TAOGLAS



Datasheet

Multiband High Precision GNSS Stacked Patch Antenna

Part No:
GPDF5012.A

Description

Passive Multiband High Precision GNSS Stacked Patch Antenna

Features:

Bands Covered:

- GPS (L1/L2/L5)
- IRNSS (L5)
- QZSS (L1/L2C/L5)
- Galileo (E1/E5a/E5b)
- GLONASS (G1/G2/G3)
- BeiDou (B1/B2a/B2b)

Dual pin, dual feed, 4-pin configuration

Dimensions: 50 x 50 x 12mm

RoHS & Reach Compliant

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1. Introduction



The Taoglas **GPDF5012.A** is a high performance, multi-band passive GNSS antenna that has been carefully designed to provide fantastic positional accuracy on the full GNSS spectrum. It covers GPS/QZSS L1/L2/L5, GLONASS G1/G2/G3, Galileo E1/E5a/E5b, BeiDou B1/B2a/B2b, NAVIC L5, as well as SBAS (WAAS/EGNOS/GAGAN/SDCM/SNAS).

Correct implementation of the GPDF5012.A allows the user to achieve higher location accuracy, as well as stability of position tracking in urban environments. The stacked patch construction has excellent performance across the full bandwidth of the antenna. Its design has an even gain across the hemisphere, giving excellent axial ratio, which in turn makes it extremely resilient to multipath rejection and provides excellent phase centre stability.

Typical applications that benefit from high precision capabilities include:

- Autonomous Driving
- Precision Positioning for Robotics
- Precision Agriculture
- Telematics & Container / Asset Tracking
- Timing Accuracy Synchronization



The GPDF5012.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 GPDF5012.A can achieve genuine cm-level accuracy with proven results.

Full integration guidelines are contained in Section 8 of this datasheet including the Taoglas HC125.A hybrid coupler that will be required for use for dual pin feed patch integrations. An active version of this antenna, the ADFGP.50A.07.0100C is available and supplied with 100mm cable and I-PEX MHFI connector as standard.

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

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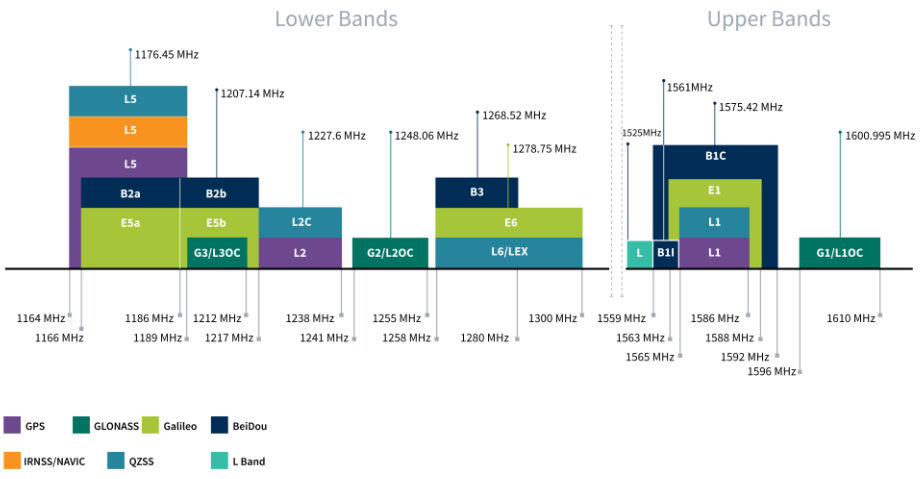
2. Specification

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

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GNSS Electrical							
Frequency (MHz)	**1176.45**	**1207.14**	**1227.6**	**1248.06**	**1561**	**1575.42**	**1602**
VSWR (max.)	1.11:1	1.31:1	1.47:1	1.35:1	1.18:1	1.06:1	1.17:1
Efficiency (%)	41.03	80.05	50.76	28.48	54.28	67.61	68.36
Average Gain (dB)	-3.87	-0.96	-2.94	-5.45	-2.65	-1.70	-1.65
Peak Gain (dBi)	1.47	4.07	1.99	-0.49	2.66	3.54	3.48
Axial Ratio (dB)	6.80	4.44	2.21	2.31	3.59	3.87	4.64
PCO x (cm)	1.69	1.43	1.42	1.32	1.05	1.05	1.18
PCO y (cm)	0.37	0.38	0.62	0.70	0.88	0.82	0.75
PCV (cm)	0.006	0.015	0.014	0.017	0.005	0.005	0.004
Polarization	RHCP						
Impedance	50 Ω						
Note: The antenna with Hybrid coupler was tested on a 70x70 mm ground plane							

Mechanical	
Height	12.5 mm
Planner Dimension	50 x 50 mm diameter
Weight	86 g

Environmental	
Temperature Range	-40°C to 85°C
RoHS Compliant	Yes
REACH Compliant	Yes

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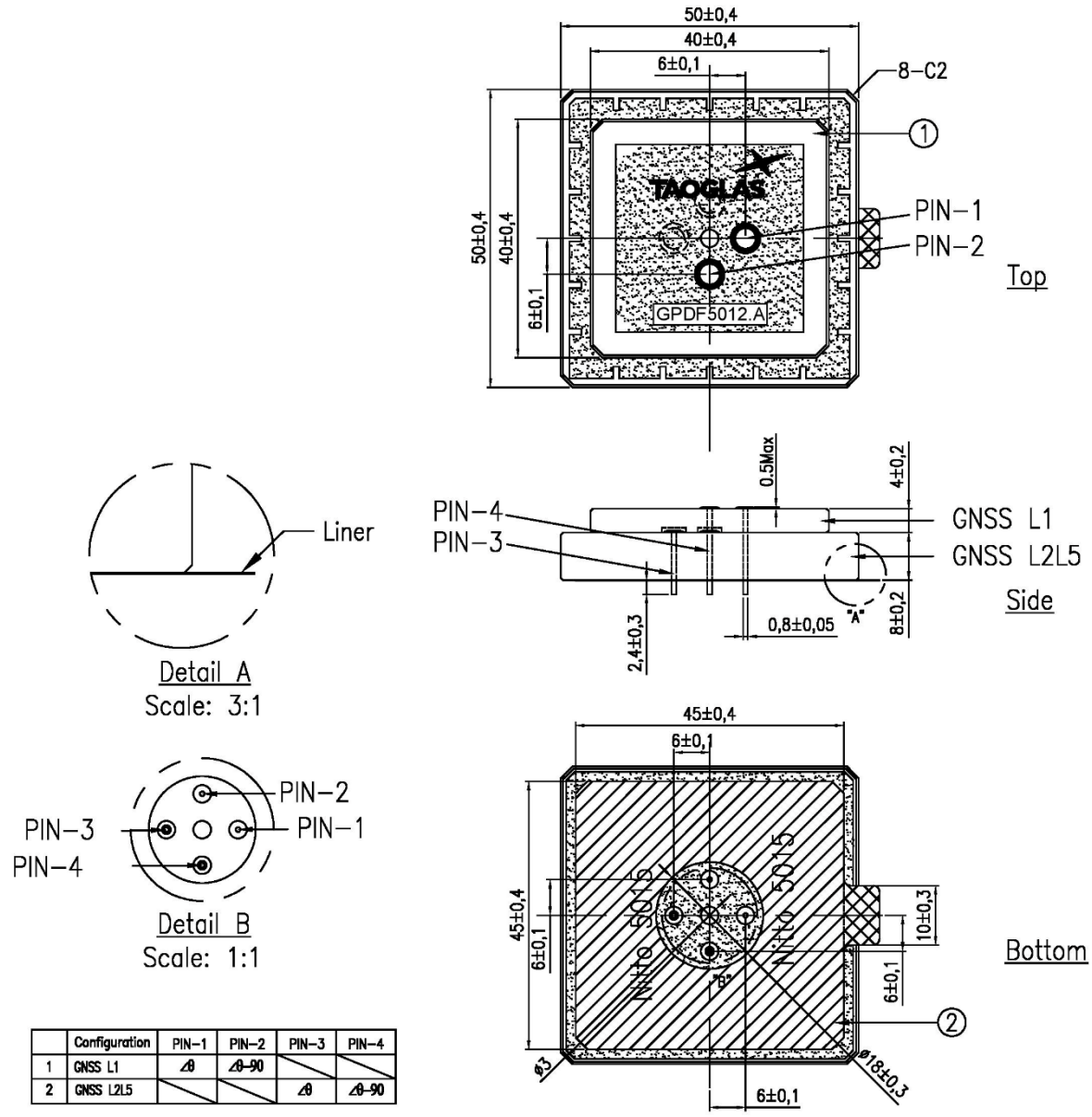
3. Mechanical Drawing

NOTES: 1. Soldermask Area:
2. Adhesive Tape :
3. Silver :
4. Release paper :



	Configuration	PIN-1	PIN-2	PIN-3	PIN-4
1	GNSS L1	⊿θ	⊿θ-90		
2	GNSS L2L5			⊿θ	⊿θ-90

	Name	P/N	Material	Finish	QTY
1	GPDF5012A Patch 50x50x12mm	013A69AZ00J040	Ceramic	Clear	1
2	Double sided Adhesive	013A69AZ00J040	NITTO 5015	White Liner	1

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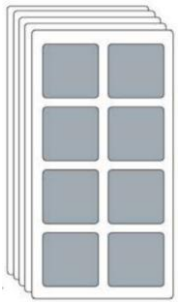
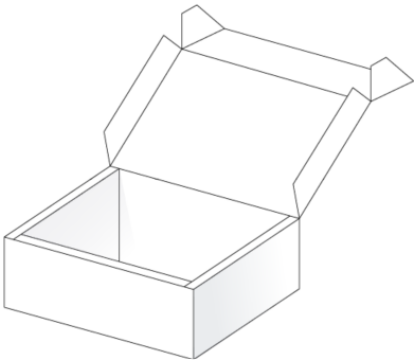
4. Packaging

