Customer Name & Project: Sercomm WIFI7 for Charter

Prepared By: Angela

Date: 13th Feb 2025

Airgain Project Code:

Introduction

- Airgain proposes an embedded antenna solution for Sercomm WIFI7 for Charter
  - **Open mold**

DUT Description

- The solution for this device is as follows:
  - **Cable-fed Antennas:**
    4 pcs 2.4G+5G dual band Antennas(2.4GHz-2.49GHz, 5.15GHz-5.925GHz)
    4 pcs 6G signal band Antennas(5.925GHz-7.125GHz)
    1 pcs IOT Antenna(2.4GHz-2.49GHz)

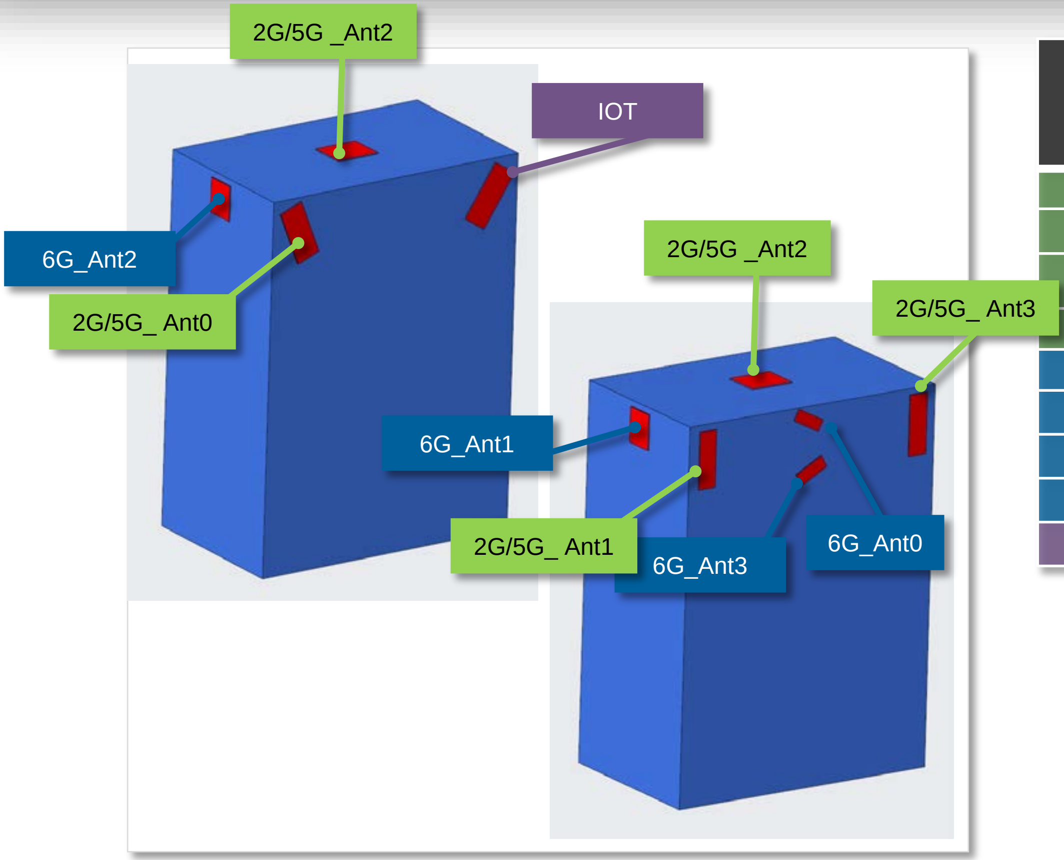
- The antenna is mounted on the plastic holder and connect to the radio through coaxial I-PEX EQ connector.
- Passive measurement results are presented

Summary of Requirements

- Return Loss :
  All band <-10dB
- Isolation:
  Below -20dB between all antennas
- Peak Gain:
  Less than 6dBi for antennas

Airgain Antenna System Proposal

Antenna System Proposal

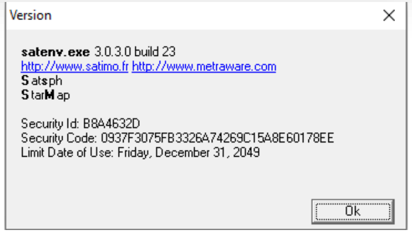


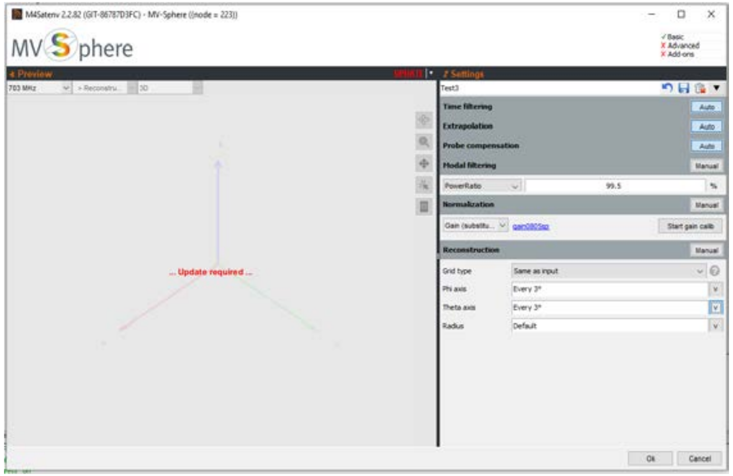
Antenna #	Part Number	Type	Cable length(Test)
2G/5G_Ant0	AC03SMBAA	FR4, Cable fed	LG65mm
2G/5G _Ant1	AC03SMBAB	FR4, Cable fed	LB180mm
2G/5G _Ant2	AC03SMBAC	FR4, Cable fed	LW145mm
2G/5G _Ant3	AC03SMBAD	FR4, Cable fed	LA116mm
6G_Ant0	AC06SMBAE	FR4, Cable fed	LE203mm
6G_Ant1	AC06SMBAF	FR4, Cable fed	LY149mm
6G_Ant2	AC06SMBAG	FR4, Cable fed	LR230mm
6G_Ant3	AC06SMBAH	FR4, Cable fed	LK160mm
IOT	AC01SMBAJ	FR4, Cable fed	LG105mm

