Exhibit – D – 01

INVALIDITY CONTENTIONS FOR U.S. PATENT NO. 11,031,677 B2
BASED ON U.S. PATENT APPLICATION NO. 2007/0200773 TO DOU ET AL. ("DOU")

Based upon Plaintiff's Complaint, Infringement Contentions, and apparent claim constructions and application of the claims to Defendants' accused products, as best as they can be deciphered, the reference charted below anticipates or at least renders obvious some or all of the asserted claims. These invalidity contentions are not an admission by the Defendants that the accused products are covered by or infringe claims 1, 2, 3, 4, 5, 6, 7, 8, 9, 12, 13, 14, 15, 16, and 17 ("the '677 Asserted Claims")[1], particularly when these claims are properly construed and applied.

AIA law applies because the application that issued as the '677 Patent was filed on March 27, 2020, after the AIA came into force on March 16, 2013.

U.S. Patent Application No. 2007/0200773 to Dou et al. ("Dou") was filed on February 24, 2006, published on August 30, 2007, and issued as U.S. Patent No. 7,548,208 on June 16, 2009. This patent is prior art under at least 35 U.S.C. § 102(e), 103(a), and AIA 35 U.S.C. §102(a)(1). As described in the following claim chart, the asserted claims of U.S. Patent No. 11,031,677 (the "'677 Patent"), are invalid as anticipated by Dou.

To the extent that Dou is found not to anticipate one or more of the asserted claims of the '677 Patent, these claims are invalid as obvious in view of Dou alone or as modified in view of or in combination with other prior art references disclosed in Defendants' Invalidity Contentions and accompanying charts, including without limitation as set forth below.

- Chinese Patent No. 2,765,337. ("Wei") was filed on February 6, 2005, and was granted on March 15, 2006. This patent is prior art under at least 35 U.S.C. §§ 102(a), 102(e), 103(a), and AIA 35 U.S.C. §102(a)(1).
- PCT Publication No. 2004/042868 to Castany et al. ("Castany868") was filed on November 7, 2002 and published on May 21, 2004, on August 30, 2007. This patent is prior art under at least 35 U.S.C. § 102(e), 103(a), and AIA 35 U.S.C. §102(a)(1).
- U.S. Patent No. 6,943,746 to Talvitie et al. ("Talvitie") was filed on October 23, 2003, published on July 15, 2004, and issued on September 13, 2005. This patent is prior art under at least 35 U.S.C. § 102(e), 103(a), and AIA 35 U.S.C. §102(a)(1).
- U.S. Patent Application No. 2002/0238433 to Chou ("Chou") was filed on March 1, 2005, published on October 26, 2006, and issued as U.S. Patent No. 7,129,898 on October 31, 2006. This patent is prior art under at least 35 U.S.C. § 102(e), 103(a), and AIA 35 U.S.C. §102(a)(1).

[1] Defendants understand that that, by not charting claims 10-11 and 18-20 in its Infringement Contentions, Plaintiff does not assert these claims against Defendants.

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These invalidity contentions are not an admission that the Defendants concede or acquiesce to any claim construction implied or suggested by Plaintiff's Complaint or Infringement Contentions. Nor are Defendants asserting any claim construction positions through these charts, including whether the preamble is a limitation. The portions of the prior art reference cited below are not exhaustive but are exemplary in nature. Defendants reserve the right to update their constructions and contentions in view of this Court's claim construction order.[2]

Claim No.	U.S. Patent No. 11,031,677 B2	Dou
Claim 1		
1[pre]	A wireless device comprising:	To the extent the preamble is limiting, Dou expressly or inherently discloses this claim element. *See, e.g.*, "A wireless device typically operates using a radio transmitter/receiver ("transceiver") and one or more antennas. Recently, diversity antennas have been applied to wireless devices such as mobile telephones and handheld computers. In general, diversity antennas are based on the concept of a smart array and tend to improve the receiving sensitivity of a wireless device by reducing multi-path interference." Dou at [0001] "FIG. 1 illustrates a wireless device 100 having a conventional diversity antenna architecture. As shown, the wireless device 100 comprises an external housing 102 and a printed circuit board (PCB) 104. The diversity antenna architecture includes an external antenna 106 and an internal antenna 108 having different polarized radiation patterns to reduce mutual coupling and allow cooperative operation." Dou at [0002]

[2] Defendants incorporate herein any related work performed by or on behalf of an author or an inventor in the United States under 35 U.S.C. § 102(g)(2). Defendants reserve the right to supplement and/or alter this chart based on further investigation and ongoing discovery.

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		"As shown in FIG. 2A, the wireless device 200 may have an internal diversity antenna architecture comprising a first internal antenna 206 and a second internal antenna 208 disposed on the PCB 204 for achieving diversity. In various embodiments, the first internal antenna 206 and the second internal antenna 208 may remain in a fixed position internal to the housing 202 in order to eliminate the need for an external antenna and reduce the overall size and bulkiness of the wireless device 200. In one embodiment, the internal diversity antenna architecture may comprise a first internal antenna 206 located substantially near the top of the wireless device 200. For example, the first internal antenna 206 may be located substantially near the top of the housing 202 and/or the top of the PCB 204. The internal diversity antenna architecture may comprise a second internal antenna 208 located substantially near the bottom of the wireless device 200. For example, the second internal antenna 208 may be located substantially near the bottom of the housing 202 and/or the bottom of the PCB 204." Dou at [0017] "FIG. 3A illustrates one embodiment of a wireless device 300 having an internal diversity antenna architecture. In various embodiments, the wireless device 300 may be similar in some structural and operational aspects as wireless device 200, as described above." Dou at [0031] "FIG. 4A illustrates one embodiment of a wireless device 400 having an internal diversity antenna architecture. In various embodiments, the wireless device 400 may be similar in some structural and operational aspects as wireless device 200 and/or wireless device 300, as described above." Dou at [0035] "When implemented as a wireless system, for example, system 100 may include one or more wireless nodes arranged to communicate information over one or more types of wireless communication media, sometimes referred to herein as wireless shared media. An example of a

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		wireless communication media may include portions of a wireless spectrum, such as the radio-frequency (RF) spectrum. The wireless nodes may include components and interfaces suitable for communicating information signals over the designated wireless spectrum, such as one or more antennas, wireless transceivers, amplifiers, filters, control logic, and so forth. **As used herein, the term "transceiver" may be used in a very general sense to include a transmitter, a receiver, or a combination of both. The embodiments are not limited in this context.**" Dou at [0052]

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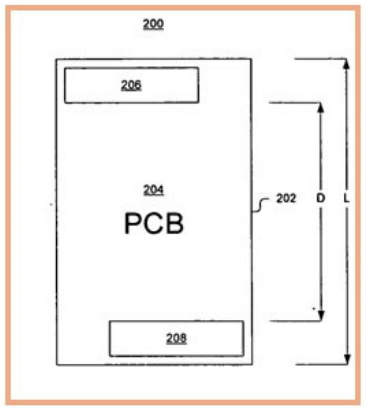


FIG. 2A

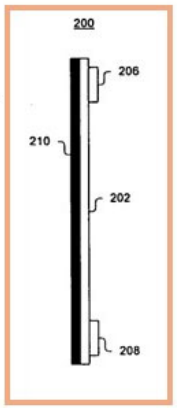


FIG. 2B

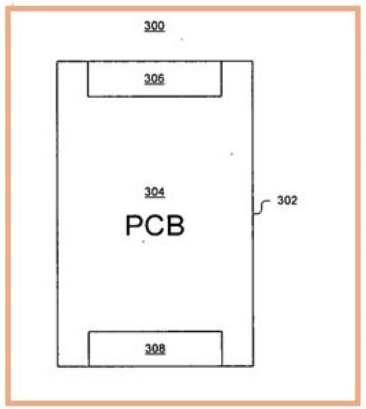


FIG. 3A

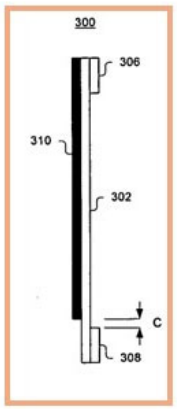
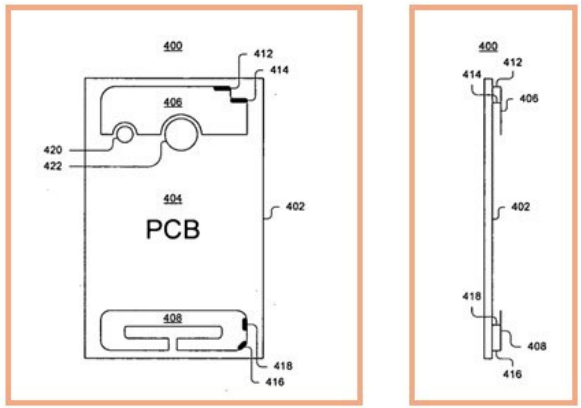


FIG. 3B

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Claim No.	U.S. Patent No. 11,031,677 B2	Dou
		 FIG. 4A FIG. 4B Dou at Figures 2A-B, 3A-B, and 4A-B
1[a]	an antenna system comprising:	Dou expressly or inherently discloses this claim element. *See, e.g.*, "As shown in FIG. 2A, the wireless device 200 may have an internal diversity antenna architecture comprising a first internal antenna 206 and a second internal antenna 208 disposed on the PCB 204 for achieving diversity. In various embodiments, the first internal antenna 206 and the second internal antenna 208 may remain in a fixed position internal to the housing 202 in order to eliminate the need for an external antenna and reduce the overall size and bulkiness of the

Claim No.	U.S. Patent No. 11,031,677 B2	Dou
		wireless device 200. In one embodiment, the internal diversity antenna architecture may comprise a first internal antenna 206 located substantially near the top of the wireless device 200. For example, the first internal antenna 206 may be located substantially near the top of the housing 202 and/or the top of the PCB 204. The internal diversity antenna architecture may comprise a second internal antenna 208 located substantially near the bottom of the wireless device 200. For example, the second internal antenna 208 may be located substantially near the bottom of the housing 202 and/or the bottom of the PCB 204." Dou at [0017] "FIG. 2B illustrates a side view of the wireless device 200 of FIG. 2A. As shown, the wireless device 200 may comprise a ground plane 210. In various implementations, the ground plane 210 may improve antenna performance in talk position and reduce SAR [(Specific Absorption Rate)]. As shown, the ground plane 210 may extend underneath the first internal antenna 206 and the second internal antenna 208. The ground plane 210 may be required underneath the second internal antenna 208, for example, if a key pad is positioned at the edge of the PCB 204 and demands a ground layer underneath for its circuitry. In this embodiment, the first internal antenna 206 and the second antenna 208 may each comprise a planar inverted F-antenna, for example, including at least one read port and one or more ground ports. The embodiments are not limited in this context." Dou at [0029] "As shown in FIG. 3A, the wireless device 300 may have an internal diversity antenna architecture comprising a first internal antenna 306 and a second internal antenna 308 disposed on the PCB 304 for achieving diversity. In this embodiment, the internal diversity antenna architecture may comprise a first internal antenna 306 located substantially at the top of the wireless device 300. For example., the first internal antenna 306 may be located substantially at the top of the housing 302 and/or the top of the PCB 304. The internal diversity antenna architecture may comprise a second internal antenna 308 located substantially at the bottom of the

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		wireless device 300. For example, the second internal antenna 308 may be located substantially at the bottom of the housing 302 and/or the bottom of the PCB 304." Dou at [0032] "FIG. 3B illustrates a side view of the wireless device 300 of FIG. 3A. As shown, the wireless device 300 may comprise a ground plane 310 to improve antenna performance in talk position and reduce SAR. As shown, the ground plane 310 does not extend underneath the second internal antenna 308. In this embodiment, the second internal antenna 208 may be separated from the ground plane 310 by a clearance distance (C) that is no less than 5 mm (>5 mm). The first internal antenna 206 may comprise, for example, a planar inverted F-antenna. The second internal antenna 208 may comprise, for example, a monopole-antenna, an inverted-L antenna, a meandered monopole, a printed helical antenna, a dipole antenna, a balanced antenna, or other suitable antenna. The embodiments are not limited in this context." Dou at [0034] "As shown in FIG. 4A, the wireless device 400 may have an internal diversity antenna architecture comprising a first internal antenna 406 and a second internal antenna 408 disposed on the PCB 404 for achieving diversity. In this embodiment, the first internal antenna 406 may comprise a first feed point 412 and a first ground point 414, and the second internal antenna 408 may comprise a second feed point 416 and a second ground point 418. The first internal antenna 406 may be located substantially near the top of the wireless device 400, and the second internal antenna 408 may be located substantially near the bottom of the wireless device 400. Dou at [0036]

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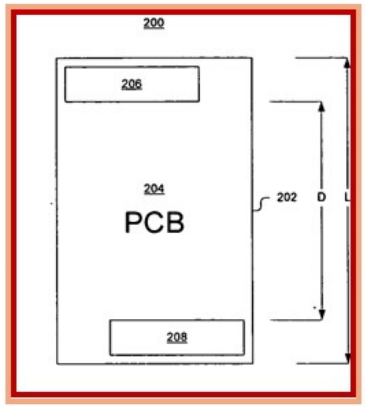


FIG. 2A

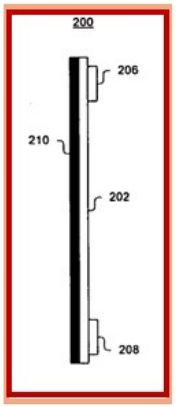


FIG. 2B

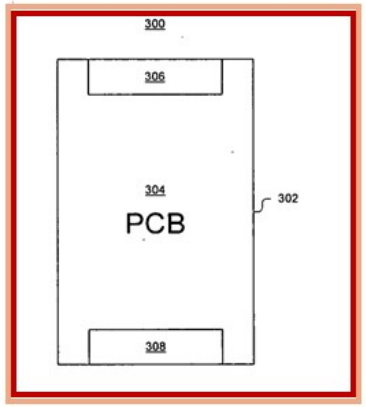


FIG. 3A

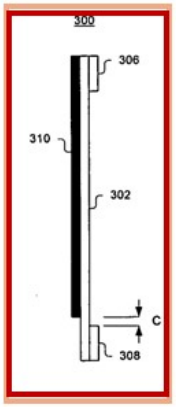
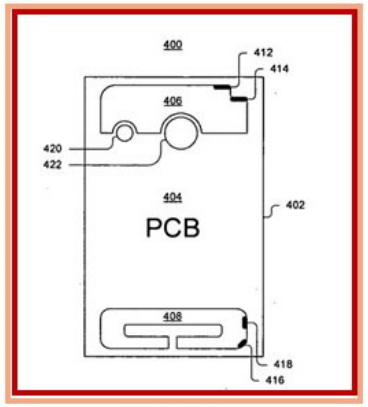
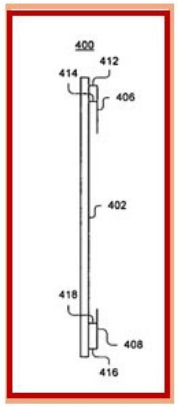


FIG. 3B

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Claim No.	U.S. Patent No. 11,031,677 B2	Dou
		 FIG. 4A  FIG. 4B Dou at Figures 2A-B, 3A-B, and 4A-B
1[b]	[*the antenna system comprising*] a ground plane;	Dou expressly or inherently discloses this claim element. *See, e.g.*, "FIG. 2B illustrates a side view of the wireless device 200 of FIG. 2A. As shown, the wireless device 200 may comprise a ground plane 210. In various implementations, the ground plane 210 may improve antenna performance in talk position and reduce SAR. As shown, the ground plane 210 may extend underneath the first internal antenna 206 and the second internal antenna 208. The ground plane 210 may be required underneath the second internal antenna 208, for example, if a key pad is positioned at the edge of the PCB 204 and demands a ground layer underneath for its circuitry. In this embodiment, the first internal antenna 206 and the second antenna 208 may each

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		comprise a planar inverted F-antenna, for example, including at least one read port and one or more ground ports. The embodiments are not limited in this context." Dou at [0029] "FIG. 3B illustrates a side view of the wireless device 300 of FIG. 3A. As shown, the wireless device 300 may comprise a ground plane 310 to improve antenna performance in talk position and reduce SAR. As shown, the ground plane 310 does not extend underneath the second internal antenna 308. In this embodiment, the second internal antenna 208 may be separated from the ground plane 310 by a clearance distance (C) that is no less than 5 mm (>5 mm). The first internal antenna 206 may comprise, for example, a planar inverted F-antenna. The second internal antenna 208 may comprise, for example, a monopole-antenna, an inverted-L antenna, a meandered monopole, a printed helical antenna, a dipole antenna, a balanced antenna, or other suitable antenna. The embodiments are not limited in this context." Dou at [0034]

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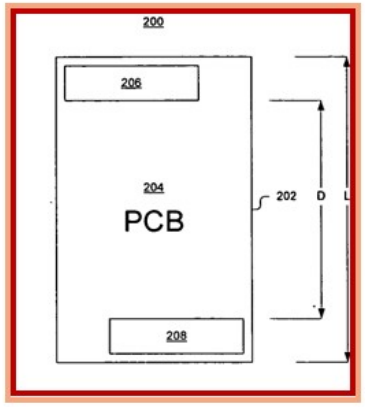


FIG. 2A

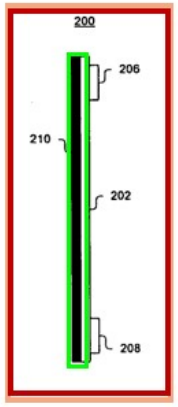


FIG. 2B

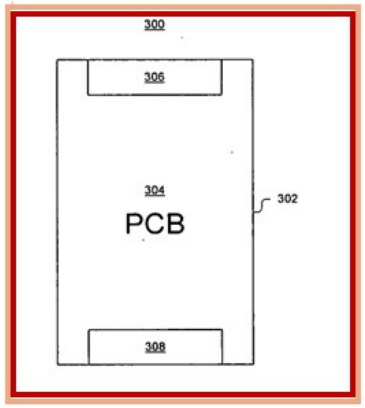


FIG. 3A

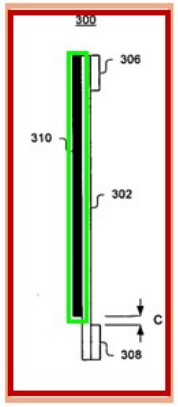


FIG. 3B

Dou at Figures 2B and 3B

Claim No.	U.S. Patent No. 11,031,677 B2	Dou
1[c]	[*the antenna system comprising*] a first antenna within the wireless device and	Dou expressly or inherently discloses this claim element. *See, e.g.*, "As shown in FIG. 2A, the wireless device 200 may have an internal diversity antenna architecture comprising a first internal antenna 206 and a second internal antenna 208 disposed on the PCB 204 for achieving diversity. In various embodiments, the first internal antenna 206 and the second internal antenna 208 may remain in a fixed position internal to the housing 202 in order to eliminate the need for an external antenna and reduce the overall size and bulkiness of the wireless device 200. In one embodiment, the internal diversity antenna architecture may comprise a first internal antenna 206 located substantially near the top of the wireless device 200. For example, the first internal antenna 206 may be located substantially near the top of the housing 202 and/or the top of the PCB 204. The internal diversity antenna architecture may comprise a second internal antenna 208 located substantially near the bottom of the wireless device 200. For example, the second internal antenna 208 may be located substantially near the bottom of the housing 202 and/or the bottom of the PCB 204." Dou at [0017] "As shown in FIG. 3A, the wireless device 300 may have an internal diversity antenna architecture comprising a first internal antenna 306 and a second internal antenna 308 disposed on the PCB 304 for achieving diversity. In this embodiment, the internal diversity antenna architecture may comprise a first internal antenna 306 located substantially at the top of the wireless device 300. For example., the first internal antenna 306 may be located substantially at the top of the housing 302 and/or the top of the PCB 304. The internal diversity antenna architecture may comprise a second internal antenna 308 located substantially at the bottom of the wireless device 300. For example, the second internal antenna 308 may be located substantially at the bottom of the housing 302 and/or the bottom of the PCB 304."

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Claim No.	U.S. Patent No. 11,031,677 B2	Dou
		Dou at [0032] "As shown in FIG. 4A, the wireless device 400 may have an internal diversity antenna architecture comprising a first internal antenna 406 and a second internal antenna 408 disposed on the PCB 404 for achieving diversity. In this embodiment, the first internal antenna 406 may comprise a first feed point 412 and a first ground point 414, and the second internal antenna 408 may comprise a second feed point 416 and a second ground point 418. The first internal antenna 406 may be located substantially near the top of the wireless device 400, and the second internal antenna 408 may be located substantially near the bottom of the wireless device 400." Dou at [0036]

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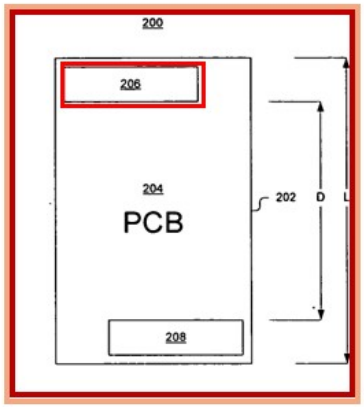


FIG. 2A

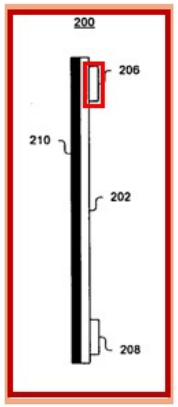


FIG. 2B

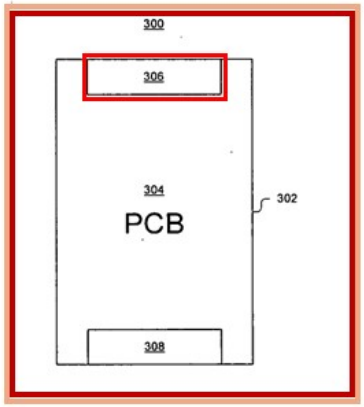


FIG. 3A

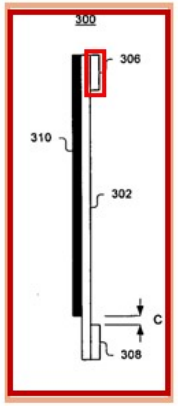
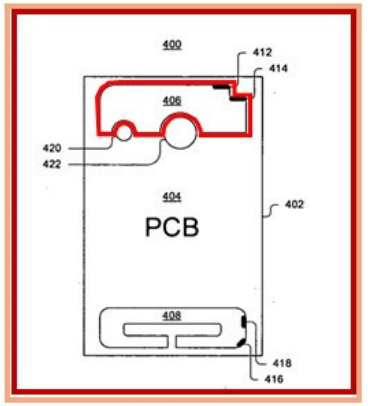
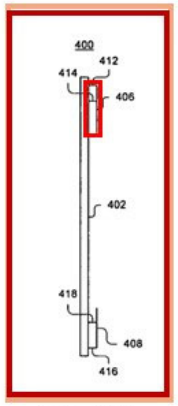


FIG. 3B

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Claim No.	U.S. Patent No. 11,031,677 B2	Dou
		 FIG. 4A  FIG. 4B Dou at Figures 2A-B, 3A-B, and 4A-B
1[d]	configured to support at least three frequency bands contained within first and second frequency ranges of the electromagnetic spectrum,	Dou expressly or inherently discloses this claim element. *See, e.g.*, "The first internal antenna 206 and the second internal antenna 208 may be tuned for operating at one or more frequency bands. For example, the first internal antenna 206 and the second internal antenna 208 may allow the wireless device 200 to operate in the 824-894 Megahertz (MHz) frequency band for GSM operations, the 1850-1990 MHz frequency band for Personal Communications Services (PCS) operations, the 1575 MHz frequency band for Global Positioning System (GPS) operations, the 824-860 MHz frequency band for NAMPS operations, the 1710-2170 MHz frequency band for WCDMA/UMTS operations, ISM band in 2.4 GHz range for WiFi

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		and Bluetooth, and other frequency bands. This may be desirable since the wireless device 200 may be compatible with multiple wireless data, multimedia and cellular telephone systems. In addition, first internal antenna 206 and the second internal antenna 208 may be used to implement various spatial diversity techniques to improve communication of wireless signals across one or more frequency bands of wireless shared media. In various embodiments, the first internal antenna 206 and the second internal antenna 208 may be designed for Evolution Data Optimized (EVDO) diversity at both the 800 MHz band (cellular) and the 1900 MHz (PCS). In various implementations, for EVDO diversity, the efficiency may be approximately 50% at 850 MHz and 60% at 1900 MHz." Dou at [0022]-[0023] "The transceiver may be implemented, for example, by any transceiver suitable for operating at a given set of operating frequencies and wireless protocols for a particular wireless system. For example, the transceiver may be a two-way radio transceiver arranged to operate in the 824-894 MHz frequency band (GSM), the 1850-1990 MHz frequency band (PCS), the 1575 MHz frequency band (GPS), the 824-860 MHz frequency band (NAMPS), the 1710-2170 MHz frequency band (WCDMA/UMTS), or other frequency bands. In various embodiments, an antenna may be electrically connected to a transceiver operatively associated with a signal processing circuit or processor positioned on a PCB. In order to increase power transfer, the transceiver may be interconnected to an antenna such that respective impedances are substantially matched or electrically tuned to compensate for undesired antenna impedance. In some cases, the transceiver may be implemented as part of a chip set associated with a processor. The embodiments are not limited in this context." Dou at [0045]-[0046]

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1[e]	the second frequency range being higher in frequency than the first frequency range and	Dou expressly or inherently discloses this claim element. *See, e.g.*, "The first internal antenna 206 and the second internal antenna 208 may be tuned for operating at one or more frequency bands. For example, the first internal antenna 206 and the second internal antenna 208 may allow the wireless device 200 to operate in the 824-894 Megahertz (MHz) frequency band for GSM operations, the 1850-1990 MHz frequency band for Personal Communications Services (PCS) operations, the 1575 MHz frequency band for Global Positioning System (GPS) operations, the 824-860 MHz frequency band for NAMPS operations, the 1710-2170 MHz frequency band for WCDMA/UMTS operations, ISM band in 2.4 GHz range for WiFi and Bluetooth, and other frequency bands. This may be desirable since the wireless device 200 may be compatible with multiple wireless data, multimedia and cellular telephone systems. In addition, first internal antenna 206 and the second internal antenna 208 may be used to implement various spatial diversity techniques to improve communication of wireless signals across one or more frequency bands of wireless shared media." Dou at [0022] ""The transceiver may be implemented, for example, by any transceiver suitable for operating at a given set of operating frequencies and wireless protocols for a particular wireless system. For example, the transceiver may be a two-way radio transceiver arranged to operate in the 824-894 MHz frequency band (GSM), the 1850-1990 MHz frequency band (PCS), the 1575 MHz frequency band (GPS), the 824-860 MHz frequency band (NAMPS), the 1710-2170 MHz frequency band (WCDMA/UMTS), or other frequency bands." Dou at [0045] To the extent that this reference does not expressly disclose this claim limitation, in light of Plaintiff's apparent claim construction and infringement positions with respect to the Accused

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Claim No.	U.S. Patent No. 11,031,677 B2	Dou
		Products, a POSA would have understood it to implicitly disclose it or would have found the claim limitation obvious. It would have been obvious to a person of ordinary skill in the art that frequency bands with higher Hertz values would be higher in frequency than frequency bands with relatively lower Hertz values. Additionally, it would have been obvious to a person of ordinary skill in the art to modify this reference with any one or more of the references disclosed in Defendants' Invalidity Contentions based on knowledge of one of ordinary skill in the art and for the reasons articulated in Defendants' Invalidity Contentions Cover Pleading.
1[f]	at least one of the three frequency bands being associated with a 4G communication standard,	Dou expressly or inherently discloses this claim element. *See, e.g.*, "The first internal antenna 206 and the second internal antenna 208 may be tuned for operating at one or more frequency bands. For example, the first internal antenna 206 and the second internal antenna 208 may allow the wireless device 200 to operate in the 824-894 Megahertz (MHz) frequency band for GSM operations, the 1850-1990 MHz frequency band for Personal Communications Services (PCS) operations, the 1575 MHz frequency band for Global Positioning System (GPS) operations, the 824-860 MHz frequency band for NAMPS operations, the 1710-2170 MHz frequency band for WCDMA/UMTS operations, ISM band in 2.4 GHz range for WiFi and Bluetooth, and other frequency bands. This may be desirable since the wireless device 200 may be compatible with multiple wireless data, multimedia and cellular telephone systems. In addition, first internal antenna 206 and the second internal antenna 208 may be used to implement various spatial diversity techniques to improve communication of wireless signals across one or more frequency bands of wireless shared media."

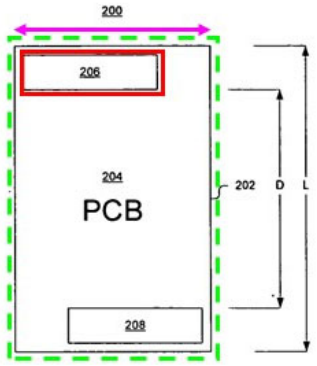
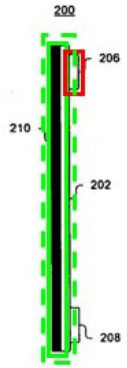
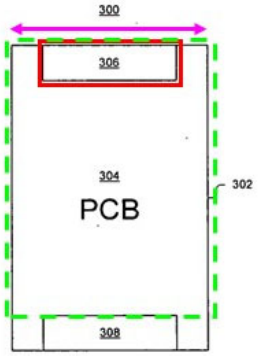
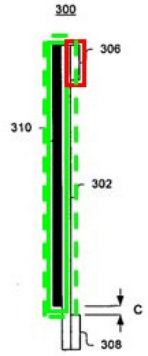
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Claim No.	U.S. Patent No. 11,031,677 B2	Dou
		Dou at [0022] "The transceiver may be implemented, for example, by any transceiver suitable for operating at a given set of operating frequencies and wireless protocols for a particular wireless system. For example, the transceiver may be a two-way radio transceiver arranged to operate in the 824-894 MHz frequency band (GSM), the 1850-1990 MHz frequency band (PCS), the 1575 MHz frequency band (GPS), the 824-860 MHz frequency band (NAMPS), the 1710-2170 MHz frequency band (WCDMA/UMTS), or other frequency bands." Dou at [0045] To the extent that this reference does not expressly disclose this claim limitation, in light of Plaintiff's apparent claim construction and infringement positions with respect to the Accused Products, a POSA would have understood it to implicitly disclose it or would have found the claim limitation obvious. Additionally, it would have been obvious to a person of ordinary skill in the art to modify this reference with any one or more of the references disclosed in Defendants' Invalidity Contentions based on knowledge of one of ordinary skill in the art and for the reasons articulated in Defendants' Invalidity Contentions Cover Pleading.
1[g]	the first antenna being proximate to a first short side of a ground plane rectangle enclosing the ground plane and	Dou expressly or inherently discloses this claim element. *See, e.g.*, "It is also worthy to note that any reference to "one embodiment" or "an embodiment" means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment. The appearances of the phrase "in one embodiment" in various places in the specification are not necessarily all referring to the same embodiment."

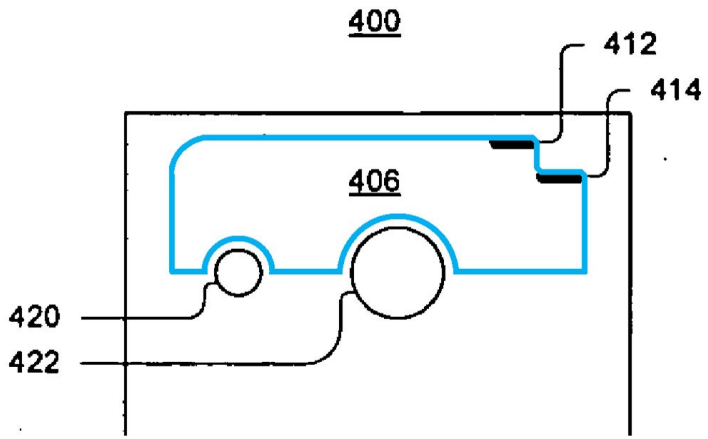
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Claim No.	U.S. Patent No. 11,031,677 B2	Dou
		Dou at [0013] "FIG. 2B illustrates a side view of the wireless device 200 of FIG. 2A. As shown, the wireless device 200 may comprise a ground plane 210. In various implementations, the ground plane 210 may improve antenna performance in talk position and reduce SAR. As shown, the ground plane 210 may extend underneath the first internal antenna 206 and the second internal antenna 208. The ground plane 210 may be required underneath the second internal antenna 208, for example, if a key pad is positioned at the edge of the PCB 204 and demands a ground layer underneath for its circuitry. In this embodiment, the first internal antenna 206 and the second antenna 208 may each comprise a planar inverted F-antenna, for example, including at least one read port and one or more ground ports. **The embodiments are not limited in this context.**" Dou at [0029] "As shown, the communications system 500 may include a wireless node 510. In various embodiments, **the wireless node 510 may be implemented as a wireless device such as wireless device 200, 300, or 400. Examples of wireless node 510 also may include any of the previous examples for a node as previously described."** Dou at [0053]

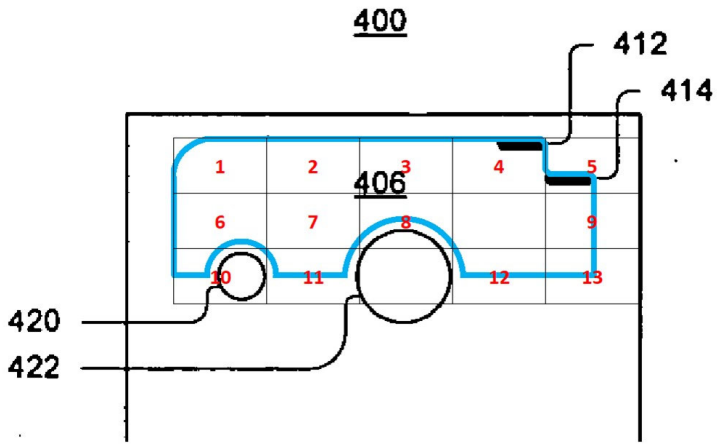
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Claim No.	U.S. Patent No. 11,031,677 B2	Dou
		 FIG. 2A  FIG. 2B  FIG. 3A  FIG. 3B

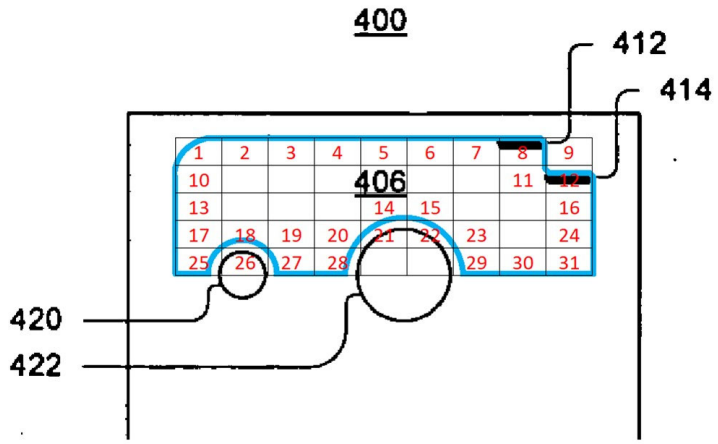
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Claim No.	U.S. Patent No. 11,031,677 B2	Dou
		Dou at Figures 2A-B and 3A-B
1[h]	defining a first antenna contour comprising an entire perimeter of the first antenna,	Dou expressly or inherently discloses this claim element. *See, e.g.*,  Dou at Figure 4A
1[i]	wherein the first antenna contour has a level of complexity defined by	Dou expressly or inherently discloses this claim element. *See, e.g.*,

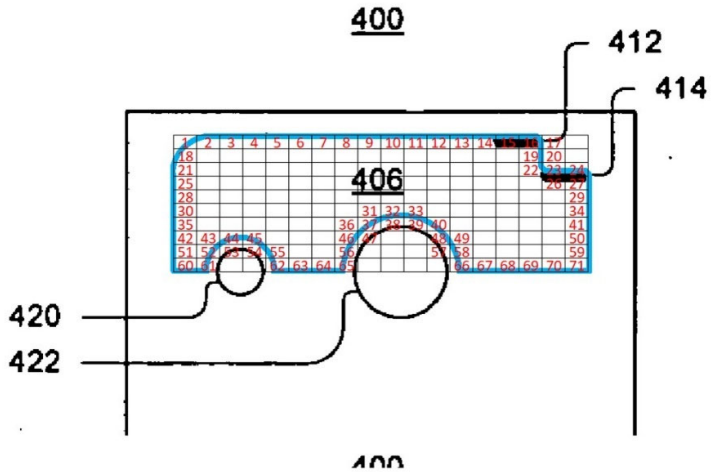
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Claim No.	U.S. Patent No. 11,031,677 B2	Dou
	complexity factor F_{21} having a value of at least 1.20 and	 Dou at Figure 4A, Calculating N_1

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Claim No.	U.S. Patent No. 11,031,677 B2	Dou
		 Dou at Figure 4A, Calculating N_2

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Claim No.	U.S. Patent No. 11,031,677 B2	Dou
		 Dou at Figure 4A, Calculating N_3 Further, it would have been obvious to a person of ordinary skill in the art that, when $N_1 = 13$; $N_2 = 31$; and $N_3 = 71$; that given $$F_{21=} - \frac{(\log_{10}(N_2) - \log_{10}(N_1)}{\log_{10} 1/2}$$

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Claim No.	U.S. Patent No. 11,031,677 B2	Dou
		solving for F_{21} results in $$F_{21=-}\frac{(\log_{10}(31)-\log_{10}(13)}{\log_{10}1/2}=\ 1.2538$$ and $$1.20\ \leq 1.2538$$
1[j]	complexity factor F_{32} having a value less than 1.75; and	Dou expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[i] Further, it would have been obvious to a person of ordinary skill in the art that, when $N_1\ =\ 13$; $N_2\ =\ 31$; and $N_3\ =\ 71$; that given $$F_{32=-}\frac{(\log_{10}(N_3)-\log_{10}(N_2)}{\log_{10}1/2}$$ solving for F_{32} results in $$F_{32=-}\frac{(\log_{10}(71)-\log_{10}(31)}{\log_{10}1/2}=\ 1.1956$$

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Claim No.	U.S. Patent No. 11,031,677 B2	Dou
		and $1.1956 < 1.75$
1[k]	a second antenna within the wireless device and	Dou expressly or inherently discloses this claim element. *See, e.g.*, "As shown in FIG. 2A, the wireless device 200 may have an internal diversity antenna architecture comprising a first internal antenna 206 and a second internal antenna 208 disposed on the PCB 204 for achieving diversity. In various embodiments, the first internal antenna 206 and the second internal antenna 208 may remain in a fixed position internal to the housing 202 in order to eliminate the need for an external antenna and reduce the overall size and bulkiness of the wireless device 200. In one embodiment, the internal diversity antenna architecture may comprise a first internal antenna 206 located substantially near the top of the wireless device 200. For example, the first internal antenna 206 may be located substantially near the top of the housing 202 and/or the top of the PCB 204. The internal diversity antenna architecture may comprise a second internal antenna 208 located substantially near the bottom of the wireless device 200. For example, the second internal antenna 208 may be located substantially near the bottom of the housing 202 and/or the bottom of the PCB 204." Dou at [0017] "As shown in FIG. 3A, the wireless device 300 may have an internal diversity antenna architecture comprising a first internal antenna 306 and a second internal antenna 308 disposed on the PCB 304 for achieving diversity. In this embodiment, the internal diversity antenna architecture may comprise a first internal antenna 306 located substantially at the top of the wireless device 300. For example., the first internal antenna 306 may be located substantially at

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Claim No.	U.S. Patent No. 11,031,677 B2	Dou
		the top of the housing 302 and/or the top of the PCB 304. The internal diversity antenna architecture may comprise a second internal antenna 308 located substantially at the bottom of the wireless device 300. For example, the second internal antenna 308 may be located substantially at the bottom of the housing 302 and/or the bottom of the PCB 304." Dou at [0032] "As shown in FIG. 4A, the wireless device 400 may have an internal diversity antenna architecture comprising a first internal antenna 406 and a second internal antenna 408 disposed on the PCB 404 for achieving diversity. In this embodiment, the first internal antenna 406 may comprise a first feed point 412 and a first ground point 414, and the second internal antenna 408 may comprise a second feed point 416 and a second ground point 418. The first internal antenna 406 may be located substantially near the top of the wireless device 400, and the second internal antenna 408 may be located substantially near the bottom of the wireless device 400. Dou at [0036]

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Claim No.	U.S. Patent No. 11,031,677 B2	Dou

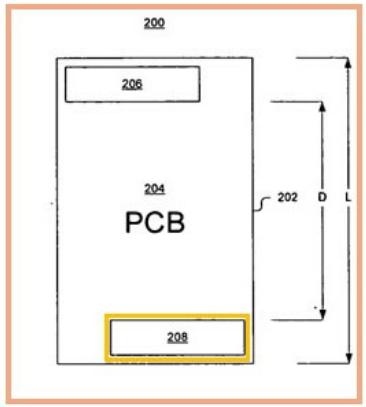


FIG. 2A

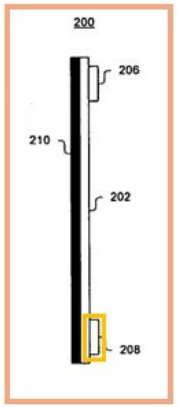


FIG. 2B

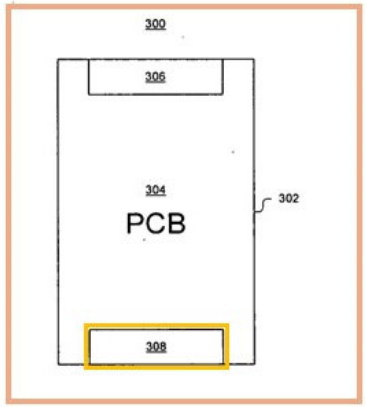


FIG. 3A

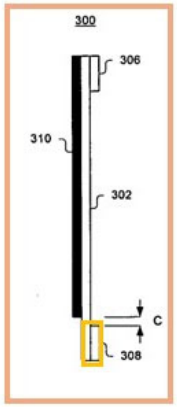
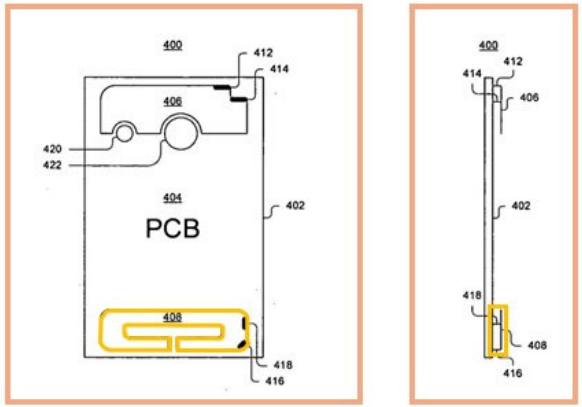


FIG. 3B

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Claim No.	U.S. Patent No. 11,031,677 B2	Dou
		 FIG. 4A FIG. 4B Dou at Figures 2A-B, 3A-B, and 4A-B
1[l]	configured to support at least one frequency band different from the at least three frequency bands supported by the first antenna,	Dou expressly or inherently discloses this claim element. *See, e.g.*, "The first internal antenna 206 and the second internal antenna 208 may be tuned for operating at one or more frequency bands. For example, the first internal antenna 206 and the second internal antenna 208 may allow the wireless device 200 to operate in the 824-894 Megahertz (MHz) frequency band for GSM operations, the 1850-1990 MHz frequency band for Personal Communications Services (PCS) operations, the 1575 MHz frequency band for Global Positioning System (GPS) operations, the 824-860 MHz frequency band for NAMPS operations, the 1710-2170 MHz frequency band for WCDMA/UMTS operations, ISM band in 2.4 GHz range for WiFi and Bluetooth, and other frequency bands. This may be desirable since the wireless device 200

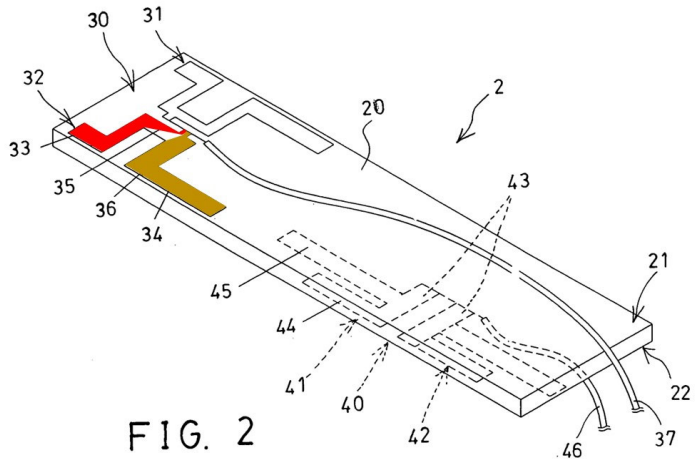
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Claim No.	U.S. Patent No. 11,031,677 B2	Dou
		may be compatible with multiple wireless data, multimedia and cellular telephone systems. **In addition, first internal antenna 206 and the second internal antenna 208 may be used to implement various spatial diversity techniques to improve communication of wireless signals across one or more frequency bands of wireless shared media**. In various embodiments, the first internal antenna 206 and the second internal antenna 208 may be designed for Evolution Data Optimized (EVDO) diversity at both the 800 MHz band (cellular) and the 1900 MHz (PCS). In various implementations, for EVDO diversity, the efficiency may be approximately 50% at 850 MHz and 60% at 1900 MHz." Dou at [0022]-[0023] To the extent that this reference does not expressly disclose this claim limitation, in light of Plaintiff's apparent claim construction and infringement positions with respect to the Accused Products, a POSA would have understood it to implicitly disclose it or would have found the claim limitation obvious. Additionally, it would have been obvious to a person of ordinary skill in the art to modify this reference with any one or more of the references disclosed in Defendants' Invalidity Contentions based on knowledge of one of ordinary skill in the art and for the reasons articulated in Defendants' Invalidity Contentions Cover Pleading. *See, e.g.,* "It is preferable that the antenna members 31, 32 of the antenna device 30 each includes two antenna segments 33, 34 disposed up and down relative to each other, and an intermediate and/or C-shaped antenna segment 35 disposed between the antenna segments 33, 34, for receiving and transmitting signals of different frequencies, for example. It is further preferable that the antenna segments 33, 34, 35 of the two antenna members 31, 32 are disposed side by side and/or parallel to each other, or arranged in mirror symmetric relative to each other, for receiving and

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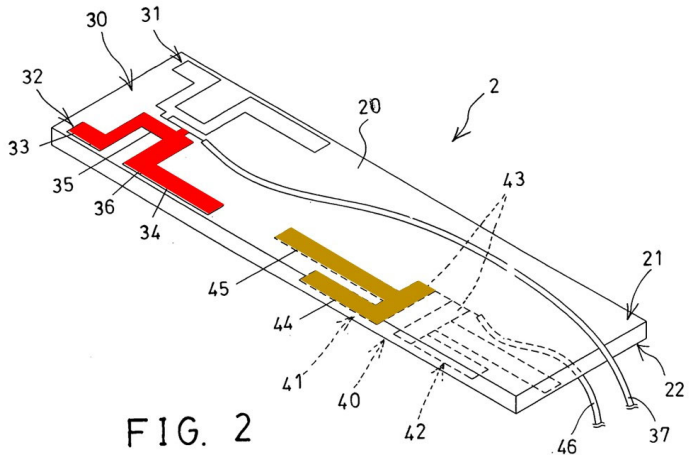
Claim No.	U.S. Patent No. 11,031,677 B2	Dou
		transmitting signals toward different lateral directions 39 relative to each other, or away from each other." Chou at [0028] "Similarly, the antenna members 41, 42 of the antenna device 40 each includes a base antenna segment 43 disposed up and down relative to each other, and two antenna segments 44, 45 extended from the base antenna segment 43 and parallel to each other, for receiving and transmitting signals of different frequencies, for example. It is further preferable that the antenna segments 43, 44, 45 of the two antenna members 41, 42 are disposed up and down relative to each other, or arranged in mirror symmetric relative to each other, for receiving and transmitting signals toward different vertical directions 49 relative to each other, or away from each other." Chou at [0030]

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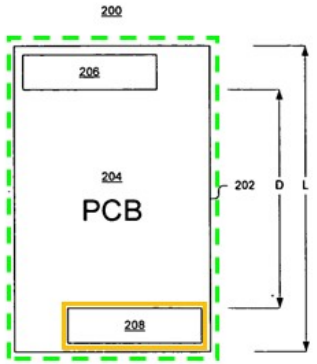
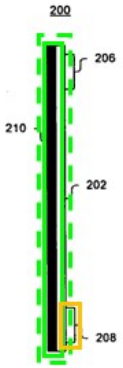
Claim No.	U.S. Patent No. 11,031,677 B2	Dou
		 FIG. 2 Chou at Figure 2 "It is preferable that the antenna members 31, 32 of the antenna device 30 each includes two antenna segments 33, 34 disposed up and down relative to each other, and an intermediate and/or C-shaped antenna segment 35 disposed between the antenna segments 33, 34, for receiving and transmitting signals of different frequencies, for example. It is further preferable that the antenna segments 33, 34, 35 of the two antenna members 31, 32 are disposed side by side and/or parallel to each other, or arranged in mirror symmetric relative to each other, for receiving and transmitting signals toward different lateral directions 39 relative to each other, or away from each other." Chou at [0028]

Claim No.	U.S. Patent No. 11,031,677 B2	Dou
		"Similarly, the antenna members 41, 42 of the antenna device 40 each includes a base antenna segment 43 disposed up and down relative to each other, and two antenna segments 44, 45 extended from the base antenna segment 43 and parallel to each other, for receiving and transmitting signals of different frequencies, for example. It is further preferable that the antenna segments 43, 44, 45 of the two antenna members 41, 42 are disposed up and down relative to each other, or arranged in mirror symmetric relative to each other, for receiving and transmitting signals toward different vertical directions 49 relative to each other, or away from each other." Chou at [0030] "Furthermore, each of the antenna devices 30, 40 may include two or more antenna segments 33, 34, 35; and 43, 44, 45 respectively, for receiving and transmitting signals of different frequencies, and thus for allowing the antenna devices 30, 40 to receive and transmit signals of various frequencies. There will be no dead ends or dead corners formed or generated by the antenna devices 30, 40." Chou at [0033]

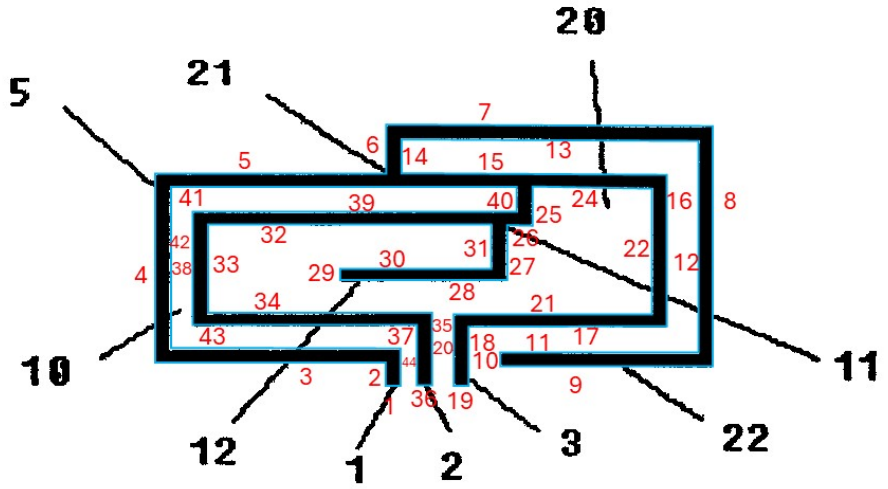
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Claim No.	U.S. Patent No. 11,031,677 B2	Dou
		 FIG. 2 Chou at Figure 2
1[m]	the second antenna being arranged completely within the ground plane rectangle.	Dou expressly or inherently discloses this claim element. *See, e.g.*,

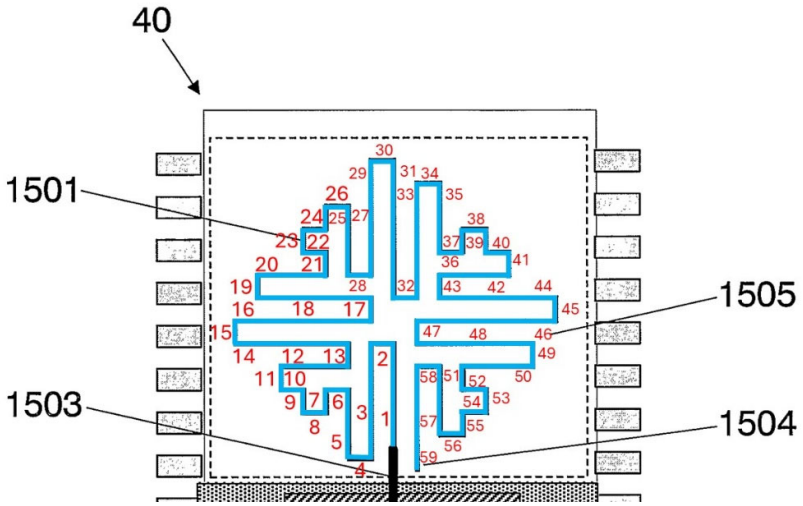
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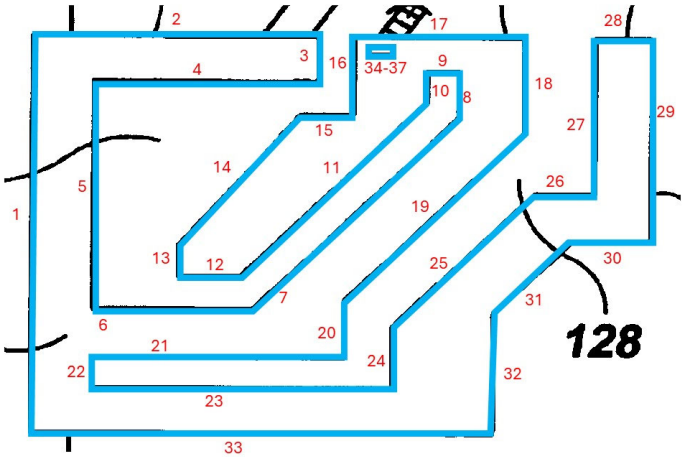
Claim No.	U.S. Patent No. 11,031,677 B2	Dou
		 FIG. 2A  FIG. 2B Dou at Figures 2A-B
Claim 2		
2	The wireless device of claim 1, wherein the first antenna contour comprises at least 20 segments.	Dou expressly or inherently discloses this claim element. To the extent that this reference does not expressly disclose this claim limitation, in light of Plaintiff's apparent claim construction and infringement positions with respect to the Accused Products, a POSA would have understood it to implicitly disclose it or would have found the claim limitation obvious.

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Claim No.	U.S. Patent No. 11,031,677 B2	Dou
		Additionally, it would have been obvious to a person of ordinary skill in the art to modify this reference with any one or more of the references disclosed in Defendants' Invalidity Contentions based on knowledge of one of ordinary skill in the art and for the reasons articulated in Defendants' Invalidity Contentions Cover Pleading. *See e.g.,*  Wei at Figure 2B

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Claim No.	U.S. Patent No. 11,031,677 B2	Dou
		 Castany868 at Figure 15

Claim No.	U.S. Patent No. 11,031,677 B2	Dou
		 Talvitie at Figure 1
Claim 3		
3	The wireless device of claim 2, wherein the perimeter of the first antenna contour comprises at least 35 segments.	Dou expressly or inherently discloses this claim element. *See, e.g.*, claim element 2
Claim 4		
4	The wireless device of claim 1, wherein the antenna system	Dou expressly or inherently discloses this claim element.

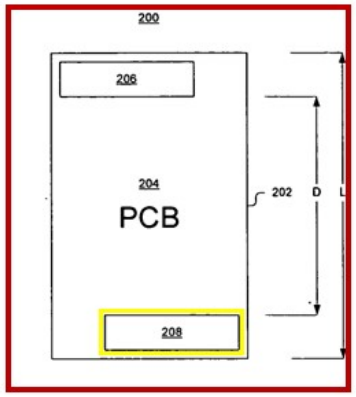
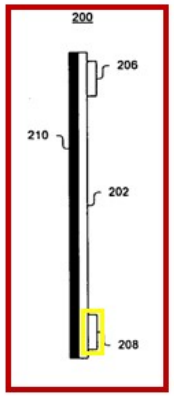
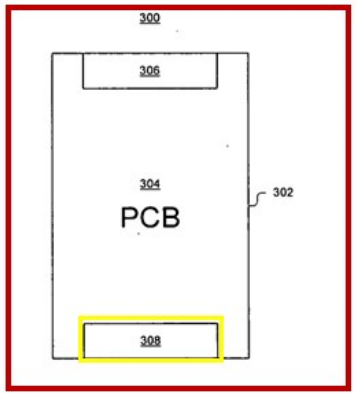
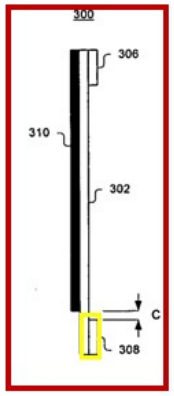
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Claim No.	U.S. Patent No. 11,031,677 B2	Dou
	comprises a third antenna configured to receive signals employing a 4G communication standard.	*See, e.g.*, "In various embodiments, for example, the antenna architecture may comprise three or more antennas. In some implementations, an additional antenna may comprise any suitable type of internal antenna disposed within the housing of a wireless device. In other implementations, an additional antenna may comprise any suitable type of external antenna such as a whip antenna, extendable antenna, antenna stubby, and so forth. The embodiments are not limited in this context" Dou at [0040] "The transceiver may be implemented, for example, by any transceiver suitable for operating at a given set of operating frequencies and wireless protocols for a particular wireless system. For example, the transceiver may be a two-way radio transceiver arranged to operate in the 824-894 MHz frequency band (GSM), the 1850-1990 MHz frequency band (PCS), the 1575 MHz frequency band (GPS), the 824-860 MHz frequency band (NAMPS), the 1710-2170 MHz frequency band (WCDMA/UMTS), or other frequency bands. In various embodiments, an antenna may be electrically connected to a transceiver operatively associated with a signal processing circuit or processor positioned on a PCB. In order to increase power transfer, the transceiver may be interconnected to an antenna such that respective impedances are substantially matched or electrically tuned to compensate for undesired antenna impedance. In some cases, the transceiver may be implemented as part of a chip set associated with a processor. The embodiments are not limited in this context." Dou at [0045]-[0046] "When implemented as a wireless system, for example, system 100 may include one or more wireless nodes arranged to communicate information over one or more types of wireless communication media, sometimes referred to herein as wireless shared media. An example of a

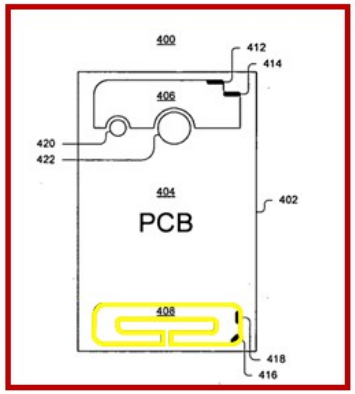
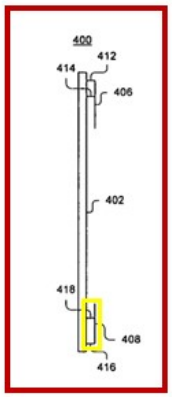
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Claim No.	U.S. Patent No. 11,031,677 B2	Dou
		wireless communication media may include portions of a wireless spectrum, such as the radio-frequency (RF) spectrum. The wireless nodes may include components and interfaces suitable for communicating information signals over the designated wireless spectrum, such as one or more antennas, wireless transceivers, amplifiers, filters, control logic, and so forth. **As used herein, the term "transceiver" may be used in a very general sense to include a transmitter, a receiver, or a combination of both. The embodiments are not limited in this context.**" Dou at [0052]

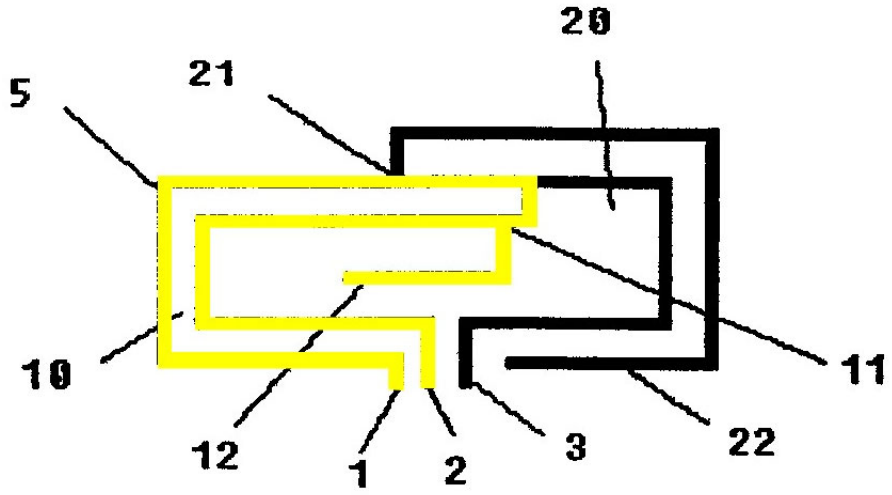
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Claim No.	U.S. Patent No. 11,031,677 B2	Dou
		 FIG. 2A  FIG. 2B  FIG. 3A  FIG. 3B

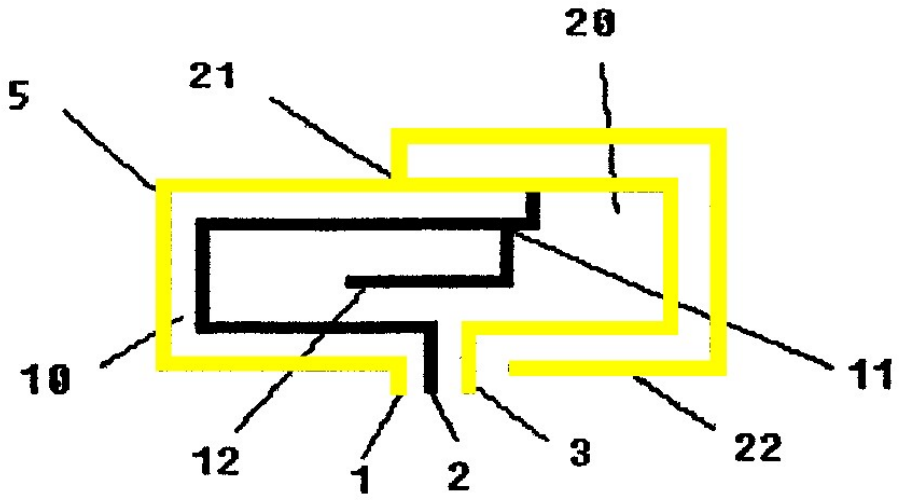
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Claim No.	U.S. Patent No. 11,031,677 B2	Dou
		 FIG. 4A  FIG. 4B Dou at Figures 2A-B, 3A-B, and 4A-B To the extent that this reference does not expressly disclose this claim limitation, in light of Plaintiff's apparent claim construction and infringement positions with respect to the Accused Products, a POSA would have understood it to implicitly disclose it or would have found the claim limitation obvious. Additionally, it would have been obvious to a person of ordinary skill in the art to modify this reference with any one or more of the references disclosed in Defendants' Invalidity Contentions based on knowledge of one of ordinary skill in the art and for the reasons articulated in Defendants' Invalidity Contentions Cover Pleading. *See e.g.,*

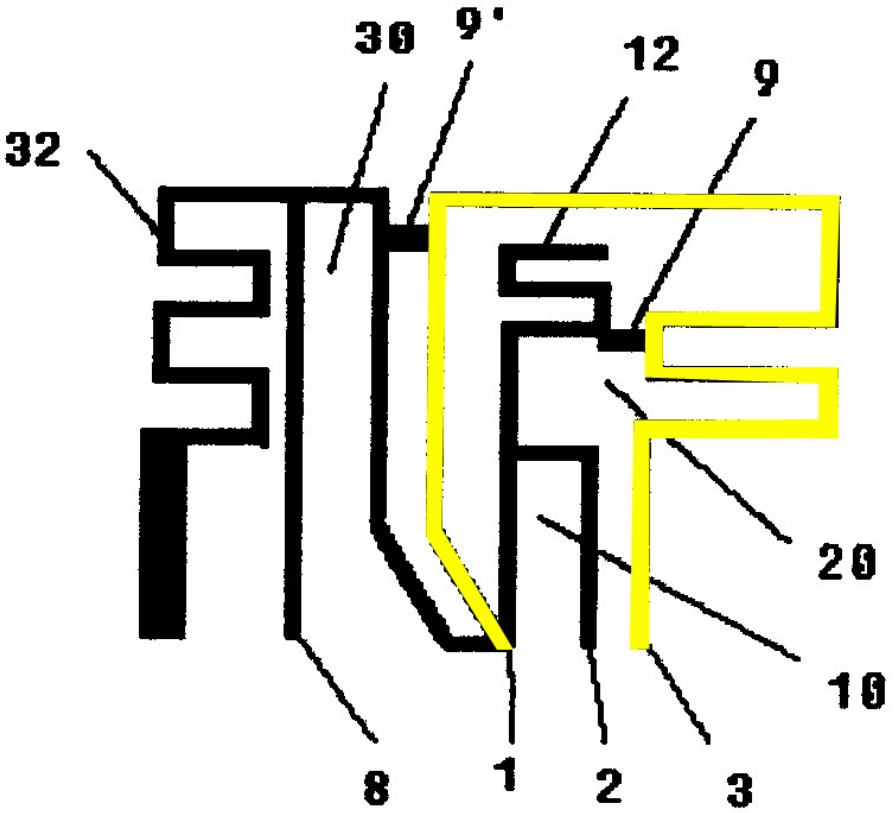
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Claim No.	U.S. Patent No. 11,031,677 B2	Dou
		 Wei at Figure 2B

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Claim No.	U.S. Patent No. 11,031,677 B2	Dou
		 Wei at Figure 2B (Alternative)

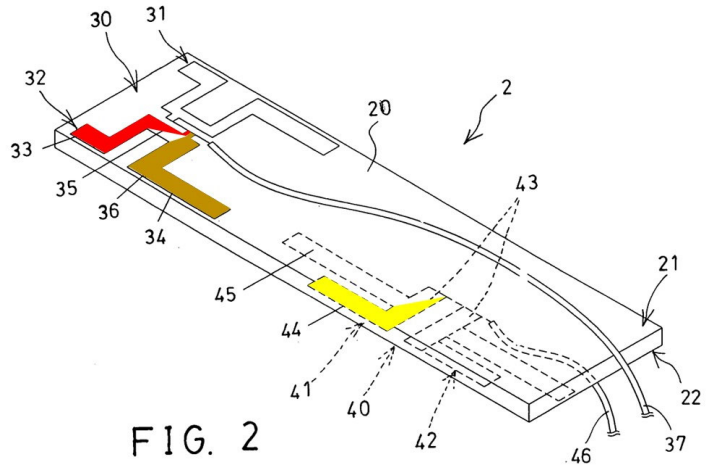
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Claim No.	U.S. Patent No. 11,031,677 B2	Dou
		 Wei at Figure 9 "It is preferable that the antenna members 31, 32 of the antenna device 30 each includes two antenna segments 33, 34 disposed up and down relative to each other, and an intermediate and/or

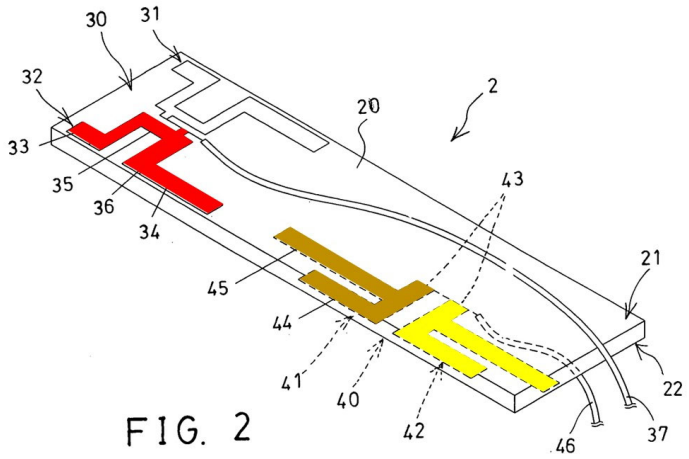
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Claim No.	U.S. Patent No. 11,031,677 B2	Dou
		C-shaped antenna segment 35 disposed between the antenna segments 33, 34, for receiving and transmitting signals of different frequencies, for example. It is further preferable that the antenna segments 33, 34, 35 of the two antenna members 31, 32 are disposed side by side and/or parallel to each other, or arranged in mirror symmetric relative to each other, for receiving and transmitting signals toward different lateral directions 39 relative to each other, or away from each other." Chou at [0028] "Similarly, the antenna members 41, 42 of the antenna device 40 each includes a base antenna segment 43 disposed up and down relative to each other, and two antenna segments 44, 45 extended from the base antenna segment 43 and parallel to each other, for receiving and transmitting signals of different frequencies, for example. It is further preferable that the antenna segments 43, 44, 45 of the two antenna members 41, 42 are disposed up and down relative to each other, or arranged in mirror symmetric relative to each other, for receiving and transmitting signals toward different vertical directions 49 relative to each other, or away from each other." Chou at [0030] "Furthermore, each of the antenna devices 30, 40 may include two or more antenna segments 33, 34, 35; and 43, 44, 45 respectively, for receiving and transmitting signals of different frequencies, and thus for allowing the antenna devices 30, 40 to receive and transmit signals of various frequencies. There will be no dead ends or dead corners formed or generated by the antenna devices 30, 40." Chou at [0033]

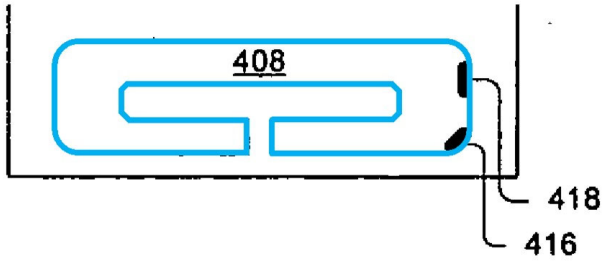
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Claim No.	U.S. Patent No. 11,031,677 B2	Dou
		 FIG. 2 Chou at Figure 2

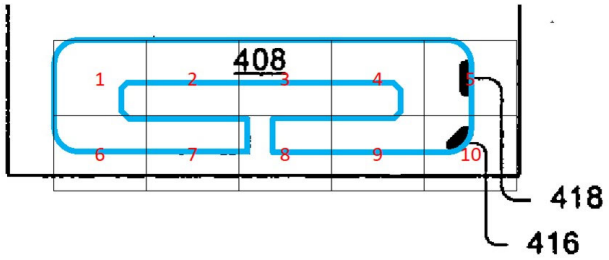
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Claim No.	U.S. Patent No. 11,031,677 B2	Dou
		 FIG. 2 Chou at Figure 2 (Alternative)
Claim 5		
5[a]	The wireless device of claim 4, wherein the third antenna defines an antenna contour comprising an entire perimeter of the third antenna, and	Dou expressly or inherently discloses this claim element. *See, e.g.*, claim elements 1[h], 1[k], 1[l], 1[m], 4

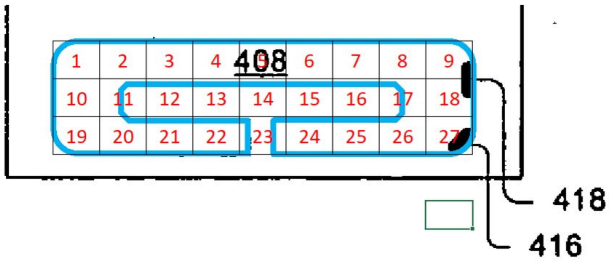
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Claim No.	U.S. Patent No. 11,031,677 B2	Dou
		 Dou at Figure 4A To the extent that this reference does not expressly disclose this claim limitation, in light of Plaintiff's apparent claim construction and infringement positions with respect to the Accused Products, a POSA would have understood it to implicitly disclose it or would have found the claim limitation obvious. Additionally, it would have been obvious to a person of ordinary skill in the art to modify this reference with any one or more of the references disclosed in Defendants' Invalidity Contentions based on knowledge of one of ordinary skill in the art and for the reasons articulated in Defendants' Invalidity Contentions Cover Pleading.
5[b]	wherein the antenna contour of the third antenna has a level of	Dou expressly or inherently discloses this claim element.

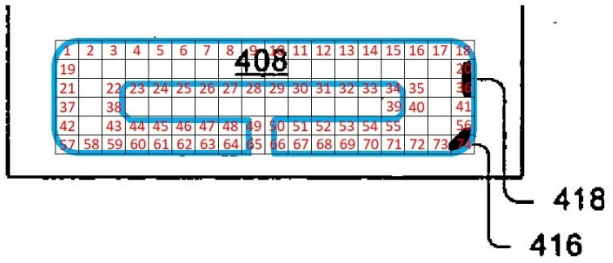
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Claim No.	U.S. Patent No. 11,031,677 B2	Dou
	complexity defined by complexity factor F_{21} having a value of at least 1.2 and	*See, e.g.*,  Dou at Figure 4A, Calculating N_1

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Claim No.	U.S. Patent No. 11,031,677 B2	Dou
		 Dou at Figure 4A, Calculating N_2

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Claim No.	U.S. Patent No. 11,031,677 B2	Dou
		 Dou at Figure 4A, Calculating N_3 Further, it would have been obvious to a person of ordinary skill in the art that, when $N_1 = 10$; $N_2 = 27$; and $N_3 = 74$; that given $$F_{21=-}\frac{(\log_{10}(N_2)-\log_{10}(N_1)}{\log_{10}1/2}$$

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Claim No.	U.S. Patent No. 11,031,677 B2	Dou
		solving for F_{21} results in $$F_{21=-}\frac{(\log_{10}(27)-\log_{10}(10)}{\log_{10}1/2}=\ 1.4330$$ and $$1.20\ \leq 1.4330$$ To the extent that this reference does not expressly disclose this claim limitation, in light of Plaintiff's apparent claim construction and infringement positions with respect to the Accused Products, a POSA would have understood it to implicitly disclose it or would have found the claim limitation obvious. Additionally, it would have been obvious to a person of ordinary skill in the art to modify this reference with any one or more of the references disclosed in Defendants' Invalidity Contentions based on knowledge of one of ordinary skill in the art and for the reasons articulated in Defendants' Invalidity Contentions Cover Pleading.
5[c]	a complexity factor F_{32} having a value of at least 1.35.	Dou expressly or inherently discloses this claim element. *See, e.g.*, claim element 5[b] Further, it would have been obvious to a person of ordinary skill in the art that, when $N_1\ =\ 10$; $N_2\ =\ 27$; and $N_3\ =\ 74$; that given

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Claim No.	U.S. Patent No. 11,031,677 B2	Dou
		$$F_{32=-}\frac{(\log_{10}(N_3)-\log_{10}(N_2)}{\log_{10}1/2}$$ solving for F_{32} results in $$F_{32=-}\frac{(\log_{10}(74)-\log_{10}(27)}{\log_{10}1/2}=\ 1.4546$$ and $$1.35\ \leq 1.4546$$ To the extent that this reference does not expressly disclose this claim limitation, in light of Plaintiff's apparent claim construction and infringement positions with respect to the Accused Products, a POSA would have understood it to implicitly disclose it or would have found the claim limitation obvious. Additionally, it would have been obvious to a person of ordinary skill in the art to modify this reference with any one or more of the references disclosed in Defendants' Invalidity Contentions based on knowledge of one of ordinary skill in the art and for the reasons articulated in Defendants' Invalidity Contentions Cover Pleading.
Claim 6		
6[pre]	A wireless device comprising:	To the extent the preamble is limiting, Dou expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[pre]

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Claim No.	U.S. Patent No. 11,031,677 B2	Dou
6[a]	an antenna system comprising:	Dou expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[a]
6[b]	[*the antenna system comprising*] a ground plane;	Dou expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[b]
6[c]	[*the antenna system comprising*] a first antenna within the wireless device and	Dou expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[c]
6[d]	configured to support at least two frequency bands contained within first and second frequency ranges of the electromagnetic spectrum,	Dou expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[d]
6[e]	the second frequency range being higher in frequency than the first frequency range,	Dou expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[e]
6[f]	the first antenna being proximate to a first short side	Dou expressly or inherently discloses this claim element.

