TAOGLAS

Datasheet

All-band High Precision GNSS Stacked Patch Antenna

Part No:
GPDF6010.A

Description

Passive All-band High Precision GNSS Stacked Dual Pin Dual Feed Patch Antenna

Features:

Bands Covered:
- GPS (L1/L2/L5)
- IRNSS (L5)
- QZSS (L1/L2C/L5/L6)
- Galileo (E1/E5a/E5b/E6)
- GLONASS (G1/G2/G3)
- BeiDou (B1/B2a/B2b/B3)

Dual pin, dual feed, 4-pin configuration
Dimensions: D60 x 10mm
RoHS & Reach Compliant
Patent Pending

1. Introduction

The Taoglas **GPDF6010.A** is an innovative high performance, multi-band passive high precision GNSS antenna that has been carefully designed to provide fantastic positional accuracy on the full GNSS spectrum. It covers GPS/QZSS L1/L2/L5/L6, GLONASS G1/G2/G3, Galileo E1/E5a/E5b, BeiDou B1/B2a/B2b/B3, NAVIC L5, as well as SBAS (WAAS/EGNOS/GAGAN/SDCM/SNAS) and L-band corrections.

Correct implementation of the GPDF6010.A allows the user to achieve higher location accuracy, as well as stability of position tracking in urban environments. The novel Terrablast circular stacked patch construction has excellent performance across the full bandwidth of the antenna while reducing weight by nearly 40% compared to other antenna options. Its unique design provides excellent polarization and phase performance, providing exceptional positional and timing accuracy.

Typical applications that benefit from high precision capabilities include:

- Autonomous Driving
- Unmanned Aerial Vehicles
- Precision Positioning for Robotics
- Precision Agriculture
- Timing Accuracy Synchronization

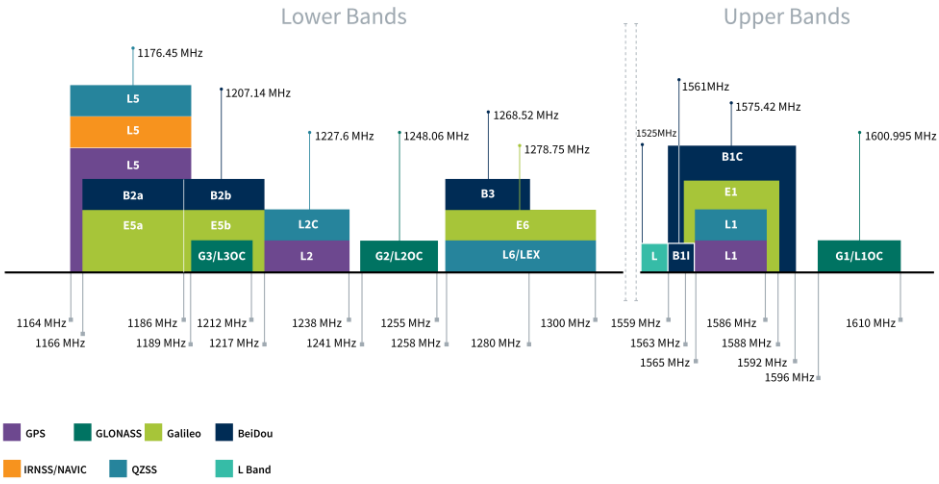
The GPDF6010.A is the latest embedded addition to Taoglas' product portfolio of high precision GNSS antennas. When used on the base and/or the rover as part of an RTK configuration, the GPDF6010.A can achieve genuine cm-level accuracy with proven results.

Full integration guidelines are contained in Section 6 of this datasheet including the Taoglas HC125.A hybrid coupler that will be required for use for dual pin feed patch integrations.

Contact your local Taoglas Customer Services team for more information on any of the products listed above or for support regarding integration.

2. Specification

GNSS Frequency Bands					
GPS	L1 1575.42 MHz	L2 1227.6 MHz	L5 1176.45 MHz		
	■	■	■		
GLONASS	G1 1602 MHz	G2 1248 MHz	G3 1207 MHz		
	■	■	■		
Galileo	E1 1575.24 MHz	E5a 1176.45 MHz	E5b 1201.5 MHz	E6 1278.75 MHz	
	■	■	■	■	
BeiDou	B1C 1575.42 MHz	B1I 1561 MHz	B2a 1176.45 MHz	B2b 1207.14 MHz	B3 1268.52 MHz
	■	■	■	■	■
L-Band	L-Band 1542 MHz				
	■				
QZSS (Regional)	L1 1575.42 MHz	L2C 1227.6 MHz	L5 1176.45 MHz	L6 1278.75e6	
	■	■	■	■	
IRNSS (Regional)	L5 1176.45 MHz				
	□				
SBAS	L1/E1/B1 1575.42 MHz	L5/B2a/E5a 1176.45 MHz	G1 1602 MHz	G2 1248 MHz	G3 1207 MHz
	■	■	■	■	■



GNSS Bands and Constellations

GNSS Electrical							
Frequency (MHz)	**1176.45**	**1227.6**	**1278**	**1525**	**1561**	**1575.42**	**1602**
VSWR (max.)	1.5:1	1.5:1	1.5:1	1.5:1	1.5:1	1.5:1	1.5:1
Passive Antenna Efficiency (%)	20	40	20	38	53	50	38
Passive Antenna Gain at Zenith (dBic)	-1.5	1.8	-1.5	2.6	4.2	4.0	2.7
Axial Ratio (dB)	< 1.5	< 1	< 1	< 2	< 1.5	< 1	< 1
Group Delay (ns)	5.0	3.7	4.6	3.5	4.0	4.4	4.7
PCO (cm)	1.3	1.1	0.7	1.2	1.0	1.0	1.0
PCV (cm)	0.6	0.3	0.5	0.4	0.3	0.3	0.3
Polarization	RHCP						
Impedance	50 Ω						
Note: The antenna with Hybrid couplers and matching circuit was tested on a 100 mm-diameter ground plane The PCO and PCV are calculated using a field of view of 60° elevation from zenith							

Mechanical	
Height	10 mm
Planner Dimension	60 mm diameter
Weight	45 g

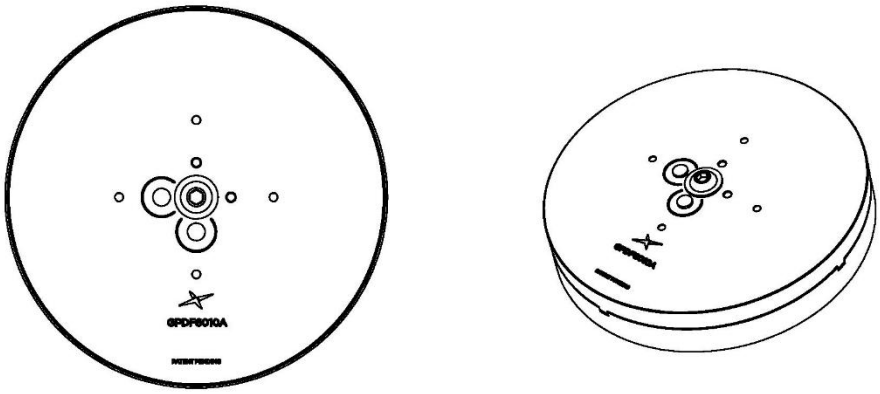
Environmental	
Operation Temperature	-40°C to 85°C
Storage Temperature	-40°C to 85°C
RoHS & Reach Compliant	Yes

3. Mechanical Drawing

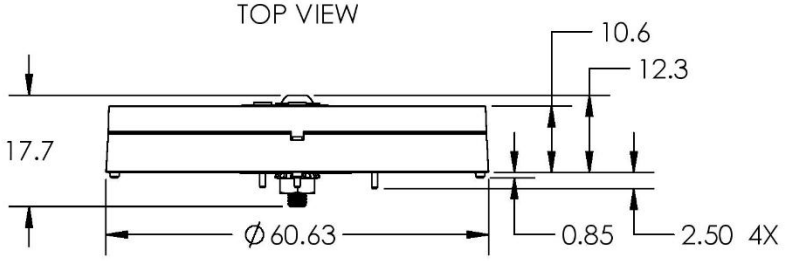
3.1 Antenna

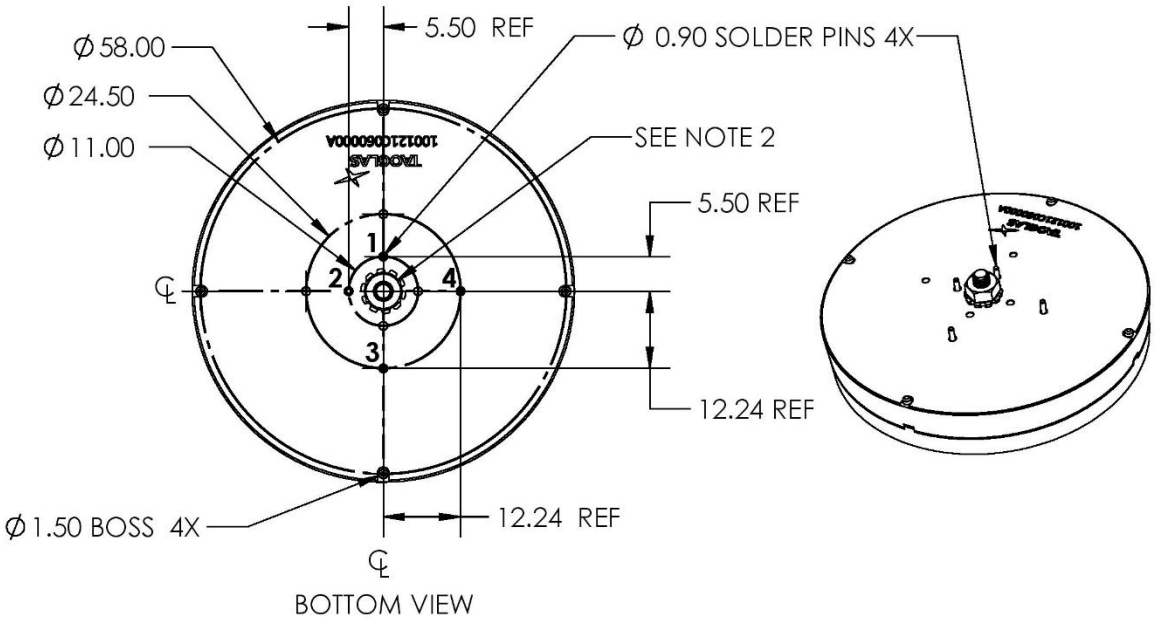
Antenna Installation Guide:

- Remove the hex nut from antenna before attaching to board (PCB).
- Reinstall the nut and torque to 4 in-lbs (45 N-cm) MAX. Before soldering the pins.



