

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

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

v.

CELLECT, LLC,
Patent Owner.

IPR2020-00512
Patent 9,186,052 B1

Before JAMESON LEE, PATRICK M. BOUCHER, and
JOHN R. KENNY, *Administrative Patent Judges*.

KENNY, *Administrative Patent Judge*.

JUDGMENT
Final Written Decision
Determining Challenged Claim Unpatentable
35 U.S.C. § 318(a)

I. INTRODUCTION

Samsung Electronics Co., Ltd. and Samsung Electronics America, Inc. (“Petitioner”) filed a Petition to institute an *inter partes* review of claim 2 (“challenged claim”) of U.S. Patent No. 9,186,052 B1 (Ex. 1001, the “’052 patent”) pursuant to 35 U.S.C. § 311 *et seq.* Paper 2 (“Petition” or “Pet.”). Collect, LLC (“Patent Owner”) filed a Preliminary Response. Paper 6. With our authorization, Petitioner filed a Preliminary Reply (Paper 9) and Patent Owner filed a Preliminary Sur-reply (Paper 12). On August 18, 2020, we instituted *inter partes* review of the challenged claim. Paper 15.

Patent Owner filed a Patent Owner’s Response (Paper 18, “PO Resp.”). Petitioner filed a Reply to Patent Owner’s Response (Paper 21, “Pet. Reply.”), and Patent Owner filed a Sur-reply (Paper 24, “Sur-reply”). At the parties’ request (Papers 26, 27), an Oral Hearing was held on May 26, 2021, a transcript of which is included in the record. Paper 31 (“Tr.”).

We have jurisdiction to conduct this *inter partes* review under 35 U.S.C. § 6. For the reasons discussed herein, we determine that Petitioner has shown, by a preponderance of the evidence, that claim 2 of the ’052 patent is unpatentable.

A. Related Matters

The parties identify the following related district court litigation: *Collect, LLC v. Samsung Electronics Co., Ltd. et al.*, 1-19-cv-00438 (D. Colo.). Pet. 5; Paper 5, 1.¹

¹ That action has been stayed by order of the district court. Paper 11 (Appx. A).

IPR2020-00512
Patent 9,186,052 B1

The parties note that the challenged patent is also the subject of IPR2020-00475. Pet. 6; Paper 5, 1. Petitioner further identifies the following related patents and respective proceedings:

Patent	Proceeding(s)
6,043,839	IPR2020-00472
6,275,255 B1	IPR2020-00473
6,982,740 B2	IPR2020-00474 ex parte reexamination
9,198,565 B2	IPR2020-00476
9,667,896 B2	IPR2020-00477
6,982,742 B2	IPR2020-00559 IPR2020-00560 IPR2020-00561 ex parte reexamination
6,424,369 B1	IPR2020-00562 IPR2020-00563 IPR2020-00564 ex parte reexamination
6,452,626 B1	IPR2020-00565 IPR2020-0566 IPR2020-00567 ex parte reexamination
6,862,036 B2	IPR2020-00568 IPR2020-00569
7,002,621 B2	IPR2020-00571 IPR2020-00572 ex parte reexamination

Pet. 6–7.

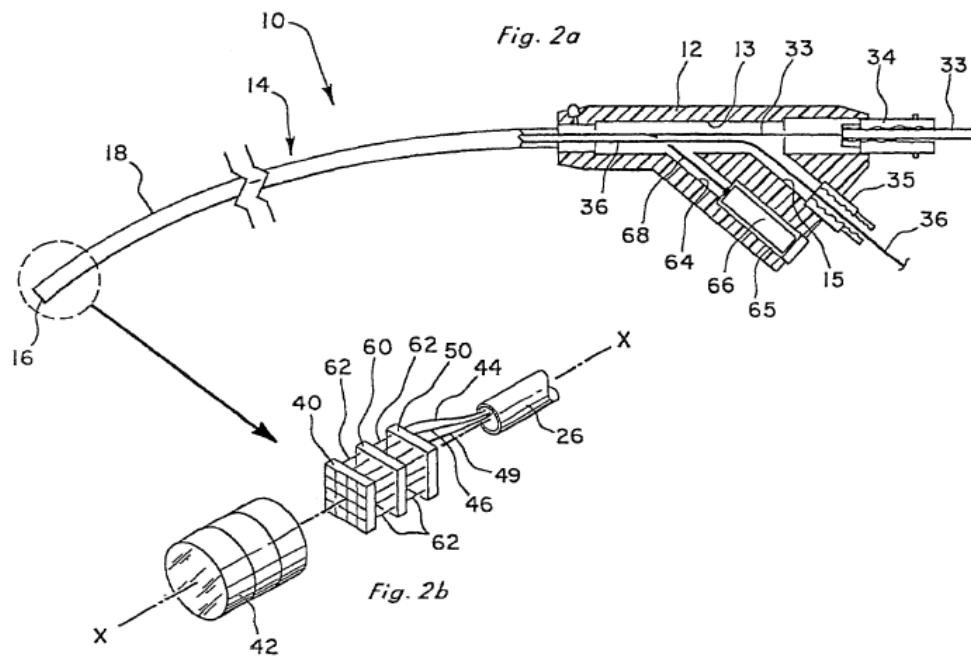
B. The '052 Patent

The '052 patent is titled “Reduced Area Imaging Device Incorporated Within Endoscopic Devices.” Ex. 1001, code (54). By way of background, the '052 patent explains that “endoscopic surgery has become the accepted standard for conducting many types of surgical procedures.” *Id.* at 1:40–42.

Solid state imaging technology is increasingly replacing the rod lens endoscope, due to “its cost of manufacture, failure rate, and requirement to be housed within a rigid and straight housing.” *Id.* at 1:52–57. Solid state imaging technology “enables the image sensor to be placed at the distal tip of the investigating device.” *Id.*

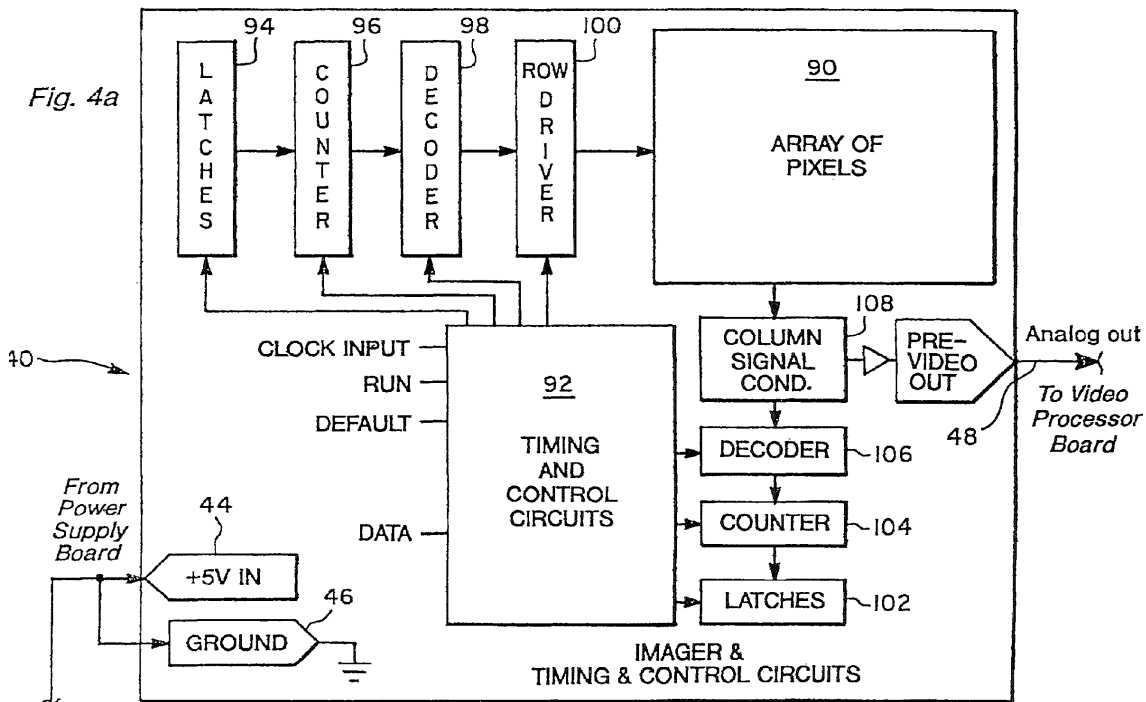
Complementary metal oxide semiconductor (CMOS) imaging devices are solid state imaging devices that “offer improved functionality and simplified system interfacing” and “can be manufactured at a fraction of the cost of other solid state imaging technologies.” Ex. 1001, 1:61–65. However, despite improved CMOS imaging devices that permit a “camera on a chip” concept (*see id.* at 3:1–:21), the ’052 patent reports that “a need still exists for a reduced area imaging device which can be used in even the smallest type of endoscopic instruments.” *Id.* at 3:29–31.

The ’052 patent purports to improve “camera on a chip” technology by “rearrang[ing] the circuitry in a stacked relationship so that there is a minimum profile presented when used within a surgical instrument or other investigative device.” Ex. 1001, 3:31–36. In an embodiment, an imaging device may be entirely self-contained in the distal end of an endoscope. *Id.* at 9:53–57. Figure 2a shows a cross-sectional view of an endoscope with an imaging device incorporated into the distal tip of the endoscope, and Figure 2b shows a partially exploded perspective view of the distal end of the endoscope shown in Figure 2a, both of which are reproduced below (*id.* at 6:55–61):



As shown in Figure 2b, an imaging device in the distal end 16 of endoscope 10 may include image sensor 40 electrically coupled, via pin connectors 62, to video processing board 50 and optional supplementary board 60. *Id.* at 9:58–10:8. Image sensor 40 may be bonded to lens system 42. *Id.* at 10:16–19.

Figure 4a, reproduced below, shows a detailed schematic diagram of image sensor 40 (Ex. 1001, 12:26–28):



As shown in Figure 4a above, image sensor 40 contains array of pixels 90 and timing and control circuits 92. *Id.* at 12:26–28. Array of pixels 90 is an active pixel group and “[e]ach pixel circuit has its own amplifier which is controlled by the timing and control circuitry.” *Id.* at 12:45–64.

C. Challenged Claim

Petitioner challenges independent claim 2 (Pet. 1), which reads:

2. An imaging device comprising:

a housing;

an image sensor mounted in said housing, said image sensor including a first circuit board having a length and a width thereto, wherein said length and width of said first circuit board define a first plane, said first circuit board including an array of CMOS pixels thereon, wherein a plurality of CMOS pixels within said array of CMOS pixels each include an amplifier, said first circuit board further including timing and control circuitry thereon, said timing and control circuitry being coupled to said array of CMOS pixels, said image sensor producing a pre-video signal;

a second circuit board mounted in said housing, said second circuit board being electrically coupled to said first circuit board, said second circuit board having a length and a width thereto, wherein said length and width of said second circuit board define a second plane, said second circuit board including circuitry thereon to convert said pre-video signal to a post-video signal, said second circuit board being positioned in a stacked arrangement with respect to said first circuit board, said second plane of said second circuit board being substantially parallel to said first plane of said first circuit board;

a lens mounted in said housing, said lens being integral with said imaging device, said lens focusing images on said array of CMOS pixels of said image sensor;

a video screen, said video screen being electrically coupled to said second circuit board, said video screen receiving said post-video signal and displaying images from said post-video signal; and

a power supply mounted in said housing, said power supply being electrically coupled to said first circuit board to provide power to said array of CMOS pixels and said timing and control circuitry, said power supply also being electrically coupled to said second circuit board to provide power thereto;

wherein a largest dimension of said image sensor along said first plane is between 2 and 12 millimeters.

Ex. 1001, 21:64–22:37.

D. Asserted Grounds

Petitioner challenges claim 2 based on the following grounds:

Claim Challenged	35 U.S.C. §	References
2	103	Swift, ² Ricquier, ³ Suzuki ⁴
2	103	Larson, ⁵ Swift, Ricquier, Suzuki

Pet. 9. Petitioner relies on the Declaration of Dr. Dean P. Neikirk in Support of Petition for *Inter Partes* Review of U.S. Patent No. 9,186,052 (Ex. 1004) and the Declaration of Dr. Dean P. Neikirk, Ph.D. in Support of Petitioner's Reply to Patent Owner's Response (Ex. 1086). Patent Owner relies on the Declaration of Dr. Michael Lebby in Support of Patent Owner's Response (Ex. 2088).

² WO Application Publication No. 95/34988, published December 21, 1995 (Ex. 1005).

³ Ricquier, N., et al. "*CIVIS Sensor: A Flexible Smart Imager with Programmable Resolution*," Charge-Coupled Devices and Solid State Optical Sensors IV. Vol. 2172, International Society for Optics and Photonics, 1994. Petitioner submitted two copies of this article, each with an accompanying declaration, as Exhibits 1033 and 1038. According to the accompanying declarations, Exhibits 1033 and 1038 are copies of the article obtained from SPIE and from the University of Wisconsin, respectively. Ex. 1033, 1; Ex. 1038, 1–2 (these cites refer to the page numbers added by Petitioner to these exhibits). In this decision, we cite to Exhibit 1038, which Petitioner identifies as "Ricquier," using the article's original page numbers unless noted otherwise. Pet. iv.

⁴ US Patent 5,233,426, filed December 12, 1991, issued August 3, 1993 (Ex. 1015).

⁵ US Patent 5,541,640, issued July 30, 1996 (Ex. 1029).

II. LEVEL OF SKILL IN THE ART AND CLAIM CONSTRUCTION

A. Level of Ordinary Skill in the Art

Petitioner asserts that on or before October 6, 1997, a person of ordinary skill in the art (“POSITA”) would have had “a minimum of a Bachelor’s degree in Electrical Engineering, Physics, or a related field” and “approximately two years of professional experience in the field of imaging devices.” Pet. 13 (citing Ex. 1004 ¶¶ 34–37).

