

CONFIDENTIAL - DEAN NEIKIRK, PH.D.

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

CASE IPR 2020-00476

U.S. Patent No. 9,198,565

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SAMSUNG ELECTRONICS CO., LTD, and SAMSUNG
ELECTRONICS AMERICA, INC.,

Petitioners,
v.

CELLECT, LLC,

Patent Owner.

-----X

CONFIDENTIAL DEPOSITION

VIA ZOOM VIDEOCONFERENCING

OF

DEAN NEIKIRK, PH.D.

Wednesday, September 30, 2020

Reported By:

LINDA J. GREENSTEIN

JOB NO. 1038

AMG Reporting LLC 917-969-4493

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<p>Page 2</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 September 30, 2020 3 11:11 A.M. EST 4 5 6 7 Confidential Deposition held via 8 Zoom Videoconferencing of Dean Neikirk, 9 Ph.D., taken by Respective Parties, before 10 Linda J. Greenstein, a Certified Shorthand 11 Reporter and Notary Public of the State of 12 New York. 13 14 15 16 17 18 19 20 21 22 23 24 25</p>	<p>Page 3</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 A P P E A R A N C E S: 3 (All parties appearing via Zoom 4 Videoconferencing) 5 6 ROPES & GRAY, L.L.P. 7 Counsel for Petitioners 8 1900 University Avenue 9 6th Floor 10 East Palo Alto, California 11 94303-2284 12 BY: JAMES L. DAVIS, JR., ESQ. 13 650.617.4794 14 james.l.davis@ropesgray.com 15 16 KRAMER LEVIN NAFTALIS & FRANKEL, L.L.P. 17 Counsel for Patent Owner Collect, LLC 18 1177 Avenue of the Americas 19 New York, New York 10036 20 BY: JONATHAN S. CAPLAN, ESQ. 21 212.715.9488 22 jcaplan@kramerlevin.com 23 24 Also Present: 25 ROPES & GRAY, L.L.P. Carolyn Redding, Esq.</p>
<p>Page 4</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 THE COURT REPORTER: Good 3 morning. 4 We're here in the Matter of 5 Samsung versus Collect. 6 Today is Wednesday, 7 September 30, 2020. 8 Counsel, do you agree that the 9 witness will be sworn today remotely? 10 MR. CAPLAN: I do. It's fine. 11 I'm with Collect. 12 MR. DAVIS: Yes, this is Jim 13 Davis for the Samsung petitioners. 14 MR. CAPLAN: Good morning, 15 Dr. Neikirk. 16 Again, my name is Jonathan 17 Caplan of Kramer Levin. We represent 18 Collect in this IPR proceeding. 19 Just one administrative kind of 20 issue I'll just raise with Jim, just at the 21 outset. 22 There's going to be, some of 23 these topics kind of are common across the 24 different proceedings, background and other 25 things, so instead of going through it each</p>	<p>Page 5</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 time, I assume the common lines of 3 questioning we'll use across as opposed to 4 going through background and the same 5 issues multiple times, so I assume that's 6 okay with you? It will also make things 7 shorter. 8 MR. DAVIS: Yes. 9 MR. CAPLAN: Great. 10 DEAN NEIKIRK, PH.D., 11 having been first duly sworn, was examined 12 and testified as follows: 13 EXAMINATION BY 14 MR. CAPLAN: 15 Q. It's a little different doing 16 this by Zoom, Dr. Neikirk, just, again, as 17 it's more of an administrative issue for 18 you, generally we'll go about an hour. 19 If you need to take a break at 20 any time prior to that, just let us know, 21 that's not an issue. But normally we'll 22 certainly take a break at least once an 23 hour. 24 Just for the record, Dr. 25 Neikirk, is that how you pronounce it,</p>

<p style="text-align: right;">Page 6</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 "Neikirk"? 3 A. Yes, that is correct. 4 Q. Okay. Just can you state your 5 full name for the record and where you 6 currently reside and then work. 7 A. My name is Dean Paul Neikirk and 8 I reside in Dripping Springs, Texas and I 9 work at the University of Texas at Austin. 10 Q. Okay. Starting with your 11 background a little bit, you have a 12 Bachelor's and a Master's and a Ph.D.; is 13 that right? 14 A. Yes, that is correct. 15 Q. Okay. I'm just going to go 16 through to get a little understanding of 17 your background some more. 18 Your Bachelor's degree, can you 19 just describe what your focus was as an 20 undergrad. 21 A. My Bachelor's degree was in 22 physics from Oklahoma State University. 23 I also have sort of as a 24 byproduct of doing that a degree in 25 mathematics.</p>	<p style="text-align: right;">Page 7</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 My university specialty in terms 3 of physics was solid-state physics, and I 4 did do research as an undergraduate of 5 optical effects in solid-state materials. 6 Q. And what kind of -- can you give 7 a little more of a description of kind of 8 what that subject matter was about. 9 A. As an undergraduate, I worked on 10 what are called stoichiometric-laser host 11 materials. This was a long time ago and 12 lasers were pretty new. 13 And we were looking at how you 14 get energy into a crystal and how it comes 15 out as a light. 16 Q. Again, that was part of your 17 undergraduate coursework, so did you do any 18 kind of a capstone or research project as 19 part of that? 20 A. So in our physics curriculum we 21 have numerous laboratories all the way from 22 basic introductory physics to electronics 23 and so on. 24 My -- essentially, my capstone 25 research project was working in a research</p>
<p style="text-align: right;">Page 8</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 lab for a faculty member and publishing as 3 a result of that work I think two journal 4 articles. 5 Q. And what were the articles 6 about? 7 A. Again, they were about the laser 8 host materials. 9 Q. And did any of that undergrad 10 research, which I know is a little bit of a 11 few years ago, was that related to imager 12 technology, things with pixel arrays in it? 13 A. So I did a full year of 14 electromagnetics and a half a year of 15 optics. 16 At the time -- so this is, 17 again, in late '70s -- there weren't a 18 whole lot of pixelated imaging arrays 19 around. And that wasn't part of our 20 coursework. I did do that work as a 21 graduate student, but not as an 22 undergraduate. 23 Q. I want to talk about that 24 briefly because you have a Master's degree 25 from California Institute of Technology.</p>	<p style="text-align: right;">Page 9</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 Can you tell me what that was 3 about, what the focus of your studies were 4 for that degree? 5 A. So at Caltech, where I was a 6 graduate student, you were admitted to 7 pursue a Ph.D. degree. 8 Along the way, by completing the 9 appropriate coursework, you receive a 10 Master's, so the Master's itself is really 11 coursework-based. * 12 I was in applied physics and our 13 focus included some numerous areas of 14 fundamental physics, as well as 15 electromagnetics and solid-state physics. 16 Q. Did you work on a particular 17 type of product or problem in that 18 undergraduate coursework or was it more 19 broad-based? * 20 A. So are you asking about my 21 graduate coursework? 22 Q. Yes, the Master's coursework. 23 A. The Master's, we are covering 24 fundamentals. I was already conducting 25 research, again, initially in optical</p>

<p style="text-align: right;">Page 10</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 properties and materials, and then 3 specifically the design, fabrication and 4 testing of imaging arrays. 5 That work I would really 6 characterize that as my Ph.D. work rather 7 than my Master's work. 8 Q. I think you just mentioned the 9 optical properties and materials. 10 What in particular are you 11 talking about in that area? 12 A. So, again, given in that time 13 frame, I worked with a faculty member who 14 is called a chemical physicist. 15 Ultimately, he was a Nobel 16 laureate some years later in chemistry. 17 We were trying to understand 18 better how light is captured or interacts 19 with sounds, and then how that light -- the 20 energy that light produces in the solids, 21 ultimately is emitted by those solids, so 22 it's a study of fluorescents, 23 phosphorescence and energy transfer. 24 I don't know -- that's a 25 moderately technical version of it, but it</p>	<p style="text-align: right;">Page 11</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 would be a little bit harder to rephrase 3 it. Those are the terms of the field. 4 Q. And was that in connection with 5 devices that were capturing images for 6 display or more just about the transfer of 7 energy between the photons and the 8 material? 9 A. So I did both. 10 Initially, I was doing work 11 really on the transfer of energy in a solid 12 under the supervision of a chemistry 13 faculty member. 14 I changed to another research 15 group under the supervision of an 16 electrical engineer, and in that group I 17 actually built imaging arrays. 18 So they were arrays specifically 19 to capture electromagnetic radiation and 20 form and image. 21 Q. Were they particular types of 22 arrays, I mean in terms of -- and on this 23 case we were talking about certain types of 24 arrays, but in that work you're just 25 describing, were those particular types of</p>
<p style="text-align: right;">Page 12</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 arrays? 3 A. Yes, they were, and we were 4 interested in a region of the 5 electromagnetic spectrum called the 6 millimeter and submillimeter region. 7 This is also frequently called 8 the far infrared, and those are terms we 9 used back then. Nowadays they call it 10 terahertz, but we were interested in 11 capturing those wavelengths. 12 To do that requires the use of 13 antennas coupled to a solid-state detector, 14 so I was designing and fabricating the 15 antennas. 16 I was also designing and 17 fabricating the detectors that those 18 antennas coupled to and then placing that 19 in an overall electronic system that 20 allowed us to capture data from many 21 antennas, pixels, and the kind of parlance 22 we use here, to form an image. 23 Those happen to be what were 24 called line arrays, so it was a linear 25 array of antennas. To get the second</p>	<p style="text-align: right;">Page 13</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 dimension in the image you used what are 3 called scanning optics. 4 Q. And that coursework and those 5 studies I believe you explained were on the 6 pathway to getting your Ph.D.; is that 7 right? 8 A. Yes, that's correct. 9 Q. So were there other areas you 10 studied or what did you do from that point 11 through your Ph.D. studies or research? 12 A. Well, that was my research, so I 13 was making use of the teachings from my 14 graduate instructors in solid state and 15 electromagnetics and using that to come up 16 with new ideas for antennas, those are the 17 electromagnetic structures, and the 18 detectors. I happened to work on what are 19 called microbolometers. 20 Combining all that with actually 21 building this, so in order to do this I had 22 to put together an IC -- integrated circuit 23 fabrication laboratory. 24 I was my advisor's first 25 graduate student, and his background was in</p>

<p style="text-align: right;">Page 14</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 actually building things at Berkeley, where 3 they had an established microfabrication 4 facility. We built our own at Caltech, and 5 that was primarily one of my 6 responsibilities. 7 So in order to do that, I had to 8 learn all about microlithography, 9 depositions, chemical vapor deposition, 10 physical vapor deposition. All of those 11 assorted topics that are related to 12 actually building integrated circuits. 13 Q. So what would be some of the 14 applications or products that these 15 antennas and detectors were working on 16 would be -- would it be applications that 17 they would be used for or products that 18 they would be incorporated into? 19 A. So the work that I did was, I 20 had a very specific application. It was 21 used to do electron density measurements in 22 tokamak plasma. So a tokamak is a type of 23 magnetically confined fusion reactor, which 24 was being investigated for use for fusion, 25 energy generation.</p>	<p style="text-align: right;">Page 15</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 In order to measure the density 3 of electrons in that plasma, we had to come 4 up with a new technique, and that's what 5 the imaging arrays were for. 6 More broadly, these wavelengths 7 are of interest -- were of interest to the 8 military, for instance, because they 9 penetrate smoke and fog, and so there was a 10 lot of interest in using it for doing 11 imaging -- in environments where normal 12 optical imaging devices don't function 13 well. 14 MR. CAPLAN: I'm sorry. I just 15 want to check with the court reporter to 16 make sure she's able to hear everything. 17 You were breaking up a little bit. 18 (Discussion held off the 19 record.) 20 THE WITNESS: I was looking at 21 my Internet connection. I think it's still 22 fine. 23 If my microphone does start to 24 break up, please let me know because I 25 can't tell from this end.</p>
<p style="text-align: right;">Page 16</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 MR. CAPLAN: Okay. That's fine. 3 BY MR. CAPLAN: 4 Q. And in the course of those Ph.D. 5 studies, did you make any actual products? 6 A. Well, I made many arrays, which 7 I then supplied to other users. 8 Whether you call that a product 9 or not, it wasn't work for sale, so -- it 10 was a product in the sense that what I 11 built had to be functional and ready to use 12 by someone else, and I delivered many of 13 those to other laboratories for their use. 14 Personally, I'm not sure I'd 15 call that a product, but it's certainly 16 related. 17 Q. Okay. And you mentioned you 18 were involved with fabrication in some of 19 these products that you were working on; 20 right? 21 A. Yes, that's correct. 22 Q. And that was done -- well, I 23 just want to make sure, I'd like to 24 understand a little bit better what kind of 25 fabrication, where was it being done and</p>	<p style="text-align: right;">Page 17</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 what kind of a fab process were you working 3 with at that time. 4 A. So it was being done in the 5 laboratory that I built and it was being 6 done by me, so I actually obtained, to do 7 photolithography, which is one of the steps 8 you need, a mask liner is one of the pieces 9 of equipment. 10 I obtained three surplus mask 11 liners from IBM, disassembled them to put 12 together one that worked, and so I was 13 using a mask liner that I made work and 14 maintained myself. Put together the 15 laminar flow clean room apparatus necessary 16 to allow us to apply photoresist, to expose 17 it with mask liner, to do the mask 18 alignments themselves. 19 We built our own masks, so we 20 used a very, by today's standards, archaic 21 technique called rubilith, where we cut our 22 rubilith and did photographic production. 23 I did all of that myself. 24 So I was intimately involved in 25 everything from the on-paper design to the</p>

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2 generation of masks to the
3 photolithography, followed by the
4 deposition of numerous -- I use mostly
5 metals. I built three different what are
6 called physical vapor deposition apparatus
7 to do that.
8 I also used a number of
9 dielectrics to protect the materials and
10 then assembled the whole thing into a
11 package, so I was responsible for the wire
12 bonding, and that means I did the wire
13 bonding to put it into the package.
14 So really -- I don't know --
15 soup-to-nuts, it was basically everything
16 from designing it on paper to producing
17 something that I could hand to another user
18 and expect that they would be able to use
19 it and it would work.
20 Q. It sounds like that was a pretty
21 customized fabrication process that was
22 tailored for your particular needs at the
23 time.
24 A. Yes, it was. I mean, every
25 fabrication process in some sense -- well,

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2 in the area of solid-state devices ranging
3 from microwave to optical devices.
4 I did a lot of work on far
5 infrared and infrared sensors, so I did
6 continue work for my graduate -- sort of an
7 extension of my graduate work, looking at
8 different types of infrared sensors.
9 I worked with the techniques
10 used to make those, including molecular
11 beam epitaxy, which is a crystal growth
12 technique, which my group focused on of the
13 use of that to build microwave and higher
14 frequency devices.
15 The other students in our group
16 worked primarily on laser diodes, so they
17 worked on optical devices.
18 Over the years from that point
19 I've continued that work on infrared
20 sensors. I've also done a great deal of
21 work on many other kinds of sensors,
22 including acoustic ones, pressure
23 transducers. Chemical sensors was a large
24 focus of my research in the mid '90s to mid
25 2000s, that primarily for medical

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2 it's always tailored to what it is you're
3 trying to make.
4 Q. And those projects you were
5 working with your Ph.D. studies, you
6 wouldn't characterize those as trying to
7 design and build a charge-coupled device or
8 CCD image sensor, would you?
9 A. No, those were not CCDs.
10 Those were microbolometer
11 arrays. Different type of sensor.
12 Q. Separate from your Ph.D. studies
13 now, what other kind of sensors have you
14 worked on? We'll kind of go in sequence.
15 Once you got your Ph.D., was
16 there a focus of your work as a post-doc in
17 academia?
18 A. So I did not do post-doc.
19 I went direct from my graduate
20 studies to being an assistant professor at
21 the University of Texas at Austin.
22 At the University of Texas, I
23 was the second member of what's called the
24 Microelectronics Research Center at the
25 time. Our general focus was to do research

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2 diagnostics.
3 Q. So the mid '90s, so you were
4 working mostly with chemical sensors, you
5 were saying, in that time period?
6 A. In the mid '90s -- I'm sorry, I
7 talked over you.
8 Could you please give me your
9 question again.
10 Q. I just want to understand, I
11 think you were saying in the mid '90s you
12 were working on a particular type of sensor
13 technology, and I think you said it was
14 chemical sensors?
15 A. That was one of the focuses of
16 my group.
17 At that time some of my students
18 were working on what is called
19 interconnects and interconnect modeling for
20 use in integrated circuit design.
21 Other of my students were
22 working on infrared sensors, which were
23 focal point array devices.
24 And other of my students were
25 working on chemical sensing. That involved

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2 **what's called micromachining and**
3 **microfluidics works, a lot of our work done**
4 **in collaboration with a number of chemists.**
5 Q. In that time period, in the mid
6 '90s, were you working on CCD imagers, the
7 charge-coupled device, that type of sensor?
8 A. So the type of -- the
9 wavelengths that we were interested in are
10 very long and CCDs will not work. Photo
11 diodes will not work because the photon
12 energy is far too small.
13 We certainly looked at types of
14 CCDs, which are called -- that the material
15 required for that is mercury cadmium
16 telluride, MerCadTel.
17 That's -- you are able to build
18 something that is a the infrared equivalent
19 of a CCD that works at about 10 microns.
20 That was something that we made sure we
21 understood as a background area.
22 We did not do new research
23 ourselves in that area because we were
24 interested in wavelengths where -- even
25 longer wavelengths where MerCad Telluride

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2 **working on those kind of photo detectors.**
3 We occasionally did use some
4 with our molecular beam epitaxy system.
5 (Reporter clarification.)
6 A. We did use those. It was the
7 molecular beam epitaxy, and for short I'll
8 use the acronym MBE -- simpler -- but
9 that's the acronym.
10 Our MBE systems were
11 particularly well-suited for depositing
12 very thin layers of compound
13 semiconductors, which are very useful for
14 both photo sensing and photo generation, so
15 both for laser diodes, to produce light,
16 and photo diodes, to receive light, we did
17 on occasion do testing on those sorts of
18 things.
19 The advantage of that material
20 system is what's called a direct band gap
21 semiconductor. So it's more efficient than
22 silicon. It has disadvantages in that it's
23 harder to work with and it's more
24 expensive.
25 Q. Okay. I appreciate that.

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2 **simply would not work. So we were**
3 **temporarily interested in what are called**
4 **microbial metric detectors.**
5 Q. I'm not sure if I understood
6 that last term. It looks like "microbial
7 metric detectors"?
8 A. Yes. I'm sorry, yes. That's
9 the word. It's from microbolometer.
10 Q. I know I asked you about the --
11 this really wasn't in the CCD area, but it
12 sounds like it was not also related to the
13 CMOS imager technology at that time either,
14 in that period, that mid '90s period; is
15 that right?
16 A. Yeah, in that time period and
17 still today. None of the conventional
18 semiconductors photo diode or photo
19 generation is really the key.
20 In both the CCD and the
21 CMOS-type detector array you have to have
22 light with enough energy to create electron
23 whole pairs, and we were interested in
24 light of such low energy that you simply
25 cannot do that. So we were not directly

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2 So just I'm clear, I think it
3 was clear, but so in that mid 90s period,
4 the focus of your research and your
5 oversight in academia was not on CCD
6 imagers; is that right?
7 MR. CAPLAN: Object to the form.
8 A. I think it's fair to say that
9 the focus -- I had more than one focus --
10 the foci of my research was not on CCD
11 specifically.
12 Q. And the same question in
13 connection with CMOS: That was also not a
14 focus of your work at that time; is that
15 right?
16 MR. CAPLAN: Same objection.
17 A. Well, so as to CMOS -- actually,
18 one of the prongs of my research group was
19 developing models of interconnects to be
20 used primarily in MOS integrated circuits,
21 so it was for CMOS.
22 In my coursework, I taught a
23 laboratory course where we built CMOS
24 devices, but the CMOS, for instance, active
25 pixels, that was not a focus of my own

<p style="text-align: right;">Page 26</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 research group's work. 3 Q. Okay. I appreciate that. 4 I did take a look at your CV so 5 it's not a quiz, and obviously I believe 6 you have your declaration, I was going to 7 say your report, but your declaration in 8 this IPR, so if any of these questions -- 9 it's not a memory test, if you need to look 10 at anything, just let me know. That's 11 obviously fine. 12 Did you work in industry, 13 though? Obviously you have quite a career 14 in academia. Have you worked in industry 15 at all? 16 A. I have worked with industry 17 extensively, but I would not say I worked 18 in industry. 19 I have been a full-time academic 20 for my entire career, but a great deal of 21 my research was very applied and was either 22 of interest to the semiconductor industry 23 or to the Department of Defense, but by the 24 '90s -- I'm trying to remember the time 25 frame -- probably mid 90s and into the</p>	<p style="text-align: right;">Page 27</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 2000s, one of the major prongs of my 3 research was really driven by the needs of 4 the silicon world. 5 So the silicon fabrication 6 businesses, Motorola, AMD. I did research 7 work for Sematech, which was a research 8 consortium for semiconductor manufacturing. 9 So in that environment, I was 10 working quite closely with my industry 11 partners, but I was not on their payroll. 12 MR. CAPLAN: I'm sorry, you know 13 what? I really hate to do this. I'm 14 having some medical issues in my family. 15 Can we take a short break? 16 MR. DAVIS: No problem. 17 (A recess was taken.) 18 BY MR. CAPLAN: 19 Q. Dr. Neikirk, again, I apologize, 20 I had to take a brief break there, but you 21 were going over some of your work with 22 industry as opposed to in industry, and you 23 mentioned a couple of companies, and that 24 was actually one of the questions I had for 25 you.</p>
<p style="text-align: right;">Page 28</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 When you said you worked with 3 industry, I just want to get a sense of 4 what particular companies you were working 5 with at that time, and I assume we're still 6 talking in this mid '90s time period, if 7 that's correct. 8 A. Mid '90s stretching into the 9 2000s. 10 Q. And so what companies were you 11 working with at that time? 12 A. So the very active members in 13 the research field that I was working with 14 included Motorola and IBM. I was in fairly 15 close contact with a number of people at 16 IBM, T.J. Watson Research Center primarily, 17 but Al Rhueli and a few other people at 18 IBM. 19 Similarly, people at Motorola. 20 At that time, some of our models 21 were being incorporated into some of the 22 computer-aided design systems, so we worked 23 a bit with Silvaco and with Mentor 24 Graphics, to some extent with AMD, a number 25 of students ended up going to work at AMD.</p>	<p style="text-align: right;">Page 29</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 Some of the collaborators were 3 also at Microsoft -- excuse me -- Intel, 4 not Microsoft. Intel. 5 So those would be ones that come 6 to mind off the top of my head. 7 Q. And the work with industry was 8 in connection with the same technologies 9 that you described that you were working on 10 in overseeing research for; is that right? 11 A. Yes. And, in particular, the 12 what's called interconnect modeling and 13 characterization work was of very great 14 interest to those at Intel and IBM and at 15 Motorola, as well as the computer-aided 16 design firms. 17 Separate from that, some of my 18 sensor work, specifically pressure for the 19 sensor work, was of interest at Motorola. 20 Different research group, or different 21 group of people at Motorola, but that work 22 was also one that we did some collaboration 23 on. 24 And the infrared sensor work, 25 which was mostly funded and driven by the</p>

<p style="text-align: right;">Page 30</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 interests of the Department of Defense, but 3 we worked with a company called Foster 4 Miller, which was a defense contractor, on 5 some Small Business Innovation Research 6 grants, SBIR grants. And that was specific 7 to the infrared focal point array work. 8 Q. And, again, it sounds like your 9 work with industry was not in connection 10 with products or research tied to CCD 11 imager products; is that right? 12 A. So the interconnect work, I 13 would agree, that's really not related to 14 CCDs, and neither is the pressure 15 transducer work. 16 As I think I already tried to 17 explain, the infrared focal point work, our 18 primary competition was the mercury cadmium 19 telluride work, which is related to CCDs. 20 It is a photo detector array. But we were 21 looking at alternatives for that, so we had 22 to understand it because it was our 23 competition, but that's not what we were 24 building. 25 Q. And was that the same -- to the</p>	<p style="text-align: right;">Page 31</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 extent you were looking at the CCD 3 technology at that time, was that the same 4 CCD technology that was used in commercial 5 consumer products at that time? 6 A. So the mercury cadmium 7 telluride-type devices were more exotic. 8 They were only used in military systems. 9 They were not based on silicon. They were 10 very expensive. They were occasionally 11 used on telescopes for their infrared 12 response. 13 The silicon-based CCDs were -- 14 only work for visible wavelengths of light. 15 We were primarily interested in longer 16 wavelengths. 17 Q. I asked you that question which 18 you were just responding about CCDs, but 19 the same in connection with CMOS: 20 Your work with industry at that 21 time wasn't in connection with CMOS imager 22 products or CMOS imager sensors, was it? 23 MR. DAVIS: Object. 24 Form. 25 A. I think that it's fair to say</p>
<p style="text-align: right;">Page 32</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 that the work that we were doing was not 3 directly in the area of CMOS imaging 4 devices or CMOS pixels. 5 Q. Okay. You've obtained a number 6 of patents; is that right? 7 A. Yes, that's correct. 8 Q. It looks like you got them all 9 while you were on the faculty at the 10 University of Texas; is that correct? 11 A. Yes. All of my patents are 12 assigned to the University of Texas. 13 Q. It looks like -- I'll ask you, 14 but your patents appear to be in the same 15 technology areas that you've been 16 describing you've been working on; is that 17 right? 18 A. Yes, I think that's correct, 19 yes. 20 Q. And we don't have to go through 21 all your patents, that's not the focus 22 here, but the two questions I've been 23 asking I do want to follow up on here, is 24 that it didn't appear -- and do any of your 25 patents relate to CCD imager products or</p>	<p style="text-align: right;">Page 33</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 CCD image sensors? 3 A. So the chemical sensing work 4 that we did, most of it was what's called 5 optically transduced, and so we would use 6 imaging arrays, silicon-based, as the photo 7 detectors to capture the signals from our 8 chemical sensors. 9 But I would say that those 10 patents largely view the image sensor part 11 of it as being conventional and well-known. 12 It was the chemical interaction 13 with light that was the new focus and ways 14 of assembling that into arrays. 15 But the final photo detection, 16 which we usually use arrays, frequently 17 CMOS arrays, those, I think -- where 18 they're discussed in the patents, I'm 19 pretty sure they would be discussed as 20 conventional and well-known. 21 Q. So you wouldn't characterize any 22 of your patents as being CCD imager patents 23 then, would you? 24 MR. DAVIS: Objection to form. 25 A. Well, so certainly they were not</p>