TOP VIEW

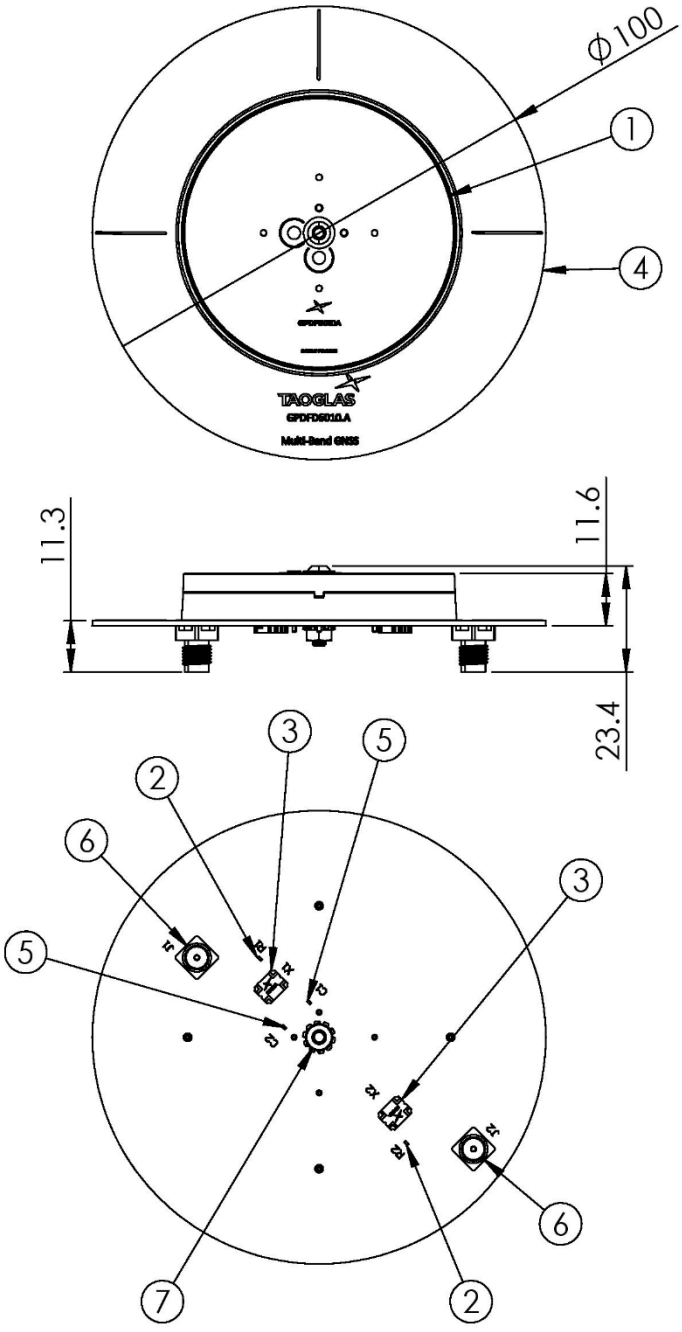


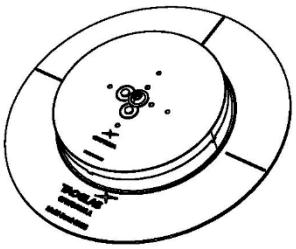


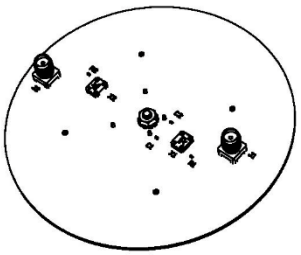
BOTTOM VIEW

3.2 Evaluation Board

Notes: Critical dimensions are indicated by an inspection symbol







	Name	Material	Designator	QTY
1	Multiband GNSS Dual Feed Stacked Patch Antenna	Plastic	ANT1	1
2	Resistor, 49.9 Ohms	NA	R1, R2	2
3	Hybrid Coupler, 3DB 90Deg, Taoglas HC125	NA	X1, X2	2
4	GPDF6010.A Multi-Band GNSS Evaluation PCB	FR4	NA	1
5	Ceramic Capacitor, 4.7pF, C0g, 0402, 50V	Ceramic	C1, C2	2
6	SMA Jack STR 50 Ohm PCB Surface Mount	Brass	J1, J2	2
7	Hex Nut, M3 x .5 w/Ext Tooth Lock Washer	Steel	NA	1

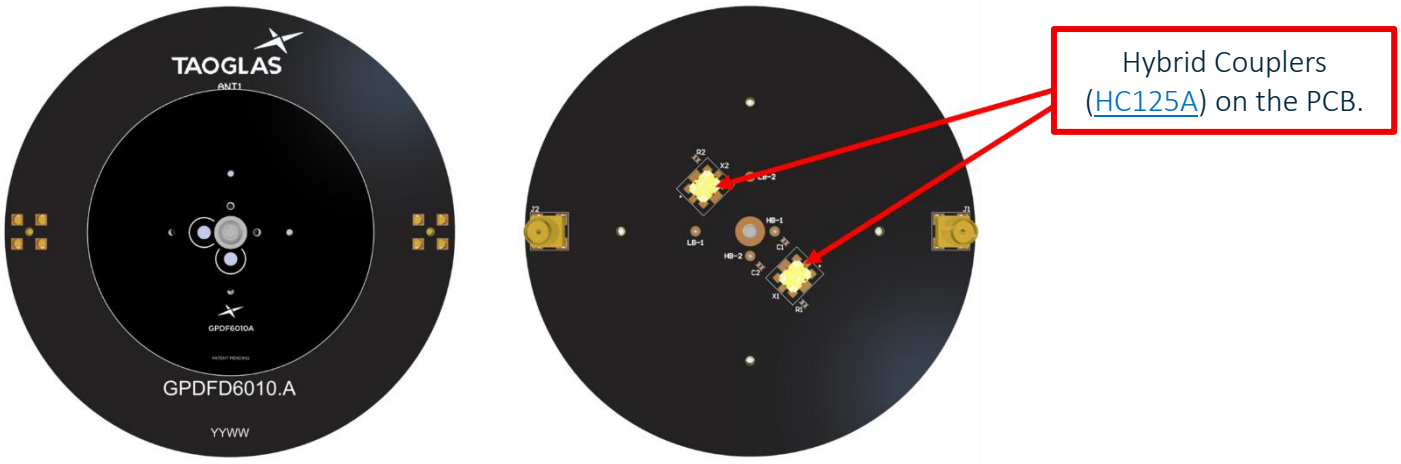
4. Antenna Integration Guide

The following is an example on how to integrate the GPDF6010.A into a design. This antenna has five pins, two pins are used for the L1 band, and two other pins are used for the L2/L5/L6 bands. Hybrid couplers (HC125A) are used to combine the feeds for the high and low bands, to create a Right Hand Circular Polarized (RHCP) signal at the output of the hybrid coupler. Taoglas recommends using a minimum of Ø100mm ground plane (PCB) to ensure optimal performance.

Top and bottom view of PCB.

Please find the Integration files in Altium, 2D formats and the 3D model for the GPDF6010.A here:
https://www.taoglas.com/product/gpdf6010-a-all-band-high-precision-gnss-stacked-patch-antenna/

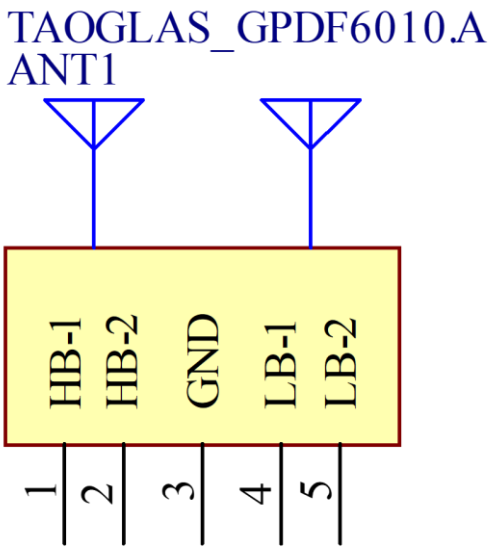
4.1 Schematic Symbol and Pin Definitions



Above are the 3D models of the GPDF6010.A and the HC125A on the PCB.

The circuit symbol for the GPDF6010.A is shown below. The antenna has 5 pins as indicated below.

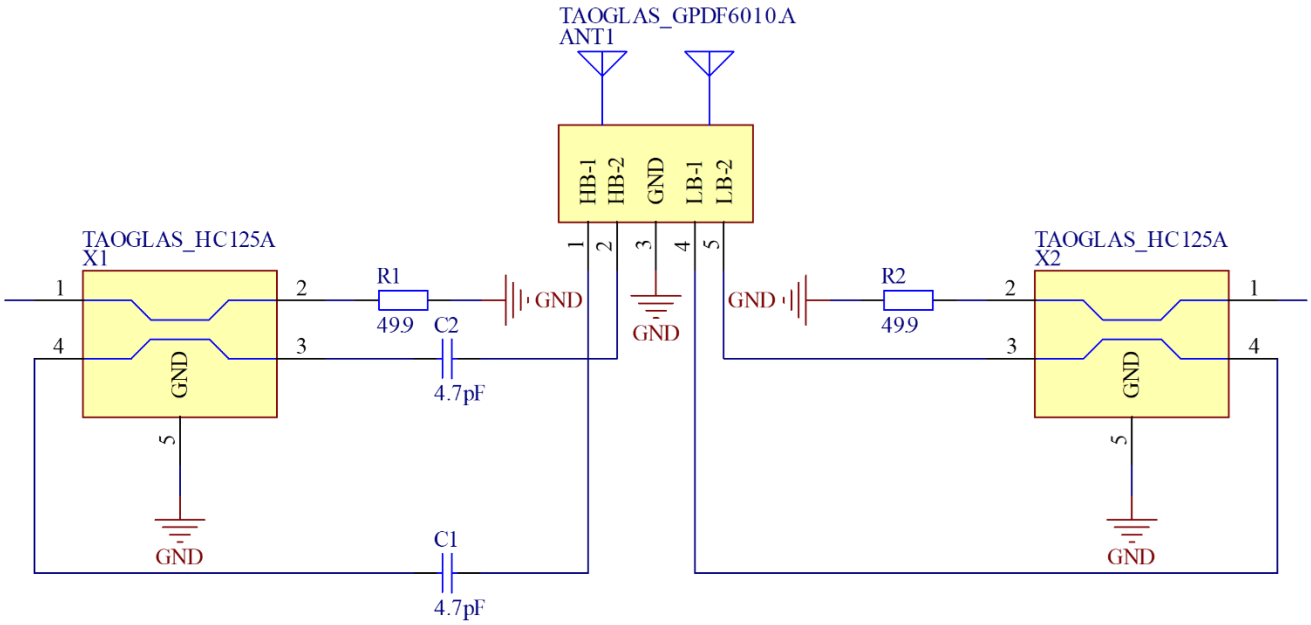
Pin	Description
1	L1 (0˚)
2	L1 (-90˚)
3	Ground
4	L2/L5/L6 (0˚)
5	L2/L5/L6 (-90˚)



4.2 Schematic Layout

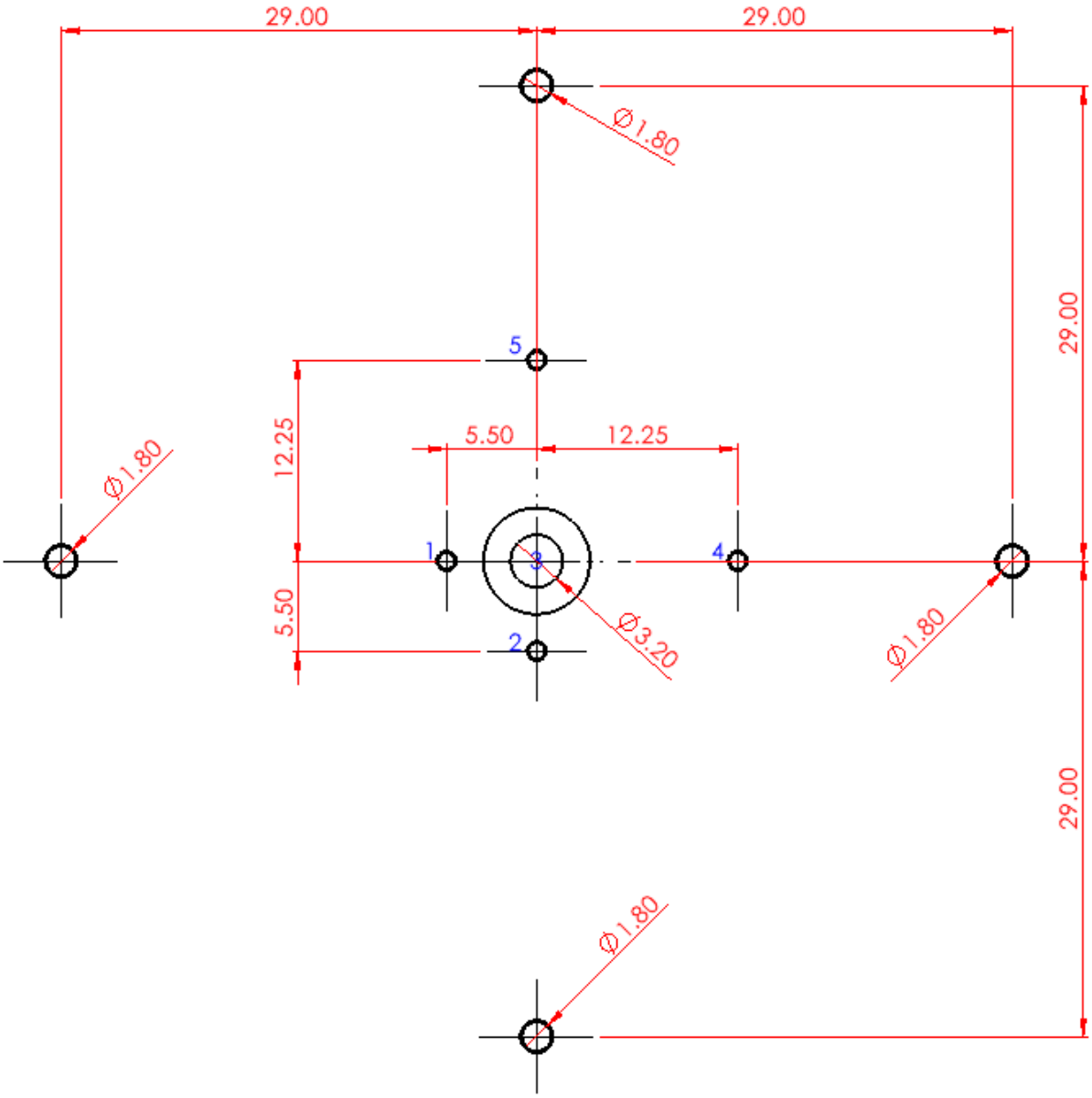
The GPDF6010.A uses two orthogonal feeds that need to be combined in a hybrid coupler to ensure optimal axial ratio and RHCP Gain is achieved. Taoglas recommends our HC125A, a high-performance hybrid coupler specifically engineered for use with our multi feed patches.