Airgain Antenna Measurement System

Test Information

Item	Description
Chamber Brand Name	MVG
Equipment	Sercomm WIFI7 for Charter
Test Location	24/F,Building B,Junma Land Plaza,Zhangjiagang City, Jiangsu Province
Test Condition	Radiation
Test Engineer	Randy
Test Environment	MVG STARLAB
Test Date	February 13th, 2025
Measurement control	Satimo Passive Measurement 1.8.0
Near/Far field transform	M4Satenv 2.2.82(GIT-86787D3FC)
OTA measurement suite	Satenv 3.0.3.0build 23

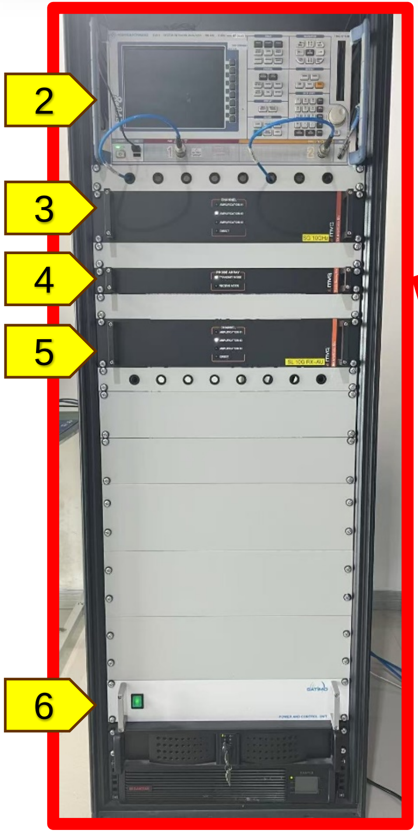


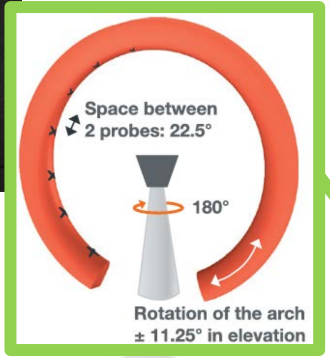


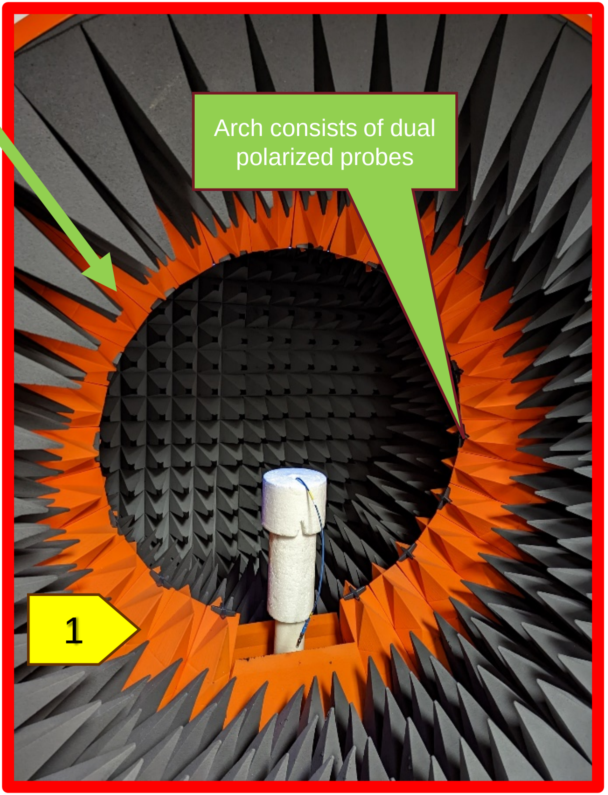
Test Equipment and Calibration

No	Instrument	Brand	Characteristics	Model No	Serial No	Calibration Due
1	Anechoic Chamber	MVG	600MHz-10GHz	Star Lab	1102283-0006	December 2025
2	VNA	ROHDE&SCHWARZ	300kHz-8GHz	ZVB.8	100225	August 2025
3	Tx Amplifier	MVG	NA	TxAU	1102527-4551	December 2025
4	Transfer Switching Unit	MVG	NA	TSU	1102183-26343	December 2025
5	Rx Amplifier	MVG	NA	RxAU	1102564-3748	December 2025
6	Power and Control Unit	MVG	NA	PACU	1101225-2238	December 2025

Measurement setup Architecture







Reference: MVG Starlab Manual

Measurement setup Architecture for Passive Near-Field measurement

- Starlab uses an Active Switching Unit to switch between near-field passive measurement and OTA measurement
- For near-field passive measurement a Vector Network analyzer is used as RF source/receiver
- The power and control unit supplies the power and driver the RF units on the arch
- Starlab performs a over sampling by mechanically rotating the arch by ±11.25° in elevation
- The software translates the measured near-field into far-field
- All the AUT/DUT are measured with phase center located in the quite zone of the chamber for calibration, Validation and performance evaluation
- Starlab can accommodate AUT/DUT up to 45 cm in diameter

Measurement Procedure

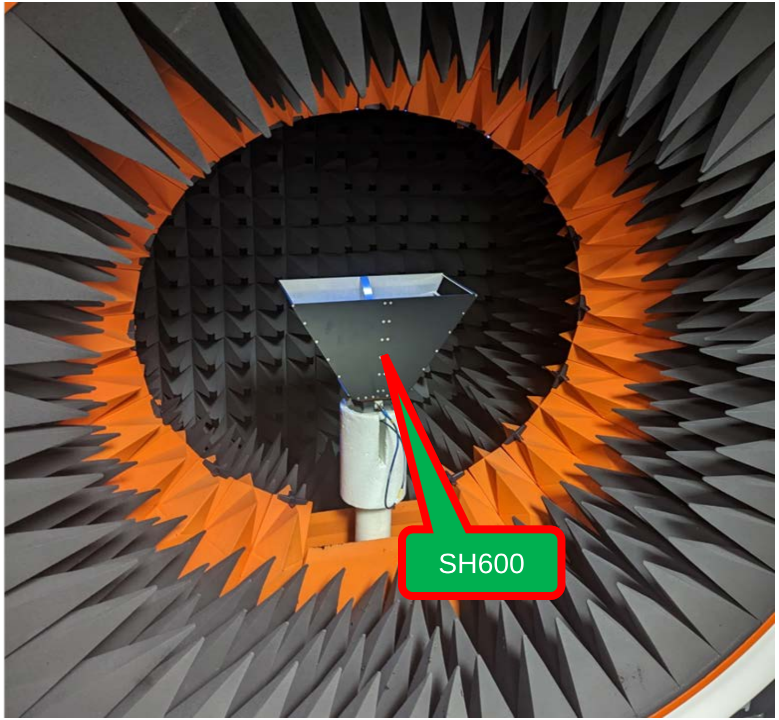
- DUT Setup
  - Mount the DUT securely on the Starlab's positioning system.
  - Ensure the antenna's phase center aligns with the system's rotation center.
  - Connect the RF feed to the AUT using a phase-stable cable in the chamber.