Patent Owner asserts: “a person of ordinary skill in the art in October 6, 1997 (the earliest effective date of the ’052 patent) would have had a Bachelor’s degree in Electrical Engineering, Physics, or a related field, and approximately three years of professional experience in the field of visible optical imaging devices.” PO Resp. 12–13 (citing Ex. 2088 ¶ 40).

Neither party identifies any material differences between a skill level corresponding to approximately two years of professional experience in the field of imaging devices and approximately three years of professional experience in the field of visible optical imaging devices, or any difference in the field of imaging devices and the field of visible optical imaging devices. On this record, there is none.

We determine that the level of ordinary skill in the art is at the level of one who would have had a Bachelor’s degree in Electrical Engineering, Physics, or a related field, and approximately two to three years of professional experience in the field of visible optical imaging devices.⁶ This definition is consistent with the prior art of record. *Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001).

⁶ We do not adopt Petitioner’s inclusion of the qualifier “minimum,” to keep the specified level of skill more definite.

B. Claim Construction

“[I]n an *inter partes* review proceeding, a claim of a patent . . . shall be construed using the same claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. [§] 282(b), including construing the claim in accordance with the ordinary and customary meaning of such claim as understood by one of ordinary skill in the art and the prosecution history pertaining to the patent.” 37 C.F.R. § 42.100(b) (2019). In applying a district court-type claim construction, we are guided by the principle that the words of a claim “are generally given their ordinary and customary meaning,” as would have been understood by a person of ordinary skill in the art at the time of the invention. *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312–13 (Fed. Cir. 2005) (en banc) (citation omitted). “In determining the meaning of the disputed claim limitation, we look principally to the intrinsic evidence of record, examining the claim language itself, the written description, and the prosecution history, if in evidence.” *DePuy Spine, Inc. v. Medtronic Sofamor Danek, Inc.*, 469 F.3d 1005, 1014 (Fed. Cir. 2006) (citing *Phillips*, 415 F.3d at 1312–17). There is a “heavy presumption,” however, that a claim term carries its ordinary and customary meaning. *CCS Fitness, Inc. v. Brunswick Corp.*, 288 F.3d 1359, 1366 (Fed. Cir. 2002).

We also are guided by the principle that we only construe claim terms if, and to the extent that, it is necessary for this proceeding. *See, e.g., Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (“[W]e need only construe terms ‘that are in controversy, and only to the extent necessary to resolve the controversy.’” (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999))).

Neither party requests the construction of any claim term. Pet. 13; PO Resp. 12. Further, we do not find that any claim term requires express construction.

III. ANALYSIS OF ASSERTED GROUNDS OF UNPATENTABILITY

A. Principles of Law

To prevail in its challenge to Patent Owner's claims, Petitioner must demonstrate by a preponderance of the evidence that the claims are unpatentable.⁷ 35 U.S.C. § 316(e) (2018); 37 C.F.R. § 42.1(d). That burden never shifts to the patentee. *Dynamic Drinkware, LLC v. Nat'l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015).

A patent claim is unpatentable under 35 U.S.C. § 103 if the differences between the claimed subject matter and the prior art are such that the subject matter, as a whole, would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations including (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of ordinary skill in the art; and (4) when in evidence, objective evidence of nonobviousness. *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

⁷ The burden of showing something by a preponderance of the evidence requires the trier of fact to believe that the existence of a fact is more probable than its nonexistence before the trier of fact may find in favor of the party who carries the burden. *Concrete Pipe & Prods. of Cal., Inc. v. Constr. Laborers Pension Tr. for S. Cal.*, 508 U.S. 602, 622 (1993).

With these principles in mind, we make our determination of patentability based on the entirety of the evidence before us, both for and against obviousness. Below, we first address the evidence of nonobviousness submitted by Patent Owner. With that evidence in mind, we then address the parties' contentions and evidence regarding the prior art references.

B. Patent Owner's Evidence of Nonobviousness

Patent Owner asserts that the following secondary considerations support nonobviousness in this case: (1) commercial success, (2) satisfaction of a long-felt but unresolved need, (3) industry skepticism, (4) unexpected results, (5) industry praise, and (6) proceeding contrary to accepted wisdom. PO Resp. 39–47.

It is well established that to accord substantial weight to secondary considerations in an obviousness analysis, the evidence of secondary considerations must have a nexus to the challenged claim, i.e., there must be a legally and factually sufficient connection between the evidence and the patented invention. *Fox Factory, Inc. v. SRAM, LLC*, 944 F.3d 1366, 1373 (Fed. Cir. 2019). A patentee is entitled to a presumption of nexus when the patentee shows that the asserted objective evidence is tied to a specific product and that product embodies the claimed features and is coextensive with them. *Id.* Even where nexus cannot be presumed, “the patent owner is still afforded an opportunity to prove nexus by showing that the evidence of secondary considerations is the ‘direct result of the unique characteristics of the claimed invention.’” *Id.* (quoting *In re Huang*, 100 F.3d 135, 140 (Fed. 1996)).

1. Alleged Commercial Success

As evidence of commercial success, Patent Owner asserts that “companies have taken a license to the ’052 Patent.” PO Resp. 41. Patent Owner asserts:

Patent Owner and its parent, Micro-Imaging Solutions has licensed its patented reduced [area] imaging device to several companies including: Gyrus Group PLC, Cook Inc., Cook Medical Technologies LLC, Coopersurgical, Inc., Ethicon Endo-Surgery, Inc., Fujikura Ltd., Microtek Medical, Inc., Endosee Corp., Karl Storz Imaging, Inc., and Voyage Medical Inc. *See* Ex. 2074.

Id. at 41. Patent Owner does not indicate which of the above-identified entities, or how many, have taken a license to the ’052 patent, nor has Patent Owner identified what, if any, other patents were subject to the licenses involving these companies. Exhibit 2074, cited by Patent Owner, is unexplained by Patent Owner with regard to its nature, source, origin, and authorship, and does not identify or refer to any specific licensed patent or licensee (except Fujikura Ltd.). Exhibit 2074 does not demonstrate that any entity has taken a license to any claim of the ’052 patent, much less for what specific reason. There is only Patent Owner’s bare assertion that companies have taken a license to the ’052 patent. This is not sufficient to create a presumption of nexus between any license and the merits of the ’052 patent, and Patent Owner has not separately proved a nexus between any license and the ’052 patent.

In that regard, the Court of Appeals for the Federal Circuit has stated:

Antor, beyond alleging the existence of a number of licenses, has not asserted any nexus between the merits of the invention and the licenses themselves. *See In re GPAC Inc.*, 57 F.3d 1573, 1580 (Fed. Cir. 1995). Antor merely lists the licensees and their respective sales revenue. The licenses themselves are not even

part of the record. Antor provides no evidence showing that the licensing program was successful either because of the merits of the claimed invention or because they were entered into as business decisions to avoid litigation, because of prior business relationships, or for other economic reasons.

In re Antor Media Corp., 689 F.3d 1282, 1293–94 (Fed. Cir. 2012). Here, Patent Owner’s assertions are even less than that of the patentee in *Antor*, in that Patent Owner has not identified any specific licensee of the ’052 patent. Also, as in *Antor*, Patent Owner has not submitted any actual license, redacted or non-redacted, for any patent, into the record.

Accordingly, there is no presumption of nexus, and Patent Owner has not separately proved the required nexus for the alleged licensing and commercial success. Thus, there is not a legally and factually sufficient connection between the evidence of licensing and the patented invention.

2. Alleged Satisfaction of Long-Felt but Unresolved Need

Patent Owner also asserts that the ’052 patent satisfied a long-felt but unresolved “pressing need for [a] smaller, more cost effective and reliable endoscope.” PO Resp. 41. Patent Owner cites an article by Orthopaedic Product News as recognizing Patent Owner’s incorporation of a reduced-area CMOS imaging device. *Id.* at 42–43. The article states:

A Denver-based company has developed and patented high resolution, sturdy and inexpensive CMOS sensors (Complimentary Metal Oxide Semiconductors) that are actually built into the distal tip of arthroscopes, as well as other commonly used endoscopes.

It is evident that we have needed an appropriate and thoughtful improvement to the scope and video system as we currently know it. The development of the CMOS sensor has addressed the needs of the surgeon, surgical facility and the patient while addressing the important issues of video image, thoughtful design and cost-effectiveness. This disposable scope system

represents a significant advancement for arthroscopists, cost-conscious hospitals and surgeon centers and I believe it will be embraced by the endoscopy companies. The justification that my peers and I always recall is that if we can't see . . . we can't do the procedure.

Ex. 2089, 2–3 (cited at PO Resp. 42–43). For numerous reasons, Patent Owner's assertion that the claimed invention of the '052 patent satisfied a long-felt but unresolved need is not supported by the evidence of record.

A long-felt need can be established by objective evidence that the invention has provided a long-awaited, widely accepted, and promptly adopted solution to a problem extant in the art, or that others had tried but failed to solve that problem. *In re Mixon*, 470 F.2d 1374, 1377 (CCPA 1973); *In re Allen*, 324 F.2d 993, 997 (CCPA 1963). Patent Owner has not provided such evidence.

First, Patent Owner does not explain why we should find that the referenced Denver-based company in the news article is the Patent Owner. PO Resp. 42–43. Second, Patent Owner does not explain whether the referenced tips of arthroscopes and endoscopes with a built-in CMOS sensor make use of the claimed invention of the '052 patent, and if so, which claims. *Id.* Third, Patent Owner does not indicate whether any significant features are included in the referenced tips of arthroscopes and endoscopes, which are not recited in any claim of the '052 patent. *Id.* Fourth, Patent Owner does not explain how long a pressing need purportedly existed for a smaller, more cost effective and reliable endoscope. *Id.* Fifth, Patent Owner has not identified any prompt adoption of the claimed invention by anyone nor has Patent Owner identified any specific prior failed attempts to resolve the alleged need. *Id.* Sixth, this single article does not sufficiently

demonstrate widespread recognition by those with ordinary skill in the art that there was a problem without a solution in the industry. *Id.*

Finally, even assuming that there was a long-felt but unresolved need for a smaller and more cost-effective arthroscope or endoscope, Patent Owner has not shown a nexus to the claimed invention, and none can be presumed. The challenged claim does not require either an arthroscope or endoscope. Assuming that the article is referring to a product of Patent Owner, Patent Owner has not shown that the product is “coextensive” with any challenged claim from the perspective of satisfaction of a long-felt but unresolved need. *See Fox Factory*, 944 F.3d at 1373.

For the foregoing reasons, there is not a legally and factually sufficient connection between the alleged long-felt but unresolved need and the claimed invention.

3. Alleged Industry Skepticism

Patent Owner further asserts that, at the time of the invention of the ’052 patent, the industry was skeptical regarding the use of CMOS imagers for medical imaging because CMOS imager quality was “meaningfully lower than [the image quality] available with CCD [charged coupled device] imager devices.” PO Resp. 43–44. Patent Owner cites a declaration of a named inventor of the ’052 patent that was submitted in a related patent application. *Id.* In that declaration, the inventor states:

There has been great skepticism in the industry as to the capability to use CMOS technology in medical imaging applications. CMOS imagers have been characterized as not being capable of producing high quality images. Despite this skepticism, we were able to locate companies developing CMOS technology that might be useable within an imaging device . . . [that] utilized a CMOS pixel array with timing and control placed

together on one plane or circuit board, and remaining processing circuitry either placed in a remote control box, or on other circuit boards placed closely adjacent the CMOS pixel array.

Ex. 1003, 84–85 (¶¶ 7–8).

Patent Owner has not shown sufficient nexus between the alleged industry skepticism and the claimed invention. As Petitioner correctly observes (Reply 26), the alleged industry skepticism pertains to the image quality of CMOS image sensors incorporated in medical devices. Yet, the challenged claim does not require incorporation of the CMOS image sensor in a medical device, such as an endoscope, and the challenged claim does not require a minimum or threshold level of image quality. The claimed features are not coextensive or commensurate in scope with the purported industry skepticism. *See Fox Factory*, 944 F.3d at 1373. Further, the testimony by the inventor that the claimed invention overcame the alleged skepticism is conclusory. Ex. 1003, 84–85. The inventor states that the industry was skeptical that CMOS imagers could produce high quality images and that he and his co-inventors produced an imaging device that produced an extremely high quality image, but he cites no evidence to support this testimony. *Id.* Further, he does not provide any indication of what he means by an extremely high quality image or what improvement with respect to imaging quality the claimed invention allegedly obtained. *Id.* Thus, for these reasons, the proffered alleged industry skepticism provides little objective evidence of non-obviousness.

4. Alleged Unexpected Results

According to Patent Owner, its named inventors discovered an unknown but very important advantage that the claimed invention has over CCD type imagers, i.e., the capability to reject *radio frequency interference*

(RFI) emitted by electrosurgical generators used during surgery. PO Resp. 44–45. Patent Owner notes that an inventor’s declaration was submitted during prosecution of a related application, wherein it was stated that CCD devices cannot be used near an electrical surgical generator without requiring significant shielding, and that even with shielding, RFI levels are only brought to a reasonable level, which may still result in an obstructed view of the surgical area. *Id.* (citing Ex. 1003, 85 (¶ 11)). Patent Owner further notes that in that declaration, the inventor further states that “[a]fter testing several types of CMOS configurations, we concluded that remoting processing circuitry from the CMOS imager and timing and control circuits eliminated the need for shielding.” *Id.* (citing Ex. 1003, 85 (¶ 12)).

