

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

APPLE INC.,

Petitioner,

v.

OMNI MEDSCI, INC.,

Patent Owner.

U.S. Patent No. 9,651,533

IPR Case No.: IPR2019-00916

REMOTE DEPOSITION OF

DUNCAN LEO MACFARLANE, PH.D., P.E.

Thursday, April 16, 2020; 10:04 a.m. EST

Job No.: 568049

Pgs. 1 - 90

Reported by: Cindy L. Sebo, RMR, CRR, RPR, CSR, CCR,
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A P P E A R A N C E S:

(All via video teleconference)

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INDEX TO EXHIBITS

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(Exhibits Attached to the Original Transcript)

MACFARLANE

DEPOSITION

EXHIBIT NUMBER	DESCRIPTION	PAGE
1	Declaration of Duncan L. MacFarlane, Ph.D., P.E.	
	Bates stamped OMNI 2122	19
2	U.S. Patent Number 9,241,676 B2	46
3	U.S. Patent Application	
	Publication US 2005/0049468 A1	60



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1 P R O C E E D I N G S

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Remote Deposition

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Thursday, April 16, 2020; 10:04 a.m.

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DUNCAN LEO MACFARLANE, PH.D., P.E.,

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after having been first duly sworn remotely by the

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certified stenographer, was examined

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and testified as follows:

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EXAMINATION BY COUNSEL FOR PETITIONER

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15

BY MR. BROUGHAN:

16

Q. Good morning.

17

Would you please state your name for

18

the record?

19

A. My name is Duncan Leo MacFarlane.

20

Q. And, Dr. MacFarlane, you've had your

21

deposition taken before?

22

A. Yes.



1 Q. Approximately how many times?

2 A. Certainly over a dozen.

3 Q. And what was the most recent time,
4 approximately?

5 A. It was the last time that we had a
6 deposition in this -- in this matter.

7 Q. So you're generally familiar with
8 depositions, so I won't really go over the ground
9 rules very much.

10 I'll just say that this deposition is
11 being taken by remote means, so we need to be extra
12 careful not to speak over each other. And, in
13 addition, if anything I say is unclear because it's
14 garbled or you can't hear it or the question is
15 just bad, let me know, please, and I will be happy
16 to try to state it again more clearly or rephrase
17 the question in a manner that's more understandable
18 for you.

19 Do you understand?

20 A. Yes, Tom, I do.

21 Your volume is just a little low, so --
22 I can hear you --



1 Q. Sure.

2 A. -- but your volume is just a little bit
3 low.

4 Q. Okay. Great. Thank you for that.

5 And, you know, throughout this, if that
6 happens again, just let me know.

7 A. Okay.

8 MR. LEROY: Hey, Tom, this is
9 John LeRoy.

10 Before we get too far into it, would
11 you mind doing a roll call, just so we know
12 who's on the line?

13 And -- and for Omni MedSci, it's
14 myself, John LeRoy; Thomas Lewry, also
15 counsel for Omni MedSci; and, of course,
16 the witness, Dr. MacFarlane.

17 Who is on the call from Apple's
18 side, besides yourself?

19 MR. BROUGHAN: For Apple, it's me,
20 Tom Broughan, as well as Matthew Hopkins.

21 MR. LEROY: Anybody else? I see
22 there's a Magna Support.



1 CERTIFIED STENOGRAPHER: I can tell
2 you that. That's the back office in case
3 anything happens with the remote video or
4 the streaming. They're going to assist so
5 they can take care of it for you.

6 MR. LEROY: Okay. Thank you.

7 All set.

8 BY MR. BROUGHAN:

9 Q. Dr. MacFarlane, you're aware that this
10 deposition concerns an IPR proceeding about
11 U.S. Patent Number 9,651,533?

12 A. Yes.

13 Q. And if I refer to that patent as the
14 "'533 patent," that would be understandable to you?

15 A. Yes.

16 Q. And you submitted a declaration
17 concerning the '533 patent in this matter?

18 A. I did.

19 Q. Also, I understand that you have
20 several exhibits in front of you; is that correct?

21 A. I do.

22 Q. And none of those have any notes in

1 them or anything that you wrote down; they're the
2 original copies of the exhibits, correct?

3 A. They're all clean copies, yes.

4 Q. Okay. Would you mind just stating for
5 the record which exhibits you have in front of you?
6 And referring to them by exhibit number is fine.

7 A. Yes. Here's my notebook. I'll go
8 through -- I'll go through tab by tab.

9 Q. Thank you.

10 A. The first tab is a copy -- a clean copy
11 of my declaration.

12 The second tab is a copy of the
13 Lisogurski patent, Number 9,241,676 B2.

14 The third tab -- well, the next tab is
15 a copy of the Carlson patent -- actually, I take
16 that back, please. It is a copy of the
17 Carlson Patent Application Publication
18 US 2005/0049468 A1, which was published on
19 March 3rd, 2005.

20 The next tab is the Mannheimer patent,
21 Number 5,746,206.

22 The next document is the Declaration of

1 Brian Anthony, Ph.D., regarding U.S. Patent
2 Number 9,651,533.

3 The next document is the Patent Owner's
4 Response to Petition for Inter Partes Review in the
5 Matter of the U.S. Patent Number 9,651,533,
6 Case Number IPR 2019-00916.

7 The next document is the patent by
8 Dr. Mohammed Islam, 9,651,533.

9 The next one -- the next document -- it
10 has a -- it has a Bates number on it; it's
11 OMNI 2120. And it's an international
12 application -- patent application. The
13 international publication number is W0/2014/143276
14 A2, for the inventor Dr. Mohammed Islam.

15 The next document is the
16 United States patent application publication with
17 the inventor of Mohammed Islam, Publication Number
18 US 2014/0236021 A1. And that -- that has -- that
19 has a number OMNI 2121.

20 And then the last document in my
21 notebook is Paper Number 16, which is the decision
22 granting of Inter Partes Review by the Patent Trial

1 and Appeal Board for Case IPR 2019-00916.

2 Q. Thank you.

3 Could you turn to the '533 patent,
4 please, and, in particular, Claim 5? And I would
5 direct your attention to the limitation that
6 appears from Lines 51 to 55.

7 That limitation --

8 A. The light --

9 Q. -- yes, correct -- The light source
10 configured to increase signal-to-noise ratio by
11 increasing a light intensity from at least one of
12 the plurality of semiconductor sources and by
13 increasing a pulse rate of at least one of the
14 plurality of semiconductor sources.

15 Do you see that?

16 A. Yes, I do.

17 Q. Okay. I'd like to ask you a number of
18 questions about this limitation.

19 MR. LEROY: Hey, Tom, this is
20 John LeRoy.

21 MR. BROUGHAN: Yes.

22 MR. LEROY: Dr. MacFarlane just has

1 a binder with some tabs. I think you
2 referred to them as "exhibits." They sort
3 of are what they are.

4 Did you want to mark this patent as
5 Deposition Exhibit 1, just so we can keep
6 track of these as we go?

7 MR. BROUGHAN: Yeah. So, I mean,
8 the way I've always done it in IPRs is the
9 exhibits are -- they have exhibit numbers
10 already. It's -- this patent is already
11 Exhibit 1001. And so I would --

12 MR. LEROY: That's fine with me. I
13 just want to have a plan so we have a clear
14 record.

15 MR. BROUGHAN: I assume you're not
16 going to challenge the authenticity of your
17 own patent, but --

18 MR. LEROY: No. I'm talking about
19 for the rest of the day.

20 MR. BROUGHAN: Yeah. It's a little
21 bit different, so let me take a step back
22 here --

1 THE WITNESS: Tom?

2 BY MR. BROUGHAN:

3 Q. Yes, Dr. MacFarlane?

4 A. I'm sorry to break in and interrupt,
5 but this particular copy of the -- this document
6 that I have in front of me, the '533, has the
7 exhibit number 1001 marked.

8 However, if we talk about other
9 exhibits, may we confirm the exhibit number?

10 Q. Yes.

11 If you -- just stay on this limitation
12 for a second, but let me just go back and make a --
13 to try to make the record clear.

14 Dr. MacFarlane, you're looking at
15 Exhibit 1001; is that correct?

16 A. Yes, I am.

17 Q. And Exhibit 1001 is the '533 patent?

18 A. That's my understanding, yes.

19 Q. Okay. And we will try to use this as
20 an exhibit in this deposition. And it's premarked
21 Exhibit 1001.

22 Now, if you would, turn to Claim 5,



1 please, the light source limitation.

