IN THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF TEXAS
MARSHALL DIVISION

W&WSENS DEVICES INC., *Plaintiff*, v. SAMSUNG ELECTRONICS CO., LTD, and SAMSUNG ELECTRONICS AMERICA, INC., *Defendants*.	Case No. 2:24-CV-00854-JRG **JURY TRIAL DEMANDED**

DEFENDANTS' SUPPLEMENTAL INVALIDITY CONTENTIONS

Pursuant to Local Patent Rules 3-3 and 3-4 and the Court's Docket Control Order (Dkt. 38), Defendants, Samsung Electronics Co., Ltd. ("SEC") and Samsung Electronics America, Inc. ("SEA") (collectively, "Samsung" or "Defendants"), provide these Supplemental Invalidity Contentions and accompanying document production to Plaintiff, W&Wsens Devices Inc. ("W&W").

I. Overview

In this action, Plaintiff asserted in its P.R. 3-1 and 3-2 Disclosures of January 7, 2025 ("Infringement Contentions") and April 18, 2025 ("Supplemental Infringement Contentions") that Defendants allegedly infringe claims 1-4, 6-8, 10-12, and 14-18 of U.S. Patent No. 12,087,871 (the "'871 patent"), claims 1, 3, 5, 6, 8, and 9 of U.S. Patent No. 11,621,360 (the "'360 patent"), claims 1, 3, 7, 9, 10, 16, 20, 24, 26, 28-30, and 32 of U.S. Patent No. 10,468,543 (the "'543 patent"), claims 1, 3, 7, 9, 10, 16, 20, 24, 26, 28-30, and 32 of U.S. Patent No. 10,446,700 (the

"'700 patent"), claims 1-3, 5, 7, 8, 11-15, 17-19, and 21 of U.S. Patent No. 9,525,084 (the "'084 patent"), and claims 1-8 and 10-16[1] of U.S. Patent No. 12,243,948 (the "'948 patent") (collectively, the "Patents-in-Suit" and the "Asserted Claims").

This Court has not yet construed any of the terms in the Patents-in-Suit. Defendants' Invalidity Contentions are based on Defendants' present understanding of Plaintiff's apparent interpretation of the Asserted Claims, as advanced by Plaintiff in its Complaint and Infringement Contentions, and Defendants' own understanding of the scope of the Asserted Claims. Defendants take no position on any matter of claim construction or interpretation in these contentions. Defendants' contentions herein are not, and should in no way be seen as, admissions about or adoptions of any particular claim scope or construction, or any admission that any particular element is met in any particular way. Defendants object to any attempt to imply claim constructions from any identification or application of potential prior art. Any statement herein describing or tending to describe any claim element is provided solely for the purpose of understanding the relevant prior art. By including prior art that anticipates or renders obvious claims based on Plaintiff's apparent claim construction, Defendants do not thereby adopt Plaintiff's apparent claim construction.

Moreover, nothing herein should be construed as an admission that Defendants agree with Plaintiff's claim interpretations or that Plaintiff has a plausible basis to allege infringement. Similarly, nothing herein shall be construed as an admission regarding the application of the

[1] Plaintiff did not assert claim 9 of the '948 patent. *See* Supplemental Infringement Contentions at 2 (asserting "Claims 1, 2, 3, 4, 5, 6, 7, 8, 10, 11, 12, 13, 14, 15, and 16 of the '948 Patent"). However, Plaintiff provided claim charts for claim 9. *See* Supplemental Infringement Contentions Appendices F-1 and F-2. Accordingly, to account for the possibility that Plaintiff is later permitted to add claim 9 as an asserted claim, Samsung provides invalidity analysis of now-unasserted claim 9.

A. Prior Art Patents, Patent Applications, and Publications

Table 1: Prior Art Patents and Patent Applications

Country	Patent/ Application/ Publication No.	Date of Filing	Date of Issue/ Publication	Inventor(s)	Bates Range
US	4,981,525	February 9, 1989	January 1, 1991	Kiyama et al.	SAM-W&W_00032972-SAM-W&W_00032994
US	5,055,900	October 11, 1989	October 8, 1991	Fossum et al.	SAM-W&W_00032995-SAM-W&W_00033011
US	5,061,977	January 8, 1991	October 29, 1991	Funaba	SAM-W&W_00036105-SAM-W&W_00036117
US	5,410,175	June 18, 1992	April 25, 1995	Kyomasu et al.	SAM-W&W_00033012-SAM-W&W_00033042
US	5,448,099	March 1, 1994	September 5, 1995	Yano	SAM-W&W_00036118-SAM-W&W_00036142
US	6,222,951	April 3, 2000	April 24, 2001	Huang	SAM-W&W_00036143-SAM-W&W_00036153
US	6,376,868	June 15, 1999	April 23, 2002	Rhodes	SAM-W&W_00040204-SAM-W&W_00040225
US	6,485,998	June 11, 1999	November 26, 2002	Frahm et al.	SAM-W&W_00036154-SAM-W&W_00036158
US	6,593,635	July 3, 2002	July 15, 2003	Yanagisawa et al.	SAM-W&W_00033043-SAM-W&W_00033058
US	6,667,528	January 3, 2002	December 23, 2003	Cohen et al.	SAM-W&W_00033059-SAM-W&W_00033082
US	6,680,495	August 1, 2001	January 20, 2004	Fitzergald	SAM-W&W_00036159-SAM-W&W_00036175
US	6,800,914	August 19, 2002	October 5, 2004	Ito et al.	SAM-W&W_00033083-SAM-W&W_00033102

Country	Patent/ Application/ Publication No.	Date of Filing	Date of Issue/ Publication	Inventor(s)	Bates Range
US	6,858,912	August 8, 2001	February 22, 2005	Marshall et al.	SAM-W&W_00036176-SAM-W&W_00036197
US	6,914,008	May 6, 2004	July 5, 2005	Den et al.	SAM-W&W_00036198-SAM-W&W_00036219
US	6,919,609	April 1, 2004	July 19, 2005	Lindemann et al.	SAM-W&W_00036220-SAM-W&W_00036253
US	7,049,640	June 30, 2004	May 23, 2006	Boisvert et al.	SAM-W&W_00036254-SAM-W&W_00036260
US	7,083,998	July 1, 2004	August 1, 2006	Chu et al.	SAM-W&W_00037903-SAM-W&W_00037924
US	7,109,517	November 15, 2002	September 19, 2006	Zaidi	SAM-W&W_00033103-SAM-W&W_00033141
US	7,153,720	June 1, 2005	December 26, 2006	Augusto	SAM-W&W_00037925-SAM-W&W_00037961
US	7,453,129	October 13, 2004	November 18, 2008	King et al.	SAM-W&W_00037962-SAM-W&W_00037977
US	7,456,452	December 15, 2005	November 25, 2008	Wells et al.	SAM-W&W_00035725-SAM-W&W_00035743
US	7,498,574	July 8, 2005	March 3, 2009	Puscasu et al.	SAM-W&W_00037978-SAM-W&W_00038011
US	7,518,172	January 30, 2007	April 14, 2009	Moon et al.	SAM-W&W_00038012-SAM-W&W_00038041
US	7,521,737	March 2, 2005	April 21, 2009	Augusto	SAM-W&W_00033142-SAM-W&W_00033178
US	7,525,170	October 4, 2006	April 28, 2009	Hsu et al.	SAM-W&W_00033179-SAM-W&W_00033195
US	7,576,404	December 13, 2006	August 18, 2009	Wilson et al.	SAM-W&W_00038042-SAM-W&W_00038050

Country	Patent/ Application/ Publication No.	Date of Filing	Date of Issue/ Publication	Inventor(s)	Bates Range
US	7,595,213	September 7, 2006	September 29, 2009	Kwon et al.	SAM-W&W_00038051-SAM-W&W_00038065
US	7,608,824	September 20, 2007	October 27, 2009	Korsah et al.	SAM-W&W_00038066-SAM-W&W_00038077
US	7,646,943	September 4, 2008	January 12, 2010	Wober	SAM-W&W_00040084-SAM-W&W_00040105
US	7,659,627	December 5, 2007	February 9, 2010	Miyachi et al.	SAM-W&W_00033196-SAM-W&W_00033212
US	7,701,629	April 19, 2007	April 20, 2010	Wang et al.	SAM-W&W_00033213-SAM-W&W_00033236
US	7,714,368	June 26, 2006	May 11, 2010	Yang et al.	SAM-W&W_00040034-SAM-W&W_00040054
US	7,759,703	June 20, 2008	July 20, 2010	Nam et al.	SAM-W&W_00038078-SAM-W&W_00038092
US	7,795,686	September 16, 2008	September 14, 2010	Shioya et al.	SAM-W&W_00038093-SAM-W&W_00038104
US	7,800,193	March 8, 2007	September 21, 2010	Fujikata et al.	SAM-W&W_00033237-SAM-W&W_00033265
US	7,847,362	July 2, 2008	December 7, 2010	Ogino et al.	SAM-W&W_00038105-SAM-W&W_00038145
US	7,880,255	July 19, 2004	February 1, 2011	Baggenstoss	SAM-W&W_00035761-SAM-W&W_00035781
US	7,910,965	June 13, 2008	March 22, 2011	Lee et al.	SAM-W&W_00038146-SAM-W&W_00038161
US	7,920,781	June 18, 2008	April 5, 2011	Onuki	SAM-W&W_00033266-SAM-W&W_00033308
US	7,964,925	January 17, 2007	June 21, 2011	Fattal et al.	SAM-W&W_00038162-SAM-W&W_00038176

