# Antenna measurement report for CGA-437C project
# (with LAB2A PCBA & SATIMO chamber SG24)

Pegatron BU6

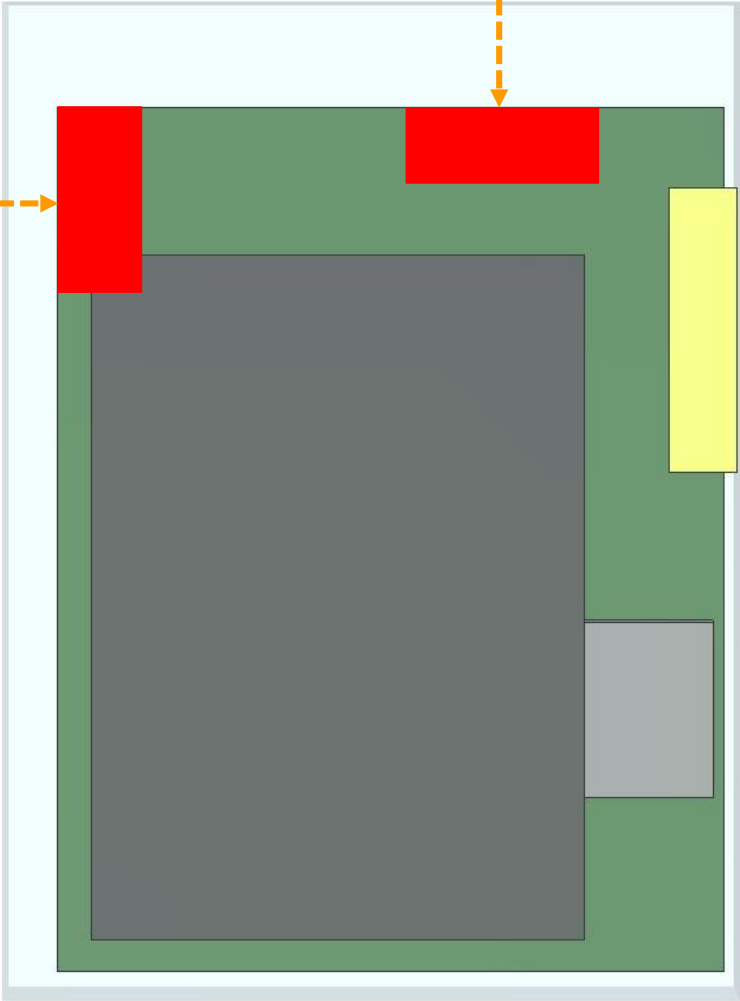2025/6/19

# Antenna specification

| Antenna Proposal | |
|---|---|
| Wireless Function | ■ Wi-Fi 2 x 2.4GHz antenna<br>■ Wi-Fi 2 x 5GHz antenna |
| Antenna type | ■ On-board : 2G+5G dual band antenna*2 |

