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(54) **A diamond-shaped loop antenna for a wireless I/O device**

(57) A novel design of diamond-shaped loop antenna is proposed. The proposed devise can be embedded in any I/O device for wireless application, such as a wireless keyboard, mouse, game pad, etc. This right angle structure of both wings of the antenna can be used to

improve the palm loading effect for pattern performance, especially in 2.4GHz ISM (Industrial, Scientific and Medical) band. Its circumference length is about one wavelength and pattern looks like circular-loop antenna's radiation. Moreover, this antenna can be fabricated by light-weighted, low cost material of copper.

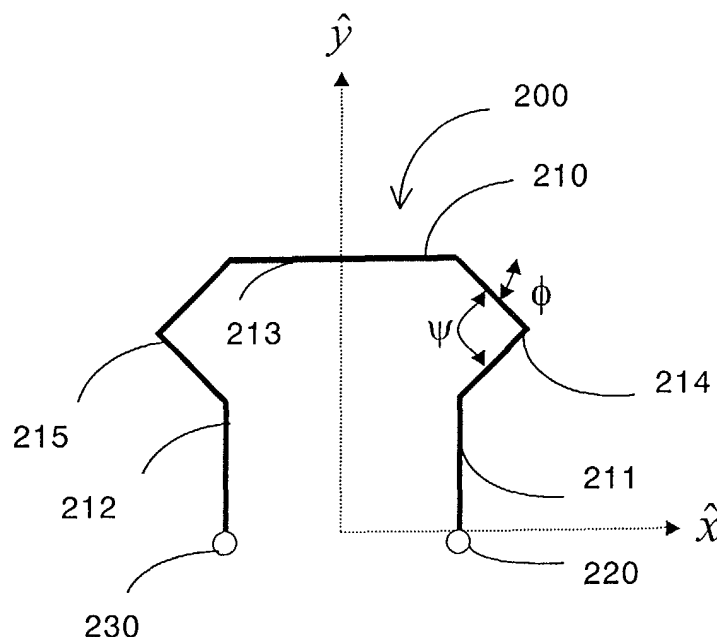


FIG. 2

Description

FIELD OF THE INVENTION

[0001] The present invention generally relates to a loop antenna for a wireless I/O device, and more specifically to a diamond-shaped loop antenna with a side wing on two opposite sides respectively.

BACKGROUND OF THE INVENTION

[0002] Today, due to the portability of wireless communication, users can use the device without considering the limitation of locations, which makes wireless communication more and more popular than before. Thus, users can use the device anywhere to get information he wants or to communicate with another person. However, an antenna is a very important component in wireless communication, thus the quality of the antenna has tremendous influence on the unevenness of receiving signals.

[0003] In the general use of wireless I/O module (i.e. RF-Module) for the computer peripheral, the shape of an antenna mostly used is a simple type of loop antenna, e.g. rectangular-shaped, circular-shaped, etc. FIG. 1 shows such a typical rectangular-shaped loop antenna 100. When the frequency band of this simple type of loop antenna is operated at below 1GHz, there is a nice characteristic. But when at 2.4GHz ISM (Industrial, Scientific and Medical) band, because the operating band becomes close to the harmony frequency of water molecules and the human body is composed of 70% of water molecules, thus when we hold it in our hands, we will absorb quite a lot of power. Therefore the design of the antenna at this frequency band is substantial important. Based on this reason, the present invention provides the diamond-shaped loop antenna after a long period of researching, which is a reasonable design that effectively improves the above drawbacks.

SUMMARY OF THE INVENTION

[0004] The primary object of this invention is to provide a loop antenna with a diamond-shaped structure, which under the condition of matching the circuit impedances, the antenna has a high efficiency of radiation, and is less affected by hand.

[0005] To achieve the object, this invention proposes a diamond-shaped loop antenna for wireless I/O device, its feature is as follows: on two opposite sides of the loop antenna each has a side wing, which forms an upper-edge-angle with the upper side of the antenna. The side wing itself also has a wing-angle, and both the upper-edge-angle and the wing-angle are located on the same plane.

[0006] The foregoing and other objects, features, aspects and advantages of the present invention will become better understood after careful reading of a de-

tailed description provided below with appropriate reference to the drawings accompanied.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] FIG. 1 shows the block diagram of a typical rectangular-shaped loop antenna.

[0008] FIG. 2 shows the block diagram of an embodiment of the diamond-shaped loop antenna according to this invention.

[0009] FIG. 3 shows the experimental result of return loss measured for the embodiment according to this invention.

