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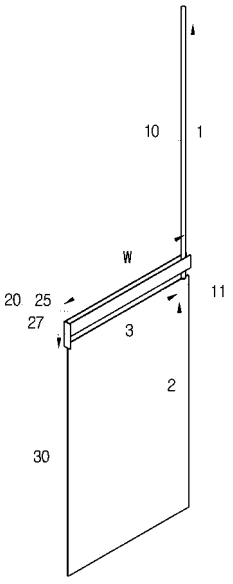
(54) Monopole antenna with expanded bandwidth, and mobile communication terminal having the same

(57) A monopole antenna is provided, including: a radiating unit (10) for radiating electromagnetic waves; a ground (30) connected to one side of the radiating unit; and a radiation inducing unit (20) formed along a first side of the ground that faces the radiating unit, and connected to the ground. Accordingly, various services can be provided through one antenna by expanding the operating frequency bandwidth.

FIG. 1



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Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a monopole antenna with an expanded bandwidth and a mobile communication terminal having the same. More particularly, the present invention relates to a monopole antenna with an expanded bandwidth which can provide various services without an additional antenna, by expanding an operating frequency bandwidth by using a supplementary structure, and a mobile communication terminal having the same.

[0002] With the recent development of mobile communication technology, various services are provided through a mobile communication terminal.

[0003] For example, an RFID system and mobile communication are combined to provide new technology and service called mobile RFID (mRFID). In the mRFID technology, an electronic tag, a reader, an antenna and a processing module are mounted on the mobile communication terminal, for reading information from another electronic tag and providing a useful information service to a user, or transmitting information of the mobile communication terminal to another device through the electronic tag in the mobile communication terminal.

[0004] An RFID antenna for the mRFID technology transmits and receives radio signals of 908.5 to 914MHz band, but an antenna for communication of the mobile communication terminal transmits and receives radio signals of 800MHz band.

[0005] A digital multimedia broadcasting (DMB) service or a digital video broadcasting-handhelds (DVB-H) service which receives and transmits broadcasting signals of VHF band has drawn attention among the services provided through the mobile communication terminal.

[0006] The DMB service or the DVB-H service is a new concept mobile multimedia broadcasting service combining communication and broadcasting. The user can watch a low frequency band broadcast through the wireless terminal. A ground wave DMB service uses a frequency band of 176 to 212MHz, and a satellite DMB service uses an S-band of 2.630 to 2.655GHz, which is higher than the frequency band of the ground wave DMB service.

[0007] On the other hand, the DVB-H service based on digital video broadcasting-terrestrial (DVB-T) which is a digital TV broadcasting standard developed and mainly used in Europe uses a frequency band of 400 to 800MHz.

[0008] In order to provide various services through the mobile communication terminal, antennas for transmitting and receiving radio signals for each service must be installed in the mobile communication terminal. At the initial stage of the service provision, a mobile communication antenna for transmitting and receiving mobile communication radio signals for communication which is an intrinsic function of the mobile communication terminal, and a service antenna for transmitting and receiving radio signals for each service are mounted on the mobile communication terminal.

[0009] However, mounting of separate antennas increases the size of the mobile communication terminal, which is contrary to a miniaturization tendency of the mobile communication terminal.

[0010] Accordingly, there are increasing demands for an antenna of a mobile communication terminal having a broad operating frequency band to transmit and receive both mobile communication radio signals and service radio signals. The antenna mounted on a small-sized device such as the mobile communication terminal is seriously affected by the surrounding environment and sensitive to a frequency. It is thus difficult to attain the broadband of the antenna.

[0011] It is necessary to find a method for attaining the broadband of the antenna of the mobile communication terminal by a simple structure.

SUMMARY OF THE INVENTION

[0012] According to the invention, there is provided a monopole antenna with an expanded bandwidth, comprising:

a radiating unit for radiating electromagnetic waves;
a ground connected to one side of the radiating unit; and
a radiation inducting unit formed along a first side of the ground that faces the radiating unit, and connected to the ground.

