Datasheet

GNSS Dual Feed Stacked Patch

Part No:
HP54510A

Description

Passive Multiband High Precision GNSS L1/L5 Stacked Patch Antenna

Features:

Bands Covered:
- BeiDou (B1/B2a)
- GPS/QZSS (L1/L5)
- GLONASS (G1)
- Galileo (E1/E5a)
- L Band Corrections

Dual pin, dual feed, 4-pin configuration
Dimensions: 45 x 45 x 10mm
RoHS & Reach Compliant

Ireland ISO 9001: 2015 Certified

Taiwan ISO 9001: 2015 Certified

IATF16949

1. Introduction

The Taoglas HP54510A is a high performance, multi-band passive GNSS antenna that has been carefully designed to provide fantastic positional accuracy on the L1/L5 GNSS spectrum. It covers GPS/QZSS L1/L5, GLONASS G1, Galileo E1/E5a, BeiDou B1/B2a, as well as SBAS (WAAS/EGNOS/GAGAN/SDCM/SNAS) as well as the L Band at 1525MHz.

Correct implementation of the HP54510A 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 center stability to ensure a location is correctly established in a navigation system.

Typical applications that benefit from high precision capabilities include:

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

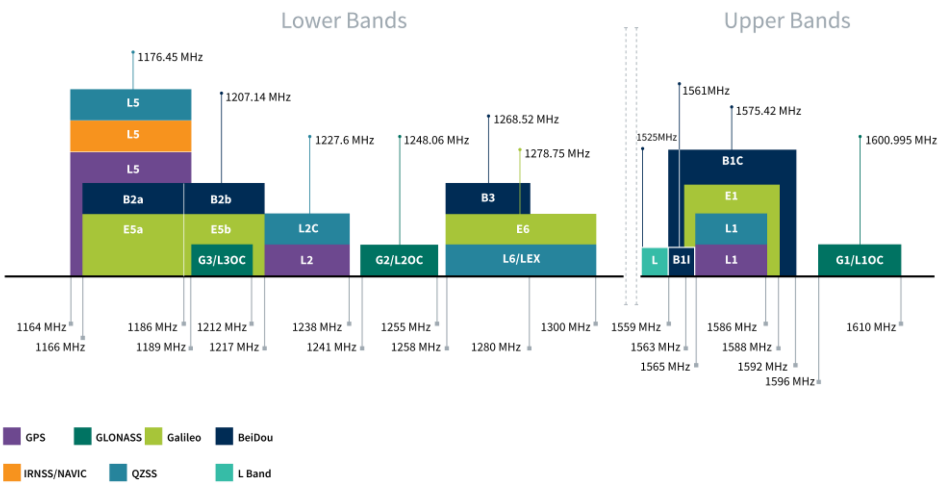
The HP54510A is the latest embedded addition to Taoglas' product portfolio of high precision GNSS antennas. When used on the base and/or the rover as part of an RTK configuration, the HP54510A can achieve genuine cm-level accuracy with proven results.

Full integration guidelines are contained in Section 6 of this datasheet including the Taoglas HC125A hybrid coupler that will be required for use for dual pin feed patch integrations.

Contact your regional 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

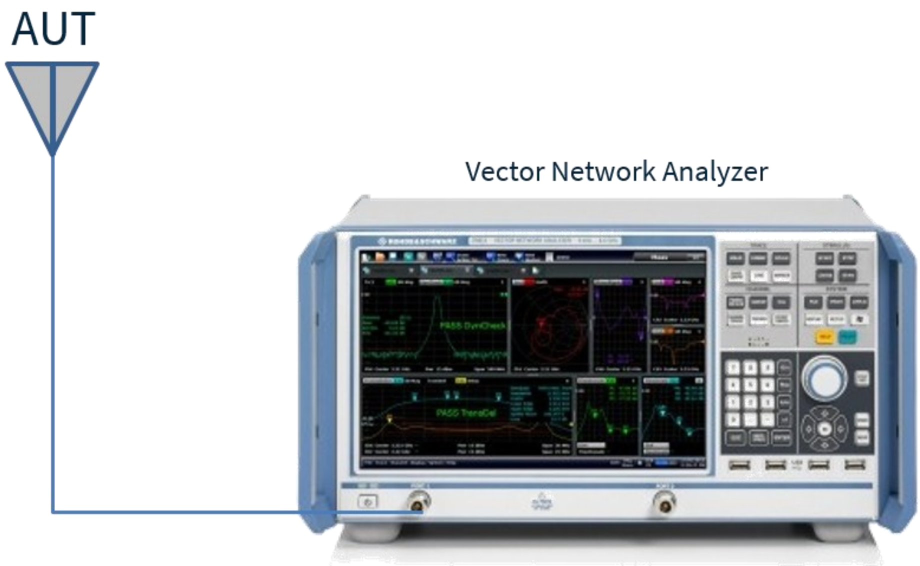
Electrical					
Frequency (MHz)	GPS L5	L Band	BeiDou B1	GPS L1	GLONASS G1
	1166-1187	1525-1559	1559-1563	1563-1587	1593-1610
Efficiency (%)	82.7	71.5	83.5	83.5	61.1
Average Gain (dB)	-0.83	-1.46	-0.78	-0.78	-2.14
Peak Gain (dBi)	4.82	4.94	5.06	5.08	4.15
Axial Ratio(dB)	4.42	1.35	1.27	1.34	1.82
Impedance	50 Ω				
Polarization	RHCP				
Radiation Pattern	Directional				

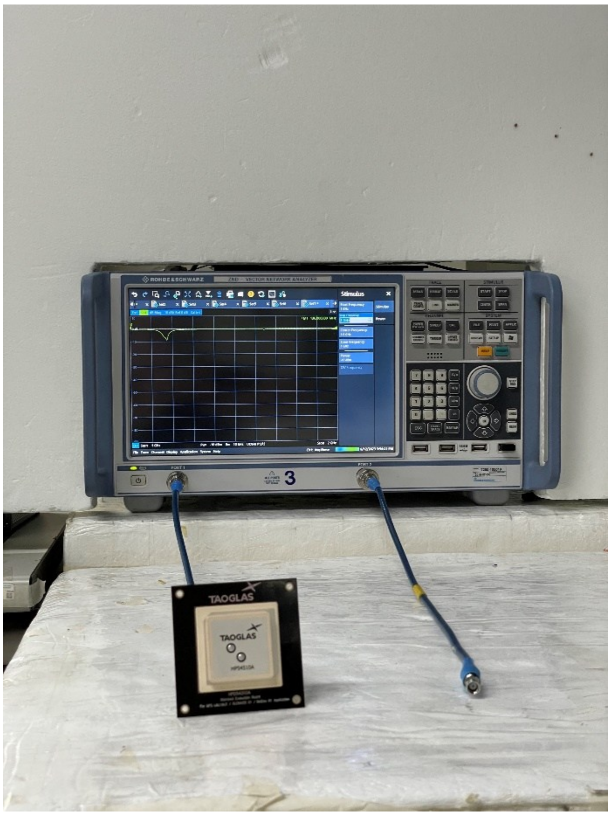
*Antenna properties were measured with the antenna mounted on 70*70mm Ground Plane with Hybrid Coupler

Mechanical	
Dimensions	45 x 45 x 10 mm
Weight	54g
Material	Ceramic
Environmental	
Operating Temperature	-40°C to 85°C
Storage Temperature	-40°C to 85°C
Humidity	Non-condensing 65°C 95% RH

