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NEW CONTINUING PATENT APPLICATION UNDER 37 C.F.R. §1.53(b)

APPLICATION TITLE:

MULTIPLE-BODY-CONFIGURATION MULTIMEDIA AND SMARTPHONE MULTIFUNCTION WIRELESS DEVICES

FIRST NAMED INVENTOR:

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ATTORNEY DOCKET NO.:

0690.0023CN4

ENCLOSED ARE THE FOLLOWING **APPLICATION PARTS**:

☒ Specification (pages 1 to 64);

☒ Claims (pages 65 to 69)

20 total claims; 2 independent claim(s)

☒ Abstract (page 70);

☒ 29 Sheets of Drawings including Figures 1A, 1B, 2A, 2B, 3, 4, 5A-5C, 6A-6C, 7, 8A-8C, 9A-9C, 10A-10C, 11, 12A, 12B, 13A-13C, 14A-14C, 15, 16, 17A-17H, 18, 19A, 19B, 20A-20F

☒ Application Data Sheet (Form PTO/AIA/14)

☒ Executed Declaration

- ☐ A newly executed Declaration is attached
- ☒ A copy of the Declaration from U.S. Application No. 14/246,491 is attached

☒ Executed Power of Attorney

ALSO ENCLOSED ARE THE FOLLOWING **APPLICATION PAPERS**:

☒ Information Disclosure Statement (Form PTO/SB08a) and IDS Transmittal Letter

☐ Foreign Patent Documents or Abstract

☐ Non-Patent Literature (NPL) Documents

☐ Preliminary Amendment

☐ Nonpublication Request and Certification under 35 U.S.C. 122(b)(2)(B)(i)

☐ Other:

INFORMATION RELATING TO DOMESTIC AND FOREIGN **PRIORITY**

☒ Domestic and/or Foreign Priority are provided on the Application Data Sheet or in the Specification.

☐ This application is a

- ☒ Continuation
- ☐ Divisional
- ☐ Continuation-in-Part

of pending Patent U.S. Nonprovisional Application No. 15/856,626

DELETION OF INVENTORS

☐ This continuation or divisional application is being filed by less than all the inventors named in the prior application. In accordance with 37 C.F.R. §1.63(d)(2), the Director is requested to delete the name(s) of the following person or persons who are not inventors of the invention being claimed in this application:

Delete Inventor:

Delete Inventor:

THE **FEES** HAVE BEEN CALCULATED AS FOLLOWS:

Basic Utility Application Fees: Filing Fee ($300 LE; $75 if SE filing electronically; $75 if Micro Entity) Examination Fee ($760/$380/$190) Search Fee ($660/$330/$165) **Subtotal**					 $300.00 $760.00 $660.00 **$1720.00**
Number of Total Claims Over 20	→ **0**	**$100** (Large Entity) **$50** (Small Entity) **$25** (Micro Entity)	x $		$0.00
Number of Independent Claims over 3	→ **0**	**$460** (Large Entity) **$230** (Small Entity) **$115** (Micro Entity)	x $		$0.00
Surcharge for late filing fee, search fee, examination fee or Oath or Declaration ($160/$80/$40)					$160.00
Other fees (e.g., late filing of English translation; # of pages >100, etc.):					$
TOTAL FEE DUE					$1880.00

☐ **Applicant is entitled to Small Entity Status**

☐ **Applicant is entitled to Micro Entity Status**

☒ This application is being filed **without** a filing fee. Issuance of a Notice to File Missing Parts of Application is respectfully requested.

☐ Credit card payment has been submitted concurrently with the filing of this transmittal. The Director is hereby authorized to treat any concurrent or future reply, requiring a petition for an extension of time under this paragraph for its timely submission, as incorporating a petition for extension of time for the appropriate length of time. In addition, the Director is hereby authorized to charge any additional appropriate fees that may be required during the pendency of the above-identified application (e.g., in the concurrent or in any future reply), as well as to credit any overpayment, to Deposit Account No. **05-0460**.

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MULTIPLE-BODY-CONFIGURATION MULTIMEDIA AND SMARTPHONE MULTIFUNCTION WIRELESS DEVICES

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is a continuation of U.S. Patent Application No. 15/856,626 filed December 28, 2017, which is a continuation of U.S. Patent Application No. 14/738,090 filed June 12, 2015, which is now U.S. Patent No. 9,899,727, issued on February 20, 2018, which is a continuation of U.S. Patent Application No. 14/246,491 filed April 7, 2014, which is now U.S. Patent No. 9,099,773, issued on August 4, 2015, which is a continuation of U.S. Patent Application No. 11/614,429 filed December 21, 2006, which is now U.S. Patent No. 8,738,103, issued on May 27, 2014, which claims the benefit of U.S. Provisional Application No. 60/831,544, filed on July 18, 2006, and claims the benefit of U.S. Provisional Application No. 60/856,410, filed on November 3, 2006, the entire contents of which are hereby incorporated by reference. This patent application further claims priority from, and incorporates by reference the entire disclosure of European Patent Application No. EP 06117352.2, filed July 18, 2006.

FIELD OF THE INVENTION

[0002] The present invention relates to a multifunction wireless device (MFWD), and, more particularly, but not by way of limitation, to a multifunction wireless device and antenna designs thereof combining into a single unit mobile data and voice services with at least one of multimedia capabilities (multimedia terminal (MMT) and personal computer capabilities, (i.e., smartphone) or with both MMT and smartphone (SMRT) capabilities (MMT+SMRT).

BACKGROUND

[0003] MFWDs are usually individually adapted to specific functions or needs of a certain type of users. In some cases, it may be desirable that the MFWD is either e.g. small while in other cases this is not of importance since e.g. a keyboard or screen is provided by the MFWD which already requires a certain size.

[0004] Many of the demands for modern MFWDs also translate to specific demands for the antennas thereof. For example, one design demand for antennas of multifunctional wireless devices is usually that the antenna be small in order to occupy as little space as possible within the MFWD which then allows for smaller MFWDs or for more specific equipment to provide certain function of the MFWD. At the same time, it is sometimes required for the antenna to be flat since this allows for slim MFWDs or in particular, for MFWDs which have two parts that can be shifted or twisted against each other.

[0005] In the context of the present application, a device is considered to be slim if it has a thickness of less than about 14 mm, 13 mm, 12 mm, 11 mm, 10 mm, 9 mm or 8 mm. A slim MFWD should be mechanically stable, mechanical stability being more difficult to achieve in slim devices.

[0006] Additionally, antennas in some embodiments are required to be multi-band antennas and to cover different frequency bands and/or different communication system bands. Beyond that, some of the bands have to be particularly broad like the UMTS band which has a bandwidth of 12.2%. For a good wireless connection, high gain and efficiency are further required. Other more common design demands for antennas are the voltage standing wave ratio (VSWR) and the impedance which is typically about 50 ohms.

[0007] Furthermore of particular importance, is omni-directional coverage which means that the antenna radiates with a substantially donut-shaped radiation pattern such that e.g. terrestrial base stations of mobile telephone communication systems can be contacted within any direction in the horizontal plane.

[0008] However, for satellite communication (for example, for rece1vmg GPS signals), other radiation patterns are preferred, in particular, those which radiate into the upper hemisphere. Here radiation into the horizontal plane is usually less desired. The polarization of the emitted or received radiation also has to be taken into consideration. Other demands for antennas for modem MFWDs are low cost and a low specific absorption rate (SAR).

[0009] Furthermore, an antenna has to be integrated into a device such as MFWD such that an appropriate antenna may be integrated therein which puts constraints upon the mechanical fit, the electrical fit and the assembly fit of the antenna within the device. Of further importance, usually, is the robustness of the antenna which means that the antenna does not change antenna properties in response to smaller shocks to the device.

[0010] As can be imagined, a simultaneous improvement of all features described above is a major challenge for persons skilled in the art. A typical exemplary design problem is the generally uniform line of thinking that due to the limits of diffraction, a substantial increase in gain and directivity can only be achieved through an increase in the antenna size.

[0011] On the other hand, a MFWD that has a high directivity and hence, a high gain, has to be properly oriented towards a transceiver-base station. This, however, is not always practical since portable device users need to have the freedom to move and change direction with respect to a base station without losing coverage and, therefore, losing the wireless connection. Therefore, less gain is usually accepted in order to obtain an omni-directional (donut-like) radiation pattern.

[0012] It has to be taken into account that a palmtop, laptop, or desktop portable device might require a radiation pattern that enhances radiation in the upper hemisphere, i.e., pointing to the ceiling and the walls rather than pointing to the floor, since transceiver stations such as a hotspot antenna or a base station are typically located above or on the side of the portable device. If, however, such a device is used for a voice phone call it will be held substantially upright close to the user's head in which case an omni-directional pattern is preferred which is oriented so that the donut-like shape of the radiation pattern lies in the horizontal.

[0013] While it might appear desirable to provide an antenna with a uniform radiation pattern (sphere-like) for voice calls such a pattern turns out to have substantial drawbacks in terms of a desired low specific absorption rate since it sometimes leads to an increased absorption of radiation within the hand and the head of the user during a voice phone call.

[0014] In every MFWD, the choice of the antenna, its placement in the device and its interaction with the surrounding elements of the device will have an impact on the overall wireless connection performance making its selection non-trivial and subject to constraints due to particular target use, user and market segments for every device.

[0015] As established by L.J. Chu in "Physical Limitations of Omni-Directional Antennas", Journal of Applied Physics, Vol. 19, Dec, 1948, pg. 1163-1175, and Harold A. Wheeler, in "Fundamental Limitations of Small Antennas", Proceedings of the I.R.E., 1947, pgs. 14 79-1488.

small antennas may not exceed a certain bandwidth. The bandwidth of the antenna decreases in proportion to the volume of the antenna. The bandwidth, however, is proportional to the maximum data rate the wireless connection can achieve and, therefore, a reduction in the antenna size is additionally linked to a reduction in the speed of data transmission.

[0016] Furthermore, a reduction of the antenna size can be achieved, for example, by loading the antenna with high dielectric materials for instance by stuffing, backing, coating, filling, printing or over-molding a conductive antenna element with a high dielectric material. Such materials tend to concentrate a high dielectric and magnetic field intensity into a smaller volume. This concentration leads to a high quality factor which, however, leads to a smaller bandwidth. Further, such a high concentration of electromagnetic field in the material leads to inherent electrical losses. Those losses may be compensated by a higher energy input into the antenna which then leads to a portable wireless device with a reduced standby or talk/connectivity time. In the design of MFWDs, every micro Joule of energy available in the battery has to be used in the most efficient way.

[0017] Multi-band antennas require a certain space since for each band a resonating physical structure is usually required. Such additional resonating physical structures occupy additional space which then increases the size of the antenna. It is therefore particularly difficult to build antennas which are both small and multi-band at the same time.

[0018] As already mentioned above, there exists a fundamental limit established by Chu and Wheeler between the bandwidth and antenna size. Therefore, many small antennas have great difficulty in achieving a desired large bandwidth.

[0019] Broadband operation may be achieved by two closely neighboring bands which then require additional space for the resonating physical structure of each of the bands. Further, those two antenna portions may not be provided too close together since, due to electric coupling between the two elements, the merging of the two bands into a single band is not achieved, but rather splitting the resonant spectrum into independent sub-bands which is not acceptable for meeting the requirements of wireless communication standards.

[0020] Furthermore, for broadband operation the resonating physical structure needs a certain width. This width, however, requires additional space which further shows that small broadband antennas are difficult to achieve.

[0021] It is known to achieve a broadband operation with parasitic elements which, however, require additional space. Such parasitic elements may also not be placed too close to other antenna portions since this will also lead to splitting the resonant spectrum into multiple sub-bands.

[0022] An antenna type which may be particularly suitable for slim multifunctional devices or those composed of two parts which can be moved against each other (such as twist, clamshell or slide devices) is a patch antenna (and particularly a PIF A antenna). However patch antennas, are unfortunately known to have poor gain and narrow bandwidths, typically in the range of 1% to 5% which is unsuitable for coverage of certain bands such as the UMTS band.

[0023] Although it is known that the bandwidth may be increased by changing the separation between the patch and its ground plane, this then destroys the advantage of patch antennas being flat. This also leads to a distortion of the radiating pattern, for instance, due to surface wave effects.

[0024] For patch antennas it is known that by providing a high dielectric material between the patch and the ground plane, it is possible to reduce the antenna size. As mentioned above, such high dielectric materials tend to reduce the bandwidth which is then disadvantageous for patch antennas. Such materials also generally increase losses.

[0025] Further difficulties in antenna design occur when trying to build multi-band antennas. While it is possible to separate different antenna portions from each other with appropriate slots or the like, currents and charges in the respective parts always interact with one another by strong and far-reaching electromagnetic fields. Those different antenna branches are, therefore, never completely independent of one another. Trying to add a new branch to an existing antenna structure to produce a new antenna frequency of resonance therefore changes entirely the previous antenna frequencies. Therefore, it is difficult to simply take a working antenna and try to add one more band by just adding one more antenna portion. All previously achieved optimizations for already established frequency bands are lost by such an approach.

[0026] Trying to design an antenna with three or more bands gives rise to a linear or, in the worst case an exponential, rise in the number of parameters to consider or problems to resolve. For each band, resonant frequency, bandwidth, and other above-mentioned parameters such as impedance, polarization, gain, and directivity must all be controlled simultaneously. Furthermore, multi-band antennas may be coupled with two or more radio frequency devices. Such coupling raises the issue of isolation between the different radio frequency devices, which are both connected to the same antenna. Isolation of this type is a very difficult task.

[0027] Physical changes intended to optimize one parameter of one antenna band change other antenna parameters, most likely in a counter-productive way. It is usually not obvious how to control the counter-productive effects or how to compensate for them without creating still more problems.

[0028] Mechanical considerations must also be taken into account in antenna design. For example, the antenna needs to be firmly held in place within a device. However, the materials that are in very close proximity to the metal piece or the conductive portion which forms an antenna or antenna portion, have a great impact on the antenna characteristics. Sometimes extensions or small recesses in the metal piece are provided to firmly hold the antenna in place, however such means which are intended for giving mechanical robustness to the antenna also interact with and change the electric properties of the antenna.

[0029] All these different design problems of antennas may only be solved in the design of the geometry of the antenna. All parameters such as size, flatness, multi-band operation, broadband operation, gain, efficiency, impedance, radiation patterns, specific absorption rate, robustness and polarization are highly dependent on the geometry of the antenna. Nevertheless, it is practically impossible to identify at least one or two geometric features which affect only one or two of the above-mentioned antenna characteristics. Thus, there is no individual geometry feature which can be identified in order to optimize one or two antenna characteristics, without also influencing all other antenna characteristics.

[0030] Any change to the antenna geometry may harm more than it helps without knowing in advance how and why it happens or how it can be avoided.

[0031] Additionally, every platform of a wireless device is different in terms of form factor, market and technical requirements and functionality which requires different antennas for each device.

[0032] One problem is solved by providing the MFWD with an RF system and an antenna system with the capability of fully functioning in one, two, three or more communication standards (such as e.g. GSM 850, GSM 900, GSM 1800, GSM 1900, UMTS, CDMA, W-CDMA, etc.), and in particular mobile or cellular communication standards, each standard allocated in one or more frequency bands, each of said frequency bands being fully contained within one of the following regions of the electromagnetic spectrum:

the 810MHz - 960MHz region,

the 1710MHz- 1990MHz region,

and the 1900MHz - 2170MHz region

such that the MFWD is able to operate in three, four, five, six or more of said bands contained in at least said three regions.

[0033] One problem to be solved by the present invention is therefore to provide an enhanced wireless connectivity. Another effect of the invention is to provide antenna design parameters that tend to optimize the efficiency of an antenna for a MFWD device while observing the constraints of small device size and enhanced performance characteristics.

SUMMARY

[0034] A multifunction wireless device having at least one of multimedia functionality and smartphone functionality, the multifunction wireless device including an upper body and a lower body, the upper body and the lower body being adapted to move relative to each other in at least one of a clamshell, a slide, and a twist manner. The multifunction wireless device further includes an antenna system disposed within at least one of the upper body and the lower body and having a shape with a level of complexity of an antenna contour defined by complexity factors F_{21} having a value of at least 1.05 and not greater than 1.80 and having a value of at least 1.10 and not greater than 1. 90.

[0035] A multifunction wireless device having at least one of multimedia and smartphone functionality, the multifunction wireless device including a microprocessor and operating system adapted to permit running of word-processing, spreadsheet, and slide software applications, and at least one memory interoperably coupled to the microprocessor, the at least one memory having a total capacity of at least 1 GB. The multifunction wireless device further includes an antenna system having a shape with a level of complexity of an antenna contour defined by complexity factor F_{21} having a value of at least 1.05 and not greater than 1.80 and by complexity factor F_{32} having a value of at least 1.10 and not greater than 1.90.

[0036] A multifunction wireless device having at least one of multimedia and smartphone functionality, the multifunction wireless device including a receiver of at least one of analog and digital sound signals, an image recording system comprising at least one of an image sensor having at least 2 Megapixels in size, a flash light, an optical zoom, and a digital zoom, and data storage means having a capacity of at least 1 GB. The multifunction wireless device further includes an antenna system having a shape with a level of complexity of an antenna contour defined by complexity factor F_{21} having a value of at least 1.05 and not greater than 1.80 and by complexity factor F_{32} having a value of at least 1.10 and not greater than 1.90.

[0037] The present invention is related to a portable multifunction wireless device (MFWD) and in particular to a handheld multifunction wireless device. In some embodiments, the MFWD will take the form of a handheld multimedia terminal (MMT) including wireless connectivity to mobile networks. In some embodiments, the MFWD will take the form of a handheld device combining personal computer capabilities, mobile data and voice services into a single unit (smartphone, SMRT), while in others the MFWD will combine both multimedia and smartphone capabilities (MMT +SMR T).

[0038] It is an object of the present invention to provide wireless connectivity to an MFWD that takes the form of a handheld multimedia terminal (MMT). In some embodiments, the MMT will include means to reproduce digital music and sound signals, preferably in a data compressed format such as for instance a MPEG standard such as MP3 (MPEG3) or MP4 (MPEG4). In some embodiments, the MMT will include a digital camera to record still (pictures, photos) and/or moving images (video), combined with a microphone or microphone system to record live sound and convert it to a digital compressed format. The present invention will be particularly suitable for those MMT embodiments combining both music and image capabilities, by providing means to efficiently integrate music, images, live video and sound recording and playing into a very small, compact and lightweight handheld device.

[0039] It is an object of the present invention as well, to provide wireless connectivity to an MFWD that takes the form of a smartphone (SMRT). In some embodiments, the smartphone will consist of a handheld electronic unit comprising a microprocessor and operating system (such as for instance but not limited to Pocket PC, Windows Mobile, Windows CE, Symbian, Palm OS, Brew, Linux) with the capability of downloading and installing multiple software applications and enhanced computing capabilities compared to a typical state of the art mobile phone. Typically, SMR T will comprise a small, compact (handheld) computer device with the capability of sharing, opening and editing typical word processing, spreadsheets and slide files that are handled by a personal computer (for instance a laptop or desktop). Although many current mobile phones feature some very basic electronic agenda functions (calendars, task lists and phonebooks) and are even able to install small Java or Brew games, they are not considered here to be smartphones (SMRT).

[0040] It is one purpose of the present invention to provide enhanced wireless capabilities to any of the MFWD devices described above. In some embodiments though, providing a wide geographical coverage will be a priority rather than enhanced multimedia or computing capabilities, while in others the priority will become to provide a high-speed connection and/ or a seamless connection to multiple networks and standards.

BRIEF DESCRIPTION OF THE DRAWINGS

[0041] Further characteristics and advantages of the invention will become apparent in view of the detailed description which follows of some preferred embodiments of the invention given for purposes of illustration only and in no way meant as a definition of the limits of the invention, made with reference to the accompanying drawings:

[0042] Figure 1A shows a block diagram of a MFWD of the present invention illustrating the basic functional blocks thereof;

[0043] Figure 1B shows a perspective view of a MFWD including a space for the integration of an antenna system, and its corresponding antenna box and antenna rectangle;

[0044] Figure 2A shows an example MFWD comprising a ground plane layer included in a PCB, and its corresponding ground plane rectangle;

[0045] Figure 2B shows the ground plane rectangle of the MFWD of Figure 2a in combination with an antenna rectangle for an antenna system;

[0046] Figure 3 shows an example of an antenna contour of an antenna system for a MFWD;

[0047] Figure 4 from top to down shows an example of a process (for instance a stamping process) followed to shape a rectangular conducting plate to create the structure of an antenna system for a MFWD;

[0048] Figures 5A-B show an example of MFWD being held typically by a right-handed user to originate a phone call, and how the feeding point corner of the antenna rectangle of said MFWD may be selected;

[0049] Figure 5C shows an exploded view of an exemplary clamshell-type MFWD;

[0050] Figure 6A shows an example of a first grid to compute the complexity factors of an antenna contour;

[0051] Figure 6B shows an example of a second grid to compute the complexity factors of an antenna contour;

[0052] Figure 6C shows an example of a third grid to compute the complexity factors of an antenna contour;

[0053] Figure 7 shows the two-dimensional representation of the F_{32} vs. F_{21} space;

[0054] Figure 8A shows an example of an antenna contour inspired in a Hilbert curve under a first grid to compute the complexity factors of said antenna contour;

[0055] Figure 8B shows the example of the antenna contour of Figure 8A under a second grid to compute the complexity factors of said antenna contour;

[0056] Figure 8C shows the example of the antenna contour of Figure 8A under a third grid to compute the complexity factors of said antenna contour;

[0057] Figure 9A shows an example of a quasi-rectangular antenna contour featuring a great degree of convolution in its perimeter under a first grid to compute the complexity factors of said antenna contour;

[0058] Figure 9B shows the example of the quasi-rectangular antenna contour featuring a great degree of convolution of Figure 9a under a second grid to compute the complexity factors of said antenna contour;

[0059] Figure 9C shows the example of the quasi-rectangular antenna contour featuring a great degree of convolution of Figure 9a under a third grid to compute the complexity factors of said antenna contour;

[0060] Figure l0A shows an example of a triple branch antenna contour under a first grid to compute the complexity factors of said antenna contour;

[0061] Figure l0B shows the example of the triple branch antenna contour of Figure 10A under a second grid to compute the complexity factors of said antenna contour;

[0062] Figure l0C shows the example of the triple branch antenna contour of Figure 10A under a third grid to compute the complexity factors of said antenna contour;

[0063] Figure 11 shows the mapping of the antenna contour of Figures 6, 8, 9 and 10 in the F_{32} vs. F_{21} space;

[0064] Figure 12A shows an example of antenna contour of the antenna system of a MFWD according to the present invention;

[0065] Figure 12B shows an example of a PCB of a MFWD including a layer that serves as the ground plane to the antenna system of Figure 12A;

[0066] Figure 13A shows the antenna contour of Figure 12A placed under a first grid to compute the complexity factors of said antenna contour;

[0067] Figure 13B shows the antenna contour of Figure 12A placed under a second grid to compute the complexity factors of said antenna contour;

[0068] Figure 13C shows the antenna contour of Figure 12A placed under a third grid to compute the complexity factors of said antenna contour;

[0069] Figure 14A shows an antenna contour according to the present invention placed under a first grid to compute the complexity factors of said antenna contour;

[0070] Figure 14B shows the antenna contour according to the present invention of Figure 14a placed under a second grid to compute the complexity factors of said antenna contour;

[0071] Figure 14C shows the antenna contour according to the present invention of Figure 14a placed under a third grid to compute the complexity factors of said antenna contour;

[0072] Figure 15 shows the mapping of the antenna contour of Figures 12 and 14 in the F_{32} vs. F_{21} space;

[0073] Figure 16 illustrates a flow diagram for optimizing the geometry of an antenna system to obtain superior performance within a wireless device;

[0074] Figures 17A-17H illustrate the progressive modification of an antenna system through the different steps of the optimization process in accordance with the principles of the present invention;

[0075] Figure 18 is a complexity factor plain graphically illustrating the complexity factors of Figures 17A-17H;

[0076] Figure 19A is a graphical representation of the VSWR of the antenna system relative to frequency;

[0077] Figure 19B is a graphical representation of the efficiency of the antenna system as a function of the frequency; and

[0078] Figures 20A-20F illustrate cross-sectional views of exemplary MFWDs comprising three bodies.

DETAILED DESCRIPTION

[0079] Referring first to Figure 1A, a multifunction wireless device (MFWD) of the present invention 100 advantageously comprises five functional blocks: display 11, processing module 12, memory module 13, communication module 14 and power management module 15. The display 11 may be, for example, a high resolution LCD or equivalent is an energy consuming module and most of the energy drain comes from the backlight use. The processing module 12, that is the microprocessor or CPU and the associated memory module 13, are also major sources of power consumption. The fourth module responsible of energy consumption is the communication module 14, an essential part of which is the antenna system. The MFWD 100 has a single source of energy and it is the power management module 15 mentioned above that provides and manages the energy of the MFWD 100. In a preferred embodiment, the processing module 12 and the memory module 13 have herein been listed as separate modules. However, in another embodiment, the processing module 12 and the memory module 13 may be separate functionalities within a single module or a plurality of modules. In a further embodiment, two or more of the five functional blocks of the MFWD 100 may be separate functionalities within a single module or a plurality of modules.

[0080] The MFWD 100 generally comprises one, two, three or more multilayer printed circuit boards (PCBs) on which to carry and interconnect the electronics. At least one of the PCBs includes feeding means and/or grounding means for the antenna system.

[0081] At least one of the PCBs, preferably the same one as the at least one PCB including feeding means and/or grounding means, includes a layer that serves as a ground plane of the antenna system.

[0082] The antenna system within the communication module 14 generally is regarded as an essential element of a multifunction wireless device. In particular it can be regarded an essential element of the MFWD 100, as it provides the MFWD 100 with wide geographical and range coverage, high-speed connection and/or seamless connection to multiple networks and standards. Thus, a volume of space within the MFWD 100 needs to be made available to the integration of the antenna system. However, the integration of the antenna system is complicated by the fact that the MFWD 100 also includes one or more advanced functions provided by at least one, two, three or more additional electronic subsystems within the various modules 11-15 such as:

- a receiver of analog and/or digital sound signals (e.g. for FM, DAB, XDARS, SDARS, or the like).
- a receiver of digital broadcast TV signals (such as DVB-H, DMB)
- a module to download and play streamed video,
- an advanced image recording system (comprising e.g. one, two, three or more of: optical or digital zoom; flash light; one, two or more image sensors, one, two or more of which maybe more than 2 Megapixels in size),

- data storage means in excess of 1 GB (fixed and/or removable; hard disk drive; non volatile (e.g. magnetic, ferroelectric or electronic) memory),
- a high resolution image and/or character and graphic display (more than 100 times 100 pixels or more than 320 times 240 pixels (e.g. more than 75,000 pixels) and/or 65,000 color levels or more),
- a full keyboard (e.g. number keys and character keys separated therefrom and/or at least 26, 30, 36, 40 or 50 keys; the keyboard may be integrated within the MFWD or may be connectable to the MFWD by a cable or a short range wireless connectivity system),
- a touch screen with a size of at least half of the overall device
- a geolocalization system (such as e.g. GPS or Galileo or a mobile network related terrestrial system),
- and/or a module to handle an internet access protocol and/or messaging capabilities (such as email, instant messaging, SMS, MMS or the like).

[0083] In some examples, the integration of an antenna system into the MFWD 100 is further complicated by the presence in the MFWD 100 of additional antennas, such as for example antennas for reception of broadcast radio and/or TV, antennas for geolocalization services, and/or antennas for wireless connectivity systems.

[0084] The MFWD 100 according to one embodiment achieves an efficient integration of an antenna system alongside other electronic modules and/or subsystems that provide sophisticated functionality to the MFWD 100, (and possibly also in conjunction with additional antennas), in a way that the MFWD meets size, weight and/or battery consumption constraints critical for a portable small-sized device.

[0085] The MFWD 100 according to one embodiment is preferably able to provide both voice and high-speed data transmission and receive services through at least one or more of said frequency regions in the spectrum. For that purpose, a MFWD will include the RF capabilities, antenna system and signal processing hardware to connect to a mobile network at a speed of preferably at least 350 Kbits/s, while in some embodiments the data transfer will be performed with at least 1 Mbit/s, 2 Mbit/s or 10 Mbit/s or beyond. For this purpose, a MFWD will preferably include at least 3G (such as for instance UMTS, UMTS-FDD, UMTS-TDD, W-

CDMA, cdma2000, TD-SCDMA, Wideband CDMA) and/or 3.5G and/or 4G services (including for instance HSDPA, WiFi, WiMax, WiBro and other advanced services) in one or more of said frequency regions. In some embodiments a MFWD will include also 2G and 2.5G services such as GSM, GPRS, EDGE, TDMA, PCS, CDMA, cdmaOne. In some embodiments a MFWD will include 2G and/or 2.5G services at one or both of the first two frequency regions (810-960 MHz and 1710-1990 MHz) and a 3G or a 4G service in the upper frequency region (1900-2170 MHz). In particular, some MFWD devices will provide 3 GSM/GPRS services (GSM900, GSM1800, GSM1900 or PCS) and UMTS/W-CDMA, while some others will provide 4 GSM/GPRS services (GSM850, GSM900, GSM1800, GSM1900 or PCS) and UMTS and/or W-CDMA to ensure seamless connectivity to multiple networks in several geographical domains such as for instance Europe and North America. In some embodiments, a MFWD will include 3G, 3.5G, 4G or a combination of such services in said three frequency regions.

[0086] In some embodiments of the invention, the MFWD 100 includes wireless connectivity to other wireless devices or networks through a wireless system such as for instance WiFi (IEEE802.11 standards), Bluetooth, ZigBee, UWB in some additional frequency regions such as for instance an ISM band (for instance around 430 MHz or 868 MHz, or within 902-928 MHz or in the 2400-2480 MHz range, or in the 5.1-5.9 GHz frequency range or a combination of them) and/or within a ultra wide-band range (UWB) such as the 3-5 GHz or 3-11 GHz frequency range.

[0087] In some embodiments of the invention, the MFWD 100 provides voice over IP services (VoIP) through a wireless connection using one or more wireless standards such as WiFi, WiMax and WiBro, within the 2-11 GHz frequency region or in particular the 2.3-2.4 GHz frequency region.

[0088] The MFWD 100 may have a bar shape, which means that it is given by a single body. It may also have a two-body structure such as a clamshell, flip or slider structure. It may further or additionally have a twist structure in which a body portion e.g. with a screen can be twisted (rotated with two or more axes of rotation which are preferably not parallel).

[0089] The MFWD 100 may operate simultaneous in two or more wireless services (e.g. a short range wireless connectivity service and a mobile telephone service, a geolocalization service and a mobile telephone service, etc.).

[0090] For any wireless service, more than one antenna (system) may be provided in order to obtain a diversity system and/or a multiple input/multiple output system.

[0091] In a MFWD 100 according to an embodiment of the present invention, the structure of the antenna system is advantageously shaped to efficiently use the volume of physical space made available for its integration within the MFWD 100 in order to obtain a superior RF performance of the antenna system (such as for example, and without limitation, input impedance level, impedance bandwidth, gain, efficiency, and/or radiation pattern) and/or superior RF performance of the MFWD 100 (such as for example and without limitation, radiated power, received power and/or sensitivity) in at least one of the communication standards of operation in at least one of the frequency regions. Alternatively, the antenna system can be advantageously shaped to minimize the volume required within the MFWD 100 yet still achieve a certain RF performance.

[0092] As a consequence, the resulting MFWD 100 may exhibit in some examples one, two, three or more of the following features:

- increased communication range,
- improved quality of the communication or quality of service (QoS),
- extended battery life for higher autonomy of the device,
- reduced device profile and/or the size (an aspect particularly critical for slim phones and/or twist phones),
- and/or reduced weight of the device (aspect particularly critical for multimedia phones and/or smart phones),

all of which are qualities that translate into increased user acceptance of the MFWD 100.

[0093] The antenna system also comprises at least one feeding point and may optionally comprise one, two or more grounding points. In some examples of MFWDs, the antenna system may comprise more than one feeding point, such as for example two, three or more feeding points.

[0094] The MFWD 100 comprises one, two, three, four, five or more contact terminals. A contact terminal couples the feeding means included in a PCB of the MFWD 100 with a feeding point of the antenna system. The feeding means comprise one, two, three or more RF transceivers coupled to the antenna system through contact terminals.

[0095] Similarly, a contact terminal can also couple the grounding means included in a PCB of the MFWD 100 with a grounding point of the antenna system. A contact terminal may take for instance the form of a spring contact with a corresponding landing area, or a pogo pin with a corresponding landing area, or a couple of pads held in electrical contact by fastening means (such as a screw) or by pressure means.

[0096] A volume of space within the MFWD 100 of one embodiment of the invention is dedicated to the integration of the antenna system into the device. An antenna box for the MFWD 100 is herein defined as being the minimum-sized parallelepiped of square or rectangular faces that completely encloses the antenna volume of space and wherein each one of the faces of the minimum-sized parallelepiped is tangent to at least one point of the volume. Moreover, each possible pair of faces of the minimum-size parallelepiped shares an edge forming an inner angle of 90º.

[0097] For example, the antenna box shown at 103 of Figure 1B delimits the volume of space within the MFWD 100 dedicated to the antenna system in the sense that, although other elements of the MFWD 100 (such as for instance an electronic module or subsystem) can be within the antenna box, no portion of the antenna system can extend outside the antenna box.

[0098] Therefore, although the volume within the MFWD 100 dedicated to the integration of the antenna system will generally be irregularly shaped, the antenna box itself will have the shape of a right prism (i.e., a parallelepiped with square or rectangular faces and with the inner angles between two faces sharing an edge being 90º).

[0099] An antenna system of the MFWD 100 of one embodiment of the invention has a structure able to support different radiation modes so that the antenna system can operate with good performance and reduced size in the communication standards allocated in multiple frequency bands within at least three different regions of the electromagnetic spectrum. Such an effect is achieved by appropriately shaping the structure of the antenna system in a way that different paths are provided to the electric currents that flow on the conductive parts of said structure of the antenna system, and/or to the equivalent magnetic currents on slots, apertures or openings within said structure, thereby exciting radiation modes for the multiple frequency bands of operation. In some cases the structure of an antenna system will comprise a first portion that provides a first path for the currents associated with a radiation mode in a first frequency band within a first region of the electromagnetic spectrum, a second portion that provides a second path for the currents associated with a radiation mode in a second frequency band within a second region of the electromagnetic spectrum and a third portion that provides a third path for the currents associated with a radiation mode in a third frequency band within a third region of the electromagnetic spectrum.

[0100] Some of these basic concepts of antenna design are set forth in co-pending U.S. Patent Application Serial No. 11/179,257, filed July 12, 2005 and entitled “Multi-Level Antenna” and in co-pending U. S. Patent Application Serial No. 11/179,250, filed July 12, 2005 and entitled “Space-Filing Miniature Antenna” both of which are hereby incorporated by reference herein.

[0101] In some embodiments of the invention the first, second and third portions are overlapping partially or completely with each other, while in other embodiments the three portions are essentially non-overlapping. In some embodiments only two of the three portions overlap either partially or completely and in some cases one portion of the three portions is the entire antenna system.

[0102] In some examples, at least one of the paths has an electrical length substantially close to one time, three times, five times or a larger odd integer number of times a quarter of the wavelength at a frequency of the associated radiation mode. In other examples, at least one of the paths has an electrical length approximately equal to one time, two times, three times or a larger integer number of times a half of the wavelength at a frequency of the associated radiation mode.

[0103] A structure of an antenna system of the MFWD 100 according to the present invention is able to support different radiation modes. Such an effect is advantageously achieved by means of one of, or a combination of, the following mechanisms:

creating slots, apertures and/or openings within the structure,

bending and/or folding the structure,

because an edge-rich, angle-rich and/or discontinuity-rich structure is obtained in which different portions of the structure offer longer and more winding paths for the electric currents and/or the equivalent magnetic currents associated with different frequency bands of operation than would the path of a simpler structure that uses neither one of the aforementioned mechanisms.

[0104] The process of shaping the structure of the antenna system into a configuration that supports different radiation modes can be regarded as the process of lowering the frequency of a first radiation mode associated with a first frequency band, and/or subsequently including additional radiation modes associated with additional frequency bands, to an antenna formed of a substantially square or rectangular conducting plate (or a substantially planar structure) that occupies the largest face of the antenna box.

[0105] The geometry of a substantially square or rectangular conducting plate occupying a largest face of the antenna box is an advantageous starting point for the design of the geometry of the structure of the antenna system since such a structure offers a priori the longest path for the currents of a radiation mode corresponding to a lowest frequency band, together with the maximum antenna surface. Antenna designers have frequently encountered difficulty in maintaining the performance of small antennas. There is a fundamental physical limit between size and bandwidth in that the bandwidth of an antenna is generally directly related with the volume that the antenna occupies. Thus, in antenna design it may be preferable to pursue maximization of the surface area of an antenna in order to achieve maximum bandwidth. The geometry of an antenna comprised of a substantially square or rectangular conducting plate can be modified by at least one of the following:

- creating slots, gaps or apertures within the extension of the plate,
- removing peripheral parts of the plate,
- folding or bending parts of said plate, so that the folded or bent parts are no longer on the plane defined originally by the plate,
- and/or including additional conducting parts in the antenna box that are not contained on the plane originally defined by the plate;

in order to adapt the antenna system to the frequency bands of operation, to the space required by additional electronic modules or subsystems, and/or to other space constraints of the MFWD 100 (as for example those imposed by the ergonomics, or the aesthetics of the MFWD).

[0106] In some examples within embodiments of the present invention, one or several modifications of the structure of an antenna system are aimed at lengthening the path of the electric currents and/or the equivalent magnetic currents of a particular radiation mode to decrease its associated frequency band. In other examples, one or several modifications of the structure of an antenna system are aimed at splitting, or partially diverting, the electric currents and/or the equivalent magnetic currents on different parts of the structure of the antenna system to enhance multimode radiation, which may be advantageous for wideband behavior.

[0107] The resulting antenna structure (i.e., after modifying its geometry) includes a plurality of portions that allow the operation of the antenna system in multiple frequency bands. Generally, the structure of the antenna system comprises one, two, three, four or more antenna elements with each element being formed by a single conducting geometric element, or by a plurality of conducting geometric elements that are in electrical contact with one another (i.e., there is electrical continuity for direct or continuous current flow). One antenna element may comprise one or more portions of the structure of the antenna system and one portion of the antenna system may comprise one, two, three or more antenna elements. Different antenna elements may be electromagnetically coupled (either capacitively coupled or inductively coupled). Generally an antenna element of the antenna system is not connected by direct contact to another antenna element of said antenna system, unless such contact is optionally done through the ground plane of the antenna system. In some examples, an antenna system with a structure comprising several antenna elements is advantageous to increase the number of frequency bands of operation of said antenna system and/or to enhance the RF performance of said antenna system or that of a MFWD including said antenna system.

[0108] In some examples, slots, gaps or apertures created between different antenna elements, or between parts of a same antenna element, serve to decrease electromagnetic coupling between the antenna elements, or the parts of the same antenna element. In other examples, the structure of the antenna system seeks to create proximity regions between antenna elements, or between parts of a same antenna element, to enhance the coupling between the antenna elements, or the parts of a same antenna element.

[0109] The design of the structure of the antenna system is intended to use efficiently as much of the volume of the space within the antenna box as possible in order to obtain a superior RF performance of the antenna system and/or superior RF performance of the MFWD 100 in at least one frequency band. In particular, according to the present invention, the structure of the antenna system comes into contact with each of the six (6) faces of the antenna box in at least one point of each face to make better use of the available volume. However, it is generally advantageous to position the geometrical complexity of the structure predominantly on a largest face of the antenna box, and use the third dimension of the antenna box (i.e., the dimension not included in said largest face) to separate the antenna system from other elements of the MFWD 100 (such as for instance, and without limitation, a ground plane, a grounded shield can, a loudspeaker module, a vibrating module, a memory card socket, a hard disk drive, and/or a connector) that may degrade the RF performance of the antenna system and/or the RF performance of the MFWD 100.

[0110] For one purpose of the design of the antenna system, an antenna rectangle is defined as being the orthogonal projection of the antenna box along the normal to the face with largest area of the antenna box.

[0111] In some exemplary MFWDs, one of the dimensions of the antenna box can be substantially smaller than any of the other two dimensions, or even be close to zero. In such cases, the antenna box collapses to a practically two-dimensional structure (i.e., the antenna box becomes approximately the antenna rectangle).

[0112] The antenna rectangle has a longer side and a shorter side. The length of the longer side is referred to as the width of the antenna rectangle (W), and the length of the shorter side is referred to as the height of the antenna rectangle (H). The aspect ratio of the antenna rectangle is defined as the ratio between the width and the height of the antenna rectangle.

[0113] In addition to the antenna rectangle, a ground plane rectangle is defined as being the minimum-sized rectangle that encompasses the ground plane of the antenna system included in the PCB of the MFWD 100 that comprises the feeding means responsible for the operation of the antenna system in its lowest frequency band. That is, the ground plane rectangle is a rectangle whose edges are tangent to at least one point of the ground plane.

[0114] The area ratio is defined as the ratio between the area of the antenna rectangle and the area of the ground plane rectangle.

[0115] In some examples, the antenna system of the present invention advantageously places a feeding point of the antenna system, preferably a feeding point responsible for the operation of the antenna system in its lowest frequency band, near a corner of the antenna rectangle, because it may provide a longer path on the structure of the antenna system for the electric currents and/or the equivalent magnetic currents coupled to the antenna system through the feeding point.

[0116] In other examples, the antenna system of the present invention advantageously places a feeding point of the antenna system, preferably a feeding point responsible for the operation of the antenna system in its lowest frequency band, in such a way that a contact terminal of the MFWD 100 is located near an edge of a ground plane encompassed by the ground plane rectangle. Preferably that edge is common with a side of the ground plane rectangle, and preferably the side is a short side of the ground plane rectangle. Such placement of the feeding point of the antenna system, and that of the contact terminal of the MFWD 100 associated with the feeding point, may provide a longer path for electric and/or magnetic currents flowing on the ground plane of the antenna system enhancing the RF performance of the antenna system, or that of the MFWD 100, in at least the lowest frequency band. This becomes particularly relevant in those MFWD 100 having form factors that require a small size of the ground plane rectangle and, consequently, a small size of the whole device.

[0117] The structure of the antenna system becomes geometrically more complex as the number of frequency bands in which the MFWD 100 has to operate increases, and/or the size of the antenna box decreases, and/or the RF performance requirements are made more stringent in at least one frequency band of operation. In a MFWD 100 according to the present invention, the structure of the antenna system is geometrically defined by its antenna contour. The antenna contour of the antenna system is a set of joined and/or disjointed segments comprising:

the perimeter of one or more antenna elements placed in the antenna rectangle,

the perimeter of closed slots and/or closed apertures defined within the antenna elements, and/or the orthogonal projection onto the antenna rectangle of perimeters of antenna elements, or perimeters of or parts of antenna elements that are placed in the antenna box but not in the antenna rectangle.

[0118] The antenna contour, i.e., its peripheral both internally and externally, can comprise straight segments, curved segments or a combination thereof. Not all the segments that form the antenna contour need to be connected (i.e., to be joined). In some cases, the antenna contour comprises two, three, four or more disjointed subsets of segments. A subset of segments is defined by one single segment or by a plurality of connected segments. In other cases, the entire set of segments that form the antenna contour are connected together defining a single set of joined segments (i.e., the antenna contour has only one subset of segments).

[0119] Along the contour different segments can be identified e.g. by a corner between two segments, wherein the corner is given by a point on the contour where no unique tangent can be identified. At the corners the contour has an angle. The segments next to a corner may be straight or curved or one straight and the other curved. Further, segments may be separated by a point where the curvature changes from left to right or from right to left. In a sine curve, for example such points are given where the curve intersects the horizontal axis (x-axis, abscissa, $\sin(x) = 0$).

[0120] It is preferred that right and left curved segments are provided (when following the contour) and/or that at corners angles to the left and to the right (when following the contour) are provided. Preferably the numbers of left and right curved segments respectively, (if provided) do not differ by more than 80%, 70%, 60%, 50%, 40%, 30%, 20% or 10% of the larger of the two numbers. Also the number of corner angles between adjacent segments which following the contour go to the right and those that go to the left do not differ by more than 80%, 70%, 60%, 50%, 40%, 30%, 20% or 10% of the larger of the two numbers. Further preferably the number of the left curved segments plus the number of the corners where the contour turns left and the number of the right curved segments plus the number of corners where the contour turns right do not differ by more than 80%, 70%, 60%, 50%, 40%, 30%, 20% or 10% of the larger of the two numbers.

[0121] Generally, one, two, three or more subsets of segments of the antenna contour advantageously each comprise at least a certain minimum number of segments that are connected in such a way that each segment forms an angle with any adjacent segments or a curved segment interposed between such segments, such that no pair of adjacent segments defines a larger straight segment. The angles at corners or curved segments increase the degree of convolution of the curves formed by the segments of each of said subsets leading to an antenna contour that is geometrically rich in at least one of edges, angles, corners or discontinuities, when considered at different levels of detail. Possible values for the minimum number of segments of a subset include 5, 6, 7, 8, 10, 12, 14, 16, 18, 20, 25, 30, 35, 40, 45 and 50. Also a maximum number of segments of a subset may be given. Possible values of said maximum number are 10, 15, 20, 25, 30, 40, 50, 75, 100, 150, 200, 250 and 500.

[0122] Additionally, to shape the structure of an antenna system in some embodiments the segments of the antenna contour should be shorter than at least one fifth of a free-space wavelength corresponding to the lowest frequency band of operation, and possibly shorter than one tenth of said free-space wavelength. Moreover, in some further examples the segments of the antenna contour should be shorter than at least one twentieth of said free-space wavelength.

[0123] The antenna contour needs to make efficient use of the area of the antenna rectangle in order to attain enough geometrical complexity to make the resulting structure of an antenna system suitable for the MFWD 100. In particular, according to the present invention, the antenna contour preferably comes into contact with each of the four (4) sides of the antenna rectangle in at least one point of each side of the antenna rectangle. The antenna contour should include at least ten segments in order to provide some multiple frequency band behavior, and/or size reduction, and/or enhanced RF performance to the resulting antenna system. However, a larger number of segments may be used, such as for instance 15, 20, 25, 30, 35, 40, 45, 50 or more segments. In general, the larger the number of segments of the antenna contour and the narrower the angles between connected segments, the more convoluted the structure of the antenna system becomes. The number of segments of the antenna contour may be less than 20, 25, 30, 40, 50, 75, 100, 150, 200, 250 or 500.

[0124] The length of the antenna contour of an antenna system is defined as the sum of the lengths of each one of the disjointed subsets that make up the antenna contour. The larger the length of the antenna contour, the higher the richness of the antenna contour in at least one of edges, angles, corners or discontinuities, making the resulting structure of an antenna system suitable for a MFWD.

[0125] In some examples the length of the antenna contour is larger than 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 15, 20, 25, 30, 40, or more times the length of the diagonal of the antenna rectangle or less than any of those values.

[0126] Each of the one or more antenna elements comprised in the antenna system might be arranged according to different antenna topologies, such as for instance any one of the topologies selected from the following list: monopole antenna, dipole antenna, folded dipole antenna, loop antenna, patch antenna (and its derivatives for instance PIFA antennas), IFA antenna, slot antenna. Any of such antenna arrangements might comprise a dielectric material with a high dielectric constant (for instance larger than 3) to influence the operating frequency, impedance or both aspects of the antenna system.

[0127] In accordance with embodiments of the invention, the level of complexity of an antenna contour can be advantageously parameterized by means of two complexity factors, hereinafter referred to as F_{21} and F_{32}, which capture and characterize certain aspects of the geometrical details of the antenna contour (such as for instance its edge-richness, angle-richness and/or discontinuity-richness) when viewed at different levels of scale.

[0128] For the computation of F_{21} and F_{32} of a particular antenna, a first, a second, and a third grid (hereinafter called grid G_1, grid G_2 and grid G_3 respectively) of substantially square or rectangular cells are placed on the antenna rectangle. The three grids are adaptive to the antenna rectangle. That is, the size and aspect ratio of the cells of each one of said three grids is determined by the size and aspect ratio of the antenna rectangle itself. The use of adaptive grids is advantageous because it provides a sufficient number of cells within the antenna rectangle to fully capture the geometrical features of the antenna contour at differing levels of detail.

[0129] Moreover, the three grids are selected to span a range of levels of scale corresponding to two octaves: A cell of grid size G_2 is half the size of a cell of grid G_1 (i.e., a ½ scaling factor or an octave of scale); a cell of grid size G_3 is half the size of a cell of grid G_2, or one fourth the size of a cell of grid G_1 (i.e., a ¼ scaling factor or two octaves of scale). A range of scales of two octaves provides a sufficient variation in the size of the cells across the three grids as to capture gradually from the coarser features of the antenna contour to the finer ones.

[0130] Grids G_1 and G_3 are constructed from grid G_2, which needs to be defined in the first place.

[0131] As far as the second grid (or grid G_2) is concerned, the size of a cell and its aspect ratio (i.e., the ratio between the width and the height of the cells) are first chosen so that the antenna rectangle is perfectly tessellated with an odd number of columns and an odd number of rows.

[0132] In the present invention, columns of cells are associated with the longer side of an antenna rectangle, while rows of cells are associated with a shorter side of the antenna rectangle. In other words, a longer side of the antenna rectangle spans a number of columns, with the columns being parallel to the shorter side of the antenna rectangle. In the same way a shorter side of the antenna rectangle spans a number of rows, with the rows being parallel to the longer side of the antenna rectangle.

[0133] If the antenna rectangle is tessellated with an excessive number of columns, then the size of the resulting cells is much smaller than the range of typical sizes of the features necessary to shape the antenna contour. However, if the antenna rectangle is tessellated with an insufficient number of columns, then the size of the resulting cells is much larger than the range of typical sizes of the features necessary to shape the antenna contour. It has been found that setting to nine (9) the number of columns that tessellate the antenna rectangle provides an advantageous compromise, for the preferred sizes of an MFWD, and the corresponding available volumes for the antenna system, according to the present invention. Therefore, a cell width (W_2) is selected to be equal to a ninth (1/9) of the length of the longer side of the antenna rectangle (W).

[0134] Moreover, it is also advantageous to use cells that have an aspect ratio close to one. In other words, the number of columns and rows of cells of the second grid that tessellate the antenna rectangle are selected to produce a cell as square as possible. A grid formed by cells having an aspect ratio close to one is preferred in order to perceive features of the antenna contour using approximately a same level of scale along two orthogonal directions defined by the longer side and the shorter side of the antenna rectangle. Therefore, preferably, the cell height

(H_2) is obtained by dividing the length of the shorter side of the antenna rectangle (H) by the odd integer number larger than one (1) and smaller than, or equal to, nine (9), that results in an aspect ratio W_2/H_2 closest to one.

[0135] In the particular case that two different combinations of a number of columns and rows of cells of the second grid produce a cell as square as possible, a second grid is selected such that the aspect ratio is larger than 1.

[0136] Thus, the antenna rectangle is tessellated perfectly with 9 by (2n+1) cells of grid G_2, wherein n is an integer larger than zero (0) and smaller than five (5).

[0137] A first grid (or grid G_1) is obtained by combining four (4) cells of the grid G_2. Each cell of the grid G_1 consists of a 2-by-2 arrangement of cells of grid G_2. Therefore, a cell of the grid G_1 has a cell width equal to twice (2) the width of a cell of the second grid (W_2) (i.e., $W_1=2 \times W_2$); and a cell height (H_1) equal to twice (2) the height of a cell of the second grid (H_2) (i.e., $H_1=2 \times H_2$).

[0138] Since grid G_2 tessellates perfectly the antenna rectangle with an odd number of columns and an odd number of rows, an additional row and an additional column of cells of said grid G_2 are necessary to have enough cells of the grid G_1 as to completely cover the antenna rectangle.

[0139] In order to uniquely define the tessellation of the antenna rectangle with grid G_1 a corner of said antenna rectangle is selected to start placing the cells of the grid G_1.

[0140] A feeding point corner is defined as being the corner of the antenna rectangle closest to a feeding point of the antenna system responsible for the operation of the antenna system in its lowest frequency band. In case that the feeding point is placed at an equal distance from more than one corner of the antenna box, then the corner closest to a perimeter of the ground plane of the PCB of the MFWD 100 is selected, preferably the corner closest to a shorter edge of the ground-plane rectangle. In case both corners are placed at the same distance from the feeding point and from the shorter edge of the ground-plane rectangle, the feeding point corner will be chosen as follows. For reasons of ergonomics and taking into account the absorption of radiation in the hand of the MFWD user, and considering that there is a predominance of right hand users, it has been observed that in some embodiments it is convenient to place a feeding point and/or to designate the feeding point corner on the corner of the antenna rectangle which is closer to a left corner of the ground plane rectangle. That is, the left side of the ground plane rectangle being the closest to the left side of the MFWD 100 as seen by a right-handed user typically holding the MFWD 100 with the right hand to originate a phone call, while facing a display of the MFWD 100. Also, the selection of the feeding point corner on the top or bottom corner on the left side of the MFWD 100 depends on the position of the antenna system with respect to a body of the MFWD 100. That is, an upper-left corner of the antenna rectangle is preferred in those cases in which the antenna system is placed substantially near the top part of the body of the MFWD (usually, above and/or behind a display) and a lower-left corner of the antenna rectangle is preferred in those cases in which the antenna system is placed substantially near the bottom part of the body of the MFWD 100 (usually, below and/or behind a keypad). Again, due to ergonomics reasons, a top and a bottom part of a body of a MFWD are defined as seen by a right-handed user holding MFWD typically with the right hand to originate a phone call, while facing a display 501 as seen in Figures 5 (a) and 5 (b).

[0141] A first cell of the grid G_1 is then created by grouping four (4) cells of grid G_2 in such a manner that a corner of the first cell is the feeding point corner, and the first cell is positioned completely inside the antenna rectangle.

[0142] Once the first cell of the grid G_1 is placed, other cells of said grid G_1 can be placed uniquely defining the relative position of the grid G_1 with respect to the antenna rectangle. The antenna rectangle spans 5 by (n+1) cells of the grid G_1, (when G_2 includes 9 columns) requiring the additional row and the additional column of cells of the grid G_2 that meet at the corner of the antenna rectangle that is opposite to the feeding point corner, and that are not included in the antenna rectangle.

[0143] The complexity factor F_{21} is computed by counting the number of cells N_1 of the grid G_1 that are at least partially inside the antenna rectangle and include at least a point of the antenna contour (in the present invention the boundary of the cell is also part of the cell), and the number of cells N_2 of the grid G_2 that are completely inside the antenna rectangle and include at least a point of the antenna contour, and then applying the following formula:

$$F_{21} = -\frac{\log(N_2) - \log(N_1)}{\log(\frac{1}{2})}$$

[0144] Complexity factor F_{21} is predominantly characterized by capturing the complexity and degree of convolution of features of the antenna contour that appear when the contour is viewed at coarser levels of scale. As it is illustrated in the example of Figures 8A-C, the election of grid G_1 801 and grid G_2 802, and the fact that with grid G_2 802 the antenna rectangle 800 is perfectly tessellated by an odd number of columns and an odd number of rows, results in a value of the factor F_{21} equal to one for an antenna contour shaped as the antenna rectangle 800. On the other hand, an antenna contour whose shape is inspired in a Hilbert curve that fills the antenna rectangle 800 features a value of the factor F_{21} smaller than two. Therefore the factor F_{21} is geared more towards assessing an overall complexity of an antenna contour (i.e., whether the degree of convolution of an antenna contour distinguishes sufficiently from a simple rectangular shape when looked at from a zoomed-out view), rather than estimating if the full complexity of an antenna contour (i.e., the complexity of the antenna contour when looked at from a zoomed-in view) approaches that of a highly-convoluted curve such as the Hilbert curve.

[0145] Moreover, in some embodiments the factor F_{21} is related to the number of paths that a structure of the antenna system provides to electric currents and/or the equivalent magnetic currents to excite radiation modes (i.e., factor F_{21} tends to increase with the number of antenna portions within the structure of the antenna system and/or the number of antenna elements that form the antenna system). In general, the more frequency bands and/or radiation modes that need to be supported by the antenna structure of the MFWD 100, the higher the value of the factor F_{21} that needs to be attained by the antenna contour of the antenna system of the MFWD 100. This is in particular more important as the size of the antenna rectangle decreases.

[0146] A third grid (or grid G_3) is readily obtained by subdividing each cell of grid G_2 into four cells, with each of the cells having a cell width (W_3) equal to one half (1/2) of the width of a cell of the second grid (W_2) (i.e., W_3=1/2 x W_2); and a cell height (H_3) equal to one half (1/2) of the height of a cell of the second grid (H_2) (i.e., H_3=1/2 x H_2).

[0147] Therefore, since each cell of the grid G_2 is replaced with 2-by-2 cells of the grid G_3, then 18 by (4n+2) cells of grid G_3 are thus required to tessellate completely the antenna rectangle.

[0148] The complexity factor F_{32} is computed by counting the number of cells N_2 of grid G_2 that are completely inside the antenna rectangle and include at least a point of the antenna contour, and the number of cells N_3 of the grid G_3 that are completely inside the antenna rectangle and include at least a point of the antenna contour, and applying then the following formula:

$$F_{32} = -\frac{\log(N_3) - \log(N_2)}{\log(1/2)}$$

[0149] Complexity factor F_{32} is predominantly characterized by capturing the complexity and degree of convolution of features of the antenna contour that appear when the contour is viewed at finer levels of scale. As it is illustrated in the example of Figures 8A-C, the election of grid G_2 802 and grid G_3 803 is such that an antenna contour whose shape is inspired in a Hilbert curve that fills the antenna rectangle 800 features a value of the factor F_{32} equal to two. On the other hand, an antenna contour shaped as the antenna rectangle 800 features a value of the factor F_{32} larger than one. Therefore the factor F_{32} is geared more towards evaluating the full complexity of an antenna contour (i.e., whether the degree of convolution of an antenna contour tends to approach that of a highly-convoluted curve such as the Hilbert curve), rather than discerning if said antenna contour is substantially different from a rectangular shape.

[0150] Moreover, the factor F_{32} is in some embodiments related to the degree of miniaturization achieved by the antenna system. In general, the smaller the antenna box of the MFWD 100, the higher the value of the factor F_{32} that needs to be attained by the antenna contour of the antenna system of the MFWD 100.

[0151] The complexity factors F_{21} and F_{32} span a two-dimensional space on which the antenna contour of the antenna system of the MFWD 100 is mapped as a single point with coordinates (F_{21}, F_{32}). Such a mapping can be advantageously used to guide the design of the antenna system by tailoring the degree of convolution of the antenna contour until some preferred values of the factors F_{21} and F_{32} are attained, so that the resulting antenna system: (a) provides the required number of frequency bands in which the MFWD operates; (b) meets MFWD size and/or integration constraints; and/or (c) enhances the RF performance of the antenna system and/or that of the MFWD in at least one of the frequency bands of operation.

[0152] In a preferred embodiment of the present invention, the MFWD 100 comprises an antenna system whose antenna contour features a complexity factor F_{21} larger than one and a complexity factor F_{32} larger than one. In a preferred embodiment, the MFWD 100 comprises an antenna system whose antenna contour features a complexity factor F_{21} larger than or equal to 1.1 and a complexity factor F_{32} larger than or equal to 1.1.

[0153] In some examples the antenna contour features a complexity factor F_{32} larger than a certain minimum value in order to achieve some degree of miniaturization.

[0154] An antenna contour with a complexity factor F_{32} approximately equal to two, despite achieving substantial size reduction, may not be preferred for the MFWD 100 of the present invention as the antenna system is likely to have reduced capability to operate in multiple frequency bands and/or limited RF performance. Therefore in some examples of embodiments of the present invention the antenna contour features a complexity factor F_{32} smaller than a certain maximum value in order to achieve enhanced RF performance.

[0155] In some cases of embodiments of the present invention the antenna contour features a complexity factor F_{32} larger than said minimum value but smaller than said maximum value.

[0156] Said minimum and maximum values for the complexity factor F_{32} can be selected from the list of values comprising: 1.10, 1.15, 1.20, 1.25, 1.30, 1.35, 1.40, 1.45, 1.50, 1.55, 1.60, 1.65, 1.70, 1.75, 1.80, 1.85, and 1.90.

[0157] Similarly, in some examples an antenna contour advantageously features a complexity factor F_{21} larger than a lower bound and/or smaller than an upper bound. The lower and upper bounds for the complexity factor F_{21} can be selected from the list of comprising: 1.05, 1.10, 1.15, 1.20, 1.25, 1.30, 1.35, 1.40, 1.45, 1.50, 1.55, 1.60, 1.65, 1.70, 1.75, and 1.80.

[0158] The complexity factors F_{21} and F_{32} have turned out to be relevant parameters that allow for an effective antenna design. Evaluation of those parameters gives good hints on possible changes of antennas in order to obtain improved antennas.

[0159] In some cases the parameters F_{21} and F_{32} allow for easy identification of unsuitable antennas. Further those parameters may also be used in numerical optimization algorithms as target values or to define target intervals in order to speed up such algorithms.

[0160] In the following paragraphs some parameter ranges for F_{21} and F_{32} which have turned out to be particularly advantageous or useful are summarized.

[0161] It has been found that for MFWDs it is particularly useful to have a value of F_{21} larger than 1.43, 1.45, 1.47 or even preferably greater than 1.50. Such values in this complexity factor translate into a richer frequency response of the antenna which allows for more possible resonant frequencies and more frequency bands with better bandwidths or a combination of those effects.

[0162] Furthermore, for SMRT or MMT, design demands may be different since those devices are usually larger and a reduction of the antenna size is not of such utmost importance, but energy consumption may be important since those devices have to operate to provide many different functionalities. For those devices a complexity factor F_{21} of only more than 1.39, preferably 1.41 or most preferred more than 1.43 turns out to be advantageous.

[0163] For clamshell, twist or slider devices it has to be taken into account that those phones consist of at least two parts which may be moved relative to each other. As a result only a small amount of space is available for the phones and hence, a value of F_{21} of more than 1.43, 1.45, 1.47, or even more preferably greater than 1.50 is advantageous. The same applies to slim devices. For those devices, where there is the requirement of the antenna to be flat, a value of F_{21} greater than the above-mentioned limits provides sufficient possibilities for fringing electromagnetic fields to escape from the area below a patch such that the patch achieves a higher bandwidth and a higher gain. The antenna in case of clamshell, twist or slider devices does not necessarily have to become a patch or patch-like antenna.

[0164] For some MFWDs it is usually not possible to allocate a certain volume of space which is only available for the antenna. It may, for example, be necessary to fit an antenna around one, two or more openings in which a camera, a speaker, RF connectors, digital connectors, speaker connectors, power connectors, infrared ports and/or mechanical elements such as screws, plastic insets, posts or clips have to be provided. The respective opening(s) can be achieved by a certain value F_{21} which is higher than 1.38, 1.40, or 1.42, or more preferably greater than 1.45 or 1.50.

It turns out that with such values for F_{21} it is possible to provide sufficient opening in order to insert other components.

[0165] For those antennas which in their physical properties come quite close to patch antennas namely those with an overlap between the antenna and the ground-plane (patch-like antennas), a value of F_{21} being higher than 1.45, 1.47, 1.50, or 1.60 turns out to be a good measure for an antenna to provide an expected improved bandwidth or gain with respect to a patch antenna without any complexity in at least one of the frequency bands. This region for F_{21} further turns out to be useful for an MFWD with two or more RF transceivers. With a lower value it will be difficult to sufficiently isolate the two RF transceivers against each other. By the complexity factor F_{21} being more than 1.45, 1.47 or 1.50 the two RF transceivers can be electrically separated sufficiently, e.g. by connecting them to two antenna portions which are not in direct electrical contact.

[0166] The last mentioned range is also equally suitable for a MFWD with two, three or more antenna elements. Those elements may be convoluted into each other in order to occupy less space which translates into a high value of F_{21}.

[0167] A MFWD with an antenna with a complexity factor of F_{32} being larger than 1.55, 1.57 or 1.60 is advantageous. Such a high value of F_{32} provides an additional factor for tuning the frequency of high frequency bands without changing the gross geometry for low frequency bands. For this range of F_{32} it turns out that the parameter F_{21} being lower than 1.41, 1.39, 1.37, or 1.35 is advantageous since for a high value of F_{32} which provides some miniaturization, F_{21} may be low in particular to avoid an antenna with too many separate portions or antenna arms since such independent portions are difficult to physically secure with a device in order to achieve proper mechanical robustness.

[0168] For a SMRT or MMT device a value of F_{32} being larger than 1.50, 1.52, 1.55 or 1.60 is desirable. The phones which usually operate in high frequency bands such as UMTS and/or a wireless connectivity at a frequency of around 2.4 GHz a higher value of F_{32} can be used to appropriately adapt the antenna to a desired resonance frequency and/or bandwidth in those bands.

[0169] For slim devices (thickness less than 14 mm, 13 mm, 12 mm, 11 mm, 10 mm, 9 mm or 8 mm) it turns out that a parameter of F_{32} being larger than 1.60, 1.62 or 1.65 may be desired in order to achieve an edge rich structure that reduces the problems of certain antenna structures, such as flat patch antennas. A high value of F_{32} may lead to an increased bandwidth which is useful in certain cases such as coverage of the UMTS band. For the same reasons, in some embodiments of MFWD and particularly in slim devices, it is preferred that the intersection of the projection of the antenna rectangle 110 onto the ground plane rectangle 202 is less than 90% of the area of said antenna rectangle. In particular, such a intersection should be in some cases below 80%, 70%, 50%, 30%, 20% or 10% of said area. Such values for the intersection may be given also for devices which are not considered slim.

[0170] For clamshell, twist or slider devices, even higher values of F_{32} such as higher than 1.63, 1.65, 1.68 or 1.70 may be necessary since in those MFWDs the antennas have to be even more flat.

[0171] MFWDs which have a camera or any other item such as a connector integrated in the antenna box it is desirable to have a value of F_{32} being larger than 1.56, 1.58, 1.60 or 1.63. For those devices it turns out that the mechanical fixing of the antenna may be difficult due to other items which are within the antenna box. With a high value of F_{32} being more than 1.55, or the other values mentioned above, the antenna usually has an edge or recess rich structure that facilitates fixing of the antenna at its border. Therefore, usually there is no problem in mechanically securing an antenna with a high value of F_{32} within a wireless device.

[0172] For antennas which are overlapping with the ground plane of a PCB of the MFWD with at least 50% or 100%, it is possible to achieve appropriate antenna performance even if the value of F_{21} is smaller than e.g. 1.42, 1.40 or 1.38 in cases that the complexity factor F_{32} is more than 1.55. Such edges, curves or steps in the border which lead to a high value of F_{32}, increase efficiency and gain since they lead to strong reorientations of current. This may compensate for lower values of F_{21}, in particular for antennas of patch-like geometry (i.e. those where the antenna overlaps 100% with the ground plane of a PCB of the MFWD).

[0173] Equally for MFWDs with two or more RF transceivers, efficient antennas are possible for values of F_{21} being lower than 1.40, 1.38 or 1.35 in cases that the complexity factor F_{32} is larger than 1.50, 1.52, 1.53, 1.57 or 1.60. Appropriate separation of the two RF transceivers is difficult with a low value of F_{21}. It may still be possible, however, with a high complexity value of F_{32}, which enables some kind of compensation for a low value of F_{21}.

[0174] In some embodiments, when a high level of complexity is sought it might be necessary to design an antenna system whose structure comprises 2, 3 or more antenna elements. Such complexity may be achieved at a coarser and/or finer level of detail. When a high level of complexity is sought in a coarser level of detail, a high value of F_{21} might be required, namely more than 1.43, 1.45, 1.47, or 1.50. When a high level of complexity is sought in a finer level of detail, a high value of F_{32} might be required, namely more than 1.61, 1.63, 1.65 or 1.70.

[0175] Furthermore, it turns out that for some MFWDs with three or more antenna elements, a value of F_{21} lower than 1.36, 1.34, 1.32, 1.30, or even less than 1.25 is advantageous. In these cases the use of an additional antenna element pursues the enhancement of the radio electric performance of the antenna system in at least one of the frequency bands rather than introducing an additional frequency band disjoined from those already supported by the antenna system. For the above mentioned reason it may be advantageous to keep the value of F_{21} below a certain maximum. That can be achieved by reducing the separation of the third or additional antenna elements with respect to the antenna elements already present in the structure of the antenna system, so that the gaps between those antenna elements are not fully observed at a coarser level of detail. Therefore, for MFWDs with three or more antenna elements, lower values of F_{21} may be preferred in certain cases. Additionally, the separation of the antenna system into three or more antenna elements allows for easier adaptation of each antenna element to space requirements within the MFWD such that miniaturization is not such an issue. Therefore, it is possible to have antennas with larger dimensions which then provide for improved radiation efficiency, higher gain and also simply easier design and hence, less costly antennas.

[0176] With MFWDs, in general, it turns out to be particularly useful to have a value of F_{21} greater than 1.42, 1.44, 1.46, 1.48 or 1.50 while at the same time having a value of F_{32} being lower than 1.44, 1.42, 1.40 or 1.38. This is because for the portion of the antenna that resonates at low frequencies (which means long wavelengths, and hence, a long antenna portion), higher miniaturization is required. This miniaturization of large-scale portions translates into a high value of F_{21} and vice versa. For higher frequencies which have smaller wavelengths, there is not such a strong requirement for miniaturization but, rather an enhanced bandwidth is desired. Therefore lower values of F_{32} may be preferred. Low values of F_{32} further allow for maximum efficiency since those antennas do not need to be extremely miniaturized.

[0177] It is particularly useful to use a parameter range of F_{21} being more than 1.32, 1.34 or 1.36 and less than 1.54, 1.52 or 1.50 while at the same time F_{32} is less than 1.44, 1.42 or 1.40 and more than 1.22, 1.24 or 1.26. In this parameter range the values of F_{21} and F_{32} assume intermediate values which give the possibility of having different design parameters such as smallness, multi-band and broadband operation, as well as an appropriate antenna gain and efficiency to be taken into account equally. This parameter range is particularly useful for MFWDs where there is no single or no two design parameters which are of outstanding importance.

[0178] Another useful parameter range is given by F_{21} being less than 1.32, 1.30 or 1.28 with a value of F_{32} being less than 1.54, 1.52 or 1.50 and at the same time being greater than 1.34, 1.36 or 1.38. This parameter range is useful for MFWDs where the robustness of the device is of outstanding importance since a low value of F_{21} leads to devices with a particularly simple geometry without having many highly diffracted portions which are difficult to mechanically secure individually within a device. In order to achieve some miniaturization, however, a value of F_{32} in the indicated range is preferred when taking into account the trade off between the disadvantages of too high values of F_{32} (in terms of too strong miniaturization which leads to a poor bandwidth) while on the other hand wanting to have at least some kind of miniaturization corresponding to F_{32} being above a lower limit.

[0179] For some MFWDs it may be desirable to have the value of F_{32} being less than 1.52, 1.50, 1.48, or 1.45. It was found that antenna elements with highly complex borders are often quite difficult to manufacture and assemble. For instance stamping tools require more resolution and wear out more easily in case of complex borders (which means high value of F_{32}) which translates into higher manufacturing costs (tooling manufacturing costs, tool maintenance cost, larger number of hits per piece of the stamping tool) and delivery lead times, particularly for large volume production.

[0180] This turns out to be important for large volume devices such as slim phones where mass production is common. High volume puts extreme pressure on manufacturing costs, time to market and production volumes.

[0181] Additionally, shapes with high factors of F_{32} are very complicated to model with appropriate CAD tools as the very complicated shapes turn out to consume a lot of computing time. This increases development costs which in turn increases total costs of such an antenna design.

[0182] Equally, for clamshell, twist or slider phones (which may have a major portion of the market share where mass manufacturing is carried out), it may be desirable to have a value of F_{32} being less than 1.30, 1.28 or 1.26.

[0183] For relatively low cost and robust antenna design, it is preferable to have the value of F_{21} being more than 1.15 or 1.17 and at the same time being less than 1.40, 1.38 or 1.36 while the value of F_{32} is less than 1.30, 1.28 and more than 1.15 or 1.17.

[0184] Additionally, it is advantageous to have a SMRT or a MMT device which is of the type twist, or clamshell.

[0185] For a MFWD which is slim (which here means it has a thickness of less than on the order of 14 mm) and is of the type clamshell, twist or slider the flatness requirement is very demanding because each of the parts forming the clamshell, twist or slider may only have a maximum thickness of 5, 6, 7, 8 or 9 mm. With the technology disclosed herein, it is possible to design flat antennas even for such MFWDs.

[0186] A MFWD incorporating 3.5G or 4G features (i.e. comprising 3G and other advanced services such as for instance HSDPA, WiBro, WiFi, WiMAX, UWB or other high-speed wireless standards, hereinafter 4G services) might require operation in additional frequency bands corresponding to said 4G standards (for instance, bands within the frequency region 2-11 GHz and some of its sub-regions such as for instance 2-11 GHz, 3-10 GHz, 2.4-2.5 GHz and 5-6 GHz or some other bands). In some cases, to achieve a maximum volume compactness it would be advantageous that the same antenna system is capable of supporting the radiation modes corresponding to the additional frequency bands. Nevertheless, this approach can be inconvenient as it will increase complexity to the RF circuitry of the MFWD 100, for example by filters to separate the frequency bands of the 4G services from the frequency bands of the rest of services. Therefore it may be advantageous to have a dedicated antenna for 4G services although inside the antenna box.

[0187] In other cases, achieving good isolation between the frequency bands of the 4G services and the frequency bands of the rest of services (3G and below) is preferred to compactness. In those cases the 4G antenna (i.e. the one or more additional antenna covering one or more of the 4G services) will preferably be separated as much as possible from the antenna box. Generally the longer side of the antenna rectangle is placed alongside a short edge of the ground plane rectangle. In some cases it would be advantageous to place the 4G antenna substantially close to the edge that is opposite to the shorter edge. In other cases it would be advantageous to place the 4G antenna substantially close to an edge that is adjacent to the shorter edge. Therefore since the MFWDs physical dimensions are usually predefined, the separation between antennas can be further increased by reducing the shorter side of the antenna rectangle and thus increasing its aspect ratio. As a consequence, for those devices, it may be desirable to have a value of F_{32} higher than 1.35, 1.50, 1.60, 1.65 or 1.75. When the complexity factor F_{21} is in the lower half of the typical range, for example when F_{21} is smaller than 1.40, it may be advantageous to have a value of F_{32} higher than 1.35. On the other hand when the complexity factor F_{21} is in the upper half of its typical range, for example when F_{21} is larger than 1.45, it may be advantageous to have a value of F_{32} higher than a minimum value that can be selected from the list of values comprising: 1.10, 1.15, 1.20, 1.25, 1.30, 1.35, 1.40, 1.45, 1.50, 1.55, 1.60, 1.65, 1.70, 1.75, 1.80, 1.85, and 1.90.

[0188] Advantageously MFWD including 4G services may have two or more dedicated antennas for the 4G services forming an antenna diversity arrangement. In those cases not only is good isolation between the antenna system and the antennas for the 4G services required but also good isolation between the two or more antennas forming the antenna diversity arrangement.

[0189] One, two or more 4G antennas may be IFA-antennas and they may be located outside of the ground plane rectangle. They may be located next to the ground plane. One, two or more 4G antennas may be slot antennas, preferably within the ground plane.

[0190] Typically the number of contacts in an antenna system is proportional to the number of RF transceivers coupled to the antenna system and to the number of antenna elements comprised in the structure of the antenna system. Each RF transceiver drives an antenna element through typically one contact. Additionally each of the antenna elements may have a second contact for grounding purposes. Parasitic antenna elements typically comprise a contact terminal used for grounding purposes.

[0191] In some examples, the MFWD integrates an antenna system in such a way that the antenna rectangle of the antenna system is at least partially (such as for instance at least a 10%, 20%, 30%, 40%, 50% or even 60%) or completely on the projection of the ground plane rectangle of said MFWD. In some other examples, the antenna rectangle is completely outside of the projection of the ground plane rectangle of said MFWD.

[0192] In other examples in which the antenna rectangle of an antenna system is in the projection of the ground plane rectangle of a MFWD in an area of less than 10%, 20% or 30% of the antenna rectangle, the antenna contour of the antenna system preferably features a complexity factor F_{21} larger than 1.20, 1.30, 1.40 or 1.50. In still other examples in which the antenna rectangle of an antenna system is in the projection of the ground plane rectangle of a MFWD in an area larger than 80%, 90% or 95% of said antenna rectangle, the antenna contour of the antenna system preferably features a complexity factor F_{21} smaller 1.30, 1.35, 1.40 or 1.45.

[0193] Another aspect of the integration of an antenna system within a MFWD is the positioning of the antenna system with respect to the one or more bodies comprised in the MFWD.

[0194] An antenna system can be integrated either in the top part of the body of a MFWD (usually, above and/or behind a display), or in the bottom part of a body of the MFWD (usually, below and/or behind a keypad).

[0195] In some examples, an antenna system integrated within the bottom part of a body of a MFWD features advantageously an antenna contour with a complexity factor F_{21} smaller than 1.45 and a complexity factor F_{32} smaller than 1.50, since generally there is quite a bit more space available in such a part of the device. In some other examples, the antenna contour preferably features a factor F_{21} larger than 1.45 and/or a factor F_{32} larger than 1.75.

[0196] In some examples, an antenna system integrated on the top part of the body of a MFWD advantageously features an antenna contour with a complexity factor F_{21} smaller than 1.30, 1.25, or 1.20. In some other examples, the antenna contour preferably features a factor F_{21} larger than 1.45, 1.50 or 1.55.

[0197] In some cases, a two-body MFWD (such as for instance a clamshell or a flip-phone, a twist device, or a slider device) integrates the antenna system in the vicinity of the hinge that allows rotation of at least one of the two bodies. In such cases, the antenna contour of the antenna system preferably features a complexity factor F_{21} larger than 1.20 and/or a complexity factor F_{32} larger than or equal to 1.55.

[0198] Further of advantage for a general trade off between multiple parameters are values of a complexity factor of F_{21} being more than 1.52 and less than 1.65 and/or a complexity factor F_{32} being more than 1.55 and less than 1.70.

Illustration Examples

[0199] Referring now to Figure 1B, there is shown a perspective view of a MFWD 100 comprising, in this particular example, only one body. A volume of space 101 within the MFWD 100 is made available for the integration of an antenna system. The MFWD 100 also comprises a multilayer PCB that includes feeding means and/or grounding means. A layer 102 of the PCB serves as a ground plane of the antenna system.

[0200] An antenna box 103 is obtained as a minimum-sized parallelepiped that completely encloses the volume 101. In this example, the antenna box 103 has rectangular faces 104–109. According to the present invention as described above, the structure of the antenna system comes into contact with each of the six (6) faces of the antenna box 104–109 in at least one point of each face. Moreover, the antenna system of MFWD 100 has no portion that extends outside the antenna box 103.

[0201] An antenna rectangle 110 is obtained as the orthogonal projection of the antenna box 103 along the normal to the face with largest area, which in this case is the direction normal to faces 104 and 105.

[0202] Referring now to Figure 2A, there is shown a top plan view of the MFWD 100. For the sake of clarity, the volume of space 101 has been omitted in figure 2A. A ground plane rectangle 200 is adjusted around the layer 102 that serves as a ground plane to the antenna system of the MFWD 100. The ground plane rectangle 200 is the minimum-sized rectangle in which each of its edges is tangent to at least one point of the perimeter of layer 102.

[0203] Figure 2B depicts the relative position of the ground plane rectangle 200 and the antenna rectangle 110 for the MFWD 100 of Figure 1A. The antenna rectangle 110 has a long side 203 and a short side 204. The ground plane rectangle 110 has a long edge 202 and a short edge 201.

[0204] In this particular example, the antenna rectangle 110 and the ground plane rectangle 200 lie substantially on a same plane (i.e., the antenna rectangle 110 and the ground plane rectangle 200 are substantially coplanar). Furthermore, a long side 203 of the antenna rectangle 110 is substantially parallel to a short edge 201 of the ground plane rectangle 200, while in some other embodiments it will be substantially parallel to a long edge 202 of the ground plane rectangle 200.

[0205] In this example, the antenna rectangle 110 is partially overlapping the ground plane rectangle 200. Although in other cases, they can be completely overlapping or completely non-overlapping. Moreover, in this example the placement of the antenna rectangle 110 is not symmetrical with respect to an axis of symmetry that is parallel to the long edge 202 of the ground plane rectangle 200 and that passes by the middle point of the short edge 201 of said ground plane rectangle 200. In other words, the antenna rectangle 110 is shifted slightly to the left as seen in this view.

[0206] Figure 3 shows an example of a structure of an antenna system contained within an antenna box 301. In this particular example, the structure comprises only one antenna element 300. The antenna element 300 has been shaped to be able to support different radiation modes, in order that the resulting antenna system can operate in multiple frequency bands. In particular, two apertures 302 and 303 with closed perimeters have been created in the antenna element 300. Additionally, the antenna element 300 also features an opening 304 that increases the number of segments that form the perimeter of the antenna element 300. The antenna element 300 also includes two parts 305 and 306 that are bent 90° with respect to the rest of the antenna element 300, but are fully contained in the antenna box 301.

[0207] The bottom part of Figure 3 shows an antenna rectangle 351 associated with the antenna box 301. The antenna rectangle 351 contains the antenna contour 350 associated with the antenna element 300.

[0208] The antenna contour 350 comprises three disjointed subsets of segments: (a) a first subset is formed by the segments of the perimeter 357 (which includes both external segments of the antenna element 300 and those segments added to said antenna element by the opening 304) and the group of segments 356 corresponding to the orthogonal projection of part 306 of the antenna element 300; (b) a second subset is formed by the segments 352 associated to the perimeter of aperture 302; and (c) a third subset is formed by the segments 353 associated to the perimeter of aperture 303.

[0209] Note that in this example, part 305 of the antenna element 300 has an orthogonal projection that completely matches a segment of the perimeter 357, and therefore does not increase the number of segments of the antenna contour 350.

[0210] Referring now to Figure 4 there is shown how the structure of an antenna system such as the one presented in Figure 3 can be obtained by appropriately shaping a rectangular conducting plate 400. The structure in Figure 4 can be seen to have been formed in three steps (top to down) in a manufacturing process of antenna system by means of, for instance, a stamping process.

[0211] The top part of Figure 4 shows the plate 400 occupying (and extending beyond) the antenna rectangle 351 (represented as a dash-dot line). The cut out lines that delimit those parts of the conducting plate 400 that will be removed are depicted as dashed lines. A peripheral part of the plate 400 will be removed, as indicated by the outline 401. Additionally, two closed apertures will be created as defined by outline 402 and outline 403.

[0212] The middle part of Figure 4 shows a planar structure 430 resulting after eliminating the parts of plate 400 that will not be used to create the antenna system. In the planar structure 430, two closed apertures 302 and 303, and an opening 304 can be identified.

[0213] The planar structure 430 has a first part 405, and a second part 406, that extend beyond the antenna rectangle 351. The first and second parts 405 and 406 are bent or folded so that their orthogonal projection does not extend outside the antenna rectangle 351.

[0214] The bottom part of Figure 4 shows the antenna element 300 obtained from the planar structure 430. The antenna element 300 is a three-dimensional structure that fits within the antenna box 301 (also depicted as a dash-dot line). The first part of the planar structure 405 is bent 90 degrees downwards (in the direction indicated by arrow 431) to become part 305 of the antenna element 300. The second part of the planar structure 406 is folded twice to become part 306 of said antenna element 300. The second part 406 is rotated a first time 90 degrees downwards (as indicated by the arrow 432), and then at another point along the second part 406 rotated a second time 90 degrees leftwards (as indicated by the arrow 433).

[0215] Referring now to Figure 5A-B there is shown a MFWD 500 consisting of a single body being typically held by a right-handed user to originate a phone call while facing a display 501 of the MFWD 500. The MFWD 500 comprises an antenna system and a PCB that includes a layer that serves as a ground plane of the antenna system 502 (depicted in dashed line). The antenna system is arranged inside an antenna box, whose antenna rectangle 503, 504 is depicted also in dashed line. The antenna rectangle 503, 504 is in the projection of the ground plane layer 502. In the case of Figure 5A, the antenna rectangle 503 is placed substantially in the top part of the body of the MFWD 500 (i.e., above and/or behind a display 501), while in Figure 5B the antenna rectangle 504 is placed substantially in the bottom part of the body of the MFWD 500 (i.e., below and/or behind a keypad).

[0216] For reasons of ergonomics, it is advantageous in the examples of Figure 5 to select a corner of the antenna rectangle close to the left edge of the MFWD 500. The upper left corner of the antenna rectangle 505 is selected as the feeding point corner in the case of Figure 5A, while the lower left corner of the antenna rectangle 506 is selected as the feeding point corner in the case of Figure 5B. In these two examples the corners designated as feeding point corners 505, 506 are also substantially close to a short edge of a ground plane rectangle (not depicted in Figure 5) that encloses the ground plane layer 502.

[0217] Figure 5C illustrates an alternate embodiment of a MFWD 500 having a clamshell-type configuration. The MFWD 500 includes a lower circuit board 522, an upper circuit board 524, and an antenna system. The antenna system is arranged inside an antenna box, whose antenna rectangle 523 is depicted also in dashed line. The antenna rectangle 523 is secured to a mounting structure 526. Figure 5C further illustrates an upper housing 528, a lower housing 530 that join to enclose the circuit boards 522, 524 and the antenna rectangle 523. The lower circuit board includes a ground plane 532, a feeding point 534, and communications circuitry 536. The antenna rectangle 523 is secured to a mounting structure 526 and coupled to the lower circuit board 522. The lower circuit board 522 is then connected to the upper circuit board 524 with a hinge 538, enabling the lower circuit board 522 and the upper circuit board 524 to be folded together in a manner typical for clamshell-type phones. In some embodiments, the hinge 538 may be adapted to provide rotation of the upper circuit board 524 with respect to the lower circuit board 522 around two or more, preferably non-parallel, axes of rotation, resulting in a MFWD 500 having a twist-type configuration. In order to reduce electromagnetic interference from the circuit boards 522, 524, the antenna rectangle 523 is preferably mounted on the lower circuit board 522 adjacent to the hinge 538.

[0218] Figure 6A-6C represents, respectively examples of a first grid 601, a second grid 602 and a third grid 603 used for the computation of the complexity factors F_{21} and F_{32} of an antenna contour that fits in an antenna rectangle 600. The antenna rectangle 600 has a long side 603 and a short side 604.

[0219] In Figure 6B, the second grid 602 has been adjusted to the size of the antenna rectangle 600. The long side of the antenna rectangle 603 is fitted with nine (9) columns of cells of the second grid 602. As far as the number of rows is concerned, the aspect ratio of the antenna rectangle 600 in this particular example is such that a cell aspect ratio closest to one is obtained when the short side of the antenna rectangle 604 is fitted with five (5) rows of cells of the second grid. Therefore, the antenna rectangle 600 is perfectly tessellated with 9 by 5 cells of the second grid 602.

[0220] Figure 6A shows a possible first grid 601 obtained from grouping 2-by-2 cells of the second grid 602. In this example, the upper left corner of the antenna rectangle 600 is selected as the feeding point corner 605. A first cell of the first grid 606 is placed such that the cell 606 has a corner designated as the feeding point corner 605 and is completely inside the antenna box 600. In the example of Figure 6A, the antenna rectangle 600 spans five (5) columns and three (3) rows of cells of the first grid 601.

[0221] Since the antenna rectangle 600 is tessellated with an odd number of columns and rows of cells of the second grid. An additional column 608 and an additional row 609 of cells of the second grid 602 are necessary to have enough cells of the first grid 601 to completely cover the antenna rectangle 600. The additional column 608 and additional row 609 meet at the lower right corner of the antenna rectangle 607 (i.e., the corner opposite to the feeding point corner 605).

[0222] Figure 6C shows the third grid 603 obtained from dividing each cell of the second grid 602 into four (4) cells. Each cell of the third grid 603 has a cell width and cell height equal a half of the cell width and cell height of a cell of the second grid 602. Thus, in this example the antenna rectangle 600 is perfectly tessellated with eighteen (18) columns and ten (10) rows of cells of the third grid 603.

[0223] Referring now to Figure 7 there is shown a graphical representation of the two-dimensional space 700 defined by the complexity factors F_{21} and F_{32} for an illustrative antenna (not shown). The antenna contour of the illustrative antenna system of a MFWD is represented as a bullet 701 of coordinates (F_{21}, F_{32}) in the two-dimensional space 700.

[0224] Figures 8A-8C provide examples to illustrate the complexity factors that feature two radically different antennas: (1) A solid planar rectangular antenna that occupies the entire area of an antenna rectangle 800 for a MFWD (not specifically shown); and (2) an antenna whose contour is inspired in a Hilbert curve 810 that fills the available space within the antenna rectangle 800 (the antenna structure shown in the rectangle 800 of each of Figures 8A-8C). These two antenna examples, although not advantageous to provide the multiple frequency band behavior required for the antenna system of a MFWD, help to show the relevance and characteristics of the two complexity factors F_{21} and F_{32}.

[0225] Figures 8A-8C show antenna 810 inside the antenna rectangle 800 under a first grid 801, a second grid 802, and a third grid 803. In this example, the antenna rectangle 800 is perfectly tessellated with nine (9) columns and five (5) rows of cells of said second grid 802 (Figure 8b). The antenna 810 has a feeding point 811, located substantially close to the lower left corner of the antenna rectangle 805 (being thus the feeding point corner).

[0226] In Figure 8A, there are fifteen (15) cells of the first grid 801 at least partially inside the antenna rectangle 800 and that include at least a point of the antenna contour of antenna 810 (i.e., N_1=15). In Figure 8B, there are forty-five (45) cells of the second grid 802 completely inside the antenna rectangle 800 and that include at least a point of the antenna contour of the antenna 810 (i.e., N_2=45). Finally in Figure 8C, there are one hundred eighty (180) cells of the third grid 803 completely inside the antenna rectangle 800 and that include at least a point of the antenna contour of the antenna 810 (i.e., N_3=180). Therefore, in the present example, an antenna whose contour is inspired in the Hilbert curve 810 shown within the antenna space 800 of Figures 8A-8C features F_{21}=1.58 (i.e., smaller than 2.00) and F_{32}=2.00.

[0227] On the other hand if the process of counting the cells in each of the three grids is repeated for a planar rectangular antenna whose contour fills the entire rectangular space of the antenna rectangle 800 (not actually shown) then N_1=12, N_2=24 and N_3=52, which results in F_{21}=1.00 and F_{32}=1.12 (i.e., larger than 1.00).

[0228] These results illustrate that complexity factor F_{21} is geared more towards discerning if the antenna contour of a particular antenna system distinguishes sufficiently from a simple planar rectangular antenna rather than capturing the complete intricacy of said antenna contour, while complexity factor F_{32} is predominantly directed towards capturing whether the degree of complexity of the antenna contour approaches to that of a highly-convoluted curve such as a Hilbert curve.

[0229] Figures 9A-9C and 10A-10C provide two examples illustrating the complexity factors that characterize a quasi-rectangular antenna 910 having a highly convoluted perimeter and a triple branch antenna 1010, respectively. These two exemplary antennas help to show the relevance of the two complexity factors.

[0230] Figures 9A-9C show, respectively, the antenna 910 inside an antenna rectangle 900 under a first grid 901, a second grid 902, and a third grid 903. In this example, the antenna rectangle 900 is perfectly tessellated with nine (9) columns and five (5) rows of cells of said second grid 902 (Figure 9b). The antenna 910 has a feeding point 911, located substantially close to the upper left corner of the antenna rectangle 905 (being thus the feeding point corner).

[0231] In Figure 9A, there are twelve (12) cells of the first grid 901 at least partially inside the antenna rectangle 900 and that include at least a point of the antenna contour of antenna 910 (i.e., N_1=12). In Figure 9B, there are twenty-four (24) cells of the second grid 902 completely inside the antenna rectangle 900 and that include at least a point of the antenna contour of the antenna 910 (i.e., N_2=24). Finally in Figure 9C, there are ninety-six (96) cells of the third grid 903 completely inside the antenna rectangle 900 and that include at least a point of the antenna contour of the antenna 910 (i.e., N_3=96). Therefore, in the present example, a quasi-rectangular antenna 910 having a highly convoluted perimeter features F_{21}=1.00 and F_{32}=2.00. This antenna example appears on a coarse scale (as probed e.g. by a long wavelength resonance) quite similar to a simple planar rectangular antenna which is also shown by F_{21} being very low. On the other hand the edge is highly convoluted which will have influence on small wavelength resonances. This feature is characterized by a high value of F_{32}.

[0232] Figures 10A-C show, respectively, antenna 1010 inside the antenna rectangle 1000 under a first grid 1001, a second grid 1002, and a third grid 1003. In this example, the antenna rectangle 1000 is perfectly tessellated with nine (9) columns and five (5) rows of cells of said second grid 1002 (Figure 10b). The antenna 1010 has a feeding point 1011, located substantially close to the bottom left corner of the antenna rectangle 1005 (being thus the feeding point corner).

[0233] As for the antenna 1010 as shown in Figure 10A, there are ten (10) cells of the first grid 1001 at least partially inside the antenna rectangle 1000 and that include at least a point of the antenna contour of antenna 1010 (i.e., N_1=10). In Figure 10B, there are thirty-four (34) cells of the second grid 1002 completely inside the antenna rectangle 1000 and that include at least a point of the antenna contour of the antenna 1010 (i.e., N_2=34). Finally in Figure 10C, there are seventy (70) cells of the third grid 1003 completely inside the antenna rectangle 1000 and that include at least a point of the antenna contour of the antenna 1010 (i.e., N_3=70). Therefore, in the present example, a triple branch antenna, similar to an asymmetric fork, features F_{21}=1.77 and F_{32}=1.04. In this fork example the antenna is not miniaturized since the three branches are essentially straight. This configuration corresponds to a low value of F_{32}. The fork, however is substantially different from a rectangle in that the three branches can be identified clearly and performance of the calculations in accordance with the principles of the invention yields a high value of F_{21}.

[0234] Figure 11 is a graphical presentation that maps the values of the complexity factors F_{21} and F_{32} of the exemplary antennas of figures 6, 8, 9, and 10. In Figure 11 the horizontal axis represents increasing values of F_{21} while the vertical axis represents increasing values of F_{32}. The exemplary simple planar, rectangular antenna discussed above in connection with Figure 6, occupies the entire area of an antenna rectangle 800 and is characterized by a pair of complexity factors F_{21}=1.00 and F_{32}=1.12 that are mapped as bullet 1102 in Figure 11. The complexity factors for the antenna whose contour is discussed above in connection with Figure 8, and that is inspired in a Hilbert curve 810 are F_{21}=1.58 and F_{32}=2.00 and is mapped onto Figure 11 as bullet 1101. The quasi-rectangular antenna, discussed above in connection with Figure 9, and having a highly convoluted perimeter of 910 is characterized by complexity factors F_{21}=1.00 and F_{32}=2.00 and is mapped onto Figure 11 as bullet 1103. Bullet 1104 represents the pair of complexity factors F_{21}=1.77 and F_{32}=1.04 for the exemplary triple branch antenna 1010 discussed above in connection with Figure 10. These antenna examples help to show the value and antenna characteristics represented by the two complexity factors. F_{21} and F_{32} Further, Figure 11 and the bullets 1001-1004 illustrate how a two dimensional graphical space 700 might be used for antenna system design.

[0235] Referring to Figure 11 and the bullet 1102 in connection with the configuration and performance characteristics of the sample planar rectangular antenna of Figure 6 it can be seen that such an antenna has a relatively low level of complexity on both a gross as well as a finer level of detail. Thus, while the antenna is relatively large and resonant at a relatively low frequency, it is less likely to provide multiple frequencies of resonance for multiband performance. As one moves up along the vertical axis toward bullet 1103 in connection with the configuration and performance characteristics of the generally rectangular antenna with a convoluted space-filling perimeter of Figure 9, it can be seen that while the complexity of the antenna remains low at a gross level of detail, the complexity increases at a finer level of detail.

This, in turn, enhances the miniaturization of the antenna to some degree and causes the antenna to resonate at lower harmonic frequencies and behave as a larger antenna than it actually is even though this may not be enough of a change to render the antenna suitable for successful use.