[0013] The invention thus provides a monopole antenna with an expanded bandwidth which can provide various services without an additional antenna, by expanding an operating frequency bandwidth by using a supplementary structure. The invention also provides a mobile communication terminal having the same.

[0014] The invention thus addresses the above disadvantages and other disadvantages not described above. Also, the present invention is not required to overcome the disadvantages described above, and an exemplary embodiment of the present invention may not overcome any of the problems described above.

[0015] The radiation inducing unit may include a pair of induction strips formed along the first side of the ground and disposed in parallel with each other.

[0016] The pair of induction strips preferably each comprise first connecting units formed on first ends opposite to the radiating unit in a lengthwise direction, the first connecting units connected with each other.

[0017] The pair of induction strips may each comprise second connecting units formed on second ends adjacent to the radiating unit in a lengthwise direction, the second connecting units connected with each other.

[0018] Preferably, the first connecting units are extended to contact with the ground.

[0019] The radiating unit can be a whip antenna, and the second ends of the induction strips are then extended to the radiating unit and spaced apart from the radiating unit at a predetermined interval.

[0020] The current flow may be formed on the ground in the lengthwise direction of the radiation inducing unit, and an additional operating frequency is generated in a second antenna operation mode by the current formed on the ground and the current flowing through the radiating unit.

[0021] The operating frequency of the second antenna operation mode is preferably formed adjacent to that of an existing first antenna operation mode.

[0022] The pair of induction strips can be made of a rectangular conductor plate extended to one direction, or a conductor wire.

[0023] Preferably, the total length of the pair of induction strips is about $\lambda/4$.

[0024] The radiating unit can be supplied with power between each induction strip and the ground.

[0025] The invention also provides a mobile communication terminal having a monopole antenna, including: a monopole antenna having a radiating unit for radiating electromagnetic waves, and a ground connected to one side of the radiating unit; and a radiation inducing unit formed by coating a conductive paint long on an inside surface of a casing in the lengthwise direction of the radiating unit, and connected to the ground.

[0026] The casing preferably includes a front casing and a rear casing, and the radiation inducing unit is formed on the inner circumferences of the front casing and the rear casing.

[0027] The radiation inducing unit coated on the side of the casing preferably contacts a ground-formed circuit board.

BRIEF DESCRIPTION OF THE DRAWINGS

[0028] The above aspects and features of the present invention will be more apparent by describing certain exemplary embodiments of the present invention with reference to the accompanying drawings, in which:

FIG. 1 is a perspective view illustrating a monopole antenna according to an exemplary embodiment of the present invention;

FIG. 2 is an enlarged perspective view illustrating part of the monopole antenna of FIG. 1;

FIG. 3 is an enlarged perspective view illustrating part of a monopole antenna according to another exemplary embodiment of the present invention;

FIG. 4 is a disassembly perspective view illustrating part of a mobile communication terminal having a monopole antenna according to still another exemplary embodiment of the present invention;

FIG. 5 is a graph showing S11 characteristics of the monopole antenna of the present invention and the general monopole antenna;

FIG. 6 is a view illustrating radiation patterns in a first antenna operation mode of the monopole antenna according to exemplary embodiments of the present invention; and

FIG. 7 is a view illustrating radiation patterns in a second antenna operation mode of the monopole antenna according to exemplary embodiments of the present invention.

DETAILED DESCRIPTION OF THE EXEMPLARY EMBODIMENTS

[0029] A monopole antenna with an expanded bandwidth and a mobile communication terminal having the same according to exemplary embodiments of the present invention will now be described in detail with reference to the accompanying drawings.

[0030] FIG. 1 is a perspective view illustrating a monopole antenna according to an exemplary embodiment of the present invention, and FIG. 2 is an enlarged perspective view illustrating part of the monopole antenna of FIG. 1.

[0031] The monopole antenna includes a radiating unit 10, a ground 30 and a radiation inducing unit 20.

