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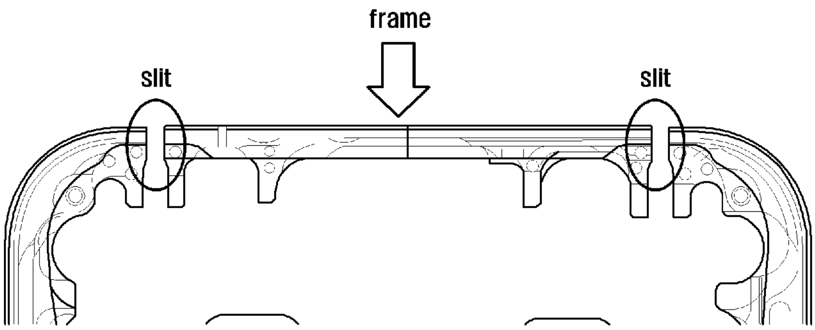
(54) **Title:** GPS ANTENNA STRUCTURE FOR ELECTRONIC TERMINAL AND ELECTRONIC TERMINAL



(57) **Abstract:** Embodiments of the present disclosure provide a GPS antenna structure for an electronic terminal and the electronic terminal, the GPS antenna structure comprising: at least two antennas, separating a metal frame of the electronic terminal by at least one slit into at least two portions, each portion of the at least two portions being made into a separate antenna to form at least two antennas, one side of a first antenna of the at least the two antennas being used for connecting to a feeding point, the first antenna being configured to receive a wireless signal in a first frequency band of a GPS, and a first preset position of a second antenna of the at least two antennas being used for connecting to a second frequency band module of the GPS, the second antenna being configured to receive a wireless signal in the second frequency band of the GPS. The GPS antenna structure for an electronic terminal and the electronic terminal of example embodiments of the present disclosure can be used to effectively reduce the interference between antennas, and improve the overall performance of the antennas.

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Description

Title of Invention: GPS ANTENNA STRUCTURE FOR ELECTRONIC TERMINAL AND ELECTRONIC TERMINAL

Technical Field

[1] The present disclosure generally relates to an antenna structure, and more specifically relates to a GPS (Global Positioning System) antenna structure for an electronic terminal and an electronic terminal having the GPS antenna structure.

Background Art

[2] With the continuous development of electronic communication technology, an electronic terminal has increasingly abundant functions, and there are also increasing antennas supporting the electronic terminal to achieve various data transmission and communication functions.

Disclosure of Invention

Technical Problem

[3] At present, a common antenna setting mode used in the electronic terminal is configured by additionally providing an antenna stand in the electronic terminal, and designing the antenna using LDS (Laser-Direct-structuring, LDS direct molding technology) or a FPCB (Flexible Printed Circuit Board). However, this design approach increases the material cost, and the antenna is designed on a printed circuit board without clearance and height, thereby resulting in low antenna performance (the antenna efficiency is generally 16% or less).

[4] In addition to the above antenna design approach, a metal frame of the electronic terminal may be further used as a portion of the antenna, and a plurality of functions may be integrated onto the same antenna. For example, for a GPS dual-frequency antenna of an electronic terminal, a portion of the metal frame of the electronic terminal is used as the antenna, and supports a frequency band GPS L1/L5 and a BT/WIFI frequency band, covering a frequency band range of 1170-2500 MHz, and such a large span will bring a problem that it is difficult to debug the antenna. In addition, since a plurality of functions is integrated, the use of combiners is increased on a channel, resulting in increased channel losses.

[5] An object of an example embodiment of the present disclosure is to provide a GPS antenna structure for an electronic terminal and the electronic terminal, to overcome at least one of the above defects.

Solution to Problem

[6] An aspect of an example embodiment of the present disclosure provides a global positioning system (GPS) antenna structure for an electronic terminal, including: at least

two antennas, separating a metal frame of the electronic terminal by at least one slit into at least two portions, each portion of the at least two portions being made into a separate antenna to form at least two antennas, one side of a first antenna of the at least the two antennas being used for connecting to a first feeding point, the first antenna being configured to receive a wireless signal in a first frequency band of a GPS, and a first preset position of a second antenna of the at least two antennas being used for connecting to a second feeding point, the second antenna being configured to receive a wireless signal in a second frequency band of the GPS.

[7] Alternatively, the first antenna may be further configured to receive or irradiate a wireless signal in a third frequency band of long term evolution (LTE), and the second antenna may be further configured to receive or irradiate a wireless signal in a fourth frequency band of the LTE.

[8] Alternatively, a second preset position of the second antenna may be used for connecting to a third feeding point, such that the wireless signal in the fourth frequency band of the LTE is activated via the third feeding point. The GPS antenna structure may further include: a band pass filter, one terminal of the band pass filter is connected to the first preset position, and another terminal of the band pass filter is connected to the second feeding point, such that the wireless signal in the second frequency band of the GPS is activated via the second feeding point.

[9] Alternatively, the first frequency band of the GPS may be a frequency band GPSL1, the second frequency band of the GPS may be a frequency band GPSL5, the third frequency band of the LTE may be a medium-high frequency band of the LTE, and the fourth frequency band of the LTE may be a low frequency band of the LTE.