3. Antenna Characteristics

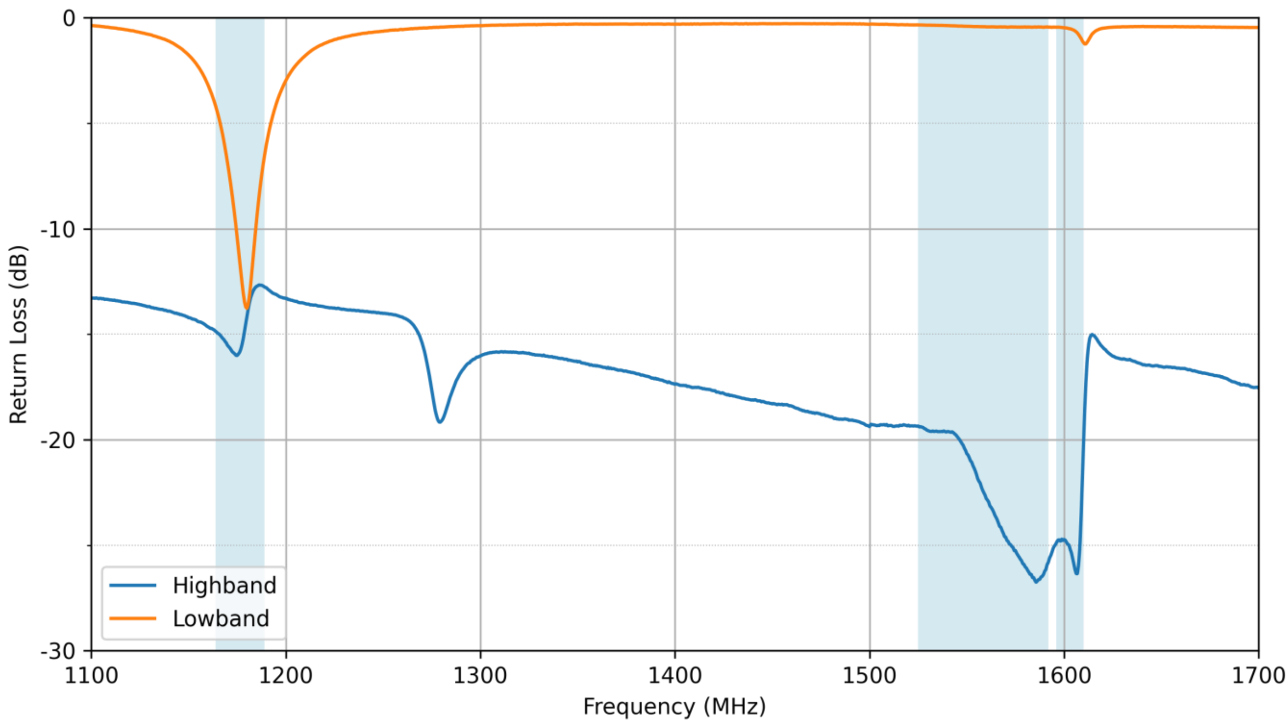
3.1 Test Setup



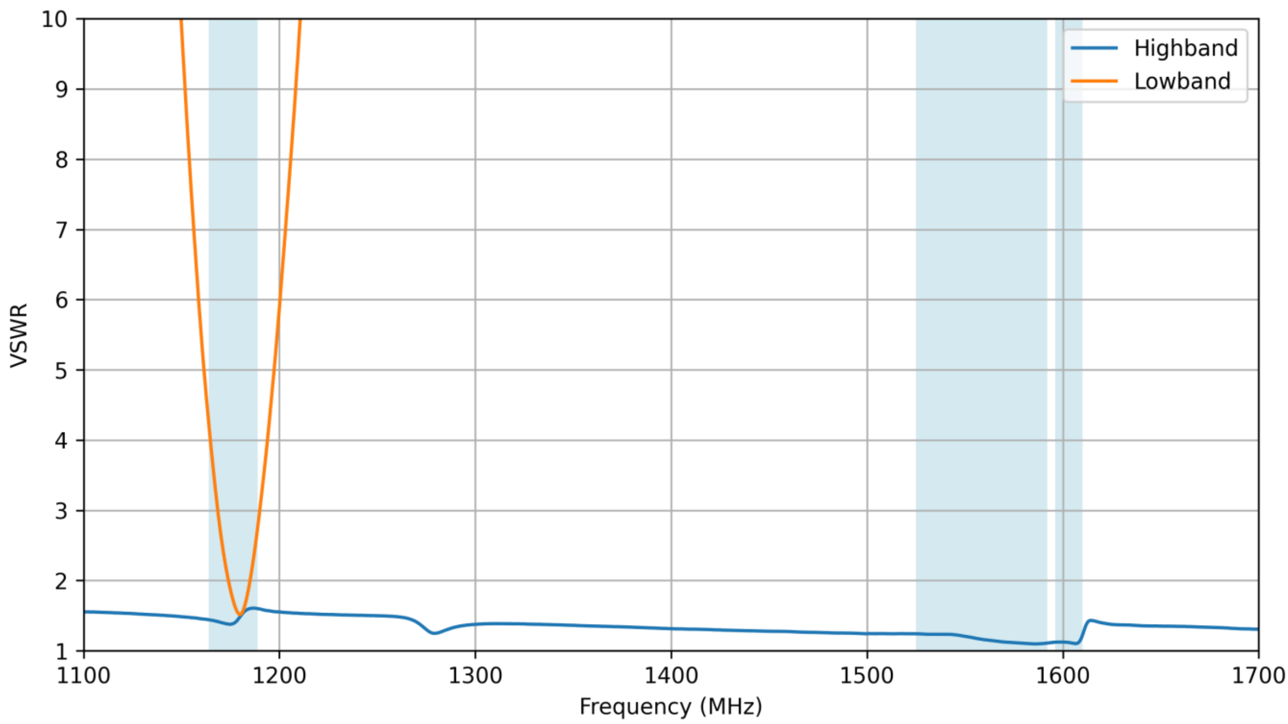


Tested on a 70x70mm Ground Plane

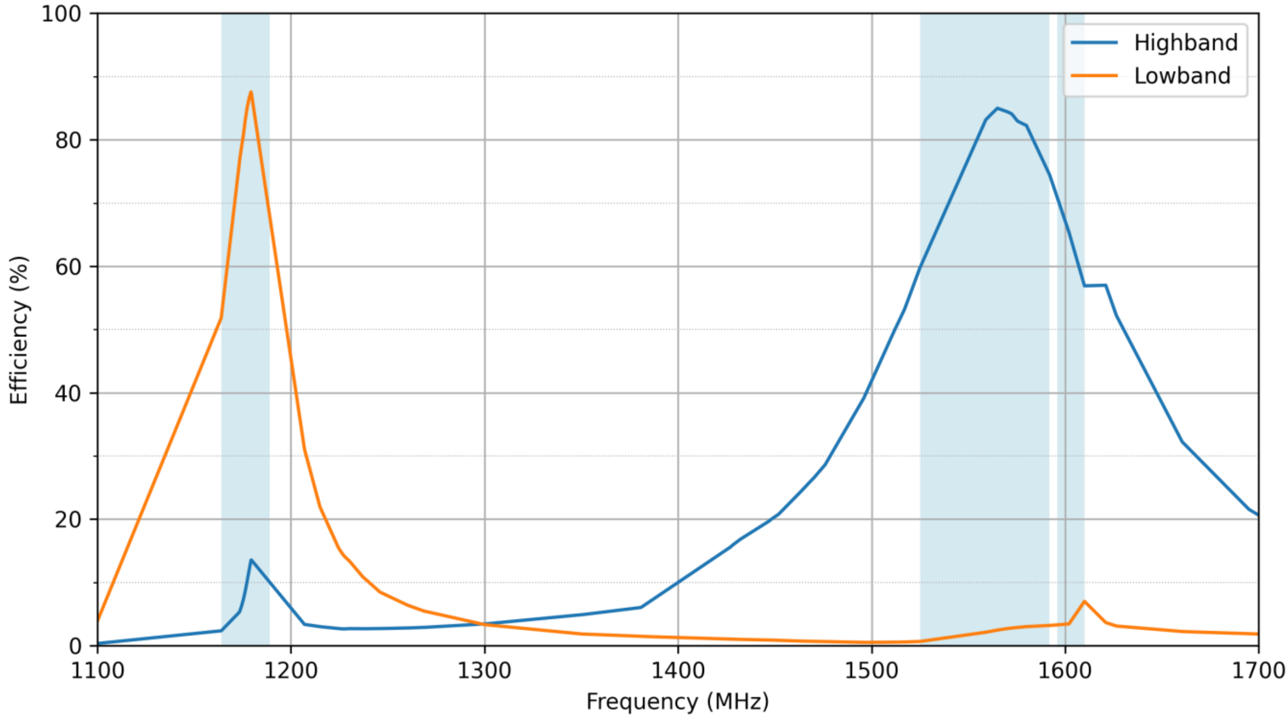
3.2 Return Loss



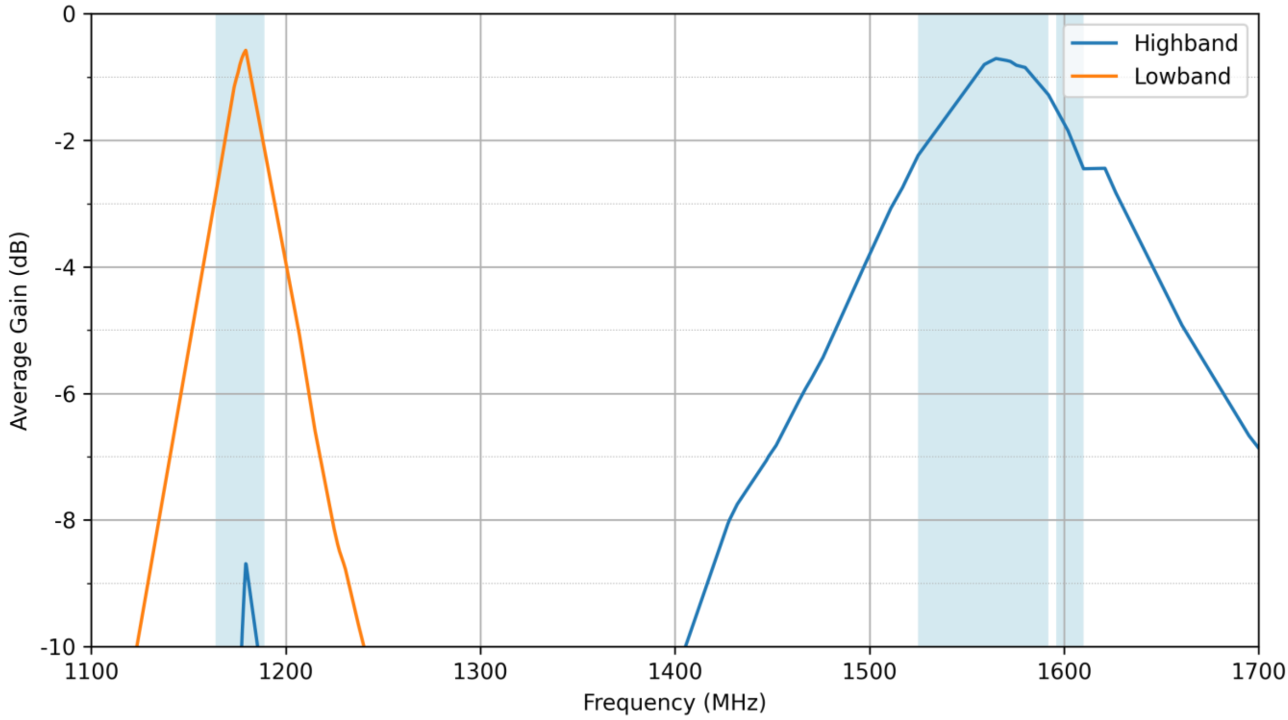
3.3 VSWR



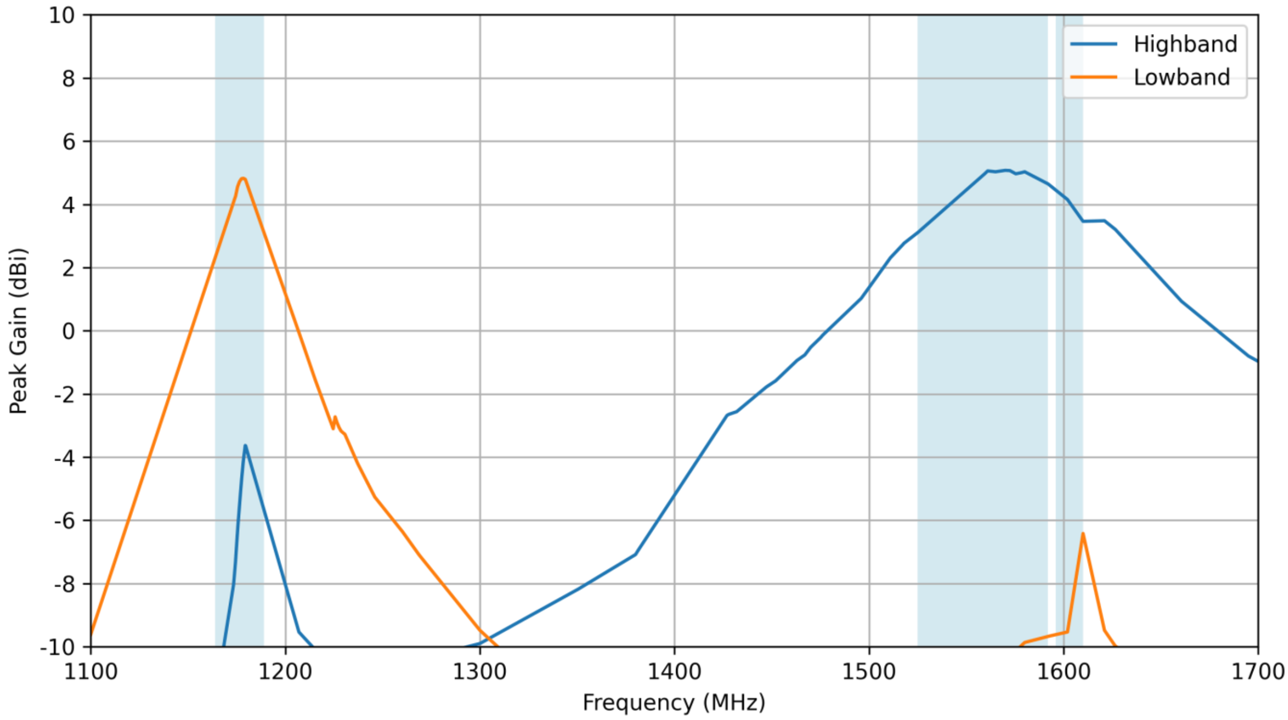
3.4 Efficiency



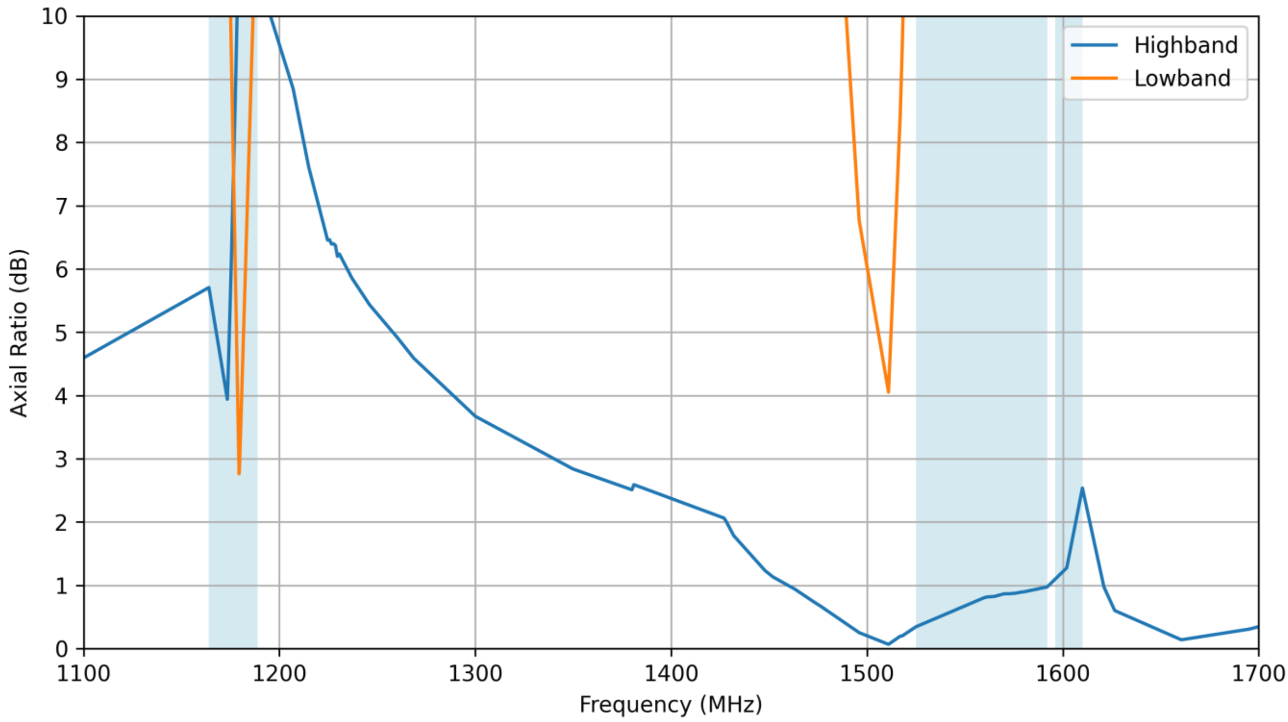
3.5 Average Gain



3.6 Peak Gain

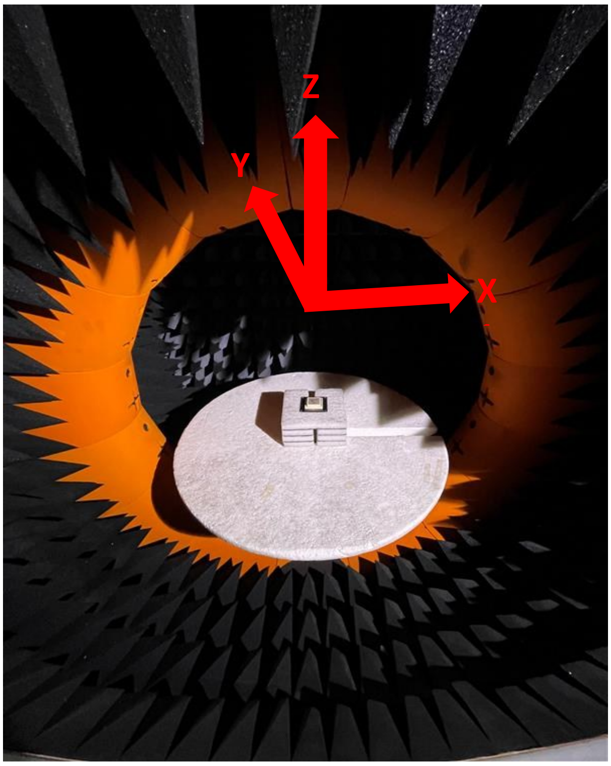


