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

ACORN SEMI, LLC,

*Plaintiff*,
vs.

SAMSUNG ELECTRONICS CO., LTD.; SAMSUNG ELECTRONICS AMERICA, INC.; SAMSUNG SEMICONDUCTOR, INC.; AND SAMSUNG AUSTIN SEMICONDUCTOR, LLC,

*Defendants*.

Civil Action No.: 2:19cv347

**JURY TRIAL DEMANDED**

## COMPLAINT FOR PATENT INFRINGEMENT

Plaintiff Acorn Semi, LLC ("Acorn") brings this action against Samsung Electronics Co., Ltd. ("SEC"), Samsung Electronics America, Inc. ("SEA"), Samsung Semiconductor, Inc. ("SSI"), and Samsung Austin Semiconductor, LLC ("SAS") (collectively "Samsung" or "Defendants") and alleges as follows:

## NATURE OF THE ACTION

1. This is an action for patent infringement under the Patent Laws of the United States, 35 U.S.C. § 1 *et seq*., including 35 U.S.C. §§ 271, 281-85.

2. This lawsuit involves significant, ground-breaking advancements in semiconductor processing and semiconductor devices. These innovations, developed by Acorn, a longtime pioneer in the design and development of semiconductor technologies, have enabled the design and manufacture of chips for computers and mobile devices that are smaller, faster, lighter, and more efficient than ever before.

3. One of the most fundamental electrical devices used in modern circuits is the metal-semiconductor junction. In this junction, a metal (such as aluminum) is brought into contact with a semiconductor (such as silicon).

4. Unfortunately, when a metal and a semiconductor are brought into contact with each other, a contact resistance arises against the flow of electrons between the metal and the semiconductor. This contact resistance at a metal-semiconductor junction can affect the electrical characteristics of a device incorporating such a junction—even limiting the device's usefulness for performing certain functions. As semiconductor devices have grown smaller and smaller, the impact of this metal-semiconductor contact resistance on the functioning of semiconductor devices has grown greater.

5. In or around 2002, researchers attempting to minimize contact resistance at a metal-semiconductor junction in a semiconductor device generally used three techniques: (1) they doped the silicon at the interface to the greatest extent possible; (2) they maximized the area of the metal-semiconductor junction within the geometric constraints of a particular node; and (3) they made the connection between the metal and the semiconductor as direct as possible by eliminating any oxide layer that might naturally occur between the metal and the semiconductor. While these techniques were mostly workable for the size of semiconductor devices in 2002, it was clear to Acorn researchers Dr. Daniel E. Grupp and Dr. Daniel J. Connelly that these techniques would not sufficiently minimize contact resistance for smaller and smaller semiconductor devices. Dr. Grupp and Dr. Connelly applied their considerable expertise and experience—including bachelor's degrees in Physics and Electrical Engineering, a master's degree in Engineering, a PhD in Physics and Nanotechnology, and years of experience at respected research institutions—to the problem.

6. Drs. Grupp and Connelly discovered that applying a contrary principle in fact reduced the contact resistance in a metal-semiconductor junction. Drs. Grupp and Connelly discovered that—instead of eliminating material between the metal and the semiconductor—they could minimize contact resistance between a metal and a semiconductor by *inserting material between the two substances*. To protect their novel and counter-intuitive invention, Drs. Grupp and Connelly applied for, and obtained, several U.S. patents.

7. In their first patent on this technology, filed on August 12, 2002, Drs. Grupp and Connelly predicted that their invention would "become even more important as device sizes shrink even further." This pioneering vision of Acorn's researchers has proven correct. Drs. Grupp and Connelly's inventions have indeed become increasingly important as the electronics industry has continued its progression toward even smaller, faster, and more computationally powerful electronic devices.

8. The United States Patent and Trademark Office ("USPTO") issued several patents related to Drs. Grupp and Connelly's inventions.

9. On August 1, 2006, the USPTO duly and legally issued U.S. Patent No. 7,084,423 ("the '423 Patent"), titled *Method for Depinning the Fermi Level of a Semiconductor at an Electrical Junction and Devices Incorporating Such Junctions*, to inventors Daniel E. Grupp and Daniel J. Connelly. A true and correct copy of the '423 Patent is attached hereto as Exhibit 1.

10. On July 1, 2014, the USPTO duly and legally issued U.S. Patent No. 8,766,336 ("the '336 Patent"), titled *Method for Depinning the Fermi Level of a Semiconductor at an Electrical Junction and Devices Incorporating Such Junctions*, to the same inventors. A true and correct copy of the '336 Patent is attached hereto as Exhibit 2.

11. On December 8, 2015, the USPTO duly and legally issued U.S. Patent No. 9,209,261 ("the '261 Patent"), titled *Method for Depinning the Fermi Level of a Semiconductor at an Electrical Junction and Devices Incorporating Such Junctions*, to the same inventors. A true and correct copy of the '261 Patent is attached hereto as Exhibit 3.

12. On October 4, 2016, the USPTO duly and legally issued U.S. Patent No. 9,461,167 ("the '167 Patent"), titled *Method for Depinning the Fermi Level of a Semiconductor at an Electrical Junction and Devices Incorporating Such Junctions*, to the same inventors. A true and correct copy of the '167 Patent is attached hereto as Exhibit 4.

13. On February 27, 2018, the USPTO duly and legally issued U.S. Patent No. 9,905,691 ("the '691 Patent"), titled *Method for Depinning the Fermi Level of a Semiconductor at an Electrical Junction and Devices Incorporating Such Junctions*, to the same inventors. A true and correct copy of the '691 Patent is attached hereto as Exhibit 5.

14. On October 2, 2018, the USPTO duly and legally issued U.S. Patent No. 10,090,395 ("the '395 Patent," and collectively with the '423 Patent, the '336 Patent, the '261 Patent, the '167 Patent, and the '691 Patent, "the Acorn Patents"), titled *Method for Depinning the Fermi Level of a Semiconductor at an Electrical Junction and Devices Incorporating Such Junctions*, to the same inventors. A true and correct copy of the '395 Patent is attached hereto as Exhibit 6.

15. Acorn owns the entire right and title to the '423 Patent, the '336 Patent, the '261 Patent, the '167 Patent, the '691 Patent, and the '395 Patent.