[0032] The radiating unit 10 which radiates electromagnetic waves of a preset frequency band is a bar-shaped whip antenna. The radiating unit 10 is supplied with power through a power feeding point 11 formed between the radiation inducing unit 20 and the ground 30.

[0033] The ground 30 is incorporated with a circuit board mounted on a mobile communication terminal. The radiating unit 10 is connected to one side of the top end of the ground 30. The ground 30 is formed in a rectangular plate shape having a length larger than a width by the shape of the circuit board.

[0034] The radiation inducing unit 20 is formed along the width direction of the ground 30, and includes a pair of induction strips 25 disposed in parallel with each other at a predetermined interval. Referring to FIGS. 1 and 2, each of the induction strips 25 is made of a long band-shaped conductor plate, and extended from one side end to the other side end of the ground 30.

[0035] The pair of induction strips 25 are mounted on the top end of the ground 30 to be isolated from the ground 30 at a predetermined interval. The side ends of the induction strips 25 facing the radiating unit 10 are connected by a first connecting unit 27. The first connecting unit 27 is downwardly extended to be coupled to the ground 30. That is, each induction strip 25 is electrically coupled to the ground 30.

[0036] The radiation inducing unit 20 must not contact the radiating unit 10. Accordingly, the interval between the induction strips 25 is larger than the thickness of the radiating unit 10, and the induction strips 25 are disposed to be isolated from the radiating unit 10 at a predetermined interval.

[0037] On the other hand, still referring to FIGS. 1 and 2, the induction strips 25 of the radiation inducing unit 20

are formed in a band shape, but can be made of a metal wire formed along the width direction of the ground 30.

[0038] In the above embodiment, the induction strips 25 of the radiation inducing unit 20 are connected merely by the first connecting unit 27. However, as shown in FIG. 3, a second connecting unit 28 can be formed to connect the ends of the induction strips 25 adjacent to the radiating unit 10. In this case, the radiation inducing unit 20 forms a closed loop by the induction strips 25, the first connecting unit 27 and the second connecting unit 28.

[0039] Identically to the radiating unit 10, the length W of the radiation inducing unit 20 is about λ/4, which is adjusted to vary an operating frequency.

[0040] As shown in FIG. 1, in each induction strip 25 of the radiation inducing unit 20, the current flows from the radiating unit side 10 to the first connecting unit side 27, and reaches the ground 30 through the first connecting unit 27. Therefore, in the ground 30, the current flows in '3' direction.

[0041] In the general monopole antenna, the current flows in '2' and '1' directions of FIG. 1. The current flow forms a first antenna operation mode which is an existing antenna operation mode. Accordingly, as shown in the conventional art of the graph of FIG. 5, the general monopole antenna has one operating frequency.

[0042] Conversely, in the monopole antenna of the present invention, coupling is generated between each induction strip 25 of the radiation inducing unit 20 and the ground 30 by the current flowing through the induction strips 25. The current flows in '3' direction in the ground 30 by the coupling. Therefore, the current 3 forms a second antenna operation mode with the current 1. When the first antenna operation mode formed by the current 2 and the current 1 and the second antenna operation mode formed by the current 3 and the current 1 are adjacent to each other, namely, when the operating frequency bands generated by the first and second antenna operation modes are adjacent to each other, the two operating frequencies are connected to expand the whole operating frequency bandwidth. As a result, as depicted in FIG. 5, the broadband operating frequencies having two poles are formed.

[0043] In the operating frequencies of the present invention as shown in FIG. 5, the first pole region is formed by the first antenna operation mode and the operating frequency is generated in 900MHz band which is a general mobile communication frequency band, and the second pole region is formed by the second antenna operation mode and the operating frequency is generated in 1.2GHz band adjacent to 900MHz band.

[0044] In the monopole antenna, the operating frequency band corresponding to the second pole can be moved by adjusting the length and width of each induction strip 25 of the radiation inducing unit 20. Therefore, various services can be provided through one monopole antenna by expanding the operating frequency bandwidth of the monopole antenna.