3.7 Axial Ratio



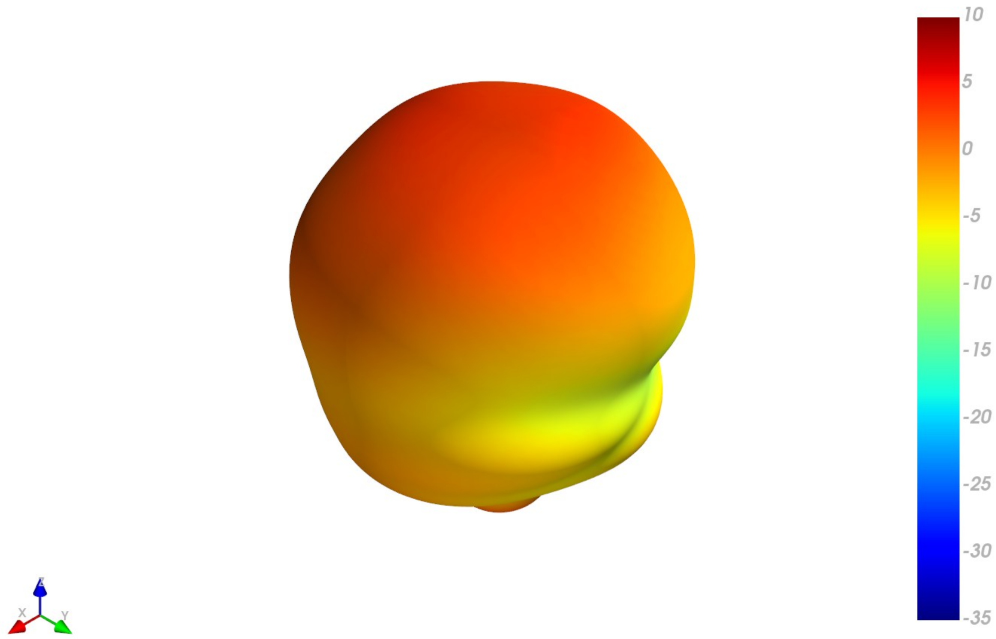
4. Radiation Patterns

4.1 Test Setup

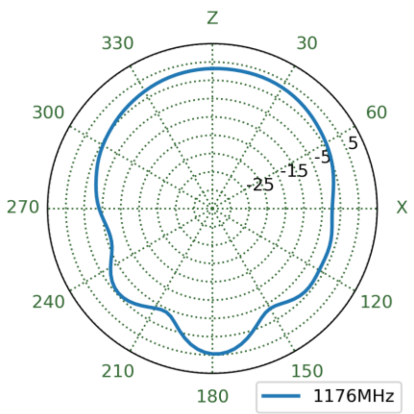


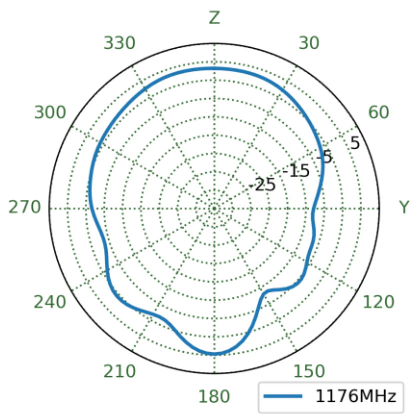
Tested on a 70x70mm Ground Plane

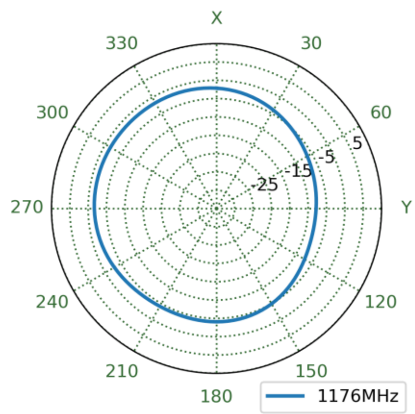
4.2 Patterns at 1176.45MHz



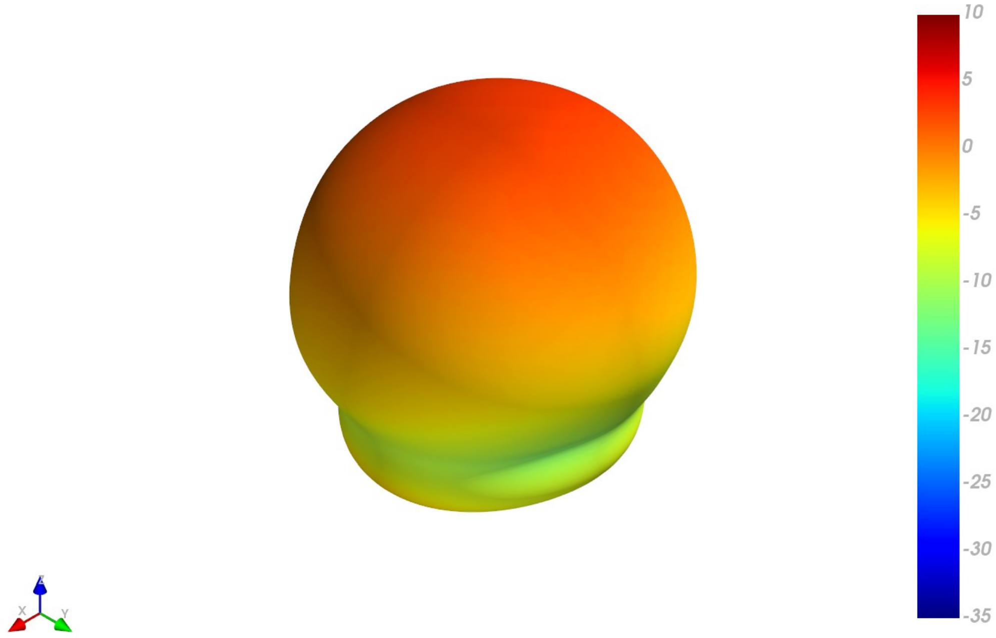
XZ Plane	YZ Plane	XY Plane



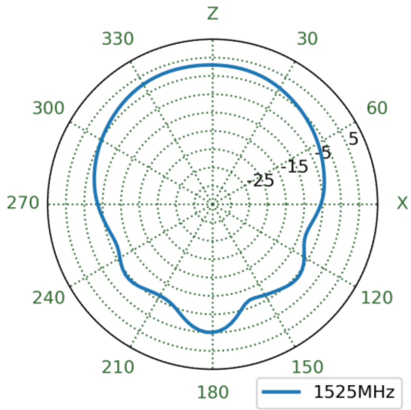


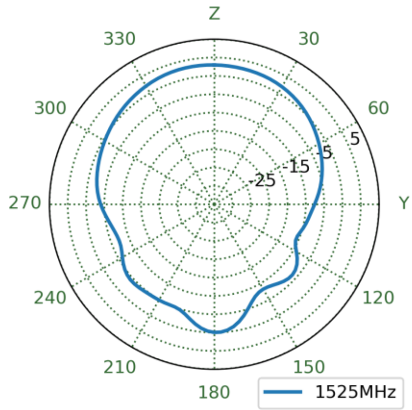