We first find that Patent Owner has not shown sufficient nexus between the alleged unexpected result and the challenged claim. The alleged unexpected result is based on RFI caused by electrosurgical generators used during surgery. However, the challenged claim does not require that its device is incorporated in a medical surgical device, such as an endoscope. Thus, the unexpected result, even if true, is not commensurate in scope with what has been claimed. “In order to establish unexpected results for a claimed invention, objective evidence of non-obviousness must be commensurate in scope with the claims which the evidence is offered to support.” *In re Clemens*, 622 F.2d 1029, 1035 (CCPA 1980) (citations omitted).

Further, to establish a showing of unexpected results, Patent Owner has to compare the claimed invention with the closest prior art. *In re Fracalossi*, 681 F.2d 792, 794 (CCPA 1982); *In re Fenn*, 639 F.2d 762, 765 (CCPA 1981). Patent Owner has not shown that the closest prior art is a

CCD imager. According to Patent Owner, CMOS technology and CCD technology are very different from each other. PO Resp. 4–12. On that basis, it would appear that closer prior art than a CCD device would be a CMOS imager, such as that disclosed in Swift.

Additionally, Dr. Neikirk testifies that the alleged discovery was not unexpected but, rather, predictable. Ex. 1004 ¶ 299. Dr. Neikirk explains as follows:

[A]s the declaration notes, they were using endoscopic cameras around an “electrosurgical generator” that was used to “cut or cauterize” tissue. ’839 File History, 85. It would have been understood by a person of ordinary skill in the art that such an electrosurgical generator would create a large amount of electromagnetic (“EM”) radiation. Moreover, while the declaration does not clearly state how many wires were in the CCD system at issue, a person of ordinary skill in the art would have understood that such EM radiation would cause radio frequency interference (“RFI”) in a system, and would have a more significant adverse effect on a system with more wires than a system with fewer wires. It was also known that a CCD sensor could have many more wires than a CMOS sensor. For example, according to the declaration, the prior art CCD sensor identified in the declaration (“Pelchy”) includes “a large number of transmission wires 33 which interconnect the circuit boards placed perpendicular to the pixel array with an external processor 13.” ’839 File History, 92. Thus, in a CCD sensor with many wires, the radio frequency interference would have a relatively large effect on the quality of images produced by the image sensor. On the other hand, CMOS sensors require only a few wires to connect to the pixel array, and thus interference created in a CMOS image sensor would be much smaller than in such a CCD arrangement.

Ex. 1004 ¶ 299. This testimony is not rebutted by Patent Owner’s expert, Dr. Lebby. Patent Owner does not identify any testimony of Dr. Lebby conveying that it would have been unexpected to one of ordinary skill in the

art that a CMOS sensor with remotely located processing circuitry would have no need for RFI shielding.

Dr. Neikirk's testimony is rational, and we credit his testimony over the testimony of Patent Owner's inventor, who provides no explanation as to why it was purportedly unexpected that, as compared to CCD devices, a CMOS imager with remotely located processing circuitry requires no RFI shielding.

For the foregoing reasons, Patent Owner has not established that the alleged unexpected result would have been unexpected to an ordinarily skilled artisan. Further, even assuming the alleged unexpected result truly would have been unexpected to an ordinarily skilled artisan, Patent Owner has not shown sufficient nexus between the unexpected result and the claimed invention.

5. Alleged Industry Praise

Patent Owner asserts that it has received industry praise. PO Resp. 45–46. Specifically, Patent Owner states:

Micro-Imaging Systems won the Orthopedics This Week's 2016 Sports Medicine Technology Award for its "Distally mounted CMOS Sensor for disposable/reusable and rigid/flexible scopes" which features the claimed reduced-area imaging device, Orthopedics This Week noted the benefits of Patent Owner's CMOS sensors that could be placed in the tip of an endoscope.

Id. (citing Ex. 2090, 14–15). The cited portion of Exhibit 2090 reads as follows:

Current cameras and endoscopes (all types) have remained unchanged for decades and degrade from "Day 1" of utilization thus causing undesirably compromise of visual clarity at an extremely inconvenient time! This technology allows for flexible or rigid applications as a reusable or a disposable with significant value. Utilization of this technology can eliminate the

five things that degrade current and problematic technology. It has the real benefit of reducing repair costs as well as OR “down time” and the need to acquire costly surplus inventory to avoid catastrophes.

Ex. 2090, 14–15.

Patent Owner has not identified a sufficient nexus between the above-quoted text in Exhibit 2090 and the features of the invention claimed in the ’052 patent, and between the “award” and the features of the invention claimed in the ’052 patent. There is insufficient detail in the above-quoted text to associate that which is praised with the features claimed in the ’052 patent. The references to “this technology” do not reveal specific features of what is being praised. Even assuming that “this technology” includes the features of the claimed invention, the praise also is directed to additional features not recited in the challenged claim, i.e., an imaging device mounted on an *endoscope*. The challenged claim does not require the image sensor to be mounted on or affixed to an endoscope. Thus, Patent Owner has not shown that the alleged industry praise is “coextensive” with the challenged claim. *See Fox Factory*, 944 F.3d at 1373. There is not a legally and factually sufficient connection between the alleged industry praise and the claimed invention.

6. Allegedly Proceeding Contrary to Accepted Wisdom

Patent Owner argues:

Prior to the ’052 Patent, the accepted wisdom in the art was that CMOS imagers should be implemented in an on-chip integration manner. Dr. Eric Fossum⁸ spearheaded the

⁸ Dr. Fossum is the author of the article titled “Active-pixel sensors challenge CCDs,” published in *Laser Focus World*. Ex. 1048. Another exhibit (Ex. 1060), a *Business Week* article, discusses a design for a “camera-on-a-chip” by Dr. Fossum. Ex. 1060, 1.

development of the CMOS camera on a chip design efforts. Fossum's design would enable full realization of the benefits of a CMOS imager boasting numerous benefits over the dominant CCD image sensor. For example, the CMOS camera on a chip would enable designers to "make a camera small and cheap enough to open vast new markets for everything from dolls that [']see['] to rear-bumpers cameras that would help drivers back up." Ex. 1060. However, Patent Owner recognized that a need still existed for a reduced area imaging device which could be used in even smaller devices, such as endoscopic instruments, in order to view areas that are particularly difficult to access, and to further minimize patient trauma by an even smaller diameter invasive instrument. As a result, the '052 Patent describes and claims a reduced area imaging device which took advantage of Fossum's revolutionary "camera on a chip" technology, but rearranged the circuitry to separate out circuitry so that a further minimum profile could be achieved.

PO Resp. 46–47.

Patent Owner does not cite to any expert testimony that supports the position that a CMOS imager with off-chip circuitry was inoperative, unworkable, or undesirable. In fact, the record evidence is to the contrary. Dr. Neikirk specifically identifies examples of prior-art disclosures of CMOS imagers with off-chip configurations. Ex. 1004 ¶¶ 40 (identifying Swift and Monroe), 77 ("Monroe teaches a CMOS imager"), 229.

Further, the record evidence does not support Patent Owner's assertion that the accepted wisdom in the art was that CMOS imagers should be implemented only in an on-chip integration manner, and we do not find that to be so. Also, Patent Owner appears to have not accounted for the basic skills or fundamental engineering principles that would have been possessed by one with ordinary skill in the art, e.g., offloading some components to another chip or another circuit board would decrease the required size for the containing chip or circuit board. For example,

Dr. Neikirk testifies that “a person of ordinary skill would have known that components could be placed on a number of circuit boards and arranged in any number of different ‘planes’ based on the design needs and intended applications of a given device.” Ex. 1004 ¶ 40. Patent Owner does not identify any contrary testimony from its expert, Dr. Lebby, and we credit this testimony from Dr. Neikirk.

For the foregoing reasons, Patent Owner’s argument that it proceeded against accepted wisdom adds very little to the strength of its evidence on objective indicia of nonobviousness.

7. Summary of Objective Evidence of Nonobviousness

For the foregoing reasons, the objective evidence of nonobviousness relied on by Patent Owner is weak. As set forth below, we have considered this evidence together with the evidence discussed below, to arrive at a conclusion of whether Petitioner has proven that the challenged claim would have been obvious.

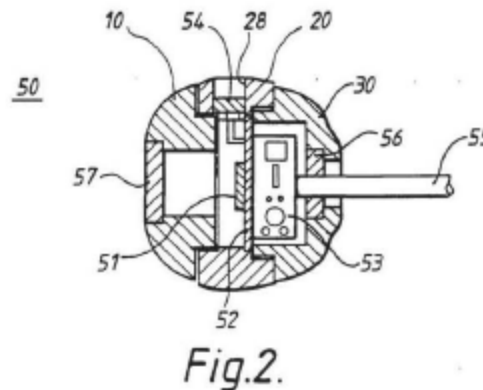
C. Asserted Obviousness of Claim 2 over Swift, Ricquier, and Suzuki

Petitioner asserts that claim 2 would have been obvious over Swift, Ricquier, and Suzuki. Pet. 15–50.

1. Swift

Swift published on December 21, 1995. Ex. 1005, code (43). The earliest priority date claimed for the ’052 patent is based on the priority filing date of U.S. Patent Application No. 08/944,322, which is October 6, 1997. Ex. 1001, code (63). Thus, Swift is prior art to the ’052 patent under 35 U.S.C. § 102(b). Patent Owner does not contest the prior art status of Swift. *See generally* PO Resp.

Swift is titled “Miniature Cameras.” Ex. 1005, code (54). Swift teaches a miniature video camera that includes a housing and an image sensor mounted in the housing. *Id.* at code (57), 4:11–15, 8:31–9:5, Fig. 2. Figure 2 of Swift, reproduced below, illustrates miniature camera 50 (*id.* at 7:10–13):



As shown in Figure 2 above, miniature camera 50 has a housing with front portion 10, center portion 20, and rear portion 30, and all of these portions have a substantially circular cross-section. *Id.* at 7:10–15. Miniature camera 50 also includes imager sensor 51 mounted on circular circuit board 52; circuit board 53; miniature microphone 54; cable 55; and wide angle lens 57. *Id.* at 8:31–9:25. Circuit board 53 is mounted on circuit board 52 substantially at a right angle. *Id.* at 9:5–7. Circuit components mounted on circuit board 53 power image sensor 52, process image signals received from image sensor 52, and process audio signals from miniature microphone 54. *Id.* at 9:8–13. Cable 55 provides a connection between miniature video camera 50 and external circuitry. *Id.* at 9:13–17.

Image sensor 51 is preferably of a CMOS/APS (Active Pixel Sensor) type. Ex. 1005, 10:1–2.

2. Suzuki

Suzuki issued on August 3, 1993. Ex. 1015, code (45). Thus, Suzuki is prior art to the '052 patent under 35 U.S.C. § 102(b). Ex. 1001, code (63). Patent Owner does not contest the prior art status of Suzuki. *See generally* PO Resp.

Suzuki is titled “Reduced Diameter Camera Head for [a] Solid-State Image Pickup Device And Method of Producing Same.” Ex. 1015, code (54). Figure 2, reproduced below, is a cross-sectional view of camera head 2:

FIG. 2

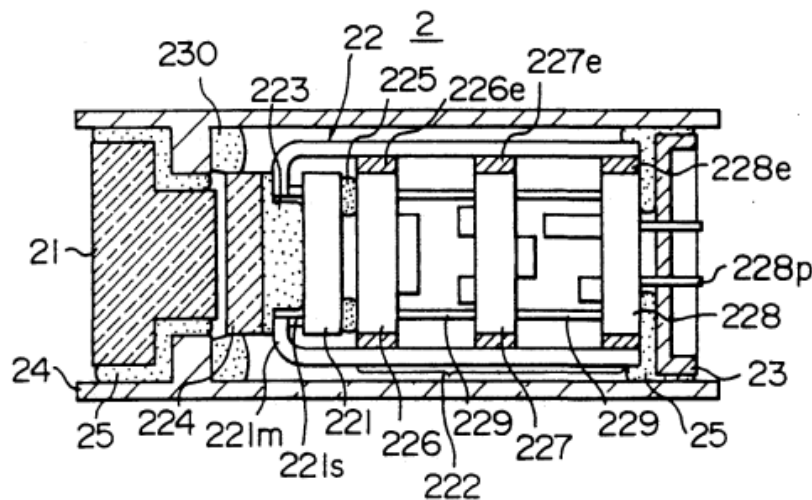
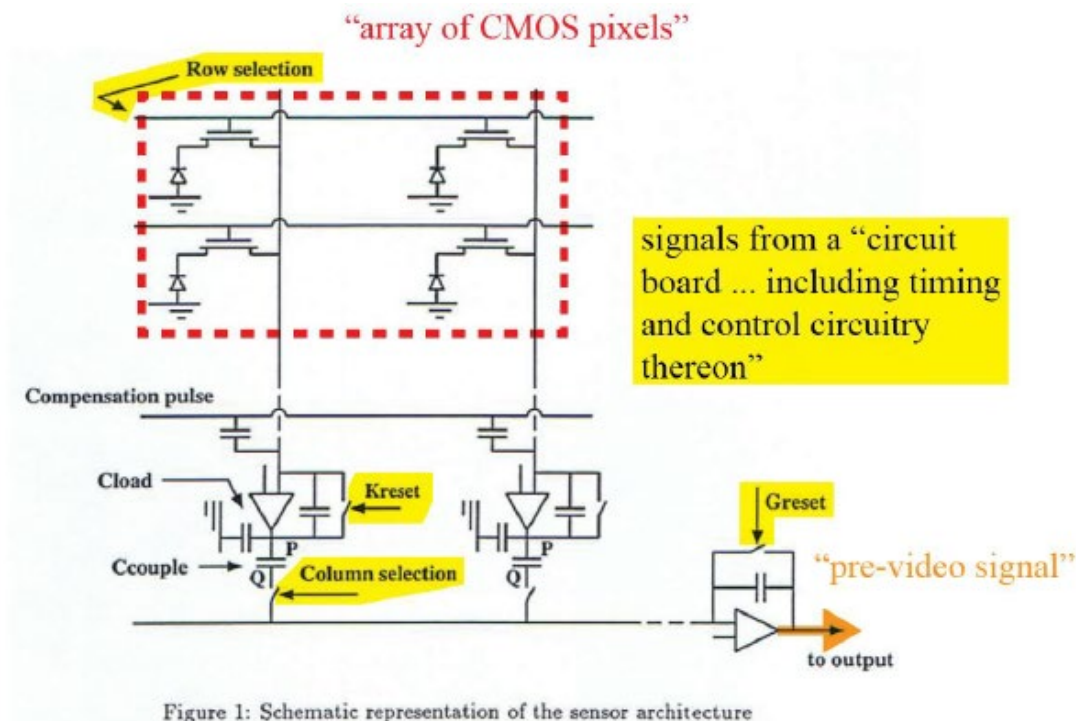


Figure 2 above shows camera head 2 with image pickup unit 22, the latter of which comprises solid-state image pickup chip 221 and circuit module 222. Ex. 1015, 2:38–41. Suzuki discloses the use of an 8.5 mm solid-state image pickup chip with an outer camera head diameter of about 10 mm. *Id.* at 4:6–11.

