

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

ADVANCED MICRO DEVICES, INC.; and  
ATI TECHNOLOGIES ULC

Plaintiffs,

v.

TCL INDUSTRIES HOLDINGS CO., LTD.;  
TCL INDUSTRIES HOLDINGS (H.K.)  
LIMITED;  
TCL ELECTRONICS HOLDINGS LIMITED;  
TCL TECHNOLOGY GROUP  
CORPORATION;  
TTE CORPORATION;  
TCL HOLDINGS (BVI) LIMITED;  
TCL KING ELECTRICAL APPLIANCES  
(HUIZHOU) CO. LTD.;  
SHENZHEN TCL NEW TECHNOLOGIES  
CO., LTD.;  
TCL MOKA INTERNATIONAL LIMITED;  
TCL SMART DEVICE (VIETNAM) CO.,  
LTD;  
MANUFACTURAS AVANZADAS SA DE  
CV;  
TCL ELECTRONICS MEXICO, S DE RL DE  
CV;  
TCL OVERSEAS MARKETING LTD.; and  
REALTEK SEMICONDUCTOR CORP.

Defendants.

C.A. No.: 2:22-cv-00134

JURY TRIAL DEMANDED

**COMPLAINT FOR PATENT INFRINGEMENT**

Plaintiffs Advanced Micro Devices, Inc. and ATI Technologies ULC (collectively, “AMD” or “Plaintiffs”), bring this action for patent infringement under 35 U.S.C. § 271 against Defendants TCL Industries Holdings Co. Ltd., TCL Industries Holdings (H.K.) Limited, TCL Electronics Holdings Limited, TCL Technology Group Corporation, TTE Corporation, TCL

Holdings (BVI) Limited, TCL King Electrical Appliances (Huizhou) Co. Ltd., Shenzhen TCL New Technologies Co., Ltd., TCL MOKA International Limited, and TCL Smart Device (Vietnam) Co., Ltd, Manufacturas Avanzadas SA de CV, TCL Electronics Mexico, S de RL de CV, and TCL Overseas Marketing Ltd. (together, “TCL”), and against Defendant Realtek Semiconductor Corp. (“Realtek”) (TCL and Realtek together, “Defendants”). Plaintiffs allege as follows:

**Plaintiffs’ Patented Technology**

1. Plaintiff Advanced Micro Devices, Inc. is a corporation organized and existing under the laws of the State of Delaware, and maintains its principal place of business at 2485 Augustine Drive, Santa Clara, California 95054. Plaintiff ATI Technologies ULC is incorporated in Canada and has a principal place of business at 1 Commerce Valley Drive East, Markham, Ontario L3T 7X6, Canada. Plaintiff ATI Technologies ULC is a wholly-owned indirect subsidiary of Plaintiff Advanced Micro Devices, Inc.

2. Advanced Micro Devices, Inc. was founded in 1969 as a Silicon Valley start-up, with a few dozen employees focused on leading-edge semiconductor products. ATI Technologies ULC began as a semiconductor technology corporation based in Markham, Ontario and with locations in Silicon Valley, specializing in the development of graphics processing units and chipsets. Since at least as early as 1985, ATI Technologies ULC has made substantial investments to research, develop, and have manufactured high quality graphics systems. On July 24, 2006, Advanced Micro Devices, Inc. and ATI Technologies ULC jointly announced that Advanced Micro Devices, Inc. would acquire ATI Technologies ULC in a deal valued at \$5.4 billion.

3. From those modest beginnings, AMD has grown into a global company, achieving many important industry firsts, and today develops high-performance computing products to address some of the world’s toughest challenges. As of December 25, 2021, AMD has

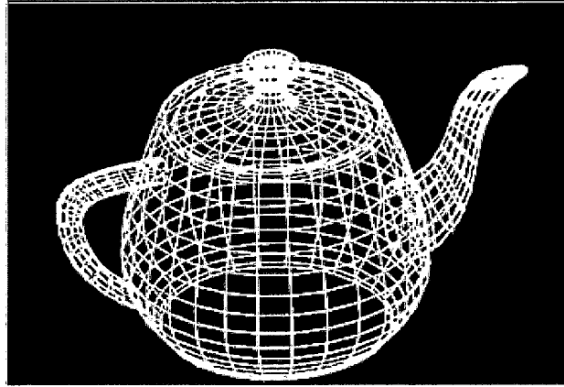
approximately 15,500 employees across the globe, as reported in AMD's annual report in February 2022.

4. The Asserted Patents stem from the research and design of innovative proprietary technology developed by AMD. AMD has continued to make substantial investments to research, develop, and have manufactured high quality graphics systems that practice the Asserted Patents. AMD has invested substantial resources collectively researching, developing, testing, launching, supporting, and maintaining groundbreaking graphics technology that practices the Asserted Patents.

5. The Asserted Patents cover inventions relating to important aspects of AMD's graphics processing units ("GPUs"), central processing units ("CPUs"), and accelerated processing units ("APUs").

6. One of the patents asserted in this action (U.S. Patent No. 7,742,053) has been upheld as valid by the U.S. Court of Appeals for the Federal Circuit. *ATI Techs. ULC v. Iancu*, 920 F.3d 1362, 1364-65 (Fed. Cir. 2019). According to the Federal Circuit's background description:

The prior art describes that computer-graphics images are drawn on a screen by filling in a grid of dots called 'pixels.' Shapes are represented by a collection of simple polygons such as triangles or squares, called 'primitives,' formed by the interconnection of pixels. The corner of each primitive is called a 'vertex,' with each vertex defined by the spatial coordinates: x, y, and z. Color and texture are applied to the individual pixels that comprise the shape, based on the location of the pixels within the primitive and the primitive's orientation relative to the generated shape. *Id.* To orient the wireframe three-dimensional model, matrix transformations applied to vertices  $V_x$ ,  $V_y$ , and  $V_z$  of the primitives generate new vertices  $V_x'$ ,  $V_y'$ , and  $V_z'$ , which are then translated into pixels. The graphics processor interconnects the primitives and applies color and texture to the generated shapes. The following illustration shows an example set of graphics displaying a three-dimensional object as a two-dimensional image:



Prior art processors required separate shaders to specify how and with what attributes a final image is drawn, in transforming primitives by adjusting the x, y, and z coordinates of their vertices. Prior art graphics processors required both a vertex shader and a pixel shader, because vertex operations and pixel operations have different processing requirements and were required to be performed separately and sequentially by separate shader systems.

*Id.* (citing *inter alia*, U.S. Patent No. 6,897,871 at 1:11-60).

7. The '053 Patent asserted in this action, as well as others, as described more specifically below, claim novel systems that perform unified shading.

#### **The TCL Defendants and Their Product Offerings**

8. The TCL Defendants in this action (collectively referred to as “TCL”) are foreign-based corporations who, along with their own subsidiaries and associates, operate as agents of one another, and work in concert together as a business group to make, use, offer to sell, or sell any patented invention, within the United States or import into the United States infringing products, including digital TVs, in the United States, including in Texas and this judicial district.

9. For example, in TCL’s Annual Report 2020, TCL first defines “TCL Holdings” as “**TCL Industries Holdings Co. Ltd.**,” which is a “joint stock limited company established under the laws of the PRC, **the ultimate controlling shareholder of the Company**” and “TCL Holdings Group” as “TCL Holdings and its subsidiaries.” TCL Annual Report 2020 at 315 (emphasis added)

(<https://doc.irasia.com/listco/hk/tcelelectronics/annual/2020/ar2020.pdf>) (accessed Mar. 8, 2022).

Second, TCL defines “T.C.L. Industries (H.K.)” as “**T.C.L. Industries Holdings (H.K.) Limited**,” which is “a company incorporated in Hong Kong with limited liability, the immediate controlling shareholder of the Company and a wholly-owned subsidiary of TCL Holdings.” *Id.*

Third, TCL defines the “Company” as “**TCL Electronics Holdings Limited**, a company incorporated in the Cayman Islands with limited liability[,]” and the “Group” as “the Company and its subsidiaries.” And fourth, TCL defines “TCL Technology” as “**TCL Technology Group Corporation**[,] formerly known as TCL Corporation[,], a joint stock limited company established under the laws of the PRC” and defines “TCL Technology Group” as “TCL Technology and its subsidiaries.” *Id.* at 316. As explained by TCL “the ultimate holding company of the Company [i.e, TCL Electronics Holdings Limited] has changed to TCL Holdings [i.e, TCL Electronics Holdings Limited] following the completion of [a] restructuring” relating to TCL Technology Group Corporation. *Id.* at 139. However, as TCL also explains, because “the major shareholders of TCL Holdings are the key management of TCL Technology [i.e., TCL Technology Group Corporation], TCL Technology [Group Corporation] remained a related party of the Group [i.e., the Company (TCL Electronics Holdings Limited) and its subsidiaries].” *Id.*

10. TCL describes its various corporate relatives as operating together in “synergies” in order to establish an “eco-system enterprise based on smart TVs”:

[T]he Company [i.e., **TCL Electronics Holdings Limited**] maintains good relationships with its suppliers[.] Further, the Group [i.e., TCL Electronics Holdings Limited and its subsidiaries] has been pursuing and will continue to pursue synergies with multiple industries of TCL Holdings Group [i.e., **TCL Industries Holdings Co. Ltd.** and its subsidiaries] and TCL Technology Group [i.e., **TCL Technology Group Corporation** and its subsidiaries] and leverage the advantages from the long-term relationship with CSOT (which is a major panel supplier in the PRC) from integrated industrial chain in order to become a forerunner in capitalising [sic]

opportunities arising from the revolution of the industry and to establish an eco-system enterprise based on smart TVs.

*Id.* at 94 (emphases added). Also, TCL’s executives overlap across TCL’s various entities, including in its Company’s “Strategy Committee.” *Id.* at 315. For example, Mr. Li Dongsheng is “an executive Director and the chairman of the [Company’s] Strategy Committee[, . . .] is the founder of the Company and has served the Group since 1999[, and he] is currently the chairman and chief executive officer of TCL Technology (000100.SZ), a director of T.C.L. Industries (H.K.), TCL Holdings and certain subsidiary(ies) of the Company.” *Id.* at 38. Also, Mr. Wang Chen is “an executive Director, CEO and a member of the Strategy Committee[, and he] is also: . . . the chief executive officer of TCL Holdings[.]” *Id.* at 39. Also, Mr. Hu Dien Chien is “the chief financial officer of the Company, a member of the Remuneration Committee and the Nomination Committee[, and he] “became an executive Director with effect from December 2020[, and] is also the chief financial officer of TCL Holdings.” *Id.* at 41.

11. TCL has extensive contacts with the United States market including with Texas and this district. For example, on page 2 of its own press release on 2021 annual results (<https://doc.irasia.com/listco/hk/tcelectronics/annual/2021/respress.pdf>) (accessed Mar. 16, 2022), TCL states that:

[In 2021,] the market share of TCL smart screen by sales volume ranked ***No. 2 in the U.S.*** . . .

[T]he sales revenue of ***TCL smart screen*** in the North American markets ***increased by 24.8% year-on-year [in 2021]***.

*Id.* at 2 (emphases added). Further, according to TCL’s most recent annual report, TCL’s goal is to

constantly improve the brand power and competitiveness of the [TCL] Group in domestic and overseas TV markets in order to step towards the target of becoming ***No. 1 brand in the global TV market***.

TCL Annual Report 2020 at 25 (emphasis added) (<https://doc.irasia.com/listco/hk/tcelelectronics/annual/2020/ar2020.pdf>) (accessed Mar. 16, 2022).

12. According to TCL, the TCL “Group” is organized into “business units based on their geographical TV segments” and other product types and has “four reportable operating segments” as follows:

- (a) TV segment – manufacture and sale of TV sets in:
  - TCL TV – the PRC market; and
  - TCL TV – the overseas markets;
- (b) Internet business segment – advertising, value-added, video-on-demand and membership cards;
- (c) Smart mobile, connective devices and service segment – manufacture and sale of mobile phones, smart connective products and display and service; and
- (d) Smart commercial display, smart home and other businesses segment.

*Id.* at 192. In the year 2020 alone, TCL sold \$1.9 billion in the “TV and other products” segment in the North American market, an increase from \$1.4 billion in 2019. *Id.* at 194–95. Further, in the first half of 2021 alone, TCL sold \$1.32 billion in the “smart screen and other products” segment in the North American market. *See* TCL 2021 Interim Results at 16 (<https://doc.irasia.com/listco/hk/tcelelectronics/interim/2021/intrep.pdf>) (accessed Mar. 16, 2022).