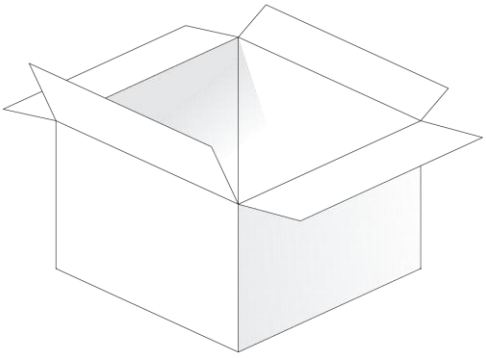
8pcs GPDF5012.A per Tray
Weight: 690g



32pcs GPDF5012.A per Inner Carton
Dimensions: 263*154*96 mm
Weight: 3Kg



128pcs GPDF5012.A per Inner Carton
Dimensions: 327*280*218 mm
Weight: 12.5Kg



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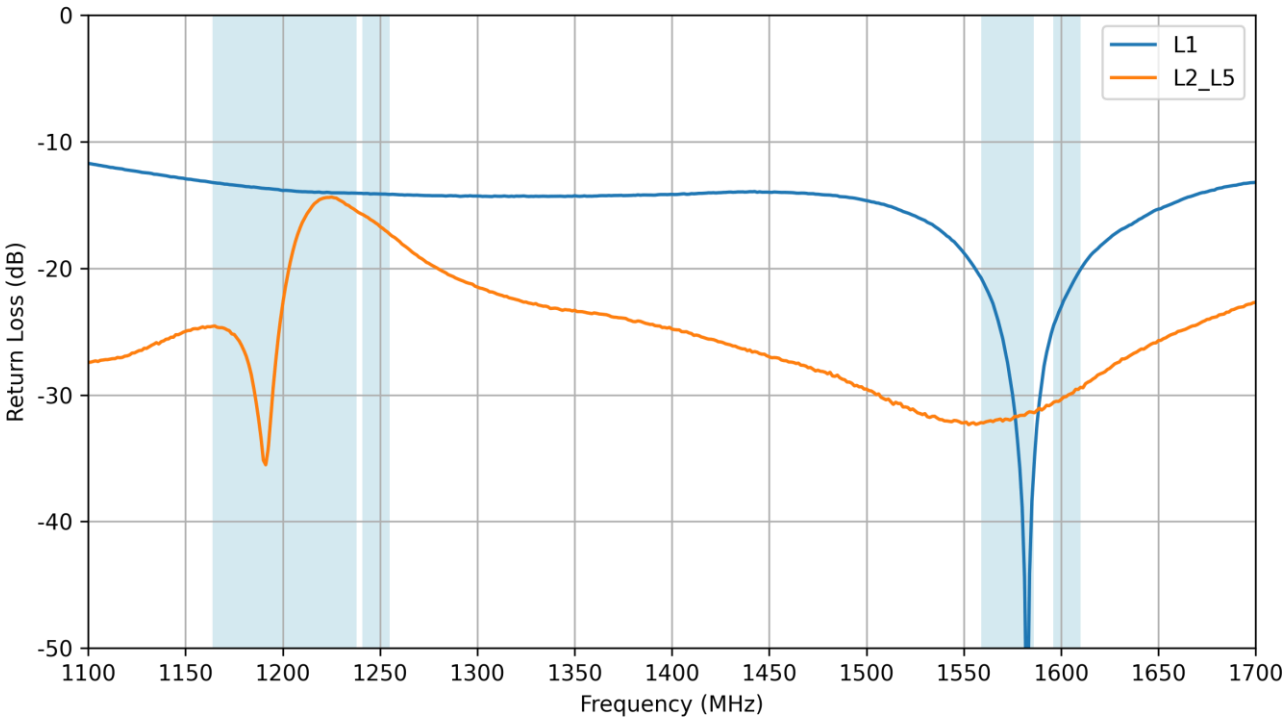
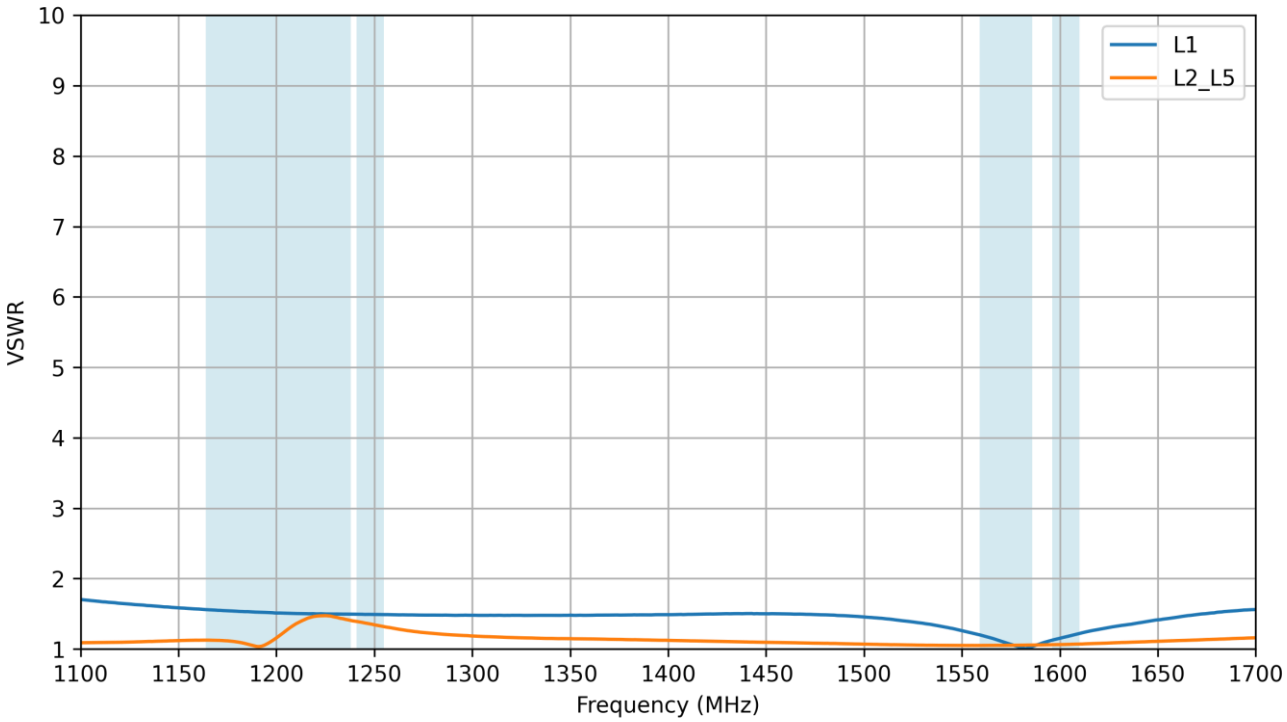
5. Antenna Characteristics (with hybrid coupler)

The following results illustrate the low-band and high-band performance achieved with a hybrid coupler. Performance for each band (L1, L2L5) is shown independently, as the low-band and high-band signals are not combined.

5.1 Return Loss (From Hybrid Couplers)



5.2 Isolation (From Hybrid Couplers)



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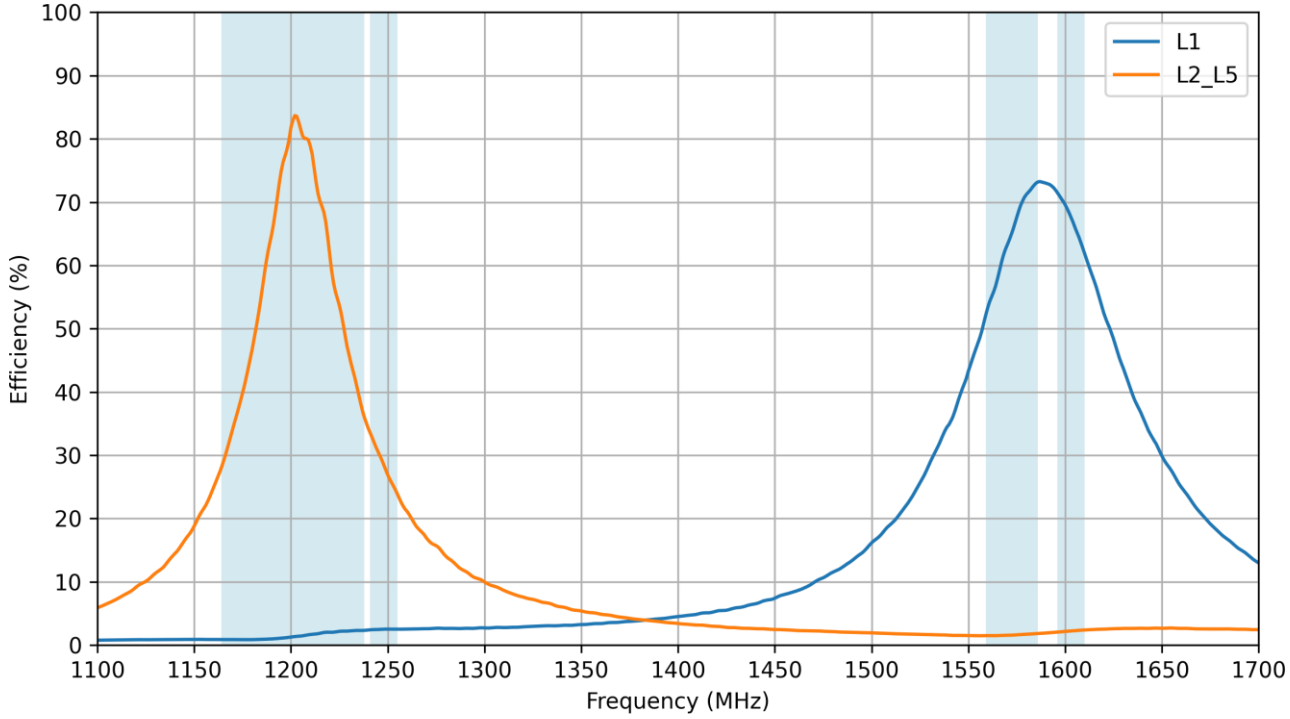
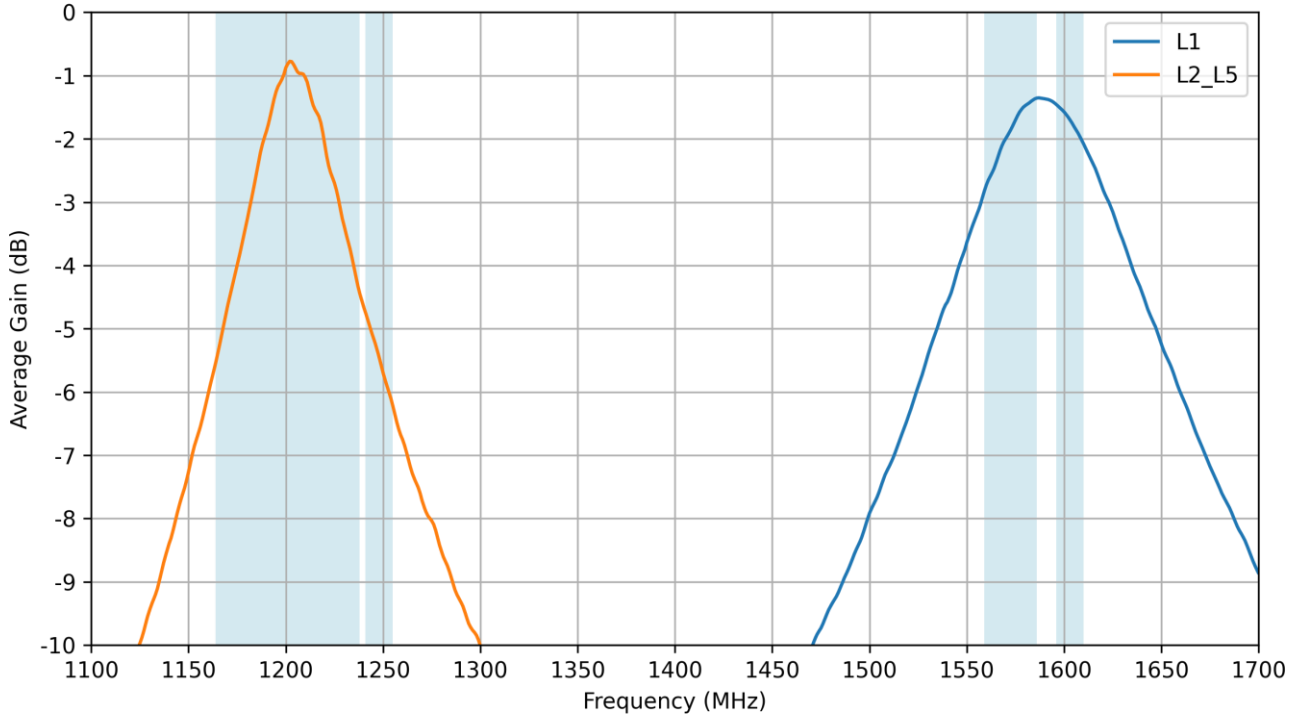
5.3 Efficiency