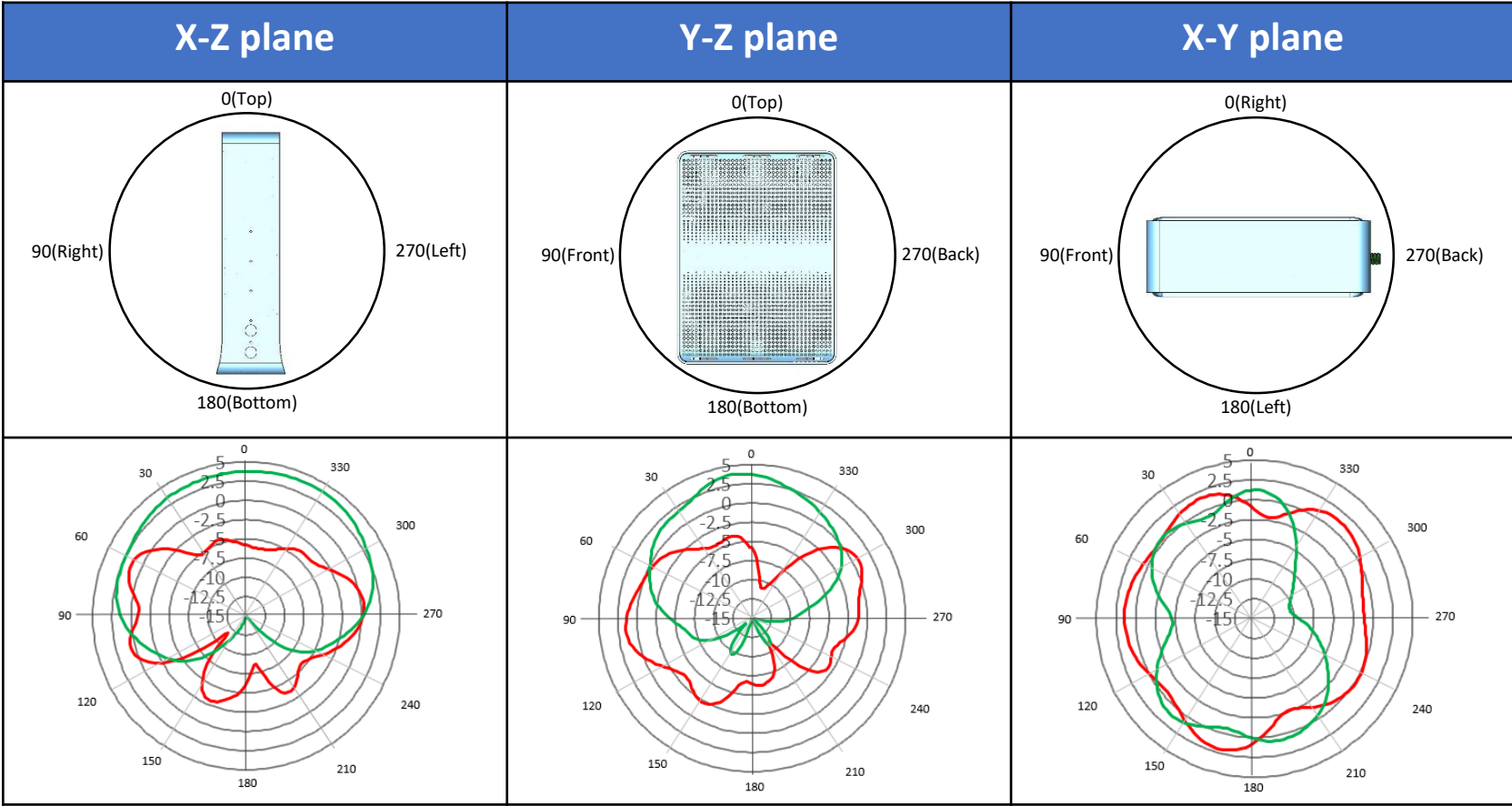| Specification and Measurement data | | |
|---|---|---|
| | Customer spec. | Measurement data |
| Return loss | <-10 dB | <-12 dB |
| Isolation | < -20 dB | ■ DB to DB antenna < -28 dB |
| Peak Gain | 2G Peak < 4.5 dBi<br>5G Peak < 6 dBi | ■ 2G Peak < 4.11 dBi<br>■ 5G Peak < 5.37 dBi |

