IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF DELAWARE

ELM 3DS INNOVATIONS, LLC, a Delaware limited liability company, Plaintiff, v. SAMSUNG ELECTRONICS CO., LTD., a Korean business entity, SAMSUNG SEMICONDUCTOR, INC., a California corporation, SAMSUNG ELECTRONICS AMERICA, INC., a New York corporation, and SAMSUNG AUSTIN SEMICONDUCTOR, LLC, a Delaware limited liability company, Defendants.	C.A. No. 14-cv-1430-LPS-CJB **Jury Trial Demanded**

SECOND AMENDED COMPLAINT FOR PATENT INFRINGEMENT

Plaintiff Elm 3DS Innovations, LLC ("Plaintiff" or "Elm 3DS"), by its attorneys, for its complaint against Defendants Samsung Electronics Co., Ltd., and its U.S. subsidiaries and related entities Samsung Semiconductor, Inc., Samsung Electronics America, Inc., and Samsung Austin Semiconductor, LLC (individually or collectively "Defendants" or "Samsung") hereby supplements its First Amended Complaint (D.I. 18) and alleges as follows:

INTRODUCTION

1. This is an action for patent infringement under the Patent Laws of the United States, 35 U.S.C. § 1 et seq., for infringing the following Elm 3DS patents:

(a) U.S. Patent No. 7,193,239 ("Leedy '239 patent"), entitled "Three Dimensional Structure Integrated Circuit," owned by Elm 3DS Innovations, LLC (attached as Ex. 1);

(b) U.S. Patent No. 7,474,004 ("Leedy '004 patent"), entitled "Three Dimensional Structure Memory," owned by Elm 3DS Innovations, LLC (attached as Ex. 2);

(c) U.S. Patent No. 7,504,732 ("Leedy '732 patent"), entitled "Three Dimensional Structure Memory," owned by Elm 3DS Innovations, LLC (attached as Ex. 3);

(d) U.S. Patent No. 8,410,617 ("Leedy '617 patent"), entitled "Three Dimensional Structure Memory," owned by Elm 3DS Innovations, LLC (attached as Ex. 4);

(e) U.S. Patent No. 8,629,542 ("Leedy '542 patent"), entitled "Three Dimensional Structure Memory," owned by Elm 3DS Innovations, LLC (attached as Ex. 5);

(f) U.S. Patent No. 8,653,672 ("Leedy '672 patent"), entitled "Three Dimensional Structure Memory," owned by Elm 3DS Innovations, LLC (attached as Ex. 6);

(g) U.S. Patent No. 8,796,862 ("Leedy '862 patent"), entitled "Three Dimensional Structure Memory," owned by Elm 3DS Innovations, LLC (attached as Ex. 7);

(h) U.S. Patent No. 8,841,778 ("Leedy '778 patent"), entitled "Three Dimensional Memory Structure," owned by Elm 3DS Innovations, LLC (attached as Ex. 8).

(i) U.S. Patent No. 8,907,499 ("Leedy '499 patent"), entitled "Three Dimensional Structure Memory," owned by Elm 3DS Innovations, LLC (attached as Ex. 9);

(j) U.S. Patent No. 8,928,119 ("Leedy '119 patent"), entitled "Three Dimensional Structure Memory," owned by Elm 3DS Innovations, LLC (attached as Ex. 10);

(k) U.S. Patent No. 8,933,570 ("Leedy '570 patent"), entitled "Three Dimensional Structure Memory," owned by Elm 3DS Innovations, LLC (attached as Ex. 11); and

(l) U.S. Patent No. 8,791,581 ("Leedy '581 patent"), entitled "Three Dimensional Structure Memory," owned by Elm 3DS Innovations, LLC (attached as Ex. 12).

2. The Elm 3DS patents cover foundational semiconductor technologies in the design and manufacture of three-dimensional integrated circuits such as memory, processors, and image sensors. These fundamental technologies reduce manufacturing costs while improving speed and efficiency. Among other things, the Elm 3DS patents disclose technologies that enable

semiconductor manufacturers to stack multiple integrated circuits ("die") on top of one another within one integrated circuit package, and to form interconnect circuitry for communication among the stacked die, including interconnect circuitry passing through silicon substrates in stacked integrated circuits.

3. Samsung has infringed and continues to infringe the Elm 3DS patents, directly and indirectly, by making using, selling, offering for sale, and/or importing into the United States, semiconductor products with multiple stacked die and/or electronics products containing the same; and by encouraging third parties to use, sell, offer for sale, and/or import into the United States, Samsung semiconductor products with multiple stacked die and/or electronics products containing the same, with knowledge of the Elm 3DS patents and in the infringement resulting therefrom.

4. Elm 3DS incorporates by reference "Elm's Disclosure of Asserted Claims and Infringement Contentions," served on Samsung 11/20/2015.

THE PARTIES

5. Elm 3DS Innovations, LLC, is a Delaware limited liability company with its principal address at 26147 Carmelo Street, Carmel, California 93923. Elm 3DS owns patents, originally issued to its President, inventor Glenn J. Leedy, covering Mr. Leedy's groundbreaking technology for thinning, vertically stacking and interconnecting integrated circuits.

6. Samsung Electronics Co., Ltd. ("SEC") is a Korean business entity that lists its global headquarters as 129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, Republic of Korea. On information and belief, SEC is the global leader in the electronics market, which includes computer memory and consumer electronics products such as mobile phones and tablet computers. On information and belief, SEC is the second largest semiconductor manufacturer in the world, and the leader in DRAM, NAND Flash, solid state drives ("SSDs"), mobile DRAM and graphics memory. On information and belief, SEC designs, manufactures, has manufactured, uses, offers for sale, sells

and/or imports into the United States—including into Delaware—billions of dollars of computer memory and consumer electronics each year.

7. Samsung Electronics America, Inc. ("SEA") is a New York corporation that lists its headquarters as 85 Challenger Road, Ridgefield Park, New Jersey 07660. SEA is a wholly-owned subsidiary of SEC. On information and belief, SEA markets, uses, offers for sale, sells and/or imports into the United States—including into Delaware—various electronics products including, plasma TVs and cameras; computer monitors, laser printers and solid state drives; and handheld wireless smartphones.

8. Samsung Semiconductor, Inc. ("SSI") is a California corporation that lists its headquarters as 3655 North First Street, San Jose, California 95134. SSI is a wholly- owned subsidiary of SEC. On information and belief, SSI manufactures, has manufactured, uses, offers for sale, sells and/or imports into the United States—including into Delaware—various semiconductor products including DRAM, NAND Flash, SSDs, mobile DRAM, graphics memory, and system logic.

9. Samsung Austin Semiconductor, LLC ("SAS") is a Delaware limited liability company that lists its headquarters as 12100 Samsung Boulevard, Austin, TX 78754. On information and belief, SAS operates as a subsidiary of SSI. On information and belief, SAS operates a semiconductor fabrication plant in Austin, TX, where it manufactures, has manufactured, uses, offers for sale, sells and/or imports into the United States—including into Delaware—NAND flash memory and system logic.

JURISDICTION

10. This is an action for patent infringement, over which this Court has subject matter jurisdiction pursuant to 28 U.S.C. §§ 1331 and 1338(a).

11. This Court has personal jurisdiction over each of the Defendants consistent with the requirements of the Due Process Clause of the United States Constitution and the Delaware Long Arm Statute. On information and belief, each Defendant transacts substantial business in Delaware, and/or has committed and continues to commit acts of patent infringement in Delaware as alleged in this Complaint. In addition, Samsung Telecommunications America, LLC and Samsung Austin Semiconductor, LLC are incorporated under the laws of Delaware. Further, on information and belief, the Defendants have admitted or not contested proper personal jurisdiction in this District in other patent infringement actions.

VENUE

12. Venue is proper in this District pursuant to 28 U.S.C. §§ 1391 (b)-(d) and 1400(b) because Defendants are subject to personal jurisdiction in this District, each has committed acts of patent infringement in this District, each has purposefully availed itself of the rights and benefits of Delaware law and regularly does and solicits business in Delaware, and each derives substantial revenue from things used or consumed in this District. Further, on information and belief, the Defendants have admitted or not contested proper venue in this District in other patent infringement actions.

FACTUAL BACKGROUND

I. The Elm 3DS Patents

13. Plaintiff solely owns all rights, titles, and interests in and to the following United States patents (collectively, the "Elm 3DS Patents"), including the exclusive rights to bring suit with respect to any past, present, and future infringement thereof:

(a) U.S. Patent No. 7,193,239 ("Leedy '239 patent"), entitled "Three Dimensional Structure Integrated Circuit," which was duly and legally issued on March 20, 2007, from a patent application filed July 3, 2003, with Glenn J. Leedy as the named

inventor. The Leedy '239 patent claims priority from U.S. Patent No. 5,915,167, which was duly and legally issued on June 22, 1999, from a patent application filed on April 4, 1997, with Glenn J. Leedy as the named inventor;

(b) U.S. Patent No. 7,474,004 ("Leedy '004 patent"), entitled "Three Dimensional Structure Memory," which was duly and legally issued on January 6, 2009, from a patent application filed December 18, 2003, with Glenn J. Leedy as the named inventor. The Leedy '004 patent claims priority from U.S. Patent No. 5,915,167, which was duly and legally issued on June 22, 1999, from a patent application filed on April 4, 1997, with Glenn J. Leedy as the named inventor;

(c) U.S. Patent No. 7,504,732 ("Leedy '732 patent"), entitled "Three Dimensional Structure Memory," which was duly and legally issued on March 17, 2009, from a patent application filed August 19, 2002, with Glenn J. Leedy as the named inventor. The Leedy '732 patent claims priority from U.S. Patent No. 5,915,167, which was duly and legally issued on June 22, 1999, from a patent application filed on April 4, 1997, with Glenn J. Leedy as the named inventor;

(d) U.S. Patent No. 8,410,617 ("Leedy '617 patent"), entitled "Three Dimensional Structure Memory," which was duly and legally issued on April 2, 2013, from a patent application filed July 4, 2009, with Glenn J. Leedy as the named inventor. The Leedy '617 patent claims priority from U.S. Patent No. 5,915,167, which was duly and legally issued on June 22, 1999, from a patent application filed on April 4, 1997, with Glenn J. Leedy as the named inventor;

(e) U.S. Patent No. 8,629,542 ("Leedy '542 patent"), entitled "Three Dimensional Structure Memory," which was duly and legally issued on January 14, 2014, from a patent application filed March 17, 2009, with Glenn J. Leedy as the named inventor.

The Leedy '542 patent claims priority from U.S. Patent No. 5,915,167, which was duly and legally issued on June 22, 1999, from a patent application filed on April 4, 1997, with Glenn J. Leedy as the named inventor;

(f) U.S. Patent No. 8,653,672 ("Leedy '672 patent"), entitled "Three Dimensional Structure Memory," which was duly and legally issued on February 18, 2014, from a patent application filed May 27, 2010, with Glenn J. Leedy as the named inventor. The Leedy '672 patent claims priority from U.S. Patent No. 5,915,167, which was duly and legally issued on June 22, 1999, from a patent application filed on April 4, 1997, with Glenn J. Leedy as the named inventor;

(g) U.S. Patent No. 8,796,862 ("Leedy '862 patent"), entitled "Three Dimensional Structure Memory," which was duly and legally issued on August 5, 2014, from a patent application filed August 9, 2013, with Glenn J. Leedy as the named inventor. The Leedy '862 patent claims priority from U.S. Patent No. 5,915,167, which was duly and legally issued on June 22, 1999, from a patent application filed on April 4, 1997, with Glenn J. Leedy as the named inventor;

(h) U.S. Patent No. 8,841,778 ("Leedy '778 patent"), entitled "Three Dimensional Memory Structure," which was duly and legally issued on September 23, 2014, from a patent application filed August 9, 2013, with Glenn J. Leedy as the named inventor. The Leedy '778 patent claims priority from U.S. Patent No. 5,915,167, which was duly and legally issued on June 22, 1999, from a patent application filed on April 4, 1997, with Glenn J. Leedy as the named inventor;

(i) U.S. Patent No. 8,907,499 ("Leedy '499 patent"), entitled "Three Dimensional Structure Memory," which was duly and legally issued on December 9, 2014, from a patent application filed January 4, 2013, with Glenn J. Leedy as the named inventor.