5.4 Average Gain



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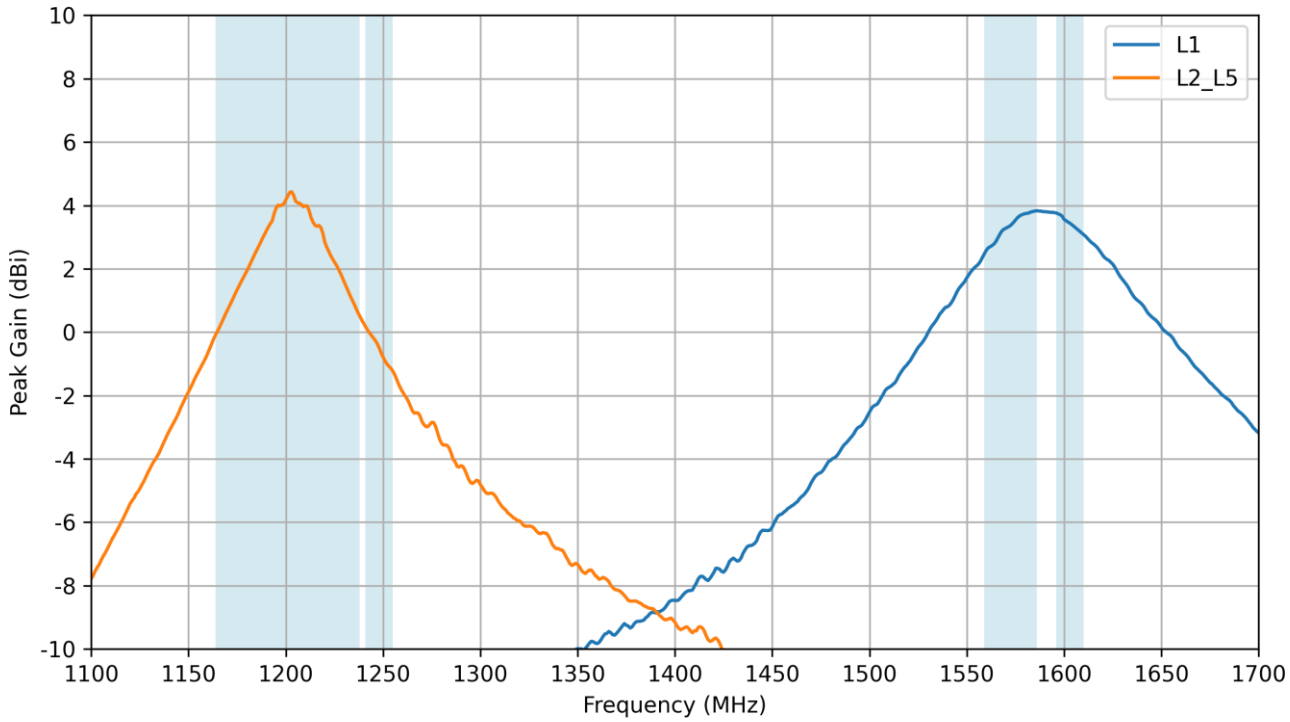
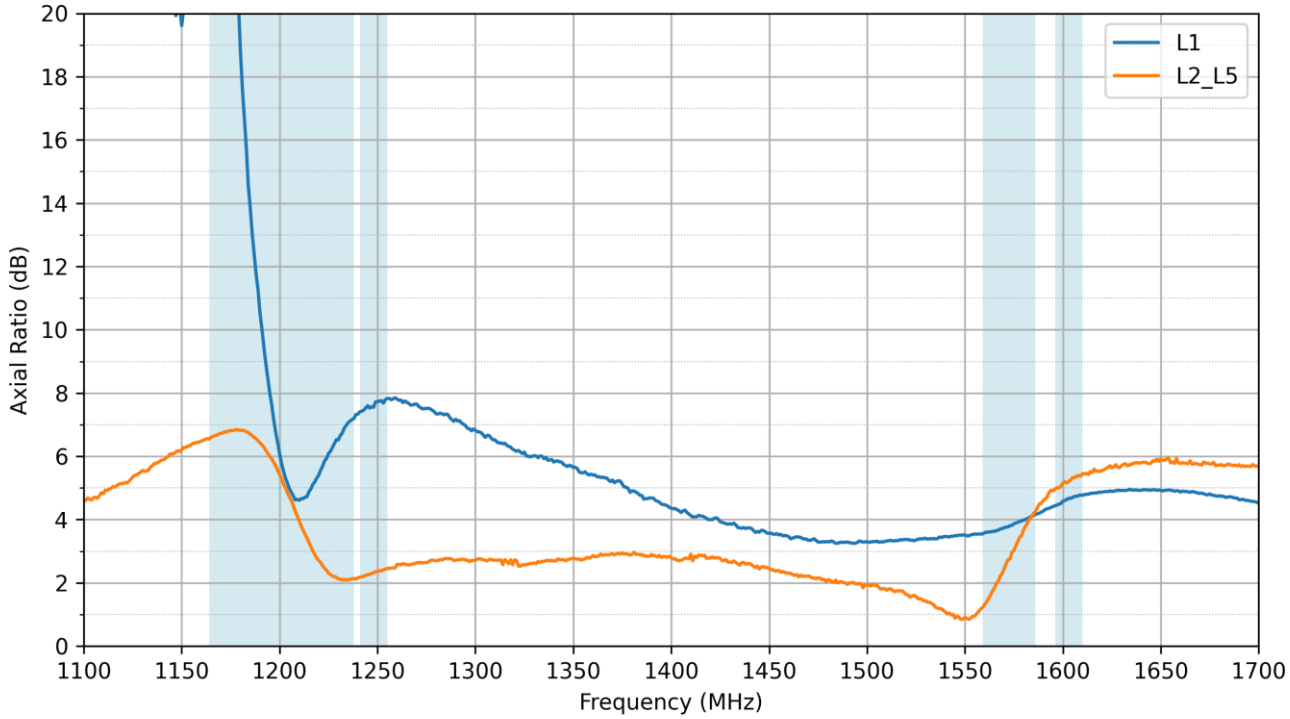
5.5 Peak Gain



5.6 Axial Ratio



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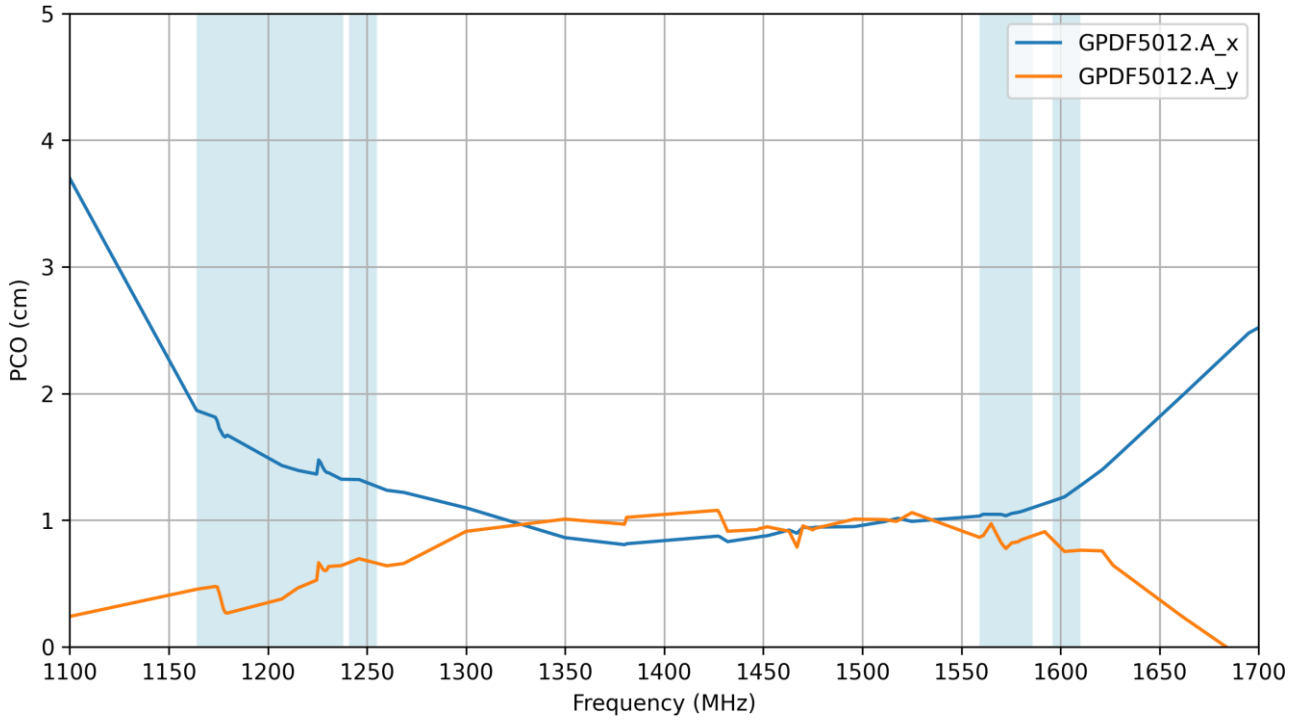
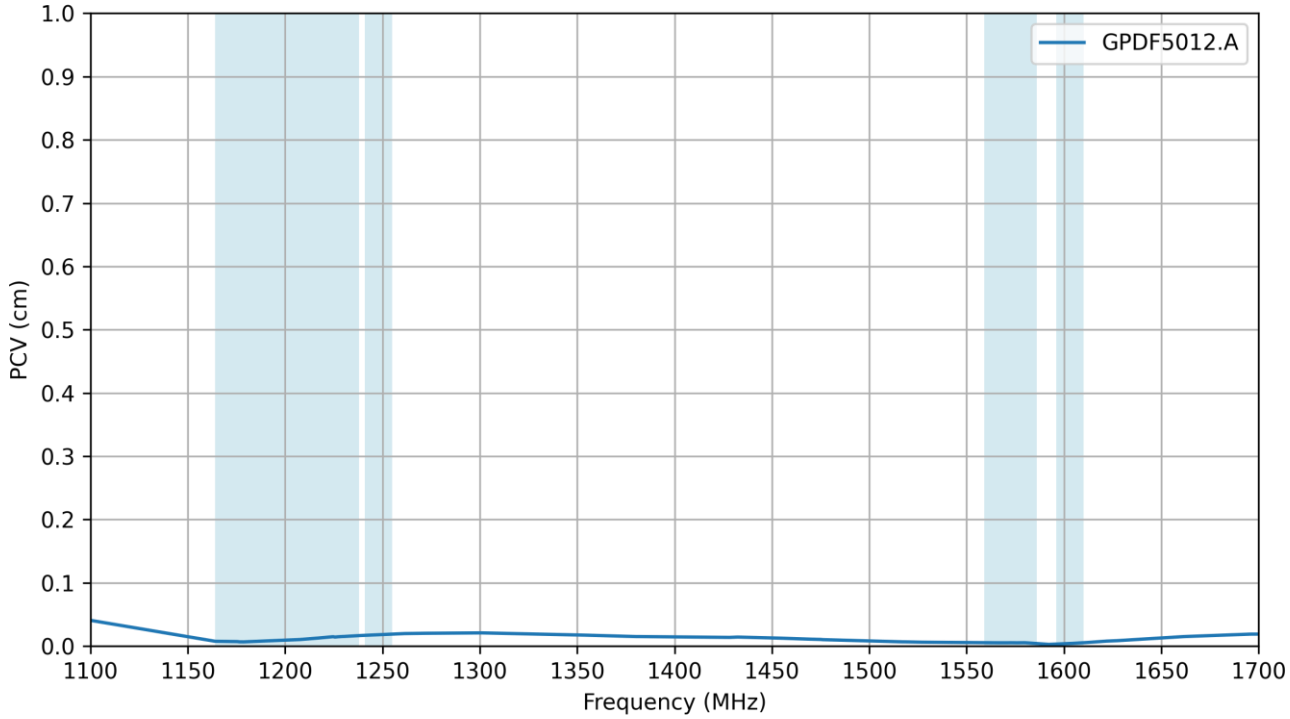
5.7 PCO



5.8 PCV



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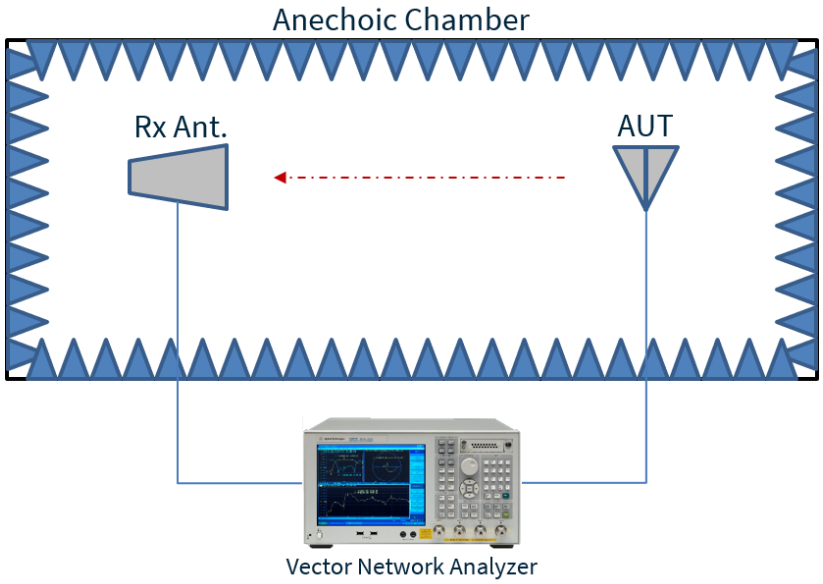
6. Radiation Patterns

