UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

APPLE INC.,

PETITIONER,

V.

RESONANT SYSTEMS, INC.,

PATENT OWNER.

CASE NO. IPR2024-00697

U.S. PATENT NO. 8,093,767

DEPONENT: BLAKE HANNAFORD, PH.D.

TAKEN: JANUARY 27, 2025

REPORTER: DANNIELLE COPELAND
REGISTERED DIPLOMATE REPORTER
CERTIFIED REALTIME REPORTER
CALIFORNIA CSR 14444

STENOGRAPHICALLY REPORTED REMOTELY VIA ZOOM VIDEOCONFERENCE

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I N D E X

EXAMINATION: PAGE

BY ATTORNEY RUBIN 4
BY ATTORNEY DEUTSCH 89
BY ATTORNEY RUBIN 92
BY ATTORNEY DEUTSCH 96

CERTIFICATE 99

E X H I B I T S

NONE MARKED

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

THE DEPOSITION OF BLAKE HANNAFORD, PH.D., TAKEN PURSUANT TO NOTICE HERETOFORE FILED, VIA ZOOM VIDEOCONFERENCE, ON JANUARY 27, 2025, AT APPROXIMATELY 9:02 A.M., PACIFIC TIME, UPON ORAL EXAMINATION, AND TO BE USED IN ACCORDANCE WITH THE CALIFORNIA CODE OF CIVIL PROCEDURE.

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Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

BLAKE HANNAFORD, PH.D., AFTER BEING FIRST DULY SWORN, WAS EXAMINED AND DEPOSED AS FOLLOWS:

EXAMINATION

BY ATTORNEY RUBIN:

Q. Good morning, Dr. Hannaford.

A. Good morning.

Q. So I don't believe we've met before, but I am an attorney representing patent owner --

A. Mr. Rubin, you're very -- your voice is very quiet for hearing it, and my -- we're pretty sure that my computer's turned up to the max on my volume.

Q. All right. Sorry. I --

A. This is much better. This is much better.

Q. You know, I thought I turned up my mic earlier, but I had instead turned up my --

A. No, you fixed it.

Q. -- speaker. Sorry.

So you can hear me just fine now; is that right?

A. Yes.

Q. All right. Well, let's go on.

Have you been deposed before?

A. Yes.

Q. How many times?

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

1 A. About seven.
2 Q. Okay. And were those all cases where you
3 were an expert witness?
4 A. Yes.
5 Q. How many of those were IPR cases?
6 A. I've never been deposed for an IPR before.
7 Q. Were the other cases --
8 A. I've contributed to them, but they were
9 patent litigation in, like, International Trade
10 Commission or federal court. One case was a -- a
11 copyright infringement, but mostly they're patent
12 infringement cases.
13 Q. And were you offering expert opinions on
14 behalf of Apple in any of those other cases?
15 A. I have.
16 Q. Which cases were those?
17 A. I'd have to go look at -- you know, it's
18 several years ago, and I would have to go back and look
19 at my list to -- to give you the details.
20 Q. Okay. Would all those be listed in the CV
21 that's -- I believe is attached to your declarations in
22 these cases?
23 A. It's usually not in my CV. I have a
24 special document that lists -- it's like a spreadsheet
25 of my previous expert witness engagements, and I know I

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

supplied that at some point. I don't know if you've been provided with that or not.

Q. We'll come back to that in a minute -- in a few minutes. Let me just finish with the preliminaries.

You understand today that you're under oath just as if you were testifying in a court of law?

A. Yes, I do.

Q. Okay. And the purpose of today's deposition -- or at least one of the purposes is to get a -- a clear record of your testimony. We have a court reporter here today, and she's taking a record of everything that's said here. Particularly since we don't have a video recording, though, it is important that all your testimony be in the form of words as opposed to non-word utterances or -- or gestures.

Do you understand?

A. Understood.

Q. And also, it's important so that our court reporter can -- can do a good job that we not talk over one another. So I ask that you please make sure you give me a chance to finish my answer -- or my question, rather, before you start answering, and I'll try my very best not to talk over your answers.

Is that fair?

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

A. Sounds good.

Q. And if at any point you don't hear or don't understand a question, please let me know and we'll try to make sure that you clearly understand the question.

Is that fair?

A. I will do that.

Q. And do you agree that if you do answer a question, it's fair for us to assume that you've -- that you've heard the question and understand it?

A. I will certainly try to make sure I understand the question before I give you an answer.

Q. Okay. So we'll generally be taking a break for a few minutes at the end of every hour, hour and a half of testimony. If you do need a break before that, please let me know. I will ask, though, that if there's a question pending, you answer the question before we take the break.

Is that fair?

A. Understood.

Q. Is there any reason you cannot give complete and accurate testimony here today?

A. No.

Q. Okay. Are you sick today?

A. I am not.

Q. Are you on any medication today that would

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

1 affect your memory or your ability to testify?
2 **A. No, I am not.**
3 Q. And at some points during today's
4 deposition Apple's attorneys may object to some of my
5 questions, but you still have to answer the question in
6 spite of the objection, unless you're specifically
7 instructed not to answer.
8 Do you understand?
9 **A. That is my understanding.**
10 Q. All right. So today we're here in this
11 deposition to address declarations that you submitted
12 on behalf of Apple in support of two IPR petitions,
13 both challenging the same patent, the 8,093,767 patent.
14 Do you understand that?
15 **A. That's correct, in my understanding.**
16 Q. All right. And just to make sure it's in
17 the record, the -- the two IPRs that Apple has filed
18 challenging that patent are IPR 2024-00697 and
19 IPR 2024-00698.
20 Do you have any pertinent materials with you
21 today?
22 **A. I have physical copies of my -- the two**
23 **declarations freshly printed out and given to me by**
24 **counsel this morning.**
25 Q. Do you have copies of any other exhibits

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

from these two IPRs, such as patents or other prior art?

A. This laptop has a folder that contains those.

Q. Are there any other materials on that laptop that -- well, withdrawn.

Who owns the laptop that you just referred to, if you know?

A. Counsel, their firm. Fish & Richardson.

Q. All right. So the materials from these IPRs, were those loaded onto the laptop by somebody working at Fish & Richardson?

A. That's my understanding, yes.

Q. Are there any materials that you have access to on that laptop other than documents that have been filed in these two IPRs?

A. Not that I'm aware of. I certainly have not done some kind of search of this laptop, but I have one specific folder that I've opened, and that one contains only those materials.

Q. Okay. How many files are there in that folder?

A. A lot. I don't know the number, but it's dozens.

Q. Well, during the course of today's

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

deposition I'll be asking you to look at certain exhibits. I'm -- well, I guess withdrawn.

Do you know whether -- withdrawn.

The documents in those -- in that folder you referred to, are those all PDF files?

A. I -- I -- again, that's not a thing I systematically checked, but I think the predominance of them are -- at least the predominance are PDFs. I did not -- I don't recall seeing any other types in there.

ATTORNEY RUBIN: Well, let me ask counsel.

Is the witness right that the files in that folder were loaded by counsel at -- or staff at Fish & Richardson?

THE WITNESS: That was a question for you, I think.

ATTORNEY DEUTSCH: Counsel, can you repeat that?

ATTORNEY RUBIN: Yeah. So I -- you know, I -- I just want to make sure that I understand what the documents are that the witness has been provided and will be accessing during today's deposition, but I -- I don't want to spend too much time on this if we don't have to.

So the witness's understanding is that there's a folder on the laptop that's in front of him

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

that was prepared by counsel or staff at Fish & Richardson.

Is -- is that correct?

ATTORNEY DEUTSCH: Yeah. Counsel, the -- there's just a file -- clean file from the record that was made available to the extent you request that he pulls anything up.

ATTORNEY RUBIN: Okay. So that was the main question that I had for you.

The folder just contains documents as filed in the -- in the PTAB docket in these two IPRs without any modifications to them?

ATTORNEY DEUTSCH: That's correct.

ATTORNEY RUBIN: Okay. Very good.

ATTORNEY DEUTSCH: That was our understanding from the -- the arrangements I made.

ATTORNEY RUBIN: Okay.

BY ATTORNEY RUBIN:

Q. So during today's deposition, Dr. Hannaford, I'll be asking you to -- asking you questions about specific documents or directing you to look at specific documents.

If at any point you look at a document on that computer other than a document that I've directed you to or asked you about, could you please let me know

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

what it is you're looking at?

A. Yes, I will do that.

Q. Thank you.

THE WITNESS: I just realized I can't mouse this -- either the Zoom or the folder onto the other screen, so I'm effectively on this -- sorry. This is just an IT thing. I'm effectively on just one screen, which -- which I can make it work, but -- yeah. Maybe the IT can come in during a break and enable that. It's no big deal.

ATTORNEY RUBIN: All right. Well, do let me know if there are any technical issues that are --

THE WITNESS: I will.

ATTORNEY RUBIN: -- interfering with your ability to answer questions.

THE WITNESS: I will do that.

ATTORNEY RUBIN: All right.

BY ATTORNEY RUBIN:

Q. So -- so you submitted two declarations in these two IPRs that are both dated April 12th, 2024; is that right?

A. That's correct. That's my signature date, anyway, yeah.

Q. Okay. And are you able to -- well, I guess I would like to be able to refer to the two

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

1 declarations by the IPR case number that they were
2 filed in, so I would like to be able to refer to them
3 as the -- as your '697 declaration and your '698
4 declaration.
5 Do you have a way of telling which one was filed
6 in which of the IPRs?
7 **A. Actually, on my copy they both are labeled**
8 **12/782,697, if that's what you're referring to. I**
9 **don't have a '698.**
10 Q. All right. So the -- I think the number
11 that you just read off was the number listed under
12 application serial number, which is the -- a number
13 that identifies the patent application that ultimately
14 resulted in the '767 patent.
15 **A. I did read it from the application serial**
16 **number. I'm sorry if that was just like a coincidental**
17 **match of '697 or something.**
18 Q. No.
19 **A. I don't have those numbers on my copy.**
20 Q. Yeah, it is a coincidence, but you're
21 right. Those three digits are matching.
22 **A. Okay.**
23 Q. So both of your declarations list the -- on
24 the first page list the application serial number.
25 They're both -- they're both declarations. That

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

application serial number is the same because it's the same patent.

So I think, though, probably the way to distinguish the two declarations in your printed copies would be from the attorney docket number, which is sort of near the upper right-hand corner of each declaration.

A. Yes. Those are different numbers.

Q. Yeah.

So the -- so one of the attorney docket numbers ends in the characters P1, and the other one ends in the characters P2?

A. That is right.

Q. All right. And the -- withdrawn.

So the other attorney docket numbers, as I understand it, correspond to internal numbers assigned at Fish & Richardson for each of these IPRs, and I assume the documents -- the declarations that you have in front of you don't list the actual IPR number because that -- those numbers hadn't actually been assigned when this was being prepared before they were filed.

So I think it's going to give us a cleaner record if I can refer to the declaration that has a P1 in it as the '697 declaration and the one that has a P2 in it

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

as the '698 declaration.

A. Honestly, my -- my impression is that's clearer for you and more confusing for me, but I can try to work with it if you need that.

Q. So I'll try to refer to them as both, as '697, the one with the P1 in it, so that -- so when reading the transcript we can tell which we're talking about, but also it's clear to you.

In any event, if at any point you're confused about which declaration I'm asking about, which hopefully that won't happen, but if that does, please let me know and --

A. Yes. And I appreciate your help orienting me on the right declaration.

Q. Yeah. Yeah.

And so the -- the declaration with the P1 in the attorney docket number relies on a number of prior art references, including a Shahoian.

I don't know if you know how --

A. We kind of call it Shahoian, but I understood what you said.

Q. All right. Shahoian.

And then the declaration with the P2 and the docket number relies on a number of references, including one to Izumi?

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

A. That's correct.

Q. All right. And you know it may be that it's -- Shahoian, is that how you pronounce it?

A. That's understandable to me. I don't know the correct pronunciation.

Q. You know what actually might make it easier is if I just refer to the declarations by their principal reference, Shahoian versus Izumi. So hopefully if I refer to them, that way you'll know what I'm saying. And hopefully, however I refer to them, we'll at least be talking about the same thing at the end of the day. Okay?

A. Yes. That sounds okay to me too.

Q. All right. So referring to the two declarations you submit concerning IPRs of the '767 patent, the Shahoian declaration and the Izumi declaration, are you aware of any errors or things that you wish to correct sitting here today?

A. There actually is one. I -- I -- there's one little sentence that I think is now -- you know, during review I released was incorrect. It's not critical to the argument. It would take me a while to find it right now, sitting here. So I could correct it if we get to it, or I could look for it.

Q. Do you remember which declaration that

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

sentence is in?

A. No, and it could be both.

Q. Do you remember anything about what the error was?

A. Yes. I -- I think I could find it. It's related to the summarization of the Rossi reference, I believe, if I'm not mistaken.

Q. So would that be the -- when you say "the summarization of the Rossi reference," that would be in the section overview of Rossi?

A. Well, let's look at the Shahoian version overview of Rossi, and I think that's where it is. And it won't take me long if I find it. And it's -- again, it -- it was peripheral to the argument anyway.

Actually, let's look at the argument where we apply Rossi to it, and the -- it's probably under the analysis of Izumi, Cosper, and Rossi. So that would be starting at 82.

I'm sorry. I'm not finding it. It's possible I recalled that in one of my other declarations that involved Rossi or -- yeah.

Q. Okay. Do you recall --

A. But I -- if we get there in answering another question, I will -- I will call it out.

Q. Is there anything that you remember about

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

what the nature there was, related to Rossi?

A. Yes.

It -- it was a statement -- it was -- it was a paragraph concerning advantages that a POSITA would recognize for incorporating Rossi's design, and the topic was the use of diodes across the switches which was featured in Rossi.

And there were advantages listed for the diodes, and one of the advantages that I listed was that it would prevent a current surge if accidentally two switches on the same side of the H-bridge were turned on simultaneously.

And there were other advantages of the diodes, but that particular sentence -- it's just one sentence that states this advantage of protecting the devices from multiple devices turning on in a way that short-circuits the power supply.

That -- on -- on further thought about that schematic diagram, I realized the diodes do not protect the devices that way. But it was just one sentence, and it was -- and I now think that that was incorrect.

And I -- I could -- I'm sorry I couldn't find it. Again, it might be in another declaration. But if we get there, I will point it out.

Q. Okay. I appreciate that.

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

1 So you have -- you have copies of both of these
2 declarations, right, so you can look at both of them
3 simultaneously?
4 **A. I can.**
5 Q. So I want to ask you to turn to the first
6 page of the table of contents in each of your '767
7 patent declarations.
8 **A. Okay. I've turned to those.**
9 Q. All right. So in each of these tables of
10 contents, under Section 7, "Overview of the Cited
11 References," there are Sections F and G titled,
12 "Overview of Motohashi" and "Overview of Amaya."
13 Do you see those?
14 **A. Yes, I see those.**
15 Q. All right. So at least when I looked
16 through the declarations, I don't recall seeing any
17 mention of Motohashi or Amaya in the declarations
18 outside of that overview section.
19 In particular, I don't think that either of those
20 two references is part of one of the invalidity grounds
21 that -- the vague and obviousness combinations that you
22 discuss in the declarations.
23 Does that sound right?
24 ATTORNEY DEUTSCH: Objection, form.
25 **THE WITNESS: I do not see those as -- as**

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

1 **listed combinations in our grounds.**
2 BY ATTORNEY RUBIN:
3 Q. Do you recall why those references are
4 discussed in the overview of cited references sections
5 of your declarations?
6 **A. I'm sorry. There was a little bit of**
7 **garble at the beginning of the question, if you could**
8 **repeat it.**
9 Q. Yeah.
10 So do you recall why you discussed -- why you
11 provided an overview for each of those two references
12 in your declarations?
13 **A. My recollection is they're just**
14 **corroboration of the -- oh, I'm sorry. I'm going to**
15 **turn my phone completely off because it was making**
16 **little noises. Okay.**
17 **So my -- my recollection is that those were**
18 **corroboration of what a POSITA would know, just**
19 **additional references for -- for the same ideas that we**
20 **expect of a POSITA.**
21 Q. Do you recall whether in either of your
22 declarations in the sections where you discuss the
23 specific grounds of obviousness you ever mention the
24 Motohashi prior art reference?
25 ATTORNEY DEUTSCH: Objection, form.

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

1 **THE WITNESS: That's not something I recall**
2 **sitting here right now.**
3 BY ATTORNEY RUBIN:
4 Q. And do you know whether in either of your
5 declarations in the sections where you're discussing
6 the specific grounds of obviousness you ever mentioned
7 the Amaya reference?
8 ATTORNEY DEUTSCH: Objection, form.
9 **THE WITNESS: Sitting here now, I don't**
10 **recall that.**
11 BY ATTORNEY RUBIN:
12 Q. So if I could ask you to open up the
13 Shahoian reference, which I believe is Exhibit 1004 in
14 each of the IPRs.
15 **A. Sorry. What did you ask me about 1004?**
16 Q. I just wanted you to open it up.
17 **A. Got it.**
18 **Okay. I have that exhibit.**
19 Q. So this is a reference that you discuss as
20 part of an obviousness -- as part of a number of
21 obviousness combinations that you offer opinions on for
22 the '767 patent; is that right?
23 **A. Well, I guess focusing us back on this**
24 **Shahoian declaration, I certainly rely on this**
25 **reference.**

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

(TECHNICAL INTERRUPTION.)
(A DISCUSSION WAS HELD OFF THE RECORD.)
BY ATTORNEY RUBIN:
Q. So do you agree that in the Shahoian reference the haptic feedback actuator that's described is capable of operating at multiple different frequencies?
ATTORNEY DEUTSCH: Objection, form.
THE WITNESS: I guess I would want to take a look at that. Is there a, like, specific claim in '767 or a claim limitation that you're interested in here?
BY ATTORNEY RUBIN:
Q. Well, there are some claim limitations that mention frequency, as I recall, but I -- my questions were about the -- or my question was about the Shahoian reference.
Maybe if I could direct your attention to Column 7 of Exhibit 1004, and I'll ask you about the sentence that starts on line 41.
A. All right. I'm there.
Q. All right. So starting on line 41, it says, "The controller can also adjust the frequency of the drive waveform independently of the amplitude to adjust the frequency of vibration. This allows

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

1 different frequency vibrations to be output
2 independently of the magnitude of those vibrations."
3 Do you see that?
4 **A. I see that.**
5 Q. Do you have an understanding in the system
6 described in Shahoian why it would be desirable to be
7 able to output different frequency vibrations?
8 ATTORNEY DEUTSCH: Objection, form.
9 **THE WITNESS: I would have to think about**
10 **that. I'm not sure I actually have an opinion on that**
11 **question.**
12 BY ATTORNEY RUBIN:
13 Q. So if I could turn your direct -- or turn
14 your attention to -- withdrawn.
15 If I could direct you to Column 5 of this
16 reference, starting on line 50.
17 Let me know when you're there.
18 **A. I see line 50 on Column 5.**
19 Q. So it says, "Manipulandum 34 can be a
20 joystick, mouse, trackball, stylus, (e.g. at the end of
21 a linkage), steering wheel, sphere, medical instrument,
22 pool cue, hand grip, knob, button, or other object."
23 Do you see that?
24 **A. I see those -- yes, I see that language.**
25 Q. I'll have to admit, "manipulandum" is not a

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

word that I was familiar with before this -- before reading this reference.