[0236] If one now moves from the origin of the graph of Figure 11 along the horizontal axis toward bullet 1104 in connection with the configuration and performance characteristics of the forked antenna of Figure 10 we see that the antenna has a relatively high level of complexity on a gross level of detail but a low level of complexity at a finer level of detail. These characteristics tend to enrich the frequency of resonance and, thus, its, multiband capabilities as well as, in some respects, its miniaturization. Finally, in moving toward bullet 1101 of Figure 11 in connection with the configuration and performance characteristics of the antenna discussed above in connection with Figure 8, we see that the antenna is highly complex on both gross and fine levels of detail. This produces an antenna with a high degree of miniaturization which tends to penalize the bandwidth of the antenna and render it less than ideal for antenna performance.

[0237] An antenna designer can see that the complexity factors F_{21} and F_{32}, as represented and characterized by the antennas on Figure 6, 8, 9 and 10 and the illustrated graph of Figure 11 are very useful tools for modern antenna design for MFWD and similar devices. Use of these tools in accordance with the invention yields antenna designs, as well as MFWD devices having antennas, with enhanced performance characteristics.

[0238] Figure 12A shows a top-plan view of one illustrated embodiment of the structure 1200 of an antenna system for a MFWD according to the present invention. The antenna rectangle 1210 is depicted as a dashed line. The structure 1200 has been shaped to attain the desired multiple frequency band operation as well as desired RF performance. In particular, peripheral parts of a substantially flat conducting plate have been removed, and slots 1230–1233 have been created within the structure 1200. Slot 1232 divides the structure 1200 into two antenna elements 1201 and 1202. Antenna element 1201 and antenna element 1202 are not in direct contact, although the two antenna elements 1201 and 1202 are in contact through the ground plane of the MFWD.

[0239] The resulting structure 1200 supports different radiation modes so as to operate in accordance with two mobile communication standards: GSM and UMTS. More specifically it operates in accordance with the GSM standard in the 900MHz band (completely within the 810MHz – 960MHz region of the spectrum), in the 1800MHz band (completely within the 1710MHz – 1990MHz region of the spectrum), and in the 1900MHz band (also completely within the 1710MHz – 1990MHz region of the spectrum). The UMTS standard makes use of a band completely within the 1900MHz – 2170MHz region of the radio spectrum. Therefore, the antenna system operates in four (4) separate frequency bands within three (3) separate regions of the electromagnetic spectrum.

[0240] In the example of Figure 12A, the MFWD comprises four (4) contact terminals to couple the structure of said antenna system 1200 with feeding means and grounding means included on a PCB of said MFWD. In Figure 12A, the antenna element 1201 includes a feeding point 1204 and a grounding point 1203, while the antenna element 1202 includes another feeding point 1205 and a grounding point 1206.

[0241] The feeding point 1204 is responsible for the operation of the antenna system in its lowest frequency band (i.e., in accordance with the 900MHz band of the GSM standard). Therefore, the lower left corner of the antenna rectangle 1211 is chosen to be the feeding point corner.

[0242] Figure 12B shows the position of the antenna rectangle relative to the PCB that includes the layer 1220 that serves as a ground plane of the antenna system. The layer 1220 is confined in a minimum-sized rectangle 1221 (depicted in dash-dot line), defining the ground plane rectangle for the MFWD. In this example, the antenna rectangle 1210 is placed substantially in the bottom part of the PCB of said MFWD. Moreover, the antenna rectangle 1210 is substantially parallel to the ground plane rectangle 1221. The antenna rectangle 1210 in this example is completely located in the projection of the ground plane rectangle 1221; however, the antenna rectangle 1210 is not completely on the projection of the ground plane layer 1220 that serves as a ground plane.

[0243] A long side of the antenna rectangle 1210 is substantially parallel to a short edge of the ground plane rectangle. The feeding corner 1211 is near a corner of the ground plane rectangle, providing advantageously a longer path to the electric and/or equivalent magnetic currents flowing on the ground plane layer 1220 to potentially enhance the RF performance of the antenna system or the RF performance of the MFWD in at least a lowest frequency band.

[0244] The antenna contour of the structure of antenna system 1200 of the example in Figure 12A is formed by the combination of two disjoint subsets of segments. A first subset is given by the perimeter of the antenna element 1201 and comprises forty-eight (48) segments. A second subset is given by the perimeter of the antenna element 1202 and comprises twenty-six (26) segments. Additionally, all these segments are shorter than at least one tenth of a free-space wavelength corresponding to the lowest frequency band of operation of said antenna system.

[0245] Moreover, the length of the antenna contour of the structure 1200 is more than six (6) times larger than the length of a diagonal of the antenna rectangle 1210 in which said antenna contour is confined.

[0246] In Figures 13A-13B, the antenna contour of the structure of the antenna system 1200 is placed under a first grid 1301, a second grid 1302, and a third grid 1303 for the computation of the complexity factors of said structure 1200.

[0247] The antenna rectangle 1210 has been fitted with nine (9) columns and five (5) rows of cells of said second grid 1302 (in Figure 13B), as the aspect ratio of the antenna rectangle 1210 is such that fitting five (5) rows of cells in the short side of the antenna rectangle 1210 produces a cell of the second grid 1302 with an aspect ratio closest to one.

[0248] In Figure 13A, there are thirteen (13) cells of the first grid 1301 that, while being at least partially inside the antenna rectangle 1210 and including at least a point of the antenna contour of the structure 1200 (i.e., N_1=13).

[0249] In Figure 13B, there are thirty-eight (38) cells of the second grid 1302 completely inside the antenna rectangle 1210 and that include at least a point of the antenna contour of the structure 1200 (i.e., N_2=38).

[0250] Finally in Figure 13C, there are one hundred and fourteen (114) cells of the third grid 1303 completely inside the antenna rectangle 1210 and that include at least a point of the antenna contour of the structure 1200 (i.e., N_3=114).

[0251] The complexity factor F_{21} for the antenna shown in Figures 12A, 13A and 13B is computed as

$$F_{21} = -\frac{\log(38) - \log(13)}{\log(\frac{1}{2})} = 1.55$$

while the complexity factor F_{32} is obtained as

$$F_{32} = -\frac{\log(114) - \log(38)}{\log(\frac{1}{2})} = 1.58$$

[0252] Therefore, the exemplary structure of antenna system for a MFWD 1200 shown in 12A, 13A and 13B is characterized advantageously by complexity factors F_{21}=1.55 and F_{32}=1.58.

[0253] Figures 14A-14C show, respectively, another exemplary antenna 1410 inside the antenna rectangle 1400 under a first grid 1401, a second grid 1402, and a third grid 1403 for the computation of the complexity factors of the antenna 1410. In this example, the antenna rectangle 1400 may be tessellated with nine (9) columns and five (5) rows of cells of the second grid 1402 (Figure 14B) as well as with nine (9) columns and seven (7) rows of cells of said second grid (not depicted) since in both cases the aspect ratio is at its closest to one. A second grid 1402 with nine (9) columns and five (5) rows of cells has been selected since the aspect ratio for grid 1402 is bigger than 1. The antenna 1410 has a feeding point 1411, located substantially close to the bottom left corner of the antenna rectangle 1405 (being thus the feeding point corner).

[0254] In Figure 14A, there are fifteen (15) cells of the first grid 1401 that, while being at least partially inside the antenna rectangle 1400 and that include at least a point of the antenna contour 1410 (i.e., N_1=15). It should be noted that the cells have been shaded forming the group of cells 1412 to add clarity to the discussion contained herein.

[0255] In Figure 14B, there are forty-two (42) cells of the second grid 1402 completely inside the antenna rectangle 1400 and that include at least a point of the antenna contour 1410 (i.e., N_2=42). These cells are shaded forming the group of cells 1413 for clarity as set forth above.

[0256] Finally in Figure 14C, there are one hundred and forty-two (142) cells of the third grid 1403 completely inside the antenna rectangle 1400 and that include at least a point of the antenna contour of the structure 1410 (i.e., N_3=142). These cells are shaded forming the group of cells 1414 for clarity as set forth above.

[0257] The complexity factor F_{21} is for the antenna shown in Figures 14A-14C computed as

$$F_{21} = -\frac{\log(42) - \log(15)}{\log(\frac{1}{2})} = 1.49$$

while the complexity factor F_{32} is obtained as

$$F_{32} = -\frac{\log(142) - \log(42)}{\log(\frac{1}{2})} = 1.76$$

[0258] Therefore, the example antenna 1410 for a MFWD features advantageously complexity factors F_{21}=1.49 and F_{32}=1.76.

[0259] The antenna complexity contour of the antenna structure 1200, Figures 12A, 13A and 13B is mapped in the graphical representation of Figure 15 as a bullet 1501 with coordinates (F_{21}=1.55 or F_{32}=1.58). The antenna 1410 of Figures 14A-14C is mapped on the graph of Figure 15 as a bullet 1502 with coordinates (F_{21}=1.49 or F_{32}=1.76). Those two examples show cases where intermediate values of F_{21} and F_{32} are used. For intermediate values the value of F_{21} of the structure 1200 is relatively high and in case of the structure 1400 the value of F_{32} is relatively high.

[0260] Referring now to Figures 16 – 19, there is shown one example of optimizing the geometry of an antenna system to obtain a superior performance for MFWDs. In that sense, complexity factors F_{21} and F_{32}, as described above, are useful in guiding the optimization process of the structure of an antenna system to reach a target region of the (F_{21}, F_{32}) plane, as it is depicted in the flowchart 1600 in Figure 16.

[0261] In one embodiment, the process to design an antenna system starts with a set of specifications 1601. A set of specifications includes a list of heterogeneous requirements that relate to mechanical and/or functional aspects of said antenna system. A typical set of specifications may comprise:

- Dimensional information of the MFWD, and more particularly of the space available within the MFWD for the integration of an antenna system (data necessary to define the antenna box and the antenna rectangle) and of the ground-plane of the MFWD (data necessary to define the ground plane rectangle).

- Communication standards operated by the MFWD, and some requirements on RF performance of the antenna system (such as for example, and without limitation, input impedance level, impedance bandwidth, gain, efficiency, and/or radiation pattern) and/or RF performance of the MFWD (such as for example, and without limitation, radiated power, received power and/or sensitivity).

- Information on the functionality envisioned for a given MFWD (i.e., MMT, SMRT, or both), number of bodies the MFWD comprises (for instance whether the MFWD features a bar, clamshell, flip, slider or twist structure), and presence of other electronic modules and/or subsystems in the vicinity of the antenna box, or even (at least partially) within the antenna box.

[0262] As described above, an aspect of the present invention is the relation between functional properties of an antenna system of a MFWD and the geometry of the structure of the antenna system. According to the present invention, a set of specifications for an antenna system can be translated into a certain level of geometrical complexity of the antenna contour associated to the structure of said antenna system, which is advantageously parameterized by means of factors F_{21} and F_{32} described above.

[0263] Therefore, once a set of specifications has been compiled, one embodiment of the design method of the present invention translates the set of specifications into a target region of the (F_{21}, F_{32}) plane 1602. In some examples, the target region is defined by a minimum and/or a maximum value of factor F_{21} (denoted by F_{21}^{min} and F_{21}^{max} in Figure 16), and/or a minimum and/or a maximum value of factor F_{32} (denoted by F_{21}^{min} F_{21}^{max} in Figure 16).

[0264] It will then be advantageous in order to benefit from a superior RF performance of the antenna system and/or a superior RF performance of the MFWD to shape the structure of the antenna system so that its antenna contour features complexity factors within the target region of the (F_{21}, F_{32}) plane.

[0265] Starting from an initial structure of an antenna system 1603, whose antenna contour features complexity factors $F21^0$ and $F32^0$), most likely outside the target region of the (F_{21}, F_{32}) plane, an antenna system designer may need to gradually modify the structure of antenna system 1605 (such as, for instance, creating slots, apertures and/or openings within said structure; or bending and/or folding said structure) to adjust the complexity factors of its antenna contour. This process can be performed in an iterative way, verifying after each step whether factors F21[1] and F31[2] are within the target region of the (F_{21}, F_{32}) plane 1604. Depending on the current values of the complexity factors after step "i" of this iterative process, an antenna system designer can apply changes to the structure of the antenna system at step "i+1" to correct the value of one, or both, complexity factors in a particular direction of the (F_{21}, F_{32}) plane.

[0266] The design process ends 1606 when a structure of the antenna system has an antenna contour featuring complexity factors within the target region of the (F_{21}, F_{32}) plane (denoted by F_{21}* and F_{32}* in Figure 16).

[0267] In further illustration of the above, an example of designing an antenna system of a MFWD can be illustrated by reference to one process to obtain the antenna system of Figure 12a.

[0268] In this particular example, the MFWD is intended to provide advanced functionality typical of a MMT device and/or a SMRT device. The MFWD must operate two mobile communication standards: GSM and UMTS. More specifically it operates the GSM standard in the 900MHz band (completely within the 810MHz – 960MHz region of the spectrum), in the 1800MHz band (completely within the 1710MHz 1990MHz region of the spectrum), and in the 1900MHz band (also completely within the 1710MHz – 1990MHz region of the spectrum). The UMTS standard makes use of a band completely within the 1900MHz – 2170MHz region of the spectrum. The MFWD comprises one RF transceiver to operate each mobile communication standard (i.e., two RF transceivers).

[0269] The MFWD has a bar-type form factor, comprising a single PCB. The PCB includes a ground plane layer 1220, whose shape is depicted in Figure 12B. The antenna system is to be integrated in the bottom part of the PCB, such integration being complicated by the presence of a bus connector and a microphone module.

[0270] In this example the ground plane rectangle 1221 is approximately 100mm x 43mm. The antenna rectangle 1210 has a long side approximately equal to the short side of the ground plane rectangle 1221, and a short side approximately equal to one fourth of the long side of the ground plane rectangle 1221. Also in this example, the space provided within the MFWD for the integration of said antenna system allows placing parts of the structure of the antenna system at a maximum distance of approximately 6mm above the ground plane layer 1220.

[0271] Furthermore, there are additional functional requirements in terms of impedance, VSWR and efficiency levels in each frequency band, and requirements on the mechanical structure of the antenna system and materials to be used. These requirements are listed in Table 1 below.

Parameter	Condition	TARGET			Unit
		Minimum	Typical	Maximum	
Impedance			50		Ohm
Frequency Bands	GSM900	800		960	MHz
	GSM1800	1710		1880	
	GSM1900	1850		1990	
	UMTS	1920		2170	
VSWR	GSM900			3.5:1	
	GSM1800			3.0:1	
	GSM1900			3.0:1	
	UMTS			2.5:1	
Efficiency	GSM900	20			%
	GSM1800	30			
	GSM1900	30			
	UMTS	30			
Antenna System Structure	Type	Patch, PIFA, Monopole, IFA…			
				3	
			2		
				3	
Antenna System Materials	Radiator	Bronze, brass, stainless steel, nickel-silver… (Thickness: 0.1, 0.15, 0.2, 0.3, 0.4, or 0.5mm			
	Plating	Nickel, gold… (Thickness: between 0.1 and 10microns)			
	Carrier	ABS, PC-ABS, POM, LCP			
	Assembly	Clips, screws, adhesive, heat-stakes…			

Table 1

[0272] The PCB area required by other electronic modules carried by the MFWD makes it difficult to remove any additional portions of the ground plane layer 1220 underneath the antenna system. Since substantial overlapping of the antenna rectangle 1210 and the ground plane rectangle 1221 occurs, a patch antenna solution is preferred for the MFWD of this example.

[0273] In order to take full advantage of the dimensions of the ground plane layer 1220 to potentially enhance the RF performance of the antenna system or the RF performance of the MFWD in at least a lowest frequency band, a feeding point of the antenna system will be placed substantially close to the bottom left corner of the ground plane layer 1220, so that a longer path is offered to the electric and/or equivalent magnetic currents flowing on said ground plane layer 1220. Therefore, the bottom left corner of the antenna rectangle 1211 is selected to be the feeding corner.

[0274] The antenna rectangle 1210 is then fitted with nine (9) columns and five (5) rows of cells of a second grid 1302 (in Figure 13B), as the aspect ratio of the antenna rectangle 1210 is such that fitting five (5) rows of cells in the short side of the antenna rectangle 1210 produces a cell of the second grid 1302 with an aspect ratio closest to one.

[0275] Once a set of mechanical and/or functional specifications has been compiled, they are translated into a level of geometrical complexity that the antenna contour associated to the structure of an antenna system needs to attain.

[0276] For those antennas in which their physical properties come quite close to patch antennas, a value of F_{21} being higher than 1.45, 1.47, 1.50, or 1.60 turns out to be a good measure for an expected improved bandwidth or gain with respect to a patch antenna without any complexity in at least one of the frequency bands. In the example of Figure 12, a value of F_{21} higher than 1.50 is preferred.

[0277] For a SMRT or MMT device a value of F_{32} being larger than 1.50, 1.52, 1.55 or 1.60 is desirable. The phones which usually operate in high frequency bands such as UMTS and/or a wireless connectivity of around 2.4 GHz a higher value of F_{32} can be used to appropriately adapt the antenna to a desired resonance frequency and/or bandwidth in those bands. In the example of Figure 12, a value of F_{32} higher than 1.55 is preferred.

[0278] Moreover, for MFWDs which have e.g. a camera or any other item such as a connector integrated in the antenna box, it is desirable to have a value of F_{32} being larger than 1.56, 1.58, 1.60 or 1.63. Therefore, since in the example of Figure 12 a connector and a microphone module are to be integrated in the antenna box alongside the antenna system, it is preferred to further increase the value of F_{32} to make it higher than 1.56.

[0279] In conclusion, it will be advantageous to shape the structure of the antenna system in such a way that its antenna contour features complexity factor F_{21} higher than 1.50 and F_{32} higher than 1.56, thus defining a target region 1800 in the upper right part of the (F_{21}, F_{32}) plane in Figure 18.

[0280] Referring now to Figure 17, there is shown the progressive modification of the antenna contour as the structure of the antenna system through the different steps of the optimization process. As indicated by the designer of the MFWD, a feeding point to couple the RF transceiver that operates the GSM communication standard should be preferably located at point 1722, while a feeding point to couple the RF transceiver that operates the UMTS communication standard should be preferably located at point 1724. Furthermore, grounding points should be preferably located at points 1721 and 1723.

[0281] Table 2 lists for each step the number of cells of the first, second and third grids considered for the computation of the complexity factors of the antenna contour, and the values of said complexity factors F_{21}, F_{32}.

Step	Cells Counted in First Grid (N_1)	Cells Counted in Second Grid (N_2)	Cells counted in Third Grid (N_3)	Complexity Factor $\mathbf{F_{21}}$	Complexity Factor $\mathbf{F_{32}}$
0	12	24	52	1.00	1.12
1	15	31	82	1.05	1.40
2	13	31	82	1.25	1.40
3	13	37	103	1.51	1.48
4	13	38	113	1.55	1.57
5	13	36	103	1.47	1.52
6	13	38	110	1.55	1.53
7	13	38	114	1.55	1.58

Table 2

[0282] As a starting point (step 0), the structure of the antenna system is simply a rectangular plate 1701 occupying the entire antenna rectangle 1210 and placed at the maximum distance allowed above the ground plane layer 1220 (see Figure 17a). In this case the antenna contour is equal to the antenna rectangle 1210, and features complexity factors F_{21}=1.00 and F_{32}=1.12 (represented as point 1801 in Figure 18), obviously outside the target region 1800.

[0283] In the first iteration (step 1), a slot 1702 is practiced in the rectangular plate 1701, dividing said plate 1701 into two separate geometric elements: a larger antenna element 1711 and a smaller antenna element 1712, as shown in Figure 17b. The larger antenna element 1711 will be coupled to the RF transceiver that operates the GSM communication standard, while the smaller antenna element 1712 will be coupled to the RF transceiver that operates the UMTS communication standard.

[0284] The slot 1702 increases the geometrical complexity of the antenna contour, mainly along the F_{32} axis, mapping as point 1802 with coordinates F_{21}=1.05 and F_{32}=1.40 on the (F_{21}, F_{32}) plane.

[0285] In order to offer a longer path to the electrical currents flowing on the antenna element 1711, particularly those currents responsible for a radiation mode associated to the lowest frequency band of said antenna system, the next iteration step (step 2) is initiated. An upper right portion of the antenna element 1711 is removed creating an opening 1703 (Figure 17C). As it can be seen in Table 2, the effect sought when creating opening 1703 in the structure of the antenna system is directed towards enhancing the coarse complexity of the antenna contour (F_{21} increases from 1.05 to 1.25), while leaving its finer complexity unchanged. This modification accounts in Figure 18 for the jump from point 1802 to 1803, still far from the target region 1800. A fringe benefit of creating the opening 1703 in the structure of the antenna system is that additional space within the MFWD, and in particular within the antenna box, is made available for the integration of other functional modules.

[0286] In the next iteration (step 3) a second slot is introduced in the structure of the antenna system (Figure 17D). Slot 1704 is practiced in antenna element 1711 with the main purpose of creating different paths for the currents flowing on said antenna element, so that it can support several radiation modes. The slot 1704 intersects the perimeter of the antenna element 1711 and has two closed ends: a first end 1730 near the left side of the antenna rectangle, and a second end 1731. As a result, the antenna element 1711 comprises a first arm 1732, a second arm 1733, and a third arm 1734.

[0287] From Table 2 it can be seen that the complexity factor F_{21} has been augmented to 1.51 in recognition of the improvement in the multiple frequency band and/or multiple radiation mode behavior of the structure shown in Figure 17D. The convoluted shape of slot 1704 contributes also to an increase of complexity factor F_{32}, reaching the value of 1.48.

[0288] After step 3, the antenna contour corresponds to point 1804 on the (F_{21}, F_{32}) plane of Figure 18. It can be noticed that while F_{21} is already above the minimum value of 1.50, F_{32} has not reached the minimum value of 1.56 yet.

[0289] In order to increase the value of F_{32} (step 4), three small slots 1705, 1706, 1707, are created in the structure of the antenna system, in particular in the antenna element 1711 (see Figure 17E). Slots 1706 and 1707 are connected to slot 1702, introduced in the structure to separate the larger antenna element 1711 from the 15 smaller antenna element 1712. The slots 1705, 1706, 1707 are effective in providing a more winding path for the electrical currents flowing on the arms of antenna element 1711, hence increasing the degree of miniaturization of the resulting antenna system.

[0290] At this stage the antenna contour features complexity factors F_{21}=1.55 and F_{32}=1.57 and maps into point 1805 on the (F_{21}, F_{32}) plane of Figure 18, clearly within the target region 1800.

[0291] However, the design in Figure 17E is to be modified for mechanical reasons (step 5). A portion in the lower left corner of antenna element 1711 is to be removed (creating the opening 1708) in order for the antenna system to fit in its housing in the body of the MFVVD. Moreover in order to accommodate a connector and a microphone module, portion 1740 on the right side of the antenna element 1712 needs to be shortened and then bent 90 degrees downwards (i.e. towards the ground plane layer 1220) forming a capacitive load. Such a modification results in opening 1709.

[0292] Unfortunately, the changes introduced in step 5 lead to an antenna system whose antenna contour is no longer within the target region of the (F_{21}, F_{32}) plane 1800: F_{21} has dropped to 1.47 (i.e., below 1.50) and F_{32} to 1.52 (i.e., below 1.56), which corresponds to point 1806.

[0293] The detuning of the antenna system in its upper frequency band due mostly to the reduction in size of antenna element 1712 can be readily corrected by creating a slot 1760 in said antenna element 1712 (step 6), to increase the electrical length of said antenna element. With this modification, the antenna contour of Figure 17G has fully restored the value of F_{21} to 1.55, and partially that of F_{32} (point 1807 in Figure 18).

[0294] A final fine-tuning of the structure of the antenna system is performed at step 7 (Figure 17H) aimed at restoring the level of F_{32} to be within the target region 1800, in which small indentations 1770, 1771, 1772, 1773, 1774 are created in the proximity of the feeding points 1722, 1724 and grounding points 1721, 1723 of the antenna system. The final design of the antenna system has a structure whose antenna contour features F_{21}=1.55 and F_{32}=1.58 (represented as point 1808 in Figure 18), well within the target region of the (F_{21}, F_{32}) plane 1800.

[0295] The typical performance of the antenna system of Figure 12a (or Figure 17h) is presented in Figure 19.

[0296] Referring specifically to Figure 19A, there is shown the VSWR of the antenna system referred to an impedance of 50 Ohms as a function of the frequency. Solid curve 1901 represents the VSWR of antenna element 1711 (i.e., the antenna element coupled to the RF transceiver that operates the GSM communication standard), while dashed curve 1902 represents the VSWR of antenna element 1712 (i.e., the antenna element coupled to the RF transceiver that operates the UMTS communication standard). The shaded regions 1903 and 1904 correspond to the mask of maximum VSWR allowed constructed from the functional specifications provided in Table 1. As it can be observed in Figure 19A, the VSWR curves 1901, 1902 are below the mask 1903, 1904 for all frequencies within the frequency bands of operation of the antenna system.

[0297] Figure 19B shows the efficiency of the antenna system as a function of the frequency. Curve 1951 represents the efficiency of antenna element 1711 in the 900MHz band of the GSM standard; curve 1952 represents the efficiency of antenna element 1711 in the 1800MHz and 1900MHz bands of the GSM standard; and curve 1953 represents the efficiency of antenna, element 1712 in the frequency band of the UMTS standard. The dashed regions 1954 and 1955 correspond to the mask of minimum efficiency required constructed from the functional specifications provided in Table 1. As it can be observed in Figure 19b, the efficiency curves 1951, 1952, 1953 are above the mask 1954, 1955 for all frequencies within the frequency bands of operation of the antenna system.

[0298] Figures 20A-20F illustrate cross-sectional views of exemplary MFWDs comprising three bodies in which at least one body is rotated with respect to another body around two parallel axes.

[0299] Figures 20A-B illustrate a MFWD 2000 comprising a first body 2001, a second body 2002, and a third body 2003. A first connecting means 2004, such as, for example, a hinge, connects the first body 2001 to the third body 2003 and provides rotation of the first body 2001 around a first axis. A second connecting means 2005 connects the second body 2002 to the third body 2003 and provides rotation of the second body 2002 around a second axis. The first and second axes of rotation are parallel to each other and each of the axes is perpendicular to the cross-sectional plane of the figure. In this particular example, the third body 2003 is substantially smaller in size than the first and second bodies 2001, 2002 of the MFWD 2000.

[0300] Figure 20A illustrates the three bodies 2001, 2002, 2003 of the MFWD 2000 in a closed (or folded) state. The dashed lines indicate the position occupied by the centers of the first body 2001 and that of the second body 2002 when they are in the closed state.

[0301] Figure 20B illustrates the MFWD 2000 in a partially extended state. The first body 2001 and the second body 2002 are displaced with respect to a position they occupy in the closed state. The possible directions of rotation of the first body 2001 and the second body 2002 are indicated by the arrows.

[0302] Figures 20C-20D illustrate a MFWD 2030 comprising a first body 2031, a second body 2032, and a third body 2033. The MFWD 2030 further comprises a first connecting means 2034 connecting the first body 2031 to the third body 2033 and provides rotation of the first body 2031 around a first axis. The MFWD 2030 further comprises a second connecting means 2035 connecting the second body 2032 to the third body 2033 and provides rotation of the second body 2032 around a second axis. As shown in Figures 20A-20B, the first and second axes of rotation are parallel to each other.

[0303] In this particular example, the third body 2033 is substantially larger than the first and second bodies 2031, 2032 of the MFWD 2030, allowing the first body 2031 and the second body 2032 to be folded on top of the third body 2033 (and more generally on a same side of the third body 2033) when the MFWD 2030 is in its closed state, as illustrated in Figure 20C. In some cases, the first body 2031 and the second body 2032 will be substantially equal in size, while in other cases, the first body 2031 and the second body 2032 will have substantially different dimensions.

[0304] Figure 20D illustrates the MFWF 2030 in a partially extended state. In the partially extended state, the first body 2031 is rotated around the first rotation axis provided by the first connecting means 2034, while the second body 2032 is rotated around the second rotation axis provided by the second connecting means 2035.

[0305] A third example of a MFWD is presented in Figure 20E-F, in which the MFWD 2060 comprises a first body 2061, a second body 2062, and a third body 2063. According to this example, the first, second, and third bodies 2061, 2062, 2063 can be selectively folded and unfolded by means of a first connecting means 2064 and a second connecting means 2065.

[0306] Figure 20E illustrates the MFWD 2060 in a closed state. In this example, the first body 2061 is located on top of the third body 2063 while the second body 2062 is located below the third body 2063 (and more generally on an opposite side of the third body 2063).

[0307] The MFWD 2060 can be extended to its maximum size state by rotating the first body 2061 around a first rotation axis provided by the first connecting means 2064 and rotating the second body 2062 around a first rotation axis provided by the second connecting means 2065. Figure 20F represents the MFWD 2060 in a partially extended state. The directions of rotation of the first body 2061 and the second body 2062 are indicated by means of the arrows shown in figure 20F.

[0308] As can be seen from the various examples and explanations above the use of the complexity factor F_{21} and F_{32} in accordance with the principles of the present invention are very useful in the design of MFWD devices and, in particular, multiband antennas for such devices. The choice of certain complexity factor ranges to optimize both the miniaturization of the antenna as well as the multiband and RF performance characteristics, all in accordance with the principles of the invention, should be clear to one of ordinary skill in the art from the above explanations.

[0309] The previous Detailed Description is of embodiment(s) of the invention. The scope of the invention should not necessarily be limited by this Description. The scope of the invention is instead defined by the following claims and the equivalents thereof.

COMBINED DECLARATION (37 CFR 1.63) AND ASSIGNMENT FOR UTILITY OR DESIGN APPLICATION

Title of the Invention	MULTIPLE-BODY-CONFIGURATION MULTIMEDIA AND SMARTPHONE MULTIFUNCTION WIRELESS DEVICES

DECLARATION

As a below named inventor, I hereby declare that:

This declaration is directed to the above-identified application for United States Letters Patent and further identified by the Attorney Docket Number provided above in the header of this document.

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims.

I acknowledge the duty to disclose to the Office all information known to me to be material to patentability as defined in 37 CFR §1.56.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

ASSIGNMENT

For good and valuable consideration, the undersigned inventor(s), hereinafter individually or collectively referred to as "Assignor";

Hereby sell, assign and transfer to **Fractus, S.A.**, a corporation organized and existing under the laws of Spain, having its principal place of business at Avda. Alcalde Barnils, 64-68, Edificio Testa - Módulo C, 3°, Parque Empresarial Sant Joan, Sant Cugat del Vallès, E-08190 Barcelona, Spain, hereinafter "Assignee", its successors, assigns and legal representatives, the entire right, title and interest in and for the United States and all foreign countries, in and to any and all improvements which are disclosed in the above-identified application for United States Letters Patent, and in and to said application and all divisional, continuing, substitute, renewal, reissue, and all other applications for Letters Patent which have been or shall be filed in the United States and all foreign countries on any of said improvements; and in and to all original and reissued patents which have been or shall be filed in the United States and all foreign countries on said improvements;

Agree that said Assignee may apply for and receive Letters Patent for said improvements in its own name; and that, when requested, without charge to but at the expense of said Assignee, its successors, assigns and legal representatives, to carry out in good faith the intent and purpose of this assignment, the undersigned will execute all divisional, continuing, substitute, renewal, reissue, and all other patent applications on any and all said improvements; execute all rightful oaths, assignments, powers of attorney and other papers; communicate to said Assignee, its successors, assigns, and legal representatives, all facts known to the undersigned relating to said improvements and the history thereof; and generally do everything possible which said Assignee, its successors, assigns or legal representatives shall consider desirable for aiding in securing and maintaining proper patent protection for said improvements and for vesting title to said improvements and all applications for patents and all patents on said improvements, in said Assignee, its successors, assigns and legal representatives; and

Covenant with said Assignee, its successors, assigns and legal representatives that no assignment, grant, mortgage, license or other agreement affecting the rights and property herein conveyed has been made to others by the undersigned, and that full right to convey the same as herein expressed is possessed by the undersigned.

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Note: An application data sheet (PTO/AIA/14 or equivalent), naming the entire inventive entity, either accompanies this form or was filed previously and thus is currently of record in the file.

WHAT IS CLAIMED IS:

1. A wireless device comprising:

an antenna system comprising a ground plane layer and at least four antennas within the wireless device, the antenna system comprising:

a first antenna configured to support at least three frequency bands contained within a first and second frequency regions of the electromagnetic spectrum, the second frequency region being higher in frequency than the first frequency region, the first antenna being proximate to a first short side of a ground plane rectangle defined by the ground plane layer, the first antenna defining a first antenna contour comprising the perimeter of the first antenna being placed in a first antenna box, the first antenna box being a minimum-sized parallelepiped that completely encloses the volume of the first antenna and wherein each one of the faces of the minimum-sized parallelepiped is tangent to at least one point of the volume of the first antenna, and 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 complexity factor F_{32} having a value of at least 1.35;

a second antenna configured to support at least two frequency bands contained within the second frequency region, the second antenna being proximate to the first short side of the ground plane rectangle;

a third antenna configured to support at least two frequency bands contained within the first and second frequency regions, wherein the third antenna defines a second antenna contour comprising a perimeter of the third antenna placed in a second antenna box, an orthogonal projection of the second antenna box along a normal to a face with a largest area of the second antenna box defining an antenna rectangle, an aspect ratio of the antenna rectangle being defined as a ratio between the width and the height of the antenna rectangle, and wherein the aspect ratio has a value of at least 2; and

a fourth antenna configured to support at least two frequency bands contained within the second frequency region, and wherein the fourth antenna is proximate to a second short side being opposite to the first short side of the ground plane rectangle.

2. The wireless device of claim 1, wherein the third antenna is proximate to the second short side of the ground plane rectangle.

3. The wireless device of claim 2, wherein the perimeter of the second antenna contour comprises at least 20 segments.

4. The wireless device of claim 2, wherein a complexity factor F_{32} of the fourth antenna has a value of at least 1.35.

5. The wireless device of claim 2, wherein the first antenna is configured to transmit and receive signals from a 4G communication standard.

6. The wireless device of claim 5, wherein the fourth antenna is configured to receive signals from a 4G communication standard.

7. The wireless device of claim 6, wherein the fourth antenna is proximate to a corner of the ground plane rectangle.

8. The wireless device of claim 3, wherein the perimeter of the second antenna defines a third antenna contour having a level of complexity defined by complexity factor F_{21} having a value of at least 1.15.

9. The wireless device of claim 8, wherein the third antenna contour has a level of complexity defined by complexity factor F_{32} having a value lower than 1.50.

10. A wireless device comprising:

an antenna system comprising a ground plane layer and at least four antennas within the wireless device, the antenna system comprising:

a first antenna having a conductive plate configured to support radiation modes in at least two frequency bands contained within a first and a second frequency regions of the electromagnetic spectrum, the second frequency region being higher in frequency than the first frequency region, the first antenna being proximate to a first short side of a ground plane rectangle defined by the ground plane layer, the first antenna defining a first antenna contour comprising the perimeter of the first antenna placed in a first antenna box, an orthogonal projection of the first antenna box along a normal to a face with a largest area of the first antenna box defining a first antenna rectangle, an aspect ratio of the first antenna rectangle being defined as a ratio between the width and the height of the first antenna rectangle, and wherein the aspect ratio has a value of at least 2;

a second antenna having a conductive plate configured to support radiation modes in at least two frequency bands contained within the second frequency region of the electromagnetic spectrum, wherein the second antenna is proximate to the first short side of the ground plane rectangle;

a third antenna placed in a second antenna box, the third antenna having a conductive plate configured to support radiation modes in at least three frequency bands contained within the first and second frequency regions of the electromagnetic spectrum, and wherein the perimeter of the third antenna defines a second antenna contour having a level of complexity defined by complexity factor F_{21} having a value of at least 1.20 and complexity factor F_{32} having a value of at least 1.35; and

a fourth antenna having a conductive plate configured to support radiation modes in at least two frequency bands contained within the second frequency region, the fourth antenna being proximate to a second short side being opposite to the first short side of the ground plane rectangle.

11. The wireless device of claim 10, wherein the first antenna is configured to transmit and receive signals from a 4G communication standard.

12. The wireless device of claim 11, wherein the first antenna contour comprises at least 20 segments.

13. The wireless device of claim 11, wherein the second antenna is placed in a third antenna box, an orthogonal projection of the third antenna box along a normal to a face with a largest area of the third antenna box defining a second antenna rectangle, the aspect ratio of the second antenna rectangle being defined as the ratio between the width and the height of the second antenna rectangle, and wherein the aspect ratio has a value of at least 2.

14. The wireless device of claim 11, wherein the third antenna is proximate to the second short side of the ground plane rectangle.

15. The wireless device of claim 14, wherein the perimeter of the fourth antenna defines a third antenna contour having a level of complexity defined by complexity factor F_{32} complexity factor having a value less than 1.75.

16. The wireless device of claim 14, wherein the fourth antenna is configured to provide wireless connectivity.

17. The wireless device of claim 13, wherein the perimeter of the second antenna defines a fourth antenna contour, and wherein the length of the fourth antenna contour being greater than two times a diagonal of the second antenna rectangle.

18. The wireless device of claim 17, wherein the second antenna is proximate to a first corner of the ground plane rectangle.

19. The wireless device of claim 15, wherein the complexity factor F_{21} having a value higher than 1.15.

20. The wireless device of claim 19, wherein the complexity factor F_{32} having a value higher than 1.35.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	0690.0023CN4
	Application Number	

Title of Invention	Multiple-Body-Configuration Multimedia and Smartphone Multifunction Wireless Devices

The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76.
This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.

Secrecy Order 37 CFR 5.2:

☐ Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	0690.0023CN4
	Application Number	

Title of Invention	Multiple-Body-Configuration Multimedia and Smartphone Multifunction Wireless Devices

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All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the **Add** button. Add

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below. For further information see 37 CFR 1.33(a).

☐ **An Address is being provided for the correspondence Information of this application.**

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Application Information:

Title of the Invention	Multiple-Body-Configuration Multimedia and Smartphone Multifunction Wireless Devices		
Attorney Docket Number	0690.0023CN4	**Small Entity Status Claimed**	☐
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	29	**Suggested Figure for Publication (if any)**	

Filing By Reference:

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	0690.0023CN4
	Application Number	
Title of Invention	Multiple-Body-Configuration Multimedia and Smartphone Multifunction Wireless Devices	

Publication Information:

☐	Request Early Publication (Fee required at time of Request 37 CFR 1.219)
☐	**Request Not to Publish.** I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application **has not and will not** be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32).
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Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, 365(c), or 386(c) or indicate National Stage entry from a PCT application. Providing benefit claim information in the Application Data Sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.
When referring to the current application, please leave the "Application Number" field blank.

Prior Application Status	Pending		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
	Continuation of	15/856626	2017-12-28

Prior Application Status	Patented				Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
15/856626	Continuation of	14/738090	2015-06-12	9899727	2018-02-20

Prior Application Status	Patented				Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
14/738090	Continuation of	14/246491	2014-04-07	9099773	2015-08-04

Prior Application Status	Patented				Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
14/246491	Continuation of	11/614429	2006-12-21	8738103	2014-05-27

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	0690.0023CN4
	Application Number	
Title of Invention	Multiple-Body-Configuration Multimedia and Smartphone Multifunction Wireless Devices	

Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
11/614429	Claims benefit of provisional	60/831544	2006-07-18
Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
11/614429	Claims benefit of provisional	60/856410	2006-11-03
Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the **Add** button.			Add

Foreign Priority Information:

This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55. When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX)[i] the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(i)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

			Remove
Application Number	Country[i]	Filing Date (YYYY-MM-DD)	Access Code[i] (if applicable)
06117352.2	EP	2006-07-18	
Additional Foreign Priority Data may be generated within this form by selecting the **Add** button.			Add

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

☐ This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013.
NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	0690.0023CN4
	Application Number	

Title of Invention	Multiple-Body-Configuration Multimedia and Smartphone Multifunction Wireless Devices

Authorization or Opt-Out of Authorization to Permit Access:

When this Application Data Sheet is properly signed and filed with the application, applicant has provided written authority to permit a participating foreign intellectual property (IP) office access to the instant application-as-filed (see paragraph A in subsection 1 below) and the European Patent Office (EPO) access to any search results from the instant application (see paragraph B in subsection 1 below).

Should applicant choose not to provide an authorization identified in subsection 1 below, applicant **must opt-out** of the authorization by checking the corresponding box A or B or both in subsection 2 below.

NOTE: This section of the Application Data Sheet is **ONLY** reviewed and processed with the **INITIAL** filing of an application. After the initial filing of an application, an Application Data Sheet cannot be used to provide or rescind authorization for access by a foreign IP office(s). Instead, Form PTO/SB/39 or PTO/SB/69 must be used as appropriate.

1. Authorization to Permit Access by a Foreign Intellectual Property Office(s)

A. Priority Document Exchange (PDX) - Unless box A in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the State Intellectual Property Office of the People's Republic of China (SIPO), the World Intellectual Property Organization (WIPO), and any other foreign intellectual property office participating with the USPTO in a bilateral or multilateral priority document exchange agreement in which a foreign application claiming priority to the instant patent application is filed, access to: (1) the instant patent application-as-filed and its related bibliographic data, (2) any foreign or domestic application to which priority or benefit is claimed by the instant application and its related bibliographic data, and (3) the date of filing of this Authorization. See 37 CFR 1.14(h)(1).

B. Search Results from U.S. Application to EPO - Unless box B in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the EPO access to the bibliographic data and search results from the instant patent application when a European patent application claiming priority to the instant patent application is filed. See 37 CFR 1.14(h)(2).

The applicant is reminded that the EPO's Rule 141(1) EPC (European Patent Convention) requires applicants to submit a copy of search results from the instant application without delay in a European patent application that claims priority to the instant application.

2. Opt-Out of Authorizations to Permit Access by a Foreign Intellectual Property Office(s)

☐ A. Applicant **DOES NOT** authorize the USPTO to permit a participating foreign IP office access to the instant application-as-filed. If this box is checked, the USPTO will not be providing a participating foreign IP office with any documents and information identified in subsection 1A above.

☐ B. Applicant **DOES NOT** authorize the USPTO to transmit to the EPO any search results from the instant patent application. If this box is checked, the USPTO will not be providing the EPO with search results from the instant application.

NOTE: Once the application has published or is otherwise publicly available, the USPTO may provide access to the application in accordance with 37 CFR 1.14.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	0690.0023CN4
	Application Number	
Title of Invention	Multiple-Body-Configuration Multimedia and Smartphone Multifunction Wireless Devices	

Applicant Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Applicant 1 Remove

If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.

Clear

● Assignee	Legal Representative under 35 U.S.C. 117	Joint Inventor
Person to whom the inventor is obligated to assign.	Person who shows sufficient proprietary interest	

If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:

Name of the Deceased or Legally Incapacitated Inventor:

If the Applicant is an Organization check here. ☒

Organization Name	Fractus, S.A.		
Mailing Address Information For Applicant:			
Address 1	Avda. Alcalde Barnils, 64-68		
Address 2	Sant Cugat del Valles		
City	Barcelona	**State/Province**	
Country	ES	Postal Code	E-08174
Phone Number		Fax Number	
Email Address			

Additional Applicant Data may be generated within this form by selecting the Add button. Add

Assignee Information including Non-Applicant Assignee Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	0690.0023CN4
	Application Number	
Title of Invention	Multiple-Body-Configuration Multimedia and Smartphone Multifunction Wireless Devices	

Assignee 1

Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication. An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.

Remove

If the Assignee or Non-Applicant Assignee is an Organization check here. ☐

Prefix	**Given Name**	Middle Name	**Family Name**	Suffix

Mailing Address Information For Assignee including Non-Applicant Assignee:

Address 1			
Address 2			
City		**State/Province**	
Country i		Postal Code	
Phone Number		Fax Number	
Email Address			

Additional Assignee or Non-Applicant Assignee Data may be generated within this form by selecting the Add button. Add

Signature:

Remove

NOTE: This Application Data Sheet must be signed in accordance with 37 CFR 1.33(b). **However, if this Application Data Sheet is submitted with the <u>INITIAL</u> filing of the application <u>and</u> either box A or B is <u>not</u> checked in subsection 2 of the "Authorization or Opt-Out of Authorization to Permit Access" section, then this form must also be signed in accordance with 37 CFR 1.14(c).**

This Application Data Sheet **must** be signed by a patent practitioner if one or more of the applicants is a **juristic entity** (e.g., corporation or association). If the applicant is two or more joint inventors, this form must be signed by a patent practitioner, **all** joint inventors who are the applicant, or one or more joint inventor-applicants who have been given power of attorney (e.g., see USPTO Form PTO/AIA/81) on behalf of **all** joint inventor-applicants.

See 37 CFR 1.4(d) for the manner of making signatures and certifications.

Signature	/Patrick J. Finnan/			Date (YYYY-MM-DD)	2020-03-27
First Name	Patrick	Last Name	Finnan	Registration Number	39189

Additional Signature may be generated within this form by selecting the Add button. Add

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	0690.0023CN4
	Application Number	

Title of Invention	Multiple-Body-Configuration Multimedia and Smartphone Multifunction Wireless Devices

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1 The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3 A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent CooperationTreaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

ABSTRACT

A multifunction wireless device having at least one of multimedia functionality and smartphone functionality, the multifunction wireless device including an upper body and a lower body, the upper body and the lower body being adapted to move relative to each other in at least one of a clamshell, a slide, and a twist manner. The multifunction wireless device further includes an antenna system disposed within at least one of the upper body and the lower body and having a shape with a level of complexity of an antenna contour defined by complexity factors F_{21} having a value of at least 1.05 and not greater than 1.80 and F 32 having a value of at least 1.10 and not greater than 1.90.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No.	:	Not Yet Assigned
First Named Inventor	:	Carles PUENTE BALIARDA
Confirmation No.	:	Unknown
Filed	:	Herewith
TC/A.U.	:	Unknown
Examiner	:	Unknown
Customer No.	:	27896
Docket No.	:	0690.0023CN4
Title	:	Multiple-Body-Configuration Multimedia and Smartphone Multifunction Wireless Devices

INFORMATION DISCLOSURE STATEMENT UNDER 37 C.F.R. §§ 1.97 & 1.98

Pursuant to the duty imposed by 37 C.F.R. §1.56 to disclose information which may be material to the patentability of the above-identified patent application, the Applicant would like to direct the Examiner's attention to the documents listed on the enclosed Information Disclosure Citation Form (PTO/SB/08A).

Applicant hereby submits the attached IDS under:

☒ 37 C.F.R. 1.97(b) (i.e., within three months of the filing date of the application; within three months of the date of entry of the national stage application; before the mailing of a first Office action; or before the mailing of a first Office action after the filing of a request for continued examination).

☐ 37 C.F.R. 1.97(c) (i.e., after the mailing of a first Office action, but before the close of prosecution). The IDS is accompanied by *one* of: (1) the appropriate statement (indicated on Form PTO/SB08a) <u>or</u> (2) the fee set forth in § 1.17(p).

☐ 37 C.F.R. 1.97 (d) (i.e., after the close of prosecution, but on or before payment of the issue fee). The IDS is accompanied by *both* of (1) the appropriate statement (indicated on Form PTO/SB08a) <u>and</u> (2) the fee set forth in § 1.17(p).

☐ The IDS cites foreign documents not in English. Pursuant to 37 C.F.R. 1.98(a)(3), a concise explanation of the relevance is provided as indicated below:

☐ Enclosed is a copy of a non-English publication(s) _____. Applicant submits an English-language version of the search report or action, which cites such non-English language publication(s) and indicates the degree of relevance found by the foreign office.

☐ Enclosed is a copy of a non-English publication(s) _____. Applicant submits an English language abstract of the non-English publication(s).

☐ Other:

☐ The IDS cites foreign patent documents in English and/or Non-Patent Literature (NPL) Documents. Applicant submits a copy of the Abstract or of the complete publication.

☐ Pursuant to 37 C.F.R. 1.98(a)(2)(iii), enclosed is a copy of pending patent Application Serial No. _____.

☒ No copies of the non-English or non-patent publications listed on the attached Form PTO/SB/08A are being provided pursuant to 37 C.F.R. §1.98(d) because the publications were previously cited by or submitted to the Office in prior Application Serial No. 15/856,626, to which the above-identified application claims priority under 35 U.S.C. §120.

The submission of the listed documents is not intended as an admission that any such document constitutes prior art against the claims of the present application. Applicant does not waive any right to take any action that would be appropriate to antedate or otherwise remove any listed document as a competent reference against the claims of the present application.

The Director is hereby authorized to charge any additional appropriate fees that may be required for the above-identified application, and to credit any overpayment, to Deposit Account No. **05-0460**.

Dated: March 27, 2020

Respectfully submitted by:

/Patrick J. Finnan/

Patrick J. Finnan
Reg. No. 39189

EDELL, SHAPIRO & FINNAN, LLC
CUSTOMER NO. 27896
9801 Washingtonian Blvd., Suite 750
Gaithersburg, MD 20878
(301) 424-3640

PTO/AIA/82B(07-12)
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U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

POWER OF ATTORNEY BY APPLICANT

I hereby revoke all previous powers of attorney given in the application identified in the attached transmittal letter.

[✓] I hereby appoint Practitioner(s) associated with the following Customer Number as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the application referenced in the attached transmittal letter (form PTO/AIA/82A or equivalent): 27896

OR

[ ] I hereby appoint Practitioner(s) named below as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the application referenced in the attached transmittal letter (form PTO/AIA/82A or equivalent):

Name	Registration Number	Name	Registration Number

Please recognize or change the correspondence address for the application identified in the attached transmittal letter to:

[✓] The address associated with the above-mentioned Customer Number

OR

[ ] The address associated with Customer Number:

OR

[ ] Firm or Individual Name					
Address					
City		State		Zip	
Country					
Telephone		Email			

I am the Applicant:

[ ] Inventor or Joint Inventor

[ ] Legal Representative of a Deceased or Legally Incapacitated Inventor

[✓] Assignee or Person to Whom the Inventor is Under an Obligation to Assign

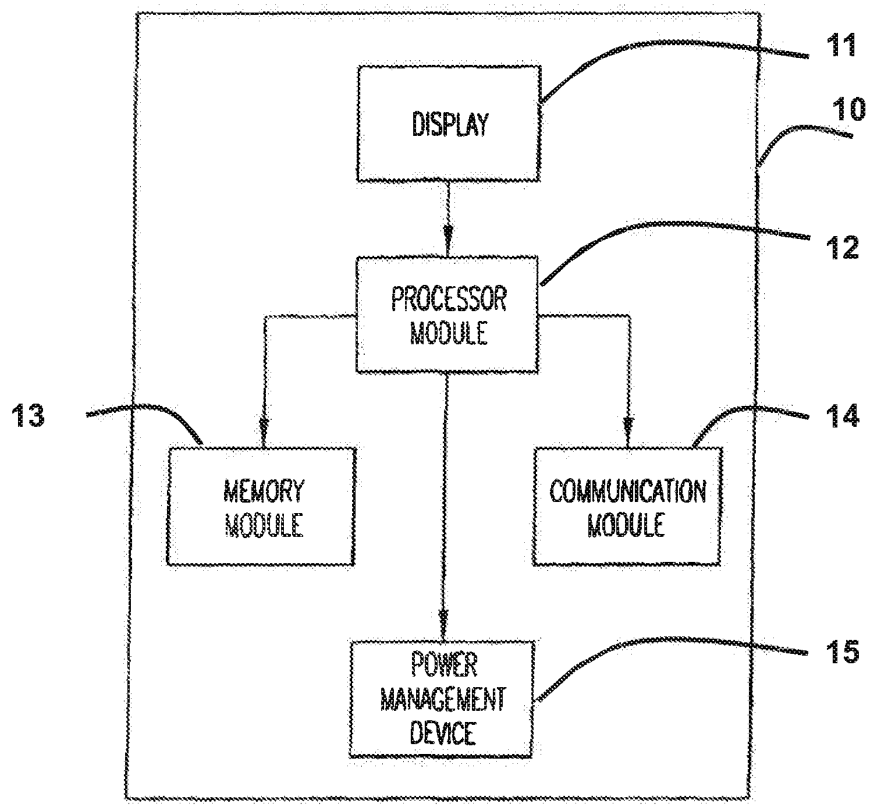
[ ] Person Who Otherwise Shows Sufficient Proprietary Interest (*e.g.*, a petition under 37 CFR 1.46(b)(2) was granted in the application or is concurrently being filed with this document)

SIGNATURE of Applicant for Patent

Signature		Date	7 Jan 2013
Name		Telephone	
Title and Company	CEO, [illegible] S.A.		

NOTE: Signature - This form must be signed by the applicant in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. Submit multiple forms for more than one signature, see below*.

[ ] *Total of ____________ forms are submitted.


DISPLAY
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MEMORY MODULE
COMMUNICATION MODULE
POWER MANAGEMENT DEVICE
10
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FIG. 1A

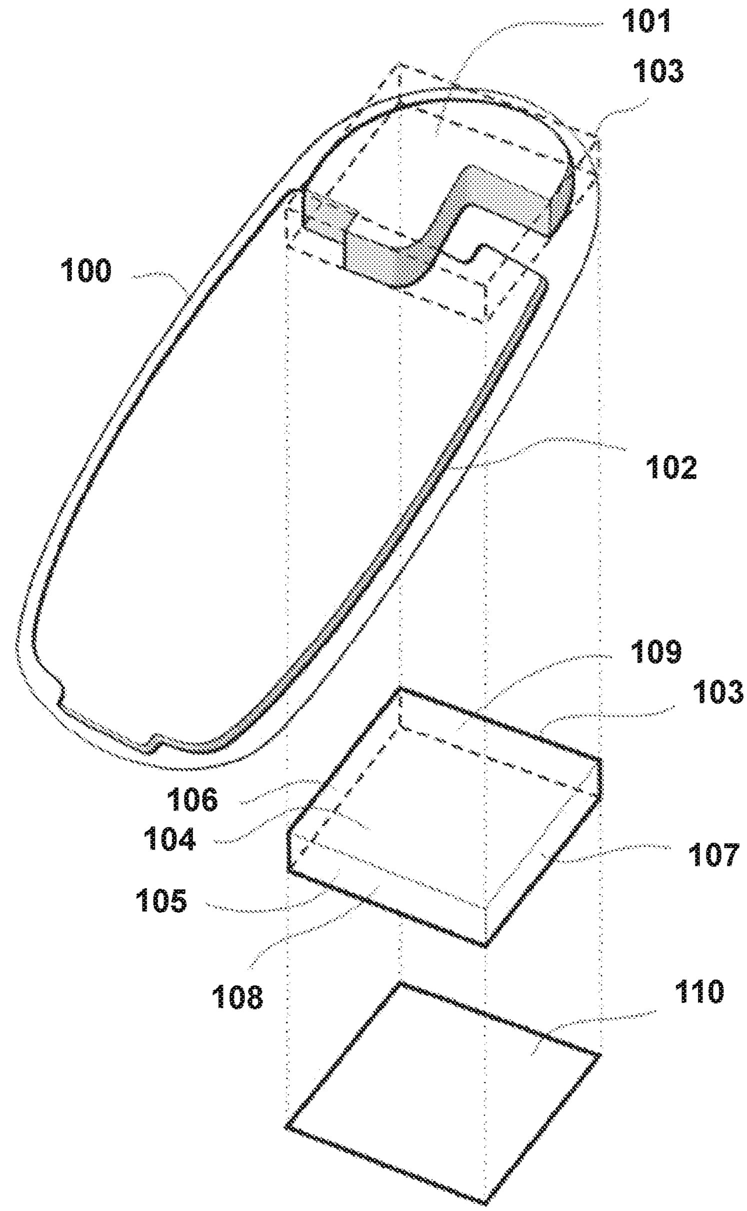

FIG. 1B

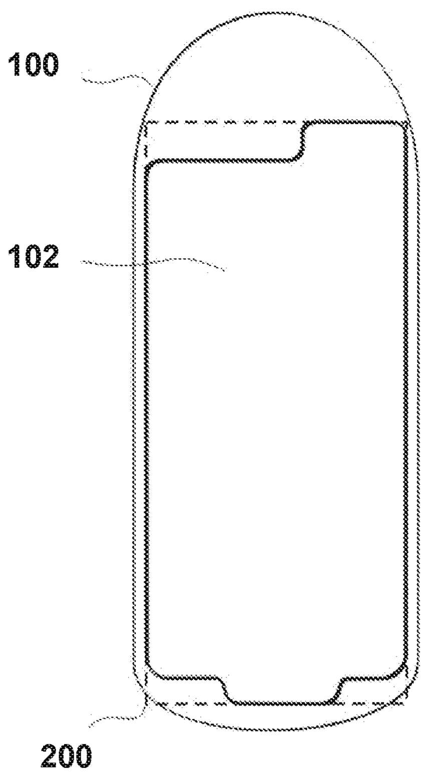

FIG. 2A

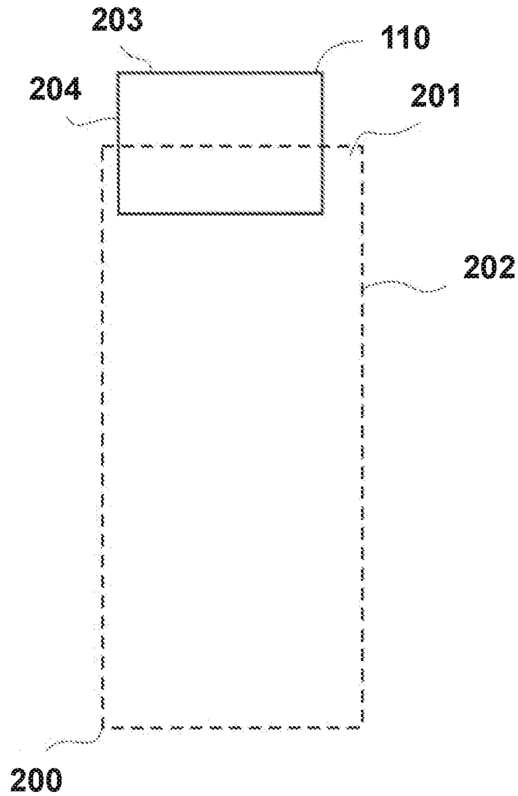

FIG. 2B

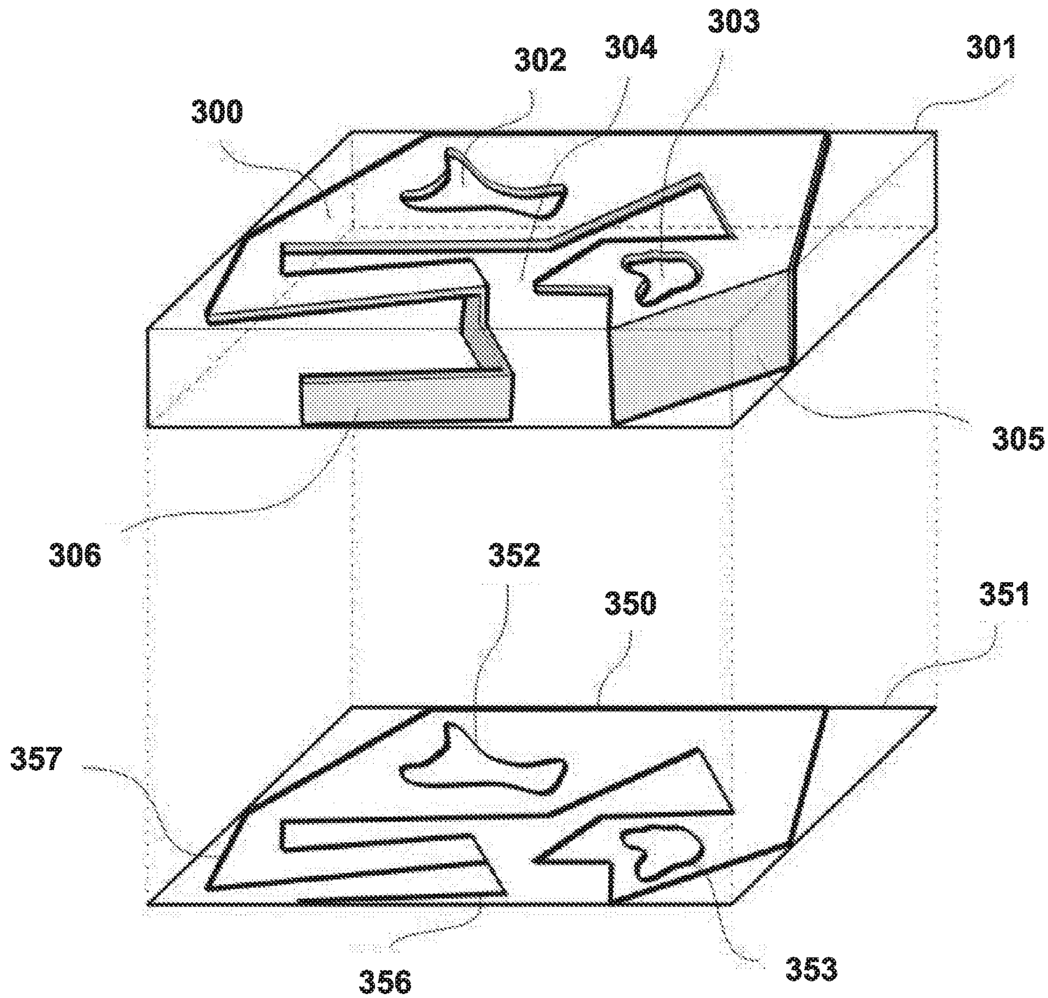

FIG. 3

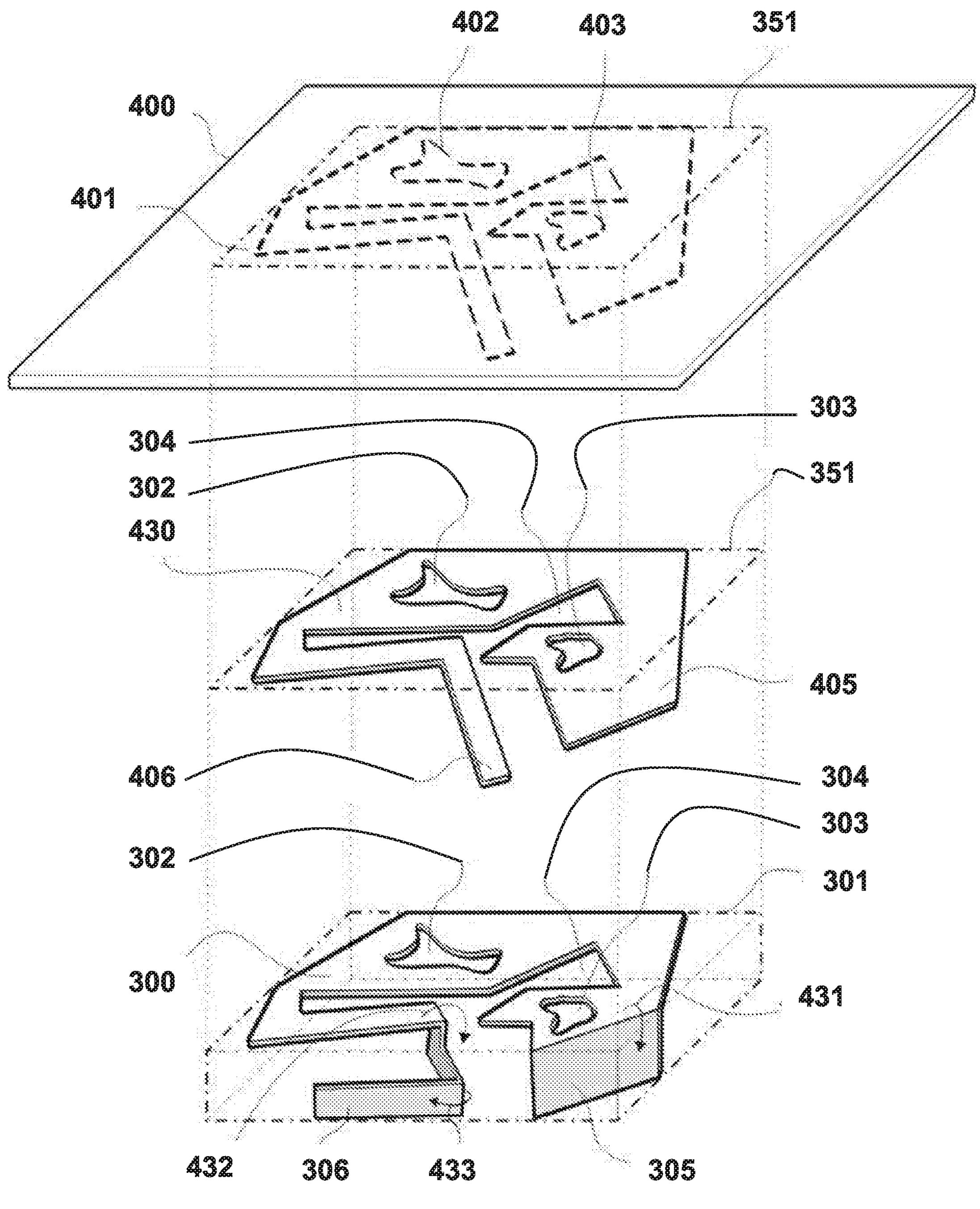
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FIG. 4

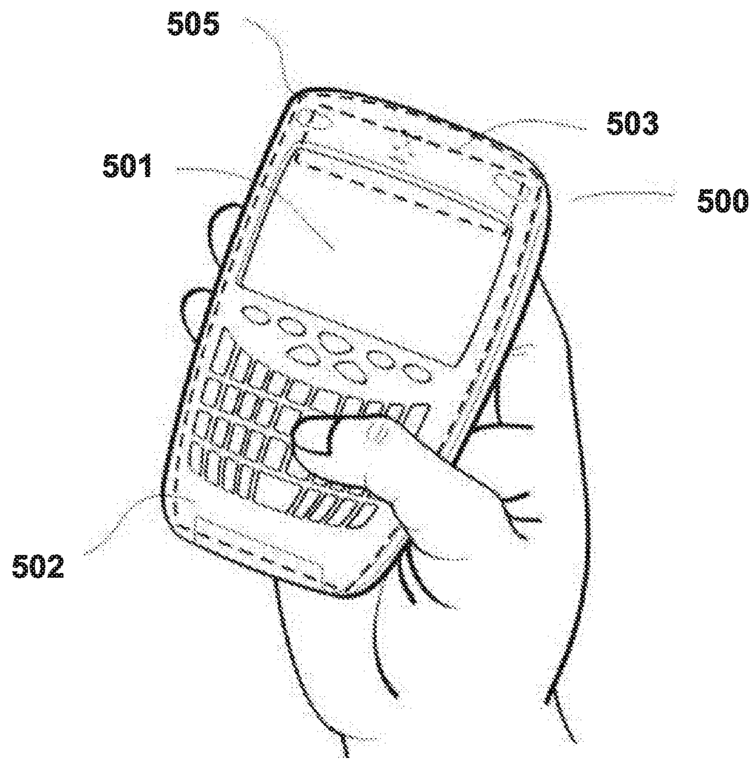

FIG. 5A

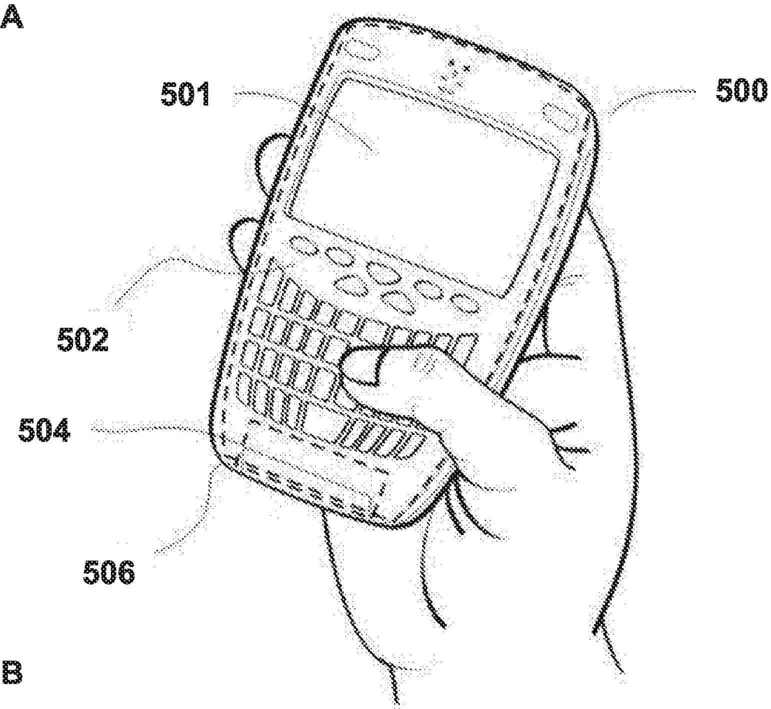

FIG. 5B

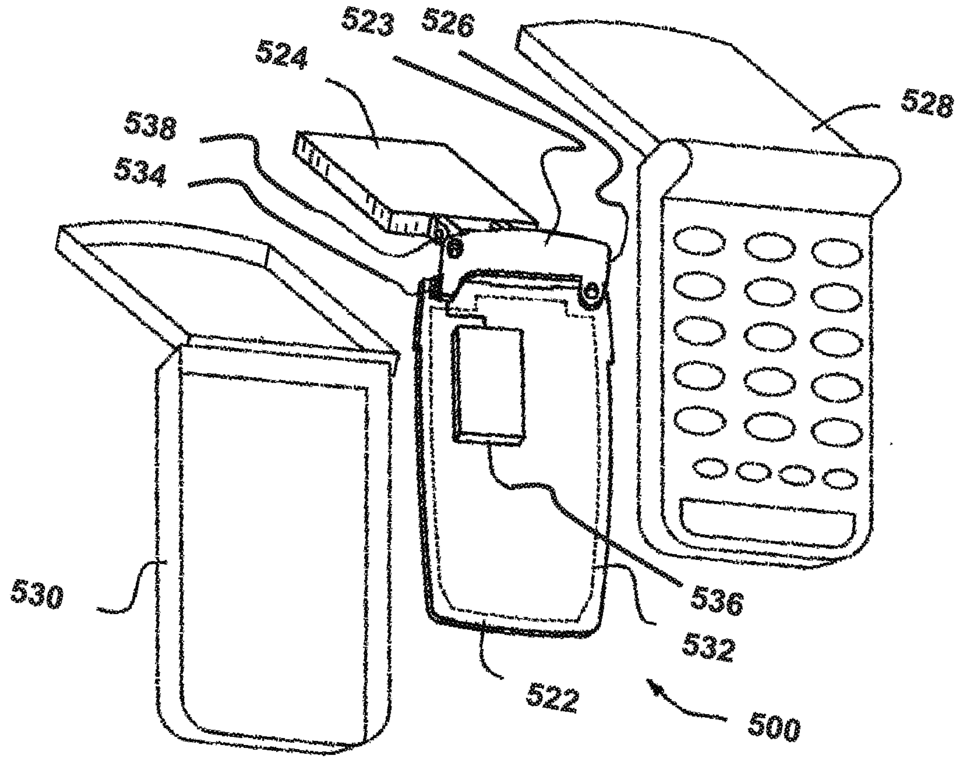

FIG. 5C

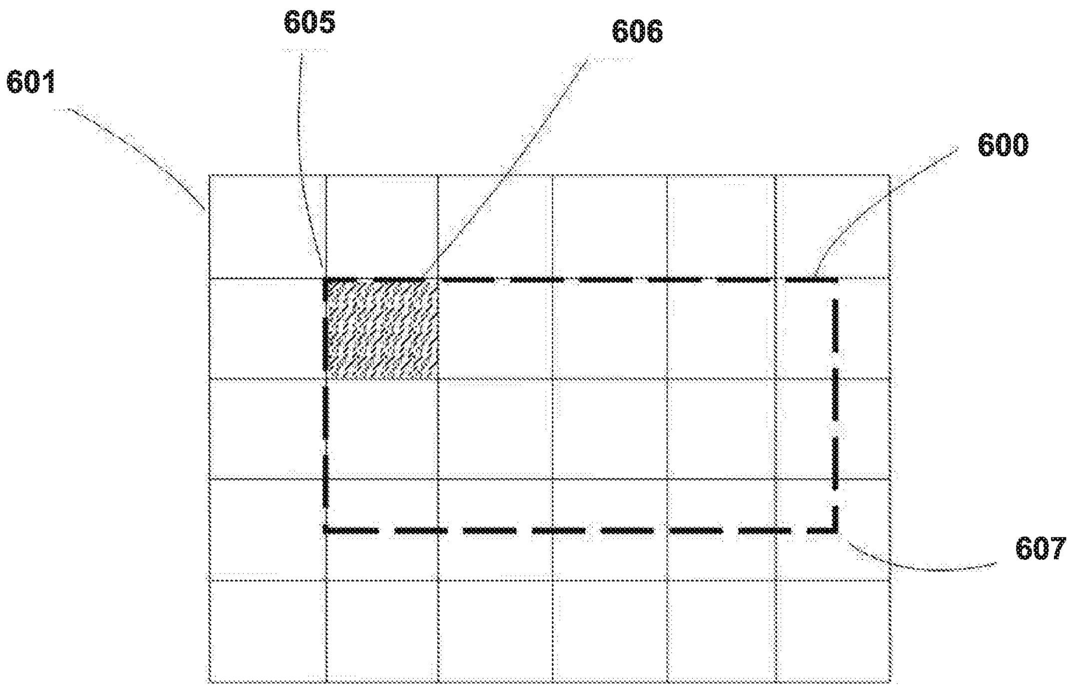

FIG. 6A

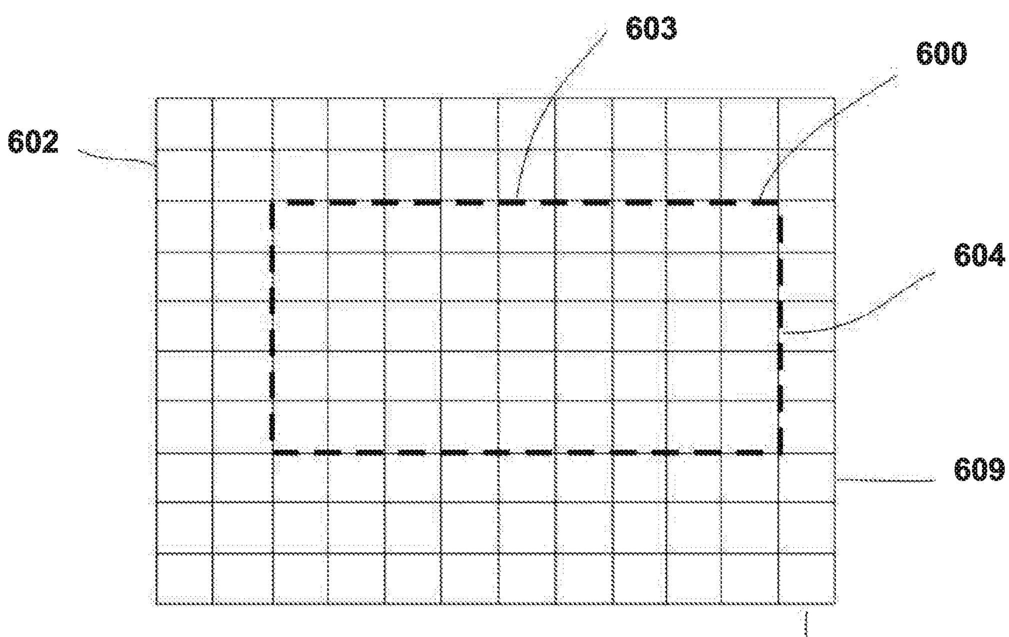

FIG. 6B

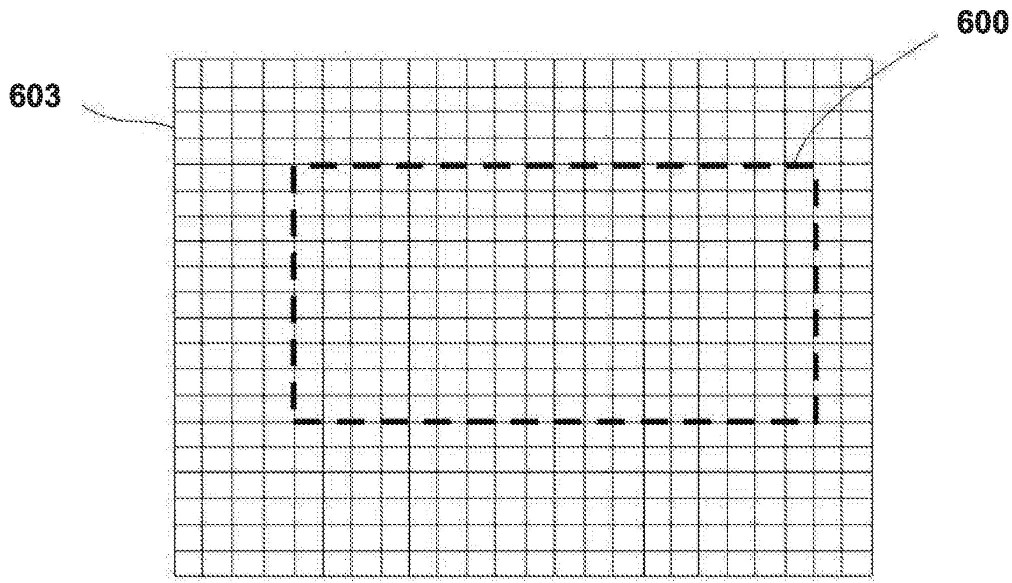
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FIG. 6C

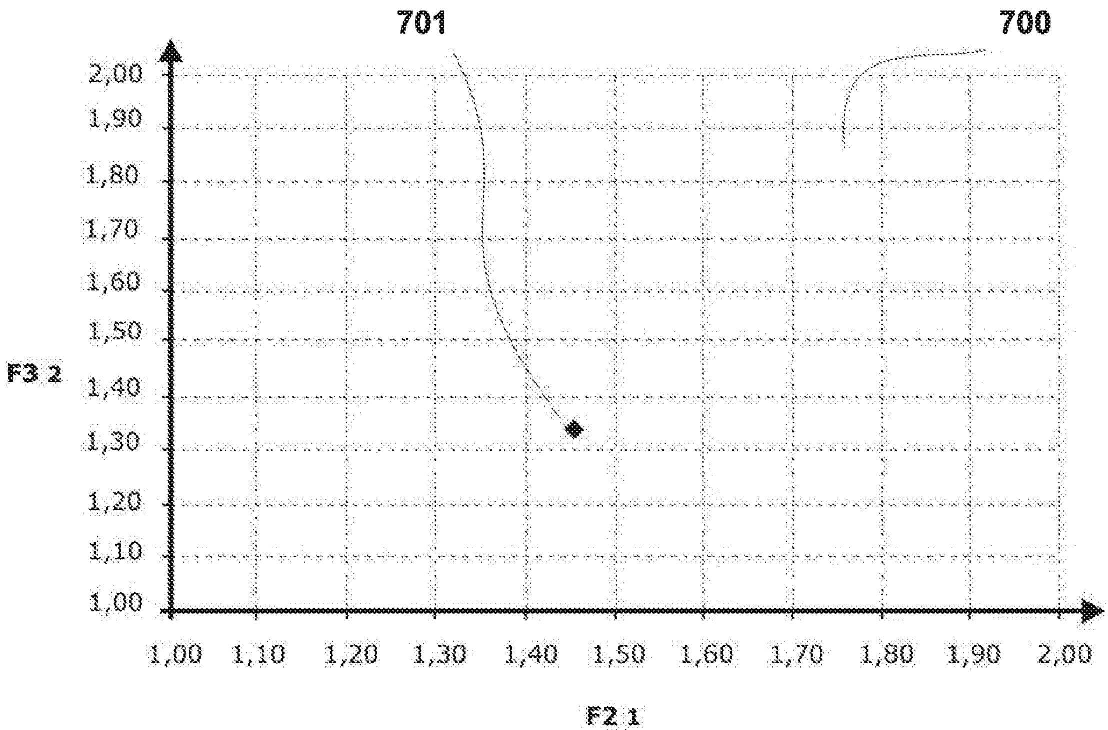
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FIG. 7

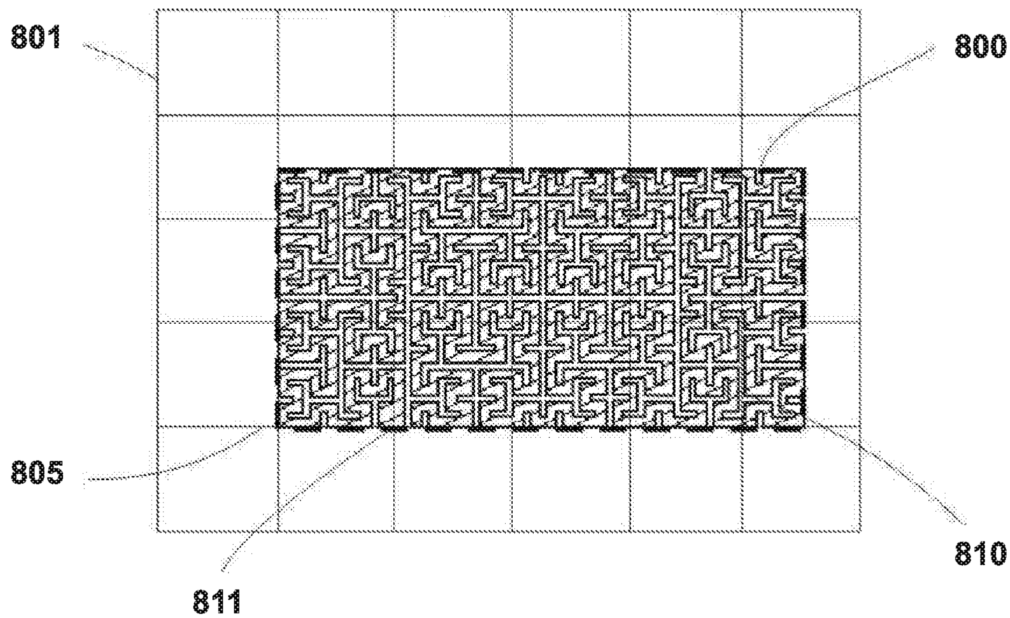


FIG. 8A

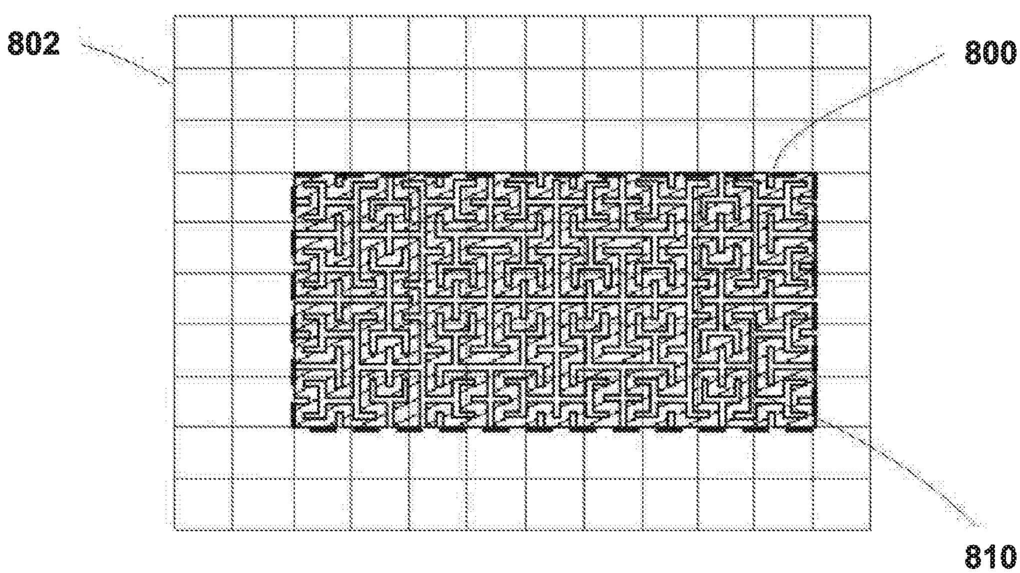


FIG. 8B

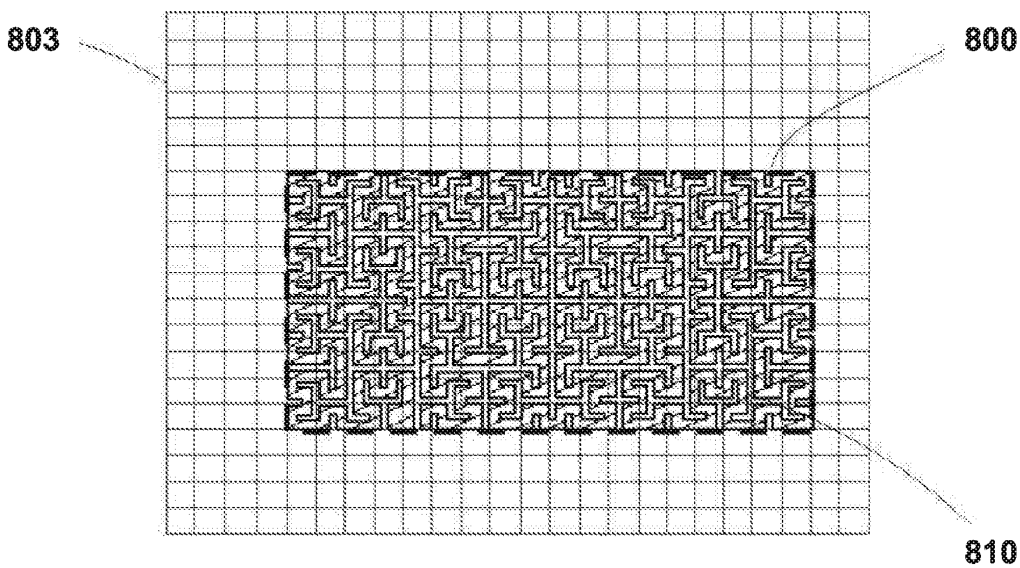


FIG. 8C

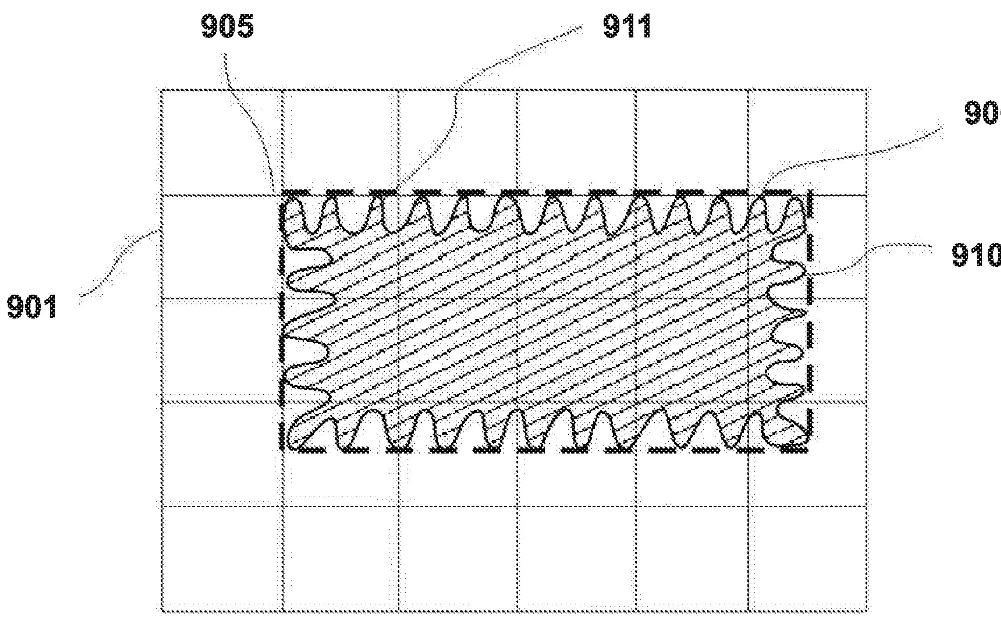


FIG. 9A

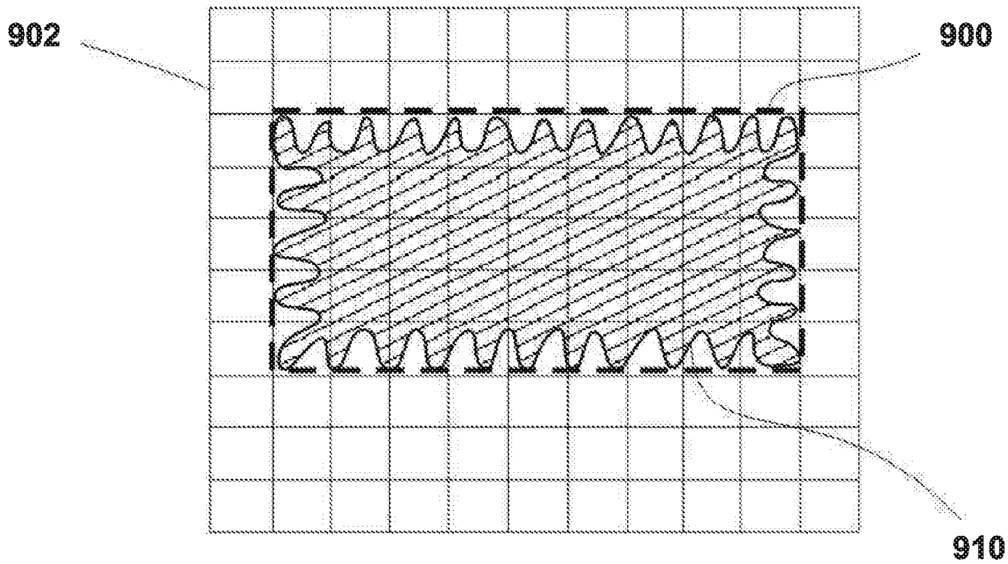


FIG. 9B

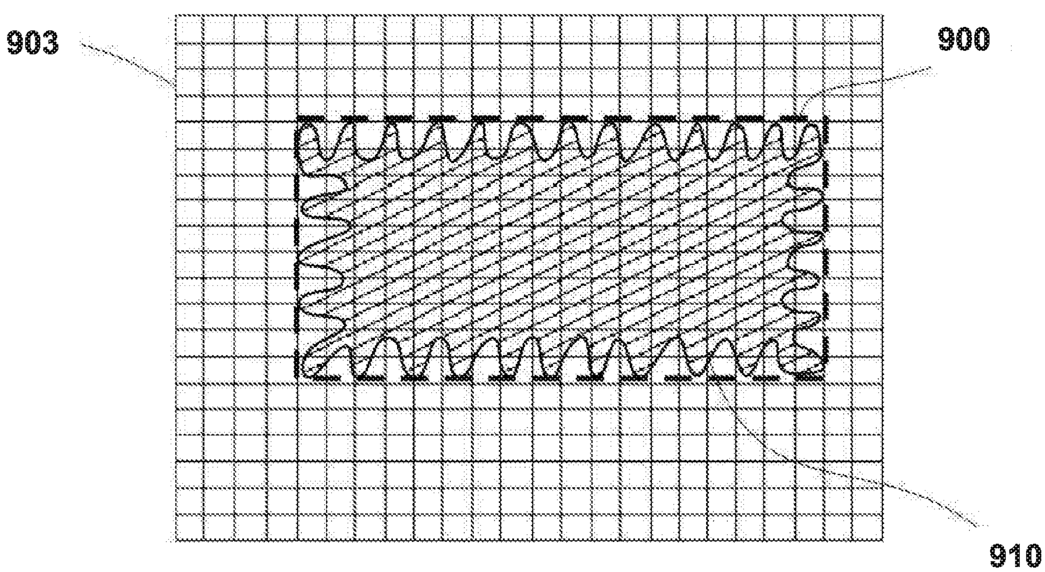


FIG. 9C

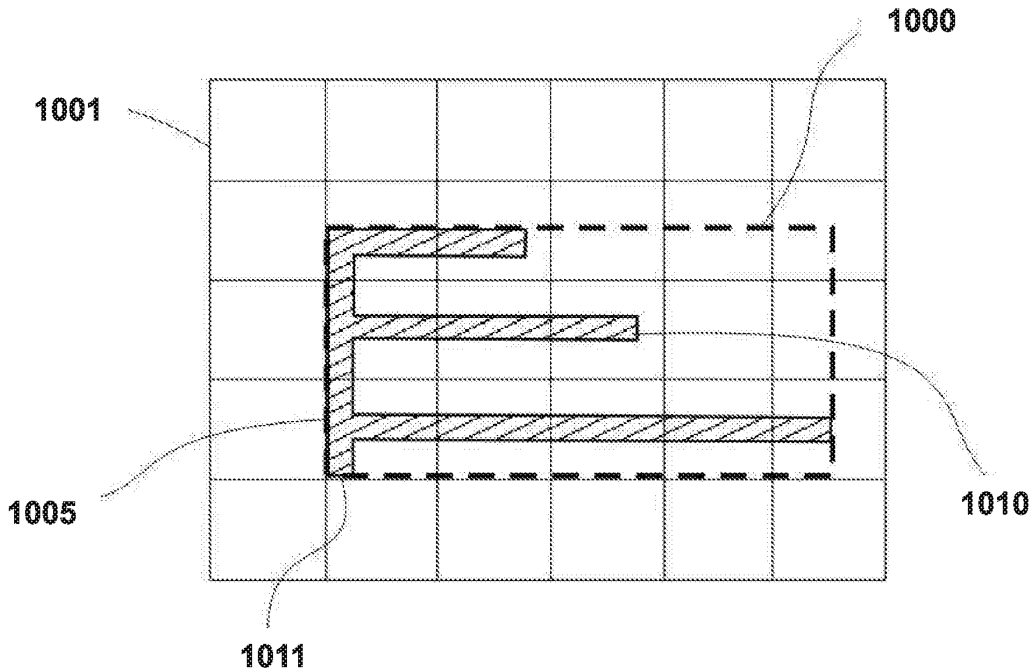


FIG. 10A

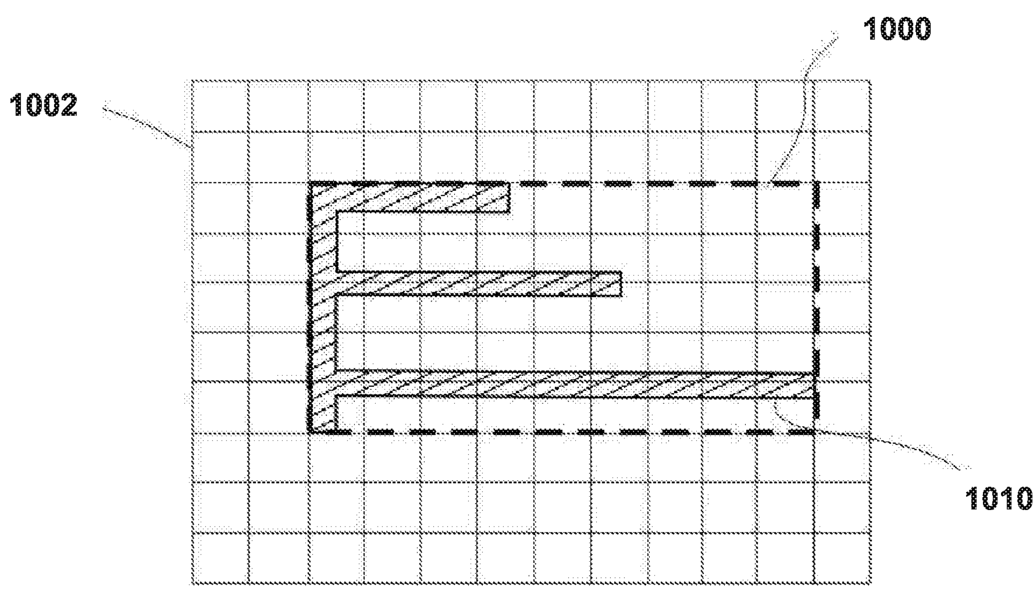


FIG. 10B

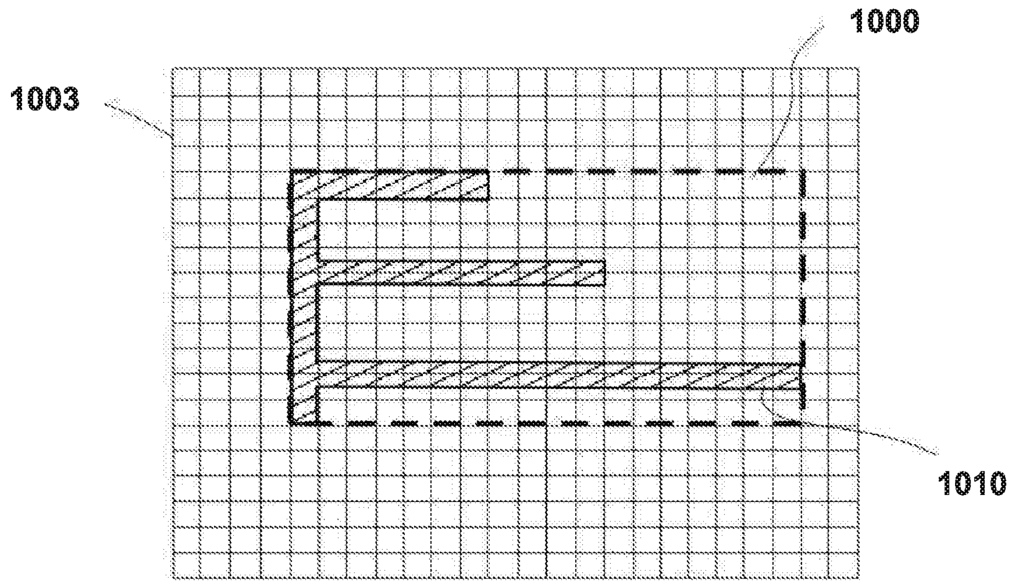


FIG. 10C

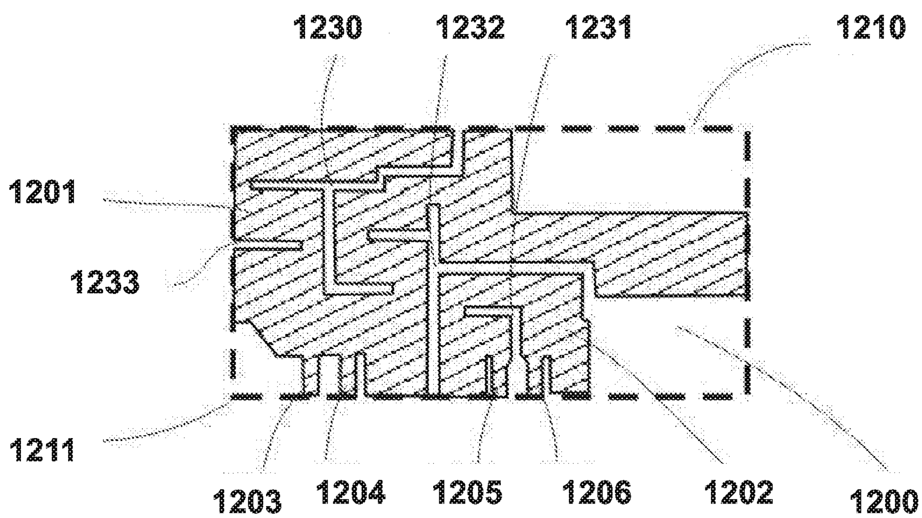
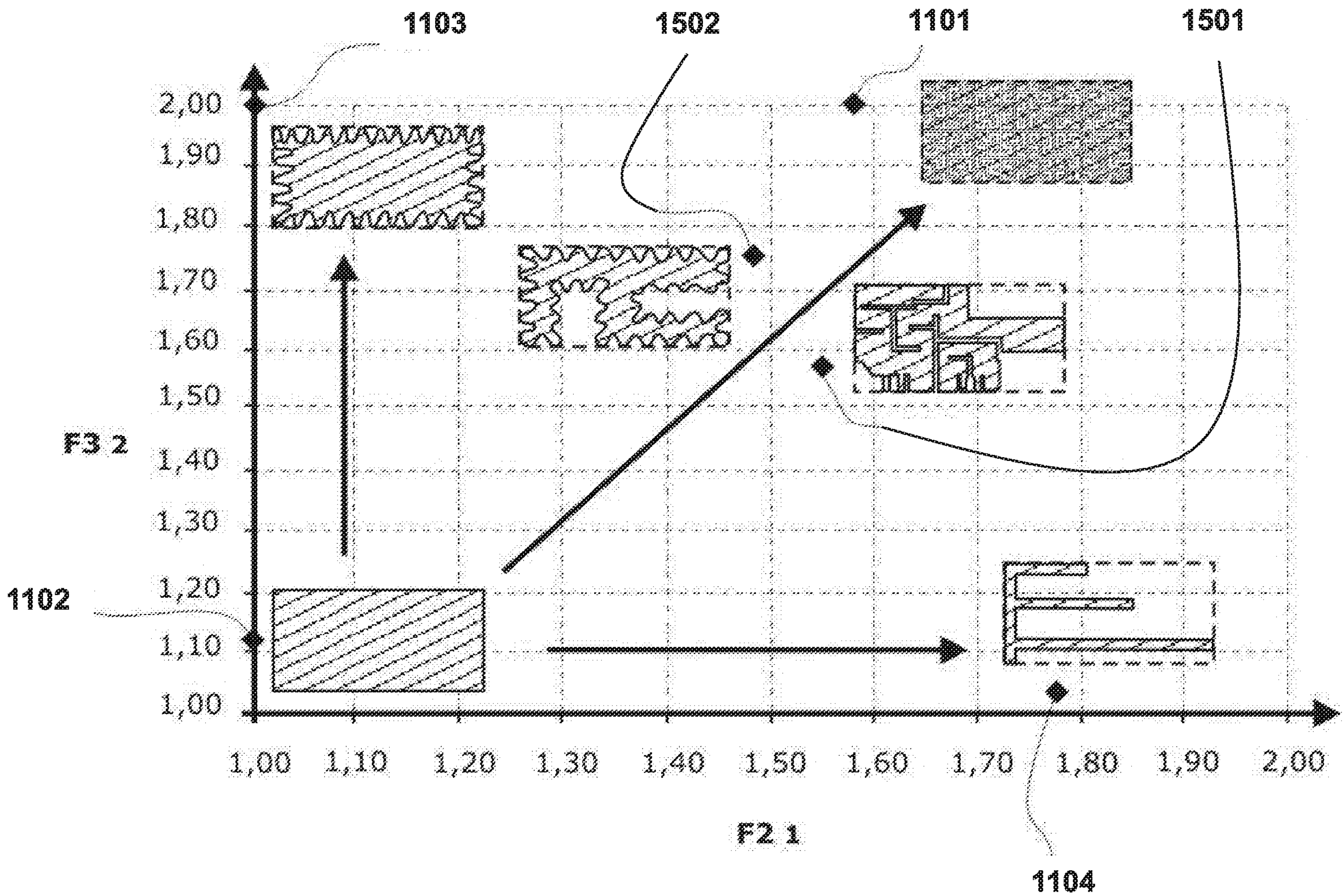