Country	Patent/ Application/ Publication No.	Date of Filing	Date of Issue/ Publication	Inventor(s)	Bates Range
US	7,972,885	September 24, 2009	July 5, 2011	Dutta et al.	SAM-W&W_00033309-SAM-W&W_00033336
US	7,977,637	August 20, 2009	July 12, 2011	Yap et al.	SAM-W&W_00033337-SAM-W&W_00033360
US	8,003,883	January 11, 2007	August 23, 2011	Korevaar et al.	SAM-W&W_00033361-SAM-W&W_00033381
US	8,022,390	August 17, 2007	September 20, 2011	Kim et al.	SAM-W&W_00033382-SAM-W&W_00033399
US	8,035,184	September 25, 2009	October 11, 2011	Dutta et al.	SAM-W&W_00038177-SAM-W&W_00038204
US	8,039,800	April 19, 2010	October 18, 2011	Soma et al.	SAM-W&W_00038205-SAM-W&W_00038218
US	8,049,203	June 15, 2007	November 1, 2011	Samuelson et al.	SAM-W&W_00033400-SAM-W&W_00033433
US	8,063,424	November 16, 2009	November 22, 2011	Gebara et al.	SAM-W&W_00033434-SAM-W&W_00033443
US	8,093,488	August 28, 2008	January 10, 2012	Richter et al.	SAM-W&W_00038219-SAM-W&W_00038225
US	8,106,289	December 31, 2007	January 31, 2012	Dutta	SAM-W&W_00038226-SAM-W&W_00038247
US	8,119,434	August 14, 2009	February 21, 2012	Cohen	SAM-W&W_00038248-SAM-W&W_00038259
US	8,120,079	March 13, 2009	February 21, 2012	Augusto	SAM-W&W_00038260-SAM-W&W_00038288
US	8,129,710	October 31, 2008	March 6, 2012	Cho et al.	SAM-W&W_00038289-SAM-W&W_00028303
US	8,138,013	February 14, 2011	March 20, 2012	Fattal et al.	SAM-W&W_00038304-SAM-W&W_00038315

Country	Patent/ Application/ Publication No.	Date of Filing	Date of Issue/ Publication	Inventor(s)	Bates Range
US	8,143,687	December 17, 2009	March 27, 2012	Wehner et al.	SAM-W&W_00038316-SAM-W&W_00038325
US	8,174,059	April 7, 2009	May 8, 2012	Dutta	SAM-W&W_00038326-SAM-W&W_00038372
US	8,183,612	July 7, 2009	May 22, 2012	Chong et al.	SAM-W&W_00038373-SAM-W&W_00038380
US	8,224,134	April 3, 2009	July 17, 2012	Baeyens et al.	SAM-W&W_00038381-SAM-W&W_00038393
US	8,232,617	June 4, 2009	July 31, 2012	Ma et al.	SAM-W&W_00033444-SAM-W&W_00033463
US	8,237,175	September 23, 2011	August 7, 2012	Moustakas et al.	SAM-W&W_00038394-SAM-W&W_00038467
US	8,253,211	September 24, 2009	August 28, 2012	Cheng et al.	SAM-W&W_00038468-SAM-W&W_00038501
US	8,257,997	October 17, 2008	September 4, 2012	Chen et al.	SAM-W&W_00038502-SAM-W&W_00038540
US	8,258,557	April 10, 2007	September 4, 2012	Gaebler et al.	SAM-W&W_00033464-SAM-W&W_00033504
US	8,269,303	March 9, 2009	September 18, 2012	Fujikata et al.	SAM-W&W_00038541-SAM-W&W_00038570
US	8,279,519	September 15, 2010	October 2, 2012	Takahashi et al.	SAM-W&W_00038571-SAM-W&W_00038619
US	8,304,759	June 22, 2010	November 6, 2012	Dutta	SAM-W&W_00038620-SAM-W&W_00038631
US	8,314,400	January 27, 2011	November 20, 2012	Nikolic et al.	SAM-W&W_00033505-SAM-W&W_00033533
US	8,330,090	April 29, 2008	December 11, 2012	Agarwal	SAM-W&W_00038632-SAM-W&W_00038646

Country	Patent/ Application/ Publication No.	Date of Filing	Date of Issue/ Publication	Inventor(s)	Bates Range
US	8,338,857	August 28, 2010	December 25, 2012	Morse et al.	SAM-W&W_00038647-SAM-W&W_00038657
US	8,357,960	September 17, 2009	January 22, 2013	Dutta	SAM-W&W_00033534-SAM-W&W_00033565
US	8,384,007	October 7, 2009	February 26, 2013	Yu et al.	SAM-W&W_00033566-SAM-W&W_00033597
US	8,415,713	February 17, 2009	April 9, 2013	Ogura	SAM-W&W_00038658-SAM-W&W_00038681
US	8,431,817	June 8, 2010	April 30, 2013	Kim et al.	SAM-W&W_00038682-SAM-W&W_00038746
US	8,436,370	December 22, 2009	May 7, 2013	Park et al.	SAM-W&W_00033598-SAM-W&W_00033623
US	8,472,802	March 10, 2008	June 25, 2013	Ahn et al.	SAM-W&W_00038747-SAM-W&W_00038771
US	8,476,637	June 8, 2010	July 2, 2013	Kim et al.	SAM-W&W_00038772-SAM-W&W_00038836
US	8,487,396	August 11, 2011	July 16, 2013	Mazzillo	SAM-W&W_00033624-SAM-W&W_00033645
US	8,507,840	December 21, 2010	August 13, 2013	Yu et al.	SAM-W&W_00033646-SAM-W&W_00033676
US	8,515,216	November 3, 2009	August 20, 2013	Abad et al.	SAM-W&W_00038837-SAM-W&W_00038858
US	8,603,849	August 28, 2009	December 10, 2013	Kim et al.	SAM-W&W_00038859-SAM-W&W_00038875
US	8,637,951	January 9, 2009	January 28, 2014	Okamoto et al.	SAM-W&W_00038876-SAM-W&W_00038897
US	8,659,037	June 8, 2010	February 25, 2014	Kim et al.	SAM-W&W_00038898-SAM-W&W_00038961

Country	Patent/ Application/ Publication No.	Date of Filing	Date of Issue/ Publication	Inventor(s)	Bates Range
US	8,664,739	May 26, 2011	March 4, 2014	King et al.	SAM-W&W_00038962-SAM-W&W_00038977
US	8,670,471	February 23, 2010	March 11, 2014	Kim et al.	SAM-W&W_00033677-SAM-W&W_00033700
US	8,692,301	September 4, 2009	April 8, 2014	Samuelson et al.	SAM-W&W_00038978-SAM-W&W_00038989
US	8,772,623	October 30, 2012	July 8, 2014	Wanlass et al.	SAM-W&W_00038990-SAM-W&W_00039022
US	8,829,410	August 21, 2013	September 9, 2014	Kuboi	SAM-W&W_00033701-SAM-W&W_00033732
US	8,829,566	March 15, 2007	September 9, 2014	Morse et al.	SAM-W&W_00033733-SAM-W&W_00033743
US	8,835,905	March 15, 2011	September 16, 2014	Wober et al.	SAM-W&W_00039023-SAM-W&W_00039061
US	8,861,909	February 16, 2012	October 14, 2014	Lipson et al.	SAM-W&W_00033744-SAM-W&W_00033762
US	8,941,005	July 26, 2010	January 27, 2015	Ohmi	SAM-W&W_00039062-SAM-W&W_00039071
US	8,941,203	September 12, 2012	January 27, 2015	Wehner et al.	SAM-W&W_00039072-SAM-W&W_00039091
US	8,967,859	April 20, 2010	March 3, 2015	Harmon et al.	SAM-W&W_00039092-SAM-W&W_00039136
US	8,994,136	September 4, 2013	March 31, 2015	Park et al.	SAM-W&W_00039137-SAM-W&W_00039153
US	9,025,074	January 2, 2014	May 5, 2015	Kishi	SAM-W&W_00033763-SAM-W&W_00033785
US	9,059,055	February 5, 2013	June 16, 2015	Konno et al.	SAM-W&W_00039154-SAM-W&W_00039177

Country	Patent/ Application/ Publication No.	Date of Filing	Date of Issue/ Publication	Inventor(s)	Bates Range
US	9,105,789	March 24, 2011	August 11, 2015	Mazzillo et al.	SAM-W&W_00039178-SAM-W&W_00039202
US	9,153,610	January 14, 2013	October 6, 2015	Kobayashi et al.	SAM-W&W_00033786-SAM-W&W_00033813
US	9,209,345	November 19, 2013	December 8, 2015	Haddad et al.	SAM-W&W_00033814-SAM-W&W_00033826
US	9,231,014	October 21, 2014	January 5, 2016	Frey et al.	SAM-W&W_00039203-SAM-W&W_00039211
US	9,231,019	December 6, 2013	January 5, 2016	Shimotsusa	SAM-W&W_00039212-SAM-W&W_00039227
US	9,236,548	March 18, 2013	January 12, 2016	Yan et al.	SAM-W&W_00039228-SAM-W&W_00039256
US	9,257,583	May 25, 2011	February 9, 2016	Watanabe et al.	SAM-W&W_00033827-SAM-W&W_00033847
US	9,288,380	June 23, 2014	March 15, 2016	Nomura	SAM-W&W_00039257-SAM-W&W_00039279
US	9,312,422	November 29, 2011	April 12, 2016	Miura et al.	SAM-W&W_00039280-SAM-W&W_00039297
US	9,324,891	December 22, 2010	April 26, 2016	Shigeta et al.	SAM-W&W_00039298-SAM-W&W_00039345
US	9,395,489	October 8, 2014	July 19, 2016	Cheng et al.	SAM-W&W_00039346-SAM-W&W_00039369
US	9,496,428	June 22, 2010	November 15, 2016	Nishi et al.	SAM-W&W_00039370-SAM-W&W_00039388
US	9,568,606	March 13, 2013	February 14, 2017	Ikemoto	SAM-W&W_00033848-SAM-W&W_00033874
US	9,595,628	August 11, 2014	March 14, 2017	Okandan et al.	SAM-W&W_00033875-SAM-W&W_00033891

