
Antenna Test Report

Bluetooth On-Board Antenna

BC04SPP Module

TABLE OF AUTHORISATION

Name	Role	Organisation	Signature

TABLE OF DISTRIBUTION

Name	Role/Organisation

DOCUMENT HISTORY

The next table gives an overview of the changes to the document

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1 INTRODUCTION

This document is to analyze electrical performances of BT on-board antenna embedded in BC04SPP module applied for interwriting device. Typical electrical tests will be fulfilled such as S-parameter, peak gain, radiation pattern and so on.

2 ELECTRICAL SPECIFICATIONS

The electrical specifications for BT on-board antenna are listed in following tables. All measured antenna parameters have to meet the requirements stated in the tables.

Parameter	Bluetooth	Unit
Total frequency range	2400 ~ 2485	MHz
Nominal impedance	50	Ohm
Return loss	< -10	dB
Antenna gain over frequency band	> 1.0	dBi
Antenna total efficiency	> 50	%
Polarization	Linear	-
Radiation pattern	Omni-directional	-

3 MEASUREMENT SETUP

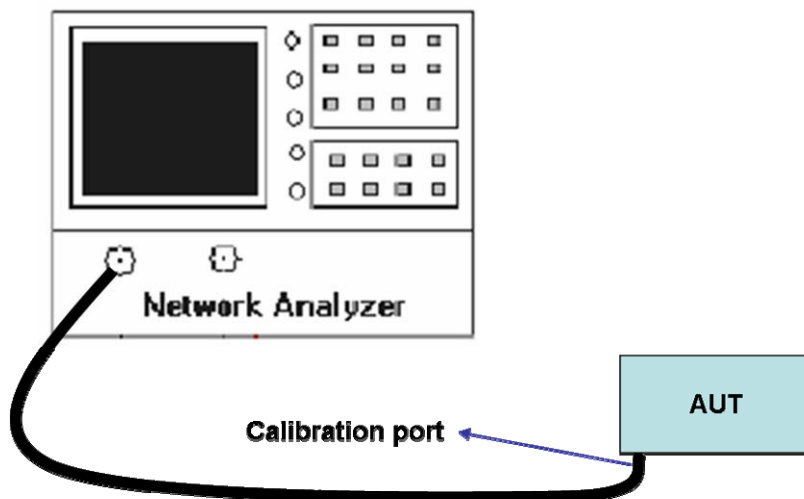
3.1 TEST EQUIPMENTS

For BT antenna tests, the measurement facilities include:

- Vector network analyzer (HP 8720D) or similar setup capable to measure return loss.
- Anechoic room (ANTCOM) or similar setup capable to measure radiation characteristics.
- Reference antenna (EMCO model 3115 double-rigid guide horn antenna).
- Probe antenna (WR430).

