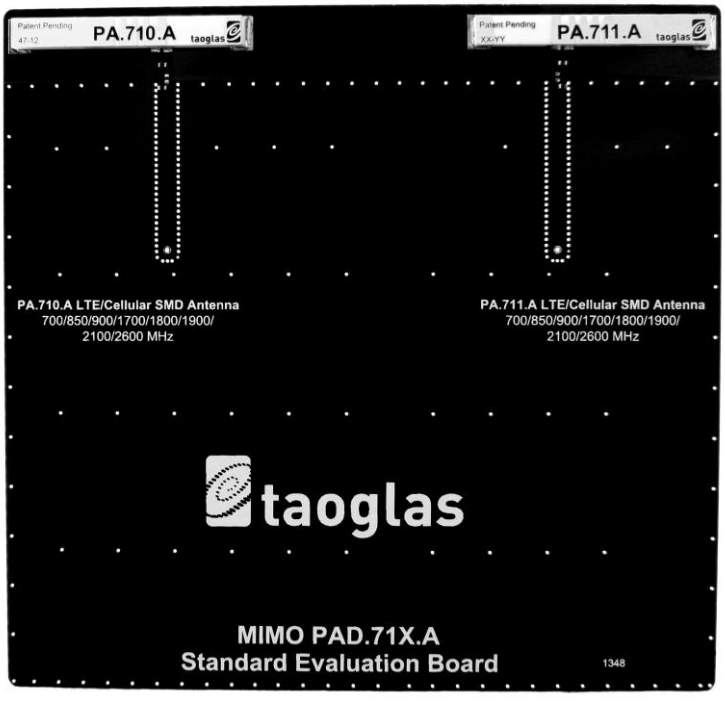
SPECIFICATION
Patent Pending

Part Number: **PAD.71X.A**

Product Name: GEMINI EMBEDDED LTE MIMO 2*2 ANTENNA
with PA.710.A and PA.711.A Antennas
For 2G/3G/4G 2x2 MIMO systems applications
LTE/GSM/CDMA/DCS/PCS/WCDMA/UMTS/HSPA/GPRS/EDGE/IMT
698MHz to 960MHz, 1710MHz to 2690Mhz

Features: Highest Efficiency Wide-band Embedded MIMO Antenna
>40% on all 4G/3G/2G Bands
<0.3 ECC on all bands
Patent pending
SMA(F) Connectors
Surface Mount Technology
120.0 x 125.0 x 0.75 mm
RoHS Compliant ✓



1. Introduction

The Gemini LTE MIMO 2*2 Embedded Antenna is the only compact MIMO antenna solution for the world LTE M2M and Internet of Things (IOT) market of today. Gemini has two antenna elements, the existing PA.710 LTE MIMO ceramic antenna successfully used in many LTE MIMO devices today, along with its new brother the PA.711 LTE MIMO ceramic antenna. By altering the radiation pattern of the PA.711 to that of the PA.710 (similar to reflecting), Taoglas has created the world's first high efficiency MIMO embedded wide-band cellular antenna conforming to an envelope correlation co-efficient of below 0.3. This minimal self interference is critical to achieve high data rates in today's advanced LTE systems.

The patent pending antenna is ideal for integration into high data throughput devices which depend on high efficiency MIMO antennas. Typical applications

- Intelligent Transport Systems
- High Definition Video Broadcast Systems
- Wireless LTE MIMO M2M devices with legacy 2G/3G Functionality

Antenna board size, dimensions and antenna placement have all been carefully evaluated for optimum performance. It is not recommended to go below this antenna board dimensions, as efficiency will reduce dramatically along with poor isolation. The antennas may also need to be re-tuned to fit into different custom enclosures. Taoglas offers full customization of the antenna system for your device.

Alternatively, PA.710 and PA.711 can be integrated directly on your main board, provided that you follow strict guidelines on meeting minimum main-board ground plane dimensions, transmission line design, matching, and placement of antennas.

Contact Taoglas regional sales office for support.

2. Specification

ELECTRICAL				
Antenna	PA.710 and PA.711			
Standard	4G/3G/2G			
Operation Frequency (MHz)	698~960MHz	1710~2170MHz	2300~2400MHz	2490~2690MHz
Peak Gain	1.0dBi	3.0dBi	3.5dBi	2.8dBi
Average Gain	-2.7 dB	-2.6 dB	-2.5dB	-2.2dB
Efficiency	53%	54%	55%	60%
VSWR	<3.5:1			
Impedance	50Ω			
Polarization	Linear			
Radiation Properties	Omni-directional			
Max Input Power	5 W			

- The PA.710 and PA.711 antennas performances were measured with 106x125mm ground plane.

MECHANICAL	
Dimensions (mm)	106x125.0x0.75 mm
Material	FR4
Termination	Ag (environmental-friendly Pb free)
EVB Connector	SMA(F)

ENVIRONMENTAL	
Operation Temperature	-40°C to 85°C
Storage Temperature	-40°C to 105°C
Relative Humidity	Non-condensing 65°C 95% RH
RoHs Compliant	Yes

LTE BANDS				
Band Number	LTE / LTE-Advanced / WCDMA / HSPA / HSPA+ / TD-SCDMA			
	Uplink	**Downlink**	**PA710.A**	**PA.711.A**
1	UL: 1920 to 1980	DL: 2110 to 2170	✓	✓
2	UL: 1850 to 1910	DL: 1930 to 1990	✓	✓
3	UL: 1710 to 1785	DL: 1805 to 1880	✓	✓
4	UL: 1710 to 1755	DL: 2110 to 2155	✓	✓
5	UL: 824 to 849	DL: 869 to 894	✓	✓
7	UL: 2500 to 2570	DL:2620 to 2690	✓	✓
8	UL: 880 to 915	DL: 925 to 960	✓	✓
9	UL: 1749.9 to 1784.9	DL: 1844.9 to 1879.9	✓	✓
11	UL: 1427.9 to 1447.9	DL: 1475.9 to 1495.9	✗	✗
12	UL: 699 to 716	DL: 729 to 746	✓	✓
13	UL: 777 to 787	DL: 746 to 756	✓	✓
14	UL: 788 to 798	DL: 758 to 768	✓	✓
17	UL: 704 to 716	DL: 734 to 746 (LTE only)	✓	✓
18	UL: 815 to 830	DL: 860 to 875 (LET only)	✓	✓
19	UL: 830 to 845	DL: 875 to 890	✓	✓
20	UL: 832 to 862	DL: 791 to 821	✓	✓
21	UL: 1447.9 to 1462.9	DL: 1495.9 to 1510.9	✗	✗
22	UL: 3410 to 3490	DL: 3510 to 3590	✗	✗
23	UL:2000 to 2020	DL: 2180 to 2200 (LTE only)	✓	✓
24	UL:1625.5 to 1660.5	DL: 1525 to 1559 (LTE only)	✓	✓
25	UL: 1850 to 1915	DL: 1930 to 1995	✓	✓
26	UL: 814 to 849	DL: 859 to 894	✓	✓
27	UL: 807 to 824	DL: 852 to 869 (LTE only)	✓	✓
28	UL: 703 to 748	DL: 758 to 803 (LTE only)	✓	✓
29	UL: -	DL: 717 to 728 (LTE only)	✓	✓
30	UL: 2305 to 2315	DL: 2350 to 2360 (LTE only)	✓	✓
31	UL: 452.5 to 457.5	DL: 462.5 to 467.5 (LTE only)	✗	✗
32	UL: -	DL: 1452 - 1496	✓	✓
35	1850 to 1910		✓	✓
38	2570 to 2620		✓	✓
39	1880 to 1920		✓	✓
40	2300 to 2400		✓	✓
41	2496 to 2690		✓	✓
42	3400 to 3600		✗	✗
43	3600 to 3800		✗	✗