13. **TCL Industries Holdings Co. Ltd.** is a Chinese corporation with a principal place of business at 22nd Floor, TCL Technical Tower, Huifeng Third Road, Zhongkai Development Zone, Huizhou, Guangdong, P.R. China 516006. On information and belief, TCL Industries Holdings Co. Ltd. is the ultimate controlling shareholder of Defendant TCL Electronics Holdings Limited, and an ultimate parent corporation of the other TCL Defendants named in this action. In addition, TCL Industries Holdings Co. Ltd. has represented in legal filings that it is one of several TCL entities who “is a manufacturer and seller of consumer electronics, including . . .

televisions[.]” Complaint at ¶ 2, *TCL Indus. Holdings Co., Ltd. et al v. Bell Northern Rsch., LLC*, Case No. 3:21-cv-01598 (S.D. Cal. Sept. 13, 2021) (“TCL Complaint”).

14. Upon information and belief, TCL Industries Holdings Co. Ltd., either itself or through its affiliates and corporate relatives, is engaged in the designing, manufacturing, research, development, testing, marketing, distribution, shipping, importation, and selling of televisions, smart devices, and graphics devices that are manufactured outside of the United States. Also, upon information and belief, TCL Industries Holdings Co. Ltd. is engaged in contributing to (and/or instructing others, including customers in the United States, regarding) the use, manufacture, sale, and/or importation, of televisions, smart devices, and graphics devices in a directly infringing manner.

15. **TCL Industries Holdings (H.K.) Limited** is a Hong Kong corporation with a principal place of business at 8th Floor, Building 22E, Phase Three, Hong Kong Science Park, Pak Shek Kok, New Territories, Hong Kong. On information and belief, TCL Industries Holdings (H.K.) Limited is a wholly-owned subsidiary of Respondent TCL Industries Holdings Co., Ltd. According to TCL Annual Report 2020, TCL Industries Holdings (H.K.) Limited is the immediate controlling shareholder of “the Company,” i.e., Respondent TCL Electronics Holdings Ltd. *Id.* According to S&P Capital IQ, TCL Industries Holdings (H.K.) Limited “offers products such as television[s].” *See, e.g.*, S&P Capital IQ Company Report for TCL Industries Holdings (H.K.) Limited (Oct. 7, 2021). In addition, TCL Industries Holdings (H.K.) Limited has represented in legal filings that it is one of several TCL entities who “is a manufacturer and seller of consumer electronics, including . . . televisions[.]” TCL Complaint at ¶ 2.

16. Upon information and belief, TCL Industries Holdings (H.K.) Limited, either itself and/or through the activities of its affiliates and corporate relatives, is in the business of designing,



manufacturing, using, importing, offering to sell, and/or selling, televisions, smart devices, and graphics devices that are manufactured outside of the United States. Also, upon information and belief, TCL Industries Holdings (H.K.) Limited is engaged in contributing to (and/or instructing others, including customers in the United States, regarding) the use, manufacture, sale, offer for sale, and/or importation, of televisions, smart devices, and graphics devices in a directly infringing manner.

17. **TCL Electronics Holdings Limited** is a Cayman Islands corporation with a principal place of business at 7/F, Building 22E, 22 Science Park East Avenue, Hong Kong Science Park, Sha Tin, New Territories, Hong Kong. On information and belief, TCL Electronics Holdings Limited is (i) a subsidiary of Defendant TCL Industries Holdings Co. Ltd., and (ii) a direct or indirect parent of Defendants TCL Holdings (BVI) Limited, TCL King Electrical Appliances (Huizhou) Co. Ltd., Shenzhen TCL New Technologies Co., Ltd., TCL MOKA International Limited, and TCL Smart Device (Vietnam) Co., Ltd. According to Bloomberg’s Company Profile, “TCL Electronics Holdings Limited manufactures televisions and display products” in addition to “produc[ing] and sell[ing] television sets, audio visual products, company monitors, and other products.” (emphasis added) (<https://www.bloomberg.com/profile/company/1070:HK>) (accessed Mar. 8, 2022). In addition, TCL Electronics Holdings Limited has represented in legal filings that it is one of several TCL entities who “is a manufacturer and seller of consumer electronics, including . . . televisions[.]” TCL Complaint at ¶ 2.

18. Upon information and belief, TCL Electronics Holdings Limited, either itself or through its affiliates and corporate relatives, is engaged in the manufacturing, research, development, testing, marketing, distribution, shipping, importation, and selling of televisions, smart devices, and graphics devices that are manufactured outside of the United States. Also, upon

information and belief, TCL Electronics Holdings Limited is engaged in contributing to (and/or instructing others, including customers in the United States, regarding) the use, manufacture, sale, offer for sale, and/or importation, of televisions, smart devices, and graphics devices in a directly infringing manner.

19. **TCL Technology Group Corporation** is a Chinese corporation with a principal place of business at TCL Technology Building, No. 17, Huifeng Third Road, Zhongkai High-tech Zone, Huizhou, Guangdong, P.R. China 516006. On information and belief, TCL Technology Group Corporation is (i) a subsidiary of Defendant TCL Electronics Holdings Limited, and (ii) a direct or indirect parent corporation of the other TCL Defendants named in this action. According to Bloomberg's Company Profile, TCL Technology Group Corporation "operates as a semiconductor display manufacturer[.]" "researches, develops, manufactures, and distributes flexible printing display organic light emitting diode, active matrix organic light emitting diode, thin film transistor liquid crystal display, and other products[.]" and "conducts businesses globally." (<https://www.bloomberg.com/profile/company/000100:CH>) (accessed Mar. 8, 2022). In addition, TCL Technology Group Corporation has represented in legal filings that it is one of several TCL entities who "is a manufacturer and seller of consumer electronics, including . . . televisions[.]" TCL Complaint at ¶ 2.

20. Upon information and belief, TCL Technology Group Corporation, either itself or through its affiliates and corporate relatives, is engaged in the manufacturing, research, development, testing, marketing, distribution, shipping, importation, and selling of televisions, smart devices, and graphics devices that are manufactured outside of the United States. Also, upon information and belief, TCL Technology Group Corporation is engaged in contributing to (and/or instructing others, including customers in the United States, regarding) the use, manufacture, sale,

offer for sale, and/or importation, of televisions, smart devices, and graphics products in a directly infringing manner.

21. **TTE Corporation** is a British Virgin Islands corporation with a principal place of business at 7/F, Building 22E, 22 Science Park East Avenue, Hong Kong Science Park, Sha Tin, New Territories, Hong Kong. On information and belief, TTE Corporation is a direct or indirect subsidiary of Respondent TCL Electronics Holdings Ltd. *See, e.g.*, Certificate of Interest at 4, *In re TCL Electronics Holdings Ltd.*, Case No. 20-129 (Fed. Cir. May 26, 2020). According to S&P Capital IQ, TTE Corporation manufactures and markets colored television sets in Europe, North America, and China]. *See, e.g.*, S&P Capital IQ Company Report for TTE Corporation (Oct. 7, 2021). Also, according to Zoominfo, “TTE Corporation is the world’s largest TV company in volume.” (emphasis added) (<https://www.zoominfo.com/c/tte-corporation/147603476>) (accessed Mar. 8, 2022). In addition, TTE Corporation has represented in legal filings that it is one of several TCL entities who “is a manufacturer and seller of consumer electronics, including . . . televisions[.]” TCL Complaint at ¶ 2.

22. TTE Corporation, either itself and/or through the activities of its affiliates and corporate relatives, is in the business of designing, manufacturing, importing, offering for sale, and/or selling, televisions, smart devices, and graphics devices that are manufactured outside of the United States. Also, upon information and belief, TTE Corporation is engaged in contributing to (and/or instructing others, including customers in the United States, regarding) the use, manufacture, sale, offer for sale, and/or importation, of televisions, smart devices, and graphics devices in a directly infringing manner.

23. **TCL Holdings (BVI) Limited** is a British Virgin Islands corporation with a principal place of business at 5/F, Building 22E, 22 Science Park East Avenue, Hong Kong Science

Park, Sha Tin, New Territories, Hong Kong. On information and belief, TCL Holdings (BVI) Limited is a direct or indirect subsidiary of Defendant TCL Electronics Holdings Limited, which is engaged “mainly engaged in the R&D, production and sales of large-screen display terminals” including TVs. *See, e.g.*, Decl. of Jin Yang Ex. A at 9, 35, 93, *Canon, Inc. v. TCL Electronics Holdings Ltd.*, No. 2:18-cv-546 (E.D. Tex. Aug. 12, 2019). According to World Box’s company profile, TCL Holdings (BVI) Limited is also subsidiary of Defendant TCL Industries Holdings Co., Limited, and a parent of Defendant TCL King Electrical Appliances (Huizhou) Company Limited. World Box ([https://worldbox.net/company/tcl-holdings-bvi-limited\\_VG0000026731](https://worldbox.net/company/tcl-holdings-bvi-limited_VG0000026731)) (accessed Mar. 8, 2022). In addition, TCL Holding (BVI) Limited has represented in legal filings that it is one of several TCL entities who “is a manufacturer and seller of consumer electronics, including . . . televisions[.]” TCL Complaint at ¶ 2.

24. Upon information and belief, TCL Holdings (BVI) Limited, either itself or through its affiliates and corporate relatives, is engaged in the manufacturing, research, development, testing, marketing, distribution, shipping, importation, and selling of televisions, smart devices, and graphics devices that are manufactured outside of the United States. Also, upon information and belief, TCL Holdings (BVI) Limited is engaged in contributing to (and/or instructing others, including customers in the United States, regarding) the use, manufacture, sale, offer for sale, and/or importation, of televisions, smart devices, and graphics devices in a directly infringing manner.

25. **TCL King Electrical Appliances (Huizhou) Co. Ltd.** is a Chinese corporation with its principal place of business located at No. 78, Huifeng Fourth Road, Zhongkai Development Zone, Huizhou, Guangdong, P.R. China 516006. On information and belief, TCL King Electrical Appliances (Huizhou) Co. Ltd. is (i) a subsidiary of Defendant TCL Holdings

(BVI) Limited, and (ii) a direct or indirect parent of Defendants Shenzhen TCL New Technologies Co., Ltd., TCL MOKA International Limited, and TCL Smart Device (Vietnam) Co., Ltd. According to Bloomberg’s Company Profile, TCL King Electrical Appliances (Huizhou) Co. Ltd. “develops, produces and sells color televisions, liquid crystal display and plasma display panel[s]” and “markets their products throughout the world.” (<https://www.bloomberg.com/profile/company/HIALRZ:CH>) (accessed Mar. 8, 2022). In addition, TCL King Electrical Appliances (Huizhou) Co. Ltd. has represented in legal filings that it is one of several TCL entities who “is a manufacturer and seller of consumer electronics, including . . . televisions[.]” TCL Complaint at ¶ 2.

26. Upon information and belief, TCL King Electrical Appliances (Huizhou) Co. Ltd., either itself or through its affiliates and corporate relatives, is engaged in the manufacturing, research, development, testing, marketing, distribution, shipping, importation, and selling of televisions, smart devices, and graphics devices that are manufactured outside of the United States. Also, upon information and belief, TCL King Electrical Appliances (Huizhou) Co. Ltd. is engaged in contributing to (and/or instructing others, including customers in the United States, regarding) the use, manufacture, sale, offer for sale, and/or importation, of televisions, smart devices, and graphics products in a directly infringing manner.

27. **Shenzhen TCL New Technologies Co., Ltd.** is a Chinese corporation with a principal place of business at 9th Floor, TCL Electronics Holdings Limited Building, TCL International E City, No. 1001, Zhongshan Park Road, Nanshan District, Shenzhen, Guangdong, P.R. China 518067. On information and belief, Shenzhen TCL New Technologies Co., Ltd. is a direct or indirect subsidiary of TCL King Electrical Appliances (Huizhou) Co. Ltd. According to Crunchbase’s Company Profile, Shenzhen TCL New Technologies Co., Ltd. is described as

“manufacturing . . . radio and television broadcasting and communications equipment.” (<https://www.crunchbase.com/organization/shenzhen-tcl-new-technology>) (accessed Mar. 8, 2022). In addition, Shenzhen TCL New Technologies Co., Ltd. has represented in legal filings that it is one of several TCL entities who “is a manufacturer and seller of consumer electronics, including . . . televisions[.]” TCL Complaint at ¶ 2.