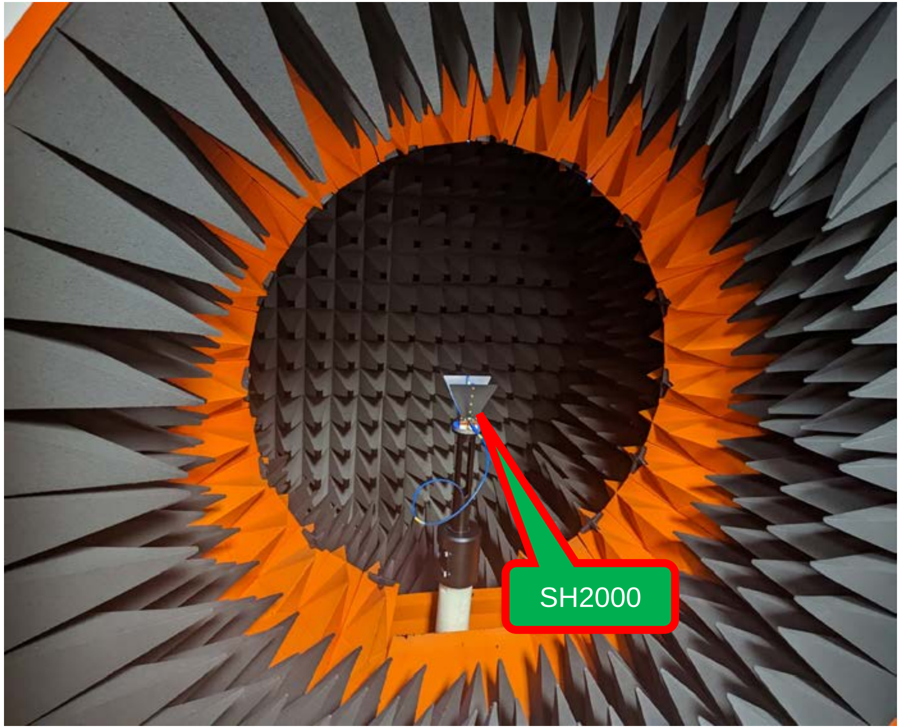
- Measurement Setup
  - Open SPM and Satenv
  - Configure the settings of frequency, Oversampling.

- Data Acquisition
  - Start the scan. VNA No2 as the equipment used for testing.
  - The RF power is transmitted out of the antenna under test. This RF power is fed through VNA No2 to TxAU No3 through the TSU No4.
  - The Near field energy out of the Antenna is captured by the Vertical and Horizonal polarized probes on the ring.
  - The captured power passes through TSU No4 to RxAU No5 and finally to VNA No2.
  - The Phi angle on of the turn table rotates from 0-177 degrees and the ring captures the signal and writes in the data matrix for each frequency.
  - The offsets to +-11.25 degrees to capture the near field in the angles in between the probes.
  - Nearfield data is stored.

- Post Processing and Results
  - Upon completion of measurements the postprocessing is done with Satenv.
  - The measured data is computed against calibrated file *(Please check Calibration Process on Slide 7)* for reconstruction and transition of the far field data at each measurement frequency.
  - The data is loaded into SatEnv to plot the measurement parameters and the plots

Passive Antenna Calibration Setup





Passive Antenna Calibration (Gain Substitution Method)

- Starlab is calibrated on a week basis by using MVG calibration method

- A standard Satimo horn antenna SH600 and SH2000 are used for calibrating the changer in low and high frequency bands of operation

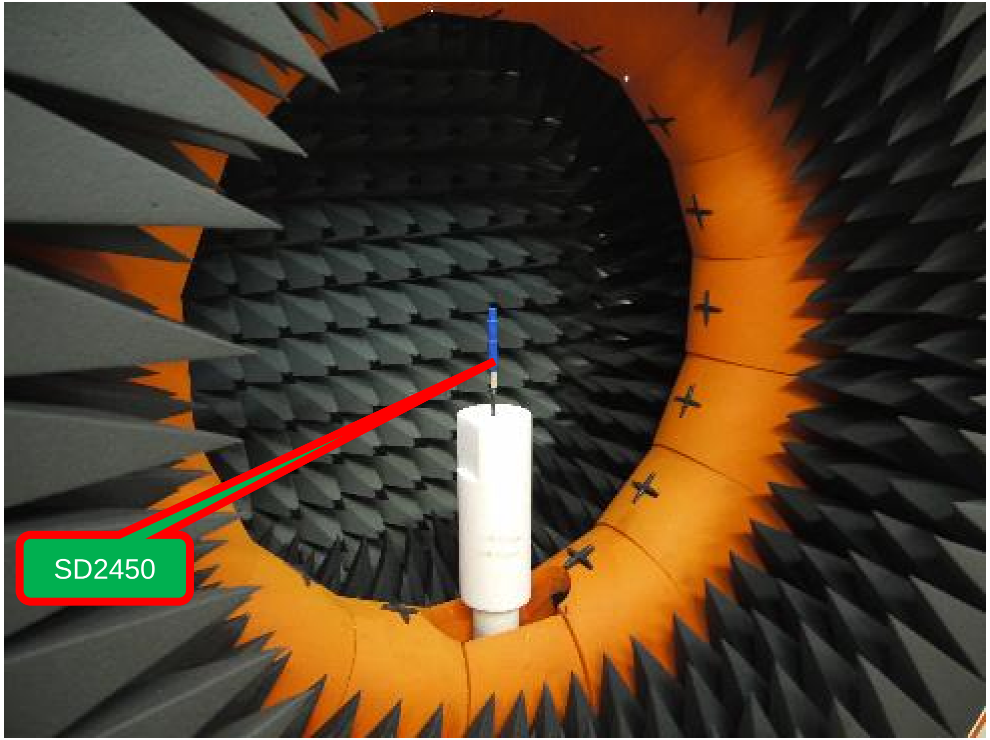
- The horn antennas are measured in the chamber and the calibration is performed in post processing with reference to standard gain values of the horn which are certified and provided by MVG