The Leedy '499 patent claims priority from U.S. Patent No. 5,915,167, which was duly and legally issued on June 22, 1999, from a patent application filed on April 4, 1997, with Glenn J. Leedy as the named inventor;

(j) U.S. Patent No. 8,928,119 ("Leedy '119 patent"), entitled "Three Dimensional Structure Memory," which was duly and legally issued on January 6, 2015, from a patent application filed March 17, 2009, with Glenn J. Leedy as the named inventor. The Leedy '119 patent claims priority from U.S. Patent No. 5,915,167, which was duly and legally issued on June 22, 1999, from a patent application filed on April 4, 1997, with Glenn J. Leedy as the named inventor;

(k) U.S. Patent No. 8,933,570 ("Leedy '570 patent"), entitled "Three Dimensional Structure Memory," which was duly and legally issued on January 13, 2015, from a patent application filed March 17, 2009, with Glenn J. Leedy as the named inventor. The Leedy '570 patent claims priority from U.S. Patent No. 5,915,167, which was duly and legally issued on June 22, 1999, from a patent application filed on April 4, 1997, with Glenn J. Leedy as the named inventor; and

(l) U.S. Patent No. 8,791,581 ("Leedy '581 patent"), entitled "Three Dimensional Structure Memory," which was duly and legally issued on July 29, 2014, from a patent application filed October 23, 2013, with Glenn J. Leedy as the named inventor. The Leedy '581 patent claims priority from U.S. Patent No. 5,915,167, which was duly and legally issued on June 22, 1999, from a patent application filed on April 4, 1997, with Glenn J. Leedy as the named inventor.

Each of the Elm 3DS Patents is valid and enforceable.

14. The Elm 3DS Patents disclose three-dimensional integrated circuit structures and methods for manufacturing the same. In one exemplary embodiment, the patents disclose a three-

dimensional structure with thinned and polished integrated circuit substrates that are stacked on top of one another and electrically connected. The disclosed technology enhances memory speed and efficiency because the signal paths are shorter. The disclosed technology also improves memory density because multiple storage arrays can be stacked within a single package that meets industry form-factor requirements. Industry implementations are referred to as "stacked" memories that are electrically connected with either wire bonds or through-silicon vias ("TSV").

II. The Inventor

15. Glenn J. Leedy is the sole named inventor on the Elm 3DS Patents. Mr. Leedy had been involved in the information technology industry since the 1960s. Working first for established IT companies such as IBM and Fairchild Semiconductor, and eventually as an independent inventor, Mr. Leedy had consistently developed essential technologies that have significantly advanced the state of the art. Today, Mr. Leedy's foundational inventions are used in literally billions of semiconductor products around the world.

16. Mr. Leedy graduated from the University of Michigan with a degree in Mathematics, in 1968.

17. After working at IBM, the University of Michigan, Sycor and ComShare, Mr. Leedy joined Digital Equipment Corporation ("DEC") in 1976. While there, Mr. Leedy assisted in the design of DEC's first 32-bit minicomputer, and in the development of the first 16-bit microprocessor. Mr. Leedy also invented a solution for providing high-speed backup and restore for large databases, an advance in the technology that saved DEC and its customers millions of dollars.

18. Mr. Leedy joined Fairchild Semiconductor in 1978. While there, Mr. Leedy assisted in the development of gate-array programmable logic products. Mr. Leedy's time at Fairchild also provided him with the opportunity to become familiar with the semiconductor fabrication processes used to manufacture the integrated circuits he helped design.

19. In 1981, Mr. Leedy joined National Semiconductor. While there, Mr. Leedy assisted in the development of the computer industry's first 32-bit microprocessor.

20. In 1983, Mr. Leedy left National Semiconductor to start his own business: American Information Systems ("AIS"). Mr. Leedy formed his own business to continue inventing but with independent creative control and ownership of his inventions.

21. Under Mr. Leedy's direction, AIS developed and sold a 32-bit minicomputer. The minicomputer used the 32-bit National Semiconductor microprocessor Mr. Leedy had helped develop, and the minicomputer was instantly popular because it cost a fraction of the 32-bit DEC minicomputer Mr. Leedy worked on for his prior employer. AIS was short-lived, however, as National Semiconductor decided to cease manufacture and development of its 32-bit microprocessor. Without an affordable alternative 32-bit processor on the market, AIS' cost-performance advantage disappeared and it was forced to shut down.

22. After AIS, Mr. Leedy worked for General Research for several years before again going into business for himself in 1989. Mr. Leedy then devoted himself to finding solutions to the various technological challenges he had encountered during his two decades in the IT industry. Over the next few years, Mr. Leedy developed the technologies underlying two patent portfolios that disclose and claim foundational inventions found in modern semiconductors the world over.

23. In the early 1990s, Mr. Leedy applied for and received a portfolio of patents built around his Membrane Dielectric Isolation ("MDI") technology. The MDI technology uses a thin, flexible membrane of dielectric material to electrically isolate semiconductor devices such as transistors, which can then be used to form test circuitry.

24. Mr. Leedy developed the MDI technology in an effort to develop a semiconductor-grade dielectric that could serve as a membrane for testing bare integrated circuits. Mr. Leedy first worked on integrated circuit fabrication equipment in the basement of a friend, and later with an

integrated circuit equipment manufacturer. One key aspect of the MDI technology was Mr. Leedy's development of a tensile low-stress dielectric that could be fabricated into a flexible, free-standing membrane. The ductile characteristics of the novel membrane permitted "at speed" testing of integrated circuits while in wafer form.

25. Mr. Leedy's MDI technology enabled testing methods and devices that ultimately became essential components in the semiconductor manufacturing process, a fact validated by Mr. Leedy's sale of the MDI patent portfolio in 2008 to Taiwan Semiconductor Manufacturing Co., the world's largest semiconductor foundry.

26. Following the successful development of his MDI technology, Mr. Leedy next applied for and received a portfolio of patents built around his Three-Dimensional Stacked "3DS" integrated circuit technology. The 3DS technology uses thinned, polished, flexible substrates to form vertical stacks of integrated circuits that are connected to one another using either wire-bonds, or vertical interconnects that pass through the stacked substrates.

27. Mr. Leedy developed the 3DS technology in an effort to solve the processor-memory bottleneck—a longstanding barrier in computer-system design. The bottleneck arises when a computer's processor is able to request and process data faster than the memory is able to provide it. Mr. Leedy believed that building the memory vertically, by stacking memory circuits on top of each other, rather than laying the memory circuits out horizontally, would shorten the electrical paths used to read and write data, thereby improving memory read/write speeds. Mr. Leedy was the first to understand that, in order to obtain an acceptable yield when stacking and connecting multiple thinned and polished integrated circuits, one needed to use a tensile low-stress dielectric layer to retain the structural integrity of the thinned and polished substrates. This prevented the substrates from cracking or warping, which can cause "bad" die.

28. Mr. Leedy maintained control over the Elm 3DS portfolio until his passing in July 2017, as Elm 3DS's President, and was extremely active in its development. In preparing the 3DS technology for patenting, Mr. Leedy drafted a rich specification that provides— among other things—a detailed account of the technical aspects of his inventions, the benefits associated with the inventions, and various embodiments of the inventions. The disclosures in the specification have provided enormous benefit to the semiconductor industry, and also permitted Mr. Leedy to claim the technical aspects of his inventions across the portfolio in many different ways that the semiconductor industry can understand. He continued to prosecute a number of patent applications that arose from his groundbreaking inventions until July 2017.

29. Mr. Leedy's 3DS technology has allowed semiconductor manufacturers to improve performance and to lower the "cost-per-bit" of memory storage. Using thin integrated circuits allows manufacturers to stack multiple integrated circuits in a single industry-standard package with a thickness of 1.2 mm, a feature demanded by form- factor sensitive industries such as servers and smartphones. Further, using vertical interconnects improves memory speed, reduces power consumption, and shrinks the integrated circuit footprint.

30. Presently, all three leading memory manufacturers—Samsung, SK Hynix and Micron—use Mr. Leedy's 3DS technology in various stacked semiconductor products. And in the future the industry's adoption of Mr. Leedy's 3DS technology will become more widespread, as the cost of propagating Moore's Law and fitting more and more transistors on a single silicon die becomes increasingly cost-prohibitive.

31. In 2006, the transistor design node used to fabricate leading microprocessors was 65 nm. Today, the transistor design node used to fabricate leading microprocessors is 22 nm. According to one industry report, constructing a semiconductor fabrication facility at the 65 nm transistor design node cost under $3 billion, and designing a chip for fabrication on the 65 nm node cost

under $50 million. http://www.eetimes.com/author.asp?section_id=36&doc_id=1323755 (last accessed Nov. 20, 2014) (attached as Ex. 13). According to the same report, constructing a semiconductor fabrication facility at the 22 nm node cost nearly $9 billion, and designing a chip for fabrication on the 22 nm node cost nearly $150 million.

32. Mr. Leedy's 3DS technology provides the solution to the compounding cost of semiconductor fabrication at smaller transistor nodes, by providing semiconductor manufacturers with the technologies needed to continue delivering faster, denser, and more efficient memories—it allows the manufacturers to expand memory up rather than out. The manufacturers' adoption of this technology can be seen in their development of technologies such stacked NAND flash, the Hybrid Memory Cube ("HMC"), and TSV.

III. The Meeting With Defendants

33. Mr. Leedy personally met with Samsung America's President in 2000 or 2001, shortly after issuance of the '167 patent, the first in the 3DS family of patents, in 1999. During the meeting, Mr. Leedy provided Samsung America's President with a slide presentation and a copy of the '167 patent, and explained the benefits of the patented technology. Mr. Leedy also explained that the technology was available to a limited number of licensees. Terms were not discussed, and a license agreement was never reached.

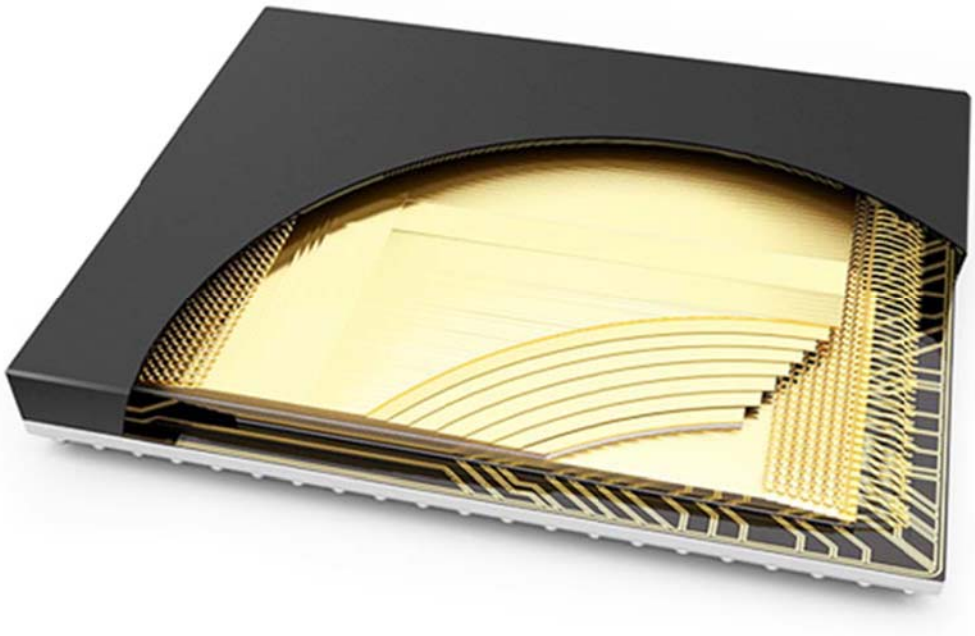
IV. The Defendants' Direct Infringement

34. Despite not having a license to Mr. Leedy's 3DS technology, Defendants have widely used it in their stacked memory products. Evidence of Defendants' infringement can be found on their website, at www.samsung.com, where Defendants describe their stacked semiconductor products.