16. Samsung has infringed and continues to infringe one or more claims of the '423 Patent, the '336 Patent, the '261 Patent, the '167 Patent, the '691 Patent, and the '395 Patent. Samsung incorporates Acorn's patented technology into transistors Samsung manufactures

according to Samsung's 14 nm FinFET process technology, including transistors manufactured according to Samsung's 14LPE and 14LPP processes. Samsung further incorporates these infringing transistors into processors that Samsung makes, uses, sells, offers for sale, imports, advertises, makes available, and/or markets. By engaging in these activities, Samsung has infringed and continues to infringe Acorn's patents. Processors incorporating Samsung's infringing transistors have been incorporated into an array of popular products, including the Samsung Galaxy S6 and S7 smartphones, Apple iPhone 6s and 6s Plus, and various other products. Samsung has committed and continues to commit these acts of infringement without obtaining a license to Acorn's patents.

17. Acorn brings this suit to protect its rights and put an end to Samsung's infringement. Acorn seeks, among other things, monetary damages and injunctive relief.

## THE PARTIES

18. Acorn is a limited liability company organized and existing under the laws of the State of Delaware, with its principal place of business at 445 Cambridge Avenue, Suite A, Palo Alto, CA 94306.

19. Samsung Electronics Co., Ltd. ("SEC") is a corporation organized and existing under the laws of the Republic of Korea, with its principal place of business at 129 Samsung-ro, Yeongton-gu, Suwon-si, Gyeonggdi-do, Republic of Korea.

20. Samsung Electronics America, Inc. ("SEA") is a corporation organized and existing under the laws of the State of New York, with its principal place of business at 85 Challenger Road, Ridgefield Park, New Jersey 07660. SEA maintains a 216,000 square-foot campus at 6625 Excellence Way, Plano, Texas 75023. SEA may be served with process through

its registered agent for service in Texas: CT Corporation System, 1999 Bryan Street, Suite 900, Dallas, Texas 75201.

21. Samsung Semiconductor, Inc. ("SSI") is a corporation organized and existing under the laws of the State of California, with its principal place of business at 3655 North First Street, San Jose, California 95134. SSI may be served with process through its registered agent for service in Texas: National Registered Agents, Inc., 1999 Bryan Street, Suite 900, Dallas, Texas 75201.

22. Samsung Austin Semiconductor, LLC ("SAS") is a limited liability company organized and existing under the laws of Delaware, with its principal place of business at 12100 Samsung Boulevard, Austin, Texas 78754. SAS may be served with process through its registered agent for service in Texas: CT Corporation System, 1999 Bryan Street, Suite 900, Dallas, Texas 75201.

23. SAS is a wholly-owned subsidiary of SSI, which is a wholly-owned subsidiary of SEA, which is a wholly-owned subsidiary of SEC.

24. Samsung offers its products and services, including the products accused of infringement in this Complaint, to customers and potential customers located in the Eastern District of Texas.

## JURISDICTION AND VENUE

25. This Court has subject matter jurisdiction over this action pursuant to 28 U.S.C. §§ 1331, 1332, and 1338(a).

26. Defendants are subject to this Court's specific and general personal jurisdiction consistent with the principles of due process and/or the Texas Long Arm Statute.

27. This Court has personal jurisdiction over Defendants pursuant to the laws of the State of Texas and the United States Constitution because Defendants regularly and continuously transact business in the jurisdiction, including marketing and selling their services and products throughout the State of Texas, including in this District, and Defendants are registered with the Secretary of State to do business in the State of Texas. In addition, Samsung makes, uses, sells, offers for sale, imports, advertises, makes available, and/or markets products within the state of Texas, and specifically the Eastern District of Texas, that infringe one or more claims of the patents asserted in this Complaint, as alleged more particularly below.

28. Samsung has infringed or caused infringement in the State of Texas, including in this District by, among other things, promoting, offering for sale and selling infringing products in the District. Samsung has various physical locations at which it transacts business and recruits and hires employees in the State of Texas, including within this District. For example, in addition to maintaining an office in Richardson, Texas and a 216,000 square-foot campus in Plano, Samsung also has authorized sellers and sales representatives throughout Texas that offer and sell infringing products pertinent to this Complaint, including in this District and to consumers throughout this District, such as: AT&T Store at 1712 E Grand Ave., Marshall, Texas 76570; Verizon Authorized Retailer – Victra at 1006 E End Blvd. N, Marshall, Texas 75670; Best Buy at 422 W TX-281 Loop Suite 100, Longview, Texas 75605; and Amazon.com (which delivers infringing products throughout this District). Samsung intends for customers to use the infringing products within the Eastern District of Texas. Therefore, the exercise of jurisdiction over Samsung is appropriate under the applicable jurisdictional statutes and would not offend traditional notions of fair play and substantial justice.

29. Venue in this District is proper under 28 U.S.C. §§ 1400(b) and 1391(b) and (c) because each Defendant is subject to personal jurisdiction in this District and has committed acts of infringement in this District. Each Defendant, through its own acts and/or through the acts of each other Defendant acting as its agent, representative, or alter ego, makes, uses, sells, and/or offers to sell infringing products within this District, has a continuing presence within the District, and has the requisite minimum contacts with the District such that this is a fair and reasonable venue. Upon information and belief, each Defendant has transacted and continues to transact business within this District.

30. Venue is further proper with respect to Defendant SEC under 28 U.S.C. § 889 F.3d 1349, 1354-55 (Fed. Cir. 2018). Venue is further proper as to SEC under 28 U.S.C. § 1391(b)(2) because SEC performs a substantial part of its infringing acts in this District by making, using, selling, offering to sell, and importing infringing products in this District. Thus SEC has committed, and continues to commit, acts of patent infringement within the District.

31. Venue is further proper with respect to Defendant SEA under 28 U.S.C. § 1400(b) because SEA maintains a regular and established place of business within this District, including an office at 1301 E. Lookout Drive, Richardson, Texas 75082, as well as a 216,000 square-foot campus in Plano's Legacy Central at 6625 Declaration Drive, Plano, Texas 75023, located within this District. At these locations, SEA owns or rents real estate, hires and pays employees, advertises in the community, and engages in business, including business directed at promoting, offering for sale, and/or selling the infringing products.

32. Venue is further proper with respect to SEA under 28 U.S.C. § 1391(b)(2) because SEA performs a substantial part of its infringing acts in this District by making, using, selling, and offering to sell infringing products within this District and by importing infringing

products into this District. Thus SEA has committed, and continues to commit, acts of patent infringement within the District. In addition, SEA has registered with the Texas Secretary of State's Office to do business in the State of Texas and has appointed a registered agent for service.

33. All four Defendants have admitted or not contested proper venue in this District in other patent infringement actions, including patent infringement actions filed after *In re HTC Corp.*, 889 F.3d 1349, 1354-55 (Fed. Cir. 2018).

