

In the Matter Of:
Intel Corp v Telefonaktiebolaget

Emmanouil M. Tentzeris, PHD

December 17, 2024



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1 UNITED STATES PATENT AND TRADEMARK OFFICE
2 BEFORE THE PATENT TRIAL AND APPEAL BOARD

3 INTEL CORPORATION,)
4 Petitioner,)
5 vs.)
6 TELEFONAKTIEBOLAGET L M)
7 ERICSSON (publ),)
8 Patent Owner.)

9
10 Case No. IPR2024-00728
11 Patent No. 7,151,430 b2
12

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14 DEPOSITION OF
15 EMMANOUIL M. TENTZERIS, PHD
16 TAKEN BY REMOTE VIDEOCONFERENCE

17 December 17, 2024
18 10:00 a.m. EST
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21 Pamela L. Porter, RPR, CCR-B-2160
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23	(Exhibits have been attached to the original		
24	transcript.)		
25			

1 (Reporter disclosure made pursuant to
2 Article 10.B of the Rules and Regulations of the
3 Board of Court Reporting of the Judicial Council
4 of Georgia.)

5 (Due to the need for this deposition to
6 take place remotely, the parties have stipulated
7 that the court reporter may swear in the witness
8 via videoconference and that the witness has
9 verified that he/she is in fact EMMANOUIL M.
10 TENTZERIS, PHD.)

11 (Exhibits 1001 to 1010 were marked for
12 identification.)

13 EMMANOUIL M. TENTZERIS, PHD,
14 having been first duly sworn, was examined and
15 testified as follows:

16 CROSS-EXAMINATION

17 BY MR. WARR:

18 Q. Good morning, Dr. Tentzeris. Am I
19 pronouncing your name correctly?

20 A. That's great.

21 Q. Okay. Very good. Have you given
22 testimony by deposition before?

23 A. Yes, I have.

24 Q. So you understand the process?

25 A. I do. I do.

1 Q. If at any time I ask a question that is
2 not clear to you or you do not hear me, please let me
3 know so that I can rephrase the question. Is that
4 fair?

5 A. That's fair.

6 Q. And where are you currently situated, sir?

7 A. I'm in Atlanta, Georgia.

8 Q. Is anybody with you?

9 A. Not at all. I'm the only person in the
10 building right now.

11 Q. Okay. And do you have any written
12 materials with you relevant to this IPR proceeding?

13 A. Just the material you guys send me in
14 electronic form.

15 Q. The exhibits 1001 --

16 A. The exhibits 1001 to 1009.

17 Q. And if I can remind you, if you could just
18 wait until my questions are finished, it makes it much
19 easier for the court reporter to get a good
20 transcription for us. Is that fair?

21 A. Sure.

22 Q. And did you review those exhibits 1001
23 through 1009 in advance of your testimony today?

24 A. Yes, I did.

25 Q. Are you in communication with anybody

1 **right now?**

2 A. No. This is a secure room with no other
3 signal than the Wi-Fi.

4 **Q. Okay. In the declaration that you signed**
5 **for this IPR proceeding, you state that you are being**
6 **paid at your standard consulting rate.**

7 **What is that rate?**

8 A. This rate is -- well, first of all, is it
9 privileged information? I don't know. I have to ask
10 Christie.

11 MS. LAROCHELLE: No. You can give your
12 rate.

13 THE WITNESS: So this is 650, \$650 per
14 hour.

15 **Q. (By Mr. Warr) Exhibit 1004 is your CV.**
16 **Are you familiar with that document?**

17 A. Yes. I put it together.

18 **Q. And towards the end of that document you**
19 **identify a number of situations where you have**
20 **provided expert testimony, including several IPR**
21 **proceedings. Do you remember that?**

22 A. Yes, I do.

23 **Q. Have you ever served as an expert on**
24 **behalf of a patent owner in an IPR?**

25 A. I believe so. I believe so. I cannot

1 recall exactly, but I believe so.

2 **Q. Have you ever served as an expert witness**
3 **on behalf of Intel Corporation before?**

4 A. Yes, I have.

5 **Q. How many times?**

6 A. Once. If I remember correctly, once.

7 **Q. Was that in an IPR as well?**

8 A. That was in an IPR, yes.

9 **Q. Did that involve Ericsson?**

10 A. No, it did not involve Ericsson. I think
11 it involved Seta or some company called something like
12 that.

13 **Q. Have you served as an expert in cases**
14 **involving Ms. Larochelle's firm, Goodwin Proctor,**
15 **before?**

16 A. I don't think so. I cannot recall so.

17 **Q. In your declaration you discuss a number**
18 **of prior art references; correct?**

19 A. That is correct.

20 **Q. Did you find those references, or were**
21 **they provided to you?**

22 A. I found most of the reference. Some were
23 provided to me, but they agreed with my technical
24 opinion. That's why I -- I had some opinion included
25 in the declaration.

1 **Q. Do you recall which prior art references**
2 **you found as opposed to those that were provided to**
3 **you?**

4 A. It's been almost a year. So I cannot
5 recall.

6 **Q. Can you explain to me in your words,**
7 **please, your understanding of the differences between**
8 **antennas and inductors.**

9 A. Would you like me to discuss in an
10 abstract way, or considering the '430 patent? Because
11 I have included some stuff in my declaration. So
12 would you like me to give you the general definition I
13 give in my classes?

14 **Q. Just your general definition, if you**
15 **would, please, sir.**

16 A. Okay. So in general, that's the
17 definition I give in my 4350 electromagnetic
18 application class I have taught more than 30 times now
19 to more than 2,000 engineers working in most major
20 telecommunication industry.

21 Antennas are structures that can work in
22 two modes. One is transmission. The other is
23 reception mode. And these are structures that in the
24 transmission mode are fed with some form of
25 electromagnetic power through a current or voltage.

1 And they radiate. They emit
2 electromagnetic fields, which means they emit some
3 energy to some, potentially, objects at some distance.
4 That's for the transmission. That's for transmission
5 mode.

6 And there are variations of the antennas.
7 There are antennas that mainly operate utilizing a
8 magnetic flux, such as the roof antennas, and that's
9 at least I would say in the earliest references of
10 World War 2 antennas they utilized in battleships
11 in -- some loop antennas.

12 And the whole idea in this is you feed
13 them with current, and they radiate a magnetic field.
14 So they radiate some magnetic flux for a set of
15 magnetic lines.

16 And then in the receiving mode you have
17 similar or different antennas. So, for example,
18 another loop antenna, that gets actuated in the
19 presence of the -- of the magnetic flux.

20 So in reality these are structures that
21 have, in general, the capability of transmitting and
22 receiving electromagnetic flux, electromagnetic energy
23 in different forms.

24 And, actually, I have included in -- even
25 in my deposition, if I can recall, some -- let me see

1 if I can find it. Let me see.

2 Yeah. So it's in paragraph 53 where -- at
3 the end of the paragraph 53 of my declaration, "That
4 an antenna produces magnetic flux when current is
5 applied to it or actuates in the presence of magnetic
6 flux."

7 So this is the idea of the antennas. And
8 antenna is a very critical part in any wireless
9 system. Antennas are very important because they have
10 the feature of guiding the wave or controlling the
11 directions where you could have zero radiation.

12 And interference, I would say, or
13 cross-coupling between multiple antennas is one of the
14 major issues right now, for example.

15 And I would say from the onset of the
16 wireless communications. So, for example, in the
17 mid -- I'd say mid-'90s when Ericsson and Nokia were
18 the dominant ones, then interference between antennas
19 was really critical issue.

20 And now this is a really critical issue,
21 especially nowadays, that you have to bundle antennas
22 close to each other.

23 And one important point is, especially for
24 the antennas, that there are antennas operating,
25 obviously, at different frequencies. So talking about

1 antennas nowadays, you are talking antennas spanning
2 all the frequency range from megahertz all the way up
3 to gigahertz or nowadays gigahertz for 6G antennas.

4 The physical principles underlying the
5 radiation of electromagnetic flux, though, they are
6 independent of the frequency. Their only thing you
7 have to do to maintain singular characteristics is
8 scale the dimensions.

9 So you have antennas, literally tenths of
10 centimeters and antennas in the order of millimeters
11 or even, I would say, below millimeter when you're
12 talking about 6G that feature exactly the same
13 characteristics, that suffer exactly from the same
14 issues, and that can perform exactly well just by
15 scaling down the physical dimensions in order to
16 satisfy the electrical dimension requirements for
17 specific applications.

18 So that's -- that's in a nutshell what I'm
19 teaching in my class. And I try to summarize that
20 even in the declaration.

21 **Q. And how does that definition differ from**
22 **an inductor?**

23 MS. LAROCHELLE: Object to form.

24 THE WITNESS: Again, you're asking me
25 about an inductor in an abstract way or in terms

1 of the -- of the patent? Because I have -- let
2 me -- let me show something here. Give me one
3 second.

4 So in paragraph 85 where I discuss about
5 loop antennas are inductors, I explain that loop
6 antennas actually are inductors because they
7 have exactly similar features.

8 So if you look at the paragraph, 85, you
9 have a couple of antennas, loop antenna. These
10 are "Taniguchi's antenna one and two. Both
11 generate magnetic flux when a current flows
12 through them. And therefore are both inductors.
13 Every moving charge, flow of current, is
14 associated with magnetic field. And in
15 Taniguchi the supply of electrical current into
16 antennas one and two generate magnetic flux."

17 So that's the inductive behavior.
18 Inductive behavior, as I have included in the
19 introduction section of my declaration, means
20 that you have conductors run by current and then
21 creating magnetic flux.

22 So supply of electric current into these
23 conductors, they generate magnetic flux. And
24 these magnetic flux is, in a sense, the
25 fundamental feature of both the loop antennas

1 and inductors.

2 Even looking at the -- at the patent, we
3 discuss the '430, going, for example, in column
4 five, the line nine, so that's Exhibit 101.
5 There's discussion about a "mechanism that
6 causes the radiated EM field from the first
7 inductor and then causes the EM field to receive
8 sensitivity of the second inductor to be
9 reduced."

10 So the performance of both loop antenna
11 and inductor of the feature of the loop antenna
12 and inductor is similar.

13 **Q. (By Mr. Warr) In your answer to my**
14 **question about antennas, several times you used the**
15 **phrase "nowadays." Were you referring to 2024, 2023,**
16 **2024 time frame when you used that phrase?**

17 **A.** I referred, as I clarified, from the time
18 for World War 2 to now. So that's why I utilized
19 this. The only reason I use the term nowadays was
20 because now of today, or even in 2000 or even in '95
21 more and more people became aware of the antennas from
22 the public.

23 But these discussions, these features,
24 these principles, as I told you, existed even in World
25 War 2 when the first loop antennas were installed in

1 US battleship, in Midway battle.

2 So if you ask about exact year, I would
3 say, like, 1943, 1945 was the first time people start
4 talking about.

5 **Q. So when you use the phrase nowadays,**
6 **you're covering 75 to 80 years history; is that right?**

7 A. Exactly.

8 **Q. Okay.**

9 A. At least to Maxwell time. This is the
10 sort --

11 **Q. Pardon me?**

12 A. If you consider this effect was identified
13 by Maxwell in 1965, 1950s nowadays.

14 **Q. In the context of the '430 patent, what is**
15 **inductance?**

16 MS. LAROCHELLE: Object to form.

17 **Q. Let me rephrase it. Generally speaking,**
18 **what is inductance?**

19 A. Generally speaking, is pretty much exactly
20 what I told you when I read the declaration. So
21 it's -- go back. In paragraph 85, inductor is -- let
22 me see. Is a structure where the supply of electrical
23 current generate magnetic flux.

24 And that's what I have stressed in my
25 declaration, stressing why the loop antennas are

1 inductors because they are conductive structures that
2 flow of current is associated with magnetic field and
3 generate magnetic flux.

4 **Q. Do all wires have some level of**
5 **inductance?**

6 MS. LAROCHELLE: Object to form.

7 THE WITNESS: Are you asking again
8 abstractly?

9 **Q. (By Mr. Warr) Yes.**

10 A. Because if I go back to the introduction,
11 when I talk about the Lanslow [phon.]. Let me figure
12 it out.

13 If you go to paragraph 24, all of -- it
14 says that "the strength of a magnetic field is
15 directly proportional to the amount of current flowing
16 through the wire inductor and inversely proportional
17 to the distance of the wire."

18 And "the direction of the magnetic field
19 generated by the wire conductor can be described in
20 accordance with the right-hand rule."

21 And that's shown in Figure 22.14 on here.

22 And, also, if I can go up. If I can go to
23 Finkenzeller reference in paragraph 23, "Every moving
24 charge or flow of current is associated with a
25 magnetic field."

1 Now, this current, in order for these
2 observation to have a practical meaning, this current
3 has to be an AC current. I mean if you have DC, then
4 the magnetic field is very low.

5 But as I show in paragraphs 23 and 24,
6 conductors run by current create magnetic field. And
7 every moving charge flow of current is associated with
8 magnetic field, as shown in Figure 4.1 in paragraph
9 23.

10 **Q. Does the amount of inductance depend on**
11 **the geometry of the wire?**

12 MS. LAROCHELLE: Object to form.

13 THE WITNESS: Can you be more specific?
14 Because you're asking, again, in abstract way
15 of -- I guess that's an abstract way question,
16 similar to what I'm teaching. Can you repeat
17 the question?

18 **Q. (By Mr. Warr) Let me try -- if I can**
19 **rephrase the question.**

20 **If -- does the inductance increase as the**
21 **length of a wire increases, all else being equal?**

22 MS. LAROCHELLE: Object to form.

23 THE WITNESS: Again, not in the -- not
24 considered in '430, but just in abstract way,
25 there are different factors controlling the

1 amount of inductance.

2 So if you try to design an inductor, and
3 even in 2000 there were a lot of quasi-static
4 design tools to do that.

5 But typically you consider three main
6 parameters. One parameter is the number of
7 turns. So typically whenever you have more
8 turns, you have a larger value of inductor.
9 That's factor number one.

10 **Q. (By Mr. Warr) Can I interrupt you just**
11 **there? When you say increase the number of turns, so**
12 **we have a clear record, when you use the word "turns,"**
13 **what are you referring to?**

14 A. There are different configurations of
15 inductors. One could be a single loop. There are
16 inductors as well with different number of loops. And
17 there are different configurations of these.