35. According to Samsung's website, it uses "High-density Packaging Technology for Flash memory products, which stacks individual memory chips on top of one another within a

single package with a low-profile, enabling the production of flash memory devices with the highest densities and storage capacities." Samsung further states that "Internally, the die stack design for the flash memorystack [sic] is critical factors[sic] to determine the packaging yield, its reliability of products, and its form factor." *See* http://www.samsung.com/global/business/semiconductor/support/package-info/package-datasheet/flash (last accessed Nov. 20, 2014) (attached as Ex. 14).

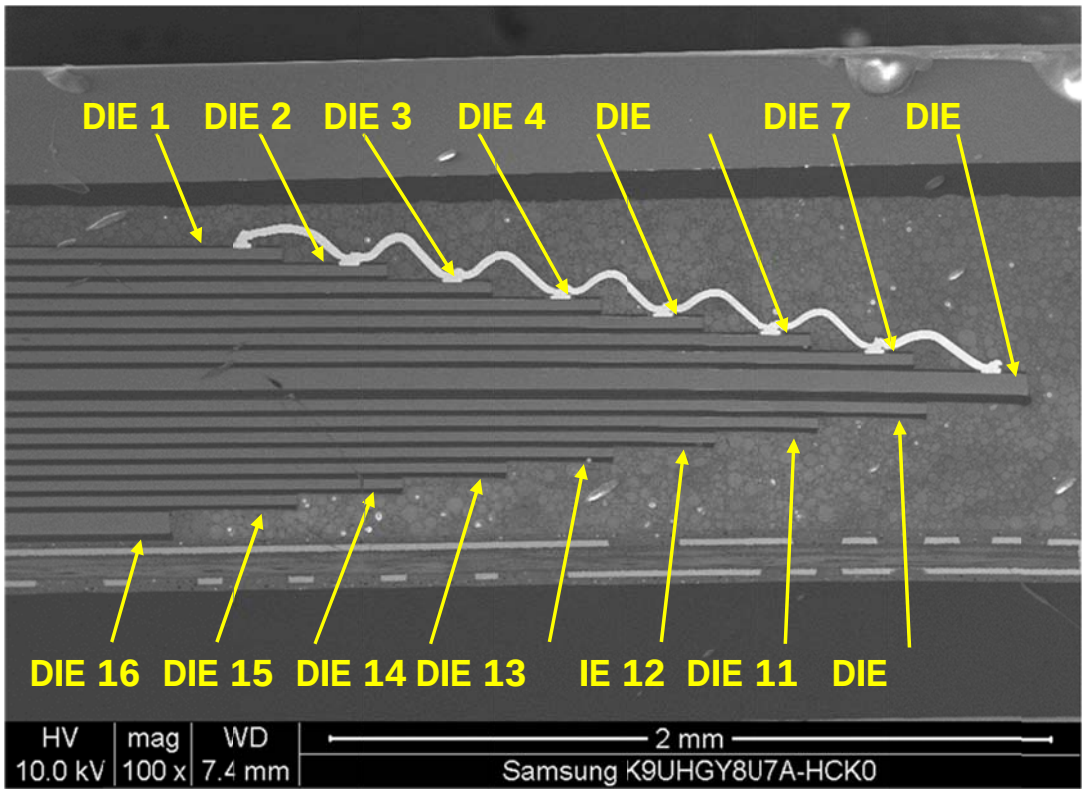
36. Samsung's website represents that the "The immediate advantage of this [die-stacking] approach is a significant saving in the total area occupied by the memory device. The die stack design is thus extensively used in flash memory for applications where space is severely restricted, such as mobile handsets, SSDs, and memory cards, among others." This technology "is resulting in faster and higher capacity nonvolatile storage devices, such as solid state drives." *See* Ex. 14. Samsung provides the following image of its die-stack design



37. According to Samsung, the die-stacking technology allows it to provide the following benefits:

- Ultra-high memory densities – Samsung flash memory is the highest density flash memory across the electronics and semiconductor segment. Samsung supplies 128 GB flash memory devices internally organized as 16-stack MCP flash memory, with 64 Gb per die.
- Lowest footprints and thinnest profiles – Samsung provides the smallest packages for all types of flash memory. Samsung's processes make it easier to deploy the memory device in space-constrained applications such as SSD modules of notebooks, tablets and mobile handsets.

38. An example of Samsung's die-stacking technology in Flash NAND memory is shown below:



39. Samsung's website also describes its 3D V-NAND technology, which, in addition to stacking die vertically, stacks memory cells vertically. *See* http://www.samsung.com/global/business/semiconductor/html/product/flash-

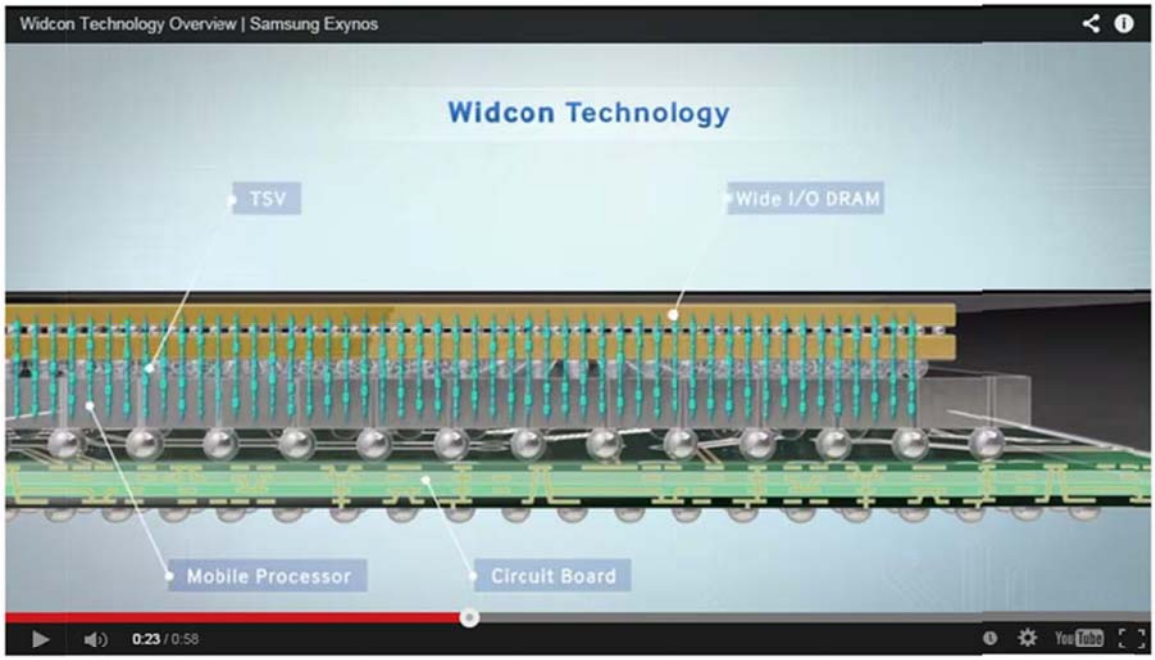
solution/vnand/overview.html (last accessed Nov. 20, 2014) (attached as Ex. 15). On information and belief, Samsung offers 3D V-NAND in 2 stack, 4-stack, 8-stack and 16-stack configurations.

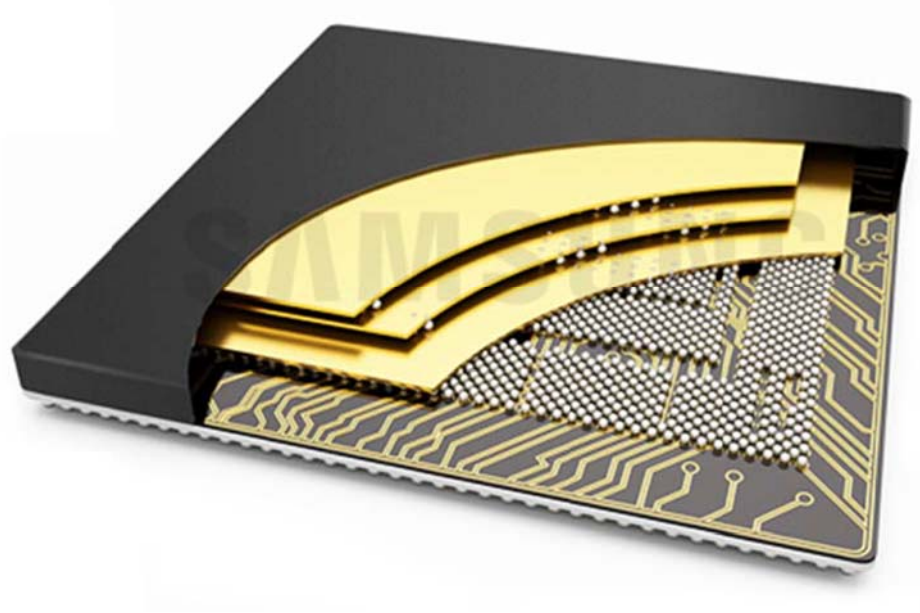
40. Samsung's website also discusses stacked memories in the context of its DRAM products. According to Samsung, the Flip Chip technology used in its DRAM packages means the products are suitable for future packaging technologies such as TSV. http://www.samsung.com/global/business/semiconductor/support/package-info/package-datasheet/dram (last accessed Nov. 20, 2014) (attached as Ex. 16).

41. Samsung has represented that it is using TSV technology in its Wide IO Memory Solutions. According to a presentation, Samsung stated that it was applying 3D TSV to Logic and Wide IO Memory. http://www.samsung.com/us/business/oem-solutions/pdfs/Web_DAC2012_TSV_demo-ah.pdf (last accessed Nov. 20, 2014) (attached as Ex. 17).

42. One example of Samsung's use of Wide IO technology with TSV—marketed as Widcon – is its Exynos 5 Octa processor. Samsung states that TSV provides better energy efficiency, higher bandwidth, maximum performance even at low clock speeds, and superior thermal dissipation for full performance at low power. http://www.samsung.com/global/business/semiconductor/minisite/Exynos/w/solution.html#?v=octa_widcon (last accessed Nov. 20, 2014) (attached as Ex. 18).

43. Samsung's website provides the following illustrations and videos describing the Widcon technology in its Exynos Octa processors





http://www.samsung.com/global/business/semiconductor/support/package-info/package-datasheet/application-processor (last accessed Nov. 20, 2014) (attached as Ex. 19).

44. Samsung has also represented that it is using TSV technology in some of its new DDR4 DRAM memory modules. According to a press release, "To build a 3D TSV DRAM package, the DDR4 dies are ground down as thin as a few dozen micrometers, then pierced to contain hundreds of fine holes. They are vertically connected through electrodes that are passed through the holes. As a result, the new 64GB TSV module performs twice as fast as a 64GB module that uses wire bonding packaging, while consuming approximately half the power." http://www.samsung.com/global/business/semiconductor/news-events/press-releases/detail?newsId=13602 last accessed Nov. 20, 2014) (attached as Ex. 20).