# Antenna placement

**2.4G port 1/5G port0**
Dual Band-2 (2G/5G)
(On board Ant.)

**2.4G port 0/5G port1**
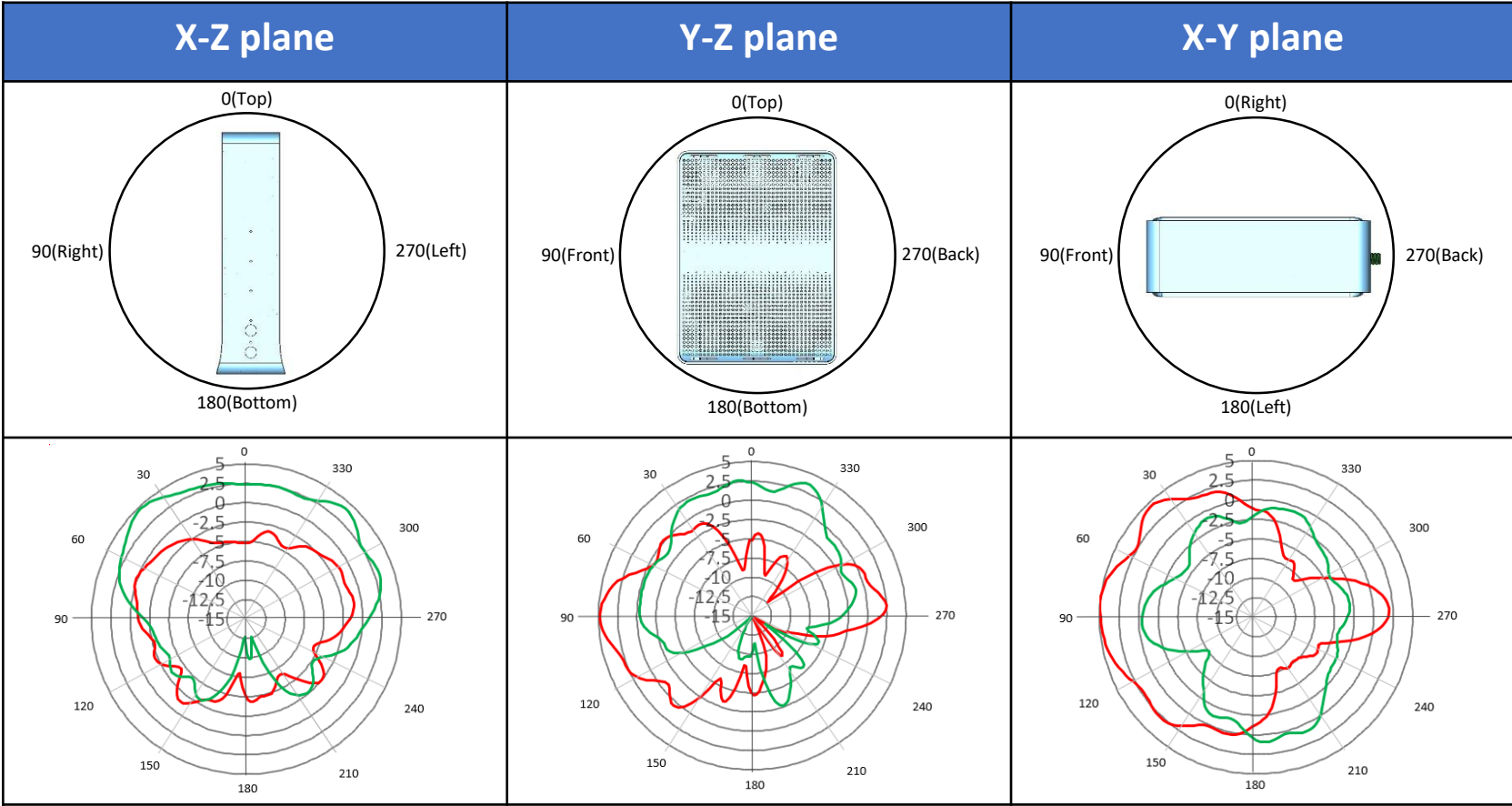Dual Band-1 (2G/5G)
(On board Ant.)

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# Measurement data

- Radiation pattern – 2.45G



| X-Z plane | Y-Z plane | X-Y plane |
| --- | --- | --- |

DB-1
DB-2

# Measurement data

- Radiation pattern – 5.47G



| X-Z plane | Y-Z plane | X-Y plane |
|---|---|---|

Legend: — DB-1   — DB-2

# Measurement data

- Gain table

| Frequency | (MHz) | 2400 | 2450 | 2500 | 5150 | 5200 | 5300 | 5400 | 5470 | 5500 | 5600 | 5700 | 5800 | 5850 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DB-1 | Peak Gain (dBi) | 2.47 | 2.27 | 1.96 | 4.59 | 4.57 | 4.5 | 4.42 | 4.76 | 5.02 | 5.37 | 5.01 | 4.87 | 4.4 |
| | Position (θ,Φ) | (26,66) | (20,102) | (86,94) | (52,88) | (50,88) | (46,90) | (44,84) | (82,92) | (82,92) | (76,92) | (38,86) | (72,80) | (68,82) |
| | Polarization | Theta | Theta | Theta | Theta | Theta | Theta | Theta | Theta | Theta | Theta | Theta | Theta | Theta |
| DB-2 | Peak Gain (dBi) | 4.11 | 3.98 | 3.69 | 4.97 | 4.87 | 4.71 | 4.52 | 4.69 | 4.5 | 4.4 | 4.15 | 3.91 | 3.83 |
| | Position (θ,Φ) | (86,4) | (176,26) | (178,34) | (178,20) | (178,-34) | (178,-38) | (0,40) | (0,42) | (0,44) | (2,46) | (4,48) | (2,50) | (2,52) |
| | Polarization | Theta | Phi | Phi | Phi | Phi | Phi | Phi | Phi | Phi | Phi | Phi | Phi | Phi |