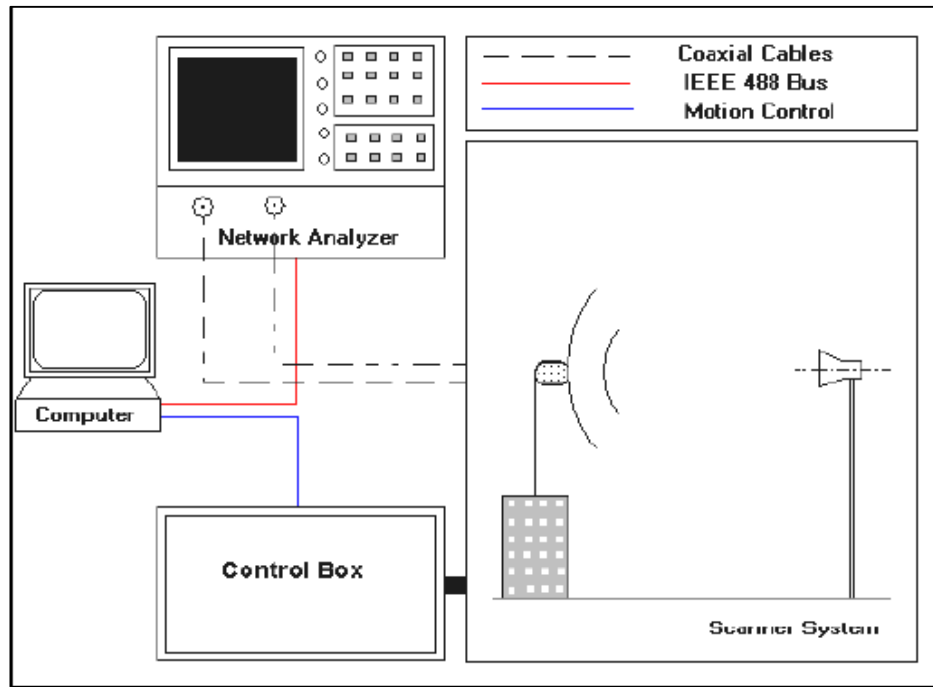
3.2 RETURN LOSS MEASUREMENT

Return loss measurement is performed by network analyzer (HP 8720D).



3.3 RADIATION PATTERN MEASUREMENT

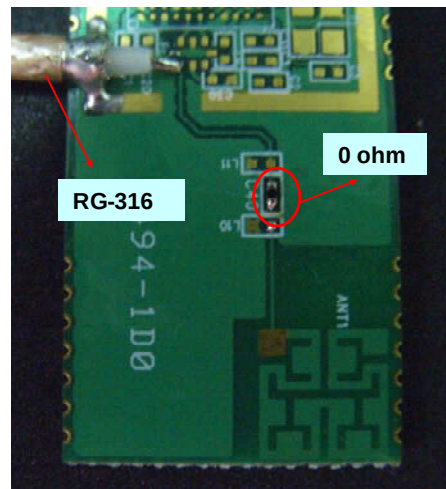
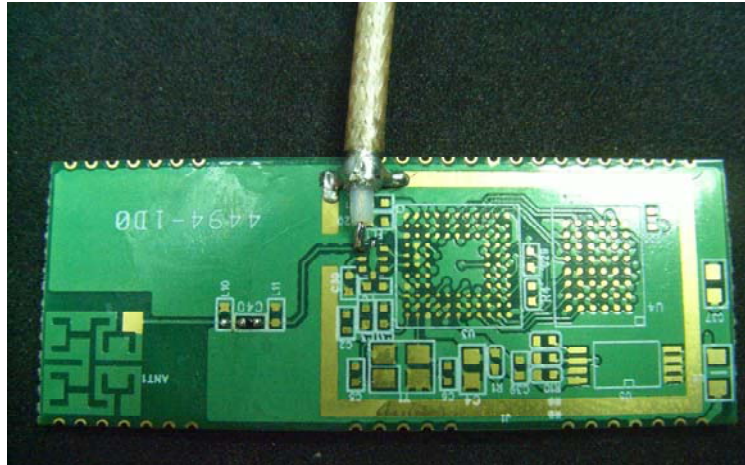
ANTCOM 3D chamber is a near-field test system. The S21 amplitude is received for calculating gain, axial ratio, and radiation pattern through FFT (Fast Fourier Transformation). The distance between probe and AUT is 76 cm for GPS and 75 cm for Bluetooth frequency band.



4 ELECTRICAL TESTS FOR BT ANTENNA

4.1 TEST JIG SETUP

The test jig setup picture is shown as the following figure. This test jig is used for S-parameter test and antenna radiation measurement. A 50 ohm RG-316 coaxial cable is soldered at unbalance port (pin1) of balance filter (FL1) at one end and equipped SMA connector at another end. During calibration process, a 50 ohm RG-316 coaxial cable equipped SMA connectors whose length equal 15 cm and commercial calibration kit (HP 85052B) are used for calibrating network analyzer. Network analyzer has to be switched on 1 hour before performing tests.