3. Test Setup

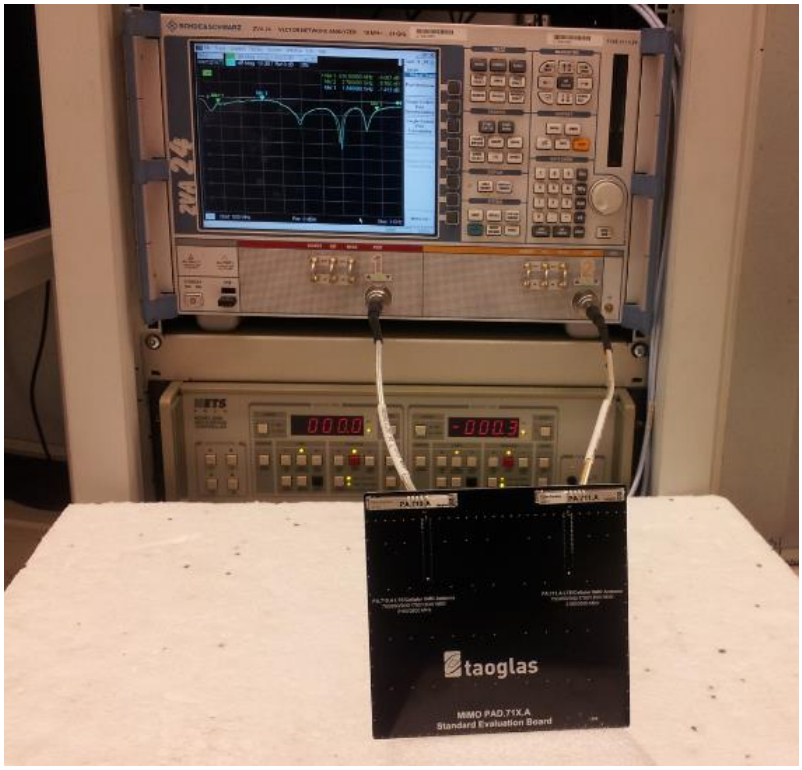


Figure 1. Return Loss and VSWR test set up

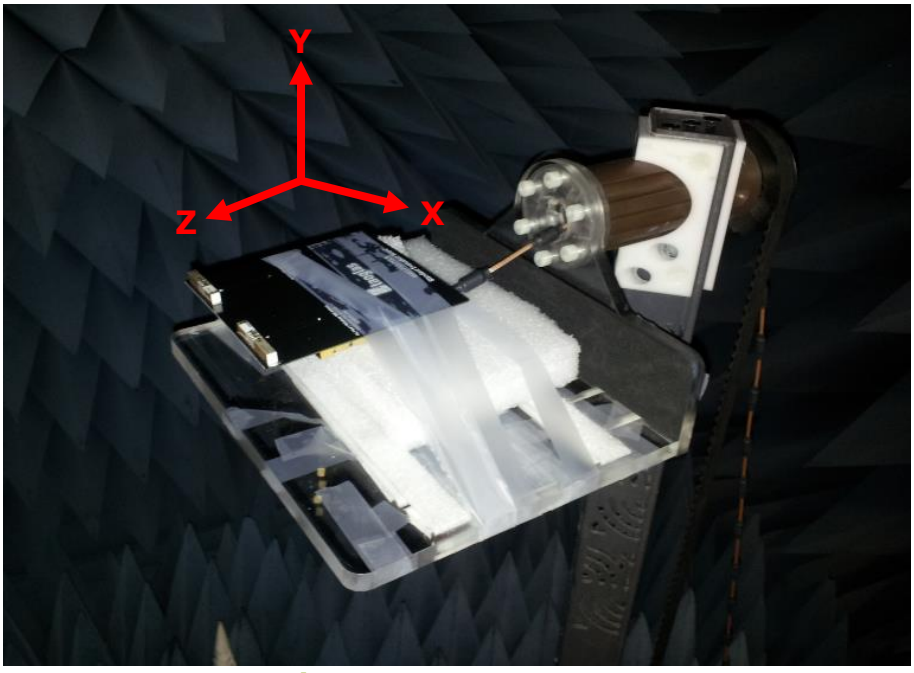


Figure 2. OTA test set up

4. Antenna Parameters

4.1. Return Loss

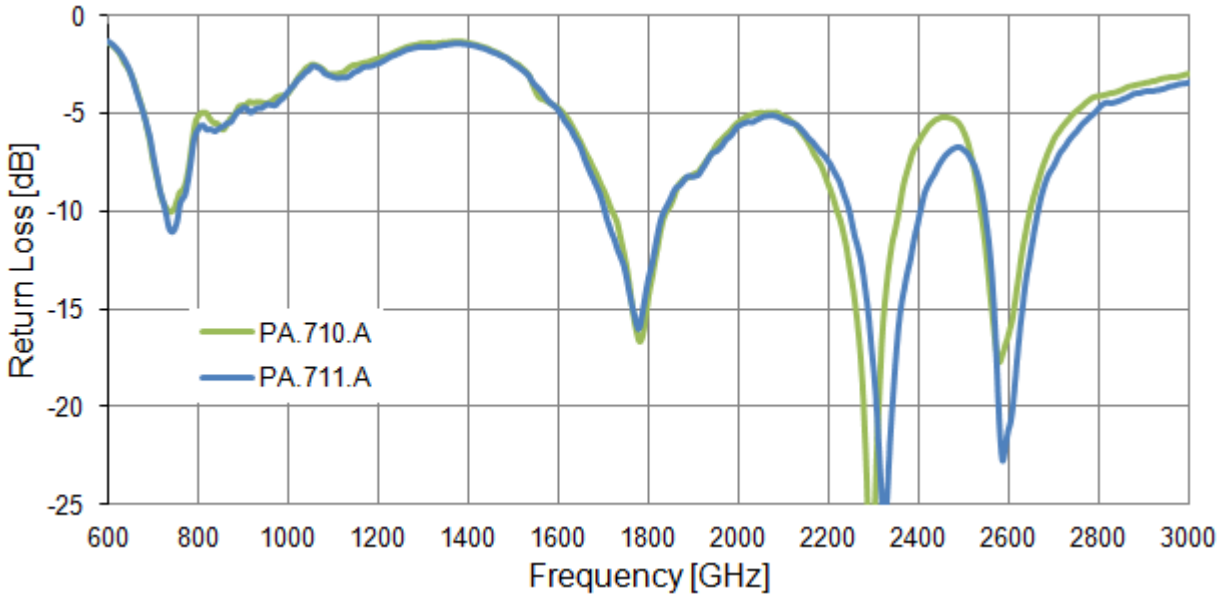


Figure 3. Return Loss of the PA.710 and PA.711 antennas

4.2. VSWR

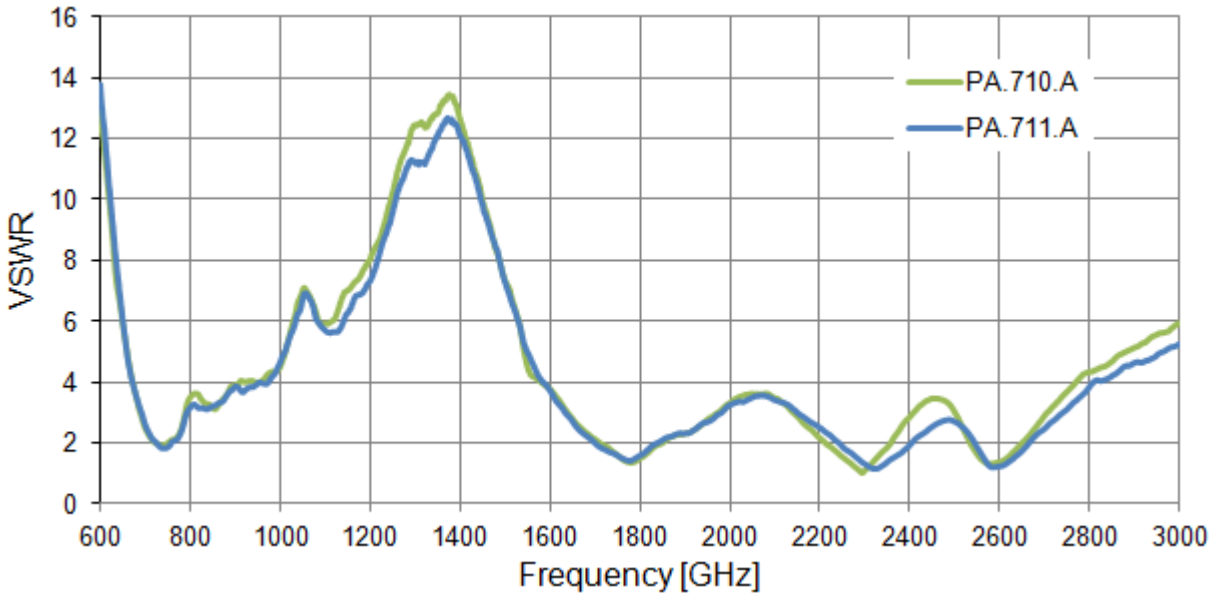


Figure 4. VSWR of the PA.710 and PA.711 antennas

4.3. Isolation

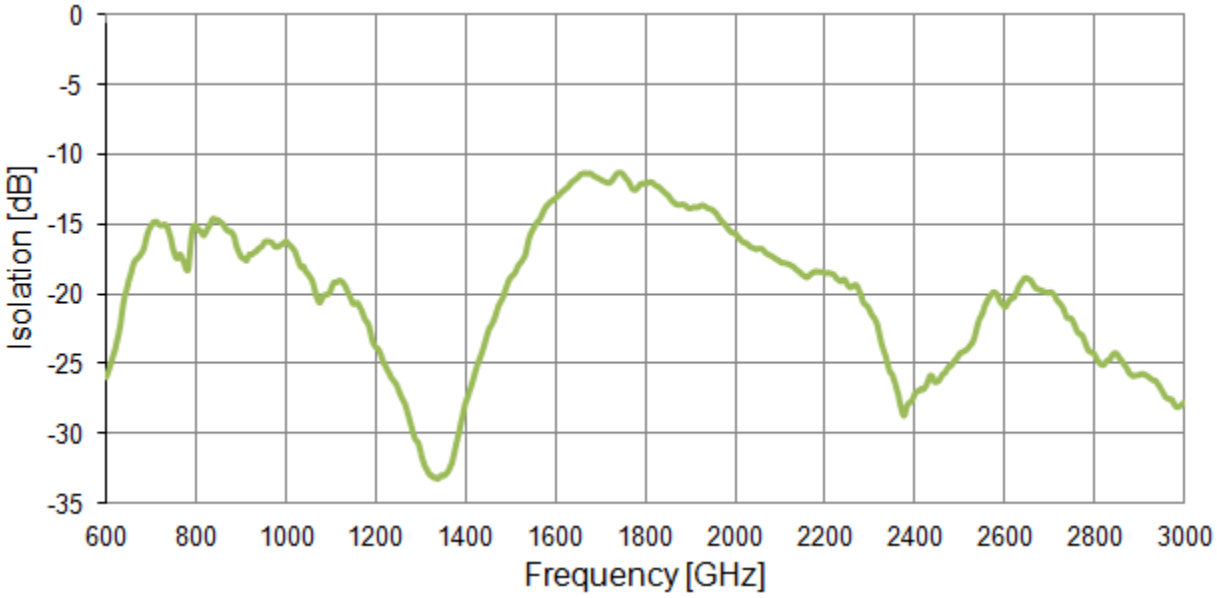


Figure 5. Isolation of the PA.710 and PA.711 antennas