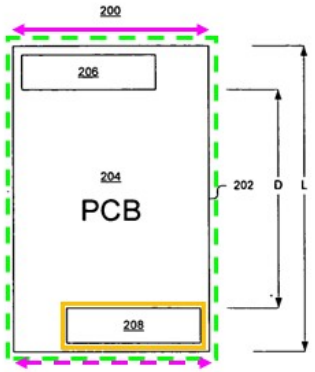
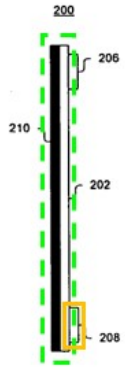
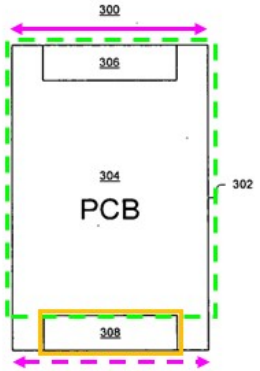
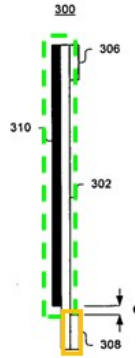
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Claim No.	U.S. Patent No. 11,031,677 B2	Dou
	of a ground plane rectangle enclosing the ground plane and	*See, e.g.*, claim element 1[g]
6[g]	defining a first antenna contour comprising an entire perimeter of the first antenna,	Dou expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[h]
6[h]	wherein the first antenna contour has a level of complexity defined by complexity factor F_{21} having a value of at least 1.20 and	Dou expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[i]
6[i]	complexity factor F_{32} having a value less than 1.75; and	Dou expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[j]
6[j]	[*the antenna system comprising*] a second antenna within the wireless device and	Dou expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[k]

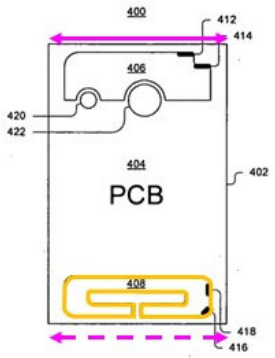
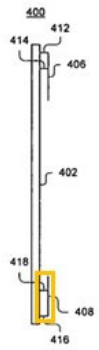
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Claim No.	U.S. Patent No. 11,031,677 B2	Dou
6[k]	defining a second antenna contour comprising an entire perimeter of the second antenna,	Dou expressly or inherently discloses this claim element. *See, e.g.*, claim elements 1[h], 1[k], 1[l], 1[m], 4, 5[a]
6[l]	the second antenna being proximate to a second short side of the ground plane rectangle that is opposite to the first short side of the ground plane rectangle,	Dou expressly or inherently discloses this claim element. *See, e.g.*,

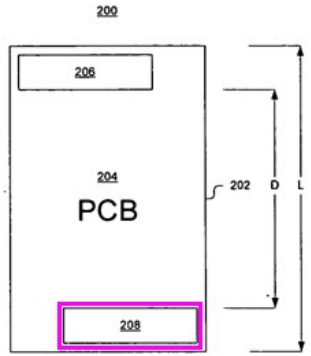
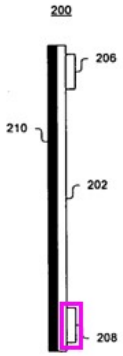
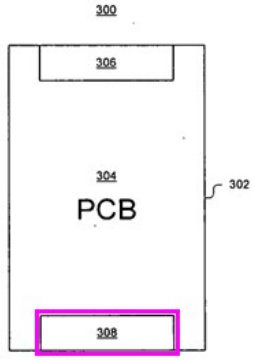
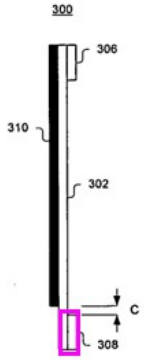
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Claim No.	U.S. Patent No. 11,031,677 B2	Dou
		 FIG. 2A  FIG. 2B  FIG. 3A  FIG. 3B

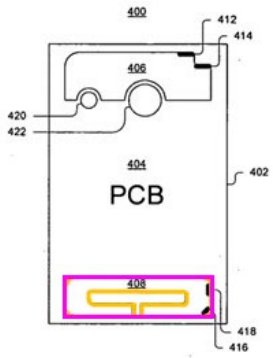
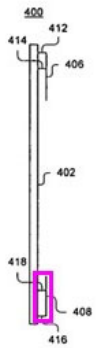
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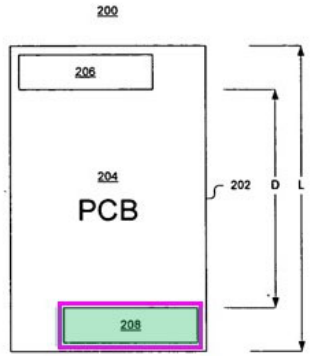
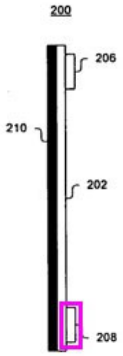
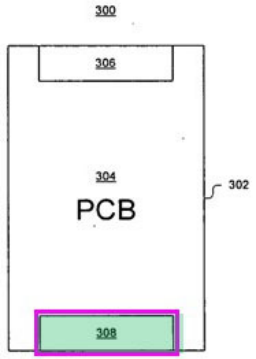
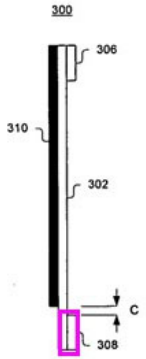
Claim No.	U.S. Patent No. 11,031,677 B2	Dou
		 FIG. 4A  FIG. 4B Dou at Figures 2A-B, 3A-B, and 4A-B
6[m]	a minimum-sized parallelepiped of rectangular faces that completely encloses a volume of the second antenna defining an antenna box, and	Dou expressly or inherently discloses this claim element. *See, e.g.*,

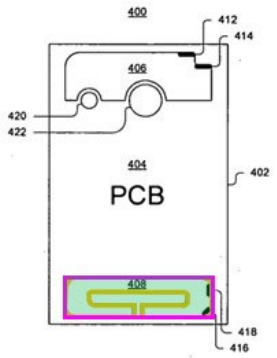
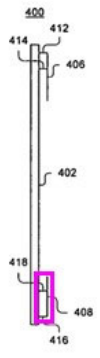
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Claim No.	U.S. Patent No. 11,031,677 B2	Dou
		 FIG. 2A  FIG. 2B  FIG. 3A  FIG. 3B

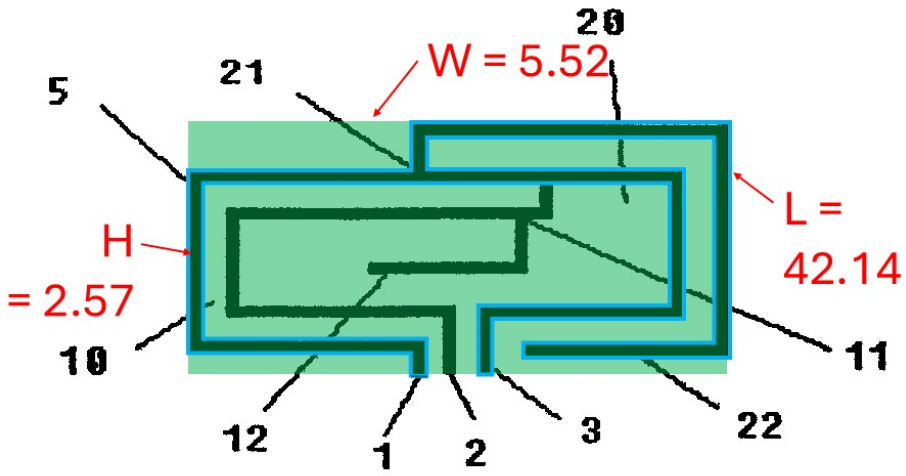
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Claim No.	U.S. Patent No. 11,031,677 B2	Dou
		 FIG. 4A  FIG. 4B Dou at Figures 2A-B, 3A-B, and 4A-B
6[n]	an orthogonal projection of the antenna box along a normal to a face with a largest area of the second antenna defining	Dou expressly or inherently discloses this claim element. *See, e.g.*, claim element 6[m], 6[o]
6[o]	an antenna rectangle,	Dou expressly or inherently discloses this claim element. *See, e.g.*,

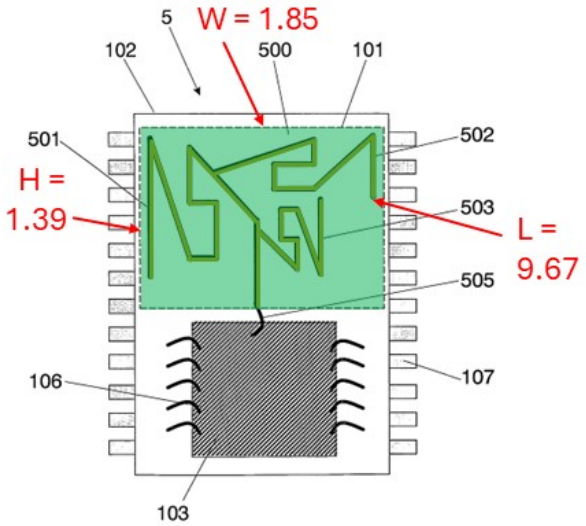
Claim No.	U.S. Patent No. 11,031,677 B2	Dou
		 FIG. 2A  FIG. 2B  FIG. 3A  FIG. 3B

Claim No.	U.S. Patent No. 11,031,677 B2	Dou
		 FIG. 4A  FIG. 4B Dou at Figures 2A-B, 3A-B, and 4A-B
6[p]	wherein a length of the second antenna contour is greater than four times a diagonal of the antenna rectangle.	Dou expressly or inherently discloses this claim element. To the extent that this reference does not expressly disclose this claim limitation, in light of Plaintiff's apparent claim construction and infringement positions with respect to the Accused Products, a POSA would have understood it to implicitly disclose it or would have found the claim limitation obvious. Additionally, it would have been obvious to a person of ordinary skill in the art to modify this reference with any one or more of the references disclosed in Defendants' Invalidity Contentions based on knowledge of one of ordinary skill in the art and for the reasons articulated in Defendants' Invalidity Contentions Cover Pleading.

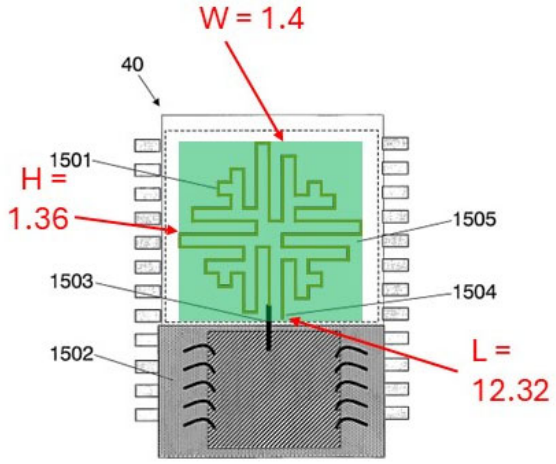
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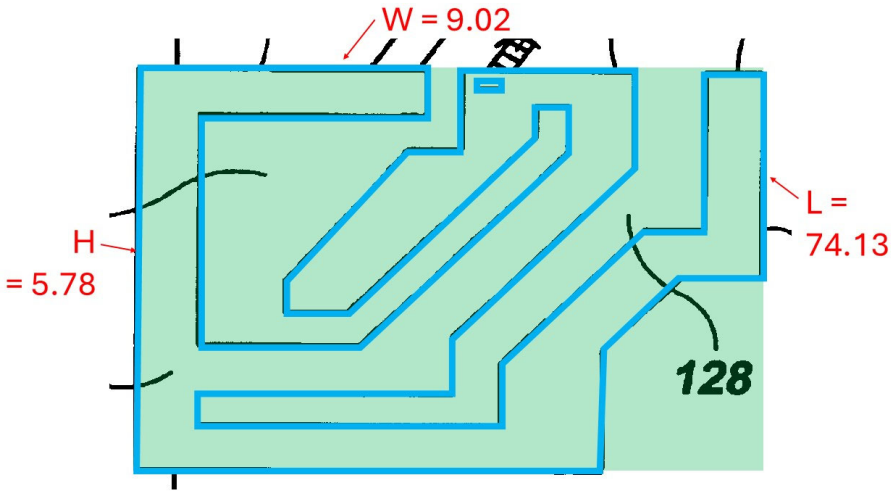
Claim No.	U.S. Patent No. 11,031,677 B2	Dou
		See e.g.,  Wei at Figure 2B

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Claim No.	U.S. Patent No. 11,031,677 B2	Dou
		 FIG.5 Castany868 at Figure 5

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Claim No.	U.S. Patent No. 11,031,677 B2	Dou
		 FIG.15 Castany868 at Figure 15

Claim No.	U.S. Patent No. 11,031,677 B2	Dou
		 Talvitie at Figure 1
Claim 7		
7	The wireless device of claim 6, wherein the first antenna contour comprises at least 20 segments.	Dou expressly or inherently discloses this claim element. *See, e.g.*, claim element 2

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Claim No.	U.S. Patent No. 11,031,677 B2	Dou
Claim 8		
8	The wireless device of claim 6, wherein the first antenna contour comprises at least 35 segments.	Dou expressly or inherently discloses this claim element. *See, e.g.*, claim element 3
Claim 9		
9[a]	The wireless device of claim 6, wherein the second antenna contour has a level of complexity defined by complexity factor F_{21} having a value of at least 1.2 and	Dou expressly or inherently discloses this claim element. *See, e.g.*, claim elements 1[h], 1[k], 1[l], 1[m], 4, 5[a], 5[b]
9[b]	a complexity factor F_{32} having a value of at least 1.35.	Dou expressly or inherently discloses this claim element. *See, e.g.*, claim elements 1[h], 1[k], 1[l], 1[m], 4, 5[a], 5[b], 5[c], 9[a]
Claim 12		
12[pre]	A wireless device comprising:	To the extent the preamble is limiting, Dou expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[pre], 6[pre]

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Claim No.	U.S. Patent No. 11,031,677 B2	Dou
12[a]	an antenna system comprising:	Dou expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[a], 6[a]
12[b]	[*the antenna system comprising*] a ground plane;	Dou expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[b], 6[b]
12[c]	[*the antenna system comprising*] a first antenna within the wireless device and	Dou expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[c], 6[c]
12[d]	configured to provide operation in at least four frequency bands,	Dou expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[d], 6[d]
12[e]	at least one of the at least four frequency bands is contained	Dou expressly or inherently discloses this claim element.

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Claim No.	U.S. Patent No. 11,031,677 B2	Dou
	within a first frequency range and	*See, e.g.*, 1[d], 6[d], 12[d] "The first internal antenna 206 and the second internal antenna 208 may be tuned for operating at one or more frequency bands. For example, the first internal antenna 206 and the second internal antenna 208 may allow the wireless device 200 to operate in the 824-894 Megahertz (MHz) frequency band for GSM operations, the 1850-1990 MHz frequency band for Personal Communications Services (PCS) operations, the 1575 MHz frequency band for Global Positioning System (GPS) operations, the 824-860 MHz frequency band for NAMPS operations, the 1710-2170 MHz frequency band for WCDMA/UMTS operations, ISM band in 2.4 GHz range for WiFi and Bluetooth, and other frequency bands. This may be desirable since the wireless device 200 may be compatible with multiple wireless data, multimedia and cellular telephone systems. In addition, first internal antenna 206 and the second internal antenna 208 may be used to implement various spatial diversity techniques to improve communication of wireless signals across one or more frequency bands of wireless shared media. In various embodiments, the first internal antenna 206 and the second internal antenna 208 may be designed for Evolution Data Optimized (EVDO) diversity at both the 800 MHz band (cellular) and the 1900 MHz (PCS). In various implementations, for EVDO diversity, the efficiency may be approximately 50% at 850 MHz and 60% at 1900 MHz." Dou at [0022]-[0023]
12[f]	at least one other of the four frequency bands is contained within a second frequency range,	Dou expressly or inherently discloses this claim element. *See, e.g.*, "The first internal antenna 206 and the second internal antenna 208 may be tuned for operating at one or more frequency bands. For example, the first internal antenna 206 and the second internal

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Claim No.	U.S. Patent No. 11,031,677 B2	Dou
		antenna 208 may allow the wireless device 200 to operate in the 824-894 Megahertz (MHz) frequency band for GSM operations, the 1850-1990 MHz frequency band for Personal Communications Services (PCS) operations, the 1575 MHz frequency band for Global Positioning System (GPS) operations, the 824-860 MHz frequency band for NAMPS operations, the 1710-2170 MHz frequency band for WCDMA/UMTS operations, ISM band in 2.4 GHz range for WiFi and Bluetooth, and other frequency bands. This may be desirable since the wireless device 200 may be compatible with multiple wireless data, multimedia and cellular telephone systems. In addition, first internal antenna 206 and the second internal antenna 208 may be used to implement various spatial diversity techniques to improve communication of wireless signals across one or more frequency bands of wireless shared media. In various embodiments, the first internal antenna 206 and the second internal antenna 208 may be designed for Evolution Data Optimized (EVDO) diversity at both the 800 MHz band (cellular) and the 1900 MHz (PCS). In various implementations, for EVDO diversity, the efficiency may be approximately 50% at 850 MHz and 60% at 1900 MHz." Dou at [0022]-[0023]
12[g]	the first frequency range being lower in frequency than the second frequency range,	Dou expressly or inherently discloses this claim element. *See, e.g.*, claim element 12[e], 12[f] To the extent that this reference does not expressly disclose this claim limitation, in light of Plaintiff's apparent claim construction and infringement positions with respect to the Accused Products, a POSA would have understood it to implicitly disclose it or would have found the claim limitation obvious.

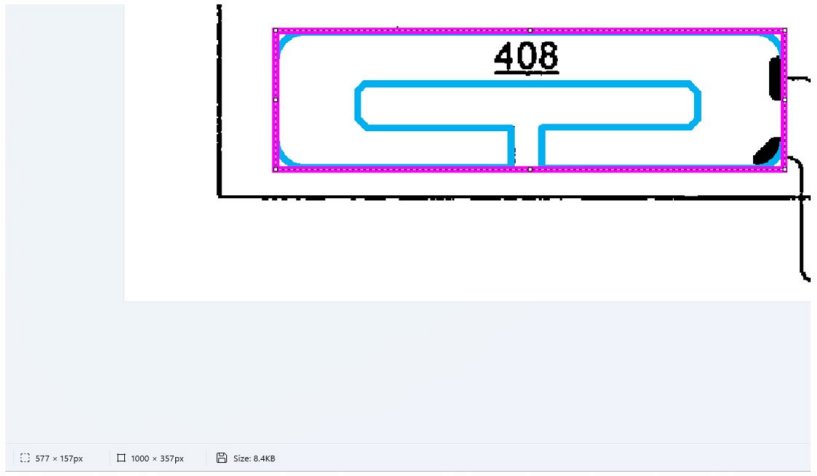
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Claim No.	U.S. Patent No. 11,031,677 B2	Dou
		It would have been obvious to a person of ordinary skill in the art that frequency bands with higher Hertz values would be higher in frequency than frequency bands with relatively lower Hertz values. Additionally, it would have been obvious to a person of ordinary skill in the art to modify this reference with any one or more of the references disclosed in Defendants' Invalidity Contentions based on knowledge of one of ordinary skill in the art and for the reasons articulated in Defendants' Invalidity Contentions Cover Pleading.
12[h]	the first antenna being proximate to a first short side of a ground plane rectangle enclosing the ground plane,	Dou expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[g], 6[f]
12[i]	the first antenna defining a first antenna contour comprising an entire perimeter of the first antenna, and	Dou expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[h], 6[g]
12[j]	wherein the first antenna contour has a level of complexity defined by complexity factor F_{21} having a value of at least 1.20 and	Dou expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[i], 6[h]

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Claim No.	U.S. Patent No. 11,031,677 B2	Dou
12[k]	complexity factor F_{32} having a value less than 1.75; and	Dou expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[j], 6[i]
12[l]	wherein the first antenna is configured to transmit and receive signals from a 4G communication standard; and	Dou expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[f], 4
12[m]	[*the antenna system comprising*] a second antenna within the wireless device and configured to receive signals from a 4G communication standard,	Dou expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[f], 4, 12[l]
12[n]	a minimum-sized parallelepiped of rectangular faces that completely encloses a volume of the second antenna defining an antenna box,	Dou expressly or inherently discloses this claim element. *See, e.g.*, claim element 6[m]
12[o]	an orthogonal projection of the antenna box along a normal to	Dou expressly or inherently discloses this claim element. *See, e.g.*, claim element 6[n]

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Claim No.	U.S. Patent No. 11,031,677 B2	Dou
	a face with a largest area of the second antenna defining	
12[p]	an antenna rectangle,	Dou expressly or inherently discloses this claim element. *See, e.g.*,
12[q]	an aspect ratio of the antenna rectangle being defined as a ratio between a width and a height of the antenna rectangle, and wherein the aspect ratio has a value of at least 2.	Dou expressly or inherently discloses this claim element. *See, e.g.*, 

Claim No.	U.S. Patent No. 11,031,677 B2	Dou
		Dou at Figure 4A, showing measurements of antenna rectangle Further, it would have been obvious to a person of ordinary skill in the art that a length of 577 pixels and a height of 157 pixels results in $577/157 = 3.6752$ And $2 \leq 3.6752$
Claim 13		
13	The wireless device of claim 12, wherein the first antenna contour comprises at least 20 segments.	Dou expressly or inherently discloses this claim element. *See, e.g.*, claim element 2, 7
Claim 14		
14	The wireless device of claim 13, wherein the first antenna	Dou expressly or inherently discloses this claim element. *See, e.g.*, claim element 3, 8

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Claim No.	U.S. Patent No. 11,031,677 B2	Dou
	contour comprises at least 35 segments.	
	Claim 15	
15	The wireless device of claim 12, wherein the second antenna is proximate to a second short side of the ground plane rectangle that is opposite to the first short side of the ground plane rectangle.	Dou expressly or inherently discloses this claim element. *See, e.g.*, claim element 6[l]
	Claim 16	
16[a]	The wireless device of claim 12, wherein the second antenna defines a second antenna contour comprising an entire perimeter of the second antenna,	Dou expressly or inherently discloses this claim element. *See, e.g.*, claim elements 1[h], 1[k], 1[l], 1[m], 4, 5[a], 6[k]
16[b]	and wherein the second antenna contour has a level of complexity defined by complexity factor F_{21} having a value of at least 1.2 and	Dou expressly or inherently discloses this claim element. *See, e.g.*, claim elements 1[h], 1[k], 1[l], 1[m], 4, 5[a], 5[b], 9[a]

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Claim No.	U.S. Patent No. 11,031,677 B2	Dou
16[c]	a complexity factor F_{32} having a value of at least 1.35.	Dou expressly or inherently discloses this claim element. *See, e.g.*, claim elements 1[h], 1[k], 1[l], 1[m], 4, 5[a], 5[b], 5[c], 9[a], 9[b]
Claim 17		
17	The wireless device of claim 16, wherein the second antenna contour comprises at least 20 segments.	Dou expressly or inherently discloses this claim element. *See, e.g.*, claim elements 2, 7, 13

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Exhibit – D – 02

INVALIDITY CONTENTIONS FOR U.S. PATENT NO. 11,031,677 B2
BASED ON CHINESE PATENT NO. 2,765,337 TO WEI ("WEI")

Based upon Plaintiff's Complaint, Infringement Contentions, and apparent claim constructions and application of the claims to Defendants' accused products, as best as they can be deciphered, the reference charted below anticipates or at least renders obvious some or all of the asserted claims. These invalidity contentions are not an admission by the Defendants that the accused products are covered by or infringe claims 1, 2, 3, 4, 5, 6, 7, 8, 9, 12, 13, 14, 15, 16, and 17 ("the '677 Asserted Claims")[1], particularly when these claims are properly construed and applied.

AIA law applies because the application that issued as the '677 Patent was filed on March 27, 2020, after the AIA came into force on March 16, 2013.

Chinese Patent No. 2,765,337. ("Wei") was filed on February 6, 2005, and was granted on March 15, 2006. This patent is prior art under at least 35 U.S.C. §§ 102(a), 102(e), 103(a), and AIA 35 U.S.C. §102(a)(1). As described in the following claim chart, the asserted claims of U.S. Patent No. 11,031,677 (the "'677 Patent"), are invalid as anticipated by Wei.

To the extent that Wei is found not to anticipate one or more of the asserted claims of the '677 Patent, these claims are invalid as obvious in view of Wei alone or as modified in view of or in combination with other prior art references disclosed in Defendants' Invalidity Contentions and accompanying charts, including without limitation as set forth below.

- U.S. Patent Application No. 2007/0200773 to Dou et al. "Dou") was filed on February 24, 2006, published on August 30, 2007, and issued as U.S. Patent No. 7,548,208 on June 16, 2009. This patent is prior art under at least 35 U.S.C. § 102(e), 103(a), and AIA 35 U.S.C. §102(a)(1).
- PCT Publication No. 2004/042868 to Castany et al. ("Castany868") was filed on November 7, 2002 and published on May 21, 2004, on August 30, 2007. This patent is prior art under at least 35 U.S.C. § 102(e), 103(a), and AIA 35 U.S.C. §102(a)(1).
- U.S. Patent No. 6,943,746 to Talvitie et al. ("Talvitie") was filed on October 23, 2003, published on July 15, 2004, and issued on September 13, 2005. This patent is prior art under at least 35 U.S.C. § 102(e), 103(a), and AIA 35 U.S.C. §102(a)(1).
- U.S. Patent Application No. 2002/0238433 to Chou ("Chou") was filed on March 1, 2005, published on October 26, 2006, and issued as U.S. Patent No. 7,129,898 on October 31, 2006. This patent is prior art under at least 35 U.S.C. § 102(e), 103(a), and AIA 35 U.S.C. §102(a)(1).

[1] Defendants understand that that, by not charting claims 10-11 and 18-20 in its Infringement Contentions, Plaintiff does not assert these claims against Defendants.

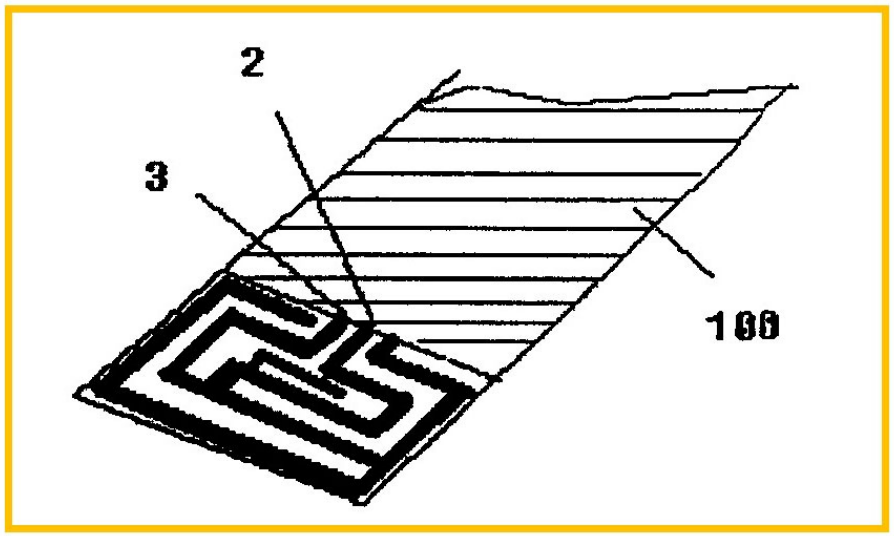
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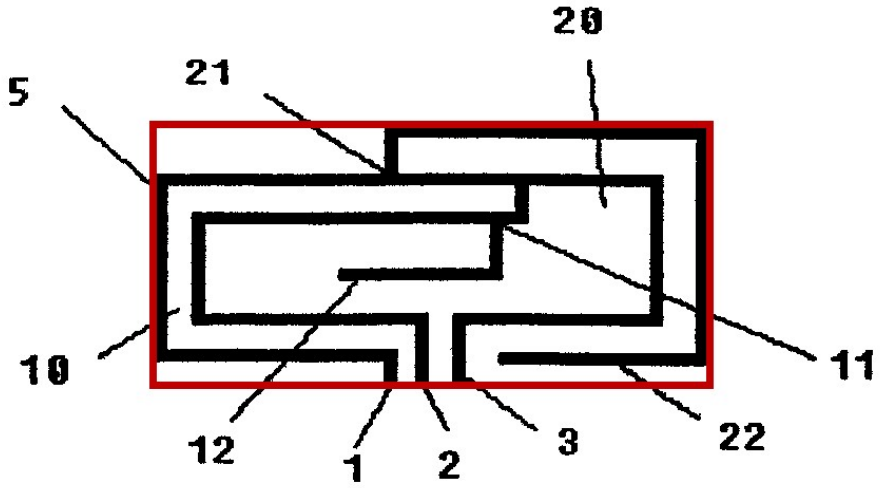
These invalidity contentions are not an admission that the Defendants concede or acquiesce to any claim construction implied or suggested by Plaintiff's Complaint or Infringement Contentions. Nor are Defendants asserting any claim construction positions through these charts, including whether the preamble is a limitation. The portions of the prior art reference cited below are not exhaustive but are exemplary in nature. Defendants reserve the right to update their constructions and contentions in view of this Court's claim construction order.[2]

Claim No.	**U.S. Patent No. 11,031,677 B2**	**Wei**
	Claim 1	
1[pre]	A wireless device comprising:	To the extent the preamble is limiting, Wei expressly or inherently discloses this claim element. *See, e.g.*, "This utility model relates to an antenna of a mobile terminal (such as a mobile phone, a mobile personal digital assistant (PDA), a mobile smartphone, a mobile point of sales (POS) machine, or a wide local area network (WLAN) terminal), and in particular, to a wide-band multi-loop mobile terminal antenna with a high gain." Wei at 6:4-7 "A technical problem to be solved by this utility model is to overcome the shortcomings of the existing art, and a wide-band multi-loop mobile terminal antenna is provided. The antenna can cover a plurality of frequency bands and implement multi-band resonance, so that a mobile terminal (such as a mobile phone) with the antenna can be sold and used in a global market. This facilitates material management of a manufacturer and helps the manufacturer to reduce production costs. Moreover, good matching in a plurality of frequency bands and a plurality of usage scenarios can be implemented. In addition, the antenna has the characteristics of high efficiency and high gain, thereby improving call quality, enlarging a signal coverage region, and prolonging call duration and standby time."

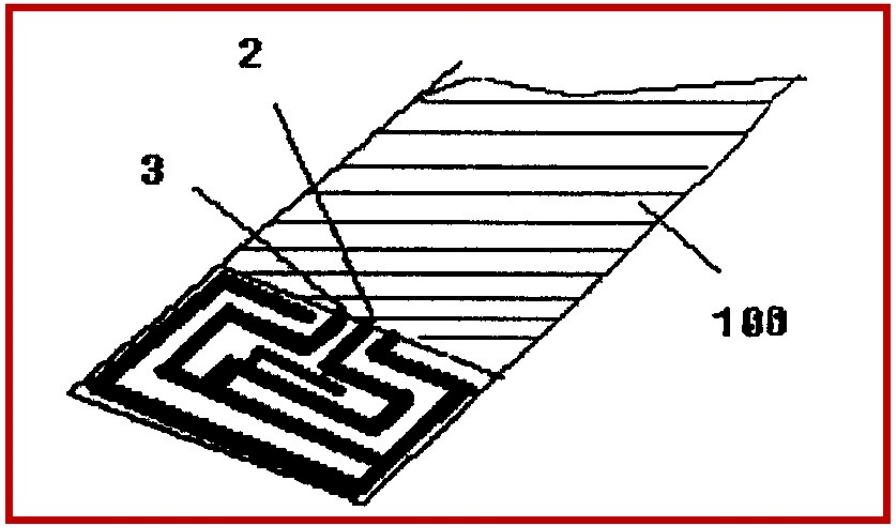
[2] Defendants incorporate herein any related work performed by or on behalf of an author or an inventor in the United States under 35 U.S.C. § 102(g)(2). Defendants reserve the right to supplement and/or alter this chart based on further investigation and ongoing discovery.

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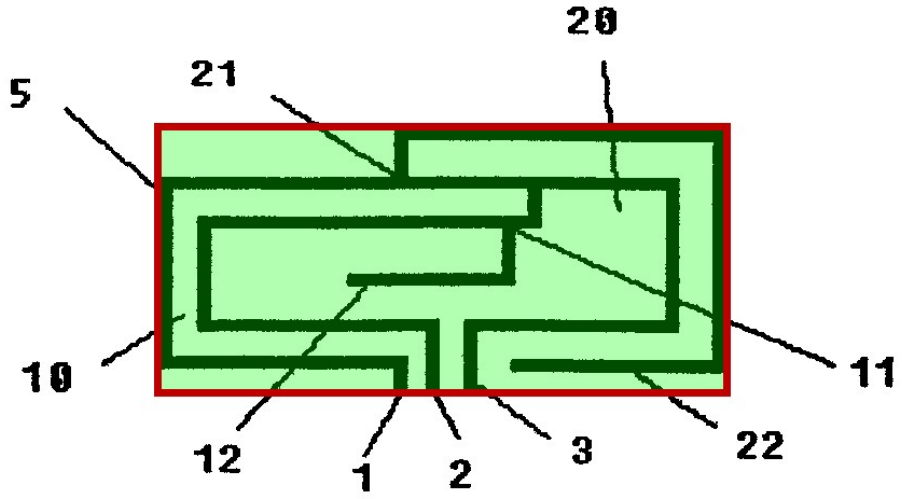
Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		Wei at 7:24-32  Wei at Figure 2B
1[a]	an antenna system comprising:	Wei expressly or inherently discloses this claim element. *See, e.g.*, "As shown in FIG. 2B, the metal conductor part is electrically connected to a mobile terminal mainboard 100. The mobile terminal mainboard 100 is a main circuit board of a mobile terminal, and a transmitting circuit, receiving circuit, control circuit, and the like of signals are printed on the mainboard according to needs."

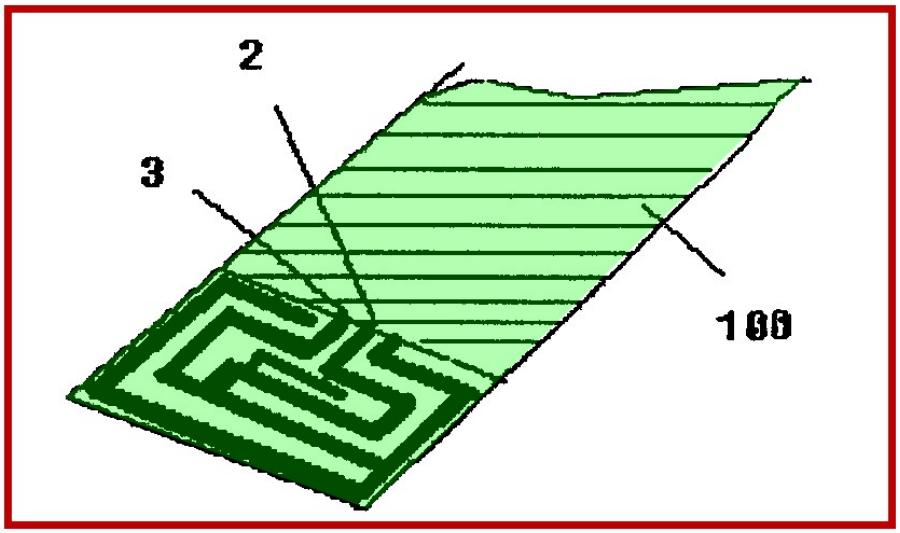
Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		Wei at 14:25-28  Wei at Figure 2A

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Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		 Wei at Figure 2B
1[b]	[*the antenna system comprising*] a ground plane;	Wei expressly or inherently discloses this claim element. *See, e.g.*, "The so-called "ground point" means a physical connection point between an antenna and a reference ground plane of a mobile terminal mainboard, namely, an end point of a signal loop of this utility model. The ground point is connected to a reference ground point of a feed point through a conductor, thus forming a loop. An antenna

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Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		provided by this utility model has a plurality of ground points, and the ground points are connected through metal conductors (namely, ground planes).” Wei at 14:7-12  Wei at Figure 2A

Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		 Wei at Figure 2B To the extent that this reference does not expressly disclose this claim limitation, in light of Plaintiff's apparent claim construction and infringement positions with respect to the Accused Products, a POSA would have understood it to implicitly disclose it or would have found the claim limitation obvious. Additionally, it would have been obvious to a person of ordinary skill in the art to modify this reference with any one or more of the references disclosed in Defendants' Invalidity Contentions based on knowledge of one of ordinary skill in the art and for the reasons articulated in Defendants' Invalidity Contentions Cover Pleading. *See, e.g.,*

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Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		"FIG. 2B illustrates a side view of the wireless device 200 of FIG. 2A. As shown, the wireless device 200 may comprise a ground plane 210. In various implementations, the ground plane 210 may improve antenna performance in talk position and reduce SAR. As shown, the ground plane 210 may extend underneath the first internal antenna 206 and the second internal antenna 208. The ground plane 210 may be required underneath the second internal antenna 208, for example, if a key pad is positioned at the edge of the PCB 204 and demands a ground layer underneath for its circuitry. In this embodiment, the first internal antenna 206 and the second antenna 208 may each comprise a planar inverted F-antenna, for example, including at least one read port and one or more ground ports. The embodiments are not limited in this context." Dou at [0029] "FIG. 3B illustrates a side view of the wireless device 300 of FIG. 3A. As shown, the wireless device 300 may comprise a ground plane 310 to improve antenna performance in talk position and reduce SAR. As shown, the ground plane 310 does not extend underneath the second internal antenna 308. In this embodiment, the second internal antenna 208 may be separated from the ground plane 310 by a clearance distance (C) that is no less than 5 mm (>5 mm). The first internal antenna 206 may comprise, for example, a planar inverted F-antenna. The second internal antenna 208 may comprise, for example, a monopole-antenna, an inverted-L antenna, a meandered monopole, a printed helical antenna, a dipole antenna, a balanced antenna, or other suitable antenna. The embodiments are not limited in this context." Dou at [0034]

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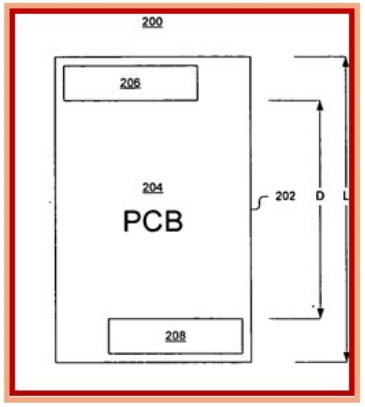


FIG. 2A

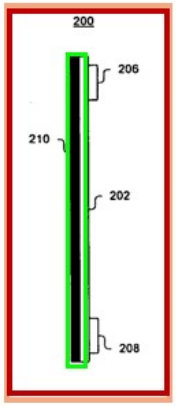


FIG. 2B

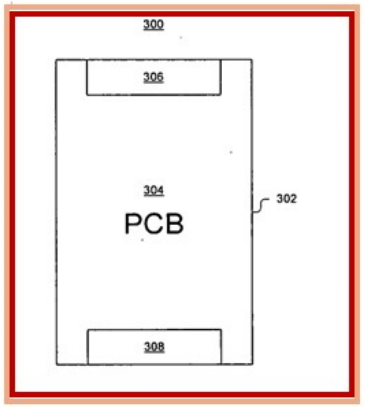


FIG. 3A

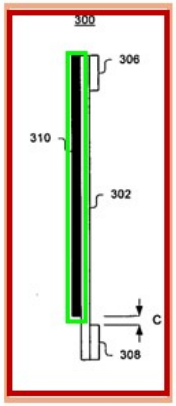
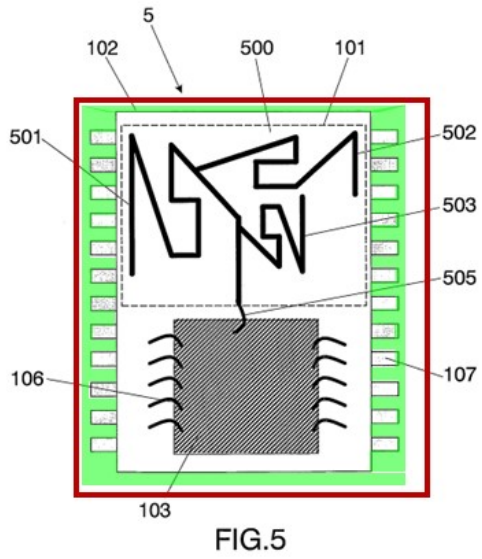


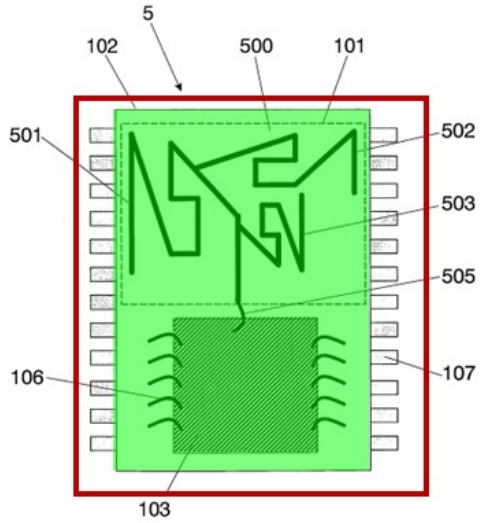
FIG. 3B

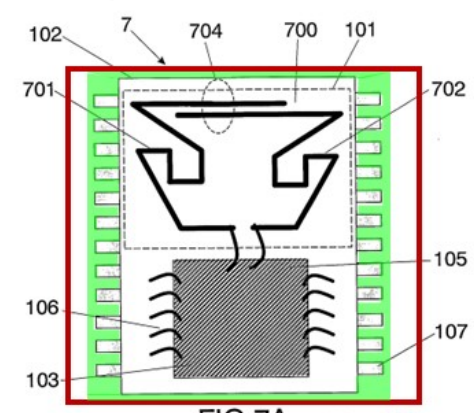
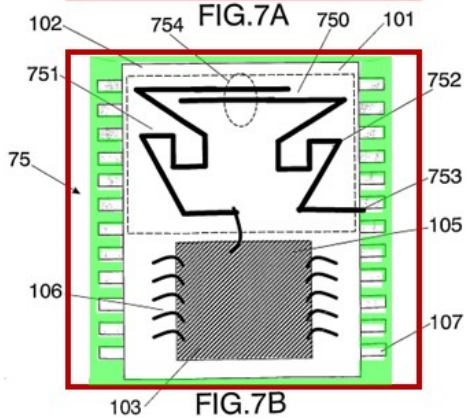
Dou at Figures 2B and 3B

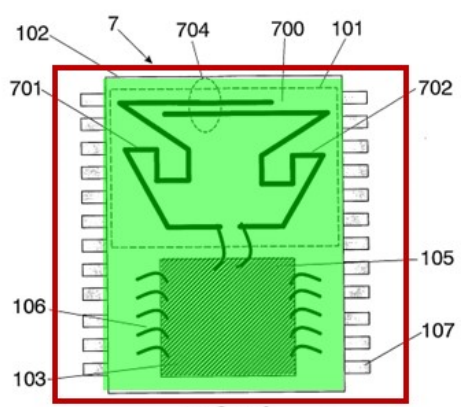
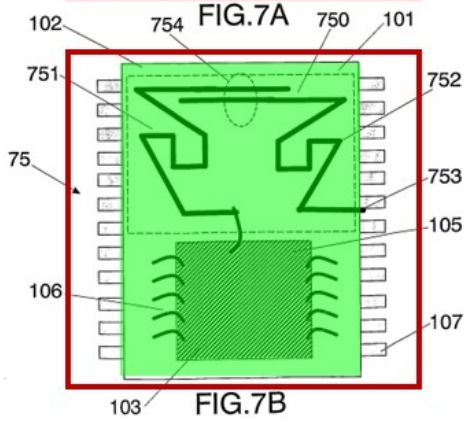
Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		"Other embodiments where the antenna structure is split on several parallel layers consists on an active-parasitic arrangement. That is, the package includes a plurality of dielectric layers within one or more substrates of the package, wherein the package includes at least a first conducting pattern for the antenna in a first of the layers, the first conducting pattern on the first layer being coupled or connected to the semiconductor die. Such a first conducting pattern that is fed by the die is the active element of the antenna arrangement. In this arrangement, the package includes at least a second conducting pattern on at least a second layer of any of the substrates, the second conducting pattern being capacitively or inductively coupled to the first conducting pattern of the antenna, the second conducting pattern acting as a parasitic element for the antenna. As an example, the antennas on the package embodiments shown in Figures 1-6, 11-15 and 17-22 could become the active antenna in such an active-parasitic antenna arrangement, wherein at least an additional antenna pattern on a parallel layer on the same or other substrate would act as the parasitic element or elements of the antenna structure. The effect of such parasitic elements is primarily an increase in the bandwidth and efficiency of the antenna, together with a finer tuning of the input impedance to match the output of the output amplifier connected to the antenna." Castany868 at 13:26-14:9 "Figure 5 shows a multibranch antenna structure on a package 5, where several curves, with not necessarily the same lengths, intersect each other at some points. In particular, the antenna 500 includes three arms 501 , 502, 503, each of them being in the form of a curve according to the present invention. In this particular example the antenna takes the form of a monopole as in Figure 1 , with a single feeding port connected to the die by means of connection 105 and one or more connections within terminals 107 connected to an external ground plane." Castany868 at 17:6-12 "Package 7 in Figure 7A includes coupled dipole antenna 700 with two arms 701 and 702 which are coupled together by means of a close proximity region 704. According to the present invention, the minimum distance between conductors in 704 should be less than one-tenth of the longest free-space operating wavelength of the antenna. Figure 7B discloses another embodiment where the package 75 includes an active monopole 751 and a parasitic monopole 752, the parasitic monopole being grounded to an external ground plane or ground

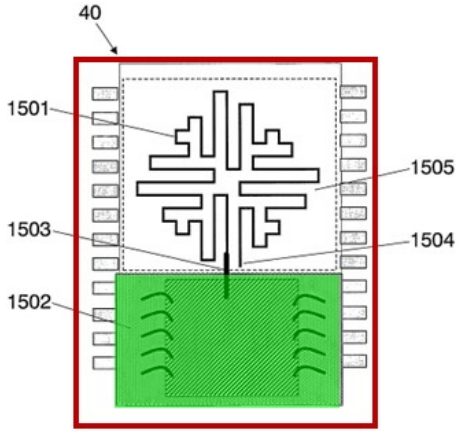
Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		counterpoise by means of at least one of the terminals of the package such as for instance 753." Castany868 at 17:30-18:3 "When more than 50% of the area below 101 is filled with a conducting material, the antenna becomes a microstrip or patch antenna according to the present invention, the conducting material being the ground for the microstrip or patch antenna. The antenna also becomes a planar inverted F antenna (PIFA), if additionally, at least one short to ground is placed at any point within the conducting antenna pattern. In the case of either a microstrip or patch arrangement, or in the PIFA case, the ground covering more than 50% or the area underneath the antenna is preferred. Such a ground can be included in any of the layers of a substrate 102 supporting the antenna and/or the chip 103, or alternatively it can be included in the external substrate or PCB supporting the package." Castany868 at 19:1-11 "Figure 15 displays a package [40] including a monopole antenna 1501. In this example, a part of the grounding plane or ground counterpoise 1502 is placed on the same layer as the antenna, in such a way that it does not overlap the rectangular area 1505 in which the monopole arm 1501 is enclosed. The antenna is fed through one conductor 1503. In this particular embodiment, it is shown how the tip of the monopole 1504 can be put close to the ground plane 1502. This would provide some capacitive loading to the antenna that contributes to the overall antenna miniaturization." Castany868 at 23:18-25

Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		 FIG.5 Castany868 at Figure 5

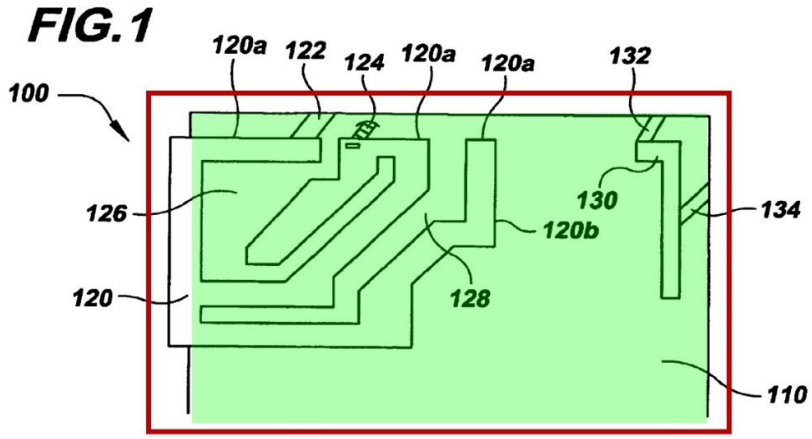
Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		 FIG.5 Castany868 at Figure 5 (Alternate)

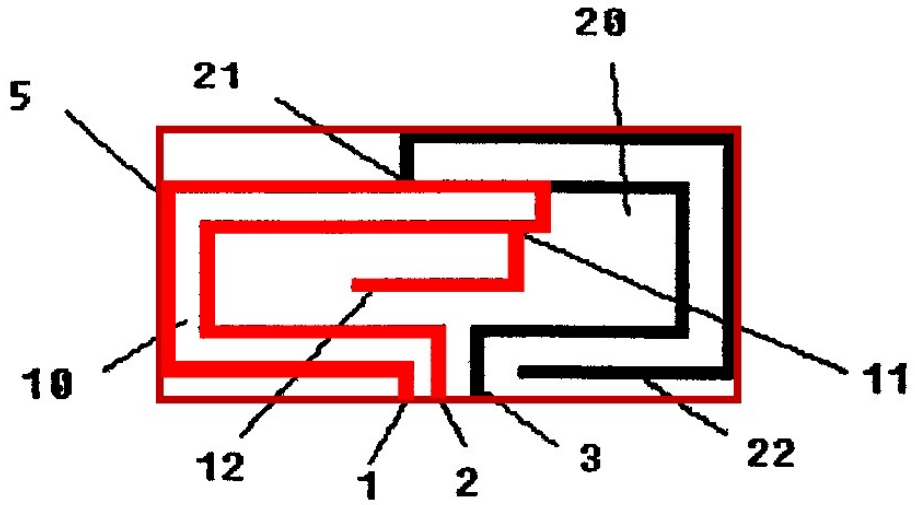
Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		 FIG.7A  FIG.7B Castany868 at Figures 7A and 7B

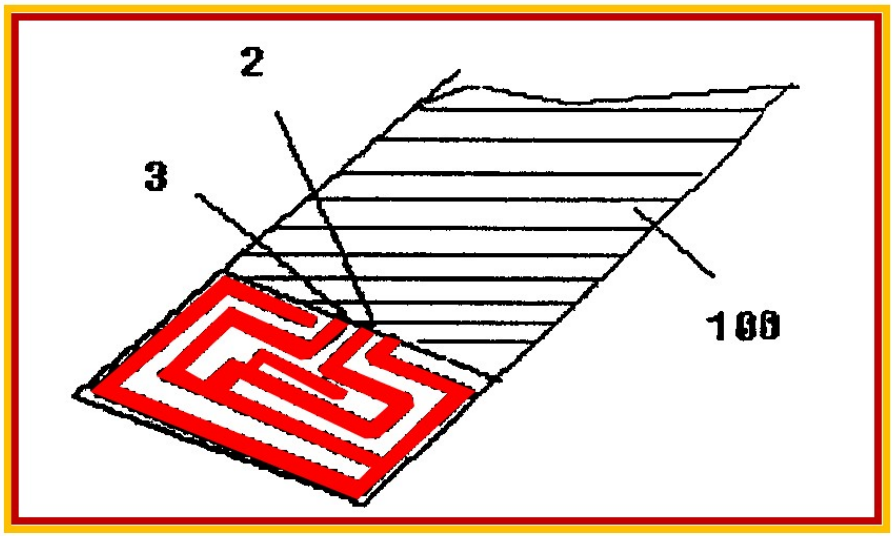
Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		 FIG.7A  FIG.7B Castany868 at Figures 7A and 7B (Alternate)

Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		 FIG.15 Castany868 at Figure 15 "Referring to FIG. 1, a preferred embodiment will be described in the following. FIG. 1 shows a planar antenna structure called a PIFA (Planar Inverted F Antenna) antenna structure 100 comprising a ground plane 110, a first radiator 120 and a second radiator 130. The radiators 120, 130 are located at a distance from the ground plane 110 such that air or another dielectric material is, as an isolating material, provided between the ground plane 110 and the radiators 120, 130. The first radiator 120 is a "groove plane antenna" which is connected to the ground plane 110 by a ground point 122 and to which radiation power is fed from a feed point 124. The ground point 122 constituting a grounding line is located substantially at the edge of the radiator 120. The feed point 124 can be implemented as coaxial feed e.g. as a lead-through from the ground plane such that it resides at a substantial distance from the edge of the radiator. The feed point 124 can also be implemented by placing it at the edge of the radiator 120, in a similar manner to that of the ground point."

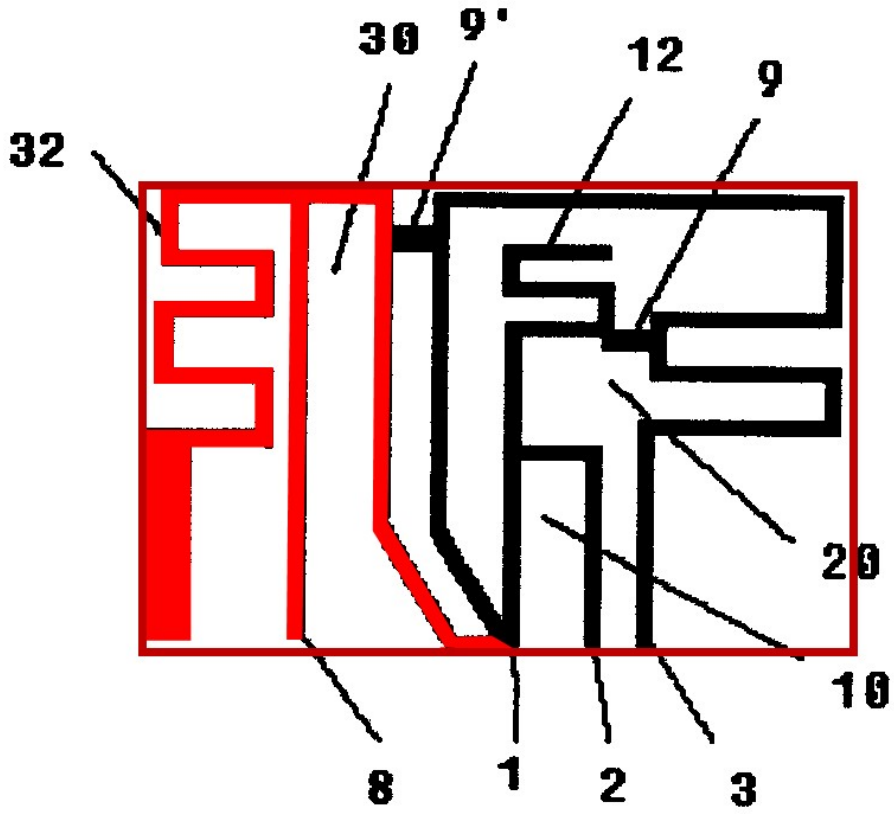
Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		Talvitie at 3:47-65 "The second radiator 130 is a narrow, planar radiator whose surface area in this embodiment is substantially smaller than that of the first radiator 120. The second radiator 130 also comprises a ground point 132 connecting the radiator 130 to a ground plane 110, and a feed point 134 feeding radiation power. The ground point 132 constituting a grounding line is located substantially at the edge of the radiator 130. The feed point 134 can be implemented as coaxial feed e.g. as a lead-through from the ground plane such that it resides at a substantial distance from the edge of the radiator. The feed point 134 can also be implemented by placing it at the edge of the radiator 130, in a similar manner to that of the ground point. The second radiator is configured to radiate within a frequency range at least partly overlapping with at least one frequency range, preferably with a higher frequency range, of the first radiator. As far as the operation of the present embodiments is concerned, the shape or location of the second radiator 130 with respect to the first radiator 120 is irrelevant; the only point is that both radiators are provided with a feed point of their own and, preferably but not necessarily, a common ground plane." Talvitie at 4:47-67

Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		 Talvitie at Figure 1
1[c]	[*the antenna system comprising*] a first antenna within the wireless device and	Wei expressly or inherently discloses this claim element. *See, e.g.*, "As shown in FIG. 2A, in a first preferred embodiment provided in this utility model, the metal conductor part includes two signal loops which are respectively a first signal loop 10 and a second signal loop 20. As shown in the figure, the first and second signal loops 10, 20 start from the same common feed point 1 and respectively terminate at two ground points 2, 3 (the numerals are the same below) with different physical positions. The second signal loop 20 completely surrounds the first signal loop 10, and the two signal loops have a common conductor 5."

Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		Wei at 15:7-13 "The antenna of this utility model is mounted on the mobile terminal mainboard 100. A positional relationship between the antenna and the mobile terminal mainboard 100 and a structure of a ground plane of the mobile terminal mainboard 100 may affect a frequency band characteristic of the antenna." Wei at 18:1-4  Wei at Figure 2A

Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		 Wei at Figure 2B "Referring to FIG. 9, in an eighth preferred embodiment provided in this utility model, the metal conductor part includes three signal loops which are respectively a first signal loop 10, a second signal loop 20, and a third signal loop 30. The three signal loops have no other common parts except the common feed point 1. The signal loops respectively terminate at ground points 2, 3, 8, and each of the first and third signal loops 10, 30 has one conductor branch 12, 32." Wei at 16:25-29

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Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		 Wei at Figure 9

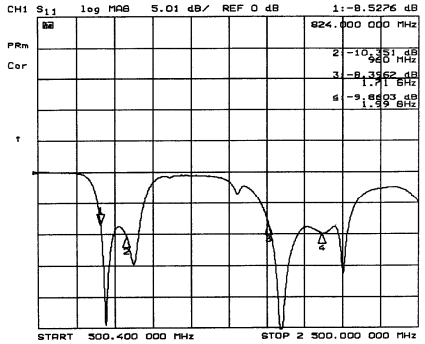
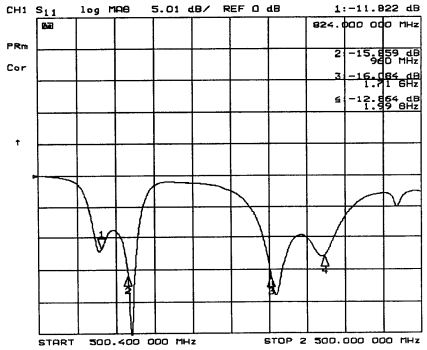
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Claim No.	U.S. Patent No. 11,031,677 B2	Wei
1[d]	configured to support at least three frequency bands contained within first and second frequency ranges of the electromagnetic spectrum,	Wei expressly or inherently discloses this claim element. *See, e.g.*, "With the development of the mobile communication industry, the requirements for a mobile terminal antenna are evolving toward multi-band operation (for example: GSM 800/900/1800/1900 Hz or WLAN 2.4 GHz/5.1 GHz/5.8 GHz), high gain, and adaptability to a plurality of usage scenarios (such as an open or closed state of a foldable phone, a handheld mode, a waist-mounted mode, or flat placement on a desktop). The existing mobile terminal antennas are categorized into two types: external antennas and internal antennas. The internal antennas are increasingly prevalent in mobile phones due to their aesthetic appearance, high portability, and improved resistance to damage from drops. The internal antennas include various planar inverted-F antennas (PIFAs) and monopole (or helical) antennas designed based on technologies similar to an external antenna technology. Since an internal antenna is required to have a small volume and a compact structure, it is difficult to achieve multi-band and high-gain performance, and even more challenging to implement good matching of a plurality of frequency bands under different states. For example, many internal antennas cover only two frequency bands such as GSM 900/GSM 1800 or GSM 800/GSM 1900, while some internal antennas may cover three frequency bands such as GSM 900/GSM 1800/GSM 1900 or GSM 800/GSM 1800/GSM 1900M. A manufacturer of whole mobile phones urgently desires to produce a quad-band mobile phone which can be sold in a global market. Without ability to develop and manufacture the quad-band mobile phones, manufacturers are compelled to offer two separate tri-band models to different markets. Consequently, two different versions need to be researched and developed for one model. This complicates production and material management, and hinders cost reduction." Wei at 6:9-29 "FIG. 16A is a schematic diagram of test results of an application example of a wide-band multi-loop terminal antenna of this utility model. The antenna covers five frequency bands: GSM 800/900/1800/1900 and a universal mobile telecommunications system (UMTS).

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Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		FIG. 16B is a schematic diagram of test results of another application example of a wide-band multi-loop terminal antenna of this utility model. The antenna has good matching in four frequency bands: GSM 850/GSM 900/GSM 1800/GSM 1900." Wei at 19:8-18

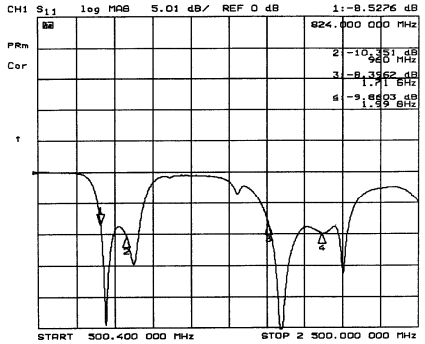
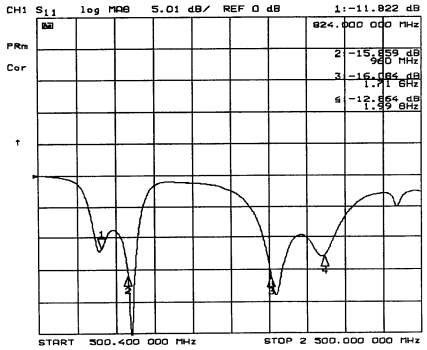
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Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		 图16A  图16B Wei at Figure 16A and 16B

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Claim No.	U.S. Patent No. 11,031,677 B2	Wei
1[e]	the second frequency range being higher in frequency than the first frequency range and	Wei expressly or inherently discloses this claim element. *See, e.g.*, "FIG. 16A is a schematic diagram of test results of an application example of a wide-band multi-loop terminal antenna of this utility model. The antenna covers five frequency bands: GSM 800/900/1800/1900 and a universal mobile telecommunications system (UMTS). FIG. 16B is a schematic diagram of test results of another application example of a wide-band multi-loop terminal antenna of this utility model. The antenna has good matching in four frequency bands: GSM 850/GSM 900/GSM 1800/GSM 1900." Wei at 19:8-18

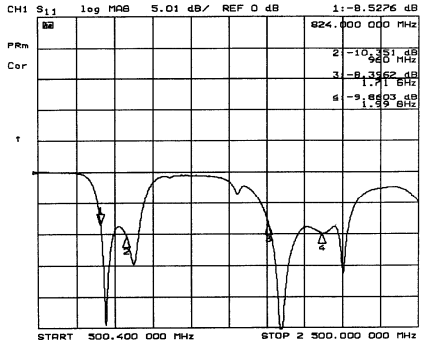
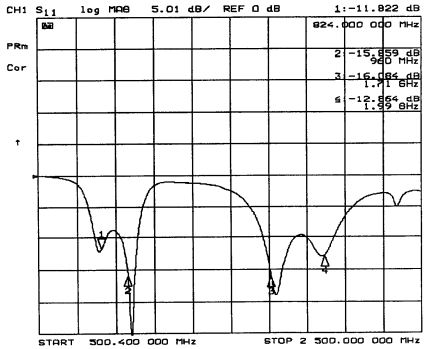
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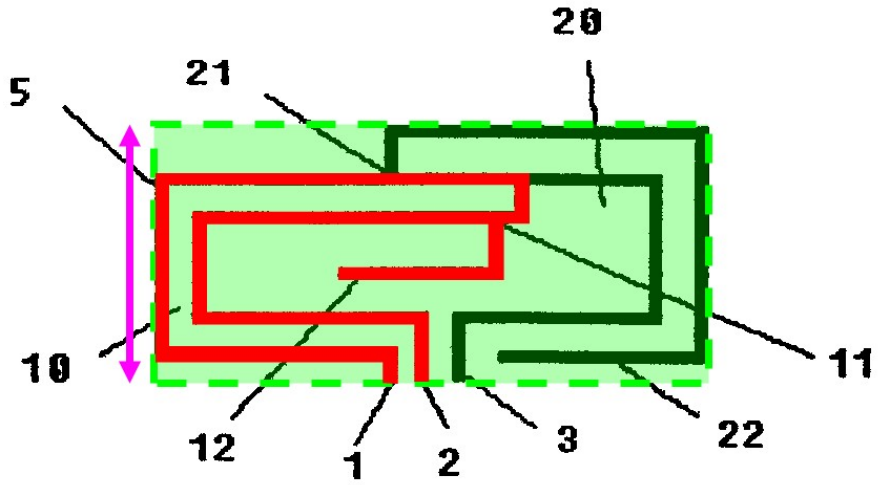
Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		 图16A  图16B Wei at Figure 16A and 16B

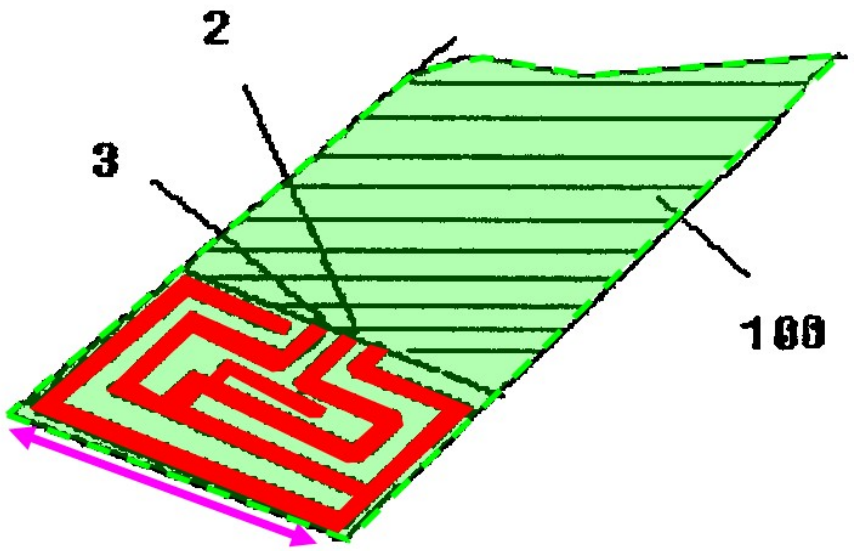
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Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		To the extent that this reference does not expressly disclose this claim limitation, in light of Plaintiff's apparent claim construction and infringement positions with respect to the Accused Products, a POSA would have understood it to implicitly disclose it or would have found the claim limitation obvious. It would have been obvious to a person of ordinary skill in the art that frequency bands with higher Hertz values would be higher in frequency than frequency bands with relatively lower Hertz values. Additionally, it would have been obvious to a person of ordinary skill in the art to modify this reference with any one or more of the references disclosed in Defendants' Invalidity Contentions based on knowledge of one of ordinary skill in the art and for the reasons articulated in Defendants' Invalidity Contentions Cover Pleading.
1[f]	at least one of the three frequency bands being associated with a 4G communication standard,	Wei expressly or inherently discloses this claim element. *See, e.g.*, "FIG. 16A is a schematic diagram of test results of an application example of a wide-band multi-loop terminal antenna of this utility model. The antenna covers five frequency bands: GSM 800/900/1800/1900 and a universal mobile telecommunications system (UMTS). FIG. 16B is a schematic diagram of test results of another application example of a wide-band multi-loop terminal antenna of this utility model. The antenna has good matching in four frequency bands: GSM 850/GSM 900/GSM 1800/GSM 1900." Wei at 19:8-18

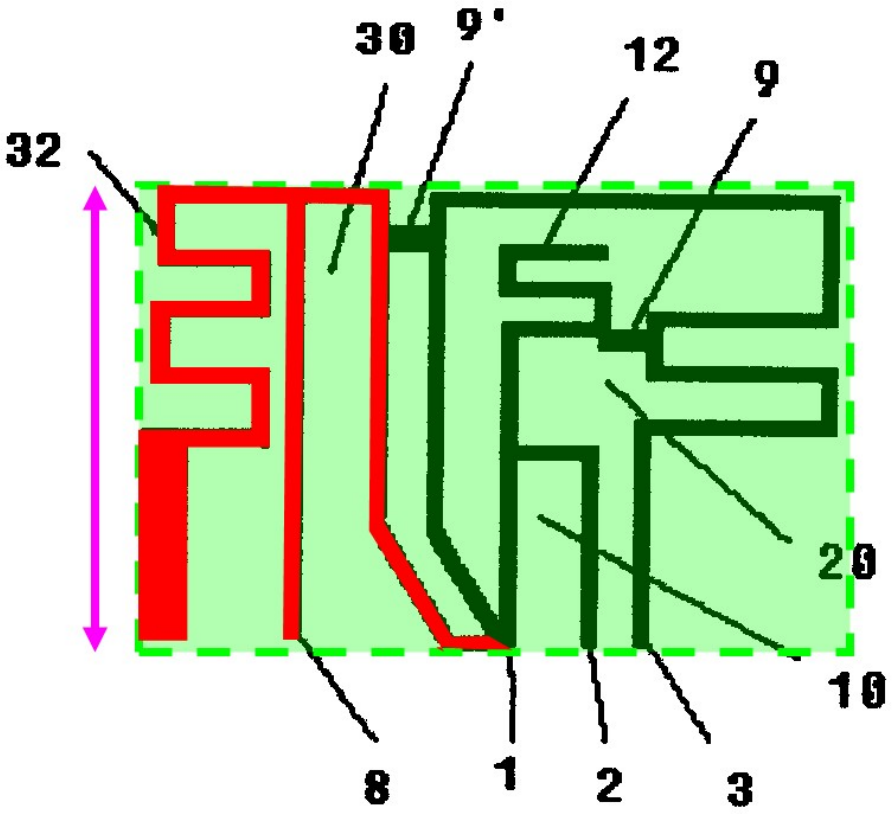
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Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		 图16A  图16B Wei at Figure 16A and 16B

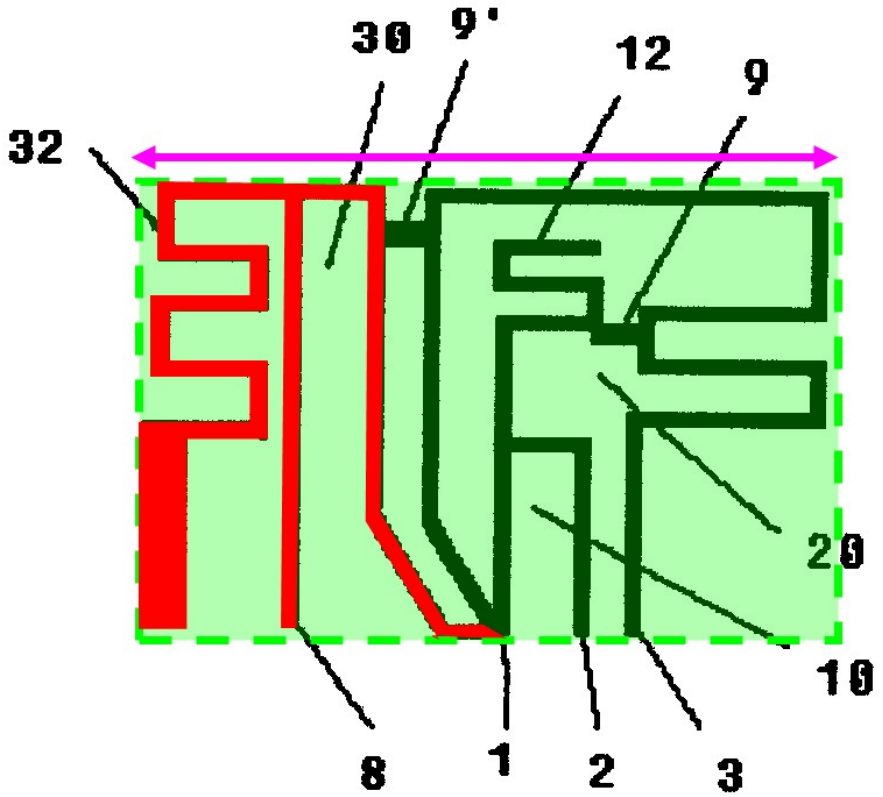
Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		To the extent that this reference does not expressly disclose this claim limitation, in light of Plaintiff's apparent claim construction and infringement positions with respect to the Accused Products, a POSA would have understood it to implicitly disclose it or would have found the claim limitation obvious. Additionally, it would have been obvious to a person of ordinary skill in the art to modify this reference with any one or more of the references disclosed in Defendants' Invalidity Contentions based on knowledge of one of ordinary skill in the art and for the reasons articulated in Defendants' Invalidity Contentions Cover Pleading.
1[g]	the first antenna being proximate to a first short side of a ground plane rectangle enclosing the ground plane and	Wei expressly or inherently discloses this claim element. *See, e.g.*, 

Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		Wei at Figure 2A  Wei at Figure 2B

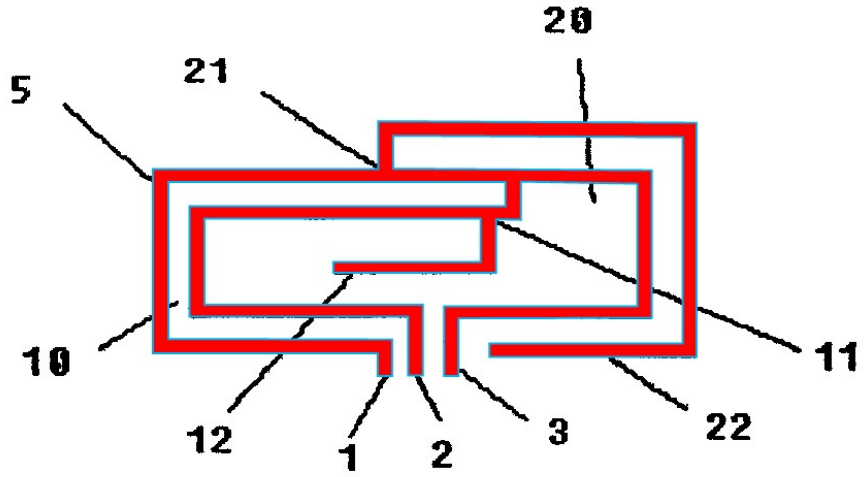
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Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		 Wei at Figure 9

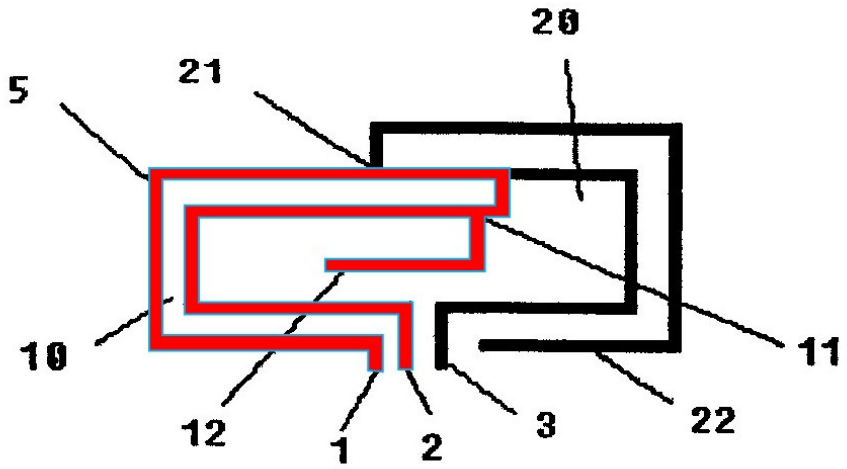
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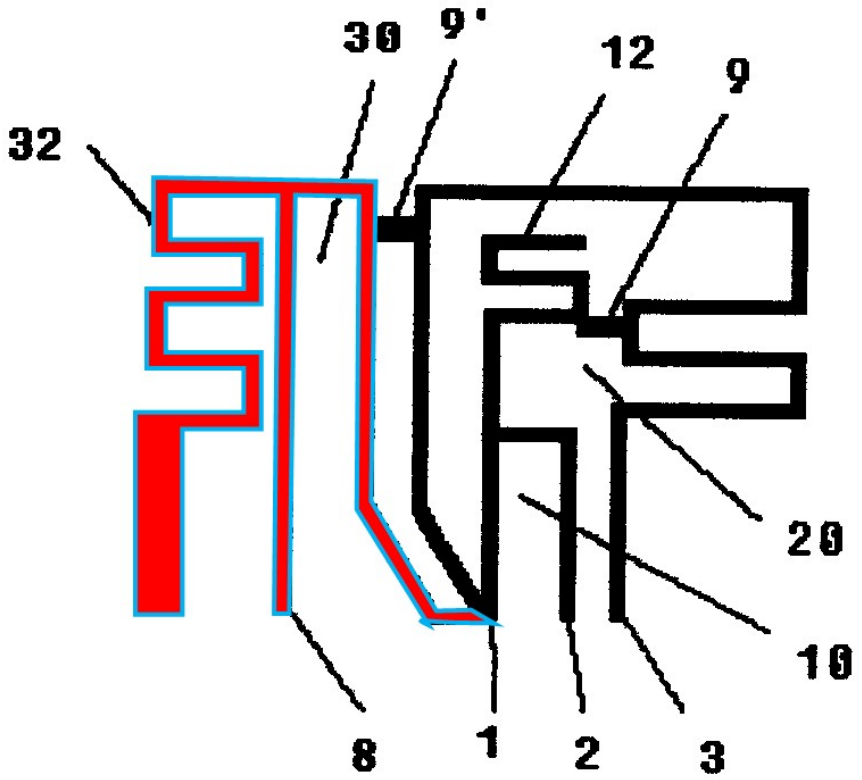
Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		 Wei at Figure 9 (Alternative)

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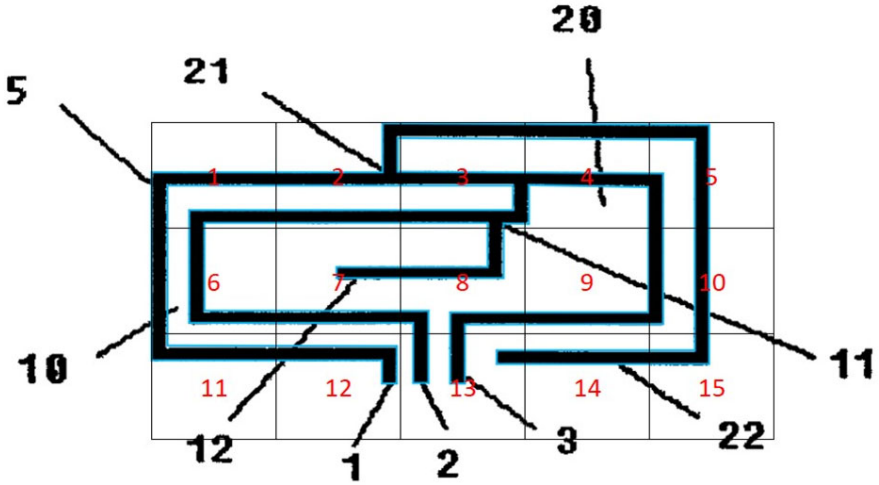
Claim No.	U.S. Patent No. 11,031,677 B2	Wei
1[h]	defining a first antenna contour comprising an entire perimeter of the first antenna,	Wei expressly or inherently discloses this claim element. *See, e.g.*,  Wei at Figure 2A

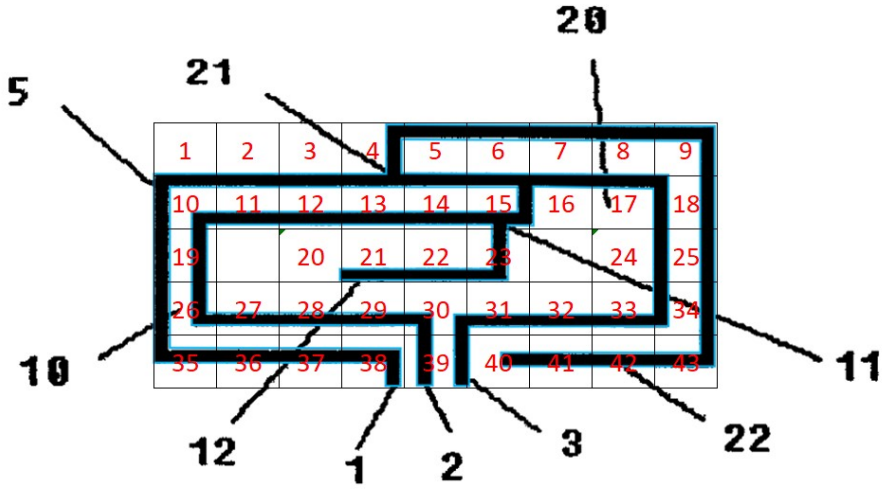
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Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		 Wei at Figure 2A (Alternative)

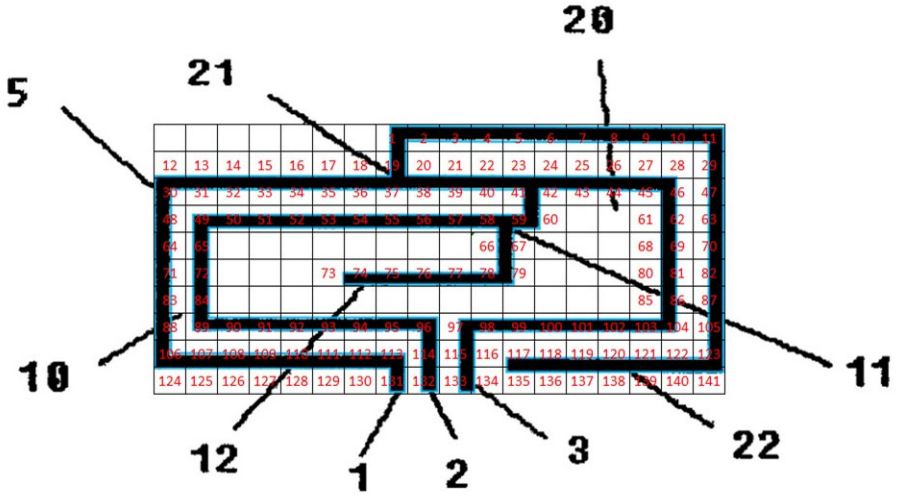
Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		 Wei at Figure 9
1[i]	wherein the first antenna	Wei expressly or inherently discloses this claim element.