Do you know what it means?

ATTORNEY DEUTSCH: Objection, scope.

THE WITNESS: Well, defin- -- defining that term was not something I was asked to give an opinion on.

There's more -- in this column just above the -- like between 40 and 50, there's more explanation of it. It was a term commonly used in the art.

BY ATTORNEY RUBIN:

Q. So do you think that a person skilled in the art reading the Shahoian reference and its discussion of providing haptic feedback to devices like the ones that I -- the ones in the sentence that I read would find it desirable to be able to provide haptic feedback at more than one frequency at different times?

ATTORNEY DEUTSCH: Objection, form and scope.

THE WITNESS: Sorry. Could you -- could you repeat that question again?

BY ATTORNEY RUBIN:

Q. So a person skilled in the art reading the Shahoian reference, would that person believe that in providing haptic feedback to devices such as a

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

joystick, mouse, trackball, stylus, sphere, medical instrument, pool cue, hand grip, knob, button, or other object would find it desirable to be able to provide haptic responses at more than one frequency at different points in time?

ATTORNEY DEUTSCH: Objection to the form and the scope.

THE WITNESS: I don't think that was an opinion I was asked to form, and I don't think that's addressed in my report, if I recall it correctly.

BY ATTORNEY RUBIN:

Q. If we could turn back to Column 7, starting at line 56. So I believe you quote from this sentence in your declaration.

It says, quote, This gain at higher frequencies is due primarily to the vibration occurring at the resonance frequency of the mechanical system, including actuator, foam, housing, etc., and, if desired, can be compensated for in other embodiments to obtain a more flat response by providing compensating frequencies that will provide the desired response (e.g., from a look-up table or firmware)."

Do you see that?

A. Yes, I see that text.

Q. So what does the sentence mean when it

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

refers to a, quote, flat -- or a more flat response?

ATTORNEY DEUTSCH: Objection, form.

THE WITNESS: Again, I -- I didn't -- I wasn't asked to offer an opinion on this, and I would -- if I were, I would want to take the time to read the whole specification again, if not including the claims as well, and then be able to give an opinion on that question.

BY ATTORNEY RUBIN:

Q. You do cite to this paragraph, the paragraph that I was reading from in your declaration concerning the Shahoian reference, right?

A. Would you help me out by pointing me to the citation in the -- in the -- in the declaration?

Q. Sure.

So in the declaration where you address the Shahoian reference, on page 53, near the middle of paragraph 108, you say, "Shahoian also describes the advantages of operating the linear actuator at resonance," and then you cite to this paragraph from the reference and explain what you believe it describes.

Do you see that?

A. Yes.

Q. So in offering that opinion about what this

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

paragraph describes, I take it that you -- you did read and try to understand the -- the full paragraph that you cite to; is that right?

A. Yeah. Let me just re-read this paragraph quickly in its entirety.

Okay. I've done that, and yeah, I think this does represent my opinion involving that statement in the patent.

Q. And so when the paragraph that you cite to refers to, quote, a "more flat response," what does that mean?

ATTORNEY DEUTSCH: Objection, form.

THE WITNESS: As I interpret it, it says optionally, that's the language, if desired -- first -- the first part of that sentence is describing advantages of operating at resonance, greater magnitude. And then it says if desired, maybe you don't want it to be acting as a resonance.

So a resonance -- you know, if any vibrational system is known to a POSITA or just known to have a frequency response which has a peak at a certain frequency that we call a resonant frequency. A flat response has a negligible peak, a small or nonexistent peak at any one frequency but instead would have a maximum value over a range of frequencies and

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

not exhibit a clear peak.

So that's an optional way that Shahoian is describing their invention to be used.

BY ATTORNEY RUBIN:

Q. And Shahoian talks about obtaining a more flat response by, quote, compensating for the gain due to resonance, right?

ATTORNEY DEUTSCH: Objection, form.

THE WITNESS: I see language "by providing compensating frequencies that will provide." That's the language I see on line 61.

BY ATTORNEY RUBIN:

Q. And earlier in the sentence it says, quote, This gain at higher frequencies is due primarily to the vibration occurring at the resonance frequency of the mechanical system, including actuator, foam, housing, etc., and, if desired, can be compensated for," and then the sentence continues.

You would agree that there it's talking about -- that is the Shahoian reference, is talking about compensating for the gain that require -- or that occurs at the resonance frequency, right?

ATTORNEY DEUTSCH: Objection, form.

THE WITNESS: I -- I think I've already answered that as well. I mean, I -- it's -- it's an

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

1 optional way to control the actuator, is to drive it to
2 make a flat response. The word "compensation" is
3 widely used for any means of changing frequencies or
4 changing frequency response.
5 For example, in control systems there's a
6 compensator -- lead -- lead compensator, lag
7 compensator, other compensators. It's a widely used
8 term to describe changing a frequency response, and if
9 desired in Shahoian's specification, the engineer can
10 use those techniques to obtain a more flat frequency
11 response.
12 BY ATTORNEY RUBIN:
13 Q. In your opinion, in a haptic feedback
14 system, is a greater magnitude of vibrations always
15 more desirable than a lesser magnitude of vibrations?
16 ATTORNEY DEUTSCH: Objection to form and
17 scope.
18 THE WITNESS: I -- I don't think I offer an
19 opinion on that in my declaration, if I recall, but
20 there's -- I would not make an absolute statement that
21 greater magnitude is better than smaller magnitude in
22 all situations.
23 BY ATTORNEY RUBIN:
24 Q. So focusing on this same paragraph that you
25 cite from Shahoian, the first sentence of that

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

1 paragraph reads, quote, The linear actuator 100
2 provides a greater magnitude of vibrations at higher
3 frequencies (assuming the waveform magnitude is held
4 constant)."
5 Do you see that?
6 **A. Yes, I see that.**
7 Q. So I think we can agree that that sentence
8 states that for a given waveform magnitude, the
9 magnitude of vibrations will be greater at higher
10 frequencies, which the paragraph goes on to explain is
11 when you're closer to resonance.
12 Is there anything in that sentence, however,
13 that -- that says that in the view of the Shahoian
14 inventors that's a desirable effect?
15 ATTORNEY DEUTSCH: Objection, form.
16 **THE WITNESS: First of all, I was confused**
17 **about which sentence you were referring to.**
18 BY ATTORNEY RUBIN:
19 Q. All right. Paragraph -- let's talk about
20 the -- the paragraph as a whole. That is Column 7,
21 lines 54 through 62, which you cite.
22 So my first question concerning that paragraph is:
23 You would agree that that paragraph says that for a
24 given waveform magnitude, the magnitude of vibrations
25 will be greater at higher frequencies because the

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

actuator is operating closer to resonance; is that right?

ATTORNEY DEUTSCH: Objection, form.

THE WITNESS: The gain -- you know, I'm just seeing it there. This gain at higher frequencies is due primarily to the vibration occurring at the resonance frequency of the mechanical system.

BY ATTORNEY RUBIN:

Q. Is there anything in that paragraph -- Column 7, lines 54 through 62 of Shahoian -- which says that the greater gain at higher frequencies is a desirable phenomenon?

ATTORNEY DEUTSCH: Objection, form.

THE WITNESS: I think this paragraph is simply laying out properties -- actually well-known ones to a POSITA -- of resonance, and if resonant behavior was not desired, then it offers a way to change that; but implicitly, if resonance is desired, it talks about that mode as well.

ATTORNEY RUBIN: So I would like to go off the record briefly, if that's all right.

(RECESS TAKEN.)

ATTORNEY RUBIN: If I could ask you to pull up Exhibit 1009, the Cosper prior art reference.

And I'll also upload that to the chat for

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

1 anyone who needs a copy.
2 BY ATTORNEY RUBIN:
3 Q. Do you have that open, sir?
4 **A. Oh, sorry. Yes, I do have it open.**
5 Q. All right.
6 **A. Cosper, '532.**
7 Q. So if you look at the first page of Cosper,
8 the 1009 -- well, and just for -- well, never mind.
9 Withdrawn.
10 If you look at the first page of the Cosper
11 reference, Exhibit 1009, you'll see that it lists two
12 inventors, James Cosper and Enrique Gutierrez.
13 Do you see that?
14 **A. I see that.**
15 Q. Now, sometimes a patent will list an
16 assignee, an entity that -- that owns the patent.
17 This doesn't appear to list an assignee on the
18 face of the patent, would you agree -- or I should say
19 on the face of the patent publication, would you agree?
20 ATTORNEY DEUTSCH: Objection, form.
21 **THE WITNESS: I don't see an assignee here.**
22 BY ATTORNEY RUBIN:
23 Q. Do you happen to know who this patent was
24 filed by?
25 ATTORNEY DEUTSCH: Objection, scope.

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

THE WITNESS: No.
BY ATTORNEY RUBIN:
Q. So you don't know who, if anyone, Mr. Cosper and Mr. Gutierrez worked for when they developed what's described in this patent?
ATTORNEY DEUTSCH: Objection, form.
THE WITNESS: Not that I can recall sitting here.
BY ATTORNEY RUBIN:
Q. So I'll represent to you that there are records at the patent office indicating that this was -- this patent application was assigned to an Omnilux, Inc.
Have you ever heard of them?
A. I don't recall hearing of Omnilux.
Q. So if you could turn to paragraph 3 of the Cosper reference.
Let me know when you're there.
A. Okay.
Q. So the last sentence of that paragraph reads, quote, In one example the systems are described for use with illumination systems, including an oscillating resonant engine."
Do you see that?
A. I see it.

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

Q. Do you have any understanding of what the use would be of a -- of mechanical oscillation in an illumination system?

ATTORNEY DEUTSCH: Objection, form.

THE WITNESS: That's definitely not a question I was asked to give an opinion about.

BY ATTORNEY RUBIN:

Q. So do you have any understanding of what type of product the invention that's described in the Cosper patent application would have been used in?

ATTORNEY DEUTSCH: Objection to form.

THE WITNESS: I take that whole paragraph 3 as answering that. Any product with mass and bias elements that oscillate at resonance. And in one example the systems are described for use with illumination systems, including oscillating resonant engines. So I think that explains it.

BY ATTORNEY RUBIN:

Q. So would you agree that Cosper describes the use of a parabolic reflector in at least some of the embodiments of its invention?

ATTORNEY DEUTSCH: Objection, form.

THE WITNESS: Well, I wasn't asked to give an opinion on that. I recall something that looks like a parabola in some of the figures.

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

BY ATTORNEY RUBIN:

Q. If you could look, please, at Figure 7 of Cosper.

Would you agree that that figure shows a parabolic reflector at least partially surrounding what's labeled as a bulb?

A. Yes, I see those things in Figure 7.

Q. And would you agree that the control system described in Cosper is specifically designed to drive the mechanical system at resonance?

ATTORNEY DEUTSCH: Objection, form.

THE WITNESS: I -- I would have to form a new opinion, I think, on that if -- because of your wording, "specifically designed." I don't have an opinion on "specifically designed."

BY ATTORNEY RUBIN:

Q. Okay. So if I could ask you to turn to page 58 of your declaration where you address -- of the declaration in which you address the Shahoian reference.

A. Are you referring to addressing the Shahoian and Cosper combination?

Q. So let me -- let me restate it. Thanks.

So I want to refer you to a -- to one of your two declarations.

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

A. Okay.

Q. And the declaration I want you to look at is the one that talks about Shahoian.

A. Okay.

Q. All right. And then within that declaration I would like you to please turn to page 58.

A. Okay. I'm there.

Q. And page 58 contains, at the beginning of the page, part of paragraph 115.

Do you see that?

A. Well, I see that 115 starts on 57 with a couple of lines, and most of it is on page 58, yeah.

Q. Okay. So the second-to-last sentence of page -- of paragraph 115 reads, quote, For example, Cosper's sensors and control system is specifically designed for use in resonant systems that involve a linearly moving mass, including reciprocal electromagnetic drivers, like that of Shahoian."

Do you see that?

A. I see that.

Q. So you -- in the sentence that I read from, you use the phrase "specifically designed."

And would you agree that the sensors and control system in Cosper are specifically designed to drive the resonant systems at their resonant frequency?

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

ATTORNEY DEUTSCH: Objection to form.

THE WITNESS: I think -- I think -- first of all, it's -- it's designed -- you know, the Cosper reference is very clear that it applies to any resonant system, and it gives ways to drive it involving the resonance, but if the frequency happens to be off of resonance, it is still covered by -- by -- it's still disclosed in Shahoian.

BY ATTORNEY RUBIN:

Q. Well, turning to -- I'm sorry.

You said it's still disclosed in Shahoian. My question was about Cosper.

A. I meant -- I'm sorry. I meant Cosper. Yeah. Thanks for that clarification.

Q. So turning back to paragraph 3 of Cosper, the first sentence reads, "This application generally relates to systems and methods for control of a mass and bias (e.g., 'elastomeric members') subassembly including oscillating mechanical systems that operate in an oscillatory mode at or near their mechanical resonant frequency."

Do you see that?

A. I see it.

Q. So would you agree that the systems described in Cosper are designed to operate at or near

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

1 their mechanical resonant frequency?
2 ATTORNEY DEUTSCH: Objection, form and
3 scope.
4 **THE WITNESS: Yeah, I think I -- I think I**
5 **would want to form an opinion more carefully, and that**
6 **would require some study on this one. You know, I**
7 **don't think my opinion answers that question.**
8 BY ATTORNEY RUBIN:
9 Q. So sitting here today, is there anything
10 that you can point to in Cosper that describes driving
11 a system at a frequency that is other than, at, or near
12 the resonant frequency?
13 ATTORNEY DEUTSCH: Objection, form.
14 **THE WITNESS: Yeah, again, that would**
15 **require me to study Cosper again with that question in**
16 **mind.**
17 BY ATTORNEY RUBIN:
18 Q. So in that same declaration we've been
19 looking at, the declaration that addresses combinations
20 involving Shahoian, could you please turn to page 68?
21 **A. Okay. I'm there.**
22 Q. And this -- the text on page 68
23 specifically is within your section addressing blame --
24 I'm sorry, addressing ground 1A.
25 **A. I'll just refer to the table of contents to**

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

refresh my memory of that, but -- yes. That's -- that appears to be right.

Q. So I'll read you the sentence that begins at the bottom of page 68. Quote, To be clear, the control component of the combined system includes a control program that receives the value of an output signal, compares that value to a different value, and adjusts one or more operational control outputs based on that comparison, in accordance with Cosper's description of maintaining oscillation at a resonant frequency."

Do you see that?

A. Yes, I see that.

Q. So you would agree that in the specific combination of Shahoian and Cosper that you provide your obviousness opinions based upon, in that combination oscillation is maintained at a resonant frequency?

ATTORNEY DEUTSCH: Objection, form.

THE WITNESS: I -- I would -- I think this opinion says that the adjustment of control is in accordance with Cosper's description of maintaining an oscillation at a resonance frequency, which may or may not be the same as your statement. I'm not sure. But that's my precise opinion.

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

BY ATTORNEY RUBIN:

Q. So if we could turn back to the Shahoian reference, Exhibit 1004, and specifically turn to Figure 1.

Are you there?

A. I'm almost there.

Okay. Figure 1.

Q. So toward the middle on the right-hand side of this figure, there's a box, 28, that's labeled "sensors."

Do you see that?

A. I see that.

Q. And I think in your declaration you mention at some point the fact that Shahoian describes sensors.

Do you recall that?

A. I -- I -- I guess I would have to look, but sitting here right now I think I recall that.

Q. Yeah.

So for example, on -- in paragraph 75 on page 35 of your declaration addressing the Shahoian grounds, you at least mention the fact that Shahoian has one or more sensors 28.

Do you see that?

A. Yeah, I see that on page 35. Uh-huh.

Q. So if you could please turn to page 74 of

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

1 your declaration.
2 Let me know when you're there.
3 **A. I'm on 74.**
4 Q. So there in bold, italic text, you included
5 the text of Element 1.6 of the '767 patent claims.
6 Do you see that?
7 **A. Yes, I see that.**
8 Q. And this element begins, quote, the control
9 component receiving output signals from sensors, close
10 quote.
11 Do you see that?
12 **A. I see it without your quotes, but I -- I**
13 **get your point. Yeah.**
14 Q. Yeah.
15 And it ends -- basically the last three lines as
16 you've produced them here, I'll quote, in order that
17 subsequent operation of linear resonant vibration
18 module produces desired outputs from the one or more
19 sensors corresponding to one or more operational
20 control parameters."
21 Do you see that?
22 **A. I'm sorry. That's in the 1.6 limitation**
23 **bolded and italicized; is that where you're pointing**
24 **me?**
25 Q. That's right.

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

A. Yeah, I see it.

Q. And would you agree that this is describing some sort of feedback mechanism where the control component is adjusting outputs such that the outputs from the one or more sensors have desired values?

ATTORNEY DEUTSCH: Objection, form.

THE WITNESS: I think I addressed that on the very next page near the top, "The microprocessor adjusts one or more operational control outputs, such as then H-bridge transistor control signals," et cetera.

According to the received sensor, output signals from the sensors in particular -- you know, dot, dot, dot -- adjust control outputs in order to do the subsequent operation produces desired outputs from the sensor.