The HC125A is required for the high GNSS band of operation (1559- 1610MHz) and the low GNSS band of operation (1164- 1300MHz) for this antenna . These hybrid couplers should be placed close to the antenna pins and terminated correctly using a 49.9 Ohm resistor.

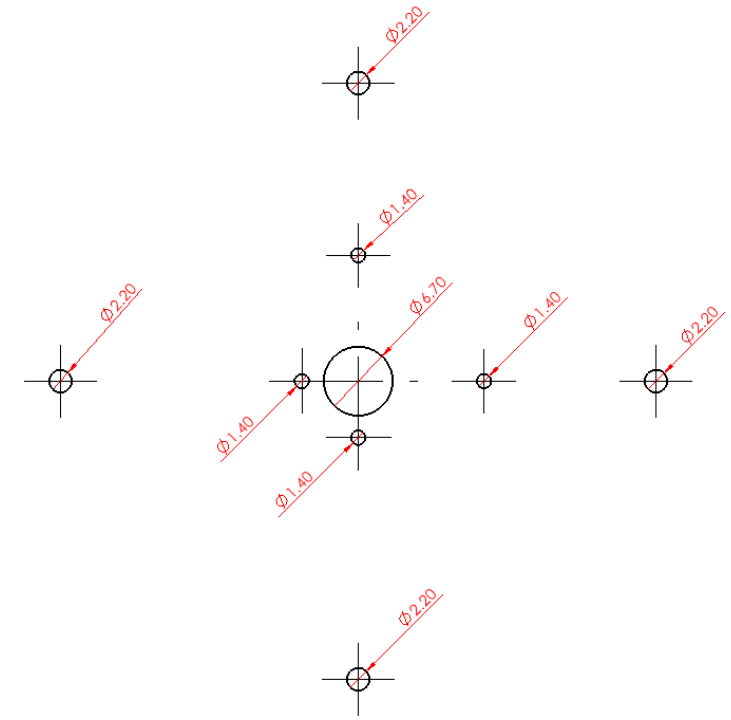


Designator	Type	Value	Manufacturer	Manufacturer Part Number
R1, R2	Resistor	49.9 Ohms	Panasonic	ERJ-2RKF49R9X

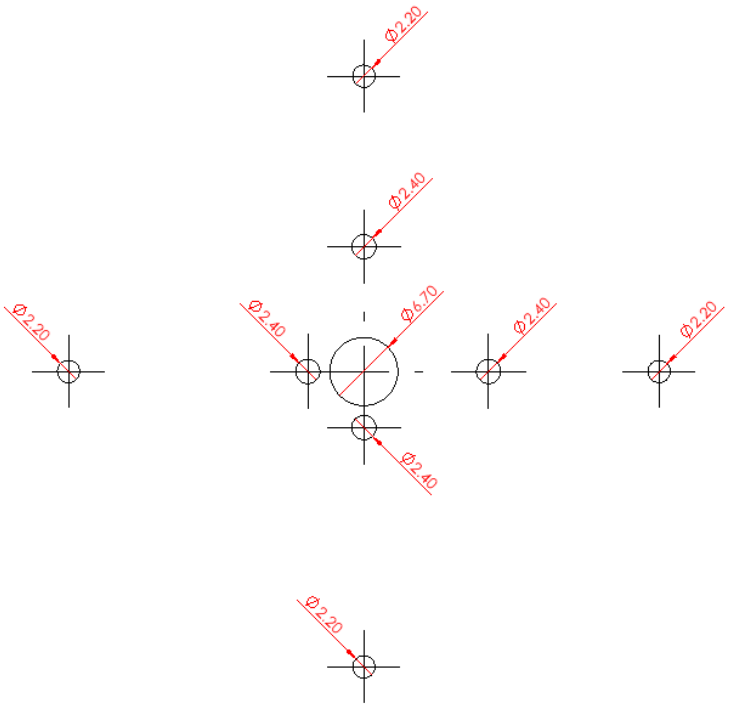
4.3 Antenna Footprint



4.4 Top and Bottom Solder



Top

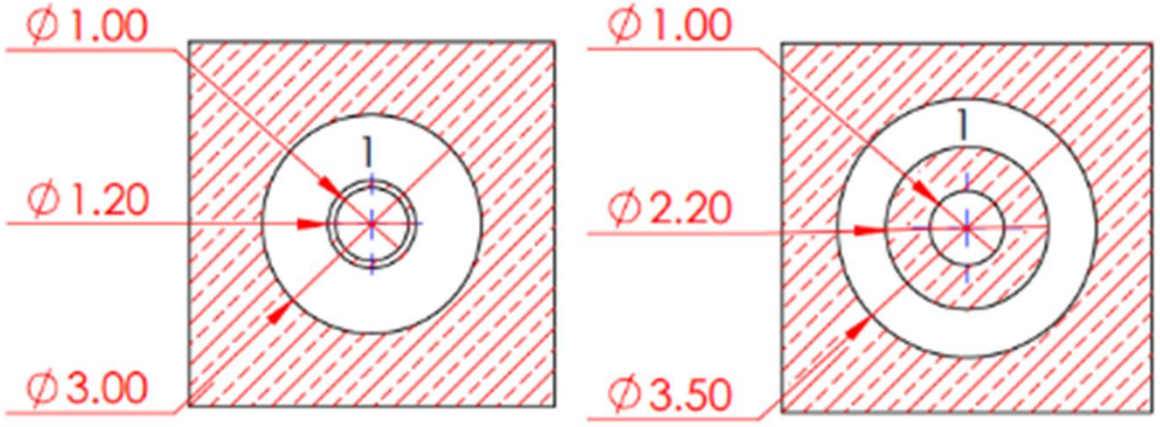


Bottom

4.5 Copper Clearance for GPDF6010.A

The footprint and clearance on the PCB must comply with the antenna's specification. The PCB layout shown in the diagram below demonstrates the GPDF6010.A clearance area for all RF feed pads. The bottom copper keep out area only applies to the bottom layer and the top copper keep out area applies to all other layers.

There should be a Ø3mm copper clearance around the antenna pins on the top side of the PCB with a Ø3.5mm copper clearance around the antenna pins on the bottom side.

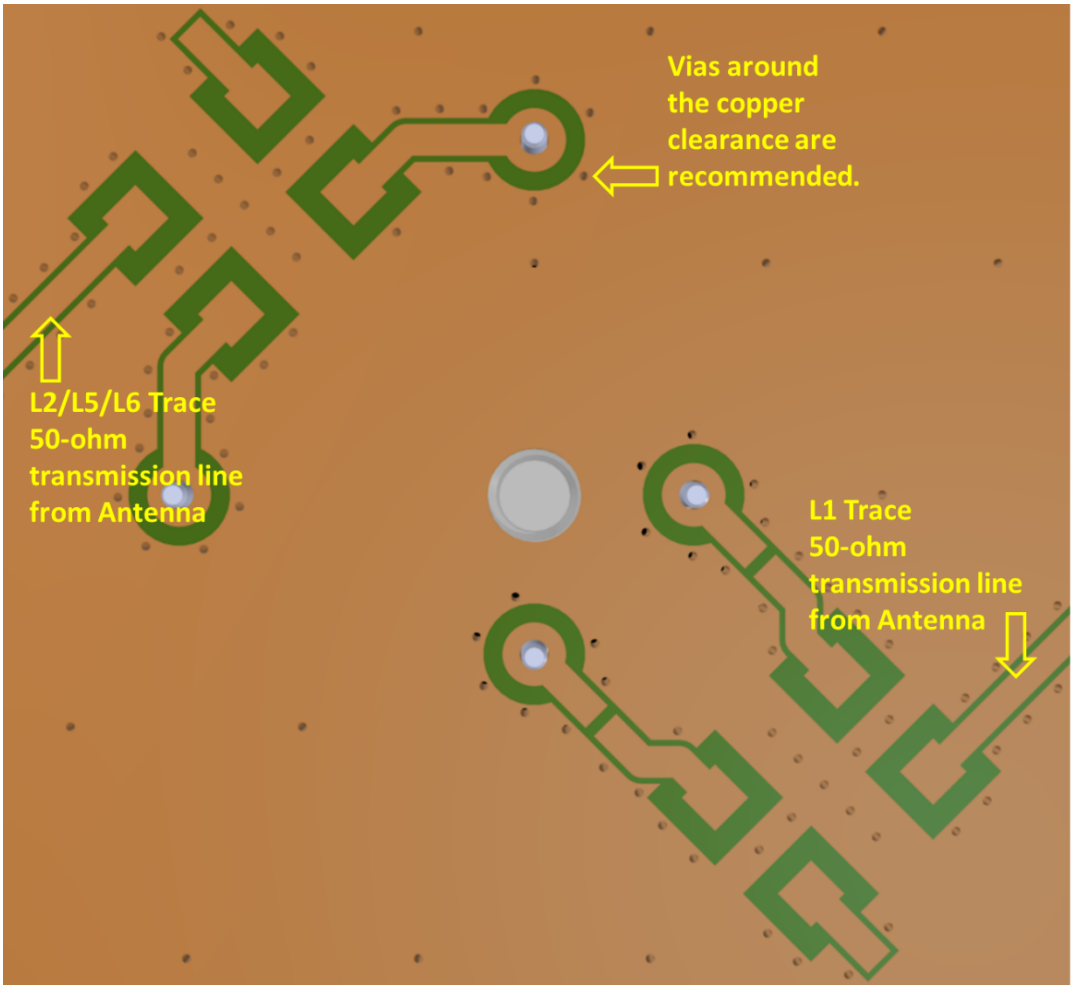


Top

Bottom

4.6 Antenna Integration

The GPDF6010.A should be placed in the centre of the PCB to take advantage of the ground plane. The RF traces must maintain a 50 Ohm transmission line. Ground vias should be placed around the copper clearance area.