FIG. 12A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F2 1
1104

FIG. 11

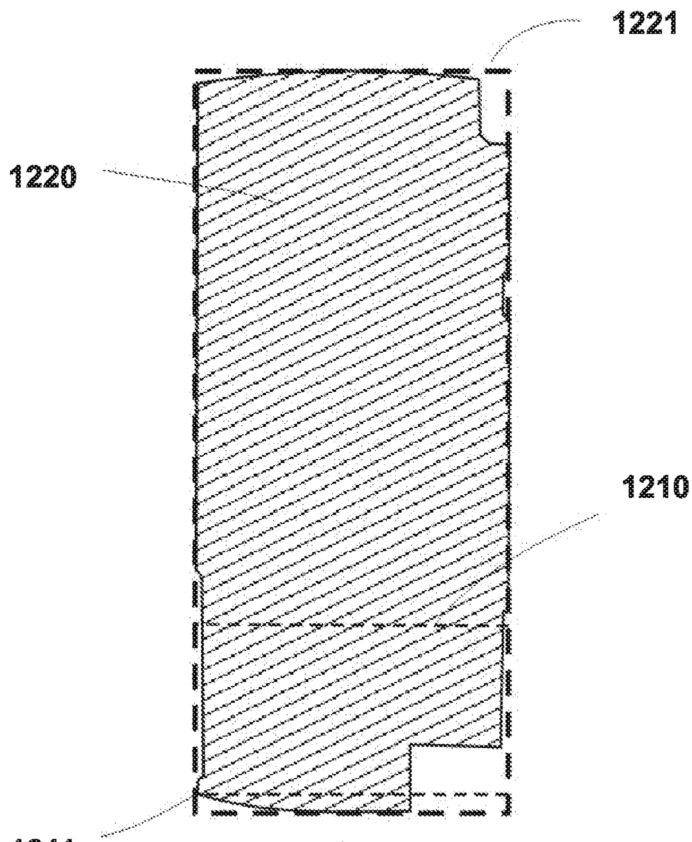


FIG. 12B

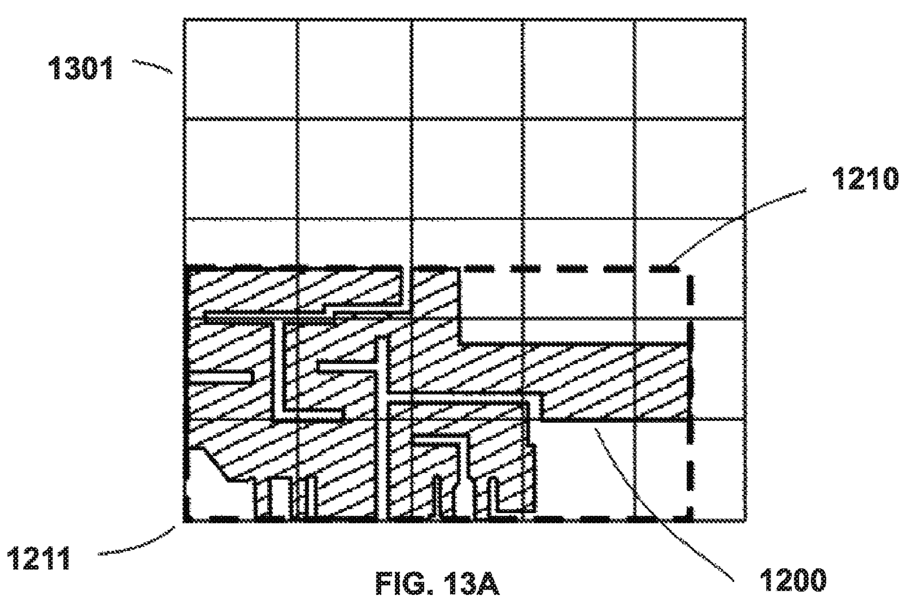


FIG. 13A

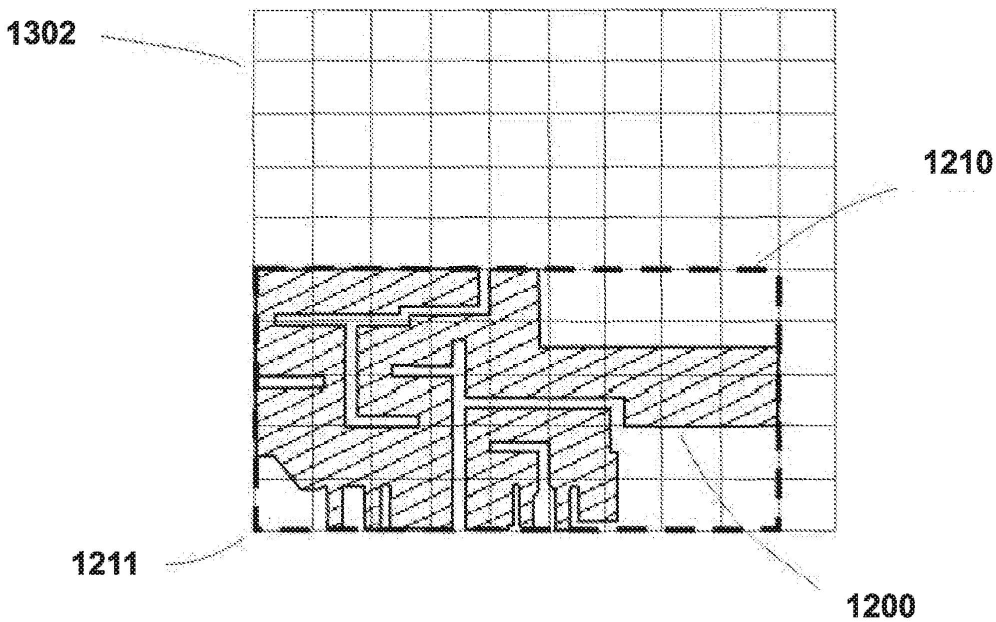


FIG. 13B

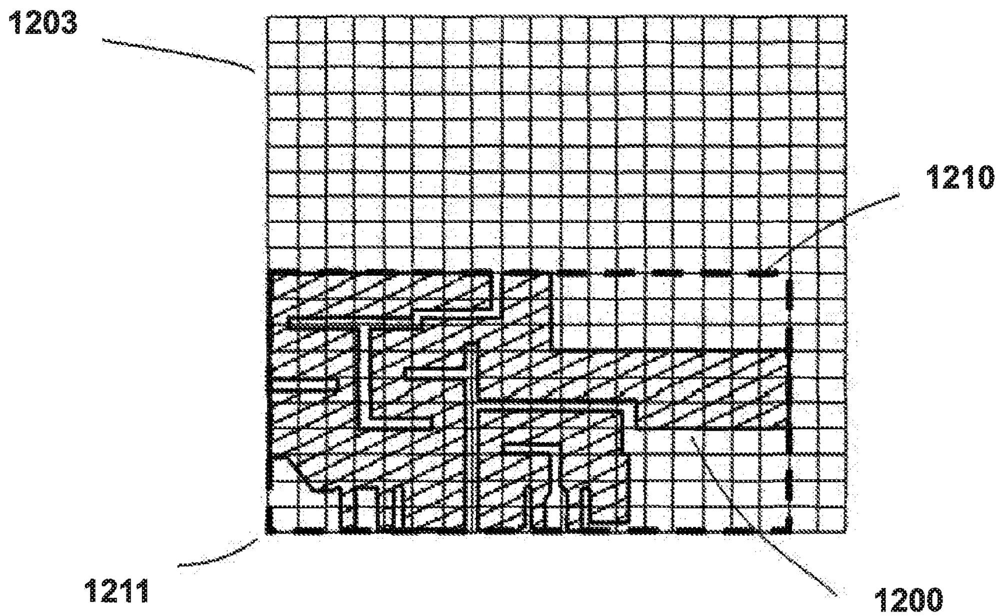


FIG. 13C

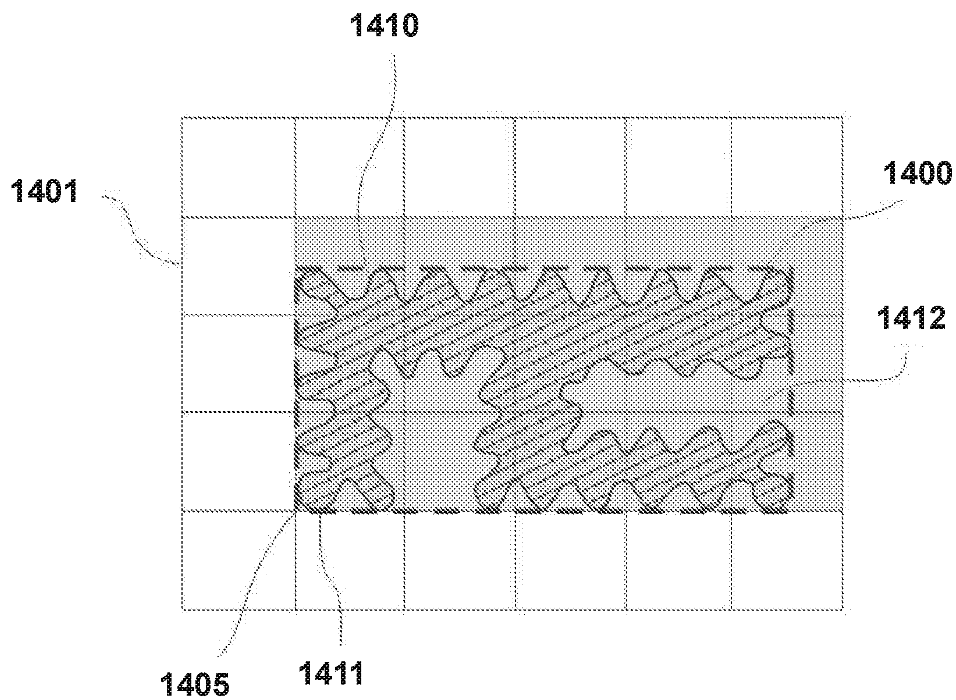


FIG. 14A

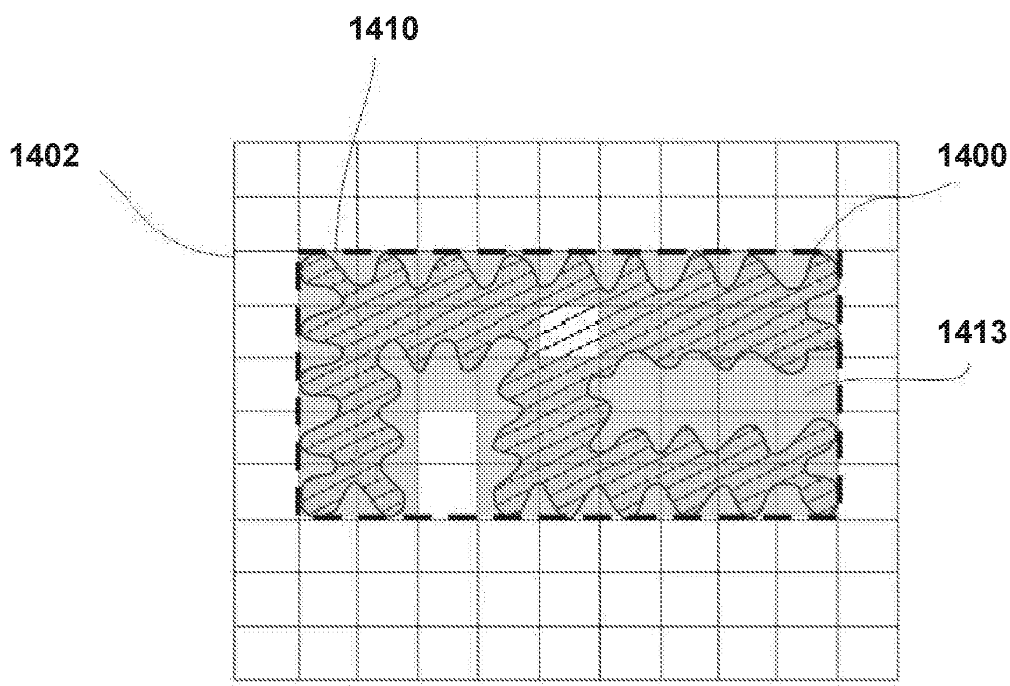


FIG. 14B

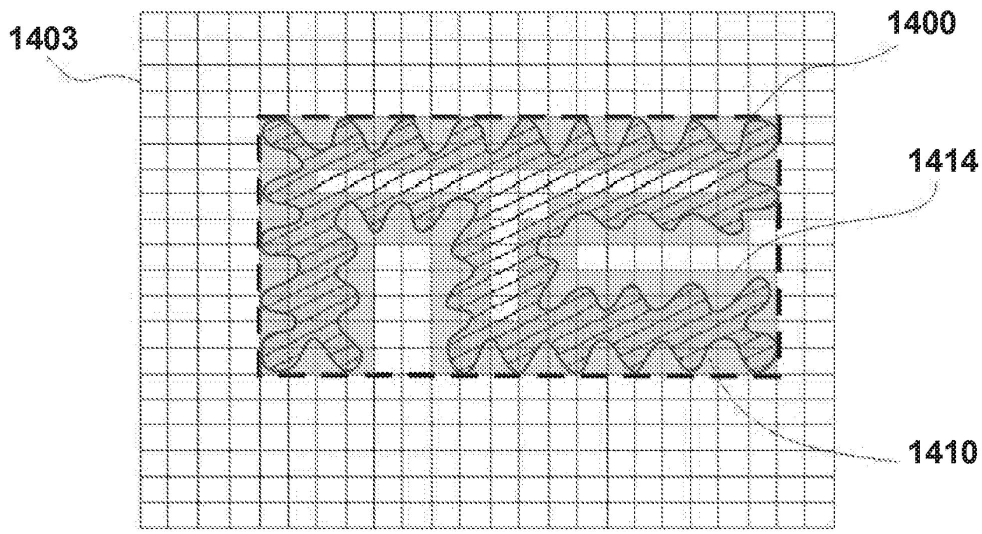


FIG. 14C

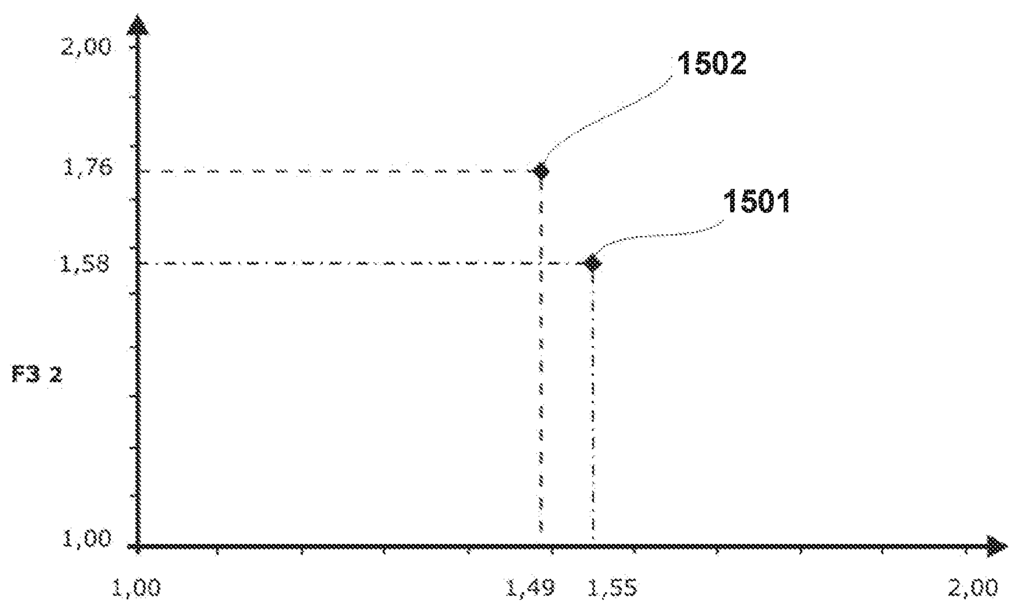


FIG. 15

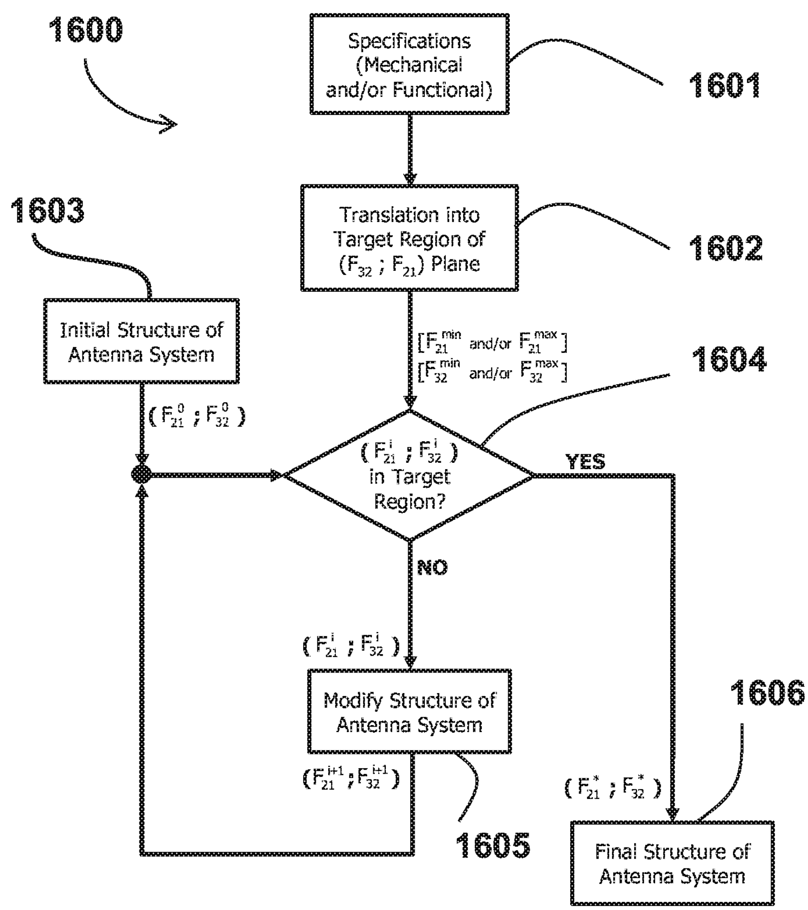

1600
Specifications (Mechanical and/or Functional)
1601
Translation into Target Region of (F_{32} ; F_{21}) Plane
1602
1603
Initial Structure of Antenna System
[F_{21}^{min} and/or F_{21}^{max}]
[F_{32}^{min} and/or F_{32}^{max}]
1604
(F_{21}^{0} ; F_{32}^{0})
(F_{21}^{i} ; F_{32}^{i}) in Target Region?
YES
NO
(F_{21}^{i} ; F_{32}^{i})
Modify Structure of Antenna System
1606
(F_{21}^{i+1} ; F_{32}^{i+1})
(F_{21}^{*} ; F_{32}^{*})
1605
Final Structure of Antenna System

FIG. 16

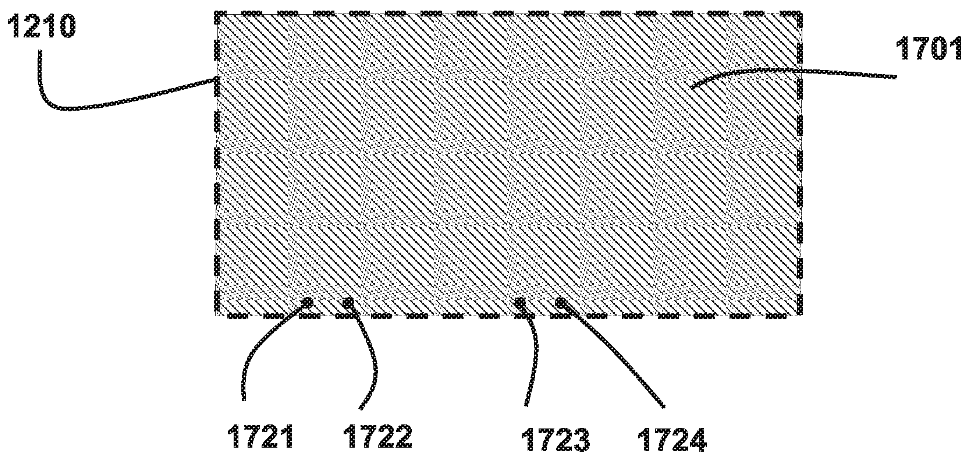


FIG. 17A

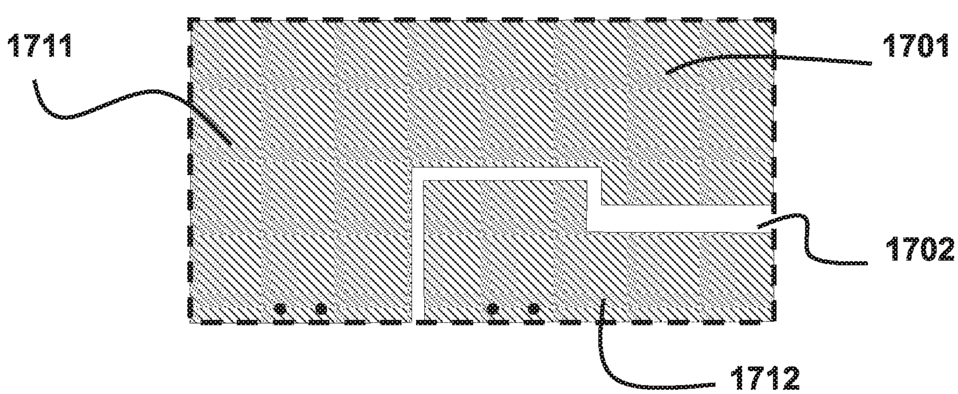


FIG. 17B

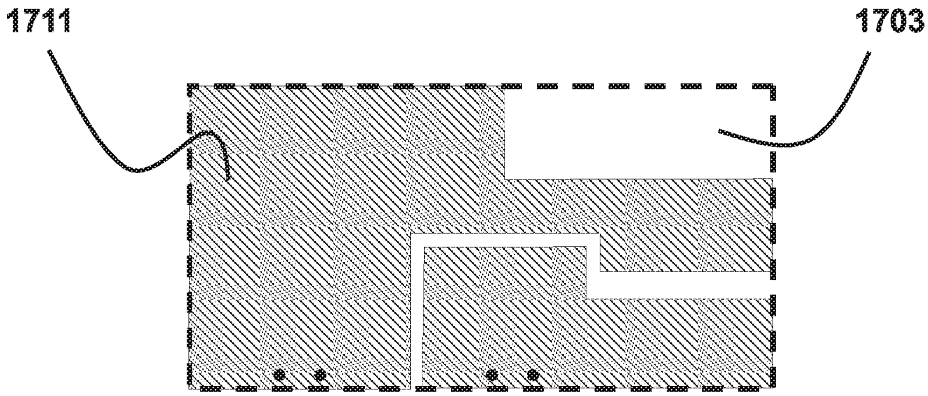


FIG. 17C

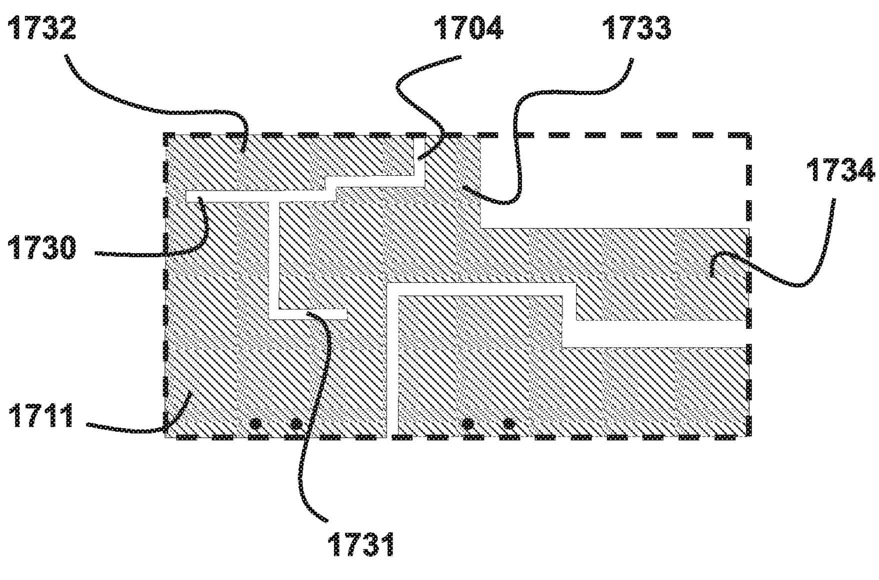


FIG. 17D

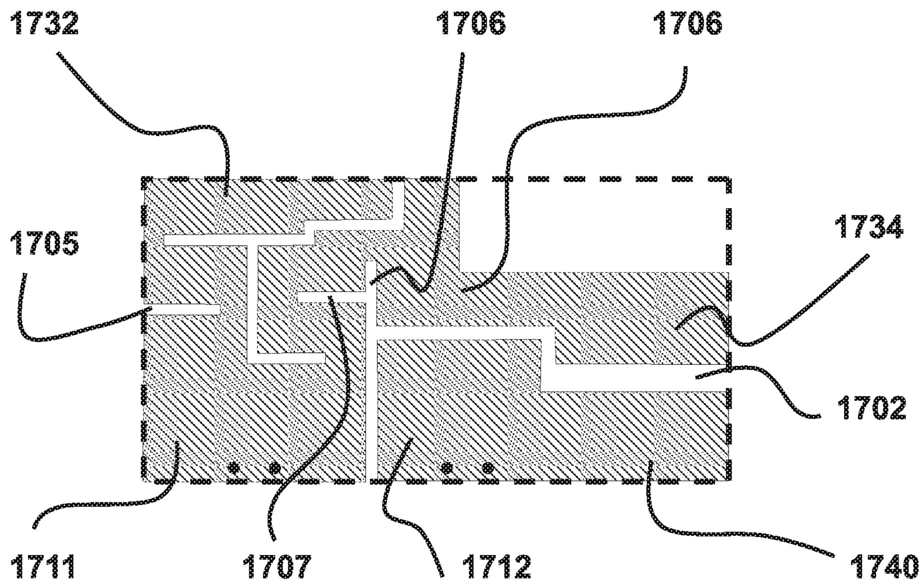


FIG. 17E

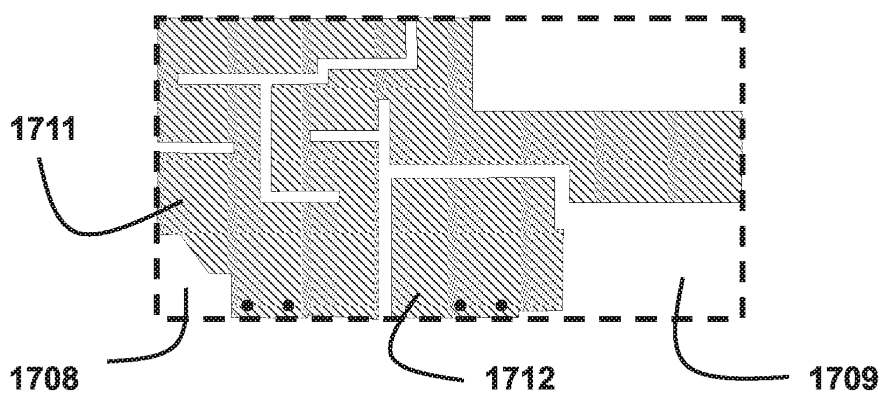


FIG. 17F

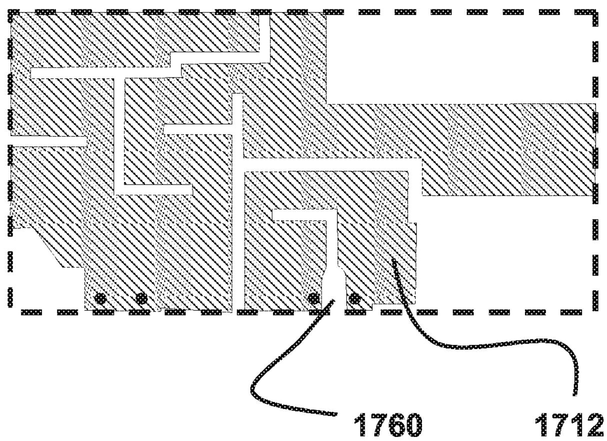


FIG. 17G

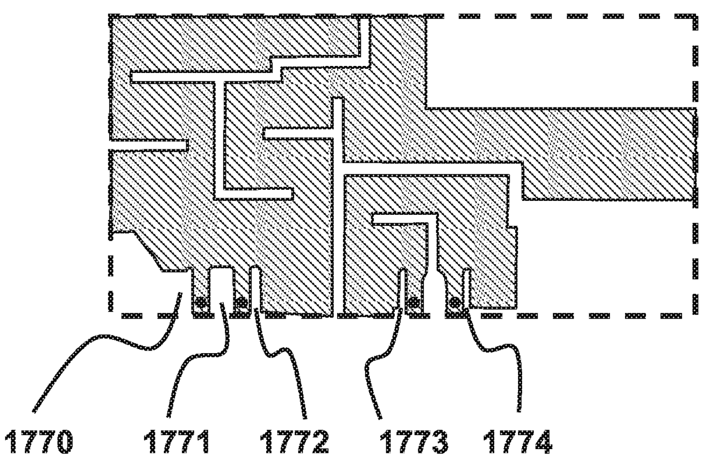
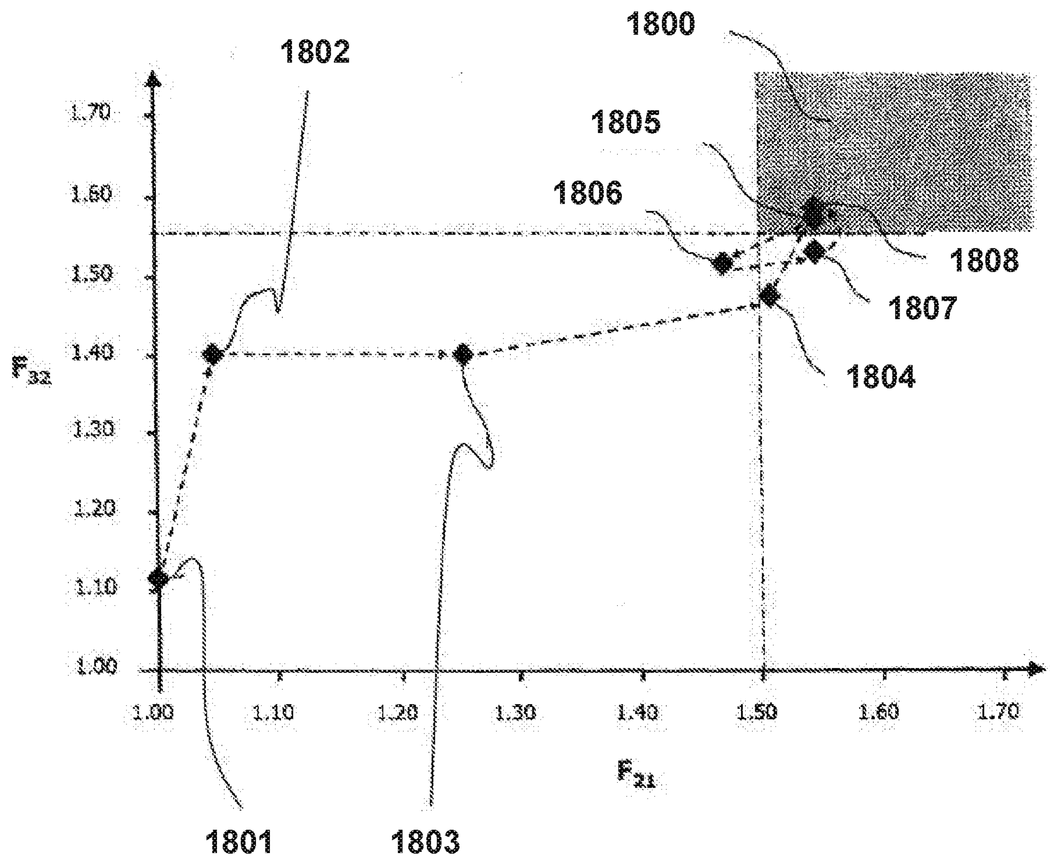


FIG. 17H


1800
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1804
1801
1803
1.70
1.60
1.50
1.40
1.30
1.20
1.10
1.00
1.00
1.10
1.20
1.30
1.40
1.50
1.60
1.70
F_{32}
F_{21}

FIG. 18

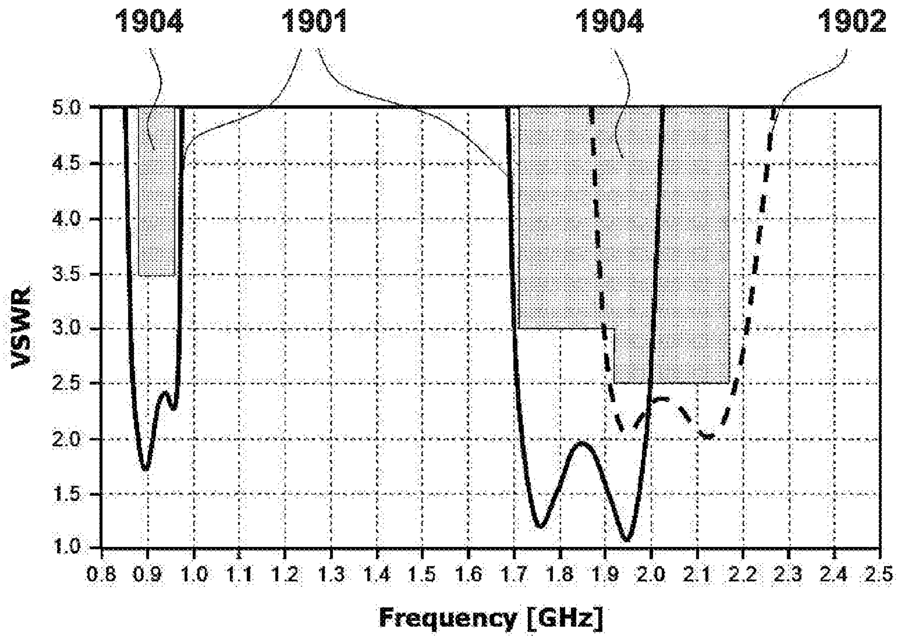

FIG. 19A

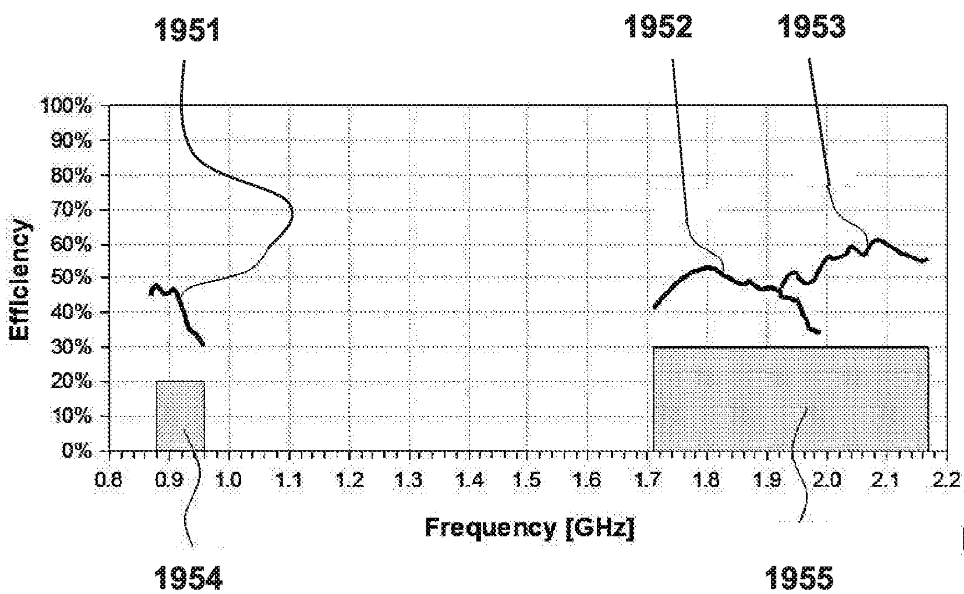

FIG. 19B

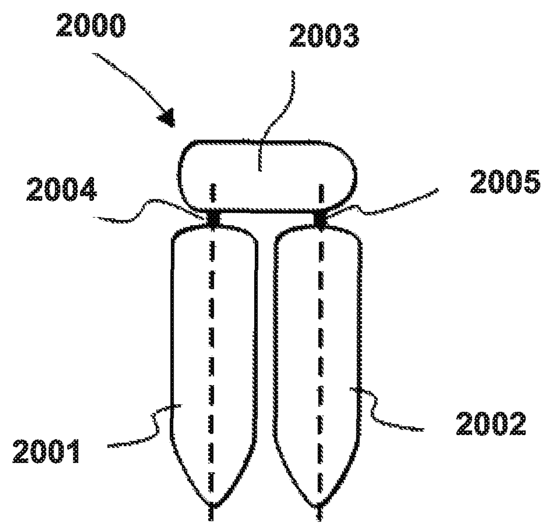

FIG. 20A

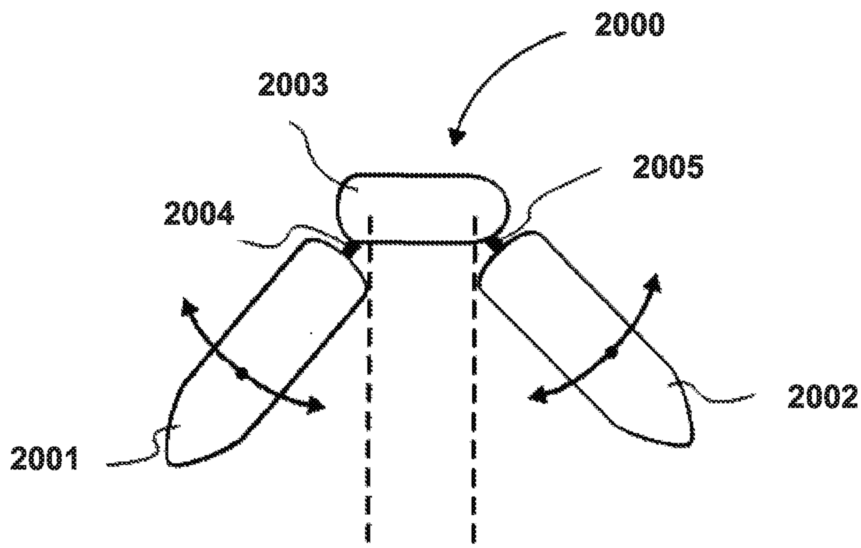

FIG. 20B

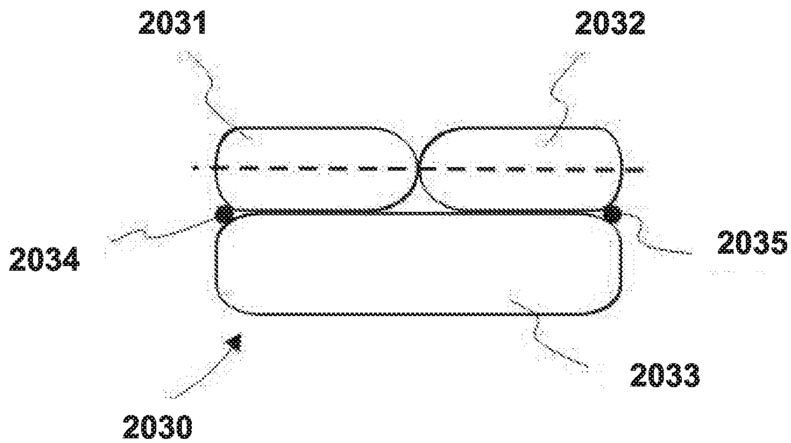

FIG. 20C

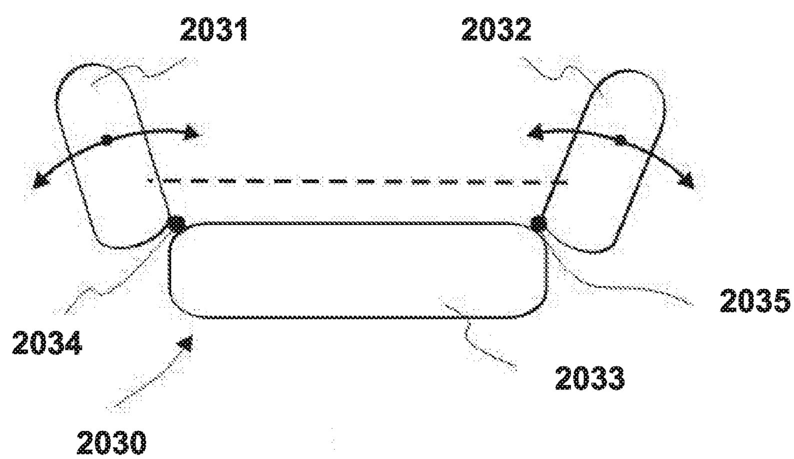

FIG. 20D

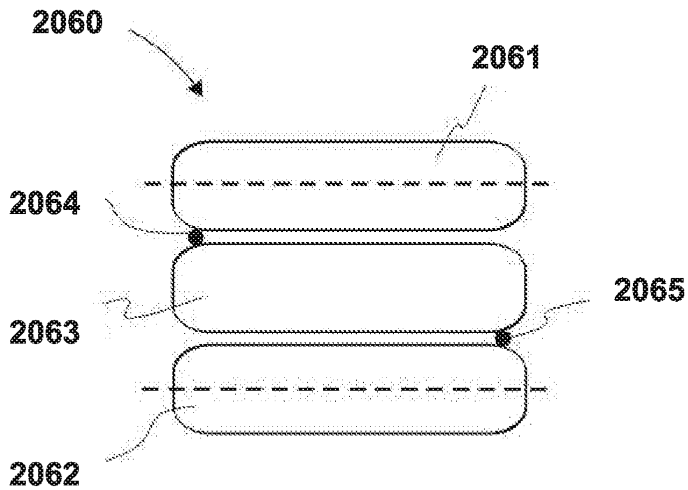

FIG. 20E

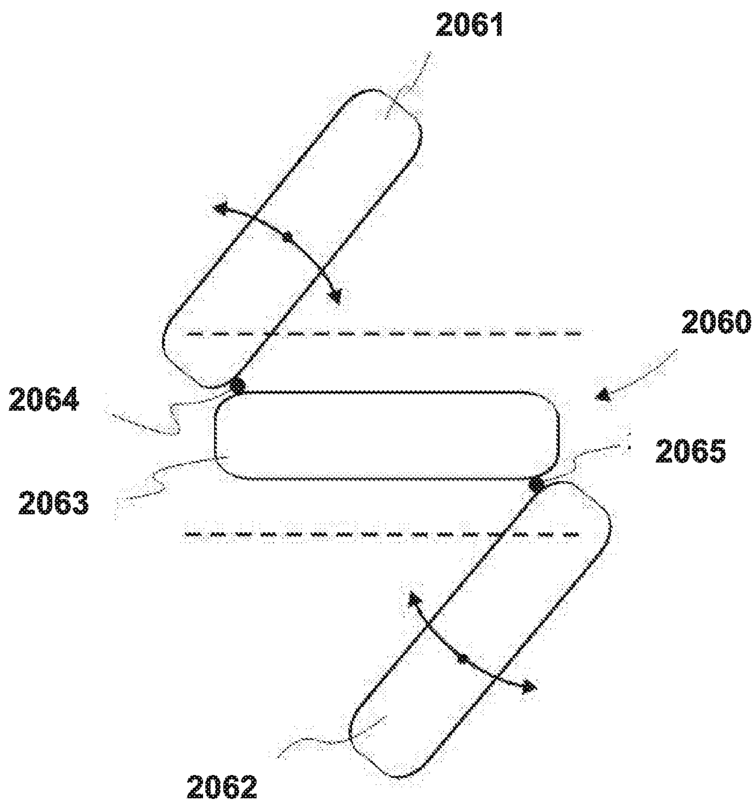

FIG. 20F

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	4	3622890		1971-11-23	FUJIMOTO	
	5	3683376		1972-08-08	PRONOVOST	
	6	3683379		1972-08-08	SADDLER	
	7	3689929		1972-09-02	MOODY	
	8	3818490		1974-06-18	LEAHY	

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	11	4021810		1977-05-03	URPO	
	12	4024542		1977-05-17	IKAWA	
	13	4038662		1977-07-26	TURNER	
	14	4072951		1978-02-07	KALOI	
	15	4131893		1978-12-26	MUNSON	
	16	4141016		1979-02-20	NELSON	
	17	4318109		1982-03-02	WEATHERS	
	18	4356492		1982-10-26	KALOI	
	19	4381566		1983-04-26	KANE	

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	21	4471493		1984-09-11	SHOBER	
	22	4504834		1985-03-12	GARAY	
	23	4536725		1985-08-20	HUBLER	
	24	4543581		1985-09-24	NEMET	
	25	4571595		1986-02-18	PHILLIPS	
	26	4584709		1986-04-22	KNEISEL	
	27	4608572		1986-08-26	BLAKNEY	
	28	4623894		1986-11-18	LEE	
	29	4628322		1986-12-09	MARKO	
	30	4673948		1987-06-16	KUO	

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	32	4730195		1988-03-08	PHILLIPS	
	33	4752968		1988-06-21	LINDENMEIER	
	34	4827266		1989-05-02	SATO	
	35	4827271		1989-05-02	BERNEKING	
	36	4839660		1989-06-13	HADZOGLOU	
	37	4843468		1989-06-27	DREWERY	
	38	4847629		1989-07-11	SHIMAZAKI	
	39	4849766		1989-07-18	INABA	
	40	4857939		1989-08-15	SHIMAZAKI	
	41	4860019		1989-08-22	JIANG	

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	43	4894663		1990-01-16	URBISH	
	44	4907011		1990-03-06	KUO	
	45	4912481		1990-03-27	MACE	
	46	4975711		1990-12-04	LEE	
	47	5030963		1991-07-09	TADAMA	
	48	5138328		1992-08-11	ZIBRICK	
	49	5168472		1992-12-01	LOCKWOOD	
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	8	20020109633		2002-08-15	OW	
	9	20020126051		2002-09-12	JHA	
	10	20020126054		2002-09-12	FUERST	
	11	20020126055		2002-09-12	LINDENMEIER	

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	17	20020190904		2002-12-19	COHEN	
	18	20020175866		2002-11-28	GRAM	
	19	20030025637		2003-02-06	MENDOLIA	
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	21	20030090421		2003-05-15	SAJADINIA	
	22	20030098814		2003-05-29	KELLER	

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	30	20040085244		2004-05-06	KADAMBI	
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	32	20040095289		2004-05-20	BAE	
	33	20040110479		2004-06-10	ORMSON	

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	36	20040198436		2004-10-07	ALDEN	
	37	20040204008		2004-10-14	DENG	
	38	20040204126		2004-10-14	REYES	
	39	20040212545		2004-10-28	LI	
	40	20040214541		2004-10-28	CHOI	
	41	20050017910		2005-01-27	PARK	
	42	20050041624		2005-02-24	HUI	
	43	20050057398		2005-03-17	RYKEN	
	44	20050069069		2005-03-31	GUNZELMANN	

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	46	20050088340		2005-04-28	DENG	
	47	20050107052		2005-05-19	ZANGERL	
	48	20050136958		2005-06-23	SESHADRI	
	49	20050153709		2005-07-14	FORRESTER	
	50	20050156785		2005-07-21	RYKEN	

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	5	2525859	CA		2006-02-15	QI		
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	8	10138265	DE		2003-07-03	HUBER		
	9	10142965	DE		2003-03-20	HAMANN		
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	11	19929689	DE		2001-01-11	PAN		
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	13	0096847	EP		1983-12-28	HOFMANN		
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	17	0396033	EP		1990-11-07	LINDENMEIER		
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	20	0590671	EP		1993-09-30	SEKINE		
	21	0620677	EP		1994-10-19	DELABASTITA		
	22	0688040	EP		1995-12-20	HORI		
	23	0736926	EP		1996-10-09	ANNAMAA		
	24	0749176	EP		2002-09-18	SANAD		
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	31	0856907	EP		1998-08-05	PAPATHEODOROU		
	32	0871238	EP		1998-10-14	OLLIKAINEN		
	33	0892459	EP		1999-01-20	PANKINAHO		
	34	0902472	EP		1999-03-17	FUREY		
	35	0924793	EP		2003-06-26	SMITH		
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	38	0938158	EP		1999-08-25	SAARI		
	39	0942488	EP		1999-09-15	KAWAHATA		
	40	0969375	EP		2000-01-05	STOUTAMIRE		
	41	0986130	EP		2000-03-15	HUBER		
	42	0993070	EP		2000-04-12	SAITO		
	43	0997972	EP		2000-03-05	PUENTE		
	44	0997974	EP		2000-05-03	ISOHÄTÄLÄ		
	45	1011167	EP		2000-06-21	KANE		
	46	1016158	EP		2003-12-03	SADLER		
	47	1018777	EP		2000-07-12	GEERAERT		

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	First Named Inventor	Carles PUENTE BALIARDA
	Art Unit	
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	1	Verdura, O., Miniature fractal antenna : Antena fractal miniatura, Universitat Politecnica de Catalunya (UPC), 19970901	☒
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	37	Wu , C. S. et al., Personal mobile multimedia communications in a wireless WAN environment, Multimedia Signal Processing, 1st , 1997. IEEE Workshop on, 19970623	☐
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	42	Infringement Chart - Blackberry 8100. Patent: 7148850, Fractus, 20091105	☐
	43	Infringement Chart - Blackberry 8100. Patent: 7202822, Fractus, 20091105	☐
	44	Infringement Chart - Blackberry 8110. Patent: 7148850, Fractus, 20091105	☐

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	45	Infringement Chart - Blackberry 8110. Patent: 7202822, Fractus, 20091105	☐
	46	Infringement Chart - Blackberry 8120. Patent: 7148850, Fractus, 20091105	☐
	47	Infringement Chart - Blackberry 8120. Patent: 7202822, Fractus, 20091105	☐
	48	Infringement Chart - Blackberry 8130. Patent: 7148850, Fractus, 20091105	☐
	49	Infringement Chart - Blackberry 8130. Patent: 7202822, Fractus, 20091105	☐
	50	Infringement Chart - Blackberry 8220. Patent: 7148850, Fractus, 20091105	☐

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	2	Infringement Chart - Blackberry 8310. Patent: 7148850, Fractus, 20091105	
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	31	Infringement Chart - HTC My Touch. Patent: 7202822, Fractus, 20091105	
	32	Infringement Chart - HTC Ozone, Fractus, 20091105	
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7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**		
	Application Number	
	Filing Date	
	First Named Inventor	Carles PUENTE BALIARDA
	Art Unit	
	Examiner Name	
	Attorney Docket Number	0690.0023CN4

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**	Application Number	
	Filing Date	
	First Named Inventor	Carles PUENTE BALIARDA
	Art Unit	
	Examiner Name	
	Attorney Docket Number	0690.0023CN4

	1	Infringement Chart - HTC Touch Pro. Patent: 7148850, Fractus, 20091105	
	2	Infringement Chart - HTC Touch Pro. Patent: 7202822, Fractus, 20091105	
	3	Infringement Chart - HTC Wing, Fractus, 20091105	
	4	Infringement Chart - HTC Wing. Patent: 7148850, Fractus, 20091105	
	5	Infringement Chart - HTC Wing. Patent: 7202822, Fractus, 20091105	
	6	Infringement Chart - Kyocera Jax, Fractus, 20091105	
	7	Infringement Chart - Kyocera Jax. Patent: 7148850, Fractus, 20091105	
	8	Infringement Chart - Kyocera Jax. Patent: 7202822, Fractus, 20091105	
	9	Infringement Chart - Kyocera MARBL, Fractus, 20091105	
	10	Infringement Chart - Kyocera MARBL. Patent: 7148850, Fractus, 20091105	
	11	Infringement Chart - Kyocera MARBL. Patent: 7202822, Fractus, 20091105	

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	First Named Inventor	Carles PUENTE BALIARDA
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	Attorney Docket Number	0690.0023CN4

	12	Infringement Chart - Kyocera NEO E1100, Fractus, 20091105	
	13	Infringement Chart - Kyocera NEO E1100. Patent: 7148850, Fractus, 20091105	
	14	Infringement Chart - Kyocera NEO E1100. Patent: 7202822, Fractus, 20091105	
	15	Infringement Chart - Kyocera S2400, Fractus, 20091105	
	16	Infringement Chart - Kyocera S2400. Patent: 7148850, Fractus, 20091105	
	17	Infringement Chart - Kyocera S2400. Patent: 7202822, Fractus, 20091105	
	18	Infringement Chart - Kyocera Wildcard M1000, Fractus, 20091105	
	19	Infringement Chart - Kyocera Wildcard M1000. Patent: 7148850, Fractus, 20091105	
	20	Infringement Chart - Kyocera Wildcard M1000. Patent: 7202822, Fractus, 20091105	
	21	Infringement Chart - LG 300G., Fractus, 20091105	
	22	Infringement Chart - LG 300G. Patent: 7148850, Fractus, 20091105	

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	23	Infringement Chart - LG 300G. Patent: 7202822, Fractus, 20091105	
	24	Infringement Chart - LG Aloha LX140., Fractus, 20091105	
	25	Infringement Chart - LG Aloha LX140. Patent: 7148850, Fractus, 20091105	
	26	Infringement Chart - LG Aloha LX140. Patent: 7202822, Fractus, 20091105	
	27	Infringement Chart - LG AX155., Fractus, 20091105	
	28	Infringement Chart - LG AX155. Patent: 7148850, Fractus, 20091105	
	29	Infringement Chart - LG AX155. Patent: 7202822, Fractus, 20091105	
	30	Infringement Chart - LG AX300, Fractus, 20091105	
	31	Infringement Chart - LG AX300. Patent: 7148850, Fractus, 20091105	
	32	Infringement Chart - LG AX300. Patent: 7202822, Fractus, 20091105	
	33	Infringement Chart - LG AX380, Fractus, 20091105	

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	First Named Inventor	Carles PUENTE BALIARDA
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	Examiner Name	
	Attorney Docket Number	0690.0023CN4

	34	Infringement Chart - LG AX380. Patent: 7148850, Fractus, 20091105	
	35	Infringement Chart - LG AX380. Patent: 7202822, Fractus, 20091105	
	36	Infringement Chart - LG AX585., Fractus, 20091105	
	37	Infringement Chart - LG AX585. Patent: 7148850, Fractus, 20091105	
	38	Infringement Chart - LG AX585. Patent: 7202822, Fractus, 20091105	
	39	Infringement Chart - LG AX8600, Fractus, 20091105	
	40	Infringement Chart - LG AX8600. Patent: 7148850, Fractus, 20091105	
	41	Infringement Chart - LG AX8600. Patent: 7202822, Fractus, 20091105	
	42	Infringement Chart - LG CF360., Fractus, 20091105	
	43	Infringement Chart - LG CF360. Patent: 7148850, Fractus, 20091105	
	44	Infringement Chart - LG CF360. Patent: 7202822, Fractus, 20091105	

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	First Named Inventor	Carles PUENTE BALIARDA
	Art Unit	
	Examiner Name	
	Attorney Docket Number	0690.0023CN4

	45	Infringement Chart - LG Chocolate VX8550, Fractus, 20091105	
	46	Infringement Chart - LG Chocolate VX8550. Patent: 7148850, Fractus, 20091105	
	47	Infringement Chart - LG Chocolate VX8550. Patent: 7202822, Fractus, 20091105	
	48	Infringement Chart - LG CU515, Fractus, 20091105	
	49	Infringement Chart - LG CU515. Patent: 7148850, Fractus, 20091105	
	50	Infringement Chart - LG CU515. Patent: 7202822, Fractus, 20091105	

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	Art Unit	
	Examiner Name	
	Attorney Docket Number	0690.0023CN4

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Patrick J. Finnan/	Date (YYYY-MM-DD)	2020-03-27
Name/Print	Patrick J. Finnan	Registration Number	39189

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**		
	Application Number	
	Filing Date	
	First Named Inventor	Carles PUENTE BALIARDA
	Art Unit	
	Examiner Name	
	Attorney Docket Number	0690.0023CN4

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Examiner Initial*	Cite No	Patent Number	Kind Code1	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number	
	Filing Date	
	First Named Inventor	Carles PUENTE BALIARDA
	Art Unit	
	Examiner Name	
	Attorney Docket Number	0690.0023CN4

	1	Infringement Chart - LG Dare VX9700 . Patent 7528782, Fractus, 20091105	
	2	Infringement Chart - LG Dare VX9700. Patent: 7148850, Fractus, 20091105	
	3	Infringement Chart - LG Dare VX9700. Patent: 7202822, Fractus, 20091105	
	4	Infringement Chart - LG enV Touch VX1100., Fractus, 20091105	
	5	Infringement Chart - LG enV Touch VX1100. Patent: 7148850, Fractus, 20091105	
	6	Infringement Chart - LG enV Touch VX1100. Patent: 7202822, Fractus, 20091105	
	7	Infringement Chart - LG enV VX-9900, Fractus, 20091105	
	8	Infringement Chart - LG enV VX-9900. Patent: 7148850, Fractus, 20091105	
	9	Infringement Chart - LG enV VX-9900. Patent: 7202822, Fractus, 20091105	
	10	Infringement Chart - LG EnV2 VX9100, Fractus, 20091105	
	11	Infringement Chart - LG EnV2 VX9100. Patent: 7148850, Fractus, 20091105	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT **(Not for submission under 37 CFR 1.99)**	
Application Number	
Filing Date	
First Named Inventor	Carles PUENTE BALIARDA
Art Unit	
Examiner Name	
Attorney Docket Number	0690.0023CN4

	12	Infringement Chart - LG EnV2 VX9100. Patent: 7202822, Fractus, 20091105	
	13	Infringement Chart - LG EnV3 VX9200., Fractus, 20091105	
	14	Infringement Chart - LG EnV3 VX9200. Patent: 7148850, Fractus, 20091105	
	15	Infringement Chart - LG EnV3 VX9200. Patent: 7202822, Fractus, 20091105	
	16	Infringement Chart - LG Flare LX165, Fractus, 20091105	
	17	Infringement Chart - LG Flare LX165. Patent: 7148850, Fractus, 20091105	
	18	Infringement Chart - LG Flare LX165. Patent: 7202822, Fractus, 20091105	
	19	Infringement Chart - LG GT365 NEON., Fractus, 20091105	
	20	Infringement Chart - LG GT365 NEON. Patent: 7148850, Fractus, 20091105	
	21	Infringement Chart - LG GT365 NEON. Patent: 7202822, Fractus, 20091105	
	22	Infringement Chart - LG Lotus, Fractus, 20091105	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number	
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	First Named Inventor	Carles PUENTE BALIARDA
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	Examiner Name	
	Attorney Docket Number	0690.0023CN4

	23	Infringement Chart - LG Lotus. Patent: 7148850, Fractus, 20091105	
	24	Infringement Chart - LG Lotus. Patent: 7202822, Fractus, 20091105	
	25	Infringement Chart - LG MUZIQ LX570, Fractus, 20091105	
	26	Infringement Chart - LG Muziq LX570. Patent: 7148850, Fractus, 20091105	
	27	Infringement Chart - LG Muziq LX570. Patent: 7202822, Fractus, 20091105	
	28	Infringement Chart - LG Rumor, Fractus, 20091105	
	29	Infringement Chart - LG Rumor 2., Fractus, 20091105	
	30	Infringement Chart - LG Rumor 2. Patent: 7148850, Fractus, 20091105	
	31	Infringement Chart - LG Rumor 2. Patent: 7202822, Fractus, 20091105	
	32	Infringement Chart - LG Rumor. Patent: 7148850, Fractus, 20091105	
	33	Infringement Chart - LG Rumor. Patent: 7202822, Fractus, 20091105	

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	First Named Inventor	Carles PUENTE BALIARDA
	Art Unit	
	Examiner Name	
	Attorney Docket Number	0690.0023CN4

	34	Infringement Chart - LG Shine CU720, Fractus, 20091105	
	35	Infringement Chart - LG Shine CU720. Patent: 7148850, Fractus, 20091105	
	36	Infringement Chart - LG Shine CU720. Patent: 7202822, Fractus, 20091105	
	37	Infringement Chart - LG UX280, Fractus, 20091105	
	38	Infringement Chart - LG UX280. Patent: 7148850, Fractus, 20091105	
	39	Infringement Chart - LG UX280. Patent: 7202822, Fractus, 20091105	
	40	Infringement Chart - LG Versa VX9600, Fractus, 20091105	
	41	Infringement Chart - LG Versa VX9600. Patent: 7148850, Fractus, 20091105	
	42	Infringement Chart - LG Versa VX9600. Patent: 7202822, Fractus, 20091105	
	43	Infringement Chart - LG Voyager VX10000, Fractus, 20091105	
	44	Infringement Chart - LG Voyager VX10000. Patent: 7148850, Fractus, 20091105	

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	Examiner Name	
	Attorney Docket Number	0690.0023CN4

	45	Infringement Chart - LG Voyager VX10000. Patent: 7202822, Fractus, 20091105
	46	Infringement Chart - LG VU CU920, Fractus, 20091105
	47	Infringement Chart - LG Vu CU920. Patent: 7148850, Fractus, 20091105
	48	Infringement Chart - LG Vu CU920. Patent: 7202822, Fractus, 20091105
	49	Infringement Chart - LG VX5400, Fractus, 20091105
	50	Infringement Chart - LG VX5400. Patent: 7148850, Fractus, 20091105

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[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

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☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

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A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Patrick J. Finnan/	Date (YYYY-MM-DD)	2020-03-27
Name/Print	Patrick J. Finnan	Registration Number	39189

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	Attorney Docket Number	0690.0023CN4

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number	
	Filing Date	
	First Named Inventor	Carles PUENTE BALIARDA
	Art Unit	
	Examiner Name	
	Attorney Docket Number	0690.0023CN4

	1	Infringement Chart - LG VX5400. Patent: 7202822, Fractus, 20091105	
	2	Infringement Chart - LG VX5500, Fractus, 20091105	
	3	Infringement Chart - LG VX5500. Patent: 7148850, Fractus, 20091105	
	4	Infringement Chart - LG VX5500. Patent: 7202822, Fractus, 20091105	
	5	Infringement Chart - LG VX8350, Fractus, 20091105	
	6	Infringement Chart - LG VX8350. Patent: 7148850, Fractus, 20091105	
	7	Infringement Chart - LG VX8350. Patent: 7202822, Fractus, 20091105	
	8	Infringement Chart - LG VX8360., Fractus, 20091105	
	9	Infringement Chart - LG VX8360. Patent: 7148850, Fractus, 20091105	
	10	Infringement Chart - LG VX8360. Patent: 7202822, Fractus, 20091105	
	11	Infringement Chart - LG VX8500, Fractus, 20091105	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**	Application Number	
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	First Named Inventor	Carles PUENTE BALIARDA
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	Attorney Docket Number	0690.0023CN4

	12	Infringement Chart - LG VX8500. Patent: 7148850, Fractus, 20091105	
	13	Infringement Chart - LG VX8500. Patent: 7202822, Fractus, 20091105	
	14	Infringement Chart - LG VX8560 Chocolate 3, Fractus, 20091105	
	15	Infringement Chart - LG VX8560 Chocolate 3. Patent: 7148850, Fractus, 20091105	
	16	Infringement Chart - LG VX8560 Chocolate 3. Patent: 7202822, Fractus, 20091105	
	17	Infringement Chart - LG VX8610, Fractus, 20091105	
	18	Infringement Chart - LG VX8610. Patent: 7148850, Fractus, 20091105	
	19	Infringement Chart - LG VX8610. Patent: 7202822, Fractus, 20091105	
	20	Infringement Chart - LG VX8800, Fractus, 20091105	
	21	Infringement Chart - LG VX8800. Patent: 7148850, Fractus, 20091105	
	22	Infringement Chart - LG VX8800. Patent: 7202822, Fractus, 20091105	

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	23	Infringement Chart - LG VX9400, Fractus, 20091105	
	24	Infringement Chart - LG Xenon GR500., Fractus, 20091105	
	25	Infringement Chart - LG Xenon GR500. Patent: 7148850, Fractus, 20091105	
	26	Infringement Chart - LG Xenon GR500. Patent: 7202822, Fractus, 20091105	
	27	Infringement Chart - Palm Centro 685, Fractus, 20091105	
	28	Infringement Chart - Palm Centro 685. Patent: 7148850, Fractus, 20091105	
	29	Infringement Chart - Palm Centro 685. Patent: 7202822, Fractus, 20091105	
	30	Infringement Chart - Palm Centro 690, Fractus, 20091105	
	31	Infringement Chart - Palm Centro 690. Patent: 7148850, Fractus, 20091105	
	32	Infringement Chart - Palm Centro 690. Patent: 7202822, Fractus, 20091105	
	33	Infringement Chart - Palm Pre, Fractus, 20091105	

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	Examiner Name	
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	34	Infringement Chart - Palm Pre. Patent: 7148850, Fractus, 20091105	
	35	Infringement Chart - Palm Pre. Patent: 7202822, Fractus, 20091105	
	36	Infringement Chart - Pantech Breeze C520., Fractus, 20091105	
	37	Infringement Chart - Pantech Breeze C520. Patent: 7148850, Fractus, 20091105	
	38	Infringement Chart - Pantech Breeze C520. Patent: 7202822, Fractus, 20091105	
	39	Infringement Chart - Pantech C610, Fractus, 20091105	
	40	Infringement Chart - Pantech C610. Patent: 7148850, Fractus, 20091105	
	41	Infringement Chart - Pantech C610. Patent: 7202822, Fractus, 20091105	
	42	Infringement Chart - Pantech C740, Fractus, 20091105	
	43	Infringement Chart - Pantech C740. Patent: 7148850, Fractus, 20091105	
	44	Infringement Chart - Pantech C740. Patent: 7202822, Fractus, 20091105	

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	Attorney Docket Number	0690.0023CN4

	45	Infringement Chart - Pantech DUO C810., Fractus, 20091105	
	46	Infringement Chart - Pantech DUO C810. Patent: 7148850, Fractus, 20091105	
	47	Infringement Chart - Pantech DUO C810. Patent: 7202822, Fractus, 20091105	
	48	Infringement Chart - Pantech Slate C530, Fractus, 20091105	
	49	Infringement Chart - Phone: LG Dare VX9700, Fractus, 20091105	
	50	Infringement Chart - RIM Blackberry 8110, Fractus, 20091105	

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	Art Unit	
	Examiner Name	
	Attorney Docket Number	0690.0023CN4

CERTIFICATION STATEMENT

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See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Patrick J. Finnan/	Date (YYYY-MM-DD)	2020-03-27
Name/Print	Patrick J. Finnan	Registration Number	39189

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3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

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5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

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	Application Number	
	Filing Date	
	First Named Inventor	Carles PUENTE BALIARDA
	Art Unit	
	Examiner Name	
	Attorney Docket Number	0690.0023CN4

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	Filing Date	
	First Named Inventor	Carles PUENTE BALIARDA
	Art Unit	
	Examiner Name	
	Attorney Docket Number	0690.0023CN4

	1	Infringement Chart - RIM Blackberry 8120, Fractus, 20091105	
	2	Infringement Chart - RIM Blackberry 8130, Fractus, 20091105	
	3	Infringement Chart - RIM Blackberry 8220, Fractus, 20091105	
	4	Infringement Chart - RIM Blackberry 8310, Fractus, 20091105	
	5	Infringement Chart - RIM Blackberry 8320, Fractus, 20091105	
	6	Infringement Chart - RIM Blackberry 8330, Fractus, 20091105	
	7	Infringement Chart - RIM Blackberry 8820, Fractus, 20091105	
	8	Infringement Chart - RIM Blackberry 8830, Fractus, 20091105	
	9	Infringement Chart - RIM Blackberry 8900, Fractus, 20091105	
	10	Infringement Chart - RIM Blackberry 9630, Fractus, 20091105	
	11	Infringement Chart - RIM Blackberry Bold 9000., Fractus, 20091105	

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	Attorney Docket Number	0690.0023CN4

	12	Infringement Chart - RIM Blackberry Pearl 8100, Fractus, 20091105	
	13	Infringement Chart - RIM Blackberry Storm 9530., Fractus, 20091105	
	14	Infringement Chart - Samsung Blackjack II SCH-I617. Patent: 7148850, Fractus, 20091105	
	15	Infringement Chart - Samsung Blackjack II SCH-I617. Patent: 7202822, Fractus, 20091105	
	16	Infringement Chart - Samsung Blackjack II SGH-i617., Fractus, 20091105	
	17	Infringement Chart - Samsung Blast SGH-T729. Patent: 7148850, Fractus, 20091105	
	18	Infringement Chart - Samsung Blast SGH-T729. Patent: 7202822, Fractus, 20091105	
	19	Infringement Chart - Samsung Blast SGH T729, Fractus, 20091105	
	20	Infringement Chart - Samsung EPIX SGH-I907, Fractus, 20091105	
	21	Infringement Chart - Samsung FlipShot SCH-U900, Fractus, 20091105	
	22	Infringement Chart - Samsung FlipShot SCH-U900. Patent: 7148850, Fractus, 20091105	

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	Examiner Name	
	Attorney Docket Number	0690.0023CN4

	23	Infringement Chart - Samsung FlipShot SCH-U900. Patent: 7202822, Fractus, 20091105	
	24	Infringement Chart - Samsung Instinct M800, Fractus, 20091105	
	25	Infringement Chart - Samsung Instinct M800. Patent: 7148850, Fractus, 20091105	
	26	Infringement Chart - Samsung Instinct M800. Patent: 7202822, Fractus, 20091105	
	27	Infringement Chart - Samsung M320, Fractus, 20091105	
	28	Infringement Chart - Samsung M320. Patent: 7148850, Fractus, 20091105	
	29	Infringement Chart - Samsung M320. Patent: 7202822, Fractus, 20091105	
	30	Infringement Chart - Samsung Messager, Fractus, 20091105	
	31	Infringement Chart - Samsung Messager. Patent: 7148850, Fractus, 20091105	
	32	Infringement Chart - Samsung Messager. Patent: 7202822, Fractus, 20091105	
	33	Infringement Chart - Samsung Omnia SGH-I900, Fractus, 20091105	

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	Examiner Name	
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	34	Infringement Chart - Samsung Omnia SGH-I900. Patent: 7148850, Fractus, 20091105	
	35	Infringement Chart - Samsung Omnia SGH-I900. Patent: 7202822, Fractus, 20091105	
	36	Infringement Chart - Samsung SCH-A630, Fractus, 20091105	
	37	Infringement Chart - Samsung SCH-A630. Patent: 7148850, Fractus, 20091105	
	38	Infringement Chart - Samsung SCH-A630. Patent: 7202822, Fractus, 20091105	
	39	Infringement Chart - Samsung SCH-A645, Fractus, 20091105	
	40	Infringement Chart - Samsung SCH-A645. Patent: 7148850, Fractus, 20091105	
	41	Infringement Chart - Samsung SCH-A645. Patent: 7202822, Fractus, 20091105	
	42	Infringement Chart - Samsung SCH-A870, Fractus, 20091105	
	43	Infringement Chart - Samsung SCH-A887 Solstice. Patent: 7148850, Fractus, 20091105	
	44	Infringement Chart - Samsung SCH-A887 Solstice. Patent: 7202822, Fractus, 20091105	

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	45	Infringement Chart - Samsung SCH-I910, Fractus, 20091105	
	46	Infringement Chart - Samsung SCH-I910. Patent: 7148850, Fractus, 20091105	
	47	Infringement Chart - Samsung SCH-I910. Patent: 7202822, Fractus, 20091105	
	48	Infringement Chart - Samsung SCH-R430, Fractus, 20091105	
	49	Infringement Chart - Samsung SCH-R430. Patent: 7148850, Fractus, 20091105	
	50	Infringement Chart - Samsung SCH-R430. Patent: 7202822, Fractus, 20091105	

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☒ A certification statement is not submitted herewith.

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Signature	/Patrick J. Finnan/	Date (YYYY-MM-DD)	2020-03-27
Name/Print	Patrick J. Finnan	Registration Number	39189

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	Attorney Docket Number	0690.0023CN4

	1	Infringement Chart - Samsung SCH-R500., Fractus, 20091105	
	2	Infringement Chart - Samsung SCH-R500. Patent: 7148850, Fractus, 20091105	
	3	Infringement Chart - Samsung SCH-R500. Patent: 7202822, Fractus, 20091105	
	4	Infringement Chart - Samsung SCH-R600, Fractus, 20091105	
	5	Infringement Chart - Samsung SCH-R600. Patent: 7148850, Fractus, 20091105	
	6	Infringement Chart - Samsung SCH-R600. Patent: 7202822, Fractus, 20091105	
	7	Infringement Chart - Samsung SCH-R800, Fractus, 20091105	
	8	Infringement Chart - Samsung SCH-R800. Patent: 7148850, Fractus, 20091105	
	9	Infringement Chart - Samsung SCH-R800. Patent: 7202822, Fractus, 20091105	
	10	Infringement Chart - Samsung SCH-U310, Fractus, 20091105	
	11	Infringement Chart - Samsung SCH-U310. Patent: 7148850, Fractus, 20091105	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT **(Not for submission under 37 CFR 1.99)**	Application Number	
	Filing Date	
	First Named Inventor	Carles PUENTE BALIARDA
	Art Unit	
	Examiner Name	
	Attorney Docket Number	0690.0023CN4

	12	Infringement Chart - Samsung SCH-U310. Patent: 7202822, Fractus, 20091105	
	13	Infringement Chart - Samsung SCH-U430, Fractus, 20091105	
	14	Infringement Chart - Samsung SCH-U430. Patent: 7148850, Fractus, 20091105	
	15	Infringement Chart - Samsung SCH-U430. Patent: 7202822, Fractus, 20091105	
	16	Infringement Chart - Samsung SCH-U470, Fractus, 20091105	
	17	Infringement Chart - Samsung SCH-U470. Patent: 7148850, Fractus, 20091105	
	18	Infringement Chart - Samsung SCH-U470. Patent: 7202822, Fractus, 20091105	
	19	Infringement Chart - Samsung SCH-U520, Fractus, 20091105	
	20	Infringement Chart - Samsung SCH-U520. Patent: 7148850, Fractus, 20091105	
	21	Infringement Chart - Samsung SCH-U520. Patent: 7202822, Fractus, 20091105	
	22	Infringement Chart - Samsung SCH-U740, Fractus, 20091105	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	
	Filing Date	
	First Named Inventor	Carles PUENTE BALIARDA
	Art Unit	
	Examiner Name	
	Attorney Docket Number	0690.0023CN4

	23	Infringement Chart - Samsung SCH-U740. Patent: 7148850, Fractus, 20091105	
	24	Infringement Chart - Samsung SCH-U740. Patent: 7202822, Fractus, 20091105	
	25	Infringement Chart - Samsung SCH-U750, Fractus, 20091105	
	26	Infringement Chart - Samsung SCH-U750. Patent: 7148850, Fractus, 20091105	
	27	Infringement Chart - Samsung SCH-U750. Patent: 7202822, Fractus, 20091105	
	28	Infringement Chart - Samsung SCH-U940, Fractus, 20091105	
	29	Infringement Chart - Samsung SCH-U940. Patent. 7202822, Fractus, 20091105	
	30	Infringement Chart - Samsung SCH-U940. Patent: 7148850, Fractus, 20091105	
	31	Infringement Chart - Samsung SCH A127, Fractus, 20091105	
	32	Infringement Chart - Samsung SCH U340., Fractus, 20091105	
	33	Infringement Chart - Samsung SCH U340. Patent: 7148850, Fractus, 20091105	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number	
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	Art Unit	
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	Attorney Docket Number	0690.0023CN4

	34	Infringement Chart - Samsung SCH U340. Patent: 7202822, Fractus, 20091105	
	35	Infringement Chart - Samsung SCH U410., Fractus, 20091105	
	36	Infringement Chart - Samsung SCH U410. Patent: 7148850, Fractus, 20091105	
	37	Infringement Chart - Samsung SCH U410. Patent: 7202822, Fractus, 20091105	
	38	Infringement Chart - Samsung SCH U700, Fractus, 20091105	
	39	Infringement Chart - Samsung SCH U700. Patent: 7148850, Fractus, 20091105	
	40	Infringement Chart - Samsung SCH U700. Patent: 7202822, Fractus, 20091105	
	41	Infringement Chart - Samsung SGH-A237, Fractus, 20091105	
	42	Infringement Chart - Samsung SGH-A237. Patent: 7148850, Fractus, 20091105	
	43	Infringement Chart - Samsung SGH-A237. Patent: 7202822, Fractus, 20091105	
	44	Infringement Chart - Samsung SGH-A257, Fractus, 20091105	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**	Application Number		
	Filing Date		
	First Named Inventor	Carles PUENTE BALIARDA	
	Art Unit		
	Examiner Name		
	Attorney Docket Number	0690.0023CN4	

	45	Infringement Chart - Samsung SGH-A257 Magnet. Patent: 7148850, Fractus, 20091105	
	46	Infringement Chart - Samsung SGH-A257 Magnet. Patent: 7202822, Fractus, 20091105	
	47	Infringement Chart - Samsung SGH-A837, Fractus, 20091105	
	48	Infringement Chart - Samsung SGH-A837. Patent: 7148850, Fractus, 20091105	
	49	Infringement Chart - Samsung SGH-A837. Patent: 7202822, Fractus, 20091105	
	50	Infringement Chart - Samsung SGH-A887, Fractus, 20091105	

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
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	First Named Inventor	Carles PUENTE BALIARDA
	Art Unit	
	Examiner Name	
	Attorney Docket Number	0690.0023CN4

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Patrick J. Finnan/	Date (YYYY-MM-DD)	2020-03-27
Name/Print	Patrick J. Finnan	Registration Number	39189

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.
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	Application Number	
	Filing Date	
	First Named Inventor	Carles PUENTE BALIARDA
	Art Unit	
	Examiner Name	
	Attorney Docket Number	0690.0023CN4

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**	Application Number		
	Filing Date		
	First Named Inventor	Carles PUENTE BALIARDA	
	Art Unit		
	Examiner Name		
	Attorney Docket Number	0690.0023CN4	

	1	Infringement Chart - Samsung SGH-I907. Patent: 7148850, Fractus, 20091105	
	2	Infringement Chart - Samsung SGH-I907. Patent: 7202822, Fractus, 20091105	
	3	Infringement Chart - Samsung SGH-T219., Fractus, 20091105	
	4	Infringement Chart - Samsung SGH-T219. Patent: 7148850, Fractus, 20091105	
	5	Infringement Chart - Samsung SGH-T219. Patent: 7202822, Fractus, 20091105	
	6	Infringement Chart - Samsung SGH-T239, Fractus, 20091105	
	7	Infringement Chart - Samsung SGH-T239. Patent: 7148850, Fractus, 20091105	
	8	Infringement Chart - Samsung SGH-T239. Patent: 7202822, Fractus, 20091105	
	9	Infringement Chart - Samsung SGH-T559, Fractus, 20091105	
	10	Infringement Chart - Samsung SGH-T559 Comeback. Patent: 7148850, Fractus, 20091105	
	11	Infringement Chart - Samsung SGH-T559 Comeback. Patent: 7202822, Fractus, 20091105	

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	First Named Inventor	Carles PUENTE BALIARDA
	Art Unit	
	Examiner Name	
	Attorney Docket Number	0690.0023CN4

	12	Infringement Chart - Samsung SGH-T639, Fractus, 20091105	
	13	Infringement Chart - Samsung SGH-T639. Patent: 7148850, Fractus, 20091105	
	14	Infringement Chart - Samsung SGH-T639. Patent: 7202822, Fractus, 20091105	
	15	Infringement Chart - Samsung SGH-T739, Fractus, 20091105	
	16	Infringement Chart - Samsung SGH-T739. Patent: 7148850, Fractus, 20091105	
	17	Infringement Chart - Samsung SGH-T739. Patent: 7202822, Fractus, 20091105	
	18	Infringement Chart - Samsung SGH-T819, Fractus, 20091105	
	19	Infringement Chart - Samsung SGH-T819. Patent: 7148850, Fractus, 20091105	
	20	Infringement Chart - Samsung SGH-T819. Patent: 7202822, Fractus, 20091105	
	21	Infringement Chart - Samsung SGH-T929, Fractus, 20091105	
	22	Infringement Chart - Samsung SGH-T929. Patent: 7148850, Fractus, 20091105	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**	Application Number	
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	First Named Inventor	Carles PUENTE BALIARDA
	Art Unit	
	Examiner Name	
	Attorney Docket Number	0690.0023CN4

	23	Infringement Chart - Samsung SGH-T929. Patent: 7202822, Fractus, 20091105	
	24	Infringement Chart - Samsung SGH A117, Fractus, 20091105	
	25	Infringement Chart - Samsung SGH A117. Patent: 7148850, Fractus, 20091105	
	26	Infringement Chart - Samsung SGH A117. Patent: 7202822, Fractus, 20091105	
	27	Infringement Chart - Samsung SGH A127. Patent: 7148850, Fractus, 20091105	
	28	Infringement Chart - Samsung SGH A127. Patent: 7202822, Fractus, 20091105	
	29	Infringement Chart - Samsung SGH A437, Fractus, 20091105	
	30	Infringement Chart - Samsung SGH A437. Patent: 7148850, Fractus, 20091105	
	31	Infringement Chart - Samsung SGH A437. Patent: 7202822, Fractus, 20091105	
	32	Infringement Chart - Samsung SGH A737, Fractus, 20091105	
	33	Infringement Chart - Samsung SGH A737. Patent: 7148850, Fractus, 20091105	

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	First Named Inventor	Carles PUENTE BALIARDA
	Art Unit	
	Examiner Name	
	Attorney Docket Number	0690.0023CN4

	34	Infringement Chart - Samsung SGH A737. Patent: 7202822, Fractus, 20091105	
	35	Infringement Chart - Samsung SGH A867, Fractus, 20091105	
	36	Infringement Chart - Samsung SGH A867. Patent: 7148850, Fractus, 20091105	
	37	Infringement Chart - Samsung SGH A867. Patent: 7202822, Fractus, 20091105	
	38	Infringement Chart - Samsung SGH T229, Fractus, 20091105	
	39	Infringement Chart - Samsung SGH T229. Patent: 7148850, Fractus, 20091105	
	40	Infringement Chart - Samsung SGH T229. Patent: 7202822, Fractus, 20091105	
	41	Infringement Chart - Samsung SGH T439, Fractus, 20091105	
	42	Infringement Chart - Samsung SGH T439. Patent: 7148850, Fractus, 20091105	
	43	Infringement Chart - Samsung SGH T439. Patent: 7202822, Fractus, 20091105	
	44	Infringement Chart - Samsung SGH T459, Fractus, 20091105	

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	Filing Date	
	First Named Inventor	Carles PUENTE BALIARDA
	Art Unit	
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	Attorney Docket Number	0690.0023CN4

	45	Infringement Chart - Samsung SGH T459. Patent: 7148850, Fractus, 20091105	
	46	Infringement Chart - Samsung SGH T459. Patent: 7202822, Fractus, 20091105	
	47	Infringement Chart - Samsung SGH T919, Fractus, 20091105	
	48	Infringement Chart - Samsung SGH T919. Patent: 7148850, Fractus, 20091105	
	49	Infringement Chart - Samsung SGH T919. Patent: 7202822, Fractus, 20091105	
	50	Infringement Chart - Samsung Spex R210a, Fractus, 20091105	

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[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

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CERTIFICATION STATEMENT

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See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Patrick J. Finnan/	Date (YYYY-MM-DD)	2020-03-27
Name/Print	Patrick J. Finnan	Registration Number	39189

Privacy Act Statement

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2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

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5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

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	First Named Inventor	Carles PUENTE BALIARDA
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	Attorney Docket Number	0690.0023CN4

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	Examiner Name	
	Attorney Docket Number	0690.0023CN4

	1	Infringement Chart - Samsung Spex R210a. Patent: 7148850, Fractus, 20091105	
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	4	Infringement Chart - Samsung SPH-A523. Patent: 7148850, Fractus, 20091105	
	5	Infringement Chart - Samsung SPH-A523. Patent: 7202822, Fractus, 20091105	
	6	Infringement Chart - Samsung SPH-M550, Fractus, 20091105	
	7	Infringement Chart - Samsung SPH-M550. Patent: 7148850, Fractus, 20091105	
	8	Infringement Chart - Samsung SPH-M550. Patent: 7202822, Fractus, 20091105	
	9	Infringement Chart - Samsung SPH M520, Fractus, 20091105	
	10	Infringement Chart - Samsung SPH M520. Patent: 7148850, Fractus, 20091105	
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	Examiner Name		
	Attorney Docket Number	0690.0023CN4	

	12	Infringement Chart - Samsung SPH M540., Fractus, 20091105	
	13	Infringement Chart - Samsung SPH M540. Patent: 7148850, Fractus, 20091105	
	14	Infringement Chart - Samsung SPH M540. Patent: 7202822, Fractus, 20091105	
	15	Infringement Chart - Samsung Sway SCH-U650, Fractus, 20091105	
	16	Infringement Chart - Samsung Sway SCH-U650. Patent: 7148850, Fractus, 20091105	
	17	Infringement Chart - Samsung Sway SCH-U650. Patent: 7202822, Fractus, 20091105	
	18	Infringement Chart - Sanyo Katana II., Fractus, 20091105	
	19	Infringement Chart - Sanyo Katana II. Patent: 7148850, Fractus, 20091105	
	20	Infringement Chart - Sanyo Katana II. Patent: 7202822, Fractus, 20091105	
	21	Infringement Chart - Sanyo Katana LX, Fractus, 20091105	
	22	Infringement Chart - Sanyo Katana LX. Patent: 7148850, Fractus, 20091105	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
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	23	Infringement Chart - Sanyo Katana LX. Patent: 7202822, Fractus, 20091105	
	24	Infringement Chart - Sanyo S1, Fractus, 20091105	
	25	Infringement Chart - Sanyo S1. Patent: 7148850, Fractus, 20091105	
	26	Infringement Chart - Sanyo S1. Patent: 7202822, Fractus, 20091105	
	27	Infringement Chart - Sanyo SCP 2700., Fractus, 20091105	
	28	Infringement Chart - Sanyo SCP 2700. Patent: 7148850, Fractus, 20091105	
	29	Infringement Chart - Sanyo SCP 2700. Patent: 7202822, Fractus, 20091105	
	30	Infringement Chart - Sharp Sidekick 3, Fractus, 20091105	
	31	Infringement Chart - Sharp Sidekick 3. Patent: 7148850, Fractus, 20091105	
	32	Infringement Chart - Sharp Sidekick 3. Patent: 7202822, Fractus, 20091105	
	33	Infringement Chart - Sharp Sidekick 2008., Fractus, 20091105	

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	34	Infringement Chart - Sharp Sidekick 2008. Patent: 7148850, Fractus, 20091105	
	35	Infringement Chart - Sharp Sidekick 2008. Patent: 7202822, Fractus, 20091105	
	36	Infringement Chart - Sharp Sidekick LX 2009., Fractus, 20091105	
	37	Infringement Chart - Sharp Sidekick LX 2009. Patent: 7148850, Fractus, 20091105	
	38	Infringement Chart - Sharp Sidekick LX 2009. Patent: 7202822, Fractus, 20091105	
	39	Infringement Chart - Sharp Sidekick LX. Patent: 7148850, Fractus, 20091105	
	40	Infringement Chart - Sharp Sidekick LX. Patent: 7202822, Fractus, 20091105	
	41	Infringement Chart - UTStarcom CDM7126., Fractus, 20091105	
	42	Infringement Chart - UTStarcom CDM7126. Patent: 7148850, Fractus, 20091105	
	43	Infringement Chart - UTStarcom CDM7126. Patent: 7202822, Fractus, 20091105	
	44	Infringement Chart - UTStarcom Quickfire GTX75., Fractus, 20091105	

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	45	Infringement Chart - UTStarcom Quickfire GTX75. Patent: 7148850, Fractus, 20091105	
	46	Infringement Chart - UTStarcom Quickfire GTX75. Patent: 7202822, Fractus, 20091105	
	47	Claim construction and motion for summary judgement - Markman Hearing - [Defendants], Defendants, 20100902	
	48	Defendant's Invalidity Contentions including appendix B and exhibits 6, 7, 10, 11 referenced in Space Filling Antenna, Defendants, 20100224	
	49	Demonstratives presented by Dr. Steven Best during trial, Defendants, 20110519	
	50	Demonstratives presented by Dr. Stuart Long during trial, Fractus, 20110518	

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OR

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The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Patrick J. Finnan/	Date (YYYY-MM-DD)	2020-03-27
Name/Print	Patrick J. Finnan	Registration Number	39189

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3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

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	First Named Inventor	Carles PUENTE BALIARDA
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	1	Detailed rejection of US patent application 12/347462, Defendants, 20100701	
	2	Document 0001 - Complaint for patent infringement, Susman Godfrey, 20090505	
	3	Document 0014 - Amended complaint for patent infringement, Fractus, 20090506	
	4	Document 0032 - Defendants LG Electronics Mobilecomm USA., Inc.'s answer and counterclaim to complaint, Defendants, 20091001	
	5	Document 0064 - Defendant Pantech Wireless, INC.'S answer, affirmative defenses and counterclaims to Fractus SA' s Amended complaint, Defendants, 20090604	
	6	Document 0066 - Defendant UTStarcom, Inc's answer affirmative defenses and counterclaims to plaintiff's amended complaint, Defendants, 20090608	
	7	Document 0073 - Plaintiff Fractus SA' s answer to defendant Pantech Wireless, Inc' s counterclaims, Defendants, 20090624	
	8	Document 0079 - Plaintiff Fractus SA' s answer to defendant UTStarcom, Inc' s counterclaims, Fractus, 20090629	
	9	Document 0091 - Answer, affirmative defenses and counterclaims to the amended complaint for patent infringement on behalf of Defendant Personal Communications Devices Holdings, LLC, Defendants, 20090720	
	10	Document 0099 - Defendant Sanyo North America Corporation's partial answer to amended complaint for patent infringement, Defendants, 20090720	
	11	Document 0106 - Kyocera Communications Inc's answer, affirmative defenses and counterclaims to plaintiff's amended complaint, Defendants, 20090721	