So I think that's where I would say the answer to your question is.

BY ATTORNEY RUBIN:

Q. All right. And then on page 75, starting at -- well, on page 75, the sixth line from the bottom, you refer to this in your words as, quote, a -- I'm sorry, as a, quote, feedback system.

Would you agree?

A. I'm just taking a look at that in context.

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

I use the term "feedback system" to describe what is -- what is performing the seeking. Yeah.

Q. Now, the sensors that are involved in this feedback system are something that you identify in the prior art in the Cosper reference, correct?

ATTORNEY DEUTSCH: Objection, form.

THE WITNESS: I would just want to -- I certainly talk about sensors in the -- with regards to the Cosper reference, but I'm not going to say that's the only place.

BY ATTORNEY RUBIN:

Q. Okay. You don't offer any opinion that the sensors in the Shahoian reference satisfy the requirements of Limitation 1.6 that the, quote, Subsequent operation of linear resonant vibration modules produces desired outputs from the one or more sensors," correct?

ATTORNEY DEUTSCH: Objection, form.

THE WITNESS: I'm just -- I want to just review this a little bit before I answer your question.

I don't see right now that I invoke Shahoian's reference in this argument, again, that the 1.6 limitation is anticipated.

BY ATTORNEY RUBIN:

Q. Would you agree that the sensors in the

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

Shahoian reference function to receive user input rather than to measure the operation of the linear resonant vibration module?

A. I guess I would want to refresh my memory by pulling it -- pulling it up, if that -- if that's okay with you.

Q. Sure. So I think at least some relevant description in Exhibit 1004 would be the paragraph on -- in Column 4, starting at line --

A. Sorry. Did you say -- I heard "7," but I didn't hear the previous digit in -- that you were directing me.

Q. Sorry. Column 4, starting at line 56.

A. 56. Okay.

What I'm seeing there is sensors 28 sense the position, motion, and/or other characteristics of user manipulandum 34 of the interface device along one or more degrees of freedom to provide signals.

That's what I'm seeing there. And they're not specific to user inputs.

Q. So in the sentence that starts at the bottom of Column 4, Shahoian says, quote, For example, these sensor signals can be used by the host computer to influence the host application program (e.g., to steer a race car in a game or move a cursor across the

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

screen, close quote.

Do you see that?

A. I see it.

Q. So at least in that sentence it's talking about using sensor signals to detect user input; would you agree?

A. That example, "e.g., detects user inputs," yes.

Q. So turning back to your declaration, if we look at the section of your declaration addressing Limitation 1.6 and the combination of Shahoian with Cosper -- so that's paragraphs 136 and 137 -- you don't cite to anything in those paragraphs from Shahoian as satisfying this limitation, 1.6; do you agree?

A. From looking here right now, I don't --

ATTORNEY DEUTSCH: Objection, form.

THE WITNESS: Looking here right now, I don't see such a citation.

BY ATTORNEY RUBIN:

Q. And in particular, you don't offer an opinion in -- in those paragraphs, 136 and -- 130 -- or 137, that the sensors in Shahoian would satisfy Limitation 1.6, correct?

A. These paragraphs address the combination of Shahoian with Cosper, and I -- and I think that is

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

1 **correct in -- in these paragraphs, that they do not**
2 **offer an opinion about Shahoian by itself.**
3 Q. If you could turn, please, to page 76 of
4 the same declaration.
5 **A. Okay. I'm on 76.**
6 Q. And I'm going to read to you the last two
7 sentences of paragraph 137. Quoting, it says,
8 "Additionally, the term 'the one or more sensors' lacks
9 antecedent basis. For my analysis here, I have
10 attempted to interpret the claim to the best of my
11 ability, although I believe the lack of antecedent
12 basis renders the meaning of the claim term
13 indefinite."
14 Do you see that?
15 **A. I see that.**
16 Q. So I understand that you believe that
17 there's a lack of antecedent basis, but you do say that
18 you've attempted to interpret the claim to the best of
19 your ability, and so as you attempted to apply
20 Limitation 1.6 to the prior art, you've offered
21 opinions on, how you interpreted the phrase, quote, the
22 one or more sensors, close quote?
23 ATTORNEY DEUTSCH: Objection, form.
24 **THE WITNESS: First of all, I didn't apply**
25 **1.6 to the prior art. I applied the prior art to 1.6,**

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

if that makes a difference. Okay?

And I'm applying -- I guess to the best of my ability I'm looking for -- there's -- your -- your two terms which you -- you read out when you were reading me -- you even pointed out the first and last sentence of -- or -- or lines of 1.6.

The beginning, the term used is "sensors," and near the end it's "the one or more sensors." And so that's the issue, is the difference between those two, and not -- and using "the" implies that there's a prior mention of it.

So there's some confusion there. I looked for I would say the biggest interpretation there, "one or more."

BY ATTORNEY RUBIN:

Q. So as you've interpreted Limitation 1.6 in offering your opinions about the combinations of the prior art, did you assume that, quote, the one or more sensors, close quote, referred to the same thing as, quote, sensors, close quote, near the beginning of Limitation 1.6?

ATTORNEY DEUTSCH: Objection, form and scope.

THE WITNESS: I think that characterizes my assumption, yes, with -- subject to the ambiguity that

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

they aren't written the same. So that's why I -- that's why I believe that the meaning is indefinite.

ATTORNEY RUBIN: So if you have the '767 patent open or if you can open that.

And I'll upload that for the court reporter's benefit.

THE WITNESS: I'm just -- actually, I have a hardcopy of that patent right here.

ATTORNEY RUBIN: Okay.

THE WITNESS: So I'm going to just use that.

BY ATTORNEY RUBIN:

Q. So just to be clear, it sounds like you have hardcopies of the two declarations. You have a hardcopy of the '767 patent.

Are there any other documents you have hardcopies of with you today?

A. No.

Q. Just those three?

A. But I have two copies of the '767 -- or maybe that's Craig's copy. But in terms of unique documents, I have a hardcopy of '767, and I have the P1 and P2 doc- -- declarations that we talked about, 177P1 -- IP1, 177IP2, and that's it.

Q. Do you have any notes with you here today?

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

A. No, I don't.

Q. Well, I won't -- I won't ask you to tell me anything about counsel's copy of the '767 patent, but yeah, I understand you've got your copy of the '767 patent in front of you. And if you could turn to the last page, Column 11.

A. Okay.

Q. So starting at the end of line 25 is the word "sensors."

Do you see that?

A. Yes.

Q. And that's also -- line 25 is also where Limitation 1.6 starts; would you agree?

A. Yes.

I think just checking the first few words and the last few words, line 25 to I guess 30-some -- 31, '2, '3, are the same as the highlighted text in bold on page 74 of my declaration.

Q. Okay. So that Limitation 1.6 which appears in the '767 patent, Column 11, lines 25 through 33, actually contains the word "sensors" three times. I'll point you to the three times that it appears.

So there's once starting at the end of line 25.

Do you see that?

A. Yes. It's hyphenated into the next line.

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

Yeah.

Q. And then the lines -- I'm sorry. Withdrawn.

Line 30 contains the phrase, quote, these sensors.

Do you see that?

A. I see that too.

Q. And then line 32 contains the phrase, quote, the one or more sensors, close quote.

Do you see that?

A. Yes, I see that.

Q. So understanding that it's your opinion this limitation is actually indefinite, as you've interpreted the claim to the best of your ability in offering your opinions, have you interpreted Limitation 1.6 such that "sensors" starting at the end of line 25, "the sensors" on line 30, and "the one or more sensors" on line 32 are all referring to the same thing?

ATTORNEY DEUTSCH: Objection, form.

THE WITNESS: I would just say I -- I -- this is why I believe the meaning of that term is indefinite, because I can't answer that question from what I read in the claim element.

BY ATTORNEY RUBIN:

Q. Well, I take it from your declaration that

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

there is some interpretation of Limitation 1.6 that you applied in an offering opinion that the combinations of the prior art you discussed in your declaration satisfied that limitation.

Is that right, that there's some interpretation of Limitation 1.6 that you applied?

ATTORNEY DEUTSCH: Objection, form.

THE WITNESS: I struggle to know the definite meaning of the claim term, but under many -- or a lot of possible interpretations, I think Cosper covers them.

BY ATTORNEY RUBIN:

Q. So is one of the interpretations that you just referred to the interpretation where "sensors" on lines 25 to 26, "the sensors" on line 30, and "the one or more sensors" on line 32 all refer to the same things?

ATTORNEY DEUTSCH: Objection, form.

THE WITNESS: I -- I didn't, you know, form an opinion on whether they're -- those things are the same. That's -- a lot of this is legal knowledge beyond my expertise, so however that's resolved, sensors maps to it and applies to it, but I don't have an opinion on whether -- you know, whether or not it has antecedent basis and they're the same.

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

BY ATTORNEY RUBIN:

Q. Well, let's imagine that under the correct interpretation of Limitation 1.6, quote, the one or more sensors, close quote, on line 32, have to be different sensors from, quote, sensors on lines 25 through 26 or, quote, the sensors on line 30.

That's not an interpretation that you've shown that Cosper satisfies in your declaration; would you agree?

ATTORNEY DEUTSCH: Objection, form and mischaracterizes.

THE WITNESS: I feel that pulls me pretty far from my opinion and my way of thinking about it, so I would not agree.

BY ATTORNEY RUBIN:

Q. All right. Point to me where you've offered such an opinion.

A. My point was I have not offered that opinion. I have not offered an opinion that the -- those two versions are the same.

Q. Sorry. When you refer to "those two versions," two versions of what?

A. I think you used the word "versions." Correct me if I'm wrong.

But the claim term is ambiguous and it's -- you

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

1 **know, you -- you described "sensors" and contrasted**
2 **that with "one or more sensors," and I have not offered**
3 **an opinion that those things are the same, if I**
4 **understood your question correctly.**
5 Q. So my question was about what you've
6 pointed to in the prior art combination that you
7 propose based upon Shahoian and Cosper.
8 You understand that in order to demonstrate
9 obviousness you need to show that that combination
10 would have satisfied each element of the claims,
11 including each element of what you've called Limitation
12 1.6, correct?
13 **A. Sorry. I -- I lost the beginning of the**
14 **question.**
15 Q. All right. So I think earlier today in
16 answering one of my questions you pointed out that the
17 analysis that you did was applying the combination of
18 the prior art to the -- the claims that Apple contends
19 are invalid.
20 Would you agree that that's at least one of the
21 things you did in your declarations?
22 **A. Yes.**
23 Q. All right. So would you agree that in
24 order to show a claim is obvious based upon the
25 combination of Shahoian with Cosper, you need to show

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

that that combination satisfies each element of that claim and, thus, for Claim 1, among the things you'd need to show is that that combination satisfies each element of Limitation 1.6?

A. Is that a question or...

Q. Yeah.

You would agree that that's something you need to show?

A. I agree I need to show the combination describes all the pieces of the claim.

Q. So among the things you need to show is that the combination of Shahoian and Cosper satisfies the limitation "sensors" from lines 25 to 26, right?

A. Yes.

Q. And you also need to show that the combination of Shahoian with Cosper satisfies "the sensors" from line 30, right?

A. Yes.

Q. And you also need to show that the combination of Shahoian with Cosper satisfies "the one or more sensors" from line 32, correct?

A. Yes.

Q. All right. So in the combination of Cosper with Shahoian as you apply it to Claim 1, are you pointing to the same thing in that combination for each

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

of those three elements?

ATTORNEY DEUTSCH: Objection, form.

THE WITNESS: Well, as I said, I tried to resolve the potential ambiguity to the best of my ability.

And the way I read it and the way I think a POSITA would read Cosper is that "sensors," the word "sensors," would -- would apply to "sensors" -- I'm sorry, I was doing air quotes, but I -- I know that doesn't count, but I think my answer still holds -- and also the word "sensors" -- the description of sensors in Cosper also applies to one or more sensors, and I don't have an opinion if those are the same thing or different things.

BY ATTORNEY RUBIN:

Q. So if I understand that last sentence there correctly, are you saying that you don't have an opinion whether the sensors in Cosper that satisfy the limitation "sensors" from Column 11, line 25 of the '767 patent are the same as the sensors in Cosper that satisfy "the one or more sensors" from Column 11, line 32 of the '767 patent?

A. I don't think that characterizes my answer correctly.

I'm saying the sensors of Cosper describe sensors

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

on line 50, or approximately, the sensors, and they also apply to the one or more sensors. If those are different things, if those are the same things, it still applies. They -- the -- they still apply to all of them.

Q. All right. Staying in the same declaration, could you please turn to page 85?

A. Okay. I'm on 85.

Q. So here you're discussing the combination of prior art references Shahoian plus Cosper plus Rossi.

Do you see that?

A. Yes, in regards to Claims 1 through 4.

Q. And here you reproduce a claim limitation that you label 2.3 which reads, I'll quote, a directional-signal splitter/inverter that generates two complementary internal signals, d and d bar, corresponding to directional-signal d; and, close quote.

Do you see that?

A. I see it.

Q. Now turning to the next page, you reproduce the limitation that you labeled 2.4. And I'll quote from the -- I'll quote the first two lines as you've reproduced them. "Two pairs of solid-state switches, a

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

first switch of each pair controlled by internal signal d and a second switch of the pair controlled by internal signal d bar."

Do you see that?

A. Yes.

Q. So would you agree that the internal signal d bar referred to in Limitation 2.4 is the same as the internal signal d bar generated by the splitter/inverter in Limitation 2.3?

ATTORNEY DEUTSCH: Objection, form.

THE WITNESS: Sitting here right now, I would say yes.

BY ATTORNEY RUBIN:

Q. Now, at the top of page 86 you've reproduced and annotated a portion of Rossi Figure 6.

Do you see that?

A. I see it at the top of the page.

Q. Would you agree that Rossi Figure 6 contains two inverters, one that's close to the transistor SW2 and another one that's close to the transistor SW3?

A. Yes, I see that.

Q. So would you agree that in Rossi -- withdrawn.

Would you agree that in the portion of Rossi that

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

you cite there is no inverter that generates a signal that's used by both of the switch pairs?

ATTORNEY DEUTSCH: Objection, form.

THE WITNESS: What I'm -- what I -- what my opinion is saying is that -- let me get to where I've got that.

Yeah, I -- you know, the switch includes a directional signal splitter and inverter I that generates two complementary internal signals, d and d bar, or given their names in Rossi, IN1 and IN1 bar.

So it contains the exact structure or -- you know, and function that's -- I don't want to use those -- I know those words have significance, but it contains the exact things that are described in Limitation 2.3, and that's my understanding of anticipation.

BY ATTORNEY RUBIN:

Q. You just referred to anticipation.

Your opinions in your declaration are that the claims are obvious, not that they're anticipated; is that right?

A. Well, that's -- that's fair, but in addition -- it certainly makes it obvious as well.

Q. So as you apply the combination of Shahoian and Cosper and Rospi -- Rossi -- withdrawn.

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

As you apply the combination of Shahoian, Cosper and Rossi to Claim 2, would you agree that -- that the two pairs of solid-state switches you point to are a first pair, SW1 and SW3; and a second pair, SW2 and SW4?

ATTORNEY DEUTSCH: Objection, form.

THE WITNESS: Let's see. Can we get back to the -- the claim limitation that we're talking about here?

I'm sorry. Could you clarify that claim limitation for me?

BY ATTORNEY RUBIN:

Q. Sure.

So I'll read you the beginning of claim Limitation 2.4. From the beginning to the first comma reads, quote, two pairs of solid-state switches, close quote.

A. Oh, sorry. Okay. My -- my pages got a little mixed up. "First pair controlled by internal signal d and a second switch of the pair controlled by d bar."

Okay. I'm there.

Q. All right. Right now I'm just asking about the first six words, quote, two pairs of solid-state switches."

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

Do you see that?

A. Okay.

Q. All right. And so I think you identify what those two pairs are at the beginning of your paragraph 153.

Do you see paragraph --

A. Yes.

Q. -- 153?

So you would agree that the two pairs that you identify in the prior art are the first pair, Rossi's switches S1 -- SW1 and SW3; and the second pair, Rossi's switches SW2 and SW4?

ATTORNEY DEUTSCH: Objection, form.

THE WITNESS: I think that's -- that is what it says in that first sentence, right? So yes, I agree with that.

BY ATTORNEY RUBIN:

Q. Now, as we saw on page 85, Limitation 2.3 requires a splitter/inverter, and on page 86 you actually label some components with an annotation and arrows that say -- that says "splitter/inverter."

Do you see that?

A. Yes, I see the figure with annotations on page 86.

Q. All right. And that -- what you've

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

annotated as being a splitter/inverter includes a circuit schematic signal -- symbol, a circuit schematic symbol for an inverter labeled I to the left of transistor labeled SW3, correct?

ATTORNEY DEUTSCH: Objection, form.

THE WITNESS: Yes. That is the very well-known standard schematic symbol for an inverter. It's a triangle with a little circle at the tip.

BY ATTORNEY RUBIN:

Q. And the output of that inverter controls the switch SW3, correct?

A. Yes.

Q. Now, the output of that inverter, which you've -- which is part of what you've annotated as splitter/inverter, does not control the transistor SW2, correct; there's a different inverter that controls SW2?

ATTORNEY DEUTSCH: Objection, form.

THE WITNESS: The way I interpreted 2.4 is that the first switch is controlled by internal signal d. It does not say that it's controlled by a specific component. And in fact, the IN1 bar signal in Rossi corresponds exactly to the signal d bar, and both -- and SW2 and SW3 in Rossi's figure are both controlled by the same signal just the way it describes in

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

1 **Limitation 2.4.**
2 **And I would also add that there are many**
3 **ways to supply the correct switch signals known to**
4 **persons of ordinary skill in the art at the time, in**
5 **fact way before the time of this invention, and this is**
6 **one way you can do it. There's a very specific mapping**
7 **between the signals labeled in Rossi on those switches**
8 **and this claim limitation signals.**
9 BY ATTORNEY RUBIN:
10 Q. So as you've applied -- withdrawn.
11 As you've interpreted Limitation 2.4 in your
12 analysis applying the combination of the prior art to
13 Claim 2, have you interpreted Limitation 2.4 to require
14 that at least one switch in each pair be controlled by
15 the same signal d bar?
16 ATTORNEY DEUTSCH: Objection, form.
17 **THE WITNESS: It says a second switch of**
18 **the pair controlled by internal signal d bar, and I --**
19 **I didn't think that requires interpretation. It's --**
20 **it would be clear to any POSITA what that requires.**
21 BY ATTORNEY RUBIN:
22 Q. So you would agree that the one switch in
23 each pair has to be controlled by d bar, correct?
24 ATTORNEY DEUTSCH: Objection, form.
25 **THE WITNESS: The second switch of each**

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

pair, yeah. That's the one I -- that's what I agree with.