<p style="text-align: right;">Page 34</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 specific to CCD imagers. 3 They frequently related to 4 imagers or used them, but, no, again, I 5 don't think that the novel aspect for which 6 we obtained the patents was because of the 7 CCD or CMOS, as often as I think we did use 8 CMOS. 9 Q. And when you talk about imagers, 10 I just want to make sure I understand your 11 understanding of that term "imager." 12 What are you referring to when 13 you talk about an imager, because I know 14 it's come up a few times? I just want to 15 be clear about that. 16 A. Broadly speaking, I usually use 17 that word to relate to a system which has 18 to have something to collect light optics, 19 a detector or transducer to convert that 20 light into an electrical system, and then 21 in many cases electronics, to produce a 22 signal that can be otherwise used. 23 And so an imager, the way I was 24 using it, is frequently that -- all of 25 those things put together.</p>	<p style="text-align: right;">Page 35</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 Not just the focal point array, 3 which is the term I usually use to talk 4 about the device that has the photo 5 detectors which convert light into an 6 electrical signal. 7 Q. Okay. So then it sounds like 8 there are a lot of different types of 9 imagers as you use that term. 10 There are a lot of different 11 technologies which can be employed in an 12 imager, as you've been describing it; is 13 that right? 14 A. Yes. I think that's fair. 15 There are many different types. All 16 combined, there are different types of 17 focal point arrays, for instance. 18 Clearly, there are different 19 types of optics and there are different 20 electronic processing done after the light 21 is converted to an electrical signal. 22 Q. Okay. In terms of manufacturing 23 experience, I know you talked about some of 24 the -- you had a lab and you did some fab 25 work which you were describing in</p>
<p style="text-align: right;">Page 36</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 connection with your Ph.D. studies. 3 Have you actually done any CCD 4 imager manufacturing in the course of your 5 career? 6 A. No, I haven't done specifically 7 CCD fabrication. I worked -- I developed a 8 course on silicon integrated circuit 9 fabrication and taught that course for 25, 10 30 years, along with a laboratory to 11 actually do it, but we did not do CCD 12 arrays. 13 Q. And have you done any CMOS image 14 sensor manufacturing in the course of your 15 career? 16 A. Again, that specific type of 17 detector was not a focus and we did not 18 make those in our teaching class either. 19 We were primarily focused on 20 things more applicable for digital 21 applications. 22 Q. What do you mean by that, for 23 digital applications? 24 A. Well, the primary -- so my 25 teaching course, the graduate students and</p>	<p style="text-align: right;">Page 37</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 undergraduates in that class were typically 3 being employed by industry, and the vast 4 majority of industry was in fabricating 5 digital CMOS silicon devices. 6 So our focus was on silicon 7 devices, silicon transistors, and our focus 8 was more the transistor side than the photo 9 detector work. Photo detectors are much 10 more of a niche application. 11 And so in terms of an education 12 and training environment, we needed to 13 focus on things that the students were most 14 likely going to be employed to do. 15 Q. Okay. So then it sounds like 16 your focus was not on the photo detector 17 aspect of these different imagers; is that 18 right? 19 MR. DAVIS: Object to form. 20 A. So in terms of my teaching, I 21 would say that's correct. 22 My research, again, was 23 different and primarily focused on infrared 24 photo detectors, which typically are not 25 CMOS, nor are they CCD.</p>

<p style="text-align: right;">Page 38</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 Q. I know you talked a little bit 3 about CCD technology that was kind of 4 peripherally related to some of the work 5 you were doing, but was there a particular 6 point in time where you became more 7 familiar with CCD imager technology, and 8 I'm talking about an imager which has -- 9 trying to use your language so we're not 10 talking past each other -- a CCD photo 11 detector sensor? 12 A. So when I was in graduate 13 school, I worked -- one of the groups that 14 I worked with were people in astronomy, and 15 a number of the faculty I worked with, 16 their area of application was astronomical 17 systems. 18 At that time, the imaging array 19 of choice was a CCD, and I became familiar 20 with them even then, as, if you will, 21 competition, so I had to know what the 22 performance metrics were for a CCD device 23 to understand whether what we were working 24 on could ever perform that well, or 25 preferably perform better.</p>	<p style="text-align: right;">Page 39</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 So I've been familiar with CCDs 3 since at least the early '80s. 4 Q. And when you became first 5 familiar with the CCD technology in the 6 early '80s, were you familiar with how CCDs 7 were being manufactured at that time and 8 designed or just how they operated or the 9 results? 10 A. I would say both. In order to 11 understand how they operate, you also have 12 to understand how they're made. 13 And, again, you'll recall I've 14 already explained this, that one of my 15 areas that I've always worked in is actual 16 fabrication, so even if I was fabricating 17 infrared devices, I was always interested 18 in keeping myself informed in how people 19 use similar fabrication techniques to make 20 other things, and that would include CCDs. 21 Q. So you did study CCD image 22 sensor manufacturing? 23 A. I would say to some extent, yes, 24 I was certainly aware of it. 25 Q. And that was in your graduate</p>
<p style="text-align: right;">Page 40</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 studies? Is that when that happened? 3 A. Well, it wasn't in a formal 4 course. It was -- it was background 5 information I needed to know to be able to 6 put my own work in context, and that 7 continued forever. 8 I mean, I always need to know 9 what the competition does, how it works, 10 how it's made. I want to understand a 11 different device's advantages and 12 disadvantages. 13 Q. Okay. So then you would agree 14 then you studied CCD technology, it sounds 15 like it started in the '90s, as background 16 information to your core research which was 17 not on CCD image sensor technology; is that 18 right? 19 A. I think that's a fair way to 20 describe it, yes. 21 Q. Okay. And how about CMOS 22 technology? When did you develop an 23 understanding of CMOS technology? 24 A. Well, of course CMOS is a much 25 broader term, but if you're asking -- are</p>	<p style="text-align: right;">Page 41</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 you asking specifically about CMOS photo 3 detector architectures? 4 Q. Yes, let's focus on the CMOS. I 5 should have said that. 6 So CMOS photo detector 7 technology, when did you become familiar 8 and start to learn about that technology? 9 A. Well, that technology really 10 didn't even exist in the early '80s, or at 11 least not in any broad-based form. 12 That was something that really 13 started to develop in the late '80s and 14 early '90s. And I became aware of it at 15 the time, at that time. 16 The idea of -- the photo diode 17 itself is -- in some of the implementations 18 is, I'll say, conventional. 19 The idea of incorporating at 20 each pixel storage and addressing circuitry 21 was something that was going on both in 22 that area, CMOS focal planes and the 23 infrared focal planes, which was really 24 more of my interest. 25 I mentioned I worked on</p>

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 microbolometers. To make that a useful
3 imaging product, they had to -- they used
4 CMOS circuitry, which was called a readout
5 IC, ROIC, under the infrared detectors.
6 And so, again, I was doing
7 research on how to make the detector
8 better, but it was very important for me to
9 understand the other part, which was the
10 CMOS part.
11 So I would say I became aware of
12 it in the late '80s, early '90s. Again, I
13 had to understand how that was working to
14 put my own work in context or understand
15 how my work might be used in combination
16 with CMOS technology.
17 Q. Okay. So, again, then your
18 introduction and understanding of CMOS
19 technology evolved as related
20 information -- call it maybe background
21 information -- for other work you were
22 doing, but the focus of your study and
23 research was not on this CMOS image sensor
24 focal point array itself; is that right?
25 MR. DAVIS: Object to form.

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 faint objects, so it was critical that they
3 have high sensitivity and very low noise,
4 and CCDs, that was the device of choice at
5 the time.
6 Q. And by the time CMOS became a
7 technology that you started hearing about
8 and getting some background on, was there
9 -- what were the differences between those
10 two technologies in terms of how they were
11 starting to be used in the marketplace?
12 A. Well, broadly, the CCDs -- when
13 the first CMOS imagers came out, they
14 tended to be higher noise, so from a purely
15 electrical performance perspective --
16 optical and electrical performance
17 perspective, they typically were not as
18 good as CCDs, but they tended to be
19 cheaper.
20 CMOS was -- the techniques to
21 fabricate CMOS were widely available, and
22 by the mid '90s to late '90s used to build
23 many millions of transistor circuitry.
24 They were pretty cheap.
25 CCD fabrication, although it's

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 A. I think that's a reasonable way
3 to describe it. It wasn't the focus of my
4 own new research.
5 Q. Let's span back when you started
6 learning about the CCD technology.
7 Were there particular benefits
8 of the technology at that time? What was
9 it about the technology that caused you to
10 need to learn about it?
11 A. Well, so in the early '80s --
12 '70s and early '80s, the types of available
13 solid-state focal point arrays, so the
14 solid-state replacement for film, there
15 were few choices, and I'm trying -- CCD was
16 certainly one, and maybe the only one in
17 roughly 1980. I've forgotten what other
18 alternatives there were.
19 A CCD, when cooled, is -- can be
20 a very sensitive and low noise device, and
21 that was very important for the
22 astronomers.
23 The people I worked with were
24 working at the observatories in Hawaii.
25 They were interested in observing very

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 still silicon usually, required a slightly
3 different set of processes, and because of
4 that, you're -- you have to -- a
5 fabrication facility is dedicated to
6 basically one style of process.
7 If you can make many different
8 types of parts that can be used by many,
9 many -- in many, many applications, then
10 essentially you have a manufacturing
11 technique with a big market and that tends
12 to drive costs down.
13 The CCD processing is a little
14 bit more unique and tends to be one where
15 you're now dedicating that fabrication
16 plant/facility to really just one product
17 and roughly only one sector of application.
18 It tends to make it a bit more expensive.
19 So I think I said earlier that I
20 work with astronomers. Astronomers' cost
21 was not an issue. Cost was irrelevant.
22 Performance was everything. They didn't
23 use very many CCDs, but they had to be
24 really good and they paid a lot of money
25 for them, and by a lot of money in some

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 cases I believe they were tens of thousands
3 to hundreds of thousands of dollars for
4 just photo detectors.
5 By the '90s, there was a lot of
6 interest in consumer applications, where
7 cost is very important and people were
8 trying very hard to make CCDs cost
9 competitive.
10 But one of the big promises of
11 the CMOS imagers was they could say -- and
12 early on, there wasn't a market yet, so
13 they couldn't demonstrate it, but they
14 could say: "We have all of this
15 infrastructure already in place for CMOS,
16 we've already demonstrated it's cheap, CMOS
17 imagers should probably be able to be
18 cheap." And then over the years they
19 demonstrated that.
20 They also improved the
21 performance to a point where the
22 performance of the CMOS imagers -- focal
23 point arrays -- were certainly adequate for
24 consumer applications or more than
25 adequate.

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 in the last couple of questions, it sounds
3 like you would agree that at the time,
4 let's talk about the mid '90s, that is a
5 relevant time frame for us, so in the mid
6 '90s, as the CMOS technology was coming to
7 market or becoming more developed, even at
8 that time, in the mid '90s, CCD image
9 sensor quality was higher than the CMOS
10 image sensor quality.
11 Do you agree with that?
12 MR. DAVIS: Object to form.
13 **A. From the perspective of pure**
14 **performance numbers, meaning noise, that**
15 **was probably still true roughly mid '90s,**
16 **but it was already clear at that time that**
17 **for most camera -- consumer camera**
18 **applications, for instance, that noise**
19 **level was not a limiting factor for either**
20 **device.**
21 **Again, it depends on what you're**
22 **going to use things for. If you're taking**
23 **snapshots, ultimately low noise performance**
24 **is probably not your driver.**
25 **If you're building a military**

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 **And so any advantage you might**
3 **get from a CCD from a performance**
4 **perspective really wasn't relevant. Cost**
5 **was.**
6 **So that's roughly how that area**
7 **evolved. And I follow that fairly closely**
8 **with a great interest in those areas, focal**
9 **point arrays, and in the areas of**
10 **integrated circuit.**
11 Q. The CCD devices you worked on or
12 you looked at in connection with the
13 astronomy applications, those were not in
14 consumer devices; right?
15 Those were more industrial
16 applications; is that correct?
17 **A. Yes, that's correct. Those --**
18 **the CCD arrays used by the astronomers on**
19 **telescopes, I wouldn't refer to those as**
20 **consumer products.**
21 **Could someone else buy them?**
22 **Yes. But as I said, they were very**
23 **expensive, and the average consumer would**
24 **not be putting them in a camera.**
25 Q. So just based on your testimony

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 **system for use on the battlefield, cost is**
3 **probably not the driver, but performance**
4 **is.**
5 **So I think that was well**
6 **understood by the -- by the mid '90s, that**
7 **CMOS worked, it was cheaper and its**
8 **performance for many applications was good**
9 **enough, whereas if you went to some other**
10 **applications where noise was the limiting**
11 **character but cost was not relevant, you**
12 **might choose CMOS -- I'm sorry -- you might**
13 **choose CCD instead.**
14 MR. CAPLAN: Is this a good
15 point if we can take a short break here?
16 Maybe 10 minutes.
17 (A recess was taken.)
18 BY MR. CAPLAN:
19 Q. So, Dr. Neikirk, you were just
20 testifying about some of the differences
21 between the CCD and the CMOS technology in
22 that mid '90s time period and you made a
23 comment about the cost and quality issues,
24 in particular, that CCDs tend to be more
25 expensive to manufacture and the CMOS

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1 CONFIDENTIAL - DEAN NEIKIRK, PH.D.
2 imager pixel arrays were less expensive to
3 manufacture but had a lesser quality result
4 than the CCD image sensors; is that
5 correct?
6 **A. I don't think I used the word**
7 **"quality." I specifically mentioned noise.**
8 MR. DAVIS: And objection to
9 form.
10 **A. Quality is a much fuzzier**
11 **metric. Noise is a specific thing.**
12 Q. And if there's a lot of noise in
13 an image, is it harder to see the image
14 clearly compared to an image that has less
15 noise?
16 **A. That's -- that's one way to look**
17 **at it. It's usually more of an issue for**
18 **very, very low light level systems.**
19 Q. Okay. And my follow-up question
20 then is, what's the basis for your
21 testimony about the comparison and
22 contrasting of the CCD and the CMOS imager,
23 image sensor? You talked about the photo
24 detector aspect of it in the market at that
25 time.

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1 CONFIDENTIAL - DEAN NEIKIRK, PH.D.
2 general terms, but these issues we've just
3 been discussing is something that I was
4 aware of at the time as -- anybody working
5 in the field of imaging systems needs to be
6 aware of the larger universe than their own
7 narrow slice of that imaging, so it was
8 being aware of the environment I was
9 working in.
10 Q. And in that environment that you
11 were working in, it was related background
12 reading either on CCD or CMOS photo
13 detector sensors at the time where you were
14 getting your information at that point,
15 because it was not the focus of your
16 research and work at that time; is that
17 right?
18 **A. Right. So it would have been**
19 **from reading scholarly journal articles and**
20 **trade magazines. I subscribed to most of**
21 **-- to numerous of the optics sort of area.**
22 **Laser Focus, for instance, subscribed to**
23 **Laser Focus for many, many years -- that**
24 **was a trade magazine -- so, those.**
25 **IEEE Spectrum, which is kind of**

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1 CONFIDENTIAL - DEAN NEIKIRK, PH.D.
2 **A. I'm sorry, you asked me what my**
3 **basis is?**
4 Q. Yes, the basis.
5 What's the basis that it's your
6 view that those were the issues and that's
7 how the products are being treated in the
8 marketplace?
9 Was it just your observation or
10 was it something you had studied? What's
11 the underlying basis for that?
12 **A. My awareness at the time of the**
13 **issues related to building imaging systems.**
14 **Again, as I pointed out, I was**
15 **working in types of imaging systems,**
16 **different wavelengths, but it's important**
17 **to understand the context.**
18 **I was also working very actively**
19 **with those in the fabrication world and**
20 **understanding the various differences in**
21 **how fabrication is done for different**
22 **things was important.**
23 **So I would say the basis is my**
24 **-- I may have some specific citations in my**
25 **declaration about the technologies in**

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1 CONFIDENTIAL - DEAN NEIKIRK, PH.D.
2 the monthly publication, the IEEE.
3 So there were lots of places
4 where these topics were being discussed at
5 the time.
6 Q. Was that a common way that you
7 would keep current with issues in the
8 imager sensor industry, looking at some of
9 these different publications, like Laser
10 Focus or IEEE?
11 **A. I think that's what most**
12 **scholars do. They read the literature.**
13 **They attend conferences. I was a regular**
14 **attendee at SPIE conferences.**
15 **There would be sessions**
16 **dedicated to my own subspecialty of**
17 **infrared detectors. There would be other**
18 **sessions dedicated to other types of**
19 **sensors. I would go to those.**
20 **So I think that's just generally**
21 **what researchers in the field need to do,**
22 **and especially those in academics.**
23 Q. Okay. Do you have a view as to
24 when -- I'll call it the noise -- I guess
25 the noise issue in CMOS photo detector

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1 CONFIDENTIAL - DEAN NEIKIRK, PH.D.
2 compared to a CCD image detector, when the
3 CMOS caught up to the quality or the noise
4 level of the CCD?
5 MR. DAVIS: Objection to form.
6 **A. Actually, I'm not sure that they**
7 **ever have.**
8 **There were other -- one of the**
9 **particular problems with CMOS in the early**
10 **days was what's called fixed pattern noise.**
11 **Also a problem in the sub area**
12 **-- the infrared detectors that I work in,**
13 **fixed pattern noise is related to the fact**
14 **that every -- that your photo detectors**
15 **don't all have the same response**
16 **characteristic.**
17 **So even if you illuminate the**
18 **array with a uniform scene, it appears to**
19 **not be uniform, okay, and that's always the**
20 **same. That's why it's called fixed-pattern**
21 **noise.**
22 **What the CMOS folks were able to**
23 **do was to reduce that level to some extent**
24 **and then also to use various signal**
25 **processing techniques, which because it was**

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1 CONFIDENTIAL - DEAN NEIKIRK, PH.D.
2 others.
3 You would agree, though, that
4 the CMOS photo detector array has become
5 the dominant technology in many of those
6 other industrial applications, maybe not in
7 the Hawaii system, but in other industrial
8 applications.
9 Would you agree with that?
10 MR. DAVIS: Object to the form.
11 **A. So it's a very broad question,**
12 **but I think in general terms, CMOS-based**
13 **focal point arrays, imaging detectors, are**
14 **probably -- if you counted up all the**
15 **applications, they are used in more than**
16 **CCDs. I think that's probably true.**
17 **I haven't tried to do that as an**
18 **exercise in counting, but I think that's**
19 **probably true.**
20 Q. All right.
21 Are you familiar with -- let's
22 talk about in that mid '90s time frame,
23 even into 2000, but let's call it the
24 '94-'95 to '99 time period, are you
25 familiar with who were the major

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 **CMOS, they could add transistors, if you**
3 **will, very cheaply. So you could either**
4 **put the circuitry off the chip or put it**
5 **on. It makes some difference. The size of**
6 **the chip would change, cost would change**
7 **some, but the incremental cost was**
8 **acceptable. And it produced an imaging**
9 **array with performance sufficient for many**
10 **applications.**
11 **I am not absolutely sure, but I**
12 **think to this day if you look at the**
13 **astronomy world, you'll find that they tend**
14 **to use cooled CCDs because they have the**
15 **lowest noise level.**
16 **So, I mean, I don't know that**
17 **CMOS ever outstripped CCDs from this noise**
18 **perspective, but they certainly did become**
19 **less expensive and of performance**
20 **sufficient to support many, many consumer**
21 **applications; consumer cameras, broadly**
22 **speaking, for instance.**
23 Q. Okay. There are a lot of
24 applications, industrial applications, it
25 sounds like astronomers and there are

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1 CONFIDENTIAL - DEAN NEIKIRK, PH.D.
2 manufacturers of CCD, photo detector arrays
3 or CMOS photo detector arrays?
4 **A. You know, I don't recall**
5 **specific companies -- yeah, I don't recall**
6 **specific companies. That is quite a while**
7 **ago.**
8 Q. But also in that same time
9 period, do you have any understanding of
10 the volume of products or the different
11 applications for CCD photo detector arrays
12 and CMOS photo detector arrays in that time
13 period?
14 **A. Well --**
15 MR. DAVIS: Objection to form.
16 **A. Again, I haven't tried to do as**
17 **-- I don't recall doing a broad-based**
18 **survey, but there were cameras available to**
19 **the public, if you will, somewhere in that**
20 **time frame. I think the earlier ones that**
21 **you could buy were CCD.**
22 **But right in roughly that time**
23 **frame, some came out that were CMOS. I**
24 **don't recall specifically what year, and**
25 **I'm just using cameras that a consumer can**

<p>Page 58</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 purchase as kind of my example for that. 3 Q. And I believe you talked about 4 this already but I just want to confirm. 5 So it's your understanding, 6 again, in that time period, in that mid 7 '90s time period, that the CMOS photo 8 detector arrays had more noise than the CCD 9 photo detector arrays; is that right? 10 MR. DAVIS: Object to form. 11 A. I think for noise, as the 12 characteristic -- characterization, yes, I 13 think that's true, for noise, and of course 14 it depends on the application as to whether 15 the noise mattered. 16 Q. Are you familiar with the term 17 "on-chip" and "off-chip" in connection with 18 semiconductor manufacturing? 19 A. Well, on-chip is a fairly 20 descriptive term. It refers to things that 21 are fabricated, and I'm going to use the 22 word monolithically, on the same piece of 23 semiconductor versus things that are not 24 off-chip. 25 Q. And with respect to CCD image</p>	<p>Page 59</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 sensor and photo detector array technology, 3 again, in this time period, the mid '90s, 4 did that use an off-chip approach to the 5 overall design of those products, do you 6 know? 7 A. My recollection, and I believe 8 some of the art, as I've discussed in my 9 declaration, the -- including some 10 circuitry on the CCD was done, it varied in 11 terms of how it was partitioned. How much 12 was on-chip and how much was off. I think 13 it varied. It depended on the application 14 and manufacturer, I think. 15 Q. Are you saying you could put 16 additional circuitry onto the same piece of 17 silicon where the CCD photo detector array 18 was located? Is that your understanding in 19 that time period? 20 A. Yes, you could, and I believe 21 some did. I'm not sure that -- you know, I 22 don't recall whether they had -- well, you 23 say circuitry. 24 The CCD itself was a circuit, 25 and, you know, additional circuitry, yes, I</p>
<p>Page 60</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 think some was there and sometimes not. It 3 just depended on the specific application 4 and the manufacturing. 5 Q. Are you thinking about a 6 particular device or reference or 7 description of a CCD device that has 8 multiple components on the circuit with the 9 CCD photo detector array? 10 A. Well, I believe, again, I think 11 I mentioned -- if I -- could I find the 12 art... 13 I think this was background art. 14 It wasn't art that I cited as art in the 15 invalidity analysis, but I cited a number 16 of other articles. 17 But I think one of the pieces of 18 art I used also cited within itself to a 19 laser focus article. I think that was an 20 Eric Fossum article in which he gave a 21 general background and discussion of CCDs. 22 He started off with pros and 23 cons and then he talked about the evolving 24 area of CMOS sensors. And that one might 25 be -- I don't recall right off the top of</p>	<p>Page 61</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 my head, but I know I've seen it, and I 3 recall it from the time that it just varies 4 to how much you put on board -- how much 5 you put on-chip, how much you put off-chip. 6 Q. So what kind of circuitry or 7 components would or could you put on-chip 8 in a CCD photo detector array? 9 MR. DAVIS: Objection to form. 10 A. You know, off the top of my 11 head, I don't recall what specific ones 12 were done. 13 You know, obvious things that 14 may or may not have been included would be 15 the possibility of putting timing and 16 control, some forms of that. 17 There are many different forms 18 of that form of circuitry. Basically 19 circuitry that assists with the readout. 20 Remember, a CCD is kind of a 21 bucket per grade readout, which is 22 typically quite different from how you read 23 out CMOS. So peripheral circuitry to help 24 handle that readout may or may not have 25 been included.</p>

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 Q. As you sit here today, can you
3 identify a particular reference or product
4 that has other circuitry on-chip with the
5 CCD photo detector array?
6 **A. Off the top of my head, I don't**
7 **know that I can point you to one**
8 **specifically.**
9 Q. You mentioned Eric Fossum.
10 Do you know Eric Fossum?
11 **A. I certainly know him by**
12 **reputation and his field of research.**
13 **I don't personally know him.**
14 Q. I'm sorry, what -- go ahead.
15 **A. He worked at JPL in the -- I**
16 **think late '80s, certainly through the**
17 **'90s. JPL was managed by Caltech, and I**
18 **used to do some work at JPL when I was a**
19 **graduate student, so there's sort of a --**
20 **there was also an astronomy connection,**
21 **which is also a connection to NASA.**
22 **I tended to follow people in**
23 **work that went on at my old institution, so**
24 **there was that connection, but I don't know**
25 **him personally.**

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 that -- in the CMOS imager photo detector
3 array area?
4 **A. Yes, I think that's fair.**
5 Q. I believe in your report --
6 MR. CAPLAN: And I know, Jim,
7 you said Dr. Neikirk has his declaration
8 and the exhibits there; is that right?
9 MR. DAVIS: Yes.
10 **THE WITNESS: I do.**
11 BY MR. CAPLAN:
12 Q. So there is an Exhibit 1060.
13 It's a Business Week article. Is that
14 something that --
15 MR. CAPLAN: Jim, just in terms
16 of how we're doing it, I assume we're going
17 to use the IPR exhibit numbers for the
18 deposition?
19 MR. DAVIS: Yes, that makes
20 sense.
21 MR. CAPLAN: So I'll just refer
22 to Exhibit 1060.
23 (Exhibit 1060 for
24 identification, Business Week article,
25 shown to witness.)

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 Q. Okay. I believe you said you
3 know he had a reputation.
4 What was his reputation, at
5 least at that time? And it sounds like
6 we're talking about -- well, we are talking
7 about the mid '90s period.
8 Do you have an understanding of
9 his reputation at that time?
10 **A. Well, I think that his -- he was**
11 **at JPL, the Jet Propulsion Laboratory, and**
12 **the Jet Propulsion Laboratory supported**
13 **NASA projects, and, in particular, one of**
14 **the things they supported was map imaging**
15 **systems for NASA. And I believe**
16 **Dr. Fossum's work was broadly in the area**
17 **of supporting the focal point arrays for**
18 **use in NASA camera systems or telescopes.**
19 **So I think, you know, I don't**
20 **recall that -- I don't think he started out**
21 **with CMOS. I think his broader role was**
22 **that imaging support. So he would have**
23 **looked at everything, I would think.**
24 Q. Is it your understanding that
25 Dr. Fossum was a recognized innovator in

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 **THE WITNESS: I do have that**
3 **open in front of me.**
4 MR. CAPLAN: Great.
5 BY MR. CAPLAN:
6 Q. So this is an article that you
7 cite in your report, or your declaration --
8 sorry -- Dr. Neikirk?
9 **A. Yes, I do.**
10 Q. Okay. And this article is about
11 the work that Eric Fossum was doing at JPL
12 for NASA; is that right?
13 **A. I believe that is correct.**
14 **It identifies three inventors**
15 **from JPL, and they identify Eric Fossum as**
16 **the leader. This was written in '95, this**
17 **particular article, yes.**
18 Q. This is a document that you
19 looked at in connection with preparing your
20 declaration in this IPR; is that right?
21 **A. It is.**
22 Q. When you read this article, did
23 you recall if you agreed with it or not, in
24 terms of what it's describing as the
25 state of the art at the time?