Country	Patent/ Application/ Publication No.	Date of Filing	Date of Issue/ Publication	Inventor(s)	Bates Range
US	9,680,046	December 31, 2013	June 13, 2017	Dutta et al.	SAM-W&W_00039389-SAM-W&W_00039409
US	9,698,295	March 16, 2016	July 4, 2017	Pagani	SAM-W&W_00033892-SAM-W&W_00033910
US	9,748,306	November 15, 2013	August 29, 2017	Morgan	SAM-W&W_00039410-SAM-W&W_00039425
US	9,761,746	March 11, 2013	September 12, 2017	Kang et al.	SAM-W&W_00039426-SAM-W&W_00039442
US	9,794,457	June 20, 2014	October 17, 2017	Masuda et al.	SAM-W&W_00039443-SAM-W&W_00039483
US	9,813,152	September 30, 2008	November 7, 2017	Pinguet et al.	SAM-W&W_00033911-SAM-W&W_00033931
US	10,134,926	June 30, 2015	November 20, 2018	Akkaya et al.	SAM-W&W_00035545-SAM-W&W_00035563
US	10,866,343	April 15, 2014	December 15, 2020	Noda et al.	SAM-W&W_00035782-SAM-W&W_00035803
US	2004/0021062	November 15, 2002	February 5, 2004	Zaidi	SAM-W&W_00031766-SAM-W&W_00031806
US	2004/0201042	May 6, 2004	October 14, 2004	Den et al.	SAM-W&W_00031807-SAM-W&W_00031826
US	2005/0106767	September 27, 2004	May 19, 2005	Takahashi et al.	SAM-W&W_00031827-SAM-W&W_00031838
US	2005/0109388	October 25, 2004	May 26, 2005	Murakami et al.	SAM-W&W_00031839-SAM-W&W_00031863
US	2006/0008933	August 14, 2003	January 12, 2006	Muller et al.	SAM-W&W_00031864-SAM-W&W_00031871
US	2006/0076589	March 14, 2005	April 13, 2006	Gao et al.	SAM-W&W_00031872-SAM-W&W_00031888

Country	Patent/ Application/ Publication No.	Date of Filing	Date of Issue/ Publication	Inventor(s)	Bates Range
US	2006/0207647	March 16, 2005	September 21, 2006	Tsakalakos et al.	SAM-W&W_00035804-SAM-W&W_00035839
US	2006/0261430	March 28, 2006	November 23, 2006	Holz	SAM-W&W_00031889-SAM-W&W_00031905
US	2006/0273358	May 31, 2006	December 7, 2006	Hasegawa	SAM-W&W_00031906-SAM-W&W_00031916
US	2007/0152289	December 30, 2005	July 5, 2007	Morse et al.	SAM-W&W_00035840-SAM-W&W_00035846
US	2007/0170476	January 20, 2006	July 26, 2007	Giziewicz et al.	SAM-W&W_00031917-SAM-W&W_00031931
US	2008/0048283	August 21, 2007	February 28, 2008	Han	SAM-W&W_00035847-SAM-W&W_00035852
US	2008/0246106	April 3, 2007	October 9, 2008	Beausoleil et al.	SAM-W&W_00031932-SAM-W&W_00031960
US	2008/0259981	April 19, 2007	October 23, 2008	Wang et al.	SAM-W&W_00031961-SAM-W&W_00031983
US	2008/0295882	May 27, 2008	December 4, 2008	Stephens et al.	SAM-W&W_00031984-SAM-W&W_00032034
US	2009/0121306	December 21, 2005	May 14, 2009	Ishikawa	SAM-W&W_00032036-SAM-W&W_00032055
US	2009/0159123	December 15, 2008	June 25, 2009	Kothari et al.	SAM-W&W_00035853-SAM-W&W_00035921
US	2009/0194160	February 3, 2009	August 6, 2009	Chin et al.	SAM-W&W_00035922-SAM-W&W_00035955
US	2010/0032786	August 5, 2009	February 11, 2010	Jung	SAM-W&W_00040073-SAM-W&W_00040083
US	2010/0089443	September 24, 2009	April 15, 2010	Bloomstein et al.	SAM-W&W_00032056-SAM-W&W_00032100

Country	Patent/ Application/ Publication No.	Date of Filing	Date of Issue/ Publication	Inventor(s)	Bates Range
US	2010/0117108	April 10, 2007	May 13, 2010	Gaebler et al.	SAM-W&W_00032101-SAM-W&W_00032144
US	2010/0127153	April 28, 2008	May 27, 2010	Agarwal	SAM-W&W_00032145-SAM-W&W_00032158
US	2010/0148221	December 8, 2009	June 17, 2010	Yu et al.	SAM-W&W_00035956-SAM-W&W_00036004
US	2010/0289103	December 13, 2006	November 18, 2010	Yamamoto et al.	SAM-W&W_00032159-SAM-W&W_00032175
US	2010/0307557	May 27, 2010	December 9, 2010	Yamazaki et al.	SAM-W&W_00032176-SAM-W&W_00032233
US	2010/0308428	January 9, 2009	December 9, 2010	Okamoto et al.	SAM-W&W_00032234-SAM-W&W_00032255
US	2011/0126891	November 29, 2010	June 2, 2011	Goto et al.	SAM-W&W_00036005-SAM-W&W_00036046
US	2011/0147877	December 17, 2009	June 23, 2011	Wehner et al.	SAM-W&W_00032256-SAM-W&W_00032265
US	2011/0226937	November 12, 2010	September 22, 2011	Yu et al.	SAM-W&W_00032266-SAM-W&W_00032320
US	2011/0227138	September 17, 2010	September 22, 2011	Haddad et al.	SAM-W&W_00032321-SAM-W&W_00032346
US	2011/0240099	March 30, 2010	October 6, 2011	Ellinger et al.	SAM-W&W_00032347-SAM-W&W_00032370
US	2011/0253208	November 27, 2009	October 20, 2011	Ohmi	SAM-W&W_00036047 - SAM-W&W_00036060
US	2011/0315988	May 12, 2011	December 29, 2011	Yu et al.	SAM-W&W_00032371-SAM-W&W_00032464
US	2012/0012741	July 12, 2011	January 19, 2012	Vasylyev	SAM-W&W_00032465-SAM-W&W_00032485

Country	Patent/ Application/ Publication No.	Date of Filing	Date of Issue/ Publication	Inventor(s)	Bates Range
US	2012/0033119	August 2, 2011	February 9, 2012	Shinohara	SAM-W&W_00032486-SAM-W&W_00032509
US	2012/0049044	August 19, 2011	March 1, 2012	Kuboi	SAM-W&W_00032510-SAM-W&W_00032542
US	2012/0111396	May 4, 2011	May 10, 2012	Saylor et al.	SAM-W&W_00036061-SAM-W&W_00036081
US	2012/0146172	June 20, 2011	June 14, 2012	Carey et al.	SAM-W&W_00032543-SAM-W&W_00032562
US	2012/0153124	December 21, 2010	June 21, 2012	Yu et al.	SAM-W&W_00032563-SAM-W&W_00032590
US	2012/0154919	December 14, 2010	June 21, 2012	Hu et al.	SAM-W&W_00040013-SAM-W&W_00040033
US	2012/0186638	July 22, 2011	July 26, 2012	Ohmi	SAM-W&W_00032591-SAM-W&W_00032604
US	2012/0213468	February 16, 2012	August 23, 2012	Lipson et al.	SAM-W&W_00032605-SAM-W&W_00032625
US	2012/0273911	December 17, 2010	November 1, 2012	Shigeta et al.	SAM-W&W_00032626-SAM-W&W_00032657
US	2012/0313201	May 8, 2012	December 13, 2012	Hebert et al.	SAM-W&W_00032658-SAM-W&W_00032685
US	2013/0014814	January 10, 2011	January 17, 2013	Han et al.	SAM-W&W_00036082-SAM-W&W_00036104
US	2013/0082343	September 12, 2012	April 4, 2013	Fudaba, et al.	SAM-W&W_00032686-SAM-W&W_00032695
US	2013/0094865	September 30, 2008	April 18, 2013	Pinguet et al.	SAM-W&W_00032696-SAM-W&W_00032715
US	2013/0105927	December 22, 2010	May 2, 2013	Shigeta et al.	SAM-W&W_00032716-SAM-W&W_00032743

