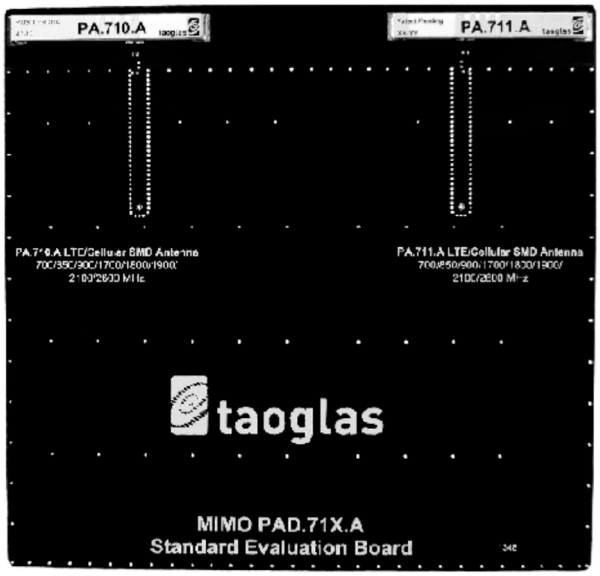



# PA.711.A

## Specification

Patent Pending

| | |
|---|---|
| **Part No.** | **PAD.71X.A** |
| **Product Name** | GEMINI EMBEDDED LTE MIMO 2*2 ANTENNA<br>with PA.710.A and PA.711.A Antennas<br>For 2G/3G/4G 2x2 MIMO systems applications<br>LTE/GSM/CDMA/DCS/PCS/WCDMA/UMTS/HSPA/GPRS/EDGE/IMT<br>698MHz to 960MHz, 1710MHz to 2690Mhz |
| **Feature** | Highest Efficiency Wide-band Embedded MIMO Antenna<br>>40% on all 2G/3G/4G Bands<br><0.3 ECC on all bands<br>Patent pending<br>SMA(F) Connectors<br>Surface Mount Technology<br>120.0 x 125.0 x 0.75 mm<br>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. Specifications

| ELECTRICAL | | | | |
|---|---|---|---|---|
| **ANTENNA** | **PA.710 and PA.711** | | | |
| **STANDARD** | **2G/3G/4G** | | | |
| **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 performance 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 |