2 A. Yes.

3 Q. So for purposes of our discussion,
4 would you agree with me that this limitation can
5 roughly be split into two parts: one part is
6 increasing the signal-to-noise ratio by increasing
7 a light intensity from at least one of the
8 plurality of semiconductor sources -- that's one
9 part -- and the second part is increasing
10 signal-to-noise ratio by increasing a pulse rate of
11 at least one of the plurality of semiconductor
12 sources, that's the second part?

13 A. What do you mean -- do I need to worry
14 about the word "roughly," Tom?

15 Q. No. I wanted to be able to ask you
16 questions just about the pulse rate part without
17 tripping up over the first part.

18 A. Okay.

19 So can we -- so I think what you'd like
20 to do is consider the "and" in there, and so --

21 Q. Yes, sir.

22 A. -- may I read -- for the purposes of

1 context, may I read what I think you want me to
2 think about, which is the light source configured
3 to increase signal-to-noise ratio by increasing a
4 pulse rate of at least one of the plurality of
5 semiconductor sources?

6 Q. Yes, that is correct.

7 The claim says that the light source is
8 what increases the pulse rate; is that correct?

9 A. The claim says, The light source
10 configured to increase signal-to-noise ratio by
11 increasing the pulse rate of at least one of the
12 plurality of semiconductor sources.

13 So the light source is configured to
14 change that pulse rate.

15 Q. If a processor is what instructed
16 circuitry to change the pulse rate of a light
17 source, would that meet the claim?

18 A. Could you repeat the question, please?

19 MR. LEROY: Objection to form.

20 Sorry, Cindy, I had an objection to
21 form.

22 CERTIFIED STENOGRAPHER: Thank you.



1 BY MR. BROUGHAN:

2 Q. Would a processor increase the
3 signal-to-noise ratio of a light source by
4 increasing its pulse rate and still meet the claim?

5 A. The -- that -- the -- that -- the claim
6 says, The light source configured to increase
7 signal-to-noise ratio by increasing a pulse rate of
8 at least one of the plurality of semiconductor
9 sources.

10 So if you want to substitute "in a
11 microprocessor configured to increase," then --
12 then I don't understand that -- I don't
13 understand -- I haven't considered that, and I
14 don't understand that substitution.

15 Q. How would a light source by itself
16 increase its own pulse rate?

17 MR. LEROY: Objection: form.

18 THE WITNESS: The light
19 source -- the light source -- the light
20 source would -- if this goes to
21 what -- this goes to what would be
22 considered a light source.

1 So the light source itself -- the
2 light source would include provisions in
3 this. And the specification teaches us a
4 fair amount about what is -- what else is
5 going on with this light source.

6 For example, in the -- in the
7 background supporting material, we learn
8 that the light source is an active
9 illuminator -- I'm going to take out -- my
10 declaration out of my notebook.

11 BY MR. BROUGHAN:

12 Q. Sure.

13 A. So in that -- in -- in those teachings,
14 the light source has provision within it to
15 adjust -- to be configured to increase the
16 signal-to-noise ratio by increasing the pulse rate
17 of at least one of the plurality of semiconductor
18 sources.

19 Q. Are we looking at a particular
20 paragraph of your declaration?

21 A. Not yet.

22 Q. Okay.

1 Page 15.

2 A. Thirty-four, The Board's construction
3 also creates ambiguity --

4 Q. Correct, that's the paragraph, yes.

5 A. -- as to whether the -- do you want me
6 to read it?

7 Q. No, no. I just wanted to direct your
8 attention to it. And I wanted to ask you a
9 question about something in the paragraph, and that
10 is you are drawing a distinction between whether a
11 pulse rate is actively increased by the device or
12 manually increased by a human.

13 I wanted to know what you meant by
14 having the pulse rate actively increased by the
15 device itself.

16 A. So if you go on to Paragraph 35 in my
17 declaration, The '533 patent specification makes
18 clear that the change in pulse rate is done by the
19 device, not a manual adjustment. The '533
20 specification discloses that the LEDs may operate
21 in a pulsed mode of operation, during which a pulse
22 rate is increased to increase SNR.

1 There's a citation there, Exhibit 1001,
2 5:11 to 15; 19 -- Column 19, Line 67, to Column 20,
3 Line 2.

4 The specification states --

5 Q. Perhaps I -- oh, sorry.

6 A. -- The light source is configured to
7 increase signal-to-noise ratio by increasing a
8 pulse rate of at least one of the plurality of
9 semiconductor sources. The specification states
10 that by use of an active -- by use of an active
11 illuminator, a number of advantages may be
12 achieved, including higher signal-to-noise ratios.

13 Q. So let me just pause you one second and
14 clarify my question a little bit.

15 I guess -- my question is really more
16 what's the difference between, like, an active
17 illuminator -- sorry. Strike that.

18 You said that -- you mentioned that the
19 device would actively increase SNR.

20 And what's the difference between a
21 device actively increasing SNR versus the device
22 increasing SNR?

1 What does the "actively" part mean in
2 there?

3 A. I'm explaining the word "active" in
4 light of the specification and -- and the -- and
5 the PCT applications.

6 So I'd like to continue to just read
7 this paragraph, and then we can -- then we can
8 explore in more detail, if necessary, which
9 probably isn't.

10 PCT --

11 Q. The paragraph is in the record already.
12 Unlike a district court proceeding, this is -- this
13 paragraph is your official testimony that's in the
14 record. And I just -- you know, I can read it, and
15 the Board can read it. But I think what would be
16 helpful for me -- and hopefully, also, the Board --
17 is for you to explain how an active illuminator
18 differs from an illuminator.

19 A. Okay. I'd still like to get these last
20 couple of lines into the record so that I can use
21 them as a springboard.

22 Q. Sure. They're in the record, but go



1 ahead.

2 A. PCT Application Serial Number
3 PCT/US2013/075767, Publication WO/2014/143276,
4 which is incorporated by reference into the '533
5 specification, describes the use of an active
6 illuminator to achieve higher signal-to-noise
7 ratios despite variations due to sunlight and the
8 effects of weather, such as clouds and rain.

9 This is Exhibit 101, Column 1, 33 to
10 37. That's where the cite is. And then it's an
11 exhibit, 2120 at 25 to 26, Paragraph 0079.

12 And this is consistent with
13 U.S. Patent Application Serial Number 14/109,007,
14 Publication Number 2014/0236021, also incorporated
15 by reference into the '533 specification, which
16 discloses that the modulation frequency of the
17 light source is nonzero and can range between 0.1
18 to 100 kilohertz. And this is Exhibit 1001 at 1 --
19 at Column -- at Column 1, 40 to 42 -- that's the
20 cite -- Exhibit 2121 at 4, Paragraph 0045.

21 So did you want to repeat your
22 question?

1 Q. How is an active illuminator different
2 from an illuminator?

3 A. So there's a -- to -- to a person of
4 ordinary skill in the art in this matter, there's
5 the word "active" and then the core of the -- the
6 reflection of that, or the opposite of that, or the
7 distinction of that is the word "passive."

8 So by calling -- by -- by having the
9 specification call into play an active illuminator,
10 someone of ordinary skill would know that it's not
11 a passive illuminator, that there would be some
12 active elements associated with this -- with this
13 illuminator.

14 Q. How does that differ from a passive
15 illuminator?

16 A. So a passive illuminator would merely
17 send out light in a prescribed manner with
18 prescribed characteristics associated with it.
19 The light in a room -- the light in a room, for
20 example -- you buy a light; you put it in place;
21 you throw the switch; the light comes on. You
22 might determine, to some extent, the color, the

1 size of the light bulb, and so on, but that's
2 basically the -- the -- the -- the illumination.

3 Active illumination and -- active
4 illumination means there's usually -- well, there
5 are parameters that are controlled in the
6 illuminator. In the particular part of the claim
7 element that we're talking about, it's the pulse
8 rate. And that's controlled in response to the
9 scene or the device under test or the -- or the
10 sample under test.

11 So there's a feedback loop involved
12 that makes a measurement, makes a decision and --
13 and will adjust characteristics of the -- of the
14 illumination responsive to, in this particular
15 case, the signal-to-noise ratio.

16 Q. Okay. An active illuminator would vary
17 how it provides illumination based on some
18 parameter of the environment; is that correct?