18 There are configurations where you could
19 have some external loop then connected to some
20 internal loops. For example, similar to what's given
21 in Exhibit 1008 of Raghaven or -- and in this case,
22 for example, you could have loops embedded to one into
23 another, tied, combined different ways. So that's one
24 configuration.

25 There are other configurations where you

1 have different shapes, like serpentine and all of
2 these.

3 But I would say consideration number one
4 has to do with the number of the -- of the loops. So
5 you could have an external loop, and then you could
6 have more loops, one within the other. That's
7 consideration number one.

8 Consideration number two, to answer your
9 question, because the answer is not so simple,
10 otherwise everybody would have the perfect inductors.

11 Consideration number two is something we
12 call the quality factor of your inductor. And as
13 everybody knows, no inductor is perfect. No matter
14 how good your process is, no matter whether you
15 utilize the cleanest possible process with very low in
16 the normative gate size, still you are having limiting
17 factors to how close to ideal an inductor is.

18 For example, the value of inductance you
19 asked before, one factor is the number of loops. The
20 second factor is how much this value is reduced by
21 parasitic capacitance.

22 **Q. How much --**

23 **A.** How much this inductance value, the
24 effective inductance value is affected by parasitic
25 capacitance.

1 **Q. When you say parasitic capacitance, how**
2 **are you using that term? How do you define that term?**

3 A. I believe I have defined this in my
4 declaration. Give me a second to open this up.

5 So in paragraph 243 that -- I have
6 stressed this issue. I stress that "Ooi explains that
7 the quality factor of an on-chip inductor is seriously
8 affected by three major components, crossover
9 capacitance, capacitive coupling, the capacitance
10 between the spiral and the substrate, and then the
11 substrate capacitance."

12 So -- and that was -- I mean, this
13 capacitive effect was one of the reasons for the
14 introduction in 1998 by a group in Toronto of
15 symmetrical spiral inductors.

16 And that's what I have stressed in 243
17 paragraph on my declaration saying that "For the same
18 inner dimension, width, spacing, and number of turns
19 of a spiral inductor, the symmetrical spiral inductor
20 needs one less overlap than the traditional,
21 non-symmetrical spiral inductor. And as such, the
22 capacitance caused by the overlaps will be 1/n times
23 smaller than that in the non-symmetrical spiral
24 inductor."

25 And the reduction in capacitance utilized

1 in symmetrical inductors results in enhancement of the
2 overall quality factor.

3 So I was actually physically present in
4 '98 when they announced that at the IPP International
5 Symposium. They're the first, let's say, symmetrical
6 inductors.

7 And this capacitance, if you think in
8 practice this capacitance effectively reduces the
9 inductance. So it makes you having or required to
10 have more turns, larger area, and more difficult to
11 place it in some circuitry.

12 That was factor number two. And the
13 quality factor also involves not only the capacitance,
14 as I covered before, the three capacitive factors, but
15 also includes the impact of the finite conductivity of
16 the conductor you utilize.

17 So most of the times utilize copper.
18 Lately, and I would say after '95, people started
19 testing as well gold and silver. But I'll say the
20 majority of the practical commercial systems utilize
21 copper.

22 And copper conductivity, 5.8 by 7 siemens
23 per meter, causes significant loss of power.

24 So if you think in terms of an equivalent
25 circuit of inductor, and that's what you have to

1 utilize to optimize the effective value of inductance
2 you asked me in the beginning, the equivalent circuit
3 will have an inductor, a capacitor, and a resistor.

4 And that's exactly what's the equivalent
5 circuit as well of the -- of the loop antenna if you
6 look at the references.

7 So first parameter for the overall
8 inductance value, the number of turns, number two is
9 the quality factor, Q. And the third factor has to do
10 also with the frequency of operation and also the --
11 the size.

12 So typically trying to find the overall
13 value of an inductance is not a very straightforward
14 case. And that's why people are utilizing simulation
15 tools. There being -- at the time of '430, even if
16 you look at my CV, were very heavily involved in
17 embedded passives because I was participating in the
18 Package and Research Center. They are National
19 Science Foundation, Package Research Center of Georgia
20 Tech, which was exactly focusing on optimizing, as we
21 called, passives.

22 And inductors was one of the major focal
23 points of my effort, since it is very well known in
24 inductors are bulkiest passives, pretty much on every
25 RF circuit tree.

1 Now, there is a third parameter, as I said
2 in the beginning, and the third parameter that control
3 the overall inductance of an inductor or a loop
4 antenna -- that's used interchangeably. But the third
5 parameter is the presence of magnetic materials
6 nearby.

7 So I remember in '99 or 2000 when we were
8 analyzing loads of, let's say, cell phones
9 applications or applications enabling, I would say,
10 the first commercial gadgets above 1.9 gigahertz. We
11 saw that more and more people were utilizing ferrites.
12 So --

13 **Q. Were utilizing? Pardon me?**

14 A. Ferrites, ferrites, magnetic materials.
15 Like iron oxide or something similar to this one.

16 So to increase the inductance or decrease
17 the inductance, there are different tricks you may
18 apply. Tricks having to do, as we said, with the
19 number of tests. That was the easiest one, but in a
20 sense that was the more brute force.

21 Number two was the quality factor base.
22 So you had to come up with topologies, mostly
23 symmetrical, I would say, after '98.

24 And the third one was the game of cost and
25 ferrites because if you were laying the inductor on

1 top of a ferrite or a ferritic layer on top of some
2 semiconductor die, then you could have a very high
3 inductance for a very small number of loops.

4 So different tricks. That really depended
5 on what was available, how would you like to treat the
6 cause, how would you like to treat the application as
7 well.

8 **Q. It sounds like you have Exhibit 1003, your**
9 **declaration, open on your computer; is that correct?**

10 A. That is correct.

11 **Q. Okay. Did you prepare that declaration**
12 **yourself?**

13 A. I prepared -- the declaration reflects my
14 technical opinion. The first draft of the declaration
15 was developed in conjunction with the attorneys, who
16 did mostly the fonts, the structure, and they provided
17 some information about the legal terms because I'm not
18 a lawyer.

19 So I have become familiar with some of
20 these terms. But this declaration reflects my
21 technical opinions and only my technical opinions.

22 **Q. If I can direct your attention, please, to**
23 **paragraph 31 on page 16.**

24 A. Give me one second. You said the
25 paragraph 31?

1 Q. 31 on page 16.

2 A. Okay. Yes, I have it in front me.

3 Q. Okay. Directing your attention to the
4 last sentence above the two figures there or the
5 figure there, you talk about the magnitude of the
6 coupling depends on the geometric dimensions of both
7 loops in relation to one another and the magnetic
8 properties of the medium.

9 Do you see that?

10 A. Yes, I do.

11 Q. And it's your reference to the --

12 A. Finkenzeller.

13 Q. Pardon me?

14 A. That's Finkenzeller. Reference is one of
15 the most commonly used references.

16 Q. Do you have an understanding -- the
17 reference to properties of the medium, does that mean
18 the material that is used to make the loop?

19 A. There --

20 MS. LAROCHELLE: Object to form.

21 THE WITNESS: So talking about the medium,
22 and this was just a schematic. An example here,
23 very generic one, with the conductor loop with
24 area A2 and area A1. Again, that's an abstract
25 one talking about the physical principle.

1 When I refer to the term magnetic
2 properties of the medium, depend on environment
3 could mean a couple of things.

4 So one thing has to do the presence or
5 lack of presence of magnetic material I referred
6 before, like a ferrite.

7 So capacity is well known of ferrites
8 increases the effective magnetic permeability of
9 the system and can narrow the spread of the
10 magnetic lines. And also ferrite beads are
11 commonly utilized to shield closely spaced
12 coils.

13 I would say that has been the way that
14 inductors in the old-style radios were shielded
15 from one another utilizing ferrite beads or
16 ferrite layers isolating one from the other.
17 And that's how you could treat and so on.

18 So one way you could think of the medium
19 is this one, the presence or lack of presence of
20 magnetic materials. And that's the main
21 parameter because magnetic materials are the
22 ones affecting very drastically the density of
23 the magnetic lines and also the concentration of
24 the overall magnetic field specific directions.

25 So that's the main parameter, I would say.

1 And not only for the medium in between the two
2 loops. That's why I said it's not only the
3 medium in between the loops but also the
4 presence or lack of presence of a magnetic
5 material as a substrate of the coils.

6 As we said before, one of the most common
7 considerations for the inductance determination,
8 for the effective inductance value determination
9 is the use of magnetic films under or above the
10 coil. So that was what I meant by the
11 properties the medium.

12 **Q. (By Mr. Warr) And in that same sentence,**
13 **the reference to geometric dimensions of both loops,**
14 **does that refer to the physical size and shape of the**
15 **loops?**

16 MS. LAROCHELLE: Object to form.

17 THE WITNESS: Talking, again, in general
18 about the magnetic coupling, describe the
19 magnetic coupling physically described in 31 so
20 detected by ampere. You refer to the dependence
21 of the magnitude of the coupling flux on the
22 geometrical dimensions of both loops to one
23 another.

24 Now, we're talking about geometrical
25 dimensions means that -- again, many different

1 things. One thing has to do with the dimensions
2 of the loops comprising the inductor as a
3 function of the frequency of operation.

4 So keep in mind, especially in
5 electromagnetics, and that's something I always
6 stress in my first class with my CE 4350 class.
7 Whenever we refer to geometric dimensions of
8 some electromagnetic structure like the loops,
9 we effectively refer to electrical lengths and
10 how they translate to a fraction of wavelength
11 to the frequency of operation.

12 So whenever they use the term geometric
13 dimensions, whenever Finkenzeller uses this
14 term, he means the dimensions of the loop
15 expressed in electrical lengths for the
16 frequency of operations.

17 So it's something really important. If
18 you talk about geometric dimensions of a loop or
19 inductor without giving a reference to the
20 frequency, that's absolutely useless.

21 But talking about the geometrical loops,
22 the geometrical dimension expressed as fractions
23 of electrical length, that is one of the --
24 that's one of the set of dimensions affecting
25 the coupling.

1 And I'm saying that because this is
2 actually the foundation of electromagnet factors
3 working in different frequency.

4 In 2000 one of the biggest challenge was
5 to start spreading the upper frequencies to much
6 higher frequencies than before. So initially
7 all the major companies, what they did was they
8 got some of their inductors. They just utilized
9 the same dimensions, or they utilized some
10 quasi-static solvers to migrate to different
11 substrates.

12 So, for example, going from a PCB
13 substrate to a -- some silicone or gas
14 substrate.

15 And then the most important thing they
16 forgot was anytime you do that, the only thing
17 you have to do is scale your dimensions. So
18 talking about geometrical dimensions of both
19 loops, one set of dimensions, as we said, is
20 geometrical dimension of the loops scaled to
21 electrical length fractions for the frequency of
22 operation.

23 Number two set of dimensions included in
24 this is possibly the spacing of the turns. So
25 you could say how wide these conductors would

1 be.

2 Pretty much everybody knows that the
3 narrower you make some conductor, the more
4 difficult it is for the charges to move and the
5 current goes down.

6 So the second set of geometrical
7 dimensions had to do with the spacing of the
8 loops, and the third set of geometric dimensions
9 had to do, again, with dimensions of your
10 package. And also the dimensions of the
11 mounting structure.

12 Unless you utilize mams [phon.] loops that
13 are realized on membranes, all have to be placed
14 on top of some substrate. This is required. I
15 would say especially for the loops. Unless you
16 utilize the very old generation of loops. We
17 utilized, for example, for the ships I saw
18 before, they were just wires.

19 But you have to -- now, for most of the
20 commodities, then you have to mount them on a --
21 on a substrate. And there's a variety of
22 substrates that loops, loop inductors or loop
23 antennas can with be realized onto.

24 **Q. (By Mr. Warr) Dr. Tentzeris, can I direct**
25 **your attention, please, to paragraph 53 of your**

1 declaration. It starts on page 31.

2 A. 53, yes.

3 Q. In this paragraph you're discussing the
4 prosecution history of the application that led to the
5 '430 patent; correct?

6 A. That is correct. I would say the
7 technical points of the prosecution. As I said, I
8 could not understand the legal terms. So that is the
9 technical points of the prosecution.

10 Q. Fair enough. And in paragraph 53 you
11 refer to a reference FR-Acher; correct?

12 A. That is correct.

13 Q. If you go down to the top of page 32
14 towards the end of paragraph 53, there's a sentence
15 that reads, "Notably, applicant, P0, did not contend
16 that the antenna of FR-Acher is not an inductor and
17 thus tacitly acknowledged that an antenna that
18 produces magnetic flux when current is applied to it
19 or that actuates in the presence of magnetic flux is
20 an inductor."

21 Do you see that sentence?

22 A. Yes, I do.

23 Q. And what did you mean with the phrase
24 "tacitly acknowledged"?

25 A. I mean -- and that was my technical

1 opinion, and that's how a person of ordinary skills
2 will translate this -- that the antenna given in this
3 reference the Acher -- give me one second because my
4 Adobe froze. So give me a second.

5 So the Figure 4 -- the antenna, the figure
6 eight antenna shown in Figure 4 of FR-Acher and
7 actually the second antenna with an eight shape
8 winding is an antenna in the vicinity of a single-loop
9 antenna, through which -- and alternate in magnetic
10 field.

11 So based on how I read it, the EP -- the
12 EP examiner found that the second antenna 32 actuating
13 an alternative magnetic field and made it by an
14 inductor.

15 Now, you have a magnetic field. You have
16 an antenna 32, which intercepts magnetic flux created
17 by the antenna 30. And this is quite similar, I would
18 say identical, to what's given in the '430 patent when
19 in column you see -- column five, line eight, radiated
20 infield from the first inductor and then the second
21 inductor has EM field receive sensitivity. That's
22 exactly the same.

23 So whenever I -- I discussed about the --
24 again, that's 53. So whenever I said tacitly
25 acknowledge that the antenna is an inductor, I just

1 stress that an antenna that produces magnetic flux
2 when current is applied with or actuate in the
3 presence of magnetic flux is an inductor, as clearly
4 shown in both Acher and also in Patent '430.

