain some consistency in the programming
7 model, the instruction set, et cetera, that they're used
8 to.

9 In addition, there are some standard operations
10 that any digital signal processing chip needs to
11 perform, such as the multiply and addition operation
12 that I mentioned before.

13 So there is no -- there is no formal standard,
14 but different manufacturers will try and both maintain
15 consistency within their own successive devices, and, of
16 course, they will also -- there will be some
17 compatibility or analogy between the instruction sets of
18 the families of devices from different manufacturers,
19 both because -- if someone -- if a competitor comes up
20 with a good idea, they're going to want to incorporate
21 it. And, you know, if they want to try and draw market
22 share away from their competitors, then they want to
23 make sure that the people working with competing
24 products don't feel like it would be too difficult to
25 transfer.

1 BY MR. CRAIN:

2 Q. That's kind of what I want to focus on now,
3 between two different manufacturers of DSPs.

4 Can you think of another manufacturer of DSPs
5 that would have been contemporary to what we see in
6 Exhibit 15?

7 A. Yes.

8 Q. Can you give me an example of one.

9 A. I'm thinking of Motorola.

10 Q. Is there a specific chip design?

11 A. I'm thinking of the Motorola 56000 series.

12 Q. Is that a well-known DSP of that time?

13 A. Yes. I mean, it's not -- it's, you know, like
14 the TMS320. There were a good number of chips that were
15 in that family. But it's very much the big market
16 competitor to the TMS320. Possibly the TMS320C20
17 generation.

18 Q. Now, based on your understanding -- well, let me
19 back up.

20 I think you have indicated that you really
21 consider yourself to be kind of the DSP guy at Columbia.

22 A. That's correct.

23 Q. Do you own the Motorola chip that you
24 referenced?

25 A. I don't. Although, I have worked with it.

1 Q. That's what I was going to ask. Some people,
2 like with automobiles, Porsche, Corvette, or something
3 like that. Right?

4 A. That's right.

5 Q. Is that kind of true with DSPs, that people have
6 maybe brand allegiance?

7 A. Not really like that. I think people have brand
8 allegiance, but not for reasons of romance or
9 sentimentality.

10 Q. DSPs aren't very romantic?

11 A. Well, no, not to many people. But the
12 manufacturer will have a whole ecosystem and people will
13 be familiar with that, which will incline them to stick
14 with that.

15 Q. Based on your understanding of DSPs -- and
16 specifically, we'll use as an example, the TMS320 that
17 maybe you own, in comparison to the Motorola 56000 --

18 A. Yes.

19 Q. -- that you've also worked with and have
20 familiarity -- can you share with me any understanding
21 that you may have with respect to how hard it would be
22 to take one chip and replace it with the other for a
23 given application.

24 MR. DAS: Objection, form.

25 THE WITNESS: Replacing a chip would require

1 redesigning the circuit board.

2 BY MR. CRAIN:

3 Q. Why is that?

4 A. There is no standardization of the pin-outs on
5 these chips. It's not like, oh, we're going to make a
6 compatible chip you can just plug straight in instead.

7 Q. What is a pin-out?

8 A. The pin-out is the device. It has a bunch of
9 little metal conductors coming out of the side or coming
10 out of the bottom. Each of those has a specific
11 function. That's what we call a pin-out.

12 Q. Can you show me -- is the pin-out represented in
13 Exhibit 15 anywhere? Can you flip through it and see if
14 you can find it?

15 A. This picture we're looking at on page -- on the
16 face, you see the lower large square has --

17 Q. I do.

18 A. -- a number of -- it has -- in the inside of the
19 square, there are a set of numbers, which are the pin
20 numbers. On the outside of the square, alongside each
21 number is a short label which identifies the function of
22 that particular pin. That's the pin-out.

23 Q. Let's turn to the back and see if maybe we can
24 further amplify this. This is very interesting.

25 A. Isn't it?

1 Q. Sorry?

2 A. Isn't it?

3 Q. Page 55. I can tell we're in your wheelhouse.

4 A. Yes.

5 Q. Your smile gives it away that you really seem to
6 like these things.

7 Does 55 show us a pin-out? Page 55.

8 A. Yeah. So 55 shows us where the pins are for a
9 different form of the device. It doesn't give us the
10 labels. There would be additional information
11 indicating which of these particular functions that are
12 shown on the FN and FZ package diagram on page one, how
13 these would appear on this GB package. I think the
14 only -- there is a picture of the GB package on page
15 one. I think the only reason they didn't label the pin
16 functions is it's difficult to fit it in, into that
17 picture.

18 Q. Well, going back to page one, I think you were
19 showing me the bottom image or pointing to the bottom
20 image as the pin-out.

21 A. Yes.

22 Q. The lower image, that is.

23 What does the upper image show?

24 A. The upper image shows the physical form of a GB
25 package.

1 Q. So does -- for example, in the upper image, do I
2 understand that I can correlate -- well, let me lay the
3 foundation here.

4 What do the black circles inside the -- it looks
5 like a square -- almost a square -- appear to be to you?

6 A. They indicate where pins -- metal posts that are
7 connected to the chip inside -- where they stick out the
8 bottom of the package.

9 Q. Is there a way to correlate the pin to what's
10 shown in the image below, the lower image?

11 A. No. In all likelihood, there is an exact
12 one-to-one correspondence, that every one of those black
13 dots corresponds to one of those pins in the lower
14 image. But without having a table, we wouldn't know
15 which one was which.

16 Q. Would you expect there to be such a table in the
17 document?

18 A. I would.

19 Q. Let's see if we can find it. This is helpful.

20 A. All right.

21 It's not here. I don't find it.

22 Q. Okay. I don't think it's crucial to our
23 understanding.

24 A. Okay.

25 Q. It would have just been helpful.

1 Turn to page 56 of Exhibit 15.

2 A. Yes.

3 Q. Do we see the pins of the DSP of Exhibit 15 on
4 page 56?

5 A. Yes.

6 Q. Would you identify them, please.

7 A. So this is two views, a top view and a side
8 view. We can see them in both views. In the top view,
9 we can see the top of each of the pins -- of each of the
10 four rows of pins -- the individual pins in the four
11 rows. In the side view, we can see the edge -- it's the
12 side-on view of one row of pins, and we can see the
13 edge-on views of two other rows of pins; but because
14 we're looking at them edge on, we only see one pin.

15 Q. Hold on to that.

16 A. Yeah.

17 Q. Would you put a line out and just label what
18 you've circled. You're calling them pins. So if you
19 want to call them that, that's fine. If you'll just
20 identify them by what you'd like to call them.

21 A. (Complies).

22 Q. Would you the turn to page 55. Let's do it
23 there as well. Because I think we get a different
24 understanding of the pins.

25 Before you do, specifically point me to where

1 you see pins. Show me.

2 A. These are the pins seen from the side and these
3 are the pins --

4 Q. Kind of the middle image?

5 A. Yes.

6 Q. The side view?

7 A. And these are the pins seen from underneath, end
8 on.

9 Q. Would you mark them for us.

10 A. Sure.

11 MR. DAS: Mr. Crain, we've gone an hour and 45
12 minutes.

13 MR. CRAIN: Have we really?

14 MR. DAS: Yes. We've been having way too much
15 fun with pins.

16 MR. CRAIN: This is awesome. Let's take a
17 break.

18 THE VIDEOGRAPHER: This is the end of Media
19 No. 1 in the deposition of Dr. Daniel Ellis. The time
20 is 10:45 a.m. We are now off the record.

21 (Recess taken from 10:45 to 11:09.)

22 THE VIDEOGRAPHER: This is the beginning of
23 Media No. 2 in the deposition of Dr. Daniel Ellis. The
24 time is 11:09 a.m. We are back on the record.

25 BY MR. CRAIN:

1 Q. Dr. Ellis, during the last break, did you have
2 an opportunity to consult with QSC's counsel?

3 A. I had the opportunity.

4 Q. Did you consult or confer with QSC's counsel
5 regarding any of your prior testimony?

6 A. No.

7 Q. Did you consult or confer with QSC regarding the
8 substance of any testimony that may be anticipated to be
9 given?

10 A. No.

11 Q. And during the break, did QSC's counsel suggest
12 to you the manner in which questions should be answered?

13 A. No.

14 Q. If you'll return to Exhibit 15. We were talking
15 about pins.

16 A. Yes.

17 Q. Remind me again, what is the purpose of the pins
18 in this TMS320?

19 A. The pins are to connect the DSP chip to other
20 devices in the whole circuit.

21 Q. I think we kind of got into this because we were
22 talking about how easy or difficult it might be to take
23 this TMS320 and replace it with say a Motorola 56000 in
24 a given board or application. Do you remember talking
25 about that?

1 A. Yes.

2 Q. If I understand you correctly, I think you
3 indicated that it would be extremely difficult?

4 A. Yeah. My understanding is it would require a
5 redesign of the board.

6 Q. The board that the DSP connects to?

7 A. That's right.

8 Q. How does this DSP that we see in Exhibit 15
9 connect to the board?

10 MR. DAS: Objection, form.

11 THE WITNESS: So the document describes several
12 different packages which would have different ways of
13 connecting.

14 BY MR. CRAIN:

15 Q. Can you point me to where in the document it
16 discusses that issue.

17 A. Oh, the picture on the front shows these two
18 different packages, which would have different ways of
19 connecting to a board.

20 Q. Please describe them for me.

21 MR. DAS: Objection, form.

22 THE WITNESS: In these cases -- I think in both
23 of these cases, there would be a socket on the board
24 that the device fits into.

25 BY MR. CRAIN:

1 Q. Is the socket a standard-type socket for any
2 type of DSP?

3 MR. DAS: Objection, form.

4 THE WITNESS: The socket is specific to the --
5 to the mechanical form of the chip. In this case, a
6 68-pin GB or a 68-pin FN or FZ.

7 BY MR. CRAIN:

8 Q. Are those standard packages?

9 MR. DAS: Objection, form.

10 THE WITNESS: Yes. These are not the only chips
11 that have this form.

12 BY MR. CRAIN:

13 Q. How is a chip secured in a socket?

14 MR. DAS: Objection, form.

15 THE WITNESS: Usually by friction.

16 BY MR. CRAIN:

17 Q. What do you mean?

18 A. There is mechanical -- the pins will
19 mechanically touch the socket, which is how the
20 electrical connection is made, because of two pieces of
21 metal pushing against each other. And then there will
22 also be friction associated with that pushing together,
23 which will hold the -- can hold the chip in.

24 Q. So is it your understanding that some type of
25 securing like soldering is required or not required?

1 A. In the case of these devices, they would not
2 require soldering. It's quite likely that these chips
3 were also released -- ultimately released in packages
4 that did require soldering, thereby avoiding the expense
5 of a socket.

6 Q. So does Exhibit 15 demonstrate or illustrate
7 configurations that do require sockets?

8 A. Yes.

9 Q. Would you turn to page 59, please.

10 A. Yes.

11 Q. Would you please take a moment to review page 59
12 of Exhibit 15.

13 A. Yes.

14 Q. Can you explain to me what page 59 appears to
15 depict to you.

16 MR. DAS: Objection, form.

17 THE WITNESS: Well, according to the caption,
18 it's showing how to connect the DSP chip -- a particular
19 version of the DSP chip -- to -- let me just read the
20 previous page to get the context.

21 It shows how to connect to the pins of the
22 TMS320E25 to make it appear as a different chip, an
23 EPROM chip, the TMS27C64. Based on my review, that's
24 what I believe is happening. The diagram shows -- so on
25 page 58, there is a picture of a device, and I think

1 this is the wiring of that device.

2 BY MR. CRAIN:

3 Q. You're referring to Figure 8 on page 58?

4 A. That's right.

5 Q. What do you understand Figure 8 to be?

6 A. It's the EPROM adapter socket. It's a socket
7 that you can plug the -- put the chip into, which then
8 provides extra pins on the bottom which allow you to
9 plug that whole assembly into an EPROM programmer.

10 Q. Do you have any understanding of why -- let me
11 ask it again a different way. Do you have any
12 understanding of the purpose of having an EPROM cell?

13 MR. DAS: Objection, form.

14 THE WITNESS: Yes.

15 BY MR. CRAIN:

16 Q. Why?

17 A. It allows you to change the program on the DSP
18 chip. It allows you to change the program stored in the
19 internal -- one of the internal memories of the DSP
20 chip.

21 Q. Is there -- on page six -- let's turn to that.
22 If that's not the one, maybe you can show me another
23 page. Does page six illustrate what is contained on the
24 TMS320 DSP chip depicted in Exhibit 15?

25 A. This is the functional block diagram which

1 shows, in schematic form, the main functional units that
2 are part of the chip.

3 Q. Do you see, on kind of the center, upper half of
4 the page, a block that has the words, "Address, program
5 ROM/EPROM"; in parens there, it says, "4096 X 16."

6 A. Yes.

7 Q. Do you have any understanding of what that
8 functional block relates to?

9 A. That's the internal read-only memory that I was
10 referring to.

11 Q. That you were referring to that is resident on
12 the chip, itself?

13 A. When we were discussing the pin-out on page 59,
14 I was saying it was to allow for programming of one of
15 the internal memories of the chip, and that's the one,
16 the one that you just described.

17 Q. Are there any other memories that you are able
18 to identify in the functional block diagram on page six?

19 A. Yes.

20 Q. Where are they?

21 A. Well, I -- I haven't gone through all the units,
22 but I see two -- two boxes containing the word RAM,
23 R-A-M, towards the bottom. One is the Data RAM,
24 Block B1 and Block B2; and the other is called the
25 DATA/PROG RAM, Block B0.

1 Q. Do you feel like you have any understanding of
2 what those two blocks you just identified do in the DSP?

3 A. Yes.

4 Q. Please share that with me.

5 A. So RAM stands for random access memory, which
6 means memory that you -- which actually means memory
7 that can be both read and written on the time scale of
8 individual instruction cycles. The Data RAM is
9 specifically to hold data values, such as the sampled
10 values of signals. The DATA/PROG RAM is separate
11 because it can either be used to hold data that would
12 then be used as part of the algorithm, or it can be used
13 to hold the program -- the actual algorithm that's being
14 executed.

15 Q. Now, are either one of these devices that you've
16 identified as RAM or types of RAM non-volatile memory?

17 A. These would be normally considered volatile
18 memory. Of course, non-volatility is not necessarily an
19 intrinsic property of the memory. It's a property of
20 the entire implementation. So if you provide -- if you
21 have a memory chip that, under certain conditions, will
22 lose its memory, you can say it's the volatile memory;
23 but if you embed it in a system that prevents it from
24 losing its memory, then you've got a non-volatile
25 memory.

1 Q. Do you see any other memories other than the
2 three we've identified so far?

3 A. There are a bunch of buffers or registers, I
4 guess. Like the AR0, these are registers. The stack,
5 these are registers. They are similar to memory,
6 because they hold binary numbers, but they are smaller,
7 they have fewer bits.

8 Do I see any others? There are other registers
9 described. But that's it.

10 Q. Do you have any understanding of whether these
11 buffers and registers that you're speaking about are
12 non-volatile memory?

13 A. They are not.

14 Q. Do you see yet any other types of memory in the
15 functional block diagram of the TMS320 shown on page six
16 of Exhibit 15 that we've not already identified?

17 A. No.

18 Q. I don't think -- let's go back and look at the
19 first one that we were talking about, the Program
20 ROM/EPROM. Do you have any understanding of what that
21 component appears to be?

22 A. Yes.

23 Q. Please explain.

24 A. It's a memory for storing the program to be
25 executed, which is either a mask programmed ROM, where

1 the program is stored -- is defined at the time of
2 manufacture of the device; or it's an EPROM, a
3 programmable read-only memory, where the program can be
4 written into the device after it's been manufactured.

5 Q. Do I understand you to say that the functional
6 block diagram that you're focusing on as ROM/EPROM could
7 be either/or?

8 A. That's correct. And it's not that I don't know
9 which one it is, but they're using this to cover both of
10 those cases.

11 Q. What's your understanding, if you have one, on
12 why the memory might actually be a ROM and not an EPROM?

13 A. The reason would be if you developed a program
14 and you don't -- you want to mass produce it, then the
15 cheapest way will be to have it specially manufactured --
16 if you're manufacturing very large volumes, to have it
17 as a mask programmed ROM.

18 Q. What's cheaper about that?

19 A. It's probably simpler. It's probably a simpler
20 circuit. And then, of course, you know, if you were
21 going to use the EPROM, you would then have to actually
22 program that ROM for each device that you manufactured,
23 as a subsequent stage to manufacture.

24 Q. I don't understand that last statement.

25 A. So we could take the chip with the EPROM, we

1 could -- it comes off the production line. We have the
2 program that we want to write into the read-only memory.
3 We take the chip and put it into the programmer or
4 somehow arrange it in circuitry that performs the
5 programming, and then we write the program in. If we
6 didn't have the EPROM, if it was part of the actual
7 manufacture process, then the chip that came out of the
8 manufacturing would already have the program in it.

9 Q. Is ROM non-volatile memory?

10 A. Yes.

11 Q. Is EPROM non-volatile memory?

12 A. Yes.

13 Q. Does -- according to your understanding --
14 Exhibit 15 give us any additional information about the
15 ROM and the EPROM, about the type?

16 A. It probably does. It might not. As we noticed
17 with the pin-out, this is clearly marked, "Advance
18 Information." So there may be some details which are
19 simply not included.

20 Q. Well, based on your understanding of Exhibit 15,
21 what would you understand the ROM to constitute?

22 A. I would understand ROM to be the situation where
23 it's mask programmed.

24 Q. What is your understanding of what the EPROM
25 would constitute if it were EPROM and not ROM?

1 A. That would mean a different device where that
2 memory was in the form of a programmable read-only
3 memory.

4 Q. And we talked yesterday about a couple of
5 different types of EPROM -- or EPROM, and I think the
6 comparison between what's known as EPROM and EEPROM.
7 Are you able to tell us what may be included or excluded
8 by the EPROM shown in the functional block diagram on
9 page six?

10 A. Sorry. There is no mention of EEPROM in this
11 document. Okay?

12 Q. How do you know that?

13 A. Oh, sorry. I don't. I'm not aware of -- I
14 haven't noticed any mention of EEPROM in this document.

15 Q. Well, you said that with such seeming sureness,
16 I thought maybe you had checked.

17 A. I would have expected it to be something that
18 they put on the headlines on the front page.

19 Q. In that they apparently have not, then what does
20 that leave you, according to your understanding, as to
21 what an EPROM is, in this situation?

22 A. You know, all I can say is the E in EPROM is for
23 erasable. The P is for programmable. I don't know how
24 they're going to do the erasing.

25 Q. Do you know whether or not the EPROM referenced

1 in the functional block diagram speaks to the type of
2 EPROM that requires an ultraviolet light to be erased?

3 A. I don't know. Wait.

4 I don't know, but I notice, on page 57, a round
5 window.

6 Q. What does this round window on page 57 tell you?

7 A. It suggests to me that that is the window to
8 provide the ultraviolet light to erase the ROM.

9 Q. So should I understand that the image that we
10 see on page 57 correlates to the functional block
11 diagram of an EPROM or ROM on page six? Is that what
12 you're saying?

13 MR. DAS: Objection, compound.

14 THE WITNESS: The image on page 57 is another
15 mechanical encapsulation of this chip.

16 BY MR. CRAIN:

17 Q. Oh, okay. So does the image of the chip show --
18 hold on a second. Let me make sure I understand.

19 Are the images on page 57 one instance of the
20 TMS320 chip, according to your understanding?

21 A. Yes.

22 Q. State again, what does that circle in one of the
23 diagrams of the chip mean to you?

24 A. It looks like the window that would be provided
25 to allow erasing the PROM with UV.

1 Q. Would this be the EPROM then that you're
2 referring to that requires an ultraviolet light to be
3 erased?

4 A. Yes.

5 Q. Go to the next page. We were talking about this
6 a moment ago. Let's see if we can wrap this up.

7 Do you see the paragraph -- I guess at the
8 bottom of the page -- talking about the TMS320E25 EPROM
9 cell?

10 A. Yes.

11 Q. I believe it does go on to talk about that
12 they're ultraviolet light erasable, if you see that.

13 A. That's right. I see that.

14 Q. Now, is that referencing the DSP, according to
15 your understanding, or something else?

16 A. No. It's referencing the TMS27C64.

17 Q. What do we understand the TMS27C64 to be?

18 A. It's an EPROM chip.

19 Q. But that chip is separate to the DSP; isn't it?

20 A. That's right.

21 Q. So this is an entirely different EPROM than what
22 we see on page 57. Is that correct?

23 A. Yes.

24 Q. Thank you. But both of those EPROMs, on 57 and
25 58, are the ultraviolet light erasable type?

1 A. It doesn't -- I haven't seen it say that, but
2 the inclusion of a window makes me think that.

3 Q. Let's go back to page six. We were talking
4 about the ROM and the EPROM. What type of information
5 would you expect to be contained in either the ROM or
6 the EPROM, based on your understanding of what's
7 depicted in the functional block diagram of page six?

8 MR. DAS: Objection, asked and answered.

9 You can answer.

10 THE WITNESS: As I mentioned before, the labels
11 are -- one of these areas is labeled Program ROM/EPROM,
12 one is labeled Data RAM, one is labeled DATA/PROG RAM.
13 We notice that the EPROM is labeled Program ROM, which
14 means that it stores the program, the algorithm, and
15 also -- but the program could also be stored in the
16 DATA/PROG RAM.

17 BY MR. CRAIN:

18 Q. So then, naturally, that means that we would not
19 store data in the ROM or EPROM block?

20 A. Actually, I don't think that's true.

21 Q. What do you base that on?

22 A. My experience.

23 Q. Why do you believe that's not true?

24 A. It's -- when you're distinguishing between data
25 and program memories, generally you're talking about a

1 restricted capability for the data memory and a less
2 restricted capability for the program memory.

3 Q. So?

4 A. I'm sorry. I've forgotten what I'm trying to
5 explain.

6 Q. Well, I think you're trying to tell me --

7 A. Are you --

8 Q. Sorry?

9 A. You were asking whether the program memory could
10 be assumed to not contain data.

11 Q. Well, yeah. Because you were telling me that,
12 well, these things have labels.

13 A. Yes.

14 Q. So, therefore, it's pretty clear. But then, I
15 seem to hear you say that perhaps, well, I could put
16 data in the program.

17 A. Yes.

18 Q. Okay. I'm trying to understand how you know
19 that --

20 A. Yes.

21 Q. -- or what in Exhibit 15 suggests that to you.

22 A. Data is not a very specific term. Right? It's
23 not -- there are different kinds of data. But in
24 general, when you're writing a program, you can have
25 the -- some of the data directly within the program,

1 itself. So, in that case, you would be storing data in
2 the program memory.

3 Q. Define data for me, then.

4 A. That's a very broad term. Here, they're
5 distinguishing between program and data. So the program
6 is specifically the machine code instructions, and the
7 data is the parts of -- the values we're moving -- we're
8 dealing with which are not the machine code instructions.

9 Q. So the block having the words "Program
10 ROM/EPROM" in figure -- the functional block diagram on
11 page six, are you telling me that it is or is not
12 limited to machine code instructions?

13 A. It's not.

14 Q. Does Exhibit 15 teach that to you?

15 A. It's inherent. I'm -- if that's the right term.
16 It's something that -- I don't think -- in any kind of
17 processor of this kind, it would -- it's normal to have
18 data mixed in, in the program memory.

19 Q. Would this data be data that would be updated
20 from time to time?

21 A. This would be the data which is much -- no, this
22 would be the data that's intrinsic to the program, to
23 the algorithm.

24 Q. Can you give me an example of data that you
25 consider not to be intrinsic to the program, so I'll

1 know a clear distinction.

2 A. Anything that you would want to change through
3 the operation of -- that you would want to be able to
4 take on different values during the operation of the
5 program.

6 Q. Can I call that non-intrinsic data, for our
7 purposes, or is there a better title?

8 A. There is a better title. The data in the
9 program memory would be called constant data.

10 Q. Okay. And what would other type of data be
11 called?

12 A. Data.

13 Q. All right. That's fair enough.

14 A. Variable data. Okay. Variable data.

15 Q. I don't want to suggest a term. I want to use a
16 term that you tell me is the correct term.

17 A. I know.

18 Q. So we're going to use constant data and variable
19 data. Is that correct?

20 A. Yes.

21 Q. Where would you expect for me to find variable
22 data in the functional block diagram on page six?

23 A. In either of -- any of the RAM blocks.

24 Q. Would you expect me to find variable data in the
25 Program ROM/EPROM block?

1 A. No.

2 Q. Why not?

3 A. The definition I'm using for variable data is
4 data that constitutes a variable in the program. That
5 means that's something whose value changes during the
6 operation of the program. You would not be able to
7 change the value of something stored in the ROM during
8 the operation of the program.

9 Q. What about if it was an EPROM?

10 A. In this case, the EPROM -- erasing and
11 reprogramming the EPROM is a lengthy process. It
12 requires several minutes say at least. So that's
13 totally outside the scope of the program.

14 Q. Because a person actually has to shine a UV
15 light on it?

16 A. We have to somehow cause UV light to be shown on
17 it.

18 Q. Also looking at figure -- the functional block
19 diagram, figure -- page six, I see two items that appear
20 to be similar to me. One appears to be identified as a
21 data bus; another appears to be identified as a program
22 bus. Do you see those?

23 A. Yes.

24 Q. Can you describe each of those two items for me.

25 MR. DAS: Objection, compound.

1 THE WITNESS: The data bus would be a set of
2 essentially wires that carry values of data between
3 memories and registers and processing units. The
4 program bus would be a similar set of wires that carry
5 the elements of the -- of the program between the
6 different places they may need to go. As we've
7 discussed, elements of the program may include constant
8 data.

9 BY MR. CRAIN:

10 Q. Let me see if I can summarize to make sure I
11 understood you. The program bus carries the program and
12 constant data, comprised of a series of wires?

13 A. Electrical connections. Obviously, they're not
14 really wires.

15 Q. Electrical paths or connections?

16 A. Okay.

17 Q. Is it more than one?

18 A. Yes.

19 Q. How do you know?

20 A. The -- well, again, because it always is. But
21 in the figure, there are these -- when we see the
22 connections -- the marks that connect to these two wide
23 gray buses, they're single lines, which have a short
24 diagonal line with a number next to it. That indicates
25 the number of actual separate binary values being

1 carried. You can't always assume that that number is
2 the same as the total number in the bus, but I think you
3 can assume that it's at least -- the bus is at least as
4 big as those numbers.

5 Q. Is it the nature of a bus to allow for either --
6 faster communication?

7 MR. DAS: Objection, form.

8 BY MR. CRAIN:

9 Q. I'm trying to understand what the nature of it
10 is. Is it a capacity or speed issue?

11 MR. DAS: Objection, form.

12 THE WITNESS: Is what?

13 BY MR. CRAIN:

14 Q. Is the data bus or the program bus -- let me
15 back up even further. Are they essentially the same in
16 construct, but perhaps different in purpose?

17 MR. DAS: Objection, form.

18 THE WITNESS: They are different buses. They're
19 given different names.

20 BY MR. CRAIN:

21 Q. Right. But I mean, are they -- would you expect
22 them to be constructed similarly?

23 MR. DAS: Objection, form.

24 THE WITNESS: You know, at the level of the
25 chip -- these are abstract concepts.

1 BY MR. CRAIN:

2 Q. Right.

3 A. But I would expect some similarity between them,
4 yes.

5 Q. Why, according to your understanding, would you
6 expect to have any type of bus on a digital signal
7 processor?

8 A. So as I said, the bus is an abstract concept.
9 It's a way of explaining to the human, a human potential
10 user, and to some extent, allowing a designer to explain
11 to him or herself what's going on. You know, all -- let
12 me leave it at that.

13 Q. Did I understand you correctly earlier to
14 indicate that a bus would be understood as a multiple
15 number of communication paths or connections?

16 A. In this instance, I'm confident that the data
17 and program bus have multiple connectors -- have
18 multiple bits.

19 Q. Why is that?

20 A. Because of the notations on the block diagram
21 showing, in many cases, 16 lines coming in and out of
22 the bus -- both buses.

23 Q. Okay. So for any of these connections coming
24 off a bus that has the little diagonal line with a 16 --

25 A. Yeah.

1 Q. -- we're to understand that there is actually 16
2 lines?

3 A. That's right.

4 Q. And were you telling me earlier -- well, that
5 means that the bus then has to at least have 16 lines?
6 Is that what you meant to say?

7 A. That's what I was saying. So you notice, there
8 is one over here with only three. So sometimes you
9 don't take all the pins off a bus. But I don't see any
10 numbers larger than 16. So I think the buses are
11 probably 16 bit.

12 Q. Is this like a parallel-type connection, a bus?

13 MR. DAS: Objection, vague.

14 THE WITNESS: The buses they're talking about
15 here are, in my estimation, 16 parallel lines, yeah.

16 BY MR. CRAIN:

17 Q. Does that mean that one component can either
18 send or receive data on all 16 lines at one time?

19 MR. DAS: Objection, form.

20 THE WITNESS: That -- that's -- I think that's
21 what -- I think that's what I mean. So yes. The bus
22 would be a set of -- would allow connection between two
23 different components; and in this case, most likely 16
24 bits at a time.

25 BY MR. CRAIN:

1 Q. How is a parallel connection different from a
2 serial connection?

3 A. So we haven't discussed serial connections at
4 all. Right?

5 Q. No.

6 A. It's used in a bunch of different ways. There
7 is no -- I'm not sure there is any discussion of serial
8 connections in this document.

9 Q. Can you answer the question, though?

10 A. Well, it would be easier to answer it if you
11 were telling me about a particular domain in which those
12 terms might be used.

13 Q. Well, do you have an understanding of what a
14 serial connection is?

15 A. I have several.

16 Q. Lay them on me.

17 A. Okay. So the most common -- the first usage
18 that comes to mind is the serial port commonly found on
19 computers.

20 Q. Does it have a name?

21 A. There are many different kinds of serial ports.

22 Q. What do we call them? Just a serial port?

23 A. They're often called a serial port. Yes.

24 Again, what are you trying to -- what is the question,
25 names of serial ports?

1 Q. Well, if they have them.

2 A. I can give you two instances.

3 Q. Okay.

4 A. The -- well, they have a lot of names. But
5 let's say the RS-232 port is a serial port.

6 Q. Okay.

7 A. And another one is the USB, the universal serial
8 bus. That's a serial port. So I've named two serial
9 ports.

10 Q. Okay. I'm trying to understand how a serial
11 communication --

12 A. Yes.

13 Q. -- link, line, whatever you want to call it, is
14 different than what we may understand to be a parallel
15 communication link, line, or whatever.

16 MR. DAS: Objection, form. Objection, compound.
17 BY MR. CRAIN:

18 Q. Let me give you another question. I don't mean
19 to frustrate you. You seem to be frustrated.

20 A. I just wanted to point out that it's -- you're
21 characterizing this program bus as a parallel
22 connection, which seems reasonable to me, but it's not
23 the way it's being described here.

24 Q. Well, you've forgotten more about buses than
25 I'll probably ever know. So I'm just going off of what

1 I understand you to share with me. If I misstate that,
2 please correct me.

3 A. So where did the term "parallel" come from?

4 Q. Well, I thought we were talking about
5 communication -- you said 16 communication lines. Even
6 though you may have forgotten what I already know, I may
7 have a little bit of understanding. So I'm wondering if
8 that's a parallel type of communication. Whether this
9 one is or not is immaterial. But I'm trying to
10 understand how that might be commonly implemented. And
11 of course, you've indicated that you're kind of a -- you
12 know, understand DSPs. So I want to understand from you
13 what you understand it to mean. Does that make sense?

14 A. Okay.

15 Q. Okay. We need to start at a high level and
16 maybe drill down as needed. At a high level, what do
17 you understand the differences to be between a serial
18 communication path or link and a parallel communication
19 path or link?

20 MR. DAS: Objection, compound.

21 THE WITNESS: So the -- in computers, we often
22 talk about serial and parallel buses actually --
23 sorry -- serial and parallel interfaces. In fact, these
24 days, parallel interfaces are pretty rare. But in
25 early -- you know, in the IBM PC over many years, there

1 would be both a serial and a parallel interface on it.
2 And the distinction there is that the serial port has
3 fewer wires and it manages to convey comparable
4 information by sending successive data bits down the
5 same wire, whereas in the parallel port, those data bits
6 would be sent over separate wires all at the same time.

7 BY MR. CRAIN:

8 Q. You asked me where I got the notion of parallel.

9 A. Yes.

10 Q. Does that not seem to be more akin to what you
11 describe with respect to either one of the two buses
12 shown in the figure on page six?

13 A. Yes.

14 MR. DAS: Objection, form.

15 BY MR. CRAIN:

16 Q. Okay. So I think we're talking about the same
17 thing.

18 You mentioned USB as a type of serial interface.
19 Is that an accurate description?

20 A. Yes.

21 Q. Do you recall when USB first was introduced?

22 MR. DAS: Objection, form.

23 THE WITNESS: USB was -- is the -- is very much
24 the successor to the RS-232 port that was present on
25 many of the PCs of the '80s and '90s. And my

1 recollection, USB appeared sometime between 1995 and
2 2000. That is -- that's when it would be, you know,
3 something that you would actually have on a piece of
4 equipment you would buy.

5 BY MR. CRAIN:

6 Q. What about RS-232? Do you have an understanding
7 of when RS-232 was introduced?

8 A. RS-232 is, in technology terms, ancient. So I
9 don't know when it was introduced, but it could have
10 been the '50s or the '60s.

11 Q. I think you indicated that USB replaced RS-232?

12 A. Yes.

13 Q. Why?

14 A. There were various limitations to RS-232 which
15 were improved upon by USB.

16 Q. What were some of those limitations?

17 A. USB is faster.

18 Q. Any others?

19 A. Oh, yes. USB allows more sophisticated
20 configuration of the device so that when you plug it in,
21 the computer can find out what the device is, which --
22 it was both -- USB is a much more complicated standard.
23 An RS-232 device was not well standardized. So there
24 was no way that -- there was no nice industry standard
25 way that people producing RS-232 peripherals could allow

1 the devices they were connected to, to automatically
2 identify what they were.

3 Q. Going back to the first reason you gave, faster,
4 or speed, faster in what regard?

5 A. Higher data rates. Able to transfer a large
6 amount of data in the same amount of time.

7 Q. On USB versus RS-232?

8 A. Yes. The RS-232 has a relatively low maximum
9 bandwidth.

10 Q. Do you have any understanding with respect to
11 data transfer rates or speeds in parallel interfaces?

12 A. Yes.

13 Q. Can you give me a frame of reference for a
14 parallel interface in comparison to what you've
15 described with USB or RS-232?

16 Let me help you further. I'm trying to
17 understand how it may fit, relate, if at all.

18 A. The difference between RS-232 and USB is -- the
19 reason the USB is faster is mainly due to improved
20 specification of the electrical characteristics, which
21 allow the voltages to change more rapidly without
22 becoming distorted. If it weren't for that, USB would
23 not be intrinsically faster than RS-232.

24 Using those kinds of electrical specifications,
25 you could implement a parallel interface. Typically,

1 the parallel interface would be -- would have intrinsic
2 higher bandwidth, with a higher data rate for both
3 cases. So if we have a single electrical standard, we
4 build a serial port, we build a parallel port, the
5 parallel port is faster.

6 Q. Is that a general truth?

7 A. Yes. Okay. It's a rule of thumb. Parallel
8 port -- serial port, as I've said, covers a lot of
9 different things. Parallel port probably covers an even
10 wider range of things.

11 Q. An even wider range.

12 A. Um-hmm.

13 Q. How so?

14 A. Because you have to specify how you're going to
15 manage --

16 (Interruption.)

17 THE WITNESS: You have a lot of choices of how
18 you're going to manage the parallel transfer of data.

19 BY MR. CRAIN:

20 Q. Is it common to interface a serial connection
21 with a parallel interface?

22 MR. DAS: Objection, form.

23 THE WITNESS: They're different interfaces.

24 BY MR. CRAIN:

25 Q. Okay. I apologize for my overly simplistic --

1 but if I had an RS-232 wire. Right? And I had a
2 parallel -- like a ribbon cable? Is that a parallel
3 type of connection?

4 A. A ribbon cable would be something you could use
5 to carry the electrical signals from a parallel
6 interface.

7 Q. Can you interface the parallel cable to the
8 serial cable in some fashion?

9 A. You could build a device that converts between
10 them.

11 Q. What would this device be?

12 A. It would be a piece of electronics with a
13 parallel port on one side and a serial port on the other
14 and some circuitry in between to transfer the data
15 between them.

16 Q. Are these off-the-shelf-type devices?

17 A. Obviously, it depends on the particular choice
18 of parallel and serial port. I know for a fact you can
19 get off the shelf, a device that converts between a USB
20 port and a so-called Centronics parallel printer port.

21 Q. Is that a device that's available now or
22 sometime --

23 A. It is.

24 Q. Could you design such an interface yourself?

25 A. Yes.

1 Q. How hard would it be?

2 A. It's not something I would do every day. It's
3 not -- I mean -- well, that's interesting. That
4 depends. I'd have to think about how to do it. It
5 wouldn't be that hard. It wouldn't be -- you know, I
6 would have to have a good reason to do it, but I could
7 certainly do it.

8 Q. Okay. Tell me how you would do it.

9 A. Well, you have one part of the circuitry which
10 is, you know, doing whatever is required of the serial
11 interface. For instance, there is a -- you know, you
12 can buy chips that are specifically assembled to make
13 that easy, a so-called UART, U-A-R-T. You could have
14 one of those to deal with assembling and disassembling
15 the information on the serial side. You would then have
16 a bunch of pins that came out of that device. You would
17 then have some kind of buffer and some control logic to
18 handle the parallel port.

19 Q. When you say a buffer, you would need some type
20 of memory?

21 A. It depends. It would make it a lot more
22 complicated if you wanted to give it a memory buffer.
23 The easiest thing would be to have something where the
24 speed of communication was the same on both ports, the
25 serial and the parallel port.

1 Q. Didn't you tell me generally that parallel ports
2 are faster?

3 A. What I meant to indicate by that was they're
4 potentially faster. Any data port, you can run at less
5 than its maximum rate. But usually in design, the
6 maximum rate is the most interesting -- is the thing you
7 care about.

8 Q. I was going to say, I wouldn't think you would
9 want to slow something down if you didn't have to.
10 Right?

11 MR. DAS: Objection, form.

12 THE WITNESS: I mean, all other things being
13 equal. But that's -- in many cases, that's not the
14 primary design limitation.

15 BY MR. CRAIN:

16 Q. Well, if I understood you correctly, I thought
17 you were saying that, well, you might ideally want them
18 to be at the same speed.

19 A. Yeah.

20 Q. Again, from a general perspective, a serial
21 connection may not be as fast as a parallel connection.
22 Is that fair?

23 A. The maximum throughput, as imposed by the
24 interface, using the same electrical standards, would
25 be -- the parallel port would have a higher maximum

1 throughput capacity than a serial port.

2 Q. Would that have been true in 1994 as well?

3 A. Yes.

4 Q. So if there is a higher throughput on the
5 parallel connection, how do you make it the same speed
6 as the serial interface?

7 MR. DAS: Objection, form.

8 THE WITNESS: Well, it's the -- it's the maximum
9 speed. So, you know, you could build the interface such
10 that it was only able to transmit data up to the speed
11 of the slower of the two interfaces. In fact, you know,
12 at some level, you would have to do that.

13 BY MR. CRAIN:

14 Q. So if I was communicating the data across the
15 parallel interface into the serial interface, if I
16 understand what you're saying, I may have a larger
17 amount of data coming through the parallel interface.
18 How do I keep -- I want to say it's like a bottleneck or
19 it seems like it would crash or something.

20 A. Um-hmm.

21 Q. How do I get it into what I need for the serial
22 interface?

23 MR. DAS: Objection, form.

24 THE WITNESS: It's easy to imagine a
25 circumstance where you wouldn't be able to do that. But

1 at the same time, I've described that such devices
2 exist. So there is this whole area of communications
3 interfaces we haven't spoken about called handshaking,
4 which is wires other than the ones we've discussed that
5 are used to modulate the transfer of data.

6 BY MR. CRAIN:

7 Q. What I'm trying to get back to was you had
8 mentioned a buffer. Would that be a way to do it, to
9 buffer what's coming on the parallel so that I can read
10 that out on the serial?

11 A. No. That's not what I'm talking about.

12 Q. I wasn't sure. That's the reason I'm asking.
13 What was the purpose of the buffer that you referenced
14 earlier?

15 A. The buffer is like these registers. Like we've
16 got this single word coming in on a serial port. We get
17 it coming out of the UART, we store it in the register,
18 and then that becomes -- that drives our parallel port.