34. Defendants are properly joined under 35 U.S.C. § 299(a)(1) because, as set forth more fully below, Defendants, through their own acts and/or through the acts of other Defendants acting as their agent, representative, or alter ego, commonly and/or jointly manufacture semiconductors and/or sell infringing processors and consumer products incorporating such processors, such that at least one right to relief is asserted against Defendants jointly, severally, and in the alternative with respect to the same transactions, occurrences, or series of transactions or occurrences relating to the making, using, selling and/or offering to sell in, and/or importing into the United States the same accused products.

35. Defendants are properly joined under 35 U.S.C. § 299(a)(2) because, as set forth more fully below, Defendants, through their own acts and/or through the acts of other Defendants acting as their agent, representative, or alter ego, make, use, sell, and/or offer to sell in, and/or import into the United States the same or similar accused processors for use in the same or similar accused products, such that questions of fact will arise that are common to all Defendants.

36. Upon information and belief, each Defendant serves as agent, representative, and/or alter ego of each other Defendant for the purposes of conducting business in the United

States and this District in relation to making, using, selling, offering to sell, and importing into the United States the infringing processors and products incorporating those processors.

37. Upon information and belief, each Defendant exercises direction and control over the performance of each other Defendant, or the Defendants form a joint enterprise such that the performance by one Defendant is attributable to each other Defendant.

## FACTUAL ALLEGATIONS

### I. Acorn Technologies and the Inventors

38. Acorn is a wholly owned, semiconductor-focused subsidiary of Acorn Technologies, Inc. ("Acorn Technologies"). Acorn Technologies has long been a pioneer in the design and development of semiconductor technologies. It was founded in 1998 to help semiconductor manufacturers and chip design companies overcome technology bottlenecks to achieve their performance goals for advanced integrated circuits used in next-generation devices. With its unique portfolio of patent-protected and licensable IP cores and scalable semiconductor process technologies, Acorn helps customers create semiconductors that perform better, faster, and use less power, especially for applications in challenging wireless applications. Acorn's core competencies include the highly specialized ability to shrink transistor size and channels, as well as expertise in new materials, strained silicon, and nanoscaling.

39. In or around 2000, inventors Dr. Daniel E. Grupp and Dr. Daniel J. Connelly both worked for Acorn Technologies. Dr. Grupp had a bachelor's degree in Physics from Cornell University and a PhD in Physics and Nanotechnology from the University of Pennsylvania. Dr. Grupp had worked as a Visiting Scientist at the NEC Research Institute in Princeton, NJ, and as a Visiting Scholar at Stanford University. Dr. Connelly had a bachelor's degree in Electrical Engineering and Physics from MIT, a master's degree in Engineering from MIT, and had

completed the requirements for a PhD in Electrical Engineering from Stanford (conferred in 2002). Dr. Connelly had worked for the Advanced Products Research and Development Laboratory, a research division of Motorola, in Austin, Texas. Both were highly qualified research scientists in the semiconductor space doing research and development at the forefront of their fields.

## II. Background for the Inventions

40. Semiconductor devices are ubiquitous in modern electronic systems. They are electronic components that utilize the electronic properties of semiconductor materials (typically silicon, germanium, or gallium arsenide) in order to control electrical conduction. Controlling the conduction of electricity through semiconductors forms the basis of diodes, transistors, and logic gates, all of which are fundamental to modern electronic circuits or integrated circuits.

41. Semiconductor materials have an electrical conductivity falling somewhere between that of a conductor (such as copper) and an insulator (such as glass). Semiconductor materials are useful because their conducting behavior can be manipulated. For example, semiconductor devices may be designed to provide a specific level of electrical resistance, to allow current to pass more easily in one direction than another, or to show sensitivity to light or heat.

42. Metal-semiconductor junctions are a type of electrical junction in which a metal comes in close contact with a semiconductor material. These junctions can be inherently rectifying, which means that they will tend to conduct current in one direction more favorably than in the other direction. One researcher—Walter H. Schottky—described this rectifying behavior in the 1930s as depending on a "barrier" at the surface of contact between the metal and the semiconductor. The height of the "barrier," in Schottky's model, was measured by the

energy needed to move an electron between the metal and the semiconductor. This became known as the "Schottky barrier." Schottky predicted that the height of the Schottky barrier, $\Phi_{b,}$ could be measured by the difference between: (1) the work function of the metal $\Phi_m$ (the amount of energy needed to remove an electron from the metal to a point in the vacuum immediately outside the metal); and (2) the electron affinity of the semiconductor $X_s$ (the difference between the energy of a free electron and the conduction band edge of the semiconductor). Expressed mathematically, his theory was as follows: $\Phi_{b=} \Phi_m - X_s$[1]. The below energy-band diagram from the patents illustrates the values that make up Schottky's formula:

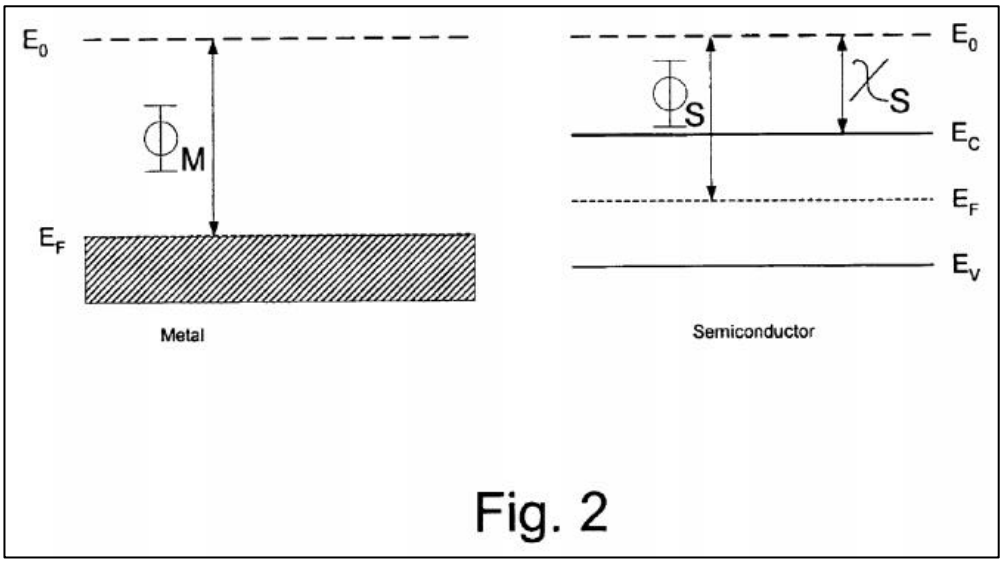



Fig. 2

43. Schottky was wrong. In reality, the Schottky barrier at a metal-semiconductor junction is generally different than Schottky's equation would predict. The energy-band diagram below from the patents illustrates an increased Schottky barrier at a metal-semiconductor junction.

