TAOGLAS

Datasheet

Part No:
PA.176.A

Description

High-Band 5G Ceramic SMD Antenna covering 1.7-6GHz

Features:

Patent Pending Ceramic Antenna
Covering 1.7 - 6GHz
High Efficiency across all cellular High-Bands
Small Footprint
Dimensions: 20 x 10 x 3mm
Surface Mount Distribution (SMD) - Supplied on Tape & Reel
Manufactured in our IATF16949 Certified Facility
CE Certified
RoHS & REACH Compliant

1. Introduction

The **PA.176.A** is a patent-pending, 5G/4G high-band cellular SMD antenna designed especially for direct mount on a device's PCB. It provides very high efficiency across multiple cellular bands, operating between 1.7 - 6GHz, in an extremely small form factor. The shape and compact size of just 20*10*3mm, allows the PA.176.A to be easily integrated solution for mounting on the edge of the device's PCB. It is lightweight and is the perfect antenna for mounting on a PCB where space may be limited, as the keep out area for other electronic components, is minimal. Using SMD (on-board) antennas saves on assembly, cable, and connector costs. SMD antennas also lead to higher integration yield rates, higher transmit power and higher sensitivity.

Typical cellular applications include:

- Telematic Control and On-board Diagnostic Units
- Wireless Medical Devices
- First Responder and Public Safety Devices
- UAV's and Robotics
- Media and Smart Home

Care should be taken to the follow layout instructions provided in Section 4 of this datasheet and in placing antenna on the edge of board with adequate clearance to metal. Minimum ground-plane requirements must be met to achieve targeted efficiencies. The PA.176.A is manufactured in Taoglas' IATF16949 Certified Facility and is suitable for automotive applications.

Taoglas provides optimization services for matching, and active TRP, TIS and RSE testing. Integration files for the PA.176.A can be downloaded from the product page on the website. For further information or additional support please contact your regional Taoglas customer support team.

2. Specification

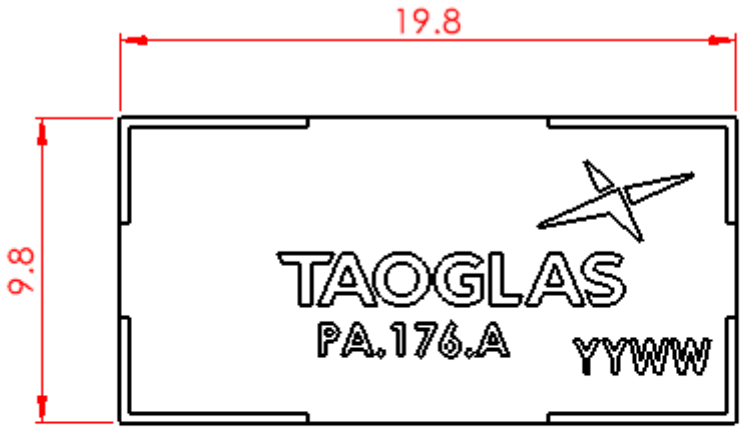
Electrical								
Band	Frequency (MHz)	Efficiency (%)	Average Gain (dB)	Peak Gain (dBi)	Impedance	Polarization	Radiation Pattern	Max. input power
4G/3G Band 3,4,9,25,35,66	1710-1880	79.7	-0.98	3.39	50 Ω	Linear	Omni	2W
4G/3G Band 1,2,3,9,25,35,39	1850-1990	78.5	-1.05	3.47				
4G/3G Band 1,2,4,23,25	1920-2170	78.9	-1.03	3.47				
4G/3G Band 7,30,38,40,41	2300-2690	65.2	-1.86	4.05				
5G/4G Band 22,42,78	3000-3500	81.1	-0.91	5.43				
5G/4G Band 22,42,43,48,77,78,79	3200-4650	77.1	-1.13	5.71				
Greater than 5GHz	5150-5925	76.9	-1.14	6.19				

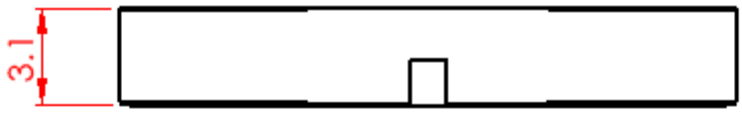
Mechanical	
Dimension	20*10*3 mm
Material	Ceramic
Termination	Ag (environmental Pb free) - Solder Pad
EVB Connector	SMA-Female
Weight	1.8g

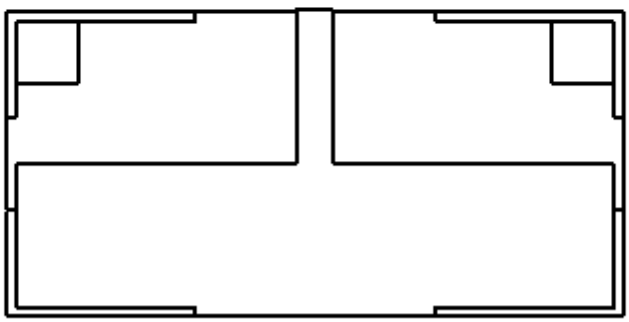
Environmental	
Operation Temperature	-40°C to 85°C
Storage Temperature	-40°C to 85°C
Moisture Sensitivity	Level 3

5G/4G Bands			
Band Number	**5GNR / FR1 / LTE / LTE-Advanced / WCDMA / HSPA / HSPA+ / TD-SCDMA / NTN**		
	Uplink	**Downlink**	**Covered**
B1	1920 to 1980	2110 to 2170	✓
B2	1850 to 1910	1930 to 1990	✓
B3	1710 to 1785	1805 to 1880	✓
B4	1710 to 1755	2110 to 2155	✓
B5	824 to 849	869 to 894	✗
B7	2500 to 2570	2620 to 2690	✓
B8	880 to 915	925 to 960	✗
B9*	1749.9 to 1784.9	1844.9 to 1879.9	✓
B11	1427.9 to 1447.9	1475.9 to 1495.9	✓
B12	699 to 716	729 to 746	✗
B13	777 to 787	746 to 756	✗
B14	788 to 798	758 to 768	✗
B17	704 to 716	734 to 746	✗
B18	815 to 830	860 to 875	✗
B19	830 to 845	875 to 890	✗
B20	832 to 862	791 to 821	✗
B21	1447.9 to 1462.9	1495.9 to 1510.9	✓
B22*	3410 to 3490	3510 to 3590	✓
B23 / n23	2000 to 2020	2180 to 2200	✓
B24 / n255	1626.5 to 1660.5	1525 to 1559	✓
B25	1850 to 1915	1930 to 1995	✓
B26	814 to 849	859 to 894	✗
B27*	807 to 824	852 to 869	✗
B28	703 to 748	758 to 803	✗
B29	717 to 728		✗
B30	2305 to 2315	2350 to 2360	✓
B31	452.5 to 457.5	462.5 to 467.5	✗
B32	1452 to 1496		✓
B34	2010 to 2025		✓
B35	1850 to 1910		✓
B36	1930 to 1990		✓
B37	1910 to 1930		✓
B38	2570 to 2620		✓
B39	1880 to 1920		✓
B40	2300 to 2400		✓
B41	2496 to 2690		✓
B42	3400 to 3600		✓
B43	3600 to 3800		✓
B45	1447 to 1467		✓
B46	5150 to 5925		✓
B47	5855 to 5925		✓
B48	3550 to 3700		✓
B49	3550 to 3700		✓
B50	1432 to 1517		✓
B51	1427 to 1432		✗
B52	3300 to 3400		✓
B53	2483.5 to 2495		✓
B65	1920 to 2010	2110 to 2200	✓
B66	1710 to 1780	2110 to 2200	✓
B68	698 to 728	753 to 783	✗
B69	2570 to 2620		✓
B70	1695 to 1710	1995 to 2020	✓
B71	663 to 698	617 to 652	✗
B72	451 to 456	461 to 466	✗
B73	450 to 455	460 to 465	✗
B74	1427 to 1470	1475 to 1518	✓
B75	1432 to 1517		✓
B76	1427 to 1432		✗
B77	3300 to 4200		✓
B78	3300 to 3800		✓
B79	4400 to 5000		✓
B85	698 to 716	728 to 746	✗
B87	410 to 415	420 to 425	✗
B88	412 to 417	422 to 427	✗
n256	1980 to 2010	2170 to 2200	✓

3. Mechanical Drawing







4. Antenna Integration Guide

The following is an example on how to integrate the PA.176.A into a design. This antenna has 6 pins, where one pin is used for the RF Feed. Taoglas recommends using a minimum of 49x20mm ground plane (PCB) to ensure optimal performance.

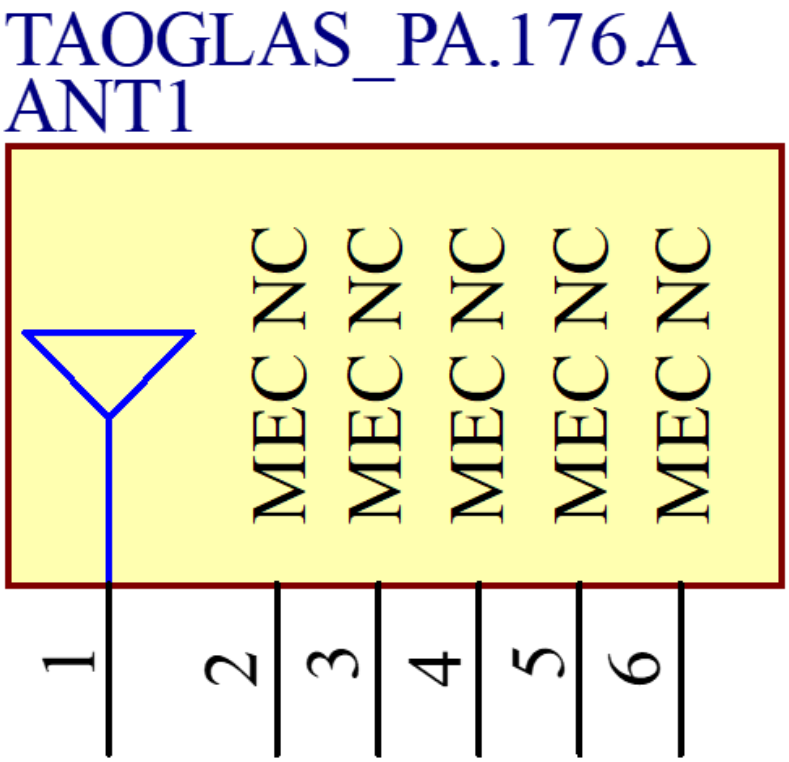
Top view of a PCB reference design

Please find the Integration files in Altium, 2D formats and the 3D model for the CGGBP.35.6.A.02 here: https://www.taoglas.com/product/5g-4g-wideband-cellular-smd-antenna/

4.1 Schematic and Symbol Definition

The circuit symbol for the PA.176.A is shown below. The antenna has 6 pins as indicated below.