19 Q. Look back at page six.

20 A. Yeah.

21 Q. Again, I understand that this is a functional
22 block diagram. I'd like your understanding, based on
23 your experience, as best you can ascertain it, for what
24 this document appears to disclose as of, I guess, 1990.

25 You pointed my attention to several smaller

1 lines with the diagonal lines through them. Do you
2 remember that?

3 A. Yes.

4 Q. And they have the numbers out beside them as
5 well, such as 16.

6 A. Yes.

7 Q. Would you expect each of the communication links
8 here that we see, these types of diagonal lines coming
9 off the bus, to be the same type of interface as the
10 bus? I don't know if I'm even asking that right.

11 MR. DAS: Objection, form.

12 THE WITNESS: It's not -- within the chip here,
13 it's not really -- I don't really -- I'm not sure what
14 you mean by "interface."

15 BY MR. CRAIN:

16 Q. An overly simplistic here issue would be if we
17 were to consider one of these buses as a parallel type
18 of interface, would I expect any of these traces to any
19 of the functional blocks to be a serial interface?

20 MR. DAS: Objection, form.

21 THE WITNESS: It's possible. I don't think it's
22 true, but it is possible there is some serial device in
23 here, but I don't see it. The lines coming off the
24 program bus would not be -- I mean -- would not be
25 serial.

1 BY MR. CRAIN:

2 Q. I'm sorry?

3 A. The lines coming off the program bus or the data
4 bus would not be serial.

5 Q. Hopefully, last question on this. You said you
6 didn't see any, but you seem to think that, well, I
7 guess that's possible.

8 A. Yes.

9 Q. What would it look like if that were the case?

10 MR. DAS: Objection, form.

11 THE WITNESS: I was looking for a box, one of
12 these functional boxes that had one of these lines going
13 out that looks like it was a serial interface line.

14 BY MR. CRAIN:

15 Q. How would it be represented, according to your
16 understanding, if it were a serial interface line?

17 A. There are conventions for labeling these lines.
18 These little letters we see on the edge of the diagram
19 and elsewhere, they -- if you're looking at this, there
20 is a bunch of conventions that you'd know what they
21 mean -- you'd have a good idea what they mean.

22 In a classic serial interface, there is an RX
23 and a TX line for receive and transmit.

24 Q. Right.

25 A. I was looking to see if there are any pins

1 marked like that. I don't see them.

2 Q. Dr. Ellis, has there been an occasion where you
3 have been requested by someone to develop a DSP solution?

4 MR. DAS: Objection to form.

5 THE WITNESS: Yes.

6 BY MR. CRAIN:

7 Q. Are you able to share with us who it was that
8 approached you?

9 MR. DAS: I'm going to caution you not to get
10 into other people's confidential information.

11 BY MR. CRAIN:

12 Q. To the extent it's confidential, that's fine.
13 Are you able to share that?

14 A. I'm thinking of -- I mean, I'm thinking of
15 several consulting things, just because the way you
16 phrased it makes it sound like kind of a business thing.
17 That's the closest relevance. But, you know, for the
18 purpose of the question -- I don't know. What do you
19 want me to say? Most often, when I'm developing things,
20 it's because I'm asking me to do it.

21 BY MR. CRAIN:

22 Q. Okay. Without -- let's try it this way, if we
23 can:

24 Without identifying any company or person --
25 outside person -- have you been approached and asked to

1 develop a DSP solution for someone else?

2 A. Yes.

3 Q. Without identifying the person, can you give me
4 at least a description of the person or entity that made
5 the request?

6 A. For instance, a small company trying to develop
7 a product that will be responsive to certain kinds of
8 sounds.

9 Q. Are you thinking of a specific instance when you
10 share that?

11 A. I'm thinking of two at the moment.

12 Q. When were those?

13 A. Oh.

14 MR. DAS: Objection, form.

15 THE WITNESS: They're the most recent ones.

16 Like within the past couple of years.

17 BY MR. CRAIN:

18 Q. Can you speak to the type of problem that you
19 were asked to solve with respect to the DSP solution
20 that you developed?

21 MR. DAS: Objection, form. Also caution you not
22 to get into confidential information.

23 THE WITNESS: Thank you.

24 My current research is about sound processing.

25 So it's those kinds of problems, recognizing or

1 processing sound.

2 BY MR. CRAIN:

3 Q. Is this through LabROSA?

4 A. Yes. I mean -- is it through LabROSA? No.
5 It's my independent consulting, the ones I'm thinking
6 about.

7 Q. Oh, okay.

8 Were you compensated in each of these two
9 instances you're thinking of?

10 A. One of them, I haven't completed, and I have not
11 received any compensation. The other one, I think I
12 was -- I think I have some equity.

13 Q. Again, what -- I'd like to understand the scope
14 of what you're trying to do. So can you explain that to
15 me, to the best of your ability.

16 A. What do you mean?

17 MR. DAS: Objection, asked and answered.

18 BY MR. CRAIN:

19 Q. The scope of what you are trying to develop or
20 solve.

21 MR. DAS: Objection, asked and answered. Again,
22 I would caution you not to get into confidential
23 information.

24 THE WITNESS: Okay. It would -- maybe it would
25 be easier to have these questions if I could think of

1 one where there was no confidentiality involved.

2 BY MR. CRAIN:

3 Q. Is there one you can think of?

4 A. Sure.

5 Q. Okay. Which one?

6 A. I'm thinking about some work I did -- this time,
7 through LabROSA -- for the -- a government project where
8 we were trying to recognize a particular tone in a
9 signal, in an audio signal.

10 Q. Did you design a digital signal processor to do
11 that?

12 A. No.

13 Q. Have you ever designed a digital signal
14 processor?

15 A. Again, it depends what you call a digital signal
16 processor. I haven't ever designed anything like these
17 kinds of -- what I would call a DSP chip.

18 Q. Or could we say hardware even? Would that be an
19 accurate --

20 MR. DAS: Objection, form.

21 THE WITNESS: No.

22 BY MR. CRAIN:

23 Q. Why not? What's wrong with hardware?

24 A. Well, because a system -- a digital signal
25 processing system always comprises hardware. Right? So

1 there is -- and there is the -- you know, it also
2 comprises software, but the software doesn't do anything
3 without the hardware that it runs on.

4 Q. Have you ever designed DSP hardware?

5 A. Let me think of a good example then.

6 Q. Before you do, let me ask you this: This may
7 help us. Have you ever designed DSP software?

8 A. Yes.

9 Q. Of the two, is there one that you've done more
10 of?

11 A. Yes.

12 Q. Which?

13 A. Software.

14 Q. Is DSP software more of your area of expertise?

15 A. Yes.

16 Q. I did interrupt you a minute ago. So let's
17 circle back to that. I think I was asking you, could
18 you think of any instances where you had developed DSP
19 hardware. Isn't that what I was asking and you were
20 thinking about?

21 A. Yes.

22 Q. So let me ask you the question. Can you think
23 of any instances when you developed DSP hardware?

24 A. Yes. I'm thinking of one. I mean, like I say,
25 any DSP solution involves hardware.

1 Q. Okay. Is one the total that you can think of
2 right now?

3 A. Well, no. Any of them. Right? I mean -- but
4 it just depends on what -- how involved is the design of
5 the hardware.

6 Q. Well, let's talk about it in the context of what
7 we see in Figure 6 (sic).

8 A. Um-hmm.

9 Q. Now, these are functional block diagrams; but if
10 I understand it correctly, it relates to a chip.

11 A. Yeah.

12 Q. Can we call it hardware?

13 A. Yes.

14 Q. Have you had instances where you designed
15 hardware in a similar fashion to what we see on page six
16 of Exhibit 15?

17 MR. DAS: Objection, form.

18 THE WITNESS: No.

19 BY MR. CRAIN:

20 Q. When you say "no," are you able to think of any
21 instance when you engaged in the design or development
22 of hardware for a digital signal processor chip in a
23 similar fashion to what we see on page six of Exhibit 15?

24 MR. DAS: Objection, form.

25 THE WITNESS: So I understand your question to

1 mean work that would involve drawing a diagram like
2 this, but a new one, as part of the design. And in that
3 case, I have not.

4 BY MR. CRAIN:

5 Q. Have you ever created a design for a DSP chip?

6 A. No. That's a very specialized activity.

7 MR. CRAIN: Let's go off the record.

8 THE VIDEOGRAPHER: We're off the record at
9 12:23 p.m.

10 (Lunch recess taken from 12:23 to 1:18.)

11 THE VIDEOGRAPHER: We're back on the record.

12 The time is 1:18 p.m.

13 BY MR. CRAIN:

14 Q. Dr. Ellis.

15 A. Hi.

16 Q. During your lunch break, did you have an
17 opportunity to speak with QSC's counsel?

18 A. I did.

19 Q. Did you consult or confer with QSC's counsel
20 during the break regarding the substance of any
21 testimony you've given so far today?

22 A. No.

23 Q. Did you consult with QSC's counsel during the
24 break regarding the substance of any testimony that may
25 be anticipated to be given by you today?

1 A. No.

2 Q. Did QSC's counsel, during the break, suggest to
3 you the manner in which any questions should be
4 answered?

5 A. No.

6 Q. Earlier today, we were talking about the TMS320
7 DSP. Do you recall that?

8 A. Yes.

9 Q. I believe you own such TMS320, the C25?

10 A. Yes.

11 Q. Is the TMS320 DSP, like we see in Exhibit 15,
12 the state of the art, according to your understanding,
13 with respect to DSPs?

14 MR. DAS: Objection, form.

15 THE WITNESS: Certainly not.

16 BY MR. CRAIN:

17 Q. Why not?

18 A. Well, it's -- this is a device from the late
19 '80s.

20 Q. Okay. Well --

21 A. So you said if there was something that I
22 remembered, I should tell you about it?

23 Q. Oh, yes. Okay. You were anticipating that I
24 was going to tell you something. I was going to ask you
25 that. I forgot. So thank you.

1 A. You know, just before the break, we were talking
2 about this block diagram on page six, I think it was.
3 You were asking me, "Have you ever designed one of these
4 yourself?" And I said, "No, it's a very specialized
5 thing." This is the domain of digital VLSI, which is
6 not my particular area. Because in order to design one
7 of these, you would need then a whole infrastructure to
8 go out and manufacture it, which means somebody etching
9 silicon chips somewhere. People in my department do it,
10 but I don't.

11 However, I then remembered that I've recently
12 had some experience which is actually very similar to
13 this. I teach signal processing, and I'm very
14 interested in the ways that people can understand it.
15 One of the things that I've found that is helpful in
16 having people understand signal processing is to have
17 something that responds immediately. This is the kind
18 of thing that DSP chips were initially developed to be
19 able to do. It turns out, these days, you don't
20 actually use a DSP chip at all. I've been able to do a
21 lot of work like this just running on my regular laptop,
22 the stuff like that on my website.

23 But I've also been interested in the educational
24 power of things that you can hold and build, because
25 that's -- there is a whole trend going on at the moment

1 which seems very powerful to me. So I've been looking
2 for something like this that I can use in that context
3 to give people -- give my students an opportunity to
4 work with basic DSP operations and have something that
5 works in real time that's a small little device they can
6 run by themselves.

7 So I've been experimenting with an FPGA chip.
8 These are relatively recent developments, so they've
9 only relatively recently become affordable. And instead
10 of having to do a design like this and then send it out
11 to some fab, fabrication, to have it made in silicon,
12 they have a set of -- a very large collection of
13 individual gates with some mechanism for electrically
14 connecting the gates. And you can do basically the same
15 things you would do if you were designing a DSP chip,
16 but you don't need a fabrication. You can just download
17 it onto this FPGA and you can try it out. And I've been
18 experimenting with some signal processing systems using
19 that.

20 Q. When did you start doing that?

21 A. I think -- I think within the past two years.

22 Q. This sounds at least somewhat similar to the kit
23 that you used to do -- and you mentioned yesterday --
24 with a Class AB amplifier. Is it kind of like that?
25 Did you have a kit and you can make it -- configure it

1 the way you want it?

2 A. It's not like that.

3 Q. I'm sorry. I don't mean to insult you.

4 A. No, it's much more like -- that's the amazing
5 thing about it. It's much more like actually full-up
6 VLSI hardware design.

7 Now, in the late '80s, VLSI hardware design was
8 a very difficult thing to do. Because I don't know --
9 you know, these chips had tens of thousands of
10 individual gates. And that was the point at which, you
11 know, it was like, well, a single design that can
12 actually go and individually assign tens of thousands of
13 individual gates, but, you know, it's really hard.

14 Since then, the field of VLSI has developed a
15 set of design tools where you have a hierarchical way of
16 specifying the sets of gates that are being used.
17 That's how you would design the chip. In fact, there
18 are these standard languages, like Verilog and VHDL,
19 which are used for specifying the layout of a chip in
20 terms of gates through a set of design files. And you
21 use the same design language for FPGAs. So that's what
22 I've been working with.

23 Q. Are you writing some type of software that --
24 let me back up just a second. FPGA?

25 A. Yes.

1 Q. Stands for, again?

2 A. Field-programmable gate array.

3 Q. And I know you said it, so I'm sorry to have to
4 go back and ask more about it. But how do you actually
5 program the gate array? Is it through some type of
6 software configuration?

7 A. It uses -- it involves software. So you have
8 the board containing the FPGA. It has -- actually, this
9 one, the one I'm using, has a USB port on it. So you
10 connect it to the USB port of the host computer. The
11 host computer is running these design tool software
12 applications, which is a standard way of designing
13 large-scale digital systems now and basically for the
14 last 20 years at least. And you -- in that software,
15 you type in the files that describe your design.

16 Q. Okay.

17 A. But the reason that I wanted to mention it is
18 because what happens then is it will -- there are
19 various ways you specify it, but mostly just typing in
20 text into data files. It then draws pictures which look
21 like this. Because that's what -- that's what you're
22 specifying.

23 Q. Once you write these text files -- into your
24 laptop?

25 A. Yes.

1 Q. That's connected by a USB connection to the
2 FPGA --

3 A. FPGA --

4 Q. Can we call it a chip?

5 A. Sure.

6 Q. How does the instructions that you write become
7 implemented in the actual chip?

8 A. The instructions that you're writing are
9 specifying how to connect together units. Basically, at
10 some level, you're just saying what each of the arcs --
11 each of the lines are on a diagram like this. Now,
12 obviously, this is a high-level view; that each of the
13 boxes could then be blown up, and you would have a bunch
14 of lines inside there. Until you get down to the lowest
15 level, which would be the individual logic elements.

16 Q. Right.

17 A. That's exactly how these things work. You have
18 one file which will define a particular block. You
19 know, at some level, you're going to bottom out in these
20 files that place individual gates. There is some level
21 of abstraction there, because again, it's trying to make
22 design easy. But you've got that level of control.

23 Then you write files that reference those things
24 and specify how they're connected together. Then you
25 can write files that reference the already encapsulated

1 things. You can keep doing it. That's why it's
2 called -- VHDL is one of the languages. It's called
3 VLSI hierarchical description language.

4 Q. Now, again -- this is all very interesting. My
5 question to you about this is once you program the text
6 files --

7 A. Yes.

8 Q. Can we call that software or is that not
9 software?

10 A. It's not -- it looks like software, because
11 you're typing in some text files to make a device do
12 something, but it's so different from programming.

13 Q. Right. Because -- sorry?

14 A. It's just different.

15 Q. So when these text files are communicating from
16 your laptop over the USB connection into the actual
17 chip, is there some type of processor or controller that
18 receives that and says, oh, okay, so I need to implement
19 whatever instructions is received?

20 A. No. The -- so the text -- okay. I said it was
21 different. You can think of the text files as
22 describing where the wires go. Right? There is a bunch
23 of gates on the chip, a large number of gates, like a
24 million. From the user's point of view, I can ask any
25 of these gates to be connected together. Of course,

1 that would be very difficult. But the software is
2 clever enough to hide the limitations until you bump up
3 against them.

4 So there is design software which takes your
5 specification of what you want to connect together,
6 knows about, you know, what's in the chip, and figures
7 out a -- the set of data, which then gets basically
8 written into a set of registers on the chip, which then
9 basically switch these things so the gates are connected
10 together according to your specification.

11 Q. Is the chip that receives these instructions
12 making new physical connections on the chip?

13 A. They're electrical switches. But the point is
14 that it's -- it's analogous to the EPROM simulating the
15 ROM. This is like these electrical connections
16 simulating what would happen if you actually taped out,
17 as it's called, and got a chip manufactured.

18 Q. And you've never done this other than within the
19 last two years.

20 A. No, that's right. Well, these -- these devices
21 have come down a lot in cost. So I have never had
22 access to them before.

23 Q. Did I understand you to say that your design --
24 the purpose -- did I understand you correctly to say
25 that the purpose that you have in using these devices is

1 largely educational?

2 A. That's my motivation.

3 Q. Well -- and so you've not implemented one that
4 has resulted in the manufacture of a device, for example.

5 MR. DAS: Objection, form.

6 THE WITNESS: No, I haven't. That's, you
7 know -- that would be a nice thing to be able to do in
8 academia, but it's not that common.

9 BY MR. CRAIN:

10 Q. What's not that common?

11 A. You know, to have the work that you do as an
12 academic turn into some kind of commercial device.

13 Q. Does Columbia not have a tech transfer office?

14 A. Oh, yes. Of course.

15 Q. Are inventions that people at Columbia come up
16 with not commercialized through that tech transfer
17 office?

18 A. Some are.

19 Q. So, in fact, it does happen.

20 A. I said it wasn't very common.

21 Q. But it happens.

22 A. Of course. I didn't say it was impossible.

23 Q. Have you ever had an invention go through the
24 tech transfer office?

25 A. Yeah.

1 Q. Has one ever been commercialized and been part
2 of a business that was spun out of the tech transfer
3 office?

4 MR. DAS: Objection, form.

5 THE WITNESS: I've had a couple of patents that
6 have been licensed, so I believe.

7 BY MR. CRAIN:

8 Q. What do you mean, so you believe?

9 A. That's what I've been told.

10 Q. Do you know if they're the patents that are
11 listed on your CV?

12 A. They probably are listed on my current CV. I
13 believe they're listed on my current CV.

14 Q. But not the CV that we have as an exhibit from
15 yesterday?

16 A. That's right. Well -- that's right.

17 Q. What made you remember this --

18 A. Because it was -- you know, you were asking me
19 about these diagrams, and it's like, yeah, for sure,
20 I've never taped out a chip. But it was like, oh, wait,
21 but there is something relevant here. That's why I
22 didn't think of it immediately. Right? Because it's
23 not the exact same thing you were asking about. Have I
24 ever been a DSP chip designer? No, I've never worked in
25 a company like that.

1 Q. So the closest you've ever been to a DSP chip
2 designer is the experience of FPGA --

3 A. Yeah.

4 Q. -- design?

5 A. But, you know, I thought that was nice to
6 introduce, because actually, that's what a
7 contemporary -- I'm using the same software tools or
8 tools which look very similar -- no, I'm using the same
9 specification language that today's chip designers use.

10 Q. When you use this phrase, "today's chip
11 designers," who are you referring to?

12 A. People working in industry. You know, companies
13 like Intel that create new chips for people to use in
14 devices.

15 Q. Are you saying that the way Intel or a company
16 like Intel designs their chips is exactly what you're
17 doing with this FPGA --

18 A. It's the same specification language. In the
19 same way -- what they're working at would be much
20 larger-scale projects, but it's the same basic process,
21 yes.

22 Q. I'm not sure I follow you with respect to what
23 you mean when you say "same specification language."
24 That sounds like software, but I don't think that's what
25 you mean. Or is it more analogous to we're speaking

1 English language?

2 A. No, no, no. It's a machine readable
3 specification.

4 Q. Oh, it is. So it sounds like it is more akin to
5 software then.

6 A. That's the state of the art in -- so let's try
7 and imagine what a -- someone designing a chip, what
8 they actually do. They could solder things together.
9 Well, obviously, you can't do that on a silicon chip.
10 It's too small. You could draw out the masks, but then
11 go into some photo lithography process to make the chip
12 through etching, et cetera. That's how it was done in
13 the 1970s and 1980s. You could have some software tools
14 that generate those masks that then -- I guess that
15 was -- maybe hand drawing would be a 1970s technique.
16 Software tools to generate those images would be a 1980s
17 technique. Or you could allow computers to take on some
18 of the burden of having to decide each of those
19 decisions of where the traces and doping goes, and you
20 just -- now you can specify it at a more abstract level,
21 to say okay, I want some gates and some latches, and I
22 want them connected together in this topology; but I'll
23 let you, my software tool, decide for me where to put
24 them. This is called CAD, computer-aided design, for
25 VLSI. That's how it's been for 20 years or so.

1 Q. Is that the state of the art for chip design
2 now?

3 A. That's the -- what industry does, yeah.

4 Q. Would it be true that at least one difference
5 between what a company like Intel may be doing in their
6 chip design as opposed to someone using --

7 A. FPGA?

8 Q. Thank you.

9 -- is that you're constrained by what may be
10 available on the chip or is that the --

11 A. Yes.

12 MR. DAS: Objection, form.

13 THE WITNESS: Any designer is constrained by
14 some kind of resource limitation. That's engineering.
15 If I'm designing to an FPGA, then there is a finite
16 number of gates on the particular FPGA I'm using. If
17 I'm designing a chip, then there is a finite number of
18 gates that can fit on whatever size chip I decide to
19 use. I potentially have the option to make large or
20 small chips. There is not a limit on how large a chip
21 you can make.

22 BY MR. CRAIN:

23 Q. Is there anything else about this that you want
24 to share with us before we get back to --

25 A. No.

1 Q. In clarifying this, I still believe I understand
2 that you've not had the occasion to design a hardware
3 DSP chip.

4 A. That's right. But I'm saying this is -- you
5 know, it's not like I have no conception or no
6 experience -- no relevant experience.

7 Q. Well, I understand. With the exception of the
8 recent advent of FPGA chips, you've not had the
9 opportunity to design a DSP chip hardware.

10 A. That's correct.

11 Q. But thank you. That's helpful.

12 I think where I had left off, or what I was
13 starting to ask you about, was about whether the TMS320
14 DSP that's described in Exhibit 15 is currently the
15 state of the art.

16 A. Oh, that's right. Yes.

17 Q. So let me ask you, then we'll get back to that.
18 Is the TMS320 digital signal processor, as described in
19 Exhibit 15, the current state of the art in digital
20 signal processors, according to your understanding?

21 A. I'm sure it isn't.

22 Q. Could you explain the basis of your conclusion.

23 A. Well, the reason I'm sure is because there has
24 been a significant advance in technology, particularly
25 this kind of chip technology, since the time of this

1 document. I mean, that's one -- one reason.

2 Q. Are you aware of any others?

3 A. Well, other -- I mean, I know -- you know, I
4 know of some of the subsequent chips in the TMS320
5 series that replaced this one.

6 Q. And you mentioned some advances.

7 A. Yes.

8 Q. Are you able to speak to any of those advances
9 that you have familiarity with?

10 A. I mean, the events I'm talking about are just
11 basically primarily advances in chip manufacture that
12 increase the number of gates and the speed -- the
13 switching speed that you can achieve in large-scale
14 integrated chips.

15 Q. What are some of the advantages that these
16 advances provide for users of DSP chips?

17 A. They can -- the problems that the chip can solve
18 become faster. So the time of this chip and the time of
19 the work we're talking about, DSP chips were beginning
20 to -- were beginning to be used in audio. Because at
21 that time, it was pretty hard to process audio on a
22 conventional computer, nay impossible. But the
23 additional speed afforded by the special purpose
24 hardware in a DSP chip would mean that you would be able
25 to do something like simulate a particular concert hall

1 in real time using a DSP system.

2 Q. It says concert hole in the transcript. You
3 mean hall.

4 A. Hall.

5 Now, what's interesting -- that's why I was
6 interested in it at the time -- what's interesting since
7 then -- although it was -- it wasn't that pleasurable to
8 use, so a lot of the work I've done has been still
9 running in software on computers and sacrificing the
10 realtime aspect, because for me, my interests led to,
11 well, what can the algorithms do. I'll let someone else
12 worry about how to make it run fast enough to run in
13 real time.

14 As I mentioned, I've recently been increasingly
15 interested in the problems of teaching signal
16 processing. To my delight now, that kind of software is
17 actually -- because computers have gotten that much
18 faster -- the same software is now able to do very nice,
19 sophisticated digital signal processing operations
20 without the need for a special DSP chip.

21 DSP chips have continued to become faster and
22 more powerful. What that's meant is that they've moved
23 on from applications in audio to more demanding
24 applications in things like radios and video.

25 Q. What's the first instance that you are

1 personally aware of, of the use of a digital signal
2 processor in an audio application?

3 A. We mentioned the Speak & Spell. That's a nice
4 starting point. Like I say, I think there are earlier
5 ones. I have this memory of this speed control system
6 that was from the early '70s.

7 Q. Moving forward from the Speak & Spell, would you
8 walk through the ones that at least today, as you sit
9 here, that you can recall. And as you think of your
10 answer, Speak & Spell, I think you said earlier, was mid
11 '70s?

12 A. Yes. That's my belief.

13 Q. Okay.

14 A. You know, some of the -- in the late '80s, I was
15 interested -- I was particularly interested in music and
16 in -- you know, music production, music studio practice.
17 As someone with a technological bent, I was interested
18 in studio processing gear. That was the time at which
19 digital audio signal processing was moving into music
20 recording studios.

21 Q. What I'm trying to understand -- let me ask my
22 question again to see if it changes what you want to
23 share as a response -- I'm trying to understand from you
24 any devices or specific applications -- you mentioned
25 like the Speak & Spell. That's a device. Right?

1 A. Yeah.

2 Q. I'm trying to understand if you have any
3 familiarity with other devices that --

4 A. So --

5 Q. Let me get my question. I know you're ready to
6 go.

7 -- that use a DSP in audio application.

8 MR. DAS: Objection, form.

9 THE WITNESS: So I mentioned studio gear. So
10 the kinds of things you would have in a studio would be
11 things like delay lines and reverberators. So digital
12 versions of those.

13 BY MR. CRAIN:

14 Q. Do you recall any particular brands or models of
15 such devices?

16 A. I'm thinking about the Lexicon. Lexicon made a
17 digital reverberator. They made a series of them. I
18 don't remember when the first one was, but I think it
19 was in the mid '80s, that was very well renowned.

20 Q. So we've gone from '75 to the mid '80s.

21 A. Yeah. So now we're switching from things I know
22 about as a student of the history of signal processing
23 to things that I have direct personal memory of.

24 Q. Okay. So you understand, we've been talking
25 about kind of this DSP revolution.

1 A. Yeah.

2 Q. I'm trying to understand this revolution from
3 what you had shared earlier, how it started and some of
4 the various things we've talked about. So really what
5 I'm trying to get to now is how did this revolution grow
6 and change to where we are now? That's why I asked you
7 about the -- whether or not this TMS320 is the state of
8 the art now. You've told me it's not, things have
9 changed. So now what I'm trying to get to is your
10 understanding, recollection, prior experience, with
11 respect to maybe devices along that revolution. Okay?
12 So let me ask you the question.

13 Again, what devices do you know about or perhaps
14 have had personal experience about that use a DSP in an
15 audio application during this digital revolution that
16 we've been talking about?

17 MR. DAS: Objection, asked and answered.

18 THE WITNESS: So I mean --

19 BY MR. CRAIN:

20 Q. Well, let me speak to the objection. To the
21 extent that you've not shared one. If you've exhausted
22 your information, that's fine. I'm not asking you to go
23 back and re-cover any that you've already shared.

24 A. Oh, you know what? Lexicon was, you know, a
25 major player in -- oh, no. There is -- there is --

1 there is a device in the studio called a harmonizer.
2 Eventide was a company that manufactured the harmonizer.
3 And the harmonizer will take audio input and produce a
4 simulation of someone singing in harmony or multiple
5 instruments playing in harmony. I want to say that
6 those are also things that were emerging in the mid
7 '80s.

8 Most of these devices had analog precedence. So
9 when I talk about the digital -- DSP revolution, it's
10 the replacement of analog implementations with DSP-based
11 implementations of these things.

12 MR. DAS: Dr. Ellis, you're tending to swallow
13 the last couple of words that you're saying.

14 THE WITNESS: Sorry.

15 BY MR. CRAIN:

16 Q. How quickly did this DSP revolution occur that
17 involved the replacement of analog implementations with
18 DSP-based implementations?

19 MR. DAS: Objection, form.

20 THE WITNESS: It's pretty difficult to draw
21 boundaries on it. Right? It's spreading through
22 different application areas, as I've discussed.

23 BY MR. CRAIN:

24 Q. Why is it difficult to explain?

25 A. Just it's difficult to draw a boundary. Like

1 well -- I guess, when there is no longer any analog
2 processing, that everything that could have been
3 replaced by the digital domain processing has been
4 replaced, then we can say it's over. And we may be
5 getting close to that now, but probably not.

6 Q. Why is it taking so long?

7 A. One obvious reason is because you require, you
8 know, the digital technology to be a preferable
9 solution, meaning in particular a cheaper solution. And
10 that depends on the technology. The technology becomes
11 cheaper.

12 Q. So there are times when a DSP solution is not
13 cheaper than an analog solution with respect to audio?

14 MR. DAS: Objection, form.

15 THE WITNESS: There certainly have been times.

16 BY MR. CRAIN:

17 Q. Help me understand one or more of those times.

18 A. So let's say in 1985, I could maybe buy a
19 Lexicon digital reverberator probably for several
20 thousand dollars, or I could buy an analog spring reverb
21 for maybe \$50.

22 Q. Well, I'm asking you more from the
23 manufacturer's viewpoint. You're sharing with me the
24 retailer. I was presuming that you were speaking to it
25 from the creator, the designer's perspective, but I

1 don't think you are.

2 MR. DAS: Objection, form.

3 BY MR. CRAIN:

4 Q. Am I mistaken?

5 A. I was explaining it. I was illustrating it from
6 the consumer's point of view.

7 Q. Right. But I mean --

8 A. But there is no difference between that --
9 engineering is about can we make something useful, at a
10 price that people want it.

11 Q. What I was trying to understand from you is the
12 digital revolution that you're talking about maybe is
13 nearly complete where the replacement of an analog
14 solution to a DSP solution can be accomplished. It
15 sounds like there is still analog applications that have
16 not been so replaced for one reason or another. Did I
17 understand that correctly?

18 MR. DAS: Objection, form.

19 THE WITNESS: I mean, like I say, there probably
20 are some. I'm not thinking of any specific ones. But,
21 you know, like ten years ago, full digital processing
22 for video systems would be very high end. Now it's more
23 commonplace. Now it's ubiquitous.

24 BY MR. CRAIN:

25 Q. What do you attribute that to, over the last ten

1 years, for video?

2 A. I mean, okay, ten years isn't actually long
3 enough. Let's say 15 years.

4 Q. Well, whatever time it is.

5 A. Yeah. It's the increasing speed and capacity of
6 the digital devices. You know, I'm not sure that the
7 concept of a DSP chip is as important as it was at the
8 time that we're talking about here, because as I've
9 said, general purpose chips have become so fast and so
10 powerful that they can do -- we can do many of these
11 things without special purpose hardware. But certainly
12 on the leading edge of things like video processing, you
13 will still have special purpose hardware that's doing
14 digital signal processing functions.

15 Q. So, 15 years ago, or for example, back when the
16 TMS320 --

17 A. Which is 25 years ago.

18 Q. Twenty-five years ago.

19 I think you said one of the advances in DSP
20 since the TMS320 is speed.

21 A. Yes. The biggest advance was the switch to
22 floating point, actually.

23 Q. So DSPs today can do more than the TMS320 DSP?

24 A. Yes.

25 Q. Then, would we likewise be safe in understanding

1 that the TMS320 DSP could do more than the DSP of ten
2 years earlier than that?

3 A. The TMS320C25 was significantly more powerful
4 than the TMS320C10, which was the preceding generation.

5 Q. Really? Okay.

6 So you've given me a reference point here. I'm
7 just going to use C10 and C25. We're talking about the
8 TMS320. Okay?

9 When I only had the C10, could I do as much
10 digital signal processing with it as compared to what I
11 could be able to do if I had the C25?

12 MR. DAS: Objection, form.

13 THE WITNESS: You know, it's like -- we're
14 being -- we're being a little bit fuzzy about what --
15 how we measure the quantity of digital signal
16 processing. The C25 would be able to process a larger
17 amount of data in the same amount of time.

18 BY MR. CRAIN:

19 Q. So would that allow me to accomplish more
20 functions?

21 A. Yes.

22 MR. DAS: Objection, form.

23 BY MR. CRAIN:

24 Q. Okay. While you've got that TMS320 document,
25 turn back to the functional diagram, please.

1 A. Yes.

2 Q. According to your understanding -- and if you
3 need to look anywhere else in the documents, please
4 do --

5 A. Okay.

6 Q. -- what type of interfaces does the TMS320 -- we
7 can talk about the C25 since that seems to be the one
8 that you have great familiarity with -- so my question
9 is, what type of interfaces does the TMS320C25 support,
10 according to your understanding?

11 MR. DAS: Objection, form.

12 THE WITNESS: What kind of interfaces? You
13 know, the way we're using interfaces is more a property
14 of the computer system. The processing chip is the
15 hardware computer system, but there are typically a
16 number of other parts around it. The interface is, in a
17 sense, like an RS-232 or a USB port, would, particularly
18 at this time, be provided by other chips that were part
19 of the computer system.

20 BY MR. CRAIN:

21 Q. What does that mean?

22 A. That if you wanted to build a TMS320C25 system,
23 you could put whatever interfaces on it you wanted.

24 Q. So according to your understanding, does it
25 support a serial interface?

1 A. It would be very easy to build one with a serial
2 interface.

3 Q. Tell me how you would do it.

4 A. You would add a serial interface chip to the
5 design.

6 Q. What is a serial interface chip?

7 A. It's a chip that allows -- supports -- drives,
8 you know, a serial interface standard.

9 Q. Can you identify any by name?

10 A. Yes. I recently had cause to use a MAX232.
11 This is a contemporary chip that wasn't available at the
12 time. But it's a chip for interfacing between logic
13 levels inside a computer, and the particular voltage
14 levels used in RS-232, which are higher voltages than
15 are used within a computer.

16 Q. For purposes of this specific discussion, let's
17 constrain our time to around the time of the TMS320C25.

18 A. Right.

19 Q. Late '80s, early '90s. I mean, I think the
20 document is dated November 1990.

21 A. Yeah.

22 Q. Is that an adequate time for you?

23 A. Sure.

24 Q. So if you were using the chip at that time, the
25 TMS320, would it have supported a serial interface?

1 A. It would be easy to build systems, based on this
2 chip, that had a serial interface.

3 Q. I want to talk about the systems that would be
4 easy to build.

5 A. Yeah.

6 Q. In the time frame of when the TMS320C25 was
7 available.

8 A. By the way, you asked me earlier about
9 applications. I did not finish listing all the
10 applications. One that we might want to include is, of
11 course, digital hearing aids -- digital signal
12 processing in hearing aids.

13 Q. Why do we want to include that?

14 A. Because one of the references I use in my
15 statement is -- describes such a system. Also, it's
16 been -- it's of huge impact -- it's been of huge impact
17 to the millions of people around the world who have
18 hearing loss.

19 Q. So applications for what exactly again?

20 A. For digital audio signal processing. For DSP
21 chips used in audio.

22 Q. Oh, okay. Was that with respect to the TMS320?

23 A. No. In hearing aids, they're typically custom
24 chips.

25 Q. Why is that?

1 A. Hearing aids are a very demanding application
2 where you need -- you need the greatest possible
3 efficiency. You can't really afford to use a chip
4 that's been designed -- that's been specified for
5 anything other than being used in a hearing aid.

6 Q. I still don't understand why -- give me just a
7 second. Why not? I still don't understand why.

8 MR. DAS: Objection, form.

9 THE WITNESS: Why what?

10 BY MR. CRAIN:

11 Q. Let me read it back. Where you need the
12 greatest possible efficiency. You really can't afford
13 to use a chip that's been designed -- specifically
14 designed for anything other than being used in a hearing
15 aid.

16 A. Yes.

17 Q. Why not?

18 A. So the hearing aid application has extreme
19 requirements in terms of size, in terms of power budget.
20 So those are the things that -- you have no flexibility
21 in your design to waste on making the chip larger than
22 you need it to be or making it use more power than you
23 need it to use.

24 Q. Why is power of grave concern?

25 A. Because the hearing aid is going to run off of

1 battery, and you want to make the battery last as long
2 as possible and/or be as small as possible.

3 Q. Size is obviously crucial because of the
4 application of where a hearing aid is installed.

5 A. Yes.

6 Q. Have you ever designed a DSP for a hearing aid?

7 A. No.

8 Q. Have you ever had occasion to work with a DSP
9 for a hearing aid?

10 A. I haven't worked at that level. Some of the
11 work that I've done, some of the research that I've
12 done, has been motivated by hearing aid type
13 applications. I've interacted with people in hearing
14 aid companies. But again, that's -- the actual dealing
15 with the chip, itself, is specialized and not something
16 I've been involved in.

17 MR. CRAIN: Let's go off the record.

18 THE WITNESS: Okay.

19 THE VIDEOGRAPHER: This is the end of Media
20 No. 2 in the deposition of Dr. Daniel Ellis. The time
21 is 2:03 p.m. We are now off the record.

22 (Recess taken from 2:03 to 2:18.)

23 THE VIDEOGRAPHER: This is the beginning of
24 Media No. 3 in the deposition of Dr. Daniel Ellis. The
25 time is 2:18 p.m. We are back on the record.

1 MR. CRAIN: Thank you.

2 BY MR. CRAIN:

3 Q. Dr. Ellis, did you have an opportunity to speak
4 with your attorneys during the break?

5 A. Yes.

6 Q. Did you speak with your attorneys about your
7 testimony?

8 A. No.

9 Q. Did you speak with your attorneys about any
10 testimony anticipated to be given?

11 A. No.

12 Q. If you recall, before our break, we were
13 speaking about the TMS320 and the type of interfaces
14 that it may or may not support.

15 A. Um-hmm.

16 Q. Do you recall what your response was to that?

17 A. I was saying that it would be easy to build a
18 system with a TMS320C25 and a serial port.

19 Q. And again, constraining our analysis and your
20 response to the time frame of around 1990 or so --

21 A. Yes.

22 Q. -- tell me, please, how you would go about doing
23 that.

24 MR. DAS: Objection, asked and answered.

25 MR. CRAIN: Actually, it wasn't.

1 THE WITNESS: No. Because of the -- you -- so
2 the functionality you would need would be something to
3 construct the serial stream, and then some electrical
4 interface to generate the electrical signal specified by
5 the RS-232 standard. The formation of the stream would
6 be most likely done with one of a number of chips that
7 were available at that time to do that, which the
8 generic name for those chips was a UART, U-A-R-T,
9 universal asynchronous receiver transmitter. That's
10 what it was for. But it would still generate logic
11 levels which you would then have to switch up to the
12 full plus or minus 12 volts of RS-232, using properly
13 external transistors.

14 BY MR. CRAIN:

15 Q. Is that all?

16 A. That's all you would need.

17 Q. So you have a serial communication line coming
18 to the chip. Then what you've described here, I'm still
19 not clear on what it does so that it can communicate
20 with the TMS320.

21 MR. DAS: Objection, form.

22 THE WITNESS: So with this kind of computer
23 technology, you notice, in the pin-outs, there are a
24 number of pins labeled D and A. I'm looking at the
25 picture on the front cover of the reference.

1 BY MR. CRAIN:

2 Q. Um-hmm. I'm looking at it.

3 A. So the way -- the D stands for data and the A
4 stands for address. The way this chip and any
5 microprocessor of the era would interface to many of the
6 external chips that it might connect with is through
7 this data and address bus. The microprocessor -- in
8 this case, the DSP -- sets up an address, a binary
9 number on the address pins; it sets up a data -- a value
10 on the data pins. Then there is like some other control
11 pins. There is a read-write pin probably somewhere,
12 which then says, okay, I want to either read data from
13 this address or write data to this address. So the UART
14 would similarly have a bunch of data pins. It would not
15 need so many address pins. But there would be some
16 logic to say, okay, when the address pins are in this
17 particular configuration, we'll enable the UART to know
18 if it's being written to, then basically everything else
19 will be taken care of.

20 Q. So the UART would be written to from the DSP?

21 A. Right. So a program inside the DSP would push
22 values, push bytes to the UART, and then the UART would
23 just write them out as a serial stream.