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1 CONFIDENTIAL - DEAN NEIKIRK, PH.D.
2 MR. DAVIS: Objection.
3 Form.
4 A. So let me scan it again. It's
5 been a while. Largely it's talking about
6 the active pixel sensors and makes
7 reference to costing less than CCDs.
8 Q. Do you agree with that?
9 A. I do, in general terms.
10 "Incorporating" -- to quote from
11 it -- "all manner of electronic controls
12 that are usually on multiple chips."
13 And again I believe that that
14 was viewed as being easier because it's
15 fundamentally a CMOS technology.
16 Some of the special processes
17 required for CCD you have to be careful
18 when you mix them with CMOS. It doesn't
19 mean you couldn't, but it tends not to give
20 you the cost advantage.
21 This particular article said it
22 required less power. I think that's
23 probably, in general terms, fair.
24 Q. So you agree with that as well
25 then?

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1 CONFIDENTIAL - DEAN NEIKIRK, PH.D.
2 sentence that says: "Chip offers fresh
3 opportunities to the companies that have
4 been stymied by the high barriers to
5 entering the CCD production."
6 So I think that this was -- in
7 '95, I think some of these statements were
8 probably ones that fell more in the
9 category that we should be able to do this,
10 and I think they had a reason to be very
11 confident -- confident they would be able
12 to do all of these things.
13 I don't know which one of these
14 things had been demonstrated by '95, and I
15 think in terms of commercial production I
16 think it was fairly limited.
17 Remember, for instance, Fossum's
18 own chips, the earlier pieces were done in
19 what's called a foundry, specifically for
20 JPL. That's not a consumer product yet.
21 Q. In the article, if you're
22 looking -- the beginning of the article it
23 makes reference to -- it says "get ready
24 for the camera-on-a-chip" in the first
25 sentence.

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1 CONFIDENTIAL - DEAN NEIKIRK, PH.D.
2 A. I think so.
3 MR. DAVIS: Objection to form.
4 A. In general terms.
5 Q. Just so I understand that,
6 because you said "in general terms" you
7 agree with it, is there some aspect of it
8 that you don't?
9 A. Well, if you had -- of course it
10 depends on the number of pixels. I mean, I
11 suppose if you built a 100 pixel CCD and a
12 mega pixel CMOS, I don't know how the
13 prices would compare -- would compare, but
14 -- so that's what I mean by "in general."
15 If you tried to put -- make
16 other things a constant, I think the CMOS
17 would tend -- certainly today it is cheaper
18 because the technology has matured.
19 Q. That was true at the time of
20 this article too as well, though, wasn't
21 it?
22 A. Well, I think at the time of
23 this article, it was a discussion of --
24 more of promise. You know, this was
25 written in '95. You know, there's another

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1 CONFIDENTIAL - DEAN NEIKIRK, PH.D.
2 Do you see that?
3 A. Yes, I do see that.
4 Q. Is "camera-on-a-chip" a phrase
5 you were familiar with at that time?
6 A. That was a phrase that -- and I
7 don't know precisely who coined it. It may
8 have even been Fossum. I don't recall.
9 But it was a term that was
10 thrown around or began to be used in the
11 early -- I think early '90s, I don't know,
12 maybe it got thrown out in the late '80s.
13 But, in general, the idea was
14 having as much camera functionality as
15 possible on a single chip.
16 Now, what actually meets the
17 definition, I don't think there was a
18 definition at the time. I think it was
19 more of a -- a term of promise. You know,
20 by switching to CMOS, we ought to be able
21 to integrate more and more on chip, and so
22 at some point perhaps we have all the
23 functionality we need to have a complete
24 camera on one chip.
25 Q. I'm just looking at the

<p style="text-align: right;">Page 70</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 transcript. You said it was because a CMOS 3 detector ray was built using CMOS that you 4 could have this integration, 5 camera-on-a-chip, with all the features 6 integrated on a chip; is that right? 7 MR. DAVIS: Objection to form. 8 A. It's a question of process 9 compatibility. 10 So when you manufacture an 11 integrated circuit you have a certain set 12 of fabrication processes, and those 13 processes have to be -- are developed to 14 make a certain type of devices. 15 If you've optimized the 16 processes for making MOS transistors, and 17 the only thing you have to use is MOS 18 transistors for whatever your goal is, that 19 means you can probably do it, okay. 20 For the CMOS pixels, mainly what 21 you build are either CMOS transistors, or 22 depending on the design, a photo diode 23 area, which actually looks like part of a 24 CMOS transistor. 25 So because of process</p>	<p style="text-align: right;">Page 71</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 compatibility, yes, you can then take CMOS 3 logic, or whatever, and largely expect you 4 can put it together, and the manufacturing 5 technique will work for all of it. 6 Q. And that's the ability to do 7 everything in CMOS that is what gave rise 8 to the camera-on-a-chip process being 9 possible? 10 MR. DAVIS: Objection to form. 11 A. I'd say that's reasonable, but 12 the -- at least camera-on-a-chip at a more 13 reasonable cost. 14 It's possible to design a 15 process flow to combine CCD with other 16 things, but it's not a standard process 17 flow. 18 So the -- I'm trying to think of 19 an analogy. A -- an automobile 20 manufacturing plant is optimized to make 21 one model. Maybe there are options, right, 22 but they make one model. 23 If you decide to change models, 24 you've got to retool the plan, and that 25 costs money.</p>
<p style="text-align: right;">Page 72</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 Same thing with types of 3 integrated circuit devices. At this time, 4 in late '80s/early '90s, the idea of what's 5 called standard CMOS process flow was 6 evolving, and things called foundries were 7 coming into existence, which basically 8 would manufacture anybody's design as long 9 as it fit in their process flow. 10 Trying to combine CCD with 11 generic CMOS logic doesn't really fit that 12 standard process flow, whereas the CMOS 13 pixels did, or do, still do. 14 And so it was -- I think there's 15 a quote in here from Dr. Fossum himself 16 where he said -- where did he say this? I 17 just noticed it, that they sort of turned 18 it on its head. Where is it -- he talks 19 about since it's made on standard 20 semiconductor production lines. That's 21 what I was just talking about. 22 Where is that -- somewhere in 23 here he points out that at some point they 24 sort of started to realize, well, rather 25 than staying with the CCD and creating this</p>	<p style="text-align: right;">Page 73</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 custom fabrication process, maybe they 3 should just say "all right, let's use the 4 standard process and figure out whether we 5 can make a good photo cell, a good pixel," 6 and that's what I think led to the active 7 -- the pixels that they developed, as well 8 as a recognition of their potential, and 9 ultimately that potential has been 10 realized. 11 Q. So in this Exhibit 1060, where 12 Dr. Fossum is talking about CCD and CMOS 13 devices that he's working with, you would 14 agree that he -- Dr. Fossum's approach was 15 not to combine CCD and CMOS products at 16 that time; right? 17 A. Well, I mean, actually, I'm not 18 sure that he hadn't already tried that. 19 I think the -- by this point in 20 time, the -- I'll call it selling point, 21 the -- what they were trying to point out 22 were the advantages of not doing that. 23 That you can use standard CMOS 24 processing that manufacturers already had, 25 didn't require them to retool, and that's</p>

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 that high barrier to entering CCD
3 production language that's in that article.
4 So I think what he was pointing
5 out is that there may be circumstances
6 where best performance as measured by noise
7 isn't really the right thing you should
8 focus on, and that by going to this
9 technology you could build an imaging chip
10 that had more functionality, but really one
11 of the critical pieces was it cost you less
12 to make that.
13 I don't think it was so much a
14 statement that it is impossible to do it
15 with CCD. It's just that it costs a lot,
16 and if you didn't already make CCDs, it
17 would cost you a whole lot to get into that
18 business. And I think he says that right
19 there. This article says that.
20 Q. So the state of the art at the
21 time is, as described in this article, was
22 going to camera-on-a-chip CMOS photo
23 detector array image sensors; is that
24 right?
25 MR. DAVIS: Object to form.

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 very much to do that. It's the same
3 process.
4 I think that that is what, at
5 the time, my recollection of how this
6 evolved, having worked in fabrication for
7 CMOS, I was well aware of foundry
8 processing.
9 But virtually everything -- all
10 the manufacturers I knew of were doing
11 digital. Nothing analog. There were a few
12 custom analog circuits done by Motorola for
13 sensor products, but they were typically
14 different. And this idea that you could
15 start to do analog using a process you
16 already had was a clever one.
17 It was: Okay, well, let's go
18 back and look at the circuit design, look
19 at what you're able to do with the standard
20 process and see what circuits we could
21 build that we didn't used to try.
22 One of my own graduate students,
23 we wanted to build an analog processing
24 unit to measure some specific analog
25 signals. And we wanted to use a standard

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 A. I think at the time of this
3 article, it was more of a promise than a
4 reality. But, again, I think it was a
5 promise made with a lot of good reasons.
6 So recognizing that this was a
7 good place to go was an important
8 innovation.
9 Now, exactly what year, what got
10 incorporated where, you know, exactly how
11 much has to be on-chipped, call it a
12 camera-on-a-chip, those are all -- first of
13 all, I don't recall what years are exactly
14 what, and, you know, one person's
15 camera-on-a-chip might not be somebody
16 else's in terms of functionality on a chip.
17 But I think in 1995, when this
18 article was published, what they were
19 pointing to Fossum's group at JPL as being
20 key innovators on is recognizing that using
21 standard CMOS processing had a lot of
22 advantages in terms of cost and the ability
23 to combine both the pixel, the imaging
24 sensor and other electronics could be one
25 of great advantage because it doesn't cost

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 process, but the process available to us
3 was digital CMOS.
4 So using this philosophy, we
5 simply sat down and said: Well, gee, can
6 we use that process to build what we want.
7 We could. It ended up with kind
8 of an unusual circuit. It's not how we
9 would have implemented had we done a custom
10 design.
11 But the potential advantage was,
12 we could send that design to a foundry and
13 they could build it.
14 And that was, I think, a clever
15 recognition at the time and one that I
16 certainly can't take credit for. We got it
17 from other people.
18 Q. So the standard processes you're
19 talking about as applied to the work that
20 Dr. Fossum was doing was the CMOS
21 manufacturing process, right, that was the
22 standard process that he was able to
23 leverage in a different way to further
24 advance these CMOS photo detector arrays;
25 right?

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1 CONFIDENTIAL - DEAN NEIKIRK, PH.D.
2 **A. Yes, I think broadly, that's**
3 **right.**
4 Q. And you agree that the CCD
5 manufacturing process you talked about a
6 little bit a few moments ago was more
7 difficult and pretty tailored to the CCD
8 issues?
9 MR. DAVIS: Objection to form.
10 **A. So the "pretty tailored" I think**
11 **is certainly true. You know, is it more**
12 **difficult? It's a different production**
13 **line, for sure, right? People made CCDs in**
14 **the '70s and 80s and they worked very well,**
15 **but the processes used were very tailored**
16 **to do that.**
17 **So I'm not sure whether I really**
18 **should call it more difficult or not, but**
19 **it's certainly different and it's tailored.**
20 **So the difference between being**
21 **able to buy shirts off the rack or having**
22 **to have every shirt made by a tailor,**
23 **right. Clearly, that's -- they're both**
24 **doable, but one is probably more expensive**
25 **than the other.**

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1 CONFIDENTIAL - DEAN NEIKIRK, PH.D.
2 is that if you have in hand the steps
3 necessary to do the very specialized one
4 surrounded by the more standard steps, you
5 could do both.
6 But if you don't need the
7 specialized device, then any fabrication
8 facility that has the general ones can make
9 it.
10 So it's the difference, again,
11 between, you know, a tailored shirt still
12 uses buttons manufactured by a big button
13 manufacturer, right? The buttons were
14 cheap and easy, you know, you don't use the
15 custom -- the very narrow techniques if you
16 don't need to use them. I think that's --
17 that's the point. That's one of the key
18 differences between CCD and CMOS.
19 Q. You don't have to make the
20 process harder than it needs to be if
21 there's an easier way to make the CMOS
22 photo detector arrays with a CMOS system
23 that they can just use?
24 MR. DAVIS: Objection to form.
25 **A. I think from the perspective of**

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 Q. And a person skilled in the art
3 wouldn't take that tailored CCD process to
4 manufacture a device with a CMOS photo
5 detector array, would they?
6 MR. DAVIS: Objection to form.
7 **A. So the process optimized to do**
8 **CCDs has steps which are very specific to**
9 **the CCD pixel itself. You don't need those**
10 **if you're using a CMOS pixel.**
11 **Now, could you do it? Well,**
12 **yeah, you just skip those steps, but it**
13 **would be silly to use that manufacturing**
14 **facility. You'd be better off going to a**
15 **standard CMOS manufacturing facility.**
16 Q. It sounds like you would not mix
17 and match CCD and CMOS manufacturing
18 technologies in a single product?
19 MR. DAVIS: Objection to form.
20 **A. Well, I actually -- we could**
21 **probably find examples of CCD manufacturers**
22 **who did that, but, again, it's because they**
23 **already had those specialized steps**
24 **available that allowed them to do this CCD.**
25 **So what I'm trying to point out**

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 **semiconductor manufacturing that you never**
3 **want to use anything harder than you have**
4 **to, and the more different products that**
5 **can use the same process, the cheaper every**
6 **one of those products would be.**
7 **So using a standard CMOS product**
8 **to make an imaging device and making the**
9 **digital controller in your dishwasher means**
10 **they're both cheaper, okay, whereas using a**
11 **highly customized process with a small**
12 **market tends to cost you more per device.**
13 Q. Dr. Fossum was describing in
14 this exhibit, the focal point of the
15 Exhibit, so 1060, that's the same
16 Dr. Fossum whose work is cited and
17 described and incorporated by reference in
18 the '565 patent that's the subject of your
19 declaration; right?
20 MR. DAVIS: Objection to form.
21 **A. It is the same Fossum, yes.**
22 Q. Also in this article there is a
23 comment -- let me just go to that. Of
24 course, now I can't find it. I was about
25 to point you to it, but I'm sure once you

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1 CONFIDENTIAL - DEAN NEIKIRK, PH.D.
2 answer the question, I'll find it.
3 Do you agree -- and I believe
4 it's on the first page of the article,
5 Dr. Fossum talks about the power required
6 for a CCD imager compared to the power
7 required for a CMOS imager, and he makes
8 the point that a CCD image sensor with a
9 CCD photo detector array requires more
10 power than a CMOS image sensor with a CMOS
11 photo detector array.
12 Do you agree with that?
13 MR. DAVIS: Objection to form.
14 A. I think that's -- that's a
15 reasonable thing. I think the article says
16 100th to the power. I don't know whether
17 it's 100.
18 But in general terms, yes, I
19 think that's -- that is a characteristic of
20 CMOS imagers compared to CCD imagers.
21 Q. And why is -- why do CCD image
22 sensors with a CCD photo detector array
23 require more power than a CMOS device with
24 a CMOS photo detector array?
25 A. Well, in a CMOS pixel, as long

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1 CONFIDENTIAL - DEAN NEIKIRK, PH.D.
2 Q. Is it your understanding that
3 most CCD photo detector arrays, the
4 ordinary sensor with CCD photo detector
5 array require a voltage of 12 to 15 volts
6 for that device? Is that your
7 understanding?
8 MR. DAVIS: Object to form.
9 A. You know, I don't honestly
10 remember the exact voltage ranges.
11 That it is typically larger than
12 what you use in, say, a TTL level CMOS
13 circuit. That, I'm certainly aware of.
14 Q. So then based on that, a design
15 of a CCD photo detector array image sensor
16 would have different requirements than the
17 design of a CMOS photo detector array image
18 sensor, certainly with respect to the power
19 levels that are required for the device; is
20 that right?
21 MR. DAVIS: Objection to form.
22 A. They are different, and I think
23 that although one of ordinary skill I think
24 at this time, at the time of the patents,
25 was well aware of both and well aware of

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1 CONFIDENTIAL - DEAN NEIKIRK, PH.D.
2 as you could make good transistors with
3 good off-state characteristics, low
4 leakage, it means that once you store the
5 charge there, it will stay there, and
6 turning that transistor on and off is a
7 relatively low power event.
8 For CCD, you do have to use --
9 you have charge stored in one element which
10 you have to transfer to an adjacent
11 element. And that stepping process
12 requires more voltages and it's the
13 movement of current in response to applied
14 voltages, as opposed to in CMOS, you're
15 allowing current to flow from a naturally
16 occurring higher potential to a lower one.
17 So in CMOS, the part of the
18 driving energy is already there.
19 In CCDs, you have to lift the --
20 you have to pick the bucket up to get it
21 higher than the adjacent bucket and pour
22 that out. That's a voltage and a current
23 that consumes power, so that's sort of a
24 very broad way to look at it in a very
25 basic way.

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1 CONFIDENTIAL - DEAN NEIKIRK, PH.D.
2 their differences, but it is true, I think,
3 that you would use different circuits to
4 work with CCD than you would with CMOS.
5 Q. So would you agree then that CCD
6 photo detector array components or --
7 strike that.
8 A CCD image sensor with a CCD
9 photo detector array doesn't -- would not
10 be interchangeable with parts of a CMOS
11 image sensor, with a CMOS photo detector
12 array, you couldn't mix and match the parts
13 for those two image sensors; is that right?
14 MR. DAVIS: Objection to form.
15 A. So if what you're asking is if
16 all of the electronics were present in
17 great specificity, actually built, and you
18 had a CCD chip plugged into that and you
19 unplugged it and plugged in a CMOS chip and
20 made no changes whatsoever in any of the
21 other circuitry, that -- well, again,
22 somebody could probably design the chip so
23 that that would work, but I wouldn't expect
24 that to be the normal course of affairs.
25 You would design the rest of

<p style="text-align: right;">Page 86</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 your circuitry to be compatible with 3 whichever type of imaging device you're 4 going to use, focal point array you're 5 going to use. 6 Q. Right. So that you would -- 7 that approach, if somebody were to try it, 8 would require a redesign of the device; is 9 that right? 10 MR. DAVIS: Objection to form. 11 A. I think it is a different design 12 and one that was well-known at the time, 13 but it's a different design. 14 If by redesign you mean use a 15 different one also known, just like the 16 first one was known, I would agree. 17 Q. I just want to make sure we're 18 not talking past each other, that if you 19 had a CCD image sensor where the CCD photo 20 detector array and a CMOS image sensor with 21 a CMOS photo detector array and you wanted 22 to take parts of one and use it in the 23 other, that would require a redesign of 24 whichever sensor you were trying to 25 incorporate the parts into; is that right?</p>	<p style="text-align: right;">Page 87</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 MR. DAVIS: Objection to form. 3 A. I would expect that there would 4 be parts of the electronics that you would 5 replace. Again, with the design, I believe 6 at this time, this was well-known to ones 7 of ordinary skill, how to use a CCD as well 8 as how to use CMOS, and there would be some 9 differences at some point in the signal 10 conditioning. 11 I would expect that the signal 12 might be in a format that the rest would 13 not have to change. But if you will, very 14 close to the focal point array itself there 15 are differences, for sure. 16 Q. So just on that point, you 17 talked about the rest of the circuitry 18 might not have to change. 19 What are you talking about and 20 what falls into that "rest" category? 21 A. Well, it depends on what the 22 overall functions of the camera are. 23 If the overall functions of the 24 camera are to produce a standard video 25 signal, the video -- for a standard TV, for</p>
<p style="text-align: right;">Page 88</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 instance, let's say NTSC format, that's 3 well-known, it's a standard, and part of 4 the electronics that do that formatting 5 would -- I would expect would be the same 6 for both. 7 At the opposite extreme, the 8 information, as it first leaves the imaging 9 pixel itself, it's different for the two. 10 And so, I mean, in both cases, 11 it is charge, so it's current in both 12 cases, so there are some similarities. 13 But, for instance, the voltages 14 used to get that charge out are different, 15 so there are drivers that I would expect to 16 be different for the two. Some parts might 17 very well be the same. Some portions of 18 this overall camera system might well be 19 the same. Some parts would definitely be 20 different. 21 Q. I may have probably asked the 22 harder question in terms of kind of what 23 wouldn't have to change, but can you 24 identify, again, in this circumstance, 25 where you're combining devices, one is</p>	<p style="text-align: right;">Page 89</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 CCD-based *, the other is CMOS-based, * 3 you're combining them, are there circuitry 4 that would definitely have to change if you 5 wanted to combine, let's say, putting a 6 CMOS photo detector array into a CCD image 7 sensor, which originally has a CMOS -- a 8 CCD photo detector array? 9 MR. DAVIS: Objection to form. 10 A. I understand what you're asking. 11 It seems you're asking, the swap 12 -- when you said one is CMOS, you're 13 talking about the focal point array, one is 14 CCD and one is CMOS. 15 Because I want to separate that 16 from the rest of the electronics because 17 it's highly likely that most of the rest of 18 the electronics are CMOS anyway. 19 Q. Okay. 20 A. There may very well be analog 21 circuitry in the rest. That's not CMOS. 22 But -- well, it might be. 23 But if you're just talking about 24 swapping the focal point array, the thing 25 that has the pixel, then I would expect</p>

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 that certain parts of the readout
3 electronics that gets the data -- the
4 information off the chip, for CMOS and for
5 CCD, they are different and you change
6 those.
7 Now, again, at the time, in '95,
8 the electronics necessary for CCD, that was
9 well-known. There were CCD products out
10 there and the CMOS designs I believe were
11 also relatively well-known, so I think one
12 of ordinary skill would know what to
13 change, but they would have to change
14 something.
15 Q. Any others? That sounds like
16 you identified readout electronics, voltage
17 drivers I believe you mentioned.
18 Anything else that would change
19 in that scenario?
20 MR. DAVIS: Objection to form.
21 A. The readout electronics and the
22 drivers, those are interrelated. I'm not
23 really sure that I'd call them separate
24 things. I just used different names.
25 The drive voltages are part of

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 the chip is of sufficient magnitude for
3 subsequent electronics to work with it, and
4 those are frequently called drivers as
5 well.
6 Q. And you talked about drivers to
7 produce different voltage levels, that
8 would be something that relates to a CCD
9 device because I believe you said that the
10 CMOS device just used the same voltage for
11 the whole device; is that right?
12 A. Pretty much, the CMOS -- you
13 know, there's some biasing for the storage
14 regions, but I think generally what people
15 try to do in their design is to try to make
16 sure they use a design that uses the same
17 logic level voltage as you use everywhere
18 else. So in that sense, the whole -- an
19 objective is to make sure that you don't
20 have to have any custom voltages. That's
21 why it has an advantage.
22 Q. That's why the CMOS
23 implementation has an advantage, because it
24 would all be the same voltage because it's
25 all the same manufacturing technology?