19 MR. LEROY: Objection.

20 THE WITNESS: I caught almost all of
21 that question. It's still low volume.

22

1 BY MR. BROUGHAN:

2 Q. The stupid phone. My fault.

3 A. I have my volume all the way up, Tom.

4 Q. It's probably the cell phone. One
5 second.

6 An active illuminator would vary how it
7 provides illumination based on some parameter of
8 the environment that it is in; is that accurate?

9 A. Would --

10 THE WITNESS: Could -- Cindy, could
11 you repeat back my answer?

12 - - -

13 (Whereupon, the certified
14 stenographer read back the
15 pertinent part of the record.)

16 - - -

17 THE WITNESS: Thank you.

18 Tom, what was your question again,
19 and how was it different from the answer
20 that I just gave?

21 BY MR. BROUGHAN:

22 Q. My question is, An active illuminator



1 would vary how it provides illumination based on
2 some parameter of the environment that it is in; is
3 that correct?

4 A. At this instant, I don't see anything
5 wrong with that.

6 Q. I want to turn to passive illuminator.

7 A. To where?

8 Q. "Passive illuminator."

9 A. Okay.

10 Q. A passive illuminator would provide
11 illumination at a set -- or sorry. Strike that.

12 A passive illuminator provides
13 illumination based on its own set parameters, and
14 it does not respond to changes in the environment
15 that it is in.

16 Would that be accurate?

17 A. Repeat the question, please, one more
18 time.

19 Q. Yes, sir.

20 A passive illuminator provides
21 illumination based on its own preset parameters,
22 and it does not respond to changes in the

1 environment that it is in.

2 Is that accurate?

3 MR. LEROY: Objection to the form of
4 the question: incomplete hypothetical.

5 THE WITNESS: A passive illuminator
6 is not configured to respond to changes in
7 the environment, for example.

8 BY MR. BROUGHAN:

9 Q. Okay. You mentioned the example of
10 just a light in a room, that you turn it on, it's
11 on; and then, later, you can turn it off, and it
12 doesn't kind of change how it works based on that?

13 A. That was an example that I gave in
14 that -- to that particular question -- in answer to
15 that particular question, yes.

16 Q. Would it -- let me give you another
17 example.

18 A strobe light that -- you turn it on,
19 and it just pulses at a fixed frequency and fixed
20 intensity; and then it'll keep going until you turn
21 it off.

22 Would that also be an example of a

1 passive illuminator?

2 A. There were two words that --
3 that -- that faded out, Tom.

4 Q. Yes.

5 Okay. Would a strobe light that you
6 turn on -- and it pulses at a fixed frequency and
7 fixed intensity until you turn it off -- would that
8 also be an example of a passive illuminator?

9 A. Without any further details of knowing
10 the strobe light, without any sort of things that
11 are wrinkled in there, without considering it in
12 any great detail, if -- if -- if -- if it's
13 manually driven by a human, then, yes, I would -- I
14 would -- I would characterize -- as I understand
15 that strobe light to be -- a passive illuminator.

16 If you have a different opinion --
17 understanding of what you're describing than I do,
18 then I apologize for that. And -- and -- and I --
19 I worry about the efficacy of my answer in that
20 context -- in that statement.

21 Q. Have you described the term "active
22 illuminator" -- have you relied on any lexicography

1 or explicit definition in the Omni patent, the '533
2 patent, or are you relying on some other
3 understanding for the meaning of that term?

4 MR. LEROY: Objection to the form of
5 the question.

6 THE WITNESS: The first place --
7 when trying to understand a term, the first
8 place I -- I would go would be to the
9 patent -- to the teachings of the patent.

10 There is -- however, I would also
11 read that in the context of a person of
12 ordinary skill in the art. I was at least
13 of ordinary skill in the art at the time of
14 this -- of this matter.

15 And so what I read in the patent
16 application, the -- the
17 specification -- the -- the three exhibits
18 that we've talked -- that I talked about
19 earlier was consistent with what I know as
20 a -- as a person of ordinary skill in the
21 art at the time for what an active
22 illuminator would be.

1 BY MR. BROUGHAN:

2 Q. Let me go back to the strobe light
3 example.

4 If I had a strobe light that could
5 pulse at two different frequencies, let's say
6 2 hertz and 4 hertz, and a human turned on the
7 pulse -- sorry -- the human turned on the strobe
8 lights at 2 hertz, the human then observed how the
9 room looked and decided that it would be better to
10 light pulse the 4 hertz and push the button on the
11 strobe light to make it change to 4 hertz.

12 Would that be an active illuminator?

13 MR. LEROY: Objection to form.

14 THE WITNESS: Not as I -- as I
15 understand your example, which, again,
16 I'm -- I'm -- I haven't considered in any
17 deep manner or any -- or any -- I have not
18 considered your example very carefully.

19 Because of the human interaction
20 involved, I would not necessarily -- I
21 would not necessarily think that to be a --
22 an active illuminator.

1 BY MR. BROUGHAN:

2 Q. If a human pushed a button on the
3 device to change its pulse rate, that would be an
4 example of more of a passive illuminator scenario?

5 MR. LEROY: Objection to form.

6 THE WITNESS: As I understand your
7 example, yes.

8 BY MR. BROUGHAN:

9 Q. So in your declaration, you describe --

10 A. Tom, I'm sorry. Could you -- I'm
11 sorry. I'm sorry. Could you repeat the question,
12 please?

13 Q. Which question, the one I'm about to
14 ask or the one -- the one I was asking or the prior
15 one?

16 A. The very last one.

17 Q. If a human pushed a button on a device
18 to change its pulse rate, for example, from 2 hertz
19 to 4 hertz, that would be an example of a passive
20 illuminator scenario, correct?

21 A. As I understand your example, yes.

22 MR. LEROY: The same objection to

1 form.

2 BY MR. BROUGHAN:

3 Q. And continuing on this active
4 illuminator topic -- I'm looking now at
5 Paragraph 36 of your declaration -- you mentioned
6 that the active illuminator is used to achieve
7 higher SNR despite variations due to sunlight and
8 the effects of weather, such as clouds and rain.

9 And my question is, Why would you need
10 an active illuminator to deal with variations due
11 to sunlight and the effects of weather, such as
12 clouds or rain?

13 A. Repeat the question, please.

14 Q. Yes.

15 Why would you need to use an active
16 illuminator to achieve higher SNR in the presence
17 of variations due to sunlight and the effects of
18 weather, such as clouds and rain?

19 A. That's not what I wrote. I wrote that
20 an active illuminator is used to achieve higher SNR
21 despite variations due to sunlight and the effects
22 of the weather, such as clouds and rain.

1 Q. Why would you -- let me -- let me ask a
2 better question.

3 Why would you use an active illuminator
4 to deal with those variations?

5 A. Because sunlight variations and the
6 weather are constantly changing environmental
7 conditions, it would be impractical, as a matter of
8 common sense, to have the user manually reconfigure
9 the LED pulse rate as conditions change to achieve
10 higher SNR, as recited in the claims and as
11 described in the specification.

12 Q. So you're relying on a matter of common
13 sense -- strike that.

14 So you're relying on common sense to
15 conclude that the -- because environmental
16 conditions change, you would need your lighting to
17 change in response to those changing conditions?

18 MR. LEROY: Objection to form.

19 THE WITNESS: I'll -- the entire
20 sentence is important.

21 Because sunlight variations and the
22 weather are constantly changing

1 environmental conditions, it would be
2 impractical, as a matter of common sense,
3 to have the user manually reconfigure the
4 LED pulse rate as conditions change to
5 achieve a higher SNR, as recited in the
6 claims and as described in the
7 specification.

8 BY MR. BROUGHAN:

9 Q. You're relying on common sense for that
10 opinion, as opposed to a specific teaching in the
11 '533 patent; is that correct?

12 MR. LEROY: Objection to form.

13 THE WITNESS: That sentence
14 describes some of the advantages of using
15 an active illuminator to achieve the higher
16 SNR despite variations due to sunlight and
17 the effects of the weather, such as clouds
18 and rain.

19 BY MR. BROUGHAN:

20 Q. You have concluded that those are
21 advantages based on common sense as opposed to any
22 particular teaching in the '533 patent, correct?

1 A. I have a view as a person of ordinary
2 skill in the art who might think through the
3 use -- the choice of -- of an active illuminator to
4 improve the SNR versus asking a consumer to learn
5 what SNR is and force that consumer to -- to adjust
6 it as a cloud moves across the sun and then back
7 again.