BY ATTORNEY RUBIN:

Q. All right.

A. That's what's there.

Q. But as you've interpreted Claim 2, that signal d bar controlling each of those two switches does not need to come from the -- as an output from the same inverter; is that right?

ATTORNEY DEUTSCH: Objection, form, mischaracterizes.

THE WITNESS: The -- the -- as I read that, the limitation, 2.4, requires that the switch is controlled by a certain signal. It doesn't specify or require how that signal is generated.

BY ATTORNEY RUBIN:

Q. And your answer right now was about Limitation 2.4.

If you take all of the limitations of Claim 2 together, does Claim 2 require that both of the second switches be controlled by a signal generated by the same inverter?

ATTORNEY DEUTSCH: Objection, form and scope.

THE WITNESS: I -- I've -- in forming my

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

opinion, I've taken each limitation on its own and looked for support in the prior art that in combination, you know, makes the whole claim invalid.

BY ATTORNEY RUBIN:

Q. So in doing that did you believe that Claim 2 requires that both of the second switches be controlled by a signal generated by the same inverter, or did you think the claim could be satisfied by second switches controlled by internal signals d bar that were generated by two different inverters?

ATTORNEY DEUTSCH: Objection, scope.

THE WITNESS: I -- I -- I didn't -- I don't think it's required to have an opinion about how the signals d bar and d are generated. It's -- it's clear that Rossi labels the two inputs to those two switches IN1 bar.

And so those two signals have the same name, and a POSITA would know that no matter how it's generated -- first of all, having the same name means they're the same signal in -- in schematic diagrams.

Secondly, the logic that's shown with Rossi shows two inverters, and a POSITA would know that the two outputs of the two inverters, because their inputs are the same, the two outputs would be identical and would know that it's not a mistake, those two are

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

labeled with the same label, IN1 bar, because they're the same, and they're the same signal, the same internal signal corresponding exactly to d bar and d.

BY ATTORNEY RUBIN:

Q. All right. I would like to ask you to turn in the same declaration to page 90, please.

A. Okay. I'm on 90.

Q. So towards the bottom of page 90 is the start of paragraph 158. And I'll read the portion of the first sentence up to the first comma. Quote, The Shahoian-Cosper-Rossi linear resonant vibration module includes an accelerometer, close quote.

A. I see it.

Q. All right. So I don't see any citations in that paragraph to any of the prior art references. I do see a citation at the very end the '767 patent.

But would you agree that you don't cite in this paragraph to any of the prior art references?

ATTORNEY DEUTSCH: Objection, form.

THE WITNESS: I do not see a citation there.

ATTORNEY DEUTSCH: Neil, I wonder if we are due for a break.

ATTORNEY RUBIN: Sure. Yeah. How about I'll just --

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

ATTORNEY DEUTSCH: Don't mean to interrupt.
ATTORNEY RUBIN: -- wrap up this line of questions, and then we can take a break.
THE WITNESS: That's okay with me.
ATTORNEY RUBIN: Yeah.
BY ATTORNEY RUBIN:
Q. So when you say that the Shahoian-Cosper-Rossi linear resonant vibration module includes an accelerometer and then in the next sentence you say the acceleration -- or I'm sorry, in the next sentence you say the accelerometer is a vibration sensor, do you believe that a particular one of those three references -- Shahoian, Cosper, and Rossi -- includes an accelerometer that is a vibration sensor?
A. I just have to review and look for it. But I recall it, but I don't recall which particular one.
ATTORNEY RUBIN: Well, let's take a break.
THE WITNESS: Okay.
(RECESS TAKEN.)
BY ATTORNEY RUBIN:
Q. So just before the break I asked you some questions about what you were pointing to as an accelerometer in the Shahoian-Cosper-Rossi combination, and you answered that you would have to review and look for it and didn't recall which particular reference

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

1 included an accelerometer.
2 In the -- over the break did you have a chance to
3 look or think about it some more, or is it the same
4 answer as we sit here right now?
5 **A. No, I didn't do anything over the break. I**
6 **took a break.**
7 Q. Perfectly fine.
8 So if you could turn in the declaration that
9 addresses the Shahoian combinations to page 91.
10 Are you there?
11 **A. Yeah. I am on 91, and I am just**
12 **referencing the TOC so that I know where I am.**
13 **Okay.**
14 Q. All right.
15 **A. And yeah, just for the record, this is the**
16 **attorney docket 0177IP1.**
17 Q. Very good.
18 So right above paragraph 159 on this page you
19 reproduce what you call Limitation 3.2, which begins,
20 I'll quote, wherein the control program continuously
21 monitors output from the vibration sensor, close quote.
22 Do you see that?
23 **A. I see that.**
24 Q. All right. Do you cite to anything in the
25 prior art that shows that monitoring is done, quote,

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

continuously?

ATTORNEY DEUTSCH: Objection, form.

THE WITNESS: It's my opinion that the combination discloses a control program which continuously monitor -- monitors that output.

BY ATTORNEY RUBIN:

Q. So what would be the evidence that supports your opinion that the monitoring is -- is done continuously?

A. Well, like I say below, I know the combination is like the examples recited by '767, which recites that the control loop uses continuous feedback control. So there's a control loop in the combination, and so it maps pretty well, in my opinion.

Q. So the evidence that the prior art combination monitors continuously is this quote that you have from the '767 patent specification saying that its control loop uses continuous feedback?

ATTORNEY DEUTSCH: Objection to form.

THE WITNESS: No, I would not use -- I'm sorry if I misspoke to that degree. I would not use a patent itself to disqualify it or to call it prior art.

BY ATTORNEY RUBIN:

Q. So what is your basis for having the opinion that the monitoring in the combination of prior

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

art references would be continuous monitoring?

A. A control program of this combination -- and, you know, I could start looking more at those references to find specifics, but certainly I would have used, at a minimum, a -- the disclosures that there's a control process which reads sensors and adjusts the outputs to achieve a goal to optimize performance and that that is widely, widely known to be implemented with a control loop.

So if there's -- and -- and the -- you know, the -- the -- if there's a specific thing, I would need to look for it more, like a mention in a specific citation of control loop, but we could start -- we can -- I can't recall specifically where that is, but that's what I'm talking about.

Q. Turning to page 108 of the declaration we're talking about with attorney docket number ending in P1.

Let me know when you're there.

A. Okay. I am there.

Q. So there's a Section B titled, Analysis of Shahoian, Copper -- Cosper, Ramsey, and Aldrich with respect to Claims 1 through 5.

Would you agree that for that specific combination of those four references, you only offer an obviousness

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

opinion addressing Claim 1?

ATTORNEY DEUTSCH: Objection, form.

THE WITNESS: Well, I would have to look through it.

BY ATTORNEY RUBIN:

Q. Well, let's --

A. I don't know until I -- you know -- you mean Section B refers only to Claim 1?

Please clarify.

Q. Well, I think Section B is the section where you're analyzing that combination of four references with respect to any of the claims of the '767 patent.

Now, for Ground 2B in Section 12 starting on page 130, do you address a combination of Shahoian, Cosper, Ramsey, Aldrich, and Rossi, so adding Rossi as a fifth reference, but with respect to the four references, Shahoian, Cosper, Ramsey, and Aldrich, I believe the only claim analysis you provide is for Claim 1.

Would you agree?

A. I guess, you know, really I -- I want to review it to be careful because some of these analyses of the -- of sublimitations -- or limitations of Claim 1, you know, they go on kind of long, so I -- I

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

want to see for sure where we cite claim limitations. 1.5. 1.3. 1.6.

Right now, looking at these roughly 22 pages, I see only the claim limitations as -- that are part of Claim 1.

Q. All right. Can I have you turn to Exhibit 1005, which is Izumi.

ATTORNEY RUBIN: And I'll put that in the chat.

THE WITNESS: Okay. I have Izumi ending in '294 up on the screen.

BY ATTORNEY RUBIN:

Q. All right. So this is a -- a reference that you include in obviousness combinations that you analyze in the second declaration we're here to address today, the one with the docket number ending in P2.

Is that right?

A. Yes, that agrees with my -- my copy. And yeah, that is correct.

Q. Would you agree that the Izumi patent application describes using its invention as an actuator in an electric shaver?

ATTORNEY DEUTSCH: Objection, form.

THE WITNESS: Predominantly, yes.

BY ATTORNEY RUBIN:

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

Q. Do you recall Izumi mentioning any applications of its invention that did not involve an electric shaver?

A. Well, I -- you know, the technical field, paragraph 1, says, "The present invention relates to" driving -- "a driving unit and a method for driving a resonance system comprising an elastic body and a moving element supported by the elastic body."

So it doesn't even mention shavers. It mentions resonant systems. But I agree that predominantly this describes examples in electric shavers.

Q. Would you agree that there's nothing in Izumi that mentions haptic feedback?

A. I don't recall --

ATTORNEY DEUTSCH: Objection, form. Sorry.

THE WITNESS: I don't recall a mention of haptic feedback in Izumi right sitting here now.

BY ATTORNEY RUBIN:

Q. Could you turn to page 5 of the specification, and in particular the last paragraph on that page, paragraph 63.

A. Okay. I have paragraph 63.

Q. So the first sentence of paragraph 63 of Izumi I'll read. Quote, Although each of the on time

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

1 and the off time of the voltage is controlled in order
2 to form the intended current waveform in this
3 embodiment, in the actual realtime control it can be
4 difficult to perform complicated control at every half
5 cycle or one cycle of the moving element 1 due to a
6 constraint of the control device such as CPU speed, ROM
7 capacity, etc."
8 Do you see that?
9 **A. I see the -- yeah, I see that sentence.**
10 Q. So would you agree that that sentence is
11 referring to using a control device that includes a CPU
12 and memory in order to perform what it refers to as,
13 quote, complicated control?
14 ATTORNEY DEUTSCH: Objection, form.
15 **THE WITNESS: I -- I'm not sure I really**
16 **understand that question.**
17 **This is making a statement -- this is not**
18 **making a statement about what's being used.**
19 BY ATTORNEY RUBIN:
20 Q. Okay. Can you help me understand what you
21 mean by -- by that?
22 ATTORNEY DEUTSCH: Objection, form, scope.
23 **THE WITNESS: In order to form the intended**
24 **current waveform in the actual realtime control, it can**
25 **be difficult to perform complicated control at every**

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

half cycle or cycle due to constraints from CPU speed.

So I mean it -- it doesn't say that it's performing the complicated control. It says it can be difficult, perhaps it's not even possible because of their constraints from the CPU speed. That's how I read that sentence.

BY ATTORNEY RUBIN:

Q. So I won't read the second sentence, but you can see what it is. I will read the third sentence. Quote, that is, the controller may use a so-called PWM control method, close quote.

Do you see that?

A. Yes, I see that.

Q. Do you know what "PWM" stands for there?

A. PWM is a very, very widely used term in the art known to every POSITA, which means pulse-width modulation.

Q. And what is pulse-width modulation?

A. Modulation refers to the ability to vary something, adjust it, and pulse width is the length of time the pulse is turned on. So modulating the pulse width is pulse-width modulation.

Q. The next sentence says, "In this case the controller 6 can form an intended waveform without using a complex control system."

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

Do you see that?

A. I see that.

Q. Do pulse-width modulation systems sometimes utilize purely analog control methods?

ATTORNEY DEUTSCH: Objection, form and scope.

THE WITNESS: Yeah, I -- I -- in the -- in the abstract that -- you know, unrelated to this case, PWM can perhaps be generated by an analog system.

BY ATTORNEY RUBIN:

Q. Are you familiar with the designs of switch mode power supplies?

A. Only a little bit. It's not what I consider my expertise.

Q. What's your understanding of what a switch mode power supply is?

ATTORNEY DEUTSCH: Objection, scope.

THE WITNESS: My understanding is it converts power from, for example, one voltage to another by a circuit that switches it on and off and filters the resulting power as needed for the user, quote/unquote, or the person that used the output of the switch mode power supply.

BY ATTORNEY RUBIN:

Q. And -- withdrawn.

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

Would that switching on and off be considered by those in the art to be an example of pulse-width modulation?

ATTORNEY DEUTSCH: Objection, scope.

THE WITNESS: Well, again, I haven't offered any opinions about switch mode power supplies that I can recall. And also, it's a field of its own that I'm not an expert in.

But given those -- those qualifications, no, I think there's other ways to control the switching that are not PWM. Maybe some switch mode power supplies use it, but maybe they use other switching methods.

BY ATTORNEY RUBIN:

Q. So you should have in front of you your declaration in the IPR that includes grounds based on Izumi. So that's the declaration with the docket -- the attorney docket number ending in P2.

Do you have that?

A. Yes, I -- yes. I have that in front of me.

Q. Could you turn to page 72, please.

A. Okay. I'm at page 72.

Q. So right above paragraph 134 you quote the claim limitation 1.5.3, which I'll read. Quote, A switch that receives a directional signal d from the

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

processor and that selects a corresponding direction of the two opposite directions in which the driving component drives the movable component."

So the switch in that claim limitation -- you point to a Figure 22A from Izumi.

In your opinion, does that figure depict a switch that satisfies Limitation 1.5.3?

ATTORNEY DEUTSCH: Objection, form.

THE WITNESS: I think that figure satisfies 1.5.3.

BY ATTORNEY RUBIN:

Q. And what is the switch in that figure that satisfies 1.5.3?

A. The figure clearly shows an H-bridge circuit which is composed of four switches.

Q. Well, you're sort of getting at my question, my real question.

Is there one switch in Figure 12 point -- I'm sorry, Figure 22A that is made up of the four transistors, or are there four switches, each one being one of the transistors?

ATTORNEY DEUTSCH: Objection, form and scope.

THE WITNESS: I think this combination includes a switch, and it's described as H-bridge -- as

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

Izumi's H-bridge switch circuit. So a lot of times an H-bridge is described as a switch.

BY ATTORNEY RUBIN:

Q. So I -- I think it's a reasonable question.

As you're applying Izumi -- combinations of Izumi with other art to Limitation 1.5.3, what is it in this figure that you're identifying as, quote, a switch?

ATTORNEY DEUTSCH: Objection, form.

THE WITNESS: I'm identifying the H-bridge switch, composed of individual switches, but I'm -- I'm looking for -- or I'm matching it based on an H-bridge switch circuit.

BY ATTORNEY RUBIN:

Q. So the four transistors -- withdrawn.

So the circuit containing the four transistors is the switch of Limitation 1.5.3; is that right?

ATTORNEY DEUTSCH: Objection, form.

THE WITNESS: It's the H-bridge switch circuit, and yes, that contains four transistors acting as switches.

BY ATTORNEY RUBIN:

Q. Let me see if I understand the points that you're making here.

I think you've said more than once that each of the transistors is a switch -- just taking that term in

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

isolation for the moment, each of the transistors is a switch; is that right?

A. Transistors can operate in other ways as well, but in H-bridge switches, by far the most common understanding of how they operate is in switch mode. So transistors have switch modes and they have other modes for, like, amplifying audio, which is not a switch. So in H-bridge switches, transistors are almost -- to my knowledge, exclusively operated in a switch mode.

Q. Okay. So the transistors that make up the Izumi H-bridge are each a switch --

ATTORNEY DEUTSCH: Objection.

BY ATTORNEY RUBIN:

Q. -- as that circuit is meant to operate; is that right?

ATTORNEY DEUTSCH: Objection, form.

BY ATTORNEY RUBIN:

Q. I mean, I think that's a point that you've affirmative -- that you've volunteered a few times. I'm not trying to trip you up here, but, I mean --

A. And I've answered it.

Q. Okay. So -- yeah.

So you don't disagree that each individual transistor is operating as a switch in the Izumi

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

circuit -- in the Izumi H-bridge circuit?

ATTORNEY DEUTSCH: Objection, form.

THE WITNESS: I will say that I -- I wasn't -- I didn't need to talk about the transistors as switches in my opinion. I wasn't asked for an opinion of that.

This is a circuit commonly -- very, very commonly called an H-bridge switch, and the transistors in H-bridge switches, which there seems to be always four, they are very, very uniformly driven in switching mode.

BY ATTORNEY RUBIN:

Q. Okay.

A. So you can call them switches, and you can call the whole thing a switch.

Q. And as you're applying Izumi's circuits to Limitation 1.5.3, it's the whole H-bridge that you're --

A. The -- the --

Q. -- saying is the claim switch?

A. I'm sorry to interrupt you.

ATTORNEY DEUTSCH: Objection, form.

THE WITNESS: The limitation simply asks for a switch.

BY ATTORNEY RUBIN:

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

Q. Well, let's try to -- I mean, I'll disagree a little bit.

I think it says a switch that receives a signal and that selects a corresponding direction, so it has to be a switch that does certain things.

A. Okay.

Q. So I guess my -- my question for you is: You've identified, I take it, a switch in Izumi that you think does the things that the claim requires the switch do, and am I correct in understanding that the switch you've identified that you believe does those things required by the claim is the H-bridge switch which contains, at the very least, four transistors?

A. I didn't make an opinion on the difference between those or which one is required. I think both actually read directly onto the claim limitation.

Q. So one of the things that the claim limitation requires the switch do is, quote, selects a corresponding direction of the two opposite directions in which the driving component drives the movable component."

So let's pick one of the transistors, Q1.

Is it your opinion that Q1 selects a direction in which the driving component drives the movable component?