45. Further, "Samsung, has worked on improving 3D TSV technology since it developed 40nm-class 8GB DRAM RDIMMs in 2010 and 30nm-class 32GB DRAM RDIMMs in 2011 using 3D TSV. This year, Samsung started operating a new manufacturing system dedicated to TSV packaging, for mass producing the new server modules." *See id.*

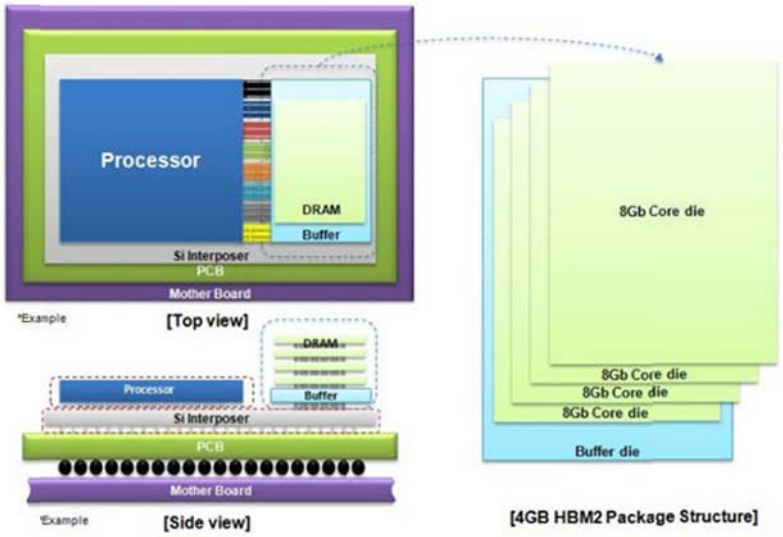
46. Samsung's use, sale, offer for sale and/or manufacture of stacked NAND, stacked DRAM, TSV and other stacked semiconductor products in the United States, and/or importation of said products into the United States, constitutes infringement of at least one of the Leedy '239, '004, '732, '617, '542, '672, '862, '778, '499, '119, and '570 patents.

47. Samsung has directly infringed, and continues to infringe, literally or under the doctrine of equivalents, one or more claims of the Elm 3DS Patents by acting without authority to make, have made, use, offer to sell, sell within the United States, and/or import into the United States, semiconductor products that practice the claimed inventions, and/or electronics products that incorporate said semiconductor products, including inter alia smartphones and solid state drives ("SSD").

48. The above-described acts of infringement committed by Defendants have caused injury and damage to Plaintiff, and will cause additional severe and irreparable injury and damages in the future.

SAMSUNG'S POST-SUIT DIRECT INFRINGEMENT

49. According to Samsung, the newly introduced HBM2 DRAM line of products "marks the latest milestone in TSV (Through Silicon Via) DRAM technology." https://news.samsung.com/global/samsung-begins-mass-producing-worlds-fastest-dram-bsed-on-newest-high-bandwidth-memory-hbm-interface (last accessed April 8, 2016) (attached as Ex. 21).



50. Specifically 4GB HBM2 DRAM devices are created "by stacking a buffer die at the bottom and four 8-gigabit (Gb) core dies on top. They are then vertically interconnected by TSV holes and microbumps." *See* Ex. 21. The 4GB HBM2 DRAM was announced in a press release on January 19, 2016. *See id.*

51. Samsung's use, sale, offer for sale and/or manufacture of the HBM2 DRAM and other stacked semiconductor products in the United States, and/or importation of said products into the United States, constitutes infringement of at least one of the Leedy '239, '004, '732, '617, '542, '672, '581, '862, '778, '499, '119, and '570 patents.

52. Samsung has directly infringed, and continues to infringe, literally or under the doctrine of equivalents, one or more claims of the Elm 3DS Patents by acting without authority to make, have made, use, offer to sell, sell within the United States, and/or import into the United States, HBM2 DRAM and other stacked semiconductor products that practice the claimed inventions, and/or electronics products that incorporate said semiconductor products, including inter alia smartphones and solid state drives ("SSD").

53. The above-described acts of infringement committed by Defendants have caused injury and damage to Plaintiff, and will cause additional severe and irreparable injury and damages in the future.

V. The Defendant's Indirect Infringement

GENERAL ALLEGATIONS

54. Samsung indirectly infringes the Elm 3DS Patents by inducing infringement by others, such as OEMs, manufacturers, importers, resellers, customers and end users under 35 U.S.C. § 271(b) in this District and elsewhere in the United States. On information and belief, Samsung has intended and continues to intend to induce patent infringement by these third parties and has had actual knowledge that the inducing acts would cause infringement or has been willfully blind to the possibility that its inducing acts would cause infringement. For example, Samsung is aware of the Elm 3DS patents, that the structural aspects of thinned, stacked, and electrically interconnected semiconductors are always present in infringing stacked semiconductor packages and cannot be modified by a purchaser of such stacked semiconductor packages and, therefore, that Samsung's customers will infringe one or more claims of the Elm 3DS Patents by incorporating such stacked semiconductor packages in other products, and that subsequent sales of such products in the United States would be a direct infringement of one or more claims of the Elm 3DS Patents.

55. On information and belief, Samsung indirectly infringes one or more claims of the Elm 3DS Patents by inducing numerous third-party OEMs, manufacturers, importers, resellers, customers, and end users to make, have made, use, sell, offer to sell in, and/or import into the United States, products that incorporate stacked semiconductor products and/or multiple semiconductor die that are thinned, stacked on top of and electrically connected to one another through vertical interconnects within a single chip package, which are manufactured by Samsung and infringe one or more claims of the Elm 3DS Patents.

56. On information and belief, Samsung has designed, marketed and sold infringing products to third parties with knowledge and the specific intent to cause the third parties to in turn make, have made, use, sell, offer to sell in, and/or import into the United States, products incorporating Samsung's stacked semiconductor products and/or multiple semiconductor die that are thinned, stacked on top of and electrically connected to one another through vertical interconnects within a single chip package.

57. On information and belief, Samsung has designed its infringing products such that, as incorporated into the products of third parties, the third-party product infringes one or more claims of the Elm 3DS Patents if made, used, sold, offered for sale in, or imported into the United States.

58. On information and belief, Samsung is aware that by making, having made, using, selling, offering to sell in, or importing into the United States products that incorporate Samsung's infringing products, these third parties directly infringe one or more claims of the Elm 3DS Patents.

59. On information and belief, Samsung is aware that these third parties include, among many others, Apple, Dell, Intel, Amazon, Microsoft, and Google; and that products they make, have made, use, sell, offer to sell in, or import into the United States, include, among many others, SSD, server hardware, and mobile devices.

SAMSUNG'S PRE-SUIT INDIRECT INFRINGEMENT

A. NOTICE OF PATENTS

60. Samsung had pre-suit notice of the '239 Patent.

61. In 2000 or 2001, Mr. Leedy provided Samsung with a presentation on the Elm 3DS technology and sent a copy of the 5,915,167 patent. The '167 Patent is the parent patent in the Elm 3DS patent portfolio. The presentation comprised several slides depicting figures from the '167 patent, and explained the benefits of the technology.

62. Upon information and belief, since 2000, Samsung followed Mr. Leedy's Elm 3DS portfolio as it obtained the patents-in-suit.

63. Further, Samsung has cited to Elm 3DS Patents, in prosecuting its own patents, for many years. For example:

(a) U.S. Patent No. 8,136,017 assigned to Samsung and issued on March 13, 2012 cites to Mr. Leedy's U.S. Patent Nos. 5,915,167; 6,133,640; 6,208,545; and 6,551,857.

(b) U.S. Patent No. 8,031,505 assigned to Samsung and issued on October 4, 2011 cites to Mr. Leedy's U.S. Patent No. 6,133,640. In all, 3 Samsung patents cite to the '640 Patent.

64. Further, the Leedy '239 patent is well-known in the semiconductor industry as it has been cited by at least 40 issued U.S. patents since 2008. These citations were on patents assigned to well-known Hynix competitors in the semiconductor field: Micron Technology, Inc., Elpida Memory, Inc.; Sanyo Electric Co., Ltd., Xilinx, Inc., Tessera, Inc., IBM Corporation, and Sharp. *See* https://www.google.com/patents/US7193239?dq=7,193,239&hl=en&sa=X&ei=_ewUVbDxC8HToASwloH4DA&ved=0CB0Q6AEwAA (last accessed March 27, 2015) (attached as Ex. 22).

65. Hynix, Samsung, Micron Technology, Inc., Xilinx, Inc., and IBM Corporation are all participants in the HMC Consortium, which is a forum of semiconductor manufacturers that have

come together for the explicit purpose of developing and adopting an industry-wide interface for DRAM memory architectures that revolves around vertical stacks of DRAM die. On information and belief, these companies discuss intellectual property relating to the HMC design as part of their work in the consortium. *See* http://www.hybridmemorycube.org/about.html (last accessed March 27, 2015) (attached as Ex. 23).

66. Additionally, Micron Technology, Inc., one of Samsung's largest competitors in the semiconductor industry, routinely cites to the Elm 3DS portfolio. For example, since 2000, 40 patents assigned to Micron have cited to at least one U.S. patent issued to Mr. Leedy and owned by Elm 3DS.

67. Micron Technology, Inc. has had actual notice of the '239 patent as of 2008 or 2013 as it included the '239 patent on Information Disclosure Statements submitted during prosecution of applications that eventually issued as U.S. patents. Further, Micron submitted a supplemental IDS in 2013 that was devoted entirely to disclosing patents and patent applications belonging to Mr. Leedy, including the '239 patent, the '542 patent, and the '672 patent.

68. Mr. Leedy's Elm 3DS patent portfolio and in particular, the '239 Patent, were frequently referenced in the semiconductor industry, and were widely and publicly known. The semiconductor industry is tight knit and highly aware of each other's action. Therefore based on industry knowledge, Samsung's meeting with Mr. Leedy in 2000 or 2001, Samsung's participation in the HMC consortium, Samsung's citation of other Elm 3DS patents, and the belief that Samsung was following the development of Mr. Leedy's 3DS patent portfolio, Samsung had pre-suit notice of the '239 patent as of the date it issued (March 20, 2007).

B. NOTICE OF HOW PRODUCTS INFRINGE

69. On information and belief, Samsung understood that its customers, companies in the computing, consumer, networking, telecommunications, and imaging markets, directly infringed the

'239 patent when they imported or sold finished electronics products containing infringing Samsung semiconductor chips in the United States. Examples of infringing electronics products include, but are not limited to, mobile phones, desktop PCs, servers, notebooks and workstations.

70. On information and belief, while Samsung was following Mr. Leedy's Elm 3DS portfolio as it obtained the patents-in-suit, Samsung engineers reviewed the specification and claims of the '239 patent as others in the industry did.