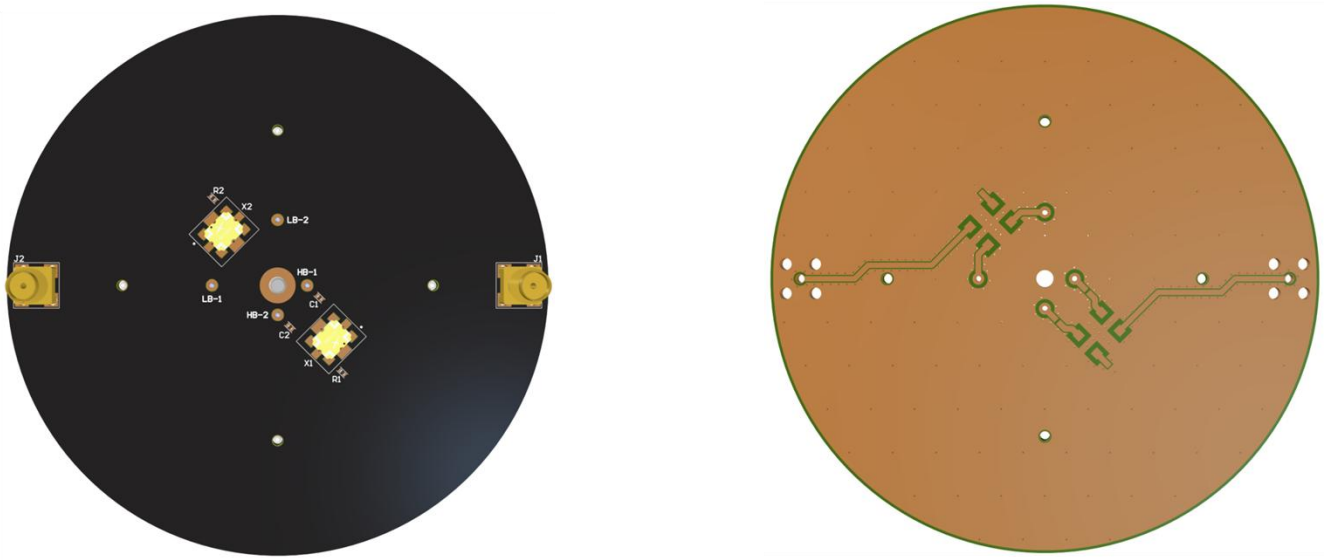


Bottom view of the PCB, showing transmission lines and integration notes.

4.7 Final Integration

The bottom side image shown below highlights the antenna connections to the hybrid couplers (HC125A). It shows the 49.9 Ohm terminating resistors necessary for the hybrid couplers (HC125A). Taoglas recommends using a minimum of Ø100mm ground plane (PCB) to ensure optimal performance.

Top Side (GPDF6010.A placement on 70x70mm PCB)



Bottom Side (HC125A placement)

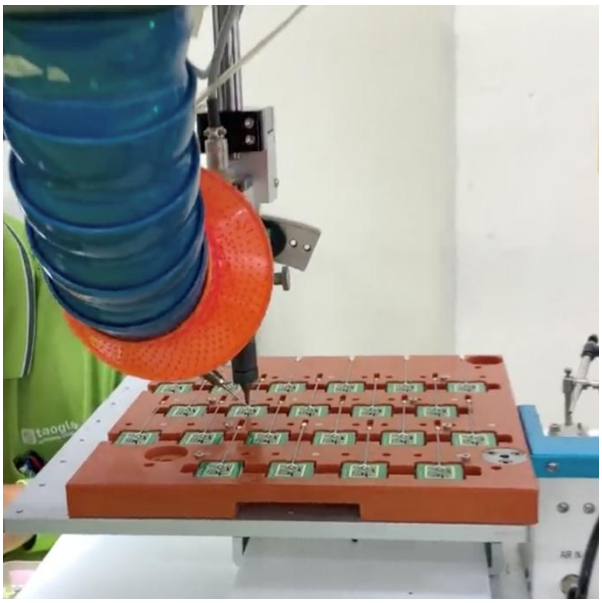
5. Solder Recommendations

5.1 Manual Soldering

Soldering Temperature: 360-380°C
Soldering Duration: 3~4 seconds

5.2 Automated Ferrochrome Soldering Machine

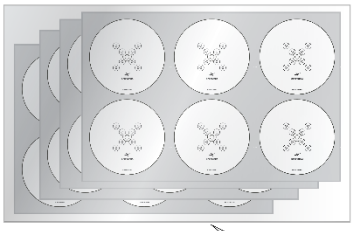
Soldering Temperature: 360-380°C
Soldering Duration: 3~4 seconds



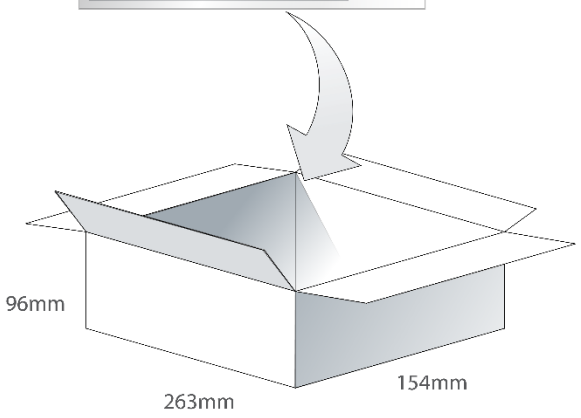
Please note that this process will require a one-time fixture to be made for each PCB design.

6. Packaging

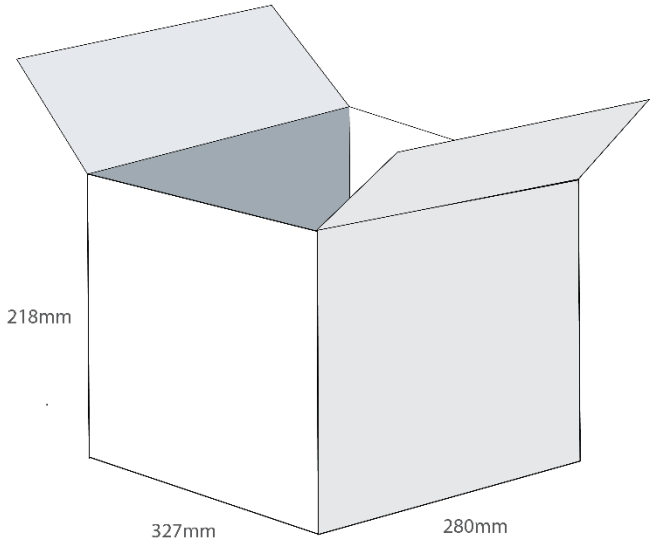
24 pcs GPDF6010A
per PE Bag
Weight - 1100g



