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COREPHOTONICS, LTD.

UNITED STATES DISTRICT COURT

NORTHERN DISTRICT OF CALIFORNIA

COREPHOTONICS, LTD. Plaintiff, vs. APPLE INC. Defendant.	Civil Action No. 3:19-cv-4809 **COMPLAINT FOR PATENT INFRINGEMENT** **DEMAND FOR JURY TRIAL**

COMPLAINT

1. Plaintiff Corephotonics, Ltd. ("Corephotonics") hereby submits its Complaint against Defendant Apple Inc. ("Apple") and alleges as follows:

NATURE OF THE ACTION

2. This is a civil action for infringement under the patent laws of the United States, 35 U.S.C. § 1, *et seq*.

3. The United States Patent and Trademark Office duly and legally issued U.S. Patent 9,661,233 (the "'233 patent"), entitled "Dual Aperture Zoom Digital Camera," on May 23, 2017. Corephotonics is the legal owner of the '233 patent by assignment. A true and correct copy of the '233 patent is attached hereto as Exhibit A.

4. The United States Patent and Trademark Office duly and legally issued U.S. Patent 10,230,898 (the "'898 patent"), entitled "Dual Aperture Zoom Camera With Video Support And Switching / Non-Switching Dynamic Control," on March 12, 2019. Corephotonics is the legal owner of the '898 patent by assignment. A true and correct copy of the '898 patent is attached hereto as Exhibit B.

5. The United States Patent and Trademark Office duly and legally issued U.S. Patent 10,288,840 (the "'840 patent"), entitled "Miniature Telephoto Lens Module And A Camera Utilizing Such A Lens Module," on May 14, 2019. Corephotonics is the legal owner of the '840 patent by assignment. A true and correct copy of the '840 patent is attached hereto as Exhibit C.

6. The United States Patent and Trademark Office duly and legally issued U.S. Patent 10,317,647 (the "'647 patent"), entitled "Miniature Telephoto Lens Assembly," on June 11, 2019. Corephotonics is the legal owner of the '647 patent by assignment. A true and correct copy of the '647 patent is attached hereto as Exhibit D.

7. The United States Patent and Trademark Office duly and legally issued U.S. Patent 10,324,277 (the "'277 patent"), entitled "Miniature Telephoto Lens Assembly," on June 18, 2019. Corephotonics is the legal owner of the '277 patent by assignment. A true and correct copy of the '277 patent is attached hereto as Exhibit E.

8. The United States Patent and Trademark Office duly and legally issued U.S. Patent 10,330,897 (the "'897 patent"), entitled "Miniature Telephoto Lens Assembly," on June 25, 2019. Corephotonics is the legal owner of the '897 patent by assignment. A true and correct copy of the '897 patent as-issued, together with a certificate of correction dated July 23, 2019, is attached hereto as Exhibit F.

9. The United States Patent and Trademark Office duly and legally issued U.S. Patent 10,225,479 (the "'479 patent"), entitled "Dual Aperture Zoom Digital Camera," on March 5, 2019. Corephotonics is the legal owner of the '479 patent by assignment. A true and correct copy of the '479 patent is attached hereto as Exhibit G.

10. The United States Patent and Trademark Office duly and legally issued U.S. Patent 10,015,408 (the "'408 patent"), entitled "Dual Aperture Zoom Digital Camera," on July 3, 2018. Corephotonics is the legal owner of the '408 patent by assignment. A true and correct copy of the '408 patent is attached hereto as Exhibit H.

11. The United States Patent and Trademark Office duly and legally issued U.S. Patent 10,356,332 (the "'332 patent"), entitled "Dual Aperture Zoom Camera With Video Support And Switching / Non-Switching Dynamic Control," on July 16, 2019. Corephotonics is the legal owner of the '332 patent by assignment. A true and correct copy of the '332 patent is attached hereto as Exhibit I.

12. The United States Patent and Trademark Office duly and legally issued U.S. Patent 10,326,942 (the "'942 patent"), entitled "Dual Aperture Zoom Digital Camera," on June 18, 2019. Corephotonics is the legal owner of the '942 patent by assignment. A true and correct copy of the '942 patent is attached hereto as Exhibit J.

13. Apple has infringed and continues to infringe one or more claims of each of the '233 patent, the '898 patent, the '840 patent, the '647 patent, the '277 patent, the '897 patent, the '479 patent, the '408 patent, the '332 patent, and the '942 patent (collectively the "Asserted Patents"), at least by importing, using, selling, and/or offering to sell the iPhone 7 Plus, iPhone 8 Plus, iPhone X, iPhone Xs, and/or iPhone Xs Max (the "Accused Products"), as set forth in detail below. Corephotonics seeks, among other things, monetary damages and injunctive relief.

THE PARTIES

14. Plaintiff Corephotonics is a company organized and existing under the laws of the State of Israel with its principal place of business at 25 HaBarzel St., Tel Aviv 6971035, Israel.

15. Defendant Apple is a corporation organized and existing under the laws of the State of California with its principal place of business at 1 Infinite Loop, Cupertino, California.

JURISDICTION AND VENUE

16. This Court has subject matter jurisdiction over Corephotonics' claims for patent infringement pursuant to the 28 U.S.C. §§ 1331 and 1338(a).

17. Apple is subject to this Court's personal jurisdiction because Apple resides and has its primary place of business within this District. This Court also has personal jurisdiction over Apple because Apple has committed and induced acts of patent infringement and has regularly and systematically conducted and solicited business in this District by and through at least its sales and offers for sale of Apple products and services, and other contractual arrangements with Apple customers and third parties using such Apple products and services located in and/or doing business in this District.

18. Venue is proper in this District under 28 U.S.C. §§ 1391(b) and 1400(b) because Apple resides in this District, has a regular and established place of business in this District, and has committed acts of infringement in this District.

INTRADISTRICT ASSIGNMENT

19. This action for patent infringement is assigned on a district-wide basis under Civil L.R. 3-2(c).

FACTUAL ALLEGATIONS

A. Corephotonics' Dual Camera Technology Innovations

20. Corephotonics is a pioneer in the development of dual camera technologies for mobile devices. Corephotonics was founded in 2012 to develop the next generation of mobile phone cameras. Its founders brought with them decades of experience in the fields of optics and miniature digital cameras and were led by Dr. David Mendlovic, a Professor at Tel Aviv University and former Chief Scientist of the Israeli Ministry of Science.

21. Corephotonics' dual-aperture camera technology changes the way smartphones take pictures by using advanced lens design and sophisticated computational optics. The advanced lens design is used to create a miniature telephoto lens that can fit within the confines of a modern, thin smartphone but still provide the superior image quality and light sensitivity demanded by smartphone consumers.

22. Corephotonics' innovative dual-aperture camera technology uses two fixed-focal length lenses, a wide-angle lens as typically found in smartphones with single-aperture cameras, and a miniature telephoto lens. Traditional optical zoom is accomplished by using a variable focal length lens assembly. At the small formats required for smartphones, however, it is difficult to reliably include movable components, so smartphones were stuck with small, fixed lenses. This means that in a typical single-aperture smartphone camera, all zoom functionality is provided with digital zoom, *i.e.*, a processor digitally modifies the image to create a magnified but poorer resolution image. With Corephotonics' dual-aperture camera technology, by contrast, the second camera with telephoto lens provides much higher optical resolution than the wide-angle camera. Images from both of these cameras can also be processed by computational algorithms to create an effectively greater level of zoom without degrading image quality by combining digital and optical zoom.

23. For video, which captures thirty or more frames per second, Corephotonics discovered that implementing image fusion for each frame demands higher than normal processing resources and power. At the same time, the beneficial pixel finesse achieved by image fusion is less observable at the rapid frame rate of HD video due to human perception limits. Corephotonics thus developed technology for dual-aperture cameras where image fusion is only used when taking still pictures, but not for video. In video, when zooming in, digital zoom is used first on the image from the wide-angle camera only and then switched to the image from the telephoto camera only. When zooming back out, a similar transition happens from using the telephoto camera only, switching back to the wide-angle camera only. This approach conserves resources and power. Because the two lenses are different and necessarily view the subject from different points of view,

Corephotonics also developed special processing that can ensure that the transition from the wide lens to the telephoto lens and back would be smooth.

24. Corephotonics has filed for and received patents on its advanced telephoto lens designs, multi-aperture camera technologies, and optical processing technologies, including the patents-in-suit. Corephotonics is continuing to develop multi-aperture camera technologies, and it has filed and obtained patents on these technologies as well.

25. The press recognized Corephotonics' pioneering advances in dual-aperture camera technology for smartphones. For example, Corephotonics demonstrated its dual-aperture camera technology at Mobile World Congress (MWC) 2014 and received very positive reviews from the tech media, including headlines such as "Corephotonics' dual-camera tech will change smartphone imaging"[1] and statements like "We think [the Corephotonics dual camera technology] has the potential to change the direction of smartphone photography."[2]

26. Corephotonics now employs over 60 staff, the majority of whom are engineers, scientists, and technologists. Corephotonics depends on its patents to protect its business and continue to develop its innovative miniaturized multi-camera technologies, for mobile devices and new applications. The customers of Corephotonics' technology offerings include leading camera module and mobile device manufacturers.

27. Corephotonics spent years demonstrating its technologies to Apple and discussing potential collaborations and business arrangements. Apple, however, refused. Instead, Apple has gone ahead and marketed its newest generations of iPhones with dual cameras that employ Corephotonics' innovative designs – without any regard to Corephotonics' intellectual property rights.

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[1] "Corephotonics' dual-camera tech will change smartphone imaging," *C|Net*, https://www.cnet.com/news/corephotonics-dual-camera-tech-will-change-smartphone-imaging/

[2] "Best of Mobile World Congress: Samsung Galaxy S5, Mozilla $25 phone, smart glove and more," *C|Net*, "https://www.cnet.com/news/best-of-mobile-world-congress-samsung-galaxy-s5-mozilla-25-phone-smart-glove-and-more/

B. Apple's Interest in Corephotonics' Technology and Intellectual Property

28. As one of its first acts as a company, Corephotonics reached out to Apple in the hopes of establishing a strategic partnership. The founding team contacted someone they knew from their previous work in digital camera technology, Graham Townsend, then Senior Director Camera Hardware at Apple, highlighting some of the innovations Corephotonics was working on related to a high-end compact camera module ("CCM") solution. Throughout 2012, Corephotonics and Apple had meetings regarding the early technologies that Corephotonics was developing during that time. At an early meeting in June 2012, Corephotonics told Apple of its intention to protect its current and future developments in multi-camera technology with patents.

29. In May 2013, an Apple engineer emailed Corephotonics communicating Apple's interest in learning more about Corephotonics' other technology offerings and intellectual property, in particular a telephoto lens that for a dual-aperture camera that included a telephoto lens and associated software algorithms, and expressed interest in learning more about that invention. Corephotonics provided a brief description of its telephoto lens architecture that was part of its intellectual property and referenced other pending patents.

30. In June 2013, a meeting was held at Corephotonics' headquarters in Tel Aviv, Israel with Mr. Townsend and other Apple camera engineers. At this meeting Corephotonics described its intellectual property and technology plans, which included a detailed presentation and discussion of computational algorithms for dual-aperture cameras and numerous system architecture and design details for a dual system. These design details closely resembled what was eventually deployed in the market by Apple. At the same time, Corephotonics also engaged in engineering discussions of its telephoto lens design, and sent a file describing the lens design and including key design details. Corephotonics provided Apple with a full set of technology descriptions covering what was discussed. At the meeting, Corephotonics provided Mr. Townsend with a USB drive containing presentation files, which included a Corephotonics' five element telephoto lens design layout, information about Corephotonics' algorithm, and a slide describing Corephotonics' pending patent applications and patent plans, including filing of applications underlying the Asserted Patents. Corephotonics followed up with further correspondence, which

included technical descriptions and responses to Apple's technical inquiries. Later, in October 2013, a larger team, this time including members of Apple's image processing and system groups, visited Corephotonics' Tel Aviv office again for more in-depth discussions, which included dual camera processing methods.