5 It's the same physical effect where you
6 have radiation of magnetic flux and receiving of
7 magnetic flux.

8 But in my opinion whenever you have this
9 reference in '430 I referred to for radiated EM field
10 from the first inductor and received EM field from the
11 second inductor, and then in Acher where you have one
12 antenna, the antenna 30 transmitting similar to
13 magnetic field, and the figure eight 32 antenna
14 receiving this, this is the same physical effect.

15 So they are -- no matter the term
16 utilized, it's the same component. Now, if we call it
17 inductor, if you call loop antenna or figure eight
18 antenna is the same one. So inductor and loop antenna
19 are both inductors.

20 **Q. I might have misspoke earlier in my**
21 **question. I suggested that you were discussing**
22 **prosecution that led to the '430 patent. I think that**
23 **was an error. You're talking about the prosecution of**
24 **EP3567614; correct?**

25 **If you need to go to paragraph 49 for**

1 **reference, that's what I'm looking at, sir.**

2 A. 49. Yes. So 3567614, reading the
3 description of and the claims of this patent, they
4 were similar to -- they were quite similar to the
5 patent '430.

6 And that's why I -- I came up with this
7 conclusion. So there was a single independent claim
8 at 3567614 talking about the radiofrequency
9 transceiver comprising the first inductor, which is
10 substantially symmetric about a symmetry axis, first
11 inductor comprising terminals, first loop, second loop
12 where the first loop and the second loop are arranged
13 such that the current of the first loop travels in the
14 direction that is opposite to the current in the
15 second loop such that electromagnetic field components
16 emanated from the first loop also have opposite
17 directions and tend to counteract each other and where
18 the terminals are connected to the second loop.

19 Now, going back to '430 and reading the
20 claim of -- the claim number one, again, you have an
21 inductor layout where you have a first inductor having
22 a reduced far field, first loop having a shape that is
23 substantially symmetrical about the first predefined
24 axis and a second loop connected to the first loop,
25 second loop having a size and shape substantially

1 identical to the first loop. Second loop arranged
2 such that the magnetic field emanating therefrom tends
3 to cast a magnetic field emanating from the first
4 loop.

5 So getting back to paragraph 53 and the
6 patent EP3567614, reading the claim of '67614, you see
7 a first inductor. So you have an inductor. We'll
8 just call it the first inductor. That's substantially
9 similar about the symmetry axis. You have two loops,
10 a first loop and a second loop, arranged that the
11 current in the first loop travels in a direction
12 opposite the current in the second loop. That means
13 an inductor with two loops in figure eight
14 configuration.

15 And the second loop have opposite
16 directions that tend to counteract each other, which
17 means that the magnetic field is to opposite
18 directions. Wherein the first loop is connected to a
19 second loop.

20 So it's clearly an inductor composed by
21 two loops, two loops that are run from opposite
22 currents. And two loops -- and I'm referring to the
23 EP patent, claim one.

24 So you have you two loops run by two
25 currents going to opposite directions, creating

1 magnetic fields in opposite directions.

2 So that's what's happening here. You have
3 a figure eight loop. And the Acher one is a figure
4 eight antenna. This is a detection device which
5 includes a single-loop antenna 30, which meets a
6 magnetic field, and then a second antenna, 32, again
7 composed of two loops connected to each other
8 substantially symmetrical over one axis with current
9 going to opposite directions for the two loops,
10 canceling the overall magnetic field.

11 So 32 actuates in an alternative magnetic
12 field. And the EP patent was, again, a figure eight
13 utilizing exactly the same physical mechanism.

14 Now, this conclusion that the -- let me go
15 back to 53. The conclusion of 53, and that's my
16 technical opinion, that P0 did not contend that the
17 antenna was of Acher is not an inductor was something
18 that the P0 did not contend was because the two figure
19 eight structures, one, the structure in the European
20 patent and the antenna 32 in Acher produced magnetic
21 flux when current was applied to it, and actuates in
22 the presence of magnetic flux on an inductor.

23 So this was a generic conclusion,
24 depending on the similar structures, similar current
25 flow, similar number of interconnected coils to cause

1 interconnecting with opposite current flux.

2 And, in general, loop antennas. So same
3 features, same geometry, same operation.

4 Now, even with differences between the
5 '430 and the European patent one, and I really thank
6 you for pointing to my initial typo. So even with
7 minor differences, this one does not change the fact
8 that you have a two-coil inductor, and you have a
9 figure-eight antenna that can be considered identical.

10 And they produce magnetic flux when
11 current is applied to them or actuate in the presence
12 of magnetic flux.

13 **Q. Is it your understanding that the claims**
14 **in EP3567614 are identical to the claims in the '430**
15 **patent?**

16 MS. LAROCHELLE: Object to form.

17 THE WITNESS: As I said before, my
18 conclusion given in paragraph 53 is based on the
19 fact that you have in the European patent an
20 inductor made by two coils run by current in
21 opposite directions substantially symmetrical
22 over an axis. And that's the same thing for
23 Acher.

24 So they are independent of the fact of
25 having identical claims, and I cannot recall the

1 exact claims from the EP patent. I -- I have
2 expressed technical opinions for the claims I
3 discuss here and the fact that the structure in
4 European patent claim one is a figure eight
5 inductor, and the structure in Acher is a figure
6 eight antenna, loop antenna. Do not depend on
7 claims being ideal or similar. They just depend
8 on the technical fact that you have a coil
9 antenna in the European patent and you have a
10 two-coil antenna, European patent, two-coil
11 antenna in Acher.

12 One is calling it an inductor. The other
13 is calling it a figure eight antenna. They have
14 the same characteristics. They're the same
15 features. And thus the figure eight antenna
16 term could be used interchangeably with some
17 inductor of the generic form given in European
18 patent or in any other patent on the same field.

19 **Q. (By Mr. Warr) Do you know whether the**
20 **Acher reference was directed to a noncontact**
21 **communication device?**

22 MS. LAROCHELLE: Object to form.

23 THE WITNESS: For this reference is -- I
24 have to stress that that's why I have not
25 expressed some detailed technical opinion in my

1 declaration. I skimmed through these
2 references, and I focused on the most important
3 points that I list in my declaration.

4 Now, I focused on the physical effect, and
5 the more important point in my opinion was the
6 use of these two antennas.

7 Now, in terms of the application, you may
8 have to give me the opportunity to review
9 thoroughly this reference. I cannot recall the
10 details. I mean, it's been almost a year, and
11 the -- in my opinion the main point was they
12 were on -- so, like, in Figure 4, I cannot
13 recall the application.

14 If you would like to give it to me to
15 review now, that will be fine, but I cannot
16 confirm or refute what you're saying.

17 We like to have quick break, five-minute
18 break?

19 MR. WARR: You must have been reading my
20 mind. I was just going to ask how you were
21 getting on. This does not have to be a
22 marathon. If you'd like a five-minute break,
23 that's fine.

24 THE WITNESS: Thank you so much.

25 MR. WARR: Okay.

1 THE WITNESS: Be back in five minutes.

2 Thank you.

3 (Deposition in recess, 11:01 a.m. to
4 11:06 a.m.)

5 Q. (By Mr. Warr) Did you speak with anybody
6 during the break about your testimony?

7 A. Nobody.

8 Q. Do you agree that the '430 patent is
9 directed to reducing mutual electromagnetic coupling
10 between inductors implemented on a semiconductor chip?

11 MS. LAROCHELLE: Object to form.

12 THE WITNESS: Let me -- asking me
13 independent claim one, '430 claims an inductor
14 layout having reduced mutual electromagnetic
15 coupling comprising the first inductor having a
16 reduced far field said first inductor comprising
17 the first loop having the shape that is
18 substantially symmetrical about the first
19 predefined axis. The second loop connected to
20 the first loop, said second loop having the size
21 and shape substantially identical to the first
22 loop, said second loop arranged such that the
23 magnetic field emanating therefrom tends to
24 cancel the magnetic field emanating from the
25 first loop to closely spaced terminals connected

1 to the first loop will supply an electrical
2 current to the first and second loops while
3 minimizing magnetic field contributions from the
4 terminals in the second inductor position at a
5 predetermined distance from the first inductor
6 wherein the mutual electromagnetic coupling
7 between the first inductor and the second
8 inductor is reduced as a result of the inductor
9 having a reduced electromagnetic field.

10 So this is the main point of the
11 independent claim one. There is a dependent
12 claim about claim two, the inductor layout
13 according to claim one wherein said first
14 inductor and said second inductor are formed on
15 a single semiconductor die. That's my
16 understanding.

17 **Q. (By Mr. Warr) That's your understanding**
18 **of the subject matter of the '430 patent?**

19 MS. LAROCHELLE: Object to form.

20 THE WITNESS: That's -- let me go back.
21 Give me one second. Once again it froze.

22 MS. LAROCHELLE: I'll just make sure my
23 form objection is on the record. Thank you.

24 THE WITNESS: So it's giving me the
25 abstract of '430. '430 discloses a method and

1 system for reducing mutual coupling between
2 resonators and implementing the same on a single
3 semiconductor chip. The metal consistently
4 involved using inductors that are substantially
5 symmetrical about horizontal and vertical axis
6 and providing current to the inductors in a way
7 so that the exact magnetic field components tend
8 to cancel each other by virtue of symmetry.

9 In addition, two such inductors may be
10 placed near each other oriented in a way so that
11 they use current in the second inductor due to
12 the magnetic field originating from first
13 inductor is significantly reduced. And
14 inductors could have multiple shapes, maybe
15 eight shaped, four-leaf clover shape, single
16 turn, multi turn, rotated relative to one
17 another and/or vertically opposite related to
18 one another.

19 So that's what described in patent '430.

20 **Q. (By Mr. Warr) It looked to me,**
21 **Dr. Tentzeris, that you were reading from the '430**
22 **patent when you just gave that response; is that**
23 **correct?**

24 **A. Exactly, exactly. I wanted to be**
25 **accurate. That's why I read from '430.**

1 Q. And were you reading the abstract of the
2 '430 patent?

3 A. I was reading the abstract, yes.

4 Q. If we can go back to your declaration down
5 to paragraph 61 on page 35, please.

6 A. 61 of page 35. Yes.

7 Q. And this is in the section of your
8 declaration discussing claim construction; correct?

9 A. That is correct.

10 Q. And the first -- you see the table there
11 at the bottom of the page 35?

12 A. Yep.

13 Q. The first line item as to claim 11 talks
14 about the first inductor and second inductor on a
15 semiconductor die. Do you see that, sir?

16 A. Yes, I do. That's claim 11.

17 Q. Okay. And you're looking at a claim
18 construction order from an ITC proceeding; correct?

19 A. Exactly.

20 Q. And that ITC ruling determined the
21 preamble to Claim 11 was limiting. Is that your
22 understanding?

23 A. Yes, that's my understanding. I don't
24 know the exact legal meaning of this, as I told you.
25 But I can see, and I agree with the constructions.

1 **Q. Do you agree that Claim 11 requires the**
2 **first inductor to be positioned on a semiconductor**
3 **die?**

4 MS. LAROCHELLE: Object to scope and form.

5 THE WITNESS: What I describe in Claim 11
6 is a method of reducing mutual electromagnetic
7 coupling between the first inductor and the
8 second inductor on a semiconductor die.

9 So the first and second inductor are on
10 the same semiconductor -- are on the
11 semiconductor die.

12 **Q. (By Mr. Warr) So as a person with your**
13 **academic credentials, you would read that Claim 11 to**
14 **require both the first and the second inductor to be**
15 **on the semiconductor die?**

16 MS. LAROCHELLE: Object to scope and form,
17 calls for a legal conclusion.

18 THE WITNESS: What is given on Claim 11 is
19 a first inductor and a second inductor on a
20 semiconductor die. That's what's given in
21 Claim 11, and give me one second to go back to
22 Claim 11 and '430 to confirm.

23 On a semiconductor die. So what's given
24 in Claim 1 is a first inductor and a second
25 inductor on a semiconductor die.

1 Q. (By Mr. Warr) If you can go down to the
2 next page, please, the last -- in the same table, the
3 last line item regarding the reduced electromagnetic
4 field. Do you see that?

5 A. Yes, I do.

6 Q. After having studied the '430 patent, did
7 you have an understanding of what the reduced
8 electromagnetic field was?

9 MS. LAROCHELLE: Object to form.

10 THE WITNESS: As I have related in the
11 claim -- claim construction section, this table
12 we're discussing right now, the ITC agreed and
13 adopted, said that the plain and ordinary
14 meaning applies, which is the electromagnetic
15 field emanating from the first inductor is
16 reduced at a certain distance from the first
17 inductor where the second inductor is
18 positioned.

19 So that's the ITC claim, and I -- I
20 followed that in my analysis.

21 Now, if you are asking me in an abstract
22 way, possibly I would have -- I would not
23 completely agree with this, not in the context
24 of '430. But the context of '430, I follow this
25 claim construction.

1 Q. (By Mr. Warr) I'm going to --

2 Dr. Tentzeris, I have some questions regarding the
3 Taniguchi reference, which is Exhibit 1005.

4 A. Okay.

5 Q. Do you have that open on your screen, sir?

6 A. I do. Let me go up.

7 Yes. That's the -- Exhibit 1005, isn't
8 it?

9 Q. Correct.

10 A. Okay.

11 Q. And you've studied Taniguchi in some
12 detail; correct?

13 A. Yes.

14 Q. How would you describe the teachings of
15 Taniguchi to somebody who does not have your level of
16 skill?

17 That's a really bad question. I'm going
18 to rephrase it. My apologies.

19 In your words, what does Taniguchi teach?

20 MS. LAROCHELLE: Object to form.

21 THE WITNESS: Let me point you. So as I
22 have listed in paragraph 63, overview of
23 Taniguchi, Taniguchi relates -- paragraph 64.
24 Taniguchi relates to a radio guidance antenna
25 for use in non-contact identification apparatus

1 such as physical distribution systems,
2 electronic coupon tag systems and the like, a
3 data communication method and a non-contact data
4 communication apparatus, which make use of such
5 antenna.

6 Specifically, Taniguchi presents a radio
7 guidance antenna in which the sum of mutual
8 inductances of antennas is minimized.

