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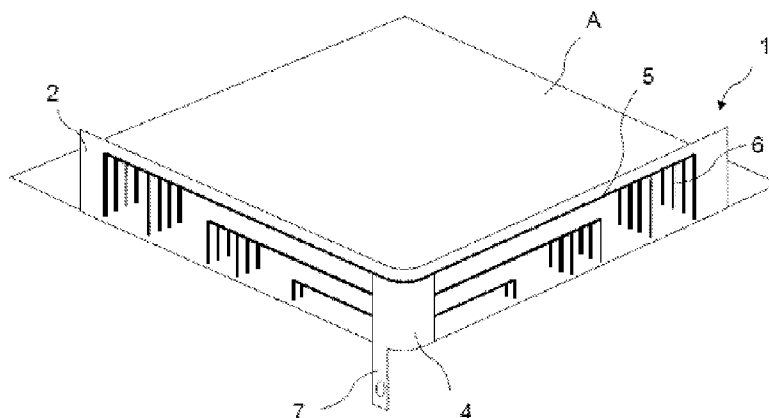
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[Continued on next page]

(54) Title: BROADBAND ANTENNA

Figure 2



(57) Abstract: The present invention relates to an antenna which is used in mobile digital broadcast receiving devices, and which enhances signal receiving performance of the receiving device by enabling signal gain in three dimensions, and which comprises an elastic substrate (2) having conductive trace (4) disposed in the middle of the substrate, conductive micro-strip paths (5) extending from the trace (4) in opposed directions towards the left and right ends of the substrate and the ends of which are furcated into parallel branches (6) of different lengths extending perpendicular to the conductive paths (5) towards the bottom end of the substrate. The substrate (2) comprises portrusions (3) at the bottom end for connecting the antenna in a broadcast receiving device. The substrate is folded at the conductive trace (4) and mounted on the corner of the PCB. The three dimensional extension of the antenna elements, enables signal gain in three dimensions.

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Description

BROADBAND ANTENNA

[1] Field of the Invention

[2] The present invention relates to an antenna used in mobile receiving devices.

[3] Prior Art

[4] In determining the quality of broadcast provided to the user in electronic devices capable of receiving digital broadcasts, antenna structures that enhance power gain on the signals reaching the device are of great importance. With the widespread use of mobile devices as broadcast receivers, special antenna designs are needed for these devices. On the other hand, small dimensions of the mobile devices impose various restrictions in terms of design. For example, problems are encountered in positioning the antennas designed to be used in these devices and these antennas cause the volume of the devices to increase.

[5] Among the applications developed to prevent problems that might arise concerning positioning, there are antennas which are designed to be located on a planar circuit board and which comprise micro-strip formed conductors. Since the said planar designs can enable receiving the broadcast signals only in two dimensions, three dimensional antennas have been developed which can ensure higher efficiency. However the current three dimensional designs do not provide a practical solution for the problem of positioning. Additionally, since designs for enabling the antenna assembly to be a receiver in the third dimension have a plurality of parts and are complex, they yield to problems such as difficulty in production and mounting, and being costly.

[6] The USA patent document No. US4987424, an application within the state of the art, describes a planar antenna with conductive strips formed on an elastic and non-conducting plane.

[7] The Japanese patent document No. JP2004282243, an application within the state of the art, describes an antenna structure comprised of two antenna planes. One of the antenna planes designed to receive signals in different frequency bands can rotate around the hinge located on the edge that it shares with the other antenna plane and the angle between the two antenna planes can be changed.

[8] The antenna designs disclosed in the above mentioned patents can realize receiving broadcast signals only in two dimensions or use a plurality of antenna groups for receiving signals in three dimensions and require multipart assemblies.

[9] Summary of the Invention

[10] The objective of the present invention is to realize an easily mountable antenna which is used in mobile broadcast receiving devices, takes up small space, and operates efficiently.

[11] Another objective of the invention is to realize an antenna which enhances broadcast receiving performance by increasing the gain applied to the broadcast signals in all three dimensions.

[12] A further objective of the invention is to realize an antenna which can easily be folded without using a plurality of parts and components, and can be mounted to the receiving device.

[13] Yet another objective of the invention is to realize an antenna comprising conductive strips designed so as to realize receiving signals in three dimensions.

[14] The antenna realized to fulfill the objectives of the present invention and defined in Claim 1 and its dependent claims, provides ease in production and mounting and reduces costs since it is comprised of a single piece and it can easily be mounted to the device upon being folded in the middle. Additionally, thanks to its foldable structure and the geometry of the conductive strips thereon, it increases the gain of the signals it receives in all three dimensions thereby increasing signal receiving performance of the receiving device.