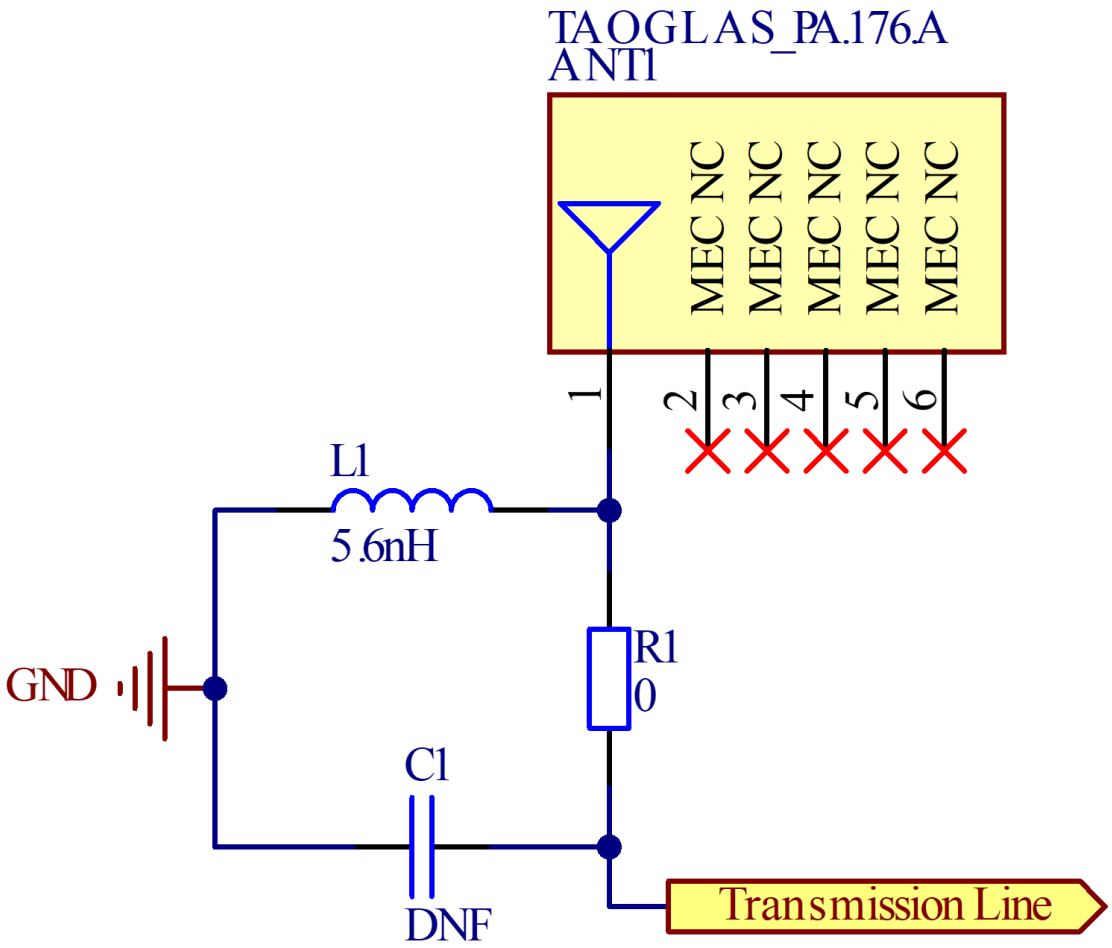
Pin	Description
1	RF Feed
2, 3, 4, 5, 6	Mechanical, No Connection



Above is a schematic symbol of PA.176.A and a table of the pin definitions.

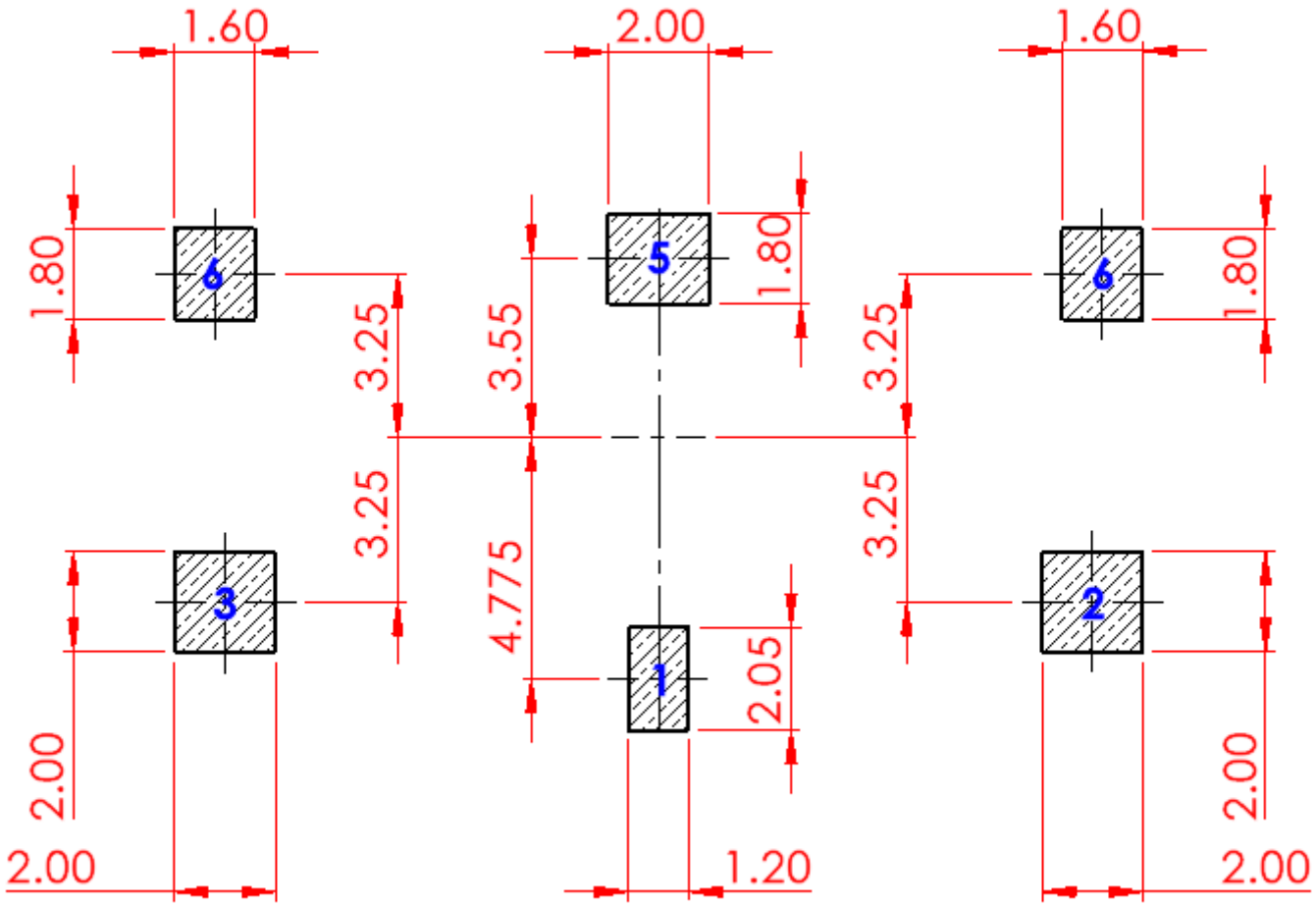
4.2 Schematic Layout

Matching components with the PA.176.A are required for the antenna to have optimal performance in the spaces specified in the schematic below. Additional matching components may be necessary for your device, Taoglas recommends incorporating extra component footprints, forming a “Pi” network, for the PA.176.A.



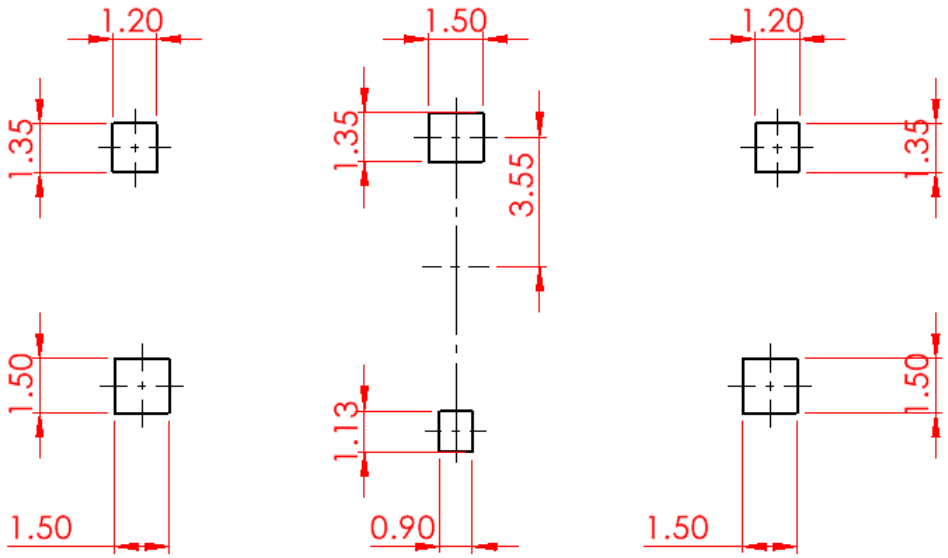
Designator	Type	Value	Manufacturer	Manufacturer Part Number
L1	Inductor	5.6nH	TDK	MLK1005S5N6DT000
R1	Resistor	0 Ohm	YAGEO	RC0402JR-070RL