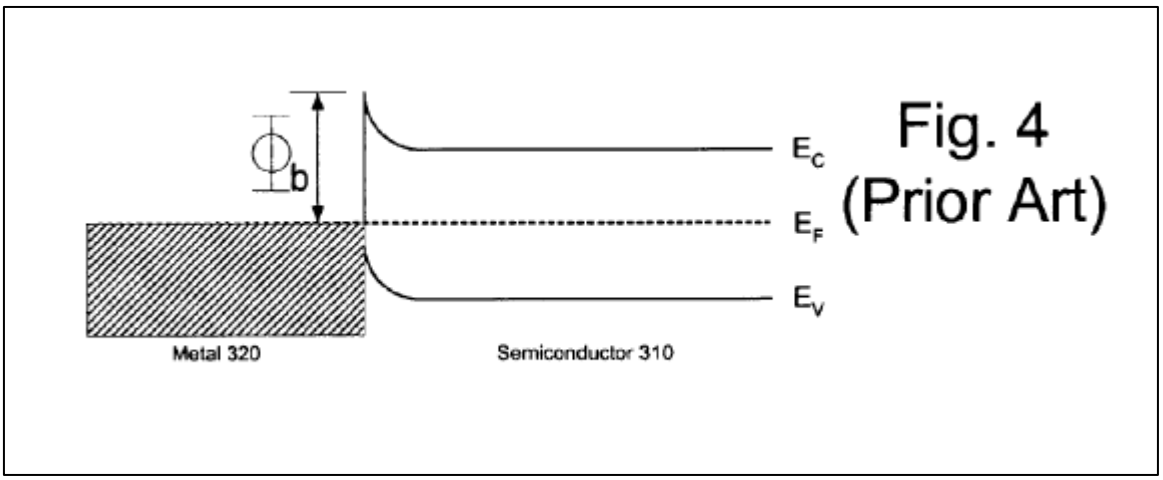



Fig. 4 (Prior Art)

44. The patents describe the increased Schottky barrier at a metal-semiconductor junction as the result of the Fermi level of the conductor being "pinned" between the valence and conduction bands of the semiconductor. According to the patents, "the importance of the barrier height at a metal-semiconductor interface is that it determines the electrical properties of the junction. Thus, if one were able to control or adjust the barrier height of a metal-semiconductor junction, one could produce electrical devices of designer characteristics. Such barrier height tuning may become even more important as device sizes shrink even further."

## III. Acorn's Groundbreaking Innovations

45. Around 2000, Drs. Grupp and Connelly were working to develop a new type of field-effect transistor (FET) that they hoped would be smaller and faster than prior FETs. A FET is a semiconductor device that has three terminals, and uses an electric field to control the flow of current through the device. The three terminals are the source, the gate, and the drain. Applying a voltage to the gate alters the conductivity between the source and the drain, either by inducing a conductive channel that allows current to flow between them, or by stopping current flow through the channel between them, depending on the type of FET.

46. The FET that Drs. Grupp and Connelly were working on required source and drain portions made of metal. The channel portion of their device was made of silicon. The

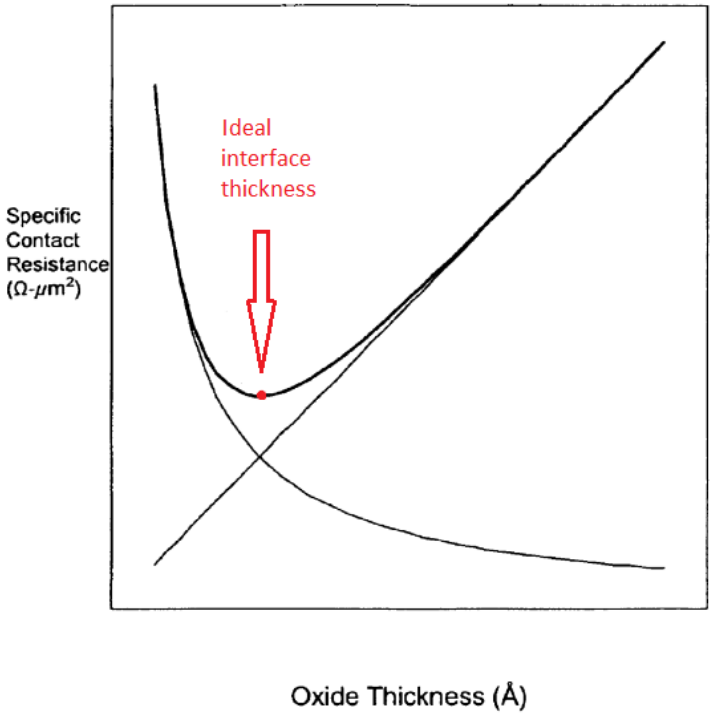
design thus included two metal-silicon junctions, one between the source and the channel, and another between the channel and the drain.

47. With two metal-silicon junctions in their design, Drs. Grupp and Connelly had to contend with a Schottky barrier at both junctions. And these Schottky barriers severely limited the functionality of the device Drs. Grupp and Connelly were developing. The device Drs. Grupp and Connelly were developing required less resistance at the source/channel and channel/drain interfaces. So, Drs. Grupp and Connelly worked to find a way to reduce the Schottky barriers.

48. Drs. Grupp and Connelly knew that inserting an insulating interface layer between a metal and a semiconductor could be used to reduce a Schottky barrier. As their patents later explained, an insulating interface layer can reduce a Schottky barrier because it "depins" the Fermi level of the conductor from a point between the valence and conduction bands of the semiconductor. But an insulating interface layer was not generally considered to be a solution for applications where the goal was to reduce resistance in a design. This is because adding an insulating layer between a metal and a semiconductor typically *increases* resistance in the design. The idea of *adding* an insulator to *reduce* resistance is counterintuitive.

49. At this point, Drs. Grupp and Connelly came to a remarkable insight that no one in the art had yet reached. They theorized that there may be a way to balance: (1) the potential Schottky-barrier reduction that would result from adding an insulating interface layer between the metal and the semiconductor; with (2) the increased resistance that would result from adding that insulating interface layer. As shown in the below figure, they theorized that there might be a specific interface-layer thickness that was thick enough to effectively reduce the Schottky barrier, while still being thin enough to avoid introducing too much resistance into the design.