24 Q. And the serial stream that the UART receives,
25 how does that get into the DSP?

1 A. In a similar kind of way. The UART has a
2 separate circuit that receives the inputs, the serial
3 stream, and turns them into a byte. The way it
4 typically works is there is a status bit that the --
5 either -- that the DSP chip can deliberately go
6 out and -- that the DSP chip can go and poll, or they
7 might use one of the interrupt lines. I guess that
8 would be the more efficient way. So the UART would be
9 connected to one of the interrupt lines. These are the
10 pins marked INT0, INT1, INT2 on the chip. What happens
11 with these lines is -- so the UART would be sitting
12 there, getting the serial input. It would say, okay,
13 I've received a byte of serial data, it would pull low,
14 a data ready pin or something like that, which would be
15 connected to the interrupt pin. This would cause an
16 interrupt to happen in the DSP processor, which means
17 that the program counter is modified to go and execute
18 program statements at a particular point in memory
19 called an interrupt handler. Those statements would
20 know to go to the particular address of the UART data
21 register and do a read operation to read back the byte
22 that's just been received.

23 Q. What is the data register?

24 A. The UART has a -- has some latches internally
25 which it uses to temporarily record the data that's

1 coming over the serial line. That's the thing that is
2 connected to the data pins when this read operation
3 happens.

4 Q. The register or the latches that you talk about,
5 could I describe that also as just a type of memory?

6 A. That's interesting. It's the smallest element
7 of memory. It's like one word of memory. So memory,
8 you could view as a very large number of latches. That
9 would be kind of stretching the definition.

10 Q. But it is a type of memory, even if it's small
11 and short term.

12 A. It's not about it being short term. I think
13 people in this area would be a little bit uncomfortable
14 with calling a single latch a memory. But technically,
15 it stores -- it remembers a value, yes.

16 Q. Does the same thing happen in reverse from the
17 DSP through the UART to the serial connection?

18 MR. DAS: Objection, form.

19 THE WITNESS: That was actually the first thing
20 I described.

21 BY MR. CRAIN:

22 Q. Right. So the data would be written to the
23 UART, stored on a register.

24 A. Yes.

25 Q. Then --

1 A. Sent out in a serial line.

2 Q. Is the connection between the UART and the DSP a
3 serial line?

4 A. No.

5 Q. What would you describe it as?

6 A. I would describe it as a hard wire connection.
7 But if you wanted to call it parallel, it's connecting
8 the data point -- the data bits are connected in a set
9 of parallel wires.

10 Q. Have you ever heard of something called Harvard
11 architecture?

12 A. I've heard it.

13 Q. What is that?

14 A. I'm not exactly sure, but I believe it's -- I
15 wish I knew what the -- yeah, Harvard architecture is
16 when you have separate address spaces for program and
17 data.

18 Q. Does the TMS320 employ a Harvard architecture,
19 according to what you know about it?

20 A. Maybe. I'm looking at the block diagram. I see
21 a separate program bus and data bus.

22 Q. Let me catch up to you. Where are you looking
23 to, sir?

24 A. The functional block diagram. Let me just see.

25 No, I don't think it does. Because there is

1 only one -- it looks like there is only one address
2 space. I don't know. I don't know. You know, it's --
3 it's a distinction of interest to computer science
4 theoreticians.

5 Q. Just to be clear, you don't know whether or not
6 the TMS320 does or does not employ a Harvard
7 architecture?

8 A. That's right.

9 (Exhibit 16 marked for identification.)

10 BY MR. CRAIN:

11 Q. Dr. Ellis, I've handed you what has been marked
12 as Exhibit 16. Would you please take a moment to review
13 it and identify it when you're able, if you can.

14 A. Well, this is Patent No. 5,822,775. It's the
15 reference I refer to as Sudo in my declaration.

16 Q. Have you had occasion to read the patent that
17 we're calling Sudo as Exhibit 16, though?

18 A. Yes.

19 Q. Do you recall approximately how many times
20 you've read Sudo?

21 MR. DAS: Objection, form.

22 THE WITNESS: I've read it a couple times. I've
23 read the whole thing a couple of times, and I've, you
24 know, dipped into it other times.

25 BY MR. CRAIN:

1 Q. Do you recall if you reviewed Sudo this week?

2 A. I have.

3 Q. Did you read it through completely?

4 A. Yes.

5 Q. What do you understand Sudo to be related to?

6 MR. DAS: Objection, form.

7 THE WITNESS: It's describing a particular
8 approach to transferring coefficients in a running DSP
9 system with -- doing it efficiently and without
10 interrupting the process.

11 BY MR. CRAIN:

12 Q. So Sudo pertains to a DSP. Correct?

13 A. Yes.

14 Q. Do you see a DSP in any of the figures of Sudo?

15 A. Yes.

16 Q. Where do you see a DSP in Sudo?

17 A. So Figure 1 is a functional block diagram. Item
18 two is labeled DSP.

19 Q. You said item two is labeled DSAP. Are you
20 referring to the numeral two that has connection to a
21 dashed box?

22 A. Yes.

23 Q. What do you understand the dashed box to be?

24 A. The DSP.

25 Q. Do you understand the DSP 2 in Sudo, Figure 1,

1 to be a DSP chip?

2 A. A DSP system.

3 Q. What's the difference?

4 A. I don't know if it's a chip or if it's a -- it
5 could be implemented as a collection of chips.

6 Q. What does Sudo tell you?

7 A. I don't know. I'm not aware of him telling me
8 either. He just calls it a digital signal processor.

9 Q. So you're unable to tell whether he's referring
10 to a single DSP integrated circuit or not?

11 MR. DAS: Objection, asked and answered.

12 THE WITNESS: That's right.

13 BY MR. CRAIN:

14 Q. What suggests to you that it may very well be a
15 DSP system on multiple chips?

16 A. The material in this patent is about changing
17 the internal -- the architecture within this box. If
18 you had to build a new DSP chip every time you wanted to
19 change it, you would have a very, very slow development
20 cycle.

21 Q. When I asked you earlier what is Sudo related
22 to, you said, it's describing a particular approach to
23 transferring coefficients in a running DSP system
24 with -- doing it efficiently and without interrupting
25 the process. And just now, you said the material in

1 this patent is about changing the internal -- the
2 architecture within this box. If you had to build a new
3 DSP every time you wanted to change it, it would be --
4 it would have a very, very slow development cycle.

5 A. Right.

6 Q. Those seem to be two different things.

7 A. They are.

8 Q. So is the patent about both of those things?

9 A. The patent is not about the development cycle.
10 But in order to do the work -- to do the experiments to
11 devise the invention, you need to be able to manipulate
12 the internals of the digital signal processor.

13 Q. Well, you've used the term manipulating the
14 internals and changing the internals. What do you mean
15 by that?

16 MR. DAS: Objection, form. Objection, compound.

17 THE WITNESS: I mean making changes to this
18 block diagram.

19 BY MR. CRAIN:

20 Q. Does it make changes to the physical
21 architecture?

22 MR. DAS: Objection, form.

23 THE WITNESS: What do you mean, the physical
24 architecture?

25 BY MR. CRAIN:

1 Q. Well, that's what I'm trying to understand, what
2 you're saying. Does it physically change the chip?

3 MR. DAS: Objection, form.

4 THE WITNESS: If it was a chip, then these --
5 the kinds of changes they're talking about would
6 involve -- the kinds of -- the kinds of modifications --
7 the kinds of systems -- the techniques they're talking
8 about would involve special functionality within the
9 chip.

10 BY MR. CRAIN:

11 Q. I'm still not following you. What do you mean
12 by that?

13 MR. DAS: Objection, form.

14 THE WITNESS: So they're talking about, you
15 know, a field of invention. Those inventions rely on
16 particular hardware support within the DSP system.

17 BY MR. CRAIN:

18 Q. What hardware support are you referring to?

19 A. Well, many of these items are separately
20 specified because they relate to the invention.

21 Q. How is that relevant?

22 MR. DAS: Objection to form.

23 THE WITNESS: I'm saying the invention is about
24 the particular layout of these hardware items.

25 BY MR. CRAIN:

1 Q. Are you suggesting that the invention changes
2 those hardware items?

3 MR. DAS: Objection, form.

4 THE WITNESS: The invention doesn't change them,
5 but in order to create the invention would require
6 changing them.

7 BY MR. CRAIN:

8 Q. What does that mean?

9 A. So I'm imagining these guys in a research lab
10 doing the work that then gets reported in this patent.
11 They have to experiment with different internal
12 architectures of the DSP systems in order to arrive at
13 the solution.

14 Q. Okay. But once they arrive at the solution and
15 they want to change coefficients, how do you understand
16 that to operate?

17 A. That's what the patent is describing.

18 Q. Would you explain it to me, according to your
19 understanding.

20 A. There is a process by which the new coefficients
21 are transferred from the microcomputer and they're
22 written into the coefficient Data RAM at a particular
23 moment that minimizes the impact on the system.

24 Q. Can you give me an example, according to your
25 understanding, of impact on the system.

1 A. They mean that they want to be able to do it
2 without interrupting the audio processing.

3 Q. Why is that important?

4 A. So that you can make changes smoothly.

5 Q. As opposed to?

6 A. Making changes that result in a glitch in the
7 output.

8 Q. What is an example of a glitch in the output?

9 A. A click in the audio stream.

10 Q. Something that would be audible?

11 A. Yes.

12 Q. Do you understand the disclosure of Sudo to
13 avoid such a scenario?

14 A. Yes. I mean -- yes.

15 Q. What is the significance of the dashed box that
16 we have labeled as numeral two?

17 A. It's the digital signal processing system --
18 digital signal processor.

19 Q. The thing I'm still struggling with is what your
20 understanding is of how that digital signal processor is
21 disclosed in Sudo.

22 A. How it's disclosed?

23 Q. Yes. What is it, according to the Sudo
24 disclosure?

25 A. It's this. Here it's described in terms of its

1 functional block diagram.

2 Q. So what's inside the box is part of the DSP?

3 A. What's inside the box is the digital signal
4 processing system.

5 Q. Do you see it described as digital signal
6 processing system in the Sudo patent?

7 A. No. I see it described as digital signal
8 processor.

9 Q. You keep describing it as a digital signal
10 processing system.

11 A. Yes.

12 Q. Why?

13 A. That seems to me a clearer form of words.

14 Q. Than what the inventors used?

15 A. Have you read the patent?

16 Q. Why do you ask?

17 A. Because the language is very poor.

18 Q. What's poor about it?

19 A. It seems like it was not written by a native
20 speaker.

21 Q. Can you give me some examples of some of the
22 poor writing.

23 A. The title is, "Efficient Data Processing Method
24 for Coefficient Data in a Digital Dignal, Processor."
25 That's clearly a typo. They meant "signal" instead of

1 "dignal." And the comma is completely redundant. There
2 are quite a number of such instances.

3 Q. Okay. So there is no such thing as a digital
4 dignal processor?

5 A. Not to my knowledge.

6 Q. Can you point me to some more?

7 A. Yeah. Yes. So, in the abstract, it says,
8 "whereby a processing" -- starting at the end of the
9 third line -- "whereby a processing program and
10 coefficient data are transferred and supplied from a
11 microcomputer determination, whether an instruction is a
12 read instruction," et cetera. The comma should have
13 come before "determination." It should be, "transferred
14 and supplied from a microcomputer, determination whether
15 an instruction is a read instruction," et cetera.

16 Q. Okay. So, so far, we see two typos.

17 A. Yeah.

18 Q. And a couple of misplaced commas. What else?

19 A. Oh, my God. It's so bad that it took me forever
20 to figure out what they were saying -- what they were
21 saying about that particular sentence.

22 I'm sorry. I can't find them. I recall
23 noticing them when I read it, but I don't want to waste
24 any more time.

25 Q. No, please go ahead.

1 A. Okay.

2 Q. Where are you in your reading?

3 A. I'm jumping around. I remember particularly
4 there was like this weird misplaced article, as I
5 remember, but I can't find where it is.

6 Q. Did you find it?

7 A. No.

8 Q. Are you looking for one specific item?

9 A. Yes. Well -- so I have a recollection of
10 thinking, when I was reading this, that it was written
11 by a non-native speaker. Actually, you, having more
12 experience in patents, may know that that was almost
13 certainly not true, which is fine.

14 Q. I'm sorry. I didn't understand the last
15 thing you said.

16 A. You may know that it's almost certainly not
17 true, which is fine.

18 Q. I don't.

19 A. So yeah. What do you want to do? Do you want
20 me to read the whole thing?

21 Q. Well, you've identified two typos. You've
22 indicated that it's very poorly written. This is all
23 relevant to this thing of DSP to you, every time you see
24 it, means DSP system. So I'm trying to understand why,
25 and you've only shown me two typos. So if you're able

1 to show me more that lead you to that conclusion, please
2 do; but if you can't, that's fine, too.

3 A. So there is a second sentence of the misspelling
4 of signal as dignal. Right? I believe.

5 Q. Okay.

6 A. Just in the title. In column one. But I can't
7 find the other instances that I recall.

8 Q. How many other instances are you thinking about
9 that you may recall?

10 A. I'm recalling one particular thing where I seem
11 to remember there was a miss -- there was like a
12 redundant article, but in general, I found the language
13 quite difficult to follow.

14 Q. When you say "redundant article," are you
15 talking about a and the?

16 A. Yes.

17 Q. So that sounds like a typo, but I don't have it
18 here. I don't know exactly where it is, so I don't want
19 to presume. It sounds like maybe three or four typos.
20 What else?

21 A. I'm just saying, that my impression on reading
22 it was that it was not written -- it was not written in
23 a very fluid way.

24 Q. Well, based on what you've identified so far,
25 that led you to the conclusion that DSP means DSP

1 system?

2 MR. DAS: Objection, form.

3 THE WITNESS: Sorry. Was that a question?

4 BY MR. CRAIN:

5 Q. It was. Based on your reading of the Sudo
6 patent and the -- I'll give you five typos so far that
7 you've identified -- that led you to the conclusion that
8 every reference of DSP in the Sudo patent means DSP
9 system. Right?

10 A. No.

11 MR. DAS: Objection, form.

12 BY MR. CRAIN:

13 Q. Okay. Then how did you get to the conclusion
14 that DSP means DSP system and not what it says in the
15 Sudo patent?

16 A. Well, it says it means digital signal processor.

17 Q. Can you find an instance in Sudo where it
18 describes it as a digital signal processing system?

19 A. I don't think so. It always refers to it as a
20 DSP.

21 Q. But you're construing it, if I understand you
22 correctly -- I'm just trying to make sure I understand
23 you clearly --

24 A. Absolutely.

25 Q. You're construing DSP not as a digital signal

1 processor, but a digital signal processing system?

2 A. No. I'm saying a digital signal processor
3 doesn't exclude digital signal processing system.
4 Digital signal processor is a -- you could call that a
5 digital signal processing system.

6 Q. Does Sudo?

7 A. He calls it a digital signal processor.

8 Q. He doesn't call it a digital signal processing
9 system; does he?

10 A. No, he doesn't. That's not really a term of
11 art. I mean, it's not -- there is not like specific
12 meanings to these different forms of words. DSP chip,
13 that has a specific meaning. Digital signal processor,
14 digital signal processing system, DSP system, DSP,
15 they're not so narrowly defined.

16 Q. In the time of this patent that was filed around
17 1991, how was a DSP implemented during that time,
18 according to your understanding?

19 MR. DAS: Objection, form.

20 THE WITNESS: If you were developing digital
21 signal processing systems which you would be intending
22 to render into say DSP chips, you would most likely have
23 some kind of discrete logic version that you would use
24 to develop it.

25 BY MR. CRAIN:

1 Q. I don't know what you mean.

2 A. So let's say I'm experimenting with different
3 architectures of this kind. Do I need this transfer
4 buffer 18? Can I maybe get by without it? How am I
5 going to test that idea? I need a system that has it
6 and a system that doesn't have it. How am I going to,
7 you know -- maybe I'm working on it and I want to
8 introduce this transfer buffer. What am I going to do?
9 The most natural way to be able to do it would be to
10 have a system composed of discrete components that I
11 could modify.

12 Q. Once you come up with the system, as you used
13 the term, as we see in Figure 1, is it your
14 understanding that this would have been created in some
15 tangible form?

16 MR. DAS: Objection, form.

17 THE WITNESS: Sorry? Objection, form.

18 Yes.

19 BY MR. CRAIN:

20 Q. And what form or forms might that have taken
21 during the time of the patent?

22 A. I'm imagining that the researchers in the lab
23 had some kind of prototype system.

24 Q. What lab?

25 A. Whichever -- the research lab they were working

1 in.

2 Q. Why do you presume that they were working in a
3 lab?

4 A. That's my -- that's my assumption of a patent.
5 Patents are inventions. Inventions come from labs.

6 Q. Why do inventions come from labs?

7 A. It would be pretty hard to be developing
8 innovations in architectures of digital signal
9 processing systems without access to a lot of
10 specialized equipment such as might be found in a lab.

11 Q. So do you have any specific understanding of
12 whether or not the patent that we see here in Sudo was
13 or was not developed in a lab?

14 A. Beyond the fact that the assignee is a known
15 Japanese manufacturer of consumer electronics who almost
16 surely had a lab where they developed novel devices,
17 that's the basis.

18 Q. So it's a conclusion you're drawing based on
19 your understanding and what you see as the assignee?

20 A. Honestly, I can't imagine any other circumstance
21 in which -- where such an invention would come from.

22 Q. Do you believe that also to be true with the
23 '544 patent?

24 A. No.

25 Q. Why not?

1 A. The '544 patent doesn't -- hang on. Let me
2 just -- do I have it? I don't have it. Right? Do I
3 have it? I do have it. Sorry.

4 Q. Exhibit 14.

5 A. It doesn't involve changes to the, you know,
6 internal architecture of a digital signal processing
7 system.

8 Q. So only patents that involve changes in
9 architecture, you think, have to be invented in labs?

10 MR. DAS: Objection, form.

11 THE WITNESS: It's kind of -- it's not -- it's
12 difficult to boil it down to a simple test like that,
13 based on my assessment of the kind of work involved.
14 There are some things that I could imagine doing at
15 home, in my garage say; there are some things which I
16 could not imagine doing at home.

17 BY MR. CRAIN:

18 Q. Because you describe the '544 patent as not
19 getting into the architecture of the DSP, you believe
20 that it likely was not invented in a lab?

21 MR. DAS: Objection, form.

22 THE WITNESS: No.

23 BY MR. CRAIN:

24 Q. When you say "no," do you mean that's correct;
25 or no, you disagree?

1 A. I disagree with your statement.

2 Q. So then you think that it may have been invented
3 in a lab?

4 A. Oh, yeah. You know -- sorry. Carry on.

5 Q. I'm sorry. What were you going to say?

6 A. Nothing.

7 Q. Drawing your attention back to Sudo --

8 A. Yeah.

9 Q. So the DSP 2 that we see, could that have taken
10 the tangible form of a DSP chip around the time of 1991,
11 1992, when it was filed as a patent for invention?

12 A. The system described in Figure 1 is the kind of
13 thing you could build as a chip, yes.

14 Q. Well, the system in Figure 1 has more than
15 just -- more items than just the DSP 2. Are you saying
16 all of it would be on one chip?

17 A. Sorry. No. The item labeled DSP.

18 Q. All right. Well, let's ask the question again
19 so we have it clean.

20 A. Yeah.

21 Q. The item identified as DSP 2 in Figure 1, do you
22 believe that it could have been implemented as a DSP
23 chip at the time of invention in the year 1992?

24 MR. DAS: Objection, form.

25 THE WITNESS: I believe that the item labeled

1 DSP in Figure 1 could have been implemented as a single
2 chip or equally as a system comprising several chips.

3 BY MR. CRAIN:

4 Q. Okay. So that's one part. A single chip. You
5 agree with that. But you also believe it could have
6 been implemented as multiple chips.

7 A. Yes.

8 Q. Do you see any suggestion in Sudo to do that?

9 MR. DAS: Objection, form.

10 THE WITNESS: The reason I mention that is
11 because I'm imagining the process of actually doing the
12 research involved in generating these results.

13 BY MR. CRAIN:

14 Q. But would you answer my question.

15 A. Do I see any direction to implement it as
16 multiple chips?

17 Q. In Sudo.

18 A. I don't see any direction either way.

19 Q. Either way what?

20 A. Either as -- it doesn't talk about the number of
21 chips he's going to use to implement it.

22 Q. So you don't believe the fact that we have a box
23 there labeled as DSP 2 at least indicates that it can be
24 one chip. I thought you already said it could.

25 MR. DAS: Objection, asked and answered.

1 THE WITNESS: I said it could be one chip. I
2 think that it's -- it would have been technically
3 possible, at the time, to put all of this on a single
4 chip, but he doesn't say anything about it.

5 BY MR. CRAIN:

6 Q. Tell me your experience with digital signal
7 processors in 1992 involving multiple chips.

8 MR. DAS: Objection, form.

9 THE WITNESS: I did not have any such
10 experience. As I'm saying, this idea of this system
11 based on multiple chips is based on my idea of how it
12 would be done in a lab that were developing signal
13 processing architectures at the time.

14 BY MR. CRAIN:

15 Q. Tell me all the DSP chips that you can think
16 of -- let me start again.

17 Tell me, as of 1992, all of the DSPs that would
18 have been on multiple chips that you know about.

19 A. So, as I'm saying, the only ones I'm imagining
20 are systems being used for development of DSP
21 architectures within labs, not commercial products.

22 Q. So you don't know of any commercial product DSPs
23 that would have been on multiple chips as of 1992; do
24 you?

25 A. You wouldn't call it a -- you wouldn't sell

1 multiple chips and say, "These things, use them together
2 to make a single DSP." If you were going to sell them
3 like that, you would put them on one chip.

4 Q. Then why in the world are you telling me they
5 could be on multiple chips based on what Sudo discloses?
6 That makes no sense.

7 MR. DAS: Objection, asked and answered.

8 THE WITNESS: I think I've explained this.

9 BY MR. CRAIN:

10 Q. You're telling me nobody would do that
11 commercially?

12 A. No one would make it as a product.

13 Q. Right.

14 A. But somebody has got to figure out how those
15 products are going to work. Someone has got to do
16 experiments and do research before we can build the
17 products.

18 Q. So they would build separate chips with these
19 components on some chips and on other chips?

20 A. Yes.

21 Q. And those chips would never see the light of
22 day?

23 A. Oh, no. I mean, the chips are just standard
24 digital logic.

25 Q. So you're speaking really in the confines of

1 theory testing.

2 MR. DAS: Objection, form.

3 THE WITNESS: I'm talking about practical
4 testing.

5 BY MR. CRAIN:

6 Q. Well, if someone were going to practice what
7 Sudo teaches, which you've told me you have difficulty
8 reading, how would they do it, on one chip or multiple
9 chips?

10 MR. DAS: Objection, form.

11 THE WITNESS: Yeah, you would -- I think -- the
12 goal would be to build a final product that was a single
13 chip, involving this idea. It's interesting how you
14 would get there. Right? So you could design -- yeah, I
15 think -- well -- I don't know. But it's quite likely --
16 it's quite possible -- seems quite possible to me that
17 you would want to build some prototypes before you
18 committed to the final chip.

19 BY MR. CRAIN:

20 Q. Okay. What does that have to do with anything?

21 A. Well, the prototypes would not be a single chip;
22 it would be more pieces. It would be some kind of
23 development board with different -- the opportunity to
24 put different things together.

25 Q. Right. And you've already told me that this

1 thing was assigned to Pioneer. Do you have any
2 understanding or belief that Pioneer would have
3 ultimately reduced this to one chip or not? Do you
4 know?

5 MR. DAS: Objection, form. Objection, compound.

6 THE WITNESS: This is not -- you know, this only
7 deals with one aspect of the -- of the processing
8 system, but -- I have no idea if they did, but I assume
9 from the fact -- one reason for this patent existing is
10 because this is something that they developed and used
11 and put into chips that they manufactured.

12 BY MR. CRAIN:

13 Q. But I think you did say earlier that you
14 wouldn't expect a commercial embodiment of the invention
15 in Sudo to be manufactured on multiple chips.

16 A. That's right.

17 Q. In Figure 1, do you see a box labeled 19 with
18 the text "Interface"?

19 A. Yes.

20 Q. Feel free to refer to the patent text. I'd like
21 to understand your understanding of what do you
22 understand Sudo to disclose interface 19 to be?

23 MR. DAS: Objection, form.

24 THE WITNESS: An interface, you know, implies
25 circuitry whose only function is to connect together two

1 systems that cannot be directly connected together to --
2 you know, two systems. This is the interface that's
3 handling the translation between the microcomputer and
4 Bus 17 -- Main Bus 17.

5 BY MR. CRAIN:

6 Q. Why can the two systems that you were referring
7 to in your prior response not be connected together?

8 A. You know, typically, when you're connecting an
9 external microcomputer into some other system, there
10 will have to be some, you know, fairly low-level
11 translation of voltages, possibly modifications of
12 timing, things like that.

13 Q. Do you believe that Sudo is disclosing
14 Interface 19 to be a connector?

15 A. I don't think he's talking about the connectors.
16 I don't think he -- this description would not be at the
17 level of connectors. It's not -- that's not really --
18 that would be kind of irrelevant to the material.

19 Q. So it's not a connector, in your opinion?

20 A. He's not -- he didn't put that box there because
21 he wanted to remind us to use a connector.

22 Q. Not use a connector. That it is a connector.

23 MR. DAS: Objection, form.

24 THE WITNESS: I mean, it's teaching how to do
25 this. Right? So it's like, oh, in order to do this,

1 you'll have to put a connector here. That's not what
2 he's saying. Because you wouldn't -- it would be kind
3 of absurd to describe the use of the individual
4 connectors at this level of abstraction.

5 BY MR. CRAIN:

6 Q. You agree with me, then, that Interface 19 is
7 not disclosed by Sudo to be a connector, then. Correct?

8 A. That's right. That's my impression.

9 Q. What do you understand Main Bus 17 to be?

10 A. As we've discussed before, a bus is more of a
11 design abstraction. It's a set of nodes that are
12 connected together in a circuit, but they're ones where,
13 you know, you use them for multiple purposes, which
14 is -- so that's why you call it a bus.

15 Q. Let me see if I can help the discussion.

16 A. Yeah.

17 Q. Remember when we were talking about a data bus
18 and a program bus earlier with respect to the TMS320?

19 A. Yes.

20 Q. Would you expect Main Bus 17 to be materially
21 different from either the data bus or the program bus?

22 MR. DAS: Objection, form. Objection, compound.

23 THE WITNESS: It looks to me like a program bus.
24 He calls it the main bus, but it's similar to the
25 program bus.

1 BY MR. CRAIN:

2 Q. To be clear, what you're saying, Main Bus 17
3 appears to be similar to you to the program bus that we
4 saw in, I think it was Exhibit 15, the TMS320 document.

5 A. What I mean is if you were trying to make
6 analogies between the two designs, that would be a
7 reasonable analogy to make.

8 Q. Thank you.

9 What differences do you see between Interface 19
10 and I/O Interface 3, both within DSP numeral two?

11 MR. DAS: Objection, form.

12 THE WITNESS: Interface 19 is connecting the
13 external microcomputer to the bus. I/O Interface 3 is
14 connecting a different bus to the external A to D and D
15 to A converters which are supplying the input and the
16 output to the DSP system.

17 BY MR. CRAIN:

18 Q. Understanding that these two interfaces are
19 shown as, I guess, functional blocks, but do they
20 represent hard-wired components if you're going to build
21 this physically?

22 A. The individual interfaces?

23 Q. Right.

24 A. Those blocks represent hard-wired components.
25 They would be implemented with some components which

1 would be connected together. They would be implemented
2 with some components which would be connected together.

3 Q. Is connected together and hard wired different?

4 A. You know, hard wired, I guess you're -- I don't
5 know what that means. I mean, I do know what that
6 means, but we haven't defined it.

7 Q. Okay. What does it mean?

8 A. Hard wired means -- implies that it's done in an
9 inflexible way.

10 Q. What other type of connections are there that we
11 should also be concerned with? And let me define the
12 universe. Within what we're talking about with Sudo
13 here.

14 MR. DAS: Objection, form.

15 THE WITNESS: You know, I'm thinking about this
16 as a development environment. So I'm thinking about
17 systems where you might want to change the connections
18 between the chips. So you might have a wish to have
19 them implemented in some mechanism whereby you could
20 connect things together without having to go out and
21 solder things.

22 BY MR. CRAIN:

23 Q. And that would have been the case in 1992?

24 A. They were not -- you don't -- yeah, you don't
25 get out your soldering iron every time you want to

1 change a circuit.

2 Q. What suggests to you the desire to change the
3 circuit?

4 A. Because they're doing research on the structure
5 of this -- of this system.

6 Q. Where do you see that?

7 A. Well, because it's a patent about -- an idea
8 about the structure of the system.

9 Q. But what makes you think there is a desire in
10 the Sudo patent to change what's represented in the Sudo
11 patent?

12 A. Well, because that's what they're talking about.
13 They're talking about how they've come up with this new
14 idea to how to arrange one of these, which means like --
15 well, they must have -- they must be starting from
16 something different.

17 Q. But where is the end?

18 MR. DAS: Objection, form.

19 THE WITNESS: Where is the end?

20 BY MR. CRAIN:

21 Q. Yes. So they're starting from something. Is
22 this not the end of what they reached?

23 A. This is the end, yes.

24 Q. So if this were being built as a commercial
25 chip, how would you expect to see the connection between

1 Main Bus 17, Interface 19, Microcomputer 20, and
2 similarly, the Bus 4, Input/Output Interface 3, and each
3 of those A to Ds and D to As?

4 MR. DAS: Objection, compound. Objection, form.

5 THE WITNESS: If this were being built as a
6 chip, then all the signals coming in and out of the
7 system would be carried by pins on the chip. Those
8 pins, of course, would not be something that you could
9 directly connect to an external computer or an external
10 analog-to-digital, digital-to-analog converter. As with
11 any DSP chip, the actual product, you wouldn't -- there
12 would be a product which was a chip, then there would be
13 a product which was some kind of system including that
14 chip. That system would provide some kind of ability to
15 actually connect these things, including connectors.

16 BY MR. CRAIN:

17 Q. Where would the pins on the chip be?

18 MR. DAS: Objection, form.

19 THE WITNESS: On the chip.

20 BY MR. CRAIN:

21 Q. Where would we expect to find pins with respect
22 to what's shown in Figure 1?

23 MR. DAS: Objection, form.

24 THE WITNESS: Figure 1 does not provide any kind
25 of direct correspondence to individual pins. We've been

1 talking about the idea of reducing the digital signal
2 processor, as he styles it, into a single chip. But
3 those -- I think -- and earlier, I said that was a
4 sensible thing to do. But boxes three and nineteen, the
5 I/O interface and the interface, are probably the
6 least -- least likely candidates to be included within a
7 single chip. So there would certainly be pins on the
8 chip which would be involved in the process of
9 connecting the DSP chip to other -- other units, but
10 it's unlikely that there would be no other -- no other
11 circuit elements involved in those interfaces, external
12 to the chip.

13 So what I'm saying is the way I imagine this, if
14 this whole thing were reduced to a single chip, would be
15 most of the box two would be within that chip, but some
16 of boxes three and nineteen would be constituted by
17 external circuits on the same circuit board as the chip
18 to handle the details of interfacing to the converters
19 and the microcomputer.

20 BY MR. CRAIN:

21 Q. So you believe that Interface 19 would actually
22 be partially or completely outside of the box that we
23 see as DSP 2?

24 A. I think there would -- there would almost
25 certainly be some of it -- now we're talking about a

1 hypothetical rendering of the system into a chip -- I
2 think there would most likely be some interface
3 circuitry -- there would certainly be some interface
4 circuitry inside the chip, and there would most likely
5 be some that was outside the chip.

6 Q. Why do you say that? And qualify your answer
7 with the time of the invention that we see in Sudo.

8 A. Absolutely.

9 Q. Okay. Make sure.

10 A. When you're building a chip, you know, you want
11 to build a single chip that's going to be useful in a
12 variety of circumstances. You don't -- it's a very
13 delicate process in design to choose your boundaries at
14 the right point. But you don't want to include --
15 particularly, you know, a chip is an expensive thing to
16 build. You don't want to include too much inside of it.
17 So things that you might want to vary in the different
18 uses you might make for this chip, such as the style of
19 the interface to other system components, it wouldn't
20 make sense to hard wire them within the chip, to bake
21 them into the chip.

22 So you would try and have some kind of very
23 generic portions of the interface, something that you're
24 pretty much going to need in any circumstance within the
25 chip; and then you would be able to build boards, the

1 DSP boards, including this chip; and then put whatever
2 additional circuitry you needed to specialize it for the
3 particular devices that you wanted to connect it to, you
4 would be able to put those on the board externally.

5 Q. Well, a few minutes ago, you were telling me
6 that everything inside a DSP 2 could be implemented on a
7 chip. Now you're telling me that's not the case.

8 A. Yes.

9 Q. Why are you changing?

10 A. When we were talking about it, I wasn't thinking
11 carefully about boxes three and nineteen. You drew my
12 attention to them subsequently.

13 Q. So now your testimony is that it could not be
14 implemented on one chip, because blocks three and
15 nineteen would have to be implemented, at least in part,
16 outside of DSP 2.

17 A. No. That's not what I said. I'm saying -- you
18 could implement on one chip, but most likely, good
19 engineering design procedure would lead you to divide
20 the implementation of those interfaces to be partially
21 on the chip and partially external.

22 Q. So you're telling me that it would be good
23 engineering design to not put too much on one chip. You
24 said that phrase, too. So now, Pioneer is going to sell
25 not one chip, but two chips.

1 MR. DAS: Objection, form.

2 BY MR. CRAIN:

3 Q. Because you can't put the interface now on just
4 one chip, you've got to have two.

5 MR. DAS: Objection, form.

6 THE WITNESS: No. They're going to sell one
7 chip, and then the point is the other half of the
8 interface is a detail of the particular implementation.
9 It's not a specialized chip.

10 BY MR. CRAIN:

11 Q. Show me in Sudo that supports that.

12 A. I don't see anything in Sudo that speaks to
13 that. That's just how you do electronics design.

14 Q. Show me in Sudo that teaches pulling that box 19
15 out of DSP 2.

16 MR. DAS: Objection, form.

17 THE WITNESS: I don't know what I'm looking for
18 really.

19 BY MR. CRAIN:

20 Q. It doesn't teach it; does it?

21 A. It doesn't really -- so you're saying what would
22 that mean? If it was partially outside of the box, then
23 it would say the interface which is not entirely within
24 the digital signal processor or something like that.

25 Q. It makes no sense to me -- and you know more

1 about this than I do -- but it makes absolutely no sense
2 to me that you would have a box with components inside
3 it and say, well, you know, these are actually going to
4 be outside. Well, why did you draw them inside? You're
5 telling me they could be outside. Okay. Then where is
6 that in Sudo? Because he seems to think something
7 different than what you're saying. Unless you can show
8 me where he says it.

9 A. Well, what's the -- I mean, you can understand
10 this as -- well, in a sense, this sort of speaks to my
11 original impression that the box doesn't particularly
12 describe a chip, but describes a system. The
13 interface -- all of the Interface 19 that we're
14 discussing, in my view, is within the system. Part of
15 the circuitry is on -- say on this chip, part of it is
16 external to the chip. That would be the conventional
17 way to do it. As I've explained, that would be good
18 engineering practice.

19 Q. And you're unable to find one jot or tittle in
20 Sudo that supports what you just said. Right?

21 MR. DAS: Objection, argumentative.

22 THE WITNESS: Because that's really not the --
23 that's not what the patent -- that's not the level of
24 abstraction the patent is working at.

25 BY MR. CRAIN:

1 Q. What you're suggesting, though, doesn't that
2 change or effectively get rid of the box that is labeled
3 as DSP 2?

4 A. No. It actually puts it into my original
5 construction, which is like this is a system. Digital
6 signal processing, which likely consists of multiple
7 chips.

8 Q. But the word "system" for DSP is not in the
9 patent either.

10 A. Okay. This is a digital signal processor that
11 likely includes multiple chips.

12 Q. Okay. So you've completely backed away now from
13 what you said earlier about the DSP 2 being implemented
14 on one chip, at least in one instance?

15 MR. DAS: Objection, form. Objection,
16 argumentative.

17 THE WITNESS: No. I think -- remember when you
18 asked me what an interface was, and I tried to explain
19 that it was the name for some low-level process of
20 translating say electrical levels? It's not -- it's
21 something you would want to put in there, because hey,
22 let's not forget, you're going to have to do -- you may
23 need to do some translation of electrical levels in
24 here. But it's not like, oh, this is some important,
25 crucial function. It's sort of just -- it's a very

1 minor detail of the system.

2 BY MR. CRAIN:

3 Q. Can you tell me why a person of ordinary skill
4 in the art of the '544 patent not understand Interface 19
5 to be a buffer circuit to the interface pins of the DSP,
6 a chip, and then Main Bus 17?

7 A. Why they would not understand it to be that?

8 Q. Yes. No, no, no. Why they would understand it
9 to be -- well, let me flip it. Because I think the not
10 there is confusing.

11 Do you believe a person of ordinary skill in the
12 art would understand Interface 19 to be a buffer circuit
13 to interface the external pins of the DSP chip as
14 connected to Microcomputer 20 and then Main Bus 17?

15 MR. DAS: Objection, form. Objection, compound.

16 THE WITNESS: I don't understand -- you know,
17 there is more to it than that. Right? What is the
18 connection to the microcomputer? So I kind of -- I like
19 parts of what you said, that there would be -- part of
20 the Interface 19 would involve --

21 (Interruption.)

22 THE WITNESS: That the Interface 19 would
23 involve some buffer circuit. That's what I was --
24 that's the kind of thing I was talking about, about
25 translating voltage levels. But there is sort of a

1 second half to that, which is like, well, okay, so
2 that's taking something that comes off say pins on a DSP
3 chip and interfacing them to something that might be an
4 internal data bus. But then it's like, okay, what do we
5 do with these pins on the DSP chip to connect them to a
6 microcomputer?

7 BY MR. CRAIN:

8 Q. Does Main Bus 17 operate at high speed,
9 according to your understanding of Sudo?

10 A. It's -- you know, the speed of Main Bus 17 is
11 important. It's one of the -- it's part of the -- the
12 speed limit -- you know, the ultimate speed of the whole
13 system, yes. And high speed, you know, what does that
14 mean? But high speed meaning like high speed relative
15 to other systems in the -- relative to other components
16 in the system, yes.

17 Q. Just to be clear, do you believe that Main Bus
18 17 is a high-speed bus?

19 MR. DAS: Objection, asked and answered.

20 THE WITNESS: We haven't defined high speed. A
21 high-speed bus.

22 BY MR. CRAIN:

23 Q. I think you did suggest that speed is important
24 in Sudo. Correct?

25 A. That's right.

1 Q. What can you explain to me about the speed of
2 Main Bus 17?

3 MR. DAS: Objection, form.

4 THE WITNESS: A system like this, a
5 microprocessor system like this, will have a clock. It
6 has a clock that synchronizes all the different
7 operations. I think Main Bus 17 changes state with
8 every clock cycle, which is probably the most rapid
9 changes that occur in the system.

10 BY MR. CRAIN:

11 Q. Describe for me how Interface 19 is connected to
12 Microcomputer 20, according to your understanding of
13 Sudo.

14 A. It doesn't say.

15 Q. Do you have any understanding?

16 A. I understand that the -- there is a
17 microcomputer which is delivering data to the system
18 through that interface. So there must be some form of
19 interface. And as it turns out, the ability to -- I
20 think the microcomputer has the ability to -- has quite
21 a high level of control over the state of the internals
22 of the digital signal processor through this interface
23 and through its control of Main Bus 17.

24 Q. So based on that, what type of connection do you
25 believe Microcomputer 20 to have with Interface 19 of

1 DSP 2?

2 A. I would expect it to have a high-speed
3 connection.

4 Q. You used the term "high speed" there. So can I
5 also apply that to Main Bus 17?

6 A. Yes.

7 Q. So we're going to use that as the benchmark.
8 Okay?

9 A. Okay.

10 Q. Tell me, as of 1992, what type of high-speed
11 connections would be in existence that you would have
12 expected to see between Interface 19 and Microcomputer
13 20.

14 A. You know, my best estimate would be something
15 like the PCI bus. This was the internal -- the
16 connection that was used to allow you to insert cards
17 into a microcomputer, like an IBM PC or something.

18 Q. You believe it could have been that?

19 A. That's the kind of thing I expect it to be.

20 Q. Do you believe it could have been anything else?

21 A. It could have been anything else.

22 Q. Like what? I want you to tell me.

23 A. You could certainly generate some special
24 purpose interface. You know, you can -- it's not clear.
25 It certainly doesn't have to be that.