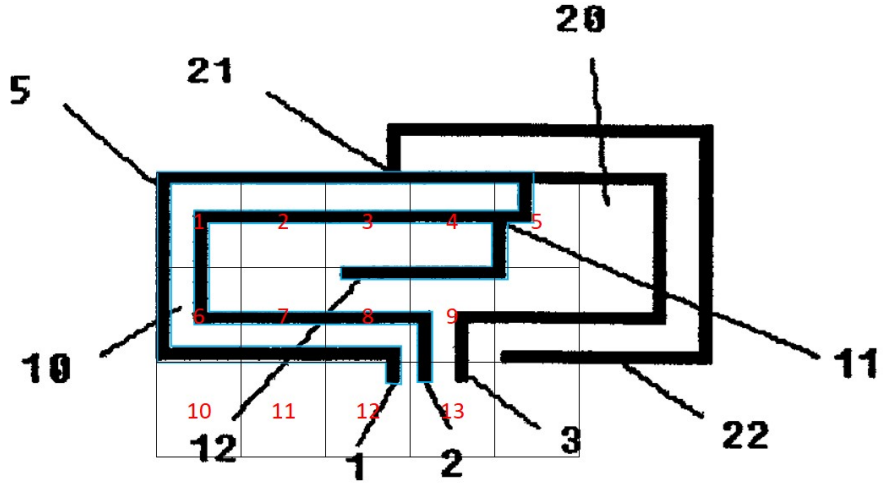
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Claim No.	U.S. Patent No. 11,031,677 B2	Wei
	contour has a level of complexity defined by complexity factor F_{21} having a value of at least 1.20 and	*See, e.g.*,  Wei at Figure 2A Calculating N_1

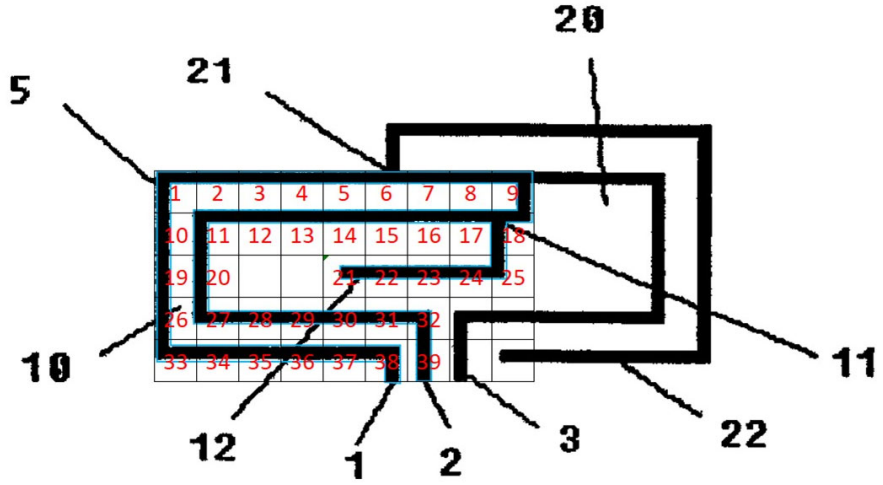
Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		 Wei at Figure 2A Calculating N_2

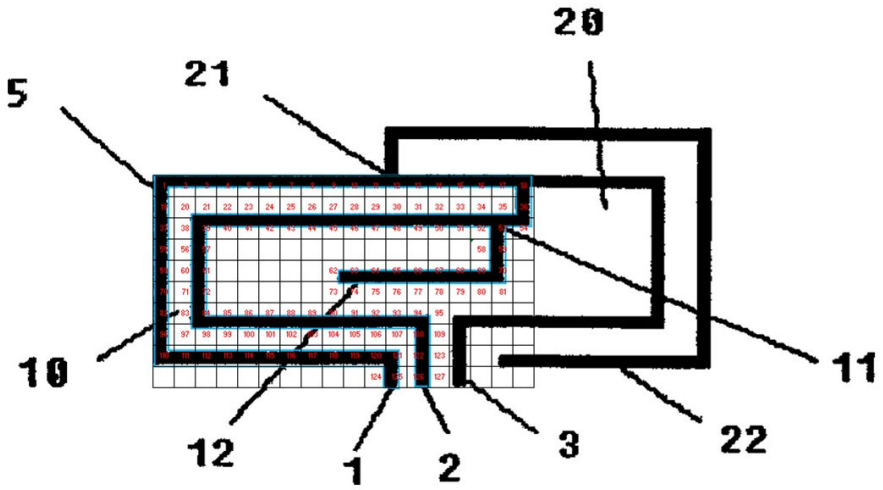
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Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		 Wei at Figure 2A Calculating N_3 Further, it would have been obvious to a person of ordinary skill in the art that, when $N_1 = 15$; $N_2 = 43$; and $N_3 = 141$; that given $$F_{21=-} \frac{(\log_{10}(N_2) - \log_{10}(N_1)}{\log_{10} 1/2}$$

Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		solving for F_{21} results in $$F_{21=-}\frac{(\log_{10}(43)-\log_{10}(15)}{\log_{10}1/2}=\ 1.5194$$ and $$1.20\ \leq 1.5194$$  Wei at Figure 2A (Alternative) Calculating N_1

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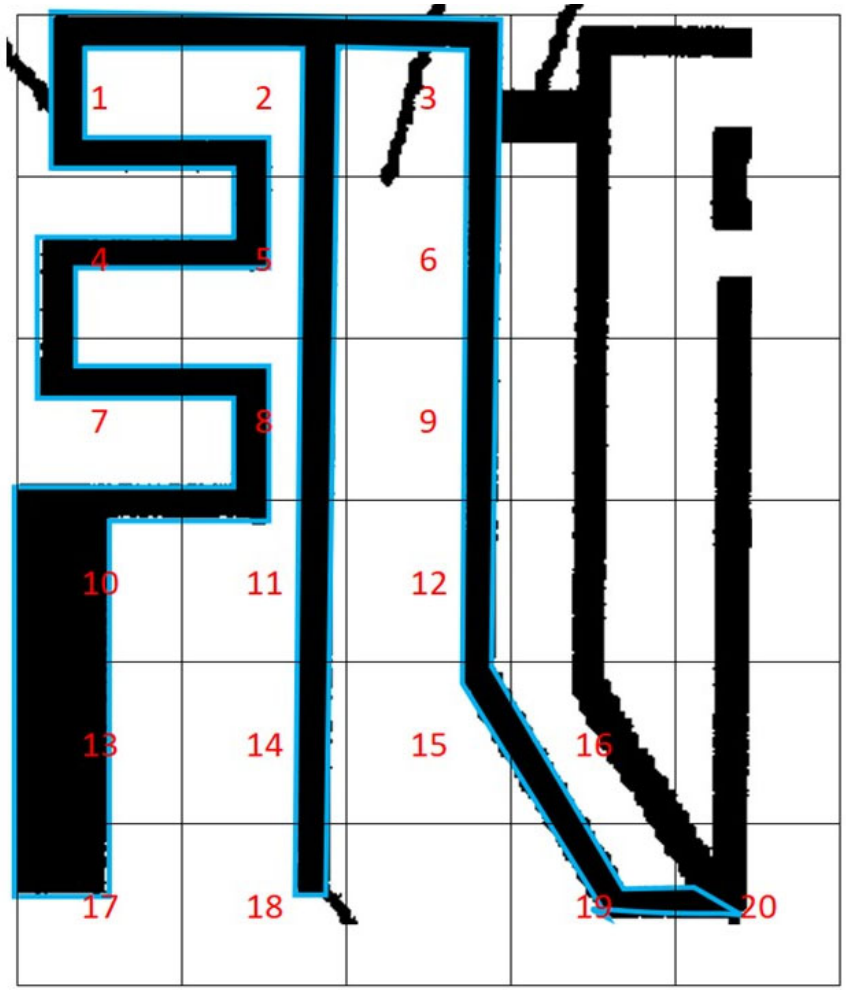
Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		 Wei at Figure 2A (Alternative) Calculating N_2

Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		 Wei at Figure 2A (Alternative) Calculating N_3 Additionally, it would have been obvious to a person of ordinary skill in the art that, when $N_1 = 13$; $N_2 = 39$; and $N_3 = 127$; that given $$F_{21=-} \frac{(\log_{10}(N_2) - \log_{10}(N_1)}{\log_{10} 1/2}$$

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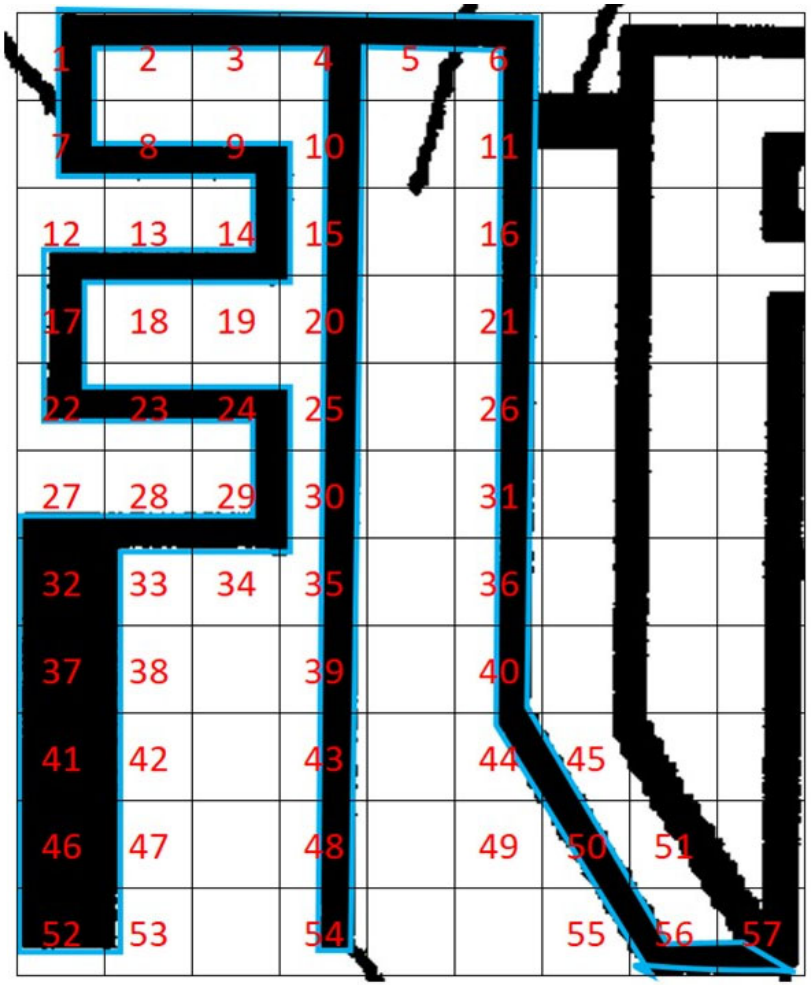
Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		solving for F_{21} results in $$F_{21=-}\frac{(\log_{10}(39)-\log_{10}(13)}{\log_{10}1/2}=\ 1.5850$$ and $$1.20\ \leq 1.5850$$

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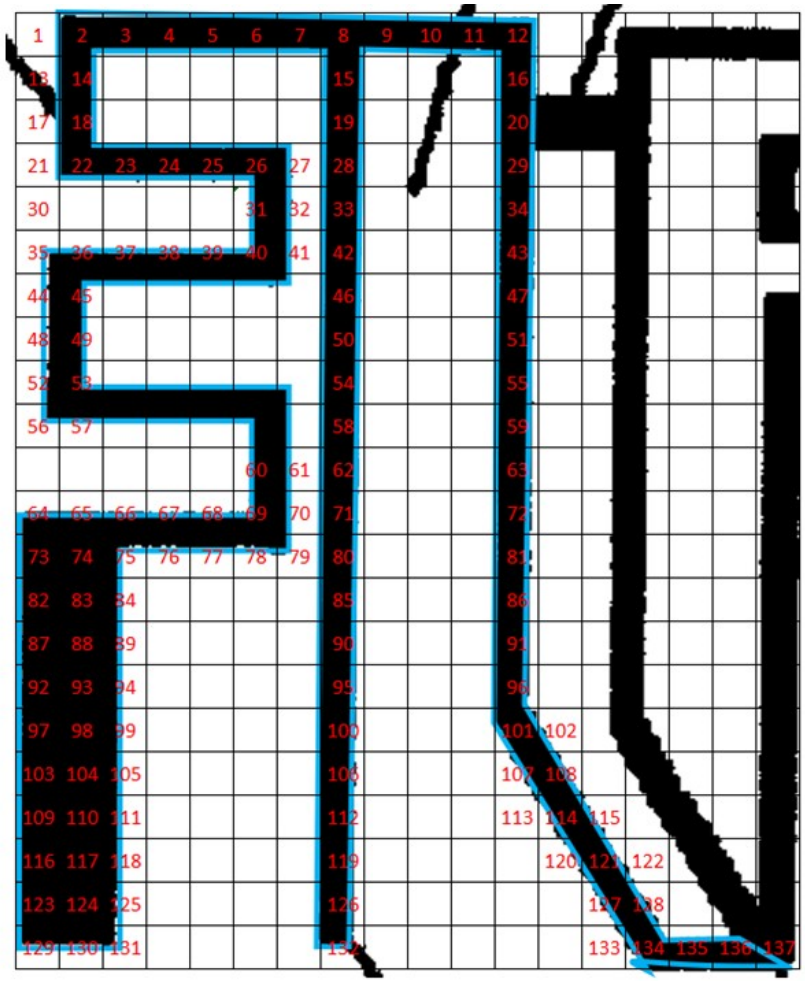


Wei at Figure 9 Calculating N_1

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Wei at Figure 9 Calculating N_2



Wei at Figure 9 Calculating N_3

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Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		Still further, it would have been obvious to a person of ordinary skill in the art that, when $N_1 = 20$; $N_2 = 57$; and $N_3 = 137$; that given $$F_{21=-} \frac{(\log_{10}(N_2) - \log_{10}(N_1)}{\log_{10} 1/2}$$ solving for F_{21} results in $$F_{21=-} \frac{(\log_{10}(57) - \log_{10}(20)}{\log_{10} 1/2} = 1.5110$$ and $$1.20 \leq 1.5110$$
1[j]	complexity factor F_{32} having a value less than 1.75; and	Wei expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[i] Further, it would have been obvious to a person of ordinary skill in the art that, when $N_1 = 15$; $N_2 = 43$; and $N_3 = 141$;

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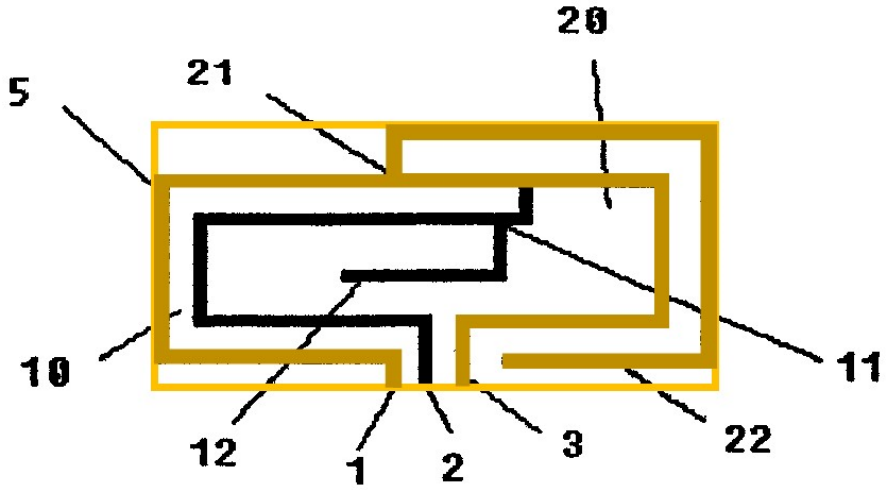
Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		that given $$F_{32=-}\frac{(\log_{10}(N_3)-\log_{10}(N_2)}{\log_{10}1/2}$$ solving for F_{32} results in $$F_{32=-}\frac{(\log_{10}(141)-\log_{10}(43)}{\log_{10}1/2}=\ 1.7133$$ and $$1.7133\ <1.75$$ Additionally, given $N_1\ =\ 13$; $N_2\ =\ 39$; and $N_3\ =\ 127$; that given $$F_{32=-}\frac{(\log_{10}(N_3)-\log_{10}(N_2)}{\log_{10}1/2}$$ solving for F_{32} results in $$F_{32=-}\frac{(\log_{10}(127)-\log_{10}(39)}{\log_{10}1/2}=\ 1.7033$$

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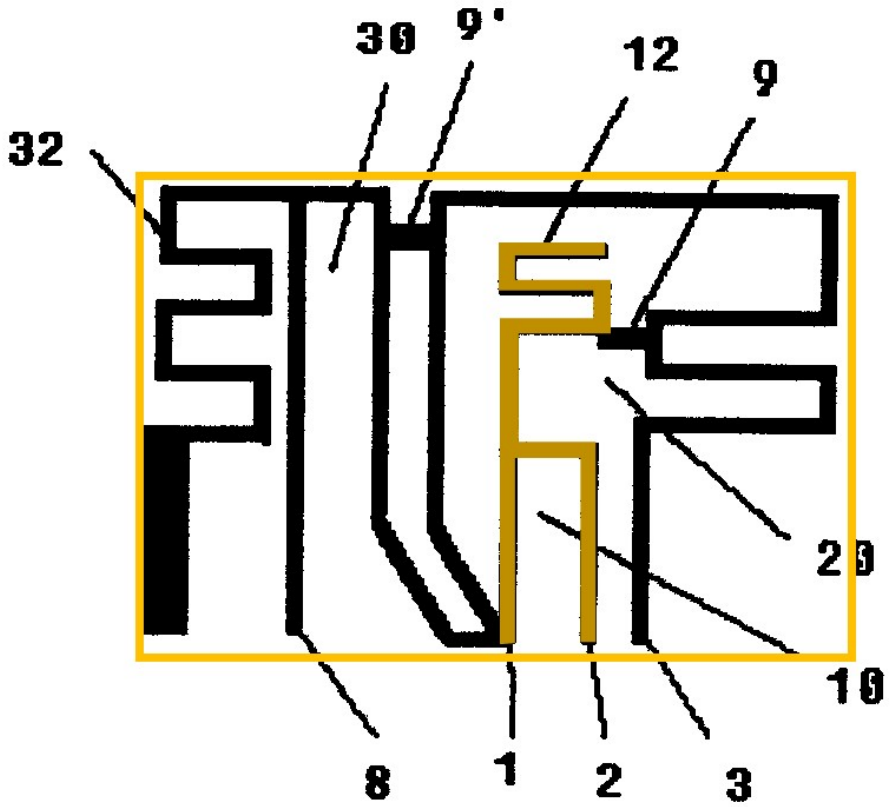
Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		and $$1.7033 < 1.75$$ Still further, given $N_1 = 20$; $N_2 = 57$; and $N_3 = 137$; that given $$F_{32=-} \frac{(\log_{10}(N_3) - \log_{10}(N_2)}{\log_{10} 1/2}$$ solving for F_{32} results in $$F_{32=-} \frac{(\log_{10}(137) - \log_{10}(3579)}{\log_{10} 1/2} = 1.2651$$ and $$1.2651 < 1.75$$
1[k]	a second antenna within	Wei expressly or inherently discloses this claim element. *See, e.g.*,

Claim No.	U.S. Patent No. 11,031,677 B2	Wei
	the wireless device and	"As shown in FIG. 2A, in a first preferred embodiment provided in this utility model, the metal conductor part includes two signal loops which are respectively a first signal loop 10 and a second signal loop 20. As shown in the figure, the first and second signal loops 10, 20 start from the same common feed point 1 and respectively terminate at two ground points 2, 3 (the numerals are the same below) with different physical positions. The second signal loop 20 completely surrounds the first signal loop 10, and the two signal loops have a common conductor 5." Wei at 15:7-13 "The antenna of this utility model is mounted on the mobile terminal mainboard 100. A positional relationship between the antenna and the mobile terminal mainboard 100 and a structure of a ground plane of the mobile terminal mainboard 100 may affect a frequency band characteristic of the antenna." Wei at 18:1-4

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Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		 Wei at Figure 2A "Referring to FIG. 9, in an eighth preferred embodiment provided in this utility model, the metal conductor part includes three signal loops which are respectively a first signal loop 10, a second signal loop 20, and a third signal loop 30. The three signal loops have no other common parts except the common feed point 1. The signal loops respectively terminate at ground points 2, 3, 8, and each of the first and third signal loops 10, 30 has one conductor branch 12, 32." Wei at 16:25-29

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Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		 Wei at Figure 9

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Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		To the extent that this reference does not expressly disclose this claim limitation, in light of Plaintiff's apparent claim construction and infringement positions with respect to the Accused Products, a POSA would have understood it to implicitly disclose it or would have found the claim limitation obvious. Additionally, it would have been obvious to a person of ordinary skill in the art to modify this reference with any one or more of the references disclosed in Defendants' Invalidity Contentions based on knowledge of one of ordinary skill in the art and for the reasons articulated in Defendants' Invalidity Contentions Cover Pleading. *See e.g.,* "As shown in FIG. 2A, the wireless device 200 may have an internal diversity antenna architecture comprising a first internal antenna 206 and a second internal antenna 208 disposed on the PCB 204 for achieving diversity. In various embodiments, the first internal antenna 206 and the second internal antenna 208 may remain in a fixed position internal to the housing 202 in order to eliminate the need for an external antenna and reduce the overall size and bulkiness of the wireless device 200. In one embodiment, the internal diversity antenna architecture may comprise a first internal antenna 206 located substantially near the top of the wireless device 200. For example, the first internal antenna 206 may be located substantially near the top of the housing 202 and/or the top of the PCB 204. The internal diversity antenna architecture may comprise a second internal antenna 208 located substantially near the bottom of the wireless device 200. For example, the second internal antenna 208 may be located substantially near the bottom of the housing 202 and/or the bottom of the PCB 204." Dou at [0017] "As shown in FIG. 3A, the wireless device 300 may have an internal diversity antenna architecture comprising a first internal antenna 306 and a second internal antenna 308 disposed on the PCB 304 for achieving diversity. In this embodiment, the internal diversity antenna architecture may comprise a first internal antenna 306 located substantially at the top of the wireless device 300. For example., the first internal antenna 306 may be located substantially at the top of the housing 302 and/or the top of the PCB 304. The internal diversity antenna architecture may comprise a second internal antenna 308 located substantially at the bottom of the wireless device

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Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		300. For example, the second internal antenna 308 may be located substantially at the bottom of the housing 302 and/or the bottom of the PCB 304." Dou at [0032] "As shown in FIG. 4A, the wireless device 400 may have an internal diversity antenna architecture comprising a first internal antenna 406 and a second internal antenna 408 disposed on the PCB 404 for achieving diversity. In this embodiment, the first internal antenna 406 may comprise a first feed point 412 and a first ground point 414, and the second internal antenna 408 may comprise a second feed point 416 and a second ground point 418. The first internal antenna 406 may be located substantially near the top of the wireless device 400, and the second internal antenna 408 may be located substantially near the bottom of the wireless device 400. Dou at [0036]

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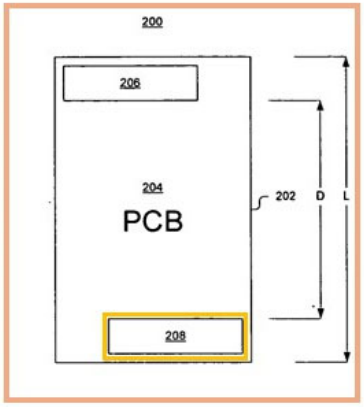


FIG. 2A

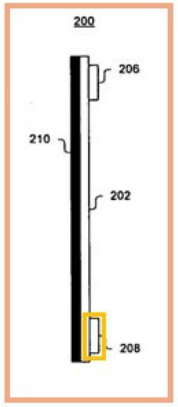


FIG. 2B

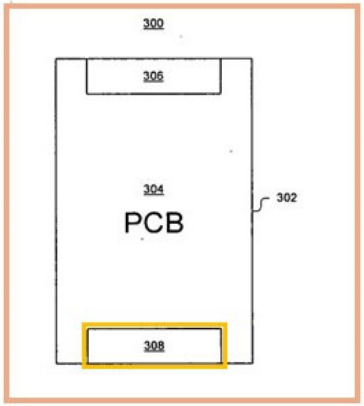


FIG. 3A

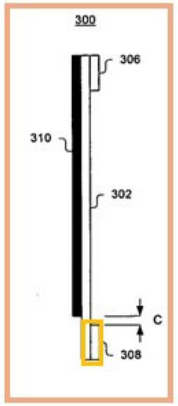
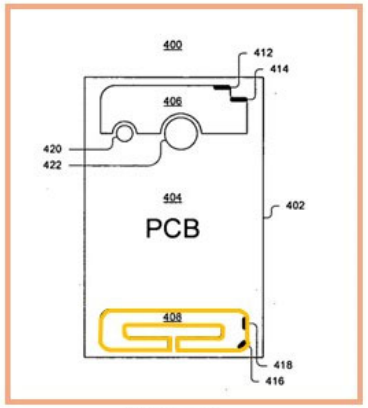
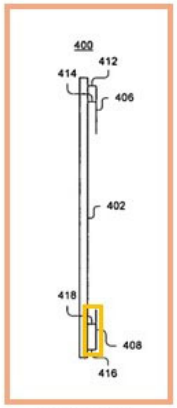
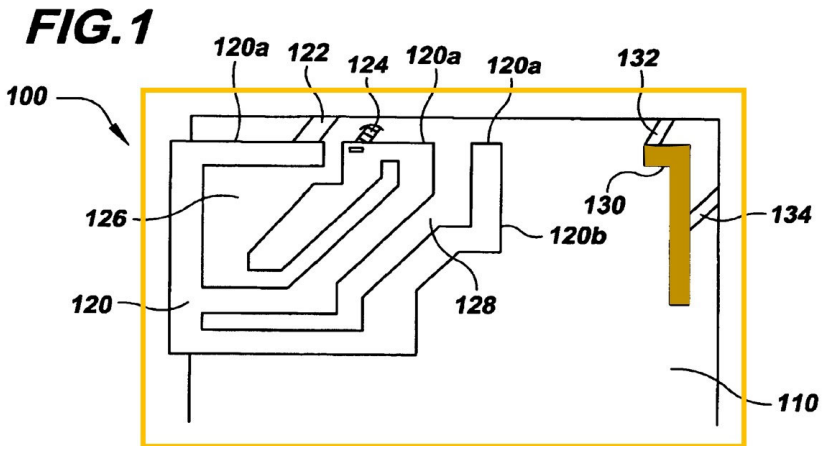


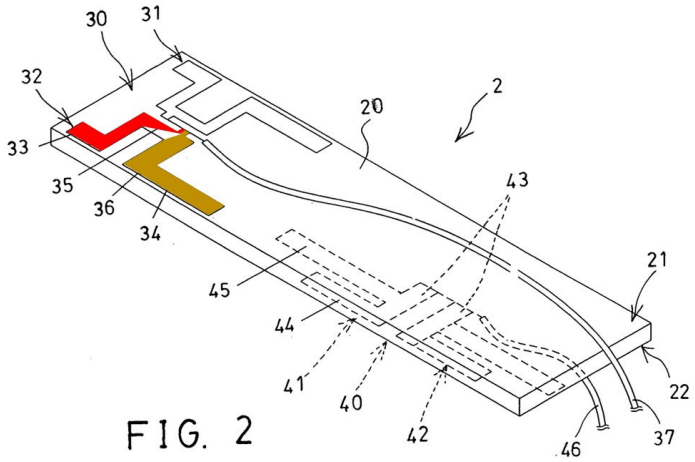
FIG. 3B

Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		 FIG. 4A  FIG. 4B Dou at Figures 2A-B, 3A-B, and 4A-B "Although a multiband antenna such as for instance a multibranch antenna can be used within the package when several services or operating frequency bands are to be integrated in the same system, it is clear that other options within the present invention include arranging two or more antennas within the same package. For instance, those two or more antennas according to the present invention can be arranged in the same substrate layer, in different layers within the same substrate, in different substrates or even in the substrate and in the plastic casing of the package. One possible arrangement for a two antenna package includes two similar antennas wherein each one is fed independently, and wherein one conducting pattern is rotated 90° with respect to the other antenna pattern. This provides an effective means for integrating a polarization diversity communication system inside a single package."

Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		Castany868 at 30:1-12 "The invention is based on the unexpected discovery that when an antenna structure comprising two radiators matched for at least partly the same frequency range is used, at least one of the radiators being the above-mentioned groove plane antenna matched for several frequency ranges, considerable isolation is provided between the radiators. Such an antenna structure thus comprises at least one ground plane, at least a first and a second radiator located at a distance from the ground plane, both radiators being configured to provide at least one resonance frequency in order to provide at least one frequency band, and an isolating layer between the ground plane and the radiators." Talvitie at 2:20-32 "Referring to FIG. 1, a preferred embodiment will be described in the following. FIG. 1 shows a planar antenna structure called a PIFA (Planar Inverted F Antenna) antenna structure 100 comprising a ground plane 110, a first radiator 120 and a second radiator 130. The radiators 120, 130 are located at a distance from the ground plane 110 such that air or another dielectric material is, as an isolating material, provided between the ground plane 110 and the radiators 120, 130. The first radiator 120 is a "groove plane antenna" which is connected to the ground plane 110 by a ground point 122 and to which radiation power is fed from a feed point 124. The ground point 122 constituting a grounding line is located substantially at the edge of the radiator 120." Talvitie at 3:47-59 "The antenna structure of FIG. 1 can preferably be configured to operate as an antenna structure for a multifrequency mobile station. " Talvitie at 5:1-3

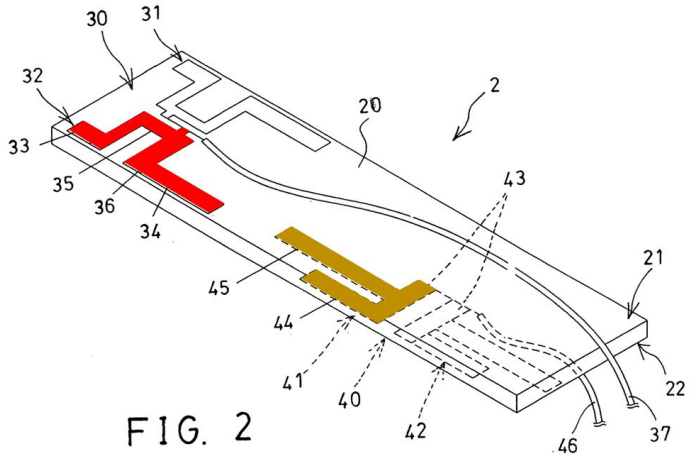
Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		 Talvitie at Figure 1
1[l]	configured to support at least one frequency band different from the at least three frequency bands supported by	Wei expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[d] To the extent that this reference does not expressly disclose this claim limitation, in light of Plaintiff's apparent claim construction and infringement positions with respect to the Accused Products, a POSA would have understood it to implicitly disclose it or would have found the claim limitation obvious.

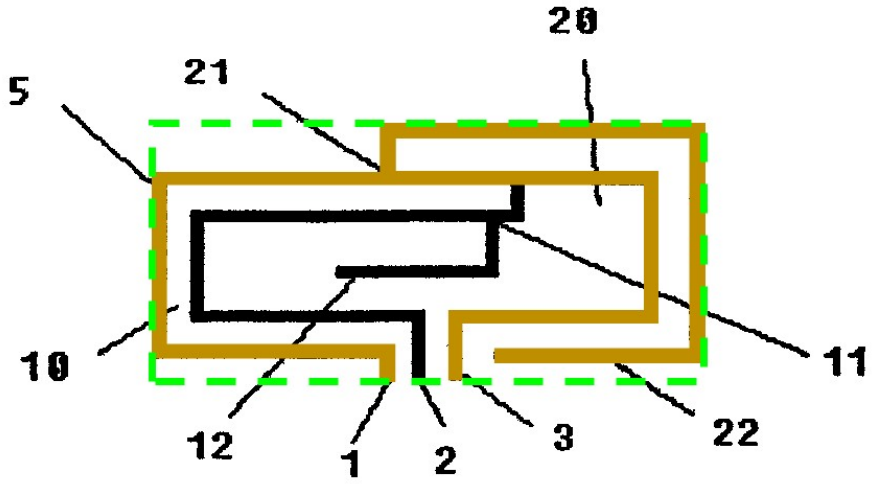
Claim No.	U.S. Patent No. 11,031,677 B2	Wei
	the first antenna,	Additionally, it would have been obvious to a person of ordinary skill in the art to modify this reference with any one or more of the references disclosed in Defendants' Invalidity Contentions based on knowledge of one of ordinary skill in the art and for the reasons articulated in Defendants' Invalidity Contentions Cover Pleading. *See, e.g.,* "It is preferable that the antenna members 31, 32 of the antenna device 30 each includes two antenna segments 33, 34 disposed up and down relative to each other, and an intermediate and/or C-shaped antenna segment 35 disposed between the antenna segments 33, 34, for receiving and transmitting signals of different frequencies, for example. It is further preferable that the antenna segments 33, 34, 35 of the two antenna members 31, 32 are disposed side by side and/or parallel to each other, or arranged in mirror symmetric relative to each other, for receiving and transmitting signals toward different lateral directions 39 relative to each other, or away from each other." Chou at [0028] "Similarly, the antenna members 41, 42 of the antenna device 40 each includes a base antenna segment 43 disposed up and down relative to each other, and two antenna segments 44, 45 extended from the base antenna segment 43 and parallel to each other, for receiving and transmitting signals of different frequencies, for example. It is further preferable that the antenna segments 43, 44, 45 of the two antenna members 41, 42 are disposed up and down relative to each other, or arranged in mirror symmetric relative to each other, for receiving and transmitting signals toward different vertical directions 49 relative to each other, or away from each other." Chou at [0030]

Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		 FIG. 2 Chou at Figure 2 "It is preferable that the antenna members 31, 32 of the antenna device 30 each includes two antenna segments 33, 34 disposed up and down relative to each other, and an intermediate and/or C-shaped antenna segment 35 disposed between the antenna segments 33, 34, for receiving and transmitting signals of different frequencies, for example. It is further preferable that the antenna segments 33, 34, 35 of the two antenna members 31, 32 are disposed side by side and/or parallel to each other, or arranged in mirror symmetric relative to each other, for receiving and transmitting signals toward different lateral directions 39 relative to each other, or away from each other." Chou at [0028] "Similarly, the antenna members 41, 42 of the antenna device 40 each includes a base antenna segment 43 disposed up and down relative to each other, and two antenna segments 44, 45 extended from the base antenna

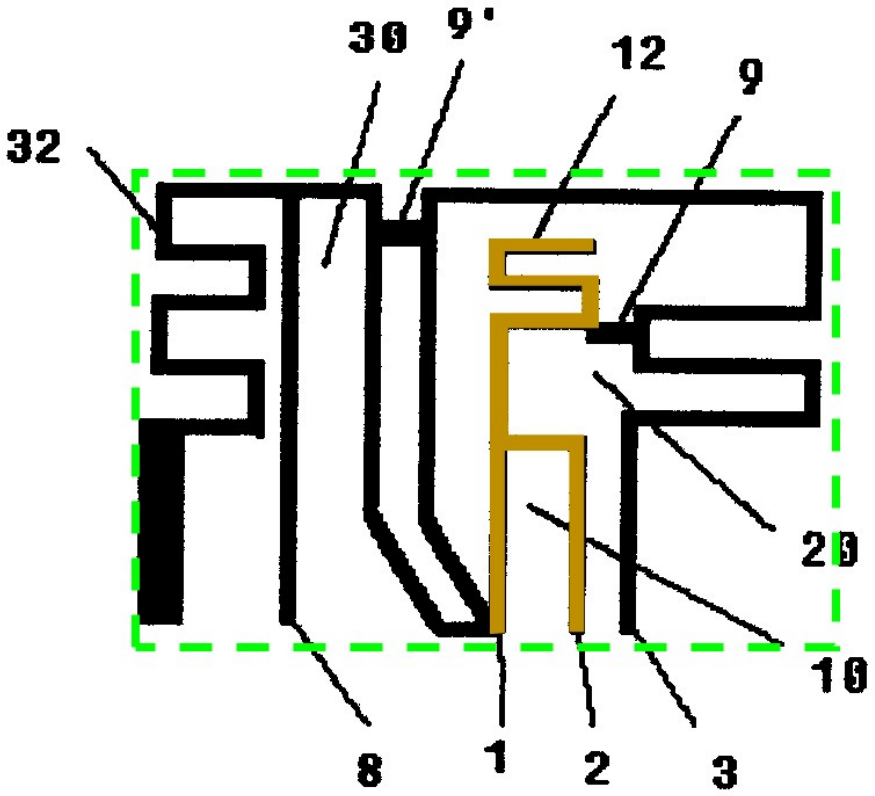
Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		segment 43 and parallel to each other, for receiving and transmitting signals of different frequencies, for example. It is further preferable that the antenna segments 43, 44, 45 of the two antenna members 41, 42 are disposed up and down relative to each other, or arranged in mirror symmetric relative to each other, for receiving and transmitting signals toward different vertical directions 49 relative to each other, or away from each other." Chou at [0030] "Furthermore, each of the antenna devices 30, 40 may include two or more antenna segments 33, 34, 35; and 43, 44, 45 respectively, for receiving and transmitting signals of different frequencies, and thus for allowing the antenna devices 30, 40 to receive and transmit signals of various frequencies. There will be no dead ends or dead corners formed or generated by the antenna devices 30, 40." Chou at [0033]

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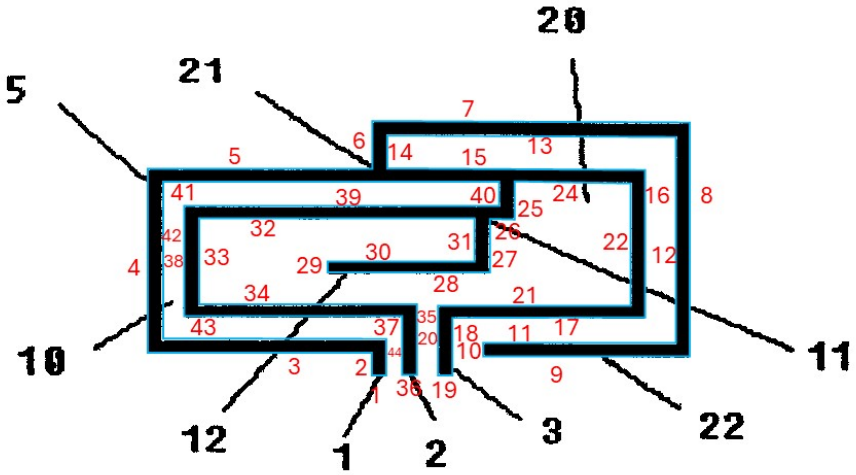
Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		 FIG. 2 Chou at Figure 2
1[m]	the second antenna being arranged completely within the ground plane rectangle.	Wei expressly or inherently discloses this claim element. *See, e.g.*,

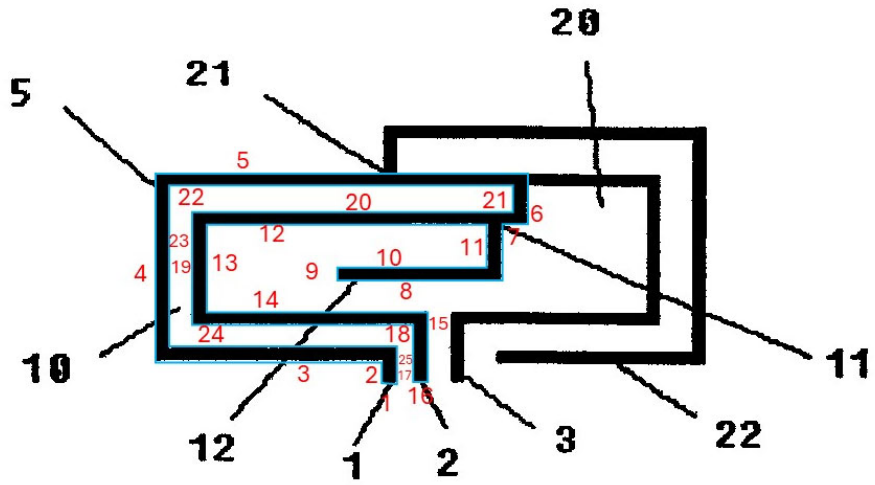
Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		 Wei at Figure 2A

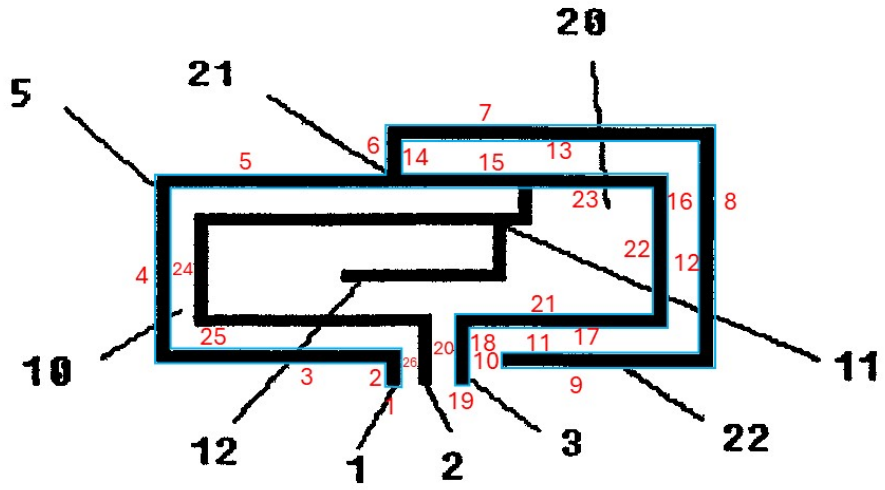
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Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		 Wei at Figure 9

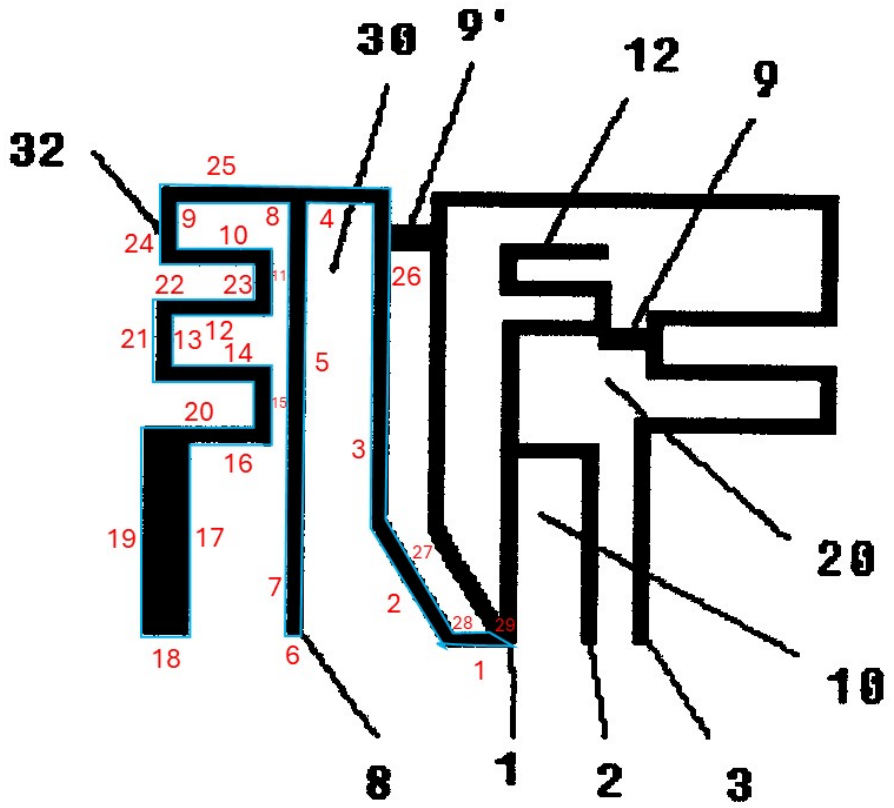
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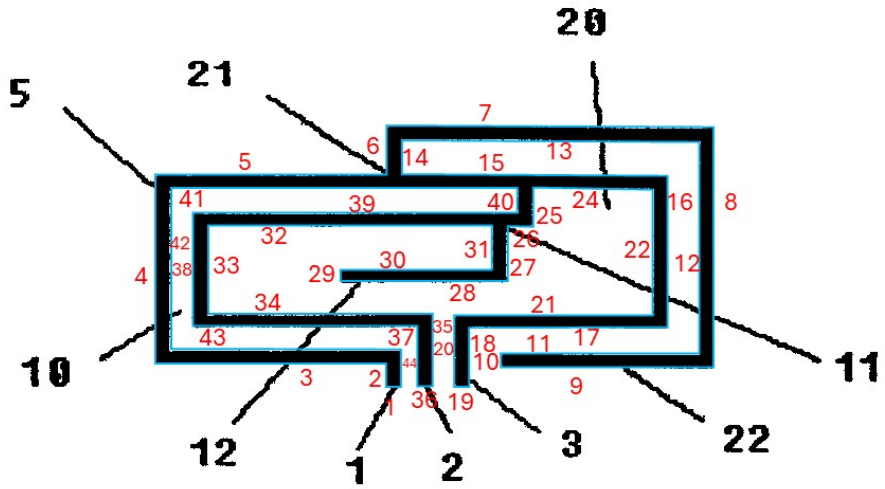
Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		Claim 2
2	The wireless device of claim 1, wherein the first antenna contour comprises at least 20 segments.	Wei expressly or inherently discloses this claim element. *See, e.g.*,  Wei at Figure 2A

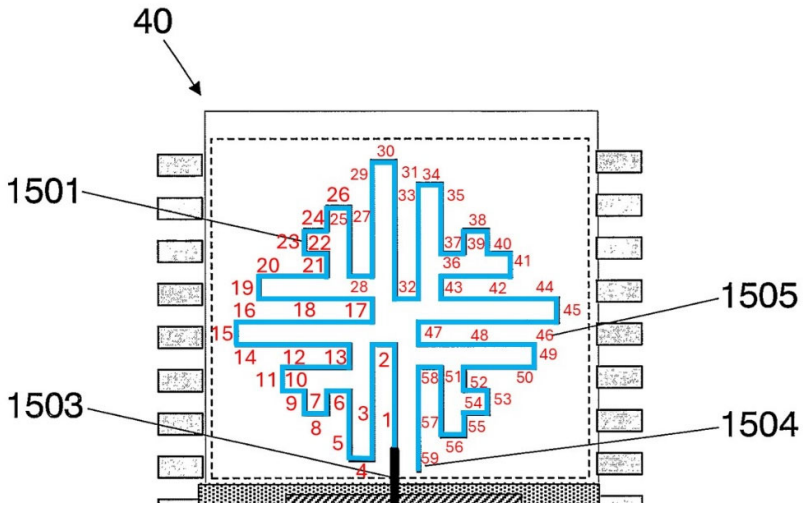
Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		 Wei at Figure 2A (Alternative)

Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		 Wei at Figure 2A (Second Alternative)

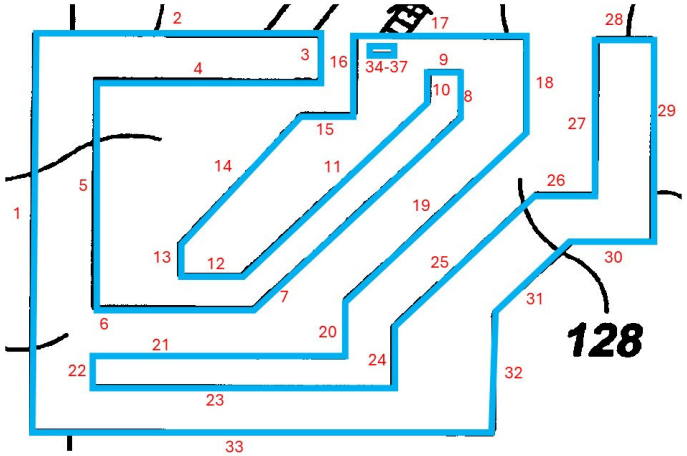
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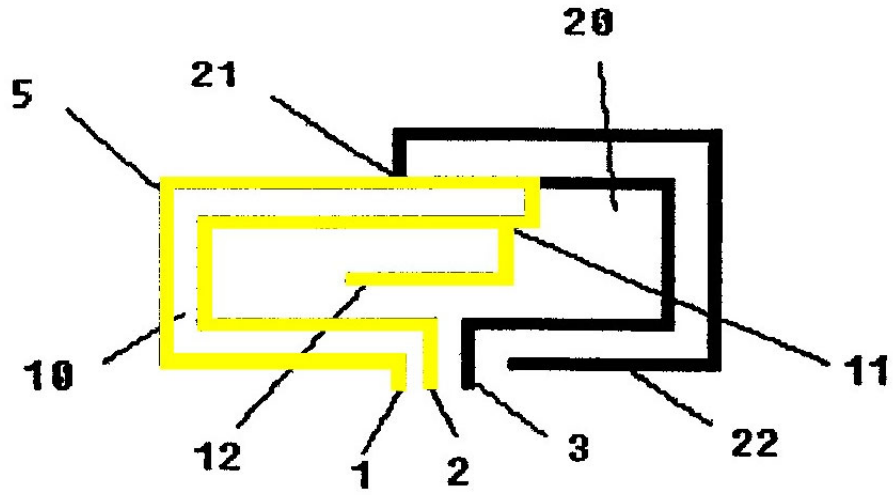
Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		 Wei at Figure 9

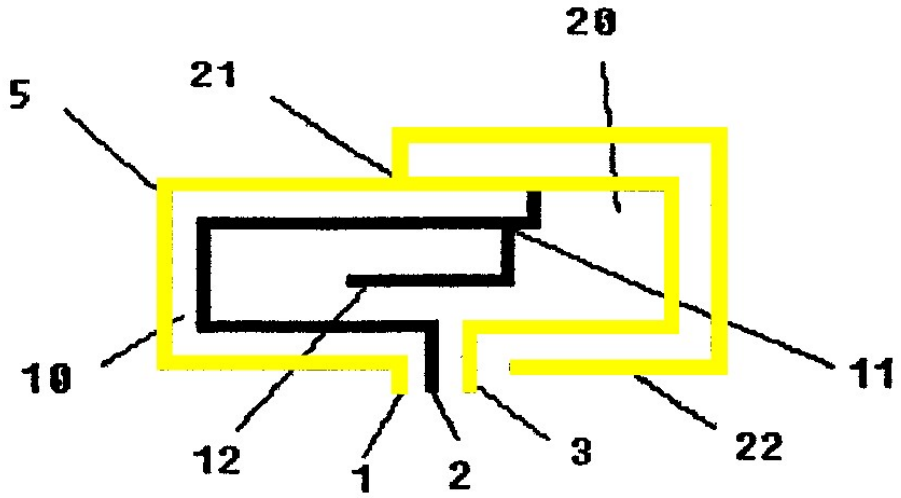
Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		Claim 3
3	The wireless device of claim 2, wherein the perimeter of the first antenna contour comprises at least 35 segments.	Wei expressly or inherently discloses this claim element. *See, e.g.*,  Wei at Figure 2A To the extent that this reference does not expressly disclose this claim limitation, in light of Plaintiff's apparent claim construction and infringement positions with respect to the Accused Products, a POSA would have understood it to implicitly disclose it or would have found the claim limitation obvious.

Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		Additionally, it would have been obvious to a person of ordinary skill in the art to modify this reference with any one or more of the references disclosed in Defendants' Invalidity Contentions based on knowledge of one of ordinary skill in the art and for the reasons articulated in Defendants' Invalidity Contentions Cover Pleading. *See, e.g.,*  Castany868 at Figure 15

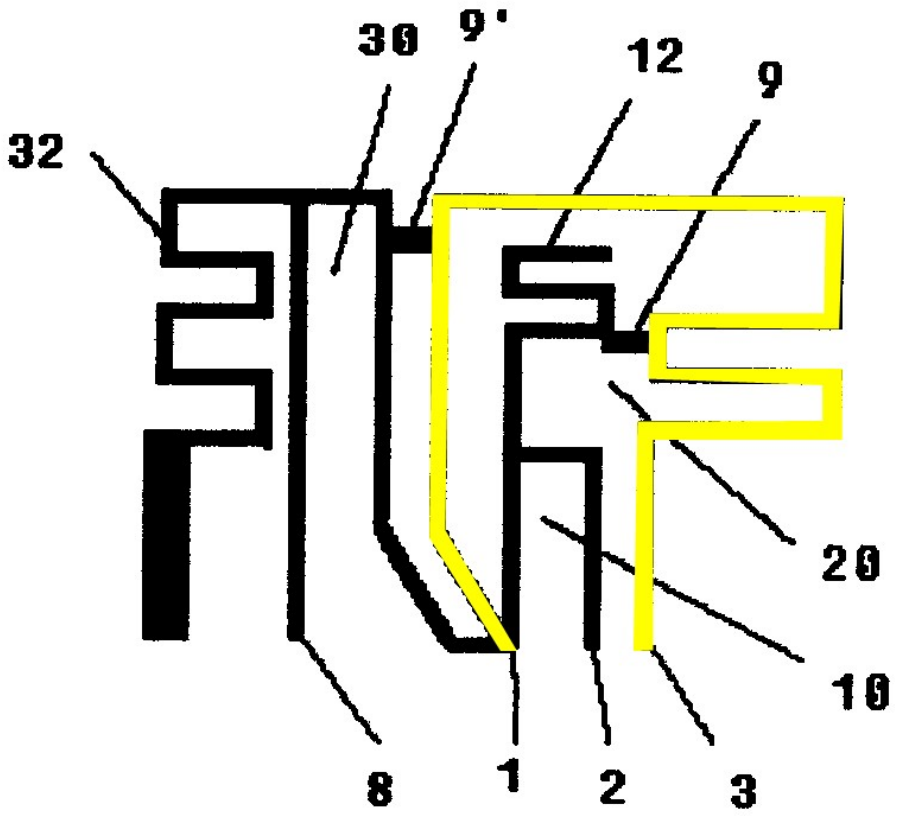
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Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		 Talvitie at Figure 1
Claim 4		
4	The wireless device of claim 1, wherein the antenna system comprises a third antenna configured to receive signals	Wei expressly or inherently discloses this claim element. *See, e.g.*,

Claim No.	U.S. Patent No. 11,031,677 B2	Wei
	employing a 4G communication standard.	 Wei at Figure 2A

Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		 Wei at Figure 2A (Alternative)

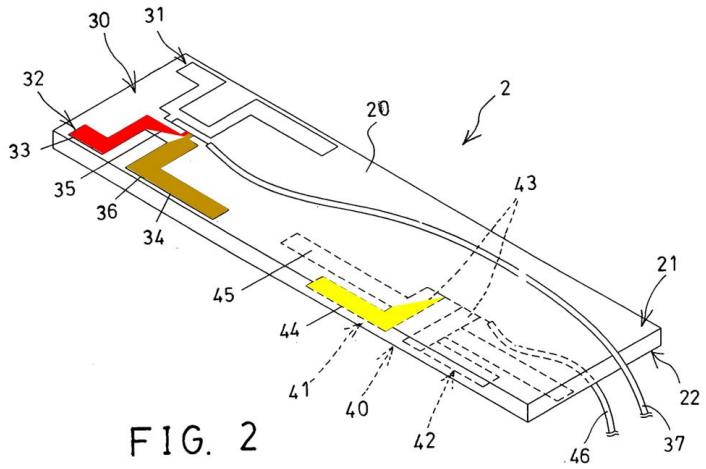
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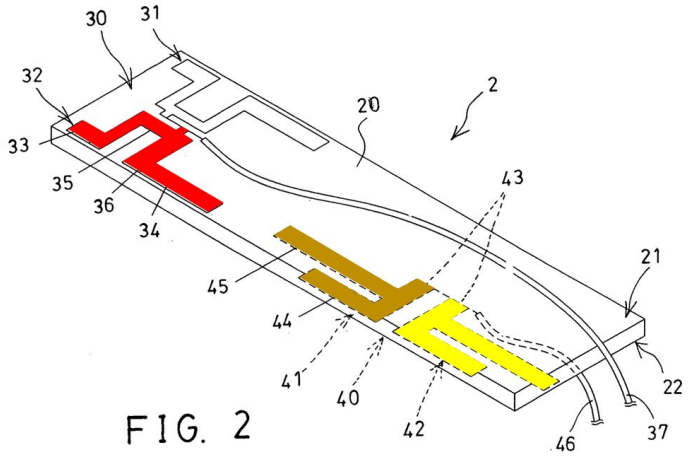
Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		 Wei at Figure 9

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Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		To the extent that this reference does not expressly disclose this claim limitation, in light of Plaintiff's apparent claim construction and infringement positions with respect to the Accused Products, a POSA would have understood it to implicitly disclose it or would have found the claim limitation obvious. Additionally, it would have been obvious to a person of ordinary skill in the art to modify this reference with any one or more of the references disclosed in Defendants' Invalidity Contentions based on knowledge of one of ordinary skill in the art and for the reasons articulated in Defendants' Invalidity Contentions Cover Pleading. *See e.g.,* "It is preferable that the antenna members 31, 32 of the antenna device 30 each includes two antenna segments 33, 34 disposed up and down relative to each other, and an intermediate and/or C-shaped antenna segment 35 disposed between the antenna segments 33, 34, for receiving and transmitting signals of different frequencies, for example. It is further preferable that the antenna segments 33, 34, 35 of the two antenna members 31, 32 are disposed side by side and/or parallel to each other, or arranged in mirror symmetric relative to each other, for receiving and transmitting signals toward different lateral directions 39 relative to each other, or away from each other." Chou at [0028] "Similarly, the antenna members 41, 42 of the antenna device 40 each includes a base antenna segment 43 disposed up and down relative to each other, and two antenna segments 44, 45 extended from the base antenna segment 43 and parallel to each other, for receiving and transmitting signals of different frequencies, for example. It is further preferable that the antenna segments 43, 44, 45 of the two antenna members 41, 42 are disposed up and down relative to each other, or arranged in mirror symmetric relative to each other, for receiving and transmitting signals toward different vertical directions 49 relative to each other, or away from each other." Chou at [0030]

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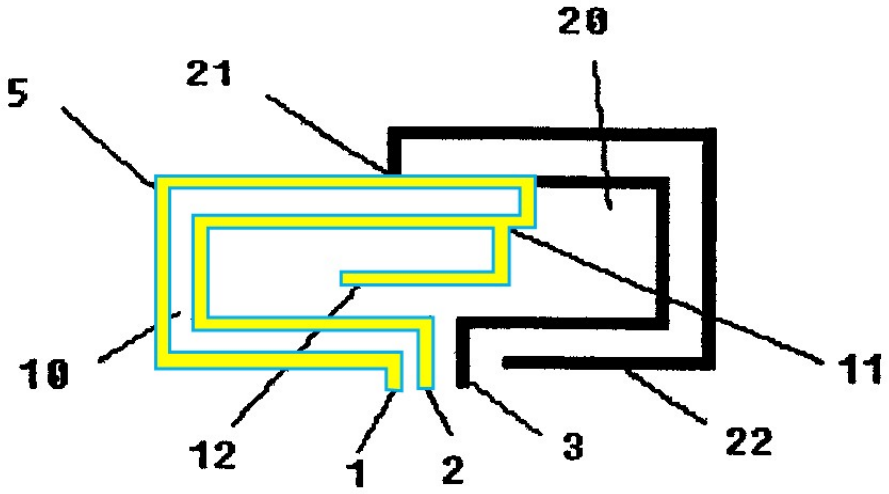
Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		"Furthermore, each of the antenna devices 30, 40 may include two or more antenna segments 33, 34, 35; and 43, 44, 45 respectively, for receiving and transmitting signals of different frequencies, and thus for allowing the antenna devices 30, 40 to receive and transmit signals of various frequencies. There will be no dead ends or dead corners formed or generated by the antenna devices 30, 40." Chou at [0033]  FIG. 2 Chou at Figure 2

Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		 FIG. 2 Chou at Figure 2 (Alternative)
		Claim 5
5[a]	The wireless device of claim 4, wherein the third antenna defines an antenna contour comprising an	Wei expressly or inherently discloses this claim element. *See, e.g.*, claim elements 1[h], 1[k], 1[l], 1[m], 4 "Referring to FIG. 8A, in a seventh preferred embodiment provided in this utility model, the metal conductor part includes three signal loops which are respectively a first signal loop 10, a second signal loop 20, and a third signal loop 30. The three signal loops start from the common feed point 1 and terminate at respective ground points 2, 3, 8. The three signal loops have a common conductor 5. The first signal loop 10 does not have a conductor branch, and each of the second signal loop 20 and the third signal loop 30 has one conductor branch 22, 32. Referring to

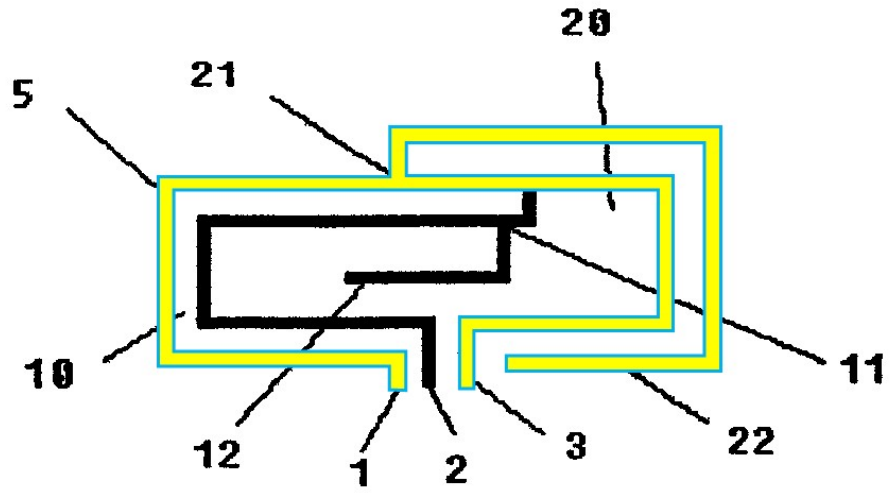
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Claim No.	U.S. Patent No. 11,031,677 B2	Wei
	entire perimeter of the third antenna, and	FIG. 8B, in an alternative form of this embodiment, each of the three signal loops 10, 20, 30 has one conductor branch 12, 22, 32. Referring to FIG. 9, in an eighth preferred embodiment provided in this utility model, the metal conductor part includes three signal loops which are respectively a first signal loop 10, a second signal loop 20, and a third signal loop 30. The three signal loops have no other common parts except the common feed point 1. The signal loops respectively terminate at ground points 2, 3, 8, and each of the first and third signal loops 10, 30 has one conductor branch 12, 32. Certainly, there may alternatively be another form to design the conductor branch according to a calculation result. One or each of two of the first signal loop 10, the second signal loop 20, and the third signal loop 30 has two conductor branches, and each of the other two signal loops or the other one signal loop has one conductor branch. A length of the conductor branch 12, 22, 32 is 0.1 to 80 mm. A distance from a connection point 11, 21, 31 of the conductor branch 12, 22, 32 and the signal loop to the feed point 1 is 10% to 90% of a total length of a conductor of the signal loop. As shown in FIG. 8C, in a further improvement on the seventh preferred embodiment, a part of the first signal loop 10 except the common conductor 5 and a part of the second signal loop 20 except the common conductor 5 are connected through one conductor connection sheet 9. The part of the second signal loop 20 except the common conductor 5 and a part of the third signal loop 30 except the common conductor 5 are connected through one conductor connection sheet 9'. Similarly, as shown in FIG. 9, in a further improvement on the eighth preferred embodiment, the first signal loop 10 and the second signal loop 20 are connected through one conductor connection sheet 9. The second signal loop 20 and the third signal loop 30 are connected through one conductor connection sheet 9'. Certainly, according to a design result and a calculation result, two signal loops may be completely designed to be connected through a plurality of conductor connection sheets. The metal conductor part of the antenna of this utility model may further include four or more signal loops. Referring to FIG. 10, in a ninth preferred embodiment provided in this utility model, the metal conductor part includes four signal loops which are respectively a first signal loop 10, a second signal loop 20, a third signal loop

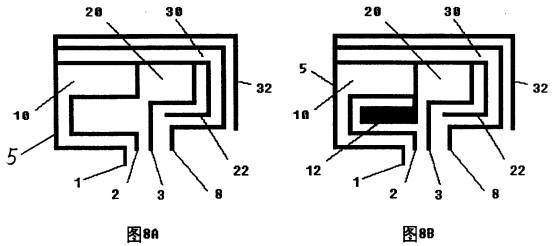
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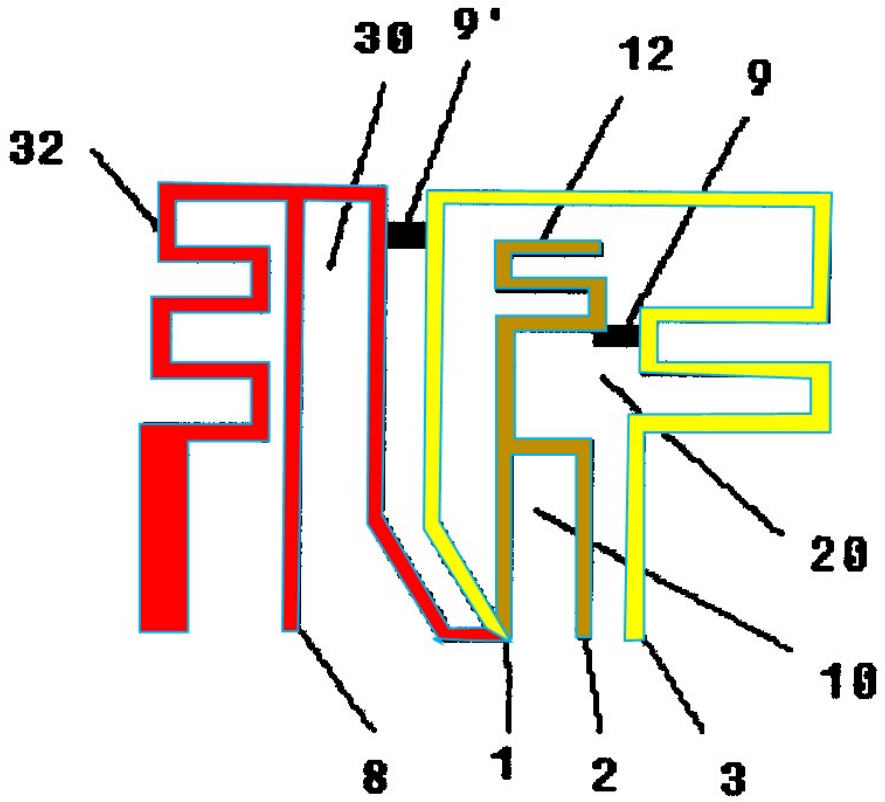
Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		30, and a fourth signal loop 40. The first, second, third, and fourth signal loops respectively have independent ground points 2, 3, 8, 8', and each of the four signal loops has one conductor branch 12, 22, 32, 42. Referring to FIG. 11, in a tenth preferred embodiment provided in this utility model, the metal conductor part also includes four signal loops which are respectively a first signal loop 10, a second signal loop 20, a third signal loop 30, and a fourth signal loop 40. A difference from the ninth preferred embodiment is that the four signal loops have three ground points 2, 3, 8, where the third and fourth signal loops share the same ground point 8. The third signal loop does not have a conductor branch, and each of the first, second, and fourth signal loops has one conductor branch 12, 22, 42." Wei at 16:17-17:26 

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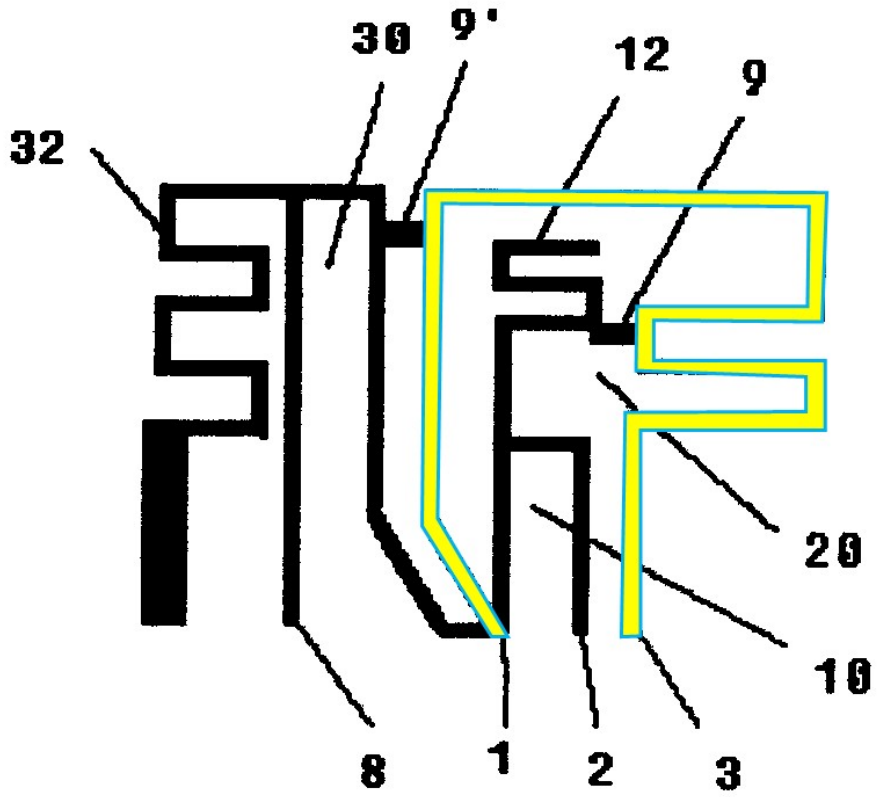
Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		Wei at Figure 2A  Wei at Figure 2A (Alternative)