They hoped that a low point for contact resistance—such as in the figure below—might exist at a certain interface-layer thickness.




50. Experimentation and modeling confirmed their theory. Drs. Grupp and Connelly found that inserting a very thin insulating interface layer between a metal and a semiconductor could in fact *reduce* resistance across the contact. In their early experiments, performed with Aluminum-Insulator-Silicon junctions, Drs. Grupp and Connelly found a contact resistance that was *10,000x* lower than it was without the insulator. This remarkable result occurred at such a specific and difficult to create interface thickness that it would not have been found had Drs. Grupp and Connelly not been looking specifically for it. Their discovery—which allows the production of more effective semiconductor devices—underlies the inventions claimed in the multiple patents asserted in this lawsuit.

51. When Drs. Grupp and Connelly published their insight and results, they received widespread industry recognition. And, as the inventors correctly predicted, their innovations

have become even more important as electronic devices have continued to shrink. According to Google Scholar, their 2004 article, entitled "A new route to zero-barrier metal source/drain MOSFETs" and published in IEEE Transactions on Nanotechnology, has been cited 143 times, and their 2006 article, entitled "Fermi-level depinning for low-barrier Schottky source-drain transistors" and published in Applied Physics Letters, has been cited 131 times. In fact, the latter article has been cited twice by researchers from the Samsung Advanced Institute of Technology.

## IV. Acorn Patents Its Intellectual Property

52. Recognizing the significant importance of Drs. Grupp and Connelly's invention, Acorn applied for—and received—multiple U.S. patents covering methods and systems incorporating that invention, including those asserted in this lawsuit.

## V. Samsung's Infringement of the Acorn Patents

53. In or around 2015, Samsung began making, using, selling, offering for sale, and importing Samsung Exynos processors having transistors manufactured by Samsung according to Samsung's 14 nm FinFET process technology. By engaging in these activities, Samsung has infringed and continues to infringe Acorn's patents. Exynos processors that incorporate infringing Samsung transistors manufactured according to Samsung's 14 nm FinFET process technology include the Samsung Exynos 7420, Samsung Exynos 7570, Samsung Exynos 7870, Samsung Exynos 7880, Samsung Exynos 7872, Samsung Exynos 7874, Samsung Exynos 7885, Samsung Exynos 8890, Samsung Exynos 7904, and Samsung Exynos 7270 processors.

54. In or around 2015, Samsung began making, using, selling, offering for sale, and importing products incorporating Samsung Exynos processors having transistors manufactured by Samsung according to Samsung's 14 nm FinFET process technology. By engaging in these activities, Samsung has infringed and continues to infringe Acorn's patents. Samsung products

that incorporate Exynos processors having infringing Samsung transistors manufactured according to Samsung's 14 nm FinFET process technology include the Samsung Galaxy A40, Samsung Galaxy A30, Samsung Galaxy M30, Samsung Galaxy M20, Samsung Galaxy M10, Samsung Galaxy J2 Core, Samsung Galaxy On6, Samsung Galaxy J6, Samsung Galaxy J4, Samsung Galaxy A6, Samsung Galaxy On7 Prime, Samsung Galaxy A8, Samsung Galaxy A8+, Samsung Galaxy J7, Samsung Galaxy J5, Samsung Galaxy J3, Samsung Galaxy Xcover 4, Samsung Galaxy A7, Samsung Galaxy A5, Samsung Galaxy A3, Samsung Galaxy A8, Samsung Galaxy J7, Samsung Galaxy S7 Edge, Samsung Galaxy S7, Samsung Galaxy Note5, Samsung Galaxy S6 Edge+, Samsung Galaxy S6 Edge, Samsung Galaxy S6, Samsung Galaxy S6 Active, Samsung Galaxy Tab A10.1, Samsung Galaxy Tab Active 2, Samsung Galaxy J7 Duo, Samsung Galaxy Gear Sport, Samsung Galaxy Gear S3 Frontier, and Samsung Galaxy Gear S3 Classic.

55. In or around 2015, Samsung began making, using, selling, offering for sale, or importing third-party processors having transistors manufactured by Samsung according to Samsung's 14 nm FinFET process technology. By engaging in these activities, Samsung has infringed and continues to infringe Acorn's patents. Apple A9 processors, which are used in Apple iPhones, are just one example of a third-party processor manufactured by Samsung having infringing Samsung transistors manufactured according to Samsung's 14 nm FinFET process technology. Third-party processors that have infringing Samsung transistors and are made, used, sold, offered for sale, or imported by Samsung are incorporated into a wide variety of devices, including the Apple iPhone 6s, Apple iPhone 6s Plus, Xiaomi Mi 5, Alcatel Idol 4S Windows 10 mobile(6071W), ASUS ZenFone 3 Deluxe, Blackberry DTEK60, Gree Phone 2, Gree Phone 2 mini, HP Elite X3, HTC 10, Light L 16, LeEco (leTv) Le Max 2 X820, LeEco (LeTv) LeMax Pro X910, LeEco (LeTv) Le Pro 3 Elite, LeEco (LeTv) Max 3 X920, Lenovo ZUK Z2, Lenovo

ZUK Z2 Pro, LG G5, LG Q8, LG V20, Moto Z, Moto Z Force, OnePlus 3, Qiku 360 Q5 Plus, Samsung Galaxy S7, Samsung Galaxy S7 Edge, Samsung Galaxy S7 Active, Samsung Galaxy Note 7, Samsung Galaxy Tab S3, Sharp Aquos Zeta SH-04H, Sharp Aquos XX3, Sony Xperia X Performance, Sony Xperia XZ, Sony Xperia XZS, TCL 950, Vertu Constellation, Vivo Xplay 5 Elite, Vivo Xplay 6, 8848 M4, Xiaomi Mi 5 Prime/Pro, ZTE Axon 7, ZTE Nubia Z11, Google Pixel, Google Pixel XL, Xiaomi Mi 5s, HTC U Ultra, ASUS ZenFone 3 Deluxe, Asus Zenfone AR, Asus Zenfone Ares, Xiaomi Mi 5s Plus, Xiaomi Mi Note 2, Xiaomi Mi Mix, LeEco Le Pro 3, LeEco Cool Changer S1, Smartisan M1, Smartisan M1L, OnePlus 3T, Lenovo ZUK Edge, LG G6, LG G6+, LG G7 Fit, ZTE Axon 7s, ZTE Axon M, and Samsung Galaxy Note FE.

56. Samsung performs acts of infringement by making, using, selling offering for sale, or importing processors having transistors manufactured according to Samsung's 14 nm FinFET process technology, as well as any products that incorporate such processors (collectively, "the Accused Products").