4.4. Envelope Correlation Coefficient

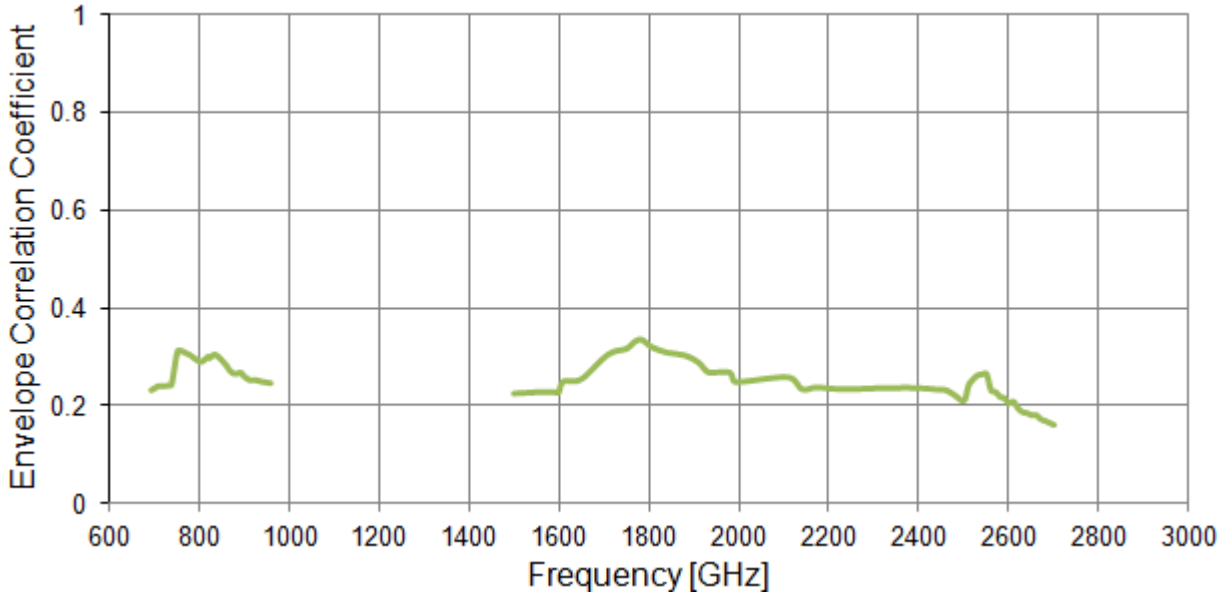


Figure 6. ECC of the PA.710 and PA.711 antennas

4.5. Efficiency

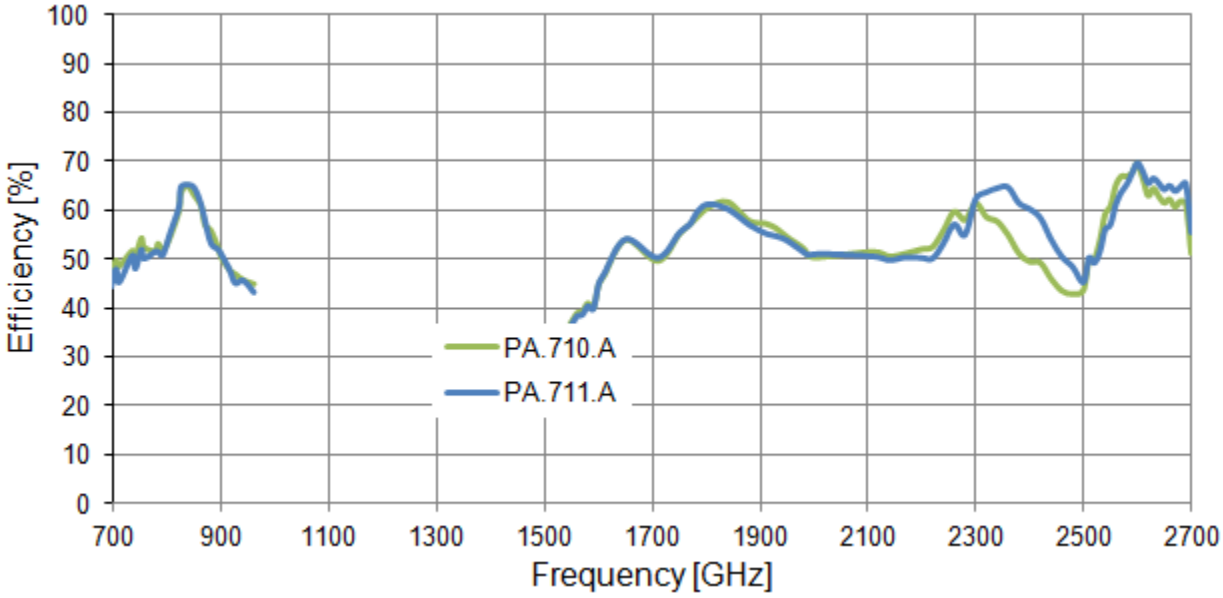


Figure 7. Efficiency of the PA.710 and PA.711 antennas

4.6. Peak Gain

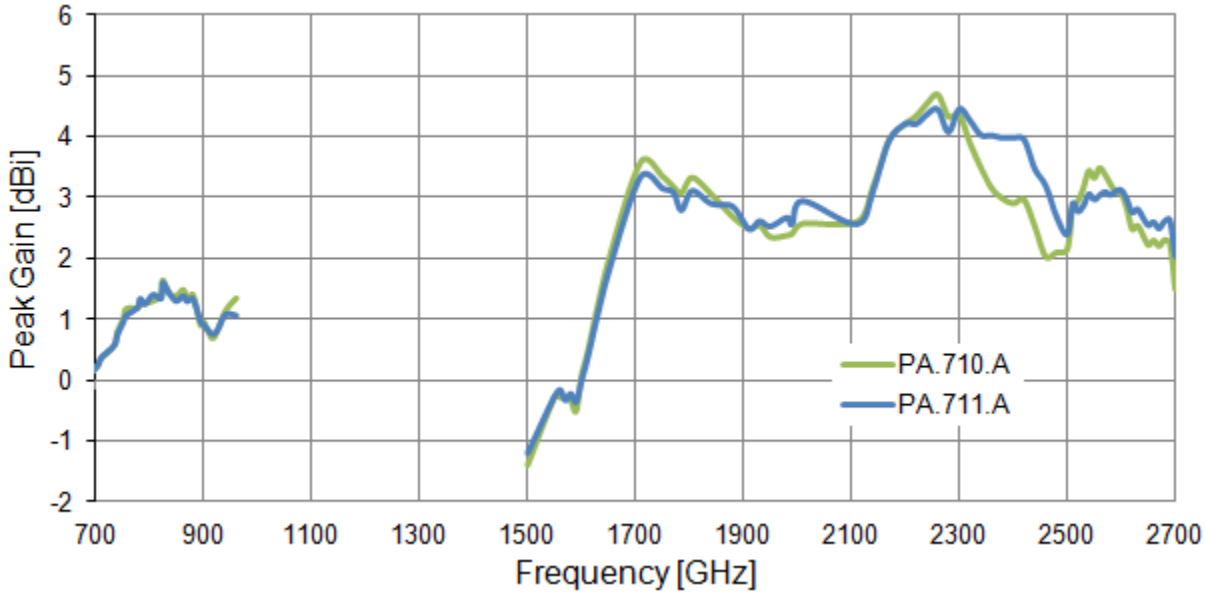


Figure 8. Peak Gain of the PA.710 and PA.711 antennas

4.7. Average Gain

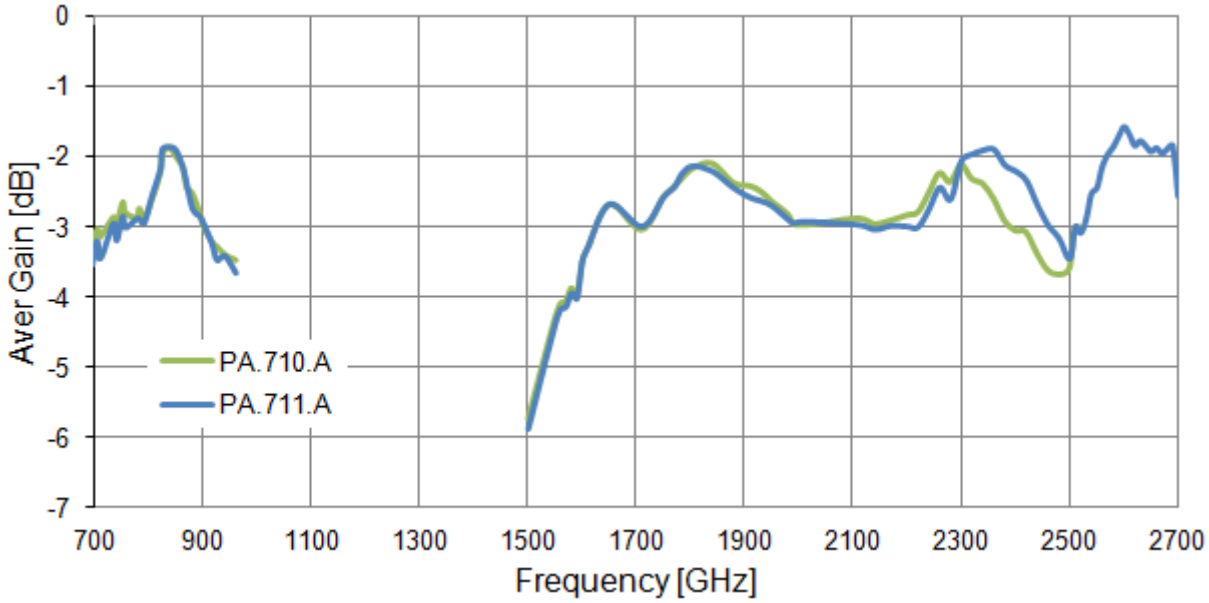


Figure 9. Average Gain of the PA.710 and PA.711 antennas

4.8. 3D Radiation Pattern (measured on 120*125mm EVB)