3. Ricquier

Ricquier is a conference paper. Exs. 1033, 1038. According to declarations submitted by Petitioner, Ricquier was disseminated and available in a library by May 1994. Ex. 1004 ¶¶ 302–308; Ex. 1033, 1; Ex. 1038, 1.⁹ Ricquier, thus, is prior art to the '052 patent under 35 U.S.C. § 102(b). Ex. 1001, code (63). Patent Owner does not contest the prior art status of Ricquier. *See generally* PO Resp.

Ricquier describes a dedicated imager for a camera operating in several resolutions. Ex. 1038, 2. The imager includes a CMOS array of 256 x 256 pixels addressable by column and row using a timing controller on an off-chip driving unit. *Id.* at 2–4. Petitioner submitted an annotated copy of Figure 1 of Ricquier, reproduced below:



⁹ These cites refer to the page numbers added by Petitioner to Exhibits 1033 and 1038.

Pet. 36. The unannotated version of Figure 1 above is a schematic representation of Ricquier's sensor architecture. Ex. 1038, 3. As illustrated above, Petitioner maps the recited pre-video signal of claim 2 to the output of this sensor architecture. Pet. 34–37. Petitioner argues that readout in this sensor architecture is done by controlling the clock scheme using a timing controller on an off-chip driving unit for driving the row selection, column selection, and reset signal inputs. *Id.* at 37. Those inputs are identified via annotations in the figure above. *Id.* at 36. Ricquier does not state whether its off-chip driving unit is on the same circuit board with its CMOS pixels.

4. Combination of Swift and Ricquier

Petitioner argues that an ordinarily skilled artisan would have combined Swift's and Ricquier's teachings. Pet. 20–24. In particular, Petitioner asserts that an ordinarily skilled artisan would have combined (i) Swift's teachings of a miniature camera with a CMOS image sensor with (ii) Ricquier's teachings of a CMOS pixel array and an off-chip timing controller to yield a miniature camera with an image sensor, comprising a CMOS pixel array, and a timing controller. *Id.* at 22–23. Petitioner further argues that an ordinarily skilled artisan would have placed the timing controller in this combination on the same circuit board as the image sensor. *Id.* at 23. Patent Owner disputes that an ordinarily skilled artisan would have made this combination. PO Resp. 25–35.

In this section, we first address the parties' arguments regarding whether an ordinarily skilled artisan would have combined Swift's and Ricquier's teachings in the manner proposed by Petitioner. Then, we provide our analysis.

a. Parties' Arguments

As mentioned, Petitioner argues that an ordinarily skilled artisan would have been motivated to combine Swift's and Ricquier's teachings. Pet. 20–24. Petitioner asserts that Ricquier teaches using a CMOS array for a CMOS sensor. *Id.* at 22. Petitioner further asserts that Ricquier teaches the advantages of its imager's selective addressability, multiple resolutions, and data rates. *Id.* at 24 (citing Ex. 1038). Petitioner further argues that Ricquier teaches the advantages of using an off-chip timing controller, which adds flexibility in making design choices to fill components into available space and stack those components for a more compact camera head. *Id.* at 22–23. Further, Petitioner asserts that an ordinarily skilled artisan would have been motivated to locate Ricquier's off-chip timing and control circuitry in Swift's miniature camera on the opposite side of circuit board 52 to image sensor 51 to minimize the camera's overall size. *Id.* at 23 (citing Ex. 1016, 4–5; Ex. 1015, Fig. 2). Petitioner further argues that placing components in this stackwise arrangement is a common design consideration for portable devices. *Id.* at 23–24 (citing Ex. 1045, 15, 20; Ex. 1016, 3–4). Further, Petitioner argues that an ordinarily skilled artisan would have had a reasonable expectation of success in combining Swift and Ricquier in this manner. *Id.*

Patent Owner argues that an ordinarily skilled artisan would not have been motivated to combine Swift's and Ricquier's teachings. PO Resp. 25–35. Patent Owner argues that Swift “is a reference fundamentally at odds with itself.” PO Resp. 14. Patent Owner continues: “[a]lthough Swift states that its image sensor ‘is preferably of a CMOS/Aps (Active Pixel Sensor) type,’ Swift’s description of its system architecture betrays the reality that

the author merely contemplated placing a CMOS imager within the incompatible CCD system architecture.” *Id.* (citing Ex. 1005, 10) (emphasis omitted). Patent Owner further argues that “the author presumably gave no thought to the fact that the two systems are incompatible.” *Id.* Patent Owner asserts, however, that: “[n]evertheless, Swift discloses an embodiment in which the camera uses Dr. Fossum’s CMOS sensor, disclosed in Ex. 1048.” *Id.* at 16.

Patent Owner asserts that an ordinarily skilled artisan would not have combined Swift’s embodiment with Ricquier’s off-chip timing and control circuit because Swift’s embodiment includes Dr. Fossum’s sensor, which includes timing and control circuitry on the same chip as the imager. PO Resp. 25–27. Patent Owner argues that Figure 7 of Swift shows that Swift’s sensor is a camera on a chip embodiment because it has a portion for circuit components. *Id.* at 26. Patent Owner further argues that Figure 7 of Swift shows a similar sensor structure to that shown in the Laser World article illustrating Dr. Fossum’s sensor. *Id.* at 27 (citing Ex. 1060, 2). Patent Owner argues that no evidence in the record shows that an ordinarily skilled artisan would have been motivated to de-integrate these features of the Swift/Fossum camera on a chip. *Id.* at 27–28.

Patent Owner further argues that Ricquier is silent with respect to minimizing a device’s size or profile area. PO Resp. 28. Further, Patent Owner asserts that an ordinarily skilled artisan would have kept the camera-on-the-chip design to minimize camera size. *Id.*

Patent Owner further argues that Petitioner has not shown that there were known advantages of using an off-chip timing controller. PO Resp. 29. Patent Owner contends that Ricquier discloses no such advantages. *Id.*

Further, Patent Owner asserts that a reason Ricquier chose CMOS was that its processing electronics could be integrated into the same chip as the pixel array. *Id.*

Patent Owner additionally argues that flexibility for fitting components into available space would not have motivated Petitioner's combination because an ordinarily skilled artisan would not have moved Swift's timing and control circuitry off chip. PO Resp. 30. Patent Owner also argues that Petitioner relies on the design choice doctrine to place the timing and control circuitry in its proposed combination, but the choice of where to locate the timing and control circuitry is not a design choice, because the recited placement solved a stated problem and gave rise to unexpected results. *Id.* at 30–31. Patent Owner asserts that Ricquier is silent with respect to noise reduction. *Id.* Further, Patent Owner argues that the timing and control circuits should be placed on the same planar structure with the pixel array to reduce noise. *Id.* at 32.

Patent Owner further argues that Swift's camera-on-a-chip embodiment already has the advantages of selective addressability and multiple resolution, so selective addressability and multiple resolutions would not have motivated an ordinarily skilled artisan to combine Swift's and Ricquier's teachings. PO Resp. 33.

Patent Owner also argues that Ricquier teaches away from using the off-chip driver that it used in its tests. Pet. 34. Patent Owner notes that Ricquier describes cointegration of processing electronics as a goal. *Id.*

In its Reply, Petitioner argues that Patent Owner's arguments are based on an inaccurate premise that Swift only teaches a camera-on-a-chip. Pet. Reply 2–3. Petitioner argues that Swift expressly teaches that

processing circuitry resides off-chip on circuit board 53. *Id.* at 4. Petitioner further argues that Swift's disclosure of a CMOS/APS (Active Pixel Sensor) type does not reference any specific sensor or product. *Id.* Further, Petitioner argues that the prior art confirms that CMOS sensors were not all camera-on-a-chip. *Id.* at 5. Petitioner also argues that there is too little similarity between Swift's Figure 7 and Fossum's camera on a chip to limit Swift to Fossum's disclosures. *Id.* Further, Petitioner asserts that Ricquier teaches using off-chip timing and control circuitry. *Id.* at 6.

In its Sur-reply, Patent Owner argues that Swift discloses a CMOS APS camera-on-a-chip image sensor. Sur-reply 3. Patent Owner further argues that the design uses Fossum's camera-on-a-chip sensor. *Id.* at 3–4. Patent Owner argues that the industry equated APS CMOS imagers with camera-on-a-chip design. *Id.* at 4. Patent Owner further argues that benefits for the camera-on-a-chip design were known. *Id.* at 5. Patent Owner also argues that the space shown in Figure 7 of Swift that does not include the pixels is for processing because CMOS sensors would not be fabricated with empty space. *Id.* Patent Owner further argues that Swift discloses using either a camera-on-the-chip design or a CCD design. *Id.* at 9. Patent Owner also argues that Swift's voltage is consistent with a CCD design. *Id.* at 10–11.

b. Analysis

We find that an ordinarily skilled artisan would have been motivated to combine Swift's and Ricquier's teachings in the manner proposed by

Petitioner.¹⁰ Ex. 1004 ¶¶ 237–240; Ex. 1086 ¶ 15. We further find that an ordinarily skilled artisan would have had a reasonable expectation of success in so doing. Ex. 1004 ¶ 240

First, many of the disputes between the parties regarding the motivation to combine these teachings concern whether Swift teaches or suggests the use of a CMOS sensor with off-chip circuitry. Petitioner argues that Swift teaches such an embodiment, whereas Patent Owner argues that Swift only teaches CMOS camera-on-chip embodiments, where all of the circuitry is on-chip. We find that Swift teaches a CMOS sensor with off-chip circuitry. In particular, Swift discloses that the “image sensor 51 is preferably of a CMOS/APS (Active Pixel Sensor) type.” Ex. 1005, 10:1–2. Swift further discloses that “image sensor 51 is mounted on circular printed board 52.” *Id.* at 8:34–35. Further, Swift discloses that another printed circuit board, “printed circuit board 53,” has “[v]arious circuitry components . . . mounted . . . to . . . process image signals.” *Id.* at 9:8–10. Thus, Swift discloses a CMOS sensor on circuit board 52 with off-chip processing circuitry (i.e., circuitry that is not on the sensor chip and, in fact, is not on the same circuit board as the sensor). 1004 ¶¶ 229–230.

Dr. Neikirk testifies that locating Ricquier’s timing controller to the opposite side of circuit board 52 from image sensor 51 permits flexibility for fitting components into available space to allow for a more compact camera head. Ex. 1004 ¶ 239; Ex. 1038, 3. The evidence of record supports this

¹⁰ We make our findings and determinations, and perform our analysis regarding the asserted obviousness of the challenged claims, with full consideration of the objective evidence of nonobviousness discussed in Section III.B, above.

testimony, and we credit this testimony. Ex. 1016, 4. Dr. Lebby testifies that an ordinarily skilled artisan would put the timing and control circuitry on the same planar structure with the image sensor. Ex. 2088 ¶ 19. With this placement, the timing and control circuitry would be on the same side of circuit board 52 as image sensor 51. *Id.* (testifying that an ordinarily skilled artisan would not want to place the timing and control circuitry on the opposite side of that circuit board). Either placement of the timing and control circuitry, however, would satisfy claim 2, because claim 2 merely requires that the timing and control circuitry be on the recited first circuit board (circuit board 52). Ex. 1001, 21:64–22:38.

Further, as mentioned, we do not agree with Patent Owner that Swift’s CMOS disclosures are limited to camera-on-a-chip embodiments. Although Swift discloses an alternative embodiment where “[a] single circuit board (e.g., circular) may be provided instead of the two circuit boards 52 and 53” and the use of a single circuit board in this alternative embodiment is consistent with a CMOS camera-on-a-chip design, Swift merely presents this as an alternative embodiment. Ex. 1005, 9:20–21. Swift’s disclosure of this alternative embodiment does not negate its teaching of a CMOS embodiment with two circuit boards (an embodiment with off-chip circuitry).

We also do not agree with Patent Owner that Swift’s reference to the Laser World Article (Ex. 1060) means that only the CMOS chip that could be used with Swift is the one shown in the article. PO Resp. 25–27. Swift merely informs an ordinarily skilled artisan that “[f]urther information on APS-type sensors may be found in the publication ‘Laser Focus World,’ June 1993, Page 83.” Ex. 1005, 10:4–6. Swift does not state that the

particular CMOS/APS sensor shown in that article is the only CMOS/APS sensor that could be used as its imager. *Id.* To the contrary, Swift discloses an embodiment with a CMOS sensor with off-chip circuitry. *Id.* at 8:31–10:6.