8 It would be impractical and not very
9 nice product design to -- to -- to force your user
10 to do that. And that seems -- that seems a matter
11 of common sense, to me, but, again, that's from the
12 perspective of a person of ordinary skill in the
13 art.

14 Q. All right. So I'd like to look back to
15 some of the claim language here. And I believe the
16 claim language, as you paraphrased it, is, The
17 light source configured to increase signal-to-noise
18 ratio by increasing a pulse rate.

19 A. Are we back in the '533 patent?

20 Q. Yes, though this quotation is also in
21 your declaration.

22 A. Okay. Do you want to point me to that?

1 Q. Yeah, sure. Paragraph 37.

2 A. Got it. Thank you.

3 Q. Okay. Now, if I have a device that
4 pulses an LED and has a detector that leads the
5 light reflected back from those pulses of LED and
6 then measures something -- sorry.

7 Strike that.

8 Why is it that changing the pulse rate
9 of an LED would affect signal-to-noise ratio?

10 A. I missed the last phrase of your
11 question, Tom.

12 Q. Yes.

13 Why is it that changing the pulse rate
14 of an LED would change the signal-to-noise ratio?

15 A. There are a number of reasons -- there
16 are a number of reasons why that might happen.

17 Generally speaking, the faster the
18 modulation, the faster the pulse rate, the lower
19 the background noise.

20 That's a general statement that
21 describes something that -- that's a general
22 statement of -- of truth. There are -- there are

1 counterexamples, but generally speaking, as -- as
2 you have a faster or an increased pulse rate, you
3 see a lower noise environment.

4 Q. So in general, when you increase the
5 pulse rate, you'll increase the signal-to-noise
6 ratio?

7 A. Not always.

8 MR. LEROY: Objection: form.

9 THE WITNESS: Sorry. I'm sorry,
10 Tom. I talked over you.

11 Repeat the question again, please.

12 MR. LEROY: That was actually
13 John LeRoy, Duncan. I said, "Objection:
14 form."

15 BY MR. BROUGHAN:

16 Q. I'll repeat the question.

17 A. Thanks, Tom.

18 Q. In general -- no problem.

19 In general, when you increase the pulse
20 rate, you'll increase the signal-to-noise ratio?

21 MR. LEROY: Objection to form.

22 THE WITNESS: As I said -- as I

1 said, not always.

2 BY MR. BROUGHAN:

3 Q. In general, when you increase the pulse
4 rate, you will increase the signal-to-noise ratio,
5 though that won't always happen?

6 MR. LEROY: Objection to form.

7 THE WITNESS: Was that a question?

8 BY MR. BROUGHAN:

9 Q. Yes.

10 A. I'm sorry. I didn't hear it as a
11 question. I heard it as a statement.

12 Q. Will you agree that in general, when
13 you increase the pulse rate of an LED, you will
14 increase the signal-to-noise ratio, though that
15 won't always happen?

16 MR. LEROY: Objection to form.

17 THE WITNESS: Yes.

18 BY MR. BROUGHAN:

19 Q. Would you agree that when you increase
20 the pulse rate of an LED, one of three things could
21 happen: signal-to-noise ratio would increase,
22 signal-to-noise ratio would decrease, or



1 signal-to-noise ratio would stay the same?

2 MR. LEROY: Objection to form.

3 THE WITNESS: I believe that to be
4 true.

5 BY MR. BROUGHAN:

6 Q. Actually, I want to go back to an
7 earlier question.

8 I should strike that.

9 A. If I could add to the last -- to my
10 answer?

11 Q. Go ahead.

12 A. We're talking -- again, to establish
13 the context or to fold the answer into the context
14 in here, we're working with an active illuminator,
15 which allows a decision to be made whether or not
16 increasing the -- the pulse rate will increase the
17 signal-to-noise ratio, and that's part of the -- of
18 the -- of the -- and that is part of the teachings
19 of the claim element, which is a light source
20 configured to increase signal-to-noise ratio by
21 increasing a pulse rate of at least one of the
22 plurality of the semiconductor sources.

1 Q. Okay. I think, actually, you
2 are -- it's a good segue into my next question,
3 which is along the lines of what you're already
4 talking about.

5 Would the claim be satisfied by a
6 device that increased the pulse rate of an LED and,
7 as a result, the signal-to-noise ratio increased,
8 if that device did not increase the pulse rate for
9 the purpose of increasing the signal-to-noise
10 ratio?

11 MR. LEROY: Objection to form of the
12 question.

13 THE WITNESS: Repeat the question,
14 please.

15 BY MR. BROUGHAN:

16 Q. Would the claim be satisfied by a
17 device that increased the pulse rate of an LED and,
18 as a result, increased the signal-to-noise ratio,
19 if that device did not do so for the purpose of
20 increasing the signal-to-noise ratio?

21 A. That's a hypothetical.

22 I don't know the -- I don't know the --



1 you asked me if this -- if your hypothetical device
2 satisfies the claim. I have no idea how to analyze
3 that hypothetical device in the context of the --
4 of the claim of the patent. So I have -- I have no
5 opinion at all based on -- on your hypothetical.

6 Can we take a break fairly soon?

7 Q. Yes. I have a couple of -- just a
8 couple of additional questions, and then we'll take
9 a break, if that's okay with you, or do you need
10 one right now?

11 A. No, that's fine.

12 Q. Okay. Great.

13 So what I'm really trying to get at
14 here is whether there -- in your opinion, there is
15 an intent element to the claim such that a device
16 needs to -- sorry. Strike that.

17 So that the claim requires a device to
18 intend to increase the signal-to-noise ratio and
19 thereby increase the pulse rate of the LED, or is
20 the claim only requires increasing of the pulse
21 rate of the LED that results in increasing the SNR.

22 That's the general idea I'm trying to

1 get at.

2 Does that make sense?

3 MR. LEROY: Objection to the form of
4 the question.

5 BY MR. BROUGHAN:

6 Q. I'll ask a better question. I'm just
7 asking if that general -- if those two concepts
8 make sense to you.

9 MR. LEROY: Well, if you expect a
10 response from him, then I maintain the
11 objection.

12 BY MR. BROUGHAN:

13 Q. So the question is, Dr. MacFarlane,
14 Does that distinction make sense to you?

15 MR. LEROY: Objection to form.

16 THE WITNESS: I don't know what
17 distinction you're getting at. I guess
18 I -- I guess I just have to say, No, I
19 don't know -- I don't -- I don't -- I've --
20 you've got me confused on the question.

21 I apologize.

22

1 BY MR. BROUGHAN:

2 Q. The claim language specifies, The light
3 source configured to increase signal-to-noise ratio
4 by increasing a pulse rate.

5 Does that require the device to intend
6 to increase signal-to-noise ratio when it increases
7 the pulse rate, or is it satisfied by any device
8 that increases the pulse rate and that results in
9 increasing the signal-to-noise ratio?

10 MR. LEROY: Objection to the form of
11 the question.

12 THE WITNESS: I haven't considered
13 that. I don't have an opinion on it.

14 BY MR. BROUGHAN:

15 Q. Okay. I have -- you know what --
16 sorry.

17 Strike that.

18 MR. BROUGHAN: Let's take a break
19 now.

20 How long does everyone want to take?

21 Ten minutes? Five minutes?

22 MR. LEROY: That's up to you.

1 MR. BROUGHAN: Do you have an
2 opinion, Dr. MacFarlane? How much time
3 would you like?

4 THE WITNESS: Ten minutes. Is that
5 okay?

6 MR. BROUGHAN: Yeah, that's no
7 problem.

8 Is that okay with you, Cindy?

9 CERTIFIED STENOGRAPHER: Yeah,
10 that's fine. Thanks.

11 MR. BROUGHAN: So approximately
12 11:10, 11:11 Eastern.

13 MR. LEROY: You got it.

14 - - -

15 (Whereupon, a recess was taken from
16 11:01 a.m. EST to 11:12 a.m. EST)

17 - - -

18 BY MR. BROUGHAN:

19 Q. Dr. MacFarlane, you have a copy of the
20 Lisogurski patent in your binder, correct?

21 A. I think you're referring me to the
22 Lisogurski patent.



1 Q. Yes, sir. Let me know once you've
2 found it.

3 A. So this is Exhibit 1011?

4 Q. Yes.

5 A. Go ahead.

6 MR. BROUGHAN: So you have in front
7 of you Exhibit 1011, and we'll introduce
8 that into the record.

9

- - -

10 (MacFarlane Deposition Exhibit
11 Number 2, U.S. Patent 9,241,676 B2,
12 marked for identification, as of
13 this date.)