31. During this period through late 2014, Corephotonics personnel visited Apple's facilities in California on numerous occasions, meeting with key members of Apple's camera team, including the leaders of Apple's hardware and software efforts. Corephotonics personnel set up numerous simulations and demonstrations of its technology for Apple. Apple further evaluated Corephotonics' test boards, lens modules, and simulation files at its own facilities, in the absence of Corephotonics personnel.

32. During this period in 2014, Corephotonics learned from the contractor who was manufacturing Corephotonics' prototype telephoto lens modules that Apple had sought Corephotonics' samples from them without notifying Corephotonics, and the contractor had rejected that request. Corephotonics then contacted Apple and agreed to provide Apple with physical samples of Corephotonics' lens and camera modules, which embody the claimed designs of Corephotonics '647, '277, and '897 patents.

33. Apple also received "black box" simulation files for Corephotonics' lens designs and a software simulator for the computational algorithms for image processing, and also was provided access to Corephotonics' system prototypes, which simulated embodiments of U.S. Patent Nos. 9,185,291 ("'291 patent") and 9,538,152 ("'152 patent) (as well as continuations therefrom, such as the '233, '479, and '408 patents asserted in this Complaint).

34. In May 2014, Corephotonics was told by Apple that high-level technical staff and executives in Apple's camera engineering group had observed a demonstration of Corephotonics' technology and had reacted very positively. Corephotonics understood that Apple's management had determined to move forward and engage with Corephotonics.

35. In June 2014, Apple expressed interest in licensing Corephotonics' dual camera algorithms and software for commercial use in its devices, and a meeting was arranged for July 30, 2014. Apple provided a business proposal prior to that meeting. Corephotonics provided

Apple's business team with a description of its range of technology offerings and provided Apple with a description of its (then) over ten patent families, including low-profile telephoto lens designs for mobile cameras and algorithms for improving dual-aperture cameras with telephoto lenses. During this meeting, in response to Corephotonics claim about the commercial value of its patents, Apple's lead negotiator responded that even if Apple infringed, it would take years and millions of dollars in litigation before Apple might have to pay something.

36. After the meeting, Apple asked Corephotonics to provide a sample of its telephoto lens. Apple indicated that it intended to evaluate Corephotonics' lens design and that it could potentially engage with Corephotonics on lens design technology depending on the outcome of that evaluation.

37. By late August, business negotiations were halted by Apple. Technical discussions between Apple and Corephotonics continued until later that year, while Corephotonics was waiting to hear from Apple's business team.

38. On November 18, 2014, an article appeared in the media reporting that Apple would potentially adopt dual-aperture camera technology, suggesting that it would be similar to the dual camera technology that Corephotonics had developed and presented earlier that year, and which Corephotonics had been discussing over this period with Apple.[3] Apple did not engage in further efforts to obtain a license to Corephotonics' intellectual property.

39. In January 2016, after sporadic contacts with Apple personnel through 2015, Corephotonics again reached out to Apple. Corephotonics' CEO, Dr. Mendlovic, emailed a high-level hardware executive suggesting continued collaboration. Corephotonics pointed out, "Corephotonics had the privilege to be the first to invent, implement and demonstrate dual cameras which outperform the best single compact cameras. Thus, our IP portfolio is the widest and, in our opinion, has the best defensive value for such applications." Corephotonics offered to discuss collaboration and joint projects with Apple. The Apple executive wrote back that he was looking into it, and that another Apple engineer would be in touch. That engineer and a colleague from

[3] *See* "Apple May Introduce 'Biggest Camera Jump Ever' in Next-Generation iPhone," https://www.macrumors.com/2014/11/18/apple-biggest-camera-jump-ever/.

Apple visited Corephotonics' facility in Israel for an in-person meeting, at which Corephotonics presented some of its most recent technology offerings.

40. At that meeting and in subsequent meetings and communications, Apple expressed interest in learning more about Corephotonics' technologies. Corephotonics indicated a desire to formalize a business arrangement, and in June 2016, Mr. Townsend emailed Corephotonics introducing them to Apple personnel on its business side to engage in setting up a deal that would govern the technology collaboration. Corephotonics sent Apple a proposal, and in August 2016, Apple followed up and asked Corephotonics to provide a proposal for licensing its intellectual property to Apple. Corephotonics informed Apple that its intellectual property included over 25 patent families, and discussions continued to proceed.

41. On September 7, 2016, Apple announced the iPhone 7 Plus, which included, for the first time for Apple, a rear dual camera assembly including a telephoto camera for enhanced zoom – one of Corephotonics' core innovative concepts. Apple specifically touted the telephoto camera on iPhone 7 Plus as a key feature. The hardware specifications and important software functionalities were similar to what Corephotonics had shown and demonstrated to Apple throughout the aforementioned exchanges starting in 2013.

42. By October 2016, negotiations between Corephotonics had stopped progressing, and Corephotonics arranged a face-to-face meeting with Apple. Two meetings were set up, which included technical and business personnel from Apple. During these meetings, Corephotonics offered to negotiate an agreement with Apple for access to Corephotonics' technology offerings and patents. Corephotonics offered to share its patents with Apple employees at both meetings. At the second meeting, Mr. Townsend stated that he was not permitted by his company to look at the patents, and he asked Corephotonics instead to send it to Apple's business personnel instead. One of Apple's business personnel followed up immediately thereafter with an unsolicited email stating, "Please do not send any patents to us until further notice. Legal counsel might reach out with any questions."

43. Corephotonics did not hear from Apple's legal counsel after receiving that email. In an attempt to continue efforts to develop a business relationship, during 2017 Corephotonics

again met with and communicated with individuals from Apple's camera team on several occasions, but Apple no longer expressed interest in continuing to discuss a collaboration with Corephotonics.

44. On October 31, 2017, Corephotonics wrote to Apple informing it that after examining Apple's iPhone 7 Plus and 8 Plus cameras and zoom functionality, it believed that these products infringed certain of Corephotonics' patents. Apple did not respond.

45. On November 6, 2017, Corephotonics filed a complaint alleging and describing the infringement by Apple's iPhone 7 Plus product of U.S. Patent Nos. 9,402,032 ("'032 patent"), 9,568,712 ("'712 patent"), the '291 patent", and the '152 patent. That case is pending in this District before the Honorable Judge Lucy Koh, Case No. 5:17-cv-06457-LHK, and is administratively stayed pending resolution of *inter partes* review ("IPR") proceedings initiated by Apple against Corephotonics' patents.

46. On April 16, 2018, Corephotonics wrote to Apple informing it that it had examined Apple's iPhone 7 Plus, iPhone 8 Plus, and iPhone X products and concluded those products infringed U.S. Patent No. 9,857,568 ("the '568 patent") as well as recently allowed claims in U.S. Patent Application 15/424,853 ('853 application), the latter of which is a continuation of the '291 patent.

47. On April 25, 2018, Apple responded to Corephotonics' April 18, 2018 correspondence with a letter of its own, wherein Apple stated that Corephotonics had not "articulate[d] any detail for its claim" relating to the '568 patent and'853 application but suggested that it had begun an "investigation into [Corephotonics'] allegations."

48. On April 30, 2018, Corephotonics filed a second complaint alleging and describing infringement by Apple's iPhone 7 Plus, iPhone 8 Plus, and iPhone X products of the '712 patent and U.S. Patent No. 9,568,712 and the '568 patent. That case is pending in this District before Judge Koh, Case No. 5:18-cv-02555-LHK, and is administratively stayed pending the resolution of related IPR proceedings.

49. On July 26, 2018, Corephotonics wrote to Apple to informing it that the '853 application had been issued as the '408 patent, and reiterated Corephotonics' belief that the iPhone X infringed the issued claims of the '408 patent.

50. On August 8, 2018, Apple responded to Corephotonics' July 26, 2018 letter, contending again that Corephotonics had provided insufficient information regarding the '408 patent and that such fact "impede[d] Apple's investigation into [the] allegations."

51. On November 30, 2018, Corephotonics wrote to Apple to inform it that Apple infringed claims that would soon issue in U.S. Patent Application Nos. 15/540,676 ("the '676 application"), 15/817,235 ("the '235 application"), 15/976,391 ("the '391 application"), and 15/976,422 ("the '422 application"). Attached to that letter were charts, prepared by Corephotonics, describing Apple's infringement of certain recently-allowed claims of the '408 patent, the '391 application, the '422 application; the '235 application, and U.S. Patent Application 15/324,720 ("the '720 application").

52. Of the patent applications identified by Corephotonics in its November 30, 2018 letter, all subsequently matured into issued patents now asserted in this Complaint:

- the '676 application issued as the '840 patent;
- the '235 application issued as the '277 patent;
- the '391 application issued as the '897 patent;
- the '422 application issued as the '647 patent; and
- the '720 application issued as the '898 patent.

53. During the relevant time period, Corephotonics continued to prosecute and obtain continuation patents on the patents it had already specifically identified and/or asserted against Apple in its pending litigations. This included U.S. Application No. 16/048,242, which is a continuation of the '291 patent (and the '408 patent, as well) and later issued as the '479 patent.

C. Apple's Analysis of Corephotonics' Patents and Patent Applications During Apple's Pursuit of its Own Patents

54. During the period that Apple was in discussions with Corephotonics, and investigating and evaluating Corephotonics' technology, Apple was filing its own patent

applications on small-format camera designs, including telephoto cameras that could be used in a mobile device. During this time, Corephotonics' patents and related patent applications were significant in the art. Apple was well aware of Corephotonics' patents and related patent applications, including the patents in suit and applications that issued as the patents in suit, as it sought to obtain its own patents over Corephotonics' prior art.

55. For instance, Apple filed U.S. Patent Application No. 14/069,027 (the "'027 application"), which later issued as U.S. Patent No. 9,223,118. On February 18, 2015, the U.S. Patent & Trademark Office issued an Office Action in the prosecution of the '027 application. The examiner cited published application U.S. Pub. App. No. 2015/0029601A1 to Dror, *et al.* (the "Dror Application"), as anticipating, or rendering obviousness in combination with other references, all the pending claims of the '027 application. The Dror Application is a family member of certain of the patents asserted by Corephotonics in this action and its two previously-filed actions (referred to herein nonexclusively as "Dror family" patents and applications). Amendments and arguments associated with those amendments were filed on May 15, 2015, which extensively discussed Corephotonics' patent application and analyzed purported differences between its disclosures and the claims of Apple's '027 application. The inventor of Apple's '027 application, Roman Mercado continued to work for Apple through the introduction of the iPhone 7 Plus.

56. Apple was familiar with and had analyzed the extent of Corephotonics' patent portfolio throughout its pursuit of Apple's own patents. By way of example, the earliest IDS that Apple filed for the '720 application, filed on September 30, 2015, included four references, of which two of the four were Corephotonics patent applications. Other examples of Apple's actual knowledge and familiarity with Corephotonics' patent portfolio include:

- Apple also disclosed the Dror Application as prior art to its '720 application, submitted in Apple's March 24, 2016 IDS filing. Apple further disclosed the Dror Application as prior art to its '716 application and its '136 application.
- The '291 patent to Shabtay et al. (of which multiple patents asserted in this Complaint are continuations, such as the '233 patent, '408 patent, and '479 patent) is cited on the face of

numerous patents assigned to Apple, such as U.S. Patent Nos. 9,769,389; 9,774,787; 9,781,345; 10,063,783; 10,122,931; 10,136,048; and 10,264,188.

- Published patent applications within the same family as the '291 patent (nonexclusively referred to herein as "Shabtay family" patents and applications), including U.S. Patent Application Nos. 2015/02449420 and 2015/0085174, have been cited by numerous recently-issued patents assigned to Apple.

57. Apple also asked Corephotonics to provide three samples of telephoto lens elements similar to the embodiments disclosed in the Dror family patents and patent applications. Corephotonics provided those samples, and Apple has not returned them to Corephotonics as of the date of this Complaint.

FIRST CAUSE OF ACTION

Infringement of Patent No. 9,661,233

58. Corephotonics incorporates the foregoing paragraphs as though fully set forth herein.

59. Apple has directly infringed, and continues to directly infringe, at least claim 1 of the '233 patent pursuant to 35 U.S.C. § 271, by making, using, selling, offering to sell, and/or importing within the United States, without authority, the iPhone 7 Plus.