6.1 Test Setup





Chamber Test Set-up

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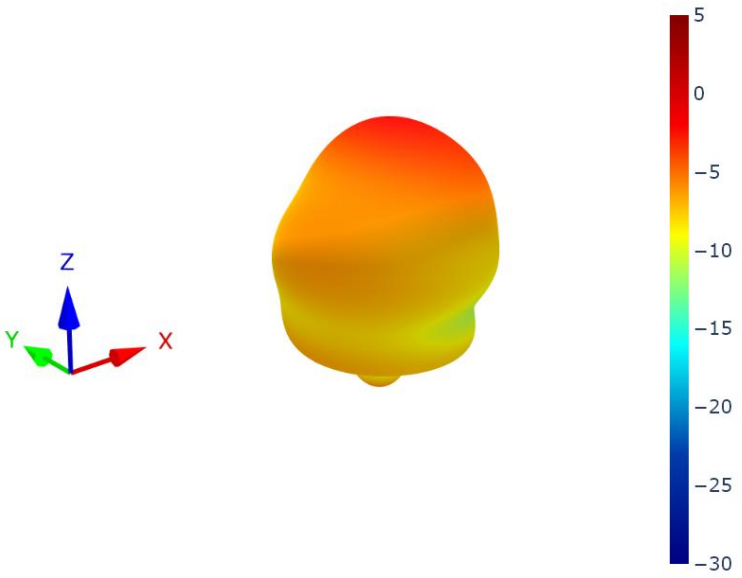
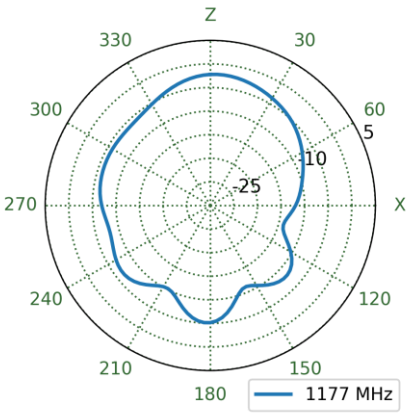
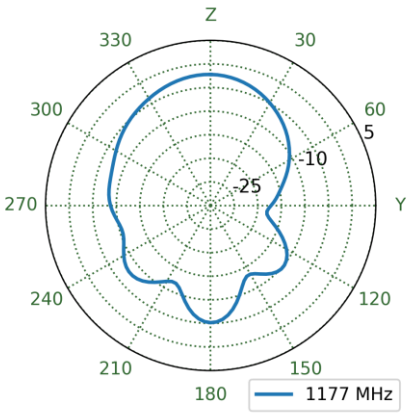
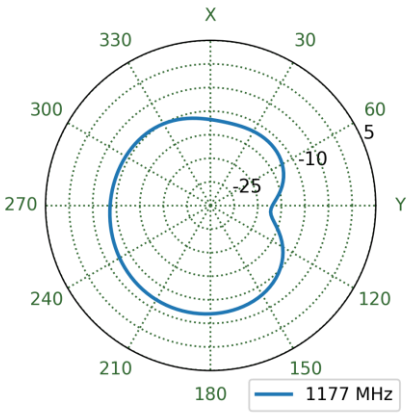
6.2 L2-L5 Band - Patterns at 1177 MHz



XZ Plane	YZ Plane	XY Plane
		

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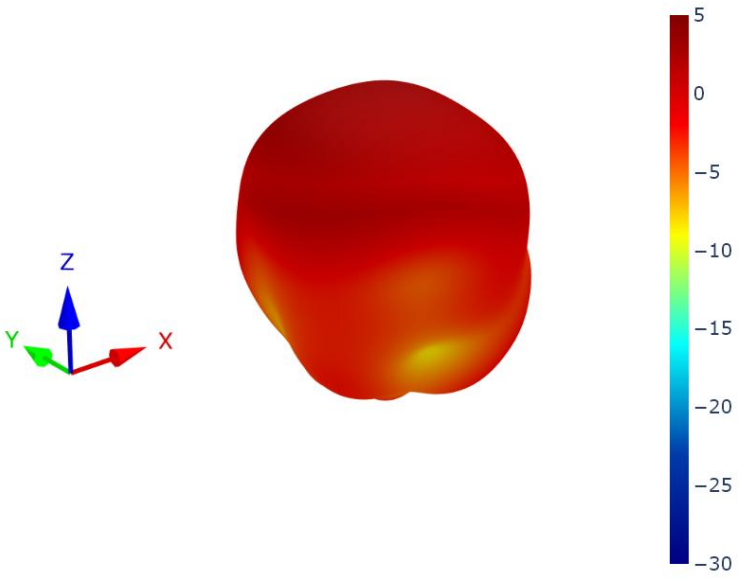
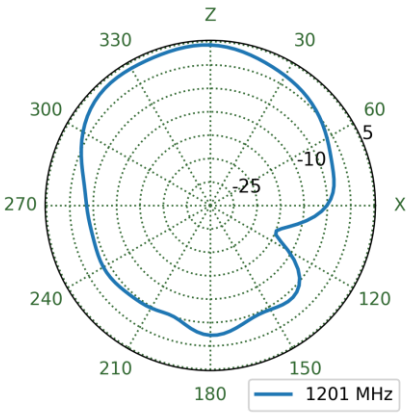
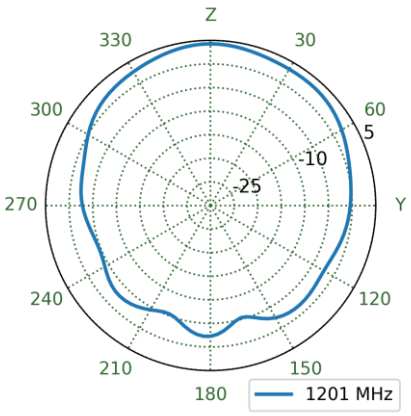
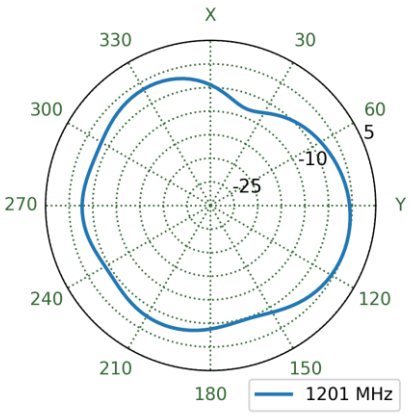
6.3 L2_L5 - Patterns at 1201 MHz



XZ Plane	YZ Plane	XY Plane
		

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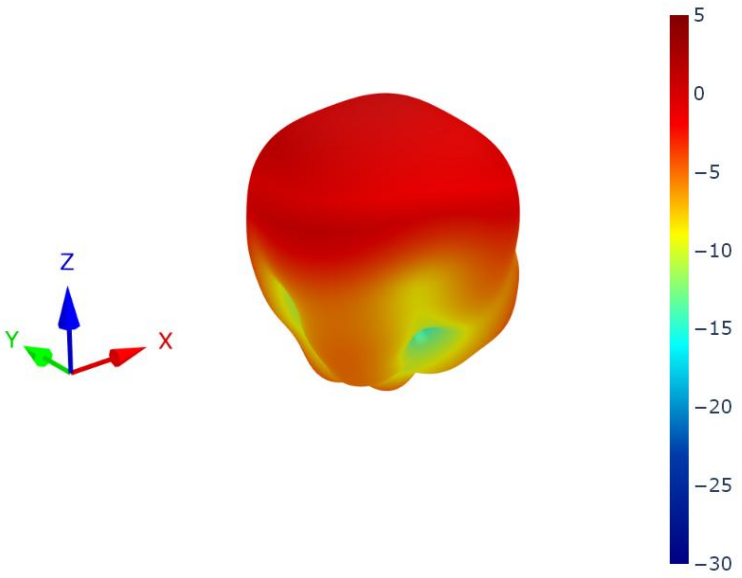
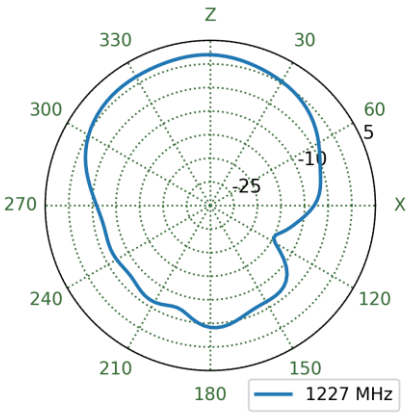
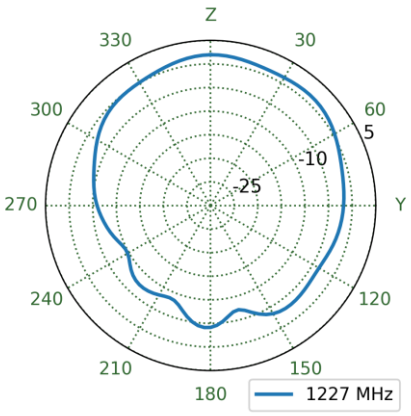
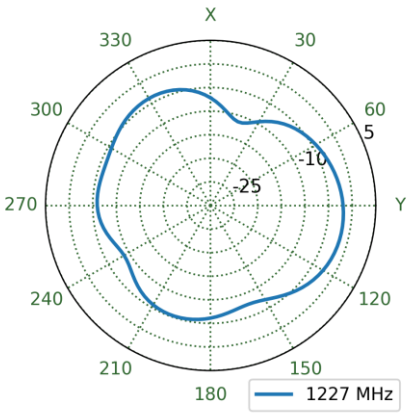
6.4 L2_L5 - Patterns at 1227 MHz



XZ Plane	YZ Plane	XY Plane
		

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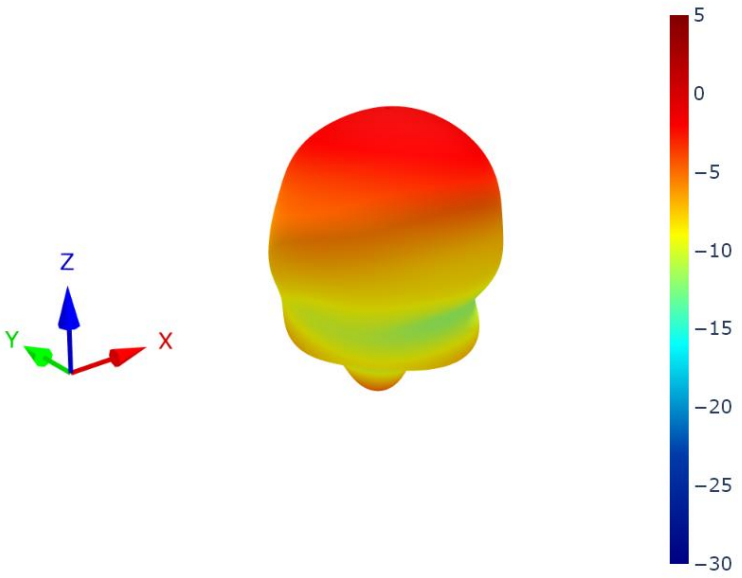
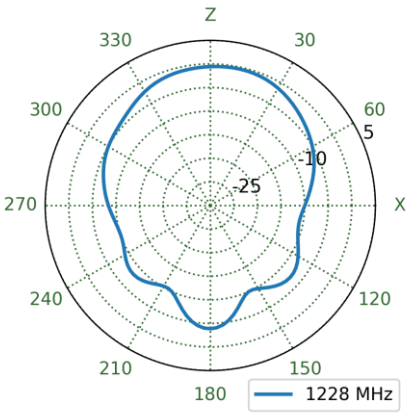
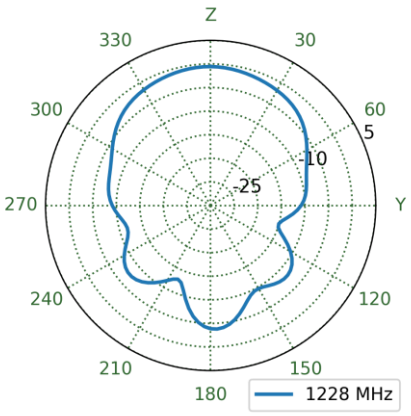
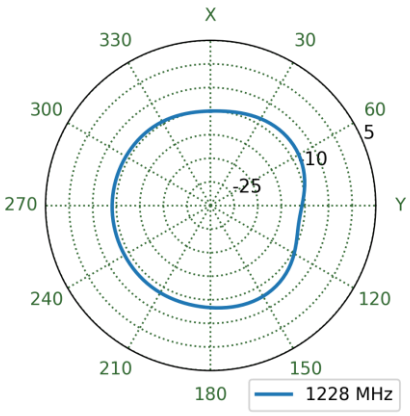
6.5 L2-L5 Band - Patterns at 1228 MHz