14

- - -

15 BY MR. BROUGHAN:

16 Q. And you also have the -- your
17 declaration separate as well so you can refer to
18 both the patent -- the Lisogurski patent and your
19 declaration --

20 A. I do.

21 Q. -- so you can have it set up.

22 Great.



1 A. Sorry.

2 I do.

3 Q. So if you could also grab your
4 declaration and turn to Paragraph 49, please.
5 That's on Page 22.

6 A. Okay.

7 Q. The second sentence there, you're
8 quoting part of Lisogurski, and it states, Thus,
9 quote, the system may vary parameters related to
10 the light drive signal including drive current or
11 light brightness, duty cycle, firing rates and
12 other suitable parameters, end quote.

13 Do you see that?

14 A. Yes, I do.

15 Q. What do you understand "firing rate" to
16 mean?

17 A. I understand it to be the rate of the
18 pulses delivered by the device.

19 Q. And you agree Lisogurski is able to
20 vary the firing rates of a light source, correct?

21 A. Again, I could only hear a small -- I
22 could only half hear you.

1 Q. Sorry. Sorry.

2 Sorry.

3 You agree that Lisogurski is able to
4 vary the firing rates of a light source, correct?

5 A. To the extent that I heard your
6 question, yes, I agree with it.

7 Q. Okay.

8 Lisogurski can also vary the drive
9 currents or light brightness, correct?

10 A. Yes.

11 Q. What do you understand "drive current"
12 or "light brightness" to mean?

13 A. I understand it to be the drive current
14 that -- I understand it -- at this instance, to be
15 the drive current that governs the -- the light
16 brightness.

17 Q. What do you understand "duty cycle" to
18 be?

19 A. The relative amount of time that the
20 light is on versus the light is off.

21 Q. Lisogurski talks about cardiac cycle
22 modulation .

1 Do you recall that?

2 A. To some extent, I do.

3 Q. Do you have a high-level understanding
4 of what cardiac cycle modulation is that you can
5 tell me?

6 A. I haven't reviewed that particular term
7 in a while --

8 Q. Okay.

9 A. -- and I want to be careful with my
10 answer, so . . .

11 So I believe it to be modulation
12 techniques that are related to be -- to -- to the
13 cardiac cycle.

14 Q. What is the cardiac cycle?

15 A. At a high level, it's the beating of
16 your heart.

17 Q. Is a cardiac cycle -- sorry.

18 I'm not even sure how to ask the
19 question. Strike that.

20 A cardiac cycle -- is that on the order
21 of maybe a second or two, or is that something
22 that's more on the order of, like, a minute or some

1 other unit of time?

2 A. Say that again, please, Tom.

3 Q. A cardiac cycle -- would that be
4 something like a second or two, or is it -- is a
5 cycle more along the lines of, like, a minute or
6 some other time period?

7 A. It's -- let's say it's about a second.

8 Q. Are you familiar with PQRST waves?

9 A. I have some familiarity with them, but
10 I've not reviewed them for this deposition.

11 Q. Okay. Would a cardiac cycle just be,
12 like, one set of beats -- so a beat of the heart
13 is -- strike that.

14 Do you know what's encompassed within
15 one cardiac cycle?

16 A. I haven't reviewed that for this
17 deposition, and so I'm reluctant to testify under
18 oath.

19 Q. Why would you alter cardiac cycle
20 modulation based on noise, ambient light or other
21 reasons?

22 A. So I'm going to go to the -- the

1 '676 patent, Column 9, Line 46: In some
2 embodiments, the system may alter the cardiac cycle
3 modulation technique based on the level of noise,
4 ambient light, other suitable reasons, or any
5 combination thereof. The system may receive, for
6 example, an increased level of background noise in
7 the signal due to patient motion. The system may
8 increase the brightness of the light sources in
9 response to the noise to improve the
10 signal-to-noise ratio.

11 In some embodiments, the system may
12 increase brightness throughout the cardiac cycle
13 because the system may require increased signal
14 amplitudes to differentiate between fiducial and
15 other points of interest related to physiological
16 parameters and those related to noise or motion.

17 In some embodiments, the system may
18 change from a modulated light output to a constant
19 light output in response to noise, patient motion,
20 or ambient light.

21 Q. Why would Lisogurski change the
22 brightness throughout the cardiac cycle?

1 MR. LEROY: Objection to form.

2 THE WITNESS: It says -- and, again,
3 I'm going to read this from the
4 specification itself: The system may
5 increase the brightness of the light
6 sources in response to the noise to improve
7 the signal-to-noise ratio.

8 BY MR. BROUGHAN:

9 Q. What benefit would increasing signal
10 amplitudes to differentiate between different
11 fiducial -- I'm sorry.

12 Strike that.

13 Lisogurski says, The system may require
14 increased signal amplitudes to differentiate
15 between fiducial and other points of interest
16 related to physiological parameters and those
17 related to noise or motion.

18 Do you see that?

19 A. Around Line 55 of Column 9?

20 Q. Correct. Correct.

21 Why would increasing the brightness
22 affect the -- Lisogurski's ability to differentiate

1 between fiducial and other points of interest
2 related to physiological parameters and those
3 related to noise or motion?

4 MR. LEROY: Objection to form.

5 THE WITNESS: I haven't thought
6 deeply about that. I -- I don't have -- I
7 don't have an answer beyond what's written
8 in front of me.

9 BY MR. BROUGHAN:

10 Q. Lisogurski states that it may alter
11 cardiac cycle modulation based on the level of
12 noise or ambient light, correct?

13 A. Where are you?

14 Q. Column 9, Lines 46 to 48.

15 A. Okay.

16 Q. And "modulation technique" refers to
17 the parameters of the light being emitted by the
18 system?

19 A. That's my understanding.

20 Q. You would agree that Lisogurski
21 discloses a type of active illuminator, correct?

22 MR. LEROY: Objection to form.

1 THE WITNESS: I haven't attempted to
2 classify Lisogurski's as either active or
3 passive.

4 BY MR. BROUGHAN:

5 Q. You agree that Lisogurski will change
6 parameters of the light source modulation based on
7 environmental conditions?

8 A. Repeat that again, please.

9 Q. You agree that Lisogurski will change
10 modulation parameters of the light source based on
11 environmental conditions, such as the level of
12 noise or ambient light, correct?

13 MR. LEROY: Objection to the form of
14 the question.

15 THE WITNESS: In some embodiments,
16 the system may alter the cardiac cycle
17 modulation technique based on the level of
18 noise, ambient light, other suitable
19 reasons, or any combination thereof.

20 BY MR. BROUGHAN:

21 Q. You agree that ambient light is an
22 environmental condition?

1 A. Ambient light is ambient light.

2 Q. Is that an environmental condition?

3 A. What do you mean by "environmental
4 conditions"?

5 Q. Is sunlight an example of ambient
6 light?

7 A. It can be.

8 Q. If you are outdoors, will changes in
9 cloud cover affect the ambient light?

10 A. It can.

11 Q. You agree that Lisogurski can change
12 the firing rates of an LED, correct?

13 A. Where does it say that in Lisogurski?

14 Q. The question -- hold on.

15 A. Pardon?

16 Q. I'm sorry.

17 One -- hold on. Good question.

18 Hold on.

19 (Pause.)

20 BY MR. BROUGHAN:

21 Q. I thought I had it written down, but
22 it's not immediately jumping out at me.

1 Let's start in Lisogurski, Column 27,
2 Lines 44 to 49.

3 A. Sorry. Column 27?

4 Q. Correct, Column 27, Lines 44 to 49.

5 A. It will also be understood that
6 modulation of the light drive signal (i.e., the on
7 and off states illustrated by light drive signal)
8 is merely exemplary and may include modulation of
9 parameters, including drive current or light
10 brightness, duty cycle, firing rate, modulation
11 parameters, other suitable parameters, or any
12 combination thereof.

13 Q. You agree that Lisogurski describes
14 modulation of the firing rate of an LED, correct?

15 A. I don't -- may include modulation of
16 parameters, including firing rate, is what I read
17 here.

18 Q. You would agree that Lisogurski
19 describes modulation of parameters, and one of
20 those parameters is the firing rates of an LED,
21 correct?

