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EXO 8 Antennas

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EXO 8 Antenna Compliance with Cellular Module Integration Requirements

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1 Document Revision History

Revision	Date	Author	Summary
1	Nov 5, 2024	Scott Jacobsen	Initial Release

2 Purpose of this Report

The purpose of this report is to show the radio frequency (RF) exposure compliance of the cellular module integration on EXO 8.

3 Identifiers

3.1 Host Product

Product Name: EXO 8

Model: EX8N-01-NA2

3.2 Module Identifiers

Module Description	Model	FCC ID	IC ID	Grantee
Cellular	LARA-R6001D	XPYUBX21BE01	8595A-UBX21BE01	u-blox AG

3.3 Antennas

Frequency Band	Vendor	Model	Peak Gain(dBi)	Data Sheet Reference
Cellular	Blackline Safety	103452r2	See section 3.5	

3.4 Module Grant Requirements – XPYUBX21BE01

Output power listed is conducted. Single Modular Approval. The module antenna must be installed to meet the RF exposure compliance separation distance of 20 cm. For mobile and fixed operating configurations the antenna gain, including cable loss, must not exceed

3.9dBi at GSM850
4.5dBi at GSM1900
9.9dBi at FDD Band 2
9.5dBi at FDD LTE Band 2
6.0dBi at FDD LTE Band 4
10.4dBi at FDD Band 5 and FDD LTE Bands 5 and 26
10.3dBi at FDD LTE Band 7
10.2dBi at FDD LTE Band 13
9.7dBi at FDD LTE Band 12
10.8dBi at FDD LTE Band 8
9.1dBi at TDD LTE Band 38
8.8dBi at TDD LTE Band 41

Integration not consistent with these conditions will entail additional testing and authorization process. Co-location of this module with other transmitters that operate simultaneously are required to be evaluated using the FCC multi-transmitter procedures. Host integrators must be provided with antenna

installation instructions and transmitter operating conditions to satisfy RF exposure compliance. Host integrator is responsible for complying with the instructions and requirements for each transmitter they choose to integrate into a host product. This device supports bandwidth modes of 1.4, 3, 5, 10, 15 and 20 MHz for FDD LTE Bands 2 and 4; bandwidth modes of 5, 10, 15 and 20 MHz for FDD LTE Band 7 and TDD LTE Bands 38 and 41; bandwidth modes of 1.4, 3, 5 and 10 MHz for FDD LTE Bands 5, 12 and 26; bandwidth modes of 5 and 10 MHz for FDD LTE Band 13 and bandwidth modes of 1.4 and 3 MHz for FDD LTE Band 8.

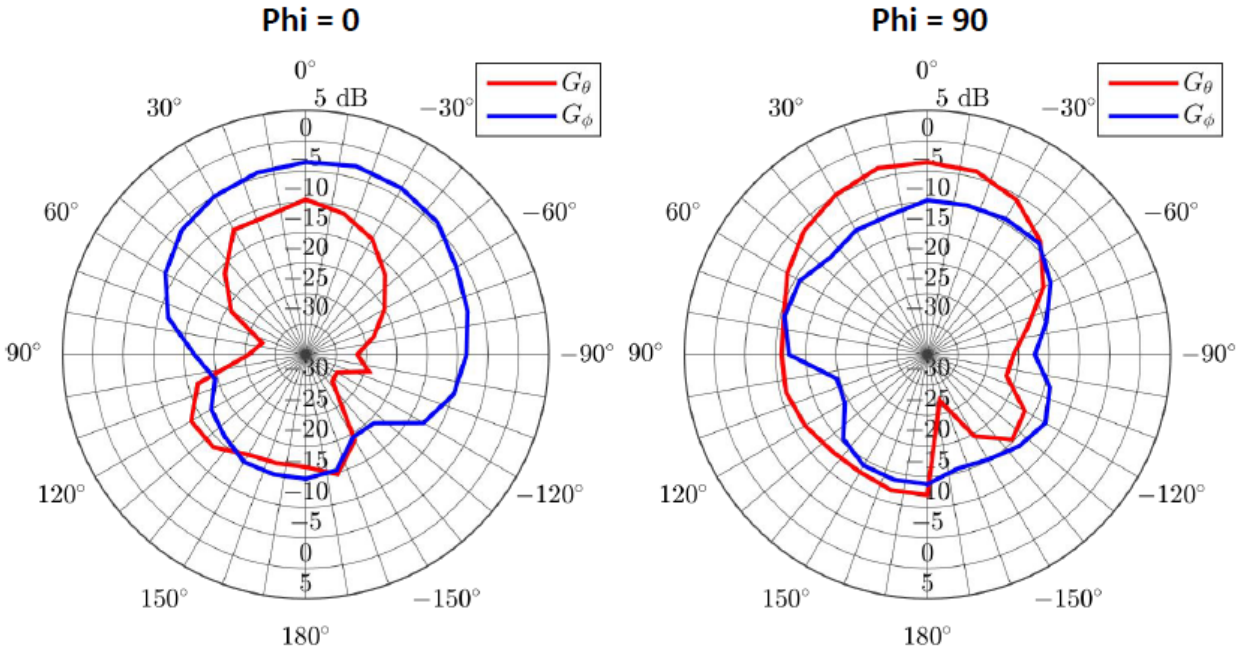
3.5 Comparison of Antenna Gain with Module Requirements

Requirement Maximum Gain	Band	Measured Actual Gain	Frequency
9.7 dBi	FDD LTE Band 12	-7.2 dBi	700 MHz
9.7 dBi	FDD LTE Band 12	-6.7dBi	707 MHz
9.7 dBi	FDD LTE Band 12	-6.4 dBi	715 MHz
10.2 dBi	FDD LTE Band 13	-4.0 dBi	780 MHz
10.2 dBi	FDD LTE Band 13	-3.9 dBi	784 MHz
3.9 dBi	GSM850	-3.6 dBi	826 MHz
3.9 dBi	GSM850	-3.1 dBi	837 MHz
3.9 dBi	GSM850	-1.7 dBi	847 MHz
10.4 dBi	FDD Band 5 and FDD LTE Bands 5 and 26	-3.6 dBi	826 MHz
10.4 dBi	FDD Band 5 and FDD LTE Bands 5 and 26	-3.1 dBi	837 MHz
10.4 dBi	FDD Band 5 and FDD LTE Bands 5 and 26	-1.7 dBi	847 MHz
10.8 dBi	FDD LTE Band 8	-1.4 dBi	899 MHz
6.0 dBi	FDD LTE Band 4	1.6 dBi	1710 MHz
6.0 dBi	FDD LTE Band 4	1.0 dBi	1730 MHz
6.0 dBi	FDD LTE Band 4	-0.8 dBi	1750 MHz
4.5 dBi	GSM1900	-0.3 dBi	1850 MHz
4.5 dBi	GSM1900	-0.6 dBi	1880 MHz
4.5 dBi	GSM1900	-1.8 dBi	1910 MHz
9.9 dBi	FDD Band 2	-0.3 dBi	1850 MHz
9.9 dBi	FDD Band 2	-0.6 dBi	1880 MHz
9.9 dBi	FDD Band 2	-1.8 dBi	1910 MHz

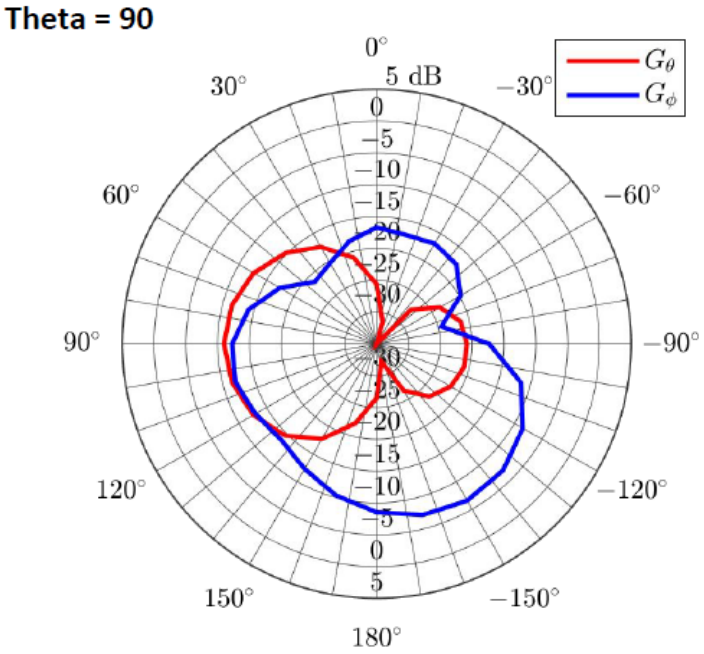
9.5 dBi	FDD LTE Band 2	-0.3 dBi	1850 MHz
9.5 dBi	FDD LTE Band 2	-0.6 dBi	1880 MHz
9.5 dBi	FDD LTE Band 2	-1.8 dBi	1910 MHz
10.3 dBi	FDD LTE Band 7	1.2 dBi	2500 MHz
10.3 dBi	FDD LTE Band 7	1.3 dBi	2530 MHz
10.3 dBi	FDD LTE Band 7	1.3 dBi	2560 MHz
9.1 dBi	TDD LTE Band 38	1.4 dBi	2570 MHz
9.1 dBi	TDD LTE Band 38	1.4 dBi	2590 MHz
9.1 dBi	TDD LTE Band 38	1.4 dBi	2610 MHz
8.8 dBi	TDD LTE Band 41	1.2 dBi	2500 MHz
8.8 dBi	TDD LTE Band 41	1.4 dBi	2590 MHz
8.8 dBi	TDD LTE Band 41	1.5 dBi	2680 MHz

3.6 Sample Radiation Patterns

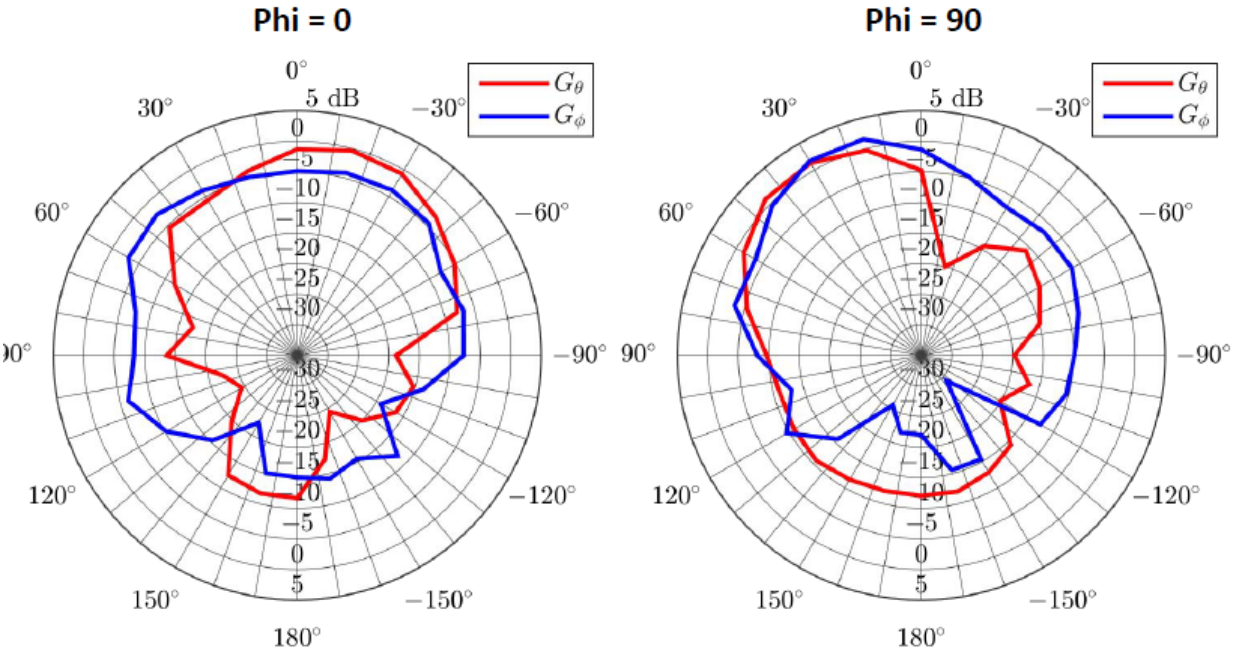
Cellular Linear Gain vs Theta Angle 0.75 GHz