24 pcs GPDF6010A per Carton
Carton Dimensions - 263 x 154 x 96mm
Weight - 1200g

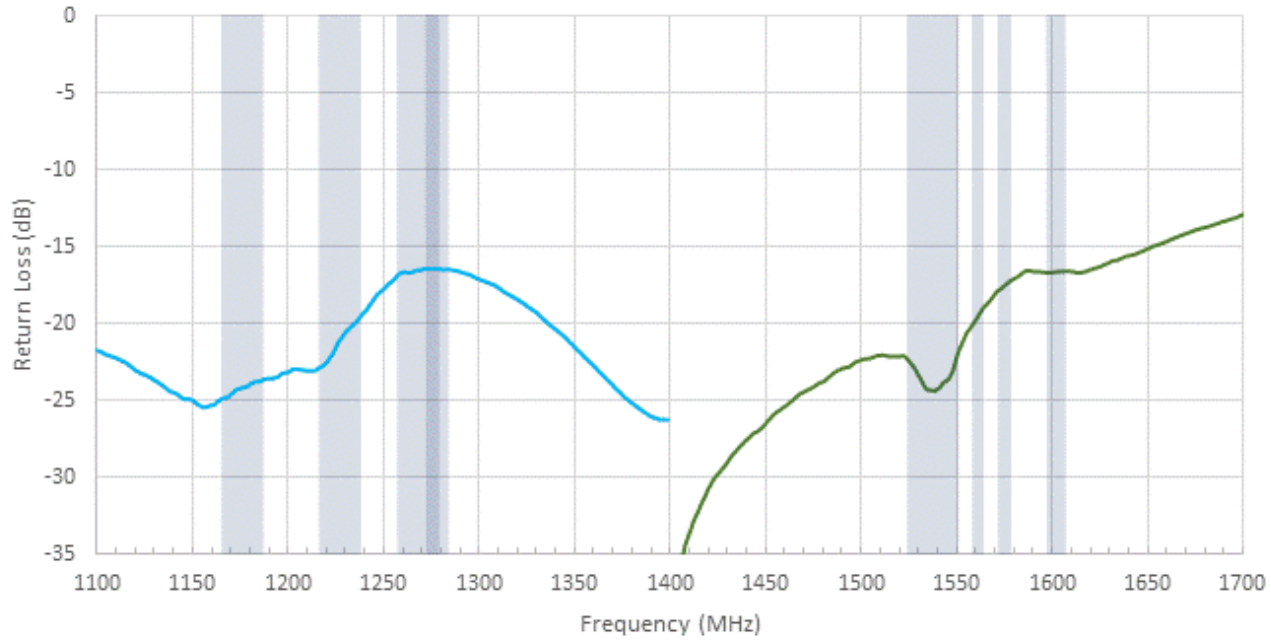


96 pcs GPDF6010A per Carton
Carton Dimensions - 327 x 280 x 218mm
Weight - 5Kg

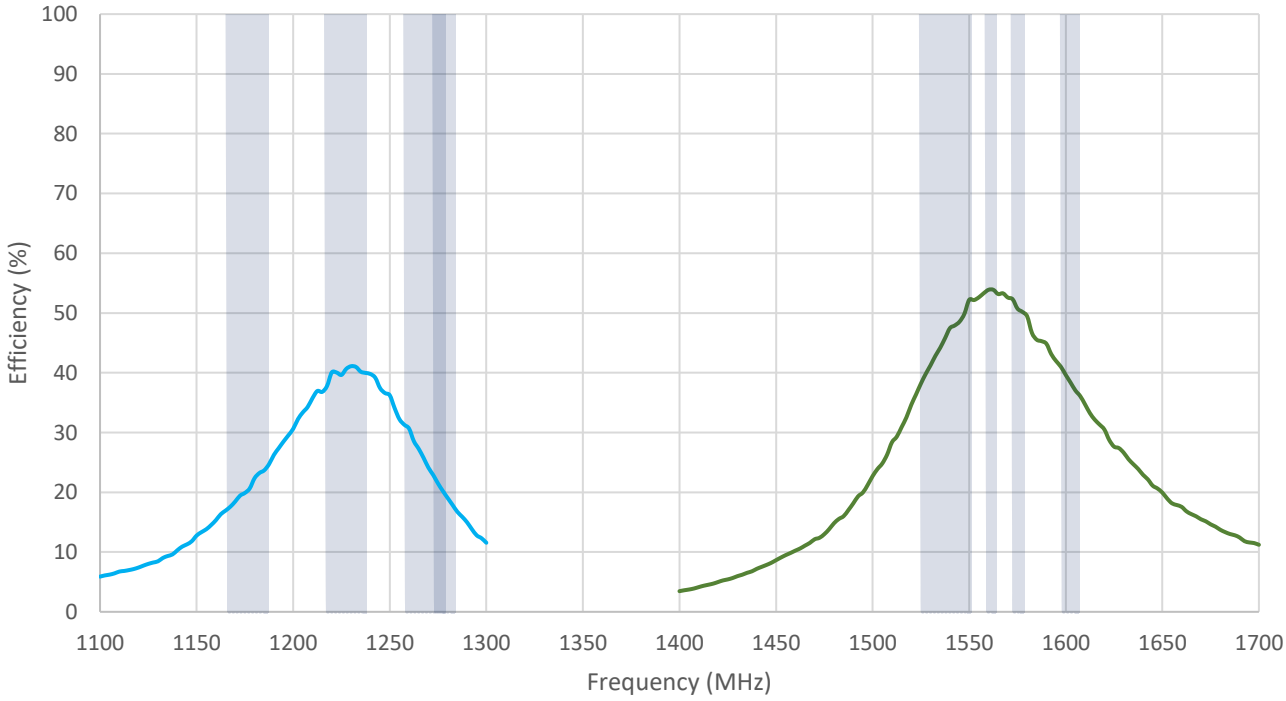


7. Antenna Characteristics (with hybrid coupler)

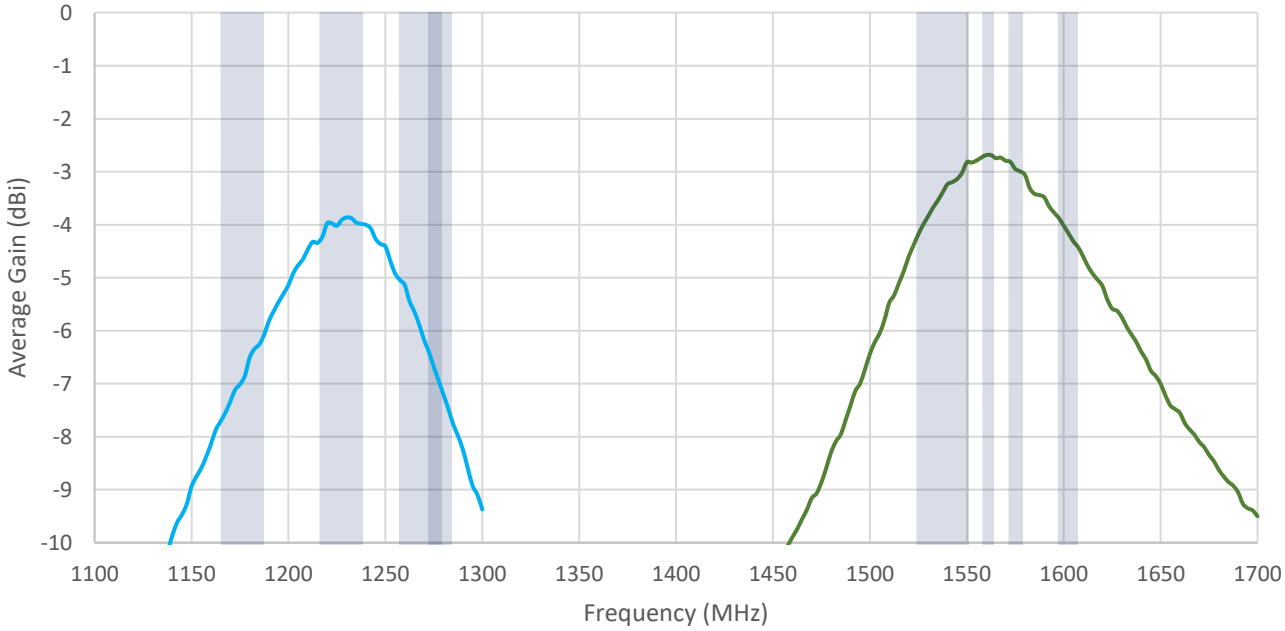
7.1 Return Loss



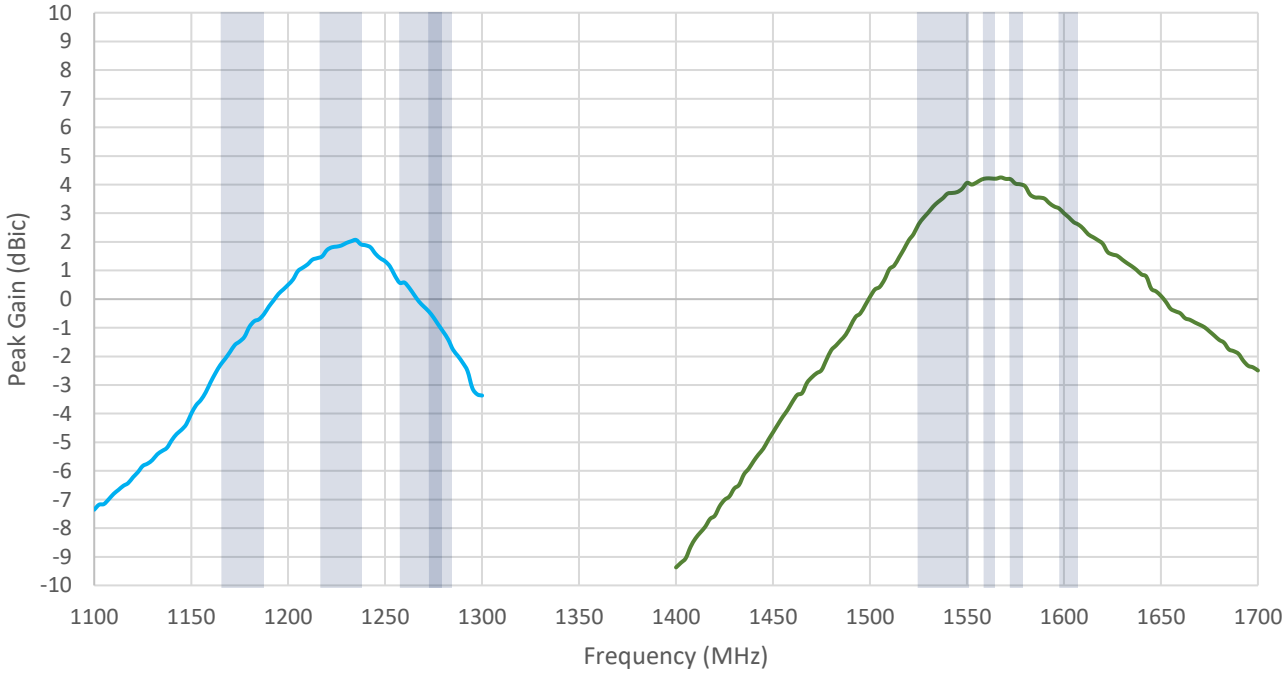
7.2 Efficiency