60. Set forth below (with claim language in italics) is an exemplary and non-limiting description of infringement of claim 1 of the '233 patent in connection with the iPhone 7 Plus. Corephotonics reserves the right to modify this description, including, for example, on the basis of information it obtains during discovery:

Claim 1

[*1.*] *A multiple aperture zoom digital camera, comprising*: To the extent the preamble is limiting, the rear-facing dual camera assembly of the iPhone 7 Plus is a multiple aperture zoom digital camera.

[1a] *a Wide imaging section that includes a Wide sensor and a fixed focal length Wide lens with a Wide field of view (POV), the Wide imaging section operative to output a Wide image*: the

iPhone 7 Plus has a dual camera that includes a wide-angle camera, which Apple has described as being a 28 mm equivalent and with a field of view of approximately 75°.

[1b] *a Tele imaging section that includes a Tele sensor and a fixed focal length Tele lens with a Tele POV that is narrower than the Wide POV, the Tele imaging section operative to output a Tele image; and*: the iPhone 7 Plus has a dual camera that includes a telephoto camera, which, *e.g.*, Apple has described as being a 56 mm equivalent lens, i.e., with a field of view that will be narrower than the field of view of the wide-angle lens (which is equivalent to 28 mm) given a similar image sensor size.

[1c] *a camera controller operatively coupled to the Wide and Tele imaging sections and configured to reduce an image jump effect seen in video output images and to provide continuous zoom video output images by executing registration between the Wide and Tele images for performing position matching to the video output images when switching from an output of the Tele imaging section to an output of the Wide imaging section or vice versa*: Apple has configured the iPhone 7 Plus dual-aperture camera to provide a continuous zoom in video mode with a reduced image jump effect using registration between the wide-angle and telephoto cameras. According to Apple "[t]he Dual camera's defining feature is its ability to smoothly transition between wide and tele cameras, acting like a single lens camera with optical zoom at 2x." https://forums.developer.apple.com/thread/63347. Samples of the iPhone 7 Plus' smooth transition in video mode are available at http://appleinsider.com/articles/16/09/23/apples-iphone-7-camera-delivers-nice-slice-of-enhancements-but-iphone-7-plus-takes-the-cake. The camera controller responsible for the reduction in image jump effect is the Apple A10 system-on-a-chip (SoC), specifically the A10 Fusion APL1W24 SoC + Samsung 3 GB LPDDR4 RAM. *See, e.g.*, https://www.ifixit.com/Teardown/iPhone+7+Plus+Teardown/67384 (indicating the Apple A10 processor).

61. As set forth in its Factual Allegations of this Complaint, Apple's infringement of the '233 patent has been and continues to be wanton, deliberate, egregious, and willful. Prior to the introduction of the Accused Products, Apple was engaged in five years of technical and business discussions surrounding a potential collaboration. Apple repeatedly expressed interest in

learning more about and ultimately obtaining the right to use Corephotonics' technology and intellectual property in the software and hardware associated with small-format multi-aperture cameras for use in mobile devices. Corephotonics disclosed a telephoto lens assembly design to Apple and told Apple that it was seeking patent protection on its small photo telephoto lens assembly designs as early as June 2013. Apple later sought and obtained samples of lens assemblies like those disclosed in the '233 patent. Corephotonics continued to inform Apple that it had a substantial and growing portfolio of patents and patent applications in that space, which included the lens design that could be used for a small-format telephoto camera suitable for use in mobile devices, the subject matter of the '233 patent. Apple further learned of and had to analyze the features claimed in the '233 patent in its own patenting efforts. Even while the '233 patent was pending and after its underlying and related application had published, Apple knew that patents on a small format telephoto design that claimed the design features of the embodiments, like the '233 patent and its related applications, were potentially going to issue. Shortly after Apple announced the iPhone 7 Plus, Corephotonics tried to inform Apple of its specific patents and patent applications in the context of a business negotiations. Apple's employees, however, refused to receive the patents in the context of business and technical discussions. Despite this, Apple has continued to cite Corephotonics' patents and patent applications in the Dror family and Shabtay family in prosecuting its own patents.

62. In its pending litigations in this District against Apple, Corephotonics has asserted infringement of numerous patents from both the Dror family and Shabtay family of patents. The '233 patent is a member of the Shabtay family.

63. Accordingly, by the date the '233 patent issued or thereafter Apple should have known of the patent's existence. Accordingly, Apple has had knowledge of or been willfully blind to its infringement of the '233 patent.

64. For at least the foregoing and other reasons set forth herein, Corephotonics is entitled to enhanced damages for Apple's infringement of the '233 patent in accordance with 35 U.S.C. § 284.

65. As described in the Factual Allegations in this Complaint, Apple has also had knowledge of or been willfully blind to its infringement of the '233 patent such that based on that knowledge or willful blindness, it has also indirectly infringed the '233 patent since at least as early as the date of issuance of the '233 patent.

66. Apple has also had actual knowledge of Corephotonics' rights in the '233 patent and details of Apple's infringement of the '233 patent based on at least the filing of this Complaint and, based on that knowledge, is also indirectly infringing the '233 patent.

67. Apple manufactures, uses, imports, offers for sale, and/or sells the Accused Products with knowledge of or willful blindness to the fact that its actions will induce Apple's customers and end users to infringe the '233 patent by using the telephoto lens on the iPhone 7 Plus.

68. Apple actively and knowingly induces its customers and end users to infringe the '233 patent by publishing information promoting the dual-aperture camera of the Accused Products, and by providing its customers and end users with instructions for using that camera. For example, Apple highlighted the benefits of the dual-aperture camera when it introduced the iPhone 7 Plus. *See* https://www.youtube.com/watch?v=NS0txu_Kzl8 at 1:08:22, https://www.youtube.com/watch?v=Q6dsRpVyyWs at 1:05.

69. As the direct and proximate result of Apple's conduct, Corephotonics has suffered and, if Apple's conduct is not stopped, will continue to suffer, severe competitive harm, irreparable injury, and significant damages, in an amount to be proven at trial. Because Corephotonics' remedy at law is inadequate, Corephotonics seeks, in addition to damages, permanent injunctive relief. Corephotonics' business operates in a competitive market and will continue suffering irreparable harm absent injunctive relief.

70. Corephotonics is entitled to injunctive relief and damages of no less than a reasonable royalty in accordance with 35 U.S.C. §§ 154, 271, 281, 283, and 284.

71. Apple's infringement of the '233 patent is exceptional and entitles Corephotonics to attorneys' fees and costs under 35 U.S.C. § 285.

SECOND CAUSE OF ACTION

Infringement of Patent No. 10,230,898

72. Corephotonics incorporates the foregoing paragraphs as though fully set forth herein.

73. Apple has directly infringed, and continues to directly infringe, at least claim 1 of the '898 patent pursuant to 35 U.S.C. § 271, by making, using, selling, offering to sell, and/or importing within the United States, without authority, the iPhone 7 Plus, the iPhone 8 Plus, the iPhone X, iPhone Xs, and iPhone Xs Max.

74. As just one non-limiting example, set forth below (with claim language in italics) is a description of infringement of exemplary claim 1 of the '898 patent in connection with the iPhone X, which applies similarly to the other Accused Products. Corephotonics reserves the right to modify this description, including, for example, on the basis of information about the Accused Products that it obtains during discovery:

Claim 1 of the '898 patent

1. A zoom digital camera comprising: To the extent the preamble is limiting, the dual camera assembly of the iPhone X is a zoom digital camera.

[1a] *a) a Wide imaging section that includes a fixed focal length Wide lens with a Wide field of view (FOV) and a Wide sensor, the Wide imaging section operative to provide Wide image data of an object or scene*. The iPhone X has a dual camera that includes a wide-angle camera with a wide field of view.

[1b] *b) a Tele imaging section that includes a fixed focal length Tele lens with a Tele FOV that is narrower than the Wide FOV and a Tele sensor, the Tele imaging section operative to provide Tele image data of the object or scene; and*. The iPhone X has a dual camera that includes a telephone camera with a field of view narrower than that of the wide-angle camera in the dual camera assembly.

[1c] *c) a camera controller operatively coupled to the Wide and Tele imaging sections and.* The iPhone X's A12 Bionic system-on-a-chip (SoC) is a camera controller coupled to and for processing data from the rear dual camera assembly.

[1d] *configured to evaluate if a no-switching criterion is fulfilled or not fulfilled, wherein if the no-switching criterion is fulfilled in a zoom-in operation between a lower zoom factor (ZF) value and a higher ZF value at a zoom factor (ZF) higher than an up-transfer ZF, the camera controller is further configured to output a zoom video output image that includes only Wide image data, and*. The iPhone X provides a zoom video output image that includes only image data captured from the wide angle lens under certain conditions, e.g., when there are a low light conditions or the user is focused on objects or a part of the scene that is close to the lens and the telephoto lens cannot focus. *See, e.g.*, "Dual Lens Switching on iPhone X," Studio Neat, https://www.studioneat.com/blogs/main/dual-lens-switching-on-the-iphone-x; see also, e.g., "Blow up: iPhone 7 Plus uses digital zoom instead of optical more often than you'd expect," https://www.macworld.com/article/3121661/apple-phone/blow-up.

[1e] *wherein if the no-switching criterion is not fulfilled, the camera controller is further configured to output a zoom video output image that includes only transformed, digitally zoomed Tele image data*. Under conditions other than those in which digital zoom is used instead of optical zoom at 2X magnification, see, e.g., claim element 1.[d], increasing zoom beyond 2X uses the telephoto lens image.

75. As set forth in its Factual Allegations of this Complaint, Apple's infringement of the '898 patent has been and continues to be wanton, deliberate, egregious, and willful. Prior to the introduction of the Accused Products, Apple was engaged in five years of technical and business discussions surrounding a potential collaboration. Apple repeatedly expressed interest in learning more about and ultimately obtaining the right to use Corephotonics' technology and intellectual property in the software and hardware associated with small-format multi-aperture cameras for use in mobile devices. Corephotonics disclosed a telephoto lens assembly design to Apple and told Apple that it was seeking patent protection on its small photo telephoto lens assembly designs as early as June 2013. Apple later sought and obtained samples of lens assemblies like those disclosed in the '898 patent. Corephotonics continued to inform Apple that it had a substantial and growing portfolio of patents and patent applications in that space, which included the lens design that could be used for a small-format telephoto camera suitable for use in

mobile devices, the subject matter of the '898 patent. Apple further learned of and had to analyze the features claimed in the '898 patent in its own patenting efforts. Even while the '898 patent was pending and after its underlying and related application had published, Apple knew that patents on a small format telephoto design that claimed the design features of the embodiments, like the '898 patent and its related applications, were potentially going to issue. Shortly after Apple announced the iPhone 7 Plus, Corephotonics tried to inform Apple of its specific patents and patent applications in the context of a business negotiations. Apple's employees, however, refused to receive the patents in the context of business and technical discussions. Despite this, Apple has continued to cite Corephotonics' patents and patent applications in prosecuting its own patents.

76. In its pending litigations in this District against Apple, Corephotonics has asserted infringement of numerous patents from different patent families. And, in its November 30, 2018 correspondence to Apple, Corephotonics described Apple's infringement of allowed claims of the '720 application, which later issued as the '898 patent.

77. Accordingly, by the date the '898 patent issued or thereafter Apple should have known of the patent's existence. Accordingly, Apple has had knowledge of or been willfully blind to its infringement of the '898 patent.

78. Apple further compounded its infringement, either with knowledge or willful blindness and in wanton disregard to Corephotonics' rights under the '898 patent, with Apple's introduction of the iPhone X and the other Accused Products to the marketplace. Corephotonics has filed two Complaints alleging Apple's infringement of Corephotonics' patents, which are now pending in this District. Even in spite of those Complaints being filed, and Apple having already had extensive knowledge of and recognizing Corephotonics' inventive contributions in the '898 patent, Apple has continued to infringe the '898 patent since it issued earlier this year. Notwithstanding, Apple has refused to alter its conduct. Apple's conduct, and its past and continued willful infringement of the '898 patent, has been egregious.

79. For at least the foregoing and other reasons set forth herein, Corephotonics is entitled to enhanced damages for Apple's infringement of the '898 patent in accordance with 35 U.S.C. § 284.