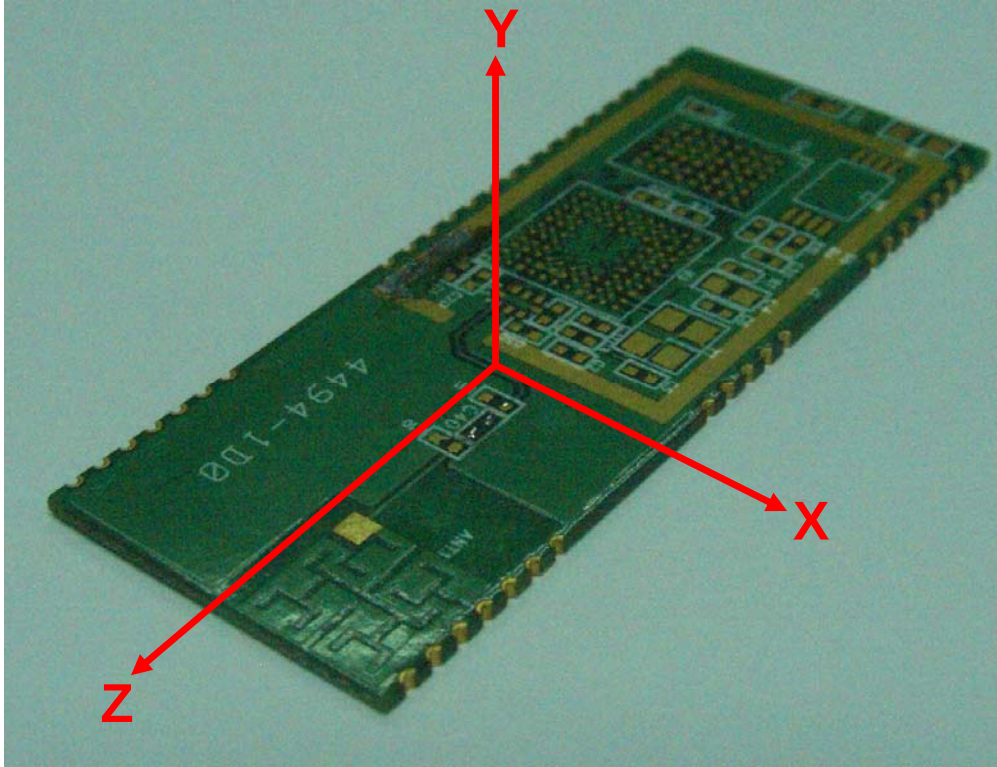
4.2 COORDINATE SYSTEM

The coordinate system for measured Bluetooth-on-board antenna is illustrated in the figure.

XY plane: φ cut, $\theta = 90^\circ$.

YZ plane: θ cut, $\varphi = 0^\circ$.

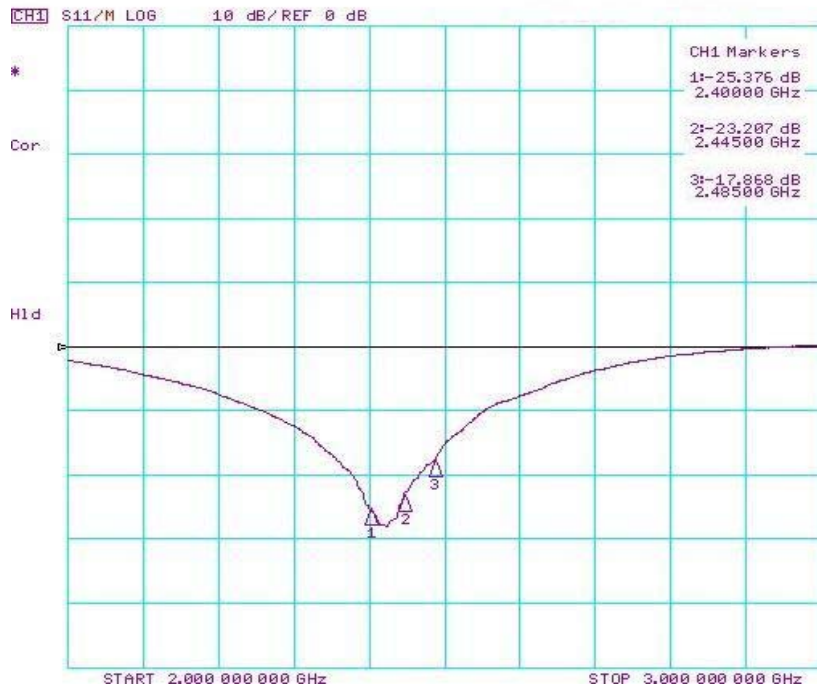
XZ plane: θ cut, $\varphi = 90^\circ$.