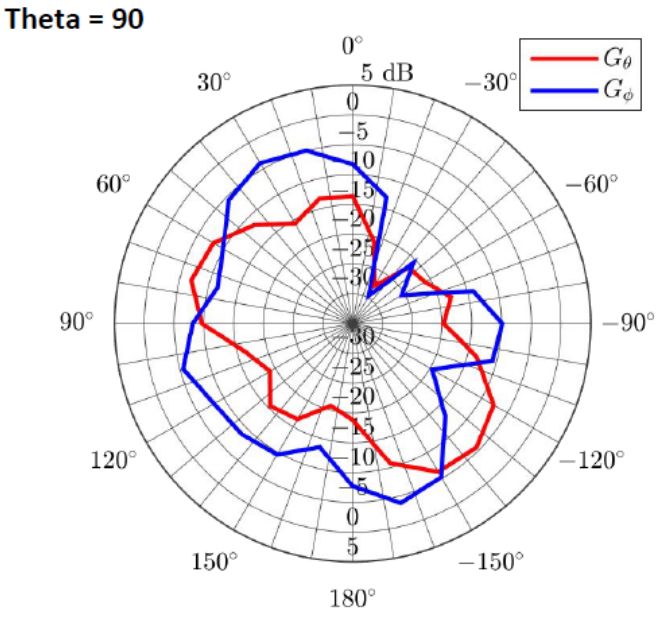
Cellular Linear Gain vs Phi Angle 0.75 GHz



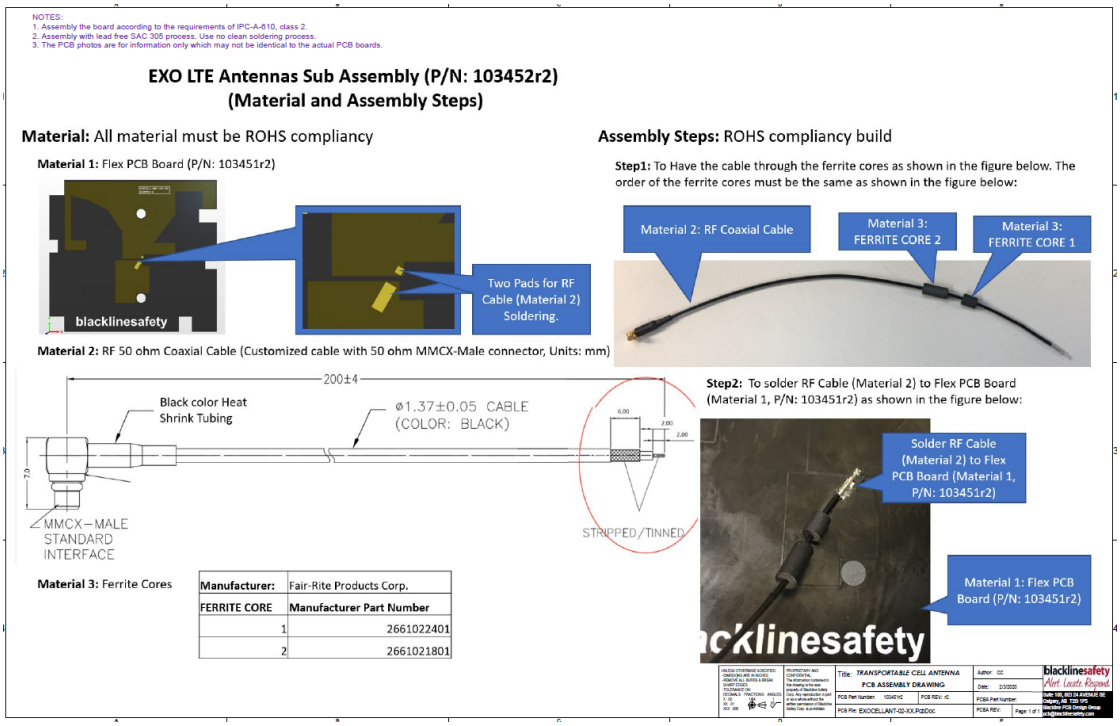
Cellular Linear Gain vs Theta Angle 1.85 GHz



Cellular Linear Gain vs Phi Angle 1.85 GHz

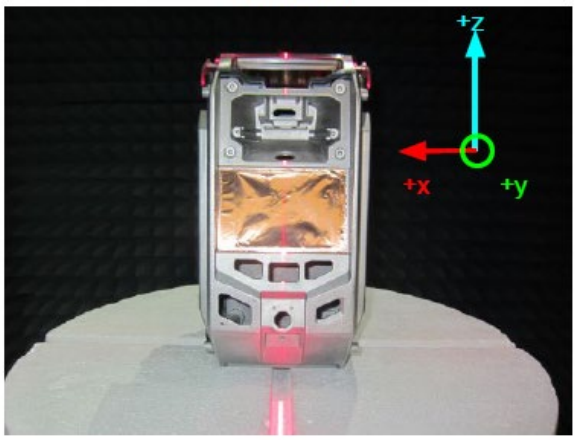


3.7 Antenna Assembly

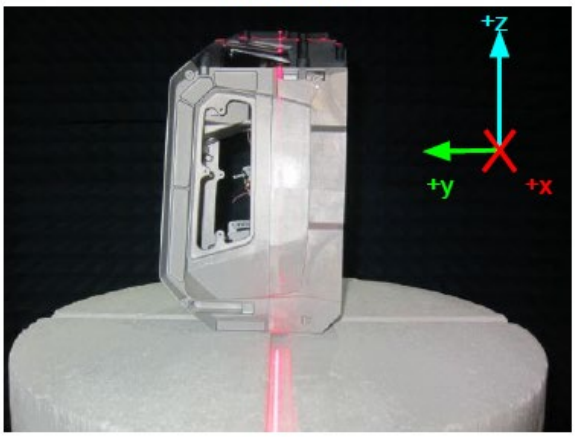


3.8 Test Setup Pictures

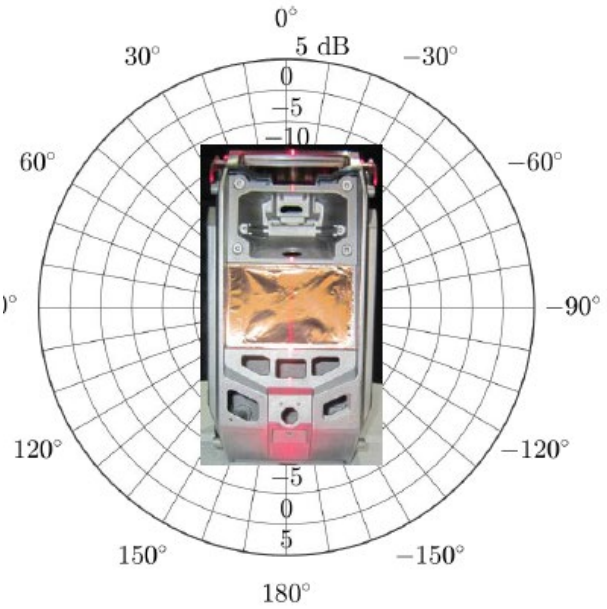
Front View



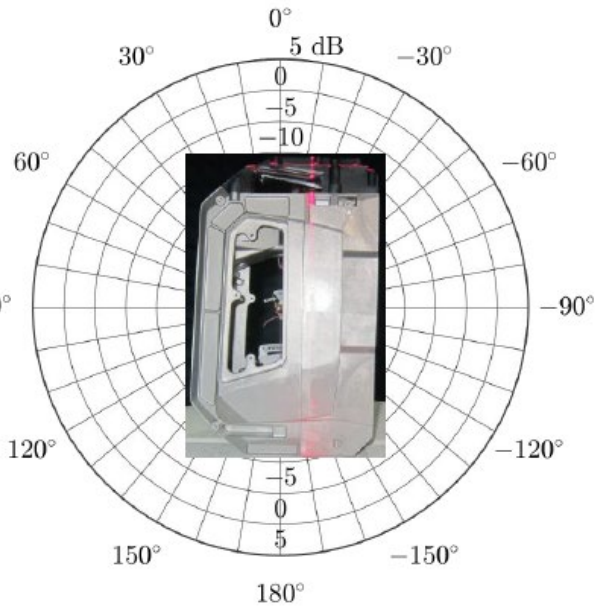
Side View



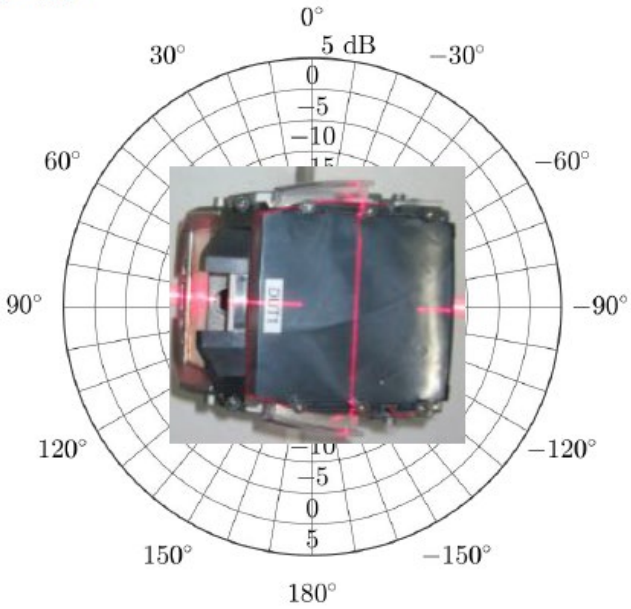
Phi = 0



Phi = 90



Theta = 90



4 Statement of Compliance

The gain values found for Blackline cellular antenna 103452r2 are below the maximum allowed levels according to module integration requirements.

