

# Bluetooth Antenna

## Application Note

**GSM/GPRS Module Series**

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## About the Document

### History

Revision	Date	Author	Description
1.0	2014-12-17	Cat WANG/Rain ZHOU	Initial

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# 1 Introduction

Generally, there are several types of bluetooth antennas in present market, such as dipole antenna, planar inverted-F antenna, meander line antenna, ceramic antenna, liquid crystal polymer (LCP) antenna and rod antenna (only for 2.4G) etc. The features of almost omni-directional radiation pattern, simple structure and low cost make them widely used in embedded Bluetooth devices.

This document mainly introduces the design of four kinds of Bluetooth antennas which are frequently used.

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## 2 Ceramic (Chip) Antenna

Ceramic antenna generally has small size, however, the design of ceramic antenna is relatively complex, especially for encapsulation and PCB design. It has certain requirements on ground plane and the clearance around. There are various dimensions, sizes and design requirements for different chip antennas, even you design the antenna according to the reference design completely, you still need to tune carefully to achieve the best performance. The following part is a practical application of INPAQ 5036 chip antenna which is used on M66 TE-A.

### Recommended PCB layout (unit:mm)

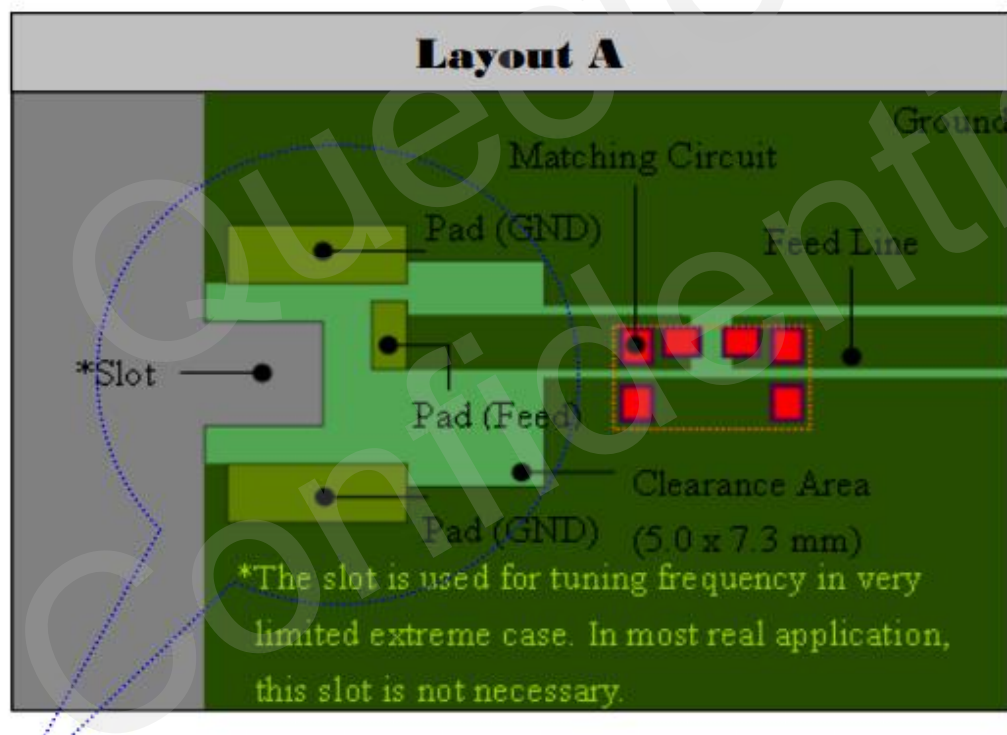


Figure 1: Recommended PCB Layout

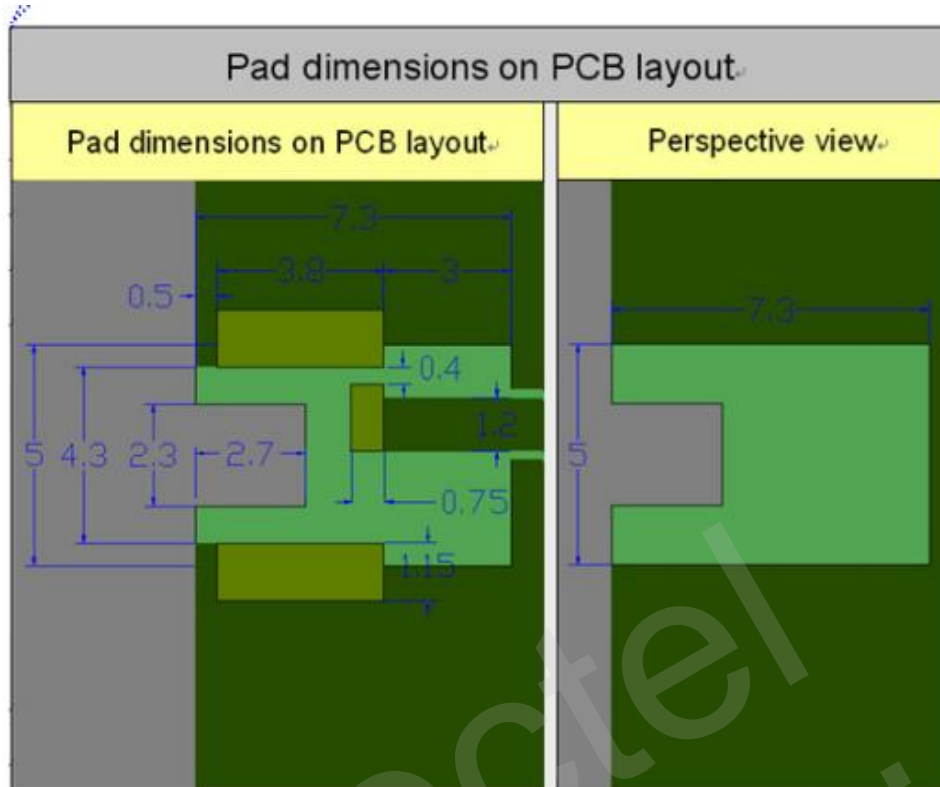


Figure 2: Pad Dimensions on PCB Layout



Figure 3: INPAQ 5036 Chip Antenna on M66 TE-A

**NOTE**

Please refer to **Document [1]** for more information about INPAQ 5036 SPEC. Same as other vendors' ceramic antenna, you also need to follow reference design strictly and tune the antenna matching after PCBA design.



### 3 Planar Inverted-F Antenna

Planar inverted-F antenna just needs metal conductor, suitable feed line and connection to ground, so its cost is low and it can be soldered on PCB directly to form an integrated structure.

Planar inverted-F antenna could be linear or flaky. Figure 4 and 5 provide the PCB design encapsulation parameters of the planar inverted-F antenna.

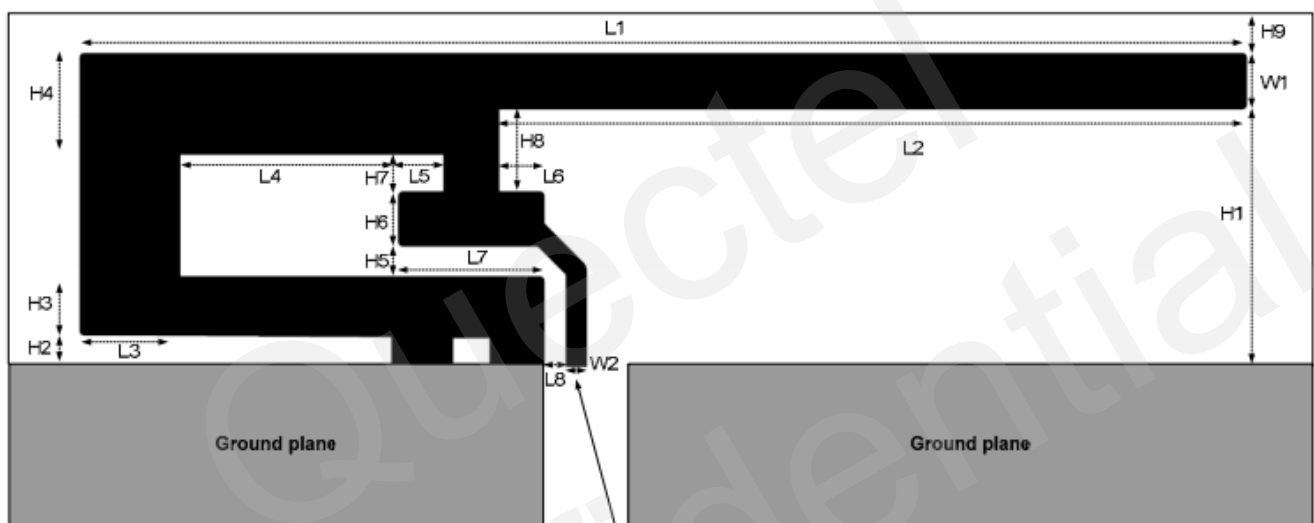


Figure 4: Planar Inverted F Antenna PCB Design

H1	5.70 mm	W2	0.46 mm
H2	0.74 mm	L1	25.58 mm
H3	1.29 mm	L2	16.40 mm
H4	2.21 mm	L3	2.18 mm
H5	0.66 mm	L4	4.80 mm
H6	1.21 mm	L5	1.00 mm
H7	0.80 mm	L6	1.00 mm
H8	1.80 mm	L7	3.20 mm
H9	0.61 mm	L8	0.45 mm
W1	1.21 mm		