Country	Patent/ Application/ Publication No.	Date of Filing	Date of Issue/ Publication	Inventor(s)	Bates Range
US	2013/0182163	January 14, 2013	July 18, 2013	Kobayashi et al.	SAM-W&W_00032744-SAM-W&W_00032770
US	2013/0320479	March 15, 2013	December 5, 2013	Ahn et al.	SAM-W&W_00037842-SAM-W&W_00037859
US	2013/0342722	August 21, 2013	December 26, 2013	Kuboi	SAM-W&W_00032771-SAM-W&W_00032803
US	2014/0175372	December 21, 2012	June 26, 2014	Aberg et al.	SAM-W&W_00032804-SAM-W&W_00032822
US	2015/0053923	August 21, 2014	February 26, 2015	Frey et al.	SAM-W&W_00032823-SAM-W&W_00032830
US	2015/0312461	April 27, 2015	October 29, 2015	Kim et al.	SAM-W&W_00037860-SAM-W&W_00037902
US	2016/0015987	February 27, 2014	January 21, 2016	Perraud et al.	SAM-W&W_00032831-SAM-W&W_00032848
US	2016/0126381	May 22, 2014	May 5, 2016	Wang et al.	SAM-W&W_00032849-SAM-W&W_00032925
US	2018/0182806	October 30, 2017	June 28, 2018	Jin et al.	SAM-W&W_00035679-SAM-W&W_00035724
CN	103400872A	June 30, 2013	November 20, 2013	Guo et al.	SAM-W&W_00024560-SAM-W&W_00024600; SAM-W&W_00039902-SAM-W&W_00039940
CN	103400872B	June 30, 2013	August 26, 2015	Guo et al.	SAM-W&W_00040055-SAM-W&W_00040072
CN	103050498	December 28, 2012	April 17, 2013	Jian et al.	SAM-W&W_00034690-SAM-W&W_00034702; SAM-W&W_00037122-SAM-W&W_00037134

Country	Patent/ Application/ Publication No.	Date of Filing	Date of Issue/ Publication	Inventor(s)	Bates Range
DE	102009009814 A1	February 20, 2009	August 26, 2010	Leipold et al.	SAM-W&W_00025325-SAM-W&W_00025388
DE	102012216433 A1	September 14, 2012	March 20, 2014	Kautzsch	SAM-W&W_00025389-SAM-W&W_00025466
EP	0064918B1	April 29, 1982	November 13, 1985	Rebondy et al.	SAM-W&W_00025485-SAM-W&W_00025491
EP	0696747A2	August 8, 1995	February 14, 1996	Tatsuya et al.	SAM-W&W_00025492-SAM-W&W_00025538
EP	2172974A1	October 1, 2008	April 7, 2010	NXP B.V.	SAM-W&W_00025539-SAM-W&W_00025561
JP	S59-16385	July 19, 1982	January 27, 1984	Sakura et al.	SAM-W&W_00035333-SAM-W&W_00035335
JP	H09-017993A	December 8, 1995	January 17, 1997	Michiguchi et al.	SAM-W&W_00035269-SAM-W&W_00035281
JP	H09-246586A	March 5, 1996	September 19, 1997	Doi et al.	SAM-W&W_00035282-SAM-W&W_00035292; SAM-W&W_00040116-SAM-W&W_00040164
JP	H11-195810A	December 26, 1997	July 21, 1999	Toda	SAM-W&W_00035293-SAM-W&W_00035300
JP	H11-195806A	December 26, 1997	July 21, 1999	Toda	SAM-W&W_00035301-SAM-W&W_00035309
JP	2002-314116A	April 9, 2001	October 25, 2002	Harada et al.	SAM-W&W_00026604-SAM-W&W_00026621; SAM-W&W_00027055-SAM-W&W_00027063
JP	2003-031790A	July 17, 2001	January 31, 2003	Uda et al.	SAM-W&W_00034765-SAM-W&W_00034786

Country	Patent/ Application/ Publication No.	Date of Filing	Date of Issue/ Publication	Inventor(s)	Bates Range
JP	2003-133251A	October 24, 2001	May 9, 2003	Wada et al.	SAM-W&W_00034787-SAM-W&W_00034795
JP	2004-193527A	December 13, 2002	July 8, 2004	Kuriyama et al.	SAM-W&W_00034796-SAM-W&W_00034822
JP	2004-319664A	April 15, 2003	November 11, 2004	Ishi et al.	SAM-W&W_00034823-SAM-W&W_00034836
JP	2005-159002A	November 26, 2003	June 16, 2005	Koyama et al.	SAM-W&W_00034837-SAM-W&W_00034852
JP	2006-173329A	December 15, 2004	June 29, 2006	Masamitsu et al.	SAM-W&W_00026622-SAM-W&W_00026668; SAM-W&W_00034853-SAM-W&W_00034899; SAM-W&W_00039941-SAM-W&W_00040007
JP	2006-245163A	March 2, 2005	September 14, 2006	Hirano et al.	SAM-W&W_00034900-SAM-W&W_00034922
JP	2006-339533A	June 3, 2005	December 14, 2006	Hasegawa	SAM-W&W_00034923-SAM-W&W_00034932
JP	2007-059615A	August 24, 2005	March 8, 2007	Kayao et al.	SAM-W&W_00034933-SAM-W&W_00034940
JP	2007-129024A	November 2, 2005	May 24, 2007	Hasegawa et al.	SAM-W&W_00026669-SAM-W&W_00026691; SAM-W&W_00026954-SAM-W&W_00026982
JP	2007-165359A	December 9, 2005	June 28, 2007	Makita et al.	SAM-W&W_00026692-SAM-W&W_00026711; SAM-W&W_00040165-SAM-W&W_0040203

Country	Patent/ Application/ Publication No.	Date of Filing	Date of Issue/ Publication	Inventor(s)	Bates Range
JP	2007-273832A	March 31, 2006	October 18, 2007	Okamoto	SAM-W&W_00026712-SAM-W&W_00026776
JP	2007-281266A	April 10, 2006	October 25, 2007	Inoguchi	SAM-W&W_00034970-SAM-W&W_00034987
JP	2008-028421A	October 10, 2007	February 7, 2008	Yagyu et al.	SAM-W&W_00034988-SAM-W&W_00035004
JP	2008-311562A	June 18, 2007	December 25, 2008	Obara et al.	SAM-W&W_00026777-SAM-W&W_00026803; SAM-W&W_00026983-SAM-W&W_00027019
JP	2008-544559A	June 28, 2006	December 4, 2008	Morse et al.	SAM-W&W_00035042-SAM-W&W_00035055
JP	2009-130276A	November 27, 2007	June 11, 2009	Tai et al.	SAM-W&W_00026804-SAM-W&W_00026883
JP	2009-206304A	February 28, 2008	September 10, 2009	Ishimura et al.	SAM-W&W_00035056-SAM-W&W_00035066
JP	2010-212347A	March 9, 2009	September 24, 2010	Imai	SAM-W&W_00035067-SAM-W&W_00035086
JP	2010-212469A	March 11, 2009	September 24, 2010	Yokoyama	SAM-W&W_00035087-SAM-W&W_00035120
JP	2010-232264A	March 26, 2009	October 14, 2010	Miura et al.	SAM-W&W_00026884-SAM-W&W_00026940
JP	2011-077370A	September 30, 2009	April 14, 2011	Otsuki	SAM-W&W_00035121-SAM-W&W_00035136
JP	2011-135058A	November 24, 2010	July 7, 2011	Hiruma et al.	SAM-W&W_00035137-SAM-W&W_00035183
JP	2011-139058A	December 15, 2010	July 14, 2011	Wehner et al.	SAM-W&W_00035184-SAM-W&W_00035196

Country	Patent/ Application/ Publication No.	Date of Filing	Date of Issue/ Publication	Inventor(s)	Bates Range
JP	2012-178457A	February 25, 2011	September 13, 2012	Enomoto	SAM-W&W_00035197-SAM-W&W_00035233
JP	2013-033864A	August 2, 2011	February 14, 2013	Sasaki et al.	SAM-W&W_00035234-SAM-W&W_00035268
JP	2013-157567A	January 31, 2012	August 15, 2013	Noda et al.	SAM-W&W_00035310-SAM-W&W_00035332
JP	05343729A	June 12, 1992	December 24, 1993	Ajisawa et al.	SAM-W&W_00027020-SAM-W&W_00027035
JP	3912024B2	April 9, 2001	May 9, 2007	Harada et al.	SAM-W&W_00026941-SAM-W&W_00026953
JPWO	2009/088071	January 9, 2009	May 26, 2011	Okamoto et al.	SAM-W&W_00027036-SAM-W&W_00027054
KR	100439760B1	June 18, 2002	July 12, 2004	Noh et al.	SAM-W&W_00027064-SAM-W&W_00027079
KR	2004-0036338	October 24, 2002	April 30, 2004	Choi et al.	SAM-W&W_00035336-SAM-W&W_00035341
KR	2004-0076331	February 25, 2003	September 1, 2004	Kim et al.	SAM-W&W_00035342-SAM-W&W_00035360
KR	100851759B1	May 3, 2007	August 11, 2008	Shim	SAM-W&W_00027080-SAM-W&W_00027105
KR	2010-0135548	June 17, 2009	December 27, 2010	Cho et al.	SAM-W&W_00035361-SAM-W&W_00035416
WO	2006/129427	April 18, 2006	December 7, 2006	Katoh et al.	SAM-W&W_00033932-SAM-W&W_00033960
WO	2009/034623	September 12, 2007	March 19, 2009	Masuoka et al.	SAM-W&W_00039487-SAM-W&W_00039539
WO	2008/052067	October 24, 2007	May 2, 2008	Munteanu et al.	SAM-W&W_00039484-SAM-W&W_00039486