SPECIFICATION
Iridium Certified

Part No.	:	**IP.1621.25.4.A.02**
Product Name	:	**4mm thick Iridium Patch Antenna, 1621MHz**
Features	:	25.1mm*25.1mm*4mm ROHS Compliant

:

1. Introduction

This miniaturized ceramic Iridium patch antenna is based on smart ***XtremeGain™*** technology. It is mounted via pin and double-sided adhesive and has been selected as optimal solution for the customer device environment. Iridium certifies the IP.1621.25.4.A.02 for commercial use in connection with the Iridium Communications systems.

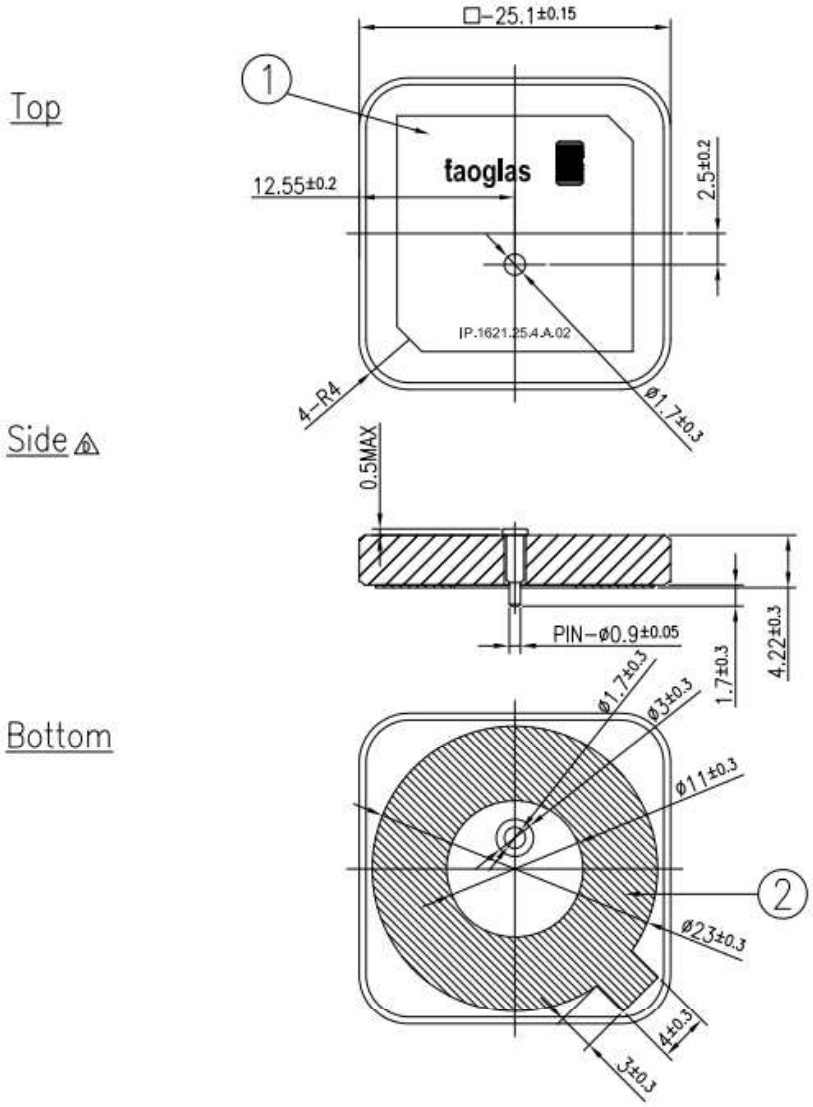
2. Key Antenna Performance Indicators

Original Patch Specification tested on 50*50mm ground plane

No	Parameter	Specification	Notes
1	Range of Receiving Frequency	1616~1626.5Mhz	
2	Center Frequency	1621MHz ±3MHz	with 50*50mm GND Plane
3	Bandwidth	16MHz	Return Loss ≤-10dB
4	VSWR	1.5 max	Center Frequency
5	Gain at Zenith	+2.0dBi typ.	Center Frequency
6	Gain at 10° Elevation	--	Center Frequency
7	Axial Ratio	3 dB Max	Center Frequency
8	Polarization	RHCP	
9	Impedance	50Ω	
10	Frequency Temp Coefficient (Tf)	0±20ppm/°C	-40°C to +85°C
11	Operating Temperature	-40°C to +85°C	
12	Antenna Weight	10g	

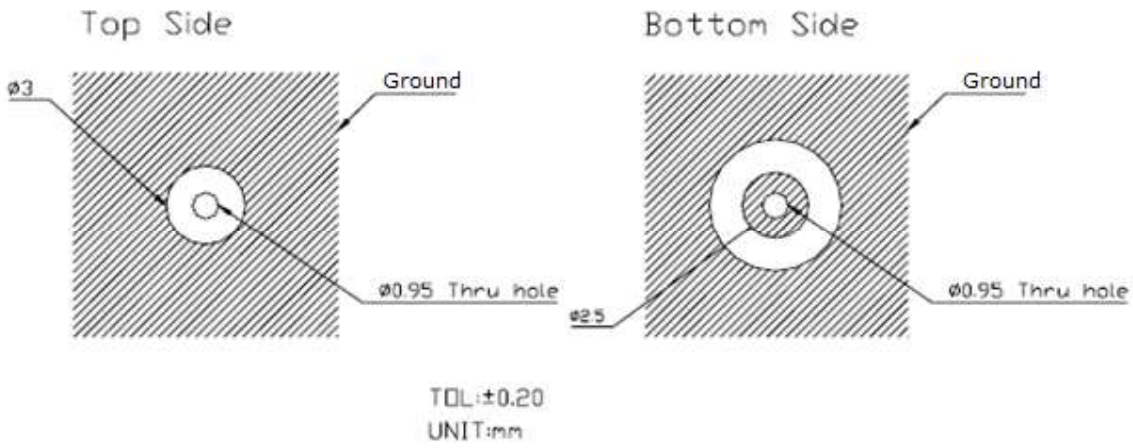
3. Mechanical Drawing

3.1 Shape and Dimension



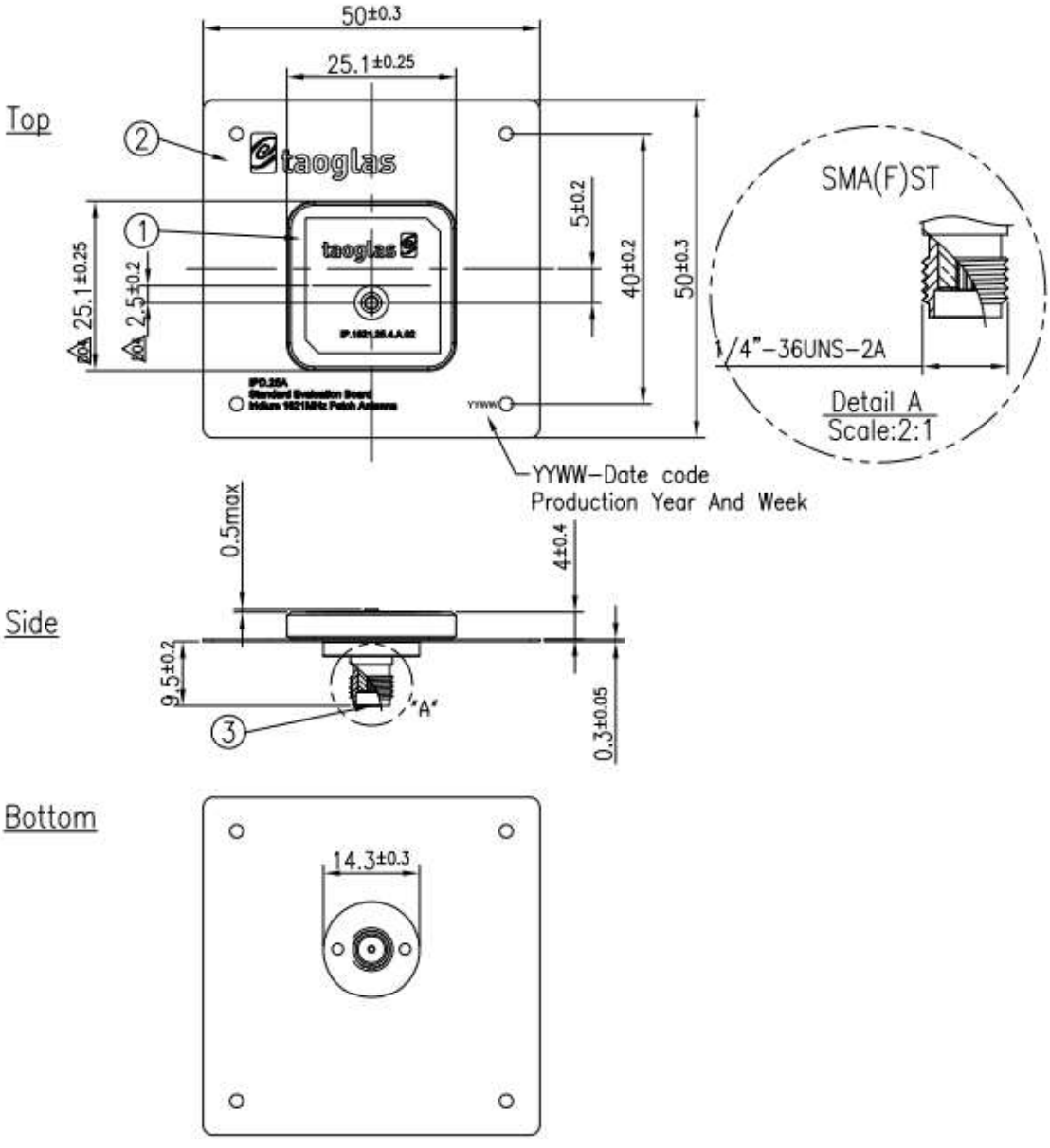
	Name	P/N	Material	Finish	QTY
1	IP.25A Iridium Patch(25.1x25.1x4mm)	001514C000007A	Ceramic	Clear	1
2	Double sided Adhesive	001013C180007A	NITTO 5015	White Liner	1