[0045] FIG. 6 is a view illustrating radiation patterns in the first antenna operation mode of the monopole antenna according to exemplary embodiments of the present invention.

[0046] As illustrated in FIG. 6, as seen from X-Y plane, the radiation patterns of the first antenna operation mode formed in 900MHz band are omnidirectional, which is a characteristic of the general monopole antenna.

[0047] FIG. 7 is a view illustrating radiation patterns in the second antenna operation mode of the monopole antenna according to exemplary embodiments of the present invention.

[0048] As depicted in FIG. 7, as seen from X-Y plane, the radiation patterns of the second antenna operation mode formed in 1.2GHz band are omnidirectional.

[0049] That is, as shown in FIGS. 6 and 7, since the monopole antenna has the omnidirectional characteristic required in the mobile communication terminal, it is applicable to the mobile communication terminal.

[0050] In FIGS. 1 to 3, the radiation inducing unit 20 is mounted as a shaped structure. However, as shown in FIG. 4, a radiation inducing unit 70 can be formed by coating a conductive paint on an inside surface of a casing 50 of a mobile communication terminal.

[0051] FIG. 4 shows the casing 50 mounted on the rear surface. The conductive paint is coated in a band shape on the top end of the rear casing 50 along the circumference of the rear casing 50. In the same manner, a conductive paint is coated in a band shape on a front casing (not shown). The conductive paint is downwardly coated on one side of the rear casing 50. The downwardly-extended part contacts a ground 80 formed on a circuit board, thereby forming the radiation inducing unit 70 operated as described above. When the paint is not coated on the side of the casing 50 adjacent to a radiating unit 60, the radiation inducing unit 70 is formed with a ⊏-shaped section, and when the paint is coated on the side of the casing 50 adjacent to the radiating unit 60, the radiation inducing unit 70 is formed in a closed loop shape.

[0052] The monopole antenna generates the additional antenna operation mode besides the existing antenna operation mode, by forming the radiation inducing unit 20 or 70 in the simple structure shape or by using the conductive paint. Since the existing antenna operation mode and the additional antenna operation mode are adjacent to each other, the operating frequency bandwidth of the monopole antenna is expanded.

[0053] As the bandwidth of the monopole antenna is expanded, the monopole antenna is less sensitive to variations of the surrounding environment, thereby improving reliability. Moreover, the monopole antenna can provide services included in the expanded bandwidth.

[0054] The radiation inducing unit 20 formed as the simple structure simplifies installation and design change, cuts down expenses, and does not increase the size of the mobile communication terminal. In addition, the radiation inducing unit 20 causes impedance varia-

tions to the monopole antenna, thereby improving efficiency.

[0055] As discussed earlier, according to exemplary embodiments of the present invention, various services can be provided through one antenna by expanding the operating frequency bandwidth.

[0056] The foregoing exemplary embodiment and advantages are merely exemplary and are not to be construed as limiting the present invention. The present teaching can be readily applied to other types of apparatuses. Also, the description of the exemplary embodiments of the present invention is intended to be illustrative, and not to limit the scope of the claims, and many alternatives, modifications, and variations will be apparent to those skilled in the art.

Claims

1. A monopole antenna, comprising:

a radiating unit for radiating electromagnetic waves;
a ground connected to one side of the radiating unit; and
a radiation inducting unit formed along a first side of the ground that faces the radiating unit, and connected to the ground.

2. The monopole antenna as claimed in claim 1, wherein the radiation inducing unit comprises a pair of induction strips formed along the first side of the ground and disposed in parallel with each other.

3. The monopole antenna as claimed in claim 2, wherein the pair of induction strips each comprise first connecting units formed on first ends opposite to the radiating unit in a lengthwise direction, the first connecting units connected with each other.

4. The monopole antenna as claimed in claim 3, wherein the first connecting units are extended to contact with the ground.

5. The monopole antenna as claimed in claim 2, wherein the pair of induction strips each comprise second connecting units formed on second ends adjacent to the radiating unit in a lengthwise direction, the second connecting units connected with each other.