XZ Plane	YZ Plane	XY Plane
		

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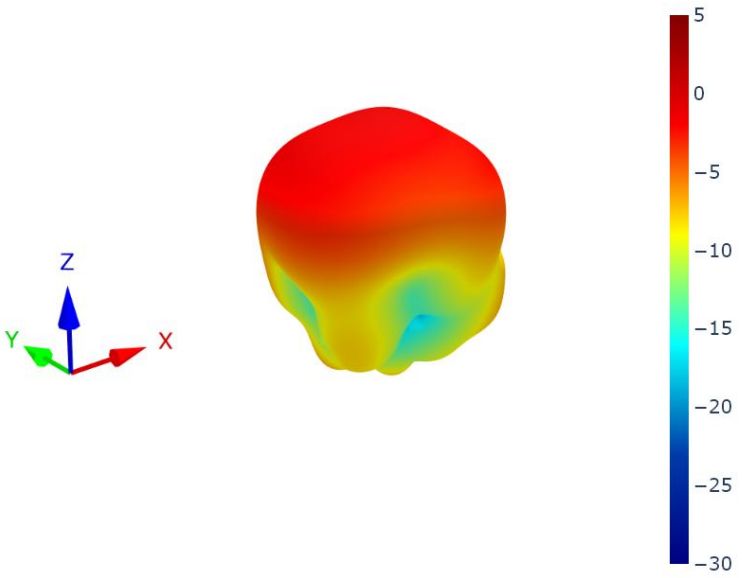
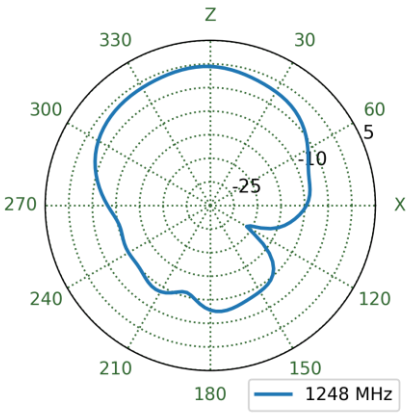
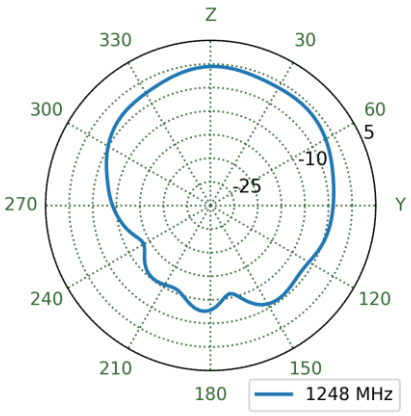
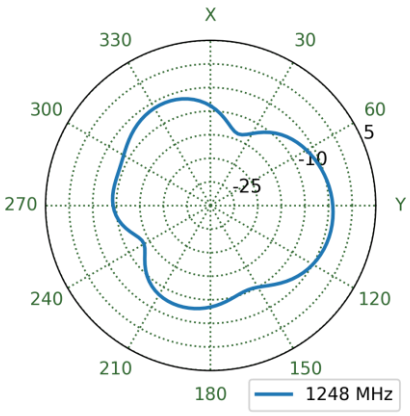
6.6 L2_L5 - Patterns at 1248 MHz



XZ Plane	YZ Plane	XY Plane
		

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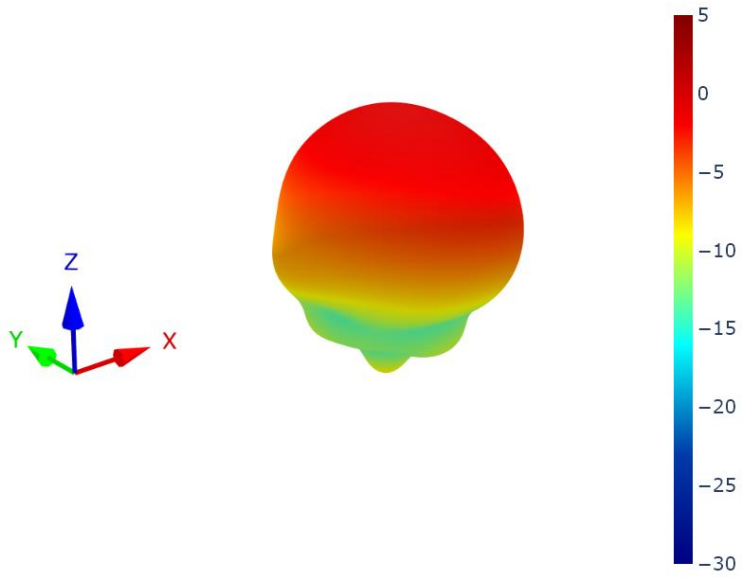
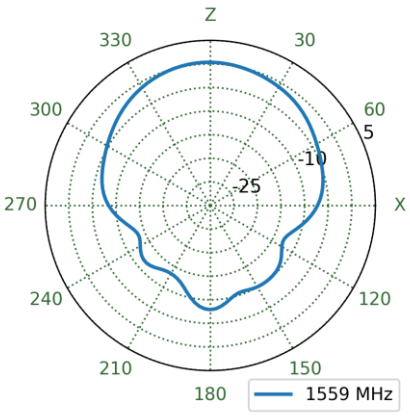
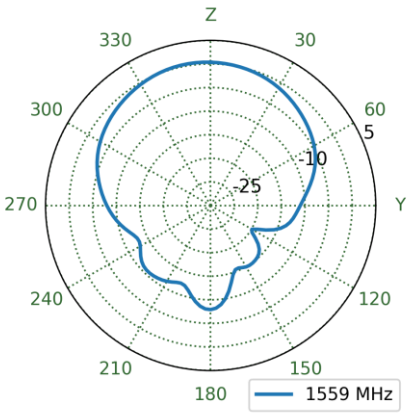
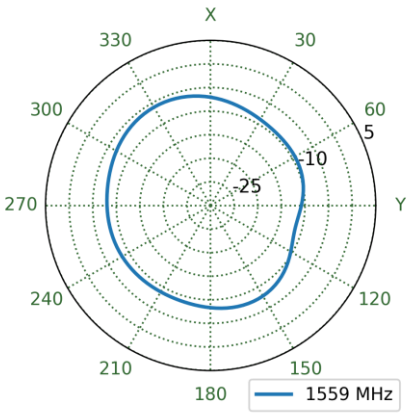
6.7 L1 Band - Patterns at 1559 MHz



XZ Plane	YZ Plane	XY Plane
		

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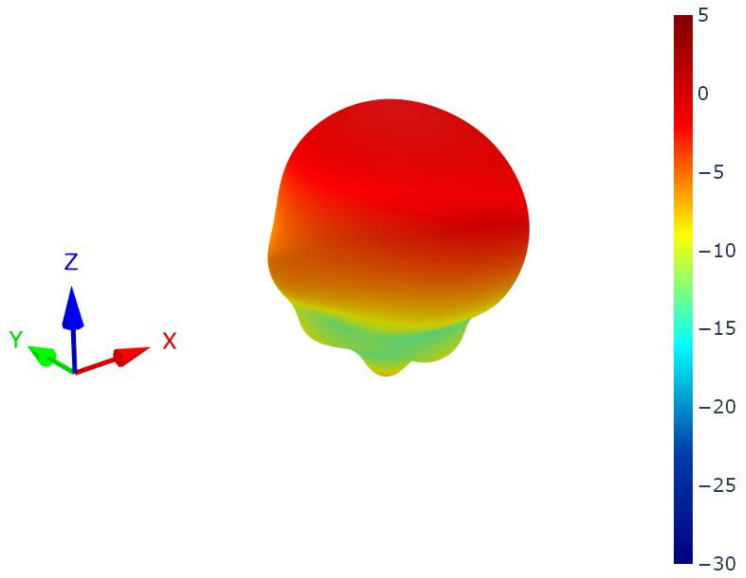
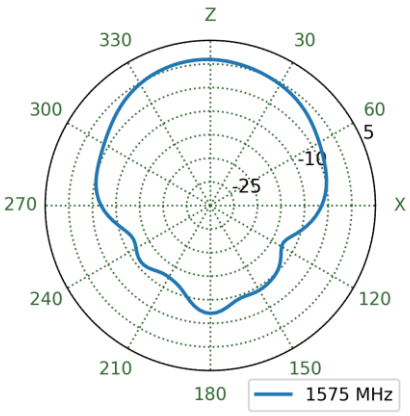
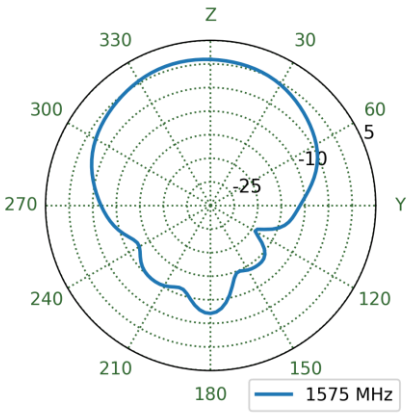
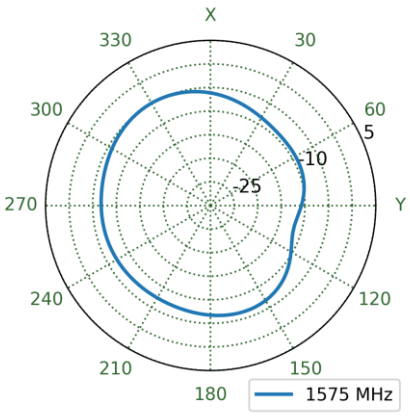
6.8 L1 Band - Patterns at 1575 MHz



XZ Plane	YZ Plane	XY Plane
		

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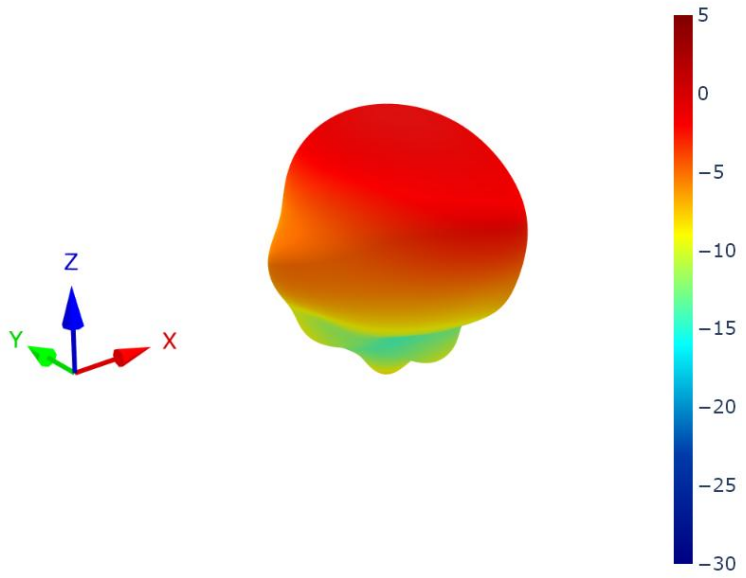
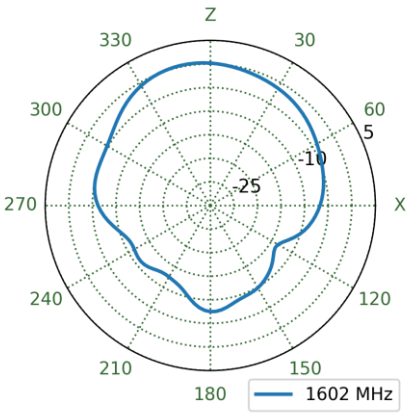
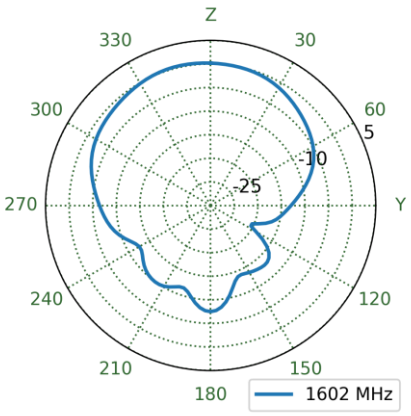
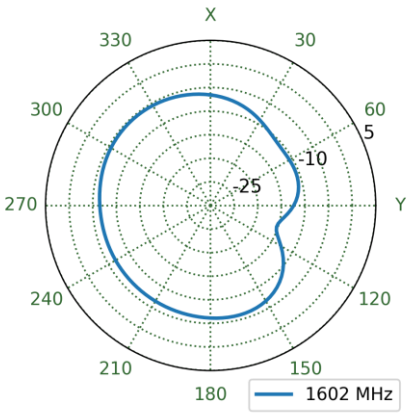
6.9 L1 Band - Patterns at 1602 MHz



XZ Plane	YZ Plane	XY Plane
		

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7. Field Test Results

This section outlines the field test result for GPDF5012.A antenna. The test was performed when the antenna was mounted on a static rooftop test set up in an open sky environment for a minimum of 6 hours.