4.3 RETURN LOSS AND VSWR

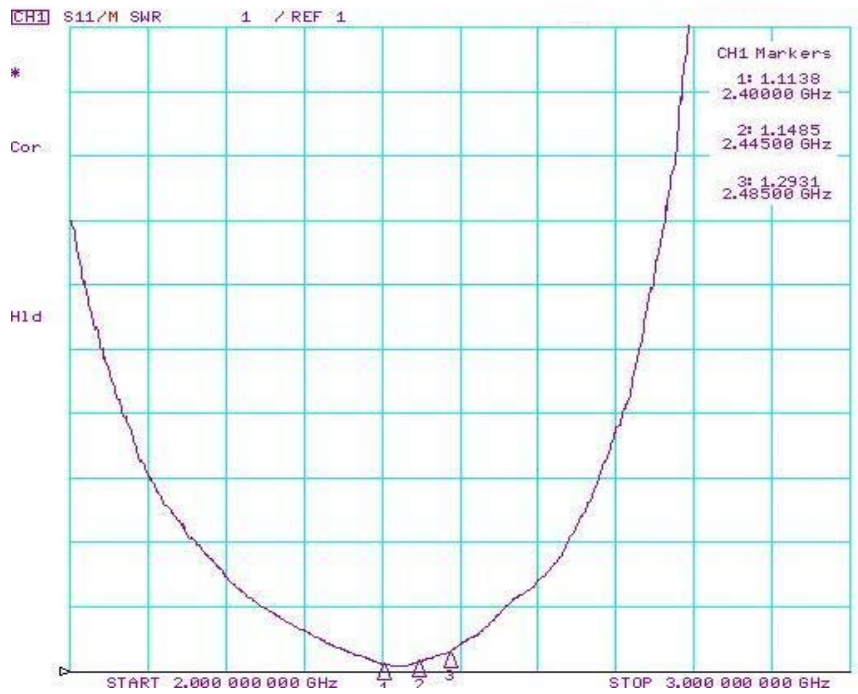
Return loss and VSWR have to be measured at least in low, middle, and high frequency of Bluetooth band.

BT	Return Loss				/ dB
	Average	Worst	Low	Mid	High
Measured frequency (MHz)			2.400	2.445	2.485
Free Space	22.150	-17.868	-25.376	-23.207	-17.868



FREQUENCY	UNITS
GHz	dB
2.400	-25.376
2.405	-25.891
2.410	-26.643
2.415	-27.696
2.420	-27.857
2.425	-27.800
2.430	-27.105
2.435	-26.779
2.440	-24.817
2.445	-23.207
2.450	-22.657
2.455	-21.542
2.460	-20.815
2.465	-20.135
2.470	-19.421
2.475	-18.727
2.480	-18.303
2.485	-17.868
2.490	-16.856
2.495	-16.047
2.500	-15.143

BT	VSWR				
	Average	Worst	Low	Mid	High
Measured frequency (MHz)			2.400	2.445	2.485
Free Space	1.18	1.29	1.11	1.15	1.29