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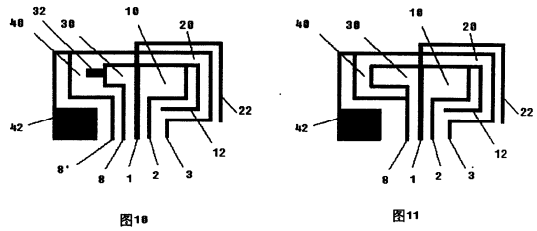
Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		 Wei at Figures 8A and 8B

Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		 Wei at Figure 9

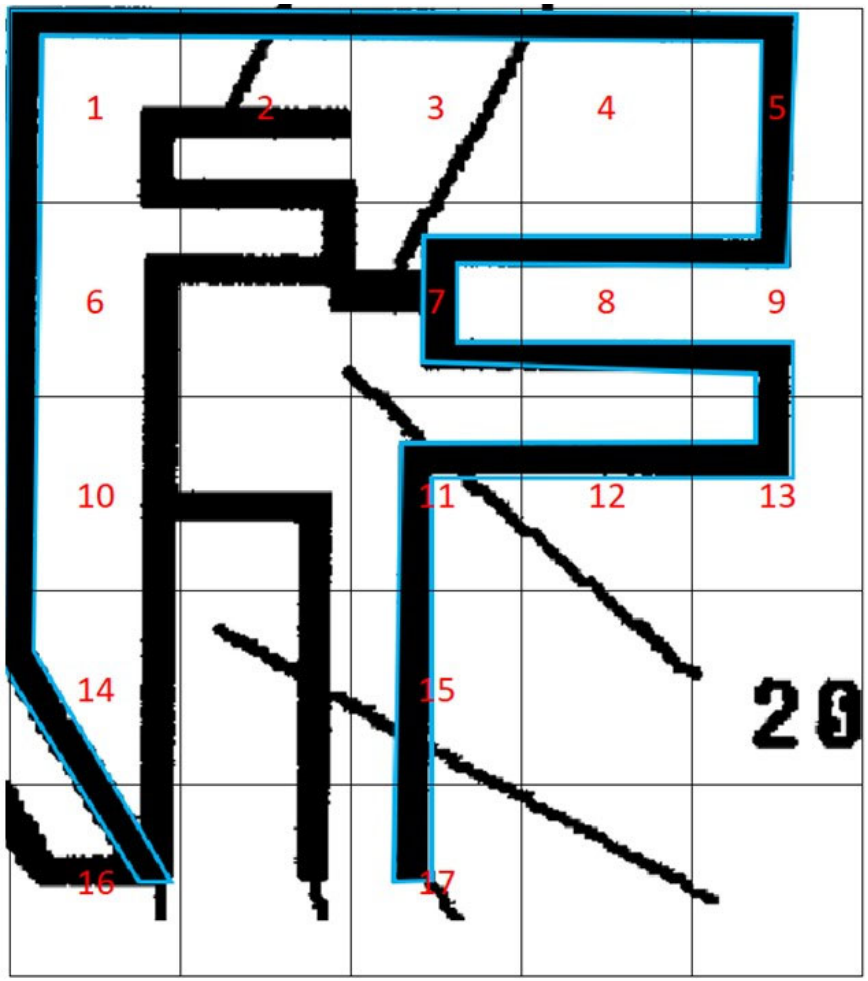
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Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		 Wei at Figure 9 (Alternative)

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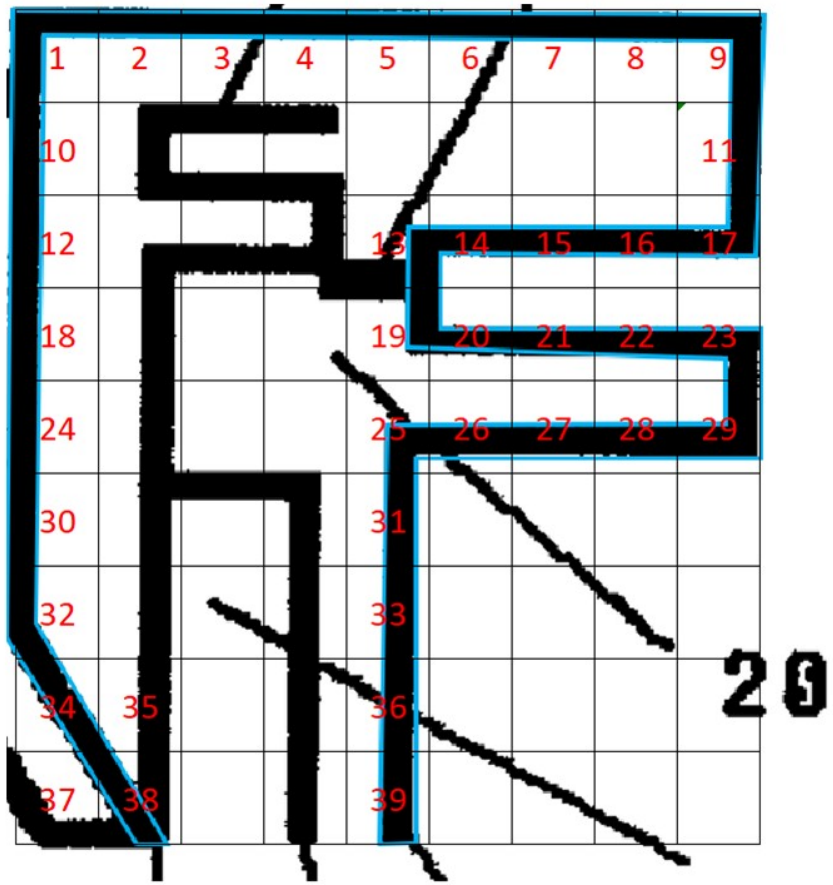
Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		 Wei at Figures 10, 11
5[b]	wherein the antenna contour of the third antenna has a level of complexity defined by complexity factor F_{21} having a value of at least 1.2 and	Wei expressly or inherently discloses this claim element. *See, e.g.*, claim elements 1[h], 1[k], 1[l], 1[m], 4, 5[a]

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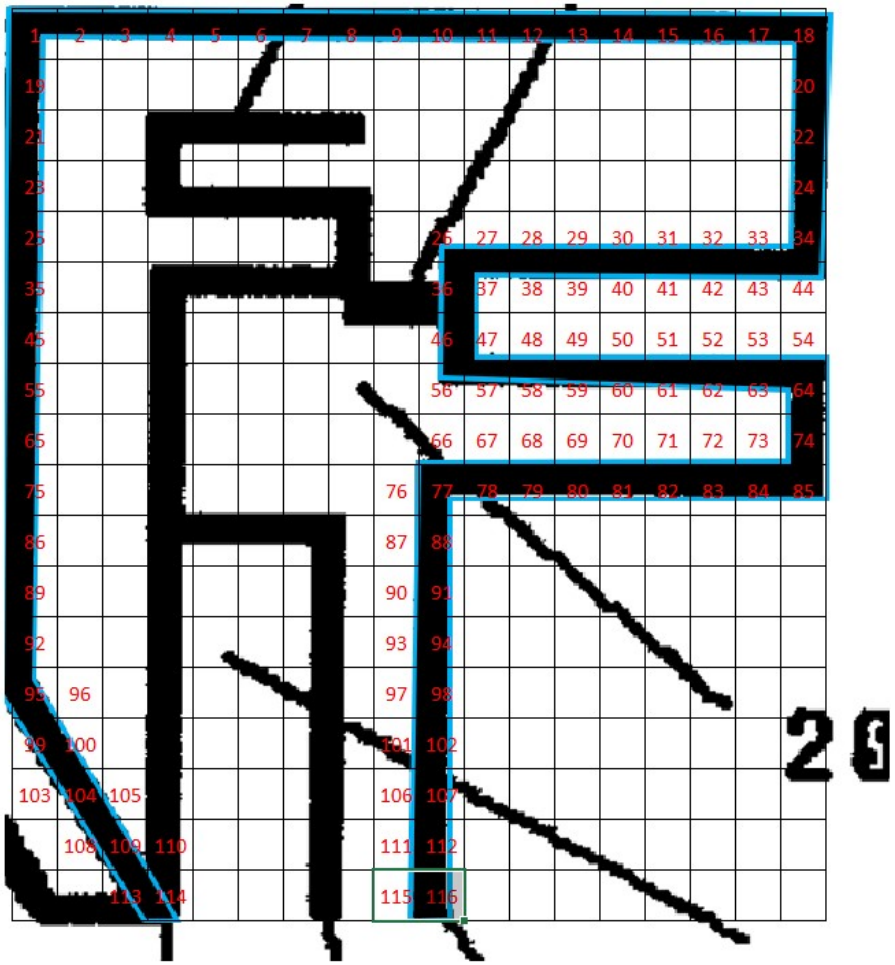


Wei at Figure 9, Calculating N_1

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Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		 Wei at Figure 9, Calculating N_2

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Wei at Figure 9, Calculating N_3

Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		To the extent that this reference does not expressly disclose this claim limitation, in light of Plaintiff's apparent claim construction and infringement positions with respect to the Accused Products, a POSA would have understood it to implicitly disclose it or would have found the claim limitation obvious. Additionally, it would have been obvious to a person of ordinary skill in the art to modify this reference with any one or more of the references disclosed in Defendants' Invalidity Contentions based on knowledge of one of ordinary skill in the art and for the reasons articulated in Defendants' Invalidity Contentions Cover Pleading.
5[c]	a complexity factor F_{32} having a value of at least 1.35.	Wei expressly or inherently discloses this claim element. *See, e.g.*, claim elements 1[h], 1[k], 1[l], 1[m], 4, 5[a], 5[b] Further, it would have been obvious to a person of ordinary skill in the art that, when $N_1 = 17$; $N_2 = 39$; and $N_3 = 116$; that given $$F_{32=-}\frac{(\log_{10}(N_3)-\log_{10}(N_2)}{\log_{10}1/2}$$ solving for F_{32} results in $$F_{32=-}\frac{(\log_{10}(116)-\log_{10}(39)}{\log_{10}1/2}= 1.5726$$ and

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Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		$1.35 \leq 1.5726$ To the extent that this reference does not expressly disclose this claim limitation, in light of Plaintiff's apparent claim construction and infringement positions with respect to the Accused Products, a POSA would have understood it to implicitly disclose it or would have found the claim limitation obvious. Additionally, it would have been obvious to a person of ordinary skill in the art to modify this reference with any one or more of the references disclosed in Defendants' Invalidity Contentions based on knowledge of one of ordinary skill in the art and for the reasons articulated in Defendants' Invalidity Contentions Cover Pleading.
Claim 6		
6[pre]	A wireless device comprising:	To the extent the preamble is limiting, Wei expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[pre]
6[a]	an antenna system comprising:	Wei expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[a]
6[b]	[*the antenna system*	Wei expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[b]

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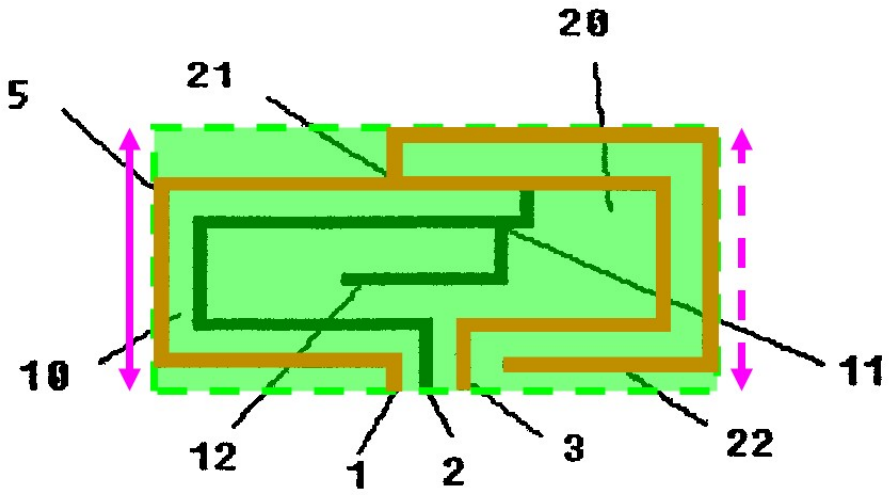
Claim No.	U.S. Patent No. 11,031,677 B2	Wei
	comprising] a ground plane;	
6[c]	[*the antenna system comprising*] a first antenna within the wireless device and	Wei expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[c]
6[d]	configured to support at least two frequency bands contained within first and second frequency ranges of the electromagnetic spectrum,	Wei expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[d]
6[e]	the second frequency range being higher in frequency than	Wei expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[e]

Claim No.	U.S. Patent No. 11,031,677 B2	Wei
	the first frequency range,	
6[f]	the first antenna being proximate to a first short side of a ground plane rectangle enclosing the ground plane and	Wei expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[g]
6[g]	defining a first antenna contour comprising an entire perimeter of the first antenna,	Wei expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[h]
6[h]	wherein the first antenna contour has a level of complexity defined by	Wei expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[i]

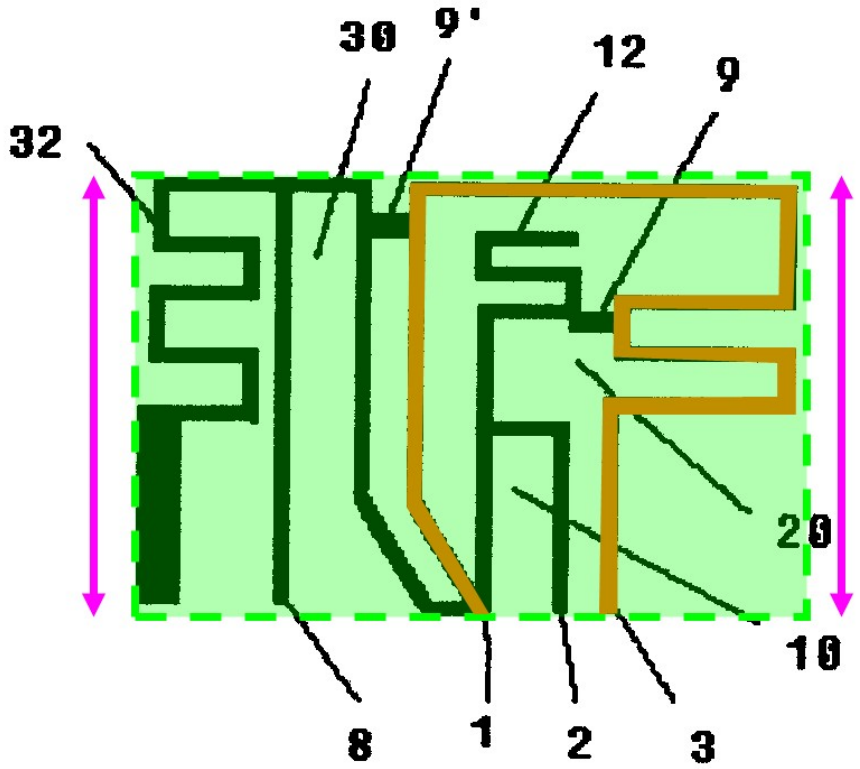
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Claim No.	U.S. Patent No. 11,031,677 B2	Wei
	complexity factor F_{21} having a value of at least 1.20 and	
6[i]	complexity factor F_{32} having a value less than 1.75; and	Wei expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[j]
6[j]	[*the antenna system comprising*] a second antenna within the wireless device and	Wei expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[k]
6[k]	defining a second antenna contour comprising an entire perimeter of the second antenna,	Wei expressly or inherently discloses this claim element. *See, e.g.*, claim elements 1[h], 1[k], 1[l], 1[m], 4, 5[a]

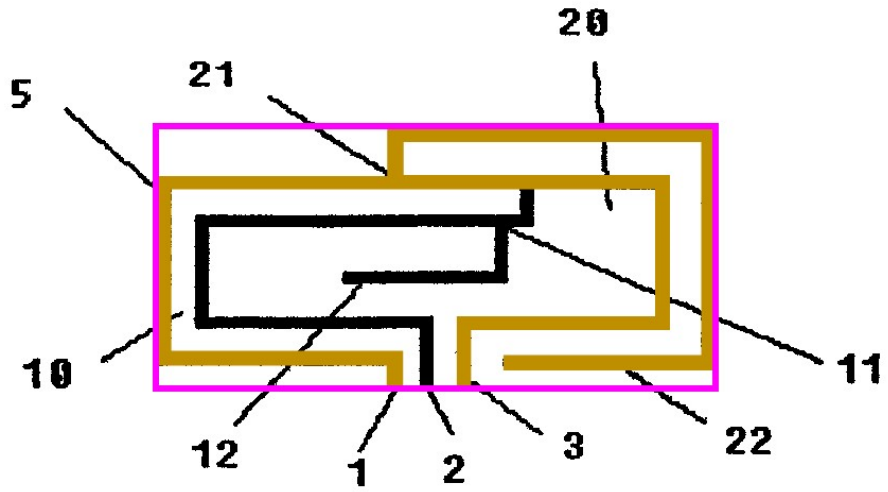
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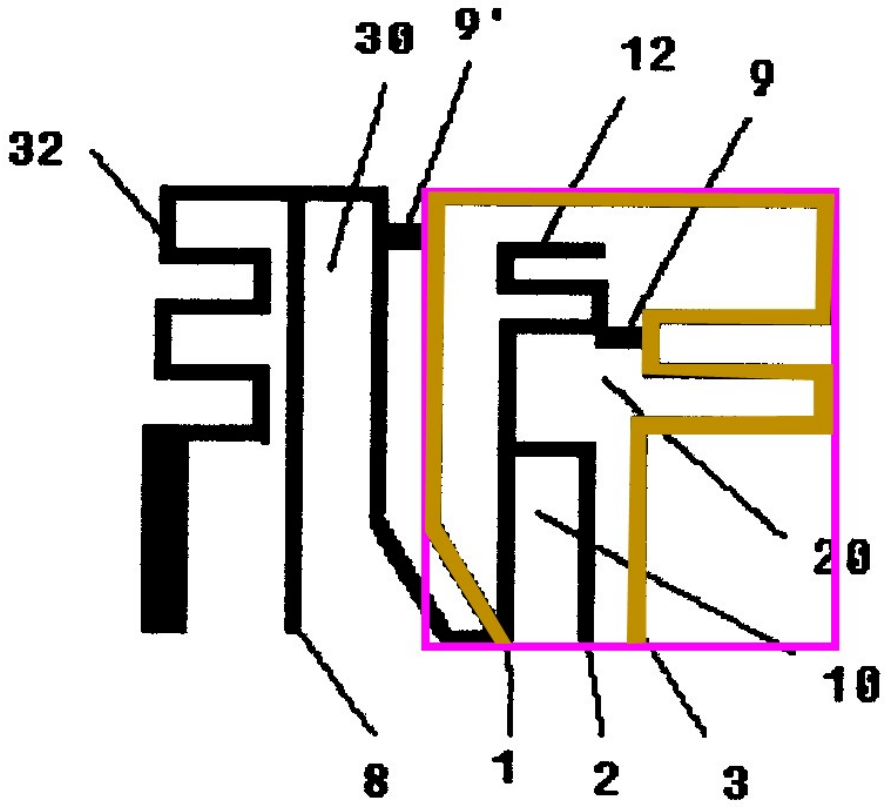
Claim No.	U.S. Patent No. 11,031,677 B2	Wei
6[l]	the second antenna being proximate to a second short side of the ground plane rectangle that is opposite to the first short side of the ground plane rectangle,	Wei expressly or inherently discloses this claim element. *See, e.g.*,  Wei at Figure 2A

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Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		 Wei at Figure 9
6[m]	a minimum-sized	Wei expressly or inherently discloses this claim element.

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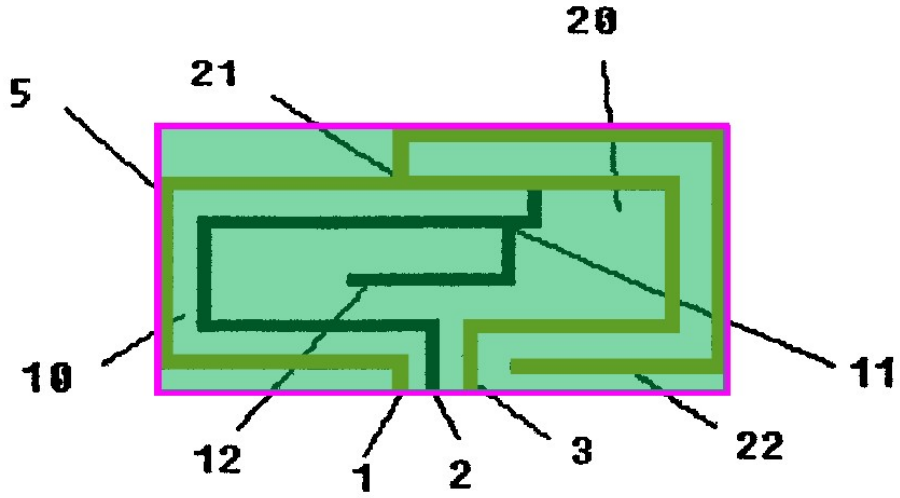
Claim No.	U.S. Patent No. 11,031,677 B2	Wei
	parallelepiped of rectangular faces that completely encloses a volume of the second antenna defining an antenna box, and	*See, e.g.*,  Wei at Figure 2A

Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		 Wei at Figure 9

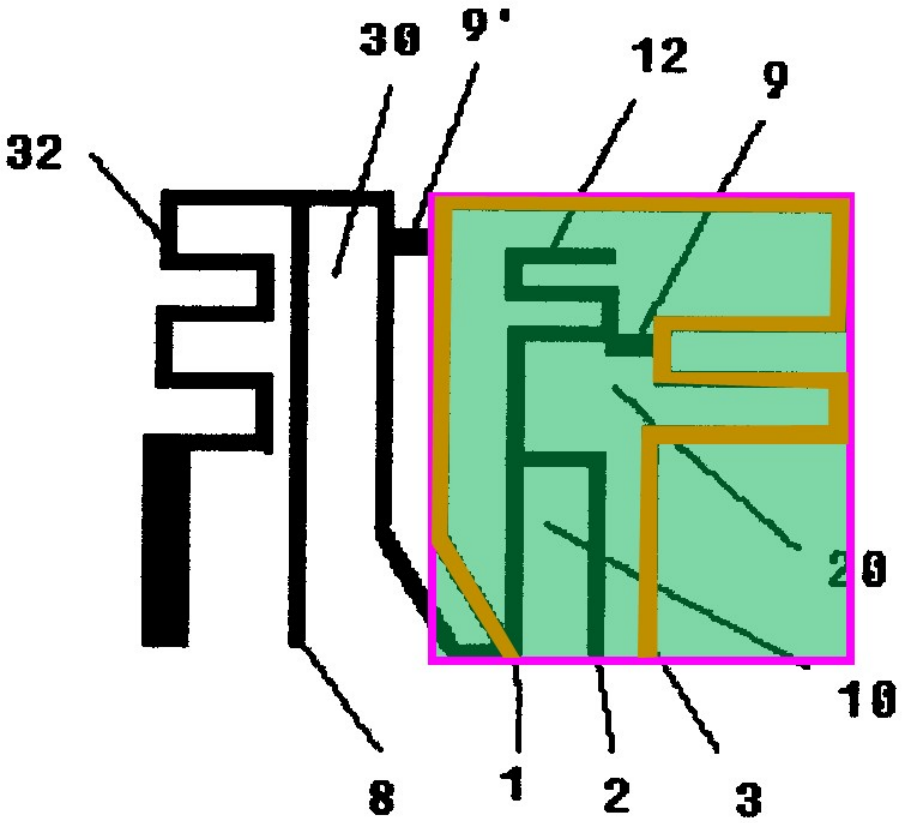
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Claim No.	U.S. Patent No. 11,031,677 B2	Wei
6[n]	an orthogonal projection of the antenna box along a normal to a face with a largest area of the second antenna defining	Wei expressly or inherently discloses this claim element. *See, e.g.*, claim element 6[m], 6[o]
6[o]	an antenna rectangle,	Wei expressly or inherently discloses this claim element. *See, e.g.*,

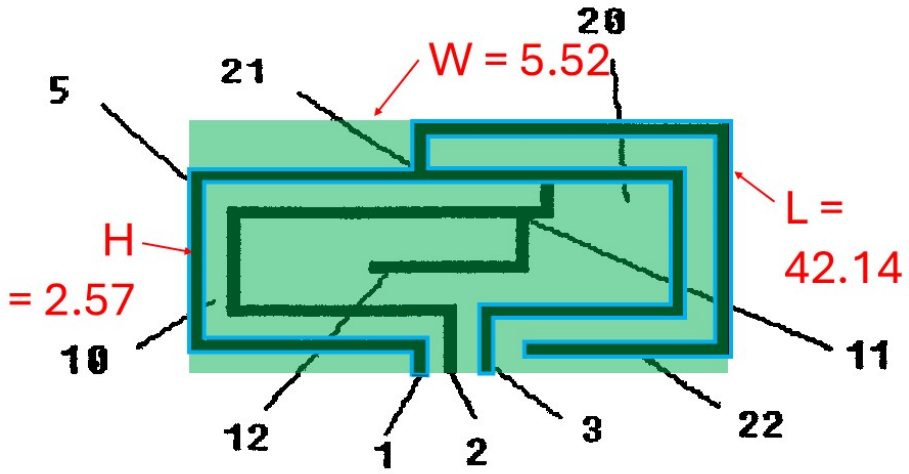
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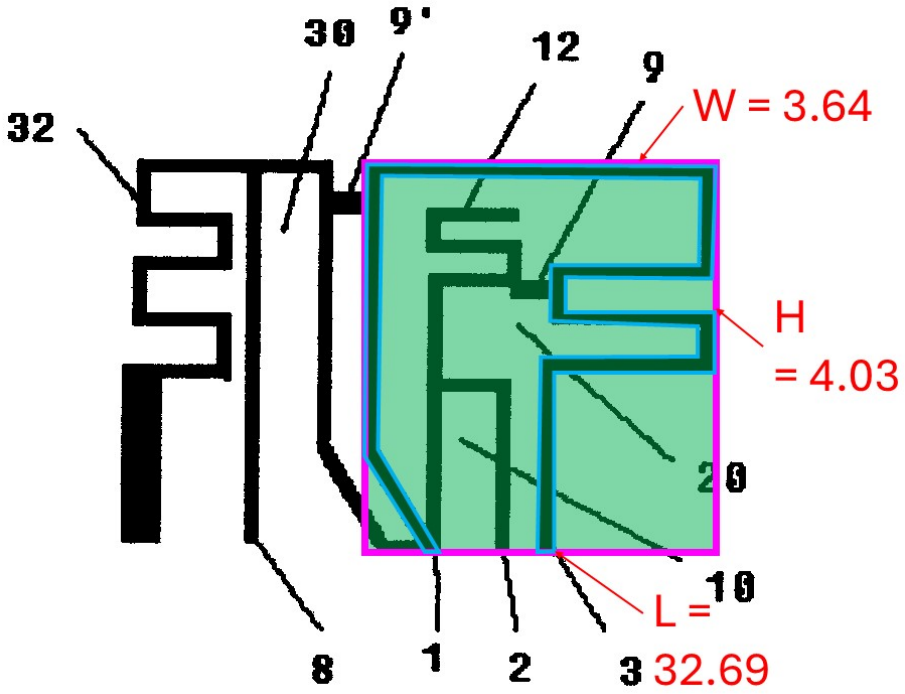
Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		 Wei at Figure 2A

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Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		 Wei at Figure 9

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Claim No.	U.S. Patent No. 11,031,677 B2	Wei
6[p]	wherein a length of the second antenna contour is greater than four times a diagonal of the antenna rectangle.	Wei expressly or inherently discloses this claim element. *See, e.g.*,  Wei at Figure 2A It would have been obvious to a person of ordinary skill in the art that a width of 5.52 and a height of 2.57 results in a diagonal of 6.09, and that four times that diagonal is 24.36. Additionally, it would have been obvious that a length of 42.14 is greater than 24.36.

Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		 Wei at Figure 9 It would have been obvious to a person of ordinary skill in the art that a width of 3.64 and a height of 4.03 results in a diagonal of 5.43, and that four times that diagonal is 21.72. Additionally, it would have been obvious that a length of 32.69 is greater than 21.72.

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Claim No.	U.S. Patent No. 11,031,677 B2	Wei
		To the extent that this reference does not expressly disclose this claim limitation, in light of Plaintiff's apparent claim construction and infringement positions with respect to the Accused Products, a POSA would have understood it to implicitly disclose it or would have found the claim limitation obvious. Additionally, it would have been obvious to a person of ordinary skill in the art to modify this reference with any one or more of the references disclosed in Defendants' Invalidity Contentions based on knowledge of one of ordinary skill in the art and for the reasons articulated in Defendants' Invalidity Contentions Cover Pleading.
Claim 7		
7	The wireless device of claim 6, wherein the first antenna contour comprises at least 20 segments.	Wei expressly or inherently discloses this claim element. *See, e.g.*, claim element 2
Claim 8		
8	The wireless device of claim 6, wherein the first antenna contour comprises at	Wei expressly or inherently discloses this claim element. *See, e.g.*, claim element 3

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Claim No.	U.S. Patent No. 11,031,677 B2	Wei
	least 35 segments.	
Claim 9		
9[a]	The wireless device of claim 6, wherein the second antenna contour has a level of complexity defined by complexity factor F_{21} having a value of at least 1.2 and	Wei expressly or inherently discloses this claim element. *See, e.g.*, claim elements 1[h], 1[k], 1[l], 1[m], 4, 5[a], 5[b]
9[b]	a complexity factor F_{32} having a value of at least 1.35.	Wei expressly or inherently discloses this claim element. *See, e.g.*, claim elements 1[h], 1[k], 1[l], 1[m], 4, 5[a], 5[b], 5[c], 9[a]
Claim 12		

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Claim No.	U.S. Patent No. 11,031,677 B2	Wei
12[pre]	A wireless device comprising:	To the extent the preamble is limiting, Wei expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[pre], 6[pre]
12[a]	an antenna system comprising:	Wei expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[a], 6[a]
12[b]	[*the antenna system comprising*] a ground plane;	Wei expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[b], 6[b]
12[c]	[*the antenna system comprising*] a first antenna within the wireless device and	Wei expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[c], 6[c]
12[d]	configured to provide	Wei expressly or inherently discloses this claim element.

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Claim No.	U.S. Patent No. 11,031,677 B2	Wei
	operation in at least four frequency bands,	*See, e.g.*, claim element 1[d], 6[d]
12[e]	at least one of the at least four frequency bands is contained within a first frequency range and	Wei expressly or inherently discloses this claim element. *See, e.g.*, 1[d], 6[d], 12[d]
12[f]	at least one other of the four frequency bands is contained within a second frequency range,	Wei expressly or inherently discloses this claim element. *See, e.g.*, 1[d], 6[d], 12[d], 12[e]
12[g]	the first frequency range being lower in frequency than	Wei expressly or inherently discloses this claim element. *See, e.g.*, claim element 12[e], 12[f]

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Claim No.	U.S. Patent No. 11,031,677 B2	Wei
	the second frequency range,	To the extent that this reference does not expressly disclose this claim limitation, in light of Plaintiff's apparent claim construction and infringement positions with respect to the Accused Products, a POSA would have understood it to implicitly disclose it or would have found the claim limitation obvious. It would have been obvious to a person of ordinary skill in the art that frequency bands with higher Hertz values would be higher in frequency than frequency bands with relatively lower Hertz values. Additionally, it would have been obvious to a person of ordinary skill in the art to modify this reference with any one or more of the references disclosed in Defendants' Invalidity Contentions based on knowledge of one of ordinary skill in the art and for the reasons articulated in Defendants' Invalidity Contentions Cover Pleading.
12[h]	the first antenna being proximate to a first short side of a ground plane rectangle enclosing the ground plane,	Wei expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[g], 6[f]
12[i]	the first antenna defining a first antenna contour comprising an entire perimeter	Wei expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[h], 6[g]

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Claim No.	U.S. Patent No. 11,031,677 B2	Wei
	of the first antenna, and	
12[j]	wherein the first antenna contour has a level of complexity defined by complexity factor F_{21} having a value of at least 1.20 and	Wei expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[i], 6[h]
12[k]	complexity factor F_{32} having a value less than 1.75; and	Wei expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[j], 6[i]
12[l]	wherein the first antenna is configured to transmit and receive signals from a 4G	Wei expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[f], 4

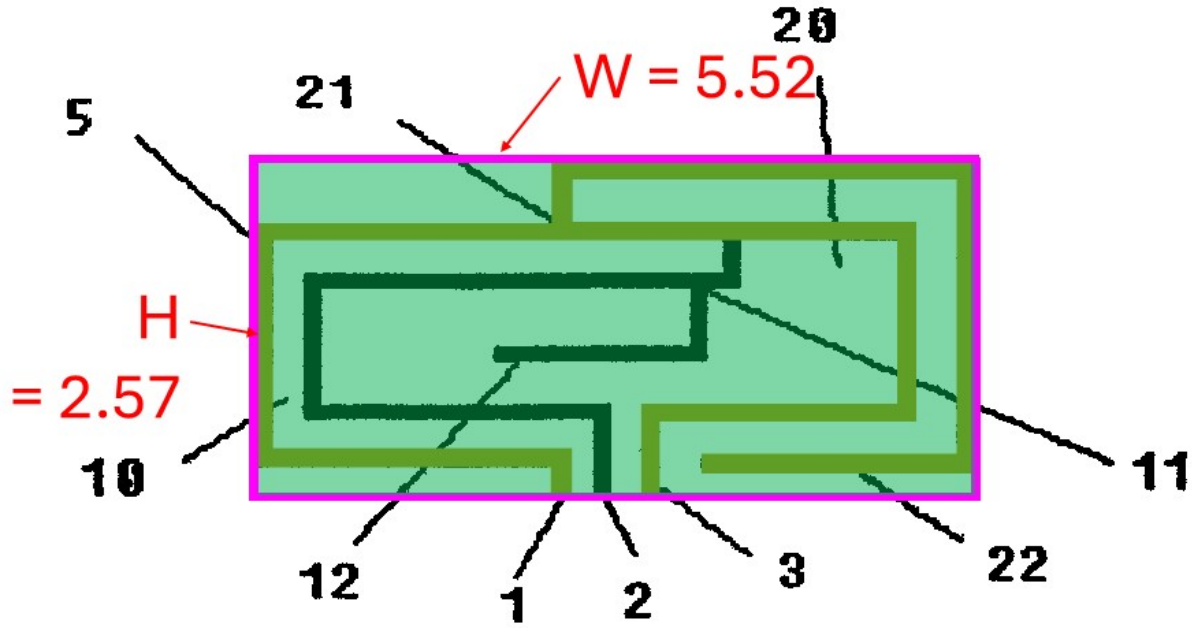
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Claim No.	U.S. Patent No. 11,031,677 B2	Wei
	communication standard; and	
12[m]	[*the antenna system comprising*] a second antenna within the wireless device and configured to receive signals from a 4G communication standard,	Wei expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[f], 4, 12[l]
12[n]	a minimum-sized parallelepiped of rectangular faces that completely encloses a volume of the second antenna defining an antenna box,	Wei expressly or inherently discloses this claim element. *See, e.g.*, claim element 6[m]

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Claim No.	U.S. Patent No. 11,031,677 B2	Wei
12[o]	an orthogonal projection of the antenna box along a normal to a face with a largest area of the second antenna defining	Wei expressly or inherently discloses this claim element. *See, e.g.*, claim element 6[n]
12[p]	an antenna rectangle,	Wei expressly or inherently discloses this claim element. *See, e.g.*, claim element 6[o]
12[q]	an aspect ratio of the antenna rectangle being defined as a ratio between a width and a height of the antenna rectangle, and wherein the aspect ratio has	Wei expressly or inherently discloses this claim element. *See, e.g.*,

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Claim No.	U.S. Patent No. 11,031,677 B2	Wei
	a value of at least 2.	 Wei at Figure 2A It would have been obvious to a person of ordinary skill in the art that a width of 5.52 and a height of 2.57 results in an aspect ratio of 2.15, and that 2.15 is greater than 2.
Claim 13		

Claim No.	U.S. Patent No. 11,031,677 B2	Wei
13	The wireless device of claim 12, wherein the first antenna contour comprises at least 20 segments.	Wei expressly or inherently discloses this claim element. *See, e.g.*, claim element 2, 7
	Claim 14	
14	The wireless device of claim 13, wherein the first antenna contour comprises at least 35 segments.	Wei expressly or inherently discloses this claim element. *See, e.g.*, claim element 3, 8
	Claim 15	
15	The wireless device of claim 12, wherein the second antenna is proximate to	Wei expressly or inherently discloses this claim element. *See, e.g.*, claim element 6[l]

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Claim No.	U.S. Patent No. 11,031,677 B2	Wei
	a second short side of the ground plane rectangle that is opposite to the first short side of the ground plane rectangle.	
	Claim 16	
16[a]	The wireless device of claim 12, wherein the second antenna defines a second antenna contour comprising an entire perimeter of the second antenna,	Wei expressly or inherently discloses this claim element. *See, e.g.*, claim elements 1[h], 1[k], 1[l], 1[m], 4, 5[a], 6[k]
16[b]	and wherein the second antenna contour has a level of complexity	Wei expressly or inherently discloses this claim element. *See, e.g.*, claim elements 1[h], 1[k], 1[l], 1[m], 4, 5[a], 5[b], 9[a]

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Claim No.	U.S. Patent No. 11,031,677 B2	Wei
	defined by complexity factor F_{21} having a value of at least 1.2 and	
16[c]	a complexity factor F_{32} having a value of at least 1.35.	Wei expressly or inherently discloses this claim element. *See, e.g.*, claim elements 1[h], 1[k], 1[l], 1[m], 4, 5[a], 5[b], 5[c], 9[a], 9[b]
Claim 17		
17	The wireless device of claim 16, wherein the second antenna contour comprises at least 20 segments.	Wei expressly or inherently discloses this claim element. *See, e.g.*, claim elements 2, 7, 13

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Exhibit – D – 03

5INVALIDITY CONTENTIONS FOR U.S. PATENT NO. 11,031,677 B2
BASED ON PCT PUBLICATION NO. 2004/042868 TO CASTANY ET AL. ("CASTANY868")

Based upon Plaintiff's Complaint, Infringement Contentions, and apparent claim constructions and application of the claims to Defendants' accused products, as best as they can be deciphered, the reference charted below anticipates or at least renders obvious some or all of the asserted claims. These invalidity contentions are not an admission by the Defendants that the accused products are covered by or infringe claims 1, 2, 3, 4, 5, 6, 7, 8, 9, 12, 13, 14, 15, 16, and 17 ("the '677 Asserted Claims")[1], particularly when these claims are properly construed and applied.

AIA law applies because the application that issued as the '677 Patent was filed on March 27, 2020, after the AIA came into force on March 16, 2013.

PCT Publication No. 2004/042868 to Castany et al. ("Castany868") was filed on November 7, 2002 and published on May 21, 2004, on August 30, 2007. This patent is prior art under at least 35 U.S.C. § 102(e), 103(a), and AIA 35 U.S.C. §102(a)(1). As described in the following claim chart, the asserted claims of U.S. Patent No. 11,031,677 (the "'677 Patent"), are invalid as anticipated by Castany868.

To the extent that Castany868 is found not to anticipate one or more of the asserted claims of the '677 Patent, these claims are invalid as obvious in view of Castany868 alone or as modified in view of or in combination with other prior art references disclosed in Defendants' Invalidity Contentions and accompanying charts, including without limitation as set forth below.

- U.S. Patent Application No. 2007/0200773 to Dou et al. "Dou") was filed on February 24, 2006, published on August 30, 2007, and issued as U.S. Patent No. 7,548,208 on June 16, 2009. This patent is prior art under at least 35 U.S.C. § 102(e), 103(a), and AIA 35 U.S.C. §102(a)(1).
- Chinese Patent No. 2,765,337. ("Wei") was filed on February 6, 2005, and was granted on March 15, 2006. This patent is prior art under at least 35 U.S.C. §§ 102(a), 102(e), 103(a), and AIA 35 U.S.C. §102(a)(1).
- U.S. Patent No. 6,943,746 to Talvitie et al. ("Talvitie") was filed on October 23, 2003, published on July 15, 2004, and issued on September 13, 2005. This patent is prior art under at least 35 U.S.C. § 102(e), 103(a), and AIA 35 U.S.C. §102(a)(1).
- U.S. Patent Application No. 2002/0238433 to Chou ("Chou") was filed on March 1, 2005, published on October 26, 2006, and issued as U.S. Patent No. 7,129,898 on October 31, 2006. This patent is prior art under at least 35 U.S.C. § 102(e), 103(a), and AIA 35 U.S.C. §102(a)(1).

[1] Defendants understand that that, by not charting claims 10-11 and 18-20 in its Infringement Contentions, Plaintiff does not assert these claims against Defendants.

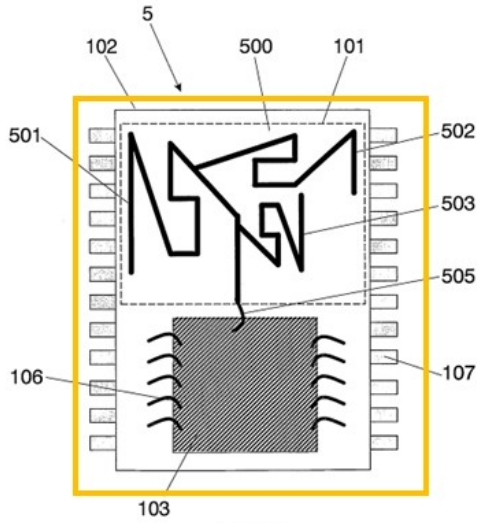
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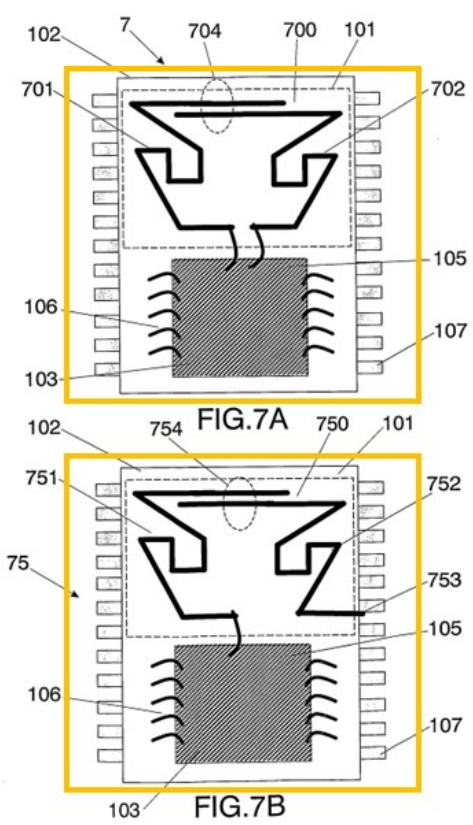
These invalidity contentions are not an admission that the Defendants concede or acquiesce to any claim construction implied or suggested by Plaintiff's Complaint or Infringement Contentions. Nor are Defendants asserting any claim construction positions through these charts, including whether the preamble is a limitation. The portions of the prior art reference cited below are not exhaustive but are exemplary in nature. Defendants reserve the right to update their constructions and contentions in view of this Court's claim construction order.[2]

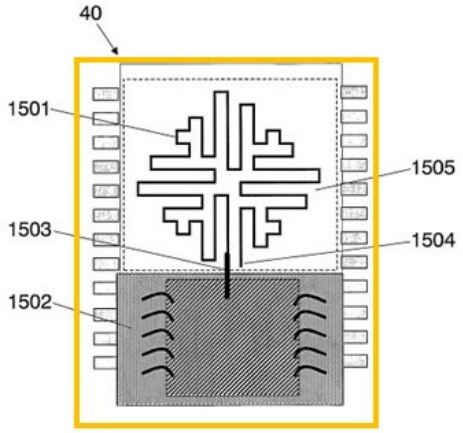
Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
	Claim 1	
1[pre]	A wireless device comprising:	To the extent the preamble is limiting, Castany868 expressly or inherently discloses this claim element. *See, e.g.*, "The present invention allows the integration of a full wireless system into a single component. There is a trend in the semiconductor industry towards the so-called System on Chip (SoC) and System on Package (SoP) concepts. This means integrating as many components of an electronic system as possible (processors, memories, logic gates, biasing circuitry, etc.) into a single semiconductor chip (or "die") (SoC) or at least into a single integrated circuit package (SoP). The full integration of systems or subsystems into a single chip or package provides many advantages in terms of cost, size, weight, consumption, performance and product design complexity. Several electronics components for consumer applications, such as handsets, wireless devices, personal digital assistants (PDA) or personal computers are becoming more and more integrated into SoP/SoC products.

[2] Defendants incorporate herein any related work performed by or on behalf of an author or an inventor in the United States under 35 U.S.C. § 102(g)(2). Defendants reserve the right to supplement and/or alter this chart based on further investigation and ongoing discovery.

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Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		The concept of integrating a full wireless system into a SoC/SoP device (FWSoC and FWSoP) is especially attractive owing to the tremendous growth and success of cellular and wireless systems." Castany868 at 1:16-21  FIG.5 Castany868 at Figure 5

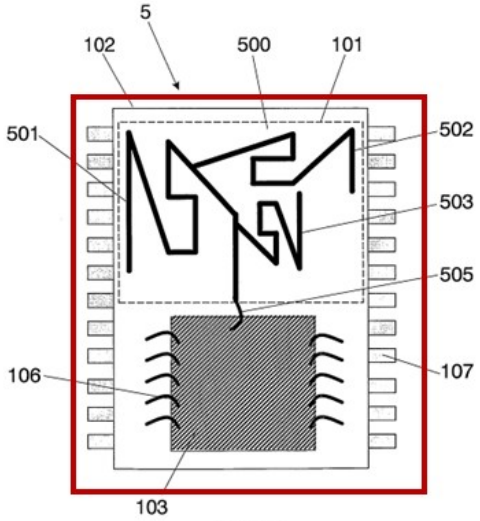
Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		 Castany868 at Figures 7A and 7B

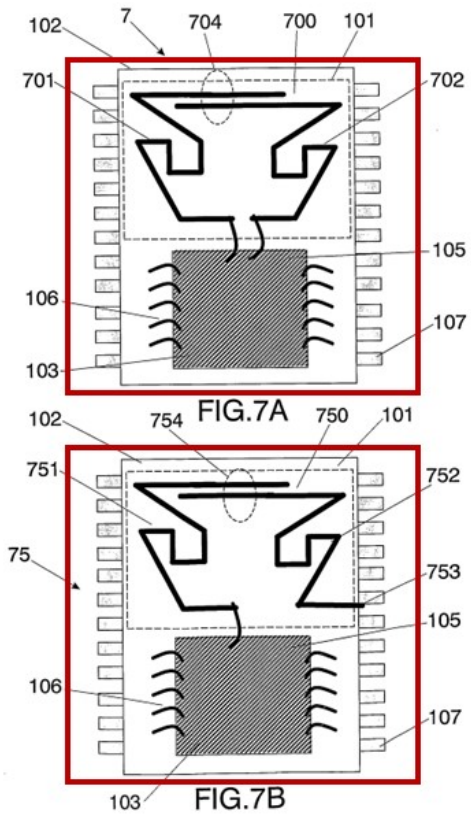
Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		 FIG.15 Castany868 at Figure 15
1[a]	an antenna system comprising:	Castany868 expressly or inherently discloses this claim element. *See, e.g.*, "Figure 5 shows a multibranch antenna structure on a package 5, where several curves, with not necessarily the same lengths, intersect each other at some points. In particular, the antenna 500 includes three arms 501 , 502, 503, each of them being in the form of a curve according to the present invention. In this particular example the antenna takes the form of a monopole as in Figure 1 , with a single feeding port connected to the die by means of connection 105 and one or more connections within terminals 107 connected to an external ground plane." Castany868 at 17:6-12

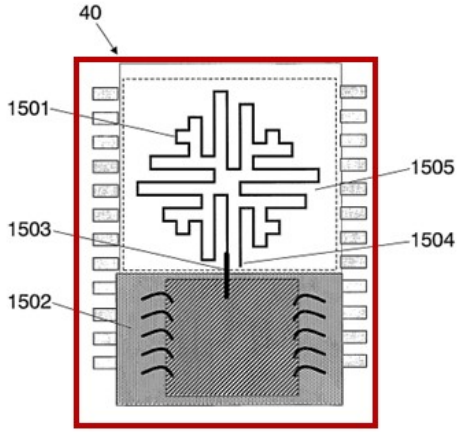
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Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		"Package 7 in Figure 7A includes coupled dipole antenna 700 with two arms 701 and 702 which are coupled together by means of a close proximity region 704. According to the present invention, the minimum distance between conductors in 704 should be less than one-tenth of the longest free-space operating wavelength of the antenna. Figure 7B discloses another embodiment where the package 75 includes an active monopole 751 and a parasitic monopole 752, the parasitic monopole being grounded to an external ground plane or ground counterpoise by means of at least one of the terminals of the package such as for instance 753." Castany868 at 17:30-18:3 "Figure 15 displays a package [40] including a monopole antenna 1501. In this example, a part of the grounding plane or ground counterpoise 1502 is placed on the same layer as the antenna, in such a way that it does not overlap the rectangular area 1505 in which the monopole arm 1501 is enclosed. The antenna is fed through one conductor 1503. In this particular embodiment, it is shown how the tip of the monopole 1504 can be put close to the ground plane 1502. This would provide some capacitive loading to the antenna that contributes to the overall antenna miniaturization." Castany868 at 23:18-25

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Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		 FIG.5 Castany868 at Figure 5

Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		 Castany868 at Figures 7A and 7B

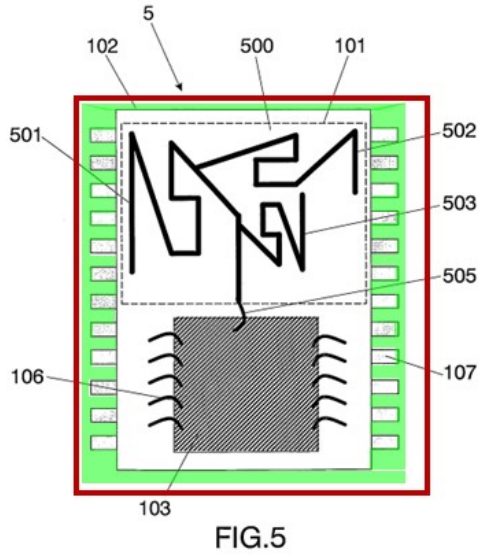
Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		 FIG.15 Castany868 at Figure 15
1[b]	[*the antenna system comprising*] a ground plane;	Castany868 expressly or inherently discloses this claim element. *See, e.g.*, "Other embodiments where the antenna structure is split on several parallel layers consists on an active-parasitic arrangement. That is, the package includes a plurality of dielectric layers within one or more substrates of the package, wherein the package includes at least a first conducting pattern for the antenna in a first of the layers, the first conducting pattern on the first layer being coupled or connected to the semiconductor die. Such a first conducting pattern that is fed by the die is the active element of the antenna arrangement. In this arrangement, the package includes at least a second conducting pattern on at least a second layer of any of the substrates, the second

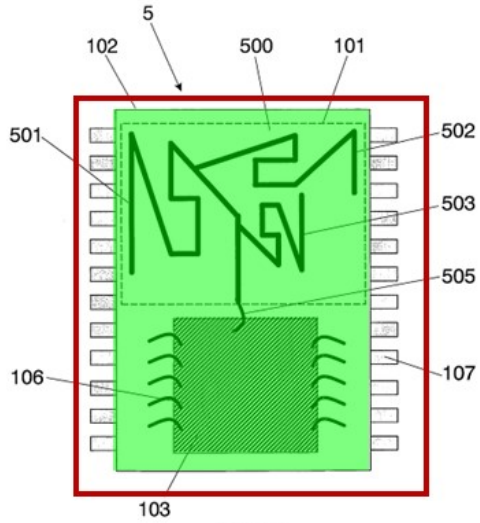
Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		conducting pattern being capacitively or inductively coupled to the first conducting pattern of the antenna, the second conducting pattern acting as a parasitic element for the antenna. As an example, the antennas on the package embodiments shown in Figures 1-6, 11-15 and 17-22 could become the active antenna in such an active-parasitic antenna arrangement, wherein at least an additional antenna pattern on a parallel layer on the same or other substrate would act as the parasitic element or elements of the antenna structure. The effect of such parasitic elements is primarily an increase in the bandwidth and efficiency of the antenna, together with a finer tuning of the input impedance to match the output of the output amplifier connected to the antenna." Castany868 at 13:26-14:9 "Figure 5 shows a multibranch antenna structure on a package 5, where several curves, with not necessarily the same lengths, intersect each other at some points. In particular, the antenna 500 includes three arms 501 , 502, 503, each of them being in the form of a curve according to the present invention. In this particular example the antenna takes the form of a monopole as in Figure 1 , with a single feeding port connected to the die by means of connection 105 and one or more connections within terminals 107 connected to an external ground plane." Castany868 at 17:6-12 "Package 7 in Figure 7A includes coupled dipole antenna 700 with two arms 701 and 702 which are coupled together by means of a close proximity region 704. According to the present invention, the minimum distance between conductors in 704 should be less than one-tenth of the longest free-space operating wavelength of the antenna. Figure 7B discloses another embodiment where the package 75 includes an active monopole 751 and a parasitic monopole 752, the parasitic monopole being grounded to an external ground plane or ground counterpoise by means of at least one of the terminals of the package such as for instance 753." Castany868 at 17:30-18:3 "When more than 50% of the area below 101 is filled with a conducting material, the antenna becomes a microstrip or patch antenna according to the present invention, the conducting material being the ground for the microstrip or patch antenna. The antenna also becomes a planar inverted F antenna (PIFA), if additionally, at least one short to ground is placed at any point within the conducting antenna pattern. In the case of either a microstrip

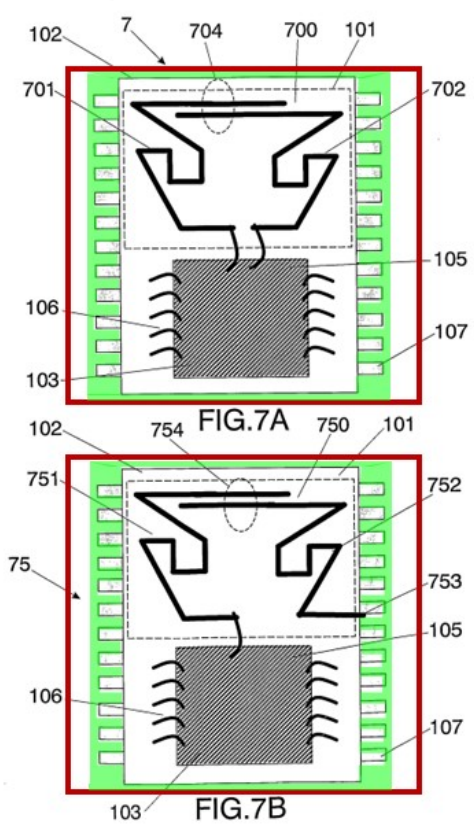
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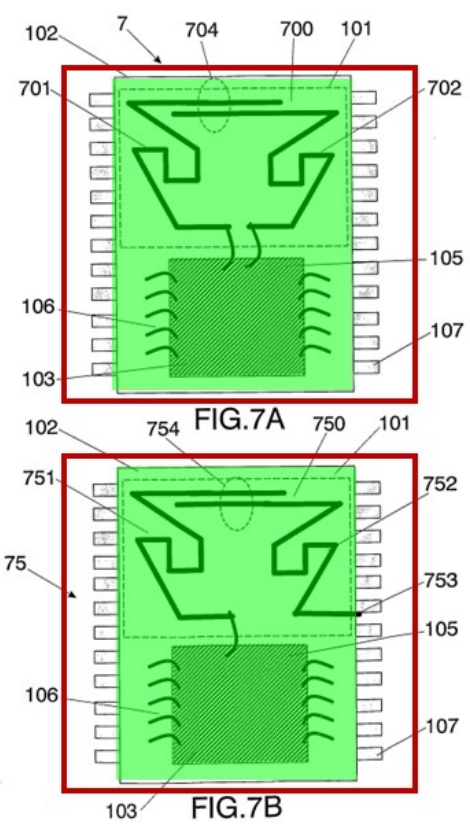
Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		or patch arrangement, or in the PIFA case, the ground covering more than 50% or the area underneath the antenna is preferred. Such a ground can be included in any of the layers of a substrate 102 supporting the antenna and/or the chip 103, or alternatively it can be included in the external substrate or PCB supporting the package." Castany868 at 19:1-11 "Figure 15 displays a package [40] including a monopole antenna 1501. In this example, a part of the grounding plane or ground counterpoise 1502 is placed on the same layer as the antenna, in such a way that it does not overlap the rectangular area 1505 in which the monopole arm 1501 is enclosed. The antenna is fed through one conductor 1503. In this particular embodiment, it is shown how the tip of the monopole 1504 can be put close to the ground plane 1502. This would provide some capacitive loading to the antenna that contributes to the overall antenna miniaturization." Castany868 at 23:18-25

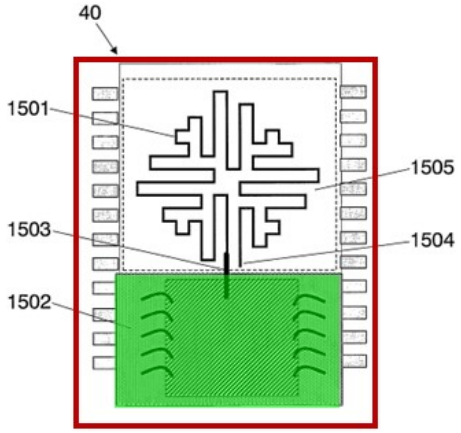
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Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		 FIG.5 Castany868 at Figure 5

Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		 FIG.5 Castany868 at Figure 5 (Alternate)

Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		 Castany868 at Figures 7A and 7B

Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		 Castany868 at Figures 7A and 7B (Alternate)

Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		 FIG.15 Castany868 at Figure 15 To the extent that this reference does not expressly disclose this claim limitation, in light of Plaintiff's apparent claim construction and infringement positions with respect to the Accused Products, a POSA would have understood it to implicitly disclose it or would have found the claim limitation obvious. Additionally, it would have been obvious to a person of ordinary skill in the art to modify this reference with any one or more of the references disclosed in Defendants' Invalidity Contentions based on knowledge of one of ordinary skill in the art and for the reasons articulated in Defendants' Invalidity Contentions Cover Pleading. *See, e.g.,*

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Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		"FIG. 2B illustrates a side view of the wireless device 200 of FIG. 2A. As shown, the wireless device 200 may comprise a ground plane 210. In various implementations, the ground plane 210 may improve antenna performance in talk position and reduce SAR. As shown, the ground plane 210 may extend underneath the first internal antenna 206 and the second internal antenna 208. The ground plane 210 may be required underneath the second internal antenna 208, for example, if a key pad is positioned at the edge of the PCB 204 and demands a ground layer underneath for its circuitry. In this embodiment, the first internal antenna 206 and the second antenna 208 may each comprise a planar inverted F-antenna, for example, including at least one read port and one or more ground ports. The embodiments are not limited in this context." Dou at [0029] "FIG. 3B illustrates a side view of the wireless device 300 of FIG. 3A. As shown, the wireless device 300 may comprise a ground plane 310 to improve antenna performance in talk position and reduce SAR. As shown, the ground plane 310 does not extend underneath the second internal antenna 308. In this embodiment, the second internal antenna 208 may be separated from the ground plane 310 by a clearance distance (C) that is no less than 5 mm (>5 mm). The first internal antenna 206 may comprise, for example, a planar inverted F-antenna. The second internal antenna 208 may comprise, for example, a monopole-antenna, an inverted-L antenna, a meandered monopole, a printed helical antenna, a dipole antenna, a balanced antenna, or other suitable antenna. The embodiments are not limited in this context." Dou at [0034]

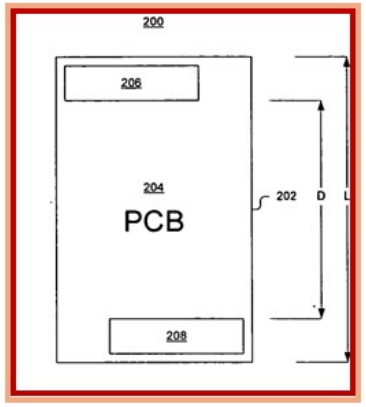


FIG. 2A

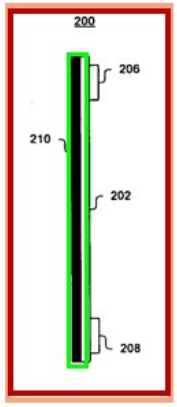


FIG. 2B

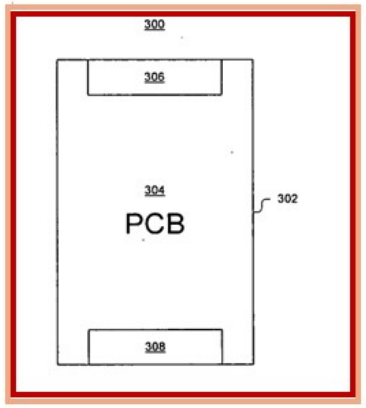


FIG. 3A

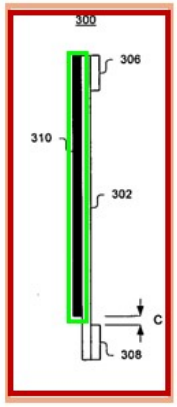
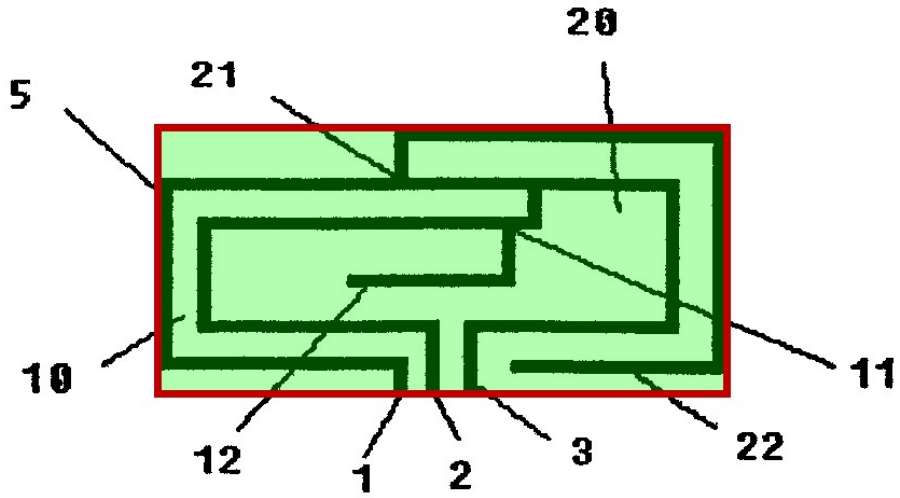
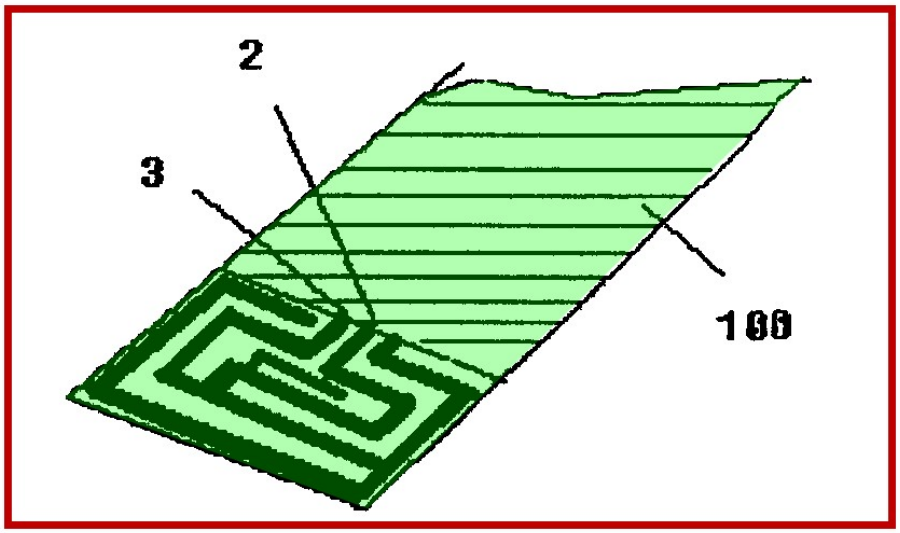


FIG. 3B

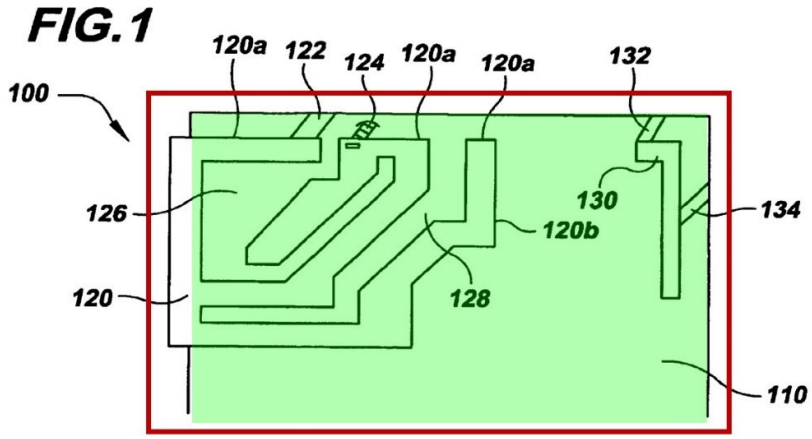
Dou at Figures 2B and 3B

Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		"The so-called "ground point" means a physical connection point between an antenna and a reference ground plane of a mobile terminal mainboard, namely, an end point of a signal loop of this utility model. The ground point is connected to a reference ground point of a feed point through a conductor, thus forming a loop. An antenna provided by this utility model has a plurality of ground points, and the ground points are connected through metal conductors (namely, ground planes)." Wei at 14:7-12  Wei at Figure 2A

Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		 Wei at Figure 2B "Referring to FIG. 1, a preferred embodiment will be described in the following. FIG. 1 shows a planar antenna structure called a PIFA (Planar Inverted F Antenna) antenna structure 100 comprising a ground plane 110, a first radiator 120 and a second radiator 130. The radiators 120, 130 are located at a distance from the ground plane 110 such that air or another dielectric material is, as an isolating material, provided between the ground plane 110 and the radiators 120, 130. The first radiator 120 is a "groove plane antenna" which is connected to the ground plane 110 by a ground point 122 and to which radiation power is fed from a feed point 124. The ground point 122 constituting a grounding line is located substantially at the edge of the radiator 120. The feed point 124 can be implemented as coaxial feed e.g. as a lead-through from the ground plane such that it resides at a substantial

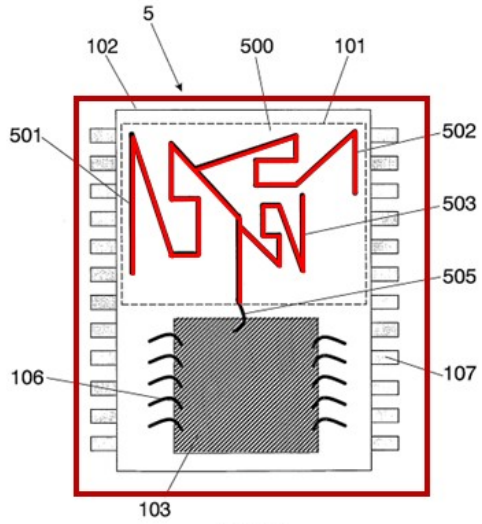
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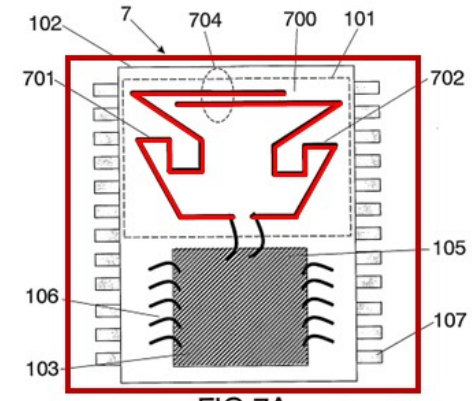
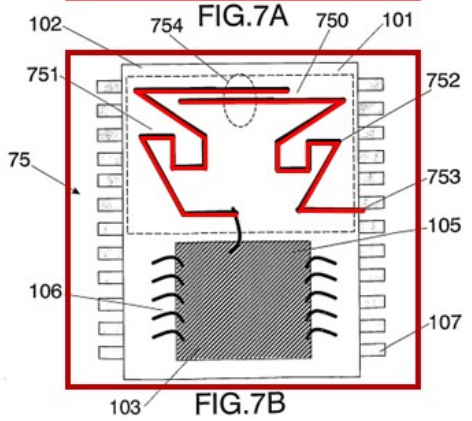
Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		distance from the edge of the radiator. The feed point 124 can also be implemented by placing it at the edge of the radiator 120, in a similar manner to that of the ground point." Talvitie at 3:47-65 "The second radiator 130 is a narrow, planar radiator whose surface area in this embodiment is substantially smaller than that of the first radiator 120. The second radiator 130 also comprises a ground point 132 connecting the radiator 130 to a ground plane 110, and a feed point 134 feeding radiation power. The ground point 132 constituting a grounding line is located substantially at the edge of the radiator 130. The feed point 134 can be implemented as coaxial feed e.g. as a lead-through from the ground plane such that it resides at a substantial distance from the edge of the radiator. The feed point 134 can also be implemented by placing it at the edge of the radiator 130, in a similar manner to that of the ground point. The second radiator is configured to radiate within a frequency range at least partly overlapping with at least one frequency range, preferably with a higher frequency range, of the first radiator. As far as the operation of the present embodiments is concerned, the shape or location of the second radiator 130 with respect to the first radiator 120 is irrelevant; the only point is that both radiators are provided with a feed point of their own and, preferably but not necessarily, a common ground plane." Talvitie at 4:47-67

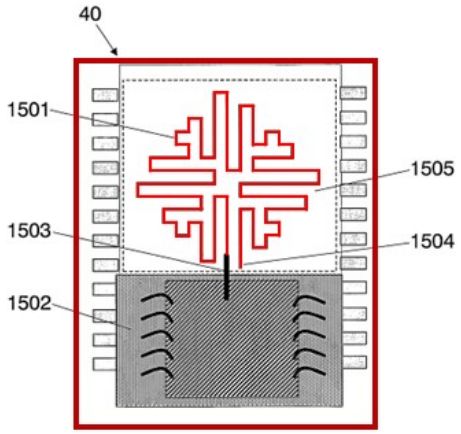
Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		 Talvitie at Figure 1
1[c]	[*the antenna system comprising*] a first antenna within the wireless device and	Castany868 expressly or inherently discloses this claim element. *See, e.g.*, "Figure 5 shows a multibranch antenna structure on a package 5, where several curves, with not necessarily the same lengths, intersect each other at some points. In particular, the antenna 500 includes three arms 501 , 502, 503, each of them being in the form of a curve according to the present invention. In this particular example the antenna takes the form of a monopole as in Figure 1 , with a single feeding port connected to the die by means of connection 105 and one or more connections within terminals 107 connected to an external ground plane." Castany868 at 17:6-12

Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		"Package 7 in Figure 7A includes coupled dipole antenna 700 with two arms 701 and 702 which are coupled together by means of a close proximity region 704. According to the present invention, the minimum distance between conductors in 704 should be less than one-tenth of the longest free-space operating wavelength of the antenna. Figure 7B discloses another embodiment where the package 75 includes an active monopole 751 and a parasitic monopole 752, the parasitic monopole being grounded to an external ground plane or ground counterpoise by means of at least one of the terminals of the package such as for instance 753." Castany868 at 17:30-18:3 "Figure 15 displays a package [40] including a monopole antenna 1501. In this example, a part of the grounding plane or ground counterpoise 1502 is placed on the same layer as the antenna, in such a way that it does not overlap the rectangular area 1505 in which the monopole arm 1501 is enclosed. The antenna is fed through one conductor 1503. In this particular embodiment, it is shown how the tip of the monopole 1504 can be put close to the ground plane 1502. This would provide some capacitive loading to the antenna that contributes to the overall antenna miniaturization." Castany868 at 23:18-25

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Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		 FIG.5 Castany868 at Figure 5

Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		 FIG.7A  FIG.7B Castany868 at Figures 7A and 7B

Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		 FIG.15 Castany868 at Figure 15
1[d]	configured to support at least three frequency bands contained within first and second frequency ranges of the	Castany868 expressly or inherently discloses this claim element. *See, e.g.*, "the antennas on the package embodiments shown in Figures 1-6, 11-15 and 17-22 could become the active antenna in such an active-parasitic antenna arrangement, wherein at least an additional antenna pattern on a parallel layer on the same or other substrate would act as the parasitic element or elements of the antenna structure. The effect of such parasitic elements is primarily an increase in the bandwidth and efficiency of the antenna, together with a finer tuning of the input impedance to match the output of the output amplifier connected to the antenna."