9 And that's the general overview of
10 Taniguchi. I have included some more details in
11 the paragraphs 65 and below, adding some details
12 about the layout of transmission loop antennas
13 aiming for the sum of mutual inductances of
14 antennas to be small, given in paragraph 69, as
15 well as stressing the use of substantially
16 figure-eight shapes and discussing three
17 different layouts, three different orientations
18 of the antennas in Taniguchi. And that's in
19 paragraph 69 and below.

20 So Taniguchi is talking about, in a
21 nutshell, it's talking about two loop antennas
22 similar to what we discussed before to the
23 inductors, and the target is to minimize the
24 coupling, the magnetic coupling between these
25 two transmitter antennas for a variety of

1 distances.

2 You have orientations that the antennas
3 are on the same plane or on two sides in close
4 proximity, vertical proximity, same plane, where
5 you have two antennas at horizontal proximity
6 and you have some demonstrations of some
7 potential applications or implementations.

8 So if you want to summarize in this case
9 you -- you have a patent that has a variety of
10 claims, in my opinion, and that's what I
11 expressed. My technical opinion here had to do
12 with the -- with some method to minimize the
13 cross-talk or the magnetic coupling between two
14 different antennas that can be utilized as both
15 transmitter antennas or receiving antennas shown
16 here.

17 And these -- these antennas can be
18 utilized in a variety of applications, as I
19 stressed in paragraph 64 talking about
20 noncontact identification for a very large
21 variety of form factors.

22 You could see form factors ranging from
23 physical distribution systems to electronic
24 coupon ticket systems or -- and then a variety
25 of distances between the antennas. So what's

1 happened here is you have a technique here that
2 can be utilized for different form factors going
3 from large to very small.

4 And you will have capacity stress in the
5 abstract radio guidance antenna, which means you
6 have antennas that you can control the null and
7 the picks. So talking about radio -- the nulls
8 and the picks.

9 So typically whenever of you have the term
10 of radio guidance antenna and in general when
11 you have antennas, you can choose distances,
12 angles, orientations that you can zero out the
13 wave and you can enhance.

14 So in reality what's happening in
15 Taniguchi's, you have a way of utilizing two
16 antennas at a distance ranging from literally
17 microns to meters that you can -- you minimize
18 the magnetic coupling between.

19 And there are other features. So I don't
20 want to spend time on this. Just -- but give
21 you a very brief listing of this. You have
22 figure-eight antennas that are substantially
23 symmetrical. You have antennas with variable
24 amount of reduce magnetic coupling. You see
25 values of reduced magnetic coupling from a lot

1 of these pretty much. And you even have cases
2 of complete nulling, of complete elimination of
3 magnetic coupling in some of these cases. So
4 here.

5 **Q. In Taniguchi, does antenna one have a near**
6 **field?**

7 MS. LAROCHELLE: Object to form.

8 THE WITNESS: Can you provide me some
9 guidance about the term near field?

10 The reason I'm asking is because that's
11 something I would like to stress since we have
12 this discussion. Abstract-wise when we're
13 talking about near and far field, I did not -- I
14 don't think that '430 fits the scope of the term
15 near field.

16 So near field and far field, there are a
17 variety of definitions in general. And you can
18 find these definitions pretty much in any
19 antenna book and even in any circuit design book
20 right now.

21 But talking about near field and far field
22 and even in the claim we discussed before there
23 was nothing in the -- there was just a generic
24 form in the claim construction when it was
25 shown, like the term reduce far field.

1 The claim said -- and that was in the
2 claim construction table, reduce electromagnetic
3 field at a certain distance from the first
4 inductor. So this certain distance could be
5 anything utilizing this claim.

6 So if you could provide me some guidance
7 what you mean by near field, I would really
8 appreciate.

9 But talking about a certain distance, for
10 a far field that could be one centimeter, one
11 kilometer, one micron. So it's indefinite, in
12 my opinion.

13 **Q. (By Mr. Warr) In the context of**
14 **Taniguchi, can you determine whether antenna two is**
15 **positioned in the near field of antenna one?**

16 MS. LAROCHELLE: Object to form.

17 THE WITNESS: Can you point me to a
18 specific figure? There's a variety of --

19 **Q. (By Mr. Warr) Look at Figure 4.**

20 A. Figure 4. Okay.

21 **Q. Of Taniguchi.**

22 A. You have Figure 4. So antenna one and
23 antenna two. In Taniguchi, and, again, I -- let me --
24 give me one second once again.

25 So talking about Taniguchi, I -- in

1 paragraph 84 where I write the fact that the '430
2 patent does not provide guidance regarding the bounds
3 of the term "reduced far field."

4 And as I discuss in claim construction
5 section, in the ITC case construed the nearly
6 identical term first inductor having a reduced far
7 field of claim one as reduced the electromagnetic
8 field at a certain distance from the first inductor
9 where the second inductor is positioned. And the
10 statement from the specification of the construction
11 provide no description into where the far field may be
12 located, including because there are no bounds to the
13 distance of the field from the inductor or the loop
14 antennas we discussed before or distance of the field
15 between the inductor and position of any second
16 inductor for this limitation to be met.

17 So regardless of what the boundaries of
18 the far field may be, Taniguchi discloses this term
19 for all figures because you may consider this certain
20 distance for a far field for all these figures.

21 I mean, if you look at Figure 4, there is
22 some distance between antenna one and two. There's a
23 certain distance. So according to this construction,
24 these two elements can be considered to be in the far
25 field.

1 And the same thing if you look, for
2 example, at the detailed Figure 6C. There is distance
3 between the two antennas, which is a certain distance
4 between the top and the bottom loop.

5 Figure 7A, 7B, there is a certain
6 horizontal distance between the two antennas, one and
7 two. Figure 8C or 8B or 8A, again, there's a certain
8 distance between the two antennas.

9 So utilizing this claim construction,
10 antenna two is at a certain distance from antenna one.
11 Since there's no guidance about the scope of the
12 certain distance, I would consider this to be in far
13 field.

14 I would say Taniguchi discloses two
15 antennas in the far field, two loop antennas, two
16 inductors in the far field, one of each other.

17 **Q. I hate to bounce you back and forth**
18 **between Taniguchi and your declaration, but if we can**
19 **go back to your declaration, Dr. Tentzeris,**
20 **particularly paragraph 67, and more particularly the**
21 **figure that appears on the top of page 40 of your**
22 **declaration, which is Figure 23 from Taniguchi.**

23 A. 67 you said?

24 **Q. Yes. Paragraph 67, which rolls over to**
25 **the top of page 40 of your declaration.**

1 A. Okay. Yes.

2 Q. And you see Figure 23 there; correct?

3 A. Figure 23 with the red lines, yes.

4 Q. Does Figure 23 show one way to combine two
5 antennas to create a more complex magnetic field to
6 increase the communication probability with the tags
7 211, 212, and 213?

8 MS. LAROCHELLE: Object to form.

9 THE WITNESS: Give me one second.

10 That's -- that's the -- one of the effects
11 shown in Figure 23. So what is shown here as is
12 stressed also in Taniguchi, to achieve these
13 effect, the mutual coupling between the antennas
14 220 and 221 has to be minimized.

15 As it's stressed in Taniguchi, one of the
16 main points of this patent is typically when you
17 have the Figure 23 orientation, you have some
18 magnetic lines or magnetic field from one
19 antenna, let's say, transmission 221 radiated --
20 providing additional transmission to 222.

21 So one of the issues is, unless you are
22 very careful, and that's given in paragraphs,
23 let's say, ten and 11, and that's what I tried
24 to stress in my declaration is, unless you have
25 minimized the mutual coupling between 221 and

1 220, some of the magnetic lines of 220 will be
2 wasted to inducing an electro motor force of 221
3 effectively reducing the magnetic field of 221.

4 So pretty much that confirms what I told
5 you before, that the main target of Taniguchi is
6 to find a way or to propose a way that the
7 magnetic coupling between the two antennas, 220
8 and 221 will be minimized or reduced at a
9 certain distance.

10 And obviously there's a certain distance
11 between the centers of 220 and 221. So
12 Taniguchi provides a technique to reduce
13 significantly the magnetic coupling between
14 these two antennas, a/k/a the number of magnetic
15 lines from one coil to the other coil, from coil
16 220 to coil 221, and this way will lead to a
17 more efficient system. So you're not going to
18 waste lots of power.

19 So Figure 23 pretty much confirms what we
20 said before, that Taniguchi aims in reducing the
21 coupling between two coils, between two
22 inductors in proximity in order to enhance the
23 efficiency of the system. So --

24 **Q. (By Mr. Warr) And when you say efficiency**
25 **of the system, are you referring to the ability of the**

1 **antennas to communicate with the tags that are**
2 **depicted in Taniguchi's Figure 23?**

3 MS. LAROCHELLE: Object to form.

4 THE WITNESS: I refer to the ability of
5 the inductors or loop antennas to perform their
6 function without wasting power or without
7 detrimental effects from one to another.

8 There is a demonstration here of one
9 potential application and just one demonstration
10 of this optimized placement of two inductors
11 close to each other, two coils close to each
12 other, and for this embodiment there's a
13 discussion about communication with tags.

14 I mean, this one could be very different
15 case. You could have two filters. You could
16 have two wireless harvesters, lots of different
17 applications.

18 As we show here, Taniguchi deals with a
19 whole slew of different applications.

20 I would say my opinion is -- and that's
21 why I expressed my technical opinion of this is
22 the main port of this figure is very similar to
23 what's given in patent '430. You have two
24 coils. You have two loop antennas at a certain
25 distance one from the other.

1 And unless you are very careful, unless
2 you come up with a technique to reduce the
3 magnetic coupling between them, the system that
4 will rely utilizing those two inductors will
5 start suffering performance-wise because they'll
6 require more power, maybe they will shift in
7 frequency, maybe you will have breakage and so
8 on.

9 So 101 and 103, they address the same
10 problem, which means we --

11 **Q. (By Mr. Warr) When you say 101 and 103,**
12 **what are you talking about?**

13 A. I said '430 and Taniguchi. So that's what
14 I -- because I see on my PDF with the number of the
15 exhibits, that's why.

16 **Q. Okay.**

17 A. So they address the same problem. So you
18 have inductors or loop antennas placed close to each
19 other, and you have to find ways to minimize, if not
20 reduce dramatically, the coupling for -- to allow them
21 to perform their functions as they are designed.

22 **Q. Do you have Exhibit 1005 open, Taniguchi?**

23 A. Yes, I do.

24 **Q. Could you go to Figure 3, please.**

25 A. Figure 3. Okay. It's there.

1 Q. And from your declaration I took away that
2 the embodiment of Taniguchi shown in Figure 3 is
3 consistent across the various embodiments of
4 Taniguchi, i.e., the same plane or the co-planer
5 embodiments; is that correct?

6 A. That --

7 MS. LAROCHELLE: Object to form.

8 THE WITNESS: -- and got a bit confused.

9 Q. (By Mr. Warr) Okay. Let me back up a
10 little bit. Figure 3 shows two antennas; correct?

11 A. Yes. Two -- I would say, so, two loop
12 antennas or inductors.

13 Q. Okay. And in Figure 3, are those two loop
14 antennas formed on the same plane? Do you know?

15 MS. LAROCHELLE: Object to form.

16 THE WITNESS: I have to go back and check.
17 Just give me one second.

18 Q. (By Mr. Warr) Well, before you -- we'll
19 come back to that in a little bit, Dr. Tentzeris, as
20 we go through the figures.

21 In Taniguchi, is antenna two connected
22 electrically with antenna one?

23 A. No electrical connection here based on
24 some details in Figure 6, Figure 7, or Figure 8, there
25 is no electrical connection between these two

1 antennas.

2 Q. If I can direct your attention to -- 6,
3 since you just mentioned it, do you have that up in
4 your screen, sir?

5 A. You broke off. Can you say that again?

6 Q. Yes. I'm sorry. Can we go to Figure 6,
7 since you just -- of Taniguchi since you just
8 mentioned --

9 A. Yes, yes, yes.

10 Q. And you have that up on your screen?

11 A. Yes.

12 Q. And does Figure 6 show a layer of
13 insulation separating antenna 101 and 102 -- excuse
14 me -- antenna one from antenna two?

15 MS. LAROCHELLE: Object to form.

16 THE WITNESS: From what is shown here, you
17 have antenna one being on one metallization
18 layer, then ten is an inductor. And antenna two
19 is at the second layer of metallization on the
20 other side of the inductor.

21 Q. (By Mr. Warr) In Figure 6 is it your
22 understanding that what is in Figure 6D, what is
23 labeled ten is a layer of insulation separating
24 antenna one and antenna two?

25 MS. LAROCHELLE: Object to form.

1 THE WITNESS: Let me double-check.
2 So that's an insulator, if I am correct.
3 That's an insulator, the way it's described. So
4 the substrate ten -- and let me read more in
5 this Figure 6.

6 That's a plate-shaped insulation 10.
7 That's what's described in paragraph 67 of
8 Taniguchi. So there is an insulating layer.
9 That's correct.

10 **Q. (By Mr. Warr) And, again, looking at**
11 **Figure 6A through E, it shows antennas one and two as**
12 **overlapping each other; correct?**

13 A. Can you define the term overlapping?
14 Because these are -- these are some generic
15 schematics. So relative dimensions are not
16 represented here.

17 For example, if you look at 6D, the sizes
18 are different. The way I look at this is you have one
19 antenna, for example, like the antenna on Figure 6B,
20 which has two loops. And that's substantially
21 symmetrical over an axis. You have, like, two halves,
22 so the two loops are substantially similar in size and
23 area.

24 And you have an orientation of an antenna
25 given in Figure 6B that the currents run in opposite

1 directions of the bottom and the top loop producing
2 some cancelling magnetic field.

3 So that's what you would exclude from
4 Figure 6B, which is the antenna you want to minimize
5 the interference of.

6 And you have two terminals, close the
7 space. So now the relative size between the top and
8 the bottom antenna is -- is an open-ended question.
9 So --

10 **Q. When you say the top and the bottom**
11 **antenna are you referring to antenna one and antenna**
12 **two?**

13 A. Exactly. Sorry for doing that. So the
14 antennas from Figure 6B and Figure 6E. So the
15 relative size of these two antennas is -- is quite
16 generic.