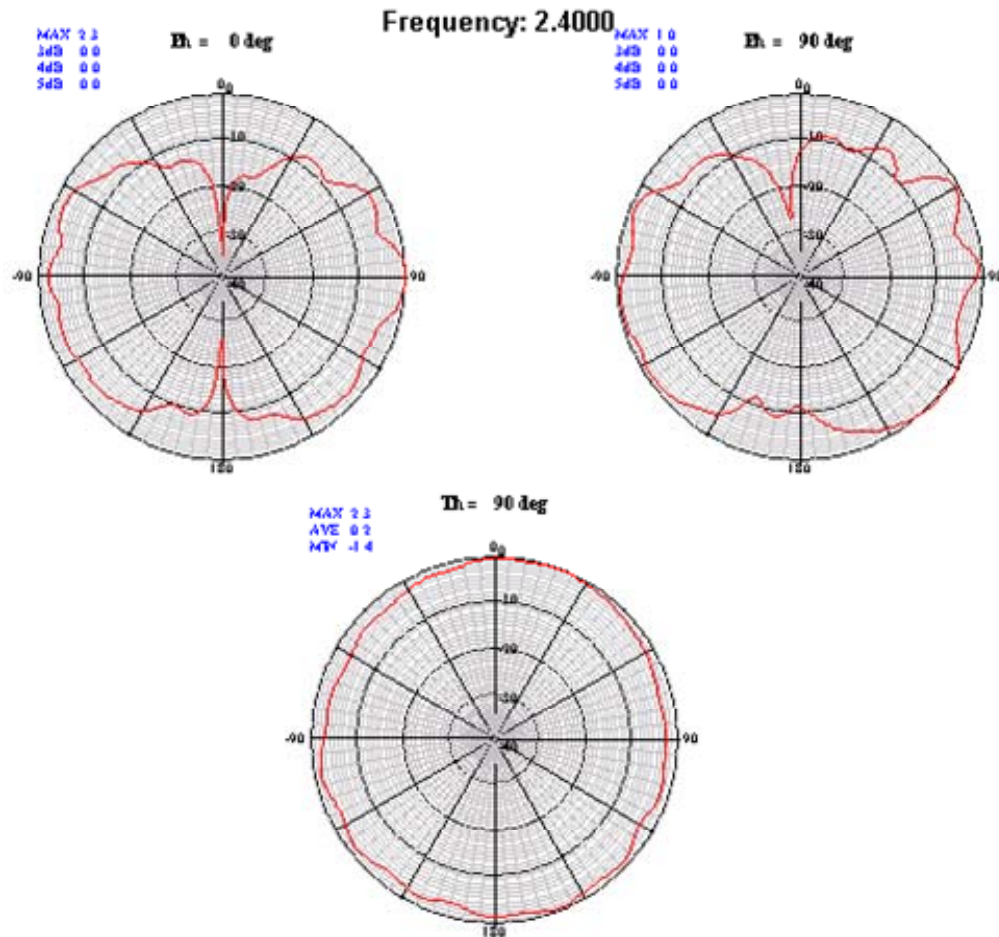


FREQUENCY	UNITS
GHz	
2.400	1.11
2.405	1.11
2.410	1.10
2.415	1.09
2.420	1.08
2.425	1.08
2.430	1.09
2.435	1.10
2.440	1.12
2.445	1.15
2.450	1.16
2.455	1.18
2.460	1.20
2.465	1.22
2.470	1.24
2.475	1.26
2.480	1.28
2.485	1.29
2.490	1.34
2.495	1.37
2.500	1.42

4.4 GAIN MEASUREMENT

The peak gain and three principal cuts (XY plane, YZ plane and XZ plane) for Bluetooth antenna are measured at least in low, middle, and high frequency of Bluetooth frequency band.