28. Upon information and belief, Shenzhen TCL New Technologies Co., Ltd., either itself or through its affiliates and corporate relatives, is engaged in the manufacturing, research, development, testing, marketing, distribution, shipping, importation, and selling of televisions, smart devices, and graphics devices that are manufactured outside of the United States. Also, upon information and belief, Shenzhen TCL New Technologies Co., Ltd. is engaged in contributing to (and/or instructing others, including customers in the United States, regarding) the use, manufacture, sale, offer for sale, and/or importation, of televisions, smart devices, and graphics devices in a directly infringing manner.

29. **TCL MOKA International Limited** is a Hong Kong corporation with a principal place of business at 7/F Hong Kong Science Park, Building 22 E, 22 Science Park East Avenue, Sha Tin, New Territories, Hong Kong. On information and belief, TCL MOKA International Limited is a direct or indirect subsidiary of TCL Electronics Holdings Ltd. According to Panjiva, TCL MOKA International Limited’s “[t]op products” include “led television[s]” and, for example, it imported a “SMART TV 8528729600” on August 7, 2021. (<https://panjiva.com/Tcl-Moka-International-Ltd/26640824>) (accessed Mar. 8, 2022).

30. Upon information and belief, TCL MOKA International Limited, either itself or through its affiliates and corporate relatives, is engaged in the manufacturing, research, development, testing, marketing, distribution, shipping, importation, and selling of televisions,

smart devices, and graphics devices that are manufactured outside of the United States. Also, upon information and belief, TCL MOKA International Limited is engaged in contributing to (and/or instructing others, including customers in the United States, regarding) the use, manufacture, sale, offer for sale, and/or importation, of televisions, smart devices, and graphics devices in a directly infringing manner.

31. **TCL Smart Device (Vietnam) Co., Ltd.** is a Vietnam corporation with its principal place of business at No. 26 VSIP II-A, Street 32, Vietnam Singapore Industrial Park II-A, Tan Binh Commune, Bac Tan Uyen District, Binh Duong Province, Vietnam 75000. On information and belief, TCL Smart Device (Vietnam) Co., Ltd. is a direct or indirect subsidiary of Defendant TCL Electronics Holdings Ltd. According to Panjiva, TCL Smart Device (Vietnam) Co., Ltd., whose “[t]op products” include “led television[s],” regularly imports led televisions to the United States, including “50” LED TV MODEL 50S431” on July 24, 2021. (<https://panjiva.com/Tcl-Smart-Device-Vietnam-Co/71214654>) (accessed Mar. 8, 2022). Furthermore, according to TCL’s website, TCL Smart Device (Vietnam) Co., Ltd. “will supply products to both the Vietnam market and other overseas markets, including . . . the U.S. . . . , to meet the growing demand for superior quality TVs.” (<https://www.tcl.com/au/en/blogs/constructions-starts-on-new-tcl-integrated-manufacturing-base-in-vietnam.html>) (accessed Mar. 8, 2022). In addition, TCL Smart Device (Vietnam) Co., Ltd. has represented in legal filings that it is one of several TCL entities who “is a manufacturer and seller of consumer electronics, including . . . televisions[.]” TCL Complaint at ¶ 2.

32. Upon information and belief, TCL Smart Device (Vietnam) Co., Ltd., either itself or through its affiliates and corporate relatives, is engaged in the manufacturing, research, development, testing, marketing, distribution, shipping, importation, and selling of televisions,

smart devices, and graphics devices that are manufactured outside of the United States. Also, upon information and belief, TCL Smart Device (Vietnam) Co., Ltd. is engaged in contributing to (and/or instructing others, including customers in the United States, regarding) the use, manufacture, sale, offer for sale, and/or importation, of televisions, smart devices, and graphics devices in a directly infringing manner.

33. **Manufacturas Avanzadas SA de CV** is a Mexican corporation located at Blvd. Independencia #2151, Parque Industrial Salvacar, Ciudad Juárez, Chihuahua, Mexico 32574. On information and belief, Manufacturas Avanzadas SA de CV is a (direct or indirect) subsidiary of Respondent TCL Electronics Holdings Ltd. TCL Annual Report 2020 at 140, 313. According to TCL Annual Report 2020, Manufacturas Avanzadas SA de CV manufactures TV products. *Id.* In addition, Manufacturas Avanzadas SA de CV has represented in legal filings that it is one of several TCL entities who “is a manufacturer and seller of consumer electronics, including . . . televisions[.]” TCL Complaint at ¶ 2.

34. Upon information and belief, Manufacturas Avanzadas SA de CV, either itself and/or through the activities of its affiliates and corporate relatives, is in the business of designing, manufacturing, importing, and/or selling, televisions, smart devices, and graphics devices that are manufactured outside of the United States. Also, upon information and belief, Manufacturas Avanzadas SA de CV is engaged in contributing to (and/or instructing others, including customers in the United States, regarding) the use, manufacture, sale, offer for sale, and/or importation, of televisions, smart devices, and graphics devices in a directly infringing manner.

35. **TCL Electronics Mexico, S de RL de CV** is a Mexican corporation located at Av. Insurgentes Sur 1425, Insurgentes Mixcoac, Benito Juarez, Distrito Federal, Mexico 03920. On information and belief, TCL Electronics Mexico, S de RL de CV is a direct or indirect subsidiary



of Respondent TCL Electronics Holdings Ltd. According to LinkedIn, TCL Electronics Mexico, S de RL de CV “make[s] [their] own TV panels (the most expensive part of the TV, which is essentially the screen) in [their] state-of-the-art TCL Moka factory in Tijuana, [and] the screens are assembled and distributed to the most popular stores under the brand name TCL.” (<https://www.linkedin.com/company/tclmex/?originalSubdomain=mx>) (accessed on Mar. 8, 2022). In addition, according to TCL, “TCL Electronics [Mexico, S de RL de CV] had seized upper hand in strategic layout in the worldwide, and focused on optimizing its global supply chain deployment so as to enhance its competitive edge in different regions and the world. (emphasis added) (<https://www.businesswire.com/news/home/20200825005821/en/TCL-Electronics%E2%80%99-Revenue-in-the-Second-Quarter-Increased-by-36.6-Against-Downward-Trend-to-HK10.28-Billion-with-Market-Share-Jumping-to-Second-in-the-Global-Market>) (accessed Mar. 8, 2022). In the second quarter of 2020, TCL Electronics Mexico, S de RL de CV achieved mass production as planned in Phase I Project of the MASA factory located in Ciudad Juárez, Mexico, mainly producing large-screen smart TVs. *Id.* In addition, the Company kicked off the preparation for Phase II project of the MASA factory, to meet the increasing demand for large-screen TV in the North American markets as well as the global market.” *Id.* In addition, TCL Electronics Mexico, S de RL de CV has represented in legal filings that it is one of several TCL entities who “is a manufacturer and seller of consumer electronics, including . . . televisions[.]” TCL Complaint at ¶ 2.

36. Upon information and belief, TCL Electronics Mexico, S de RL de CV, either itself and/or through the activities of its affiliates and corporate relatives, is in the business of designing, manufacturing, importing, and/or selling, televisions, smart devices, and graphics devices that are manufactured outside of the United States. Also, upon information and belief, TCL Electronics

Mexico, S de RL de CV is engaged in contributing to (and/or instructing others, including customers in the United States, regarding) the use, manufacture, sale, offer for sale, and/or importation, of televisions, smart devices, and graphics devices in a directly infringing manner.

37. **TCL Overseas Marketing Ltd.** is a British Virgin Islands corporation with a principal place of business at 5/F, Building 22E, 22 Science Park East Avenue, Hong Kong Science Park, Sha Tin, New Territories, Hong Kong. On information and belief, TCL Overseas Marketing Ltd. is a direct or indirect subsidiary of Respondent TCL Electronics Holdings Ltd. TCL Annual Report 2020 at 141. According to TCL Annual Report 2020, TCL Overseas Marketing Ltd. primarily focuses on the trading of TV products and components. *Id.* According to Bloomberg, “TCL Overseas Marketing Limited is headquartered in Hong Kong. The company’s line of business includes the wholesale distribution of electrical appliances, television and radio sets.” (emphasis added) (<https://www.bloomberg.com/profile/company/0687766D:HK>) (accessed Mar. 8, 2022). In addition, TCL Overseas Marketing Limited has represented in legal filings that it is one of several TCL entities who “is a manufacturer and seller of consumer electronics, including . . . televisions[.]” TCL Complaint at ¶ 2.

38. Upon information and belief, TCL Overseas Marketing Ltd., either itself and/or through the activities of its affiliates and corporate relatives, is in the business of designing, manufacturing, importing, and/or selling, televisions, smart devices, and graphics devices that are manufactured outside of the United States. Also, upon information and belief, TCL Overseas Marketing Ltd. is engaged in contributing to (and/or instructing others, including customers in the United States, regarding) the use, manufacture, sale, offer for sale, and/or importation, of televisions in a directly infringing manner.

**Defendant Realtek and Realtek's Products**

39. **Realtek Semiconductor Corp.** (“Realtek”) is a Taiwanese corporation with a principal place of business at No. 2, Innovation Road II, Hsinchu Science Park, Hsinchu 300, Taiwan.

40. According to its website, Realtek “is a world-leading IC provider that designs and develops a wide range of IC products for connected media, communications network, computer peripheral, and multimedia applications” including “LCD Monitor/ATV/DTV Controllers, and Digital Home Center Controllers.” (<https://www.realtek.com/en/press-room/news-releases/item/realtek-to-announce-full-range-of-communications-network-multimedia-and-consumer-electronics-solutions-at-2022-ces>) (accessed Mar. 8, 2022).

41. Upon information and belief, Realtek, either itself or through its affiliates, corporate relatives, customers and/or business partners (such as TCL) is engaged in the manufacturing, research, development, testing, marketing, distribution, shipping, importation, offering for sale, and selling of integrated circuits incorporating graphics processing units, reference design kits and associated software specifying the structure, function, and operation of printed circuit board assemblies incorporating such integrated circuits (collectively “RDKs”), and development/demonstration printed circuit board assemblies incorporating such RDKs and integrated circuits.

42. At the 2020 Consumer Electronics Show in Las Vegas, Nevada, Realtek exhibited and demonstrated RDKs, development and demonstration printed circuit boards, and integrated circuits containing graphics processing units, such as its 4K TV system-on-chip (“SoC”) and “Android and RDK STB[,]” which, upon information and belief, Realtek imported into the United States. (<https://www.realtek.com/en/press-room/news-releases/item/realtek-to-demonstrate-full->

range-of-connectivity-multimedia-and-consumer-electronics-solutions-at-2020-ces) (accessed Mar. 8, 2022). Realtek also featured “Android and RDK STB” reference designs at 2022 CES. (<https://www.realtek.com/en/press-room/news-releases/item/realtek-to-announce-full-range-of-communications-network-multimedia-and-consumer-electronics-solutions-at-2022-ces>) (accessed Mar. 8, 2022).

43. Further, upon information and belief, Realtek makes, uses, imports, offers for sale, and/or sells such integrated circuits, RDKs, and development/demonstration boards, including to its customers such as the TCL Defendants, for integration and/or incorporation into digital televisions manufactured outside of and intended for importation into the United States. For example, a “Strategic Sales Manager – President Office” at Realtek has included in her job description “Key technology and solution roadmap introduction to the leading Telecom ISP and Cable Provider customer of the **U.S.A in order to adapt Realtek’s latest chipset solutions, including TV SoC[.]**” (emphasis added) (<https://www.linkedin.com/in/melody-chiang-b51574a/?originalSubdomain=tw>) (accessed Mar. 8, 2022) (also listing as a job description “**Engineering reference design** developing with worldwide **third-party chipset partners** in LTE, WiFi, MoCA, **TV** and STB product solution” and listing “**TCL**” as a Realtek “Partner[.]”). *Id.* (emphases added). Also, upon information and belief, Realtek is engaged in contributing to (and/or instructing others, including customers in the United States, regarding) the use, manufacture, sale, offer for sale, and/or importation, of integrated circuits, RDKs and development/demonstration printed circuit board assemblies incorporating such RDKs and integrated circuits in a directly infringing manner.

44. According to Realtek, it is “headquartered in Taiwan and it has sales or R&D teams in China, Singapore, the United States, Japan, and South Korea.” Realtek 2020 Annual Report at

4 ([https://www.realtek.com/images/ar/-\\_\\_\\_.pdf](https://www.realtek.com/images/ar/-___.pdf)) (accessed Mar. 8, 2022). As part of its 2020 Annual Report’s description of Realtek’s “Communications Network Products” and “Multimedia Products” industries, and market overview, Realtek stated that:

. . . Fierce competition among suppliers of LCD TV Controllers in recent years has led key suppliers to gradually downsize, merge, or leave the market. **Realtek, however, continues to develop new products..., as well as a new generation of Integrated 4K Smart LCD TV Controllers** that support HDR . . . . Realtek provides an 8K TV decoder solution for customers to have a seamless transition to 8K TV without changing the original TV architecture, and more competitive products for LCD television manufacturers.