17 So you're going to have similar sizes,
18 different sizes. That really depends on the
19 application. I mean, the only -- I would say the main
20 feature you can see here is just the fundamental
21 features of Figure 6B, which is the potential source
22 of magnetic coupling.

23 And that's what we said, having to do with
24 the number of coils, the symmetry, the fact that they
25 are two halves, the two close-in-space terminals and

1 the opposite running current. I would say that's --
2 that's what I would take out of this as a person of
3 ordinary skills.

4 **Q. Can I ask you to go up to Figure 5,**
5 **please, of Taniguchi.**

6 A. Figure 5. Okay.

7 **Q. And is Figure 5 a more rudimentary**
8 **depiction of what's shown in Figure 6A through E --**

9 MS. LAROCHELLE: Object to form.

10 **Q. (By Mr. Warr) -- as far as the**
11 **orientation of antennas one and two?**

12 A. Again, that's a very generic expression
13 because if you go to Figure 5 and go to the
14 description of Figure 5 -- let me go up.

15 So in Figure 5, the whole point of this is
16 showing the state -- paragraph 65 of Taniguchi.
17 Figure 5 shows the state in which many lines of
18 magnetic flux make interlinkage with different tags
19 and lines of magnetic flux make interlinkage with tag
20 212, which has been put in this state of favorable
21 communication with antenna one and exceedingly weak.

22 So whenever you look at Figure 5, what I
23 would take out was there are two -- two antennas.
24 Antennas, antenna one and antenna two, and, again, the
25 information I would exclude is just the information of

1 having one antenna which is made out of two loops,
2 like a figure eight antenna. That's the antenna one.

3 And you have a second antenna, a second
4 loop antenna or a second inductor, two, that is placed
5 in a configuration of the same plane or parallel
6 plane. That's what I would exclude out of this
7 information.

8 Now, dimensions, relative orientation, all
9 of these would depend at some more specific
10 schematics, like Figure 6, 7, or 8. Because, I mean,
11 you're asking me about orientation, and talking about
12 orientation of an inductor, as I have written in my
13 declaration, again, it's a term that's not defined in
14 '430.

15 There is reference to orientation, but
16 there is no specific definition of orientation, and
17 that's how, for example, I have some sections on my
18 declaration about orientation.

19 So looking at this Figure 5, I mean, I
20 cannot give you an answer about orientation. That's
21 something to be seen by specific schematics like
22 Figure 6, Figure 7, Figure 8 where you can see clearly
23 the terminals.

24 The way I followed in my technical
25 analysis in terms of the orientation -- just give me

1 one second just to point you to the right paragraph.

2 Like in paragraph 299, that's what I used
3 as the resource --

4 Q. Pardon me if I -- you said paragraph which
5 one?

6 A. 299 of my declaration.

7 Q. Of Exhibit 1003?

8 A. Exhibit 1003. So if you could go to
9 paragraph 299, I refer to the orientation. I
10 addressed and expressed technical opinions in my
11 declaration.

12 So 299 says, "If the positioning of the
13 terminals and the direction of current flow in and out
14 of the inductor determines orientation." So that's
15 what I define orientation. Otherwise orientation
16 could take different meanings.

17 And as it is -- I tried really hard to
18 find some guidance about this term orientation in
19 '430. I could not find any.

20 So this is the common person of ordinary
21 skill orientation way, which has to do with the
22 direction of the current. This is something that's
23 typically excluded when you see the schematic of your
24 inductor.

25 And that's why I pointed you to Figure 6,

1 7, or 8. I mean, if you look at Figure 5 you showed
2 me, I cannot even see where the -- where the terminals
3 or the flow direction. So I cannot tell you anything
4 about orientation.

5 I can tell you that these two inductors or
6 these two loop antennas are placed on the same plane
7 or parallel plane, but that's all I can say.

8 Q. And in Figures 6, 7, and 8 of Taniguchi,
9 antennas one and two are on the same plane or
10 co-planer, and these figures show the antennas to
11 be --

12 A. Either on the same or in different
13 orientation.

14 Q. But they're aligned in generally the same
15 way or they could be offset, but the center of antenna
16 one is usually consistent with the center of antenna
17 two; is that correct?

18 MS. LAROCHELLE: Object to form.

19 THE WITNESS: In this case -- let me see.
20 So if you go back to my declaration, paragraph
21 163, for example, referring to Figure 7, the
22 antenna two is placed concentrically within
23 antenna one such that the two antennas share a
24 common horizontal, vertical, and z-axis. And
25 the concentric arrangement is necessary to

1 achieve zero mutual inductance between the
2 antennas.

3 And similarly, in paragraph 166 for
4 Figure 7, the inductor layout of each embodiment
5 has reduced mutual EM coupling by virtue of
6 eight-shaped configuration of the antenna, and
7 the antenna two is positioned concentrically
8 with antenna one.

9 And the same thing for Figure 8 in
10 paragraph 184. So you have a concentric -- a
11 concentric placement of the -- of the coils in
12 this case.

13 Now, one thing I have to stress has to do
14 that you have a concentric placement shown
15 there. Now, in the -- in the claims of
16 Taniguchi, there is no specific -- let me --
17 give me one second.

18 There's no listing of concentric, and
19 these are some demonstrations, I would say 6, 7,
20 and 8 to demonstrate the idea of Taniguchi. So
21 for 6, 7, and 8 you have a concentric placement
22 of these -- of these coils or these antennas.

23 **Q. (By Mr. Warr) Does that concentric**
24 **placement of antennas one and two as shown, for**
25 **example, in Figure 6 of Taniguchi have an impact on**

1 the amount of reduced mutual inductance between
2 antenna one and antenna two?

3 MS. LAROCHELLE: Object to form.

4 THE WITNESS: As I stressed in these three
5 paragraphs in my declaration, the concentric
6 placement leads to a significant cancellation of
7 mutual coupling.

8 So if you go to page -- to paragraph 163,
9 I list that the concentric arrangement is
10 necessary to achieve zero mutual inductance
11 between the antennas.

12 Now, I stress the fact of zero mutual
13 inductance. So concentric arrangement achieves,
14 theoretically, zero mutual inductance. Even if
15 you are -- even if you are slightly off
16 concentric, then utilizing a figure eight
17 antenna with symmetrical characteristics.
18 That's well-known in -- in the antenna work.

19 Then even if you are off concentric
20 placement, still that would achieve a much lower
21 mutual inductance.

22 But concentric arrangement is necessary
23 because theoretically you're going to get zero
24 mutual inductance. That would be the ideal
25 case.

1 And that's how Taniguchi has chosen this,
2 just to show that for this placement you can
3 ideally have zero mutual inductance.

4 But if you have an antenna, which is
5 figure eight, you would still have a much lower
6 mutual inductance at the predetermined distance
7 from the figure eight antenna. It would just
8 not be zero. It would be lower maybe by 20, 30,
9 40, 40B as well. So that's --

10 **Q. (By Mr. Warr) I lost part of your last**
11 **answer, Dr. Tentzeris. Could you repeat it for me,**
12 **please?**

13 A. No. What I said is concentric placement
14 of one coil, one loop on top of each other would
15 theoretically lead to an ideally zero mutual coupling.

16 So I would say that would be the best --
17 the absolutely best case scenario due to the
18 cancellation, due to coupling cancellation.

19 Now, even non-concentric placement would
20 lead -- even slightly off, would lead to some reduced
21 coupling as the figure eight coils or inductors, they
22 tend to cancel magnetic field for the two individual
23 loops, even for arbitrary placement, not on the top,
24 but even left and right.

25 So even if you had a second antenna not

1 being placed concentric, maybe placed, I would say, at
2 some other points, still the use of these figure eight
3 antennas stressed in Figure 6, 7, and 8 would lead to
4 a lower magnetic coupling, just not zero. Concentric
5 means zero, which would be the ideal case, the optimum
6 case, if you wanted to completely eliminate the impact
7 of magnetic coupling.

8 **Q. If we could go back to Exhibit 103, your**
9 **declaration, paragraph 82 starting on page 54.**

10 A. That's 82?

11 **Q. Paragraph 82.**

12 A. Okay. 82, yes.

13 **Q. And this is where you start discussing**
14 **Independent Claim 20 of the '430 patent; correct?**

15 A. Yes, that is correct.

16 **Q. And do you understand -- scratch that.**
17 **Did you also look at Independent Claims 1**
18 **and 11 of the '430 patent?**

19 A. Yes.

20 **Q. And is it true that there are similar**
21 **claim limitations as one looks at Claim 1, Claim 11,**
22 **and Claim 20? There are some differences, but there**
23 **are some common elements; correct?**

24 MS. LAROCHELLE: Object to form.

25 THE WITNESS: Looking at these claims,

1 there are some similarities. There are
2 differences. So, for example, some of them talk
3 about layout. Some of them talk about the
4 technique itself. So I would say there are
5 similarities and differences.

6 **Q. (By Mr. Warr) Looking at Claim 20 on page**
7 **54, for example, 20A talks about a first loop. Do you**
8 **see that?**

9 A. Talking about a first loop, yes. You're
10 talking about 20A, is it?

11 **Q. Correct. And Claims 1 and 11 also talk**
12 **about a first loop. And my question is did you --**
13 **does your discussion of the first loop in Claim 20**
14 **also apply to the first loop limitation in Claims 1**
15 **and 11?**

16 A. So the question, just to clarify, because
17 Claim 20 has a preamble and then three different
18 parts. So first loop having a shape substantially
19 symmetrical above the first predefined axis, a second
20 loop having the size and shape substantially identical
21 to the first loop, and then second loop arranged at
22 the magnetic field therefrom tends to cast a magnetic
23 field emanating from the first loop.

24 So you'll have a second loop and then two
25 closely spaced terminals connecting to the first loop

1 for supplying electrical current to the first and
2 second loops while minimizing magnetic field
3 contributions.

4 Let me read the other two because I have
5 to refresh. So --

6 Q. I'm not trying to make this too difficult,
7 Dr. Tentzeris. But later on in your declaration when
8 you're discussing, for example, Claim 1 you oftentimes
9 refer back to your discussion of similar claim
10 limitations in Claim 20.

11 A. Yes. So what I am saying here is, for
12 example, Claim 11 adds the limitation for
13 semiconductor die.

14 Now, in talking about the main
15 orientation -- that's why I wanted to check the
16 Claim 1 because, again, you have first conductor with
17 reduced far field, first loop having a shape that's
18 substantially symmetrical about the first predefined
19 axis.

20 The second loop connected to the first
21 loop having a size and shape substantially identical
22 to the first loop, two closely spaced terminals
23 minimizing magnetic field.

24 So up to this point, the structure of the
25 first inductor is similar to Claim 20 the way I look

1 at this.

2 Now, for the second inductor let me look
3 at the Claim 20 because it's -- so Claim 20 does not
4 refer to a second inductor, for example. Both of
5 them -- now, Claim 1, for example, is talking about
6 reduced mutual electromagnetic coupling. And then the
7 first inductor having a reduced far field.

8 I mean, Claim 20 says the whole inductor
9 has a reduced far field, quite similar.

10 And then talking about the two loops. So
11 shape, substantially symmetrical, shape substantially
12 symmetrical. Second loop size and shape
13 substantially -- second loop, second connecting -- and
14 then the other difference I would stress between
15 Claim 20 and Claim 21 is the connection of the two
16 loops. So I would say the main difference is a second
17 loop connected to the first loop.

18 I mean, I don't -- unless I missed
19 something, I don't see in Claim 20 the second loop
20 connected to the first loop.

21 Yeah, I do not see any point about the
22 connection of the first and the second loop. So
23 Claim 1 teaches the second loop connected to the first
24 loop shown here. That's mentioned for Claim 20.

25 And actually it's quite interesting

1 because, again, I feel that -- it's my opinion that
2 '430 does not teach a way to connect the second loop
3 to the first loop.

4 So, in my opinion, again, that's --
5 there's no mention of the scope of connection. I
6 mean, I could not see anything about the connection of
7 the second loop to the first loop except from the
8 listing in Claim 1.

9 I assume the connection of the -- of the
10 second loop has to do with the current flow, but there
11 is no reference, no teaching of the connection of the
12 first and the second loop. I looked all of the -- all
13 the figures.

14 And apart from Figure 2 in '430 that shows
15 two connected loops with a zigzag line, I could not
16 see anything.

17 So I would say the answer is the loop
18 description in 1 and 20 is similar with the main
19 difference on the connection of the first and the
20 second.

21 We can have a break?

22 **Q. Could you give me five or ten minutes?**
23 **There's a few questions, and then it's a natural spot**
24 **for us to break, if that's okay with you.**

25 **A. No problem. Please keep on going.**

1 Q. If we can jump down to paragraph 84 of
2 your declaration, please.

3 A. Yes. Paragraph 84, yes.

4 Q. And this is talking about that reduced far
5 field again; correct?

6 A. Exactly. That's what I'm stressing, that
7 I don't see any guidance for reduced far field '430
8 patent.

9 Q. So if -- so as I understand your
10 testimony, the '430 patent does not provide guidance
11 regarding the reduced far field claim language. Is
12 that what you're telling me?

13 MS. LAROCHELLE: Object to form.

14 THE WITNESS: I said discussed. ITC
15 construed the nearly identical term, first
16 inductor having reduced far field as reduce the
17 electromagnetic field at a certain distance from
18 the first inductor.

19 But there's no description on the site of
20 where the far field may be located because there
21 are no bounds to the distance of the field from
22 the inductor or the distance of the field
23 between the inductor and the position of the
24 second inductor for this limitation to be met.

25 But regardless of what the boundary is,

1 Taniguchi discloses this term to the extent
2 that's described in the patent specification as
3 we discussed because the second antenna, the
4 second loop antenna, second loop coil, they're
5 at a certain distance from the first antenna,
6 first coil.

7 And '430 teaches where it's to reduce the
8 electromagnetic field at a certain distance from
9 the first one at the distance that antenna two
10 is located.