80. As described in the Factual Allegations in this Complaint, Apple has also had knowledge of or been willfully blind to its infringement of the '898 patent such that based on that knowledge or willful blindness, it has also indirectly infringed the '898 patent since at least as early as the date of issuance of the '898 patent.

81. Apple has also had actual knowledge of Corephotonics' rights in the '898 patent and details of Apple's infringement of the '898 patent based on at least the filing of this Complaint and, based on that knowledge, is also indirectly infringing the '898 patent.

82. Apple manufactures, uses, imports, offers for sale, and/or sells the Accused Products with knowledge of or willful blindness to the fact that its actions will induce Apple's customers and end users to infringe the '898 patent by using the telephoto lens on the iPhone X.

83. Apple actively and knowingly induces its customers and end users to infringe the '898 patent by publishing information promoting the zoom features of the Accused Products, and by providing its customers and end users with instructions for using those features. For example, Apple touts its telephoto lens in the product description for the Accused Products. *See, e.g.*, https://www.apple.com/iphone-x/, https://www.apple.com/iphone-7/specs/, and https://-www.apple.com/iphone-8/specs/. As another example, Apple provides how-to video tutorials on photography, which include one on "How to compose with telephoto camera" using the "iPhone 7+, iPhone 8+, and the iPhone X." *See* https://www.apple.com/iphone/photography-how-to/. As a further example, Apple highlighted the benefits of the telephoto lens when it introduced the iPhone 7 Plus. *See, e.g.*, https://www.youtube.com/watch?v=NS0txu_Kzl8 at 1:08:22, and https://www.youtube.com/watch?v=Q6dsRpVyyWs at 1:05.

84. As the direct and proximate result of Apple's conduct, Corephotonics has suffered and, if Apple's conduct is not stopped, will continue to suffer, severe competitive harm, irreparable injury, and significant damages, in an amount to be proven at trial. Because Corephotonics' remedy at law is inadequate, Corephotonics seeks, in addition to damages, permanent injunctive relief. Corephotonics' business operates in a competitive market and will continue suffering irreparable harm absent injunctive relief.

85. Corephotonics is entitled to injunctive relief and damages of no less than a reasonable royalty in accordance with 35 U.S.C. §§ 154, 271, 281, 283, and 284.

86. Apple's infringement of the '898 patent is exceptional and entitles Corephotonics to attorneys' fees and costs under 35 U.S.C. § 285.

THIRD CAUSE OF ACTION

Infringement of Patent No. 10,288,840

87. Corephotonics incorporates the foregoing paragraphs as though fully set forth herein.

88. Apple has directly infringed, and continues to directly infringe, at least claim 1 of the '840 patent pursuant to 35 U.S.C. § 271, by making, using, selling, offering to sell, and/or importing within the United States, without authority, the iPhone X, iPhone Xs, and iPhone Xs Max.

89. As just one non-limiting example, set forth below (with claim language in italics) is a description of infringement of exemplary claim 1 of the '840 patent in connection with the iPhone X, which applies similarly to the iPhone Xs and iPhone Xs Max. Corephotonics reserves the right to modify this description, including, for example, on the basis of information about the Accused Products that it obtains during discovery:

Claim 1 of the '840 patent

1. A mobile electronic device comprising an integrated camera. To the extent the preamble is limiting, the iPhone X is a mobile device comprising an integrated camera.

[1a] *wherein the camera comprises a Wide camera unit comprising a Wide lens unit and a Telephoto camera unit comprising a Telephoto lens unit.* The iPhone X has a dual camera that includes a wide-angle camera (Wide lens unit) and a telephoto camera (Telephoto lens unit). *See, e.g.*, Apple iPhone X Specifications, https://www.apple.com/iphone-x/specs/.

[1b] *the Telephoto lens unit and the Wide lens unit having, respectively, total track length (TTL)/effective focal length (EFL) ratios smaller and larger than 1 and defining separate Telephoto and Wide optical paths*. Both the telephoto camera and wide-angle camera of the iPhone X are disposed along separate but substantially parallel optical paths. Both cameras have TTL and

EFL values. For the telephoto camera, the TTL is approximately 5.7 mm and the EFL is approximately 6.0 mm, resulting in a TTL/EFL ratio of less than one. For the wide angle camera, the TTL is approximately 4.5mm and the EFL is approximately 4.0 mm, resulting in a TTL/EFL ratio of larger than one.

[1c] *wherein the Telephoto lens unit comprises multiple lens elements made of at least two different polymer materials having different Abbe numbers.* The telephoto camera of the iPhone X has multiple lens elements made from different polymer materials which have Abbe numbers of either greater than 50 or less than 30.

[1d] *wherein the multiple lens elements comprise a first group of at least three lens elements configured to form a telephoto lens assembly and a second group of at least two lens elements*. The iPhone X's telephoto camera has a first group of at least three lens elements.

[1e] *the second group of at least two lens elements spaced apart from the first group of at least three lens elements by a predetermined effective gap equal to or larger than ⅕ of the TTL of the Telephoto lens unit*. The iPhone X telephoto camera has a second group of lens elements, wherein the gap between the first group and second group of lens elements is greater than TTL/5 for the telephoto camera (which is approximately 1.2mm).

[1f] *wherein the first group of at least three lens elements comprises, in order from an object plane to an image plane along an optical axis of the Telephoto lens unit*. The first group of at least three lens elements are situated along the optical axis of the assembly.

[1g] *a first lens element having positive optical power and a pair of second and third lens elements having together negative optical power such that the Telephoto lens assembly provides a Telephoto optical effect of the Telephoto lens unit and such that the second and third lens elements are each made of one of the at least two different polymer materials having a different Abbe number for reducing chromatic aberrations of the Telephoto lens*. Of the first group of at least three lens elements, in order from the image-side along the optical axis, the first lens element has a positive refractive power (e.g., a focal length of between 3.1 and 3.2, which is greater than zero and indicates a positive refractive power). The pair of second and third lens elements have together a negative optical power, which together with L1 provide a telephoto optical effect. The

second and third lenses are each made from two different polymer materials and have different Abbe numbers. In particular, the second lens has an Abbe number of less than 30, and the third lens has an Abbe number of greater than 50. This configuration reduces chromatic aberrations in the lens assembly.

[1h] *wherein the second group of lens elements includes a fourth lens element and a fifth lens element made of the different polymer materials having different Abbe numbers and is configured to correct a field curvature and to compensate for residual chromatic aberrations of the Telephoto lens assembly dispersed during light passage through the effective gap between the Telephoto lens assembly and the second group of at least two lens elements, and wherein the first, third and fifth lens elements have each an Abbe number greater than 50 and the second and fourth lens elements have each an Abbe number smaller than 30.* The fourth and fifth lenses of the second group of lens elements are each made from different polymer materials, and are configured to correct a field curvature to compensate for chromatic aberrations of the lens assembly. Between the first and second groups of lens elements, the first, third, and fifth lenses have Abbe numbers greater than 50, and the second and fourth lenses have Abbe numbers of less than 30.

90. As set forth in its Factual Allegations of this Complaint, Apple's infringement of the '840 patent has been and continues to be wanton, deliberate, egregious, and willful. Prior to the introduction of the Accused Products, Apple was engaged in five years of technical and business discussions surrounding a potential collaboration. Apple repeatedly expressed interest in learning more about and ultimately obtaining the right to use Corephotonics' technology and intellectual property in the software and hardware associated with small-format multi-aperture cameras for use in mobile devices. Corephotonics disclosed a telephoto lens assembly design to Apple and told Apple that it was seeking patent protection on its small photo telephoto lens assembly designs as early as June 2013. Apple later sought and obtained samples of lens assemblies like those disclosed in the '840 patent. Corephotonics continued to inform Apple that it had a substantial and growing portfolio of patents and patent applications in that space, which included the lens design that could be used for a small-format telephoto camera suitable for use in mobile devices, the subject matter of the '840 patent. Apple further learned of and had to analyze

the features claimed in the '840 patent in its own patenting efforts. Even while the '840 patent was pending and after its underlying and related application had published, Apple knew that patents on a small format telephoto design that claimed the design features of the embodiments, like the '840 patent and its related applications, were potentially going to issue. Shortly after Apple announced the iPhone 7 Plus, Corephotonics tried to inform Apple of its specific patents and patent applications in the context of a business negotiations. Apple's employees, however, refused to receive the patents in the context of business and technical discussions. Despite this, Apple has continued to cite Corephotonics' patents and patent applications in prosecuting its own patents.

91. In its pending litigations in this District against Apple, Corephotonics has asserted infringement of numerous patents from different patent families. And, in its November 30, 2018 correspondence to Apple, Corephotonics informed Apple that allowed claims of the '676 application were infringed by Apple. The '676 application later issued as the '840 patent.

92. Accordingly, by the date the '840 patent issued or thereafter Apple should have known of the patent's existence. Accordingly, Apple has had knowledge of or been willfully blind to its infringement of the '840 patent.

93. Apple further compounded its infringement, either with knowledge or willful blindness and in wanton disregard to Corephotonics' rights under the '840 patent, with Apple's introduction of the iPhone X and the other Accused Products to the marketplace. Corephotonics has filed two Complaints alleging Apple's infringement of Corephotonics' patents, which are now pending in this District. Even in spite of those Complaints being filed, and Apple having already had extensive knowledge of and recognizing Corephotonics' inventive contributions in the '840 patent, Apple has continued to infringe the '840 patent since it issued earlier this year. Notwithstanding, Apple has refused to alter its conduct. Apple's conduct, and its past and continued willful infringement of the '840 patent, has been egregious.

94. For at least the foregoing and other reasons set forth herein, Corephotonics is entitled to enhanced damages for Apple's infringement of the '840 patent in accordance with 35 U.S.C. § 284.

95. As the direct and proximate result of Apple's conduct, Corephotonics has suffered and, if Apple's conduct is not stopped, will continue to suffer, severe competitive harm, irreparable injury, and significant damages, in an amount to be proven at trial. Because Corephotonics' remedy at law is inadequate, Corephotonics seeks, in addition to damages, permanent injunctive relief. Corephotonics' business operates in a competitive market and will continue suffering irreparable harm absent injunctive relief.

96. Corephotonics is entitled to injunctive relief and damages of no less than a reasonable royalty in accordance with 35 U.S.C. §§ 154, 271, 281, 283, and 284.

97. Apple's infringement of the '840 patent is exceptional and entitles Corephotonics to attorneys' fees and costs under 35 U.S.C. § 285.

FOURTH CAUSE OF ACTION

Infringement of Patent No. 10,317,647

98. Corephotonics incorporates the foregoing paragraphs as though fully set forth herein.

99. Apple has directly infringed, and continues to directly infringe, at least claim 1 of the '647 patent pursuant to 35 U.S.C. § 271, by making, using, selling, offering to sell, and/or importing within the United States, without authority, the iPhone 7 Plus, iPhone 8 Plus, iPhone X, iPhone Xs, and iPhone Xs Max.

100. As just one non-limiting example, set forth below (with claim language in italics) is a description of infringement of exemplary claim 1 of the '647 patent in connection with the iPhone X, which applies similarly to the iPhone 7 Plus, iPhone 8 Plus, iPhone Xs and iPhone Xs Max. Corephotonics reserves the right to modify this description, including, for example, on the basis of information about the Accused Products that it obtains during discovery:

Claim 1 of the '647 patent

1. An optical lens assembly comprising. To the extent the preamble is limiting, the telephoto camera of the iPhone X comprises an optical lens assembly.

[1a] *in order from an object side to an image side: a) a first lens element L_1 with positive refractive power, a focal length f_1.* The telephoto camera of the iPhone X comprises a lens

assembly with, in order from the object side to an image side, a first lens element with a positive refractive power and a focal length of between 3.1 and 3.2.

[1b] *b) a second lens element L_2 with negative refractive power and a focal length f_2 and having a meniscus shape with convex object-side surface*. The second lens element has a focal length of between approximately -8.2 and -8.4, and hence the refractive power is negative. The second lens is also meniscus shaped with the convex portion on the object-side.

[1c] *c) a third lens element L_3 with negative refractive power and a focal length f_3.* The third lens element has a negative refractive power and a focal length of approximately -50.

[1d] *d) a fourth lens element L_4.* The telephoto camera of the iPhone X comprises a lens assembly with a fourth lens element.