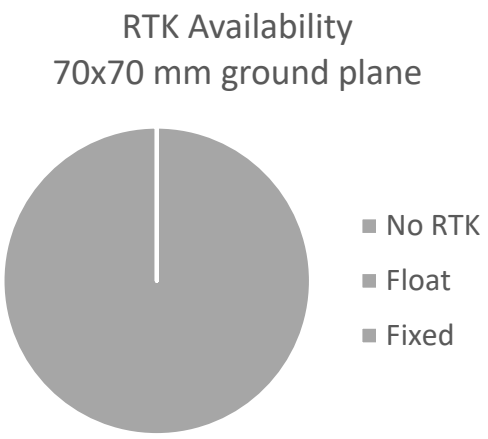
Taoglas will show the field test results using the following receivers:

7.1 Ublox ZED-F9P-0XB

Receiver features:

- Multi-band GNSS: 184-channel GPS L1C/A L2C, GLONASS: L1OF L2OF, Galileo: E1B/C E5b, BeiDou: B1I B2I, QZSS: L1C/A L2C
- Multi-band RTK with fast convergence times and reliable performance
- Nav. update rate RTK up to 20 Hz
- Position accuracy = RTK 0.01 m + 1 ppm CEP

Positioning Accuracy Table (2D Accuracy)					
Test Condition	**DRMS(cm)**	**CEP (50%)**	**DRMS (68%)**	**2DRMS (95-98.2%)**	**TTFF (sec)**
70x70mm Ground Plane	RTK DISABLED	46.6	56.4	112.8	32
	RTK ENABLED	1.0	1.2	2.4	32



Downloaded from Arrow.com.

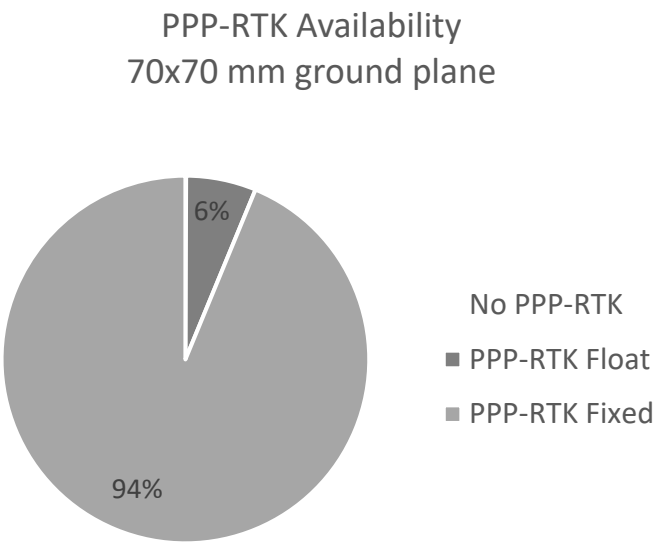
7.2 Ublox NEO-F9P-15B

Receiver features:

- Multi-band GNSS: GPS / QZSS (L1C/A, L5) GLONASS (L1OF) Galileo (E1-B/C, E5a) BeiDou (B1I, B2a) NavIC (SPS-L5)
- Multi-band PPP-RTK with fast convergence times and reliable performance
- Nav. update rate RTK up to 25 Hz
- Position accuracy = RTK 0.01 m + 1 ppm CEP

Positioning Accuracy Table (2D Accuracy)					
Test Condition	**DRMS(cm)**	**CEP (50%)**	**DRMS (68%)**	**2DRMS (95-98.2%)**	**TTFF (sec)**
70x70mm Ground Plane	PPP-RTK DISABLED	103.19	123.52	247.06	27
	PPP-RTK ENABLED	16.7	20.04	40.08	33

*The RTK correction service used in previous measurements provides superior corrections compared to the PPP-RTK service used for measurements on the NEO-F9P.



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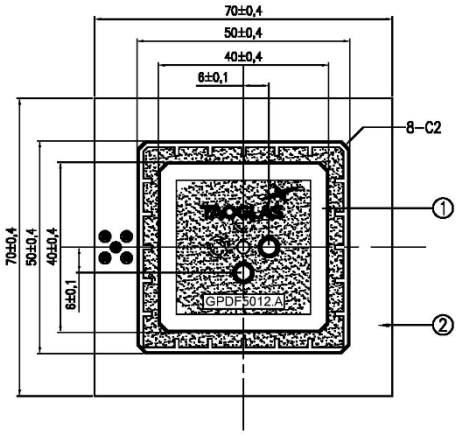
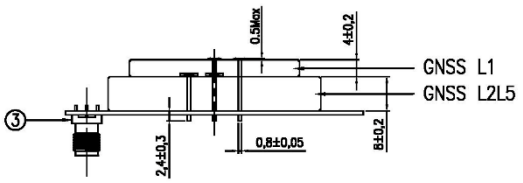
8. Evaluation Board Drawing (Units: mm)

The GPDFD5012.A evaluation board combines the low-band and high-band feeds for passive measurements through a single RF port. Due to the combiner, an approximate 3 dB performance reduction is expected. The results shown in this datasheet are based on uncombined feeds and are not representative of the combined evaluation board performance.

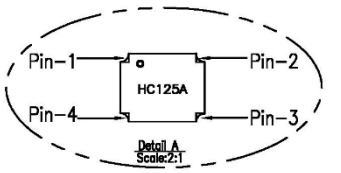
NOTES: 2. Soldermask Area:
3. Adhesive Tape :
4. Silver :



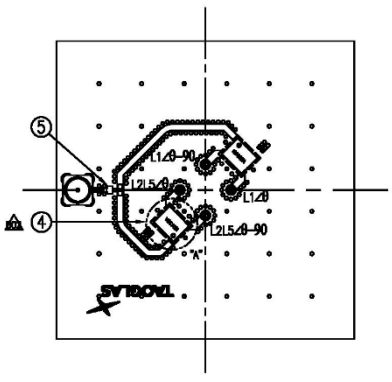
Top



Side



	Configuration	Pin-1	Pin-2	Pin-3	Pin-4
1	GNSS L1	Output	Isolated	∠0	∠0-90
2	GNSS L2L5	Output	Isolated	∠0	∠0-90



Bottom

	Name	P/N	Material	Finish	QTY
1	GPDF5012.A Patch 50x50x12mm	013ABAZ00J04D	Ceramic	Clear	1
2	PCB_70x70x1.0mm	02110213040100	FR-4	Black	1
3	SMA(M) Connector	02104220000040	Copper	Gold	1
4	Hybrid Coupler	02121139081000	–	Silver	2
5	Power Divider	02102NPD092210	–	Black	1

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9. Antenna Integration Guide

The following example demonstrates the integration of the GPDF5012.A into a design. The antenna features four feed pins, with two dedicated to the L1 band and two dedicated to the L2/L5 bands. A hybrid coupler, such as the Taoglas HC125A, can be used to combine the L1 and L2/L5 feeds, generating a Right-Hand Circularly Polarized (RHCP) signal at the coupler output.

To achieve optimal performance, Taoglas recommends a minimum PCB ground plane size of 70 × 70 mm.

In this integration guide, the Taoglas TFM.120.A active electronics module is used to illustrate the implementation of the GPDF5012.A and transform it from a passive to an active antenna.



Top and bottom view of PCB reference design.

Please find the Integration files in Altium, 2D formats and the 3D model for the GPDF5012.A here: https://www.taoglas.com/product/multiband-high-precision-gnss/

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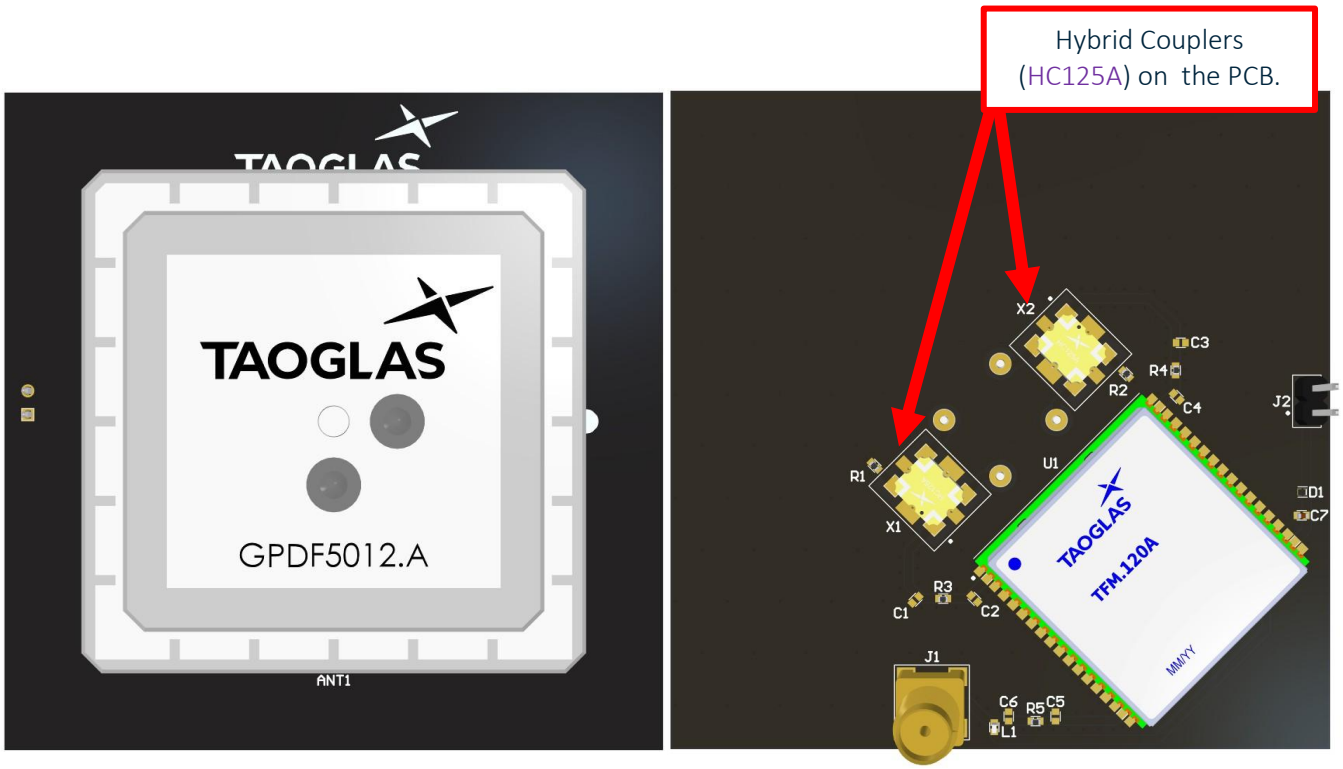
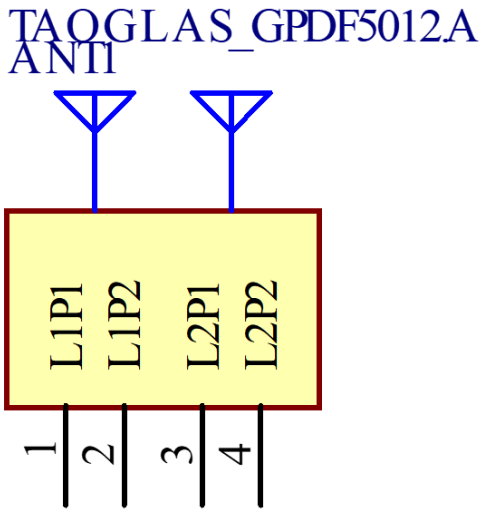
9.1 Schematic Symbol and Pin Definitions



The circuit symbol for the GPDF5012.A is shown below. The antenna has 4 pins as indicated below.

Pin	Description
1	L1P1 (0˚)
2	L1P2 (-90˚)
3	L2P1 (0˚)
4	L2P2 (-90˚)



Above is a schematic symbol of GPDF5012.A and a table of the pin definitions.