11 **Q. (By Mr. Warr) So are you telling me you**
12 **were able to reach the conclusion that Taniguchi**
13 **discloses the reduced far field, even though you don't**
14 **know what the boundaries of that reduced far field**
15 **are?**

16 MS. LAROCHELLE: Object to form.

17 THE WITNESS: Reading the documents,
18 reading '430 patent, there is no guidance. And
19 then following the claim construction about the
20 reduced far field term, which means reduce the
21 electromagnetic field at a certain distance,
22 I -- it's my opinion that Taniguchi discloses
23 this term because it discloses a reduced
24 electromagnetic field at a certain distance from
25 antenna one from the loop antenna or antenna

1 one, which represents the first inductor.

2 And Taniguchi's doing that for a variety
3 of topologies where the second inductor is
4 positioned, examples of which are given in
5 Figure 6, 7, or 8.

6 **Q. (By Mr. Warr) Do you have an opinion as**
7 **to whether that boundary for the far field will vary**
8 **depending on the orientation of antennas one and two?**

9 MS. LAROCHELLE: Object to form.

10 THE WITNESS: Again, is it an abstract
11 question or a question under the patent '430?

12 **Q. (By Mr. Warr) Let me rephrase the**
13 **question.**

14 **In the context of the '430 patent, will**
15 **the boundary of the far field vary depending on the**
16 **orientation of the two claimed inductors?**

17 A. I would point you to the same paragraph,
18 paragraph 84, in the claim construction. Expressing
19 reduced -- as reduced far field, the reduced field at
20 a certain distance from the first inductor.

21 So no matter what the orientation of the
22 antennas will be, and we discussed about the issues
23 about the term orientation before.

24 I pointed you to another lack of guidance
25 about the orientation in '430 in my convention -- in

1 my report.

2 So -- but leaving that apart, again,
3 Figure 6, Figure 7, Figure 8, which shows antennas in
4 a variety of relative orientations still in all three
5 configurations, the electromagnetic field is reduced
6 at a certain distance.

7 Now, are there values of the certain
8 distance? Are there specific variations? I need to
9 know the frequency. I need to know the inductor size.
10 I need to know the -- the material of this inductor.

11 So I cannot give you an answer in this.
12 The only answer I can give is that Taniguchi teaches
13 reduced field at a certain distance from the first
14 inductor or the first loop. That's all I can exclude
15 from this.

16 MR. WARR: This is probably a logical spot
17 for a break if you're hungry. Want to take a
18 half hour or 45 minutes or hour for lunch. It's
19 purely up to you.

20 THE WITNESS: That's fine. 45 minutes.

21 MR. WARR: Come back at 1:00 Eastern?

22 THE WITNESS: Come back at 1:00, sure.

23 MR. WARR: 1:00 Eastern. Okay. Very

24 good.

25

1 (Deposition in recess, 12:14 p.m. to
2 12:58 p.m.)

3 Q. (By Mr. Warr) Dr. Tentzeris, do you
4 understand you're still under oath?

5 A. Yes.

6 Q. And did you speak with anybody over the
7 lunch break about your testimony?

8 A. Nope.

9 Q. Okay.

10 A. As I told you, there's nobody in the
11 building.

12 Q. Pardon me?

13 A. There's nobody in the building.

14 Q. Can you get Exhibit 1001, the '430 patent
15 open, please.

16 A. Okay.

17 Q. And could you go to page 12, specifically
18 Claim 1 of the '430 patent?

19 A. Page 12, yes.

20 Q. And if I could direct your attention to
21 the limitation that reads, "A first loop having a
22 shape that is substantially symmetrical about a first
23 predefined axis." Do you see that?

24 A. Yes.

25 Q. How did you interpret substantially

1 **symmetrical in that claim?**

2 MS. LAROCHELLE: Object to form.

3 THE WITNESS: First of all, as I list in
4 paragraph 108 from my declaration, so
5 it's paragraph 108 of Exhibit 1003, the '430
6 patent does not provide any guidance as to the
7 scope of the term substantially symmetrical
8 because it does not describe the boundaries of
9 substantially.

10 So, still, looking at the geometries in
11 Figure 7, same plane, 8, 9, and 10, of
12 Taniguchi, it discloses the limitation, and the
13 reason is that they utilize figure eight
14 structures as the antenna one.

15 Now, going to paragraph 99 -- let me check
16 the exact part. Please give me one second.

17 So going to paragraph 111 -- sorry for the
18 previous one -- talking about the Figure 8B for
19 Taniguchi, so paragraph 111 of my declaration, I
20 show above paragraph 111 schematic of Taniguchi
21 annotated Figure 8B to the left and the '430
22 patent which annotated Figure 2 on the right
23 from the patent under discussion.

24 And as can be seen in the annotated Figure
25 8B, conductor 102 in the first loop, that's the

1 purple loop, is symmetric about the vertical
2 axis.

3 Q. (By Mr. Warr) And by the vertical axis
4 you're referring to --

5 A. Referring to --

6 Q. -- the annotated as the first predefined
7 axis in --

8 A. I refer -- there's a horizontal line and a
9 vertical line. All of them are defined as first
10 predefined axis because both of them satisfy the
11 teaching of this claim.

12 But I refer now to the one that's parallel
13 to the terminal lines so the vertical one. This one
14 that's crossing the crossover X.

15 So Taniguchi, if you look at this one,
16 varies -- symmetry actually, it's completely
17 symmetrical with respect to the -- to this vertical
18 axis. The conductor one or two of the first loop,
19 since it's symmetrical, it's obviously substantially
20 symmetrical.

21 And then also the conductor 102, again, of
22 the lower first loop is also substantially symmetrical
23 with respect to the horizontal axis. That's the
24 horizontal purple line denoted as first predefined
25 axis.

1 Now, this is what I'm talking about
2 substantially symmetrical as -- at least in paragraph
3 112, this is -- the conductor 102 has symmetry above
4 the horizontal axis except for the presence of
5 terminals at the bottom. And that's consistent with
6 the '430 Figure 2 shown to the right.

7 So in both of these schematics, the
8 Taniguchi Figure 8B and the '430 patent Figure 2, you
9 see that there is substantial symmetry around the
10 horizontal axis except from the presence of terminals
11 in bottom.

12 And one thing I would like to stress is
13 something out of the '430 patent stating that by
14 making the two loops, 206A and 206B substantially
15 symmetrical, cancellation of a significant amount of
16 far field on either side of the horizontal symmetry
17 axis may be achieved. That's column four, lines 22,
18 25.

19 And the reason of substantial symmetry for
20 both of them for Figure 8B for Taniguchi and Figure 2
21 in '430 patent is that perfect symmetry between the
22 two loops may be difficult to achieve given the
23 presence of the terminals.

24 So consistent with the disclosure of '430
25 patent, so in light of the '430 patent regarding

1 substantially symmetrical loop conductor 102, the
2 first loop, also has a shape that's substantially
3 symmetrical about the horizontal axis.

4 So you can see here that this limitation
5 is satisfied with respect to both axis, the vertical
6 and the horizontal as it's shown in the schematics
7 above paragraph 111.

8 **Q. So you were able to reach that conclusion**
9 **without forming an understanding of what substantially**
10 **symmetrical means in claim one?**

11 MS. LAROCHELLE: Object to form.

12 THE WITNESS: As I said before, the '430
13 patent in paragraph 108 does not provide any
14 guidance as to the scope over the term of
15 substantially symmetrical because it does not
16 describe the boundaries of substantially.

17 And I came to this conclusion directly
18 comparing figures -- Figure 8B of Taniguchi and
19 Figure 2 from '430 patent featuring the same
20 form of substantial symmetry as it's shown
21 clearly here.

22 There's no scope what's substantial.
23 Nothing's told in '430. But comparing the
24 Figure 8B of Taniguchi and Figure 2 of '430,
25 substantial symmetry is demonstrated.

1 Q. (By Mr. Warr) Going back to Exhibit 1001,
2 Dr. Tentzeris, Claim 1, do you have that open on your
3 screen, sir?

4 A. Yes, I have.

5 Q. Okay. I'm going down to the next claim
6 limitation, "A second loop connected to the first
7 loop, said second loop having a size and shape
8 substantially identical to the first loop," it looks
9 like there was a typo there that was corrected after
10 issuance.

11 How did you interpret substantially
12 identical in that context of Claim 1?

13 A. Let me --

14 MS. LAROCHELLE: Object to form.

15 THE WITNESS: So, again, let me -- it
16 again froze.

17 So, again, my opinion of '430, there's not
18 anything about the scope of substantially
19 identical. Still looking at the -- Taniguchi's
20 patent on -- in paragraph 55, as I list in
21 paragraph 113 of my declaration, so going to
22 Taniguchi Exhibit 1005, paragraph 55 -- let me
23 reach that.

24 I read paragraph 55 from Taniguchi, and
25 I'm talking about the second sentence in

1 Figure 3, the first antenna is provided by
2 forming antenna conductors 101, 102 in a
3 substantially figure eight shape, which reduces
4 a remote electromagnetic field effect. The
5 first antenna one is divided into upper and
6 lower halves.

7 Now, as I explain in paragraph 115 of the
8 declaration, conductor 101 in Taniguchi, second
9 loop -- that's the orange one -- has a
10 rectangular shape with the same size as the
11 rectangular conductor 102 as shown on Figure 8B
12 we discussed before.

13 And also Taniguchi teaches that conductors
14 101 and 102 have the same size and shape,
15 describing that the first antenna is divided
16 into upper and lower halves.

17 So talking about halves, that means that
18 they have the same size and shape. That's why
19 they utilized the term halves. And this one
20 teaches substantially identical, but it's
21 utilizing the term halves.

22 So substantially identical with the same
23 shape and size. They are two halves, similar to
24 each other.

25 **Q. (By Mr. Warr) Going back to your**

1 declaration, Dr. Tentzeris, in particular starting at
2 paragraph 126 on page -- starts on page 91, the bottom
3 of 91.

4 A. Yes.

5 Q. And here you're talking about the two
6 closely spaced terminal limitations; is that correct?

7 A. That is correct.

8 Q. Looking at the claim language of the '430
9 patent relating to two closely spaced terminals, what
10 did you understand closely spaced to mean?

11 MS. LAROCHELLE: Object to form.

12 THE WITNESS: So, again, I have to use the
13 same opinion I said before about the
14 substantially, that '430 does not teach the
15 scope of the term closely spaced. So closely
16 could mean many, many different things.

17 And when I came across this term, I -- I
18 tried to understand technically how a person of
19 ordinary skills would figure that out.

20 And specifically what I -- what I saw is I
21 focused on the '430 patent annotated Figures 1
22 and 2 as well as the decision about the Japanese
23 litigation.

24 So as discussed on paragraph 136 you asked
25 me to read. The distance between looking at the

1 Figure 8B, which is the annotated figure from
2 Taniguchi, the distance between the terminals is
3 close. And that's close for all three of the
4 poles they show, Figure 7, 8, and 9.

5 So the distance between the terminals is
6 close relative to the widths of conductor loops
7 101 and 102. Clearly if you look at the bottom
8 purple loop, 102, the terminals 111 have a
9 distance that's closer than the width, which is
10 the horizontal dimension between the left and
11 the right vertical sides of the loop 102.

12 So Taniguchi's consistent with '430 patent
13 constituting the closely spaced because I noted
14 in the patent '430, and that's still in the
15 paragraph 126, Figure 1, which was the prior art
16 terminals with the spacing greater than the
17 width of inductor loop.

18 And Figure 2, which represents what's for
19 '430 had the two terminals, 204 and 205, that
20 are more closely spaced relative to the width of
21 the inductor loop than the inductor in Figure 1.

22 And this depiction is consistent with the
23 arguments also at the Japanese prosecution,
24 specifically the document 2 Einzinger that the
25 two terminals were placed at an interval greater

1 than the width of the winding loop.

2 And the configuration is the opposite of
3 the invention stated in Claim 1 of the present
4 application.

5 So considering these factors, I came to
6 the conclusion that Taniguchi Figure 8 at left,
7 the lower feeding point, provides two closely
8 spaced terminal consistent with the disclosure
9 of the '430 patent.

10 Now, I have to stress one important point.
11 In addition to what I have included in this
12 paragraph, it's very -- one of the first points
13 we stress in our class of -- for the 3000 level
14 class on microelectronics and also the 4000
15 level class I'm teaching on electromagnetic
16 fields, where you have different conductors in
17 proximity or different passives, one of the most
18 important points is put the terminals as close
19 as possible.

20 Place them as close as possible to
21 minimize the magnetic field contributions for
22 the terminals. This is -- this is important
23 characterization. The main issue is for
24 anything having to do semiconductor integrated
25 structure given PCB mounting structures, if you

1 have a significant distance between the
2 terminals, that art in a sense the two
3 conductors, inserting and removing the card out
4 of the passive.

5 So in a sense you have two conductors of
6 the same signal and the opposite side. One is
7 going in. The other is going out.

8 So the first rule we stress is place them
9 as close as possible to minimize the magnetic
10 field contributions from the terminals because
11 you'll end up with some effective inductance
12 that is very different than the inductance you
13 want to realize.

14 Same thing for a capacitor as well. It's
15 not only utilized for the inductor. Same thing
16 for capacitors sometimes.

17 So if you look at literally any paper, I
18 would say from ITP for measurements and that was
19 a very important issue in '98. I mean, when I
20 did this analysis, I considered the status of
21 the technology right then.

22 Now, one of the main challenges we could
23 see in our major conference was the big
24 difficulty imposed by these closed terminals for
25 the measurements.

1 Now, if you see all these measures you see
2 you have the passive with closed terminals to
3 each other, and then they're flaring out to
4 accommodate the network analyzer. And the main
5 reason was, despite all the limitations from the
6 measurement equipment, despite all the
7 limitations from the measurements, you had to
8 have the terminals very close to each other.

9 I've listed a textbook in paragraph 127
10 where I discuss about the minimization of the
11 magnetic field contributions from the terminals
12 due to the opposing currents flowing through the
13 wires of the terminals.

14 And this textbook is by Brooks. That's
15 published in 2003. There are a lot of books I
16 would say published after '98 textbooks being
17 utilized in most EMI/EMC classes in all the
18 universities that describe the same principle.

19 And the same principle means -- if you
20 scroll down on page 127 in the end -- I guess
21 the bottom line in paragraph 128, if the wires
22 are very close together, their EMI radiations
23 would completely cancel and would not be
24 measurable.