[0010] FIG. 4 shows the measurement result on the Smith Chart for the embodiment according to this invention.

[0011] FIG. 5 shows the result of radiation field type measured for the embodiment according to this invention.

[0012] FIG. 6 shows the result of radiation field type measured for the embodiment according to this invention.

DETAILED DESCRIPTION OF THE INVENTION

[0013] To disclose this invention in detail, the following is an embodiment in accordance with the drawings for the detailed description. FIG. 2 shows the block diagram of an embodiment of the diamond-shaped loop antenna 200 comprising: a microwave element 210 having first side 211, second side 212 and third side 213 formed by a metal wire, said sides being formed in a loop shape, said first side 211 and second side 212 having a side wing 214, 215 respectively; a feedline 220 being located at one end of said first side 211; and an output end 230 being located at one end of said second side 212; wherein said side wing 214 and said third side 213 of the microwave element 210 form an upper-edge-angle Φ , and said side wing 214 itself also has a wing-angle Ψ . The upper-edge-angle Φ and the wing-angle Ψ are located on the same plane, wherein the two upper-edge-angles Φ both have a degree of 45° , and the two wing-angles Ψ both have a degree of 90° . The antenna is made of copper with diameter of 0.8mm.

[0014] Due to the structure of this invention can't be easily applied theoretical methods to conduct the analysis, thus the present invention conducts the real case verification by experimental and simulation methods.

[0015] Because the diamond-shaped antenna 200 has two side wings 214, 215, which result in the upper-edge-angle Φ and the wing-angle Ψ , it reduces the hand effect from antenna radiation characteristics. In the experimental measure, the antenna radiation field type is measured by using the near-field measurement system developed by the Near-field System Inc. (NSI). To measure the rectangular-shaped loop antenna 100 as shown in FIG. 1, in the broadside direction, the maximum far-

field value obtained for the antenna transmitted power is -53.54dB, but to measure the effect when a hand is located 2cm above the antenna, the maximum far-field value obtained is -57.53dB, thus the hand has an effect of about 4dB for the antenna. However if the diamond-shaped loop antenna 200 is measured as shown in FIG. 2, the maximum far-field value obtained is -52.21dB, and when a hand is located 2cm above the antenna, the maximum far-field value obtained is -55.95dB. The hand has an effect of about 3.7dB on the antenna. Based on the above results, the diamond-shaped loop antenna 200 by itself has radiation efficiency higher than the general rectangular-shaped loop antenna 100, and its hand effectiveness is also relatively smaller than the general rectangular-shaped loop antenna 100.

[0016] FIG. 3 shows the experimental result of return loss measured for the embodiment according to this invention. It is operating at 2.45GHz, and the return loss coefficient S11 of the antenna is measured by using the vector network analyzer HP8720C. Based on the experimental result, when this invention is operating at 2.45GHz, the return loss can be lowered to -15.89dB, and therefore this invention surely has a good receive/send behavior, and the frequency bandwidth of this invention is about 200MHz (VSWR=2). FIG. 4 shows the measurement result on the Smith Chart for the embodiment according to this invention. The chart shows that the same conclusion is obtained in this figure as in FIG. 3.

[0017] FIG. 5 shows the result of radiation field type measured for the embodiment according to this invention. The measured E plane (x-z plane) field type is obtained by operating the antenna at 2.45GHz, wherein the thick line represents the experimental result without palm effect and the thin line represents the experimental result with palm effect respectively. FIG. 6 shows the result of radiation field type measured for the embodiment according to this invention. The measured H plane (y-z plane) field type is obtained by operating the antenna at 2.45GHz, wherein the thick line represents the experimental result without palm effect and the thin line represents the experimental result with palm effect respectively. Based on the experimental results, the radiation field type (E-plane: x-z), which is perpendicular to the hand direction (y direction), is less affected by hand. The radiation field type (H-plane: y-z), which is parallel to the hand direction (y direction), is more affected by hand.

[0018] In summary of above descriptions, this invention proposes a diamond-shaped loop antenna having a simple design, only needing to change the two opposite sides of the general rectangular-shaped loop antenna into two side wings with diamond-shaped structure. Then the radiation efficiency can be improved, and the hand effect on the antenna characteristics is reduced. Moreover, a typical copper may fabricate the material of the antenna. This achieves an antenna with low cost, high application value, and good efficiency. It has not

only accomplished an expecting practical use but also a new design.