. . . [T]he market for UHD televisions is rising and UHD HDR video content is becoming widespread . . . . Realtek is therefore developing highly integrated multimedia controllers with new features and a high cost-performance ratio . . . . Sales of LCD televisions in 2021 are expected to be at about the same level as those in 2020. **Key growth will come from** Central and South America, **North America**, China, and Southeast Asia.

Realtek 2020 Annual Report at 78, 84–85 (emphases added).

45. Accordingly, upon information and belief, Realtek offers for sale, supports, imports, sells for importation, and/or sells within the United States after importation, into the United States, graphics systems and components thereof pertaining to digital televisions, smart devices, and graphics devices.

#### **JURISDICTION AND VENUE**

46. This action arises under the Patent Act, 35 U.S.C. § 1 *et seq.*, including §§ 271, 281, and 284–285, among others.

47. Subject matter jurisdiction is proper in this Court under 28 U.S.C. §§ 8711 and 8718(a).

48. This Court has personal jurisdiction over all Defendants.

49. TCL acts without authority to make, have made, use, offer to sell, sell within the United States, and/or import into the United States, televisions, smart devices, and graphics devices. TCL has conducted and does conduct business within the State of Texas and the Eastern District of Texas. TCL, directly or through subsidiaries or intermediaries (including distributors, retailers, and others), ships, distributes, offers for sale, sells, and advertises (including the provision of an interactive web page) its products and/or services in the United States and the Eastern District of Texas.

50. Upon information and belief, TCL is subject to this Court's personal jurisdiction pursuant to due process and/or the Texas Long Arm Statute, due at least to its substantial business in Texas and judicial district. TCL, directly and through subsidiaries or intermediaries (including distributors, retailers, and others), has purposefully and voluntarily placed one or more of its infringing products and/or services, as described below, into the stream of commerce with the expectation that those products will be purchased and used by consumers in the Eastern District of Texas. These infringing products and/or services have been and continue to be purchased and used by consumers in the Eastern District of Texas. TCL has committed acts of patent infringement within the Eastern District of Texas. On information and belief, TCL has also placed televisions, smart devices, and graphics devices into the stream of commerce by shipping infringing products into Texas and this judicial district, knowing that those products would be shipped into Texas and this judicial district.

51. Realtek acts without authority to make, have made, use, offer to sell, sell within the United States, and/or import into the United States, integrated circuits, RDKs and development/demonstration printed circuit board assemblies incorporating such RDKs and integrated circuits pertaining to televisions, smart devices, and graphics devices, including those

incorporated by the TCL Defendants for the U.S. market. Realtek has conducted and does conduct business within the State of Texas and the Eastern District of Texas. Realtek, directly or through subsidiaries or intermediaries (including distributors, retailers, and others), ships, distributes, offers for sale, sells, and advertises (including the provision of an interactive web page) its products and/or services in the United States and the Eastern District of Texas.

52. Upon information and belief, Realtek is subject to this Court's personal jurisdiction pursuant to due process and/or the Texas Long Arm Statute, due at least to its substantial business in Texas and judicial district. Realtek, directly and through subsidiaries or intermediaries (including distributors, retailers, and others), has purposefully and voluntarily placed one or more of its infringing products and/or services, as described below, into the stream of commerce with the expectation that those products will be purchased and used by consumers in the Eastern District of Texas. These infringing products and/or services have been and continue to be purchased and used by consumers in the Eastern District of Texas. Realtek has committed acts of patent infringement within the Eastern District of Texas. On information and belief, Realtek has also placed integrated circuits, RDKs and development/demonstration printed circuit board assemblies incorporating such RDKs and integrated circuits pertaining to televisions, smart devices, and graphics devices into the stream of commerce by shipping infringing products into Texas and this judicial district, and/or knowing that those products would be shipped into Texas and this judicial district.

53. Venue in this District is proper under 28 U.S.C. §§ 1391(b) and (c) and 1400(b). Venue is proper in this judicial district pursuant to 28 U.S.C. § 1391 because, among other things, none of the TCL or Realtek Defendants are residents in the United States, and thus may be sued in any judicial district, including this one, pursuant to 28 U.S.C. § 1391(c)(3).

### **JOINDER**

54. Joinder of Defendants is proper under 35 U.S.C. § 299. Allegations of patent infringement contained herein arise out of the same series of transactions or occurrences relating to the importing (or having imported) into the United States and/or making (or having made), using (or inducing the use of), selling, or offering for sale within the United States, the same televisions, smart devices, and graphics devices, and components thereof, including TCL's televisions incorporating Realtek's integrated circuits, RDKs and development/demonstration printed circuit board assemblies incorporating such RDKs and integrated circuits.

55. Examples of these products include, but are not limited to Realtek's video processing devices (such as integrated circuits, RDKs and development/demonstration printed circuit board assemblies incorporating such RDKs and integrated circuits), and TCL digital smart televisions containing the same, and are imported, sold, offered for sale, and/or used in this District.

### **THE ASSERTED PATENTS**

56. The Asserted Patents (i.e., the '053, '454, '628, '547, and '381 Patents) cover novel architectures for graphics processing unit circuitry.

57. At least two of the Asserted Patents (i.e., the '053 and '454 Patents) disclose a novel "unified shader" hardware architecture. In a break from the fixed-function architecture, the unified shader hardware architecture includes a shared processing unit that can handle both geometry and pixel processing operations, while leaving certain other graphics operations to dedicated, fixed-function circuitry. In some embodiments, the unified shader hardware can simultaneously perform vertex and pixel operations at various degrees of completion by switching between programs or instructions in an instruction store. Despite initial skepticism, the graphics processing industry has embraced AMD's groundbreaking unified shader architecture. By employing the patented unified shader hardware architecture, graphics processors are smaller and more power efficient. As a



result, the patents' advances enable smaller form factor consumer products that are more power efficient.

58. United States Patent No. 7,742,053 (“the ’053 Patent”) is entitled “Multi-Thread Graphics Processing System,” and issued on June 22, 2010 to inventors Laurent Lefebvre; Andrew E. Gruber, Stephen L. Morein. The ’053 Patent issued from United States Patent Application No. 11/746,453 filed on May 9, 2007. The ’053 Patent is the result of a continuation of United States Patent Application No. 10/673,761 (now United States Patent No. 7,239,322), filed on September 29, 2003. As held by the Federal Circuit, the ’053 Patent was conceived and reduced to practice with diligence no later than August 24, 2001. *ATI Techs. ULC v. Iancu*, 920 F.3d 1362, 1375 (Fed. Cir. 2019). All rights, title, and interest in the ’053 Patent were assigned by each inventor to ATI Technologies, Inc. on September 22 and 26, 2003 (Reel/Frame 037408/0951), and, through a change of name, by ATI Technologies Inc. to ATI Technologies ULC on October 25, 2006 (Reel/Frame 037437/0531).

59. United States Patent No. 8,760,454 (“the ’454 Patent”) is entitled “Graphics processing architecture employing a unified shader,” and issued on June 24, 2014 to inventors Stephen L. Morein, Laurent Lefebvre, Andrew E. Gruber, and Andi Skende. The ’454 Patent issued from United States Patent Application No. 13/109,738 filed on May 17, 2011. The ’454 Patent is the result of a continuation of United States Patent Application No. 12/791,597 (now abandoned), filed on June 1, 2010, which is a continuation of United States Patent Application No. 11/842,256 (now abandoned), filed on August 21, 2007, which is a continuation of United States Patent Application No. 11/117,863 (now United States Patent No. 7,327,369), filed on April 29, 2005, which is a continuation of United States Patent Application No. 10/718,318 (now United States Patent No. 6,897,871), filed on November 20, 2003, which, as held by the Federal Circuit,

was conceived and reduced to practice with diligence no later than August 24, 2001. *ATI Techs. ULC v. Iancu*, 920 F.3d 1362, 1375 (Fed. Cir. 2019). All rights, title, and interest in the '454 Patent were assigned by each inventor to ATI Technologies, Inc. on August 20 and 21, 2003 (Reel/Frame 032217/0137), and, through a change of name, by ATI Technologies Inc. to ATI Technologies ULC on October 25, 2006 (Reel/Frame 032265/0101).

60. United States Patent No. 11,184,628 (“the '628 Patent”) is entitled “Texture Decompression Techniques,” and issued on November 23, 2021 to inventors Konstantine Iourcha and Andrew S.C. Pomianowski. The '628 Patent issued from United States Patent Application No. 16/257,500 filed on January 25, 2019. The '628 Patent is the result of a continuation of United States Patent Application No. 15/237,134 (now United States Patent No. 10,205,956), filed on August 15, 2016, which is a continuation of United States Patent Application No. 11/513,190 (now United States Patent No. 9,418,450), filed on August 31, 2006. All rights, title, and interest in the '628 Patent were assigned by each inventor to ATI Technologies Inc. on August 30, 2006 (Reel/Frame 057820/0955), and, through a change of name, by ATI Technologies Inc. to ATI Technologies ULC on October 25, 2006 (Reel/Frame 057820/0993).

61. United States Patent No. 8,468,547 (“the '547 Patent”) is entitled “Method and System for Synchronizing Thread Wavefront Data and Events,” and issued on June 18, 2013 to inventors Laurent Lefebvre, Michael Mantor, and Deborah Lynne Szasz. The '547 Patent issued from United States Patent Application No. 12/953,367, which was filed on November 23, 2010. All rights, title, and interest in the '547 Patent were assigned by Laurent Lefebvre to ATI Technologies ULC, and Michael Mantor and Deborah Lynne Szasz to Advanced Micro Devices, Inc., on October 18, 2010 (Reel/Frame 025401/0161, Reel/Frame 025401-0181).

62. United States Patent No. 8,854,381 (“the ’381 Patent”) is entitled “Processing Unit That Enables Asynchronous Task Dispatch,” and issued on Oct. 7, 2014 to inventors Michael Mantor and Rex McCrary. The ’381 Patent issued from United States Patent Application No. 12/874,134, which was filed on September 1, 2010. The ’381 Patent claims priority from United States Provisional Patent Application No. 61/239,712, filed on September 3, 2009. All rights, title, and interest in the ’381 Patent were assigned by each inventor to Advanced Micro Devices, Inc. on January 24 and 25, 2011 (Reel/Frame 025720/0001).

63. The ’053, ’454, ’628, ’547, and ’381 Patents (collectively, the “Asserted Patents”) are each valid and enforceable. The inventions of the Asserted Patents are directed to improvements to the structure, function, and operation of computers and computing devices, including (but not limited to) integrated circuits and televisions, smart devices, and graphics devices incorporating the same, and address several technical problems.

### **INFRINGEMENT ALLEGATIONS**

64. Defendants have infringed the Asserted Patents by making, using, selling, offering for sale in the United States, and/or importing into the United States, televisions, smart devices, and graphics devices, and components thereof (including integrated circuits, RDKs and development/demonstration printed circuit board assemblies incorporating such RDKs and integrated circuits) and other similar devices that infringe the Asserted Patents. The infringing TCL products include those with infringing Realtek integrated circuits, RDKs and development/demonstration printed circuit board assemblies incorporating such RDKs and integrated circuits. These products include, but are not limited to, TCL’s 3-Series, 4-Series, 5-Series, 6-Series, and 8-Series Roku, Android, and Google televisions, and Realtek chip RTD2873.

65. Defendants have, and continue to, directly infringe the Asserted Patents by engaging in acts constituting infringement under 35 U.S.C. § 271, including but not necessarily limited to one or more of making, using, selling and/or offering to sell, in this District and elsewhere in the United States, and importing into this District and elsewhere in the United States, certain infringing televisions, smart devices, graphics devices, integrated circuits, RDKs and development/demonstration printed circuit board assemblies incorporating such RDKs and integrated circuits, including but not limited to televisions which incorporate the functionalities and compositions described in detail in Counts I-X.