We also do not agree with Patent Owner that Swift “is a reference fundamentally at odds with itself.” PO Resp. 14. Patent Owner argues that “Swift’s description of its system architecture betrays the reality that the author merely contemplated placing a CMOS imager within the incompatible CCD system architecture.” *Id.* We do not find that Swift teaches only CCD architectures. Swift never mentions the use of a CCD in its system. *See generally* Ex. 1005; Ex. 1086 ¶ 16. And we credit Dr. Neikirk’s testimony that CMOS sensors with off-chip circuitry were known. Ex. 1004 ¶¶ 77, 161–165, 238, 259–263; Ex. 1086 ¶ 19; *see also* Ex. 1007, 3:36–62, 8:8–11, Fig. 3; Ex. 1038, 2–4. Further, we do not agree with Patent Owner’s argument that the fact that Swift’s camera may have a maximum dimension that is larger than the camera disclosed in the ’052 patent or can operate at a higher voltage means it uses a CCD imager. PO Resp. 14–16; Ex. 2088 ¶¶ 97–98. Swift discloses a 12 volt operating voltage for the camera. Ex. 1005, 15:28–31. The ’052 patent indicates the power for its preferred imaging device “can be a 1.5 to a 12 volt source.” Ex. 1001, 9:44–47. Further, the voltage for the camera power can be higher than the voltage provided to the imager. Ex. 1086 ¶ 18.

We also do not agree with Patent Owner that Figure 7 of Swift shows that Swift only uses a CMOS camera-on-a-chip embodiment. PO Resp. 25–27. Even if we were to accept Patent Owner’s argument that Figure 7 shows space where circuitry could be placed on image sensor 201, Swift still

discloses that its image sensor is placed on board 52 and circuitry to process image signals are mounted on circuit board 53. Ex. 1005, 9:7–13; Ex. 1086 ¶ 14. Thus, even if some circuitry were placed on imager 201, Swift still teaches placing circuitry for processing images off-chip. Ex. 1086 ¶ 14.

Second, we find that an ordinarily skilled artisan would have been motivated to combine Swift’s CMOS embodiment with off-chip circuitry with Ricquier’s teachings of a CMOS pixel array to obtain the advantages of selective addressability and multiple resolutions. Ex. 1038, 2; Ex. 1004 ¶ 239. Patent Owner does not dispute that Ricquier’s CMOS array has those advantages. PO Resp. 33. Patent Owner argues, however, that Swift only discloses using Fossum’s camera-on-a-chip, which has the same advantages, so the advantages of selective addressability and multiple resolutions would not have motivated an ordinarily skilled artisan to use Ricquier’s CMOS array with Swift. *Id.* As discussed above, we disagree with Patent Owner’s argument that Swift only discloses a CMOS camera-on-a-chip embodiment. Petitioner’s proposed combination involves Swift’s CMOS embodiment with off-chip circuitry, so, for that combination, Petitioner does not need to provide a motivation to alter Fossum’s camera-on-a-chip by demonstrating advantages that Fossum’s imager lacks.

Patent Owner’s expert, Dr. Lebby, testifies that all CMOS sensors have the advantages of selective addressability and multiple resolutions. Ex. 2088 ¶ 120. We do not credit that testimony, however, because it is inadequately supported. Dr. Lebby cites only one article to support that testimony and that article itself does not disclose that all CMOS sensors have such advantages. *Id.* (citing Ex. 1060, 2).

Third, an ordinarily skilled artisan would have been motivated to place timing and control circuitry on circuit board 52. Ex. 1004 ¶ 239. Dr. Neikirk testifies that an ordinarily skilled artisan would have been motivated to place Ricquier’s timing and control circuitry on the opposite side of Swift’s circuit board 52 to image sensor 51 to permit flexibility for fitting components into available space to allow for a more compact camera head. Ex. 1038, 3, 4; Ex. 1004 ¶ 239. The evidence of record supports this testimony. Ex. 1016, 4–5 (benefits of mounting image sensor chip on one side of a circuit board and other circuit components on the circuit board’s underside include that it “does not require many lead wires, so there is a high degree of reliability, and excellent matching characteristics . . . [and] allow[s] for a more compact camera head”); Ex. 1015, Fig. 2 (mounting circuitry on the opposite side of chip-connecting board 226 from image pickup chip 221).

Patent Owner does not dispute that an ordinarily skilled artisan would have included timing and control circuitry on Swift’s circuit board 52. PO Resp. 30–32. Patent Owner, however, disputes that the timing and control circuitry would be placed on the opposite side of circuit board 52 from image sensor 51. *Id.* Dr. Lebby indicates that timing and control circuitry would be on the same side of circuit board 52 as image sensor 51 because timing and control circuitry is part of Fossum’s camera-on-a-chip, which Swift’s imager uses. Ex. 2088 ¶ 117. Dr. Lebby further testifies that an ordinarily skilled artisan would have wanted the timing and control circuitry on the same planar structure with the image sensor (*id.* ¶ 119), which again would mean the timing and control circuitry would be on same side of circuit board 52 as image sensor 52. *Id.* (testifying that an ordinarily skilled

artisan would not want to place the timing and control circuitry on the opposite side of the circuit board). Thus, based on Dr. Lebby's testimony the timing and control circuitry would be on the same side of circuit board 52 as image sensor 51.

As discussed above, we do not agree with Patent Owner's argument that Swift only discloses camera-on-a-chip CMOS embodiments. Nevertheless, the disagreement between Dr. Neikirk and Dr. Lebby regarding where a timing and control circuit would be placed on circuit board 52 is of no consequence for our analysis of the patentability of claim 2. Claim 2 requires that the recited image sensor includes a first circuit board with CMOS pixels and timing and control circuitry. Claim 2 does not specify that CMOS pixels and the timing and control circuitry need to be on opposite sides of that first circuit board. With either expert's placement (i.e., on the same side or the opposite side of circuit board 52 from image sensor 51), the timing and control circuitry and the CMOS pixels are on the same circuit board (circuit board 52), thus satisfying the placement requirement of claim 2.

Fourth, we do not agree with Patent Owner's argument that Ricquier teaches that its off-chip driving unit must be placed on the same circuit board (and chip) as the imager in any actual product. PO Resp. 34–35. Ricquier merely states: "A CMOS technology was chosen because it offers the selective addressability together with the possibility of further cointegration of processing electronics on the same chip." Ex. 1038, 2. This statement does not indicate that further cointegration in Ricquier is mandatory or that such cointegration would necessarily include Ricquier's off-circuit driving unit. Ex. 1086 ¶ 30. But even if an ordinarily skilled

artisan allegedly were to integrate the timing and control circuit from Ricquier onto the same chip as Swift's imager, that would not undermine Petitioner's showing because claim 2 does not require the timing and control circuitry to be on a different printed circuit board than the sensor. Ex. 1001, 21:64–22:38.

Fifth, we disagree with Patent Owner's argument that (i) Petitioner merely relies on the design choice doctrine to justify its proposed placement of timing and control circuitry but (ii) the design choice doctrine is inapplicable because the recited placement of that circuitry solved a stated problem and produced unexpected results. PO Resp. 30–31. For one, Petitioner does not rely merely on the design choice doctrine to justify its proposed placement of timing and control circuitry. Pet. 23–24 (citing Ex. 1016; Ex. 1006; Ex. 1045). Further, we do not agree the recited placement of the timing and control circuitry solved a stated problem or produced unexpected results. Patent Owner argues that the recited placement of the timing and control circuitry solved the problem of further miniaturizing the camera on the chip. PO Resp. 31. Patent Owner, however, also argues that the camera on the chip inherently contains timing and control circuitry. *Id.* at 25–26. Accepting the latter argument, that means that the camera on a chip has the recited placement (i.e., the timing and control circuitry is on the same circuit board as the camera on the chip because it is in the camera on the chip). Thus, the recited placement did not solve any stated problem for a camera on a chip—with respect to the recited circuit boards, the recited timing and control circuitry has the same placement as the prior art camera on a chip. We also do not find that the recited placement of the timing and control circuitry yielded unexpected results. *See* Section III.B.4, above.

Sixth, we do not agree with Patent Owner's argument that an ordinarily skilled artisan would not have made the proposed combination because Ricquier's off-chip driver would limit the rate at which the on-chip amplifier can handle charge packets. PO Resp. 33–34. Patent Owner relies on a reference (Ex. 2034) regarding serial outputs of CCD sensors to support this argument, but Ricquier and Swift disclose the use of a CMOS sensor. *Id.* (citing Ex. 2034, 1:45–52); Ex. 1086 ¶ 29; Ex. 1038, 1, 2, 5, 8; Ex. 1005, 10. We credit Dr. Neikirk's testimony that the issue addressed in Exhibit 2034 concerning CCD imagers is not applicable to Ricquier's and Swift's CMOS sensors. Ex. 1086 ¶ 29.

In sum, we find that an ordinarily skilled artisan would have been motivated to combine Swift's and Ricquier's teachings in the manner proposed by Petitioner. Ex. 1004 ¶¶ 237–240; Ex. 1086 ¶ 15. We further find that an ordinarily skilled artisan would have had a reasonable expectation of success in making that combination. Ex. 1004 ¶ 240.

5. Combination of Suzuki with Swift and Ricquier

Petitioner argues that an ordinarily skilled artisan would have combined Suzuki's teachings with those of Swift and Ricquier. Pet 24–27. In particular, Petitioner argues that an ordinarily skilled artisan would have combined Swift's imager apparatus (as modified by Ricquier) with Suzuki's teachings of (i) a stacked arrangement of parallel circuit boards and (ii) a solid-state image pickup chip of 8.5 mm with a 10 mm chassis. *Id.* Patent Owner disputes that an ordinarily skilled artisan would have made this combination. PO Resp. 21–35.

In this section, we first address the parties' arguments regarding whether an ordinarily skilled artisan would have combined Suzuki's

teachings with Swift's and Ricquier's teachings. Then, we provide our analysis.

a. Parties' Arguments

Petitioner argues that an ordinarily skilled artisan would have been motivated to apply Suzuki's teachings of a stacked arrangement with a small image pickup chip to Swift's miniature camera (as modified by Ricquier) to reduce the camera's overall size and improve the camera's stability and reliability. Pet. 24–25. Petitioner further argues that Swift acknowledges that its circuit boards can be disposed in directions other than that shown in its figures. *Id.* at 25. Further, Petitioner asserts that Suzuki explains that, by arranging the image sensor and circuit boards so that they are aligned with each other as illustrated in Fig. 2 of Suzuki, the camera can have an outer diameter closer to a diagonal length of a solid-state image pickup chip. *Id.* Petitioner also asserts that an ordinarily skilled artisan would have had a reasonable expectation of success in combining Suzuki's teachings with the teachings of Swift and Ricquier. *Id.* at 27.

Patent Owner disputes this purported motivation, arguing that Suzuki teaches a CCD camera, so an ordinarily skilled artisan would not have looked to Suzuki for ideas of how to implement a system architecture for a CMOS camera. PO Resp. 35. Patent Owner further asserts that Swift's CMOS sensor is a camera-on-a-chip sensor so it includes circuitry to convert a pre-video signal to a post-video signal. *Id.* at 36. Further, Patent Owner argues that Swift never states that circuit board 53 converts a pre-video signal to a post-video signal. *Id.* at 37. In addition, Patent Owner argues that an ordinarily skilled artisan would not have made Swift's CMOS sensor the same size as Suzuki's sensor because Swift's camera has far larger

dimensions than Suzuki's. *Id.* at 21. Patent Owner asserts that circuit board 52 in Swift is far larger than 12 mm. *Id.* at 22.

In its Reply, Petitioner argues that Suzuki's teachings are not limited to CCD technology. Pet. Reply 16. Petitioner asserts that Suzuki teaches the use of a solid state imaging pickup chip, and the term solid-state imaging encompasses CMOS sensors. *Id.* at 16–17. Petitioner further argues that Swift's disclosure of a maximum dimension of 38 mm for its housing does not preclude smaller dimensions. *Id.* at 19.

In its Sur-reply, Patent Owner argues that Suzuki describes a CCD architecture. Sur-reply 14.

b. Analysis

We find that an ordinarily skilled artisan would have been motivated to combine the teachings of Suzuki with the teachings of Swift and Ricquier. First, we find that Suzuki's teachings regarding image sensor size apply to CMOS sensors, as well as CCD sensors. Suzuki describes its sensor as a solid state image pickup chip, rather than referring to it as CCD. Ex. 1015, 4:6–11; Ex. 1086 ¶ 33. In fact, Suzuki does not mention CCDs. *See generally* Ex. 1015; Ex. 1086 ¶ 43. Further, the term solid state image sensor encompasses both CMOS and CCD sensors. Ex. 1004 ¶¶ 42, 48.

We also credit Dr. Neikirk's testimony that CMOS sensors were known before the filing of Suzuki. Ex. 1086 ¶ 35. Renshaw (Ex. 1090), which was publicly available in May 1990, and Shizukuishi (Ex. 1089), which issued in 1989, both disclose CMOS image sensors. *Id.*; Ex. 1090, 2, 4 ("Two image array sensors designed and fabricated using a standard two level metal ASIC CMOS process."); Ex. 1089, code (45), 2:46–50 ("the present invention uses a CMOS IC manufacturing process to provide a solid

state pickup device.”). We further credit Dr. Neikirk’s testimony that Suzuki’s off-chip driving and amplifications do not limit Suzuki to a CCD, because driving circuitry can refer to a driving circuit for power. Ex. 1086 ¶ 34.