[0019] Although this invention has been described with a certain degree of particularity, it is to be understood that the present disclosure has been made by way of preferred embodiments only and that numerous changes in the detailed construction and combination as well as arrangement of parts may be restored to without departing from the spirit and scope of the invention as hereinafter set forth.

In the present specification "comprise" means "includes or consists of" and "comprising" means "including or consisting of".

The features disclosed in the foregoing description, or the following claims, or the accompanying drawings, expressed in their specific forms or in terms of a means for performing the disclosed function, or a method or process for attaining the disclosed result, as appropriate, may, separately, or in any combination of such features, be utilised for realising the invention in diverse forms thereof.

Claims

1. A diamond-shaped loop antenna for a wireless I/O device, comprising:

a microwave element having first, second and third sides formed by a metal wire, said sides being formed in a loop shape, said first and second sides having a side wing respectively; a feedline being located at one end of said first side; and an output end being located at one end of said second side;

wherein said side wing and said third side of the microwave element form an upper-edge-angle, and said side wing has a wing-angle.

2. The diamond-shaped loop antenna for a wireless I/O device as claimed in claim 1, wherein said upper-edge-angle and said wing-angle are located on the same plane.
3. The diamond-shaped loop antenna for a wireless I/O device as claimed in claim 2, wherein said two upper-edge-angles are equal and said two wing-angles are equal.
4. The diamond-shaped loop antenna for a wireless I/O device as claimed in claim 3, wherein said two upper-edge-angles both are 45°, and said two wing-angles both are 90°.
5. The diamond-shaped loop antenna for a wireless I/O device as claimed in claim 4, wherein said anten-

na is made of copper.

6. A loop antenna for a wireless communication device comprising a microwave element in the form of a loop having two side arms and a length bridging the two side arms, each side arm having a wing including two lengths of the loop which subtend an angle to one another to point outwardly from the loop. 5
- 10
7. A loop antenna according to Claim 6, wherein the two lengths of the wing in one side arm are located opposite the two lengths of the wing located in the other side arm so that the wings point away from one another. 15
8. A loop antenna according to Claim 6 or 7, wherein the lengths of the wings included in each side arm are of equal length. 20
9. A loop antenna according to any one of Claims 6 to 8, wherein one end of a wing terminates at an end of one of the side arms and the other end of the wing terminates at an end of the length bridging the two side arms. 25
10. A loop antenna according to any one of Claims 6 to 9, wherein the wing comprises two equal sides of an isosceles triangle. 30

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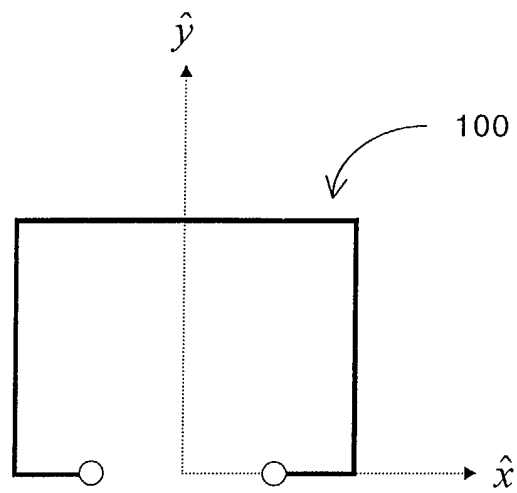