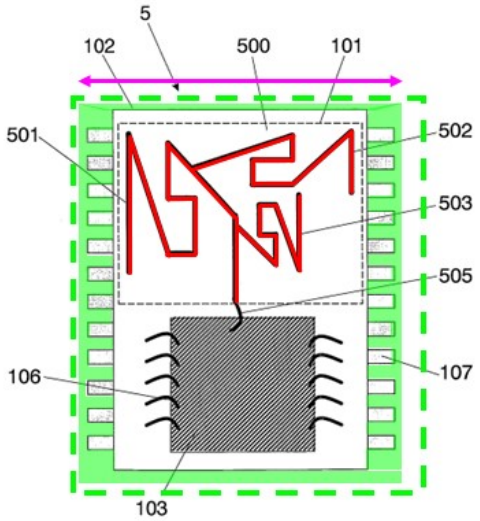
Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
	electromagnetic spectrum,	Castany868 at 14:2-9 "Figure 5 shows a multibranch antenna structure on a package 5, where several curves, with not necessarily the same lengths, intersect each other at some points. In particular, the antenna 500 includes three arms 501 , 502, 503, each of them being in the form of a curve according to the present invention. In this particular example the antenna takes the form of a monopole as in Figure 1 , with a single feeding port connected to the die by means of connection 105 and one or more connections within terminals 107 connected to an external ground plane. By adjusting the number and length of the antenna arms the frequency response of the antenna can be tailored. In general, for a wide-band behavior, the length from the tips of the arms to the feeding point of the antenna will be similar. For a multiband response with no overlapping between frequency bands, the length of each arm is associated mainly with the center frequency of a particular band within the antenna response. Such a multibranch arrangement is also compatible with, but not limited to, a dipole, an inverted F antenna, or a slot antenna. " Castany868 at 17:6-19 "Package 7 in Figure 7A includes coupled dipole antenna 700 with two arms 701 and 702 which are coupled together by means of a close proximity region 704. According to the present invention, the minimum distance between conductors in 704 should be less than one-tenth of the longest free-space operating wavelength of the antenna. Figure 7B discloses another embodiment where the package 75 includes an active monopole 751 and a parasitic monopole 752, the parasitic monopole being grounded to an external ground plane or ground counterpoise by means of at least one of the terminals of the package such as for instance 753." Castany868 at 17:30-18:3 "Figure 15 displays a package [40] including a monopole antenna 1501. In this example, a part of the grounding plane or ground counterpoise 1502 is placed on the same layer as the antenna, in such a way that it does not overlap the rectangular area 1505 in which the monopole arm 1501 is enclosed. The antenna is fed through one conductor 1503. In this particular embodiment, it is shown how the tip of the monopole 1504 can be put close to the ground plane 1502. This would provide some capacitive loading to the antenna that contributes to the overall

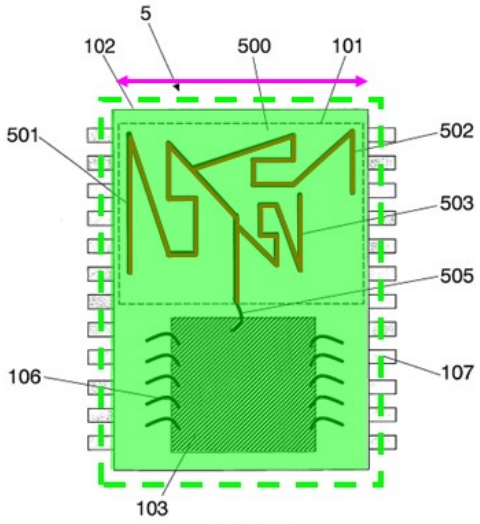
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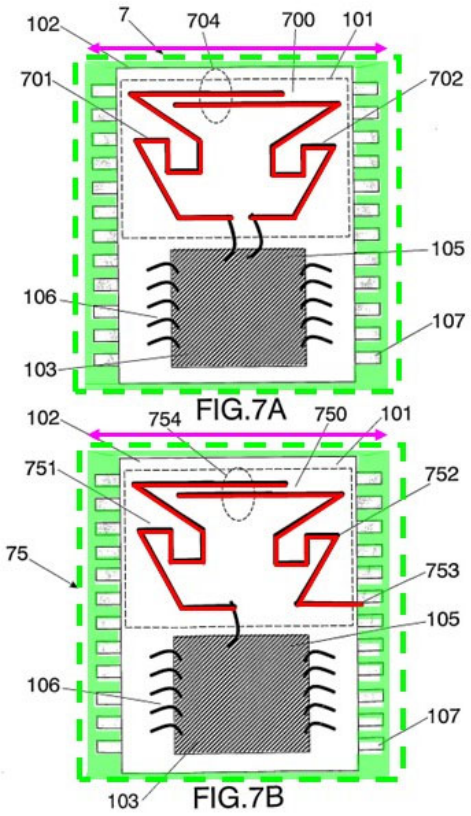
Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		antenna miniaturization." Castany868 at 23:18-25
1[e]	the second frequency range being higher in frequency than the first frequency range and	Castany868 expressly or inherently discloses this claim element. *See, e.g.*, "Figure 5 shows a multibranch antenna structure on a package 5, where several curves, with not necessarily the same lengths, intersect each other at some points. In particular, the antenna 500 includes three arms 501 , 502, 503, each of them being in the form of a curve according to the present invention. In this particular example the antenna takes the form of a monopole as in Figure 1 , with a single feeding port connected to the die by means of connection 105 and one or more connections within terminals 107 connected to an external ground plane. By adjusting the number and length of the antenna arms the frequency response of the antenna can be tailored. In general, for a wide-band behavior, the length from the tips of the arms to the feeding point of the antenna will be similar. For a multiband response with no overlapping between frequency bands, the length of each arm is associated mainly with the center frequency of a particular band within the antenna response. Such a multibranch arrangement is also compatible with, but not limited to, a dipole, an inverted F antenna, or a slot antenna. " Castany868 at 17:6-19 "For instance, the present invention enables packaging a system operating within the 0.5 to 5.5 GHz frequency band in an area smaller than 10 x 10 mm." Castany868 at 30:13-17

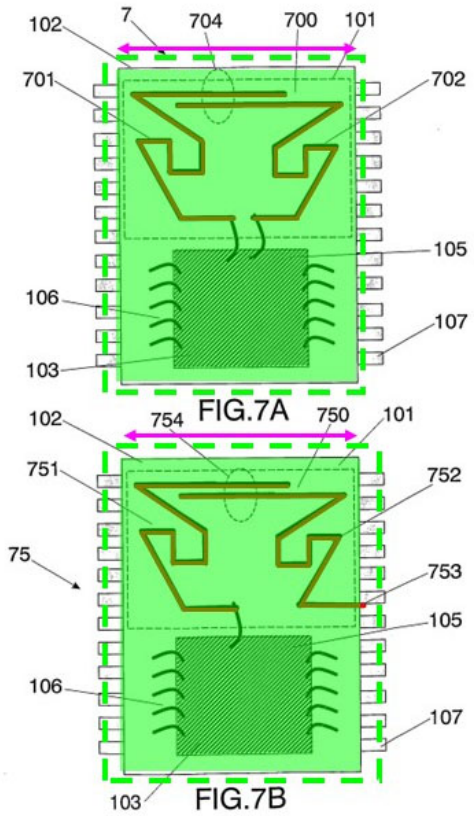
Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		To the extent that this reference does not expressly disclose this claim limitation, in light of Plaintiff's apparent claim construction and infringement positions with respect to the Accused Products, a POSITA would have understood it to implicitly disclose it or would have found the claim limitation obvious. It would have been obvious to a person of ordinary skill in the art that frequency bands which do not overlap can be grouped into two frequency ranges, and as the frequency bands do not overlap one of the frequency ranges must be higher in frequency than the other frequency range. Additionally, it would have been obvious to a person of ordinary skill in the art to modify this reference with any one or more of the references disclosed in Defendants' Invalidity Contentions based on knowledge of one of ordinary skill in the art and for the reasons articulated in Defendants' Invalidity Contentions Cover Pleading.
1[f]	at least one of the three frequency bands being associated with a 4G communication standard,	Castany868 expressly or inherently discloses this claim element. *See, e.g.*, "For instance, the present invention enables packaging a system operating within the 0.5 to 5.5 GHz frequency band in an area smaller than 10 x 10 mm." Castany868 at 30:13-17 To the extent that this reference does not expressly disclose this claim limitation, in light of Plaintiff's apparent claim construction and infringement positions with respect to the Accused Products, a POSITA would have understood it to implicitly disclose it or would have found the claim limitation obvious. It would have been obvious to a person of ordinary skill in the art that the 4G LTE Bands 1-54, 65-76, 103, and 106 are between 500 and 5500 MHz, and as such operating within the 0.5 to 5.5 GHz frequency band is operating on frequency bands associated with a 4G communication standard.

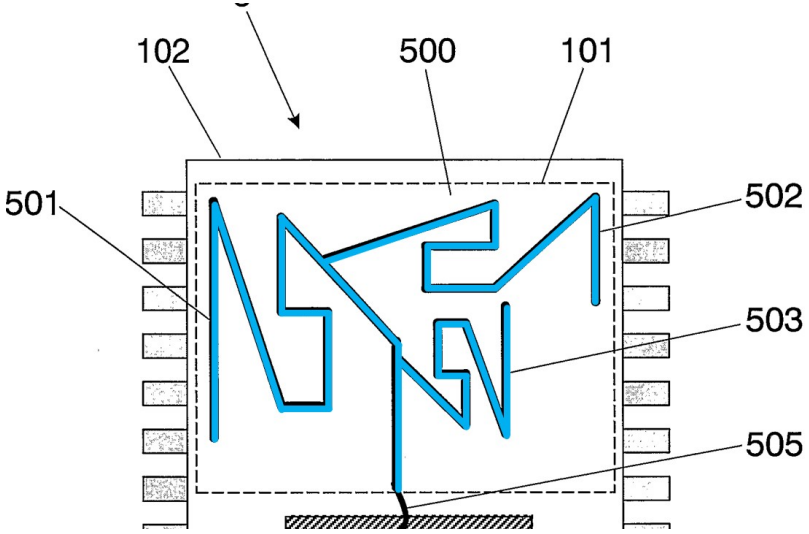
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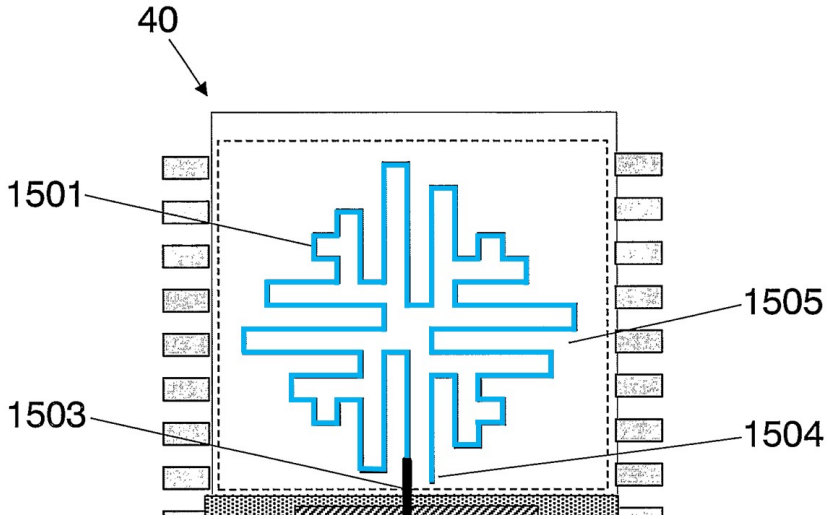
Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		Additionally, it would have been obvious to a person of ordinary skill in the art to modify this reference with any one or more of the references disclosed in Defendants' Invalidity Contentions based on knowledge of one of ordinary skill in the art and for the reasons articulated in Defendants' Invalidity Contentions Cover Pleading.
1[g]	the first antenna being proximate to a first short side of a ground plane rectangle enclosing the ground plane and	Castany868 expressly or inherently discloses this claim element. *See, e.g.*,  FIG.5 Castany868 at Figure 5

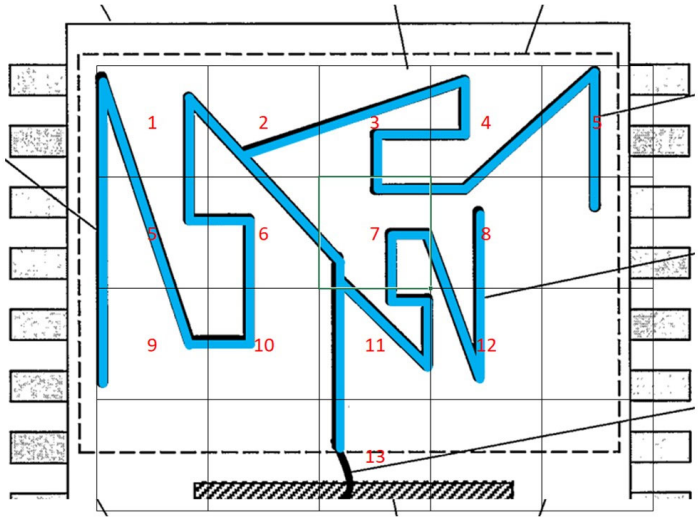
Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		 FIG.5 Castany868 at Figure 5 (Alternate)

Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		 Castany868 at Figures 7A and 7B

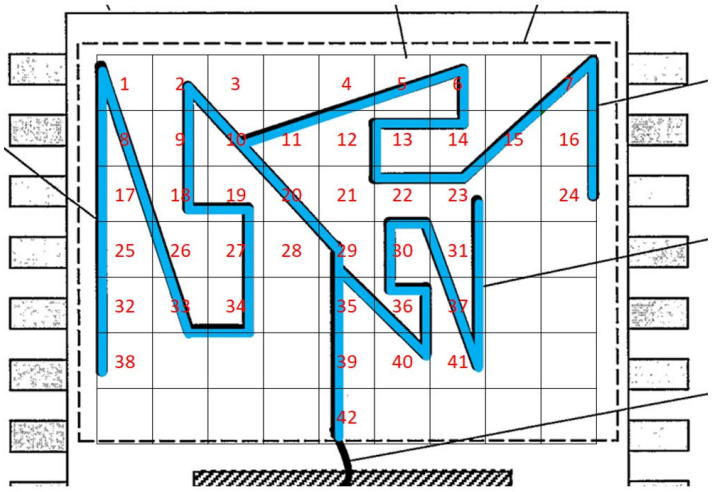
Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		 Castany868 at Figures 7A and 7B (Alternate)

Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		To the extent that this reference does not expressly disclose this claim limitation, in light of Plaintiff's apparent claim construction and infringement positions with respect to the Accused Products, a POSITA would have understood it to implicitly disclose it or would have found the claim limitation obvious. Additionally, it would have been obvious to a person of ordinary skill in the art to modify this reference with any one or more of the references disclosed in Defendants' Invalidity Contentions based on knowledge of one of ordinary skill in the art and for the reasons articulated in Defendants' Invalidity Contentions Cover Pleading.
1[h]	defining a first antenna contour comprising an entire perimeter of the first antenna,	Castany868 expressly or inherently discloses this claim element. *See, e.g.*, 

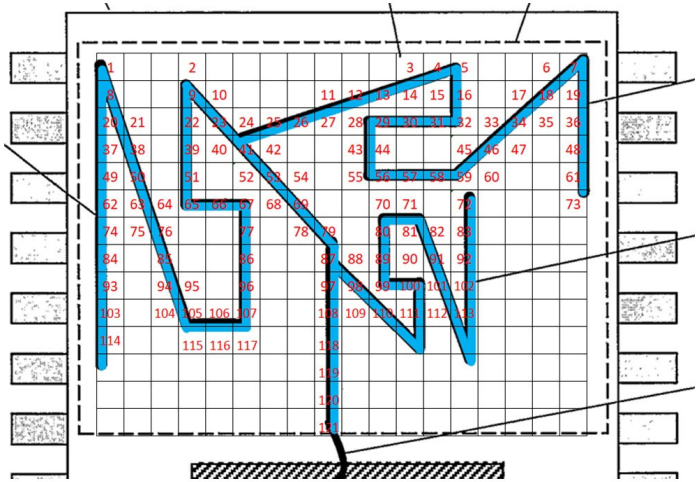
Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		Castany868 at Figure 5  Castany868 at Figure 15
1[i]	wherein the first antenna contour has a level of complexity defined by	Castany868 expressly or inherently discloses this claim element. *See, e.g.*,

Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
	complexity factor F_{21} having a value of at least 1.20 and	 Castany868 at Figure 5, Calculating N_1

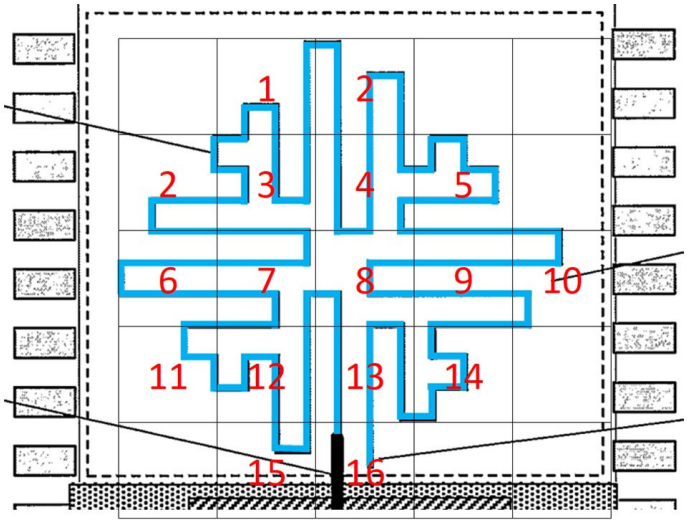
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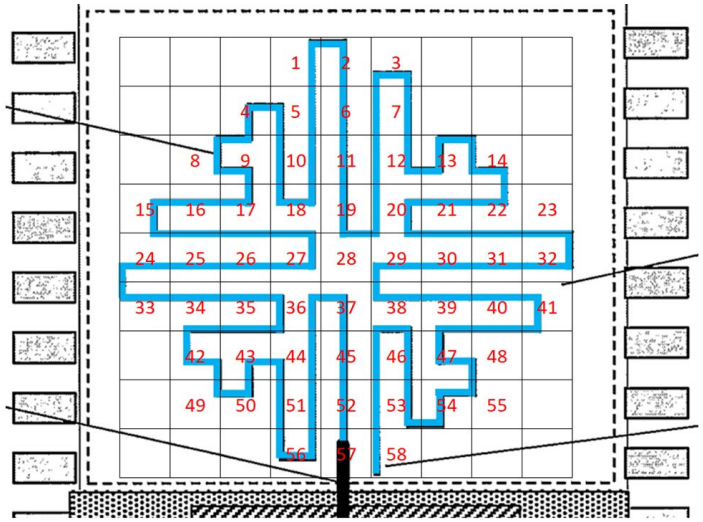
Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		 Castany868 at Figure 5, Calculating N_2

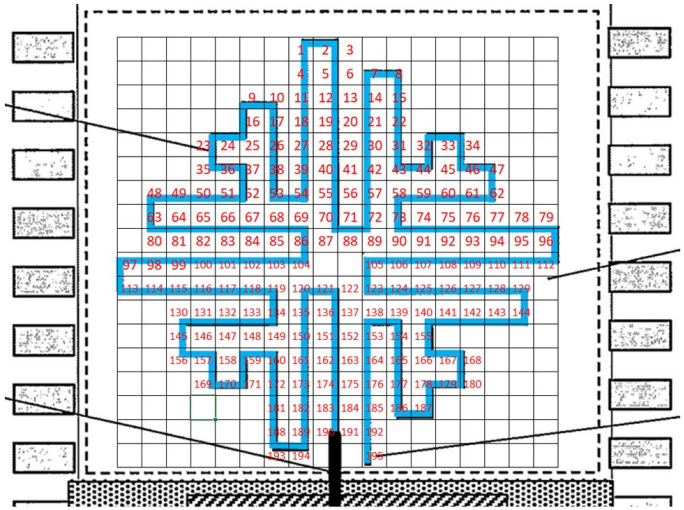
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Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		 Castany868 at Figure 5, Calculating N_3

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Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		 Castany868 at Figure 15, Calculating N_1

Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		 Castany868 at Figure 15, Calculating N_2

Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		 Castany868 at Figure 15, Calculating N_3 Further, it would have been obvious to a person of ordinary skill in the art that, when $N_1 = 13$; $N_2 = 42$; and $N_3 = 121$; that given

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Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		$$F_{21=-}\frac{(\log_{10}(N_2)-\log_{10}(N_1)}{\log_{10}1/2}$$ solving for F_{21} results in $$F_{21=-}\frac{(\log_{10}(42)-\log_{10}(13)}{\log_{10}1/2}=\ 1.6919$$ and $$1.20\ \leq 1.6919$$ Still further, it would have been obvious to a person of ordinary skill in the art that, when $N_1\ =\ 16$; $N_2\ =\ 58$; and $N_3\ =\ 195$; that given $$F_{21=-}\frac{(\log_{10}(N_2)-\log_{10}(N_1)}{\log_{10}1/2}$$ solving for F_{21} results in $$F_{21=-}\frac{(\log_{10}(58)-\log_{10}(16)}{\log_{10}1/2}=\ 1.8580$$

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Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		and $1.20 \leq 1.8580$
1[j]	complexity factor F_{32} having a value less than 1.75; and	Castany868 expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[i] Further, it would have been obvious to a person of ordinary skill in the art that, when $N_1 = 13$; $N_2 = 42$; and $N_3 = 121$; that given $F_{32=-} \frac{(\log_{10}(N_3) - \log_{10}(N_2)}{\log_{10} 1/2}$ solving for F_{32} results in $F_{32=-} \frac{(\log_{10}(121) - \log_{10}(42)}{\log_{10} 1/2} = 1.5265$ and $1.5265 < 1.75$ Still further, it would have been obvious to a person of ordinary skill in the art that, when

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Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		$N_1 = 16$; $N_2 = 58$; and $N_3 = 195$; that given $$F_{32=-} \frac{(\log_{10}(N_3) - \log_{10}(N_2)}{\log_{10} 1/2}$$ solving for F_{32} results in $$F_{32=-} \frac{(\log_{10}(195) - \log_{10}(58)}{\log_{10} 1/2} = 1.7493$$ and $$1.7493 < 1.75$$
1[k]	a second antenna within the wireless device and	Castany868 expressly or inherently discloses this claim element. *See, e.g.*, "Although a multiband antenna such as for instance a multibranch antenna can be used within the package when several services or operating frequency bands are to be integrated in the same system, it is clear that other options within the present invention include arranging two or more antennas within the same package. For instance, those two or more antennas according to the present invention can be arranged in the same substrate layer, in different layers within the same substrate, in different substrates or even in the substrate and in the plastic casing of the package. One possible arrangement for a two antenna package includes two similar antennas wherein each one is fed independently, and wherein one conducting pattern is rotated 90° with respect to the other antenna pattern.

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Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		This provides an effective means for integrating a polarization diversity communication system inside a single package." Castany868 at 30:1-12 To the extent that this reference does not expressly disclose this claim limitation, in light of Plaintiff's apparent claim construction and infringement positions with respect to the Accused Products, a POSA would have understood it to implicitly disclose it or would have found the claim limitation obvious. Additionally, it would have been obvious to a person of ordinary skill in the art to modify this reference with any one or more of the references disclosed in Defendants' Invalidity Contentions based on knowledge of one of ordinary skill in the art and for the reasons articulated in Defendants' Invalidity Contentions Cover Pleading. *See e.g.,* "As shown in FIG. 2A, the wireless device 200 may have an internal diversity antenna architecture comprising a first internal antenna 206 and a second internal antenna 208 disposed on the PCB 204 for achieving diversity. In various embodiments, the first internal antenna 206 and the second internal antenna 208 may remain in a fixed position internal to the housing 202 in order to eliminate the need for an external antenna and reduce the overall size and bulkiness of the wireless device 200. In one embodiment, the internal diversity antenna architecture may comprise a first internal antenna 206 located substantially near the top of the wireless device 200. For example, the first internal antenna 206 may be located substantially near the top of the housing 202 and/or the top of the PCB 204. The internal diversity antenna architecture may comprise a second internal antenna 208 located substantially near the bottom of the wireless device 200. For example, the second internal antenna 208 may be located substantially near the bottom of the housing 202 and/or the bottom of the PCB 204." Dou at [0017]

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Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		"As shown in FIG. 3A, the wireless device 300 may have an internal diversity antenna architecture comprising a first internal antenna 306 and a second internal antenna 308 disposed on the PCB 304 for achieving diversity. In this embodiment, the internal diversity antenna architecture may comprise a first internal antenna 306 located substantially at the top of the wireless device 300. For example., the first internal antenna 306 may be located substantially at the top of the housing 302 and/or the top of the PCB 304. The internal diversity antenna architecture may comprise a second internal antenna 308 located substantially at the bottom of the wireless device 300. For example, the second internal antenna 308 may be located substantially at the bottom of the housing 302 and/or the bottom of the PCB 304." Dou at [0032] "As shown in FIG. 4A, the wireless device 400 may have an internal diversity antenna architecture comprising a first internal antenna 406 and a second internal antenna 408 disposed on the PCB 404 for achieving diversity. In this embodiment, the first internal antenna 406 may comprise a first feed point 412 and a first ground point 414, and the second internal antenna 408 may comprise a second feed point 416 and a second ground point 418. The first internal antenna 406 may be located substantially near the top of the wireless device 400, and the second internal antenna 408 may be located substantially near the bottom of the wireless device 400. Dou at [0036]

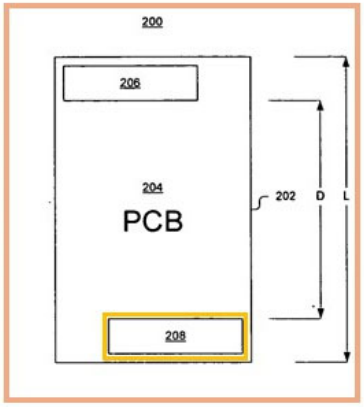


FIG. 2A

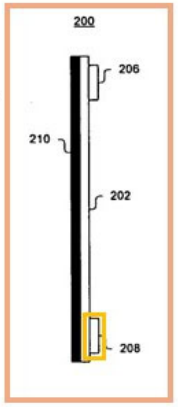


FIG. 2B

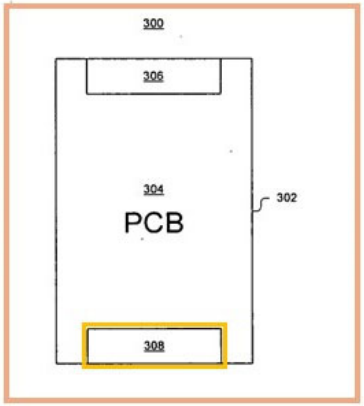


FIG. 3A

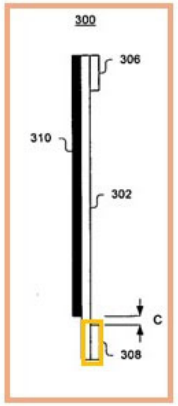
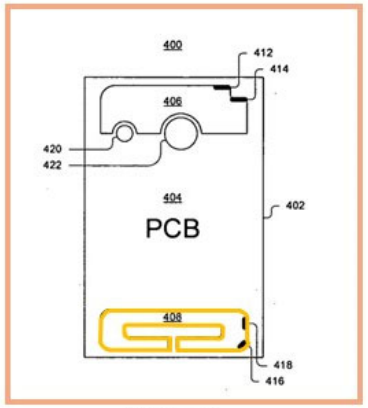
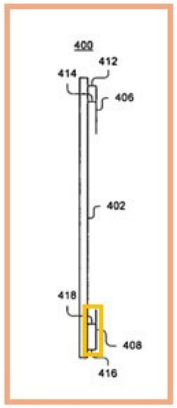
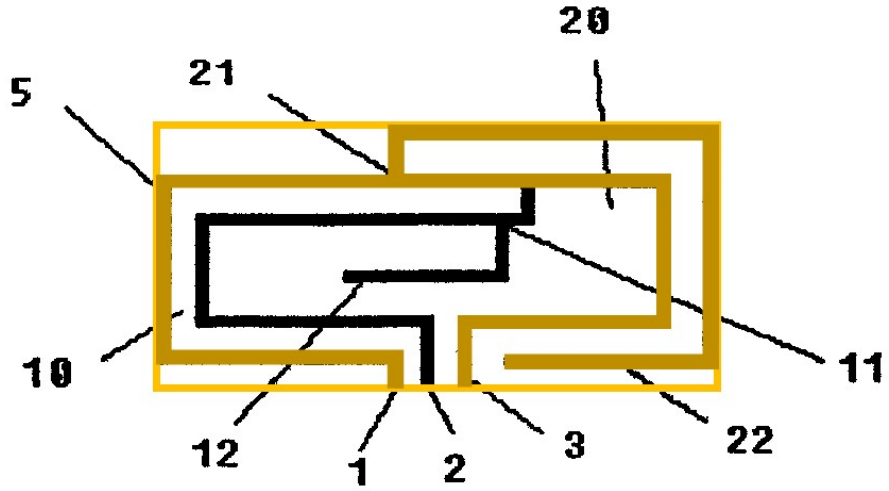


FIG. 3B

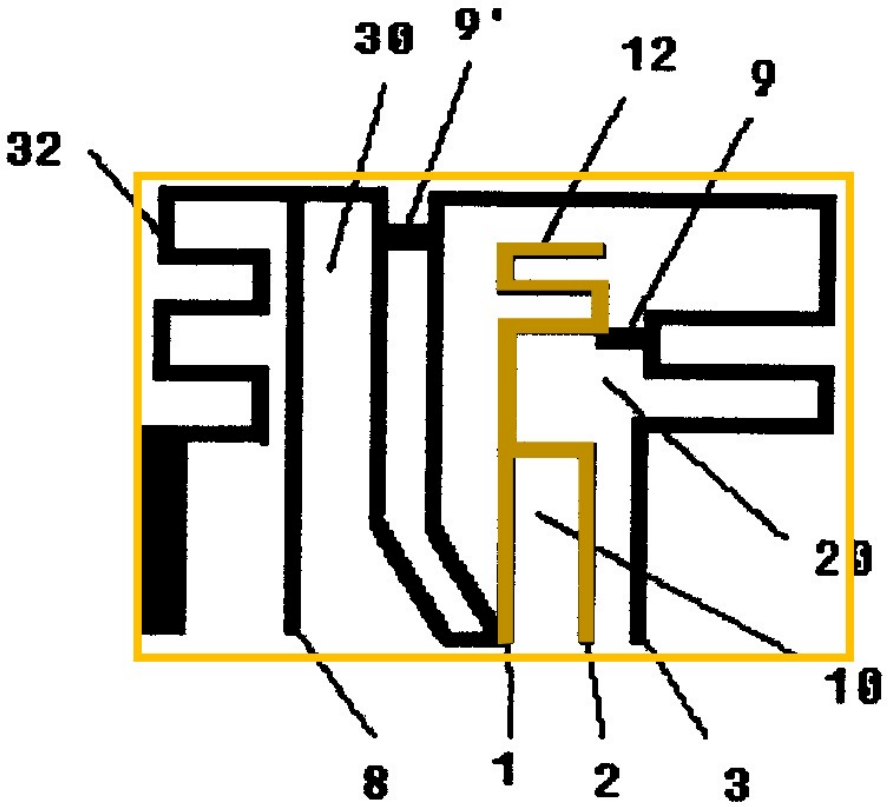
Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		 FIG. 4A  FIG. 4B Dou at Figures 2A-B, 3A-B, and 4A-B "As shown in FIG. 2A, in a first preferred embodiment provided in this utility model, the metal conductor part includes two signal loops which are respectively a first signal loop 10 and a second signal loop 20. As shown in the figure, the first and second signal loops 10, 20 start from the same common feed point 1 and respectively terminate at two ground points 2, 3 (the numerals are the same below) with different physical positions. The second signal loop 20 completely surrounds the first signal loop 10, and the two signal loops have a common conductor 5." Wei at 15:7-13

Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		"The antenna of this utility model is mounted on the mobile terminal mainboard 100. A positional relationship between the antenna and the mobile terminal mainboard 100 and a structure of a ground plane of the mobile terminal mainboard 100 may affect a frequency band characteristic of the antenna." Wei at 18:1-4  Wei at Figure 2A "Referring to FIG. 9, in an eighth preferred embodiment provided in this utility model, the metal conductor part includes three signal loops which are respectively a first signal loop 10, a second signal loop 20, and a third signal loop 30. The three signal loops have no other common parts except the common feed point 1. The signal loops

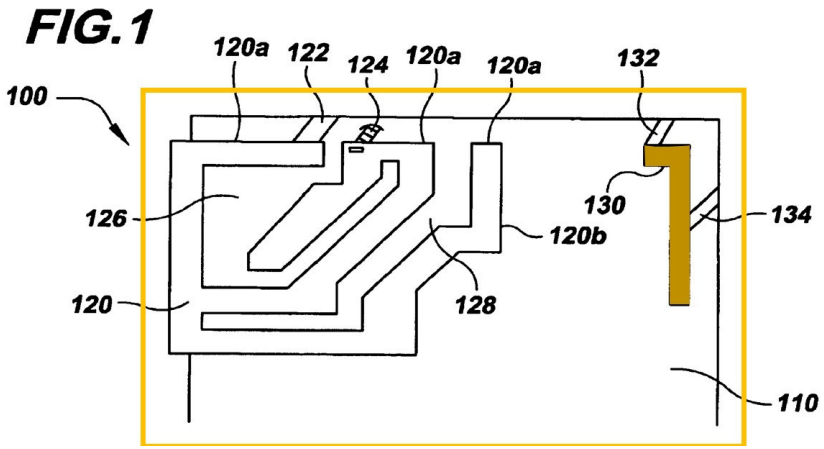
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Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		respectively terminate at ground points 2, 3, 8, and each of the first and third signal loops 10, 30 has one conductor branch 12, 32." Wei at 16:25-29

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Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		 Wei at Figure 9

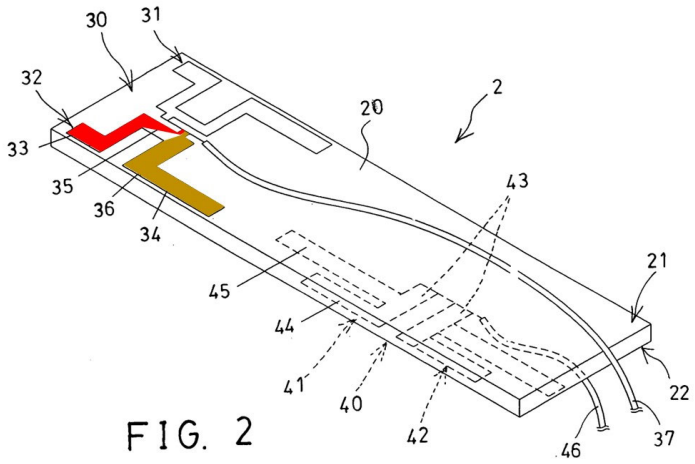
Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		"The invention is based on the unexpected discovery that when an antenna structure comprising two radiators matched for at least partly the same frequency range is used, at least one of the radiators being the above-mentioned groove plane antenna matched for several frequency ranges, considerable isolation is provided between the radiators. Such an antenna structure thus comprises at least one ground plane, at least a first and a second radiator located at a distance from the ground plane, both radiators being configured to provide at least one resonance frequency in order to provide at least one frequency band, and an isolating layer between the ground plane and the radiators." Talvitie at 2:20-32 "Referring to FIG. 1, a preferred embodiment will be described in the following. FIG. 1 shows a planar antenna structure called a PIFA (Planar Inverted F Antenna) antenna structure 100 comprising a ground plane 110, a first radiator 120 and a second radiator 130. The radiators 120, 130 are located at a distance from the ground plane 110 such that air or another dielectric material is, as an isolating material, provided between the ground plane 110 and the radiators 120, 130. The first radiator 120 is a "groove plane antenna" which is connected to the ground plane 110 by a ground point 122 and to which radiation power is fed from a feed point 124. The ground point 122 constituting a grounding line is located substantially at the edge of the radiator 120." Talvitie at 3:47-59 Talvitie expressly or inherently discloses this claim element. *See, e.g.*, "The antenna structure of FIG. 1 can preferably be configured to operate as an antenna structure for a multifrequency mobile station. " Talvitie at 5:1-3

Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		 Talvitie at Figure 1
1[l]	configured to support at least one frequency band different from the at least three frequency bands supported by	Castany868 expressly or inherently discloses this claim element. *See, e.g.*, "Although a multiband antenna such as for instance a multibranch antenna can be used within the package when several services or operating frequency bands are to be integrated in the same system, it is clear that other options within the present invention include arranging two or more antennas within the same package. For instance, those two or more antennas according to the present invention can be arranged in the same substrate layer, in different layers within the same substrate, in different substrates or even in the substrate and in the plastic casing of the package. One possible arrangement for a two antenna package includes two similar antennas wherein each one is fed independently, and wherein one conducting pattern is rotated 90° with respect to the other antenna pattern.

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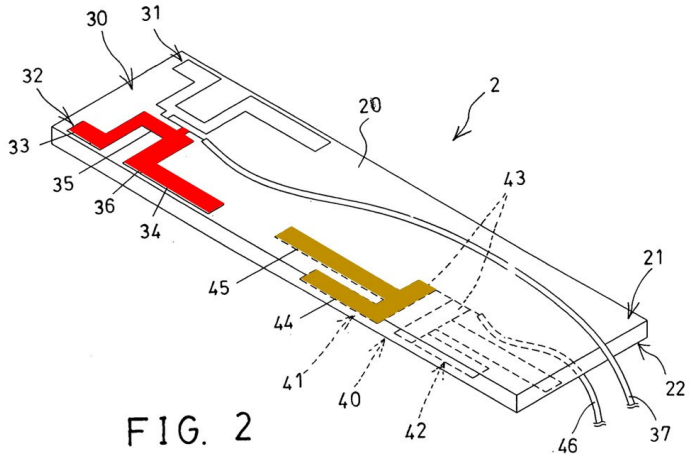
Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
	the first antenna,	This provides an effective means for integrating a polarization diversity communication system inside a single package." Castany868 at 30:1-12 To the extent that this reference does not expressly disclose this claim limitation, in light of Plaintiff's apparent claim construction and infringement positions with respect to the Accused Products, a POSA would have understood it to implicitly disclose it or would have found the claim limitation obvious. Additionally, it would have been obvious to a person of ordinary skill in the art to modify this reference with any one or more of the references disclosed in Defendants' Invalidity Contentions based on knowledge of one of ordinary skill in the art and for the reasons articulated in Defendants' Invalidity Contentions Cover Pleading. *See, e.g.,* "It is preferable that the antenna members 31, 32 of the antenna device 30 each includes two antenna segments 33, 34 disposed up and down relative to each other, and an intermediate and/or C-shaped antenna segment 35 disposed between the antenna segments 33, 34, for receiving and transmitting signals of different frequencies, for example. It is further preferable that the antenna segments 33, 34, 35 of the two antenna members 31, 32 are disposed side by side and/or parallel to each other, or arranged in mirror symmetric relative to each other, for receiving and transmitting signals toward different lateral directions 39 relative to each other, or away from each other." Chou at [0028] "Similarly, the antenna members 41, 42 of the antenna device 40 each includes a base antenna segment 43 disposed up and down relative to each other, and two antenna segments 44, 45 extended from the base antenna segment 43 and parallel to each other, for receiving and transmitting signals of different frequencies, for example. It is further preferable that the antenna segments 43, 44, 45 of the two antenna members 41, 42 are disposed up and

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Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		down relative to each other, or arranged in mirror symmetric relative to each other, for receiving and transmitting signals toward different vertical directions 49 relative to each other, or away from each other." Chou at [0030]  FIG. 2 Chou at Figure 2 "It is preferable that the antenna members 31, 32 of the antenna device 30 each includes two antenna segments 33, 34 disposed up and down relative to each other, and an intermediate and/or C-shaped antenna segment 35 disposed between the antenna segments 33, 34, for receiving and transmitting signals of different frequencies, for example. It is further preferable that the antenna segments 33, 34, 35 of the two antenna members 31, 32 are disposed side

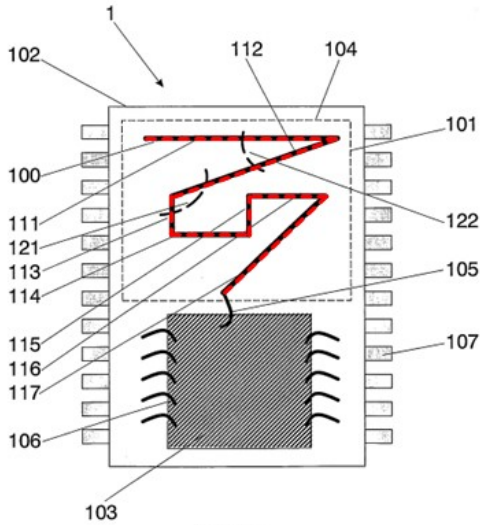
Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		by side and/or parallel to each other, or arranged in mirror symmetric relative to each other, for receiving and transmitting signals toward different lateral directions 39 relative to each other, or away from each other." Chou at [0028] "Similarly, the antenna members 41, 42 of the antenna device 40 each includes a base antenna segment 43 disposed up and down relative to each other, and two antenna segments 44, 45 extended from the base antenna segment 43 and parallel to each other, for receiving and transmitting signals of different frequencies, for example. It is further preferable that the antenna segments 43, 44, 45 of the two antenna members 41, 42 are disposed up and down relative to each other, or arranged in mirror symmetric relative to each other, for receiving and transmitting signals toward different vertical directions 49 relative to each other, or away from each other." Chou at [0030] "Furthermore, each of the antenna devices 30, 40 may include two or more antenna segments 33, 34, 35; and 43, 44, 45 respectively, for receiving and transmitting signals of different frequencies, and thus for allowing the antenna devices 30, 40 to receive and transmit signals of various frequencies. There will be no dead ends or dead corners formed or generated by the antenna devices 30, 40." Chou at [0033]

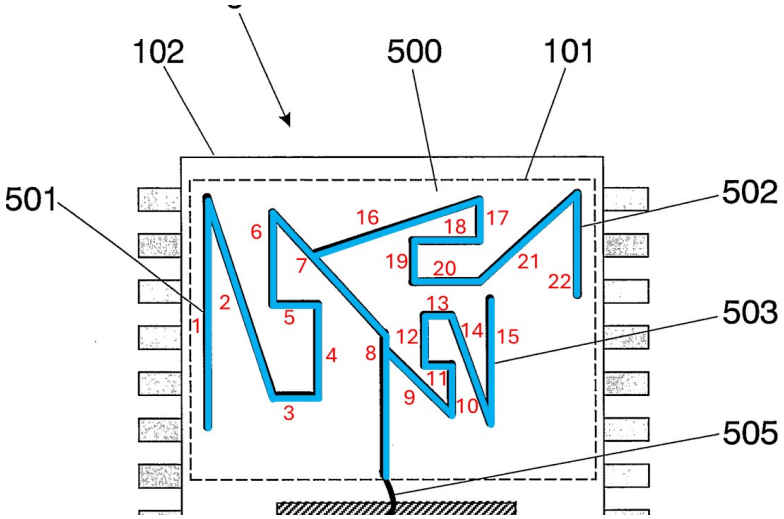
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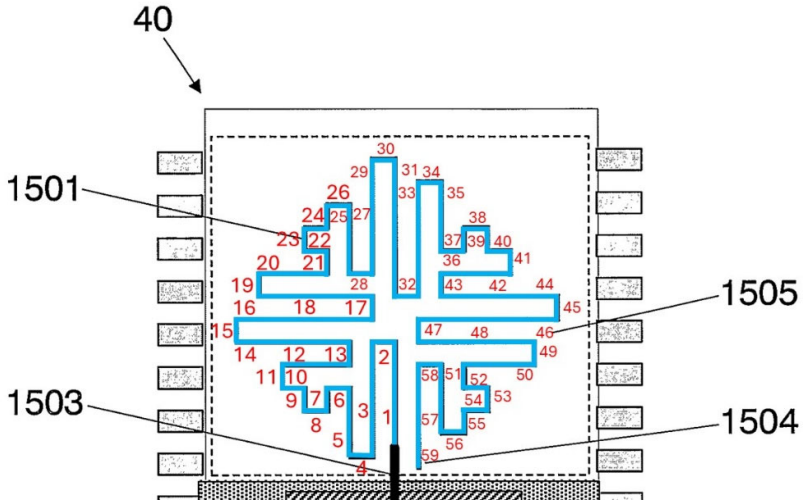
Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		 FIG. 2 Chou at Figure 2
1[m]	the second antenna being arranged completely within the ground plane rectangle.	Castany868 expressly or inherently discloses this claim element. *See, e.g.*, "Although a multiband antenna such as for instance a multibranch antenna can be used within the package when several services or operating frequency bands are to be integrated in the same system, it is clear that other options within the present invention include arranging two or more antennas within the same package. For instance, those two or more antennas according to the present invention can be arranged in the same substrate layer, in different layers within the same substrate, in different substrates or even in the substrate and in the plastic casing of the package. One possible arrangement for a two antenna package includes two similar antennas wherein each one is fed independently, and wherein one conducting pattern is rotated 90° with respect to the other antenna pattern.

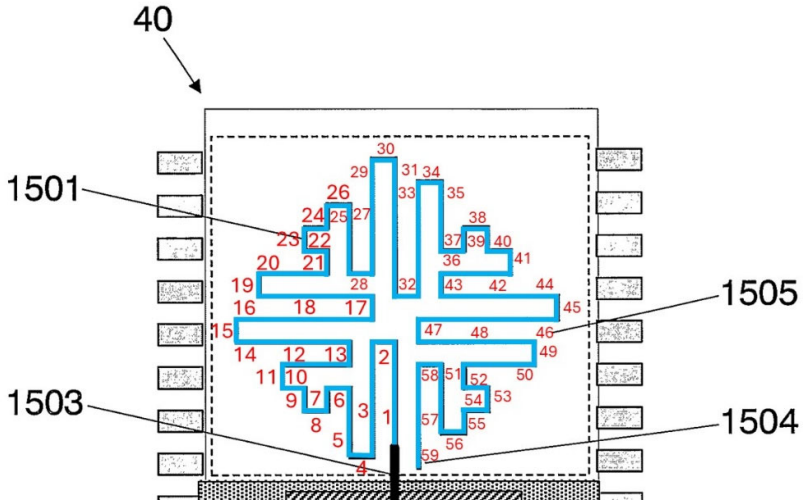
Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		This provides an effective means for integrating a polarization diversity communication system inside a single package." Castany868 at 30:1-12 To the extent that this reference does not expressly disclose this claim limitation, in light of Plaintiff's apparent claim construction and infringement positions with respect to the Accused Products, a POSITA would have understood it to implicitly disclose it or would have found the claim limitation obvious. Additionally, it would have been obvious to a person of ordinary skill in the art to modify this reference with any one or more of the references disclosed in Defendants' Invalidity Contentions based on knowledge of one of ordinary skill in the art and for the reasons articulated in Defendants' Invalidity Contentions Cover Pleading.
Claim 2		
2	The wireless device of claim 1, wherein the first antenna contour comprises at least 20 segments.	Castany868 expressly or inherently discloses this claim element. *See, e.g.*, "Figure 1 shows one embodiment according to the present invention. The package layout is arranged such that the die 103 is displaced with respect to the center of the substrate 102 to allocate the antenna 100 in the area 101. According to the present invention, the maximum side length of rectangular area 101 is the longest operating wavelength for the antenna divided by five. This particular embodiment includes a monopole antenna with a single radiating arm 100. The arm is formed by five or more segments (seven segments 111 through 117 in this particular example)" Castany868 at 14:21-28

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Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		 FIG.1 Castany868 at Figure 1, Showing Seven Segments

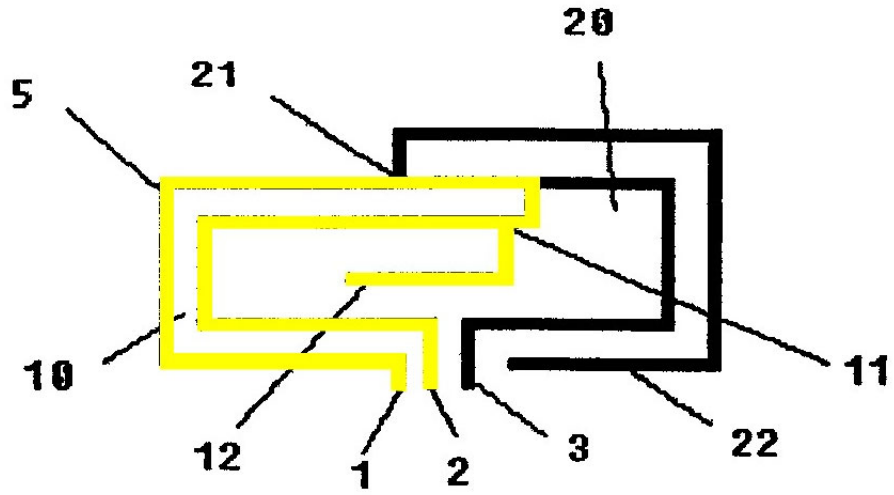
Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		 Castany868 at Figure 5, Counting at Least 20 Segments

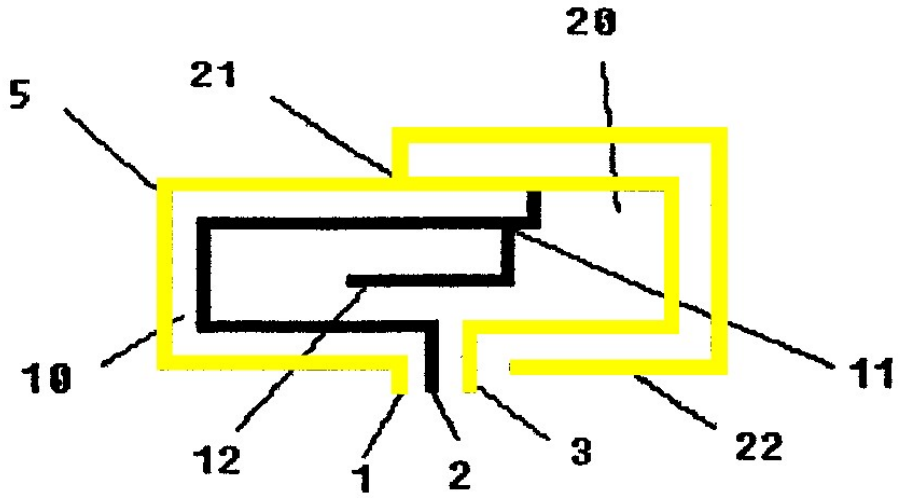
Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		 Castany868 at Figure 15, Counting at Least 20 Segments
	Claim 3	
3	The wireless device of claim 2, wherein the perimeter of the first antenna contour comprises at	Castany868 expressly or inherently discloses this claim element. *See, e.g.*, claim element 2

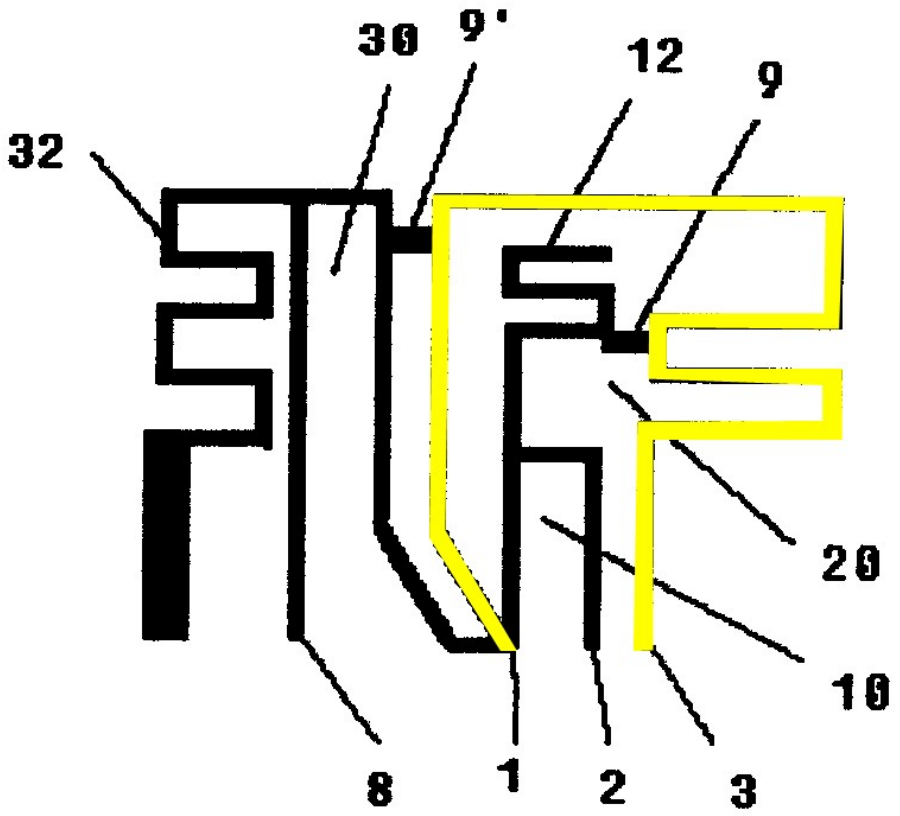
Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
	least 35 segments.	 Castany868 at Figure 15, Counting at Least 35 Segments
		Claim 4
4	The wireless device of claim 1, wherein the antenna system comprises a third antenna configured to receive signals	Castany868 expressly or inherently discloses this claim element. *See, e.g.*, "Although a multiband antenna such as for instance a multibranch antenna can be used within the package when several services or operating frequency bands are to be integrated in the same system, it is clear that other options within the present invention include arranging two or more antennas within the same package. For instance, those two or more antennas according to the present invention can be arranged in the same substrate layer, in different layers within the same substrate, in different substrates or even in the substrate and in the plastic casing of the

Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
	employing a 4G communication standard.	package. One possible arrangement for a two antenna package includes two similar antennas wherein each one is fed independently, and wherein one conducting pattern is rotated 90° with respect to the other antenna pattern. This provides an effective means for integrating a polarization diversity communication system inside a single package. For instance, the present invention enables packaging a system operating within the 0.5 to 5.5 GHz frequency band in an area smaller than 10 x 10 mm." Castany868 at 30:1-17 To the extent that this reference does not expressly disclose this claim limitation, in light of Plaintiff's apparent claim construction and infringement positions with respect to the Accused Products, a POSITA would have understood it to implicitly disclose it or would have found the claim limitation obvious. It would have been obvious to a person of ordinary skill in the art that the 4G LTE Bands 1-54, 65-76, 103, and 106 are between 500 and 5500 MHz, and as such operating within the 0.5 to 5.5 GHz frequency band is operating on frequency bands associated with a 4G communication standard. Additionally, it would have been obvious to a person of ordinary skill in the art to modify this reference with any one or more of the references disclosed in Defendants' Invalidity Contentions based on knowledge of one of ordinary skill in the art and for the reasons articulated in Defendants' Invalidity Contentions Cover Pleading. *See, e.g.,*

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Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		 Wei at Figure 2B

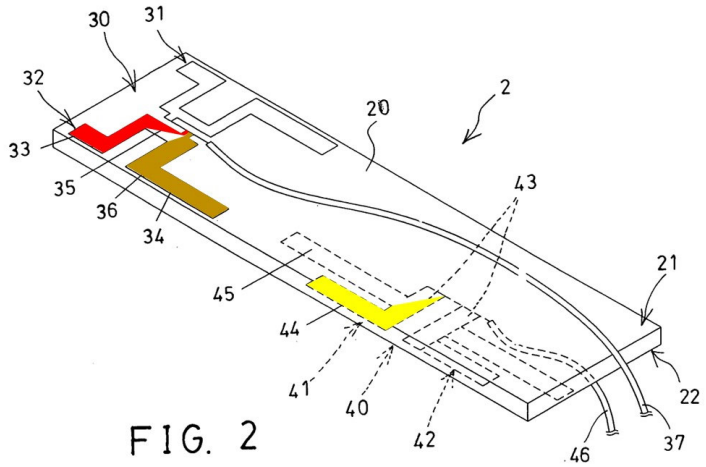
Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		 Wei at Figure 2B (Alternative)

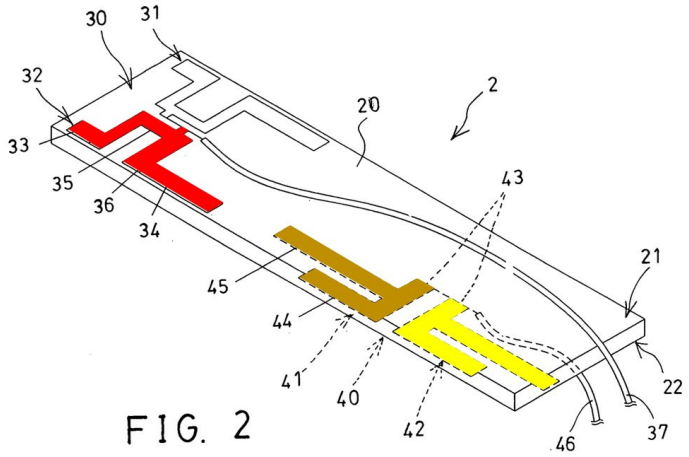
Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		 Wei at Figure 9

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Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		"It is preferable that the antenna members 31, 32 of the antenna device 30 each includes two antenna segments 33, 34 disposed up and down relative to each other, and an intermediate and/or C-shaped antenna segment 35 disposed between the antenna segments 33, 34, for receiving and transmitting signals of different frequencies, for example. It is further preferable that the antenna segments 33, 34, 35 of the two antenna members 31, 32 are disposed side by side and/or parallel to each other, or arranged in mirror symmetric relative to each other, for receiving and transmitting signals toward different lateral directions 39 relative to each other, or away from each other." Chou at [0028] "Similarly, the antenna members 41, 42 of the antenna device 40 each includes a base antenna segment 43 disposed up and down relative to each other, and two antenna segments 44, 45 extended from the base antenna segment 43 and parallel to each other, for receiving and transmitting signals of different frequencies, for example. It is further preferable that the antenna segments 43, 44, 45 of the two antenna members 41, 42 are disposed up and down relative to each other, or arranged in mirror symmetric relative to each other, for receiving and transmitting signals toward different vertical directions 49 relative to each other, or away from each other." Chou at [0030] "Furthermore, each of the antenna devices 30, 40 may include two or more antenna segments 33, 34, 35; and 43, 44, 45 respectively, for receiving and transmitting signals of different frequencies, and thus for allowing the antenna devices 30, 40 to receive and transmit signals of various frequencies. There will be no dead ends or dead corners formed or generated by the antenna devices 30, 40." Chou at [0033]

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Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		 FIG. 2 Chou at Figure 2

Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		 FIG. 2 Chou at Figure 2 (Alternative)
		Claim 5
5[a]	The wireless device of claim 4, wherein the third antenna defines an antenna contour comprising an	Castany868 expressly or inherently discloses this claim element. *See, e.g.*, claim elements 1[h], 1[k], 1[l], 1[m], 4

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Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
	entire perimeter of the third antenna, and	
5[b]	wherein the antenna contour of the third antenna has a level of complexity defined by complexity factor F_{21} having a value of at least 1.2 and	Castany868 expressly or inherently discloses this claim element. *See, e.g.*, claim elements 1[i], 5[a]
5[c]	a complexity factor F_{32} having a value of at least 1.35.	Castany868 expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[j], 5[b]
Claim 6		

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Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
6[pre]	A wireless device comprising:	To the extent the preamble is limiting, Castany868 expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[pre]
6[a]	an antenna system comprising:	Castany868 expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[a]
6[b]	[*the antenna system comprising*] a ground plane;	Castany868 expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[b]
6[c]	[*the antenna system comprising*] a first antenna within the wireless device and	Castany868 expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[c], 1[k],
6[d]	configured to support at least two frequency	Castany868 expressly or inherently discloses this claim element.

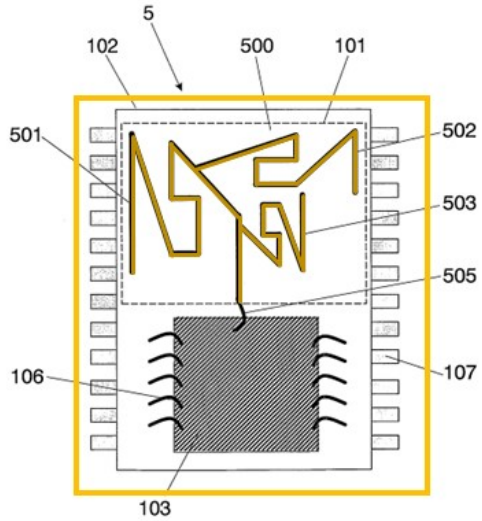
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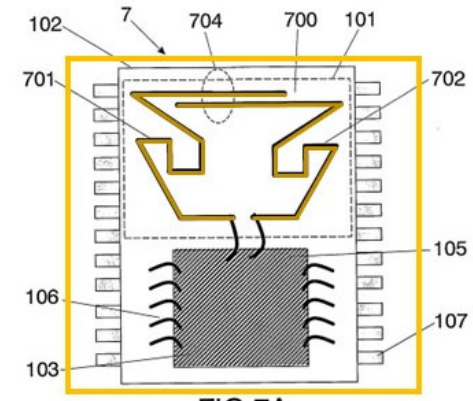
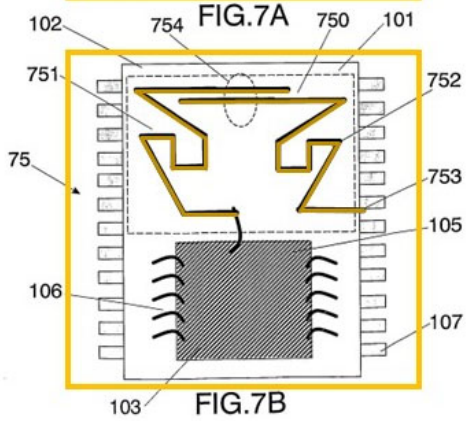
Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
	bands contained within first and second frequency ranges of the electromagnetic spectrum,	*See, e.g.*, claim element 1[d], 1[l], 6[c]
6[e]	the second frequency range being higher in frequency than the first frequency range,	Castany868 expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[e], 6[c]
6[f]	the first antenna being proximate to a first short side of a ground plane rectangle enclosing the ground plane and	Castany868 expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[g], 6[c]

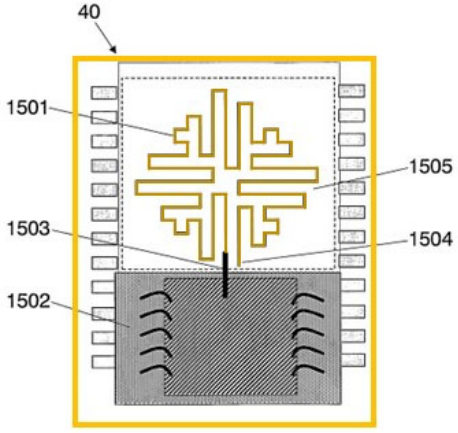
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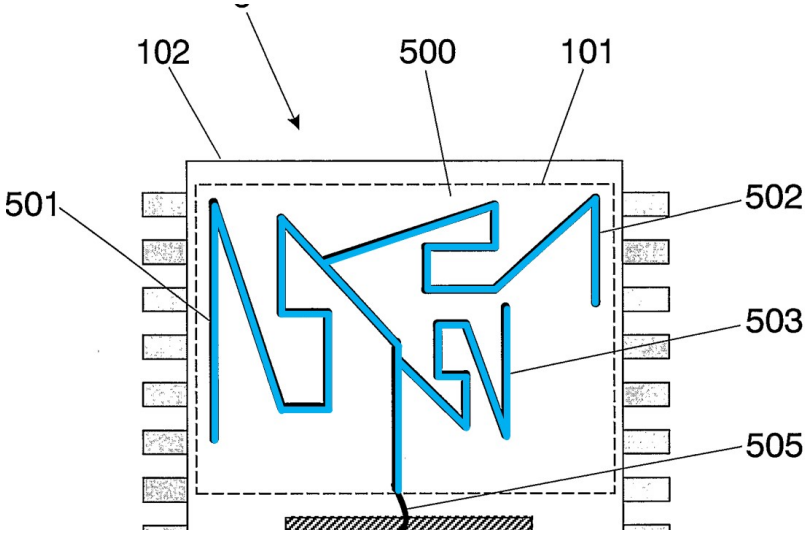
Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
6[g]	defining a first antenna contour comprising an entire perimeter of the first antenna,	Castany868 expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[h], 6[c]
6[h]	wherein the first antenna contour has a level of complexity defined by complexity factor F_{21} having a value of at least 1.20 and	Castany868 expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[i], 6[c]
6[i]	complexity factor F_{32} having a value less than 1.75; and	Castany868 expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[j], 6[c]
6[j]	[*the antenna system*	Castany868 expressly or inherently discloses this claim element.

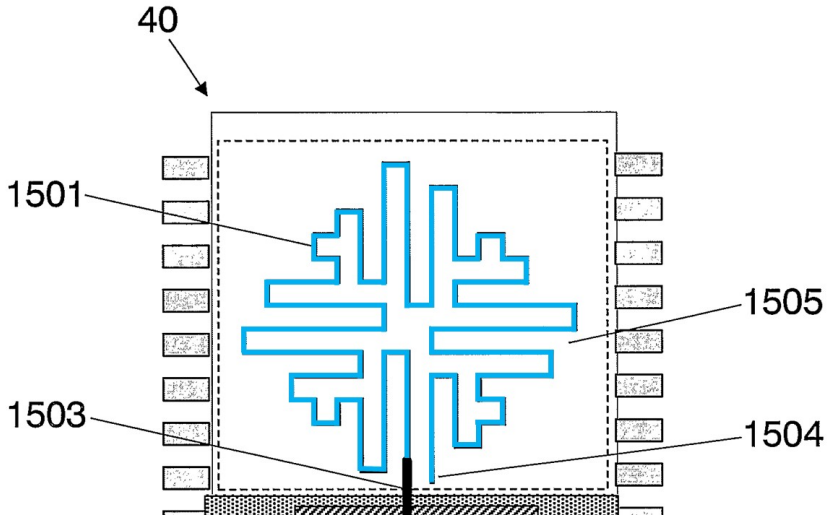
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Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
	comprising] a second antenna within the wireless device and	*See, e.g.*, claim element 1[k], 6[c]  FIG.5 Castany868 at Figure 5

Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		 FIG.7A  FIG.7B Castany868 at Figures 7A and 7B

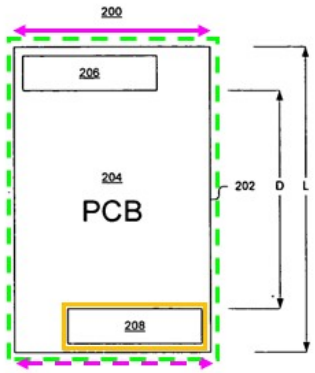
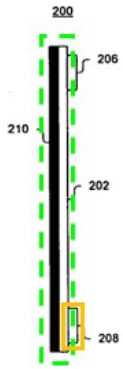
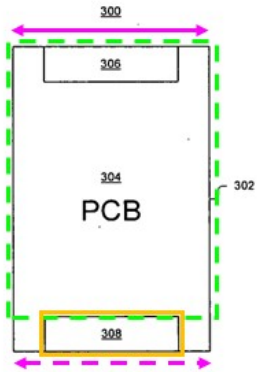
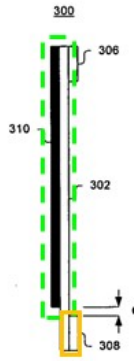
Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		 FIG.15 Castany868 at Figure 15
6[k]	defining a second antenna contour comprising an entire perimeter of the second antenna,	Castany868 expressly or inherently discloses this claim element. *See, e.g.*, claim elements 1[h], 1[k], 1[l], 1[m], 4, 5[a], 6[c]

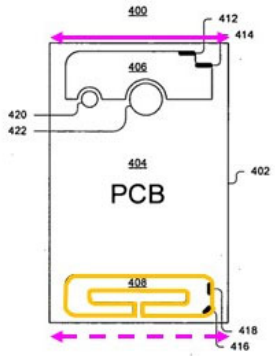
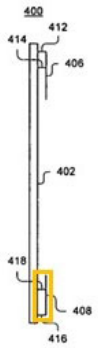
Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		 Castany868 at Figure 5

Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		 Castany868 at Figure 15
6[l]	the second antenna being proximate to a second short side of the ground plane rectangle that is opposite to the	Castany868 expressly or inherently discloses this claim element. *See, e.g.*, claim elements 1[h], 1[g], 1[k], 6[c], 6[j] To the extent that this reference does not expressly disclose this claim limitation, in light of Plaintiff's apparent claim construction and infringement positions with respect to the Accused Products, a POSITA would have understood it to implicitly disclose it or would have found the claim limitation obvious.

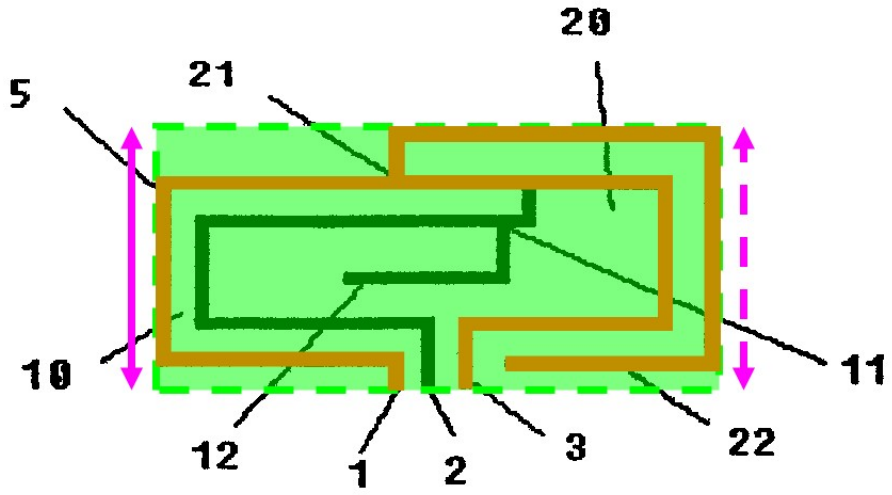
Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
	first short side of the ground plane rectangle,	Additionally, it would have been obvious to a person of ordinary skill in the art to modify this reference with any one or more of the references disclosed in Defendants' Invalidity Contentions based on knowledge of one of ordinary skill in the art and for the reasons articulated in Defendants' Invalidity Contentions Cover Pleading. *See, e.g.,*

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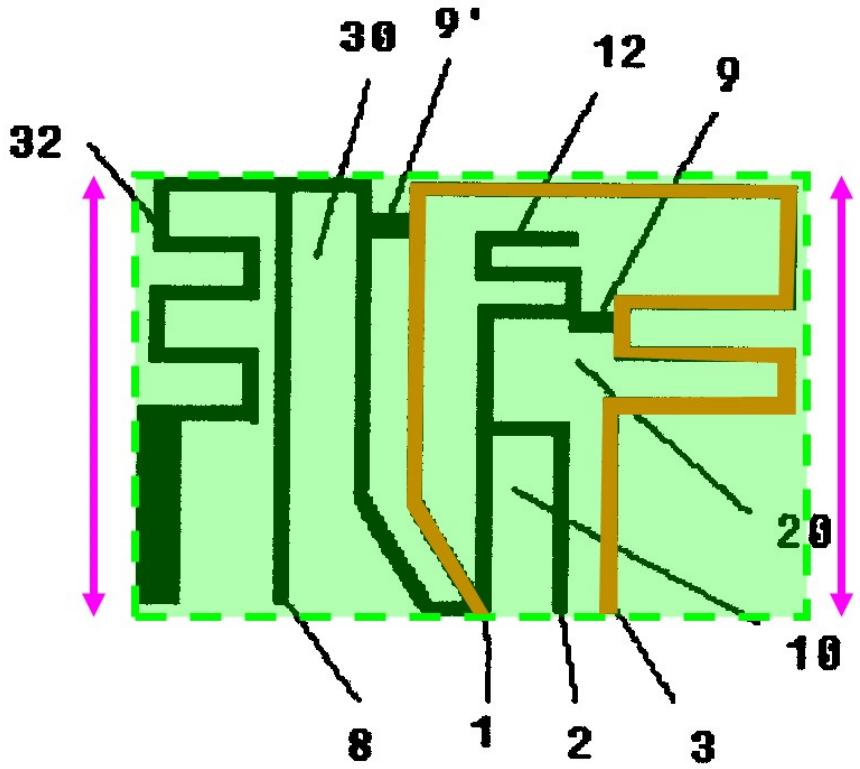
Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		 FIG. 2A  FIG. 2B  FIG. 3A  FIG. 3B

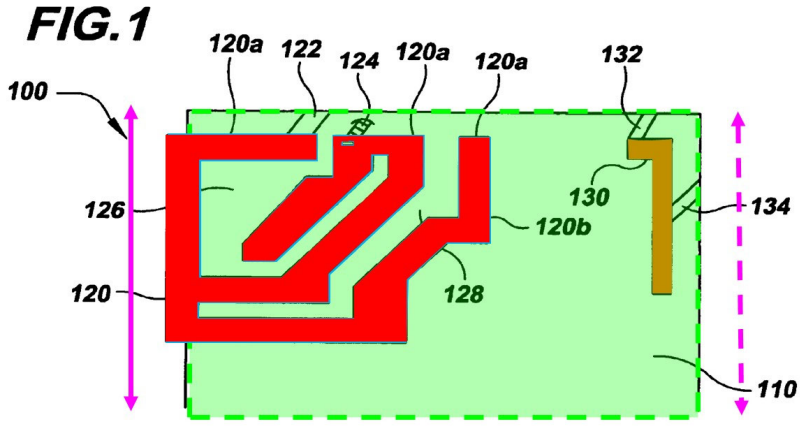
Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		 FIG. 4A  FIG. 4B Dou at Figures 2A-B, 3A-B, and 4A-B

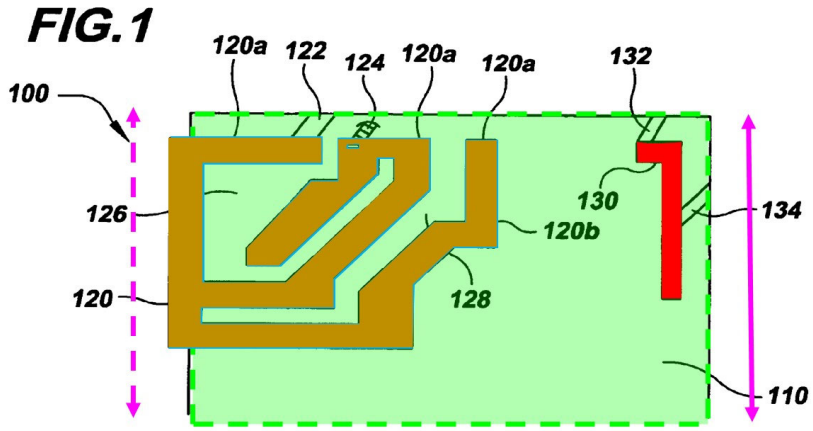
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Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		 Wei at Figure 2B

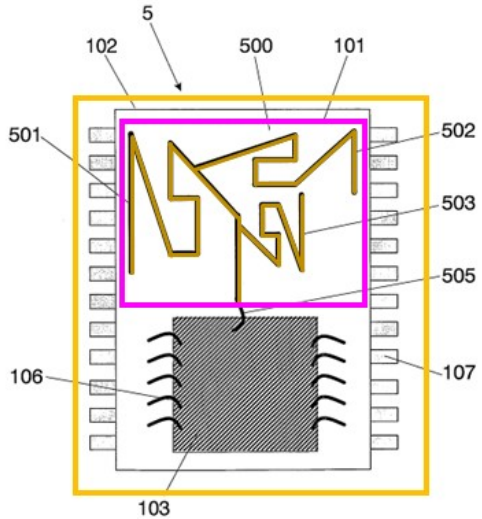
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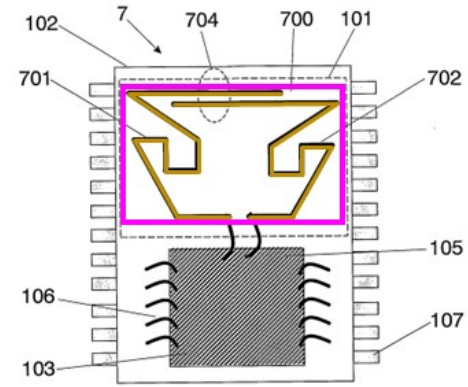
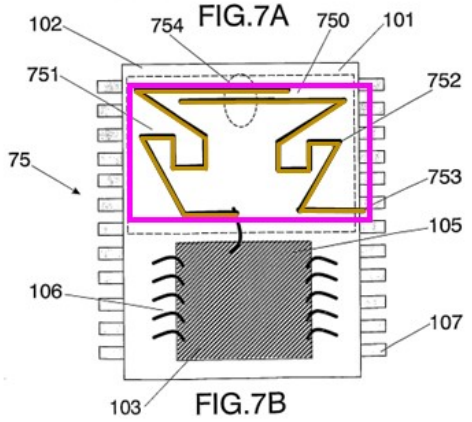
Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		 Wei at Figure 9

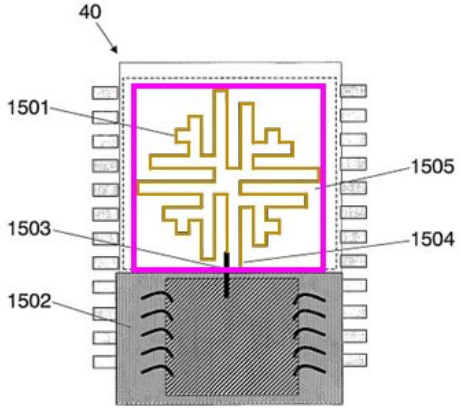
Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		 Talvitie at Figure 1

Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		 Talvitie at Figure 1 (Alternative)
6[m]	a minimum-sized parallelepiped of rectangular faces that completely encloses a volume of the second antenna defining an	Castany868 expressly or inherently discloses this claim element. *See, e.g.*,

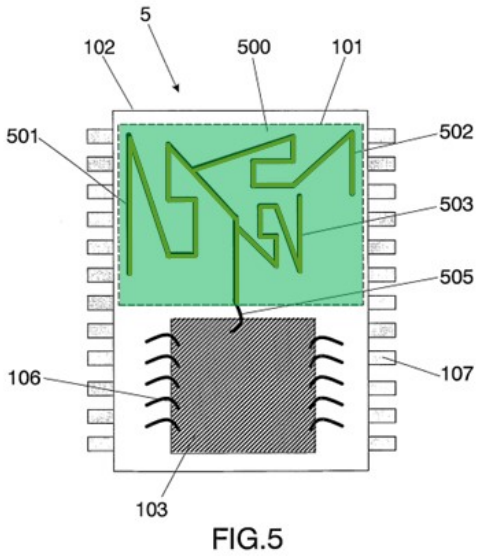
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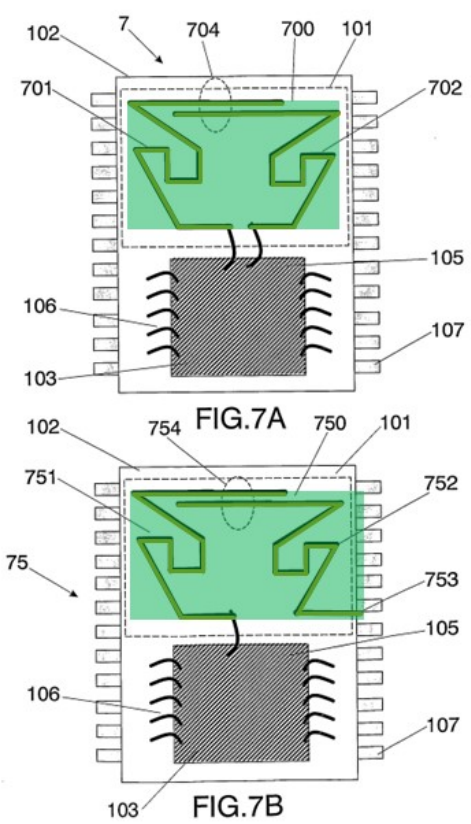
Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
	antenna box, and	 FIG.5 Castany868 at Figure 5

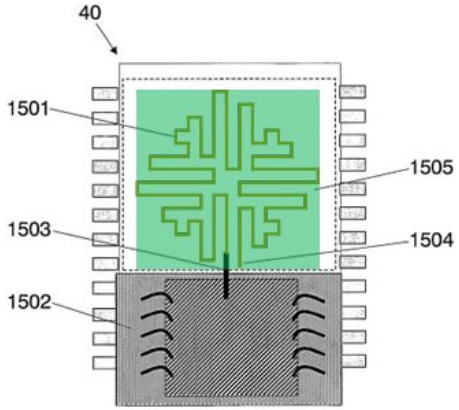
Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		 FIG.7A  FIG.7B Castany868 at Figures 7A and 7B

Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		 FIG.15 Castany868 at Figure 15
6[n]	an orthogonal projection of the antenna box along a normal to a face with a largest area of the second antenna defining	Castany868 expressly or inherently discloses this claim element. *See, e.g.*, claim element 6[m], 6[o]

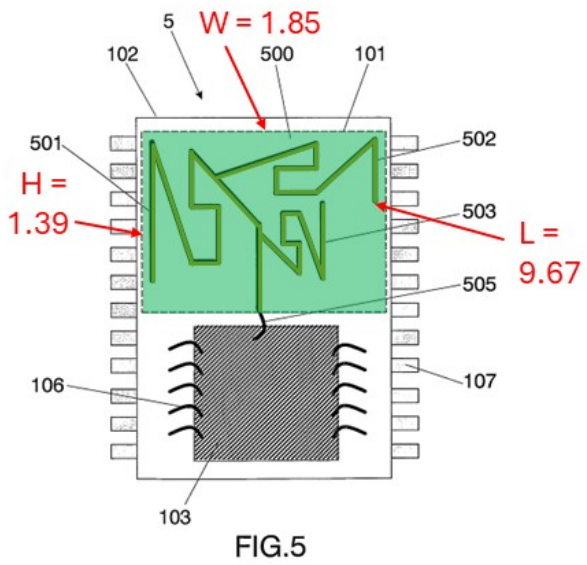
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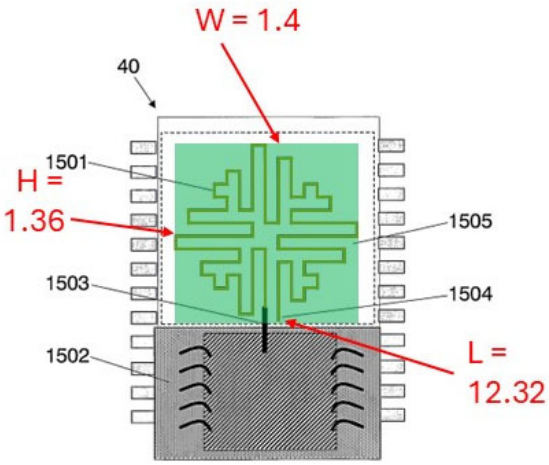
Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
6[o]	an antenna rectangle,	Castany868 expressly or inherently discloses this claim element. *See, e.g.*,  FIG.5 Castany868 at Figure 5

Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		 Castany868 at Figures 7A and 7B

Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		 FIG.15 Castany868 at Figure 15
6[p]	wherein a length of the second antenna contour is greater than four times a diagonal of the antenna rectangle.	Castany868 expressly or inherently discloses this claim element. *See, e.g.*,

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Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		 FIG.5 Castany868 at Figure 5

Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		 FIG.15 Castany868 at Figure 15 It would have been obvious to a person of ordinary skill in the art that a width of 1.85 and a height of 1.39 results in a diagonal of 2.31, and that four times that diagonal is 9.26. Additionally, it would have been obvious that a length of 9.67 is greater than 9.26. Further, it would have been obvious to a person of ordinary skill in the art that a width of 1.4 and a height of 1.36 results in a diagonal of 1.95, and that four times that diagonal is 7.81. Additionally, it would have been obvious that a length of 12.32 is greater than 7.81.

Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
Claim 7		
7	The wireless device of claim 6, wherein the first antenna contour comprises at least 20 segments.	Castany868 expressly or inherently discloses this claim element. *See, e.g.*, claim element 2
Claim 8		
8	The wireless device of claim 6, wherein the first antenna contour comprises at least 35 segments.	Castany868 expressly or inherently discloses this claim element. *See, e.g.*, claim element 3

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Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
Claim 9		
9[a]	The wireless device of claim 6, wherein the second antenna contour has a level of complexity defined by complexity factor F_{21} having a value of at least 1.2 and	Castany868 expressly or inherently discloses this claim element. *See, e.g.*, claim elements 1[h], 1[k], 1[l], 1[m], 4, 5[a], 5[b]
9[b]	a complexity factor F_{32} having a value of at least 1.35.	Castany868 expressly or inherently discloses this claim element. *See, e.g.*, claim elements 1[h], 1[k], 1[l], 1[m], 4, 5[a], 5[b], 5[c], 9[a]
Claim 12		
12[pre]	A wireless device comprising:	To the extent the preamble is limiting, Castany868 expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[pre], 6[pre]

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Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
12[a]	an antenna system comprising:	Castany868 expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[a], 6[a]
12[b]	[*the antenna system comprising*] a ground plane;	Castany868 expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[b], 6[b]
12[c]	[*the antenna system comprising*] a first antenna within the wireless device and	Castany868 expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[c], 6[c]
12[d]	configured to provide operation in at least four	Castany868 expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[d], 6[d]

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Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
	frequency bands,	
12[e]	at least one of the at least four frequency bands is contained within a first frequency range and	Castany868 expressly or inherently discloses this claim element. *See, e.g.*, 1[d], 6[d], 12[d]
12[f]	at least one other of the four frequency bands is contained within a second frequency range,	Castany868 expressly or inherently discloses this claim element. *See, e.g.*, 1[d], 6[d], 12[d], 12[e]
12[g]	the first frequency range being lower in frequency than the second	Castany868 expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[e], 6[e], 12[e], 12[f]

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Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
	frequency range,	To the extent that this reference does not expressly disclose this claim limitation, in light of Plaintiff's apparent claim construction and infringement positions with respect to the Accused Products, a POSITA would have understood it to implicitly disclose it or would have found the claim limitation obvious. It would have been obvious to a person of ordinary skill in the art that frequency bands which do not overlap can be grouped into two frequency ranges, and as the frequency bands do not overlap one of the frequency ranges must be lower in frequency than the other frequency range. It would have been obvious to a person of ordinary skill in the art that frequency bands with higher Hertz values would be higher in frequency than frequency bands with relatively lower Hertz values. Additionally, it would have been obvious to a person of ordinary skill in the art to modify this reference with any one or more of the references disclosed in Defendants' Invalidity Contentions based on knowledge of one of ordinary skill in the art and for the reasons articulated in Defendants' Invalidity Contentions Cover Pleading.
12[h]	the first antenna being proximate to a first short side of a ground plane rectangle enclosing the ground plane,	Castany868 expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[g], 6[f]
12[i]	the first antenna defining a first antenna	Castany868 expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[h], 6[g]

Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
	contour comprising an entire perimeter of the first antenna, and	
12[j]	wherein the first antenna contour has a level of complexity defined by complexity factor F_{21} having a value of at least 1.20 and	Castany868 expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[i], 6[h]
12[k]	complexity factor F_{32} having a value less than 1.75; and	Castany868 expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[j], 6[i]
12[l]	wherein the first antenna is configured to transmit and	Castany868 expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[f], 4

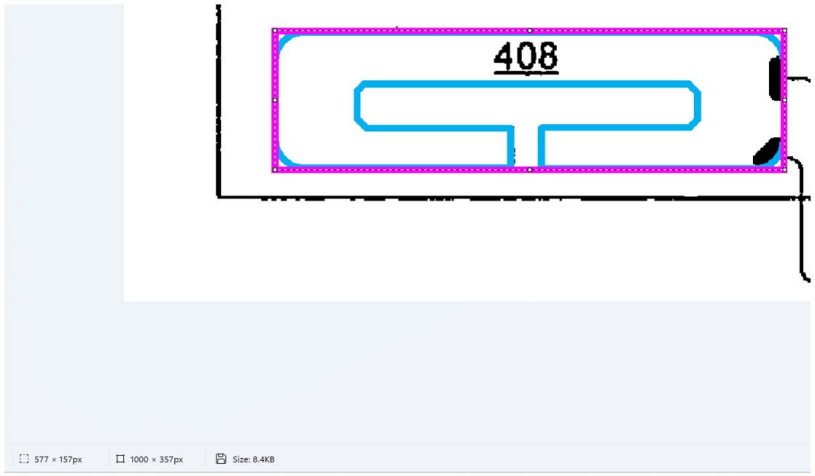
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Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
	receive signals from a 4G communication standard; and	
12[m]	[*the antenna system comprising*] a second antenna within the wireless device and configured to receive signals from a 4G communication standard,	Castany868 expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[f], 4, 12[l]
12[n]	a minimum-sized parallelepiped of rectangular faces that completely encloses a volume of the second antenna	Castany868 expressly or inherently discloses this claim element. *See, e.g.*, claim element 6[m]

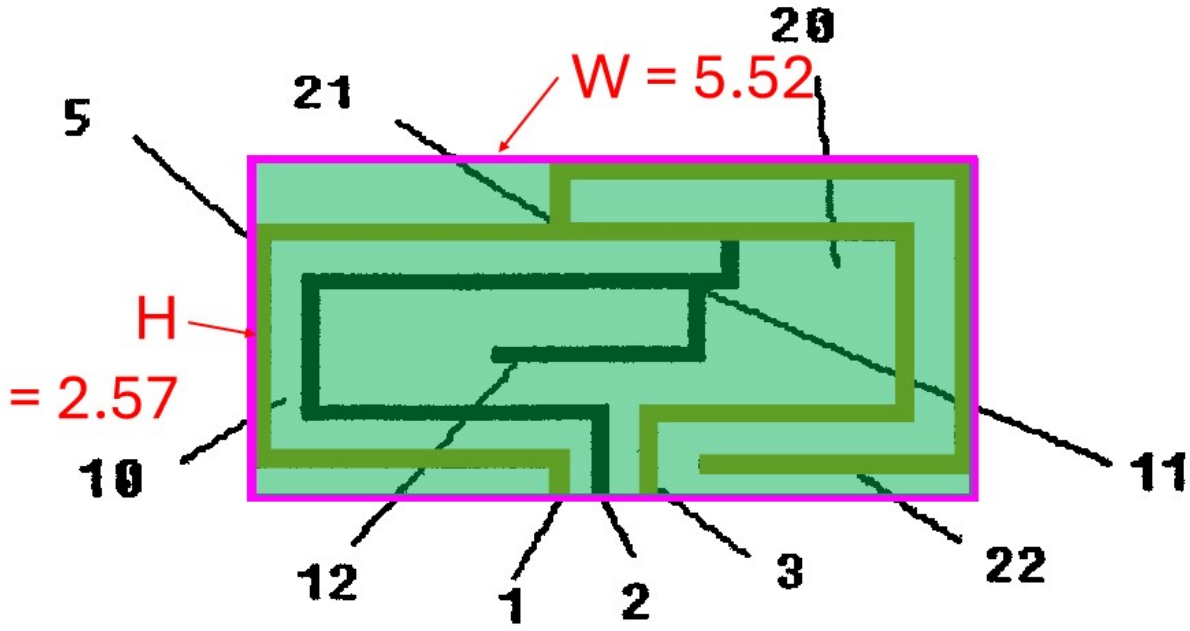
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Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
	defining an antenna box,	
12[o]	an orthogonal projection of the antenna box along a normal to a face with a largest area of the second antenna defining	Castany868 expressly or inherently discloses this claim element. *See, e.g.*, claim element 6[n]
12[p]	an antenna rectangle,	Castany868 expressly or inherently discloses this claim element. *See, e.g.*, 6[o]
12[q]	an aspect ratio of the antenna rectangle being defined as a ratio between a width and a height of the antenna rectangle, and	Castany868 expressly or inherently discloses this claim element. *See, e.g.*, To the extent that this reference does not expressly disclose this claim limitation, in light of Plaintiff's apparent claim construction and infringement positions with respect to the Accused Products, a POSITA would have understood it to implicitly disclose it or would have found the claim limitation obvious.

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Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
	wherein the aspect ratio has a value of at least 2.	Additionally, it would have been obvious to a person of ordinary skill in the art to modify this reference with any one or more of the references disclosed in Defendants' Invalidity Contentions based on knowledge of one of ordinary skill in the art and for the reasons articulated in Defendants' Invalidity Contentions Cover Pleading. *See, e.g.,*  Dou at Figure 4A, showing measurements of antenna rectangle Further, it would have been obvious to a person of ordinary skill in the art that a length of 577 pixels and a height of 157 pixels results in $$577/157 = 3.6752$$

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Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		And $2 \leq 3.6752$  Wei at Figure 2B It would have been obvious to a person of ordinary skill in the art that a width of 5.52 and a height of 2.57 results in an aspect ratio of 2.15, and that 2.15 is greater than 2.

Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
		Claim 13
13	The wireless device of claim 12, wherein the first antenna contour comprises at least 20 segments.	Castany868 expressly or inherently discloses this claim element. *See, e.g.*, claim element 2, 7
		Claim 14
14	The wireless device of claim 13, wherein the first antenna contour comprises at least 35 segments.	Castany868 expressly or inherently discloses this claim element. *See, e.g.*, claim element 3, 8
		Claim 15
15	The wireless device of claim 12, wherein the	Castany868 expressly or inherently discloses this claim element.

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Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
	second antenna is proximate to a second short side of the ground plane rectangle that is opposite to the first short side of the ground plane rectangle.	*See, e.g.*, claim element 6[l]
		Claim 16
16[a]	The wireless device of claim 12, wherein the second antenna defines a second antenna contour comprising an entire perimeter of the second antenna,	Castany868 expressly or inherently discloses this claim element. *See, e.g.*, claim elements 1[h], 1[k], 1[l], 1[m], 4, 5[a], 6[k]
16[b]	and wherein the second antenna contour has a	Castany868 expressly or inherently discloses this claim element.

Claim No.	U.S. Patent No. 11,031,677 B2	Castany868
	level of complexity defined by complexity factor F_{21} having a value of at least 1.2 and	*See, e.g.*, claim elements 1[h], 1[k], 1[l], 1[m], 4, 5[a], 5[b], 9[a]
16[c]	a complexity factor F_{32} having a value of at least 1.35.	Castany868 expressly or inherently discloses this claim element. *See, e.g.*, claim elements 1[h], 1[k], 1[l], 1[m], 4, 5[a], 5[b], 5[c], 9[a], 9[b]
Claim 17		
17	The wireless device of claim 16, wherein the second antenna contour comprises at least 20 segments.	Castany868 expressly or inherently discloses this claim element. *See, e.g.*, claim elements 2, 7, 13

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INVALIDITY CONTENTIONS FOR U.S. PATENT NO. 11,031,677 B2
BASED ON U.S. PATENT NO. 6,943,746 TO TALVITIE ET AL. ("TALVITIE")

Based upon Plaintiff's Complaint, Infringement Contentions, and apparent claim constructions and application of the claims to Defendants' accused products, as best as they can be deciphered, the reference charted below anticipates or at least renders obvious some or all of the asserted claims. These invalidity contentions are not an admission by the Defendants that the accused products are covered by or infringe claims 1, 2, 3, 4, 5, 6, 7, 8, 9, 12, 13, 14, 15, 16, and 17 ("the '677 Asserted Claims")[1], particularly when these claims are properly construed and applied.

AIA law applies because the application that issued as the '677 Patent was filed on March 27, 2020, after the AIA came into force on March 16, 2013.

U.S. Patent No. 6,943,746 to Talvitie et al. ("Talvitie") was filed on October 23, 2003, published on July 15, 2004, and issued on September 13, 2005. This patent is prior art under at least 35 U.S.C. § 102(e), 103(a), and AIA 35 U.S.C. §102(a)(1). As described in the following claim chart, the asserted claims of U.S. Patent No. 11,031,677 (the "'677 Patent"), are invalid as anticipated by Talvitie.

To the extent that Talvitie is found not to anticipate one or more of the asserted claims of the '677 Patent, these claims are invalid as obvious in view of Talvitie alone or as modified in view of or in combination with other prior art references disclosed in Defendants' Invalidity Contentions and accompanying charts, including without limitation as set forth below.

- U.S. Patent Application No. 2007/0200773 to Dou et al. "Dou") was filed on February 24, 2006, published on August 30, 2007, and issued as U.S. Patent No. 7,548,208 on June 16, 2009. This patent is prior art under at least 35 U.S.C. § 102(e), 103(a), and AIA 35 U.S.C. §102(a)(1).
- Chinese Patent No. 2,765,337. ("Wei") was filed on February 6, 2005, and was granted on March 15, 2006. This patent is prior art under at least 35 U.S.C. §§ 102(a), 102(e), 103(a), and AIA 35 U.S.C. §102(a)(1).
- PCT Publication No. 2004/042868 to Castany et al. ("Castany868") was filed on November 7, 2002 and published on May 21, 2004, on August 30, 2007. This patent is prior art under at least 35 U.S.C. § 102(e), 103(a), and AIA 35 U.S.C. §102(a)(1).
- U.S. Patent Application No. 2002/0238433 to Chou ("Chou") was filed on March 1, 2005, published on October 26, 2006, and issued as U.S. Patent No. 7,129,898 on October 31, 2006. This patent is prior art under at least 35 U.S.C. § 102(e), 103(a), and AIA 35 U.S.C. §102(a)(1).

[1] Defendants understand that that, by not charting claims 10-11 and 18-20 in its Infringement Contentions, Plaintiff does not assert these claims against Defendants.

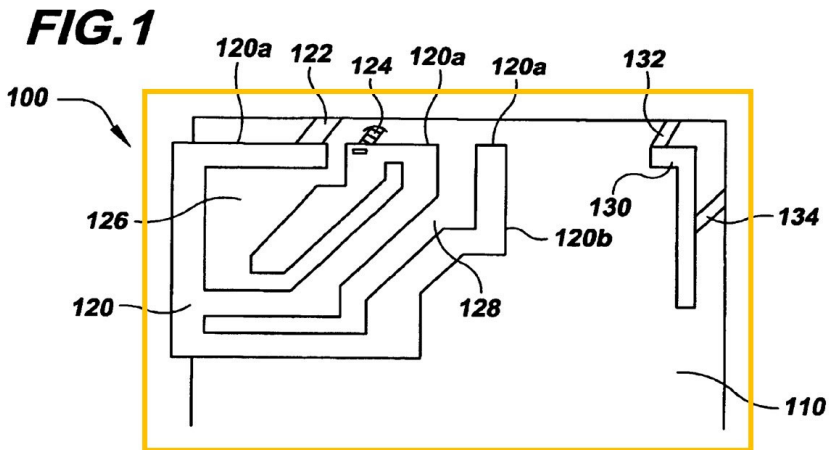
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These invalidity contentions are not an admission that the Defendants concede or acquiesce to any claim construction implied or suggested by Plaintiff's Complaint or Infringement Contentions. Nor are Defendants asserting any claim construction positions through these charts, including whether the preamble is a limitation. The portions of the prior art reference cited below are not exhaustive but are exemplary in nature. Defendants reserve the right to update their constructions and contentions in view of this Court's claim construction order.[2]

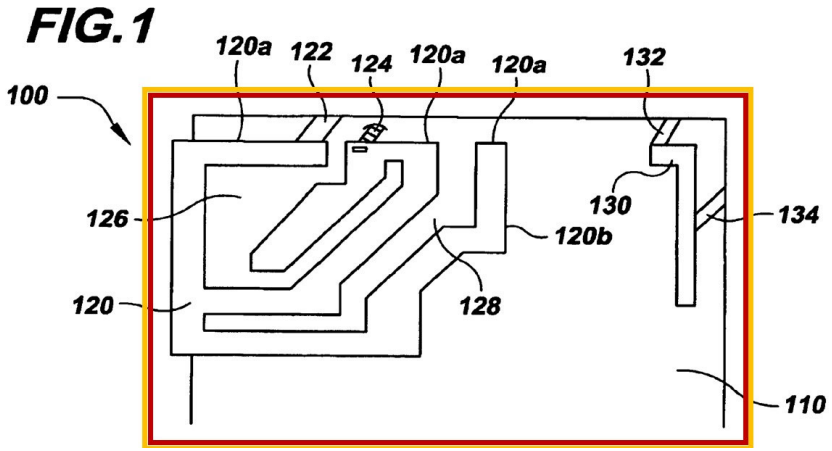
Claim No.	U.S. Patent No. 11,031,677 B2	Talvitie
	Claim 1	
1[pre]	A wireless device comprising:	To the extent the preamble is limiting, Talvitie expressly or inherently discloses this claim element. *See, e.g.*, "The invention relates to antenna structures, and particularly to internal antennas used in radio devices, such as mobile stations." Talvitie at 1:6-9 "A radio device according to an embodiment comprises the above-described antenna structure for delivering a radio-frequency signal" Talvitie at 2:51-52 "The antenna structure of FIG. 1 can preferably be configured to operate as an antenna structure for a multifrequency mobile station. " Talvitie at 5:1-3

[2] Defendants incorporate herein any related work performed by or on behalf of an author or an inventor in the United States under 35 U.S.C. § 102(g)(2). Defendants reserve the right to supplement and/or alter this chart based on further investigation and ongoing discovery.

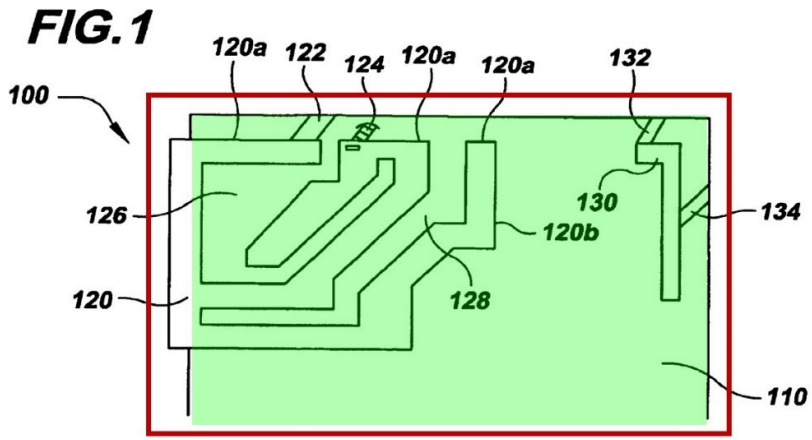
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Claim No.	U.S. Patent No. 11,031,677 B2	Talvitie
		 Talvitie at Figure 1
1[a]	an antenna system comprising:	Talvitie expressly or inherently discloses this claim element. *See, e.g.*, "The invention relates to antenna structures, and particularly to internal antennas used in radio devices, such as mobile stations." Talvitie at 1:6-9

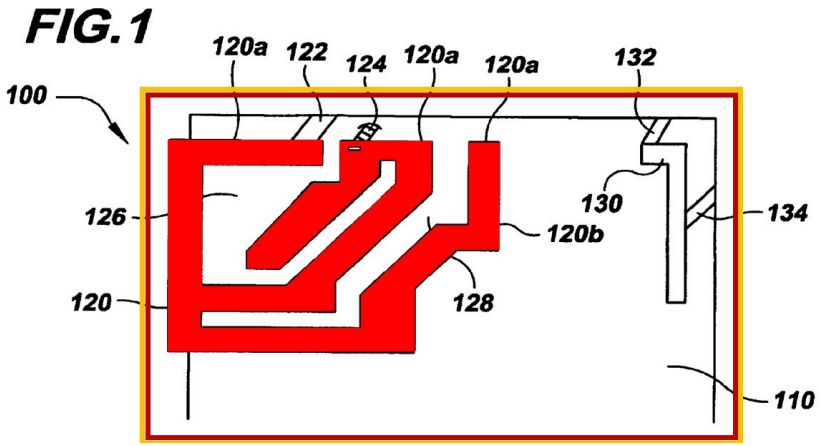
Fractus Exhibit 2003
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Claim No.	U.S. Patent No. 11,031,677 B2	Talvitie
		"A radio device according to an embodiment comprises the above-described antenna structure for delivering a radio-frequency signal" Talvitie at 2:51-52 "The antenna structure of FIG. 1 can preferably be configured to operate as an antenna structure for a multifrequency mobile station. " Talvitie at 5:1-3  Talvitie at Figure 1

Claim No.	U.S. Patent No. 11,031,677 B2	Talvitie
1[b]	[*the antenna system comprising*] a ground plane;	Talvitie expressly or inherently discloses this claim element. *See, e.g.*, "Referring to FIG. 1, a preferred embodiment will be described in the following. FIG. 1 shows a planar antenna structure called a PIFA (Planar Inverted F Antenna) antenna structure 100 comprising a ground plane 110, a first radiator 120 and a second radiator 130. The radiators 120, 130 are located at a distance from the ground plane 110 such that air or another dielectric material is, as an isolating material, provided between the ground plane 110 and the radiators 120, 130. The first radiator 120 is a "groove plane antenna" which is connected to the ground plane 110 by a ground point 122 and to which radiation power is fed from a feed point 124. The ground point 122 constituting a grounding line is located substantially at the edge of the radiator 120. The feed point 124 can be implemented as coaxial feed e.g. as a lead-through from the ground plane such that it resides at a substantial distance from the edge of the radiator. The feed point 124 can also be implemented by placing it at the edge of the radiator 120, in a similar manner to that of the ground point." Talvitie at 3:47-65 "The second radiator 130 is a narrow, planar radiator whose surface area in this embodiment is substantially smaller than that of the first radiator 120. The second radiator 130 also comprises a ground point 132 connecting the radiator 130 to a ground plane 110, and a feed point 134 feeding radiation power. The ground point 132 constituting a grounding line is located substantially at the edge of the radiator 130. The feed point 134 can be implemented as coaxial feed e.g. as a lead-through from the ground plane such that it resides at a substantial distance from the edge of the radiator. The feed point 134 can also be implemented by placing it at the edge of the radiator 130, in a similar manner to that of the ground point. The second radiator is configured to radiate within a frequency range at least partly overlapping with at least one frequency range, preferably with a higher frequency range, of the first radiator. As far as the operation of the present embodiments is concerned, the shape or location of the second radiator 130 with respect to the first radiator 120 is irrelevant; the only point is that both radiators are provided with a feed point of their own and, preferably but not necessarily, a common ground plane." Page 5 of 58 Fractus Exhibit 2003 Fractus v. Cellco Page 302 of 923

Claim No.	U.S. Patent No. 11,031,677 B2	Talvitie
		Talvitie at 4:47-67  Talvitie at Figure 1
1[c]	[*the antenna system comprising*] a first antenna within the wireless device and	Talvitie expressly or inherently discloses this claim element. *See, e.g.*, "Referring to FIG. 1, a preferred embodiment will be described in the following. FIG. 1 shows a planar antenna structure called a PIFA (Planar Inverted F Antenna) antenna structure 100 comprising a ground plane 110, a first radiator 120 and a second radiator 130. The radiators 120, 130 are located at a distance from the ground plane 110 such that air or another dielectric material is, as an isolating material, provided between the ground plane 110 and the radiators 120, 130. The first radiator 120 is a "groove plane antenna" which is connected to the ground plane

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Claim No.	U.S. Patent No. 11,031,677 B2	Talvitie
		110 by a ground point 122 and to which radiation power is fed from a feed point 124. The ground point 122 constituting a grounding line is located substantially at the edge of the radiator 120." Talvitie at 3:47-59  Talvitie at Figure 1
1[d]	configured to support at least three frequency bands contained within first and	Talvitie expressly or inherently discloses this claim element. *See, e.g.*, "The antenna structure further comprises separate feed points for the at least two radiators, the radiators are grounded by a ground point to at least some ground plane, and at least the first radiator is a groove plane antenna

Claim No.	U.S. Patent No. 11,031,677 B2	Talvitie
	second frequency ranges of the electromagnetic spectrum,	configured to provide at least two frequency bands, preferably at least one lower frequency band and at least one higher frequency band" Talvitie at 2:33-39 "The antenna structure of FIG. 1 can preferably be configured to operate as an antenna structure for a multifrequency mobile station. An example of a multifrequency mobile station is a mobile station configured to support EGSM 900 (880 to 960 MHz), GSM 1900 (1850 to 1990 MHz), WCDMA 2000 (1920 to 2170 MHz) systems and frequency ranges." Talvitie at 5:1-6 To the extent that this reference does not expressly disclose this claim limitation, in light of Plaintiff's apparent claim construction and infringement positions with respect to the Accused Products, a POSITA would have understood it to implicitly disclose it or would have found the claim limitation obvious. It would have been obvious to a person of ordinary skill in the art that disclosing at least two frequency bands discloses a third or more frequency bands. Additionally, it would have been obvious to a person of ordinary skill in the art to modify this reference with any one or more of the references disclosed in Defendants' Invalidity Contentions based on knowledge of one of ordinary skill in the art and for the reasons articulated in Defendants' Invalidity Contentions Cover Pleading.
1[e]	the second frequency range being higher in frequency than the first	Talvitie expressly or inherently discloses this claim element. *See, e.g.*, "The antenna structure further comprises separate feed points for the at least two radiators, the radiators are grounded by a ground point to at least some ground plane, and at least the first radiator is a groove plane antenna

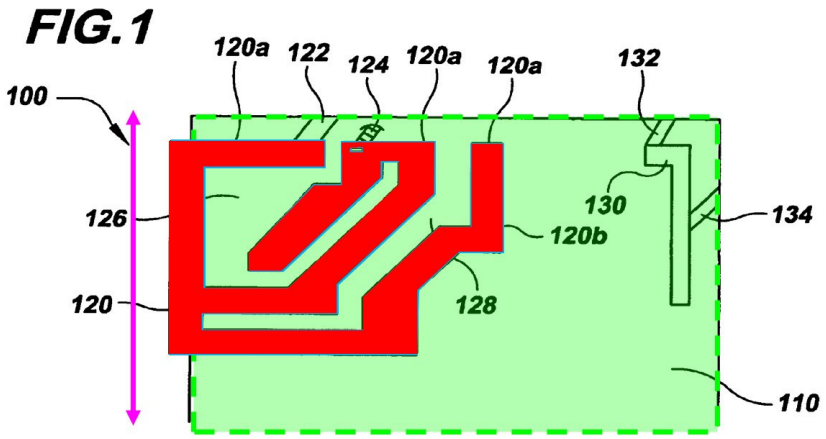
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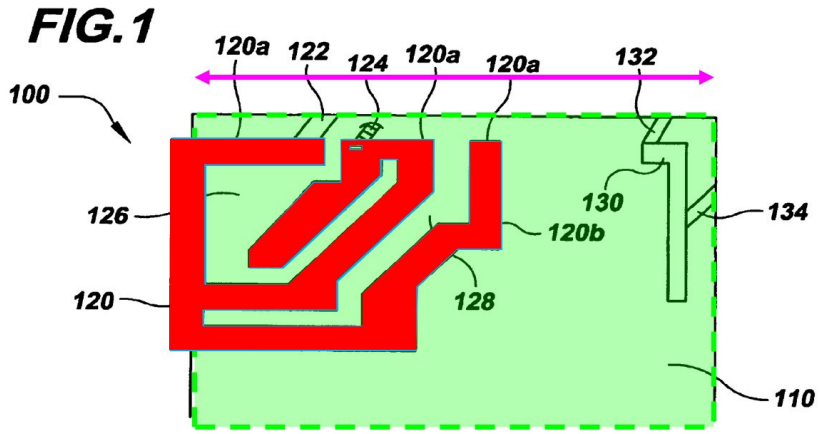
Claim No.	U.S. Patent No. 11,031,677 B2	Talvitie
	frequency range and	configured to provide at least two frequency bands, preferably at least one lower frequency band and at least one higher frequency band" Talvitie at 2:33-39 "The antenna structure of FIG. 1 can preferably be configured to operate as an antenna structure for a multifrequency mobile station. An example of a multifrequency mobile station is a mobile station configured to support EGSM 900 (880 to 960 MHz), GSM 1900 (1850 to 1990 MHz), WCDMA 2000 (1920 to 2170 MHz) systems and frequency ranges." Talvitie at 5:1-6 To the extent that this reference does not expressly disclose this claim limitation, in light of Plaintiff's apparent claim construction and infringement positions with respect to the Accused Products, a POSITA would have understood it to implicitly disclose it or would have found the claim limitation obvious. It would have been obvious to a person of ordinary skill in the art that frequency bands with higher Hertz values would be higher in frequency than frequency bands with relatively lower Hertz values. Additionally, it would have been obvious to a person of ordinary skill in the art to modify this reference with any one or more of the references disclosed in Defendants' Invalidity Contentions based on knowledge of one of ordinary skill in the art and for the reasons articulated in Defendants' Invalidity Contentions Cover Pleading.
1[f]	at least one of the three frequency bands being associated with a 4G	Talvitie expressly or inherently discloses this claim element. *See, e.g.*, "The antenna structure of FIG. 1 can preferably be configured to operate as an antenna structure for a multifrequency mobile station. An example of a multifrequency mobile station is a mobile station configured to

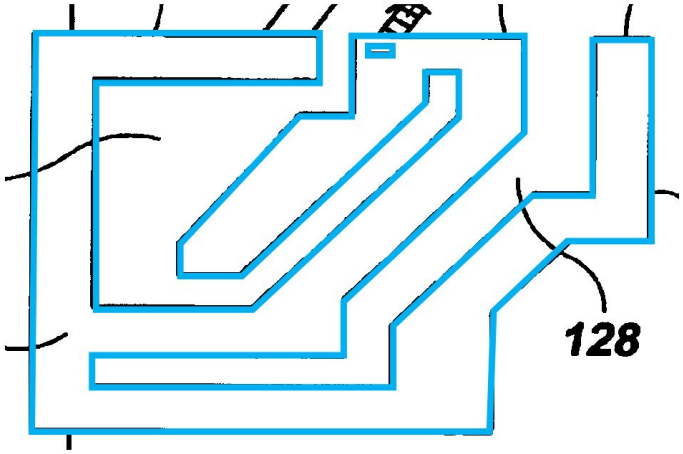
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Claim No.	U.S. Patent No. 11,031,677 B2	Talvitie
	communication standard,	support EGSM 900 (880 to 960 MHz), GSM 1900 (1850 to 1990 MHz), WCDMA 2000 (1920 to 2170 MHz) systems and frequency ranges." Talvitie at 5:1-6 To the extent that this reference does not expressly disclose this claim limitation, in light of Plaintiff's apparent claim construction and infringement positions with respect to the Accused Products, a POSITA would have understood it to implicitly disclose it or would have found the claim limitation obvious. Additionally, it would have been obvious to a person of ordinary skill in the art to modify this reference with any one or more of the references disclosed in Defendants' Invalidity Contentions based on knowledge of one of ordinary skill in the art and for the reasons articulated in Defendants' Invalidity Contentions Cover Pleading.
1[g]	the first antenna being proximate to a first short side of a ground plane rectangle enclosing the ground plane and	Talvitie expressly or inherently discloses this claim element. *See, e.g.*,

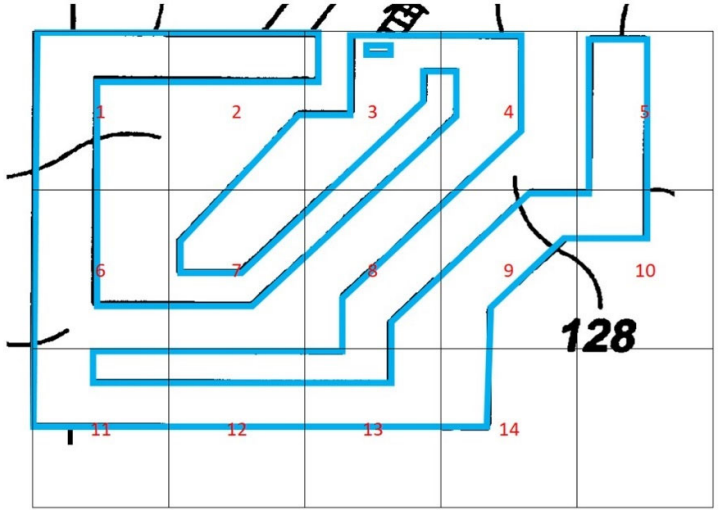
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Claim No.	U.S. Patent No. 11,031,677 B2	Talvitie
		 Talvitie at Figure 1

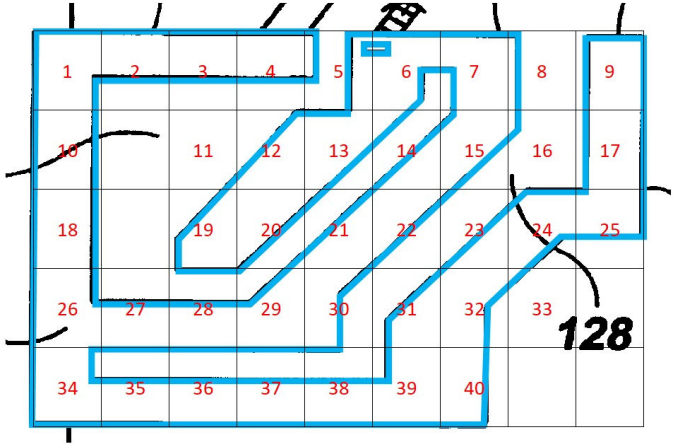
Claim No.	U.S. Patent No. 11,031,677 B2	Talvitie
		 Talvitie at Figure 1 (Alternative)
1[h]	defining a first antenna contour comprising an entire perimeter of the first antenna,	Talvitie expressly or inherently discloses this claim element. *See, e.g.*,

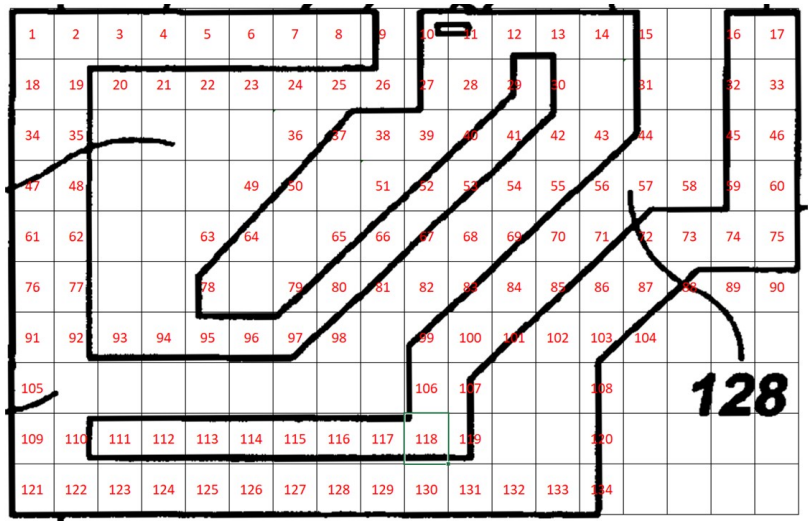
Claim No.	U.S. Patent No. 11,031,677 B2	Talvitie
		 Talvitie at Figure 1
1[i]	wherein the first antenna contour has a level of complexity defined by complexity	Talvitie expressly or inherently discloses this claim element. *See, e.g.*,

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Claim No.	U.S. Patent No. 11,031,677 B2	Talvitie
	factor F_{21} having a value of at least 1.20 and	 Talvite at Figure 1 Calculating N_1

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Claim No.	U.S. Patent No. 11,031,677 B2	Talvitie
		 Talvite at Figure 1 Calculating N_2

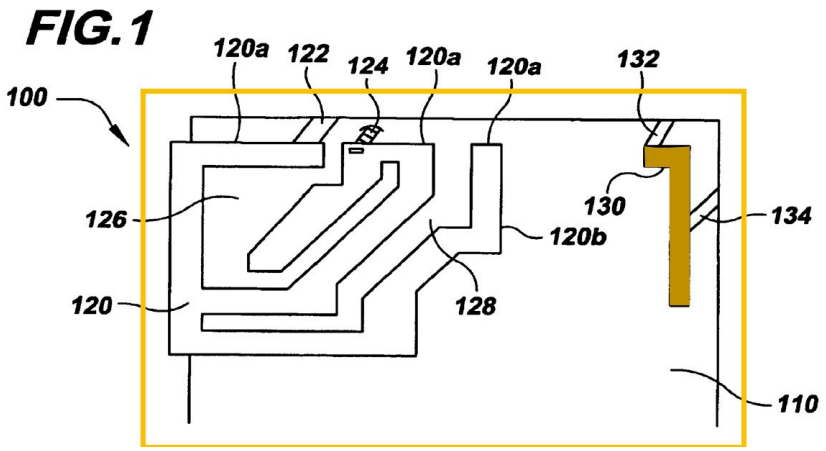
Claim No.	U.S. Patent No. 11,031,677 B2	Talvitie
		 Talvite at Figure 1 Calculating N_3 Further, it would have been obvious to a person of ordinary skill in the art that, when $N_1 = 14$; $N_2 = 40$; and $N_3 = 134$; that given

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Claim No.	U.S. Patent No. 11,031,677 B2	Talvitie
		$$F_{21=-}\frac{(\log_{10}(N_2)-\log_{10}(N_1)}{\log_{10}1/2}$$ solving for F_{21} results in $$F_{21=-}\frac{(\log_{10}(40)-\log_{10}(14)}{\log_{10}1/2}=\ 1.5146$$ and $$1.20\ \leq 1.5146$$
1[j]	complexity factor F_{32} having a value less than 1.75; and	Talvitie expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[i] Further, it would have been obvious to a person of ordinary skill in the art that, when $N_1\ =\ 14$; $N_2\ =\ 40$; and $N_3\ =\ 134$; that given $$F_{32=-}\frac{(\log_{10}(N_3)-\log_{10}(N_2)}{\log_{10}1/2}$$

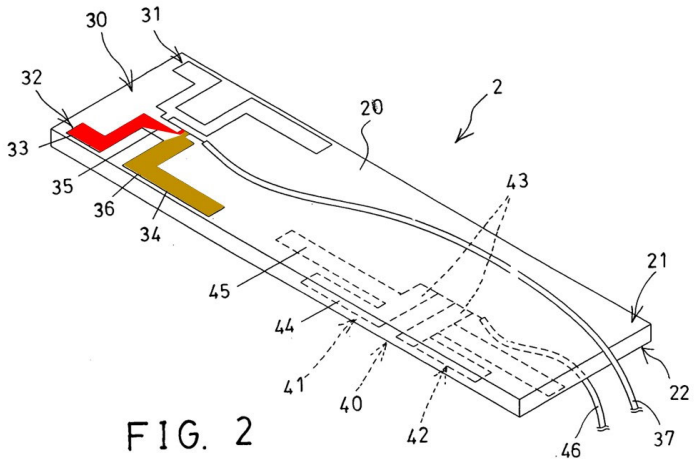
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Claim No.	U.S. Patent No. 11,031,677 B2	Talvitie
		solving for F_{32} results in $$F_{32=-}\frac{(\log_{10}(134)-\log_{10}(40)}{\log_{10}1/2}=\ 1.7442$$ and $$1.7442\ <1.75$$
1[k]	a second antenna within the wireless device and	Talvitie expressly or inherently discloses this claim element. *See, e.g.*, "The invention is based on the unexpected discovery that when an antenna structure comprising two radiators matched for at least partly the same frequency range is used, at least one of the radiators being the above-mentioned groove plane antenna matched for several frequency ranges, considerable isolation is provided between the radiators. Such an antenna structure thus comprises at least one ground plane, at least a first and a second radiator located at a distance from the ground plane, both radiators being configured to provide at least one resonance frequency in order to provide at least one frequency band, and an isolating layer between the ground plane and the radiators." Talvitie at 2:20-32 "Referring to FIG. 1, a preferred embodiment will be described in the following. FIG. 1 shows a planar antenna structure called a PIFA (Planar Inverted F Antenna) antenna structure 100 comprising a ground plane 110, a first radiator 120 and a second radiator 130. The radiators 120, 130 are located at a distance from the ground plane 110 such that air or another dielectric material is, as an isolating material, provided between the ground plane 110 and

Claim No.	U.S. Patent No. 11,031,677 B2	Talvitie
		the radiators 120, 130. The first radiator 120 is a "groove plane antenna" which is connected to the ground plane 110 by a ground point 122 and to which radiation power is fed from a feed point 124. The ground point 122 constituting a grounding line is located substantially at the edge of the radiator 120." Talvitie at 3:47-59  Talvitie at Figure 1
1[l]	configured to support at least one frequency band different from the at	Talvitie expressly or inherently discloses this claim element. *See, e.g.*,

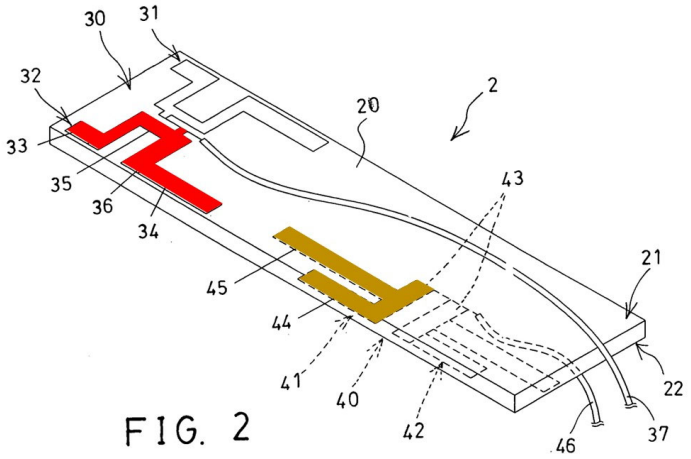
Claim No.	U.S. Patent No. 11,031,677 B2	Talvitie
	least three frequency bands supported by the first antenna,	"The second radiator is configured to radiate within a frequency range at least partly overlapping with at least one frequency range, preferably with a higher frequency range, of the first radiator." Talvitie at 4:59-62 To the extent that this reference does not expressly disclose this claim limitation, in light of Plaintiff's apparent claim construction and infringement positions with respect to the Accused Products, a POSA would have understood it to implicitly disclose it or would have found the claim limitation obvious. Additionally, it would have been obvious to a person of ordinary skill in the art to modify this reference with any one or more of the references disclosed in Defendants' Invalidity Contentions based on knowledge of one of ordinary skill in the art and for the reasons articulated in Defendants' Invalidity Contentions Cover Pleading. *See, e.g.,* "It is preferable that the antenna members 31, 32 of the antenna device 30 each includes two antenna segments 33, 34 disposed up and down relative to each other, and an intermediate and/or C-shaped antenna segment 35 disposed between the antenna segments 33, 34, for receiving and transmitting signals of different frequencies, for example. It is further preferable that the antenna segments 33, 34, 35 of the two antenna members 31, 32 are disposed side by side and/or parallel to each other, or arranged in mirror symmetric relative to each other, for receiving and transmitting signals toward different lateral directions 39 relative to each other, or away from each other." Chou at [0028] "Similarly, the antenna members 41, 42 of the antenna device 40 each includes a base antenna segment 43 disposed up and down relative to each other, and two antenna segments 44, 45 extended from the base antenna segment 43 and parallel to each other, for receiving and transmitting signals of different frequencies, for example. It is further preferable that the antenna segments 43, 44, 45 of the two antenna members 41, 42 are disposed up and

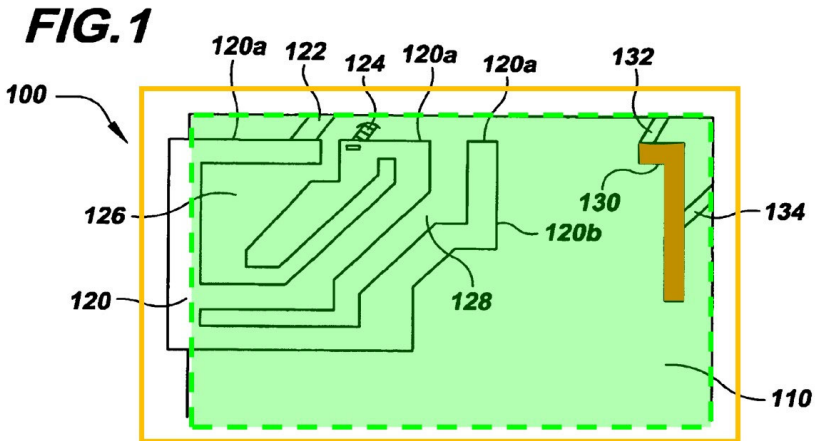
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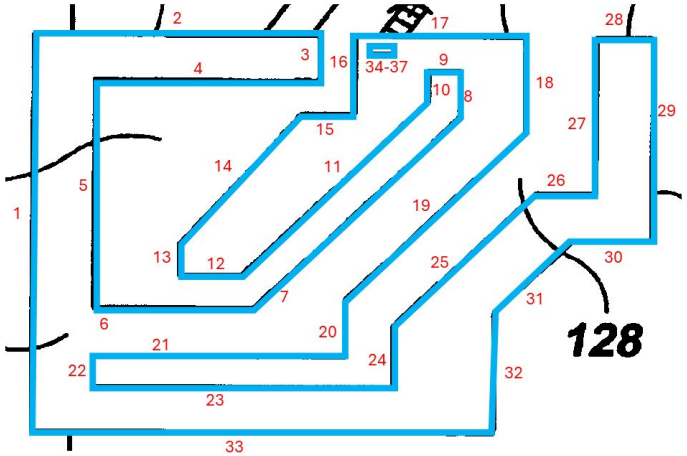
Claim No.	U.S. Patent No. 11,031,677 B2	Talvitie
		down relative to each other, or arranged in mirror symmetric relative to each other, for receiving and transmitting signals toward different vertical directions 49 relative to each other, or away from each other." Chou at [0030]  FIG. 2 Chou at Figure 2 "It is preferable that the antenna members 31, 32 of the antenna device 30 each includes two antenna segments 33, 34 disposed up and down relative to each other, and an intermediate and/or C-shaped antenna segment 35 disposed between the antenna segments 33, 34, for receiving and transmitting signals of different frequencies, for example. It is further preferable that the antenna segments 33, 34, 35 of the two antenna members 31, 32 are disposed side

Claim No.	U.S. Patent No. 11,031,677 B2	Talvitie
		by side and/or parallel to each other, or arranged in mirror symmetric relative to each other, for receiving and transmitting signals toward different lateral directions 39 relative to each other, or away from each other." Chou at [0028] "Similarly, the antenna members 41, 42 of the antenna device 40 each includes a base antenna segment 43 disposed up and down relative to each other, and two antenna segments 44, 45 extended from the base antenna segment 43 and parallel to each other, for receiving and transmitting signals of different frequencies, for example. It is further preferable that the antenna segments 43, 44, 45 of the two antenna members 41, 42 are disposed up and down relative to each other, or arranged in mirror symmetric relative to each other, for receiving and transmitting signals toward different vertical directions 49 relative to each other, or away from each other." Chou at [0030] "Furthermore, each of the antenna devices 30, 40 may include two or more antenna segments 33, 34, 35; and 43, 44, 45 respectively, for receiving and transmitting signals of different frequencies, and thus for allowing the antenna devices 30, 40 to receive and transmit signals of various frequencies. There will be no dead ends or dead corners formed or generated by the antenna devices 30, 40." Chou at [0033]

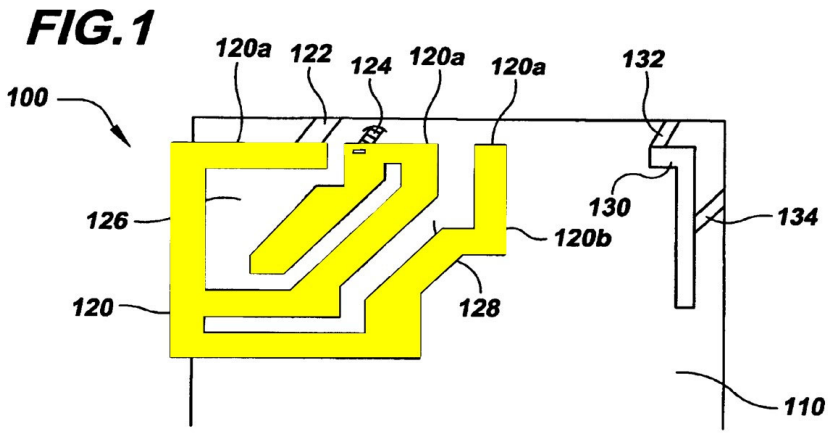
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Claim No.	U.S. Patent No. 11,031,677 B2	Talvitie
		 FIG. 2 Chou at Figure 2
1[m]	the second antenna being arranged completely within the ground plane rectangle.	Talvitie expressly or inherently discloses this claim element. *See, e.g.*,

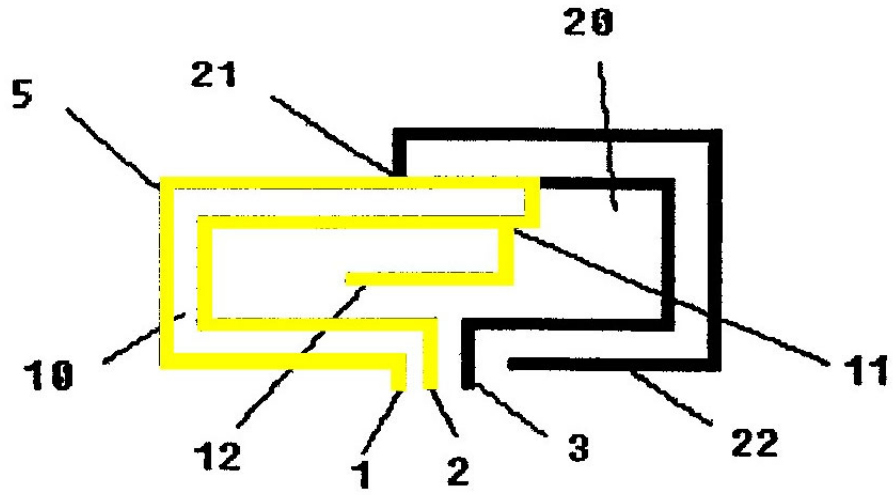
Claim No.	U.S. Patent No. 11,031,677 B2	Talvitie
		 Talvitie at Figure 1
		Claim 2
2	The wireless device of claim 1, wherein the first antenna contour comprises at	Talvitie expressly or inherently discloses this claim element. *See, e.g.*,

Claim No.	U.S. Patent No. 11,031,677 B2	Talvitie
	least 20 segments.	 Talvitie at Figure 1
Claim 3		
3	The wireless device of claim 2, wherein the perimeter of the first antenna contour comprises at	Talvitie expressly or inherently discloses this claim element. *See, e.g.*, claim element 2

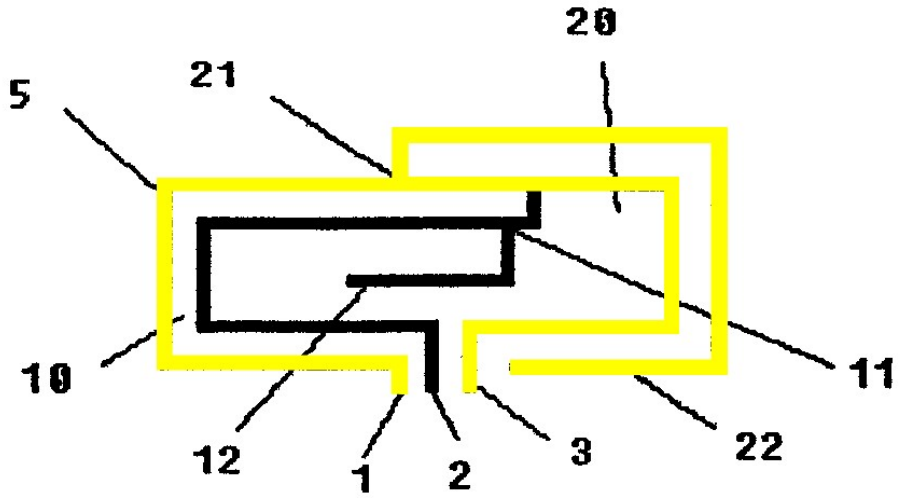
Claim No.	U.S. Patent No. 11,031,677 B2	Talvitie
	least 35 segments.	
Claim 4		
4	The wireless device of claim 1, wherein the antenna system comprises a third antenna configured to receive signals employing a 4G communication standard.	Talvitie expressly or inherently discloses this claim element. *See, e.g.*, "at least a first and a second radiator located at a distance from the ground plane and grounded by a ground point to the ground plane" Talvitie at claim 1 "As far as the operation of the present embodiments is concerned, the shape or location of the second radiator 130 is irrelevant" Talvitie at 4:62-65

Claim No.	U.S. Patent No. 11,031,677 B2	Talvitie
		 Talvitie at Figure 1 To the extent that this reference does not expressly disclose this claim limitation, in light of Plaintiff's apparent claim construction and infringement positions with respect to the Accused Products, a POSITA would have understood it to implicitly disclose it or would have found the claim limitation obvious. Additionally, it would have been obvious to a person of ordinary skill in the art to modify this reference with any one or more of the references disclosed in Defendants' Invalidity Contentions based on knowledge of one of ordinary skill in the art and for the reasons articulated in Defendants' Invalidity Contentions Cover Pleading. *See, e.g.,*

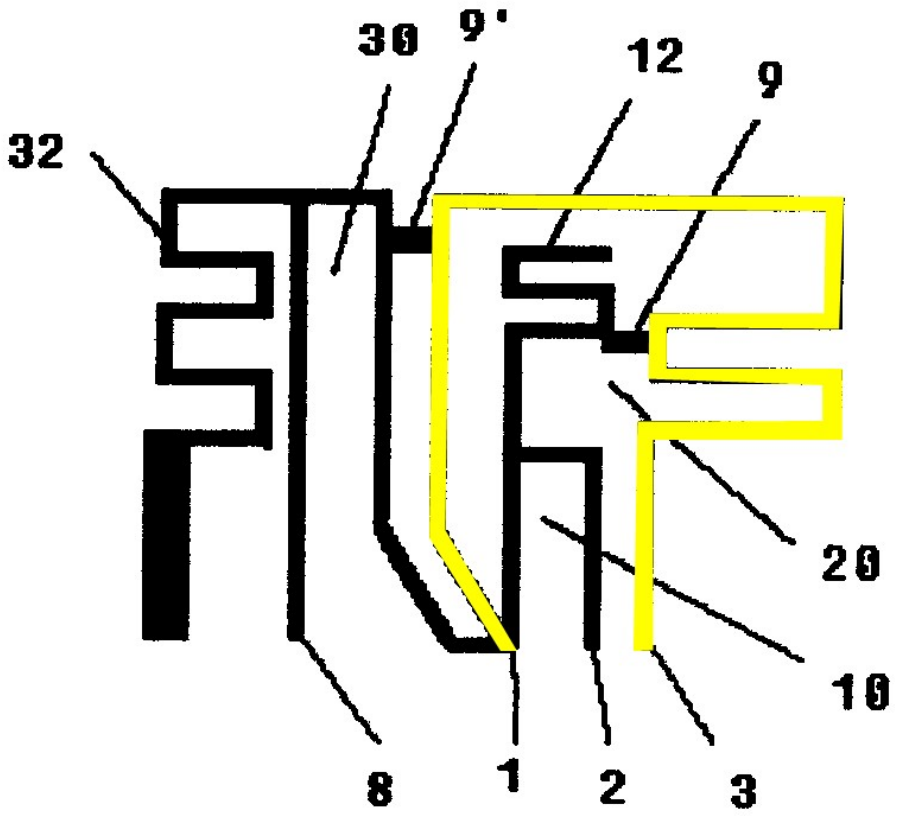
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Claim No.	U.S. Patent No. 11,031,677 B2	Talvitie
		 Wei at Figure 2B

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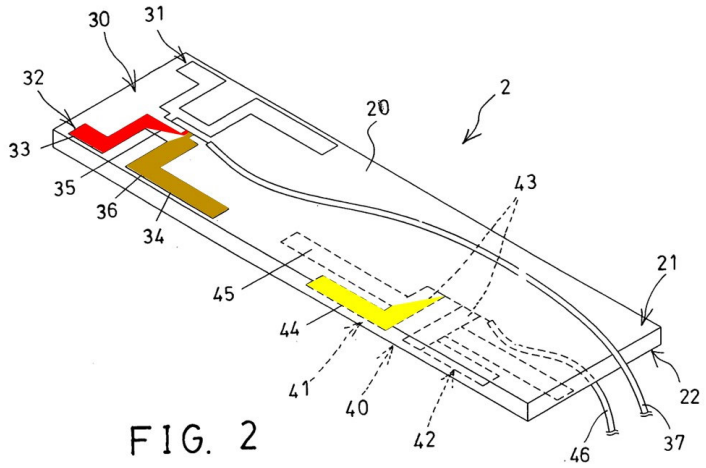
Claim No.	U.S. Patent No. 11,031,677 B2	Talvitie
		 Wei at Figure 2B (Alternative)

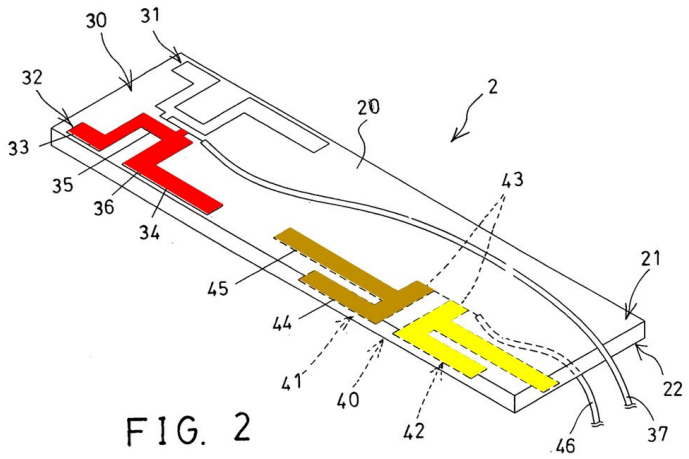
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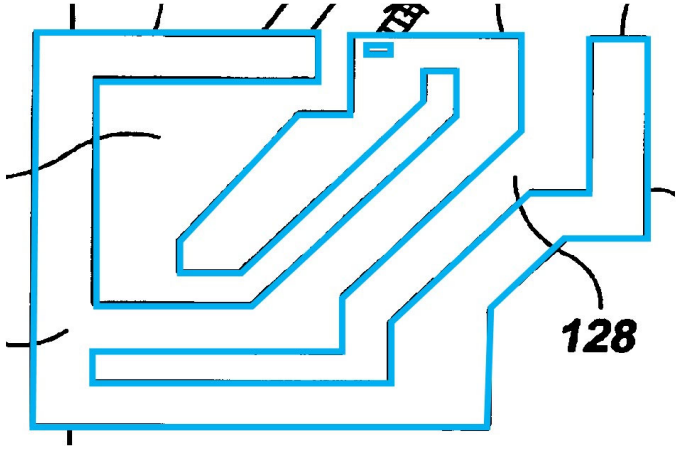
Claim No.	U.S. Patent No. 11,031,677 B2	Talvitie
		 Wei at Figure 9

Claim No.	U.S. Patent No. 11,031,677 B2	Talvitie
		"Although a multiband antenna such as for instance a multibranch antenna can be used within the package when several services or operating frequency bands are to be integrated in the same system, it is clear that other options within the present invention include arranging two or more antennas within the same package. For instance, those two or more antennas according to the present invention can be arranged in the same substrate layer, in different layers within the same substrate, in different substrates or even in the substrate and in the plastic casing of the package. One possible arrangement for a two antenna package includes two similar antennas wherein each one is fed independently, and wherein one conducting pattern is rotated 90° with respect to the other antenna pattern. This provides an effective means for integrating a polarization diversity communication system inside a single package. For instance, the present invention enables packaging a system operating within the 0.5 to 5.5 GHz frequency band in an area smaller than 10 x 10 mm." Castany868 at 30:1-17 "It is preferable that the antenna members 31, 32 of the antenna device 30 each includes two antenna segments 33, 34 disposed up and down relative to each other, and an intermediate and/or C-shaped antenna segment 35 disposed between the antenna segments 33, 34, for receiving and transmitting signals of different frequencies, for example. It is further preferable that the antenna segments 33, 34, 35 of the two antenna members 31, 32 are disposed side by side and/or parallel to each other, or arranged in mirror symmetric relative to each other, for receiving and transmitting signals toward different lateral directions 39 relative to each other, or away from each other." Chou at [0028] "Similarly, the antenna members 41, 42 of the antenna device 40 each includes a base antenna segment 43 disposed up and down relative to each other, and two antenna segments 44, 45 extended from the base antenna segment 43 and parallel to each other, for receiving and transmitting signals of different frequencies, for example. It is further preferable that the antenna segments 43, 44, 45 of the two antenna members 41, 42 are disposed up and

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Claim No.	U.S. Patent No. 11,031,677 B2	Talvitie
		down relative to each other, or arranged in mirror symmetric relative to each other, for receiving and transmitting signals toward different vertical directions 49 relative to each other, or away from each other." Chou at [0030] "Furthermore, each of the antenna devices 30, 40 may include two or more antenna segments 33, 34, 35; and 43, 44, 45 respectively, for receiving and transmitting signals of different frequencies, and thus for allowing the antenna devices 30, 40 to receive and transmit signals of various frequencies. There will be no dead ends or dead corners formed or generated by the antenna devices 30, 40." Chou at [0033]  FIG. 2

Claim No.	U.S. Patent No. 11,031,677 B2	Talvitie
		Chou at Figure 2  FIG. 2 Chou at Figure 2 (Alternative)
Claim 5		
5[a]	The wireless device of claim 4, wherein the third antenna defines an antenna	Talvitie expressly or inherently discloses this claim element. *See, e.g.*, claim elements 1[h], 1[k], 1[l], 1[m], 4

Claim No.	U.S. Patent No. 11,031,677 B2	Talvitie
	contour comprising an entire perimeter of the third antenna, and	 Talvitie at Figure 1
5[b]	wherein the antenna contour of the third antenna has a level of complexity defined by complexity factor F_{21}	Talvitie expressly or inherently discloses this claim element. *See, e.g.*, claim elements 1[h], 1[i], 1[j], 1[k], 1[l], 1[m], 4 Further, it would have been obvious to a person of ordinary skill in the art that, when

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Claim No.	U.S. Patent No. 11,031,677 B2	Talvitie
	having a value of at least 1.2 and	$N_1 = 14$; $N_2 = 40$; and $N_3 = 134$; that given $$F_{21=-} \frac{(\log_{10}(N_2) - \log_{10}(N_1)}{\log_{10} 1/2}$$ solving for F_{21} results in $$F_{21=-} \frac{(\log_{10}(40) - \log_{10}(14)}{\log_{10} 1/2} = 1.5146$$ and $$1.20 \leq 1.5146$$
5[c]	a complexity factor F_{32} having a value of at least 1.35.	Talvitie expressly or inherently discloses this claim element. *See, e.g.*, claim element 5[b] Further, it would have been obvious to a person of ordinary skill in the art that, when $N_1 = 14$; $N_2 = 40$; and $N_3 = 134$;

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Claim No.	U.S. Patent No. 11,031,677 B2	Talvitie
		that given $$F_{32=-}\frac{(\log_{10}(N_3)-\log_{10}(N_2)}{\log_{10}1/2}$$ solving for F_{32} results in $$F_{32=-}\frac{(\log_{10}(134)-\log_{10}(40)}{\log_{10}1/2}=\ 1.7442$$ and $$1.35\ \leq 1.7442$$
Claim 6		
6[pre]	A wireless device comprising:	To the extent the preamble is limiting, Talvitie expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[pre]
6[a]	an antenna system comprising:	Talvitie expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[a]

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Claim No.	U.S. Patent No. 11,031,677 B2	Talvitie
6[b]	[*the antenna system comprising*] a ground plane;	Talvitie expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[b]
6[c]	[*the antenna system comprising*] a first antenna within the wireless device and	Talvitie expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[c]
6[d]	configured to support at least two frequency bands contained within first and second frequency ranges of the electromagnetic spectrum,	Talvitie expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[d]

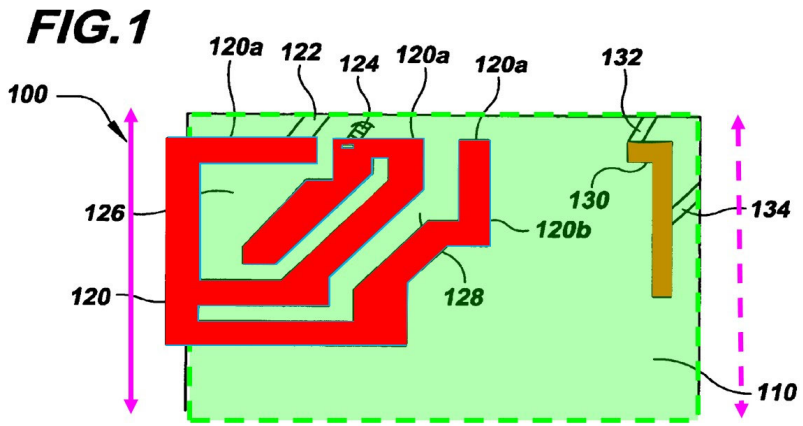
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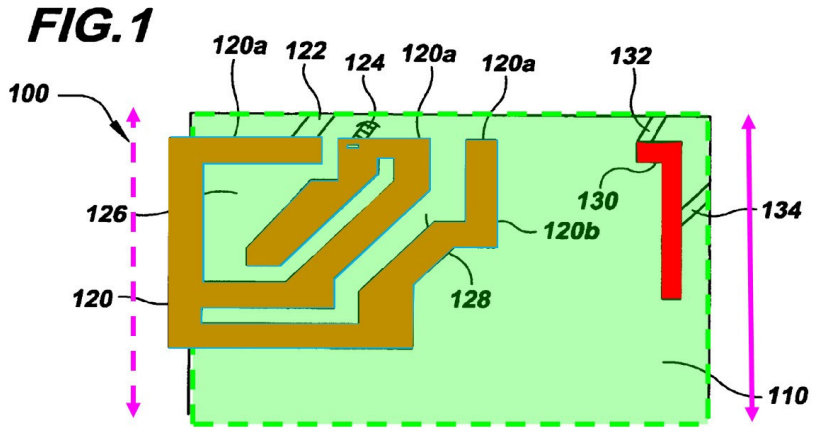
Claim No.	U.S. Patent No. 11,031,677 B2	Talvitie
6[e]	the second frequency range being higher in frequency than the first frequency range,	Talvitie expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[e]
6[f]	the first antenna being proximate to a first short side of a ground plane rectangle enclosing the ground plane and	Talvitie expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[g]
6[g]	defining a first antenna contour comprising an entire perimeter of the first antenna,	Talvitie expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[h]

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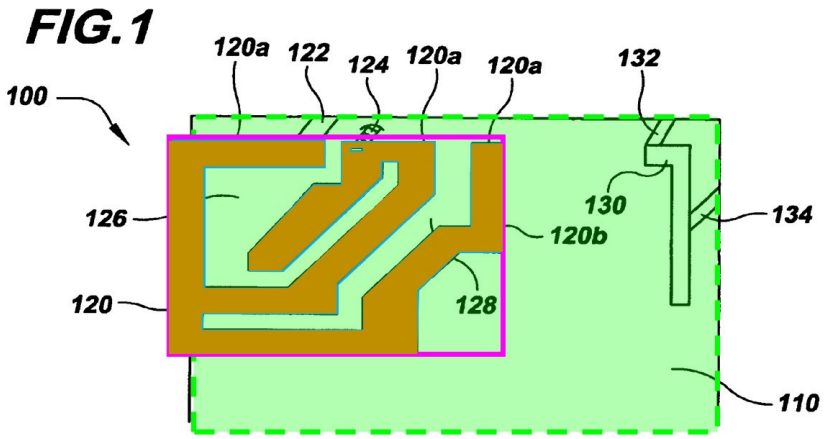
Claim No.	U.S. Patent No. 11,031,677 B2	Talvitie
6[h]	wherein the first antenna contour has a level of complexity defined by complexity factor F_{21} having a value of at least 1.20 and	Talvitie expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[i]
6[i]	complexity factor F_{32} having a value less than 1.75; and	Talvitie expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[j]
6[j]	[*the antenna system comprising*] a second antenna within the wireless device and	Talvitie expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[k]
6[k]	defining a second antenna	Talvitie expressly or inherently discloses this claim element.