[10] Alternatively, the one side of the first antenna may be the one side of the first antenna close to the second antenna, and another side of the first antenna away from the second antenna may be grounded.

[11] Alternatively, the GPS antenna structure may further include a frequency selecting switch and a second grounding point, wherein, a common terminal of the frequency selecting switch is connected to the second preset position, and a plurality of connection terminals of the frequency selecting switch is connected to the second grounding point respectively, wherein, the frequency selecting switch may be controlled to connect, based on a current working frequency band of the second antenna, a connection terminal corresponding to the current working frequency band to the common terminal.

[12] Alternatively, the at least two antennas may further include a third antenna, and the first antenna, the second antenna and the third antenna are three portions of the metal frame separated by two slits and ranked in sequence, where the third antenna is configured to receive or irradiate a wireless signal in a Bluetooth and/or WIFI

frequency band.

[13] Alternatively, one side of the third antenna close to the second antenna may be used for connecting to a Bluetooth and/or WIFI module, and another side of the third antenna away from the second antenna may be grounded, wherein, the GPS antenna structure may further include: a high pass filter and a third grounding point, wherein, one terminal of the high pass filter may be connected to one side of the second antenna close to the third antenna, and another terminal of the high pass filter may be connected to the third grounding point, such that a wireless signal above a preset frequency can be grounded via the high pass filter.

[14] According to another aspect of an example embodiment of the present disclosure, an electronic terminal is provided, including the above GPS antenna structure for an electronic terminal.

Advantageous Effects of Invention

[15] The GPS antenna structure for an electronic terminal and the electronic terminal of example embodiments of the present disclosure can not only reduce the number of antennas, and save space, but also effectively reduce the interference between antennas, and improve the overall performance of the antennas.

[16] Additional aspects and/or advantages of the general concept of the present disclosure will be partially set forth in the following description. Another portion will be apparent from the description, or may be known by implementing the general concept of the present disclosure.

Brief Description of Drawings

[17] The above and other objectives, features and advantages of example embodiments of the present disclosure will become more apparent in conjunction with detailed description of the accompanying drawings of the embodiments illustratively shown below.

[18] Fig. 1 shows a schematic diagram of a metal frame of an electronic terminal according to an example embodiment of the present disclosure;

[19] Fig. 2 shows a schematic diagram of a GPS antenna structure for an electronic terminal according to an example embodiment of the present disclosure;

[20] Fig. 3 shows a schematic diagram of a trend of a wireless signal in a first antenna according to an example embodiment of the present disclosure;

[21] Fig. 4 shows a schematic diagram of a connection line of a frequency selecting switch according to an example embodiment of the present disclosure;

[22] Fig. 5 shows a schematic diagram of a trend of a wireless signal in a frequency band GPS L5 of a second antenna according to an example embodiment of the present disclosure;

[23] Fig. 6 shows a schematic diagram of a trend of a wireless signal in a low frequency band of LTE of a second antenna according to an example embodiment of the present disclosure;

[24] Fig. 7 shows a schematic diagram of a trend of a wireless signal in a Bluetooth/WIFI frequency band of a third antenna according to an example embodiment of the present disclosure; and

[25] Fig. 8 shows a schematic diagram of an antenna efficiency of a GPS antenna structure according to an example embodiment of the present disclosure.

Mode for the Invention

[26] Examples of the embodiments will be shown in the accompanying drawings in detail with reference to the embodiments of the present disclosure, where like reference numerals refer to like components throughout. The embodiments will be described below with reference to the accompanying drawings, in order to explain the present disclosure.

[27] Fig. 1 shows a schematic diagram of a metal frame of an electronic terminal according to an example embodiment of the present disclosure. As an example, the electronic terminal may be an electronic device with a metal frame, such as a smart phone, a tablet computer, a personal digital assistant, and a game machine.

[28] The metal frame of the electronic terminal according to an example embodiment of the present disclosure is separated by at least one slit into at least two portions, each slit may be filled with an insulating material (e.g., resin), and each portion of the at least two portions is made into a separate antenna to form at least two antennas. As shown in Fig. 1, the figure shows a schematic diagram of the metal frame of the electronic terminal being separated by two slits into three portions, to form a first antenna, a second antenna, and a third antenna.

[29] Fig. 2 shows a schematic diagram of a GPS antenna structure for an electronic terminal according to an example embodiment of the present disclosure. It should be understood that, in an example embodiment of the present disclosure, introduction is provided by taking a metal frame of the electronic terminal being separated into three antennas as an example, but the present disclosure is not limited to the example. Those skilled in the art may increase or decrease the number of antennas based on actual requirements.

[30] As show in Fig. 2, a first antenna T1, a second antennaT2, and a third antenna T3 may be three portions of the metal frame of the electronic terminal separated by two slits and ranked in sequence, i.e., the separated antennas are close pairwise.

[31] Preferably, the second antenna T2 may be located between the first antenna T1 and the third antenna T3, because wireless signals received or irradiated by the first

antenna T1 and the third antenna T3 are in close frequency bands, the first antenna T1 is separated from the third antenna T3 by the second antenna T2, which can reduce the interference between the signals.