66. For all TCL's and Realtek's products that infringe, TCL and Realtek have, themselves, directly infringed the Asserted Patents by, at least, (i) making and/or having made televisions, smart devices, graphics devices, integrated circuits, RDKs and development/demonstration printed circuit board assemblies incorporating such RDKs and integrated circuits that infringe one or more claims of the Asserted Patents in the United States, (ii) designing, engineering, testing, and/or using televisions, smart devices, graphics devices, integrated circuits, RDKs and development/demonstration printed circuit board assemblies incorporating such RDKs and integrated circuits that infringe one or more claims of the Asserted Patents in the United States, (iii) selling and/or offering to sell televisions, smart devices, graphics devices, integrated circuits, RDKs and development/demonstration printed circuit board assemblies incorporating such RDKs and integrated circuits that infringe one or more claims of the Asserted Patents in the United States; and/or (iv) importing televisions, smart devices, graphics devices, integrated circuits, RDKs and development/demonstration printed circuit board assemblies incorporating such RDKs and integrated circuits that infringe one or more claims of the Asserted Patents into the United States.

67. Defendants also indirectly infringe the Asserted Patents by actively inducing, and/or contributing to, direct infringement by its customers, and that these infringing activities also result in Defendants' worldwide sales of their televisions, smart devices, graphics devices, integrated circuits, RDKs and development/demonstration printed circuit board assemblies incorporating such RDKs and integrated circuits.

68. Defendants have been placed on actual notice of one or more of the Asserted Patents. The filing of this Complaint also constitutes notice in accordance with 35 U.S.C. § 287. Despite such notice, Defendants continue to import into, market, offer for sale and/or sell in the United States products that infringe the Asserted Patents.

69. Defendants' infringement has caused damage to Plaintiffs. Plaintiffs are entitled to recover from Defendants the damages sustained by Plaintiffs as a result of Defendants' wrongful acts.

**COUNT I**  
**(Defendants' Infringement of the '053 Patent)**

70. Plaintiffs incorporate the allegations of all of the foregoing Paragraphs as if fully restated herein.

71. Defendants have directly infringed and continue to directly infringe the '053 Patent by making, using, selling, offering for sale, or importing into the United States products and/or methods covered by one or more claims of the '053 Patent including, but not limited to, televisions, smart devices, graphics devices, integrated circuits, RDKs and development/demonstration printed circuit board assemblies incorporating such RDKs and integrated circuits. The products that infringe one or more claims of the '053 Patent include, but are not limited to, at least the TCL and Realtek infringing products identified in this Complaint. Further discovery may reveal additional infringing products and/or models.

72. For example, and without limitation, making, using, selling, offering for sale, and/or importing the Exemplary TCL Television and the Exemplary Realtek Integrated Circuit infringes one or more claims of the '053 Patent, including but not limited to claim 1.

73. The TCL 50S535 television, and the Realtek RTD2873 system on chip incorporated therein, are exemplary products covered by at least claim 1 of the '053 Patent. On information and belief, many other products provided by, and to be provided by TCL and/or Realtek, infringe the '053 Patent.

74. On information and belief, the infringing products include all limitations of at least claim 1 of the '053 Patent. Specifically, the '053 Patent claims, e.g.: a graphics processing system comprising: at least one memory device comprising a first portion operative to store a plurality of pixel command threads and a second portion operative to store a plurality of vertex command threads; an arbiter, coupled to the at least one memory device, operable to select a command thread from either of the plurality of pixel command threads and the plurality of vertex command threads; and a plurality of command processing engines, coupled to the arbiter, each operable to receive and process the command thread.

75. For example, the TCL 50S535 television containing a Realtek RTD2873 SoC, which is a 4K TV SoC, incorporates a graphics processing system. More specifically, Realtek's SoC includes an ARM Mali-G31 GPU. On information and belief, GPUs implementing the Bifrost architecture, including the Mali-G31 GPU, share substantially similar structure, function, and operation.

76. In addition, on information and belief, the TCL 50S535 television containing a Realtek RTD2873 SoC includes at least one memory device comprising a first portion operative to store a plurality of pixel command threads and a second portion operative to store a plurality of

vertex command threads. For example, the Mali GPU includes “a pair of queues, one for vertex/tiling/compute workloads and one for fragment workloads, with all work for one render target being submitted as a single submission into each queue.” (<https://community.arm.com/developer/tools-software/graphics/b/blog/posts/the-mali-gpu-an-abstract-machine-part-4---the-bifrost-shader-core>) (accessed Mar. 8, 2022). Also, on information and belief, the exemplary product includes an arbiter, coupled to the at least one memory device, operable to select a command thread from either of the plurality of pixel command threads and the plurality of vertex command threads. For example, the Mali GPUs include the Inter-Core Task Management unit, Job Manager, Compute Frontend, Fragment Frontend, Warp Manager, Quad Manager, Quad Creator, logic associated with Quad Control and quad execution, Vertex/Compute Thread Creator, the Fragment Thread Creator, and/or the Spawn Queue, (individually or collectively, the “Frontend Circuit”) to select a command thread from either of the plurality of pixel command threads and the plurality of vertex command threads. (<https://developer.arm.com/ip-products/graphics-and-multimedia/mali-gpus/mali-performance-counters/mali-g31-counters>) (accessed Mar. 8, 2022); ([https://community.arm.com/cfs-file/\\_\\_key/telligent-evolution-components-attachments/01-2066-00-00-00-00-71-76/HotChips-Presentation-Jem-Davies.pdf](https://community.arm.com/cfs-file/__key/telligent-evolution-components-attachments/01-2066-00-00-00-00-71-76/HotChips-Presentation-Jem-Davies.pdf)) (accessed Mar. 8, 2022); ([https://community.arm.com/cfs-file/\\_\\_key/telligent-evolution-components-attachments/01-2066-00-00-00-00-71-76/HotChips-Presentation-Jem-Davies.pdf](https://community.arm.com/cfs-file/__key/telligent-evolution-components-attachments/01-2066-00-00-00-00-71-76/HotChips-Presentation-Jem-Davies.pdf)) (accessed Mar. 8, 2022); (<https://developer.arm.com/ip-products/graphics-and-multimedia/mali-gpus/mali-performance-counters/mali-g31-counters>) (accessed Mar. 8, 2022); (<https://developer.arm.com/documentation/102546/0100/The-Bifrost-Shader-Core>) (accessed Mar. 8, 2022). Also, on information and belief, the exemplary product includes a plurality of command processing engines, coupled to the arbiter, each operable to

receive and process the command thread; for example, “[t]he programmable Execution Core (EC) on a Bifrost GPU consists of one or more Execution Engines (EEs).” (<https://developer.arm.com/documentation/102546/0100/The-Bifrost-Shader-Core>) (accessed Mar. 8, 2022). The Mali GPU includes one Execution Core that further includes two execution engines. *Id.*

77. Upon information and belief, Defendants have had, and have, knowledge of, or were willfully blind to, the Asserted Patents. For example, TCL has had knowledge of the ’053 Patent. At least as early as November 1, 2019, Plaintiffs specifically informed TCL of the identity of the patent and the activity believed to be an infringement, accompanied by a proposal to abate the infringement, whether by license or otherwise. Realtek has had knowledge of the ’053 Patent since at least as of the pre-suit letter regarding this patent and/or the filing of this Complaint.

78. On information and belief, Defendants contribute to and induce direct infringement by others, including Defendants’ customers, such as, e.g., application companies, application developers, consumer electronics companies, retailers, and/or end-users. Defendants induce and contribute to their customers’ directly infringing acts, including those customers’ making, importation, sales, use, and/or offers for sale of articles that are covered by the Asserted Patents. *See also, e.g., ¶¶ 10-38, 40-44, supra.* For example, on information and belief, third parties and retailers such as Best Buy and presenters at trade shows such as CES provide floor demonstrations of the operation of Defendants’ integrated circuits, RDKs and development/demonstration printed circuit board assemblies incorporating such RDKs and integrated circuits, and/or televisions, smart devices, and graphics devices that infringe. Also for example, on information and belief, when an end-user connects Defendants’ products that infringe to the internet, (such as, e.g., televisions),



they download and/or activate software that facilitate the operation of the infringing systems and methods of those televisions and components thereof.

79. Upon information and belief, Defendants knowingly induced and induce direct infringing acts by others with specific intent to encourage infringement. For example, Defendants actively induce customers' direct infringement by contracting with and encouraging customers to make, use, offer to sell, sell, and/or import in the United States products that infringe the Asserted Patents. Defendants know, or should have known, that these induced acts directly infringe the Asserted Patents because of, for example, the infringement allegations and evidence provided in connection with this Complaint, and the aforementioned notice letters to Defendants.

80. Defendants also contribute to the foregoing infringement by customers by making, using, offering to sell, selling, and/or importing in the United States Defendants products that constitute a material part of the articles that practice the Asserted Patents. Defendants know, or should have known, that such Defendants' products have no substantial non-infringing uses, are a material part of the invention of each Asserted Patent, especially made or especially adapted for use in an infringement of such patent, and not a staple article or commodity of commerce suitable for substantial non-infringing use.

81. Defendants' continued infringement of the '053 Patent has damaged and will continue to damage Plaintiffs.

82. Plaintiffs are entitled to recover damages adequate to compensate for Defendants' infringement.

83. ATI is the assignee and lawful owner of all right, title and interest in and to the '053 Patent. The '053 Patent is valid and enforceable.

**COUNT II**  
**(Defendants' Willful Infringement of the '053 Patent)**

84. Plaintiffs incorporate the allegations of all of the foregoing Paragraphs as if fully restated herein.

85. Defendants have willfully infringed and/or do willfully infringe the '053 Patent.

86. Upon information and belief, Defendants have had, and have, knowledge of, or were willfully blind to, the Asserted Patents. For example, TCL has had knowledge of the '053 Patent. At least as early as November 1, 2019, Plaintiffs specifically informed TCL of the identity of the patent and the activity believed to be an infringement, accompanied by a proposal to abate the infringement, whether by license or otherwise. Realtek has received actual notice of the '053 Patent at least as of the pre-suit notice letter. After receiving such actual notice of the '053 Patent, and/or notice of this Complaint filing, Defendants proceeded and continue to proceed to make, use, sell, and/or offer to sell in this District and elsewhere in the United States, and import into this District and elsewhere in the United States, the infringing TCL and Realtek products.

87. On information and belief, Defendants engaged in such activities despite an objectively high likelihood that their actions constituted infringement of valid patents, including the '053 Patent. Defendants knew and should have known that their actions would cause direct infringement of the '053 Patent.

**COUNT III**  
**(Defendants' Infringement of the '454 Patent)**

88. Plaintiffs incorporate the allegations of all of the foregoing Paragraphs as if fully restated herein.

89. Defendants have directly infringed and continue to directly infringe the '454 Patent by making, using, selling, offering for sale, or importing into the United States products and/or methods covered by one or more claims of the '454 Patent including, but not limited to, televisions, smart devices, graphics devices, integrated circuits, RDKs and development/demonstration printed

circuit board assemblies incorporating such RDKs and integrated circuits. The infringing products that infringe one or more claims of the '454 Patent include, but are not limited to, at least the TCL and Realtek infringing products identified in this Complaint. Further discovery may reveal additional infringing products and/or models.

90. For example, and without limitation, making, using, selling, offering for sale, and/or importing the Exemplary TCL Television and the Exemplary Realtek Integrated Circuit infringes one or more claims of the '454 Patent, including but not limited to claim 2.

91. The TCL 50S535 television, and the Realtek RTD2873 system on chip incorporated therein, are exemplary products covered by at least claim 2 of the '454 Patent. On information and belief, many other products provided by, and to be provided by TCL and/or Realtek, infringe the '454 Patent.

92. On information and belief, the infringing products include all limitations of at least claim 2 of the '454 Patent. Specifically, the '454 Patent claims, e.g.: a unified shader, comprising: a general purpose register block for maintaining data; a processor unit; a sequencer, coupled to the general purpose register block and the processor unit, the sequencer maintaining instructions operative to cause the processor unit to execute vertex calculation and pixel calculation operations on selected data maintained in the general purpose register block; and wherein the processor unit executes instructions that generate a pixel color in response to selected data from the general purpose register block and generates vertex position and appearance data in response to selected data from the general purpose register block.

93. For example, the TCL 50S535 television containing a Realtek RTD2873 SoC, which is a 4K TV SoC, incorporates a graphics processing system. More specifically, Realtek's SoC includes an ARM Mali-G31 GPU. On information and belief, GPUs implementing the Bifrost

architecture, including the Mali-G31 GPU, share substantially similar structure, function, and operation.