25 And here is one of the most basic

1 principles. If you want to minimize
2 electromagnetic interference radiation, keep the
3 signals and returns close together.

4 And that's independent of the inductor, as
5 I stressed. So any time you have passives, PCB,
6 printed electronics, semiconductor ICs, this
7 is -- whenever you want to connect an inductor
8 or any other passive, you keep the signals and
9 their returns together.

10 And that's real important for pretty much
11 most terminals for passives here.

12 **Q. (By Mr. Warr) In paragraph 126 you're**
13 **discussing the closely spaced terminals in the context**
14 **of Claim 20, and you have given a very thorough**
15 **explanation of your thinking on that.**

16 **Does your thinking apply equally to the**
17 **closely spaced terminal limitations as they appear in**
18 **Claim 1 and Claim 11 of the '430 patent?**

19 MS. LAROCHELLE: Object to form.

20 THE WITNESS: Let me take another look at
21 Claim 1 and Claim 11. Two closely spaced
22 terminals connected to the first loop for supply
23 electrical current to the first and second loops
24 while minimizing magnetic field contributions
25 from the terminals.

1 Then 11 has -- let me see. 11.

2 Connecting two closely spaced terminals to the
3 first loop. Okay.

4 And 20, two closely spaced terminals
5 connecting to the first loop will supply.

6 So the term closely spaced terminals, as I
7 discussed before, is the most fundamental rule.
8 Electromagnetic interference for any case that
9 you have terminals leading in and out currents,
10 so one terminal having the signal current
11 feeding in, the other terminal signal out, same
12 amplitude, different signs.

13 So this is a generic rule for -- for this
14 type of passives. So -- for passives. And I
15 say least, in paragraph 128, this is the most
16 fundamental principle. That means that would be
17 valid literally for inductors or capacitors
18 realized in a variety of platforms.

19 And the most basic principle is if you
20 want to minimize EMI radiation, keep the signals
21 and their returns close together.

22 Again, I have to stress the fact that '430
23 does not attain the scope of the term closely.
24 So just stressing the fundamental principle, the
25 fundamental physical principle, the physical

1 effect underlying inductors or passives in
2 different platforms, different configurations,
3 different applications.

4 Q. (By Mr. Warr) My question was -- you were
5 talking about paragraphs 126, 127 in your declaration.
6 Those paragraphs appear in your discussion relating to
7 Claim 20 and the term "closely spaced terminals" as it
8 appears in Claim 20.

9 My question to you was: Was your
10 explanation in the context of Claim 20 for the closely
11 spaced terminal limitation applicable to that same
12 limitation in Claims 1 and 11?

13 A. The answer is that the terminals of
14 conductors in, let's say, passive conductors, are --
15 have to be placed close together the whole time.

16 So if you think about claim -- Claim 1,
17 Claim 11, and Claim 20, these were requirement of this
18 comparison of closely spaced terminals between
19 Taniguchi and '430 is equally valid.

20 If you say, for example, my discussion
21 from independent of Claim 1 and 135 and you see the
22 mapping of 183 and 20C, the same requirement is
23 enforced.

24 Now, I can -- I can look in my declaration
25 about this, but even if you go to a page 109 -- the

1 paragraph 146 where I discuss the two closely spaced
2 terminals and two closely spaced terminals for
3 Claims 1A and 20C, they -- they're treated the same
4 way. So Claim 1, Claim 20 same way.

5 Q. Directing your attention to paragraph 127
6 of your declaration that talks about minimizing the
7 magnetic field contributions from the terminals. Do
8 you see that, sir?

9 A. 127.

10 Q. The first sentence in 127.

11 A. Yes.

12 Q. And then in paragraph 128 you start
13 talking about Brooks, which is Exhibit 1010, and you
14 quote a passage from Brooks, quote, "EMI radiation
15 from that wire will be greater than that from the
16 other," end quote. Do you see that?

17 A. Can you -- that's on 128?

18 Q. Yeah. Starting on the end of the third
19 line of paragraph 128.

20 A. Yeah. Okay. Yes, I saw that.

21 Q. Is it your understanding that the
22 reference to EMI radiation in Brooks as referenced in
23 paragraph 128 is the same as the magnetic field
24 contributions that you talk about in paragraph 127 in
25 the context of Taniguchi?

1 MS. LAROCHELLE: Object to form.

2 THE WITNESS: Looking at 27, 128, the
3 reference of the textbook Brooks is the one been
4 utilized. But can you please explain to me what
5 the question had to do with the passage you
6 asked. So the EMI radiation from that wire
7 would be greater than that from the other.

8 The way I read Brooks is typically if you
9 place two wires that are far apart, not at a
10 close distance, and you position another
11 conductors, like the reader, as it's called, the
12 reader, then the magnetic field of the closed
13 wire will be significantly different than the
14 magnetic field for the further-out wire.

15 And that's exactly what's given, the EMI
16 radiation from that wire.

17 And then that's why Brooks said if we move
18 the two wires close together, so the distance of
19 the wires to the, quote -- quote reader, victim,
20 is almost similar, then you see that the
21 radiation from its wire becomes more equal. And
22 they're opposite in phase and polarity and they
23 tend to cancel.

24 So paragraph 128 in the first sentence you
25 stressed means that if you have two terminals

1 far apart, then the overall EMI magnetic
2 radiation will be quite significant because the
3 closer wire will affect the victim more
4 significantly than the further-out wire.

5 So what's given by Brooks is be careful.
6 Bring the two wires close together. Then
7 radiation for each wire are much more equal, and
8 then they end up in opposite phase and polarity.
9 They cancel. So there is no overall parasitic
10 magnetic radiation.

11 That's the meaning of 128. And that's
12 actually the motivation and another alternative
13 description of the problem. If the terminals
14 are far apart, then the EMI radiation, the
15 overall EMI radiation will be measurably
16 significant.

17 If they're close together, then they would
18 increasingly cancel. And if they are as close
19 as possible, pretty much they will cancel and
20 they will not be measurable.

21 And that's how I end up with the
22 conclusion of if you want to minimize the EMI
23 radiation, keep the signals and their returns
24 close together.

25 **Q. (By Mr. Warr) Can I direct your**

1 attention, please, to paragraph 162 and 163 of your
2 declaration starting on page 123.

3 A. Are you referring to the paragraph
4 starting "The inductor layout of the same plane
5 embodiment"?

6 Q. Figure 7 is the same plane embodiment;
7 right?

8 A. Yes.

9 Q. And that means the antenna one and antenna
10 two are positioned in the same plane?

11 A. That is correct.

12 Q. In paragraph 163, about halfway down you
13 state, "However, antenna two is further placed
14 concentrically within antenna one such that the two
15 antennas share common horizontal axis, vertical axis,
16 and z-axis." Do you see that?

17 A. Yes.

18 Q. From your prior discussion, I understand
19 the vertical axis and the horizontal axis. But for
20 the record, what do you mean with the z-axis?

21 A. The z-axis is the axis that's
22 perpendicular to the plane of the antennas. So I
23 would say that would point out of the screen in this
24 situation.

25 Q. And further on in that paragraph you state

1 that the "concentric arrangement is necessary to
2 achieve zero mutual inductance," towards the bottom of
3 page 124. Do you see that?

4 A. Yes, I do.

5 Q. Does that hold true to the other
6 embodiments of Taniguchi such as those shown in
7 Biggers 8, 9, and 10, i.e., embodiments that are not
8 the same plane embodiments?

9 MS. LAROCHELLE: Object to form.

10 THE WITNESS: So for this embodiment,
11 that's necessary. And we said that the
12 concentric is necessary to lead to an ideally
13 zero mutual inductance.

14 So let me scroll down to check that.

15 So it's Figure 7, same plane.

16 So concentric placement in the same plane,
17 the overlapping regions, S1 and S2 are equal
18 resulting in zero mutual inductance, and for
19 these embodiments, the reason for all these
20 three embodiments, the reason of placing
21 concentrically the inductors, one above the
22 other one, below the other is to make sure the
23 overlapping regions between the two sections of
24 the figure eight antenna are equal, resulting in
25 zero mutual inductance.

1 Now if you want to have zero mutual
2 inductance, the concentric placement helps on
3 doing that. If you want to have reduced
4 interference, then you would have -- you could
5 just take advantage of the figure eight.

6 But as I said even in paragraph 185, as
7 demonstrated in Figure 7B below, the -- in that
8 was placed concentrically on the same plane in
9 overlapping regions, S1, S2 are similar.

10 Now, the whole idea of this placement is
11 to have equal overlapping regions. Same thing
12 when we were talking about figure eight on
13 Figure 10 in paragraph 184.

14 In paragraph 184, it says confirmed by
15 Taniguchi specification which describes
16 concentric placement of antenna two in the
17 Figure 2 embodiment having a rectangular second
18 antenna so that overlapping regions S1 and S2
19 are equal and the Figures 9, 10 embodiment
20 having an eight-shaped antenna so that
21 overlapping regions S1 and S2 equals regions S3
22 and S4.

23 Now, doing that allows for ideally zeroing
24 out the coupling. So the concentric placement
25 would effectively not just reduce the magnetic

1 field but actually completely cancel, ideally,
2 the mutual coupling. And that's happening for
3 the three embodiments, Figure 7, Figure 8, and
4 Figure 9 and 10.

5 **Q. (By Mr. Warr) Going back to the closely**
6 **spaced terminal limitation, Dr. Tentzeris, does**
7 **Taniguchi discuss the need to minimize the magnetic**
8 **field contributions from those terminals?**

9 MS. LAROCHELLE: Object to form.

10 **Q. (By Mr. Warr) Do you recall?**

11 A. So Taniguchi aims in realizing some -- as
12 given in paragraph 1, relates to radio guidance
13 antenna, data communication method, and noncontact
14 data communication apparatus to radio guidance antenna
15 for use in non-contact apparatus such as physical
16 distribution systems, electronic coupon ticket systems
17 and the like, a data communication method and
18 non-contact data communication apparatus.

19 Now, if I can stress something here. So
20 if I can stress something here, I have given in my
21 declaration for Taniguchi in paragraph 203 that --
22 Taniguchi wants to have efficient circuit design. And
23 as given in paragraph 22 in 8695, you have Taniguchi
24 saying the goal of making identical communication
25 apparatus, which is small sized, lightweight, and high

1 in performance.

2 So talking about small size. I mean,
3 small size and lightweight is a really important part
4 of what Taniguchi's doing. And you can keep on
5 reading on this and saying that the principle of all
6 this -- have understood that this is beneficial for
7 such applications to integrate as many components as
8 possible to achieve a small device.

9 Now, that means, since you need to
10 integrate something in the handheld or wearable
11 portable configuration with small size and there are
12 multiple references given an order magnitude of the
13 small size given in paragraph 204 by Heinrich, a
14 hand-mounted RFID antenna, given in 205 by Kovach and
15 so on.

16 Taniguchi aims in creating small form
17 factor -- antennas for small form factor platforms.
18 So they minimized para -- electromagnetic
19 interference, they minimized parasitic electromagnetic
20 field is going to be paramount to bundle these
21 antennas in small form factor platforms.

22 And as we said before, the -- placing the
23 conductors very closely is really important to
24 minimize this parasitic magnetic field that would
25 affect other components placed next to each other in a

1 small form factor platforms, similar to the ones
2 Taniguchi is spending time on.

3 So Taniguchi stressing the fact of small
4 factor requires much more than generic applications.
5 The fact that the terminals of the conductor -- of the
6 inductor have to be placed closely to minimize
7 parasitic magnetic interference to closely spaced --
8 to neighboring components in these small form
9 platforms.

10 The whole idea of this is efficient
11 circuit design. And as I said before, to do efficient
12 circuit design, you have to minimize the parasitics of
13 the terminals, which is realized by closely spaced
14 terminals. The past has been -- taught us well by
15 Brooks.

16 But I would say Brooks, the textbook,
17 pretty much reiterating a well-known rule. There
18 is -- Brooks was a way to show that this closely
19 spaced terminals was a well-known approach to a person
20 of ordinary skill, so well known that it was listed in
21 textbooks.

22 And since Taniguchi is talking about small
23 form platforms and also talking about integrated
24 antennas, close terminals is going to be a really
25 important requirement for an efficient circuit design.

1 **Q. Dr. Tentzeris, you just mentioned that**
2 **Taniguchi talks about small form solutions.**

3 **Does Taniguchi suggest its teachings could**
4 **be applied to semiconductor chips?**

5 MS. LAROCHELLE: Object to form.

6 THE WITNESS: So let me point your
7 attention to -- to paragraph 201, and especially
8 the Figure 8. So Figure 8D, so as you asked me
9 before, so as an example of two inductors, two
10 loop antennas placed at two different
11 metallization layers separated by an inductor.

12 That was the number ten you asked me
13 before.

14 So in this case, you had two coils being
15 placed at two sides of an insulator, and then on
16 the other side one -- another exhibit I utilized
17 Rostoker exhibit, which shows how loop antennas
18 or inductors are integrated on a chip.

19 They refer to Figure 7B, which is an
20 exhibit showing of how you realize inductors or
21 mount loop antennas on top of a --

22 **Q. (By Mr. Warr) I'm sorry, Dr. Tentzeris,**
23 **to interrupt. I missed -- I didn't quite hear what**
24 **you said. Something --**

25 A. Oh, sorry.

1 Q. -- in that last sentence. I was following
2 along, and I got -- I didn't hear.

3 A. First I started with Taniguchi. And
4 Taniguchi shows, as we said before, you have two
5 different coils, two different loop antennas placed at
6 both sides of an insulator, as we discussed before.

7 Now, on the right side, which is an
8 exhibit showing how you fabricate multiple poles,
9 multiple loop antennas on a semiconductor die 702,
10 that source, that the way you can do that is take
11 advantage of two metallization layers on the two sides
12 of an insulator 710.

13 So Taniguchi showing just one example on
14 PCB. That's a generic example on an insulator. And
15 the example of -- in the schematic on Rostoker showing
16 how you realize the coils. It is pretty much the
17 same.