[32] In the example shown in Fig. 2, the first antenna T1 is on the left side of the second antenna T2, and the third antenna T3 is on the right side of the second antenna T2, but the present disclosure is not limited to the example. The third antenna T3 may also be on the left side of the second antenna T2, and the first antenna T1 may also be on the right side of the second antenna T2.

[33] One side of the first antenna T1 is used for connecting to a feeding point A1, a first preset position on the second antenna T2 is used for connecting to a second frequency band module of a GPS A2, the first antenna T1 is configured to receive a wireless signal in a first frequency band of the GPS, and the second antenna T2 is configured to receive a wireless signal in a second frequency band of the GPS. Here, the first preset position on the second antenna T2 may be connected to the second frequency band module of the GPS A2 by direct connection or coupling connection.

[34] As an example, the first frequency band of the GPS may be a frequency band GPS L1. Here, the frequency band GPS L1 is used for a low precision positioning system, the positioning accuracy of which is generally 30 m. The second frequency band of the GPS may be a frequency band GPS L5. Here, the frequency band GPS L5 is used for a high precision positioning system, the positioning accuracy of which may generally reach 30 cm.

[35] In the GPS antenna structure of an example embodiment of the present disclosure, the frequency band GPS L1 and the frequency band GPS L5 are designed on two antennas respectively. Such a dual-frequency antenna design of the GPS can greatly reduce the difficulty of antenna debugging, save space, and further ensure good antenna performance.

[36] In a preferable embodiment, the first antenna T1 and the second antenna T2 may be further configured to consider other frequency bands. For example, the first antenna T1 may be further configured to receive or irradiate a wireless signal in a third frequency band of LTE (long term evolution), and the second antenna T2 may be further configured to receive or irradiate a wireless signal in a fourth frequency band of the LTE.

[37] As an example, the third frequency band of the LTE may be a medium-high frequency band of the LTE (i.e., a frequency band satisfying requirements of a first frequency band range). For example, the frequency band range covered by the third frequency band of the LTE may include 1550 MHz-2700 MHz. The fourth frequency band of the LTE may be a low frequency band of the LTE (i.e., a frequency band satisfying requirements of a second frequency band range). For example, the frequency

band range covered by the fourth frequency band of the LTE may include 850 MHz-960 MHz.

[38] Preferably, the one side of the first antenna T1 for connecting to the feeding point A1 is one side of the first antenna T1 close to the second antenna T2, i.e., one side of the first antenna T1 close to the second antenna T2 is used for connecting to the feeding point A1, and another side of the first antenna T1 away from the second antenna T2 is grounded. In this case, the wireless signal in the first frequency band of the GPS and the wireless signal in the third frequency band of the LTE may be activated via the feeding point A1.

[39] In a preferable embodiment, the GPS antenna structure according to an example embodiment of the present disclosure may further include: a duplexer E, one terminal of the duplexer E is connected to the feeding point A1 (or connected to one side of the first antenna T1 close to the second antenna T2), another terminal of the duplexer E is connected to a GPS L1 module of the electronic terminal (i.e., a first frequency band module of the GPS) and a medium-high frequency module of the LTE (i.e., a third frequency band module of the LTE), respectively. The duplexer is configured to integrate a link of the frequency band GPS L1 and a link of the medium-high frequency band of the LTE. Here, the feeding point A1 may be connected to one terminal of the duplexer E by direct connection or coupling connection.

[40] Fig. 3 shows a schematic diagram of a trend of a wireless signal in a first antenna T1 according to an example embodiment of the present disclosure.

[41] As shown in Fig. 3, the first antenna T1 uses a Loop feeding form, and wireless signals in a frequency band GPS L1 and a medium-high frequency band of the LTE are activated via a feeding point A1. By the above antenna design approach, the first antenna T1 can achieve better antenna performance.

[42] Preferably, the GPS antenna structure according to an example embodiment of the present disclosure may further include: a first grounding point G1. A third preset position on one side of a second antenna T2 close to the first antenna T1 is used for connecting to the first grounding point G1. By providing the first grounding point G1, the interference of the second antenna T2 with the first antenna T1 may be substantially eliminated.

[43] In order to cause the second antenna T2 to be able to support a second frequency band of a GPS and a fourth frequency band of LTE, in a preferable embodiment, a GPS antenna circuit according to an example embodiment of the present disclosure may further include a band pass filter (BPF).

[44] A first preset position on the second antenna T2 is used for connecting to a GPS L5 module A2 (i.e., a second frequency band module of the GPS) in an electronic terminal. A second preset position on the second antenna T2 may be used for

connecting to a fourth frequency band module of the LTE A3, such that a wireless signal in the fourth frequency band of the LTE is activated via the second preset position. The second preset position may be located between the third preset position for connecting to the first grounding point G1 and the first preset position on the second antenna T2. Here, both the first preset position and the second preset position on the second antenna T2 may be connected to the GPS L5 module A2 and the fourth frequency band module of the LTE A3 by direct connection or coupling connection.