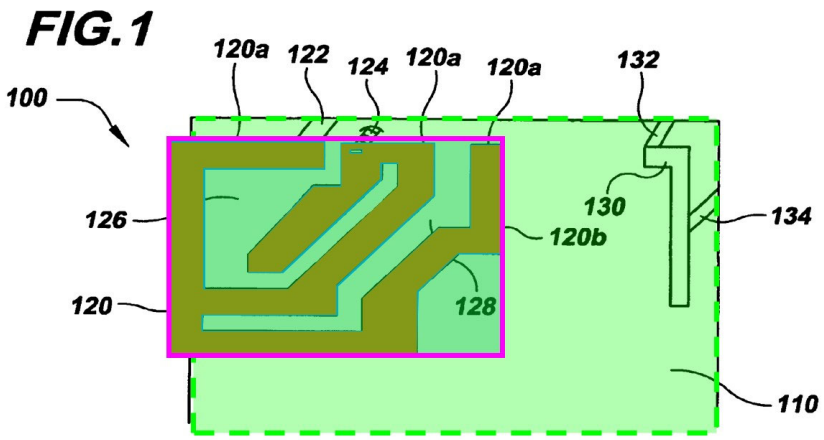
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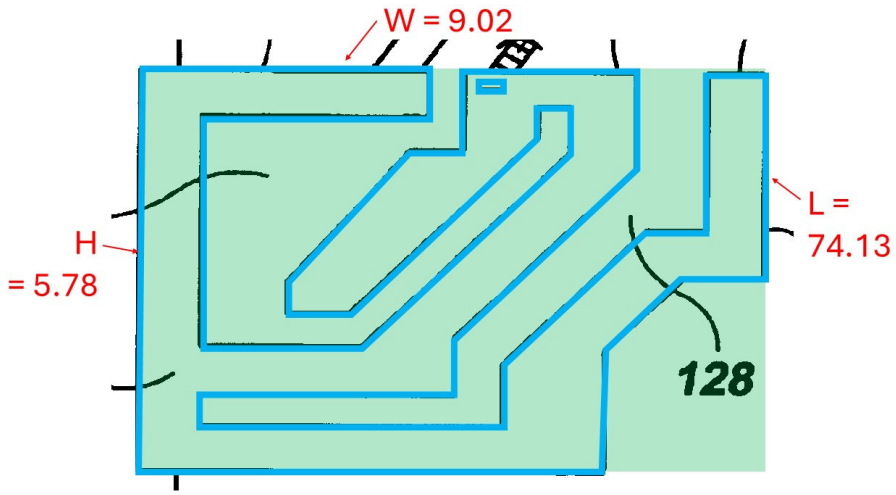
Claim No.	U.S. Patent No. 11,031,677 B2	Talvitie
	contour comprising an entire perimeter of the second antenna,	*See, e.g.*, claim elements 1[h], 1[k], 1[l], 1[m], 4, 5[a]
6[l]	the second antenna being proximate to a second short side of the ground plane rectangle that is opposite to the first short side of the ground plane rectangle,	Talvitie expressly or inherently discloses this claim element. *See, e.g.*,  Talvitie at Figure 1

Claim No.	U.S. Patent No. 11,031,677 B2	Talvitie
		 Talvitie at Figure 1 (Alternative)
6[m]	a minimum-sized parallelepiped of rectangular faces that completely encloses a volume of the second antenna defining an	Talvitie expressly or inherently discloses this claim element. *See, e.g.*,

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Claim No.	U.S. Patent No. 11,031,677 B2	Talvitie
	antenna box, and	 Talvitie at Figure 1
6[n]	an orthogonal projection of the antenna box along a normal to a face with a largest area of the second antenna defining	Talvitie expressly or inherently discloses this claim element. *See, e.g.*, claim element 6[m], 6[o]

Claim No.	U.S. Patent No. 11,031,677 B2	Talvitie
6[o]	an antenna rectangle,	Talvitie expressly or inherently discloses this claim element. *See, e.g.*,  Talvitie at Figure 1
6[p]	wherein a length of the second antenna contour is greater than	Talvitie expressly or inherently discloses this claim element. *See, e.g.*,

Claim No.	U.S. Patent No. 11,031,677 B2	Talvitie
	four times a diagonal of the antenna rectangle.	"Furthermore, the invention is not restricted to antenna configurations wherein a second antenna A**2** operates as a WCDMA transmission or reception antenna only but e.g. some of the GSM functions can be configured in the second antenna A**2**. Consequently, the embodiment of FIG. 5 *b*, for example, can be used as an antenna configuration, wherein the functions of the GSM 1900 system (transmission and reception) are moved to the second antenna A**2** together with the WCDMA 2000 system reception. In such a case, a switch S should also be provided in connection with the second antenna A**2** to control the transmission and reception of the system used, as described above." Talvitie at 7:42-54  Talvitie at Figure 1

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Claim No.	U.S. Patent No. 11,031,677 B2	Talvitie
		To the extent that this reference does not expressly disclose this claim limitation, in light of Plaintiff's apparent claim construction and infringement positions with respect to the Accused Products, a POSITA would have understood it to implicitly disclose it or would have found the claim limitation obvious. Additionally, it would have been obvious to a person of ordinary skill in the art to modify this reference with any one or more of the references disclosed in Defendants' Invalidity Contentions based on knowledge of one of ordinary skill in the art and for the reasons articulated in Defendants' Invalidity Contentions Cover Pleading.
Claim 7		
7	The wireless device of claim 6, wherein the first antenna contour comprises at least 20 segments.	Talvitie expressly or inherently discloses this claim element. *See, e.g.*, claim element 2
Claim 8		
8	The wireless device of claim 6, wherein the first antenna contour comprises at	Talvitie expressly or inherently discloses this claim element. *See, e.g.*, claim element 3

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Claim No.	U.S. Patent No. 11,031,677 B2	Talvitie
	least 35 segments.	
Claim 9		
9[a]	The wireless device of claim 6, wherein the second antenna contour has a level of complexity defined by complexity factor F_{21} having a value of at least 1.2 and	Talvitie expressly or inherently discloses this claim element. *See, e.g.*, claim elements 1[h], 1[k], 1[l], 1[m], 4, 5[a], 5[b]
9[b]	a complexity factor F_{32} having a value of at least 1.35.	Talvitie expressly or inherently discloses this claim element. *See, e.g.*, claim elements 1[h], 1[k], 1[l], 1[m], 4, 5[a], 5[b], 5[c], 9[a]
Claim 12		

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Claim No.	U.S. Patent No. 11,031,677 B2	Talvitie
12[pre]	A wireless device comprising:	To the extent the preamble is limiting, Talvitie expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[pre], 6[pre]
12[a]	an antenna system comprising:	Talvitie expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[a], 6[a]
12[b]	[*the antenna system comprising*] a ground plane;	Talvitie expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[b], 6[b]
12[c]	[*the antenna system comprising*] a first antenna within the wireless device and	Talvitie expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[c], 6[c]
12[d]	configured to provide	Talvitie expressly or inherently discloses this claim element.

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Claim No.	U.S. Patent No. 11,031,677 B2	Talvitie
	operation in at least four frequency bands,	*See, e.g.*, claim element 1[d], 6[d]
12[e]	at least one of the at least four frequency bands is contained within a first frequency range and	Talvitie expressly or inherently discloses this claim element. *See, e.g.*, 1[d], 6[d], 12[d]
12[f]	at least one other of the four frequency bands is contained within a second frequency range,	Talvitie expressly or inherently discloses this claim element. *See, e.g.*,
12[g]	the first frequency range being lower in frequency than	Talvitie expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[e], 12[e], 12[f]

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Claim No.	U.S. Patent No. 11,031,677 B2	Talvitie
	the second frequency range,	"The antenna structure further comprises separate feed points for the at least two radiators, the radiators are grounded by a ground point to at least some ground plane, and at least the first radiator is a groove plane antenna configured to provide at least two frequency bands, preferably at least one lower frequency band and at least one higher frequency band" Talvitie at 2:33-39 "The antenna structure of FIG. 1 can preferably be configured to operate as an antenna structure for a multifrequency mobile station. An example of a multifrequency mobile station is a mobile station configured to support EGSM 900 (880 to 960 MHz), GSM 1900 (1850 to 1990 MHz), WCDMA 2000 (1920 to 2170 MHz) systems and frequency ranges." Talvitie at 5:1-6 To the extent that this reference does not expressly disclose this claim limitation, in light of Plaintiff's apparent claim construction and infringement positions with respect to the Accused Products, a POSITA would have understood it to implicitly disclose it or would have found the claim limitation obvious. It would have been obvious to a person of ordinary skill in the art that frequency bands with higher Hertz values would be higher in frequency than frequency bands with relatively lower Hertz values. Additionally, it would have been obvious to a person of ordinary skill in the art to modify this reference with any one or more of the references disclosed in Defendants' Invalidity Contentions based on knowledge of one of ordinary skill in the art and for the reasons articulated in Defendants' Invalidity Contentions Cover Pleading.
12[h]	the first antenna being	Talvitie expressly or inherently discloses this claim element.

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Claim No.	U.S. Patent No. 11,031,677 B2	Talvitie
	proximate to a first short side of a ground plane rectangle enclosing the ground plane,	*See, e.g.*, claim element 1[g], 6[f]
12[i]	the first antenna defining a first antenna contour comprising an entire perimeter of the first antenna, and	Talvitie expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[h], 6[g]
12[j]	wherein the first antenna contour has a level of complexity defined by complexity factor F_{21} having a value	Talvitie expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[i], 6[h]

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Claim No.	U.S. Patent No. 11,031,677 B2	Talvitie
	of at least 1.20 and	
12[k]	complexity factor F_{32} having a value less than 1.75; and	Talvitie expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[j], 6[i]
12[l]	wherein the first antenna is configured to transmit and receive signals from a 4G communication standard; and	Talvitie expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[f], 4
12[m]	[*the antenna system comprising*] a second antenna within the wireless device and configured to receive signals from a 4G	Talvitie expressly or inherently discloses this claim element. *See, e.g.*, claim element 1[f], 4, 12[l]

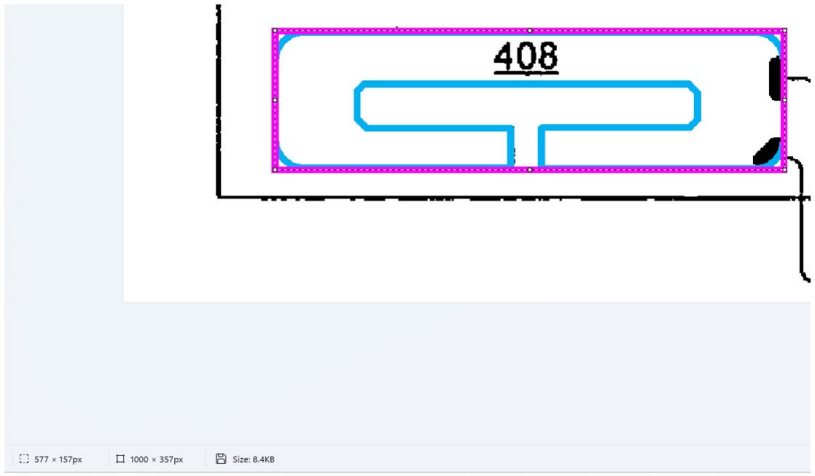
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Claim No.	U.S. Patent No. 11,031,677 B2	Talvitie
	communication standard,	
12[n]	a minimum-sized parallelepiped of rectangular faces that completely encloses a volume of the second antenna defining an antenna box,	Talvitie expressly or inherently discloses this claim element. *See, e.g.*, claim element 6[m]
12[o]	an orthogonal projection of the antenna box along a normal to a face with a largest area of the second antenna defining	Talvitie expressly or inherently discloses this claim element. *See, e.g.*, claim element 6[n]
12[p]	an antenna rectangle,	Talvitie expressly or inherently discloses this claim element.

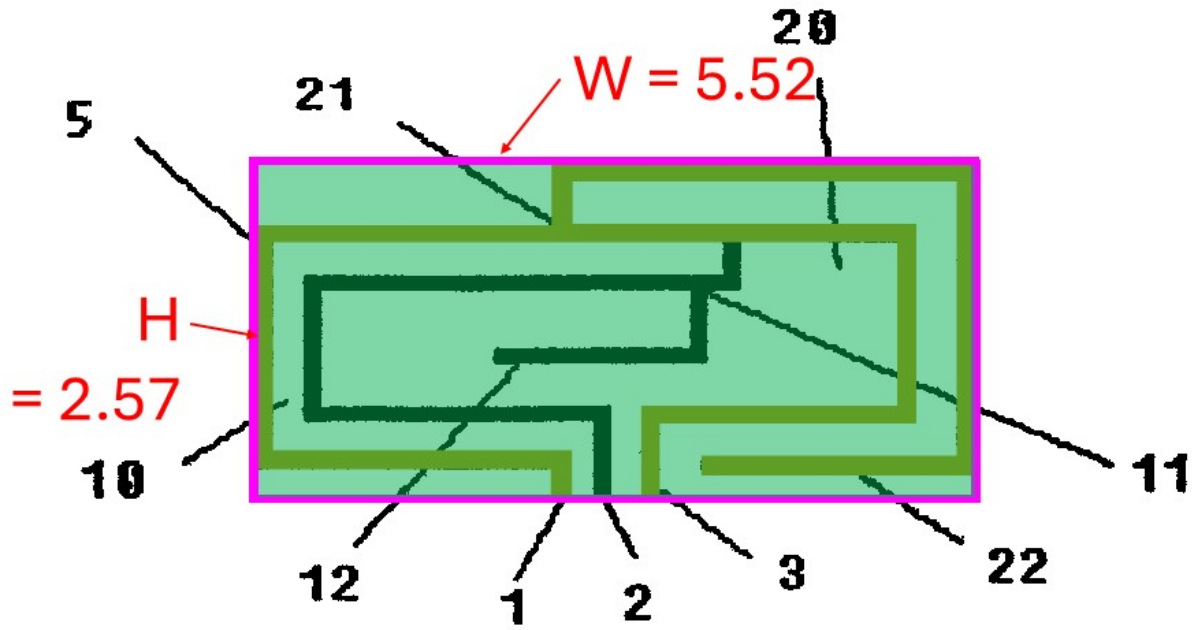
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Claim No.	U.S. Patent No. 11,031,677 B2	Talvitie
		See, e.g., claim element 6[o]
12[q]	an aspect ratio of the antenna rectangle being defined as a ratio between a width and a height of the antenna rectangle, and wherein the aspect ratio has a value of at least 2.	Talvitie expressly or inherently discloses this claim element. To the extent that this reference does not expressly disclose this claim limitation, in light of Plaintiff's apparent claim construction and infringement positions with respect to the Accused Products, a POSITA would have understood it to implicitly disclose it or would have found the claim limitation obvious. Additionally, it would have been obvious to a person of ordinary skill in the art to modify this reference with any one or more of the references disclosed in Defendants' Invalidity Contentions based on knowledge of one of ordinary skill in the art and for the reasons articulated in Defendants' Invalidity Contentions Cover Pleading. *See, e.g.,*

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Claim No.	U.S. Patent No. 11,031,677 B2	Talvitie
		 Dou at Figure 4A, showing measurements of antenna rectangle Further, it would have been obvious to a person of ordinary skill in the art that a length of 577 pixels and a height of 157 pixels results in $577/157 = 3.6752$ And $2 \leq 3.6752$

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Claim No.	U.S. Patent No. 11,031,677 B2	Talvitie
		 Wei at Figure 2B It would have been obvious to a person of ordinary skill in the art that a width of 5.52 and a height of 2.57 results in an aspect ratio of 2.15, and that 2.15 is greater than 2.
Claim 13		

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Claim No.	U.S. Patent No. 11,031,677 B2	Talvitie
13	The wireless device of claim 12, wherein the first antenna contour comprises at least 20 segments.	Talvitie expressly or inherently discloses this claim element. *See, e.g.*, claim element 2, 7
	Claim 14	
14	The wireless device of claim 13, wherein the first antenna contour comprises at least 35 segments.	Talvitie expressly or inherently discloses this claim element. *See, e.g.*, claim element 3, 8
	Claim 15	
15	The wireless device of claim 12, wherein the second antenna is proximate to	Talvitie expressly or inherently discloses this claim element. *See, e.g.*, claim element 6[l]

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Claim No.	U.S. Patent No. 11,031,677 B2	Talvitie
	a second short side of the ground plane rectangle that is opposite to the first short side of the ground plane rectangle.	
	Claim 16	
16[a]	The wireless device of claim 12, wherein the second antenna defines a second antenna contour comprising an entire perimeter of the second antenna,	Talvitie expressly or inherently discloses this claim element. *See, e.g.*, claim elements 1[h], 1[k], 1[l], 1[m], 4, 5[a], 6[k]
16[b]	and wherein the second antenna contour has a level of complexity	Talvitie expressly or inherently discloses this claim element. *See, e.g.*, claim elements 1[h], 1[k], 1[l], 1[m], 4, 5[a], 5[b], 9[a]

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Claim No.	U.S. Patent No. 11,031,677 B2	Talvitie
	defined by complexity factor F_{21} having a value of at least 1.2 and	
16[c]	a complexity factor F_{32} having a value of at least 1.35.	Talvitie expressly or inherently discloses this claim element. *See, e.g.*, claim elements 1[h], 1[k], 1[l], 1[m], 4, 5[a], 5[b], 5[c], 9[a], 9[b]
Claim 17		
17	The wireless device of claim 16, wherein the second antenna contour comprises at least 20 segments.	Talvitie expressly or inherently discloses this claim element. *See, e.g.*, claim elements 2, 7, 13

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INVALIDITY CONTENTIONS FOR U.S. PATENT NO. 11,031,677 B2 BASED ON THE BENQ P50 ("P50")

Based upon Plaintiff's Complaint, Infringement Contentions, and apparent claim constructions and application of the claims to Defendants' accused products, as best as they can be deciphered, the reference charted below anticipates or at least renders obvious some or all of claims 1, 2, 3, 4, 5, 6, 7, 8, 9, 12, 13, 14, 15, 16, and 17 ("the '677 Asserted Claims")[1]. These invalidity contentions are not an admission by the Defendants that the accused products are covered by or infringe the asserted claims, particularly when these claims are properly construed and applied.

AIA law applies because the application that issued as the '677 Patent was filed on March 27, 2020, after the AIA came into force on March 16, 2013.

BenQ Corporation's ("BenQ") P50, as publicly demonstrated, known, offered for sale, sold, and/or used by BenQ and/or customers of BenQ, including without limitation any known customers of BenQ that have documents showing use, ("P50" or "BenQ P50") was presented at Consumer Electronics Show ("CES") 2005 in January 2005[2], which is more than one year prior to the critical date of the '677 patent. Accordingly, the BenQ P50 qualifies as prior art under pre-AIA 35 U.S.C. § 102(a)-(b), or (g)(2) and/or AIA 35 U.S.C. § 102(a)(1). At least the following documents provide evidence as to the date the P50 was "offered for sale or publicly used or known," "the date the offer or use of the item took place or the information became known", and the "identity of the person or entity which made the use or which made and received the offer, or the person or entity which made the information known or to whom it was made known"[3]:

- Phone Scoop Website, CES 2005 at Tab "BenQ," at Tab "P50": https://www.phonescoop.com/articles/article.php?a=30&p=1346 (last accessed June 11, 2025)

[1] Defendants understand that that, by not charting claims 10-11 and 18-20 in its Infringement Contentions, Plaintiff does not assert these claims against Defendants.
[2] *See* Phone Scoop Website, CES 2005 at Tab "BenQ," at Tab "P50": https://www.phonescoop.com/articles/article.php?a=30&p=1346 (last accessed June 11, 2025).
[3] Defendants do not yet have complete information regarding the dates by which this product was publicly disclosed, made, used, sold, or offered for sale, the circumstances under which the research, design, and development activities were conducted, and the identities of the particular individuals involved in such activities. Defendants anticipate that the actual dates, circumstances, and identities of individuals will be the subject of third party discovery during this lawsuit. Defendants therefore reserve the right to amend and/or supplement their Invalidity Contentions and this chart if additional information becomes available during the course of discovery. The date the P50 was "offered for sale or publicly used or known," as well as "the date the offer or use of the item took place or the information became known" is at least as early as the dates identified in the published documents. The "identity of the person or entity which made the use or which made and received the offer, or the person or entity which made the information known or to whom it was made known" includes at least those persons associated with the publication(s), press releases, and conference attendees, or other documents associated with each version on the P50. Defendants also reserve the right to rely on the public use, offer for sale, sale, or installation of the devices described in the publications identified herein once Defendants have had a fair opportunity to take discovery on these subjects.

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- BenQ Website; archived April 18, 2005 at: https://web.archive.org/web/20050418102346/http://www.benq.us/News/index.cfm?year=2005&id=936 (last accessed June 11, 2025)
- FCC ID Search, https://www.fcc.gov/oet/ea/fccid (Grantee Code: "JVP"; Product Code: "57P50"; Record Option: 1/4 "Detail"; Attachment: "Internal Photos" (last accessed June 11, 2025) ("FCC Internal Photos")
- FCC ID Search, https://www.fcc.gov/oet/ea/fccid (Grantee Code: "JVP"; Product Code: "57P50"; Record Option: 1/4 "Detail"; Attachment: "Test Report WLAN and BT" (last accessed June 11, 2025) ("FCC BT/WLAN Test Report")
- GSMArena.com, *BenQ P50*, https://www.gsmarena.com/benq_p50-759.php (last accessed June 13, 2025).
- PhoneArena.com, *BenQ P50*, https://www.phonearena.com/phones/BenQ-P50_id1044 (last accessed June 13, 2025).
- PhoneDB.com, *BenQ P50*, https://phonedb.net/index.php?m=device&id=157&c=benq_p50 (last accessed June 13, 2025)

As described in the following claim chart, the asserted claims of U.S. Patent No. 11,031,677 (the "'677 Patent"), are invalid as anticipated by P50. To the extent that P50 is found not to anticipate one or more of the asserted claims of the '677 Patent, these claims are invalid as obvious in view of P50 alone or as modified in view of or in combination with other prior art references disclosed in Defendants' Invalidity Contentions and accompanying charts, including without limitation as set forth below.

One of ordinary skill in the art, as of the priority date of the '677 Patent, would have known to combine or modify the prior art elements disclosed by the foregoing references using known methods, and to use these elements according to their established functions in order to achieve a known and predictable result.

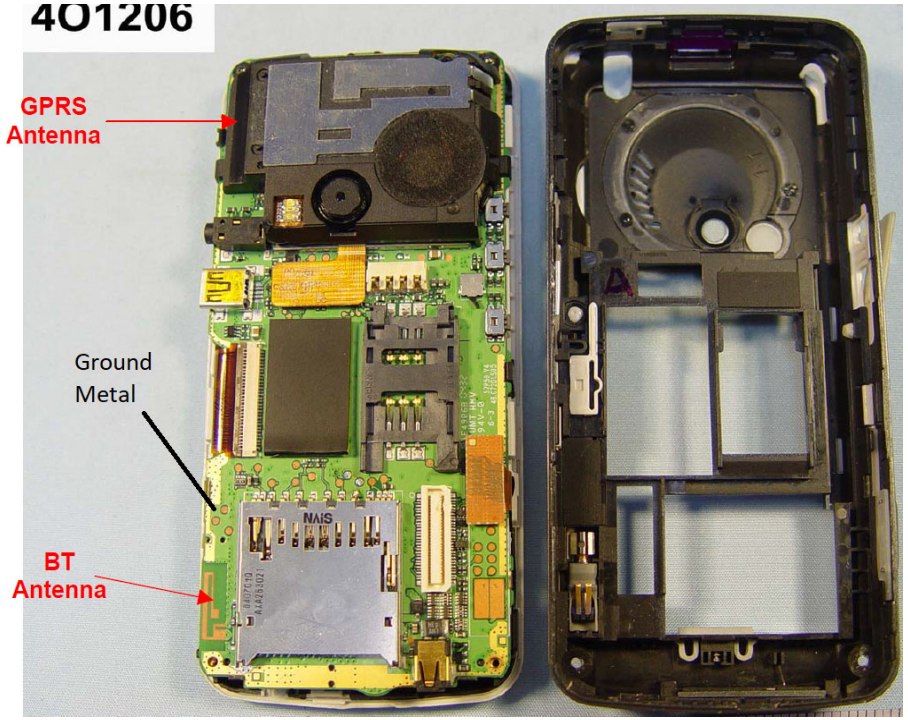
These invalidity contentions are not an admission that the Defendants concede or acquiesce to any claim construction implied or suggested by Plaintiff's Complaint or Infringement Contentions. Nor are Defendants asserting any claim construction positions through these charts, including whether the preamble is a limitation. The portions of the prior art reference cited below are not exhaustive but are exemplary in nature. Defendants retain the right to update their constructions and contentions in view of this Court's claim construction order.[4]

[4] Defendants reserve the right to supplement and/or alter this chart based on further investigation and ongoing discovery.

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Claim No.	U.S. Patent No. 11,031,677 B2	BenQ P50
		Claim 1
1[pre]	A wireless device comprising:	To the extent the preamble is limiting, BenQ P50 expressly or inherently discloses this claim element. *See, e.g.*, The big news from BenQ was the P50, the company's first branded device running Windows Mobile. This impressive device has nearly every feature you could want, including a QWERTY keyboard, a megapixel camera, and an SD card slot. It's also super-connected, with triple radios: quad-band GSM, Bluetooth, and Wi-Fi.  *See* Phone Scoop Website, CES 2005 at Tab "BenQ," at Tab "P50": https://www.phonescoop.com/articles/article.php?a=30&p=1346 (last accessed June 11, 2025)

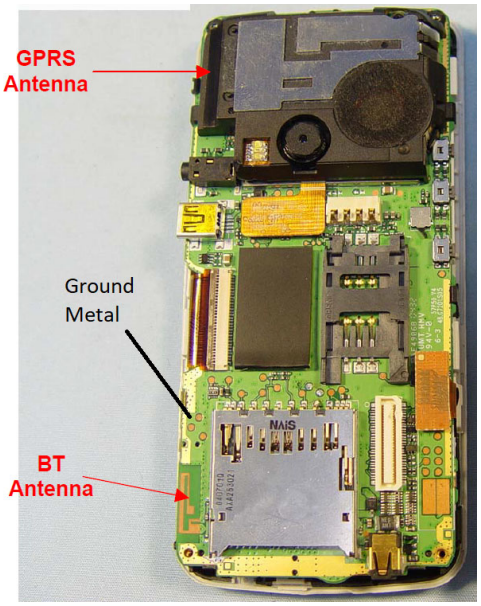
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Claim No.	U.S. Patent No. 11,031,677 B2	BenQ P50
1[a]	an antenna system comprising:	BenQ P50 expressly or inherently discloses this claim element. *See, e.g.*, The BenQ P50 has an antenna system including a ground plane. The ground plane is a metal layer embedded in a printed circuit board that is housed within a plastic housing. 

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Claim No.	U.S. Patent No. 11,031,677 B2	BenQ P50
		See FCC Internal Photos at 1.
1[b]	[*the antenna system comprising*] a ground plane;	BenQ P50 expressly or inherently discloses this claim element. *See* Claim 1[a].
1[c]	[*the antenna system comprising*] a first antenna within the wireless device and	BenQ P50 expressly or inherently discloses this claim element. *See, e.g.*, The antenna system of the BenQ P50 includes a first antenna within the wireless device, which is a cellular (GPRS) antenna.

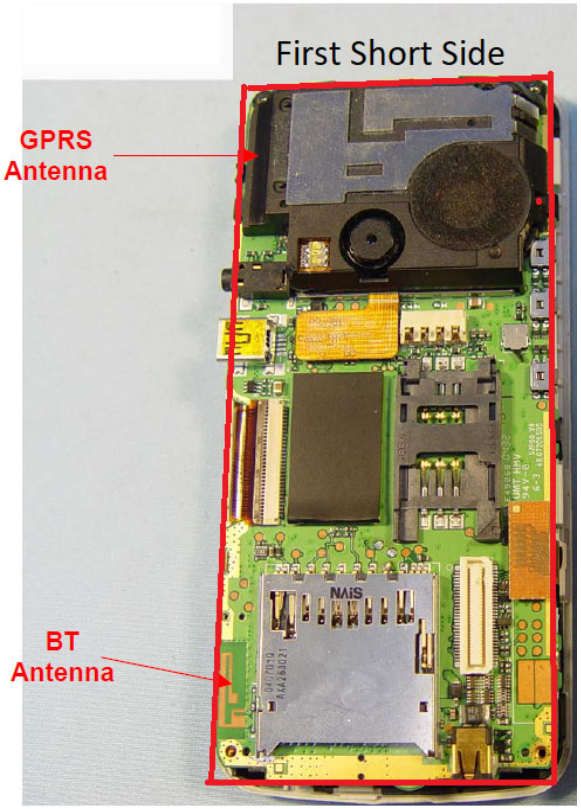
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Claim No.	U.S. Patent No. 11,031,677 B2	BenQ P50
		 *See* FCC Internal Photos at 1.
1[d]	[*the antenna system*] configured to support at least three frequency bands contained within first and second frequency ranges of the electromagnetic spectrum,	BenQ P50 expressly or inherently discloses this claim element. *See, e.g.*, The first antenna of the BenQ P50 is configured to support at least three frequency bands contained within first and second frequency ranges of the electromagnetic spectrum, the second frequency range being higher in frequency than the first frequency range.

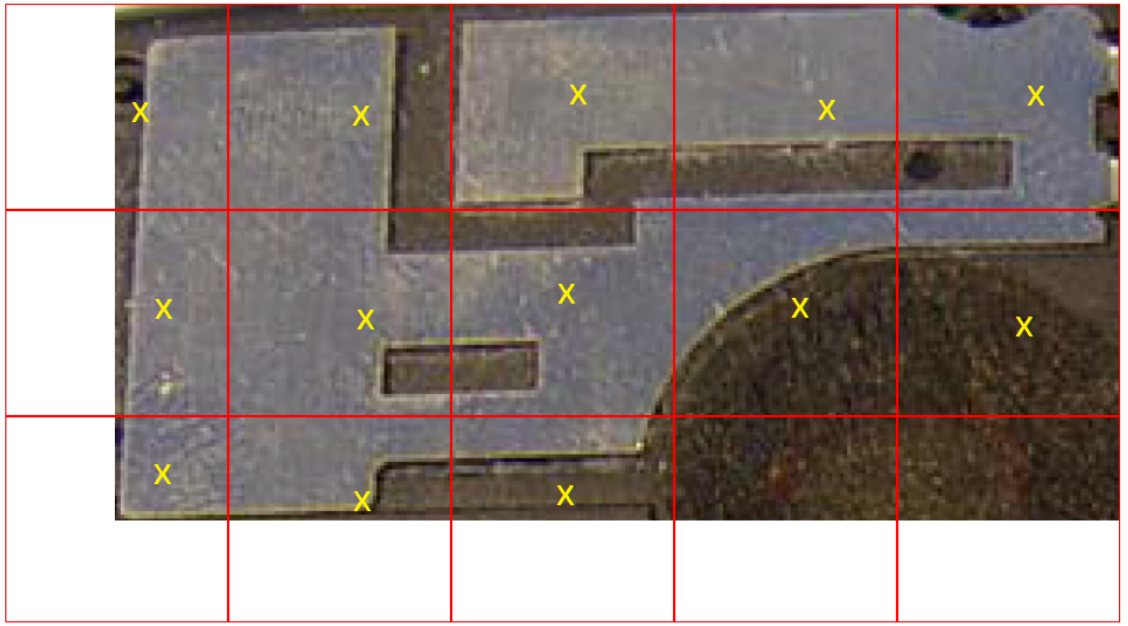
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Claim No.	U.S. Patent No. 11,031,677 B2	BenQ P50
		P50 Smart Phone Specifications ▸ Quad-band 850/900/1800/1900 MHz GPRS class 10 BenQ Website; archived 4/18/2005 at: https://web.archive.org/web/20050418102346/http://www.benq.us/News/index.cfm?year=2005&id=936 (last accessed June 11, 2025) At least one of the three frequency bands is associated with a 4G communication standard.
1[e]	the second frequency range being higher in frequency than the first frequency range and	BenQ P50 expressly or inherently discloses this claim element. *See* Claim 1[d].
1[f]	at least one of the three frequency bands being associated with a 4G communication standard,	BenQ P50 expressly or inherently discloses this claim element. *See* Claim 1[d].
1[g]	the first antenna being proximate to a first short side of a ground plane	BenQ P50 expressly or inherently discloses this claim element. *See, e.g.*,

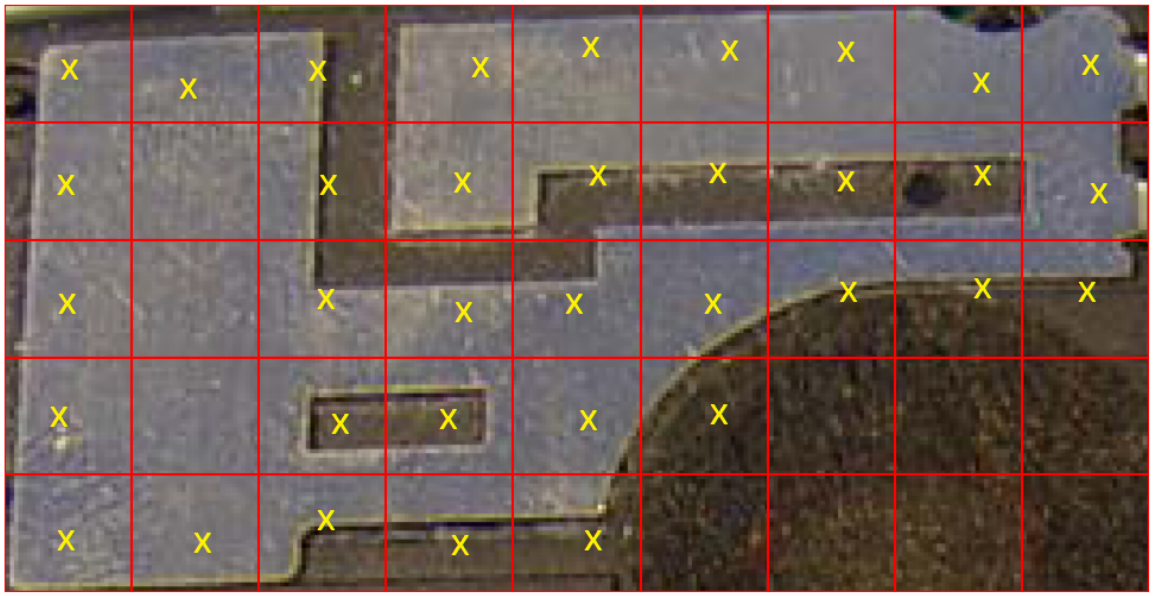
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Claim No.	U.S. Patent No. 11,031,677 B2	BenQ P50
	rectangle enclosing the ground plane and	The first antenna of the BenQ P50 is proximate to a first short side of a ground plane rectangle enclosing the ground plane.  *See* FCC Internal Photos at 1 (annotated).
1[h]	defining a first antenna contour comprising an	BenQ P50 expressly or inherently discloses this claim element.

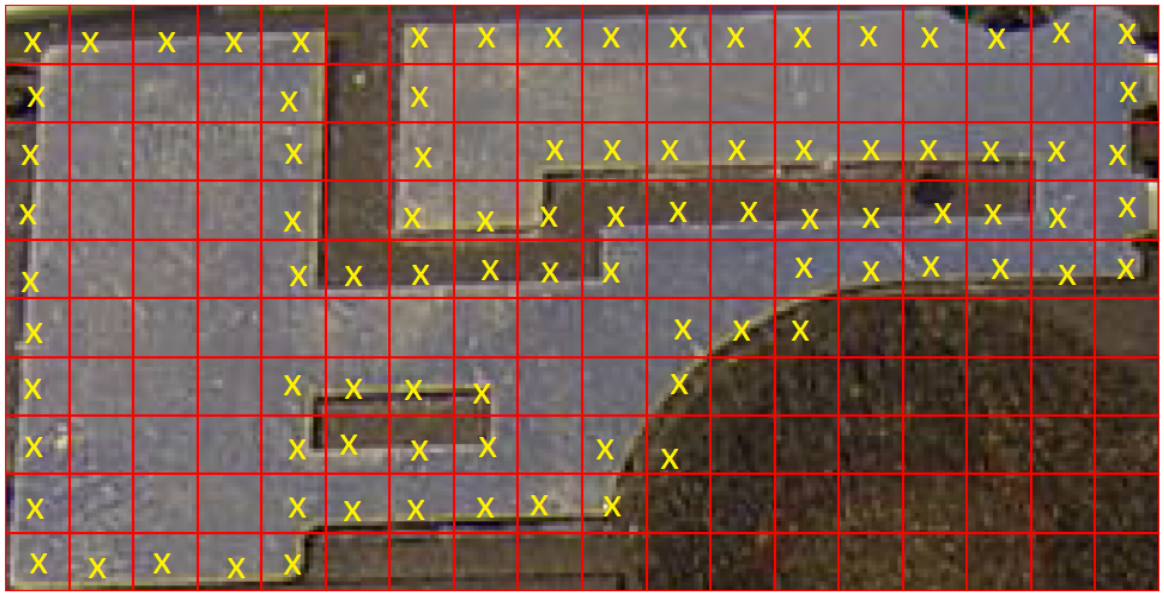
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Claim No.	U.S. Patent No. 11,031,677 B2	BenQ P50
	entire perimeter of the first antenna,	*See, e.g.*, The complexity factor calculation is performed according to the method in the patent. The first antenna of the BenQ P50 defines a first antenna contour comprising an entire perimeter of the first antenna, wherein the first antenna contour has a level of complexity defined by complexity factor F21 having a value of at least 1.20 and complexity factor F32 having a value less than 1.75. N1=13  N2 = 35

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Claim No.	U.S. Patent No. 11,031,677 B2	BenQ P50
		 N3 = 90

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Claim No.	U.S. Patent No. 11,031,677 B2	BenQ P50
		 F21=log(35/13)/log(2)=1.43 F32=log(90/35)/log(2)=1.36
1[i]	wherein the first antenna contour has a level of complexity defined by complexity factor F_{21} having a value of at least 1.20 and	BenQ P50 expressly or inherently discloses this claim element. *See* Claim 1[h].

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Claim No.	U.S. Patent No. 11,031,677 B2	BenQ P50
1[j]	complexity factor F_{32} having a value less than 1.75; and	BenQ P50 expressly or inherently discloses this claim element. *See* Claim 1[h].
1[k]	a second antenna within the wireless device and	BenQ P50 expressly or inherently discloses this claim element. *See, e.g.*, The antenna system of the BenQ P50 has a second antenna (Bluetooth antenna, labeled "BT" below) within the BenQ P50 and configured to support at least one frequency band different from the at least three frequency bands supported by the first antenna, the second antenna being arranged completely within the ground plane rectangle. The at least one frequency band is at least from 2.4 GHz to 2.4835 GHz.

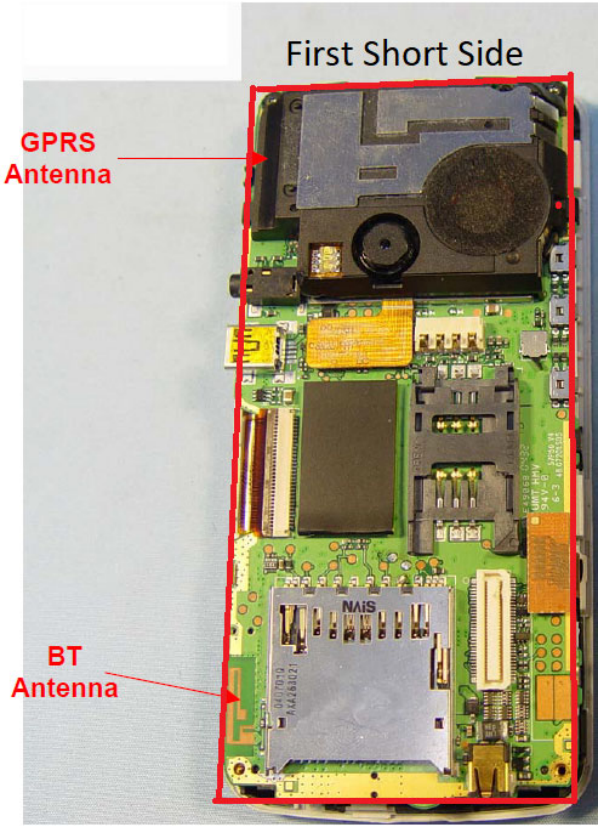
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Claim No.	U.S. Patent No. 11,031,677 B2	BenQ P50

Product Feature & Specification				
1. Type of Modulation	802.11b:CCK(11Mbps),DQPSK(5.5Mbps) DQPSK(2Mbps),DBPSK(1Mbps) BT: GFSK			
2. Number of Channels	802.11b: 11 Channels BT: 79 Channels			
3. Frequency Band	2.4GHz~2.4835GHz			
4. Carrier Frequency of each channel	802.11b: 2412MHz+(n-1)*5MHz, n=1~11 BT: 2402MHz+n*1MHz, n=0~78			
5. Channel Spacing	802.11b: 5MHz BT: 1MHz			
6. Maximum Output Power to Antenna (Normal Condition)	802.11b: 17.82 dBm BT: 0.58 dBm			
7. Type of Antenna Connector	N/A			
8. Antenna Type	802.11b: FPA (Flexibe Printed Antenna) BT: PCB (Printed Circuit Board) Antenna			
9. Antenna Gain	802.11b: -0.63 dBi BT: 0.98 dBi			
10. Function Type	Transmitter		Transceiver	V
11. Duty Cycle	N/A			
12. Basic function of product	With Wireless LAN and BT for data networking applications			

See FCC BT & WLAN Test Report at 5.

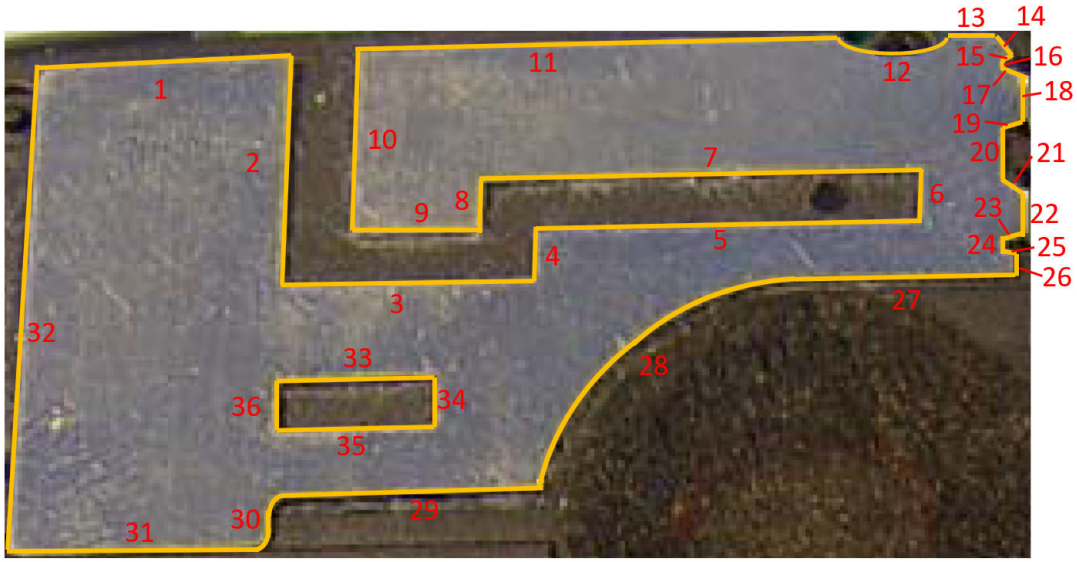
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Claim No.	U.S. Patent No. 11,031,677 B2	BenQ P50
		 *See* FCC Internal Photos at 1 (annotated).
1[l]	configured to support at least one frequency band different from the at least three frequency bands	BenQ P50 expressly or inherently discloses this claim element. *See* Claim 1[k].

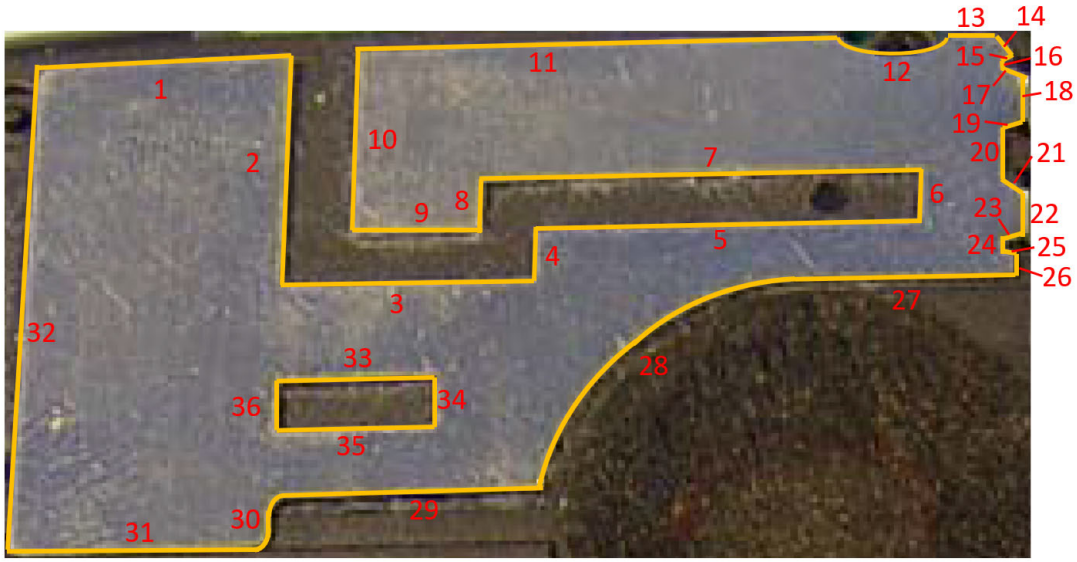
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Claim No.	U.S. Patent No. 11,031,677 B2	BenQ P50
	supported by the first antenna,	
1[m]	the second antenna being arranged completely within the ground plane rectangle.	BenQ P50 expressly or inherently discloses this claim element. *See* Claim 1[k].
Claim 2		
2	The wireless device of claim 1, wherein the first antenna contour comprises at least 20 segments.	BenQ P50 expressly or inherently discloses this claim element. *See, e.g.*, The first antenna contour of the BenQ P50 has 36 segments.

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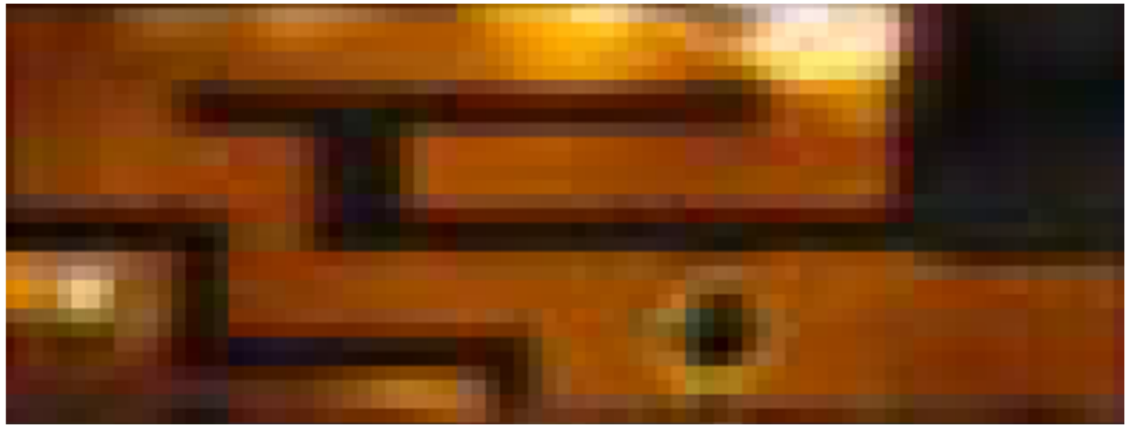
Claim No.	U.S. Patent No. 11,031,677 B2	BenQ P50
		
Claim 3		
3	The wireless device of claim 2, wherein the perimeter of the first antenna contour comprises at least 35 segments.	BenQ P50 expressly or inherently discloses this claim element. *See, e.g.*, The first antenna contour of the BenQ P50 has 36 segments.

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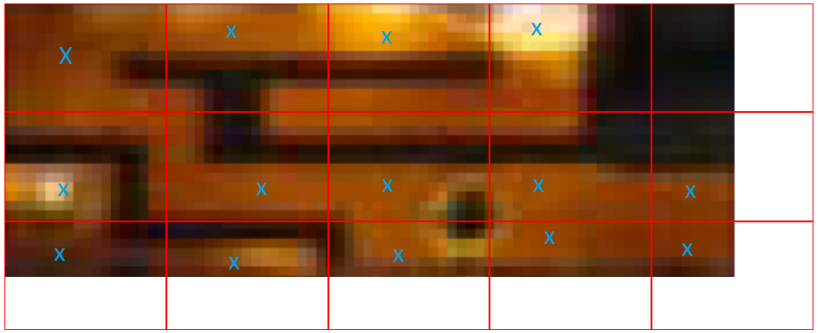
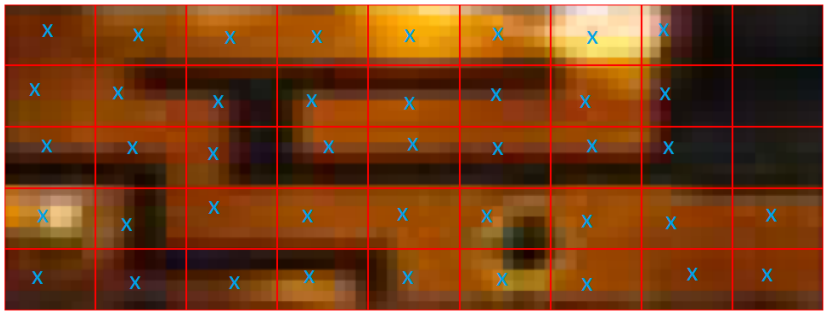
Claim No.	U.S. Patent No. 11,031,677 B2	BenQ P50
		
Claim 4		
4	The wireless device of claim 1, wherein the antenna system comprises a third antenna configured to receive signals employing a 4G communication standard.	BenQ P50 expressly or inherently discloses this claim element. *See, e.g.*, The antenna system of the BenQ P50 includes a third antenna configured to receive signals employing a 4G communication standard.

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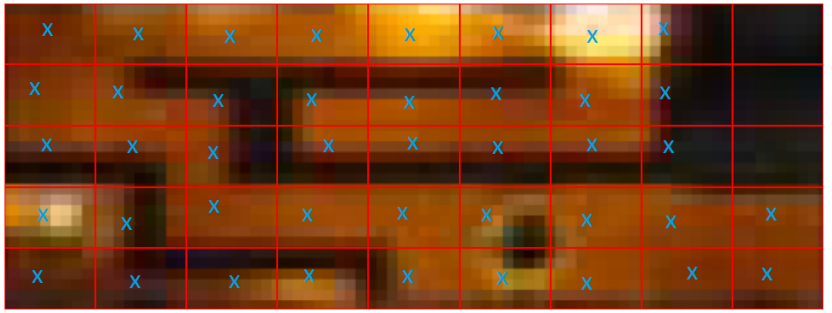
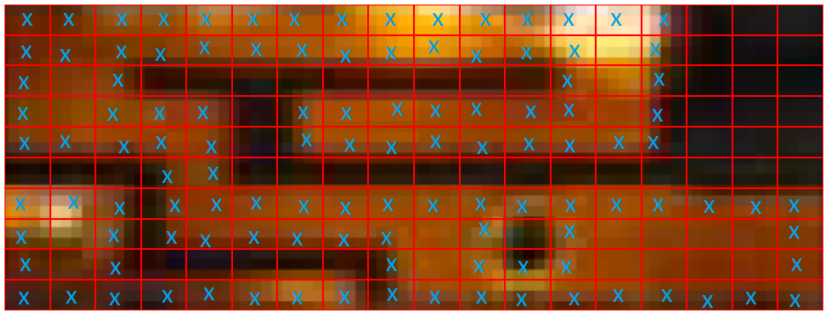

WLAN
Antenna

Claim No.	U.S. Patent No. 11,031,677 B2	BenQ P50
		See FCC Internal Photos at 2.
	Claim 5	
5[a]	The wireless device of claim 4, wherein the third antenna defines an antenna contour comprising an entire perimeter of the third antenna, and	BenQ P50 expressly or inherently discloses this claim element. *See, e.g.*, The third antenna of the BenQ P50 defines an antenna contour comprising an entire perimeter of the third antenna: 
5[b]	wherein the antenna contour of the third antenna has a level of complexity defined by complexity factor F_{21}	BenQ P50 expressly or inherently discloses this claim element. *See, e.g.*, N1 = 14

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Claim No.	U.S. Patent No. 11,031,677 B2	BenQ P50
	having a value of at least 1.2 and	 N2 = 42  F21=log(42/14)/log(2)=1.58
5[c]	a complexity factor F_{32} having a value of at least 1.35.	BenQ P50 expressly or inherently discloses this claim element. *See, e.g.*, N2 = 42

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Claim No.	U.S. Patent No. 11,031,677 B2	BenQ P50
		 N3=115  F32=log(115/42)/log(2)=1.45
		Claim 12
12[pre]	A wireless device comprising:	To the extent the preamble is limiting, BenQ P50 expressly or inherently discloses this claim element. *See* Claim 1[pre].

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Claim No.	U.S. Patent No. 11,031,677 B2	BenQ P50
12[a]	an antenna system comprising:	BenQ P50 expressly or inherently discloses this claim element. *See* Claim 1[a].
12[b]	[*the antenna system comprising*] a ground plane;	BenQ P50 expressly or inherently discloses this claim element. *See* Claim 1[b].
12[c]	[*the antenna system comprising*] a first antenna within the wireless device and	BenQ P50 expressly or inherently discloses this claim element. *See* Claim 1[c].
12[d]	configured to provide operation in at least four frequency bands,	BenQ P50 expressly or inherently discloses this claim element. *See* Claim 1[d].
12[e]	at least one of the at least four frequency bands is contained within a first frequency range and	BenQ P50 expressly or inherently discloses this claim element. *See* Claim 1[d].

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Claim No.	U.S. Patent No. 11,031,677 B2	BenQ P50
12[f]	at least one other of the four frequency bands is contained within a second frequency range,	BenQ P50 expressly or inherently discloses this claim element. *See* Claim 1[d].
12[g]	the first frequency range being lower in frequency than the second frequency range,	BenQ P50 expressly or inherently discloses this claim element. *See* Claim 1[d].
12[h]	the first antenna being proximate to a first short side of a ground plane rectangle enclosing the ground plane,	BenQ P50 expressly or inherently discloses this claim element. *See* Claim 1[g].
12[i]	the first antenna defining a first antenna contour comprising an entire perimeter of the first antenna, and	BenQ P50 expressly or inherently discloses this claim element. *See* Claim 1[h].

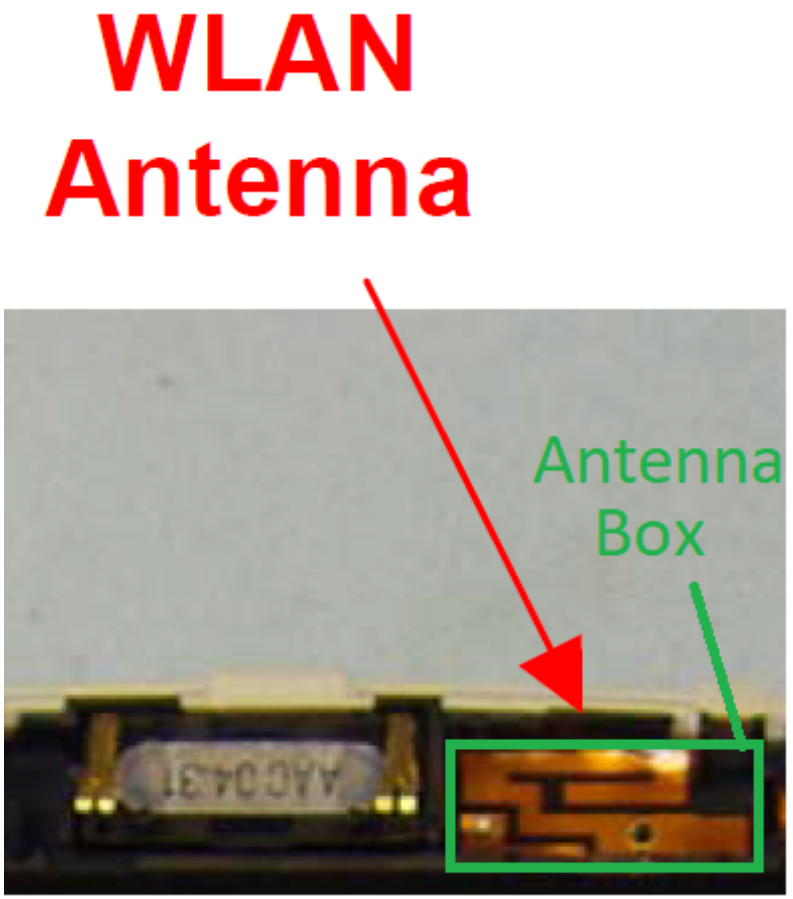
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Claim No.	U.S. Patent No. 11,031,677 B2	BenQ P50
12[j]	wherein the first antenna contour has a level of complexity defined by complexity factor F_{21} having a value of at least 1.20 and	BenQ P50 expressly or inherently discloses this claim element. *See* Claim 1[i].
12[k]	complexity factor F_{32} having a value less than 1.75; and	BenQ P50 expressly or inherently discloses this claim element. *See* Claim 1[j].
12[l]	wherein the first antenna is configured to transmit and receive signals from a 4G communication standard; and	BenQ P50 expressly or inherently discloses this claim element. *See* Claim 1[F].
12[m]	[*the antenna system comprising*] a second antenna within the wireless device and configured to receive signals from a 4G communication standard,	BenQ P50 expressly or inherently discloses this claim element. *See* Claim 4.
12[n]	a minimum-sized parallelepiped of	BenQ P50 expressly or inherently discloses this claim element.

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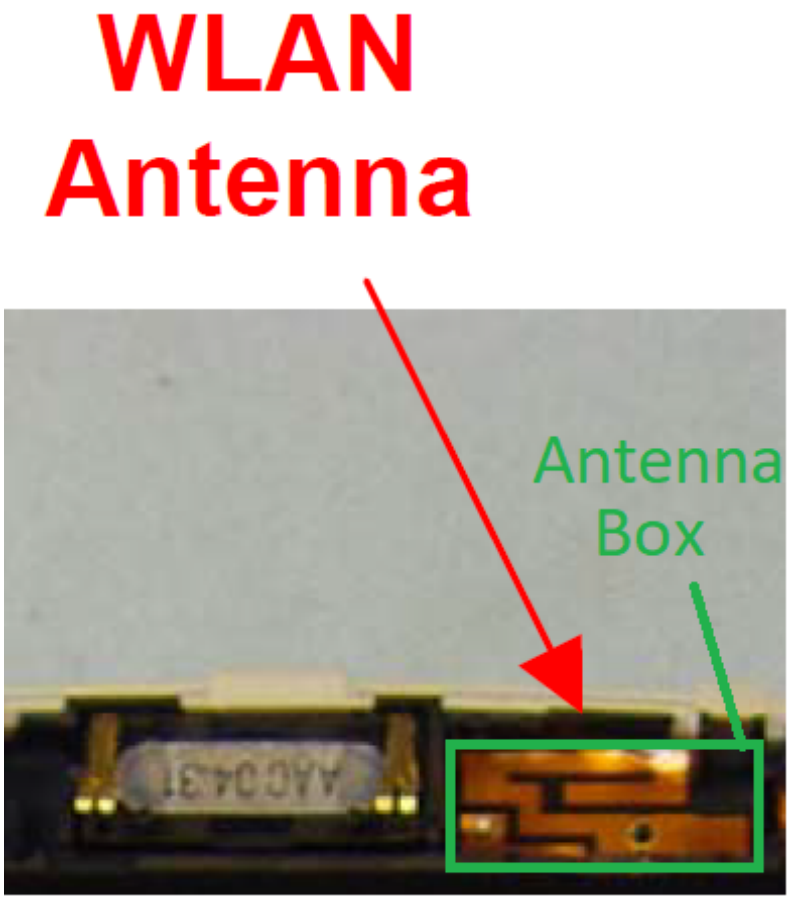
Claim No.	U.S. Patent No. 11,031,677 B2	BenQ P50
	rectangular faces that completely encloses a volume of the second antenna defining an antenna box,	*See, e.g.*, A volume of the second antenna of the BenQ P50 is enclosed within a minimum-sized parallelepiped of rectangular faces that defines an antenna box:

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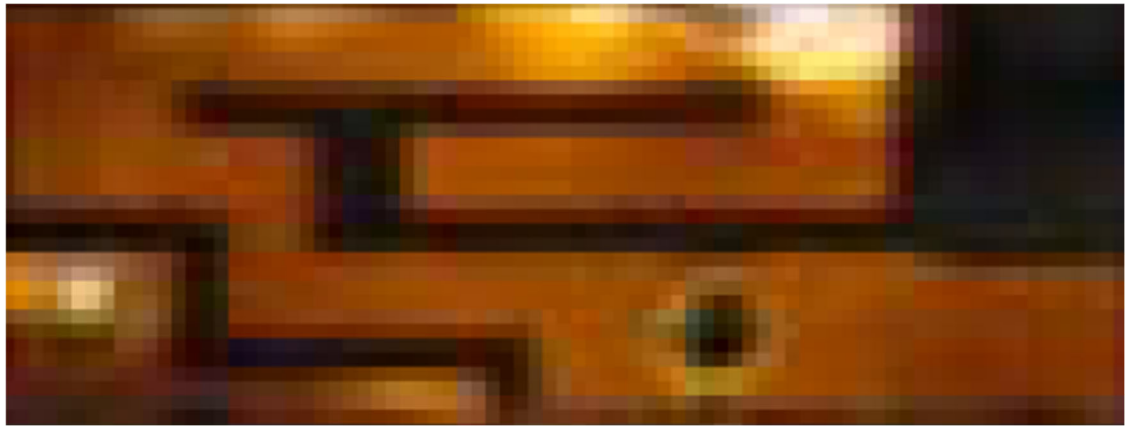
Claim No.	U.S. Patent No. 11,031,677 B2	BenQ P50
		 *See* FCC Internal Photos at 2.

Claim No.	U.S. Patent No. 11,031,677 B2	BenQ P50
12[o]	an orthogonal projection of the antenna box along a normal to a face with a largest area of the second antenna defining	BenQ P50 expressly or inherently discloses this claim element. *See, e.g.*, The antenna box of second antenna of the BenQ P50 has an orthogonal projection along a normal to a face with a largest area of the second antenna:

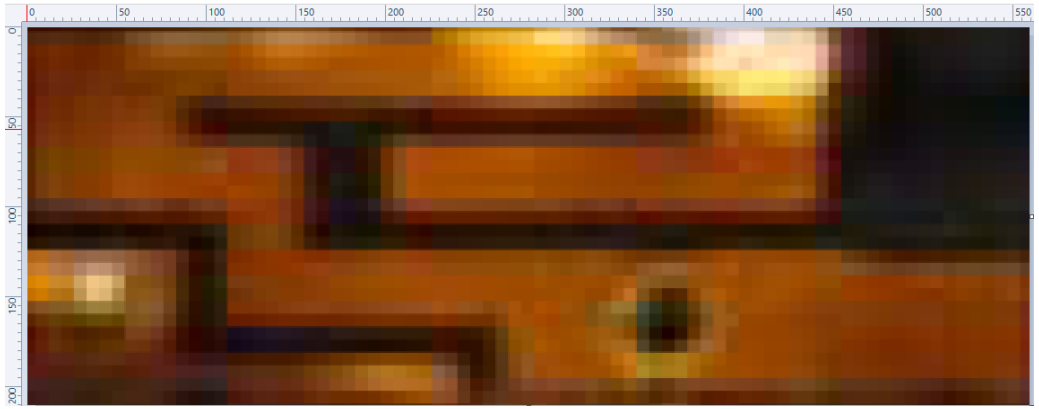
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Claim No.	U.S. Patent No. 11,031,677 B2	BenQ P50
		 *See* FCC Internal Photos at 2.
12[p]	an antenna rectangle,	BenQ P50 expressly or inherently discloses this claim element.

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Claim No.	U.S. Patent No. 11,031,677 B2	BenQ P50
		See, e.g., The below photo from the BenQ P50 shows the antenna rectangle. 
12[q]	an aspect ratio of the antenna rectangle being defined as a ratio between a width and a height of the antenna rectangle, and wherein the aspect ratio has a value of at least 2.	BenQ P50 expressly or inherently discloses this claim element. *See, e.g.*,

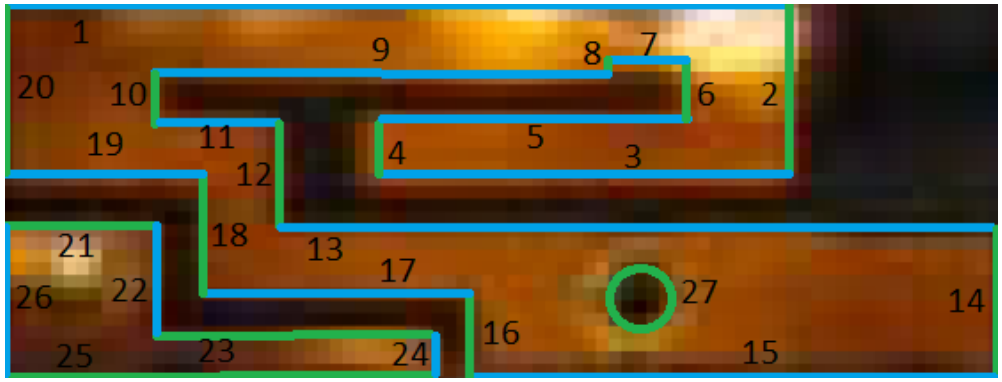
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Claim No.	U.S. Patent No. 11,031,677 B2	BenQ P50
		 Aspect Ratio=width/height=560/210 pixels=2.67
		Claim 13
13	The wireless device of claim 12, wherein the first antenna contour comprises at least 20 segments.	BenQ P50 expressly or inherently discloses this claim element. *See* Claim 2.
		Claim 14
14	The wireless device of claim 13, wherein the first antenna contour comprises at least 35 segments.	BenQ P50 expressly or inherently discloses this claim element. *See* Claim 3.

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Claim No.	U.S. Patent No. 11,031,677 B2	BenQ P50
	Claim 16	
16[a]	The wireless device of claim 12, wherein the second antenna defines a second antenna contour comprising an entire perimeter of the second antenna,	BenQ P50 expressly or inherently discloses this claim element. *See* Claim 5.
16[b]	and wherein the second antenna contour has a level of complexity defined by complexity factor F_{21} having a value of at least 1.2 and	BenQ P50 expressly or inherently discloses this claim element. *See* Claim 16[a].
16[c]	a complexity factor F_{32} having a value of at least 1.35.	BenQ P50 expressly or inherently discloses this claim element. *See* Claim 16[a].
	Claim 17	
17	The wireless device of claim 16, wherein the second antenna contour	BenQ P50 expressly or inherently discloses this claim element. *See, e.g.*,

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Claim No.	U.S. Patent No. 11,031,677 B2	BenQ P50
	comprises at least 20 segments.	The second antenna contour has at least 26 segments. 

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INVALIDITY CONTENTIONS FOR U.S. PATENT NO. 11,031,677 B2 BASED ON THE CINGULAR 8125/HTC WIZARD ("CINGULAR 8125")

Based upon Plaintiff's Complaint, Infringement Contentions, and apparent claim constructions and application of the claims to Defendants' accused products, as best as they can be deciphered, the reference charted below anticipates or at least renders obvious some or all of claims 1, 2, 3, 4, 5, 6, 7, 8, 9, 12, 13, 14, 15, 16, and 17 ("the '677 Asserted Claims")[1]. These invalidity contentions are not an admission by the Defendants that the accused products are covered by or infringe the asserted claims, particularly when these claims are properly construed and applied.

AIA law applies because the application that issued as the '677 Patent was filed on March 27, 2020, after the AIA came into force on March 16, 2013.

Cingular Wireless's ("Cingular") Cingular 8125, including identify any subsets of the Cingular 8125 (also known as, *inter alia*, the HTC Wizard 100/110[2], Dopod 838, HTC P4300, Qtek A9100, and Vodafone VPA Compact II), as publicly demonstrated, known, offered for sale, sold, and/or used by Cingular and/or customers of Cingular or otherwise available to the public, including in this country, ("Cingular 8125" or "HTC Wizard") was available for purchase in the United States no later than February 15, 2006.[3] Thus, the Cingular 8125 is available as prior art at least under pre-AIA 35 U.S.C. § 102(a)-(b), (g)(2) or AIA 35 U.S.C. § 102(a)(1). At least the following documents provide evidence as to the date the Cingular 8125 was "offered for sale or publicly used or known," "the date the offer or use of the item took place or the information became known", and the "identity of the person or entity which made the use or which made and received the offer, or the person or entity which made the information known or to whom it was made known" [4]:

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[1] Defendants understand that that, by not charting claims 10-11 and 18-20 in its Infringement Contentions, Plaintiff does not assert these claims against Defendants.

[2] *See* Phonescoop.com, Cingular 8125, https://www.phonescoop.com/phones/phone.php?p=781 (last accessed June 13, 2025).

[3] *See* Cingular Website; archived on February 15, 2006 at: https://web.archive.org/web/20060215183508/http://www.cingular.com/8125_consumer (last accessed June 11, 2025)

[4] Defendants do not yet have complete information regarding the dates by which this product was publicly disclosed, made, used, sold, or offered for sale, the circumstances under which the research, design, and development activities were conducted, and the identities of the particular individuals involved in such activities. Defendants anticipate that the actual dates, circumstances, and identities of individuals will be the subject of third party discovery during this lawsuit. Defendants therefore reserve the right to amend and/or supplement their Invalidity Contentions and this chart if additional information becomes available during the course of discovery. The date the Cingular 8125 was "offered for sale or publicly used or known," as well as "the date the offer or use of the item took place or the information became known" is at least as early as the dates identified in the published documents. The "identity of the person or entity which made the use or which made and received the offer, or the person or entity which made the information known or to whom it was made known" includes at least those persons associated with the publication(s), press releases, and conference attendees, or other documents associated with each version on the Cingular 8125. Defendants also reserve the right to rely on the public use, offer for sale, sale, or installation of the devices described in the publications identified herein once Defendants have had a fair opportunity to take discovery on these subjects.

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- Cingular Website; archived on February 15, 2006 at: https://web.archive.org/web/20060215183508/http://www.cingular.com/8125_consumer (last accessed June 11, 2025)
- FCC ID Search, https://www.fcc.gov/oet/ea/fccid (Grantee Code: "NM8"; Product Code: "WZ"; Record Option: 1/4 "Detail"; Attachment: "Internal Photos WIZA110" (last accessed June 11, 2025) ("FCC Internal Photos")
- Phonescoop.com, *Cingular 8125*, https://www.phonescoop.com/phones/phone.php?p=781 (last accessed June 13, 2025)
- PhoneArena.com, *Cingular 8125*, https://www.phonearena.com/news/Cingular-8125-to-be-launched-soon_id732 (last accessed June 13, 2025)
- PhoneDB.com, *Cingular 8125*, https://phonedb.net/index.php?m=device&id=402&c=cingular_8125__htc_wizard_110 (last accessed June 13, 2025)
- Wikipedia.com, *Cingular 8125*, https://en.wikipedia.org/wiki/HTC_Wizard (last accessed June 13, 2025)

As described in the following claim chart, the asserted claims of U.S. Patent No. 11,031,677 (the "'677 Patent"), are invalid as anticipated by Cingular 8125. To the extent that Cingular 8125 is found not to anticipate one or more of the asserted claims of the '677 Patent, these claims are invalid as obvious in view of Cingular 8125 alone or as modified in view of or in combination with other prior art references disclosed in Defendants' Invalidity Contentions and accompanying charts, including without limitation as set forth below.

One of ordinary skill in the art, as of the priority date of the '677 Patent, would have known to combine or modify the prior art elements disclosed by the foregoing references using known methods, and to use these elements according to their established functions in order to achieve a known and predictable result.

These invalidity contentions are not an admission that the Defendants concede or acquiesce to any claim construction implied or suggested by Plaintiff's Complaint or Infringement Contentions. Nor are Defendants asserting any claim construction positions through these charts, including whether the preamble is a limitation. The portions of the prior art reference cited below are not exhaustive but are exemplary in nature. Defendants retain the right to update their constructions and contentions in view of this Court's claim construction order.[5]

Claim No.	U.S. Patent No. 11,031,677 B2	Cingular 8125/HTC Wizard
Claim 1		

[5] Defendants reserve the right to supplement and/or alter this chart based on further investigation and ongoing discovery.

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Claim No.	U.S. Patent No. 11,031,677 B2	Cingular 8125/HTC Wizard
1[pre]	A wireless device comprising:	To the extent the preamble is limiting, Cingular 8125 expressly or inherently discloses this claim element. *See, e.g.*, The Cingular 8125 is a wireless device.  *See* Cingular Website; archived on February 15, 2006 at: https://web.archive.org/web/20060215183508/http://www.cingular.com/8125_consumer (last accessed June 11, 2025).

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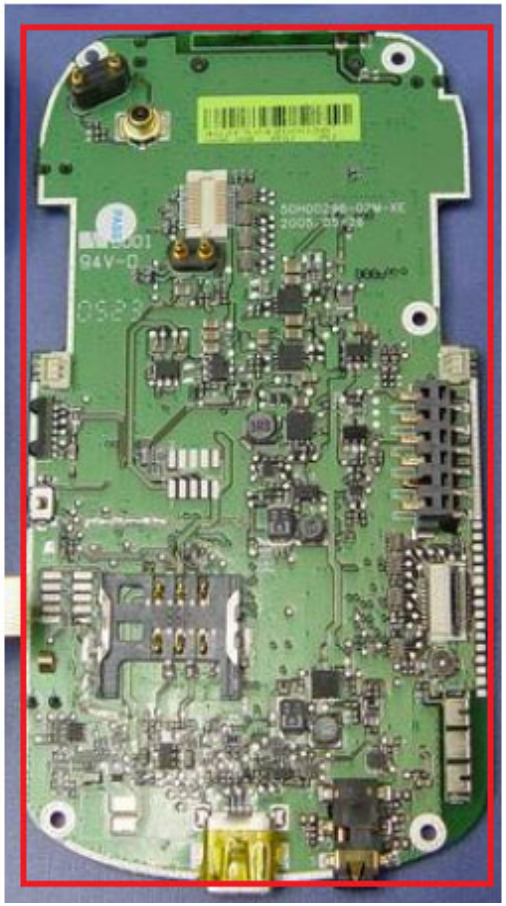
Claim No.	U.S. Patent No. 11,031,677 B2	Cingular 8125/HTC Wizard
1[a]	an antenna system comprising:	Cingular 8125 expressly or inherently discloses this claim element. *See, e.g.*, The Cingular 8125 has an antenna system including a ground plane. 

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Claim No.	U.S. Patent No. 11,031,677 B2	Cingular 8125/HTC Wizard
		

Claim No.	U.S. Patent No. 11,031,677 B2	Cingular 8125/HTC Wizard
		

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Claim No.	U.S. Patent No. 11,031,677 B2	Cingular 8125/HTC Wizard
		 *See* FCC Internal Photos at 5 (annotated).

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Claim No.	U.S. Patent No. 11,031,677 B2	Cingular 8125/HTC Wizard
1[b]	[*the antenna system comprising*] a ground plane;	Cingular 8125 expressly or inherently discloses this claim element. *See* Claim 1[a].
1[c]	[*the antenna system comprising*] a first antenna within the wireless device and	Cingular 8125 expressly or inherently discloses this claim element. *See, e.g.*, The antenna system of the Cingular 8125 includes a first antenna within the wireless device, which is a cellular antenna. 