4.3 Antenna Footprint

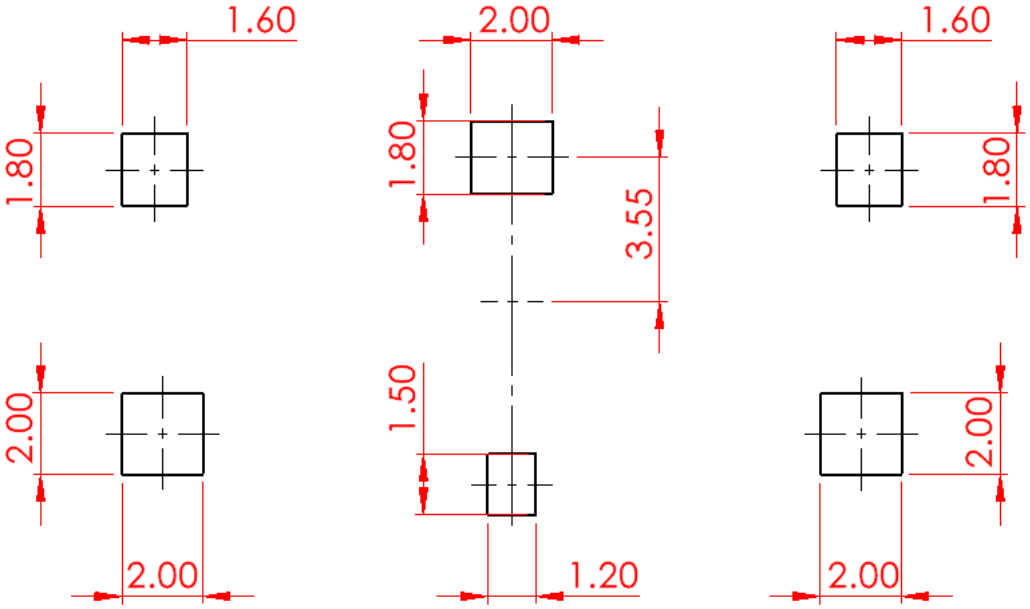


Pin	Description
1	RF Feed
2, 3, 4, 5, 6	Mechanical, No Connection

4.4 Top Solder Paste



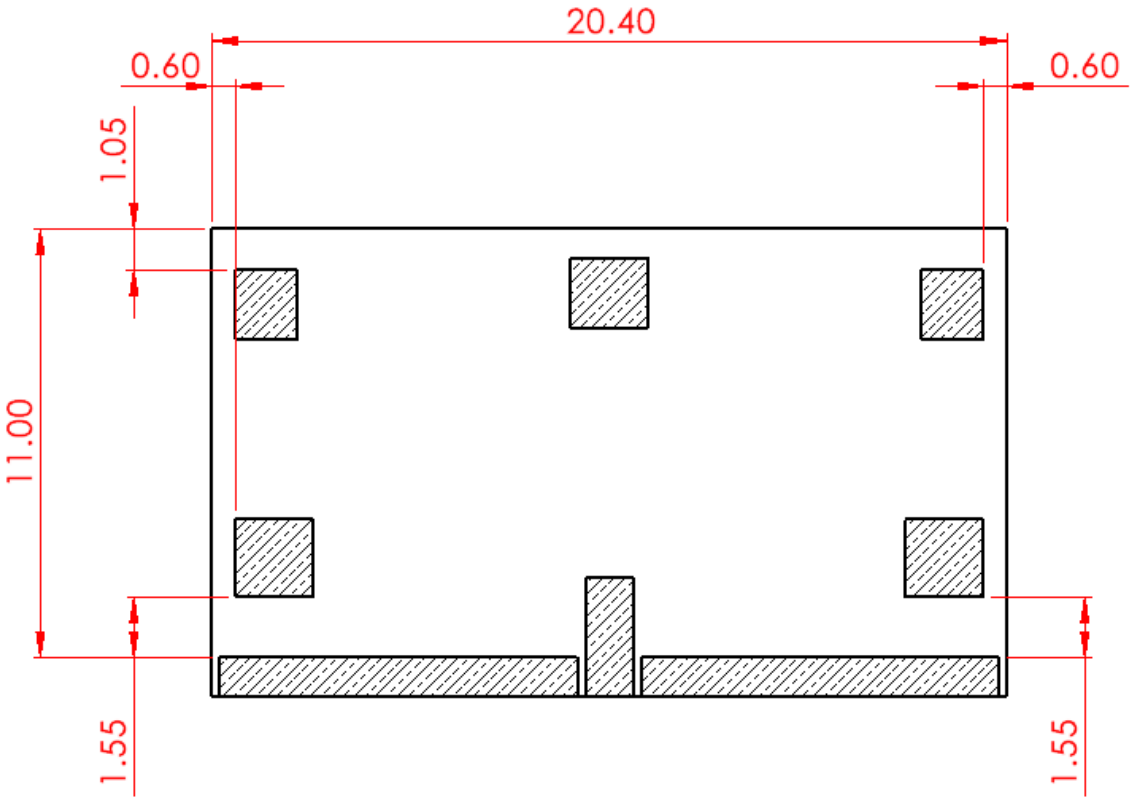
4.5 Top Solder Mask



4.6 Copper Clearance

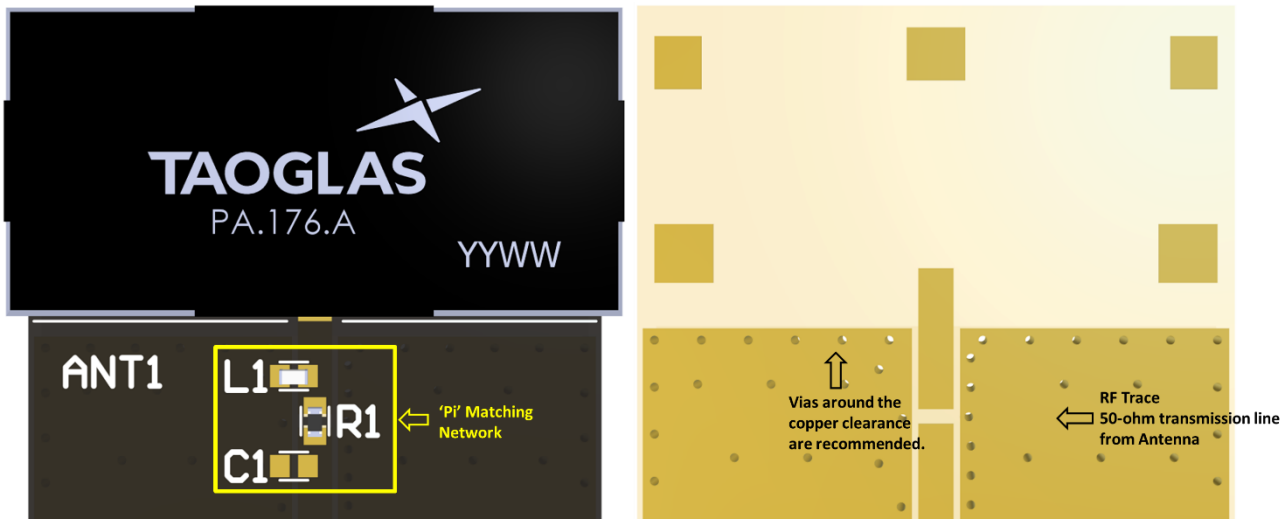
The footprint and clearance on the PCB must comply with the antenna's specification. The PCB layout shown in the diagrams below demonstrates the PA.176.A clearance area. The copper keep out area applies to all layers that are below the PA.176.A.

There should be a 1.55mm copper clearance from the mechanical pads to the ground plane and a board edge clearance to the antenna of 1.05mm.



4.7 Antenna Integration

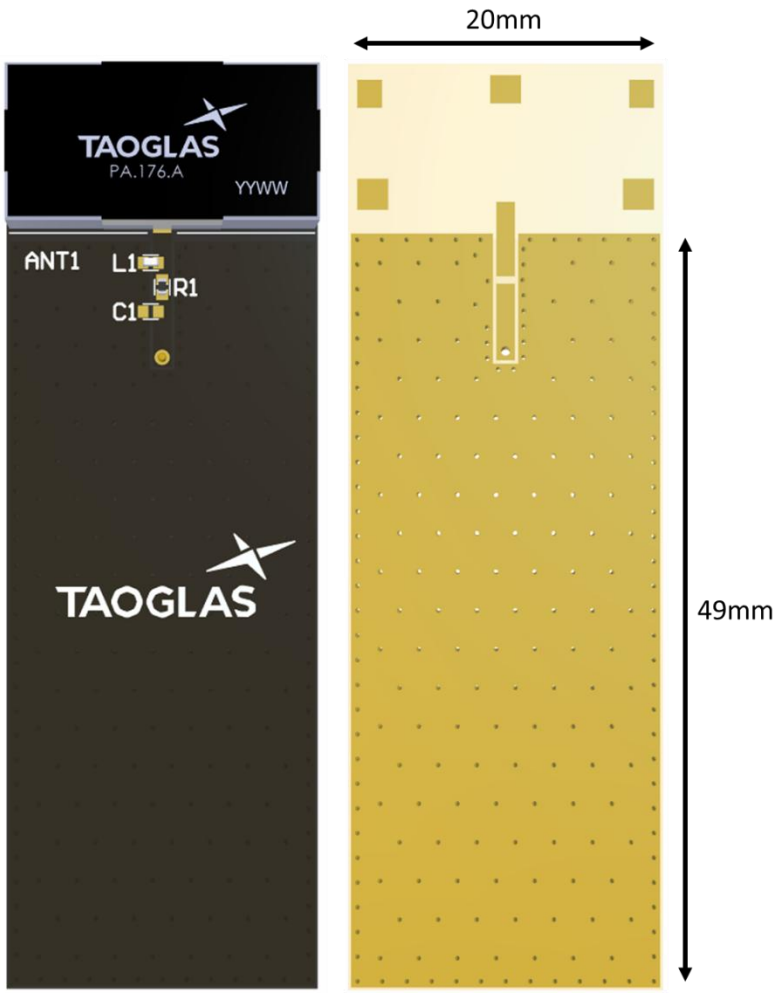
The PA.176.A should be placed in the centre, as close to the edge on the long side of the PCB as possible, to take advantage of the ground plane. The RF trace must maintain a 50 Ohm transmission line. A “Pi” Matching Network is recommended for the RF transmission line, the values and components for the matching circuit will depend on the tuning needed. Ground vias should be placed around the copper clearance area.