3.2 Layout



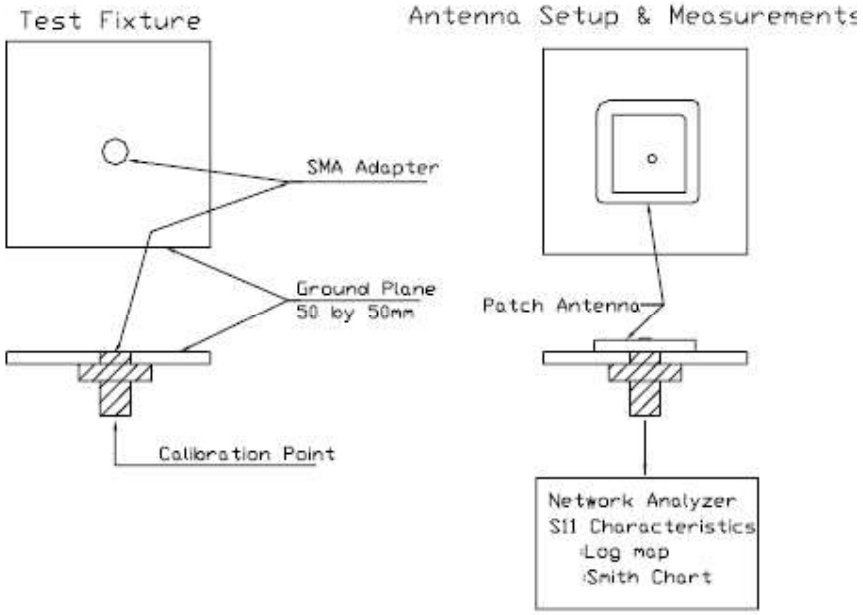
3.3 Mark

3.4 Evaluation Board (IPD.25A)

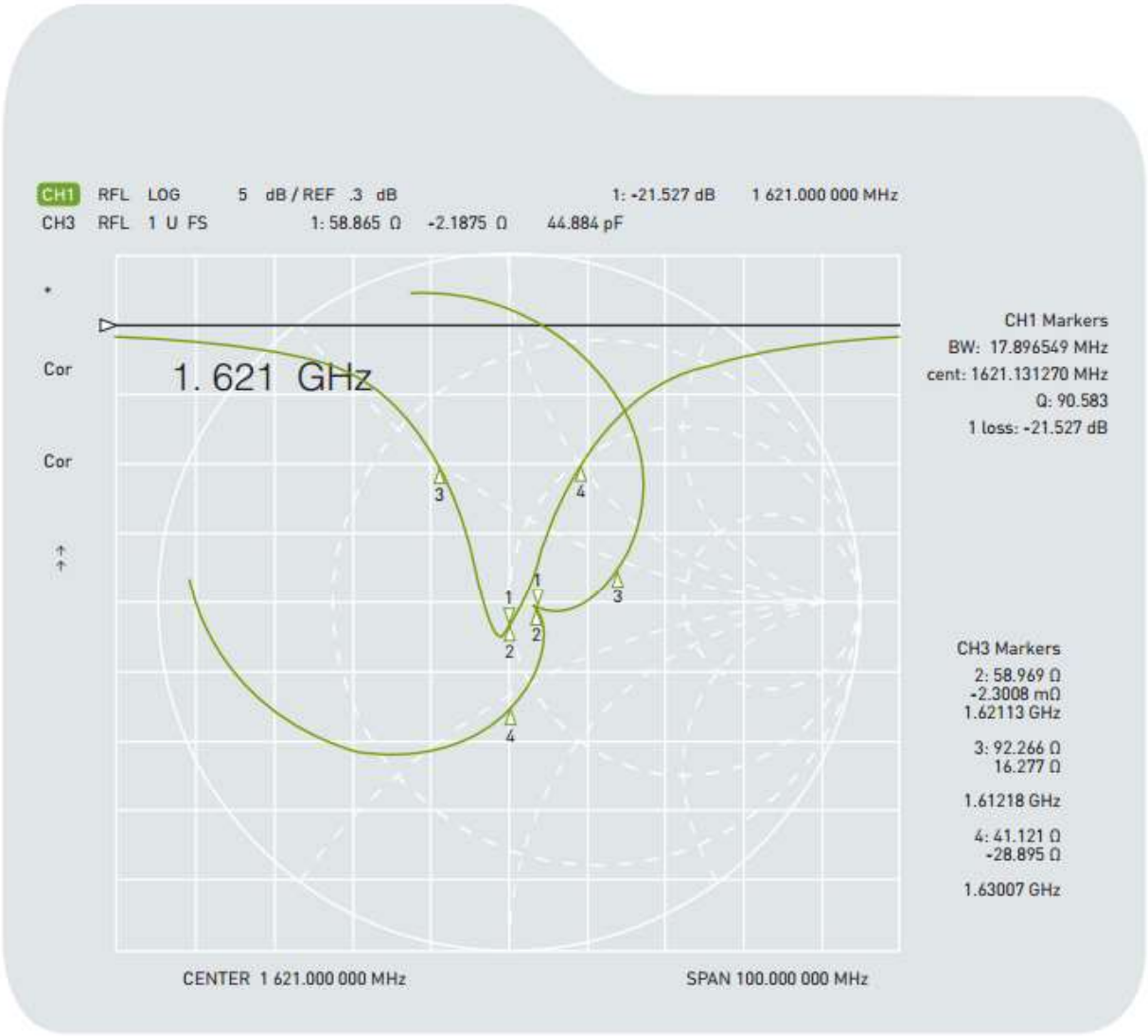


	Name	P/N	Material	Finish	QTY
1	IP.25A Iridium Patch(25.1x25.1x4mm)	001514C000007A	Ceramic	Clear	1
2	Ground-Plane(50x50x0.3mm)	000514C000007A	Brass	Silver	1
3	SMA(F) ST	200413L000007A	Brass	Au Plated	1