1 Q. What does it have to be?

2 A. It has to be some -- it has to be able to allow
3 the microcomputer to access the bus in order to perform
4 the functions that it specified.

5 Q. According to your understanding of what type of
6 high-speed connections were available during the time of
7 the filing of the Sudo patent, what would that menu be?

8 MR. DAS: Objection, form.

9 THE WITNESS: You could create --

10 BY MR. CRAIN:

11 Q. Let me ask the question again. What would the
12 menu of available options of the interconnection between
13 Interface 19 and microcomputer be to achieve the high
14 speed that you talked about?

15 A. You could develop -- you could construct some
16 kind of custom parallel connection to do that.

17 Q. So I would have to create something from
18 scratch?

19 A. Sure.

20 Q. Okay. You mentioned a PCI bus.

21 A. Yes.

22 Q. Is that an option?

23 A. Um-hmm. PCI bus requires quite a lot of
24 overhead to manage. But that's the kind of role that
25 would have been used -- that's the -- you know -- so I'm

1 imagining them building a development -- you know, when
2 you build a card like this -- when you build a chip or a
3 system like this, you typically -- you don't send it out
4 to your customers as a chip. You give them a
5 development board which they can then use for their own
6 experiments to see what they can do with your chip.
7 Very often, those development boards would be PCI bus
8 boards.

9 Q. What else? That's two.

10 A. Well, so obviously a custom parallel -- so
11 custom means everything other than some existing
12 standard.

13 Q. So I've got to make up something.

14 A. Well, it's often -- if you know exactly what you
15 want, why would you want to use a standard? The purpose
16 of using a standard is to provide interoperability. If
17 this is the only thing you're going to do with it, then
18 you don't need that.

19 Q. Okay. So I still think you're on two. A PCI
20 bus and some type of custom solution.

21 A. Okay.

22 Q. Can you think of a third?

23 A. No. I can't think of one.

24 Q. So RS-232 wouldn't be --

25 A. RS-232 would not be suitable.

1 Q. Why?

2 A. Too slow.

3 Q. Too slow for what?

4 A. Too slow for the detail of the way that the data
5 transfers occur in this invention.

6 Q. So to be clear, according to your understanding
7 of Sudo, you do not believe that the connection between
8 Microcomputer 20 and Interface 19 could be an RS-232
9 connection.

10 A. Yes.

11 Q. And it couldn't be a USB connection, because
12 that hadn't been developed yet.

13 A. That's right. Yeah.

14 Q. Are there any other serial-type connections that
15 we haven't talked about, that this could be?

16 A. At this point in technology, serial connections
17 were not fast enough for this.

18 Q. When was PCI bus developed?

19 A. The PCI buses identified with the IBM PC AT
20 which came out in like 1984 or something.

21 MR. DAS: Mr. Crain, we've been going almost an
22 hour and a half now.

23 MR. CRAIN: Have we?

24 MR. DAS: If this is a good time for a break.

25 MR. CRAIN: A couple questions. I'm at a point

1 here --

2 BY MR. CRAIN:

3 Q. Would PC bus -- PCI bus -- let me start again.

4 Would PCI bus have allowed for a removable
5 connection between Microcomputer 20 and Interface 19?

6 A. Yes.

7 Q. Would this undefined custom -- was it a parallel
8 connection?

9 A. Yes.

10 Q. Would this undefined parallel connection that
11 was a custom connection also allow for a removable
12 connection between the Microcomputer 20 and Interface 19?

13 A. Yes.

14 Q. How?

15 A. It's a custom. You can build it any way you
16 want.

17 Q. We don't know, though.

18 A. I'm trying to think how it would not. Right?
19 It depends on what Microcomputer 20 is. But if it isn't
20 removable, that means that somehow it has to be
21 permanently connected, which would mean that it was, you
22 know, an integral part of the entire system.

23 Q. What does the circle between Interface 19 and
24 Microcomputer 20 that's in the dashed line box represent
25 to you?

1 A. It represents the port.

2 Q. What port?

3 A. It doesn't represent very much. It's just a --
4 I just see it as -- it doesn't have any particularly
5 strong interpretation. It represents -- it normally
6 would indicate a transition between -- you know,
7 something like leaving a circuit board.

8 Q. Could it represent a pin?

9 A. It could represent a pin. Well, in this case,
10 it could not represent one pin.

11 MR. CRAIN: All right. We'll take a break.

12 THE WITNESS: Thanks.

13 THE VIDEOGRAPHER: This is the end of Media
14 No. 3 in the deposition of Dr. Daniel Ellis. The time
15 is 3:44 p.m. We're off the record.

16 (Recess taken from 3:44 to 3:55.)

17 THE VIDEOGRAPHER: This is the beginning of
18 Media No. 4 in the deposition of Dr. Daniel Ellis. The
19 time is 3:55 p.m. We are back on the record.

20 BY MR. CRAIN:

21 Q. Would you please turn to Exhibit 13.

22 A. Okay.

23 Q. I think you did this earlier. But would you
24 please again identify Exhibit 13.

25 A. This is my declaration in the matter at hand.

1 Q. Did you author your declaration?

2 A. Yes.

3 Q. Did you type all of the content in your
4 declaration?

5 A. I didn't type it all. The history -- I'll let
6 you ask the questions.

7 Q. Well, go on. The history what?

8 A. (No response).

9 Q. What were you going to say?

10 A. I don't know.

11 Q. You don't know? Did you forget?

12 A. I didn't finish composing a sentence.

13 Q. What were you starting to say?

14 A. I said the history.

15 Q. And you don't remember what you were going to
16 say after that?

17 A. Not by now.

18 Q. Okay. By the way, is there anything with
19 respect to your testimony from earlier today that you
20 would like to change or correct?

21 A. No. Thank you.

22 Q. And did you speak with your attorneys during the
23 break?

24 A. I spoke with them.

25 Q. Did you speak about the substance of your

1 testimony to date?

2 A. No.

3 Q. What parts of your declaration did you not type?

4 A. I don't know. I can't identify --

5 Q. What parts of your declaration do you remember
6 typing yourself?

7 A. Various parts throughout.

8 Q. Turn to native page three, QSC page six of your
9 declaration.

10 A. Yeah.

11 Q. Do you recall whether or not you composed
12 Section IV(A) of your declaration?

13 A. Section IV(A)? Yes. I did.

14 Q. You did compose --

15 A. I believe so.

16 Q. Does that include paragraphs ten through
17 fourteen?

18 A. Yes.

19 Q. Did you insert a copy of Figure 1 from Sudo onto
20 native page four?

21 A. Did I insert it?

22 Q. Yes.

23 A. I don't think so.

24 Q. Did you direct it to be inserted?

25 A. Yes.

1 Q. Why did you direct it to be inserted?

2 A. This is what I really liked about Sudo is this
3 picture that makes it very clear there is a separation
4 between the microcomputer and the digital signal
5 processor.

6 Q. Did you compose paragraph 13 of your
7 declaration?

8 A. Yes.

9 Q. Earlier, you seemed to have trouble or you
10 quibbled with me a little bit about the term "hard
11 wired."

12 A. Yes.

13 Q. I see the word "hard wired" in paragraph 13.

14 A. Yes.

15 Q. So I need for you to explain it to me, what you
16 intend that word to mean so that we can talk about it.

17 A. In this case, it's in contrast to a removable
18 connection. It's a non-removable connection.

19 Q. Hard wired means non-removable?

20 A. Yes.

21 Q. What does removable connection mean to you?

22 A. A connection that you can physically separate.

23 Q. Permanently?

24 A. A connection that you can physically separate
25 and reconnect multiple times.

1 Q. What you just said is your understanding of the
2 term "removable connection" in Sudo?

3 A. "Removable connection" in Sudo or in this
4 paragraph?

5 Q. Is there a difference?

6 A. I don't know what "removable connection" in Sudo
7 means.

8 Q. Is there a difference in what the term
9 "removable connection" in Sudo means and what it means
10 in paragraph 13?

11 A. I don't believe it appears in Sudo.

12 Q. I'm sorry. Thank you.

13 In the '544 patent.

14 A. Oh, great. Is there a difference in what
15 "removable connection" means? In that extent, I don't
16 believe so, no.

17 Q. Is the term "removable connection" in Sudo?

18 A. I think not. I think if it had been, I would
19 have mentioned that.

20 Q. Does Sudo teach the concept of a removable
21 connection?

22 A. The subject matter of Sudo is not about those
23 kinds of issues.

24 Q. Is that a no?

25 A. Sudo doesn't teach a removable connection. Sudo

1 is about ways of updating parameter RAM.

2 Q. In paragraph 13, where you use the term
3 "removable connection," what do you mean?

4 MR. DAS: Objection, asked and answered.

5 MR. CRAIN: Well, I didn't understand him the
6 first time, so I've got to ask again.

7 BY MR. CRAIN:

8 Q. Let me ask a question. What do you mean by the
9 term "removable connection" in paragraph 13?

10 A. I mean that the connection between the digital
11 signal processor and the microcomputer was most likely
12 something that could be disconnected and reconnected
13 multiple times with little effort.

14 Q. Based on what?

15 A. Based on my understanding of how -- of, you
16 know, the kind of system that was being described and
17 the activities that were involved in developing the
18 patent.

19 Q. Show me, if you would, in Sudo -- if you have
20 that patent handy --

21 A. Yes.

22 Q. Just a moment. I think I've gotten myself
23 confused.

24 I think we were looking at Sudo. Let's look at
25 something there. I think, before the break, we were

1 talking about these interfaces. What do you understand
2 A to D numeral one to be?

3 A. A system for converting an analog input signal
4 to a digital output signal.

5 Q. What do you understand D to A 22 to be?

6 A. A system for converting a digital input signal
7 to an analog output signal.

8 Q. Would you describe for me how your understanding
9 of A to D numeral one is connected to I/O Interface No. 3.

10 A. We're not given any information. It's not
11 material. That's why we're not given any information.
12 You know, the -- all he's saying is, okay, this is a
13 thing that's connected to an analog input and output.
14 It's a digital processor. So we have to have
15 converters, because we're -- because we're needing to
16 access these things in an ongoing fashion, we'll need
17 some kind of interface to handle the details of the
18 transfer from whatever format it comes from the A to D
19 system into whatever format we need to use internally.

20 Q. Is A to D No. 1 removably connected from I/O
21 Interface 3? Let me ask it again. I said that wrong.

22 Is A to D No. 1 removably connectable to I/O
23 Interface 3, according to your understanding of Sudo?

24 MR. DAS: Objection, form.

25 THE WITNESS: Again, my understanding of this is

1 there is some kind of development system, but they're in
2 the business of developing these things. They're going
3 to have existing A-to-D and D-to-A modules, which
4 they're going to use across all their difficult -- many
5 different projects. In that case, yes, it would
6 certainly be removably connected.

7 BY MR. CRAIN:

8 Q. So you could unplug it and plug it back as many
9 times as you wanted to?

10 A. Absolutely.

11 Q. Identify for me, if you can, any devices that
12 you've had prior experience with where an A to D was
13 removably connectable to the DSP. I'm not talking about
14 in a lab. I'm talking about real devices.

15 A. Yeah. That's very common. Because the A to D
16 is an extremely delicate piece of equipment. They're
17 commonly manufactured as separate units. So they can
18 be -- you know, you can choose your own A to D, how much
19 you're going to pay, and buy the best one.

20 Q. So are you saying just because it's a separate
21 component, it's inherently removably connectable?

22 A. Because it's -- I mean, the idea of it being a
23 separate module, something in a case, that would make it
24 inherently removably connectable, yes.

25 Q. Is that what you understand Sudo to be telling

1 us about it?

2 A. That's not what he's telling us about it. He
3 doesn't talk about it at all. But that's my
4 understanding of what's being represented in this figure.

5 Q. Draw your focus, please, back to Microcomputer
6 20.

7 A. Okay.

8 Q. I understand, I think, the Sudo patent talks
9 about -- I forget what it calls it -- Hall 1 and Hall 2.
10 I think they may be like functions. Does that sound
11 familiar to you?

12 A. Sorry. Hall? Oh, Hall 1.

13 Q. Hall. H-A-L-L. I'm going to show you the
14 language. Look at the bottom of column three of the
15 Sudo patent. Do you see where it says, "Control keys of
16 sound fields, such as Hall 1 and Hall 2, are prepared on
17 the keyboard 21"? You're welcome to read that and
18 continuing on, but I'm asking for your understanding of
19 what Sudo is telling us with respect to how -- what
20 Hall 1 and Hall 2 appear to be to you.

21 A. I'd just like to point out that is the kind of
22 sentence that led me to feel that this may not have been
23 composed by a native speaker. But -- you don't want to
24 go there. Right?

25 Q. No. I do. Tell me. Explain to me.

1 A. "Control keys of sound fields such as Hall 1 and
2 Hall 2 are prepared on the keyboard 21." I don't
3 understand why it's saying that the keys are prepared on
4 a keyboard. What does that mean? I don't know what
5 that means.

6 Q. You have no understanding of that?

7 A. I mean, I understand that there may be keys
8 present on a keyboard, but I don't understand why it
9 means they're prepared.

10 Q. What do you understand "prepared" to mean?

11 A. Like something is being set up specially.

12 Q. So you don't understand that to mean that there
13 is a key on a keyboard set up especially for this
14 function of Hall 1?

15 A. That's not how I would have written it.

16 Q. But that's not what I asked you.

17 A. I didn't misunderstand the sentence. It just
18 struck me as strange wording.

19 Q. It wasn't written the way you would have written
20 it.

21 A. That's right.

22 Q. You're certainly able to understand things you
23 didn't write. Correct?

24 A. That's right.

25 Q. So getting back to what I was trying to ask --

1 I'm trying to understand how microprocessor 22 --

2 A. What?

3 Q. I'm sorry. Microprocessor -- microcomputer --
4 let me get my terms right -- how does Microcomputer 20,
5 according to your understanding of Sudo, cause the
6 implementation of Hall 2 sound field?

7 MR. DAS: Objection, form.

8 THE WITNESS: Let me just read the following
9 sentences.

10 BY MR. CRAIN:

11 Q. Certainly.

12 A. So it's -- it describes how when the key is
13 pressed, the microcomputer transfers program and
14 coefficient data into the memory of the digital signal
15 processor through the Interface 19.

16 Q. What is a signal processing function?

17 A. It's a -- the -- it's a description of the
18 modification you wish to perform, to be performed upon
19 the input signal to generate the output signal.

20 Q. What are parameters?

21 A. They are a variety of values that may control
22 aspects of that function -- of that program algorithm
23 procedure.

24 Q. Is a signal processing function then different
25 from a signal processing function parameter?

1 A. Yes.

2 Q. When it's talking about Hall 1 or Hall 2 -- and
3 I think it describes them as sound fields -- do you
4 understand whether or not those correspond to what may
5 be a signal processing function or a signal processing
6 function parameter?

7 MR. DAS: Objection, compound.

8 THE WITNESS: He says that the microcomputer
9 specifically reads out the program corresponding to the
10 key and the coefficient data group. I would
11 understand -- the coefficient data group is the sort of
12 thing I would call a signal processing function
13 parameter, and the stuff that's not the coefficient data
14 group could be usefully described as a signal processing
15 function.

16 BY MR. CRAIN:

17 Q. Look back at Fig. 1. There is still something I
18 can't get out of my mind here. You were just telling
19 me, if I understood you correctly, that A to D No. 1 is
20 removably connectable, according to your understanding
21 of Sudo.

22 MR. DAS: Objection, form.

23 THE WITNESS: What I said was I'm imagining the
24 piece of equipment that's being -- you know, what's
25 being depicted -- the physical realization that's being

1 depicted here, I'm imagining it as a piece of equipment
2 in the laboratory, including an external A to D
3 converter which is in a box which is removably connected
4 to the remainder of the equipment.

5 BY MR. CRAIN:

6 Q. Is that the only way that it could be imagined?

7 A. No.

8 Q. What other ways could you imagine it?

9 A. You could imagine putting the A to D converter
10 as a chip, on a card, that has -- you know, that has
11 other -- has -- you know, the breadboard system that has
12 other components that are being built into the system.

13 Q. Is that still in a laboratory?

14 A. Yes.

15 Q. Can you imagine any implementations of Figure 1
16 outside of a laboratory?

17 A. Yes.

18 Q. What can you imagine?

19 A. I can imagine this as a -- you know, a
20 development card. I can imagine it as a development
21 card that you could plug into a computer. I can imagine
22 it as a complete system.

23 Q. In any of those implementations that you can
24 imagine, inside or outside of a laboratory, if you
25 disconnect A to D No. 1, what happens to the audio

1 signals?

2 MR. DAS: Objection, form.

3 THE WITNESS: It depends. But certainly, if you
4 remove the input, then the outputs in a short while are
5 going to cease to reflect what -- I mean, reflect what's
6 going on. So there are two things. It depends what
7 happens -- how the I/O interface would deal with the
8 absence of that input. It could either read it as
9 zeros, or it could stop working altogether, read it as
10 silence.

11 BY MR. CRAIN:

12 Q. But it would no longer be processing audio
13 signals. Is that correct?

14 A. It would be processing whatever it's got in its
15 memory.

16 Q. But it would no longer be processing the audio
17 signals that were being communicated by A to D No. 1.
18 Correct?

19 A. If it's not connected, then it won't be getting
20 any information from it.

21 Q. When on the keyboard, the preset button for
22 Hall 1 or Hall 2 is depressed, what do you understand
23 Microcomputer 20 to do?

24 MR. DAS: Objection, asked and answered.

25 THE WITNESS: I understand it to find --

1 retrieve a corresponding program, a set of instructions
2 and some data, a set of values, and to transfer them
3 into the memory of the digital signal processor -- into
4 the memories of the digital signal processor.

5 BY MR. CRAIN:

6 Q. Does that result in the modification of a signal
7 processing function?

8 A. It would unless it happened to be writing the
9 same program that was already there.

10 Q. It would unless it was writing the same program
11 that was already there?

12 A. That's right.

13 Q. So if Hall 1 was being executed by the DSP and
14 the button for Hall 2 was pressed, what signal
15 processing function would be modified, if any?

16 A. So, you know, you asked me before about the
17 difference between the signal processing function and
18 the signal processing function parameters.

19 Q. Yes, I did.

20 A. And I think I answered it by saying something
21 about signal processing function parameters, and then
22 sort of defining signal processing function relatively
23 as everything that wasn't included in the parameters.
24 It's not that easy to -- it's not like, oh, there is --
25 there is a very clear distinction between these in all

1 cases. It's sort of depending on what you -- you know,
2 what you're interested in, what perspective you were
3 taking on the class of problems, the different
4 algorithms. Different parts of that overall algorithm
5 might be considered to be in the parameters or not in
6 the parameters in the function.

7 Q. Describe for me, Dr. Ellis, your understanding
8 of how, in this example, Hall 1 would be modified as a
9 signal processing function by the depressing of the
10 button for Hall 2.

11 A. How Hall 1 would be modified as a signal
12 processing function -- how the signal processing
13 function associated with Hall 1 would be modified by
14 pressing the Hall 2 button.

15 Q. How would it modify the signal processing
16 function for Hall 1?

17 A. So can I -- so one -- what I've just said about
18 parameters -- what I'm saying is there is a boundary --
19 we could imagine that here is all the stuff you need to
20 run Hall 1. We can now draw a boundary here and say
21 here are the parameters, here is everything else, which
22 we're going to call the signal processing function.

23 Q. I'm listening.

24 A. I'll still using my hands, which I guess is
25 probably -- you told me not to do. There are two parts.

1 One is the parameters, which is sort of -- we can -- we
2 have some flexibility in how we define it. And for the
3 purposes of this discussion, we're going to define
4 everything else as the function.

5 It might be that the difference between -- in
6 fact, it's quite likely -- it's quite possible that the
7 difference between Hall 1 and Hall 2 only exists in the
8 parameters, or it could be that the differences exist in
9 both the parameters and the function.

10 Q. Do you remember my question?

11 A. How does the signal processing function of
12 Hall 2 get modified -- Hall 1 get modified when you
13 press the button for Hall 2.

14 Q. Okay.

15 A. Do you remember my first answer?

16 Q. I don't. Because it was kind of so long --

17 A. My first answer was, if it was the same, it
18 wouldn't get modified. It might be the same, in which
19 case it wouldn't get modified.

20 Q. Does Sudo indicate to us that it would be the
21 same?

22 A. You know, it was -- that was what it suggested
23 to me. Sudo is, again, not at all -- it's not really
24 talking about these algorithms at all. It's just saying,
25 as an illustration, as a motivation, these are the kind

1 of things you would do.

2 Q. What do you mean, it's not talking about these
3 algorithms at all?

4 A. It's not talking about the algorithms. It's
5 talking about how to update the coefficient Data RAM.

6 Q. The last answer we have on the transcript is,
7 it's not talking about the algorithms. This is you.

8 A. Yeah.

9 Q. It's talking about how to update the
10 coefficient --

11 A. The coefficient Data RAM.

12 Q. Data RAM. Yes. Would you explain that.

13 A. The substance of the invention is a mechanism
14 for updating values in the coefficient Data RAM without
15 interrupting the processing.

16 Q. So does it, in any way, teach the modification
17 of the algorithm?

18 A. It starts off by explaining a mechanism -- by
19 describing a scenario in which the algorithm may have
20 been modified.

21 Q. Where is that?

22 A. When it says that the --

23 Q. Where are you looking?

24 A. Sorry. The bottom of column three. The place
25 we were looking just now. That the microcomputer reads

1 out the processing program corresponding to the operated
2 sound field control key and transfer -- I'm skipping the
3 comments -- and transfers this data to the DSP through
4 the interface.

5 Q. Where does that say that it modifies it?

6 A. It transfers it. There is a program -- the DSP
7 is only running one program at a time.

8 Q. Right.

9 A. So when it transfers that program into
10 presumably the program RAM, the understanding is that's
11 then the program that the DSP will be running.

12 Q. So if Hall 1 is the program that is running, how
13 is Hall 1 modified by the insertion of Hall 2?

14 A. Yes, there are two possibilities. One is Hall 1
15 and Hall 2 share the same program. So the program,
16 itself, remains unchanged even though, as it's described,
17 we understand that the program RAM is overwritten. If
18 it's overwritten with the same values, it remains
19 unchanged. In that case, the difference between Hall 1
20 and Hall 2 would be merely in the coefficients.

21 Q. What is the other?

22 A. The other is that Hall 1 and Hall 2 have
23 different programs. So that when it transfers the new
24 program into the program RAM, an entirely new -- a
25 different algorithm is -- begins to be implemented.

1 Q. In the second scenario that you just described,
2 is the first program changed in any way, other than just
3 not being run anymore?

4 A. It's obliterated. It's replaced in memory with
5 the second program.

6 Q. But it's not modified then?

7 A. No.

8 Q. And if we want to go back to Hall 1, we'll press
9 the Hall 1 button. That program comes back out of
10 Microcomputer 20 into the RAM. Correct?

11 A. That's my understanding, yes.

12 Q. And it would be the same program that was
13 initially running in this hypothetical before we went to
14 Hall 2.

15 A. Yes.

16 Q. So it's never modified as an algorithm.

17 A. That's not -- yes, that's not part of this
18 disclosure.

19 Q. Now, the first instance is they just happen to
20 be the same.

21 A. Yes.

22 Q. Is that a common implementation, in your
23 experience?

24 A. Yeah.

25 Q. So Hall 1 and Hall 2 -- understandably, it might

1 be close, because maybe there are some tweaks -- but
2 what about other types of algorithms or functions maybe
3 for this big football stadium they have down here? Have
4 you heard about this thing? I mean, this thing gets
5 really loud. So if they want to play sound down in this
6 thing, maybe they have to do it in a way that might be
7 different from Hall 1. Would you expect the algorithms
8 to be the same?

9 MR. DAS: Objection, form.

10 THE WITNESS: It's interesting, but it turns out
11 that the algorithms that they're suggesting -- right --
12 which is this -- the couple of times they specify some
13 of AiDi --

14 BY MR. CRAIN:

15 Q. Where are you looking?

16 A. So column one, line 34, it's Greek letter sigma,
17 Greek letter alpha, subscript I, center dot, lower case
18 D, subscript I, all in parenthesis. That's -- they call
19 it -- they give it a name. I can give it a name. The
20 product sum arithmetic operation. So it turns out this
21 is a very well known -- a fundamental operation in
22 signal processing, because you can do a lot of -- you
23 can simulate a very wide range of, for instance, halls
24 with that.

25 Q. Is that specifically for halls?

1 A. No.

2 Q. So it could be stadiums?

3 A. Yes.

4 Q. So, in your first scenario, again, the signal
5 processing function is not modified, because it's the
6 same no matter what the --

7 A. Right.

8 Q. -- operation is?

9 A. Yes.

10 Q. Only the coefficients are different.

11 A. That's right.

12 (Exhibit 17 marked for identification.)

13 BY MR. CRAIN:

14 Q. Dr. Ellis, I'm going to hand you what has been
15 marked as Exhibit 17. Would you please take a moment to
16 review it.

17 A. Okay.

18 Q. Are you able to identify what has been marked as
19 Exhibit 17?

20 A. Yes. This is an international patent
21 application. It's a patent. It's not a U.S. patent.
22 It's some kind of patent description, which is the
23 reference I referred to as Krokstad in my declaration.

24 Q. Is it referred to as Krokstad because that
25 appears to be the first named inventor?

1 A. It appears to be the family name of the
2 inventor.

3 Q. Correct. Thank you.

4 Do you believe Exhibit 17 to be an international
5 application published under the Patent Cooperative
6 Treaty?

7 A. Yes.

8 MR. DAS: Objection, form.

9 BY MR. CRAIN:

10 Q. Have you reviewed -- let's call it the Krokstad
11 reference --

12 A. Yes.

13 Q. Have you reviewed the Krokstad reference?

14 A. Yes.

15 Q. Do you recall how many times?

16 A. Three or four times.

17 Q. Like the others, I'm sure you reviewed it as
18 well this week.

19 A. That's right.

20 Q. Would you explain for me what you understand the
21 Krokstad reference to be directed to.

22 A. It's about a design of a hearing aid, a digital
23 hearing aid, a hearing aid that processes sound using a
24 digital signal processor, using digital signal
25 processing, and various details of other aspects of this

1 hearing aid to make it good.

2 Q. Why is it your belief that a person of ordinary
3 skill in the art in 1994 would look to hearing aid
4 technology like what's disclosed in Krokstad for
5 teaching -- let me start that question again.

6 Why is it your opinion that a person of ordinary
7 skill in the art of the '544 patent would look to the
8 Krokstad reference for teaching and insight?

9 MR. DAS: Objection, form.

10 THE WITNESS: Because the use of digital signal
11 processing in hearing aids was a very exciting and
12 important development at the time.

13 BY MR. CRAIN:

14 Q. How do you know that?

15 A. That's my recollection.

16 Q. Based on what?

17 A. Based on what I remember about the time. This
18 is -- this is early for a digital hearing aid. I guess
19 that's why they're filing a patent on it. Because
20 it's -- again, as I've described, there is a process by
21 which the digital technology has to become cheap enough
22 to be suitable in the right format. So this is the time
23 at which this -- these -- the hearing aids which had
24 previously been analog were switching to digital, making
25 possible a much greater range of functionalities and

1 flexibilities, which was -- which was an exciting
2 development.

3 Q. Do you have any understanding of whether or not
4 the Krokstad reference teaches a removable connection as
5 is claimed in the '544 patent?

6 A. I think it does.

7 Q. Would you show me where you believe that to be.

8 A. So, for instance, in Figure 5a, we actually
9 see -- well, we see firstly a box labeled "RS-232," also
10 labeled "IF," which clearly refers to the serial
11 programming interface described that can be used to
12 update the internal settings of the hearing aid.

13 We also see a broken line between the box marked
14 RAM 7 and the box marked RAM 2. It's an interrupted
15 arrow, which I believe corresponds to a removable
16 connection between the part of the hearing aid that's
17 inserted in the ear and a case that it is put in when
18 it's not in the ear.

19 Q. Do you have Exhibit 12 handy? If you want to
20 pull -- reference Exhibit 13, which is your declaration,
21 we can look at both of them. We'll be jumping back and
22 forth.

23 A. Okay.

24 Q. So you've got 13 and you've got 12, and then the
25 Krokstad reference.

1 A. Yeah.

2 Q. So we'll look at all three of them.

3 In Exhibit 12, please turn to page 24 -- 23, 24.

4 A. Yeah.

5 Q. I was wrong. Make that 25, 26.

6 A. Yeah.

7 Q. Let's just start with the last two elements that
8 we see on page 26.

9 A. Yes.

10 Q. I believe you also talk about them in your
11 declaration. So we can flip back and forth.

12 Now, do you see in the left column where it
13 says, "An external programmer"?

14 A. Yes.

15 Q. And the right column, it shows -- it actually
16 references Sudo and not Krokstad. Do you see that?

17 A. Yes.

18 Q. And we've just been talking about
19 Microcomputer 20.

20 A. Yes.

21 Q. So I take it from this that -- let me go back
22 here.

23 Let's look at your opinion as well.

24 A. Yes.

25 Q. Do you see any reference in your opinion, on

1 pages six, seven, or eight, with respect to Krokstad
2 disclosing or teaching an external programmer?

3 A. In paragraph 18, I say, "Krokstad also shows the
4 use of an RS-232 input port that is used to program the
5 DSP with functions that are selected for a particular
6 user."

7 Q. Do you see a reference to an external programmer
8 in that paragraph?

9 A. Yes.

10 Q. Is the RS-232 the external programmer?

11 A. It's the interface to the external programmer.
12 So it's used to program these -- obviously, the RS-232
13 input port is a port. It's not the port that can
14 program it; it's the thing you connect to the port.

15 Q. Yeah, you're getting ahead of me. That's right.
16 I think you're right. So where is the thing that
17 connects to the port? Is it in Krokstad is what I'm
18 trying to understand?

19 A. Oh, he mentions it. Yeah. He mentions the idea
20 of using some kind of audiometry system. That's what's
21 connected through the RS-232 port.

22 Q. Before you go to that, do you reference what
23 you're trying to find in your port?

24 A. That's what I'm talking about.

25 Q. Where are you talking about it, again?

1 A. I'm talking about there is an RS-232 port that
2 is used to program the DSP.

3 Q. And you're not suggesting that it is the RS-232
4 port that's the external programmer. Correct?

5 A. That wouldn't make any sense.

6 Q. According to your understanding of Krokstad,
7 what's connected to the RS-232 port?

8 A. It's a connection between two devices. It's a
9 connection between an external computer, which is used
10 for setting the hearing aid, and it's connecting to the
11 hearing aid circuitry.

12 Q. So are you then now contending that this
13 computer connected to the RS-232 port would be an
14 external programmer?

15 A. Yes.

16 Q. If you look at the next element, it starts out
17 with, "A programming signal input port." We've already
18 talked about Sudo, so I think I'm good with that. That
19 appears to correspond to the first two paragraphs of
20 Exhibit 12. Does that appear to be correct? I only say
21 because see how it references Exhibit 5 and 3?

22 A. Sorry. You lost me.

23 Q. Okay. Are you on page 26 of Exhibit 12?

24 A. Yes.

25 Q. In the right column, across from the element

1 that begins, "A programming signal interface port," do
2 you see the paragraph that begins, "Sudo discloses"?

3 A. Yes.

4 Q. Do you understand that paragraph to be
5 pertaining to Sudo?

6 A. Yes.

7 Q. To what does the second paragraph pertain?

8 A. Also Sudo.

9 Q. That's what I was trying to get at. Sorry to
10 confuse you.

11 A. Yes.

12 Q. I think that's right.

13 A. I agree.

14 Q. Do you understand Krokstad to disclose a
15 programming signal input port?

16 A. So there are various names given to -- I think
17 there are like three different levels that are
18 distinguished in the '544 patent. And I'm not -- it's
19 not totally clear to me what the distinctions are. But
20 in -- in natural usage, the -- I would say that would be
21 a good way to describe it. The way that a person of
22 ordinary skill would understand a programming signal
23 input port -- a programming signal input port, then that
24 would -- that would apply to the RS-232 port in
25 Krokstad.

1 Q. So you do believe that Krokstad discloses a
2 programming signal input port, and if I understand you
3 correctly, you represent it to be the RS-232 input port?

4 A. Yes. RS-232 port.

5 Q. Is that the only thing it would be?

6 A. There is this -- there is this second removable
7 connection in Krokstad between -- it's the one I
8 described as the broken line.

9 Q. What is that?

10 A. It's this connection between what appears to be
11 a cradle that the hearing aid is put into when not in
12 use and which -- the hearing aid doesn't have an RS-232
13 port on it. An RS-232 port has a physical size which
14 would be impractical to put on a hearing aid. So there
15 is some kind of box or case that the hearing aid can be
16 put into when it's not in use. And according to the
17 description, there is some electrical connection that's
18 made when it's put in the case.

19 Q. Is that the programming signal input port?

20 A. That connection could also be described as the
21 programming signal input port. A programming signal
22 input port.

23 Q. But is that port removably connectable to the
24 external programmer?

25 MR. DAS: Objection, form.

1 THE WITNESS: You know, it depends on what
2 you're defining -- where you're defining the boundary
3 between the external programmer and the digital signal
4 processor.

5 BY MR. CRAIN:

6 Q. I'm asking you.

7 A. Well, you could define either of them. I only
8 mention it because it's a possibility.

9 Q. What's a possibility, again?

10 A. That you could define -- you could define the
11 boundary -- you could define the removable connection
12 between the external programmer and the digital signal
13 processor as being the RS-232 port or the broken arrow
14 between those two RAMs in figure -- in the figure I was
15 talking about.

16 Q. I'm confused. Is it one or the other or is it
17 both?

18 A. Depending on your taste, you could define it
19 either way.

20 Q. How are you defining it, is what I'm asking?

21 A. I'm happy to define it either way.

22 Q. Okay. Does that mean both?

23 A. Not at the same time. It depends. You know. I
24 don't see the need to rule out one of them.

25 Q. What is the external programmer if you're going

1 to say that the removable connection is -- I take it to
2 be that broken area between RAM 7 and RAM 2.

3 A. In Figure 5a.

4 Q. Yes.

5 A. Yes. Then the external programmer would be
6 everything to the right of that broken line, which would
7 be RAM 7, the RS-232 interface, and the external computer
8 connected to that interface which is not shown.

9 Q. What does RAM 7 do?

10 A. I'm not really sure. It seems to be a backup
11 memory that can store parameters.

12 Q. Is that it?

13 A. Yeah.

14 Q. Do you agree with my understanding of Krokstad
15 that it appears to disclose a hearing aid component, a
16 case or I think you said a cradle, and then some type of
17 computing device? Is that a fair characterization?

18 A. The invention makes reference to the computing
19 device, yes.

20 Q. As well as the hearing aid, obviously?

21 A. Yes.

22 Q. And some type of case?

23 A. Yes.

24 Q. Describe for me your understanding of what
25 Krokstad teaches in order to program the hearing aid.

1 A. That's interesting. He talks about -- you know,
2 that the -- there is a computer connected to the
3 interface, and you can download data through that into
4 the various memories of the hearing aid system to change
5 its function.

6 Q. Could you get into a little bit more detail. I
7 think that's a very high-level explanation.

8 A. Yes.

9 Q. Would you walk me through the steps that you
10 understand. What is the first thing you would do?

11 A. To do what?

12 Q. Well, if I want to program the DSP that I
13 presume is in the hearing aid --

14 A. Yes.

15 Q. -- what is the first step to do that, that you
16 understand, in Krokstad?

17 MR. DAS: Objection to form.

18 THE WITNESS: Well, I don't know -- if the exact
19 sequence doesn't matter, we'd have to establish a
20 connection between the external programmer and the DSP.
21 So that would involve, for instance, plugging the
22 external computer into the RS-232 interface and
23 connecting the ear unit to the case.

24 BY MR. CRAIN:

25 Q. Are you suggesting they all have to be connected

1 at one time?

2 A. That would be one way. That would certainly be
3 one way of doing it.

4 Q. Okay.

5 A. Now, I haven't -- I haven't read Krokstad
6 closely enough. Looking at the picture, it seems like,
7 well, maybe you could write into RAM 7, and then later --
8 write into RAM 7 when it's not connected to the hearing
9 aid, and then later connect the hearing aid to the case
10 and the data in RAM 7 could be transferred. That's just
11 something that is suggested to me by the figure.

12 Q. Tell me, if you would -- take a moment to review
13 Krokstad and tell me if either one of those or both of
14 those are suggested in Krokstad.

15 A. Oh. So yes -- it might be helpful for me to
16 note at this point that in my previous review, I
17 concluded that in that figure -- in Figure 5 -- 5a, I
18 think it is -- Figure 5a, I concluded that what's
19 labeled "RAM 7" was actually meant to be labeled RAM 1,
20 that this was a -- you know, an error in preparing the
21 figure. This is based on comparison with Figure 4a
22 where you see RAM 2, the broken line, and the RS-232
23 interface.

24 Q. Are you telling me you put that in your report?
25 Is that in your report?

1 A. No.

2 Q. All right. I thought you said that.

3 So you believe that there is a typo in
4 Figure 5a?

5 A. Yes.

6 Q. And I think I interrupted you and I apologize.
7 Explain to me why you believe that RAM 7 is an error.

8 A. Well, so, you know, one thing is a one and a
9 seven are somewhat similar. You can imagine if this was
10 being transcribed from a hand-drawn figure, that that
11 would be a mistake that could happen. But mainly by
12 comparison of the surrounding units between Figure 4a
13 and Figure 5a, the things on either side of that box are
14 the same, but for some reason, the number inside the box
15 is changed from RAM 1 to RAM 7.

16 The other thing is that RAM 7 appears in
17 Figure 5b in a completely different place, immediately
18 before RAM 8 within the DSP. There is no interpretation
19 that I could come up with why the other RAMs have
20 corresponding -- RAM 2, which appears in both figures,
21 is in the same place. There is no reason I could think
22 of why RAM 7 would suddenly be moved from downstream of
23 the separation connection in Figure 5a to the internal
24 of the DSP in Figure 5b.

25 Q. So the question I asked you before that -- I

1 appreciate that information -- was for you to review
2 Krokstad and tell me if one or both of the two methods
3 are disclosed.

4 MR. DAS: Objection, form. Objection, compound.

5 THE WITNESS: So I'm looking at the third
6 paragraph on native page 21. It starts, "The hearing
7 aid can easily be reprogrammed." This describes -- it
8 says, "Reprogramming is performed in that the random
9 access memory RAM 1 in the case or secondary section two
10 is connected via an interface IF of type RS-232 to a
11 computer, e.g. a personal computer which is connected to
12 an audiometer system."

13 BY MR. CRAIN:

14 Q. What do you understand that to be teaching?

15 A. That the -- to reprogram it -- to reprogram the
16 hearing aid, you connect an external computer to the
17 RS-232 interface and transfer data.

18 Q. So is this the method where the computer, via an
19 RS-232 connection in the case, transfers data into
20 RAM 1?

21 A. In both of the scenarios I mentioned, this is
22 part of it.

23 Q. Okay.

24 A. The data has to be transferred from the computer
25 to RAM 1 to the rest of the hearing aid.

1 Q. Right. I think you had said that one embodiment
2 might be where they're all connected at the same time,
3 the PC to the case to the hearing aid. And then I think
4 you said another one was, well, you could do it where PC
5 to the case, and then later in time, case to the hearing
6 aid. Did I understand that to be correct?

7 A. I did say that, yes.

8 Q. This text you're suggesting -- you're reading to
9 me here, pointing out to me, is that one or the other of
10 the two -- is that one or the other of the two
11 approaches?

12 A. I can't tell. He only talks about transferring
13 it to RAM 1 in this paragraph. He doesn't talk about
14 what happens to it after it's in RAM 1. It's inherent
15 that it doesn't stay in RAM 1, but has to get to the
16 actual hearing aid. He doesn't say whether it is
17 happening -- whether it could happen later. He doesn't
18 say in that paragraph. I don't know if it says it
19 elsewhere.

20 Q. In either situation, when a computer is
21 connected via the RS-232 interface to the case and
22 RAM 1, what does Krokstad tell us that is being
23 communicated from the computer to RAM 1?

24 A. He says it's being reprogrammed to suit altered
25 user conditions and changes in the hearing of the user

1 or the hearing of another user. So he's telling us that
2 what's being reprogrammed is the particular signal
3 processing functions that the hearing aid can perform.