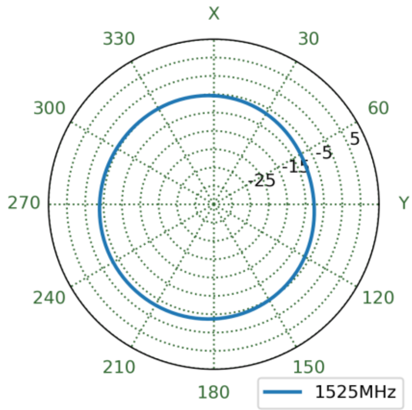
4.3 Patterns at 1525MHz



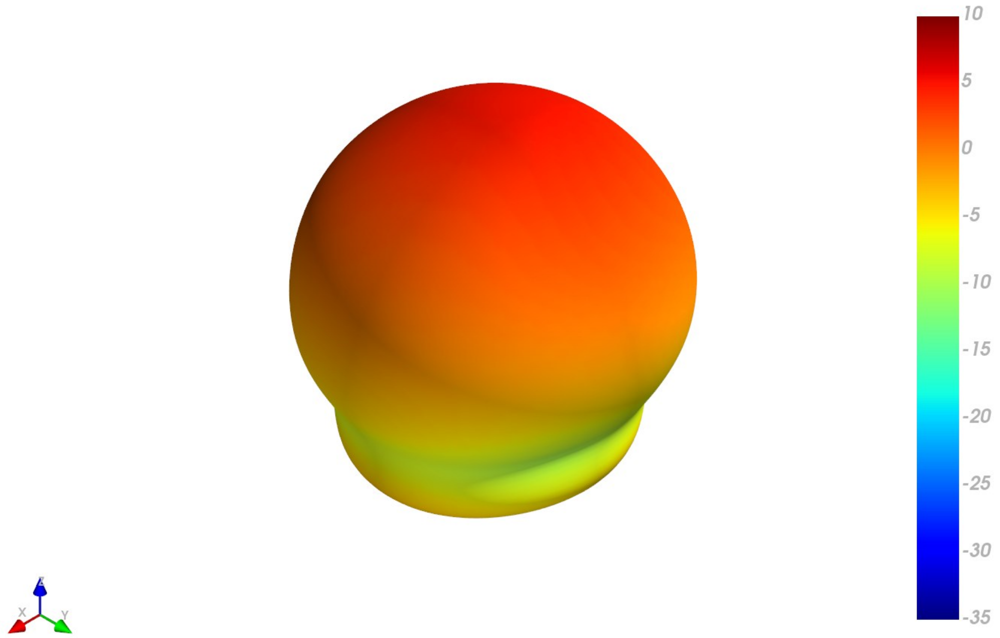
XZ Plane	YZ Plane	XY Plane



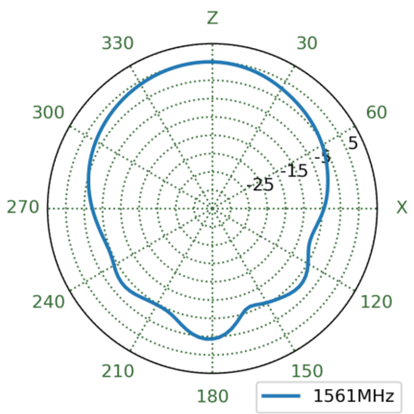


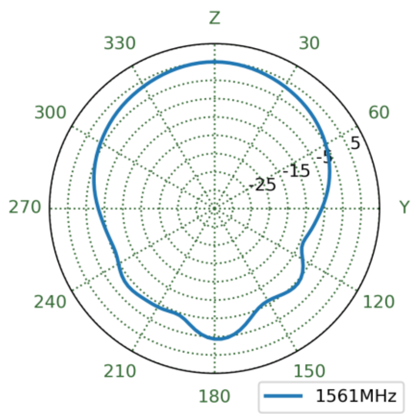


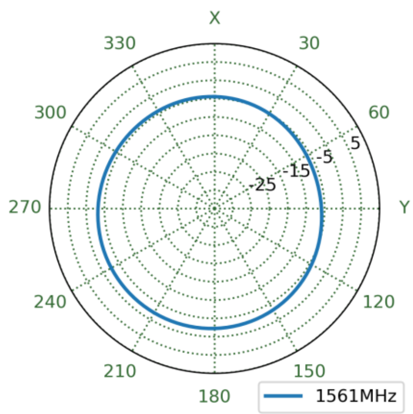
4.4 Patterns at 1561MHz



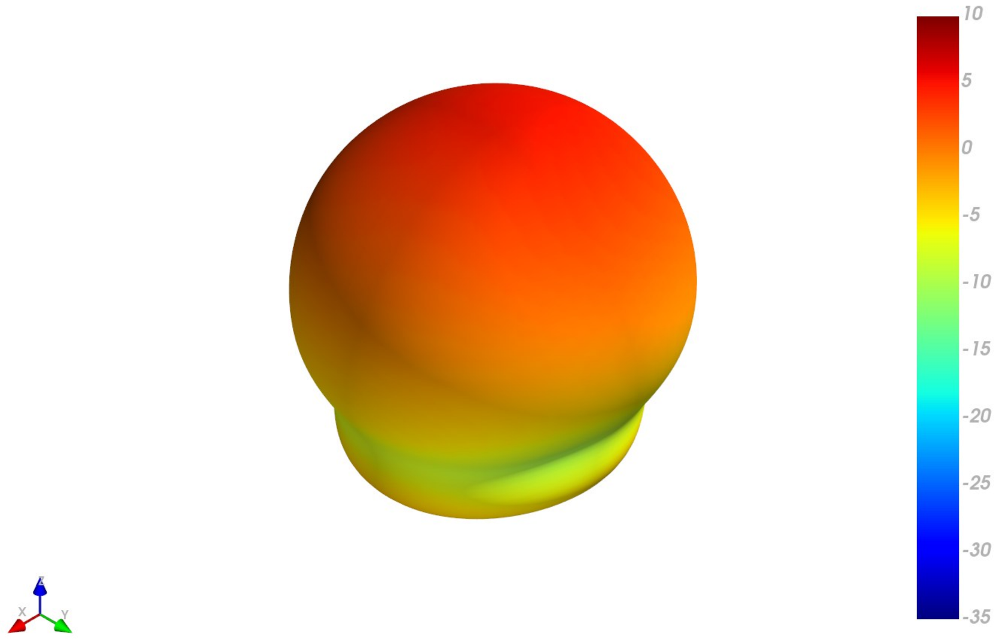
XZ Plane	YZ Plane	XY Plane



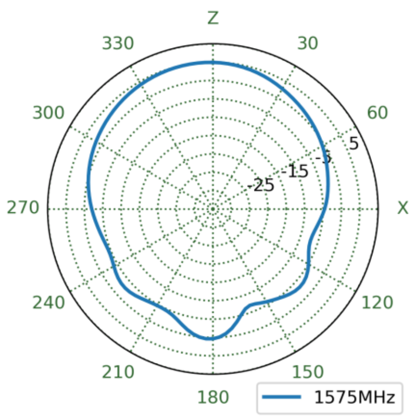


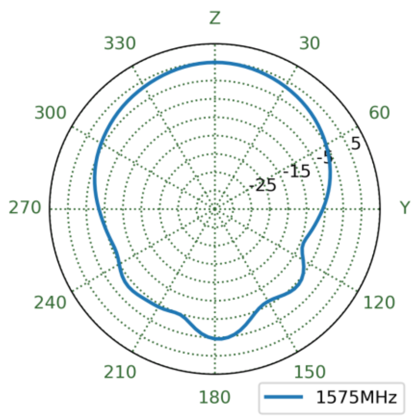


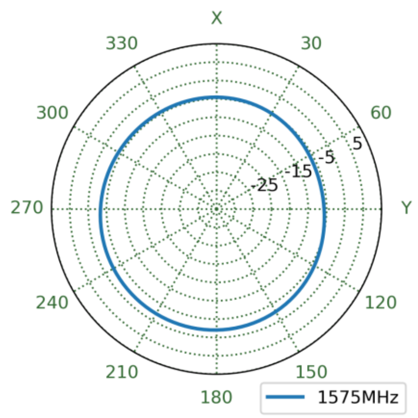