BT	Peak Gain				/ dBi
	Average	Worst	Low	Mid	High
Measured frequency (MHz)			2.400	2.445	2.485
Free Space	2.1	1.8	2.3	2.2	1.8

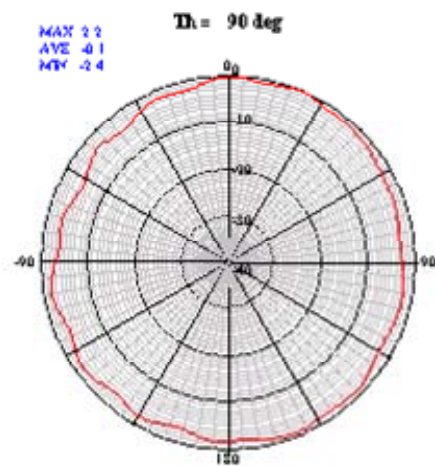
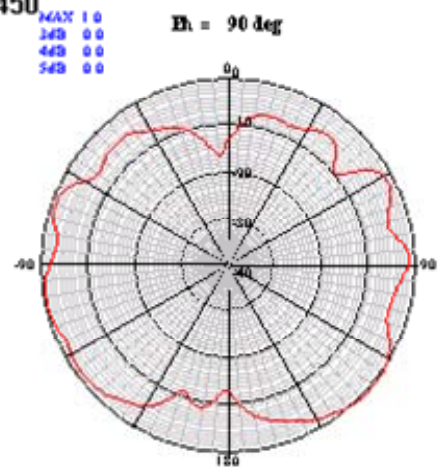
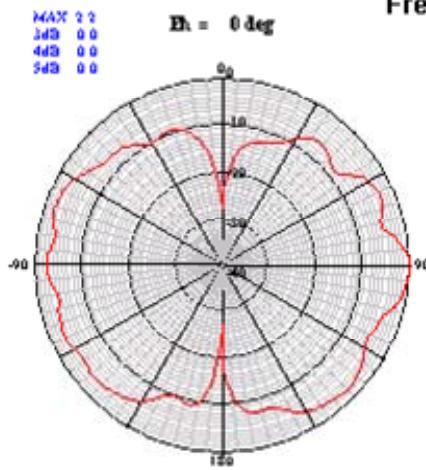