6. The monopole antenna as claimed in claim 2, wherein the pair of induction strips are made of a rectangular conductor plate extended to one direction.

7. The monopole antenna as claimed in claim 2, wherein the pair of induction strips are made of a conductor wire.

8. The monopole antenna as claimed in any one of claims 2 to 7, wherein the total length of the pair of induction strips is about $\lambda/4$.

9. The monopole antenna as claimed in any one of claims 2 to 8, wherein the radiating unit is supplied with power between each induction strip and the ground.

10. The monopole antenna as claimed in any one of claims 2 to 9, wherein the radiating unit is a whip antenna, and the second ends of the induction strips are extended to the radiating unit and spaced apart from the radiating unit at a predetermined interval.

11. The monopole antenna as claimed in any preceding claim, wherein the current flow is formed on the ground in the lengthwise direction of the radiation inducing unit, and an additional operating frequency is generated in a second antenna operation mode by the current formed on the ground and the current flowing through the radiating unit.

12. The monopole antenna as claimed in claim 11, wherein the operating frequency of the second antenna operation mode is formed adjacent to that of an existing first antenna operation mode.

13. A mobile communication terminal having a monopole antenna, comprising:

a monopole antenna as claimed in any preceding claim, wherein the radiation inducing unit is formed by coating a conductive paint along an inside surface of a casing of the terminal in the lengthwise direction of the radiating unit, and is connected to the ground.

14. A mobile communication terminal having a monopole antenna, comprising:

a monopole antenna having a radiating unit for radiating electromagnetic waves, and a ground connected to one side of the radiating unit; and
a radiation inducing unit formed by coating a conductive paint along an inside surface of a casing in the lengthwise direction of the radiating unit, and connected to the ground.

15. The mobile communication terminal as claimed in claim 13 or 14, wherein the casing comprises a front casing and a rear casing, and the radiation inducing unit is formed on the inner circumferences of the front casing and the rear casing.

16. The mobile communication terminal as claimed in claim 13, 14 or 15, wherein the radiation inducing unit coated on the side of the casing contacts a

ground-formed circuit board.