We also credit Dr. Neikirk’s testimony that Suzuki’s design reduces a camera’s overall size and improves the camera device’s stability and reliability. Ex. 1004 ¶ 273. Consistent with this testimony, Suzuki discloses that: “[i]t is an object of this invention to provide a camera head for a solid-state image pickup device which camera head has an outer diameter closer to a diagonal length of a solid-state image pickup chip.” Ex. 1015, 1:53–56; *see also id.* at 3:61–4:12, 4:30–65. These disclosures support Dr. Neikirk’s opinion that an ordinarily skilled artisan would apply Suzuki’s teachings to Swift’s teachings to decrease the size and increase stability and reliability of Swift’s camera. Ex. 1004 ¶ 242. We further credit Dr. Neikirk’s testimony that the size of circuit board 52 would not preclude an ordinarily skilled artisan from reducing the size of camera based on a smaller imager. Ex. 1086 ¶ 40. With a smaller imager, an ordinarily skilled artisan can use a smaller board (52) on which to mount the imager. *Id.*

As discussed above, we do not agree with Patent Owner that Suzuki discloses only CCD sensors. Ex. 1015, 4:6–11; Ex. 1086 ¶ 43. As discussed in Section III.C.4.b above, we do not agree with Patent Owner that Swift only discloses a CMOS embodiment with a camera-on-a-chip design. Further, we do not agree with Patent Owner that the maximum dimensions disclosed in Swift for its camera would discourage an ordinarily skilled artisan from using an imager with Suzuki’s disclosed size. PO Resp. 21. Maximums are not minimums, and we credit Dr. Neikirk’s testimony that an

ordinarily skilled artisan would use Suzuki’s teachings of imager size to make Swift’s camera smaller. Ex. 1086 ¶ 40.

In sum, we find that an ordinarily skilled artisan would have combined the teachings of Swift, Suzuki, and Ricquier (Ex. 1004 ¶¶ 241–245) and would have had a reasonable expectation of success in so doing (*id.* ¶ 246).

6. Element-by-Element Analysis of Claim 2

The parties dispute whether Swift, Ricquier, and Suzuki teach the following limitations in claim 2: (i) “said second circuit board including circuitry thereon to convert said pre-video signal to a post-video signal,” and (ii) “wherein a largest dimension of said image sensor along said first plane is between 2 and 12 millimeters.” Pet. 38–44, 48–50; PO Resp. 21–25, 35–38. We address both the disputed and undisputed limitations of claim 2 below. The disputed limitations are limitations 2.f and 2.j,¹¹ which are addressed in sections III.C.6.g and III.C.6.k below.

a. [2.pre] an imaging device

For the preamble of claim 2, Petitioner argues Swift’s miniature camera is an imaging device.¹² Pet. 27. Patent Owner does not dispute that Swift teaches an imaging device. PO Resp. 19–38.

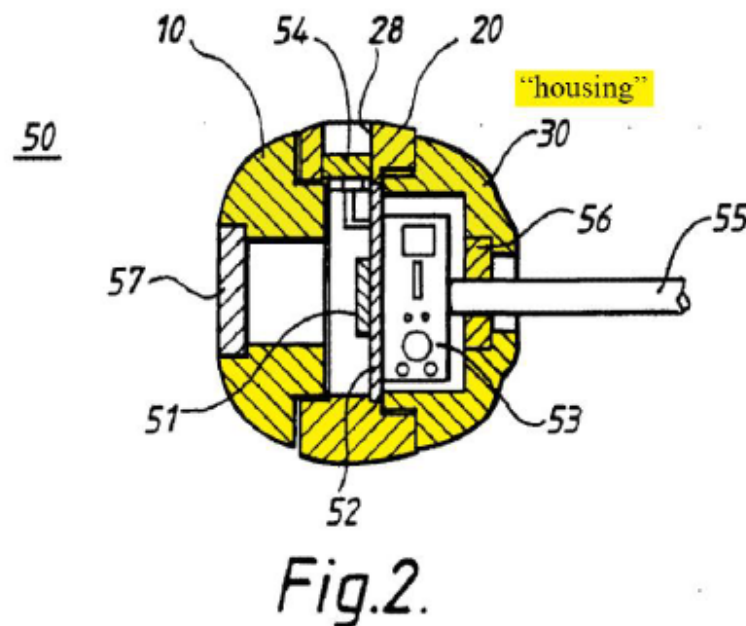
¹¹ For ease of reference, we use the labels provided in the Petition for the preamble and limitations of claim 2. Pet. 27–50.

¹² Petitioner argues that to the extent the preamble requires that the recited video monitor be in the same physical housing as the “camera,” that arrangement would have been an obvious implementation choice. Pet. 28. No party, however, has argued that this preamble requires that the recited video monitor be in the recited housing of claim 2, and we do not independently reach such a conclusion.

We find that Swift teaches a camera, which is an imaging device. Swift describes: “[t]his invention relates to cameras and is concerned particularly, although not exclusively, with miniature cameras.” Ex. 1005, 1:2–5. Swift also describes: “[a] video monitor or TV 154 is provided, to display a signal received from the camera 152.” *Id.* at 15:7–9. Thus, Swift teaches a camera, which is an imaging device. Ex. 1004 ¶¶ 247–249.¹³

b. [2.a] a housing;

Petitioner argues that Swift teaches limitation 2.a. Pet. 28. In particular, Petitioner argues that Swift’s camera has a housing comprised of three housing portions engaged with one another. *Id.* Petitioner provides the following annotated version of Figure 2 of Swift:



Pet. 29. In this annotated figure, Petitioner shades housing portions 10, 20, and 30 yellow to indicate that they constitute the recited housing. *Id.*

¹³ For this reason, we do not need to determine whether the preamble of claim 2 is a claim limitation.

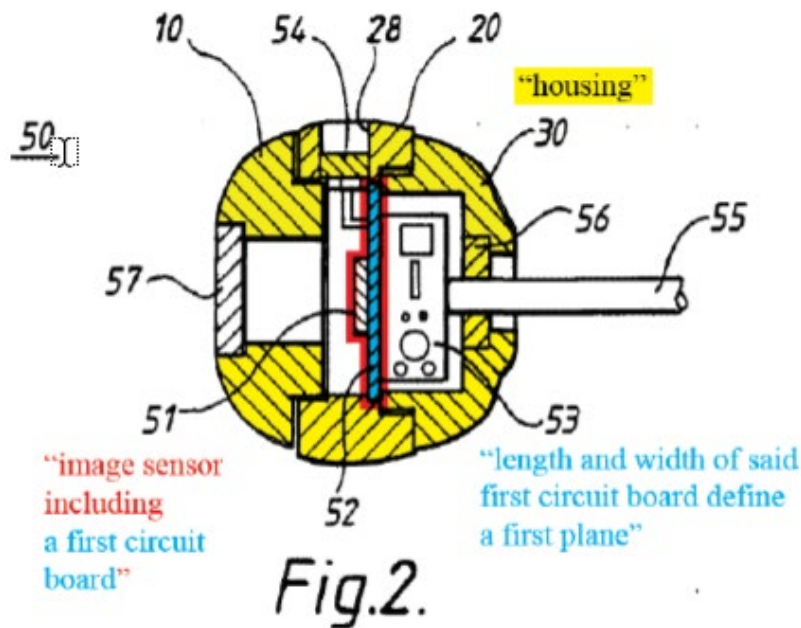
Patent Owner does not dispute that Swift teaches or suggests limitation 2.a.
PO Resp. 19–38.

We find that Swift teaches this limitation. Swift discloses that “Figure 2 shows the three housing portions 10, 20 and 30 engaged with one another, to make up the housing, which is generally ovoid, or egg-shaped.”

Ex. 1005, 8:31–33. Swift also describes that “camera 60 comprises a housing 61.” *Id.* at 10:26–29. Further when describing housing portions 10, 20, and 30, Swift discloses: “[i]n use, the front and rear housing portions 10 and 30 screw-threadedly engage the central housing portion 20.” *Id.* at 8:15–16. Thus, Swift teaches limitation 2.a. Ex. 1004 ¶¶ 250–251.

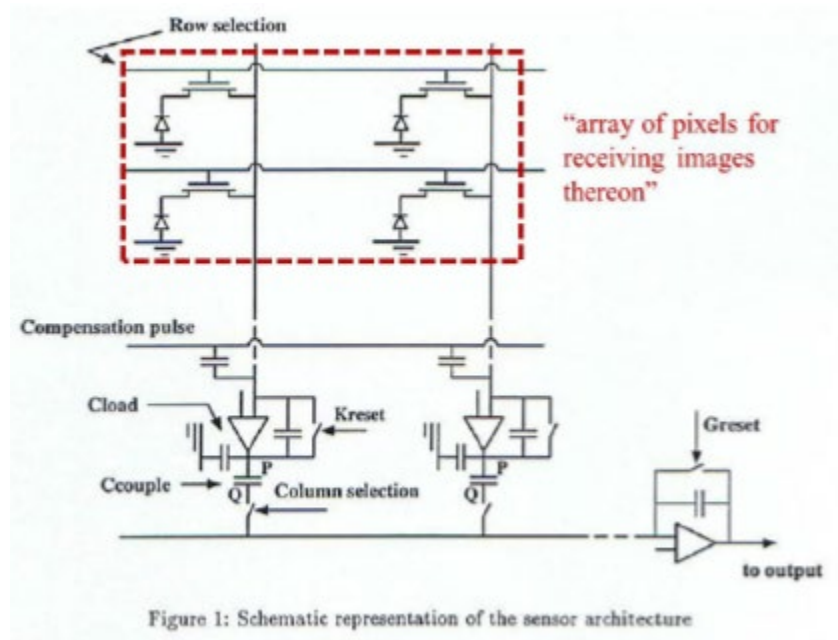
c. [2.b] an image sensor mounted in said housing, said image sensor including a first circuit board having a length and a width thereto, wherein said length and width of said first circuit board define a first plane, said first circuit board including an array of CMOS pixels thereon

Petitioner argues that Swift and Ricquier combined teach limitation 2.b. Pet. 29–33. Petitioner asserts that Swift teaches an image sensor mounted in Swift’s housing where the image sensor (51 and 52) includes a first circuit board (circular printed circuit board 52) that has a length and width that define a first plane with the image sensor mounted thereon. Petitioner provides the following annotated version of Figure 2 of Swift:



Pet. 31. In the above annotated figure, Petitioner identifies circular printed circuit board 52 as the recited first circuit board. Petitioner further argues that Swift's image sensor is a CMOS active pixel sensor type chip. *Id.* at 30.

Petitioner argues that Ricquier teaches an array of CMOS pixels for receiving images. Pet. 31. Petitioner provides the following annotated version of Figure 1 of Ricquier:



Pet. 33. In the above annotated figure, Petitioner identifies the array of pixels for receiving images in Ricquier’s schematic representation of sensor architecture. *Id.*

Patent Owner does not dispute that Swift and Ricquier combined teach limitation 2.b. PO Resp. 19–38.

We find that Swift and Ricquier combined teach this limitation. Swift discloses that “image sensor 51 is mounted on a circular printed circuit board 52, which engages within the intermediate bore 23 in the central housing portion 20, and is clamped in position there by the rear housing portion 30.” Ex. 1005, 8:31–9:18. Swift further discloses that its “image sensor is preferably a CMOS sensor.” *Id.* at 4:11–13. Swift also discloses that “image sensor 51 is preferably of a CMOS/APS (Active Pixel Sensor) type. An APS acts similarly to a random access memory (RAM) device, wherein each pixel contains its own selection and readout transistors.” *Id.* at 10:1–6. Ricquier discloses: “a dedicated imager has been developed. The camera can be programmed to operate in several resolutions. This is done

by binning the signal charges of neighbouring pixels on the sensor plane itself This square 256*256 imager was fabricated in a standard 1.5 μm CMOS technology.” Ex. 1038, Abstract; *see also id.* at 3. Ricquier further describes: “[t]he pixel array consists of 256 by 256 square pixels arranged on a pixel pitch of 19 μm and realised in a 1.5 μm n-well CMOS technology.” *Id.* at 5. Ricquier also describes that “images are formed on the sensor plane.” *Id.* at 6. Thus, Swift and Ricquier combined teach limitation 2.b. Ex. 1004 ¶¶ 255–256.

d. [2.c] wherein a plurality of CMOS pixels within said array of CMOS pixels each include an amplifier

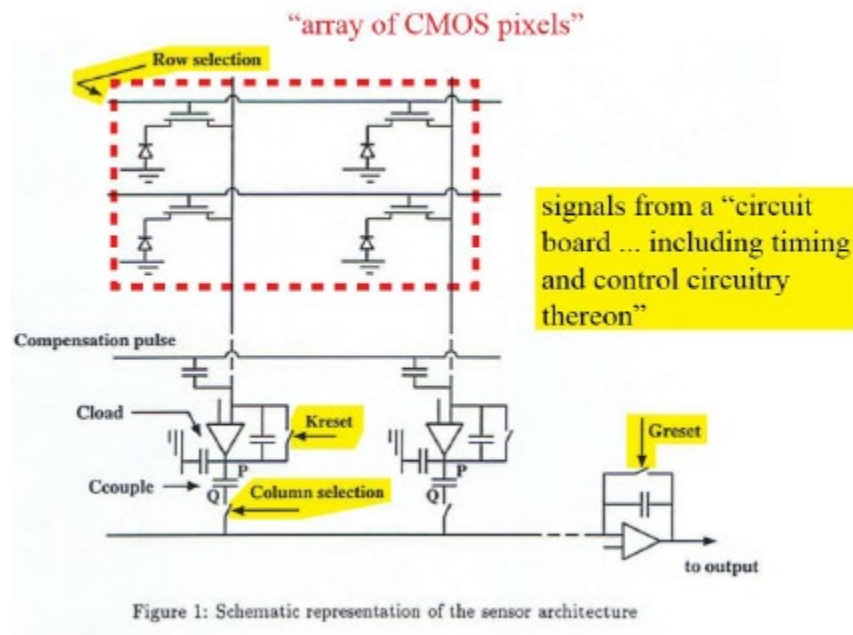
Petitioner argues that Swift and Ricquier combined teach limitation 2.c. Pet. 33–34. Petitioner argues that Swift discloses a CMOS active pixel sensor and that each active pixel in a CMOS active pixel sensor includes an amplifier. *Id.* at 33. Petitioner further argues that Ricquier teaches an array of CMOS pixels. *Id.* at 34.