[45] One terminal of the band pass filter (BPF) may be connected to the first preset position on the second antenna T2, and another terminal of the band pass filter (BPF) may be used for connecting to a second frequency band module of the GPS A2, such that a wireless signal in the second frequency band of the GPS is activated via the first preset position. Here, a frequency band range of signals allowed to pass through by the band pass filter (BPF) may be a frequency band range of the second frequency band of the GPS, i.e., 1176.45 MHz±1.023 MHz. That is, the band pass filter (BPF) only allows wireless signals in the second frequency band of the GPS to pass through, thereby avoiding the interference by other signals. Here, due to the frequency selection characteristic of the band pass filter (BPF), the band pass filter (BPF) presents high resistance to out-of-band signals, such that wireless signals at 700 MHz-960 MHz cannot pass through, thereby avoiding mutual interference with the wireless signal in the fourth frequency band of the LTE.

[46] The wireless signal in the fourth frequency band of the LTE may be activated via the second preset position. In a preferable embodiment, the GPS antenna structure according to an example embodiment of the present disclosure may further include: a frequency selecting switch S and a second grounding point G2.

[47] Fig. 4 shows a schematic diagram of a connection line of a frequency selecting switch according to an example embodiment of the present disclosure. It should be understood that Fig. 4 is introduced by taking a frequency selecting switch including three connection terminals as an example, but the present disclosure is not limited to the example. Those skilled in the art may adjust the number of connection terminals of the frequency selecting switch according to actual requirements.

[48] As show in Fig. 4, a common terminal S1 of the frequency selecting switch is connected to a second preset position on a second antenna T2. Here, the second preset position on the second antenna T2 may be connected to a low frequency module of LTE in an electronic terminal, i.e., the common terminal S1 of the frequency selecting switch may also be connected to a connection line between the second preset position and a fourth frequency band module of the LTE. A plurality of connection terminals (e.g., S2-S4) of the frequency selecting switch is connected to a second grounding point G2 respectively.

[49] In this case, the electronic terminal may detect a current working frequency band of the second antenna T2, and control the frequency selecting switch to connect a connection terminal corresponding to the current working frequency band to the common terminal based on the current working frequency band of the second antenna T2.

[50] That is, the frequency selecting switch may be used for frequency switching of 700 MHz-960 MHz, to meet the bandwidth requirements.

[51] Fig. 5 shows a schematic diagram of a trend of a wireless signal in a frequency band GPS L5 of a second antenna according to an example embodiment of the present disclosure. Fig. 6 shows a schematic diagram of a trend of a wireless signal in a low frequency band of LTE of a second antenna according to an example embodiment of the present disclosure.

[52] As shown in Fig. 5 and Fig. 6, the second antenna uses dual feeding points and an IFA feeding form, the wireless signal in the frequency band GPS L5 is activated via a second frequency band module of the GPS A2, and only the wireless signal in the frequency band GPS L5 (i.e., 1176.45 MHz±1.023 MHz signal) passes through a band pass filter (BPF), thereby avoiding the interference by other signals.

[53] The wireless signal in the low frequency band of the LTE is activated via a fourth frequency band module of the LTE A3, and performs frequency switching of 700 MHz-960 MHz in combination with use of a frequency selecting switch, to meet the bandwidth requirements.

[54] One side of a third antenna T3 close to the second antenna T2 is used for connecting to a Bluetooth and/or WIFI module A4, and another side of the third antenna T3 away from the second antenna T2 is grounded. Here, the one side of the third antenna T3 close to the second antenna T2 may be used for connecting to a Bluetooth and/or WIFI module A4 by direct connection or coupling connection.

[55] In a preferable embodiment, a GPS antenna structure for an electronic terminal according to an example embodiment of the present disclosure may further include: a high pass filter (HPF) and a third grounding point G3. One terminal of the high pass filter (HPF) is connected to one side of the second antenna T2 close to the third antenna T3, and another terminal of the high pass filter (HPF) is connected to the third grounding point G3, such that a wireless signal above a preset frequency can be grounded via the high pass filter (HPF).

[56] Here, the high pass filter (HPF) is configured to filter out a wireless signal in a frequency band supported by the third antenna T3 (i.e., a Bluetooth BT/WIFI frequency band). As an example, the preset frequency may include, but is not limited to, a frequency of 2 GHz.

[57] Fig. 7 shows a schematic diagram of a trend of a wireless signal in a Bluetooth/WIFI

frequency band of a third antenna according to an example embodiment of the present disclosure.

[58] As shown in Fig. 7, the third antenna T3 uses a Loop feeding form, and a high pass filter (HPF) is provided on one side of a second antenna T2 close to the third antenna. Due to the frequency selection characteristic of the high pass filter (HPF), a wireless signal T2 above a preset frequency (e.g., 2 GHz) is grounded at an end of the second antenna T2, and then the interference of the second antenna T2 with the third antenna T3 is substantially eliminated. By the above antenna design approach, the third antenna T3 can achieve better antenna performance.

[59] For a low frequency signal of the second antenna T2, the high pass filter (HPF) presents high resistance, equivalent to a disconnection effect. Therefore, addition of the high pass filter (HPF) will substantially not affect the low frequency performance of the second antenna T2.