FIG. 1

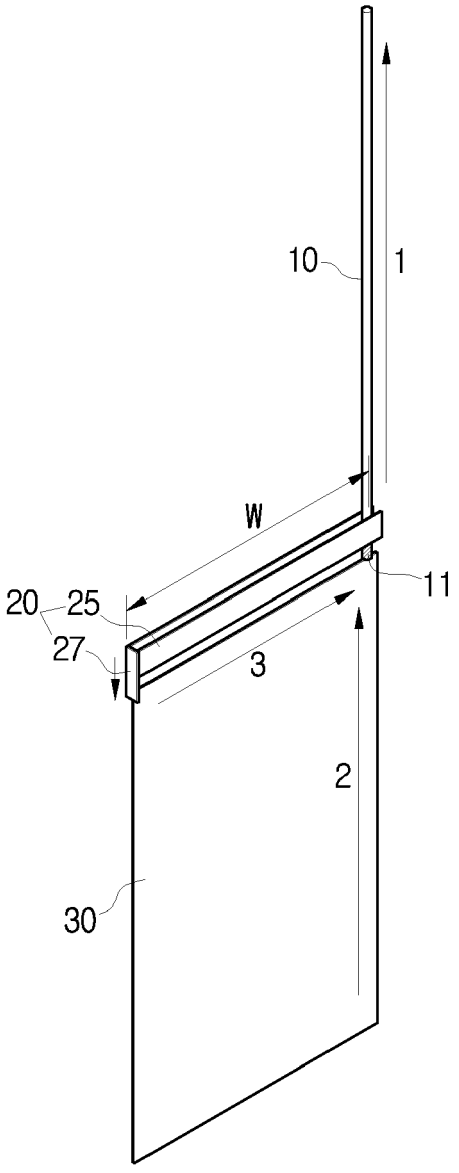

FIG. 2

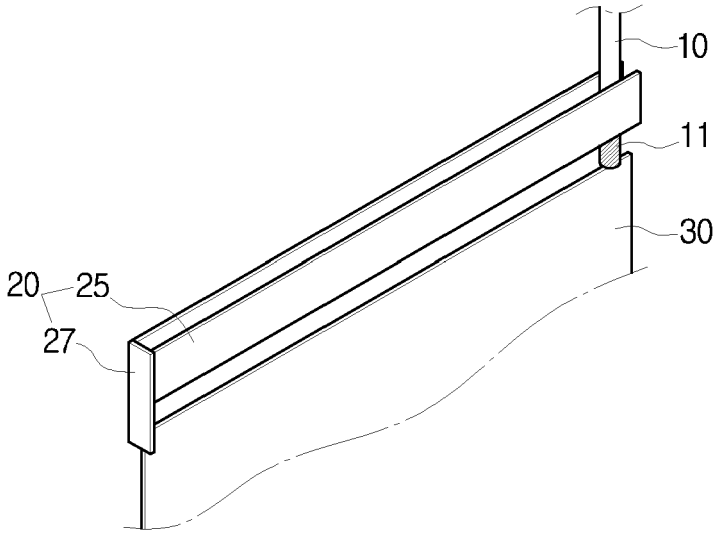

FIG. 3

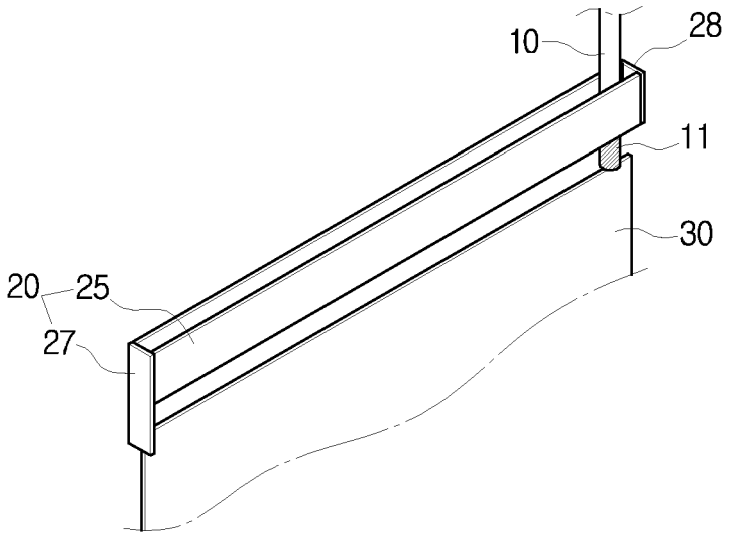

FIG. 4

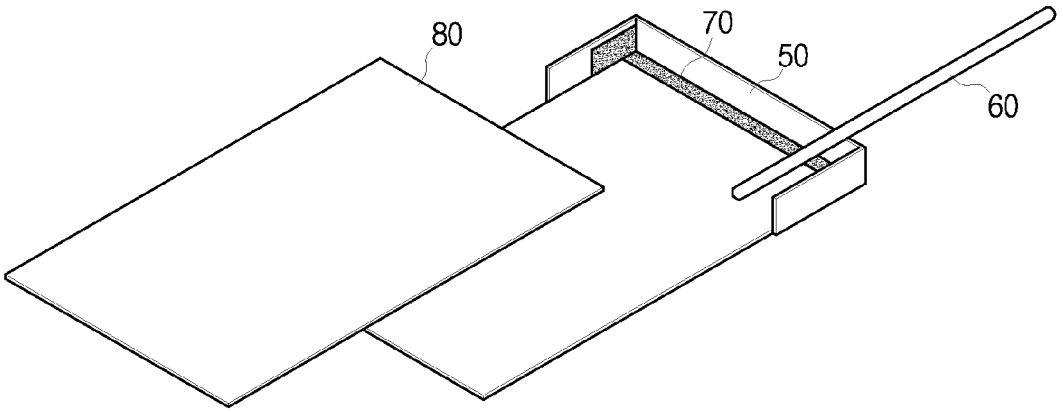