57. Samsung actively markets and sells devices incorporating processors having infringing transistors to customers across the United States, including in the Eastern District of Texas.

**COUNT I**

**(Infringement of the '423 Patent)**

58. Acorn incorporates by reference paragraphs 1 through 57 and Exhibits 1-6 attached hereto.

59. The '423 Patent is valid and enforceable.

60. In violation of 35 U.S.C. § 271(a) (literally or under the doctrine of equivalents), Samsung makes, uses, offers to sell, sells, and imports the Accused Products and thereby directly

infringes the ’423 Patent. By manufacturing the Accused Products, Samsung also employs every step of the methods claimed in one or more claims of the ’423 Patent and thereby directly infringes these claims. The Accused Products, and/or Samsung’s manufacturing thereof, satisfy each and every limitation of one or more claims of the ’423 Patent, including at least Claim 62. Samsung thereby directly infringes one or more claims of the ’423 Patent.

61. In violation of 35 U.S.C. § 271(b) (literally or under the doctrine of equivalents), Samsung advertises to, sells to, encourages, and instructs third parties, to use one or more of the Accused Products covered by the ’423 Patent. Samsung thereby induces infringement of one or more claims of the ’423 Patent, including at least Claim 62, by having the specific intent to induce others to infringe the ’423 Patent, despite knowledge that use of the Accused Products infringes the ’423 Patent.

62. In violation of 35 U.S.C. § 271(c) (literally or under the doctrine of equivalents), Samsung offers to sell and sells material components of the invention claimed in the ’423 Patent that have no substantial non-infringing use and constitute a material part of the invention, to third parties. Samsung has thereby contributorily infringed and continues to contributorily infringe one or more of the claims of the ’423 Patent, including at least Claim 62, despite its knowledge that material components are especially made or especially adapted for use in infringing the ’423 Patent, and are not a staple article or commodity of commerce suitable for substantial non-infringing use.

63. Specifically and for example, transistors manufactured according to Samsung’s 14 nm FinFET process technology infringe Claim 62 of the ’423 Patent, which reads:

> 62. An electrical device, comprising a junction between a Si-based semiconductor and a conductor separated from the semiconductor by an interface layer having a thickness sufficient to depin a Fermi level of the conductor in a vicinity of the junction yet thin enough

> to provide the junction with a specific contact resistance that is generally dependent on the workfunction of the conductor.

Transistors manufactured according to Samsung's 14 nm FinFET process technology are electrical devices. Their source/drain areas are made of a Silicon-based semiconductor, while the contacts to those areas include a conductor, such as tungsten or titanium nitride. At the junctions between those source/drain areas and their respective contacts, there is a layer of silicon oxide and a layer of titanium silicon oxide. Those layers, together and/or separately, have a thickness sufficient to depin a Fermi level of the conductor, while being thick enough to provide the junction with a specific contact resistance that is generally dependent on the workfunction of the conductor.

64. Samsung's ongoing infringement of the '423 Patent is willful.

65. Acorn has suffered and continues to suffer damages and irreparable harm because of Samsung's past and ongoing infringement.

66. Unless Samsung's infringement is enjoined, Acorn will continue to be damaged and irreparably harmed.

67. Acorn meets the criteria for, and is entitled to, temporary, preliminary, and permanent injunctive relief.

**COUNT II**

**(Infringement of the '336 Patent)**

68. Acorn incorporates by reference paragraphs 1 through 67 and Exhibits 1-6 attached hereto.

69. The '336 Patent is valid and enforceable.

70. In violation of 35 U.S.C. § 271(a) (literally or under the doctrine of equivalents), Samsung makes, uses, offers to sell, sells, and imports the Accused Products and thereby directly

infringes the ’336 Patent. The Accused Products satisfy each and every limitation of one or more claims of the ’336 Patent, including at least Claim 1. Samsung thereby directly infringes one or more claims of the ’336 Patent.

71. In violation of 35 U.S.C. § 271(b) (literally or under the doctrine of equivalents), Samsung advertises to, sells to, encourages, and instructs third parties, to use one or more of the Accused Products covered by the ’336 Patent. Samsung thereby induces infringement of one or more claims of the ’336 Patent, including at least Claim 1, by having the specific intent to induce others to infringe the ’336 Patent, despite knowledge that use of the Accused Products infringes the ’336 Patent.

72. In violation of 35 U.S.C. § 271(c) (literally or under the doctrine of equivalents), Samsung offers to sell and sells material components of the invention claimed in the ’336 Patent that have no substantial non-infringing use and constitute a material part of the invention, to third parties. Samsung has thereby contributorily infringed and continues to contributorily infringe one or more of the claims of the ’336 Patent, including at least Claim 1, despite its knowledge that material components are especially made or especially adapted for use in infringing the ’336 Patent, and are not a staple article or commodity of commerce suitable for substantial non-infringing use.

73. Specifically and for example, transistors manufactured according to Samsung’s 14 nm FinFET process technology infringe Claim 1 of the ’336 Patent, which reads:

> 1. An electrical junction comprising an interface layer disposed between a contact metal and a group IV semiconductor, the semiconductor comprising a source or drain of a transistor, the interface layer comprising a metal oxide and configured to reduce a height of a Schottky barrier between the contact metal and the semiconductor from that which would exist at a contact junction between the contact metal and the semiconductor without the interface layer disposed therebetween, and wherein the electrical

> junction has a specific contact resistance of less than or equal to approximately 10 Ω-μm$^2$.

Transistors manufactured according to Samsung's 14 nm FinFET process technology have source-drain areas made of a Silicon-based semiconductor, and contacts to those areas made of a contact metal such as tungsten or titanium nitride. Silicon is a group IV semiconductor. Between the source-drain areas and their respective contacts lies an interface layer that includes titanium silicon oxide—a metal oxide. The interface layer is configured to reduce the height of the Schottky barrier between the contact metal and the semiconductor from that which would exist at a contact junction between the contact metal and the semiconductor without the interface layer disposed therebetween. Finally, the resulting electrical junction has a specific contact resistance of less than or equal to approximately 10 Ω-μm$^2$.

74. Samsung's ongoing infringement of the '336 Patent is willful.

75. Acorn has suffered and continues to suffer damages and irreparable harm because of Samsung's past and ongoing infringement.