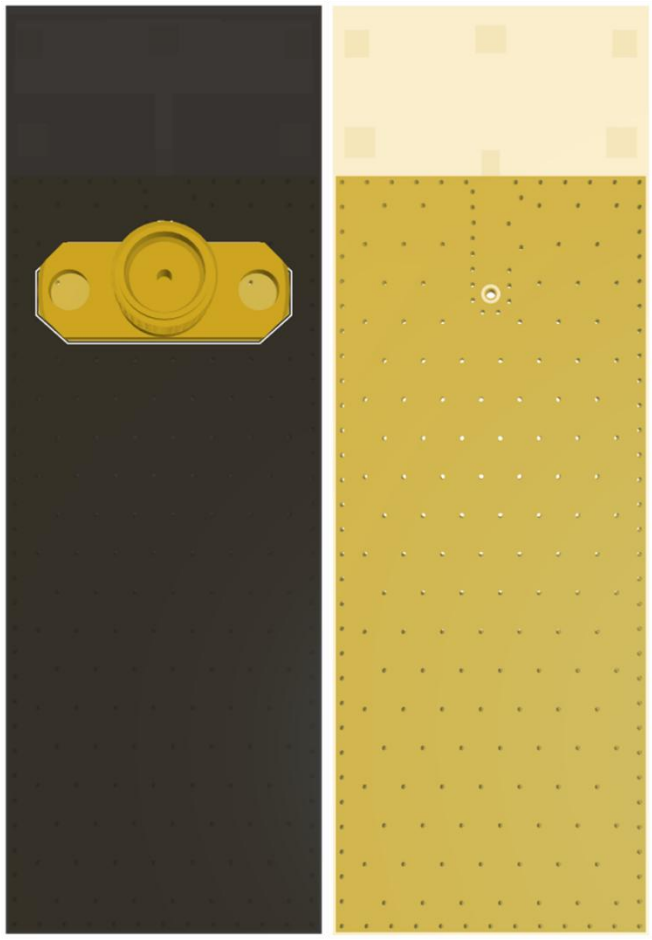
PA.176.A antenna mounted on a PCB reference ground, showing transmission lines and integration notes.

4.8 Final Integration

The top side image shown below highlights the antenna transmission line. Taoglas recommends using a minimum of 49x20mm ground plane (PCB) to ensure optimal performance.



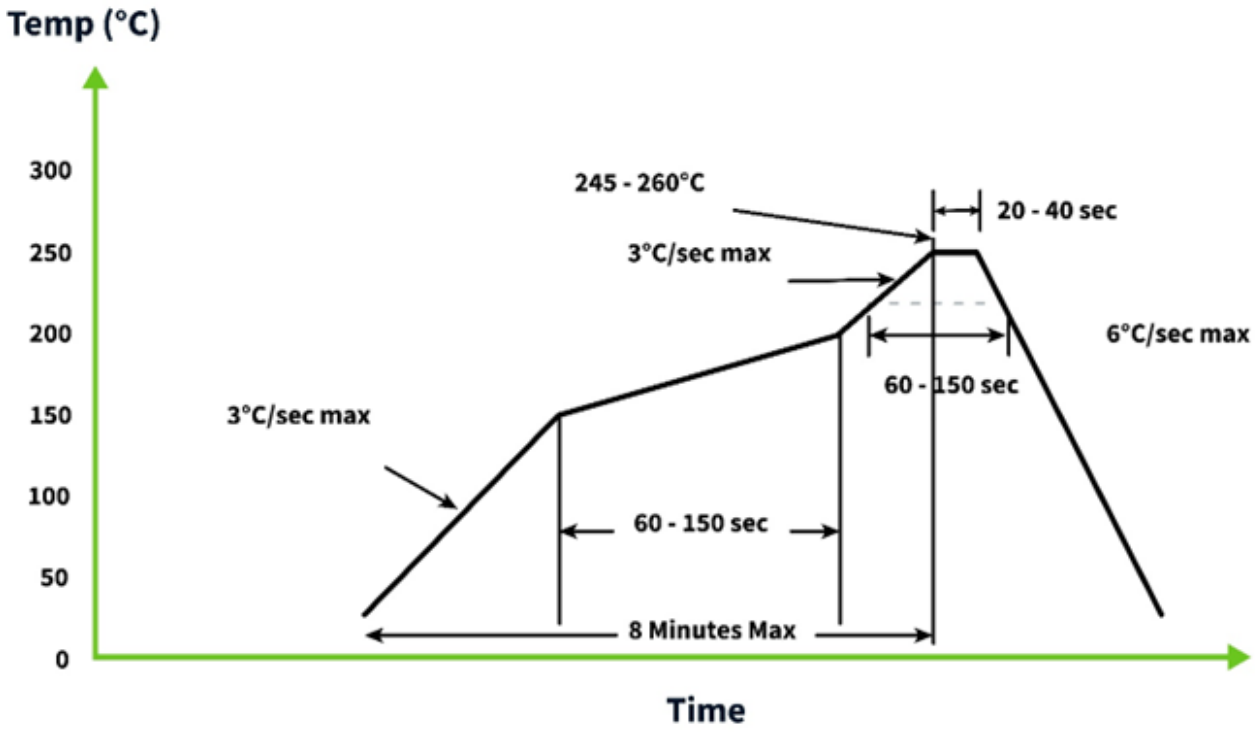
Top Side (PA.176.A placement on 49x20mm PCB reference design)



Bottom Side (PA.176.A placement on 49x20mm PCB reference design)

5. Solder Reflow Profile

The PA.176.A can be assembled by following the recommended soldering temperatures are as follows:



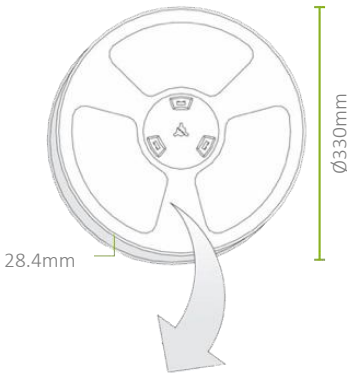
*Temperatures listed within a tolerance of +/- 10º C

Smaller components are typically mounted on the first pass, however, we do advise mounting the PA.176.A when placing larger components on the board during subsequent reflows.

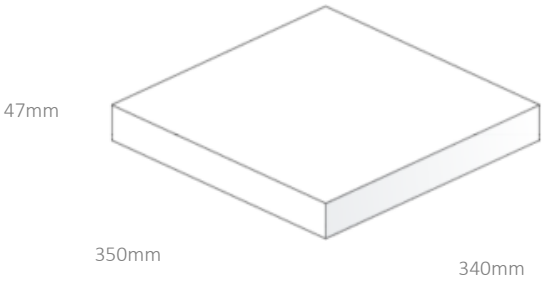
Note: Soldering flux classified ROL0 under IPC J-STD-004 is recommended.

6. Packaging

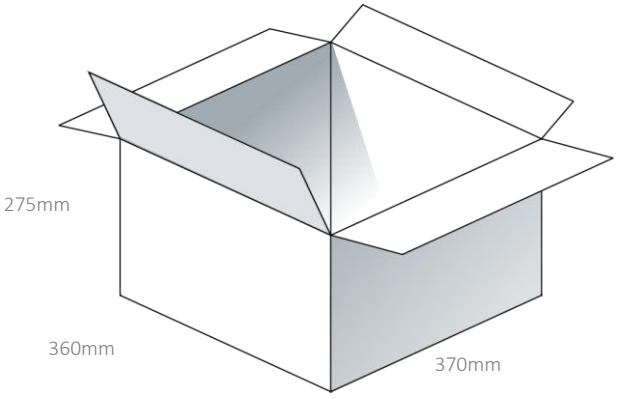
1000pcs PA.176.A per Tape & Reel
Dimensions - Ø330*28.4
Weight - 1Kg



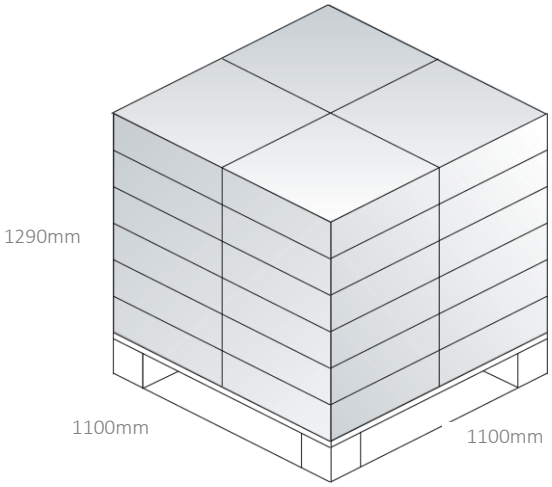
1000pcs PA.176.A per carton
Dimensions - 350*340*47mm
Weight - 1.2Kg



6000pcs PA.176.A per carton
Dimensions - 360*370*275mm
Weight - 6.8Kg

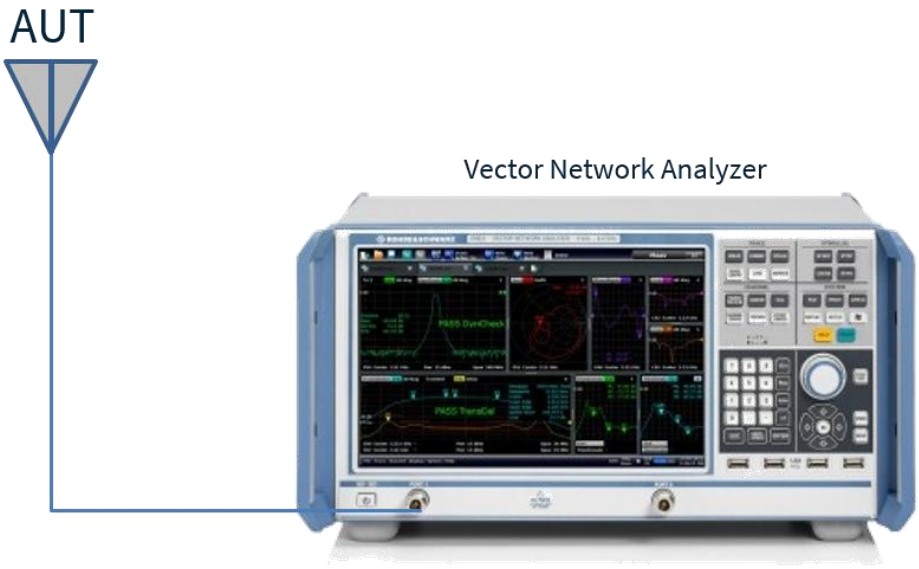


Pallet Dimensions:
1100*1100*1300mm
36 Cartons Per Pallet
9 Cartons Per Layer, 4 Layers