[1e] *e) a fifth lens element L_5.* The telephoto camera of the iPhone X comprises a lens assembly with a fifth lens element.

[1f] *wherein $1.2\times|f_3|>|f_2|>1.5\times f_1$, wherein the lens assembly has an effective focal length (EFL), wherein a lens system that includes the lens assembly plus a window positioned between the fifth lens element and an image plane has a total track length (TTL) of 6.5 millimeters or less and wherein the lens assembly has a ratio TTL/EFL<1.0.* The first, second, and third lens elements have focal lengths of approximately f_1 = between 3.1 to 3.2, f_2 = -8.2 to -8.4, and f_3 < -50. The condition is thus satisfied, e.g., $1.2\times|f_3|>|f_2|>1.5\times f_1$ is approximately 60 > 8.35 > 4.7. The TTL of the telephoto lens camera assembly, e.g., distance from surface of top-most lens in the above diagram to the sensor surface, is approximately 5.7 mm, and the EFL is approximately 6 mm; hence the ratio of TTL to EFL is approximately. 5.7 / 6 < 1. The lens assembly is separated from the sensor surface by a window ("cover glass").

101. As set forth in its Factual Allegations of this Complaint, Apple's infringement of the '647 patent has been and continues to be wanton, deliberate, egregious, and willful. Prior to the introduction of the Accused Products, Apple was engaged in five years of technical and business discussions surrounding a potential collaboration. Apple repeatedly expressed interest in learning more about and ultimately obtaining the right to use Corephotonics' technology and intellectual property in the software and hardware associated with small-format multi-aperture

cameras for use in mobile devices. Corephotonics disclosed a telephoto lens assembly design to Apple and told Apple that it was seeking patent protection on its small photo telephoto lens assembly designs as early as June 2013. Apple later sought and obtained samples of lens assemblies like those disclosed in the '647 patent. Corephotonics continued to inform Apple that it had a substantial and growing portfolio of patents and patent applications in that space, which included the lens design that could be used for a small-format telephoto camera suitable for use in mobile devices, the subject matter of the '647 patent. Apple further learned of and had to analyze the features claimed in the '647 patent in its own patenting efforts. Even while the '647 patent was pending and after its underlying and related application had published, Apple knew that patents on a small format telephoto design that claimed the design features of the embodiments, like the '647 patent and its related applications, were potentially going to issue. Shortly after Apple announced the iPhone 7 Plus, Corephotonics tried to inform Apple of its specific patents and patent applications in the context of a business negotiations. Apple's employees, however, refused to receive the patents in the context of business and technical discussions. Despite this, Apple has continued to cite Corephotonics' patents and patent applications in prosecuting its own patents.

102. In its pending litigations in this District against Apple, Corephotonics has asserted infringement of numerous patents from both the Dror family and Shabtay family of patents. The '647 patent is a member of the Dror family. And, in its November 30, 2018 correspondence to Apple, Corephotonics explained that allowed claims of the '422 application were infringed by Apple. The '422 application later issued as the '647 patent.

103. Accordingly, by the date the '647 patent issued or thereafter Apple should have known of the patent's existence. Accordingly, Apple has had knowledge of or been willfully blind to its infringement of the '647 patent.

104. Apple further compounded its infringement, either with knowledge or willful blindness and in wanton disregard to Corephotonics' rights under the '647 patent, with Apple's introduction of the iPhone X and the other Accused Products to the marketplace. Corephotonics has filed two Complaints alleging Apple's infringement of Corephotonics' patents, which are now pending in this District. Even in spite of those Complaints being filed, and Apple having already

had extensive knowledge of and recognizing Corephotonics' inventive contributions in the '647 patent, Apple has continued to infringe the '647 patent since it issued earlier this year. Notwithstanding, Apple has refused to alter its conduct. Apple's conduct, and its past and continued willful infringement of the '647 patent, has been egregious.

105. For at least the foregoing and other reasons set forth herein, Corephotonics is entitled to enhanced damages for Apple's infringement of the '647 patent in accordance with 35 U.S.C. § 284.

106. As the direct and proximate result of Apple's conduct, Corephotonics has suffered and, if Apple's conduct is not stopped, will continue to suffer, severe competitive harm, irreparable injury, and significant damages, in an amount to be proven at trial. Because Corephotonics' remedy at law is inadequate, Corephotonics seeks, in addition to damages, permanent injunctive relief. Corephotonics' business operates in a competitive market and will continue suffering irreparable harm absent injunctive relief.

107. Corephotonics is entitled to injunctive relief and damages of no less than a reasonable royalty in accordance with 35 U.S.C. §§ 154, 271, 281, 283, and 284.

108. Apple's infringement of the '647 patent is exceptional and entitles Corephotonics to attorneys' fees and costs under 35 U.S.C. § 285.

FIFTH CAUSE OF ACTION

Infringement of Patent No. 10,324,277

109. Corephotonics incorporates the foregoing paragraphs as though fully set forth herein.

110. Apple has directly infringed, and continues to directly infringe, claims of the '277 patent pursuant to 35 U.S.C. § 271, by making, using, selling, offering to sell, and/or importing within the United States, without authority, the iPhone 7 Plus, iPhone 8 Plus, iPhone X, iPhone Xs, and iPhone Xs Max.

111. As just one non-limiting example, set forth below (with claim language in italics) is a description of infringement of exemplary claim 1 of the '277 patent in connection with the iPhone 7 Plus, which applies similarly to the iPhone 8 Plus. Corephotonics reserves the right to

modify this description, including, for example, on the basis of information about the Accused Products that it obtains during discovery:

Claim 1 of the '277 patent

1. A lens assembly, comprising. To the extent the preamble is limiting, the telephoto camera of the iPhone 7 Plus comprises a lens assembly.

[1a] *a plurality of refractive lens elements arranged along an optical axis.* The telephoto camera of the iPhone 7 Plus has a lens assembly with five lenses arranged along an optical axis.

[1b] *wherein at least one surface of at least one of the plurality of lens elements is aspheric*. The first lens element on the object-side of the iPhone 7 Plus's telephoto lens assembly is aspheric.

[1c] *wherein the lens assembly has an effective focal length (EFL).* The EFL of the telephoto lens assembly in the iPhone 7 Plus is approximately 6.5mm

[1d] *wherein a lens system that includes the lens assembly plus a window positioned between the plurality of lens elements and an image plane has a total track length (TTL) of 6.5 millimeters or less, wherein a ratio TTL/EFL is less than 1.0*. The telephoto camera of the iPhone 7 Plus has an electronic image sensor surface that is separated from the lens assembly by a glass window. The TTL is approximately 5.9mm, and EFL is approximately 6.5mm. The ratio of TTL/EFL is therefore less than 1.0.

[1e] *wherein the plurality of lens elements comprises, in order from an object side to an image side, a first lens element with positive refractive power, a second lens element with negative refractive power, and a third lens element, wherein a focal length f1 of the first lens element is smaller than TTL/2 and*. The iPhone 7 Plus's telephoto lens assembly has a plurality of lens elements comprising, from object side, a first lens element with positive refractive power (which has a positive focal length), a second lens with negative refractive power (which has a negative focal length), and a third lens element. The focal length of the first lens is approximately 2.6mm, which is smaller than TTL/2 (which is approximately 5.9 / 2 = 2.95mm).

[1f] *wherein a lens assembly F # is smaller than 2.9*. The f-number of the telephoto camera's lens assembly is approximately 2.8.

112. As set forth in its Factual Allegations of this Complaint, Apple's infringement of the '277 patent has been and continues to be wanton, deliberate, egregious, and willful. Prior to the introduction of the Accused Products, Apple was engaged in five years of technical and business discussions surrounding a potential collaboration. Apple repeatedly expressed interest in learning more about and ultimately obtaining the right to use Corephotonics' technology and intellectual property in the software and hardware associated with small-format multi-aperture cameras for use in mobile devices. Corephotonics disclosed a telephoto lens assembly design to Apple and told Apple that it was seeking patent protection on its small photo telephoto lens assembly designs as early as June 2013. Apple later sought and obtained samples of lens assemblies like those disclosed in the '277 patent. Corephotonics continued to inform Apple that it had a substantial and growing portfolio of patents and patent applications in that space, which included the lens design that could be used for a small-format telephoto camera suitable for use in mobile devices, the subject matter of the '277 patent. Apple further learned of and had to analyze the features claimed in the '277 patent in its own patenting efforts. Even while the '277 patent was pending and after its underlying and related application had published, Apple knew that patents on a small format telephoto design that claimed the design features of the embodiments, like the '277 patent and its related applications, were potentially going to issue. Shortly after Apple announced the iPhone 7 Plus, Corephotonics tried to inform Apple of its specific patents and patent applications in the context of a business negotiations. Apple's employees, however, refused to receive the patents in the context of business and technical discussions. Despite this, Apple has continued to cite Corephotonics' patents and patent applications in prosecuting its own patents.

113. In its pending litigations in this District against Apple, Corephotonics has asserted infringement of numerous patents from both the Dror family and Shabtay family of patents. The '277 patent is a member of the Dror family. And, in its November 30, 2018 correspondence to Apple, Corephotonics explained that allowed claims of the '235 application were infringed by Apple. The '235 application later issued as the '277 patent.

114. Accordingly, by the date the '277 patent issued or thereafter Apple should have known of the patent's existence. Accordingly, Apple has had knowledge of or been willfully blind to its infringement of the '277 patent.

115. Apple further compounded its infringement, either with knowledge or willful blindness and in wanton disregard to Corephotonics' rights under the '277 patent, with Apple's introduction the Accused Products to the marketplace. Corephotonics has filed two Complaints alleging Apple's infringement of Corephotonics' patents, which are now pending in this District. Even in spite of those Complaints being filed, and Apple having already had extensive knowledge of and recognizing Corephotonics' inventive contributions in the '277 patent, Apple has continued to infringe the '277 patent since it issued earlier this year. Notwithstanding, Apple has refused to alter its conduct. Apple's conduct, and its past and continued willful infringement of the '277 patent, has been egregious.

116. For at least the foregoing and other reasons set forth herein, Corephotonics is entitled to enhanced damages for Apple's infringement of the '277 patent in accordance with 35 U.S.C. § 284.

117. As the direct and proximate result of Apple's conduct, Corephotonics has suffered and, if Apple's conduct is not stopped, will continue to suffer, severe competitive harm, irreparable injury, and significant damages, in an amount to be proven at trial. Because Corephotonics' remedy at law is inadequate, Corephotonics seeks, in addition to damages, permanent injunctive relief. Corephotonics' business operates in a competitive market and will continue suffering irreparable harm absent injunctive relief.

118. Corephotonics is entitled to injunctive relief and damages of no less than a reasonable royalty in accordance with 35 U.S.C. §§ 154, 271, 281, 283, and 284.

119. Apple's infringement of the '277 patent is exceptional and entitles Corephotonics to attorneys' fees and costs under 35 U.S.C. § 285.

SIXTH CAUSE OF ACTION

Infringement of Patent No. 10,330,897

120. Corephotonics incorporates the foregoing paragraphs as though fully set forth herein.

121. Apple has directly infringed, and continues to directly infringe, claims of the '897 patent pursuant to 35 U.S.C. § 271, by making, using, selling, offering to sell, and/or importing within the United States, without authority, the iPhone 7 Plus, iPhone 8 Plus, iPhone X, iPhone Xs, and iPhone Xs Max.

122. As just one non-limiting example, set forth below (with claim language in italics) is a description of infringement of exemplary claim 1 of the '897 patent in connection with the iPhone X, which applies similarly to the iPhone X and iPhone Xs Max. Corephotonics reserves the right to modify this description, including, for example, on the basis of information about the Accused Products that it obtains during discovery:

Claim 1 of the '897 patent

1. A lens assembly, comprising. To the extent the preamble is limiting, the telephoto camera of the iPhone X comprises a lens assembly.

[1a] *a plurality of lens elements arranged along an optical axis and spaced apart by respective spaces.* The telephoto camera of the iPhone X has a lens assembly a plurality of lenses arranged along an optical axis, with the lens spaced apart from one another.