76. Unless Samsung's infringement is enjoined, Acorn will continue to be damaged and irreparably harmed.

77. Acorn meets the criteria for, and is entitled to, temporary, preliminary, and permanent injunctive relief.

**COUNT III**

**(Infringement of the '261 Patent)**

78. Acorn incorporates by reference paragraphs 1 through 77 and Exhibits 1-6 attached hereto.

79. The '261 Patent is valid and enforceable.

80. In violation of 35 U.S.C. § 271(a) (literally or under the doctrine of equivalents), Samsung makes, uses, offers to sell, sells, and imports the Accused Products and thereby directly infringes the '261 Patent. The Accused Products satisfy each and every limitation of one or more claims of the '261 Patent, including at least Claim 21. Samsung thereby directly infringes one or more claims of the '261 Patent.

81. In violation of 35 U.S.C. § 271(b) (literally or under the doctrine of equivalents), Samsung advertises to, sells to, encourages, and instructs third parties, including LG, to use one or more of the Accused Products covered by the '261 Patent. Samsung thereby induces infringement of one or more claims of the '261 Patent, including at least Claim 21, by having the specific intent to induce others to infringe the '261 Patent, despite knowledge that use of the Accused Products infringes the '261 Patent.

82. In violation of 35 U.S.C. § 271(c) (literally or under the doctrine of equivalents), Samsung offers to sell and sells material components of the invention claimed in the '261 Patent that have no substantial non-infringing use and constitute a material part of the invention, to third parties including LG. Samsung has thereby contributorily infringed and continues to contributorily infringe one or more of the claims of the '261 Patent, including at least Claim 21, despite its knowledge that material components are especially made or especially adapted for use in infringing the '261 Patent, and are not a staple article or commodity of commerce suitable for substantial non-infringing use.

83. Specifically and for example, transistors manufactured according to Samsung's 14 nm FinFET process technology infringe Claim 1 of the '261 Patent, which reads:

> 1. An electrical junction comprising a metal oxide interface layer disposed between a contact metal and a group IV semiconductor, the semiconductor comprising a source or drain of a transistor, the interface layer configured to reduce a height of a Schottky barrier

> between the contact metal and the semiconductor from that which would exist at a contact junction between the contact metal and the semiconductor without the interface layer disposed therebetween, and wherein the interface layer has a thickness of approximately 0.1 nm to 5 nm.

Transistors manufactured according to Samsung's 14 nm FinFET process technology have source-drain areas made of a Silicon-based semiconductor, and contacts to those areas made of a contact metal such as tungsten or titanium nitride. Silicon is a group IV semiconductor. Between the source-drain areas and their respective contacts lies an interface layer that includes titanium silicon oxide—a metal oxide. The interface layer is configured to reduce the height of the Schottky barrier between the contact metal and the semiconductor from that which would exist at a contact junction between the contact metal and the semiconductor without the interface layer disposed therebetween. Finally, the interface layer has a thickness of approximately 0.1 nm to 5 nm.

84. Samsung's ongoing infringement of the '261 Patent is willful.

85. Acorn has suffered and continues to suffer damages and irreparable harm because of Samsung's past and ongoing infringement.

86. Unless Samsung's infringement is enjoined, Acorn will continue to be damaged and irreparably harmed.

87. Acorn meets the criteria for, and is entitled to, temporary, preliminary, and permanent injunctive relief.

**COUNT IV**

**(Infringement of the '167 Patent)**

88. Acorn incorporates by reference paragraphs 1 through 87 and Exhibits 1-6 attached hereto.

89. The '167 Patent is valid and enforceable.

90. In violation of 35 U.S.C. § 271(a) (literally or under the doctrine of equivalents), Samsung makes, uses, offers to sell, sells, and imports the Accused Products and thereby directly infringes the ’167 Patent. The Accused Products satisfy each and every limitation of one or more claims of the ’167 Patent, including at least Claim 1. Samsung thereby directly infringes one or more claims of the ’167 Patent.

91. In violation of 35 U.S.C. § 271(b) (literally or under the doctrine of equivalents), Samsung advertises to, sells to, encourages, and instructs third parties, including LG, to use one or more of the Accused Products covered by the ’167 Patent. Samsung thereby induces infringement of one or more claims of the ’167 Patent, including at least Claim 1, by having the specific intent to induce others to infringe the ’167 Patent, despite knowledge that use of the Accused Products infringes the ’167 Patent.

92. In violation of 35 U.S.C. § 271(c) (literally or under the doctrine of equivalents), Samsung offers to sell and sells material components of the invention claimed in the ’167 Patent that have no substantial non-infringing use and constitute a material part of the invention, to third parties including LG. Samsung has thereby contributorily infringed and continues to contributorily infringe one or more of the claims of the ’167 Patent, including at least Claim 1, despite its knowledge that material components are especially made or especially adapted for use in infringing the ’167 Patent, and are not a staple article or commodity of commerce suitable for substantial non-infringing use.

93. Specifically and for example, transistors manufactured according to Samsung’s 14 nm FinFET process technology infringe Claim 1 of the ’167 Patent, which reads:

> 1. An electrical junction comprising an interface layer disposed between a contact metal and a semiconductor, the semiconductor comprising a source or drain of a transistor, the interface layer configured to provide a specific contact resistivity between the

> contact metal and the semiconductor of less than 1 Ω-μm$^2$, the interface layer comprising a metal oxide and an oxide of the semiconductor.

Transistors manufactured according to Samsung's 14 nm FinFET process technology have source-drain areas made of a Silicon-based semiconductor, and contacts to those areas made of a contact metal such as tungsten or titanium nitride. Between the source-drain areas and their respective contacts lies an interface layer that includes titanium silicon oxide—a metal oxide—as well as silicon oxide. The interface layer is configured to provide a specific contact resistivity between the contact metal and the semiconductor less than 1 Ω-μm$^2$.

94. Samsung's ongoing infringement of the '167 Patent is willful.

95. Acorn has suffered and continues to suffer damages and irreparable harm because of Samsung's past and ongoing infringement.

96. Unless Samsung's infringement is enjoined, Acorn will continue to be damaged and irreparably harmed.

97. Acorn meets the criteria for, and is entitled to, temporary, preliminary, and permanent injunctive relief.

**COUNT V**

**(Infringement of the '691 Patent)**

98. Acorn incorporates by reference paragraphs 1 through 97 and Exhibits 1-6 attached hereto.

99. The '691 Patent is valid and enforceable.

100. In violation of 35 U.S.C. § 271(a) (literally or under the doctrine of equivalents), Samsung makes, uses, offers to sell, sells, and imports the Accused Products and thereby directly infringes the '691 Patent. The Accused Products satisfy each and every limitation of one or

more claims of the ’691 Patent, including at least Claim 25. Samsung thereby directly infringes one or more claims of the ’691 Patent.