18 So you have an insulator called 10 on
19 Taniguchi, called 710 on this antenna -- loop antenna
20 or in that by Rostoker that 710. You have one coil or
21 loop antenna called 110 or 724A and B for the two of
22 them. And another inductor or coil on the bottom of
23 insulator 734A, 734B.

24 So looking at this means that the
25 requirements for a fabrication process utilizing any

1 arbitrary insulator, or an insulator mounted on a
2 semiconductor die 702, is -- they're exactly the same.

3 As listed in paragraph 201, you can see
4 that antennas are utilized in two different
5 metallization layers with an insulation layer
6 separating the two metallization layers on both of
7 them.

8 And that would be just -- of substrates.
9 So at least in paragraph 203 as well, realizing that's
10 from different substrates. Pretty much aim for the
11 same target, efficient circuit design.

12 So Taniguchi aims in small size,
13 lightweight, and high performance. He gives an
14 example of two antennas, two loop antennas, and that
15 was placed on two sides of an insulator, and the
16 application was small size.

17 So that would come as a natural
18 consequence as shown in paragraph 203 that that was
19 beneficial for all of these applications requiring
20 small size and lightweight and high performance to
21 integrate as many components as possible, including
22 the antennas, on a single die to achieve a small form
23 factor device.

24 I mean, the blueprint for fabrication has
25 been shown as listed in the figure we discussed before

1 for paragraph 201, same structure, two metallization
2 layers, one insulator in between them.

3 And also, I've given in my declaration in
4 203, 204, 205, some examples of known art, the time of
5 this patent, stressing the benefits of integration as
6 many components as possible, including the antennas on
7 the single die to achieve a small factor device shown
8 here.

9 Q. Can we jump down to paragraph 308 in your
10 declaration that talks about the Midya reference,
11 please?

12 A. That's page 247?

13 Q. Starts on 245.

14 A. 245.

15 Q. 308.

16 A. Yes, I found it.

17 Q. Okay. All right. And I want to scroll
18 down to the image on the top of page 247.

19 A. Page 247, yes.

20 Q. And generally this discussion, these
21 paragraphs talk about an embodiment where the first
22 and second inductors do not share a common access;
23 right?

24 A. That's correct.

25 Q. Is the figure at 247, is that something

1 **that you created, or did you take that from Midya?**

2 A. I combined Midya and Raghaven, and that's
3 how I came up with this figure taking advantage -- or
4 taking advantage of the important features of Midya
5 and addressing the deficiencies of Midya utilizing the
6 Raghaven symmetrical approach.

7 As we discussed in the beginning of this
8 deposition, symmetrical inductors were developed in
9 1998, and the idea for these symmetrical inductors was
10 to improve the quality of factor.

11 Now, please allow me to look at my
12 declaration. One second. Allow me to check. It's
13 very slow.

14 So starting from paragraph 274, just --
15 you asked me how I came up with this schematic. So
16 starting from paragraph 274 Midya teaches that its
17 invention provides a method and planar
18 inductor/transformer that maximizes cancellation of a
19 moment of the plurality of loops/spiral conductor
20 coils over a predetermined range such that
21 interference with external and adjacent circuitry is
22 minimized.

23 And more specifically the loops of Midya's
24 multi-loop inductor have the same predetermined
25 structure, provide maximum cancellation of a moment

1 over 360 degrees range. And that's how Midya teaches
2 different layouts.

3 Now, Midya, Figure 26, that was a
4 diagrammatic representation as stated in paragraph 275
5 of an exemplary stacked inductor layout. So here. So
6 page 221.

7 **Q. Page or paragraph, sir?**

8 A. That's page 221. That's paragraph --
9 that's the figure above paragraph 276. Okay?

10 **Q. Okay. I've got -- okay. Thank you.**

11 A. Sure. So Midya describe this topology
12 shown in the right, which features a reduced
13 interference to a second inductor, and that's a
14 reduced interference for a variety of configurations
15 on the same plane, concentric above, two lengths away
16 from this and so on.

17 Now, one of the main -- that's -- that
18 improved, as it's given in my declaration, the
19 coupling of these two antennas quite significantly.

20 **Q. And when you say the coupling of the two**
21 **antennas, you're referring to that figure we're just**
22 **talking about in paragraph 275 of your declaration?**

23 A. Let me see.

24 **Q. On page 221.**

25 A. 275. Let me go back.

1 So I referred to a schematic to the left.
2 That's what's taken out of Midya. That's figure 26 on
3 the left.

4 **Q. Got it. Okay.**

5 A. Then going back to paragraph -- let me
6 see -- 242, despite the fact that Midya featured this
7 lower coupling, there was an issue. And the issue is
8 shown in this paragraph 242.

9 So Raghaven explains that the
10 configuration requires the conductor eight leading to
11 the center of spiral to cross over under the winding,
12 which could add undesired capacity coupling.

13 So the conventional spiral inductor, below
14 right, includes similar crossovers that will add
15 capacitive coupling to each loop of the inductor.

16 And the use of Raghaven's symmetric
17 inductor in the place of Midya's inductors reduces the
18 problematic crossovers, minimizing the capacitive
19 effects.

20 Now, a very important point for this is
21 that combining Midya -- combining Raghaven symmetric
22 conductor with Midya optimized coil topology for
23 reduced coupling requires the maintenance of the
24 oppositely excited loops next to each other. And
25 that's what I discuss in paragraph 240, 241, and 42.

1 So there was a problem with Midya. The
2 problem was the parasitic capacitive coupling due to
3 these crossover under the winding, but also as related
4 in 240, in order to maintain the positives of the
5 Midya, then you have the same predetermined structure
6 in size and shape to provide the maximum cancellation
7 over 360 degrees range and to achieve the cancellation
8 of the field, Midya connects the inner terminal of the
9 bottom left loop with the inner terminal of the top
10 left loop, the outer terminal -- the top left loop to
11 outer terminal, of the top right and the inner
12 terminal of the top right loop to the inner terminal
13 of the bottom right loop.

14 So this connection achieved opposite
15 current in adjacent coils, as shown below. So current
16 flows counterclockwise bottom left, clockwise top
17 left, counterclockwise top right, clockwise in bottom
18 right spiral.

19 And that was the real important part that
20 we maintained in order to improve the performance of
21 this. And to achieve that, as I list in paragraph
22 241, and maintain the similar size and shape for the
23 terminals and replicate the current flow direction in
24 Midya Figure 1, I connected the Raghaven's terminal,
25 as shown in the figure, and as can be seen in the

1 combined four-loop noninteracting conductor, current
2 enters in the bottom left via terminal one, flows
3 counterclockwise, leaves the bottom left loop via
4 terminal two, enters the upper left loop via terminal
5 two, flows in the clockwise direction, then
6 counterclockwise in the top right, clockwise in the
7 lower left.

8 So how I came up with this new schematic,
9 I started with a schematic of Midya, which was a
10 well-known solution to cancel the magnetic
11 interference with other coils, either co-planer or
12 placed above.

13 And then we -- I replaced the coils with
14 Raghaven's coil, which addressed the issue of
15 parasitic capacitance due to the crossovers. Now you
16 see there are no crossovers through the winding.
17 Effectively maintaining the current flow to be
18 counterclockwise, clockwise, counterclockwise,
19 clockwise.

20 And at the same time improving the quality
21 factor through the minimization of the unwanted
22 capacitive effect of underpasses.

23 And that's how I ended with the schematic
24 you asked me to comment below.

25 **Q. Jump down to paragraph 322 of your**

1 **declaration, please.**

2 A. 322.

3 **Q. You're talking the Gardner reference here,**
4 **Exhibit 1009?**

5 A. Yes. I found it.

6 **Q. Would you agree that Gardner's directed to**
7 **integrated circuits?**

8 MS. LAROCHELLE: Object to form.

9 THE WITNESS: That Gardner teaches
10 inductors fabricated on chip and integrated
11 circuits fabricated with one or more inductors.

12 So taking advantage of semiconductor
13 processing to form chips having inductors. So
14 Gardner's inductors are manufactured using
15 semiconductor dies, fabricated on an IC or chip
16 using semiconductor processing. So you're
17 process is different in areas with a chip. And
18 the chip could be small die. So any die,
19 silicone, glass, silicone.

20 **Q. (By Mr. Warr) Can you pull up the Gardner**
21 **reference, Exhibit 1009, please.**

22 A. 1009. I did.

23 **Q. And can you go to paragraph five, please.**

24 A. Paragraph five. Frozen again.

25 Just bear with me. It froze again. So

1 paragraph five.

2 Paragraph five, yes.

3 Q. If I could direct your attention to the
4 last sentence of paragraph five that starts, "Such
5 integrated inductors are designed to the extent
6 possible to have a relatively high frequency range."

7 Do you see that?

8 A. Yes, I do.

9 Q. And do you know what that range is?

10 MS. LAROCHELLE: Object to form.

11 THE WITNESS: There is no reference to
12 specific frequencies except from the one given
13 in the first sentence talking about variety of
14 microelectronic circuit applications,
15 transformers, power converters, electromagnetic
16 interference, radio frequency, and microwave
17 circuitry.

18 So these frequency ratings could be
19 anything going from, I would say, kilohertz all
20 the way to tens of gigahertz. There is no
21 specific teaching of the scope.

22 Just reading the first sentence talking
23 about microwave circuitry, for example. RF
24 circuitry typically covers everything for RFIDs.
25 And RFIDS go from kilohertz to 60 gigahertz

1 nowadays. I would say in 2000 -- around 2000
2 talking about RFIDs, there were kilohertz,
3 megahertz, high megahertz, and maybe 2.4
4 gigahertz.

5 So I would say from kilohertz to
6 gigahertz. But I don't see any specific
7 frequencies here. I believe what's given here
8 to have relatively high frequency range, most
9 likely they refer to frequency rates covering
10 standards for these specific applications, I
11 believe. That's my take because I don't see any
12 specific details about this.

13 **Q. (By Mr. Warr) When you -- in your answer**
14 **you referred to that would cover these specific**
15 **applications. What were you referring to?**

16 A. What I read in the first sentence, and I
17 read from paragraph five you pointed to. And there is
18 a variety of applications, such as, for example, and
19 I'm reading from the patent, transformers, converters,
20 EMI noise reduction, and radio frequency and microwave
21 circuitry.

22 **Q. So those are the applications you were**
23 **referring to?**

24 A. These are the applications. And these are
25 the applications this patent aims to address.

1 MR. WARR: If I can have about five
2 minutes off the record. I'd like to consult my
3 notes. I think we're just finished,
4 Dr. Tentzeris.

5 THE WITNESS: Thank you very much. Please
6 feel free. Take your time.

7 (Deposition in recess, 2:08 p.m. to
8 2:13 p.m.)

9 MR. WARR: Those are all the questions I
10 have, Dr. Tentzeris. I appreciate your time and
11 your patience with me.

12 THE WITNESS: Thank you very much.
13 Appreciate your questions and have great
14 holidays.

15 MS. LAROCHELLE: I have no questions.

16 (Off-the-record discussions ensued.)

17 MS. LAROCHELLE: Regular delivery is fine
18 for us. You'll do a rough?

19 (Off-the-record discussions ensued.)

20 MR. WARR: I would like rough rush because
21 I'm banging on a deadline that Christie doesn't
22 have.

23 (Deposition concluded at 2:14 p.m.)
(Pursuant to Rule 30(e) of the Federal
Rules of Civil Procedure and/or O.C.G.A.
24 9-11-30(e), signature of the witness has been
reserved.)
25

1 The following reporter and firm
2 disclosures were presented at this proceeding
3 for review by counsel:

3 REPORTER DISCLOSURES

4 The following representations and
5 disclosures are made in compliance with Georgia Law,
6 more specifically:

6 Article 10(B) of the Rules and Regulations of the
7 Board of Court Reporting (disclosure forms)

7 OCGA 9-11-28(c) (disqualification of reporter for
8 financial interest)

8 OCGA 15-14-37(a) and (b) (prohibitions against
9 contracts except on a case-by-case basis).

- 9 - I am a certified reporter in the State of Georgia.
- 10 - I am a subcontractor for IST Court Reporting.
- 11 - I have been assigned to make a complete and accurate
12 record of these proceedings.
- 12 - I have no relationship of interest in the matter on
13 which I am about to report which would disqualify me
14 from making a verbatim record or maintaining my
15 obligation of impartiality in compliance with the
16 Code of Professional Ethics.
- 17 - I have no direct contract with any party in this
18 action and my compensation is determined solely by
19 the terms of my subcontractor agreement.

1 C E R T I F I C A T E

2

3 STATE OF GEORGIA:
4 COUNTY OF COBB:

5

6 I hereby certify that the foregoing
7 transcript was taken down, as stated in the
8 caption, and the colloquies, questions, and
9 answers were reduced to typewriting under my
10 direction; that the transcript is a true and
11 correct record of the evidence given upon said
12 proceeding.13 I further certify that I am not a relative
14 or employee or attorney of any party, nor am I
15 financially interested in the outcome of this
16 action.17 I have no relationship of interest in this
18 matter which would disqualify me from
19 maintaining my obligation of impartiality in
20 compliance with the Code of Professional Ethics.21 I have no direct contract with any party
22 in this action and my compensation is based
23 solely on the terms of my subcontractor
24 agreement.25 Nothing in the arrangements made for this
proceeding impacts my absolute commitment to
serve all parties as an impartial officer of the
court.

This, the 23rd day of December, 2024.

18

19

20 *Pamela L. Porter*

21 PAMELA L. PORTER, CCR-B-2160

22

23

24

25

1 ERRATA for Assignment # 5362

2

3 I, the undersigned, do hereby certify that I have read
4 the transcript of my testimony, and that

5 There are no changes noted.
6 The following changes are noted:

7 Pursuant to Rule 30(7)(e) of the Federal Rules of
8 Civil Procedure and/or OCGA 9-11-30(e), any changes in
9 form or substance which you desire to make to your
10 testimony shall be entered upon the deposition with a
11 statement of the reasons given for making them.
12 To assist you in effecting corrections, please use the
13 form below. If additional pages are necessary, please
14 furnish same and attach.

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16 Page Line Change

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DEPONENT'S SIGNATURE

21

Sworn to and subscribed before me, this day of
22 , 20 .

23

Notary Public
24 My commission expires:

25

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