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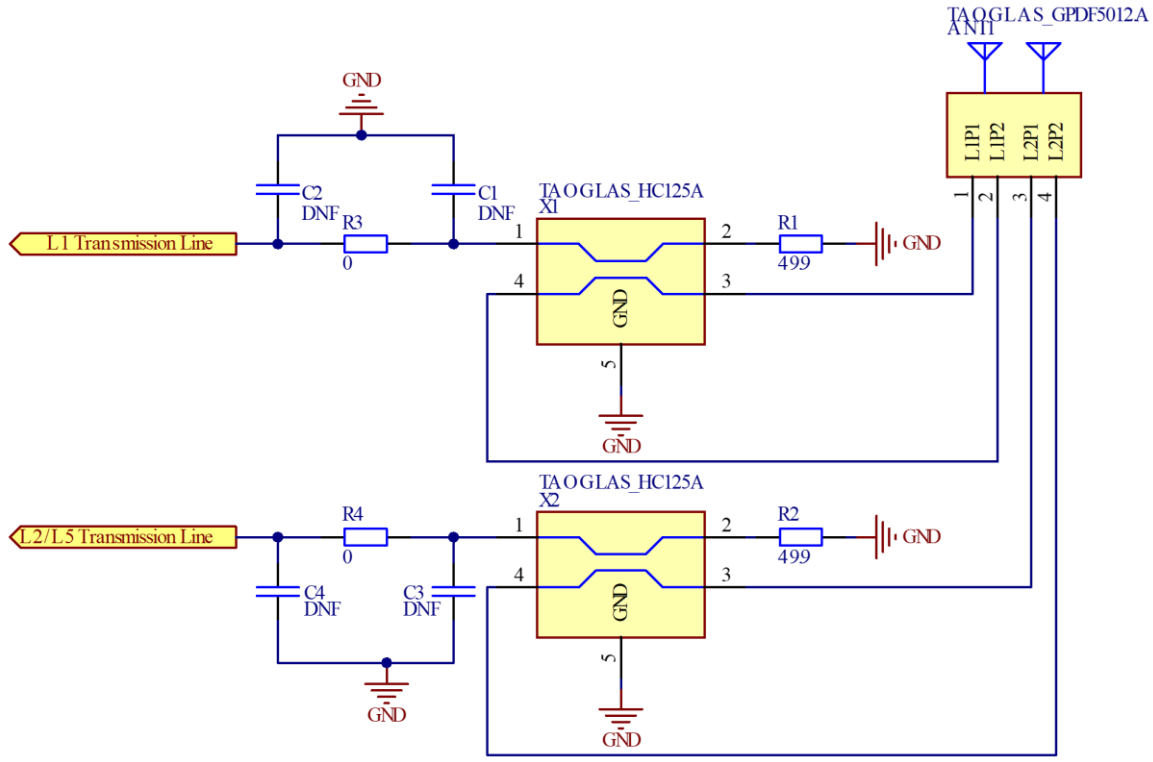
9.2 Schematic Layout

The GPDF5012.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.

Two HC125As are required for this antenna, one for the high GNSS band of operation (1559-1610MHz) and another for the low GNSS band (1164MHz-1300MHz). This hybrid coupler should be placed close to the antenna pins and terminated correctly using a 49.9 Ohm resistors.

The output of each of the hybrid couplers can feed into separate paths for high and low band GNSS filtering and amplification.



Designator	Type	Value	Manufacturer	Manufacturer Part Number
C1, C2, C3, C4	Capacitor	Not Fitted	-	-
R1, R2	Resistor	49.9 Ohms	Murata	RC0402FR-0749R9L
R3, R4	Resistor	0 Ohm	Murata	RC0402JR-070RL

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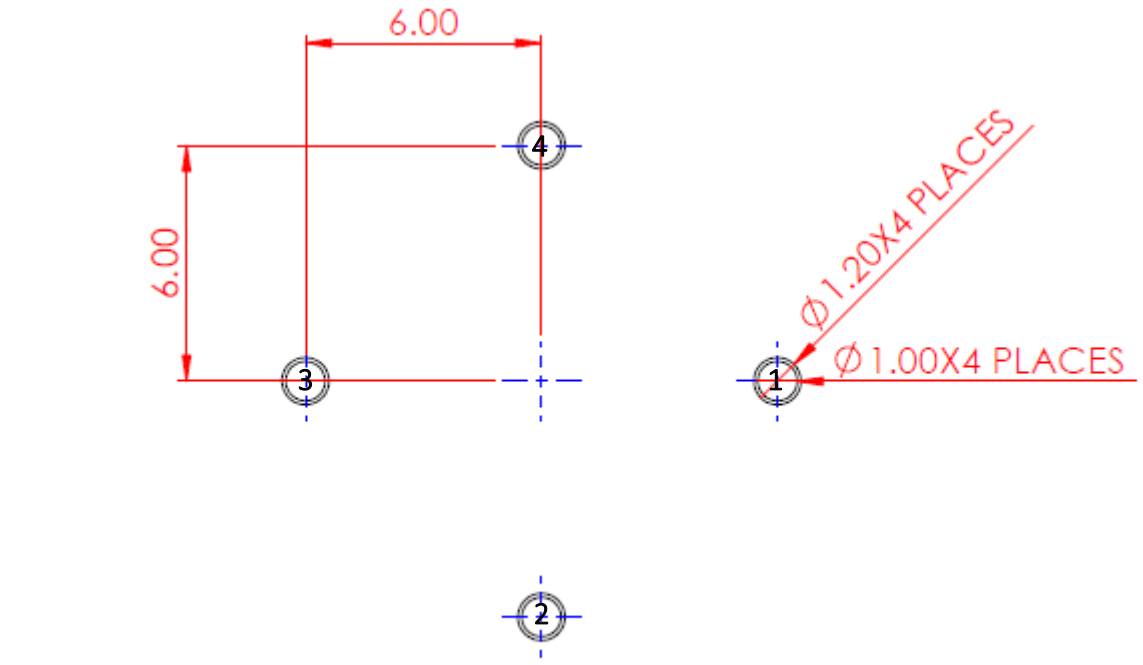
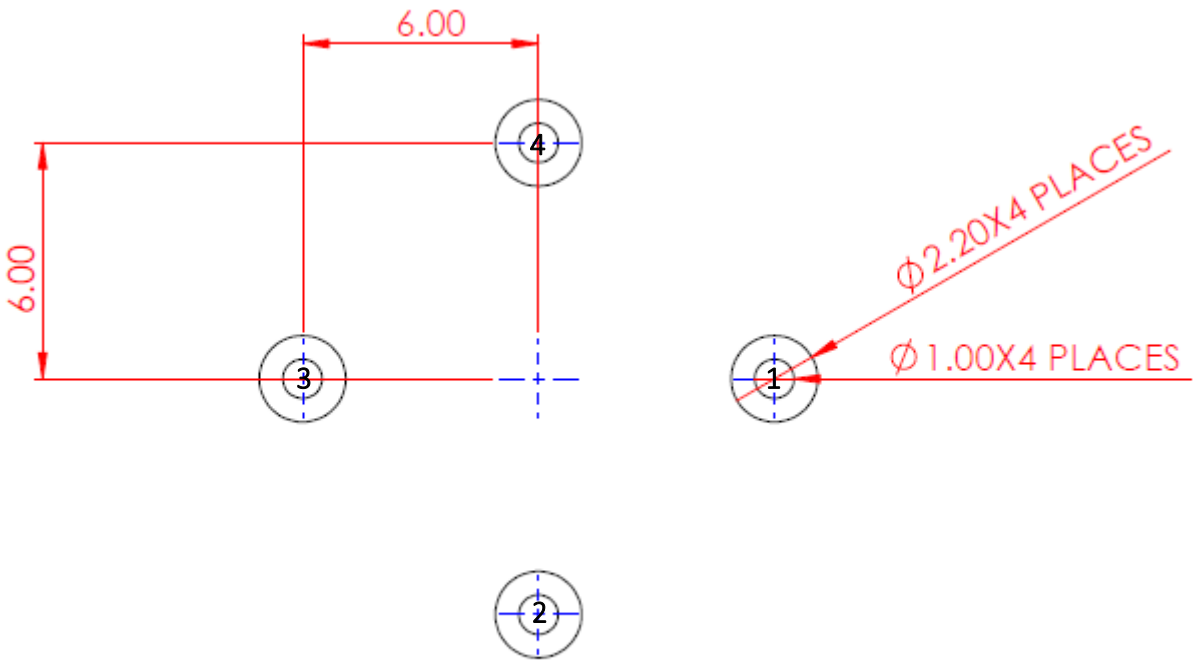
9.3 Antenna Footprint



TOP COPPER



BOTTOM COPPER

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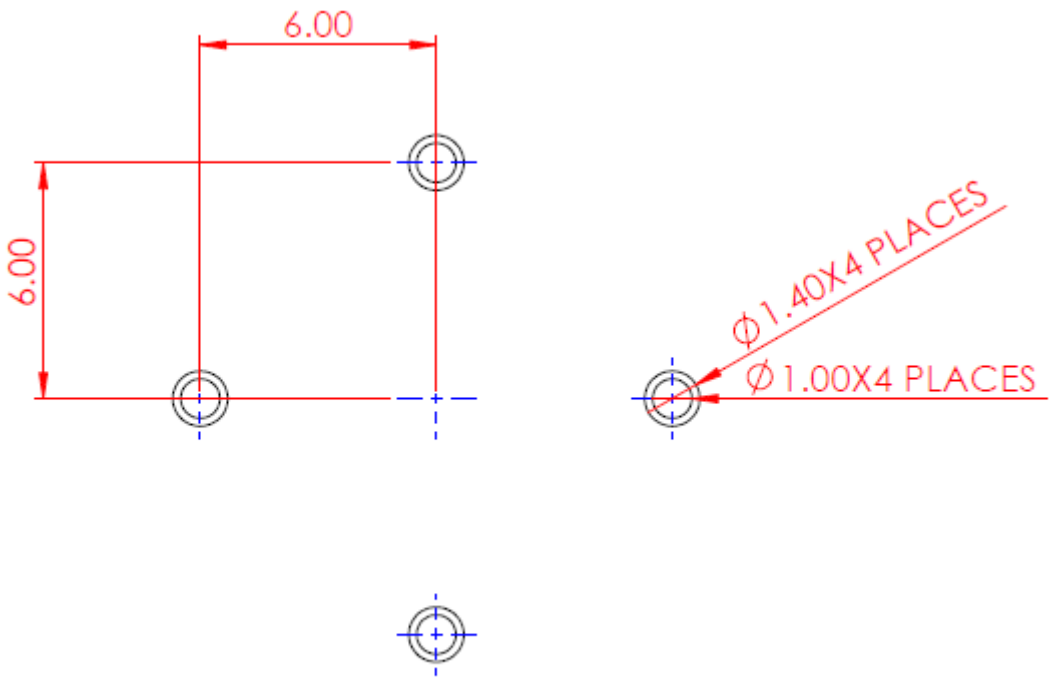
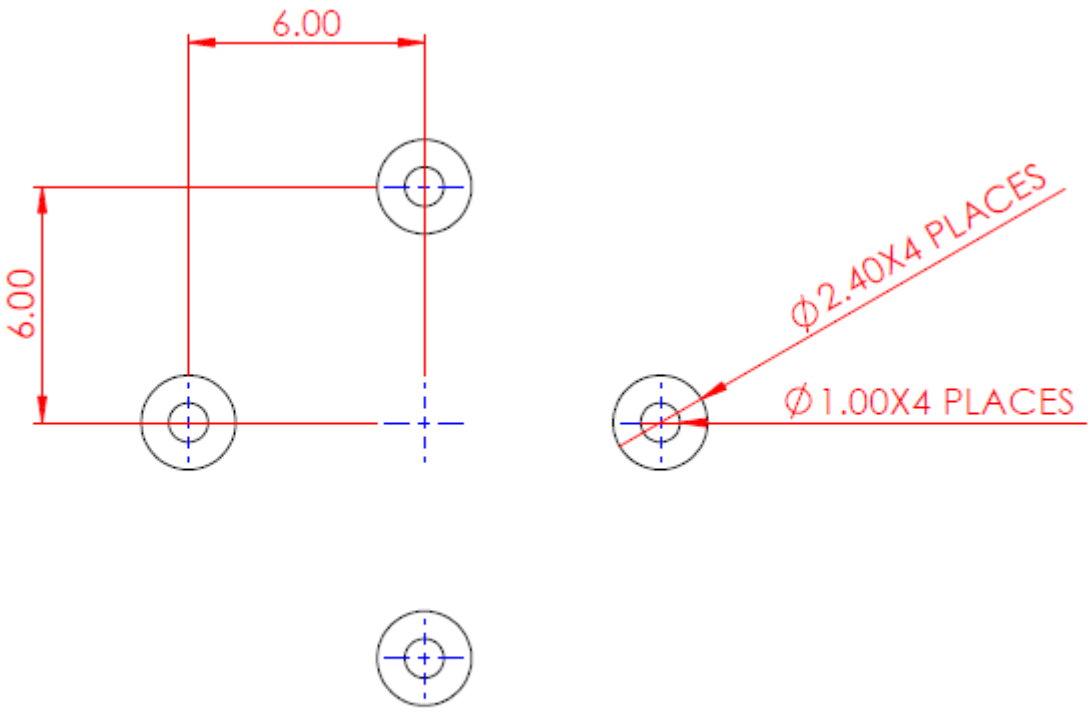
9.4 Solder Mask