Patent Owner does not dispute that Swift and Ricquier combined teach limitation 2.c. PO Resp. 19–38.

We find that Swift and Ricquier combined teach this limitation. Swift discloses that “image sensor 51 is preferably of a CMOS/APS (Active Pixel Sensor) type.” Ex. 1005, 10:1–6. Each active pixel in a CMOS active pixel sensor includes an amplifier. Ex. 1004 ¶ 258; *see also* Ex. 1001, 2:23–25; Ex. 1041 ¶ 6. Further, as discussed in Section III.C.6.c above, Ricquier discloses placing CMOS pixels in an array. Ex. 1038, Abstract, 3, 5, 9. Thus, Swift and Ricquier combined teach limitation 2.c. Ex. 1004 ¶¶ 257–258.

e. [2.d] said first circuit board further including timing and control circuitry thereon, said timing and control circuitry being coupled to said array of CMOS pixels

Petitioner argues that Swift and Ricquier combined suggest limitation 2.d. Pet. 34–36. Petitioner asserts that Swift’s circuit board 52 is the recited first circuit board. Pet. 34. Petitioner further argues that Ricquier discloses circuitry with timing and control circuitry that are coupled to an array of CMOS pixels. *Id.* Petitioner provides the following annotated version of Figure 1 of Ricquier:



Pet. 36. In the above annotated figure, Petitioner identifies timing and control circuitry in Ricquier’s schematic representation of the sensor architecture. *Id.*

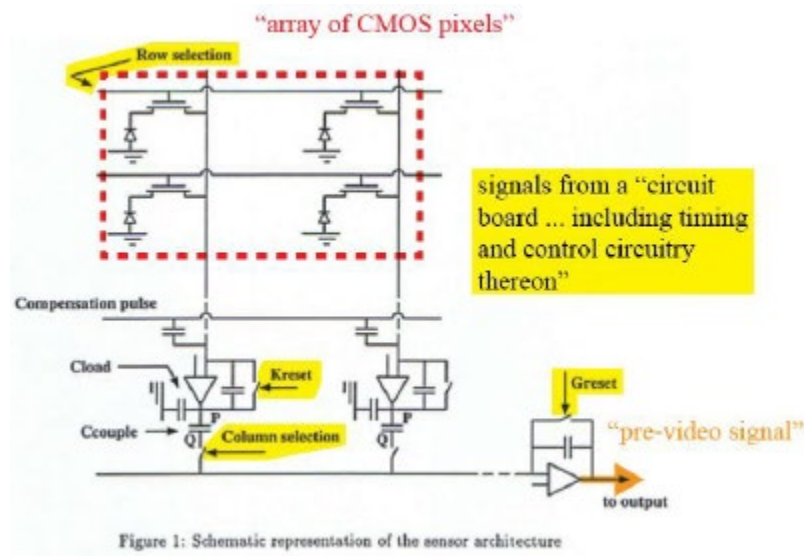
Patent Owner does not dispute that Swift and Ricquier combined suggest limitation 2.d. PO Resp. 19–38.

We find that Swift and Ricquier combined suggest this limitation for the reasons discussed above. Swift and Ricquier teach “said first circuit

board.” See Section III.C.6.c, above. Further, Ricquier teaches timing and control circuitry being coupled to said array of CMOS pixels. In particular, Ricquier’s “off-chip driving unit” (Ex. 1038, 4) is circuitry that includes a “timing controller” (*id.*) to “drive . . . row selection[s]” (*id.* at 3) of “X-Y addressable photodiode array” (*id.* at 9). Thus, Ricquier’s timing controller has timing and control circuitry. Ex. 1004 ¶¶ 259–262. Ricquier’s timing controller is also coupled to Ricquier’s CMOS pixel array. Ex. 1038, Fig. 1; Ex. 1004 ¶¶ 259, 262. For reasons discussed in Section III.C.4 above, an ordinarily skilled artisan would have placed the off-chip timing controller on the same circuit board that includes Swift’s image sensor. Thus, Swift and Ricquier combined suggest limitation 2.d. Ex. 1004 ¶¶ 259–263.

f. [2.e] said image sensor producing a pre-video signal

Petitioner argues that Ricquier teaches limitation 2.e. Pet. 36–37. Petitioner asserts that Ricquier discloses producing a pre-video signal from the image sensor. *Id.* at 36. Petitioner provides the following annotated version of Figure 1 of Ricquier:



Pet. 37. In this annotated figure, Petitioner identifies the arrow in the figure above the words “to output” as carrying the pre-video signal from Ricquier’s image sensor. *Id.*

Patent Owner does not dispute that Ricquier teaches limitation 2.e.
PO Resp. 19–38.

We find that Ricquier teaches that its image sensor produces a pre-video signal. Ex. 1004 ¶¶ 264–267; *see also* Ex. 1038, Abstract, 3, 4, Fig. 1. Thus, Ricquier teaches limitation 2.e. Ex. 1004 ¶¶ 264–267.

g. [2.f] a second circuit board mounted in said housing, said second circuit board being electrically coupled to said first circuit board, said second circuit board having a length and a width thereto, wherein said length and width of said second circuit board define a second plane, said second circuit board including circuitry thereon to convert said pre-video signal to a post-video signal, said second circuit board being positioned in a stacked arrangement with respect to said first circuit board, said second plane of said second circuit board being substantially parallel to said first plane of said first circuit board

Petitioner argues that Swift and Suzuki combined teach limitation 2.f. Pet. 38–44. Patent Owner disputes that Swift and Suzuki teach the following recitation in limitation 2.f: “said second circuit including circuitry thereon to convert said pre-video signal to a post-video signal.” PO Resp. 35–38. First, we address the undisputed recitations in limitation 2.f., which we collectively designate as limitation 2.f.i. Then we address the disputed recitation, which we designate as limitation 2.f.ii.

i. [2.f.i] a second circuit board mounted in said housing, said second circuit board being electrically coupled to said first circuit board, said second circuit board having a length and a width thereto, wherein said

length and width of said second circuit board define a second plane, said second circuit board being positioned in a stacked arrangement with respect to said first circuit board, said second plane of said second circuit board being substantially parallel to said first plane of said first circuit board

Petitioner argues that Swift and Suzuki combined teach limitation

2.f.i. Pet. 38–44. Petitioner asserts that:

Swift discloses a second circuit board (e.g., “printed circuit board 53”) mounted in said housing (e.g., “printed circuit board 53” mounted in “rear housing portion 30” as shown in Fig. 2), said second circuit board being electrically coupled to said first circuit board (e.g., “circuit board 53” connected to “circuit board 52” “to ... process image signals received” from “image sensor 51...mounted on...circuit board 52”), said second circuit board having a length and a width thereto, wherein said length and width of said second circuit board define a second plane (e.g., length and width of “circuit board 53” define a second plane), . . . said second circuit board being positioned in a stacked arrangement with respect to said first circuit board (e.g., “board 53” rotated parallel to and in a stacked arrangement with respect to “board 52”), said second plane of said second circuit board being substantially parallel to said first plane of said first circuit board (e.g., plane of “board 53” being substantially parallel to plane of “board 52”).

Pet. 38 (emphasis omitted).

Petitioner further argues that: “Swift discloses the ‘circuit board 53’ is electrically connected to and receives the ‘image signals’ (pre-video signal) from ‘image sensor 51’ and includes a ‘video processor’ and ‘circuitry components’ that convert the received signal into a signal that may be received by a monitor or television.” *Id.* at 39. Petitioner further asserts that “Suzuki discloses a circuit board positioned in a stacked arrangement with respect to another circuit board attached to an image sensor chip, where the

planes defined by the lengths and widths of the circuit boards are substantially parallel to one another (e.g., ‘circuit board 227’ and ‘chip connecting board 226’ ‘bonded’ to ‘solid state image pickup chip’ ‘are aligned with each other’ as shown in Figs. 2, 3C), wherein the planes defined by the lengths and widths of the circuits boards are substantially parallel (e.g., as shown in Figs. 2, 3C).” *Id.* at 41 (emphasis omitted).

Patent Owner does not dispute that Swift and Suzuki combined teach limitation 2.f.i. PO Resp. 19–38.

We find that Swift and Suzuki combined teach this limitation. We have reviewed the citations provided by pages 38–44 of the Petition for this limitation and find that those citations and the record as a whole support Petitioner’s arguments. Thus, we find that Swift and Suzuki combined teach limitation 2.f.i. Ex. 1004 ¶¶ 270–273.

ii. [2.f.ii] said second circuit board including circuitry thereon to convert said pre-video signal to a post-video signal

First we address the parties’ arguments regarding limitation 2.f.ii. Then we provide our analysis.

(a) Parties’ Arguments

Petitioner argues that Swift teaches limitation 2.f.ii. Pet. 38. Petitioner maps the recited second circuit board to Swift’s printed circuit board 53. *Id.* Petitioner asserts that “Swift discloses the ‘circuit board 53’ is electrically connected to and receives the ‘image signals’ (pre-video signal) from ‘image sensor 51’ and includes a ‘video processor’ and ‘circuitry components’ that convert the received signal into a signal that may be received by a monitor or television.” *Id.* at 39.

Patent Owner disagrees. PO Resp. 35–38. Patent Owner argues that Swift discloses using CMOS APS sensors disclosed in an article by Dr. Fossum in *Laser World* (Ex. 2004) and that these sensors are cameras on a chip. *Id.* at 35–36. Further, Patent Owner argues that because Swift’s CMOS sensor is a camera on a chip, its circuitry for converting a pre-video signal to a post-video signal would not be on a second circuit board, like circuit board 53. *Id.* at 36. Patent Owner further argues that Swift never states that circuit board 53 has circuitry for converting a pre-video signal to a post-video signal. *Id.* at 37. Patent Owner further asserts that Figure 7 of Swift shows that Swift’s image sensor includes space for processing circuitry, consistent with a camera-on-a-chip design. *Id.* at 26. Patent Owner argues that thus Swift does not teach limitation 2.f.ii. *Id.* at 38–44.

In its Reply, Petitioner asserts that Swift never limits its sensor to a camera-on-a-chip. Reply Br. 4. Petitioner further asserts that Swift teaches that processing circuitry resides off-chip on circuit board 53. *Id.* at 21. Petitioner also argues that Swift’s disclosure of a CMOS/APS type does not reference any specific sensor. *Id.* at 4–5. Petitioner asserts that Swift merely states that further information on APS-type sensors may be found in the *Laser World* article, Swift does not limit its APS sensors to only those described in that article. *Id.* Petitioner also argues that Swift has no description of the regions of Figure 7 of Suzuki where Patent Owner asserts processing would be placed. *Id.* at 5. Further, Petitioner argues that Swift’s Figure 7 does not show the same layout as the *Laser World* article. *Id.* at 5–6.

In its Sur-reply, Patent Owner argues that Swift expressly references the design in the *Laser World* article and thus an ordinarily skilled artisan

would understand that Swift's CMOS sensor is a camera-on-a-chip design. Sur-reply 3–4. Patent Owner further argues that the standard APS CMOS sensor of the time was a camera-on-the chip. *Id.* at 4–6. Patent Owner also argues that Swift describes CCD embodiments because Swift describes the use of 12 volts to power its camera module and describes 12 volts as a low voltage. *Id.* at 8–11. Further, Patent Owner also argues that Figure 7 of Swift shows regions of the imaging chip where additional circuitry could be placed, consistent with a camera on the chip design. *Id.* at 5–6.

(b) Analysis

We find that Swift teaches limitation 2.f.ii.

In Section III.C.4 above, we address the parties' dispute as to whether Swift's CMOS disclosures are limited to camera-on-a-chip embodiments. For the reasons set forth in that section, we find that Swift's CMOS disclosures are not so limited, and that Swift discloses an embodiment with a CMOS sensor on a circuit board 52 and off-chip circuitry on circuit board 53.

Swift further teaches that “[v]arious circuitry components are mounted on the circuit board 53, to provide power to the image sensor, process image signals received therefrom” Ex. 1005, 9:7–13. We credit Dr. Neikirk's testimony that the term “image signals” in this context refers to pre-video signals. Ex. 1004 ¶ 236. Swift also teaches the use of a video monitor with “a camera 152, which may . . . be similar to the camera 50 shown in Figures 1 and 2.” Ex. 1005, 15:4–11. (Camera 50 includes image sensor 51 and circuit boards 52 and 53. *Id.* at Fig. 2.) Swift further teaches that camera 152 provides video signals: “[w]ith the video signals provided from the camera 152 as either video or UHF signals”

Ex. 1005, 17:35–18:3. Further, Swift describes that its disclosed cameras produce video signals: “[a]ny of the cameras mentioned above may be connected to such a terminal box in order to distribute video signals from the camera(s) to the or each TV in the dwelling.” *Id.* at 18:8–11. Swift further describes that a converter can be added to housing 50 to convert a video signal into a UHF signal, which also teaches that its camera produces video signals. *Id.* at 10:17–20. Swift discloses that printed circuit board 53 is connected to external processing circuitry via cable 55 (e.g., processing circuitry that could convert a pre-video signal to a UHF signal). *Id.* at 9:13–17. We find that these disclosures teach that the processing performed on circuit board 53 (the recited second circuit board) includes video processing (i.e., converting a pre-video signal to a video signal). In particular, in light of the fact that printed circuit board 53 is receiving a pre-video signal and it is providing the camera’s output, which is a video signal, Swift teaches that circuit board 53 is converting a pre-video signal to a video signal.

We find that Swift teaches limitation 2.f.ii. Ex. 1004 ¶¶ 268–273; Ex. 1086 ¶¶ 41–44.

h. [2.g] a lens mounted in said housing, said lens being integral with said imaging device, said lens focusing images on said array of CMOS pixels of said image sensor

Petitioner asserts that Swift and Ricquier combined teach limitation 2.g. Pet. 44–45. Petitioner argues:

Swift discloses a lens mounted in said housing (e.g., “wide angle lens 57 . . . mounted in the . . . front housing portion 10”), said lens being integral with said imaging device (e.g., as shown in Fig. 2; “image sensor 201 engaged with a lens holder 202 . . . to hold the lens 204 at a fixed . . . distance from the sensor”), said

lens focusing images on . . . said image sensor (e.g., “positioned as to focus an image onto the image sensor 51”).