- During postposing a ***gain substitution*** method is used and the measured gain/efficiency data is computed against the standard gain/efficiency values of the horn antenna and a new calibration file is generated

- The calibrated file generated is stored as a new primary calibration file which will be recalled automatically during post processing of any AUT/DUT measurements

Passive Antenna Validation Dipoles

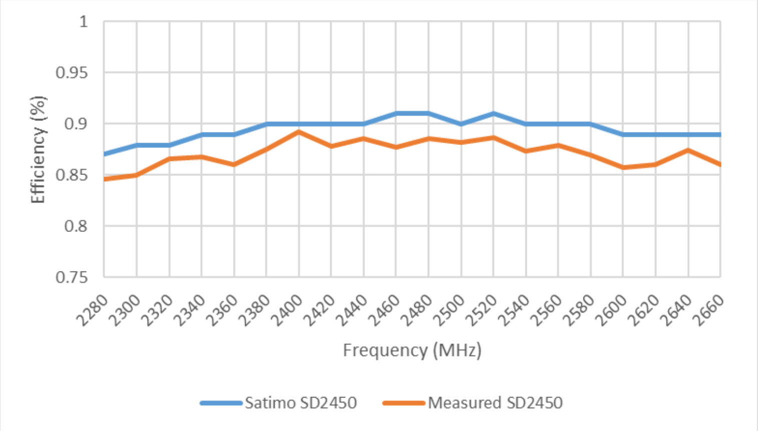
Passive Antenna Validation Setup

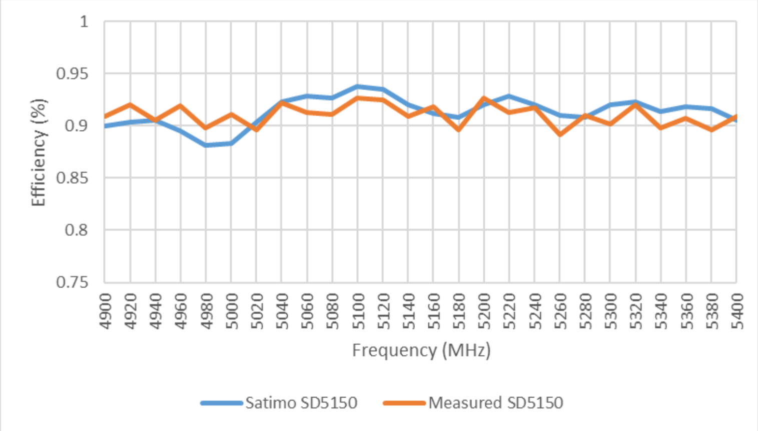


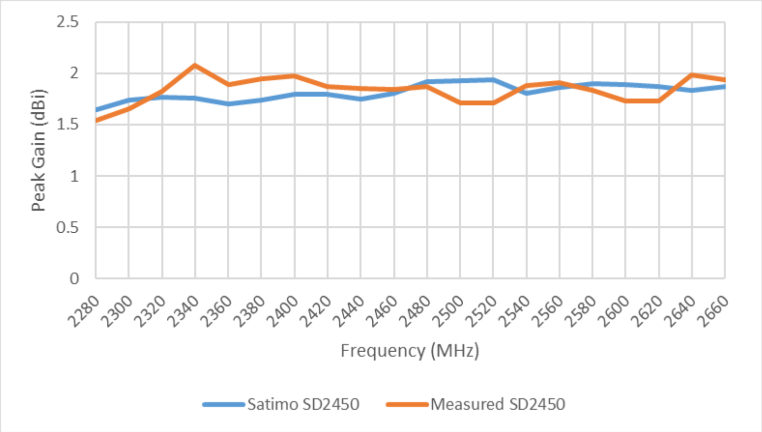
Passive Antenna Validation

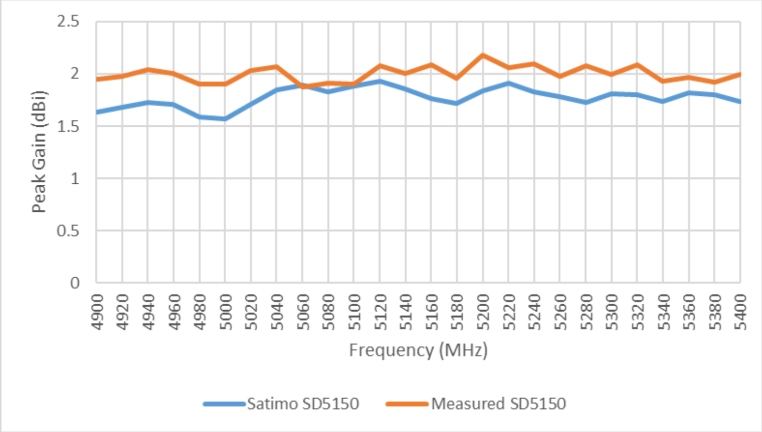
- Starlab is validated after the calibration process is completed, and a routine validation is performed every week to ensure the calibration has not been drifted over the time.
- Standard Satimo dipoles are measured in different frequency range based upon the dipole specs.
- Standard dipole include SD2450, SD5150, SD5650
- Dipoles are measured and post processed with standard AUT/DUT measurement steps
- Upon postprocessing the output gain and efficiency of the dipole is compared to the standard dipole data provided and certified by MVG/Satimo
- If the measured values are out of limit a new calibration is performed if needed

Passive Antenna Validation Results









Chamber stability certified by MVG

- MVG visits on site every year and performs a full set of system calibration which is valid for a year
- During the calibration and validation process MVG checks the performance of the full system and ensures the measured/validated data is in the tolerance limit of Starlab specs

Calibration Certificate

Manufacturer's Name : MVG Industries

Manufacturer's Address : 13, rue du Zéphir
Parc d'Activité de l'Océane
91140 Villejust
FRANCE

Declares that product

Customer name : AIRGAIN

Product Name: SLv2

Serial Number : HKG0827S

Calibration date 11/12/2024

Has been calibrated according MVG procedure and \ Or according ISO 9001 requirements.

11 December 2024 — MVG Quality Manager

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Fax : +33 (0)46 33 39 02

Technical Document - MATR.346.1.24.HKG.A

Summary:

This document presents the results of the acceptance tests performed on the system.