[60] The antenna design scheme according to the above example embodiments of the present disclosure may divide specific functions of the above three antennas as follows: the first antenna T1 supports a frequency band GPS L1 and a medium-high frequency band of LTE, the second antenna T2 supports a frequency band GPS L5 and a low frequency band of the LTE, and the third antenna T3 supports the BT/WIFI frequency band. By the above division, the three antennas support different frequency bands respectively, thereby contributing to improving the problem of mutual interference and influence of the antennas.

[61] Fig. 8 shows a schematic diagram of an antenna efficiency of a GPS antenna structure according to an example embodiment of the present disclosure. In the present example, the abscissa represents the frequency f (GHz), and the ordinate represents the antenna efficiency Eff (%).

[62] As show in Fig. 8, a curve 1 represents an antenna efficiency of a second antenna in three frequency bands of the low frequency band of LTE, a curve 2 represents an antenna efficiency of the second antenna in a frequency band GPS L5, a curve 3 represents an antenna efficiency of a first antenna, and a curve 4 represents an antenna efficiency of a third antenna.

[63] As can be seen from Fig. 8, the antenna efficiency of the second antenna may substantially reach 25%, the antenna efficiency of the first antenna and the third antenna may substantially reach 40%, and the antennas each has very good performance.

[64] According to another aspect of an example embodiment of the present disclosure, an electronic terminal is further provided. The electronic terminal includes the above GPS antenna structure for an electronic terminal.

[65] By using the GPS antenna structure for an electronic terminal and the electronic terminal of example embodiments of the present disclosure, with the frequency band

GPS L5 compatible on the antenna in the middle of a metal frame via dual feeding points, and a frequency band GPS L1 is designed on the metal frame in a rim angle, in combination with use of filters, the interference between the antennas is effectively reduced, and the overall performance of the antennas is improved.

[66] The GPS antenna structure for an electronic terminal and the electronic terminal of some example embodiments of the present disclosure can not only reduce the number of antennas, and save space, but also reduce the channel losses, improve the isolation degree, and flexibly adjust the overall performance of the antennas.

[67] The example embodiments of the present disclosure have been described above. It should be understood that the above description is merely illustrative, rather than exhaustive, and the present disclosure is not limited to the disclosed example embodiments. Numerous modifications and alterations are apparent to those of ordinary skills in the technical field without departing from the scope and spirit of the embodiments of the present disclosure. Therefore, the scope of protection of the present disclosure should be subject to the scope of the appended claims.

Claims

[Claim 1] A GPS (Global Positioning System) antenna structure for an electronic terminal, comprising:
at least two antennas, separating a metal frame of the electronic terminal by at least one slit into at least two portions, each portion of the at least two portions being made into a separate antenna to form at least two antennas,
one side of a first antenna of the at least two antennas being used for connecting to a feeding point, the first antenna being configured to receive a wireless signal in a first frequency band of the GPS, and
a first preset position of a second antenna of the at least two antennas being used for connecting to a second frequency band module of the GPS, the second antenna being configured to receive a wireless signal in the second frequency band of the GPS.

[Claim 2] The GPS antenna structure according to claim 1, wherein the first antenna is further configured to receive or irradiate a wireless signal in a third frequency band of long term evolution (LTE), and the second antenna is further configured to receive or irradiate a wireless signal in a fourth frequency band of the LTE,
and/or, the GPS antenna structure further comprises:
a duplexer, one terminal of the duplexer being connected to the feeding point, another terminal of the duplexer being connected to a first frequency band module of the GPS and a third frequency band module of the LTE, respectively.

[Claim 3] The GPS antenna structure according to claim 2, wherein the GPS antenna structure further comprises:
a band pass filter, one terminal of the band pass filter being connected to the first preset position, another terminal of the band pass filter being connected to the second frequency band module of the GPS.

[Claim 4] The GPS antenna structure according to claim 3, wherein a second preset position of the second antenna is used for connecting to a fourth frequency band module of LTE,
and/or, the GPS antenna structure further comprises:
a first grounding point, a third preset position of the second antenna close to one side of the first antenna being used for connecting to the first grounding point,
wherein the second preset position is located between the third preset

position and the first preset position.

[Claim 5] The GPS antenna structure according to claim 4, wherein the first frequency band of the GPS is a frequency band GPSL1, the second frequency band of the GPS is a frequency band GPSL5, the third frequency band of the LTE is a medium-high frequency band of the LTE, and the fourth frequency band of the LTE is a low frequency band of the LTE.

[Claim 6] The GPS antenna structure according to claim 1, wherein the one side of the first antenna is the side of the first antenna close to the second antenna, and another side of the first antenna away from the second antenna is grounded.

[Claim 7] The GPS antenna structure according to claim 4, wherein the GPS antenna structure further comprises a frequency selecting switch and a second grounding point,
wherein a common terminal of the frequency selecting switch is connected to the second preset position, and a plurality of connection terminals of the frequency selecting switch is connected to the second grounding point respectively,
wherein the frequency selecting switch is controlled to connect, based on a current working frequency band of the second antenna, a connection terminal corresponding to the current working frequency band to the common terminal.