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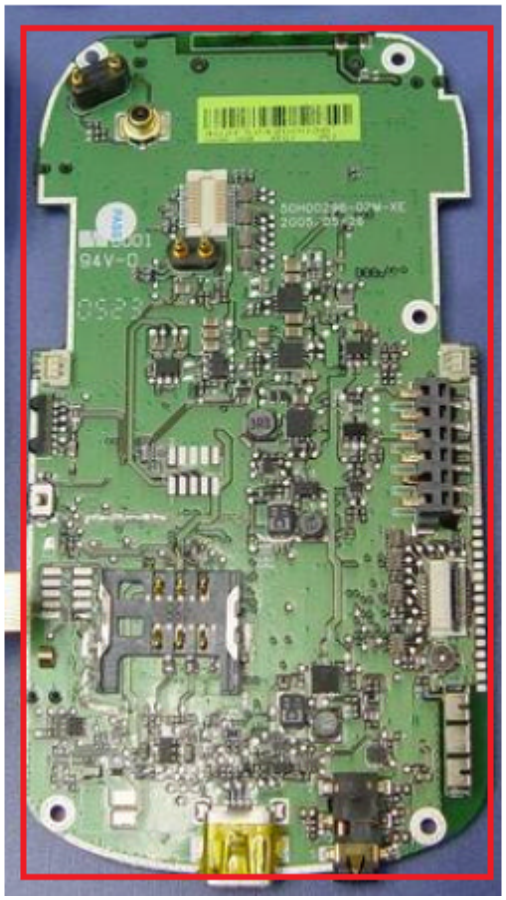
Claim No.	U.S. Patent No. 11,031,677 B2	Cingular 8125/HTC Wizard
		
1[d]	[*the antenna system*] configured to support at least three frequency	Cingular 8125 expressly or inherently discloses this claim element. *See, e.g.*,

Claim No.	U.S. Patent No. 11,031,677 B2	Cingular 8125/HTC Wizard
	bands contained within first and second frequency ranges of the electromagnetic spectrum,	The first antenna of the Cingular 8125 is configured to support at least three frequency bands contained within first and second frequency ranges of the electromagnetic spectrum, the second frequency range being higher in frequency than the first frequency range. • Quad-band GSM/GPRS/EDGE 850/900/1800/1900 MHz for enhanced global use *See* Cingular Website; archived on February 15, 2006 at: https://web.archive.org/web/20060215183508/http://www.cingular.com/8125_consumer (last accessed June 11, 2025). At least one of the three frequency bands is associated with a 4G communication standard.
1[e]	the second frequency range being higher in frequency than the first frequency range and	Cingular 8125 expressly or inherently discloses this claim element. *See* Claim 1[d].
1[f]	at least one of the three frequency bands being associated with a 4G communication standard,	Cingular 8125 expressly or inherently discloses this claim element. *See* Claim 1[d].
1[g]	the first antenna being proximate to a first short side of a ground plane rectangle	Cingular 8125 expressly or inherently discloses this claim element. *See, e.g.*,

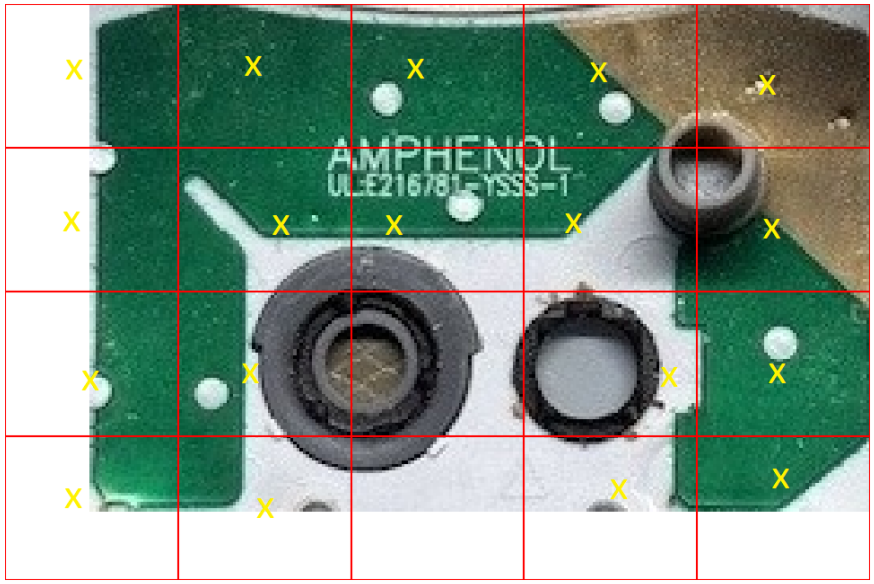
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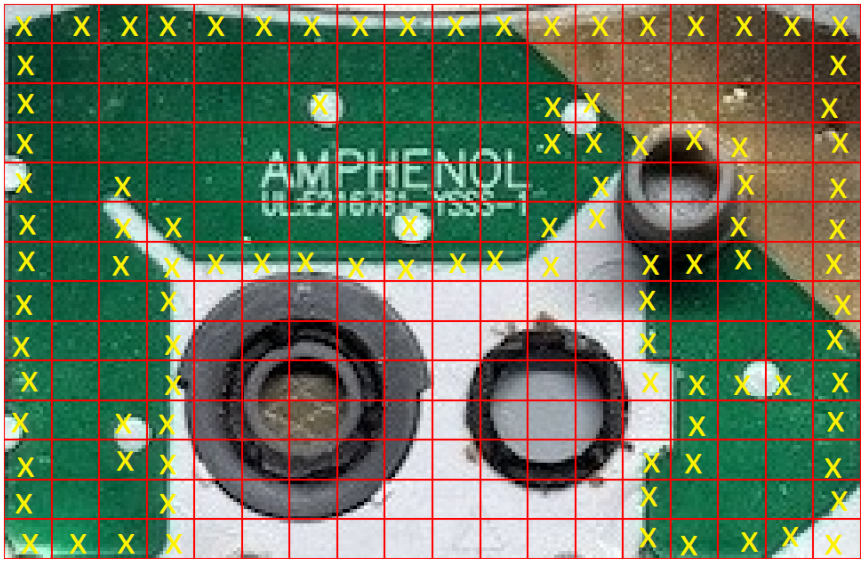
Claim No.	U.S. Patent No. 11,031,677 B2	Cingular 8125/HTC Wizard
	enclosing the ground plane and	The first antenna of the Cingular 8125 is proximate to a first short side of a ground plane rectangle enclosing the ground plane.  *See* FCC Internal Photos at 4 (annotated).

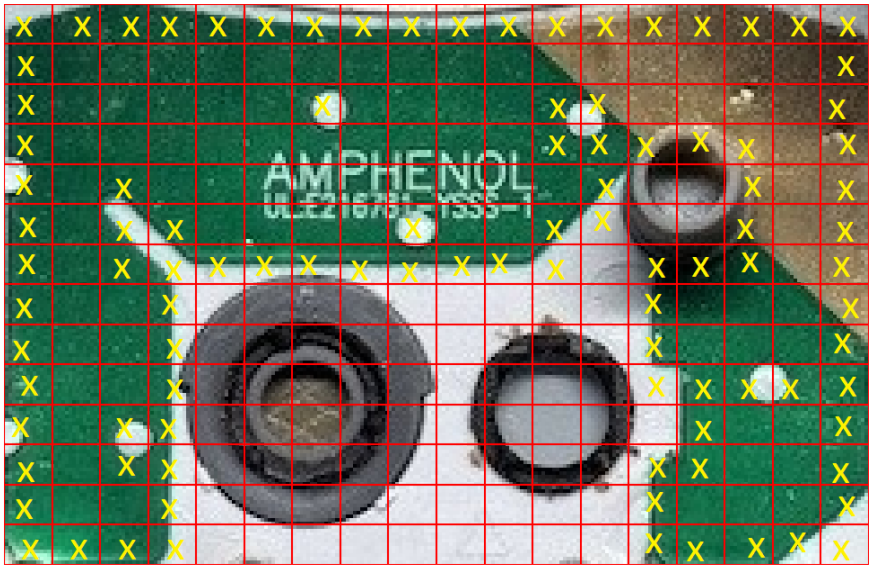
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Claim No.	U.S. Patent No. 11,031,677 B2	Cingular 8125/HTC Wizard
		First Short Side  *See* FCC Internal Photos at 5 (annotated).

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Claim No.	U.S. Patent No. 11,031,677 B2	Cingular 8125/HTC Wizard
1[h]	defining a first antenna contour comprising an entire perimeter of the first antenna,	Cingular 8125 expressly or inherently discloses this claim element. *See, e.g.*, The complexity factor calculation is performed according to the method in the patent. The first antenna of the Cingular 8125 defines a first antenna contour comprising an entire perimeter of the first antenna, wherein the first antenna contour has a level of complexity defined by complexity factor F21 having a value of at least 1.20 and complexity factor F32 having a value less than 1.75. N1=18  N2=46

Claim No.	U.S. Patent No. 11,031,677 B2	Cingular 8125/HTC Wizard
		 N3=98

Claim No.	U.S. Patent No. 11,031,677 B2	Cingular 8125/HTC Wizard
		 F21=log(46/18)/log(2)=1.35 F32=log(98/46)/log(2)=1.09
1[i]	wherein the first antenna contour has a level of complexity defined by complexity factor F_{21} having a value of at least 1.20 and	Cingular 8125 expressly or inherently discloses this claim element. *See* Claim 1[h].

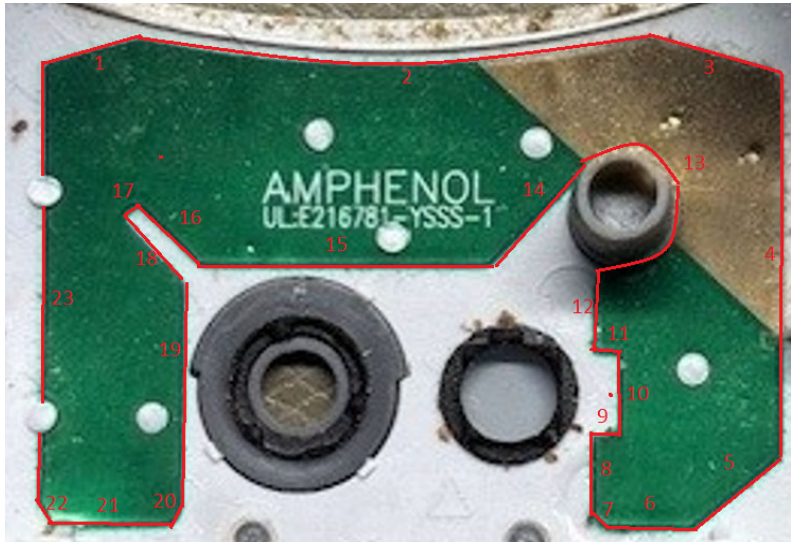
Claim No.	U.S. Patent No. 11,031,677 B2	Cingular 8125/HTC Wizard
1[j]	complexity factor F_{32} having a value less than 1.75; and	Cingular 8125 expressly or inherently discloses this claim element. *See* Claim 1[h].
1[k]	a second antenna within the wireless device and	Cingular 8125 expressly or inherently discloses this claim element. *See, e.g.*, The antenna system of the Cingular 8125 has a second antenna (Bluetooth antenna) within the Cingular 8125 and configured to support at least one frequency band different from the at least three frequency bands supported by the first antenna, the second antenna being arranged completely within the ground plane rectangle. The at least one frequency band is at least from 2.4 GHz to 2.48 GHz. ∴ Integrated Bluetooth Class II *See* Cingular Website; archived on February 15, 2006 at: https://web.archive.org/web/20060215183508/http://www.cingular.com/8125_consumer (last accessed June 11, 2025).

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Claim No.	U.S. Patent No. 11,031,677 B2	Cingular 8125/HTC Wizard
		

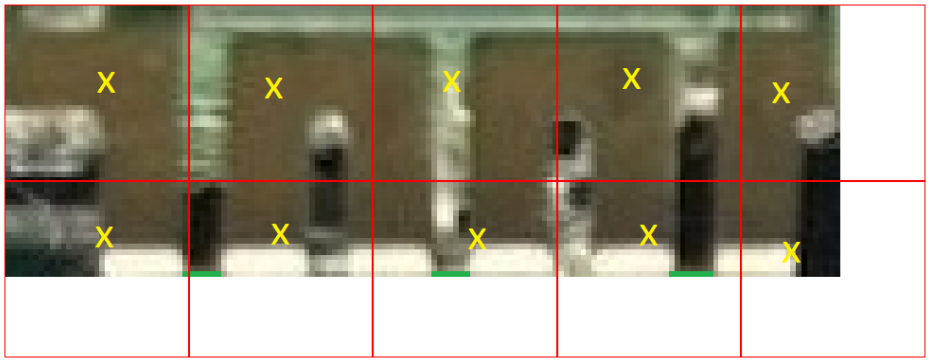
Claim No.	U.S. Patent No. 11,031,677 B2	Cingular 8125/HTC Wizard
		 *See* FCC Internal Photos at 5 (annotated).
1[l]	configured to support at least one frequency band different from the at least three frequency bands supported by the first antenna,	Cingular 8125 expressly or inherently discloses this claim element. *See* Claim 1[k].

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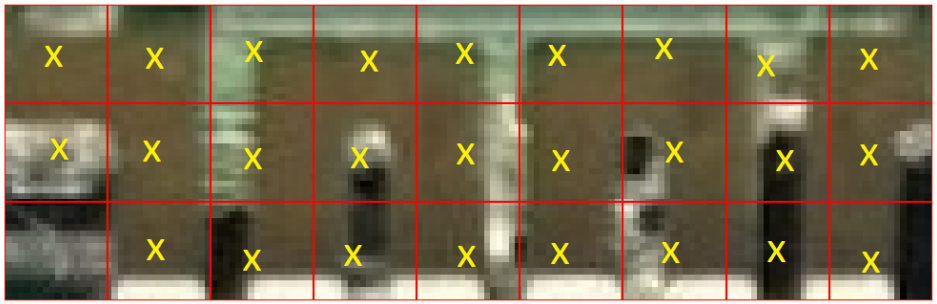
Claim No.	U.S. Patent No. 11,031,677 B2	Cingular 8125/HTC Wizard
1[m]	the second antenna being arranged completely within the ground plane rectangle.	Cingular 8125 expressly or inherently discloses this claim element. *See* Claim 1[k].
Claim 2		
2	The wireless device of claim 1, wherein the first antenna contour comprises at least 20 segments.	Cingular 8125 expressly or inherently discloses this claim element. *See, e.g.*, The first antenna contour of the Cingular 8125 has at least 23 segments. 

Claim No.	U.S. Patent No. 11,031,677 B2	Cingular 8125/HTC Wizard
		Claim 4
4	The wireless device of claim 1, wherein the antenna system comprises a third antenna configured to receive signals employing a 4G communication standard.	Cingular 8125 expressly or inherently discloses this claim element. *See, e.g.*, The antenna system of the Cingular 8125 includes a third antenna configured to receive antennas employing a 4G communication standard. 

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Claim No.	U.S. Patent No. 11,031,677 B2	Cingular 8125/HTC Wizard
		⁘ Integrated 802.11b support *See* Cingular Website; archived on February 15, 2006 at: https://web.archive.org/web/20060215183508/http://www.cingular.com/8125_consumer (last accessed June 11, 2025).
		Claim 5
5[a]	The wireless device of claim 4, wherein the third antenna defines an antenna contour comprising an entire perimeter of the third antenna, and	Cingular 8125 expressly or inherently discloses this claim element. *See, e.g.*, The complexity factor calculation is performed according to the method in the patent. The third antenna of the Cingular 8125 defines an antenna contour comprising an entire perimeter of the third antenna, and the antenna contour of the third antenna has a level of complexity defined by complexity factor F21 having a value of at least 1.2 and a complexity factor F32 having a value of at least 1.35. N1=10 

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Claim No.	U.S. Patent No. 11,031,677 B2	Cingular 8125/HTC Wizard
		N2=26  N3=80  F21=log(26/10)/log(2)=1.38 F32=log(80/26)/log(2)=1.62
5[b]	wherein the antenna contour of the third antenna has a level of complexity defined by complexity factor F_{21}	Cingular 8125 expressly or inherently discloses this claim element. *See* Claim 5[a].

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Claim No.	U.S. Patent No. 11,031,677 B2	Cingular 8125/HTC Wizard
	having a value of at least 1.2 and	
5[c]	a complexity factor F_{32} having a value of at least 1.35.	Cingular 8125 expressly or inherently discloses this claim element. *See* Claim 5[a].
Claim 6		
6[pre]	A wireless device comprising:	To the extent the preamble is limiting, Cingular 8125 expressly or inherently discloses this claim element. *See, e.g.*, The Cingular 8125 is a wireless device.

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Claim No.	U.S. Patent No. 11,031,677 B2	Cingular 8125/HTC Wizard
		 *See* (https://web.archive.org/web/20060215183508/ http://www.cingular.com/8125_consumer).
6[a]	an antenna system comprising:	Cingular 8125 expressly or inherently discloses this claim element. *See, e.g.*, The Cingular 8125 has an antenna system including a ground plane.

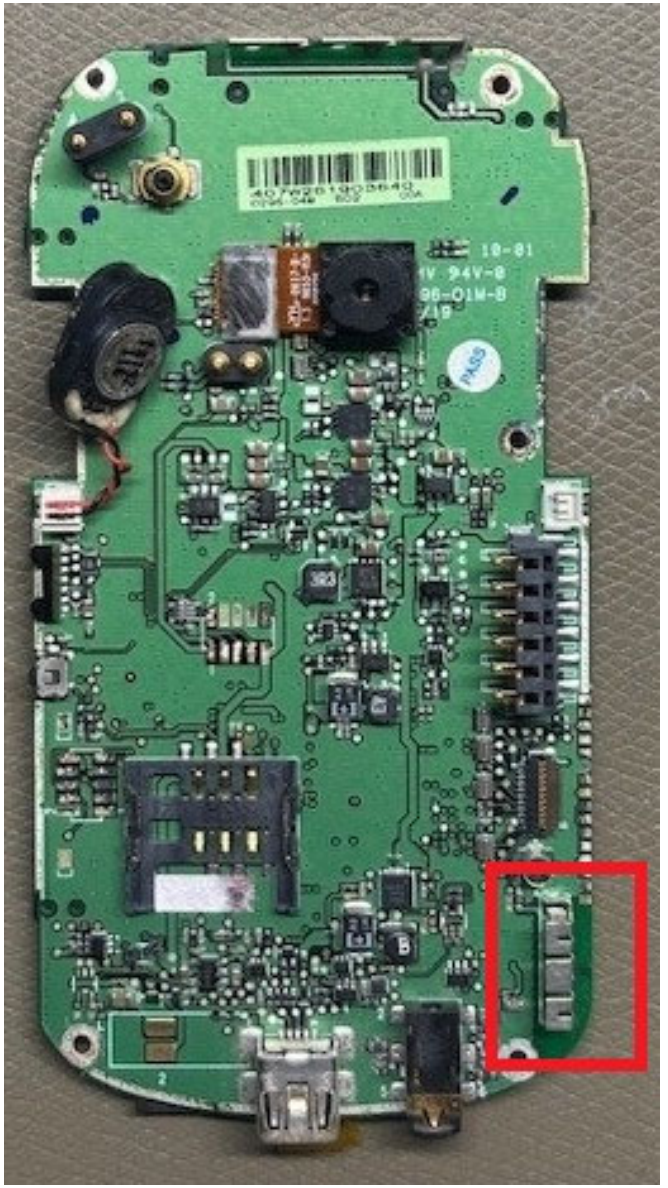
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Claim No.	U.S. Patent No. 11,031,677 B2	Cingular 8125/HTC Wizard
		

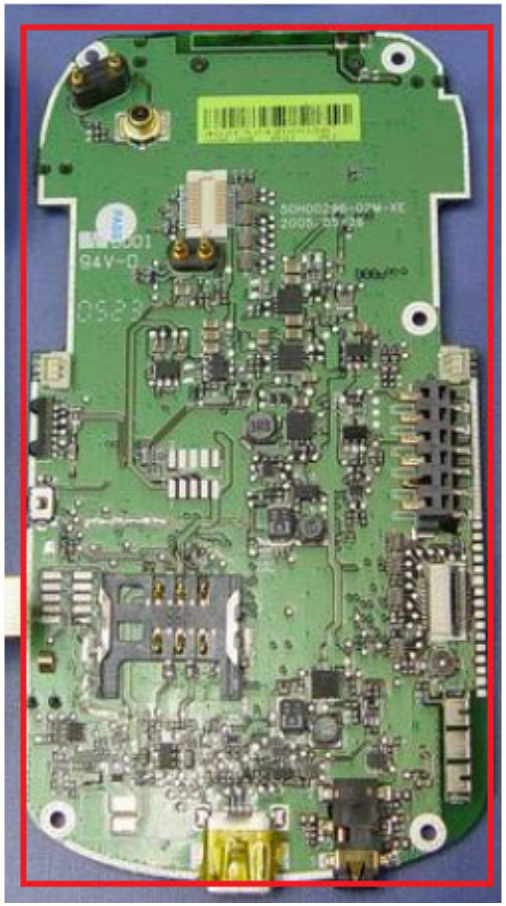
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Claim No.	U.S. Patent No. 11,031,677 B2	Cingular 8125/HTC Wizard
		

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Claim No.	U.S. Patent No. 11,031,677 B2	Cingular 8125/HTC Wizard
		 *See* FCC Internal Photos at 5 (annotated).

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Claim No.	U.S. Patent No. 11,031,677 B2	Cingular 8125/HTC Wizard
6[b]	[*the antenna system comprising*] a ground plane;	Cingular 8125 expressly or inherently discloses this claim element. *See* Claim 6[a].
6[c]	[*the antenna system comprising*] a first antenna within the wireless device and	Cingular 8125 expressly or inherently discloses this claim element. *See, e.g.*, The antenna system of the Cingular 8125 includes a first antenna within the wireless device, which is a cellular antenna. 

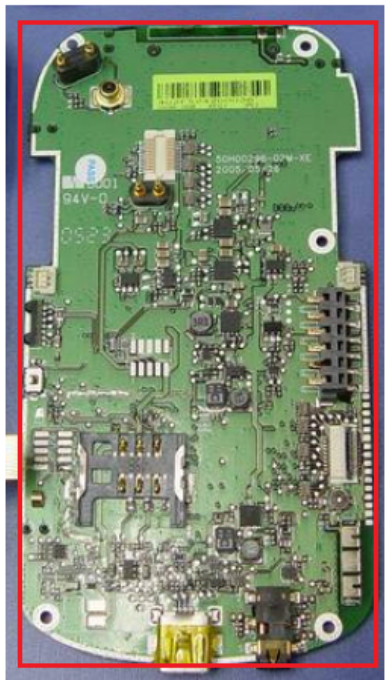
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Claim No.	U.S. Patent No. 11,031,677 B2	Cingular 8125/HTC Wizard
		The first antenna of the Cingular 8125 is configured to support at least two frequency bands contained within first and second frequency ranges of the electromagnetic spectrum, the second frequency range being higher in frequency than the first frequency range. Quad-band GSM/GPRS/EDGE 850/900/1800/1900 MHz for enhanced global use *See* Cingular Website; archived on February 15, 2006 at: https://web.archive.org/web/20060215183508/http://www.cingular.com/8125_consumer (last accessed June 11, 2025).
6[d]	configured to support at least two frequency bands contained within first and second frequency ranges of the electromagnetic spectrum,	Cingular 8125 expressly or inherently discloses this claim element. *See* Claim 6[c].
6[e]	the second frequency range being higher in frequency than the first frequency range,	Cingular 8125 expressly or inherently discloses this claim element. *See* Claim 6[c].
6[f]	the first antenna being proximate to a first short side of a ground plane rectangle	Cingular 8125 expressly or inherently discloses this claim element. *See, e.g.*,

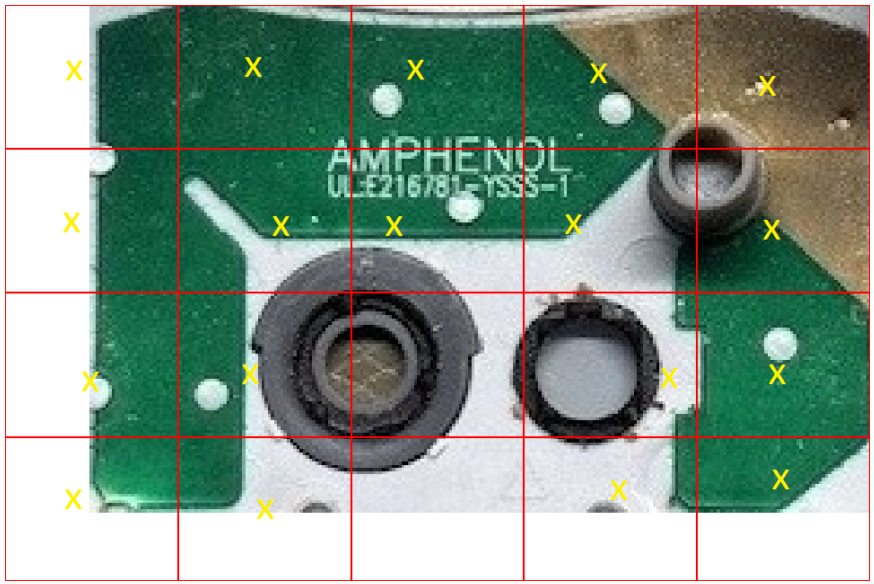
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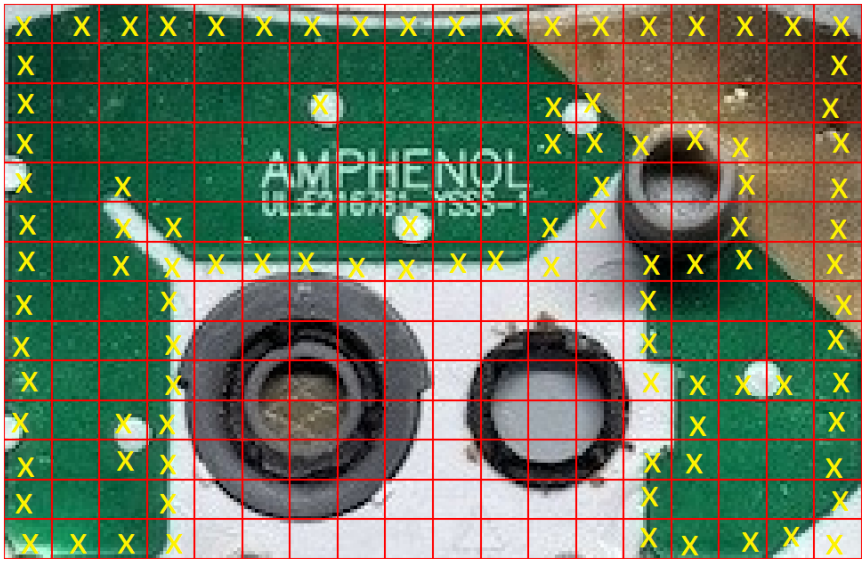
Claim No.	U.S. Patent No. 11,031,677 B2	Cingular 8125/HTC Wizard
	enclosing the ground plane and	The first antenna of the Cingular 8125 is proximate to a first short side of a ground plane rectangle enclosing the ground plane.  *See* FCC Internal Photos at 4.

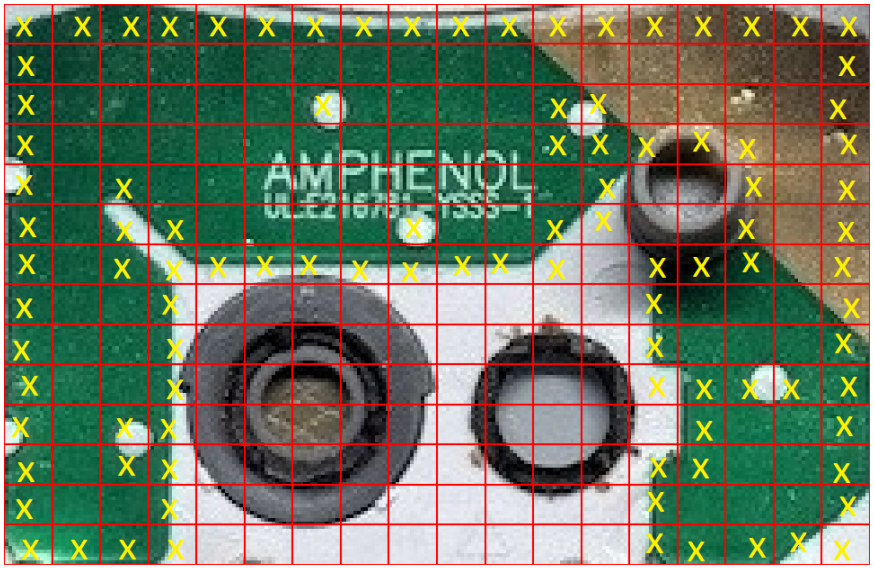
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Claim No.	U.S. Patent No. 11,031,677 B2	Cingular 8125/HTC Wizard
		First Short Side  *See* FCC Internal Photos at 5 (annotated).
6[g]	defining a first antenna contour comprising an entire perimeter of the first antenna,	Cingular 8125 expressly or inherently discloses this claim element. *See, e.g.*, The complexity factor calculation is performed according to the method in the patent.

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Claim No.	U.S. Patent No. 11,031,677 B2	Cingular 8125/HTC Wizard
		The first antenna of the Cingular 8125 defines a first antenna contour comprising an entire perimeter of the first antenna, wherein the first antenna contour has a level of complexity defined by complexity factor F21 having a value of at least 1.20 and complexity factor F32 having a value less than 1.75. N1=18  N2=46

Claim No.	U.S. Patent No. 11,031,677 B2	Cingular 8125/HTC Wizard
		 N3=98

Claim No.	U.S. Patent No. 11,031,677 B2	Cingular 8125/HTC Wizard
		 F21=log(46/18)/log(2)=1.35 F32=log(98/46)/log(2)=1.09
6[h]	wherein the first antenna contour has a level of complexity defined by complexity factor F_{21} having a value of at least 1.20 and	Cingular 8125 expressly or inherently discloses this claim element. *See* Claim 6[g].

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Claim No.	U.S. Patent No. 11,031,677 B2	Cingular 8125/HTC Wizard
6[i]	complexity factor F_{32} having a value less than 1.75; and	Cingular 8125 expressly or inherently discloses this claim element. *See* Claim 6[g].
6[j]	[*the antenna system comprising*] a second antenna within the wireless device and	Cingular 8125 expressly or inherently discloses this claim element. *See, e.g.*, The Cingular 8125 includes a second antenna within the wireless device, which is a WLAN antenna.

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Claim No.	U.S. Patent No. 11,031,677 B2	Cingular 8125/HTC Wizard
		
6[k]	defining a second antenna contour	Cingular 8125 expressly or inherently discloses this claim element.

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Claim No.	U.S. Patent No. 11,031,677 B2	Cingular 8125/HTC Wizard
	comprising an entire perimeter of the second antenna,	*See* Claim 6[j].
6[l]	the second antenna being proximate to a second short side of the ground plane rectangle that is opposite to the first short side of the ground plane rectangle,	Cingular 8125 expressly or inherently discloses this claim element. *See, e.g.*, The second antenna of the Cingular 8125 is proximate to a second short side of the ground plane rectangle that is opposite to the first short side of the ground plane rectangle.

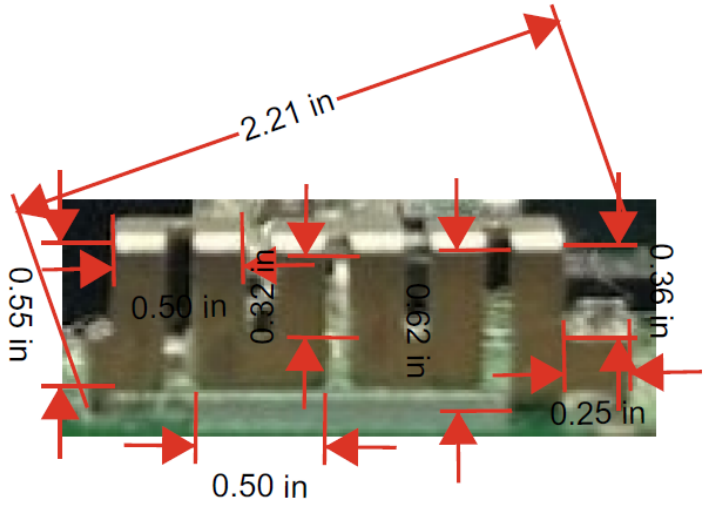
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Claim No.	U.S. Patent No. 11,031,677 B2	Cingular 8125/HTC Wizard
		First Short Side  Second Short Side *See* FCC Internal Photos at 5 (annotated).
6[m]	a minimum-sized parallelepiped of rectangular faces that completely encloses a volume of the second	Cingular 8125 expressly or inherently discloses this claim element. *See, e.g.*, The complexity factor calculation is performed according to the method in the patent.

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Claim No.	U.S. Patent No. 11,031,677 B2	Cingular 8125/HTC Wizard
	antenna defining an antenna box, and	In the Cingular 8125, a minimum-sized parallelepiped of rectangular faces that completely encloses a volume of the second antenna defines an antenna box, and an orthogonal projection of the antenna box along a normal to a face with a largest area of the second antenna defines an antenna rectangle.  A length of the second antenna contour is greater than four times a diagonal (D, above) of the antenna rectangle. A length of the second antenna contour is greater than four times a diagonal (D, above) of the antenna rectangle.

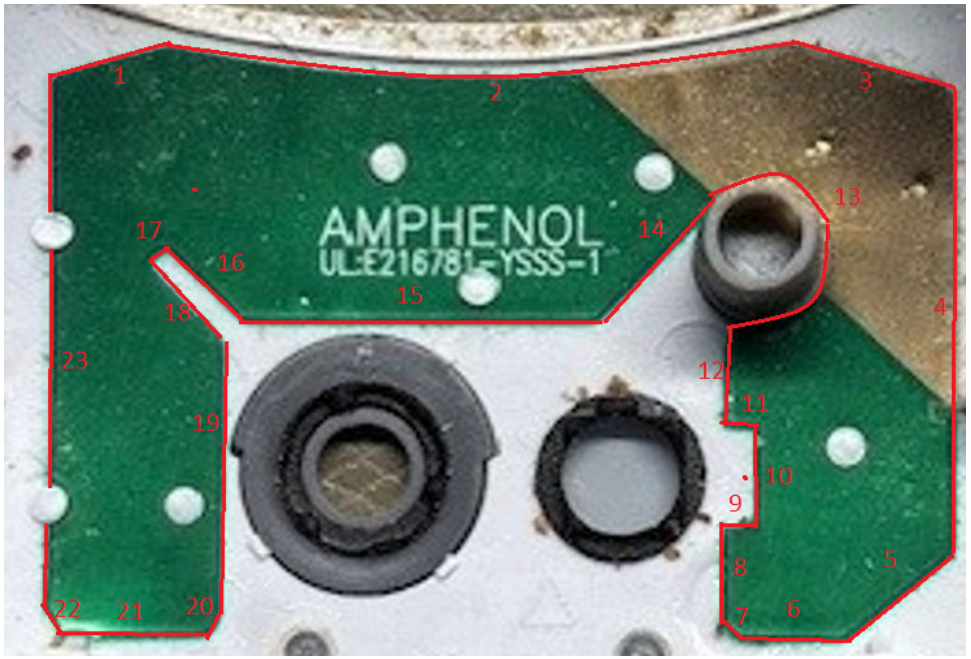
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Claim No.	U.S. Patent No. 11,031,677 B2	Cingular 8125/HTC Wizard
		 4xD=2.21*4=8.84 L>6(0.55)+5(0.5)+4(.32)+6(.36)>9.24
6[n]	an orthogonal projection of the antenna box along a normal to a face with a largest area of the second antenna defining	Cingular 8125 expressly or inherently discloses this claim element. *See* Claim 6[m].
6[o]	an antenna rectangle,	Cingular 8125 expressly or inherently discloses this claim element.

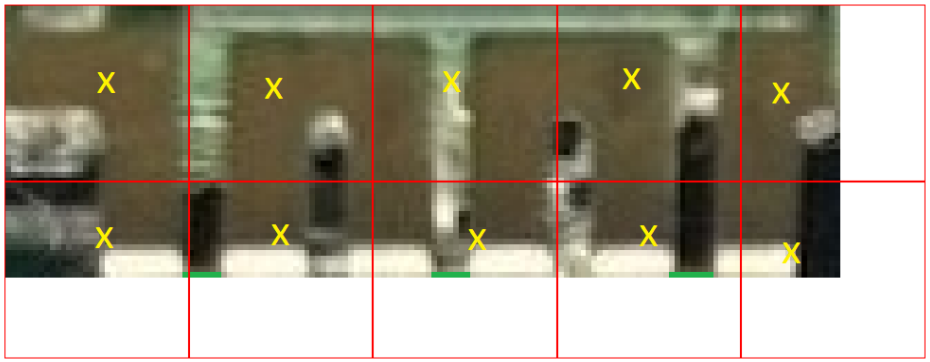
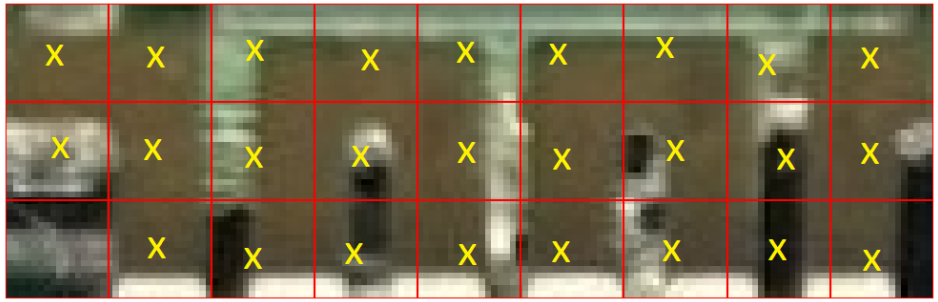
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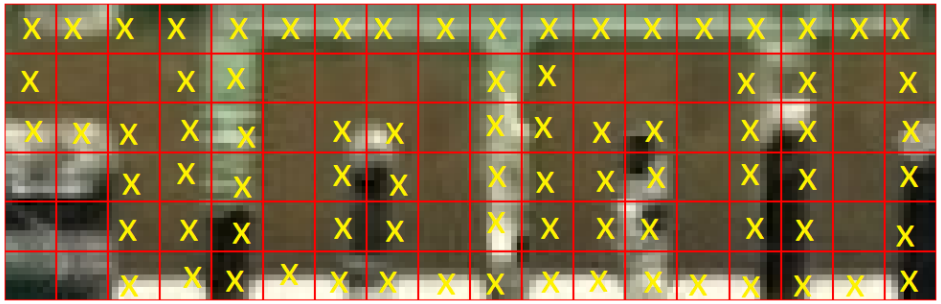
Claim No.	U.S. Patent No. 11,031,677 B2	Cingular 8125/HTC Wizard
		See Claim 6[m].
6[p]	wherein a length of the second antenna contour is greater than four times a diagonal of the antenna rectangle.	Cingular 8125 expressly or inherently discloses this claim element. *See* Claim 6[m].
Claim 7		
7	The wireless device of claim 6, wherein the first antenna contour comprises at least 20 segments.	Cingular 8125 expressly or inherently discloses this claim element. *See, e.g.*, The first antenna contour of the Cingular 8125 has at least 23 segments.

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Claim No.	U.S. Patent No. 11,031,677 B2	Cingular 8125/HTC Wizard
		
Claim 9		
9[a]	The wireless device of claim 6, wherein the second antenna contour has a level of complexity defined by complexity factor F_{21}	Cingular 8125 expressly or inherently discloses this claim element. *See, e.g.*, The complexity factor calculation is performed according to the method in the patent.

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Claim No.	U.S. Patent No. 11,031,677 B2	Cingular 8125/HTC Wizard
	having a value of at least 1.2 and	The second antenna contour of the second antenna of the Cingular 8125 has a level of complexity defined by complexity factor F21 having a value of at least 1.2 and a complexity factor F32 having a value of at least 1.35. N1=10  N2=26  N3=80

Claim No.	U.S. Patent No. 11,031,677 B2	Cingular 8125/HTC Wizard
		 F21=log(26/10)/log(2)=1.38 F32=log(80/26)/log(2)=1.62
9[b]	a complexity factor F_{32} having a value of at least 1.35.	Cingular 8125 expressly or inherently discloses this claim element. *See* claim 9[a].
	Claim 12	
12[pre]	A wireless device comprising:	To the extent the preamble is limiting, Cingular 8125 expressly or inherently discloses this claim element. *See, e.g.*, The Cingular 8125 is a wireless device.

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Claim No.	U.S. Patent No. 11,031,677 B2	Cingular 8125/HTC Wizard
		 *See* Cingular Website; archived on February 15, 2006 at: https://web.archive.org/web/20060215183508/http://www.cingular.com/8125_consumer (last accessed June 11, 2025).
12[a]	an antenna system comprising:	Cingular 8125 expressly or inherently discloses this claim element. *See, e.g.*,

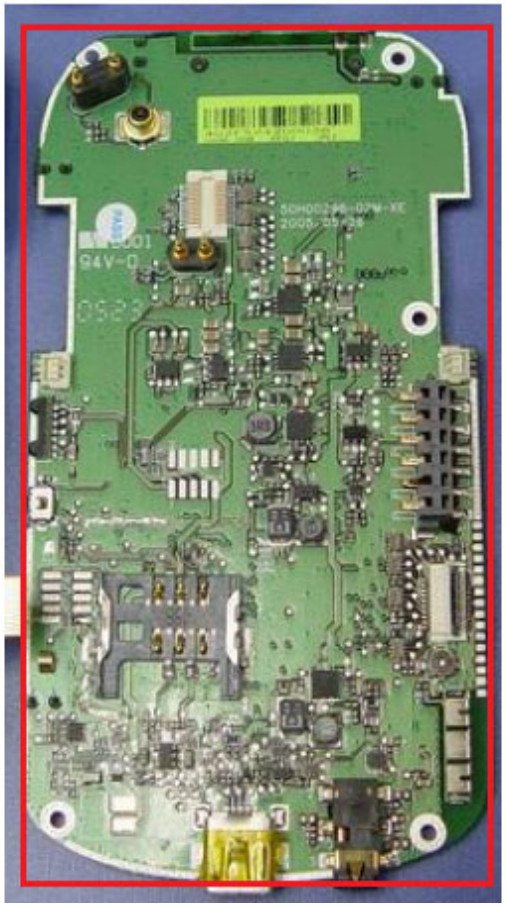
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Claim No.	U.S. Patent No. 11,031,677 B2	Cingular 8125/HTC Wizard
		The Cingular 8125 has an antenna system including a ground plane. 

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Claim No.	U.S. Patent No. 11,031,677 B2	Cingular 8125/HTC Wizard
		

Claim No.	U.S. Patent No. 11,031,677 B2	Cingular 8125/HTC Wizard
		

Claim No.	U.S. Patent No. 11,031,677 B2	Cingular 8125/HTC Wizard
		 *See* FCC Internal Photos at 5 (annotated).

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Claim No.	U.S. Patent No. 11,031,677 B2	Cingular 8125/HTC Wizard
12[b]	[*the antenna system comprising*] a ground plane;	Cingular 8125 expressly or inherently discloses this claim element. *See* Claim 12[a].
12[c]	[*the antenna system comprising*] a first antenna within the wireless device and	Cingular 8125 expressly or inherently discloses this claim element. *See, e.g.*, The antenna system of the Cingular 8125 includes a first antenna within the wireless device, which is a cellular antenna. 

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Claim No.	U.S. Patent No. 11,031,677 B2	Cingular 8125/HTC Wizard
		
12[d]	configured to provide operation in at least four frequency bands,	Cingular 8125 expressly or inherently discloses this claim element. *See, e.g.*, The first antenna of the Cingular 8125 is configured to support at least four frequency bands, at least one of the at least four frequency bands is contained within a first frequency range and at least one other of the four frequency bands is contained within a second frequency range, the first frequency range being lower in frequency than the second frequency range,

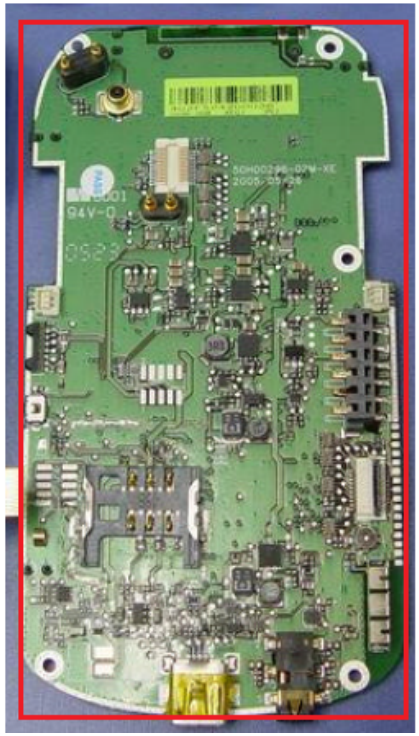
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Claim No.	U.S. Patent No. 11,031,677 B2	Cingular 8125/HTC Wizard
		Quad-band GSM/GPRS/EDGE 850/900/1800/1900 MHz for enhanced global use *See* Cingular Website; archived on February 15, 2006 at: https://web.archive.org/web/20060215183508/http://www.cingular.com/8125_consumer (last accessed June 11, 2025).
12[e]	at least one of the at least four frequency bands is contained within a first frequency range and	Cingular 8125 expressly or inherently discloses this claim element. *See* Claim 12[d].
12[f]	at least one other of the four frequency bands is contained within a second frequency range,	Cingular 8125 expressly or inherently discloses this claim element. *See* Claim 12[d].
12[g]	the first frequency range being lower in frequency than the second frequency range,	Cingular 8125 expressly or inherently discloses this claim element. *See* Claim 12[d].
12[h]	the first antenna being proximate to a first short side of a ground	Cingular 8125 expressly or inherently discloses this claim element.

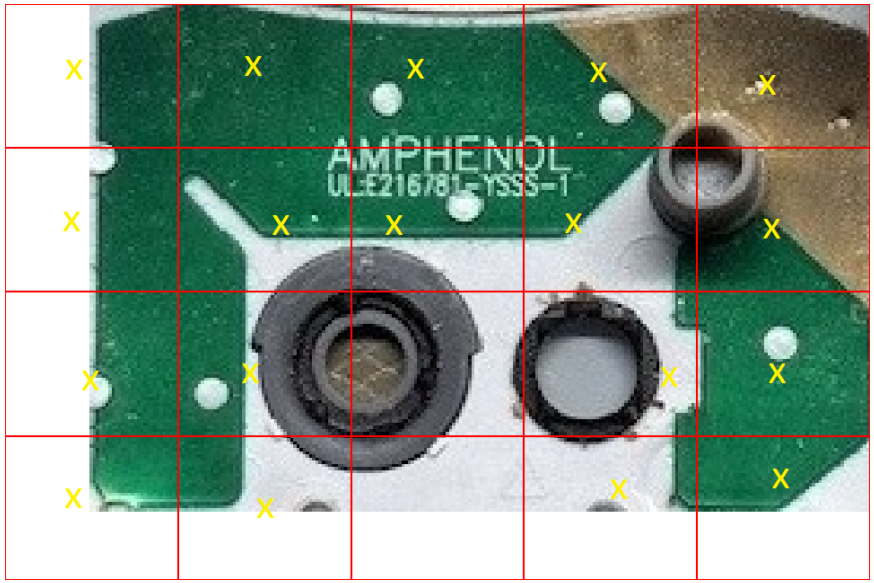
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Claim No.	U.S. Patent No. 11,031,677 B2	Cingular 8125/HTC Wizard
	plane rectangle enclosing the ground plane,	*See, e.g.*, The first antenna of the Cingular 8125 is proximate to a first short side of a ground plane rectangle enclosing the ground plane.  *See* FCC Internal Photos at 4.

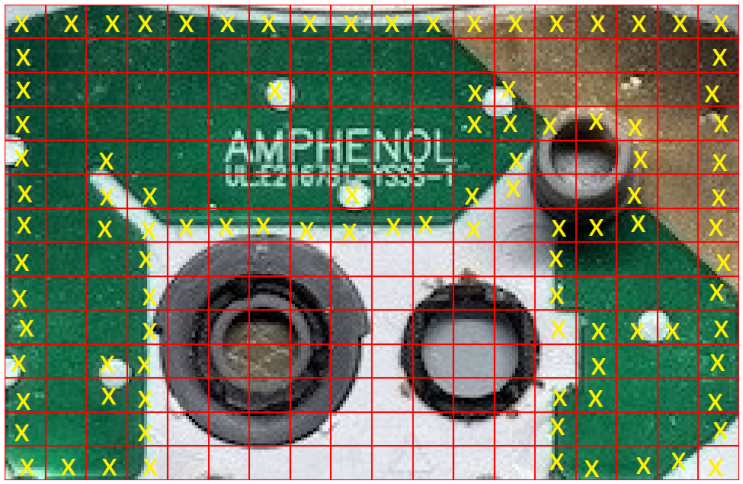
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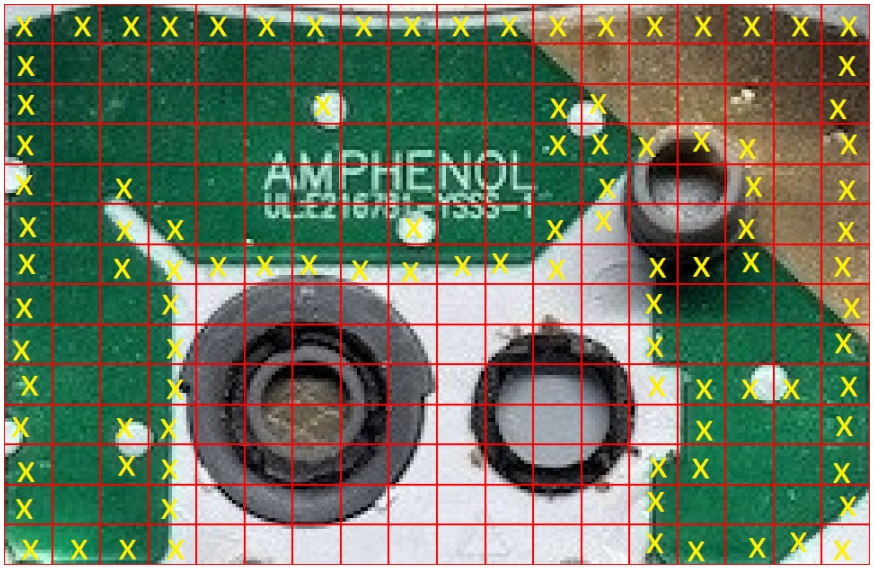
Claim No.	U.S. Patent No. 11,031,677 B2	Cingular 8125/HTC Wizard
		First Short Side  *See* FCC Internal Photos at 5 (annotated).
12[i]	the first antenna defining a first antenna contour comprising an	Cingular 8125 expressly or inherently discloses this claim element. *See, e.g.*,

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Claim No.	U.S. Patent No. 11,031,677 B2	Cingular 8125/HTC Wizard
	entire perimeter of the first antenna, and	The complexity factor calculation is performed according to the method in the patent. The first antenna of the Cingular 8125 defines a first antenna contour comprising an entire perimeter of the first antenna, wherein the first antenna contour has a level of complexity defined by complexity factor F21 having a value of at least 1.20 and complexity factor F32 having a value less than 1.75. N1=18  N2=46

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Claim No.	U.S. Patent No. 11,031,677 B2	Cingular 8125/HTC Wizard
		 N3=98

Claim No.	U.S. Patent No. 11,031,677 B2	Cingular 8125/HTC Wizard
		 F21=log(46/18)/log(2)=1.35 F32=log(98/46)/log(2)=1.09
12[j]	wherein the first antenna contour has a level of complexity defined by complexity factor F_{21} having a value of at least 1.20 and	Cingular 8125 expressly or inherently discloses this claim element. *See* Claim 12[i].

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Claim No.	U.S. Patent No. 11,031,677 B2	Cingular 8125/HTC Wizard
12[k]	complexity factor F_{32} having a value less than 1.75; and	Cingular 8125 expressly or inherently discloses this claim element. *See* Claim 12[i].
12[l]	wherein the first antenna is configured to transmit and receive signals from a 4G communication standard; and	Cingular 8125 expressly or inherently discloses this claim element. *See, e.g.*, The first antenna of the Cingular 8125 is configured to transmit and receive signals from a 4G communication standard.
12[m]	[*the antenna system comprising*] a second antenna within the wireless device and configured to receive signals from a 4G communication standard,	Cingular 8125 expressly or inherently discloses this claim element. *See, e.g.*, The Cingular 8125 includes a second antenna within the wireless device, which is a WLAN antenna. The second antenna of the Cingular 8125 is configured to receive signals from a 4G communication standard.

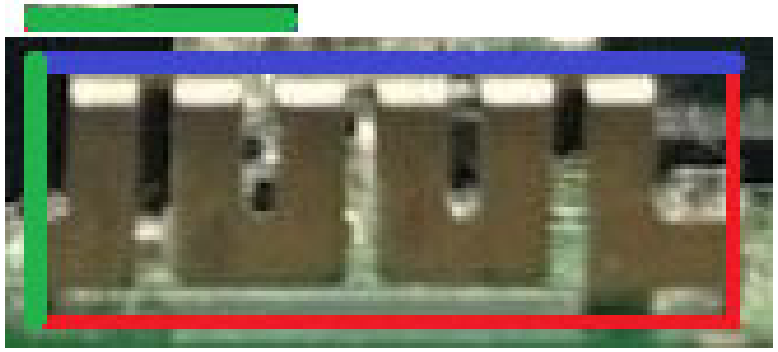
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Claim No.	U.S. Patent No. 11,031,677 B2	Cingular 8125/HTC Wizard
		 Integrated 802.11b support *See* Cingular Website; archived on February 15, 2006 at: https://web.archive.org/web/20060215183508/http://www.cingular.com/8125_consumer (last accessed June 11, 2025).
12[n]	a minimum-sized parallelepiped of rectangular faces that	Cingular 8125 expressly or inherently discloses this claim element. *See, e.g.*,

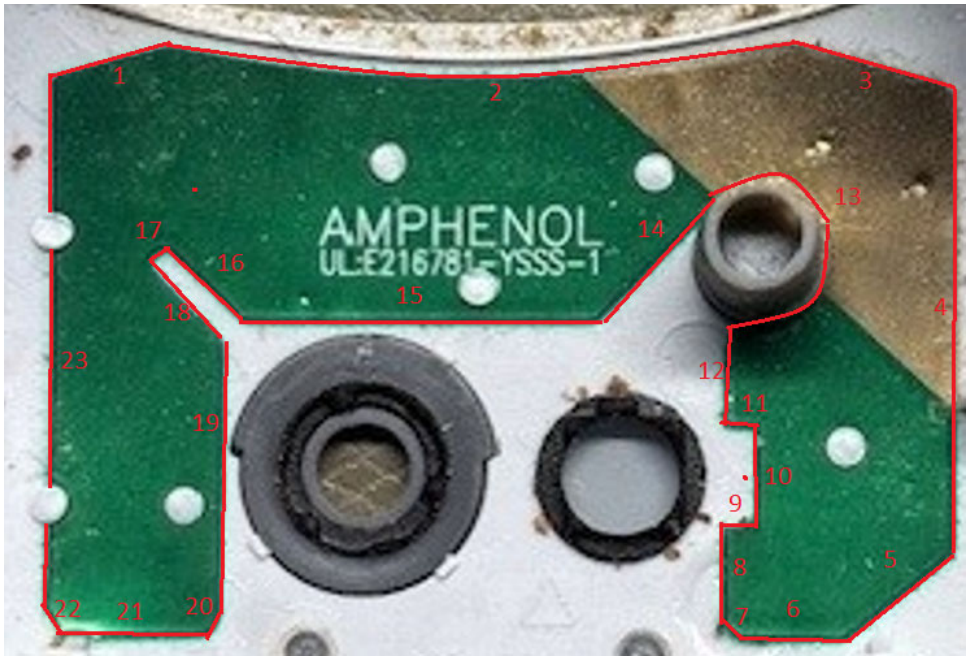
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Claim No.	U.S. Patent No. 11,031,677 B2	Cingular 8125/HTC Wizard
	completely encloses a volume of the second antenna defining an antenna box,	In the Cingular 8125, a minimum-sized parallelepiped of rectangular faces that completely encloses a volume of the second antenna defines an antenna box, and an orthogonal projection of the antenna box along a normal to a face with a largest area of the second antenna defines an antenna rectangle. 
12[o]	an orthogonal projection of the antenna box along a normal to a face with a largest area of the second antenna defining	Cingular 8125 expressly or inherently discloses this claim element. *See* Claim 12[n].
12[p]	an antenna rectangle,	Cingular 8125 expressly or inherently discloses this claim element. *See* Claim 12[n].
12[q]	an aspect ratio of the antenna rectangle	Cingular 8125 expressly or inherently discloses this claim element.

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Claim No.	U.S. Patent No. 11,031,677 B2	Cingular 8125/HTC Wizard
	being defined as a ratio between a width and a height of the antenna rectangle, and wherein the aspect ratio has a value of at least 2.	*See, e.g.*, In the Cingular 8125, an aspect ratio of the antenna rectangle of the second antenna is defined as a ratio between a width and a height of the antenna rectangle, and wherein the aspect ratio has a value of at least 2.  A width (blue above) of the antenna rectangle is more than twice a height (green above) of the antenna rectangle, and thus the aspect ratio has a value of at least 2.
Claim 13		
13	The wireless device of claim 12, wherein the first antenna contour comprises at least 20 segments.	Cingular 8125 expressly or inherently discloses this claim element. *See, e.g.*, The first antenna contour of the Cingular 8125 has at least 23 segments.

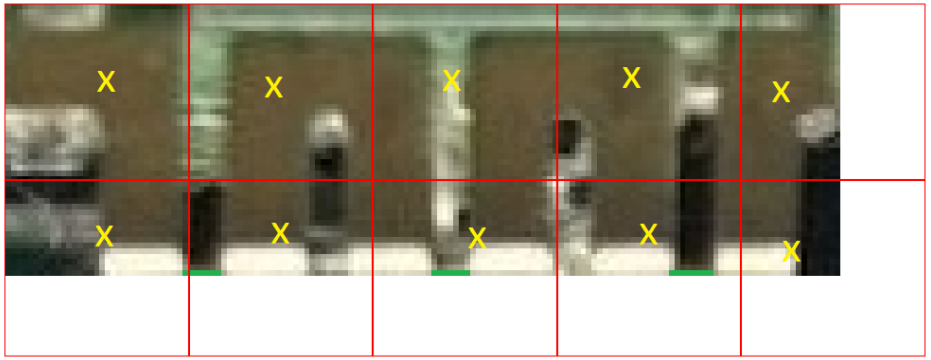
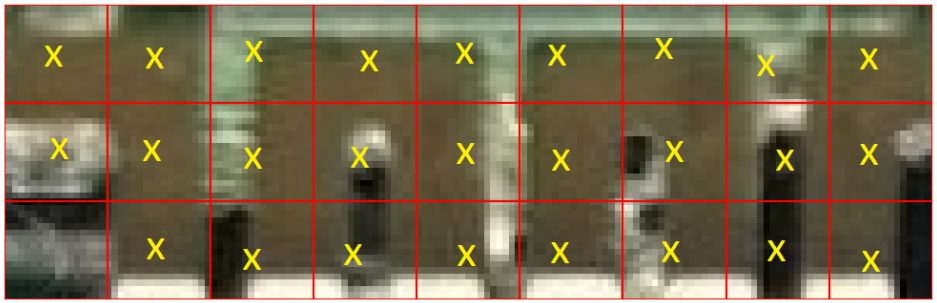
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Claim No.	U.S. Patent No. 11,031,677 B2	Cingular 8125/HTC Wizard
		
Claim 15		
15	The wireless device of claim 12, wherein the second antenna is proximate to a second short side of the ground plane rectangle that is opposite to the	Cingular 8125 expressly or inherently discloses this claim element. *See, e.g.*, The second antenna of the Cingular 8125 is proximate to a second short side of the ground plane rectangle that is opposite to the first short side of the ground plane rectangle.

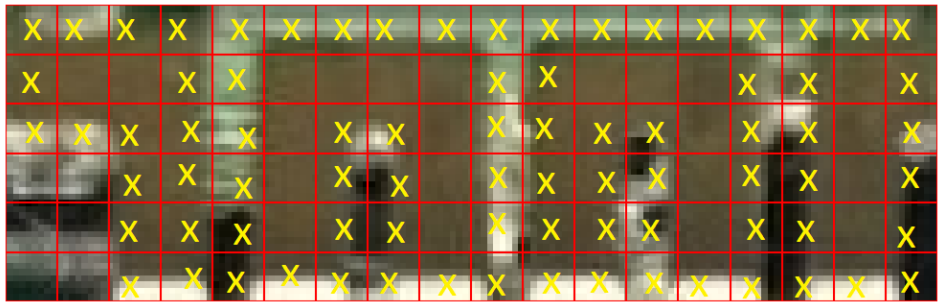
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Claim No.	U.S. Patent No. 11,031,677 B2	Cingular 8125/HTC Wizard
	first short side of the ground plane rectangle.	First Short Side  Second Short Side *See* FCC Internal Photos at 5 (annotated).
		Claim 16
16[a]	The wireless device of claim 12, wherein the second antenna defines a second antenna contour comprising an	Cingular 8125 expressly or inherently discloses this claim element. *See, e.g.*,

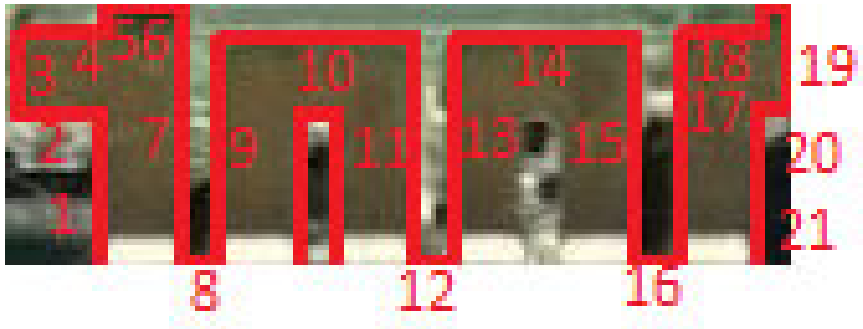
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Claim No.	U.S. Patent No. 11,031,677 B2	Cingular 8125/HTC Wizard
	entire perimeter of the second antenna,	The complexity factor calculation is performed according to the method in the patent. The second antenna contour of the Cingular 8125 defines a second antenna comprising an entire perimeter of the second antenna, and the second antenna contour has a level of complexity defined by complexity factor F21 having a value of at least 1.2 and a complexity factor F32 having a value of at least 1.35. N1=10  N2=26 

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Claim No.	U.S. Patent No. 11,031,677 B2	Cingular 8125/HTC Wizard
		N3=80  F21=log(26/10)/log(2)=1.38 F32=log(80/26)/log(2)=1.62
16[b]	and wherein the second antenna contour has a level of complexity defined by complexity factor F_{21} having a value of at least 1.2 and	Cingular 8125 expressly or inherently discloses this claim element. *See* Claim 16[a].
16[c]	a complexity factor F_{32} having a value of at least 1.35.	Cingular 8125 expressly or inherently discloses this claim element. *See* Claim 16[a].

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Claim No.	U.S. Patent No. 11,031,677 B2	Cingular 8125/HTC Wizard
		Claim 17
17	The wireless device of claim 16, wherein the second antenna contour comprises at least 20 segments.	Cingular 8125 expressly or inherently discloses this claim element. *See, e.g.*, The second antenna contour of the second antenna of the Cingular 8125 has at least 20 segments.  The second antenna contour of the second antenna of the Cingular 8125 has at least 21 segments.

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INVALIDITY CONTENTIONS FOR U.S. PATENT NO. 11,031,677 B2 BASED ON U.S. PATENT APP. PUB. NO. 2007/0200773 ("DOU")

Based upon Plaintiff's Complaint, Infringement Contentions, and apparent claim constructions and application of the claims to Defendants' accused products, as best as they can be deciphered, the reference charted below anticipates or at least renders obvious certain of the asserted claims. These invalidity contentions are not an admission by the Defendants that the accused products are covered by or infringe claims 1, 2, 3, 4, 5, 6, 7, 8, 9, 12, 13, 14, 15, 16, and 17 ("the '677 Asserted Claims")[1], particularly when these claims are properly construed and applied.

AIA law applies because the application that issued as the '677 Patent was filed on March 27, 2020, after the AIA came into force on March 16, 2013.

U.S. Patent Application Publication No. 2007/0200773 to Dou et al. ("Dou") was filed on February 24, 2006 and published on August 30, 2007. This patent is prior art under at least pre-AIA 35 U.S.C. § 102(a) or (b), (e), and/or (g)(2), or AIA 35 U.S.C. § 102(a). As described in the following claim chart, the asserted claims of U.S. Patent No. 11,031,677 (the "'677 Patent"), are invalid as anticipated by Dou.

To the extent that Dou is found not to anticipate one or more of the asserted claims of the '677 Patent, these claims are invalid as obvious in view of Dou alone or as modified in view of or in combination with other prior art references disclosed in Defendants' Invalidity Contentions and accompanying charts, including without limitation as set forth below.

- P. Ciais, R. Staraj, G. Kossiavas, and C. Luxey. "Design of an Internal Quad-Band Antenna for Mobile Phones," IEEE Microwave and Wireless Components Letters, vol. 14, no. 4, pp. 148-150, April 2004 ("Ciais-Quadband")
- H. Nakano, Y. Sato, H. Mimaki and J. Yamauchi. "An Inverted FL Antenna for Dual-Frequency Operation," IEEE Transactions on Antennas and Propagation, vol. 53, no. 8, pp. 2417-2421, Aug. 2005 ("Nakano")

These invalidity contentions are not an admission that the Defendants concede or acquiesce to any claim construction implied or suggested by Plaintiff's Complaint or Infringement Contentions. Nor are Defendants asserting any claim construction positions through these charts, including whether the preamble is a limitation. The portions of the prior art reference cited below are not exhaustive but are exemplary in nature. Defendants reserve the right to update their constructions and contentions in view of this Court's claim construction order.[2]

[1] Defendants understand that that, by not charting claims 10-11 and 18-20 in its Infringement Contentions, Plaintiff does not assert these claims against Defendants.
[2] Defendants incorporate herein any related work performed by or on behalf of an author or an inventor in the United States under 35 U.S.C. § 102(g)(2). Defendants reserve the right to supplement and/or alter this chart based on further investigation and ongoing discovery.

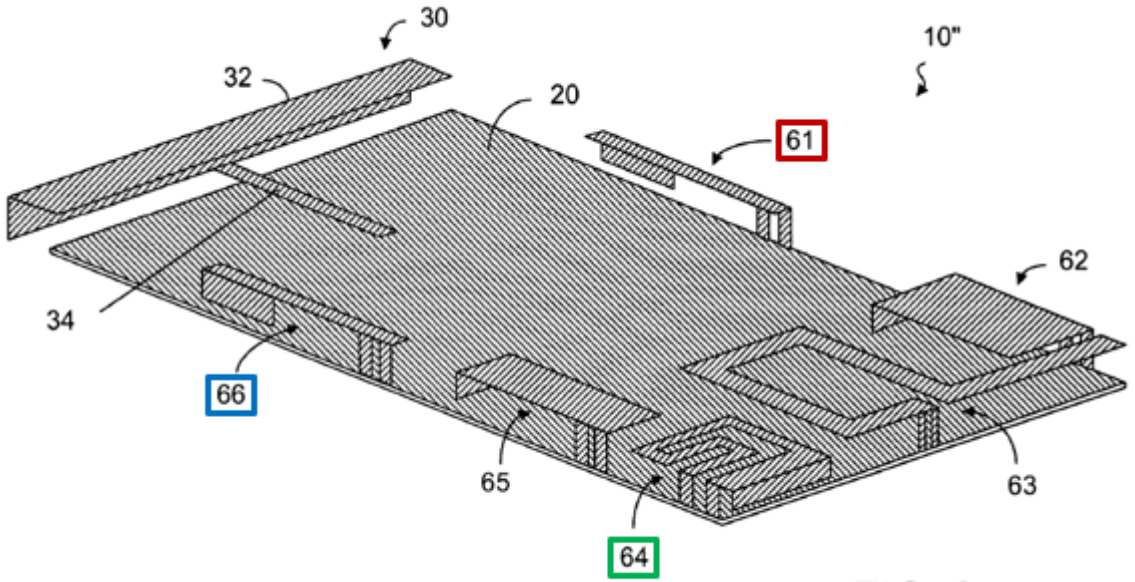
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Claim No.	U.S. Patent No. 11,031,677 B2	Dou
Claim 1		
1[pre]	A wireless device comprising:	To the extent the preamble is limiting, Dou expressly or inherently discloses this claim element. *See, e.g.*, Dou describes a wireless device comprising, e.g., a handheld computer, mobile telephone, or PDA. Dou, [0015]-[0016], [0031], claim 1.
1[a]	an antenna system comprising:	Dou expressly or inherently discloses this claim element. To the extent that this reference does not expressly disclose this claim limitation, in light of Plaintiff's apparent claim construction and infringement positions with respect to the Accused Products, a POSITA would have understood it to implicitly disclose it or would have found the claim limitation obvious. ***See, e.g.*, Ciais:** While Dou describes a wireless handheld device having internally-mounted antennas, it does not describe particular antennas for implementing its wireless devices and Dou leaves the antenna selection to a POSA. A POSA had reasons to implement each of Dou's first antenna 206 and second antenna 208, as shown in Dou Figures 2A-2B, as a Ciais quadband antenna. Ciais's quadband antenna was designed for internal use in mobile phones, making it suitable for use as Dou's "internal antenna" 206 and 208 "disposed within… housing 202 of the wireless device 200." Dou,

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Claim No.	U.S. Patent No. 11,031,677 B2	Dou
		[0018]; Ciais-Quadband, 148, 150; Ciais's quadband antenna is a planar inverted-F antenna (PIFA) (Ciais-Quadband, Abstract), which Dou describes using for the first and second antennas. Dou, [0028]. Ciais's quadband antenna provided operation at 870-960 MHz and 1710-2170 MHz, each of which used well-known communication standards (GSM, DCS, PCS, UMTS), making the antenna "suitable for mobile phone applications" like Dou's wireless device. Ciais-Quadband, 148, 150; Dou, [0022] (describing exemplary coverage for GSM, PCS, and "WCDMA/UMTS" operations). Dou describes its wireless device having "three or more antennas" that "may comprise any suitable type of internal antenna" (Dou, [0040]), and describes the wireless device having an antenna covering frequencies for GPS (1575 MHz) or WiFi or Bluetooth (ISM 2.4 GHz). Dou, [0022]. A POSA would have had reasons to include a GPS antenna and an antenna supporting WiFi and Bluetooth to provide the services that Dou describes, in frequency ranges Ciais's quadband antenna did not cover. The resulting combination has four antennas: antennas 206 and 208, a GPS antenna, and a 2.4 GHz antenna for WiFi/Bluetooth. Providing GPS and WiFi/Bluetooth antennas in a mobile device was conventional. U.S. Patent Publication No. 2006/0214857 ("Ollikainen"), Fig. 9 (below), [0044] (GPS antenna 64, WLAN antenna 61, Bluetooth antenna 66).

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Claim No.	U.S. Patent No. 11,031,677 B2	Dou
		 FIG. 9 Implementing Dou's wireless device with Dou's first antenna 206 and second antenna 208 each provided by a separate Ciais quadband antenna would have been nothing more than combining familiar elements according to known methods with predictable results, and been no more than the "predictable use of prior art elements according to their established functions." KSR Int'l v. Teleflex, 550 U.S. 398, 416-417 (2007). The same is true of adding an antenna for GPS and another for WiFi and Bluetooth to Dou's device to provide the multiband coverage that Dou describes. A POSA would have had a reasonable expectation of success in using Ciais's quadband antenna in Dou's wireless device because Ciais designed the quadband antenna for internal

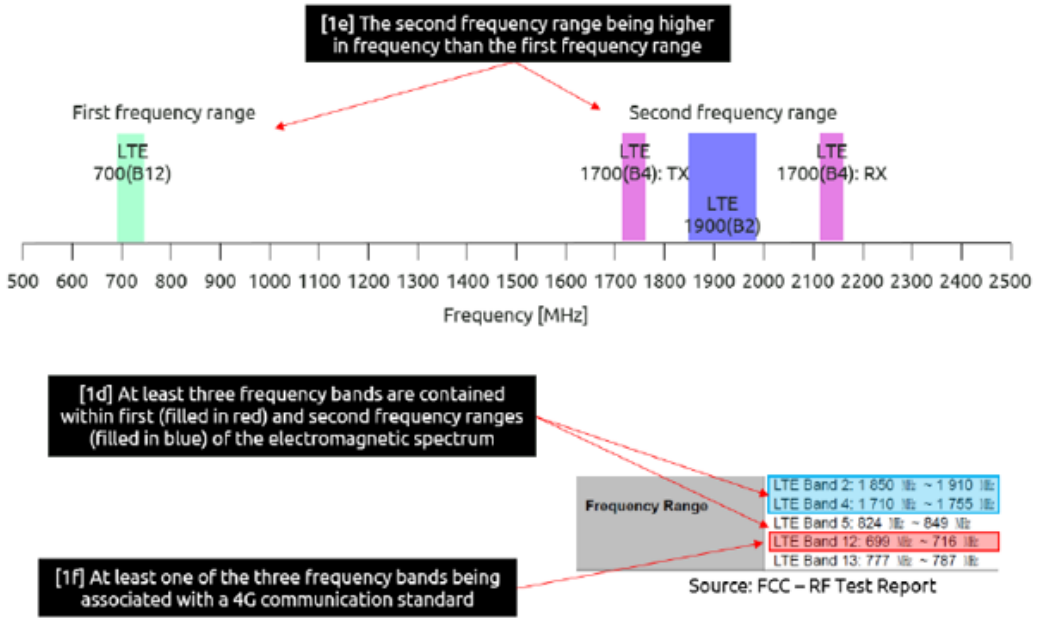
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Claim No.	U.S. Patent No. 11,031,677 B2	Dou
		use in cellular telephones (Ciais-Quadband, 148, 150), and Dou expressly contemplates using a multiband PIFA antenna—like the Ciais quadband antenna—as its first and second internal antennas (e.g., Dou, [0028]-[0029]). Dou describes antenna placement within the device according to "various performance and design constraints" known to a POSA. Dou, [0030]. Ciais describes placing the quadband antenna at the end of a PCB "on the corner of a ground plane" where Dou places its antennas 206 and 208. Ciais-Quadband, Fig. 1, 148; Dou, Figs. 2A-2B, [0029]. It was well within the POSA's ordinary skill to implement Dou's wireless device with Ciais's quadband antenna, and the resulting antenna operation was predictable. Dou, [0012], [0063]. A POSA also would have had a reasonable expectation of success including an antenna covering GPS and another covering WiFi and Bluetooth in Dou's wireless device—as Dou describes—because it was conventional (Ollikainen, [0044]), Dou explains that "the antenna architecture may comprise three or more antennas" (Dou, [0040]), and Dou specifically describes the wireless device having coverage including for GPS, WiFi, and Bluetooth (Dou, [0022]). This combination of Dou in view of Ciais-Quadband (hereinafter "Dou+Ciais-Quadband") meets the asserted claims as shown below. Additionally, it would have been obvious to a person of ordinary skill in the art to modify this reference with any one or more of the references disclosed in Defendants' Invalidity Contentions based on knowledge of one of ordinary skill in the art and for the reasons articulated in Defendants' Invalidity Contentions Cover Pleading. Dou's antenna system, with Ciais's quadband antenna implementing Dou's antenna 206 and 208, meets Limitations 1[a]-1[k] as shown below. Dou, [0014], [0017] ("internal diversity antenna architecture comprising a first antenna 206 and a second antenna 208 disposed on… PCB 204").

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Claim No.	U.S. Patent No. 11,031,677 B2	Dou
1[b]	[*the antenna system comprising*] a ground plane;	Dou expressly or inherently discloses this claim element. *See, e.g.*, Dou+Ciais-Quadband meets 1[b] because it Dou's ground plane 210 to implement Ciais's ground plane teaching. Dou, Fig. 2B, [0029]; Ciais-Quadband, 148, 150, Fig. 1(a).
1[c]	[*the antenna system comprising*] a first antenna within the wireless device and	Dou expressly or inherently discloses this claim element. *See, e.g.*, The plain meaning of "at least three frequency bands contained within the first and second frequency ranges" is that the first and second frequency ranges together contain within them "at least three frequency bands." This is also how Fractus construes the language in its litigation arguments. D.I. 1, Complaint, Fractus, S.A., v. Geotab Inc., No. 2:24-cv-01008 (E.D. Tex. Dec. 6, 2024), 21 (detail below).

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Claim No.	U.S. Patent No. 11,031,677 B2	Dou
		 Dou+Ciais-Quadband meets 1[c] because it implements Dou's antenna 206, within the wireless device housing, using Ciais's quadband antenna ("first antenna"). Dou, [0017]. Ciais's quadband antenna covers—i.e., is capable of sending and receiving electromagnetic radiation at ("configured to support")—870-960 MHz and 1710-2170 MHz (e.g., "first and second frequency ranges of the electromagnetic spectrum"). Ciais-Quadband, Fig. 3, 148-150. A POSA understood that a "frequency band" is a frequency range specified by a regulatory or standards body for a particular use, such as a type of wireless communication. Ciais's quadband antenna supports "frequency bands" that are contained within the antenna's

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<table>
<tr><th>Claim No.</th><th>U.S. Patent No. 11,031,677 B2</th><th>Dou</th></tr>
<tr><td></td><td></td><td>
supported frequency ranges. Although Ciais describes its antenna as “quad-band” (Ciais-Quadband, 148), the antenna is “configured to support” at least twenty-five (25) frequency bands “contained within” the frequency ranges it supports.

The 870-960 MHz range (“first frequency range”) contains at least four “frequency bands” shown in Table 1.

Table 1: Frequency bands within 870-960 MHz.

<table>
<tr><th>Band</th><th>Range (MHz)</th></tr>
<tr><td>standard GSM900</td><td>890-960</td></tr>
<tr><td>extended GSM900</td><td>880-960</td></tr>
<tr><td>ISM</td><td>902-928</td></tr>
<tr><td>LTE Band 8</td><td>880-960</td></tr>
</table>

ETSI TS 145 005 V4.3.0 (2001-14) Technical Specification: Digital cellular telecommunications system (Phase 2+); Radio transmission and reception (3GPP TS 45.005 version 4.3.0 Release 4), 8-9 (“Standard or primary” and “Extended” “GSM 900 band”); ’677 Patent, 10:14-23 (discussing ISM 902-928 MHz); 3GPP TS 36.101 v8.4.0 (2008-12) Technical Specification: 3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception (Release 8), 2008, 13, Table 5.5-1 (“E-UTRA operating bands”); Ericsson white paper, “LTE—an introduction,” no. 284 23-3124 Uen Rev B (June 2009), 11 (listing LTE FDD and TDD bands); Pages from E. Dahlman et al., 3G Evolution: HSPA and LTE for Mobile Broadband (Academic Press 2d ed. 2008), 497-501 (“Dahlman”).
</td></tr>
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