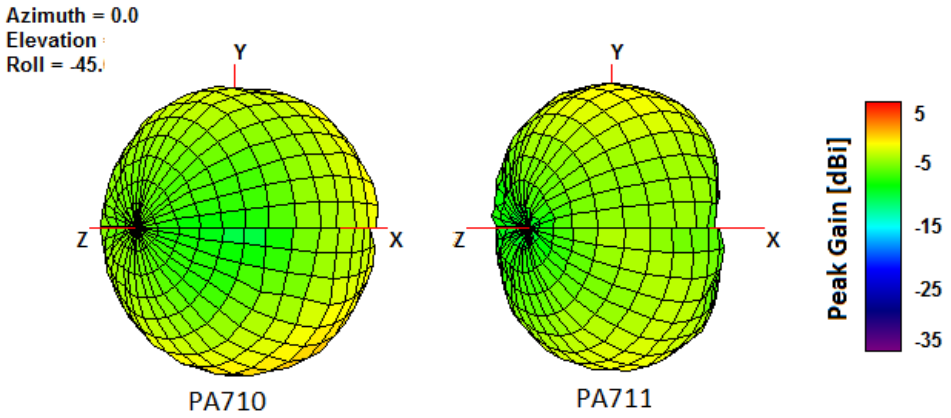


Figure 10. 3D Radiation Pattern at 700MHz of the PA.710 and PA.711 antennas

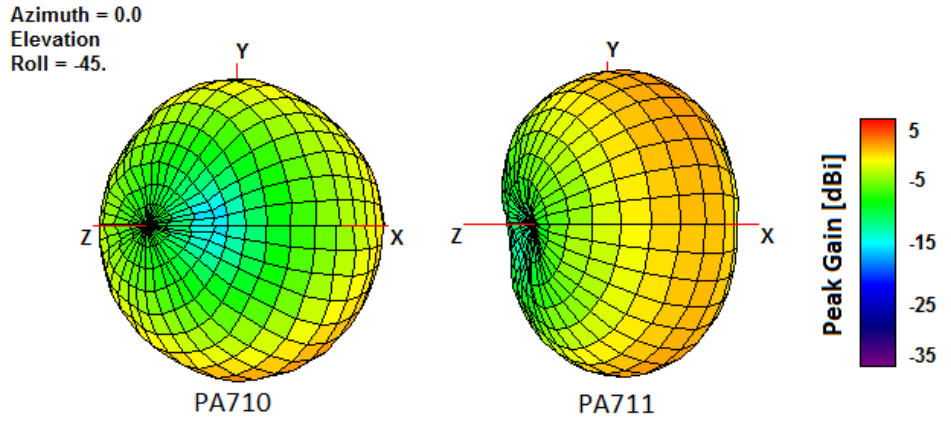


Figure 11. 3D Radiation Pattern at 800MHz of the PA.710 and PA.711 antennas

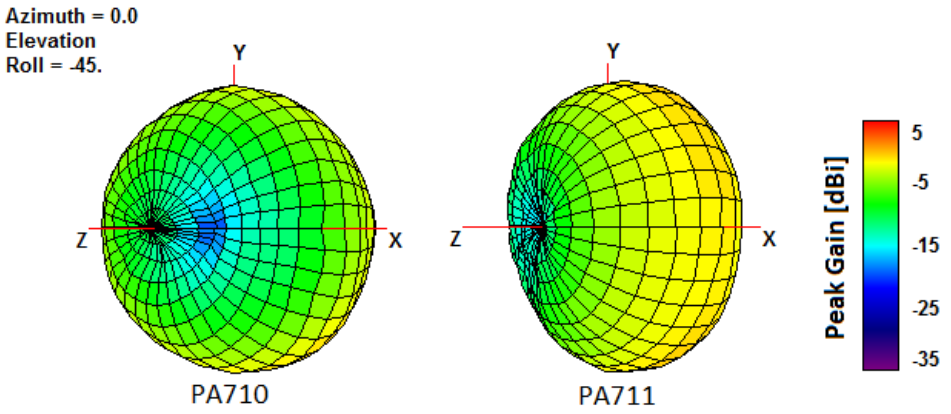


Figure 12. 3D Radiation Pattern at 900MHz of the PA.710 and PA.711 antennas

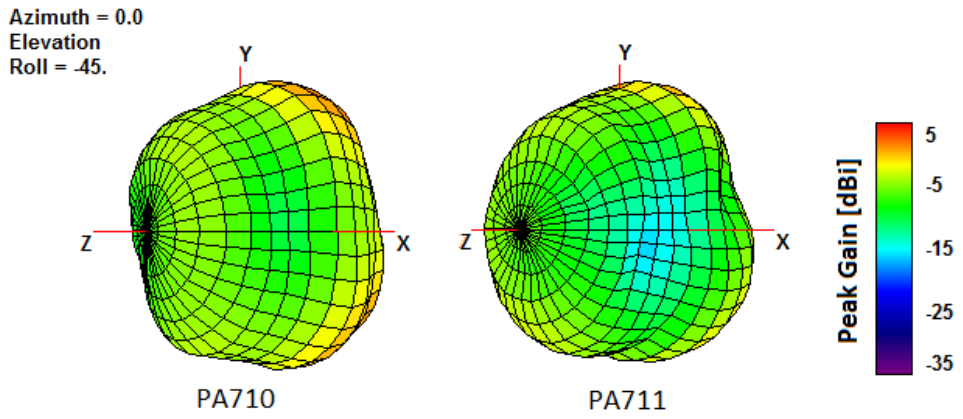


Figure 13. 3D Radiation Pattern at 1710MHz of the PA.710 and PA.711 antennas

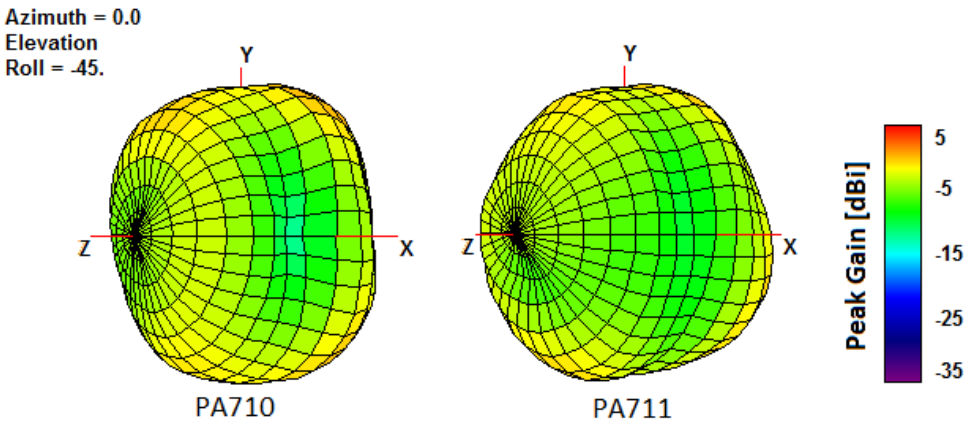