Country	Patent/ Application/ Publication No.	Date of Filing	Date of Issue/ Publication	Inventor(s)	Bates Range
WO	2010/037830	October 1, 2009	April 8, 2010	Neuilly	SAM-W&W_00033961-SAM-W&W_00033993
WO	2011/047359	October 15, 2010	April 21, 2011	Lal et al.	SAM-W&W_00039540-SAM-W&W_00039621
WO	2011/083674	December 17, 2010	July 14, 2011	Shigeta et al.	SAM-W&W_00039622-SAM-W&W_00039677
WO	2011/083694	December 22, 2010	July 14, 2011	Shigeta et al.	SAM-W&W_00039678-SAM-W&W_00039727
WO	2011/085297	May 22, 2014	May 5, 2016	Han et al.	SAM-W&W_00033994-SAM-W&W_00034036
WO	2012/053491	October 17, 2011	April 26, 2012	Hiroaki et al.	SAM-W&W_00034037-SAM-W&W_00034167
WO	2012/056782	July 29, 2011	May 3, 2012	Masuoka, et al.	SAM-W&W_00034168-SAM-W&W_00034281
WO	2012/117469	October 31, 2011	September 7, 2012	Honma	SAM-W&W_00039728-SAM-W&W_00039765
WO	2012/121706	March 8, 2011	September 13, 2012	Oh et al.	SAM-W&W_00034282-SAM-W&W_00034318
WO	2012/160662	May 25, 2011	November 10, 2015	Watanabe et al.	SAM-W&W_00034319-SAM-W&W_00034371
WO	2012/167282	June 4, 2012	December 6, 2012	Pacifici et al.	SAM-W&W_00039766-SAM-W&W_00039807
WO	2013/111173	January 23, 2013	August 1, 2013	Oda et al.	SAM-W&W_00039808-SAM-W&W_00039847
WO	2013/136022	February 27, 2014	September 12, 2014	Simon et al.	SAM-W&W_00034473-SAM-W&W_00034488
WO	2013/189932	June 18, 2013	December 27, 2013	Wilhelm	SAM-W&W_00034372-SAM-W&W_00034423

Country	Patent/ Application/ Publication No.	Date of Filing	Date of Issue/ Publication	Inventor(s)	Bates Range
WO	2013/190646	June 20, 2012	December 27, 2013	Watanabe et al.	SAM-W&W_00039848-SAM-W&W_00039897
WO	2014/136022	February 27, 2014	September 12, 2014	Perraud et al.	SAM-W&W_00034424-SAM-W&W_00034472
WO	2014/190189	May 22, 2014	November 27, 2014	Wang et al.	SAM-W&W_00034489-SAM-W&W_00034627

Table 2: Non-Patent Publications

Title	Publication Date	Author(s)	Publisher	Bates Range
Adhesive Chemistry: Developments and Trends	1984	Lieng-Huang Lee (ed.)	Plenum Press	SAM-W&W_00036266-SAM-W&W_00037111
Integrated Electronic and Photonic Devices	1985	Margalit et al.	Bell Telephone Laboratories, Inc.	SAM-W&W_00026509-SAM-W&W_00026569
Monolithic Optoelectronic Integration: A New Component Technology for Lightwave Communications	December 1985	Forrest	IEEE	SAM-W&W_00027151-SAM-W&W_00027166
CMOS Active Pixel Image Sensor	March 3, 1994	Mendis et al.	IEEE	SAM-W&W_00024533-SAM-W&W_00024534
Mechanisms of recombination in GaN photodetectors	1996	Binet et al.	Applied Physics Letters	SAM-W&W_00027133-SAM-W&W_00027136

Title	Publication Date	Author(s)	Publisher	Bates Range
Intel Releases 971 PC Camera Kit For Production Of Affordable, Easy-To-Use, Portable PC Cameras	1997	Intel	Intel	SAM-W&W_00034749-SAM-W&W_00034751
CMOS Image Sensors: Electronic Camera-on-a-Chip	October 10, 1997	Fossum	IEEE	SAM-W&W_00024550-SAM-W&W_00024559
CMOS Image Sensors Challenge CCDs	1998	Diefendorff	Microdesign Resources, Microprocessor Report	SAM-W&W_00034681-SAM-W&W_00034685
A 19.8% Efficient Honeycomb Multicrystalline Silicon Solar Cell with Improved Light Trapping	October 10, 1999	Zhao et al.	IEEE	SAM-W&W_00024431-SAM-W&W_00024436
Advanced Optoelectronic Devices: Chapter 4 Photodetectors	1999	Dragoman et al.	Springer	SAM-W&W_00024465-SAM-W&W_00024521
Electrical Engineering Dictionary	2000	Laplante et al.	CRC Press LLC	SAM-W&W_00025575-SAM-W&W_00026348
Performance Analysis of a Color CMOS Photogate Image Sensor	2000	Blanksby et al.	IEEE	SAM-W&W_00037112-SAM-W&W_00037121
IEEE 100 The Authoritative Dictionary of IEEE Standard Terms (7th Edition)	2000	IEEE	IEEE	SAM-W&W_00026454-SAM-W&W_00026457
Signal Processing in CMOS Image Sensors	2000	Nair et al.	IEEE	SAM-W&W_00035508-SAM-W&W_00035517
CMOS Logic Circuit Design	2001	Uyemura	Kluwer Academic Publishers	SAM-W&W_00024660-SAM-W&W_00025208

Title	Publication Date	Author(s)	Publisher	Bates Range
OMNIVISION Announces 1.3-Megapixel CMOS Image Sensors	2001	OmniVision	OmniVision	SAM-W&W_00037143-SAM-W&W_00037145
OMNIVISION Announces Expanded Image Sensor	2001	OmniVision	OmniVision	SAM-W&W_00037146-SAM-W&W_00037150
OMNIVISION Datasheet OV9610/OV9110 CMOS Image Sensors	2001	OmniVision	OmniVision	SAM-W&W_00037229-SAM-W&W_00037241
The effect of indium tin oxide as an ohmic contact for the 850 nm GaAs oxide-confined VCSELs	February 2002	Jiang et al.	Elsevier Science Ltd.	SAM-W&W_00031762-SAM-W&W_00031765
Deeply Etched Grating Structures for Enhanced Absorption in Thin C-Si Solar Cells	2002	Zaidi et al.	IEEE	SAM-W&W_00037139-SAM-W&W_00037142
CMOS Sensor Inc. website describing Contact Image Sensor (CIS)	2002	CMOS Sensor Inc.	CMOS Sensor Inc.	SAM-W&W_00037151-SAM-W&W_00037151
Silicon-on-insulator waveguide photodetector with Ge/Si self-assembled islands	2002	El Kurdi et al.	Journal of Applied Physics	SAM-W&W_00030532-SAM-W&W_00030536
Silicon Substrates with Buried Distributed Bragg Reflectors for Resonant Cavity-Enhanced Optoelectronics	2002	Emsley et al.	IEEE	SAM-W&W_00035518-SAM-W&W_00035525

Title	Publication Date	Author(s)	Publisher	Bates Range
Semiconductor Physics and Devices Basic Principles (3d Edition)	2003	Neamen	McGraw Hill	SAM-W&W_00029760-SAM-W&W_00029767
Integration of 10Gb/sec Silicon Lateral Trench Photodetector with High-Performance CMOS	2003	Yang et al.	IEEE	SAM-W&W_00026577-SAM-W&W_00026578
Silicon Optoelectronic Integrated Circuits	2004	Zimmermann	Springer	SAM-W&W_00030159-SAM-W&W_00030524
Optical Microscopy Primer: Introduction to CMOS Image Sensors	July 16, 2004	Turchetta et al.	The Florida State University & Michael W. Davidson	SAM-W&W_00027641-SAM-W&W_00027649
Characterization of CsI photocathodes at grazing incidence for use in a unit quantum efficiency x-ray streak camera	October 2004	Lowney et al.	American Institute of Physics	SAM-W&W_00024646-SAM-W&W_00024652
A 3.9-mm Pixel Pitch VGA Format 10-b Digital Output CMOS Image Sensor With 1.5 Transistor/Pixel	December 2004	Takahashi et al.	IEEE J. Solid-State Circuits	SAM-W&W_00034660-SAM-W&W_00034668
CMOS Image Sensors	May 2005	El Gamal et al.	IEEE	SAM-W&W_00024535-SAM-W&W_00024549
Aligned Single-Crystalline Si Nanowire Arrays for Photovoltaic Applications	August 18, 2005	Peng et al.	Wiley Online Library	SAM-W&W_00035487-SAM-W&W_00035492
Shared pixels for CMOS image sensor arrays	2005	McGrath et al.	IEEE	SAM-W&W_00035453-SAM-W&W_00035457