# Measurement data

- Radiation pattern – Correlated 2.45GHz_Phi
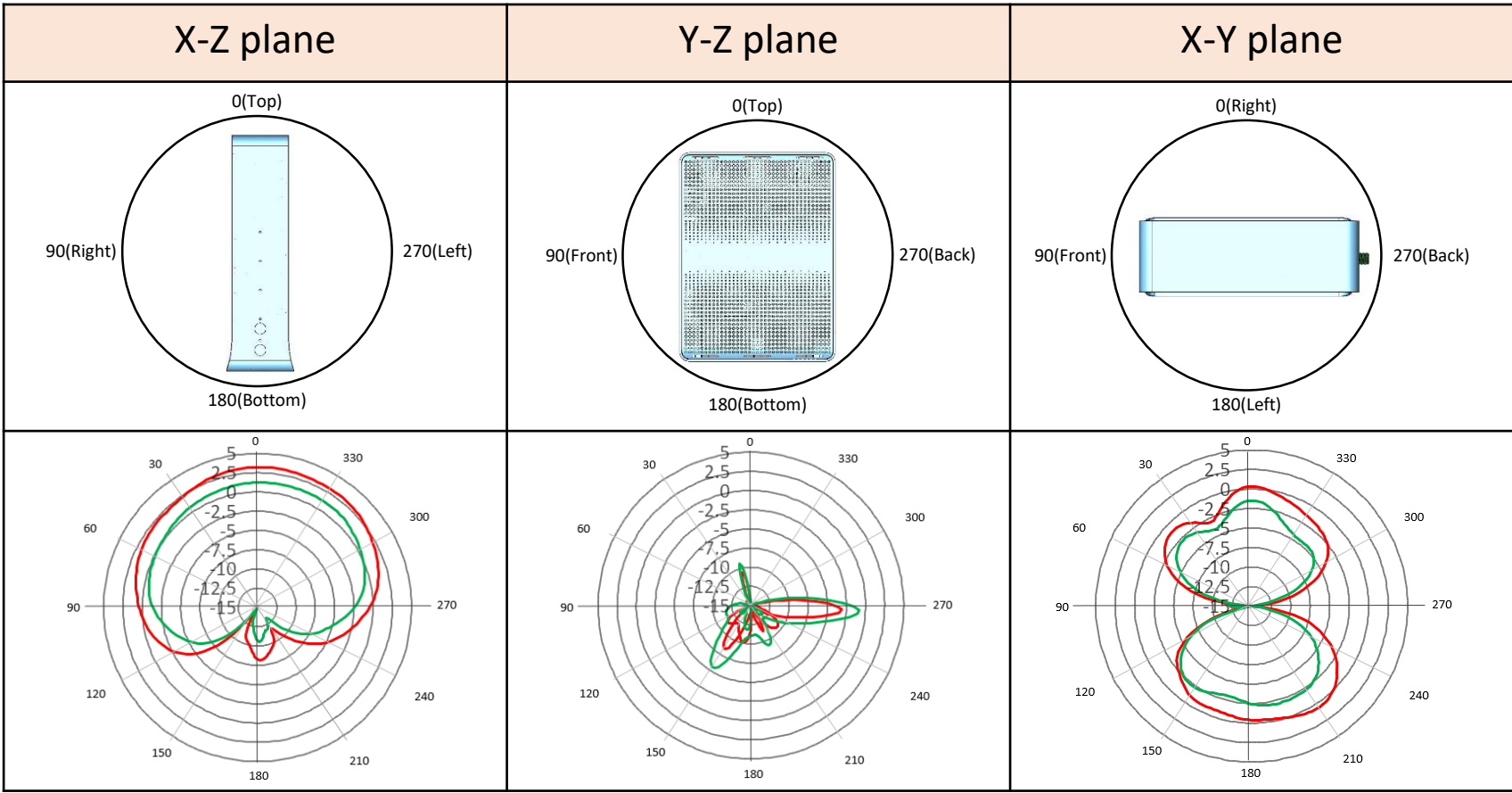


| X-Z plane | Y-Z plane | X-Y plane | Correlated / Uncorrelated |
|---|---|---|---|