FIG. 1
PRIOR ART

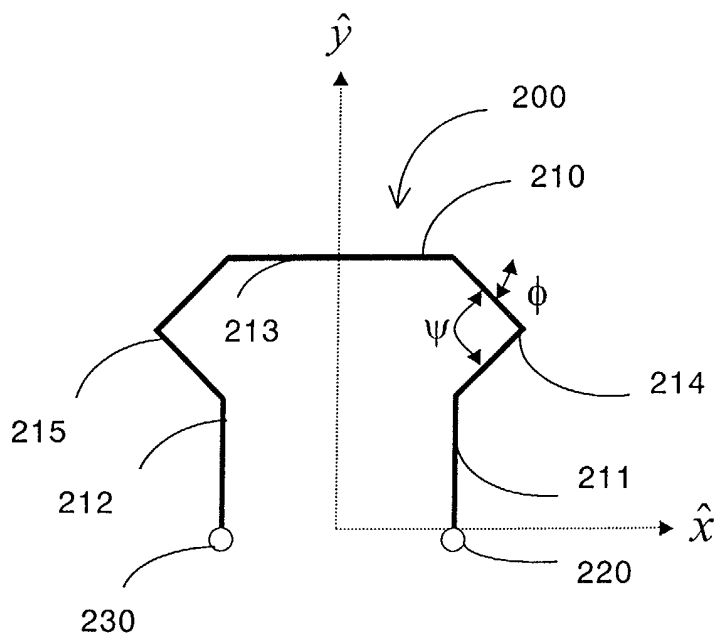


FIG. 2

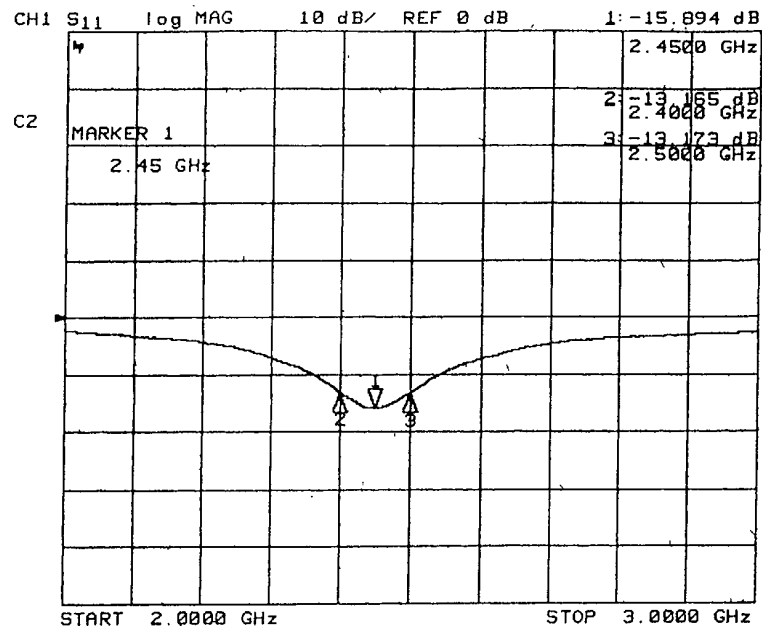


FIG. 3

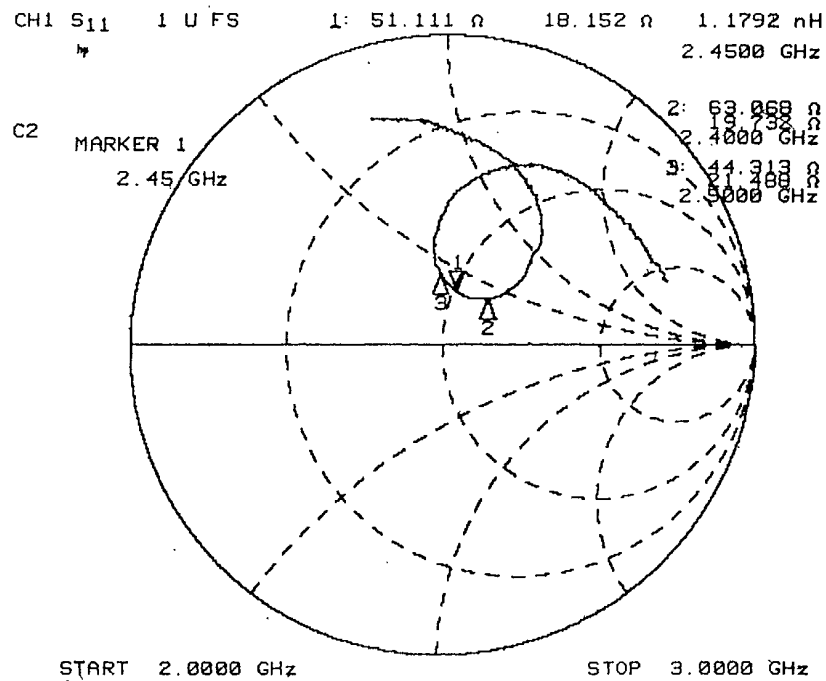


FIG. 4

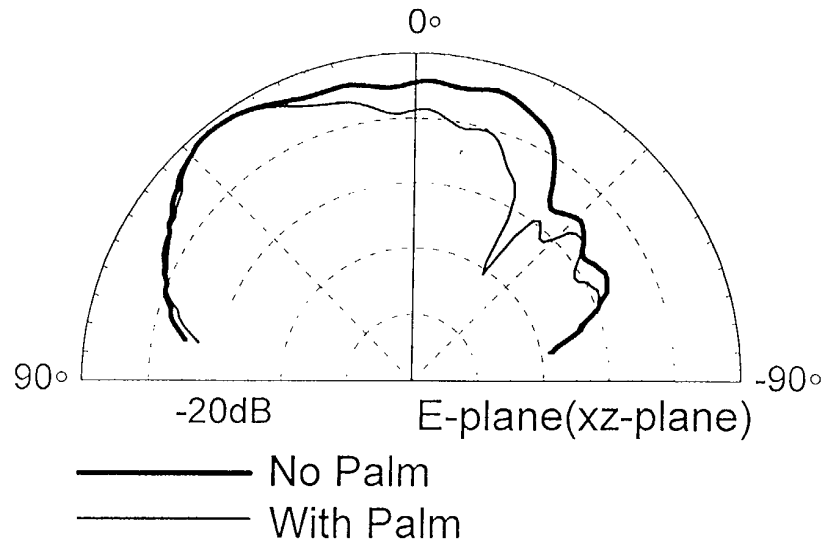


FIG. 5

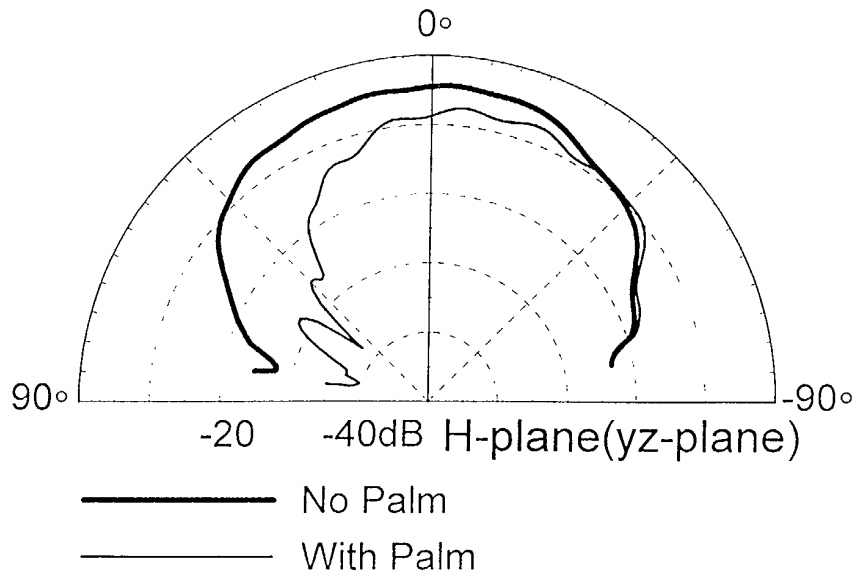


FIG. 6



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 01 11 8163

DOCUMENTS CONSIDERED TO BE RELEVANT							
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)				
X	GB 692 692 A (CHARLES ALEXANDER VIVIAN HEATH) 10 June 1953 (1953-06-10) * page 11, line 32-57 * * page 13, line 84-97; figures 1,8 *	1-10	H01Q7/00 H01Q9/26 H01Q1/36 H01Q9/42 H01Q11/06				
X	WONHA CHOE ET AL: "ANALYSIS OF HIGHER ORDER REGULAR POLYGONAL LOOP ANTENNAS" IEEE TRANSACTIONS ON ANTENNAS AND PROPAGATION, IEEE INC. NEW YORK, US, vol. 38, no. 7, 1 July 1990 (1990-07-01), pages 1114-1117, XP000137535 ISSN: 0018-926X * the whole document *	1-3,6-10					
E	WO 01 63697 A (RABIE ANTHONY) 30 August 2001 (2001-08-30) * page 3, line 21 - page 5, line 7; figure 1 *	1-3,6-10					
A	US 5 767 813 A (YAO NIAN JING ET AL) 16 June 1998 (1998-06-16) * column 3, line 49 - column 4, line 46; figure 1 *	1,6	<table border="1"> <thead> <tr> <th colspan="2">TECHNICAL FIELDS SEARCHED (Int.Cl.7)</th> </tr> </thead> <tbody> <tr> <td>H01Q</td> <td></td> </tr> </tbody> </table>	TECHNICAL FIELDS SEARCHED (Int.Cl.7)		H01Q	
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The present search report has been drawn up for all claims							
Place of search THE HAGUE		Date of completion of the search 12 December 2001	Examiner Van Dooren, G				
<table border="0"> <tr> <td> CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document </td> <td> T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document </td> </tr> </table>				CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document	T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document		
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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 01 11 8163

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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12-12-2001

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