Figure 14. 3D Radiation Pattern at 1805MHz of the PA.710 and PA.711 antennas

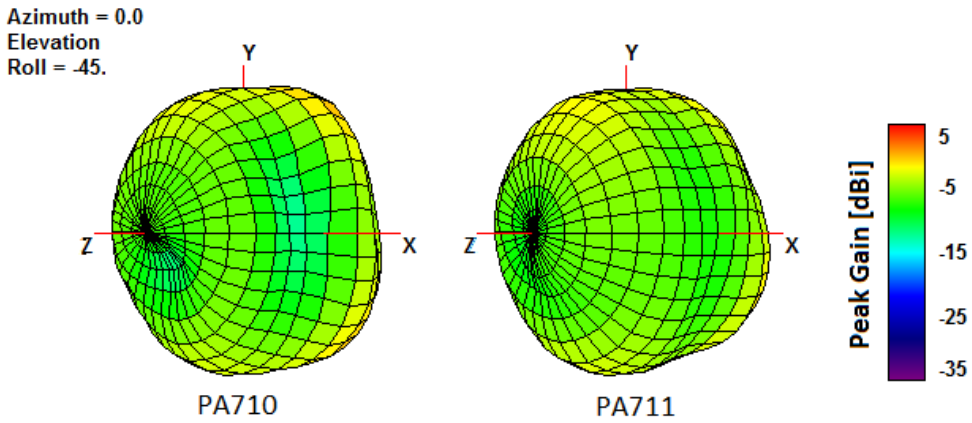


Figure 15. 3D Radiation Pattern at 1910MHz of the PA.710 and PA.711 antennas

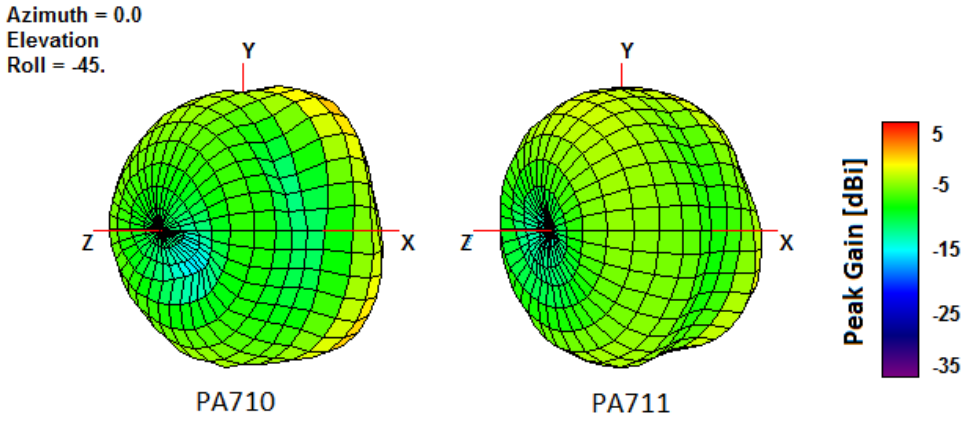


Figure 16. 3D Radiation Pattern at 1990MHz of the PA.710 and PA.711 antennas

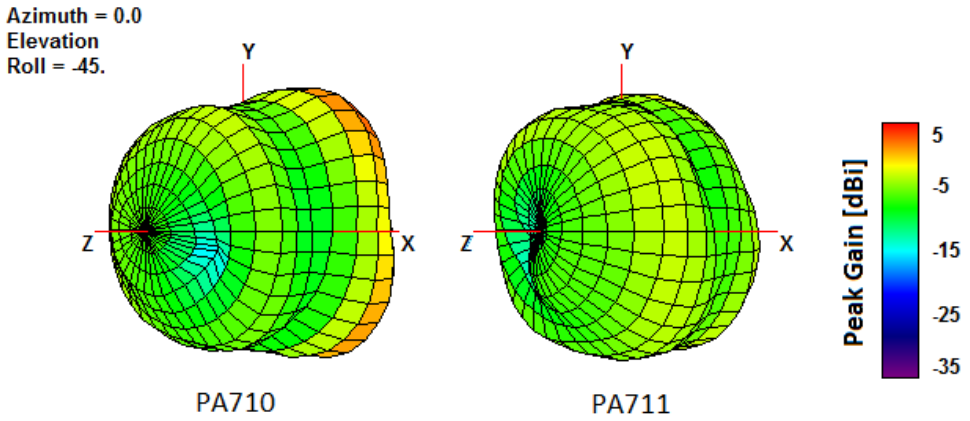


Figure 17. 3D Radiation Pattern at 2170MHz of the PA.710 and PA.711 antennas

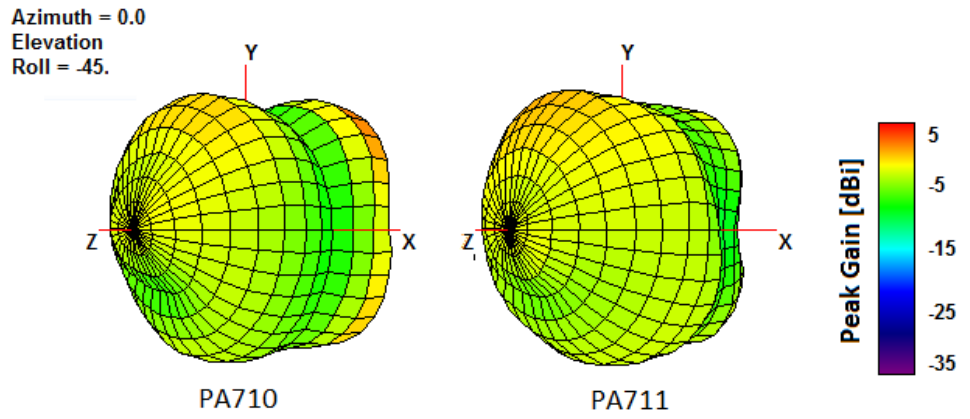