## 3. Test Set Up

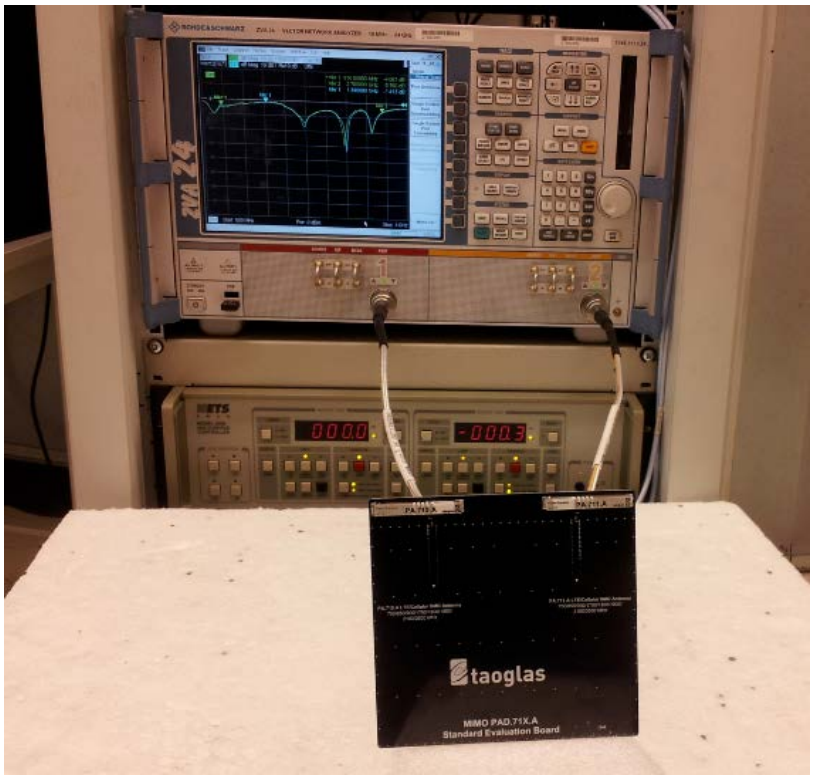



Figure 1. Return Loss and VSWR test set up

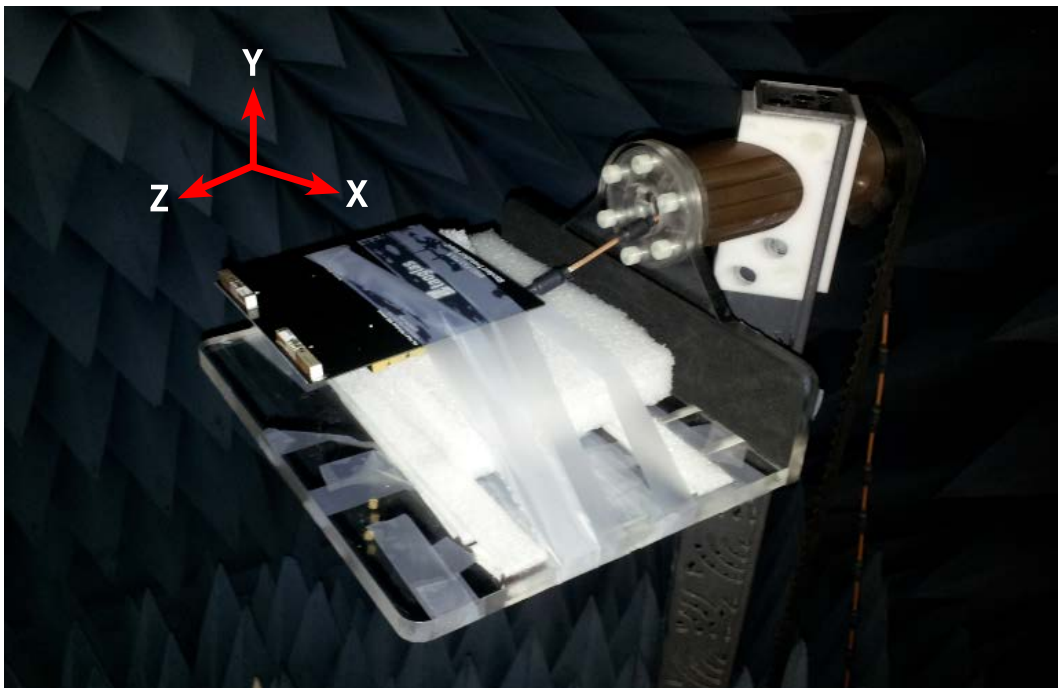



Figure 2. OTA test set up

# 4. Antenna Parameters

## 4.1. Return Loss

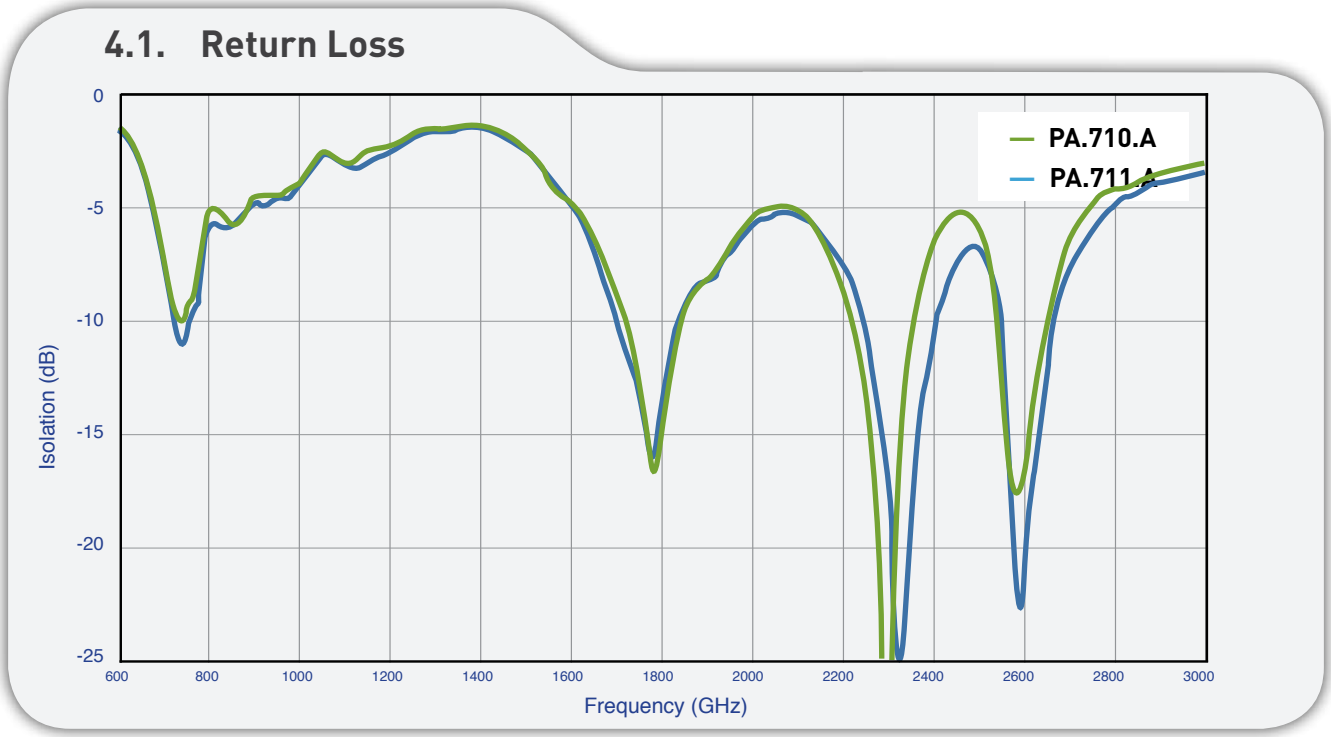



Figure 3. Return Loss of the PA.710 and PA.711 antennas

## 4.2. VSWR

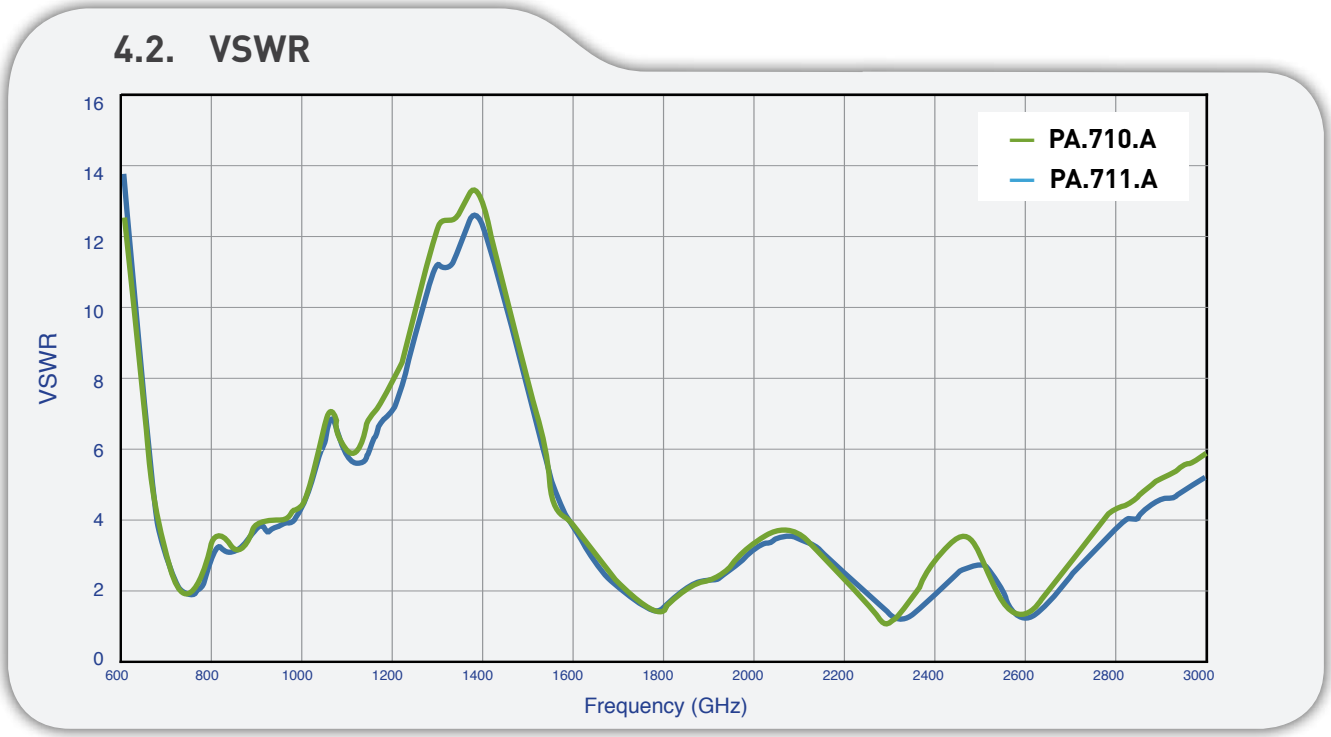



Figure 4. VSWR of the PA.710 and PA.711 antennas

## 4.3. Isolation

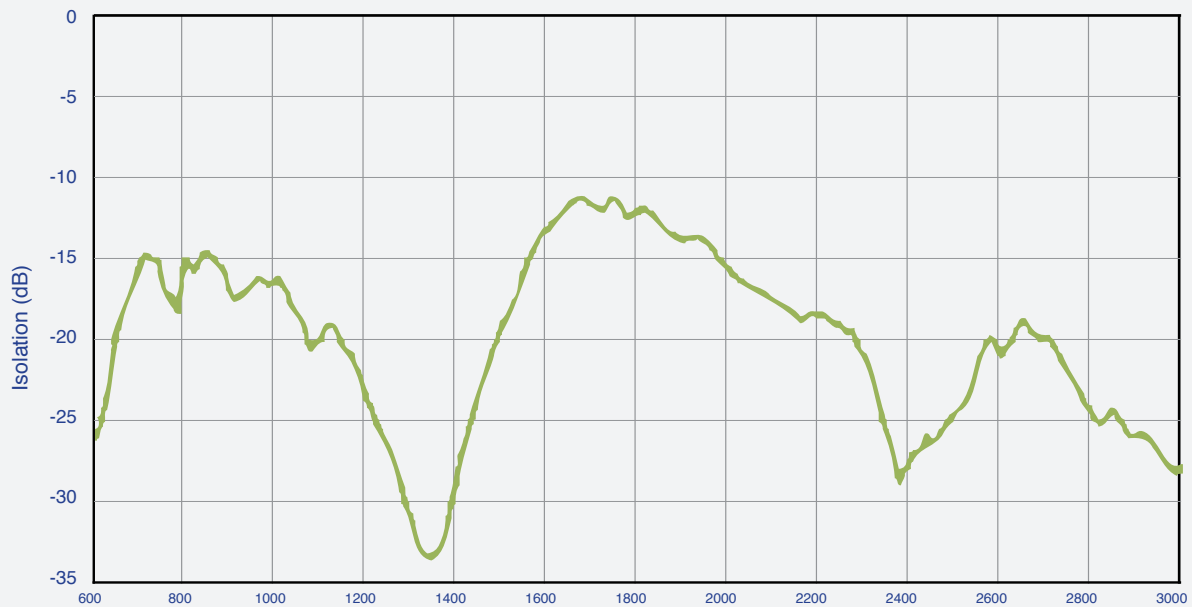