Frequency : 2.400 GHz

Directivity : 3.7 dB

Peak Gain : 2.3 dB

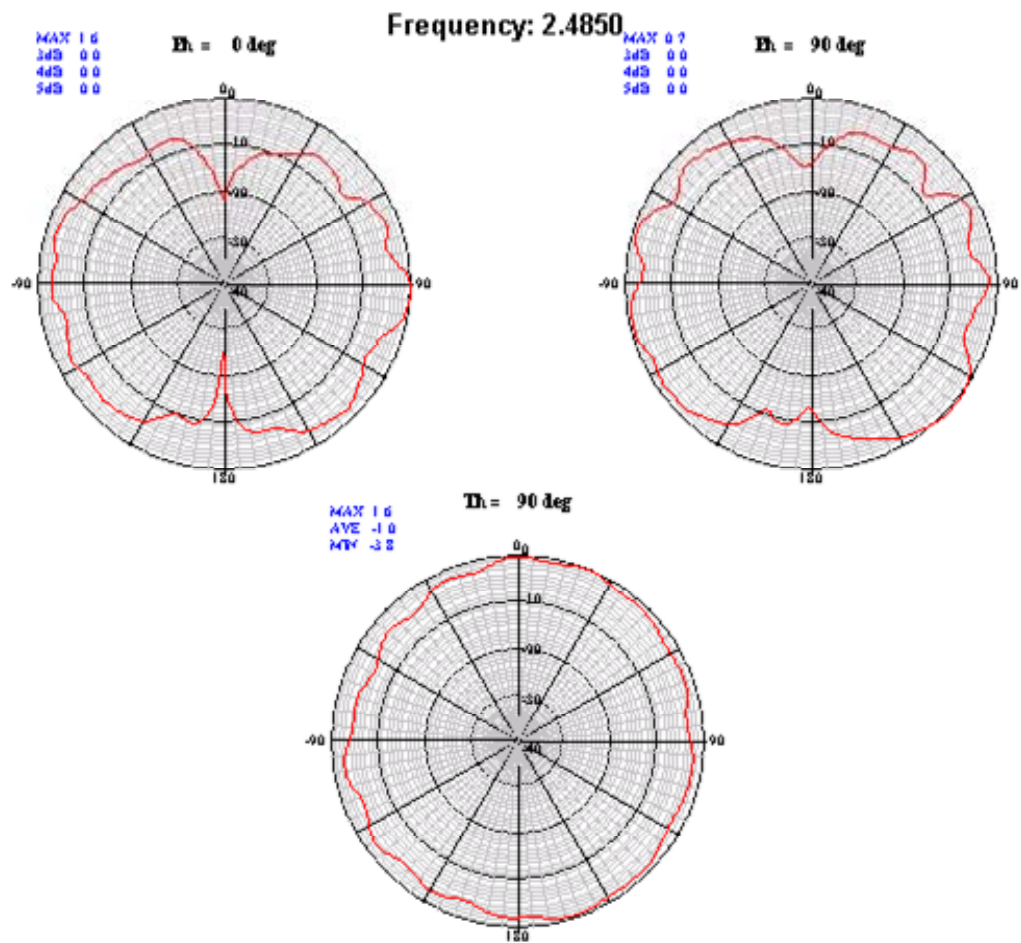
Frequency: 2.4450



Frequency : 2.445 GHz

Directivity : 3.6 dB

Peak Gain : 2.2 dB



Frequency :	2.485	GHz
Directivity :	3.7	dB
Peak Gain :	1.8	dB

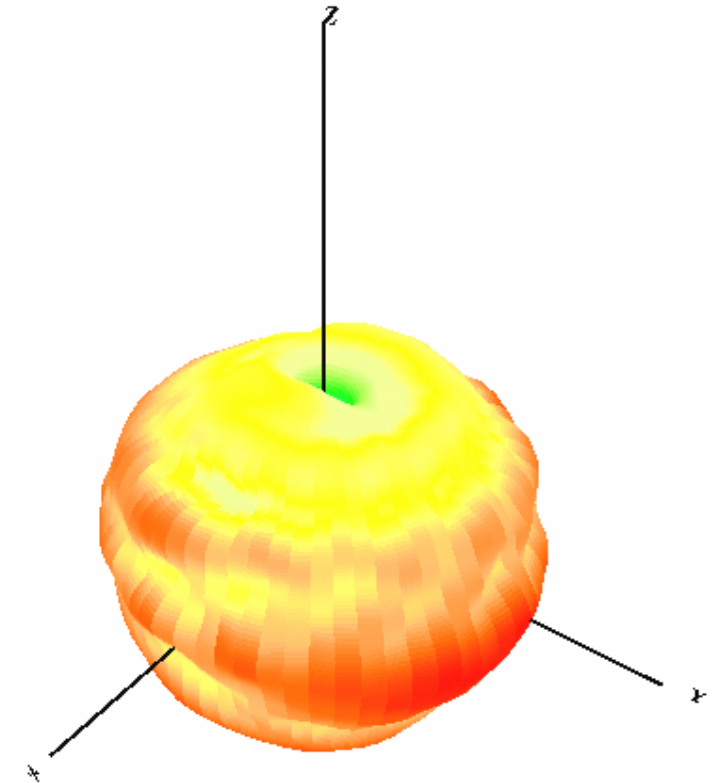
4.5 TOTAL EFFICIENCY

Antenna total efficiency is measured at least in low, middle, and high frequency of Bluetooth frequency band.

$$\text{Efficiency (dB)} = \text{Gain (dB)} - \text{Directivity (dB)}$$

BT	Total Efficiency				dB / %
	Average	Worst	Low	Mid	High
Measured frequency (MHz)			2.400	2.445	2.485
Free Space (dB)	-1.6	-1.9	-1.4	-1.4	-1.9
(%)	69	65	72	72	65

4.6 3D RADIATION PATTERN



5 APPLICATION NOTE

The BT on-board antenna is integrated to BC04SPP module. BC04SPP module is SMD type module soldered on mother board of interwriting device.

For effective radiation, the BT on-board antenna requires a ground-clearance area. A simple illustration is shown as below.