94. In addition, on information and belief, the TCL 50S535 television containing a Realtek RTD2873 SoC with the Mali GPU includes the Inter-Core Task Management unit, Job Manager, Compute Frontend, Fragment Frontend, Warp Manager, Quad Manager, Quad Creator, logic associated with Quad Control and quad execution, Vertex/Compute Thread Creator, the Fragment Thread Creator, and/or the Spawn Queue, (individually or collectively, the “Frontend Circuit”), coupled to the general purpose register block and the processor unit, that maintains instructions operative to cause the processor unit to execute vertex calculation and pixel calculations on the selected data maintained in the general purpose register block. (<https://developer.arm.com/ip-products/graphics-and-multimedia/mali-gpus/mali-performance-counters/mali-g31-counters>) (accessed Mar. 8, 2022); ([https://community.arm.com/cfs-file/\\_\\_key/telligent-evolution-components-attachments/01-2066-00-00-00-00-71-76/HotChips-Presentation-Jem-Davies.pdf](https://community.arm.com/cfs-file/__key/telligent-evolution-components-attachments/01-2066-00-00-00-00-71-76/HotChips-Presentation-Jem-Davies.pdf)) (accessed Mar. 8, 2022); ([https://community.arm.com/cfs-file/\\_\\_key/telligent-evolution-components-attachments/01-2066-00-00-00-00-71-76/HotChips-Presentation-Jem-Davies.pdf](https://community.arm.com/cfs-file/__key/telligent-evolution-components-attachments/01-2066-00-00-00-00-71-76/HotChips-Presentation-Jem-Davies.pdf)) (accessed Mar. 8, 2022); (<https://developer.arm.com/ip-products/graphics-and-multimedia/mali-gpus/mali-performance-counters/mali-g31-counters>) (accessed Mar. 8, 2022); (<https://developer.arm.com/documentation/102546/0100/The-Bifrost-Shader-Core>) (accessed Mar. 8, 2022). For example, the Frontend Circuit “is responsible for scheduling workloads onto the various processing units inside the GPU.” (<https://developer.arm.com/ip-products/graphics-and-multimedia/mali-gpus/mali-performance-counters/mali-g31-counters>) (accessed Mar. 8, 2022). Further, the Mali GPU uses “quad-parallel execution” where “one quad at a time executes in each pipeline stage.” See slide 13 at

[https://community.arm.com/cfs-file/\\_\\_key/telligent-evolution-components-attachments/01-2066-00-00-00-00-71-76/HotChips-Presentation-Jem-Davies.pdf](https://community.arm.com/cfs-file/__key/telligent-evolution-components-attachments/01-2066-00-00-00-00-71-76/HotChips-Presentation-Jem-Davies.pdf) (accessed Mar. 8, 2022).

95. Also, on information and belief, the exemplary products include a processor unit that executes instructions that generate a pixel color in response to selected data from the general purpose register block and generates vertex position and appearance data in response to selected data from the general purpose register block. For example, “[t]he graphics work for the [Mali] GPU is queued in a pair of queues, one for vertex/tiling/compute workloads and one for fragment workloads” and “[w]orkloads from both queues can be processed by a shader core at the same time; for example, vertex processing and fragment processing for different render targets can be running in parallel.” (<https://community.arm.com/developer/tools-software/graphics/b/blog/posts/the-mali-gpu-an-abstract-machine-part-4---the-bifrost-shader-core>) (accessed Mar. 8, 2022).

96. Upon information and belief, Defendants have had, and have, knowledge of, or were willfully blind to, the Asserted Patents. For example, TCL has had knowledge of the ’454 Patent. At least as early as October 25, 2018, Plaintiffs specifically informed TCL of the identity of the patent and the activity believed to be an infringement, accompanied by a proposal to abate the infringement, whether by license or otherwise. Realtek has had knowledge of the ’454 Patent since at least as of the pre-suit letter regarding this patent and/or the filing of this Complaint.

97. On information and belief, Defendants contribute to and induce direct infringement by others, including Defendants’ customers, such as, e.g., application companies, application developers, consumer electronics companies, retailers, and/or end-users. Defendants induce and contribute to their customers’ directly infringing acts, including those customers’ making, importation, sales, use, and/or offers for sale of articles that are covered by the Asserted Patents.

*See also, e.g., ¶¶ 10-38, 40-44, supra.* For example, on information and belief, third parties and retailers such as Best Buy and presenters at trade shows such as CES provide floor demonstrations of the operation of Defendants' integrated circuits, RDKs and development/demonstration printed circuit board assemblies incorporating such RDKs and integrated circuits, and/or televisions that infringe. Also for example, on information and belief, when an end-user connects Defendants' products that infringe to the internet, (such as, e.g., televisions) they download and/or activate software that facilitate the operation of the infringing systems and methods of those televisions and components thereof.

98. Upon information and belief, Defendants knowingly induced and induce direct infringing acts by others with specific intent to encourage infringement. For example, Defendants actively induce customers' direct infringement by contracting with and encouraging customers to make, use, offer to sell, sell, and/or import in the United States products that infringe the Asserted Patents. Defendants know, or should have known, that these induced acts directly infringe the Asserted Patents because of, for example, the infringement allegations and evidence provided in connection with this Complaint, and the aforementioned notice letters to Defendants.

99. Defendants also contribute to the foregoing infringement by customers by making, using, offering to sell, selling, and/or importing in the United States Defendants products that constitute a material part of the articles that practice the Asserted Patents. Defendants know, or should have known, that such Defendants' products have no substantial non-infringing uses, are a material part of the invention of each Asserted Patent, especially made or especially adapted for use in an infringement of such patent, and not a staple article or commodity of commerce suitable for substantial non-infringing use.

100. Defendants' continued infringement of the '454 Patent has damaged and will continue to damage Plaintiffs.

101. Plaintiffs are entitled to recover damages adequate to compensate for Defendants' infringement.

102. ATI Technologies ULC is the assignee and lawful owner of all right, title and interest in and to the '454 Patent. The '454 Patent is valid and enforceable.

**COUNT IV**  
**(Defendants' Willful Infringement of the '454 Patent)**

103. Plaintiffs incorporate the allegations of all of the foregoing Paragraphs as if fully restated herein.

104. Defendants have willfully infringed and/or do willfully infringe the '454 Patent.

105. Upon information and belief, Defendants have had, and have, knowledge of, or were willfully blind to, the Asserted Patents. For example, TCL has had knowledge of the '454 Patent. At least as early as October 25, 2018, Plaintiffs specifically informed TCL of the identity of the patent and the activity believed to be an infringement, accompanied by a proposal to abate the infringement, whether by license or otherwise. Realtek has received actual notice of the '454 Patent at least as of the pre-suit notice letter. After receiving such actual notice of the '454 Patent, and/or notice of this Complaint filing, Defendants proceeded and continue to proceed to make, use, sell, and/or offer to sell in this District and elsewhere in the United States, and import into this District and elsewhere in the United States, the infringing TCL and Realtek products.

106. On information and belief, Defendants engaged in such activities despite an objectively high likelihood that their actions constituted infringement of valid patents, including the '454 Patent. Defendants knew and should have known that their actions would cause direct infringement of the '454 Patent.

**COUNT V**  
**(Defendants' Infringement of the '628 Patent)**

107. Plaintiffs incorporate the allegations of all of the foregoing Paragraphs as if fully restated herein.

108. Defendants have directly infringed and continue to directly infringe the '628 Patent by making, using, selling, offering for sale, or importing into the United States products and/or methods covered by one or more claims of the '628 Patent including, but not limited to, televisions, smart devices, graphics devices, integrated circuits, RDKs and development/demonstration printed circuit board assemblies incorporating such RDKs and integrated circuits. The infringing products that infringe one or more claims of the '628 Patent include, but are not limited to, at least the TCL and Realtek infringing products identified in this Complaint. Further discovery may reveal additional infringing products and/or models.

109. For example, and without limitation, making, using, selling, offering for sale, and/or importing the Exemplary TCL Television and the Exemplary Realtek Integrated Circuit infringes one or more claims of the '628 Patent, including but not limited to claim 7.

110. The TCL 50S535 television, and the Realtek RTD2873 system on chip incorporated therein, are exemplary products covered by at least claim 7 of the '628 Patent. On information and belief, many other products provided by, and to be provided by TCL and/or Realtek, infringe the '628 Patent.

111. On information and belief, the infringing products include all limitations of at least claim 7 of the '628 Patent. Specifically, the '628 Patent claims: a computer processing system comprising: a processor and a memory, wherein the processor is configured to: receive a compressed texture block, wherein the compressed texture block includes two or more disjoint subsets into which data in the compressed texture block is to be unpacked, wherein the two or



more disjoint subsets include a first subset having a first set of color endpoints and a second subset having a second set of color endpoints; and individually decompress each of the two or more disjoint subsets to form texels, wherein the decompressing includes: determining a first texel color for a first texel that is part of the first disjoint subset by interpolating between color endpoints of the first set of color endpoints based on a first index value for the first texel; and determining a second texel color for a second texel that is part of the second disjoint subset by interpolating between color endpoints of the second set of color endpoints based on a second index value for the second texel.

112. For example, the TCL 50S535 television containing a Realtek RTD2873 SoC, which is a 4K TV SoC, incorporates an ARM Cortex-A55 CPU, an ARM Mali-G31 GPU, and on-chip and off-chip memory. On information and belief, GPUs implementing the Bifrost architecture, including the Mali-G31 GPU, share substantially similar structure, function, and operation.

113. In addition, the TCL 50S535 television containing a Realtek RTD2873 SoC with the Mali-G31 GPU supports “Adaptive Scalable Texture Compression (ASTC),” which “offers a number of advantages over existing texture compression schemes by improving image quality, reducing memory bandwidth and thus energy use.” (<https://developer.arm.com/ip-products/graphics-and-multimedia/mali-gpus/mali-g31-gpu>) (accessed Mar. 8, 2022). The Mali-G31 GPU and/or related software “allows a block to define up to four distinct color gradients, called partitions, and can assign each texel to a single partition.” (<https://developer.arm.com/documentation/102162/0002/The-ASTC-algorithm>) (accessed Mar. 8, 2022). During decompression, the Mali-G31 GPU and/or related software generate the color value for each texel “by interpolating between the two end-point colors, based on the per-texel weight.”

*Id.* “The number of partitions and the partition index can be chosen on a per-block basis, and a different color endpoint mode can be chosen per partition.” *Id.*

114. Upon information and belief, Defendants have had, and have, knowledge of, or were willfully blind to, the Asserted Patents. Defendants have had knowledge of the '628 Patent since at least as of the pre-suit letter regarding this patent and/or the filing of this Complaint.

115. On information and belief, Defendants contribute to and induce direct infringement by others, including Defendants' customers, such as, e.g., application companies, application developers, consumer electronics companies, retailers, and/or end-users. Defendants induce and contribute to their customers' directly infringing acts, including those customers' making, importation, sales, use, and/or offers for sale of articles that are covered by the Asserted Patents. *See also, e.g.,* ¶¶ 10-38, 40-44, *supra*. For example, on information and belief, third parties and retailers such as Best Buy and presenters at trade shows such as CES provide floor demonstrations of the operation of Defendants' televisions, smart devices, graphics devices, integrated circuits, RDKs and development/demonstration printed circuit board assemblies incorporating such RDKs and integrated circuits that infringe. Also for example, on information and belief, when an end-user connects Defendants' products that infringe to the internet, (such as, e.g. televisions) they download and/or activate software that facilitate the operation of the infringing systems and methods of those televisions and components thereof.

116. Upon information and belief, Defendants knowingly induced and induce direct infringing acts by others with specific intent to encourage infringement. For example, Defendants actively induce customers' direct infringement by contracting with and encouraging customers to make, use, offer to sell, sell, and/or import in the United States products that infringe the Asserted Patents. Defendants know, or should have known, that these induced acts directly infringe the

Asserted Patents because of, for example, the infringement allegations and evidence provided in connection with this Complaint, and the aforementioned notice letters to Defendants.

117. Defendants' continued infringement of the '628 Patent has damaged and will continue to damage Plaintiffs.

118. Plaintiffs are entitled to recover damages adequate to compensate for Defendants' infringement.

119. ATI Technologies ULC is the assignee and lawful owner of all right, title and interest in and to the '628 Patent. The '628 Patent is valid and enforceable.

**COUNT VI**  
**(Defendants' Willful Infringement of the '628 Patent)**

120. Plaintiffs incorporate the allegations of all of the foregoing Paragraphs as if fully restated herein.

121. Defendants have willfully infringed and/or do willfully infringe the '628 Patent.

122. Upon information and belief, Defendants have had, and have, knowledge of, or were willfully blind to, the Asserted Patents. Realtek and TCL have had knowledge of the '628 Patent since at least as of the pre-suit letter regarding this patent and/or the filing of this Complaint. After receiving such actual notice of the '628 Patent, and/or notice of this Complaint filing, Defendants proceeded and continue to proceed to make, use, sell, and/or offer to sell in this District and elsewhere in the United States, and import into this District and elsewhere in the United States, the infringing TCL and Realtek products.