[15] Detailed Description of the Invention

[16] The antenna realized to fulfill the objective of the present invention is illustrated in the accompanying figures in which,

[17] Figure 1 is the front view of the antenna.

[18] Figure 2 is the perspective view of the antenna mounted on the circuit board within the device.

[19] The components shown in the figures are numbered as follows:

[20] 1. Antenna

[21] 2. Body

[22] 3. Protrusion

[23] 4. Collector

[24] 5. Path

[25] 6. Branch

[26] 7. Extension

[27] The inventive antenna (1) is used in a broadcast receiving device such as a video and/or audio signal receiving television, satellite receiver. The antenna (1) comprises an elastic body (2); protrusions (3) at the bottom of the body (2) employed in fixing it to the main board (A) of the broadcast receiving device to which it is connected to; a collector (4), in the middle of the body, made of a conductive material, where received signals are collected; a plurality of paths (5) starting from the collector (4) and extending on both directions along the body (2); branches (6) of different lengths parallel to each other located at the end of each path (5), which branches are perpendicular to the path (5) and are produced as a result of a furcation of the path (5)

towards the bottom of the body (2); and an extension (7) which extends beneath the body (2) in alignment with the collector (4) and is used as a connection point for transferring the collected signals to the receiving device.

- [28] The body of the antenna (2) is manufactured from an elastic material and it is preferably in the form of a flexible printed circuit board (FPCB). The body (2), thanks to its elastic structure, can be folded in its middle or at a point near to its middle and it is attached to the main board (A) of the receiving device at any corner of the board (A) such that its flaps will be perpendicular to each other (Figure 2).
- [29] Attaching the body (2) to the main board (A) is realized by means of the protrusions (3) provided at the bottom of the body (2). After the folded body (2) is placed on any corner of the main board (A), the protrusions (3) fold inwards and contact the bottom surface of the main board (A), and the body (2) is fixed to the main board (A) by being attached to the main board (A) via means like adhesion or soldering.
- [30] There is provided a collector (4) at the middle section of the folding axis of the body (2) expanding towards the two flaps of the folded antenna (1), formed by coating the surface of the body (2) with a conductive material. The collector (4) is the section where the received signals are collected and transferred to the related circuits of the device. There are provided conductive paths (5), perpendicular to the folding axis of the antenna (1), starting from the collector (4), and extending parallel to the body (2) towards the two ends of the body (2). These paths (5) also extend parallel to each other and there is no intersection between them besides the collector (4) which all of them intersect perpendicularly. While the uppermost path (5) extends to the end of the body (2), each path (5) extending parallel to each other is shorter than an upper path and the points where they terminate gradually approach the collector (4) (Figure 1).
- [31] Number of parallel paths (5) extending from the collector (4) towards both directions is preferably three and their lengths are determined such that they will receive signals in certain frequency ranges depending on the type of broadcast signal that the receiving device will receive. For example, since the inventive antenna is preferably used in a device that can receive DVB-H (Digital Video Broadcasting-Handheld) and DVB-T (Digital Video Broadcasting-Terrestrial) broadcasts, it is designed to operate in the frequency band of 470MHz-850MHz which is required by these technologies. The length of the path defined as the distance between the two ends of the paths (5) intersecting the collector (4) is adjusted according to the frequency values that the antenna will operate so that the signals within the said frequency range are received in the most effective way. Lengths of the paths are determined to be $1/2N$ times the wavelengths (?) corresponding to the said frequency values, where N is any integer. This way it is ensured that the incoming broadcast signal is received more effectively by the antenna.