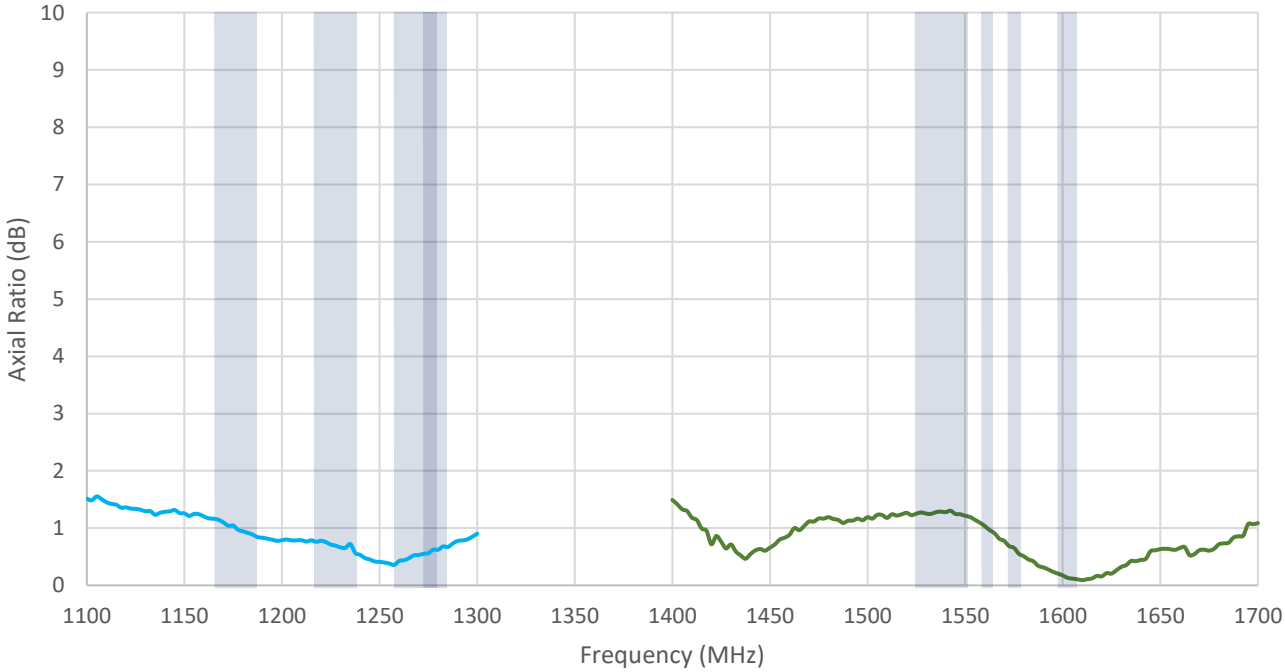
7.3 Average Gain



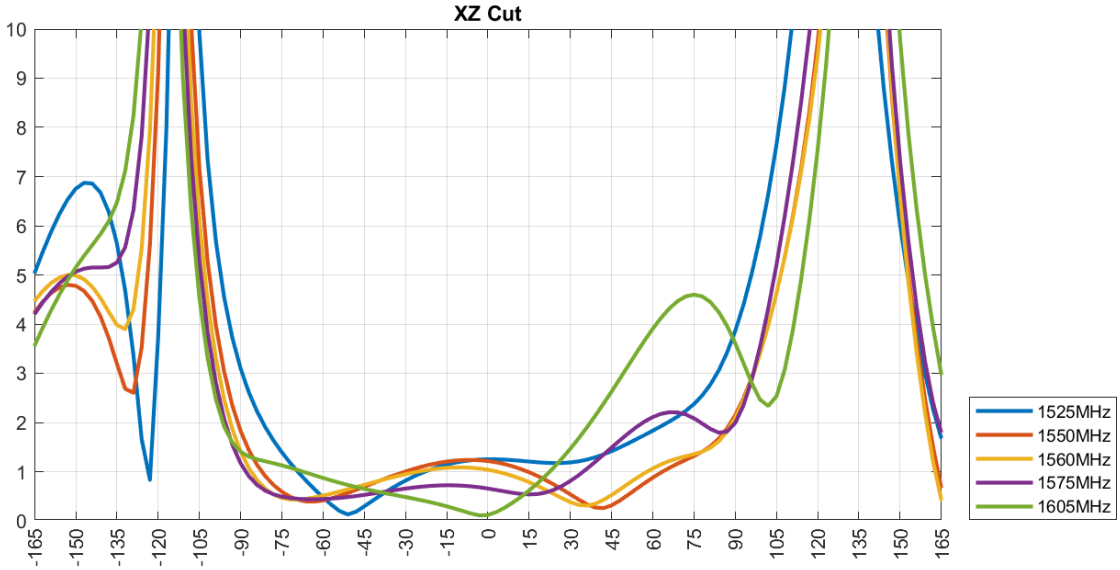
7.4 Peak Gain



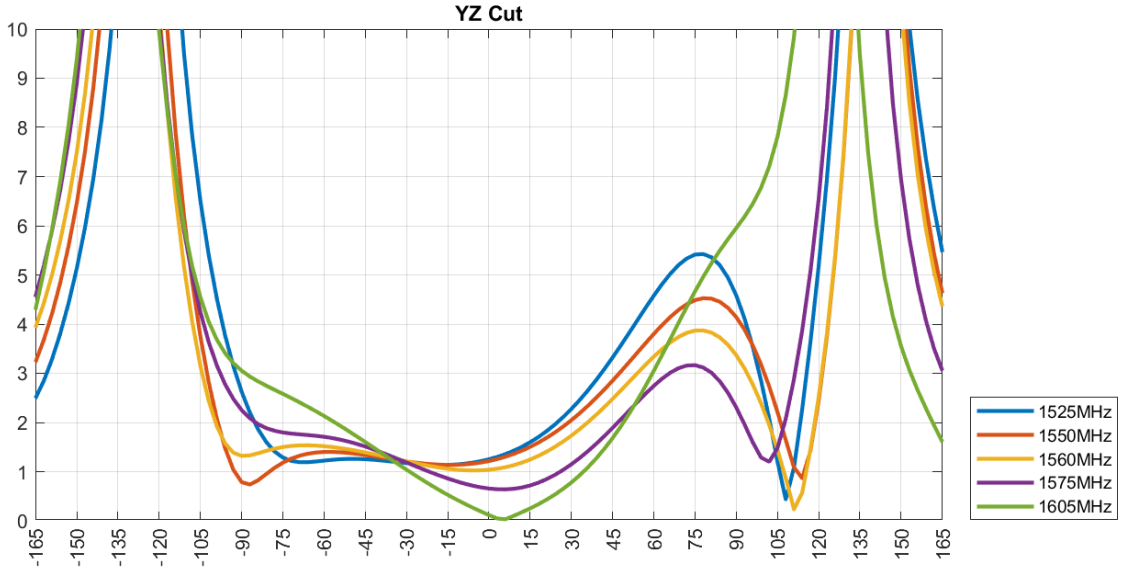
7.5 Axial Ratio



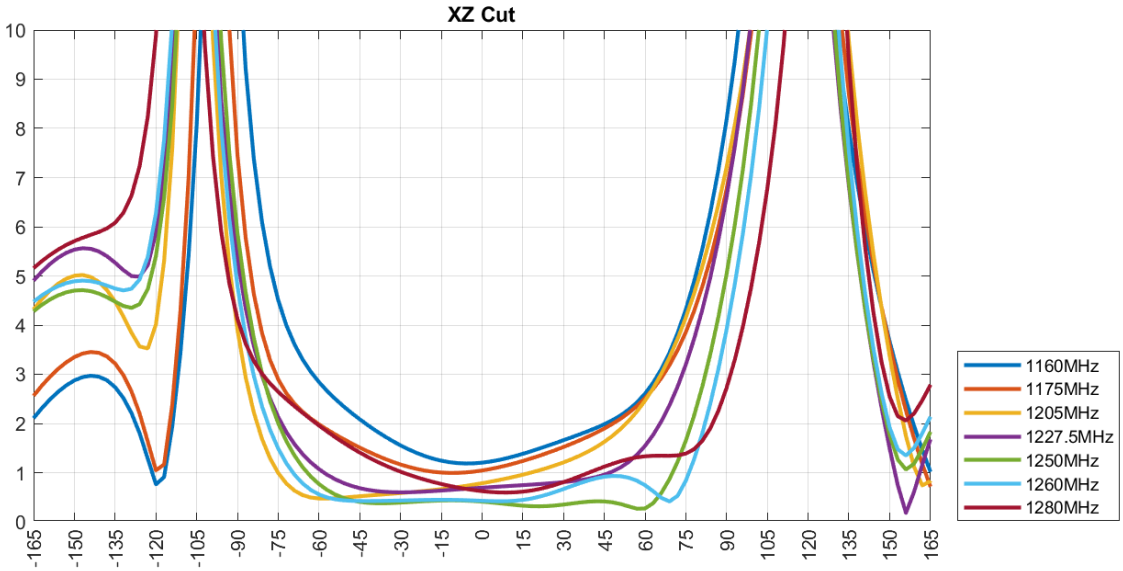
7.6 XZ Cut (High-Band)



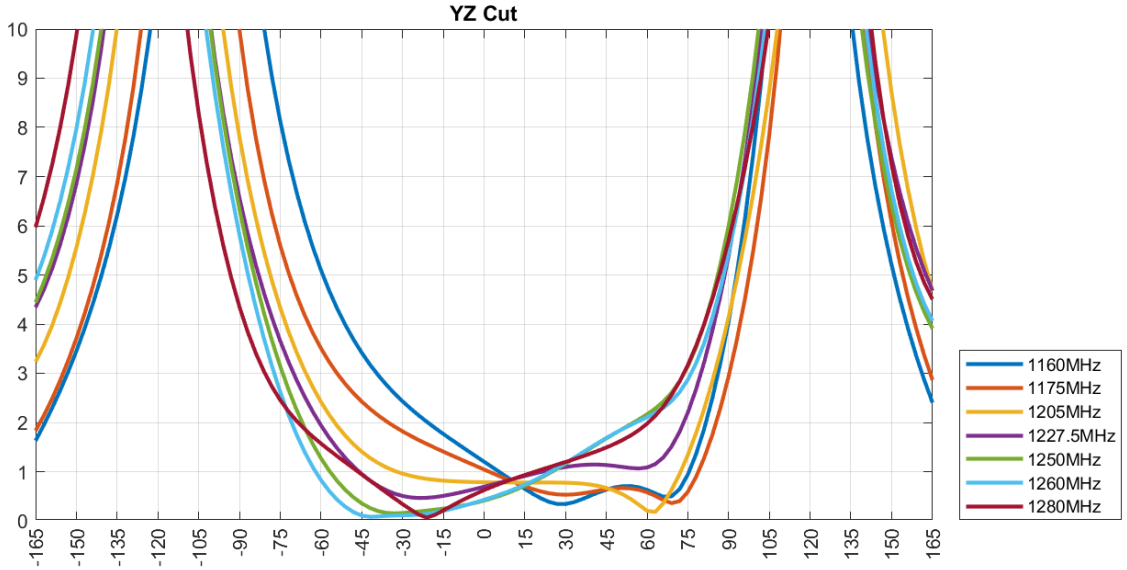
7.7 YZ Cut (High-Band)



7.8 XZ Cut (Low-Band)

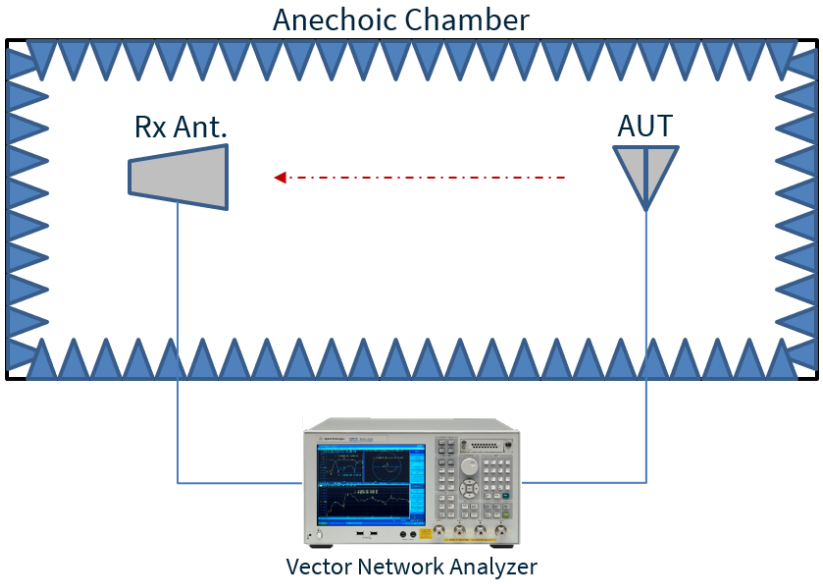


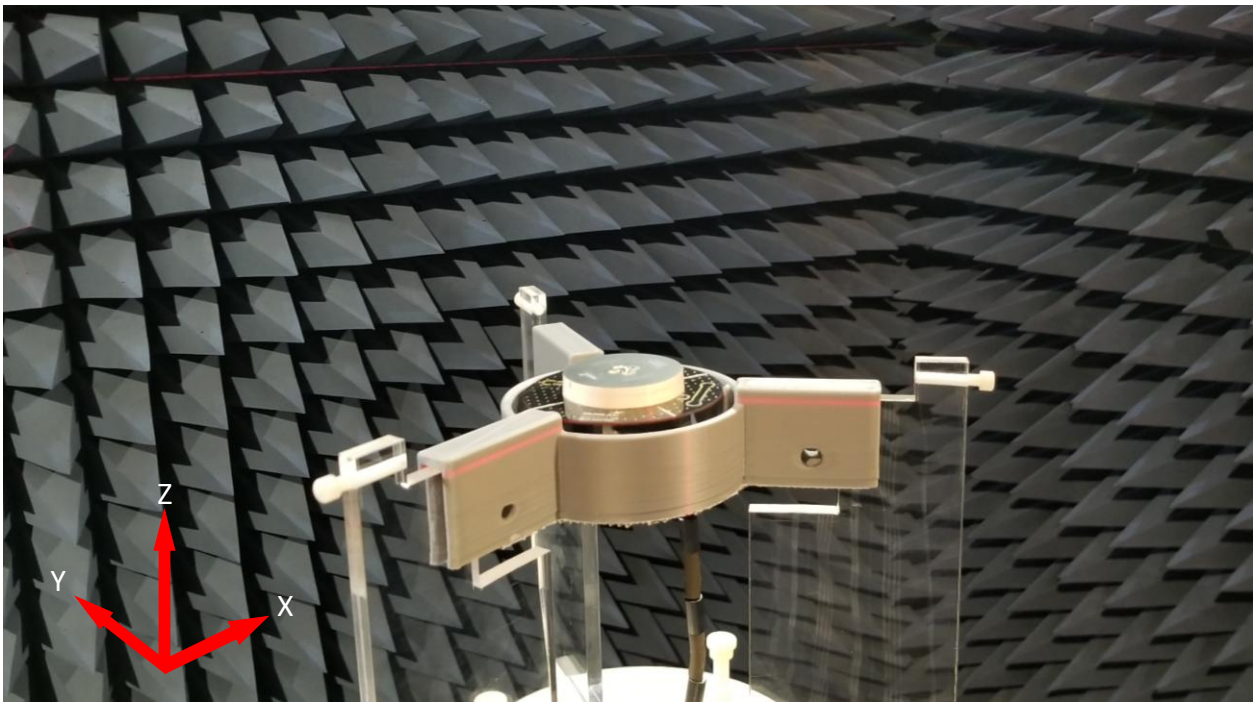
7.9 YZ Cut (Low-Band)