Title	Publication Date	Author(s)	Publisher	Bates Range
Highly Integrated VCSEL-Based 10Gb/s Miniature Optical Sub-Assembly	2005	Bernabe et al.	IEEE	SAM-W&W_00026448-SAM-W&W_00026453
Roadmap for High Efficiency Solid-State Neutron Detectors	October 2005	Nikolic et al.	Digital Commons	SAM-W&W_00029151-SAM-W&W_00029161
Integration of Photonic Detectors in Standard SiGe HBT BiCMOS	2006	Meinhardt et al.	The Electrochemical Society	SAM-W&W_00026579-SAM-W&W_00026593
1/2-inch 7.2MPixel CMOS Image Sensor with 2.25µm Pixels Using 4-Shared Pixel Structure for Pixel-Level Summation	2006	Kim et al.	IEEE – International Sold State Circuits Conference	SAM-W&W_00035424-SAM-W&W_00035433
MT9T031 Image Sensor – Product Brief	2006	Micron Technology	Micron Technology	SAM-W&W_00037217-SAM-W&W_00037228
Advances in fully CMOS integrated photonic devices	February 9, 2007	Michel et al.	SPIE	SAM-W&W_00024522-SAM-W&W_00024532
Deep Trench Isolation for Crosstalk Suppression in Active Pixel Sensors with 1.7 m Pixel Pitch	April 24, 2007	Park et al.	Japanese Journal of Applied Physics	SAM-W&W_00035479-SAM-W&W_00035482
High Sensitivity of Dielectric films Structure for Advanced CMOS Image Sensor Technology	June 7-10, 2007	Chang et al.	IEEE	SAM-W&W_00026427-SAM-W&W_00026431
Strong broadband optical absorption in silicon NW films	July 17, 2007	Tsakalakos et al.	Society of Photo-Optical Instrumentation Engineers	SAM-W&W_00035534-SAM-W&W_00035544

Title	Publication Date	Author(s)	Publisher	Bates Range
Analysis of Optical Absorption in Silicon Nanowire Arrays for Photovoltaic Applications	October 10, 2007	Hu et al.	American Chemical Society	SAM-W&W_00034742-SAM-W&W_00034747
Nanophotonic Materials Photonic Crystals, Plasmonics, and Metamaterials	November 2007	Wehrspohn et al.	Wiley-VCH	SAM-W&W_00027190-SAM-W&W_00027638
Gr Gb difference in 3M CMOS Image Sensor with 1.75µm pixel	2007	Kim et al.	International Image Sensors Society (IISS)	SAM-W&W_00035434-SAM-W&W_00035437
Solar Module Fabrication	2007	El Amrani et al.	Hindawi Publishing Corp.	SAM-W&W_00040226-SAM-W&W_00040230
Nanoelectrode Lithography: Chemical Nanoimprint that Transfers a Pattern by Electrochemical Reaction	August 2008	Yokoo et al.	NTT Technical Review	SAM-W&W_00027182-SAM-W&W_00027189
Optical confinement methods for continued scaling of CMOS image sensor pixels	November 25, 2008	Fesenmaier et al.	Optical Society of America	SAM-W&W_00027670-SAM-W&W_00027683
Advanced image sensor technology for pixel scaling down toward 1.0µm	2008	Ahn et al.	IEEE	SAM-W&W_00034672-SAM-W&W_00034675
Process Flow Innovations for Photonic Device Integration in CMOS	2008	Beals et al.	Society of Photo-Optical Instrumentation Engineers (SPIE)	SAM-W&W_00029133-SAM-W&W_00029146
Monolithic Integration of Photonic and Electronic Circuits in a CMOS Process	2008	Mekis et al.	SPIE	SAM-W&W_00027137-SAM-W&W_00027150

Title	Publication Date	Author(s)	Publisher	Bates Range
Photonic Crystals: Physics and Technology	2008	Sibilia et al.	Springer	SAM-W&W_00028844-SAM-W&W_00029132
Photonic Crystals Molding the Flow of Light 2d Edition	2008	Joannopoulos et al.	Princeton University Press	SAM-W&W_00027684-SAM-W&W_00027988
Through Silicon Vias Technology for CMOS Image Sensors Packaging	2008	Henry et al.	IEEE	SAM-W&W_00037832-SAM-W&W_00037841
Photonic Crystals Towards Nanoscale Photonic Devices 2d Edition	2008	Benisty et al.	Springer	SAM-W&W_00027989-SAM-W&W_00028502
Porous Silicon Carbide and Gallium Nitride	2008	Feenstra et al.	John Wiley & Sons, Ltd.	SAM-W&W_00028503-SAM-W&W_00028843
Absorption Enhancement in Thin-Film Silicon Solar Cells in SOI Configuration Using Physical and Geometrical Optics	2008	Prinja et al.	IEEE	SAM-W&W_00024452-SAM-W&W_00024455
CMOS Image Sensor with two-shared pixel and staggered readout architecture	June 26-28, 2009	Bogaerts et al.	Internationbal Image Sensor Workshop	SAM-W&W_00034686-SAM-W&W_00034689
Silicon Nanowire-Based Solar Cells on Glass: Synthesis, Optical Properties and Cell Parameters	March 12, 2009	Sivakov et al.	American Chemical Society	SAM-W&W_00034654-SAM-W&W_00034653
Focused ion beam technology and ultimate applications	March 20, 2009	Gierak	Semiconductor Science and Technology	SAM-W&W_00026385-SAM-W&W_00026407

Title	Publication Date	Author(s)	Publisher	Bates Range
Optical absorption enhancement in silicon nanowire arrays with a large lattice constant for photovoltaic applications	October 26, 2009	Lin et al.	Optical Society of America	SAM-W&W_00035442-SAM-W&W_00035452
Optical absorption enhancement in silicon nanowire and nanohole arrays for photovoltaic application	2010	Lin et al.	IEEE	SAM-W&W_00035477-SAM-W&W_00035478
Optical absorption enhancement in nanopore textured-silicon thin film for photovoltaic application	January 1, 2010	Wang et al.	Optical Society of America	SAM-W&W_00027650-SAM-W&W_00027652
Optical Absorption Enhancement in Silicon Nanohole Arrays for Solar Photovoltaics	February 8, 2010	Han et al.	American Chemical Society	SAM-W&W_00027655-SAM-W&W_00027658
Enhanced absorption and carrier collection in Si wire arrays for photovoltaic applications	February 14, 2010	Kelzenberg et al.	Macmillan Publishers Limited	SAM-W&W_00035417-SAM-W&W_00035423
A grazing incidence x-ray streak camera for ultrafast, single-shot measurements	March 29, 2010	Feng et al.	American Institute of Physics Publishing	SAM-W&W_00024437-SAM-W&W_00024441
High-Performance Silicon Nanohole Solar Cells	May 2010	Peng et al.	American Chemical Society	SAM-W&W_00026445-SAM-W&W_00026447
NREL's Black Silicon Increases Solar Cell Efficiency by Reducing Reflected Sunlight	November 2010	National Renewable Energy Laboratory	National Renewable Energy Laboratory	SAM-W&W_00027180-SAM-W&W_00027181
Light Trapping in Silicon Nanowire Solar Cells	2010	Garnett et al.	American Chemical Society	SAM-W&W_00027117-SAM-W&W_00027122

Title	Publication Date	Author(s)	Publisher	Bates Range
Optical absorption enhancement in silicon nanowire and nanohole arrays for photovoltaic applications	2010	Lin et al.	SPIE	SAM-W&W_00027659-SAM-W&W_00027669
Integrated microsystem for blue/ ultraviolet detection	2010	Pauchard et al.	MCB University Press	SAM-W&W_00026570-SAM-W&W_00026576
Semiconductor Devices Physics and Technology (3d Edition)	2012	Sze et al.	IEEE	SAM-W&W_00037242-SAM-W&W_00037831
Controlling Light in Optically Induced Photonic Lattices	2011	Terhalle	Springer Theses	SAM-W&W_00025209-SAM-W&W_00025324
Silicon Nanowires for Photovoltaic Solar Energy Conversion	2011	Peng et al.	Advanced Materials	SAM-W&W_00030141-SAM-W&W_00030158
Review of the 1.4 µm Pixel Generation	2011	Fontaine	International Image Sensors Society (IISS)	SAM-W&W_00034719-SAM-W&W_00034722
Pixel-to-Pixel isolation by Deep Trench technology: Application to CMOS Image Sensor	2011	Tournier et al.	International Image Sensors Society (IISS)	SAM-W&W_00035530-SAM-W&W_00035533
A 300mm Wafer-Size CMOS Image Sensor with In-Pixel Voltage-Gain Amplifier and Column-Level Differential Readout Circuitry	2011	Yamashita	IEEE International Solid-State Circuits Conference	SAM-W&W_00034669-SAM-W&W_00034671
A photonic-plasmonic structure for enhancing light absorption in thin film solar cells	September 30, 2011	Bhattacharya et al.	Applied Physics Letters	SAM-W&W_00024442-SAM-W&W_00024445

Title	Publication Date	Author(s)	Publisher	Bates Range
Optical Absorption Enhancement in Silicon Nanohole Arrays for Photovoltaics	2011	Chen et al.	IEEE	SAM-W&W_00035474-SAM-W&W_00035476
Ge-on-Si optoelectronics	October 29, 2011	Liu et al.	Elsevier	SAM-W&W_00034723-SAM-W&W_00034729
Design and fabrication of photonic crystals in epitaxial free silicon for ultrathin solar cells	November 13-16, 2011	Meng et al.	IEEE	SAM-W&W_00035458-SAM-W&W_00035464
A simple and low-cost technique for silicon nanowire arrays based solar cells	December 7, 2011	Huang et al.	Elsevier B.V.	SAM-W&W_00024446-SAM-W&W_00024451
Light harvesting by planar photonic crystals in solar cells: the case of amorphous silicon	January 12, 2012	Gomard et al.	IOP Publishing Ltd.	SAM-W&W_00034730-SAM-W&W_00034741
Black Silicon Antireflection Technology	February 14, 2012	Dennis J. Flood	InterPV	SAM-W&W_00035472-SAM-W&W_00035473; SAM-W&W_00040106-SAM-W&W_00040110
A 1920x1080 3.65 μm-Pixel 2D/3D Image Sensor with Split and Binning Pixel Structure in 0.11 μm Standard CMOS	February 22, 2012	Kim et al.	ISSCC	SAM-W&W_00035493-SAM-W&W_00035495
Electrical Properties of ITO/Crystalline-Silicon Contact at Different Deposition Temperatures	March 2012	De Cesare et al.	IEEE	SAM-W&W_00034716-SAM-W&W_00034718