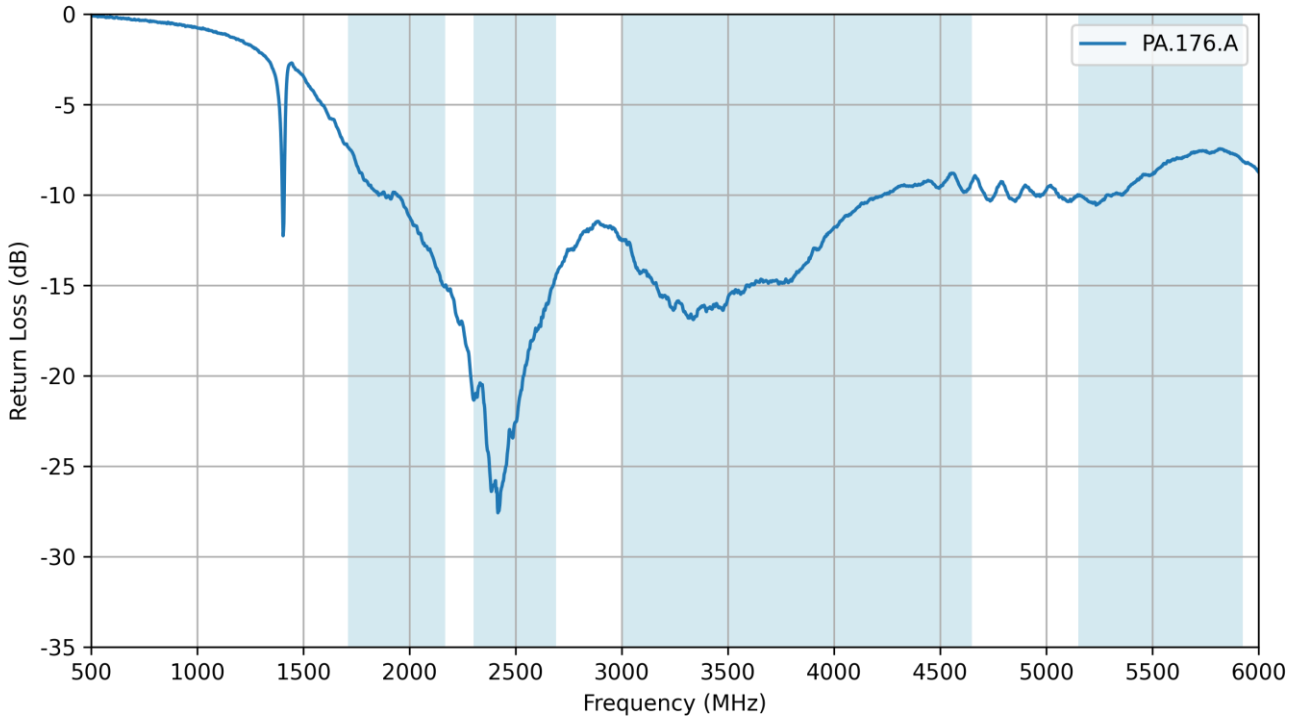
7. Antenna Characteristics

7.1 Test Setup

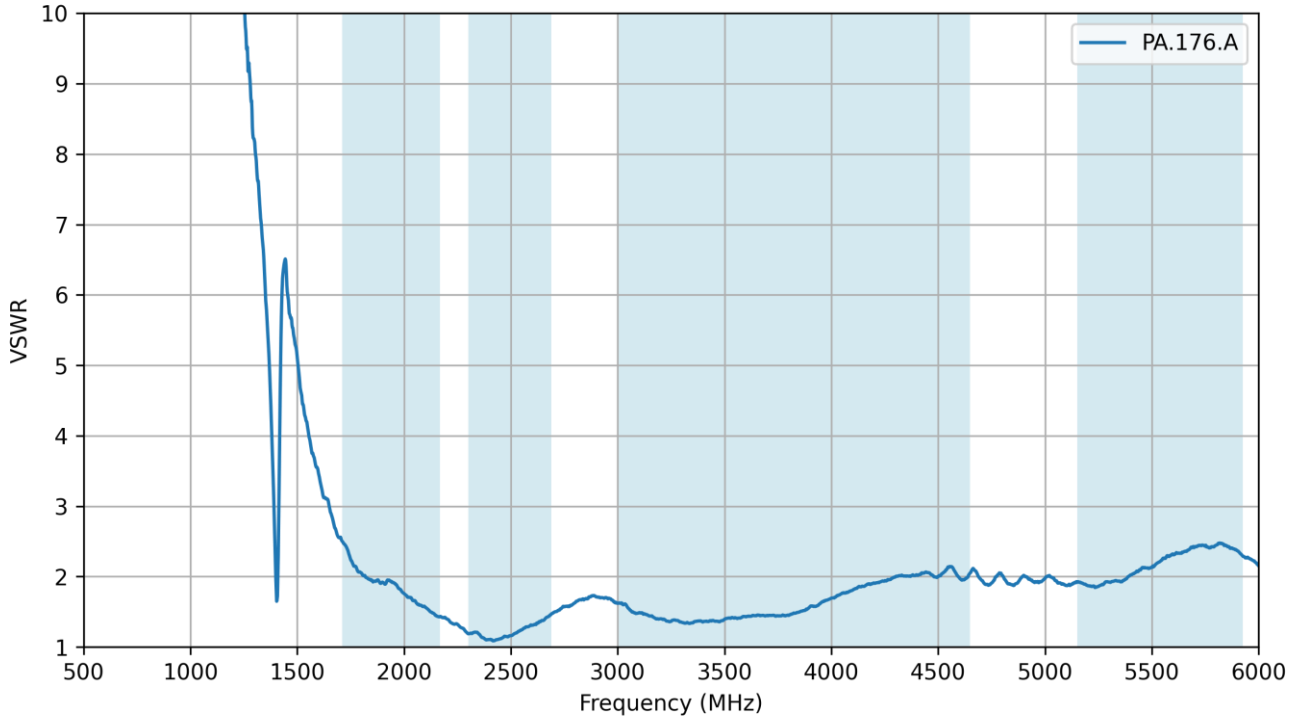


VNA Test Set-up

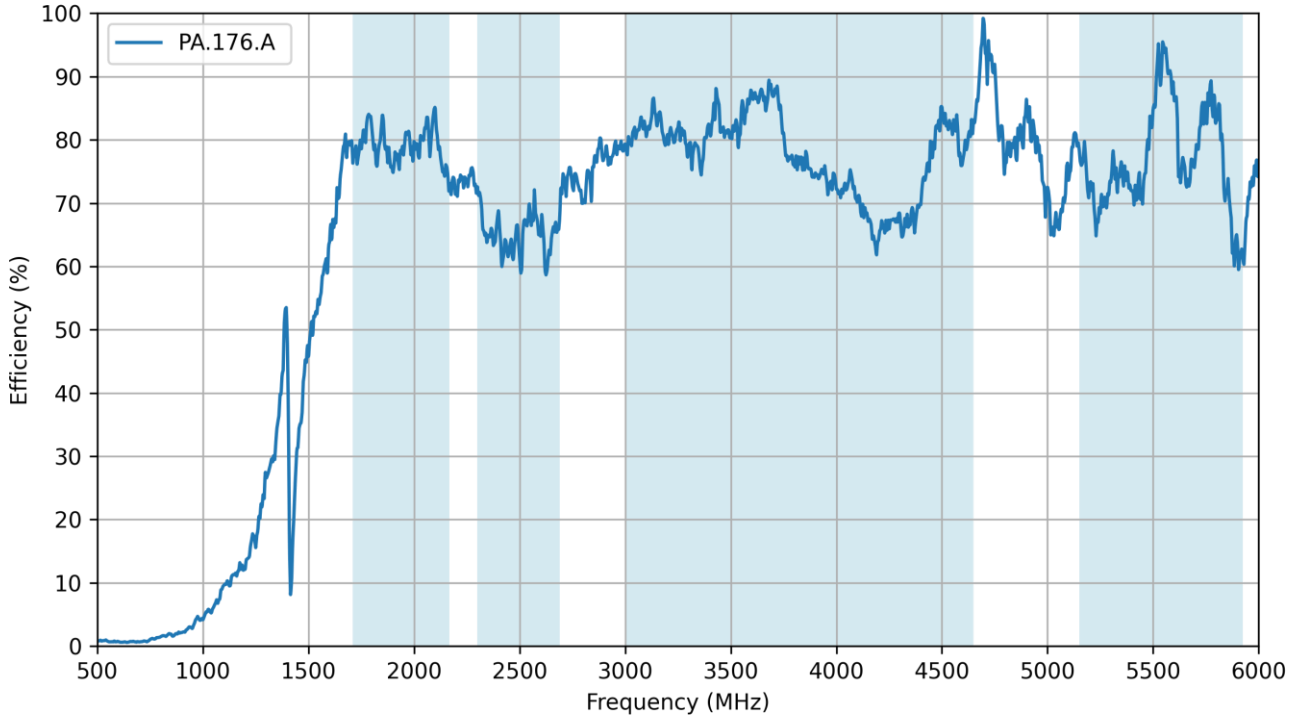
7.2 Return Loss



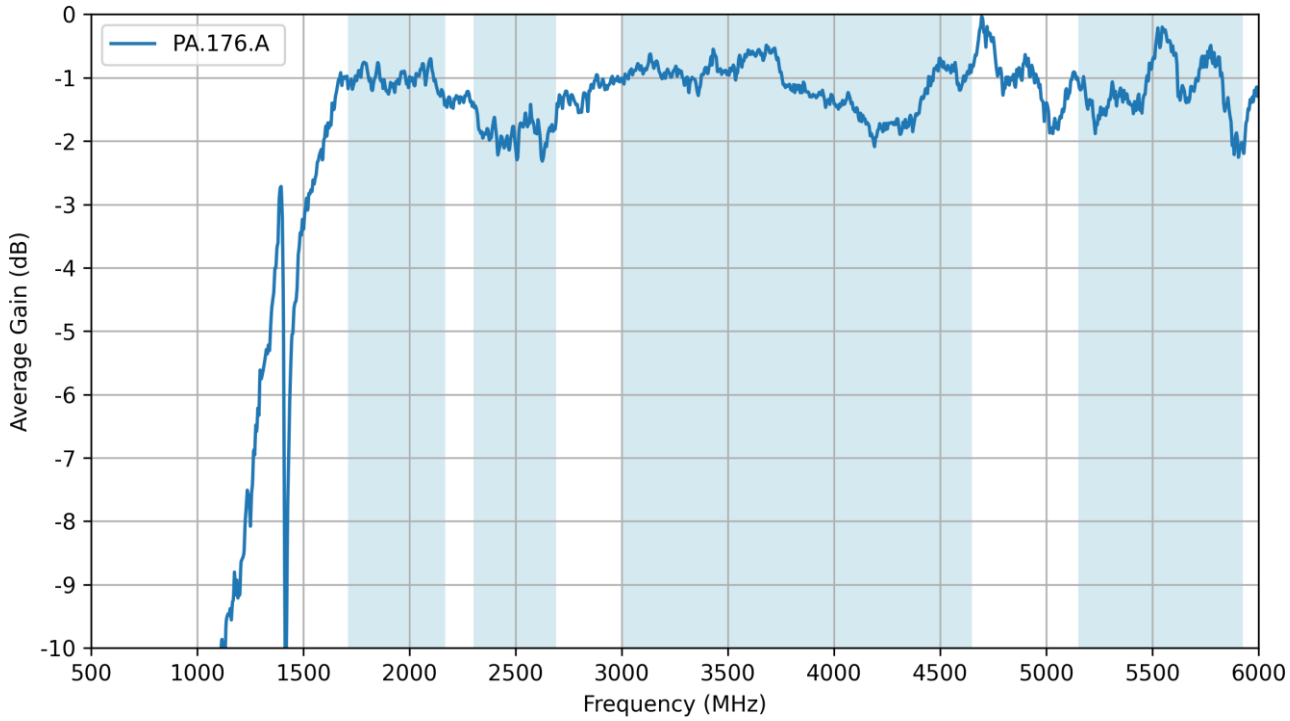
7.3 VSWR



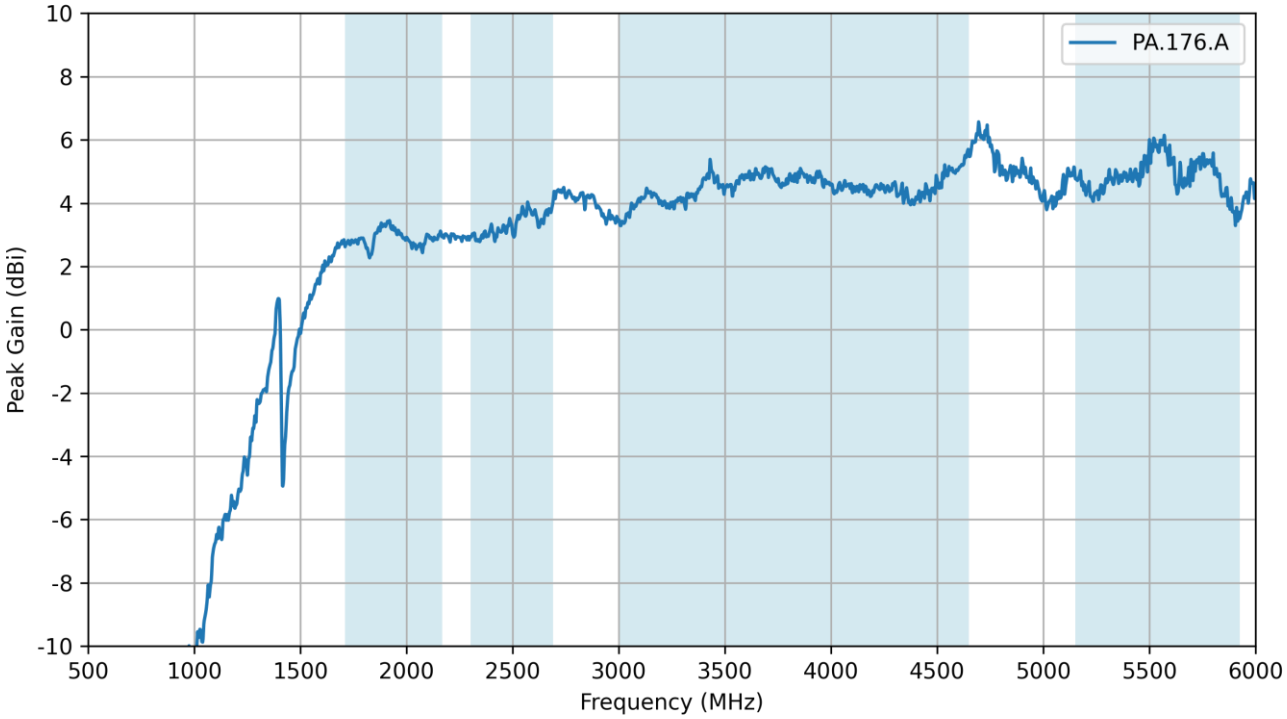