4.5 Patterns at 1575MHz



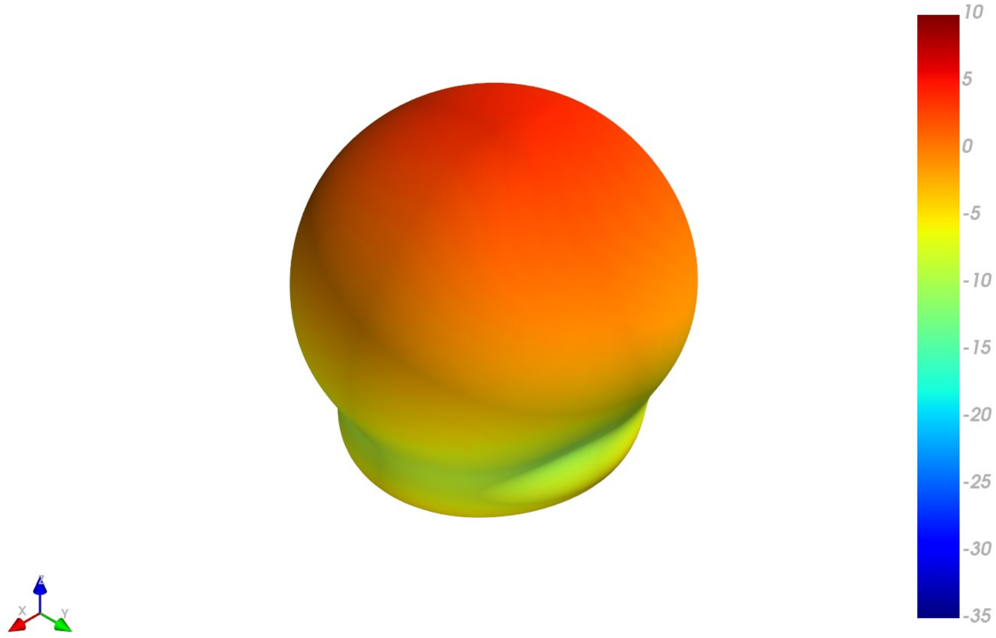
XZ Plane	YZ Plane	XY Plane

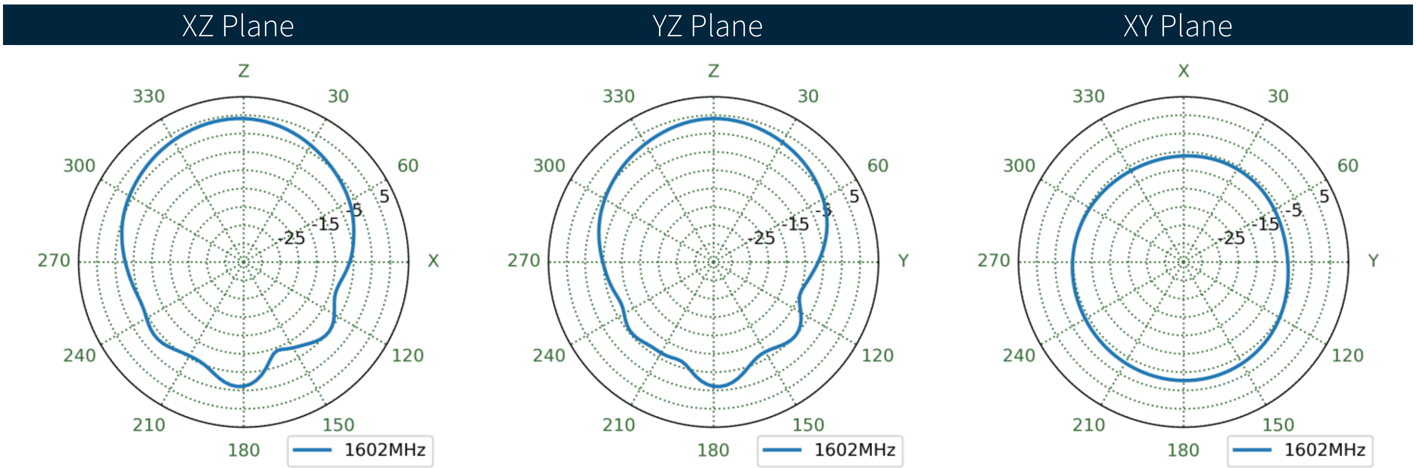




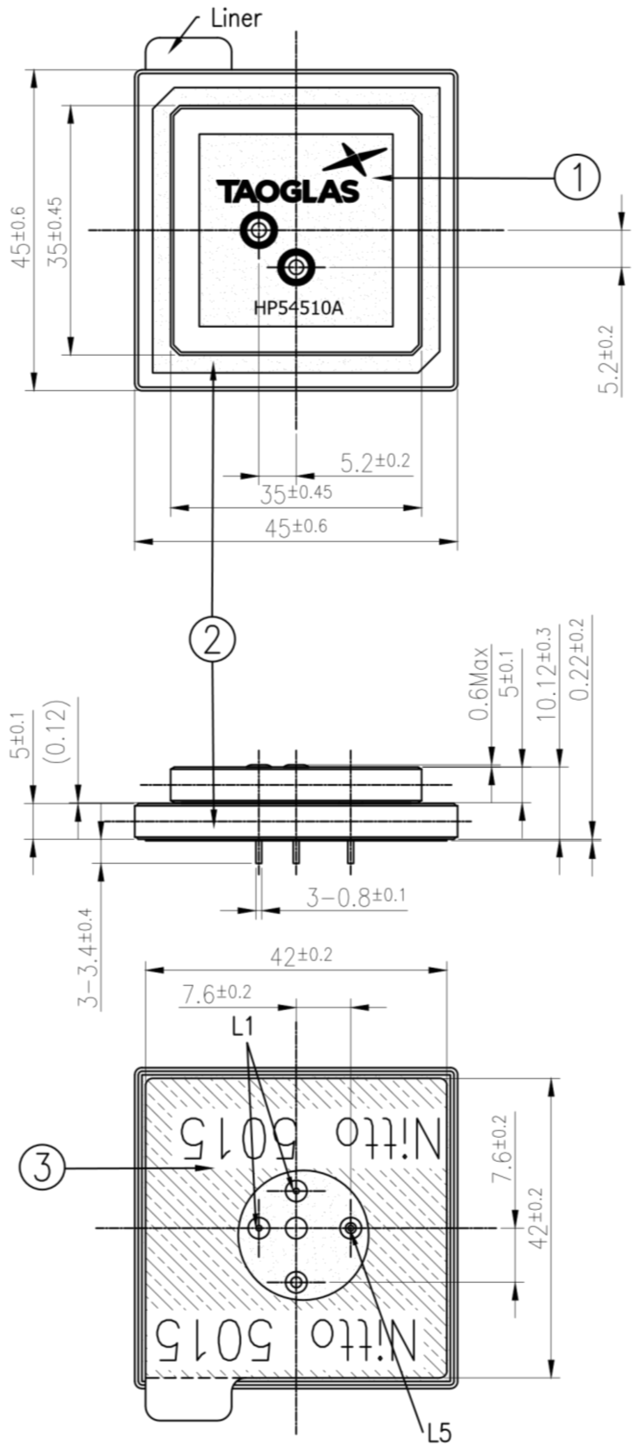


4.6 Patterns at 1602MHz





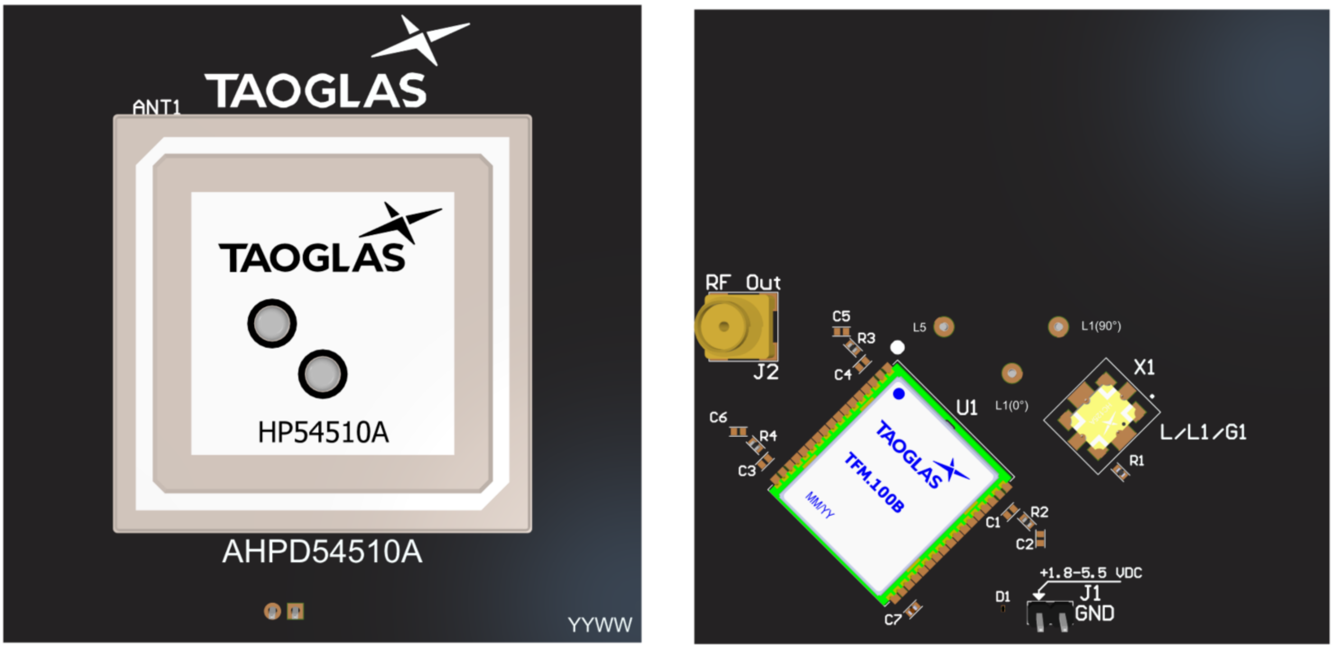
5. Mechanical Drawing



	Name	Material	Finish	QTY
1	Top Patch (35x35x5mm)	Ceramic	Clear	1
2	Bottom Patch (45x45x5mm)	Ceramic	Clear	1
3	Double sided Adhesive	NITTO 5015	White Liner	1