3.5 Test Fixture Antenna Setup and Measurements

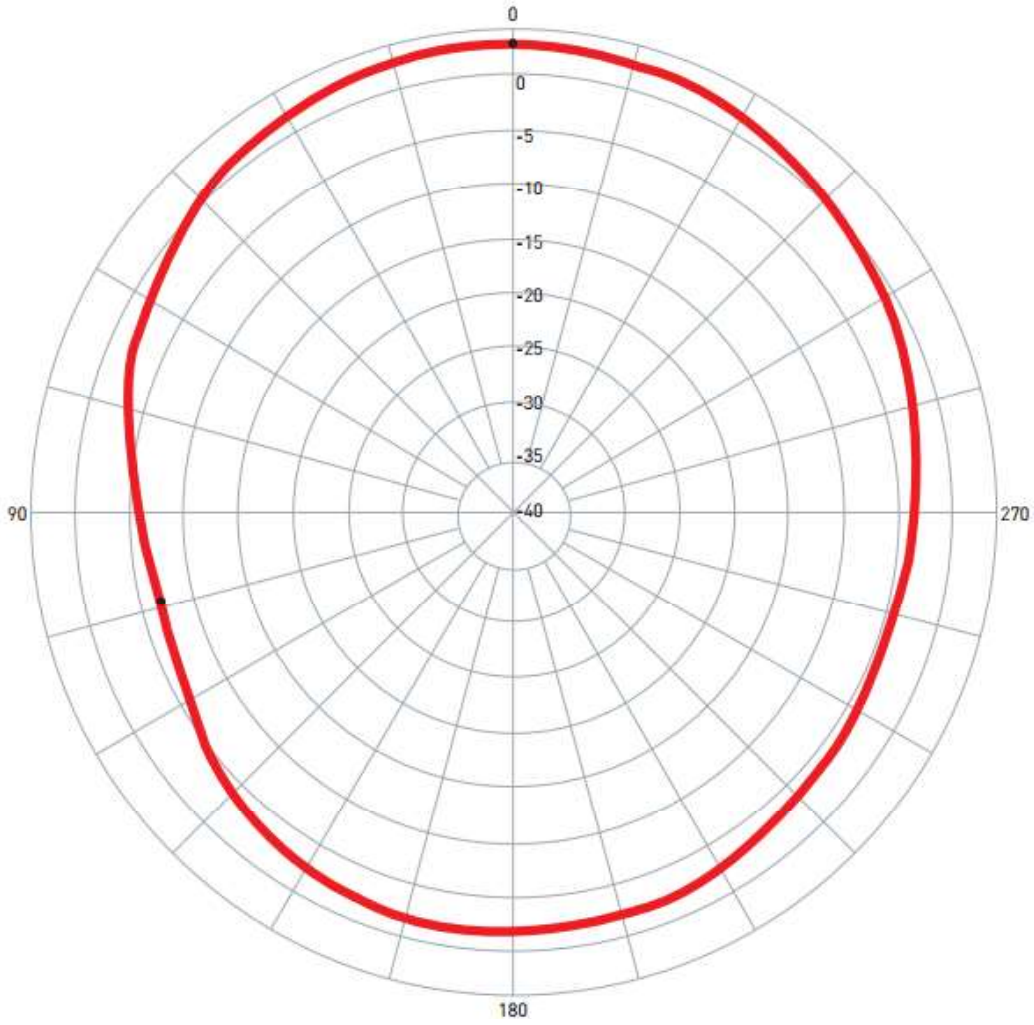


4. Performance testing and results



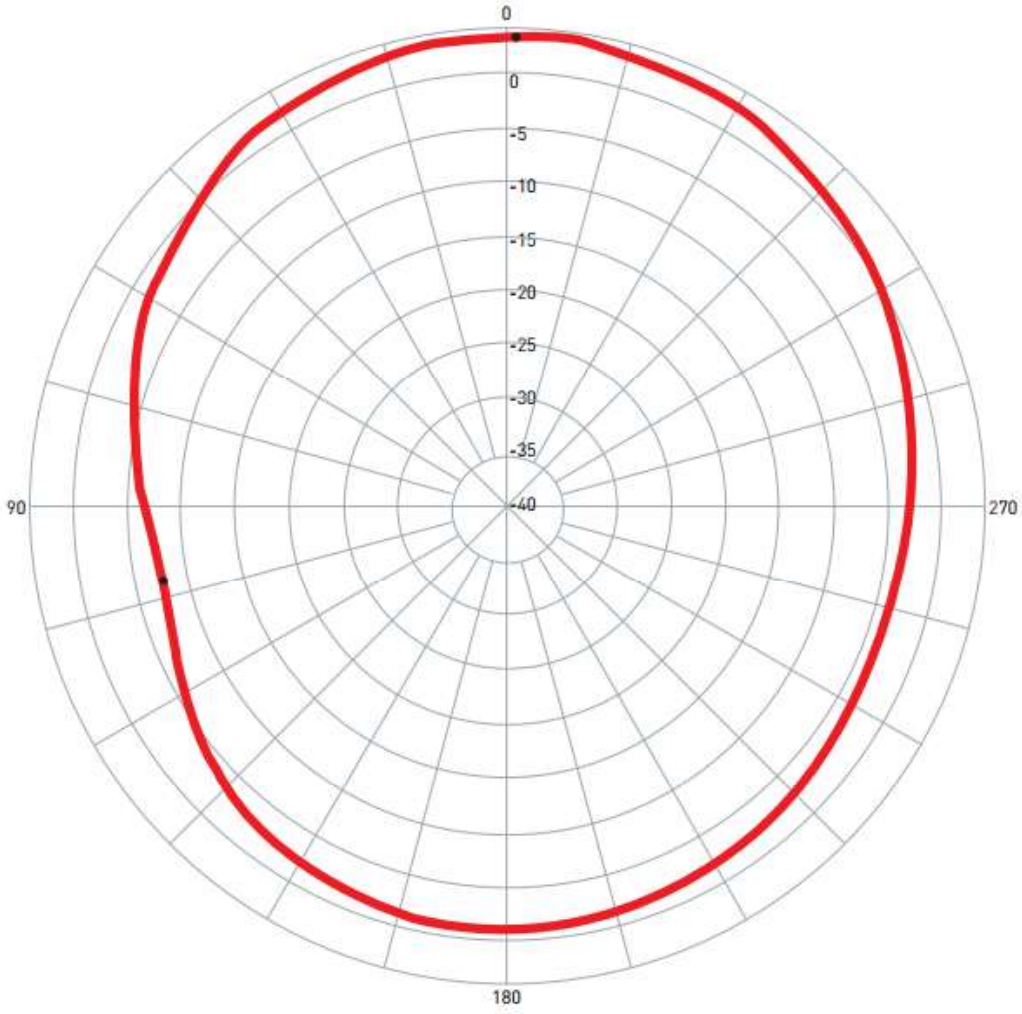
4.1 Antenna Gain Chart

4.1.1 XZ Plane



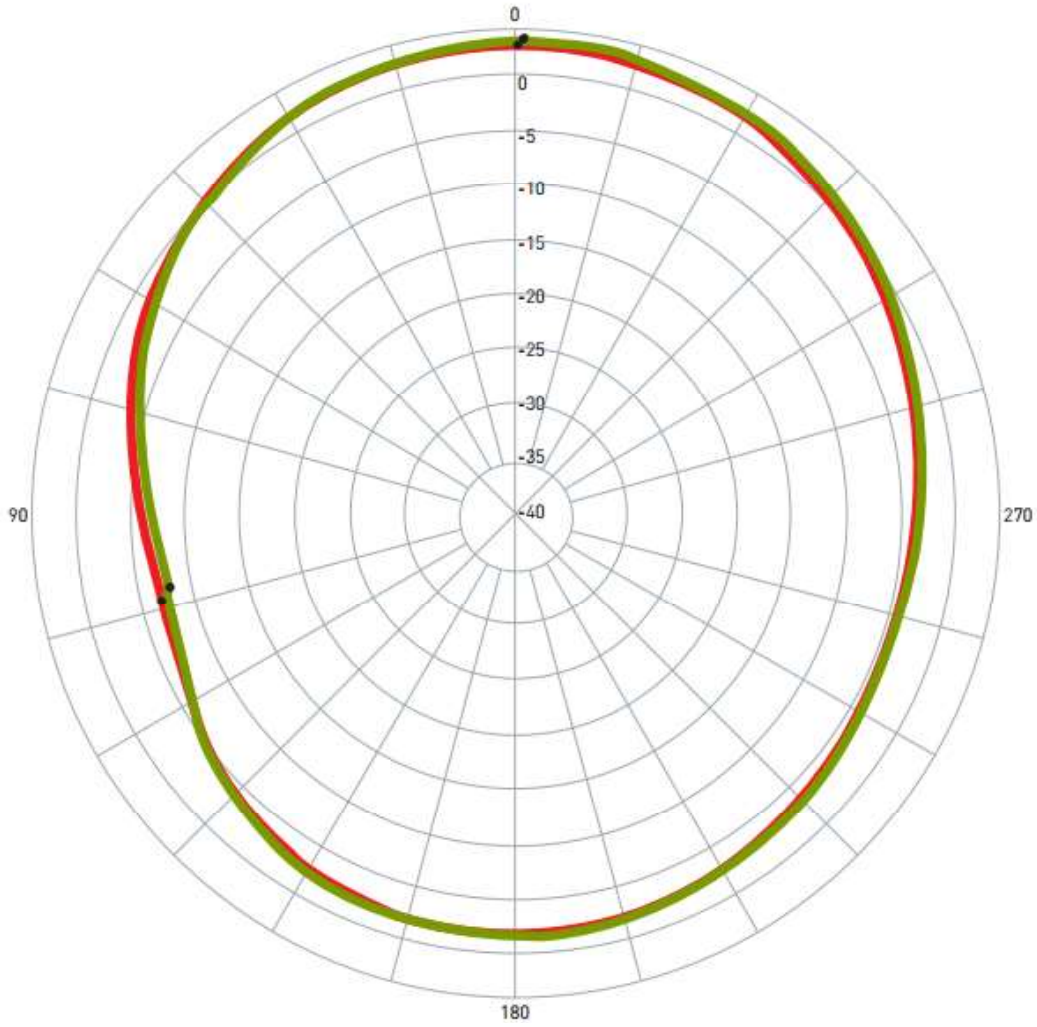
Pattern	Model No.	Test Mode	Freq (MHz)	Max Gain(dBi)	Min Gain(dBi)	Avg. Gain(dBi)	Source Polar.
1	IP.1621.25.4.A.02	XZ	1621.00	2.72 / 0.00	-6.84 / 104.00	-1.05	V+H

4.1.2 YZ Plane



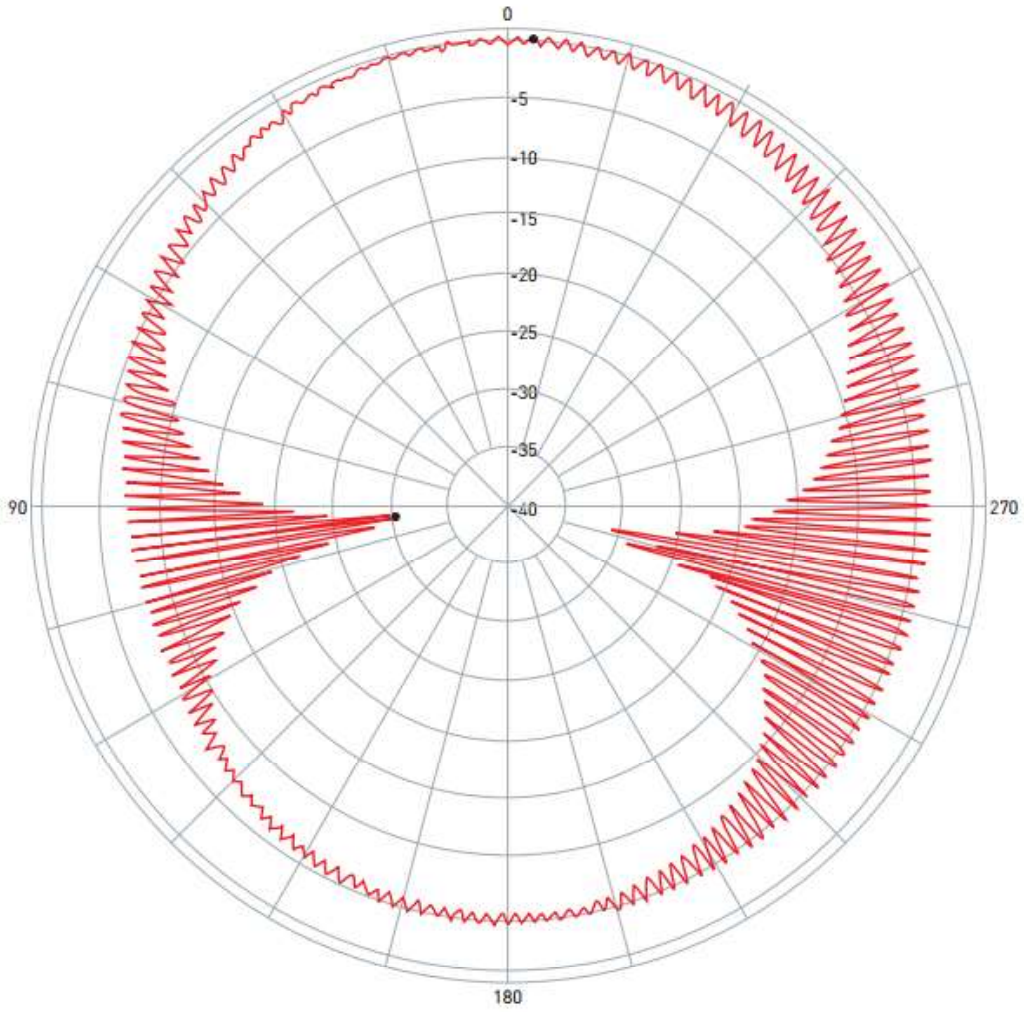
Pattern	Model No.	Test Mode	Freq (MHz)	Max Gain(dBi)	Min Gain(dBi)	Avg. Gain(dBi)	Source Polar.
1	IP.1621.25.4.A.02	YZ	1621.00	3.00 / 358.99	-7.57 / 101.85	-0.86	V+H

4.1.3 XZ +YZ Plane



Pattern	Model No.	Test Mode	Freq (MHz)	Max Gain(dBi)	Min Gain(dBi)	Avg. Gain(dBi)	Source Polar.
1	IP.1621.25.4.A.02	XZ	1621.00	2.72 / 1.00	-6.84 / 104	-1.05	V+H
2	IP.1621.25.4.A.02	YZ	1621.00	3.00 / 358.99	-7.57 / 101.85	-0.86	V+H

4.2 Axial Ratio



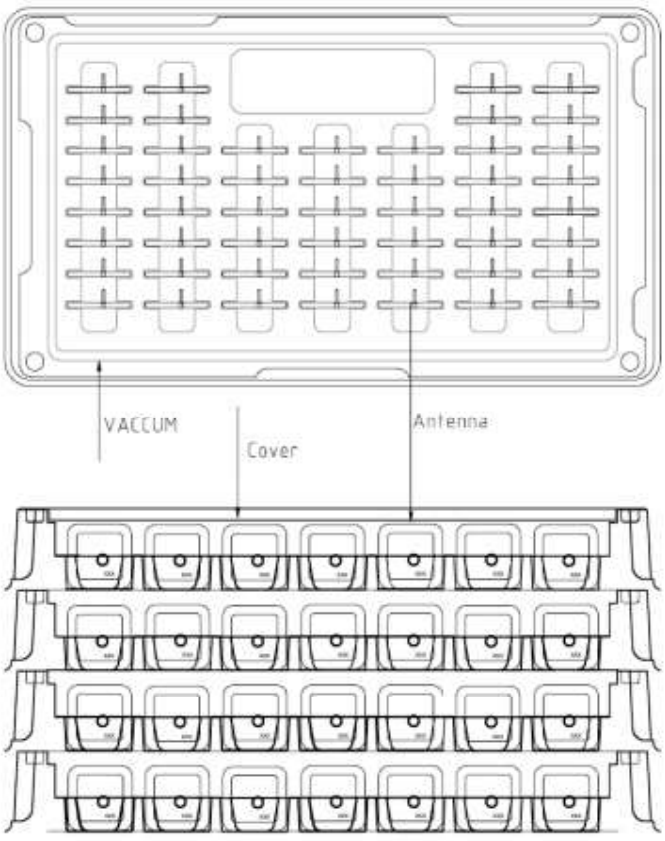
Pattern	Model No.	Test Mode	Freq (MHz)	Max Gain(dBi)	Min Gain(dBi)	Avg. Gain(dBi)	Source Polar.
1	IP.1621.25.4.A.02	Axial Ratio	1621.00	0.13 / 356.87	-30.61 / 95.76	-4.00	CP