7.4 Efficiency



7.5 Average Gain

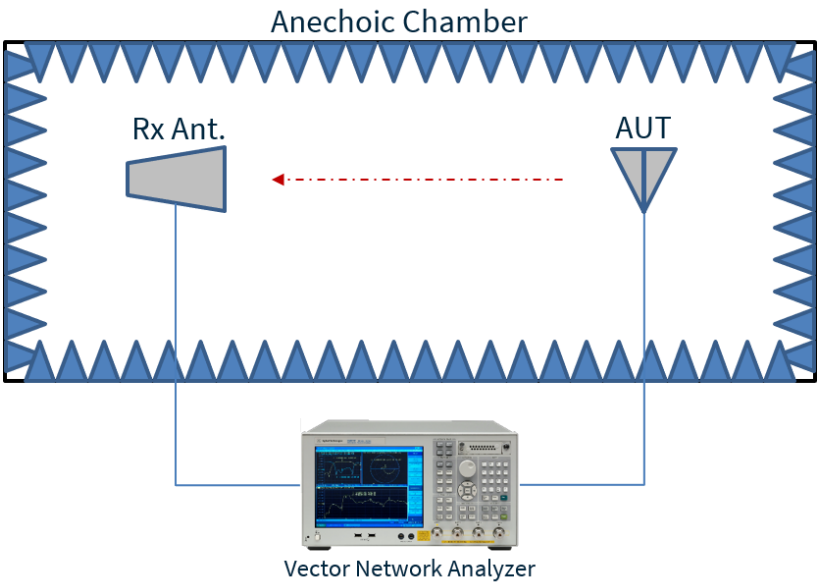


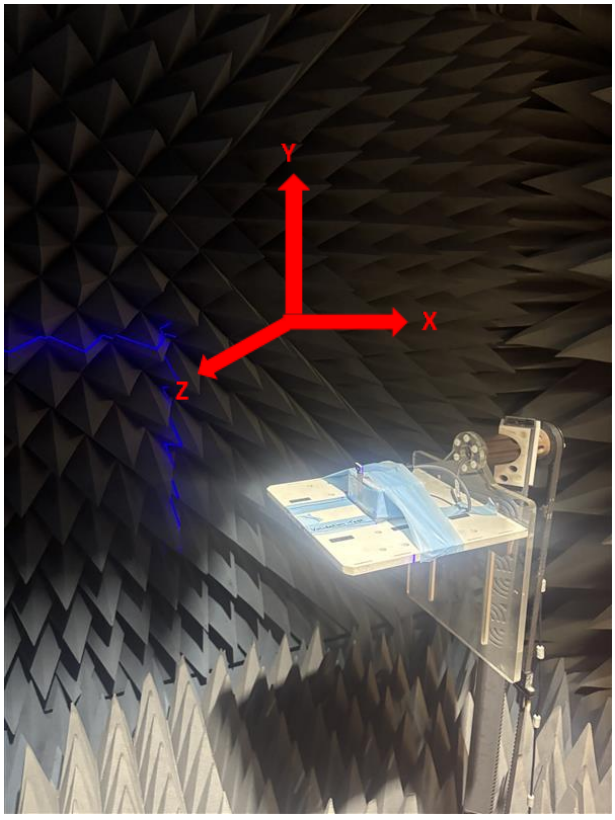
7.6 Peak Gain


PA.176.A
Peak Gain (dBi)
10
8
6
4
2
0
-2
-4
-6
-8
-10
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
Frequency (MHz)