Title	Publication Date	Author(s)	Publisher	Bates Range
Experimental Study of Design Parameters in Silicon Micropillar Array Solar Cells Produced by Soft Lithography and Metal-Assisted Chemical Etching	April 2012	Shin et al.	IEEE	SAM-W&W_00026380-SAM-W&W_00026384
Design, fabrication and optical characterization of photonic crystal assisted thin film monocrystalline-silicon solar cells	May 11, 2012	Meng et al.	Optical Society of America (OSA)	SAM-W&W_00034705-SAM-W&W_00034715
Efficient Light Trapping in Inverted Nanopyramid Thin Crystalline Silicon Membranes for Solar Cell Applications	May 21, 2012	Mavrokefalos et al.	Nano Letter	SAM-W&W_00040008-SAM-W&W_00040012
Efficient Light-Trapping in Inverted Nano-Pyramid Thin Crystalline Silicon Membranes for Solar Cell Applications	June 13, 2012	Mavrokefalos et al.	American Chemical Society	SAM-W&W_00036261-SAM-W&W_00036265
Current-Voltage Characteristics of ITO/p-Si and ITO/n-Si Contact Interfaces	June 2012	Pethuraja et al.	Advances in Materials Physics and Chemistry	SAM-W&W_00037135-SAM-W&W_00037138
Sony develops 'Exmor RS,' the world's first stacked CMOS image sensor	August 20, 2012	Sony	Phys Org	SAM-W&W_00024420-SAM-W&W_00024423
High-contrast gratings for integrated optoelectronics	September 4, 2012	Chang-Hasnain, et al.	Advances in Optics and Photonics	SAM-W&W_00037155-SAM-W&W_00037216

Title	Publication Date	Author(s)	Publisher	Bates Range
Characteristics of large-scale nanohole arrays for thin-silicon photovoltaics	October 1, 2012	Chen et al.	Wiley Online Library	SAM-W&W_00024636-SAM-W&W_00024645
Natcore Builds World's First Black Silicon Solar Cell Using Scalable Production Process	November 7, 2012	Inhabitat	Inhabitat	SAM-W&W_0027639-SAM-W&W_0027640
A CMOS Image Sensor Based on Unified Pixel Architecture With Time-Division Multiplexing Scheme for Color and Depth Image Acquisition	November 2012	Kim et al.	IEEE	SAM-W&W_00035496-SAM-W&W_00035507
High responsivity MSM black silicon photdetector	December 21, 2012	Su et al.	Elsevier	SAM-W&W_00026438-SAM-W&W_00026444
Advanced Imaging Research and Development at DARPA	2012	Dhar et al.	SPIE	SAM-W&W_00024456-SAM-W&W_00024464
Suppression of Crosstalk by Using Backside Deep Trench Isolation for 1.12μm Backside Illuminated CMOS Image Sensor	2012	Kitamura et al.	IEEE	SAM-W&W_00035438-SAM-W&W_00035441
Characterization of light absorption in thin-film silicon with periodic nanohole arrays	March 4, 2013	Yahaya et al.	Optical Society of America	SAM-W&W_00024653-SAM-W&W_00024659
Canon develops 35 mm full-frame CMOS sensor for video capture	March 4, 2013	Canon	Canon	SAM-W&W_00024632-SAM-W&W_00024633

Title	Publication Date	Author(s)	Publisher	Bates Range
Silicon/organic hybrid heterojunction infrared photodetector operating in the telecom regime	March 14, 2013	Bednorz et al.	Elsevier B.V.	SAM-W&W_00030525-SAM-W&W_00030531
Resolution Limits of Electron-Beam Lithography toward the Atomic Scale	March 14, 2013	Manfrinato et al.	American Chemical Society	SAM-W&W_00029147-SAM-W&W_00029150
Optical absorption enhancement in partially aperiodic silicon nanohole structures for photovoltaics	2013	Lin et al.	Optical Society of America	SAM-W&W_00027653-SAM-W&W_00027654
Advances in Infrared Detector Array Technology	2013	Dhar et al.	InTech	SAM-W&W_00026467-SAM-W&W_00026508
SiOnyx Announces First Products	April 4, 2013	Image Sensors World	Image Sensors World	SAM-W&W_00034628-SAM-W&W_00034635
SNR Metric and Crosstalk in Color Image Sensor of Small Size Pixel	April 22-24, 2013	Ahn et al.	IEEE	SAM-W&W_00034676-SAM-W&W_00034677
DSS 2013: SiOnyx sees digitally with 'black' silicon	May 6, 2013	Optics.org	Optics.org	SAM-W&W_00034652-SAM-W&W_00034653
Canon EOS 70D Specs (New Sensor), to be announced on July 2	June 27, 2013	Cameraegg	Cameraegg	SAM-W&W_00024611-SAM-W&W_00024613

Title	Publication Date	Author(s)	Publisher	Bates Range
Canon develops new Dual Pixel CMOS AF technology for significantly improved autofocus performance during Live View shooting and when shooting movies	July 2, 2013	Canon	Canon	SAM-W&W_00024634-SAM-W&W_00024635
Monolithic VCSEL–PIN Photodiode Integration for Bidirectional Optical Data Transmission	August 2013	Kern et al.	IEEE	SAM-W&W_00027167-SAM-W&W_00027179
A novel silicon nanostructure with effective light trapping for polycrystalline silicon thin film solar cells by means of metal-assisted wet chemical etching	September 20, 2013	Xue	Wiley Online Library	SAM-W&W_00039898-SAM-W&W_00039901
Natcore Aims To Make Black Silicon Solar Cells Even Cheaper	December 9, 2013	Tina Casey	CleanTechnica	SAM-W&W_00035465-SAM-W&W_00035471
The Evolution of CMOS Image Sensors	2013	Hirayama	IEEE	SAM-W&W_00035526-SAM-W&W_00035529
HOT infrared photodetectors	2013	Martyniuk et al.	Opto-Electronics Review	SAM-W&W_00026408-SAM-W&W_00026426
A 1/4-inch 8Mpixel CMOS Image Sensor with 3D Backside-Illuminated 1.12µm Pixel with Front-Side Deep-Trench Isolation and Vertical Transfer Gate	February 9-13, 2014	Ahn et al.	IEEE	SAM-W&W_00034678-SAM-W&W_00034680

Title	Publication Date	Author(s)	Publisher	Bates Range
Light management for photovoltaics using high-index nanostructures	April 22, 2014	Brongersma et al.	Nature Materials	SAM-W&W_00027123-SAM-W&W_00027132
High quantum efficiency photocathode simulation for the investigation of novel structured designs	Presented June 2, 2014	Opachich et al.	Review of Scientific Instruments	SAM-W&W_00026432-SAM-W&W_00026437
Si Nanostructures based solar cells	2014	Lei	Nanyang Technological University – School of Electrical and Electronic Engineering	SAM-W&W_00029768-SAM-W&W_00029953
Si nanostructures based solar cells	2014	Hong	Nanyang Technological University, School of Electrical and Electronic Engineering	SAM-W&W_00029954-SAM-W&W_00030140
The Art of Electronics (3d Edition)	2016	Horowitz et al.	Cambridge University Press	SAM-W&W_00030537-SAM-W&W_00031761
This new phone highlights Samsung's growing photography prowess	December 14, 2016	Deidre R.	SamMobile	SAM-W&W_00040111-SAM-W&W_00040114
High-performance mobile ‘Tetracell image sensor’ wins Minister’s Award at Multimedia Technology Awards!	June 2, 2017	Samsung Semiconductor	Samsung Semiconductor	SAM-W&W_00026349-SAM-W&W_00026355; SAM-W&W_00027107-SAM-W&W_00027113

Title	Publication Date	Author(s)	Publisher	Bates Range
IR sensitivity enhancement of CMOS Image Sensor with diffractive light trapping pixels	June 19, 2017	Yokogawa et al.	Scientific Reports	SAM-W&W_00026458-SAM-W&W_00026466
Sony Enhances IR Sensitivity by 80% with Pyramidal Structure	June 20, 2017	Image Sensors World	Image Sensors World	SAM-W&W_00024424-SAM-W&W_00024430
Cameras with Black Silicon Sensors Reach the Market	September 22, 2017	Image Sensors World	Image Sensors World	SAM-W&W_00034636-SAM-W&W_00034643
Samsung Electronics Launches Two New Ultra-Compact High-Definition Image Sensors ISOCELL	October 11, 2017	Samsung Semiconductor	Samsung Semiconductor	SAM-W&W_00026356-SAM-W&W_00026359; SAM-W&W_00027114-SAM-W&W_00027116
Samsung's new dual pixel mobile sensor wants to eliminate dual cameras in smartphones	October 12, 2017	John Aldred	DIY Photography	SAM-W&W_00029168-SAM-W&W_00029169
Samsung Honored for Outstanding Design and Engineering with 36 CES 2018 Innovation Awards	November 10, 2017	Yoon Sang-ho	Digital Daily	SAM-W&W_00029162-SAM-W&W_00029167
2017 Pixel Technology in Review	December 19, 2017	Image Sensors World	Image Sensors World	SAM-W&W_00034644-SAM-W&W_00034651
An All Pixel PDAF CMOS Image Sensor with 0.64μm×1.28μm Photodiode Separated by Self-aligned In-pixel Deep Trench Isolation for High AF Performance	2017	Choi et al.	IEEE	SAM-W&W_00034703-SAM-W&W_00034704
Canon Autofocus Series: Dual Pixel CMOS AF Explained	April 27, 2018	Canon	Canon	SAM-W&W_00024601-SAM-W&W_00024610