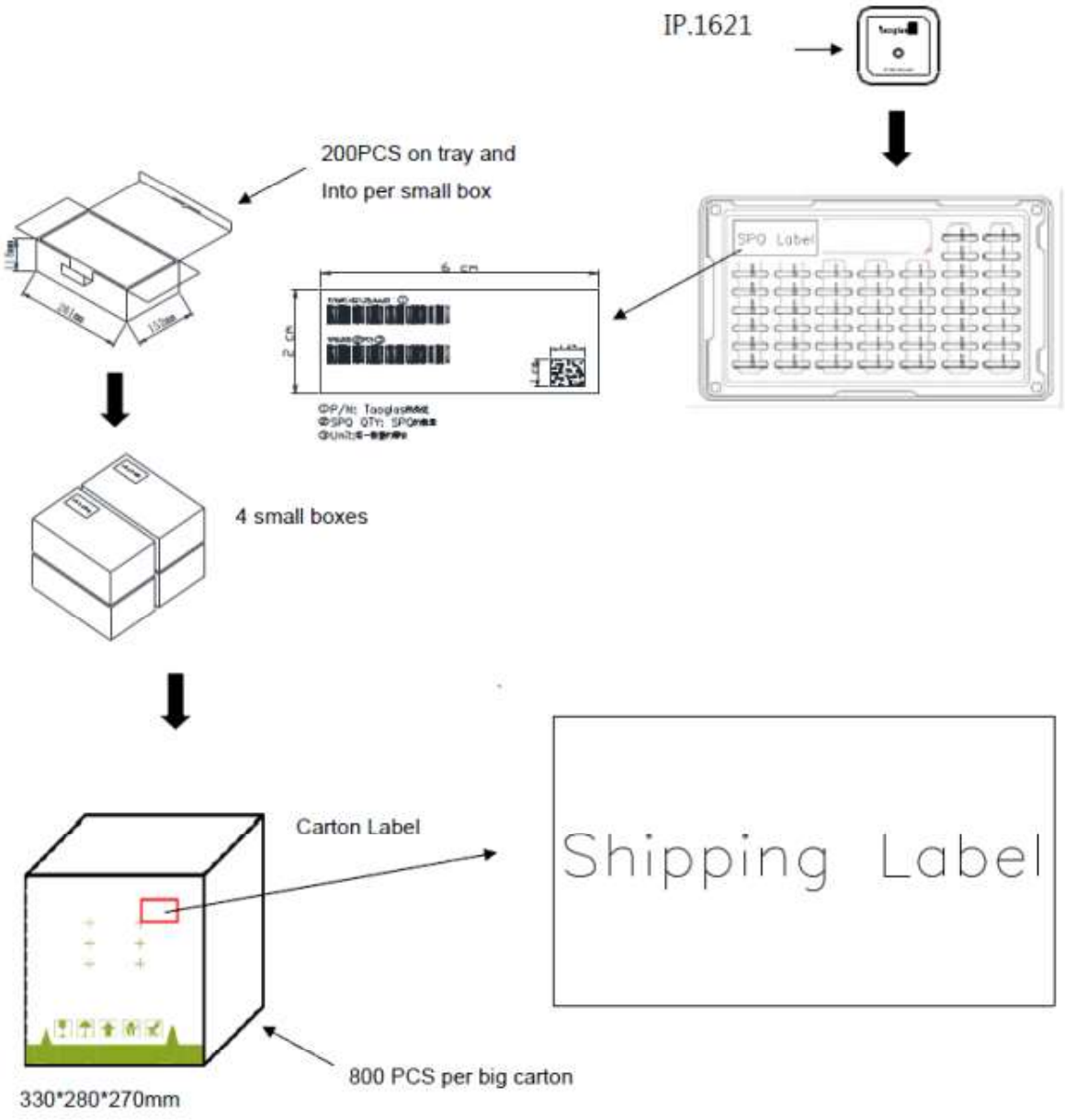
5. Packaging

Per Tray: 50 pieces

Per Carton (Inside Box) - 4 Trays = 200 pieces

Outer Carton (Outside Box) - 4 Cartons = 800 pieces





Bluetooth / WLAN / WiFi Ceramic Chip Antenna

Ground cleared under antenna, clearance area 4.00 x 4.25/6.25 mm. Pulse Part Number W3008, W3008C

Features

- Omni directional radiation
- Low profile
- Compact size W x L x H (3.2 x 1.6 x 1.1 mm)
- Low weight (33 mg)
- Fully SMD compatible
- Lead free soldering compatible
- Tape and reel packing
- RoHS Compliant Product

Applications

- Bluetooth, WLAN, WiFi
- IEEE 802.11b/g
- ZigBee IEEE 802.15.4
- 2.4 GHz WLAN
- 2.4 GHz ISM Band Systems

Electrical specifications @ +25 °C

Note: Electrical characteristics depend on test board (GP) size and antenna positioning on GP and Ground Clearance area size.

Bluetooth, W3008

Typical performance (test board size 80x37 mm, PWB ground clearance area 4.00 x 4.25 mm)

Frequency Range [MHz]	Linear Max Gain [dBi]	Efficiency [%] / [dB]	Return loss min. [dB]	Impedance [Ω]	Operating Temperature [°C]
2400–2483.5	1.7 (Peak) 0.7 (Band edges)	70 / -1.6 (Peak) 55 / -2.6 (Band edges)	-8	50	-40 to +85

Bluetooth / WLAN / WiFi, W3008C

Typical performance (test board size 80x37 mm, PWB ground clearance area 4.00 x 6.25 mm)

Frequency Range [MHz]	Linear Max Gain [dBi]	Efficiency [%] / [dB]	Return loss min. [dB]	Impedance [Ω]	Operating Temperature [°C]
2400–2483.5	2.2 (Peak) 1.9 (Band edges)	75 / -1.3 (Peak) 70 / -1.6 (Band edges)	-11	50	-40 to +85

Pulse Finland Oy
Takatie 6
90440 Kempele, Finland
Tel: +358 207 935 500
Fax: +358 207 935 501
www.pulseeng.com/antennas

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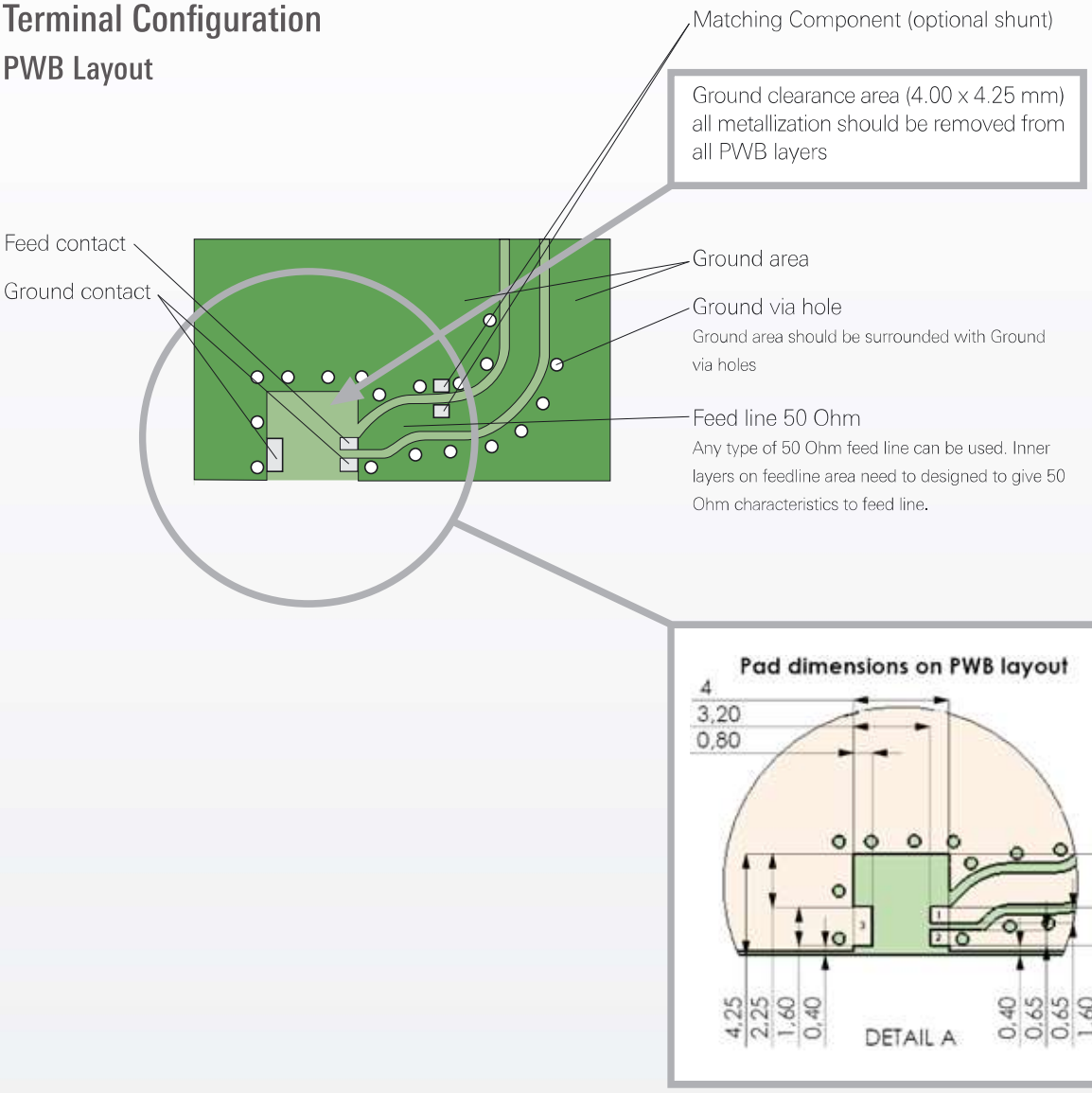
Bluetooth / WLAN / WiFi Ceramic Chip Antenna

Terminal Configuration

PWB Layout



PWB features

No.	Terminal name	Terminal Dimensions
1	Feed	0.8 x 0.65 mm
2	GND	0.8 x 0.65 mm
3	GND	0.8 x 1.60 mm