22 A. May include modulation of parameters,

1 including -- dot, dot, dot -- the firing rate.

2 Q. If you turn to Column 35, please. And
3 once you're there, if you go to Lines 27 to 31.

4 And in this passage, Lisogurski
5 describes changing the duration of the off periods
6 between when an LED is on; is that correct?

7 A. In some embodiments, the sampling
8 rate -- the sampling rate may represent the amount
9 of time between on periods. For example, the
10 time -- for example -- what's the question?

11 Q. Would you agree that Lisogurski
12 describes increasing the LED firing rate?

13 A. Similarly, decreasing the duration of
14 the off periods (i.e., increasing the emitter
15 firing rate) relates to an increased sampling rate.

16 Q. Would you agree that Lisogurski
17 describes a device that can increase the LED firing
18 rate?

19 A. Lisogurski, in this line, is describing
20 a device that's able to increase the emitter firing
21 rate.

22 Q. Do you agree that the device in

1 Lisogurski -- sorry. Strike that.

2 Do you agree that Lisogurski describes
3 the device as configured to sometimes increase the
4 emitter firing rate?

5 A. Similarly, decreasing the duration of
6 the off periods (i.e., increasing the emitter
7 firing rate) relates to an increased sampling rate.

8 Q. Do you agree that Lisogurski sometimes
9 performs that operation -- "that operation" being
10 increasing the emitter firing rate?

11 MR. LEROY: Objection to form.

12 THE WITNESS: I'm not sure where
13 that's explicitly taught.

14 BY MR. BROUGHAN:

15 Q. Do you understand Lisogurski to
16 describe a device that does operate that way
17 sometimes?

18 MR. LEROY: Objection to form.

19 THE WITNESS: Describe a device --

20 BY MR. BROUGHAN:

21 Q. Sorry. That was very -- let me
22 withdraw that. That was a very bad question.

1 Do you agree that Lisogurski describes
2 a device that is configured to increase the emitter
3 firing rate in some circumstances?

4 MR. LEROY: Objection to form.

5 THE WITNESS: I believe so.

6 BY MR. BROUGHAN:

7 Q. And this passage also describes
8 sampling rates.

9 What do you understand "sampling rate"
10 to mean?

11 A. "Sampling rate" is typically used for a
12 detector -- for the analog-to-digital sampling
13 rate -- for that detector. And I believe that's
14 how Lisogurski uses that for the most part as well.

15 Q. So a higher sampling rate means that
16 the analog-to-digital converter is making more
17 measurements?

18 A. Per unit time, yes.

19 Q. If we can go back to Column 9 of
20 Lisogurski -- I'm sorry. Actually, let's -- let's
21 set Lisogurski aside for now.

22 And can you turn to the Carlson patent,

1 which I believe is Tab 3 in your binder?

2 A. Exhibit 1009, the Carlson patent?

3 Q. Yes, sir.

4 MR. BROUGHAN: And so we will -- we
5 will introduce Exhibit 1009 into the record
6 of this deposition.

7 - - -

8 (MacFarlane Deposition Exhibit
9 Number 3, U.S. Patent Application
10 Publication US 2005/0049468 A1,
11 marked for identification, as of
12 this date.)

13 - - -

14 BY MR. BROUGHAN:

15 Q. And if you would turn to, I believe,
16 Paragraph 20.

17 A. Paragraph 20?

18 Q. Yes, sir. There are, unfortunately, no
19 line numbers, but I'm interested in the second
20 sentence. And it starts out, The basic idea of
21 using AC coupling or lock-in amplification
22 (synchronous detection) is to temporarily modulate



1 the amplitude of the optical radiation of, e.g.,
2 the LED at a carrier frequency f_c in order to shift
3 the power spectrum of the pulsoximeter signals into
4 a higher frequency range where environmental
5 optical radiation is unlikely and electronic band
6 pass filtering is technologically less stringent.

7 Do you see that?

8 A. I do.

9 Q. Now, Carlson talks about temporarily
10 modulating the amplitude of the optical radiation
11 at a carrier frequency.

12 Do you see that?

13 A. I do.

14 Q. Do you understand Carlson to say that
15 the modulation is changed over time?

16 MR. LEROY: Objection to the form.

17 (Whereupon, the witness reviews the
18 material provided.)

19 THE WITNESS: This line just
20 describes lock-in amplification and the
21 modulation of the amplitude of the optical
22 radiation to a carrier frequency.

1 BY MR. BROUGHAN:

2 Q. Well, Carlson says that the modulation
3 is temporary; is that correct?

4 A. Yes, it -- yes, it seems to temporarily
5 modulate at a carrier frequency -- I'm sorry --
6 temporarily modulate the amplitude of the optical
7 radiation of, for example, the LED at a carrier
8 frequency f_c in order to shift the power spectrum
9 of the pulsoximeter signals into a higher frequency
10 range.

11 Q. So higher frequency range -- that
12 suggests that there's also a lower frequency range,
13 correct?

14 A. No.

15 Q. Okay. Well, higher than what?

16 A. Zero or baseband.

17 Q. What is "baseband"?

18 A. Sorry?

19 Q. What is "baseband"?

20 A. Okay. So -- so let me -- let me -- for
21 context, let me stay right within the metes and
22 bounds of what we're looking at, this Paragraph 20,

1 because that way, it would be much -- it would be
2 clearer.

3 Q. Sure.

4 A. Shift -- it shifts the power spectrum
5 of the pulsoximeter signals into a higher frequency
6 range. So there's a power spectrum of the
7 pulsoximeter signals, and that's a band of
8 frequencies.

9 And I believe there's a picture of this
10 in this patent. And this is described -- this is
11 talking about shifting that power spectrum to the
12 higher frequency.

13 And that's my understanding of -- of
14 that word "higher."

15 Q. Carlson starts in one range, it
16 temporarily shifts to a higher range, and then
17 shifts back to the original range?

18 MR. LEROY: Objection to form.

19 THE WITNESS: Carlson temporarily
20 modulates the amplitude of the optical
21 radiation at a carrier fc.

22

1 BY MR. BROUGHAN:

2 Q. Do you agree that Carlson starts in one
3 range, it temporarily shifts to a higher frequency
4 range, then shifts back to the original range?

5 MR. LEROY: Objection to the form of
6 the question.

7 THE WITNESS: To the extent that I
8 can begin to understand your question, no.

9 BY MR. BROUGHAN:

10 Q. Does Carlson start at a baseband
11 range -- sorry. Strike that.

12 Does Carlson start at a baseband, shift
13 to a higher frequency range, and then shift back to
14 baseband?

15 MR. LEROY: Object to the form.

16 THE WITNESS: I don't believe
17 that -- so to answer your question, take a
18 look at Figure 7a. And Carlson explains
19 that Figure 7c -- I'm sorry --

20 BY MR. BROUGHAN:

21 Q. I'm sorry. A or c?

22 A. Figure 7c. Sorry about that.

1 So Carlson explains that Figure 7c is a
2 diagram showing power spectrum of physiological
3 signals and ambient light without phase shifting or
4 modulation of the light source.

5 And that's in Paragraph 44.

6 In other words, Figure 7c discloses the
7 power spectrum for continuous light, not pulse
8 light.

9 Carlson explains, as shown in
10 Figure 7c, that the influence of the ambient light
11 is quite substantial, and therefore the deviations
12 of the measured values compared to the real values
13 can be dramatic. And that's Paragraph 67.

14 In Paragraph 68, Carlson explains that
15 sunlight, trees and shade can further influence the
16 measurement of the pulse ox sensor.

17 Going to Paragraph 69, [as read] As a
18 consequence, it is therefore proposed to emit light
19 by the LEDs not as current or continuous light but
20 as pulsed light. The frequency is chosen in such a
21 way that it is outside the frequency spectrum of
22 the sunlight and of ambient light which, according

1 to Figure 7b, is in the range of approximately 1000
2 hertz.

3 Carlson then introduces Figure 8.
4 Figure 8 shows the shift -- the shift spectrum of
5 signal to a region where there is little influence,
6 e.g., of ambient light. F0 is the chosen frequency
7 of the emitted light to operate the pulsoximeter
8 sensor and the range between $f_0 - 5$ hertz and $f_0 + 5$
9 hertz is the consequence of the influence of the
10 frequency due to physiological signal. Therefore,
11 as shown in Figure 8, the frequency spectrum of
12 signal at the photo diode does have a basic signal
13 contribution due to physiological signal.