Figure 5. Isolation of the PA.710 and PA.711 antennas

## 4.4. Envelope Correlation Coefficient

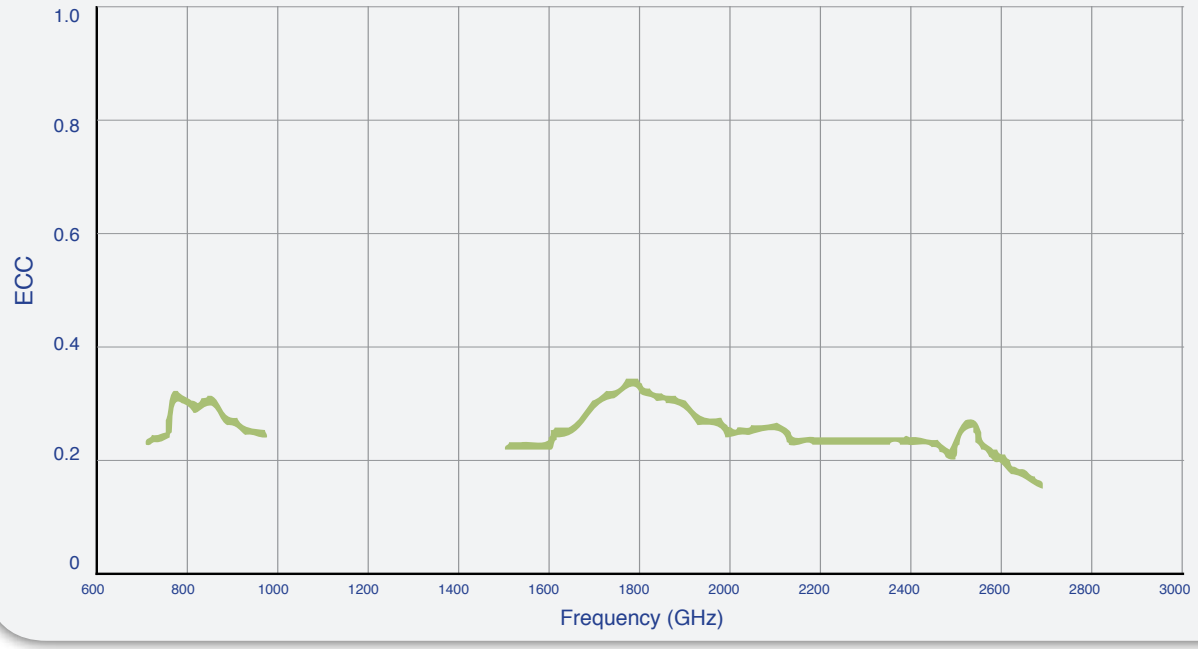



Figure 6. ECC of the PA.710 and PA.711 antennas

## 4.5. Efficiency

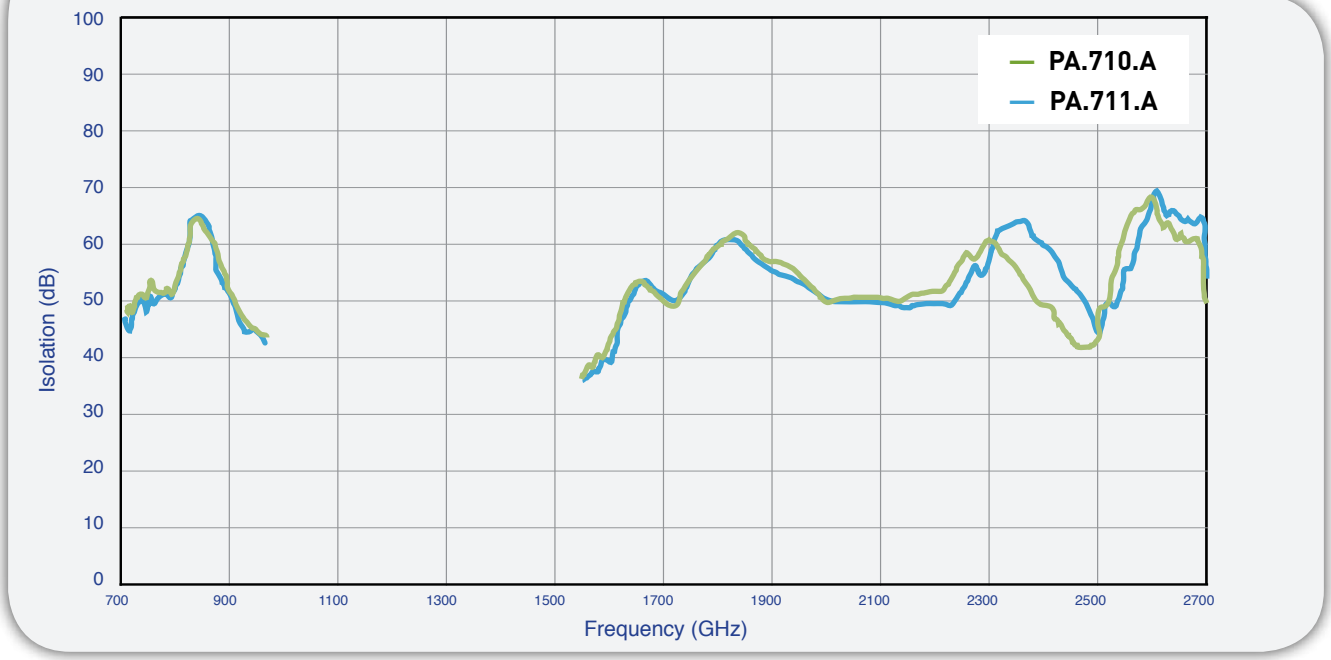



Figure 7. Efficiency of the PA.710 and PA.711 antennas

## 4.6. Peak Gain

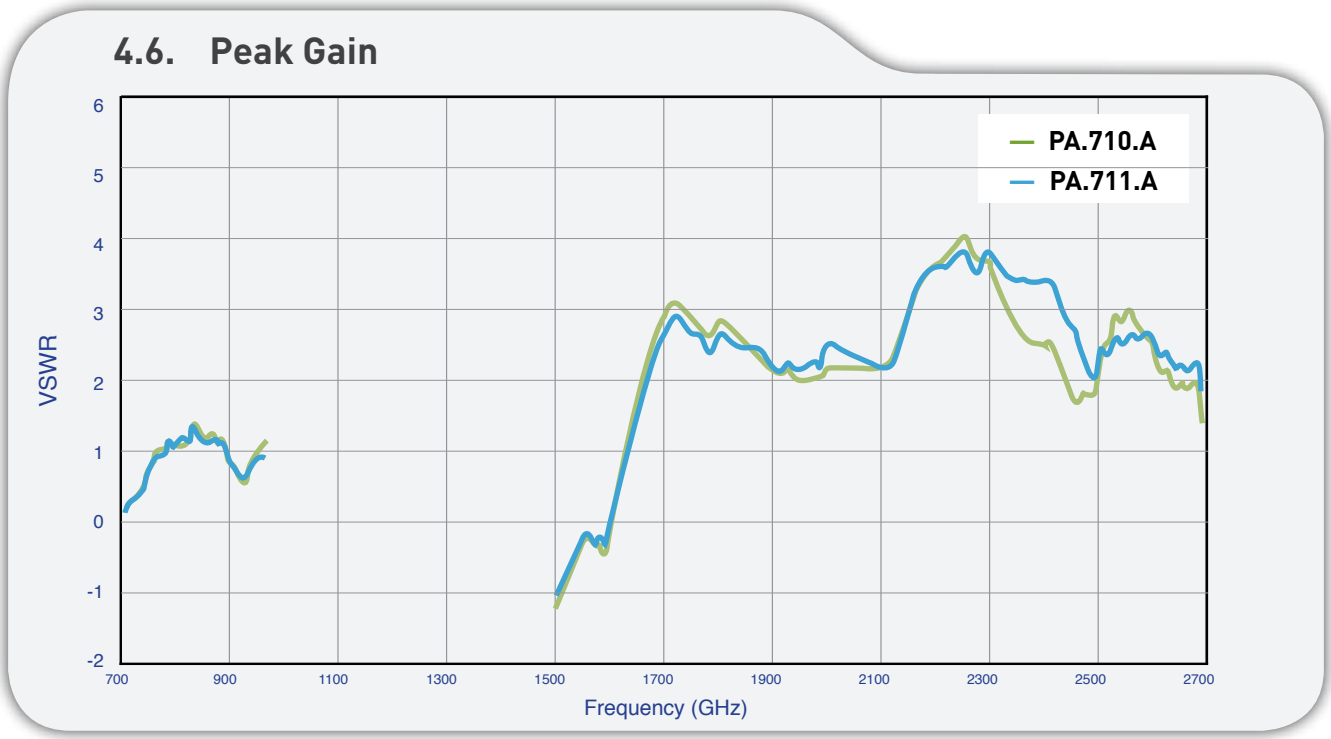



Figure 8. Peak Gain of the PA.710 and PA.711 antennas

## 4.7. Average Gain

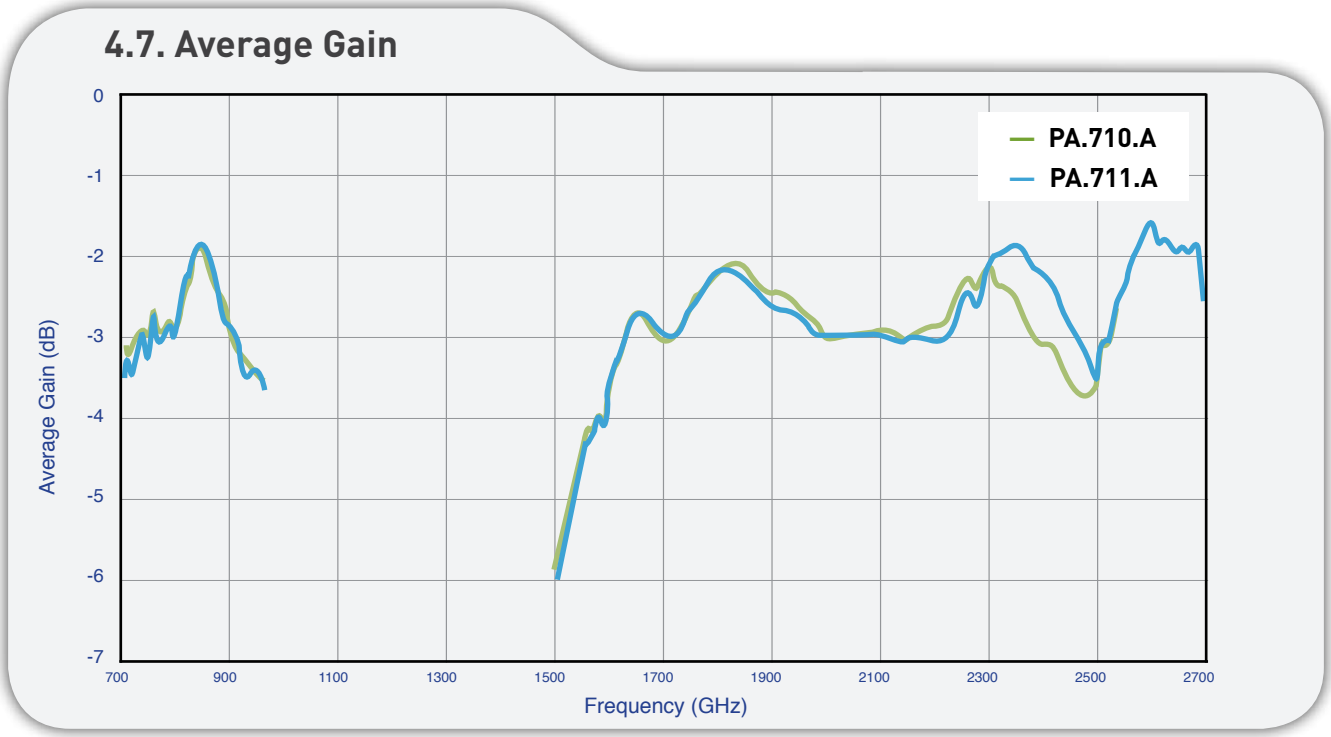



Figure 9. Average Gain of the PA.710 and PA.711 antennas