Pulse Finland Oy
Takatie 6
90440 Kempele, Finland
Tel: +358 207 935 500
Fax: +358 207 935 501
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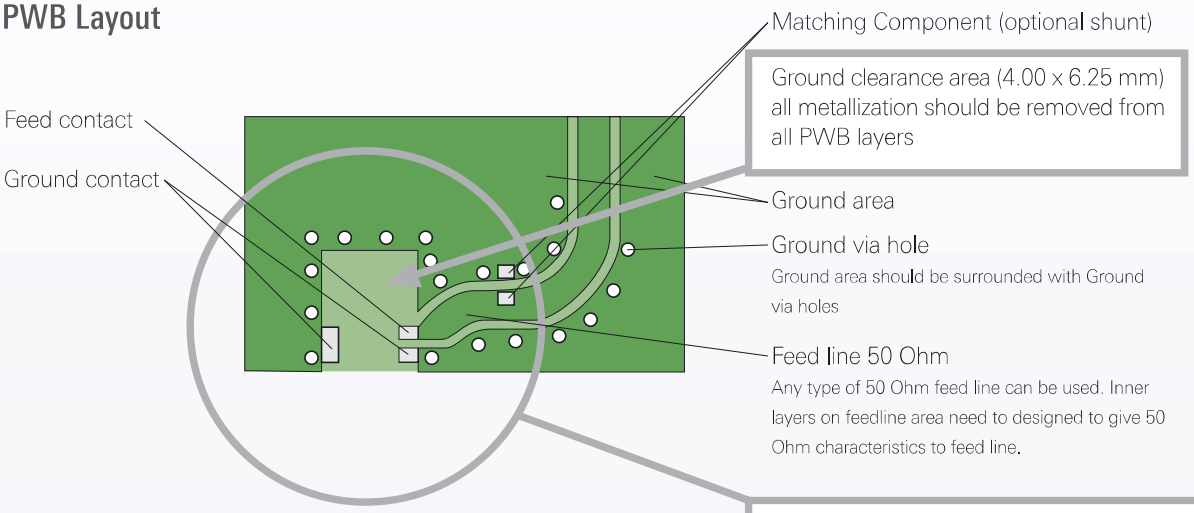
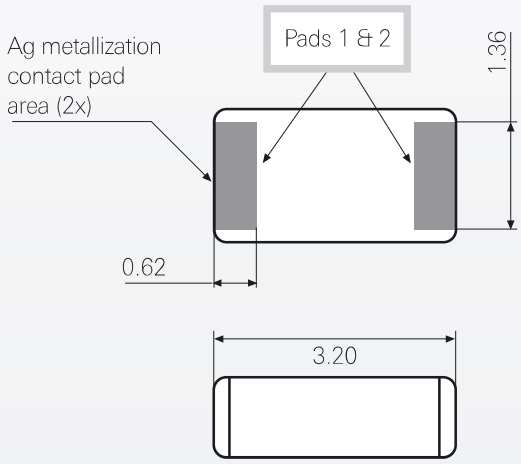
Bluetooth / WLAN / WiFi Ceramic Chip Antenna

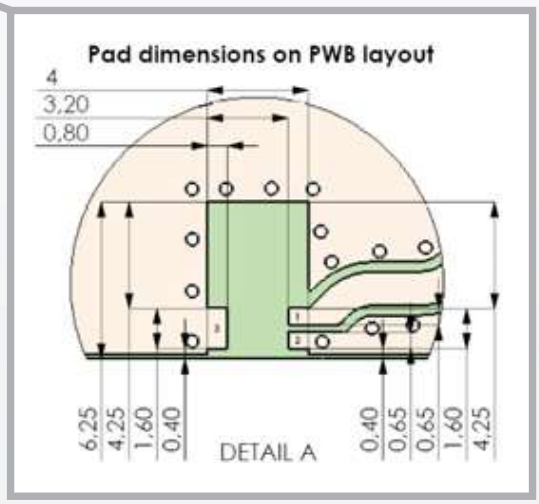
Terminal Configuration

PWB Layout



Antenna





Antenna features

No.	Terminal name	Terminal Dimensions
1	Feed / GND	0.62 x 1.36 mm
2	Feed / GND	0.62 x 1.36 mm

Antenna is symmetrical.
Either of terminals 1 or 2 can be feed / GND

PWB features

No.	Terminal name	Terminal Dimensions
1	Feed	0.8 x 0.65 mm
2	GND	0.8 x 0.65 mm
3	GND	0.8 x 1.60 mm

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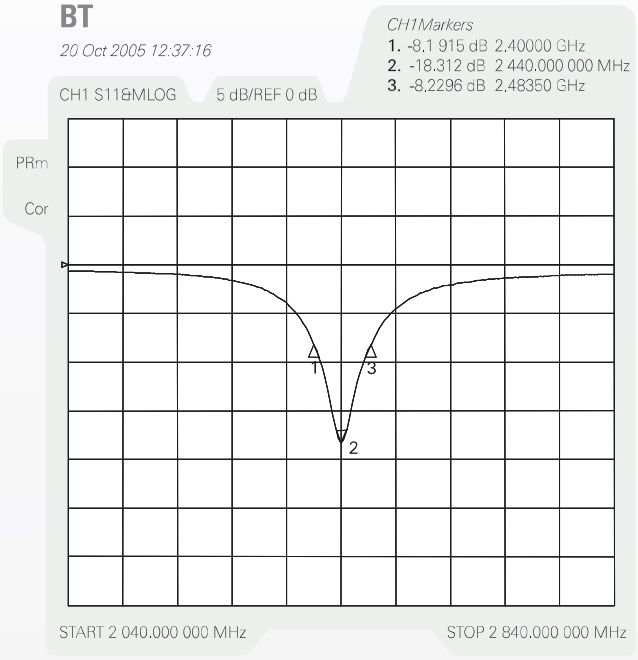
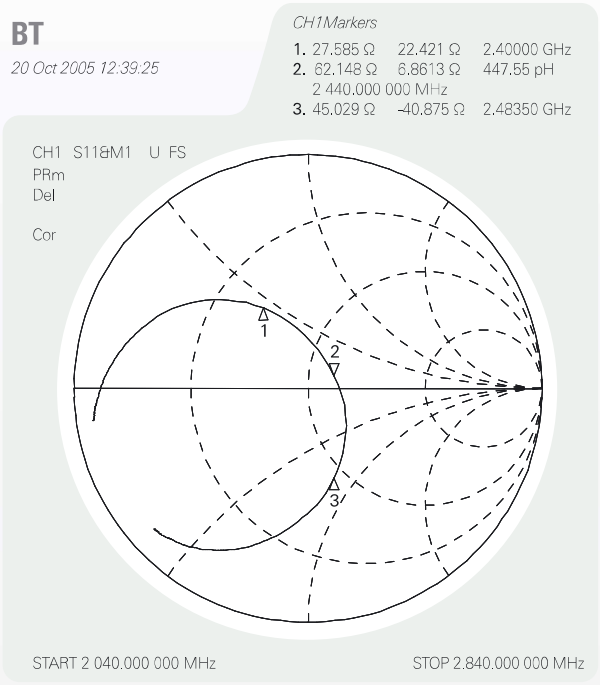
Bluetooth / WLAN / WiFi Ceramic Chip Antenna

Typical Electrical Characteristics (T=25 °C), W3008

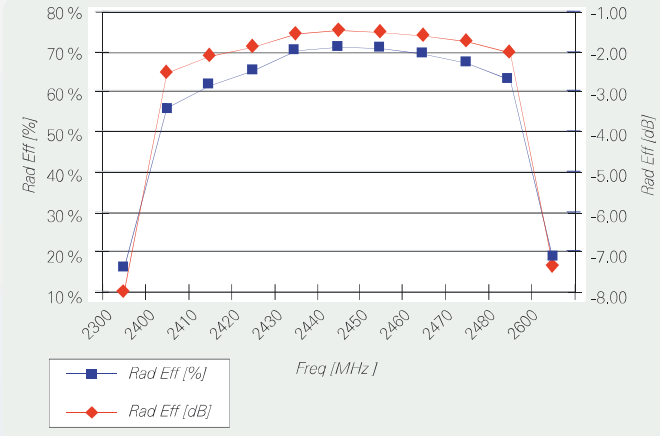
Typical Return Loss S11/ impedance, measured on the test board



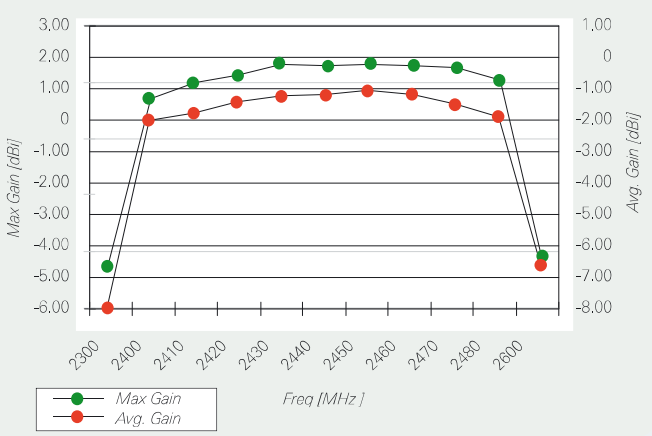


Free space efficiency and maximum gain / PWB ground clearance area 4.00 x 4.25 mm

BT GC 3.2 x 1.6 x 1.1 mm



BT GC 3.2 x 1.6 x 1.1 mm



Pulse Finland Oy
Takatie 6
90440 Kempele, Finland
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Fax: +358 207 935 501
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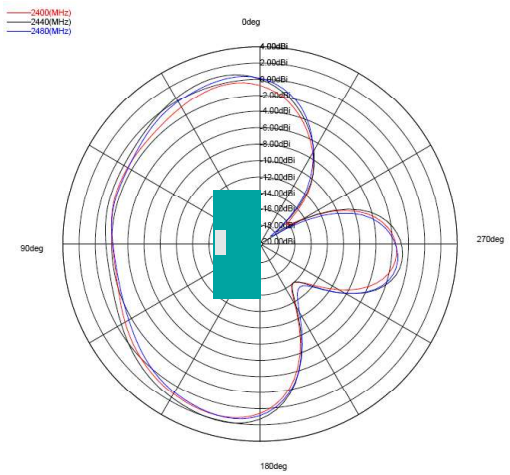
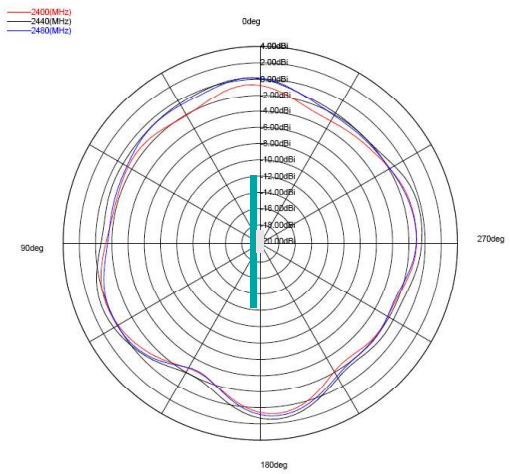
Bluetooth / WLAN / WiFi Ceramic Chip Antenna

Typical Free Space Radiation Patterns, W3008

XZ-PLANE



ZY-PLANE



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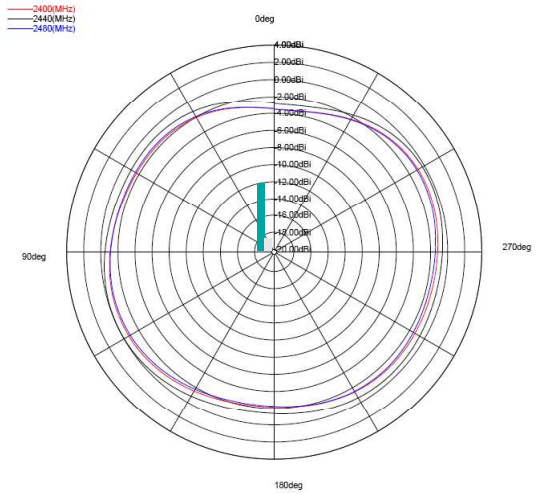