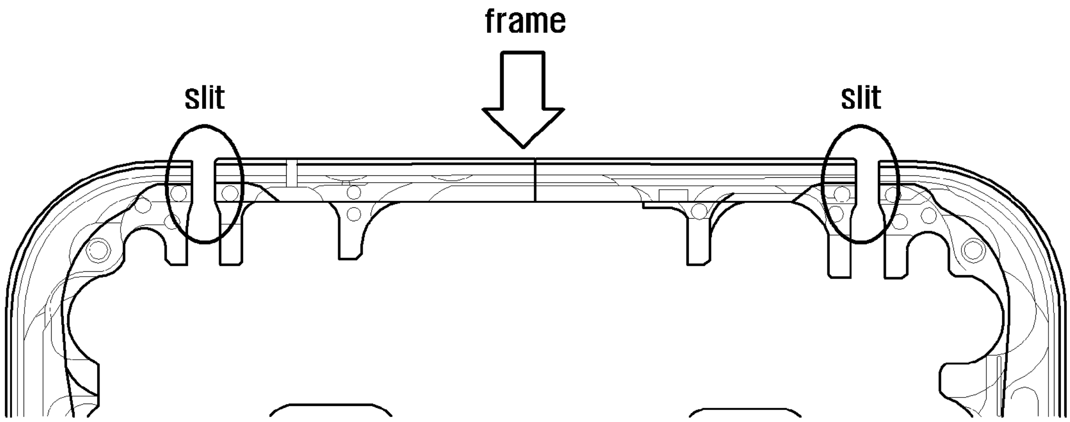
[Claim 8] The GPS antenna structure according to any one of claims 1-7, wherein the at least two antennas further comprise a third antenna, and the first antenna, the second antenna and the third antenna are three portions of the metal frame separated by two slits and ranked in sequence,
wherein the third antenna is configured to receive or irradiate a wireless signal in a Bluetooth and/or WIFI frequency band.

[Claim 9] The GPS antenna structure according to claim 8, wherein one side of the third antenna close to the second antenna is used for connecting to a Bluetooth and/or WIFI module, and another side of the third antenna away from the second antenna is grounded,
and/or, the GPS antenna structure further comprises: a high pass filter and a third grounding point,
wherein one terminal of the high pass filter is connected to one side of the second antenna close to the third antenna, and another terminal of the high pass filter is connected to the third grounding point, such that a wireless signal above a preset frequency can be grounded via the high

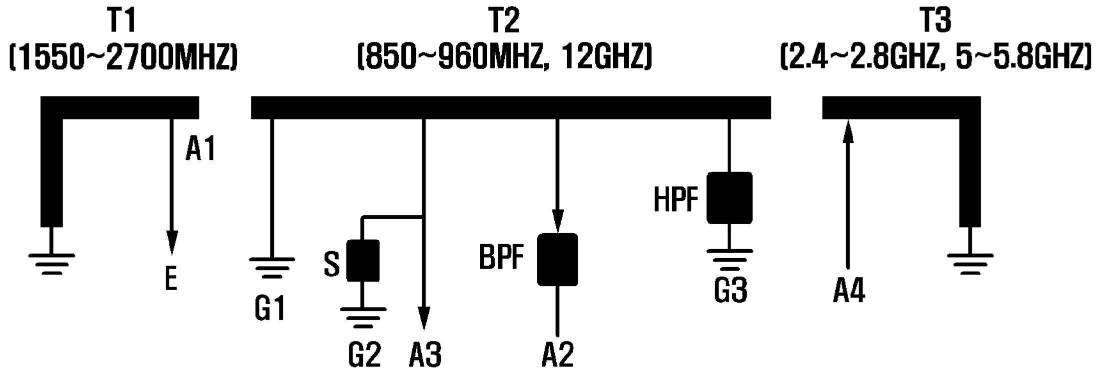
pass filter.

[Claim 10] An electronic terminal, comprising the GPS antenna structure according to any one of claims 1-9.

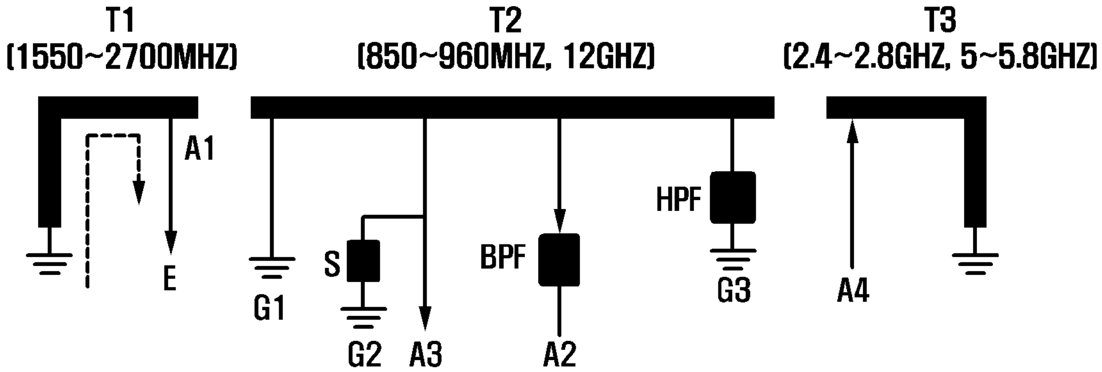
[Fig. 1]