4 Q. Would you look on native page 20.

5 A. Yes.

6 Q. Do you see the sentence midway through the
7 paragraph that starts on the top, that begins, "Each
8 individual set of filter coefficients"?

9 A. Yes.

10 Q. Take a moment, if you would, and read the rest
11 of that paragraph. As you do, it references RAM 7. My
12 question to you is going to be, which RAM 7 is that? Go
13 ahead and read the paragraph.

14 A. Yes.

15 Q. So is that RAM 7 referring to what we see in 5b,
16 according to your understanding, and not what we see in
17 Figure 5a?

18 A. Yes.

19 Q. Do you have any understanding of what he means
20 when he talks about a set of filter coefficients?

21 A. I think so.

22 Q. What do you understand that to mean?

23 A. Coefficients that control the behavior of a
24 digital filter.

25 Q. Would these be similar to parameters?

1 A. Yes.

2 Q. What do you understand a specific response
3 function for the hearing aid to be?

4 A. A complete specification of the response of the
5 hearing aid to different sound inputs.

6 Q. Do you understand Krokstad to be teaching us --
7 no matter which of the two connection methods may be
8 implemented -- that coefficients may be communicated
9 from the computer to the hearing aid?

10 A. He certainly -- I think he explicitly says
11 coefficients.

12 Q. Do you see where he talks about modifying any
13 response functions?

14 A. That would be the point of -- of having a
15 programmable hearing aid is to allow you flexibility in
16 the response functions.

17 Q. Well, remember when we were talking about Sudo,
18 how we had like Hall 1 function and Hall 2.

19 A. Yes.

20 Q. And we talked about a couple of different
21 approaches to those. But I think in neither one of the
22 two approaches in Sudo, the function was being modified.
23 It was either the same function, with different
24 coefficients; or two different functions, where one was
25 replacing the other. Do you recall that discussion? In

1 Sudo.

2 A. Yes. And in the second case, the function is
3 being modified.

4 Q. Well, I think we talked about how --

5 A. Oh, the function -- okay. You were drawing a
6 distinction between like a modification meaning a slight
7 change to the function. Right.

8 Q. Do you see an instance that teaches a
9 modification of any of the response functions -- I
10 believe it uses that term -- in Krokstad?

11 A. The only sensible interpretation of this is that
12 modifying the filter coefficients would be a part of
13 modifying the response function. The response function
14 includes the -- if you change the filter coefficients,
15 you're going to change the overall response function.
16 That's one way to change the overall response function.

17 Q. But does it change the algorithm?

18 A. Changing the filter coefficients does not change
19 the algorithm.

20 Q. Do you see any discussion in Krokstad where it
21 changes the algorithm for the function?

22 A. I don't know, but my understanding would be
23 there would be no reason to -- the most likely thing
24 would be to give the interface the ability to change all
25 the software -- all the data stored in the processor.

1 It would be -- you know, just -- it would be a strange
2 engineering decision to prevent yourself from
3 changing -- to limit -- to make it so that it was
4 limited to only changing the filter coefficients and not
5 the program.

6 Q. Well, this application was published in 1991.
7 So show me in Krokstad where it teaches or suggests
8 exactly what you just said.

9 MR. DAS: Objection, form.

10 THE WITNESS: I don't know if it does, but I'm
11 saying that it would be obvious to a person of ordinary
12 skill, that that would be the most simple way to
13 implement it.

14 BY MR. CRAIN:

15 Q. Would you like to take a moment to review
16 Krokstad to see if you can find such a suggestion?

17 A. No.

18 Q. Why not?

19 A. Because I don't think -- you know, I don't think
20 he does -- there is not going to be -- I don't expect to
21 find anything in there which is going to be, well, here
22 he's clearly talking about modifying the program.

23 Q. But he does talk about modifying coefficients;
24 doesn't he?

25 A. He talks about modifying the response function,

1 using the external programmer to change the response
2 function.

3 Q. Well, that's -- and changing the coefficients?

4 A. One way to do that would be to change the
5 coefficients.

6 Q. What is the other?

7 A. The other way would be to change the
8 coefficients and the program.

9 Q. Show me where it talks about changing the
10 program.

11 A. Well, as I said, when it says you're changing
12 the response function, that can be understood to be
13 referring to changing the program.

14 Q. Where are you looking?

15 A. "The hearing aid can easily be reprogrammed to
16 suit altered user conditions and changes in the hearing
17 of the user or the hearing of another user."

18 So he's talking about the ability of the -- the
19 ability to change the overall behavior of the device.
20 It's interesting that he uses the word "reprogrammed."

21 Q. We are talking about a hearing aid. Correct?

22 A. That's right.

23 MR. CRAIN: Let's go off the record.

24 THE VIDEOGRAPHER: We're going off the record.

25 The time is 5:08 p.m.

1 (Recess taken from 5:08 to 5:25.)

2 THE VIDEOGRAPHER: This is the beginning of
3 Media No. 5 in the deposition of Dr. Daniel Ellis. The
4 time is 5:25 p.m. We're back on the record.

5 BY MR. CRAIN:

6 Q. So, Dr. Ellis, is there any testimony that
7 you've given, either in the last session or earlier
8 today, that you would like to change or correct in any
9 way?

10 A. No.

11 Q. Did you have an opportunity to consult with
12 QSC's counsel during the break?

13 A. I spoke to them.

14 Q. Did you consult or confer with QSC's counsel
15 regarding the substance of the testimony that you have
16 given already in this deposition?

17 A. No.

18 Q. Did you consult or confer with QSC's counsel
19 regarding the substance of any testimony anticipated to
20 be given?

21 A. No.

22 Q. Including any redirect testimony?

23 A. No.

24 Q. During the break, did counsel for QSC suggest to
25 you the manner in which any questions should be answered?

1 A. No.

2 MR. CRAIN: At this time, we tender the witness.

3 MR. DAS: We'll take a short break.

4 MR. CRAIN: Okay.

5 THE VIDEOGRAPHER: We're going off the record.

6 The time is 5:26 p.m.

7 (Recess taken from 5:26 to 5:44.)

8 THE VIDEOGRAPHER: We're back on the record at
9 5:44 p.m.

10

11 E X A M I N A T I O N

12 BY MR. DAS:

13 Q. Dr. Ellis, could you turn to Exhibit 14.

14 A. Okay.

15 Q. Could you remind us what Exhibit 14 is.

16 A. Exhibit 14 is the '544 patent.

17 Q. That's the issue of the petition on which you're
18 being deposed. Correct?

19 A. Yes.

20 Q. Now, turn to the second to last page of that and
21 look at claim one, and let me know when you've finished
22 reviewing it.

23 A. Okay.

24 Q. So claim one is in column eight. If you look at
25 the paragraph that's column eight, around line 35 -- do

1 you see that?

2 A. Yes.

3 Q. It says, "A programming signal input port for
4 receiving at least one programming signal from the
5 external programmer, the external programmer being
6 removably connectable to the programming input signal
7 port for modifying at least one of a signal processing
8 function and a signal processing function parameter
9 defined in said signal processing circuit." Did I read
10 that correctly?

11 MR. CRAIN: Object to form.

12 MR. DAS: You can answer.

13 THE WITNESS: No, you transposed two words.

14 BY MR. DAS:

15 Q. Which words?

16 A. You said -- I think you said "input signal port"
17 when you meant -- when it says "signal input port."

18 Q. I apologize. But you see that paragraph.
19 Correct?

20 A. Yes.

21 Q. How would a person of ordinary skill in the art
22 of the '544 patent understand the clause, "modifying at
23 least one of a signal processing function," as used in
24 this claim one?

25 MR. CRAIN: Object to form.

1 THE WITNESS: It means changing the function
2 that's being performed by the signal processing circuit.
3 BY MR. DAS:

4 Q. Which means?

5 A. Which means changing -- that is, substituting a
6 different function.

7 Q. So would that necessarily require actually
8 changing the existing algorithm off a function that
9 exists on the DSP or could it be just replacing it with
10 an entirely new function?

11 MR. CRAIN: Object to form.

12 THE WITNESS: My understanding is that it would
13 only mean replacing the entire code. It would be very
14 difficult in practice to -- I mean, it would be fiddly
15 in practice to have an algorithm in memory where you
16 could go in and change just a few parameters. You would
17 already have to have the ability to access the memory.
18 So it would be much simpler and more -- I guess, more
19 straightforward to just go ahead and rewrite the entire
20 piece of program code. I can't think of any reason why
21 you would want to modify only part of an existing
22 program code. You already -- you know, the programmer
23 already knows what the programming code is, so -- and
24 it's already writing to memory. So you just go in and
25 write the whole thing. That would be the only way I

1 could imagine it being done.

2 BY MR. DAS:

3 Q. Now, during your cross-examination, you were
4 asked a number of questions about Exhibit 16, which is
5 Sudo.

6 A. Um-hmm.

7 Q. One of the questions -- again, I may not get the
8 exact wording correct -- was something along the lines
9 of why would a person of ordinary skill in the art of
10 the '544 patent not understand Interface 19 as being a
11 buffer circuit. Do you remember being asked a question
12 along those lines?

13 A. Yes.

14 Q. Now, what is your understanding of a person of
15 ordinary skill in the art of the '544 patent?

16 MR. CRAIN: Object to form.

17 THE WITNESS: This is covered in my declaration.

18 BY MR. DAS:

19 Q. And that's Exhibit 13?

20 A. Exhibit 13. In Section III, paragraph seven,
21 eight, and nine, I explain what I mean by a level of
22 ordinary skill in the art -- a person of ordinary skill
23 in the art.

24 Q. And in paragraph eight of your declaration, it
25 says, "In my opinion, a person of ordinary skill in the

1 art for this '544 patent would have had a master's
2 degree in electrical or electronics engineering and
3 master's-level course work, along with practical
4 experience designing and testing electronic amplifiers
5 and the associated signal processing functions." Do you
6 see that?

7 A. Yes.

8 MR. CRAIN: Object to form.

9 BY MR. DAS:

10 Q. And in your opinion, is that the only definition
11 of a person of ordinary skill in the art?

12 MR. CRAIN: Objection to form. Beyond the
13 scope.

14 THE WITNESS: No. My intention in making that
15 definition was to provide an example of the kind of
16 person I was thinking about when I was making statements
17 about obviousness. The deeper thing I was trying to get
18 at was the idea that someone who has training in
19 electrical engineering, like a bachelor's degree; and
20 who has gone on to do some further study, indicating
21 that they have, you know, correctly understood the
22 bachelor's engineering; and then they're working in the
23 area that's relevant to the patent, so that, for
24 instance, if they have this practical experience. But
25 there could be many other people who I would regard as a

1 person of ordinary skill in the art for this patent.

2 BY MR. DAS:

3 Q. So can you give us some other examples of people
4 who would be persons of ordinary skill in the art for
5 this '544 patent.

6 MR. CRAIN: Object to form, beyond the scope.

7 THE WITNESS: So this is about, you know, basic
8 electrical engineering topics, and then the use of
9 digital signal processors in a system. So anyone who
10 had that kind -- a good grasp of those topics. So
11 someone with a Ph.D. in electrical engineering and who
12 had -- who had covered signal processing topics would be
13 someone I would consider a person of ordinary skill.
14 Someone who had a master's degree and had worked with
15 digital signal processing would meet that -- would meet
16 my definition.

17 BY MR. DAS:

18 Q. Why did you not --

19 A. Sorry. Would not meet my definition. Would
20 also be the kind of person that I'm thinking about as
21 corresponding to a person of ordinary skill.

22 Q. Why did you not include those other examples in
23 paragraph eight?

24 MR. CRAIN: Object to form. Beyond the scope.

25 THE WITNESS: I was -- I was just trying to give

1 a sufficient example of the kind of skill that I was --
2 the kind of person I was talking about. I was not
3 trying to indicate the -- you know, the necessary -- the
4 conditions that could not be omitted.

5 BY MR. DAS:

6 Q. So one of the persons of ordinary skill, I
7 thought you said, was a person with a Ph.D. in
8 electrical engineering and who had covered signal
9 processing topics. Correct?

10 A. Yes.

11 MR. CRAIN: Object to form, leading. Object to
12 form, beyond the scope.

13 BY MR. DAS:

14 Q. Would you consider such a person to be a person
15 of ordinary skill in the art of the '542 patent?

16 A. Yes.

17 MR. CRAIN: Object to form. This is beyond the
18 scope. This entire line is beyond the scope.

19 THE WITNESS: Yes.

20 BY MR. DAS:

21 Q. Okay. You also identified a person of ordinary
22 skill in the art could be someone with a master's degree
23 in electrical engineering who had worked with digital
24 signal processing would be another person of ordinary
25 skill in the art of the '544 patent. Correct?

1 A. Yes.

2 MR. CRAIN: Object to form, leading. Object to
3 form, beyond the scope.

4 You can't lead your own witness, KM. You know
5 that.

6 MR. DAS: I'm not leading my witness.

7 MR. CRAIN: Read the transcript. You did.

8 MR. DAS: No.

9 BY MR. DAS:

10 Q. Would you consider that person to also be a
11 person of ordinary skill in the art in the '542 patent?

12 A. Yes.

13 MR. CRAIN: Object to form, beyond the scope.

14 MR. DAS: We have no further questions at this
15 time.

16 MR. CRAIN: Go off the record.

17 THE VIDEOGRAPHER: We're going off the record.
18 The time is 5:53 p.m.

19 (Recess taken from 5:53 to 5:56.)

20 THE VIDEOGRAPHER: We're back on the record.
21 The time is 5:56 p.m.

22

23 E X A M I N A T I O N

24 BY MR. CRAIN:

25 Q. Dr. Ellis, just a couple more questions. Thank

1 you.

2 After I finished my cross-examination, before
3 Mr. Das asked you any questions, you remember we took a
4 break.

5 A. Um-hmm.

6 Q. Did you have the opportunity to consult with
7 your counsel during that particular break?

8 A. Yes.

9 Q. Did you speak -- let me ask this again.

10 Did you consult or confer with QSC's counsel
11 regarding the substance of the testimony that you would
12 give during your redirect examination?

13 MR. DAS: Again, I would instruct you, if you
14 can answer that question without getting into privileged
15 communications, you can answer.

16 MR. CRAIN: What's the privilege?

17 MR. DAS: The privilege is that --

18 MR. CRAIN: So it's established you did talk
19 with him about the redirect testimony?

20 MR. DAS: It's attorney-client privilege what we
21 discuss with him.

22 BY MR. CRAIN:

23 Q. So can you answer the question. Did you talk
24 with your attorneys -- let me start again.

25 Did you talk with QSC's attorneys before your

1 redirect examination about your redirect examination?

2 A. And what's the privilege?

3 MR. DAS: Well, again, do you need to consult on
4 this to answer the question?

5 BY MR. CRAIN:

6 Q. I want to know what you talked about with regard
7 to the redirect examination.

8 MR. DAS: I will instruct you not to talk about
9 what we talked about during that break. Okay?

10 BY MR. CRAIN:

11 Q. Did you talk about the substance of any
12 testimony that you would give on redirect examination?

13 MR. DAS: I object, privilege, and I instruct
14 you not to answer that question.

15 BY MR. CRAIN:

16 Q. Can you not answer that question because it
17 would cause you to reveal a communication between
18 yourself and QSC's counsel? That's a yes or no.

19 A. It's an interesting thing, because at some
20 point, you know, you're asking me -- it's doing the same
21 thing. It's still revealing privilege.

22 Q. I'm not asking you for the substance of it. I'm
23 not asking you for what you talked about. That would be
24 a whole other area. I'm asking, did you speak with
25 QSC's counsel before your redirect testimony about the

1 substance of your redirect testimony?

2 MR. DAS: And I instruct you not to answer that
3 on the basis of privilege.

4 MR. CRAIN: So you won't even let him tell me
5 whether he did or didn't.

6 MR. DAS: You can ask him if he spoke to us.

7 MR. CRAIN: About the substance of the testimony
8 he would give. I'm not asking for what the substance
9 was. That's not privileged.

10 MR. DAS: It is privileged.

11 MR. CRAIN: What's the basis?

12 MR. DAS: The basis of the privilege is that it
13 goes into attorney-client communications, what the
14 substance of the communication is.

15 MR. CRAIN: I didn't ask for the substance.

16 MR. DAS: Yes. You're asking him about whether
17 he spoke about the substance of his redirect testimony.
18 That is going directly to the substance of the
19 communication.

20 MR. CRAIN: Absolutely not. I'll absolutely
21 take that to the board.

22 MR. DAS: Yes.

23 BY MR. CRAIN:

24 Q. So you're not going to answer the question that
25 is clearly in the Trial Practice Guide, Appendix D,

1 Section 6, about whether or not you did or did not
2 consult with QSC's counsel regarding the substance of
3 the testimony that you would give on redirect
4 examination. You're not going to answer that. Right?

5 MR. DAS: I'm going to instruct you not to
6 answer that question on the basis of privilege.

7 THE WITNESS: I'm following the advice of my
8 counsel.

9 BY MR. CRAIN:

10 Q. Did you consult with QSC's counsel or confer
11 with QSC's counsel, prior to your giving the redirect
12 examination, after the conclusion of my cross-
13 examination, regarding the substance of the testimony
14 that was anticipated to be given during the redirect
15 portion of your testimony?

16 MR. DAS: I will instruct you not to answer that
17 question on the basis of privilege.

18 THE WITNESS: I'm taking the advice of my
19 counsel.

20 BY MR. CRAIN:

21 Q. So you will not even tell me whether or not you
22 did or didn't, irrespective of whatever the substance
23 was. Is that correct?

24 MR. DAS: Again, I would instruct you not to
25 answer that question on the basis of privilege.

1 THE WITNESS: I'm taking my counsel's advice.

2 BY MR. CRAIN:

3 Q. During the break, after the conclusion of my
4 cross-examination, prior to the commencement of redirect
5 by Mr. Das, did QSC's counsel suggest to you the manner
6 in which you should answer any questions that would be
7 posed to you on redirect examination?

8 MR. DAS: Again, I would instruct you not to
9 answer that question on the basis of privilege.

10 MR. CRAIN: You've got to be kidding me. Golly,
11 KM.

12 BY MR. CRAIN:

13 Q. Can you answer?

14 MR. DAS: I would instruct you not to answer
15 that on the basis of privilege.

16 THE WITNESS: I'm taking the advice of my
17 counsel.

18 MR. CRAIN: Wow.

19 BY MR. CRAIN:

20 Q. I've asked you this question similar times, or
21 these questions, about consulting with QSC's attorneys,
22 after breaks, today and yesterday; haven't I?

23 A. Yes.

24 Q. This is the first time that you have refused to
25 answer those questions based on the advice of counsel;

1 is it not?

2 A. Yes.

3 MR. CRAIN: We are concluded.

4 THE VIDEOGRAPHER: This is the end of Media
5 No. 5 in the deposition of Dr. Daniel Ellis. The time
6 is 6:02 p.m. We are now off the record.

7 (Deposition adjourned at 6:02 p.m.)

8 (Signature reserved.)

9

10

11

12

13

14

15

16

17

18

19

20

21

22

23

24

25

1 S I G N A T U R E

2

3 I declare under penalty of perjury under the laws
4 of the State of Washington that I have read my within
5 deposition, and the same is true and accurate, save and
6 except for changes and/or corrections, if any, as
7 indicated by me on the CHANGE SHEET flyleaf page hereof.

8 Signed in _____, Washington,
9 this _____ day of _____ 20____.

10

11

12

13

DANIEL P.W. ELLIS, Ph.D.

14

Taken: Friday, June 27, 2014

15

16

17

18

19

20

21

22

23

24 Re: QSC Audio vs. Crest Audio
Cause No.: IPR2014-00131
25 Donald W. McKay, RMR, CRR, CCR

C E R T I F I C A T E

STATE OF WASHINGTON)
COUNTY OF KING) ss

I, the undersigned Washington Certified Court Reporter, hereby certify:

That the foregoing deposition upon oral examination of the witness named herein was taken stenographically before me and transcribed under my direction;

That the witness was duly sworn by me pursuant to RCW 5.28.010 to testify truthfully;

That the transcript of the deposition is a full, true and correct transcript to the best of my ability;

That I am neither an attorney for, nor a relative or employee of any of the parties to the action or any attorney or counsel employed by the parties hereto, nor financially interested in its outcome.

I further certify that in accordance with CR 30(e), the witness was given the opportunity to examine, read, and sign the deposition, within 30 days upon its completion and submission, unless waiver of signature was indicated in the record.



Donald W. McKay, RMR, CRR
Washington Certified Court Reporter No. 3237
License effective until: 07/02/2014

WITNESS NAME: Daniel P.W. Ellis, Ph.D., 06/27/2014

PAGE	LINE	CHANGE	REASON
------	------	--------	--------

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

I, Daniel P.W. Ellis, Ph.D., have read the foregoing deposition and hereby affix my signature that same is true and correct, except as noted above.

Daniel P.W. Ellis, Ph.D.

Sworn to and Subscribed before me

_____, Notary Public.

This _____ day of _____, 20____.

My Commission Expires:

QSC AUDIO PRODUCTS, INC. vs. CREST AUDIO, INC.

Daniel P.W. Ellis, Ph.D. on 06/27/2014

Index: \$2,500..1994

	23	221:18	63:14	64:8	172:14
\$					
	10:45	62:20,	66:6, 12		173:13
\$2,500	26:23	21	67:24		175:4, 12,
			70:16		20, 22
\$250	24:23	11 11:22, 25	72:14, 20		177:11, 25
		12:4, 7, 12	77:21		178:12
\$5,000	26:22		78:14		179:13
\$50	126:21	11:09 62:21,	104:16, 23		181:8
		24	106:11		182:5, 12,
1		12 19:9, 14,	119:14, 19		23 193:15
		20, 21, 23	128:3, 15		229:10
1	6:5	62:19	165:4		
	142:17, 25	136:12		1960s	43:4, 8
	154:13	207:19, 24	16 68:5	1970s	45:4
	157:12, 14,	208:3	83:21, 24		48:12
	21 158:1	210:20, 23	84:1, 5, 10,		50:10
	162:17		11, 15, 18,		117:13, 15
	168:22, 24	12:23 105:9,	23 97:5		
	185:19	10	141:9, 12,	1972	45:23
	189:20, 22	13 19:10, 14	17 229:4	1980	50:19
	191:9, 12,	20:10			
	16, 20	183:21, 24	17 163:4	1980s	30:17
	192:1, 14	186:6, 13	164:9, 20		117:13, 16
	194:2, 17,	187:10	165:2	1984	181:20
	19 195:15,	188:2, 9	168:1	1985	126:18
	25 196:17,	207:20, 24	175:6, 14		
	22 197:13	229:19, 20	176:8, 10,	1990	96:24
	198:8, 11,		18 177:2,		135:20
	13, 16, 20	14 20:19, 24	7, 23 178:5	1991	153:17
	199:7,	156:4	204:12, 15,		157:10
	201:12, 13,	226:13, 15,	19 205:4		223:6
	14, 19, 22	16		1992	
	202:8, 9, 25	15 9:10	18 154:4		157:11, 23
	203:7	50:22, 24	209:3		159:7, 17,
	216:19	51:10	19 162:17,		166:23
	217:15	52:23	22 163:14		178:10
	218:9, 20,	53:1, 11	164:6		
	25 219:13,	56:6 58:13	165:9, 12	1994	95:2
	14, 15, 22,	61:1, 3	168:1		206:3
			169:21		

1995	89:1	177:12, 25	2:18	5, 652, 544
1:18		178:13	134:22, 25	19:22 21:3
105:10, 12		181:8		5, 822, 775
		182:5, 12,	3	141:14
	2	19, 24		
		191:6	3 134:24	50s 89:10
2 62:23		193:4	165:10, 13	542 16:9
134:20		196:23	168:2	25:6, 12
142:25		202:10	183:14	26:4, 11, 14
157:9, 15,		208:19	189:9, 21,	232:15
21 169:23		220:4	23 210:21	233:11
171:6, 16	2000 89:2		34 203:16	544 16:9
172:15	2013 20:3,		35 226:25	17:13
174:3, 13	16 21:9		3:44	18:11
178:1	25:7 27:10		183:15, 16	20:14
191:9, 16,	2014 6:1, 9		3:55	21:24 23:2
20 192:2	21 191:17		183:16, 19	24:22
193:6	192:2			25:3, 5, 12,
194:2	218:6		4	15, 18
196:22				26:4, 11,
197:14	22 189:5		4 168:2	15, 25
198:10, 14	193:1		183:18	27:7, 13, 14
199:7, 12,	23 208:3		4096 68:5	32:21
201:13, 15,	24 208:3		45 62:11	34:16
20, 22	25 128:17		456 7:18	35:3, 9
202:14, 25	208:5		4:30 18:13	38:1 39:3,
207:14	26 33:10		4a 216:21	8, 14, 19
214:2	208:5, 8		217:12	40:4
216:22	210:23			155:23
217:20	26(b)(5)(ii)		5	156:1, 18
221:18	28:3			175:4
20 25:6, 11,	27 6:1, 9		5 210:21	187:13
16 26:7, 10	2:03		216:17	206:7
110:14	134:21, 22		225:3	207:5
117:25			239:5	211:18
168:1				226:16
175:14				227:22
				229:10, 15

QSC AUDIO PRODUCTS, INC. vs. CREST AUDIO, INC.

Daniel P.W. Ellis, Ph.D. on 06/27/2014

Index: 55..accumulate

230:1	5b 217:17,	125:7	absolutely
231:5	24 220:15	131:19	152:24
232:25		8:30 18:13	170:8
55 59:3, 7, 8	<u>6</u>	8B 7:18	173:1
61:22	6 104:7		190:10
56 61:1, 4	237:1	<u>9</u>	236:20
56000 56:11	60s 89:10	90s 88:25	abstract
57:17	68-pin 54:8	131:19	82:25 83:8
63:23	65:6	9:00 6:2, 10	117:20
57 74:4, 6,	6:02 239:6,	9:37 29:10,	149:7
10, 14, 19	7	11	abstraction
75:22, 24		9:44 29:11,	111:21
58 66:25	<u>7</u>	13	164:4, 11
67:3 75:25	7 207:14		173:24
59 66:9, 11,	214:2, 7, 9	<u>A</u>	absurd 164:3
14 68:13	216:7, 8,	A-to-d 190:3	academia
5:08 224:25	10, 19	a.m. 6:2,	114:8
225:1	217:7, 15,	29:10, 13	academic
5:25 225:1,	16, 22	62:20, 24	114:12
4	220:11, 12,	AB 108:24	access 53:22
5:26 226:6,	15	ability	69:5
7	70s 49:22	53:22	113:22
5:44 226:7,	122:6, 11	101:15	155:9
9	75 123:20	168:14	179:3
5:53		177:19, 20	189:16
233:18, 19	<u>8</u>	222:24	218:9
5:56	8 67:3, 5	224:18, 19	228:17
233:19, 21	217:18	228:17	accommodate
5a 207:8	80s 88:25	above-entitled	9:12
214:3	106:19	7:2	accomplish
216:17, 18	109:7	absence	129:19
217:4, 13,	122:14	196:8	accomplished
23 220:17	123:19, 20		127:14
			accumulate

48:15	46:16	affinity	13 216:9
accurate	address 7:17	51:6	218:7, 16,
102:19	8:25 10:22	afford	25 219:3,
achieve	137:4, 7, 8,	133:3, 12	6, 16
179:13	9, 13, 15, 16	affordable	221:3, 5, 9,
activities	138:20	108:9	224:15, 21
23:10, 13	140:16	afforded	Aidi 203:13
188:17	141:1	120:23	aids
activity	adequate	agree 158:5	132:11, 12,
24:25	131:22	164:6	23 133:1
105:6	adjourned	211:13	206:11, 23
actual 23:2	239:7	214:14	akin 88:10
45:25	adjustment	agreement	117:4
69:13 72:6	24:24	21:12, 14,	algorithm
81:25	advance	17	69:12, 13
111:7	72:17	ahead 7:16	76:14
112:16	119:24	9:15, 20	78:23
134:14	128:21	19:5, 14, 19	193:22
168:11	advanced	20:17	198:4
219:16	54:4, 6	41:13, 14	200:17, 19
adapter 67:6	advances	149:25	201:25
add 131:4	120:6, 8,	209:15	202:16
added 55:2	11, 16	220:13	222:17, 19,
addition	128:19	228:19	21 228:8,
46:23	advantages	aid 133:5,	15
55:9, 11	120:15	15, 18, 25	algorithms
additional	advent 119:8	134:4, 6, 9,	46:15
25:8 48:15	advice	12, 14	121:11
50:18	237:7, 18	205:22, 23	198:4
59:10	238:1, 16,	206:1, 3, 18	199:24
72:14	25	207:12, 16	200:3, 4, 7
120:23	AES 35:22,	210:10,	203:2, 7, 11
171:2	24 36:6, 21	212:11, 12,	all-day 26:3
additions	37:4, 9, 25	14,	allegiance
		214:15, 20,	57:6, 8
		25 215:4,	

QSC AUDIO PRODUCTS, INC. vs. CREST AUDIO, INC.

Daniel P.W. Ellis, Ph.D. on 06/27/2014 Index: allowed..approximation

allowed	168:10	217:6	205:5
17:22 28:2		227:18	223:6
29:4 48:18	analogies		
182:4	165:6	apparently	applications
		73:19	43:1, 13,
allowing	analogous		14, 19
83:10	113:14	appeared	44:20 45:2
	116:25	89:1	46:17
alongside	analogy	appears	110:12
58:20	55:17	12:3, 5	121:23,
alpha 203:17	165:7	21:2 66:14	122:24
		70:21	127:15
altered	analysis	80:20, 21	132:9, 10,
219:24	135:19	96:24	19 134:13
224:16	ancient 89:8	165:3	
altogether	and/or 134:2	187:11	applies 10:7
196:9		204:25	apply 29:20
amazing	Andrew 6:16	205:1	178:5
109:4	7:15	210:19	211:24
amount 16:7	answering	212:10	applying
53:18 90:6	24:8	214:15	31:23
129:17	answers 8:4	217:16, 20	approach
	20:12		142:8
amplifier	anticipated	Appendix	143:22
108:24	63:8	236:25	
amplifiers	105:25	applicable	approached
230:4	135:10	9:18 29:19	99:8, 25
amplify	225:19	application	approaches
58:24	237:14	45:13	219:11
		51:16	221:21, 22
analog 43:16	anticipating	57:23	
125:8, 10,	106:23	63:24	approximately
17 126:1,		122:2	15:23
13, 20	anymore	123:7	25:10, 22
127:13, 15	202:3	124:15	26:7
189:3, 7, 13	Apartment	125:22	141:19
206:24	7:18	133:1, 18	approximation
	apologize	134:4	16:12, 13
analog-to-	91:25	204:21	
digital			

AR0	70:4	5	205:25	attention
architecture		arrive	assembled	96:25
46:1 49:23		146:12, 14	93:12	157:7
140:11, 15,		arrow 207:15	assembling	171:12
18 141:7		213:13	93:14	attorney
143:17		art 40:5, 9,	assembly	21:8 27:15
144:2, 21,		16, 19, 23	67:9	28:4
24 156:6,		41:3	assess 29:19	attorney-
9, 19		106:12	assessment	client
architectures		117:6	156:13	234:20
146:12		118:1	assign	236:13
154:3		119:15, 19	109:12	attorneys
155:8		124:8	assigned	9:24
159:13, 21		153:11	162:1	12:22, 23
arcs 111:10		175:4, 12	assignee	13:21, 23
area 48:10		206:3, 7	155:14, 19	15:15
96:2		227:21	assume 53:23	16:25
103:14		229:9, 15,	82:1, 3	17:12, 17,
107:6		22, 23	162:8	20 18:6,
139:13		230:1, 11	assumed	10, 12, 21
214:2		231:1, 4	77:10	21:16
230:23		232:15, 22,	assumption	22:5, 24
235:24		25 233:11	31:19, 21	23:19
areas 39:12		article	155:4	24:15 26:3
76:11		150:4	assumptions	28:12, 20
125:22		151:12, 14	31:12, 15,	29:16
argumentative		artifact	24 32:3, 4,	30:20
173:21		42:18, 20	6, 10 33:6	31:24
174:16		ascertain	asynchronous	32:10 39:7
arithmetic		96:23	136:9	40:1 41:9
44:15		aspect	attempt	135:4, 6, 9
203:20		121:10	37:18	184:22
arrange 72:4		162:7	attorneys'	234:24, 25
167:14		aspects	24:4	238:21
array 110:2,		193:22		

QSC AUDIO PRODUCTS, INC. vs. CREST AUDIO, INC.

Daniel P.W. Ellis, Ph.D. on 06/27/2014

Index: attribute..battery

attribute	authors	103:17	56:18
127:25	37:22	105:11	57:15
audible	automatically	109:24	66:23
147:10	90:1	110:4	72:20 76:6
		118:24	96:22
audience	automobiles	119:17	132:1
55:4	57:2	124:23	151:24
audio 6:7,	avoid 147:13	128:15	152:5
17, 19, 21		129:25	155:18
21:12, 23	avoiding	133:11	156:13
30:16	66:4	134:25	159:11
35:11	aware 34:8	138:21	160:5
36:17	73:13	157:7	177:24
37:10	120:2	183:19	188:14, 15
38:16	122:1	190:8	206:16, 17
39:6, 20	143:7	191:5	216:21
43:10	awesome	192:25	238:25
102:9	62:16	194:17	
120:20, 21		202:8, 9	basic 108:4
121:23		207:21	116:20
122:2, 19	B	208:11, 21	231:7
123:7	B0 68:25	225:4	basically
124:15	B1 68:24	226:8	108:14
125:3	B2 68:24	233:20	110:13
126:13			111:9
132:20, 21	bachelor's	backed	113:7, 9
147:2, 9	230:19, 22	174:12	120:11
195:25	back 10:22	backup	137:18
196:12, 16	14:1 29:12	214:10	
audiometer	30:22	bad 14:17	basis 13:8, 9
218:12	47:23	149:19	15:5 33:4
	56:19		119:22
audiometry	58:23	bake 170:20	155:17
209:20	59:18	bandwidth	236:3, 11,
	62:24	90:9 91:2	12 237:6,
author	70:18 76:3	base 76:21	17, 25
38:20, 22	82:15 90:3	based 10:25	238:9, 15
184:1	96:7, 19	31:22 53:9	battery
			134:1

QSC AUDIO PRODUCTS, INC. vs. CREST AUDIO, INC.

Daniel P.W. Ellis, Ph.D. on 06/27/2014

Index: BBC..breadboard

BBC 30:17	biggest	144:18	170:13
38:16, 20,	128:21	148:1	boundary
22, 23	binary 70:6	blocks 69:2	125:25
40:10	81:25	79:23	198:18, 20
BBN 45:22	137:8	165:19, 24	213:2, 11
begin 43:2	bit 47:1	171:14	box 45:22
beginning	48:8 49:10	blown 111:13	98:11
6:5 62:22	84:11 87:7	board 29:5	142:21, 23
120:19, 20	129:14	53:22 58:1	143:17
134:23	138:4	63:24	144:2
183:17	139:13	64:5, 6, 9,	147:15
225:2	186:10	19, 23	148:2, 3
begins	215:6	110:8	158:22
201:25	bits 70:7	161:23	162:17
211:1, 2	83:18	169:17	163:20
220:7	84:24	171:4	169:15, 22
behalf 6:19,	88:4, 5	180:5	172:14, 22
20	140:8	183:7	173:2, 11
behavior	black 60:4,	236:21	174:2
220:23	12	boards	182:24
224:19	block 67:25	170:25	195:3
belief 15:1	68:4, 8, 18,	171:1	207:9, 13,
122:12	24, 25	180:7, 8	14 212:15
206:2	70:15 71:6	boil 156:12	217:13, 14
benchmark	73:8 74:1,	Bolt 45:22	boxes 68:22
178:7	10 76:7, 19	bottleneck	98:12
bent 122:17	78:9, 10	95:18	111:13
Beranek	79:22, 25	bottom 58:10	169:4, 16
45:22	80:18	59:19 67:8	171:11
better-	83:20	68:23 75:8	brand 51:4
performing	96:22	111:19	57:6, 7
54:25	104:9	191:14	brands
big 56:15	107:2	200:24	123:14
82:4 203:3	111:18	boundaries	breadboard
	140:20, 24	125:21	195:11
	142:17		

QSC AUDIO PRODUCTS, INC. vs. CREST AUDIO, INC.

Daniel P.W. Ellis, Ph.D. on 06/27/2014

Index: break..bytes

break 9:11,	broken	170:10	175:6, 14
21 25:16	207:13	180:1	176:4, 8,
28:25	212:8	built 45:22	10, 17, 18,
29:8, 16,	213:13	167:24	21 177:2,
18, 21	214:2, 6	168:5	7, 23
62:17	216:22	195:12	178:5, 15
63:1, 11	budget	bump 113:2	179:3, 20,
105:16, 20,	133:19	bunch 58:8	23 180:7,
24 106:2	buffer	70:3 85:6	20 181:18
107:1	93:17, 19,	93:16	182:3, 4
135:4, 12	22 96:8, 9,	98:20	buses 81:23
181:24	13, 15	111:13	82:18
183:11	154:4, 8	112:22	83:22
184:23	175:5, 12,	137:14	84:10, 14
188:25	23 229:11	burden	86:24
225:12, 24	buffers	117:18	87:22
226:3	70:3, 11	bus 80:21,	88:11
234:4, 7	build 91:4	22 81:1, 4,	97:17
235:9	95:9	11 82:2, 3,	181:19
238:3	107:24	5, 14 83:6,	business
breakdown	130:22	8, 14, 17,	99:16
27:4	132:1, 4	22, 24	190:2
breaking	135:17	84:5, 9, 12,	button
27:2	143:18	21 86:8, 21	196:21
breaks	144:2	97:9, 10, 24	197:14
238:22	157:13	98:3, 4	198:10, 14
bring 18:25	160:16, 18	137:7	199:13
19:3, 7	161:12, 17	140:21	202:9
bringing	165:20	163:4	buy 89:4
40:15	170:11, 16,	164:9, 10,	93:12
broad 33:10	25 180:2	14, 17, 18,	126:18, 20
51:16 78:4	182:15	20, 21, 23,	190:19
broader	building	24, 25	byte 138:3,
43:13, 14,	46:21	165:2, 3,	13, 21
17	48:10	13, 14	bytes 137:22
	54:17	168:1, 2	

	113:17	carries	101:22
C	117:24	81:11	caveat 9:16
	125:1	carry 81:2, 4	cease 196:5
C10 129:7, 9	138:19	92:5 157:4	cell 67:12
C25 106:9	140:10	case 6:8	75:9
129:7, 11,	calling	19:22	center 68:3
16 130:7	61:18	21:13	203:17
cable 92:2,	139:14	23:25 65:5	central
4, 7, 8	141:17	78:1 80:10	44:11, 14
CAD 117:24	calls 143:8	84:23 98:9	Centronics
calculating	153:7	105:3	92:20
43:25	164:24	137:8	cetera 55:7
44:24	191:9	166:23	149:12, 15
call 29:5	candidates	171:7	change 53:4
48:19	169:6	183:9	67:17, 18
58:11	capabilities	186:17	79:2 80:7
61:19, 20	55:2	190:5, 23	90:21
79:6 85:22	capability	201:19	124:6
86:13	77:1, 2	207:17	143:19
102:15, 17	capacity	212:15, 18	144:3
104:12	82:10 95:1	214:16, 22	145:2
111:4	128:5	215:23	146:4, 15
112:8	caption	218:9, 19	166:17
140:7	66:17	219:3, 5, 21	167:1, 2, 10
153:4, 8	card 180:2	222:2	174:2
159:25	195:10, 20,	cases 64:22,	184:20
164:14	21	23 71:10	215:4
194:12	cards 178:16	83:21 91:3	222:7, 14,
198:22	care 94:7	94:13	15, 16, 17,
203:18	137:19	198:1	18, 24
205:10	carefully	catch 140:22	224:1, 4, 7,
called 7:1	171:11	caution	19 225:8
68:24	carried 82:1	23:16	228:16
79:9, 11	168:7	24:6, 13	changed
85:23 96:3		34:17 99:9	124:9
112:2		100:21	

QSC AUDIO PRODUCTS, INC. vs. CREST AUDIO, INC.