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

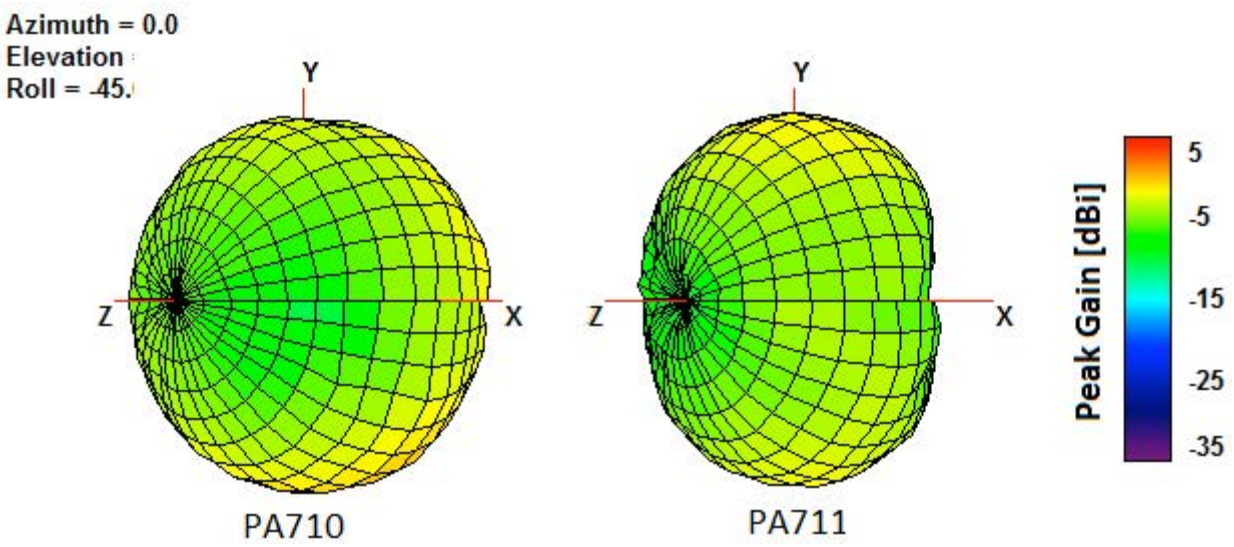



Figure 10. 3D Radiation Pattern at 700MHz of the PA.710 and PA.711 antennast

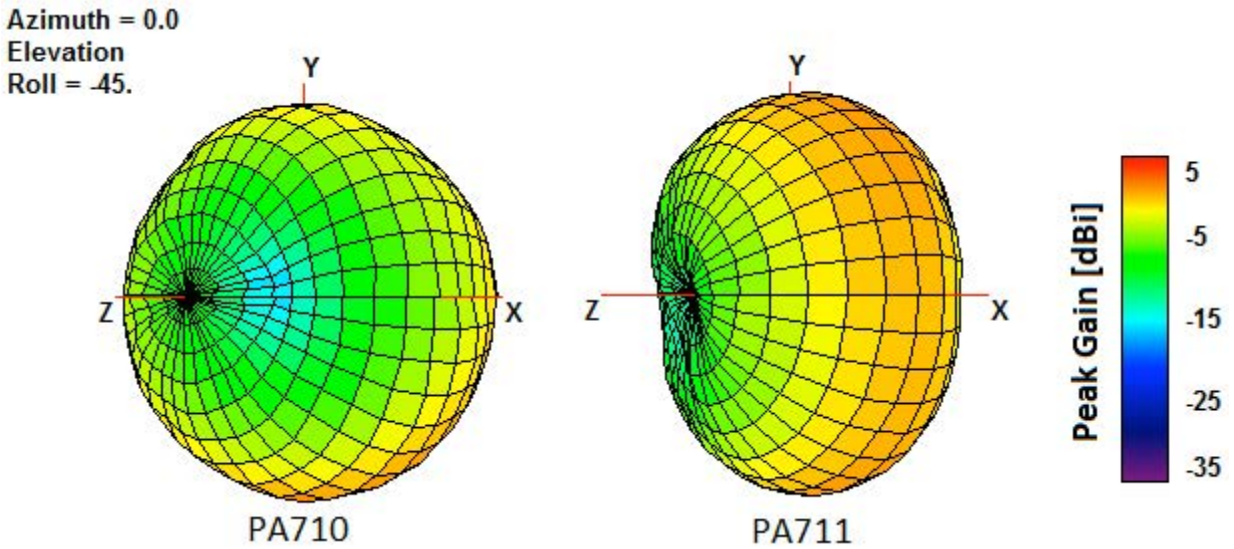



Figure 11. 3D Radiation Pattern at 800MHz of the PA.710 and PA.711 antennas

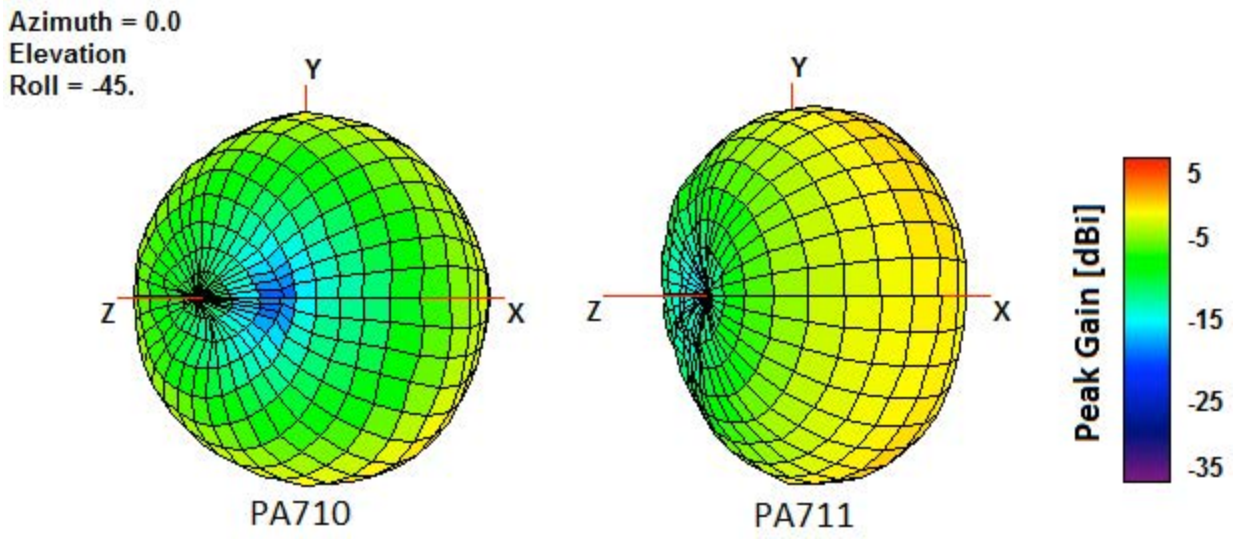



Figure 12. 3D Radiation Pattern at 900MHz of the PA.710 and PA.711 antennas

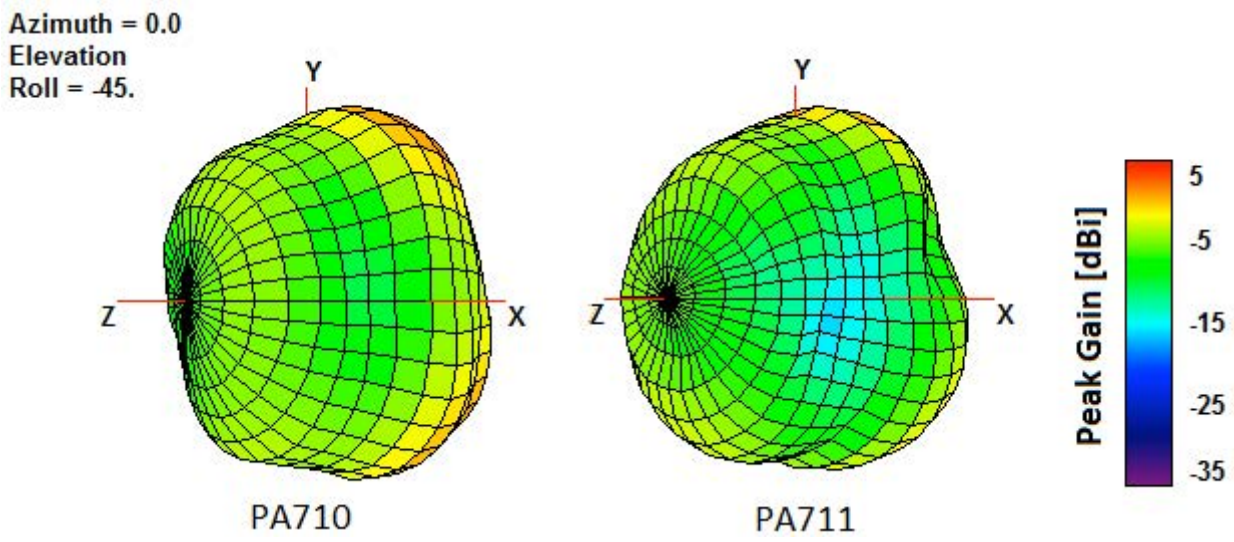



Figure 13. 3D Radiation Pattern at 1710MHz of the PA.710 and PA.711 antennas