8. Radiation Patterns

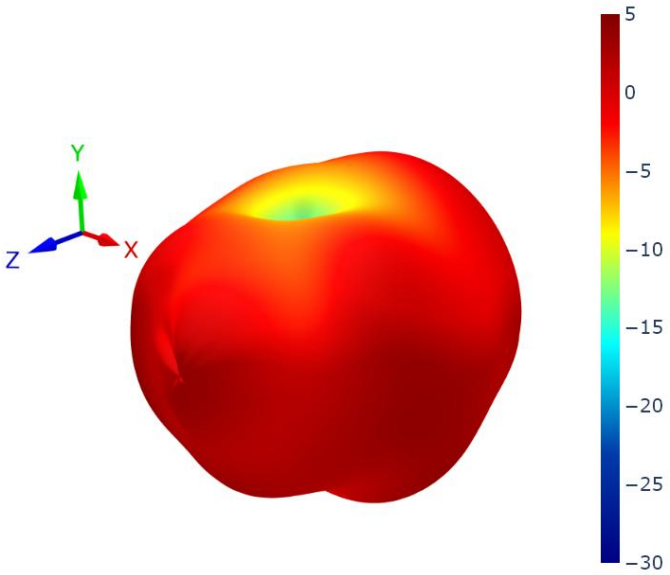
8.1 Test Setup



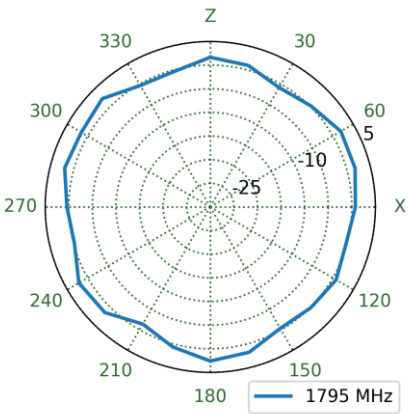


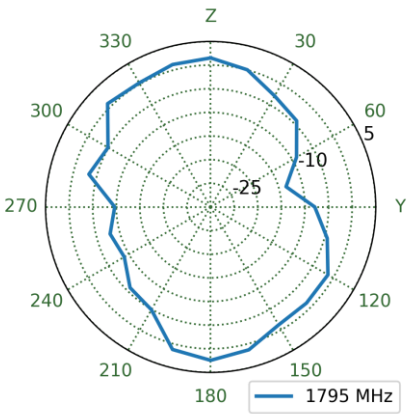
Chamber Test Set-up

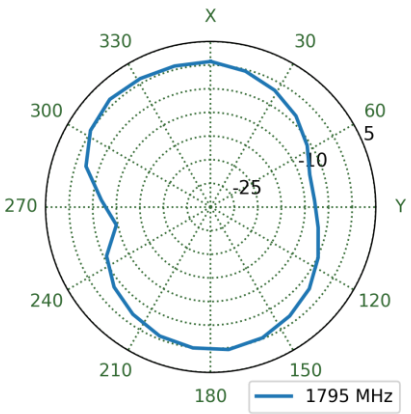
8.2 Patterns at 1795 MHz



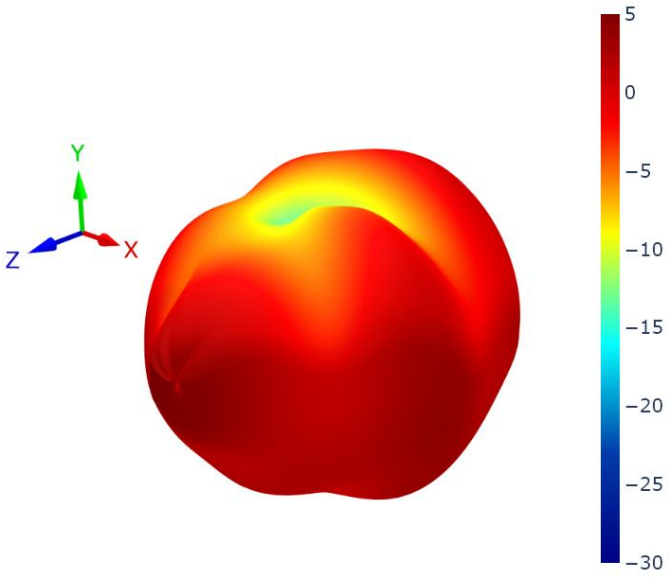
XZ Plane	YZ Plane	XY Plane

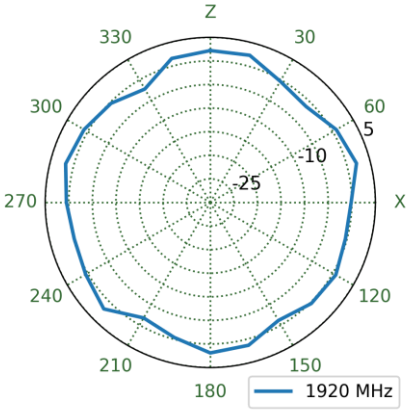
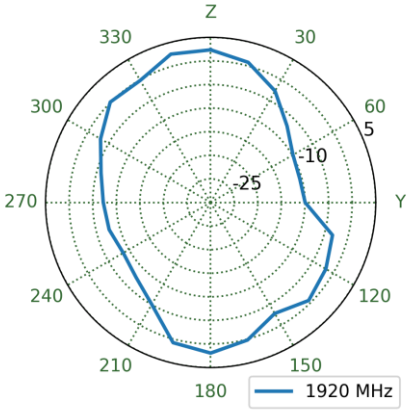
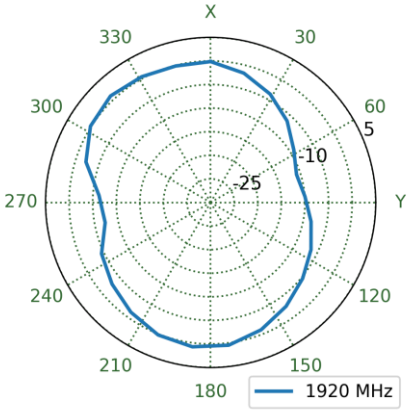




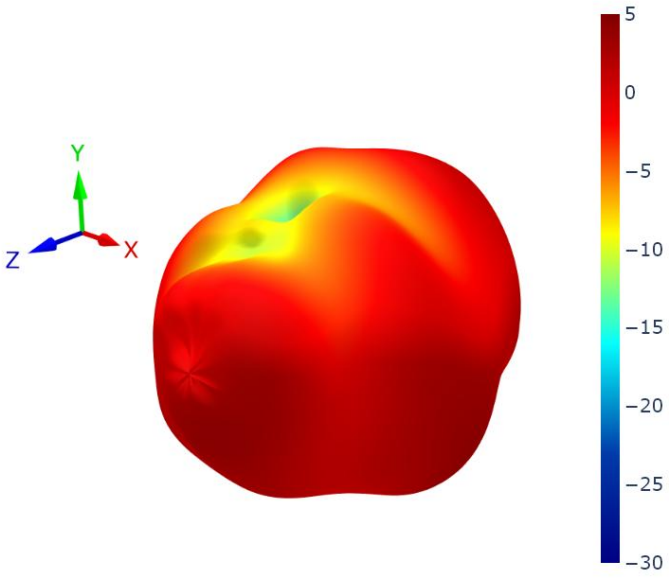


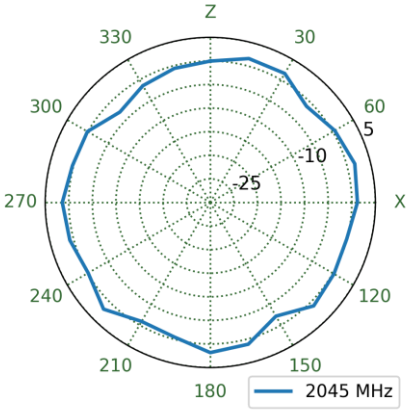
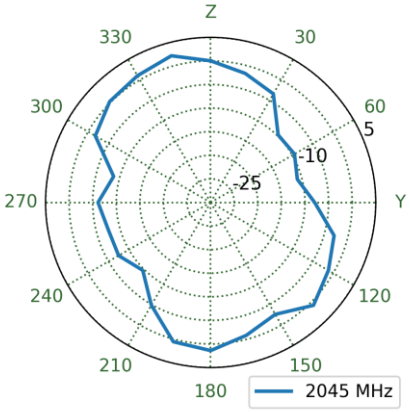
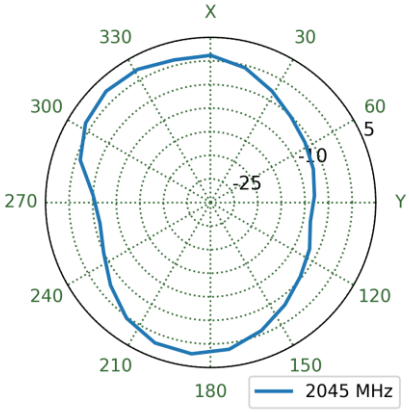
8.3 Patterns at 1920 MHz



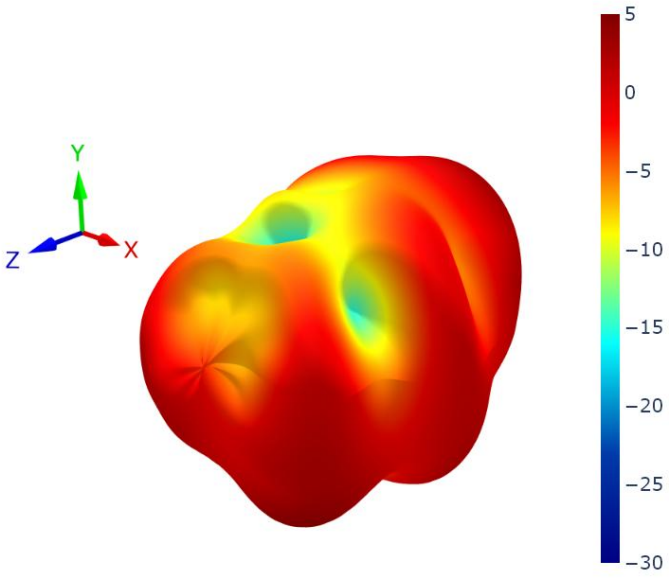
XZ Plane	YZ Plane	XY Plane
		

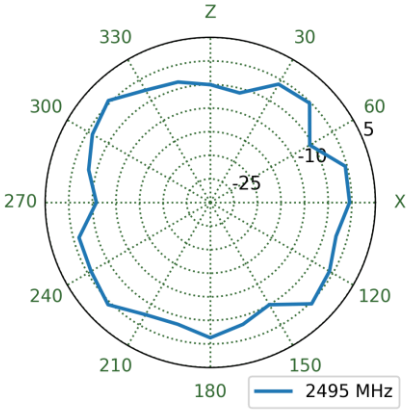
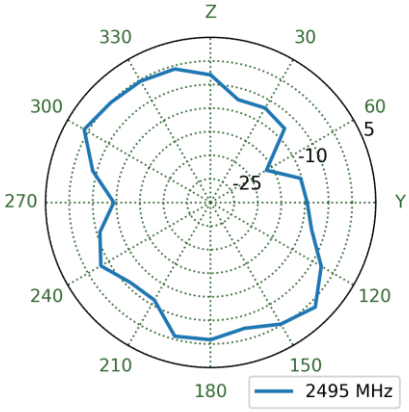
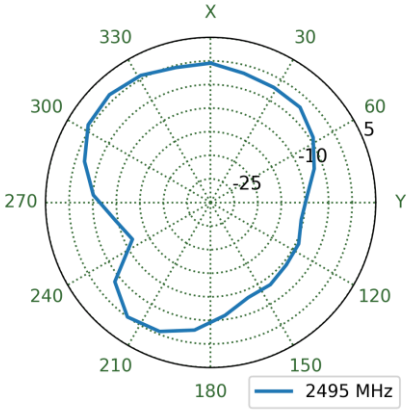
8.4 Patterns at 2045 MHz