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

1 A. Well --
2 ATTORNEY DEUTSCH: Objection, form.
3 THE WITNESS: First of all, that's not an
4 opinion I was asked to render, and, you know -- but if
5 the Q1 is on, then it can move current from left to
6 right in the coil depicted in Figure 22A, and if it's
7 off, it cannot.
8 And, you know, to go any farther than that
9 I feel like I need to form a new opinion with, you
10 know, research, thinking about this more.
11 BY ATTORNEY RUBIN:
12 Q. Now, Limitation 1.5.3 requires the switch
13 receives, quote, a directional signal d.
14 Do you see that?
15 A. Yes.
16 Q. So what is the directional signal d in
17 Izumi?
18 A. I think I have some actual language on
19 that.
20 Paragraphs 137 and 138 talk about how the
21 direction is switched by the devices and the
22 transistors, and the -- 138 talks about how the signals
23 S1 through 4 change the direction.
24 Q. So in the opinions you're presenting in
25 your declaration, are you saying that, to take an

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

example, signal S1 satisfies the claim requirement of, quote, a directional signal d?

A. I think what I mean by paragraph 138 is the signals S1 through S4, the -- the -- collectively are a directional signal. And there's lots of examples in -- of signals comprised of more than one -- let's say wire, for example. For example, a digital video signal might have eight wires sending the video signal.

Q. So would you agree that if you know -- withdrawn.

Would you agree that if the only information you have about the control signals at a particular point in time is that the control signal S1 has a value such that transistor Q1 is off, you don't know whether the driving component is driving the movable component at that moment in time?

A. What my opinion says is that the four signals collectively are a direction signal, S1 through S4.

Q. So you're not offering the opinion that S1 by itself would satisfy the -- the claim limitation of a directional signal?

ATTORNEY DEUTSCH: Objection, form and scope.

THE WITNESS: Sitting here now, I don't

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

1 **think that my opinion equates one signal, S1, with the**
2 **direction signal, but it's a part of the direction**
3 **signal.**
4 BY ATTORNEY RUBIN:
5 Q. Could you please turn to page 92.
6 Are you there?
7 **A. Not quite, but --**
8 Q. Okay.
9 **A. But now I'm on 92.**
10 Q. So right above paragraph 162 you reproduce
11 Limitation 3.1, which requires, quote, a vibration
12 sensor.
13 Do you see that?
14 **A. Yes.**
15 Q. And then in the first sentence of
16 paragraph 162, you say, and I'll quote, "The
17 Izumi-Cosper-Rossi linear resonant vibration module
18 includes a vibration sensor (accelerometer) in
19 accordance with Cosper, in addition to the sensors
20 associated with 'position' and 'velocity' that are used
21 as part of the feedback control."
22 Do you see that?
23 **A. Yes.**
24 Q. And so much like the corresponding
25 paragraph in the other declaration I asked you about

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

1 this morning, I -- I don't see a citation here to any
2 evidence of an accelerometer in any of these prior art
3 references.
4 Do you know which reference has an accelerometer?
5 ATTORNEY DEUTSCH: Objection, form.
6 **THE WITNESS: I think this is what we meant**
7 **to -- what I meant to say or we meant to say in**
8 **accordance -- by in accordance with Cosper, Cosper's**
9 **accelerometer, and to the extent that that clarifies my**
10 **earlier answer also.**
11 BY ATTORNEY RUBIN:
12 Q. If we could turn to page 102 of your
13 declaration with the docket number ending in P2.
14 **A. Okay. I'm at page 102.**
15 Q. So in paragraph 178 you have some
16 discussion of a prior art reference called Ibuki, which
17 is cited as Exhibit Apple 138.
18 Can you see that?
19 **A. Apple 1038, but yeah.**
20 Q. I stand corrected. Yes.
21 So just -- just below the halfway point of page
22 102, you quote from Ibuki, quote, at least one of a
23 driving frequency, the number of revolutions per unit
24 time, and an amplitude of the blade in the cleaning
25 drive mode is differentiated from a corresponding one

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

in the normal drive mode."

Do you see that?

A. Yes, I do.

Q. And then in your sentence following that, you say, and I'll quote, "For example, the frequency is higher in the 'normal drive mode' than in the 'cleaning drive mode.'"

Do you see that?

A. Yes.

Q. Now, would you agree that Ibuki doesn't talk about any of the frequencies it utilizes being resonant frequencies?

ATTORNEY DEUTSCH: Objection, form and scope.

THE WITNESS: I would want to check Ibuki a little bit on that. I can't recall right now, sitting here.

BY ATTORNEY RUBIN:

Q. So taking as -- well, withdrawn.

Taking the example that you give in the sentence I just quoted where the normal drive mode frequency is higher than the cleaning drive mode frequency, do you have an opinion as to which if either of those frequencies would be at resonance?

ATTORNEY DEUTSCH: Objection, form.

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

1 **THE WITNESS: No, I don't have that -- an**
2 **opinion either way on that. I wasn't asked to opine on**
3 **that, at least the best -- at least to my best**
4 **recollection.**
5 BY ATTORNEY RUBIN:
6 Q. If you could just turn to page 126, please,
7 of this declaration.
8 **A. Okay. I'm on 126.**
9 Q. So in paragraph 219, the sentence that
10 starts at the bottom of the page reads, and I'll quote,
11 "As I discussed, Shahoian's H-bridge switch circuit
12 provides a switch as recited by Element 1.5.3."
13 Now, this is in the context of a discussion of the
14 Izumi-Cosper-Ibuki-Aldrich combination, so I'm going to
15 guess that citing to Shahoian in this paragraph was not
16 what was intended?
17 **A. Yeah. I think that was a typo we**
18 **identified.**
19 **That's certainly not intended to be Shahoian's**
20 **H-bridge, but rather Ibuki's H-bridge or, let's see --**
21 **yeah, and we are not relying on Rossi there, so that**
22 **would be Ibuki's -- sorry, Izumi's H-bridge.**
23 **So yeah, sorry about that typo on the last line of**
24 **126, page 126.**
25 Q. So way back at the beginning of the

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

deposition I had asked you whether there were any errors that you were aware of, and you referred to something which I don't think is this issue, and I'll forgive you for not necessarily knowing about every typo that might have been in here, but the -- the error that you did remember you hadn't been able to find in the declaration.

With more time to think about things or as we've been going through your declarations today, do you -- do you have any better recollection of where that error was?

A. Not at this time. I was -- you know, there are several declarations, and some of them use Rossi, and it did relate to Rossi's H-bridge.

So I -- I don't remember if it's in this one or not, and since this morning I have not seen it. And I would have called it out to you if I had seen it.

And I -- and I -- I'm sorry I didn't include that one Shahoian typo I forgot about this morning. I -- you know, I do recall it. We ran into it in -- in depo prep.

Q. Okay. Are there any other typos or corrections that you can think of now that you didn't remember earlier?

A. Not at this time in my head, no.

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

Q. Okay.
ATTORNEY RUBIN: Well, I'll pass the witness as to these two IPR declarations.
ATTORNEY DEUTSCH: Thanks. Let's take a short break.
(RECESS TAKEN.)

EXAMINATION

BY ATTORNEY DEUTSCH:
Q. Thank you again, Dr. Hannaford, for your time today. I just have a couple follow-up questions.
Do you recall discussing the directional signal d a few moments ago in the context of the Izumi-Cosper combination?
A. Yes.
Q. And we were discussing Element 1.5.3 beginning at page 72 of the IP2 declaration.
A. Yeah, I am there.
Q. So I see at page 72 the claim language is reproduced in the heading at 1.5.3.
Do you see that?
A. Yes, I see the -- the reproduced 1.5.3 claim limitation.
Q. And then there are several paragraphs of

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

analysis after that, which I understand are examples of how the Izumi-Cosper combination addresses Element 1.5.3.

ATTORNEY RUBIN: Objection, leading.

BY ATTORNEY DEUTSCH:

Q. Is that correct?

ATTORNEY RUBIN: Same objection.

BY ATTORNEY DEUTSCH:

Q. I can rephrase the question.

If we turn to the top of page 73, Figure 22A of Izumi is shown.

Do you see that?

A. Yes. I've turned to that figure on that page.

Q. And there are four annotated control signals identified by red arrows; is that correct?

A. Yes.

Q. And then if we turn just immediately below that, paragraph 135 discusses the control signal input to each transistor.

And so my understanding is one way that the directional signal d is satisfied is by each control signal input to each transistor.

Is that right?

ATTORNEY RUBIN: Objection, leading.

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

BY ATTORNEY DEUTSCH:

Q. I can rephrase that.

So the paragraph 135, can you read that paragraph?

A. Yeah.

"Each control signal input to each transistor (e.g., control signals S1 through 4) provides a direction signal d that controls the on/off state of each of the switches Q1 through 4. In the combined system each switch receives the transistor control signal from the microprocessor and Izumi explicitly" -- "explicitly describes that the controller provides the control signals that drive the electromagnet and moving element."

Q. And so this paragraph is explaining that each of those four control signals input to each transistor each provides a direction signal d --

ATTORNEY RUBIN: Objection.

(A DISCUSSION WAS HELD OFF THE RECORD.)

BY ATTORNEY DEUTSCH:

Q. I understand from paragraph 135 that one way that the directional signal d is provided in the Izumi-Cosper combination is based on each control signal input to each transistor, and, more specifically, that each control signal input to each transistor provides a direction signal d that controls

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

1 the on/off state of each of the switches Q1 through Q4;
2 is that correct?
3 ATTORNEY RUBIN: Objection, leading.
4 **THE WITNESS: I believe that correctly**
5 **summarizes that -- that -- my opinion there, yeah.**
6 ATTORNEY DEUTSCH: Okay.
7 Thank you. No further questions.
8 ATTORNEY RUBIN: All right. I'll have some
9 recross.
10
11 EXAMINATION
12
13 BY ATTORNEY RUBIN:
14 Q. So with the testimony that you just gave in
15 response to Apple's counsel's questioning, I want to
16 understand where your opinions stand right now
17 concerning the directional signal d and Izumi.
18 So am I correct in understanding that you're
19 presenting two alternative opinions for what in Izumi
20 satisfies the directional signal d, that it could
21 either be a collection of the four signals S1 through
22 S4 or it could be any one of those signals taken
23 individually?
24 **A. I think it's what my opinion is written**
25 **here, that each control signal input to each transistor**

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

(e.g., the control signals S1 through S4) provides a direction signal. So they're all direction signals. The bridge needs all the direction signals to set the direction.

Q. Okay. So in the text that counsel asked you about in the first sentence of paragraph 135, you say -- and I'll read it again, quote, Each control signal input to each transistor (e.g., control signals S1 through S4) provides the direction signal d" -- and I'll end the quote there.

So here you are -- you do offer the opinion that each of the control signals, S1 through S4, taken individually, provides a direction signal d.

Would you agree?

A. They are all direction signals, but the -- the bridge requires all the direction signals to function properly. So I gave that example before with the Q1.

Q. Okay. So I think that earlier today you gave some testimony about those in the art understanding that a signal could be carried on multiple conductors in parallel.

Are you still offering the opinion that the three signals, S1 -- I'm sorry, the four signals, S1 through S4, collectively satisfy the limitation directional

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

signal d?

ATTORNEY DEUTSCH: Objection, form.

THE WITNESS: Yeah, I don't -- you know -- well, each -- each one carries directional information and is a direction signal, and collectively they operate the switch.

BY ATTORNEY RUBIN:

Q. Collectively, are they --

A. I'll be clearer.

Collectively they operate the H-bridge.

Q. Sorry for talking over you there.

Collectively, are they the claimed direction signal d?

ATTORNEY DEUTSCH: Objection, form.

THE WITNESS: They are directional signals, and they -- they are required to -- but all of them are required to fully function the H-bridge -- to make the H-bridge fully function, is probably a more accurate answer.

BY ATTORNEY RUBIN:

Q. So in Izumi could you please turn to Figure 23A?

A. You mean --

ATTORNEY DEUTSCH: Objection, scope.

THE WITNESS: You mean Apple 1005?

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

BY ATTORNEY RUBIN:

Q. Yeah, that's right.

A. Okay. And tell me the figure again.

Q. 23A.

A. All right.

Okay. 23A.

Q. So would you agree that looking at the voltage of signal S1, if all that I know is that S1 has a low voltage at a particular moment in time, I don't know whether the actuator is being driven at that moment in time?

ATTORNEY DEUTSCH: Objection, form. Objection, outside the scope of redirect.

THE WITNESS: Yeah, I -- it's -- I think it's stretching pretty far from my opinion, but this shows how, collectively, the direction signals change the direction of the current.

BY ATTORNEY RUBIN:

Q. So if S1 -- if I know that S1 has a low voltage, I'd need to know what the voltages are of at least one of the other signals, S2 through S4, to know whether -- or in which direction the actuator was being driven, correct?

A. I -- I would have to think about that a little bit in terms of the circuit analysis. Sitting

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

here right now, maybe that's correct. It might -- that's correct, I still stick with my answer that collectively all four signals are required to drive the H-bridge are the -- part of my answer.

ATTORNEY RUBIN: Pass the witness.

ATTORNEY DEUTSCH: I just have a few follow-up questions.

THE WITNESS: Okay.

EXAMINATION

BY ATTORNEY DEUTSCH:

Q. So I would like to turn back to paragraph 137 of the IP2 declaration.

ATTORNEY RUBIN: I'll just say I think the rules provide for cross, redirect, and recross. I don't think they provide for re-redirect, but -- so I'll object on that basis, but you can go ahead and answer that question subject -- or ask the question subject to that objection.

ATTORNEY DEUTSCH: Yeah, thanks for -- thanks for adding that, Neil, and I think the -- it's beyond the scope.

ATTORNEY RUBIN: Yeah, I disagree that there's a scope issue. I think the witness actually

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

offered a different opinion on redirect than he had on cross, and I think it was reasonable for me to explore that. But let's proceed.

ATTORNEY DEUTSCH: Sure. At any rate, just a few questions.

BY ATTORNEY DEUTSCH:

Q. Turning to paragraph 137, I think you had discussed that paragraph previously, and in paragraph 137 it gives an example, looking partway down the paragraph, "For example, when switching elements Q1 and Q3 are open and switching elements Q2 and Q4 are closed, the current flows through the cord on the first direction through switching elements Q2 and Q4."

And so in that example if -- if Q2 were switched, for example, due to the signal coming into -- to S2, then the state of the H-bridge would -- would change; is that correct?

ATTORNEY RUBIN: Objection, leading, and objection, scope.

THE WITNESS: I -- I'm not sure I understood that. Just repeat the switches open and close state and what you're asking.

BY ATTORNEY DEUTSCH:

Q. Sure.

And more generally for a given -- given state of

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

the respective switching elements, the signal coming into Q2, for example, is -- would control the -- whether that corresponding switching element Q2 was open or closed, correct?

A. Yes.

ATTORNEY RUBIN: Same objections.

ATTORNEY DEUTSCH: Okay.

ATTORNEY RUBIN: And just -- all right. No questions from me.

(CONCLUDED AT 2:07 P.M.)

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

REPORTER'S CERTIFICATE

I, DANNIELLE COPELAND, RDR, CRR, DO HEREBY CERTIFY THAT THE FOREGOING DEPOSITION OF BLAKE HANNAFORD, PH.D. WAS TAKEN ON 1/27/25 VIA ZOOM BEFORE ME AT 9:02 A.M. FOR THE PURPOSE IN THE CAPTION STATED; THAT THE WITNESS WAS FIRST DULY SWORN TO TELL THE TRUTH, THE WHOLE TRUTH, AND NOTHING BUT THE TRUTH; THAT THE DEPOSITION WAS TAKEN BEFORE ME STENOGRAPHICALLY AND AFTERWARDS TRANSCRIBED UNDER MY DIRECTION; THAT THE FOREGOING IS A FULL, TRUE, AND CORRECT TRANSCRIPT OF THE SAID DEPOSITION SO GIVEN; THAT COUNSEL FOR ALL PARTIES WERE PRESENT AT THE TIME OF THE DEPOSITION; THAT THERE WAS A REQUEST THAT THE WITNESS READ AND SIGN THE TRANSCRIPT.

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Dannielle Copeland

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Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

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(CITY) (STATE)

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THIS ____ DAY OF _____, 2025.

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Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

Errata Sheet

NAME OF CASE: APPLE INC. V. RESONANT SYSTEMS, INC.
DATE OF DEPOSITION: 01/27/2025
NAME OF WITNESS: BLAKE HANNAFORD, PH.D.
Reason Codes:
1. To clarify the record.
2. To conform to the facts.
3. To correct transcription errors.