Figure 18. 3D Radiation Pattern at 2400MHz of the PA.710 and PA.711 antennas

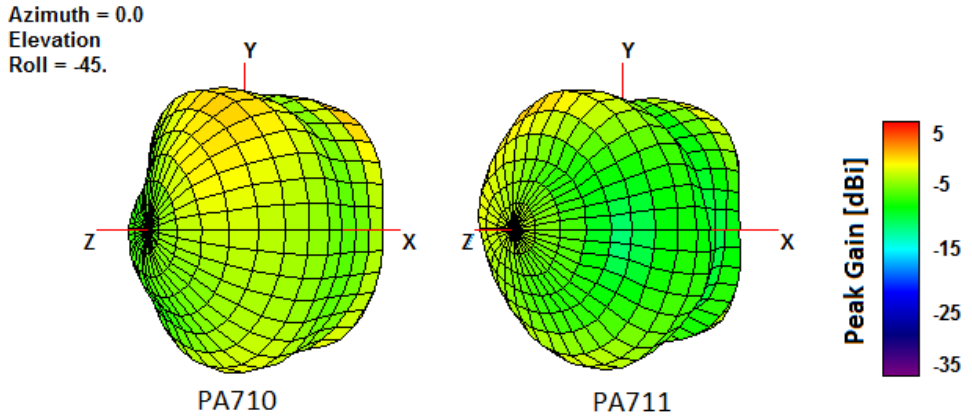


Figure 19. 3D Radiation Pattern at 2500MHz of the PA.710 and PA.711 antennas

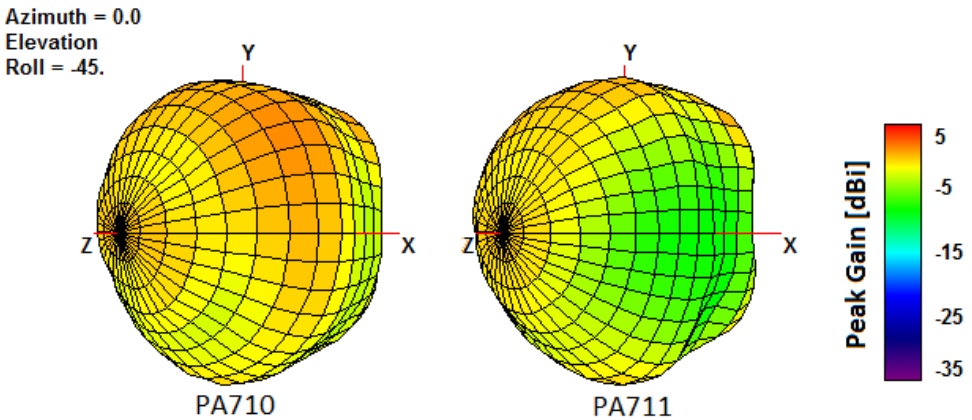


Figure 20. 3D Radiation Pattern at 2600MHz of the PA.710 and PA.711 antennas

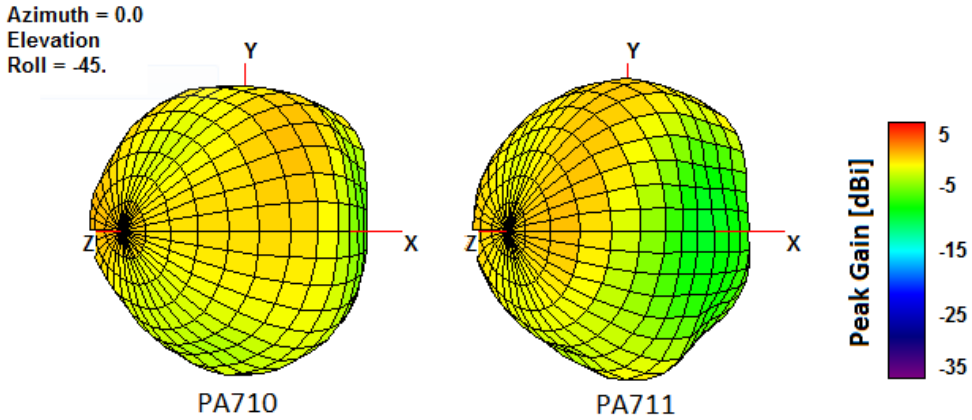


Figure 21. 3D Radiation Pattern at 2700MHz of the PA.710 and PA.711 antennas

4.9. PA.710 2D Radiation Pattern (measured on 120*125mm EVB)

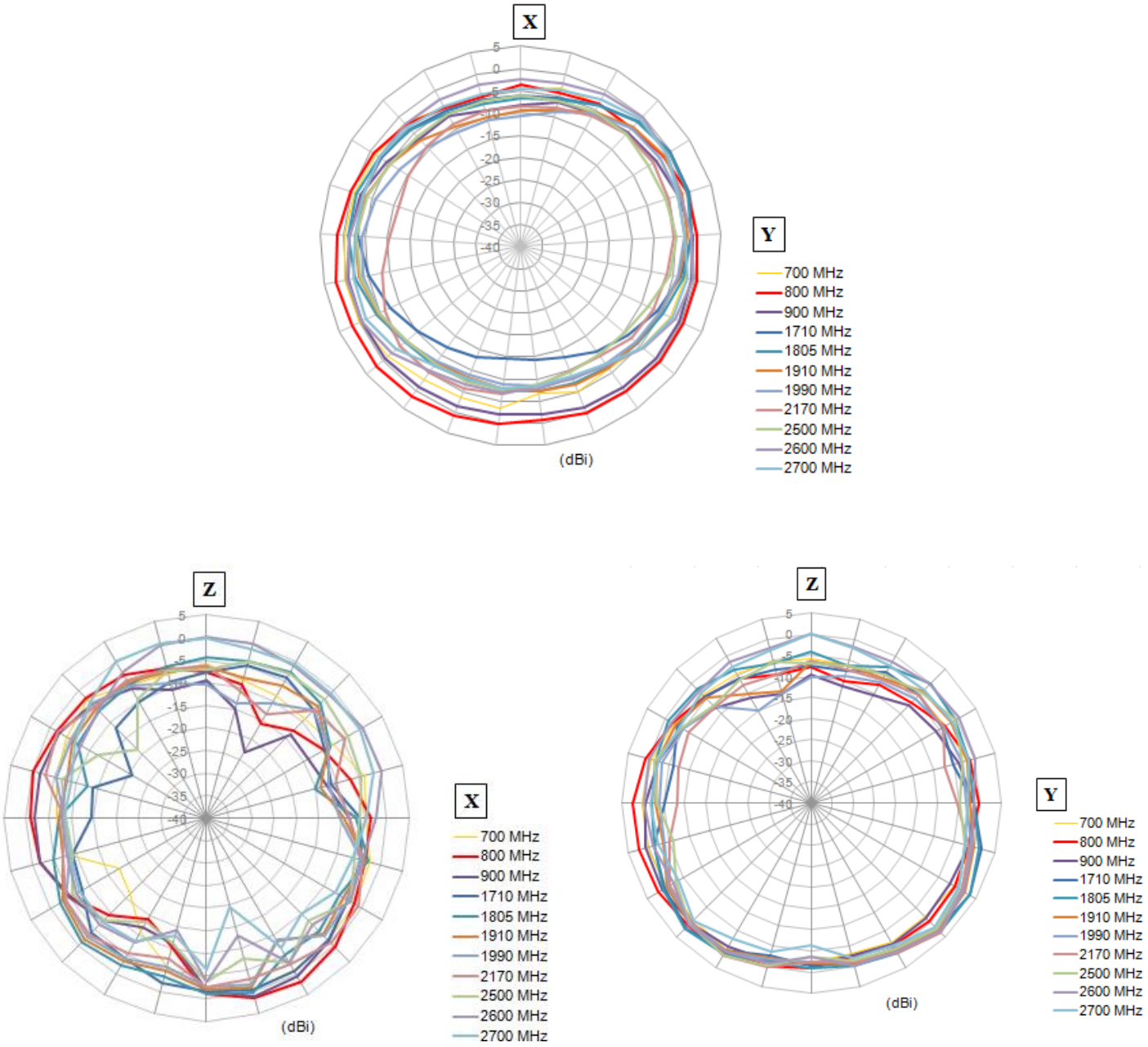