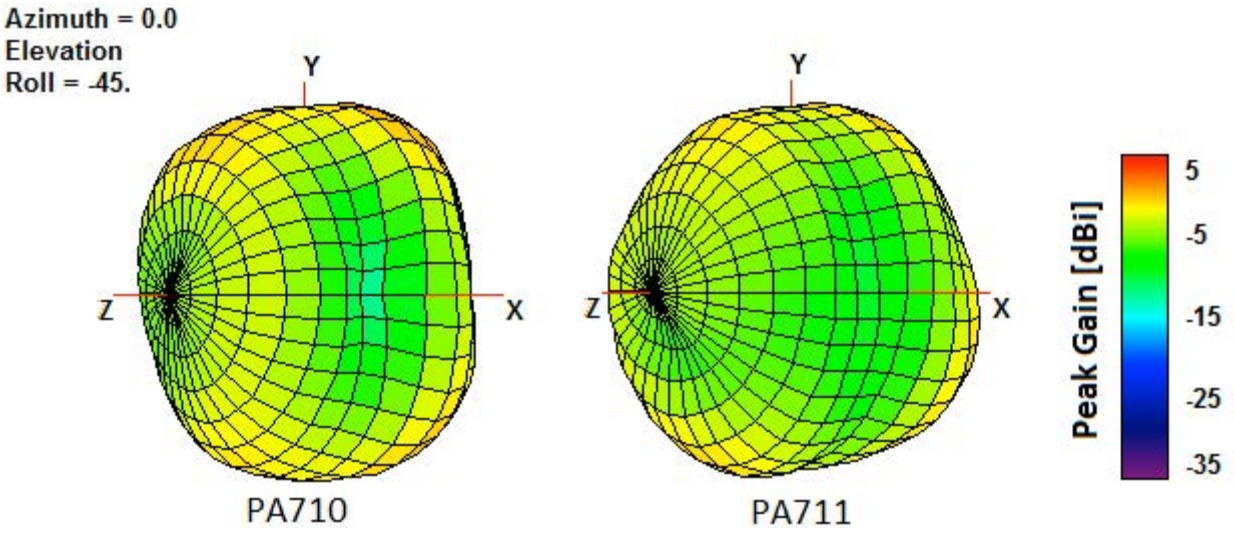



Figure 14. 3D Radiation Pattern at 1805MHz of the PA.710 and PA.711 antennas

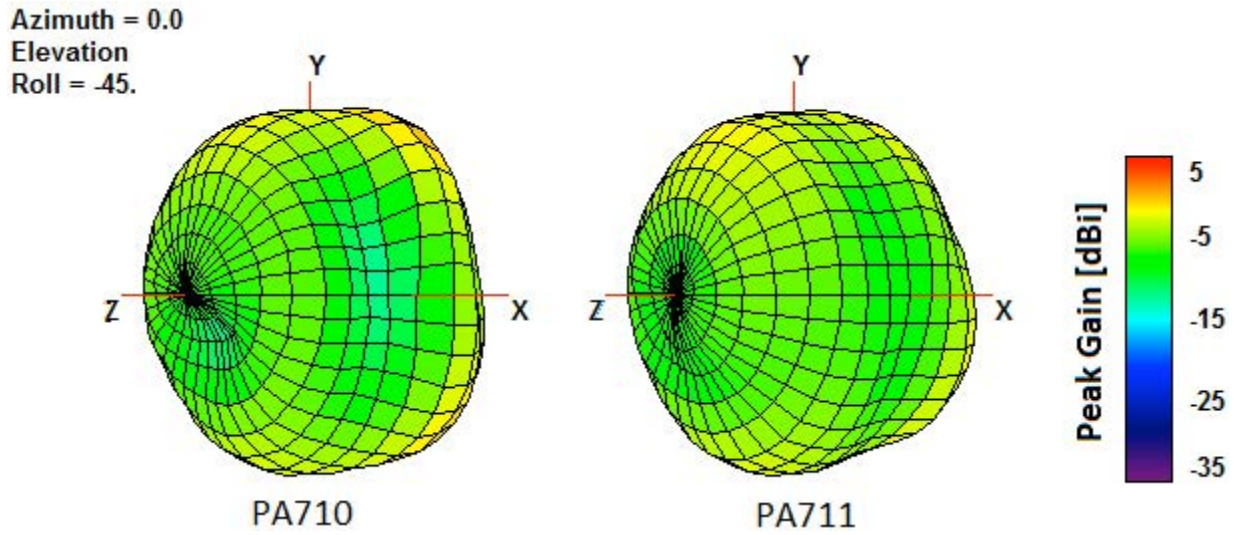



Figure 15. 3D Radiation Pattern at 1910MHz of the PA.710 and PA.711 antennas

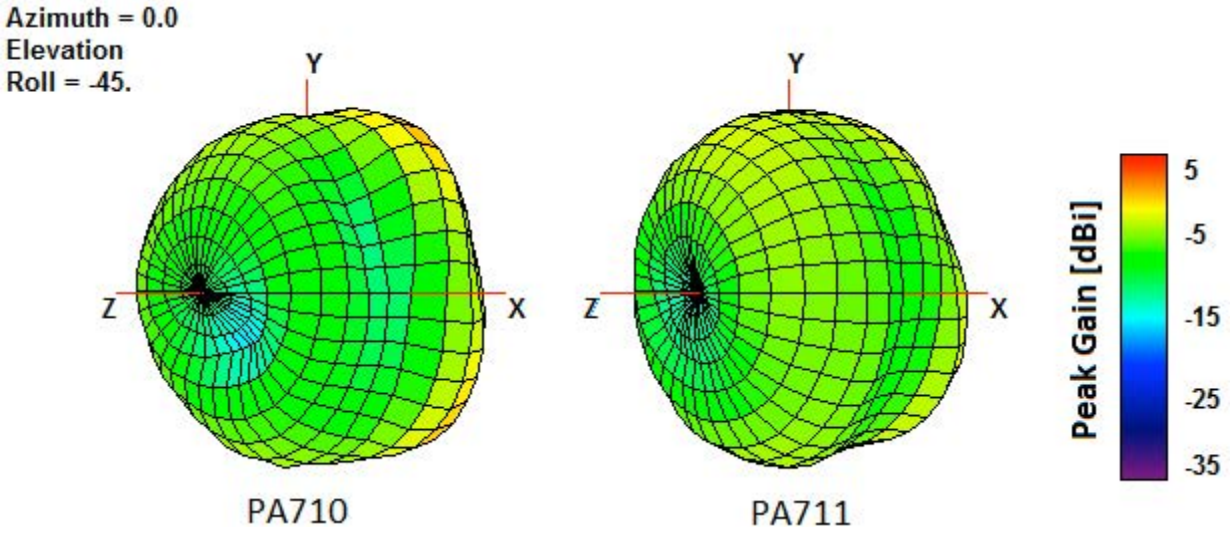



Figure 16. 3D Radiation Pattern at 1990MHz of the PA.710 and PA.711 antennast

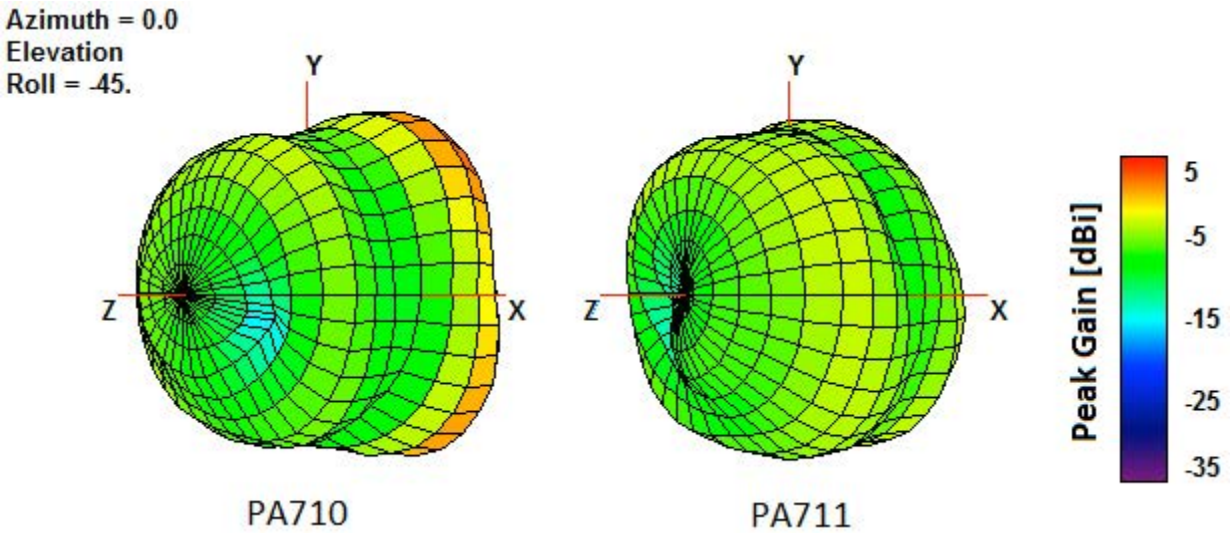



Figure 17. 3D Radiation Pattern at 2170MHz of the PA.710 and PA.711 antennas