# Measurement data

- Radiation pattern – Correlated 2.45GHz_Theta

# Measurement data

- Radiation pattern – Correlated 2.45GHz_E-total

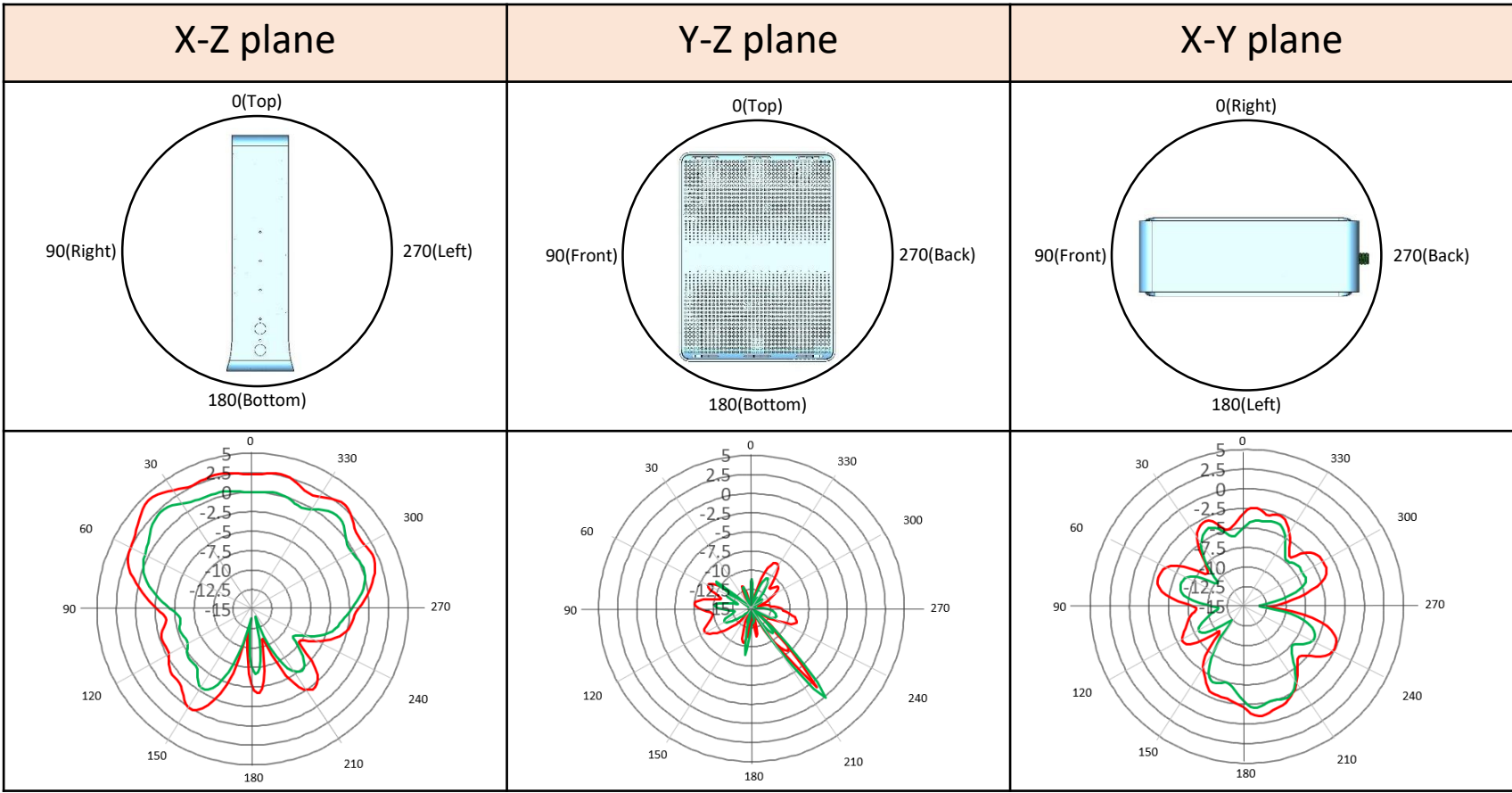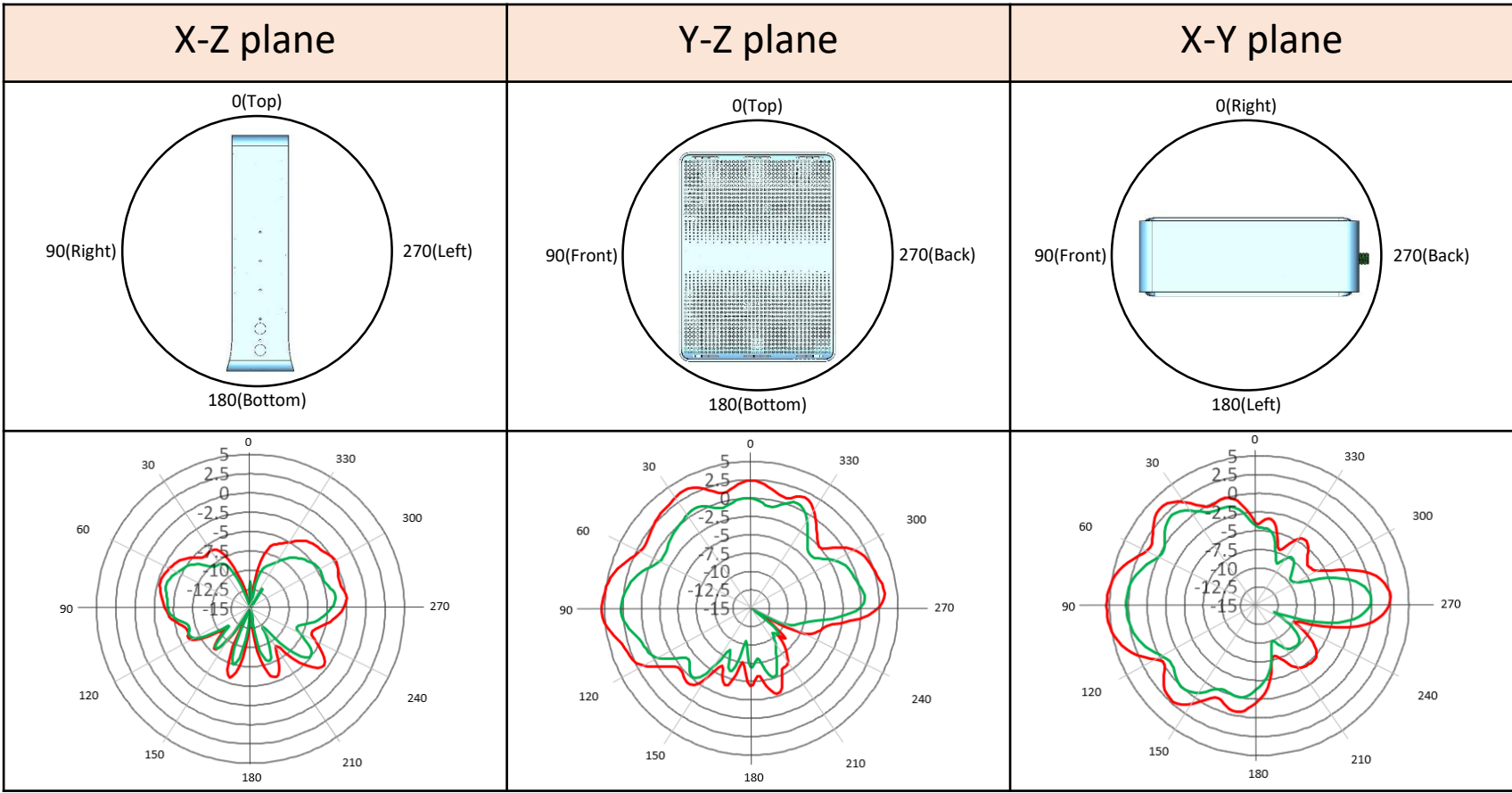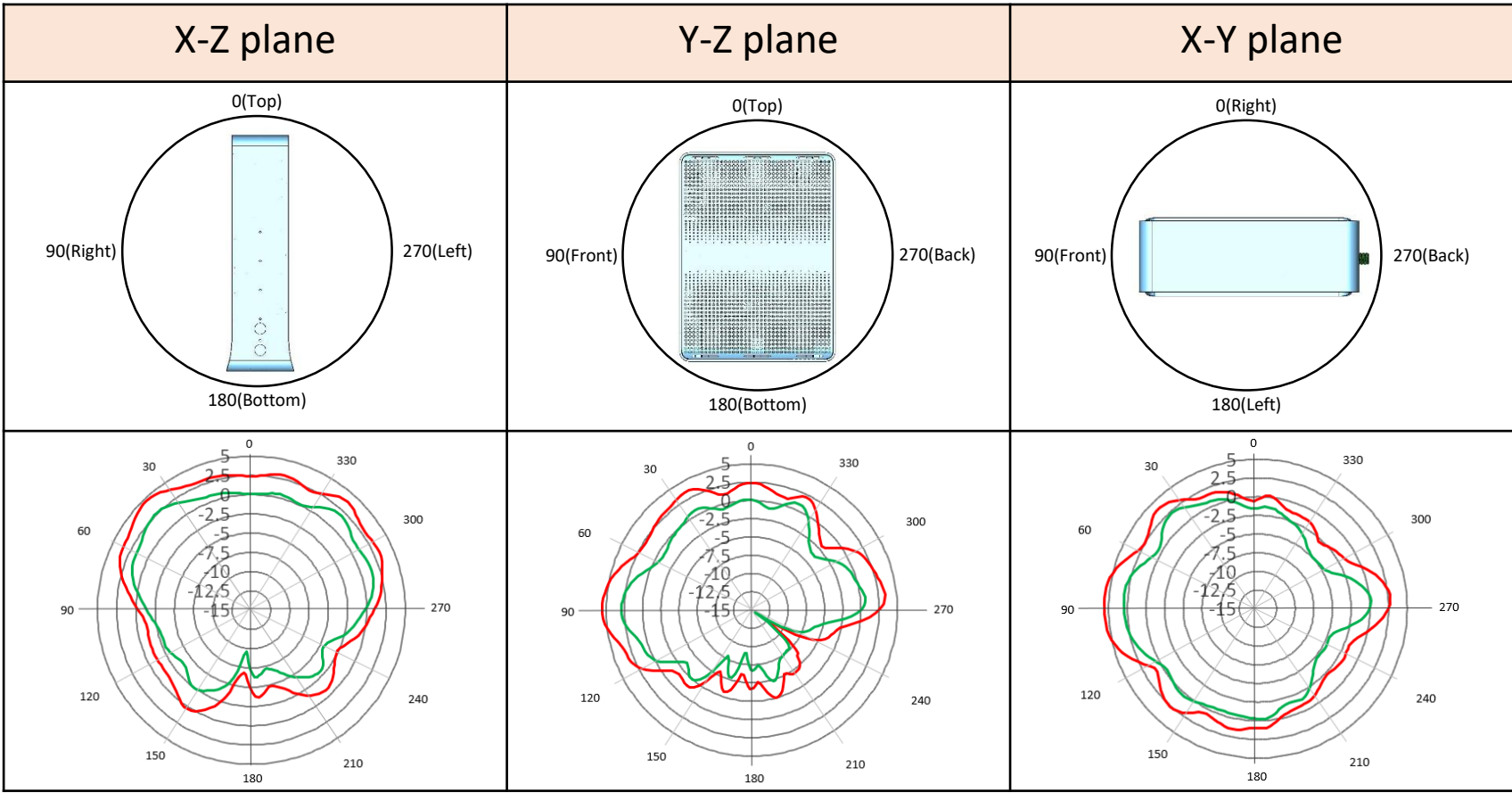# Measurement data