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 that readout electronics. They're
3 necessary to read out the information.
4 So drivers, voltages applied,
5 things like that, and I kind of call that
6 broadly. I gave it a name: Readout
7 electronics.
8 Q. Just so understand, the term
9 "driver" or maybe "driving circuit," what
10 is that referring to as you're using it
11 there?
12 A. Well, so there are -- there are
13 at least two sorts of the drivers in the
14 kind of things we're talking about.
15 One -- the thing that produces
16 the voltages necessary to make it operate,
17 if they're not the same voltages as, say,
18 the rest of the standard CMOS elsewhere,
19 you need drivers to produce those different
20 voltages.
21 If you need multiple levels of
22 voltages, which for some CCDs it's a
23 multi-faced system, those are drivers.
24 There's also the thing that
25 makes sure that the signal is -- at least

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 A. Right.
3 MR. DAVIS: Objection to form.
4 **THE WITNESS: Sorry.**
5 BY MR. CAPLAN:
6 Q. I'm sorry, I don't mean to talk
7 over you.
8 That driver is something that's
9 -- it is more directed to the CCD, where
10 you could have these higher voltages and
11 you said you can even have multiple
12 different voltages in some CCD devices?
13 A. Yes, in some CCD devices,
14 they're referred to as multi-phase. Phase
15 identifying voltage levels.
16 Q. There are multi-phase CMOS
17 devices, aren't there?
18 A. You know, I honestly don't know.
19 Again, I think a general
20 objective in CMOS imagers is to avoid that.
21 That doesn't mean that somebody
22 might not have discovered that you could
23 get some other performance advantage by
24 doing it, and then in their application
25 maybe low light level with everything. I

<p style="text-align: right;">Page 94</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 honestly don't recall. 3 It wouldn't surprise me, though, 4 because people tend to be willing to do 5 custom -- if you will, custom 6 implementations if one performance metric 7 is the most important for their 8 application. 9 MR. CAPLAN: It's 1 o'clock. 10 Can we take a short break here? 11 Is that all right? Is 15 minutes okay? 12 THE WITNESS: If you don't mind, 13 I know it's early for the West Coast, but 14 if you don't mind I'd like to do a lunch 15 break, so... 16 MR. CAPLAN: That's fine. 17 (Discussion held off the 18 record.) 19 (A recess was taken.) 20 BY MR. CAPLAN: 21 Q. Before we took that last break 22 we were talking about the driving circuits 23 and I just want to make sure I understand 24 that. 25 So we were talking about a CCD</p>	<p style="text-align: right;">Page 95</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 image sensor with a CCD photo detector 3 array would need a driver circuit, 4 certainly if it needs -- because it needs 5 the higher voltages relative to a CMOS 6 device, or it could also need multiple 7 voltage levels; is that right? 8 MR. DAVIS: Object to the form. 9 A. I think in general, yes, that's 10 typical. 11 Q. Now, for a CMOS image sensor 12 with a CMOS photo detector array, it would 13 not need a separate driving circuit because 14 the whole device runs off the same 15 voltages; is that correct? 16 MR. DAVIS: Objection to form. 17 A. I think I explained that there 18 can be different types of drivers. 19 I mentioned drivers to produce 20 voltages, but I also mentioned drivers that 21 help move the signal to other places, to 22 try to describe it. 23 So for the CMOS pixels, normally 24 they're designed to not need any other 25 voltages besides standard logic levels, and</p>
<p style="text-align: right;">Page 96</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 so those kind of voltage shift drivers 3 would not be necessary. 4 The signals produced still have 5 to be driven to other locations, so an 6 example would be an amplifier is a driver. 7 A line driver is an amplifier. So -- so it 8 depends on -- you asked a question specific 9 to the voltage levels. 10 That kind of -- we call that a 11 voltage shift driver. That kind of driver 12 would -- I would not expect to normally be 13 present in a CMOS-type pixel, but might 14 well be present in a CCD-type pixel. 15 Q. Now, if a CMOS photo detector 16 array has -- if it's an active pixel, it 17 has an amplifier at each pixel; right? 18 A. You know, I don't know that I've 19 tried to determine a definition for active 20 pixel. 21 Certainly I think that when 22 there is an amplifier present, most people 23 would put that in the class of active 24 pixel. I'm not honestly sure whether there 25 is some definition that's broader than</p>	<p style="text-align: right;">Page 97</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 that, but one with an amplifier at each 3 pixel I think most people would agree is an 4 active pixel. 5 Q. And are you calling that 6 amplifier, if it exists in a CMOS photo 7 detector array, an amplifier -- I mean a 8 driver? I'm sorry. 9 A. So amplifiers drive signals, so 10 they are drivers. So in a general sense, 11 every one of those amplifiers is a driver. 12 There may well be other 13 amplifiers in other locations to further 14 drive the signal, for instance, off-chip. 15 But usually when you're talking 16 about those, people just usually call it an 17 amplifier, but the purpose of an amplifier 18 is to drive a signal. 19 Q. Is there a distinction in the 20 field -- and, again, in this late '90s time 21 frame -- of a driving circuit? 22 Does that have a particular 23 meaning as used with CCD image sensors and 24 would it be used with a CMOS image sensor? 25 MR. DAVIS: Objection to form.</p>

<p style="text-align: right;">Page 98</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 A. I have not tried -- I've not 3 tried to figure out some specific 4 definition. Line drivers are well-known, 5 voltage shifts -- I was using that term 6 kind of broadly to get a whole class of 7 things. 8 You know, it wouldn't surprise 9 me if in some circumstances you'd find a 10 block of circuitry that one person might 11 label as a driver and another person might 12 not label it at all. They might label it 13 as an amplifier. 14 Q. Okay. But this sounds like we 15 do agree then that a CMOS image sensor or 16 the CMOS photo detector array uses the same 17 voltage across the whole device; is that 18 correct? 19 MR. DAVIS: Objection to form. 20 A. I think I said before that I'm 21 not sure that everyone does, but I think 22 that's common. 23 Q. In contrast, CCD image sensors 24 with CCD photo detector arrays, because 25 they require higher voltage for that bucket</p>	<p style="text-align: right;">Page 99</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 for gaining operation, do require 3 additional driver circuits to make sure 4 they have adequate voltage to operate the 5 CCD photo detector array; is that right? 6 MR. DAVIS: Objection to form. 7 A. Again, to qualify a little bit, 8 I think it is certainly typical, but could 9 you go out and find some CCD design where 10 someone made a compromise so that it can 11 operate at a TTL -- old fashioned TTL plus 12 or minus 5 volts? I suspect you could, but 13 I don't think that would be a typical 14 design. I think that would be a special 15 purpose design. 16 Q. Okay. So I want to turn to your 17 declaration a little bit and focus on 18 things in there. I know you have a copy of 19 that available. 20 So in your declaration, just for 21 the record, it should be Exhibit 1004. 22 (Exhibit 1004 for 23 identification, Declaration of Dean 24 Neikirk, Ph.D., shown to witness.) 25 BY MR. CAPLAN:</p>
<p style="text-align: right;">Page 100</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 Q. You have Section 4, it starts on 3 page 9. It talks about legal standards. 4 A. Yes. 5 Q. Okay. And if you need to take a 6 look at anything before you answer, that's 7 fine. Take your time. Just let me know 8 you want to look at something. 9 Let's turn to or focus on 10 paragraph 28 initially. 11 A. Paragraph 28? 12 Q. 28. It's on page 10. 13 A. It starts on page -- yes, I've 14 got it. 15 Q. You've got it? Okay. 16 So I want to ask you the first 17 sentence, which is the first five or six 18 lines, but if you just take a look at that, 19 in particular, I want to ask you about, you 20 use a phrase "apparent reasons to combine 21 known elements." That's the first. 22 It says you assessed whether 23 there are apparent reasons to combine known 24 elements. 25 Just if you can explain what's</p>	<p style="text-align: right;">Page 101</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 your understanding of that term. 3 A. Well, so the whole phrase: 4 "Assess whether there are 5 apparent reasons to combine known elements 6 in the prior art in the manner claimed in 7 view of the interrelated teachings of the 8 multiple prior art references." 9 My understanding is -- so first 10 I'm looking at pieces of art that are 11 already -- that I can establish are 12 interrelated. 13 The elements in each of those, 14 is there a reason to use some elements from 15 one and other elements from the other. 16 So my understanding is you don't 17 just arbitrarily pick and choose. In this 18 situation, I'm -- one of the things to look 19 for is, would one of ordinary skill have 20 been motivated to make that combination, 21 right, did they have a reason to do it. 22 Q. And what's your understanding or 23 meaning that you use for that interrelated 24 term? You said you would determine if 25 references are interrelated.</p>

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1 CONFIDENTIAL - DEAN NEIKIRK, PH.D.
2 What does it take to be
3 interrelated, in your view?
4 A. Well, I think, again, that's
5 viewed of one as ordinary skill, seeing
6 that the art, for instance, are in the same
7 or similar fields, that -- maybe an easier
8 one would be a counterexample.
9 Taking a cotter pin from a wagon
10 wheel and putting it into a solid-state
11 imaging device would seem likely to not be
12 related teachings or interrelated.
13 But taking an amplifier from one
14 imaging device and using it as an amplifier
15 in another imaging device, well, they're
16 both imaging devices. Well, that would be
17 part of it. I want to read the context
18 further, but generally.
19 Q. But if you were to combine two
20 things, you would have to have a reason to
21 combine them, wouldn't you?
22 A. Well, I think that is a
23 consideration. If there is a -- if there
24 are good reasons, then that's a compelling
25 -- that's part of the argument.

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1 CONFIDENTIAL - DEAN NEIKIRK, PH.D.
2 demands that need to be met and this is a
3 good way to do that.
4 Q. So you have to have a reason to
5 make the combination. You wouldn't do it
6 without a reason to go ahead and make the
7 combination?
8 A. Well, I don't know whether the
9 law would -- absolutely precludes the
10 possibility, but certainly I think that
11 it's -- that when -- when it's clear you
12 have reasons to combine, that's an
13 important issue, that having that is -- you
14 have the motivation to do it. It's not
15 arbitrary.
16 Q. If you turn -- actually,
17 paragraph 28 goes on for a number of pages.
18 You have a number of bullet points in that
19 part of your declaration and you list a
20 number of principles that you considered,
21 and on page 12 there's one and it's "common
22 sense."
23 Do you see that?
24 A. I do.
25 Q. So can you just explain how you

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1 CONFIDENTIAL - DEAN NEIKIRK, PH.D.
2 That not only do these elements
3 exist in this combination, but one of
4 ordinary skill would have a reason to have
5 put them together that way.
6 Q. And in the same paragraph, 28,
7 you talk about "effects of demands known to
8 the design community."
9 Can you just explain what you
10 mean by that aspect of your declaration?
11 It's the next --
12 A. I'm trying to get it in the
13 overall context of the paragraph.
14 So, again, I would look at
15 whether in -- let's use this example.
16 We're talking about building solid-state
17 cameras.
18 So there would be a variety of
19 demands known to the -- people working in
20 that general area and so how those demands
21 might be met by a particular combination
22 would be something that's relevant.
23 You know, in other words, those
24 in the area would -- again, it sort of --
25 have a reason to do it. There are certain

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1 CONFIDENTIAL - DEAN NEIKIRK, PH.D.
2 apply that factor into your analysis in
3 terms of, how do you apply common sense?
4 I'm not asking if you have
5 common sense. I'm just saying, how do you
6 apply it? What's the metric that you used
7 to evaluate that?
8 A. So, you know, I think all of
9 this is informed by one of ordinary skill
10 in the art. I mean, it's -- one person's
11 common sense might not be somebody else's.
12 But these are general -- general
13 knowledge that one of ordinary skill would
14 have by the definition of their skill
15 level, right?
16 And that some item that has --
17 well, I called it a primary purpose.
18 Common sense might tell you that a paper
19 clip is usually used -- its common use is
20 to hold two pieces of paper together. But,
21 in fact, you can also use that to hold
22 something else together. Two photographs
23 together. I mean, that's pretty close.
24 But, you know, that common sense
25 would guide you in this -- the function of

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 this, there's a typical function, but it's
3 clear that it could be used in some other
4 way, right? And common sense is the idea
5 that -- that this wouldn't -- this should
6 be something that would be easily seen by
7 one of ordinary skill, I guess, maybe -- I
8 hate to substitute words here, but that's
9 how I think of it.
10 Q. So you wouldn't combine things
11 if the result of the combination would
12 actually make features worse because that
13 would lack common sense.
14 Would you agree with that?
15 MR. DAVIS: Objection to form.
16 A. Not -- no, I don't think I'd
17 agree with phrasing it that way.
18 I think you said if it made it
19 worse, and the question now is made what
20 worse. If it made one thing better but
21 another thing worse, in balance, you might
22 very well still do it, right?
23 I mean, so when you say making
24 something worse, I want to know what got
25 worse and I want to know what other

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2 entirely. It depends.
3 Q. So I hear what you're saying.
4 It's contextual. But if you have multiple
5 factors that get worse with a combination
6 and only a few that get better, then common
7 sense may say it's just not worth doing?
8 MR. DAVIS: Objection to form.
9 A. You see, that's what I don't
10 agree with. I think one of ordinary skill
11 would understand using their common sense
12 which figures of merit may matter than
13 others, would matter than others, and they
14 might very well recognize that the things
15 that got worse, two of the three, I mean --
16 what did we say, three got better, five got
17 worse?
18 They might recognize that three
19 of the five don't matter at all, so now
20 they're balancing three that got better and
21 two that got worse, and they'd have to do a
22 balancing act.
23 Q. Okay.
24 A. That's what designs in any
25 electronic systems are about. It's always

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 characteristics exist.
3 Did they all get worse, every
4 single characteristic? Well, I would agree
5 with you. That doesn't seem to be common
6 sense.
7 But if five things got worse and
8 three things got better, now I've got to
9 try to think about, well, what was -- for
10 your use, what was the most important?
11 Maybe those three things that
12 got better was really all you cared about,
13 so the things that got worse, you don't
14 care about, so who cares. You do it
15 anyway, right?
16 So I think that's part of the
17 common sense, is -- is understanding that
18 when you change something, things change,
19 but you've got to look at each different
20 category, you know.
21 We use noise in CCDs versus
22 CMOS. It's pattern noise. Those are all
23 very specific characteristics. And some
24 people might not care about them at all.
25 Other people might care about them

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 a balancing act.
3 Q. On page 28 of your declaration,
4 you have two paragraphs on claim
5 construction, paragraphs 55 and 56.
6 A. Just for clarity, there's two
7 page numbers, unfortunately. There's the
8 exhibit page number and the original
9 document page number.
10 I don't care which one you use.
11 Just tell me which one you want --
12 Q. That's fair. In Exhibit 1004,
13 it's page 31 of 177.
14 A. Okay. Yes.
15 So there's a -- yes. Elements
16 or C claim construction. I do see that,
17 yes.
18 Q. And your declaration says you're
19 applying the plain and ordinary meaning to
20 claim terms; is that right?
21 A. That's correct.
22 Q. And we covered this a little bit
23 earlier, but I just want to go back and
24 confirm.
25 In terms of -- and you would

<p style="text-align: right;">Page 110</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 agree with me that the plain and ordinary 3 meaning of the terms, if that's what you're 4 going to apply, would be at the time of the 5 invention, which for these patents is in 6 1997. 7 Would you agree with that? 8 MR. DAVIS: Objection to form. 9 A. Yes. So in -- yes. I mean, 10 it's in view of one of ordinary skill in 11 the art, understanding the terms at the 12 time, yes. Terms could change meaning over 13 time so it doesn't matter what it is today. 14 It was then, yes. 15 Q. Okay. So my question is, how 16 did you develop your understanding of a 17 plain and ordinary meaning of the terms in 18 the '565 patent in 1997, which is the 19 filing date of the '565 patent? 20 A. Well, so I used -- first, of 21 course, I read the entirety of the claim 22 because context matters. 23 I consider the specification as 24 well -- context matters -- to try to 25 understand how the terms were used that</p>	<p style="text-align: right;">Page 111</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 would inform one of ordinary skill. 3 I look at the other art in the 4 area, the interrelated art, to see how 5 similar terms are being used. 6 And at the time, in the mid 7 '90s, '97, I myself was working in the 8 field and teaching students, and so many of 9 these terms I believe are ones that were in 10 pretty common usage and have a pretty clear 11 basic meaning. 12 So I'm doing all of those 13 things. I'm trying to view this through 14 the lens of one of ordinary skill. Not 15 necessarily my own skill level because I 16 might be of more than ordinary skill, but 17 we do have that definition. 18 The basic educational level, and 19 just looking at the art, the 20 contemporaneous art, the prior art is 21 something being used pretty much the same 22 way. 23 If it is, that helps inform, I 24 think, what an ordinary meaning would be. 25 Q. In that time, in '97, at that</p>
<p style="text-align: right;">Page 112</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 time, you testified earlier that you were 3 reading about CCD and CMOS image sensors, 4 in particular, CCD and CMOS photo detector 5 arrays as related reading to your core 6 research, which was in a different area; is 7 that right? 8 A. Well, so I think many of the 9 terms in the claims relate to camera 10 systems more broadly, or they might relate 11 to printed circuit boards or other things, 12 and those were in the core of my work. But 13 also things that we just broadly discussed 14 in our undergraduate EE curriculum. 15 So, you know, it depends on 16 which words we're trying to understand. 17 Some of these, the context is not specific 18 to CCD or CMOS. 19 Q. Okay. Can you turn to 20 Wakabayashi, the Wakabayashi patent, which 21 is Exhibit 1027. 22 (Exhibit 1027 for 23 identification, Wakabayashi patent, shown 24 to witness.) 25 BY MR. CAPLAN:</p>	<p style="text-align: right;">Page 113</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 A. Okay. I have it. 3 Q. So to start generally, what is 4 your understanding of what the Wakabayashi 5 patent is describing? 6 A. Well, let's use the abstract. 7 It's talking about building a 8 video camera. And I think that's a good 9 characterization for, in general, what this 10 is about, building a video camera. 11 And then it goes on to specify 12 some of its characteristics. They'd like 13 to make it compact, lighter in weight, 14 they'd like to include a display unit as 15 part of it, the video camera. They'd like 16 it to be one where you can move the lens 17 and point it different places. 18 So I have think the broadest, 19 the simplest, it's about making a video 20 camera and there are a number of 21 characteristics that they'd like to 22 incorporate into that video camera. 23 Q. Do you know if the Wakabayashi 24 reflects an actual product that was 25 actually sold?</p>

<p style="text-align: right;">Page 114</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 A. No, I do not know. 3 Q. So in Wakabayashi, it talks 4 about -- and in your declaration it refers 5 to -- you talk about Figure 7 of 6 Wakabayashi. Let me just pull out your 7 report. 8 And just looking at a little bit 9 of your report, so looking at paragraphs 58 10 to 60 at the moment, but in talking about 11 Figure 7, there is an imager device 27 and 12 a circuit board 29. 13 Do you see those? 14 A. There, yes. Paragraph 60, yes. 15 I see it. Yes, yeah. 16 Q. I want to get your understanding 17 of what each of these components are doing, 18 what their function is and what they're 19 doing. 20 We can start with the imager 21 device 27. What's your understanding of 22 that component? 23 MR. DAVIS: Objection to form. 24 A. So the imager device 27 and 25 let's -- I mean, I think later in paragraph</p>	<p style="text-align: right;">Page 115</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 60 I mention the solid-state imager device 3 as being included in the camera head 100, 4 and that I believe is a direct quotation -- 5 yes, it is. It's a quotation from 6 Wakabayashi. 7 And in my paragraph 60, I give 8 you column 9, lines 10 through 14, where he 9 discusses Figure 22. And he's talking 10 about a block diagram, solid-state imager 11 device, and let's see if he -- yes. 12 In column 6 he just calls 27 an 13 imager device, but throughout Wakabayashi I 14 think he always refers to the imager device 15 when -- as a solid-state imager device. 16 So in the words that I used 17 earlier when you were talking about my 18 general background, this would be the chip 19 that I was sometimes referring to as a 20 focal point array. The thing that converts 21 light into an electrical signal. 22 Q. Okay. And what's the role of 23 circuit board 29 that's also shown? It's 24 in your report and also shown in Figure 7. 25 A. So 29 itself -- let's find it in</p>
<p style="text-align: right;">Page 116</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 the discussion in Wakabayashi about 29... 3 MR. DAVIS: Same objection. 4 A. Certainly one of the things is 5 the imager device is attached to circuit 6 board 29. 7 In Wakabayashi itself -- let's 8 see -- skipping forward a bit. Where is it 9 -- actually, I'm going to flip through 10 Wakabayashi directly. I'll see 29 faster 11 there than I'll see it in my report. 12 Element 29 -- so in column 5 at 13 lines -- is it 63 -- it talks about where 14 it is as opposed to what it does. Sorry, 15 I'm still scanning. 16 Q. That's all right. 17 A. Well, where is it. 18 He describes it as "camera 19 circuit board." 20 Q. Do you have an understanding of 21 that term as it was used in the field at 22 that time? 23 A. I think in general terms it is 24 generally a circuit board that would carry 25 circuits used in the function of the</p>	<p style="text-align: right;">Page 117</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 camera. It's a camera circuit board. 3 You don't put in circuit boards 4 with nothing on them. Then they're not 5 circuit boards. 6 Q. What would normally be on a 7 camera circuit board at the time of 8 Wakabayashi? 9 A. I think it's a design choice. 10 MR. DAVIS: Objection to form. 11 A. You could put various things on 12 various circuit boards. Some of the things 13 might be on-chip. They might be on the 14 board. You know, it depends on how you 15 decide to partition the circuits that you 16 need to make it function into different 17 parts, into different circuit boards. 18 So I don't think there's a 19 universal definition that says only these 20 things are on a camera circuit board. 21 Q. Is there anything in Wakabayashi 22 that you're relying on that tells you 23 what's on that circuit board? 24 MR. DAVIS: Objection to form. 25 A. That's what I was scanning for,</p>

<p style="text-align: right;">Page 118</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 whether Wakabayashi has some further 3 specific statements about functions 4 performed on 29 or whether it's just you 5 can put whatever functions there you want, 6 and that's what I'm not seeing right now 7 for 29. I'm not seeing anything further to 8 Wakabayashi. 9 Q. Well, what's your 10 understanding -- if there's nothing in 11 Wakabayashi that tells you what circuit 12 board 29 does, what's your basis for 13 understanding what it actually does? 14 MR. DAVIS: Object to form. 15 A. I think it means that it's a 16 design choice one of ordinary skill can 17 make as to what they wish to put there. 18 Now, again, I'm trying to 19 remember if we get into specific claim 20 languages and what this circuit board reads 21 on, I think it would be a more productive 22 discussion as to what it needs to do and 23 what my basis is for the arguments that it 24 -- Wakabayashi does either disclose it or 25 render it obvious.</p>	<p style="text-align: right;">Page 119</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 So this would be -- you know, 3 when I did this, I was doing it within the 4 context of the claims. Not in a universe 5 without the claims involved. 6 Q. So you looked at the claims to 7 figure out what you needed in the prior art 8 to identify it for the claim; is that 9 right? 10 MR. DAVIS: Object to the form. 11 A. No, I wouldn't characterize it 12 that way. 13 Now, I do need to look at the 14 claim for plain ordinary meanings and to 15 understand, you know, I mean, there may be 16 lots of disclosures in the prior art that 17 are not claimed. 18 The question is, is the claim 19 element disclosed in the -- and are all of 20 the claim elements disclosed or rendered 21 obvious. 22 Now, I'm not using -- was there 23 a motivation to do it that way. I'm not 24 using the claim as my roadmap for picking 25 and choosing, but at the same time, if the</p>
<p style="text-align: right;">Page 120</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 prior art discloses other things, that's 3 fine. 4 Q. In paragraph 61 of your 5 declaration, that's on the same page 33 of 6 Exhibit 1004, you talk about -- 7 A. Excuse me, paragraph 61? 8 Q. 61, yes. 9 A. Yes. 10 Q. You were making reference to 11 Figure 5 of Wakabayashi, and then you 12 identify imager device 27, circuit board 29 13 and second circuit board 39. 14 Do you see that? 15 A. I do. 16 Q. Do you have an understanding of 17 what second circuit board 39 does that you 18 identified there? I know we just talked 19 about imager device 27 and circuit board 20 29. 21 Do you have an understanding of 22 second circuit board 39? 23 MR. DAVIS: Objection. 24 Form. 25 A. 39 -- so in column 6 of</p>	<p style="text-align: right;">Page 121</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 Wakabayashi at line 7 it specifically says 3 that "the circuit board 39 includes a 4 signal processing" -- 5 (Reporter clarification.) 6 A. So at column 6 starting at line 7 7, Wakabayashi specifically says: 8 "A circuit board 39 disposed in 9 housing 3, circuit board 39 includes a 10 signal processing circuit for the video 11 camera unit 5, a driver circuit for the 12 liquid crystal display 38, a system 13 circuit, power supply circuit and so on." 14 So for that one he actually says 15 some of the things specifically on 39. Of 16 course he says "and so on," so there could 17 be lots of other things there as well. 18 Q. So what does the "signal 19 processing" mean in the context there that 20 you just identified for this device? 21 A. Well, for this device, there are 22 a number of things. There is -- and I'd 23 have to check to see if he puts it 24 somewhere else, but there's a conversion 25 from -- to a video format, because he wants</p>

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 to -- he says that he wants to produce a
3 video format compatible with a video
4 display. That will require certain kinds
5 of processing. That's an example.
6 Q. When you say "conversion to a
7 video format," is that for display on a TV
8 or other display device? Is that what
9 you're talking about?
10 A. Well, in Wakabayashi, I think he
11 says -- let's see -- I do believe he says
12 something about that. That's why I'm
13 looking for it.
14 I don't know that this is the
15 best example, but in column 8 he references
16 signal supported by a VTR, videotape
17 recorder, and that one of ordinary skill in
18 the art would understand at the time that
19 videotape recorders recorded in standard
20 video formats.
21 It seems like there's another
22 spot too.
23 Q. Where would that signal be
24 coming from?
25 A. Well, ultimately he says that

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 30 -- I'm sorry, 27, excuse me, in Figure 7
3 it's 27.
4 So where is it coming from.
5 Well, originally it's coming
6 from 27.
7 27 passes into 29. 29 is then
8 coupled via the little ribbon cable to 39.
9 Q. And the signal processing you're
10 saying is done on board 39, though?
11 MR. DAVIS: Object to form.
12 A. Well, what Wakabayashi says is
13 that signal processing is done there "and
14 so on." He calls out -- what does he call
15 out: Driver circuits, signal processing.
16 He does say a signal processing
17 circuit. He doesn't say that's necessarily
18 the only, but he says a signal processing
19 circuit is there.
20 Q. So let's start at the imager
21 device 27 and just kind of to walk through,
22 because you've identified a pathway, but I
23 just want to go from start to finish just
24 so the record is clear.
25 So the imager device 27, that is

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 circuit board 39 has signal processing and
3 including that, for instance, a driver
4 circuit for the liquid crystal display, so
5 I think that the disclosure would suggest
6 that ultimately it's --
7 (Reporter clarification.)
8 A. -- coming from circuit board 39.
9 I believe that's what I said.
10 Q. Just so I'm clear, I was asking
11 where that image, where that signal is
12 coming from that's being processed by board
13 39, that's what --
14 A. I'm sorry. I misunderstood your
15 question. I thought you were asking about
16 the VTR -- the signal going to the
17 videotape recorder.
18 Q. That's where the signal is
19 going, I assume.
20 A. Right. So the way it's
21 described, circuit board 29 is coupled to
22 39. Originally, the light is converted to
23 an electrical signal by the solid-state
24 imaging device, which is -- sorry --
25 looking at Wakabayashi's numbers, which is

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 the original generator of an image signal;
3 is that correct?
4 A. Well, that is where light is
5 converted -- that is where light is
6 converted into an electrical signal, so in
7 that sense I would say that's the origin of
8 the electrical image.
9 Q. And you agree, because I think
10 it's in your declaration, you say that
11 Wakabayashi does not identify the
12 particular type of focal array that's in
13 Wakabayashi; is that right?
14 A. I think --
15 MR. DAVIS: Object the to form.
16 A. I believe Wakabayashi is silent.
17 I don't think he cares. It needs to be
18 solid state. That's all he asks for.
19 Q. And so there is an image signal.
20 Would you call that a pre-video
21 signal that comes out of image device 27?
22 MR. DAVIS: Object to form.
23 A. Pre-video is a claim term.
24 I think one of ordinary skill in
25 the art as plain ordinary meaning would