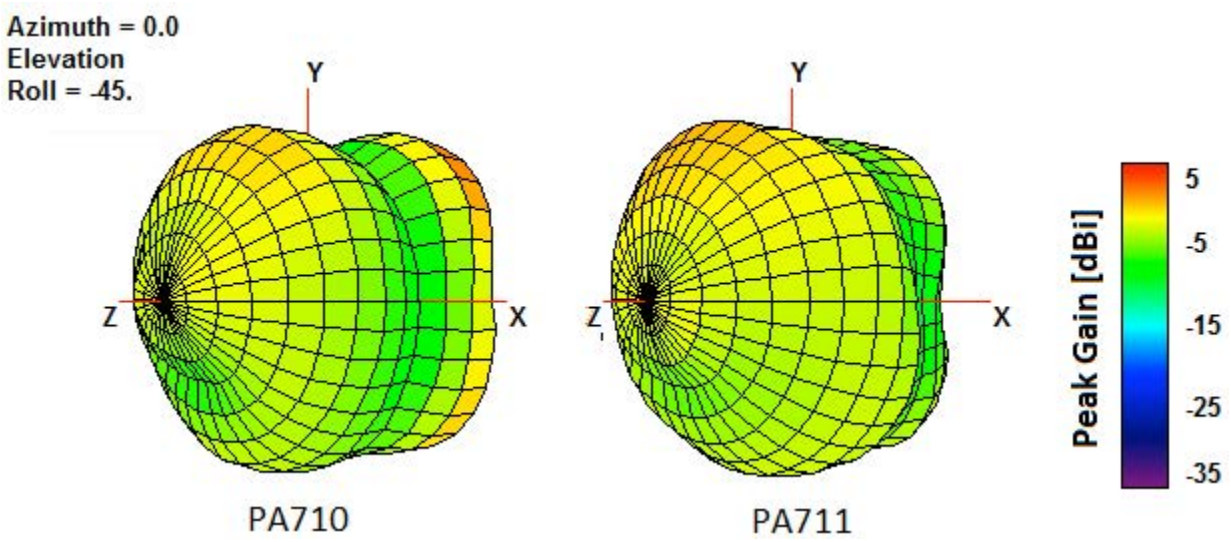



Figure 18. 3D Radiation Pattern at 2400MHz of the PA.710 and PA.711 antennas

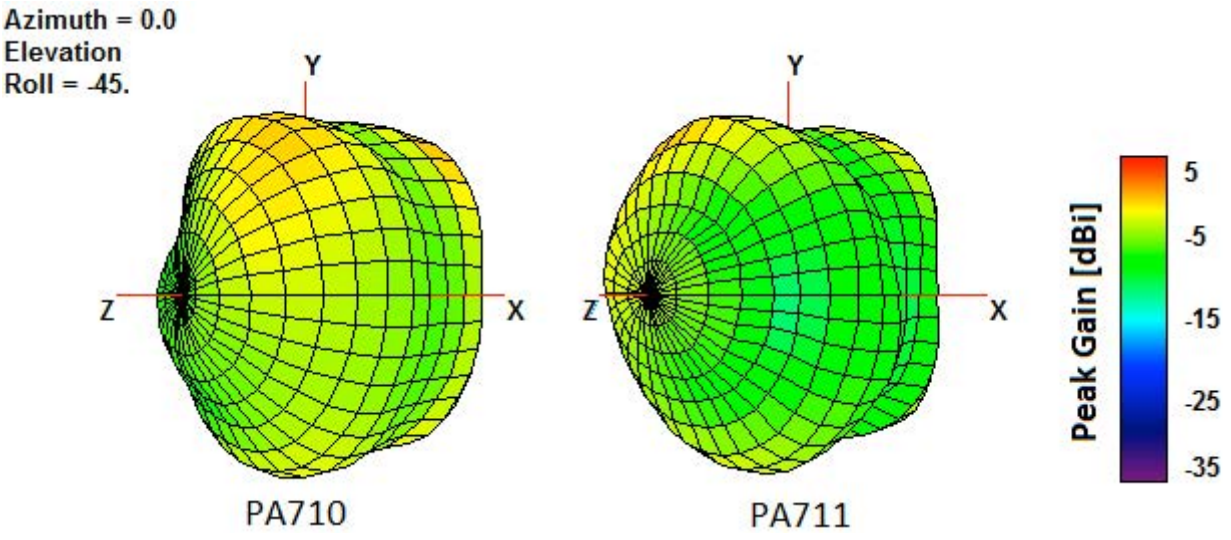



Figure 19. 3D Radiation Pattern at 2500MHz of the PA.710 and PA.711 antennas

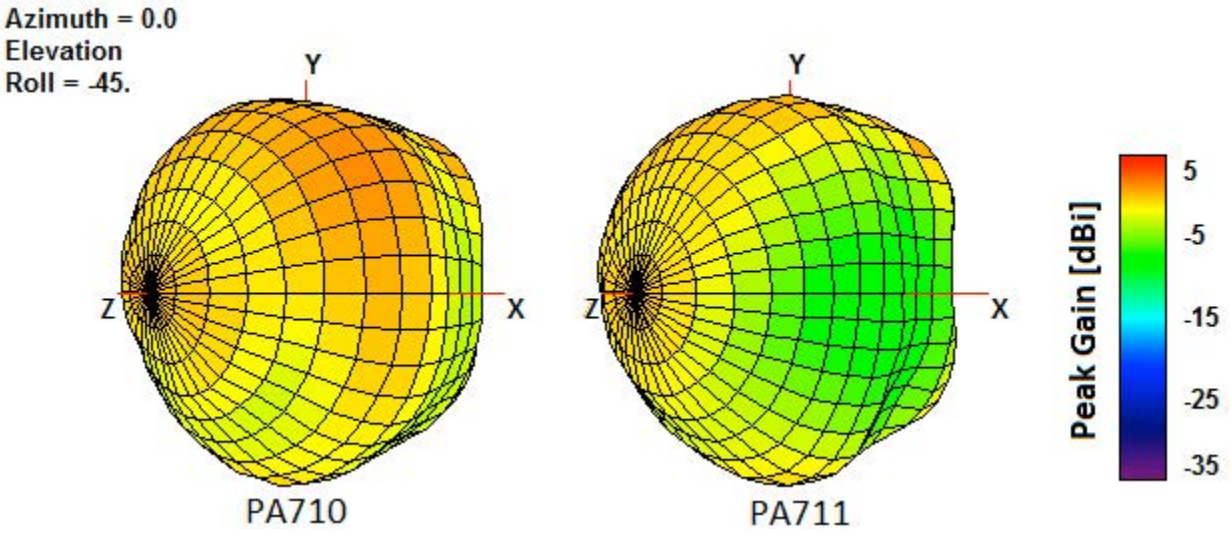



Figure 20. 3D Radiation Pattern at 2600MHz of the PA.710 and PA.711 antennas

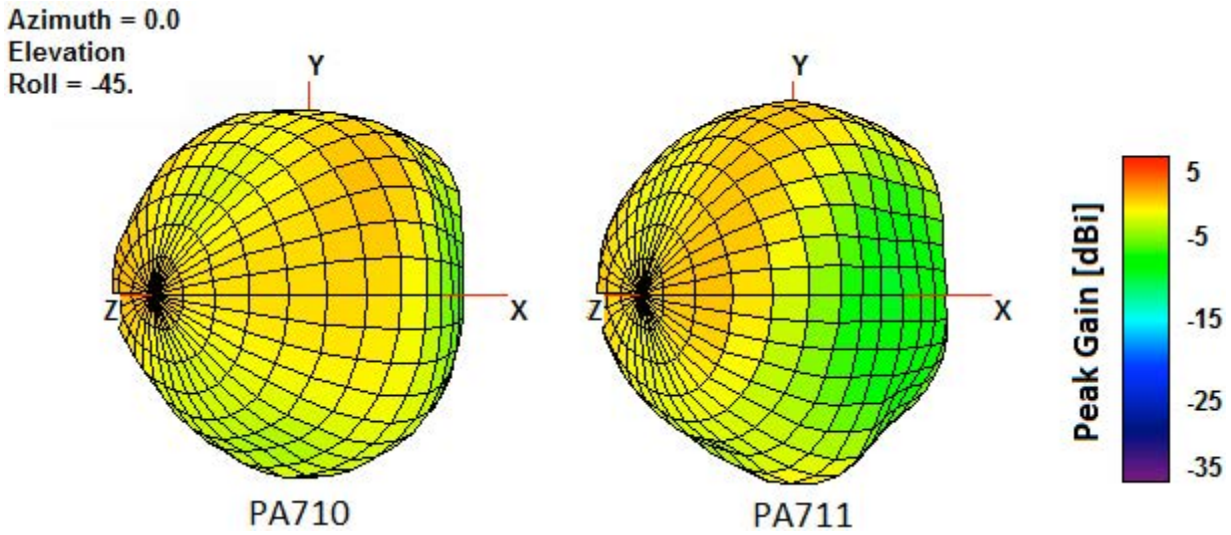



Figure 21. 3D Radiation Pattern at 2700MHz of the PA.710 and PA.711 antennas

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