This document has been automatically generated by the software:

- Acceptance Report Generator - version = 5.1.2 (GIT-0DF193121)

Diffusion List :

- Application department
- Production manager
- Project manager
- Maintenance manager
- Quality manager

Applicable documents :

- MA.I.4.D Orthomodal Calibration Procedure.pdf

	Name	Function	Date	Signature
Prepared by	Rex XUE	Aftersales Engineer	11-Dec-2024	
Checked by	Frederic CABARET	Aftersales Manager	11-Dec-2024	

MVG Chamber Validations/ Calibrations Data

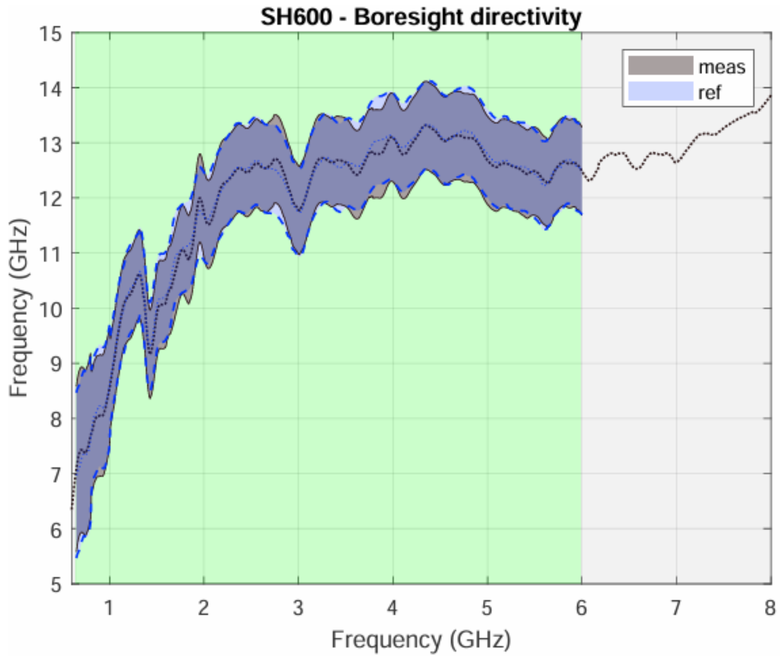


Figure 5.1: Boresight directivity

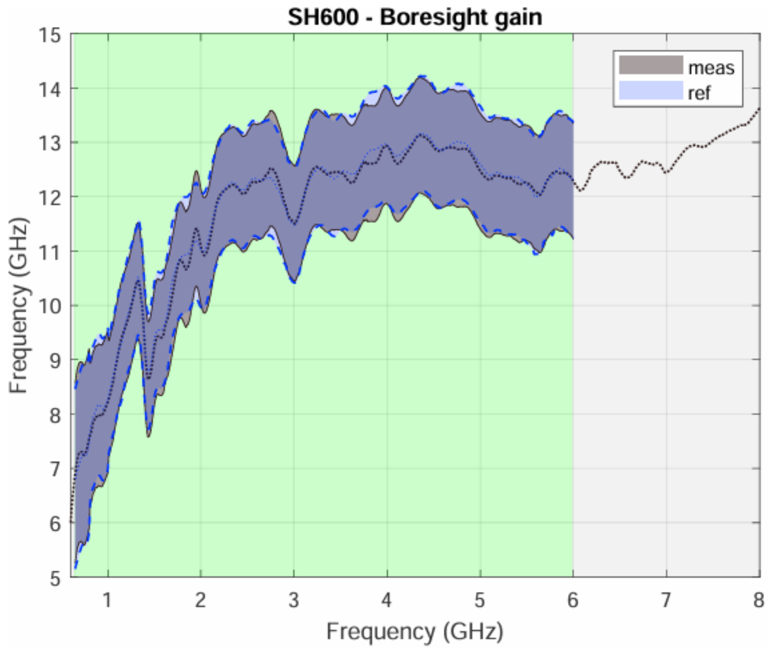


Figure 5.2: Boresight gain

MVG Chamber Validations/ Calibrations Data

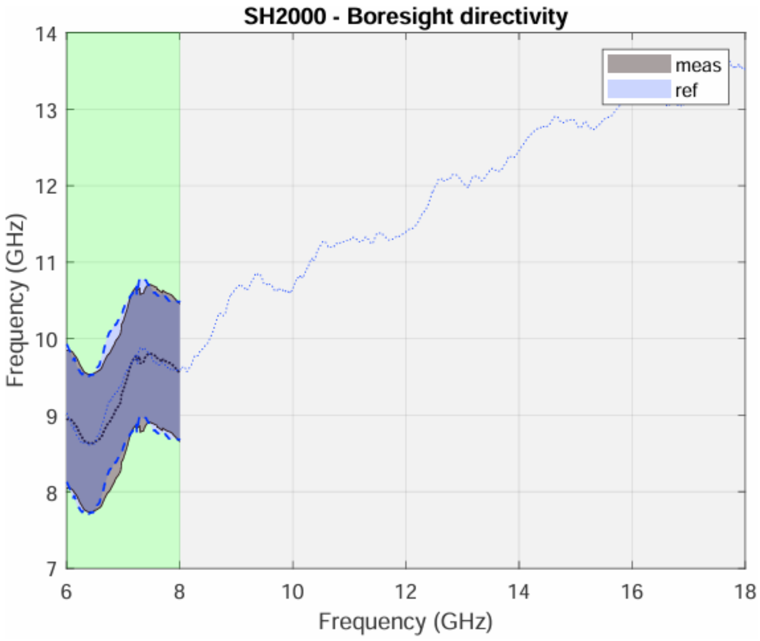


Figure 5.68: Boresight directivity

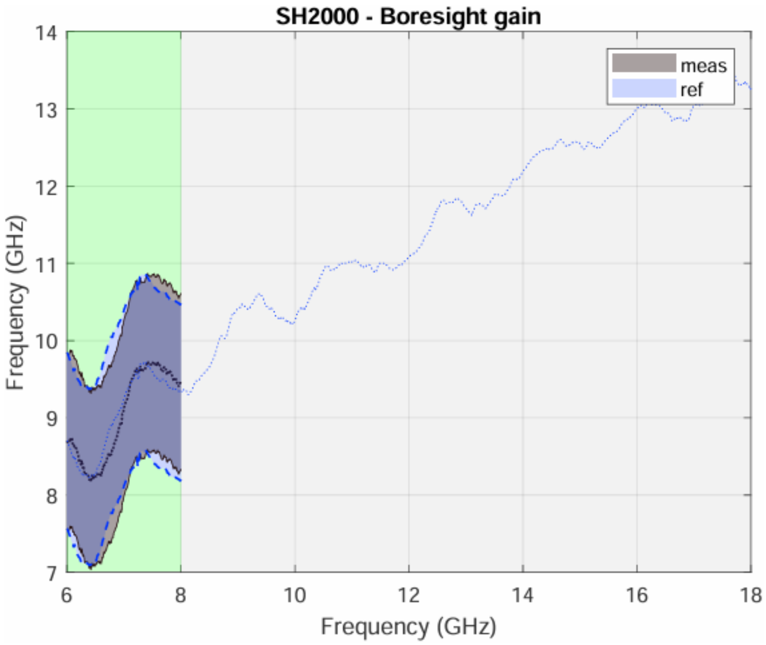


Figure 5.69: Boresight gain

MVG Chamber Validations/ Calibrations Data

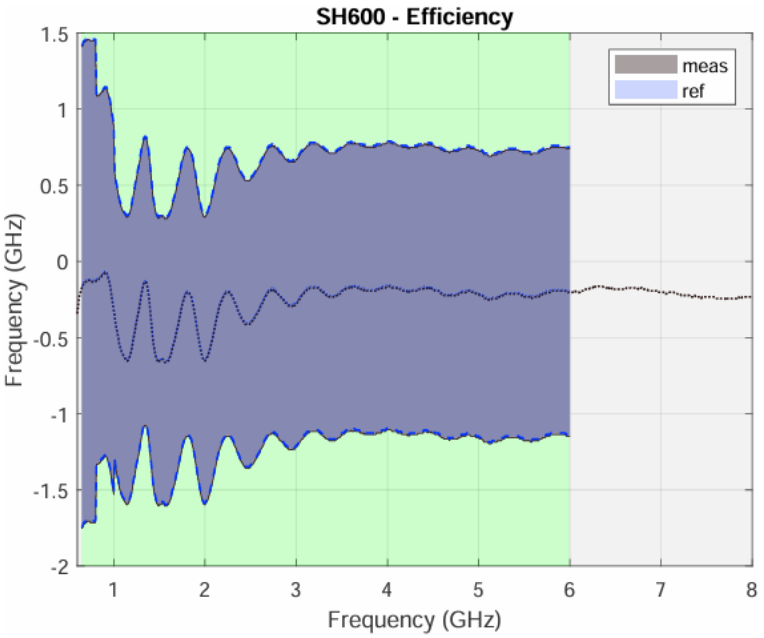


Figure 5.3: Efficiency

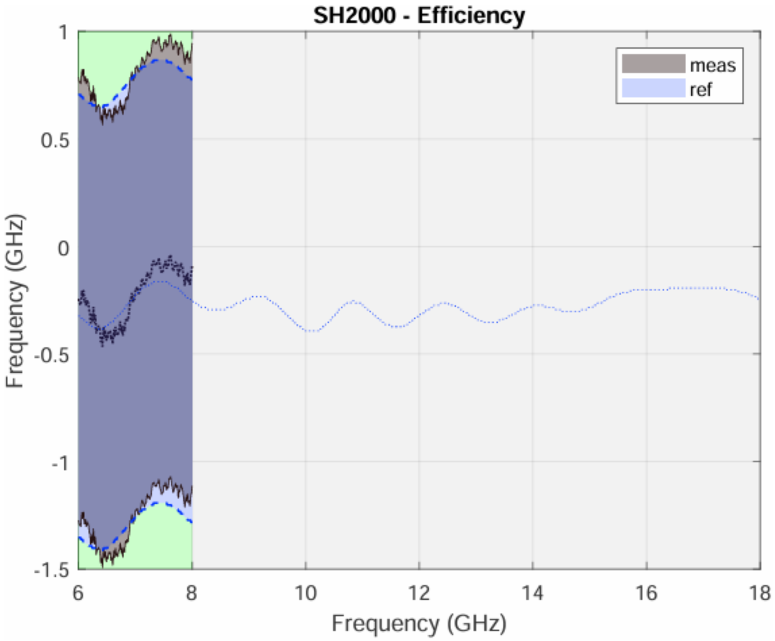
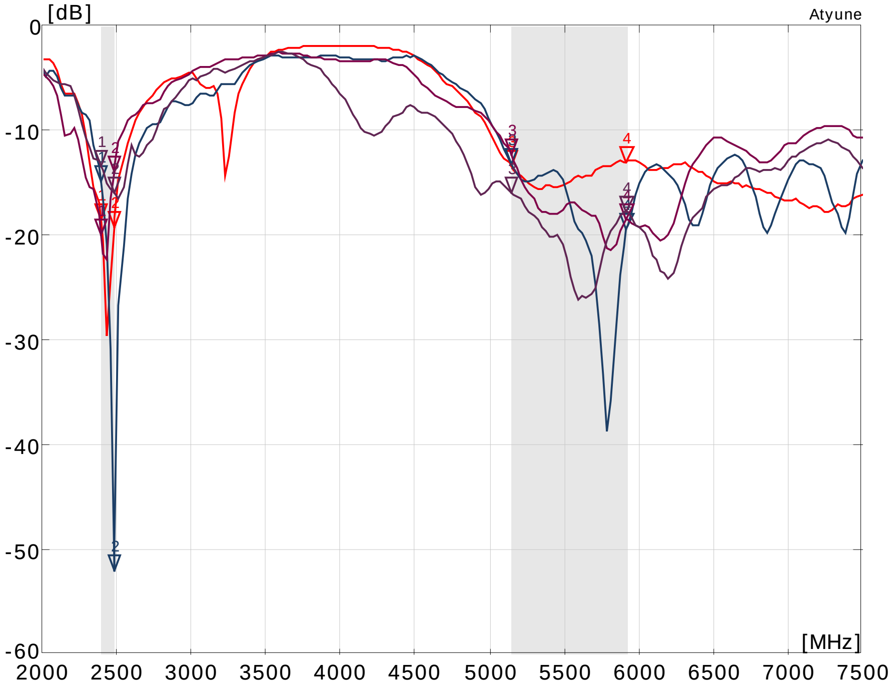