<p style="text-align: right;">Page 126</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 interpret that to mean something other than 3 standard video format. It's pre-video. 4 And, yes, I believe that signals 5 emerging from a typical solid-state imaging 6 device are not yet formatted in video 7 format, so that would be a pre-video 8 signal, yes. 9 Q. So there's a pre-video signal 10 coming out of imager device 27, which 11 Wakabayashi does not tell you a particular 12 type of imager device that that is; is that 13 correct? 14 MR. DAVIS: Object to the form. 15 A. I think that that is correct, 16 yes. 17 Q. Okay. And that image signal, 18 which we're going to call a pre-video 19 signal, is going to camera circuit board 20 29; is that correct? 21 A. Yes. Signals pass from the 22 solid-state imaging device 27 onto and into 23 circuit board 29, yes. 24 Q. And is it an analog or a digital 25 signal going from imager device 27 to</p>	<p style="text-align: right;">Page 127</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 camera circuit board 29? 3 A. So -- 4 MR. DAVIS: Object to the form. 5 A. In Wakabayashi, because he's 6 silent as to what kind of solid-state 7 device it is, it -- I don't think it says. 8 Now, in terms of these details, 9 in my analysis I went to other analogous 10 art to try to learn about the details of a 11 solid-state imaging device. In particular, 12 I used Ackland, and Ackland is certainly 13 analog. 14 MR. CAPLAN: Dr. Neikirk, I will 15 not let you accuse me of not keeping my 16 word, and it's 2 o'clock. 2:01. So we'll 17 break. An hour, is that fine? 18 THE WITNESS: An hour is plenty. 19 MR. CAPLAN: Or 45 minutes even. 20 I have to end around 6:30 East 21 Coast time, so that's 3:30 your time. 22 (Discussion held off the 23 record.) 24 (A luncheon recess was taken 25 from 2:01 p.m. EST to 2:46 p.m. EST)</p>
<p style="text-align: right;">Page 128</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 AFTERNOON SESSION 3 (Time Resumed: 2:46 p.m. EST) 4 DEAN NEIKIRK, PH.D., 5 having been previously duly sworn, resumed 6 and testified as follows: 7 CONTINUED EXAMINATION 8 BY MR. CAPLAN: 9 Q. So before we broke for lunch, 10 we've been going, marching through the 11 Figure 7, so I'm just going to pick it up 12 there. 13 And I believe we were talking 14 about imager device 27, the outputs, but we 15 -- I think we agreed to call the pre-video 16 signal to the camera circuit board 29. 17 Do you agree with that, Dr. 18 Neikirk? 19 A. Well, I don't know whether I 20 agreed -- I pointed out that in my analysis 21 of the claims for the imager chip 27, I 22 referred to Ackland and the signal produced 23 by Ackland, which is an analog signal. 24 It is certainly pre-video in 25 that example, the one that I used, and that</p>	<p style="text-align: right;">Page 129</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 is provided to board 29. 3 Q. Okay. And it was your testimony 4 that Wakabayashi itself does not describe 5 the particular type of imager device 27 6 that is described and that's shown in 7 Figure 7; is that right? 8 A. Wakabayashi calls it a 9 solid-state imaging sensor or imaging 10 device. We identified that a few minutes 11 ago. And other than that, he didn't say 12 which type. That is correct. 13 Q. And does solid-state imager have 14 a meaning to you in the context as it's 15 used here in Wakabayashi? 16 A. It certainly does. 17 Q. What is that? 18 A. It's not, for instance, a 19 videocon (ph.), which is an 20 electron-to-imaging device. It's not a 21 piece of film. 22 It's made up of solid-state 23 device, which would include, for example, 24 CCDs or CMOS image, focal plane arrays. 25 Q. So at this point, you're</p>

<div>Page 130</div> <div>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 interpreting Ackland -- I'm sorry -- you're 3 interpreting the Wakabayashi imager 27, in 4 view of Ackland, to put a pre-video signal 5 out to camera circuit board 29; right? 6 A. So the combination with Ackland, 7 yes, that would be correct. 8 Q. Well, right now I'm just asking 9 about your understanding of Wakabayashi. 10 Not Wakabayashi with Ackland. We're going 11 to get to that. 12 But I'm just asking you your 13 understanding of Wakabayashi is -- it 14 sounds like you can only understand it in 15 combination with Ackland. 16 Is that your -- 17 A. No, no. That's not what I'm 18 testifying. 19 MR. DAVIS: Object to form. 20 A. You asked and you added some 21 words to all of this. 22 For instance, you said that 27 23 produced a pre-video signal. 24 Well, Wakabayashi I don't 25 believe uses that terminology at all, and</div>	<div>Page 131</div> <div>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 so I can't say that Wakabayashi shows what 3 kind of output. We use 27, it passes to 4 29. 5 Wakabayashi says it's a 6 solid-state imaging device -- I'm sorry, I 7 keep losing track of what -- what phrase 8 exactly he used -- "imager device." 9 He does call it a solid-state 10 imager device, but other than that, he 11 doesn't provide any further detail. 12 Q. And you don't have any 13 independent understanding of what 14 particular kind of imager device that would 15 be, absent looking to Ackland; is that 16 right? 17 A. Well, the solid state -- 18 MR. DAVIS: Object to form. 19 A. That it is solid state. He says 20 that but he doesn't further limit it. 21 Q. Okay. And then we went through 22 this before, but I'll go through the whole 23 sequence now, from imager device 27 to 24 board 39, what happens at camera circuit 25 board 29 in your understanding and in</div>
<div>Page 132</div> <div>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 combination with Ackland? 3 A. Well, in -- 4 MR. DAVIS: Object to form. 5 A. In combination with Ackland, we 6 know that Ackland contains timing and 7 control circuitry as part of 27, and that 8 is on circuit board 29. 9 The claim language requires it 10 to be thereon a first circuit board, I 11 believe, is the claim language, and that is 12 met by that combination. 13 Q. Okay. I think we're mixing 14 metaphors a little bit in terms of your 15 invalidity analysis and just what you 16 understand from Wakabayashi, but is -- 17 there are connections shown between imager 18 device 27 and board 29 in Figure 7. 19 Do you see that? 20 A. Yes, I do. 21 Q. And is that the basis that you 22 say imager device 27 is on the circuit 23 board? 24 A. Yes. It's certainly on that 25 circuit board 29. I can't think of any</div>	<div>Page 133</div> <div>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 other way to describe it. 3 Q. Okay. Now, you mentioned timing 4 and control circuitry in connection with 5 the imager device; right? 6 A. I did. 7 Q. And I believe you said that the 8 timing and control circuitry is part of the 9 CMOS device in Ackland; is that right? 10 A. We can check Ackland, but that's 11 my recollection, yes. 12 So if you look at Figure -- 13 Figure 6 of Ackland, yes, I believe that's 14 what's indicated. That is a possibility. 15 Ackland clearly discloses timing and 16 control switches. 17 Q. Right. And you testified 18 previously, you said in combination with 19 Ackland, we know that Ackland contains 20 timing and control circuitry as part of 27. 21 Do you agree with that? 22 A. I think that what Ackland would 23 teach one of ordinary skill in the art is 24 that that timing and -- the timing 25 controller element 20 of Ackland could be</div>

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 part of Ackland's chip; and, hence, part of
3 27. And because of that, the timing
4 controller of Ackland would be on circuit
5 board 29.
6 Q. Is the timing and control
7 circuitry also on imager device 27?
8 A. I believe that is what Ackland
9 would teach one of ordinary skill, yes.
10 That's one possibility.
11 Q. I'm just asking what your
12 position is. So timing and control
13 circuitry on imager device 27 and on
14 circuit board 29?
15 A. So I believe -- yes, that it is
16 by -- if it is on the imaging solid-state
17 device 27 that's taught by Ackland, then it
18 is on circuit board 29.
19 Q. And that is because the imager
20 device 27 is physically connected to
21 circuit board 29.
22 Is that your position?
23 A. Well, it's -- it's physically
24 connected and it is clearly on it. It is
25 mounted directly to it. It is soldered to

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 Q. Now, what other circuits are
3 actually kind of on the same plane as
4 circuit board or a part of circuit board
5 29?
6 MR. DAVIS: Objection.
7 Form.
8 A. So I don't believe Wakabayashi
9 specifies any particular other circuitry as
10 being on 29. And in my analysis I was
11 looking at claim language and I don't
12 believe there was a discussion of requiring
13 other circuitry -- one of the claims, at
14 least -- be on the first circuit board, or
15 "thereon," I believe is the term.
16 Q. My question is, do you know what
17 other -- do you know what other circuitry
18 is on board 29?
19 MR. DAVIS: Objection.
20 A. I believe that what other
21 circuitry would be put on circuit board 29
22 would be up to the designer.
23 Q. Okay. And what happens to the
24 image signal that we were talking about,
25 which I believed you characterized as a

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 it. It is a direct connection. It is
3 sitting on circuit board 29. There's no
4 question if you look at Figure 7 of
5 Wakabayashi.
6 Q. The timing and control
7 circuitry, is it your understanding that
8 that's now/NOT part of imager device 27, is
9 integrated on the same piece of silicon
10 that -- I'm assuming it's silicon -- that
11 is imager device 27.
12 Is that your testimony?
13 MR. DAVIS: Objection to form.
14 A. So I believe that in my analysis
15 I identified that as one of the things one
16 of ordinary skill in the art would, looking
17 at Figure 6, understand, Figure 6.
18 Q. Okay. And that imager device
19 that you're taking from Ackland with the
20 timing and control is connected to circuit
21 board 29 as shown in Figure 7 of
22 Wakabayashi; right?
23 A. It is mounted on circuit board
24 29. It's electrically connected and
25 mounted on.

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 pre-video signal coming out of the imager
3 device 27 that goes to board 29? What
4 happens at that point?
5 MR. DAVIS: Objection to form.
6 A. Well, in my analysis, there
7 wasn't any -- it wasn't in the claim
8 language, any -- looking for other things
9 that happened on that first circuit board.
10 I think Wakabayashi leaves it up
11 to the designer as to what -- how they
12 partition things between the circuit
13 boards. Wakabayashi doesn't specifically
14 say, I don't think, that you have to do one
15 function on 29. He does give information
16 about functions on 39, but that leaves it
17 up to the designer.
18 Q. Does Wakabayashi somewhere say
19 it's up to the designer to put particular
20 functions wherever you deem it appropriate?
21 Is that part of Wakabayashi?
22 A. I think Wakabayashi being read
23 by one of ordinary skill in the art sees a
24 printed circuit board. Printed circuit
25 boards are used to contain circuitry.

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 And Wakabayashi doesn't tell you
3 that you have to put -- which specific
4 circuitry to put on 29, so it's an option.
5 It's something that is an option to one of
6 ordinary skill as to what they decide to
7 put there.
8 Q. Is there something express in
9 Wakabayashi that says it's an option to put
10 whatever kind of circuitry the designer
11 wants on board 29? Can you identify that?
12 A. I don't think that there's an
13 express statement said that way.
14 It identifies that 29 in
15 Wakabayashi is a circuit board. He calls
16 it the camera circuit board.
17 Now, I'm trying to remember --
18 if you give me just a moment to look at
19 Wakabayashi.
20 Q. Sure.
21 A. There's a discussion -- I'll
22 look at both Wakabayashi and my
23 declaration. Mine is section -- there's an
24 overview of Wakabayashi that starts on page
25 32 of the exhibit numbers.

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 He explains some of the things
3 that that does and ultimately generates a
4 video signal at 103 in Figure 22.
5 So Wakabayashi has two circuit
6 boards, 29 and 39. The camera head -- I'm
7 sorry, I'm flipping around a bit more --
8 which in Figure 22, the circuit diagram, he
9 calls it 100, right? Yes, he does.
10 He says what's in camera head
11 100, lens, solid-state imager and circuit
12 for driving solid-state imager and so on.
13 So at the least, that would be
14 in the other figure we were talking about,
15 Figure 7, 27 and 29 are inside
16 Wakabayashi's element 5, which I believe he
17 uses the phrase "video camera unit."
18 Q. Right. Were you done?
19 A. Figure 22 in the description in
20 column 9, at the least, I believe that the
21 camera head would include the elements it
22 describes of which circuit board 29 is
23 part.
24 Q. Okay.
25 A. He does give you some

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 Q. Okay.
3 A. So, for instance, to my
4 paragraph 60, but let's go to column 9,
5 Wakabayashi. At column 9, line 10.
6 So he does identify a block
7 circuit diagram, that's Figure 22 of
8 Wakabayashi, and he identifies that the
9 camera head 100, which includes wide
10 receiving lens, solid-state imager device,
11 a circuit for driving the solid-state
12 imager device and so on, generates an
13 optoelectrically converted signal 101 which
14 is input to camera circuit 102.
15 Camera circuit 102 includes
16 camera signal processing circuit,
17 synchronized signal generator and so on,
18 generates video signal 103.
19 So he does a circuit diagram 22,
20 the camera head, which is 100, and camera
21 circuit are illustrated there.
22 Q. You're talking about Figure 22
23 now; is that correct, Doctor?
24 A. Yes, there's camera head 100 and
25 camera circuit 102.

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 explanations as to what circuitry is
3 present, certainly.
4 Q. You mentioned a couple of times
5 you were reading from column 9.
6 There's a circuit for driving
7 the solid-state imager device, is in the
8 list of what's included in camera head 100.
9 Do you see that?
10 A. I do.
11 Q. What is that circuit for driving
12 the solid-state imager device that's
13 described there?
14 A. There are many such circuits.
15 It depends on what kind of solid-state
16 imager it is.
17 We talked about drivers earlier.
18 There are many different kinds.
19 Wakabayashi hasn't specified
20 which type of solid-state imager device and
21 has provided no further specific
22 information about a given circuit. There
23 are many such circuits.
24 Q. We spoke earlier, and we were
25 talking about, as you pointed out, the CCD

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1 CONFIDENTIAL - DEAN NEIKIRK, PH.D.
2 devices versus the CMOS devices and how --
3 and you testified that the CMOS devices
4 used one level of power in their device
5 compared to higher level regarding the CCD
6 devices.
7 Do you recall that?
8 **A. I do.**
9 Q. Okay. So -- and I believe you
10 testified that the CMOS devices with the
11 CMOS pixel array would not require a
12 driving circuit because they're operating
13 at the same CMOS voltage as the rest of the
14 device compared to the higher voltages
15 required by the CCD devices?
16 MR. DAVIS: Object to form.
17 **A. That was not my testimony.**
18 **My testimony was that it**
19 **wouldn't have the voltage drivers.**
20 **If you recall, my testimony was**
21 **that there are a variety of different kinds**
22 **of drivers and that voltage drivers to**
23 **shift levels was a specific type.**
24 **Wakabayashi doesn't say --**
25 **doesn't limit it to that kind of driver.**

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1 CONFIDENTIAL - DEAN NEIKIRK, PH.D.
2 device, which Wakabayashi leaves that as an
3 option, that's why he doesn't say what
4 kind. One of ordinary skill in the art
5 would understand what kind of driver
6 circuits would be appropriate for that
7 imager.
8 Q. You would agree with me that
9 when we're talking about Figure 7, that
10 board 29 should be characterized as
11 off-chip with respect to imager device 27.
12 Do you agree with that?
13 **A. I think that that would be a**
14 **common understanding.**
15 **I don't believe on-chip is --**
16 **it's not claim language and it's nothing**
17 **that I've particularly tried to understand,**
18 **but I think that would be a common view.**
19 **What is not on the chip is off the chip.**
20 Q. So picking up -- I think picking
21 up where we were, so now we have a signal
22 coming from the image sensor, or the imager
23 device 27 that goes to board 29, and I
24 don't think you've testified as to exactly
25 what happens to the signal at board 29,

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1 CONFIDENTIAL - DEAN NEIKIRK, PH.D.
2 He simply says that -- "circuit for
3 driving."
4 Well, there are lots of such
5 circuitries. And for a CCD, one of the
6 things you might need is a voltage shift
7 driver, and I did testify that for CMOS you
8 wouldn't necessarily need that. But I
9 never said that there are no drivers.
10 Q. In the context to a person of
11 skill in the art in Wakabayashi, is there a
12 meaning for this circuit for driving the
13 solid-state imager based on your
14 understanding?
15 **A. Precisely what it says. Given a**
16 **particular choice for solid-state imaging**
17 **device, one of ordinary skill would be able**
18 **to identify an appropriate driver circuit.**
19 Q. So it's your testimony that
20 whatever a person decides Wakabayashi can
21 mean, you would have a driving circuit
22 appropriate for whatever you decided it
23 could mean; is that right?
24 **A. One of ordinary skill in the art**
25 **selecting a given solid-state imager**

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1 CONFIDENTIAL - DEAN NEIKIRK, PH.D.
2 have you?
3 MR. DAVIS: Objection.
4 Form.
5 **A. No, I don't think that's quite**
6 **correct. I was quoting from paragraph 9,**
7 **which identified camera head. Let me look**
8 **-- so there's camera circuit 102.**
9 **Camera circuit 102 identifies**
10 **signal processing circuit.**
11 **If you look earlier in column 6,**
12 **it says that the signal processing circuit**
13 **for the video camera unit 5 is on circuit**
14 **board 39.**
15 **So reading these together in**
16 **Figure 22, some of the circuitry is on 29.**
17 **Some is on 39.**
18 **And part of what's required in**
19 **the block labeled 102, camera circuit --**
20 **according to Wakabayashi, column 9 -- is**
21 **signal processing.**
22 **He did tell me where that is.**
23 **He said that's on 39.**
24 **In column 9, Wakabayashi tells**
25 **me the camera head 100 includes the wide**

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 receiving lens, solid-state imager device
3 and a circuit for driving solid-state
4 imager device and so on.
5 That's what it says.
6 If you look at Figure 3, you see
7 where the lens is, you see where the
8 circuit board 29 is, you see where the
9 solid-state imager device 30 is. They're
10 all inside 5.
11 And although he didn't say that
12 camera head 100 is only what's inside 5,
13 the description he gives is consistent with
14 that.
15 Several of the elements that --
16 in circuit diagram in Figure 22 called
17 camera head 100 are clearly inside 5 in
18 Figure 3.
19 So the circuit board 29 is
20 certainly involved in that functionality,
21 100, in the circuit diagram for Figure 22,
22 just as he specifically says that the
23 signal processing -- a signal, camera
24 signal process circuit is in that second
25 block 102, but he earlier says that's on

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 Q. What is the process being done
3 on 39 then?
4 A. Well, he tells you what the
5 process being done on 102 -- in 102, which
6 includes camera signal processing circuit,
7 synchronization signal generator and so on
8 generates video signal 103.
9 He earlier clearly stated that
10 on circuit board 39 is that it includes a
11 signal process circuit for video camera
12 unit 5, a driver circuit for the liquid
13 crystal panel 38, a system circuit, a power
14 circuit and so on.
15 Q. So is it your testimony then
16 that camera circuit 102, which is shown in
17 Figure 22, is on board 39 then? Is that
18 your testimony?
19 MR. DAVIS: Objection to form.
20 A. Certainly parts of 102 are on
21 39. He's very clear about the signal
22 processing circuit.
23 It doesn't make sense I think to
24 one of ordinary skill in the art to place
25 the rest of what he describes as being in

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 39. So he is giving indications as to how
3 various things are partitioned between 29
4 and 30.
5 Q. And, Dr. Neikirk, you can't tell
6 me now, it sounds like, what functions are
7 performed on board 29 and what functions
8 are performed on board 39, can you?
9 A. I believe --
10 MR. DAVIS: Object to form.
11 A. I believe that in column 9 he's
12 telling you that at least on 29, which is
13 where the imager device is attached, that
14 there's a circuit for driving the
15 solid-state imager and so on.
16 Now, he doesn't say whether
17 that's necessarily on-chip or off-chip, but
18 this is all part of camera head 100.
19 So I believe that one of
20 ordinary skill in the art reading that
21 would interpret that to mean that's related
22 to circuit board 29.
23 He's very clear that
24 functionality contained in camera circuit
25 102 is on circuit board 39.

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 102 onto 29.
3 If the signal processing circuit
4 is on 39, then you'd put the rest of that
5 on 39. There are only two circuit boards
6 identified in Wakabayashi. It's all got to
7 be on one or the other.
8 Q. So all the signal processing is
9 either going to be on board 29 or 39 is
10 your testimony; is that correct?
11 MR. DAVIS: Objection to form.
12 A. No. Did you just ask me if I
13 was testifying that the video -- that the
14 signal processing was on 29? I'm sorry,
15 maybe I misheard your question.
16 Q. You said it would make sense if
17 you put all the signal processing in one
18 place, so I believe you're saying it would
19 be on board 29.
20 Is that your testimony?
21 A. No, no. That's not what I
22 testified.
23 I said that in column 6 he
24 specifically says that the signal
25 processing circuit is on 39. It's at

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 column 6, line 7 through 10, very
3 explicitly.
4 So that element of camera
5 circuit 102 at least is certainly on 39.
6 He says so. It's an explicit disclosure.
7 Q. And that signal processing
8 circuit for the video camera unit; right?
9 That's what it says.
10 MR. DAVIS: Object to the form.
11 A. So in column 6 it says that
12 circuit board 39 includes a signal
13 processing circuit for the video camera
14 unit 5. That was what it says.
15 Q. And what kind of processing is
16 that doing?
17 A. Well, he identified a number of
18 things. He identifies generating a video
19 signal 103 in television signal format from
20 the optoelectrically converted signal 101.
21 That's in column 8 -- let's see -- at line
22 16. Now, that is identified as a
23 generation -- it actually doesn't say
24 that's specifically part of the signal
25 processing circuit.

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 Q. So your testimony is yes, that
3 circuit 102 is on board 39; correct?
4 MR. DAVIS: Objection to form.
5 A. So certainly at least part of
6 102 is on 39.
7 Q. What part would be on it?
8 A. Well, the part that he
9 explicitly discloses, the signal processing
10 circuit.
11 Now, looking at the other things
12 that he mentions as being part of 102,
13 including synchronization, signal
14 generator, signal path and so on, which
15 produces -- generates -- excuse me -- video
16 signal 103, so it leaves -- the camera
17 circuit 102 is a video signal in television
18 format.
19 And given the things that you
20 would need to do to all this, to go from
21 the optoelectrically converted signal 101
22 to video signal 103 in television format, I
23 believe one of ordinary skill in the art
24 would interpret that, yes, the things that
25 are described as being in 102 would -- some

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 He does have other disclosure
3 related to turning upside down images right
4 side up. I'm trying to look -- let's see.
5 Does he identify that as signal processing
6 or is he more generic about signal
7 processing. Let's see.
8 Oh, no, actually, he identifies
9 that it's circuit 107. That's the version.
10 But if you look at Figure 22,
11 there are numerous other circuit blocks.
12 For instance, power supply
13 circuit 115. Well, he's already said in
14 column 6 that the power supply circuit is
15 on 39.
16 Q. It's your testimony -- is it
17 your testimony that camera circuit 102 is
18 also on board 39?
19 MR. DAVIS: Objection to form.
20 A. He explicitly has stated that
21 the camera circuit 102 includes camera
22 signal processing circuit.
23 In column 6, he explicitly
24 states that signal processing circuit for
25 the camera unit is on 39.

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 of it is required to be on -- is an
3 explicit disclosure that it's on 39.
4 But the rest of it only makes
5 sense if it's on 39, so I would say that
6 what Wakabayashi is teaching is the fact
7 that it's located on 39.
8 Q. And board 39 is also off-chip
9 with respect to imager device 27; correct?
10 A. Yes, it's not part of the chip,
11 27.
12 Q. And you did make reference to
13 what you were referring to earlier, I think
14 it was in column 6, a driver circuit for
15 the liquid crystal panel 38, column 6
16 between lines 5 and 10.
17 Do you see that?
18 A. I do. At that point it says
19 that circuit board 39 includes signal
20 processing for video camera, driver circuit
21 for a liquid crystal panel 38, a systems
22 circuit, a power supply circuit and so on.
23 Q. Is that the same driver circuit
24 that we spoke about in connection with
25 Figure 22 in column 9, where you were

<p style="text-align: right;">Page 154</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 testifying earlier? 3 MR. DAVIS: Objection to form. 4 A. No, no. In column 9 it says 5 that the driver for the solid-state imager 6 device. In column 6 it's a driver circuit 7 for the liquid crystal panel. 8 Those are not the same in any 9 way, shape or form. 10 Q. Okay. Now, in Figure 22 you 11 pointed to element 104, which I believe is 12 a flipping circuit. 13 Is that what you -- I think you 14 pointed that out recently. 15 Do you recall that? 16 A. Yeah, I don't think it's 17 necessarily the entirety of 104. Perhaps 18 it's -- it explains -- sorry. 19 Q. What's your understanding of 20 that circuit in Wakabayashi that's 21 identified by 104? 22 A. So in column 9 at line 22, it 23 states that the video signal 103 is next 24 input to an image arrangement converter 25 circuit 104, and then he goes on to explain</p>	<p style="text-align: right;">Page 155</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 how pieces within 104 function in order to 3 take an upside down image, and based on 4 further down in column 9, starting at line 5 46, when the video signal 103 represents an 6 upside down image, this image should be 7 converted to an upright image, as described 8 above, whether an upside down image has 9 been taken, in a sense, based on a rotating 10 angle of the video camera unit 5. 11 He then goes on and explains 12 that -- let's see -- then when you have 13 detected such an upside down version image 14 -- I'm down around line 58 -- the read 15 address circuit 107, which is -- that's in 16 the bottom of the box dash line 104 -- 17 forced to generate addresses in the reverse 18 -- in the order reversed to that of the 19 right address generator 106, whereby a 20 video signal 111 is read from RAM 105 in 21 order reverse to the order in which the 22 video signal was written. 23 Explains quite clearly what it 24 does there. 25 Q. Do you know why Wakabayashi</p>
<p style="text-align: right;">Page 156</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 needs that particular circuit in it? 3 A. Well, because Wakabayashi has a 4 rotating -- I keep trying to use his 5 phrasing -- camera unit 5 does rotate. 6 Q. It has a selfie mode in it? 7 A. I don't recall whether he calls 8 it a selfie mode, and it doesn't 9 necessarily -- I don't know whether he 10 restricts it to only point in two 11 directions. It certainly rotates. 12 Q. Do you have an understanding of 13 how pixel arrays or I guess the photo 14 detector arrays are read out for a CCD 15 photo detector array? 16 A. I think I've already actually 17 described that. A typical CCD array reads 18 out the entire pixel content in a serial 19 fashion. 20 Q. And for a CMOS photo detector 21 array, is it the same mechanism to read out 22 the pixel array? 23 A. Well, firstly, the physics is 24 not the same at all because in a CMOS 25 array, switches are used to connect pixels</p>	<p style="text-align: right;">Page 157</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 via row and column, address thing. 3 But in a typical CMOS array, you 4 read out one column after another and then 5 the image data again is serial, but it's 6 collected, if you will, a column at a time. 7 So one column follows another column 8 follows another column. 9 Whereas in a CCD, at least the 10 most common version, it's not the only way 11 to do it, but the most common, it's one 12 pixel followed by another pixel followed by 13 another. 14 And depending on how the CCD was 15 built, that might be in row order, it might 16 be in column order. It's not in random 17 order. 18 Q. A CMOS photo detector array, 19 though, is addressable in the XY. 20 You can read it out randomly, 21 each pixel; is that correct? 22 A. Some can be. It doesn't 23 necessarily -- a lot of them use a common, 24 for instance, a column address, so you read 25 out the whole column or you don't read it</p>