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	12	Document 0107 - Kyocera Wireless Corp's answer, affirmative defenses and counterclaims to plaintiff's amended complaint, Defendants, 20090721	
	13	Document 0108 - Palm Inc.'s answer, affirmative defenses and counterclaims to plaintiff's amended complaint, Defendants, 20090721	
	14	Document 0111 - Civil cover sheet, Susman Godfrey, 20090505	
	15	Document 0175 - Defendant HTC Corporation's amended answer and counterclaim to plaintiff's second amended complaint, Defendants, 20090925	
	16	Document 0176 - Defendant HTC America Inc's answer and counterclaim to plaintiff's amended complaint, Defendants, 20090925	
	17	Document 0180 - Defendants Samsung Electronics Co., Ltd.'s; Samsung Electronics Research Institute's and Samsung Semiconductor Europe GMBH' s answer; and Samsung Telecommunications America LLC' s answer and counterclaim, Defendants, 20091001	
	18	Document 0185 - Defendants Research in Motion LTD, and Research in Motion Corporation's answers, defenses and counterclaims to plaintiff's amended complaint, Defendants, 20091001	
	19	Document 0187 - Defendants LG Electronics Inc., LG Electronics USA, Inc., and LG Electronics Mobilecomm USA Inc. answer and counterclaim to amended complaint, Defendants, 20091001	
	20	Document 0190 - Defendant HTC Corporation's First amended answer and counterclaim to plaintiff's amended complaint, Defendants, 20091002	
	21	Document 0191 - Defendant HTC America, Inc's first amended answer and counterclaims to plaintiff's amended complaint, Defendants, 20091002	
	22	Document 0217 - Defendants Research in Motion LTD, and Research in Motion Corporation's amended answer, defenses and counterclaims to plaintiff's amended complaint, Defendants, 20091124	

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	23	Document 0222 - Second amended complaint for patent infringement, Susman Godfrey, 20091202	
	24	Document 0227 - Second amended complaint for patent infringement - Case 6:09-cv-00203, Fractus, 20091208	
	25	Document 0235 - Answer, affirmative defenses and counterclaims to the second amended complaint for patent infringement on behalf of Defendant Personal Communications Devices Holdings, LLC, Defendants, 20091217	
	26	Document 0238 - Defendant HTC America, Inc's answer and counterclaims to plaintiff's second amended complaint, Defendants, 20091221	
	27	Document 0239 - Defendant HTC Corporation's answer and counterclaims to plaintiff's second amended complaint, Defendants, 20091221	
	28	Document 0241 - Defendant Research in Motion LTD and Research in Motion Corporation's second answer, defenses and counterclaims to plaintiff's second amended complaint, Defendants, 20091221	
	29	Document 0242 - Defendant Pantech Wireless, Inc's answer, affirmative defenses and counterclaims to Fractus SA's second amended complaint, Defendants, 20091221	
	30	Document 0243 - Defendant Sanyo Electric Co. LTD's answer to second amended complaint for patent infringement, Defendants, 20091222	
	31	Document 0244 - Defendant Sanyo North America Corporation's answer to second amended complaint for patent infringement, Defendants, 20091222	
	32	Document 0246 - Defendant UTStarcom, Inc's answer, affirmative defenses and counterclaims to Fractus SA's second amended complaint, Defendants, 20091222	
	33	Document 0247 - Palm, Inc's answer, affirmative defenses and counterclaims to plaintiff's second amended complaint, Defendants, 20091222	

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	34	Document 0248 - Kyocera Communications, Inc's answer, affirmative defenses and counterclaims to plaintiff's second amended complaint, Defendants, 20091222	
	35	Document 0249 - Kyocera Wireless Corp's answer, affirmative defenses and counterclaims to plaintiff's second amended complaint, Defendants, 20091222	
	36	Document 0250 - Defendants Samsung Electronics Co., Ltd.'s; Samsung Electronics answer and counterclaim to the second amended complaint of plaintiff Fractus, Defendants, 20091223	
	37	Document 0251 - Defendants LG Electronics Inc., LG Electronics USA, Inc., and LG Electronics Mobilecomm USA Inc. answer and counterclaim to second amended complaint, Defendants, 20091228	
	38	Document 0252 - Answer of the Sharp Defendants to plaintiff's second amended complaint, Defendants, 20091229	
	39	Document 0255 - Plaintiff Fractus, S. A.'s answer to defendant Personal Communications Devices Holdings, LLC's counterclaims to the Second Amended Complaint, Susman Godfrey, 20100104	
	40	Document 0256 - Plaintiff Fractus, S. A.'s answer to the counterclaims of defendants Research in Motion LTD. and Research in Motion Corporation to the Second Amended Complaint, Susman Godfrey, 20100104	
	41	Document 0257 - Plaintiff Fractus, S. A.'s answer to counterclaims of defendant Pantech Wireless, Inc. to the Second Amended Complaint, Susman Godfrey, 20100104	
	42	Document 0258 - Plaintiff Fractus, S. A.'s answer to defendant Kyocera Communications, Inc's Counterclaims to the Second Amended Complaint, Susman Godfrey, 20100104	
	43	Document 0259 - Plaintiff Fractus, S. A.'s answer to defendant Kyocera Wireless Corp's Counterclaims to the Second Amended Complaint, Susman Godfrey, 20100104	
	44	Document 0260 - Plaintiff Fractus, S. A.'s answer to defendant Palm, Inc's Counterclaims to the Second Amended Complaint, Susman Godfrey, 20100104	

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	45	Document 0261 - Plaintiff Fractus, S. A.'s answer to defendant UTStarcom, Inc's Counterclaims to the Second Amended Complaint, Susman Godfrey, 20100104	
	46	Document 0262 - Plaintiff Fractus, S. A.'s answer to counterclaims of defendant Samsung Telecommunications America LLC to the Second Amended Complaint, Susman Godfrey, 20100104	
	47	Document 0263 - Plaintiff Fractus, S. A.'s answer to counterclaims of defendants LG Electronics Inc., Electronics USA, Inc., and LG Electronics Mobilecomm USA, Inc. to the Second Amended Complaint, Susman Godfrey, 20100104	
	48	Document 0273 - Plaintiff Fractus, S. A.'s answer to counterclaims of defendants HTC America, Inc to the Second Amended Complaint, Susman Godfrey, 20100114	
	49	Document 0286 - Amended answer of the Sharp defendants to plaintiff's second amended complaint, Defendants, 20100224	
	50	Document 0287 - Defendants Samsung Electronics Co., Ltd.'s; Samsung Electronics Research Institute's and Samsung Semiconductor Europe GMBH' s first amended answer; and Samsung Telecommunications America LLC' s first amended answer, Defendants, 20100224	

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Name/Print	Patrick J. Finnan	Registration Number	39189

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	1	Document 0288 - Defendants LG Electronics Inc., LG Electronics USA, Inc., and LG Electronics Mobilecomm USA Inc. First amended answer and counterclaim to second amended complaint, Defendants, 20100224	
	2	Document 0290 - Defendant HTC America, Inc.'s amended answer and counterclaim to plaintiff's second amended complaint, Defendants, 20100224	
	3	Document 0291 - Defendant HTC Corporation's amended answer and counterclaim to plaintiff's second amended complaint, Defendants, 20100224	
	4	Document 0297 - Defendant HTC Corporation's amended answer and counterclaim to plaintiff's second amended complaint, Defendants, 20100225	
	5	Document 0298 - Defendant HTC America, Inc.'s amended answer and counterclaim to plaintiff's second amended complaint, Defendants, 20100225	
	6	Document 0351 - Plaintiff Fractus, S. A.'s answer to amended counterclaims of defendant Samsung Telecommunications America LLC's to Fractus's Second Amended Complaint, Susman Godfrey, 20100401	
	7	Document 0352 - Plaintiff Fractus, S. A.'s answer to amended counterclaims of defendant HTC Corporation to Fractus's Second Amended Complaint, Susman Godfrey, 20100401	
	8	Document 0353 - Plaintiff Fractus, S. A.'s answer to amended counterclaims of defendant HTC America, Inc. To Fractus's Second Amended Complaint, Susman Godfrey, 20100401	
	9	Document 0354 - Plaintiff Fractus, S. A.'s answer to amended counterclaims of defendant LG Electronics Inc., LG Electronics USA, Inc., and LG Electronics Mobilecomm USA Inc's to Fractus's Second Amended Complaint, Susman Godfrey, 20100401	
	10	Document 0415 - P.R. 4-3 joint claim construction statement, Susman Godfrey, 20100614	
	11	Document 0423 - Fractus SA's Opening Claim Construction Brief with Parties' Proposed and Agreed Constructions in the case of Fractus SA v. Samsung Electomics Co. Ltd. et al., Susman Godfrey, 20100716	

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	12	Document 0428 - Response of defendants Kyocera Communications, Inc; Palm Inc. and UTStarcom, Inc. to plaintiff Fractus SA's opening claim construction brief in "Case 6:09-cv-00203-LED-JDL", Defendants, 20100730	
	13	Document 0429 - Declaration of Jeffery D. Baxter - Including Exhibits: J, K, L, M ,N ,O, P, Q, R, S, T, U, Z, AA, KK, LL, Defendants, 20100730	
	14	Document 0430 - Defendants RIM, Samsung, HTC, LG and Pantech's response to plaintiff Fractus SA's opening claim construction brief, Defendants, 20100730	
	15	Document 0430 - Defendants RIM, Samsung, HTC, LG and Pantech's response to plaintiff Fractus SA's opening claim construction brief - Exhibit 1 - Chart of Agreed Terms and Disputed Terms, Defendants, 20100730	
	16	Document 0430 - Defendants RIM, Samsung, HTC, LG and Pantech's response to plaintiff Fractus SA's opening claim construction brief - Exhibit 2 - Family Tree of Asserted Patents, Defendants, 20100730	
	17	Document 0430 - Defendants RIM, Samsung, HTC, LG and Pantech's response to plaintiff Fractus SA's opening claim construction brief - Exhibit 33 - Excerpt from Plaintiff's '868 pat. inf.cont.for Samsung SPH M540, Defendants, 20100730	
	18	Document 0430 - Defendants RIM, Samsung, HTC, LG and Pantech's response to plaintiff Fractus SA's opening claim construction brief - Exhibit 34 - Excerpts from Plaintiff's '431 patent Infringement Contentions of HTC Diamond, Defendants, 20100730	
	19	Document 0430 - Defendants RIM, Samsung, HTC, LG and Pantech's response to plaintiff Fractus SA's opening claim construction brief - Exhibit 41 - Demonstrative re: counting segments, Defendants, 20100730	
	20	Document 0430 - Defendants RIM, Samsung, HTC, LG and Pantech's response to plaintiff Fractus SA's opening claim construction brief - Exhibit 42 - Demonstrative showing how straight segments can be fitted over a curved surface, Defendants, 20100730	
	21	Document 0430 - Defendants RIM, Samsung, HTC, LG and Pantech's response to plaintiff Fractus SA's opening claim construction brief - Exhibit 57 - Excerpts from Plaintiff's '868 and '762 Pat. Infr. cont. for RIM 8310, Defendants, 20100730	
	22	Document 0440 - Fractus's opposition to defendants' motion for summary judgement of invalidity based on indefiniteness and lack of written description for certain terms, Susman Godfrey, 20100816	

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	23	Document 0440-1 - Expert declaration by Dr. D. Jaggard including exhibits (curriculum and datasheets from Cushcraft, Antenova, Ethertronics and Taoglas), Susman Godfrey, 20100816	
	24	Document 0440-2 - Declaration of Micah Howe in support of Fractus SA opposition to defendants' motion for summary judgement of invalidity based on indefiniteness and lack of written description for certain terms, Heim , Payne and Chorus LLP, 20100816	
	25	Document 0452 - Defendant's reply in support of their motion for summary judgment of invalidity based on indefiniteness and lack of written description for certain terms with exhibits WW, BBB, EEE, GGG, HHH, III, KKK, MMM, NNN, OOO, PPP, Q, Defendants, 20100830	
	26	Document 0475 - Order. Provisional claim construction and motion for summary judgement. Provisional markman order, Court, 20101109	
	27	Document 0526 - Memorandum order and opinion, Court, 20101217	
	28	Document 0575 - Fractus ´s Objections to claim construction memorandum and order, Susman Godfrey, 20110114	
	29	Document 0582 - Memorandum opinion and order, Court, 20110120	
	30	Document 0583 - Defendant's notice of compliance regarding second amended invalidity contentions, Defendants, 20110121	
	31	Document 0607 - Declaration of Thomas E. Nelson - Exhibit A - Antenna photos, Defendants, 20110203	
	32	Document 0609 - Fractus' reply to defendant's motion for reconsideration of, and objections to, magistrate Judge Love's markman order, Susman Godfrey, 20110204	
	33	Document 0611 - Report and recommendation of United States magistrate judge, Court, 20110208	

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	34	Document 0622 - Order adopting report and recommendation of magistrate judge, Court, 20110211	
	35	Document 0624 - Notice of compliance with motion practice orders, Susman Godfrey, 20110214	
	36	Document 0641 - Defendant HTC America, Inc's second amended answer and counterclaim to plaintiff's second amended complaint, Defendants, 20110225	
	37	Document 0642 - Defendant HTC Corporation's second amended answer and counterclaim to plaintiff's second amended complaint, Defendants, 20110225	
	38	Document 0645 - Reply brief in support of Defendant's motion for reconsideration of the court's ruling on the term "at least a portion" in the court's December 17, 2010 claim construction order based on newly-available evidence, Defendants, 20110225	
	39	Document 0647 - Defendants Samsung Electronics Co LTD (et al) second amended answer and counterclaims to the second amended complaint of plaintiff Fractus SA - Document 647, Defendants, 20110228	
	40	Document 0649 - Defendants LG Electronics Inc, LG Electronics USA, and LG Electronics Mobilecomm USA Inc's second amended answer and counterclaim to second amended complaint, Defendants, 20110228	
	41	Document 0657 - Defendant Pantech Wireless Inc amended answer, affirmative defenses, and counterclaims to Fractus' second amended complaint, Defendants, 20110228	
	42	Document 0666 - Fractus's sur-reply to defendants' motion for reconsideration of the court's december 17, 2010 claim construction order based on newly-available evidence, Susman Godfrey, 20110308	
	43	Document 0670 - Order, Court, 20110309	
	44	Document 0678 - Plaintiff Fractus SA's answer to second amended counterclaims of defendant HTC Corporation to Fractus's second amended complaint, Susman Godfrey, 20110314	

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	45	Document 0680 - Plaintiff Fractus SA's answer to second amended counterclaims of defendant HTC to Fractus's second amended complaint, Susman Godfrey, 20110314	
	46	Document 0694 - Plaintiff Fractus SA's answer to second amended counterclaims of defendant LG Electronics to Fractus's second amended complaint, Susman Godfrey, 20110315	
	47	Document 0695 - Plaintiff Fractus SA's answer to second amended counterclaims of defendant Samsung to Fractus's second amended complaint, Susman Godfrey, 20110315	
	48	Document 0696 - Plaintiff Fractus SA's answer to amended counterclaims of defendant Pantech Wireless Inc to Fractus's second amended complaint, Susman Godfrey, 20110315	
	49	Document 0715 - Letter to John D. Love - Permission to file a summary judgment motion of no indefiniteness on the issues wher the Court's Report and Recommendation already has held that the claim term is not indefinite, Susman Godfrey, 20110318	
	50	Document 0716 - Letter to John D. Love - Permission to file a partial summary judgement motion on infringement., Susman Godfrey , LLP, 20110318	

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	1	Document 0721 - Letter to John D. Love - Permission to file a motion for summary judgment of invalidity of the following 7 asserted claims from the MLV, patent family..., Defendants - Baker Botts, LLP, 20110318	
	2	Document 0768 - Fractus, S.A.'s objections to the Court's March 9, 2011, Order, Susman Godfrey, 20110325	
	3	Document 0780 - Defendants' opposition to Fractus SA objections to the Court's March 9, 2011 Order, Defendants - Baker Botts, LLP, 20110331	
	4	Document 0783 - Order, Court, 20110401	
	5	Document 0841 - Stipulation of Dismissal of all Claims and Counterclaims re '850 and '822, Defendants, 20110415	
	6	Document 0843 - Joint Motion to Dismiss Claims and Counterclaims re '850 and '822, Defendants, 20110415	
	7	Document 0854 - Defendants' Motion to Clarify Claim Construction, Defendants, 20110418	
	8	Document 0868 - Order, Court, 20110419	
	9	Document 0876 - Fractus's surreply to defendants' Motion for Summary Judgment re publication dates of three references, Susman Godfrey, 20110420	
	10	Document 0887 - Fractus's Response to Defendants' Motion to Clarify Claim Construction, Susman Godfrey, 20110425	
	11	Document 0889 - Reply in support of defendants' motion to clarify claim construction, Defendants, 20110427	

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	12		Document 0893 - Fractus SA's surreply to defendant's motion to clarify claim construction, Susman Godfrey, 20110429	
	13		Document 0900 - Order, Court, 20110429	
	14		Document 0901 - Report and recommendation of United States Magistrate Judge, Court, 20110502	
	15		Document 0902 - Fractus SA's objections to defendants' prior art notice, Susman Godfrey, 20110502	
	16		Document 0915 - Defendants' response to plaintiff's objections to defendants notice of prior art, Defendants, 20110505	
	17		Document 0933 - Defendants' motion for reconsideration of, and objections to, the May 2, 2011 report and recommendation clarifying claim construction, Defendants, 20110509	
	18		Document 0939 - Fractus's response to defendants' motion for reconsideration of and objections to the May 2, 2011, report and recommendations clarifying claim construction, Susman Godfrey, 20110510	
	19		Document 0968 - Order, Court, 20110513	
	20		Document 0971 - Order, Court, 20110513	
	21		Document 1082 - Joint motion to dismiss HTC, Susman Godfrey LLP, 20110913	
	22		Document 1083 - Order - Final consent judgement HTC, Court, 20110915	

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	23	Document 1088 - Samsung's motion to determine intervening rights in view of new Federal Circuit case law or, in the alternative, to stay the case pending the outcome of reexamination, Defendants, 20111019	
	24	Document 1091 - Fractus's response to Samsung's motion to determine intervening rights or to stay the case pending the outcome of reexamination, Susman Godfrey LLC, 20111102	
	25	Document 1092 - Samsung's reply in support of its motion to determine intervening rights in view of new Federal Circuit case law or, in the alternative, to stay the case pending the outcome of reexamination, Defendants, 20111114	
	26	Expert report of Dr. Warren L. Stutzman (redacted) - expert witness retained by Fractus, Fractus, 20110223	
	27	Expert report of Dwight L. Jaggard (redacted) - expert witness retained by Fractus, Fractus, 20110223	
	28	Expert report of Dwight L. Jaggard (redacted) - expert witness retained by Fractus, Fractus, 20110223, Pages: ii-vi, 12-24	
	29	Expert report of Stuart Long (redacted) - expert witness retained by Fractus, Fractus, 20110223	
	30	Fractus' Claim Construction Presentation - Markman Hearing, Fractus, 20100902	
	31	Letter from Baker Botts to Howison & Arnott LLP including exhibits, Defendants - Baker Botts, 20100805	
	32	Letter from Baker Botts to Kenyon & Kenyon LLP, Winstead PC and Howison & Arnott LLP including exhibits., Defendants - Baker Botts, 20091028	
	33	Oral and videotaped deposition of Dr. Stuart Long - Volume 1, , 20110311	

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	34	Oral and videotaped deposition of Dr. Stuart Long - Volume 2, Fractus, 20110313	
	35	Oral and videotaped deposition of Dr. Stuart Long - Volume 3, Fractus, 20110314	
	36	Oral and videotaped deposition of Dr. Warren L. Stutzman - Volume 1, Fractus, 20110303	
	37	Oral and videotaped deposition of Dr. Warren L. Stutzman - Volume 2, Fractus, 20110304	
	38	Rebuttal expert report of Dr. Dwight L. Jaggard (redacted version), Fractus, 20110216	
	39	Rebuttal expert report of Dr. Stuart A. Long (redacted version), Fractus, 20110216	
	40	Rebuttal expert report of Dr. Warren L. Stutzman (redacted version), Fractus, 20110216	
	41	The oral and videotaped deposition of Dwight Jaggard. Volume 1, Defendants, 20110308	
	42	The oral and videotaped deposition of Dwight Jaggard. Volume 2, Defendants, 20110309	
	43	The oral and videotaped deposition of Dwight Jaggard. Volume 3, Defendants, 20110310	
	44	Transcript of jury trial before the Honorable Leonard Davis - May 18, 2011 - 1:00 PM, Court, 20110518	

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	45	Transcript of jury trial before the Honorable Leonard Davis - May 18, 2011 - 8:45 AM, Court, 20110518	
	46	Transcript of jury trial before the Honorable Leonard Davis - May 19, 2011 - 1:00 PM, Court, 20110519	
	47	Transcript of jury trial before the Honorable Leonard Davis - May 19, 2011 - 8:45 AM, Court, 20110519	
	48	Transcript of jury trial before the Honorable Leonard Davis - May 20, 2011 - 12:30 PM, Court, 20110520	
	49	Transcript of jury trial before the Honorable Leonard Davis - May 20, 2011 - 8:30 AM, Court, 20110520	
	50	Transcript of jury trial before the Honorable Leonard Davis - May 23, 2011 - 8:55 AM, Court, 20110523	

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT **(Not for submission under 37 CFR 1.99)**	Application Number		
	Filing Date		
	First Named Inventor	Carles PUENTE BALIARDA	
	Art Unit		
	Examiner Name		
	Attorney Docket Number	0690.0023CN4	

	1	Transcript of jury trial before the Honorable Leonard Davis US District Judge - May 17, 2011 - 8:00 AM, Court, 20110517	
	2	Transcript of jury trial before the Honorable Leonard Davis, US District Judge - May 17, 2011 - 1:10 PM, Court, 20110517	
	3	Transcript of pretrial hearing before the Honorable Leonard Davis, US District Judge - May 16, 2011 - 2:00 PM, Court, 20110516	
	4	CN00818542 - Response to Office Action dated on November 5, 2004, Herrero & Asociados, 20050331	
	5	CN01823716 - Office action dated on February 16, 2007, CN-PTO, 20070216	
	6	CN01823716 - Response to the office action dated on February 16, 2007, CN-PTO, 20070821	
	7	CN01823716 - Response to the office action dated on September 21, 2007, CN-PTO, 20071203	
	8	EP00909089 - Claims, Herrero & Asociados, 20050128	
	9	EP00909089 - Minutes from Oral Proceedings, EPO, 20050128	
	10	EP00909089 - Office Action dated on February 07, 2003, EPO, 20030207	
	11	EP00909089 - Response to Office Action dated on February 7, 2003, Herrero & Asociados, 20030814	

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	Attorney Docket Number	0690.0023CN4

	12	EP00909089 - Summons to attend oral proceedings, EPO, 20041028	
	13	EP00909089 - Written submissions, Herrero & Asociados, 20041215	
	14	EP05012854 - Communication of the board of appeal, EPO, 20101230	
	15	EP05012854 - Decision of the Technical Board of Appeal of the European Patent Office dated April 20, 2012, EPO, 20120420	
	16	PCT/EP00/00411 - International preliminary examination report dated on August 29, 2002 - Notification concerning documents transmitted, EPO, 20020829	
	17	PCT/EP00/00411 - Invitation to restrict or to pay additional fees dated on March 5, 2002, EPO, 20020305	
	18	PCT/ES99/00296 - Reply to the Written Opinion dated on November 15, 2001 - Declaration of J. Baxter - Exhibit FFF -, Herrero & Asociados, 20011115	
	19	US10/102568 - Amendment and response to the Office Action dated on January 23, 2004, Jones Day, 20040526	
	20	US10/102568 - Office Action dated on January 23, 2004, USPTO, 20040123	
	21	US10/102568 - Preliminary Amendment - Exhibit CCCC, Rosenman & Colin LLP, 20020318	
	22	US10/181790 - Office action dated on August 4, 2005, USPTO, 20050804	

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	Examiner Name		
	Attorney Docket Number	0690.0023CN4	

	23	US10/181790 - Office action dated on August 27, 2004, USPTO, 20040827	
	24	US10/181790 - Office action dated on June 2, 2005, USPTO, 20050602	
	25	US10/181790 - Office action dated on March 2, 2005, USPTO, 20050302	
	26	US10/181790 - Response to office action dated on August 27, 2004, Jones Day, 20041208	
	27	US10/181790 - Response to the office action dated on June 2, 2005, Jones Day, 20050720	
	28	US10/181790 - Response to the office action dated on March 2, 2005, Jones Day, 20050314	
	29	US10/182635 - Amendment and response to office action dated on December 13, 2004, Jones Day, 20050317	
	30	US10/182635 - Amendment and response to office action dated on October 04, 2004, Jones Day, 20041112	
	31	US10/182635 - Notice of Allowance dated on April 11, 2005, USPTO, 20050411	
	32	US10/182635 - Office Action dated on December 13, 2004, USPTO, 20041213	
	33	US10/182635 - Office action dated on October 4, 2004, USPTO, 20041004	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**	Application Number: Filing Date: First Named Inventor: Carles PUENTE BALIARDA Art Unit: Examiner Name: Attorney Docket Number: 0690.0023CN4

	34	US10/371676 - Amendment and response to final rejection dated on October 06, 2001, Kyocera, 20041203	
	35	US10/422578 - Advisory Action before the filing of an Appeal Brief, USPTO, 20050623	
	36	US10/422578 - Office Action dated on April 7, 2005, USPTO, 20050407	
	37	US10/422578 - Office Action dated on August 23, 2007, USPTO, 20070823	
	38	US10/422578 - Office Action dated on August 24, 2005, USPTO, 20050824	
	39	US10/422578 - Office Action dated on January 26, 2006, USPTO, 20060126	
	40	US10/422578 - Office Action dated on March 12, 2007, USPTO, 20070312	
	41	US10/422578 - Office action dated on March 26, 2008, USPTO, 20080326	
	42	US10/422578 - Office Action dated on October 4, 2004, USPTO, 20041004	
	43	US10/422578 - Request for Continued Examination with response to the office action dated on April 7, 2005 and the advisory action dated on June 23, 2005, Jones Day, 20050808	
	44	US10/422578 - Response to the Office Action dated on April 7, 2005, Jones Day, 20050531	

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	First Named Inventor	Carles PUENTE BALIARDA
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	45	US10/422578 - Response to the Office Action dated on October 4, 2004, Jones Day, 20050106	
	46	US10/422578 - Response to the Office Action mailed on January 26, 2006 and Advisory Action mailed on March 29, 2006, Jones Day, 20060501	
	47	US10/797732 - Office action dated on August 9, 2007, USPTO, 20070809	
	48	US10/797732 - Response to Office Action dated August 9, 2007, Winstead, 20071108	
	49	US10/822933 - Notice of allowance dated on October 18, 2007, USPTO, 20071018	
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	Art Unit	
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	Attorney Docket Number	0690.0023CN4

CERTIFICATION STATEMENT

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See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Patrick J. Finnan/	Date (YYYY-MM-DD)	2020-03-27
Name/Print	Patrick J. Finnan	Registration Number	39189

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7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

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	First Named Inventor	Carles PUENTE BALIARDA
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	Attorney Docket Number	0690.0023CN4

	1	US10/822933 - Response to Office Action dated on October 5, 2006, Jenkens & Gilchrist, 20070104	
	2	US10/963080 - Notice of allowance dated on September 1, 2005., USPTO, 20050901	
	3	US10/963080 - Preliminary amendment - Declaration of J. Baxter - Exhibit W, Jones Day, 20041210	
	4	US11/021597 - Office action dated October 30, 2007, USPTO, 20071030	
	5	US11/021597 - Office Action dated on March 12, 2007, USPTO, 20070312	
	6	US11/021597 - Response to the Office Action dated March 12, 2007, Winstead, 20070809	
	7	US11/021597 - Response to the office action dated October 30, 2007, Winstead, 20071228	
	8	US11/033788 - Response to Office Action dated February 7, 2006, Jenkens & Gilchrist, 20060601	
	9	US11/102390 - Notice of allowance dated on July 6, 2006., USPTO, 20060625	
	10	US11/110052 - Notice of Allowance dated on March 29, 2006, USPTO, 20060331	
	11	US11/110052 - Notice of Allowance dated on May 30, 2006, USPTO, 20060530	

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	12	US11/110052 - Preliminary amendment dated on April 18, 2005, Howison & Arnott, 20050418	
	13	US11/124768 - Amendment in response to non-final office action dated August 23, 2006, Jenkens & Gilchrist, 20061113	
	14	US11/154843 - Amendment and response to office action dated August 2, 2006, Howison & Arnott, 20060811	
	15	US11/154843 - Notice of Allowance dated on October 24, 2006, USPTO, 20061024	
	16	US11/154843 - Office Action dated on August 2, 2006, USPTO, 20060802	
	17	US11/154843 - Office action dated on May 9, 2006, USPTO, 20060509	
	18	US11/179250 - Notice of Allowance dated on January 20, 2007, USPTO, 20070126	
	19	US11/179250 - Response office action, Howison & Arnott, 20050712	
	20	US11/179257 - Notice of allowance dated on October 19, 2006, USPTO, 20061019	
	21	US11/550256 - Office Action dated on January 15, 2008, USPTO, 20080115	
	22	US11/614429 - Office Action dated on August 16, 2010, USPTO, 20100816	

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	23	US11/614429 - Office Action dated on March 7, 2011, USPTO, 20110307	
	24	US11/614429 - Office action dated on March 19, 2013, USPTO, 20130319	
	25	US11/614429 - Office Action dated on May 27, 2011., USPTO, 20110527	
	26	US11/614429 - Response to the Final Office Action dated on May 27, 2011, Winstead, 20111123	
	27	US11/614429 - Response to the Office Action dated on August 16, 2010, Winstead, 20110211	
	28	US11/686804 - Amendment and response to office action dated April 15, 2008, Howison & Arnott, 20080709	
	29	US11/686804 - Notice of Allowance dated on September 9, 2008, USPTO, 20080909	
	30	US11/686804 - Office action dated on April 15, 2008., USPTO, 20080415	
	31	US11/780932 - Preliminary amendment dated on July 20, 2007, Howison & Arnott, 20070720	
	32	US12/309463 - Amendment after final action, Winstead, 20120523	
	33	US12/309463 - Office action, USPTO, 20120328	

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	34	US12/309463 - Office action dated on August 04, 2011, USPTO, 20110804	
	35	US12/309463 - Response to non-final office action dated on August 4, 2011, Winstead, 20120123	
	36	US12/347462 - Amendment and response to office action dated October 28, 2009, Howison & Arnott, 20100315	
	37	US12/347462 - Amendment and response to office action dated on December 7, 2011, Howison & Arnott, 20120403	
	38	US12/347462 - Notice of allowance dated on April 13, 2012, USPTO, 20120413	
	39	US12/347462 - Notice of Allowance dated on April 19, 2010, USPTO, 20100419	
	40	US12/347462 - Notice of Allowance dated on June 29, 2010, USPTO, 20100629	
	41	US12/347462 - Notice of Allowance dated on May 18, 2009, USPTO, 20090518	
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	45	US12/498090 - Notice of allowance dated on April 13, 2012, USPTO, 20120413	
	46	US12/498090 - Notice of Allowance dated on March 10, 2011, USPTO, 20110310	
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	49	US12/498090 - Response to office action dated on August 18, 2010, Howison & Arnott, 20110117	
	50	US13/020034 - Amendment and response to office action dated on November 8, 2011, Howison & Arnott, 20120403	

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Name/Print	Patrick J. Finnan	Registration Number	39189

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EFS ID:	38990527
Application Number:	16832820
International Application Number:	
Confirmation Number:	3871
Title of Invention:	Multiple-Body-Configuration Multimedia and Smartphone Multifunction Wireless Devices
First Named Inventor/Applicant Name:	Carles PUENTE BALIARDA
Customer Number:	27896
Filer:	Patrick J. Finnan/Janet Dorgan
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Attorney Docket Number:	0690.0023CN4
Receipt Date:	27-MAR-2020
Filing Date:	
Time Stamp:	16:19:14
Application Type:	Utility under 35 USC 111(a)

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6	Transmittal Letter	2020-03-27_IDSTransmittalLtr-0023CN4.pdf	145182 4f4c2ecbd34bc1d00267e95f6abe6beae17d0946	no	2
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7	Drawings-only black and white line drawings	2020-03-27_Drawings-0023CN4.pdf	2263518 4aaef294277d961d5bad19d3b7241c639c9acb65	no	29

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8	Information Disclosure Statement (IDS) Form (SB08)	2020-03-27_PTO-Form01-06900023CN4.pdf	635659 a20076228c773de24194b518046b1b9c1568449d	no	22
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9	Information Disclosure Statement (IDS) Form (SB08)	2020-03-27_PTO-Form02-06900023CN4.pdf	633561 54d4daceff7aa609f82d05dabfe21346c0bee941	no	20
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10	Information Disclosure Statement (IDS) Form (SB08)	2020-03-27_PTO-Form03-06900023CN4.pdf	633030 e50307795e9e60f807852ccc566205cd7b71d0b5	no	17
Warnings:					
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11	Information Disclosure Statement (IDS) Form (SB08)	2020-03-27_PTO-Form04-06900023CN4.pdf	632481 74df689f4e2f23eaa03a69c68fa226c77cb070c8	no	17
Warnings:					
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12	Information Disclosure Statement (IDS) Form (SB08)	2020-03-27_PTO-Form05-06900023CN4.pdf	631947 949a7a6d5e13b2eac972e982d773d3f9ac15f364	no	17
Warnings:					
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13	Information Disclosure Statement (IDS) Form (SB08)	2020-03-27_PTO-Form06-06900023CN4.pdf	631490 cfd528ae42fd919b556bc16d810ffebb3acbb3b6	no	16
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14	Information Disclosure Statement (IDS) Form (SB08)	2020-03-27_PTO-Form07-06900023CN4.pdf	626805 94940919c4df30f20407558717c6207d052d47c7	no	8
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15	Information Disclosure Statement (IDS) Form (SB08)	2020-03-27_PTO-Form08-06900023CN4.pdf	627400 01df188078c31616e5d889025ffd0d9113037c16	no	8

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16	Information Disclosure Statement (IDS) Form (SB08)	2020-03-27_PTO-Form09-06900023CN4.pdf	628255 36e1d770918f524e3c6c578c925da8467bcf982b	no	8

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17	Information Disclosure Statement (IDS) Form (SB08)	2020-03-27_PTO-Form10-06900023CN4.pdf	626841 ffc9ddd3f4af856f0bf0c8e95dce5ae1e7924c7d	no	8

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18	Information Disclosure Statement (IDS) Form (SB08)	2020-03-27_PTO-Form11-06900023CN4.pdf	622205 7368befec3ae14b7c6db1fa872a9f30a78b012db	no	8

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19	Information Disclosure Statement (IDS) Form (SB08)	2020-03-27_PTO-Form12-06900023CN4.pdf	622216 eb36330453da82ca83c2debf392743b608a a6244	no	8

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20	Information Disclosure Statement (IDS) Form (SB08)	2020-03-27_PTO-Form13-06900023CN4.pdf	622297 bde02727797ed3cf8f12b1214a351324dafd a249	no	8

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21	Information Disclosure Statement (IDS) Form (SB08)	2020-03-27_PTO-Form14-06900023CN4.pdf	622253 5b39c21c5da7ab9ee04d46a7241c392eea0 a78ec	no	8

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22	Information Disclosure Statement (IDS) Form (SB08)	2020-03-27_PTO-Form15-06900023CN4.pdf	622325 5f06ca8fd1e0433c8994639bf8f4e963f2f3cc 41	no	8

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23	Information Disclosure Statement (IDS) Form (SB08)	2020-03-27_PTO-Form16-06900023CN4.pdf	622139 9c44c44a9ca8ac85eafc8823e1267c280abc e451	no	8

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25	Information Disclosure Statement (IDS) Form (SB08)	2020-03-27_PTO-Form18-06900023CN4.pdf	622642 fcedbbbdcb8abbe2ec13c99e488a64569436aa81	no	8

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28	Information Disclosure Statement (IDS) Form (SB08)	2020-03-27_PTO-Form21-06900023CN4.pdf	624426 725b62dc34019cc5235d040df6553c3b5b8aad22	no	8

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29	Information Disclosure Statement (IDS) Form (SB08)	2020-03-27_PTO-Form22-06900023CN4.pdf	624127 7d19d1a39e25dea7be9e4d2ff564220c114f872e	no	8

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32	Information Disclosure Statement (IDS) Form (SB08)	2020-03-27_PTO-Form25-06900023CN4.pdf	623262 7c9b264b27c4becc2a31631c5d2acb69e08b3e74	no	6

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33	Information Disclosure Statement (IDS) Form (SB08)	2020-03-27_PTO-Form26-06900023CN4.pdf	1049638 7e1ce4fd6c920d5b30ce6a19c77584b85b3ac873	no	5

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	First Named Inventor	Carles PUENTE BALIARDA
	Art Unit	
	Examiner Name	
	Attorney Docket Number	0690.0023CN4

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	First Named Inventor	Carles PUENTE BALIARDA
	Art Unit	
	Examiner Name	
	Attorney Docket Number	0690.0023CN4

	1	US13/020034 - Communication to examiner and preliminary amendment, Howison & Arnott, 20120724	
	2	US13/020034 - Notice of allowance dated April 23, 2012, USPTO, 20120423	
	3	US13/020034 - Notice of allowance dated January 15, 2013, USPTO, 20130115	
	4	US13/020034 - Notice of allowance dated on April 03, 2013, USPTO, 20130403	
	5	US13/020034 - Office Action dated on November 8, 2011, USPTO, 20111108	
	6	US13/038883 - Amendment and response to office action dated December 1, 2011, Howison & Arnott, 20120403	
	7	US13/038883 - Amendment and response to office action dated on July 2, 2013, Howison and Arnott, 20130725	
	8	US13/038883 - Amendment to the claims and RCE, Howison & Arnott, 20130607	
	9	US13/038883 - Communication to examiner and preliminary amendment, Howison & Arnott, 20120810	
	10	US13/038883 - Notice of allowance dated April 30, 2012, USPTO, 20120430	
	11	US13/038883 - Notice of allowance dated August 6, 2013, USPTO, 20130806	

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	12	US13/038883 - Notice of Allowance dated on April 2, 2013, USPTO, 20130402	
	13	US13/038883 - Office action dated on December 1, 2011, USPTO, 20111201	
	14	US13/038883 - Office action dated on July 2, 2013, USPTO, 20130702	
	15	US13/044207 - Amendment and response to office action dated on December 5, 2011, Howison & Arnott, 20120403	
	16	US13/044207 - Amendment and response to office action dated on July 2, 2013, Howison and Arnott, 20130725	
	17	US13/044207 - Amendment to the claims and RCE, Howison & Arnott, 20130607	
	18	US13/044207 - Communication to examiner and preliminary amendment, Howison & Arnott, 20120814	
	19	US13/044207 - Notice of allowance dated August 5, 2013, USPTO, 20130805	
	20	US13/044207 - Notice of allowance dated May 01, 2012, USPTO, 20120501	
	21	US13/044207 - Notice of Allowance dated on April 2, 2013, USPTO, 20130402	
	22	US13/044207 - Office action dated on December 5, 2011, USPTO, 20111205	

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	Examiner Name	
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	23	US13/044207 - Office action dated on July 2, 2013, USPTO, 20130702	
	24	US95/000592 - Request for inter partes reexamination for US patent 7202822 including exhibits from CC1 to CC6, Kyocera, 20101116	
	25	US95/000593 - Request for inter partes reexamination for US patent 7148850 including exhibits from CC1 to CC7, Kyocera, 20101116	
	26	US95/000598 - Request for inter partes reexamination for US patent 7148850 including exhibits from C1 to F3, HTC, 20101203	
	27	US95/000610 - Request for inter partes reexamination of US patent no. 7202822 including exhibits C1-I5, HTC, 20101214	
	28	US95/001389 - Office Action for the US patent 7123208 dated on August 12, 2010, USPTO, 20100812	
	29	US95/001390 - Office Action for the US patent 7015868 dated August 19, 2010, USPTO, 20100819	
	30	US95/001390 - Response to the Office Action for the US patent 7015868 dated on August 19, 2010, Sterne Kessler Goldstein Fox, 20101119	
	31	US95/001413 - Request for inter partes reexamination for US patent 7148850 including claim charts from CC-A to CC-F, Samsung, 20100804	
	32	US95/001413 - Request for inter partes reexamination for US patent 7148850. CC-F: Claim Chart Comparing Claims 1, 4, 6, 16, 17, 19, 21, 22, 24-26, 29, 35, 38, 40, 45-48, 51, 53, 57, 58, 61, 65, 66, 69, and 70 to US patent 5363114 Shoemaker, Samsung, 20100801	
	33	US95/001413 - Request for inter partes reexamination for US patent no 7148850. CC-A: Claim Chart Comparing Claims 1, 4, 6, 17, 19, 21, 22, 24-26, 29, 35, 38, 40, 45-48, 51, 53, 58, 61, 65, 66, 69, and 70 to US patent 6140975 Cohen, Samsung, 20100801	

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	Examiner Name	
	Attorney Docket Number	0690.0023CN4

	34		US95/001413 - Request for inter partes reexamination for US patent no 7148850. CC-B: Claim Chart Comparing Claims 1, 4, 6, 16, 17, 19, 21, 22, 24-26, 29, 35, 38, 40, 45-48, 51, 53, 57, 58, 61, 65, 66, 69 and 70 to US patent 6140975 Cohen, Samsung, 20100801	
	35		US95/001413 - Request for inter partes reexamination for US patent no 7148850. CC-C: Claim Chart Comparing Claims 1, 4, 6, 17, 19, 21, 22, 24-26, 29, 35, 38, 40, 45-48, 53, 58, 61, 65, 66, and 69 to US patent 6140975 Cohen, Samsung, 20100801	
	36		US95/001413 - Request for inter partes reexamination for US patent no 7148850. CC-D: Claim Chart Comparing Claims 1, 4, 6, 16, 17, 19, 21, 22, 24-26, 29, 35, 38, 40, 45-48, 51, 53, 57, 58, 61, 65, 66, and 69 to US patent 6140975 Cohen, Samsung, 20100801	
	37		US95/001413 - Request for inter partes reexamination for US patent no 7148850. CC-E: Claim Chart Comparing Claims 1, 4, 6, 16-17, 19, 21, 22, 24-26, 29, 35, 38, 40, 45-48, 51, 53, 57, 58, 61, 65, 66, 69 and 70 to patent EP0590671B1 Sekine, Samsung, 20100801	
	38		US95/001413 - US95/000593 - Action Closing Prosecution dated on April 20, 2012 for US patent 7148850, USPTO, 20120420	
	39		US95/001413 - US95/000593 - Action closing prosecution dated on July 27, 2012 for US patent 7148850, USPTO, 20120727	
	40		US95/001413 - US95/000593 - Inter partes reexamination certificate for US patent 7148850, USPTO, 20130606	
	41		US95/001413 - US95/000593 - Patent owner amendment in response to the Right of Appeal Notice mailed December 13, 2012 for US patent 7148850, Edell , Shapiro & Finnan, LLC, 20130313	
	42		US95/001413 - US95/000593 - Right of appeal notice for the US7148850, USPTO, 20121213	
	43		US95/001413 - US95/000593 - Third party requester's comments to patent owner's response of October 31, 2011 for US patent 7148850, Samsung - Kyocera, 20120323	
	44		US95/001413 - US95/000593 - US95/000598- Third party requester's comments to patent owner's reply dated on April 11, 2011 for US patent 7148850, Samsung - Kyocera - HTC, 20110502	

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	45	US95/001413 - US95/000593 - US95/000598- Third party requester's comments to patent owner's reply dated on January 10, 2011 for US patent 7148850, Samsung - Kyocera - HTC, 20110209	
	46	US95/001413 - US95/000593 - US95/000598 - Corrected Patent Owner´s Response to First Office Action of October 8, 2010 of US patent no. 7148850, Sterne Kessler Goldstein Fox, 20110411	
	47	US95/001413 - US95/000593 - US95/000598 - Corrected Patent Owner´s Response to First Office Action of October 8, 2010 of US patent no. 7148850 - Exhibit 1, Sterne Kessler Goldstein Fox, 20110411	
	48	US95/001413 - US95/000593 - US95/000598 - Decision Sua Sponte to merge reexamination proceedings of US patent 7148850, USPTO, 20110608	
	49	US95/001413 - US95/000593 - US95/000598 - Office action for the US patent 7148850 dated on October 8, 2010, USPTO, 20101008	
	50	US95/001413 - US95/000593 - US95/000598 - Office Action of US patent 7148850 dated July 29, 2011, USPTO, 20110729	

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	Application Number	
	Filing Date	
	First Named Inventor	Carles PUENTE BALIARDA
	Art Unit	
	Examiner Name	
	Attorney Docket Number	0690.0023CN4

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Signature	/Patrick J. Finnan/	Date (YYYY-MM-DD)	2020-03-27
Name/Print	Patrick J. Finnan	Registration Number	39189

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	Attorney Docket Number	0690.0023CN4

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	1	US95/001413 - US95/000593 - US95/000598 - Patent owner´s response to first office action for US patent 7148850 of July 29, 2011, Sterne Kessler Goldstein Fox, 20111031	
	2	US95/001414 - Corrected Patent Owner´s Response to Office Action of October 8, 2010 of US patent no. 7202822, Sterne Kessler Goldstein Fox, 20110411	
	3	US95/001414 - Office action for the US patent 7202822 dated on October 8, 2010, USPTO, 20101008	
	4	US95/001414 - Request for inter partes reexamination for US patent 7202822 including claim charts from CC-A-1 to CCD, Samsung, 20100804	
	5	US95/001414 - Request for inter partes reexamination for US patent no. 7202822 - CC-A-1 - Claim chart comparing claims 1, 4-5, 7-9, 20-21, 25 and 31 of US patent 7202822 to US patent 6140975, Samsung, 20100809	
	6	US95/001414 - Request for inter partes reexamination for US patent no. 7202822 - CC-D - Claim Chart Comparing claims 1, 4-5, 7-9, 12, 13, 15, 18, 21, 25, 29-31, 35, 44, 46, 48 and 52 of US patent no. 7202822 to U.S. Pat.5363114 to Shoemaker, Samsung, 20100804	
	7	US95/001414 - Request for inter partes reexamination for US patent no. 7202822 issued April 10, 2007 - CC-C - Claim Chart Comparing claims 1, 4, 5, 7-9, 12, 13, 15, 18, 21, 25, 29-31, 35, 44, 46, 48 and 52 of US patent no.7202822 to Sanad., Samsung, 20100804	
	8	US95/001414 - Request for inter partes reexamination for US patent no. 7202822. Exhibit CC-A-2. Claim chart comparing claims 1, 4-5, 7-9, 12-13, 15, 18, 20-22, and 31 of US patent 7202822 to US patent 6140975, Samsung, 20100809	
	9	US95/001414 - Request for inter partes reexamination for US patent no. 7202822. Exhibit CC-A-3. Claim Chart Comparing claims 1, 4, 5, 7-9, 12, 13, 15, 18, 20-25, 29-31, 35, 44, 46, 48, 52 and 53 of US patent 7202822 to US patent 6140975, Samsung, 20100809	
	10	US95/001414 - Request for inter partes reexamination for US patent no. 7202822. Exhibit CC-A-4 Claim Chart Comparing claims 1, 4, 5, 7-9, 12, 13, 15, 18, 20-25, 29-31, 35, 44, 46, 48, 52 and 53 of US patent 7202822 to US patent 6140975, Samsung, 20100809	
	11	US95/001414 - Request for inter partes reexamination for US patent no. 7202822. Exhibit CC-B Claim Chart Comparing claims 1, 4, 5, 7-9, 13, 15, 18, 20-25, 29-31, 35, 44, 46, 48, 52, and 53 of US 7202822 to Sekine, Samsung, 20100809	

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	12	US95/001414 - Request for inter partes reexamination of US patent no. 7202822 issued April 10, 2007 - OTH-B - Samsung SCH U340, Samsung, 20100810	
	13	US95/001414 - Request for inter partes reexamination of US patent no. 7202822 issued April 10, 2007 - OTH-C - Samsung SCH-R500, Samsung, 20100810	
	14	US95/001414 - Request for inter partes reexamination of US patent no. 7202822 issued April 10, 2007 - OTH-D - Civil Action No. 6:09-cv-00203, Samsung, 20100528	
	15	US95/001414 - Third party requester's comments to patent owner's reply dated on January 10, 2011 for US patent 7202822, Samsung, 20110209	
	16	US95/001414 - US95/000592 - Action closing prosecution dated August 9, 2012 for US patent 7202822, USPTO, 20120809	
	17	US95/001414 - US95/000592 - Action Closing Prosecution dated on April 20, 2012 for US patent 7202822, USPTO, 20120420	
	18	US95/001414 - US95/000592 - Patent owner amendment in response to Right of Appeal Notice mailed on December 13, 2012 for US patent 7202822, Edell , Shapiro & Finnan , LLC, 20130313	
	19	US95/001414 - US95/000592 - Right of appeal notice for the US7202822, USPTO, 20121217	
	20	US95/001414 - US95/000592 - US95/000610 - Decision Sua Sponte to merge reexamination proceedings of US patent 7202822, USPTO, 20110607	
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	23	US95/001414 - US95/000592 - US95/000610 - Third party requester's comments to patent owner's response of October 31, 2011 for US patent 7202822, Samsung - Kyocera - HTC, 20120323	

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	1	9099773	B2	2015-08-04	BALIARDA	
	2	9899727	B2	2018-02-20	BALIARDA	

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	1	20020000944	A1	2002-01-03	SABET et al.	
	2	20030137461	A1	2003-07-24	PENG	
	3	20040145527	A1	2004-07-09	MIKKOLA	
	4	20050001767	A1	2005-01-06	WULFF ET AL.	

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	5	20050176390	A1	2005-08-11	NAVSARIWALA et al.	
	6	20050184909	A1	2005-08-25	TCHISTIAKOV et al.	
	7	20060044195	A1	2006-03-02	ARKKO et al.	
	8	20060082505	A1	2006-04-20	BALIARDA et al.	
	9	20060121865	A1	2006-06-08	FRANK et al.	

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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 16/832,820

APPLICATION AS FILED - PART I

FOR	NUMBER FILED (Column 1)	NUMBER EXTRA (Column 2)	SMALL ENTITY RATE($)	SMALL ENTITY FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY FEE($)
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	300
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	660
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	760
TOTAL CLAIMS (37 CFR 1.16(i))	20 minus 20 =	*			OR	x 100 =	0.00
INDEPENDENT CLAIMS (37 CFR 1.16(h))	2 minus 3 =	*				x 460 =	0.00
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						0.00
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							0.00
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL			TOTAL	1720

APPLICATION AS AMENDED - PART II

AMENDMENT A	CLAIMS REMAINING AFTER AMENDMENT (Column 1)		HIGHEST NUMBER PREVIOUSLY PAID FOR (Column 2)	PRESENT EXTRA (Column 3)	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
Application Size Fee (37 CFR 1.16(s))									
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
					TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

AMENDMENT B	CLAIMS REMAINING AFTER AMENDMENT (Column 1)		HIGHEST NUMBER PREVIOUSLY PAID FOR (Column 2)	PRESENT EXTRA (Column 3)	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
Application Size Fee (37 CFR 1.16(s))									
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
					TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest found in the appropriate box in column 1.

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
16/832,820	03/27/2020	2845	0.00	0690.0023CN4	20	2

CONFIRMATION NO. 3871

FILING RECEIPT

OC000000116045489

27896
EDELL, SHAPIRO & FINNAN, LLC
9801 Washingtonian Blvd.
Suite 750
Gaithersburg, MD 20878

Date Mailed: 04/08/2020

Receipt is acknowledged of this non-provisional utility patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF FIRST INVENTOR, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection.

Please verify the accuracy of the data presented on this receipt. If an error is noted on this Filing Receipt, please submit a written request for a corrected Filing Receipt, including a properly marked-up ADS showing the changes with strike-through for deletions and underlining for additions. If you received a "Notice to File Missing Parts" or other Notice requiring a response for this application, please submit any request for correction to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections provided that the request is grantable.

Inventor(s)

Carles PUENTE BALIARDA, Barcelona, SPAIN;
Josep MUMBRU, Asnieres-sur-Seine, FRANCE;
Jordi ILARO, Barcelona, SPAIN;

Applicant(s)

Fractus, S.A., Barcelona, SPAIN;

Power of Attorney: The patent practitioners associated with Customer Number 27896

Domestic Priority data as claimed by applicant

This application is a CON of 15/856,626 12/28/2017
which is a CON of 14/738,090 06/12/2015 PAT 9899727
which is a CON of 14/246,491 04/07/2014 PAT 9099773
which is a CON of 11/614,429 12/21/2006 PAT 8738103
which claims benefit of 60/831,544 07/18/2006
and claims benefit of 60/856,410 11/03/2006

Foreign Applications (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see http://www.uspto.gov for more information.)
EUROPEAN PATENT OFFICE (EPO) 06117352.2 07/18/2006 No Access Code Provided

Permission to Access Application via Priority Document Exchange: Yes

Permission to Access Search Results: Yes

Applicant may provide or rescind an authorization for access using Form PTO/SB/39 or Form PTO/SB/69 as appropriate.

Request to Retrieve - This application either claims priority to one or more applications filed in an intellectual property Office that participates in the Priority Document Exchange (PDX) program or contains a proper **Request to Retrieve Electronic Priority Application(s)** (PTO/SB/38 or its equivalent). Consequently, the USPTO will attempt to electronically retrieve these priority documents.

If Required, Foreign Filing License Granted: 04/07/2020

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 16/832,820**

Projected Publication Date: To Be Determined - pending completion of Missing Parts

Non-Publication Request: No

Early Publication Request: No

Title

Multiple-Body-Configuration Multimedia and Smartphone Multifunction Wireless Devices

Preliminary Class

343

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at http://www.uspto.gov/web/offices/pac/doc/general/index.html.

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, http://www.stopfakes.gov. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4258).

LICENSE FOR FOREIGN FILING UNDER

Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

GRANTED

The applicant has been granted a license under 35 U.S.C. 184, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" followed by a date appears on this form. Such licenses are issued in all applications where the conditions for issuance of a license have been met, regardless of whether or not a license may be required as set forth in 37 CFR 5.15. The scope and limitations of this license are set forth in 37 CFR 5.15(a) unless an earlier license has been issued under 37 CFR 5.15(b). The license is subject to revocation upon written notification. The date indicated is the effective date of the license, unless an earlier license of similar scope has been granted under 37 CFR 5.13 or 5.14.

This license is to be retained by the licensee and may be used at any time on or after the effective date thereof unless it is revoked. This license is automatically transferred to any related applications(s) filed under 37 CFR 1.53(d). This license is not retroactive.

The grant of a license does not in any way lessen the responsibility of a licensee for the security of the subject matter as imposed by any Government contract or the provisions of existing laws relating to espionage and the national security or the export of technical data. Licensees should apprise themselves of current regulations especially with respect to certain countries, of other agencies, particularly the Office of Defense Trade Controls, Department of State (with respect to Arms, Munitions and Implements of War (22 CFR 121-128)); the Bureau of Industry and Security, Department of Commerce (15 CFR parts 730-774); the Office of Foreign AssetsControl, Department of Treasury (31 CFR Parts 500+) and the Department of Energy.

NOT GRANTED

No license under 35 U.S.C. 184 has been granted at this time, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" DOES NOT appear on this form. Applicant may still petition for a license under 37 CFR 5.12, if a license is desired before the expiration of 6 months from the filing date of the application. If 6 months has lapsed from the filing date of this application and the licensee has not received any indication of a secrecy order under 35 U.S.C. 181, the licensee may foreign file the application pursuant to 37 CFR 5.15(b).

SelectUSA

The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation, and commercialization of new technologies. The U.S. offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to promote and facilitate business investment. SelectUSA provides information assistance to the international investor community; serves as an ombudsman for existing and potential investors; advocates on behalf of U.S. cities, states, and regions competing for global investment; and counsels U.S. economic development organizations on investment attraction best practices. To learn more about why the United States is the best country in the world to develop technology, manufacture products, deliver services, and grow your business, visit http://www.SelectUSA.gov or call +1-202-482-6800.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
16/832,820	03/27/2020	Carles PUENTE BALIARDA	0690.0023CN4

CONFIRMATION NO. 3871

FORMALITIES LETTER

OC000000116045490

27896
EDELL, SHAPIRO & FINNAN, LLC
9801 Washingtonian Blvd.
Suite 750
Gaithersburg, MD 20878

Date Mailed: 04/08/2020

NOTICE TO FILE MISSING PARTS OF NONPROVISIONAL APPLICATION

FILED UNDER 37 CFR 1.53(b)

Filing Date Granted

Items Required To Avoid Abandonment:

An application number and filing date have been accorded to this application. The item(s) indicated below, however, are missing. Applicant is given **TWO MONTHS** from the date of this Notice within which to file all required items below to avoid abandonment. Extensions of time may be obtained by filing a petition accompanied by the extension fee under the provisions of 37 CFR 1.136(a).

- The statutory basic filing fee is missing.
- The application search fee must be submitted.
- The application examination fee must be submitted.
- Surcharge as set forth in 37 CFR 1.16(f) must be submitted.
  The surcharge is due for any one of:
  - late submission of the basic filing fee, search fee, or examination fee,
  - late submission of inventor's oath or declaration,
  - filing an application that does not contain at least one claim on filing, or
  - submission of an application filed by reference to a previously filed application.

SUMMARY OF FEES DUE:

The fee(s) required within **TWO MONTHS** from the date of this Notice to avoid abandonment is/are itemized below. No entity status discount is in effect. If applicant is qualified for small entity status, a written assertion of small entity status must be submitted to establish small entity status. (See 37 CFR 1.27). If applicant is qualified for micro entity status, an acceptable Certification of Micro Entity Status must be submitted to establish micro entity status. (See 37 CFR 1.29 and forms PTO/SB/15A and 15B.)

- $ **300** basic filing fee.
- $ **160** surcharge.
- $ **660** search fee.
- $ **760** examination fee.
- $(**0**) previous unapplied payment amount.
- $ **1880** TOTAL FEE BALANCE DUE.

Items Required To Avoid Processing Delays:

Applicant is notified that the above-identified application contains the deficiencies noted below. No period for reply is set forth in this notice for correction of these deficiencies. However, if a deficiency relates to the inventor's oath or declaration, the applicant must file an oath or declaration in compliance with 37 CFR 1.63, or a substitute statement in compliance with 37 CFR 1.64, executed by or with respect to each actual inventor no later than the expiration of the time period set in the "Notice of Allowability" to avoid abandonment. See 37 CFR 1.53(f).

- A properly executed inventor's oath or declaration has not been received for the following inventor(s) *as named on the application data sheet:*
  Jordi ILARO
  An inventor's oath or declaration in compliance with 37 CFR 1.63 or 1.64 executed by or with respect to each inventor must be submitted no later than the date on which the issue fee is paid in response to a notice requiring such fee. See 37 CFR 1.53(f).
  If the name of the inventor provided on the ADS is not correct, applicant must submit a request to correct the inventor name according to 37 CFR 1.48(f), accompanied by the appropriate fee under 37 CFR 1.17(i) and a corrected ADS in compliance with 37 CFR 1.76(c), i.e., identifying the information that is being changed with underlining for insertions, and strike-through or brackets for text removed.

Replies must be received in the USPTO within the set time period or must include a proper Certificate of Mailing or Transmission under 37 CFR 1.8 with a mailing or transmission date within the set time period. For more information and a suggested format, see Form PTO/SB/92 and MPEP 512.

Replies should be mailed to:

Mail Stop Missing Parts
Commissioner for Patents
P.O. Box 1450
Alexandria VA 22313-1450

Registered users of EFS-Web may alternatively submit their reply to this notice via EFS-Web, including a copy of this Notice and selecting the document description "Applicant response to Pre-Exam Formalities Notice".
https://sportal.uspto.gov/authenticate/AuthenticateUserLocalEPF.html

For more information about EFS-Web please call the USPTO Electronic Business Center at 1-866-217-9197 or visit our website at http://www.uspto.gov/ebc.

If you are not using EFS-Web to submit your reply, you must include a copy of this notice.

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at **(571) 272-4000** or **(571) 272-4200** or **1-888-786-0101**.

/slee/

Electronic Patent Application Fee Transmittal

Application Number:	16832820
Filing Date:	27-Mar-2020
Title of Invention:	Multiple-Body-Configuration Multimedia and Smartphone Multifunction Wireless Devices
First Named Inventor/Applicant Name:	Carles PUENTE BALIARDA
Filer:	Patrick J. Finnan/Janet Dorgan
Attorney Docket Number:	0690.0023CN4

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
UTILITY APPLICATION FILING	1011	1	300	300
UTILITY SEARCH FEE	1111	1	660	660
UTILITY EXAMINATION FEE	1311	1	760	760
Pages:				
Claims:				
Miscellaneous-Filing:				
LATE FILING FEE FOR OATH OR DECLARATION	1051	1	160	160
Petition:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**1880**

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No.	:	16/832,820
First Named Inventor	:	Carles PUENTE BALIARDA
Confirmation No.	:	3871
Filed	:	March 27, 2020
TC/A.U.	:	2845
Examiner	:	Unknown
Customer No.	:	27896
Docket No.	:	0690.0023CN4
Title	:	Multiple-Body-Configuration Multimedia and Smartphone Multifunction Wireless Devices

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

TRANSMITTAL OF SUPPLEMENTAL APPLICATION DATA SHEET

Sir:

Applicant hereby submits a Supplemental Application Data Sheet in connection with U.S. Application No. 16/832,820. The Supplemental Application Data Sheet is being submitted to correct the spelling of the Family name of Inventor 3 from "ILARO", to the correct spelling, "ILARIO". Since the Declaration submitted with the filing of the application on March 27, 2020, has the correct spelling of the inventor, Applicant is not resubmitting the executed Declaration which again has the correct spelling of inventor Jordi ILARIO. No new matter has been introduced.

The Director is hereby authorized to treat any concurrent or future reply, requiring a petition for an extension of time under this paragraph for its timely submission, as incorporating a petition for extension of time for the appropriate length of time. In addition, the Director is hereby authorized to charge any additional appropriate fees that may be required during the pendency of the above-identified application (e.g., in the concurrent or in any future reply), as well as to credit any overpayment, to Deposit Account No. **05-0460**.

Dated: June 8, 2020

Respectfully submitted by:

EDELL, SHAPIRO & FINNAN, LLC
CUSTOMER NO. 27896
9801 Washingtonian Blvd., Suite 750
Gaithersburg, MD 20878
(301) 424-3640

/Patrick J. Finnan/
Patrick J. Finnan
Reg. No. 39189

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No.	:	16/832,820
First Named Inventor	:	Carles PUENTE BALIARDA
Confirmation No.	:	3871
Filed	:	March 27, 2020
TC/A.U.	:	2845
Examiner	:	Unknown
Customer No.	:	27896
Docket No.	:	0690.0023CN4
Title	:	Multiple-Body-Configuration Multimedia and Smartphone Multifunction Wireless Devices

REPLY TO NOTICE TO FILE MISSING PARTS OF APPLICATION UNDER 37 CFR § 1.52 OR § 1.53
(APPLICANT RESPONSE TO PRE-EXAM FORMALITIES NOTICE)

Enclosed are:

☒ Supplemental Application Data Sheet
☐ Other

and the payment of the following fee(s):

☒ Filing fee of $1,720.00 (☐ Applicant claims Small Entity Status)
☒ Surcharge fee for Late Filing Fees of $160.00
☐ Other fees: Surcharge for English Translation: $0.00
☐ Other fees: Petition for Extension of Time: $0.00

Total Fee due: $1,880.00

The Director is hereby authorized to treat any concurrent or future reply, requiring a petition for an extension of time under this paragraph for its timely submission, as incorporating a petition for extension of time for the appropriate length of time. In addition, the Director is hereby authorized to charge any additional appropriate fees that may be required during the pendency of the above-identified application (e.g., in the concurrent or in any future reply), as well as to credit any overpayment, to Deposit Account No. **05-0460**.

Dated: June 8, 2020

Respectfully submitted by:

/Patrick J. Finnan/

Patrick J. Finnan
Reg. No. 39189

EDELL, SHAPIRO & FINNAN, LLC
CUSTOMER NO. 27896
1901 Research Boulevard, Suite 400
Rockville, MD 20850
(301) 424-3640

Electronic Acknowledgement Receipt	
EFS ID:	39658391
Application Number:	16832820
International Application Number:	
Confirmation Number:	3871
Title of Invention:	Multiple-Body-Configuration Multimedia and Smartphone Multifunction Wireless Devices
First Named Inventor/Applicant Name:	Carles PUENTE BALIARDA
Customer Number:	27896
Filer:	Patrick J. Finnan/Janet Dorgan
Filer Authorized By:	Patrick J. Finnan
Attorney Docket Number:	0690.0023CN4
Receipt Date:	08-JUN-2020
Filing Date:	27-MAR-2020
Time Stamp:	17:57:30
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$1880
RAM confirmation Number	E202068H58072238
Deposit Account	
Authorized User	
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Applicant Response to Pre-Exam Formalities Notice	2020-06-08_NTFMPTransmittal Ltr-0023CN4.pdf	78905 b1a79e1b3d37c7bdf6d31ce1a6b50f8dfc4c a0bb	no	1
Warnings:					
Information:					
2	Transmittal Letter	2020-06-08_Transmittal_Supp_ ADS-0023CN4.pdf	73664 7b34368f7bcbfbd682a8996b42bfb77192e a0703	no	2
Warnings:					
Information:					
3	Application Data Sheet	2020-06-08_SuppADS-0023CN 4.pdf	142829 a4d57960118a00f13bac3e6f47df2f17c1af3 5d7	no	9
Warnings:					
Information:					
This is not an USPTO supplied ADS fillable form					
4	Fee Worksheet (SB06)	fee-info.pdf	37525 132fcc87be1a02ee6809b0279fe8058826fb 2186	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	332923		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.
National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.
New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	0690.0023CN4
	Application Number	16/832,820
Title of Invention	Multiple-Body-Configuration Multimedia and Smartphone Multifunction Wireless Devices	

The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76.
This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.

Secrecy Order 37 CFR 5.2:

☐ Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)

Inventor Information:

Inventor 1 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Carles		PUENTE BALIARDA	

Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

City	Barcelona	Country of Residence	ES

Mailing Address of Inventor:

Address 1	Av. Alcalde Barnils, 64-68, Modul C, 3ª pl		
Address 2	Sant Cugat del Valles		
City	Barcelona	**State/Province**	
Postal Code	E-08174	**Country**	ES

Inventor 2 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Josep		MUMBRU	

Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

City	Asnières-sur-Seine	Country of Residence	FR

Mailing Address of Inventor:

Address 1	4 rue Sadi Carnot		
Address 2			
City	Asnières-sur-Seine	**State/Province**	
Postal Code	92600	**Country**	FR

Inventor 3 Remove

Legal Name

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	0690.0023CN4
	Application Number	16/832,820
Title of Invention	Multiple-Body-Configuration Multimedia and Smartphone Multifunction Wireless Devices	

Prefix	**Given Name**	**Middle Name**	**Family Name**	**Suffix**
	Jordi		~~ILARO~~ ILARIO	

Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

City	Barcelona	Country of Residence	ES

Mailing Address of Inventor:

Address 1	Francisco Giner, 18, 1º 2ª		
Address 2			
City	Barcelona	**State/Province**	
Postal Code	08012	**Country**	ES

All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the **Add** button. Add

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below. For further information see 37 CFR 1.33(a).

☐ **An Address is being provided for the correspondence Information of this application.**

Customer Number	27896
Email Address	epatent@usiplaw.com

Add Email Remove Email

Application Information:

Title of the Invention	Multiple-Body-Configuration Multimedia and Smartphone Multifunction Wireless Devices		
Attorney Docket Number	0690.0023CN4	**Small Entity Status Claimed**	☐
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	29	**Suggested Figure for Publication (if any)**	

Filing By Reference:

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	0690.0023CN4
	Application Number	16/832,820
Title of Invention	Multiple-Body-Configuration Multimedia and Smartphone Multifunction Wireless Devices	

Publication Information:

☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)

☐ **Request Not to Publish.** I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application **has not and will not** be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32).
Either enter Customer Number or complete the Representative Name section below. If both sections are completed the customer Number will be used for the Representative Information during processing.

Please Select One:	◉ Customer Number	○ US Patent Practitioner	○ Limited Recognition (37 CFR 11.9)
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Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, 365(c), or 386(c) or indicate National Stage entry from a PCT application. Providing benefit claim information in the Application Data Sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.
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Prior Application Status	Pending		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
	Continuation of	15/856626	2017-12-28

Prior Application Status	Patented				Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
15/856626	Continuation of	14/738090	2015-06-12	9899727	2018-02-20

Prior Application Status	Patented				Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
14/738090	Continuation of	14/246491	2014-04-07	9099773	2015-08-04

Prior Application Status	Patented				Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
14/246491	Continuation of	11/614429	2006-12-21	8738103	2014-05-27

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	0690.0023CN4
	Application Number	16/832,820
Title of Invention	Multiple-Body-Configuration Multimedia and Smartphone Multifunction Wireless Devices	

Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
11/614429	Claims benefit of provisional	60/831544	2006-07-18
Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
11/614429	Claims benefit of provisional	60/856410	2006-11-03

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Foreign Priority Information:

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			Remove
Application Number	Country[i]	Filing Date (YYYY-MM-DD)	Access Code[i] (if applicable)
06117352.2	EP	2006-07-18	

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Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

☐ This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013.
NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	0690.0023CN4
	Application Number	16/832,820
Title of Invention	Multiple-Body-Configuration Multimedia and Smartphone Multifunction Wireless Devices	

Authorization or Opt-Out of Authorization to Permit Access:

When this Application Data Sheet is properly signed and filed with the application, applicant has provided written authority to permit a participating foreign intellectual property (IP) office access to the instant application-as-filed (see paragraph A in subsection 1 below) and the European Patent Office (EPO) access to any search results from the instant application (see paragraph B in subsection 1 below).

Should applicant choose not to provide an authorization identified in subsection 1 below, applicant **must opt-out** of the authorization by checking the corresponding box A or B or both in subsection 2 below.

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1. Authorization to Permit Access by a Foreign Intellectual Property Office(s)

A. Priority Document Exchange (PDX) - Unless box A in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the State Intellectual Property Office of the People's Republic of China (SIPO), the World Intellectual Property Organization (WIPO), and any other foreign intellectual property office participating with the USPTO in a bilateral or multilateral priority document exchange agreement in which a foreign application claiming priority to the instant patent application is filed, access to: (1) the instant patent application-as-filed and its related bibliographic data, (2) any foreign or domestic application to which priority or benefit is claimed by the instant application and its related bibliographic data, and (3) the date of filing of this Authorization. See 37 CFR 1.14(h)(1).

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	0690.0023CN4
	Application Number	16/832,820
Title of Invention	Multiple-Body-Configuration Multimedia and Smartphone Multifunction Wireless Devices	

Applicant Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Applicant 1

If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.

Clear

- (●) Assignee
- ( ) Legal Representative under 35 U.S.C. 117
- ( ) Joint Inventor
- ( ) Person to whom the inventor is obligated to assign.
- ( ) Person who shows sufficient proprietary interest

If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:

Name of the Deceased or Legally Incapacitated Inventor:

If the Applicant is an Organization check here. ☒

Organization Name	Fractus, S.A.		
Mailing Address Information For Applicant:			
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City	Barcelona	**State/Province**	
Country	ES	Postal Code	E-08174
Phone Number		Fax Number	
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	0690.0023CN4
	Application Number	16/832,820
Title of Invention	Multiple-Body-Configuration Multimedia and Smartphone Multifunction Wireless Devices	

Assignee 1

Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication. An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.

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See 37 CFR 1.4(d) for the manner of making signatures and certifications.

Signature	/Patrick J. Finnan/			Date (YYYY-MM-DD)	2020-06-08
First Name	Patrick	Last Name	Finnan	Registration Number	39189

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	0690.0023CN4
	Application Number	16/832,820
Title of Invention	Multiple-Body-Configuration Multimedia and Smartphone Multifunction Wireless Devices	

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The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

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Bescheinigung

Die angehefteten Unterlagen stimmen mit der ursprünglich eingereichten Fassung der auf dem nächsten Blatt bezeichneten europäischen Patentanmeldung überein.

Certificate

The attached documents are exact copies of the European patent application described on the following page, as originally filed.

Attestation

Les documents fixés à cette attestation sont conformes à la version initialement déposée de la demande de brevet européen spécificée à la page suivante.

Patentanmeldung Nr. **Patent application No.** **Demande de brevet n°**

06117352.2 / EP06117352

The organization code and number of your priority application, to be used for filing abroad under the Paris Convention, is EP06117352

Der Präsident des Europäischen Patentamts;
Im Auftrag

For the President of the European Patent Office

Le President de l'Office européen des brevets
p.o.

R.C. van Dijk

EPA/EPO/OEB Form 1014 02.00

Anmeldung Nr:
Application no.: 06117352.2
Demande no:

Anmeldetag:
Date of filing: 18.07.06
Date de dépôt:

Anmelder/Applicant(s)/Demandeur(s):

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Bezeichnung der Erfindung/Title of the invention/Titre de l'invention:
(Falls die Bezeichnung der Erfindung nicht angegeben ist, siehe Beschreibung.
If no title is shown please refer to the description.
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Multifunctional Wireless Device

In anspruch genommene Priorität(en) / Priority(ies) claimed / Priorité(s) revendiquée(s)
Staat/Tag/Aktenzeichen / State/Date/File no. / Pays/Date/Numéro de dépôt:

Internationale Patentklassifikation / International Patent Classification / Classification internationale de brevets:

G06F

Am Anmeldetag benannte Vertragstaaten / Contracting states designated at date of filing / Etats contractants désignées lors du dépôt:

AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU LV MC NL PL PT RO SE SI SK TR

PATENT APPLICATION

TITLE: **MULTIFUNCTION WIRELESS DEVICE**

INVENTORS: **Josep Mumbrú, Carles Puente, Jordi Ilario**

OWNER: **FRACTUS S.A.**

<u>**Multifunction wireless device**</u>

The present invention relates to a portable multifunction wireless device.

Object and background of the invention

The present invention is related to a portable multifunction wireless device (MFWD) and in particular to a handheld multifunction wireless device. In some embodiments, the MFWD will take the form of a handheld multimedia terminal (MMT) including wireless connectivity to mobile networks. In some embodiments, the MFWD will take the form of a handheld device combining personal computer capabilities, mobile data and voice services into a single unit (smartphone, SMRT), while in others the MFWD will combine both multimedia and smartphone capabilities (MMT+SMRT).

It is the object of the present invention to provide wireless connectivity to an MFWD that takes the form of a handheld multimedia terminal (MMT). In some embodiments, the MMT will include means to reproduce digital music and sound signals, preferably in a data compressed format such as for instance a MPEG standard such as MP3 (MPEG3) or MP4 (MPEG4). In some embodiments, the MMT will include a digital camera to record still (pictures, photos) and/or living images (video), combined with a microphone or microphone system to record live sound and convert it to a digital compressed format. The present invention will be particularly suitable for those MMT embodiments combining both music and image capabilities, by providing means to efficiently integrate music, images, live video and sound recording and playing into a very small, compact and lightweight handheld device.

It is the object of the present invention as well, to provide wireless connectivity to an MFWD that takes the form of a smartphone (SMRT). In some embodiments, the smartphone will consist of a handheld electronic unit comprising a microprocessor and operating system (such as for instance but not limited to

Pocket PC, Windows Mobile, Windows CE, Symbian, Palm OS, Brew, Linux) with the capability of downloading and installing multiple software applications and enhanced computing capabilities compared to a typical state of the art mobile phone. Typically, SMRT will comprise a small, compact (handheld) computer device with the capability of sharing, opening and editing typical word processing, spreadsheets and slide files that are handled by a personal computer (for instance a laptop or desktop). Although many current mobile phones feature some very basic electronic agenda functions (calendars, task lists and phonebooks) and are even able to install small Java or Brew games, they are not considered here to be smartphones (SMRT).

It is the purpose of the present invention to provide enhanced wireless capabilities to any of the MFWD devices described above. In some embodiments though, providing a wide geographical coverage will be a priority rather than enhanced multimedia or computing capabilities, while in others the priority will become to provide a high-speed connection and/ or a seamless connection to multiple networks and standards.

MFWDs are usually individually adapted to specific functions or needs of a certain type of users. In some cases it may desirable that the MFWD is either e.g. small while in other cases this is not of importance since e.g. a keyboard or screen shall be provided by the MFWD which already requires a certain size.

On the other hand, usually an MFWD shall usually be slim while on the other hand it shall be mechanically stable which is more difficult to achieve for slim devices. In the context of the present document a device is considered to be slim if it has a thickness of less than 14 mm, 13 mm, 12 mm, 11 mm, 10 mm, 9 mm or 8 mm.

Many of the demands for modern MFWDs also translate to specific demands for the antennas thereof.

In order to just name some of the design demands for antennas of multifunctional wireless devices, the antennas are usually expected to be small in order to occupy as little space as possible within the MFWD which then allows for smaller MFWDs or for more specific equipment for a certain function of the MFWD. At the same time, it is sometimes required for the antenna to be flat since this allows for slim MFWDs or in particular, for MFWDs which have two parts that can be shifted or twisted against each other.

Additionally, antennas in some embodiments are required to be multi-band antennas and to cover different frequency bands and/or different communication system bands. Above that, some of the bands have to be particularly broad like the UMTS band which has a bandwidth of 12.2%.

For a good wireless connection, high gain and efficiency are further required.

Other more common design demands for antennas are the voltage standing wave ratio (VSWR) and the impedance which is supposed to be about 50 ohms.

Of particular importance, furthermore, is omni-directional coverage which means that the antenna radiates with a substantially donut-shaped radiation pattern such that e.g. terrestrial base stations of mobile telephone communication systems can be contacted with in any direction in the horizontal plane.

For satellite communication (for example for receiving GPS-signals), however, other radiation patterns are preferred, in particular, those which radiate into the upper hemisphere. Here radiation into the horizontal plane is usually less desired.

The polarization of the emitted or received radiation has to be taken into account.

Other demands for antennas for modern MFWDs are low cost and a low specific absorption rate (SAR).

Furthermore, an antenna has to be integrated into a device or in other words an MFWD has to be constructed such that an appropriate antenna may be integrated therein which puts constraints by consideration of the mechanical fit, the electrical fit and the assembly fit.

Of further importance, usually, is the robustness of the antenna which means that the antenna does not change antenna properties upon smaller shocks to the device.

As can be imagined a simultaneous improvement of all features described above is a major challenge for persons skilled in the art.

A typical design problem is e.g. that it is known that due to the limits of diffraction, the substantial increase in gain and directivity can only be achieved through an increase in the antenna size.

On the other hand, a MFWD which has a high directivity and hence, a high gain, has to be properly oriented towards a transceiver-base station. This, however, is not practical since portable device users need to have the freedom to move and change direction with respect to a base station without losing coverage and, therefore, losing the wireless connection. Usually, therefore, less gain is accepted in order to obtain an omni-directional (donut-like) radiation pattern.

It, furthermore, has to be taken into account that e.g. a palmtop, laptop, or desktop portable device might require a radiation pattern that enhances radiation in the upper hemisphere i.e. pointing to the ceiling and the walls rather than pointing to the floor since commonly transceiver stations such as a hotspot antenna or a base station are located above or on the side of the portable device. If, however, such a device is used for a voice phone call it will be held substantially upright close to a head in which case an omni-directional pattern is preferred which is oriented such that the donut-like shape of the radiation pattern lies in the horizontal.

At the same time, it may be considerable to provide an antenna with a uniform radiation pattern (sphere-like) which then, however, turns out to have substantial drawbacks in terms of a desired low specific absorption rate since such a radiation pattern some times leads to an increased absorption of radiation within the hand and the head of the user when performing a voice phone call.

This is to show that in every MFWD the choice of the antenna, its placement in the device and its interaction with the surrounding elements of the device will have an impact on the overall wireless connection performance making its selection non-trivial and subject to constraints due to particular target use, user and market segments for every device.

As established by Chu and Wheeler, small antennas may not exceed a certain bandwidth. The bandwidth of the antenna decreases proportionally to the volume of the antenna. The bandwidth, however, is proportional to the maximum data rate the wireless connection can achieve. Therefore, a reduction in the antenna size is additionally linked to a reduction in the speed of data transmission.

Furthermore, a reduction of the antenna size can e.g. be achieved by loading the antenna with high electric materials for instance by stuffing, backing, coating, filling, printing or over-molding a conductive antenna element with a high dielectric material. Such materials tend to concentrate a high electric and magnetic field intensity into a smaller volume. This concentration leads to a high quality factor which, however, leads to a smaller bandwidth. Further, such a high concentration of field in the material leads to inherent electrical losses. Those may be compensated by a higher energy input into the antenna which, however, then leads to a portable wireless device with a reduced standby or talk/connectivity time. In the design of MFWDs, however, every micro Joule of energy available in the battery has to be used in the most efficient way.

Furthermore, multi-band antennas require a certain space since for each band a resonating physical structure is usually required. Such additional resonating physical structures occupy additional space which then increases the size of the antenna. It is therefore particularly difficult to build antennas which are both small and multi-band at the same time.

Further, as already mentioned above, there exists a fundamental limit established by Chu and Wheeler between the bandwidths and the antenna size. Therefore, small antennas have great difficulties in having a desired large bandwidth.

Broadband operation may be achieved by two closely neighboring bands which then, however, require additional space for the resonating physical structure of each of the bands. Further, those two antenna portions may not be provided too close together since then due to electric coupling between the two elements, the merging of the two bands into a single band is not achieved, but rather a splitting into independent sub-bands which is not acceptable for meeting the requirements of wireless communication standards.

Furthermore, for broadband operation the resonating physical structure needs a certain width. This width, however, requires additional space which further shows that small broadband antennas are difficult to achieve.

It is known to achieve a broadband operation with parasitic elements which, however, require additional space. Further, those parasitic elements may also not be placed too close to other antenna portions since, again, this will lead to splitting into multiple sub-bands.

An antenna type which may be particularly suitable for slim multifunctional devices or those composed of two parts which may be moved against each other (twist, clamshell or slide devices) a patch antenna (and particularly a PIFA antenna) may be useful. Patch antennas, however, unfortunately are known to have poor gain and narrow bandwidths, typically in the range of 1 to 5% which is unsuitable for e.g. coverage of the UMTS band.

Although it is known that the bandwidth may be increased with the separation between the patch and ground, this then just destroys the advantage of patch antennas being flat. Furthermore, this leads to a distortion of the radiating pattern for instance, due to surface wave effects.

For patch antennas it is known that by providing a high dielectric material between the patch and the ground plane, it is possible to reduce the antenna size. As already mentioned above, such high dielectric materials tend to reduce the bandwidth which is then in particular, disadvantageous for patch antennas. Those materials also increase losses.

Further difficulties in antenna design occur when trying to build multi-band antennas. While with appropriate slots or the like it is possible to separate different antenna portions from each other, currents and charges in the respective parts always interact by strong and far-reaching electromagnetic fields. Those different antenna branches are, therefore, never independent. Trying to add a new branch for a new antenna frequency therefore changes entirely the previous antenna frequencies. Therefore, it is difficult to simply take a working antenna and try to add one more band by just adding one more antenna portion. All previously achieved optimizations for already established frequency bands are lost by such an approach.

Additionally, trying to design an antenna with three or more bands gives rise to a linear or in the worst case, exponential rise in the number of parameters to look at or problems to take care of. For each band the resonant frequency, bandwidth and other above-mentioned parameters such as impedance, polarization, gain and directivity have to be controlled simultaneously.

Furthermore, multi-band antennas may be coupled with two or more radio frequency devices. A further issue then arises, namely the isolation between the different radio frequency devices which are both connected to a good conducting antenna such that isolation is everything else but a simple task.

Changes for optimizing one parameter of one antenna band changes all other parameters probably in a counter-productive way. It usually, however, is not obvious how to control those counter-productive effects or how to compensate for them without creating more problems.

Mechanical considerations are further to be taken into account in antenna design, namely that the antenna needs to be firmly held. However, in particular, those materials which are in very close proximity of the metal piece or the conductor portion which forms an antenna or antenna portion, have a great impact on the antenna characteristics. Sometimes extensions or smaller recesses in the metal piece are provided to firmly hold the antenna in place. Those means which are intended for giving mechanical robustness to the antenna, however, also interact with the electric properties of the antenna.

All these different design problems of antennas, however, may only be solved by designing the geometry of the antenna. All parameters such as size, flatness, multi-band operation, broadband operation, gain, efficiency, impedance, radiation patterns, specific absorption rate, robustness and polarization are highly dependent on the geometry. Nevertheless, it is practically impossible to identify at least one or two geometry features which affect only one or two of the above-mentioned antenna characteristics. Therefore, there is no individual geometry feature which can be identified in order to optimize one or two antenna characteristics, without also influencing all other antenna characteristics.

Any change to the antenna geometry may harm more than it helps without knowing in advance how and why it happens or how it can be avoided.

Additionally, every platform of a wireless device is different in terms of form factor, market and technical requirements and functionality which is translated to different antennas for each device.

The problem to be solved by the present invention is therefore to provide an enhanced wireless connectivity.

Summary of the invention

The problem is solved by providing the MFWD with an RF system and an antenna system with the capability of fully functioning in one, two, three or more communication standards (such as e.g. GSM 850, GSM 900, GSM 1800, GSM 1900, UMTS, CDMA, W-CDMA, etc.), and in particular mobile or cellular communication standards, each standard allocated in one or more frequency bands, each of said frequency bands being fully contained within one of the following regions of the electromagnetic spectrum:

- the 810MHz – 960MHz region,
- the 1710MHz – 1990MHz region,
- and the 1900MHz – 2170MHz region

such that the MFWD is able to operate in three, four, five, six or more of said bands contained in at least said three regions.

According to the present invention, a MFWD is preferably able to provide both voice and high-speed data transmission and receiving services through at least one or more of said frequency regions in the spectrum. For that purpose, a MFWD will include the RF capabilities, antenna system and signal processing hardware to connect to a mobile network at a speed of preferably at least 350 Kbits/s, while in some embodiments the data transfer will be performed with at least 1 Mbit/s, 2 Mbit/s or 10 Mbit/s or beyond. For this purpose, a MFWD will preferably include at least 3G (such as for instance UMTS, UMTS-FDD, UMTS-TDD, W-CDMA, cdma2000, TD-SCDMA, Wideband CDMA) and/or 3.5G and/or 4G services (including for instance HSDPA, WiFi, WiMax, WiBro and other advanced services) in one or more of said frequency regions. In some embodiments a MFWD will include also 2G and 2.5G services such as GSM, GPRS, EDGE, TDMA, PCS, CDMA, cdmaOne. In some embodiments a MFWD will include 2G and or 2.5G services at one or both of the first two frequency regions (810-960 MHz and 1710-1990 MHz) and a 3G or a 4G service in the upper frequency region (1900-2170 MHz). In particular, some MFWD devices will provide 3 GSM/GPRS services (GSM900, GSM1800, GSM1900 or PCS) and UMTS/W-CDMA, while some others will provide 4 GSM/GPRS services (GSM850, GSM900, GSM1800, GSM1900 or PCS) and UMTS and/or W-CDMA to ensure seamless connectivity to multiple networks in several geographical domains such as for instance Europe and North America. In some embodiments, a MFWD will include 3G, 3.5G, 4G or a combination of such services in said three frequency regions.

In some embodiments, a MFWD device includes wireless connectivity to other wireless devices or networks through a wireless system such as for instance WiFi (IEEE802.11 standards), Bluetooth, ZigBee, UWB in some additional frequency regions such as for instance an ISM band (for instance around 430 MHz or 868 MHz, or within 902-928 MHz or in the 2400-2480 MHz range, or in the 5.1-5.9 GHz frequency range or a combination of them) and/or within a ultra wide-band range (UWB) such as the 3-5 GHz or 3-11 GHz frequency range.

In some embodiments, a MFWD provides voice over IP services (VoIP) through a wireless connection using one or more wireless standards such as WiFi, WiMax and WiBro, within the 2-11 GHz frequency region or in particular the 2.3-2.4 GHz frequency region.

The MFWD may have a bar shape, which means that it is given by a single body. It may also have a two-body structure such as a clamshell, flip or slider structure. It may further or additionally have a twist structure in which a body portion e.g. with a screen can be twisted (rotated with two or more axes of rotation which are preferably not parallel).

A MFWD may operate simultaneous in two or more wireless services (e.g. a short range wireless connectivity service and a mobile telephone service, a geolocalization service and a mobile telephone service, etc.).

For any wireless service, more than one antenna (system) may be provided in order to obtain a diversity system and/or a multiple input/multiple output system.

A multifunction wireless device (MFWD) advantageously comprises five functional blocks: display, processing module, memory module, communication module and power management module. The display such as a high resolution LCD or equivalent is an energy consuming module and most of the energy drain comes from the backlight use. The processing module, that is the microprocessor or CPU and the associated memory module are also major sources of power consumption. The fourth module responsible of energy consumption is the communication module, an essential part of which is the antenna system. A

MFWD has a single source of energy and it is the power management module mentioned above the one that provides and manages the energy of the MFWD.

A MFWD generally comprises one, two, three or more multilayer printed circuit boards (PCBs) on which to carry the electronics. At least one of said PCBs includes feeding means and/or grounding means for the antenna system.

At least one of said PCBs, preferably the same as said at least one PCB including feeding means and/or grounding means, includes a layer that serves as a ground plane of the antenna system.

The antenna system is an essential element of the MFWD, as it provides the MFWD with wide geographical and range coverage, high-speed connection and/or seamless connection to multiple networks and standards. Thus, a volume within the MFWD needs to be made available to the integration of said antenna system. However, the integration of said antenna system is complicated by the fact that the MFWD also includes one or more advanced functions provided by at least one, two, three or more additional electronic modules or subsystems such as for instance:

- a receiver of analog and/or digital sound (e.g. for FM, DAB, XDARS, SDARS, or the like).
- a receiver of digital broadcast TV (such as DVB-H, DMB)
- a module to download and play streamed video,
- an advanced image recording system (comprising e.g. one, two, three or more of: optical or digital zoom; flash light; one, two or more image sensors, one, two or more of which with more than 2 Megapixels),
- data storage means in excess of 1 Gbyte (fixed and/or removable; hard disk drive; non volatile (e.g. magnetic, ferroelectric or electronic) memory),
- a high resolution image and/or character and graphic display (more than 100 times 100 pixels or more than 320 times 240 pixels (e.g. more than 75.000 pixels) and/or 65.000 color levels or more),
- a full keyboard (e.g. number keys and character keys separated therefrom and/or at least 26, 30, 36, 40 or 50 keys; the keyboard may

be integrated within the MFWD or may be connectable to the MFWD by a cable or a short range wireless connectivity system),

- a touch screen with a size of at least have of the device
- a geolocalization system (such as e.g. GPS or Gallileo or a mobile network related terrestrial system),
- and/or a module to handle an internet access protocol and/or messaging capabilities (such as email, instant messaging, SMS, MMS or the like).

In some examples, the integration of an antenna system into a MFWD is further complicated by the presence in said MFWD of additional antennas, such as for example antennas for reception of broadcast radio and/or TV, antennas for geolocalization services, and/or antennas for wireless connectivity systems.

The MFWD achieves an efficient integration of an antenna system alongside other electronic modules and/or subsystems that provide sophisticated functionality to the MFWD, and possibly also in conjunction with additional antennas, in a way that the MFWD meets size, weight and/or battery consumption constraints critical for a portable small-sized device.

In a MFWD according to the present invention, the structure of the antenna system is advantageously shaped to use efficiently the volume made available for its integration within the MFWD in order to obtain a superior RF performance of the antenna system (such as for example, and without limitation, input impedance level, impedance bandwidth, gain, efficiency, and/or radiation pattern) and/or superior RF performance of the MFWD (such as for example, and without limitation, radiated power, received power and/or sensitivity) in at least one of the communication standards of operation in at least one of the frequency regions. Alternatively, the antenna system can be advantageously shaped to minimize the volume required within the MFWD yet still achieving a certain RF performance.

As a consequence, the resulting MFWD may exhibit in some examples one, two, three or more of the following features:

- increased communication range,

- improved quality of the communication or quality of service (QoS),
- extended battery life for higher autonomy of the device,
- reduced device profile and/or the size (aspect particularly critical for slim phones and/or twist phones),
- and/or reduced weight of the device (aspect particularly critical for multimedia phones and/or smart phones),
- qualities that in turn translate into increased user acceptance of the MFWD.

The antenna system also comprises at least one feeding point and may optionally comprise one, two or more grounding points. In some examples of MFWDs, the antenna system may comprise more than one feeding point, such as for example two, three or more feeding points.

A MFWD comprises one, two, three, four, five or more contact terminals. A contact terminal couples the feeding means included in a PCB of the MFWD with a feeding point of the antenna system. The feeding means comprise one, two, three or more RF transceivers coupled to the antenna system through contact terminals.

Similarly, a contact terminal can also couple the grounding means included in a PCB of the MFWD with a grounding point of the antenna system.

A contact terminal may take for instance the form of a spring contact with a corresponding landing area, or a pogo pin with a corresponding landing area, or a couple of pads held in electrical contact by fastening means (such as a screw) or by pressure means.

A volume within the MFWD is dedicated to the integration of said antenna system. An antenna box for a MFWD is defined as being the minimum-sized parallelepiped of square or rectangular faces that completely encloses said volume and wherein each one of the faces of the minimum-sized parallelepiped is tangent to at least a point of said volume. Moreover, each possible pair of faces of said minimum-size parallelepiped sharing an edge form an inner angle of 90°.

The antenna box delimits the volume within the MFWD dedicated to the antenna system in the sense that, although other elements of the MFWD (such as for instance an electronic module or subsystem) can be within the antenna box, no portion of the antenna system can extend outside the antenna box.

Therefore, although the volume within the MFWD dedicated to the integration of the antenna system will generally be irregularly shaped, the antenna box will have the shape of a right prism (i.e., a parallelepiped with square or rectangular faces and with the inner angles between two faces sharing an edge being 90º).

An antenna system of the MFWD has a structure able to support different radiation modes so that said antenna system can operate with good performance and reduced size in the communication standards allocated in multiple frequency bands within three different regions of the electromagnetic spectrum. Such an effect is achieved by appropriately shaping the structure of the antenna system in a way that different paths are provided to the electric currents that flow on the conductive parts of said structure of the antenna system, and/or to the equivalent magnetic currents on slots, apertures or openings within said structure, exciting radiation modes for the multiple frequency bands of operation. In some cases the structure of an antenna system will comprise a first portion that provides a first path for the currents associated with a radiation mode in a first frequency band within a first region of the electromagnetic spectrum, a second portion that provides a second path for the currents associated with a radiation mode in a second frequency band within a second region of the electromagnetic spectrum and a third portion that provides a third path for the currents associated with a radiation mode in a third frequency band within a third region of the electromagnetic spectrum.

In some embodiments said first, second and third portions are overlapping partially or completely with each other, while in other embodiments said three portions are essentially non-overlapping. In some embodiments only two of said three portions overlap either partially or completely. In some cases one portion of said three portions is the entire antenna system.

In some examples, at least one of the paths has an electrical length substantially close to one time, three times, five times or a larger odd integer number of times a quarter of the wavelength at a frequency of the associated radiation mode. In other examples, at least one of the paths has an electrical length approximately equal to one time, two times, three times or a larger integer number of times a half of the wavelength at a frequency of the associated radiation mode.

A structure of an antenna system of a MFWD according to the present invention is able to support different radiation modes. Such an effect is advantageously achieved by means of one of, or a combination of, the following mechanisms:

- creating slots, apertures and/or openings within the structure,
- bending and/or folding the structure,

because an edge-rich, angle-rich and/or discontinuity-rich structure is obtained in which different portions of said structure offer longer and more winding paths for the electric currents and/or the equivalent magnetic currents associated to different frequency bands of operation than the path that a simpler structure that uses neither one of the aforementioned mechanisms.

The process of shaping the structure of the antenna system to support different radiation modes can be regarded as the process of having to lower the frequency of a first radiation mode associated to a first frequency band, and/or subsequently including additional radiation modes associated to additional frequency bands, to a substantially square or rectangular conducting plate (or a substantially planar structure) that occupies a largest face of the antenna box.

The geometry of a substantially square or rectangular conducting plate occupying a largest face of the antenna box is an advantageous starting point for the design of the geometry of structure of the antenna system since such a structure offers an *a priori* longest path for the currents of a radiation mode corresponding to a lowest frequency band, together with a maximum antenna surface. Antenna designers have encountered difficulty in maintaining the performance of small antennas. There is a fundamental limit between size and bandwidth. The Bandwidth of an antenna is directly related with the volume that the antenna occupies. In antenna design it may be preferable to pursue maximum surface to achieve maximum bandwidth. The geometry of said substantially square or rectangular conducting plate is modified by at least one of the following:

- creating slots, gaps or apertures within the extension of said plate,
- removing peripheral parts of said plate,
- folding or bending parts of said plate, so that said folded or bent parts are no longer on the plane defined originally by the plate,
- and/or including additional conducting parts in the antenna box that are not contained on the plane defined originally by the plate;

in order to adapt the antenna system to the frequency bands of operation, to the space required by additional electronic modules or subsystems, and/or to other space constraints of the MFWD (as for example those imposed by the ergonomics, or the aesthetics of the MFWD).