14 Q. Do you agree that Carlson teaches a
15 pulsoximeter that pulses an LED?

16 MR. LEROY: Objection to the form of
17 the question.

18 THE WITNESS: Repeat the question,
19 Tom, please.

20 BY MR. BROUGHAN:

21 Q. Do you agree that Carlson discloses a
22 pulsoximeter that pulses an LED?

1 MR. LEROY: Objection: form.

2 THE WITNESS: Paragraph 69, It is
3 therefore proposed to emit light by the
4 LEDs not as current or continuous light but
5 as pulsed light.

6 BY MR. BROUGHAN:

7 Q. Do you agree that Carlson discloses
8 that increasing the pulse rate of an LED can
9 increase the signal-to-noise ratio?

10 MR. LEROY: Objection to the form of
11 the question.

12 THE WITNESS: Carlson teaches the
13 frequency is chosen in such a way that it
14 is outside the frequency spectrum of
15 sunlight and of ambient light which,
16 according to Figure 7b, is in the range of
17 approximately -- of -- of above
18 approximately 1,000 hertz.

19 BY MR. BROUGHAN:

20 Q. Why does Carlson suggest selecting a
21 pulse rate in a range above a thousand hertz?

22 A. The frequency is chosen in such a way

1 that it is outside the frequency spectrum of
2 sunlight and of ambient light.

3 Q. A thousand hertz is outside the
4 frequency of ambient light or sunlight?

5 A. In the opinion of -- of Carlson and his
6 Figure 7b.

7 Q. What about in your opinion?

8 A. I'm sorry. What?

9 Q. What about in your opinion?

10 A. I've never made the measurement. I
11 have no reason to doubt this, but I've never made
12 the measurement.

13 Q. Carlson also suggests a frequency
14 of 2,000 hertz?

15 A. Where does he do that?

16 Q. It's still Paragraph 69, closer to the
17 end. You might see Figure 9 bolded, and it's three
18 lines above that.

19 A. Well -- of course -- if not, of course,
20 can be chosen at any other frequency as, for
21 example, 2,000 hertz or even higher.

22 And that's consistent with his data of

1 Figure 7b, which shows that the sunlight is, on
2 this scale at least, flat once you get between,
3 say, 1,000 and 10,000 hertz.

4 Q. Carlson mentions both f_c and f_0 , which
5 I believe you called "f-naught."

6 What's the difference between f_c and
7 f_0 ?

8 MR. LEROY: Objection to form.

9 THE WITNESS: Where does he use that
10 sub c?

11 BY MR. BROUGHAN:

12 Q. In his paragraph, he uses both. So
13 closer to the top, it says -- there's a reference
14 to See Fig. 7b in bold, and then the first full
15 sentence after that says, Thus, the pulsoximeter
16 signals are readily discriminated from electronic
17 and parasitic contributions of environmental
18 optical radiation outside the frequency $f_c \pm 5$
19 hertz.

20 And then several sentences later, he
21 starts mentioning f_0 naughts.

22 So what do you understand the

1 difference between f_c and f_0 to be?

2 MR. LEROY: So same objection.

3 THE WITNESS: So my understanding is
4 that the -- the Carlson introduces a
5 carrier frequency F_c , and I believe he does
6 that to describe the -- to describe the --
7 the modulation, particularly in terms of AC
8 coupling or lock-in amplification.

9 And then in 69 -- Paragraph 69, when
10 he's talking particularly about the pulsed
11 light -- and to be definite -- and in light
12 of Figure 7 and 8, he describes f_0 as a
13 particular chosen frequency.

14 BY MR. BROUGHAN:

15 Q. Are f_c and f_0 two different
16 frequencies?

17 MR. LEROY: Objection to form.

18 THE WITNESS: I don't read them that
19 way.

20 BY MR. BROUGHAN:

21 Q. Is f_0 just a specific example of what
22 f_c could be?

1 A. That's possible.

2 Q. Is that what Carlson says or not?

3 MR. LEROY: Objection to form.

4 THE WITNESS: It's not clear exactly
5 what Carlson intended to do with fc versus
6 f0. It could just be that the figures are
7 labeled f0. And so in the discussion of
8 the figures, they're -- he uses f0 as a
9 specific chosen frequency and then the
10 generic idea of modulating is fc.

11 I don't know. I don't -- I don't
12 have an opinion on -- on -- on what exactly
13 Carlson meant by fc versus f0, at least not
14 in my quick review of -- of Paragraphs 65
15 and 69.

16 If there's another -- a clearer
17 explanation somewhere, I haven't quickly --
18 I haven't seen it.

19 BY MR. BROUGHAN:

20 Q. If you look over at Paragraph 65,
21 Carlson describes AC coupling or lock-in
22 amplification.

1 Do you see that?

2 A. Yes.

3 Q. What -- what is AC coupling or lock-in
4 amplification?

5 A. Which one would you like me to talk
6 about?

7 Q. Are -- well, first, I guess, are AC
8 coupling and lock-in amplification different?

9 A. They can be, in my opinion.

10 Q. First would you describe what AC
11 coupling is?

12 A. I'll try. And the context I'm going to
13 answer this in is -- the context that I'm going to
14 answer this in is -- is in the context of the --
15 the -- undergraduate lectures that I've -- sorry --
16 sorry -- the undergraduate lectures that I've been
17 giving this week, which considers a -- a signal
18 that has -- both a DC and an AC signal.

19 And, again, this is in the context of
20 general filtering and -- and -- and general
21 instrumentation and general electronic --
22 electronic circuits or electric circuits even.

1 And so you have a signal that has a
2 background or a DC component and you have a signal
3 that has an AC component on it. And somehow -- and
4 you have a desire to meet the -- the signal that
5 has the AC component on it and block the background
6 DC component, or the power supply component.

7 And so you use a blocking capacitor to
8 AC couple the -- the -- the -- the signal. And so
9 the blocking capacitor blocks the DC part of it and
10 lets the AC part of it in.

11 And, again, that answer, in the context
12 not of the specifics of the patent but in the
13 general electrical -- the introductory electrical
14 engineering.

15 Q. Would the meaning of "AC coupling" in
16 Carlson be different than the meaning you just gave
17 me?

18 A. I haven't considered that.

19 Q. Okay. What does Carlson mean by
20 "lock-in amplification"?

21 A. Repeat the question, please.

22 Q. What does Carlson mean by "lock-in

1 amplification"?

2 A. So at the end of that paragraph,
3 Carlson appears to have a reference, Literature 3.
4 And I haven't looked at that reference.

5 Q. What do you understand lock-in
6 amplification to be, generally?

7 A. Sure.

8 Again, this -- so I'll answer the
9 question in a general manner in the way I -- I
10 understand lock-in amplification. And a lock-in
11 amplification is a phase-sensitive technique.

12 So if I have -- if I have a -- a signal
13 that I modulate to have a particular frequency, and
14 then I -- and then I use that signal to interrogate
15 a system under test or a device under test or a
16 sample under test, I -- I know something about not
17 only the frequency that I've modulated that signal
18 with, but I also know when I have modulated.

19 In other words, I can discriminate at
20 my detector the difference between a cosine and a
21 sine modulation or an in-phase part and an
22 out-of-phase part. And I can do that with a

1 lock-in technique or a synchronous detection
2 technique many of these use, at the heart, a
3 superheterodyne circuit. Some of them also use
4 other circuitry as well.

5 And so what the lock-in does is it
6 locks in -- it has a local oscillator that locks
7 into the signal not only at the frequency but also
8 at the phase. And so it represents a method to --
9 it represents a method to -- to be able to receive
10 and detect a signal and make a measurement of that
11 signal with -- with very -- with great precision.

12 Q. Okay. So are you Central Time,
13 Dr. MacFarlane?

14 A. Yes, I am. It's 11 -- my computer says
15 11:18.

16 MR. BROUGHAN: Can we take a
17 10-minute break? I might be -- I'm either
18 finished or I just have a few more
19 questions.

20 THE WITNESS: Okay.

21 MR. BROUGHAN: So let's take a
22 10-minute break.

1 measurement system --

2 Q. Where are you? I'm sorry.

3 A. Oh, I'm so sorry. I'm in the '533
4 patent. I'm in Column 5, beginning at Line 5.

5 Q. Thank you.

6 A. And I think -- I think -- I might be
7 mistaken, but I think this is the first mention of
8 signal-to-noise ratio in the -- in the
9 specification.