Page _____ Line _____ Reason _____
From _____ to _____
Page _____ Line _____ Reason _____
From _____ to _____
Page _____ Line _____ Reason _____
From _____ to _____
Page _____ Line _____ Reason _____
From _____ to _____
Page _____ Line _____ Reason _____
From _____ to _____
Page _____ Line _____ Reason _____
From _____ to _____
Page _____ Line _____ Reason _____
From _____ to _____

_____

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

0

0177IP1
67:16

1

1
40:4,7 54:2, 24 56:13 69:23 70:1,8, 20,25 71:5 72:5 73:5

1.3
71:2

1.5
71:2

1.5.3
76:24 77:7, 10,13 78:6,16 80:17 82:12 87:12 89:17, 21,23 90:3

1.6
41:5,22 43:14,23 45:11,14,23 46:20,25 47:6,16,21 49:13,19 50:15 51:1,6 52:3 53:12 54:4 71:2

100
30:1

1004
21:13,15 22:19 40:3 44:8

1005
71:7 94:25

1009
31:24 32:8,11

102
85:12,14,22

1038
85:19

108
26:18 69:16

11
49:6,20 55:19,21

115
36:9,11,14

12
70:14 77:18

12/782,697
13:8

126
87:6,8,24

12th
12:20

130
45:21 70:15

134
76:23

135
90:19 91:3,20 93:6

136
45:12,21

137
45:12,22 46:7 82:20 96:14 97:7,9

138
82:20,22 83:3 85:17

153
60:5,8

158
65:9

159
67:18

162
84:10,16

177IP2
48:24

177P1
48:24

178
85:15

1A
38:24

2

2
49:16 59:2 62:13 63:6, 19,20 64:6

2.3
56:15 57:9 58:15 60:18

2.4
56:23 57:7 59:15 61:19 62:1,11,13 63:13,18

2024
12:20

2024-00697
8:18

2024-00698
8:19

219
87:9

22
71:3

22A
77:5,19 82:6 90:10

23A
94:22 95:4,6

25
49:8,12,16, 20,23 50:16 51:15 52:5 54:13 55:19

26
51:15 52:6 54:13

28
40:9,22 44:15

294
71:11

2:07
98:10

2B
70:14

3

3
33:16 34:12 37:15 49:17

3.1
84:11

3.2
67:19

30
50:4,16 51:15 52:6 54:17

30-some
49:16

31
49:16

32
50:7,17 51:16 52:4 54:21 55:22

33
49:20

34
23:19 44:17

35
40:19,24

4

4
44:9,13,22 56:13 82:23 91:6,8

40
24:9

41
22:20,22

5

5
23:15,18 69:23 72:20

50
23:16,18 24:9 56:1

53
26:17

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

532
32:6

54
30:21 31:10

56
25:13 44:13, 14

57
36:11

58
35:18 36:6,8, 12

6

6
57:15,18 74:24

61
28:11

62
30:21 31:10

63
72:22,23,24

68
38:20,22 39:4

697
13:3,17 14:25 15:6

698
13:3,9 15:1

7

7
19:10 22:18 25:12 30:20 31:10 35:2,7 44:10

72
76:21,22 89:18,20

73
90:10

74
40:25 41:3 49:18

75
40:19 42:20, 21

76
46:3,5

767
13:14 16:15 19:6 21:22 22:11 41:5 48:3,15,20,22 49:3,4,20 55:20,22 65:16 68:11, 17 70:13

8

8,093,767
8:13

82
17:18

85
56:7,8 60:18

86
57:14 60:19, 24

9

90
65:6,7,8

91
67:9,11

92
84:5,9

A

ability
8:1 12:15 46:11,19 47:3 50:13 55:5 74:19

absolute
29:20

abstract
75:8

acceleration
66:10

accelerometer
65:12 66:9, 11,14,23 67:1 84:18 85:2,4, 9

access
9:15

accessing
10:21

accidentally
18:10

accordance
39:9,22 84:19 85:8

accurate
7:21 94:18

achieve
69:7

acting
27:18 78:19

actual
14:19 73:3,24 82:18

actuator
22:5 25:18 26:19 28:16 29:1 30:1 31:1 71:22 95:10,22

add
62:2

adding
70:16 96:22

addition
58:23 84:19

additional
20:19

Additionally
46:8

address
8:11 26:16 35:18,19 45:24 70:15 71:15

addressed
25:10 42:7

addresses
38:19 67:9 90:2

addressing
35:21 38:23, 24 40:20 45:10 70:1

adjust
22:23,25 42:14 74:20

adjusting
42:4

adjustment
39:21

adjusts
39:8 42:9 69:7

admit
23:25

advantage
18:15

advantages
18:4,8,9,13 26:19 27:16

affect
8:1

affirmative
79:20

agree
7:7 22:4 28:19 30:7,23 32:18,19 34:19 35:4,8 36:23 37:24 39:14 42:2,24 43:25 45:6,14 49:13 52:9,14 53:20,23 54:7,9 57:6, 18,23,25 59:2 60:9,16 62:22 63:1 65:17 69:24 70:21 71:20 72:10, 12 73:10 83:9,11 86:10 93:14 95:7

agrees
71:18

ahead

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

96:18

air
55:9

Aldrich
69:22 70:16, 18

alternative
92:19

Amaya
19:12,17 21:7

ambiguity
47:25 55:4

ambiguous
52:25

amplifying
79:7

amplitude
22:24 85:24

analog
75:4,9

analyses
70:23

analysis
17:17 46:9 53:17 62:12 69:21 70:19 90:1 95:25

analyze
71:15

analyzing
70:11

and/or
44:16

annotated
57:15 61:1,14 90:15

annotation
60:20

annotations
60:23

answering
6:23 17:23 34:13 53:16

answers
6:24 38:7

antecedent
46:9,11,17 51:25

anticipated
43:23 58:20

anticipation
58:16,18

appears
39:2 49:19,22

Apple
5:14 8:12,17 53:18 85:17, 19 94:25

Apple's
8:4 92:15

application
13:12,13,15, 24 14:1 33:12 34:10 37:16 44:24 71:21

applications
72:2

applied
46:25 51:2,6 62:10

applies
37:4 51:23 55:12 56:4

apply
17:16 46:19, 24 54:24 55:8 56:2,4 58:24 59:1

applying
47:2 53:17 62:12 78:5 80:16

approximately
56:1

April
12:20

argument
16:22 17:14, 15 43:22

arrangements
11:16

arrows
60:21 90:16

art
9:2 15:17 20:24 24:10, 13,23 31:24 43:5 46:20,25 47:18 51:3 53:6,18 56:10 60:10 62:4,12 64:2 65:15,18 67:25 68:15, 22 69:1 74:16 76:2 78:6 85:2,16 93:20

asks
80:23

assigned
14:16,21 33:12

assignee
32:16,17,21

assume
7:8 14:18 47:18

assuming
30:3

assumption
47:25

attached
5:21

attempted
46:10,18,19

attention
22:18 23:14

attorney
4:6,10 10:10, 16,18 11:4,8, 13,14,15,17, 18 12:11,14, 17,18 14:5, 10,15 15:17 19:24 20:2,25 21:3,8,11 22:3,8,13 23:8,12 24:4, 11,18,22 25:6,11 26:2, 9 27:12 28:4, 8,12,23 29:12,16,23 30:15,18 31:3,8,13,20, 23 32:2,20, 22,25 33:2,6, 9 34:4,7,11, 18,22 35:1, 11,16 37:1,9 38:2,8,13,17 39:19 40:1 42:6,19 43:6, 11,18,24 45:16,19 46:23 47:15, 22 48:3,9,12 50:19,24 51:7,12,18 52:1,10,15 55:2,15 57:10,13 58:3,17 59:6, 12 60:13,17 61:5,9,18 62:9,16,21,24 63:3,10,16,23 64:4,11 65:4, 19,22,24 66:1,2,5,6,17, 20 67:16 68:2,6,19,23 69:17 70:2,5 71:8,12,23,25 72:15,19 73:14,19,22 74:7 75:5,10, 17,24 76:4, 14,18 77:8, 11,22 78:3,8, 13,17,21 79:13,14,17, 18 80:2,12, 22,25 82:2,11 83:23 84:4 85:5,11 86:13,18,25 87:5 89:2,4, 10 90:4,5,7,8, 25 91:1,17,19 92:3,6,8,13 94:2,7,14,20, 24 95:1,12,18 96:5,6,12,15, 21,24 97:4,6, 18,23 98:6,7, 8

attorneys

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

8:4

audio
79:7

aware
9:17 16:17 88:2

B

back
5:18 6:3 21:23 25:12 37:15 40:2 45:9 59:7 87:25 96:13

bar
56:17 57:3,7,8 58:10 59:21 61:22,23 62:15,18,23 63:7 64:9,14,16 65:1,3

based
39:8,16 53:7,24 76:16 78:11 91:22

basically
41:15

basis
46:9,12,17 51:25 68:24 96:18

beginning
20:7 36:8 47:7,20 53:13 59:14,15 60:4 87:25 89:18

begins
39:3 41:8 67:19

behalf
5:14 8:12

behavior
31:17

benefit
48:6

bias
34:13 37:18

big
12:10

biggest
47:13

bit
20:6 43:20 75:13 81:2 86:16 95:25

blade
85:24

BLAKE
4:1

blame
38:23

body
72:7,8

bold
41:4 49:17

bolded
41:23

bottom
39:4 42:21 44:22 65:8 87:10

box
40:9

break
7:12,14,17 12:9 65:23 66:3,17,21 67:2,5,6 89:5

bridge
93:3,16

briefly
31:21

bulb
35:6

button
23:22 25:2

C

call
15:20 17:24 27:22 67:19 68:22 80:14,15

called
53:11 80:8 85:16 88:17

capable
22:6

capacity
73:7

car
44:25

careful
70:23

carefully
38:5

carried
93:21

carries
94:4

case
5:10 13:1 74:23 75:8

cases
5:2,5,7,12,14,16,22

cetera
42:11

challenging
8:13,18

chance
6:22 67:2

change
31:18 82:23 95:16 97:16

changing
29:3,4,8

characteristics
44:16

characterizes
47:24 55:23

characters
14:11,12

chat
31:25 71:9

check
86:15

checked
10:7

checking
49:15

circle
61:8

circuit
61:2 75:20 77:15 78:1,12,15,19 79:15 80:1,7 87:11 95:25

circuits
80:16

citation
26:14 45:18 65:16,20 69:13 85:1

citations
65:14

cite
26:10,20 27:3,9 29:25 30:21 45:13 58:1 65:17 67:24 71:1

cited
19:10 20:4 85:17

citing
87:15

claim
22:10,11,14 46:10,12,18 50:13,23 51:9 52:25 53:24 54:2,10,24 56:14 59:2,8,10,14 62:8,13 63:6,19,20 64:3,6,8 70:1,8,19,20,25 71:1,4,5 76:24 77:4 80:20 81:9,12,16,17 83:1,21 89:20,24

claimed
94:12

claims
26:7 41:5

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

53:10,18 56:13 58:20 69:23 70:12

clarification 37:14

clarifies 85:9

clarify 59:10 70:9

clean 11:5

cleaner 14:23

cleaning 85:24 86:6,22

clear 6:11 15:8 28:1 37:4 39:4 48:13 62:20 64:14

clearer 15:3 94:9

close 41:9 45:1 46:22 47:19, 20 50:8 52:4 56:18 57:19, 20 59:16 65:12 67:21 74:11 97:22

closed 97:12 98:4

closer 30:11 31:1

coil 82:6

coincidence 13:20

coincidental 13:16

collection 92:21

collectively 83:4,18 93:25 94:5,8,10,12 95:16 96:3

column 22:18 23:15, 18 24:8 25:12 30:20 31:10 44:9,13,22 49:6,20 55:19,21

combination 35:22 39:15, 17 45:11,24 53:6,9,17,25 54:1,3,9,12, 16,20,23,25 56:9 58:24 59:1 62:12 64:3 66:23 68:4,11,13, 16,25 69:2,24 70:11,15 77:24 87:14 89:15 90:2 91:22

combinations 19:21 20:1 21:21 38:19 47:17 51:2 67:9 71:14 78:5

combined 39:5 91:8

comma 59:15 65:10

Commission 5:10

common 79:4

commonly 24:10 80:7,8

compares 39:7

comparison 39:9

compensated 25:19 28:17

compensating 25:20 28:6, 10,21

compensation 29:2

compensator 29:6,7

compensators 29:7

complementary 56:17 58:9

complete 7:21

completely 20:15

complex 74:25

complicated 73:4,13,25 74:3

component 39:5 41:9 42:4 61:22 77:3 81:20, 21,24,25 83:15

components 60:20

composed 77:15 78:10

comprised 83:6

comprising 72:7

computer 11:24 44:23

computer's 4:13

CONCLUDED 98:10

conductors 93:22

confused 15:9 30:16

confusing 15:3

confusion 47:12

considered 76:1

constant 30:4

constraint 73:6

constraints 74:1,5

contends 53:18

contents 19:6,10 38:25

context 42:25 87:13 89:14

continues 28:18

continuous 68:12,18 69:1

continuously 67:20 68:1,5, 9,16

contrasted 53:1

contributed 5:8

control 29:1,5 35:8 36:15,23 37:17 39:5,6, 8,21 41:8,20 42:3,9,10,14 61:15 67:20 68:4,12,13,18 69:2,6,9,13 73:3,4,6,11, 13,24,25 74:3,11,25 75:4 76:10 83:12,13 84:21 90:15, 19,22 91:5,6, 9,12,15,22,24 92:25 93:1,7, 8,12 98:2

controlled 57:1,2 59:19, 20 61:20,21, 24 62:14,18, 23 63:14,21

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

64:7,9 73:1

controller
22:23 74:10, 24 91:11

controlling
63:7

controls
61:10,16 91:7,25

converts
75:19

copies
8:22,25 14:4 19:1 48:20

Copper
69:22

copy
13:7,19 32:1 48:21 49:3,4 71:18

copyright
5:11

cord
97:12

corner
14:6

correct
8:15 11:3,13 12:22 16:1,5, 18,23 43:5,17 45:23 46:1 52:2,24 53:12 54:21 61:4, 11,16 62:3,23 71:19 81:10 90:6,16 92:2, 18 95:23 96:1,2 97:17 98:4

corrected
85:20

corrections
88:23

correctly
25:10 53:4 55:17,24 92:4

correspond
14:16

corresponds
61:23

corroboration
20:14,18

Cosper
17:17 31:24 32:6,7,10,12 33:4,17 34:10,19 35:3,9,22 36:24 37:3, 12,13,15,25 38:10,15 39:15 43:5,9 45:12,25 51:10 52:8 53:7,25 54:12,16,20, 23 55:7,12, 18,20,25 56:10 58:25 59:1 66:13 69:22 70:16, 18 84:19 85:8

Cosper's
36:15 39:9,22 85:8

counsel
8:24 9:9 10:10,12,16 11:1,4 93:5

counsel's
49:3 92:15

count
55:10

couple
36:12 89:12

court
5:10 6:7,11, 19 48:5

covered
37:7

covers
51:11

CPU
73:6,11 74:1, 5

Craig's
48:21

critical
16:22

cross
96:16 97:2

cue
23:22 25:2

current
18:10 73:2,24 82:5 95:17 97:12

cursor
44:25

CV
5:20,23

cycle
73:5 74:1

D

date
12:22

dated
12:20

day
16:12

deal
12:10

declaration
13:3,4 14:7, 24,25 15:1, 10,14,16,23 16:16,17,25 18:23 21:24 25:14 26:11, 14,16 29:19 35:18,19 36:2,6 38:18, 19 40:13,20 41:1 45:9,10 46:4 49:18 50:25 51:3 52:8 56:7 58:19 65:6 67:8 69:16 71:15 76:16, 17 82:25 84:25 85:13 87:7 88:7 89:18 96:14

declarations
5:21 8:11,23 12:19 13:1, 23,25 14:4,18 16:7,15 17:20 19:2,7,16,17, 22 20:5,12,22 21:5 35:25 48:14,23 53:21 88:9,13 89:3

defin-
24:5

defining
24:5

definite
51:9

degree
68:21

degrees
44:18

demonstrate
53:8

depict
77:6

depicted
82:6

depo
88:20

deposed
4:2,23 5:6

deposition
6:10 8:4,11 10:1,21 11:19 88:1

describe
29:8 43:1 55:25

describes
26:18,22 27:1 34:19 38:10 40:14 54:10 61:25 71:21 72:11 91:11

describing
27:15 28:3 42:2

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

description 39:10,22 44:8 55:11
design 18:5
designed 35:9,14,15 36:16,22,24 37:3,25
designs 75:11
desirable 23:6 24:16 25:3 29:15 30:14 31:12
desired 25:18,21 27:14,17 28:17 29:9 31:17,18 41:18 42:5,15 43:16
details 5:19
detect 45:5
detects 45:7
DEUTSCH 10:16 11:4, 13,15 19:24 20:25 21:8 22:8 23:8 24:4,18 25:6 26:2 27:12 28:8,23 29:16 30:15 31:3,13 32:20,25 33:6 34:4,11,22 35:11 37:1 38:2,13 39:19 42:6 43:6,18 45:16 46:23 47:22 50:19 51:7,18 52:10 55:2 57:10 58:3 59:6 60:13 61:5,18 62:16,24 63:10,23 64:11 65:19, 22 66:1 68:2, 19 70:2 71:23 72:15 73:14, 22 75:5,17 76:4 77:8,22 78:8,17 79:13,17 80:2,22 82:2 83:23 85:5 86:13,25 89:4,10 90:5, 8 91:1,19 92:6 94:2,14, 24 95:12 96:6,12,21 97:4,6,23 98:7
developed 33:5
device 44:17 73:6,11
devices 18:15,16,20 24:14,25 82:21
diagram 18:19
diagrams 64:20
difference 47:1,9 81:14
differentiated 85:25
difficult 73:4,25 74:4
digit 44:11
digital 83:7
digits 13:21
diodes 18:6,8,13,19
direct 22:18 23:13, 15
directed 11:24
directing 11:21 44:12
direction 77:1 81:4,19, 23 82:21,23 83:18 84:2 91:7,16,25 93:2,3,4,9,13, 15,16 94:5,12 95:16,17,22 97:13
directional 58:8 76:25 82:13,16 83:2,5,22 89:13 90:22 91:21 92:17, 20 93:25 94:4,15
directional-signal 56:16,18
directions 77:2 81:19
directly 81:16
disagree 79:24 81:1 96:24
disclosed 37:8,11
discloses 68:4
disclosures 69:5
discuss 19:22 20:22 21:19
discussed 20:4,10 51:3 87:11 97:8
discusses 90:19
discussing 21:5 56:9 89:13,17
discussion 22:2 24:14 85:16 87:13 91:18
disqualify 68:22
distinguish 14:4
doc- 48:23
docket 11:11 14:5, 10,15 15:17, 24 67:16 69:17 71:16 76:17,18 85:13
document 5:24 11:23,24
documents 9:15 10:4,20 11:10,21,22 14:18 48:16, 22
dot 42:14
dozens 9:24
drive 22:24 29:1 35:9 36:24 37:5 85:25 86:1,6,7,21, 22 91:12 96:4
driven 80:10 95:10, 23
drivers 36:18
drives 77:3 81:20,24
driving 38:10 72:6 77:2 81:20,24 83:15 85:23
due 25:16 28:6,14 31:6 65:23 73:5 74:1

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

97:15
DULY
4:2

E

e.g
23:20 25:21 37:18 44:24 91:6 93:1,8
e.g.
45:7
earlier
4:17 28:13 53:15 85:10 88:24 93:19
easier
16:6
effect
30:14
effectively
12:6,7
elastic
72:7,8
elastomeric
37:18
electric
71:22 72:3,11
electromagnet
91:12
electromagnetic
36:18
element
41:5,8 50:23 53:10,11 54:1,4 72:8 73:5 87:12 89:17 90:3 91:13 98:3
elements
34:14 55:1 97:10,11,13 98:1
embodiment
73:3
embodiments
25:19 34:21
enable
12:9
end
7:13 16:12 23:20 47:8 49:8,23 50:15 65:16 93:10
ending
69:17 71:10, 16 76:18 85:13
ends
14:11 41:15
engagements
5:25
engine
33:23
engineer
29:9
engines
34:17
Enrique
32:12
entirety
27:5
entity
32:16
equates
84:1
error
17:4 88:5,10
errors
16:17 88:2
event
15:9
evidence
68:7,15 85:2
exact
58:11,14
EXAMINATION
4:4 89:8 92:11 96:10
EXAMINED
4:2
examples
68:11 72:11 83:5 90:1
exclusively
79:9
exhibit
21:13,18 22:19 28:1 31:24 32:11 40:3 44:8 71:7 85:17
exhibits
8:25 10:2
expect
20:20
expert
5:3,13,25 76:8
expertise
51:22 75:14
explain
26:21 30:10
explaining
91:14
explains
34:17
explanation
24:9
explicitly
91:10,11
explore
97:2
extent
11:6 85:9