In some examples, one or several modifications of the structure of antenna system are aimed at lengthening the path of the electric currents and/or the equivalent magnetic currents of a particular radiation mode to decrease its associated frequency band. In other examples, one or several modifications of the structure of antenna system are aimed at splitting, or diverting partially, the electric currents and/or the equivalent magnetic currents on different parts of the structure of the antenna system to enhance multimode radiation, which may be advantageous for wideband behavior.

The resulting structure (i.e., after modifying its geometry) includes a plurality of portions that allow the operation of the antenna system in multiple frequency bands. Generally, the structure of the antenna system comprises one, two, three, four or more antenna elements. An antenna element is formed by a single conducting geometric element, or by a plurality of conducting geometric elements that are in electrical contact (i.e., there is electrical continuity for direct or continuous current). One antenna element may comprise one or more portions of the structure of the antenna system. One portion of the antenna system may comprise one, two, three or more antenna elements. Different antenna elements may be electromagnetically coupled (either capacitively coupled or inductively coupled). No antenna element of the antenna system is connected by direct contact to another antenna element of said antenna system, unless such contact is optionally done through the ground plane of the antenna system. In some examples, an antenna system with a structure comprising several antenna elements is advantageous to increase the number of frequency bands of operation of said antenna system and/or to enhance the RF performance of said antenna system or that of a MFWD including said antenna system.

In some examples, slots, gaps or apertures created between different antenna elements, or between parts of a same antenna element, serve to decrease electromagnetic coupling between said antenna elements, or said parts of a same antenna element. In other examples, the structure of the antenna system seeks to create proximity regions are created between antenna elements, or between parts of a same antenna element, to enhance the coupling between said antenna elements, or said parts of a same antenna element.

The design of the structure of the antenna system is intended to use efficiently as much of the volume of the antenna box as possible in order to obtain a superior RF performance of the antenna system and/or superior RF performance of the MFWD in at least one frequency band. In particular, according to the present invention, the structure of the antenna system comes into contact with each of the six (6) faces of the antenna box in at least one point of each face to make better use of the available volume. However, it is in general advantageous to position the geometrical complexity of said structure predominantly on a largest face of the antenna box, and use a third dimension of said antenna box (i.e., the dimension not included in said largest face) to separate the antenna system from elements of the MFWD (such as for instance, and without limitation, a ground plane, a grounded shield can, a loudspeaker module, a vibrating module, a memory card socket, a hard disk drive, and/or a connector) that may degrade the RF performance of the antenna system and/or the RF performance of the MFWD.

For the purpose of the design of the antenna system, an antenna rectangle is defined as being the orthogonal projection of the antenna box along the normal to the face with largest area of the antenna box.

In some example MFWDs, one of the dimensions of the antenna box can be substantially smaller than any of the other two dimensions, or even be close to zero. In such cases, the antenna box collapses to a practically two-dimensional structure (i.e., the antenna box becomes approximately the antenna rectangle).

The antenna rectangle has a long side and a short side. The length of said long side is referred to as the width of the antenna rectangle (W), and the length of said short side is referred to as the height of the antenna rectangle (H). The aspect ratio of the antenna rectangle is defined as the ratio between the width and the height of the antenna rectangle.

In addition to the antenna rectangle, a ground plane rectangle is defined as being the minimum-sized rectangle that encompasses the ground plane of the antenna system included in the PCB of a MFWD that comprises the feeding means responsible for the operation of the antenna system in its lowest frequency band. That is, the ground plane rectangle is a rectangle whose edges are tangent to at least one point of said ground plane.

The area ratio is defined as the ratio between the area of antenna rectangle and the area of the ground plane rectangle.

In some examples, the antenna system advantageously places a feeding point of said antenna system, preferably a feeding point responsible for the operation of said antenna system in its lowest frequency band, near a corner of the antenna rectangle, because it may provide a longer path on the structure of the antenna system for the electric currents and/or the equivalent magnetic currents coupled to the antenna system through said feeding point.

In some examples, the antenna system advantageously places a feeding point of said antenna system, preferably a feeding point responsible for the operation of said antenna system in its lowest frequency band, in such a way that a contact terminal of the MFWD is located near an edge of a ground plane encompassed by the ground plane rectangle, preferably said edge being common with a side of the ground plane rectangle, and preferably said side being a short side of the ground plane rectangle. Such an election of the placement of the feeding point of the antenna system, and that of the contact terminal of the MFWD associated to said feeding point, may provide a longer path for electric and/or magnetic currents flowing on the ground plane of the antenna system enhancing the RF performance of the antenna system, or that of the MFWD, in at least said lowest frequency band, which becomes particularly relevant in those MFWD having form factors that require a small size of the ground plane rectangle, and consequently a small size of the whole device.

The structure of the antenna system becomes geometrically more complex as the number of frequency bands in which the MFWD has to operate increases, and/or the size of the antenna box decreases, and/or the RF performance requirements are made more stringent in at least one frequency band of operation. In a MFWD according to the present invention, the structure of the antenna system is geometrically defined by its antenna contour. The antenna contour of the antenna system is a set of joint and/or disjoint segments comprising:

- the perimeter of one or more antenna elements placed in the antenna rectangle,
- the perimeter of closed slots and/or closed apertures defined within said antenna elements,
- and/or the orthogonal projection onto the antenna rectangle of perimeters of antenna elements, perimeters of or parts of antenna elements, placed in the antenna box but not in the antenna rectangle.

The antenna contour can comprise straight segments, curved segments or a combination thereof. Not all the segments that form the antenna contour need to be connected (i.e., to be joint). In some cases, the antenna contour comprises two, three, four or more disjoint subsets of segments. A subset of segments is defined by one single segment or by a plurality of connected segments. In other cases, the entire set of segments that form the antenna contour are connected together defining a single set of joint segments (i.e., the antenna contour has only one subset of segments).

Along the contour different segments can be identified e.g. by a corner between two segments, wherein the corner is given by a point on the contour where no unique tangent can be identified. At the corners the contour has an angle. The segments next to a corner may be straight or curved or one straight and the other curved. Further, segments may be separated by a point where the curvature changes from left to right or from right to left. In e.g. a sin curve such points are given where the curve intersects the horizontal axis (x-axis, abscissa, sin(x) = 0) .

It is preferred that right and left curved segments are provided (when following the contour) and/or that at corners angles to the left and to the right (when following the contour) are provided. Preferably the number of left and right curved segments (if provided) does not differ by more than 80, 70, 60, 50, 40, 30, 20 or 10% of the larger of the two numbers. Also the number of corner angles between adjacent segments which following the contour go to the right and those that go to the left do not differ by more than 80, 70, 60, 50, 40, 30, 20 or 10% of the larger of the two numbers. Further preferably the number of the left curved segments plus the number of the corners where the contour turns left and the number of the right curved segments plus the number of corners where the contour turns right do not differ by more than 80, 70, 60, 50, 40, 30, 20 or 10% of the larger of the two numbers.

Generally, one, two, three or more subsets of segments of the antenna contour advantageously comprise each at least a certain minimum number of segments that are connected in such a way that each segment forms an angle with any adjacent segments or a curved segments is posed between such segments, such that no pair of adjacent segments defines a larger straight segment. The angles at corners or curved segments increase the degree of convolution of the curves formed by the segments of each of said subsets leading to an antenna contour that is geometrically rich in at least one of edges, angles, corners or discontinuities, when considered at different levels of detail. Possible values for the said minimum number of segments of a subset include 5, 6, 7, 8, 10, 12, 14, 16, 18, 20, 25, 30, 35, 40, 45 and 50. Also a maximum number of segments of a subset may be given. Possible values of said maximum number are 10, 15, 20, 25, 30, 40, 50, 75, 100, 150, 200, 250 and 500.

Additionally, to shape the structure of an antenna system, in some embodiments the segments of the antenna contour should be shorter than at least one fifth of a free-space wavelength corresponding to the lowest frequency band of operation, and possibly shorter than one tenth of said free-space wavelength. Moreover, in some further examples the segments of the antenna contour should be shorter than at least one twentieth of said free-space wavelength.

The antenna contour needs to make efficient use of the area of the antenna rectangle in order to attain enough level of geometrical complexity to make the resulting structure of an antenna system suitable for a MFWD. In particular, according to the present invention, the antenna contour comes into contact with each of the four (4) sides of the antenna rectangle in at least one point of each side of said antenna rectangle. The antenna contour should include at least ten segments in order to provide some multiple frequency band behavior, and/or size reduction, and/or enhanced RF performance to the resulting antenna system. However, a larger number of segments may be used, such as for instance 15, 20, 25, 30, 35, 40, 45, 50 or more segments. In general, the larger the number of segments of the antenna contour and the narrower the angles between connected segments, the more convoluted the structure of the antenna system. The number of segments of the antenna contour may be less than 20, 25, 30, 40, 50, 75, 100, 150, 200, 250 or 500.

The length of the antenna contour of an antenna system is defined as the sum of the lengths of each one of the disjoint subsets that make up the antenna contour. The larger the length of the antenna contour, the higher the richness of said antenna contour in at least one of edges, angles, corners or discontinuities, making the resulting structure of an antenna system suitable for a MFWD.

In some examples the length of the antenna contour is larger than 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 15, 20, 25, 30, 40, or more times the length of the diagonal of the antenna rectangle or less than any of those values.

Each of the one or more antenna elements comprised in the antenna system might be arranged according to different antenna topologies, such as for instance any one of the topologies selected from the following list: monopole antenna, dipole antenna, folded dipole antenna, loop antenna, patch antenna (and its derivatives for instance PIFA antennas), IFA antenna, slot antenna. Any of such antenna arrangements might comprise a dielectric material with a high dielectric constant (for instance larger than 3) to influence the operating frequency, impedance or both aspects of the antenna system.

The level of complexity of an antenna contour can be advantageously parameterized by means of two complexity factors, hereinafter referred to as **F_{21}** and **F_{32}**, which capture the geometrical details of the antenna contour (such as for instance its edge-richness, angle-richness and/or discontinuity-richness) when looked at different levels of scale.

For the computation of **F_{21}** and **F_{32}**, a first, a second, and a third grid (hereinafter called grid **G_1**, grid **G_2** and grid **G_3** respectively) of substantially square or rectangular cells are placed on the antenna rectangle. Said three grids are adaptive to the antenna rectangle. That is, the size and aspect ratio of the cells of each one of said three grids is determined by the size and aspect ratio of the antenna rectangle. The use of adaptive grids is advantageous because it provides sufficient number of cells within the antenna rectangle to fully capture the geometrical features of the antenna contour.

Moreover, said three grids are selected to span a range of levels of scale corresponding to two octaves: A cell of grid **G_2** is half the size of a cell of grid **G_1** (i.e., a ½ scaling factor or an octave of scale); a cell of grid **G_3** is half the size of a cell of grid **G_2**, or one fourth the size of a cell of grid **G_1** (i.e., a ¼ scaling factor or two octaves of scale). A range of scales of two octaves provides a sufficient variation in the size of the cells across the three grids as to capture gradually from the coarser features of the antenna contour to the finer ones.

Grids **G_1** and **G_3** are constructed from grid **G_2**, which needs to be defined in the first place.

As far as the second grid (or grid **G_2**) is concerned, the size of a cell and its aspect ratio (i.e., the ratio between the width and the height of the cell) are chosen so that the antenna rectangle is perfectly tessellated with an odd number of columns and an odd number of rows.

In the present document, columns of cells are associated to the long side of an antenna rectangle, while rows of cells are associated to a short side of said antenna rectangle. In other words, a long side of the antenna rectangle spans a number of columns, being said columns parallel to the short side of the antenna rectangle. In the same way a short side of the antenna rectangle spans a number of rows, being said rows parallel to the long side of the antenna rectangle.

If the antenna rectangle is tessellated with an excessive number of columns, then the size of the resulting cells is much smaller than the range of typical sizes of the features necessary to shape the antenna contour. However, if the antenna rectangle is tessellated with an insufficient number of columns, then the size of the resulting cells is much larger than the range of typical sizes of the features necessary to shape said antenna contour. It has been found that setting to nine (9) the number of columns that tessellate the antenna rectangle provides an advantageous compromise, for the preferred sizes of an MFWD, and the corresponding available volumes for the antenna system, according to the present invention. Therefore, a cell width (**W_2**) is selected to be equal to a ninth (1/9) of the length of the long side of the antenna rectangle (**W**).

Moreover, it is also advantageous to use cells that have an aspect ratio closest to one. In other words, the number of columns and rows of cells of the second grid that tessellate the antenna rectangle are selected to produce a cell as square as possible. A grid formed by cells having an aspect ratio close to one is preferred in order to perceive features of the antenna contour using approximately a same level of scale along two orthogonal directions defined by the long side and the short side of the antenna rectangle. Therefore, preferably, the cell height (**H_2**) is obtained by dividing the length of the short side of the antenna rectangle (**H**) by the odd integer number larger than one (1) and smaller than, or equal to, nine (9), that results in an aspect ratio **W_2/H_2** closest to one.

In the particular case that two different combinations of a number of columns and rows of cells of the second grid produce a cell as square as possible, a second grid is selected such that the aspect ratio is larger than 1.

Thus, the antenna rectangle is tessellated perfectly with 9 by (2n+1) cells of grid $\mathbf{G_2}$, wherein n is an integer larger than zero (0) and smaller than five (5).

A first grid (or grid $\mathbf{G_1}$) is obtained by combining four (4) cells of the grid $\mathbf{G_2}$. Each cell of the grid $\mathbf{G_1}$ consists of a 2-by-2 arrangement of cells of grid $\mathbf{G_2}$. Therefore, a cell of the grid $\mathbf{G_1}$ has a cell width equal to twice (2) the width of a cell of the second grid ($\mathbf{W_2}$) (i.e., $\mathbf{W_1}$=2 x $\mathbf{W_2}$); and a cell height ($\mathbf{H_1}$) equal to twice (2) the height of a cell of the second grid ($\mathbf{H_2}$) (i.e., $\mathbf{H_1}$=2 x $\mathbf{H_2}$).

Since grid $\mathbf{G_2}$ tessellates perfectly the antenna rectangle with an odd number of columns and an odd number of rows, an additional row and an additional column of cells of said grid $\mathbf{G_2}$ are necessary to have enough cells of the grid $\mathbf{G_1}$ as to completely cover the antenna rectangle.

In order to define uniquely the tessellation of the antenna rectangle with grid $\mathbf{G_1}$ a corner of said antenna rectangle is selected to start placing the cells of said grid $\mathbf{G_1}$.

A feeding point corner is defined as being the corner of the antenna rectangle closest to a feeding point of the antenna system responsible for the operation of the antenna system in its lowest frequency band. In case that said feeding point is placed at an equal distance from more than one corner of the antenna box, then the corner closest to a perimeter of the ground plane of the PCB of the MFWD is selected, preferably the corner closest to a shorter edge of the ground-plane rectangle. In case both corners are placed at the same distance from the feeding point and from the shorter edge of the ground-plane rectangle, the feeding point corner will be chosen, then owing to ergonomics reasons and taking into account the absorption of radiation in the hand of the MFWD user, and considering that there is a predominance on right hand users, it has been observed that in some embodiments it is convenient to place a feeding point and/or to designate the feeding point corner on the corner of the antenna rectangle which is closer to a left corner of the ground plane rectangle, being the left side of said ground plane rectangle the closest to the left side of the MFWD as seen by a right-handed user holding typically said MFWD with her right hand to originate a phone call, while facing a display of said MFWD. Also, the selection of the feeding point corner on the top or bottom corner on the left side of the MFWD depends on the position of the antenna system with respect to a body of the MFWD: An upper-left corner of the antenna rectangle is preferred in those cases in which said antenna system is placed substantially near the top part of said body of the MFWD (usually, above and/or behind a display); and a lower-left corner of the antenna rectangle is preferred in those cases in which said antenna system is placed substantially near the bottom part of said body of the MFWD (usually, below and/or behind a keypad). Again, due to ergonomics reasons, a top and a bottom part of a body of a MFWD are defined as seen by a right-handed user holding typically said MFWD with her right hand to originate a phone call, while facing a display 501 as seen in figs. 5 (a) and 5 (b).

A first cell of the grid $\mathbf{G_1}$ is then created by grouping four (4) cells of grid $\mathbf{G_2}$ in such a manner that:

- a corner of said first cell is the feeding point corner,
- and said first cell is positioned completely inside the antenna rectangle.

Once the first cell of the grid $\mathbf{G_1}$ is placed, other cells of said grid $\mathbf{G_1}$ can be placed defining uniquely the relative position of said grid $\mathbf{G_1}$ with respect to the antenna rectangle. The antenna rectangle spans 5 by (n+1) cells of the grid $\mathbf{G_1}$, (when $\mathbf{G_2}$ includes 9 columns) requiring the additional row and the additional column of cells of the grid $\mathbf{G_2}$ that meet at the corner of the antenna rectangle that is opposite to the feeding point corner, and that are not included in the antenna rectangle.

The complexity factor F21 is computed by counting the number of cells $\mathbf{N_1}$ of the grid $\mathbf{G_1}$ that are at least partially inside the antenna rectangle and include at least a point of the antenna contour (in the present invention the boundary of the cell is also part of the cell), and the number of cells $\mathbf{N_2}$ of the grid $\mathbf{G_2}$ that are completely inside the antenna rectangle and include at least a point of the antenna contour, and applying then the following formula:

$$F_{21} = -\frac{\log(N_2) - \log(N_1)}{\log(\frac{1}{2})}$$

Complexity factor $\mathbf{F_{21}}$ is predominantly aimed at capturing the complexity and degree of convolution of features of the antenna contour that appear when said contour is looked at coarser levels of scale. As it is illustrated in the example of Figure 8, the election of grid $\mathbf{G_1}$ and grid $\mathbf{G_2}$, and the fact that with grid $\mathbf{G_2}$ the antenna rectangle is perfectly tessellated by an odd number of columns and an odd number of rows, results in a value of the factor $\mathbf{F_{21}}$ equal to one for an antenna contour shaped as the antenna rectangle. On the other hand, an antenna contour whose shape is inspired in a Hilbert curve that fills the antenna rectangle features a value of the factor $\mathbf{F_{21}}$ smaller than two. Therefore the factor $\mathbf{F_{21}}$ is geared more towards assessing an overall complexity of an antenna contour (i.e., whether the degree of convolution of an antenna contour distinguishes sufficiently from a simple rectangular shape when looked at from a zoomed-out view), rather than estimating if the full complexity of an antenna contour (i.e., the complexity of the antenna contour when looked at from a zoomed-in view) approaches that of a highly-convoluted curve such as the Hilbert curve.

Moreover, in some embodiments the factor $\mathbf{F_{21}}$ is related to the number of paths that a structure of the antenna system provides to electric currents and/or the equivalent magnetic currents to excite radiation modes (i.e., factor $\mathbf{F_{21}}$ tends to increase with the number of portions within the structure of the antenna system and/or the number of antenna elements that form said antenna system). In general, the more frequency bands and/or radiation modes that need to be supported by the antenna structure of a MFWD, the higher the value of the factor $\mathbf{F_{21}}$ that needs to be attained by the antenna contour of the antenna system of said MFWD.

A third grid (or grid $\mathbf{G_3}$) is readily obtained by subdividing each cell of grid $\mathbf{G_2}$ into four cells, having each of said cells a cell width ($\mathbf{W_3}$) equal to one half (1/2) of the width of a cell of the second grid ($\mathbf{W_2}$) (i.e., $\mathbf{W_3}$=1/2 x $\mathbf{W_2}$); and a cell height ($\mathbf{H_3}$)

equal to one half (1/2) of the height of a cell of the second grid (**H_2**) (i.e., **H_3**=1/2 x **H_2**).

Therefore, since each cell of the grid **G_2** is replaced with 2-by-2 cells of the grid **G_3**, then 18 by (4n+2) cells of grid **G_3** are thus required to tessellate completely the antenna rectangle.

The complexity factor **F_{32}** is computed by counting the number of cells **N_2** of grid **G_2** that are completely inside the antenna rectangle and include at least a point of the antenna contour, and the number of cells **N_3** of the grid **G_3** that are completely inside the antenna rectangle and include at least a point of the antenna contour, and applying then the following formula:

$$F_{32} = -\frac{\log(N_3) - \log(N_2)}{\log(\frac{1}{2})}$$

Complexity factor **F_{32}** is predominantly directed at capturing the complexity and degree of convolution of features of the antenna contour that appear when said contour is looked at finer levels of scale. As it is illustrated in the example of Figure 8, the election of grid **G_2** and grid **G_3** is such that an antenna contour whose shape is inspired in a Hilbert curve that fills the antenna rectangle features a value of the factor **F_{32}** equal to two. On the other hand, an antenna contour shaped as the antenna rectangle features a value of the factor **F_{32}** larger than one. Therefore the factor **F_{32}** is geared more towards evaluating the full complexity of an antenna contour (i.e., whether the degree of convolution of an antenna contour tends to approach that of a highly-convoluted curve such as the Hilbert curve), rather than discerning if said antenna contour is substantially different from a rectangular shape.

Moreover, the factor **F_{32}** is in some embodiments related to the degree of miniaturization achieved by the antenna system. In general, the smaller the antenna box of a MFWD, the higher the value of the factor **F_{32}** that needs to be attained by the antenna contour of the antenna system of said MWFD.

The complexity factors F_{21} and F_{32} span a two-dimensional space on which the antenna contour of the antenna system of a MFWD is mapped as a single point with coordinates (F_{21}, F_{32}). Such a mapping can be advantageously used to guide the design of the antenna system by tailoring the degree of convolution of the antenna contour until some preferred values of the factors F_{21} and F_{32} are attained, so that the resulting antenna system: provides the required number of frequency bands in which the MFWD operates; meets MFWD size and/or integration constraints; and/or enhances the RF performance of the antenna system and/or that of the MFWD in at least one of the frequency bands of operation.

In a preferred embodiment, a MFWD comprises an antenna system whose antenna contour features a complexity factor F_{21} larger than one and a complexity factor F_{32} larger than one. In a preferred embodiment, a MFWD comprises an antenna system whose antenna contour features a complexity factor F_{21} larger than or equal to 1.1 and a complexity factor F_{32} larger than or equal to 1.1.

In some examples the antenna contour features a complexity factor F_{32} larger than a certain minimum value in order to achieve some degree of miniaturization.

An antenna contour with a complexity factor F_{32} approximately equal to two, despite achieving substantial size reduction, may not be preferred for a MFWD of the present invention as the antenna system is likely to have reduced capability to operate in multiple frequency bands and/or limited RF performance. Therefore in some examples of embodiments of the present invention the antenna contour features a complexity factor F_{32} smaller than a certain maximum value in order to achieve enhanced RF performance.

In some cases of embodiments of the present invention the antenna contour features a complexity factor F_{32} larger than said minimum value but smaller than said maximum value.

Said minimum and maximum values for the complexity factor $\mathbf{F_{32}}$ can be selected from the list of values comprising: 1.10, 1.15, 1.20, 1.25, 1.30, 1.35, 1.40, 1.45, 1.50, 1.55, 1.60, 1.65, 1.70, 1.75, 1.80, 1.85, and 1.90.

Similarly, in some examples an antenna contour advantageously features a complexity factor $\mathbf{F_{21}}$ larger than a lower bound and/or smaller than an upper bound. Said lower and upper bounds for the complexity factor $\mathbf{F_{21}}$ can be selected from the list of comprising: 1.05, 1.10, 1.15, 1.20, 1.25, 1.30, 1.35, 1.40, 1.45, 1.50, 1.55, 1.60, 1.65, 1.70, 1.75, and 1.80.

The complexity factors $\mathbf{F_{21}}$ and $\mathbf{F_{32}}$ have turned out to be relevant parameters that allow for an effective antenna design. Evaluation of those parameters give good hints on possible changes of antennas in order to obtain improved antennas.

In some cases the parameters $\mathbf{F_{21}}$ and $\mathbf{F_{32}}$ allow for easy identification of unsuitable antennas. Further those parameters may be used in numerical optimization algorithms as target values or to define target intervals in order to speed up such algorithms.

In the following some parameter ranges for $\mathbf{F_{21}}$ and $\mathbf{F_{32}}$ which have turned out to be particularly advantageous or useful are summarized.

For MFWDs it turned out to be in particular, useful to have a value of $\mathbf{F_{21}}$ larger than 1.43, 1.45, 1.47 or preferably more than 1.50. Such values in this complexity factor translate into a richer frequency response of the antenna which allows for more possible resonant frequencies and more frequency bands with better bandwidths or a combination of those effects.

Furthermore, for SMRT or MMT, design demands may be different since those devices are usually larger and a reduction of the antenna size is not of such utmost importance, but energy consumption may be important since those devices have to operate many different functionalities. For those devices, therefore a complexity factor F_{21} of only more than 1.39, preferably 1.41 or most preferred more than 1.43 turns out to be advantageous.

For clamshell, twist or slider devices it has to be taken into account that those phones consist of at least two parts which may be moved relative to each other. As a result only a little amount of space is available for the phones and hence, a value of F_{21} of more than 1.43, 1.45, 1.47, or more than 1.50 is advantageous. The same applies to slim devices. For those devices, where there is the requirement of the antenna to be flat, a value of F_{21} greater than the above-mentioned limits provides sufficient possibilities for fringing electromagnetic fields to escape from the area below a patch such that the patch achieves a higher bandwidth and a higher gain. The antenna in case of clamshell, twist or slider devices does not necessarily have to become a patch or patch-like antenna.

For some MFWDs it is usually no more possible to allocate a certain volume which is only available for the antenna. It may, for example, be necessary to fit an antenna around one, two or more openings in which a camera, a speaker, RF connectors, digital connectors, speaker connectors, power connectors, infrared ports and/or mechanical elements such as screws, plastic insets, posts, clips have to be provided. The respective opening(s) can be achieved by a certain value F_{21} which is higher than 1.38, 1.40, or 1.42, or more preferably higher than 1.45 or 1.50. It turned out that with such values for F_{21} it is possible to provide sufficient opening in order to insert other components.

For those antennas which in their physical properties come quite close to patch antennas namely those with an overlap between the antenna and the ground-plane (patch like antennas), a value of F_{21} being higher than 1.45, 1.47, 1.50, or 1.60 turns out to be a good measure for an expected improved bandwidth or gain with respect to a patch antenna without any complexity in at least one of the frequency bands. Said region for F_{21} further turns out to be useful for an MFWD with two or more RF transceivers. With a lower value it will be difficult to sufficiently isolate the two RF transceivers against each other. By the complexity factor F_{21} being more than 1.45, 1.47 or 1.50 the two RF transceivers can be electrically separated sufficiently, e.g. by connecting them to two antenna portions which are not in direct electrical contact.

The last mentioned range is equally suitable for a MFWD with two, three or more antenna elements. Those elements may be convoluted into each other in order to occupy less space which translates into a high value of F_{21}.

A MFWD with an antenna with a complexity factor of F_{32} being larger than 1.55, 1.57 or 1.60 is advantageous. Such a high value of F_{32} allows for an additional factor for tuning the frequency of high frequency bands without changing the gross geometry for low frequency bands. For this range of F_{32} it turns out that the parameter F_{21} being lower than 1.41, 1.39, 1.37, or 1.35 is advantageous since for a high value of F_{32} which provides some miniaturization F_{21} may be low in particular to avoid an antenna with too many separate portions or antenna arms since such independent portions are difficult to fix in order to achieve proper mechanical robustness.

For a SMRT or MMT device a value of F_{32} being larger than 1.50, 1.52, 1.55 or 1.60 is desirable. The phones which usually operate in high frequency bands such as UMTS and/or a wireless connectivity of around 2.4 GHz a higher value of F_{32} can be used to appropriately adapt the antenna to a desired resonance frequency and/or bandwidth in those bands.

For slim devices (thickness less than 14mm, 13mm, 12mm, 11mm, 10 mm, 9mm or 8mm) it turns out that a parameter of F_{32} being larger than 1.60, 1.62 or 1.65 may be desired in order to achieve an edge ridge structure which reduces the problems of e.g. flat patch antennas. A high value of F_{32} may lead to an increased bandwidth which is useful for e.g. coverage of the UMTS band. For the same reasons, in some embodiments of MFWD and particularly in slim devices, it is preferred that the intersection of the projection of the antenna rectangle 110 onto the ground plane rectangle 202 is less than 90% of the area of said antenna rectangle. In particular, such a intersection should be in some cases below 80%, 70%, 50%, 30%, 20% or 10% of said area. Such values for the intersection may be given also for devices which are not considered slim.

For clamshell, twist or slider devices, even higher values of F_{32} such as higher than 1.63, 1.65, 1.68 or 1.70 may be necessary since in those MFWDs the antennas have to be even more flat.

MFWDs which have e.g. a camera or any other item such as a connector integrated in the antenna box it is desirable to have a value of F_{32} being larger than 1.56, 1.58, 1.60 or 1.63. For those devices it turns out that the mechanical fixing of the antenna may be difficult due to other items which are within the antenna box. With a high value of F_{32} being more than 1.55 or the other values mentioned above, the antenna usually has an edge or recess rich structure which facilitates fixing of the antenna at its border. Therefore, usually there is no problem in mechanically holding an antenna with a high value of F_{32}.

Antennas which are overlapping with the ground plane of a PCB of the MFWD with at least 50% or 100%, it is possible to achieve appropriate antenna performance even if the value of F_{21} is smaller than e.g. 1.42, 1.40 or 1.38 in case that the complexity factor F_{32} is more than 1.55. Such edges, curves or steps in the border which lead to a high value of F_{32}, increase efficiency and gain since they lead to strong reorientations of current. This may compensate for lower values of F_{21}, in particular for antennas of patch-like geometry (i.e. those where the antenna overlaps 100% with the ground plane of a PCB of the MFWD).

Equally for MFWDs with two or more RF transceivers, antennas are possible for values of F_{21} being lower than 1.40, 1.38 or 1.35 in case that the complexity factor F_{32} is larger than 1.50, 1.52, 1.53, 1.57 or 1.60. Appropriate separation of the two RF transceivers is difficult with a low value of F_{21}. It may still be possible, however, with a high complexity value of F_{32}, which enables some kind of compensation for a low value of F_{21}.

In some embodiments, when a high level of complexity is sought it might be necessary to design an antenna system whose structure comprises 2, 3 or more antenna elements. Said complexity may be achieved at a coarser and/or finer level of detail. When a high level of complexity is sought in a coarser level of detail, a high value of F_{21} might be required, namely more than 1.43, 1.45, 1.47, or 1.50. When a high level of complexity is sought in a finer level of detail, a high value of F_{32} might be required, namely more than 1.61, 1.63, 1.65 or 1.70.

Furthermore, it turned out that for some MFWDs with three or more antenna elements, a value of F_{21} lower than 1.36, 1.34, 1.32, 1.30, or even less than 1.25 is advantageous. In these cases the use of an additional antenna element pursues the enhancement of the radio electric performance of the antenna system in at least one of the frequency bands rather than introducing an additional frequency band disjoint to those already supported by the antenna system. For the above mentioned reason it may be advantageous to keep the value of F_{21} below a certain maximum. That can be achieved by reducing the separation of the third or additional antenna elements with respect to the antenna elements already present in the structure of the antenna system, so that the gaps between those antenna elements are not fully observed at a coarser level of detail. Therefore, for MFWDs with three or more antenna elements lower values of F_{21} may be preferred in certain cases. Additionally, the separation of the antenna system into three or more antenna elements allows for easier adaptation of each antenna element to space requirements within the MFWD such that miniaturization is not such an issue. Therefore, it is possible to have antennas with larger dimensions which then provide for improved radiation efficiency, higher gain and also simply easier design and hence, less costly antennas.

With MFWDs, in general, it turned out to be particular useful to have a value of F_{21} greater than 1.42, 1.44, 1.46, 1.48 or 1.50 while at the same time having a value of F_{32} being lower than 1.44, 1.42, 1.40 or 1.38. This is because for the portion of the antenna which resonates at low frequencies which means long wavelengths, and hence, a long antenna portion, higher miniaturization is required. This miniaturization of large-scale portions translates into a high value of F_{21} and vice versa. For higher frequencies which have smaller wavelengths, there is not such a strong requirement for miniaturization but an enhanced bandwidth is desired. Therefore lower values of F_{32} may be preferred. Low values of F_{32} further allow for maximum efficiency since those antennas do not need to be miniaturized extremely.

It is particularly useful to use a parameter range of F_{21} being more than 1.32, 1.34 or 1.36 and less than 1.54, 1.52 or 1.50 while at the same time F_{32} is less than 1.44, 1.42 or 1.40 and more than 1.22, 1.24 or 1.26. In this parameter range the values of F_{21} and F_{32} assume intermediate values which give the possibility to have the different design parameters such as smallness, multi-band and broadband operation, and an appropriate gain and efficiency to be taken into account equally. This parameter range is particularly useful for MFWDs where there is no single or two design parameters which are of outstanding importance.

Another useful parameter range is given by F_{21} being less than 1.32, 1.30 or 1.28 with a value of F_{32} being less than 1.54, 1.52 or 1.50 and at the same time being greater than 1.34, 1.36 or 1.38. This parameter range is useful for MFWDs where the robustness of the device is of outstanding importance since a low value of F_{21} leads to devices with a particularly simple geometry without having many highly diffracted portions which are difficult to fix individually. In order to achieve some miniaturization, however, a value of F_{32} in the indicated range is preferred taking into account also the trade off between the disadvantages of too high values of F_{32} in terms of two strong miniaturization which leads to a poor bandwidth while on the other hand wanting to have at least some kind of miniaturization corresponding to F_{32} being above a lower limit.

For some MFWDs it may be desirable to have the value of F_{32} being less than 1.52, 1.50, 1.48, or 1.45. It was found that antenna elements with highly complex borders are often quite difficult to manufacture and assemble. For instance stamping tools require more resolution and wear out more easily in case of complex borders (which means high value of F_{32}) which translates into higher manufacturing costs (tooling manufacturing costs, tool maintenance cost, larger number of hits per piece of the stamping tool) and deliver lead times, particularly for large volume production.

This turns out to be important for e.g. slim phones which turn out to be sold very often such that mass production is common in this market segment which then puts extreme pressure on manufacturing costs, time to market and production volumes.

Additionally, shapes with high factors of $\mathbf{F_{32}}$ are very complicated to model with appropriate CAD tools as the very complicated shapes turn out to consume a lot of computing time. This increases development costs which in turn increases total costs of such an antenna design.

Equally, for clamshell, twist or slider phones which may have a major portion of the market share where mass manufacturing is carried out, it may be desirable to have a value of $\mathbf{F_{32}}$ being less than 1.30, 1.28 or 1.26.

For relatively low cost and robust antenna design, it is preferable to have the value of $\mathbf{F_{21}}$ being more than 1.15 or 1.17 and at the same time being less than 1.40, 1.38 or 1.36 while the value of $\mathbf{F_{32}}$ is less than 1.30, 1.28 and more than 1.15 or 1.17.

Additionally, it is advantageous to have a SMRT or a MMT device which is of the type twist, or clamshell.

Further of advantage is an MFWD which is slim (it means it has a thickness of less than 14 mm) and is of the type clamshell, twist or slider. For those devices, the flatness requirement is remarkably strong because each of the parts forming the clamshell, twist or slider may only have a maximum thickness of 5, 6, 7, 8 or 9 mm. With the technology disclosed herein, it is possible to design flat antennas even for such MFWDs.

A MFWD incorporating 3.5G or 4G features (i.e. comprising 3G and other advanced services such as for instance HSDPA, WiBro, WiFi, WiMAX, UWB or other high-speed wireless standards, hereinafter 4G services) might require operation in additional frequency bands corresponding to said 4G standards (for instance, bands within the frequency region 2-11 GHz and some of its sub-regions such as for instance 2-11 GHz, 3-10 GHz, 2.4-2.5 GHz and 5-6 GHz or some other bands). In some cases, to achieve a maximum volume compactness it would be advantageous that the same antenna system is capable of supporting the radiation modes corresponding to said additional frequency bands. Nevertheless this approach can be inconvenient as it will increase complexity to the RF circuitry of the MFWD, for example by filters to separate the frequency bands of the 4G services from the frequency bands of the rest of services. Therefore it may be advantageous to have a dedicated antenna for 4G services although inside the antenna box.

In other cases, achieving a good isolation between the frequency bands of the 4G services and the frequency bands of the rest of services (3G and below) is preferred to compactness. In those cases the 4G antenna (i.e. the one or more additional antenna covering one or more of said 4G services) will preferably be separated as much as possible from the antenna box. Generally the long side of the antenna rectangle is placed alongside a short edge of the ground plane rectangle. In some cases it would be advantageous to place the 4G antenna substantially close to the edge that is opposite to said short edge. In other cases it would be advantageous to place the 4G antenna substantially close to an edge that is adjacent to said short edge. Therefore since the MFWD dimensions are usually predefined the separation between antennas can be further increased by reducing the short side of the antenna rectangle and thus increasing its aspect ratio. As a consequence, for those devices, it may be desirable to have a value of $\mathbf{F_{32}}$ higher than 1.35, 1.50, 1.60, 1.65 or 1.75. When the complexity factor $\mathbf{F_{21}}$ is in the lower half of the typical range, for example $\mathbf{F_{21}}$ smaller than 1.40, it may be advantageous to have a value of $\mathbf{F_{32}}$ higher than 1.35. On the other hand when the complexity factor $\mathbf{F_{21}}$ is in the upper half of its typical range, for example $\mathbf{F_{21}}$ larger than 1.45, it may be advantageous to have a value of $\mathbf{F_{32}}$ higher than a minimum value that can be selected from the list of values comprising: 1.10, 1.15, 1.20, 1.25, 1.30, 1.35, 1.40, 1.45, 1.50, 1.55, 1.60, 1.65, 1.70, 1.75, 1.80, 1.85, and 1.90.

Advantageously MFWD including 4G services may have two or more dedicated antennas for said 4G services forming an antenna diversity arrangement. In those cases not only good isolation between the antenna system and the antennas for said 4G services is required but also good isolation between the two or more antennas forming said antenna diversity arrangement.

One, two or more 4G antennas may be IFA-antennas. They may be located outside of the ground plane rectangle. They may be located next to the ground plane. One, two or more 4G antennas may be slot antennas, preferably within the ground plane.

Typically the number of contacts in an antenna system is proportional to the number of RF transceivers coupled to said antenna system and to the number of antenna elements comprised in the structure of said antenna system. Each RF transceiver drives an antenna element through typically one contact. Additionally each of said antenna elements may have a second contact for grounding purposes. Parasitic antenna elements typically comprise a contact terminal used for grounding purposes.

In some examples, the MFWD integrates an antenna system in such a way that the antenna rectangle of said antenna system is at least partially (such as for instance at least a 10%, 20%, 30%, 40%, 50% or even 60%) or completely on the projection of the ground plane rectangle of said MFWD. In some other examples, said antenna rectangle is completely outside of the projection of the ground plane rectangle of said MFWD.

In some examples in which the antenna rectangle of an antenna system is in the projection of the ground plane rectangle of a MFWD in an area of less than 10, 20 or 30% of said antenna rectangle, the antenna contour of said antenna system preferably features a complexity factor $\mathbf{F_{21}}$ larger than 1.20, 1.30, 1.40 or 1.50. In other examples in which the antenna rectangle of an antenna system is in the projection of the ground plane rectangle of a MFWD in an area larger than 80, 90 or 95% of said antenna rectangle, the antenna contour of said antenna system preferably features a complexity factor $\mathbf{F_{21}}$ smaller 1.30, 1.35, 1.40 or 1.45.

Another aspect of the integration of an antenna system within a MFWD is the positioning of said antenna system with respect to the one or more bodies comprised in said MFWD.

An antenna system can be integrated either in the top part of a body of a MFWD (usually, above and/or behind a display), or in the bottom part of a body of said MFWD (usually, below and/or behind a keypad).

In some examples, an antenna system integrated on the bottom part of a body of a MFWD features advantageously an antenna contour with a complexity factor $\mathbf{F_{21}}$ smaller than 1.45 and a complexity factor $\mathbf{F_{32}}$ smaller than 1.50, since generally there is quite more space available in such a part of the device. In some other examples, said antenna contour features preferably a factor $\mathbf{F_{21}}$ larger than 1.45 and/or a factor $\mathbf{F_{32}}$ larger than 1.75.

In some examples, an antenna system integrated on the top part of a body of a MFWD features advantageously an antenna contour with a complexity factor $\mathbf{F_{21}}$ smaller than 1.30, 1.25, or 1.20. In some other examples, said antenna contour features preferably a factor $\mathbf{F_{21}}$ larger than 1.45, 1.50 or 1.55.

In some cases, a two-body MFWD (such as for instance a clamshell or a flip-phone, a twist device, or a slider device) integrates the antenna system in the vicinity of the hinge that allows rotation of at least one of the two bodies. In such cases, the antenna contour of said antenna system features preferably a complexity factor $\mathbf{F_{21}}$ larger than 1.20 and/or a complexity factor $\mathbf{F_{32}}$ larger than or equal to 1.55.

Further of advantage for a general trade off between multiple parameters are values of a complexity factor of $\mathbf{F_{21}}$ being more than 1.52 and less than 1.65 and/or a complexity factor $\mathbf{F_{32}}$ being more than 1.55 and less than 1.70.

List of figures

Further characteristics and advantages of the invention will become apparent in view of the detailed description which follows of some preferred embodiments of the invention given for purposes of illustration only and in no way meant as a definition of the limits of the invention, made with reference to the accompanying drawings:

Fig. 1 – shows a perspective view of a MFWD including a space for the integration of an antenna system, and its corresponding antenna box; and antenna rectangle.

Fig. 2a – shows an example MFWD comprising a ground plane layer included in a PCB, and its corresponding ground plane rectangle.

Fig. 2b – shows the ground plane rectangle of the MFWD of Fig. 2a in combination with an antenna rectangle for an antenna system.

Fig. 3 – shows an example of an antenna contour of an antenna system for a MFWD.

Fig. 4 – from top to down shows an example of a process (for instance a stamping process) followed to shape a rectangular conducting plate to create the structure of an antenna system for a MFWD.

Fig. 5 – shows an example of MFWD being held typically by a right-handed user to originate a phone call, and how the feeding point corner of the antenna rectangle of said MFWD may be selected.

Fig. 6a – shows an example of a first grid to compute the complexity factors of an antenna contour.

Fig. 6b – shows an example of a second grid to compute the complexity factors of an antenna contour.

Fig. 6c – shows an example of a third grid to compute the complexity factors of an antenna contour.

Fig. 7 – shows the two-dimensional representation of the $\mathbf{F_{32}}$ vs. $\mathbf{F_{21}}$ space.

Fig. 8a – shows an example of an antenna contour inspired in a Hilbert curve under a first grid to compute the complexity factors of said antenna contour.

Fig. 8b – shows the example of the antenna contour of Fig. 8a under a second grid to compute the complexity factors of said antenna contour.

Fig. 8c – shows the example of the antenna contour of Fig. 8a under a third grid to compute the complexity factors of said antenna contour.

Fig. 9a – shows an example of a quasi-rectangular antenna contour featuring a great degree of convolution in its perimeter under a first grid to compute the complexity factors of said antenna contour.

Fig. 9b – shows the example of the quasi-rectangular antenna contour featuring a great degree of convolution of Fig. 9a under a second grid to compute the complexity factors of said antenna contour.

Fig. 9c – shows the example of the quasi-rectangular antenna contour featuring a great degree of convolution of Fig. 9a under a third grid to compute the complexity factors of said antenna contour.

Fig. 10a – shows an example of a triple branch antenna contour under a first grid to compute the complexity factors of said antenna contour.

Fig. 10b – shows the example of the triple branch antenna contour of Fig. 10a under a second grid to compute the complexity factors of said antenna contour.

Fig. 10c – shows the example of the triple branch antenna contour of Fig. 10a under a third grid to compute the complexity factors of said antenna contour.

Fig. 11 – shows the mapping of the antenna contour of Figs. 6, 8, 9 and 10 in the $\mathbf{F}_{32}$ vs. $\mathbf{F}_{21}$ space.

Fig. 12a – shows an example of antenna contour of the antenna system of a MFWD according to the present invention.

Fig. 12b – shows an example of a PCB of a MFWD including a layer that serves as the ground plane to the antenna system of Fig. 12a.

Fig. 13a – shows the antenna contour of Fig. 12a placed under a first grid to compute the complexity factors of said antenna contour.

Fig. 13b – shows the antenna contour of Fig. 12a placed under a second grid to compute the complexity factors of said antenna contour.

Fig. 13c – shows the antenna contour of Fig. 12a placed under a third grid to compute the complexity factors of said antenna contour.

Fig. 14a – shows an antenna contour according to the present invention placed under a first grid to compute the complexity factors of said antenna contour.

Fig. 14b – shows the antenna contour according to the present invention of Fig. 14a placed under a second grid to compute the complexity factors of said antenna contour.

Fig. 14c – shows the antenna contour according to the present invention of Fig. 14a placed under a third grid to compute the complexity factors of said antenna contour.

Fig. 15 – shows the mapping of the antenna contour of Figs. 12 and 14 in the $\mathbf{F_{32}}$ vs. $\mathbf{F_{21}}$ space.

Description of the figures

Figure 1 shows a perspective view of a MFWD 100 comprising in this particular example only one body. A volume 101 within said MFWD 100 is made available for the integration of an antenna system. The MFWD 100 also comprises a multilayer PCB that includes feeding means and/or grounding means. A layer 102 of said PCB serves as a ground plane of the antenna system.

An antenna box 103 is obtained as a minimum-sized parallelepiped that completely encloses the volume 101. In this example, the antenna box 103 has rectangular faces 104–109. According to the present invention, the structure of the antenna system comes into contact with each of the six (6) faces of the antenna box 104–109 in at least one point of each face. Moreover, the antenna system of MFWD 100 has no portion that extends outside the antenna box 103.

An antenna rectangle 110 is obtained as the orthogonal projection of the antenna box 103 along the normal to the face with largest area, which in this case is the direction normal to faces 104 and 105.

Figure 2a represents a top plan view of the MFWD 100. For the sake of clarity, the volume 101 has been omitted in the figure. A ground plane rectangle 200 is adjusted around the layer 102 that serves as a ground plane to the antenna system of the MFWD 100. The ground plane rectangle 200 is a minimum-sized rectangle in which each of its edges is tangent to at least one point of the perimeter of layer 102.

Figure 2b depicts the relative position of the ground plane rectangle 200 and the antenna rectangle 110 for the MFWD 100 of Figure 1. The antenna rectangle has a long side 203 and a short side 204. The ground plane rectangle has a long edge 202 and a short edge 201.

In this particular example, the antenna rectangle 110 and the ground plane rectangle 200 lie substantially on a same plane (i.e., the antenna rectangle 110 and the ground plane rectangle 200 are substantially coplanar). Furthermore, a long side of the antenna rectangle 203 is substantially parallel to a short edge of the ground plane rectangle 201, while in some other embodiments it will be substantially parallel to a long edge of the ground plane rectangle.

In this example, the antenna rectangle 110 is partially overlapping the ground plane rectangle 200. Although in other cases, they can be completely overlapping or completely non-overlapping. Moreover, in this example the placement of the antenna rectangle 110 is not symmetrical with respect to a symmetry axis that is parallel to the long edge of the ground plane rectangle 202 and that passes by the middle point of the short edge of said ground plane rectangle 201.

Figure 3 shows an example of a structure of an antenna system contained within an antenna box 301. In this particular example, said structure comprises only one antenna element 300. The antenna element 300 has been shaped as to be able to support different radiation modes, so that the resulting antenna system can operate in multiple frequency bands. In particular, two apertures 302 and 303 with closed perimeter have been created in the antenna element 300. Additionally, the antenna element 300 also features an opening 304 that increases the number of segments that form the perimeter of said antenna element 300. The antenna element 300 also includes two parts 305 and 306 that are bent 90° with respect to the rest of the antenna element 300, but are fully contained in the antenna box 301.

The bottom part of Figure 3 shows an antenna rectangle 351 associated to the antenna box 301. Said antenna rectangle 351 contains the antenna contour 350 associated to the antenna element 300.

The antenna contour 350 comprises three disjoint subsets of segments: A first subset is formed by the segments of the perimeter 357 (which includes both external segments of the antenna element 300 and those segments added to said antenna element by the opening 304) and the group of segments 356 corresponding to the orthogonal projection of part 306 of the antenna element 300; a second subset is formed by the segments 352 associated to the perimeter of aperture 302; and a third subset is formed by the segments 353 associated to the perimeter of aperture 303.

Note that in this example, part 305 of the antenna element 300 has an orthogonal projection that completely matches a segment of the perimeter 357, and therefore does not increase the number of segments of the antenna contour 350.

Figure 4 shows how the structure of an antenna system such as the one presented in Figure 3 can be obtained by appropriately shaping a rectangular conducting plate 400. The Figure can be seen also as three steps (top to down) comprised in a manufacturing process of said antenna system by means of, for instance, a stamping process.

The top part of Figure 4 shows said plate 400 occupying (and extending beyond) the antenna rectangle 351 (represented as a dash-dot line). The cut out lines that delimit those parts of the conducting plate 400 that will be removed are depicted as dashed lines. A peripheral part of the plate 400 will be removed, as indicated by the outline 401. Additionally, two closed apertures will be created as defined by outline 402 and outline 403.

The middle part of Figure 4 shows a planar structure 430 resulting after eliminating the parts of plate 400 that will not be used to create the antenna system. In said planar structure 430, two closed apertures 302 and 303, and an opening 304 can be identified.

The planar structure 430 has a first part 405, and a second part 406, that extend beyond the antenna rectangle 351. Said first and second parts 405 and

406 will need to be bent or folded so that their orthogonal projection does not extend outside the antenna rectangle 351.

The bottom part of Figure 4 shows the antenna element 300 obtained from the planar structure 430. Said antenna element 300 is a three-dimensional structure that fits within the antenna box 301 (also depicted as a dash-dot line). The first part of the planar structure 405 is bent 90 degrees downwards (in the direction indicated by arrow 431) to become part 305 of the antenna element 300. The second part of the planar structure 406 is folded twice to become part 306 of said antenna element 300. Said second part 406 is rotated a first time 90 degrees downwards (as indicated by the arrow 432), and then at another point along said second part 406 rotated a second time 90 degrees leftwards (as indicated by the arrow 433).

Figure 5 shows a MFWD 500 consisting of a single body being held typically by a right-handed user to originate a phone call while facing a display of said MFWD 501. The MFWD 500 comprises an antenna system and a PCB that includes a layer that serves as a ground plane of said antenna system 502 (depicted in dashed line). The antenna system is to be arranged inside an antenna box, whose antenna rectangle 503, 504 is depicted also in dashed line. The antenna rectangle 503, 504 is in the projection of the ground plane layer 502. In the case of Figure 5a, the antenna rectangle 503 is placed substantially in the top part of the body of the MFWD 500 (i.e., above and/or behind a display 501), while in Figure 5b the antenna rectangle 504 is placed substantially in the bottom part of the body of the MFWD 500 (i.e., below and/or behind a keypad).

For ergonomics reasons, it is advantageous in the examples of the Figure 5 to select a corner of the antenna rectangle close to the left edge of the MFWD 500. The upper left corner of the antenna rectangle 505 is selected as the feeding point corner in the case of Figure 5a, while the lower left corner of the antenna rectangle 506 is selected as the feeding point corner in the case of Figure 5. In these two examples the corners designated as feeding point corners 505, 506 are also substantially close to a short edge of a ground plane rectangle (not depicted in Figure 5) that encloses the ground plane layer 502.

Figure 6 represents an example of a first grid 601, a second grid 602 and a third grid 603 used for the computation of the complexity factors $\mathbf{F_{21}}$ and $\mathbf{F_{32}}$ of an antenna contour that fits in an antenna rectangle 600. Said antenna rectangle 600 has a long side 603 and a short side 604.

In Figure 6b, the second grid 602 has been adjusted to the size of the antenna rectangle 600. The long side of the antenna rectangle 603 is fitted with nine (9) columns of cells of said second grid 602. As far as the number of rows is concerned, the aspect ratio of the antenna rectangle 600 in this particular example is such that a cell aspect ratio closest to one is obtained when the short side of the antenna rectangle 604 is fitted with five (5) rows of cells of said second grid. Therefore, the antenna rectangle 600 is perfectly tessellated with 9 by 5 cells of the second grid 602.

Figure 6a shows a possible first grid 601 obtained from grouping 2-by-2 cells of the second grid 602. In this example, the upper left corner of the antenna rectangle 600 is selected as the feeding point corner 605. A first cell of the first grid 606 is placed such that said cell 606 has a corner being the feeding point corner 605 and is completely inside the antenna box 600. In the example of Figure 6a, the antenna rectangle 600 spans five (5) columns and three (3) rows of cells of the first grid 601.

Since the antenna rectangle 600 is tessellated with an odd number of columns and rows of cells of the second grid. An additional column 608 and an additional row 609 of cells of the second grid 602 are necessary to have enough cells of the first grid 601 to completely cover the antenna rectangle 600. Said additional column 608 and additional row 609 meet at the lower right corner of the antenna rectangle 607 (i.e., the corner opposite to the feeding point corner 605).

Figure 6c shows the third grid 603 obtained from dividing each cell of the second grid 602 into four (4) cells. Each cell of the third grid 603 has a cell width and cell height equal a half of the cell width and cell height of a cell of the second grid 602. Thus, in this example the antenna rectangle 600 is perfectly tessellated with eighteen (18) columns and ten (10) rows of cells of the third grid 603.

Figure 7 shows the two-dimensional space 700 defined by the complexity factors $\mathbf{F_{21}}$ and $\mathbf{F_{32}}$. The antenna contour of the antenna system of a MFWD is represented as a bullet 701 of coordinates ($\mathbf{F_{21}}$, $\mathbf{F_{32}}$) in said two-dimensional space 700.

Figure 8 provides an example to illustrate the complexity factors that feature two antennas radically different: A rectangular antenna that occupies the area of an antenna rectangle 800 for a MFWD; and an antenna whose contour is inspired in a Hilbert curve 810 that fills the available space within the antenna rectangle 800. These two antenna examples, although not advantageous to provide the multiple frequency band behavior required for the antenna system of a MFWD, help to show the relevance of the two complexity factors.

Figure 8 shows said antenna 810 inside the antenna rectangle 800 under a first grid 801, a second grid 802, and a third grid 803. In this example, the antenna rectangle 800 is perfectly tessellated with nine (9) columns and five (5) rows of cells of said second grid 802 (Figure 8b). The antenna 810 has a feeding point 811, located substantially close to the lower left corner of the antenna rectangle 805 (being thus the feeding point corner).

In Figure 8a, there are fifteen (15) cells of the first grid 801 at least partially inside the antenna rectangle 800 and that include at least a point of the antenna contour of antenna 810 (i.e., $\mathbf{N_1}$=15). As far as the antenna contour of the antenna 810, said contour. In Figure 8b, there are forty-five (45) cells of the second grid 802 completely inside the antenna rectangle 800 and that include at least a point of the antenna contour of the antenna 810 (i.e., $\mathbf{N_2}$=45). Finally in Figure 8c, there are one hundred eighty (180) cells of the third grid 803 completely inside the antenna rectangle 800 and that include at least a point of the antenna contour of the antenna 810 (i.e., $\mathbf{N_3}$=180). Therefore, in the present example, an antenna whose contour is inspired in the Hilbert curve 810 features $\mathbf{F_{21}}$=1.58 (i.e., smaller than 2.00) and $\mathbf{F_{32}}$=2.00.

On the other hand if the process of counting the cells in each of the three grids is repeated for a rectangular antenna whose contour is the antenna rectangle 800 then $\mathbf{N_1}$=12, $\mathbf{N_2}$=24 and $\mathbf{N_3}$=52, which results in $\mathbf{F_{21}}$=1.00 and $\mathbf{F_{32}}$=1.12 (i.e., larger than 1.00).

These results illustrate that complexity factor $\mathbf{F_{21}}$ is geared more towards discerning if the antenna contour of a particular antenna system distinguishes sufficiently from a rectangular antenna rather than capturing the complete intricacy of said antenna contour, while complexity factor $\mathbf{F_{32}}$ is predominantly directed towards capturing if the degree of complexity of said antenna contour approaches to that of a highly-convoluted curve such as a Hilbert curve.

Figures 9 and 10 provide two examples to illustrate the complexity factors that feature a quasi-rectangular antenna 910 having a highly convoluted perimeter and a triple branch antenna 1010, respectively. These two antenna examples help to show the relevance of the two complexity factors.

Figure 9 shows said antenna 910 inside the antenna rectangle 900 under a first grid 901, a second grid 902, and a third grid 903. In this example, the antenna rectangle 900 is perfectly tessellated with nine (9) columns and five (5) rows of cells of said second grid 902 (Figure 9b). The antenna 910 has a feeding point 911, located substantially close to the upper left corner of the antenna rectangle 905 (being thus the feeding point corner).

In Figure 9a, there are twelve (12) cells of the first grid 901 at least partially inside the antenna rectangle 900 and that include at least a point of the antenna contour of antenna 910 (i.e., $\mathbf{N_1}$=12). In Figure 9b, there are twenty-four (24) cells of the second grid 902 completely inside the antenna rectangle 900 and that include at least a point of the antenna contour of the antenna 910 (i.e., $\mathbf{N_2}$=24). Finally in Figure 9c, there are ninety-six (96) cells of the third grid 903 completely inside the antenna rectangle 900 and that include at least a point of the antenna contour of the antenna 910 (i.e., $\mathbf{N_3}$=96). Therefore, in the present example, a quasi-rectangular antenna 910 having a highly convoluted perimeter features F_{21}=1.00 and F_{32}=2.00. This antenna example on a coarse scale (as probed e.g. by a long wavelength resonance) appears quite similar to a rectangle which is also shown by F_{21} being very low. On the other hand the edge is highly convoluted which will have influence on small wavelength resonances. This feature is well captured by a high value of F_{32}.

Figure 10 shows antenna 1010 inside the antenna rectangle 1000 under a first grid 1001, a second grid 1002, and a third grid 1003. In this example, the antenna rectangle 1000 is perfectly tessellated with nine (9) columns and five (5) rows of cells of said second grid 1002 (Figure 10b). The antenna 1010 has a feeding point 1011, located substantially close to the bottom left corner of the antenna rectangle 1005 (being thus the feeding point corner).

As for the antenna 1010 of Figure 10, in Figure 10a, there are ten (10) cells of the first grid 1001 at least partially inside the antenna rectangle 1000 and that include at least a point of the antenna contour of antenna 1010 (i.e., N_1=10). In Figure 10b, there are thirty-four (34) cells of the second grid 1002 completely inside the antenna rectangle 1000 and that include at least a point of the antenna contour of the antenna 1010 (i.e., N_2=34). Finally in Figure 10c, there are seventy (70) cells of the third grid 1003 completely inside the antenna rectangle 1000 and that include at least a point of the antenna contour of the antenna 1010 (i.e., N_3=70). Therefore, in the present example, a triple branch antenna, similar to an asymmetric fork, features F_{21}=1.77 and F_{32}=1.04. In this fork example the antenna is not miniaturized since the three branches are essentially straight. Here this corresponds to a low value of F_{32}. The fork, however is substantially different from a rectangle this the three branches can be identified clearly. This translates to a high value of F_{21}.

Figure 11 maps the values of the complexity factors F_{21} and F_{32} of the example antennas of figures 8, 9, and 10. The example rectangular antenna that occupies the area of an antenna rectangle 800 features a pair of complexity factors F_{21}=1.00 and F_{32}=1.12 and is mapped as bullet 1102 in figure 11. The complexity factors for the antenna whose contour is inspired in a Hilbert curve 810 are F_{21}=1.58 and F_{32}=2.00 and is mapped as bullet 1101. The quasi-rectangular antenna having a highly convoluted perimeter of 910 features complexity factors $\mathbf{F_{21}}$=1.00 and $\mathbf{F_{32}}$=2.00 and is mapped as bullet 1103. Bullet 1104 represents the pair of complexity factors $\mathbf{F_{21}}$=1.77 and $\mathbf{F_{32}}$=1.04 for the example triple branch antenna 1010. These antenna examples help to show the relevance of the two complexity factors. Further they show how the entire two dimensional space 700 might be available for the antenna system design.

Figure 12a shows a top-plan view of the structure 1200 of an antenna system for a MFWD according to the present invention. The antenna rectangle 1210 is depicted as a dashed line. The structure 1200 has been shaped to attain the desired multiple frequency band operation and RF performance. In particular peripheral parts of a substantially flat conducting plate have been removed, and slots 1230–1233 have been created within said structure 1200. Slot 1232 divides the structure 1200 into two antenna elements 1201 and 1202. Antenna element 1201 and antenna element 1202 are not in direct contact, although said two antenna elements 1201 and 1202 are in contact through the ground plane of the MFWD.

The resulting structure 1200 supports different radiation modes as to operate two mobile communication standards: GSM and UMTS. More specifically it operates the GSM standard in the 900MHz band (completely within the 810MHz – 960MHz region of the spectrum), in the 1800MHz band (completely within the 1710MHz – 1990MHz region of the spectrum), and in the 1900MHz band (also completely within the 1710MHz – 1990MHz region of the spectrum). The UMTS standard makes use of a band completely within the 1900MHz – 2170MHz region of the spectrum. Therefore, the antenna system operates in four (4) frequency bands within three (3) regions of the electromagnetic spectrum.

In the example, the MFWD comprises four (4) contact terminals to couple the structure of said antenna system 1200 with feeding means and grounding means included on a PCB of said MFWD. In the figure, the antenna element 1201 includes a feeding point 1204 and a grounding point 1203, while the antenna element 1202 includes another feeding point 1205 and a grounding point 1206.

The feeding point 1204 is responsible for the operation of the antenna system in its lowest frequency band (i.e., the 900MHz band of the GSM standard). Therefore, the lower left corner of the antenna rectangle 1211 is chosen to be the feeding point corner.

Figure 12b shows the position of the antenna rectangle relative to the PCB that includes a layer 1220 that serves as a ground plane of the antenna system. Said layer is confined in a minimum-sized rectangle 1221 (depicted in dash-dot line), defining the ground plane rectangle for the MFWD. In this example, the antenna rectangle 1210 is placed substantially in the bottom part of the PCB of said MFWD. Moreover, the antenna rectangle 1210 is substantially parallel to the ground plane rectangle 1221. The antenna rectangle 1210 in this example is completely located in the projection of the ground plane rectangle 1221; however, the antenna rectangle 1210 is not completely on the projection of the ground plane layer 1220 that serves as a ground plane.

A long side of the antenna rectangle 1210 is substantially parallel to a short edge of the ground plane rectangle. The feeding corner 1211 is near a corner of the ground plane rectangle, providing advantageously a longer path to the electric and/or equivalent magnetic currents flowing on the ground plane layer 1220 to potentially enhance the RF performance of the antenna system or the RF performance of the MFWD in at least a lowest frequency band.

The antenna contour of the structure of antenna system 1200 of the example in Figure 12a is formed by the combination of two disjoint subsets of segments. A first subset is given by the perimeter of the antenna element 1201 and comprises forty-eight (48) segments. A second subset is given by the perimeter of the antenna element 1202 and comprises twenty-six (26) segments. Additionally, all these segments are shorter than at least one tenth of a free-space wavelength corresponding to the lowest frequency band of operation of said antenna system.

Moreover, the length of the antenna contour of the structure 1200 is more than six (6) times larger than the length of a diagonal of the antenna rectangle 1210 in which said antenna contour is confined.

In Figure 13, the antenna contour of the structure of the antenna system 1200 is placed under a first grid 1301, a second grid 1302, and a third grid 1303 for the computation of the complexity factors of said structure 1200.

The antenna rectangle 1210 has been fitted with nine (9) columns and five (5) rows of cells of said second grid 1302 (in Figure 10b), as the aspect ratio of the antenna rectangle 1210 is such that fitting five (5) rows of cells in the short side of the antenna rectangle 1210 produces a cell of the second grid 1302 with an aspect ratio closest to one.

In Figure 13a, there are thirteen (13) cells of the first grid 1301 that, while being at least partially inside the antenna rectangle 1210, include at least a point of the antenna contour of the structure 1200 (i.e., $\mathbf{N_1}$=13).

In Figure 13b, there are thirty-eight (38) cells of the second grid 1302 completely inside the antenna rectangle 1210 and that include at least a point of the antenna contour of the structure 1200 (i.e., $\mathbf{N_2}$=38).

Finally in Figure 13c, there are one hundred eighty (114) cells of the third grid 1303 completely inside the antenna rectangle 1210 and that include at least a point of the antenna contour of the structure 1200 (i.e., $\mathbf{N_3}$=114).

The complexity factor $\mathbf{F_{21}}$ is computed as

$$F_{21} = -\frac{\log(38) - \log(13)}{\log(\frac{1}{2})} = 1.55$$

while the complexity factor $\mathbf{F_{32}}$ is obtained as

$$F_{32} = -\frac{\log(114) - \log(38)}{\log(\frac{1}{2})} = 1.58$$

Therefore, the example of structure of antenna system for a MFWD 1200 features advantageously complexity factors $\mathbf{F_{21}}$=1.55 and $\mathbf{F_{32}}$=1.58.

Figure 14 shows antenna 1410 inside the antenna rectangle 1400 under a first grid 1401, a second grid 1402, and a third grid 1403 for the computation of the complexity factors of said antenna 1410. In this example, the antenna rectangle 1400 may be tessellated with nine (9) columns and five (5) rows of cells of said second grid 1402 (Figure 14b) as well as with nine (9) columns and seven (7) rows of cells of said second grid (not depicted) since in both cases the aspect ratio is at its closest to one. A second grid 1402 with nine (9) columns and five (5) rows of cells has been selected since the aspect ratio for grid 1402 is bigger than 1. The antenna 1410 has a feeding point 1411, located substantially close to the bottom left corner of the antenna rectangle 1405 (being thus the feeding point corner).

In Figure 14a, there are fifteen (15) cells of the first grid 1401 that, while being at least partially inside the antenna rectangle 1400, include at least a point of the antenna contour 1410 (i.e., $\mathbf{N_1}$=15).

In Figure 14b, there are forty-two (42) cells of the second grid 1402 completely inside the antenna rectangle 1400 and that include at least a point of the antenna contour 1410 (i.e., $\mathbf{N_2}$=42).

Finally in Figure 14c, there are one hundred and fifty-one (151) cells of the third grid 1403 completely inside the antenna rectangle 1400 and that include at least a point of the antenna contour of the structure 1410 (i.e., $\mathbf{N_3}$=151).

The complexity factor $\mathbf{F_{21}}$ is computed as

$$F_{21} = -\frac{\log(42) - \log(15)}{\log(1/2)} = 1.49$$

while the complexity factor $\mathbf{F_{32}}$ is obtained as

$$F_{32} = -\frac{\log(151) - \log(42)}{\log(1/2)} = 1.85$$

Therefore, the example antenna 1410 for a MFWD features advantageously complexity factors $\mathbf{F_{21}}$=1.49 and $\mathbf{F_{32}}$=1.85.

The antenna contour of the structure 1200 is mapped as a bullet 1501 with coordinates (1.55, 1.58), as depicted in Figure 15. The antenna 1410 is mapped as a bullet 1502 with coordinates (1.49, 1.85), as depicted in Figure 15 as well. Those two examples show cases where intermediate values $\mathbf{F_{21}}$ and $\mathbf{F_{32}}$ are used. For intermediate values the value of $\mathbf{F_{21}}$ of the structure 1200 is relatively high and in case of the structure 1400 the value of $\mathbf{F_{32}}$ is relatively high.

Claims

1.- Multifunction wireless device.

2. Multifunction wireless device with:

- a memory of more than 1 GByte,
- a central data processing unit (CPU),
- a screen with at least 75.000 pixels and a color resolution depth of more than 65.000 colors,
- a keypad with more than 40 keys and/or a touch screen with a size of at least half the size of the device,
- two bodies which can be moved relative against to each other, such as a clamshell, flip, twist or slider device,
- a battery for energy supply of the device without any external energy supply,
- first means for providing a wireless connection for a mobile phone service within at least two different mobile phone communication standards and,
- second means for providing a wireless connection for other digital data transmission with a data transmission rate of at least 1 Mbit/s, and
- an antenna system at least for the first means for providing a wireless connection, wherein the antenna system has:
  - a complexity factor of $\mathbf{F_{21}}$ being more than 1.52 and less than 1.65 and
  - a complexity factor $\mathbf{F_{32}}$ being more than 1.55 and less than 1.70.

Abstract

The present invention refers to a multifunction wireless device.

Figures

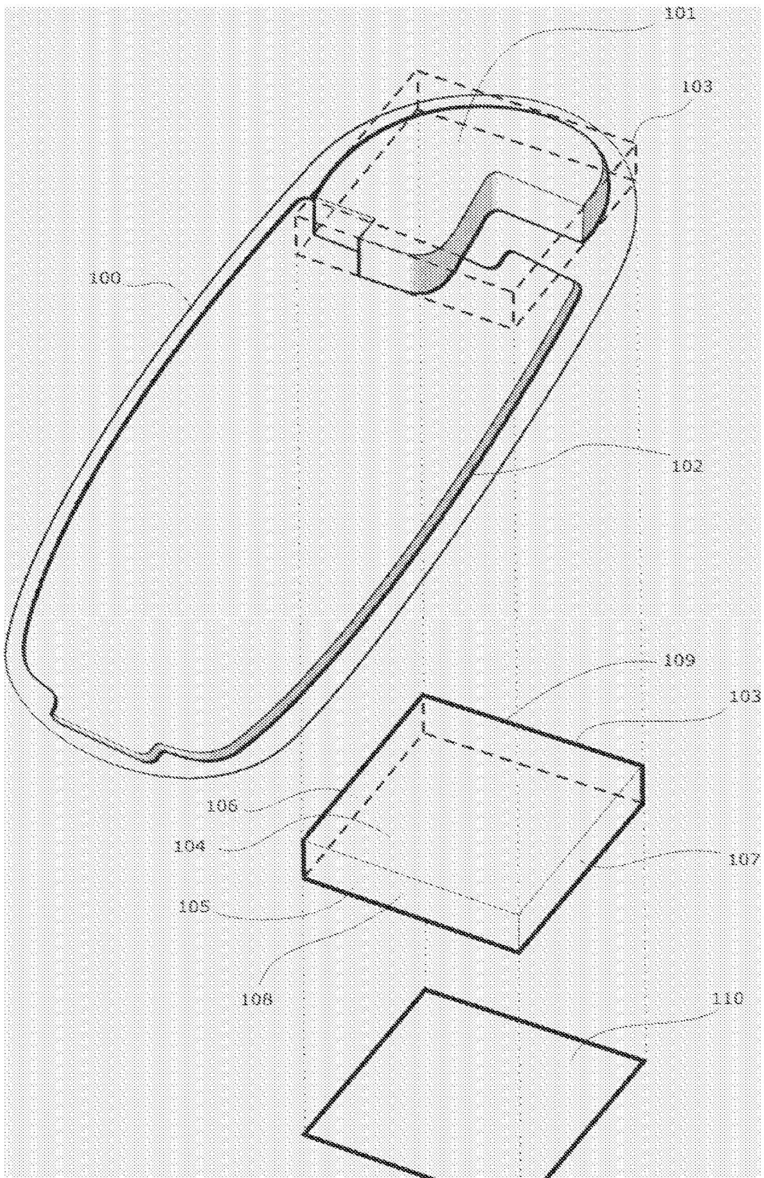
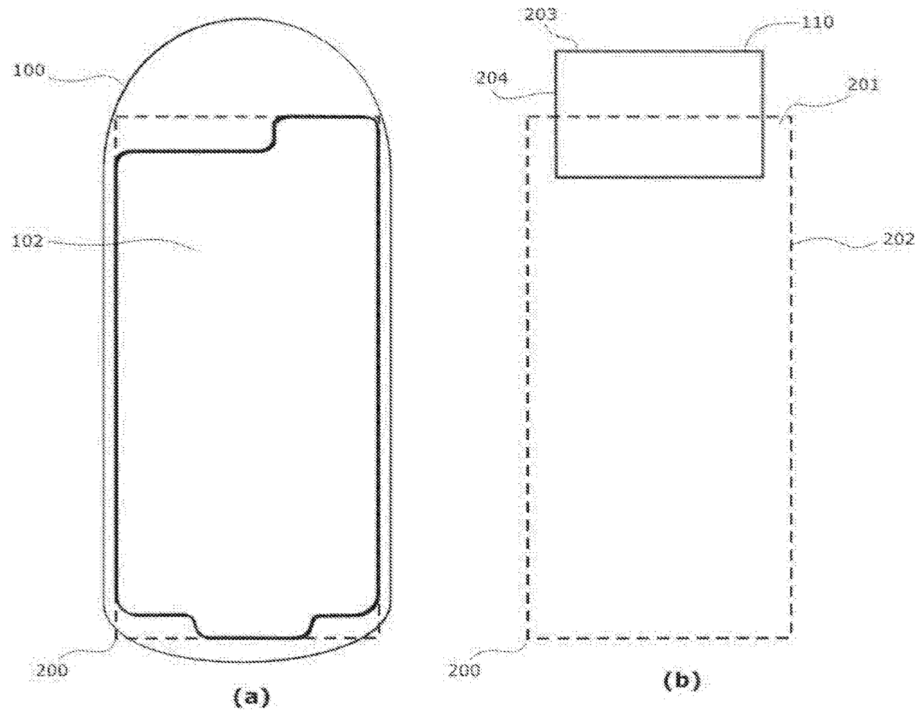


FIG. 1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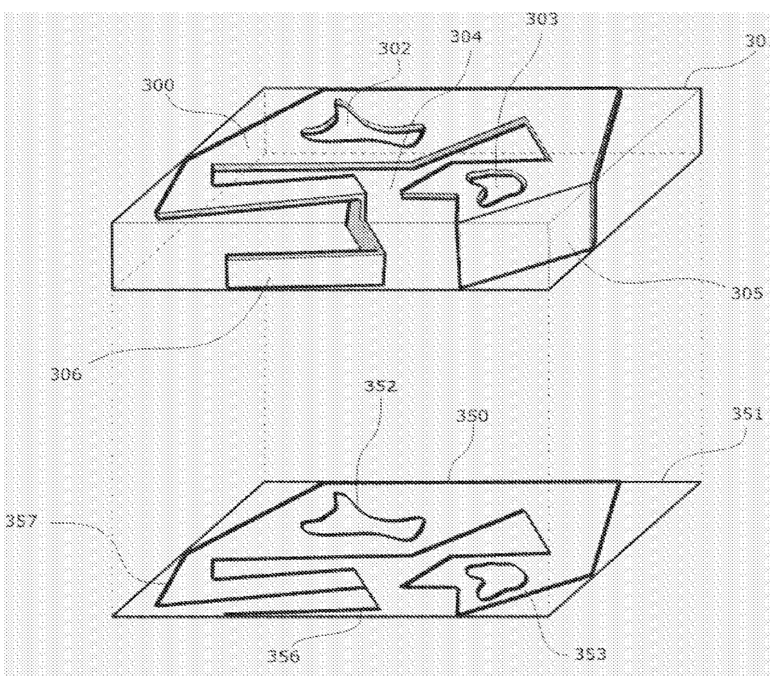
(a)
203
110
204
201
202
200
(b)

FIG. 2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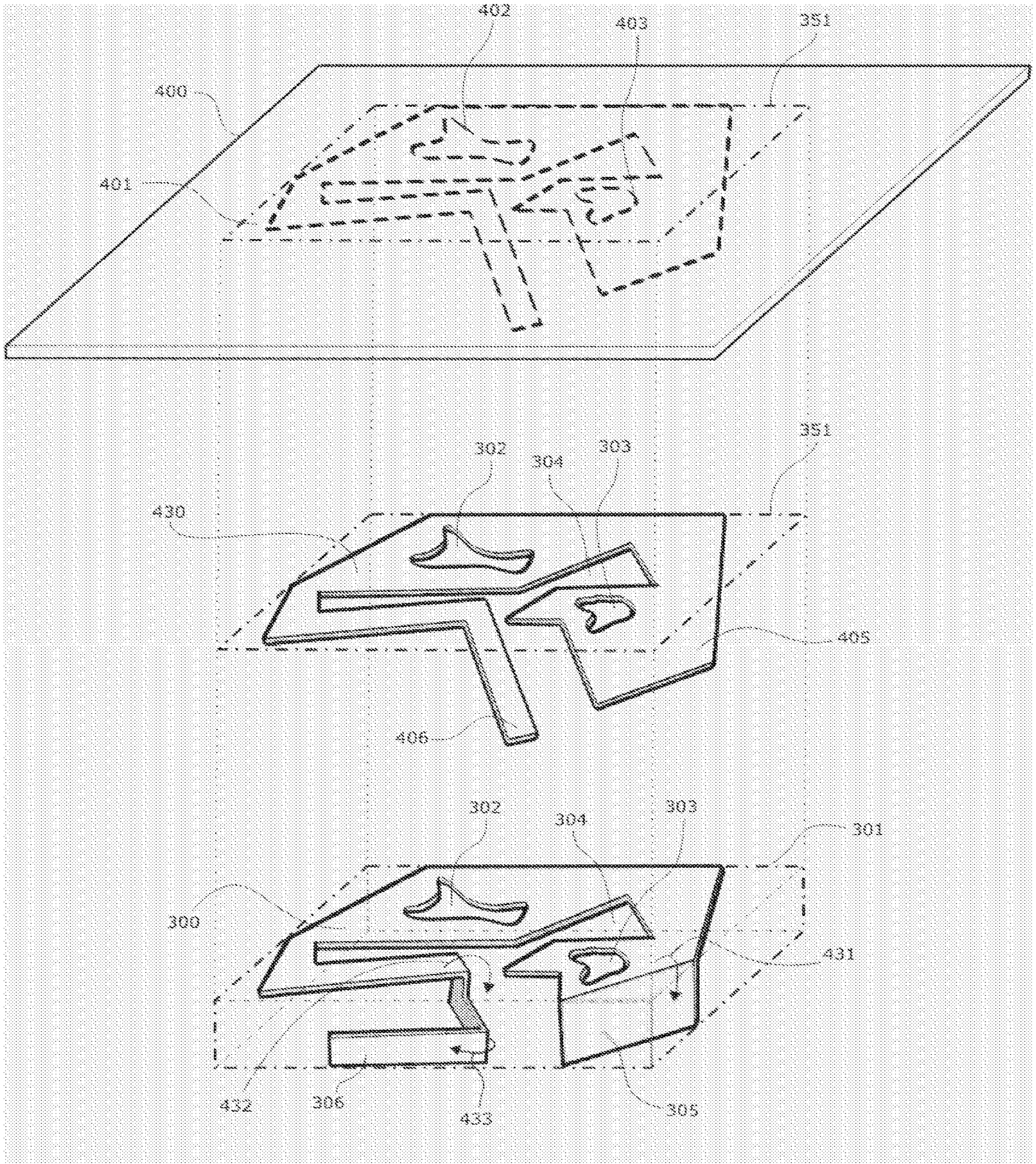
353

FIG. 3


402
403
351
400
401
302
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303
301
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433
305

FIG. 4

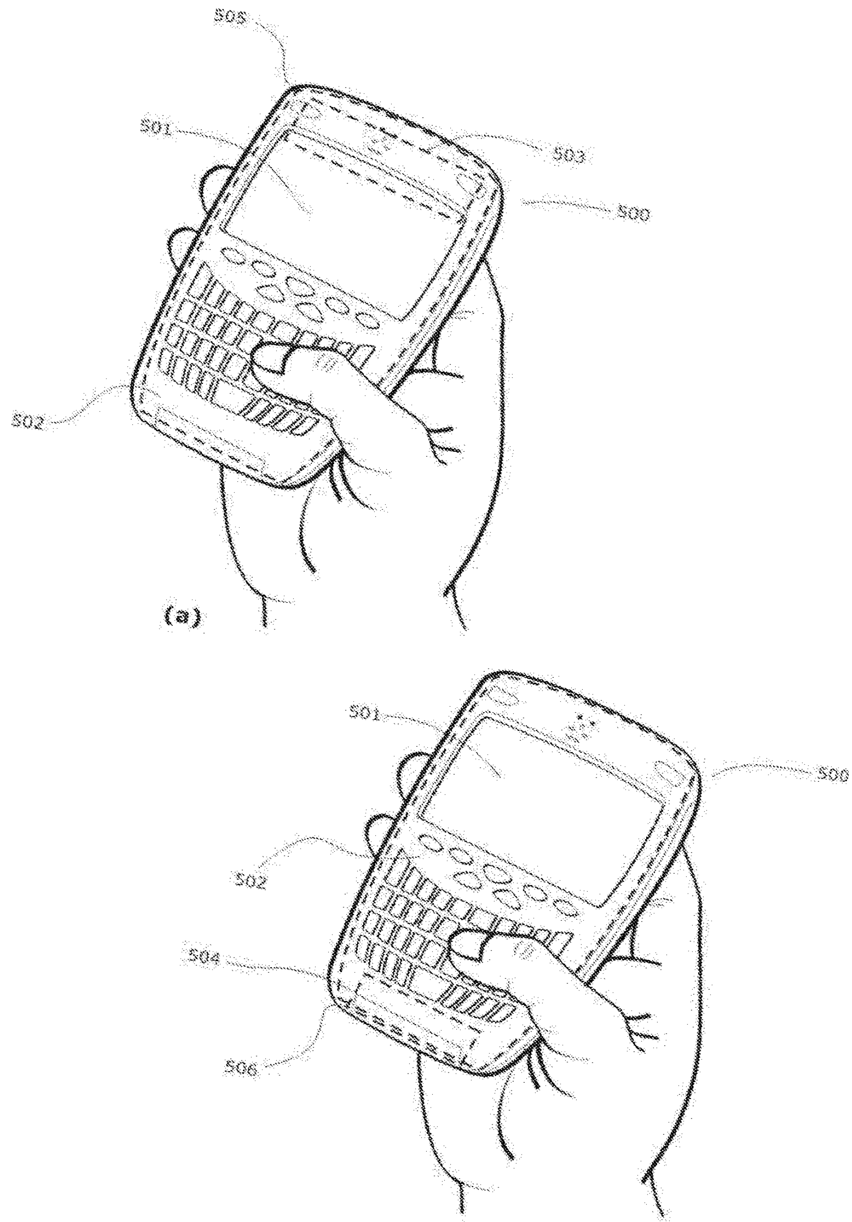
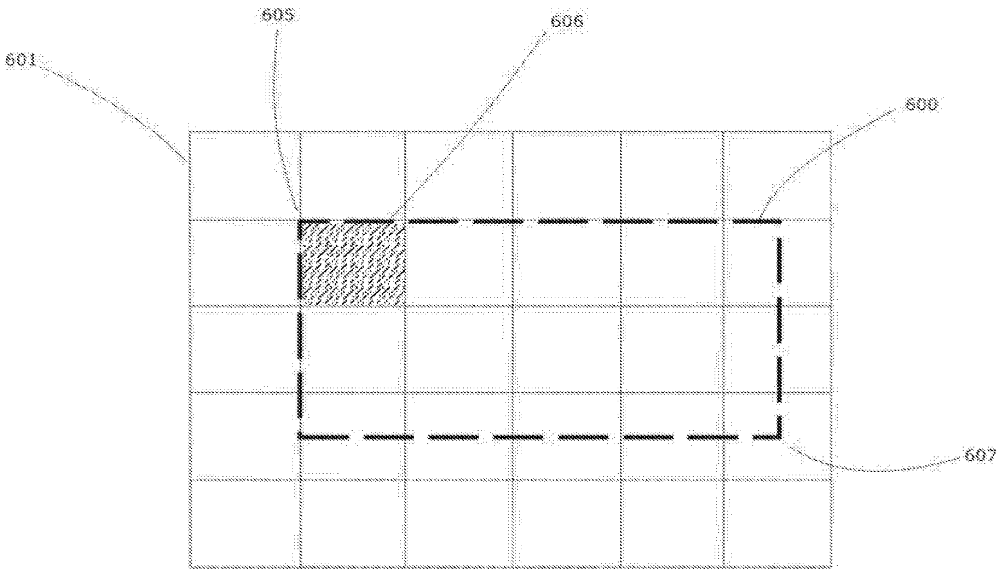
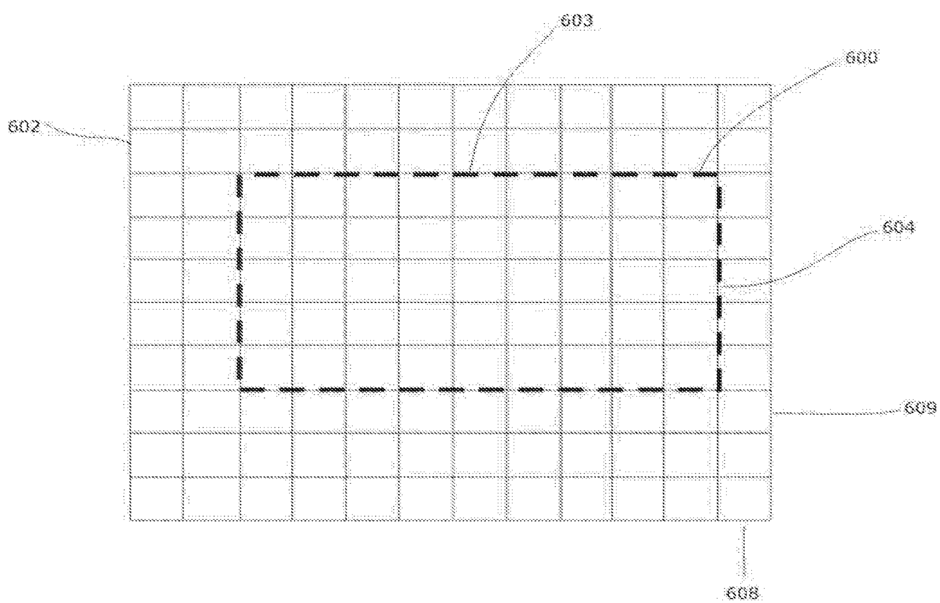


FIG. 5

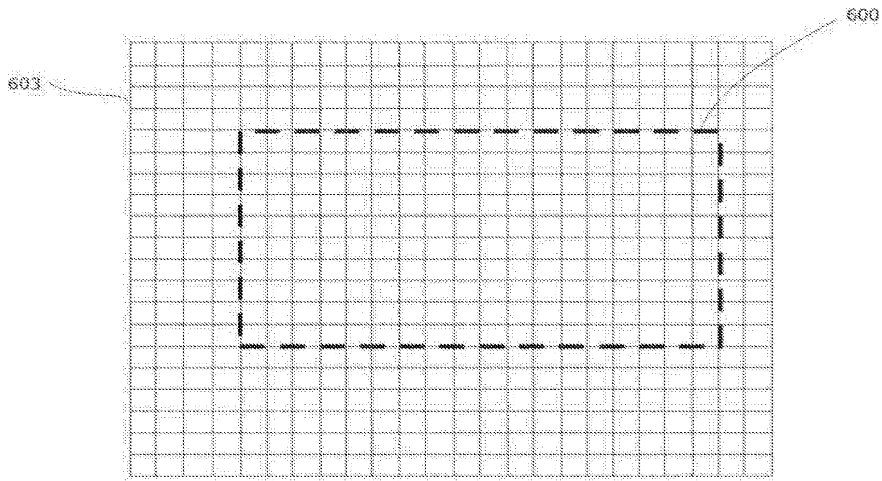
(b)



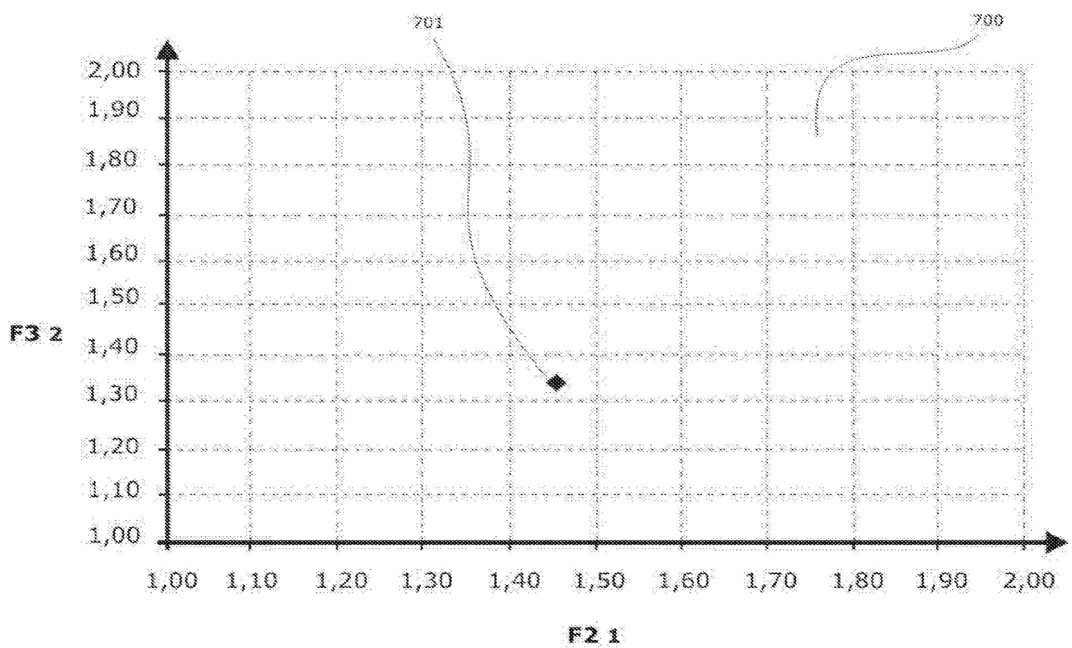
[FIG. 6a]



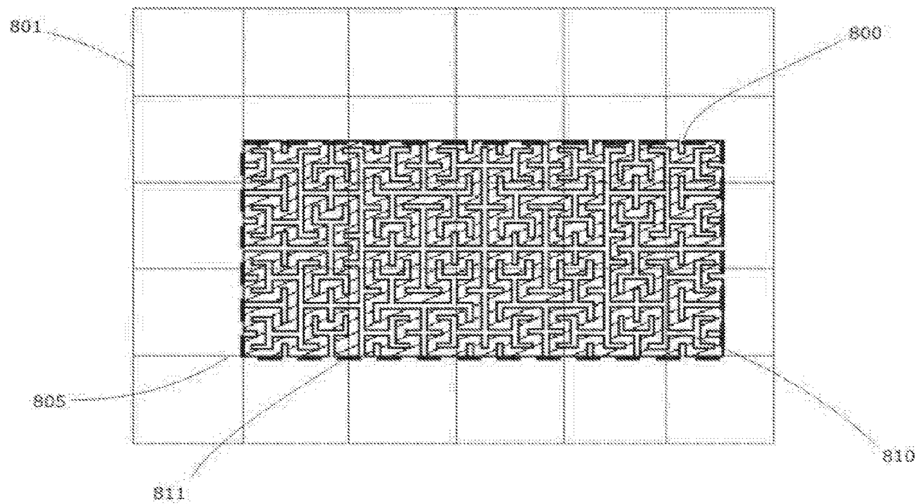
[FIG. 6b]


600
603

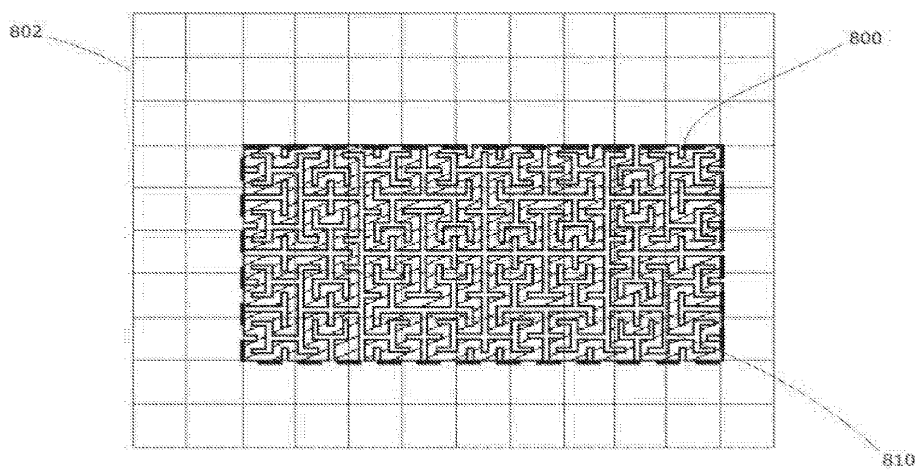
[FIG. 6c]


701
700
2,00
1,90
1,80
1,70
1,60
1,50
1,40
1,30
1,20
1,10
1,00
F3 2
1,00 1,10 1,20 1,30 1,40 1,50 1,60 1,70 1,80 1,90 2,00
F2 1

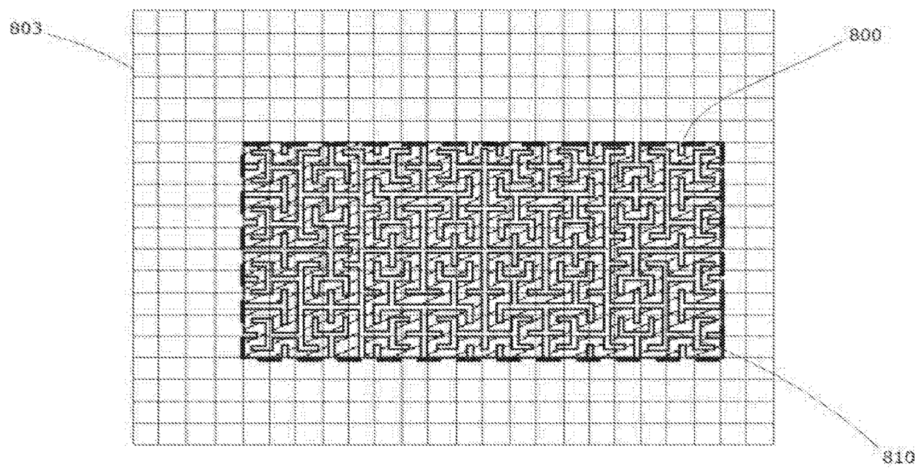
[FIG. 7]



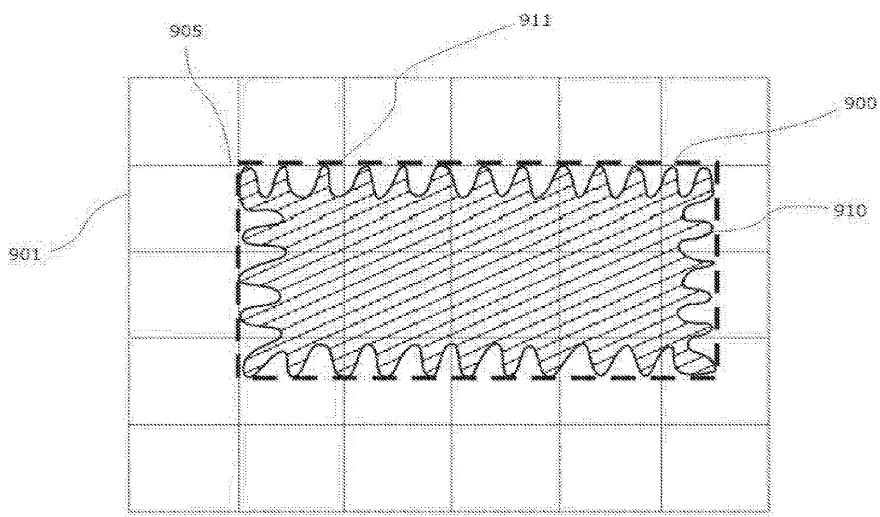
[FIG. 8a]



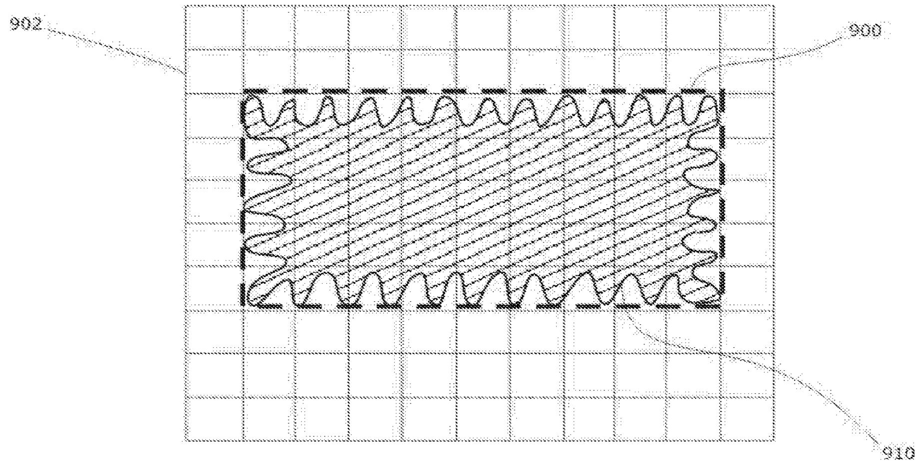
[FIG. 8b]