71. Claim 1 to the '239 patent reads as follows:

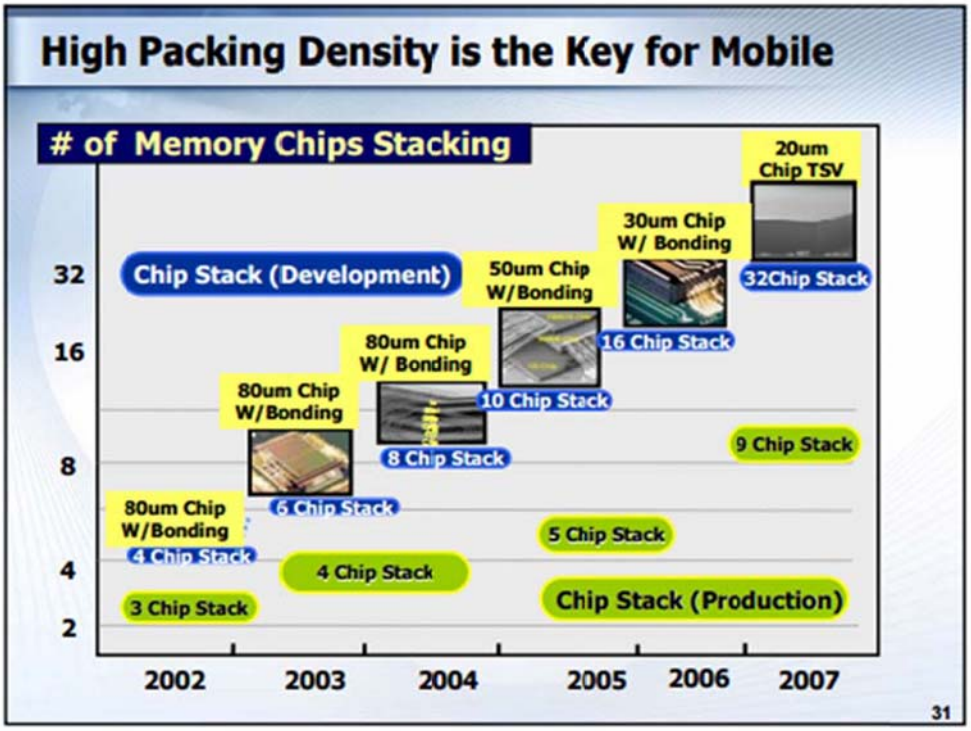
> a plurality of monolithic substrates having integrated circuits formed thereon and stacked in layers such that each layer comprises only one of the substrates, wherein at least one of the plurality of substrates is a substantially flexible substrate, and wherein a major portion of the monolithic substrate is removed; and between adjacent substrates, a bonding layer bonding together the adjacent substrates, the bonding layer being formed by bonding first and second substantially planar surfaces having a bond-forming material throughout a majority of the surface area thereof.

72. On information and belief, based on its review of the '239 patent specification and claims, Samsung understood when the '239 patent issued that the '239 patent claims cover thinned, stacked semiconductor die that are bonded together in a single package.

73. Samsung is a global manufacturer and marketer of semiconductor devices, principally DRAM and NAND Flash memory, with deep expertise in manufacturing such memory products. Thus, Samsung possessed the technical expertise required to understand the content and scope of the Leedy '239 patent.

74. On information and belief, based on its knowledge of its own products, Samsung understood when the '239 patent issued on March 20, 2007 that certain of its products comprised thinned, stacked semiconductor die that were bonded together in a single package.

75. A December 2008 presentation by Samsung Electronics Co., Ltd. entitled "Samsung Memory Technology & Solutions Roadmap" states that "high packing density is the key for mobile":



See http://www.samsung.com/sec/aboutsamsung/file/ir/irevent/analystday/2008/tech_forum_2008_002.pdf (last accessed March 26, 2015) (attached as Ex. 24).

76. The December 2008 presentation by Samsung Electronics Co., Ltd. entitled "Samsung Memory Technology & Solutions Roadmap" states that "Mobile Memory is One of Key Samsung Memory Portfolio" and that it occupied "~25% of Samsung memory business." (Ex. 24.) In 2009 or 2010, Samsung's Mobile Memories division stated in a presentation that the Handset sector was "growing at 3X faster than PCs" and that between 2009 and 2010, the Smartphone Memory Content would double. Samsung proposed to address this challenge by "dramatically increasing the memory density in the space of a single chip to enable THINnovation by packing higher density in a single die, up to 16 stacked die in a chip." *See*

http://originus.samsung.com/us/business/semiconductor/news/downloads/presMDeen.pdf (last accessed March 26, 2015) (attached as Ex. 25).

77. On information and belief, based on its knowledge of its own products and its review of the '239 patent specification and claims, Samsung understood in 2007 that certain of its products that comprised thinned, stacked semiconductor die that were bonded together in a single package infringed the '239 patent

C. NOTICE OF HOW CUSTOMERS INFRINGE

78. On information and belief, Hynix further understood in 2007 that its OEM customers were directly infringing the '239 patent when they imported into or sold in the United States, a finished product that contained thinned, stacked semiconductor die that were bonded together in a single package.

79. Samsung's 2010 Samsung Mobile Memory marketing brochure states, "Particularly well suited for today's high-performance, battery-sensitive mobile electronics, Samsung Mobile DRAM can be found in mobile phones, MP3 players, GPS devices, and digital cameras. MCPs, now designed into virtually every mobile phone, also commonly pair Mobile DRAM with NAND, PRAM, or eMMC components to maximize performance, while minimizing the memory footprint." *See* http://www.samsung.com/us/business/oem-solutions/pdfs/MobileMemory_brochure.pdf (last accessed March 27, 2015) (attached as Ex. 26).

80. On information and belief, Samsung understood that its customers including global OEMs like Apple sold finished products such as mobile phones in the United States, and imported such products into the United States.

81. On information and belief, based on its knowledge of its customers' business activities, Samsung understood that its customers would incorporate its products, including stack DRAM or NAND products, into finished electronics products sold around the world, including the

United States. In addition, based on its knowledge of its own products and its review of the '239 patent specification and claims, Samsung understood that when its customers sold finished electronics products containing Samsung stacked DRAM and NAND in the United States, or imported such electronics products into the United States, those acts constituted direct infringement of the '239 patent.

82. Samsung was aware that its stacked DRAM and NAND products cannot be used or sold in a manner that does not infringe. Samsung is aware that the infringing stacked memory products are integral components of the computer and mobile products incorporating them, that the infringing stacked memory products were built into the computer and mobile products, and cannot be removed or disabled by a purchaser of the consumer products containing the infringing circuits. Therefore, Samsung was aware that its customers would infringe one or more claims of the '239 Patent by using the products as-sold and as-marketed by Samsung, and that subsequent sales of such products in the United States would be direct infringement of the '239 patent.

D. ENCOURAGEMENT/SPECIFIC INTENT TO INDUCE THE INFRINGEMENT

83. On information and belief, Samsung actively encouraged its customers to directly infringe the '239 patent by encouraging its customers to use Samsung products comprising thinned, stacked semiconductor die that were bonded together in a single package, in their finished products, while understanding that some of those finished products would be sold in or imported into the United States.

84. Samsung's 2010 Samsung Mobile Memory brochure indicates that Samsung actively promoted the purchase and adoption of its products, including at least stacked DRAM products comprising thinned, stacked semiconductor die that were bonded together in a single package. For example, the 2010 Mobile Memory brochure states that "Performance and battery life are the key metrics upon which mobile electronics are measured. Samsung Mobile DRAM memory is optimized

to deliver on both." When referring to Multi-Chip-Packages, the brochure goes on to state that "MCPs are stacks of discrete memory die made into single packages" and that "Samsung had developed MCP technology for 2-to 16-chip stacks." Further, it states that "for its 16-die MCP, Samsung created a new wafer-thinning technology to reduce thickness to the size of a human cell—just 30 micrometers." (*See* Ex. 26.)

85. On information and belief, Samsung understood that its customers including global OEMs like Apple, Dell, Intel, Amazon, Microsoft, and Google sold finished products such as mobile phones, desktop PCs, workstations, laptops, and servers in the United States, and imported such products into the United States.

86. On information and belief, based on its knowledge of its customers' business activities, Samsung understood that its customers would incorporate its products, including stacked DRAM or NAND products, into finished electronics products sold around the world, including the United States. In addition, based on its knowledge of its own products and its review of the '239 patent specification and claims, Samsung understood that when its customers sold finished electronics products containing Samsung stacked DRAM and NAND in the United States, or imported such electronics products into the United States, those acts constituted direct infringement of the '239 patent.

87. Samsung's marketing efforts, strategic moves into the mobile market, and sales volumes all evidence its intent to induce companies to infringe one or more claims of the '239 patent. Given (1) its likely review of the '239 patent specification and claims, (2) its understanding that the '239 patent claims covered thinned, stacked semiconductor die that are bonded together in a single package, (3) its knowledge that it manufactured and sold at least stacked mobile memory products comprising thinned, stacked semiconductor die that are bonded together in a single package, (4) its knowledge that its OEM customers directly infringed by importing or selling into the

United States, a finished product that contained thinned, stacked semiconductor die that are bonded together in a single package, and (5) its sales and marketing materials encouraging third parties to include Samsung's stacked semiconductors in their products, Samsung had the specific intent to induce infringement of the '239 patent, or has been willfully blind to the direct infringement it is inducing.

SAMSUNG'S POST-SUIT INDIRECT INFRINGEMENT

A. NOTICE OF PATENTS

88. At the very latest, Samsung has had actual notice of the Leedy '239, '732,'617, '542, '672, '862, and '778 patents and of its infringement as of the date of the original Complaint [D.I. 1]. At the very latest, Samsung has had actual notice of the Leedy '004, '499, '119, and '570 patents and of its infringement as of the date of the First Amended Complaint [D.I. 18].

89. Samsung has had actual notice of the Leedy '581 patent and of its infringement at the very latest as of the date of the First Supplemental Complaint [D.I. 109].

B. NOTICE OF HOW PRODUCTS INFRINGE

90. Samsung is aware of the manner in which its stacked semiconductor products infringe the Elm 3DS Patents as set forth in paragraphs 34 – 47 of the original Complaint, at paragraphs 33 – 46 of the First Amended Complaint, and at paragraphs 34 – 53 of the First Supplemental Complaint.

C. NOTICE OF HOW CUSTOMERS INFRINGE

91. On information and belief, products sold or manufactured in the United States that incorporate Samsung's infringing stacked memory products and/or products that incorporate multiple semiconductor die that are thinned, stacked on top of and electrically connected to one another using TSV and HBM2 technology include, but by no means limited to, the Apple MacBook Pro, the Dell PowerEdge R920 server, the Intel Xeon E5–2600 v3 processor, the Amazon Fire

Phone, the Amazon Kindle Fire HDX 7", the Microsoft Surface, the Google Chromebook, and Nvidia's GPUs. These and other products incorporating Samsung's infringing products are currently offered for sale in the United States.

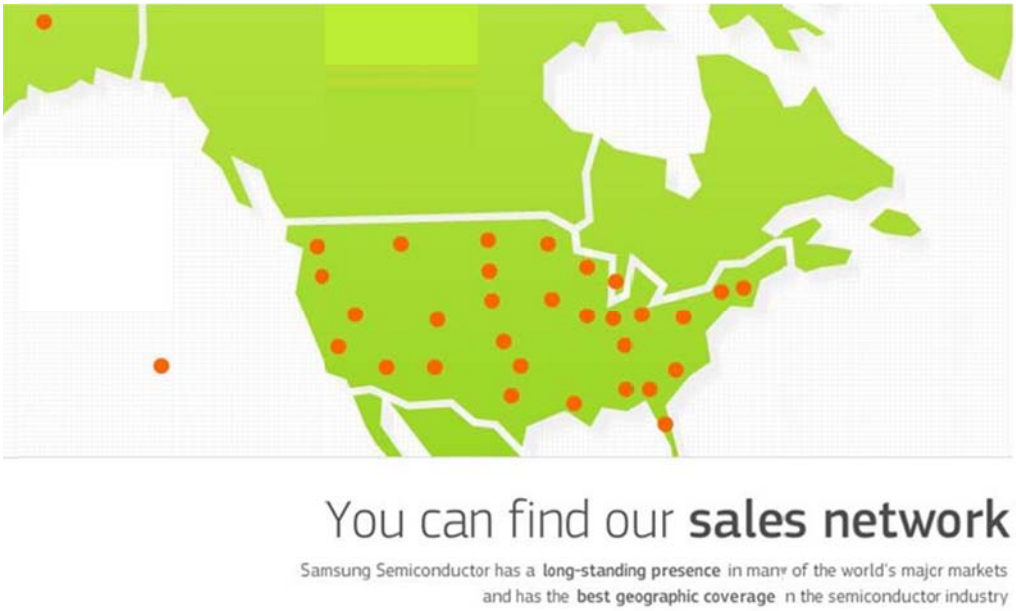
92. Samsung is aware that the products cannot be used or sold in a manner that does not infringe. Samsung is aware that the infringing stacked memory products are integral components of the computer and mobile products incorporating them, that the infringing stacked memory products are built into the computer and mobile products, and cannot be removed or disabled by a purchaser of the consumer products containing the infringing circuits. Therefore, Samsung is aware that its customers will infringe one or more claims of the Elm 3DS Patents by selling the products as-sold and as-marketed by Samsung, and that subsequent sales of such products would be direct infringement of the Elm 3DS Patents.