[1b] *wherein the lens assembly has an effective focal length (EFL), a total track length (TTL) of 6.5 millimeters or less and a ratio TTL/EFL<1.0.* The TTL of the telephoto lens camera assembly of the iPhone X, e.g., distance from surface of top-most lens in the above diagram to the sensor surface, is approximately 5.7 mm, and the EFL is approximately 6 mm; hence the ratio of TTL to EFL is approximately. 5.7 / 6 < 1.

[1c] *wherein the plurality of lens elements includes, in order from an object side to an image side, a first group comprising lens elements L_{1_1}, L_{1_2} and L_{1_3} with respective focal lengths f_{1_1}, f_{1_2} and f_{1_3} and a second group comprising lens elements L_{2_1} and L_{2_2}, wherein the first and second groups of lens elements are separated by a gap that is larger than twice any other gap*

between lens elements. The plurality of lens elements includes two groups of lens elements, in order from object side to image side, L1 _ 1, L1 _ 2 and L1 _ 3 and L2 _ 1, L2 _ 2. The first and second groups of lens elements are separated by an air gap that is greater than twice any other gap between lens elements.

[1d] *wherein lens element L_{1_1} has positive refractive power and*. The first lens element, L1_1, has a positive refractive power, e.g., has a focal length of approximately between 3.1 and 3.2, which is greater than zero; hence, the refractive power is positive.

[1e] *L_{1_2} has negative refractive power and wherein lens elements L_{2_1} and L_{2_2} have opposite refractive powers*. The second lens element, L1_2 in claim element [1c], has a negative refractive power, e.g., has a focal length of approximately -9, which is less than zero, i.e., negative. The lens elements L 2_1 and L 2_2 have, respectively, positive and negative focal lengths and thus opposite refractive powers.

123. As set forth in its Factual Allegations of this Complaint, Apple's infringement of the '897 patent has been and continues to be wanton, deliberate, egregious, and willful. Prior to the introduction of the Accused Products, Apple was engaged in five years of technical and business discussions surrounding a potential collaboration. Apple repeatedly expressed interest in learning more about and ultimately obtaining the right to use Corephotonics' technology and intellectual property in the software and hardware associated with small-format multi-aperture cameras for use in mobile devices. Corephotonics disclosed a telephoto lens assembly design to Apple and told Apple that it was seeking patent protection on its small photo telephoto lens assembly designs as early as June 2013. Apple later sought and obtained samples of lens assemblies like those disclosed in the '897 patent. Corephotonics continued to inform Apple that it had a substantial and growing portfolio of patents and patent applications in that space, which included the lens design that could be used for a small-format telephoto camera suitable for use in mobile devices, the subject matter of the '897 patent. Apple further learned of and had to analyze the features claimed in the '897 patent in its own patenting efforts. Even while the '897 patent was pending and after its underlying and related application had published, Apple knew that patents on a small format telephoto design that claimed the design features of the embodiments, like the '897

patent and its related applications, were potentially going to issue. Shortly after Apple announced the iPhone 7 Plus, Corephotonics tried to inform Apple of its specific patents and patent applications in the context of a business negotiations. Apple's employees, however, refused to receive the patents in the context of business and technical discussions. Despite this, Apple has continued to cite Corephotonics' patents and patent applications in prosecuting its own patents.

124. In its pending litigations in this District against Apple, Corephotonics has asserted infringement of numerous patents from both the Dror family and Shabtay family of patents. The '897 patent is a member of the Dror family. And, in its November 30, 2018 correspondence to Apple, Corephotonics explained that allowed claims of the '391 application were infringed by Apple. The '391 application later issued as the '897 patent.

125. Accordingly, by the date the '897 patent issued or thereafter Apple should have known of the patent's existence. Accordingly, Apple has had knowledge of or been willfully blind to its infringement of the '897 patent.

126. Apple further compounded its infringement, either with knowledge or willful blindness and in wanton disregard to Corephotonics' rights under the '897 patent, with Apple's introduction the Accused Products to the marketplace. Corephotonics has filed two Complaints alleging Apple's infringement of Corephotonics' patents, which are now pending in this District. Even in spite of those Complaints being filed, and Apple having already had extensive knowledge of and recognizing Corephotonics' inventive contributions in the '897 patent, Apple has continued to infringe the '897 patent since it issued earlier this year. Notwithstanding, Apple has refused to alter its conduct. Apple's conduct, and its past and continued willful infringement of the '897 patent, has been egregious.

127. For at least the foregoing and other reasons set forth herein, Corephotonics is entitled to enhanced damages for Apple's infringement of the '897 patent in accordance with 35 U.S.C. § 284.

128. As the direct and proximate result of Apple's conduct, Corephotonics has suffered and, if Apple's conduct is not stopped, will continue to suffer, severe competitive harm, irreparable injury, and significant damages, in an amount to be proven at trial. Because Corephotonics' remedy

at law is inadequate, Corephotonics seeks, in addition to damages, permanent injunctive relief. Corephotonics' business operates in a competitive market and will continue suffering irreparable harm absent injunctive relief.

129. Corephotonics is entitled to injunctive relief and damages of no less than a reasonable royalty in accordance with 35 U.S.C. §§ 154, 271, 281, 283, and 284.

130. Apple's infringement of the '897 patent is exceptional and entitles Corephotonics to attorneys' fees and costs under 35 U.S.C. § 285.

SEVENTH CAUSE OF ACTION

Infringement of Patent No. 10,225,479

131. Corephotonics incorporates the foregoing paragraphs as though fully set forth herein.

132. Apple has directly infringed, and continues to directly infringe, at least claim 1 of the '479 patent pursuant to 35 U.S.C. § 271, by making, using, selling, offering to sell, and/or importing within the United States, without authority, the iPhone 7 Plus, iPhone 8 Plus, iPhone X, iPhone Xs, and iPhone Xs Max.

133. As just one non-limiting example, set forth below (with claim language in italics) is a description of infringement of exemplary claim 19 of the '479 patent in connection with the iPhone X, which applies similarly to the other Accused Products. Corephotonics reserves the right to modify this description, including, for example, on the basis of information about the Accused Products that it obtains during discovery:

Claim 19 of the '479 patent

19. A *dual-aperture digital camera for imaging an object or scene, comprising.* To the extent the preamble is limiting, rear-facing dual camera system of the iPhone X is a dual-aperture digital camera for imaging an object or scene.

[19a] *a) a Wide camera comprising a Wide lens and a Wide image sensor, the Wide camera having a respective field of view* FOV_W *and being operative to provide a Wide image of the object or scene.* The iPhone X's rear-facing dual camera has a wide angle camera comprising a wide

angle lens and an image sensor, where the wide angle lens has a field of view FOV_W of approximately 75°.

[19b] *b) a Tele camera comprising a Tele lens and a Tele image sensor, the Tele camera having a respective field of view FOV_T narrower than FOV_W and being operative to provide a Tele image of the object or scene, wherein the Tele lens has a respective effective focal length EFL_T and total track length TTL_T fulfilling the condition $EFL_T/TTL_T>1$.* The iPhone X's rear-facing dual camera has a telephoto camera comprising a telephoto lens and an image sensor, where the telephoto lens has a field of view FOV_T of approximately 36°. The TTL of the telephoto lens camera assembly of the iPhone X, e.g., distance from surface of top-most lens in the above diagram to the sensor surface, is approximately 5.7 mm, and the EFL is approximately 6 mm; hence, the ratio of EFL to TTL is approximately. 6 / 5.7 > 1.

[19c] *c) a first autofocus (AF) mechanism coupled mechanically to, and used to perform an AF action on the Wide lens.* The wide angle camera on the iPhone X has a first autofocus (AF) mechanism that performs an AF action on the wide angle lens. *See, e.g.*, the "Technical Specifications" for the iPhone X, at, https://support.apple.com/kb/sp770?locale=en_US:

- Sapphire crystal lens cover
- Backside illumination sensor
- Hybrid IR filter
- Autofocus with Focus Pixels
- Tap to focus with Focus Pixels
- Live Photos with stabilization
- Wide color capture for photos and Live Photos
- Improved local tone mapping

[19d] *d) a second AF mechanism coupled mechanically to, and used to perform an AF action on the Tele lens, wherein the Wide and Tele lenses have different F numbers $F\#_{Wide}$ and $F\#_{Tele}$, wherein the Wide and Tele image sensors have pixels with respective pixel sizes Pixel $size_{Wide}$ and Pixel $size_{Tele}$ wherein Pixel $size_{Wide}$ is not equal to Pixel $size_{Tele}$, and wherein the Tele camera has a Tele camera depth of field (DOF_T) shallower than a DOF of the Wide camera (DOF_W); and.* Both the wide angle and telephoto cameras of the iPhone X's rear-facing dual camera are coupled to auto-focus mechanisms for performing autofocus actions. The telephoto

camera has a depth of field that is shallower than the depth of field of the wide angle camera. The f-numbers and pixel sizes of the iPhone X are as follows:

Accused Product	**F#Wide**	**F#Tele**	**Pixel sizeWide**	**Pixel sizeTele**
iPhone X	1.8	2.4	1.22	1.0

[19e1] *e) a camera controller operatively coupled to the first and second AF mechanisms and to the Wide and Tele image sensors and configured to control the AF mechanisms*. The iPhone X comprises a A11 Bionic SOC, which is a camera controller coupled to and configured to control the first and second auto-focus mechanisms of the wide angle and telephoto cameras, respectively. *See, e.g.*, iFixit, "iPhone X Teardown," https://www.ifixit.com/Teardown/iPhone+X+Teardown/98975.

[19e2] *to process the Wide and Tele images to find translations between matching points in the images to calculate depth information and to create a fused image suited for portrait photos, the fused image having a DOF shallower than DOF_T and having a blurred background*. When the camera application of the iPhone X is set to "Portrait Mode," the iPhone X is capable of generating images with blurred backgrounds by fusing data from Wide and Tele sensors and matching points in the images to calculate depth information, where the fused image has a depth of field shallower than DOF_T. *See, e.g.*, iPhone X Technical Specifications, https://support.apple.com/kb/sp770?locale=en_US; *see also* https://petapixel.com/2017/12/11/portrait-mode-works-compares-8000-camera/:

> As Brownlee says, the iPhone X and Note 8 use depth mapping to figure out what is in the foreground of the image. These smartphones use data from the wide angle and telephoto lenses to create a depth map, and then artificially blur objects depending on how far they are from the in-focus subject.

134. As set forth in its Factual Allegations of this Complaint, Apple's infringement of the '479 patent has been and continues to be wanton, deliberate, egregious, and willful. Prior to the introduction of the Accused Products, Apple was engaged in five years of technical and business discussions surrounding a potential collaboration. Apple repeatedly expressed interest in

learning more about and ultimately obtaining the right to use Corephotonics' technology and intellectual property in the software and hardware associated with small-format multi-aperture cameras for use in mobile devices. Corephotonics disclosed a telephoto lens assembly design to Apple and told Apple that it was seeking patent protection on its small photo telephoto lens assembly designs as early as June 2013. Apple later sought and obtained samples of lens assemblies like those disclosed in the '479 patent. Corephotonics continued to inform Apple that it had a substantial and growing portfolio of patents and patent applications in that space, which included the lens design that could be used for a small-format telephoto camera suitable for use in mobile devices, the subject matter of the '479 patent. Apple further learned of and had to analyze the features claimed in the '479 patent in its own patenting efforts. Even while the '479 patent was pending and after its underlying and related application had published, Apple knew that patents on a small format telephoto design that claimed the design features of the embodiments, like the '479 patent and its related applications, were potentially going to issue. Shortly after Apple announced the iPhone 7 Plus, Corephotonics tried to inform Apple of its specific patents and patent applications in the context of a business negotiations. Apple's employees, however, refused to receive the patents in the context of business and technical discussions. Despite this, Apple has continued to cite Corephotonics' patents and patent applications in prosecuting its own patents, including multiple patents and published patent applications in the Shabtay family

135. In its pending litigations in this District against Apple, Corephotonics has asserted infringement of numerous patents from different patent families, including patents in the Shabtay family. The '479 patent is a member of the Shabtay family.

136. Accordingly, by the date the '479 patent issued or thereafter Apple should have known of the patent's existence. Accordingly, Apple has had knowledge of or been willfully blind to its infringement of the '497 patent.