Figure 5: Corresponding Size Parameters

In Figure 4, the Bluetooth antenna feed point is connected with BT\_ANT pin, outer L-short side is connected to ground plane, and the antenna access point is located between ground plane and antenna open point. On-board F antenna is normally placed at the first layer of PCB, ground plane needs to be placed at the first layer and near the antenna, but you must keep clearance around the antenna. The following figure demonstrates the application of planar inverted-F antenna when it is designed as on-board antenna on PCB design according to above parameters.



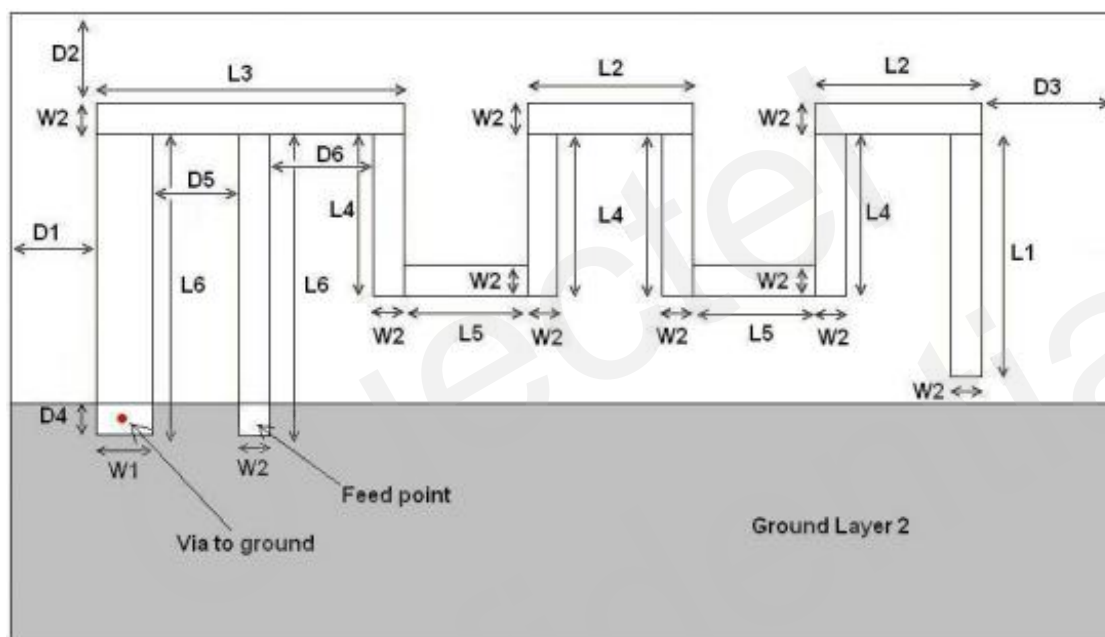
**Figure 6: Application of Planar Inverted-F Antenna on PCB**

**NOTE**

Above planar inverted-F antenna is recommend by the T1 official document, you still need to tune the antenna matching, for details, please refer to **Document [2]**.

## 4 Meander Line Antenna

Generally, meander line antenna is on-board antenna. Meanwhile, it is placed at the first layer of PCB, and ground plane should be placed at the first layer and near the antenna, but you must keep clearance around the antenna. The following figure shows the size of one meander line antenna.