Figure 22. 2D Radiation Pattern of the PA.710 Antenna

4.10. PA.711 2D Radiation Pattern (measured on 120*45mm EVB)

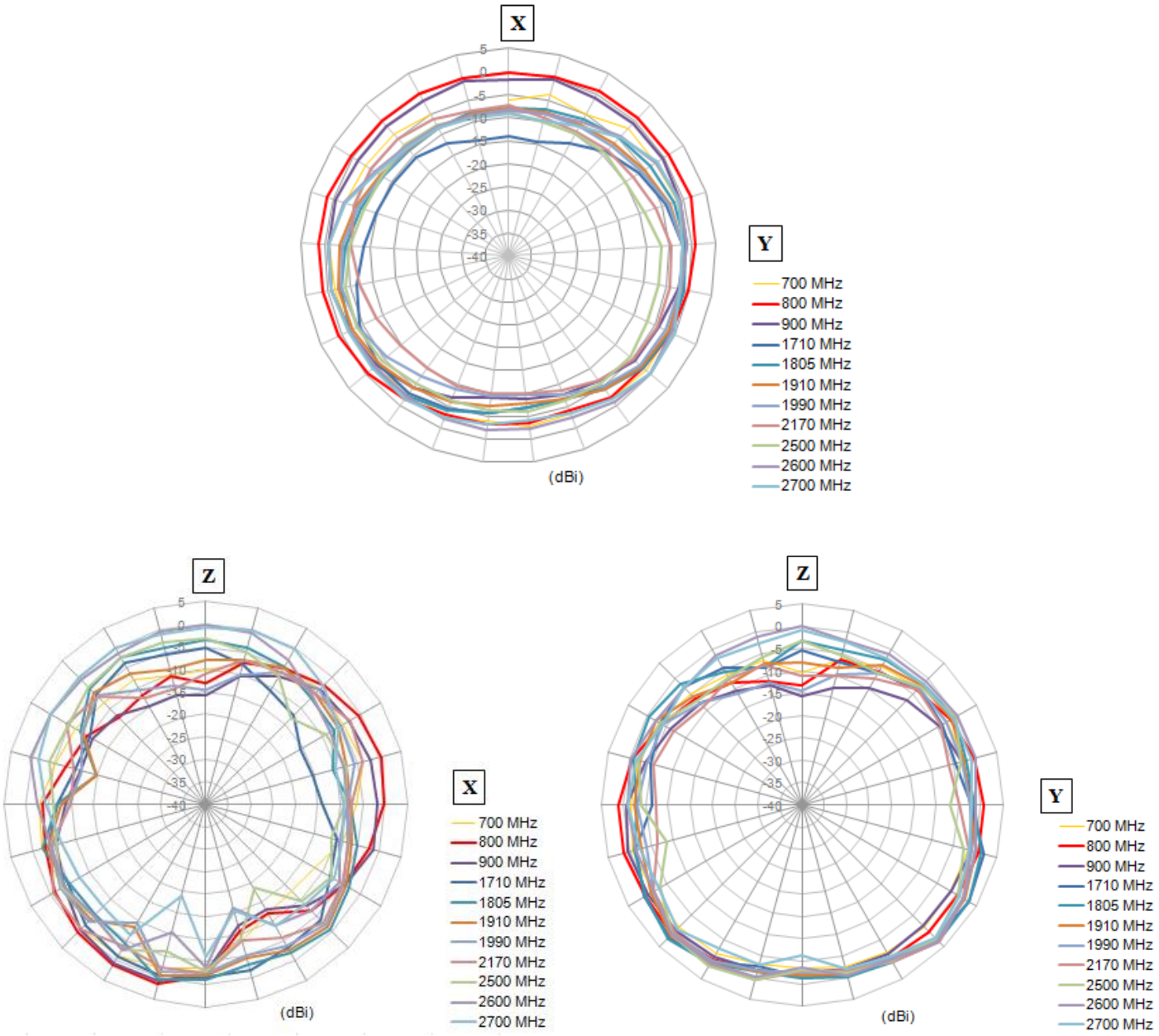


Figure 23. 2D Radiation Pattern of the PA.711 Antenna

5. Mechanical Drawing (Unit: mm)

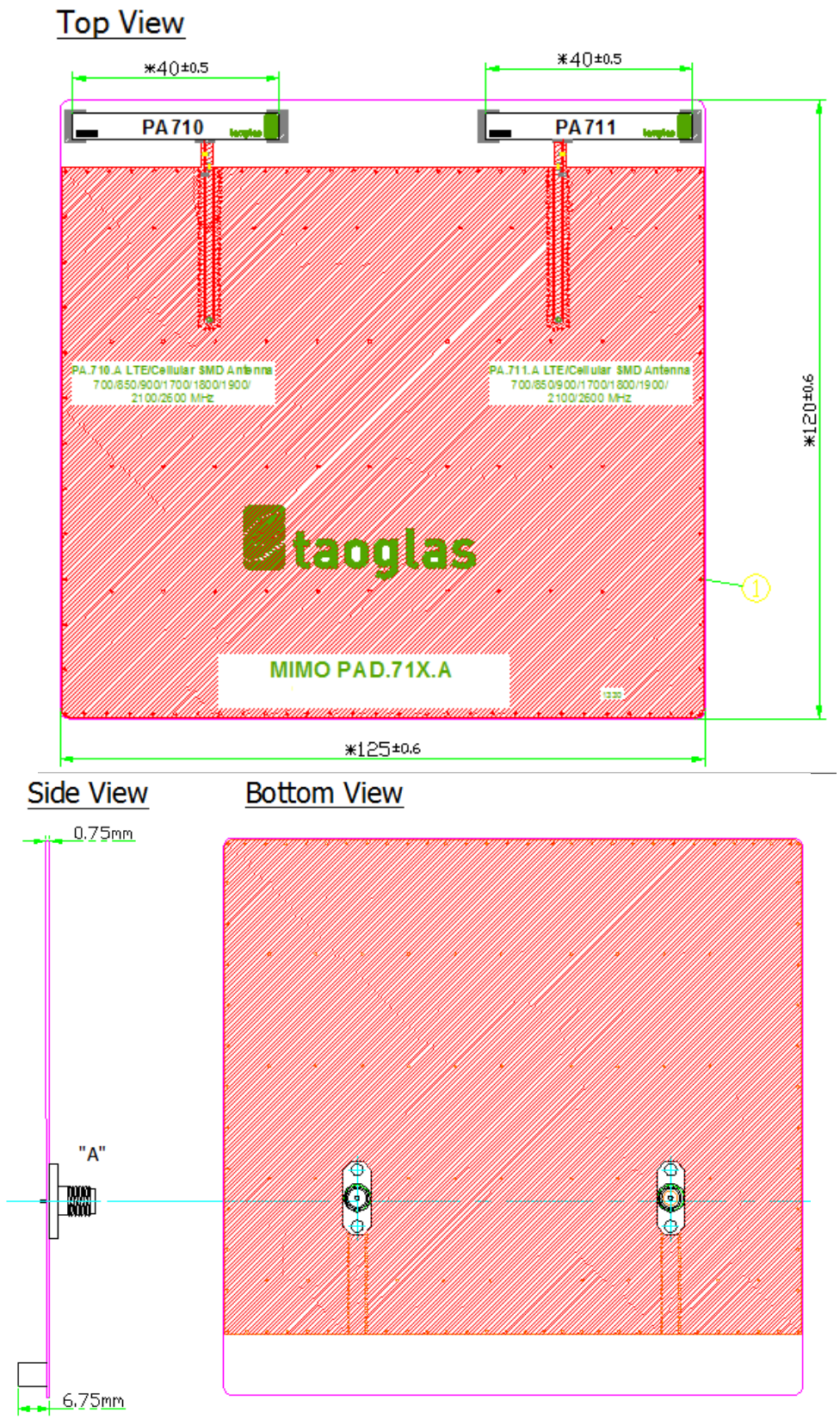


Figure 24. Mechanical drawing of PAD.71X.A

6. Layout Dimensions (Unit: mm)

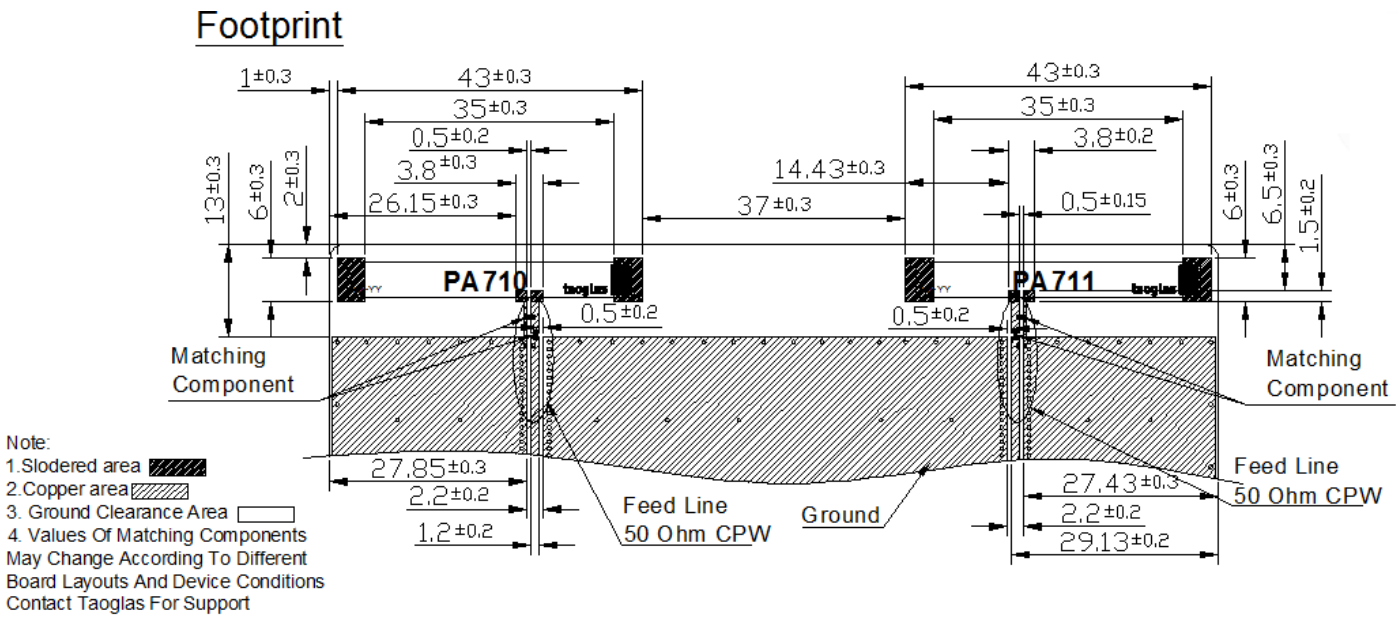
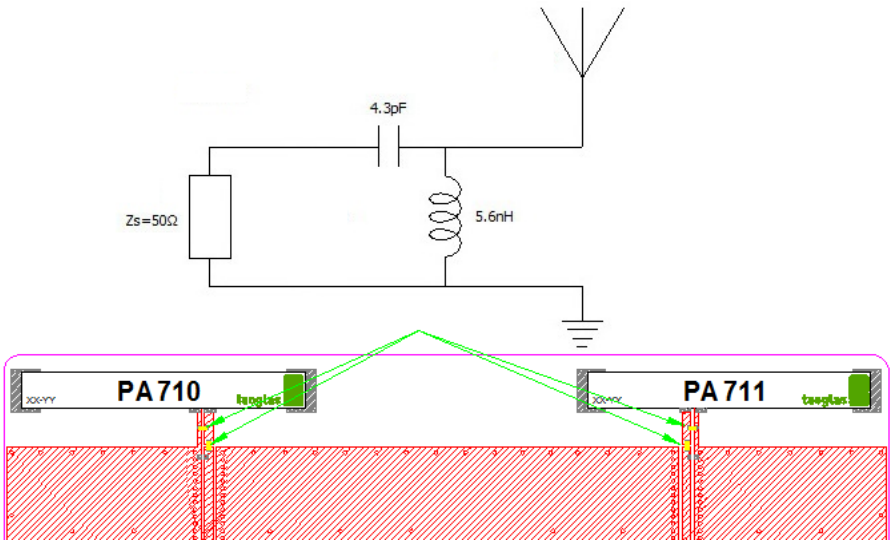
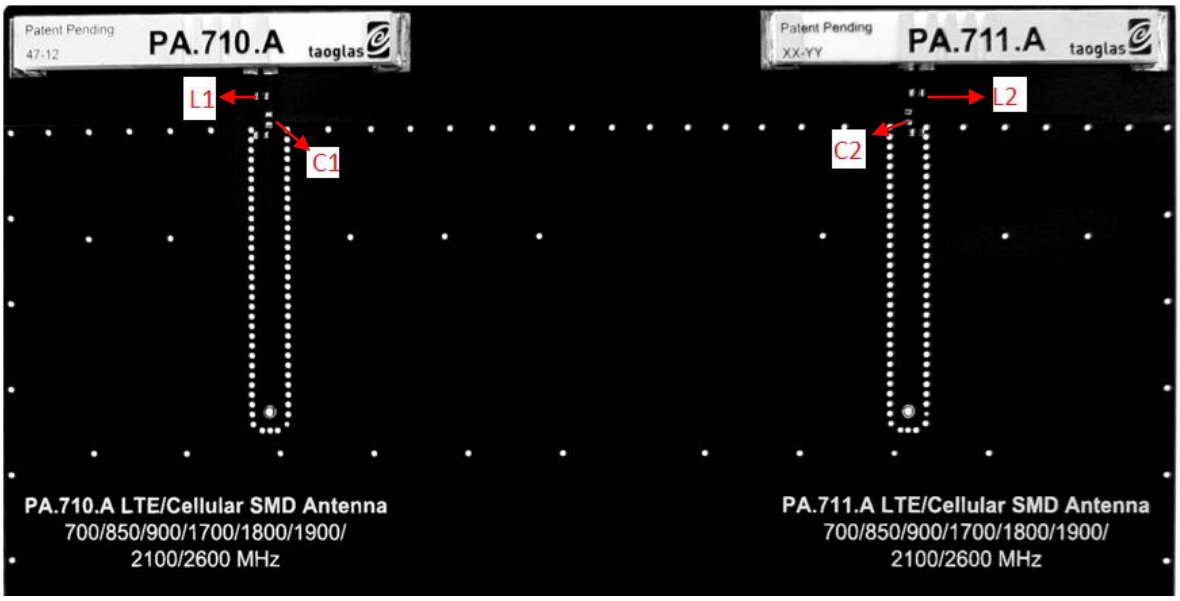