123. On information and belief, Defendants engaged in such activities despite an objectively high likelihood that their actions constituted infringement of valid patents, including the '628 Patent. Defendants knew and should have known that their actions would cause direct infringement of the '628 Patent.

**COUNT VII**  
**(Defendants' Infringement of the '547 Patent)**

124. Plaintiffs incorporate the allegations of all of the foregoing Paragraphs as if fully restated herein.

125. Defendants have directly infringed and continue to directly infringe the '547 Patent by making, using, selling, offering for sale, or importing into the United States products and/or methods covered by one or more claims of the '547 Patent including, but not limited to, televisions, smart devices, graphics devices, integrated circuits, RDKs and development/demonstration printed circuit board assemblies incorporating such RDKs and integrated circuits. The infringing products that infringe one or more claims of the '547 Patent include, but are not limited to, at least the TCL and Realtek infringing products identified in this Complaint. Further discovery may reveal additional infringing products and/or models.

126. For example, and without limitation, making, using, selling, offering for sale, and/or importing the Exemplary TCL Television and the Exemplary Realtek Integrated Circuit infringes one or more claims of the '547 Patent, including but not limited to claim 16.

127. The TCL 50S535 television, and the Realtek RTD2873 system on chip, are exemplary products covered by at least claim 16 of the '547 Patent. On information and belief, many other products provided by, and to be provided by TCL and/or Realtek, infringe the '547 Patent.

128. On information and belief, the infringing products include all limitations of at least claim 16 of the '547 Patent. Specifically, the '547 Patent claims, e.g.: a system for synchronizing one or more thread wavefronts and associated events, comprising: a shader core comprising a plurality of processing unites configured to execute a first wavefront outputting a first data; a wave event generator coupled to the shader core and configured to generate a first event associated with

the outputting of the first data; an event synchronizer configured to release the first event before releasing events inserted subsequent to the first event; a switch coupled to the shader core and a memory and configured to: insert the first event into the event synchronizer; and release the first event from the event synchronizer after the first data is stored in the memory.

129. For example, the TCL 50S535 television containing a Realtek RTD2873 SoC, which is a 4K TV SoC, incorporates a graphics processing system. More specifically, Realtek's SoC includes an ARM Mali-G31 GPU. On information and belief, GPUs implementing the Bifrost architecture, including the Mali-G31 GPU, share substantially similar structure, function, and operation.

130. In addition, the TCL 50S535 television containing a Realtek RTD2873 SoC with the Mali GPU includes a shader core, which on information and belief, comprises a plurality of processing units configured to execute a first wavefront outputting a first data. For example, the Mali GPU implements "a unified shader architecture" and includes a plurality of shader cores and execution engines. (<https://community.arm.com/developer/tools-software/graphics/b/blog/posts/the-mali-gpu-an-abstract-machine-part-4---the-bifrost-shader-core>) (accessed Mar. 8, 2022); (<https://developer.arm.com/ip-products/graphics-and-multimedia/mali-gpus/mali-performance-counters/mali-g31-counters>) (accessed Mar. 8, 2022); ([https://community.arm.com/cfs-file/\\_\\_key/telligent-evolution-components-attachments/01-2066-00-00-00-71-76/HotChips-Presentation-Jem-Davies.pdf](https://community.arm.com/cfs-file/__key/telligent-evolution-components-attachments/01-2066-00-00-00-71-76/HotChips-Presentation-Jem-Davies.pdf)) (accessed Mar. 8, 2022). On information and belief, the shader cores and execution engines are configured to execute a first wavefront outputting a first data. (<https://community.arm.com/developer/tools-software/graphics/b/blog/posts/the-mali-gpu-an-abstract-machine-part-4---the-bifrost-shader-core>) (accessed Mar. 8, 2022); ([https://community.arm.com/cfs-file/\\_\\_key/telligent-evolution-](https://community.arm.com/cfs-file/__key/telligent-evolution-)

components-attachments/01-2066-00-00-00-00-71-76/HotChips-Presentation-Jem-Davies.pdf) (accessed Mar. 8, 2022).

131. Also, on information and belief, a wave event generator coupled to the shader core and configured to generate a first event associated with the outputting of the first data. For example, on information and belief, the Mali GPU includes the Inter-Core Task Management unit, Job Manager, Compute Frontend, Fragment Frontend, Warp Manager, Quad Manager, Quad Creator, logic associated with Quad Control and quad execution, Vertex/Compute Thread Creator, the Fragment Thread Creator, and/or the Spawn Queue are coupled to the shader core and configured to generate a first event associated with the outputting of the first data. (<https://developer.arm.com/ip-products/graphics-and-multimedia/mali-gpus/mali-g31-gpu>) (accessed Mar. 8, 2022); ([https://community.arm.com/cfs-file/\\_\\_key/telligent-evolution-components-attachments/01-2066-00-00-00-00-71-76/HotChips-Presentation-Jem-Davies.pdf](https://community.arm.com/cfs-file/__key/telligent-evolution-components-attachments/01-2066-00-00-00-00-71-76/HotChips-Presentation-Jem-Davies.pdf)) (accessed Mar. 8, 2022); ([https://community.arm.com/cfs-file/\\_\\_key/telligent-evolution-components-attachments/01-2066-00-00-00-00-71-76/HotChips-Presentation-Jem-Davies.pdf](https://community.arm.com/cfs-file/__key/telligent-evolution-components-attachments/01-2066-00-00-00-00-71-76/HotChips-Presentation-Jem-Davies.pdf)) (accessed Mar. 8, 2022); (<https://developer.arm.com/ip-products/graphics-and-multimedia/mali-gpus/mali-performance-counters/mali-g31-counters>) (accessed Mar. 8, 2022). Also, on information and belief, the exemplary products include an event synchronizer configured to release the first event before releasing events inserted subsequent to the first event. For example, on information and belief, the Inter-core Task management module, Job Manager, Warp Manager, Quad Manager, Non-Frag Front-end, Fragment Front-end, Thread Creator, Quad Creator, Shader Core, Shader Core Fabric, GPU Fabric, and Message Fabric, and interfaces with the AMBA 4 ACE-LITE bus, APB control bus, and AXI data bus (individually and collectively, the “Synchronization Circuit”) are configured to release the first event before

releasing events inserted subsequent to the first event. ([https://community.arm.com/cfs-file/\\_\\_key/telligent-evolution-components-attachments/01-2066-00-00-00-00-71-76/HotChips-Presentation-Jem-Davies.pdf](https://community.arm.com/cfs-file/__key/telligent-evolution-components-attachments/01-2066-00-00-00-00-71-76/HotChips-Presentation-Jem-Davies.pdf)) (accessed Mar. 8, 2022); (<https://developer.arm.com/ip-products/graphics-and-multimedia/mali-gpus/mali-performance-counters/mali-g31-counters>) (accessed Mar. 8, 2022); (<https://developer.arm.com/ip-products/graphics-and-multimedia/mali-gpus/mali-g31-gpu>) (accessed Mar. 8, 2022); (<https://developer.arm.com/solutions/graphics-and-gaming/developer-guides/learn-the-basics/the-bifrost-shader-core/single-page>) (accessed Mar. 8, 2022); (<https://docplayer.net/90745896-Bifrost-the-gpu-architecture-for-next-five-billion.html>) (accessed Mar. 8, 2022); (<https://community.arm.com/arm-community-blogs/b/graphics-gaming-and-vr-blog/posts/bitesize-bifrost-1-the-benefits-of-include-shaders>) (accessed Mar. 8, 2022). Also, on information and belief, the exemplary products include a switch coupled to the shader core and a memory, and is configured to: insert the first event into the event synchronizer; and release the first event from the event synchronizer after the first data is stored in the memory. For example, on information and belief, the Synchronization Circuit is coupled to the shader core and a memory, and configured to insert the first event into the event synchronizer and release the first event from the event synchronizer after the first data is stored in the memory. (<https://community.arm.com/arm-community-blogs/b/graphics-gaming-and-vr-blog/posts/bitesize-bifrost-1-the-benefits-of-include-shaders>) (accessed Mar. 8, 2022).

132. Upon information and belief, Defendants have had, and have, knowledge of, or were willfully blind to, the Asserted Patents. Defendants have had knowledge of the '547 Patent since at least as of the pre-suit letter regarding this patent and/or the filing of this Complaint.

133. On information and belief, Defendants contribute to and induce direct infringement by others, including Defendants' customers, such as, e.g., application companies, application

developers, consumer electronics companies, retailers, and/or end-users. Defendants induce and contribute to their customers' directly infringing acts, including those customers' making, importation, sales, use, and/or offers for sale of articles that are covered by the Asserted Patents. *See also, e.g.,* ¶¶ 10-38, 40-44, *supra*. For example, on information and belief, third parties and retailers such as Best Buy and presenters at trade shows such as CES provide floor demonstrations of the operation of Defendants' televisions, smart devices, graphics devices, integrated circuits, RDKs and development/demonstration printed circuit board assemblies incorporating such RDKs and integrated circuits that infringe. Also for example, on information and belief, when an end-user connects Defendants' products that infringe to the internet, (such as, e.g., televisions) they download and/or activate software that facilitate the operation of the infringing systems and methods of those televisions and components thereof.

134. Upon information and belief, Defendants knowingly induced and induce direct infringing acts by others with specific intent to encourage infringement. For example, Defendants actively induce customers' direct infringement by contracting with and encouraging customers to make, use, offer to sell, sell, and/or import in the United States products that infringe the Asserted Patents. Defendants know, or should have known, that these induced acts directly infringe the Asserted Patents because of, for example, the infringement allegations and evidence provided in connection with this Complaint, and the aforementioned notice letters to Defendants.

135. Defendants' continued infringement of the '547 Patent has damaged and will continue to damage Plaintiffs.

136. Plaintiffs are entitled to recover damages adequate to compensate for Defendants' infringement.



137. Advanced Micro Devices, Inc. and ATI Technologies ULC are the assignees and lawful joint owners of all right, title and interest in and to the '547 Patent. The '547 Patent is valid and enforceable.

**COUNT VIII**  
**(Defendants' Willful Infringement of the '547 Patent)**

138. Plaintiffs incorporate the allegations of all of the foregoing Paragraphs as if fully restated herein.

139. Defendants have willfully infringed and/or do willfully infringe the '547 Patent.

140. Upon information and belief, Defendants have had, and have, knowledge of, or were willfully blind to, the Asserted Patents. Realtek and TCL have had knowledge of the '547 Patent since at least as of the pre-suit letter regarding this patent and/or the filing of this Complaint. After receiving such actual notice of the '547 Patent, and/or notice of this Complaint filing, Defendants proceeded and continue to proceed to make, use, sell, and/or offer to sell in this District and elsewhere in the United States, and import into this District and elsewhere in the United States, the infringing TCL and Realtek products.

141. On information and belief, Defendants engaged in such activities despite an objectively high likelihood that their actions constituted infringement of valid patents, including the '547 Patent. Defendants knew and should have known that their actions would cause direct infringement of the '547 Patent.

**COUNT IX**  
**(Defendants' Infringement of the '381 Patent)**

142. Plaintiffs incorporate the allegations of all of the foregoing Paragraphs as if fully restated herein.

143. Defendants have directly infringed and continue to directly infringe the '381 Patent by making, using, selling, offering for sale, or importing into the United States products and/or methods covered by one or more claims of the '381 Patent including, but not limited to, televisions, smart devices, graphics devices, integrated circuits, RDKs and development/demonstration printed circuit board assemblies incorporating such RDKs and integrated circuits. The infringing products that infringe one or more claims of the '381 Patent include, but are not limited to, at least the TCL and Realtek infringing products identified in this Complaint. Further discovery may reveal additional infringing products and/or models.

144. For example, and without limitation, making, using, selling, offering for sale, and/or importing the Exemplary TCL Television and the Exemplary Realtek Integrated Circuit infringes one or more claims of the '381 Patent, including but not limited to claim 15.

145. The TCL 50S535 television, and the Realtek RTD2873 system on chip incorporated therein, are exemplary products covered by at least claim 15 of the '381 Patent. On information and belief, many other products provided by, and to be provided by TCL and/or Realtek, infringe the '381 Patent.

146. On information and belief, the infringing products include all limitations of at least claim 15 of the '381 Patent. Specifically, the '381 Patent claims, e.g.: a computing system comprising: a first processing unit; and a bus coupled to the memory and the first processing unit, wherein the first processing unit comprises: a plurality of engines configured to receive, from a scheduling module associated with a second processing unit, a plurality of tasks and to load state data associated with each of the plurality of tasks; and a shader core configured to receive the plurality of tasks from at least one of the plurality of engines and to execute a first task from the

plurality of tasks while executing a second task from the plurality of tasks based on respective state data associated with each of the first and second tasks.