<p style="text-align: right;">Page 158</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 at all. 3 Q. Would a CMOS photo detector 4 array need a circuit like that 104 in 5 Wakabayashi to -- 6 A. Circuit -- absolutely. 7 Q. Why is that? 8 A. Because at that point it's in 9 television video format. That was -- that 10 was done by camera circuit 102. 11 Once it's in television video 12 format, it has no idea whether it came from 13 CMOS or CCD. That's managed. That is 14 irrelevant. 15 Q. We're still going to talk about 16 Wakabayashi, but I do want to bring up the 17 Ackland reference, which is Exhibit 1006. 18 A. Okay, I have that in front of 19 me. 20 (Exhibit 1006 for 21 identification, Ackland patent, shown to 22 witness.) 23 BY MR. CAPLAN: 24 Q. Okay. So you mentioned this a 25 few times.</p>	<p style="text-align: right;">Page 159</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 You looked to Ackland to get an 3 example of an imager, an imager device that 4 you used to replace imager device 27 in 5 Wakabayashi; right? 6 A. Well, I think I wouldn't agree 7 with the word "replace." 8 Wakabayashi says it needs to be 9 a solid-state imager device and gives no 10 further detail. Ackland is a solid-state 11 imager device. 12 I'm not really sure how you call 13 that a replacement. It provides further 14 detail of however a specific type works, 15 yes. 16 Q. So what's your understanding of 17 the Ackland patent, Exhibit 1006? 18 MR. DAVIS: Object to the form. 19 A. Well, it's -- as its title says, 20 about CMOS active -- about a CMOS active 21 pixel image sensor, although it is 22 addressing a specific way of building the 23 pixels in terms of fabrication technique 24 that only requires one level of 25 polysilicon.</p>
<p style="text-align: right;">Page 160</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 So in general terms, it's about 3 a CMOS active pixel imager. And in more 4 specific terms, one -- Ackland is talking 5 about the way of making the fabrication 6 use, in some sense, fewer steps by using 7 only one level of polysilicon. 8 Q. You testified earlier that 9 Wakabayashi doesn't specify the particular 10 type of technology that could perform the 11 function of the image sensor 27 for the 12 imager device 27; right? 13 A. Well, he says it has to be solid 14 state. That eliminates many things. 15 Q. Okay. But it wouldn't eliminate 16 solid state -- well, what's your 17 understanding of the options for 18 solid-state imagers that could be used with 19 that? 20 A. Well, the CMOS smart pixel is an 21 example. CCD is an example. Photo diode 22 arrays are made of solid-state devices, and 23 photo diode arrays could be made without -- 24 without using CMOS technology, for 25 instance. So those are three examples that</p>	<p style="text-align: right;">Page 161</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 come to mind. Let me think. 3 My own microbolometer work, 4 those were devices made that are solid 5 state as well. They were not 6 semiconductors, but that's still solid 7 state. It's not, you know... 8 Q. What was the problem or 9 deficiency in Wakabayashi that would cause 10 -- that caused you to combine another 11 reference, Ackland, with it? 12 MR. DAVIS: Objection to form. 13 A. Well, so in order to -- if 14 someone reading Wakabayashi wanted to build 15 Wakabayashi, they're going to have to pick 16 a sensor, and I believe that at the time 17 one of the choices certainly would be CMOS. 18 This is -- these are in the same 19 art. They're about cameras. 20 And so Ackland teaches the 21 details of a solid-state imaging device. 22 Q. But the solid-state imager is 23 just one part or one component of 24 Wakabayashi; is that right? 25 A. I would agree it is.</p>

<p style="text-align: right;">Page 162</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 Q. Wakabayashi has a number of 3 other components in it; correct? 4 A. Yes, I believe Wakabayashi is 5 replete with details about mechanical 6 arrangements and the image and version 7 circuitry, in particular, for the video, 8 the rotatable camera head. 9 So, yes, there is certainly 10 other components. 11 Q. But it has -- I'm sorry? 12 A. Excuse me. But without the 13 solid-state imaging device, of course, 14 there's no camera. 15 Q. Wakabayashi also has at least 16 two off-chip circuit boards, 29 and 39, 17 that we were talking about before, in 18 addition to those other items? 19 A. Absolutely. In particular, he 20 shows two circuit boards, yes. 21 Q. And we talked earlier about the 22 development of CMOS technology and we 23 talked about Exhibit -- I think it's 1060, 24 the Business Week article involving 25 Dr. Fossum.</p>	<p style="text-align: right;">Page 163</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 Do you recall that? 3 A. I do. 4 Q. And one of the things we talked 5 about was the state of the art with the 6 CMOS imager photo detector technology, 7 which was taking advantage of making it out 8 of CMOS. 9 Do you recall that? 10 A. I do. 11 Q. And that was one of the benefits 12 you explained; correct? 13 A. Yes, because by making it CMOS, 14 it meant that you could leverage existing 15 fabrication facilities. 16 Q. And you would get -- it would 17 all be integrated in one device. 18 That was the whole point, the 19 camera-on-a-chip; right? 20 MR. DAVIS: Objection to form. 21 A. No. No, no, no. You don't 22 integrate the power supply in that. 23 In fact, the amount that you 24 integrated on that array depended on a 25 person's design.</p>
<p style="text-align: right;">Page 164</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 The earlier ones integrated 3 nothing else, and then people, because it 4 was CMOS, they had the option to integrate 5 other things. But I know of no chip -- 6 well, I think this is fair. 7 I don't know of any chip that 8 has 100 percent of everything you need to 9 build a camera on that chip. 10 Q. Is that your understanding of 11 "camera-on-a-chip" as used in the Business 12 Week article about Dr. Fossum's work when 13 it says "get ready for the 14 camera-on-a-chip," that's 100 percent of 15 everything on one chip? 16 A. No, that's not my understanding. 17 MR. DAVIS: Object to the form. 18 A. They did not mean that 19 everything was on one chip. 20 They meant -- first of all, they 21 meant the ability to have other things on 22 there, but by "camera-on-a-chip," I don't 23 think anyone ever intended that to mean 24 that your entire camera is now that single 25 chip.</p>	<p style="text-align: right;">Page 165</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 Q. But a number of components could 3 be put on-chip if you took the CMOS 4 approach; is that correct? 5 A. Yes. Some components, some 6 circuitry could be placed on that chip. 7 Q. And I think you explained 8 earlier, you testified earlier that it 9 would be smaller and less expensive; 10 correct? 11 A. So I think what I was testifying 12 to was that by adding in that circuitry you 13 can take -- again, you're leveraging 14 fabrication. You don't manufacture two 15 pieces of silicon. You make one. 16 So the net effect is that it is 17 likely to be -- if you added the two dye 18 area and you forced them to be in the same 19 space, it might be a bit smaller. 20 Now, if you can remove the other 21 function to another circuit board, I mean, 22 you know, smaller is relative to what 23 you're trying to build. I think what I was 24 talking about was, as much as anything, is 25 the fact that you're using a standard CMOS</p>

<p style="text-align: right;">Page 166</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 process makes it easier to integrate 3 standard CMOS -- other CMOS circuitry. 4 I believe I also pointed out 5 that there were -- and I believe there may 6 still be -- CCDs that do have some 7 peripheral circuitry on the same chip, but 8 that's a specialized process because the 9 CCD process was specialized. 10 Q. You just mentioned standard CMOS 11 processes being integrated in the CMOS 12 device. 13 That would include signal 14 processing, wouldn't it? 15 A. No. I'm sorry. 16 In that context, by processing, 17 I meant the -- the fabrication process. 18 Not the circuit. 19 So signal processing is an 20 electrical phenomena. The fabrication 21 process is the steps of photo lithography 22 ion implant, oxidation diffusion 23 lithography. All of those steps. 24 When I was talking about 25 processing, standard processing, that's</p>	<p style="text-align: right;">Page 167</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 what I was talking about. IC fabrication 3 processing. I'm sorry if that wasn't 4 clear. 5 Q. And with CMOS image sensors with 6 CMOS photo detector arrays, you could use 7 standard CMOS manufacturing to incorporate 8 more features on-chip in the manufacturing 9 process; is that correct? 10 A. Yes. 11 MR. DAVIS: Object to form. 12 A. Yes. I think that is correct. 13 You could. You'd have that as an option 14 you could select. 15 Q. And putting -- when we started 16 developing the CMOS image centers with CMOS 17 photo detector arrays that were integrated 18 this way and took advantage of the CMOS 19 manufacturing ability, all the components 20 being made with a similar manufacturing 21 method, that was also referred to as having 22 a lot of the features on-chip, right, as 23 referred to in the article with Dr. Fossum? 24 MR. DAVIS: Object to form. 25 A. Yes. When you use a single</p>
<p style="text-align: right;">Page 168</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 piece of silicon to fabricate many 3 different -- different circuitry, then all 4 of that circuitry is on-chip. That would 5 be the phrasing. 6 Q. And we were just talking about 7 Wakabayashi, and you agreed that 8 Wakabayashi describes a device with 9 off-chip circuitry, right, circuit boards 10 29 and 39 are off-chip; right? 11 A. He certainly does. But, again, 12 as I think I've mentioned, I don't think 13 I've ever -- someone may have built a CMOS 14 imager that contained, for instance, a 15 microprocessor. That might exist, but I 16 don't think most of them do. 17 So what Wakabayashi was doing 18 was partitioning different pieces in 19 different places and he said where to put 20 Wakabayashi's camera -- let's try to use 21 his wording: "Signal processing circuit 22 for video camera." 23 He did say where to put that and 24 it is off-chip, but I don't think that 25 that's too surprising.</p>	<p style="text-align: right;">Page 169</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 MR. CAPLAN: You want to take a 3 short break here? 4 (A recess was taken.) 5 BY MR. CAPLAN: 6 Q. Dr. Neikirk, a couple of things 7 to kind of pick up where we were talking, 8 discussing the circuit 104 in Wakabayashi, 9 which deals with the inverted or the 10 flipped image. 11 And you testified that if -- 12 that would not be necessary -- it would be 13 necessary in a CMOS device if the image was 14 already in TV format. 15 Do you recall that? 16 MR. DAVIS: Objection to form. 17 A. No. What I said was that 18 Wakabayashi's output 103 is in video 19 format. He specifically says it is. 20 And once it's in video format, 21 the rest of the system doesn't know what 22 kind of sensor it came from, whether it's 23 CCD, CMOS, it couldn't care less. It does 24 not know once it's in video format. It 25 could have come from an old-fashioned video</p>

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 com tube.
3 **So, yes, if you want to flip the**
4 **image over once it's in video format, you**
5 **need to do what's in 104. I know that**
6 **there may be other ways, but you can do**
7 **what's in 104 in Wakabayashi.**
8 Q. If you could access the image
9 before -- the image data, the pixel data
10 before it was converted to the television
11 format, then you would need that circuit to
12 convert it, though; right?
13 MR. DAVIS: Objection to form.
14 (Reporter clarification.)
15 **A. If you would repeat the**
16 **question.**
17 Q. Sure. That would be easier.
18 If you could access the image
19 data and the pixel data before it was
20 converted to television format, then you
21 wouldn't need a circuit to convert it to a
22 different orientation; correct?
23 MR. DAVIS: Objection to form.
24 **A. No. If you had access to the**
25 **data prior to conversion to video and you**

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 **are column addressable, so some of them**
3 **will automatically give you all the data in**
4 **the column or a row.**
5 **Some of them do allow you to get**
6 **to one pixel at a time. It varies, it**
7 **depends.**
8 Q. But that's a feature of CMOS
9 photo detector pixel arrays; right?
10 **A. Well, it is a feature --**
11 MR. DAVIS: Object to form.
12 **A. It is a feature that is**
13 **certainly much easier to implement for CMOS**
14 **than it would for, for instance, CCD.**
15 **I -- I can't honestly say**
16 **whether somebody hasn't just done an exotic**
17 **CCD design that allowed them to get to**
18 **smaller pieces of it.**
19 **I -- I don't know. It's**
20 **certainly easier, I think, for CMOS than it**
21 **is for CCD.**
22 Q. So you agree then that that
23 circuit 104 that's shown in Wakabayashi is
24 necessary for a CCD photo detector array;
25 right?

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 **wanted to, quote, "convert it," unquote,**
3 **you'd have to have some other circuit.**
4 **Otherwise, it's not inverted.**
5 Q. But if you could read out the
6 array, the pixel array, in the right order
7 to account for whatever the orientation is,
8 you wouldn't need another circuit; is that
9 right?
10 **A. Well, but then you'd have --**
11 MR. DAVIS: Object to form.
12 **A. You would have to have a circuit**
13 **that allowed you to read it out in a**
14 **different order. That's a different**
15 **circuit for CCD or CMOS or other**
16 **solid-state imagers.**
17 **There is typically by the**
18 **architecture of the imaging chip itself,**
19 **there's an order format, and if you want to**
20 **change that order, it will require**
21 **circuitry to do that.**
22 Q. You would agree that a CMOS
23 active pixel photo detector array is
24 addressable, is XY addressable; right?
25 **A. Not all of them. Some of them**

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 MR. DAVIS: Objection to form.
3 **A. It would be necessary for**
4 **either -- I mean, by either.**
5 **It would be necessary for CCD as**
6 **it would be necessary for CMOS.**
7 Q. You have testified it may not be
8 necessary for CMOS because the CMOS pixel
9 array is, in fact, addressable.
10 It doesn't come out in that
11 bucket brigade; right?
12 MR. DAVIS: Objection to form.
13 **A. That's not what I testified.**
14 **You asked if it was addressable.**
15 **I agreed.**
16 **What I testified was that if you**
17 **wanted to alter the order in which you read**
18 **out the pixels so that you read them out in**
19 **one order for one circumstance and a**
20 **different order for another circumstance,**
21 **that would require circuitry.**
22 **The -- it's not the same as 104**
23 **because 104 is operating on a video signal,**
24 **but in some sort of -- so the means would**
25 **be different but the result would be -- but**

<p style="text-align: right;">Page 174</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 you would still have to have a circuit to 3 do it. 4 MR. DAVIS: Dr. Neikirk, if you 5 could just pause a little bit more before 6 the answers. We're talking over each other 7 and I want to make it easier for the court 8 reporter. Thank you. 9 THE WITNESS: My apologies. 10 That is a habit of mine. I'm sorry. 11 BY MR. CAPLAN: 12 Q. What circuit would you need to 13 change the order of the readout in a CMOS 14 you were in? 15 A. Well, if it was a CMOS circuit 16 that dumped data in a serial fashion row by 17 row, you'd at least have to have an address 18 circuit that reversed the order in which 19 you activated -- I said rows. Usually it's 20 columns. It doesn't really matter. Let me 21 use columns. 22 If you did it in columns left to 23 right, for normal circumstances, if you 24 wanted to so-call invert that, you would 25 have to read right to left, and that,</p>	<p style="text-align: right;">Page 175</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 actually, you would have to do more. 3 You'd have to say that the 4 column on the furthest right is going to be 5 converted to data for the video display 6 that's on the furthest left. 7 So it's not just simply the 8 order in which you read it out. It's the 9 further conversion to saying "this order 10 should be different in the video display." 11 If I read a CMOS array out left 12 to right or right to left, it's the same 13 image. I have to fool the video system 14 into believing I read it left to right when 15 I actually read it right to left. That 16 requires circuitry. 17 Q. Have you ever designed a circuit 18 to do that function? 19 A. To do an inversion function like 20 that? No, I've never done that because 21 none of my imagers were one where we needed 22 to invert the image. 23 Q. So you've never worked on this 24 feature with a CCD photo detector array or 25 a CMOS photo detector array, have you?</p>
<p style="text-align: right;">Page 176</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 MR. DAVIS: Objection to form. 3 A. No, but this is -- excuse me -- 4 no, I have not because I haven't had call 5 to. 6 But this is simple basic 7 understanding of how data in a 8 two-dimensional array is ultimately 9 displayed on a display. There has to be a 10 mapping between a specific location in the 11 original array and a location in the 12 display. 13 And in order to invert, you have 14 to change that mapping. Anybody who takes 15 pixelated data and tries to display this 16 would know that. 17 Q. You do agree then that the way a 18 CCD photo detector array is read out is 19 different than the way a CMOS photo 20 detector array is read out; right? 21 MR. DAVIS: Objection to form. 22 A. I think, generally speaking, 23 yes. I believe they are read out in 24 different manners. 25 But in Wakabayashi, since he</p>	<p style="text-align: right;">Page 177</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 does the inversion after conversion to 3 video, it actually didn't matter for the 4 inversion process. 5 Q. Let's talk about Wakabayashi a 6 little bit more then. 7 So one thing that we've been 8 talking a lot about is the imager device 27 9 in Wakabayashi, right, and we talked about 10 Figure 7 and the imager device 27. We 11 talked about that a lot. 12 A. Yes, we certainly discussed 13 that. 14 Q. And it's in your declaration. 15 You testified today that your 16 understanding is essentially this is a 17 roadmap to do whatever you'd like to do as 18 a design matter, and you looked to Ackland 19 to get that feature; is that correct? 20 MR. DAVIS: Objection to form. 21 A. I'm not exactly sure that's how 22 I phrased it. 23 What I said was is that 24 Wakabayashi doesn't pick a type of 25 solid-state imaging device 27. So one of</p>

<p style="text-align: right;">Page 178</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 ordinary skill wishing to build something 3 like this would be motivated to seek out 4 further information on a particular type. 5 And I pointed to Ackland as 6 providing that kind of information. 7 Q. Now, instead of Ackland, why 8 wouldn't you or why didn't you pick a CCD 9 image sensor to add more details about 10 imager device 27 in Wakabayashi? 11 A. Well, I think as the patent -- 12 sorry -- we're supposedly doing the '565 13 today. 14 It's as the '565 admitted in its 15 introduction, CMOS was widely known and it 16 was known, as we've discussed, to have 17 advantages, certain kinds of advantages. 18 Given that Wakabayashi appears 19 to be something aimed at a consumer camera 20 market as opposed to, say, scientific 21 instrument, I think one of ordinary skill 22 at the time would have already been aware 23 that for a lower cost option, CMOS has 24 advantages, so they would have a 25 preference, I think, to look for CMOS image</p>	<p style="text-align: right;">Page 179</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 chips as opposed to CCD. 3 Q. So you did look at the '565 4 patent to figure out what was the best 5 element to put in Wakabayashi for that 6 imager device 27? 7 MR. DAVIS: Objection to form. 8 A. No, I don't think that's the 9 correct way to phrase it. 10 I just explained to you why I 11 believe that one of ordinary skill in the 12 art who would have all of the literature at 13 their -- available to them, they would know 14 it all, what the motivation would be for 15 that person looking at Wakabayashi in a 16 consumer sort of camera, why they would 17 lean -- why they would look to a less 18 expensive solid-state imager, which I 19 believe it was widely recognized and 20 acknowledged that CMOS was such an image -- 21 solid-state image sensor compared to a CCD. 22 Q. So let's talk for a minute about 23 the consumer camera market. 24 So in 1995 to '97, the relevant 25 time frame that we're talking about, what</p>
<p style="text-align: right;">Page 180</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 was your understanding of the consumer 3 camera market at that time? 4 A. Well, I believe that the 5 consumer -- you know, I've forgotten 6 exactly the years. Mid to late '90s is 7 really the best to pin it down in my 8 memory. 9 Q. That's fine. 10 A. There were cameras introduced. 11 There were even cellphone cameras 12 introduced, if I remember right. 13 Some of the earliest I think did 14 use CCD, but they were rather expensive, 15 and, again, I think one of ordinary skill 16 taking advantage of the literature that was 17 available, including Ackland, knew at the 18 time that they could reduce cost by going 19 with the CMOS option. 20 So I think there's a clear -- 21 that is one -- clear motivation to go that 22 direction. 23 We talked about other advantages 24 from the perspective of circuitry. Not 25 requiring multiple voltages. Well, I think</p>	<p style="text-align: right;">Page 181</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 one of ordinary skill would recognize that 3 as an advantage as well. 4 Q. Is there something in 5 Wakabayashi that talks about making design 6 choices with the description that is 7 provided in the Wakabayashi patent that 8 focuses on lowering cost when you make 9 those design choices? 10 A. Let's see. 11 You know, I think Wakabayashi, 12 in its introduction, focuses a lot on being 13 able to do the image reversal. 14 He certainly talks about making 15 the camera units small so he can pivot more 16 easily. 17 I don't know whether Wakabayashi 18 itself explicitly uses the word "cost," 19 but, again, I think this is something that 20 would be well-known to one of ordinary 21 skill. 22 I mean, this is clearly not a 23 scientific instrument, Wakabayashi. He's 24 talking about something -- let's see, in 25 the introduction, a video camera. I think</p>

<p style="text-align: right;">Page 182</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 he talks about it's got a PCMCIA slot, so 3 it's designed to connect to another 4 computer. 5 You know, the simplest way I can 6 put it is this is not a scientific 7 instrument. Scientific instruments 8 emphasize performance over all other focus. 9 Consumer products don't do that. 10 Performance is certainly relevant, but cost 11 is highly relevant as well, and I think 12 that one of ordinary skill would recognize 13 that if you could reduce the cost, that 14 would probably be a good thing to do. 15 Q. Wakabayashi, if you look at the 16 front page of Wakabayashi, you're aware 17 that that patent is assigned to Hitachi 18 Limited of Tokyo, Japan? 19 A. I'd have to look again, yes. 20 It's certainly assigned to 21 Hitachi. 22 Q. Did you ever look at Hitachi's 23 products from that time period? This 24 application was filed in August of '95. 25 Did you ever look at Hitachi's</p>	<p style="text-align: right;">Page 183</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 products, their consumer camera products, 3 to see what they had in the market at that 4 time? 5 A. I can't say that I recall that I 6 did or did not. 7 I've certainly looked at -- not 8 necessarily in the context of this case, 9 but, you know, there's the Camera Hall of 10 Fame, where you can see cameras of 11 different types from this time period, and 12 I honestly don't remember. 13 I remember several of the 14 companies were Japanese, but that's all I 15 recall. 16 Q. So you don't know if Hitachi at 17 that time was making cameras that were 18 primarily featuring CCD photo detector 19 arrays, do you? 20 A. No, I don't know. 21 Q. With your declaration, that's 22 not anything that you looked at, is it? 23 A. I'm sorry -- 24 Q. In connection with your 25 declaration, that's not something that you</p>
<p style="text-align: right;">Page 184</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 looked at in preparing your declaration? 3 A. No. Wakabayashi is clearly 4 silent on the type of sensor and I've just 5 explained why I think one of ordinary skill 6 would be motivated to look at CMOS sensors. 7 Q. Right. And you identified cost 8 a couple of times as a factor. 9 Is that the primary factor? 10 A. Well, I think for consumer 11 products -- 12 MR. DAVIS: Objection to form. 13 A. For consumer products, that 14 certainly is one, and perhaps a fairly 15 important one. 16 Wakabayashi discusses size in a 17 variety of contexts. You know, the size 18 issue depends on pixel size a lot, and 19 pixel count. 20 At the time, and I believe 21 you'll see this at least in Fossum's laser 22 focus tubing article, there was a 23 discussion of pixel size, and at this time 24 the standard line width in CMOS was quite 25 small. It was, I believe, about a micron.</p>	<p style="text-align: right;">Page 185</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 I don't really recall what the 3 CCD processors were doing, but I think they 4 tended to have bigger pixels in this time 5 frame, so size would come into it as well. 6 Q. I know I used quality before and 7 it wasn't the right term. I think you 8 preferred signal-to-noise ratio, but do you 9 know the state of the CCD imager art, 10 signal-to-noise ratio, in this August of 11 '95 time frame? 12 A. Do I know the number and in 13 nanovolts per -- 14 Q. No, no -- 15 A. No, I don't recall the number. 16 Q. No. Just in general, kind of 17 where the state of the CCD photo detector 18 array art was at that time in terms of 19 signal or noise, and at least relative to 20 CMOS at that time. 21 MR. DAVIS: Objection to form. 22 A. In that time frame, I do believe 23 that the noise 4 in CCDs was lower than in 24 CMOS. I believe the fixed-pattern noise in 25 CMOS was worse, but that's different from</p>

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 saying that they were bad enough in CMOS
3 that they were unusable.
4 And, in fact, that is what was
5 going on in that time frame. The
6 demonstrations that people were doing for
7 CMOS was to show that the noise 4 was low
8 enough to make high quality images.
9 Q. Would you agree, though, that
10 putting CCD photo detector array in the
11 Wakabayashi patent design would give you a
12 better image output from the device through
13 the CCD?
14 A. I wouldn't phrase it that way.
15 MR. DAVIS: Objection to form.
16 THE WITNESS: Sorry.
17 A. I wouldn't phrase it that way.
18 In normal lighting conditions, I
19 don't know that that would be the case at
20 all.
21 Noise 4 is typically a much
22 bigger issue under low light conditions.
23 And, again, given the way this
24 -- Wakabayashi is described, it doesn't
25 sound to me like this was probably a design

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 the context suggests that -- in which case
3 it would be the lighting more like in an
4 office.
5 And I don't know with absolute
6 certainty that a CMOS would be as good as a
7 CCD, but I'm -- I didn't do that as an
8 investigation for my report.
9 But I would be very surprised if
10 CMOS was worse than CCD in that context, of
11 a typical office lighting situation. And,
12 excuse me, I said "worse." In terms of the
13 impact of noise 4.
14 Q. Just so I understand noise 4,
15 what is that referring to, noise 4?
16 A. So if you use a camera, a
17 solid-state imaging system with a
18 solid-state imaging chip in it, and you do
19 it in the dark, there will still be an
20 image. It will be made up of noise.
21 And the apparent brightness of
22 that noisy signal in the image you view is
23 what I'm talking about. How -- when it
24 should be completely dark, then you would
25 hope your screen would be absolutely black.