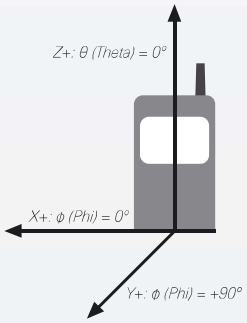

Pulse Finland Oy
Takatie 6
90440 Kempele, Finland
Tel: +358 207 935 500
Fax: +358 207 935 501
www.pulseeng.com/antennas

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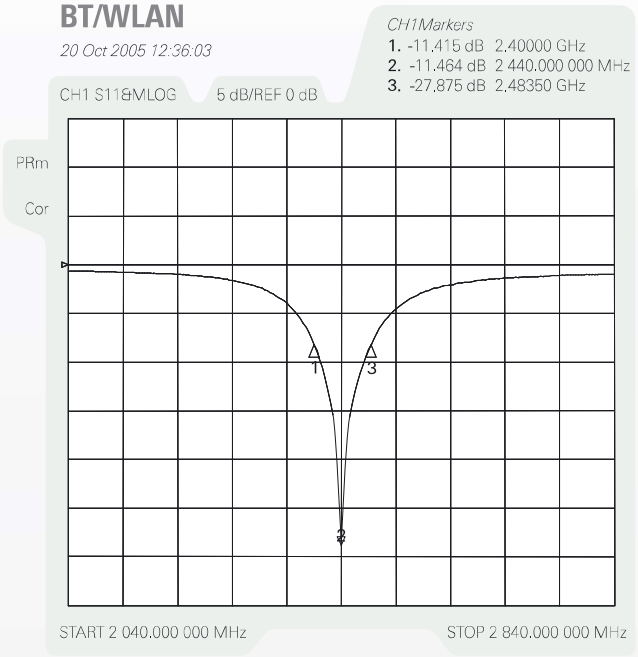
Bluetooth / WLAN / WiFi Ceramic Chip Antenna

Typical Electrical Characteristics (T=25 °C), W3008C

Typical Return Loss S11/ impedance, measured on the test board

BT/WLAN

20 Oct 2005 12:36:03



BT/WLAN

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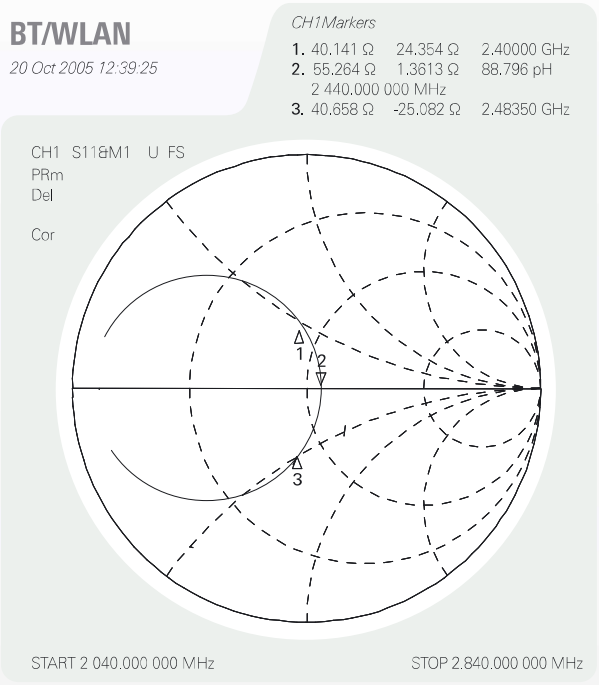
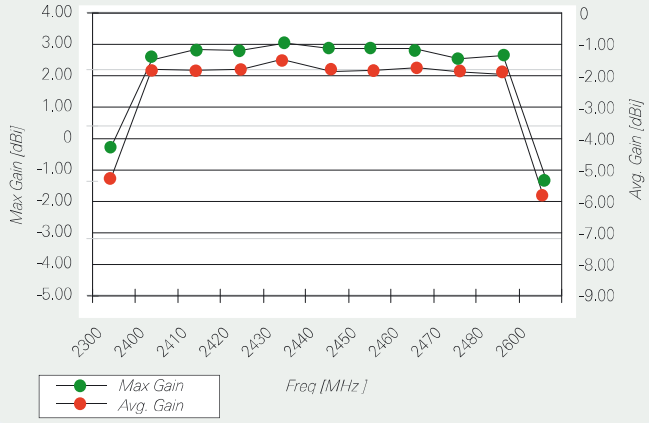


Free space efficiency and maximum gain / PWB ground clearance area 4.00 x 6.25 mm

BT GC 3.2 x 1.6 x 1.1 mm

BT GC 3.2 x 1.6 x 1.1 mm



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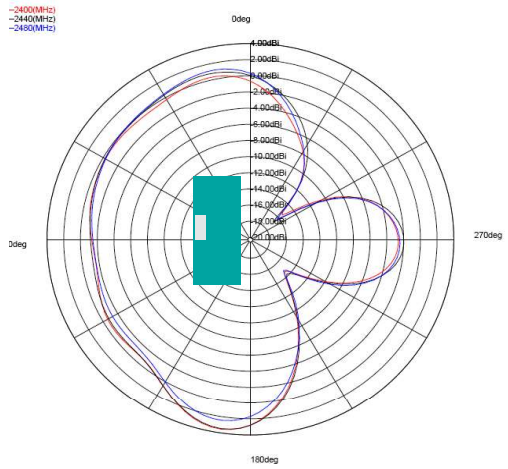
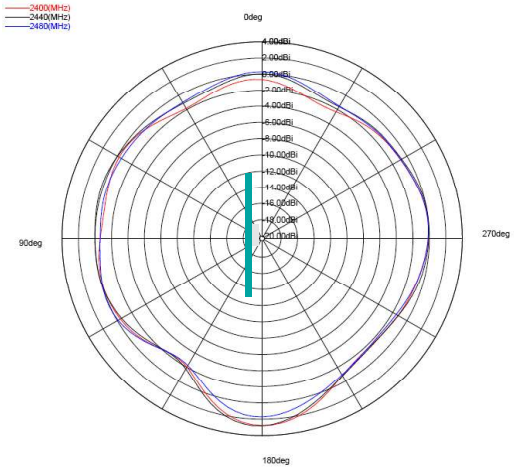
Typical Free Space Radiation Patterns , W3008C

XZ-PLANE



ZY-PLANE



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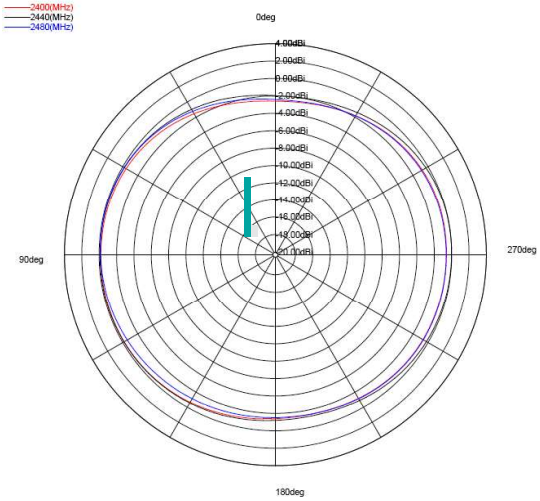

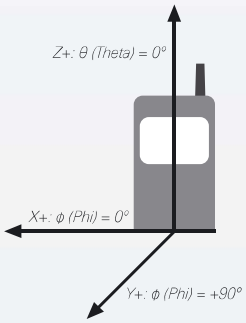

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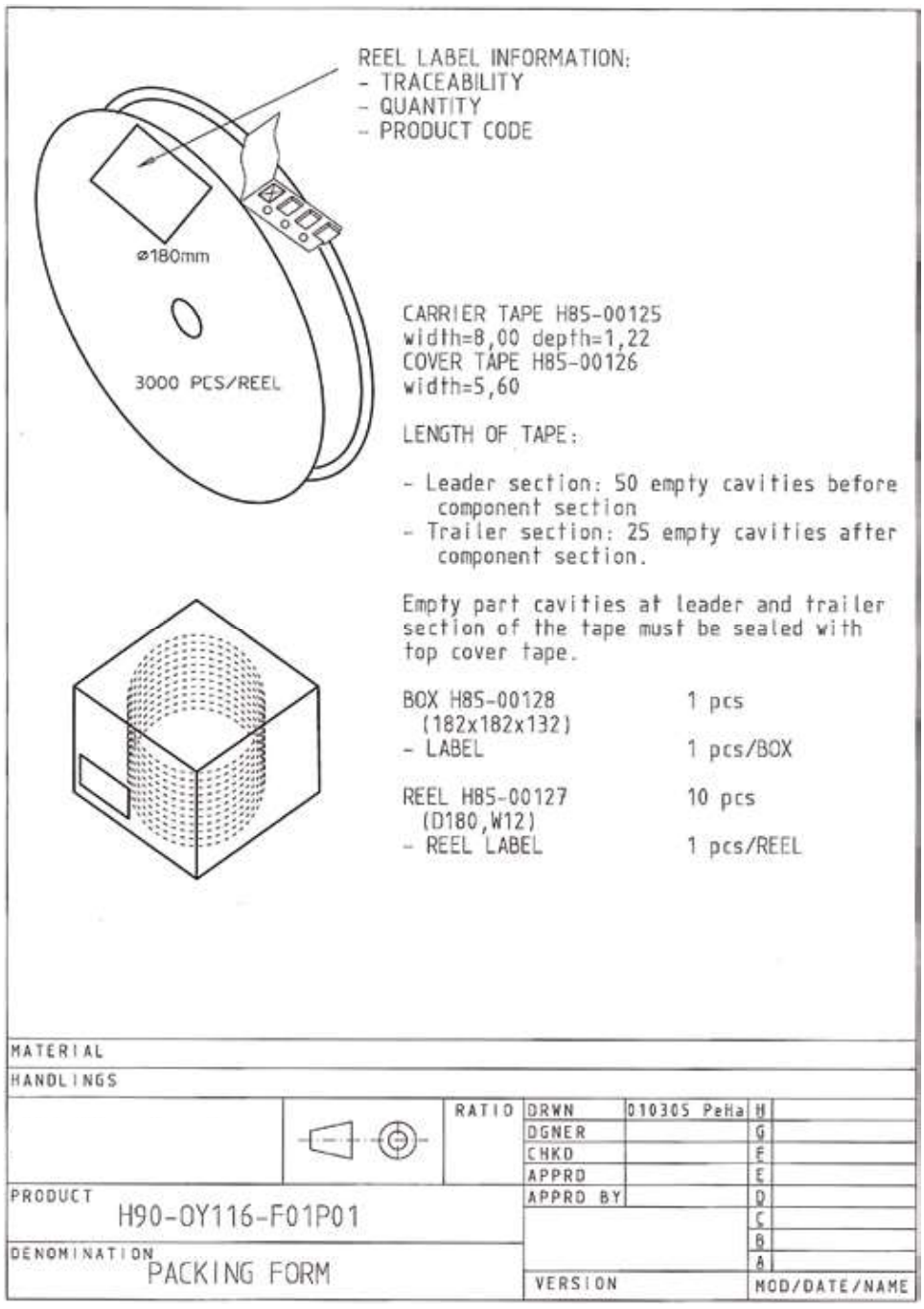
Packing Form



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