Daniel P.W. Ellis, Ph.D. on 06/27/2014

Index: changing..choice

202:2	54:5, 6, 17	121:20	175:6, 13
217:15	56:10, 23	128:7	176:3, 5
changing	57:22, 25	130:14	180:2, 4, 6
143:16	58:6 60:7	131:4, 6, 7,	195:10
144:1, 14	63:19	11, 12, 24	chips 49:8
146:6	65:5, 13, 23	132:2	50:15, 16
171:9	66:18, 19,	133:3, 13,	51:3 54:25
222:18	22, 23	21 134:15	56:14 58:5
223:3, 4	67:7, 18,	136:18	65:10 66:2
224:3, 9,	20, 24	137:4	93:12
11, 13	68:2, 12, 15	138:5, 6, 10	107:9, 18
228:1, 5, 8	69:21	143:1, 4, 18	109:9
characteristic	71:25	145:2, 4, 9	116:13, 16
s 90:20	72:3, 7	153:12	118:20
characterizati	74:15, 17,	157:10, 13,	119:8
on 214:17	20, 23	16, 23	120:4, 14,
characterizing	75:18, 19	158:2, 4, 24	16, 19
86:21	82:25	159:1, 4	121:21
cheap 206:21	97:12	160:3	128:9
cheaper	102:17	161:8, 13,	130:18
43:12	104:10, 22	18, 21	132:21, 24
47:10	105:5	162:3	136:6, 8
71:18	107:20	167:25	137:6
126:9, 11,	108:7, 15	168:6, 7,	143:5, 15
13	109:17, 19	11, 12, 14,	153:22
cheapest	111:4, 7	17, 19	158:2, 6,
71:15	112:17, 23	169:2, 7, 8,	16, 21
check 14:24	113:6, 8,	9, 12, 14,	159:7, 11,
checked	11, 12, 17	15, 17	15, 18, 23
73:16	115:20, 24	170:1, 4, 5,	160:1, 5,
chemistry	116:1, 9, 10	10, 11, 15,	18, 19, 21,
54:6	117:7, 9, 11	18, 20, 21,	23 161:9
chip 48:19,	118:1, 6,	25 171:1,	162:11, 15
23 49:12	10, 17, 18,	7, 14, 18,	166:18
	20 119:3,	21, 23, 25	171:25
	9, 25	172:4, 7, 9	174:7, 11
	120:11, 17,	173:12, 15,	choice 92:17
	18, 24	16 174:14	

choices	155:20	clever	113:2	5, 8
91:17	170:24	click	147:9	colleagues
choose	circumstances	clock	177:5,	39:16, 18
170:13	170:12	6, 8	collection	108:12
190:18	claim	close	126:5	143:5
circle	74:22	203:1	closely	Columbia
103:17	226:21,	216:6	39:11, 16,	18, 22, 24
182:23	227:24	closest	56:21	114:13, 15
circled	claimed	99:17	column	151:6
61:18	207:5	116:1	191:14	200:24
circles	clarify	10:6	203:16	208:12, 15
60:4	22:3	code	210:25	226:24, 25
circuit	clarifying	78:6,	comfortable	50:12
58:1	32:2 119:1	8, 12	comma	149:1,
71:20	class	228:13, 20,	12	commands
138:2	198:3	22, 23	commas	54:11
143:10	classic	coefficient	149:18	commence
164:12	98:22	146:22	23:11	commencement
167:1, 3	clause	148:24	238:4	comments
169:11, 17	227:22	149:10	201:3	commercial
175:5, 12,	clean	193:14	114:12	
23 183:7	157:19	194:10, 11,		
227:9	clear	13 200:5,		
228:2	32:9	10, 11, 14		
229:11	77:14 79:1	coefficients		
circuitry	136:19	142:8		
72:4 92:14	141:5	143:23		
93:9	165:2	146:15,		
162:25	176:17	201:20		
170:3, 4	178:24	204:10		
171:2	181:6	220:8, 20,		
173:15	186:3	23 221:8,		
210:11	197:25	11, 24		
circuits	211:19	222:12, 14,		
169:17	clearer	18 223:4,		
circumstance	148:13	23 224:3,		
95:25				

QSC AUDIO PRODUCTS, INC. vs. CREST AUDIO, INC.

Daniel P.W. Ellis, Ph.D. on 06/27/2014 Index: commercialized..compound

159:21, 22	82:6 83:15	compensated	70:21
162:14	86:11, 15	23:23	84:17
167:24	87:5, 8, 18	24:2, 21	190:21
commercialized	93:24 97:7	101:8	214:15
114:16	235:17	compensation	components
115:1	236:14, 19	101:11	47:4
commercially	communications	competing	48:18, 22,
160:11	21:25 22:3	55:23	24 49:1, 2
committed	23:17		84:23
161:18	24:14 96:2	competitor	154:10
common	234:15	55:19	160:19
31:20, 22	236:13	56:16	165:20, 24,
85:17	companies	competitors	25 166:2
91:20	116:12	55:22	170:19
114:8, 10,	134:14	complete	173:2
20 190:15	company	10:25 47:5	176:15
202:22	99:24	127:13	195:12
commonly	100:6	195:22	compose
85:18	115:25	221:4	185:14
87:10	116:15	completed	186:6
190:17	118:5	12:1 23:14	composed
commonplace	125:2	25:7	154:10
127:23	comparable	101:10	185:11
communicate	88:3	completely	191:23
39:25	compared	9:15 142:3	composing
136:19	129:10	149:1	184:12
communicated	comparison	169:22	compound
196:17	16:9 57:17	174:12	46:3, 11
219:23	73:6 90:14	217:17	47:17
221:8	216:21	complicated	48:20
communicating	217:12	93:22	74:13
95:14	compatibility	Complies	80:25
112:15	55:17	61:21	86:16
communication	compatible	component	87:20
	58:6	48:24	144:16
			162:5

QSC AUDIO PRODUCTS, INC. vs. CREST AUDIO, INC.

Daniel P.W. Ellis, Ph.D. on 06/27/2014 Index: comprised..connected

164:22	221:9	151:1, 25	160:25
168:4	computer-aided	152:7, 13	confuse
175:15	117:24	155:18	211:10
194:7	computers	237:12	confused
218:4	46:18	238:3	28:18
comprised	85:19	conditions	188:23
81:12	87:21	69:21	213:16
comprises	117:17	219:25	confusing
102:25	121:9, 17	224:16	175:10
103:2	computing	232:4	confusion
comprising	214:17, 18	conducted	29:6
158:2	concept	27:10	connect
compromise	32:17 34:9	conductors	63:19 64:9
54:21	83:8 128:7	58:9	66:18, 21
computational	187:20	confer 63:4,	81:22
44:9	conception	7 105:19	110:10
computations	119:5	225:14, 18	111:9
53:18	concepts	237:10	113:5
computer	82:25	confident	137:6
43:10	concern	83:16	162:25
89:21	133:24	confidential	166:20
110:10, 11	concerned	99:10, 12	168:9, 15
120:22	46:21	101:22	171:3
130:14, 15,	166:11	confidentialit	176:5
19 131:13,	concert	y 102:1	209:14
15 136:22	120:25	configuration	216:9
141:3	121:2	89:20	218:16
168:9	conclude	110:6	connectable
195:21	15:13	137:17	189:22
210:9, 13	concluded	configurations	190:13, 21,
214:7	216:17, 18	66:7	24 194:20
215:2, 22	239:3	configure	212:23
218:11, 16,	conclusion	108:25	227:6
18, 24	119:22	confines	connected
219:20, 23			60:7
			111:1, 24

QSC AUDIO PRODUCTS, INC. vs. CREST AUDIO, INC.

Daniel P.W. Ellis, Ph.D. on 06/27/2014 Index: connecting..consulting

112:25	91:20 92:3	179:6	constitute
113:9	94:21 95:5	181:14, 16	44:16
117:22	111:1		72:21, 25
138:9, 15	112:16	connector	
139:2	139:17	163:14, 19,	constituted
140:8	140:2, 6	21, 22	169:16
163:1, 7	142:20	164:1, 7	constitutes
164:12	167:25	connectors	80:4
166:1, 2, 3	175:18	83:17	constrain
175:14	177:24	163:15, 17	131:17
177:11	178:3,	164:4	constrained
182:21	179:16	168:15	118:9, 13
189:9, 13,	181:7, 9, 11	connects	constraining
20 190:6	182:5, 8,	64:6	135:19
195:3	10, 11, 12	209:17	
196:19	186:18, 21,	consideration	construct
209:21	22, 24	52:7	82:16
210:7, 13	187:2, 3, 6,	considered	136:3
214:8	9, 15, 17,	27:16	179:15
215:2, 25	21, 25	28:4, 13, 15	constructed
216:8	188:3, 9, 10	30:1, 10, 25	82:22
218:10, 11	207:4, 16	31:1, 4, 9	construction
219:2, 21	210:8, 9	33:13, 15	174:5
connecting	212:7, 10,	69:17	construing
64:13, 19	17, 20	198:5	13:17
108:14	213:11	consistency	152:21, 25
140:7	214:1	55:6, 15	consult
163:8	215:20	consists	63:2, 4, 7
165:12, 14	217:23	174:6	105:19, 23
169:9	218:19	constant	225:11, 14,
210:10	221:7	46:24	18 234:6,
215:23	connections	79:9, 18	10 235:3
connection	81:13, 15,	81:7, 12	237:2, 10
65:20	22 83:15,	constituency	consulting
84:12, 22	23 85:3, 8	55:4	99:15
85:1, 2, 14	113:12, 15		101:5
86:22	166:10, 17		
	178:11		

QSC AUDIO PRODUCTS, INC. vs. CREST AUDIO, INC.

Daniel P.W. Ellis, Ph.D. on 06/27/2014

Index: consumer..correlate

238:21	15, 22	converter	176:24
consumer	contents	168:10	184:20
155:15	40:13	195:3, 9	192:23
consumer's	context	converters	196:13, 18
127:6	66:20	165:15	202:10
contact	104:6	169:18	205:3
21:7, 19, 23	108:2	189:15	210:4, 20
22:14, 24	continued	converting	219:6
contacted	121:21	189:3, 6	224:21
21:4, 6	continuing	converts	225:8
contained	191:18	92:9, 19	226:18
15:25	contrast	convey 88:3	227:19
67:23 76:5	186:17	Cooperative	229:8
contemporaneou	control	205:5	232:9, 25
s 15:19	93:17	copies 18:3	237:23
contemporary	111:22	copy 12:10	Corrected
35:10	122:5	41:22	19:21
50:17 56:5	137:10	185:19	correction
116:7	177:21, 23	core 54:10	26:1
131:11	191:15	corporate	correctly
contend	192:1	38:22	15:16
33:15, 18	193:21	correct	25:10 37:3
contending	201:2	17:14 26:5	47:12 48:2
210:12	220:23	38:19	51:17 64:2
content 10:3	controller	44:1, 25	83:13
33:16	112:17	45:6 48:4	94:16
40:22	conventional	56:22 71:8	104:10
184:3	48:14	75:22	113:24
contention	120:22	79:16, 19	127:17
33:19, 20	173:16	87:2	152:22
contentions	conventions	119:10	194:19
32:17, 21,	98:17, 20	142:12	212:3
25 33:16	conversion	156:24	227:10
34:2, 8, 12,	45:23	164:7	230:21
			correlate
			60:2, 9

QSC AUDIO PRODUCTS, INC. vs. CREST AUDIO, INC.

Daniel P.W. Ellis, Ph.D. on 06/27/2014

Index: correlates..Crain

correlates	31:17, 18	15:22	76:17 81:9
74:10	couple 8:11	16:6, 22	82:8, 13, 20
correspond	11:8 41:14	17:8 18:4	83:1
194:4	51:21 73:4	19:5, 8, 11	84:16, 25
210:19	100:16	20:17, 20	86:17
correspondence	115:5	22:6, 20, 21	88:7, 15
60:12	125:13	23:5, 22	89:5
168:25	141:22, 23	24:7, 10, 18	91:19, 24
	149:18	27:12, 21	94:15
corresponds	181:25	28:2, 7, 10	95:13 96:6
60:13	203:12	29:2, 7, 14	97:15
207:15	221:20	31:6 32:8,	98:1, 14
Corvette	233:25	24 33:4,	99:6, 11, 21
57:2		14, 19, 25	100:17
cost 47:19	court 6:12,	34:10, 20,	101:2, 18
113:21	13, 15 8:5,	25 35:7	102:2, 22
	8	36:2, 5	104:19
counsel 6:14	cover 71:9	37:13	105:4, 7, 13
31:12	136:25	38:5, 12	106:16
63:2, 4, 11	covered	40:14	114:9
105:17, 19,	229:17	41:10	115:7
23 106:2	231:12	42:11, 19	118:22
225:12, 14,	232:8	43:18	123:13
18, 24		44:2, 7,	124:19
234:7, 10	covers 91:8,	45:18 46:7	125:15, 23
235:18, 25	9	47:11, 22	126:16
237:2, 8,	cradle	48:16, 25	127:3, 24
10, 11, 19	212:11	49:16	129:18, 23
238:5, 17,	214:16	50:20, 23	130:20
25	Crain 6:16	51:14 52:8	133:10
counsel's	7:7, 15	53:6, 19	134:17
238:1	10:11	56:1 58:2	135:1, 2, 25
count 24:16	11:23	62:11, 13,	136:14
	13:4, 8, 14,	16, 25	137:1
counter	17, 24	64:14, 25	139:21
138:17	14:3, 6, 13,	65:7, 12, 16	141:10, 25
counts	16, 25	67:2, 15	142:11
		74:16	143:13

QSC AUDIO PRODUCTS, INC. vs. CREST AUDIO, INC.

Daniel P.W. Ellis, Ph.D. on 06/27/2014

Index: crash..Das

144:19, 25	215:24	237:12	62:19, 23
145:10, 17,	218:13		134:20, 24
25 146:7	223:14	cross-	183:14, 18
152:4, 12	224:23	examination	225:3
153:25	225:5	229:3	239:5
154:19	226:2, 4	234:2	
156:17, 23	227:11, 25	238:4	Das 6:20
158:3, 13	228:11	crucial	10:6 13:1,
159:5, 14	229:16	60:22	7, 9, 16, 19
160:9	230:8, 12	134:3	14:2, 12, 22
161:5, 19	231:6, 24	174:25	15:21
162:12	232:11, 17	current	16:1, 17
164:5	233:2, 7,	37:10	17:5, 23
165:1, 17	13, 16, 24	100:24	19:4 22:2,
166:22	234:16, 18,	115:12, 13	19, 25
167:20	22 235:5,	119:19	23:16
168:16,	10, 15		24:6, 13
169:20	236:4, 7,	custom	27:8, 18, 25
172:2, 10,	11, 15, 20,	132:23	28:5, 8, 17,
19 173:25	23 237:9,	179:16	25 29:6
175:2	20 238:2,	180:10, 11,	31:5 32:2,
176:7, 22	10, 12, 18,	20 182:7,	22 33:3, 5,
179:10	19 239:3	11, 15	18, 20
181:21, 23,	crash 95:19	customers	34:4, 17, 23
25 182:2		180:4	35:5 36:2
183:11, 20	create	cv 115:11,	37:7 38:2,
188:5,	116:13	12, 13, 14	10 40:6
190:7	146:5		42:7, 14
193:10	179:9, 17	cycle 143:20	43:6, 22
194:16		144:4, 9	44:5, 13
195:5	created	177:8	45:10
196:11	105:5		46:3, 11
197:5	154:14	cycles 69:8	47:17
203:14	creator		48:6, 20
204:13	126:25	D	49:9 51:11
205:9	Crest 6:7,	D-to-a 190:3	52:4 53:2,
206:13	17, 19	Daniel 6:6	14 54:15
213:5	cross-	7:1, 18	57:24
			62:11, 14

QSC AUDIO PRODUCTS, INC. vs. CREST AUDIO, INC.

Daniel P.W. Ellis, Ph.D. on 06/27/2014

Index: dashed..data

64:10, 21	143:11	223:9	10, 12, 14,
65:3, 9, 14	144:16, 22	226:3,	18, 19, 22,
66:16	145:3, 13,	227:12, 14	24 80:3, 4,
74:13 76:8	22 146:3	228:3	21 81:1, 2,
80:25	152:2, 11	229:2, 18	8, 12 82:14
82:7, 11,	153:19	230:9	83:16
17, 23	154:16	231:2, 17	84:18
84:13, 19	156:10, 21	232:5, 13,	88:4,
86:16	157:24	20 233:6,	90:5, 6, 11
87:20	158:9, 25	8, 9, 14	91:2, 18
88:14,	159:8	234:3, 13,	92:14 94:4
91:22	160:7	17, 20	95:10, 14,
94:11	161:2, 10	235:3, 8, 13	17 96:5
95:7, 23	162:5,	236:2, 6,	98:3
97:11, 20	163:23	10, 12, 16,	110:20
98:10	164:22	22 237:5,	113:7
99:4, 9	165:11	16, 24	129:17
100:14, 21	166:14	238:5, 8, 14	137:3, 7, 9,
101:17, 21	167:18	dashed	10, 12, 13,
102:20	168:4, 18,	142:21, 23	14 138:13,
104:17, 24	23 172:1,	147:15	14, 20, 23,
106:14	5, 16	182:24	25 139:2,
114:5	173:21	data 27:15	22 140:8,
115:4	175:15	28:3, 11	17, 21
118:12	176:19	29:25 30:3	146:22
123:8	177:3	41:15, 16	148:23, 24
124:17	179:8	42:13	149:10
125:12, 19	181:21, 24	68:23	164:17, 21
126:14	188:4	69:8, 9, 11	176:4
127:2, 18	189:24	76:12, 19,	177:17
129:12, 22	194:7, 22	24 77:1,	181:4
130:11	196:2, 24	10, 16, 22,	193:14
133:8	203:9	23, 25	194:10, 11,
135:24	205:8	78:1, 3, 5,	13 197:2
136:21	206:9	7, 18, 19,	200:5, 11,
139:18	212:25	21, 22, 24	12, 14
141:21	215:17	79:6, 8, 9,	215:3
142:6	218:4		216:10

QSC AUDIO PRODUCTS, INC. vs. CREST AUDIO, INC.

Daniel P.W. Ellis, Ph.D. on 06/27/2014 Index: DATA/PROG..deposition

218:17, 19,	21, 24	166:11	133:1
24 222:25	15:3, 7, 24	199:2, 3	demonstrate
DATA/PROG	16:8 18:1	213:7, 10,	66:6
68:25	20:11	11, 18, 21	density
69:10	21:13	defined 71:1	46:19
76:12, 16	22:9, 12, 23	153:15	department
date 6:9	23:12, 15,	166:6	39:10
25:3 185:1	21 25:5, 18	176:20	107:9
dated 131:20	26:16, 18,	227:9	depending
dawn 42:22	25 27:6,	defining	24:24
day 7:12	14, 17, 23	197:22	198:1
19:13 93:2	28:14, 16	213:2, 20	213:18
160:22	30:2, 10, 11	definition	depends
days 21:18	31:2, 14, 16	40:8, 23	92:17
25:8 87:24	32:12, 20	44:6 80:3	93:4, 21
107:19	34:3 35:4,	139:9	102:15
deal 93:14	9 38:24	230:10, 15	104:4
196:7	41:1, 5	231:16, 19	126:10
dealing 78:8	141:15	degree	182:19
134:14	183:25	230:2, 19	196:3, 6
deals 162:7	184:1, 4	231:14	213:1, 23
decades	185:3, 5, 9,	232:22	depict 66:15
43:11	12 186:7	delay 123:11	depicted
decide	204:23	deliberately	67:24 76:7
117:18, 23	207:20	138:5	194:25
118:18	208:11	delicate	195:1
decision	229:17, 24	170:13	deposed 7:23
223:2	declarations	190:16	226:18
decisions	25:12	delight	deposition
117:19	26:21	121:16	6:6 7:13
declaration	27:11	delivering	12:5, 20
12:22, 25	deemed 36:21	177:17	13:6, 13
14:9, 11,	deeper	demanding	14:8 16:3,
	230:17	121:23	16 17:21
	define 54:19		18:10, 15,
	78:3		
	111:18		

QSC AUDIO PRODUCTS, INC. vs. CREST AUDIO, INC.

Daniel P.W. Ellis, Ph.D. on 06/27/2014 Index: depositions..developed

21 19:3	193:12	113:4, 23	230:4
20:8 25:24	194:3	116:4	designs
62:19, 23	218:7	117:24	116:16
134:20, 24	describing	118:1, 6	165:6
183:14, 18	30:15, 18	119:2, 9	desire 9:17
225:3, 16	35:12 51:2	131:5	167:2, 9
239:5, 7	112:22	133:21	detail 38:11
depositions	142:7	161:14	172:8
18:14	143:22	164:11	175:1
25:25 26:4	146:17	170:13	181:4
depressed	148:9	171:19, 23	215:6
196:22	200:19	172:13	details
depressing	description	205:22	23:3, 7
198:9	22:1 23:10	designations	169:18
describe	32:14	50:14	189:17
12:19	88:19	designed	205:25
21:20, 22	100:4	102:13, 16	determination
35:8 36:12	112:3	103:4, 7	149:11, 13,
39:3 44:17	163:16	104:14	14
46:8 64:20	193:17	107:3	develop 99:3
80:24	204:22	133:4, 13,	100:1, 6
88:11	212:17	14 134:6	101:19
110:15	design 49:23	designer	153:24
140:5, 6	50:6 54:19	83:10	179:15
156:18	56:10	115:24	developed
164:3	92:24	116:2	38:16
173:12	94:5, 14	118:13	43:11
177:11	102:10	designer's	71:13
189:8	104:4, 21	126:25	100:20
198:7	105:2, 5	designers	103:18, 23
211:21	107:6	116:9, 11	107:18
214:24	108:10	designing	109:14
describes	109:6, 7,	108:15	155:13, 16
64:11	11, 15, 17,	110:12	162:10
132:15	20, 21	117:7	181:12, 18
152:18	110:11, 15	118:15, 17	
	111:22		

developers	73:1	devise	118:4
55:4	89:20, 21,	144:11	127:8
developing	23 92:9,	devoted	143:3
46:20	11, 19, 21	25:17	187:5, 8, 14
99:19	93:16	diagonal	197:17
153:20	97:22	83:24	199:5, 7
155:7	106:18	97:1, 8	201:19
159:12	108:5	diagram	differences
188:17	112:11	59:12	12:16
190:2	114:4, 12	66:24	87:17
development	122:25	67:25	165:9
47:6 48:4	125:1	68:18	199:8
49:3	214:17,	70:15 71:6	difficult
104:21	224:19	73:8 74:1,	11:14
143:19	devices	11 76:7	47:16, 20
144:4, 9	35:11	78:10	55:24
159:20	36:18 39:6	79:22	59:16
161:23	45:25	80:19	63:22 64:3
166:16	47:1, 2	83:20	109:8
180:1, 5, 7	48:13	96:22	113:1
190:1	49:21	98:18	125:20, 24,
195:20	51:13, 17	105:1	25 151:13
206:12	54:8 55:5,	107:2	156:12
207:2	15, 18	111:11	190:4
developments	63:20 66:1	129:25	228:14
37:10	69:15 90:1	140:20, 24	difficulty
108:8	92:16 96:1	142:17	48:1 49:12
device 30:16	113:20, 25	144:18	161:7
40:11 42:1	116:14	148:1	digital
44:9 45:4	122:24	diagrams	30:16
50:3, 7	123:3, 15	74:23	35:11
51:4, 12	124:11, 13	104:9	36:17
53:13, 16	125:8	115:19	37:10
55:3 58:8	128:6	difference	38:16
59:9 64:24	155:16	52:12	39:6, 20
66:25 67:1	171:3	90:18	40:10
71:2, 4, 22	190:11, 14		41:23
	210:8		

QSC AUDIO PRODUCTS, INC. vs. CREST AUDIO, INC.**Daniel P.W. Ellis, Ph.D. on 06/27/2014: digital-to-analog..discussion**

42:6, 9, 25	25 153:1,	directed	disconnect
43:10, 15,	2, 3, 4, 5, 7,	205:21	195:25
20, 23, 25	8, 13, 14, 20	direction	disconnected
44:3, 10,	155:8	158:15, 18	188:12
12, 20, 23,	159:6	directly	discover
24 45:25	160:24	77:25	36:6 41:4
46:5, 6, 9,	169:1	163:1	discovered
12, 14, 20	172:24	168:9	36:20
47:2, 5, 7	174:5, 10	236:18	41:18
48:17, 19	177:22	disagree	discrete
49:3, 20	186:4	13:24	153:23
51:19, 23	188:10	156:25	154:10
52:2, 13, 19	189:4, 6,	157:1	discuss 29:1
53:10, 12	193:14	disassembling	36:17
55:10 83:6	197:3, 4	93:14	234:21
102:10, 13,	205:22, 24	disclose	discussed
15, 24	206:10, 18,	96:24	22:5 23:20
104:22	21, 24	162:22	50:16 81:7
107:5	213:3, 12	211:14	85:3 96:4
110:13	220:24	214:15	125:22
119:18,	231:9, 15	disclosed	164:10
121:19	232:23	147:21, 22	discusses
122:1, 19	digital-to-	164:7	64:16
123:11, 17	analog	206:4	discussing
124:15	168:10	218:3	18:14
125:9	dignal	discloses	41:19
126:3, 8, 19	148:24	160:5	45:22 46:2
127:12, 21	149:1,	211:2	68:13
128:6, 14	151:4	212:1	173:14
129:10, 15	dipped	disclosing	discussion
132:11, 20	141:24	163:13	15:12
143:8	direct	209:2	50:21 85:7
144:12	123:23	disclosure	131:16
147:17, 18,	168:25	147:12, 24	164:15
20 148:3,	185:24	202:18	199:3
5, 7, 9, 24	186:1		
149:3			
152:16, 18,			

QSC AUDIO PRODUCTS, INC. vs. CREST AUDIO, INC.

Daniel P.W. Ellis, Ph.D. on 06/27/2014

Index: discussions..DSP

221:25	165:4	domain 85:11	Ds 168:3
222:20	documentation	107:5	DSAP 142:19
discussions	42:1, 3	126:3	DSP 42:22,
12:22	51:2	Donald 6:12	23, 24 43:2
23:18, 20	documents	doping	49:12
distinction	11:5	117:19	50:6, 18
79:1 88:2	12:21, 24	dot 203:17	53:11
141:3	13:5, 10,	dots 60:13	54:17
197:25	11, 12, 14,	download	56:12, 21
222:6	15, 18, 20,	108:16	61:3 63:19
distinctions	22 14:5, 7	215:3	64:6, 8
211:19	15:2 16:4,	downstream	65:2
distinguished	10, 15, 21,	217:22	66:18, 19
211:18	24 17:10,	dozens 36:24	67:17, 19,
distinguishing	11, 15, 16,	draw 55:21	24 69:2
76:24 78:5	20 18:1, 5,	117:10	75:14, 19
distorted	6, 25 19:3,	125:20, 25	99:3
90:22	7, 12 20:7	173:4	100:1, 19
divide	22:4, 7, 8,	191:5	102:17
171:19	11, 22	198:20	103:4, 7,
document	23:4, 8, 19,	drawing	14, 18, 23,
11:6, 9	20 27:16,	105:1	25 105:5
12:6, 8	22 28:12,	117:15	106:7, 11
20:18	15, 19	155:18	107:18, 20
30:15, 18,	30:6, 10, 24	157:7	108:4, 15
19 34:11,	31:7, 9	222:5	115:24
14 37:2, 8	33:8, 9, 11	draws 110:20	116:1
38:15	35:12, 13	drew 171:11	119:3, 9, 14
60:17	36:6, 9, 10,	drill 87:16	120:16, 19,
64:11, 15	20, 25	Drive 7:18	24 121:1,
73:11, 14	37:4, 23	drives 96:18	20, 21
85:8 96:24	38:1, 13	131:7	123:7, 25
120:1	40:25		124:14
129:24	41:2, 5, 8		125:9, 16
131:20	130:3		126:12
	dollars		127:14
	126:20		128:7, 19,

QSC AUDIO PRODUCTS, INC. vs. CREST AUDIO, INC.

Daniel P.W. Ellis, Ph.D. on 06/27/2014

Index: DSP-BASED..efforts

23 129:1	197:13	106:6	93:13
132:20	201:3, 6, 11	122:4, 10	95:24
134:6,	209:5	124:3	111:22
137:8, 20,	210:2	129:2	132:1, 4
21, 25	215:12, 20	132:8	135:17
138:5, 6, 16	217:18, 24	143:21	197:24
139:17	228:9	162:13	
140:2		164:18	ecosystem
142:8, 12,	DSP - BASED	169:3	57:12
14, 16, 18,	125:10, 18	174:13	
24, 25	DSPS 45:14	183:23	edge 61:11,
143:1, 2,	47:13 48:4	184:19	14 98:18
10, 15, 18,	49:6 50:10	186:9	128:12
23 144:3	54:14	225:7	edge-on
145:16	56:3, 4		61:13
146:12	57:5, 10, 15	earliest	educational
148:2	87:12	45:2 46:25	107:23
150:23, 24	106:13	early 38:15	114:1
151:25	128:23	46:5, 8	
152:8, 14,	159:17, 22	87:25	EEPROM 73:6,
20, 25		122:6	10, 14
153:12, 14,	due 90:19	131:19	effectively
17, 22	duly 7:3	206:18	174:2
156:19			efficiency
157:9, 10,	E	ease 48:1	133:3, 12
15, 17, 21,		easier 47:9	efficient
22 158:1,	e-mail 21:8	54:22	19:17
23 159:15,	e.g. 218:11	85:10	138:8
20 160:2	ear 207:17,	101:25	148:23
165:10, 16	18 215:23	easiest	efficiently
168:11		93:23	142:9
169:9, 23	earlier		143:24
171:1, 6, 16	10:18, 19	easily 16:11	
172:15	15:8, 13	46:15	effort 26:3
174:3, 8, 13	45:11	218:7	188:13
175:5, 13	47:13	224:15	
176:2, 5	49:6, 20	easy 25:19	efforts
178:1	51:6 83:13	63:22	21:12, 20,
	84:4 96:14		22 22:1

QSC AUDIO PRODUCTS, INC. vs. CREST AUDIO, INC.

Daniel P.W. Ellis, Ph.D. on 06/27/2014

Index: either/or..equal

23:23	elements	emerging	173:18
24:22 25:3	81:5, 7	125:6	230:2, 19,
32:19 35:4	111:15	employ 54:11	22 231:8,
39:2, 14	169:11	140:18	11 232:8,
40:3	208:7	141:6	23
either/or	Ellis 6:6	employed	English
71:7	7:1, 8, 18	24:12, 16	117:1
elected	11:12, 17	enable	enter 21:11,
13:12	12:19	137:17	17
electrical	19:12	encapsulated	entered
65:20	20:23 24:6	111:25	21:14
81:13, 15	28:11	encapsulation	entire 69:20
90:20, 24	29:15, 25	74:15	182:22
91:3 92:5	31:11 36:2	end 8:6	228:13, 19
94:24	39:17	47:4 48:12	232:18
113:13, 15	41:11	62:7, 18	entity 100:4
136:3, 4	50:24	127:22	environment
174:20, 23	62:19, 23	134:19	166:16
212:17	63:1 99:2	149:8	EPROM 66:23
230:2, 19	105:14	167:17, 19,	67:6, 9, 12
231:8, 11	125:12	22, 23	71:2, 12,
232:8, 23	134:20, 24	183:13	21, 25
electrically	135:3	239:4	72:6, 11,
108:13	141:11	engaged	15, 24, 25
electronic	183:14, 18	20:13	73:5, 6, 8,
230:4	198:7	21:23	21, 22, 25
electronics	204:14	23:13 25:8	74:2, 11
48:22	225:3, 6	104:21	75:1, 8, 18,
92:12	226:13	engagement	21 76:4, 6,
155:15	233:25	21:11	13, 19
172:13	239:5	engineering	80:9, 10, 11
230:2	embed 69:23	43:15	113:14
element	embodiment	118:14	EPROMS 75:24
139:6	162:14	127:9	equal 16:14
210:16, 25	219:1	171:19, 23	94:13
	emerged		
	50:19		

QSC AUDIO PRODUCTS, INC. vs. CREST AUDIO, INC.

Daniel P.W. Ellis, Ph.D. on 06/27/2014

Index: equally..expect

equally 158:2	etch 54:6	exclude 24:19	104:16, 23 106:11
equipment 89:4	etching 107:8	153:3	119:14, 19
155:10	117:12	excluded 73:7	141:9, 12, 17 165:4
190:16	evenly 25:20	excluding 40:1	183:21, 24 204:12, 15, 19 205:4
194:24	26:11	execute 138:17	207:19, 20 208:3
195:1, 4	Eventide 125:2	executed 69:14	210:20, 21, 23 226:13, 15, 16
equity 101:12	events 16:4	70:25	229:4, 19, 20
era 137:5	120:10	exhausted 10:24	exist 49:14 96:2 199:8
erasable 73:23	evolution 46:9	124:21	existed 50:10
75:12, 25	exact 28:7	exhibit 11:22, 25	existence 178:11
erase 74:8	41:25	12:4, 7, 12	existing 162:9
erased 74:2	42:10	19:9, 10, 14, 20, 21, 23 20:6, 10, 19, 24 50:22, 24 51:10	180:11 190:3 228:8, 21
75:3	115:23	52:23	exists 199:7 228:9
erasing 73:24	215:18	53:1, 11	expanded 53:24 54:2
74:25	229:8	56:6 58:13	expect 53:21 60:16 76:5 79:21, 24 82:21 83:3, 6
80:10	examination 234:12	61:1, 3	
error 216:20	235:1, 7, 12	63:14 64:8	
217:7	237:4, 12, 13 238:7	66:6, 12	
essentially 81:2 82:15	examples 148:21	67:24	
establish 215:19	231:3, 22	70:16	
established 234:18	exception 16:24	72:14, 20	
estimate 178:14	17:11	77:21	
estimation 26:8 84:15	119:7	78:14	
	exciting 206:11		
	207:1		

QSC AUDIO PRODUCTS, INC. vs. CREST AUDIO, INC.

Daniel P.W. Ellis, Ph.D. on 06/27/2014

Index: expected..fair

97:7, 18	154:2	explicitly	218:16
162:14		221:10	224:1
164:20	experiments		227:5
167:25	144:10	exploit 55:2	
168:21	160:16	express 51:5	externally
178:2, 19	180:6		171:4
203:7	expert 28:4	expressed	extra 37:1, 6
223:20	33:12	27:17	67:8
	39:16, 18	28:14 29:6	
expected		30:2 31:13	extreme
73:17	expertise	32:12 34:3	133:18
178:12	103:14	extent 9:19	extremely
expense 66:4	explain	10:2 12:16	64:3
	23:12	15:11	190:16
expensive	66:14	83:10	
47:16	70:23 77:5	99:12	F
170:15	83:10	124:21	
experience	101:14	187:15	fab 108:11
39:5 50:6	119:22		fabrication
53:10	125:24	external	108:11, 16
76:22	174:18	53:22	
96:23	177:1	136:13	face 58:16
107:12	186:15	137:6	
116:2	191:25	163:9	fact 10:12
119:6	200:12	165:13, 14	87:23
124:10, 14	205:20	168:9	92:18
150:12	217:7	169:11, 17	95:11
159:6, 10	229:21	171:21	109:17
190:12		173:16	114:19
202:23	explained	175:13	155:14
230:4, 24	160:8	195:2	158:22
	173:17	208:13	162:9
experiment		209:2, 7,	199:6
146:11	explaining	10, 11	facts 27:15,
	31:17 83:9	210:4, 9, 14	20 28:3, 11
experimental	127:5	212:24	29:25 30:3
30:16	200:18	213:3, 12,	33:11
experimenting	explanation	25 214:5, 7	fair 9:7
108:7, 18	23:17	215:20, 22	13:12,
	215:7		

QSC AUDIO PRODUCTS, INC. vs. CREST AUDIO, INC.

Daniel P.W. Ellis, Ph.D. on 06/27/2014

Index: fairly..finished

79:13	feasibly	142:17, 25	220:8, 20,
94:22	54:21	149:20	24 222:12,
214:17	feel 10:3,	154:13	14, 18
fairly	8, 23, 24	157:12, 14,	223:4
163:10	11:5 16:18	21 158:1	final
familiar	50:12	160:14	161:12, 18
32:16 52:1	55:24 69:1	162:17	find 35:12,
57:13	162:20	168:22, 24	13 37:11
191:11	191:22	185:19	38:1 40:4
familiarity	fewer 70:7	191:4	58:14
52:9 57:20	88:3	195:15	60:19,
120:9	FGPA 111:2	207:8	79:21, 24
123:3	fiddly	213:14	89:21
130:8	228:14	214:3	149:22
families	field 46:20	216:11, 17,	150:5, 6
55:18	109:14	18, 21	151:7
family 18:23	145:15	217:4, 10,	152:17
56:15	193:6	12, 13, 17,	168:21
205:1	201:2	23, 24	173:19
fashion 92:8	Field-	figures	196:25
104:15, 23	programmable	113:6	209:23
189:16	110:2	142:14	223:16, 21
fast 47:15	fields	217:20	fine 7:21
94:21	191:16	file 111:18	9:11 29:2,
121:12	192:1	filed 153:16	7 61:19
128:9	194:3	157:11	99:12
181:17	fifteen	files 109:20	124:22
faster 43:12	38:18	110:15, 20,	150:13, 17
47:10	Fig 194:17	23 111:20,	151:2
53:16, 17	figure 67:3,	23, 25	finer 54:5
82:6 89:17	5 78:10	112:6, 11,	finish 24:7
90:3, 4, 19,	80:18, 19	15, 21	36:3 132:9
23 91:5	81:21	filing 179:7	184:12
94:2, 4	88:12	206:19	finished
121:18, 21	104:7	filter	226:21
			234:2

finite	folder 17:25	54:15	22 146:3
118:15, 17	follow 14:19	57:24	148:13
firm 24:4	116:22	59:9, 24	152:2, 11
firstly	151:13	64:10, 21	153:19
207:9	fond 51:24	65:3, 5, 9,	154:15, 16,
fishing		11, 14	17, 20
33:11	football	66:16	156:10, 21
fit 32:13	203:3	67:13 68:1	157:10, 24
59:16	forever	73:2 82:7,	158:9
90:17	149:19	11, 17, 23	159:8
118:18	forget	84:19	161:2, 10
fits 64:24	174:22	86:16	162:5,
fixed 53:18	184:11	88:14,	163:23
flexibilities	191:9	91:22	164:22
207:1	forgive 40:7	94:11	165:11
flexibility	forgot	95:7, 23	166:14
133:20	106:25	97:11, 20	167:18
199:2	forgotten	98:10 99:4	168:4, 18,
221:15	77:4 86:24	100:14, 21	23 172:1,
flexible	87:6	102:20	5, 16
47:9 48:12	form 14:22	104:17, 24	175:15
flip 58:13	15:21 16:1	106:14	177:3, 18
175:9	22:2, 19, 25	114:5	179:8
208:11	27:18	115:4	189:24
floating	28:17	118:12	193:7
128:22	34:23 35:5	123:8	194:22
fluid 151:23	37:7 38:2	125:19	196:2
FN 59:12	40:6 42:7	126:14	203:9
65:6	43:6, 10, 22	127:2, 18	205:8
focus 30:24	44:5, 13	129:12, 22	206:9
56:2 191:5	45:10	130:11	212:25
focusing	46:3, 11	133:8	215:17
71:6	48:6, 20	136:21	218:4
	49:9 50:6	139:18	223:9
	51:11 52:4	141:21	227:11, 25
	53:2, 14	142:6	228:11
		144:16, 22	229:16
		145:3, 13,	230:8, 12

231:6, 24	111:3	44:10	129:25
232:11, 12,	116:2, 17	46:17	140:24
17 233:2,	118:7, 15,	58:11, 21	142:17
3, 13	16 119:8	174:25	148:1
formal 55:13	FPGAS 109:21	192:14	165:19
format	frame 11:6	193:16, 22,	functionalitie
189:18, 19	90:13	24, 25	s 206:25
206:22	132:6	194:5, 6,	functionality
formation	135:20	12, 15	136:2
136:5	free 10:8	197:7, 15,	145:8
forming	16:18	17, 18, 21,	functions
27:16	162:20	22 198:6,	44:25
28:13	friction	9, 12, 13,	59:11, 16
30:1, 10	65:15, 22	16, 22	128:14
31:13, 16	Friday 6:1	199:4, 9, 11	129:20
32:11, 20	friends	215:5	179:4
33:7, 8, 13,	18:23	221:3, 18,	191:10
16 34:3	front 50:24	22, 23	203:2
forms 153:12	64:17	222:2, 5, 7,	209:5
154:20	73:18	13, 15, 16,	220:3
forward 45:8	136:25	21 223:25	221:13, 16,
122:7	frustrate	224:2, 12	24 222:9
found 85:18	86:19	227:8, 23	230:5
107:15	frustrated	228:1, 6, 8,	fundamental
151:12	86:19	10	203:21
155:10	full 10:25	functional	fuzzy 129:14
foundation	127:21	49:2 67:25	FZ 59:12
34:4 53:15	136:12	68:1, 8, 18	65:6
60:3	full-up	70:15 71:5	
fourteen	109:5	73:8 74:1,	
185:17	fully 9:15	10 76:7	G
FPGA 108:7,	fun 62:15	78:10	
17 109:24	function	79:22	gain 49:19
110:8		80:18	game 13:12,
		96:21	13
		97:19	Ganti 6:16
		98:12	
		104:9	

garage	41:23	glitch	greatest
156:15	51:19, 22,	147:6, 8	133:2, 12
gate 110:2,	23 52:12,	goal 161:12	greatly 54:2
5	13, 19	God 149:19	Greek
gates 49:4	56:17	Golly 238:10	203:16, 17
108:13, 14	129:4	good 7:8, 9	grounds 13:2
109:10, 13,	generations	8:18 43:14	32:23
16, 111:20	51:25	55:20	group
112:23, 25	52:2, 16	56:14 93:6	194:10, 11,
113:9	generic	98:21	14
117:21	136:8	103:5	grow 124:5
118:16, 18	170:23	171:18, 22	guess 70:4
120:12	give 7:17	173:17	75:7 96:24
gave 17:24,	19:12	181:24	98:7
25 90:3	20:21	206:1	117:14
GB 59:13,	45:19 53:9	210:18	126:1
14, 24 65:6	55:1 56:8	211:21	138:7
gear 122:18	59:9 72:14	231:10	165:19
123:9	78:24	Google	166:4
general	86:2, 18	35:18, 21	198:24
77:24 91:6	90:13	38:4, 9, 14	228:18
94:20	93:22	government	Guide 236:25
128:9	108:3	102:7	guy 56:21
151:12	133:6	grasp 231:10	guys 146:9
generally	146:24	grave 133:24	
76:25 94:1	148:21	Gravois 6:18	
generate	152:6	14:14	H
117:14, 16	180:4	gray 48:10	
136:4, 10	203:19	81:23	H-a-l-l
178:23	222:24	great 9:22	191:13
193:19	231:3, 25	11:3 130:8	half 68:3
generating	235:12	187:14	172:7
158:12	236:8	greater	176:1
generation	237:3	206:25	181:22
	giving 47:5,		hall 120:25
	23 237:11		

121:3, 4	handling	hard-wired	hearing
191:9, 12,	163:3	165:20, 24	132:11, 12,
13, 16, 20	hands 198:24	hardware	18, 23
192:1, 2, 14	handshaking	43:24	133:1, 5,
193:6	96:3	44:23	14, 18, 25
194:2	handy 188:20	46:13, 22	134:4, 6, 9,
196:22	207:19	47:7	12, 13
197:13, 14	hang 156:1	48:10, 15	205:22, 23
198:8, 10,	happen 10:17	50:18	206:1, 3,
11, 13, 14,	11:12	54:22	11, 18, 23
16, 20	42:13	102:18, 23,	207:12, 16
199:7, 12,	45:16	25 103:3,	210:10,
13 201:12,	52:21	4, 19, 23, 25	212:11, 12,
13, 14, 15,	113:16	104:5, 12,	14,
19, 20, 22	114:19	15, 22	214:15, 20,
202:8, 9,	139:16	109:6, 7	25 215:4,
14, 25	202:19	119:2, 9	13 216:8, 9
203:7	217:11	120:24	218:6, 16,
221:18	219:17	128:11, 13	25 219:3,
halls	happened	130:15	5, 16, 25
203:23, 25	197:8	145:16, 18,	220:1,
hand 11:24	happening	24 146:2	221:3, 5, 9,
55:1, 3	66:24	harmonizer	224:15, 16,
117:15	219:17	125:1, 2, 3	17, 21
183:25	happy 213:21	harmony	helpful
204:14	hard 57:21	125:4, 5	11:10
hand-drawn	93:1, 5	Harvard	41:11
217:10	109:13	140:10, 15,	60:19, 25
handed	120:21	18 141:6	107:15
141:11	140:6	headlines	119:11
handle	155:7	73:18	216:15
169:18	166:3, 4, 8	hear 77:15	helps 50:20
189:17	170:20	heard	hey 174:21
handler	186:10, 13,	140:10, 12	hide 113:2
138:19	19	203:4	hierarchical
			109:15

QSC AUDIO PRODUCTS, INC. vs. CREST AUDIO, INC.