101. In violation of 35 U.S.C. § 271(b) (literally or under the doctrine of equivalents), Samsung advertises to, sells to, encourages, and instructs third parties, including LG, to use one or more of the Accused Products covered by the ’691 Patent. Samsung thereby induces infringement of one or more claims of the ’691 Patent, including at least Claim 25, by having the specific intent to induce others to infringe the ’691 Patent, despite knowledge that use of the Accused Products infringes the ’691 Patent.

102. In violation of 35 U.S.C. § 271(c) (literally or under the doctrine of equivalents), Samsung offers to sell and sells material components of the invention claimed in the ’691 Patent that have no substantial non-infringing use and constitute a material part of the invention, to third parties including LG. Samsung has thereby contributorily infringed and continues to contributorily infringe one or more of the claims of the ’691 Patent, including at least Claim 25, despite its knowledge that material components are especially made or especially adapted for use in infringing the ’691 Patent, and are not a staple article or commodity of commerce suitable for substantial non-infringing use.

103. Specifically and for example, transistors manufactured according to Samsung’s 14 nm FinFET process technology infringe Claim 25 of the ’691 Patent, which reads:

> 25. An electrical junction comprising an interface layer disposed between a contact metal and a semiconductor, the semiconductor comprising a source or drain of a transistor, the interface layer comprising a metal oxide separation layer and a semiconductor oxide passivation layer and configured to provide a specific contact resistivity between the contact metal and the semiconductor of less than 1 $\Omega$-$\mu m^2$.

Transistors manufactured according to Samsung’s 14 nm FinFET process technology have source-drain areas made of a Silicon-based semiconductor, and contacts to those areas made of a

contact metal such as tungsten or titanium nitride. Between the source-drain areas and their respective contacts lies an interface layer that includes titanium silicon oxide—a metal oxide separation layer—as well as silicon oxide—a semiconductor oxide passivation layer. The interface layer is configured to provide a specific contact resistivity between the contact metal and the semiconductor less than 1 $\Omega$-$\mu m^2$.

104. Samsung's ongoing infringement of the '691 Patent is willful.

105. Acorn has suffered and continues to suffer damages and irreparable harm because of Samsung's past and ongoing infringement.

106. Unless Samsung's infringement is enjoined, Acorn will continue to be damaged and irreparably harmed.

107. Acorn meets the criteria for, and is entitled to, temporary, preliminary, and permanent injunctive relief.

**COUNT VI**

**(Infringement of the '395 Patent)**

108. Acorn incorporates by reference paragraphs 1 through 107 and Exhibits 1-6 attached hereto.

109. The '395 Patent is valid and enforceable.

110. In violation of 35 U.S.C. § 271(a) (literally or under the doctrine of equivalents), Samsung makes, uses, offers to sell, sells, and imports the Accused Products and thereby directly infringes the '395 Patent. The Accused Products satisfy each and every limitation of one or more claims of the '395 Patent, including at least Claim 1. Samsung thereby directly infringes one or more claims of the '395 Patent.

111. In violation of 35 U.S.C. § 271(b) (literally or under the doctrine of equivalents), Samsung advertises to, sells to, encourages, and instructs third parties, including LG, to use one or more of the Accused Products covered by the '395 Patent. Samsung thereby induces infringement of one or more claims of the '395 Patent, including at least Claim 1, by having the specific intent to induce others to infringe the '395 Patent, despite knowledge that use of the Accused Products infringes the '395 Patent.

112. In violation of 35 U.S.C. § 271(c) (literally or under the doctrine of equivalents), Samsung offers to sell and sells material components of the invention claimed in the '395 Patent that have no substantial non-infringing use and constitute a material part of the invention, to third parties including LG. Samsung has thereby contributorily infringed and continues to contributorily infringe one or more of the claims of the '395 Patent, including at least Claim 1, despite its knowledge that material components are especially made or especially adapted for use in infringing the '395 Patent, and are not a staple article or commodity of commerce suitable for substantial non-infringing use.

113. Specifically and for example, transistors manufactured according to Samsung's 14 nm FinFET process technology infringe Claim 1 of the '395 Patent, which reads:

> 1. An electrical junction, comprising a region in a semiconductor substrate, a metal electrical contact to said region, and an interface layer between said region and said metal electrical contact, said region being electrically connected to said metal electrical contact through said interface layer and said interface layer comprising a metal oxide and a semiconductor oxide, and being in contact with said region in the semiconductor substrate and said metal electrical contact.

Transistors manufactured according to Samsung's 14 nm FinFET process technology have source-drain areas comprised of regions in a Silicon-based semiconductor substrate, and contacts to those areas made of a contact metal such as tungsten or titanium nitride. Between the source-

drain areas and their respective contacts—and in contact with both—lies an interface layer that includes titanium silicon oxide—a metal oxide—as well as silicon oxide—a semiconductor oxide.

114. Samsung's ongoing infringement of the '395 Patent is willful.

115. Acorn has suffered and continues to suffer damages and irreparable harm because of Samsung's past and ongoing infringement.

116. Unless Samsung's infringement is enjoined, Acorn will continue to be damaged and irreparably harmed.

117. Acorn meets the criteria for, and is entitled to, temporary, preliminary, and permanent injunctive relief.

**PRAYER FOR RELIEF**

WHEREFORE, Acorn respectfully asks that the Court enter judgment against Samsung as follows:

1. That Samsung has infringed (either literally or under the doctrine of equivalents) directly, jointly, and/or indirectly by way of practicing, inducing or contributing to the infringement of one or more claims of the Acorn Patents;

2. That Samsung's infringement of the Acorn Patents was willful;

3. For temporary, preliminary, and permanent injunctive relief enjoining Samsung and its officers, directors, agents, affiliates, employees, divisions, branches, subsidiaries, parents, and all others acting in active concert or participation with it, from infringement, inducing the infringement, or contributing to the infringement of the Acorn Patents;

4. For an award to Acorn for its damages, costs, expenses, and prejudgment and post-judgment interest for Samsung's infringement of the Acorn Patents;

5. For an award to Acorn for enhanced damages equal to treble the amount of actual damages, for the willful nature of Samsung's acts of infringement as to the Acorn Patents, with notice being made at least as early as the filing of this lawsuit;

6. Reasonable attorneys' fees and costs against Samsung;

7. For any and all other relief to which Acorn may show itself to be entitled.

**JURY DEMAND**

Plaintiff demands a trial by jury for all issues so triable.

Dated: October 23, 2019

Respectfully Submitted,

By: */s/ Robert W. Weber*

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