D. ENCOURAGEMENT/SPECIFIC INTENT TO INDUCE THE INFRINGEMENT

93. Through its marketing of its infringing stacked semiconductor products, Samsung specifically intends for its customers, such as OEMs, manufacturers, importers, resellers, customers, and end users to purchase Samsung's stacked semiconductor products and to incorporate them into end products that directly infringe one or more claims of the Elm 3DS Patents. Samsung routinely markets its infringing stacked semiconductor products to third parties for inclusion in products that are sold to customers in the United States. For example, in its "Product Selection Guide" Samsung states that it "continues to lead the industry with the broadest portfolio of memory products and technology," including DRAM, Flash NAND, and SSD products that are found in "ultra-mobile notebooks," "powerful servers," and a "wide range of handheld devices such as smartphones and tablets."

94. Samsung has a section of its website devoted to marketing its stacked semiconductor and TSV products to third parties for the purpose of incorporating said products into consumer or

end-user devices that are made, have been made, used, offered for sale, sold, or imported into the United States. *See* http://www.samsung.com/us/business/oem-solutions/index.html (last accessed Nov. 20, 2014) (attached as Ex. 27). This section of Samsung's website lists over thirty locations in the United States as part of Samsung's global "sales network." According to Samsung, "Samsung Semiconductor has a long standing presence in many of the world's major markets and has the best geographic coverage in the semiconductor industry." *See* http://www.samsung.com/global/business/semiconductor/sales-network (last accessed Nov. 20, 2014) (attached as Ex. 28).



This sales network demonstrates Samsung's specific intent to induce infringement because it is established through Samsung's OEM division, which is intended to market products to third-party manufacturers who sell electronics products in the United States.

95. As discussed above in Part IV, Samsung markets the benefits of its die-stacking technology. (*See, e.g., supra* ¶ 36.) By marketing its stacked memory products directly to third parties,

Samsung is inducing them to infringe partly by showcasing the benefits of its die-stacking technology.

96. As a further example, Samsung states on its website that application processors such as the Exynos Octa-Widon, which incorporates TSV technology, are ideal for a wide variety of computing, communication and embedded devices, including mobile computing devices, mobile communications devices, entertainment/gaming devices, and consumer products. (*See* Ex. 19.)

97. Similarly, Samsung states on its website that stacked Flash NAND memory is used in a "a host of consumer, industrial, and automotive electronics" and that "[s]ome of the principal areas that stand to benefit from using Samsung's packaging techniques for flash memory include" computing devices, buffers in hybrid drives, and removable storage media. (*See* Ex. 14.)

98. Samsung also recently announced on its website that its introduction of TSV-based DDR4 DRAM memory modules "will play a key role in supporting the continued proliferation of enterprise servers and cloud-based applications, as well as further diversification of data center solutions." (*See* Ex. 20.)

99. Additionally, Samsung states in its press announcements that the HBM2 interface is to be used in high performance computing (HPC), advanced graphics and network systems, as well as enterprise servers and that "[b]y mass producing next- generation HBM2 DRAM, we can contribute much more to the rapid adoption of next- generation HPC systems by global IT companies." (*See* Ex. 21.)

100. On information and belief, Samsung has marketed its stacked semiconductor products for mobile phones specifically to third parties. Samsung has promoted its "expertise in wafer thinning, die stacking, and wire bonding." *See* http://www.samsung.com/global/business/semiconductor/product/mcp/overview (last accessed Nov. 20, 2014) (attached as Ex. 29). Samsung markets these infringing products with the goal of

including them in products that are sold in the United States. As evidenced by Samsung's publicly available revenue figures, Samsung succeeds at this goal. These marketing activities demonstrate specific intent to induce infringement.

101. On information and belief, Samsung markets or will market its HBM2 DRAM package to designers who use graphics cards and the designers can specifically specify the HBM2 DRAM packages. *See, e.g.*, Ex. 21.

102. Samsung also provides OEMs, manufacturers, importers, resellers, customers, and end users instructions, user guides, and technical specifications on how to incorporate its infringing stacked semiconductor products into electronics products that are made, used, sold, offered for sale in and/or imported into the United States. When OEMs, manufacturers, importers, resellers, customers, and end users follow such instructions, user guides, and technical specifications and embed the stacked semiconductor products in end products they make, have made, use, offer to sell, sell, or import into the United States, they directly infringe one or more claims of the 3DS Patents. Samsung knows that by providing such instructions, user guides, and technical specifications, OEMs, manufacturers, importers, resellers, customers, and end users follow these instructions, user guides, and other technical specifications, and directly infringe one or more claims of the Elm 3DS Patents. Samsung thus knows that its actions actively induce infringement.

103. On information and belief, the targets for Samsung's marketing efforts are OEMs or other manufacturers who then incorporate Samsung's infringing stacked semiconductor products into electronics products that are made used, sold, offered for sale in and/or imported into the United States. These marketing efforts demonstrate Samsung's attempts to induce infringement.

104. For example, at the 2014 Flash Memory Summit in Santa Clara, California, Samsung showcased its latest memory technologies, in an effort to encourage various OEMs, manufacturers, importers, resellers, customers, and end users to include its infringing technology in computers,

server hardware, and mobile devices. This event was attended by companies that make, have made, use, offer to sell, sell, or import into the United States products that use memory components such as those made and sold by Samsung. At the 2014 Flash Memory Summit, Samsung made presentations touting the virtues of its memory products, including products that infringe one or more claims of the Elm 3DS Patents.

105. On information and belief, examples of third-party electronics products that incorporate Samsung's stacked semiconductor products include, but are not limited, to the Apple MacBook Pro, Dell PowerEdge R920 server, the Intel Xeon E5– 2600 v3 processor, the Amazon Fire Phone, the Amazon Kindle Fire HDX 7", the Microsoft Surface, the Google Chromebook, and the Nvidia's GPUs. Samsung is aware of the manner in which its stacked products infringe the Elm 3DS patents as set forth in paragraphs 34 – 47 of the original Complaint, and at paragraphs of 36 – 46 of this First Amended Complaint, and at paragraphs 34 – 53 of the First Supplemental Complaint.

106. The specific products listed here are merely examples of the myriad products in which Samsung's infringing semiconductor products are incorporated. Samsung indirectly infringes the patents-in-suit by pursuing third-party customers for its products who then directly infringe by making, having made, using, offering to sell, selling, or importing in the United States products that infringe.

107. Samsung derives significant revenue by selling its stacked memory products to third parties who directly infringe one or more claims of the Elm 3DS Patents. For instance, Samsung derived sales of at least $61 billion of semiconductors in 2012. Samsung also derived sales in the United States of products including semiconductors of at least $86 billion in 2013.

108. Samsung's marketing efforts, press releases, sales volume, and partnerships all evidence its intent to induce companies to infringe one or more claims of the Elm 3DS Patents.

Because Samsung has marketed its products to customers which it knows infringe one or more claims of the Elm 3DS Patents, it had the manifest specific intent to cause direct infringement and is therefore liable for indirect infringement. Given: (1) Samsung's knowledge that its stacked semiconductor products infringe one or more claims of the Elm 3DS Patents; (2) the volume of Samsung's stacked semiconductor sales within the United States; (3) Samsung's ubiquitous sales and marketing efforts directed to inducing third parties to include Samsung's stacked semiconductors in their products; (4) the fact that many third parties directly infringe one or more claims of the Elm 3DS Patents by making, having made, using, offering to sell, selling, or importing products that incorporate Samsung's stacked semiconductor products, Samsung has had specific intent to induce infringement or has been willfully blind to the direct infringement it is inducing.

109. The above-described acts of infringement committed by Defendants have caused injury and damage to Plaintiff and will cause additional severe and irreparable injury and damages in the future.

FIRST CLAIM FOR RELIEF

Infringement of U.S. Patent No. 7,193,239

110. Plaintiff incorporates by reference the allegations set forth in paragraphs 1 through 109 above as if specifically set forth herein.

111. Defendants have directly infringed one or more claims of the Leedy '239 patent, literally and/or under the doctrine of equivalents, in violation of 35 U.S.C. § 271. The infringing products include, but are not limited to, certain of Samsung semiconductor products that incorporate multiple semiconductor die that are thinned, stacked on top of and electrically connected to one another within a single chip package, and Samsung electronics products that incorporate such chip packages. The infringement remains ongoing.

112. Defendants have indirectly infringed one or more claims of the Leedy '239 patent, literally and/or under the doctrine of equivalents, in violation of 35 U.S.C. § 271(b). The infringing products include third-party electronics products that incorporate certain of Samsung semiconductor products that incorporate multiple semiconductor die that are thinned, stacked on top of and electrically connected to one another within a single chip package. The infringement remains ongoing.

113. As a consequence of Defendants' infringement, Plaintiff is entitled to recover damages adequate to compensate it for the injuries complained of herein, but in no event less than a reasonable royalty.

SECOND CLAIM FOR RELIEF

Infringement of U.S. Patent No. 7,474,004

114. Plaintiff incorporates by reference the allegations set forth in paragraphs 1 through 109 above as if specifically set forth herein.

115. Defendants have directly infringed one or more claims of the Leedy '004 patent, literally and/or under the doctrine of equivalents, in violation of 35 U.S.C. § 271. The infringing products include, but are not limited to, certain of Samsung semiconductor products that incorporate multiple semiconductor die that are thinned, stacked on top of and electrically connected to one another through vertical interconnects within a single chip package, and Samsung electronics products that incorporate such chip packages. The infringement remains ongoing.

116. Defendants have indirectly infringed one or more claims of the Leedy '004 patent, literally and/or under the doctrine of equivalents, in violation of 35 U.S.C. § 271(b). The infringing products include third-party electronics products that incorporate certain of Samsung semiconductor products that incorporate multiple semiconductor die that are thinned, stacked on

top of and electrically connected to one another through vertical interconnects within a single chip package. The infringement remains ongoing.

117. As a consequence of Defendants' infringement, Plaintiff is entitled to recover damages adequate to compensate it for the injuries complained of herein, but in no event less than a reasonable royalty..

THIRD CLAIM FOR RELIEF

Infringement of U.S. Patent No. 7,504,732

118. Plaintiff incorporates by reference the allegations set forth in paragraphs 1 through 109 above as if specifically set forth herein.

119. Defendants have directly infringed one or more claims of the Leedy '732 patent, literally and/or under the doctrine of equivalents, in violation of 35 U.S.C. § 271. The infringing products include, but are not limited to, certain of Samsung semiconductor products that incorporate multiple semiconductor die that are thinned, stacked on top of and electrically connected to one another through vertical interconnects within a single chip package, and Samsung electronics products that incorporate such chip packages. The infringement remains ongoing.

120. Defendants have indirectly infringed one or more claims of the Leedy '732 patent, literally and/or under the doctrine of equivalents, in violation of 35 U.S.C. § 271(b). The infringing products include third-party electronics products that incorporate certain of Samsung semiconductor products that incorporate multiple semiconductor die that are thinned, stacked on top of and electrically connected to one another through vertical interconnects within a single chip package. The infringement remains ongoing.

121. As a consequence of Defendants' infringement, Plaintiff is entitled to recover damages adequate to compensate it for the injuries complained of herein, but in no event less than a reasonable royalty.

FOURTH CLAIM FOR RELIEF

Infringement of U.S. Patent No. 8,410,617

122. Plaintiff incorporates by reference the allegations set forth in paragraphs 1 through 109 above as if specifically set forth herein.