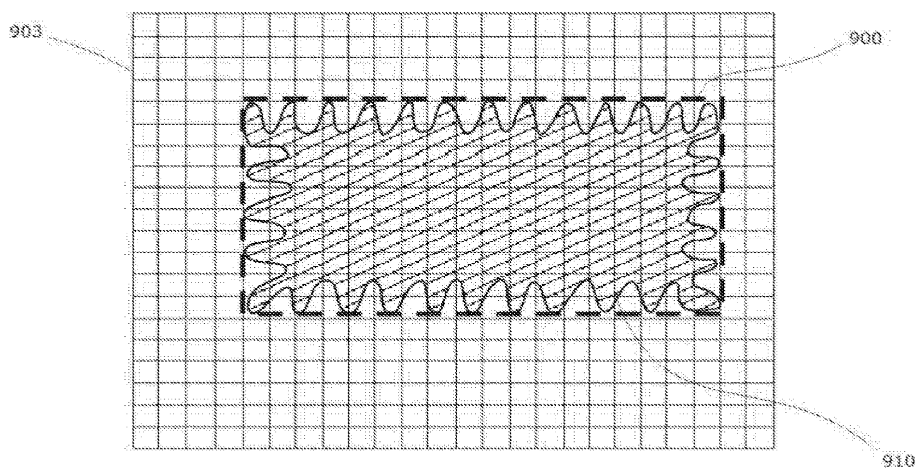
[FIG. 8c]



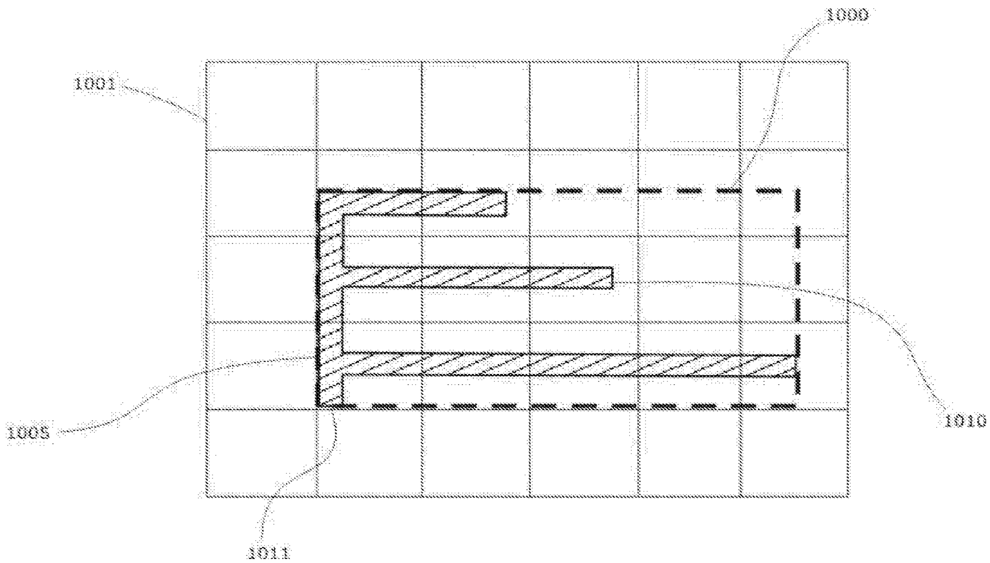
[FIG. 9a]



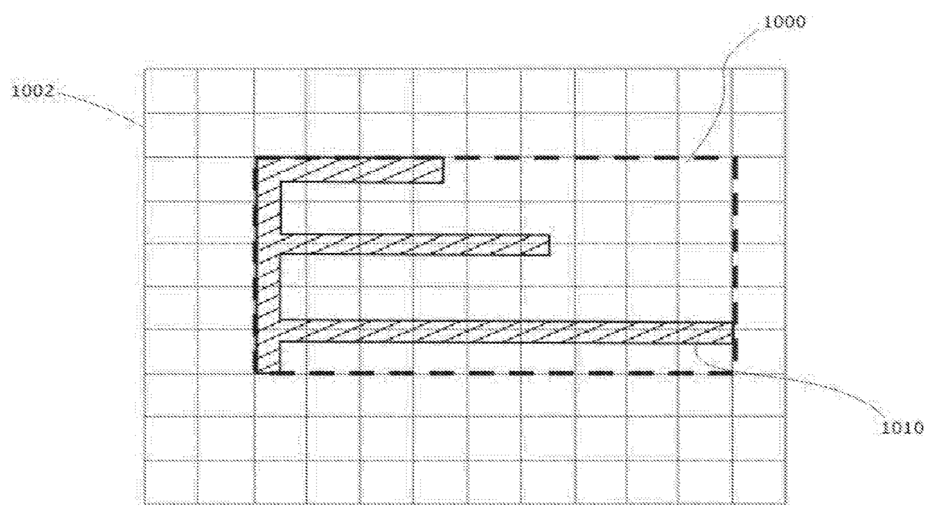
[FIG. 9b]



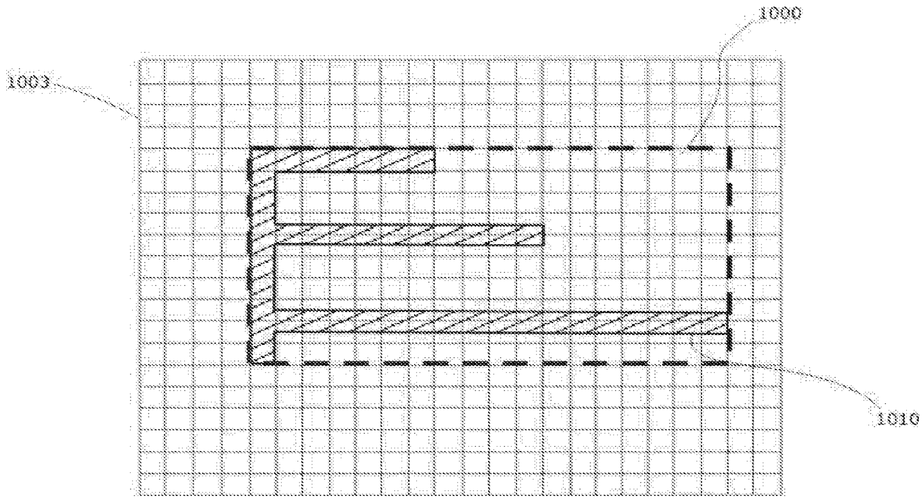
[FIG. 9c]



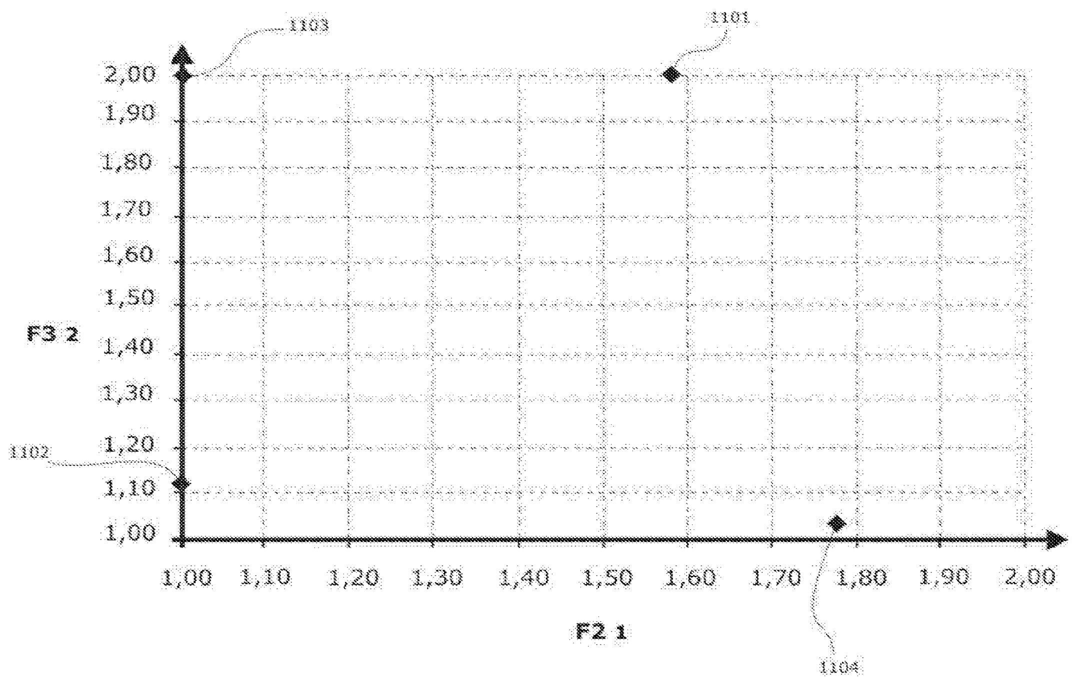
[FIG. 10a]



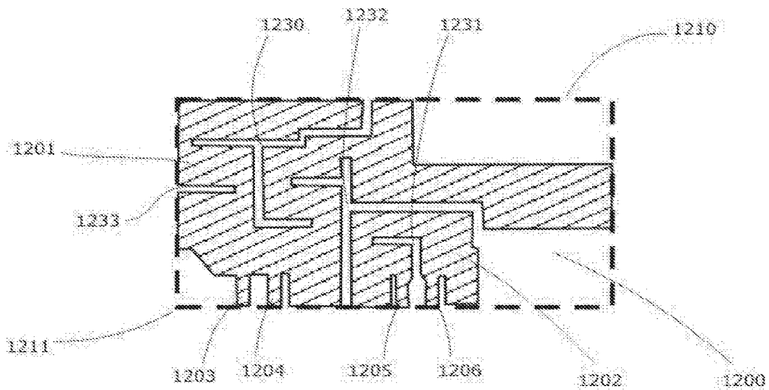
[FIG. 10b]



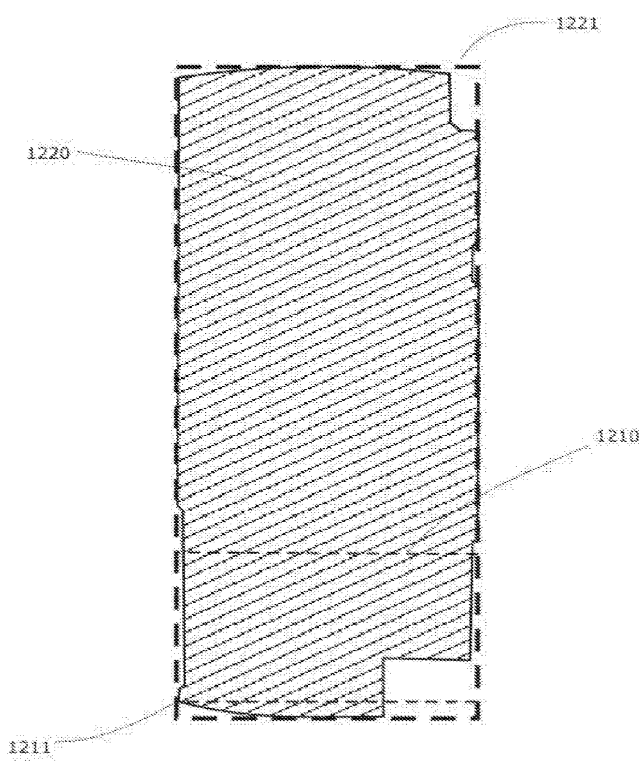
[FIG. 10c]



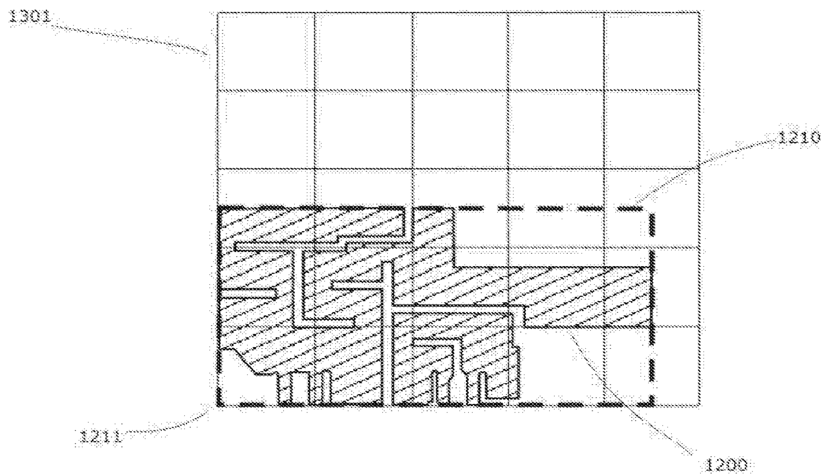
[FIG. 11]



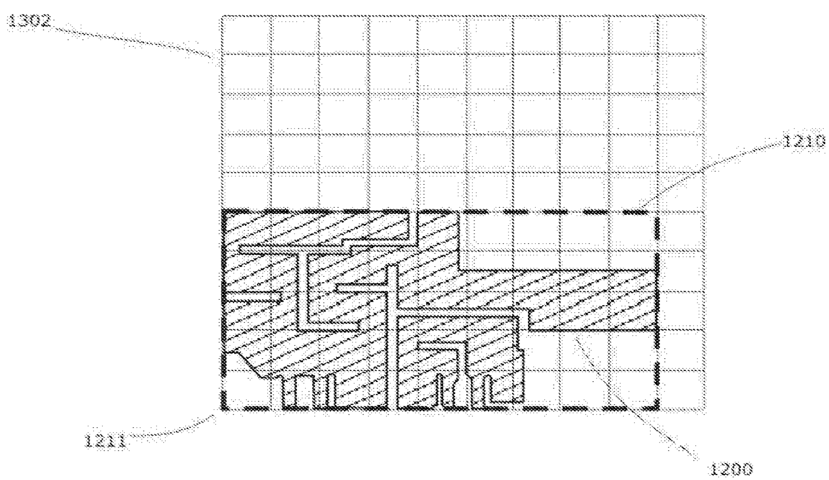
[FIG. 12a]



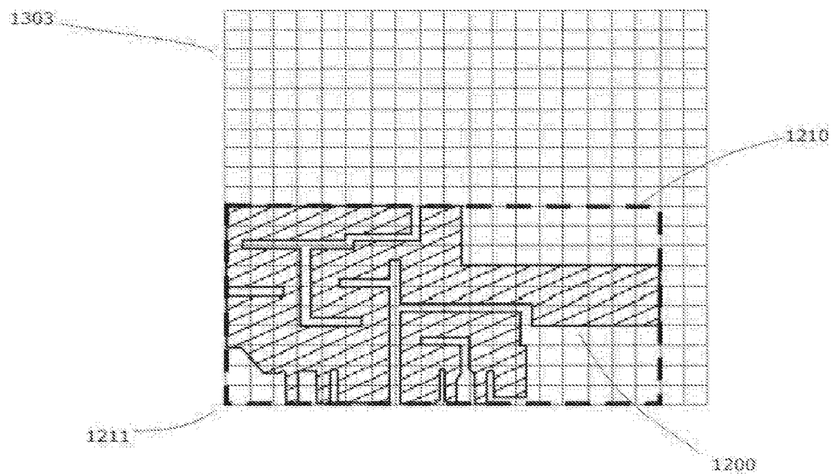
[FIG. 12b]



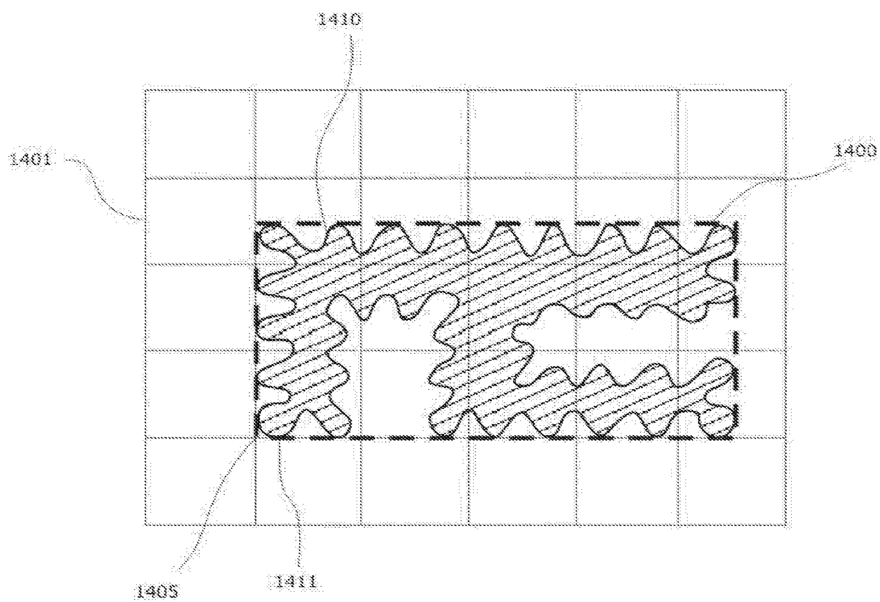
[FIG. 13a]



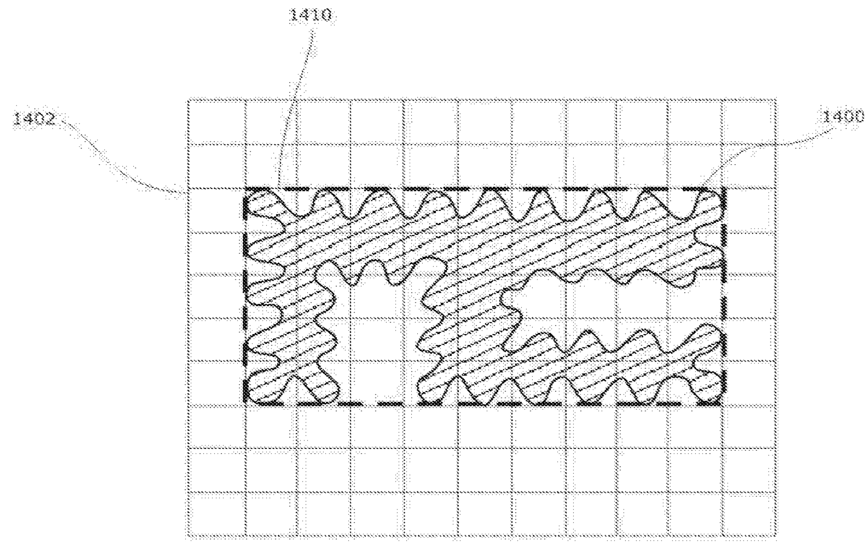
[FIG. 13b]



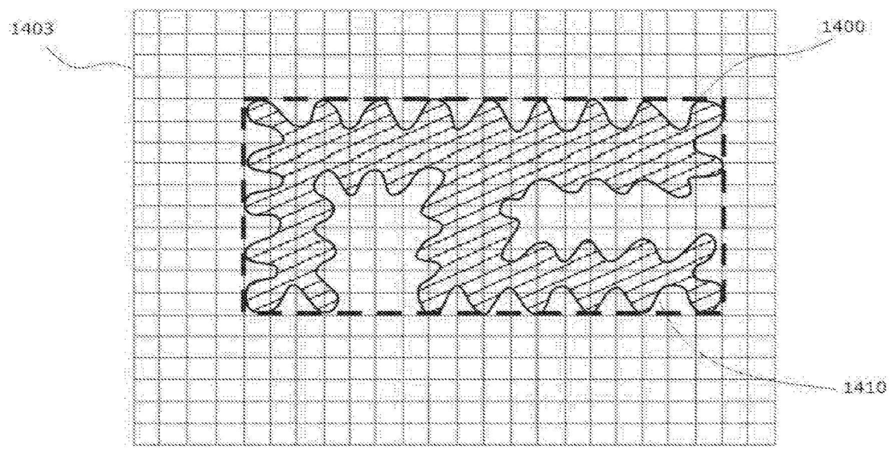
[FIG. 13c]



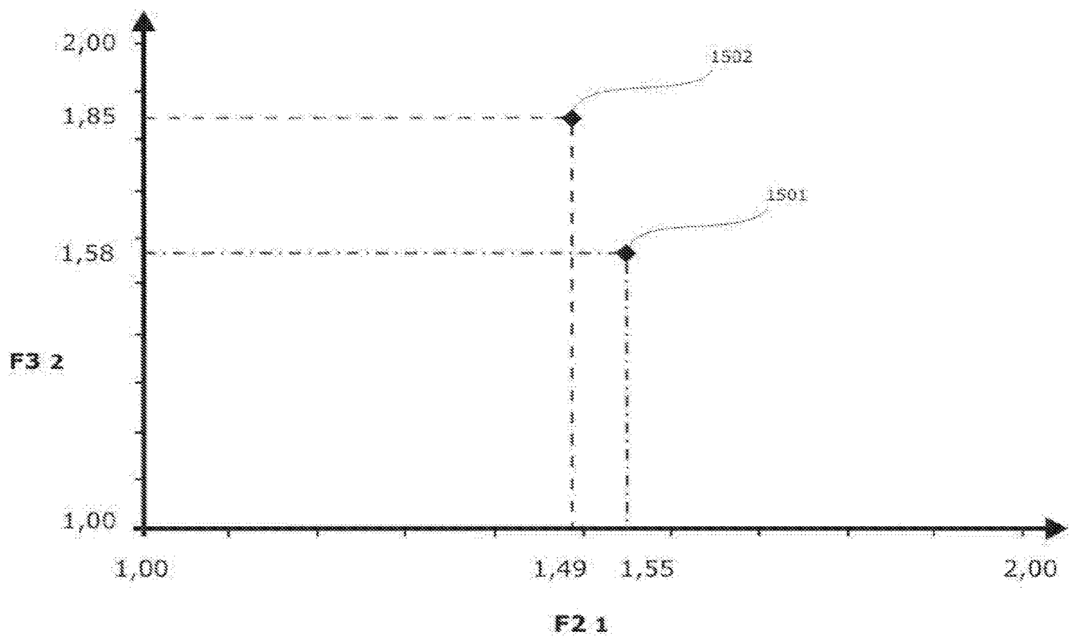
[FIG. 14a]



[FIG. 14b]



[FIG. 14c]



[FIG. 15]

PATENT APPLICATION FEE DETERMINATION RECORD
Substitute for Form PTO-875

Application or Docket Number
16/832,820

APPLICATION AS FILED - PART I

FOR	NUMBER FILED (Column 1)	NUMBER EXTRA (Column 2)	SMALL ENTITY RATE($)	SMALL ENTITY FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY FEE($)
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	300
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	660
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	760
TOTAL CLAIMS (37 CFR 1.16(i))	20 minus 20 =	*			OR	x 100 =	0.00
INDEPENDENT CLAIMS (37 CFR 1.16(h))	2 minus 3 =	*				x 460 =	0.00
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						0.00
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							0.00
			TOTAL			TOTAL	1720

* If the difference in column 1 is less than zero, enter "0" in column 2.

APPLICATION AS AMENDED - PART II

AMENDMENT A

	CLAIMS REMAINING AFTER AMENDMENT (Column 1)		HIGHEST NUMBER PREVIOUSLY PAID FOR (Column 2)	PRESENT EXTRA (Column 3)	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
Application Size Fee (37 CFR 1.16(s))									
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
					TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

AMENDMENT B

	CLAIMS REMAINING AFTER AMENDMENT (Column 1)		HIGHEST NUMBER PREVIOUSLY PAID FOR (Column 2)	PRESENT EXTRA (Column 3)	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
Application Size Fee (37 CFR 1.16(s))									
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
					TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest found in the appropriate box in column 1.

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www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
16/832,820	03/27/2020	Carles PUENTE BALIARDA	0690.0023CN4

CONFIRMATION NO. 3871

27896
EDELL, SHAPIRO & FINNAN, LLC
9801 Washingtonian Blvd.
Suite 750
Gaithersburg, MD 20878

37 CFR 1.48(f)
ACKNOWLEDGEMENT LETTER

OC000000117602483

Date Mailed: 06/12/2020

NOTICE OF ACCEPTANCE OF REQUEST UNDER 37 CFR 1.48(f)

This is in response to the applicant's request under 37 CFR 1.48(f) submitted on 06/08/2020.

The request under 37 CFR 1.48(f) to correct the inventorship, to correct or update the name of an inventor, or to correct the order of names of joint inventors is accepted.

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at **(571) 272-4000** or **(571) 272-4200** or **1-888-786-0101**.

/ltaba/

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www.uspto.gov

APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
16/832,820	03/27/2020	2643	1880	0690.0023CN4	20	2

CONFIRMATION NO. 3871

UPDATED FILING RECEIPT

OC000000117602481

27896
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9801 Washingtonian Blvd.
Suite 750
Gaithersburg, MD 20878

Date Mailed: 06/12/2020

Receipt is acknowledged of this non-provisional utility patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF FIRST INVENTOR, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection.

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Inventor(s)

Carles PUENTE BALIARDA, Barcelona, SPAIN;
Josep MUMBRU, Asnieres-sur-Seine, FRANCE;
Jordi ILARIO, Barcelona, SPAIN;

Applicant(s)

Fractus, S.A., Barcelona, SPAIN;

Power of Attorney: The patent practitioners associated with Customer Number 27896

Domestic Priority data as claimed by applicant

This application is a CON of 15/856,626 12/28/2017 PAT 10644380
which is a CON of 14/738,090 06/12/2015 PAT 9899727
which is a CON of 14/246,491 04/07/2014 PAT 9099773
which is a CON of 11/614,429 12/21/2006 PAT 8738103
which claims benefit of 60/831,544 07/18/2006
and claims benefit of 60/856,410 11/03/2006

Foreign Applications (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see http://www.uspto.gov for more information.)
EUROPEAN PATENT OFFICE (EPO) 06117352.2 07/18/2006 No Access Code Provided

Permission to Access Application via Priority Document Exchange: Yes

Permission to Access Search Results: Yes

Applicant may provide or rescind an authorization for access using Form PTO/SB/39 or Form PTO/SB/69 as appropriate.

Request to Retrieve - This application either claims priority to one or more applications filed in an intellectual property Office that participates in the Priority Document Exchange (PDX) program or contains a proper **Request to Retrieve Electronic Priority Application(s)** (PTO/SB/38 or its equivalent). Consequently, the USPTO will attempt to electronically retrieve these priority documents.

Projected Publication Date: 09/17/2020

Non-Publication Request: No

Early Publication Request: No
Title

Multiple-Body-Configuration Multimedia and Smartphone Multifunction Wireless Devices

Preliminary Class

455

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

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Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

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For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, http://www.stopfakes.gov. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4258).

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Title 37, Code of Federal Regulations, 5.11 & 5.15

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APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
16/832,820	03/27/2020	2845	1880	0690.0023CN4	20	2

CONFIRMATION NO. 3871
UPDATED FILING RECEIPT

OC000000117602331

27896
EDELL, SHAPIRO & FINNAN, LLC
9801 Washingtonian Blvd.
Suite 750
Gaithersburg, MD 20878

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EUROPEAN PATENT OFFICE (EPO) 06117352.2 07/18/2006 No Access Code Provided

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Preliminary Class

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NOT GRANTED

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16/832,820	03/27/2020	Carles PUENTE BALIARDA	0690.0023CN4

CONFIRMATION NO. 3871

PUBLICATION NOTICE

OC000000119972909

27896
EDELL, SHAPIRO & FINNAN, LLC
9801 Washingtonian Blvd.
Suite 750
Gaithersburg, MD 20878

Title: Multiple-Body-Configuration Multimedia and Smartphone Multifunction Wireless Devices

Publication No.US-2020-0295440-A1
Publication Date:09/17/2020

NOTICE OF PUBLICATION OF APPLICATION

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PTO/SB/06 (09-11)
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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 16/832,820	Filing Date 03/27/2020	☐ To be Mailed

ENTITY: ☑ LARGE ☐ SMALL ☐ MICRO

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA		RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A		N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A		N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*		x $100 =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*		x $460 =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).				
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))					
* If the difference in column 1 is less than zero, enter "0" in column 2.				TOTAL	

APPLICATION AS AMENDED - PART II

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT	09/25/2020	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 20	Minus	** 20	= 0		x $100 =	0
	Independent (37 CFR 1.16(h))	* 3	Minus	*** 3	= 0		x $460 =	0
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	0

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=		x $0 =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=		x $0 =	
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.	LDRC
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".	/EVA V GILLIS/
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".	
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.	

REMARKS

Prior to examination on the merits, the Examiner is respectfully requested to enter the above preliminary amendments, which introduces new claims 21-40 and cancels claim 1-20.

Applicant hereby petitions for any extension of time that may be necessary to maintain the pendency of this application. The Commissioner is hereby authorized to charge payment of any additional fees required for the above-identified application or credit any overpayment to Deposit Account No. 05-0460.

Dated: September 25, 2020

Respectfully submitted by:

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/Patrick J. Finnan/

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Electronic Acknowledgement Receipt

EFS ID:	40667155
Application Number:	16832820
International Application Number:	
Confirmation Number:	3871
Title of Invention:	Multiple-Body-Configuration Multimedia and Smartphone Multifunction Wireless Devices
First Named Inventor/Applicant Name:	Carles PUENTE BALIARDA
Customer Number:	27896
Filer:	Patrick J. Finnan/Janet Dorgan
Filer Authorized By:	Patrick J. Finnan
Attorney Docket Number:	0690.0023CN4
Receipt Date:	25-SEP-2020
Filing Date:	27-MAR-2020
Time Stamp:	16:43:21
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		2020-09-25_PreliminaryAmendment-0023CN4.pdf	128192 6bc4c75a02572041ea5649cddbf86ab57ff3d750	yes	7

Multipart Description/PDF files in .zip description		
Document Description	**Start**	**End**
Preliminary Amendment	1	1
Claims	2	6
Applicant Arguments/Remarks Made in an Amendment	7	7

Warnings:

Information:

Total Files Size (in bytes):	128192

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.
National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.
New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application.

Listing of Claims:

1-20. (Canceled)

21. (New) A wireless device comprising:

an antenna system comprising:

a ground plane;

a first antenna within the wireless device and 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 and at least one of the three frequency bands being associated with a 4G communication standard, the first antenna being proximate to a first short side of a ground plane rectangle enclosing the ground plane and defining 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 F_{21} having a value of at least 1.20 and complexity factor F_{32} having a value less than 1.75; and

a second antenna within the wireless device 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.

22. (New) The wireless device of claim 21, wherein the first antenna contour comprises at least 20 segments.

23. (New) The wireless device of claim 22, wherein the perimeter of the first antenna contour comprises at least 35 segments.

24. (New) The wireless device of claim 21, wherein the antenna system comprises a third antenna configured to receive signals employing a 4G communication standard.

25. (New) The wireless device of claim 24, wherein the third antenna defines an antenna contour comprising an entire perimeter of the third antenna, and 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 a complexity factor F_{32} having a value of at least 1.35.

26. (New) A wireless device comprising:

an antenna system comprising:

a ground plane;

a first antenna within the wireless device and 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, the first antenna being proximate to a first short side of a ground plane rectangle enclosing the ground plane and defining 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 F_{21} having a value of at least 1.20 and complexity factor F_{32} having a value less than 1.75; and

a second antenna within the wireless device and defining a second antenna contour comprising an entire perimeter of the second antenna, 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, a minimum-sized parallelepiped of rectangular faces that completely encloses a volume of the second antenna defining 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 defining an antenna rectangle, wherein a length of the second antenna contour is greater than four times a diagonal of the antenna rectangle.

27. (New) The wireless device of claim 26, wherein the first antenna contour comprises at least 20 segments.

28. (New) The wireless device of claim 27, wherein the first antenna contour comprises at least 35 segments.

29. (New) The wireless device of claim 26, wherein 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.

30. (New) The wireless device of claim 26, wherein the antenna system comprises a third antenna configured to provide wireless connectivity in at least two frequency bands.

31. (New) The wireless device of claim 30, wherein the third antenna defines a third antenna contour comprising an entire perimeter of the third antenna, and wherein the third 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 of at least 1.35.

32. (New) A wireless device comprising:

an antenna system comprising:

a ground plane;

a first antenna within the wireless device and configured to provide operation in 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, the first antenna being proximate to a first short side of a ground plane rectangle enclosing the ground plane, the first antenna defining a first antenna contour comprising an entire perimeter of the first antenna, and 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 complexity factor F_{32} having a value less than 1.75, and wherein the first antenna is configured to transmit and receive signals from a 4G communication standard; and a second antenna within the wireless device and configured to receive signals from a 4G communication standard, a minimum-sized parallelepiped of rectangular faces that completely encloses a volume of the second antenna defining an antenna box, an orthogonal projection of the antenna box along a normal to a face with a largest area of the second antenna defining an antenna rectangle, 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.

33. (New) The wireless device of claim 32, wherein the first antenna contour comprises at least 20 segments.

34. (New) The wireless device of claim 33, wherein the first antenna contour comprises at least 35 segments.

35. (New) The wireless device of claim 32, 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.

36. (New) The wireless device of claim 32, wherein the second antenna defines a second antenna contour comprising an entire perimeter of the second antenna, and wherein the second antenna contour has a level of complexity defined by complexity factor F_{21} having a value of at least 1.20 and complexity factor F_{32} having a value of at least 1.35.

37. (New) The wireless device of claim 36, wherein the second antenna contour comprises at least 20 segments.

38. (New) The wireless device of claim 32, wherein the antenna system comprises a third antenna configured to provide wireless connectivity in at least two frequency bands.

39. (New) The wireless device of claim 38, wherein the third antenna defines a third antenna contour comprising an entire perimeter of the third antenna, and wherein the third antenna contour has a level of complexity defined by complexity factor F_{21} having a value of at least 1.20 and complexity factor F_{32} having a value of at least 1.35.

40. (New) The wireless device of claim 38, wherein the third antenna is proximate to a third side of the antenna rectangle being orthogonal to the first short side.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No.	:	16/832,820
First Named Inventor	:	Carles PUENTE BALIARDA
Confirmation No.	:	3871
Filed	:	March 27, 2020
TC/A.U.	:	2845
Examiner	:	Unknown
Customer No.	:	27896
Docket No.	:	0690.0023CN4
Title	:	Multiple-Body-Configuration Multimedia and Smartphone Multifunction Wireless Devices

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

PRELIMINARY AMENDMENT

Sir:

Prior to examination on the merits, please amend the application as follows:

Amendments to the Claims are reflected in the listing of claims, which begins on page 2 of this paper.

Remarks begin on page 7 of this paper.

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L2	5	L1 AND ((H01Q1/36 OR H01Q1/243 OR H01Q13/16 OR H01Q19/005 OR H01Q21/30 OR H01Q9/42).CPC.)	US-PGPUB; USPAT	ADJ	ON	2020/12/18 19:23
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S192	115	("5451968" | "5453751" | "5453752" | "5457469" | "5471224" | "5493702" | "5495261" | "5508709" | "5534877" | "5537367" | "5557293" | "5569879" | "5608417" | "5619205" | "5627550" | "5646635" | "5657028" | "5680144" | "5684672" | "5703600" | "5712640" | "5767811" | "5784032" | "5790080" | "5798688" | "5808586" | "5809433" | "6127977" | "6130651" | "6131042" | "6138245" | "6140966" | "6140969" | "6140975" | "6141540" | "6147649" | "6147652" | "6147655" | "6157344" | "6160513" | "6166694" | "6172618" | "6181281" | "6181284" | "6195048" | "6198442" | "6201501" | "6204826" | "6211824" | "6211826" | "6211889" | "6215474" | "6218992" | "6236366" | "6236372" | "6239765" | "6243592" | "6255994" | "6259407" | "6266023" | "6266538" | "6271794" | "6272356" | "6275198" | "6281846" | "6281848" |	US-PGPUB; USPAT	ADJ	ON	2020/08/26 23:32

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S191	20	S190 AND ((H04B1/7115 OR H04B7/0413 OR H04L27/201 OR H04L1/0045 OR H01Q1/245).CPC.)	US-PGPUB; USPAT	ADJ	ON	2020/08/26 23:31
S190	74	(complexity or convolut$4) near2 (factor or metric or indicator) with (antenna or transmitter or receiver or transceiver) and (@ad<"20060618" or @rlad<"20060618")	US-PGPUB; USPAT	ADJ	ON	2020/08/26 23:31
S187	9	"11614429"	US-PGPUB; USPAT; USOCR	ADJ	OFF	2020/08/26 18:21
S186	4	(S181 or S182) and (complex$4 near2 (factor or metric or indicator or level))	US-PGPUB; USPAT	ADJ	ON	2020/08/26 17:42
S185	4	(S181 or S182) and (complex$4 near2 (factor or metric or indicator))	US-PGPUB; USPAT	ADJ	ON	2020/08/26 17:42
S184	250	S181 or S182 and (complex$4 near2 (factor or metric or indicator))	US-PGPUB; USPAT	ADJ	ON	2020/08/26 17:39
S183	250	S181 or S182 and (complexity near2 (factor or metric or indicator))	US-PGPUB; USPAT	ADJ	ON	2020/08/26 17:38
S182	129	("6157344" | "6160513" | "6166694" | "6172618" | "6181281" | "6181284" | "6195048" | "6198442" | "6201501" | "6204826" | "6211824" | "6211826" | "6211889" | "6215474" | "6218992" | "6236366" | "6236372" | "6239765" | "6243592" | "6255994" | "6259407" | "6266023" | "6266538" | "6271794" | "6272356" | "6275198" | "6281846" | "6281848" | "6285326" | "6285327" | "6285342" | "6288680" | "6292154" | "6300910" | "6300914" | "6301489" | "6307511" | "6307512" | "6307519" |	US-PGPUB; USPAT	ADJ	ON	2020/08/26 17:30

		"6317083" | "6320543" | "6326919" | "6327485" | "6329951" | "6329954" | "6329962" | "6333716" | "6333719" | "6343208" | "6346914" | "6348892" | "6352434" | "6353443" | "6360105" | "6366243" | "6367939" | "6373447" | "6380899" | "6380902" | "6384790" | "6388626" | "6392610" | "6396444" | "6407710" | "6408190" | "6417810" | "6417816" | "6421013" | "6431712" | "6445352" | "6452549" | "6452553" | "6452556" | "6470174" | "6476766" | "6476769" | "6480159" | "6483462" | "6496154" | "6498586" | "6498588" | "6525691" | "6538604" | "6552690" | "6573867" | "6597319" | "6603434" | "6618017" | "6650294" | "6664932" | "6680705" | "6697022" | "6697024" | "6707428" | "6716103" | "6741215" | "6756944" | "6762723" | "6784844" | "6801164" | "6806834" | "6831606" | "6839040" | "6903686" | "6928413" | "6967731" | "6989794" | "6992633" | "7015868" | "7030833" | "7068230" | "7069043" | "7075484" | "7091911" | "7148850" | "7151955" | "7183983" | "7202822" | "7229385" | "7265724" | "7394432" | "7397431" | "7511675" | "7528782" | "7548915" | "8738103" | "9099773" | "9899727" | "D441733").PN.				
S181	246	("20010002823" | "20010033250" | "20010050636" | "20020000940" | "20020000942" | "20020000944" | "20020036594" | "20020105468" | "20020109633" | "20020126051" | "20020126054" | "20020126055" | "20020140615" | "20020149519" | "20020164986" | "20020175211" | "20020175866" | "20020175879" | "20020190904" | "20030025637" | "20030064750" | "20030090421" | "20030098814" | "20030137461" | "20030189518" | "20030210200" | "20030228892" | "20040009755" | "20040027295" | "20040029581" | "20040056985" | "20040085244" | "20040090372" | "20040095289" | "20040110479" | "20040119644" | "20040145527" | "20040176025" | "20040198436" | "20040204008" | "20040204126" | "20040212545" |	US-PGPUB; USPAT	ADJ	ON	2020/08/26 17:30

		"20040214541" | "20050001767" | "20050017910" | "20050041624" | "20050057398" | "20050069069" | "20050075098" | "20050088340" | "20050107052" | "20050136958" | "20050153709" | "20050156785" | "20050157807" | "20050176390" | "20050181826" | "20050184909" | "20050192009" | "20050195112" | "20050195273" | "20050201307" | "20050231439" | "20050233705" | "20050239446" | "20050259031" | "20050264453" | "20050270995" | "20060001576" | "20060015664" | "20060019730" | "20060031616" | "20060031886" | "20060033668" | "20060044195" | "20060050473" | "20060050859" | "20060060068" | "20060077115" | "20060077310" | "20060082505" | "20060121865" | "20060290573" | "20070013589" | "20070229383" | "3079602" | "3521284" | "3599214" | "3622890" | "3683376" | "3683379" | "3689929" | "3818490" | "3967276" | "3969730" | "4021810" | "4024542" | "4038662" | "4072951" | "4131893" | "4141016" | "4318109" | "4356492" | "4381566" | "4471358" | "4471493" | "4504834" | "4536725" | "4543581" | "4571595" | "4584709" | "4608572" | "4623894" | "4628322" | "4673948" | "4723305" | "4730195" | "4752968" | "4827266" | "4827271" | "4839660" | "4843468" | "4847629" | "4849766" | "4857939" | "4860019" | "4890114" | "4894663" | "4907011" | "4912481" | "4975711" | "5030963" | "5138328" | "5168472" | "5172084" | "5200756" | "5212742" | "5214434" | "5218370" | "5227804" | "5227808" | "5245350" | "5248988" | "5255002" | "5257032" | "5307075" | "5337063" | "5337065" | "5347291" | "5355144" | "5355318" | "5363114" | "5373300" | "5402134" | "5410322" | "5420599" | "5422651" | "5451965" | "5451968" | "5453751" | "5453752" | "5457469" | "5471224" | "5493702" | "5495261" | "5508709" | "5534877" | "5537367" | "5557293" | "5569879" | "5608417" | "5619205" | "5627550" | "5646635" | "5657028" | "5680144" | "5684672" | "5703600" | "5712640" |				

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S180	278	phone with antenna and antenna with contour and (multiple or multi or plural$4) with antenna	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2020/08/26 15:18
S179	270	S178 and (antenna or transmitter or transceiver) with (tri$1band or quad$band or (three or "3" or four) near2 (band or frequency)) and (@ad<"20060618" or @rlad<"20060618")	US-PGPUB; USPAT; USOCR	ADJ	OFF	2020/08/26 15:18
S178	17,188	(antenna or transmitter or transceiver) with complexity	US-PGPUB; USPAT; USOCR	ADJ	OFF	2020/08/26 15:18
S177	11	((complexity or convolut$4) near2 (factor or metric or indicator) with (antenna or transmitter or receiver or transceiver)).dm. and S176	US-PGPUB; USPAT	ADJ	ON	2020/08/26 15:07
S176	434	S174 OR S175	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2020/08/26 15:07
S175	302	(PUENTE near2 BALIARDA near2 Carles) or (MUMBRU near2 Josep) or (ILARIO near2 Jordi)	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2020/08/26 15:07
S174	303	fractus.as.	US-PGPUB; USPAT;	ADJ	ON	2020/08/26 15:07

			DERWENT; IBM_TDB			
S171	20	S168 AND ((H04B1/7115 OR H04B7/0413 OR H04L27/201 OR H04L1/0045 OR H01Q1/245).CPC.)	US-PGPUB; USPAT	ADJ	ON	2020/01/04 13:04
S170	70	S169 AND ((H01Q1/243 OR H01Q1/36 OR H01Q9/0407 OR H01Q1/242 OR H01Q1/241 OR H01Q5/50 OR H04B1/3833 OR H04B1/005).CPC.)	US-PGPUB; USPAT	ADJ	ON	2020/01/04 12:59
S169	115	("5451968" | "5453751" | "5453752" | "5457469" | "5471224" | "5493702" | "5495261" | "5508709" | "5534877" | "5537367" | "5557293" | "5569879" | "5608417" | "5619205" | "5627550" | "5646635" | "5657028" | "5680144" | "5684672" | "5703600" | "5712640" | "5767811" | "5784032" | "5790080" | "5798688" | "5808586" | "5809433" | "6127977" | "6130651" | "6131042" | "6138245" | "6140966" | "6140969" | "6140975" | "6141540" | "6147649" | "6147652" | "6147655" | "6157344" | "6160513" | "6166694" | "6172618" | "6181281" | "6181284" | "6195048" | "6198442" | "6201501" | "6204826" | "6211824" | "6211826" | "6211889" | "6215474" | "6218992" | "6236366" | "6236372" | "6239765" | "6243592" | "6255994" | "6259407" | "6266023" | "6266538" | "6271794" | "6272356" | "6275198" | "6281846" | "6281848" | "6285326" | "6285327" | "6285342" | "6288680" | "6292154" | "6300910" | "6300914" | "6301489" | "6307511" | "6307512" | "6307519" | "6664932" | "6680705" | "6697022" | "6697024" | "6707428" | "6716103" | "6741215" | "6756944" | "6762723" | "6784844" | "6801164" | "6806834" | "6831606" | "6839040" | "6903686" | "6928413" | "6967731" | "6989794" | "6992633" | "7015868" | "7030833" | "7068230" | "7069043" | "7075484" | "7091911" | "7148850" | "7151955" | "7183983" | "7202822" | "7229385" | "7265724" | "7394432" | "7397431" | "7511675" | "7528782" | "7548915" | "8738103" | "D441733").PN.	US-PGPUB; USPAT	ADJ	ON	2020/01/04 12:59
S168	74	(complexity or convolut$4) near2 (factor or metric or indicator) with (antenna or transmitter or receiver or transceiver)	US-PGPUB; USPAT	ADJ	ON	2020/01/04 12:58

		and (@ad<"20060618" or @rlad<"20060618")				
S167	24	antenna near3 complexity near2 factor	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2020/01/04 12:58
S166	4	(US-10476134-$ or US-8738103-$ or US-9099773-$ or US-9899727-$).did.	USPAT	ADJ	ON	2020/01/02 10:59
S165	4	S164 and (complexity near2 factor).clm.	USPAT	ADJ	ON	2020/01/02 10:49
S164	417	S162 OR S163	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2020/01/02 10:49
S163	291	(PUENTE near2 BALIARDA near2 Carles) or (MUMBRU near2 Josep) or (ILARIO near2 Jordi)	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2020/01/02 10:49
S162	291	fractus.as.	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2020/01/02 10:49
S161	10	S160 and (complexity near2 factor).clm.	US-PGPUB; USPAT	ADJ	ON	2019/12/31 23:06
S160	417	S158 OR S159	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2019/12/31 23:06
S159	291	(PUENTE near2 BALIARDA near2 Carles) or (MUMBRU near2 Josep) or (ILARIO near2 Jordi)	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2019/12/31 23:06
S158	291	fractus.as.	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2019/12/31 23:06
S157	4	S155 and (complexity near2 factor).clm.	USPAT	ADJ	ON	2019/12/31 17:12
S156	10	S155 and (complexity near2 factor).clm.	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2019/12/31 17:10
S155	417	S153 OR S154	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2019/12/31 17:10

S154	291	(PUENTE near2 BALIARDA near2 Carles) or (MUMBRU near2 Josep) or (ILARIO near2 Jordi)	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2019/12/31 17:10
S153	291	fractus.as.	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2019/12/31 17:10
S152	417	S150 OR S151	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2019/12/31 14:29
S151	291	(PUENTE near2 BALIARDA near2 Carles) or (MUMBRU near2 Josep) or (ILARIO near2 Jordi)	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2019/12/31 14:29
S150	291	fractus.as.	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2019/12/31 14:29
S149	3	"14738090"	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2019/08/05 08:00
S148	3	"14738090"	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2019/08/05 08:00
S147	2	"11614429" and (fourth and short near2 side and complexity near3 factor).clm.	USPAT	ADJ	ON	2019/08/04 19:57
S146	2	"11614429" and (fourth).clm.	USPAT	ADJ	ON	2019/08/04 19:56
S145	0	"11614429" and (ratio).clm.	USPAT	ADJ	ON	2019/08/04 19:55
S144	3	"11614429" and (complexity and second near3 short).clm.	USPAT	ADJ	ON	2019/08/04 19:53
S143	3	"11614429" and (complexity and short).clm.	USPAT	ADJ	ON	2019/08/04 19:48
S142	3	"11614429" and (complexity).clm.	USPAT	ADJ	ON	2019/08/04 19:48
S141	0	"11614429" and (aspect or ratio).clm.	USPAT	ADJ	ON	2019/08/04 19:47
S140	3	"11614429" and (rectangle).clm.	USPAT	ADJ	ON	2019/08/04 19:42
S139	0	"11614429" and (parallelepiped).clm.	USPAT	ADJ	ON	2019/08/04 19:39

S138	3	"11614429" and (complexity near2 factor or ratio or rectangle).clm.	USPAT	ADJ	ON	2019/08/04 19:30
S137	8	"11614429" and (complexity near2 factor or ratio or rectangle).clm.	US-PGPUB; USPAT; DERWENT	ADJ	ON	2019/08/04 19:28
S136	9	"11614429"	US-PGPUB; USPAT; DERWENT	ADJ	ON	2019/08/04 19:26
S130	1	antenna near2 contour with segment and (@ad<"20060718" or @rlad<"20060718")	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2019/08/01 22:24
S129	11	antenna near2 contour with segment	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2019/08/01 22:21
S128	38	ratio near3 width near3 height with antenna and (@ad<"20060618" or @rlad<"20060618")	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2019/08/01 21:11
S126	66	phone near2 antenna and antenna with contour and (multiple or multi or plural$4) with antenna	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2019/08/01 21:04
S125	1	("9099773").URPN.	USPAT	ADJ	OFF	2019/08/01 21:04
S122	238	phone with antenna and antenna with contour and (multiple or multi or plural$4) with antenna	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2019/08/01 21:04
S121	302	phone with antenna and antenna with contour	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2019/08/01 21:04
S119	384	("20010002823" | "20010033250" | "20010050636" | "20020000940" | "20020000942" | "20020036594" | "20020105468" | "20020109633" | "20020126051" | "20020126054" | "20020126055" | "20020140615" | "20020149519" | "20020164986" | "20020175211" | "20020175866" | "20020175879" | "20020190904" | "20030025637" | "20030064750" | "20030090421" | "20030098814" | "20030189518" | "20030210200" | "20030228892" | "20040009755" | "20040027295" | "20040029581" |	US-PGPUB; USPAT; USOCR	ADJ	ON	2019/08/01 21:04

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S114	7	ratio with dimension with antenna and S113	US-PGPUB; USPAT	ADJ	ON	2019/08/01 17:02
S113	367	S107 or S108	US-PGPUB; USPAT	ADJ	ON	2019/08/01 17:01
S112	0	ratio near3 width near3 height with antenna with (min or least or minimum) and (@ad<"20060618" or @rlad<"20060618")	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2019/08/01 16:28
S110	109	ratio near3 width near3 height with antenna	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2019/08/01 16:27
S109	12	ratio near3 width near3 height with antenna with rectangle	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2019/08/01 16:26
S108	119	("6201501" | "6204826" | "6211824" | "6211826" | "6211889" | "6215474" | "6218992" | "6236366" | "6236372" | "6239765" | "6243592" | "6255994" | "6259407" | "6266023" | "6266538" | "6271794" | "6272356" | "6275198" | "6281846" | "6281848" | "6285326" | "6285327" | "6285342" | "6288680" | "6292154" | "6300910" | "6300914" | "6301489" | "6307511" | "6307512" | "6307519" | "6317083" | "6320543" | "6326919" | "6327485" | "6329951" | "6329954" | "6329962" | "6333716" | "6333719" | "6343208" | "6346914" | "6348892" | "6352434" | "6353443" | "6360105" | "6366243" | "6367939" | "6373447" | "6380899" | "6380902" |	US-PGPUB; USPAT	ADJ	ON	2019/08/01 16:26

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<tr><td>S106</td><td>12</td><td>S103 or S104 and (@ad<"20060618" or @rlad<"20060618")</td><td>US-PGPUB; USPAT; DERWENT; IBM_TDB</td><td>ADJ</td><td>ON</td><td>2019/08/01 15:06</td></tr>
<tr><td>S105</td><td>12</td><td>S103 or S104</td><td>US-PGPUB; USPAT; DERWENT; IBM_TDB</td><td>ADJ</td><td>ON</td><td>2019/08/01 15:06</td></tr>
<tr><td>S104</td><td>12</td><td>ratio near3 width near3 height with antenna with rectangle</td><td>US-PGPUB; USPAT; DERWENT; IBM_TDB</td><td>ADJ</td><td>ON</td><td>2019/08/01 15:05</td></tr>
<tr><td>S103</td><td>11</td><td>aspect near2 ratio with width with height with antenna with rectangle</td><td>US-PGPUB; USPAT; DERWENT; IBM_TDB</td><td>ADJ</td><td>ON</td><td>2019/08/01 15:05</td></tr>
<tr><td>S102</td><td>24,007</td><td>aspect near2 ratio with width with height</td><td>US-PGPUB; USPAT; DERWENT; IBM_TDB</td><td>ADJ</td><td>ON</td><td>2019/08/01 15:03</td></tr>
<tr><td>S101</td><td>0</td><td>"14738090" and (aspect near2 ratio with width with height).clm.</td><td>US-PGPUB; USPAT; DERWENT; IBM_TDB</td><td>ADJ</td><td>ON</td><td>2019/08/01 15:03</td></tr>
<tr><td>S100</td><td>0</td><td>"14738090" and (aspect near2 ratio).clm.</td><td>US-PGPUB; USPAT; DERWENT; IBM_TDB</td><td>ADJ</td><td>ON</td><td>2019/08/01 15:03</td></tr>
<tr><td>S99</td><td>3</td><td>"14738090" and parallelepip$4</td><td>US-PGPUB; USPAT; DERWENT; IBM_TDB</td><td>ADJ</td><td>ON</td><td>2019/08/01 14:21</td></tr>
<tr><td>S98</td><td>0</td><td>"14738090" and parallelpip$6</td><td>US-PGPUB; USPAT;</td><td>ADJ</td><td>ON</td><td>2019/08/01 14:21</td></tr>
</table>

			DERWENT; IBM_TDB			
S97	3	"14738090" and tangent	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2019/08/01 14:21
S96	3	"14738090"	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2019/08/01 13:57
S95	0	antenna with complexity near2 factor with (curve or contour) and (@ad<"20060618" or @rlad<"20060618")	US-PGPUB; USPAT; USOCR	ADJ	OFF	2019/08/01 13:53
S94	13	antenna with complexity near2 factor with (curve or contour)	US-PGPUB; USPAT; USOCR	ADJ	OFF	2019/08/01 13:51
S93	30	antenna with complexity near2 factor	US-PGPUB; USPAT; USOCR	ADJ	OFF	2019/08/01 13:50
S92	5	S90 AND ((H01Q1/36 OR H01Q1/243 OR H01Q13/16 OR H01Q19/005 OR H01Q21/30 OR H01Q9/42).CPC.)	US-PGPUB; USPAT	ADJ	ON	2018/07/28 23:24
S91	5	S90 AND ((H01Q1/36 OR H01Q1/243 OR H01Q13/16 OR H01Q19/005 OR H01Q21/30 OR H01Q9/42).CPC.)	US-PGPUB; USPAT	ADJ	ON	2018/07/28 23:23
S90	5	(US-20050176390-$ or US-20020000944-$ or US-20040145527-$).did. or (US-6989794-$ or US-6452553-$).did.	US-PGPUB; USPAT	ADJ	ON	2018/07/28 23:22
S89	21	(four or fourth) near2 (transmitter or receiver or antenna) and (@ad<"20060618" or @rlad<"20060618") and S88	US-PGPUB; USPAT	ADJ	ON	2018/07/28 23:21
S88	80	first near2 (transmitter or receiver or antenna) with (short or shorter) near2 (side or edge) and (@ad<"20060618" or @rlad<"20060618")	US-PGPUB; USPAT	ADJ	ON	2018/07/28 23:21
S87	1	"15856626"	US-PGPUB; USPAT; DERWENT	ADJ	ON	2018/07/26 22:12
S86	3	S83 or S84	USPAT	ADJ	ON	2018/07/26 15:21
S85	4	S83 or S84	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2018/07/26 14:35

S84	4	fractus.as. and (complexity near2 factor).clm.	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2018/07/26 14:24
S83	4	fractus.as. and ((four near2 time) with diagonal).clm.	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2018/07/26 14:23
S82	9	S80 and (complexity near2 factor).clm.	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2018/07/26 11:32
S81	6	S80 and (contour with (four or "4") with diagonal).clm.	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2018/07/26 11:32
S80	385	S78 OR S79	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2018/07/26 11:32
S79	273	(PUENTE near2 BALIARDA near2 Carles) or (MUMBRU near2 Josep) or (ILARIO near2 Jordi)	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2018/07/26 11:32
S78	268	fractus.as.	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2018/07/26 11:32
S77	70	S76 AND ((H01Q1/243 OR H01Q1/36 OR H01Q9/0407 OR H01Q1/242 OR H01Q1/241 OR H01Q5/50 OR H04B1/3833 OR H04B1/005).CPC.)	US-PGPUB; USPAT	ADJ	ON	2018/07/26 11:31
S76	115	("5451968" | "5453751" | "5453752" | "5457469" | "5471224" | "5493702" | "5495261" | "5508709" | "5534877" | "5537367" | "5557293" | "5569879" | "5608417" | "5619205" | "5627550" | "5646635" | "5657028" | "5680144" | "5684672" | "5703600" | "5712640" | "5767811" | "5784032" | "5790080" | "5798688" | "5808586" | "5809433" | "6127977" | "6130651" | "6131042" | "6138245" | "6140966" | "6140969" | "6140975" | "6141540" | "6147649" | "6147652" | "6147655" | "6157344" | "6160513" | "6166694" | "6172618" | "6181281" | "6181284" | "6195048" | "6198442" | "6201501" | "6204826" | "6211824" | "6211826" | "6211889" |	US-PGPUB; USPAT	ADJ	ON	2018/07/26 11:31

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<tr><td>S75</td><td>11</td><td>S74 AND ((H01Q1/243 OR H01Q19/005 OR H01Q9/0407 OR H01Q9/42 OR H01Q13/16).CPC.)</td><td>US-PGPUB; USPAT</td><td>ADJ</td><td>OFF</td><td>2018/07/26 11:31</td></tr>
<tr><td>S74</td><td>14</td><td>(US-20050195112-$ or US-20160099496-$ or US-20060121865-$ or US-20040204007-$ or US-20060082505-$ or US-20050259013-$ or US-20080252536-$ or US-20050001767-$ or US-20020000944-$ or US-20040145527-$ or US-20060044195-$ or US-20050176390-$).did. or (US-7848781-$ or US-6452553-$).did.</td><td>US-PGPUB; USPAT</td><td>ADJ</td><td>OFF</td><td>2018/07/26 11:31</td></tr>
<tr><td>S73</td><td>1</td><td>(contour$4 or outlin$6 or length or perimeter) with (time or four or "4") with diagonal with (longer or greater) with (transceiver or antenna or transmitter or receiver) and (@ad<"20060618" or @rlad<"20060618")</td><td>US-PGPUB; USPAT; USOCR; DERWENT</td><td>ADJ</td><td>OFF</td><td>2018/07/26 11:31</td></tr>
<tr><td>S72</td><td>0</td><td>(contour$4 or outlin$6 or length or perimeter) with (time or four or "4") with diagonal with (longer or greater) with (transceiver or antenna or transmitter or receiver) and (@ad<"20060618" or @rlad<"20060618")</td><td>US-PGPUB; USPAT; USOCR</td><td>ADJ</td><td>OFF</td><td>2018/07/26 11:31</td></tr>
</table>

<table>
<tr><td>S71</td><td>0</td><td>(contour$4 or outlin$6 or length) with (time or four or "4") with diagonal with (longer or greater) with (transceiver or antenna or transmitter or receiver) and (@ad<"20060618" or @rlad<"20060618")</td><td>US-PGPUB; USPAT; USOCR</td><td>ADJ</td><td>OFF</td><td>2018/07/26 11:30</td></tr>
<tr><td>S70</td><td>151</td><td>(contour$4 or outlin$6 or length) with (time or four or "4") with diagonal with (longer or greater) and (@ad<"20060618" or @rlad<"20060618")</td><td>US-PGPUB; USPAT; USOCR</td><td>ADJ</td><td>OFF</td><td>2018/07/26 11:11</td></tr>
<tr><td>S69</td><td>404</td><td>(contour$4 or outlin$6 or length) with (time or four or "4") with diagonal with (longer or greater)</td><td>US-PGPUB; USPAT; USOCR</td><td>ADJ</td><td>OFF</td><td>2018/07/26 11:11</td></tr>
<tr><td>S67</td><td>74</td><td>(complexity or convolut$4) near2 (factor or metric or indicator) with (antenna or transmitter or receiver or transceiver) and (@ad<"20060618" or @rlad<"20060618")</td><td>US-PGPUB; USPAT</td><td>ADJ</td><td>ON</td><td>2018/07/26 09:18</td></tr>
<tr><td>S66</td><td>154</td><td>(complexity or convolut$4) near2 (factor or metric or indicator) with (antenna or transmitter or receiver or transceiver)</td><td>US-PGPUB; USPAT</td><td>ADJ</td><td>ON</td><td>2018/07/26 09:03</td></tr>
<tr><td>S64</td><td>80</td><td>first near2 (transmitter or receiver or antenna) with (short or shorter) near2 (side or edge) and (@ad<"20060618" or @rlad<"20060618")</td><td>US-PGPUB; USPAT</td><td>ADJ</td><td>ON</td><td>2018/07/25 21:20</td></tr>
<tr><td>S63</td><td>22,359</td><td>(four or fourth) near2 (transmitter or receiver or antenna) and (@ad<"20060618" or @rlad<"20060618")</td><td>US-PGPUB; USPAT</td><td>ADJ</td><td>ON</td><td>2018/07/25 21:16</td></tr>
<tr><td>S62</td><td>39</td><td>S59 and (four or fourth) near2 (transmitter or receiver or antenna) and (@ad<"20060618" or @rlad<"20060618")</td><td>US-PGPUB; USPAT</td><td>ADJ</td><td>ON</td><td>2018/07/25 16:22</td></tr>
<tr><td>S59</td><td>248</td><td>("20020000944" | "20040145527" | "20050176390" | "20010002823" | "20010033250" | "20010050636" | "20020000940" | "20020000942" | "20020036594" | "20020105468" | "20020109633" | "20020126051" | "20020126054" | "20020126055" | "20020140615" | "20020149519" | "20020164986" | "20020175211" | "20020175866" | "20020175879" | "20020190904" | "20030025637" | "20030064750" | "20030090421" | "20030098814" | "20030189518" | "20030210200" | "20030228892" | "20040009755" | "20040027295" |</td><td>US-PGPUB; USPAT</td><td>ADJ</td><td>ON</td><td>2018/07/25 16:15</td></tr>
</table>

		"20040029581"	"20040056985" | "20040085244"	"20040090372" | "20040095289"	"20040110479" | "20040119644"	"20040176025" | "20040198436"	"20040204008" | "20040204126"	"20040212545" | "20040214541"	"20050017910" | "20050041624"	"20050057398" | "20050069069"	"20050075098" | "20050088340"	"20050107052" | "20050136958"	"20050153709" | "20050156785"	"20050157807" | "20050181826"	"20050192009" | "20050195112"	"20050195273" | "20050201307"	"20050231439" | "20050233705"	"20050239446" | "20050259031"	"20050264453" | "20050270995"	"20060001576" | "20060015664"	"20060019730" | "20060031616"	"20060031886" | "20060033668"	"20060050473" | "20060050859"	"20060060068" | "20060077115"	"20060077310" | "20060290573"	"20070013589" | "20070229383"	"3079602" | "3521284"	"3599214"	"3622890" | "3683376"	"3683379"	"3689929" | "3818490"	"3967276"	"3969730" | "4021810"	"4024542"	"4038662" | "4072951"	"4131893"	"4141016" | "4318109"	"4356492"	"4381566" | "4471358"	"4471493"	"4504834" | "4536725"	"4543581"	"4571595" | "4584709"	"4608572"	"4623894" | "4628322"	"4673948"	"4723305" | "4730195"	"4752968"	"4827266" | "4827271"	"4839660"	"4843468" | "4847629"	"4849766"	"4857939" | "4860019"	"4890114"	"4894663" | "4907011"	"4912481"	"4975711" | "5030963"	"5138328"	"5168472" | "5172084"	"5200756"	"5212742" | "5214434"	"5218370"	"5227804" | "5227808"	"5245350"	"5248988" | "5255002"	"5257032"	"5307075" | "5337063"	"5337065"	"5347291" | "5355144"	"5355318"	"5363114" | "5373300"	"5402134"	"5410322" | "5420599"	"5422651"	"5451965" | "5451968"	"5453751"	"5453752" | "5457469"	"5471224"	"5493702" | "5495261"	"5508709"	"5534877" | "5537367"	"5557293"	"5569879"						

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S55	2	"6989794".pn.	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2017/09/28 15:23
S53	1	S51 and diagonal with rectangle with four	US-PGPUB; USPAT; DERWENT	ADJ	OFF	2017/09/28 12:06
S52	1	S51 and complex$4 with factor	US-PGPUB; USPAT; DERWENT	ADJ	OFF	2017/09/28 12:05
S51	67	S49 and S50	US-PGPUB; USPAT; DERWENT	ADJ	OFF	2017/09/28 11:58
S50	11,652	(multi$1band or multiple band or tri$1band or triple band or quad$1band) near3 (antenna or transceiver or receiver or transmitter)	US-PGPUB; USPAT; DERWENT	ADJ	OFF	2017/09/28 11:51
S49	364	S47 OR S48	US-PGPUB; USPAT; DERWENT	ADJ	OFF	2017/09/28 11:50

S48	115	("6211889" | "6215474" | "6218992" | "6236366" | "6236372" | "6239765" | "6243592" | "6255994" | "6259407" | "6266023" | "6266538" | "6271794" | "6272356" | "6275198" | "6281846" | "6281848" | "6285326" | "6285327" | "6285342" | "6288680" | "6292154" | "6300910" | "6300914" | "6301489" | "6307511" | "6307512" | "6307519" | "6317083" | "6320543" | "6326919" | "6327485" | "6329951" | "6329954" | "6329962" | "6333716" | "6333719" | "6343208" | "6346914" | "6348892" | "6352434" | "6353443" | "6360105" | "6366243" | "6367939" | "6373447" | "6380899" | "6380902" | "6384790" | "6388626" | "6392610" | "6396444" | "6407710" | "6408190" | "6417810" | "6417816" | "6421013" | "6431712" | "6445352" | "6452549" | "6452553" | "6452556" | "6470174" | "6476766" | "6476769" | "6480159" | "6483462" | "6496154" | "6498586" | "6498588" | "6525691" | "6538604" | "6552690" | "6573867" | "6597319" | "6603434" | "6618017" | "6650294" | "6664932" | "6680705" | "6697022" | "6697024" | "6707428" | "6716103" | "6741215" | "6756944" | "6762723" | "6784844" | "6801164" | "6806834" | "6831606" | "6839040" | "6903686" | "6928413" | "6967731" | "6989794" | "6992633" | "7015868" | "7030833" | "7068230" | "7069043" | "7075484" | "7091911" | "7148850" | "7151955" | "7183983" | "7202822" | "7229385" | "7265724" | "7394432" | "7397431" | "7511675" | "7528782" | "7548915" | "8738103" | "D441733").PN.	US-PGPUB; USPAT	ADJ	OFF	2017/09/28 11:40
S47	249	("20010002823" | "20010033250" | "20010050636" | "20020000940" | "20020000942" | "20020036594" | "20020105468" | "20020109633" | "20020126051" | "20020126054" | "20020126055" | "20020140615" | "20020149519" | "20020164986" | "20020175211" | "20020175866" | "20020175879" | "20020190904" | "20030025637" | "20030064750" | "20030090421" | "20030098814" | "20030189518" | "20030210200" | "20030228892" | "20040009755" |	US-PGPUB; USPAT	ADJ	OFF	2017/09/28 11:40

		"20040027295" | "20040029581" | "20040056985" | "20040085244" | "20040090372" | "20040095289" | "20040110479" | "20040119644" | "20040176025" | "20040198436" | "20040204008" | "20040204126" | "20040212545" | "20040214541" | "20050017910" | "20050041624" | "20050057398" | "20050069069" | "20050075098" | "20050088340" | "20050107052" | "20050136958" | "20050153709" | "20050156785" | "20050157807" | "20050181826" | "20050192009" | "20050195112" | "20050195273" | "20050201307" | "20050231439" | "20050233705" | "20050239446" | "20050259031" | "20050264453" | "20050270995" | "20060001576" | "20060015664" | "20060019730" | "20060031616" | "20060031886" | "20060033668" | "20060050473" | "20060050859" | "20060060068" | "20060077115" | "20060077310" | "20060290573" | "20070013589" | "20070229383" | "3079602" | "3521284" | "3599214" | "3622890" | "3683376" | "3683379" | "3689929" | "3818490" | "3967276" | "3969730" | "4021810" | "4024542" | "4038662" | "4072951" | "4131893" | "4141016" | "4318109" | "4356492" | "4381566" | "4471358" | "4471493" | "4504834" | "4536725" | "4543581" | "4571595" | "4584709" | "4608572" | "4623894" | "4628322" | "4673948" | "4723305" | "4730195" | "4752968" | "4827266" | "4827271" | "4839660" | "4843468" | "4847629" | "4849766" | "4857939" | "4860019" | "4890114" | "4894663" | "4907011" | "4912481" | "4975711" | "5030963" | "5138328" | "5168472" | "5172084" | "5200756" | "5212742" | "5214434" | "5218370" | "5227804" | "5227808" | "5245350" | "5248988" | "5255002" | "5257032" | "5307075" | "5337063" | "5337065" | "5347291" | "5355144" | "5355318" | "5363114" | "5373300" | "5402134" | "5410322" | "5420599" | "5422651" | "5451965" | "5451968" | "5453751" | "5453752" | "5457469" | "5471224" | "5493702" | "5495261" | "5508709" | "5534877" | "5537367" | "5557293" |					

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S46	7	"6989794"	US-PGPUB; USPAT	ADJ	OFF	2017/09/26 22:52
S45	1,871	(H01Q13/10).cpc.	US-PGPUB; USPAT	ADJ	OFF	2017/09/26 22:38
S44	11	S41 AND ((H01Q1/243 OR H01Q19/005 OR H01Q9/0407 OR H01Q9/42 OR H01Q13/16).CPC.)	US-PGPUB; USPAT	ADJ	OFF	2017/09/26 22:37
S43	70	S42 AND ((H01Q1/243 OR H01Q1/36 OR H01Q9/0407 OR H01Q1/242 OR H01Q1/241 OR H01Q5/50 OR H04B1/3833 OR H04B1/005).CPC.)	US-PGPUB; USPAT	ADJ	ON	2017/09/26 22:32
S42	115	("5451968" | "5453751" | "5453752" | "5457469" | "5471224" | "5493702" | "5495261" | "5508709" | "5534877" | "5537367" | "5557293" | "5569879" | "5608417" | "5619205" | "5627550" | "5646635" | "5657028" | "5680144" | "5684672" | "5703600" | "5712640" | "5767811" | "5784032" | "5790080" | "5798688" | "5808586" | "5809433" | "6127977" | "6130651" | "6131042" |	US-PGPUB; USPAT	ADJ	ON	2017/09/26 22:26

		"6138245" | "6140966" | "6140969" | "6140975" | "6141540" | "6147649" | "6147652" | "6147655" | "6157344" | "6160513" | "6166694" | "6172618" | "6181281" | "6181284" | "6195048" | "6198442" | "6201501" | "6204826" | "6211824" | "6211826" | "6211889" | "6215474" | "6218992" | "6236366" | "6236372" | "6239765" | "6243592" | "6255994" | "6259407" | "6266023" | "6266538" | "6271794" | "6272356" | "6275198" | "6281846" | "6281848" | "6285326" | "6285327" | "6285342" | "6288680" | "6292154" | "6300910" | "6300914" | "6301489" | "6307511" | "6307512" | "6307519" | "6664932" | "6680705" | "6697022" | "6697024" | "6707428" | "6716103" | "6741215" | "6756944" | "6762723" | "6784844" | "6801164" | "6806834" | "6831606" | "6839040" | "6903686" | "6928413" | "6967731" | "6989794" | "6992633" | "7015868" | "7030833" | "7068230" | "7069043" | "7075484" | "7091911" | "7148850" | "7151955" | "7183983" | "7202822" | "7229385" | "7265724" | "7394432" | "7397431" | "7511675" | "7528782" | "7548915" | "8738103" | "D441733").PN.				
S41	14	(US-20050195112-$ or US-20160099496-$ or US-20060121865-$ or US-20040204007-$ or US-20060082505-$ or US-20050259013-$ or US-20080252536-$ or US-20050001767-$ or US-20020000944-$ or US-20040145527-$ or US-20060044195-$ or US-20050176390-$).did. or (US-7848781-$ or US-6452553-$).did.	US-PGPUB; USPAT	ADJ	OFF	2017/09/26 22:26
S40	7	S38 and (complexity near2 factor).clm.	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2017/09/22 13:42
S39	4	S38 and (contour with (four or "4") with diagonal).clm.	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2017/09/22 13:40
S38	362	S36 OR S37	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2017/09/22 13:38

S37	260	(PUENTE near2 BALIARDA near2 Carles) or (MUMBRU near2 Josep) or (ILARIO near2 Jordi)	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2017/09/22 13:32
S36	252	fractus.as.	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2017/09/22 13:25
S35	28	(compact or small or miniature) with antenna with (phone or cellular or portable) and (@ad<"20060618" or @rlad<"20060618") and antenna with (band or multi$1band or tri$1band or quad$1band or multiple band) and antenna with contour$4	US-PGPUB; USPAT; USOCR	ADJ	OFF	2017/09/22 13:13
S34	58	(compact or small or miniature) with antenna with (phone or cellular or portable) and (@ad<"20060618" or @rlad<"20060618") and antenna with (band or multi$1band or tri$1band or quad$1band or multiple band) and antenna with complexity	US-PGPUB; USPAT; USOCR	ADJ	OFF	2017/09/22 13:13
S33	282	(compact or small or miniature) with antenna with (phone or cellular or portable) and (@ad<"20060618" or @rlad<"20060618") and antenna with (box or segment)	US-PGPUB; USPAT; USOCR	ADJ	OFF	2017/09/22 06:27
S31	310	(antenna or transmitter or transceiver) with (tri or triple or three or quad or four) with (band or spectrum) with (device or phone or portable or cellular or terminal or UE or UT OR MT or mobile) and (wireless or radio or cellular) and ("455" or "370").clas. and (@ad<"20060618" or @rlad<"20060618")	US-PGPUB; USPAT; USOCR	ADJ	OFF	2017/09/22 05:37
S30	15	antenna with (tri or triple or three or quad or four) with (band or spectrum) and S20 and ("455" or "370").clas. and (@ad<"20060618" or @rlad<"20060618")	US-PGPUB; USPAT; USOCR	ADJ	OFF	2017/09/22 00:01
S29	115	S24 and (antenna or transmitter or transceiver) with (tri$1band or quad$band or (three or "3" or four) near2 (band or frequency)) and (@ad<"20060618" or @rlad<"20060618") and ("455" or "370").clas.	US-PGPUB; USPAT; USOCR	ADJ	OFF	2017/09/21 23:59

S28	6	S26 and S27	US-PGPUB; USPAT; USOCR	ADJ	OFF	2017/09/21 23:57
S27	1,159	(phone or laptop or mobile or portable or cellular or radio) with (antenna or transceiver or transmitter) near2 (four or quad)	US-PGPUB; USPAT; USOCR	ADJ	OFF	2017/09/21 23:56
S26	263	S24 and (antenna or transmitter or transceiver) with (tri$1band or quad$band or (three or "3" or four) near2 (band or frequency)) and (@ad<"20060618" or @rlad<"20060618")	US-PGPUB; USPAT; USOCR	ADJ	OFF	2017/09/21 23:56
S25	503	S24 and (antenna or transmitter or transceiver) with (tri$1band or quad$band or (three or "3" or four) near2 (band or frequency))	US-PGPUB; USPAT; USOCR	ADJ	OFF	2017/09/21 23:55
S24	13,262	(antenna or transmitter or transceiver) with complexity	US-PGPUB; USPAT; USOCR	ADJ	OFF	2017/09/21 23:54
S23	0	antenna with contour with (four or "4" or five or "5") with diagonal and (@ad<"20060618" or @rlad<"20060618")	US-PGPUB; USPAT; USOCR	ADJ	OFF	2017/09/21 23:50
S22	6	antenna with contour with (four or "4" or five or "5") with diagonal	US-PGPUB; USPAT; USOCR	ADJ	OFF	2017/09/21 23:49
S21	186	antenna with (tri or triple or three or quad or four) with (band or spectrum) and S20	US-PGPUB; USPAT; USOCR	ADJ	OFF	2017/09/21 23:48
S20	879	(phone or laptop or mobile or portable or cellular or radio) with (antenna) near2 (four or quad)	US-PGPUB; USPAT; USOCR	ADJ	OFF	2017/09/21 23:46
S19	6	"11614429" and contour with length	US-PGPUB; USPAT; USOCR	ADJ	OFF	2017/09/21 23:30
S18	6	"11614429" and (contour$4 or outlin$6 or length) with (time or four or "4")	US-PGPUB; USPAT; USOCR	ADJ	OFF	2017/09/21 23:26
S17	6	"11614429" and contour$4	US-PGPUB; USPAT; USOCR	ADJ	OFF	2017/09/21 23:23
S16	1	(US-20080018543-$).did.	US-PGPUB	ADJ	OFF	2017/09/21 23:22
S15	9	"38686677".FMID.	US-PGPUB; USPAT; FPRS	ADJ	OFF	2017/09/21 15:40

S13	57	phone near2 antenna and antenna with contour and (multiple or multi or plural$4) with antenna	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2017/09/20 00:14
S12	0	("9099773").URPN.	USPAT	ADJ	OFF	2017/09/20 00:04
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S9	160	phone with antenna and antenna with contour and (multiple or multi or plural$4) with antenna	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2016/12/29 22:07
S8	213	phone with antenna and antenna with contour	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2016/12/29 21:29
S6	249	("20010002823" | "20010033250" | "20010050636" | "20020000940" | "20020000942" | "20020036594" |	US-PGPUB; USPAT	ADJ	ON	2016/12/29 20:02

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S2	3	"9099773"	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2016/12/13 15:02

EAST Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L3	4	"11614429"	USPAT	ADJ	OFF	2020/12/18 19:29
S195	1	"11614429" and aspect near2 value	USPAT	ADJ	OFF	2020/08/26 23:25
S194	1	"11614429" and aspect near22 value	USPAT	ADJ	OFF	2020/08/26 23:25
S189	4	"11614429"	USPAT	ADJ	OFF	2020/08/26 18:34
S173	3	(complexity near2 factor with (least or minimum or min) with antenna).clm.	USPAT	ADJ	ON	2020/01/05 20:43
S172	3	(complexity factor with f21).clm.	USPAT	ADJ	ON	2020/01/05 20:42
S135	0	(width near4 height near4 ratio).clm. and S134	USPAT	ADJ	ON	2019/08/01 22:37
S134	2	(perimeter with segment with contour with antenna).clm.	USPAT	ADJ	ON	2019/08/01 22:34
S133	0	S131 and S132	USPAT	ADJ	ON	2019/08/01 22:30
S132	4	(parallelepiped near4 tangent).clm.	USPAT	ADJ	ON	2019/08/01 22:30
S131	3	(complexity near2 factor with (least or minimum or min) with antenna).clm.	USPAT	ADJ	ON	2019/08/01 22:29
S57	1	(complexity factor with f21).clm.	USPAT	ADJ	ON	2017/09/28 18:34
S56	2	(length with contour with four with diagonal with antenna).clm.	USPAT	ADJ	ON	2017/09/28 18:34

12/18/2020 8:40:42 PM
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Search Notes	Application/Control No. 16/832,820	Applicant(s)/Patent Under Reexamination PUENTE BALIARDA et al.
	Examiner DUNG HONG	Art Unit 2643

CPC - Searched*		
Symbol	**Date**	**Examiner**
H01Q1/243,H01Q1/36,H01Q9/0407,H01Q1/242,H01Q1/241,H01Q5/50,H04B1/3833,H04B1/005	12/18/2020	DH

CPC Combination Sets - Searched*		
Symbol	**Date**	**Examiner**
H01Q1/243,H01Q1/36,H01Q9/0407,H01Q1/242,H01Q1/241,H01Q5/50,H04B1/3833,H04B1/005	12/18/2020	DH

US Classification - Searched*			
Class	**Subclass**	**Date**	**Examiner**

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	**Date**	**Examiner**
Inventor search, Google search, CPC search, Text search	08/26/2020	DH

Interference Search			
US Class/CPC Symbol	**US Subclass/CPC Group**	**Date**	**Examiner**

/DUNG HONG/ Primary Examiner, Art Unit 2643	

Index of Claims	Application/Control No. 16/832,820	Applicant(s)/Patent Under Reexamination PUENTE BALIARDA et al.
	Examiner DUNG HONG	Art Unit 2643

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

CLAIMS

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	12/18/2020								
	21	✓								
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/832,820	03/27/2020	Carles PUENTE BALIARDA	0690.0023CN4	3871

27896 7590 12/23/2020
EDELL, SHAPIRO & FINNAN, LLC
9801 Washingtonian Blvd.
Suite 750
Gaithersburg, MD 20878

EXAMINER	
HONG, DUNG	
ART UNIT	**PAPER NUMBER**
2643	
NOTIFICATION DATE	**DELIVERY MODE**
12/23/2020	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

epatent@usiplaw.com

PTOL-90A (Rev. 04/07)

Office Action Summary	**Application No.** 16/832,820	**Applicant(s)** PUENTE BALIARDA et al.	
	Examiner DUNG HONG	**Art Unit** 2643	**AIA (FITF) Status** No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☑ Responsive to communication(s) filed on 09/25/2020.
☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☐ This action is **FINAL.** 2b) ☑ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5) ☑ Claim(s) 21-40 is/are pending in the application.
5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6) ☐ Claim(s) _____ is/are allowed.

7) ☑ Claim(s) 21-40 is/are rejected.

8) ☐ Claim(s) _____ is/are objected to.

9) ☐ Claim(s) _____ are subject to restriction and/or election requirement

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to **PPHfeedback@uspto.gov.**

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☑ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
Certified copies:
a)☑ All b)☐ Some** c)☐ None of the:
1.☐ Certified copies of the priority documents have been received.
2.☑ Certified copies of the priority documents have been received in Application No. 11614429.
3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☑ Notice of References Cited (PTO-892)

2) ☑ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b)
Paper No(s)/Mail Date ______.

3) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date ______.

4) ☐ Other: ______.

DETAILED ACTION

This is in response to applicant's communication filed on 09/25/2020, wherein:

Claim 1-20 are pending.

Double Patenting

The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the “right to exclude” granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on nonstatutory double patenting provided the reference application or patent either is shown to be commonly owned with the examined application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement. See MPEP § 717.02 for applications subject to examination under the first inventor to file provisions of the AIA as explained in MPEP § 2159. See MPEP § 2146 *et seq.* for applications not subject to examination under the first inventor to file provisions of the AIA. A terminal disclaimer must be signed in compliance with 37 CFR 1.321(b).

The USPTO Internet website contains terminal disclaimer forms which may be used. Please visit www.uspto.gov/patent/patents-forms. The filing date of the application in which the form is filed determines what form (e.g., PTO/SB/25, PTO/SB/26, PTO/AIA/25, or PTO/AIA/26) should be used. A web-based eTerminal Disclaimer may be filled out completely online using web-screens. An eTerminal Disclaimer that meets all requirements is auto-processed and approved immediately upon submission. For more information about eTerminal Disclaimers, refer to www.uspto.gov/patents/process/file/efs/guidance/eTD-info-I.jsp.

Claim 21-40 are rejected on the ground of nonstatutory double patenting as being unpatentable over **claim 1-5, 6, 8-9, 12, 17 of U.S. Patent No. US 8738103 B2**. Although the claims at issue are not identical, they are not patentably distinct from each other because their scopes are overlapped as presented in the following.

US 8738103 B2	16832820
1. A handheld multifunction wireless device having at least one of multimedia functionality and smartphone functionality, the handheld multifunction wireless device comprising: a touch screen; a geolocalization system; and	21. A wireless device comprising:
an antenna system comprising a ground plane layer and three antenna elements within the handheld multifunction wireless device, the handheld multifunction wireless device being configured to transmit and receive signals from at least four frequency bands, each of the at least four frequency bands being used by at least one communication standard, the antenna system comprising:	an antenna system comprising: a ground plane; a second antenna within the wireless device 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.

a first antenna element having a conductive plate configured to simultaneously support radiation modes for at least first, second and third of the at least four frequency bands; and a second antenna element configured to receive signals from a 4 G communication standard, wherein a perimeter of the second antenna element defines an antenna contour having a level of complexity defined by complexity factor F.sub.21 having a value of at least 1.20 and complexity factor F.sub.32 having a value less than 1.75. 2. The handheld multifunction wireless device of claim 1, wherein the first	a first antenna within the wireless device and 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 and at least one of the three frequency bands being associated with a 4G communication standard, the first antenna being proximate to a first short side of a ground plane rectangle enclosing the ground plane and defining 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

frequency band is contained within 810-960 MHz frequency range, the second frequency band is contained within 1710-1990 MHz frequency range, and the third frequency band is contained within 1900-2170 MHz frequency range. 3. The handheld multifunction wireless device of claim 1, wherein the first antenna element is proximate to a short side of a ground plane rectangle defined by the ground plane layer, and the second antenna element is proximate to a short side of the ground plane rectangle. 4. The handheld multifunction wireless device of claim 1, wherein the first antenna element is proximate to a short side of a ground plane rectangle	a value less than 1.75 **(see details of structure and frequency band of first antenna and second antenna of US 8738103 B2);** and 22. The wireless device of claim 21, wherein the first antenna contour comprises at least 20 segments **(see claim 9 of US 8738103 B2).** 23. The wireless device of claim 22, wherein the perimeter of the first antenna contour comprises at least 35 segments **(see claim 8 of US 8738103 B2).** 24. The wireless device of claim 21, wherein the antenna system comprises a third antenna configured to receive signals employing a 4G communication standard **(see claim 5**

defined by the ground plane layer, and the second antenna element is proximate to a long side of the ground plane rectangle.	**and claim 1 of US 8738103 B2 regarding to third antenna and employing 4G standard on antenna).**
6. A handheld multifunction wireless device having at least one of multimedia functionality and smartphone functionality, the handheld multifunction wireless device comprising: a touch screen; a microprocessor and an operating system adapted to permit running of word-processing, spreadsheet, and slide software applications; an image recording system comprising an at least two-Megapixel image sensor; an antenna system within the handheld multifunction wireless device and configured to operate in at least five frequency bands, the antenna system	25. The wireless device of claim 24, wherein the third antenna defines an antenna contour comprising an entire perimeter of the third antenna, and wherein 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 **(see claim 1 of US 8738103 B2 regarding to structure and complexity of antenna).** 26. A wireless device comprising: an antenna system comprising: a ground plane **(see claim 1 of US 8738103**

comprising: a ground plane layer; a first antenna element having a conductive plate configured to support first, second, and third radiation modes respectively providing first, second, and third paths for current respectively associated with first, second, and third frequencies bands, the first, the second, and the third radiation modes overlapping at least partially with each other, the first frequency band being contained within a first frequency region of an electromagnetic spectrum, the second and the third frequency bands being contained within a second frequency region of the electromagnetic spectrum that is higher in frequency than the first frequency region; and a second antenna element configured to operate in at least one frequency	**B2)**; a first antenna within the wireless device and 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, the first antenna being proximate to a first short side of a ground plane rectangle enclosing the ground plane and defining 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 **(see claim 1 of US 8738103 B2 regarding to structure of second antenna)**; and

band, the at least one frequency band being used by a 4 G communication standard, wherein: a perimeter of the first antenna element defines a first antenna contour having a level of complexity defined by first complexity factor F.sub.21 having a value of at least 1.20 and first complexity factor F.sub.32 having a value less than 1.75; and a perimeter of the second antenna element defines a second antenna contour having a level of complexity defined by second complexity factor F.sub.21 having a value of at least 1.20 and second complexity factor F.sub.32 having a value less than 1.75. 8. The handheld multifunction wireless device of claim 6, wherein the first	a second antenna within the wireless device and defining a second antenna contour comprising an entire perimeter of the second antenna, 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, a minimum-sized parallelepiped of rectangular faces that completely encloses a volume of the second antenna defining an antenna box **(see claim 12 and 17 of US 8738103 B2)**, and an orthogonal projection of the antenna box along a normal to a face with a largest area of the second antenna defining an antenna rectangle, wherein a length of the second antenna contour is greater than four times a diagonal of the

antenna contour comprises at least thirty-five segments.	antenna rectangle **(see claim 12 of US 8738103 B2).**
9. The handheld multifunction wireless device according to claim 8, wherein the second antenna contour comprises at least twenty segments.	27. The wireless device of claim 26, wherein the first antenna contour comprises at least 20 segments **(see claim 12 of US 8738103 B2).**
12. A handheld multifunction wireless device having at least one of multimedia functionality and smartphone functionality, the handheld multifunction wireless device comprising: a touch screen; a processing module; a memory module; a communication module; a power management module; an antenna system within the handheld multifunction wireless device and comprising: a ground plane layer; a first antenna element configured to	28. The wireless device of claim 27, wherein the first antenna contour comprises at least 35 segments **(see claim 12 of US 8738103 B2).** 29. The wireless device of claim 26, wherein 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 **(see claim 1 of US 8738103 B2**

simultaneously support radiation modes for first, second, and third frequency bands, the first frequency band being contained within a first frequency region of an electromagnetic spectrum, the second frequency band being contained within a second frequency region of the electromagnetic spectrum that is higher in frequency than the first frequency region, the third frequency band of operation being used by a 4 G communication standard, wherein a perimeter of the first antenna element defines a first antenna contour comprising at least thirty-five segments, the first antenna element defining an antenna box, an orthogonal projection of the antenna box along a normal to a face with a largest area of the antenna box	**regarding to second antenna structure).** 30. The wireless device of claim 26, wherein the antenna system comprises a third antenna configured to provide wireless connectivity in at least two frequency bands **(see claim 1 and claim 5 of US 8738103 B2).** 31. The wireless device of claim 30, wherein the third antenna defines a third antenna contour comprising an entire perimeter of the third antenna, and wherein the third 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 of at least 1.35 **(see claim 1 of US 8738103 B2**

defining an antenna rectangle, wherein a length of the first antenna contour is greater than four times a diagonal of the antenna rectangle; and a second antenna element configured to operate in at least one frequency band used by a 4 G communication standard, wherein a perimeter of the second antenna element defines a second antenna contour comprising at least twenty segments. 17. The handheld multifunction wireless device according to claim 16, wherein an antenna box is defined by the first antenna element, an antenna rectangle is defined by an orthogonal projection of the antenna box along a normal to a face with a largest area of the antenna box, and wherein a longer side of said antenna rectangle is	**regarding to second antenna structure).** 32. A wireless device comprising: an antenna system comprising: a ground plane; a first antenna within the wireless device and configured to provide operation in 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 **(see claim 1 of US 8738103 B2 about first antenna),** the first frequency range being lower in frequency than the second frequency range **(see claim 2 of US 8738103 B2)**, the first antenna being proximate to a first short side of a ground plane rectangle

substantially parallel to the first short side of the ground plane rectangle.	enclosing the ground plane, the first antenna defining a first antenna contour comprising an entire perimeter of the first antenna **(see claim 3 of US 8738103 B2),** and 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, and wherein the first antenna is configured to transmit and receive signals from a 4G communication standard; and a second antenna within the wireless device and configured to receive signals from a 4G communication standard, a minimum-sized parallelepiped of rectangular faces that completely encloses a volume of the second antenna defining an antenna box, an orthogonal projection

	of the antenna box along a normal to a face with a largest area of the second antenna defining an antenna rectangle, 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 **(see claim 6 of US 8738103 B2).** 33. The wireless device of claim 32, wherein the first antenna contour comprises at least 20 segments **(see claim 9 of US 8738103 B2)**. 34. The wireless device of claim 33, wherein the first antenna contour comprises at least 35 segments **(see claim 8 of US 8738103 B2)**.

	35. The wireless device of claim 32, 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 **(see claim 4 of US 8738103 B2).** 36. The wireless device of claim 32, wherein the second antenna defines a second antenna contour comprising an entire perimeter of the second antenna, and wherein the second 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 of at least 1.35 **(see claim 1 of US 8738103 B2).**

	37. The wireless device of claim 36, wherein the second antenna contour comprises at least 20 segments **(see claim 9 of US 8738103 B2).** 38. The wireless device of claim 32, wherein the antenna system comprises a third antenna configured to provide wireless connectivity in at least two frequency bands **(see claim 1 and claim 5 of US 8738103 B2).** 39. The wireless device of claim 38, wherein the third antenna defines a third antenna contour comprising an entire perimeter of the third antenna, and wherein the third 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 of at least 1.35 **(see claim 1 of US 8738103 B2).** 40. The wireless device of claim 38, wherein the third antenna is proximate to a third side of the antenna rectangle being orthogonal to the first short side **(see claim 12 of US 8738103 B2)**.

Claim 21-40 are rejected on the ground of nonstatutory double patenting as being unpatentable over **claim 1, 4, 7-8, and 15 of U.S. Patent No. US 9099773 B2.** Although the claims at issue are not identical, they are not patentably distinct from each other because their scopes are overlapped as presented in the following.