6. Antenna Integration

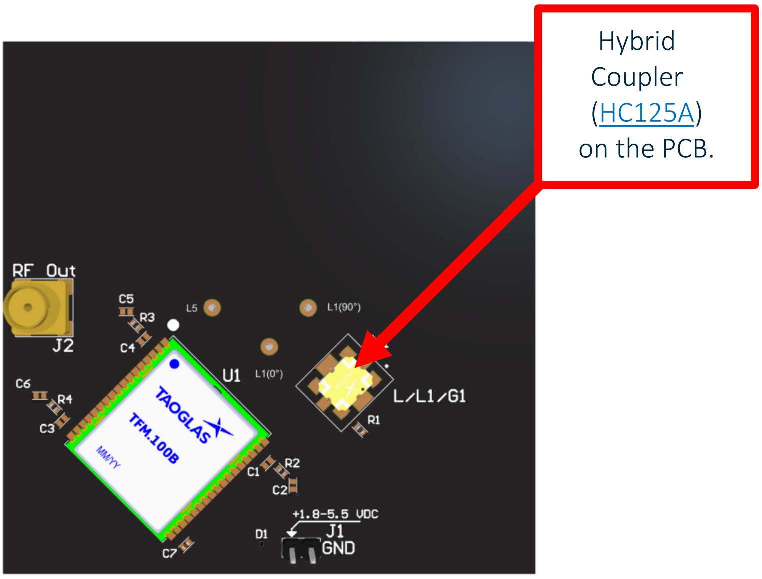
The following is an example on how to integrate the HP54510A into a design. This antenna has three pins, two pins are used for the L1 band, and the other pin is used for the L5 band. A Hybrid coupler (HC125A) is used to combine the feeds for the L1 band, to create a Right Hand Circular Polarized (RHCP) signal at the output of the hybrid coupler. Taoglas recommends using a minimum of 70x70mm ground plane (PCB) to ensure optimal performance before being presented to the GNSS Module. Taoglas recommends our TFM.100B, a high-performance GNSS Module specifically engineered for use with our multi feed patches.



Top and bottom view of PCB.

Please find the Integration files in Altium, 2D formats and the 3D model for the HP54510A here:
https://www.taoglas.com/product/hp5410a-gnss-l1-l5-stacked-patch-antenna/

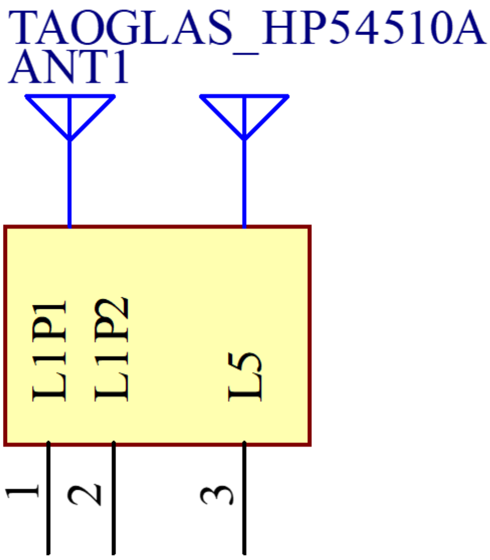
6.1 Schematic Symbol and Pin Definition



Above are the 3D models of the HP54510A and HC125A on the PCB.

The circuit symbol for the HP54510A is shown below. The antenna has 3 pins as indicated below.

Pin	Description
1	L1 (0˚)
2	L1 (-90˚)
3	L5



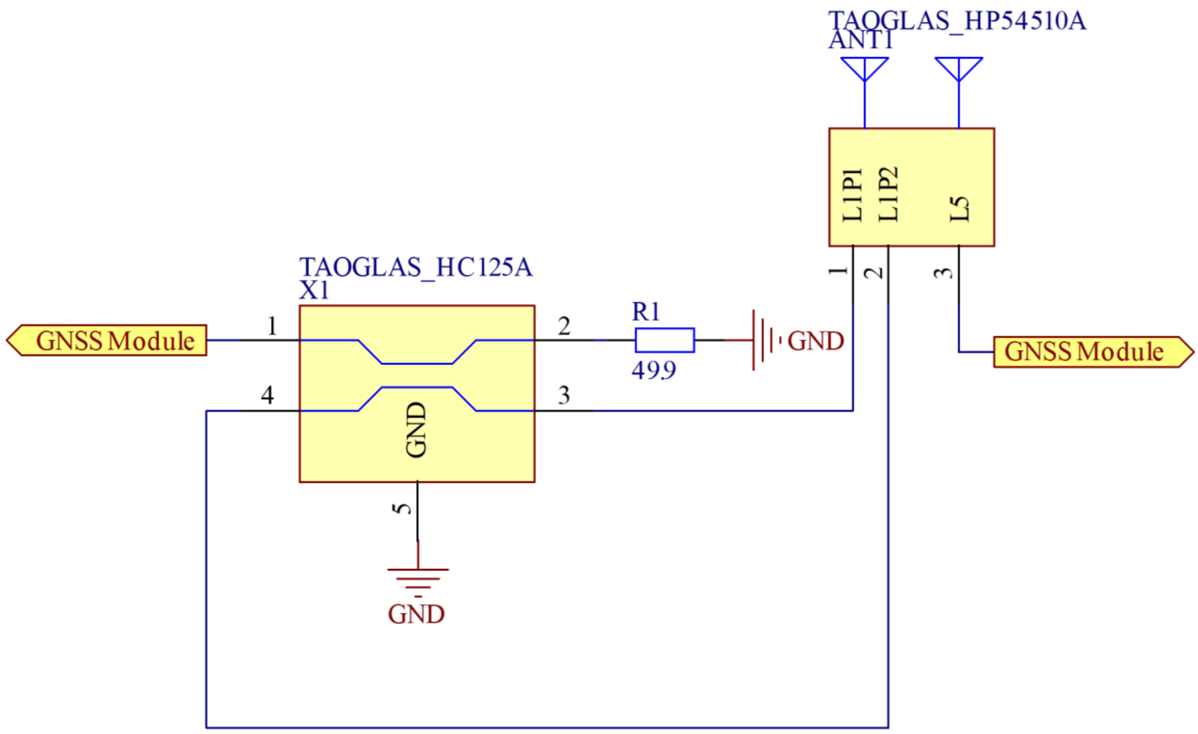
Above is a schematic symbol of HP54510A and a table of the pin definitions.

6.2 Schematic Layout

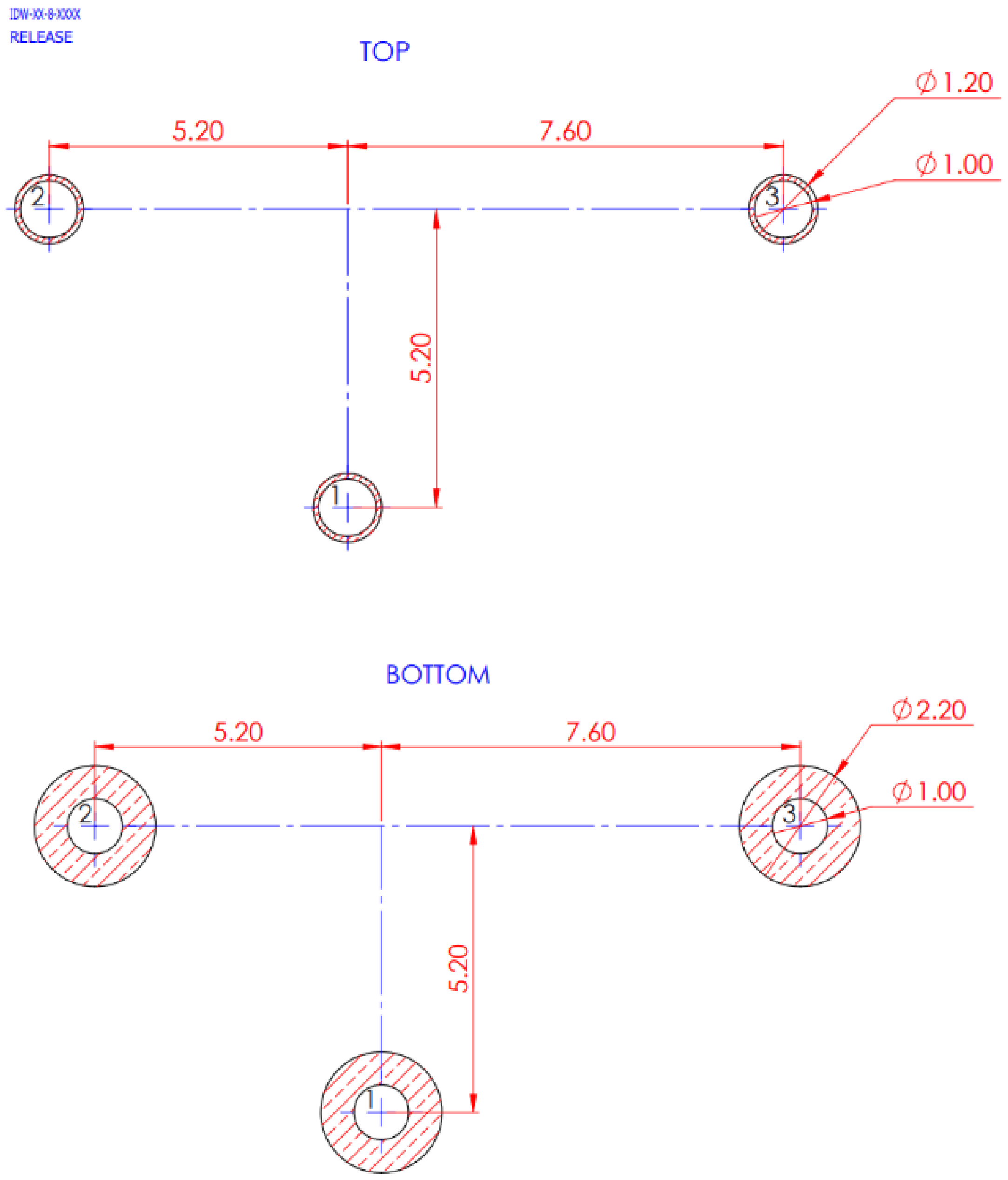
The L1 band of the HP54510A uses two orthogonal feeds that need to be combined in a hybrid coupler to ensure optimal axial ratio and RHCP Gain is achieved. Taoglas recommends our HC125A, a high-performance hybrid coupler specifically engineered for use with our multi feed patches.