L1	3.94 mm
L2	2.70 mm
L3	5.00 mm
L4	2.64 mm
L5	2.00 mm
L6	4.90 mm
W1	0.90 mm
W2	0.50 mm
D1	0.50 mm
D2	0.30 mm
D3	0.30 mm
D4	0.50 mm
D5	1.40mm
D6	1.70 mm

Figure 7: Design Parameters of Typical Meander Line Antenna

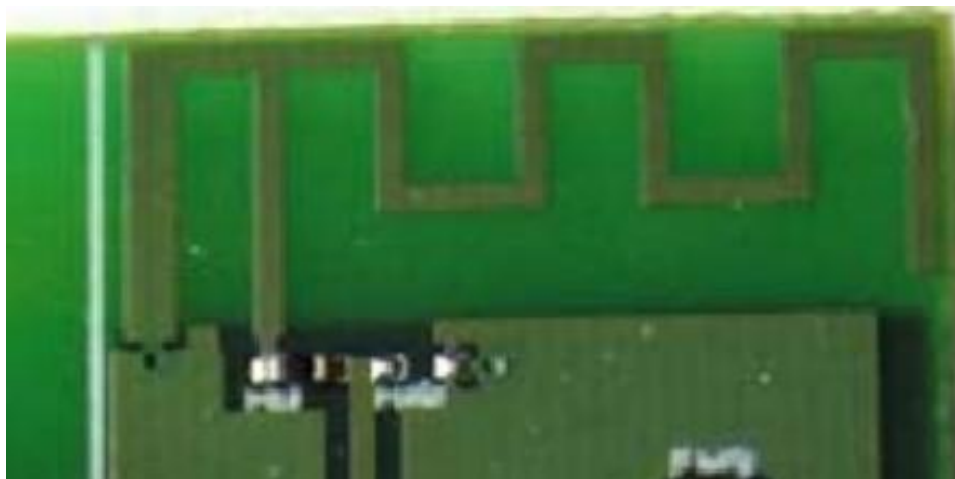


Figure 8: Application of Meander Line Antenna on PCB

**NOTE**

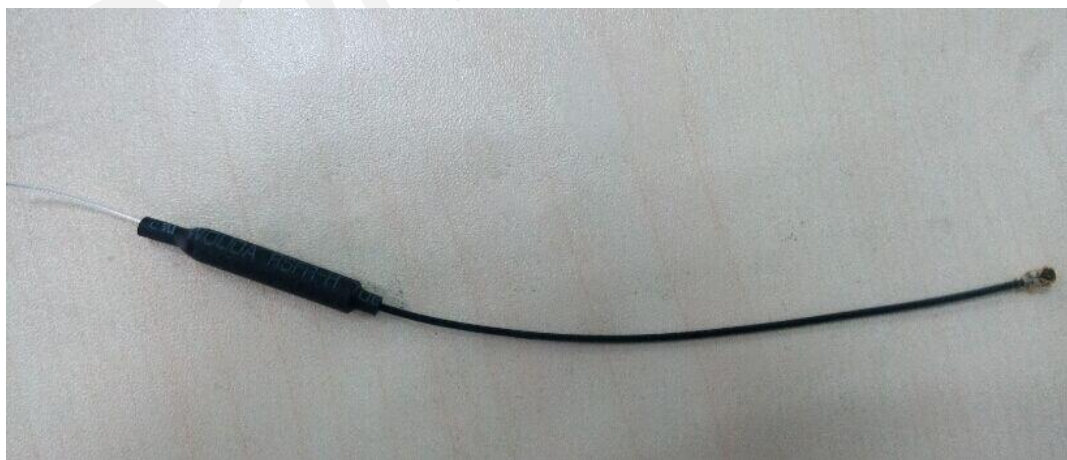
Above meander line antenna is recommend by T1 official document, you still need to tune the antenna matching, for details, please refer to **Document [3]**.

## 5 Rod Antenna for 2.4G

The figure below shows the rod Bluetooth antenna for 2.4G. Even though its dimension is bigger than others, it has the best performance and farthest transmit distance. Figure 10 is IPX socket copper pipe antenna. It is smaller than rod antenna but the performance is weaker. These two kinds of antennas are simple, you just need to control the routing impedance as 50ohm from the Bluetooth RF output to RF connector. Meanwhile, keep clearance around the antenna and pay attention that no metal shelter around the antenna is placed.



**Figure 9: 2.4G Rod Antenna (SMA Connector)**



**Figure 10: 2.4G Copper Pipe Antenna (IPX Socket)**

Antenna is sensitive to metal, the ground plane at the PCB or the metal shielding will impact antenna radiation performance seriously. In order to keep good performance of Bluetooth antenna and improve transmission quality, it is recommended to take the Bluetooth antenna design and application environment of products into consideration at the beginning of device design.

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## 6 Appendix A Reference

Table 1: Related Documents

SN	Document Name
[1]	ACA-5036-A2-CC-S Application Note
[2]	DN007 2.4GHz Inverted F Antenna (swru120b.pdf)
[3]	AN043 Small Size 2.4GHz PCB Antenna (swra117.pdf)