Figure 5.70: Efficiency

S-Parameters

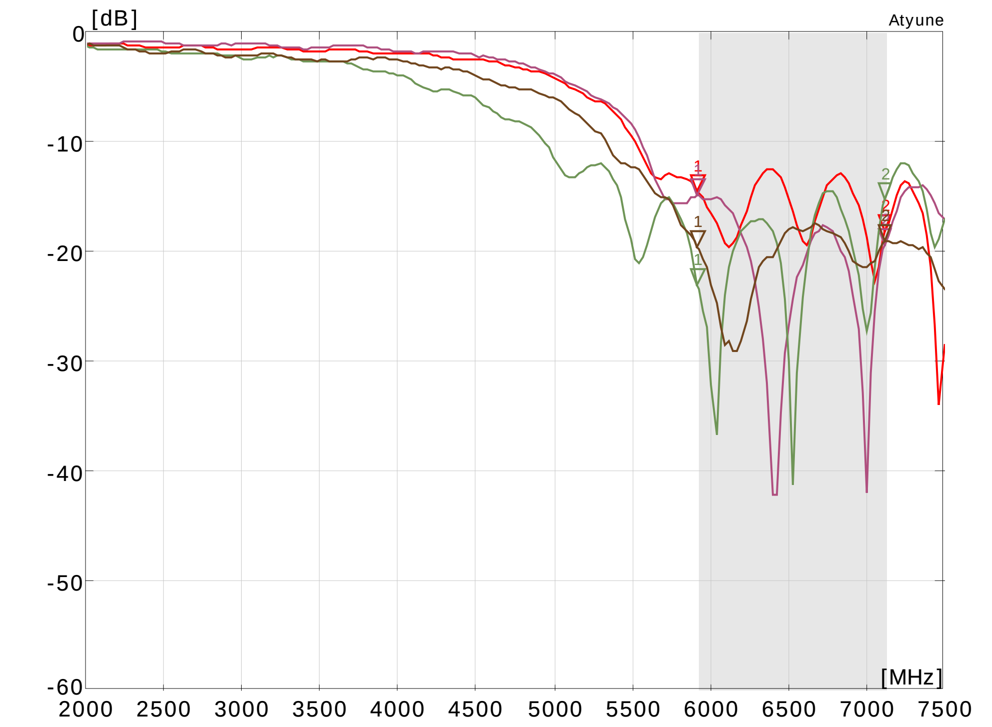
S-Parameter – Return Loss for Dual Band Antennas

Airgain



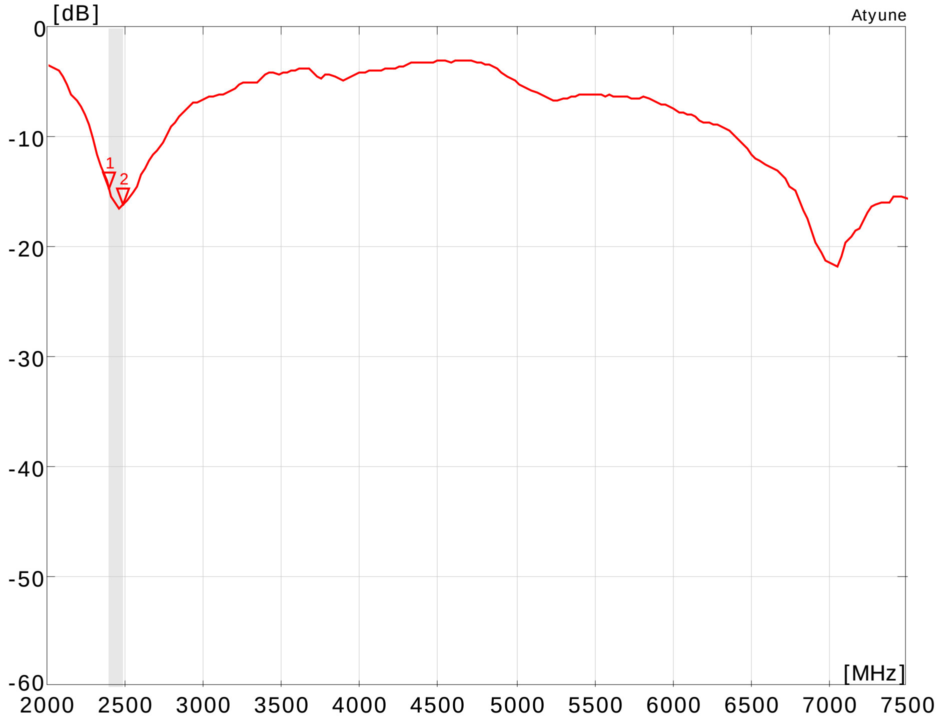
MARKERS:	MHz	dB	MHz	dB
2.5G_A0.S1P - S11				
	1: 2400	-18.44	3: 5150	-13.37
	2: 2490	-19.14	4: 5925	-12.92
2.5G_A1.S1P - S11				
	1: 2400	-14.87	3: 5150	-13.23
	2: 2490	-51.90	4: 5925	-19.41
2.5G_A2.S1P - S11				
	1: 2400	-19.87	3: 5150	-12.27
	2: 2490	-13.86	4: 5925	-18.46
2.5G_A3.S1P - S11				
	1: 2400	-13.32	3: 5150	-16.00
	2: 2490	-15.85	4: 5925	-17.64

S-Parameter – Return Loss for 6G Antennas



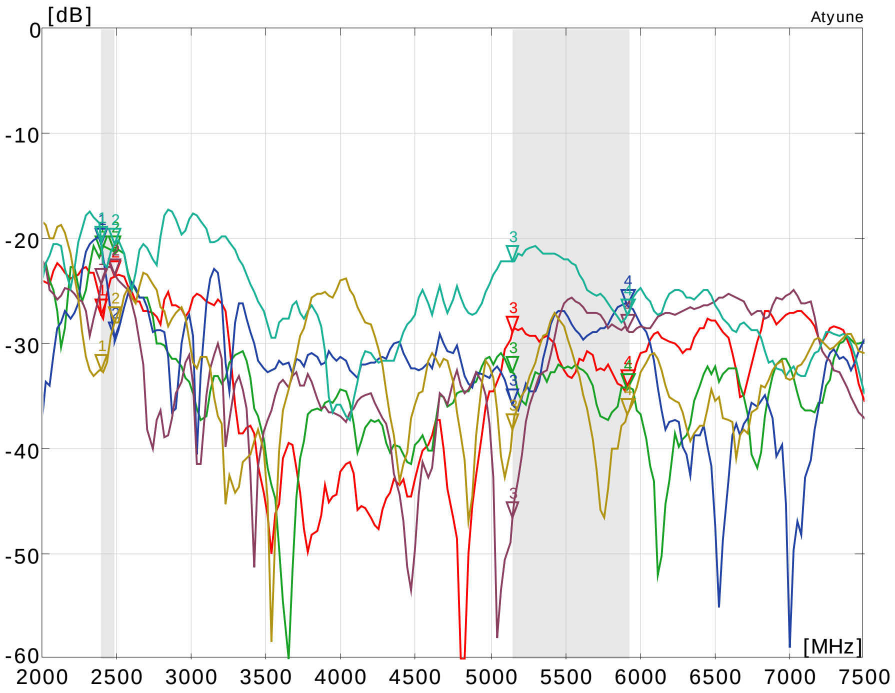
MARKERS:	MHz	dB
6G_A0.S1P - S11		
1:	5925	-14.47
2:	7125	-18.15
6G_A1.S1P - S11		
1:	5925	-14.89
2:	7125	-19.28
6G_A2.S1P - S11		
1:	5925	-22.93
2:	7125	-15.12
6G_A3.S1P - S11		
1:	5925	-19.46
2:	7125	-19.03