Daniel P.W. Ellis, Ph.D. on 06/27/2014

Index: high..imagine

112:3	155:20	162:8	31:11
high 46:19	host	167:7, 14	32:10
87:15, 16	110:10, 11	169:1	36:12, 13
127:22	hour 9:10	190:22	37:4, 15, 16
176:8, 13,	24:23	209:19	40:25 51:1
14, 20	62:11	230:18	52:25
177:21	181:22	ideally	61:6, 20
178:4	hours 16:5	94:17	68:18 90:2
179:13	25:2, 6, 11,	ideas 43:11	131:9
high-level	16, 23	identification	141:13
111:12	26:7, 10	11:22	183:24
215:7	housekeeping-	19:9, 10	185:4
high-speed	type 7:11	20:19	190:11
176:18, 21	huge 132:16	50:22	204:18
178:2, 10	human 83:9	141:9	identifying
179:6	Huseby 6:13	204:12	99:24
higher 90:5	hypothetical	identified	100:3
91:2 94:25	170:1	15:7 34:11	III 229:20
95:4	202:13	69:2, 16	illustrate
131:14		70:2, 16	66:6 67:23
historical		80:20,	illustrating
42:18, 20	I	150:21	127:5
history	I/o 165:10,	151:24	illustration
123:22	13 169:5	152:7	199:25
184:5, 7, 14	189:9, 20,	157:21	image 59:19,
hold 61:15	22 196:7	181:19	20, 22, 23,
65:23	IBM 87:25	232:21	24 60:1,
69:9, 11, 13	178:17	identifies	10, 14 62:4
70:6 74:18	181:19	58:21	74:9, 14, 17
107:24	idea 50:15	identify	images 74:19
hole 121:2	55:20	11:9 12:3	117:16
home	98:21	19:16, 20	imagine
156:15, 16	154:5	21:1	95:24
Honestly	159:10, 11	27:15, 22	117:7
	161:13	28:11	155:20
		29:25	

QSC AUDIO PRODUCTS, INC. vs. CREST AUDIO, INC.

Daniel P.W. Ellis, Ph.D. on 06/27/2014

Index: imagined..individual

156:14, 16	171:18	imposed	15:10 30:6
169:13	223:13	94:23	31:4 47:20
195:8, 9,	implementation	impossible	174:11
15, 18, 19,	171:20	120:22	222:14
20, 21, 24	172:8	impractical	including
198:19	193:6	212:14	17:16 43:9
217:9	202:22	impression	168:13, 15
229:1	implementation	24:3	171:1
imagined	s 46:5 47:1	151:21	195:2
195:6	125:10, 11,	164:8	225:22
imagining	17, 18	173:11	inclusion
49:12	195:15, 23	improved	48:18 76:2
146:9	implemented	89:15	incorporate
154:22	54:4 87:10	90:19	49:15
158:11	111:7	incessant	55:20
159:19	114:3	49:4	increase
180:1	143:5	incidentally	49:4
194:23	153:17	18:23	120:12
195:1	157:22	incline	increasing
immaterial	158:1, 6	57:13	42:24
87:9	165:25	include	128:5
immediately	166:1, 19	14:19	increasingly
107:17	171:6, 14,	27:16	121:14
115:22	15 174:13	28:12, 15	independent
217:17	201:25	81:7	101:5
impact	221:8	132:10, 13	indicating
132:16	implies	170:14,	59:11
146:23, 25	162:24	185:16	230:20
impediment	166:8	231:22	individual
48:3	important	included	48:23
implement	36:9 52:16	49:5 72:19	61:10 69:8
54:21	128:7	73:7 169:6	108:13
90:25	147:3	197:23	109:10, 13
112:18	174:24	includes	111:15, 20
158:15, 21	176:11, 23		164:3
	206:12		

QSC AUDIO PRODUCTS, INC. vs. CREST AUDIO, INC.

Daniel P.W. Ellis, Ph.D. on 06/27/2014 Index: individually..integrated

165:22	22:13, 24	131:13	28:1, 8
168:25	initially	137:21	32:22
220:8	107:18	148:2, 3	54:11
individually	202:13	170:4, 16	234:13
109:12	innovations	171:6	235:8, 13
industry	155:8	173:2, 4	236:2
89:24	input 125:3	195:24	237:5, 16,
116:12	138:12	217:14	24 238:8,
118:3	165:15	insight	14
inflexible	189:3, 6, 13	206:8	instruction
47:6, 13	193:19	installed	13:25
166:9	196:4, 8	134:4	53:24
information	209:4, 13	instance	54:1, 2, 9,
10:18, 22,	210:17	74:19	10, 19
24 11:1	211:15, 23	83:16	55:7, 17
33:21, 24	212:2, 3,	93:11	69:8
59:10	19, 21, 22	100:6, 9	149:11, 12,
72:14, 18	227:3, 6,	104:21	15
88:4 93:15	16, 17	121:25	instructions
99:10	Input/output	152:17	10:1 78:6,
100:22	168:2	174:14	8, 12
101:23	inputs 138:2	202:19	111:6, 8
124:22	221:5	203:23	112:19
189:10, 11	insert	207:8	113:11
196:20	178:16	215:21	197:1
218:1	185:19, 21	222:8	instruments
infrastructure	inserted	230:24	51:3 54:18
107:7	185:24	instances	125:5
inherent	186:1	8:11 45:14	insult 109:3
78:15	207:17	86:2 101:9	INT0 138:10
219:14	insertion	103:18, 23	INT1 138:10
inherently	201:13	104:14	INT2 138:10
190:21, 24	inside 58:18	149:2	integral
initial	60:4, 7	151:7, 8	182:22
21:7, 19, 23	111:14	instruct	integrated
		13:2, 22	

QSC AUDIO PRODUCTS, INC. vs. CREST AUDIO, INC.

Daniel P.W. Ellis, Ph.D. on 06/27/2014

Index: Intel.interrupted

120:14	139:6	19, 23	interfacing
143:10	161:13	172:3, 8, 23	131:12
Intel	203:10	173:13	169:18
116:13, 15,	215:1	174:18	176:3
16 118:5	224:20	175:4, 5,	internal
intend	235:19	12, 13, 20,	67:19
186:16	interests	22 177:11,	68:9, 15
intending	121:10	18, 19, 22,	143:17
153:21	interface	25 178:12,	144:1
intention	35:22, 23,	24 179:13	146:11
230:14	24 36:7	181:8	156:6
Inter 19:21	37:25 38:4	182:5, 12,	176:4
interacted	88:1, 18	23 189:9,	178:15
134:13	90:14, 25	17, 21, 23	207:12
interaction	91:1, 20, 21	193:15	217:23
21:16	92:6, 7, 24	196:7	internally
interconnectio	93:11	201:4	138:24
n 179:12	94:24	209:11	189:19
interest	95:6, 9, 15,	211:1	internals
42:4, 17	17, 22	214:7, 8	144:12, 14
52:10	97:9, 14,	215:3, 22	177:21
141:3	18, 19	216:23	international
interested	98:13, 16,	218:10, 17	204:20
35:10	22 130:16,	219:21	205:4
107:14, 23	25 131:2,	222:24	interoperabili
121:6,	4, 6, 8, 25	229:10	ty 180:16
122:15, 17	132:2	interfaces	interpretation
198:2	136:4	87:23, 24	183:5
interesting	137:5	90:11	217:18
42:23 52:6	162:18, 22,	91:23	222:11
54:16	24 163:2,	95:11 96:3	interrupt
58:24 93:3	14 164:6	130:6, 9,	103:16
94:6 112:4	165:9, 10,	12, 13, 23	138:7, 9,
121:5,	12, 13	135:13	15, 16, 19
	168:1, 2	165:18, 22	interrupted
	169:5, 21	169:11	
	170:2, 3,	171:20	
		189:1	

QSC AUDIO PRODUCTS, INC. vs. CREST AUDIO, INC.

Daniel P.W. Ellis, Ph.D. on 06/27/2014

Index: interrupting..keys

207:14	23 146:1,	158:12	150:8
217:6	4, 5 155:21	169:8, 11	157:17, 21,
interrupting	157:11, 23	188:17	25
142:10	162:14	involvement	items 80:19,
143:24	170:7	20:14 21:5	24 145:19,
147:2	181:5	23:11	24 146:2
200:15	200:13	involves	157:15
Interruption	214:18	103:25	IV(A)
91:16	inventions	110:7	185:12, 13
175:21	145:15	involving	
intrinsic	155:5, 6	159:7	J
69:19	inventor	161:13	Japanese
78:22, 25	204:25	IPR2014-00131	155:15
91:1	205:2	6:8	joined 14:12
intrinsically	inventors	iron 166:25	jot 173:19
90:23	148:14	irrelevant	jump 11:1
introduce	invoice	163:18	jumping
6:14 7:16	26:21	irrespective	150:3
116:6	27:3, 5, 10	237:22	207:21
154:8	invoiced	issue 9:16	June 6:1, 9
introduced	26:14, 17,	14:1, 11	
88:21	20, 24	21:2 28:21	K
89:7, 9	invoked 10:4	40:15 48:3	Kaustuv 6:20
invalidity	involve	64:16	key 192:13
32:17, 20,	105:1	82:10	193:12
25 33:16	145:6, 8	97:16	194:10
34:2, 7, 12,	156:5, 8	226:17	201:2
15, 22	175:20, 23	issues 7:11	keyboard
invented	215:21	9:17 12:14	191:17
156:9, 20	involved	16:18 41:6	192:2, 4, 8,
157:2	102:1	46:21	13 196:21
invention	104:4	187:23	keys 191:15
114:23	125:17	item	192:1, 3, 7
144:11	134:16	142:17, 19	
145:15, 20,	156:13		

kidding	191:21	212:1, 7	labels 76:10
238:10	199:16, 25	214:14, 25	77:12
kids' 45:5	204:22	215:16	laboratory
kind 47:3	209:20	216:5, 13,	195:2, 13,
56:2, 21	230:15	14 218:2	16, 24
57:5 62:4	231:10, 20	219:22	Labrosa
63:21 68:3	232:1, 2	221:6	101:3, 4
78:16, 17	kinds 37:19	222:10, 20	102:7
87:11	43:12 54:8	223:7, 16	labs 155:5,
93:17	77:23		6 156:9
99:16	85:21	L	159:21
107:17	90:24	lab 146:9	lacks 34:4
108:24	100:7, 25	154:22, 24,	language
114:12	102:17	25 155:3,	109:21
118:14	123:10	10, 13, 16	112:3
119:25	145:5, 6, 7	156:20	116:9, 18,
121:16	187:23	157:3	23 117:1
123:25	kit 108:22,	159:12	148:17
130:12	25	190:14	151:12
136:22	KM 233:4	label 58:21	191:14
138:1	238:11	59:15	languages
139:9	knew 140:15	61:17	109:18
153:23	knowledge	labeled	112:2
154:3, 23	43:7,	76:11, 12,	laptop
156:11, 13	44:21	13 136:24	107:21
157:12	53:10	142:18, 19	110:24
161:22	149:5	147:16	112:16
163:18	Krokstad	157:17, 25	large 46:15
164:2	204:23, 24	158:23	71:16 90:5
168:13, 14,	205:10, 13,	162:17	108:12
24 170:22	21 206:4, 8	174:2	112:23
175:18, 24	207:4, 25	207:9, 10	118:19, 20
178:19	208:16	216:19	139:8
179:16, 24	209:1, 3, 17	labeling	large-scale
188:16	210:6	51:25	120:13
189:17	211:14, 25	98:17	
190:1			

QSC AUDIO PRODUCTS, INC. vs. CREST AUDIO, INC.

Daniel P.W. Ellis, Ph.D. on 06/27/2014

Index: largely..longer

largely 114:1	leave 73:20 83:12	Lexicon 123:16 124:24 126:19	229:8, 12 link 86:13, 15 87:18, 19
larger 53:21, 22 84:10 129:16 133:21	leaving 183:7 led 121:10 151:25 152:7 191:22	licensed 115:6 light 74:2, 8 75:2, 12, 25 80:15, 16 160:21	links 97:7 listed 14:20 28:16 115:11, 12, 13
larger-scale 116:20	left 8:5 208:12		listening 198:23
latch 139:14	legal 28:22	likelihood 60:11	listing 132:9
latches 117:21 138:24 139:4, 8	lengthy 80:11 letter 203:16, 17	likewise 128:25 limit 118:20 176:12 223:3	lithography 117:11 LLC 6:21
late 20:3, 16 21:9 106:18 109:7 122:14 131:19	letters 98:18 level 50:8 82:24 87:15, 16 95:12 111:10, 15, 19, 20, 22 117:20 134:10 163:17 164:4 173:23 229:21	limitation 118:14 limitations 89:14, 16 113:2 limited 46:22 78:12 223:4	lodged 14:4 logic 47:2 49:3 93:17 111:15 131:12 136:10 137:16 153:23 160:24
law 24:4			logical 49:2
lay 60:2 85:16		lines 81:23 83:21 84:2, 5, 15, 18 87:5 97:1, 8, 23 98:3, 12, 17 111:11, 14 123:11 138:7, 9, 11	long 18:9 25:8 126:6 128:2 134:1 199:16
layout 109:19 145:24	levels 131:13, 14 136:11 174:20, 23 175:25 211:17		longer 126:1 196:12, 16
lead 151:1 171:19 233:4			
leading 36:18 128:12 232:11 233:2, 6			

QSC AUDIO PRODUCTS, INC. vs. CREST AUDIO, INC.

Daniel P.W. Ellis, Ph.D. on 06/27/2014

Index: looked..marked

looked	43:14	127:9	manner 63:12
49:21, 24	65:20	134:1	106:3
lose 69:22	100:4	144:20	225:25
	108:11	147:4	238:5
losing 69:24	115:17	152:22	
loss 132:18	123:16, 17	160:2, 12	manufacture
lost 210:22	212:18	165:5, 7	71:2, 23
		170:9, 18,	72:7 107:8
lot 86:4	main 68:1	20 180:13	114:4
91:8, 17	163:4	190:23	120:11
113:21	164:9, 20,	206:1	manufactured
121:8	24 165:2	210:5	30:17
155:9	168:1	223:3	71:4, 15, 22
179:23	175:6, 14		113:17
203:22	176:8, 10,	makes 42:20	125:2
	17 177:2,	76:2 99:16	162:11, 15
loud 203:5	7, 23 178:5	160:6	190:17
		167:9	
low 90:8	maintain	172:25	manufacturer
138:13	55:6, 14	173:1	54:18 56:4
low-level	major 124:25	186:3	57:12
163:10	make 11:14	214:18	155:15
174:19	14:10, 18	making 47:9,	manufacturer's
lower 58:16	22:17 32:5	10 113:12	126:23
59:22	34:1 50:18	133:21, 22	manufacturers
60:10, 13	53:25	144:17	55:14, 18
203:17	54:22	147:6	56:3
lowest	55:23 58:5	206:24	manufacturing
111:14	66:22	230:14, 16	71:16 72:8
lunch	74:18		
105:10, 16	81:10	manage	mark 62:9
	87:13	91:15, 18	
	93:12, 21	179:24	marked
	95:5		11:22, 24
M	108:25	manages 88:3	19:9, 10, 14
	111:21	manipulate	20:19, 23
machine	117:11	144:11	50:22
78:6, 8, 12	118:19, 21	manipulating	72:17 99:1
117:2	121:12	144:13	138:10
made 26:20			

QSC AUDIO PRODUCTS, INC. vs. CREST AUDIO, INC.

Daniel P.W. Ellis, Ph.D. on 06/27/2014

Index: market..mention

141:9, 11	33:18	192:5, 9	68:15, 17
204:12, 15,	183:25	220:19	70:1 76:25
18 207:13,	187:22	228:1, 4, 5	81:3 215:4
14	204:6	meant 84:6	memory 49:7,
market 45:13	215:19	94:3	13, 17, 25
55:21	221:7	121:22	52:24
56:15	MAX232	148:25	53:21, 23
marketing	131:10	216:19	68:9 69:5,
52:6	maximum 90:8	227:17	6, 16, 18,
marks 81:22	94:5, 6, 23,	measure	19, 21, 22,
mask 70:25	25 95:8	129:15	24, 25
71:17	Mckay 6:12	mechanical	70:5, 12,
72:23	Mead 6:19	65:5, 18	14, 24
masks	meaning	74:15	71:3, 12
117:10, 14	126:9	mechanically	72:2, 9, 11
mass 45:12	153:13	65:19	73:2, 3
71:14	176:14	mechanism	77:1, 2, 9
master's	222:6	108:13	78:2, 18
230:1	meanings	166:19	79:9
231:14	153:12	200:13, 18	93:20, 22
232:22	means 43:24	mechanisms	122:5
master's-level	44:23 55:5	35:20	123:23
230:3	69:6	Media 6:5	138:18
material	76:14, 18	62:18, 23	139:5, 7,
30:8 39:15	84:5 107:8	134:19, 24	10, 193:14
143:16, 25	138:16	183:13, 18	196:15
163:18	150:24	225:3	197:3
189:11	151:25	239:4	202:4
materially	152:8, 14,	medications	214:11
164:20	16 166:5,	11:13	218:9
matter 6:6	6, 8 167:14	meet	228:15, 17,
17:13	180:11	231:15, 19	24
20:14 21:5	182:20	memories	mention
23:11	186:19	67:19	45:11
	187:7, 9, 15		73:10, 14
			110:17
			158:10

QSC AUDIO PRODUCTS, INC. vs. CREST AUDIO, INC.

Daniel P.W. Ellis, Ph.D. on 06/27/2014 Index: mentioned..modifying

213:8	149:11, 14	middle 62:4	192:17
mentioned	163:3, 9	midway 220:6	mixed 78:18
18:22 22:8	165:13	million	model 55:7
25:14	168:1	112:24	models
40:10	169:19	millions	123:14
49:21 50:3	175:14, 18	132:17	modification
51:5, 15	176:6	mind 10:23	193:18
55:12	177:12, 17,	30:9	197:6
76:10	20, 25	194:18	200:16
88:18 96:8	178:12, 17	mine 42:17	222:6, 9
108:23	179:3, 13	minimizes	modifications
120:6	181:8	146:23	145:6
121:14	182:5, 12,	minor 175:1	163:11
122:3, 24	19, 24	minus 136:12	modified
123:9	186:4	minute	138:17
179:20	188:11	103:16	197:15
187:19	191:5	minutes 9:10	198:8, 11,
218:21	193:3, 4, 13	38:18	13 199:12,
mentions	194:8	80:12	18, 19
209:19	196:23	171:5	200:20
menu 179:7,	200:25	misplaced	201:13
12	202:10	149:18	202:6, 16
met 15:14	208:19	150:4	204:5
17:24	microprocessor	misspelling	221:22
18:9, 12, 18	47:3 54:12	151:3	222:3
metal 58:9	137:5, 7	misstate	modifies
60:6 65:21	177:5	87:1	201:5
method	193:1, 3	mistake	modify
148:23	microprocessor	217:11	154:11
218:18	s 48:14	mistaken	198:15
methods	50:17	127:4	228:21
218:2	mid 30:17	misunderstand	modifying
221:7	45:4		222:12, 13
microcomputer	122:10		223:22, 23,
146:21	123:19, 20		25 227:7,
	125:6		

QSC AUDIO PRODUCTS, INC. vs. CREST AUDIO, INC.

Daniel P.W. Ellis, Ph.D. on 06/27/2014

Index: modulate..number

22	moving 45:8	narrowly	nodes 164:11
modulate	122:7,19	153:15	non-intrinsic
96:5	multiple	native	79:6
module	83:14,17,	148:19	non-native
190:23	18 125:4	185:8,20	150:11
modules	143:15	191:23	non-removable
190:3	158:6,16	218:6	186:18,19
moment 50:25	159:7,11,	220:4	non-volatile
66:11 75:6	18,23	natural	69:16,24
100:11	160:1,5	154:9	70:12
107:25	161:8	211:20	72:9,11
141:12	162:15	naturally	non-volatility
146:23	164:13	76:18	69:18
188:22	174:6,11	nature 33:17	normal 78:17
204:15	186:25	54:24	Norton 6:11
216:12	188:13	82:5,9	nos 8:9
220:10	multiplication	nay 120:22	notations
223:15	46:23	necessarily	83:20
moments	multipliers	69:18	note 216:16
19:15	46:16	228:7	notice 12:5
morning 7:8,	multiply	needed 87:16	74:4 76:13
9 18:18	48:15	171:2	84:7
motivated	55:11	needing	136:23
134:12	music	189:15	noticed
motivation	122:15,16,	Newman 45:23	72:16
114:2	19	nice 42:17,	73:14
199:25	N	20 89:24	noticing
Motorola	named 86:8	114:7	149:23
56:9,11,23	204:25	116:5	notion 88:8
57:17	names 50:14	121:18	November
63:23	82:19	122:3	131:20
move 12:17	85:25 86:4	nineteen	number 7:19
41:20	211:16	169:4,16	
moved 217:22		171:11,15	

QSC AUDIO PRODUCTS, INC. vs. CREST AUDIO, INC.

Daniel P.W. Ellis, Ph.D. on 06/27/2014

Index: numbers..occasion

14:4 36:25	230:8	91:22	161:2, 10
37:5	231:6, 24	94:11	162:5,
46:14, 15	232:11, 17	95:7, 23	163:23
49:4 56:14	233:2,	97:11, 20	164:22
58:18, 21	235:13	98:10 99:4	165:11
81:24, 25	objection	100:14, 21	166:14
82:1, 2	14:3, 22	101:17, 21	167:18
83:15	15:21 16:1	102:20	168:4, 18,
112:23	19:4 22:2,	104:17, 24	23 172:1,
118:16, 17	19, 25	106:14	5, 16
120:12	27:8, 18, 25	114:5	173:21
130:16	28:17 31:5	115:4	175:15
136:6, 24	32:2 34:4,	118:12	176:19
137:9	23 35:5	123:8	177:3
139:8	37:7 38:2,	124:17, 20	179:8
149:2	10 40:6	125:19	188:4
158:20	42:7, 14	126:14	189:24
217:14	43:6, 22	127:2, 18	194:7, 22
229:4	44:5, 13	129:12, 22	196:2, 24
numbers	45:10	130:11	203:9
46:23	46:3, 11	133:8	205:8
58:19, 20	47:17	135:24	206:9
70:6 82:4	48:6, 20	136:21	212:25
84:10 97:4	49:9 51:11	139:18	215:17
numeral	52:4 53:2,	141:21	218:4
142:20	14 54:15	142:6	223:9
147:16	57:24	143:11	230:12
165:10	64:10, 21	144:16, 22	obliterated
189:2, 9	65:3, 9, 14	145:3, 13,	202:4
	66:16	22 146:3	obvious
	74:13 76:8	152:2, 11	126:7
o	80:25	153:19	223:11
	82:7, 11,	154:16, 17	obviousness
oath 11:20	17, 23	156:10, 21	230:17
object 13:1	84:13, 19	157:24	occasion
227:11, 25	86:16	158:9, 25	34:21 42:5
228:11	87:20	159:8	119:2
229:16	88:14,	160:7	

134:8	108:4	179:12	179:24
141:16	121:19	order 107:6	overly 91:25
occur 125:16	177:7	144:10	97:16
177:9	opinion	146:5,12	overview
181:5	13:11	163:25	37:9
off-the-shelf-	33:13 41:1	179:3	overwritten
type 92:16	163:19	214:25	201:17,18
office	206:6	ordinary	owner 6:17,
114:13,17,	208:23,	175:3,11	19
24 115:3	229:25	206:2,6	
	230:10	211:22	
omitted	opinions	223:11	P
232:4	27:17	227:21	
on-board	28:13 30:2	229:9,15,	p.m. 105:9,
49:7,13,25	31:13	22,25	12 134:21,
one-to-one	32:12	230:11	25 183:15,
60:12	33:6,7,8,	231:1,4,	19 224:25
ongoing	17 34:3	13,21	225:4
189:16	opportunity	232:6,15,	226:6,9
operate	29:15	21,24	233:18,21
146:16	52:23	233:11	239:6,7
176:8	63:2,3	original	P.W. 7:1
operated	105:17	173:11	package
201:1	108:3	174:4	59:12,13,
operation	119:9	origins 43:3	14,25 60:8
55:11	135:3	output	packages
79:3,4	161:23	147:7,8	64:12,18
80:6,8	225:11	165:16	65:8 66:3
138:21	234:6	189:4,7,13	packaging
139:2	opposed	193:19	54:7
203:20,21	118:6	outputs	pages 209:1
204:8	147:5	196:4	paid 24:3,
operations	option	outstanding	5,23
44:15	118:19	9:25	paper 37:9
50:19 55:9	179:22	overhead	38:20,23
	options		

QSC AUDIO PRODUCTS, INC. vs. CREST AUDIO, INC.

Daniel P.W. Ellis, Ph.D. on 06/27/2014

Index: papers..patent

45:21	180:10	176:11	35:3, 9
papers 36:17	182:7, 10	182:22	36:19 38:1
paragraph	parallel-type	202:17	39:3, 8, 14,
75:7	84:12	207:16	19, 20
186:6, 13	parameter	218:22	40:4, 12, 22
187:4, 10	188:1	222:12	141:14,
188:2, 9	193:25	228:21	143:16
209:3, 8	194:6, 13	Partes 19:22	144:1, 8, 9
211:2, 4, 7	227:8	partially	146:10, 17
218:6	parameters	169:22	148:6, 15
219:13, 18	193:20	171:20, 21	152:6, 8, 15
220:7, 11,	197:18, 21,	172:22	153:16
13 226:25	23 198:5,	parts 78:7	154:21
227:18	6, 18, 21	130:16	155:4, 12,
229:20, 24	199:1, 8, 9	175:19	23 156:1,
231:23	214:11	185:3, 5, 7	18 157:11
paragraphs	220:25	198:4, 25	162:9, 20
185:16	228:16	party's 28:4	167:7, 10,
210:19	parens 68:5	past 100:16	11 173:23,
parallel	parenthesis	108:21	24 174:9
84:15 85:1	203:18	patent 6:17,	175:4
86:14, 21	parse 14:1	19 14:11	179:7
87:3, 8, 18,	16:7	16:9, 10	187:13
22, 23, 24	part 17:2	17:13	188:18, 20
88:1, 5, 8	32:19 35:4	18:11	191:8, 15
90:11, 14,	54:18 68:2	19:22	204:20, 21,
25 91:1, 4,	69:12 72:6	20:14	22 205:5
5, 7, 9, 18,	93:9 105:2	21:2, 24	206:7, 19
21 92:2, 5,	115:1	23:3 24:22	207:5
7, 13, 18, 20	130:18	25:3, 6, 12,	211:18
93:18, 25	148:2	15, 18	226:16
94:1, 21, 25	158:4	26:14, 15,	227:22
95:5, 15, 17	171:15	25 27:7,	229:10, 15
96:9, 18	173:14, 15	13, 14	230:1, 23
97:17	175:19	32:16, 21	231:1, 5
140:7, 9		34:16	232:15, 25
179:16			233:11

QSC AUDIO PRODUCTS, INC. vs. CREST AUDIO, INC.

Daniel P.W. Ellis, Ph.D. on 06/27/2014

Index: patents..picture

patents	116:12, 13	100:3, 4	19:21
26:11	127:10	175:3, 11	226:17
115:5, 10	132:17	206:2, 6	petitioner
150:12	139:13	211:21	6:21 24:5,
155:5	230:25	223:11	12, 16
156:8	231:3	227:21	Ph.d. 7:1
path 87:18,	people's	229:9, 14,	231:11
19	99:10	22, 25	232:7
paths 83:15	perform	230:11, 16	phone 21:7
Patrick 6:11	53:17	231:1, 13,	photo 117:11
pause 19:2	55:11	20, 21	phrase
pay 190:19	179:3	232:2, 7,	116:10
payment	193:18	14, 21, 24	171:24
27:5, 9	220:3	233:10, 11	phrased
PC 87:25	performed	personal	99:16
178:17	25:5	123:23	physical
181:19	193:18	124:14	45:25
219:3, 4	218:8	218:11	48:23
PCI 178:15	228:2	personally	59:24
179:20, 23	performing	122:1	113:12
180:7, 19	44:9, 15	persons	144:20, 23
181:18, 19	performs	231:4	194:25
182:3, 4	72:4	232:6	212:13
PCS 88:25	period 39:5	perspective	physically
pending 9:14	periods 9:10	94:20	145:2
people 39:11	peripherals	126:25	165:21
43:8 51:24	89:25	198:2	186:22, 24
52:2 55:23	permanently	pertain	picture
57:1, 5, 7,	182:21	211:7	58:15
11, 12	186:23	pertaining	59:14,
89:25	person 39:21	34:15	64:17
107:9, 14,	52:25	211:5	136:25
16 108:3	80:14	pertains	186:3
114:15	99:24, 25	142:12	216:6
		petition	

QSC AUDIO PRODUCTS, INC. vs. CREST AUDIO, INC.

Daniel P.W. Ellis, Ph.D. on 06/27/2014

Index: pictures..possibilities

pictures	136:24	61:25	86:5, 8
110:20	137:9, 10,	64:15	88:2, 5, 24
piece 89:3	11, 14, 15,	86:20	91:4, 5, 8, 9
92:12	16 138:10	109:10	92:13, 18,
190:16	139:2	112:24	20 93:18,
194:24	168:7, 8,	113:13	25 94:4, 25
195:1	17, 21, 25	122:4	95:1
228:20	169:7	127:6	96:16, 18
	175:5, 13	128:22	110:9, 10
pieces 65:20	176:2, 5	129:6	130:17
161:22		138:18	135:18
pin 58:19,	Pioneer	140:8	183:1, 2
22 59:15	162:1, 2	149:6	209:4, 13,
60:9 61:14	171:24	170:14	14, 17, 21,
137:11	place 111:20	172:7	23 210:1,
138:14, 15	200:24	181:16, 25	4, 7, 13, 17
183:8, 9, 10	217:17, 21	191:21	211:1, 15,
pin-out	places 81:6	216:16	23, 24
58:7, 8, 11,	plan 9:9	221:14	212:2, 3, 4,
12, 22	play 32:24	235:20	13, 19, 21,
59:7, 20	203:5	pointed	22, 23
68:13	player	96:25	213:13
72:17	124:25	pointing	227:3, 7,
pin-outs	playing	59:19	16, 17
58:4	125:5	219:9	portion
136:23	pleasurable	points 15:5	237:15
pins 59:8	121:7	poll 138:6	portions
60:6, 13	plug 58:6	poor	170:23
61:3, 9, 10,	67:7, 9	148:17, 18,	ports 85:21,
12, 13, 18,	89:20	22	25 86:9
24 62:1, 2,	190:8	poorly	93:24 94:1
3, 7,	195:21	150:22	posed 10:20
63:15, 17,	plugging	Porsche 57:2	238:7
19 65:18	215:21	port 85:18,	position
66:21 67:8	point 9:1	22, 23	31:3 33:1
84:9 93:16			possibilities
98:25			

201:14	40:12	preset	primary
possibility	preceding	196:21	94:14
213:8, 9	43:16	press 199:13	printer
possibly	129:4	202:8	92:20
31:17	precise 23:7	pressed	prior 34:22
33:15	preferable	193:13	40:5, 9, 16,
56:16	126:8	197:14	19, 23 41:3
163:11	preparation	pressing	63:5
posts 60:6	12:20 13:6	198:14	124:10
potential	14:7 16:16	presume	163:7
21:4 83:9	17:21	151:19	190:12
potentially	18:10 20:7	155:2	237:11
94:4	25:11, 23,	215:13	238:4
118:19	25 26:4,	presuming	privilege
power 107:24	15, 24	126:24	9:17, 18
133:19, 22,	27:14, 23	pretty 26:2	10:3, 7
24	prepare	77:14	13:1 17:3,
powerful	13:13 35:4	87:24	4 27:25
108:1	prepared	120:21	28:21
121:22	191:16	125:20	29:20
128:10	192:2, 3, 9,	155:7	32:23
129:3	10	170:24	34:24 41:6
practical	preparing	prevent	234:16, 17,
43:1	13:11 25:5	223:2	20 235:2,
230:3, 24	26:17	prevents	13, 21
practice	27:6, 11	69:23	236:3, 12
122:16	35:9	previous	237:6, 17,
161:6	216:20	66:20	25 238:9,
173:18	present 9:24	216:16	15
228:14, 15	17:20	previously	privileged
236:25	88:24	206:24	16:18 22:3
precedence	192:8	price 127:10	23:17
125:8	presented	primarily	24:14 32:7
precedes	16:25	120:11	33:21, 23,
	17:12, 17		24 234:14
			236:9, 10

QSC AUDIO PRODUCTS, INC. vs. CREST AUDIO, INC.

Daniel P.W. Ellis, Ph.D. on 06/27/2014

Index: problem..production

problem	44:10, 11,	15, 22	7, 13 169:2
10:14	14, 16, 24	199:11	172:24
100:18	46:14 47:5	200:15	174:10
	55:10 81:3	201:1	177:22
problems	100:24	203:22	186:5
100:25	101:1	204:5	188:11
120:17	102:25	205:25	189:14
121:15	107:13, 16	206:11	193:15
198:3	108:18	220:3	197:3, 4
procedure	121:16, 19	227:7, 8, 9,	205:24
171:19	122:18, 19	23 228:2	213:4, 13
193:23	123:22	230:5	222:25
process	126:2, 3	231:12, 15	
11:10	127:21	232:9, 24	processors
37:18 43:9	128:12, 14		41:24 42:9
72:7 80:11	129:10, 16	processor	43:1, 20, 24
116:20	130:14	38:16	44:4, 20, 23
117:11	132:12, 20	40:10 42:6	45:25
120:21	147:2, 17	43:15	46:5, 6, 9,
129:16	148:4, 6,	44:12	21 48:17
142:10	10, 23	46:13 47:7	49:11, 21
143:25	149:8, 9	48:8, 19	52:3 53:10
146:20	152:18	51:20, 24	119:20
158:11	153:1, 3, 5,	52:13, 19	159:7
169:8	8, 14, 21	53:12	231:9
170:13	155:9	78:17 83:7	produce
174:19	156:6	102:10, 14,	71:14
206:20	159:13	16 104:22	125:3
	162:7	112:17	
processes	174:6	119:18	producing
205:23	193:16, 24,	122:2	89:25
processing	25 194:5,	138:16	product 13:2
30:16	12, 14	143:8	33:5 100:7
35:11	196:12, 14,	144:12	159:22
36:18	16 197:7,	147:18, 20	161:12
37:10	15, 17, 18,	148:8, 24	168:11, 12,
39:6, 21	21, 22	149:4	13 203:20
43:25	198:9, 12,	152:16	
		153:1, 2, 4,	production

QSC AUDIO PRODUCTS, INC. vs. CREST AUDIO, INC.

Daniel P.W. Ellis, Ph.D. on 06/27/2014

Index: products..purpose

72:1	193:13, 22	228:22	provide
122:16	194:9		21:13
products	197:1, 9, 10	programming	38:25
6:7, 21	201:1, 6, 7,	48:1, 9, 11	69:20 74:8
55:24	9, 10, 11,	55:6 68:14	120:16
159:21	12, 15, 17,	72:5	168:14, 24
160:15, 17	24 202:2,	112:12	180:16
	5, 9, 12	207:11	230:15
program	209:4, 12,	210:17	
47:9, 16, 21	14 210:2	211:1, 15,	provided
54:13	214:25	22, 23	10:25
67:17, 18	215:12	212:2, 19,	28:3, 13, 20
68:4 69:13	223:5, 22	21 227:3,	30:1, 6, 19,
70:19, 24	224:8, 10,	4, 6 228:23	25 31:12,
71:1, 3, 13,	13 228:20,	programs	24 32:3, 6,
22 72:2, 5,	22	201:23	11 33:1,
8 76:11,		progression	10, 11
13, 14, 15,	programmable	48:17	74:24
25 77:2, 9,	71:3 73:2,		130:18
16, 24, 25	23 221:15	project	publications
78:2, 5, 9,	programmed	102:7	35:23
18, 22, 25	70:25	projects	published
79:5, 9, 25	71:17	116:20	205:5
80:4, 6, 8,	72:23	190:5	223:6
13, 21	programmer	PROM 74:25	pull 138:13
81:4, 5, 7,	54:11, 23	properly	207:20
11 82:14	55:1 67:9	136:12	pulling
83:17	72:3	property	172:14
86:21	208:13	69:19	purpose 42:2
97:24 98:3	209:2, 7,	130:13	63:17
112:5	10, 11	protected	67:12
137:21	210:4, 14	9:18	82:16
138:17, 18	212:24	prototype	96:13
140:16, 21	213:3, 12,	154:23	99:18
149:9	25 214:5	prototypes	113:24, 25
164:18, 21,	215:20	161:17, 21	120:23
23, 25	224:1		128:9, 11,
165:3	227:5		

QSC AUDIO PRODUCTS, INC. vs. CREST AUDIO, INC.