- Radiation pattern – Correlated 5.47GHz_Phi

# Measurement data

- Radiation pattern – Correlated 5.47GHz_Theta

# Measurement data

- Radiation pattern – Correlated 5.47GHz_E-total

# Measurement data

❖Directional gain table

| Frequency (MHz) | 2400 | 2450 | 2500 | 5150 | 5200 | 5300 | 5400 | 5470 | 5500 | 5600 | 5700 | 5800 | 5850 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DB-1(dBi) | -4.22 | -4.21 | -4.39 | -4.83 | -5.25 | -3.32 | 4.05 | 4.67 | 4.92 | 5.11 | 4.80 | 4.19 | 3.42 |
| DB-2(dBi) | 3.78 | 3.83 | 3.46 | 4.87 | 4.84 | 4.58 | -0.62 | -0.64 | -0.89 | 0.40 | 0.80 | 0.46 | 0.41 |
| Position (θ,Φ) | (86,12) | (84,8) | (82,8) | (178,-26) | (0,34) | (2,40) | (88,90) | (88,90) | (88,90) | (88,80) | (86,80) | (84,78) | (84,76) |
| Polarization | Theta | Theta | Theta | Phi | Phi | Phi | Theta | Theta | Theta | Theta | Theta | Theta | Theta |
| Directional Gain=$10\log[(10^{G1/20}+10^{G2/20}+\ldots\ldots+10^{Gn/20})^2/N_{ANT}]$dBi | | | | | | | | | | | | | |
| Directional Gain(dBi) | 3.68 | 3.72 | 3.4 | 4.32 | 4.19 | 4.51 | 5.03 | 5.42 | 5.5 | 6.08 | 6.04 | 5.53 | 5.06 |

Unit: dBi

# Summary

- The return loss of all antenna can meet -10 dB spec.

- The efficiency of all antenna can meet 60% spec.

- The isolation of all antenna can meet -20 dB spec.

- For certification, We used the formulas as below which is based on FCC document 662911 to calculate directional gain.

(i) If transmit signals are *correlated*, then

Directional gain = $10 \log[(10^{G_1/20} + 10^{G_2/20} + \ldots + 10^{G_N/20})^2 / N_{ANT}]$ dBi [Note the "20"s in the denominator of each exponent and the square of the sum of terms; the object is to combine the signal levels coherently.]