80
70
50
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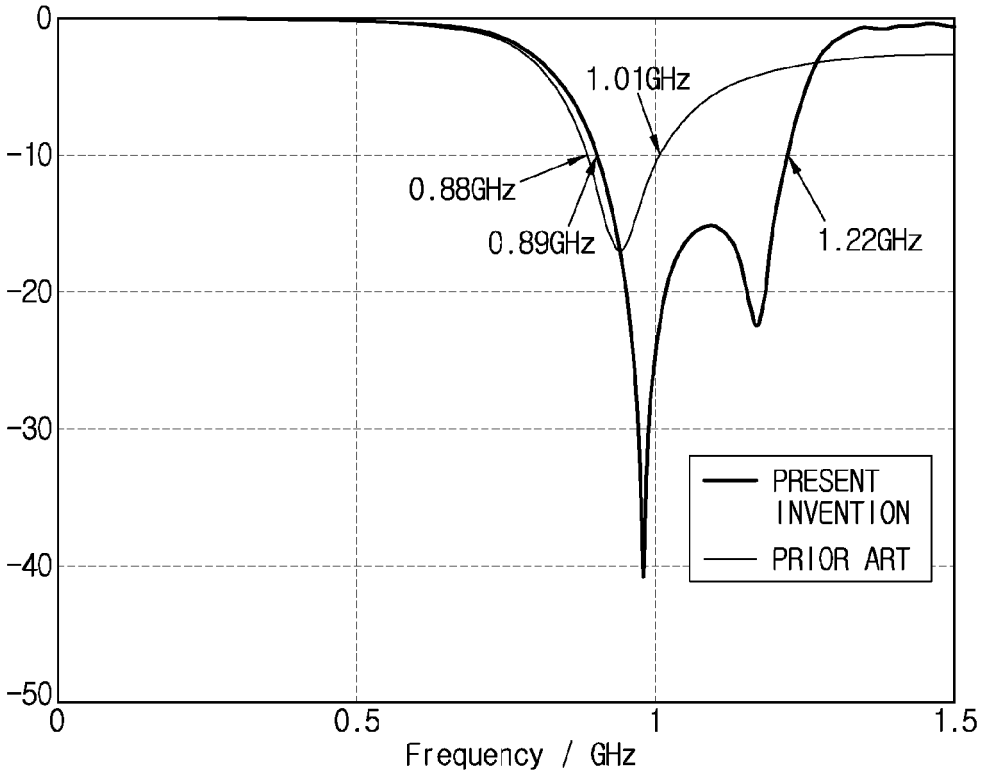
FIG. 5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PRESENT INVENTION
PRIOR ART