8. Radiation Patterns

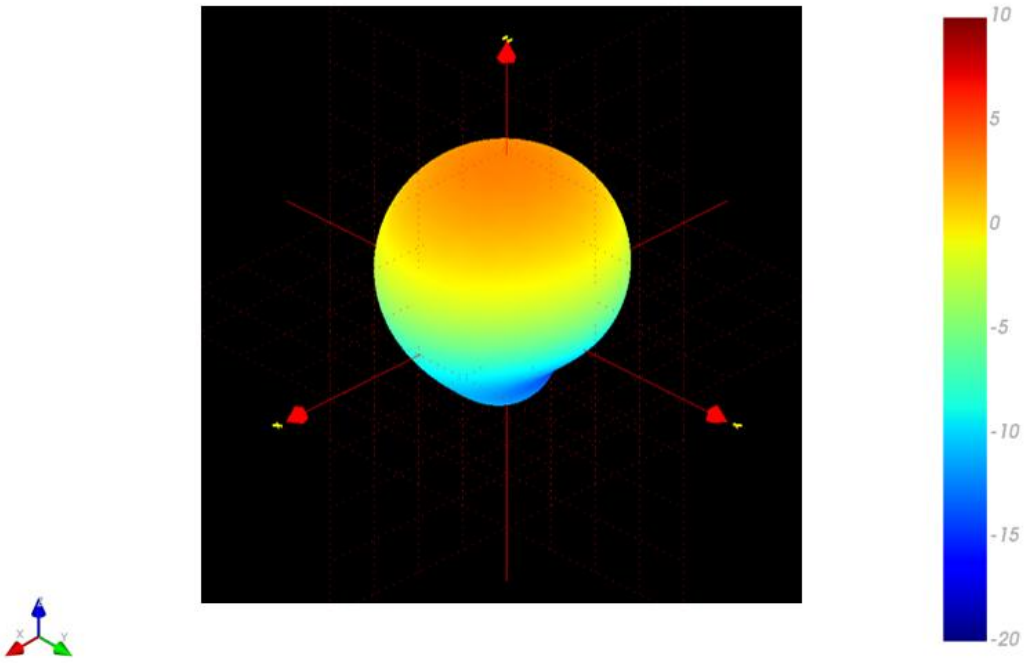
8.1 Test Setup



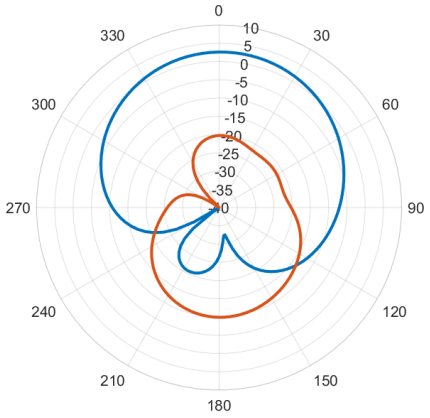


Chamber Test Setup

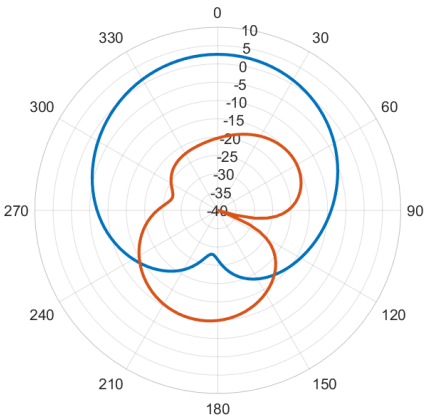
8.2 GNSS Patterns at 1525 MHz



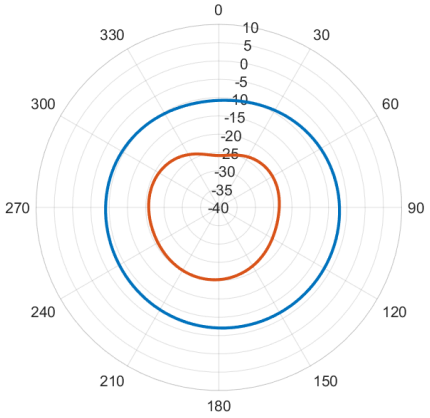
XZ Plane



YZ Plane



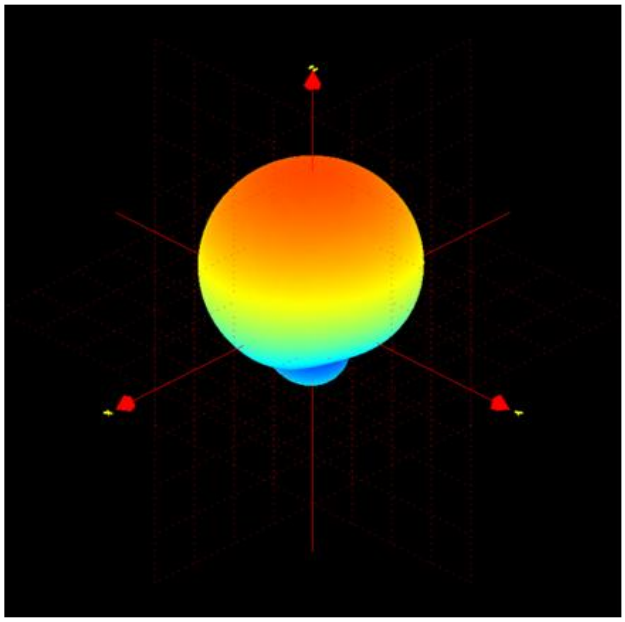
XY Plane

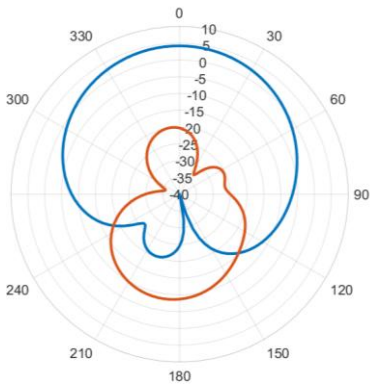
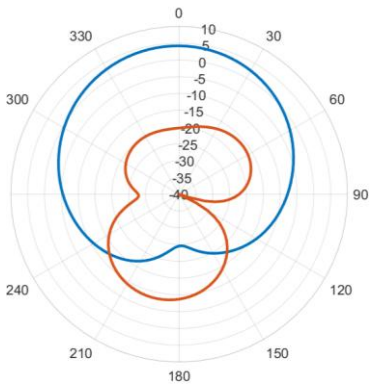
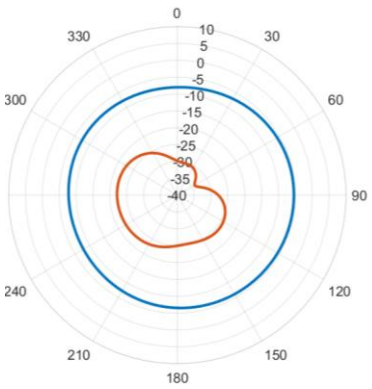


RHCP

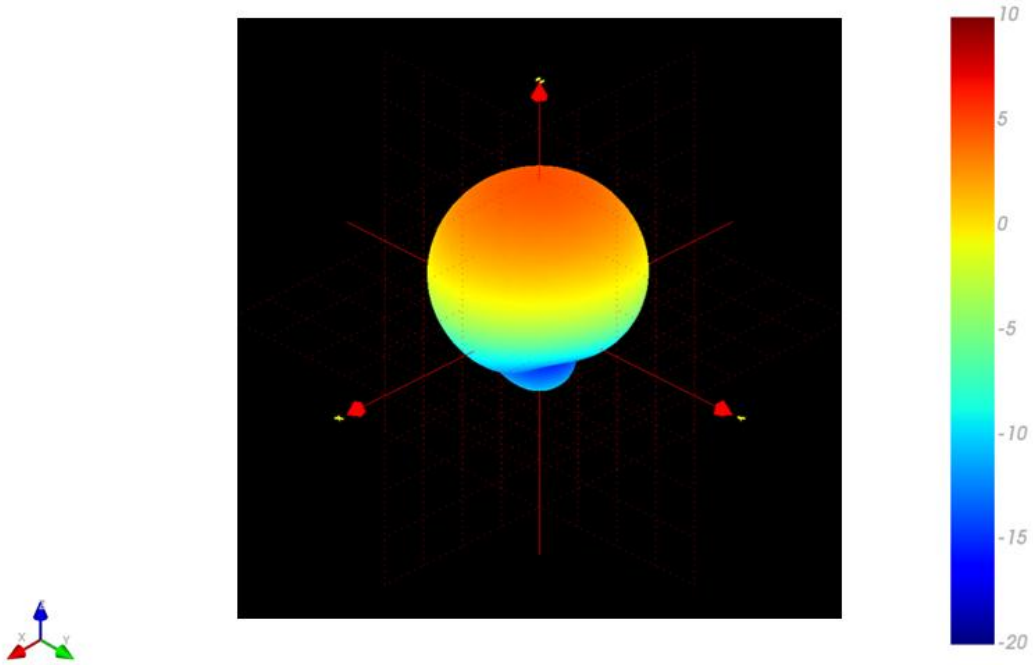
LHCP

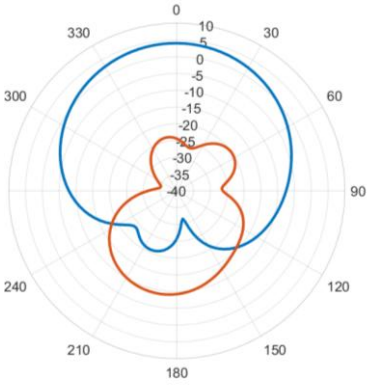
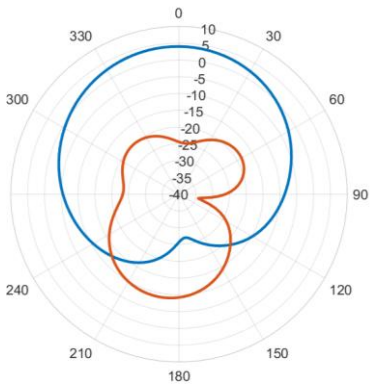
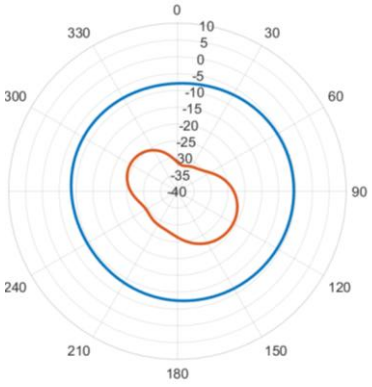
8.3 GNSS Patterns at 1561 MHz



XZ Plane	YZ Plane	XY Plane
		

8.4 GNSS Patterns at 1575 MHz

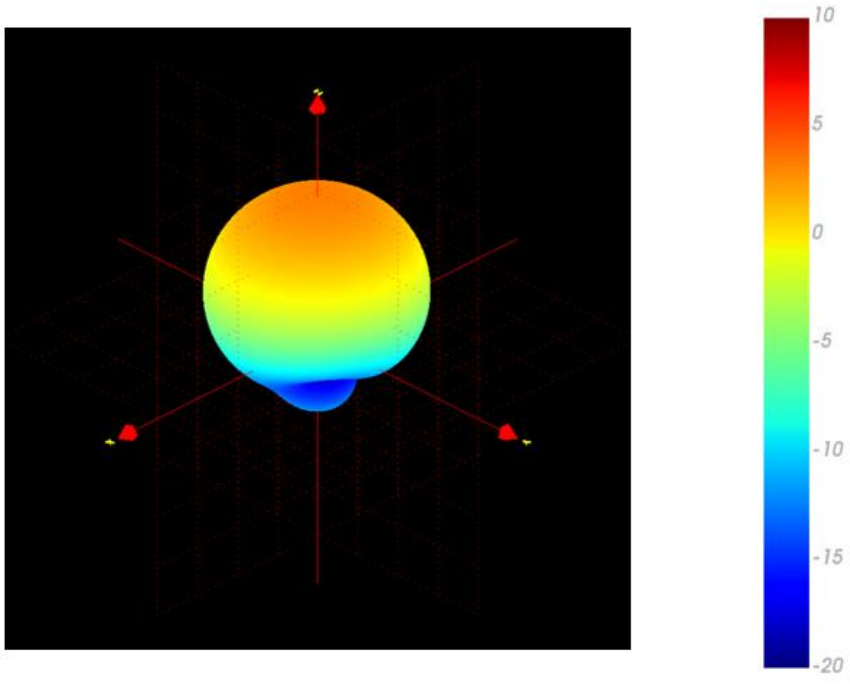


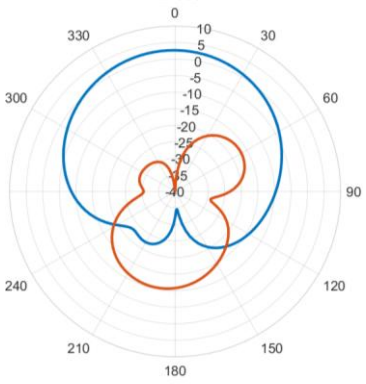
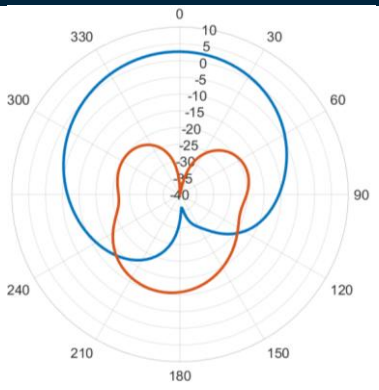
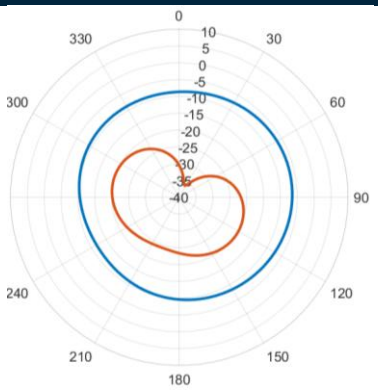
XZ Plane	YZ Plane	XY Plane
		