Daniel P.W. Ellis, Ph.D. on 06/27/2014

Index: purposes..RAM

13 178:24	26:3 27:22	17:1, 7	11:14, 18
180:15	30:1 31:12	22:20 24:7	29:20 36:3
purposes	33:1 39:8	26:19	63:12
79:7	63:7 185:8	28:1, 5, 6,	101:25
131:16	225:24	9, 31:23,	106:3
164:13	QSC'S 13:21,	25 32:3, 4,	181:25
199:3	23 18:21	5, 9 33:20,	184:6
push	22:24	22, 23	225:25
137:21, 22	27:15	44:19	229:4, 7
pushing	28:12	54:16	233:14, 25
65:21, 22	30:19	85:9, 24	234:3
put 47:4	31:24	86:18 98:5	238:6, 21,
61:17 67:7	32:10, 25	99:18	25
72:3 73:18	33:16	103:22	quibbled
77:15	34:2, 7, 12,	104:25	186:10
130:23	15, 22	112:5	quickly 7:12
160:3	63:2, 4, 11	122:22	9:13
161:24	105:17, 19,	123:5	125:16
162:11	23 106:2	124:12	
163:20	225:12, 14,	130:8	
171:1, 4, 23	18 234:10,	152:3	R
172:3	25 235:18,	157:18	R-a-m 68:23
174:21	25 237:2,	158:14	radios
207:17	10, 11	179:11	121:24
212:11, 14,	238:5, 21	188:8	RAM 68:22,
16, 18	qualify	199:10	23, 25
216:24	170:6	206:5	69:5, 8, 10,
puts 174:4	quantity	217:25	16 76:12,
putting	129:15	220:12	16 79:23
195:9	question	229:11	146:22
	8:22 9:3,	234:14, 23	188:1
Q	5, 14, 15,	235:4, 14,	200:5, 11,
QSC 6:6, 21	19, 25	16 236:24	12, 14
18:10	10:2, 4, 9,	237:6, 17,	201:10, 17,
21:12, 23	19, 20, 21	25 238:9,	24 202:10
	13:19, 21	20	207:14
	16:17	questions	214:2, 7, 9
		8:4, 8, 20	

QSC AUDIO PRODUCTS, INC. vs. CREST AUDIO, INC.

Daniel P.W. Ellis, Ph.D. on 06/27/2014

Index: RAMS..received

216:7,8, 10,19,22 217:7,15, 16,18,20, 22 218:9, 20,25 219:13,14, 15,22,23 220:11,12, 15 RAMS 213:14 217:19 ran 35:15, 16 36:7 38:8 random 69:5 218:8 range 91:10, 11 203:23 206:25 rapid 177:8 rapidly 46:24 90:21 rare 87:24 rate 46:24 91:2 94:5, 6 rates 90:5, 11 re-cover 124:23 reached 167:22	read 66:19 69:7 96:9 133:11 137:12 138:21 139:2 141:16,20, 22,23 142:3 148:15 149:12,15, 23 150:20 191:17 196:8,9 216:5 220:10,13 227:9 233:7 read-only 68:9 71:3 73:2 read-write 137:11 readable 117:2 reading 150:2,10 151:21 152:5 219:8 reads 194:9 200:25 ready 123:5 138:14 real 108:5	121:1,13 190:14 realization 194:25 realtime 121:10 reask 33:22 reason 8:23 11:17 46:12 59:15 71:13 90:3,19 93:6 96:12 110:17 119:23 120:1 126:7 127:16 158:10 162:9 217:14,21 222:23 228:20 reasonable 25:20 44:17 86:22 165:7 reasons 11:13 47:23 57:8 recall 10:17 12:6,24 15:23 16:20,23	17:9 18:8, 20 19:23 20:1, 21:6 22:7,8,10, 12,22 23:7 26:23 27:1 30:21 31:8 32:19 34:13,19, 21 36:8,9, 10,20 37:8,11,19 39:9 42:10 43:20 44:21 48:12 50:14 88:21 106:7 122:9 123:14 135:12,16 141:19 142:1 149:22 151:7,9 185:11 205:15 221:25 recalling 151:10 receive 84:18 98:23 received 27:5,9 101:11
---	--	---	--

112:19	recognizing	redesign	207:4, 20,
138:13, 22	100:25	64:5	208:25
receiver	recollection	redesigning	209:7, 22
136:9	20:15	58:1	214:18
receives	21:10 25:4	redirect	referenced
112:18	36:23	225:22	15:2, 25
113:11	45:21 89:1	234:12, 19	18:1 31:2
137:24	124:10	235:1, 7,	41:5, 17
138:2	150:9	12, 25	56:24
receiving	206:15	236:1, 17	73:25
227:4	reconnect	237:3, 11,	96:13
recent	186:25	14 238:4, 7	references
100:15	reconnected	reduced	14:9, 10,
119:8	188:12	162:3	18, 20
recently	reconsider	169:14	15:6, 25
20:5	28:6	reducing	16:8 39:1
107:11	record 6:4	169:1	40:13
108:9	7:16 8:8	redundant	132:14
121:14	29:9, 12	149:1	208:16
131:10	62:20, 24	151:12, 14	210:21
recess 29:11	105:7, 8, 11	refer 30:11	220:11
62:21	134:17, 21,	141:15	referencing
105:10	138:25	162:20	19:13
134:22	183:15, 19	reference	75:14, 16
183:16	224:23, 24	14:10, 17,	referred
225:1	225:4	18 38:23	38:17
226:7	226:5, 8	90:13	53:13
233:19	233:16, 17,	111:23, 25	204:23, 24
recited	20 239:6	129:6	referring
14:20	recorded	136:25	51:9 67:3
22:11	8:4, 5	141:15	68:10, 11
recognizable	recording	152:8	75:2
48:9, 13	122:20	204:23	116:11
recognize	recordings	205:11, 13,	142:20
102:8	45:16	21 206:8	143:9
			145:18

QSC AUDIO PRODUCTS, INC. vs. CREST AUDIO, INC.

Daniel P.W. Ellis, Ph.D. on 06/27/2014

Index: refers..replace

163:6	related 16:9	remain 53:7	remind 8:15
220:15	34:15 38:1		63:17
224:13	142:5	remainder	163:21
	143:21	195:4	226:15
refers		remains	
152:19	relates	201:16, 18	reminded
207:10	47:19 68:8		37:21
	104:10	remember	
reflect		21:7	removable
196:5	relating	22:14, 17	182:4, 11,
	12:21 42:1	23:2, 3	20 186:17,
refresh		27:2 30:18	21 187:2,
52:24	relation	35:15	3, 6, 9, 15,
	12:25	37:22	17, 20, 25
refused	relative	38:8, 13,	188:3, 9
238:24	176:14, 15	15, 20	207:4, 15
regard 21:4		45:7, 8	212:6
31:23	released	63:24 97:2	213:11
35:24	66:3		214:1
39:3, 8, 25	relevance	115:17	
40:15 90:4	27:8 42:14	123:18	removably
230:25	99:17	150:3, 5	189:20, 22
235:6		151:11	190:6, 13,
	relevant	174:17	21, 24
register	16:4 18:15	184:15	194:20
96:17	22:4, 7	185:5	195:3
138:21, 23	39:16, 18	199:10, 15	212:23
139:4, 23	40:11, 21,	221:17	227:6
registers	22 41:3	229:11	
70:3, 4, 5,	115:21	234:3	remove 196:4
8, 11 81:3	119:6		
96:15	145:21	remembered	render
113:8	230:23	30:12	153:22
		106:22	rendering
regular	relied 13:11	107:11	170:1
107:21	31:13, 15		
	32:4, 11	remembering	renowned
relate 36:17	33:6, 8, 12	11:1	123:19
47:18	47:1		
90:17		remembers	replace
145:20	rely 145:15	139:15	57:22
			63:23

QSC AUDIO PRODUCTS, INC. vs. CREST AUDIO, INC.

Daniel P.W. Ellis, Ph.D. on 06/27/2014

Index: replaced..responsive

replaced	53:17	38:22, 23	57:21
89:11	183:1, 5	39:8, 14	88:11
120:5	reprogram	40:1, 3	90:10
126:3, 4	218:15	41:18	100:19
127:16		100:24	106:13
202:4	reprogrammed	134:11	116:22
	218:7	146:9	124:11
replacement	219:24	154:25	126:13
125:10, 17	220:2	158:12	132:22
127:13	224:15, 20	160:16	164:18
replacing	reprogramming	167:4	168:21
221:25	80:11	researchers	191:19
228:9, 13	218:8	154:22	209:1
report	request 9:13	researching	respond
216:24, 25	100:5	39:3	13:3, 19
reported	requested	reserved	28:1
146:10	99:3	239:8	responding
reporter	require	resident	10:8
6:12, 15	46:18	68:11	responds
8:5, 8	57:25 64:4	resource	107:17
Reporting	66:2, 4,	37:25	response
6:13	126:7	118:14	10:25 11:6
represent	146:5	respect	34:18
165:20,	228:7	15:24	122:23
182:24	required	18:21	135:16, 20
183:3, 8, 9,	65:25	20:13	163:7
10 212:3	93:10	21:12, 24	184:8
represented	requirements	23:25	221:2, 4,
58:12	133:19	24:21	13, 16
98:15	requires	25:3,	222:9, 13,
167:10	75:2 80:12	26:15, 24	15, 16
191:4	179:23	27:13	223:25
representing	research	29:20	224:1, 12
24:16	30:17	32:21 35:8	responses
represents	35:3, 8	39:13, 19	8:7
		50:9 52:2	responsive

10:18	reverse	revolution	romantic
100:7	139:16	42:22, 23,	57:10
rest 218:25	review 11:25	24 43:2	room 9:24
220:10	12:1 13:23	123:25	roughly
restricted	14:7 15:6,	124:2, 5,	26:10
77:1, 2	16:15	11, 15	round 74:4, 6
result 40:3	17:20	125:9, 16	row 61:12
197:6	19:22	127:12	rows 61:10,
resulted	34:21	rewrite	11, 13
114:4	50:25	228:19	RS-232 86:5
results	52:23	ribbon 92:2,	88:24
37:20	66:11, 23	4	89:6, 7, 8,
158:12	141:12	rid 174:2	11, 14, 23,
retailer	204:16	risk 17:3	25 90:7, 8,
126:24	216:12, 16	Riverside	15, 18, 23
retain 55:4	218:1	7:18	92:1
retrieve	223:15	Robert 6:18	130:17
197:1	reviewed	14:13	131:14
return 63:14	12:21, 24	Rodney 6:22	136:5, 12
returned	13:5, 15, 18	role 179:24	180:24, 25
38:14	14:9, 18	ROM 70:25	181:8
reveal	15:2, 8	71:12, 17,	207:9
235:17	16:10	22 72:9,	209:4, 10,
revealing	18:2, 20:7	15, 21, 22,	12, 21
235:21	22:4, 13,	25 74:8, 11	210:1, 3, 7,
reverb	15, 23	76:4, 5, 13,	13 211:24
126:20	23:19 31:3	19 80:7	212:3, 4,
reverberator	32:25	113:15	12, 213:13
123:17	142:1	ROM/EPROM	214:7
126:19	205:10, 13,	68:5 70:20	216:22
reverberators	17	71:6 76:11	218:10, 17,
123:11	reviewing	78:10	19 219:21
	16:4, 8	79:25	rule 28:3
	17:10	romance 57:8	33:10 91:7
	30:18		213:24
	32:20		
	226:22		

rules 29:5	science 65:25	sentimentality 57:9
run 7:10	141:3	seeking 30:24
8:11 94:4	scope 101:13, 19	separate 69:10
108:6	230:13	75:19
121:12	231:6, 24	81:25 88:6
133:25	232:12, 18	selected 138:2
198:20	233:3, 13	209:5 140:16, 21
202:3	scratch 179:18	160:18
running	screens 36:24	186:22, 24
107:21	search 35:14, 15,	190:17, 20,
110:11	18, 21, 22,	23
121:9	24 36:7, 21	send 84:18
142:8	37:5, 19	separately 26:20
143:23	38:4, 8, 14	145:19
201:7, 11,	searches 35:16	separation 186:3
12 202:13	38:8, 14	217:23
runs 103:3	searching 35:20, 23	sequence 23:4, 8
RX 98:22	Seattle 6:1	215:19
	secondary 218:9	serial 85:2,
s	section 185:12, 13	3, 7, 14, 18,
sacrificing 121:9	218:9	21, 22, 23,
safe 128:25	229:20	25 86:5, 7,
sampled 69:9	237:1	8, 10
scale 69:7	secured 65:13	87:17, 22,
scenario	securing	23 88:1, 2,
147:13		18 91:4, 8,
200:19		20 92:8,
202:1		13, 18
204:4		93:10, 15,
scenarios		25 94:20
218:21		95:1, 6, 15,
schematic 68:1		21 96:10,
		16 97:19,

QSC AUDIO PRODUCTS, INC. vs. CREST AUDIO, INC.

Daniel P.W. Ellis, Ph.D. on 06/27/2014

Index: serial-type..signal

22, 25	140:8	226:3	66:21, 24
98:4, 13,	192:11, 13	shortly	68:1
16, 22	197:1, 2	21:18	208:15
130:25	220:8, 20	22:23	209:3
131:1, 4, 6,	sets 55:17	show 13:13	sic 104:7
8, 25 132:2	109:16	14:23	side 58:9
135:18	137:8, 9	58:12	61:7, 11
136:3, 17	setting	59:7, 23	62:2, 6
137:23, 24	210:10	62:1 67:22	92:13
138:2, 12,	settings	74:17	93:15
13 139:1,	207:12	151:1	217:13
17 140:1, 3	share 10:19	172:11, 14	side-on
181:16	40:18	173:7	61:12
207:10	55:22	188:19	sigma 203:16
serial-type	57:20 69:4	191:13	signal 30:16
181:14	87:1 99:7,	223:7	35:11
series 51:3	13 100:10	224:9	36:18
56:11	118:24	showed	37:10
81:12	122:23	13:15, 18	38:16
120:5	201:15	showing	39:6, 20
123:17	shared 39:4	13:10	40:10
service	41:8	59:19	41:23
23:25	124:3, 21,	66:18	42:6, 9, 25
services	23	83:21	43:15, 20,
27:6	sharing	shown 28:20	23, 25
session	126:23	59:12	44:3, 10,
225:7	sheet 41:15,	60:10	12, 16, 20,
set 53:24	17 42:13	70:15 73:8	23, 24
54:1, 2, 9,	shelf 92:19	80:16	45:25
10, 19 55:7	shine 80:14	88:12	46:5, 6, 9,
58:19	short 58:21	150:25	12, 14, 20
81:1, 4	81:23	165:19	47:7
84:22	139:11, 12	168:22	48:17, 19
108:12	196:4	214:8	51:20, 24
109:15, 20		shows 59:8,	52:3, 13, 19
113:7,		24 64:17	53:10, 12

QSC AUDIO PRODUCTS, INC. vs. CREST AUDIO, INC.

Daniel P.W. Ellis, Ph.D. on 06/27/2014

Index: signals..situation

55:10 83:6	21, 22	129:3	97:16
102:9, 10,	198:9, 11,	silence	simply 72:19
13, 15, 24	12, 15, 22	196:10	simulate
104:22	199:11	silicon	120:25
107:13, 16	203:22	54:4, 5	203:23
119:18, 20	204:4	107:9	simulating
121:15, 19	205:24	108:11	113:14, 16
122:1, 19	206:10	117:9	simulation
123:22	210:17	similar	125:4
128:14	211:1, 15,	20:12	singing
129:10, 15	22, 23	40:11 70:5	125:4
132:11, 20	212:2, 19,	80:20 81:4	single 26:21
136:4	21 213:3,	104:15, 23	27:2, 10
143:8	12 220:2	107:12	81:23 91:3
144:12	227:3, 4, 6,	108:22	96:16
147:17, 18,	7, 8, 9, 16,	116:8	109:11
20 148:3,	17, 23	138:1	139:14
5, 7, 9, 25	228:2	164:24	143:10
151:4	230:5	165:3	158:1, 4
152:16, 18,	231:9, 12,	217:9	159:3
25 153:1,	15 232:8,	220:25	160:2
2, 3, 4, 5, 7,	24	238:20	161:12, 21
8, 13, 14, 21	signals	similarity	169:2, 7, 14
155:8	43:9,	83:3	170:11
159:6, 12	69:10 92:5	similarly	sir 140:23
169:1	168:6	82:22	sit 122:8
172:24	196:1, 13,	137:14	site 37:9
174:6, 10	17	168:2	sitting
177:22	signature	simple 46:17	138:11
186:4	239:8	223:12	situation
188:11	significance	simpler	10:12
189:3, 4, 6,	51:7	71:19	72:22
7 193:14,	147:15	228:18	73:21
16, 19, 24,	significant	simplistic	219:20
25 194:5,	119:24	91:25	
12, 14	significantly		
197:3, 4, 6,			
14, 17, 18,			

size 118:18	139:10	166:25	117:4
133:19			127:15
134:3	smaller 47:3	solution	151:17, 19
212:13	70:6 96:25	99:3	
skill 175:3,	smallest	100:1, 19	space 141:2
11 206:3, 7	139:6	103:25	spaces
211:22	smile 59:5	126:9, 12,	140:16
223:12	smoothly	13 127:14	
227:21	147:4	146:13, 14	speak 8:12
229:9, 15,	so-called	180:20	9:23 10:7
22, 25	47:1 92:20	solve 100:19	29:15
230:11	93:13	101:20	39:7, 13, 23
231:1, 4,	socket 64:23	120:17	45:3 49:10
13, 21	65:1, 4, 13,	sophisticated	50:3
232:1, 6,	19 66:5	121:19	53:12, 24
15, 22, 25	67:6	sort 36:14,	54:8
233:11	sockets 66:7	16 173:10	100:18
skipping	software	175:25	105:17
201:2	103:2, 7,	194:11	120:8
slice 47:1	13, 14	197:22	122:3, 7,
48:8 49:10	109:23	199:1	10, 25
slight 222:6	110:6, 7,	sought 38:1	124:20
slow 94:9	11, 14	sound 99:16	135:3, 6, 9
143:19	112:8, 9, 10	100:24	184:22, 25
144:4	113:1, 4	101:1	234:9
181:2, 3, 4	116:7, 24	191:10, 16	235:24
slower 95:11	117:5, 13,	192:1	speaker
slowing	16, 23	193:6	148:20
45:15	121:9, 16,	194:3	150:11
small 36:25	18 222:25	201:2	191:23
37:5 100:6	solder 117:8	203:5	speaking
108:5	166:21	205:23	18:20
117:10	soldering	221:5	70:11
118:20	65:25	sounds 100:8	116:25
134:2	66:2, 4	108:22	126:24
		116:24	135:13
			160:25
			speaks 74:1

QSC AUDIO PRODUCTS, INC. vs. CREST AUDIO, INC.

Daniel P.W. Ellis, Ph.D. on 06/27/2014

Index: special..start

172:12	150:8	177:1	stack 70:4
173:10	153:11, 13	178:4	stadium
special 51:6	155:11	179:14	203:3
120:23	221:2	speeding	stadiums
121:20	specifically	45:15	204:2
128:11, 13	22:15 30:3	speeds 90:11	stage 71:23
145:8	46:20	Spell 50:3	stand 29:3
178:23	57:16	53:13, 24	standard
special-	61:25 69:9	54:8	55:9, 13
purpose 46:6	78:6 93:12	122:3, 7,	65:8
specialize	133:13	10, 25	89:22, 24
171:2	194:9	Spencer 6:18	91:3
specialized	203:25	spending	109:18
44:24	specification	15:24	110:12
45:15	90:20	spent 16:5,	131:8
46:13, 22	113:5, 10	8, 13 18:15	136:5
48:15	116:9, 18,	25:11, 22	160:23
50:18	23 117:3	26:17	180:12, 15,
105:6	221:4	split 25:20	16
107:4	specifications	26:10, 12	standard-type
134:15	90:24	spoke 184:24	65:1
155:10	specifies	225:13	standardization 58:4
172:9	46:14	236:6, 17	standardized
specially	speech 45:16	spoken 18:22	54:14
71:15	speed 45:23	24:11 96:3	89:23
192:11	47:18	spreading	standards
specific	53:20	125:21	94:24
10:12	82:10 90:4	spring	stands 69:5
22:22 34:9	93:24	126:20	110:1
45:19	94:18	spun 115:2	137:3, 4
58:10 65:4	95:5, 9, 10	square	start 21:21
77:22	120:12, 13,	58:16, 19,	24:8 87:15
100:9	23 128:5,	20 60:5	108:20
122:24	20 176:8,		
127:20	10, 12, 13,		
131:16	14, 20, 23		

159:16	step 37:1,6	streamline	subscript
182:3	215:15	15:11	203:17,18
206:5	steps 215:9	stretching	subsequent
208:7	stick 57:13	139:9	22:13
234:24	60:7	strict 40:8	71:23
started 43:8	stop 10:21	strictly	120:4
124:3	196:9	25:18	subsequently
starting	store 76:19	strong 183:5	171:12
119:13	96:17	struck	substance
122:4	214:11	192:18	10:3 63:8
149:8	stored 67:18	structure	105:20,24
167:15,21	71:1 76:15	167:4,8	184:25
184:13	80:7	struggling	200:13
starts	139:23	147:19	225:15,19
200:18	222:25	student	235:11,22
210:16	stores 76:14	123:22	236:1,7,8,
218:6	139:15	students	14,15,17,
220:7	storing	108:3	18 237:2,
state 8:20	70:24 78:1	studio	13,22
74:22	straight	122:16,18	substituting
106:12	58:6	123:9,10	228:5
117:6	straightforward 228:19	125:1	successive
118:1	strange	studios	55:15 88:4
119:15,19	192:18	122:20	successor
177:7,21	223:1	study 230:20	88:24
stated 44:22	strategy	stuff 107:22	suddenly
statement	13:10	194:13	217:22
71:24	stream	198:19	Sudo
132:15	136:3,5	style 170:18	141:15,17,
157:1	137:23,24	styles 169:2	20 142:1,
statements	138:3	subject	5,12,14,
138:18,19	147:9	187:22	16,25
230:16			143:6,21
status 138:4			147:12,21,
stay 219:15			23 148:6

QSC AUDIO PRODUCTS, INC. vs. CREST AUDIO, INC.

Daniel P.W. Ellis, Ph.D. on 06/27/2014

Index: sufficient..system

152:5, 8, 15, 17 153:6 155:12 157:7 158:8, 17 160:5 161:7 162:15, 22 163:13 164:7 166:12 167:10 170:7 172:11, 12, 14 173:6, 20 176:9, 24 177:13 181:7 185:19 187:2, 3, 6, 9, 11, 17, 20, 22, 25 188:19, 24 189:23 190:25 191:8, 15, 19 193:5 194:21 199:20, 23 208:16 210:18 211:2, 5, 8 221:17, 22 222:1 229:5 sufficient 232:1	suggest 63:11 79:15 106:2 176:23 225:24 238:5 suggested 199:22 216:11, 14 suggesting 174:1 203:11 210:3 215:25 219:8 suggestion 158:8 223:16 suggests 74:7 77:21 143:14 167:2 223:7 suit 219:24 224:16 suitable 180:25 206:22 sum 203:20 summarize 81:10 summer 20:16 21:9	supplied 149:10, 14 supplying 165:15 support 130:9, 25 135:14 145:16, 18 supported 131:25 supports 131:7 172:11 173:20 surely 155:16 sureness 73:15 surrounding 217:12 swallow 125:12 swear 6:15 switch 113:9 128:21 136:11 switches 113:13 switching 120:13 123:21 206:24 sworn 7:3	symbolic 42:21 synchronizes 177:6 synthesis 45:3 system 47:5 48:8 69:23 102:24, 25 121:1 122:5 130:14, 15, 19, 22 132:15 135:18 142:9 143:2, 15, 23 145:16 146:23, 25 147:17 148:4, 6, 10 150:24 152:1, 9, 14, 18 153:1, 3, 5, 9, 14 154:5, 6, 10, 12, 23 156:7 157:12, 14 158:2 159:10 162:8 163:9 165:16 167:5, 8 168:7, 13,
---	---	--	--

QSC AUDIO PRODUCTS, INC. vs. CREST AUDIO, INC.

Daniel P.W. Ellis, Ph.D. on 06/27/2014index: systematically..teachings

14 170:1,	taking 11:12	48:22	232:2
19 173:12,	33:1 126:6	50:13	talks 191:8
14 174:5, 8	176:2	63:14, 22,	215:1
175:1	198:3	24 70:19	219:12
176:13, 16	237:18	75:5, 8	220:20
177:4, 5, 9,	238:1, 16	76:3, 25	221:12
17 180:3	talented	84:14 87:4	223:25
182:22	39:11	88:16	224:9
188:16	talk 12:16	96:11	tangible
189:3, 6, 19	48:21	106:6	154:15
190:1	53:25	107:1	157:10
195:11, 12,	75:11	120:10, 19	taped 113:16
22 209:20	87:22	123:24	115:20
215:4	104:6	124:16	task 46:22
218:12	125:9	127:12	54:12
231:9	130:7	128:8	taste 213:18
systematically	132:3	129:7	teach 78:14
23:9	139:4	145:5, 7, 14	107:13
systems	158:20	151:15	187:20, 25
108:18	186:16	161:3	200:16
110:13	191:3	163:15	teaches
127:22	208:10	164:17	161:7
132:1, 3	219:13	167:12, 13	172:14
145:7	223:23	169:1, 25	207:4
146:12	234:18, 23,	171:10	214:25
153:21	25 235:8,	175:24	222:8
155:9	11	189:1	223:7
159:20	talked 12:14	190:13, 14	teaching
163:1, 2, 6	124:4	194:2	121:15
166:17	179:14	199:24	163:24
176:15	181:15	200:2, 4, 5,	206:5, 8
	210:18	7, 9 208:18	209:2
	221:20	209:24, 25	218:14
	222:4	210:1	221:6
	235:6, 9, 23	213:15	teachings
table 60:14,	223:22	221:17	
16	224:18, 21	223:22	
takes 113:4	talking 11:4	224:18, 21	
	32:15 34:7		

39:19	216:24	147:25	theoreticians
tech	220:1	193:4	141:4
114:13, 24	temporarily	test 154:5	theory 161:1
115:2	138:25	156:12	thing 28:7
technical	ten 16:5	testified	30:8 54:14
28:22 51:2	25:23	7:3	88:17
technically	38:17	testifying	93:23 94:6
139:14	127:21, 25	16:23 17:9	99:16
159:2	128:2	testimony	107:5, 18
technique	129:1	15:14	109:5, 8
117:15, 17	185:16	39:12	114:7
techniques	tender 226:2	63:5, 8	115:23
145:7	tending	105:21, 24	139:1, 16,
technological	125:12	135:7, 10	19 141:23
122:17	tens 109:9,	171:13	147:19
technology	12	184:19	149:3
43:12, 16	term 31:20	185:1	150:15, 20,
54:24 89:8	40:9 77:22	225:6, 15,	23 151:10
119:24, 25	78:4,	19, 22	157:13
126:8, 10	79:15, 16	234:11, 19	162:1
136:23	87:3	235:12, 25	169:4, 14
181:16	139:11, 12	236:1, 7, 17	170:15
206:4, 21	144:13	237:3, 13,	175:24
telephone	153:10	15	178:19
7:19	154:13	testing	180:17
telling	178:4	161:1,	189:13
78:11 84:4	186:10	230:4	194:12
85:11	187:2, 8, 17	Texas 51:3	203:4, 6
143:7	188:2, 9	54:18	209:14, 16
160:4, 10	222:10	text	212:5
171:5, 7, 22	terms 37:19	110:20, 23	215:10
173:5	41:3 85:12	112:5, 11,	217:8, 16
190:25	89:8	15, 20, 21	222:23
191:2, 19	109:20	114:16	228:25
194:18	133:19	162:18, 20	230:17
		219:8	235:19, 21
			things 12:18

QSC AUDIO PRODUCTS, INC. vs. CREST AUDIO, INC.

Daniel P.W. Ellis, Ph.D. on 06/27/2014

Index: thinking..TMS27C64

36:14, 16	56:9, 11	23:13	170:7
45:15 47:8	99:14	25:11, 17	179:6
48:23	100:9, 11	26:15, 17	181:24
51:21 59:6	101:5, 9	29:10	183:14, 19
77:12	102:6	45:9, 20	188:6
91:9, 10	103:20, 24	46:10	201:7
94:12	123:16	53:18	206:12, 17,
99:15, 19	127:20	56:12	22 213:23
107:15, 24	150:10	62:19, 24	216:1
108:15	151:8	69:7 71:1	219:2, 5
111:17, 23	166:15, 16	78:20	224:25
112:1	171:10	84:18, 24	225:4
113:9	230:16	90:6 96:1	226:2, 6
117:8	231:20	102:6	233:15, 18,
121:24	thought 38:6	105:12	21 238:24
123:10, 11,	39:5 73:16	108:5	239:5
21, 23	87:4 94:16	119:25	times 11:8
124:4, 8	116:5	120:18, 21	126:12, 15,
125:6,	158:24	121:1, 6, 13	17 141:19,
128:11, 12	217:2	122:18	22, 23, 24
133:20	232:7	128:4, 8	186:25
144:6, 8	thousand	129:17	188:13
156:14, 15	126:20	130:18	190:9
160:1	thousands	131:12, 17,	203:12
161:24	109:9, 12	22, 24	205:15, 16
163:12	throughput	132:6	238:20
166:20, 21	94:23	134:20, 25	timing 23:4
168:15	95:1, 4	135:20	163:12
170:17	thumb 91:7	136:7	title 79:7, 8
189:16	TI 45:3	143:18	148:23
190:2	time 6:9	144:3	151:6
192:22	7:13 9:11	149:24	titles 36:24
196:6	15:23	150:23	tittle
200:1	16:5, 7, 14	153:16, 17	173:19
217:13	19:17	154:21	TMS27C64
thinking		157:10, 23	66:23
43:9 49:1,		159:3, 13	
2 51:12		166:25	

75:16, 17	132:6	9 220:7	218:17
TMS320	135:18	topics	transferred
41:15, 16,	TMS320E25	231:8, 10,	146:21
23 42:6	66:22 75:8	12 232:9	149:10, 13
51:3, 4, 6,	today 8:21	topology	216:10
16, 19, 22	11:15, 18	117:22	218:24
52:17, 18	12:12, 13	total 16:4	transferring
56:14,	18:25 19:7	25:6 27:3	142:8
57:16	25:9 34:22	82:2 104:1	143:23
63:18, 23	48:19		219:12
67:24	105:21, 25	totally	transfers
70:15	106:6	80:13	181:5
74:20	122:8	211:19	193:13
106:6, 9, 11	128:23	touch 65:19	201:3, 6, 9,
119:13, 18	184:19	toy 45:5	23 218:19
120:4	225:8	traces 97:18	transistors
124:7	238:22	117:19	49:5
128:16, 20,	today's 6:9	training	136:13
23 129:1,	12:20 16:3	230:18	transition
8, 24 130:6	17:21		42:25
131:25	18:10, 21	transcribed	183:6
132:22	19:3	217:10	translating
135:13	116:9, 10	transcript	174:20
136:20	told 17:10	14:5 121:2	175:25
140:18	115:9	200:6	translation
141:6	124:8	233:7	163:3, 11
164:18	161:7,	transfer	174:23
165:4	198:25	55:25	transmit
TMS320C10	tone 102:8	90:5, 11	95:10
129:4	tool 110:11	91:18	98:23
TMS320C20	117:23	92:14 96:5	transmitter
56:16	tools 109:15	114:13, 16,	136:9
TMS320C25	116:7, 8	24 115:2	transposed
52:22	117:13, 16	154:3, 8	227:13
129:3	top 61:7, 8,	189:18	
130:9, 22		201:2	
131:17			

traveling	turns 107:19	97:8 203:2	ubiquitous
16:2	138:3		127:23
Treaty 205:6	177:19	typically	ultimate
trend 107:25	203:10, 20	46:24	176:12
Trial 236:25	tweaks 203:1	90:25	ultimately
trouble	Twenty-five	130:15	24:4 162:3
186:9	128:18	132:23	ultraviolet
troubles	TX 98:23	138:4	74:2, 8
8:16	type 7:10	163:8	75:2, 12, 25
true 57:5	24:25	typing	Um-hmm 91:12
76:20, 23	65:2, 24	110:19	95:20
95:2 97:22	72:15 74:1	112:11	104:8
118:4	75:25 76:4	185:6	135:15
150:13, 17	79:10 83:6	typo 148:25	137:2
155:22	87:8 88:18	151:17	179:23
truth 91:6	92:3 93:19	217:3	229:6
truthfully	97:9, 17	typos 149:16	234:5
11:18	100:18	150:21, 25	unable 143:9
Tuesday	109:23	151:19	173:19
15:9, 10,	110:5, 15	152:6	uncertain
16, 24	112:17		53:7
18:2, 7, 12,	130:6, 9	U	unchanged
16 25:23	134:12		201:16, 19
Tullett 6:22	135:13	U-a-r-t	unclarity
10:7 21:8	139:5,	93:13	9:1
turn 58:23	166:10	136:8	unclear 8:22
61:1, 22	177:24	U.S. 204:21	uncomfortable
66:9 67:21	178:10	UART 93:13	139:13
114:12	179:5	96:17	undefined
129:25	180:20	136:8	182:7, 10
183:21	184:3, 5	137:13, 17,	underneath
185:8	185:3	20, 22, 24	62:7
208:3	214:16, 22	138:1, 8,	understand
226:13, 20	218:10	11, 20, 24	
	types 69:16	139:17, 23	
	70:14 73:5	140:2	

QSC AUDIO PRODUCTS, INC. vs. CREST AUDIO, INC.

Daniel P.W. Ellis, Ph.D. on 06/27/2014 Index: understandably..universe

9:4 11:20	147:12	52:15	25 191:4,
12:13 13:4	150:14, 24	53:4, 9	18 192:6
15:13, 18	152:21, 22	56:18	193:5
25:10	162:21, 22	57:15, 20	194:20
28:22	173:9	60:23	198:7
29:18	175:4, 7, 8,	61:24 64:4	201:10
31:1, 19, 20	12, 177:16	65:24	202:11
37:3 39:10	188:5	67:10, 12	207:3
42:12	189:1, 5	68:7 69:1	210:6
46:25	190:25	70:10, 20	214:14, 24
47:2, 12	191:8	71:11	220:16, 19
48:2 51:17	192:3, 7, 8,	72:13, 20,	222:22
64:2 71:5,	10, 12, 22	24 74:20	228:12
24 72:21,	193:1	75:15 76:6	229:14
22 74:9, 18	194:4, 11	83:5 85:13	understood
75:17	196:22, 25	87:7 89:6	9:4 15:16
77:18 82:9	201:17	90:10	81:11
83:13 84:1	205:20	96:22	83:14
86:10, 14	209:18	98:16	94:16
87:1, 10,	211:4, 14,	106:12	194:19
12, 13,	22 212:2	119:20	224:12
90:17	215:10, 16	124:10	230:21
95:16	218:14	128:25	
96:21	219:6	130:2, 10,	unimportant
101:13	220:22	24 146:19,	36:22
104:10, 25	221:2, 6	25 147:20	unique 10:13
107:14, 16	227:22	153:18	unit 44:11,
113:23, 24	229:10	154:14	14 215:23
119:1, 7	understandably	155:11, 19	units 68:1,
122:21, 23	202:25	162:2, 21	21 81:3
123:2, 24	understanding	165:18	169:9
124:2	12:11	176:9	190:17
126:17	31:22 32:1	177:12, 15	217:12
127:11, 17	40:18, 20	179:5	
133:6, 7	45:24 46:4	181:6	universal
142:5, 23,	49:7, 20, 23	187:1	86:7 136:9
25 145:1	50:5, 9	188:15	universe
146:15		189:8, 23,	

QSC AUDIO PRODUCTS, INC. vs. CREST AUDIO, INC.

Daniel P.W. Ellis, Ph.D. on 06/27/2014

Index: unplug..ways

166:12	219:25	version	voltage
unplug 190:8	220:1	66:19	131:13
unsure 41:20	224:16, 17	153:23	175:25
update	user's	versions	voltages
200:5, 9	112:24	123:12	90:21
207:12	users 120:16	versus 90:7	131:14
updated	UV 74:25	VHDL 109:18	163:11
78:19	80:14, 16	112:2	volts 136:12
updating		video 121:24	volumes
188:1	v	127:22	71:16
200:14		128:1, 12	
upper 59:23,	vague 84:13	view 61:7,	w
24 60:1	values 69:9,	8, 11, 12	wait 74:3
68:3	10 78:7	62:6	115:20
usage 31:20,	79:4 81:2,	111:12	waive 17:3
22 85:17	25 137:22	112:24	walk 12:15
211:20	193:21	127:6	23:9, 14
USB 86:7	197:2	139:8	43:5 122:8
88:18, 21,	200:14	173:14	215:9
23 89:1,	201:18	viewpoint	wanted 86:20
11, 15, 17,	variable	126:23	93:22
19, 22	79:14, 18,	views 61:7,	110:17
90:7, 15,	21, 24	8, 13	130:22, 23
18, 19, 22	80:3, 4	Vivek 6:16	140:7
92:19	variety	VLSI 107:5	143:18
110:9, 10	170:12	109:6, 7, 14	144:3
111:1	193:21	112:3	163:21
112:16	vary 53:11	117:25	171:3
130:17	170:17	vocabulary	190:9
181:11	venue 34:16	54:13	Washington
usefully	verbal 8:7	voice 45:3,	6:1
194:14	Verilog	23	waste 133:21
user 83:10	109:18	volatile	149:23
209:6	versed 40:8	69:17, 22	ways 41:14

QSC AUDIO PRODUCTS, INC. vs. CREST AUDIO, INC.

Daniel P.W. Ellis, Ph.D. on 06/27/2014

Index: web..year

64:12,18	6,7,24	8 26:21	Wow 238:18
85:6	76:2	27:3,10	wrap 75:6
107:14	wire 88:5	42:5 102:6	write 54:23
110:19	92:1 140:6	105:1	72:2,5
188:1	170:20	107:21	110:23
195:8	wired 166:3,	108:4	111:6,23,
web 35:14	4,8	111:17	25 137:13,
website	186:11,13,	114:11	192:23
107:22	19	120:19	216:7,8
Wednesday	wires 81:2,	134:8,11	228:25
15:15	4,12,14	146:10	writing
17:25	88:3,6	156:13	77:24
18:16,17	96:4	160:15	109:23
26:2	112:22	230:3	111:8
week 15:8	140:9	worked 25:2	148:22
25:7 142:1	wiring 67:1	42:8 56:25	197:8,10
205:18	wondering	57:19	228:24
weeks 21:18	87:7	115:24	written
weird 150:4	word 14:17	134:10	21:11,14,
well-informed	68:22	231:14	17 69:7
39:11	96:16	232:23	71:4 113:8
well-known	139:7	working 39:6	137:18,20
56:12	174:8	48:8 55:23	146:22
wheelhouse	186:13,16	109:22	148:19
59:3	224:20	116:12,19	150:10,
Whichever	wording	154:7,25	151:22
154:25	192:18	155:2	192:15,19
wide 81:22	229:8	173:24	wrong 102:23
203:23	words 68:4	196:9	189:21
wider 91:10,	78:9	230:22	208:5
11	148:13	works 108:5	wrote 23:21
width 54:5	153:12	138:4	
window 74:5,	227:13,15	world 132:17	Y
	work 10:13	160:4	
	13:2 25:4,	worry 121:12	year 54:25
		worth 25:9	157:23

years 36:18

87:25

100:16

108:21

110:14

113:19

117:25

127:21

128:1, 2, 3,

15, 17, 18

129:2

yeses 8:8

yesterday

7:11, 22

8:2, 3, 12,

19, 21 9:9,

10:14, 16

11:4, 8

12:15 14:4

15:12, 14

16:3 20:12

25:14

26:23

32:15

39:12 73:4

108:23

115:15

238:22

York 7:19

Z

zeros 196:9