147. For example, the TCL 50S535 television containing a Realtek RTD2873 SoC, which is a 4K TV SoC, incorporates a graphics processing system and central processing unit. More specifically, Realtek's SoC includes an ARM Mali-G31 GPU and an ARM Cortex-A55 CPU. On information and belief, GPUs implementing the Bifrost architecture, including the Mali-G31 GPU, share substantially similar structure, function, and operation.

148. In addition, on information and belief, the TCL 50S535 television and the Realtek RTD2873 SoC incorporated therein include a memory. For example, the TCL 50S535 includes system memory, and the RealTek SoC includes caches, tile memory, and local memory. (<https://developer.arm.com/solutions/graphics-and-gaming/developer-guides/learn-the-basics/the-bifrost-shader-core/the-bifrost-shader-core>) (accessed Mar. 8, 2022); ([https://community.arm.com/cfs-file/\\_\\_key/telligent-evolution-components-attachments/01-2066-00-00-00-00-71-76/HotChips-Presentation-Jem-Davies.pdf](https://community.arm.com/cfs-file/__key/telligent-evolution-components-attachments/01-2066-00-00-00-00-71-76/HotChips-Presentation-Jem-Davies.pdf)) (accessed Mar. 8, 2022); (<https://developer.arm.com/solutions/graphics-and-gaming/developer-guides/learn-the-basics/the-bifrost-shader-core/the-bifrost-shader-core>) (accessed Mar. 8, 2022); ([https://www.khronos.org/registry/OpenGL/extensions/EXT/EXT\\_shader\\_pixel\\_local\\_storage.txt](https://www.khronos.org/registry/OpenGL/extensions/EXT/EXT_shader_pixel_local_storage.txt)) (accessed Mar. 8, 2022). On information and belief, the TCL 50S535 television and the Realtek RTD2873 SoC incorporated therein further include a first processing unit and a bus coupled to the memory and the first processing unit. For example, on information and belief, the Realtek SoC includes the Shader Core Fabric and Message Fabric coupled to the execution engines and L1 caches and tile memory, the GPU Fabric coupled to the Shader Cores and L2 caches, and AMBA 4 ACE-Lite bus, AXI Data Bus, APB Control Bus, and Cache Coherent Interconnect (CCI)

coupled to the Mali GPU, Shader Cores, and the system memory. ([https://twitter.com/AndroidTV\\_Rumor/status/1091304992907161602/photo/2](https://twitter.com/AndroidTV_Rumor/status/1091304992907161602/photo/2)) (accessed Mar. 8, 2022); (<https://developer.arm.com/ip-products/graphics-and-multimedia/mali-gpus/mali-g31-gpu>) (accessed Mar. 8, 2022); ([https://community.arm.com/cfs-file/\\_\\_key/telligent-evolution-components-attachments/01-2066-00-00-00-00-71-76/HotChips-Presentation-Jem-Davies.pdf](https://community.arm.com/cfs-file/__key/telligent-evolution-components-attachments/01-2066-00-00-00-00-71-76/HotChips-Presentation-Jem-Davies.pdf)) (accessed Mar. 8, 2022); (<https://documentation-service.arm.com/static/5e8f15d57100066a414f73ce?token=>) (accessed Mar. 8, 2022); (<https://developer.arm.com/documentation/102546/0100/Third-Gen-Mali-GPU-Architecture>) (accessed Mar. 8, 2022). On information and belief, the TCL 50S535 and the Realtek RTD2873 SoC incorporated therein television further include a plurality of engines configured to receive, from a scheduling module associated with a second processing unit, a plurality of tasks and to load state data associated with each of the plurality of tasks. For example, the Mali GPU includes the Inter-Core Task Management unit, Job Manager, Compute Frontend, Fragment Frontend, Warp Manager, Quad Manager, Quad Creator, logic associated with Quad Control and quad execution, Vertex/Compute Thread Creator, Fragment Thread Creator, and/or the Spawn Queue, which, on information and belief, are configured to receive a plurality of tasks from the ARM CPU and to load state data associated with each of a plurality of tasks. (<https://developer.arm.com/ip-products/graphics-and-multimedia/mali-gpus/mali-g31-gpu>) (accessed Mar. 8, 2022); ([https://community.arm.com/cfs-file/\\_\\_key/telligent-evolution-components-attachments/01-2066-00-00-00-00-71-76/HotChips-Presentation-Jem-Davies.pdf](https://community.arm.com/cfs-file/__key/telligent-evolution-components-attachments/01-2066-00-00-00-00-71-76/HotChips-Presentation-Jem-Davies.pdf)) (accessed Mar. 8, 2022); (<https://developer.arm.com/ip-products/graphics-and-multimedia/mali-gpus/mali-performance-counters/mali-g31-counters>) (accessed Mar. 8, 2022); (<https://developer.arm.com/documentation/102546/0100/The-Bifrost-Shader-Core>) (accessed

Mar. 8, 2022); (<https://community.arm.com/developer/tools-software/graphics/b/blog/posts/the-mali-gpu-an-abstract-machine-part-4---the-bifrost-shader-core>) (accessed Mar. 8, 2022); (<https://github.com/fxlin/mali>) (accessed Mar. 8, 2022).

149. Also, on information and belief, the exemplary products include a shader core configured to receive the plurality of tasks from at least one of the plurality of engines and to execute a first task from the plurality of tasks while executing a second task from the plurality of tasks based on respective state data associated with each of the first and second tasks. For example, on information and belief, the Mali GPU implements “a unified shader architecture” and includes a plurality of shader cores and execution engines. (<https://community.arm.com/developer/tools-software/graphics/b/blog/posts/the-mali-gpu-an-abstract-machine-part-4---the-bifrost-shader-core>) (accessed Mar. 8, 2022); (<https://developer.arm.com/ip-products/graphics-and-multimedia/mali-gpus/mali-performance-counters/mali-g31-counters>) (accessed Mar. 8, 2022); ([https://community.arm.com/cfs-file/\\_\\_key/telligent-evolution-components-attachments/01-2066-00-00-00-00-71-76/HotChips-Presentation-Jem-Davies.pdf](https://community.arm.com/cfs-file/__key/telligent-evolution-components-attachments/01-2066-00-00-00-00-71-76/HotChips-Presentation-Jem-Davies.pdf)) (accessed Mar. 8, 2022). The shader cores and execution engines are, on information and belief, configured to receive the plurality of tasks from at least one of the plurality of engines and to execute a first task from the plurality of tasks while executing a second task from the plurality of tasks based on respective state data associated with each of the first and second tasks. (<https://www.anandtech.com/show/10375/arm-unveils-bifrost-and-mali-g71/3>) (accessed Mar. 8, 2022); ([https://community.arm.com/cfs-file/\\_\\_key/telligent-evolution-components-attachments/01-2066-00-00-00-00-71-76/HotChips-Presentation-Jem-Davies.pdf](https://community.arm.com/cfs-file/__key/telligent-evolution-components-attachments/01-2066-00-00-00-00-71-76/HotChips-Presentation-Jem-Davies.pdf)) (accessed Mar. 8, 2022); (<https://developer.arm.com/documentation/102546/0100/The-Bifrost-Shader-Core>) (accessed Mar. 8, 2022); ([- 53 -](https://community.arm.com/developer/tools-</a></p></div><div data-bbox=)

software/graphics/b/blog/posts/the-mali-gpu-an-abstract-machine-part-4---the-bifrost-shader-core) (accessed Mar. 8, 2022); ([https://www.it.uu.se/research/upmarc/events/MCC2017/johan\\_presentation.pdf](https://www.it.uu.se/research/upmarc/events/MCC2017/johan_presentation.pdf)) (accessed Mar. 8, 2022).

150. Upon information and belief, Defendants have had, and have, knowledge of, or were willfully blind to, the Asserted Patents. Defendants have had knowledge of the '381 Patent since at least as of the pre-suit letter regarding this patent and/or the filing of this Complaint.

151. On information and belief, Defendants contribute to and induce direct infringement by others, including Defendants' customers, such as, e.g., application companies, application developers, consumer electronics companies, retailers, and/or end-users. Defendants induce and contribute to their customers' directly infringing acts, including those customers' making, importation, sales, use, and/or offers for sale of articles that are covered by the Asserted Patents. *See also, e.g.,* ¶¶ 10-38, 40-44, *supra*. For example, on information and belief, third parties and retailers such as Best Buy and presenters at trade shows such as CES provide floor demonstrations of the operation of Defendants' televisions, smart devices, graphics devices, integrated circuits, RDKs and development/demonstration printed circuit board assemblies incorporating such RDKs and integrated circuits that infringe. Also for example, on information and belief, when an end-user connects Defendants' products that infringe to the internet, (such as, e.g., televisions) they download and/or activate software that facilitate the operation of the infringing systems and methods of those televisions and components thereof.

152. Upon information and belief, Defendants knowingly induced and induce direct infringing acts by others with specific intent to encourage infringement. For example, Defendants actively induce customers' direct infringement by contracting with and encouraging customers to

make, use, offer to sell, sell, and/or import in the United States products that infringe the Asserted Patents. Defendants know, or should have known, that these induced acts directly infringe the Asserted Patents because of, for example, the infringement allegations and evidence provided in connection with this Complaint, and the aforementioned notice letters to Defendants.

153. Defendants' continued infringement of the '381 Patent has damaged and will continue to damage Plaintiffs.

154. Plaintiffs are entitled to recover damages adequate to compensate for Defendants' infringement.

155. Advanced Micro Devices, Inc. is the assignee and lawful owner of all right, title and interest in and to the '381 Patent. The '381 Patent is valid and enforceable.

**COUNT X**  
**(Defendants' Willful Infringement of the '381 Patent)**

156. Plaintiffs incorporate the allegations of all of the foregoing Paragraphs as if fully restated herein.

157. Defendants have willfully infringed and/or do willfully infringe the '381 Patent.

158. Upon information and belief, Defendants have had, and have, knowledge of, or were willfully blind to, the Asserted Patents. Realtek and TCL have had knowledge of the '381 Patent since at least as of the pre-suit letter regarding this patent and/or the filing of this Complaint. After receiving such actual notice of the '381 Patent, and/or notice of this Complaint filing, Defendants proceeded and continue to proceed to make, use, sell, and/or offer to sell in this District and elsewhere in the United States, and import into this District and elsewhere in the United States, the infringing TCL and Realtek products.

159. On information and belief, Defendants engaged in such activities despite an objectively high likelihood that their actions constituted infringement of valid patents, including

the '381 Patent. Defendants knew and should have known that their actions would cause direct infringement of the '381 Patent.

**PRAYER FOR RELIEF**

WHEREFORE, Plaintiffs respectfully request the following relief:

a) A judgment that the '053, '454, '628, '547, and '381 Patents are valid and enforceable.

b) A judgment that Defendants have infringed, either literally or under the Doctrine of Equivalents, one or more claims of the '053, '454, '628, '547, and '381 Patents;

c) A judgment that Defendants were willful, and that Defendants' continued infringement of the '053, '454, '628, '547, and '381 Patents is willful;

d) An injunction against Defendants, their officers, agents, servants, employees, and all parent and subsidiary entities, all assignees and successors in interest, and those persons or entities acting in concert or participation with Defendants, including distributors, enjoining them from further infringement of the '053, '454, '628, '547, and '381 Patents;

e) A judgment that awards Plaintiffs all appropriate damages under 35 U.S.C. § 284 for Defendants' past infringement, and any continuing or future infringement of the '053, '454, '628, '547, and '381 Patents, including pre or post judgment interest, costs, and disbursements as justified under 35 U.S.C. § 284 and, if necessary, to adequately compensate Plaintiffs for Defendants' infringement, an accounting:

i. that Plaintiffs be awarded enhanced damages by reason of the Defendants' willful infringement of the '053, '454, '628, '547, and '381 Patents;



- ii. that this case be declared exceptional within the meaning of 35 U.S.C. § 285 and that Plaintiffs be awarded its reasonable attorneys' fees against Defendants that they incur in prosecuting this action; and
- iii. that Plaintiffs be awarded costs, and expenses that they incur in prosecuting this action; and
- f) A judgment that Plaintiffs be awarded such further relief at law or in equity as the Court deems just and proper.

**DEMAND FOR JURY TRIAL**

Plaintiffs hereby demand trial by jury on all claims and issues so triable.

May 5, 2022

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