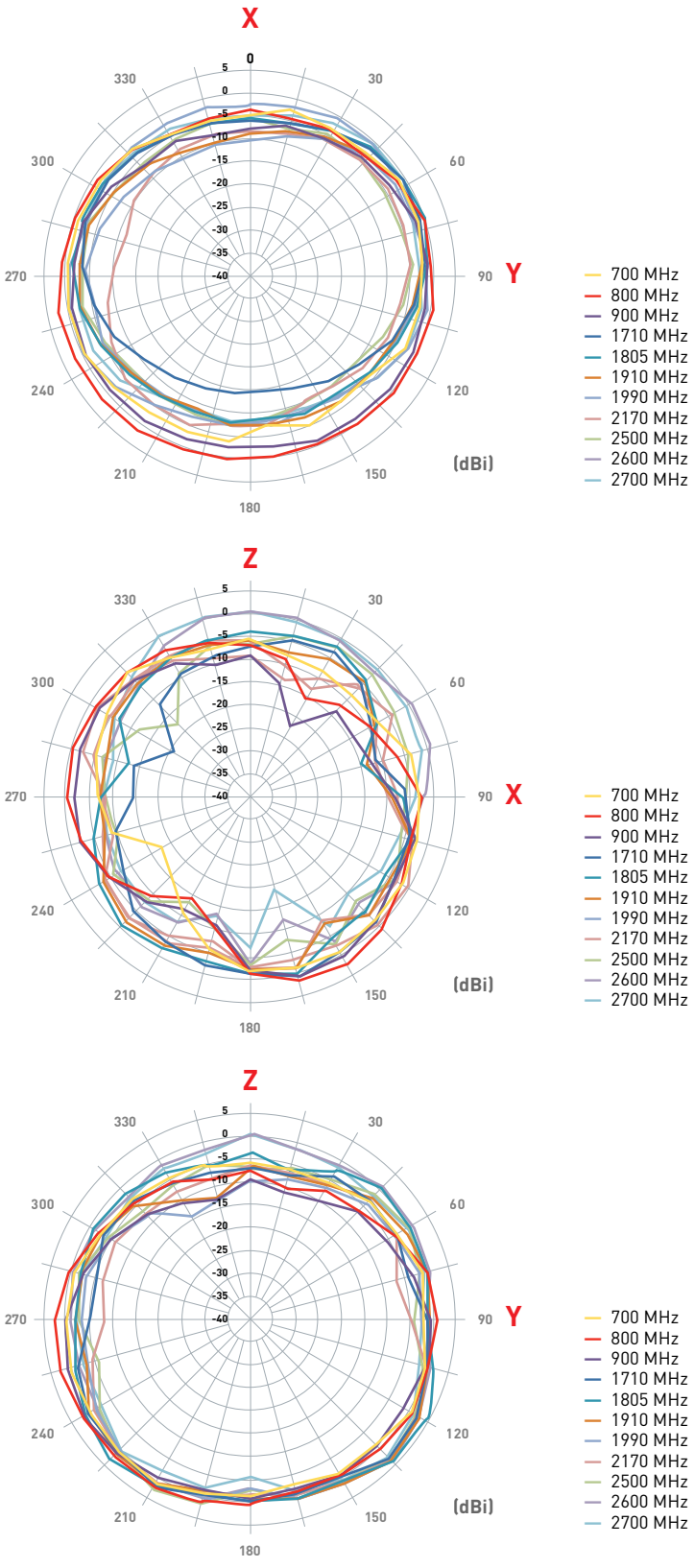



Figure 22. 2D Radiation Pattern of the PA.710 Antenna

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

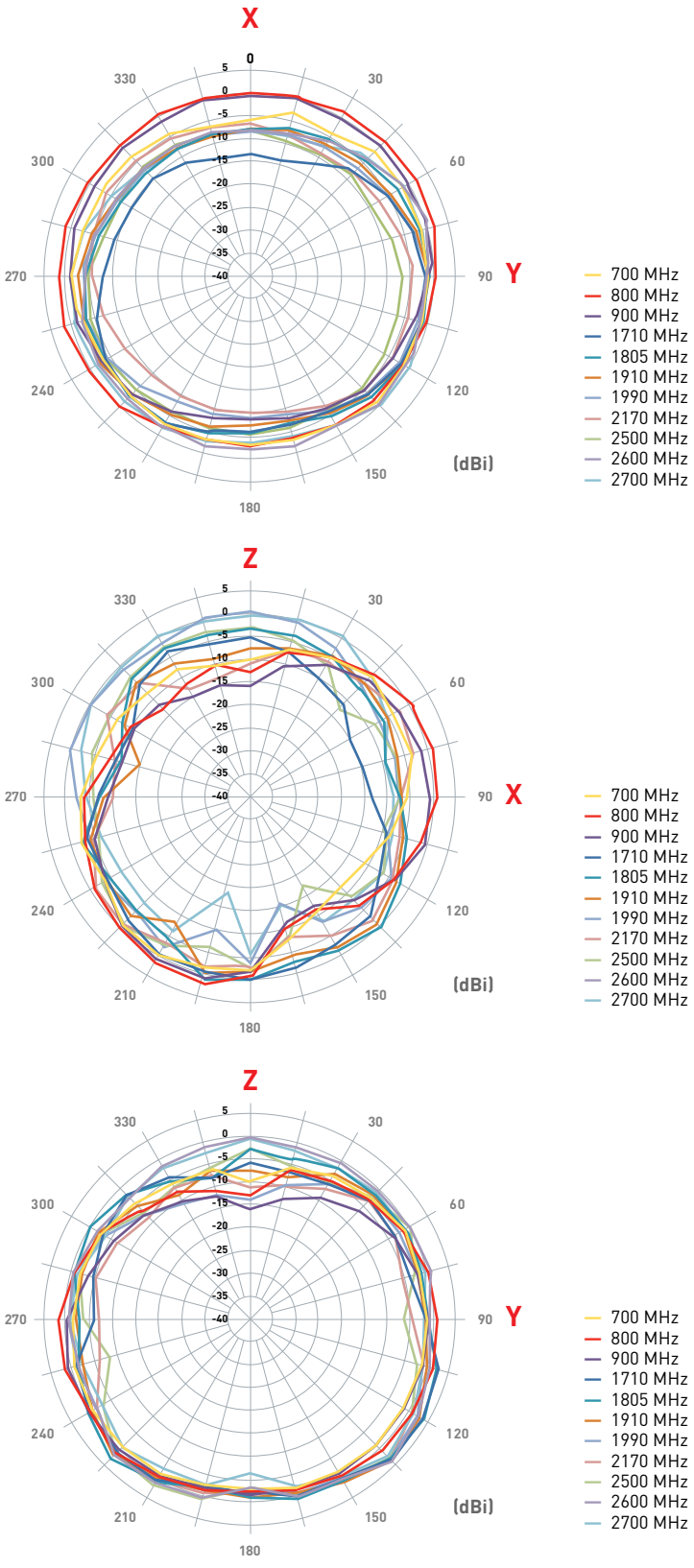



Figure 23. 2D Radiation Pattern of the PA.711 Antenna

## 5. Mechanical Drawing

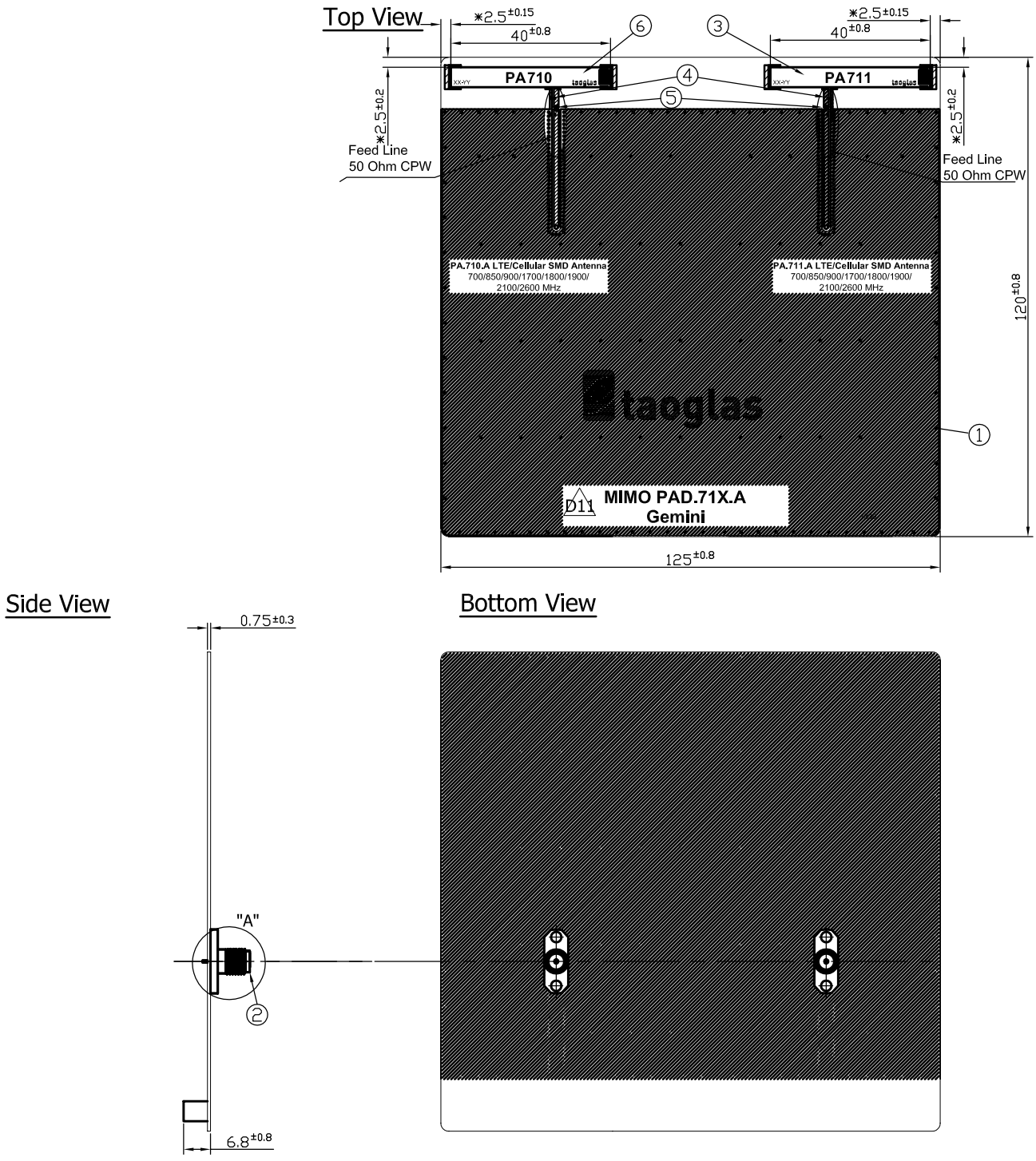



Figure 24. Mechanical drawing of PAD.71x.A

## 6. Layout Dimensions

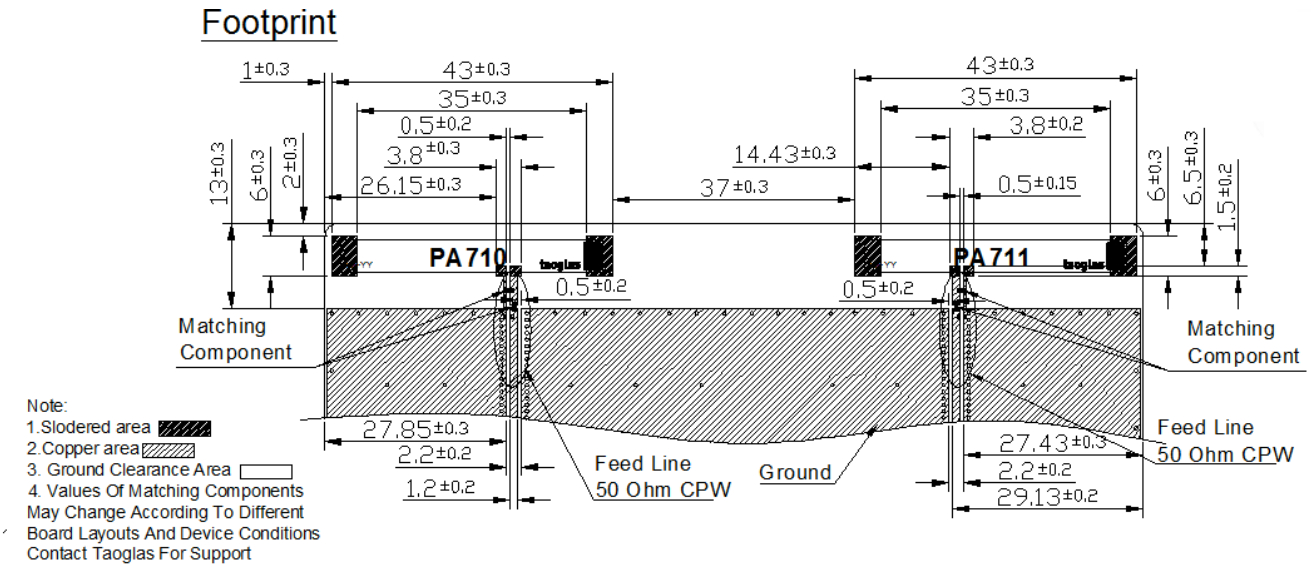
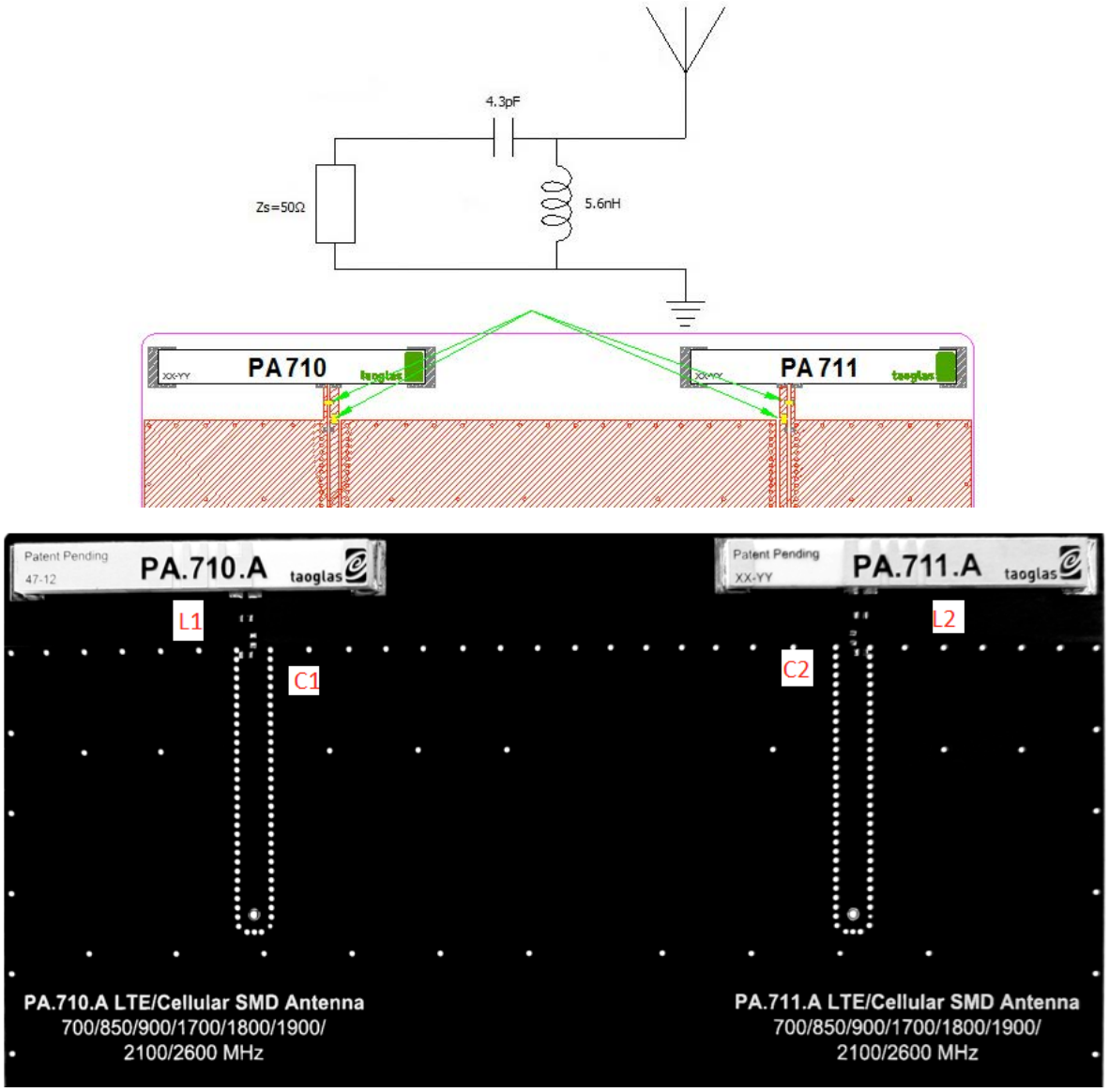



Figure 25. Layout dimensions of PAD.71x.A