- [32] The paths extending parallel to the body (2) comprise at each end thereof close parallel branches (6) perpendicular to each path (5) which extend towards the bottom of the body. In the preferred embodiment of the invention, at the end of the longest path (5) which is nearest to the upper edge of the body (2), there is a repeated structure of four branches (6) gradually getting shorter where the branch nearest to the short side of the body (2) is the longest. At the end of the medium length path (5), a structure similar to the one at the end of the longest path (5) is repeated this time as a structure with three branches (6). At the end of the shortest path (5), there is a structure with two branches (6) where the branch farther away from the collector (4) is the longest. In addition to the two dimensional signal receiving feature acquired by folding of the antenna (1), the branches (6) intersecting the paths (5) perpendicularly make the signal receiving feature three dimensional by ensuring that the conductive line is also transported to the vertical axis. Thus, a gain increase is ensured at all three dimensions.
- [33] Since there are paths and branches with the same geometry on both sides of the collector (4), the conduction line composed of conductive paths (5) and branches (6) has a symmetrical geometry relative to the collector (4).
- [34] The received broadcast signals pass over the conductive branches (6) and paths (5) and are collected at the collector (4). The collector (4) has an extension (7) at its lower part which is conductive just like itself. The extension (7) serves as a bridge for transferring the energy formed by the broadcast signals to the circuits where it will be processed in the device after it is collected in the collector (4).
- [35] The inventive antenna (1) designed as conduction lines composed of conductive micro-strips on FPCB, can be bent thanks to its elastic form and can be placed on the desired location of the receiving device. The antenna (1) preferably positioned on a corner of the main board (A) is placed within the frames (covers) of the receiving device together with the main board (A) and it is not visible from outside. Since the angle between the half dipoles on the two sides of the axis at which the antenna (1) is bent can be adjusted between 0 – 180 degrees, the antenna (1) can receive broadcast in a very wide angle range and thus the signal receiving performance of the receiving device increases. In order to avoid any interference (noise) effect on the operation of the antenna (1), the place where the antenna (1) is disposed or the covers nearby should not include metal.
- [36] The antenna (1) can be easily placed on the receiving device with various dipole angles and can realize gain increase of the signals received in all three dimensions thanks to its foldable structure and its conductive geometry composed of paths (5) and branches (6) thereon. Additionally, it can be used even in smallest mobile devices owing to the fact that it is light weighted due to the elastic material used and that it can

be produced in small dimensions. In the preferred embodiment of the invention, long side of the body (2) of the antenna (1) is 40mm - 60mm, and the short side thereof is 3mm - 6mm. The mechanical connection protrusions (3) and the electrical connection extension (7) located at the bottom of the body are 3mm - 6 mm long.

[37] In the scope of this basic concept, it is possible to develop various embodiments of the antenna (1). The invention is essentially according to the claims and it can not be limited to the examples described herein.

Claims

- [1] An antenna (1) used in video and/or audio broadcast receiving devices; comprising an elastic body (2); protrusions (3) at the bottom of the body (2) employed in fixing it to the main board (A) of the broadcast receiving device to which it is connected to; a collector (4), at the middle of the body, made of a conductive material, where the received signals are collected; paths (5) starting from the collector (4) and extending towards both sides along the body (2); branches (6) formed by the furcation of the ends of the paths (5) perpendicular to the path (5) and towards the bottom of the body (2); and an extension (7) which extends beneath the body (2) in alignment with the collector (4) and is used as a connection point for transferring the collected signals to the receiving device; characterized by a body (2) comprised of a single piece which can be bent to be placed on any part of the receiving device, and a plurality of conductive paths (5) which intersect the folding axis of the body (2) perpendicularly and extend on both directions along the body (2), and branches (6) of different lengths parallel to each other located at the end of each path (5).
- [2] An antenna (1) according to Claim 1, characterized by at least one protrusion (3) which extends from any edge of the body (2) towards out of the body (2) and upon getting folded at the said side, contacts the surface of the main board (A) and is attached to the main board (A) enabling the body (2) to be fixed to the main board (A).
- [3] An antenna (1) according to any of the preceding claims, characterized by a body (2) which can be placed, thanks to the fact that it is made of elastic material and to the conductive strip geometry thereon, by being folded from an axis perpendicular to its long side, such that there is an angle of 0 – 180 degrees between the conductive paths (5) (half dipoles) provided on the two sides of the collector (4).
- [4] An antenna (1) according to Claim 3 which can receive broadcast also in vertical axis by means of the conductive branches (6) located at the ends of the paths (5) and extending perpendicular to the paths (5), and thereby realizes signal gain increase in all three dimensions.
- [5] An antenna (1) according to Claim 3 or Claim 4 characterized by paths (5) whose lengths are determined to be $1/2N$ times the wavelengths (?) corresponding to the beginning, intermediate and end values of the frequency band at which the receiving device is operating, where N is any integer.