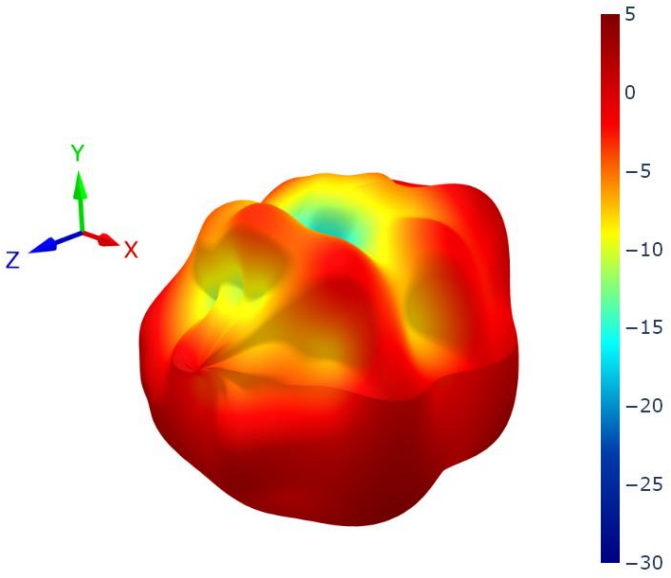
XZ Plane	YZ Plane	XY Plane
		

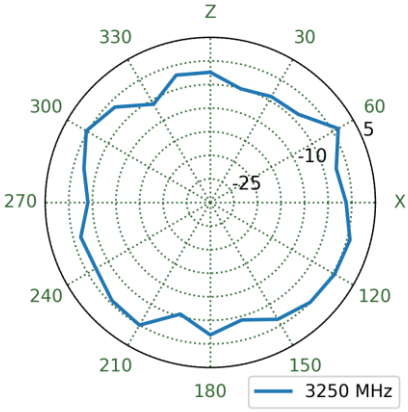
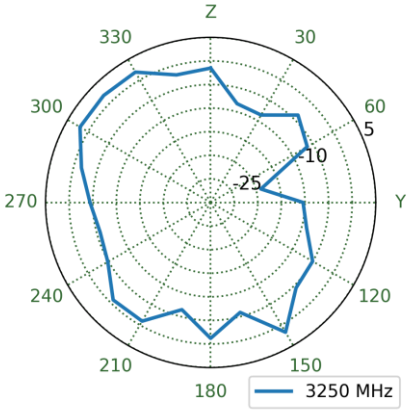
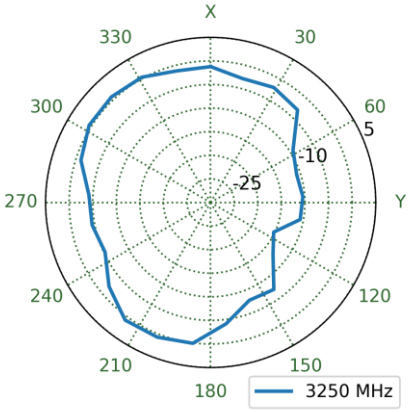
8.5 Patterns at 2495 MHz



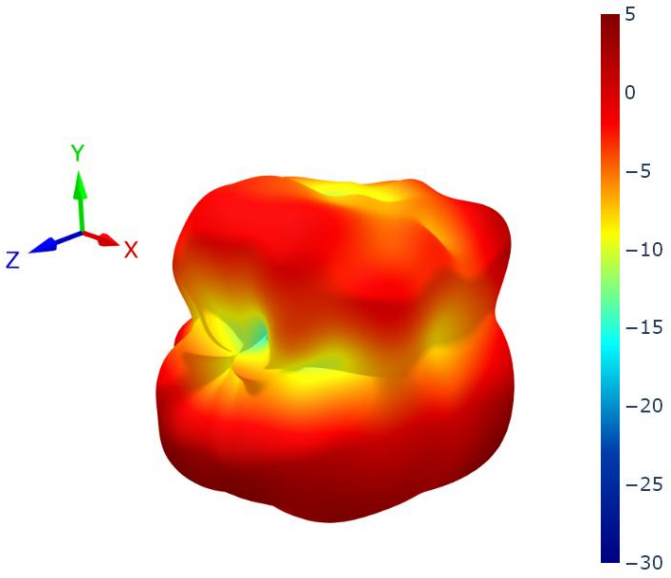
XZ Plane	YZ Plane	XY Plane
		

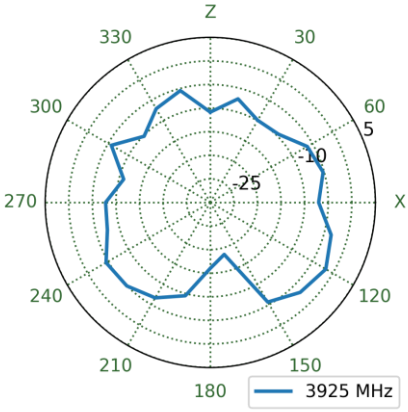
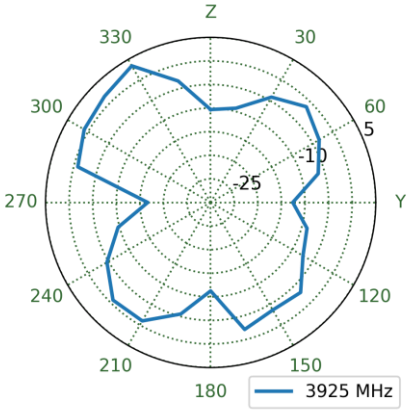
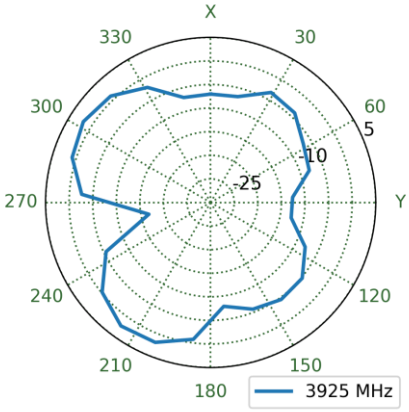
8.6 Patterns at 3250 MHz



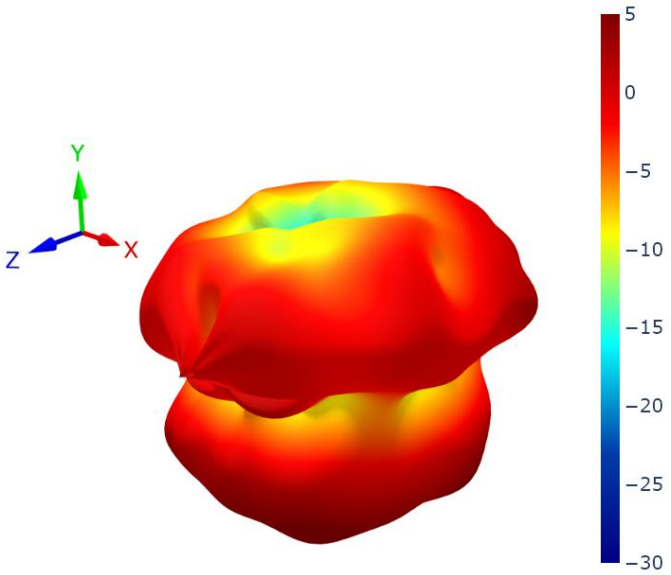
XZ Plane	YZ Plane	XY Plane
		

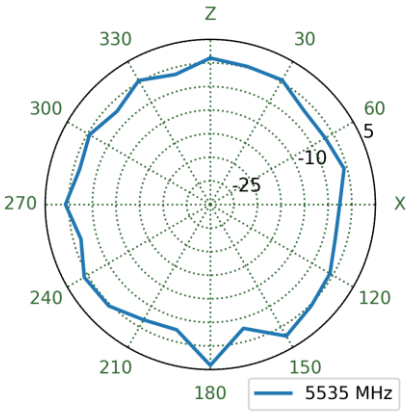
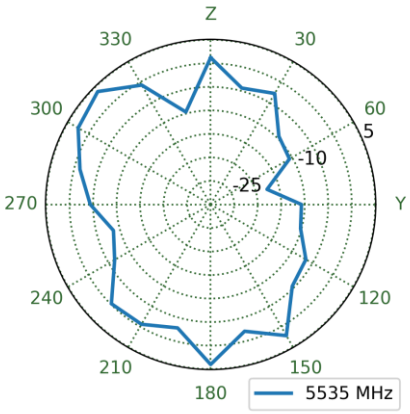
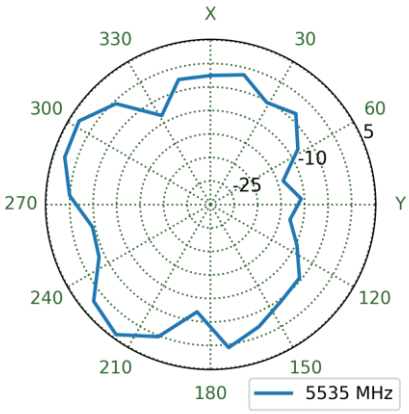
8.7 Patterns at 3925 MHz



XZ Plane	YZ Plane	XY Plane
		

8.8 Patterns at 5535 MHz



XZ Plane	YZ Plane	XY Plane
		

Changelog for the datasheet

SPE-20-8-041 – PA.176.A

Revision: D (Current Version)	
Date:	2025-12-16
Changes:	Full datasheet update.
Changes Made by:	Gary West

Revision: C	
Date:	2023-10-25
Changes:	Added Solder Reflow Profile
Changes Made by:	Cesar Sousa

Revision: B	
Date:	2020-11-05
Changes:	Specifications table amended
Changes Made by:	Dan Cantwell

Revision: A (Original First Release)	
Date:	2020-06-12
Notes:	Initial Release
Author:	Jack Conroy

TAOGLAS®

www.taoglas.com