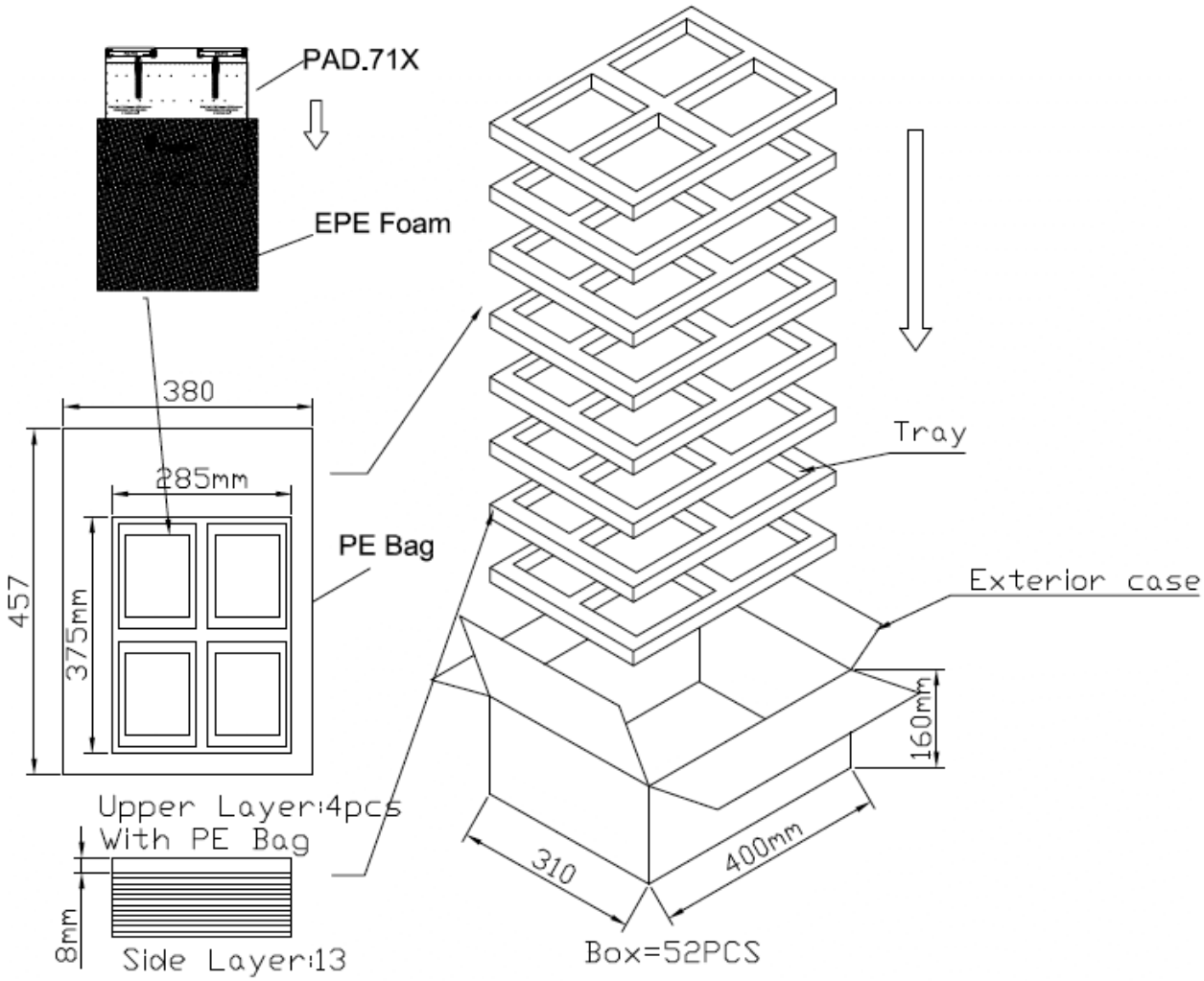
# 7. Matching Circuit




| 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


PAD.71X
EPE Foam
380
285mm
457
375mm
PE Bag
Upper Layer:4pcs
With PE Bag
8mm
Side Layer:13
Tray
Exterior case
160mm
310
400mm
Box=52PCS

# 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 |

**Temperature profile – (green area) for the assembly process in reflow ovens**

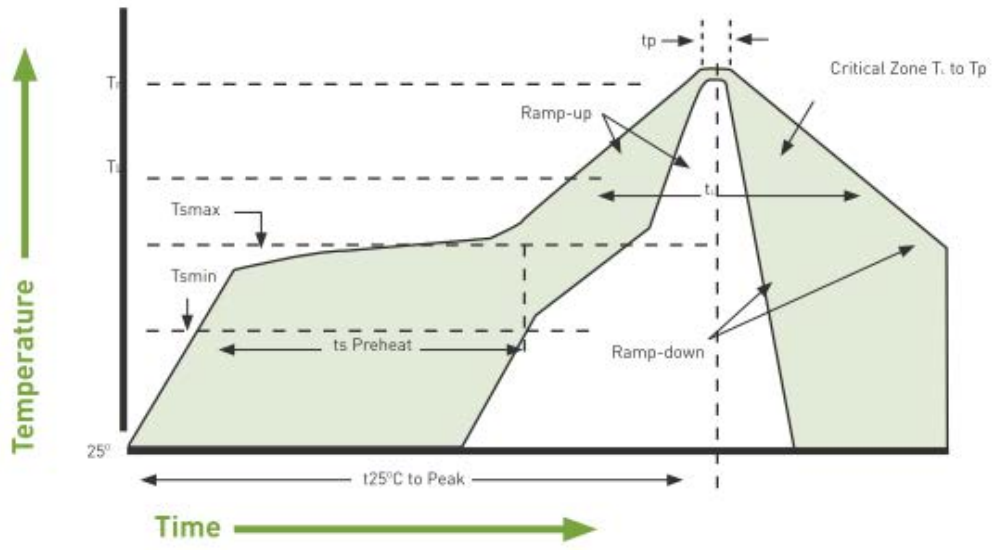



Figure 27. Temperature profile for the assembly process in reflow ovens