123. Defendants have directly infringed one or more claims of the Leedy '617 patent, literally and/or under the doctrine of equivalents, in violation of 35 U.S.C. § 271. The infringing products include, but are not limited to, certain of Samsung semiconductor products that incorporate multiple semiconductor die that are thinned, stacked on top of and electrically connected to one another through vertical interconnects within a single chip package, and Samsung electronics products that incorporate such chip packages. The infringement remains ongoing.

124. Defendants have indirectly infringed one or more claims of the Leedy '617 patent, literally and/or under the doctrine of equivalents, in violation of 35 U.S.C. § 271(b). The infringing products include third-party electronics products that incorporate certain of Samsung semiconductor products that incorporate multiple semiconductor die that are thinned, stacked on top of and electrically connected to one another through vertical interconnects within a single chip package. The infringement remains ongoing.

125. As a consequence of Defendants' infringement, Plaintiff is entitled to recover damages adequate to compensate it for the injuries complained of herein, but in no event less than a reasonable royalty.

FIFTH CLAIM FOR RELIEF

Infringement of U.S. Patent No. 8,629,542

126. Plaintiff incorporates by reference the allegations set forth in paragraphs 1 through 109 above as if specifically set forth herein.

127. Defendants have directly infringed one or more claims of the Leedy '542 patent, literally and/or under the doctrine of equivalents, in violation of 35 U.S.C. § 271. The infringing products include, but are not limited to, certain of Samsung semiconductor products that incorporate multiple semiconductor die that are thinned, stacked on top of and electrically connected to one another within a single chip package, and Samsung electronics products that incorporate such chip packages. The infringement remains ongoing.

128. Defendants have indirectly infringed one or more claims of the Leedy '542 patent, literally and/or under the doctrine of equivalents, in violation of 35 U.S.C. § 271(b). The infringing products include third-party electronics products that incorporate certain of Samsung semiconductor products that incorporate multiple semiconductor die that are thinned, stacked on top of and electrically connected to one another within a single chip package. The infringement remains ongoing.

129. As a consequence of Defendants' infringement, Plaintiff is entitled to recover damages adequate to compensate it for the injuries complained of herein, but in no event less than a reasonable royalty.

SIXTH CLAIM FOR RELIEF

Infringement of U.S. Patent No. 8,653,672

130. Plaintiff incorporates by reference the allegations set forth in paragraphs 1 through 109 above as if specifically set forth herein.

131. Defendants have directly infringed one or more claims of the Leedy '672 patent, literally and/or under the doctrine of equivalents, in violation of 35 U.S.C. § 271. The infringing products include, but are not limited to, certain of Samsung semiconductor products that incorporate multiple semiconductor die that are thinned, stacked on top of and electrically

connected to one another within a single chip package, and Samsung electronics products that incorporate such chip packages. The infringement remains ongoing.

132. Defendants have indirectly infringed one or more claims of the Leedy '672 patent, literally and/or under the doctrine of equivalents, in violation of 35 U.S.C. § 271(b). The infringing products include third-party electronics products that incorporate certain of Samsung semiconductor products that incorporate multiple semiconductor die that are thinned, stacked on top of and electrically connected to one another within a single chip package. The infringement remains ongoing.

133. As a consequence of Defendants' infringement, Plaintiff is entitled to recover damages adequate to compensate it for the injuries complained of herein, but in no event less than a reasonable royalty.

SEVENTH CLAIM FOR RELIEF

Infringement of U.S. Patent No. 8,796,862

134. Plaintiff incorporates by reference the allegations set forth in paragraphs 1 through 109 above as if specifically set forth herein.

135. Defendants have directly infringed one or more claims of the Leedy '862 patent, literally and/or under the doctrine of equivalents, in violation of 35 U.S.C. § 271. The infringing products include, but are not limited to, certain of Samsung semiconductor products that incorporate multiple semiconductor die that are thinned, stacked on top of and electrically connected to one another within a single chip package, and Samsung electronics products that incorporate such chip packages. The infringement remains ongoing.

136. Defendants have indirectly infringed one or more claims of the Leedy '862 patent, literally and/or under the doctrine of equivalents, in violation of 35 U.S.C. § 271(b). The infringing products include third-party electronics products that incorporate certain of Samsung

semiconductor products that incorporate multiple semiconductor die that are thinned, stacked on top of and electrically connected to one another within a single chip package. The infringement remains ongoing.

137. As a consequence of Defendants' infringement, Plaintiff is entitled to recover damages adequate to compensate it for the injuries complained of herein, but in no event less than a reasonable royalty.

EIGHTH CLAIM FOR RELIEF

Infringement of U.S. Patent No. 8,841,778

138. Plaintiff incorporates by reference the allegations set forth in paragraphs 1 through 109 above as if specifically set forth herein.

139. Defendants have directly infringed one or more claims of the Leedy '778 patent, literally and/or under the doctrine of equivalents, in violation of 35 U.S.C. § 271. The infringing products include, but are not limited to, certain of Samsung semiconductor products that incorporate multiple semiconductor die that are thinned, stacked on top of and electrically connected to one another through vertical interconnects within a single chip package, and Samsung electronics products that incorporate such chip packages. The infringement remains ongoing.

140. Defendants have indirectly infringed one or more claims of the Leedy '778 patent, literally and/or under the doctrine of equivalents, in violation of 35 U.S.C. § 271(b). The infringing products include third-party electronics products that incorporate certain of Samsung semiconductor products that incorporate multiple semiconductor die that are thinned, stacked on top of and electrically connected to one another through vertical interconnects within a single chip package. The infringement remains ongoing.

141. As a consequence of Defendants' infringement, Plaintiff is entitled to recover damages adequate to compensate it for the injuries complained of herein, but in no event less than a reasonable royalty.

NINTH CLAIM FOR RELIEF

Infringement of U.S. Patent No. 8,907,499

142. Plaintiff incorporates by reference the allegations set forth in paragraphs 1 through 109 above as if specifically set forth herein.

143. Defendants have directly infringed one or more claims of the Leedy '499 patent, literally and/or under the doctrine of equivalents, in violation of 35 U.S.C. § 271. The infringing products include, but are not limited to, certain of Samsung semiconductor products that incorporate multiple semiconductor die that are thinned, stacked on top of and electrically connected to one another within a single chip package and through vertical interconnected circuit block stacks or vaults within a single chip package, and Samsung electronics products that incorporate such chip packages. The infringement remains ongoing.

144. Defendants have indirectly infringed one or more claims of the Leedy '499 patent, literally and/or under the doctrine of equivalents, in violation of 35 U.S.C. § 271(b). The infringing products include third-party electronics products that incorporate certain of Samsung semiconductor products that incorporate multiple semiconductor die that are thinned, stacked on top of and electrically connected to one another within a single chip package through vertical interconnected circuit block stacks or vaults within a single chip package. The infringement remains ongoing.

145. As a consequence of Defendants' infringement, Plaintiff is entitled to recover damages adequate to compensate it for the injuries complained of herein, but in no event less than a reasonable royalty.

TENTH CLAIM FOR RELIEF

Infringement of U.S. Patent No. 8,928,119

146. Plaintiff incorporates by reference the allegations set forth in paragraphs 1 through 109 above as if specifically set forth herein.

147. Defendants have directly infringed one or more claims of the Leedy '119 patent, literally and/or under the doctrine of equivalents, in violation of 35 U.S.C. § 271. The infringing products include, but are not limited to, certain of Samsung semiconductor products that incorporate multiple semiconductor die that are thinned, stacked on top of and electrically connected to one another through vertical interconnects within a single chip package, and Samsung electronics products that incorporate such chip packages. The infringement remains ongoing.

148. Defendants have indirectly infringed one or more claims of the Leedy '119 patent, literally and/or under the doctrine of equivalents, in violation of 35 U.S.C. § 271(b). The infringing products include third-party electronics products that incorporate certain of Samsung semiconductor products that incorporate multiple semiconductor die that are thinned, stacked on top of and electrically connected to one another through vertical interconnects within a single chip package. The infringement remains ongoing.

149. As a consequence of Defendants' infringement, Plaintiff is entitled to recover damages adequate to compensate it for the injuries complained of herein, but in no event less than a reasonable royalty.

ELEVENTH CLAIM FOR RELIEF

Infringement of U.S. Patent No. 8,933,570

150. Plaintiff incorporates by reference the allegations set forth in paragraphs 1 through 109 above as if specifically set forth herein.

151. Defendants have directly infringed one or more claims of the Leedy '570 patent, literally and/or under the doctrine of equivalents, in violation of 35 U.S.C. § 271. The infringing products include, but are not limited to, certain of Samsung semiconductor products that incorporate multiple semiconductor die that are thinned, stacked on top of and electrically connected to one another through vertical interconnects within a single chip package, and Samsung electronics products that incorporate such chip packages. The infringement remains ongoing.

152. Defendants have indirectly infringed one or more claims of the Leedy '570 patent, literally and/or under the doctrine of equivalents, in violation of 35 U.S.C. § 271(b). The infringing products include third-party electronics products that incorporate certain of Samsung semiconductor products that incorporate multiple semiconductor die that are thinned, stacked on top of and electrically connected to one another through vertical interconnects within a single chip package. The infringement remains ongoing.

153. As a consequence of Defendants' infringement, Plaintiff is entitled to recover damages adequate to compensate it for the injuries complained of herein, but in no event less than a reasonable royalty.

TWELFTH CLAIM FOR RELIEF

Infringement of U.S. Patent No. 8,791,581

154. Plaintiff incorporates by reference the allegations set forth in paragraphs 1 through 109 above as if specifically set forth herein.

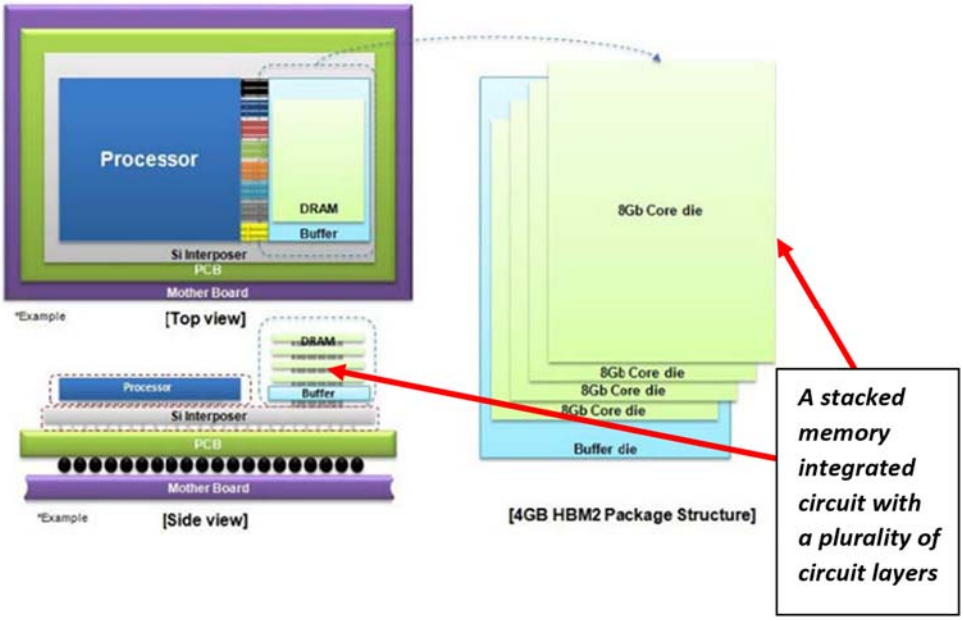
155. Defendants have directly infringed one or more claims of the Leedy '581 patent, literally and/or under the doctrine of equivalents, in violation of 35 U.S.C. § 271. The infringing products include, but are not limited to, certain of Samsung semiconductor products that incorporate multiple semiconductor die that are thinned, stacked on top of and electrically

connected to one another through vertical interconnects within a single chip package, and Samsung electronics products that incorporate such chip packages. The infringement remains ongoing.