10 In another embodiment, a measurement
11 system includes a light source comprising a
12 plurality of semiconductor sources that are
13 light-emitting diodes, the light-emitting diodes
14 configured to generate an output optical beam with
15 one or more optical wavelengths, wherein at least a
16 portion of the one or more optical wavelengths is a
17 near-infrared wavelength between 700 nanometers and
18 2500 nanometers. The light source is configured to
19 increase signal-to-noise ratio.

20 And so in that context, I read
21 "signal-to-noise ratio" as being the
22 signal-to-noise ratio of the measurement system --

1 of the measurement made.

2 Q. So that would be the signal-to-noise
3 ratio of the measurement of the analysis output
4 being reflected or transmitted from the sample?

5 A. Of the measurement made by the
6 measurement system that begins that paragraph.

7 Q. Where the claim language says, The
8 light source configured to increase signal-to-noise
9 ratio by increasing a pulse rate -- your
10 understanding is that refers to the signal-to-noise
11 ratio of the measurement made by the system?

12 A. The preamble to Claim 5 reads, A
13 measurement system comprising.

14 And I don't -- I know that -- you know,
15 I know -- I've been told -- I'm not -- I'm not --
16 I've been told by -- for my own patents, for
17 example, you know, the preamble is a little
18 different than the rest of the claims -- the rest
19 of the claims.

20 But if I just read this, you know, this
21 is referring at least to a measurement system. And
22 in -- it's very common to think about the

1 signal-to-noise when you make a measurement. And
2 there's nothing in that paragraph on Column 5
3 that -- that -- that contradicts that.

4 Q. Do you agree, then, that where the
5 claim language says, The light source configured to
6 increase the signal-to-noise ratio by increasing a
7 pulse rate, the claim is referring to the
8 signal-to-noise ratio of the measurement made by
9 the system?

10 A. Made by what?

11 Q. The system -- the system -- the
12 device's system.

13 A. That's --

14 MR. LEROY: Objection to form.

15 THE WITNESS: -- my understanding.

16 BY MR. BROUGHAN:

17 Q. Dr. MacFarlane, after this deposition
18 started this morning, have you communicated with
19 counsel about the substance of your testimony?

20 A. Absolutely not.

21 MR. BROUGHAN: Great. We have no
22 further questions at this time.

1 MR. LEROY: Okay. This is
2 John LeRoy. We'd like to take a short
3 break and get back with you, Tom, as to
4 whether we have any follow-up questions.

5 So I suggest we take, like, a
6 15-minute break, and I'll let you know.

7 MR. BROUGHAN: Okay.

8 - - -

9 (Whereupon, a recess was taken from
10 12:47 p.m. EST to 12:55 p.m. EST)

11 - - -

12 - - -

13 EXAMINATION BY COUNSEL FOR PATENT OWNER

14 - - -

15 BY MR. LEROY:

16 Q. Dr. MacFarlane, do you recall earlier
17 today being asked, quote, In general, when you
18 increase a pulse rate of an LED, you will increase
19 signal-to-noise ratio, although that will not
20 always happen, closed quote, to which you
21 responded, Yes?

22 A. I recall that.



1 Q. Have you had a chance to reflect on
2 that question?

3 A. I have.

4 Q. Would you like to clarify or change
5 your answer?

6 MR. BROUGHAN: Objection: form.

7 Objection: leading.

8 THE WITNESS: Yes.

9 The -- the question was -- was --
10 was poorly phrased, in my opinion. I
11 mis- -- I misunderstood it. The beginning
12 of it was "in general"; the end of it was
13 "not always," making the question
14 contradictory -- those two pieces are
15 contradictory, and so I answered
16 erroneously.

17 I'd like to change my answer from a
18 yes to a no.

19 MR. LEROY: Tom, that's all I have.

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EXAMINATION (CONTINUED) BY COUNSEL FOR PETITIONER

BY MR. BROUGHAN:

Q. I have a follow-up question.

I'm going to stick on a basically similar topic.

Dr. MacFarlane, when you increase a pulse rate of an LED, in some circumstances, you'll increase the signal-to-noise ratio; is that correct?

MR. LEROY: Objection to form.

THE WITNESS: Increasing the -- increasing the frequency can sometimes increase the signal-to-noise ratio.

BY MR. BROUGHAN:

Q. In general, does increasing the pulse rate of an LED increase the signal-to-noise ratio?

MR. LEROY: Objection to form.

THE WITNESS: I can't -- I can't say that in general.



1 BY MR. BROUGHAN:

2 Q. Why not?

3 A. There may be instances where that
4 doesn't happen.

5 Q. Do you know of any instances of when
6 increasing the pulse rate of an LED does not
7 increase the signal-to-noise ratio?

8 MR. LEROY: Objection to form.

9 THE WITNESS: Hypothetically, I can
10 imagine that being the case.

11 BY MR. BROUGHAN:

12 Q. Are you aware of any concrete examples
13 of when increasing the pulse rate of an LED does
14 not increase its signal-to-noise ratio?

15 A. Not -- what do you mean by "concrete
16 examples?" Something --

17 Q. Can you give me -- sorry.

18 A. No; go on.

19 Q. Could you give me an example of when
20 increasing the pulse rate of an LED does not
21 increase the signal-to-noise ratio?

22 A. If -- if increasing the band -- the --

1 if increasing the pulse rate of the LED changes the
2 signal or moves you into a regime where there's
3 more noise, then the net effect on a
4 signal-to-noise ratio may not be an increase.

5 Q. What do you mean by "changes the
6 signal"?

7 A. An example might be an amplitude
8 change. If there was some reason -- and, again,
9 we're so hypothetical here -- if there's some
10 reason why increasing the frequency -- it decreases
11 your signal, and if that effect offsets any input
12 or not, then -- then your net effect on
13 signal-to-noise ratio may not be an improvement.

14 Q. Do you agree that if you increase the
15 pulse rate of an LED, typically, the
16 signal-to-noise ratio will increase?

17 MR. LEROY: Objection to form.

18 THE WITNESS: I neither agree nor
19 disagree with that.

20 BY MR. BROUGHAN:

21 Q. Do you agree that if you increase the
22 pulse rate of an LED, sometimes the signal-to-noise

1 ratio will increase?

2 MR. LEROY: Objection to form.

3 THE WITNESS: Sometimes increasing
4 the modulation or the pulse rate of a -- of
5 a -- of an LED can increase the
6 signal-to-noise ratio of -- of the
7 measurement.

8 BY MR. BROUGHAN:

9 Q. During the last break, did you discuss
10 the substance of your testimony with counsel?

11 A. Yes.

12 Q. Did counsel instruct you to change your
13 answer?

14 A. No.

15 Q. Was it your idea to change your answer?

16 A. Yes.

17 And, really, it -- it was pointed out
18 to me, the nature of the question, and once I --
19 once I heard the question again, I -- I -- I --
20 I shook my head.

21 MR. BROUGHAN: No further questions.

22 MR. LEROY: Tom, this is John LeRoy.



1 We have no follow-up questions.

2 MR. BROUGHAN: Okay. Great.

3 Dr. MacFarlane, thank you very much
4 for your time today. Thank you very much
5 for your time today. I appreciate you
6 taking the time out for this.

7 THE WITNESS: Stay safe and healthy,
8 please.

9 MR. BROUGHAN: You as well.

10 And thank you, Cindy, as well for
11 taking the time today.

12 MR. LEROY: Thank you, Cindy.

13 CERTIFIED STENOGRAPHER: Thank you,
14 all.

15 - - -

16 (Witness excused.)

17 - - -

18 - - -

19 (Deposition concluded at 1:06 p.m.
20 EST)

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C E R T I F I C A T E

STATE OF MARYLAND:
COUNTY OF PRINCE GEORGE'S:

I, Cindy L. Sebo, a Notary Public within and for the Jurisdiction aforesaid, do hereby certify that the foregoing deposition was taken before me, pursuant to notice, at the time and place indicated; that said deponent was by me duly sworn to tell the truth, the whole truth, and nothing but the truth; that the testimony of said deponent was correctly recorded in machine shorthand by me and thereafter transcribed under my supervision with computer-aided transcription; that the deposition is a true record of the testimony given by the witness; and that I am neither of counsel nor kin to any party in said action, nor interested in the outcome thereof.

Cindy L. Sebo, RMR, CRR, RPR, CSR,
CCR, CLR, RSA, Remote Counsel
Court Reporter, LiveDeposition



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