Figure 1

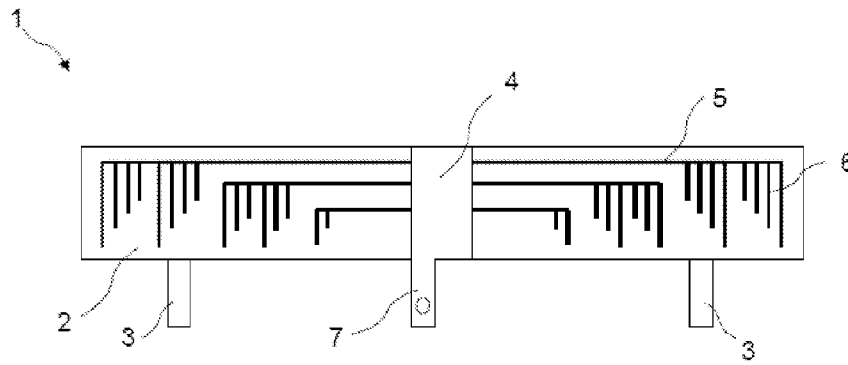
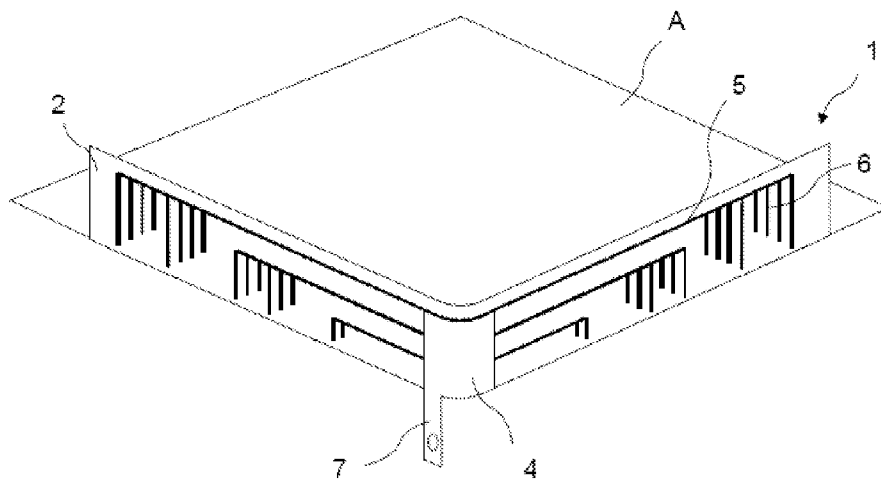


Figure 2



INTERNATIONAL SEARCH REPORT

International application No.
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A. CLASSIFICATION OF SUBJECT MATTER

INV. H01Q1/38 H01Q5/00 H01Q9/44 H01Q21/30 H01Q1/24
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B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H01Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 56 065502 A (MATSUSHITA ELECTRIC WORKS LTD) 3 June 1981 (1981-06-03) abstract; figures 1-3	1-5
X	US 4 205 317 A (YOUNG PAUL T K [US]) 27 May 1980 (1980-05-27) columns 1-4; claims 1-3; figures 4,6,8	1-5
X	WO 99/22420 A (ERICSSON TELEFON AB L M [SE]) 6 May 1999 (1999-05-06) pages 3-6; claims 1,2; figures 1-3	1-5
Y	US 2003/210187 A1 (WONG KIN LU [TW] ET AL) 13 November 2003 (2003-11-13) paragraphs [0016] - [0028]; figure 1	1-5
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Further documents are listed in the continuation of Box C.



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Date of the actual completion of the international search

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INTERNATIONAL SEARCH REPORT

International application No

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2006/038735 A1 (SHTROM VICTOR [US] ET AL) 23 February 2006 (2006-02-23) paragraph [0033]; figures 2,2c -----	1-5
Y	US 2006/214867 A1 (CHEN TAI-LEE [TW]) 28 September 2006 (2006-09-28) paragraphs [0014] - [0019]; figures 1-5 -----	1-5
A	EP 1 555 715 A (TOKYO SHIBAURA ELECTRIC CO [JP]) 20 July 2005 (2005-07-20) paragraph [0071]; figure 10I -----	1-5

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/IB2008/054350

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
JP 56065502	A	03-06-1981	NONE	
US 4205317	A	27-05-1980	NONE	
WO 9922420	A	06-05-1999	AU 9657998 A	17-05-1999
			CN 1290412 A	04-04-2001
			EP 1025613 A1	09-08-2000
			JP 2001522152 T	13-11-2001
			TW 392376 B	01-06-2000
US 2003210187	A1	13-11-2003	NONE	
US 2006038735	A1	23-02-2006	US 2008136725 A1	12-06-2008
US 2006214867	A1	28-09-2006	NONE	
EP 1555715	A	20-07-2005	JP 3805772 B2	09-08-2006
			JP 2005203878 A	28-07-2005
			US 2005153756 A1	14-07-2005