Title	Publication Date	Author(s)	Publisher	Bates Range
Pixel Technology for Improving IR Quantum Efficiency of Backsideilluminated CMOS Image Sensor	2019	Park et al.	International Image Sensors Society (IISS)	SAM-W&W_00035483-SAM-W&W_00035486
Canon Technology Explainer: What is Dual Pixel CMOS AF?	December 16, 2022	Canon	Snapshot	SAM-W&W_00024614-SAM-W&W_00024631
CMOS Sensor Inc: About | LinkedIn	July 18, 2024	CMOS Sensor Inc.	LinkedIn	SAM-W&W_00037152-SAM-W&W_00037154
Intel 971 PC Camera Kit (1997)	2024	Digitalkamera Museum	Digitalkamera Museum	SAM-W&W_00034748-SAM-W&W_00034748
Intro to Dual Pixel Autofocus (DPAF)	2025	Winston	Canon	SAM-W&W_00026594-SAM-W&W_00026603
DUAL PIXEL CMOS AF	2025	EOS Magazine	EOS Magazine	SAM-W&W_00025478-SAM-W&W_00025484
Everything you wanted to know about autofocus (AF)	2025	Canon	Canon	SAM-W&W_00026360-SAM-W&W_00026379

Defendants further incorporate by reference all "U.S. Patent Documents" and "Other Publications" cited on the face of the Patents-in-Suit. Any citation to one or more of the above prior art references, or other prior art references regarding any method or system, should be construed to constitute not only a citation to the prior art reference itself, but also a reference to the system itself. Discovery has only just begun in this case, and Defendants will supplement if and when more information becomes available from Plaintiff or third parties.

B. Prior Art Disclosures—Known/Use/Sales/Offers for Sale

Defendants believe that there were prior art disclosures in the form of sales, offers for sale, and/or uses by others of products that qualify as prior art under pre-AIA 35 U.S.C. § 102(a) and/or (b) or under AIA 35 U.S.C. § 102(a)(1) against one or more of the Asserted Claims of the Patents-in-Suit. The below-identified prior art products include products Defendants are currently aware of through an on-going diligent and reasonable investigation at this early stage of discovery and/or based on publicly available information. Details regarding such offers for sale and public uses may be within the possession of third parties. As discovery progresses, Defendants intend and reserve the right to promptly supplement and/or amend the lists below to include additional prior art products that anticipate and/or render obvious the asserted claims. To the extent Plaintiff contends that any systems presented below do not qualify as prior art to one or more Patents-in-Suit, Defendants reserve the right to rely on any of such systems as evidence of simultaneous development as an indicia of obviousness.

Table 3: Prior Art Products

System	Sale or Use Date
Intel Corp.'s 971 PC Camera Kit including CMOS Image Sensor for "portable PC cameras for home and business users"	At least as early as November 3, 1997
OMNIVISION Technologies, Inc.'s CMOS Image Sensors, including 1.3-Megapixel CMOS Image Sensors, OV8610 and OV8110 SVGA Sensors, OV5116 TV Sensor, OV6630 and OV6130 CIF Sensors.	At least as early as April 23, 2001
CMOS Image Sensor, Inc.'s CMOS image sensors.	At least as early as May 3, 2002
SiOnyx XQE CMOS sensors, including XQE-1310, XQE-0920, XQE-0570	At least as early as 2013

System	Sale or Use Date
Natcore black silicon solar cells	At least as early as 2012
Solar Cells with Inverted Nanopyramid Thin Crystalline Silicon Membranes for Efficient Light Trapping	At least as early as 2012
Samsung's ISOCELL products with dual-PD or similar PDAF features	At least as early as 2016
Samsung CMOS Image Sensor products with RGB Bayer or similar pixel-binning features	At least as early as 2016
Canon Dual Pixel Autofocus CMOS sensor products	At least as early as 2013
DARPA infrared detector	At least as early as 2012
Sony CMOS Image Sensors	At least as early as 2008

For the public uses identified herein, Defendants are investigating the identities of the individuals who knew about and/or were involved in the making, first public use, offer for sale and/or sale of these products and systems. Defendants are also investigating the exact date that these products and systems were first made, first publicly used, offered for sale and/or sold. In addition, Defendants are currently investigating the dates of conception and reduction to practice of these products and systems and when these products and systems were first known or used by others.

In the course of their investigation, Defendants may identify additional prior art documents describing these products, systems, and/or disclosures that may also anticipate and/or render obvious as invalidating printed publications. Any citation to one or more of prior art references regarding these products, systems, and/or disclosures should be construed to constitute not only a citation to the prior art reference itself, but also a reference to the associated products, systems, and/or disclosures.

5. ’084 Patent

Table 8: Exemplary Anticipatory and Combinations for the Asserted Claims of the ’084 Patent

Chart	Prior Art References
E1	Obara either alone or in combination with one or more of Kuboi, Carey, Makita, Hasegawa, Okamoto, Chen, Guo, Yahaya, Murakami, Meng, Zaidi, Prinja, NXP, Harada, Masamitsu, and Hsu.
E2	Harada either alone or in combination with one or more of Obara, Kuboi, Okandan, Carey, Makita, Hasegawa, Okamoto, Chen, Guo, Yahaya, Murakami, Meng, Zaidi, Prinja, Masamitsu, and NXP.
E3	Carey either alone or in combination with one or more of Obara, Haddad, Kuboi, Makita, Hasegawa, Okamoto, Chen, Guo, Yahaya, Murakami, Meng, Zaidi, Prinja, NXP, Den, Harada, and Shigeta.
E4	NXP either alone or in combination with one or more of Obara, Kuboi, Carey, Makita, Hasegawa, Okamoto, Chen, Guo, Yahaya, Murakami, Meng, Zaidi, Prinja, Masamitsu, Shigeta, Den, De, Harada, Hsu, .
E5	Kuboi either alone or in combination with one or more of Obara, Makita, Hasegawa, Okamoto, Chen, Guo, Yahaya, Murakami, Shigeta, Meng, Zaidi, Prinja, Okandan, NXP, Masamitsu, and Den.
E6	Makita either alone or in combination with one or more of Obara, Kuboi, Hasegawa, Chen, Guo, Yahaya, Murakami, Meng, Zaidi, Prinja, Okandan, NXP, Masamitsu, Den, Hsu, and Shigeta.
E7	CMOS Product either alone or in combination with one or more of Obara, Carey, Makita, Kuboi, Hasegawa, Okamoto, Chen, Guo, Yahaya, Murakami, NXP, Hsu, and Harada.
E8	DARPA Product either alone or in combination with one or more of Obara, Carey, Makita, Kuboi, Hasegawa, Okamoto, Chen, Guo, Yahaya, Murakami, NXP, Hsu, and Harada.
E9	Sony CMOS Sensor either alone or in combination with one or more of Obara, Carey, Makita, Kuboi, Hasegawa, Okamoto, Chen, Guo, Yahaya, Murakami, Meng, Zaidi, Prinja, Okandan, NXP, Masamitsu, Den, and Hsu
E10	Beausoleil either alone or in combination with one or more of Abad, Obara, Makita, Hasegawa, Okamoto, Chen, Guo, Yahaya, Murakami, Meng, Zaidi, Prinja, NXP, Harada, Shigeta, Den, and Hsu.

The prior art identified above, and in the attached ’084 charts, individually anticipate and/or can properly be combined in multiple ways to demonstrate the obviousness of the Asserted Claims of the ’084 patent. Various combinations of the references would have naturally been considered as part of the exercise of ordinary skill by one skilled in the art. The references disclosed in the attached charts and herein are also directed to the same or similar features as the purported invention claimed in the Asserted Claims of the ’084 patent. To the extent Plaintiff contends that any of these features solved a problem in the art, the references cited herein show that that problem was known to those of ordinary skill and had already been solved using obvious solutions.

To that end, the Asserted Claims of the ’084 patent simply combine elements already disclosed and well known in the art and yield no more than what one skilled in the art would have expected from such a combination. For example, with respect to the ’084 patent, when confronted with the alleged problems described in the ’084 patent, one of ordinary skill in the art at the time of the alleged invention would have been motivated to consider the techniques taught by the prior art cited in these Invalidity Contentions. Consideration of the teachings of this prior art, both individually and in combination, would necessarily lead to the alleged invention claimed in the ’084 patent. This is demonstrated by the cited prior art, which disclose all of the elements of the Asserted Claims of the ’084 patent, as well as motivations to modify or combine their individual teachings. One of skill in the art would have been motivated to either modify the prior art identified in the claim charts or to combine that prior art in the manner indicated by, for example, their background knowledge, design incentives, effects of demands known to the design community, or other market forces. Moreover, the cited prior art share commonalities. To the extent it is argued that any cited prior art does not expressly disclose a particular claim or element, it would have

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CERTIFICATE OF SERVICE

The undersigned hereby certifies that on May 30, 2025, copies of the foregoing Defendants' Supplemental Invalidity Contentions and Exhibits have been served to Plaintiff through its counsel of record via email.

/s/ Seth D. Katz
Seth D. Katz
Case Manager