RHCP

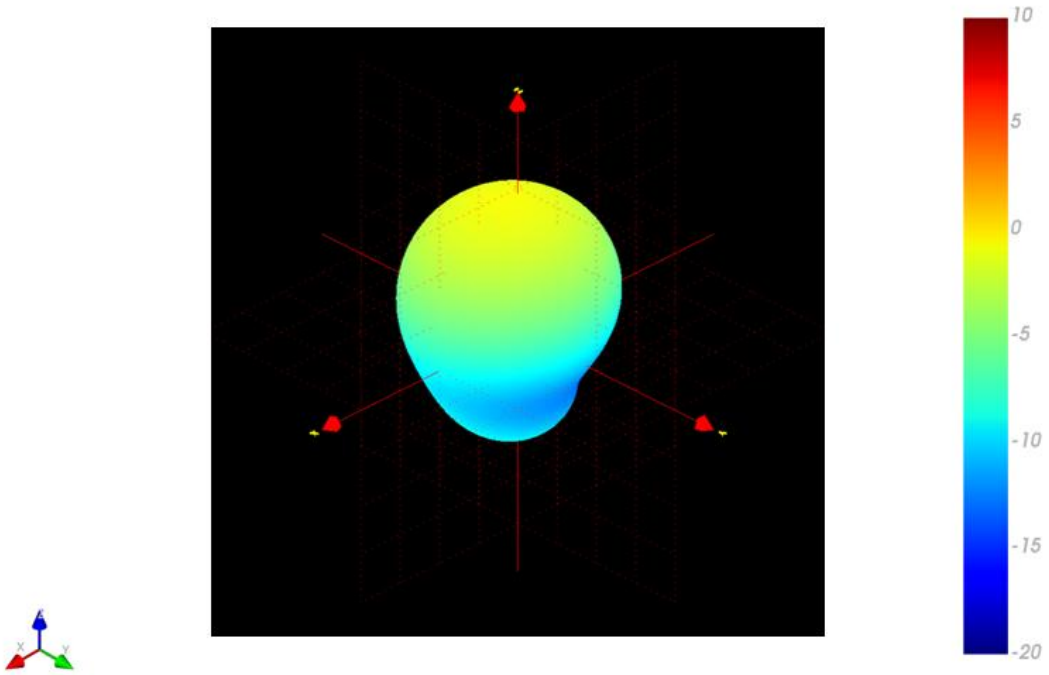
LHCP

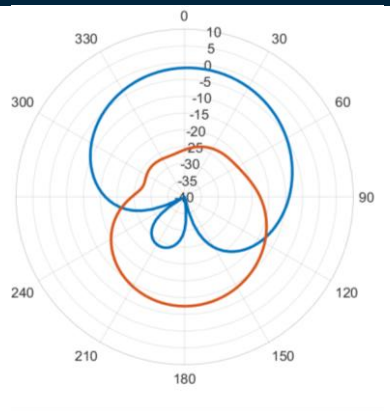
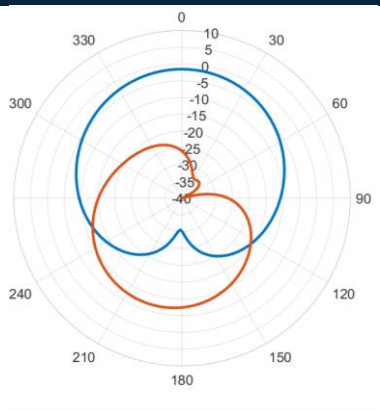
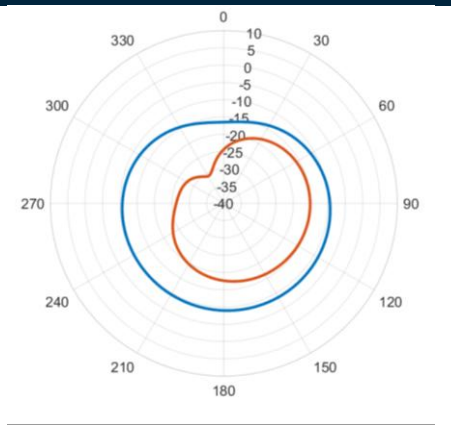
8.5 GNSS Patterns at 1605 MHz



XZ Plane	YZ Plane	XY Plane
		

8.6 GNSS Patterns at 1175 MHz

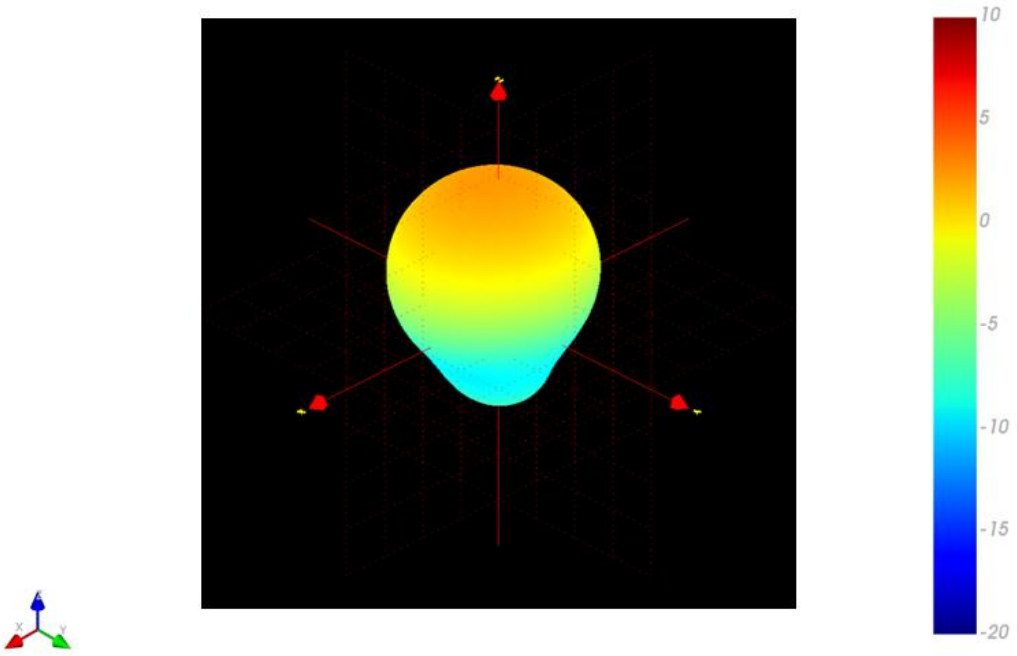


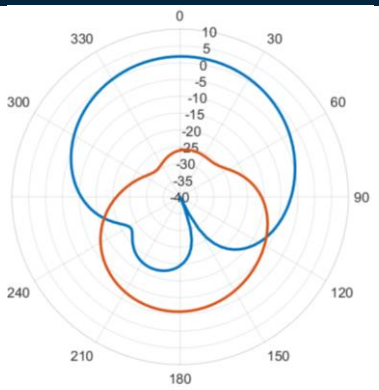
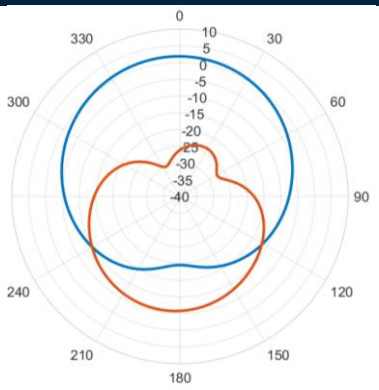
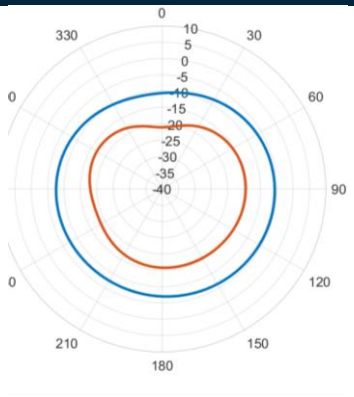
XZ Plane	YZ Plane	XY Plane
		

RHCP

LHCP

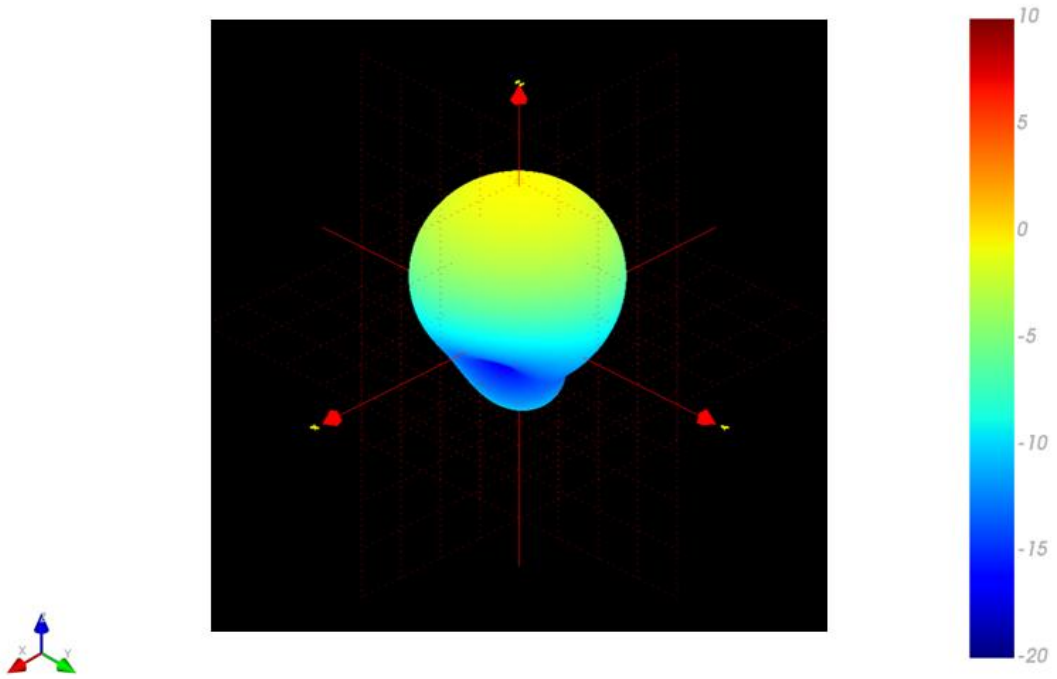
8.7 GNSS Patterns at 1227.5 MHz

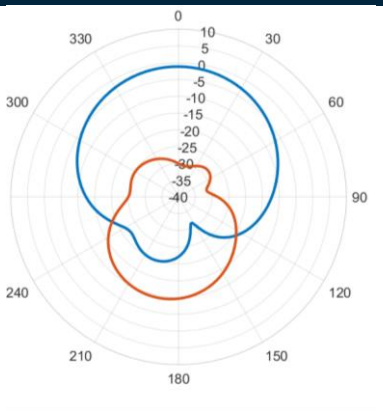
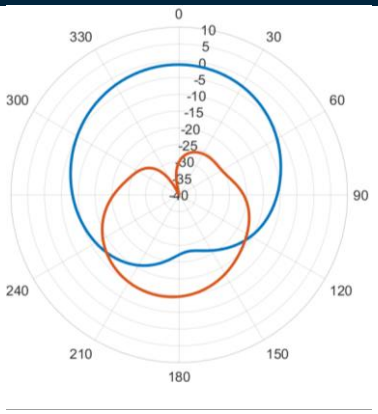
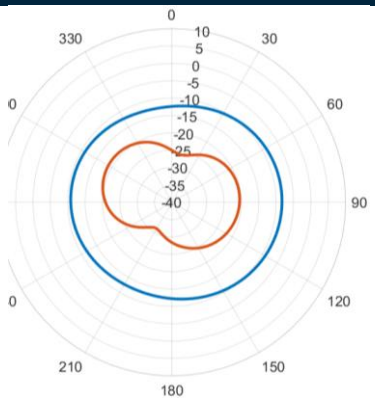


XZ Plane	YZ Plane	XY Plane
		

RHCP
LHCP

8.8 GNSS Patterns at 1280 MHz



XZ Plane	YZ Plane	XY Plane
		

Changelog for the datasheet

SPE-21-8-111 – GPDF6010.A

Revision: E (Current Version)	
Date:	2025-10-10
Notes:	Updated Antenna Integration Guide
Author:	Gary West

Previous Revisions

Revision: D	
Date:	2023-02-21
Notes:	Updated GNSS Bands & Constellations Graphics
Author:	Cesar Sousa

Revision: C	
Date:	2022-04-05
Notes:	Added Eval Board Drawing
Author:	Gary West

Revision: B	
Date:	2021-11-29
Notes:	Added updated integration guide.
Author:	Gary West

Revision: A (Original First Release)	
Date:	2020-10-14
Notes:	Initial Release
Author:	Jack Conroy

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