Figure 25. Layout dimensions of PAD.71X.A

7. Matching Circuit

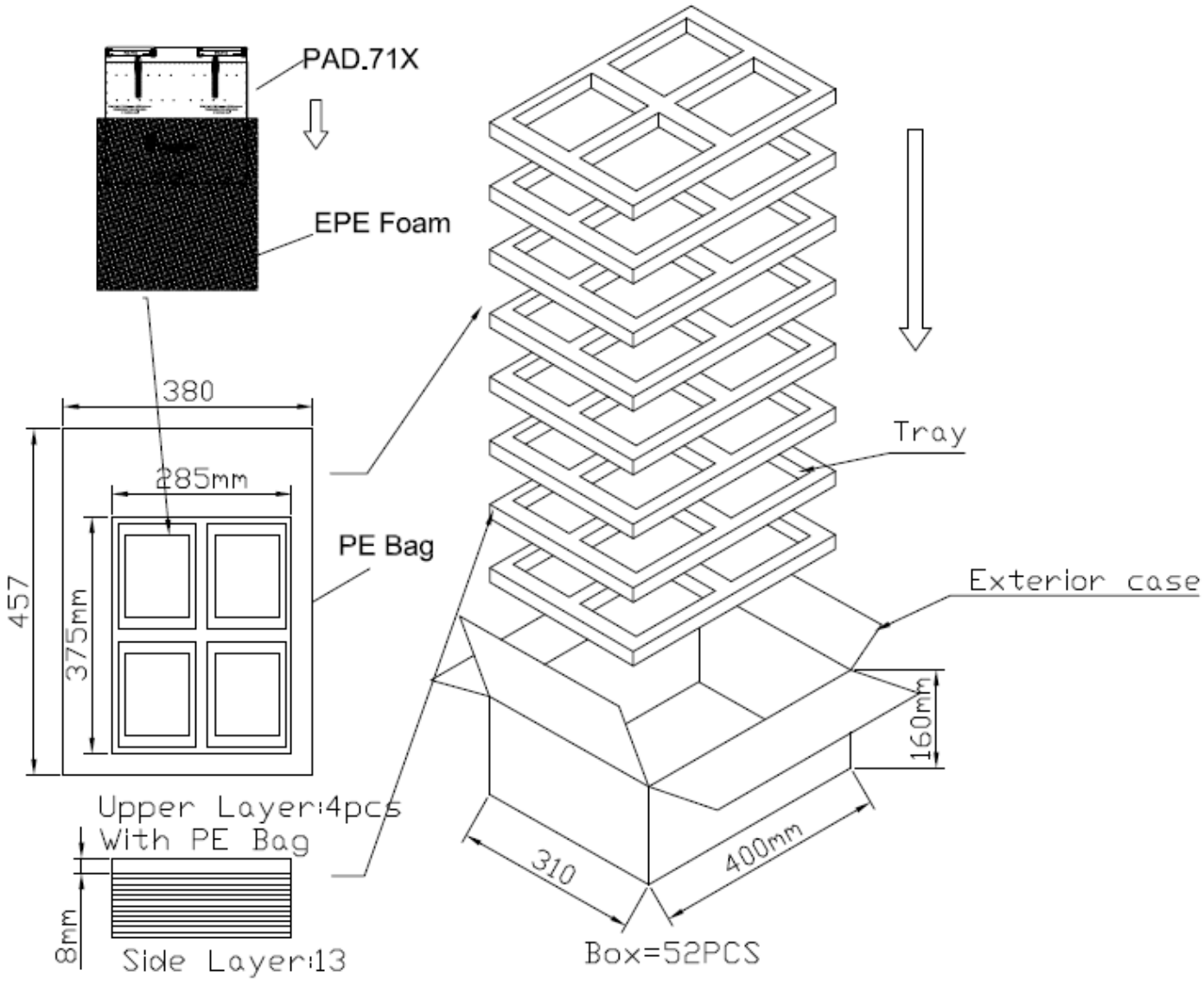




Circuit Symbol	Size	Description
L1	0402	5.6nH inductor (LQG15HS5N6S02D)
C1	0402	4.3pF Capacitor (GRM1555C1H4R3CA01D)
L2	0402	5.6nH inductor (LQG15HS5N6S02D)
C2	0402	4.3pF Capacitor (GRM1555C1H4R3CA01D)

Figure 26. Recommended matching circuit

8. Packaging



9. Recommended Reflow Temperature Profile

PA.710 and the PA.711 can be assembled following either Sn-Pb or Pb-Free assembly processes. The recommended soldering temperatures are as follows:

Phase	Profile Features	Sn-Pb Assembly	Pb-Free Assembly (SnAgCu)
Ramp-Up	Avg. Ramp-Up Rate (T_{smax} to TP)	3°C/second (max)	3°C/second (max)
Preheat	Temperature Min (T_{smin})	100°	100°
	Temperature Max (T_{smax})	150°	150°
	Time (t_{smin} to t_{smax})	60-120 seconds	60-120 seconds
Reflow	Temperature (T_L)	183°C	217°C
	Total Time Above T_L b(t_L)	60-150 seconds	60-150 seconds
Peak	Temperature (T_p)	235°C	260°C
	Time (tp)	10-30 seconds	20-40 seconds
Ramp-Down	Rate	6°C/second (max)	6°C/second (max)
Time from 25°C to peak Temperature		6 minutes max	8 minutes max

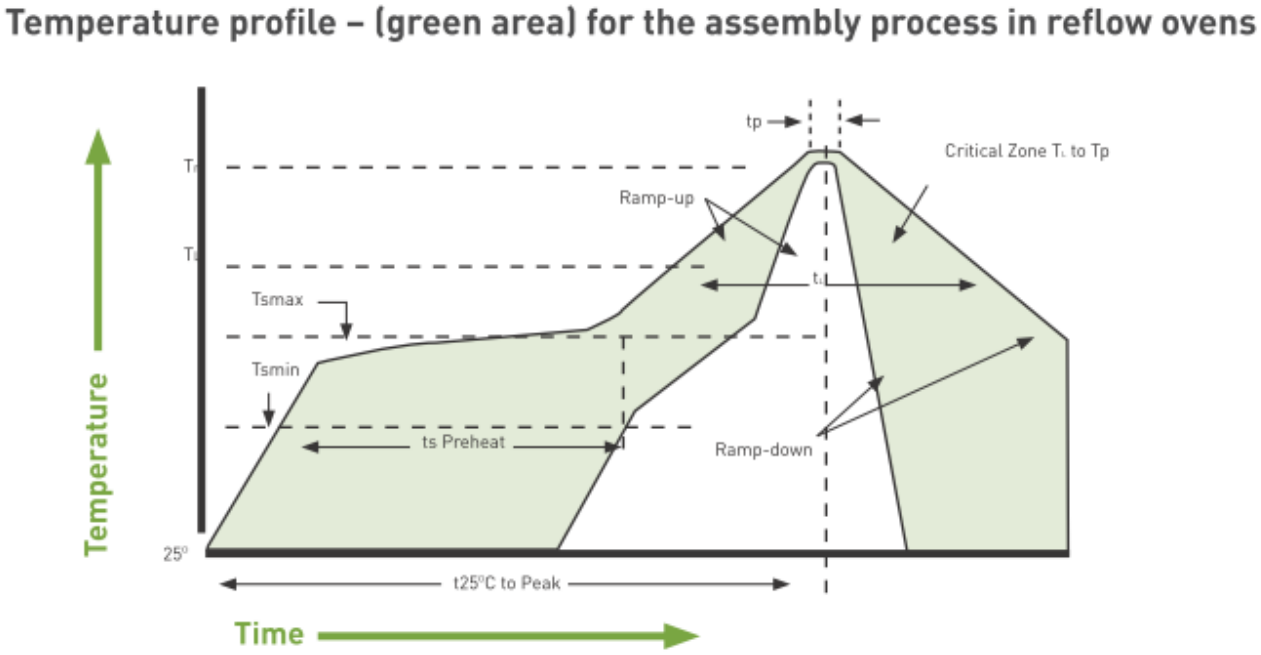


Figure 27. Temperature profile for the assembly process in reflow ovens