The HC125A is required for the high GNSS band of operation (1559- 1610MHz) for this antenna. This hybrid coupler 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	Resistor	49.9 Ohms	Panasonic	ERJ-2RKF49R9X



6.3 Antenna Footprint

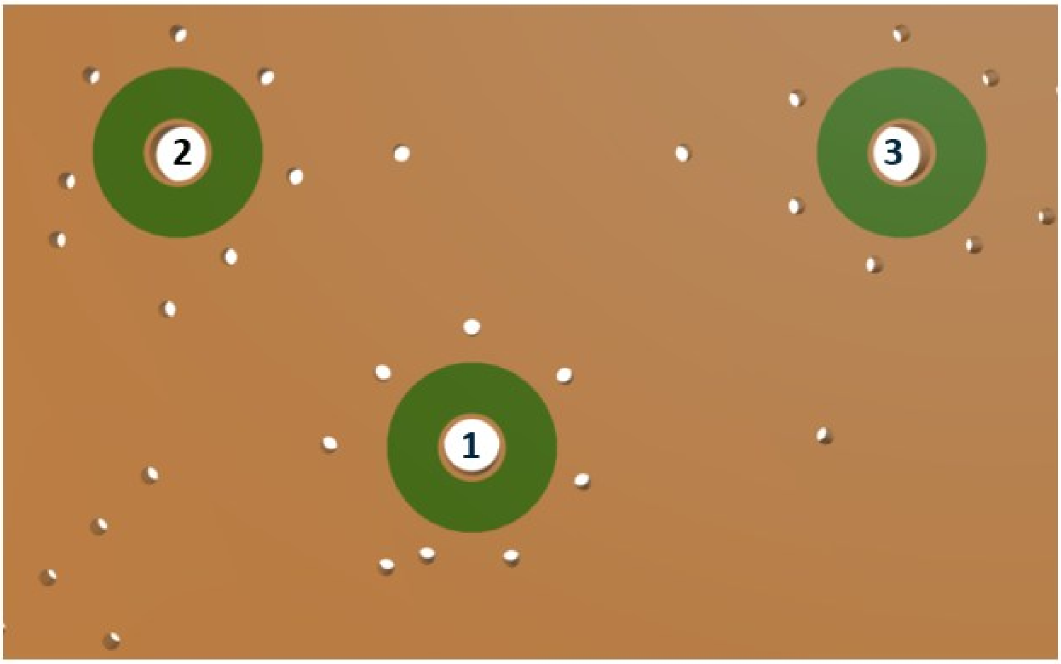


Pin	Description
1	L1 (0˚)
2	L1 (-90˚)
3	L5

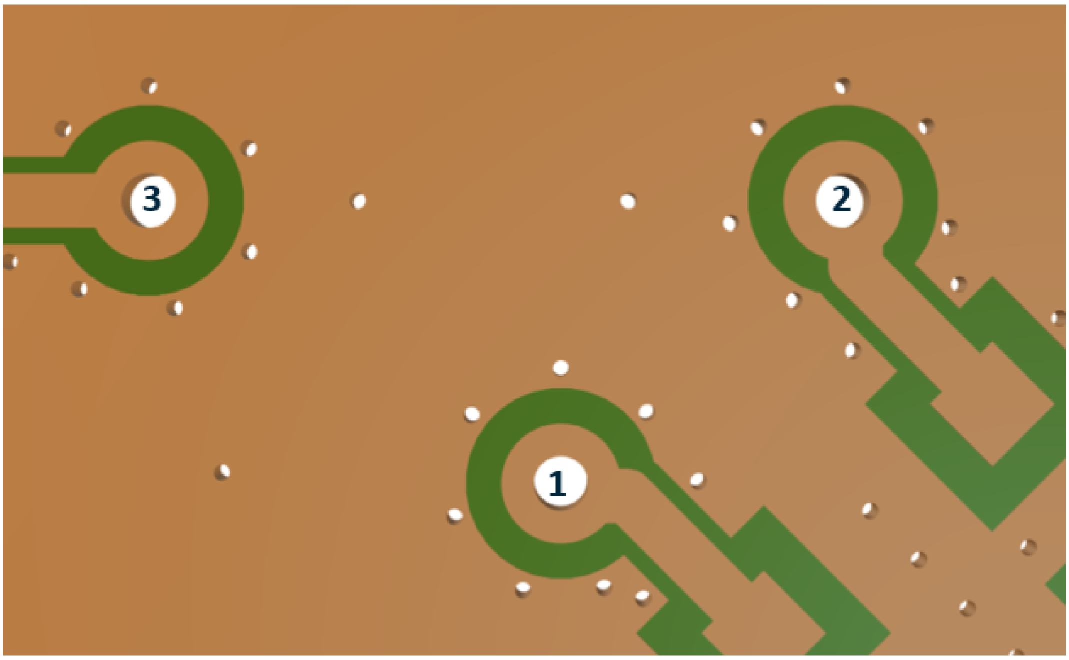
6.4 Copper Clearance for HP54510A

The footprint and clearance on the PCB must comply with the antenna's specification. The PCB layout shown in the diagrams below demonstrates the HP54510A clearance area for Pin 1 (L1P1(0˚) Pad), Pin 2 (L1P2(-90 ˚) Pad) and Pin 3 (L5 Pad). 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.

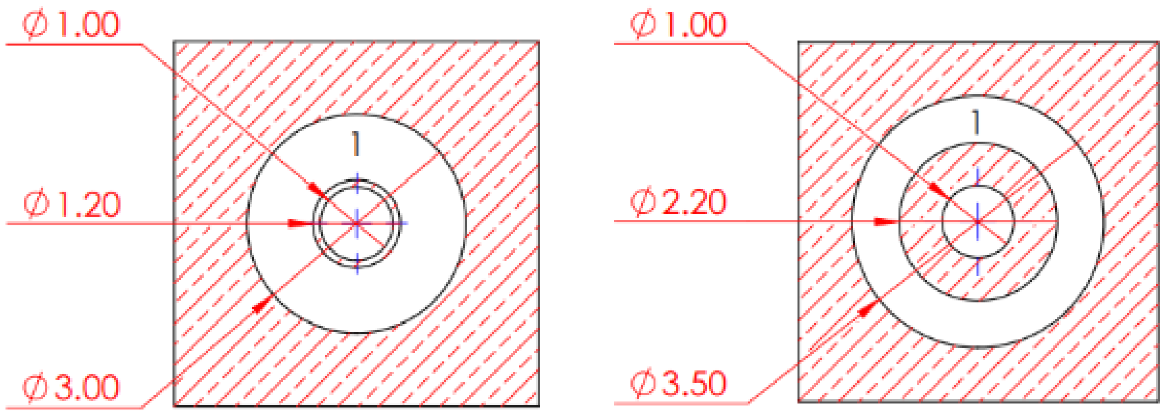


Top Side

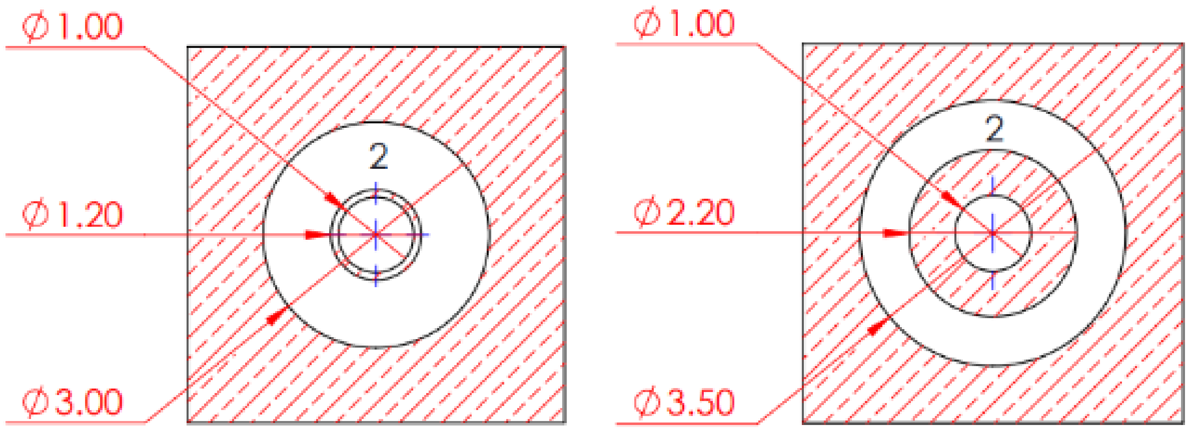


Bottom Side

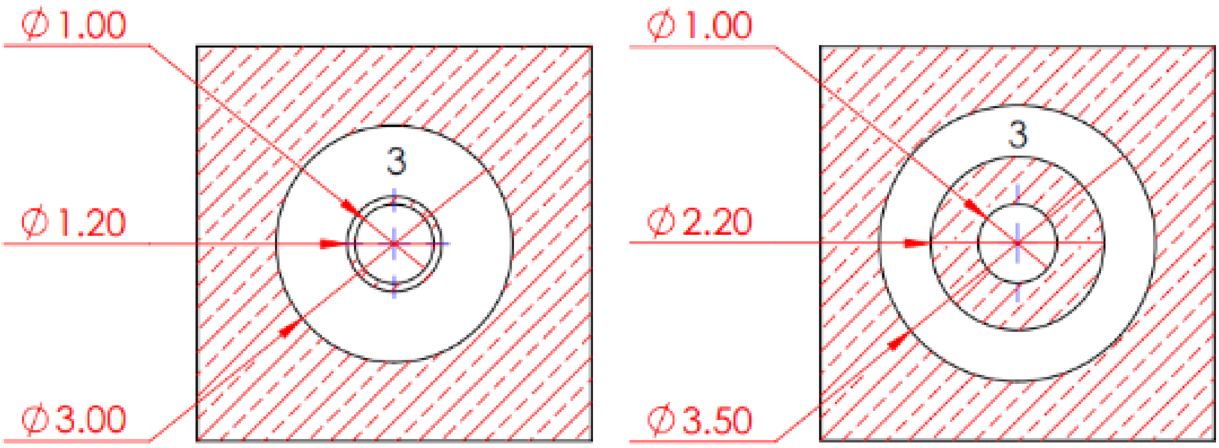
3D Images of Copper Clearances for HP54510A.