US 9099773 B2	**16832820**
8. A handheld multifunction wireless device comprising: a touch screen; a digital camera; a component to reproduce digital music; a microphone; and	21. A wireless device comprising:

an antenna system comprising a ground plane layer and at least three antennas within the handheld multifunction wireless device, the antenna system comprising:	an antenna system comprising: a ground plane;
a first antenna having a conductive plate configured to simultaneously support radiation modes for a frequency band used by a 3G communication standard and a frequency band used by a 4G communication standard, the first antenna being proximate to a first short side of a ground plane rectangle defined by the ground plane layer, a perimeter of the first antenna defining a first antenna contour comprising at least twenty segments;	a first antenna within the wireless device and 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 and at least one of the three frequency bands being associated with a 4G communication standard, the first antenna being proximate to a first short side of a ground plane rectangle enclosing the ground plane and defining a first

	antenna contour comprising an entire
a second antenna configured to receive signals from a geolocalization system,	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 **(see claim 8 and claim 15 of US 9099773 B2)**; and
the second antenna being proximate to a second short side that is opposite to the first short side of the ground plane rectangle; and a third antenna configured to receive signals from a 4G communication standard, the third antenna being proximate to the second short side, the third antenna defining an antenna box, an orthogonal projection of the antenna box along a normal to a face with a	a second antenna within the wireless device 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. 22. The wireless device of claim 21, wherein the first antenna contour

largest area of the antenna box defining an antenna rectangle, wherein a length of the third antenna contour is greater than four times a diagonal of the antenna rectangle.	comprises at least 20 segments **(see claim 8 of US 9099773 B2).** 23. The wireless device of claim 22, wherein the perimeter of the first antenna contour comprises at least 35 segments **(see claim 7 of US 9099773 B2).** 24. The wireless device of claim 21, wherein the antenna system comprises a third antenna configured to receive signals employing a 4G communication standard **(see claim 8 of US 9099773 B2).** 25. The wireless device of claim 24, wherein the third antenna defines an antenna contour comprising an entire perimeter of the third antenna, and wherein 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 **(see claim 15 of US 9099773 B2).**
1. A handheld multifunction wireless device comprising: a touch screen; a digital camera; a component to reproduce digital music; a microphone; and	26. A wireless device comprising: an antenna system comprising: a ground plane;
an antenna system comprising a ground plane layer and at least two antennas within the handheld multifunction wireless device, the antenna system comprising:	
a first antenna having a conductive plate configured to simultaneously	a first antenna within the wireless device and configured to support at

support radiation modes for at least first, second and third frequency bands, the first antenna being proximate to a first short side of a ground plane rectangle defined by the ground plane layer, the first antenna defining an antenna box, an orthogonal projection of the antenna box along a normal to a face with a largest area of the antenna box defining an antenna rectangle, a perimeter of the first antenna defining a first antenna contour whose length is greater than four times a diagonal of the antenna rectangle; and	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, the first antenna being proximate to a first short side of a ground plane rectangle enclosing the ground plane and defining 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 **(see claim 1 of US 9099773 B2 regarding to first and second antenna structure);** and
a second antenna configured to provide wireless connectivity in at least two frequency bands, wherein a perimeter of the second antenna	a second antenna within the wireless device and defining a second antenna

element defines an antenna contour having a level of complexity defined by complexity factor F21 having a value of at least 1.20 and F32 complexity factor having a value of at least 1.35. 4. The handheld multifunction device of claim 3, wherein the second antenna is proximate to a second short side that is opposite to the first short side of the ground plane rectangle. 7. The handled multifunction device of claim 1, wherein the perimeter of the first antenna element defines an antenna contour having a level of complexity defined by complexity factor F32 having a value of at least 1.35, and the first antenna contour	contour comprising an entire perimeter of the second antenna, 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, a minimum-sized parallelepiped of rectangular faces that completely encloses a volume of the second antenna defining 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 defining an antenna rectangle, wherein a length of the second antenna contour is greater than four times a diagonal of the antenna rectangle **(see claim 1 and claim 8 of US 9099773 B2).**

comprises at least thirty-five segments.	27. The wireless device of claim 26, wherein the first antenna contour comprises at least 20 segments **(see claim 8 of US 9099773 B2).** 28. The wireless device of claim 27, wherein the first antenna contour comprises at least 35 segments **(see claim 7 of US 9099773 B2).** 29. The wireless device of claim 26, wherein 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 **(see claim 1 of US 9099773 B2).** 30. The wireless device of claim 26, wherein the antenna system comprises a third antenna configured

	to provide wireless connectivity in at least two frequency bands **(see claim 1 of US 9099773 B2).**
	31. The wireless device of claim 30, wherein the third antenna defines a third antenna contour comprising an entire perimeter of the third antenna, and wherein the third 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 of at least 1.35 **(see claim 1 of US 9099773 B2).**
15. A handheld multifunction wireless device comprising: a touch screen; a digital camera; a module to reproduce digital music; a microphone; and an antenna system comprising a ground plane layer and at least four	32. A wireless device comprising: an antenna system comprising: a ground plane; a first antenna within the wireless device and configured to provide operation in at least four frequency bands, at least one of the at

antennas within the handheld multifunction wireless device, the antenna system comprising: a first antenna configured to transmit and receive signals in at least two frequency bands contained within 810-960 MHz frequency range, the first antenna being proximate to a first short side of a ground plane rectangle defined by the ground plane layer; a second antenna configured to transmit and receive signals in a frequency band contained within 1710-1990 MHz frequency range and a frequency band contained within 1900-2170 MHz frequency range, the second antenna being proximate to the first short side of the ground plane rectangle; a third antenna configured to receive signals from a 4G communication standard, the third	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, the first antenna being proximate to a first short side of a ground plane rectangle enclosing the ground plane, the first antenna defining a first antenna contour comprising an entire perimeter of the first antenna, and 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, and wherein the first antenna is configured to transmit and receive signals from a 4G

antenna being proximate to a second short side that is opposite to the first short side of the ground plane rectangle, wherein a perimeter of the third antenna defines an antenna contour having 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; and a fourth antenna configured to provide wireless connectivity in at least two frequency bands.	communication standard; and a second antenna within the wireless device and configured to receive signals from a 4G communication standard, a minimum-sized parallelepiped of rectangular faces that completely encloses a volume of the second antenna defining an antenna box, an orthogonal projection of the antenna box along a normal to a face with a largest area of the second antenna defining an antenna rectangle, 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 **(see claim 15 of US 9099773 B2)**. 33. The wireless device of claim 32, wherein the first antenna contour

	comprises at least 20 segments **(see claim 8 of US 9099773 B2).** 34. The wireless device of claim 33, wherein the first antenna contour comprises at least 35 segments **(see claim 7 of US 9099773 B2).** 35. The wireless device of claim 32, 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 **(see claim 8 of US 9099773 B2).** 36. The wireless device of claim 32, wherein the second antenna defines a second antenna contour comprising an entire perimeter of the second antenna, and wherein the second

	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 of at least 1.35 **(see claim 1 of US 9099773 B2).** 37. The wireless device of claim 36, wherein the second antenna contour comprises at least 20 segments **(see claim 8 of US 9099773 B2).** 38. The wireless device of claim 32, wherein the antenna system comprises a third antenna configured to provide wireless connectivity in at least two frequency bands **(see claim 1 of US 9099773 B2).** 39. The wireless device of claim 38, wherein the third antenna defines a

	third antenna contour comprising an entire perimeter of the third antenna, and wherein the third 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 of at least 1.35 **(see claim 1 of US 9099773 B2).** 40. The wireless device of claim 38, wherein the third antenna is proximate to a third side of the antenna rectangle being orthogonal to the first short side **(see claim 4 of US 9099773 B2)**.

Claim 21-40 are rejected on the ground of nonstatutory double patenting as being unpatentable over **claim 1, 3, 9, 12, 14, 19 of U.S. Patent No. US 9899727 B2**. Although the claims at issue are not identical, they are not patentably distinct from each other because their scopes are overlapped as presented in the following.

US 9899727 B2	16832820
1. A multifunction wireless device comprising: an antenna system comprising a ground plane and at least four antennas within the multifunction wireless device, the antenna system comprising:	21. A wireless device comprising: an antenna system comprising: a ground plane;
a first antenna configured to transmit and receive signals in at least three frequency bands contained within two separate frequency ranges, the first antenna simultaneously receiving frequency signals in the at least three frequency bands, the first antenna being proximate to a first short side of a ground plane rectangle enclosing the ground plane, the first antenna defining a first antenna box, an orthogonal projection of the first antenna box along a normal to a face	a first antenna within the wireless device and 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 and at least one of the three frequency bands being associated with a 4G communication standard, the first antenna being proximate to a first short side of a ground plane rectangle enclosing the

with a largest area of the first antenna box defining a first antenna rectangle, a length of a contour of the first antenna being greater than four times a diagonal of the first antenna rectangle;	ground plane and defining a first antenna contour comprising an entire perimeter of the first antenna **(see claim 1 of US 9899727 B2),**
	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 **(see claim 3 of US 9899727 B2)**; and
a second antenna configured to receive signals in at least two of the at least three frequency bands, the second antenna being proximate to the first short side of the ground plane rectangle;	a second antenna within the wireless device 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 **(see claim 1 of US 9899727 B2 regarding second antenna).**
a third antenna configured to receive signals in at least two of the at least three frequency bands, the third antenna being proximate to a second short side that is opposite to the first short side of the ground plane rectangle; and	

a fourth antenna configured to receive signals in at least two of the at least three frequency bands, the fourth antenna being proximate to the second short side. 3. The multifunction device of claim 2, wherein the third antenna defines an antenna contour having a level of complexity defined by complexity factor F21 having a value of at least 1.2 and complexity factor F32 having a value less than 1.75. 9. The multifunction wireless device of claim 8, wherein the second antenna defines an antenna contour comprising at least twenty segments.	22. The wireless device of claim 21, wherein the first antenna contour comprises at least 20 segments **(see claim 9 of US 9899727 B2).** 23. The wireless device of claim 22, wherein the perimeter of the first antenna contour comprises at least 35 segments **(see claim 9 of US 9899727 B2).** 24. The wireless device of claim 21, wherein the antenna system comprises a third antenna configured to receive signals employing a 4G communication standard **(see claim 1 of US 9899727 B2).** 25. The wireless device of claim 24, wherein the third antenna defines an

	antenna contour comprising an entire perimeter of the third antenna, and wherein 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 **(see claim 3 of US 9899727 B2).**
12. A multifunction wireless device comprising: an antenna system comprising a ground plane and at least four antennas within the multifunction wireless device, the antenna system comprising:	26. A wireless device comprising: an antenna system comprising: a ground plane;
a first antenna configured to transmit and receive signals in at least three frequency bands contained within two separate frequency ranges, the first	a first antenna within the wireless device and configured to support at least two frequency bands contained within first and second frequency

antenna simultaneously receiving frequency signals in the at least three frequency bands, the first antenna element defining an antenna contour having a level of complexity defined by complexity factor F21 having a value of at least 1.2 and complexity factor F32 having a value less than 1.75;	ranges of the electromagnetic spectrum, the second frequency range being higher in frequency than the first frequency range, the first antenna being proximate to a first short side of a ground plane rectangle enclosing the ground plane and defining 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; and
a second antenna configured to simultaneously receive signals in at least two of the at least three frequency bands, the second antenna defining a second antenna box, an orthogonal projection of the second	a second antenna within the wireless device and defining a second antenna contour comprising an entire perimeter of the second antenna, the second antenna being proximate to a second short side of the ground plane

antenna box along a normal to a face with a largest area of the second antenna box defining a second antenna rectangle, a length of a contour of the second antenna being greater than four times a diagonal of the second antenna rectangle; a third antenna configured to simultaneously receive signals in at least two of the at least three frequency bands, wherein the third antenna defines an antenna contour having 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; and a fourth antenna configured to simultaneously receive signals in at	rectangle that is opposite to the first short side of the ground plane rectangle, a minimum-sized parallelepiped of rectangular faces that completely encloses a volume of the second antenna defining 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 defining an antenna rectangle, wherein a length of the second antenna contour is greater than four times a diagonal of the antenna rectangle **(see claim 12, 14, and 19 of US 9899727 B2).** 27. The wireless device of claim 26, wherein the first antenna contour comprises at least 20 segments **(see claim 9 of US 9899727 B2).**

least two of the at least three frequency bands, the fourth antenna defining a fourth antenna box, an orthogonal projection of the fourth antenna box along a normal to a face with a largest area of the fourth antenna box defining a fourth antenna rectangle, a length of a contour of the fourth antenna being greater than four times a diagonal of the fourth antenna rectangle. 14. The multifunction device of claim 13, wherein the first antenna is proximate to a first short side of a ground plane rectangle enclosing the ground plane.	28. The wireless device of claim 27, wherein the first antenna contour comprises at least 35 segments **(see claim 9 of US 9899727 B2).** 29. The wireless device of claim 26, wherein 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 **(see claim 12 of US 9899727 B2).** 30. The wireless device of claim 26, wherein the antenna system comprises a third antenna configured to provide wireless connectivity in at least two frequency bands **(see claim 12 of US 9899727 B2 regarding to antenna operating on two frequency band).**

19. The multifunction device of claim 18, wherein the fourth antenna is proximate to the second short side.	31. The wireless device of claim 30, wherein the third antenna defines a third antenna contour comprising an entire perimeter of the third antenna, and wherein the third 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 of at least 1.35 **(see claim 12 of US 9899727 B2).** 32. A wireless device comprising: an antenna system comprising: a ground plane; a first antenna within the wireless device and configured to provide operation in 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, the first antenna being proximate to a first short side of a ground plane rectangle enclosing the ground plane, the first antenna defining a first antenna contour comprising an entire perimeter of the first antenna, and 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, and wherein the first antenna is configured to transmit and receive signals from a 4G communication standard; and a second antenna within the wireless device and configured to receive

	signals from a 4G communication standard, a minimum-sized parallelepiped of rectangular faces that completely encloses a volume of the second antenna defining an antenna box, an orthogonal projection of the antenna box along a normal to a face with a largest area of the second antenna defining an antenna rectangle, 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 **(see claim 12 of US 9899727 B2).** 33. The wireless device of claim 32, wherein the first antenna contour comprises at least 20 segments **(see claim 9 of US 9899727 B2).**

	34. The wireless device of claim 33, wherein the first antenna contour comprises at least 35 segments **(see claim 9 of US 9899727 B2).** 35. The wireless device of claim 32, 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 **(see claim 19 of US 9899727 B2).** 36. The wireless device of claim 32, wherein the second antenna defines a second antenna contour comprising an entire perimeter of the second antenna, and wherein the second 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 of at least 1.35 **(see claim 12 of US 9899727 B2).** 37. The wireless device of claim 36, wherein the second antenna contour comprises at least 20 segments **(see claim 9 of US 9899727 B2).** 38. The wireless device of claim 32, wherein the antenna system comprises a third antenna configured to provide wireless connectivity in at least two frequency bands **(see claim 12 of US 9899727 B2).** 39. The wireless device of claim 38, wherein the third antenna defines a third antenna contour comprising an entire perimeter of the third antenna, and wherein the third 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 of at least 1.35 **(see claim 12 of US 9899727 B2).** 40. The wireless device of claim 38, wherein the third antenna is proximate to a third side of the antenna rectangle being orthogonal to the first short side **(see claim 12 of US 9899727 B2).**

Claim 21-40 are rejected on the ground of nonstatutory double patenting as being unpatentable over **claim 1, 3, 7, 10 of U.S. Patent No. US 10644380 B2**. Although the claims at issue are not identical, they are not patentably distinct from each other because their scopes are overlapped as presented in the following.

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1. A wireless device comprising: an antenna system comprising a ground plane layer and at least four antennas within the wireless device, the antenna system comprising:	21. A wireless device comprising: an antenna system comprising: a ground plane;
a first antenna configured to support at least three frequency bands contained within a first and second frequency regions of the electromagnetic spectrum, the second frequency region being higher in frequency than the first frequency region, the first antenna being proximate to a first short side of a ground plane rectangle defined by the ground plane layer, the first antenna defining a first antenna contour comprising the perimeter of the first antenna being placed in a first antenna box, the first antenna box being a minimum-sized parallelepiped	a first antenna within the wireless device and 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 and at least one of the three frequency bands being associated with a 4G communication standard, the first antenna being proximate to a first short side of a ground plane rectangle enclosing the ground plane and defining a first

that completely encloses the volume of the first antenna and wherein each one of the faces of the minimum-sized parallelepiped is tangent to at least one point of the volume of the first antenna, and	antenna contour comprising an entire perimeter of the first antenna,
wherein the first antenna contour has a level of complexity defined by complexity factor F.sub.21 having a value of at least 1.20 and complexity factor F.sub.32 having a value of at least 1.35;	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; and
a second antenna configured to support at least two frequency bands contained within the second frequency region, the second antenna being proximate to the first short side of the ground plane rectangle; a third antenna configured to support at least	a second antenna within the wireless device 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

two frequency bands contained within the first and second frequency regions, wherein the third antenna defines a second antenna contour comprising a perimeter of the third antenna placed in a second antenna box, an orthogonal projection of the second antenna box along a normal to a face with a largest area of the second antenna box defining an antenna rectangle, an aspect ratio of the antenna rectangle being defined as a ratio between the width and the height of the antenna rectangle, and wherein the aspect ratio has a value of at least 2; and a fourth antenna configured to support at least two frequency bands contained within the second frequency region, and wherein the fourth antenna is proximate to a second short side being opposite to	rectangle **(see claim 1 of US 10644380 B2).** 22. The wireless device of claim 21, wherein the first antenna contour comprises at least 20 segments **(see claim 3 of US 10644380 B2).** 23. The wireless device of claim 22, wherein the perimeter of the first antenna contour comprises at least 35 segments **(see claim 3 of US 10644380 B2).** 24. The wireless device of claim 21, wherein the antenna system comprises a third antenna configured to receive signals employing a 4G communication standard **(see claim 7 of US 10644380 B2).**

the first short side of the ground plane rectangle. 3. The wireless device of claim 2, wherein the perimeter of the second antenna contour comprises at least 20 segments. 7. The wireless device of claim 2, wherein the first antenna is configured to transmit and receive signals from a 4G communication standard.	25. The wireless device of claim 24, wherein the third antenna defines an antenna contour comprising an entire perimeter of the third antenna, and wherein 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 **(see claim 1 of US 10644380 B2).**
10. A wireless device comprising: an antenna system comprising a ground plane layer and at least four antennas within the wireless device, the antenna system comprising: a first antenna having a conductive plate configured to support radiation	26. A wireless device comprising: an antenna system comprising: a ground plane; a first antenna within the wireless device and configured to support at

modes in at least two frequency bands contained within a first and a second frequency regions of the electromagnetic spectrum, the second frequency region being higher in frequency than the first frequency region, the first antenna being proximate to a first short side of a ground plane rectangle defined by the ground plane layer, the first antenna defining a first antenna contour comprising the perimeter of the first antenna placed in a first antenna box, an orthogonal projection of the first antenna box along a normal to a face with a largest area of the first antenna box defining a first antenna rectangle, an aspect ratio of the first antenna rectangle being defined as a ratio between the width and the height of the first antenna rectangle, and	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, the first antenna being proximate to a first short side of a ground plane rectangle enclosing the ground plane and defining 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; and a second antenna within the wireless device and defining a second antenna contour comprising an entire perimeter of the second antenna, the second

wherein the aspect ratio has a value of at least 2; a second antenna having a conductive plate configured to support radiation modes in at least two frequency bands contained within the second frequency region of the electromagnetic spectrum, wherein the second antenna is proximate to the first short side of the ground plane rectangle; a third antenna placed in a second antenna box, the third antenna having a conductive plate configured to support radiation modes in at least three frequency bands contained within the first and second frequency regions of the electromagnetic spectrum, and wherein the perimeter of the third antenna defines a second antenna contour having a level of complexity defined by complexity factor F.sub.21 having a value of at	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, a minimum-sized parallelepiped of rectangular faces that completely encloses a volume of the second antenna defining 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 defining an antenna rectangle, wherein a length of the second antenna contour is greater than four times a diagonal of the antenna rectangle **(see claim 1 and 10 of US 10644380 B2).** 27. The wireless device of claim 26, wherein the first antenna contour

least 1.20 and complexity factor F.sub.32 having a value of at least 1.35; and a fourth antenna having a conductive plate configured to support radiation modes in at least two frequency bands contained within the second frequency region, the fourth antenna being proximate to a second short side being opposite to the first short side of the ground plane rectangle.	comprises at least 20 segments **(see claim 3 of US 10644380 B2).** 28. The wireless device of claim 27, wherein the first antenna contour comprises at least 35 segments **(see claim 3 of US 10644380 B2).** 29. The wireless device of claim 26, wherein 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 **(see claim 1 of US 10644380 B2).** 30. The wireless device of claim 26, wherein the antenna system comprises a third antenna configured to provide wireless connectivity in at

	least two frequency bands **(see claim 10 of US 10644380 B2).** 31. The wireless device of claim 30, wherein the third antenna defines a third antenna contour comprising an entire perimeter of the third antenna, and wherein the third 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 of at least 1.35 **(see claim 1 of US 10644380 B2).** 32. A wireless device comprising: an antenna system comprising: a ground plane; a first antenna within the wireless device and configured to provide operation in 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, the first antenna being proximate to a first short side of a ground plane rectangle enclosing the ground plane, the first antenna defining a first antenna contour comprising an entire perimeter of the first antenna, and 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, and wherein the first antenna is configured to transmit and receive signals from a 4G communication standard; and a

	second antenna within the wireless device and configured to receive signals from a 4G communication standard, a minimum-sized parallelepiped of rectangular faces that completely encloses a volume of the second antenna defining an antenna box, an orthogonal projection of the antenna box along a normal to a face with a largest area of the second antenna defining an antenna rectangle, 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 **(see claim 1 and 10 of US 10644380 B2).** 33. The wireless device of claim 32, wherein the first antenna contour

	comprises at least 20 segments **(see claim 3 of US 10644380 B2).** 34. The wireless device of claim 33, wherein the first antenna contour comprises at least 35 segments **(see claim 3 of US 10644380 B2).** 35. The wireless device of claim 32, 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 **(see claim 1 of US 10644380 B2).** 36. The wireless device of claim 32, wherein the second antenna defines a second antenna contour comprising an entire perimeter of the second antenna, and wherein the second

	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 of at least 1.35 **(see claim 1 of US 10644380 B2).** 37. The wireless device of claim 36, wherein the second antenna contour comprises at least 20 segments **(see claim 3 of US 10644380 B2).** 38. The wireless device of claim 32, wherein the antenna system comprises a third antenna configured to provide wireless connectivity in at least two frequency bands **(see claim 1 of US 10644380 B2).** 39. The wireless device of claim 38, wherein the third antenna defines a

	third antenna contour comprising an entire perimeter of the third antenna, and wherein the third 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 of at least 1.35 **(see claim 1 of US 10644380 B2).** 40. The wireless device of claim 38, wherein the third antenna is proximate to a third side of the antenna rectangle being orthogonal to the first short side **(see claim 3 of US 10644380 B2).**

Contact Information

Any inquiry concerning this communication or earlier communications from the examiner should be directed to DUNG HONG whose telephone number is (571)270-7928. The examiner can normally be reached on Monday-Friday from 8:00 am to 5:00 pm.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, Applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

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/DUNG HONG/
Primary Examiner, Art Unit 2643

Bibliographic Data

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35 USC 119 (a-d) conditions met: ☑ Yes ☐ No ☐ Met After Allowance

Verified and Acknowledged: /DUNG HONG/

Examiner's Signature Initials

Title: Multiple-Body-Configuration Multimedia and Smartphone Multifunction Wireless Devices

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RULE			

APPLICANTS

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Josep MUMBRU, Asnieres-sur-Seine, FRANCE

Jordi ILARIO, Barcelona, SPAIN

CONTINUING DATA

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	Examiner DUNG HONG	Art Unit 2643	Page 1 of 1

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Doc description: Information Disclosure Statement (IDS) Filed

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	Attorney Docket Number	0690.0023CN4

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CERTIFICATION STATEMENT

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See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

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Signature	/Patrick J. Finnan/	Date (YYYY-MM-DD)	2020-03-27
Name/Print	Patrick J. Finnan	Registration Number	39189

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Signature	/Patrick J. Finnan/	Date (YYYY-MM-DD)	2020-03-27
Name/Print	Patrick J. Finnan	Registration Number	39189

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**	Application Number	
	Filing Date	
	First Named Inventor	Carles PUENTE BALIARDA
	Art Unit	
	Examiner Name	
	Attorney Docket Number	0690.0023CN4

	1	Detailed rejection of US patent application 12/347462, Defendants, 20100701	
	2	Document 0001 - Complaint for patent infringement, Susman Godfrey, 20090505	
	3	Document 0014 - Amended complaint for patent infringement, Fractus, 20090506	
	4	Document 0032 - Defendants LG Electronics Mobilecomm USA., Inc.'s answer and counterclaim to complaint, Defendants, 20091001	
	5	Document 0064 - Defendant Pantech Wireless, INC.'S answer, affirmative defenses and counterclaims to Fractus SA' s Amended complaint, Defendants, 20090604	
	6	Document 0066 - Defendant UTStarcom, Inc's answer affirmative defenses and counterclaims to plaintiff's amended complaint, Defendants, 20090608	
	7	Document 0073 - Plaintiff Fractus SA' s answer to defendant Pantech Wireless, Inc' s counterclaims, Defendants, 20090624	
	8	Document 0079 - Plaintiff Fractus SA' s answer to defendant UTStarcom, Inc' s counterclaims, Fractus, 20090629	
	9	Document 0091 - Answer, affirmative defenses and counterclaims to the amended complaint for patent infringement on behalf of Defendant Personal Communications Devices Holdings, LLC, Defendants, 20090720	
	10	Document 0099 - Defendant Sanyo North America Corporation's partial answer to amended complaint for patent infringement, Defendants, 20090720	
	11	Document 0106 - Kyocera Communications Inc's answer, affirmative defenses and counterclaims to plaintiff's amended complaint, Defendants, 20090721	

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	12	Document 0107 - Kyocera Wireless Corp's answer, affirmative defenses and counterclaims to plaintiff's amended complaint, Defendants, 20090721	
	13	Document 0108 - Palm Inc.'s answer, affirmative defenses and counterclaims to plaintiff's amended complaint, Defendants, 20090721	
	14	Document 0111 - Civil cover sheet, Susman Godfrey, 20090505	
	15	Document 0175 - Defendant HTC Corporation's amended answer and counterclaim to plaintiff's second amended complaint, Defendants, 20090925	
	16	Document 0176 - Defendant HTC America Inc's answer and counterclaim to plaintiff's amended complaint, Defendants, 20090925	
	17	Document 0180 - Defendants Samsung Electronics Co., Ltd.'s; Samsung Electronics Research Institute's and Samsung Semiconductor Europe GMBH' s answer; and Samsung Telecommunications America LLC' s answer and counterclaim, Defendants, 20091001	
	18	Document 0185 - Defendants Research in Motion LTD, and Research in Motion Corporation's answers, defenses and counterclaims to plaintiff's amended complaint, Defendants, 20091001	
	19	Document 0187 - Defendants LG Electronics Inc., LG Electronics USA, Inc., and LG Electronics Mobilecomm USA Inc. answer and counterclaim to amended complaint, Defendants, 20091001	
	20	Document 0190 - Defendant HTC Corporation's First amended answer and counterclaim to plaintiff's amended complaint, Defendants, 20091002	
	21	Document 0191 - Defendant HTC America, Inc's first amended answer and counterclaims to plaintiff's amended complaint, Defendants, 20091002	
	22	Document 0217 - Defendants Research in Motion LTD, and Research in Motion Corporation's amended answer, defenses and counterclaims to plaintiff's amended complaint, Defendants, 20091124	

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	23	Document 0222 - Second amended complaint for patent infringement, Susman Godfrey, 20091202	
	24	Document 0227 - Second amended complaint for patent infringement - Case 6:09-cv-00203, Fractus, 20091208	
	25	Document 0235 - Answer, affirmative defenses and counterclaims to the second amended complaint for patent infringement on behalf of Defendant Personal Communications Devices Holdings, LLC, Defendants, 20091217	
	26	Document 0238 - Defendant HTC America, Inc's answer and counterclaims to plaintiff's second amended complaint, Defendants, 20091221	
	27	Document 0239 - Defendant HTC Corporation's answer and counterclaims to plaintiff's second amended complaint, Defendants, 20091221	
	28	Document 0241 - Defendant Research in Motion LTD and Research in Motion Corporation's second answer, defenses and counterclaims to plaintiff's second amended complaint, Defendants, 20091221	
	29	Document 0242 - Defendant Pantech Wireless, Inc's answer, affirmative defenses and counterclaims to Fractus SA's second amended complaint, Defendants, 20091221	
	30	Document 0243 - Defendant Sanyo Electric Co. LTD's answer to second amended complaint for patent infringement, Defendants, 20091222	
	31	Document 0244 - Defendant Sanyo North America Corporation's answer to second amended complaint for patent infringement, Defendants, 20091222	
	32	Document 0246 - Defendant UTStarcom, Inc's answer, affirmative defenses and counterclaims to Fractus SA's second amended complaint, Defendants, 20091222	
	33	Document 0247 - Palm, Inc's answer, affirmative defenses and counterclaims to plaintiff's second amended complaint, Defendants, 20091222	

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	Attorney Docket Number	0690.0023CN4

	34	Document 0248 - Kyocera Communications, Inc's answer, affirmative defenses and counterclaims to plaintiff's second amended complaint, Defendants, 20091222	
	35	Document 0249 - Kyocera Wireless Corp's answer, affirmative defenses and counterclaims to plaintiff's second amended complaint, Defendants, 20091222	
	36	Document 0250 - Defendants Samsung Electronics Co., Ltd.'s; Samsung Electronics answer and counterclaim to the second amended complaint of plaintiff Fractus, Defendants, 20091223	
	37	Document 0251 - Defendants LG Electronics Inc., LG Electronics USA, Inc., and LG Electronics Mobilecomm USA Inc. answer and counterclaim to second amended complaint, Defendants, 20091228	
	38	Document 0252 - Answer of the Sharp Defendants to plaintiff's second amended complaint, Defendants, 20091229	
	39	Document 0255 - Plaintiff Fractus, S. A.'s answer to defendant Personal Communications Devices Holdings, LLC's counterclaims to the Second Amended Complaint, Susman Godfrey, 20100104	
	40	Document 0256 - Plaintiff Fractus, S. A.'s answer to the counterclaims of defendants Research in Motion LTD. and Research in Motion Corporation to the Second Amended Complaint, Susman Godfrey, 20100104	
	41	Document 0257 - Plaintiff Fractus, S. A.'s answer to counterclaims of defendant Pantech Wireless, Inc. to the Second Amended Complaint, Susman Godfrey, 20100104	
	42	Document 0258 - Plaintiff Fractus, S. A.'s answer to defendant Kyocera Communications, Inc's Counterclaims to the Second Amended Complaint, Susman Godfrey, 20100104	
	43	Document 0259 - Plaintiff Fractus, S. A.'s answer to defendant Kyocera Wireless Corp's Counterclaims to the Second Amended Complaint, Susman Godfrey, 20100104	
	44	Document 0260 - Plaintiff Fractus, S. A.'s answer to defendant Palm, Inc's Counterclaims to the Second Amended Complaint, Susman Godfrey, 20100104	

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	45	Document 0261 - Plaintiff Fractus, S. A.'s answer to defendant UTStarcom, Inc's Counterclaims to the Second Amended Complaint, Susman Godfrey, 20100104	
	46	Document 0262 - Plaintiff Fractus, S. A.'s answer to counterclaims of defendant Samsung Telecommunications America LLC to the Second Amended Complaint, Susman Godfrey, 20100104	
	47	Document 0263 - Plaintiff Fractus, S. A.'s answer to counterclaims of defendants LG Electronics Inc., Electronics USA, Inc., and LG Electronics Mobilecomm USA, Inc. to the Second Amended Complaint, Susman Godfrey, 20100104	
	48	Document 0273 - Plaintiff Fractus, S. A.'s answer to counterclaims of defendants HTC America, Inc to the Second Amended Complaint, Susman Godfrey, 20100114	
	49	Document 0286 - Amended answer of the Sharp defendants to plaintiff's second amended complaint, Defendants, 20100224	
	50	Document 0287 - Defendants Samsung Electronics Co., Ltd.'s; Samsung Electronics Research Institute's and Samsung Semiconductor Europe GMBH' s first amended answer; and Samsung Telecommunications America LLC' s first amended answer, Defendants, 20100224	

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EXAMINER SIGNATURE

Examiner Signature	/DUNG HONG/	Date Considered	08/26/2020

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

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	First Named Inventor	Carles PUENTE BALIARDA
	Art Unit	
	Examiner Name	
	Attorney Docket Number	0690.0023CN4

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Patrick J. Finnan/	Date (YYYY-MM-DD)	2020-03-27
Name/Print	Patrick J. Finnan	Registration Number	39189

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /D.H/

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

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Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (01-10)
Approved for use through 07/31/2012. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**		
	Application Number	
	Filing Date	
	First Named Inventor	Carles PUENTE BALIARDA
	Art Unit	
	Examiner Name	
	Attorney Docket Number	0690.0023CN4

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	First Named Inventor	Carles PUENTE BALIARDA
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	Attorney Docket Number	0690.0023CN4

	1	Infringement Chart - Samsung SCH-R500., Fractus, 20091105	
	2	Infringement Chart - Samsung SCH-R500. Patent: 7148850, Fractus, 20091105	
	3	Infringement Chart - Samsung SCH-R500. Patent: 7202822, Fractus, 20091105	
	4	Infringement Chart - Samsung SCH-R600, Fractus, 20091105	
	5	Infringement Chart - Samsung SCH-R600. Patent: 7148850, Fractus, 20091105	
	6	Infringement Chart - Samsung SCH-R600. Patent: 7202822, Fractus, 20091105	
	7	Infringement Chart - Samsung SCH-R800, Fractus, 20091105	
	8	Infringement Chart - Samsung SCH-R800. Patent: 7148850, Fractus, 20091105	
	9	Infringement Chart - Samsung SCH-R800. Patent: 7202822, Fractus, 20091105	
	10	Infringement Chart - Samsung SCH-U310, Fractus, 20091105	
	11	Infringement Chart - Samsung SCH-U310. Patent: 7148850, Fractus, 20091105	

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	First Named Inventor	Carles PUENTE BALIARDA
	Art Unit	
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	Attorney Docket Number	0690.0023CN4

	12	Infringement Chart - Samsung SCH-U310. Patent: 7202822, Fractus, 20091105	
	13	Infringement Chart - Samsung SCH-U430, Fractus, 20091105	
	14	Infringement Chart - Samsung SCH-U430. Patent: 7148850, Fractus, 20091105	
	15	Infringement Chart - Samsung SCH-U430. Patent: 7202822, Fractus, 20091105	
	16	Infringement Chart - Samsung SCH-U470, Fractus, 20091105	
	17	Infringement Chart - Samsung SCH-U470. Patent: 7148850, Fractus, 20091105	
	18	Infringement Chart - Samsung SCH-U470. Patent: 7202822, Fractus, 20091105	
	19	Infringement Chart - Samsung SCH-U520, Fractus, 20091105	
	20	Infringement Chart - Samsung SCH-U520. Patent: 7148850, Fractus, 20091105	
	21	Infringement Chart - Samsung SCH-U520. Patent: 7202822, Fractus, 20091105	
	22	Infringement Chart - Samsung SCH-U740, Fractus, 20091105	

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	23	Infringement Chart - Samsung SCH-U740. Patent: 7148850, Fractus, 20091105	
	24	Infringement Chart - Samsung SCH-U740. Patent: 7202822, Fractus, 20091105	
	25	Infringement Chart - Samsung SCH-U750, Fractus, 20091105	
	26	Infringement Chart - Samsung SCH-U750. Patent: 7148850, Fractus, 20091105	
	27	Infringement Chart - Samsung SCH-U750. Patent: 7202822, Fractus, 20091105	
	28	Infringement Chart - Samsung SCH-U940, Fractus, 20091105	
	29	Infringement Chart - Samsung SCH-U940. Patent. 7202822, Fractus, 20091105	
	30	Infringement Chart - Samsung SCH-U940. Patent: 7148850, Fractus, 20091105	
	31	Infringement Chart - Samsung SCH A127, Fractus, 20091105	
	32	Infringement Chart - Samsung SCH U340., Fractus, 20091105	
	33	Infringement Chart - Samsung SCH U340. Patent: 7148850, Fractus, 20091105	

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	34	Infringement Chart - Samsung SCH U340. Patent: 7202822, Fractus, 20091105	
	35	Infringement Chart - Samsung SCH U410., Fractus, 20091105	
	36	Infringement Chart - Samsung SCH U410. Patent: 7148850, Fractus, 20091105	
	37	Infringement Chart - Samsung SCH U410. Patent: 7202822, Fractus, 20091105	
	38	Infringement Chart - Samsung SCH U700, Fractus, 20091105	
	39	Infringement Chart - Samsung SCH U700. Patent: 7148850, Fractus, 20091105	
	40	Infringement Chart - Samsung SCH U700. Patent: 7202822, Fractus, 20091105	
	41	Infringement Chart - Samsung SGH-A237, Fractus, 20091105	
	42	Infringement Chart - Samsung SGH-A237. Patent: 7148850, Fractus, 20091105	
	43	Infringement Chart - Samsung SGH-A237. Patent: 7202822, Fractus, 20091105	
	44	Infringement Chart - Samsung SGH-A257, Fractus, 20091105	

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	45	Infringement Chart - Samsung SGH-A257 Magnet. Patent: 7148850, Fractus, 20091105	
	46	Infringement Chart - Samsung SGH-A257 Magnet. Patent: 7202822, Fractus, 20091105	
	47	Infringement Chart - Samsung SGH-A837, Fractus, 20091105	
	48	Infringement Chart - Samsung SGH-A837. Patent: 7148850, Fractus, 20091105	
	49	Infringement Chart - Samsung SGH-A837. Patent: 7202822, Fractus, 20091105	
	50	Infringement Chart - Samsung SGH-A887, Fractus, 20091105	

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See attached certification statement.

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Signature	/Patrick J. Finnan/	Date (YYYY-MM-DD)	2020-03-27
Name/Print	Patrick J. Finnan	Registration Number	39189

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7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

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Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

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The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

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A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Patrick J. Finnan/	Date (YYYY-MM-DD)	2020-03-27
Name/Print	Patrick J. Finnan	Registration Number	39189

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	1	Document 0288 - Defendants LG Electronics Inc., LG Electronics USA, Inc., and LG Electronics Mobilecomm USA Inc. First amended answer and counterclaim to second amended complaint, Defendants, 20100224	
	2	Document 0290 - Defendant HTC America, Inc.'s amended answer and counterclaim to plaintiff's second amended complaint, Defendants, 20100224	
	3	Document 0291 - Defendant HTC Corporation's amended answer and counterclaim to plaintiff's second amended complaint, Defendants, 20100224	
	4	Document 0297 - Defendant HTC Corporation's amended answer and counterclaim to plaintiff's second amended complaint, Defendants, 20100225	
	5	Document 0298 - Defendant HTC America, Inc.'s amended answer and counterclaim to plaintiff's second amended complaint, Defendants, 20100225	
	6	Document 0351 - Plaintiff Fractus, S. A.'s answer to amended counterclaims of defendant Samsung Telecommunications America LLC's to Fractus's Second Amended Complaint, Susman Godfrey, 20100401	
	7	Document 0352 - Plaintiff Fractus, S. A.'s answer to amended counterclaims of defendant HTC Corporation to Fractus's Second Amended Complaint, Susman Godfrey, 20100401	
	8	Document 0353 - Plaintiff Fractus, S. A.'s answer to amended counterclaims of defendant HTC America, Inc. To Fractus's Second Amended Complaint, Susman Godfrey, 20100401	
	9	Document 0354 - Plaintiff Fractus, S. A.'s answer to amended counterclaims of defendant LG Electronics Inc., LG Electronics USA, Inc., and LG Electronics Mobilecomm USA Inc's to Fractus's Second Amended Complaint, Susman Godfrey, 20100401	
	10	Document 0415 - P.R. 4-3 joint claim construction statement, Susman Godfrey, 20100614	
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	12	Document 0428 - Response of defendants Kyocera Communications, Inc; Palm Inc. and UTStarcom, Inc. to plaintiff Fractus SA's opening claim construction brief in "Case 6:09-cv-00203-LED-JDL", Defendants, 20100730	
	13	Document 0429 - Declaration of Jeffery D. Baxter - Including Exhibits: J, K, L, M ,N ,O, P, Q, R, S, T, U, Z, AA, KK, LL, Defendants, 20100730	
	14	Document 0430 - Defendants RIM, Samsung, HTC, LG and Pantech's response to plaintiff Fractus SA's opening claim construction brief, Defendants, 20100730	
	15	Document 0430 - Defendants RIM, Samsung, HTC, LG and Pantech's response to plaintiff Fractus SA's opening claim construction brief - Exhibit 1 - Chart of Agreed Terms and Disputed Terms, Defendants, 20100730	
	16	Document 0430 - Defendants RIM, Samsung, HTC, LG and Pantech's response to plaintiff Fractus SA's opening claim construction brief - Exhibit 2 - Family Tree of Asserted Patents, Defendants, 20100730	
	17	Document 0430 - Defendants RIM, Samsung, HTC, LG and Pantech's response to plaintiff Fractus SA's opening claim construction brief - Exhibit 33 - Excerpt from Plaintiff's '868 pat. inf.cont.for Samsung SPH M540, Defendants, 20100730	
	18	Document 0430 - Defendants RIM, Samsung, HTC, LG and Pantech's response to plaintiff Fractus SA's opening claim construction brief - Exhibit 34 - Excerpts from Plaintiff's '431 patent Infringement Contentions of HTC Diamond, Defendants, 20100730	
	19	Document 0430 - Defendants RIM, Samsung, HTC, LG and Pantech's response to plaintiff Fractus SA's opening claim construction brief - Exhibit 41 - Demonstrative re: counting segments, Defendants, 20100730	
	20	Document 0430 - Defendants RIM, Samsung, HTC, LG and Pantech's response to plaintiff Fractus SA's opening claim construction brief - Exhibit 42 - Demonstrative showing how straight segments can be fitted over a curved surface, Defendants, 20100730	
	21	Document 0430 - Defendants RIM, Samsung, HTC, LG and Pantech's response to plaintiff Fractus SA's opening claim construction brief - Exhibit 57 - Excerpts from Plaintiff's '868 and '762 Pat. Infr. cont. for RIM 8310, Defendants, 20100730	
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	23		Document 0440-1 - Expert declaration by Dr. D. Jaggard including exhibits (curriculum and datasheets from Cushcraft, Antenova, Ethertronics and Taoglas), Susman Godfrey, 20100816	
	24		Document 0440-2 - Declaration of Micah Howe in support of Fractus SA opposition to defendants' motion for summary judgement of invalidity based on indefiniteness and lack of written description for certain terms, Heim , Payne and Chorus LLP, 20100816	
	25		Document 0452 - Defendant's reply in support of their motion for summary judgment of invalidity based on indefiniteness and lack of written description for certain terms with exhibits WW, BBB, EEE, GGG, HHH, III, KKK, MMM, NNN, OOO, PPP, Q, Defendants, 20100830	
	26		Document 0475 - Order. Provisional claim construction and motion for summary judgement. Provisional markman order, Court, 20101109	
	27		Document 0526 - Memorandum order and opinion, Court, 20101217	
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	29		Document 0582 - Memorandum opinion and order, Court, 20110120	
	30		Document 0583 - Defendant's notice of compliance regarding second amended invalidity contentions, Defendants, 20110121	
	31		Document 0607 - Declaration of Thomas E. Nelson - Exhibit A - Antenna photos, Defendants, 20110203	
	32		Document 0609 - Fractus' reply to defendant's motion for reconsideration of, and objections to, magistrate Judge Love's markman order, Susman Godfrey, 20110204	
	33		Document 0611 - Report and recommendation of United States magistrate judge, Court, 20110208	

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	35	Document 0624 - Notice of compliance with motion practice orders, Susman Godfrey, 20110214	
	36	Document 0641 - Defendant HTC America, Inc's second amended answer and counterclaim to plaintiff's second amended complaint, Defendants, 20110225	
	37	Document 0642 - Defendant HTC Corporation's second amended answer and counterclaim to plaintiff's second amended complaint, Defendants, 20110225	
	38	Document 0645 - Reply brief in support of Defendant's motion for reconsideration of the court's ruling on the term "at least a portion" in the court's December 17, 2010 claim construction order based on newly-available evidence, Defendants, 20110225	
	39	Document 0647 - Defendants Samsung Electronics Co LTD (et al) second amended answer and counterclaims to the second amended complaint of plaintiff Fractus SA - Document 647, Defendants, 20110228	
	40	Document 0649 - Defendants LG Electronics Inc, LG Electronics USA, and LG Electronics Mobilecomm USA Inc's second amended answer and counterclaim to second amended complaint, Defendants, 20110228	
	41	Document 0657 - Defendant Pantech Wireless Inc amended answer, affirmative defenses, and counterclaims to Fractus' second amended complaint, Defendants, 20110228	
	42	Document 0666 - Fractus's sur-reply to defendants' motion for reconsideration of the court's december 17, 2010 claim construction order based on newly-available evidence, Susman Godfrey, 20110308	
	43	Document 0670 - Order, Court, 20110309	
	44	Document 0678 - Plaintiff Fractus SA's answer to second amended counterclaims of defendant HTC Corporation to Fractus's second amended complaint, Susman Godfrey, 20110314	

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	46	Document 0694 - Plaintiff Fractus SA's answer to second amended counterclaims of defendant LG Electronics to Fractus's second amended complaint, Susman Godfrey, 20110315	
	47	Document 0695 - Plaintiff Fractus SA's answer to second amended counterclaims of defendant Samsung to Fractus's second amended complaint, Susman Godfrey, 20110315	
	48	Document 0696 - Plaintiff Fractus SA's answer to amended counterclaims of defendant Pantech Wireless Inc to Fractus's second amended complaint, Susman Godfrey, 20110315	
	49	Document 0715 - Letter to John D. Love - Permission to file a summary judgment motion of no indefiniteness on the issues wher the Court's Report and Recommendation already has held that the claim term is not indefinite, Susman Godfrey, 20110318	
	50	Document 0716 - Letter to John D. Love - Permission to file a partial summary judgement motion on infringement., Susman Godfrey , LLP, 20110318	

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**	Application Number	
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	First Named Inventor	Carles PUENTE BALIARDA
	Art Unit	
	Examiner Name	
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CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

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See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Patrick J. Finnan/	Date (YYYY-MM-DD)	2020-03-27
Name/Print	Patrick J. Finnan	Registration Number	39189

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	47	Kuhlman , E. A., A directional flush mounted UHF communications antenna for high performance jet aircraft for the 225-400 MC frequency range, USAF Antenna Research and Development Program, 5th , 1955. Symposium on the, 19551001	
	48	Kumar , G. ; Gupta , K., Nonradiating edges and four edges gap-coupled multiple resonator broadband microstrip antennas, Antennas and Propagation, IEEE Transactions on, 19850201	
	49	Kumar , G. ; Gupta , K., Directly coupled multiple resonator wide-band microstrip antennas, Antennas and Propagation, IEEE Transactions on, 19850606, Vol.AP-33	
	50	Kumar Bisoi , A. ; Mishra , J., On calculation of fractal dimension of images, Pattern Recognition Letters, 20010501, Vol.22	

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Examiner Signature	/DUNG HONG/	Date Considered	08/26/2020

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**	Application Number	
	Filing Date	
	First Named Inventor	Carles PUENTE BALIARDA
	Art Unit	
	Examiner Name	
	Attorney Docket Number	0690.0023CN4

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Patrick J. Finnan/	Date (YYYY-MM-DD)	2020-03-27
Name/Print	Patrick J. Finnan	Registration Number	39189

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3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

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6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

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Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

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	First Named Inventor	Carles PUENTE BALIARDA
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	Examiner Name	
	Attorney Docket Number	0690.0023CN4

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	Attorney Docket Number	0690.0023CN4

	1	Infringement Chart - Samsung Spex R210a. Patent: 7148850, Fractus, 20091105	
	2	Infringement Chart - Samsung Spex R210a. Patent: 7202822, Fractus, 20091105	
	3	Infringement Chart - Samsung SPH-A523, Fractus, 20091105	
	4	Infringement Chart - Samsung SPH-A523. Patent: 7148850, Fractus, 20091105	
	5	Infringement Chart - Samsung SPH-A523. Patent: 7202822, Fractus, 20091105	
	6	Infringement Chart - Samsung SPH-M550, Fractus, 20091105	
	7	Infringement Chart - Samsung SPH-M550. Patent: 7148850, Fractus, 20091105	
	8	Infringement Chart - Samsung SPH-M550. Patent: 7202822, Fractus, 20091105	
	9	Infringement Chart - Samsung SPH M520, Fractus, 20091105	
	10	Infringement Chart - Samsung SPH M520. Patent: 7148850, Fractus, 20091105	
	11	Infringement Chart - Samsung SPH M520. Patent: 7202822, Fractus, 20091105	

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	Examiner Name	
	Attorney Docket Number	0690.0023CN4

	12	Infringement Chart - Samsung SPH M540., Fractus, 20091105	
	13	Infringement Chart - Samsung SPH M540. Patent: 7148850, Fractus, 20091105	
	14	Infringement Chart - Samsung SPH M540. Patent: 7202822, Fractus, 20091105	
	15	Infringement Chart - Samsung Sway SCH-U650, Fractus, 20091105	
	16	Infringement Chart - Samsung Sway SCH-U650. Patent: 7148850, Fractus, 20091105	
	17	Infringement Chart - Samsung Sway SCH-U650. Patent: 7202822, Fractus, 20091105	
	18	Infringement Chart - Sanyo Katana II., Fractus, 20091105	
	19	Infringement Chart - Sanyo Katana II. Patent: 7148850, Fractus, 20091105	
	20	Infringement Chart - Sanyo Katana II. Patent: 7202822, Fractus, 20091105	
	21	Infringement Chart - Sanyo Katana LX, Fractus, 20091105	
	22	Infringement Chart - Sanyo Katana LX. Patent: 7148850, Fractus, 20091105	

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	23	Infringement Chart - Sanyo Katana LX. Patent: 7202822, Fractus, 20091105	
	24	Infringement Chart - Sanyo S1, Fractus, 20091105	
	25	Infringement Chart - Sanyo S1. Patent: 7148850, Fractus, 20091105	
	26	Infringement Chart - Sanyo S1. Patent: 7202822, Fractus, 20091105	
	27	Infringement Chart - Sanyo SCP 2700., Fractus, 20091105	
	28	Infringement Chart - Sanyo SCP 2700. Patent: 7148850, Fractus, 20091105	
	29	Infringement Chart - Sanyo SCP 2700. Patent: 7202822, Fractus, 20091105	
	30	Infringement Chart - Sharp Sidekick 3, Fractus, 20091105	
	31	Infringement Chart - Sharp Sidekick 3. Patent: 7148850, Fractus, 20091105	
	32	Infringement Chart - Sharp Sidekick 3. Patent: 7202822, Fractus, 20091105	
	33	Infringement Chart - Sharp Sidekick 2008., Fractus, 20091105	

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	34	Infringement Chart - Sharp Sidekick 2008. Patent: 7148850, Fractus, 20091105	
	35	Infringement Chart - Sharp Sidekick 2008. Patent: 7202822, Fractus, 20091105	
	36	Infringement Chart - Sharp Sidekick LX 2009., Fractus, 20091105	
	37	Infringement Chart - Sharp Sidekick LX 2009. Patent: 7148850, Fractus, 20091105	
	38	Infringement Chart - Sharp Sidekick LX 2009. Patent: 7202822, Fractus, 20091105	
	39	Infringement Chart - Sharp Sidekick LX. Patent: 7148850, Fractus, 20091105	
	40	Infringement Chart - Sharp Sidekick LX. Patent: 7202822, Fractus, 20091105	
	41	Infringement Chart - UTStarcom CDM7126., Fractus, 20091105	
	42	Infringement Chart - UTStarcom CDM7126. Patent: 7148850, Fractus, 20091105	
	43	Infringement Chart - UTStarcom CDM7126. Patent: 7202822, Fractus, 20091105	
	44	Infringement Chart - UTStarcom Quickfire GTX75., Fractus, 20091105	

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	46	Infringement Chart - UTStarcom Quickfire GTX75. Patent: 7202822, Fractus, 20091105	
	47	Claim construction and motion for summary judgement - Markman Hearing - [Defendants], Defendants, 20100902	
	48	Defendant's Invalidity Contentions including appendix B and exhibits 6, 7, 10, 11 referenced in Space Filling Antenna, Defendants, 20100224	
	49	Demonstratives presented by Dr. Steven Best during trial, Defendants, 20110519	
	50	Demonstratives presented by Dr. Stuart Long during trial, Fractus, 20110518	

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Signature	/Patrick J. Finnan/	Date (YYYY-MM-DD)	2020-03-27
Name/Print	Patrick J. Finnan	Registration Number	39189

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Doc description: Information Disclosure Statement (IDS) Filed

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	1	6317083		2001-11-13	JOHNSON	
	2	6320543		2001-11-20	OHATA	
	3	6326919		2001-12-04	DIXIMUS	
	4	6327485		2001-12-04	WALDRON	
	5	6329951		2001-12-11	WEN	
	6	6329954		2001-12-11	FUCHS	
	7	6329962		2001-12-11	YING	
	8	6333716		2001-12-25	PONTOPPIDAN	

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	9	6333719		2001-12-25	VARADAN	
	10	6343208		2002-01-29	YING	
	11	6346914		2002-02-12	ANNAMAA	
	12	6348892		2002-02-19	ANNAMAA	
	13	6352434		2002-03-05	EMMERT	
	14	6353443		2002-03-05	YING	
	15	6360105		2002-03-19	NAKADA	
	16	6366243		2002-04-02	ISOHATALA	
	17	6367939		2002-04-09	CARTER	
	18	6373447		2002-04-16	ROSTOKER	
	19	6380899		2002-09-30	MADSEN	

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	20	6380902		2002-04-30	DUROUX	
	21	6384790		2002-05-07	DISHART	
	22	6388626		2002-05-14	GAMALIELSSON	
	23	6392610		2002-05-21	BRAUN	
	24	6396444		2002-05-28	GOWARD	
	25	6407710		2002-06-18	KEILEN	
	26	6408190		2002-06-18	YING	
	27	6417810		2002-07-09	HUELS	
	28	6417816		2002-07-09	SADLER	
	29	6421013		2002-07-16	CHUNG	
	30	6431712		2002-08-13	TURNBULL	

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	31	6445352		2002-09-03	COHEN	
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	33	6452553		2002-09-17	COHEN	
	34	6452556		2002-09-17	HA	
	35	6470174		2002-10-22	SCHEFTE	
	36	6476766		2002-11-05	COHEN	
	37	6476769		2002-11-05	LEHTOLA	
	38	6480159		2002-11-12	ILSU	
	39	6483462		2002-11-19	WEINBERGER	
	40	6496154		2002-12-17	GYENES	
	41	6498586		2002-12-24	PANKINAHO	

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	42	6498588		2002-12-24	CALLAGHAN	
	43	6525691		2003-02-25	VARADAN	
	44	6538604		2003-03-25	ISOHATALA	
	45	6552690		2003-04-22	VEERASAMY	
	46	6573867		2003-06-03	DESCLOS	
	47	6597319		2003-07-22	MENG	
	48	6603434		2003-08-05	LINDENMEIER	
	49	6618017		2003-09-09	RYKEN	
	50	6650294		2003-11-18	YING	

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	2	01/73890	WO		2001-10-04	WALSTRA		
	3	01/78192	WO		2001-10-18	WEN		
	4	01/82410	WO		2001-11-01	PUENTE		
	5	01/86753	WO		2001-11-15	HACKERT		
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Signature	/Patrick J. Finnan/	Date (YYYY-MM-DD)	2020-03-27
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Signature	/Patrick J. Finnan/	Date (YYYY-MM-DD)	2020-03-27
Name/Print	Patrick J. Finnan	Registration Number	39189

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	31	Infringement Chart - Samsung SGH A437. Patent: 7202822, Fractus, 20091105	
	32	Infringement Chart - Samsung SGH A737, Fractus, 20091105	
	33	Infringement Chart - Samsung SGH A737. Patent: 7148850, Fractus, 20091105	

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**		
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	First Named Inventor	Carles PUENTE BALIARDA
	Art Unit	
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	Attorney Docket Number	0690.0023CN4

	34	Infringement Chart - Samsung SGH A737. Patent: 7202822, Fractus, 20091105	
	35	Infringement Chart - Samsung SGH A867, Fractus, 20091105	
	36	Infringement Chart - Samsung SGH A867. Patent: 7148850, Fractus, 20091105	
	37	Infringement Chart - Samsung SGH A867. Patent: 7202822, Fractus, 20091105	
	38	Infringement Chart - Samsung SGH T229, Fractus, 20091105	
	39	Infringement Chart - Samsung SGH T229. Patent: 7148850, Fractus, 20091105	
	40	Infringement Chart - Samsung SGH T229. Patent: 7202822, Fractus, 20091105	
	41	Infringement Chart - Samsung SGH T439, Fractus, 20091105	
	42	Infringement Chart - Samsung SGH T439. Patent: 7148850, Fractus, 20091105	
	43	Infringement Chart - Samsung SGH T439. Patent: 7202822, Fractus, 20091105	
	44	Infringement Chart - Samsung SGH T459, Fractus, 20091105	

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	Attorney Docket Number	0690.0023CN4

	45	Infringement Chart - Samsung SGH T459. Patent: 7148850, Fractus, 20091105	
	46	Infringement Chart - Samsung SGH T459. Patent: 7202822, Fractus, 20091105	
	47	Infringement Chart - Samsung SGH T919, Fractus, 20091105	
	48	Infringement Chart - Samsung SGH T919. Patent: 7148850, Fractus, 20091105	
	49	Infringement Chart - Samsung SGH T919. Patent: 7202822, Fractus, 20091105	
	50	Infringement Chart - Samsung Spex R210a, Fractus, 20091105	

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☒ A certification statement is not submitted herewith.

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Signature	/Patrick J. Finnan/	Date (YYYY-MM-DD)	2020-03-27
Name/Print	Patrick J. Finnan	Registration Number	39189

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7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
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	Attorney Docket Number	0690.0023CN4

	1	US13/020034 - Communication to examiner and preliminary amendment, Howison & Arnott, 20120724	
	2	US13/020034 - Notice of allowance dated April 23, 2012, USPTO, 20120423	
	3	US13/020034 - Notice of allowance dated January 15, 2013, USPTO, 20130115	
	4	US13/020034 - Notice of allowance dated on April 03, 2013, USPTO, 20130403	
	5	US13/020034 - Office Action dated on November 8, 2011, USPTO, 20111108	
	6	US13/038883 - Amendment and response to office action dated December 1, 2011, Howison & Arnott, 20120403	
	7	US13/038883 - Amendment and response to office action dated on July 2, 2013, Howison and Arnott, 20130725	
	8	US13/038883 - Amendment to the claims and RCE, Howison & Arnott, 20130607	
	9	US13/038883 - Communication to examiner and preliminary amendment, Howison & Arnott, 20120810	
	10	US13/038883 - Notice of allowance dated April 30, 2012, USPTO, 20120430	
	11	US13/038883 - Notice of allowance dated August 6, 2013, USPTO, 20130806	

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	Examiner Name	
	Attorney Docket Number	0690.0023CN4

	12	US13/038883 - Notice of Allowance dated on April 2, 2013, USPTO, 20130402	
	13	US13/038883 - Office action dated on December 1, 2011, USPTO, 20111201	
	14	US13/038883 - Office action dated on July 2, 2013, USPTO, 20130702	
	15	US13/044207 - Amendment and response to office action dated on December 5, 2011, Howison & Arnott, 20120403	
	16	US13/044207 - Amendment and response to office action dated on July 2, 2013, Howison and Arnott, 20130725	
	17	US13/044207 - Amendment to the claims and RCE, Howison & Arnott, 20130607	
	18	US13/044207 - Communication to examiner and preliminary amendment, Howison & Arnott, 20120814	
	19	US13/044207 - Notice of allowance dated August 5, 2013, USPTO, 20130805	
	20	US13/044207 - Notice of allowance dated May 01, 2012, USPTO, 20120501	
	21	US13/044207 - Notice of Allowance dated on April 2, 2013, USPTO, 20130402	
	22	US13/044207 - Office action dated on December 5, 2011, USPTO, 20111205	

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	23	US13/044207 - Office action dated on July 2, 2013, USPTO, 20130702	
	24	US95/000592 - Request for inter partes reexamination for US patent 7202822 including exhibits from CC1 to CC6, Kyocera, 20101116	
	25	US95/000593 - Request for inter partes reexamination for US patent 7148850 including exhibits from CC1 to CC7, Kyocera, 20101116	
	26	US95/000598 - Request for inter partes reexamination for US patent 7148850 including exhibits from C1 to F3, HTC, 20101203	
	27	US95/000610 - Request for inter partes reexamination of US patent no. 7202822 including exhibits C1-I5, HTC, 20101214	
	28	US95/001389 - Office Action for the US patent 7123208 dated on August 12, 2010, USPTO, 20100812	
	29	US95/001390 - Office Action for the US patent 7015868 dated August 19, 2010, USPTO, 20100819	
	30	US95/001390 - Response to the Office Action for the US patent 7015868 dated on August 19, 2010, Sterne Kessler Goldstein Fox, 20101119	
	31	US95/001413 - Request for inter partes reexamination for US patent 7148850 including claim charts from CC-A to CC-F, Samsung, 20100804	
	32	US95/001413 - Request for inter partes reexamination for US patent 7148850. CC-F: Claim Chart Comparing Claims 1, 4, 6, 16, 17, 19, 21, 22, 24-26, 29, 35, 38, 40, 45-48, 51, 53, 57, 58, 61, 65, 66, 69, and 70 to US patent 5363114 Shoemaker, Samsung, 20100801	
	33	US95/001413 - Request for inter partes reexamination for US patent no 7148850. CC-A: Claim Chart Comparing Claims 1, 4, 6, 17, 19, 21, 22, 24-26, 29, 35, 38, 40, 45-48, 51, 53, 58, 61, 65, 66, 69, and 70 to US patent 6140975 Cohen, Samsung, 20100801	

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	Attorney Docket Number	0690.0023CN4

	34	US95/001413 - Request for inter partes reexamination for US patent no 7148850. CC-B: Claim Chart Comparing Claims 1, 4, 6, 16, 17, 19, 21, 22, 24-26, 29, 35, 38, 40, 45-48, 51, 53, 57, 58, 61, 65, 66, 69 and 70 to US patent 6140975 Cohen, Samsung, 20100801	
	35	US95/001413 - Request for inter partes reexamination for US patent no 7148850. CC-C: Claim Chart Comparing Claims 1, 4, 6, 17, 19, 21, 22, 24-26, 29, 35, 38, 40, 45-48, 53, 58, 61, 65, 66, and 69 to US patent 6140975 Cohen, Samsung, 20100801	
	36	US95/001413 - Request for inter partes reexamination for US patent no 7148850. CC-D: Claim Chart Comparing Claims 1, 4, 6, 16, 17, 19, 21, 22, 24-26, 29, 35, 38, 40, 45-48, 51, 53, 57, 58, 61, 65, 66, and 69 to US patent 6140975 Cohen, Samsung, 20100801	
	37	US95/001413 - Request for inter partes reexamination for US patent no 7148850. CC-E: Claim Chart Comparing Claims 1, 4, 6, 16-17, 19, 21, 22, 24-26, 29, 35, 38, 40, 45-48, 51, 53, 57, 58, 61, 65, 66, 69 and 70 to patent EP0590671B1 Sekine, Samsung, 20100801	
	38	US95/001413 - US95/000593 - Action Closing Prosecution dated on April 20, 2012 for US patent 7148850, USPTO, 20120420	
	39	US95/001413 - US95/000593 - Action closing prosecution dated on July 27, 2012 for US patent 7148850, USPTO, 20120727	
	40	US95/001413 - US95/000593 - Inter partes reexamination certificate for US patent 7148850, USPTO, 20130606	
	41	US95/001413 - US95/000593 - Patent owner amendment in response to the Right of Appeal Notice mailed December 13, 2012 for US patent 7148850, Edell , Shapiro & Finnan, LLC, 20130313	
	42	US95/001413 - US95/000593 - Right of appeal notice for the US7148850, USPTO, 20121213	
	43	US95/001413 - US95/000593 - Third party requester's comments to patent owner's response of October 31, 2011 for US patent 7148850, Samsung - Kyocera, 20120323	
	44	US95/001413 - US95/000593 - US95/000598- Third party requester's comments to patent owner's reply dated on April 11, 2011 for US patent 7148850, Samsung - Kyocera - HTC, 20110502	

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	45	US95/001413 - US95/000593 - US95/000598- Third party requester's comments to patent owner's reply dated on January 10, 2011 for US patent 7148850, Samsung - Kyocera - HTC, 20110209	
	46	US95/001413 - US95/000593 - US95/000598 - Corrected Patent Owner´s Response to First Office Action of October 8, 2010 of US patent no. 7148850, Sterne Kessler Goldstein Fox, 20110411	
	47	US95/001413 - US95/000593 - US95/000598 - Corrected Patent Owner´s Response to First Office Action of October 8, 2010 of US patent no. 7148850 - Exhibit 1, Sterne Kessler Goldstein Fox, 20110411	
	48	US95/001413 - US95/000593 - US95/000598 - Decision Sua Sponte to merge reexamination proceedings of US patent 7148850, USPTO, 20110608	
	49	US95/001413 - US95/000593 - US95/000598 - Office action for the US patent 7148850 dated on October 8, 2010, USPTO, 20101008	
	50	US95/001413 - US95/000593 - US95/000598 - Office Action of US patent 7148850 dated July 29, 2011, USPTO, 20110729	

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Signature	/Patrick J. Finnan/	Date (YYYY-MM-DD)	2020-03-27
Name/Print	Patrick J. Finnan	Registration Number	39189

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Signature	/Patrick J. Finnan/	Date (YYYY-MM-DD)	2020-03-27
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A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Patrick J. Finnan/	Date (YYYY-MM-DD)	2020-03-27
Name/Print	Patrick J. Finnan	Registration Number	39189

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /D.H/

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

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Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	
	Filing Date	
	First Named Inventor	Carles PUENTE BALIARDA
	Art Unit	
	Examiner Name	
	Attorney Docket Number	0690.0023CN4

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	First Named Inventor	Carles PUENTE BALIARDA
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	Examiner Name	
	Attorney Docket Number	0690.0023CN4

	1	US10/822933 - Response to Office Action dated on October 5, 2006, Jenkens & Gilchrist, 20070104	
	2	US10/963080 - Notice of allowance dated on September 1, 2005., USPTO, 20050901	
	3	US10/963080 - Preliminary amendment - Declaration of J. Baxter - Exhibit W, Jones Day, 20041210	
	4	US11/021597 - Office action dated October 30, 2007, USPTO, 20071030	
	5	US11/021597 - Office Action dated on March 12, 2007, USPTO, 20070312	
	6	US11/021597 - Response to the Office Action dated March 12, 2007, Winstead, 20070809	
	7	US11/021597 - Response to the office action dated October 30, 2007, Winstead, 20071228	
	8	US11/033788 - Response to Office Action dated February 7, 2006, Jenkens & Gilchrist, 20060601	
	9	US11/102390 - Notice of allowance dated on July 6, 2006., USPTO, 20060625	
	10	US11/110052 - Notice of Allowance dated on March 29, 2006, USPTO, 20060331	
	11	US11/110052 - Notice of Allowance dated on May 30, 2006, USPTO, 20060530	

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	Attorney Docket Number	0690.0023CN4

	12	US11/110052 - Preliminary amendment dated on April 18, 2005, Howison & Arnott, 20050418	
	13	US11/124768 - Amendment in response to non-final office action dated August 23, 2006, Jenkens & Gilchrist, 20061113	
	14	US11/154843 - Amendment and response to office action dated August 2, 2006, Howison & Arnott, 20060811	
	15	US11/154843 - Notice of Allowance dated on October 24, 2006, USPTO, 20061024	
	16	US11/154843 - Office Action dated on August 2, 2006, USPTO, 20060802	
	17	US11/154843 - Office action dated on May 9, 2006, USPTO, 20060509	
	18	US11/179250 - Notice of Allowance dated on January 20, 2007, USPTO, 20070126	
	19	US11/179250 - Response office action, Howison & Arnott, 20050712	
	20	US11/179257 - Notice of allowance dated on October 19, 2006, USPTO, 20061019	
	21	US11/550256 - Office Action dated on January 15, 2008, USPTO, 20080115	
	22	US11/614429 - Office Action dated on August 16, 2010, USPTO, 20100816	

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	23	US11/614429 - Office Action dated on March 7, 2011, USPTO, 20110307	
	24	US11/614429 - Office action dated on March 19, 2013, USPTO, 20130319	
	25	US11/614429 - Office Action dated on May 27, 2011., USPTO, 20110527	
	26	US11/614429 - Response to the Final Office Action dated on May 27, 2011, Winstead, 20111123	
	27	US11/614429 - Response to the Office Action dated on August 16, 2010, Winstead, 20110211	
	28	US11/686804 - Amendment and response to office action dated April 15, 2008, Howison & Arnott, 20080709	
	29	US11/686804 - Notice of Allowance dated on September 9, 2008, USPTO, 20080909	
	30	US11/686804 - Office action dated on April 15, 2008., USPTO, 20080415	
	31	US11/780932 - Preliminary amendment dated on July 20, 2007, Howison & Arnott, 20070720	
	32	US12/309463 - Amendment after final action, Winstead, 20120523	
	33	US12/309463 - Office action, USPTO, 20120328	

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	34	US12/309463 - Office action dated on August 04, 2011, USPTO, 20110804	
	35	US12/309463 - Response to non-final office action dated on August 4, 2011, Winstead, 20120123	
	36	US12/347462 - Amendment and response to office action dated October 28, 2009, Howison & Arnott, 20100315	
	37	US12/347462 - Amendment and response to office action dated on December 7, 2011, Howison & Arnott, 20120403	
	38	US12/347462 - Notice of allowance dated on April 13, 2012, USPTO, 20120413	
	39	US12/347462 - Notice of Allowance dated on April 19, 2010, USPTO, 20100419	
	40	US12/347462 - Notice of Allowance dated on June 29, 2010, USPTO, 20100629	
	41	US12/347462 - Notice of Allowance dated on May 18, 2009, USPTO, 20090518	
	42	US12/347462 - Office Action dated on December 07, 2011, USPTO, 20111207	
	43	US12/347462 - Office Action dated on October 28, 2009, USPTO, 20091028	
	44	US12/498090 - Amendment and response to office action dated December 30, 2011, Howison & Arnott, 20120403	

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	45	US12/498090 - Notice of allowance dated on April 13, 2012, USPTO, 20120413	
	46	US12/498090 - Notice of Allowance dated on March 10, 2011, USPTO, 20110310	
	47	US12/498090 - Office Action dated on August 18, 2010, USPTO, 20100818	
	48	US12/498090 - Office action dated on December 30, 2011, USPTO, 20111230	
	49	US12/498090 - Response to office action dated on August 18, 2010, Howison & Arnott, 20110117	
	50	US13/020034 - Amendment and response to office action dated on November 8, 2011, Howison & Arnott, 20120403	

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EXAMINER SIGNATURE

Examiner Signature	/DUNG HONG/	Date Considered	08/26/2020

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

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	First Named Inventor	Carles PUENTE BALIARDA
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	Examiner Name	
	Attorney Docket Number	0690.0023CN4

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Patrick J. Finnan/	Date (YYYY-MM-DD)	2020-03-27
Name/Print	Patrick J. Finnan	Registration Number	39189

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	Filing Date	
	First Named Inventor	Carles PUENTE BALIARDA
	Art Unit	
	Examiner Name	
	Attorney Docket Number	0690.0023CN4

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	First Named Inventor	Carles PUENTE BALIARDA
	Art Unit	
	Examiner Name	
	Attorney Docket Number	0690.0023CN4

	1	Infringement Chart - Blackberry 8220. Patent: 7202822, Fractus, 20091105	
	2	Infringement Chart - Blackberry 8310. Patent: 7148850, Fractus, 20091105	
	3	Infringement Chart - Blackberry 8310. Patent:7202822, Fractus, 20091105	
	4	Infringement Chart - Blackberry 8320. Patent: 7148850, Fractus, 20091105	
	5	Infringement Chart - Blackberry 8320. Patent: 7202822, Fractus, 20091105	
	6	Infringement Chart - Blackberry 8330. Patent: 7148850, Fractus, 20091105	
	7	Infringement Chart - Blackberry 8330. Patent: 7202822, Fractus, 20091105	
	8	Infringement Chart - Blackberry 8820. Patent: 7148850, Fractus, 20091105	
	9	Infringement Chart - Blackberry 8820. Patent: 7202822, Fractus, 20091105	
	10	Infringement Chart - Blackberry 8830. Patent: 7148850, Fractus, 20091105	
	11	Infringement Chart - Blackberry 8830. Patent: 7202822, Fractus, 20091105	

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	First Named Inventor	Carles PUENTE BALIARDA
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	Examiner Name	
	Attorney Docket Number	0690.0023CN4

	12	Infringement Chart - Blackberry 8900. Patent: 7148850, Fractus, 20091105	
	13	Infringement Chart - Blackberry 8900. Patent: 7202822, Fractus, 20091105	
	14	Infringement Chart - Blackberry 9630. Patent: 7148850, Fractus, 20091105	
	15	Infringement Chart - Blackberry 9630. Patent: 7202822, Fractus, 20091105	
	16	Infringement Chart - Blackberry Bold 9000. Patent: 7148850, Fractus, 20091105	
	17	Infringement Chart - Blackberry Bold 9000. Patent: 7202822, Fractus, 20091105	
	18	Infringement Chart - Blackberry Storm 9530. Patent: 7148850, Fractus, 20091105	
	19	Infringement Chart - Blackberry Storm 9530. Patent: 7202822, Fractus, 20091105	
	20	Infringement Chart - HTC Dash, Fractus, 20091105	
	21	Infringement Chart - HTC Dash. Patent: 7148850, Fractus, 20091105	
	22	Infringement Chart - HTC Dash. Patent: 7202822, Fractus, 20091105	

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	23	Infringement Chart - HTC Diamond, Fractus, 20091105	
	24	Infringement Chart - HTC Diamond. Patent: 7148850, Fractus, 20091105	
	25	Infringement Chart - HTC Diamond. Patent: 7202822, Fractus, 20091105	
	26	Infringement Chart - HTC G1 Google., Fractus, 20091105	
	27	Infringement Chart - HTC G1 Google. Patent: 7148850, Fractus, 20091105	
	28	Infringement Chart - HTC G1 Google. Patent: 7202822, Fractus, 20091105	
	29	Infringement Chart - HTC My Touch., Fractus, 20091105	
	30	Infringement Chart - HTC My Touch. Patent: 7148850, Fractus, 20091105	
	31	Infringement Chart - HTC My Touch. Patent: 7202822, Fractus, 20091105	
	32	Infringement Chart - HTC Ozone, Fractus, 20091105	
	33	Infringement Chart - HTC Ozone. Patent: 7148850, Fractus, 20091105	

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	34	Infringement Chart - HTC Ozone. Patent: 7202822, Fractus, 20091105	
	35	Infringement Chart - HTC Pure, Fractus, 20091105	
	36	Infringement Chart - HTC Pure. Patent: 7148850, Fractus, 20091105	
	37	Infringement Chart - HTC Pure. Patent: 7202822, Fractus, 20091105	
	38	Infringement Chart - HTC Snap, Fractus, 20091105	
	39	Infringement Chart - HTC Snap. Patent: 7148850, Fractus, 20091105	
	40	Infringement Chart - HTC Snap. Patent: 7202822, Fractus, 20091105	
	41	Infringement Chart - HTC TILT 8925., Fractus, 20091105	
	42	Infringement Chart - HTC TILT 8925. Patent: 7148850, Fractus, 20091105	
	43	Infringement Chart - HTC TILT 8925. Patent: 7202822, Fractus, 20091105	
	44	Infringement Chart - HTC Touch Pro 2, Fractus, 20091105	

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	45	Infringement Chart - HTC Touch Pro 2 CDMA. Patent: 7148850, Fractus, 20091105	
	46	Infringement Chart - HTC Touch Pro 2. Patent: 7202822, Fractus, 20091105	
	47	Infringement Chart - HTC Touch Pro Fuze, Fractus, 20091105	
	48	Infringement Chart - HTC Touch Pro Fuze. Patent: 7148850, Fractus, 20091105	
	49	Infringement Chart - HTC Touch Pro Fuze. Patent: 7202822, Fractus, 20091105	
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☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Patrick J. Finnan/	Date (YYYY-MM-DD)	2020-03-27
Name/Print	Patrick J. Finnan	Registration Number	39189

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	Examiner Name	
	Attorney Docket Number	0690.0023CN4

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A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Patrick J. Finnan/	Date (YYYY-MM-DD)	2020-03-27
Name/Print	Patrick J. Finnan	Registration Number	39189

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2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

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7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

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	2	Infringement Chart - LG VX5500, Fractus, 20091105	
	3	Infringement Chart - LG VX5500. Patent: 7148850, Fractus, 20091105	
	4	Infringement Chart - LG VX5500. Patent: 7202822, Fractus, 20091105	
	5	Infringement Chart - LG VX8350, Fractus, 20091105	
	6	Infringement Chart - LG VX8350. Patent: 7148850, Fractus, 20091105	
	7	Infringement Chart - LG VX8350. Patent: 7202822, Fractus, 20091105	
	8	Infringement Chart - LG VX8360., Fractus, 20091105	
	9	Infringement Chart - LG VX8360. Patent: 7148850, Fractus, 20091105	
	10	Infringement Chart - LG VX8360. Patent: 7202822, Fractus, 20091105	
	11	Infringement Chart - LG VX8500, Fractus, 20091105	

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	13	Infringement Chart - LG VX8500. Patent: 7202822, Fractus, 20091105	
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	17	Infringement Chart - LG VX8610, Fractus, 20091105	
	18	Infringement Chart - LG VX8610. Patent: 7148850, Fractus, 20091105	
	19	Infringement Chart - LG VX8610. Patent: 7202822, Fractus, 20091105	
	20	Infringement Chart - LG VX8800, Fractus, 20091105	
	21	Infringement Chart - LG VX8800. Patent: 7148850, Fractus, 20091105	
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	24	Infringement Chart - LG Xenon GR500., Fractus, 20091105	
	25	Infringement Chart - LG Xenon GR500. Patent: 7148850, Fractus, 20091105	
	26	Infringement Chart - LG Xenon GR500. Patent: 7202822, Fractus, 20091105	
	27	Infringement Chart - Palm Centro 685, Fractus, 20091105	
	28	Infringement Chart - Palm Centro 685. Patent: 7148850, Fractus, 20091105	
	29	Infringement Chart - Palm Centro 685. Patent: 7202822, Fractus, 20091105	
	30	Infringement Chart - Palm Centro 690, Fractus, 20091105	
	31	Infringement Chart - Palm Centro 690. Patent: 7148850, Fractus, 20091105	
	32	Infringement Chart - Palm Centro 690. Patent: 7202822, Fractus, 20091105	
	33	Infringement Chart - Palm Pre, Fractus, 20091105	

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	47	Infringement Chart - Pantech DUO C810. Patent: 7202822, Fractus, 20091105	
	48	Infringement Chart - Pantech Slate C530, Fractus, 20091105	
	49	Infringement Chart - Phone: LG Dare VX9700, Fractus, 20091105	
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	1	US95/001413 - US95/000593 - US95/000598 - Patent owner´s response to first office action for US patent 7148850 of July 29, 2011, Sterne Kessler Goldstein Fox, 20111031	
	2	US95/001414 - Corrected Patent Owner´s Response to Office Action of October 8, 2010 of US patent no. 7202822, Sterne Kessler Goldstein Fox, 20110411	
	3	US95/001414 - Office action for the US patent 7202822 dated on October 8, 2010, USPTO, 20101008	
	4	US95/001414 - Request for inter partes reexamination for US patent 7202822 including claim charts from CC-A-1 to CCD, Samsung, 20100804	
	5	US95/001414 - Request for inter partes reexamination for US patent no. 7202822 - CC-A-1 - Claim chart comparing claims 1, 4-5, 7-9, 20-21, 25 and 31 of US patent 7202822 to US patent 6140975, Samsung, 20100809	
	6	US95/001414 - Request for inter partes reexamination for US patent no. 7202822 - CC-D - Claim Chart Comparing claims 1, 4-5, 7-9, 12, 13, 15, 18, 21, 25, 29-31, 35, 44, 46, 48 and 52 of US patent no. 7202822 to U.S. Pat.5363114 to Shoemaker, Samsung, 20100804	
	7	US95/001414 - Request for inter partes reexamination for US patent no. 7202822 issued April 10, 2007 - CC-C - Claim Chart Comparing claims 1, 4, 5, 7-9, 12, 13, 15, 18, 21, 25, 29-31, 35, 44, 46, 48 and 52 of US patent no.7202822 to Sanad., Samsung, 20100804	
	8	US95/001414 - Request for inter partes reexamination for US patent no. 7202822. Exhibit CC-A-2. Claim chart comparing claims 1, 4-5, 7-9, 12-13, 15, 18, 20-22, and 31 of US patent 7202822 to US patent 6140975, Samsung, 20100809	
	9	US95/001414 - Request for inter partes reexamination for US patent no. 7202822. Exhibit CC-A-3. Claim Chart Comparing claims 1, 4, 5, 7-9, 12, 13, 15, 18, 20-25, 29-31, 35, 44, 46, 48, 52 and 53 of US patent 7202822 to US patent 6140975, Samsung, 20100809	
	10	US95/001414 - Request for inter partes reexamination for US patent no. 7202822. Exhibit CC-A-4 Claim Chart Comparing claims 1, 4, 5, 7-9, 12, 13, 15, 18, 20-25, 29-31, 35, 44, 46, 48, 52 and 53 of US patent 7202822 to US patent 6140975, Samsung, 20100809	
	11	US95/001414 - Request for inter partes reexamination for US patent no. 7202822. Exhibit CC-B Claim Chart Comparing claims 1, 4, 5, 7-9, 13, 15, 18, 20-25, 29-31, 35, 44, 46, 48, 52, and 53 of US 7202822 to Sekine, Samsung, 20100809	

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	First Named Inventor	Carles PUENTE BALIARDA	
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	12	US95/001414 - Request for inter partes reexamination of US patent no. 7202822 issued April 10, 2007 - OTH-B - Samsung SCH U340, Samsung, 20100810	
	13	US95/001414 - Request for inter partes reexamination of US patent no. 7202822 issued April 10, 2007 - OTH-C - Samsung SCH-R500, Samsung, 20100810	
	14	US95/001414 - Request for inter partes reexamination of US patent no. 7202822 issued April 10, 2007 - OTH-D - Civil Action No. 6:09-cv-00203, Samsung, 20100528	
	15	US95/001414 - Third party requester's comments to patent owner's reply dated on January 10, 2011 for US patent 7202822, Samsung, 20110209	
	16	US95/001414 - US95/000592 - Action closing prosecution dated August 9, 2012 for US patent 7202822, USPTO, 20120809	
	17	US95/001414 - US95/000592 - Action Closing Prosecution dated on April 20, 2012 for US patent 7202822, USPTO, 20120420	
	18	US95/001414 - US95/000592 - Patent owner amendment in response to Right of Appeal Notice mailed on December 13, 2012 for US patent 7202822, Edell , Shapiro & Finnan , LLC, 20130313	
	19	US95/001414 - US95/000592 - Right of appeal notice for the US7202822, USPTO, 20121217	
	20	US95/001414 - US95/000592 - US95/000610 - Decision Sua Sponte to merge reexamination proceedings of US patent 7202822, USPTO, 20110607	
	21	US95/001414 - US95/000592 - US95/000610 - Office Action of US patent 7202822 dated July 29, 2011, USPTO, 20110729	
	22	US95/001414 - US95/000592 - US95/000610 - Patent owner´s response to first office action of July 29, 2011 of US patent 7202822, Sterne Kessler Goldstein Fox, 20111031	

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	23	US95/001414 - US95/000592 - US95/000610 - Third party requester's comments to patent owner's response of October 31, 2011 for US patent 7202822, Samsung - Kyocera - HTC, 20120323	

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The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

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Name/Print	Patrick J. Finnan	Registration Number	39189

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7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

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	Attorney Docket Number	0690.0023CN4

	1	Document 0721 - Letter to John D. Love - Permission to file a motion for summary judgment of invalidity of the following 7 asserted claims from the MLV, patent family..., Defendants - Baker Botts, LLP, 20110318	
	2	Document 0768 - Fractus, S.A.'s objections to the Court's March 9, 2011, Order, Susman Godfrey, 20110325	
	3	Document 0780 - Defendants' opposition to Fractus SA objections to the Court's March 9, 2011 Order, Defendants - Baker Botts, LLP, 20110331	
	4	Document 0783 - Order, Court, 20110401	
	5	Document 0841 - Stipulation of Dismissal of all Claims and Counterclaims re '850 and '822, Defendants, 20110415	
	6	Document 0843 - Joint Motion to Dismiss Claims and Counterclaims re '850 and '822, Defendants, 20110415	
	7	Document 0854 - Defendants' Motion to Clarify Claim Construction, Defendants, 20110418	
	8	Document 0868 - Order, Court, 20110419	
	9	Document 0876 - Fractus's surreply to defendants' Motion for Summary Judgment re publication dates of three references, Susman Godfrey, 20110420	
	10	Document 0887 - Fractus's Response to Defendants' Motion to Clarify Claim Construction, Susman Godfrey, 20110425	
	11	Document 0889 - Reply in support of defendants' motion to clarify claim construction, Defendants, 20110427	

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	12	Document 0893 - Fractus SA's surreply to defendant's motion to clarify claim construction, Susman Godfrey, 20110429	
	13	Document 0900 - Order, Court, 20110429	
	14	Document 0901 - Report and recommendation of United States Magistrate Judge, Court, 20110502	
	15	Document 0902 - Fractus SA's objections to defendants' prior art notice, Susman Godfrey, 20110502	
	16	Document 0915 - Defendants' response to plaintiff's objections to defendants notice of prior art, Defendants, 20110505	
	17	Document 0933 - Defendants' motion for reconsideration of, and objections to, the May 2, 2011 report and recommendation clarifying claim construction, Defendants, 20110509	
	18	Document 0939 - Fractus's response to defendants' motion for reconsideration of and objections to the May 2, 2011, report and recommendations clarifying claim construction, Susman Godfrey, 20110510	
	19	Document 0968 - Order, Court, 20110513	
	20	Document 0971 - Order, Court, 20110513	
	21	Document 1082 - Joint motion to dismiss HTC, Susman Godfrey LLP, 20110913	
	22	Document 1083 - Order - Final consent judgement HTC, Court, 20110915	

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	23	Document 1088 - Samsung's motion to determine intervening rights in view of new Federal Circuit case law or, in the alternative, to stay the case pending the outcome of reexamination, Defendants, 20111019	
	24	Document 1091 - Fractus's response to Samsung's motion to determine intervening rights or to stay the case pending the outcome of reexamination, Susman Godfrey LLC, 20111102	
	25	Document 1092 - Samsung's reply in support of its motion to determine intervening rights in view of new Federal Circuit case law or, in the alternative, to stay the case pending the outcome of reexamination, Defendants, 20111114	
	26	Expert report of Dr. Warren L. Stutzman (redacted) - expert witness retained by Fractus, Fractus, 20110223	
	27	Expert report of Dwight L. Jaggard (redacted) - expert witness retained by Fractus, Fractus, 20110223	
	28	Expert report of Dwight L. Jaggard (redacted) - expert witness retained by Fractus, Fractus, 20110223, Pages: ii-vi, 12-24	
	29	Expert report of Stuart Long (redacted) - expert witness retained by Fractus, Fractus, 20110223	
	30	Fractus' Claim Construction Presentation - Markman Hearing, Fractus, 20100902	
	31	Letter from Baker Botts to Howison & Arnott LLP including exhibits, Defendants - Baker Botts, 20100805	
	32	Letter from Baker Botts to Kenyon & Kenyon LLP, Winstead PC and Howison & Arnott LLP including exhibits., Defendants - Baker Botts, 20091028	
	33	Oral and videotaped deposition of Dr. Stuart Long - Volume 1, , 20110311	

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	34	Oral and videotaped deposition of Dr. Stuart Long - Volume 2, Fractus, 20110313	
	35	Oral and videotaped deposition of Dr. Stuart Long - Volume 3, Fractus, 20110314	
	36	Oral and videotaped deposition of Dr. Warren L. Stutzman - Volume 1, Fractus, 20110303	
	37	Oral and videotaped deposition of Dr. Warren L. Stutzman - Volume 2, Fractus, 20110304	
	38	Rebuttal expert report of Dr. Dwight L. Jaggard (redacted version), Fractus, 20110216	
	39	Rebuttal expert report of Dr. Stuart A. Long (redacted version), Fractus, 20110216	
	40	Rebuttal expert report of Dr. Warren L. Stutzman (redacted version), Fractus, 20110216	
	41	The oral and videotaped deposition of Dwight Jaggard. Volume 1, Defendants, 20110308	
	42	The oral and videotaped deposition of Dwight Jaggard. Volume 2, Defendants, 20110309	
	43	The oral and videotaped deposition of Dwight Jaggard. Volume 3, Defendants, 20110310	
	44	Transcript of jury trial before the Honorable Leonard Davis - May 18, 2011 - 1:00 PM, Court, 20110518	

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	45	Transcript of jury trial before the Honorable Leonard Davis - May 18, 2011 - 8:45 AM, Court, 20110518	
	46	Transcript of jury trial before the Honorable Leonard Davis - May 19, 2011 - 1:00 PM, Court, 20110519	
	47	Transcript of jury trial before the Honorable Leonard Davis - May 19, 2011 - 8:45 AM, Court, 20110519	
	48	Transcript of jury trial before the Honorable Leonard Davis - May 20, 2011 - 12:30 PM, Court, 20110520	
	49	Transcript of jury trial before the Honorable Leonard Davis - May 20, 2011 - 8:30 AM, Court, 20110520	
	50	Transcript of jury trial before the Honorable Leonard Davis - May 23, 2011 - 8:55 AM, Court, 20110523	

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	2	Infringement Chart - LG Dare VX9700. Patent: 7148850, Fractus, 20091105	
	3	Infringement Chart - LG Dare VX9700. Patent: 7202822, Fractus, 20091105	
	4	Infringement Chart - LG enV Touch VX1100., Fractus, 20091105	
	5	Infringement Chart - LG enV Touch VX1100. Patent: 7148850, Fractus, 20091105	
	6	Infringement Chart - LG enV Touch VX1100. Patent: 7202822, Fractus, 20091105	
	7	Infringement Chart - LG enV VX-9900, Fractus, 20091105	
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The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

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A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Patrick J. Finnan/	Date (YYYY-MM-DD)	2020-03-27
Name/Print	Patrick J. Finnan	Registration Number	39189

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Name/Print	Patrick J. Finnan	Registration Number	39189

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	Application Number	
	Filing Date	
	First Named Inventor	Carles PUENTE BALIARDA
	Art Unit	
	Examiner Name	
	Attorney Docket Number	0690.0023CN4

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	1	Transcript of jury trial before the Honorable Leonard Davis US District Judge - May 17, 2011 - 8:00 AM, Court, 20110517	
	2	Transcript of jury trial before the Honorable Leonard Davis, US District Judge - May 17, 2011 - 1:10 PM, Court, 20110517	
	3	Transcript of pretrial hearing before the Honorable Leonard Davis, US District Judge - May 16, 2011 - 2:00 PM, Court, 20110516	
	4	CN00818542 - Response to Office Action dated on November 5, 2004, Herrero & Asociados, 20050331	
	5	CN01823716 - Office action dated on February 16, 2007, CN-PTO, 20070216	
	6	CN01823716 - Response to the office action dated on February 16, 2007, CN-PTO, 20070821	
	7	CN01823716 - Response to the office action dated on September 21, 2007, CN-PTO, 20071203	
	8	EP00909089 - Claims, Herrero & Asociados, 20050128	
	9	EP00909089 - Minutes from Oral Proceedings, EPO, 20050128	
	10	EP00909089 - Office Action dated on February 07, 2003, EPO, 20030207	
	11	EP00909089 - Response to Office Action dated on February 7, 2003, Herrero & Asociados, 20030814	

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	12	EP00909089 - Summons to attend oral proceedings, EPO, 20041028	
	13	EP00909089 - Written submissions, Herrero & Asociados, 20041215	
	14	EP05012854 - Communication of the board of appeal, EPO, 20101230	
	15	EP05012854 - Decision of the Technical Board of Appeal of the European Patent Office dated April 20, 2012, EPO, 20120420	
	16	PCT/EP00/00411 - International preliminary examination report dated on August 29, 2002 - Notification concerning documents transmitted, EPO, 20020829	
	17	PCT/EP00/00411 - Invitation to restrict or to pay additional fees dated on March 5, 2002, EPO, 20020305	
	18	PCT/ES99/00296 - Reply to the Written Opinion dated on November 15, 2001 - Declaration of J. Baxter - Exhibit FFF - Herrero & Asociados, 20011115	
	19	US10/102568 - Amendment and response to the Office Action dated on January 23, 2004, Jones Day, 20040526	
	20	US10/102568 - Office Action dated on January 23, 2004, USPTO, 20040123	
	21	US10/102568 - Preliminary Amendment - Exhibit CCCC, Rosenman & Colin LLP, 20020318	
	22	US10/181790 - Office action dated on August 4, 2005, USPTO, 20050804	

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	23	US10/181790 - Office action dated on August 27, 2004, USPTO, 20040827	
	24	US10/181790 - Office action dated on June 2, 2005, USPTO, 20050602	
	25	US10/181790 - Office action dated on March 2, 2005, USPTO, 20050302	
	26	US10/181790 - Response to office action dated on August 27, 2004, Jones Day, 20041208	
	27	US10/181790 - Response to the office action dated on June 2, 2005, Jones Day, 20050720	
	28	US10/181790 - Response to the office action dated on March 2, 2005, Jones Day, 20050314	
	29	US10/182635 - Amendment and response to office action dated on December 13, 2004, Jones Day, 20050317	
	30	US10/182635 - Amendment and response to office action dated on October 04, 2004, Jones Day, 20041112	
	31	US10/182635 - Notice of Allowance dated on April 11, 2005, USPTO, 20050411	
	32	US10/182635 - Office Action dated on December 13, 2004, USPTO, 20041213	
	33	US10/182635 - Office action dated on October 4, 2004, USPTO, 20041004	

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	34	US10/371676 - Amendment and response to final rejection dated on October 06, 2001, Kyocera, 20041203	
	35	US10/422578 - Advisory Action before the filing of an Appeal Brief, USPTO, 20050623	
	36	US10/422578 - Office Action dated on April 7, 2005, USPTO, 20050407	
	37	US10/422578 - Office Action dated on August 23, 2007, USPTO, 20070823	
	38	US10/422578 - Office Action dated on August 24, 2005, USPTO, 20050824	
	39	US10/422578 - Office Action dated on January 26, 2006, USPTO, 20060126	
	40	US10/422578 - Office Action dated on March 12, 2007, USPTO, 20070312	
	41	US10/422578 - Office action dated on March 26, 2008, USPTO, 20080326	
	42	US10/422578 - Office Action dated on October 4, 2004, USPTO, 20041004	
	43	US10/422578 - Request for Continued Examination with response to the office action dated on April 7, 2005 and the advisory action dated on June 23, 2005, Jones Day, 20050808	
	44	US10/422578 - Response to the Office Action dated on April 7, 2005, Jones Day, 20050531	

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	45	US10/422578 - Response to the Office Action dated on October 4, 2004, Jones Day, 20050106	
	46	US10/422578 - Response to the Office Action mailed on January 26, 2006 and Advisory Action mailed on March 29, 2006, Jones Day, 20060501	
	47	US10/797732 - Office action dated on August 9, 2007, USPTO, 20070809	
	48	US10/797732 - Response to Office Action dated August 9, 2007, Winstead, 20071108	
	49	US10/822933 - Notice of allowance dated on October 18, 2007, USPTO, 20071018	
	50	US10/822933 - Office Action dated on October 05, 2006, USPTO, 20061005	

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Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

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See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

A certification statement is not submitted herewith.

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A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Patrick J. Finnan/	Date (YYYY-MM-DD)	2020-03-27
Name/Print	Patrick J. Finnan	Registration Number	39189

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7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

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	Attorney Docket Number	0690.0023CN4

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	1	9099773	B2	2015-08-04	BALIARDA	
	2	9899727	B2	2018-02-20	BALIARDA	

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	1	20020000944	A1	2002-01-03	SABET et al.	
	2	20030137461	A1	2003-07-24	PENG	
	3	20040145527	A1	2004-07-09	MIKKOLA	
	4	20050001767	A1	2005-01-06	WULFF ET AL.	

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	5	20050176390	A1	2005-08-11	NAVSARIWALA et al.	
	6	20050184909	A1	2005-08-25	TCHISTIAKOV et al.	
	7	20060044195	A1	2006-03-02	ARKKO et al.	
	8	20060082505	A1	2006-04-20	BALIARDA et al.	
	9	20060121865	A1	2006-06-08	FRANK et al.	