137. Apple further compounded its infringement, either with knowledge or willful blindness and in wanton disregard to Corephotonics' rights under the '479 patent, with Apple's introduction the Accused Products to the marketplace. Corephotonics has filed two Complaints alleging Apple's infringement of Corephotonics' patents, which are now pending in this District.

Even in spite of those Complaints being filed, and Apple having already had extensive knowledge of and recognizing Corephotonics' inventive contributions in the '479 patent, Apple has continued to infringe the '479 patent since it issued earlier this year. Notwithstanding, Apple has refused to alter its conduct. Apple's conduct, and its past and continued willful infringement of the '479 patent, has been egregious.

138. For at least the foregoing and other reasons set forth herein, Corephotonics is entitled to enhanced damages for Apple's infringement of the '479 patent in accordance with 35 U.S.C. § 284.

139. As the direct and proximate result of Apple's conduct, Corephotonics has suffered and, if Apple's conduct is not stopped, will continue to suffer, severe competitive harm, irreparable injury, and significant damages, in an amount to be proven at trial. Because Corephotonics' remedy at law is inadequate, Corephotonics seeks, in addition to damages, permanent injunctive relief. Corephotonics' business operates in a competitive market and will continue suffering irreparable harm absent injunctive relief.

140. Corephotonics is entitled to injunctive relief and damages of no less than a reasonable royalty in accordance with 35 U.S.C. §§ 154, 271, 281, 283, and 284.

141. Apple's infringement of the '479 patent is exceptional and entitles Corephotonics to attorneys' fees and costs under 35 U.S.C. § 285.

EIGHTH CAUSE OF ACTION

Infringement of Patent No. 10,015,408

142. Corephotonics incorporates the foregoing paragraphs as though fully set forth herein.

143. Apple has directly infringed, and continues to directly infringe, at least claim 1 of the '408 patent pursuant to 35 U.S.C. § 271, by making, using, selling, offering to sell, and/or importing within the United States, without authority, the iPhone X, iPhone Xs, and iPhone Xs Max.

144. As just one non-limiting example, set forth below (with claim language in italics) is a description of infringement of exemplary claim 5 of the '408 patent in connection with the

iPhone X, which applies similarly to the iPhone Xs and iPhone Xs Max. Corephotonics reserves the right to modify this description, including, for example, on the basis of information about the Accused Products that it obtains during discovery:

Claim 5 of the '408 patent

5. A zoom digital camera comprising. To the extent the preamble is limiting, the rear-facing dual camera of the iPhone X is a zoom digital camera.

[5a] *a) a first imaging section that includes a fixed focal length first lens with a first field of view (FOV1) and a first image sensor; and.* The rear-facing dual camera of the iPhone X comprises a wide angle camera, or first imaging section, with a fixed focal length first lens with a field of view of approximately 75°. The wide angle camera comprises a Sony Exmor RS image sensor.

[5b1] *b) a second imaging section that includes a fixed focal length second lens with a second FOV (FOV2) that is narrower than FOV, and a second image sensor*. The rear-facing dual camera of the iPhone X comprises a telephoto camera with a telephoto lens assembly with a field of view of approximately 36°, which is more narrow than the approximately 75° of the wide angle camera. The telephoto camera comprises a Sony Exmor RS image sensor.

[5b2] *wherein the second lens includes five lens elements along an optical axis starting from an object starting with a first lens element with positive power, wherein the five lens elements further include a second lens element with negative power, a fourth lens element with negative power and a fifth lens element*. The lens assembly of the telephoto camera includes five lens elements: a first lens element with a positive power (which has a positive focal length), a second lens element with a negative power (which has a negative focal length), a fourth element with a negative power (which has a negative focal length), and fifth lens element.

[5b3] *wherein a largest distance between consecutive lens elements along the optical axis is a distance between the fourth lens element and the fifth lens element*. The largest distance between consecutive lenses in the telephoto lens assembly of the iPhone X is the distance between the fourth lens element and fifth lens element.

[5b4] *and wherein a ratio of a total track length (TTL) to effective focal length (EFL) of the second lens is smaller than 1*. The TTL of the telephoto lens camera assembly, e.g., distance from surface of top-most lens in the above diagram to the sensor surface, is approximately 5.7 mm, and the EFL is approximately 6 mm; hence the ratio of TTL to EFL is approximately. 5.7 / 6 < 1.

145. As set forth in its Factual Allegations of this Complaint, Apple's infringement of the '408 patent has been and continues to be wanton, deliberate, egregious, and willful. Prior to the introduction of the Accused Products, Apple was engaged in five years of technical and business discussions surrounding a potential collaboration. Apple repeatedly expressed interest in learning more about and ultimately obtaining the right to use Corephotonics' technology and intellectual property in the software and hardware associated with small-format multi-aperture cameras for use in mobile devices. Corephotonics disclosed a telephoto lens assembly design to Apple and told Apple that it was seeking patent protection on its small photo telephoto lens assembly designs as early as June 2013. Apple later sought and obtained samples of lens assemblies like those disclosed in the '408 patent. Corephotonics continued to inform Apple that it had a substantial and growing portfolio of patents and patent applications in that space, which included the lens design that could be used for a small-format telephoto camera suitable for use in mobile devices, the subject matter of the '408 patent. Apple further learned of and had to analyze the features claimed in the '408 patent in its own patenting efforts. Even while the '408 patent was pending and after its underlying and related application had published, Apple knew that patents on a small format telephoto design that claimed the design features of the embodiments, like the '408 patent and its related applications, were potentially going to issue. Shortly after Apple announced the iPhone 7 Plus, Corephotonics tried to inform Apple of its specific patents and patent applications in the context of a business negotiations. Apple's employees, however, refused to receive the patents in the context of business and technical discussions. Despite this, Apple has continued to cite Corephotonics' patents and patent applications in prosecuting its own patents, including patents and applications in the Shabtay family.

146. In its pending litigations in this District against Apple, Corephotonics has asserted infringement of numerous patents from both the Dror family and Shabtay family of patents. The

'408 patent is a member of the Shabtay family. And, in its April 25, 2018 correspondence to Apple, Corephotonics explained that allowed claims of the '853 application were infringed by Apple. The '853 application later issued as the '408 patent, a fact of which Corephotonics informed Apple in correspondence dated July 26, 2018.

147. Accordingly, by the date the '408 patent issued or thereafter Apple should have known of the patent's existence. Accordingly, Apple has had knowledge of or been willfully blind to its infringement of the '408 patent.

148. Apple further compounded its infringement, either with knowledge or willful blindness and in wanton disregard to Corephotonics' rights under the '408 patent, with Apple's introduction the Accused Products to the marketplace. Corephotonics has filed two Complaints alleging Apple's infringement of Corephotonics' patents, which are now pending in this District. Even in spite of those Complaints being filed, and Apple having already had extensive knowledge of and recognizing Corephotonics' inventive contributions in the '408 patent, Apple has continued to infringe the '408 patent since it issued in 2018. Notwithstanding, Apple has refused to alter its conduct. Apple's conduct, and its past and continued willful infringement of the '408 patent, has been egregious.

149. For at least the foregoing and other reasons set forth herein, Corephotonics is entitled to enhanced damages for Apple's infringement of the '408 patent in accordance with 35 U.S.C. § 284.

150. As the direct and proximate result of Apple's conduct, Corephotonics has suffered and, if Apple's conduct is not stopped, will continue to suffer, severe competitive harm, irreparable injury, and significant damages, in an amount to be proven at trial. Because Corephotonics' remedy at law is inadequate, Corephotonics seeks, in addition to damages, permanent injunctive relief. Corephotonics' business operates in a competitive market and will continue suffering irreparable harm absent injunctive relief.

151. Corephotonics is entitled to injunctive relief and damages of no less than a reasonable royalty in accordance with 35 U.S.C. §§ 154, 271, 281, 283, and 284.

152. Apple's infringement of the '408 patent is exceptional and entitles Corephotonics to attorneys' fees and costs under 35 U.S.C. § 285.

NINTH CAUSE OF ACTION

Infringement of Patent No. 10,356,332

153. Corephotonics incorporates the foregoing paragraphs as though fully set forth herein.

154. Apple has directly infringed, and continues to directly infringe, claims of the '332 patent pursuant to 35 U.S.C. § 271, by making, using, selling, offering to sell, and/or importing within the United States, without authority, the iPhone 7 Plus, the iPhone 8 Plus, the iPhone X, iPhone Xs, and iPhone Xs Max.

155. As just one non-limiting example, set forth below (with claim language in italics) is a description of infringement of exemplary claim 1 of the '332 patent in connection with the iPhone X, which applies similarly to the other Accused Products. Corephotonics reserves the right to modify this description, including, for example, on the basis of information about the Accused Products that it obtains during discovery:

Claim 1 of the '332 patent

1. A dual-aperture zoom digital camera comprising: To the extent the preamble is limiting, the dual camera assembly of the iPhone X is a dual-aperture zoom digital camera.

[1a] *a) a Wide imaging section that includes a fixed focal length Wide lens with a Wide field of view FOV_W and a Wide sensor, the Wide imaging section operative to provide Wide image data of an object or scene.* The iPhone X has a dual camera that includes a wide-angle camera with a wide field of view.

[1b] *b) a Tele imaging section that includes a fixed focal length Tele lens with a Tele field of view FOV_T that is narrower than FOV_W and a Tele sensor, the Tele imaging section operative to provide Tele image data of the object or scene; and.* The iPhone X has a dual camera that includes a telephone camera with a field of view narrower than that of the wide-angle camera in the dual camera assembly. The telephoto camera is operative to provide image data of an object or scene.

[1c] *c) a camera controller operatively coupled to the Wide and Tele imaging sections and.* The iPhone X's A12 Bionic system-on-a-chip (SoC) is a camera controller coupled to and for processing data from the rear dual camera assembly.

[1d] *configured to evaluate if a no-switching criterion is fulfilled or not fulfilled, wherein at a zoom factor (ZF) value greater than a zoom factor ZFT=tangent (FOV_{Wide})/tangent (FOV_{Tele}), if the no-switching criterion is fulfilled the camera controller is further configured to output a zoom video output image that includes only digitally-zoomed Wide image data, and.* The iPhone X provides a zoom video output image that includes only image data captured from the wide angle lens under certain conditions, e.g., when there are a low light conditions or the user is focused on objects or a part of the scene that is close to the lens and the telephoto lens cannot focus. *See, e.g.*, "Dual Lens Switching on iPhone X," Studio Neat, https://www.studioneat.com/blogs/main/dual-lens-switching-on-the-iphone-x; see also, e.g., "Blow up: iPhone 7 Plus uses digital zoom instead of optical more often than you'd expect," https://www.macworld.com/article/3121661/apple-phone/blow-up.

[1e] *if the no-switching criterion is not fulfilled, the camera controller is further configured to output a zoom video output image that includes only transformed, digitally zoomed Tele image data*. Under conditions other than those in which digital zoom is used instead of optical zoom at higher magnification, see, e.g., claim element 1[d], increasing zoom uses the telephoto lens image.

156. As set forth in its Factual Allegations of this Complaint, Apple's infringement of the '332 patent has been and continues to be wanton, deliberate, egregious, and willful. Prior to the introduction of the Accused Products, Apple was engaged in five years of technical and business discussions surrounding a potential collaboration. Apple repeatedly expressed interest in learning more about and ultimately obtaining the right to use Corephotonics' technology and intellectual property in the software and hardware associated with small-format multi-aperture cameras for use in mobile devices. Corephotonics disclosed a telephoto lens assembly design to Apple and told Apple that it was seeking patent protection on its small photo telephoto lens assembly designs as early as June 2013. Apple later sought and obtained samples of lens assemblies like those disclosed in the '332 patent. Corephotonics continued to inform Apple that

it had a substantial and growing portfolio of patents and patent applications in that space, which included the lens design that could be used for a small-format telephoto camera suitable for use in mobile devices, the subject matter of the '332 patent. Apple further learned of and had to analyze the features claimed in the '332 patent in its own patenting efforts. Even while the '332 patent was pending and after its underlying and related application had published, Apple knew that patents on a small format telephoto design that claimed the design features of the embodiments, like the '332 patent and its related applications, were potentially going to issue. Shortly after Apple announced the iPhone 7 Plus, Corephotonics tried to inform Apple of its specific patents and patent applications in the context of a business negotiations. Apple's employees, however, refused to receive the patents in the context of business and technical discussions. Despite this, Apple has continued to cite Corephotonics' patents and patent applications in prosecuting its own patents.