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 for use on a telescope, where the light
3 levels were exceedingly low.
4 So, no, I'm not sure at all that
5 in this application that a CCD would have
6 provided superior image quality to a CMOS.
7 Q. Is that your opinion or you
8 know? Is it just your opinion or do you
9 know that, in fact, CCD arrays were no
10 better than CMOS at that time?
11 A. What I know -- you said
12 "better." "Better" is context sensitive.
13 What I know is that the noise 4
14 for CCDs was lower than CMOS.
15 What I also know is that noise 4
16 is an issue under low light circumstances.
17 What I don't know is, for
18 instance, did the person trying to build
19 this want to operate at midnight on a
20 moonless night. Seems unlikely.
21 Given the description of
22 connecting to a monitor and using it for
23 things that appear to be videoconferencing
24 kind of applications -- I'm not sure that
25 Wakabayashi says "videoconferencing," but

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 Well, if you look hard enough,
3 that's never true.
4 For an astronomer, they have a
5 star, which is a point object, adjacent to
6 what they hope is very dark sky, and they'd
7 like to look at a very dim star, which
8 means they really want the sky adjacent to
9 it to really be black. So that noise 4 is
10 very important to an astronomer.
11 In your office, I can see your
12 image right now. I see mostly fairly
13 light-colored objects, with the exception
14 of something that looks like kind of a dark
15 wood paneling behind you along the ceiling
16 and along one side.
17 Well, in that image, I don't
18 think noise 4 is showing up at all.
19 Nothing there is dark enough for
20 me to ever notice the noise produced by the
21 image.
22 Q. Going back to '97-'98, that time
23 frame, do you know if -- and let's talk
24 about consumer cameras because we were
25 talking about that in the context of

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1 CONFIDENTIAL - DEAN NEIKIRK, PH.D.
2 Wakabayashi and you were testifying
3 earlier, so at that time, the dominant
4 imaging technology in consumer cameras in
5 '97, was it CCD or CMOS?
6 A. I -- I don't know as I sit here
7 right now what it was in '97.
8 I seem to recall -- again, I
9 mentioned the Digital Camera Hall of Fame,
10 it's a website, and being an amateur
11 photographer I have looked at that stuff
12 before.
13 And I believe I've seen both,
14 but I can't say that I've looked at it to
15 try to determine what the dominant was.
16 Q. What was the cost difference
17 between CCD and CMOS photo detector arrays
18 let's say in '97? That's the date the
19 application was filed, the filing date.
20 A. Again, I don't know a precise
21 cost difference.
22 I do recall building a camera
23 system for use with our chemical sensors,
24 which we discussed earlier today. And to
25 do that I bought a CMOS imaging chip. Not

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1 CONFIDENTIAL - DEAN NEIKIRK, PH.D.
2 talked about the different kind of
3 structure for the CCD devices, which have a
4 lot of off-chip circuitry.
5 Do you recall that?
6 A. I don't know that that was --
7 the difference has a lot to do with how you
8 have to fabricate it. So whether you put
9 the circuitry on-chip or off, you've still
10 got the problem of fabricating the
11 individual photo detectors.
12 And that's the -- that's a lot
13 of what makes CCD fabrication different
14 from CMOS. And it's not -- I mean, I
15 believe I said this, that by going to all
16 CMOS for both the image conversion element,
17 the pixel, by going to CMOS, it makes it
18 much easier to incorporate other CMOS
19 circuitry because it's all fabrication
20 compatible.
21 But there are steps in the
22 fabrication of a CCD device which are not
23 -- I wouldn't say that they're completely
24 incompatible with CMOS, that's not true,
25 but they are sufficiently different that

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1 CONFIDENTIAL - DEAN NEIKIRK, PH.D.
2 a CCD. And part of the reason I bought
3 that, as I recall, the chip itself only
4 cost me maybe \$10 or less.
5 It worked -- it was very easy to
6 use. So that's the one I picked.
7 Now, I can't honestly recall
8 whether I looked at CCDs, partially because
9 having known about CCDs from 15, 20 years
10 earlier and my recollection was that they
11 were harder to use and more expensive, but
12 I couldn't quantify it beyond that.
13 Q. So when you purchased this CMOS
14 imager, when was that? I know I had asked
15 about '97, but --
16 A. You know, I can't honestly
17 recall whether it was '97 or whether it was
18 2000. It was somewhere in that time frame.
19 I don't remember exactly.
20 Q. Okay. And earlier we talked
21 about Dr. Fossum's article, Exhibit 1060,
22 and the evolution of CMOS, the image
23 sensors, the camera-on-a-chip, in
24 leveraging CMOS manufacturing, and then in
25 that article and in our discussions, you've

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1 CONFIDENTIAL - DEAN NEIKIRK, PH.D.
2 the fabrication facility is not a standard
3 CMOS fabrication facility. It's more
4 specialized.
5 I believe that's what I
6 explained before.
7 Q. Okay. And what Wakabayashi
8 shows in imager device 27 and off-chip
9 circuit boards, which we talked about
10 before, so if you're going to -- my
11 question is, why combine a CMOS array from
12 Ackland in that structure of Wakabayashi,
13 which has these off-chip circuit boards,
14 with respect -- relative to the imager
15 device?
16 A. Because the cost advantage of
17 CMOS imagers is not entirely due to adding
18 circuitry to the chip.
19 The fabrication facilities used
20 to make the pixels themselves, those
21 fabrication facilities by this point in
22 time were very standardized. I believe
23 you'll probably find reference to people
24 like Fossum having their arrays built using
25 MOSIS.

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 **MOSIS was a foundry service, and**
3 **you could get anything built by MOSIS as**
4 **long as it was a specific kind of CMOS.**
5 **The facilities were -- the costs**
6 **were amortized over many, many, many**
7 **application fields.**
8 **People who wanted to build CCDs**
9 **had to have a dedicated line to do that.**
10 **I believe the very article that**
11 **you referenced, there is a statement in**
12 **there about a cost to entry was high. The**
13 **Japanese had already paid the cost. They**
14 **were already making CCDs.**
15 **But the CMOS opportunity to the**
16 **domestic silicon fabrication companies was**
17 **that they wouldn't have to make that new**
18 **investment. Even if they incorporate no**
19 **extra circuitry on-chip, they still garner**
20 **that advantage.**
21 **Q. And what Wakabayashi describes,**
22 **as you said, was a consumer camera device,**
23 **it was already designed, it existed.**
24 **And so -- do you agree with**
25 **that?**

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 **So what I said was that whether**
3 **you had that circuitry or not, you garner**
4 **the same advantage of using standard**
5 **integrated circuit techniques.**
6 **Ones that were widely used for**
7 **circuits that had nothing to do with**
8 **optical devices, that had to do with 555**
9 **timers or a microprocessor that runs a**
10 **dishwasher. It had to do with -- it was**
11 **general purpose, and you garner that**
12 **benefit whether you had circuitry to the**
13 **chip itself or not.**
14 **Some of the circuitry that**
15 **Wakabayashi discusses requiring --**
16 **including, for instance, the conversion to**
17 **video, is not something that is -- at least**
18 **at the time of this -- was trivially done**
19 **in silicon.**
20 **So that -- one of ordinary skill**
21 **was going to need some circuit boards to do**
22 **some of the circuitry, they would have**
23 **expected, whether they used CCD or CMOS.**
24 **I've explained that I believe**
25 **that one of ordinary skill would have**

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 **MR. DAVIS: Objection to form.**
3 **A. It was already designed and**
4 **existed? No, I don't know that.**
5 **Q. Well, the patent existed and it**
6 **shows a particular design with components.**
7 **Do you agree with that?**
8 **A. Right, the patent does.**
9 **I don't know that it was a**
10 **consumer product that I could have**
11 **purchased. I just don't know.**
12 **Q. And you're picking -- and you've**
13 **already testified and you agree that the**
14 **Wakabayashi design incorporates off-chip**
15 **circuitry; right?**
16 **A. Yes, it does.**
17 **Q. And you just testified that if**
18 **you have a CMOS array, that leads to more**
19 **CMOS circuitry because you get a benefit in**
20 **manufacturing to leverage out what you can,**
21 **implement it in CMOS; right?**
22 **MR. DAVIS: Objection to form.**
23 **A. No, that's not what I testified.**
24 **What I said -- excuse me, I**
25 **talked over the objection again.**

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 **looked to CMOS, recognizing that that chip,**
3 **that component, whether it contained a lot**
4 **of off -- on-chip circuitry or not, would**
5 **have an advantage over CCD in terms of**
6 **cost.**
7 **CCD was unlikely to have much**
8 **circuitry on it at all. Even if you got a**
9 **CMOS active pixel array, for instance, with**
10 **no circuitry on the chip, it would have**
11 **cost less.**
12 **Q. So you testified earlier that**
13 **based on your review of Wakabayashi, you**
14 **can't tell if imager device 27 is a**
15 **particular type of solid-state imager;**
16 **right?**
17 **A. Wakabayashi only says it's a**
18 **solid-state imager, and I don't believe**
19 **there's anything else in Wakabayashi that**
20 **would tell me that it is one type or**
21 **another.**
22 **Q. If it was an imager, image**
23 **device 27, and Wakabayashi was a CCD image**
24 **sensor, then in that case trying to put**
25 **Ackland into the Wakabayashi design would**

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1 CONFIDENTIAL - DEAN NEIKIRK, PH.D.
2 be quite difficult; right?
3 MR. DAVIS: Objection.
4 Form.
5 **A. Well, in that case, it wouldn't**
6 **make any sense. You wouldn't put Ackland.**
7 **If you were required to use a**
8 **CCD, then one -- one of ordinary skill**
9 **would never look to Ackland.**
10 **Ackland is not CCD.**
11 Q. Okay. But you're assuming for
12 the purposes of your explanation, at least
13 as I can understand it, is that Wakabayashi
14 is not a CCD device?
15 **A. No. I said that Wakabayashi**
16 **shows no -- he doesn't show any preference.**
17 **He's silent on this issue.**
18 **You asked a question that said,**
19 **"gee, if it was CCD, putting in Ackland**
20 **would be very expensive," and my answer was**
21 **that if it was CCD, you'd never put Ackland**
22 **in because it's already done. You picked a**
23 **CCD.**
24 Q. But --
25 **A. Wakabayashi doesn't pick CCD or**

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1 CONFIDENTIAL - DEAN NEIKIRK, PH.D.
2 why it would be beneficial to do it.
3 Why are you picking -- my
4 question is why are you picking a
5 particular -- why Ackland?
6 **A. Well, I gave you a reason:**
7 **That one of ordinary skill would**
8 **have at least been aware that CMOS imaging**
9 **chips were less expensive than CCDs and**
10 **required different circuitry, but as we**
11 **discussed earlier, they don't require**
12 **multiple voltage levels.**
13 Q. When you put -- if you were to
14 put the Ackland photo detector array into
15 the Wakabayashi design, what other elements
16 of Wakabayashi would you keep? Do you
17 know?
18 MR. DAVIS: Object to the form.
19 **A. Let's look at Figure 22.**
20 **So at the level at which he**
21 **describes -- and they're functional**
22 **descriptions, not schematic circuit**
23 **diagrams -- I think I would keep probably**
24 **everything in Figure 22.**
25 Q. Is there anything you know that

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 **CMOS.**
3 Q. Wakabayashi does pick off-chip
4 circuitry with respect to the image sensor;
5 right?
6 **A. Certainly, it does, which would**
7 **be required for both CCD and CMOS.**
8 MR. DAVIS: Dr. Neikirk, if we
9 could just pause.
10 **THE WITNESS: I'm sorry.**
11 MR. DAVIS: I'm stating my
12 objection to form again.
13 Thank you.
14 BY MR. CAPLAN:
15 Q. Would putting the Ackland CMOS
16 photo detector array into the Wakabayashi
17 design get you a better image quality or a
18 better signal of noise in the image? Do
19 you know?
20 MR. DAVIS: Objection.
21 Form.
22 **A. As -- I mean, that question -- I**
23 **don't -- better compared to what? Better**
24 **requires a reference.**
25 Q. Well, I'm trying to understand

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1 CONFIDENTIAL - DEAN NEIKIRK, PH.D.
2 you would have to change in Wakabayashi
3 besides the photo detector array from
4 Ackland?
5 MR. DAVIS: Objection.
6 Form.
7 **A. Well, at the level of detail**
8 **that Ackland describes, I think the answer**
9 **is no.**
10 **Again, it's -- I believe that**
11 **one of ordinary skill in the art is**
12 **motivated to combine these two references**
13 **because in order to implement actual --**
14 **Ackland gives functional descriptions**
15 **largely and rather broad descriptors.**
16 **For instance, we repeatedly**
17 **discussed the signal processing circuit for**
18 **the video camera. That's all Ackland**
19 **gives.**
20 **To build this, I believe one of**
21 **ordinary skill in the art would seek other**
22 **information to actually implement, Ackland**
23 **being a good example of details on the**
24 **solid-state imaging device.**
25 MR. CAPLAN: If it's okay, I'd

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1 CONFIDENTIAL - DEAN NEIKIRK, PH.D.
2 like to take a short break here.
3 (A recess was taken.)
4 BY MR. CAPLAN:
5 Q. So, Dr. Neikirk, picking up
6 where we were in the combination of
7 Wakabayashi and Ackland, so we've been
8 talking a lot about cost.
9 And so if cost is an important
10 factor, as you've testified, why have a
11 device with multiple boards, as shown in
12 Wakabayashi, if you could implement it with
13 more on-chip integration, as would be done
14 with CMOS at the time?
15 MR. DAVIS: Objection to form.
16 A. Because sometimes, depending on
17 the functionality, it does cost you more to
18 put it on-chip, and I'll use as an example
19 the conversion to standard video output,
20 which is a -- video output is purely
21 analog, has a lot of information encoded
22 and a lot of different frequencies.
23 And that process is not really
24 compatible with the purely digital CMOS
25 product. It requires what's called a mixed

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1 CONFIDENTIAL - DEAN NEIKIRK, PH.D.
2 of things. A lot of people bought them to
3 do a lot of things.
4 Trying to integrate that into
5 your dedicated imaging chip, somebody else
6 might not want those functions and then
7 they have to pay for them.
8 So partitioning function between
9 chips and boards and other chips, which are
10 usually on other boards, or on boards, is a
11 common everyday activity for somebody
12 building stuff.
13 So I don't think it's at all
14 obvious that you'd be best to put
15 everything on the solid-state imager and
16 have no circuit boards at all from a cost
17 perspective. I don't think that's clear at
18 all.
19 Q. So you made reference in this
20 answer to "mixed signal ICs."
21 What is that referring to?
22 A. So a mixed signal IC is one that
23 requires manipulating both digital and
24 analog. It also -- one of the problems you
25 have with video, pure analog video, is in

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1 CONFIDENTIAL - DEAN NEIKIRK, PH.D.
2 signal integrated circuit to do.
3 At this time frame, mixed signal
4 ICs were fairly exotic, pretty expensive to
5 design and fairly expensive to build.
6 So that's an example of why
7 sometimes putting it on-chip is not a good
8 thing to do. Sometimes it is. Sometimes
9 it's not.
10 A number of the things that
11 Wakabayashi wants to do, that being one, he
12 actually calls out -- again, here referred
13 to as, column 6, a signal processing
14 circuit for the video camera.
15 Depending on what kind of signal
16 processing you wanted to do, if you wanted
17 to do that, you might need an A-to-D
18 converter, you might want a DSP chip
19 followed by another D-to-A.
20 Those things, again, were in
21 many cases available for use in many
22 applications. They were general purpose
23 pieces of silicon.
24 And it's -- they were cheap
25 because everybody bought them to do a lot

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1 CONFIDENTIAL - DEAN NEIKIRK, PH.D.
2 many cases even if it's all analog being in
3 the end, no digital anywhere, some of the
4 filtering implementations you need require
5 components that are not -- well, a
6 band-pass filter, for instance, using
7 capacitors and inductors, especially at
8 this time we're talking about, on-chip
9 inductors were not available. So you had
10 to go off-chip onto the board to even
11 implement the video filters, usually with a
12 wire wound inductor and other components.
13 So mixed signal was one that
14 came to mind as a general descriptor, but
15 staying entirely in the analog domain, it's
16 the same issue.
17 That there are certain analog
18 functions that really are not easily
19 implemented on-chip.
20 Q. But if you were going to
21 implement a CMOS photo detector array,
22 wouldn't you try and implement as many
23 other features as part of that same
24 component, since it would all be
25 manufactured with the CMOS technology?

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1 CONFIDENTIAL - DEAN NEIKIRK, PH.D.
2 MR. DAVIS: Object to form.
3 **A. Not necessarily. Not**
4 **necessarily. It would invariably increase**
5 **dye area. Cost per chip tends to track dye**
6 **area. The more you add, the bigger the**
7 **dye, and at that very basic level, it will**
8 **cost more.**
9 **But if you're putting**
10 **functionality on there that some people**
11 **need and other people do not, the people**
12 **who don't want it don't want to pay for it.**
13 **If you keep it to being the**
14 **imager only, everybody who's doing imagers**
15 **needs the imaging chip, so it becomes a**
16 **general purpose device.**
17 **The peripheral circuitry is**
18 **probably going to vary from one application**
19 **to another, and so you want the user to be**
20 **able to place that where they need it, what**
21 **they need, and not what they do not need.**
22 **And it is the idea that**
23 **integrating everything including the**
24 **kitchen sink onto a single dye is always a**
25 **good idea is certainly not true.**

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1 CONFIDENTIAL - DEAN NEIKIRK, PH.D.
2 to put other standard -- other CMOS
3 circuitry on board.
4 It doesn't mean that you would
5 always want to do it, but it's enabled, and
6 I think that was really the whole pitch, if
7 you will, for the so-called
8 camera-on-a-chip.
9 You could incorporate what you
10 felt you needed. In a modern camera -- a
11 camera of the time, it might well have been
12 more economical to do some of these
13 functions off-chip.
14 If a manufacturer made -- if
15 Ackland's manufacturer made just the pixel
16 array, then anybody could use it without
17 paying anything extra for the chip.
18 Now, granted, they'd have to put
19 it off-chip. But, again, I think this is a
20 common design trade-off that one of
21 ordinary skill would be aware of and would
22 be willing to practice.
23 Q. You testified earlier today that
24 the ability to leverage the CMOS
25 manufacturing process for CMOS photo

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 Q. You wouldn't have to integrate
3 everything for the device; right? It could
4 just be subcomponents; right?
5 **A. You might integrate some, in**
6 **which case you'll need circuit boards to do**
7 **the others. It will be off-chip.**
8 Q. So when we were talking about
9 the camera-on-a-chip technology that's
10 described in the patent, but also in the
11 Business Week articles, Exhibit 1060, you'd
12 agree that the camera-on-a-chip didn't mean
13 that in that device that had the
14 camera-on-a-chip there wasn't other
15 circuitry separate from the
16 camera-on-a-chip; right?
17 MR. DAVIS: Objection to form.
18 **A. I think that the vision was that**
19 **for some applications you might include**
20 **certain other things.**
21 **But it would vary by application**
22 **as to what you would want to put on there.**
23 **And the general idea was that by going to**
24 **the CMOS standard process, standard**
25 **fabrication process, you enable the ability**

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1 CONFIDENTIAL - DEAN NEIKIRK, PH.D.
2 detector arrays generated a lot of cost
3 savings at that point, when you were able
4 to leverage that manufacturing process;
5 right?
6 MR. DAVIS: Object to form.
7 **A. Yes, I did say that, and that**
8 **applies even if you're only building the**
9 **pixels themselves, because you're using a**
10 **fabrication line whose costs have been**
11 **spread across many, many other products.**
12 Q. Right. So it was your
13 testimony, though, that you would take
14 advantage of that when possible because it
15 would be more cost effective; right?
16 MR. DAVIS: Object to form.
17 **A. Yes, I believe I testified that**
18 **that was true even if no other circuitry**
19 **was on there because the simple**
20 **manufacturing process of the pixels**
21 **themselves is cheaper than the dedicated**
22 **line.**
23 **If you look at that -- that**
24 **article you raised this morning, they**
25 **talked about cost of entry.**

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 **Cost of entry was the**
3 **specialized fabrication processes necessary**
4 **to make the pixels in CCD, which does not**
5 **exist if you use CMOS pixels, regardless of**
6 **whether you add additional circuitry.**
7 Q. But in that article -- you
8 should feel free to take it out if you have
9 any questions -- but it expressly talks
10 about one chip incorporating all sorts of
11 electronic controls, usually they're
12 multiple chips.
13 That was the trend in the
14 industry; right? That was your testimony
15 earlier today.
16 MR. DAVIS: Objection.
17 A. I don't think I testified that
18 that was the trend in industry.
19 That in some cases that was a
20 general philosophy, but it was always
21 well-known that at some point you carry
22 that too far, and I gave you a good
23 example: Analog filters.
24 Nobody was putting analog
25 filters on-chip in this era because they

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 something that a person would consider.
3 That's common sense; right?
4 A. They'd consider it and they may
5 then conclude that it was cheaper to
6 implement it elsewhere.
7 Q. You testified earlier today
8 that, especially in light of the article we
9 looked at, Dr. Fossum and his work in the
10 CMOS image sensors, that the on-chip
11 integration was a feature of the CMOS image
12 sensor technology; right?
13 MR. DAVIS: Objection to form.
14 A. I don't know that that was the
15 question and that was the way I phrased the
16 answer.
17 Again, by using standard CMOS
18 fabrication, you certainly enable that.
19 That doesn't mean that it was impossible to
20 integrate other circuitry with CCD, for
21 instance, and this -- I don't know whether
22 this article mentions that, but it is
23 certainly discussed in the literature.
24 But you lose the standard
25 process because as soon as you go to CCD,

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 just didn't work.
3 It was cheaper to use discrete
4 components on a printed circuit board.
5 Q. You agree that Dr. Fossum's
6 technology was to put CMOS technology, as
7 much as he could, on a chip, to have a
8 camera-on-a-chip. That was the point of
9 his technology; right?
10 A. I think I phrased it slightly
11 differently.
12 Not as much as you could, but as
13 much as you should. There's a big
14 difference.
15 As much as you could says you
16 ignore all other design issues and all
17 other fabrication issues.
18 As much as you should is an
19 engineering balance. And for consumer
20 products, it's a mixture of typically size
21 for the application and cost.
22 Q. But if cost is a concern in your
23 design of a product now, taking advantage
24 of the CMOS camera-on-a-chip if you're
25 going to use a CMOS photo detector array is

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 you have to use a specialized one for the
3 pixels.
4 Q. And that CCD manufacturing
5 process, one of the features of it was you
6 would wind up with a device which had a lot
7 of off-chip circuitry; right?
8 A. Well, what it resulted in was a
9 manufacturing process that cost more,
10 and --
11 Q. And -- I'm sorry?
12 A. And so that in and of itself
13 drove you to not waste a dye area or spend
14 additional money to mix two processes.
15 So if you want to put standard
16 CMOS on the same chip as the CCD, you
17 actually have to mix two fabrication
18 processes and that doesn't give you economy
19 of scale anymore.
20 So one of the choices there is,
21 you've already spent the money for the CCD
22 pixel. Don't waste anything more.
23 The other components are easily
24 obtained as standard CMOS products. Put
25 them on boards.

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 **Fabricating printed circuit**
3 **boards is not necessarily an expensive**
4 **proposition, and most electronic systems,**
5 **no matter what the level of integration,**
6 **still contain more than one chip integrated**
7 **together in some fashion using either a**
8 **printed circuit board or a flexible board**
9 **or something, and that's done because it's**
10 **cheaper to do it that way.**
11 Q. So it's your testimony that you
12 wouldn't mix standard CMOS technology on
13 the same chip as CCD because you'd be
14 mixing fabrication processes and that
15 doesn't give you economy of scale; right?
16 That's your testimony?
17 MR. DAVIS: Objection to form.
18 A. I don't believe I said you could
19 not or that it never happened.
20 In fact, I believe I said there
21 are examples where it did.
22 What I did say was that as a
23 general rule, a trade-off, it is not at all
24 clear that that will be advantageous, or
25 there might be some limited level of

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 **Basically it has to do with the**
3 **smallest amount of photon energy which you**
4 **can detect.**
5 **There are -- there's ways of**
6 **measuring what's called noise equivalent**
7 **power, NEP; there's ways of measuring**
8 **what's called Delta T -- what is the**
9 **acronym for that one. It's the noise**
10 **equivalent Delta T.**
11 **So there's a lot of different**
12 **ones. D star itself is specific**
13 **detectivity, if I recall, and that is a**
14 **measure of sensitivity, which is different**
15 **from noise.**
16 **When you try to evaluate**
17 **signal-to-noise ratio, you have to know**
18 **both sensitivity and noise, and it's**
19 **essentially like a ratio of the two.**
20 Q. Are you familiar -- do you know
21 Dr. Ackland? You were talking about the
22 Ackland patent.
23 Do you know Dr. Ackland and know
24 of him?
25 A. No, I do not.

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 **circuitry inclusion that is and then a**
3 **level of circuitry inclusion that is**
4 **clearly not.**
5 Q. Are you familiar with tests to
6 evaluate the signal-to-noise ratio of CCD
7 or CMOS image sensors?
8 A. Tests for doing photo detector
9 signal-to-noise? Certainly, because I've
10 done many of those.
11 Q. Are you familiar with something
12 called SNR-10?
13 A. SNR-10 I assume is referring to
14 a specific standard, so I don't know that
15 particular standard, but I'm certainly
16 familiar with signal-to-noise ratio
17 measurements, and, again, having done many
18 of them myself.
19 Q. Are you familiar with a Delta E
20 star test for image sensors, CCD or CMOS
21 image sensors?
22 A. Delta E star stands for the --
23 well, there's a noise equivalent
24 temperature difference. That is the energy
25 difference reference to noise.

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 Q. You testified before that your
3 combination of Wakabayashi with Ackland was
4 not to solve any particular problem in
5 Wakabayashi, was it?
6 MR. DAVIS: Objection to form.
7 A. I don't think I said it that way
8 or even said that at all.
9 I think that Ackland has left
10 the type of photo detector -- what is it --
11 27 -- open, and in order to implement, one
12 of ordinary skill in the art is going to
13 need to make a choice. And I think that is
14 a strong motivation to keep reading the
15 literature.
16 Now, clearly Ackland and
17 Wakabayashi are in the same field of art.
18 They would have -- my understanding is one
19 of ordinary skill in the art knows all of
20 the related art, so they would be aware of
21 these, as well as be motivated, for
22 instance, by consumer goods, which
23 Wakabayashi is an example of, to think
24 about cost at the very least.
25 The size issues are certainly

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 part of it, but I think that one of
3 ordinary skill, in order to build this
4 would want details about the imager and, as
5 we've discussed extensively, would
6 gravitate towards CMOS, given the era, as I
7 think the patents themselves admit.
8 And furthermore, the single poly
9 CMOS version from Ackland, his patent was
10 based around the idea that he could do it
11 with a single poly rather than double poly,
12 and that basically makes it cheaper.
13 I don't know that Ackland
14 phrased it that way, but anybody who does
15 fabrication is aware of that.
16 Q. So it's your testimony that the
17 Wakabayashi patent is related to a consumer
18 camera product; right?
19 MR. DAVIS: Objection to form.
20 A. I think that the description in
21 terms of the video unit and pointing at a
22 user and pointing away and displaying on a
23 TV monitor suggests it is not a scientific
24 instrument.
25 Sounds like the description of a

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 Now, NASA and JPL, they actually
3 had a fairly exotic initial mission, right,
4 that was for telescopes or for spacecraft.
5 But they were looking at the evolution of
6 that as well, and cost in those other
7 markets is a big, big issue.
8 Q. So Dr. Fossum was doing work for
9 NASA; right?
10 A. He was certainly at JPL and that
11 was what drove a lot of their earlier -- a
12 lot of their work, yes.
13 Q. So those imagers that he was
14 working on, the CMOS imagers, were intended
15 to be used in NASA systems, I guess both
16 here and in their different equipment and
17 systems that get launched into space as
18 well; right?
19 MR. DAVIS: Objection to form.
20 A. I imagine some of the work he
21 did was probably directed to that. I don't
22 know that all of it was.
23 And even if it was, I don't know
24 that that limited his vision to only of
25 those applications.