TOP SOLDER MASK



BOTTOM SOLDER MASK

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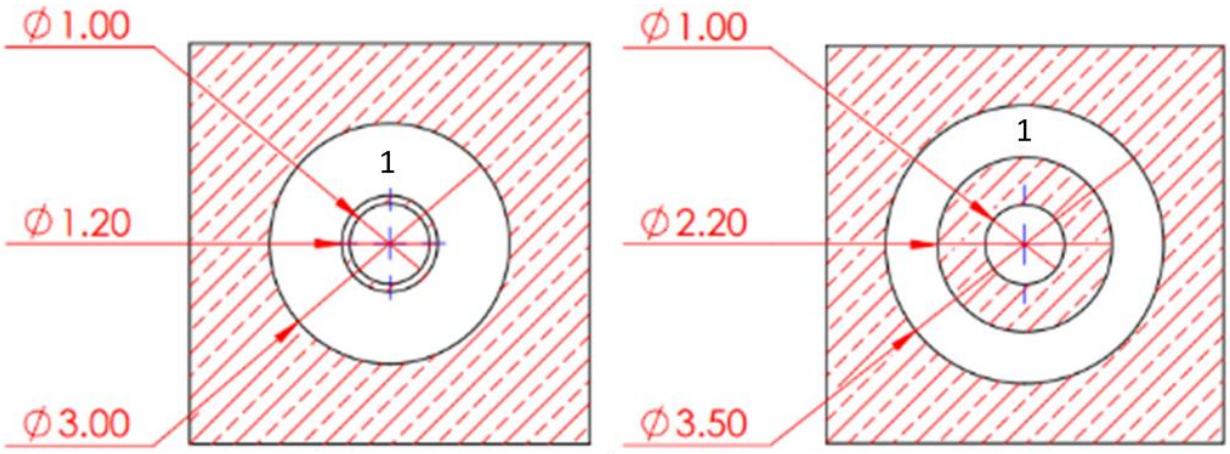
9.5 Copper Clearance

The footprint and clearance on the PCB must comply with the antenna's specification. The PCB layout shown in the diagrams below demonstrates the GPDF5012.A clearance area. The copper keep out area differs between layers that are below the GPDF5012.A for each of the 4 pins.

The copper clearance area for the bottom layer should be Ø3.5mm around the antenna pads. The copper clearance area for the top and internal layers should Ø3mm around the antenna pads.



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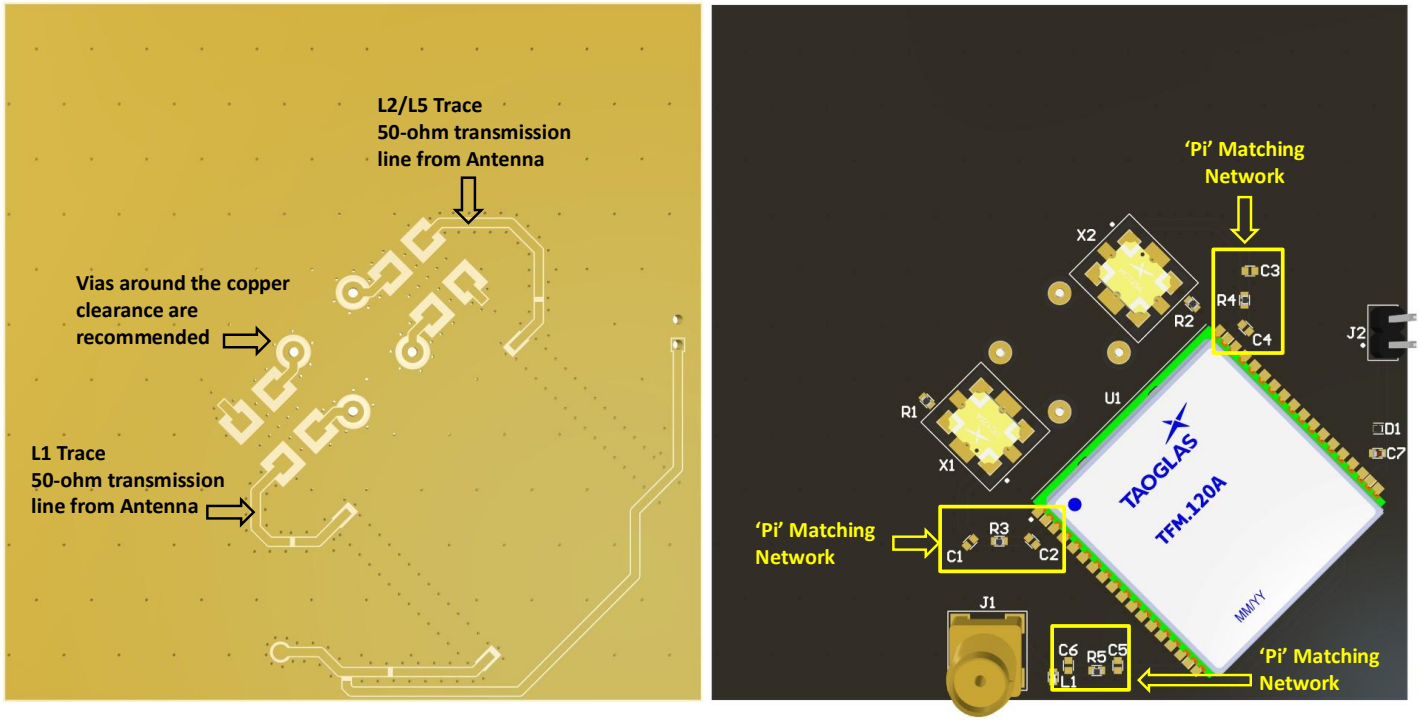
9.6 Antenna Integration

The GPDF5012.A should be placed in the centre, as close to the edge on the long side of the PCB as possible, to take advantage of the ground plane. The RF trace must maintain a 50 Ohm transmission line. A “pi” Matching Network is recommended for the RF transmission line, the values and components for the matching circuit will depend on the tuning needed. Ground vias should be placed around the transmission line and the copper clearance area.



Back view of PCB reference design, showing the transmission line and integration notes.

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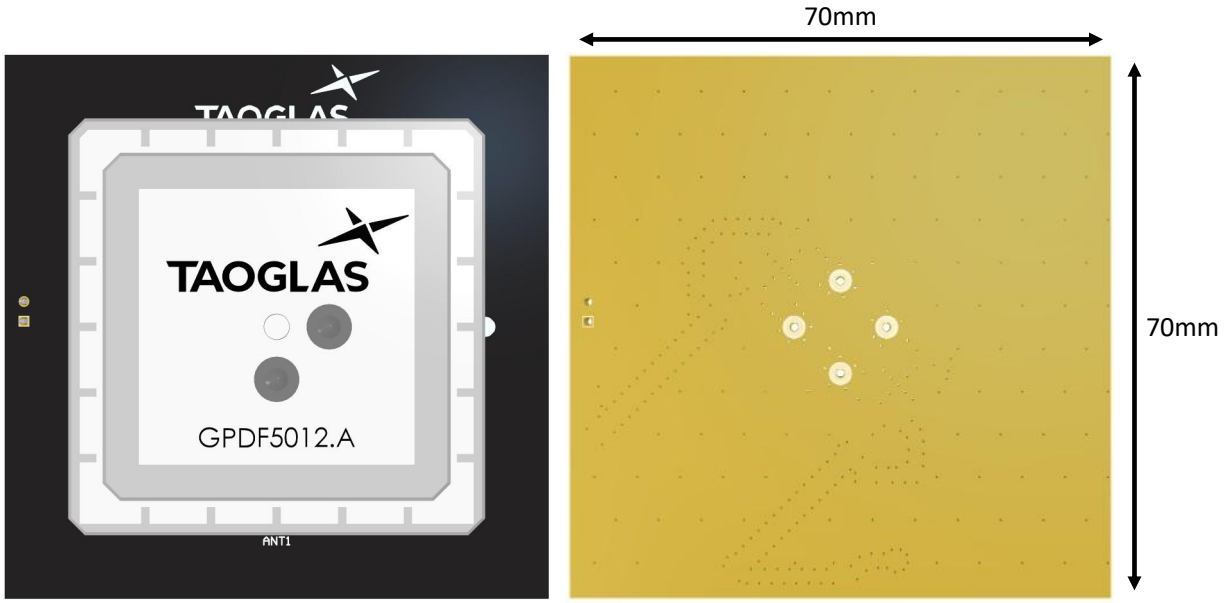
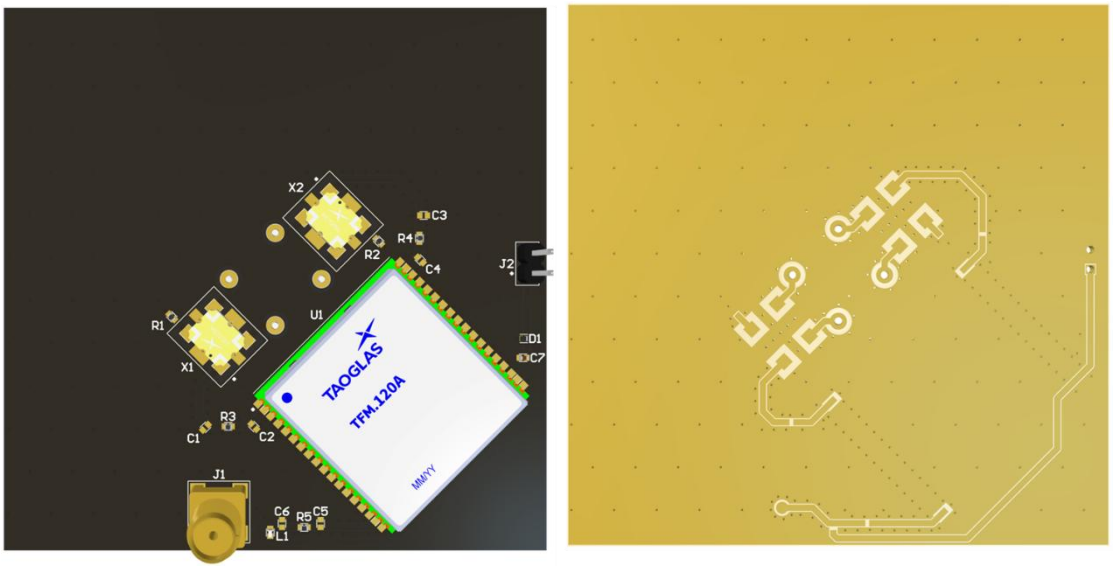
9.7 Final Integration

The top side image shown below highlights the antenna transmission line. Taoglas recommends using a minimum of 70x70mm ground plane (PCB) to ensure optimal performance.



Top Side (GPDF5012.A placement on 70x70mm PCB reference design)



Bottom Side (HC125A placement)

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Changelog for the datasheet

SPE-20-8-103– GPDF5012.A

Revision: G (Current Version)	
Date:	2026-10-01
Notes:	Updated the text to clarify testing, integration guidance, and evaluation board requirements.
Author:	Gary West

Previous Revisions

Revision: F	
Date:	2025-04-28
Notes:	Full datasheet update.
Author:	Gary West

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

Revision: E	
Date:	2023-07-25
Notes:	Updated Antenna Field Testing
Author:	Gary West

Revision: D	
Date:	2023-05-16
Notes:	Updated test data
Author:	Gary West

Revision: C	
Date:	2022-01-11
Notes:	Added integration guide
Author:	Gary West

Revision: B	
Date:	2022-01-11
Notes:	Added integration guide
Author:	Gary West

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