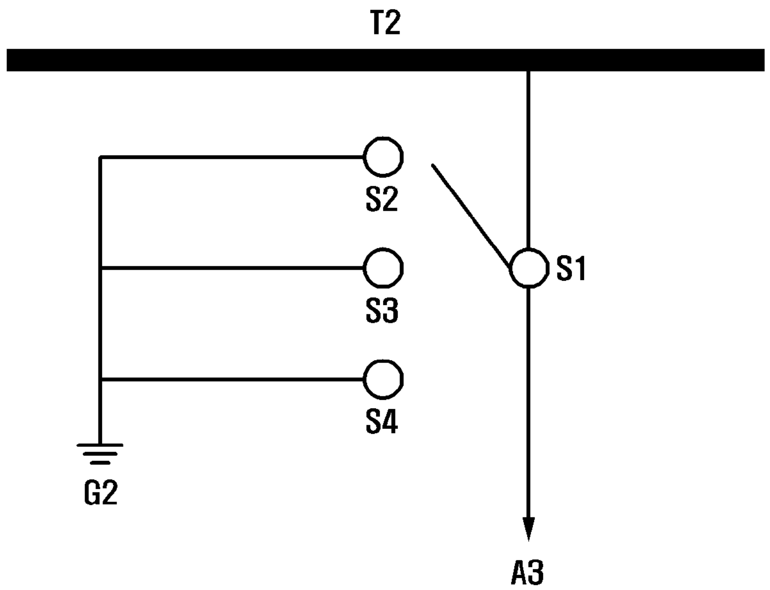
[Fig. 2]



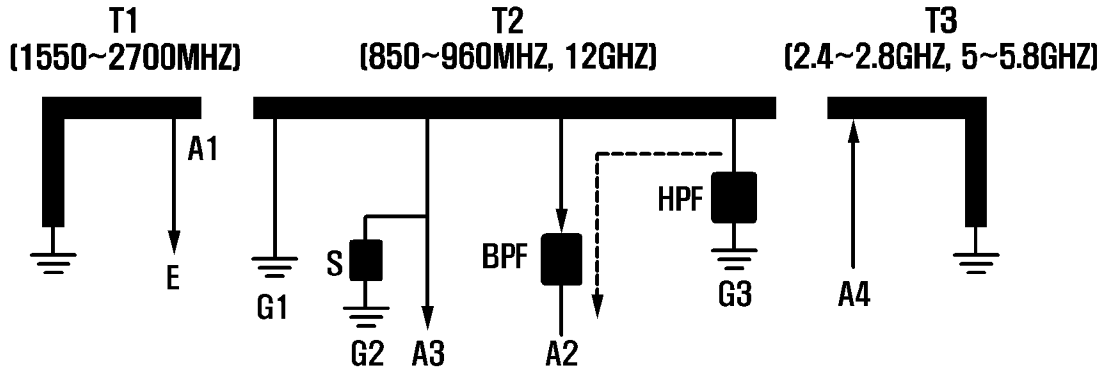
[Fig. 3]



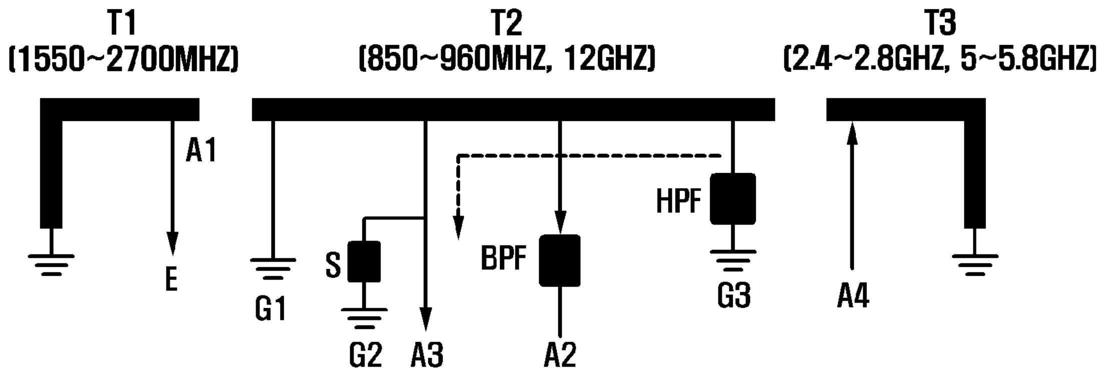
[Fig. 4]