157. In its pending litigations in this District against Apple, Corephotonics has asserted infringement of numerous patents from different patent families, including those in the Shabtay family. The '332 patent is a member of the Shabtay family.

158. Accordingly, by the date the '332 patent issued or thereafter Apple should have known of the patent's existence. Accordingly, Apple has had knowledge of or been willfully blind to its infringement of the '332 patent.

159. Apple further compounded its infringement, either with knowledge or willful blindness and in wanton disregard to Corephotonics' rights under the '332 patent, with Apple's introduction of the iPhone X and the other Accused Products to the marketplace. Corephotonics has filed two Complaints alleging Apple's infringement of Corephotonics' patents, which are now pending in this District. Even in spite of those Complaints being filed, and Apple having already had extensive knowledge of and recognizing Corephotonics' inventive contributions in the '332 patent, Apple has continued to infringe the '332 patent since it issued earlier this year. Notwithstanding, Apple has refused to alter its conduct. Apple's conduct, and its past and continued willful infringement of the '332 patent, has been egregious.

160. For at least the foregoing and other reasons set forth herein, Corephotonics is entitled to enhanced damages for Apple's infringement of the '332 patent in accordance with 35 U.S.C. § 284.

161. As described in the Factual Allegations in this Complaint, Apple has also had knowledge of or been willfully blind to its infringement of the '332 patent such that based on that knowledge or willful blindness, it has also indirectly infringed the '332 patent since at least as early as the date of issuance of the '332 patent.

162. Apple has also had actual knowledge of Corephotonics' rights in the '332 patent and details of Apple's infringement of the '332 patent based on at least the filing of this Complaint and, based on that knowledge, is also indirectly infringing the '332 patent.

163. Apple manufactures, uses, imports, offers for sale, and/or sells the Accused Products with knowledge of or willful blindness to the fact that its actions will induce Apple's customers and end users to infringe the '332 patent by using the telephoto lens on the Accused Products.

164. Apple actively and knowingly induces its customers and end users to infringe the '332 patent by publishing information promoting the zoom features of the Accused Products, and by providing its customers and end users with instructions for using those features. For example, Apple touts its telephoto lens in the product description for the Accused Products. *See, e.g.*, https://www.apple.com/iphone-x/, https://www.apple.com/iphone-7/specs/, and https://-www.apple.com/iphone-8/specs/. As another example, Apple provides how-to video tutorials on photography, which include one on "How to compose with telephoto camera" using the "iPhone 7+, iPhone 8+, and the iPhone X." *See* https://www.apple.com/iphone/photography-how-to/. As a further example, Apple highlighted the benefits of the telephoto lens when it introduced the iPhone 7 Plus. *See, e.g.*, https://www.youtube.com/watch?v=NS0txu_Kzl8 at 1:08:22, and https://www.youtube.com/watch?v=Q6dsRpVyyWs at 1:05.

165. As the direct and proximate result of Apple's conduct, Corephotonics has suffered and, if Apple's conduct is not stopped, will continue to suffer, severe competitive harm, irreparable injury, and significant damages, in an amount to be proven at trial. Because Corephotonics' remedy

at law is inadequate, Corephotonics seeks, in addition to damages, permanent injunctive relief. Corephotonics' business operates in a competitive market and will continue suffering irreparable harm absent injunctive relief.

166. Corephotonics is entitled to injunctive relief and damages of no less than a reasonable royalty in accordance with 35 U.S.C. §§ 154, 271, 281, 283, and 284.

167. Apple's infringement of the '332 patent is exceptional and entitles Corephotonics to attorneys' fees and costs under 35 U.S.C. § 285.

TENTH CAUSE OF ACTION

Infringement of Patent No. 10,326,942

168. Corephotonics incorporates the foregoing paragraphs as though fully set forth herein.

169. Apple has directly infringed, and continues to directly infringe, at least claim 1 of the '942 patent pursuant to 35 U.S.C. § 271, by making, using, selling, offering to sell, and/or importing within the United States, without authority, the iPhone 7 Plus.

170. Set forth below (with claim language in italics) is an exemplary and non-limiting description of infringement of claim 1 of the '942 patent in connection with the iPhone 7 Plus. Corephotonics reserves the right to modify this description, including, for example, on the basis of information it obtains during discovery:

Claim 1

1. A multiple aperture zoom digital camera, comprising: To the extent the preamble is limiting, the rear-facing dual camera assembly of the iPhone 7 Plus is a multiple aperture zoom digital camera.

[1a] *a) a Wide imaging section that includes a Wide sensor and a fixed focal length Wide lens with a Wide field of view (FOV), the Wide imaging section operative to output a Wide image;*: the iPhone 7 Plus has a dual camera that includes a wide-angle camera, which Apple has described as being a 28 mm equivalent and with a field of view of approximately 75°.

[1b] *b) a Tele imaging section that includes a Tele sensor and a fixed focal length Tele lens with a Tele FOV that is narrower than the Wide FOV, the Tele imaging section operative to output*

a Tele image; and: the iPhone 7 Plus has a dual camera that includes a telephoto camera, which, *e.g.*, Apple has described as being a 56 mm equivalent lens, i.e., with a field of view that will be narrower than the field of view of the wide-angle lens (which is equivalent to 28 mm) given a similar image sensor size.

[1c] *c) a camera controller operatively coupled to the Wide and Tele imaging sections and configured, when providing video output images, to:* The camera controller coupled to the wide angle and telephoto cameras is the Apple A10 system-on-a-chip (SoC), specifically the A10 Fusion APL1W24 SoC + Samsung 3 GB LPDDR4 RAM. *See, e.g.*, https://www.ifixit.com/Teardown/iPhone+7+Plus+Teardown/67384 (indicating the Apple A10 processor).

[1d] *reduce an image jump effect seen in the video output images when switching from a Wide image to a Tele image by shifting the Tele image relative to the Wide image according to a distance of an object in a Tele image region of interest (ROI), and/or reduce an image jump effect seen in the video output images when switching from a Tele image to a Wide image by shifting the Wide image relative to the Tele image according to a distance of an object in a Wide image ROI.*: Apple has configured the iPhone 7 Plus dual-aperture camera to provide a continuous zoom in video mode with a reduced image jump effect using registration between the wide-angle and telephoto cameras. Apple has also configured its software to reduce the jump effect by shifting the image of one camera relative to the image of the other camera based on the distance of an object in a region of interest using at least the focus mechanisms of the cameras. According to Apple "[t]he Dual camera's defining feature is its ability to smoothly transition between wide and tele cameras, acting like a single lens camera with optical zoom at 2x." https://forums.developer.apple.com/thread/63347. Samples of the iPhone 7 Plus' smooth transition in video mode are available at http://appleinsider.com/articles/16/09/23/apples-iphone-7-camera-delivers-nice-slice-of-enhancements-but-iphone-7-plus-takes-the-cake. The camera controller responsible for the reduction in image jump effect is the Apple A10 system-on-a-chip (SoC), specifically the A10 Fusion APL1W24 SoC + Samsung 3 GB LPDDR4 RAM. *See, e.g.*,

https://www.ifixit.com/Teardown/iPhone+7+Plus+Teardown/67384 (indicating the Apple A10 processor).

171. As set forth in its Factual Allegations of this Complaint, Apple's infringement of the '942 patent has been and continues to be wanton, deliberate, egregious, and willful. Prior to the introduction of the Accused Products, Apple was engaged in five years of technical and business discussions surrounding a potential collaboration. Apple repeatedly expressed interest in learning more about and ultimately obtaining the right to use Corephotonics' technology and intellectual property in the software and hardware associated with small-format multi-aperture cameras for use in mobile devices. Corephotonics disclosed a telephoto lens assembly design to Apple and told Apple that it was seeking patent protection on its small photo telephoto lens assembly designs as early as June 2013. Apple later sought and obtained samples of lens assemblies like those disclosed in the '942 patent. Corephotonics continued to inform Apple that it had a substantial and growing portfolio of patents and patent applications in that space, which included the lens design that could be used for a small-format telephoto camera suitable for use in mobile devices, the subject matter of the '942 patent. Apple further learned of and had to analyze the features claimed in the '942 patent in its own patenting efforts. Even while the '942 patent was pending and after its underlying and related application had published, Apple knew that patents on a small format telephoto design that claimed the design features of the embodiments, like the '942 patent and its related applications, were potentially going to issue. Shortly after Apple announced the iPhone 7 Plus, Corephotonics tried to inform Apple of its specific patents and patent applications in the context of a business negotiations. Apple's employees, however, refused to receive the patents in the context of business and technical discussions. Despite this, Apple has continued to cite Corephotonics' patents and patent applications in the Dror family and Shabtay family in prosecuting its own patents.

172. In its pending litigations in this District against Apple, Corephotonics has asserted infringement of numerous patents from both the Dror family and Shabtay family of patents. The '942 patent is a member of the Shabtay family.

173. Accordingly, by the date the '942 patent issued or thereafter Apple should have known of the patent's existence. Accordingly, Apple has had knowledge of or been willfully blind to its infringement of the '942 patent.

174. For at least the foregoing and other reasons set forth herein, Corephotonics is entitled to enhanced damages for Apple's infringement of the '942 patent in accordance with 35 U.S.C. § 284.

175. As described in the Factual Allegations in this Complaint, Apple has also had knowledge of or been willfully blind to its infringement of the '942 patent such that based on that knowledge or willful blindness, it has also indirectly infringed the '942 patent since at least as early as the date of issuance of the '942 patent.

176. Apple has also had actual knowledge of Corephotonics' rights in the '942 patent and details of Apple's infringement of the '942 patent based on at least the filing of this Complaint and, based on that knowledge, is also indirectly infringing the '942 patent.

177. Apple manufactures, uses, imports, offers for sale, and/or sells the Accused Products with knowledge of or willful blindness to the fact that its actions will induce Apple's customers and end users to infringe the '942 patent by using the telephoto lens on the iPhone 7 Plus.

178. Apple actively and knowingly induces its customers and end users to infringe the '942 patent by publishing information promoting the dual-aperture camera of the Accused Products, and by providing its customers and end users with instructions for using that camera. For example, Apple highlighted the benefits of the dual-aperture camera when it introduced the iPhone 7 Plus. *See* https://www.youtube.com/watch?v=NS0txu_Kzl8 at 1:08:22, https://www.youtube.com/watch?v=Q6dsRpVyyWs at 1:05.

179. As the direct and proximate result of Apple's conduct, Corephotonics has suffered and, if Apple's conduct is not stopped, will continue to suffer, severe competitive harm, irreparable injury, and significant damages, in an amount to be proven at trial. Because Corephotonics' remedy at law is inadequate, Corephotonics seeks, in addition to damages, permanent injunctive relief.

Corephotonics' business operates in a competitive market and will continue suffering irreparable harm absent injunctive relief.

180. Corephotonics is entitled to injunctive relief and damages of no less than a reasonable royalty in accordance with 35 U.S.C. §§ 154, 271, 281, 283, and 284.

181. Apple's infringement of the '942 patent is exceptional and entitles Corephotonics to attorneys' fees and costs under 35 U.S.C. § 285.

DEMAND FOR A JURY TRIAL

182. Corephotonics hereby demands a jury trial for all causes of action, claims, or issues in this action that are triable as a matter of right to a jury.

PRAYER FOR RELIEF

WHEREFORE, Plaintiff Corephotonics respectfully requests the following relief:

A. Judgment in Corephotonics' favor and against Apple on all causes of action alleged herein;

B. An award of damages to Corephotonics in an amount to be further proven at trial;

C. Permanent injunctive relief against Apple;

D. A finding that this case is exceptional under 35 U.S.C. § 285 and that Corephotonics be awarded its attorneys' fees;

E. An award of enhanced damages to Corephotonics as a result of Apple's willful infringement;

F. An award of prejudgment and post-judgment interest, costs and other expenses; and

Such other and further relief as the Court may deem to be just and proper.

DATED: August 14, 2019

Respectfully submitted,

RUSS, AUGUST & KABAT

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