(ii) If all transmit signals are *completely uncorrelated*, then

Directional gain = $10 \log[(10^{G_1/10} + 10^{G_2/10} + \ldots + 10^{G_N/10})/N_{ANT}]$ dBi

| Frequency (MHz) | Peak Gain of 3D Directional pattern | | | | | |
| --- | --- | --- | --- | --- | --- | --- |
| | Phi | | Theta | | E-total | |
| | Correlated | Uncorrelated | Correlated | Uncorrelated | Correlated | Uncorrelated |
| 2400 | 3.02 | 1.32 | 3.68 | 1.52 | 4.39 | 2.21 |
| 2450 | 3.27 | 1.31 | 3.72 | 1.46 | 4.13 | 2.11 |
| 2500 | 2.95 | 1.04 | 3.40 | 1.11 | 3.95 | 1.87 |
| 5150 | 4.32 | 2.30 | 4.03 | 1.75 | 4.78 | 2.84 |
| 5200 | 4.19 | 2.24 | 4.01 | 1.73 | 4.66 | 2.75 |
| 5300 | 4.51 | 2.27 | 4.51 | 1.73 | 4.94 | 2.66 |
| 5400 | 4.34 | 2.11 | 5.03 | 2.31 | 5.31 | 2.65 |
| 5470 | 4.30 | 2.18 | 5.42 | 2.78 | 5.64 | 3.05 |
| 5500 | 4.04 | 1.96 | 5.50 | 2.93 | 5.71 | 3.19 |
| 5600 | 3.88 | 1.84 | 6.08 | 3.36 | 6.17 | 3.48 |
| 5700 | 4.22 | 1.84 | 6.04 | 3.25 | 6.12 | 3.34 |
| 5800 | 4.47 | 1.86 | 5.53 | 2.76 | 5.72 | 3.07 |
| 5850 | 4.44 | 1.80 | 5.06 | 2.26 | 5.32 | 2.78 |

unit: dB

# Antenna Information

| Ant. | 2.4G port | 5G port | Brand Name | Model Name | Ant. Type | Connector | Support | Radio | Manufacturer |
|---|---|---|---|---|---|---|---|---|---|
| 1(DB-1) | 0 | 1 | Pegatron | DB-1 | PCB Antenna | N/A | 2.4G+5G | Radio 0+Radio 1 | PEGA No. 150, Lide Rd., Beitou Dist., Taipei City 112019, Taiwan (R.O.C.) |
| 2(DB-2) | 1 | 0 | Pegatron | DB-2 | PCB Antenna | N/A | 2.4G+5G | Radio 1+Radio 0 | PEGA No. 150, Lide Rd., Beitou Dist., Taipei City 112019, Taiwan (R.O.C.) |

# Antenna Vendor Info & Measurement Setup

- Antenna Vendor: Pegatron
- Test Date: 20250513
- Test Engineer :Joe Liu
- Measurement Setup:

    - Reflection Coefficient Measurement:
        1. Network Analyzer (Keysight Agilent E5071C)
        2. Setup:
            -calibrate the Network Analyzer by one port calibration using  85033E calibration kit.
            -connect the antenna under test to the Network Analyzer.
            -measure the S11 (return loss)& S12(isolation)

    - Pattern & Gain measurement:

        1. Satimo chamber (SG24)
        2. Satimo program (wave studio)
        3. system overview :

    - Test Item
        1. Antenna passive test 400MHz~6GHz
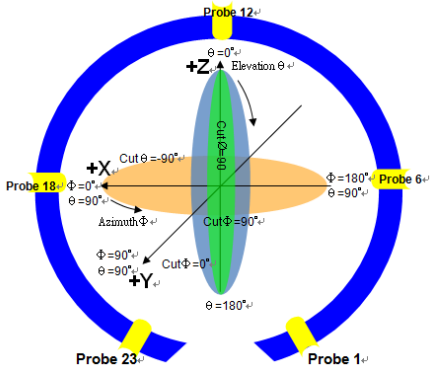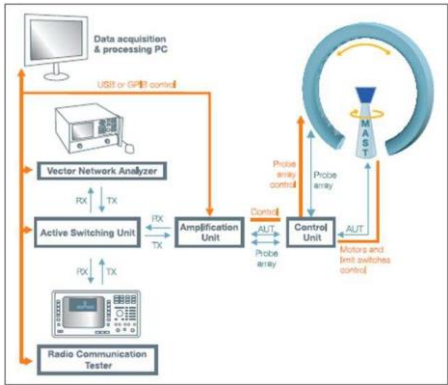


| Description Manufacturer | Model No. | Serial No. | Calibrated Date | Calibrated Until |
|---|---|---|---|---|
| OTA Chamber | Satimo SG24 | MVG/HKG0147S | 2024/09/16 | 2025/09/15 |
| Network Analyzer | Keysight E5071C | MY46212481 | 2025/5/16 | 2026/5/15 |

# Test Procedure

a)  sub-divide the whole sphere surface into many 2x2 degree subsection.

b)  Measure the gain contributed from each antenna within each subsection position.

c)  Apply the KDB 662911 D01 correlated directional gain formula to calculate directional gain for each subsection.

d)  After all subsections have been evaluated, the largest calculated value among all positions evaluated is picked as the worst-case directional gain for the system and used in RF/EMC test report.