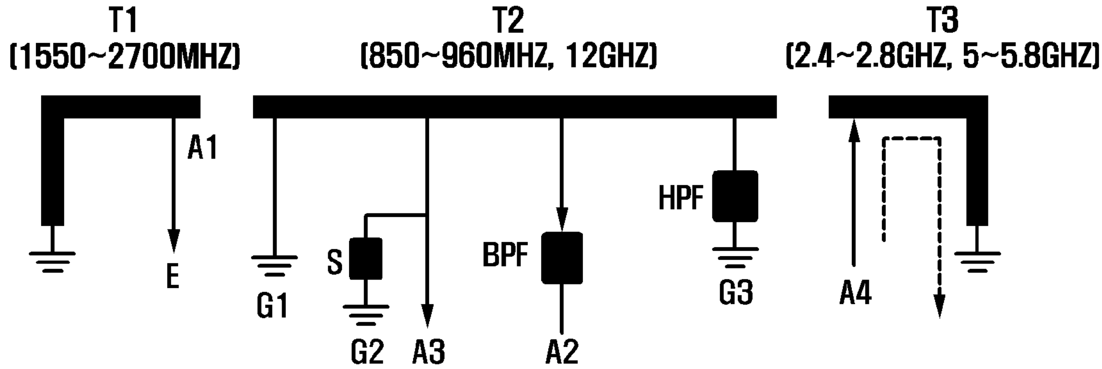
[Fig. 5]



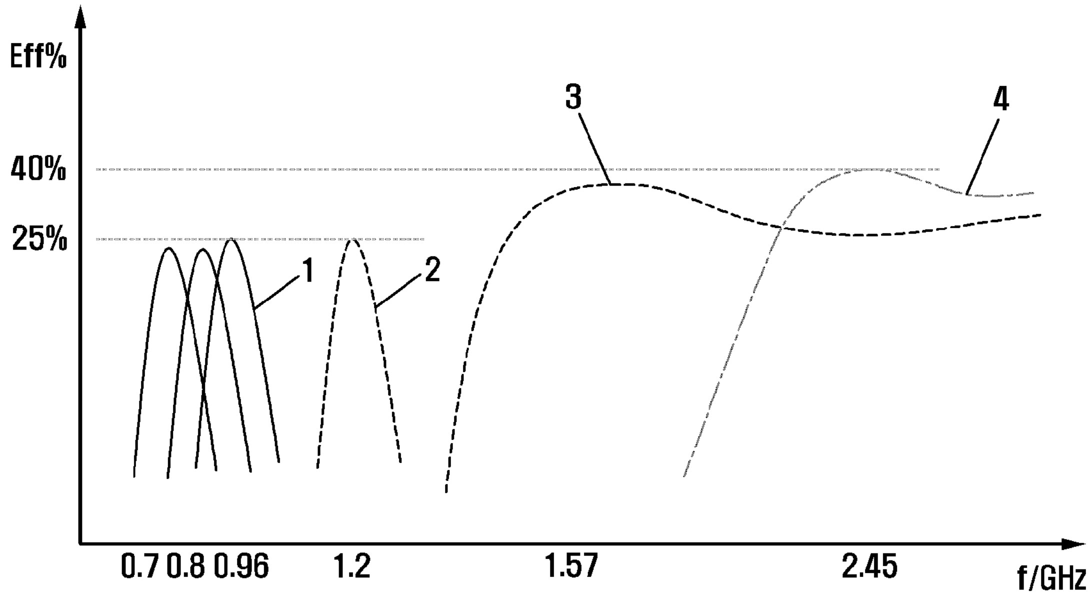
[Fig. 6]



[Fig. 7]



[Fig. 8]



INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2020/001134

A. CLASSIFICATION OF SUBJECT MATTER

H01Q 1/38(2006.01)i, H01Q 1/24(2006.01)i, H01Q 5/00(2006.01)i, H01P 1/207(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H01Q 1/38; H01Q 1/22; H01Q 1/24; H01Q 1/36; H01Q 1/44; H01Q 1/50; H01Q 1/52; H01Q 23/00; H01Q 5/307; H01Q 5/371; H01Q 5/00; H01P 1/207

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean utility models and applications for utility models
Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS(KIPO internal) & keywords: antenna, GPS, metal, frame, slit, frequency

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	CN 109193129 A (BEIJING XIAOMI MOBILE SOFTWARE CO., LTD.) 11 January 2019 paragraphs [0005], [0032]-[0046] and figure 1	1,6,10 2-5,7-9
Y	CN 104852122 A (LENOVO (BEIJING) CO., LTD.) 19 August 2015 paragraph [0048], claim 1 and figures 1-2	2-5,7-9
Y	CN 108718007 A (SAMSUNG GUANGZHOU MOBILE R&D CENTER et al.) 30 October 2018 claim 7 and figures 1-2	2-5,7-9
A	CN 107039766 A (VIVO COMMUNICATION TECHNOLOGY CO., LTD.) 11 August 2017 claims 1-9 and figures 1-3	1-10
A	US 2018-0358699 A1 (HUAWEI TECHNOLOGIES CO., LTD.) 13 December 2018 claims 23-27 and figures 1-6	1-10
PX	CN 109687115 A (SAMSUNG GUANGZHOU MOBILE R&D CENTER et al.) 26 April 2019 claims 1-10 and figures 1-8 The above document is a publication of the earlier application whose priority has been claimed in this international application.	1-10

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents,such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
01 May 2020 (01.05.2020)	**01 May 2020 (01.05.2020)**

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CN 109687115 A	26/04/2019	None	