Copper Clearances for Pin 1 (L1P1(0˚) Pad) of the HP54510A.



Copper Clearances for Pin 2 (L1P2(-90˚) Pad) of the HP54510A.

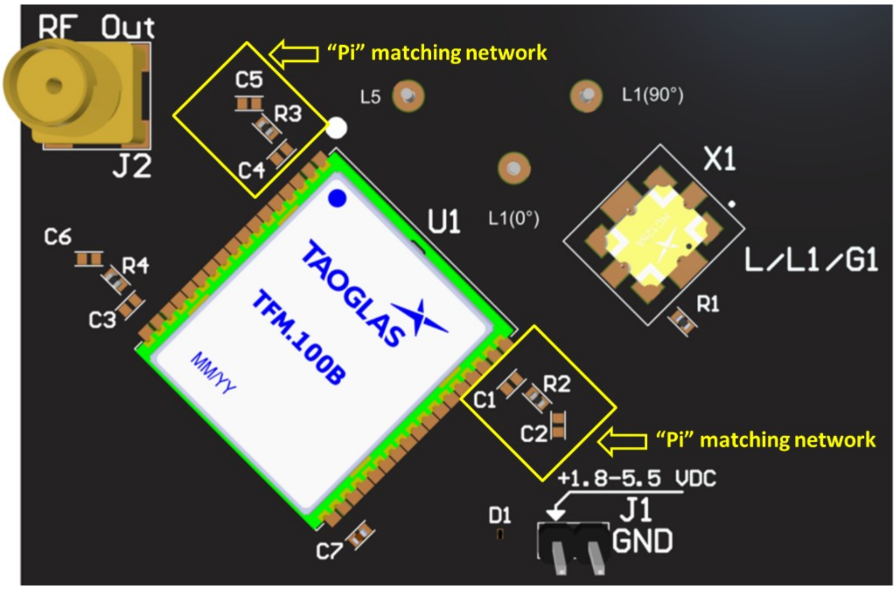


Copper Clearances for Pin 3 (L5 Pad) of the HP54510A.

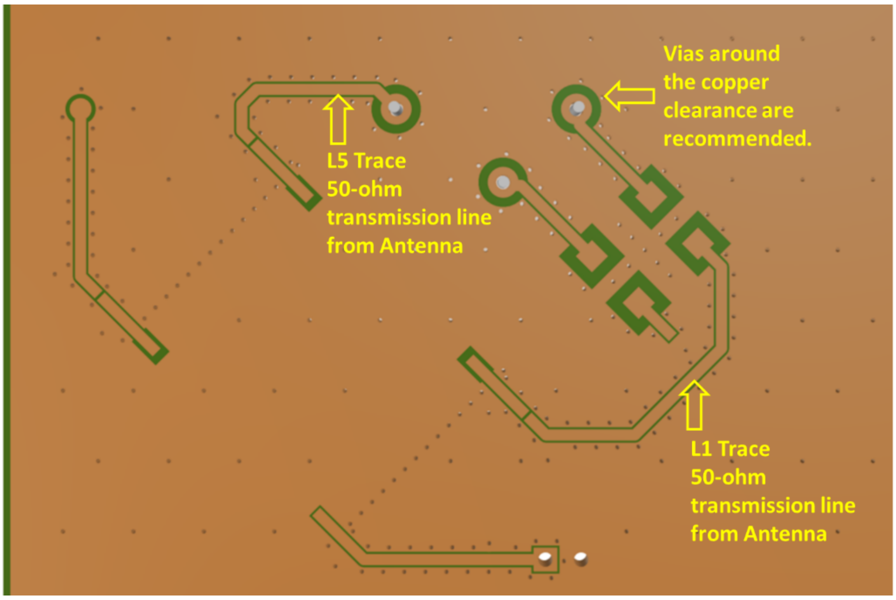
6.5 Antenna Integration

The HP54510A should be placed in the center of the PCB 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 lines, the values and components for the matching circuit will depend on the tuning needed. Ground vias should be placed around the copper clearance area.



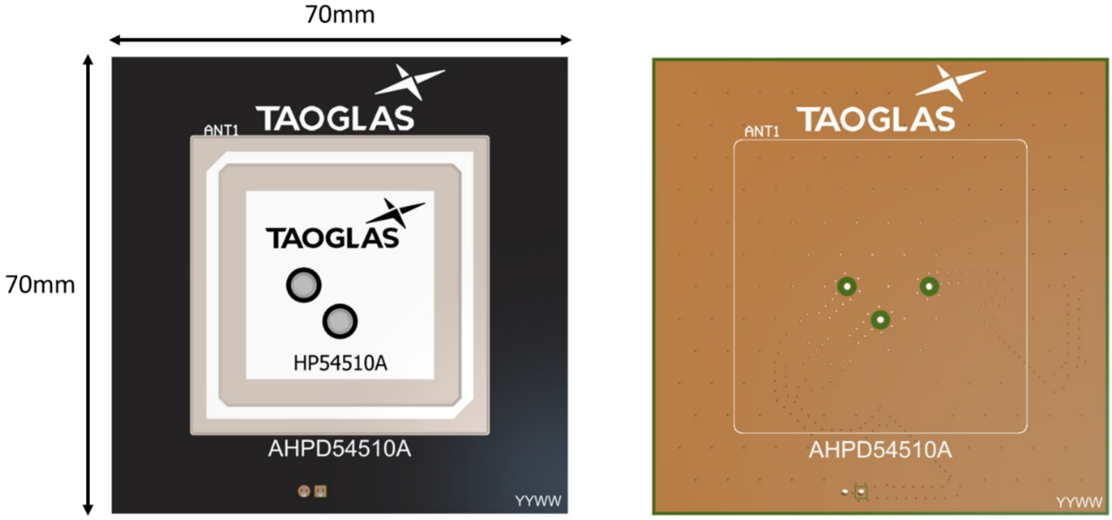
Bottom view of the PCB, showing “Pi” matching network.



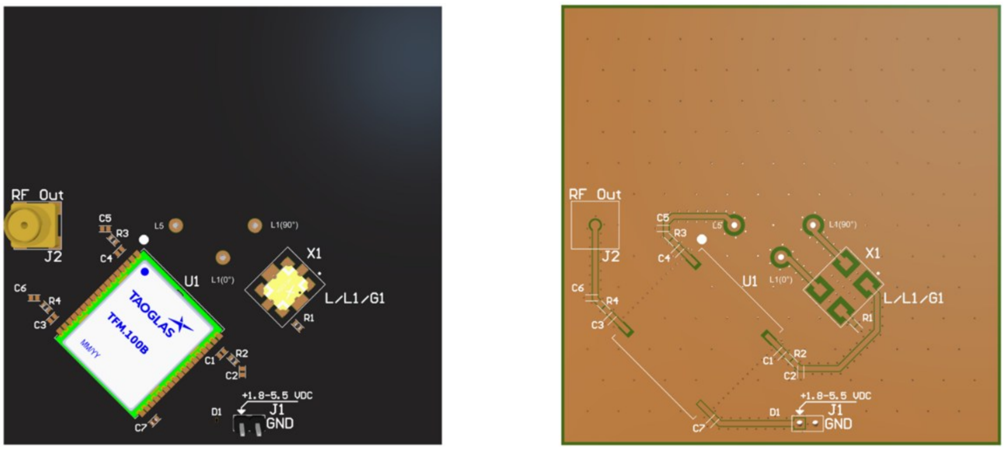
Bottom view of the PCB, showing transmission lines and integration notes.

6.6 Final Integration

The bottom side image shown below highlights the antenna connection to the hybrid coupler (HC125A). It shows the 49.9 Ohm terminating resistor necessary for the hybrid coupler (HC125A). Taoglas recommends using a minimum of 70x70mm ground plane (PCB) to ensure optimal performance.



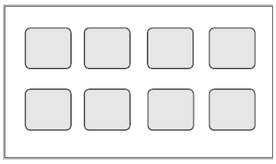
Top Side (HP54510A placement on 70x70mm PCB)



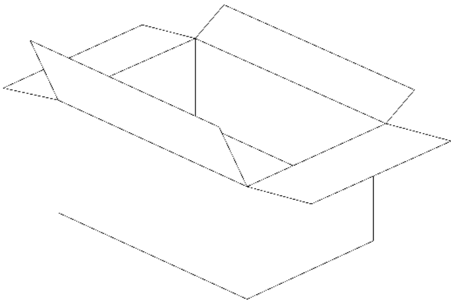
Bottom side (TFM.100B placement including HC125A)

7. Packaging

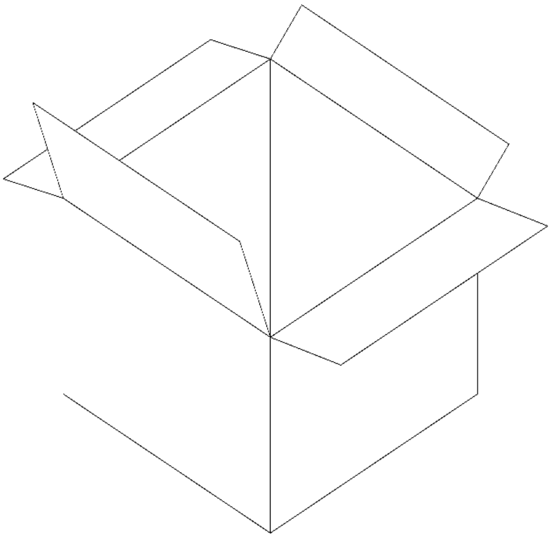
8pcs HP54510 per Tray
32pcs / Vacuum package



32pcs HP54510 per Small Box
Dimensions - 236*154*96mm



128pcs HP54510 per Carton
Dimensions - 370*370*300mm



Changelog for the datasheet

SPE-23-8-224– HP54510A

Revision: B (Current Release)	
Date:	2024-11-18
Notes:	Updated legends on graphs.
Author:	Gary West

Previous Revisions

Revision: B	
Date:	2023-12-12
Notes:	Updated graphs and antenna integration guide.
Author:	Gary West

Revision: A (Original First Release)	
Date:	2023-07-14
Notes:	Initial Release
Author:	Cesar Sousa

TAOGLAS

www.taoglas.com