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	1	Infringement Chart - HTC Touch Pro. Patent: 7148850, Fractus, 20091105	
	2	Infringement Chart - HTC Touch Pro. Patent: 7202822, Fractus, 20091105	
	3	Infringement Chart - HTC Wing, Fractus, 20091105	
	4	Infringement Chart - HTC Wing. Patent: 7148850, Fractus, 20091105	
	5	Infringement Chart - HTC Wing. Patent: 7202822, Fractus, 20091105	
	6	Infringement Chart - Kyocera Jax, Fractus, 20091105	
	7	Infringement Chart - Kyocera Jax. Patent: 7148850, Fractus, 20091105	
	8	Infringement Chart - Kyocera Jax. Patent: 7202822, Fractus, 20091105	
	9	Infringement Chart - Kyocera MARBL, Fractus, 20091105	
	10	Infringement Chart - Kyocera MARBL. Patent: 7148850, Fractus, 20091105	
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	12	Infringement Chart - Kyocera NEO E1100, Fractus, 20091105	
	13	Infringement Chart - Kyocera NEO E1100. Patent: 7148850, Fractus, 20091105	
	14	Infringement Chart - Kyocera NEO E1100. Patent: 7202822, Fractus, 20091105	
	15	Infringement Chart - Kyocera S2400, Fractus, 20091105	
	16	Infringement Chart - Kyocera S2400. Patent: 7148850, Fractus, 20091105	
	17	Infringement Chart - Kyocera S2400. Patent: 7202822, Fractus, 20091105	
	18	Infringement Chart - Kyocera Wildcard M1000, Fractus, 20091105	
	19	Infringement Chart - Kyocera Wildcard M1000. Patent: 7148850, Fractus, 20091105	
	20	Infringement Chart - Kyocera Wildcard M1000. Patent: 7202822, Fractus, 20091105	
	21	Infringement Chart - LG 300G., Fractus, 20091105	
	22	Infringement Chart - LG 300G. Patent: 7148850, Fractus, 20091105	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /D.H/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**		
	Application Number	
	Filing Date	
	First Named Inventor	Carles PUENTE BALIARDA
	Art Unit	
	Examiner Name	
	Attorney Docket Number	0690.0023CN4

	23	Infringement Chart - LG 300G. Patent: 7202822, Fractus, 20091105	
	24	Infringement Chart - LG Aloha LX140., Fractus, 20091105	
	25	Infringement Chart - LG Aloha LX140. Patent: 7148850, Fractus, 20091105	
	26	Infringement Chart - LG Aloha LX140. Patent: 7202822, Fractus, 20091105	
	27	Infringement Chart - LG AX155., Fractus, 20091105	
	28	Infringement Chart - LG AX155. Patent: 7148850, Fractus, 20091105	
	29	Infringement Chart - LG AX155. Patent: 7202822, Fractus, 20091105	
	30	Infringement Chart - LG AX300, Fractus, 20091105	
	31	Infringement Chart - LG AX300. Patent: 7148850, Fractus, 20091105	
	32	Infringement Chart - LG AX300. Patent: 7202822, Fractus, 20091105	
	33	Infringement Chart - LG AX380, Fractus, 20091105	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /D.H/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**	Application Number	
	Filing Date	
	First Named Inventor	Carles PUENTE BALIARDA
	Art Unit	
	Examiner Name	
	Attorney Docket Number	0690.0023CN4

	34	Infringement Chart - LG AX380. Patent: 7148850, Fractus, 20091105	
	35	Infringement Chart - LG AX380. Patent: 7202822, Fractus, 20091105	
	36	Infringement Chart - LG AX585., Fractus, 20091105	
	37	Infringement Chart - LG AX585. Patent: 7148850, Fractus, 20091105	
	38	Infringement Chart - LG AX585. Patent: 7202822, Fractus, 20091105	
	39	Infringement Chart - LG AX8600, Fractus, 20091105	
	40	Infringement Chart - LG AX8600. Patent: 7148850, Fractus, 20091105	
	41	Infringement Chart - LG AX8600. Patent: 7202822, Fractus, 20091105	
	42	Infringement Chart - LG CF360., Fractus, 20091105	
	43	Infringement Chart - LG CF360. Patent: 7148850, Fractus, 20091105	
	44	Infringement Chart - LG CF360. Patent: 7202822, Fractus, 20091105	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /D.H/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	
	Filing Date	
	First Named Inventor	Carles PUENTE BALIARDA
	Art Unit	
	Examiner Name	
	Attorney Docket Number	0690.0023CN4

	45	Infringement Chart - LG Chocolate VX8550, Fractus, 20091105	
	46	Infringement Chart - LG Chocolate VX8550. Patent: 7148850, Fractus, 20091105	
	47	Infringement Chart - LG Chocolate VX8550. Patent: 7202822, Fractus, 20091105	
	48	Infringement Chart - LG CU515, Fractus, 20091105	
	49	Infringement Chart - LG CU515. Patent: 7148850, Fractus, 20091105	
	50	Infringement Chart - LG CU515. Patent: 7202822, Fractus, 20091105	

If you wish to add additional non-patent literature document citation information please click the Add button Add

EXAMINER SIGNATURE

Examiner Signature	/DUNG HONG/	Date Considered	08/26/2020

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /D.H/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**	Application Number		
	Filing Date		
	First Named Inventor	Carles PUENTE BALIARDA	
	Art Unit		
	Examiner Name		
	Attorney Docket Number	0690.0023CN4	

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Patrick J. Finnan/	Date (YYYY-MM-DD)	2020-03-27
Name/Print	Patrick J. Finnan	Registration Number	39189

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /D.H/

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /D.H/

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No.	:	16/832,820
First Named Inventor	:	Carles PUENTE BALIARDA
Confirmation No.	:	3871
Filed	:	March 27, 2020
TC/A.U.	:	2643
Examiner	:	Hong, Dung
Customer No.	:	27896
Docket No.	:	0690.0023CN4
Title	:	Multiple-Body-Configuration Multimedia and Smartphone Multifunction Wireless Devices

PETITION FOR EXTENSION OF TIME UNDER 37 CFR 1.136(a)

This is a request under the provisions of 37 CFR 1.136(a) to extend the period for filing a reply in the above identified application. The applicant herewith petitions the Director of the United States Patent and Trademark Office to extend the time for reply to the Office action dated December 23, 2020 for 1 month(s) from March 23, 2021 to April 23, 2021.

The requested extension and fee are as follows:

- ☒ One month (37 CFR 1.17(a)(1); \$220/\$110/\$55)
- ☐ Two months (37 CFR 1.17(a)(2); \$640/\$320/\$160)
- ☐ Three months (37 CFR 1.17(a)(3); \$1480/\$740/\$370)
- ☐ Four months (37 CFR 1.17(a)(4); \$2320/\$1160/\$580)
- ☐ Five months (37 CFR 1.17(a)(5); \$3160/\$1580/\$790)

Total Fee Due: \$220.00. Credit card payment has been submitted concurrently with the filing of this transmittal.

The Director is hereby authorized to charge any additional appropriate fees that may be required for the above-identified application, and to credit any overpayment, to Deposit Account No. **05-0460**.

Dated: April 14, 2021

Respectfully submitted by:

/Patrick J. Finnan/

Patrick J. Finnan
Reg. No. 39189

EDELL, SHAPIRO & FINNAN, LLC
CUSTOMER NO. 27896
9801 Washingtonian Blvd., Suite 750
Gaithersburg, MD 20878
(301) 424-3640

Electronic Patent Application Fee Transmittal

Application Number:	16832820
Filing Date:	27-Mar-2020
Title of Invention:	Multiple-Body-Configuration Multimedia and Smartphone Multifunction Wireless Devices
First Named Inventor/Applicant Name:	Carles PUENTE BALIARDA
Filer:	Patrick J. Finnan/Janet Dorgan
Attorney Docket Number:	0690.0023CN4

Filed as Large Entity

Filing Fees for **Utility under 35 USC 111(a)**

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension - 1 month with $0 paid	1251	1	220	220
Miscellaneous:				
		Total in USD ($)		**220**

REMARKS

Claims 21-40 have been examined and stand rejected. No claims have been amended herein. Accordingly, claims 21-40 are still pending in the subject application. Favorable reconsideration of the application and allowance of all of the pending claims are respectfully requested in view of the above amendments and the following remarks.

Double Patenting Rejection

Claims 21-40 stand rejected on the ground of non-statutory double patenting as being unpatentable over claims 1-5, 6, 8, 9, 12, and 17 of U.S. Patent No. 8,738,103. Claims 21-40 stand rejected on the ground of non-statutory double patenting as being unpatentable over claims 1, 4, 7, 8, and 15 of U.S. Patent No. 9,099,773. Claims 21-40 stand rejected on the ground of non-statutory double patenting as being unpatentable over claims 1, 3, 9, 12, 14, and 19 of U.S. Patent No. 9,899,727. Claims 21-40 stand rejected on the ground of non-statutory double patenting as being unpatentable over claims 1, 3, 7, and 10 of U.S. Patent No. 10,644,380. A terminal disclaimer to obviate the non-statutory double patenting rejection is concurrently filed herewith in compliance with 37 CFR 1.321.

Conclusion

In view of the foregoing, Applicant respectfully requests the Examiner to find the application to be in condition for allowance with claims 21-40. However, if for any reason the Examiner feels that the application is not now in condition for allowance, the Examiner is respectfully requested to call the undersigned attorney to discuss any unresolved issues and to expedite the disposition of the application.

Applicant hereby petitions for any extension of time that may be necessary to maintain the pendency of this application. The Commissioner is hereby authorized to charge payment of any additional fees required for the above-identified application or credit any overpayment to Deposit Account No. 05-0460.

Dated: April 14, 2021

Respectfully submitted by:

/Patrick J. Finnan/

Patrick J. Finnan
Reg. No. 39189

EDELL, SHAPIRO & FINNAN, LLC
CUSTOMER NO. 27896
9801 Washingtonian Blvd., Suite 750
Gaithersburg, MD 20878
(301) 424-3640

Electronic Acknowledgement Receipt

EFS ID:	42452615
Application Number:	16832820
International Application Number:	
Confirmation Number:	3871
Title of Invention:	Multiple-Body-Configuration Multimedia and Smartphone Multifunction Wireless Devices
First Named Inventor/Applicant Name:	Carles PUENTE BALIARDA
Customer Number:	27896
Filer:	Patrick J. Finnan/Janet Dorgan
Filer Authorized By:	Patrick J. Finnan
Attorney Docket Number:	0690.0023CN4
Receipt Date:	14-APR-2021
Filing Date:	27-MAR-2020
Time Stamp:	17:20:01
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$220
RAM confirmation Number	E20214DH20152240
Deposit Account	
Authorized User	

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		2021-04-14_ResponseToOfficeAction-TD-0023CN4.pdf	96153 e36b6601b1fffa3b8b7640602159b08f5ccbf419	yes	3

Multipart Description/PDF files in .zip description

Document Description	Start	End
Amendment/Req. Reconsideration-After Non-Final Reject	1	1
Applicant Arguments/Remarks Made in an Amendment	2	3

Warnings:

Information:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
2	Extension of Time	2021-04-14_EOT-1MonthXml-0023CN4.pdf	76671 cfff1e0e1cad2e3904e7bbea834efeb3e2ce5fb8	no	1

Warnings:

Information:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
3	Fee Worksheet (SB06)	fee-info.pdf	31026 63457a7bbc0ec7f1cd7c18e883fb9057b999f4be	no	2

Warnings:

Information:

Total Files Size (in bytes): 203850

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No.	:	16/832,820
First Named Inventor	:	Carles PUENTE BALIARDA
Confirmation No.	:	3871
Filed	:	March 27, 2020
TC/A.U.	:	2643
Examiner	:	Hong, Dung
Customer No.	:	27896
Docket No.	:	0690.0023CN4
Title	:	Multiple-Body-Configuration Multimedia and Smartphone Multifunction Wireless Devices

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

RESPONSE TO OFFICE ACTION

Sir:

In response to the Office Action mailed December 23, 2020, please amend the above-identified application as follows:

Remarks begin on page 2 of this paper.

Electronic Patent Application Fee Transmittal

Application Number:	16832820
Filing Date:	27-Mar-2020
Title of Invention:	Multiple-Body-Configuration Multimedia and Smartphone Multifunction Wireless Devices
First Named Inventor/Applicant Name:	Carles PUENTE BALIARDA
Filer:	Patrick J. Finnan/Janet Dorgan
Attorney Docket Number:	0690.0023CN4

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
STATUTORY OR TERMINAL DISCLAIMER	1814	1	170	170
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**170**

Electronic Acknowledgement Receipt

EFS ID:	42452491
Application Number:	16832820
International Application Number:	
Confirmation Number:	3871
Title of Invention:	Multiple-Body-Configuration Multimedia and Smartphone Multifunction Wireless Devices
First Named Inventor/Applicant Name:	Carles PUENTE BALIARDA
Customer Number:	27896
Filer:	Patrick J. Finnan/Janet Dorgan
Filer Authorized By:	Patrick J. Finnan
Attorney Docket Number:	0690.0023CN4
Receipt Date:	14-APR-2021
Filing Date:	27-MAR-2020
Time Stamp:	17:21:45
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$170
RAM confirmation Number	E20214DH21402264
Deposit Account	
Authorized User	

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Terminal Disclaimer-Filed (Electronic)	eTerminal-Disclaimer.pdf	34839 3ef9f7400434e5e934c7da993c8e862804a52607	no	3
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	30682 7e6145ad48886648ff27e0bf651590a4733b9959	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	65521		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.
National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.
New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Doc Code: DIST.E.FILE Document Description: Electronic Terminal Disclaimer - Filed	PTO/SB/26 U.S. Patent and Trademark Office Department of Commerce

Electronic Petition Request	**TERMINAL DISCLAIMER TO OBVIATE A DOUBLE PATENTING REJECTION OVER A "PRIOR" PATENT**
Application Number	16832820
Filing Date	27-Mar-2020
First Named Inventor	Carles PUENTE BALIARDA
Attorney Docket Number	0690.0023CN4
Title of Invention	Multiple-Body-Configuration Multimedia and Smartphone Multifunction Wireless Devices

☒ Filing of terminal disclaimer does not obviate requirement for response under 37 CFR 1.111 to outstanding Office Action

☒ This electronic Terminal Disclaimer is not being used for a Joint Research Agreement.

Owner	Percent Interest
Fractus, S.A.	100%

The owner(s) with percent interest listed above in the instant application hereby disclaims, except as provided below, the terminal part of the statutory term of any patent granted on the instant application which would extend beyond the expiration date of the full statutory term of prior patent number(s)

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9099773

9899727

10644380

as the term of said prior patent is presently shortened by any terminal disclaimer. The owner hereby agrees that any patent so granted on the instant application shall be enforceable only for and during such period that it and the prior patent are commonly owned. This agreement runs with any patent granted on the instant application and is binding upon the grantee, its successors or assigns.

In making the above disclaimer, the owner does not disclaim the terminal part of the term of any patent granted on the instant application that would extend to the expiration date of the full statutory term of the prior patent, "as the term of said prior patent is presently shortened by any terminal disclaimer," in the event that said prior patent later:
- expires for failure to pay a maintenance fee;
- is held unenforceable;
- is found invalid by a court of competent jurisdiction;
- is statutorily disclaimed in whole or terminally disclaimed under 37 CFR 1.321;
- has all claims canceled by a reexamination certificate;
- is reissued; or
- is in any manner terminated prior to the expiration of its full statutory term as presently shortened by any terminal disclaimer.

(●) Terminal disclaimer fee under 37 CFR 1.20(d) is included with Electronic Terminal Disclaimer request.

( ) I certify, in accordance with 37 CFR 1.4(d)(4), that the terminal disclaimer fee under 37 CFR 1.20(d) required for this terminal disclaimer has already been paid in the above-identified application.

Applicant claims the following fee status:

( ) Small Entity

( ) Micro Entity

(●) Regular Undiscounted

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

THIS PORTION MUST BE COMPLETED BY THE SIGNATORY OR SIGNATORIES

I certify, in accordance with 37 CFR 1.4(d)(4) that I am:

(●) An attorney or agent registered to practice before the Patent and Trademark Office who is of record in this application

Registration Number 39189

( ) A sole inventor

( ) A joint inventor; I certify that I am authorized to sign this submission on behalf of all of the inventors as evidenced by the power of attorney in the application

( ) A joint inventor; all of whom are signing this request

Signature	/Patrick J. Finnan/
Name	Patrick J. Finnan

*Statement under 37 CFR 3.73(b) is required if terminal disclaimer is signed by the assignee (owner).
Form PTO/SB/96 may be used for making this certification. See MPEP § 324.

Doc Code: DISQ.E.FILE
Document Description: Electronic Terminal Disclaimer – Approved

Application No.: 16832820

Filing Date: 27-Mar-2020

Applicant/Patent under Reexamination: PUENTE BALIARDA

Electronic Terminal Disclaimer filed on April 14, 2021

☒ APPROVED

This patent is subject to a terminal disclaimer

☐ DISAPPROVED

Approved/Disapproved by: Electronic Terminal Disclaimer automatically approved by EFS-Web

U.S. Patent and Trademark Office

Main Concept Text
=================
antenna frequency band complexity factor ground plane

Concept Modifiers (1)
=====================
1. More Like Text: complexity factor

Filters (1)
===========
Publication Date: To 2006-07-18

Options
=======
De-dup: None
Cut-off: None
Sort: Relevance

Content: Patents + NPL (188)
============================
US Patents
US Designs
US Applications
EPO Patents
EPO Applications
China Patents
China Applications
Japan Patents
Japan Applications
Korea Patents
Korea Applications
WIPO Applications
Argentina Patents
Argentina Applications
Brazil Patents
Brazil Applications
Canada Patents
Canada Applications
Chile Patents
Chile Applications
Colombia Applications
Costa Rica Applications

Cuba Patents
Cuba Applications
Dominican Republic Applications
Ecuador Patents
Ecuador Applications
El Salvador Applications
Guatemala Applications
Honduras Applications
Mexico Patents
Mexico Applications
Nicaragua Patents
Panama Applications
Peru Applications
Trinidad & Tobago Patents
Uruguay Applications
Austria Patents
Austria Applications
Belarus Patents
Belgium Patents
Belgium Applications
Bosnia & Herzegovina Patents
Bosnia & Herzegovina Applications
Bulgaria Patents
Bulgaria Applications
Croatia Patents
Croatia Applications
Czech Republic Patents
Czech Republic Applications
Czechoslovakia Patents
Czechoslovakia Applications
Denmark Patents
Denmark Applications
Estonia Patents
Estonia Applications
EUIPO Patents
Finland Patents
Finland Applications
France Patents
France Applications
Germany Patents
Germany Applications
Great Britain Patents
Great Britain Applications
Greece Patents
Greece Applications
Hungary Patents
Hungary Applications
Iceland Patents

Iceland Applications
Ireland Patents
Ireland Applications
Italy Patents
Italy Applications
Latvia Patents
Latvia Applications
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Lithuania Applications
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Raw Relevance	Publication Number	Title
0.587		Design and optimization of 3-D compact stripline and microstrip Bluetooth/WLAN balun architectures using the design of experiments technique
0.582		Application of the statistical method and quality factor decomposition to determine microwave fields inside an equipment cavity
0.582		Use of low-cost patch antennas in modern wireless technology
0.578		A numerical investigation of ground plane effects on biconical antenna factor
0.575		Transmitting Antennas for Digital Television
0.575		Design of a multiband CPW-fed monopole antenna using a particle swarm optimization approach
0.573		Design of a wideband microstrip antenna and the use of artificial neural networks in parameter calculation
0.571		Review Articles
0.57		Antennas for multi-system mobile terminals
0.57		Antennas
0.565		Recent advances in dielectric-resonator antenna technology
0.565		A substrate for small patch antennas providing tunable miniaturization factors
0.565		A technique for an array to generate circular polarization with linearly polarized
0.564		IEEE Recommended Practice for Radio-Frequency (RF) Absorber Evaluation in the Range of 30 MHz to 5 GHz
0.563		Utilization of radiometric methods of antenna parameters measurements in millimeter wave band
0.563		Wide band microstrip phased array for mobile satellite communications
0.562		Microstrip antenna technology
0.561		Numerical evaluation of site attenuation, sum of antenna factors and groundplane
0.561		RF scale model range
0.561	CN1628425A	Method and apparatus for transmit power modulation in a wireless communication
0.56	US4835538	Three resonator parasitically coupled microstrip antenna array element
0.56		Numerical and analytical model of standard dipole antennas from 30 MHz to 2 GHz
0.56		Electromagnetic modeling and analysis of wireless communication antennas
0.559		Resonator-based analysis of the combination of mobile handset antenna and chassis
0.558		A quadruple-gap loop antenna for low frequency radiated emission measurements
0.558	GB2281662A	Antenna
0.558	CN1577960A	Portable radio apparatus
0.558		X-band transmit/receive module overview
0.558		Coupling element based mobile terminal antenna structures
0.557		Coupling reduction in enclosures and cavities using electromagnetic band gap
0.557		Single and double layer planar multiband PIFAs
0.557		A review of electromagnetic compatibility/interference measurement methodologies
0.557		An affordable millimeter-wave beam-steerable antenna using interleaved planar
0.556	WO2003041216A3	Dual band spiral-shaped antenna
0.556	WO2003041216A9	Dual band spiral-shaped antenna
0.556	WO2003041216A2	Dual band spiral-shaped antenna
0.556		Techniques for Improving Element Bandwidth
0.556	JPH08505501A	Homogenization of Q factor in double element endfire array antenna
0.555		Flat microwave antennas for telecommunication systems
0.555		Modeling Techniques for Microstrip Antenna Elements
0.555		Q-factor prediction and optimization of multilayer inductors for RF packaging microsystems using time domain techniques
0.555	WO2003085858A1	Method and apparatus for transmit power modulation in a wireless communication
0.554	EP1490986A1	Method and apparatus for transmit power modulation in a wireless communication

0.554		Coverage prediction for mobile radio systems operating in the 800/900 MHz frequency range
0.554		Education in Antennas, Wave Propagation and Microw Ave Techniques
0.554		Multiband antenna for airborne satellite communications
0.553	CA2481127A1	Method and apparatus for transmit power modulation in a wireless communication
0.553	KR20040093496A	Method and apparatus for transmit power modulation in a wireless communication
0.553	MXPA04009599A	Method and apparatus for transmit power modulation in a wireless communication
0.553		Broadband microstrip antenna design with the simplified real frequency technique
0.553		Slot spiral antenna
0.552		Multimode Multiband Antenna
0.552		Short low- and medium-frequency antenna performance
0.552		An improved method to determine the antenna factor
0.551	TW439322B	Dual-frequency-band patch antenna with alternating active and passive elements
0.551		Design considerations for 60 GHz CMOS radios
0.55	US20050024288	Portable radio apparatus
0.55		mm-wave microstrip and novel slot antennas on low cost large area panel MCM-D substrates-a feasibility and performance study
0.549		An analysis of the complex fit normalized site attenuation method
0.549		Analysis of Arrays and Mutual Coupling
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0.549		A planar active phased array antenna design
0.549		Active Broad X-Band Circular Patch Antenna
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0.547		Analysis of an aperture coupled microstrip antenna
0.547	TWI233713B	Multi-band antenna
0.547	US6856286	Dual band spiral-shaped antenna
0.547	JP2005528019A	Method and apparatus for transmission power modulation in a wireless communication system
0.547		FractalShaped Antennas
0.547	FR2709833A1	Broadband and low band listening instrument for space applications.
0.546	US6873831	Method and apparatus for transmit power modulation in a wireless communications system
0.546		Probe fed stacked patch antenna for UWB
0.546	US6067053	Dual polarized array antenna
0.546	US6064689	Radio communications receiver and method of receiving radio signals
0.546		An electromagnetic bandgap curl antenna for phased array applications
0.545		Compact planar antennas for short-range wireless automotive communication
0.545		Investigating the effects of antenna directivity on wireless indoor communication at 60
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0.545		Capacity obtained from multiple-input multiple-output channel measurements in fixed wireless environments at 2.5 GHz
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0.544		A new quasi-Yagi antenna for planar active antenna arrays
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0.538		Ultrawideband log-periodic dipole antenna arrays for the frequency range 0.7-12 GHz
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0.53	US20060092079	Ceramic antenna module and methods of manufacture thereof
0.53	US20040021605	Multiband antenna for mobile devices
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0.53	US20040056803	Antenna structures for reducing the effects of multipath radio signals
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0.526		HTS-technology for UMTS radio base stations
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0.526	EP0718911A1	Beam forming array for radiofrequency antenna with fast Fourier transform and device using such array, in particular for space applications
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0.524	WO2001076098A2	Method and apparatus for controlling transmissions of a communications system
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0.52		IEEE publications: Scanning the issues advance abstracts translated journals special publications
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0.52	US5781110	Electronic article surveillance tag product and method of manufacturing same
0.52		Chapter 1
0.52		Electromagnetic bandgap structures in planar circuit technology
0.52	US20030123425	Method and apparatus for controlling transmissions of a communications system
0.52	CA2435830A1	Ultra wideband antenna
0.52		Wideband cancellation of interference in a GPS receive array
0.52		Plane cover multiple access: a media access control strategy for wireless environments
0.52		The performance of space-time codes in office environments
0.52	US4443803	Lossy matching for broad bonding low profile small antennas
0.52		The Modeling, Characterization, and Design of Monolithic Inductors for Silicon RF IC's
0.52	US6965348	Broadband antenna structures
0.52	US6744743	Method and apparatus for controlling transmissions of a communications system
0.52	CA1055600A	Wideband antenna
0.52		Study of a CPW inductively coupled slot antenna
0.52	US20060007423	Passive distance measurement using spectral phase gradients
0.52	CN1412889A	Broad-band circular polarized plate antenna
0.52	JP2000509533A	Resonant tag and method of manufacturing the same
0.52		Multifunctional reconfigurable MEMS integrated antennas for adaptive MIMO systems
0.519		Amplifying active reflect-antenna using a microstrip-T coupled patch /sub e/sign and measurement
0.519	CA1152209A	Small broadband antennas using lossy matching networks
0.519	US20030011521	Widened band antenna for mobile apparatus
0.519	KR20040004584A	Tunable multiplexer
0.519	US5841330	Series coupled filters where the first filter is a dielectric resonator filter with cross-
0.519	US4328501	Small broadband antennas using lossy matching networks
0.519		Modeling and design of mems-based reconfligurable antenna arrays
0.519		Measurement and modeling of near- and far-field antenna factor
0.519	US20050259006	Beam forming apparatus and method using interference power estimation in an array antenna system
0.519	CN1582544A	Array processing for linear system solutions
0.519		A novel integrated antenna for millimeter-wave personal communications systems
0.519	US5621422	Spiral-mode microstrip (SMM) antennas and associated methods for exciting, extracting and multiplexing the various spiral modes
0.519		Power bus signal integrity improvement and EMI mitigation on multilayer high-speed digital PCBs with embedded capacitance
0.519		ModelOrder Reduction in Electromagnetics Using ModelBased Parameter Estimation
0.519		Transmit/receive module technology for X-band active array radar
0.519		Exploiting the 60 GHz band for local wireless multimedia access: prospects and future directions
0.518	WO1997041543A1	Resonant tag and method of manufacturing the same
0.518	US6798382	Widened band antenna for mobile apparatus
0.518	US20020163400	Tunable ferro-electric multiplexer
0.518	EP0896706B1	Resonant tag and method of manufacturing the same
0.518		Silicon-based reconfigurable antennas-concepts, analysis, implementation, and
0.518	EP0896706A1	Resonant tag and method of manufacturing the same
0.518	US20020105928	Method and apparatus for interference suppression in orthogonal frequency division multiplexed (OFDM) wireless communication systems
0.518		Dynamic time-division-duplex wireless local loop
0.518	US6639491	Tunable ferro-electric multiplexer
0.518	CN1328684A	Periodicity enhancement in decoding wideband signals
0.518	JP2003530009A	Apparatus and method for controlling transmission in a communication system

0.518		Electromagnetic design aspects of packages for monolithic microwave integrated circuit-based arrays with integrated antenna elements
0.518		Frequency economy in mobile radio bands
0.518	CN1537343A	Tuning multiplexer
0.518	EP0252779B1	Aerial element with a suspended stripeline between two self-supporting ground planes provided with superimposed radiating slots, and processes for its manufacture
0.518		Simulation and measurement of quasi-optical multipliers
0.518		Array Factor Considerations for Rectangular Dielectric Resonator Antennas
0.518	TW565967B	Dual band planar high-frequency antenna
0.518	CN1723587A	Integrated circuit package including miniature antenna
0.518	TW200401516A	Adaptive algorithm for a Cholesky approximation
0.518		Design and Practice of Reflector Antennas and Feed Systems in the 1990s
0.518		Design of a 5:1 bandwidth stripline notch array from FDTD analysis

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S214	14	(US-20050195112-$ or US-20160099496-$ or US-20060121865-$ or US-20040204007-$ or US-20060082505-$ or US-20050259013-$ or US-20080252536-$ or US-20050001767-$ or US-20020000944-$ or US-20040145527-$ or US-20060044195-$ or US-20050176390-$).did. or (US-7848781-$ or US-6452553-$).did.	US-PGPUB; USPAT	ADJ	OFF	2021/04/17 01:58
S213	94	phone near2 antenna and antenna with contour and (multiple or multi or plural$4) with antenna	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2021/04/17 01:57
S212	15	antenna with (tri or triple or three or quad or four) with (band or spectrum) and S211 and ("455" or "370").clas. and (@ad<"20060618" or @rlad<"20060618")	US-PGPUB; USPAT; USOCR	ADJ	OFF	2021/04/17 01:56
S211	1,395	(phone or laptop or mobile or portable or cellular or radio) with (antenna) near2 (four or quad)	US-PGPUB; USPAT; USOCR	ADJ	OFF	2021/04/17 01:56
S210	74	(complexity or convolut$4) near2 (factor or metric or indicator) with (antenna or transmitter or receiver or transceiver) and (@ad<"20060618" or @rlad<"20060618")	US-PGPUB; USPAT	ADJ	ON	2021/04/17 01:56
S208	5	S207 AND ((H01Q1/36 OR H01Q1/243 OR H01Q13/16 OR H01Q19/005 OR H01Q21/30 OR H01Q9/42).CPC.)	US-PGPUB; USPAT	ADJ	ON	2020/12/18 19:23
S207	5	(US-20050176390-$ or US-20020000944-$ or US-20040145527-$).did. or (US-6989794-$ or US-6452553-$).did.	US-PGPUB; USPAT	ADJ	ON	2020/12/18 19:23
S206	67	S204 and S205	US-PGPUB; USPAT; DERWENT	ADJ	OFF	2020/12/17 22:15
S205	14,466	(multi$1band or multiple band or tri$1band or triple band or quad$1band) near3 (antenna or transceiver or receiver or transmitter)	US-PGPUB; USPAT; DERWENT	ADJ	OFF	2020/12/17 22:15

S204	364	S202 OR S203	US-PGPUB; USPAT; DERWENT	ADJ	OFF	2020/12/17 22:15
S203	115	("6211889" | "6215474" | "6218992" | "6236366" | "6236372" | "6239765" | "6243592" | "6255994" | "6259407" | "6266023" | "6266538" | "6271794" | "6272356" | "6275198" | "6281846" | "6281848" | "6285326" | "6285327" | "6285342" | "6288680" | "6292154" | "6300910" | "6300914" | "6301489" | "6307511" | "6307512" | "6307519" | "6317083" | "6320543" | "6326919" | "6327485" | "6329951" | "6329954" | "6329962" | "6333716" | "6333719" | "6343208" | "6346914" | "6348892" | "6352434" | "6353443" | "6360105" | "6366243" | "6367939" | "6373447" | "6380899" | "6380902" | "6384790" | "6388626" | "6392610" | "6396444" | "6407710" | "6408190" | "6417810" | "6417816" | "6421013" | "6431712" | "6445352" | "6452549" | "6452553" | "6452556" | "6470174" | "6476766" | "6476769" | "6480159" | "6483462" | "6496154" | "6498586" | "6498588" | "6525691" | "6538604" | "6552690" | "6573867" | "6597319" | "6603434" | "6618017" | "6650294" | "6664932" | "6680705" | "6697022" | "6697024" | "6707428" | "6716103" | "6741215" | "6756944" | "6762723" | "6784844" | "6801164" | "6806834" | "6831606" | "6839040" | "6903686" | "6928413" | "6967731" | "6989794" | "6992633" | "7015868" | "7030833" | "7068230" | "7069043" | "7075484" | "7091911" | "7148850" | "7151955" | "7183983" | "7202822" | "7229385" | "7265724" | "7394432" | "7397431" | "7511675" | "7528782" | "7548915" | "8738103" | "D441733").PN.	US-PGPUB; USPAT	ADJ	OFF	2020/12/17 22:15
S202	249	("20010002823" | "20010033250" | "20010050636" | "20020000940" | "20020000942" | "20020036594" | "20020105468" | "20020109633" | "20020126051" | "20020126054" | "20020126055" | "20020140615" | "20020149519" | "20020164986" | "20020175211" | "20020175866" | "20020175879" | "20020190904" | "20030025637" | "20030064750" |	US-PGPUB; USPAT	ADJ	OFF	2020/12/17 22:15

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S201	270	S200 and (antenna or transmitter or transceiver) with (tri$1band or quad$band or (three or "3" or four) near2 (band or frequency)) and (@ad<"20060618" or @rlad<"20060618")	US-PGPUB; USPAT; USOCR	ADJ	OFF	2020/12/17 22:15
S200	17,657	(antenna or transmitter or transceiver) with complexity	US-PGPUB; USPAT; USOCR	ADJ	OFF	2020/12/17 22:15
S199	4	"11614429"	USPAT	ADJ	OFF	2020/12/17 15:24
S198	10	"11614429"	US-PGPUB; USPAT; USOCR	ADJ	OFF	2020/12/17 15:24
S197	0	antenna with contour with (four or "4" or five or "5") with diagonal and (@ad<"20060618" or @rlad<"20060618")	US-PGPUB; USPAT; USOCR	ADJ	OFF	2020/08/27 10:15

S196	4	"11614429"	USPAT	ADJ	OFF	2020/08/27 09:39
S193	70	S192 AND ((H01Q1/243 OR H01Q1/36 OR H01Q9/0407 OR H01Q1/242 OR H01Q1/241 OR H01Q5/50 OR H04B1/3833 OR H04B1/005).CPC.)	US-PGPUB; USPAT	ADJ	ON	2020/08/26 23:32
S192	115	("5451968" | "5453751" | "5453752" | "5457469" | "5471224" | "5493702" | "5495261" | "5508709" | "5534877" | "5537367" | "5557293" | "5569879" | "5608417" | "5619205" | "5627550" | "5646635" | "5657028" | "5680144" | "5684672" | "5703600" | "5712640" | "5767811" | "5784032" | "5790080" | "5798688" | "5808586" | "5809433" | "6127977" | "6130651" | "6131042" | "6138245" | "6140966" | "6140969" | "6140975" | "6141540" | "6147649" | "6147652" | "6147655" | "6157344" | "6160513" | "6166694" | "6172618" | "6181281" | "6181284" | "6195048" | "6198442" | "6201501" | "6204826" | "6211824" | "6211826" | "6211889" | "6215474" | "6218992" | "6236366" | "6236372" | "6239765" | "6243592" | "6255994" | "6259407" | "6266023" | "6266538" | "6271794" | "6272356" | "6275198" | "6281846" | "6281848" | "6285326" | "6285327" | "6285342" | "6288680" | "6292154" | "6300910" | "6300914" | "6301489" | "6307511" | "6307512" | "6307519" | "6664932" | "6680705" | "6697022" | "6697024" | "6707428" | "6716103" | "6741215" | "6756944" | "6762723" | "6784844" | "6801164" | "6806834" | "6831606" | "6839040" | "6903686" | "6928413" | "6967731" | "6989794" | "6992633" | "7015868" | "7030833" | "7068230" | "7069043" | "7075484" | "7091911" | "7148850" | "7151955" | "7183983" | "7202822" | "7229385" | "7265724" | "7394432" | "7397431" | "7511675" | "7528782" | "7548915" | "8738103" | "D441733").PN.	US-PGPUB; USPAT	ADJ	ON	2020/08/26 23:32
S191	20	S190 AND ((H04B1/7115 OR H04B7/0413 OR H04L27/201 OR H04L1/0045 OR H01Q1/245).CPC.)	US-PGPUB; USPAT	ADJ	ON	2020/08/26 23:31
S190	74	(complexity or convolut$4) near2 (factor or metric or indicator) with (antenna or transmitter or receiver or transceiver)	US-PGPUB; USPAT	ADJ	ON	2020/08/26 23:31

		and (@ad<"20060618" or @rlad<"20060618")				
S187	9	"11614429"	US-PGPUB; USPAT; USOCR	ADJ	OFF	2020/08/26 18:21
S186	4	(S181 or S182) and (complex$4 near2 (factor or metric or indicator or level))	US-PGPUB; USPAT	ADJ	ON	2020/08/26 17:42
S185	4	(S181 or S182) and (complex$4 near2 (factor or metric or indicator))	US-PGPUB; USPAT	ADJ	ON	2020/08/26 17:42
S184	250	S181 or S182 and (complex$4 near2 (factor or metric or indicator))	US-PGPUB; USPAT	ADJ	ON	2020/08/26 17:39
S183	250	S181 or S182 and (complexity near2 (factor or metric or indicator))	US-PGPUB; USPAT	ADJ	ON	2020/08/26 17:38
S182	129	("6157344" | "6160513" | "6166694" | "6172618" | "6181281" | "6181284" | "6195048" | "6198442" | "6201501" | "6204826" | "6211824" | "6211826" | "6211889" | "6215474" | "6218992" | "6236366" | "6236372" | "6239765" | "6243592" | "6255994" | "6259407" | "6266023" | "6266538" | "6271794" | "6272356" | "6275198" | "6281846" | "6281848" | "6285326" | "6285327" | "6285342" | "6288680" | "6292154" | "6300910" | "6300914" | "6301489" | "6307511" | "6307512" | "6307519" | "6317083" | "6320543" | "6326919" | "6327485" | "6329951" | "6329954" | "6329962" | "6333716" | "6333719" | "6343208" | "6346914" | "6348892" | "6352434" | "6353443" | "6360105" | "6366243" | "6367939" | "6373447" | "6380899" | "6380902" | "6384790" | "6388626" | "6392610" | "6396444" | "6407710" | "6408190" | "6417810" | "6417816" | "6421013" | "6431712" | "6445352" | "6452549" | "6452553" | "6452556" | "6470174" | "6476766" | "6476769" | "6480159" | "6483462" | "6496154" | "6498586" | "6498588" | "6525691" | "6538604" | "6552690" | "6573867" | "6597319" | "6603434" | "6618017" | "6650294" | "6664932" | "6680705" | "6697022" | "6697024" | "6707428" | "6716103" | "6741215" | "6756944" | "6762723" | "6784844" | "6801164" | "6806834" | "6831606" | "6839040" | "6903686" | "6928413" | "6967731" | "6989794" | "6992633" | "7015868" | "7030833" | "7068230" |	US-PGPUB; USPAT	ADJ	ON	2020/08/26 17:30

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S180	278	phone with antenna and antenna with contour and (multiple or multi or plural$4) with antenna	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2020/08/26 15:18
S179	270	S178 and (antenna or transmitter or transceiver) with (tri$1band or quad$band or (three or "3" or four) near2 (band or frequency)) and (@ad<"20060618" or @rlad<"20060618")	US-PGPUB; USPAT; USOCR	ADJ	OFF	2020/08/26 15:18
S178	17,188	(antenna or transmitter or transceiver) with complexity	US-PGPUB; USPAT; USOCR	ADJ	OFF	2020/08/26 15:18
S177	11	((complexity or convolut$4) near2 (factor or metric or indicator) with (antenna or transmitter or receiver or transceiver)).dm. and S176	US-PGPUB; USPAT	ADJ	ON	2020/08/26 15:07
S176	434	S174 OR S175	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2020/08/26 15:07
S175	302	(PUENTE near2 BALIARDA near2 Carles) or (MUMBRU near2 Josep) or (ILARIO near2 Jordi)	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2020/08/26 15:07
S174	303	fractus.as.	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2020/08/26 15:07
S171	20	S168 AND ((H04B1/7115 OR H04B7/0413 OR H04L27/201 OR H04L1/0045 OR H01Q1/245).CPC.)	US-PGPUB; USPAT	ADJ	ON	2020/01/04 13:04
S170	70	S169 AND ((H01Q1/243 OR H01Q1/36 OR H01Q9/0407 OR H01Q1/242 OR H01Q1/241 OR H01Q5/50 OR H04B1/3833 OR H04B1/005).CPC.)	US-PGPUB; USPAT	ADJ	ON	2020/01/04 12:59
S169	115	("5451968" | "5453751" | "5453752" | "5457469" | "5471224" | "5493702" | "5495261" | "5508709" | "5534877" | "5537367" | "5557293" | "5569879" | "5608417" | "5619205" | "5627550" | "5646635" | "5657028" | "5680144" | "5684672" | "5703600" | "5712640" | "5767811" | "5784032" | "5790080" | "5798688" | "5808586" | "5809433" | "6127977" | "6130651" | "6131042" | "6138245" | "6140966" | "6140969" | "6140975" | "6141540" | "6147649" | "6147652" | "6147655" | "6157344" |	US-PGPUB; USPAT	ADJ	ON	2020/01/04 12:59

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S168	74	(complexity or convolut$4) near2 (factor or metric or indicator) with (antenna or transmitter or receiver or transceiver) and (@ad<"20060618" or @rlad<"20060618")	US-PGPUB; USPAT	ADJ	ON	2020/01/04 12:58
S167	24	antenna near3 complexity near2 factor	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2020/01/04 12:58
S166	4	(US-10476134-$ or US-8738103-$ or US-9099773-$ or US-9899727-$).did.	USPAT	ADJ	ON	2020/01/02 10:59
S165	4	S164 and (complexity near2 factor).clm.	USPAT	ADJ	ON	2020/01/02 10:49
S164	417	S162 OR S163	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2020/01/02 10:49
S163	291	(PUENTE near2 BALIARDA near2 Carles) or (MUMBRU near2 Josep) or (ILARIO near2 Jordi)	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2020/01/02 10:49
S162	291	fractus.as.	US-PGPUB; USPAT;	ADJ	ON	2020/01/02 10:49

			DERWENT; IBM_TDB			
S161	10	S160 and (complexity near2 factor).clm.	US-PGPUB; USPAT	ADJ	ON	2019/12/31 23:06
S160	417	S158 OR S159	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2019/12/31 23:06
S159	291	(PUENTE near2 BALIARDA near2 Carles) or (MUMBRU near2 Josep) or (ILARIO near2 Jordi)	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2019/12/31 23:06
S158	291	fractus.as.	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2019/12/31 23:06
S157	4	S155 and (complexity near2 factor).clm.	USPAT	ADJ	ON	2019/12/31 17:12
S156	10	S155 and (complexity near2 factor).clm.	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2019/12/31 17:10
S155	417	S153 OR S154	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2019/12/31 17:10
S154	291	(PUENTE near2 BALIARDA near2 Carles) or (MUMBRU near2 Josep) or (ILARIO near2 Jordi)	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2019/12/31 17:10
S153	291	fractus.as.	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2019/12/31 17:10
S152	417	S150 OR S151	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2019/12/31 14:29
S151	291	(PUENTE near2 BALIARDA near2 Carles) or (MUMBRU near2 Josep) or (ILARIO near2 Jordi)	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2019/12/31 14:29
S150	291	fractus.as.	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2019/12/31 14:29

S149	3	"14738090"	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2019/08/05 08:00
S148	3	"14738090"	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2019/08/05 08:00
S147	2	"11614429" and (fourth and short near2 side and complexity near3 factor).clm.	USPAT	ADJ	ON	2019/08/04 19:57
S146	2	"11614429" and (fourth).clm.	USPAT	ADJ	ON	2019/08/04 19:56
S145	0	"11614429" and (ratio).clm.	USPAT	ADJ	ON	2019/08/04 19:55
S144	3	"11614429" and (complexity and second near3 short).clm.	USPAT	ADJ	ON	2019/08/04 19:53
S143	3	"11614429" and (complexity and short).clm.	USPAT	ADJ	ON	2019/08/04 19:48
S142	3	"11614429" and (complexity).clm.	USPAT	ADJ	ON	2019/08/04 19:48
S141	0	"11614429" and (aspect or ratio).clm.	USPAT	ADJ	ON	2019/08/04 19:47
S140	3	"11614429" and (rectangle).clm.	USPAT	ADJ	ON	2019/08/04 19:42
S139	0	"11614429" and (parallelepiped).dm.	USPAT	ADJ	ON	2019/08/04 19:39
S138	3	"11614429" and (complexity near2 factor or ratio or rectangle).clm.	USPAT	ADJ	ON	2019/08/04 19:30
S137	8	"11614429" and (complexity near2 factor or ratio or rectangle).clm.	US-PGPUB; USPAT; DERWENT	ADJ	ON	2019/08/04 19:28
S136	9	"11614429"	US-PGPUB; USPAT; DERWENT	ADJ	ON	2019/08/04 19:26
S130	1	antenna near2 contour with segment and (@ad<"20060718" or @rlad<"20060718")	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2019/08/01 22:24
S129	11	antenna near2 contour with segment	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2019/08/01 22:21
S128	38	ratio near3 width near3 height with antenna and (@ad<"20060618" or @rlad<"20060618")	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2019/08/01 21:11

S126	66	phone near2 antenna and antenna with contour and (multiple or multi or plural$4) with antenna	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2019/08/01 21:04
S125	1	("9099773").URPN.	USPAT	ADJ	OFF	2019/08/01 21:04
S122	238	phone with antenna and antenna with contour and (multiple or multi or plural$4) with antenna	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2019/08/01 21:04
S121	302	phone with antenna and antenna with contour	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2019/08/01 21:04
S119	384	("20010002823" | "20010033250" | "20010050636" | "20020000940" | "20020000942" | "20020036594" | "20020105468" | "20020109633" | "20020126051" | "20020126054" | "20020126055" | "20020140615" | "20020149519" | "20020164986" | "20020175211" | "20020175866" | "20020175879" | "20020190904" | "20030025637" | "20030064750" | "20030090421" | "20030098814" | "20030189518" | "20030210200" | "20030228892" | "20040009755" | "20040027295" | "20040029581" | "20040056985" | "20040085244" | "20040090372" | "20040095289" | "20040110479" | "20040119644" | "20040176025" | "20040198436" | "20040204008" | "20040204126" | "20040212545" | "20040214541" | "20050017910" | "20050041624" | "20050057398" | "20050069069" | "20050075098" | "20050088340" | "20050107052" | "20050136958" | "20050153709" | "20050156785" | "20050157807" | "20050181826" | "20050192009" | "20050195112" | "20050195273" | "20050201307" | "20050231439" | "20050233705" | "20050239446" | "20050259031" | "20050264453" | "20050270995" | "20060001576" | "20060015664" | "20060019730" | "20060031616" | "20060031886" | "20060033668" | "20060050473" | "20060050859" | "20060060068" | "20060077115" | "20060077310" | "20060290573" |	US-PGPUB; USPAT; USOCR	ADJ	ON	2019/08/01 21:04

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S114	7	ratio with dimension with antenna and S113	US-PGPUB; USPAT	ADJ	ON	2019/08/01 17:02
S113	367	S107 or S108	US-PGPUB; USPAT	ADJ	ON	2019/08/01 17:01

S112	0	ratio near3 width near3 height with antenna with (min or least or minimum) and (@ad<"20060618" or @rlad<"20060618")	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2019/08/01 16:28
S110	109	ratio near3 width near3 height with antenna	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2019/08/01 16:27
S109	12	ratio near3 width near3 height with antenna with rectangle	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2019/08/01 16:26
S108	119	("6201501" | "6204826" | "6211824" | "6211826" | "6211889" | "6215474" | "6218992" | "6236366" | "6236372" | "6239765" | "6243592" | "6255994" | "6259407" | "6266023" | "6266538" | "6271794" | "6272356" | "6275198" | "6281846" | "6281848" | "6285326" | "6285327" | "6285342" | "6288680" | "6292154" | "6300910" | "6300914" | "6301489" | "6307511" | "6307512" | "6307519" | "6317083" | "6320543" | "6326919" | "6327485" | "6329951" | "6329954" | "6329962" | "6333716" | "6333719" | "6343208" | "6346914" | "6348892" | "6352434" | "6353443" | "6360105" | "6366243" | "6367939" | "6373447" | "6380899" | "6380902" | "6384790" | "6388626" | "6392610" | "6396444" | "6407710" | "6408190" | "6417810" | "6417816" | "6421013" | "6431712" | "6445352" | "6452549" | "6452553" | "6452556" | "6470174" | "6476766" | "6476769" | "6480159" | "6483462" | "6496154" | "6498586" | "6498588" | "6525691" | "6538604" | "6552690" | "6573867" | "6597319" | "6603434" | "6618017" | "6650294" | "6664932" | "6680705" | "6697022" | "6697024" | "6707428" | "6716103" | "6741215" | "6756944" | "6762723" | "6784844" | "6801164" | "6806834" | "6831606" | "6839040" | "6903686" | "6928413" | "6967731" | "6989794" | "6992633" | "7015868" | "7030833" | "7068230" | "7069043" | "7075484" | "7091911" | "7148850" | "7151955" | "7183983" | "7202822" | "7229385" | "7265724" | "7394432" | "7397431" |	US-PGPUB; USPAT	ADJ	ON	2019/08/01 16:26

		"7511675" | "7528782" | "7548915" | "8738103" | "D441733").PN.				
S107	248	("20020000944" | "20040145527" | "20050176390" | "20010002823" | "20010033250" | "20010050636" | "20020000940" | "20020000942" | "20020036594" | "20020105468" | "20020109633" | "20020126051" | "20020126054" | "20020126055" | "20020140615" | "20020149519" | "20020164986" | "20020175211" | "20020175866" | "20020175879" | "20020190904" | "20030025637" | "20030064750" | "20030090421" | "20030098814" | "20030189518" | "20030210200" | "20030228892" | "20040009755" | "20040027295" | "20040029581" | "20040056985" | "20040085244" | "20040090372" | "20040095289" | "20040110479" | "20040119644" | "20040176025" | "20040198436" | "20040204008" | "20040204126" | "20040212545" | "20040214541" | "20050017910" | "20050041624" | "20050057398" | "20050069069" | "20050075098" | "20050088340" | "20050107052" | "20050136958" | "20050153709" | "20050156785" | "20050157807" | "20050181826" | "20050192009" | "20050195112" | "20050195273" | "20050201307" | "20050231439" | "20050233705" | "20050239446" | "20050259031" | "20050264453" | "20050270995" | "20060001576" | "20060015664" | "20060019730" | "20060031616" | "20060031886" | "20060033668" | "20060050473" | "20060050859" | "20060060068" | "20060077115" | "20060077310" | "20060290573" | "20070013589" | "20070229383" | "3079602" | "3521284" | "3599214" | "3622890" | "3683376" | "3683379" | "3689929" | "3818490" | "3967276" | "3969730" | "4021810" | "4024542" | "4038662" | "4072951" | "4131893" | "4141016" | "4318109" | "4356492" | "4381566" | "4471358" | "4471493" | "4504834" | "4536725" | "4543581" | "4571595" | "4584709" | "4608572" | "4623894" | "4628322" | "4673948" | "4723305" |	US-PGPUB; USPAT	ADJ	ON	2019/08/01 16:26

		"4730195" | "4752968" | "4827266" | "4827271" | "4839660" | "4843468" | "4847629" | "4849766" | "4857939" | "4860019" | "4890114" | "4894663" | "4907011" | "4912481" | "4975711" | "5030963" | "5138328" | "5168472" | "5172084" | "5200756" | "5212742" | "5214434" | "5218370" | "5227804" | "5227808" | "5245350" | "5248988" | "5255002" | "5257032" | "5307075" | "5337063" | "5337065" | "5347291" | "5355144" | "5355318" | "5363114" | "5373300" | "5402134" | "5410322" | "5420599" | "5422651" | "5451965" | "5451968" | "5453751" | "5453752" | "5457469" | "5471224" | "5493702" | "5495261" | "5508709" | "5534877" | "5537367" | "5557293" | "5569879" | "5608417" | "5619205" | "5627550" | "5646635" | "5657028" | "5680144" | "5684672" | "5703600" | "5712640" | "5767811" | "5784032" | "5790080" | "5798688" | "5808586" | "5809433" | "5821907" | "5838285" | "5841402" | "5841403" | "5870066" | "5872546" | "5898404" | "5903240" | "5918183" | "5926139" | "5926141" | "5929825" | "5936583" | "5936587" | "5943020" | "5966098" | "5973651" | "5986609" | "5986610" | "5986615" | "5990838" | "5995052" | "6002367" | "6005524" | "6008764" | "6011518" | "6011699" | "6016130" | "6028567" | "6028568" | "6031495" | "6031499" | "6031505" | "6040803" | "6058211" | "6069592" | "6072434" | "6075489" | "6075500" | "6078294" | "6081237" | "6087990" | "6091365" | "6094179" | "6097339" | "6097345" | "6104349" | "6107920" | "6111545" | "6122533" | "6127977" | "6130651" | "6131042" | "6138245" | "6140966" | "6140969" | "6140975" | "6141540" | "6147649" | "6147652" | "6147655" | "6157344" | "6160513" | "6166694" | "6172618" | "6181281" | "6181284" | "6195048" | "6198442").PN.				
S106	12	S103 or S104 and (@ad<"20060618" or @rlad<"20060618")	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2019/08/01 15:06

S105	12	S103 or S104	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2019/08/01 15:06
S104	12	ratio near3 width near3 height with antenna with rectangle	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2019/08/01 15:05
S103	11	aspect near2 ratio with width with height with antenna with rectangle	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2019/08/01 15:05
S102	24,007	aspect near2 ratio with width with height	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2019/08/01 15:03
S101	0	"14738090" and (aspect near2 ratio with width with height).clm.	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2019/08/01 15:03
S100	0	"14738090" and (aspect near2 ratio).clm.	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2019/08/01 15:03
S99	3	"14738090" and parallelepip$4	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2019/08/01 14:21
S98	0	"14738090" and parallelpip$6	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2019/08/01 14:21
S97	3	"14738090" and tangent	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2019/08/01 14:21
S96	3	"14738090"	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2019/08/01 13:57
S95	0	antenna with complexity near2 factor with (curve or contour) and (@ad<"20060618" or @rlad<"20060618")	US-PGPUB; USPAT; USOCR	ADJ	OFF	2019/08/01 13:53
S94	13	antenna with complexity near2 factor with (curve or contour)	US-PGPUB; USPAT; USOCR	ADJ	OFF	2019/08/01 13:51

S93	30	antenna with complexity near2 factor	US-PGPUB; USPAT; USOCR	ADJ	OFF	2019/08/01 13:50
S92	5	S90 AND ((H01Q1/36 OR H01Q1/243 OR H01Q13/16 OR H01Q19/005 OR H01Q21/30 OR H01Q9/42).CPC.)	US-PGPUB; USPAT	ADJ	ON	2018/07/28 23:24
S91	5	S90 AND ((H01Q1/36 OR H01Q1/243 OR H01Q13/16 OR H01Q19/005 OR H01Q21/30 OR H01Q9/42).CPC.)	US-PGPUB; USPAT	ADJ	ON	2018/07/28 23:23
S90	5	(US-20050176390-$ or US-20020000944-$ or US-20040145527-$).did. or (US-6989794-$ or US-6452553-$).did.	US-PGPUB; USPAT	ADJ	ON	2018/07/28 23:22
S89	21	(four or fourth) near2 (transmitter or receiver or antenna) and (@ad<"20060618" or @rlad<"20060618") and S88	US-PGPUB; USPAT	ADJ	ON	2018/07/28 23:21
S88	80	first near2 (transmitter or receiver or antenna) with (short or shorter) near2 (side or edge) and (@ad<"20060618" or @rlad<"20060618")	US-PGPUB; USPAT	ADJ	ON	2018/07/28 23:21
S87	1	"15856626"	US-PGPUB; USPAT; DERWENT	ADJ	ON	2018/07/26 22:12
S86	3	S83 or S84	USPAT	ADJ	ON	2018/07/26 15:21
S85	4	S83 or S84	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2018/07/26 14:35
S84	4	fractus.as. and (complexity near2 factor).clm.	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2018/07/26 14:24
S83	4	fractus.as. and ((four near2 time) with diagonal).clm.	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2018/07/26 14:23
S82	9	S80 and (complexity near2 factor).clm.	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2018/07/26 11:32
S81	6	S80 and (contour with (four or "4") with diagonal).clm.	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2018/07/26 11:32

S80	385	S78 OR S79	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2018/07/26 11:32
S79	273	(PUENTE near2 BALIARDA near2 Carles) or (MUMBRU near2 Josep) or (ILARIO near2 Jordi)	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2018/07/26 11:32
S78	268	fractus.as.	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2018/07/26 11:32
S77	70	S76 AND ((H01Q1/243 OR H01Q1/36 OR H01Q9/0407 OR H01Q1/242 OR H01Q1/241 OR H01Q5/50 OR H04B1/3833 OR H04B1/005).CPC.)	US-PGPUB; USPAT	ADJ	ON	2018/07/26 11:31
S76	115	("5451968" | "5453751" | "5453752" | "5457469" | "5471224" | "5493702" | "5495261" | "5508709" | "5534877" | "5537367" | "5557293" | "5569879" | "5608417" | "5619205" | "5627550" | "5646635" | "5657028" | "5680144" | "5684672" | "5703600" | "5712640" | "5767811" | "5784032" | "5790080" | "5798688" | "5808586" | "5809433" | "6127977" | "6130651" | "6131042" | "6138245" | "6140966" | "6140969" | "6140975" | "6141540" | "6147649" | "6147652" | "6147655" | "6157344" | "6160513" | "6166694" | "6172618" | "6181281" | "6181284" | "6195048" | "6198442" | "6201501" | "6204826" | "6211824" | "6211826" | "6211889" | "6215474" | "6218992" | "6236366" | "6236372" | "6239765" | "6243592" | "6255994" | "6259407" | "6266023" | "6266538" | "6271794" | "6272356" | "6275198" | "6281846" | "6281848" | "6285326" | "6285327" | "6285342" | "6288680" | "6292154" | "6300910" | "6300914" | "6301489" | "6307511" | "6307512" | "6307519" | "6664932" | "6680705" | "6697022" | "6697024" | "6707428" | "6716103" | "6741215" | "6756944" | "6762723" | "6784844" | "6801164" | "6806834" | "6831606" | "6839040" | "6903686" | "6928413" | "6967731" | "6989794" | "6992633" | "7015868" | "7030833" | "7068230" | "7069043" | "7075484" | "7091911" | "7148850" | "7151955" | "7183983" |	US-PGPUB; USPAT	ADJ	ON	2018/07/26 11:31

		"7202822" | "7229385" | "7265724" | "7394432" | "7397431" | "7511675" | "7528782" | "7548915" | "8738103" | "D441733").PN.				
S75	11	S74 AND ((H01Q1/243 OR H01Q19/005 OR H01Q9/0407 OR H01Q9/42 OR H01Q13/16).CPC.)	US-PGPUB; USPAT	ADJ	OFF	2018/07/26 11:31
S74	14	(US-20050195112-$ or US-20160099496-$ or US-20060121865-$ or US-20040204007-$ or US-20060082505-$ or US-20050259013-$ or US-20080252536-$ or US-20050001767-$ or US-20020000944-$ or US-20040145527-$ or US-20060044195-$ or US-20050176390-$).did. or (US-7848781-$ or US-6452553-$).did.	US-PGPUB; USPAT	ADJ	OFF	2018/07/26 11:31
S73	1	(contour$4 or outlin$6 or length or perimeter) with (time or four or "4") with diagonal with (longer or greater) with (transceiver or antenna or transmitter or receiver) and (@ad<"20060618" or @rlad<"20060618")	US-PGPUB; USPAT; USOCR; DERWENT	ADJ	OFF	2018/07/26 11:31
S72	0	(contour$4 or outlin$6 or length or perimeter) with (time or four or "4") with diagonal with (longer or greater) with (transceiver or antenna or transmitter or receiver) and (@ad<"20060618" or @rlad<"20060618")	US-PGPUB; USPAT; USOCR	ADJ	OFF	2018/07/26 11:31
S71	0	(contour$4 or outlin$6 or length) with (time or four or "4") with diagonal with (longer or greater) with (transceiver or antenna or transmitter or receiver) and (@ad<"20060618" or @rlad<"20060618")	US-PGPUB; USPAT; USOCR	ADJ	OFF	2018/07/26 11:30
S70	151	(contour$4 or outlin$6 or length) with (time or four or "4") with diagonal with (longer or greater) and (@ad<"20060618" or @rlad<"20060618")	US-PGPUB; USPAT; USOCR	ADJ	OFF	2018/07/26 11:11
S69	404	(contour$4 or outlin$6 or length) with (time or four or "4") with diagonal with (longer or greater)	US-PGPUB; USPAT; USOCR	ADJ	OFF	2018/07/26 11:11
S67	74	(complexity or convolut$4) near2 (factor or metric or indicator) with (antenna or transmitter or receiver or transceiver)	US-PGPUB; USPAT	ADJ	ON	2018/07/26 09:18

		and (@ad<"20060618" or @rlad<"20060618")				
S66	154	(complexity or convolut$4) near2 (factor or metric or indicator) with (antenna or transmitter or receiver or transceiver)	US-PGPUB; USPAT	ADJ	ON	2018/07/26 09:03
S64	80	first near2 (transmitter or receiver or antenna) with (short or shorter) near2 (side or edge) and (@ad<"20060618" or @rlad<"20060618")	US-PGPUB; USPAT	ADJ	ON	2018/07/25 21:20
S63	22,359	(four or fourth) near2 (transmitter or receiver or antenna) and (@ad<"20060618" or @rlad<"20060618")	US-PGPUB; USPAT	ADJ	ON	2018/07/25 21:16
S62	39	S59 and (four or fourth) near2 (transmitter or receiver or antenna) and (@ad<"20060618" or @rlad<"20060618")	US-PGPUB; USPAT	ADJ	ON	2018/07/25 16:22
S59	248	("20020000944" | "20040145527" | "20050176390" | "20010002823" | "20010033250" | "20010050636" | "20020000940" | "20020000942" | "20020036594" | "20020105468" | "20020109633" | "20020126051" | "20020126054" | "20020126055" | "20020140615" | "20020149519" | "20020164986" | "20020175211" | "20020175866" | "20020175879" | "20020190904" | "20030025637" | "20030064750" | "20030090421" | "20030098814" | "20030189518" | "20030210200" | "20030228892" | "20040009755" | "20040027295" | "20040029581" | "20040056985" | "20040085244" | "20040090372" | "20040095289" | "20040110479" | "20040119644" | "20040176025" | "20040198436" | "20040204008" | "20040204126" | "20040212545" | "20040214541" | "20050017910" | "20050041624" | "20050057398" | "20050069069" | "20050075098" | "20050088340" | "20050107052" | "20050136958" | "20050153709" | "20050156785" | "20050157807" | "20050181826" | "20050192009" | "20050195112" | "20050195273" | "20050201307" | "20050231439" | "20050233705" | "20050239446" | "20050259031" | "20050264453" | "20050270995" | "20060001576" | "20060015664" | "20060019730" |	US-PGPUB; USPAT	ADJ	ON	2018/07/25 16:15

		"20060031616" | "20060031886" | "20060033668" | "20060050473" | "20060050859" | "20060060068" | "20060077115" | "20060077310" | "20060290573" | "20070013589" | "20070229383" | "3079602" | "3521284" | "3599214" | "3622890" | "3683376" | "3683379" | "3689929" | "3818490" | "3967276" | "3969730" | "4021810" | "4024542" | "4038662" | "4072951" | "4131893" | "4141016" | "4318109" | "4356492" | "4381566" | "4471358" | "4471493" | "4504834" | "4536725" | "4543581" | "4571595" | "4584709" | "4608572" | "4623894" | "4628322" | "4673948" | "4723305" | "4730195" | "4752968" | "4827266" | "4827271" | "4839660" | "4843468" | "4847629" | "4849766" | "4857939" | "4860019" | "4890114" | "4894663" | "4907011" | "4912481" | "4975711" | "5030963" | "5138328" | "5168472" | "5172084" | "5200756" | "5212742" | "5214434" | "5218370" | "5227804" | "5227808" | "5245350" | "5248988" | "5255002" | "5257032" | "5307075" | "5337063" | "5337065" | "5347291" | "5355144" | "5355318" | "5363114" | "5373300" | "5402134" | "5410322" | "5420599" | "5422651" | "5451965" | "5451968" | "5453751" | "5453752" | "5457469" | "5471224" | "5493702" | "5495261" | "5508709" | "5534877" | "5537367" | "5557293" | "5569879" | "5608417" | "5619205" | "5627550" | "5646635" | "5657028" | "5680144" | "5684672" | "5703600" | "5712640" | "5767811" | "5784032" | "5790080" | "5798688" | "5808586" | "5809433" | "5821907" | "5838285" | "5841402" | "5841403" | "5870066" | "5872546" | "5898404" | "5903240" | "5918183" | "5926139" | "5926141" | "5929825" | "5936583" | "5936587" | "5943020" | "5966098" | "5973651" | "5986609" | "5986610" | "5986615" | "5990838" | "5995052" | "6002367" | "6005524" | "6008764" | "6011518" | "6011699" | "6016130" | "6028567" | "6028568" | "6031495" | "6031499" | "6031505" | "6040803" | "6058211" | "6069592" | "6072434" | "6075489" | "6075500" | "6078294" | "6081237" | "6087990" |				

		"6091365" | "6094179" | "6097339" | "6097345" | "6104349" | "6107920" | "6111545" | "6122533" | "6127977" | "6130651" | "6131042" | "6138245" | "6140966" | "6140969" | "6140975" | "6141540" | "6147649" | "6147652" | "6147655" | "6157344" | "6160513" | "6166694" | "6172618" | "6181281" | "6181284" | "6195048" | "6198442").PN.				
S55	2	"6989794".pn.	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2017/09/28 15:23
S53	1	S51 and diagonal with rectangle with four	US-PGPUB; USPAT; DERWENT	ADJ	OFF	2017/09/28 12:06
S52	1	S51 and complex$4 with factor	US-PGPUB; USPAT; DERWENT	ADJ	OFF	2017/09/28 12:05
S51	67	S49 and S50	US-PGPUB; USPAT; DERWENT	ADJ	OFF	2017/09/28 11:58
S50	11,652	(multi$1band or multiple band or tri$1band or triple band or quad$1band) near3 (antenna or transceiver or receiver or transmitter)	US-PGPUB; USPAT; DERWENT	ADJ	OFF	2017/09/28 11:51
S49	364	S47 OR S48	US-PGPUB; USPAT; DERWENT	ADJ	OFF	2017/09/28 11:50
S48	115	("6211889" | "6215474" | "6218992" | "6236366" | "6236372" | "6239765" | "6243592" | "6255994" | "6259407" | "6266023" | "6266538" | "6271794" | "6272356" | "6275198" | "6281846" | "6281848" | "6285326" | "6285327" | "6285342" | "6288680" | "6292154" | "6300910" | "6300914" | "6301489" | "6307511" | "6307512" | "6307519" | "6317083" | "6320543" | "6326919" | "6327485" | "6329951" | "6329954" | "6329962" | "6333716" | "6333719" | "6343208" | "6346914" | "6348892" | "6352434" | "6353443" | "6360105" | "6366243" | "6367939" | "6373447" | "6380899" | "6380902" | "6384790" | "6388626" | "6392610" | "6396444" | "6407710" | "6408190" | "6417810" | "6417816" | "6421013" | "6431712" | "6445352" | "6452549" | "6452553" |	US-PGPUB; USPAT	ADJ	OFF	2017/09/28 11:40

		"6452556" | "6470174" | "6476766" | "6476769" | "6480159" | "6483462" | "6496154" | "6498586" | "6498588" | "6525691" | "6538604" | "6552690" | "6573867" | "6597319" | "6603434" | "6618017" | "6650294" | "6664932" | "6680705" | "6697022" | "6697024" | "6707428" | "6716103" | "6741215" | "6756944" | "6762723" | "6784844" | "6801164" | "6806834" | "6831606" | "6839040" | "6903686" | "6928413" | "6967731" | "6989794" | "6992633" | "7015868" | "7030833" | "7068230" | "7069043" | "7075484" | "7091911" | "7148850" | "7151955" | "7183983" | "7202822" | "7229385" | "7265724" | "7394432" | "7397431" | "7511675" | "7528782" | "7548915" | "8738103" | "D441733").PN.				
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S46	7	"6989794"	US-PGPUB; USPAT	ADJ	OFF	2017/09/26 22:52
S45	1,871	(H01Q13/10).cpc.	US-PGPUB; USPAT	ADJ	OFF	2017/09/26 22:38
S44	11	S41 AND ((H01Q1/243 OR H01Q19/005 OR H01Q9/0407 OR H01Q9/42 OR H01Q13/16).CPC.)	US-PGPUB; USPAT	ADJ	OFF	2017/09/26 22:37
S43	70	S42 AND ((H01Q1/243 OR H01Q1/36 OR H01Q9/0407 OR H01Q1/242 OR H01Q1/241 OR H01Q5/50 OR H04B1/3833 OR H04B1/005).CPC.)	US-PGPUB; USPAT	ADJ	ON	2017/09/26 22:32
S42	115	("5451968" | "5453751" | "5453752" | "5457469" | "5471224" | "5493702" | "5495261" | "5508709" | "5534877" | "5537367" | "5557293" | "5569879" | "5608417" | "5619205" | "5627550" | "5646635" | "5657028" | "5680144" | "5684672" | "5703600" | "5712640" | "5767811" | "5784032" | "5790080" | "5798688" | "5808586" | "5809433" | "6127977" | "6130651" | "6131042" | "6138245" | "6140966" | "6140969" | "6140975" | "6141540" | "6147649" | "6147652" | "6147655" | "6157344" | "6160513" | "6166694" | "6172618" | "6181281" | "6181284" | "6195048" | "6198442" | "6201501" | "6204826" | "6211824" | "6211826" | "6211889" | "6215474" | "6218992" | "6236366" | "6236372" | "6239765" | "6243592" | "6255994" | "6259407" | "6266023" | "6266538" | "6271794" | "6272356" | "6275198" | "6281846" | "6281848" | "6285326" | "6285327" | "6285342" | "6288680" | "6292154" | "6300910" | "6300914" | "6301489" | "6307511" | "6307512" | "6307519" | "6664932" | "6680705" | "6697022" | "6697024" | "6707428" | "6716103" | "6741215" | "6756944" | "6762723" | "6784844" | "6801164" | "6806834" | "6831606" |	US-PGPUB; USPAT	ADJ	ON	2017/09/26 22:26

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S41	14	(US-20050195112-$ or US-20160099496-$ or US-20060121865-$ or US-20040204007-$ or US-20060082505-$ or US-20050259013-$ or US-20080252536-$ or US-20050001767-$ or US-20020000944-$ or US-20040145527-$ or US-20060044195-$ or US-20050176390-$).did. or (US-7848781-$ or US-6452553-$).did.	US-PGPUB; USPAT	ADJ	OFF	2017/09/26 22:26
S40	7	S38 and (complexity near2 factor).clm.	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2017/09/22 13:42
S39	4	S38 and (contour with (four or "4") with diagonal).clm.	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2017/09/22 13:40
S38	362	S36 OR S37	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2017/09/22 13:38
S37	260	(PUENTE near2 BALIARDA near2 Carles) or (MUMBRU near2 Josep) or (ILARIO near2 Jordi)	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2017/09/22 13:32
S36	252	fractus.as.	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2017/09/22 13:25
S35	28	(compact or small or miniature) with antenna with (phone or cellular or portable) and (@ad<"20060618" or @rlad<"20060618") and antenna with (band or multi$1band or tri$1band or quad$1band or multiple band) and antenna with contour$4	US-PGPUB; USPAT; USOCR	ADJ	OFF	2017/09/22 13:13
S34	58	(compact or small or miniature) with antenna with (phone or cellular or portable) and (@ad<"20060618" or	US-PGPUB; USPAT; USOCR	ADJ	OFF	2017/09/22 13:13

		@rlad<"20060618") and antenna with (band or multi$1band or tri$1band or quad$1band or multiple band) and antenna with complexity				
S33	282	(compact or small or miniature) with antenna with (phone or cellular or portable) and (@ad<"20060618" or @rlad<"20060618") and antenna with (box or segment)	US-PGPUB; USPAT; USOCR	ADJ	OFF	2017/09/22 06:27
S31	310	(antenna or transmitter or transceiver) with (tri or triple or three or quad or four) with (band or spectrum) with (device or phone or portable or cellular or terminal or UE or UT OR MT or mobile) and (wireless or radio or cellular) and ("455" or "370").clas. and (@ad<"20060618" or @rlad<"20060618")	US-PGPUB; USPAT; USOCR	ADJ	OFF	2017/09/22 05:37
S30	15	antenna with (tri or triple or three or quad or four) with (band or spectrum) and S20 and ("455" or "370").clas. and (@ad<"20060618" or @rlad<"20060618")	US-PGPUB; USPAT; USOCR	ADJ	OFF	2017/09/22 00:01
S29	115	S24 and (antenna or transmitter or transceiver) with (tri$1band or quad$band or (three or "3" or four) near2 (band or frequency)) and (@ad<"20060618" or @rlad<"20060618") and ("455" or "370").clas.	US-PGPUB; USPAT; USOCR	ADJ	OFF	2017/09/21 23:59
S28	6	S26 and S27	US-PGPUB; USPAT; USOCR	ADJ	OFF	2017/09/21 23:57
S27	1,159	(phone or laptop or mobile or portable or cellular or radio) with (antenna or transceiver or transmitter) near2 (four or quad)	US-PGPUB; USPAT; USOCR	ADJ	OFF	2017/09/21 23:56
S26	263	S24 and (antenna or transmitter or transceiver) with (tri$1band or quad$band or (three or "3" or four) near2 (band or frequency)) and (@ad<"20060618" or @rlad<"20060618")	US-PGPUB; USPAT; USOCR	ADJ	OFF	2017/09/21 23:56
S25	503	S24 and (antenna or transmitter or transceiver) with (tri$1band or quad$band or (three or "3" or four) near2 (band or frequency))	US-PGPUB; USPAT; USOCR	ADJ	OFF	2017/09/21 23:55

S24	13,262	(antenna or transmitter or transceiver) with complexity	US-PGPUB; USPAT; USOCR	ADJ	OFF	2017/09/21 23:54
S23	0	antenna with contour with (four or "4" or five or "5") with diagonal and (@ad<"20060618" or @rlad<"20060618")	US-PGPUB; USPAT; USOCR	ADJ	OFF	2017/09/21 23:50
S22	6	antenna with contour with (four or "4" or five or "5") with diagonal	US-PGPUB; USPAT; USOCR	ADJ	OFF	2017/09/21 23:49
S21	186	antenna with (tri or triple or three or quad or four) with (band or spectrum) and S20	US-PGPUB; USPAT; USOCR	ADJ	OFF	2017/09/21 23:48
S20	879	(phone or laptop or mobile or portable or cellular or radio) with (antenna) near2 (four or quad)	US-PGPUB; USPAT; USOCR	ADJ	OFF	2017/09/21 23:46
S19	6	"11614429" and contour with length	US-PGPUB; USPAT; USOCR	ADJ	OFF	2017/09/21 23:30
S18	6	"11614429" and (contour$4 or outlin$6 or length) with (time or four or "4")	US-PGPUB; USPAT; USOCR	ADJ	OFF	2017/09/21 23:26
S17	6	"11614429" and contour$4	US-PGPUB; USPAT; USOCR	ADJ	OFF	2017/09/21 23:23
S16	1	(US-20080018543-$).did.	US-PGPUB	ADJ	OFF	2017/09/21 23:22
S15	9	"38686677".FMID.	US-PGPUB; USPAT; FPRS	ADJ	OFF	2017/09/21 15:40
S13	57	phone near2 antenna and antenna with contour and (multiple or multi or plural$4) with antenna	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2017/09/20 00:14
S12	0	("9099773").URPN.	USPAT	ADJ	OFF	2017/09/20 00:04
S11	368	("20010002823" | "20010033250" | "20010050636" | "20020000940" | "20020000942" | "20020036594" | "20020105468" | "20020109633" | "20020126051" | "20020126054" | "20020126055" | "20020140615" | "20020149519" | "20020164986" | "20020175211" | "20020175866" | "20020175879" | "20020190904" | "20030025637" | "20030064750" | "20030090421" | "20030098814" |	US-PGPUB; USPAT; USOCR	ADJ	OFF	2017/09/19 23:28

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S10	6	"11614429"	US-PGPUB; USPAT; USOCR	ADJ	OFF	2017/09/19 23:16
S9	160	phone with antenna and antenna with contour and (multiple or multi or plural$4) with antenna	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2016/12/29 22:07
S8	213	phone with antenna and antenna with contour	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2016/12/29 21:29
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S3	14	"8738103"	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2016/12/13 15:02
S2	3	"9099773"	US-PGPUB; USPAT; DERWENT; IBM_TDB	ADJ	ON	2016/12/13 15:02

EAST Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S218	5	S217 and spectrum.clm.	US-PGPUB; USPAT	ADJ	ON	2021/04/17 01:55

S217	9	S216 and (enclos$5 or rectangle).clm.	US-PGPUB; USPAT	ADJ	ON	2021/04/17 01:55
S216	13	(complexity factor with antenna and frequency near2 band).clm.	US-PGPUB; USPAT	ADJ	ON	2021/04/17 01:54
S215	15	(complexity factor with antenna).clm.	US-PGPUB; USPAT	ADJ	ON	2021/04/17 01:53
S209	4	"11614429"	USPAT	ADJ	OFF	2020/12/18 19:29
S195	1	"11614429" and aspect near2 value	USPAT	ADJ	OFF	2020/08/26 23:25
S194	1	"11614429" and aspect near22 value	USPAT	ADJ	OFF	2020/08/26 23:25
S189	4	"11614429"	USPAT	ADJ	OFF	2020/08/26 18:34
S173	3	(complexity near2 factor with (least or minimum or min) with antenna).clm.	USPAT	ADJ	ON	2020/01/05 20:43
S172	3	(complexity factor with f21).clm.	USPAT	ADJ	ON	2020/01/05 20:42
S135	0	(width near4 height near4 ratio).clm. and S134	USPAT	ADJ	ON	2019/08/01 22:37
S134	2	(perimeter with segment with contour with antenna).clm.	USPAT	ADJ	ON	2019/08/01 22:34
S133	0	S131 and S132	USPAT	ADJ	ON	2019/08/01 22:30
S132	4	(parallelepiped near4 tangent).clm.	USPAT	ADJ	ON	2019/08/01 22:30
S131	3	(complexity near2 factor with (least or minimum or min) with antenna).clm.	USPAT	ADJ	ON	2019/08/01 22:29
S57	1	(complexity factor with f21).clm.	USPAT	ADJ	ON	2017/09/28 18:34
S56	2	(length with contour with four with diagonal with antenna).clm.	USPAT	ADJ	ON	2017/09/28 18:34

4/17/2021 9:47:24 PM
C:\Users\dhong\Documents\EAST\Workspaces\832820-16.wsp

Search Notes	Application/Control No. 16/832,820	Applicant(s)/Patent Under Reexamination PUENTE BALIARDA et al.
	Examiner DUNG HONG	Art Unit 2643

CPC - Searched*		
Symbol	**Date**	**Examiner**
H01Q1/243,H01Q1/36,H01Q9/0407,H01Q1/242,H01Q1/241,H01Q5/50,H04B1/3833,H04B1/005	12/18/2020	DH

CPC Combination Sets - Searched*		
Symbol	**Date**	**Examiner**
H01Q1/243,H01Q1/36,H01Q9/0407,H01Q1/242,H01Q1/241,H01Q5/50,H04B1/3833,H04B1/005	12/18/2020	DH

US Classification - Searched*			
Class	**Subclass**	**Date**	**Examiner**

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	**Date**	**Examiner**
Inventor search, Google search, CPC search, Text search	08/26/2020	DH
Inventor search, Google search, CPC search, Text search	04/16/2021	DH

Interference Search			
US Class/CPC Symbol	**US Subclass/CPC Group**	**Date**	**Examiner**
	Text search within claim	04/16/2021	DH

/DUNG HONG/ Primary Examiner, Art Unit 2643	

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NOTICE OF ALLOWANCE AND FEE(S) DUE

27896 7590 04/21/2021
EDELL, SHAPIRO & FINNAN, LLC
9801 Washingtonian Blvd.
Suite 750
Gaithersburg, MD 20878

EXAMINER	
HONG, DUNG	
ART UNIT	PAPER NUMBER
2643	

DATE MAILED: 04/21/2021

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/832,820	03/27/2020	Carles PUENTE BALIARDA	0690.0023CN4	3871

TITLE OF INVENTION: Multiple-Body-Configuration Multimedia and Smartphone Multifunction Wireless Devices

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1200	$0.00	$0.00	$1200	07/21/2021

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the ENTITY STATUS shown above. If the ENTITY STATUS is shown as SMALL or MICRO, verify whether entitlement to that entity status still applies.

If the ENTITY STATUS is the same as shown above, pay the TOTAL FEE(S) DUE shown above.

If the ENTITY STATUS is changed from that shown above, on PART B - FEE(S) TRANSMITTAL, complete section number 5 titled "Change in Entity Status (from status indicated above)".

For purposes of this notice, small entity fees are 1/2 the amount of undiscounted fees, and micro entity fees are 1/2 the amount of small entity fees.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Maintenance fees are due in utility patents issuing on applications filed on or after Dec. 12, 1980. It is patentee's responsibility to ensure timely payment of maintenance fees when due. More information is available at www.uspto.gov/PatentMaintenanceFees.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via EFS-Web.

By mail, send to: Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

By fax, send to: (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

27896 7590 04/21/2021
EDELL, SHAPIRO & FINNAN, LLC
9801 Washingtonian Blvd.
Suite 750
Gaithersburg, MD 20878

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via EFS-Web or by facsimile to (571) 273-2885, on the date below.

(Typed or printed name)

(Signature)

(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/832,820	03/27/2020	Carles PUENTE BALIARDA	0690.0023CN4	3871

TITLE OF INVENTION: Multiple-Body-Configuration Multimedia and Smartphone Multifunction Wireless Devices

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1200	$0.00	$0.00	$1200	07/21/2021

EXAMINER	ART UNIT	CLASS-SUBCLASS
HONG, DUNG	2643	455-552100

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

❑ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.

❑ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-09 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1____________________

2____________________

3____________________

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE

(B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ❑ Corporation or other private group entity ❑ Government

4a. Fees submitted: ❑Issue Fee ❑Publication Fee (if required) ❑Advance Order - # of Copies __________

4b. Method of Payment: *(Please first reapply any previously paid fee shown above)*

❑ Electronic Payment via EFS-Web ❑ Enclosed check ❑ Non-electronic payment by credit card (Attach form PTO-2038)

❑ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. __________

5. **Change in Entity Status** (from status indicated above)

❑ Applicant certifying micro entity status. See 37 CFR 1.29

❑ Applicant asserting small entity status. See 37 CFR 1.27

❑ Applicant changing to regular undiscounted fee status.

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.
NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature ____________________ Date ____________________

Typed or printed name ____________________ Registration No. ____________________

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/832,820	03/27/2020	Carles PUENTE BALIARDA	0690.0023CN4	3871

27896 7590 04/21/2021

EDELL, SHAPIRO & FINNAN, LLC
9801 Washingtonian Blvd.
Suite 750
Gaithersburg, MD 20878

EXAMINER	
HONG, DUNG	
ART UNIT	PAPER NUMBER
2643	

DATE MAILED: 04/21/2021

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(Applications filed on or after May 29, 2000)

The Office has discontinued providing a Patent Term Adjustment (PTA) calculation with the Notice of Allowance.

Section 1(h)(2) of the AIA Technical Corrections Act amended 35 U.S.C. 154(b)(3)(B)(i) to eliminate the requirement that the Office provide a patent term adjustment determination with the notice of allowance. See Revisions to Patent Term Adjustment, 78 Fed. Reg. 19416, 19417 (Apr. 1, 2013). Therefore, the Office is no longer providing an initial patent term adjustment determination with the notice of allowance. The Office will continue to provide a patent term adjustment determination with the Issue Notification Letter that is mailed to applicant approximately three weeks prior to the issue date of the patent, and will include the patent term adjustment on the patent. Any request for reconsideration of the patent term adjustment determination (or reinstatement of patent term adjustment) should follow the process outlined in 37 CFR 1.705.

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

OMB Clearance and PRA Burden Statement for PTOL-85 Part B

The Paperwork Reduction Act (PRA) of 1995 requires Federal agencies to obtain Office of Management and Budget approval before requesting most types of information from the public. When OMB approves an agency request to collect information from the public, OMB (i) provides a valid OMB Control Number and expiration date for the agency to display on the instrument that will be used to collect the information and (ii) requires the agency to inform the public about the OMB Control Number's legal significance in accordance with 5 CFR 1320.5(b).

The information collected by PTOL-85 Part B is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 30 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450. Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Notice of Allowability	**Application No.** 16/832,820	**Applicant(s)** PUENTE BALIARDA et al.	
	Examiner DUNG HONG	**Art Unit** 2643	**AIA (FITF) Status** No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1.☑ This communication is responsive to 04/14/2021.
  ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2.☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

3.☑ The allowed claim(s) is/are 21-40 . As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see **http://www.uspto.gov/patents/init_events/pph/index.jsp** or send an inquiry to **PPHfeedback@uspto.gov.**

4.☑ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a) ☑All b) ☐ Some *c) ☐ None of the:

1. ☑ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

* Certified copies not received: _____ .

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5.☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
  ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____ .

Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6.☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1.☑ Notice of References Cited (PTO-892)
2.☐ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date _____.
3.☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material _____.
4.☐ Interview Summary (PTO-413), Paper No./Mail Date. _____.
5. ☐ Examiner's Amendment/Comment
6. ☑ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

/DUNG HONG/
Primary Examiner, Art Unit 2643

REASONS FOR ALLOWANCE

The following is an examiner's statement of reasons for allowance:

Terminal Disclaimer and remarks filed on 04/14/2021 by Applicant have overcome the rejection issued on 12/23/2020. Therefore, claim 21, 26, 32, and their dependent claims are allowable over prior art of record.

All related prior art found by Examiner are listed in "Notice of Reference Cited".

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Contact Information

Any inquiry concerning this communication or earlier communications from the examiner should be directed to DUNG HONG whose telephone number is (571) 270-7928. The examiner can normally be reached on Monday-Friday from 8:00 am to 5:00 pm.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, Applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, JINSONG HU, can be reached on (571) 272-3965. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

/DUNG HONG/
Primary Examiner, Art Unit 2643

Issue Classification	Application/Control No. 16/832,820	Applicant(s)/Patent Under Reexamination PUENTE BALIARDA et al.
	Examiner DUNG HONG	Art Unit 2643

CPC						
Symbol					**Type**	**Version**
H01Q	/	1	/	243	F	2013-01-01
H01Q	/	5	/	371	I	2013-01-01
H01Q	/	5	/	40	I	2015-01-15
H01Q	/	1	/	36	I	2013-01-01
H01Q	/	9	/	0407	I	2013-01-01
H01Q	/	9	/	0421	I	2013-01-01

CPC Combination Sets								
Symbol					**Type**	**Set**	**Ranking**	**Version**
	/		/					

NONE (Assistant Examiner) (Date)	**Total Claims Allowed:** 20	
/DUNG HONG/ Primary Examiner, Art Unit 2643 17 April 2021 (Primary Examiner) (Date)	O.G. Print Claim(s) 1	O.G. Print Figure 3

U.S. Patent and Trademark Office Part of Paper No.: 20210417

Issue Classification	Application/Control No. 16/832,820	Applicant(s)/Patent Under Reexamination PUENTE BALIARDA et al.
	Examiner DUNG HONG	Art Unit 2643

INTERNATIONAL CLASSIFICATION				
CLAIMED				
H01Q1/24	/	1	/	24
H01Q5/371	/	5	/	371
H01Q5/40	/	5	/	40
H01Q1/36	/	1	/	36
H01Q9/04	/	9	/	04

NON-CLAIMED				
	/		/	

US ORIGINAL CLASSIFICATION	
CLASS	SUBCLASS

CROSS REFERENCES(S)						
CLASS	SUBCLASS (ONE SUBCLASS PER BLOCK)					

NONE (Assistant Examiner) (Date)	Total Claims Allowed: 20	
/DUNG HONG/ Primary Examiner, Art Unit 2643 17 April 2021 (Primary Examiner) (Date)	O.G. Print Claim(s) 1	O.G. Print Figure 3

U.S. Patent and Trademark Office Part of Paper No.: 20210417

Issue Classification	Application/Control No. 16/832,820	Applicant(s)/Patent Under Reexamination PUENTE BALIARDA et al.
	Examiner DUNG HONG	Art Unit 2643

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☑ T.D. ☐ R.1.47

CLAIMS

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
1	21	10	30	19	39										
2	22	11	31	20	40										
3	23	12	32												
4	24	13	33												
5	25	14	34												
6	26	15	35												
7	27	16	36												
8	28	17	37												
9	29	18	38												

NONE (Assistant Examiner) (Date)	**Total Claims Allowed:** 20	
/DUNG HONG/ 17 April 2021 Primary Examiner, Art Unit 2643 (Primary Examiner) (Date)	O.G. Print Claim(s) 1	O.G. Print Figure 3

U.S. Patent and Trademark Office Part of Paper No.: 20210417

Index of Claims	Application/Control No. 16/832,820	Applicant(s)/Patent Under Reexamination PUENTE BALIARDA et al.
	Examiner DUNG HONG	Art Unit 2643

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

CLAIMS

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☑ T.D. ☐ R.1.47

CLAIM		DATE									
Final	Original	12/18/2020	04/17/2021								
1	21	✓	=								
2	22	✓	=								
3	23	✓	=								
4	24	✓	=								
5	25	✓	=								
6	26	✓	=								
7	27	✓	=								
8	28	✓	=								
9	29	✓	=								
10	30	✓	=								
11	31	✓	=								
12	32	✓	=								
13	33	✓	=								
14	34	✓	=								
15	35	✓	=								
16	36	✓	=								
17	37	✓	=								
18	38	✓	=								
19	39	✓	=								
20	40	✓	=								

Bibliographic Data

Application No: 16/832,820

Foreign Priority claimed: ◉ Yes ○ No

35 USC 119 (a-d) conditions met: ☑ Yes ☐ No ☐ Met After Allowance

Verified and Acknowledged: /DUNG HONG/

Examiner's Signature Initials

Title: Multiple-Body-Configuration Multimedia and Smartphone Multifunction Wireless Devices

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
03/27/2020	455	2643	0690.0023CN4
RULE			

APPLICANTS

Fractus, S.A., Barcelona, SPAIN

INVENTORS

Carles PUENTE BALIARDA, Barcelona, SPAIN

Josep MUMBRU, Asnieres-sur-Seine, FRANCE

Jordi ILARIO, Barcelona, SPAIN

CONTINUING DATA

This application is a CON of 15856626 12/28/2017 PAT 10644380

15856626 is a CON of 14738090 06/12/2015 PAT 9899727

14738090 is a CON of 14246491 04/07/2014 PAT 9099773

14246491 is a CON of 11614429 12/21/2006 PAT 8738103

11614429 has PRO of 60856410 11/03/2006

11614429 has PRO of 60831544 07/18/2006

FOREIGN APPLICATIONS

EPO EP06117352.2 07/18/2006

IF REQUIRED, FOREIGN LICENSE GRANTED**

STATE OR COUNTRY

SPAIN

ADDRESS

EDELL, SHAPIRO & FINNAN, LLC
9801 Washingtonian Blvd.
Suite 750
Gaithersburg, MD 20878
UNITED STATES

FILING FEE RECEIVED

$1,880

Notice of References Cited	Application/Control No. 16/832,820	Applicant(s)/Patent Under Reexamination PUENTE BALIARDA et al.	
	Examiner DUNG HONG	Art Unit 2643	Page 1 of 2

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-20050176390-A1	08-2005	Navsariwala, Umesh D.	H01Q5/357	455/168.1
*	B	US-20040145527-A1	07-2004	Mikkola, Jyrki	H01Q19/005	343/700MS
*	C	US-6452553-B1	09-2002	Cohen; Nathan	H01Q1/246	343/702
*	D	US-20020000944-A1	01-2002	Sabet, Kazem F.	H01Q13/16	343/770
*	E	US-20050195112-A1	09-2005	Baliarda, Carles Puente	H01Q13/10	343/700MS
*	F	US-20060121865-A1	06-2006	Frank; Michael Louis	H04B1/006	455/183.1
*	G	US-20060082505-A1	04-2006	Baliarda; Carles Puente	H01Q11/16	343/700MS
*	H	US-20050259013-A1	11-2005	Gala Gala, David	H01Q5/364	343/702
*	I	US-20050001767-A1	01-2005	Wulff, Thomas	B29C45/14639	343/700MS
*	J	US-20060044195-A1	03-2006	Arkko; Aimo	H01Q9/30	343/702
*	K	US-20050184909-A1	08-2005	Tchistiakov, Nikolai	H01Q5/50	343/700MS
*	L	US-20030137461-A1	07-2003	Peng, Hongli	H01Q19/005	343/702
*	M	US-20010050636-A1	12-2001	Weinberger, Martin	H01Q21/30	343/700MS

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

U.S. Patent and Trademark Office
PTO-892 (Rev. 01-2001) **Notice of References Cited** Part of Paper No. 20210417

Notice of References Cited	Application/Control No. 16/832,820	Applicant(s)/Patent Under Reexamination PUENTE BALIARDA et al.	
	Examiner DUNG HONG	Art Unit 2643	Page 2 of 2

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-6989794-B2	01-2006	Tran; Allen	H01Q1/36	343/700MS
	B					
	C					
	D					
	E					
	F					
	G					
	H					
	I					
	J					
	K					
	L					
	M					

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
	N					
	O					
	P					
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NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
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	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Electronic Patent Application Fee Transmittal

Application Number:	16832820
Filing Date:	27-Mar-2020
Title of Invention:	Multiple-Body-Configuration Multimedia and Smartphone Multifunction Wireless Devices
First Named Inventor/Applicant Name:	Carles PUENTE BALIARDA
Filer:	Patrick J. Finnan/Janet Dorgan
Attorney Docket Number:	0690.0023CN4

Filed as Large Entity

Filing Fees for **Utility under 35 USC 111(a)**

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
UTILITY APPL ISSUE FEE	1501	1	1200	1200

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**1200**

Electronic Acknowledgement Receipt

EFS ID:	42533635
Application Number:	16832820
International Application Number:	
Confirmation Number:	3871
Title of Invention:	Multiple-Body-Configuration Multimedia and Smartphone Multifunction Wireless Devices
First Named Inventor/Applicant Name:	Carles PUENTE BALIARDA
Customer Number:	27896
Filer:	Patrick J. Finnan/Janet Dorgan
Filer Authorized By:	Patrick J. Finnan
Attorney Docket Number:	0690.0023CN4
Receipt Date:	23-APR-2021
Filing Date:	27-MAR-2020
Time Stamp:	20:03:07
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$1200
RAM confirmation Number	E20214MK03284777
Deposit Account	
Authorized User	

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Issue Fee Payment (PTO-85B)	2021-04-23_IssueFeeTransmittal_Part-B-0023CN4.pdf	202236 a95c68f9990a47654af1d1b7ca0872330389311c	no	2
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	30714 08a880c2c2c17c70fe577add8c13de2eb1546bb8	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	232950		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

<u>New Applications Under 35 U.S.C. 111</u>
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

<u>National Stage of an International Application under 35 U.S.C. 371</u>
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

<u>New International Application Filed with the USPTO as a Receiving Office</u>
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via EFS-Web.

By mail, send to: Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

By fax, send to: (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

27896 7590 04/21/2021
EDELL, SHAPIRO & FINNAN, LLC
9801 Washingtonian Blvd.
Suite 750
Gaithersburg, MD 20878

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via EFS-Web or by facsimile to (571) 273-2885, on the date below.

(Typed or printed name)

(Signature)

(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/832,820	03/27/2020	Carles PUENTE BALIARDA	0690.0023CN4	3871

TITLE OF INVENTION: Multiple-Body-Configuration Multimedia and Smartphone Multifunction Wireless Devices

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1200	$0.00	$0.00	$1200	07/21/2021

EXAMINER	ART UNIT	CLASS-SUBCLASS
HONG, DUNG	2643	455-552100

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

☐ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.

☐ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-09 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 Edell, Shapiro & Finnan, LLC
2 ____
3 ____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE: Fractus, S.A.

(B) RESIDENCE: (CITY and STATE OR COUNTRY): Barcelona, Spain

Please check the appropriate assignee category or categories (will not be printed on the patent) : ☐ Individual ☒ Corporation or other private group entity ☐ Government

4a. Fees submitted: ☒ Issue Fee ☐ Publication Fee (if required) ☐ Advance Order - # of Copies ____

4b. Method of Payment: *(Please first reapply any previously paid fee shown above)*

☒ Electronic Payment via EFS-Web ☐ Enclosed check ☐ Non-electronic payment by credit card (Attach form PTO-2038)

☒ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. 05-0460

5. **Change in Entity Status** (from status indicated above)

☐ Applicant certifying micro entity status. See 37 CFR 1.29

☐ Applicant asserting small entity status. See 37 CFR 1.27

☐ Applicant changing to regular undiscounted fee status.

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.
NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature /Patrick J. Finnan/ Date April 23, 2021

Typed or printed name Patrick J. Finnan Registration No. 39189

OMB Clearance and PRA Burden Statement for PTOL-85 Part B

The Paperwork Reduction Act (PRA) of 1995 requires Federal agencies to obtain Office of Management and Budget approval before requesting most types of information from the public. When OMB approves an agency request to collect information from the public, OMB (i) provides a valid OMB Control Number and expiration date for the agency to display on the instrument that will be used to collect the information and (ii) requires the agency to inform the public about the OMB Control Number's legal significance in accordance with 5 CFR 1320.5(b).

The information collected by PTOL-85 Part B is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 30 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450. Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/832,820	06/08/2021	11031677	0690.0023CN4	3871

27896 7590 05/19/2021

EDELL, SHAPIRO & FINNAN, LLC
9801 Washingtonian Blvd.
Suite 750
Gaithersburg, MD 20878

ISSUE NOTIFICATION

The projected patent number and issue date are specified above.

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment is 0 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (http://pair.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Application Assistance Unit (AAU) of the Office of Data Management (ODM) at (571)-272-4200.

APPLICANT(s) (Please see PAIR WEB site http://pair.uspto.gov for additional applicants):

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Carles PUENTE BALIARDA, Barcelona, SPAIN;
Josep MUMBRU, Asnieres-sur-Seine, FRANCE;
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