FIG. 6

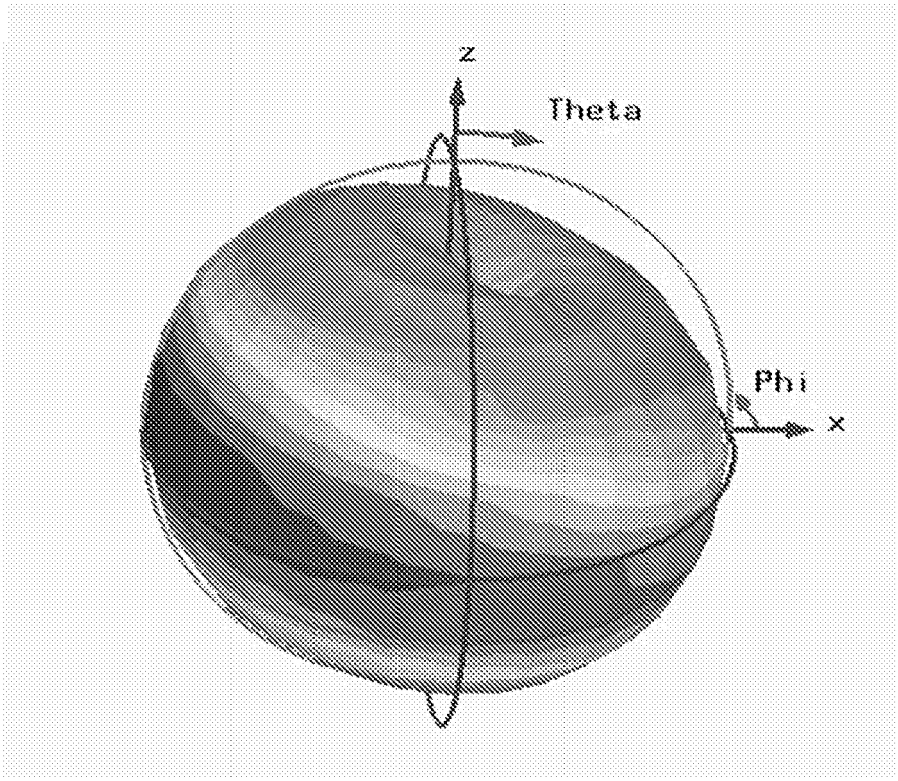
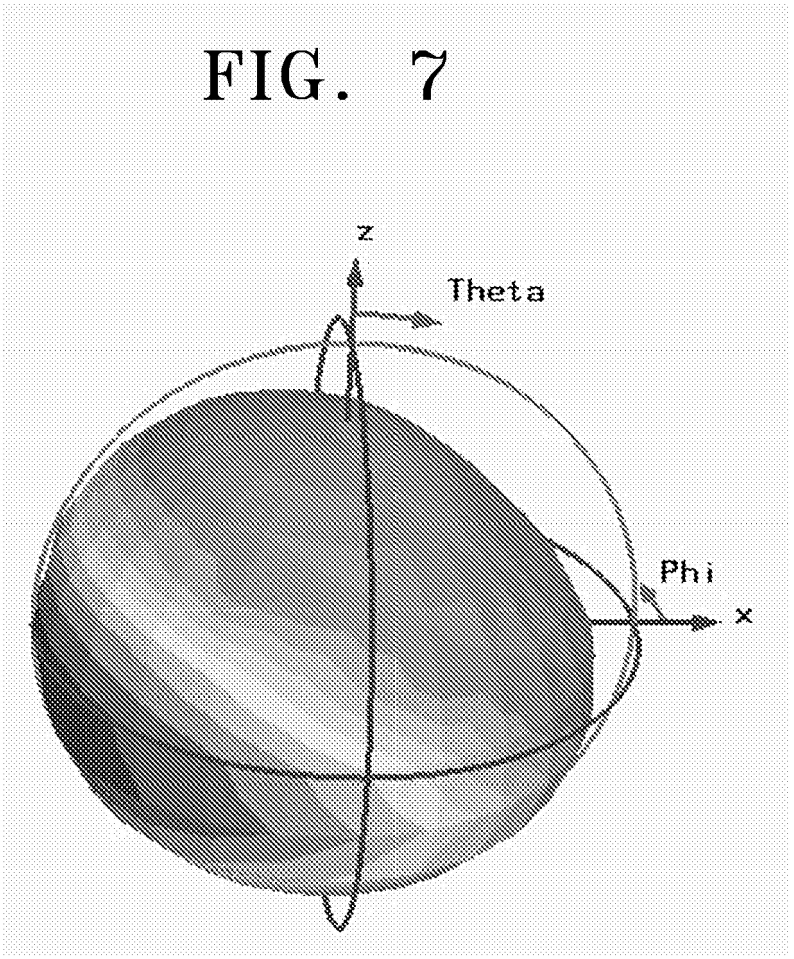


FIG. 7



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EUROPEAN SEARCH REPORT

Application Number
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H01Q
H04B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
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CATEGORY OF CITED DOCUMENTS

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