F

face
32:18,19
fact
40:14,21 61:22 62:5
fair
6:25 7:5,8,18 58:22
familiar
24:1 75:11
farther
82:8
featured
18:7
federal
5:10
feedback
22:5 24:14, 17,25 29:13 42:3,23 43:1, 4 68:12,18 72:13,18 84:21
feel
52:12 82:9
field
72:4 76:7
figure
35:2,4,7 40:4, 7,9 57:15,18 60:23 61:24 77:5,6,9,12, 14,18,19 78:7 82:6 90:10,13 94:22 95:3
figures
34:25
file
11:5
filed
8:17 9:16 11:10 13:2,5 14:22 32:24
files
9:21 10:5,11
filters
75:21
find
16:23 17:5,13 18:22 24:16 25:3 69:4 88:6
finding
17:19
fine
4:20 67:7
finish
6:4,22
firm

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

9:9

firmware
25:22

Fish
9:9,12 10:13 11:2 14:17

fixed
4:18

flat
25:20 26:1 27:10,23 28:6 29:2,10

flows
97:12

foam
25:18 28:16

focusing
21:23 29:24

folder
9:3,19,22 10:4,12,25 11:10 12:5

follow-up
89:12 96:7

forgive
88:4

forgot
88:19

form
6:15 19:24 20:25 21:8 22:8 23:8 24:18 25:6,9 26:2 27:12 28:8,23 29:16 30:15 31:3,13 32:20 33:6 34:4,11,22 35:11,12 37:1 38:2,5,13 39:19 42:6 43:6,18 45:16 46:23 47:22 50:19 51:7, 18,19 52:10 55:2 57:10 58:3 59:6 60:13 61:5,18 62:16,24 63:10,23 65:19 68:2,19 70:2 71:23 72:15 73:2, 14,22,23 74:24 75:5 77:8,22 78:8, 17 79:17 80:2,22 82:2, 9 83:23 85:5 86:13,25 94:2,14 95:12

forming
63:25

freedom
44:18

frequencies
22:7 25:15,20 27:25 28:10, 14 29:3 30:3, 10,25 31:5,11 86:11,12,24

frequency
22:15,23,25 23:1,7 24:17 25:4,17 27:21,22,24 28:15,22 29:4,8,10 31:7 36:25 37:6,21 38:1, 11,12 39:11, 18,23 85:23 86:5,21,22

freshly
8:23

front
10:25 14:19 49:5 76:15,20

full
27:2

fully
94:17,18

function
44:1 58:12 93:17 94:17, 18

G

gain
25:15 28:6, 14,21 31:4,5, 11

game
44:25

garble
20:7

gave
92:14 93:17, 20

generally
7:12 37:16 97:25

generated
57:8 63:15,21 64:7,10,14,19 75:9

generates
56:16 58:1,9

gestures
6:16

give
5:19 6:22 7:11,20 14:23 24:6 26:7 34:6,23 86:20

goal
69:7

good
4:7,8 6:20 7:1 11:14 67:17

greater
27:16 29:14, 21 30:2,9,25 31:11

grip
23:22 25:2

ground
38:24 70:14

grounds
19:20 20:1,23 21:6 40:20 76:16

guess
10:2 12:24 21:23 22:9 40:16 44:4 47:2 49:16 70:22 81:7 87:15

Gutierrez
32:12 33:4

H

H-BRIDGE
18:11 42:10 77:14,25 78:1,2,9,11, 18 79:4,8,12 80:1,8,9,17 81:12 87:11, 20,22 88:14 94:10,17,18 96:4 97:16

half
7:14 73:4 74:1

halfway
85:21

hand
23:22 25:2

Hannaford
4:1,7 11:20 89:11

happen
15:11 32:23

haptic
22:5 24:14, 16,25 25:4 29:13 72:13, 18

hardcopies
48:14,16

hardcopy
48:8,15,22

head
88:25

heading
89:21

hear
4:20 7:2 44:11

heard
7:9 33:14 44:10

hearing

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

4:12 33:15
held 22:2 30:3 91:18
higher 25:15 28:14 30:2,9,25 31:5,11 86:6, 22
highlighted 49:17
holds 55:10
Honestly 15:2
host 44:23,24
hour 7:13
housing 25:18 28:16
hyphenated 49:25

I

Ibuki 85:16,22 86:10,15
Ibuki's 87:20,22
ideas 20:19
identical 64:24
identified 81:8,11 87:18 90:16
identifies 13:13
identify 43:4 60:3,10
identifying 78:7,9
illumination 33:22 34:3,16
imagine 52:2
immediately 90:18
implemented 69:9
implicitly 31:18
implies 47:10
important 6:14,19
impression 15:2
IN1 58:10 61:22 64:16 65:1
include 71:14 88:18
included 41:4 67:1
includes 39:5 58:7 61:1 65:12 66:9,14 73:11 76:16 77:25 84:18
including 15:18,25 25:17 26:6 28:16 33:22 34:16 36:17 37:19 53:11
incorporating 18:5
incorrect 16:21 18:21
indefinite 46:13 48:2 50:12,22
independently 22:24 23:2
indicating 33:11
individual 78:10 79:24
individually 92:23 93:13
influence 44:24
information 83:11 94:4
infringement 5:11,12
input 44:1 45:5 90:19,23 91:5,15,23,24 92:25 93:8
inputs 44:20 45:7 64:15,23
instructed 8:7
instrument 23:21 25:2
intended 73:2,23 74:24 87:16,19
interested 22:11
interface 44:17
interfering 12:14
internal 14:16 56:17 57:1,3,6,8 58:9 59:19 61:20 62:18 64:9 65:3
International 5:9
interpret 27:13 46:10, 18
interpretation 47:13 51:1,5, 14 52:3,7 62:19
interpretations 51:10,13
interpreted 46:21 47:16 50:13,14 61:19 62:11, 13 63:6
interrupt 66:1 80:21
INTERRUPTION 22:1
invalid 53:19 64:3
invalidity 19:20
invention 28:3 34:9,21 62:5 71:21 72:2,5
inventors 30:14 32:12
inverter 58:1,8 61:3,7, 10,13,16 63:9,22 64:7
inverters 57:19 64:10, 22,23
invoke 43:21
involve 36:16 72:2
involved 17:21 43:3
involving 27:7 37:5 38:20
IP1 48:24
IP2 89:18 96:14
IPR 5:5,6 8:12,18, 19 13:1 14:19 76:16 89:3
IPRS 8:17 9:1,11, 16 11:11 12:20 13:6 14:17 16:15 21:14

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

isolation
79:1

issue
47:9 88:3 96:25

issues
12:12

italic
41:4

italicized
41:23

Izumi
15:25 16:8,16 17:17 71:7, 10,20 72:1, 13,18,25 76:17 77:5 78:5 79:12,25 80:1 81:8 82:17 90:11 91:10 92:17, 19 94:21

Izumi's
78:1 80:16 87:22

Izumi-cosper
89:14 90:2 91:22

Izumi-cosper-ibuki-aldrich
87:14

Izumi-cosper-rossi
84:17

J

James
32:12

job
6:20

joystick
23:20 25:1

K

kind
9:18 15:20 70:25

knob
23:22 25:2

knowing
88:4

knowledge
51:21 79:9

L

label
56:15 60:20 65:1

labeled
13:7 35:5 40:9 56:23 61:3,4 62:7 65:1

labels
64:15

lack
46:11,17

lacks
46:8

lag
29:6

language
23:24 27:14 28:9,11 82:18 89:20

laptop
9:3,6,7,11,15, 18 10:25

law
6:7

laying
31:15

lead
29:6

leading
90:4,25 92:3 97:18

left
61:3 82:5

legal
51:21

length
74:20

lesser
29:15

limitation
22:11 41:22 43:14,23 45:11,14,23 46:20 47:16, 21 49:13,19 50:12,15 51:1,4,6 52:3 53:11 54:4,13 55:19 56:14, 23 57:7,9 58:15 59:8, 11,15 60:18 62:1,8,11,13 63:13,18 64:1 67:19 76:24 77:4,7 78:6, 16 80:17,23 81:16,18 82:12 83:21 84:11 89:24 93:25

limitations
22:14 63:19 70:24 71:1,4

linear
26:19 30:1 41:17 43:15 44:2 65:11 66:8 84:17

linearly
36:17

lines
30:21 31:10 36:12 41:15 47:6 49:20 50:2 51:15 52:5 54:13 56:24

linkage
23:21

list
5:19 13:23,24 14:19 32:15, 17

listed
5:20 13:11 18:8,9 20:1

lists
5:24 32:11

litigation
5:9

loaded
9:11 10:12

logic
64:21

long
17:13 70:25

look-up
25:22

looked
19:15 47:12 64:2

loop
68:12,13,18 69:9,13

lost
53:13

lot
9:23 51:10,21 78:1

lots
83:5

low
95:9,19

M

made
11:6,16 77:19

magnitude
23:2 27:17 29:14,15,21 30:2,3,8,9,24

main
11:9

maintained
39:17

maintaining
39:10,22

make
6:21 7:4,10 8:16 10:19 12:8 16:6 29:2,20 79:11 81:14 94:17

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

makes 47:1 58:23 64:3
making 20:15 73:17, 18 78:23
manipulandum 23:19,25 44:17
mapping 62:6
maps 51:23 68:14
mass 34:13 36:17 37:17
match 13:17
matching 13:21 78:11
materials 8:20 9:5,10, 14,20
matter 64:18
max 4:13
maximum 27:25
meaning 46:12 48:2 50:21 51:9
means 24:3 29:3 64:19 74:16
meant 37:13 79:15 85:6,7
measure 44:2
mechanical 25:17 28:16 31:7 34:2 35:10 37:19, 20 38:1
mechanism 42:3
medical 23:21 25:1
medication 7:25
members' 37:18
memory 8:1 39:1 44:4 73:12
mention 19:17 20:23 22:15 40:13, 21 47:11 69:12 72:9,17
mentioned 21:6
mentioning 72:1
mentions 72:9,13
met 4:9
method 72:6 74:11
methods 37:17 75:4 76:13
mic 4:16
microprocessor 42:8 91:10
middle 26:17 40:8
mind 32:8 38:16
minimum 69:5
minute 6:3
minutes 6:4 7:13
mischaracterizes 52:11 63:11
misspoke 68:21
mistake 64:25
mistaken 17:7
mixed 59:19
mode 31:19 37:20 75:12,16,23 76:6,11 79:5, 10 80:11 85:25 86:1,6, 21,22
mode.' 86:7
modes 79:6,7
modifications 11:12
modulating 74:21
modulation 74:17,18,19, 22 75:3 76:3
module 41:18 44:3 65:11 66:8 84:17
modules 43:16
moment 79:1 83:16 95:9,11
moments 89:14
monitor 68:5
monitoring 67:25 68:8,25 69:1
monitors 67:21 68:5,16
morning 4:7,8 8:24 85:1 88:16,19
motion 44:16
Motohashi 19:12,17 20:24
mouse 12:4 23:20 25:1
movable 77:3 81:20,24 83:15
move 44:25 82:5
moving 36:17 72:8 73:5 91:12
multiple 18:16 22:6 93:22

N

names 58:10
nature 18:1
necessarily 88:4
needed 75:21
negligible 27:23
Neil 65:22 96:22
noises 20:16
non-word 6:16
nonexistent 27:24
normal 86:1,6,21
notes 48:25
number 9:23 13:1,10, 11,12,16,24

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

14:1,5,19 15:17,24 21:20 69:17 71:16 76:18 85:13,23

numbers 13:19 14:8, 10,15,16,20

O

oath 6:6

object 8:4 23:22 25:3 96:18

objection 8:6 19:24 20:25 21:8 22:8 23:8 24:4,18 25:6 26:2 27:12 28:8,23 29:16 30:15 31:3,13 32:20,25 33:6 34:4,11,22 35:11 37:1 38:2,13 39:19 42:6 43:6,18 45:16 46:23 47:22 50:19 51:7,18 52:10 55:2 57:10 58:3 59:6 60:13 61:5,18 62:16,24 63:10,23 64:11 65:19 68:2,19 70:2 71:23 72:15 73:14,22 75:5,17 76:4 77:8,22 78:8, 17 79:13,17 80:2,22 82:2 83:23 85:5 86:13,25 90:4,7,25 91:17 92:3 94:2,14,24 95:12,13 96:20 97:18, 19

objections 98:6

obtain 25:19 29:10

obtaining 28:5

obvious 53:24 58:20, 23

obviousness 19:21 20:23 21:6,20,21 39:16 53:9 69:25 71:14

occurring 25:16 28:15 31:6

occurs 28:22

offer 21:21 26:4 29:18 43:12 45:20 46:2 69:25 93:11

offered 46:20 52:17, 18,19 53:2 76:6 97:1

offering 5:13 26:25 47:17 50:14 51:2 83:20 93:23

offers 31:17

office 33:11

Omnilux 33:13,15

on/off 91:7 92:1

open 21:12,16 32:3,4 48:4 97:11,21 98:4

opened 9:19

operate 37:19,25 79:3,5,15 94:6,10

operated 79:9

operating 22:6 26:19 27:16 31:1 79:25

operation 41:17 42:15 43:15 44:2

operational 39:8 41:19 42:9

opine 87:2

opinion 23:10 24:6 25:9 26:4,7, 25 27:7 29:13,19 34:6,24 35:13,15 38:5,7 39:21, 25 43:12 45:21 46:2 50:11 51:2, 20,24 52:13, 17,19 53:3 55:13,18 58:5 64:1,13 68:3, 8,14,25 70:1 77:6 80:5,6 81:14,23 82:4,9 83:17, 20 84:1 86:23 87:2 92:5,24 93:11,23 95:15 97:1

opinions 5:13 21:21 39:16 46:21 47:17 50:14 58:19 76:6 82:24 92:16, 19

opposed 6:16

opposite 77:2 81:19

optimize 69:7

optional 28:2 29:1

optionally 27:14

order 41:16 42:14 53:8,24 73:1, 12,23

ordinary 62:4

orienting 15:13

oscillate 34:14

oscillating 33:23 34:16 37:19

oscillation 34:2 39:10, 17,23

oscillatory 37:20

output 23:1,7 39:6 41:9 42:12 61:10,13 63:8 67:21 68:5 75:22

outputs 39:8 41:18 42:4,9,14,15 43:16 64:23, 24 69:7

overview 17:10,12 19:10,12,18 20:4,11

owner 4:10

owns 9:7 32:16

P

P.M.

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

98:10

P1
14:11,24 15:6,16 48:22 69:18

P2
14:12,25 15:23 48:23 71:16 76:18 85:13

pages
59:18 71:3

pair
57:1,2 59:4, 19,20 60:10, 11 62:14,18, 23 63:1

pairs
56:25 58:2 59:3,16,24 60:4,9

parabola
34:25

parabolic
34:20 35:4

paragraph
18:4 26:10, 11,18,20 27:1,2,4,9 29:24 30:1, 10,19,20,22, 23 31:9,14 33:16,20 34:12 36:9,14 37:15 40:19 44:8 46:7 60:5,6 65:9, 15,18 67:18 72:5,21,22, 23,24 76:23 83:3 84:10, 16,25 85:15 87:9,15 90:19 91:3,14,20 93:6 96:14 97:7,8,9,10

paragraphs
45:12,13,21, 24 46:1 82:20 89:25

parallel
93:22

parameters
41:20

part
19:20 21:20 27:15 36:9 61:14 71:4 84:2,21 96:4

partially
35:5

partway
97:9

pass
89:2 96:5

patent
4:10 5:9,11 8:13,18 13:13,14 14:2 16:16 19:7 21:22 27:8 32:15,16,18, 19,23 33:5, 11,12 34:10 41:5 48:4,8, 15 49:3,5,20 55:20,22 65:16 68:17, 22 70:13 71:20

patents
9:1

PDF
10:5

PDFS
10:8

peak
27:21,23,24 28:1

pending
7:16

Perfectly
67:7

perform
73:4,12,25

performance
69:8

performing
43:2 74:3

peripheral
17:14

person
24:12,23,24 75:22

persons
62:4

pertinent
8:20

petitions
8:12

PH.D.
4:1

phenomenon
31:12

phone
20:15

phrase
36:22 46:21 50:4,7

physical
8:22

pick
81:22

pieces
54:10

place
43:10

point
6:1 7:2 11:23 15:9 18:24 38:10 40:14 41:13 49:22 52:16,18 59:3 77:5,18 79:19 83:12 85:21

pointed
47:5 53:6,16

pointing
26:13 41:23 54:25 66:22

points
8:3 25:5 78:22

pool
23:22 25:2

portion
57:15,25 65:9

POSITA
18:4 20:18,20 27:20 31:16 55:7 62:20 64:18,22 74:16

position
44:16 84:20

potential
55:4

power
18:17 75:12, 16,19,21,23 76:6,11

precise
39:25

predominance
10:7,8

predominantly
71:24 72:10

preliminaries
6:5

prep
88:21

prepared
11:1 14:21

present
72:5

presenting
82:24 92:19

pretty
4:12 52:12 68:14 95:15

prevent
18:10

previous
5:25 44:11

previously
97:8

primarily
25:16 28:14 31:6

principal

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

16:8
printed 8:23 14:4
prior 9:1 15:17 20:24 31:24 43:5 46:20,25 47:11,18 51:3 53:6,18 56:10 60:10 62:12 64:2 65:15,18 67:25 68:15, 22,25 85:2,16
proceed 97:3
process 69:6
processor 77:1
produced 41:16
produces 41:18 42:15 43:16
product 34:9,13
program 39:6 44:24 67:20 68:4 69:2
pronounce 16:3
pronunciation 16:5
properly 93:17
properties 31:15
propose 53:7
protect 18:19
protecting 18:15
provide 24:16 25:3,21 28:10 39:15 44:18 70:19 96:16,17
provided 6:2 10:20 20:11 91:21
providing 24:14,25 25:20 28:9
PTAB 11:11
publication 32:19
pull 31:23
pulling 44:5
pulls 11:7 52:12
pulse 74:20,21
pulse-width 74:16,18,22 75:3 76:2
purely 75:4
purpose 6:9
purposes 6:10
put 71:8
PWM 74:11,14,15 75:9 76:11