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 handheld video unit either for taking
3 movies, presumably he talks about putting
4 this to a videotape recorder, or for
5 videoconferencing, although I don't think
6 he identifies videoconferencing directly in
7 his descriptions.
8 Q. The Ackland patent, though, is
9 just directed to a CMOS photo detector
10 array, right, it's not directed to a
11 consumer product; is that correct?
12 A. Well, I wouldn't characterize it
13 that way.
14 It's directed to that imaging
15 chip 27, and at the time, again, remember
16 what was driving these, it wasn't the
17 scientific market.
18 Scientific market was
19 well-satisfied with CCDs. They didn't care
20 how much they spent.
21 And that market is relatively
22 small. The number of astronomers in the
23 world is not large. So pretty much
24 everybody working on this was looking
25 towards other applications.

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 If you look at the -- for
3 instance, the SPIE publications at the
4 time, it certainly didn't appear that he
5 was limiting his vision to spacecraft.
6 Q. He had a wide variety of
7 applications for that CMOS imager APS, the
8 technology that he was developing?
9 MR. DAVIS: Objection to form.
10 A. You know, I'm not Dr. Fossum. I
11 don't want to put myself in his head, but I
12 think that that would be the -- given the
13 article we talked about today would sort of
14 point in that direction.
15 MR. CAPLAN: Let me take a short
16 break and see if I have anything else
17 because we may be getting close to wrapping
18 up this part of it.
19 (A recess was taken.)
20 BY MR. CAPLAN:
21 Q. Just a couple more questions,
22 Dr. Neikirk.
23 A little while ago I asked you
24 about starting with Wakabayashi and the
25 different technologies that you could --

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 **that you decided to use for the imager**
3 **device 27, and you decided to use the**
4 **Ackland patent; right?**
5 **A. Well, I used it in my analysis.**
6 **I think one of ordinary skill in**
7 **the art was motivated to use Ackland, to be**
8 **a little bit more precise, in terms of who**
9 **did it.**
10 **Q. And are you familiar with the**
11 **CIS technology for image sensors?**
12 **A. I've forgotten what --**
13 **Q. I think I misspoke. "CID" I**
14 **think is the right acronym.**
15 **A. So CID stands for charge**
16 **injection device, and in general terms,**
17 **I've forgotten what the differences are for**
18 **CIDs, honestly.**
19 **Q. So that's not something you**
20 **considered then to use as the imager device**
21 **in 27 and Wakabayashi?**
22 **A. Again, I wouldn't quite**
23 **characterize it that way. It was not that**
24 **I decided to use.**
25 **I was viewing the art in the**

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 **I don't recall specifically all**
3 **of the art that I looked at.**
4 **Q. And you testified earlier that**
5 **you considered CCD sensors to use for image**
6 **sensor 27 in Wakabayashi and you decided**
7 **not to use a CCD image sensor; right?**
8 **MR. DAVIS: Objection to form.**
9 **A. Again, I believe that the way**
10 **I'd characterize it is I think one of**
11 **ordinary skill would understand pros and**
12 **cons, and based on that understanding would**
13 **turn to CMOS. Not to CCD.**
14 **Q. So did you do an analysis, a**
15 **cost analysis -- let's talk about cost**
16 **because you've raised that a few times -- a**
17 **cost analysis for designing a camera in**
18 **Wakabayashi with CMOS versus CCD, did you**
19 **do that cost analysis?**
20 **A. So --**
21 **MR. DAVIS: Objection to form.**
22 **A. So I did not do a specific cost**
23 **analysis.**
24 **Again, I believe one of ordinary**
25 **skill at the time would have recognized**

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 **eyes of one of ordinary skill, and I**
3 **believe the motivation is clear to look to**
4 **CMOS, and Ackland is an example of that.**
5 **And in Ackland, since it's a single poly**
6 **structure, has an advantage of being**
7 **potentially even lower cost.**
8 **So to say that I chose not to do**
9 **CID, I'm just -- that phrasing doesn't seem**
10 **to be appropriate to me.**
11 **Q. Well, why didn't you -- I'm**
12 **sorry.**
13 **Why didn't you consider CID?**
14 **A. Well, I think there's a clear**
15 **motivation for one of ordinary skill.**
16 **MR. DAVIS: Objection to form.**
17 **A. I believe there's a clear**
18 **motivation for one of ordinary skill to**
19 **turn to CMOS and to turn to Ackland, and I**
20 **didn't then turn to all other alternatives.**
21 **Q. Did you do an analysis of any**
22 **other alternatives besides CMOS?**
23 **MR. DAVIS: Objection to form.**
24 **A. I looked at a lot of art. Let's**
25 **put it that way.**

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 **that there was a cost difference and that**
3 **that is motivation to turn to the CMOS**
4 **literature as opposed to the CCD**
5 **literature. But, no, I did not try to**
6 **price out every component.**
7 **That would be difficult to do**
8 **for Wakabayashi because some of those**
9 **components are standard ones to look up the**
10 **price for. But, no, I didn't do that.**
11 **Q. And did you do any kind of an**
12 **analysis on Wakabayashi about a trade-off**
13 **of noise between a CMOS sensor and a CCD**
14 **sensor and the cost of those?**
15 **MR. DAVIS: Objection to form.**
16 **A. Again, given the area of**
17 **apparent application for Wakabayashi, I**
18 **think one of ordinary skill would have been**
19 **well aware of the differences between CMOS**
20 **and CCD.**
21 **And someone with experience in**
22 **imaging systems would recognize that the**
23 **lower noise characteristics of CCDs were**
24 **probably not an issue for this application.**
25 **I did not do a formal analysis**

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 **of looking up the minimum detectible power**
3 **for CCD to compare it to the minimum**
4 **detectible power of CMOS. I don't think**
5 **that was required.**
6 Q. And why would someone recognize,
7 as you put it, that the lower noise
8 characteristics of CCDs were probably not
9 an issue?
10 **A. Because we've already talked**
11 **about that extensively.**
12 **In low noise environments, those**
13 **are environments that are dark. And it's**
14 **pretty clear that this is not about taking**
15 **pictures of the dark sky.**
16 **I think this is, again,**
17 **something that one of ordinary skill would**
18 **clearly recognize.**
19 Q. If using a CMOS photo detector
20 array in Wakabayashi's structure was, I
21 don't know, 10 times more noisy, the noise
22 ratio was 10 times worse but it was only, I
23 don't know, 5 percent less expensive, would
24 a person of skill in the art be motivated
25 to use a CMOS photo detector array in that

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 **MR. DAVIS: Objection to form.**
3 **A. You'd use the CMOS because the**
4 **10 percent or 10X in signal and noise 4 was**
5 **irrelevant, so why not pick the 5 percent**
6 **cheaper circuit or device.**
7 Q. Have you done those analyses,
8 comparing the changes in signal quality
9 versus the cost to figure out what kind of
10 an imager you would use?
11 **MR. DAVIS: Objection to form.**
12 **A. No, I've not done a formal**
13 **analysis. Again, as I've said repeatedly,**
14 **I believe one of ordinary skill in the art**
15 **who knows anything about image systems are**
16 **well aware of these differences, and I will**
17 **point out that these are for video systems.**
18 **The noise 4 requirements for**
19 **video are much less important than for**
20 **still photographs because in video**
21 **everything is moving around anyway.**
22 **So anybody who does imaging**
23 **system designs knows these differences.**
24 **They understand the difference between**
25 **still and video. They understand when**

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 **circumstance?**
3 **MR. DAVIS: Objection to form.**
4 **A. Well, I haven't done that**
5 **specific analysis, but if by 10 percent**
6 **worse, I think you said it was 10 percent**
7 **worse --**
8 Q. 10 times worse.
9 **A. 10 times worse in terms of noise**
10 **4. If your standard of comparison was a**
11 **high performance industrial or scientific**
12 **instrument CCD, then, yeah, actually, I**
13 **think they'd be more than happy to take the**
14 **10X hit because the noise 4 is already so**
15 **low it's irrelevant.**
16 Q. Yes, but you characterized
17 Wakabayashi as a consumer camera device;
18 right?
19 **A. I think that is pretty clear**
20 **that that's what Wakabayashi was thinking**
21 **about.**
22 Q. So that that example applied to
23 Wakabayashi, 10 times worse signal to
24 noise, but 5 percent less expensive, would
25 you use the CMOS in that circumstance?

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 **noise 4 matters and when it doesn't.**
3 **And a consumer grade video**
4 **camera is simply not one where you need the**
5 **noise 4 of a scientific grade CCD, and I**
6 **believe one of ordinary skill in the art**
7 **would have recognized that.**
8 **MR. CAPLAN: I think I may be**
9 **just about done. I'll see if there's**
10 **anything else.**
11 **BY MR. CAPLAN:**
12 Q. You said a number of times that
13 this noise is being the big issue. Is that
14 the main criteria you focused on in terms
15 of what type of photo detector array you
16 would use in the Wakabayashi design?
17 **MR. DAVIS: Objection.**
18 **Form.**
19 **A. No, I wouldn't characterize my**
20 **testimony in that manner.**
21 **I think what I tried to point**
22 **out is that cost is probably more**
23 **important. When you have the noise, it's**
24 **most likely irrelevant. Not a factor to**
25 **consider because in this -- in a well-lit**

<div>Page 230</div> <div>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 video environment, the noise 4 is just not 3 very important. 4 Q. So it's your testimony that in 5 evaluating Wakabayashi and how a person of 6 skill would understand Wakabayashi, cost 7 would be the main factor in the choices you 8 would make in understanding Wakabayashi? 9 MR. DAVIS: Objection. 10 Form. 11 A. Again, I don't think that's 12 really an appropriate way to characterize 13 my testimony. 14 Wakabayashi provides certain 15 levels of detail about a system and an 16 overall structure: The housing, the 17 rotatable camera head and so on. 18 He has left as a design choice 19 the particulars of the sensor -- of sensor 20 chip 27 -- let me make sure I'm using the 21 right number -- yes, of 27. And then 22 particulars of exact circuited 23 implementation for other things. He's 24 called out general functional requirements. 25 I believe that one of ordinary</div>	<div>Page 231</div> <div>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 skill is motivated to seek out further 3 detail. That's why you use the literature, 4 the other patent literature or any other 5 literature, and use their knowledge, their 6 common sense for a consumer product, one 7 would seek lower cost options, where 8 possible. 9 They would use their knowledge 10 that in this kind of application noise is 11 probably not the determining factor. Size 12 is relevant. 13 So if they had the choice 14 between something that was very large and 15 something that was smaller, it seemed to me 16 that they would likely look into the 17 smaller options. 18 But, in particular, to the image 19 sensor 27 image device, solid-state image 20 device, I think it's clear that that would 21 lead you into the CMOS literature. 22 And Ackland is an excellent 23 example of CMOS system, where he was saying 24 his advantage was to keep it as simple as 25 he could by using single poly versus</div>
<div>Page 232</div> <div>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 multiple poly layers. 3 Q. So if consumers would accept 4 more noise for less cost, that would be 5 reflected in the actual market in '97; 6 isn't that right? 7 MR. DAVIS: Objection. 8 Form. 9 A. Well, I actually think the 10 situation is, if consumers ever even 11 noticed the noise at all. 12 So there's the trade-off between 13 usually image quality and cost. The 14 lenses, for that matter. 15 A good photographic lens or 16 cinematography lens costs thousands to 17 hundreds of thousands of dollars. Why 18 bother? Because in that application, in 19 the one where somebody picks that lens, the 20 quality of the image is overwhelmingly 21 important to them. 22 But in most consumer 23 applications, the lenses used, for 24 instance, are pretty inexpensive. They 25 produce acceptable images. Most consumers</div>	<div>Page 233</div> <div>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 never know the difference. 3 Similarly, if the noise 4 is low 4 enough, which I believe pretty much any 5 CMOS sensor at the time would have been, 6 for a videoconferencing application, then 7 they pick that because it's less expensive. 8 Q. So consumers would be the ones 9 to really determine what the market would 10 accept in connection with noise and cost. 11 It really would be consumers in 12 the market? 13 MR. DAVIS: Objection. 14 Form. 15 A. Well, I think -- I mean, you 16 know, consumers -- there are different 17 consumers who have different objectives, 18 but I think it's pretty common for a 19 consumer to get something that works well 20 enough for them that's the cheapest they 21 can get. 22 Q. That would be common sense. 23 So common sense would be if cost 24 is an issue, less parts, easier 25 manufacturing would be the way to go?</div>

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1 CONFIDENTIAL - DEAN NEIKIRK, PH.D.
2 MR. DAVIS: Objection to form.
3 BY MR. CAPLAN:
4 Q. That would be common sense;
5 right?
6 **A. So you put in "less parts."**
7 **Sometimes true, sometimes not.**
8 **As I explained earlier, when you**
9 **do a system design, the partition and the**
10 **part count, it is not universally true that**
11 **smaller part count leads to lower cost.**
12 **And one of ordinary skill and**
13 **with an electronics background would know**
14 **that.**
15 MR. CAPLAN: Okay. I don't have
16 any more questions at this point for today.
17 MR. DAVIS: I may or may not.
18 Let me take 10 minutes here.
19 (A recess was taken.)
20 EXAMINATION BY
21 MR. DAVIS:
22 Q. Dr. Neikirk, I just have a
23 couple of questions.
24 Can you direct your attention to
25 Figure 4 of Wakabayashi.

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1 CONFIDENTIAL - DEAN NEIKIRK, PH.D.
2 **A. There it is, 18.**
3 **"The camera head 100 and the**
4 **camera circuit 102 surrounded by dotted**
5 **rectangles" -- and this refers to Figure**
6 **22 -- "surrounded by dotted rectangles**
7 **constitute the video camera of the present**
8 **invention."**
9 Q. Is that referring back to the
10 video camera 22 that we discussed earlier?
11 MR. CAPLAN: Objection to form.
12 **A. So, yes, it is. 22 is**
13 **identified as the video camera and the**
14 **numbers from the circuit diagram that we**
15 **were using earlier as Figure 22 and 102. I**
16 **do see that, yes.**
17 Q. Let me rephrase the question.
18 To what does the video camera of
19 the present invention in column 9, lines 18
20 to 21, refer to?
21 **A. So the video camera there would**
22 **refer to video camera 22, which we saw in**
23 **Figure 4, and that contains circuit board**
24 **29.**
25 Q. Does that inform your opinion as

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1 CONFIDENTIAL - DEAN NEIKIRK, PH.D.
2 **A. I have Figure 4 in front of me.**
3 Q. Do you see that it's labeled as
4 element 22?
5 **A. Yes, I do.**
6 Q. What is element 22 in
7 Wakabayashi?
8 **A. So -- let me look. So 22 is**
9 **called out as being the video camera.**
10 Q. And inside of Figure 4, do you
11 see element 29?
12 **A. Yes, I do.**
13 Q. Is that the circuit board 29
14 that has been discussed at some point
15 today?
16 **A. Yes, it is.**
17 Q. Can I direct your attention to
18 column 9, lines 18 to 21.
19 **A. Yes, I'm there.**
20 Q. Do you remember a discussion
21 today about the location of where camera
22 circuit 102 is?
23 **A. Yes, I do.**
24 Q. And can you read aloud lines 18
25 to 21 starting with "the camera head 100."

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1 CONFIDENTIAL - DEAN NEIKIRK, PH.D.
2 to where camera circuit 102 is located?
3 MR. CAPLAN: Object to form.
4 **A. Yes, it does.**
5 Q. How so?
6 **A. Given that Wakabayashi has**
7 **clearly stated that block 100 and 102 are**
8 **both in the video camera, and then has**
9 **furthermore said the video camera is as**
10 **shown in Figure 4, then those circuits --**
11 **whatever the circuit is for block 100 and**
12 **circuit -- for block 102 would have to be**
13 **on the circuit board or a component on the**
14 **circuit board.**
15 **Some of that could be inside the**
16 **27, but that's all got to be connected to**
17 **board 29.**
18 Q. Do you see later on down in
19 column 9 around lines 46 to 47, where it
20 says -- actually, can you read that aloud,
21 that sentence?
22 **A. So in column 9, starting at line**
23 **46, it says: "When the video signal 103**
24 **represents an upside down image, this image**
25 **should be converted to an upright image."**

<p style="text-align: right;">Page 238</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 Did you want me to keep reading? 3 I'm sorry. 4 Q. That's fine. 5 And referring to Figure 22 that 6 you referenced earlier. 7 A. I have Figure 22 in front of me. 8 Q. Do you see element 103 that you 9 just referred to, video signal 103? 10 A. Yes, I do. 11 MR. CAPLAN: Objection as to 12 form. 13 A. So 103 is -- is the output 14 leaving the camera circuit and going onto 15 the other circuit. 16 Q. What does it connect to? 17 A. So it connects to the block 104, 18 which is further discussed in this -- in 19 this section of column 9, where he's 20 discussing how to invert the image. 21 It also goes to other locations, 22 including a video signal output, a video 23 recording unit, a video monitor unit, so 24 those are other places it goes. 25 Q. Do you know whether that block</p>	<p style="text-align: right;">Page 239</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 104 that you had just referred to is within 3 or outside of the video camera that you 4 referenced earlier? 5 MR. CAPLAN: Objection as to 6 form. 7 A. So because it clearly states 8 above that the signal -- so the -- we just 9 discussed that 100 and 102 are on circuit 10 board 29. They have to be. 11 It states that the video signal 12 has now been generated. 13 Up above -- let's see. That's a 14 description of 103. 15 It clearly states that the video 16 camera consists of everything inside of the 17 dotted lines around 100 and 102. So what's 18 in the dotted lines labeled 104 is not 19 included in that. 20 The only other circuit board of 21 Wakabayashi is 39. So this circuitry would 22 need to be on 39. 23 Q. When you say "this circuitry," 24 what are you referring to? 25 A. I'm referring to the circuitry</p>
<p style="text-align: right;">Page 240</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 to provide the functions of 104. 3 Q. Can you turn to column 6, lines 4 7 to 10. 5 A. I'm there. 6 Q. Can you read that sentence 7 aloud? 8 A. So it says: "The circuit board 9 39 includes a signal processing circuit for 10 the video camera in unit 5, a driver 11 circuit for liquid crystal panel 38, a 12 systems circuit, a power supply circuit and 13 so on." 14 Q. Do you see that language, 15 "signal processing circuit"? 16 A. I do. 17 Q. What is that referring to? 18 A. Well, one example of signal 19 processing, the video signal processing is 20 given in Figure 22, the circuitry inside 21 104 is a conversion, so that would be an 22 example of signal processing of a signal 23 processing circuit. 24 It is processing that video 25 signal to invert it.</p>	<p style="text-align: right;">Page 241</p> <p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D. 2 MR. DAVIS: No further questions 3 at this time. 4 MR. CAPLAN: Just give me a 5 minute. Should be 5 minutes or less. 6 (A recess was taken.) 7 FURTHER EXAMINATION 8 BY MR. CAPLAN: 9 Q. I have just a couple of 10 follow-ups from that. 11 You agree that the output of 12 circuit 102 is a TV signal format; right? 13 A. So I believe that -- let me get 14 to my copy of Wakabayashi. 15 And you're asking about the 16 output from 102 that's labeled as 103, and 17 I believe Wakabayashi calls that -- 18 Q. I think we're in column 9 19 before -- 20 A. Yes. For instance, at line 22, 21 he identifies the video signal 103, and it 22 talks about -- this is about the circuitry 23 to do the inversion. 24 It shows clearly in the diagram 25 that 103 is fed to a video signal output,</p>

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 **so -- I'm sorry, your question was again?**
3 Q. You agree that the output of
4 circuit 102 is a television signal format;
5 right?
6 **A. It is certainly a video format**
7 **as identified -- I don't know that**
8 **Wakabayashi says "TV."**
9 Q. If you look in column 9, it
10 looks like lines maybe 14 to 18. If you
11 can take a look at that.
12 **A. Yes. Yes, it does say -- I**
13 **think I read this earlier out loud, yes,**
14 **"video signal 103 is a television signal**
15 **format." Yes, I see.**
16 Q. Right.
17 And earlier you testified that
18 circuit 102 is on board 39; is that right?
19 MR. DAVIS: Objection to form.
20 **A. I believe what I said -- and at**
21 **the time I didn't -- I knew I was looking**
22 **for this. I was concerned I had missed**
23 **something.**
24 **At the time I said that, it**
25 **would make sense to put the conversion to**

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 MR. DAVIS: Objection to form.
3 **A. It's very clear from the**
4 **description that the signal 103, which is**
5 **video, television format, is leaving the**
6 **video camera, and it is quite clear that**
7 **the video camera contains circuit board 29**
8 **but not 39.**
9 MR. CAPLAN: No further
10 questions.
11 Thank you, Dr. Neikirk.
12 (Time noted: 6:12 p.m. EST)
13
14 DEAN NEIKIRK, PH.D.
15 Subscribed and sworn to before me
16 this ____ day of ____, 2020.
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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 **video elsewhere, but clearly it's not on**
3 **39. The figures and the text we just**
4 **talked about, it is shown as being in the**
5 **video camera, and the video camera, the**
6 **only circuit board in it is 29.**
7 Q. But you did earlier testify that
8 circuit 102 was on board 39; right?
9 MR. DAVIS: Same objection.
10 **A. I believe what I said was that**
11 **not being able to puzzle out, I could tell**
12 **for sure that 100 was on 29.**
13 **I think I probably said that it**
14 **either made sense or it likely would be the**
15 **video conversion could take place on 39.**
16 **If I said it was on 39, clearly**
17 **that was not correct.**
18 Q. Well, you said it was an
19 explicit disclosure was on 39.
20 Do you recall that?
21 **A. Of the conversion to the image**
22 **processing? If I said that, then I was**
23 **simply wrong.**
24 Q. So were you wrong then or are
25 you wrong now? Which one is it?

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1 **CONFIDENTIAL - DEAN NEIKIRK, PH.D.**
2 **C E R T I F I C A T E**
3
4 I, Linda J. Greenstein, Professional
5 Shorthand Reporter and Notary Public in and
6 for the State of New York, do hereby
7 certify that, DEAN NEIKIRK, PH.D., the
8 witness whose deposition is hereinbefore
9 set forth, was duly sworn and that such
10 deposition is a true record of the
11 testimony given by the witness to the best
12 of my skill and ability.
13 I further certify that I am neither
14 related to or employed by any of the
15 parties in or counsel to this action, nor
16 am I financially interested in the outcome
17 of this action.
18 IN WITNESS WHEREOF, I have hereunto set
19 my hand this 5th day of October 2020.
20
21 Linda Greenstein
22 Linda J. Greenstein
23
24 My commission expires: January 31, 2021
25

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<p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D.</p> <p>2 I N D E X</p> <p>3</p> <p>4 WITNESS EXAMINED BY PAGE</p> <p>5 DEAN NEIKIRK, Mr. Caplan 5, 241</p> <p>6 PH.D. Mr. Davis 234</p> <p>7</p> <p>8 ----- INFORMATION REQUESTS -----</p> <p>9 DIRECTIONS:</p> <p>10 RULINGS:</p> <p>11 TO BE FURNISHED:</p> <p>12 REQUESTS:</p> <p>13 MOTIONS:</p> <p>14 ----- E X H I B I T S -----</p> <p>15 NO. PAGE</p> <p>16</p> <p>17 (Exhibit 1060 for identification, 64</p> <p>18 Business Week article, shown to</p> <p>19 witness.)</p> <p>20 (Exhibit 1004 for identification, 99</p> <p>21 Declaration of Dean Neikirk,</p> <p>22 Ph.D., shown to witness.)</p> <p>23 (Exhibit 1027 for identification, 112</p> <p>24 Wakabayashi patent, shown to</p> <p>25 witness.)</p> <p>26 (Exhibit 1006 for identification, 158</p> <p>27 Ackland patent, shown to</p> <p>28 witness.)</p> <p>29 (Exhibits retained by counsel)</p>	<p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D.</p> <p>2 DEPOSITION ERRATA SHEET</p> <p>3</p> <p>4</p> <p>5 Our Assignment No.: 1038</p> <p>6 Case Caption: Samsung v. Collect, LLC</p> <p>7</p> <p>8 DECLARATION UNDER PENALTY OF PERJURY</p> <p>9 I declare under penalty of</p> <p>10 perjury that I have read the entire</p> <p>11 transcript of my Deposition taken in the</p> <p>12 captioned matter or the same has been read</p> <p>13 to me, and the same is true and accurate,</p> <p>14 save and except for changes and/or</p> <p>15 corrections, if any, as indicated by me on</p> <p>16 the DEPOSITION ERRATA SHEET hereof, with</p> <p>17 the understanding that I offer these</p> <p>18 changes as if still under oath.</p> <p>19</p> <p>20 DEAN NEIKIRK, PH.D.</p> <p>21 Subscribed and sworn to on the ____ day of</p> <p>22 _____, 20 ____ before me.</p> <p>23</p> <p>24 Notary Public,</p> <p>25 in and for the State of _____.</p>
<p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D.</p> <p>2 DEPOSITION ERRATA SHEET</p> <p>3 Page No.____Line No.____Change to:_____</p> <p>4</p> <p>5 Reason for change:_____</p> <p>6 Page No.____Line No.____Change to:_____</p> <p>7</p> <p>8 Reason for change:_____</p> <p>9 Page No.____Line No.____Change to:_____</p> <p>10</p> <p>11 Reason for change:_____</p> <p>12 Page No.____Line No.____Change to:_____</p> <p>13</p> <p>14 Reason for change:_____</p> <p>15 Page No.____Line No.____Change to:_____</p> <p>16</p> <p>17 Reason for change:_____</p> <p>18 Page No.____Line No.____Change to:_____</p> <p>19</p> <p>20 Reason for change:_____</p> <p>21 Page No.____Line No.____Change to:_____</p> <p>22</p> <p>23 Reason for change:_____</p> <p>24</p> <p>25</p>	<p>1 CONFIDENTIAL - DEAN NEIKIRK, PH.D.</p> <p>2 DEPOSITION ERRATA SHEET</p> <p>3 Page No.____Line No.____Change to:_____</p> <p>4</p> <p>5 Reason for change:_____</p> <p>6 Page No.____Line No.____Change to:_____</p> <p>7</p> <p>8 Reason for change:_____</p> <p>9 Page No.____Line No.____Change to:_____</p> <p>10</p> <p>11 Reason for change:_____</p> <p>12 Page No.____Line No.____Change to:_____</p> <p>13</p> <p>14 Reason for change:_____</p> <p>15 Page No.____Line No.____Change to:_____</p> <p>16</p> <p>17 Reason for change:_____</p> <p>18</p> <p>19 Page No.____Line No.____Change to:_____</p> <p>20</p> <p>21 Reason for change:_____</p> <p>22</p> <p>23 SIGNATURE:_____DATE:_____</p> <p>24 DEAN NEIKIRK, PH.D.</p> <p>25</p>

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