Id. at 44 (emphasis omitted). Petitioner provides the following annotated version of Figure 2 of Swift:

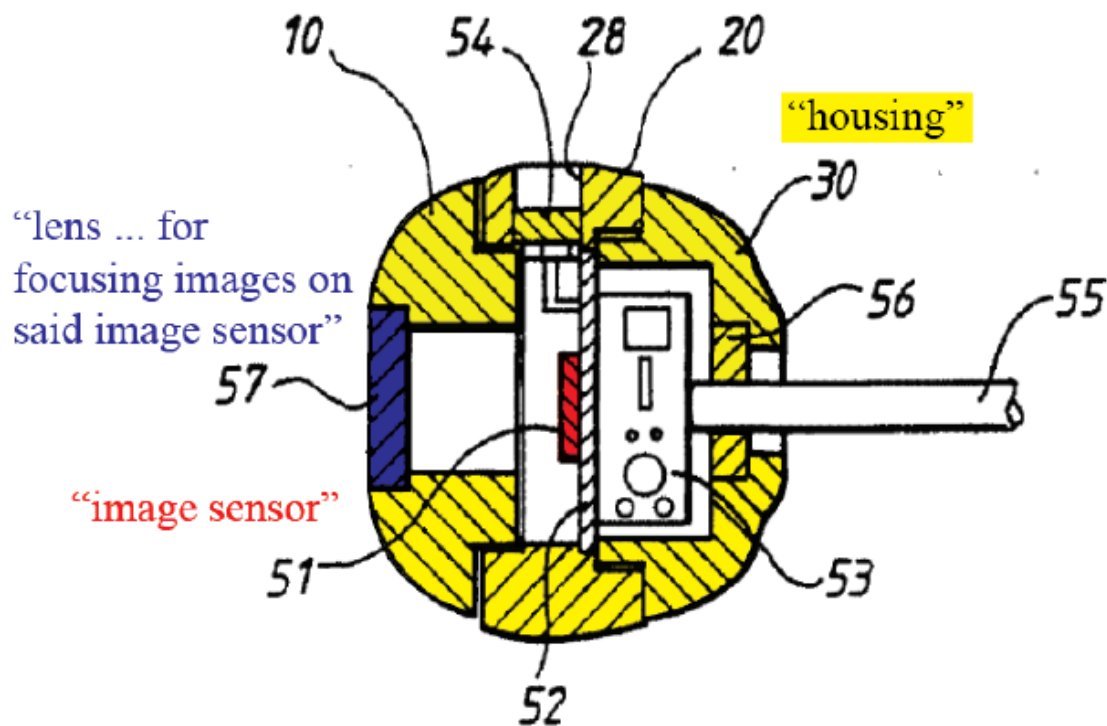


Fig.2.

Id. at 45. The annotated figure above identifies wide-angle lens 57 as the recited lens. *Id.* Petitioner further argues that Ricquier teaches the use of an array of CMOS pixels. *Id.* at 45.

Patent Owner does not dispute that Swift and Ricquier combined teach limitation 2.g. PO Resp. 19–38.

We find that Swift and Ricquier combined teach this limitation. Swift discloses: “A wide-angle lens 57 is mounted in the front bore 12 of the front housing portion 10, and bears against the annular abutment shoulder 13.

The lens 57 is so positioned as to focus an image onto the image sensor 51.”

Ex. 1005, 9:23–28; *see also id.* at Fig 2. Swift further discloses:

Figure 7 shows an image sensor 201 (e.g. of APS type), engaged with a lens holder 202 of plastics material, with an aperture 203 to receive a lens 204. With the holder 202 and lens 204 mounted together, the holder 202 serves to hold the lens 204 at a fixed, predetermined distance from the sensor 201, in order properly to focus an image onto the sensor 201. The light-sensitive area on the sensor 201 is located asymmetrically on the sensor, and the aperture 203 is positioned asymmetrically on the lens holder 202, in order to match the asymmetry of the sensor 201.

Ex. 1005, 18:13–23. As discussed in Section III.C.6.c above, Ricquier discloses the use of an array of CMOS sensors. Thus, Suzuki and Ricquier combined teach limitation 2.g. Ex. 1004 ¶¶ 274–277.

i. [2.h] a video screen, said video screen being electrically coupled to said second circuit board, said video screen receiving said post-video signal and displaying images from said post-video signal

Petitioner argues that Swift discloses limitation 2.h. Pet. 45. In particular, Petitioner argues that:

Swift discloses a video screen (e.g., “video monitor”), said video screen being electrically coupled to said second circuit board (e.g., “cable 55 is connected to the printed circuit board 53,” “[t]he camera 152 and monitor 154 are connected by . . . a cabling system 160”), said video screen receiving said post video signal and displaying images from said post-video signal (e.g., “video monitor . . . to display a signal received from the camera”).

Id. Patent Owner does not dispute that Swift teaches limitation 2.h. PO Resp. 19–38.

We find that Swift teaches this limitation. Swift discloses a video monitor connected by a cabling system to the camera to display a signal

received from the camera. Ex. 1005, 15:7–14. Swift further discloses that the cable is connected to the printed circuit board 53. *Id.* at 9:5–18; *see also id.* at 17:34–18:2, 18:8–11. These disclosures teach limitation 2.h. Ex. 1004 ¶¶ 278–279.

j. [2.i] a power supply mounted in said housing, said power supply being electrically coupled to said first circuit board to provide power to said array of CMOS pixels and said timing and control circuitry, said power supply also being electrically coupled to said second circuit board to provide power thereto

Petitioner argues that Suzuki and Ricquier combined teach limitation 2.i. Pet. 47–48. Petitioner argues that:

Swift discloses a power supply (e.g., “battery,” “voltage regulator”) mounted in said housing (e.g., “provided within the housing”), said power supply being electrically coupled to said first circuit board to provide power to said array of CMOS pixels and said timing and control circuitry, said power supply also being electrically coupled to said second circuit board to provide power thereto (e.g., “a voltage regulator to . . . provide a substantially constant supply voltage to components” including “an image sensor assembly” and “a video processor” on the “circuit board”).

Id. at 47 (emphasis omitted). Petitioner further asserts that Ricquier discloses the use of an array of CMOS pixels. *Id.* at 48.

Patent Owner does not dispute that Swift and Ricquier combined teach limitation 2.i. PO Resp. 19–38.

We find that Swift and Ricquier combined teach this limitation. Swift discloses:

there is provided an image sensor assembly for a miniature camera, the assembly comprising a printed circuit board and, mounted thereon, the image sensor, a video processor, an audio processor, and a voltage regulator to accept a plurality of

different input voltages and provide a substantially constant supply voltage to components on the printed circuit board.

Ex. 1005, 3:31–4:4. Swift further discloses: “A camera as above may incorporate a battery or voltage transformer means.” *Id.* at 4:21–22. In addition, Swift describes: “[i]f desired, the rear housing portion 30 may be replaced by another portion of different configuration, designed to accommodate additional components or different components of different configurations. For example, there may be provided within the housing 50 sufficient room to house a battery.” *Id.* at 10:12–20. Swift further discloses: “[v]arious circuitry components are mounted on the circuit board 53, to provide power to the image sensor 51, process image signals 10 received therefrom.” *Id.* at 9:7–13. Further, as discussed in Section III.C.6.c above, Ricquier discloses the use of an array of CMOS sensors. These disclosures teach limitation 2.i. Ex. 1004 ¶¶ 280–284.

k. [2.j] wherein a largest dimension of said image sensor along said first plane is between 2 and 12 millimeters.

The parties dispute whether Swift and Suzuki combined teach limitation 2.j. Pet 48–50; PO Resp. 21–38.

Petitioner argues that Swift discloses an image sensor along a first plane. Pet. 48. Petitioner further argues that Suzuki discloses an image sensor whose largest dimension along a plane is between 2 and 12 mm. *Id.* Petitioner argues that, combined, these disclosures teach limitation 2.j. *Id.* at 48–50.

Patent Owner does not dispute that Suzuki discloses an image sensor whose largest dimension along a plane is between 2 and 12 mm. PO Resp. 21–38. Patent Owner concedes Suzuki contains that disclosure. *Id.* at 21 (“Suzuki discloses an imaging device having a diameter in that range.”).

Patent Owner, however, disputes that an ordinarily skilled artisan would have combined Suzuki's teaching of an imager that is between 2 and 12 mm with the teachings of Swift (and Ricquier). PO Resp. 21–25. In addition, Patent Owner argues that if an ordinarily skilled artisan's motivation for combining Suzuki with Swift (and Ricquier) is to minimize camera size as Petitioner contends, then an ordinarily skilled artisan might have used an imager with a maximum dimension below 2 mm. Sur-reply 19.

We find that Swift and Suzuki combined teach limitation 2.j. As discussed in Section III.C.5 above, we find that an ordinarily skilled artisan would have combined Swift's and Suzuki's teachings in the manner proposed by Petitioner. Further, we find that Swift discloses an image sensor along a first plane. Ex. 1005, 8:31–9:18 (“image sensor 51 is mounted on a circular printed circuit board 52”), Figs. 2, 7; *see also* Section III.C.6.c, above. We further find that Suzuki discloses an image sensor whose largest dimension along a plane is between 2 and 12 mm. Ex. 1015, 4:6–11 (“in the case where the solid-state image pickup chip of 1/3 inch (8.5 mm) is used, the outer diameter of the camera head is about 10 mm....”); *see also* Ex. 1004 ¶¶ 285–289.

We are not persuaded by Patent Owner's argument that if an ordinarily skilled artisan's motivation for combining Suzuki with Swift and Ricquier is to minimize camera size as Petitioner proposes, then an ordinarily skilled artisan would have or may have used an imager with a maximum dimension below 2 mm. Sur-reply 19. First, Patent Owner cites no expert testimony to support this argument. *Id.* Second, the argument is misplaced because Suzuki has an objective of reducing the size of the camera head so that it comes closer to the size of the image sensor chip, not

an objective of making the smallest image sensor chip. Ex. 1015, 1:53–56. Suzuki teaches using an image sensor with a largest dimension between 8.5 and about 10 mm, which is larger than 2 mm. Ex. 1015, 4:6–11. That dimension already can reduce the size of a camera based on Suzuki. Patent Owner cites no suggestion in Suzuki or in Swift or Ricquier of using any smaller sensor, and Patent Owner provides no evidence that an ordinarily skilled artisan would have had an expectation of success in using a sensor with a maximum dimension of less than 2 mm with a combination of these references. Sur-reply 19. Thus, on this record, we do not find that Suzuki would have suggested to an ordinarily skilled artisan using a sensor with maximum dimension of less than 2 mm, even if an ordinarily skilled artisan were motivated to minimize sensor size.

We find that Swift and Suzuki combined teach limitation 2.j.
Ex. 1004 ¶¶ 285–289; Ex. 1086 ¶¶ 36–40.

l. Summary

For the foregoing reasons, after considering and balancing the evidence presented by the parties, both for and against obviousness, we determine that Petitioner has proved, by a preponderance of the evidence, that claim 2 would have been obvious over Swift, Ricquier, and Suzuki.

D. Asserted Obviousness of Claim 2 over Larson, Swift, Ricquier, and Suzuki

Petitioner argues that if its first ground (asserted obviousness over Swift, Ricquier, and Suzuki) is insufficient because the references fail to disclose a physical camera with the same physical housing as the video monitor formed for the claimed imaging device, its second ground (asserted obviousness over Larson, Swift, Ricquier, and Suzuki) provides that missing

teaching. Pet. 50. No party has argued, and we do not find, that Petitioner's first ground was insufficient because the references in that ground fail to disclose a physical camera with the same physical housing as the video monitor formed for the claimed imaging device. *See* Section III.C, above. For that reason, we do not need to address Ground 2. Further, we do not need to address Ground 2 in light of our determination that Ground 1 renders claim 2 unpatentable.

IV. CONCLUSION

Petitioner has proven by a preponderance of the evidence that claim 2 of the '052 patent is unpatentable based on the first ground of unpatentability identified in the following table:

Claims	35 U.S.C. §	Reference(s)/ Basis	Claims Shown Unpatentable	Claims Not Shown Unpatentable
2	103	Swift, Suzuki, Ricquier	2	
2	103	Larson, Swift, Ricquier, Suzuki ¹⁴		
Overall Outcome			2	

¹⁴ As indicated, in light of our determination regarding Ground 1, we did not need to determine whether Petitioner has proven that claim 2 would have been obvious over Larson, Swift, Ricquier, and Suzuki. Pet. 9.

V. ORDER

It is:

ORDERED that claim 2 has been shown, by a preponderance of the evidence, to be unpatentable;¹⁵

FURTHER ORDERED that because this is a Final Written Decision, the parties to the proceeding seeking judicial review of the decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

¹⁵ Should Patent Owner wish to pursue amendment of the challenged claims in a reissue or reexamination proceeding subsequent to the issuance of this decision, we draw Patent Owner's attention to the April 2019 *Notice Regarding Options for Amendments by Patent Owner Through Reissue or Reexamination During a Pending AIA Trial Proceeding*. See 84 Fed. Reg. 16,654 (Apr. 22, 2019). If Patent Owner chooses to file a reissue application or a request for reexamination of the challenged patent, we remind Patent Owner of its continuing obligation to notify the Board of any such related matters in updated mandatory notices. See 37 C.F.R. § 42.8(a)(3), (b)(2).

IPR2020-00512
Patent 9,186,052 B1

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