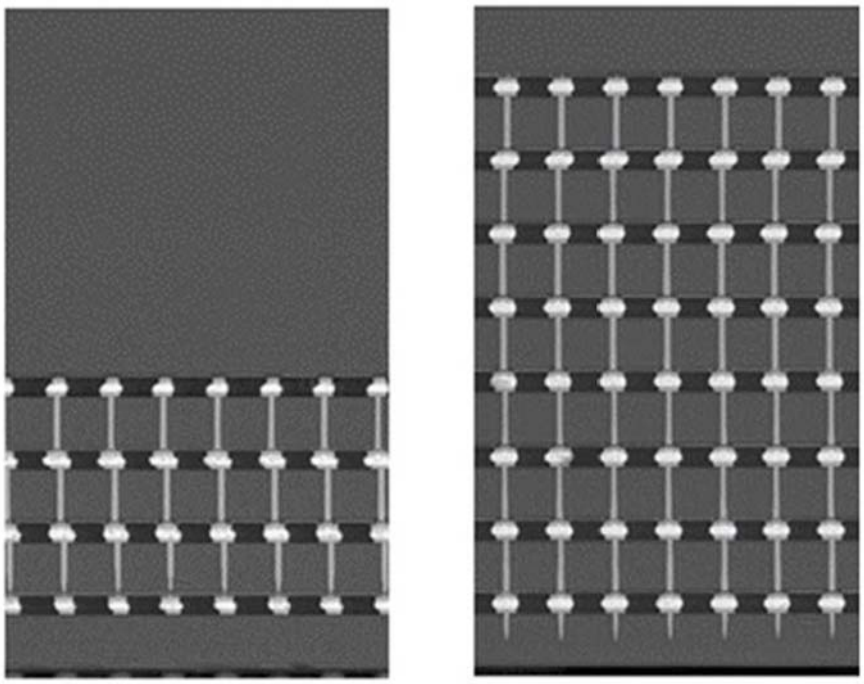
156. Defendants have indirectly infringed one or more claims of the Leedy '581 patent, literally and/or under the doctrine of equivalents, in violation of 35 U.S.C. § 271(b). The infringing products include third-party electronics products that incorporate certain of Samsung semiconductor products that incorporate multiple semiconductor die that are thinned, stacked on top of and electrically connected to one another through vertical interconnects within a single chip package. The infringement remains ongoing.

157. For example, Defendants' 4GB HBM2 DRAM products are stacked memory integrated circuits consisting of a plurality of circuit layers comprising at least one control circuit layer and at least one memory circuit layer, arranged in a stacked relationship; wherein the at least one control layer and at least one memory circuit layers of the stacked memory integrated circuit are partitioned into a plurality of vertically interconnected circuit block stacks and configured for a plurality of said vertically interconnected circuit block stacks to independently perform memory operations, as claimed by claim 1 of the Leedy '581 patent.

158. The 4GB HBM2 DRAM product is a stacked memory integrated circuit consisting of a plurality of circuit layers, as required by claim 1 of the Leedy '581 patent.



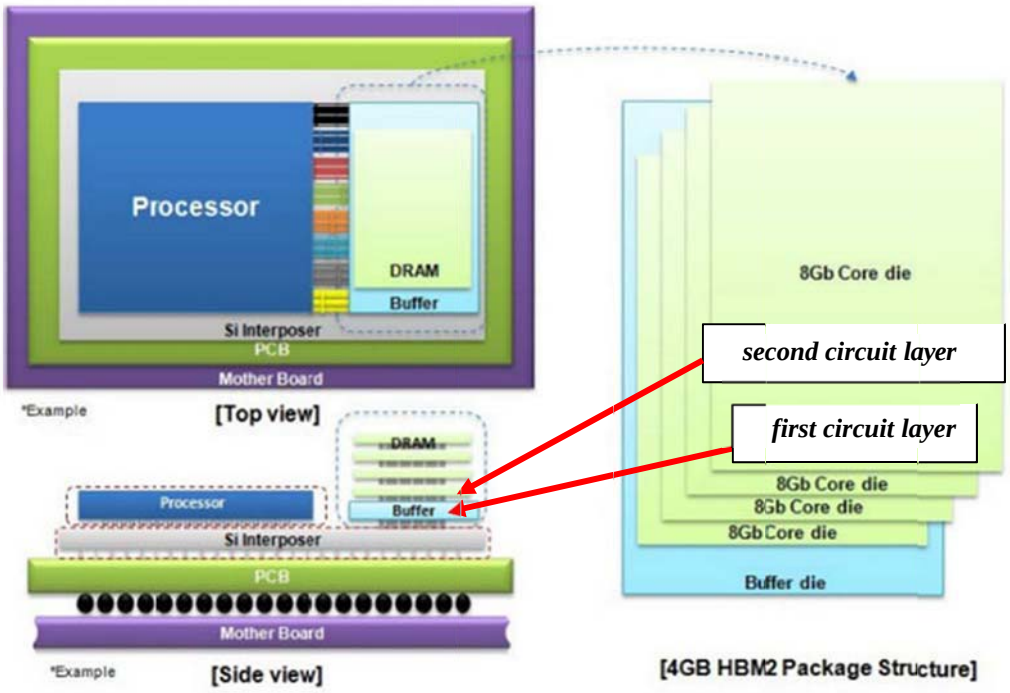
See Ex. 21.



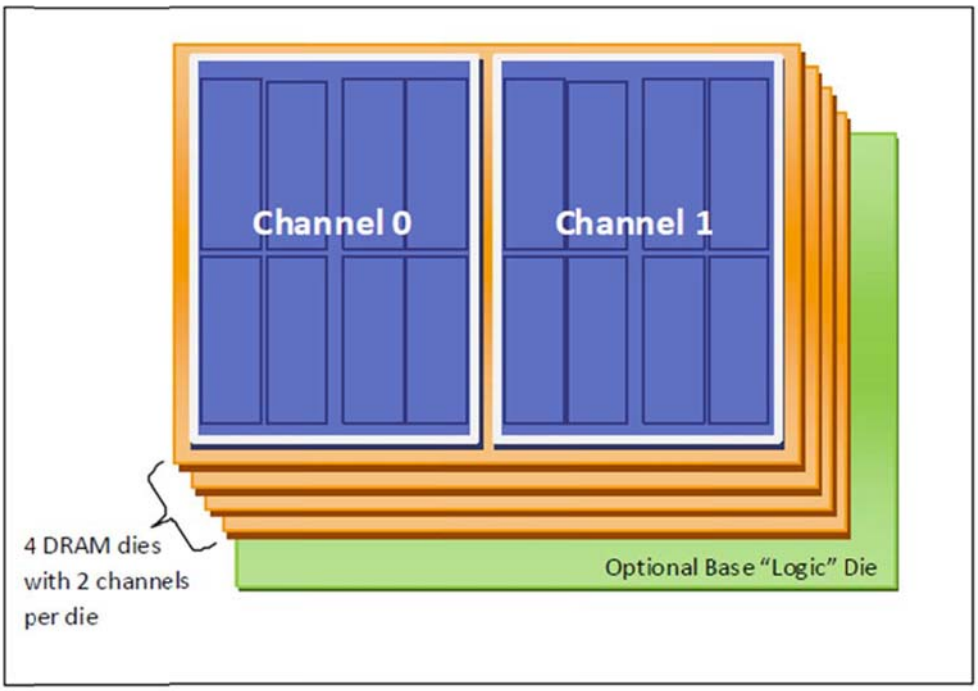
Cross sections of
4GB HBM2 DRAM & 8GB HBM2 DRAM

See http://vrworld.com/2016/01/20/samsung-hbm2-memory-enables-16-to-64gb-graphics/ (last accessed April 8, 2016) (attached as Ex. 30).

159. The 4GB HBM2 DRAM product includes at least one control circuit layer and at least one memory circuit layer arranged in a stacked relationship as required by claim 1 of the Leedy '581 patent.



160. HBM 2 technology is reported to be outlined in the JESD235A standard. *See* http://electroiq.com/insights-from-leading-edge/2016/02/ (last accessed on April 8, 2016) (attached as Ex. 31). As described in the JEDEC standard JESD235a, which defines the HBM family of devices, an "interface die . . . sits at the bottom of the stack and provides signal redistribution and other functions." *See* JEDEC Standard, HBM, JESD235a at 2 (attached as Ex. 32). The buffer die in the HBM2 product is therefore a logic die, and therefore meets the limitation of a control layer. *See also id.* at Fig. 1.



161. The 4GB HBM2 DRAM product includes at least one control layer and at least one memory circuit layer of the stacked memory integrated circuit that are partitioned into a plurality of vertically interconnected circuit block stacks and configured for a plurality of said vertically interconnected circuit block stacks to independently perform memory operations, as required by claim 1 of the Leedy '581 patent.

162. The control layer and at least one memory circuit layer are vertically interconnected. "Following Samsung's introduction of a 128GB 3D TSV DDR4 registered dual inline memory module (RDIMM) last October, the new HBM2 DRAM marks the latest milestone in TSV (Through Silicon Via) DRAM technology." *See* Ex. 21.

163. Further, the 4GB HBM2 DRAM product is partitioned into a plurality of vertically interconnected circuit block stacks and configured for a plurality of said vertically interconnected circuit block stacks to independently perform memory operations. Samsung has indicated that each HBM2 device (which include a buffer die and 4 memory die) has an aggregate bandwidth of 256GBps. The JEDEC Standard (*see* JESD 235a at 104) and third party analysts have indicated that

the intra, per data line bandwidth is up to 2 Gbps. *See* Ex. 32 at 103; *see also* http://www.anandtech.com/show/9969/jedec-publishes-hbm2-specification (last accessed April 8, 2016) (attached as Ex. 33). The JEDEC standard JESD235a indicates that each channel includes 128 data lines. *See* Ex. 32 at 3. Therefore, the Samsung HBM 2 4-memory device comprises at least 8 channels and therefore has at least 2 channels per die and the buffer chip must comprise 8 independent channel interface blocks. *See* Ex. 32 at 1- 3. The standard explains that the "interface is divided into independent channels. Each channel is completely independent of one another." *See id.* at 1. Therefore the buffer die is necessarily partitioned into a plurality of circuit blocks in order to control the multiple channels of the memory dies stacked above it. Furthermore, the 4GB HBM2 DRAM product includes at least one control layer and at least one memory circuit layer of the stacked memory integrated circuit that are partitioned into a plurality of vertically interconnected circuit block stacks configured to independently perform memory operations.

164. As a consequence of Defendants' infringement, Plaintiff is entitled to recover damages adequate to compensate it for the injuries complained of herein, but in no event less than a reasonable royalty

JURY TRIAL DEMANDED

Elm 3DS Innovations, LLC, hereby demands a trial by jury on all claims and issues so triable.

PRAYER FOR RELIEF

WHEREFORE, Plaintiff respectfully requests that this Court:

A. enter judgment that each of the Defendants has infringed one or more claims of one or more of the Elm 3DS Patents;

B. enter an order, pursuant to 35 U.S.C. § 284, awarding to Plaintiff damages adequate to compensate for Defendants' infringement of the Elm 3DS Patents (and, if necessary, related accountings), in an amount to be determined at trial, but not less than a reasonable royalty;

C. enter an order, pursuant to 35 U.S.C. § 285, deeming this to be an "exceptional case" and thereby awarding to Plaintiff its reasonable attorneys' fees, costs, and expenses;

E. enter an order that Defendants account for and pay to Plaintiff the damages to which Plaintiff is entitled as a consequence of the infringement;

F. enter an order awarding to Plaintiff pre- and post-judgment interest at the maximum rates allowable under the law; and

G. enter an order awarding to Plaintiff such other and further relief, whether at law or in equity, that this Court deems just and proper.

Dated: June 22, 2020

Respectfully submitted,

FARNAN LLP

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