Q

Q1 81:22,23 82:5 83:14 91:8 92:1 93:18 97:10
Q2 97:11,13,14 98:2,3
Q3 97:11
Q4 92:1 97:11,13
qualifications 76:9
question 6:22 7:3,4,8, 9,11,16 8:5 10:14 11:9 17:24 20:7 22:16 23:11 24:21 26:8 30:22 34:6 37:12 38:7,15 42:18 43:20 50:22 53:4,5, 14 54:5 73:16 77:17 78:4 81:7 90:9 96:19
questioning 92:15
questions 8:5 11:21 12:15 22:15 53:16 66:3,22 89:12 92:7 96:7 97:5 98:9
quickly 27:5
quiet 4:12
quote 25:13,15 26:1 27:10 28:6,13 30:1 33:21 36:14 39:4 41:8,10,16 42:22,23 43:14 44:22 45:1 46:21,22 47:18,19,20 50:4,8 52:3,4, 5,6 56:15,19, 23,24 59:16, 17,24 65:10, 12 67:20,21, 25 68:16 72:25 73:13 74:10,11 76:23,24 78:7 81:18 82:13 83:2 84:11,16 85:22 86:5 87:10 93:7,10
quote/ unquote 75:22
quoted 86:21
quotes 41:12 55:9
Quoting 46:7

R

race 44:25
Ramsey 69:22 70:16, 18
ran 88:20
range 27:25
rate 97:4
re-read 27:4
re-redirect 96:17
read 13:11,15 24:15 26:6 27:1 36:21 39:3 46:6 47:4 50:23 55:6,7 59:14 63:12 65:9 72:25 74:6,8, 9 76:24 81:16 91:3 93:7
reading 15:7 24:2,13, 23 26:11 47:5
reads 30:1 33:21 36:14 37:16 56:15 59:16 69:6 87:10

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

real 77:17
realized 12:4 18:19
realtime 73:3,24
reason 7:20
reasonable 78:4 97:2
recall 10:9 17:22 19:16 20:3, 10,21 21:1,10 22:15 25:10 29:19 33:7,15 34:24 40:15, 17 66:16,25 69:14 72:1, 14,17 76:7 86:16 88:20 89:13
recalled 17:20
receive 44:1
received 42:12
receives 39:6 76:25 81:3 82:13 91:9
receiving 41:9
RECESS 31:22 66:19 89:6
reciprocal 36:17
recited 68:11 87:12
recites 68:12
recognize 18:5
recollection 20:13,17 87:4 88:10
record 6:11,12 8:17 11:5 14:23 22:2 31:21 67:15 91:18
recording 6:14
records 33:11
recross 92:9 96:16
red 90:16
redirect 95:13 96:16 97:1
refer 12:25 13:2 14:24 15:5 16:7,9,10 35:24 38:25 42:22 51:16 52:21
reference 16:8 17:6,9 20:24 21:7, 13,19,25 22:5,17 23:16 24:2,13,24 26:12,17,21 28:20 31:24 32:11 33:17 35:20 37:4 40:3 43:5,9, 13,22 44:1 66:25 70:17 71:13 85:4,16
references 15:18,24 19:11,20 20:3,4,11,19 56:10 65:15, 18 66:13 69:1,4,25 70:12,18 85:3
referencing 67:12
referred 9:7 10:5 47:19 51:14 57:7 58:18 88:2
referring 13:8 16:14 30:17 35:21 50:17 73:11
refers 26:1 27:10 70:8 73:12 74:19
reflector 34:20 35:5
refresh 39:1 44:4
relate 88:14
related 17:6 18:1
relates 37:17 72:5
released 16:21
relevant 44:7
relies 15:17,24
rely 21:24
relying 87:21
remember 16:25 17:3,25 88:6,15,24
render 82:4
renders 46:12
repeat 10:16 20:8 24:21 97:21
rephrase 90:9 91:2
report 25:10
reporter 6:12,20
reporter's 48:6
represent 27:7 33:10
representing 4:10
reproduce 56:14,22 67:19 84:10
reproduced 56:25 57:15 89:21,23
request 11:6
require 28:21 38:6,15 62:13 63:15, 20
required 64:13 81:12, 15 94:16,17 96:3
requirement 83:1
requirements 43:14
requires 60:19 62:19, 20 63:13 64:6 81:9,18 82:12 84:11 93:16
research 82:10
resolve 55:4
resolved 51:22
resonance 25:17 26:20 27:16,18,19 28:7,15,22 30:11 31:1,7, 16,18 34:14 35:10 37:6,7 39:23 72:7 86:24
resonant 27:22 31:16

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

33:23 34:16 36:16,25 37:4,21 38:1, 12 39:10,17 41:17 43:15 44:3 65:11 66:8 72:10 84:17 86:12

respect 69:23 70:12, 17

respective 98:1

response 25:20,21 26:1 27:10,21,23 28:6 29:2,4,8, 11 92:15

responses 25:4

restate 35:23

resulted 13:14

resulting 75:21

review 16:21 43:20 66:15,24 70:23

revolutions 85:23

Richardson 9:9,12 10:13 11:2 14:17

right-hand 14:6 40:8

ROM 73:6

Rospi 58:25

Rossi 17:6,9,10,12, 16,17,21 18:1,7 56:11 57:15,18,23, 25 58:10,25 59:2 61:22 62:7 64:15,21 66:13 70:16 87:21 88:13

Rossi's 18:5 60:10,12 61:24 88:14

roughly 71:3

Rubin 4:6,11 10:10, 18 11:8,14, 17,18 12:11, 14,17,18 20:2 21:3,11 22:3, 13 23:12 24:11,22 25:11 26:9 28:4,12 29:12,23 30:18 31:8, 20,23 32:2,22 33:2,9 34:7, 18 35:1,16 37:9 38:8,17 40:1 42:19 43:11,24 45:19 47:15 48:3,9,12 50:24 51:12 52:1,15 55:15 57:13 58:17 59:12 60:17 61:9 62:9,21 63:3,16 64:4 65:4,24 66:2, 5,6,17,20 68:6,23 70:5 71:8,12,25 72:19 73:19 74:7 75:10,24 76:14 77:11 78:3,13,21 79:14,18 80:12,25 82:11 84:4 85:11 86:18 87:5 89:2 90:4,7,25 91:17 92:3,8, 13 94:7,20 95:1,18 96:5, 15,24 97:18 98:6,8

rules 96:16

S

S1 60:11 82:23 83:1,4,13,18, 20 84:1 91:6 92:21 93:1,9, 12,24 95:8,19

S2 95:21 97:15

S4 83:4,19 92:22 93:1,9,12,25 95:21

satisfied 51:4 53:10 64:8 90:22

satisfies 52:8 54:1,3, 12,16,20 77:7,9,13 83:1 92:20

satisfy 43:13 45:22 55:18,21 83:21 93:25

satisfying 45:14

schematic 18:19 61:2,7 64:20

scope 24:4,19 25:7 29:17 32:25 38:3 47:23 63:24 64:11 73:22 75:6,17 76:4 77:23 83:24 86:14 94:24 95:13 96:23,25 97:19

screen 12:6,7 45:1 71:11

search 9:18

second-to-last 36:13

section 17:10 19:10, 18 38:23 45:10 69:21 70:8,10,14

sections 19:11 20:4,22 21:5

seeking 43:2

selects 77:1 81:4,18, 23

sending 83:8

sense 44:15

sensor 42:12,16 44:23 45:5 66:12,14 67:21 84:12, 18

sensors 36:15,23 40:10,14,22 41:9,19 42:5, 13 43:3,8,13, 17,25 44:15 45:22 46:8,22 47:7,8,19,20 49:9,21 50:4, 8,15,16,17 51:14,15,16, 23 52:4,5,6 53:1,2 54:13, 17,21 55:7,8, 11,12,18,19, 20,21,25 56:1,2 69:6 84:19

sentence 16:20 17:1 18:14,20 22:19 24:15 25:13,25 27:15 28:13, 18 29:25 30:7,12,17

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

33:20 36:13, 21 37:16 39:3 44:21 45:4 47:6 55:16 60:15 65:10 66:9,11 72:24 73:9,10 74:6, 8,10,23 84:15 86:4,20 87:9 93:6

sentences 46:7

serial 13:12,15,24 14:1

set 93:3

Shahoian 15:18,20,22 16:3,8,16 17:11 21:13, 24 22:4,16 23:6 24:13,24 26:12,17,18 28:2,5,20 29:25 30:13 31:10 35:19, 22 36:3,18 37:8,11 38:20 39:15 40:2, 14,20,21 43:13 44:1,22 45:11,13,22, 25 46:2 53:7, 25 54:12,16, 20,24 56:10 58:24 59:1 66:13 67:9 69:22 70:15, 18 87:15 88:19

Shahoian's 29:9 43:22 87:11,19

Shahoian-cosper-rossi 65:11 66:8,23

shaver 71:22 72:3

shavers 72:9,11

short 89:5

short-circuits 18:17

show 53:9,24,25 54:3,8,9,11, 15,19

shown 52:7 64:21 90:11

shows 35:4 64:22 67:25 77:14 95:16

sick 7:23

side 18:11 40:8

signal 39:7 57:1,3,6, 8 58:1,8 59:20 61:2, 20,22,23,25 62:15,18 63:7,14,15,21 64:7,20 65:2, 3 76:25 81:3 82:13,16 83:1,2,5,7,8, 13,18,22 84:1,2,3 89:13 90:19, 22,23 91:5,7, 10,16,21,23, 24,25 92:17, 20,25 93:2,8, 9,13,21 94:1, 5,13 95:8 97:15 98:1

signals 41:9 42:10,13 44:18,23 45:5 56:17 58:9 62:3,7,8 64:9, 14,17 82:22 83:4,6,12,18 90:16 91:6, 12,15 92:21, 22 93:1,2,3,8, 12,15,16,24 94:15 95:16, 21 96:3

signature 12:22

significance 58:13

simply 31:15 80:23

simultaneously 18:12 19:3

sir 32:3

sit 67:4

sitting 16:18,23 21:2,9 33:7 38:9 40:17 57:11 72:18 83:25 86:16 95:25

situations 29:22

sixth 42:21

skill 62:4

skilled 24:12,23

small 27:23

smaller 29:21

so-called 74:11

solid-state 56:25 59:3, 16,24

sort 14:5 42:3 77:16

sound 19:23

sounds 7:1 16:13 48:13

speaker 4:19

special 5:24

specific 9:19 11:21,22 20:23 21:6 22:10 39:14 44:20 61:21 62:6 69:11, 12,24

specifically 8:6 35:9,14, 15 36:15,22, 24 38:23 40:3 69:14 91:24

specification 26:6 29:9 68:17 72:21

specifics 69:4

speed 73:6 74:1,5

spend 10:22

sphere 23:21 25:1

spite 8:6

splitter 58:8

splitter/inverter 56:16 57:9 60:19,21 61:1,15

spreadsheet 5:24

staff 10:12 11:1

stand 85:20 92:16

standard 61:7

stands 74:14

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

start
6:23 65:9 69:3,13

starting
17:18 22:22 23:16 25:12 42:20 44:9,13 49:8,23 50:15 70:14

starts
22:20 36:11 44:21 49:13 87:10

state
91:7 92:1 97:16,22,25

statement
18:3 27:7 29:20 39:24 73:17,18

states
18:15 30:8

Staying
56:6

steer
44:25

steering
23:21

stick
96:2

stretching
95:15

structure
58:11

struggle
51:8

study
38:6,15

stylus
23:20 25:1

subassembly
37:18

subject
47:25 96:19, 20

sublimitations
70:24

submit
16:15

submitted
8:11 12:19

subsequent
41:17 42:15 43:15

summarization
17:6,9

summarizes
92:5

supplied
6:1

supplies
75:12 76:6,12

supply
18:17 62:3 75:16,23

support
8:12 64:2

supported
72:8

supports
68:7

surge
18:10

surrounding
35:5

SW1
59:4 60:11

SW2
57:20 59:4 60:12 61:15, 17,24

SW3
57:21 59:4 60:11 61:4, 11,24

SW4
59:5 60:12

switch
57:1,2 58:2,7 59:20 61:11, 20 62:3,14, 17,22,25 63:13 75:11, 15,23 76:6, 11,25 77:4,6, 12,18,25 78:1,2,7,10, 12,16,18,25 79:2,5,6,8,10, 12,25 80:8, 15,20,24 81:3,5,8,10, 11,12,18 82:12 87:11, 12 91:9 94:6

switched
82:21 97:14

switches
18:6,11 56:25 59:3,16,25 60:11,12 62:7 63:7,21 64:6, 9,15 75:20 77:15,20 78:10,20 79:4,8 80:5,9, 14 91:8 92:1 97:21

switching
76:1,10,12 80:10 97:10, 11,13 98:1,3

SWORN
4:2

symbol
61:2,3,7

system
23:5 25:17 27:20 28:16 29:14 31:7 34:3 35:8,10 36:15,24 37:5 38:11 39:5 42:23 43:1,4 72:7 74:25 75:9 91:9

systematically
10:7

systems
29:5 33:21,22 34:15,16 36:16,25 37:17,19,24 72:10 75:3

T

table
19:6 25:22 38:25

tables
19:9

taking
6:12 7:12 42:25 78:25 86:19,20

talk
6:20,24 30:19 43:8 80:4 82:20 86:11

talked
48:23

talking
15:7 16:11 28:19,20 45:4 59:8 69:15,17 94:11

talks
28:5 31:19 36:3 82:22

technical
12:12 22:1 72:4

techniques
29:10

telling
13:5

term
24:6,10 29:8 43:1 46:8,12 47:7 50:21 51:9 52:25 74:15 78:25

terms
47:4 48:21 95:25

testify
8:1

testifying
6:7

testimony
6:11,15 7:14,

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

21 92:14 93:20

text 25:24 38:22 41:4,5 49:17 93:5

thing 10:6 12:7 16:11 47:19 50:18 54:25 55:13 69:11 80:15

things 16:17 35:7 51:17,20 53:3,21 54:2, 11 55:14 56:3 58:14 81:5,9, 12,17 88:8

thinking 52:13 82:10

thought 4:16 18:18

time 10:22 25:5 26:5 62:4,5 72:25 73:1 74:21 83:13, 16 85:24 88:8,12,25 89:12 95:9,11

times 4:25 24:17 49:21,22 78:1 79:20

tip 61:8

titled 19:11 69:21

TOC 67:12

today 6:6,12 7:21, 23,25 8:10,21 16:18 38:9 48:17,25 53:15 71:16 88:9 89:12 93:19

today's 6:9 8:3 9:25 10:21 11:19

top 42:8 57:14,17 90:10

topic 18:6

trackball 23:20 25:1

Trade 5:9

transcript 15:7

transistor 42:10 57:20, 21 61:4,15 79:25 83:14 90:20,23 91:5,9,16,23, 25 92:25 93:8

transistors 77:20,21 78:14,15,19, 25 79:1,3,6,8, 11 80:4,8 81:13,22 82:22

triangle 61:8

trip 79:21

turn 19:5 20:15 23:13 25:12 33:16 35:17 36:6 38:20 40:2,3,25 46:3 49:5 56:7 65:5 67:8 71:6 72:20 76:21 84:5 85:12 87:6 90:10,18 94:21 96:13

turned 4:13,16,17 18:11 19:8 74:21 90:13

turning 18:16 37:10, 15 45:9 56:22 69:16 97:7

type 34:9

types 10:9

typo 87:17,23 88:5,19

typos 88:22

U

Uh-huh 40:24

ultimately 13:13

understand 6:6,17 7:3,4, 9,11 8:8,14 10:19 14:16 27:2 46:16 49:4 53:8 55:16 73:16, 20 78:22 90:1 91:20 92:16

understandable 16:4

understanding 8:9,15 9:13 10:24 11:16 23:5 34:1,8 50:11 58:15 75:15,18 79:5 81:10 90:21 92:18 93:21

understood 6:18 7:19 15:21 53:4 97:21

uniformly 80:10

unique 48:21

unit 72:6 85:23

unrelated 75:8

upload 31:25 48:5

upper 14:6

user 44:1,16,20 45:5,7 75:21

utilize 75:4

utilizes 86:11

utterances 6:16

V

vague 19:21

values 42:5

vary 74:19

velocity 84:20

version 17:11

versions 52:20,22,23

versus 16:8

vibration 22:25 25:16 28:15 31:6 41:17 43:15 44:3 65:11 66:8,11,14 67:21 84:11, 17,18

vibrational 27:20

vibrations 23:1,2,7 29:14,15 30:2,9,24

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983

video
6:14 83:7,8

view
30:13

voice
4:11

voltage
73:1 75:19
95:8,9,20

voltages
95:20

volume
4:13

volunteered
79:20

W

wanted
21:16

waveform
22:24 30:3,8,
24 73:2,24
74:24

ways
37:5 62:3
76:10 79:3

well-known
31:15 61:7

wheel
23:21

widely
29:3,7 69:8
74:15

width
74:20,22

wire
83:7

wires
83:8

withdrawn
9:6 10:2,3
14:14 23:14
32:9 50:3
57:24 58:25
62:10 75:25
78:14 83:10
86:19

witness's
10:24

word
24:1 29:2
49:9,21 52:23
55:7,11

wording
35:14

words
6:15 42:22
49:15,16
58:13 59:24

work
12:8 15:4

worked
33:4

working
9:12

wrap
66:2

written
48:1 92:24

wrong
52:24

Y

years
5:18

Z

Zoom
12:5

Resonant Systems, Inc., Ex. 2011
Apple Inc. v. Resonant Systems, Inc., IPR2024-00983