S-Parameter – Return Loss for IOT Antenna



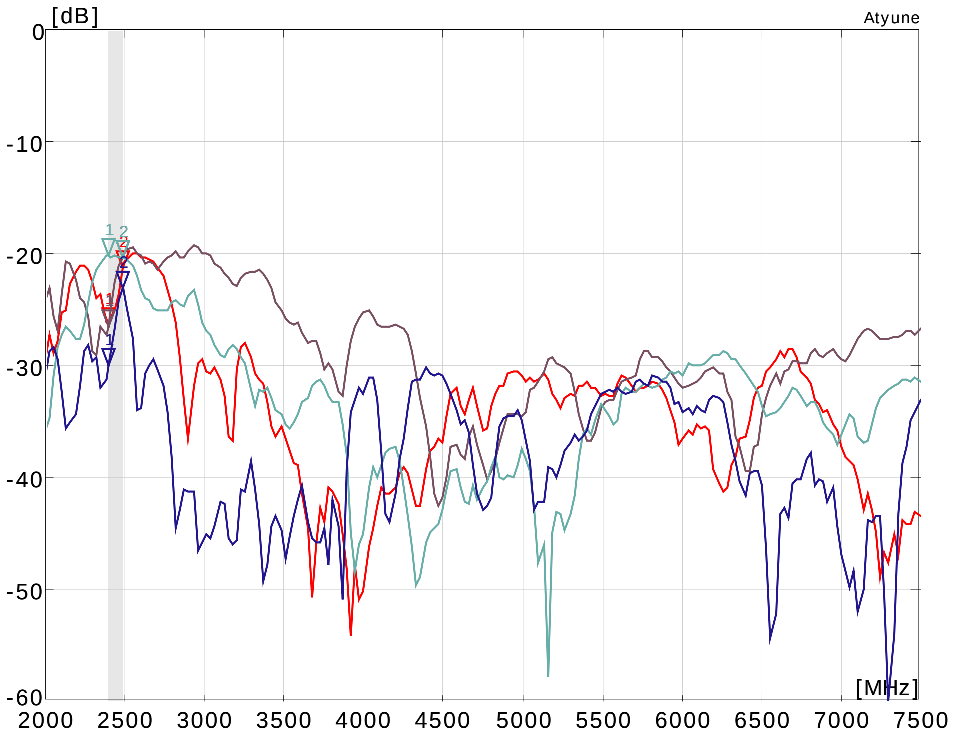
MARKERS:	MHz	dB
IOT.S1P - S11		
1:	2400	-14.73
2:	2490	-16.15

S-Parameter – Isolation for Dual Band Antennas



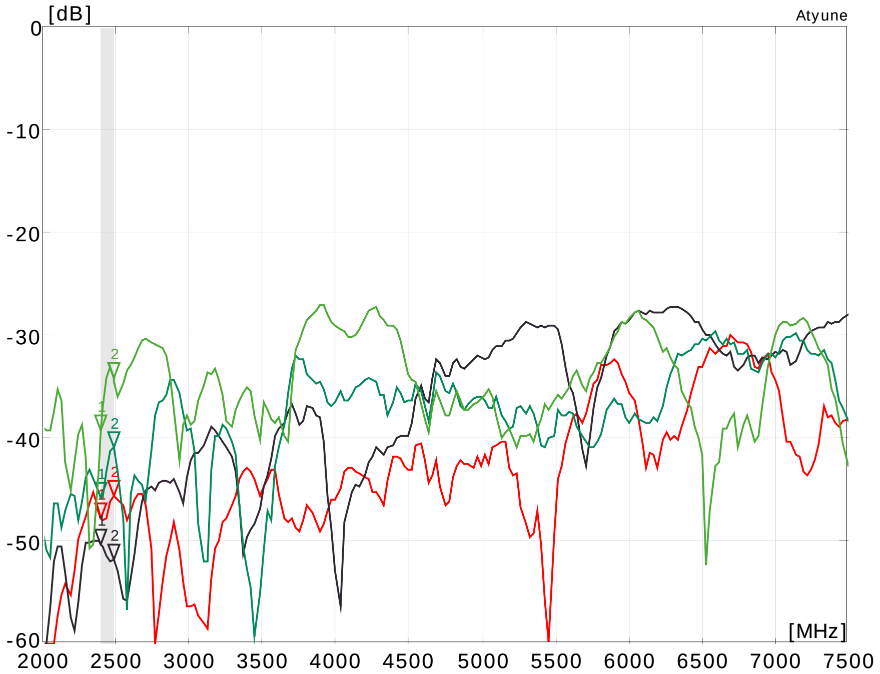
MARKERS:	MHz	dB	MHz	dB
2.5G_A0-2.5G_A1.S2P - S12				
	1: 2400	-27.12	3: 5150	-28.87
	2: 2490	-23.48	4: 5925	-33.91
2.5G_A0-2.5G_A2.S2P - S12				
	1: 2400	-21.20	3: 5150	-32.66
	2: 2490	-21.26	4: 5925	-34.23
2.5G_A0-2.5G_A3.S2P - S12				
	1: 2400	-20.52	3: 5150	-35.77
	2: 2490	-29.39	4: 5925	-26.31
2.5G_A1-2.5G_A2.S2P - S12				
	1: 2400	-24.23	3: 5150	-46.45
	2: 2490	-23.31	4: 5925	-28.62
2.5G_A1-2.5G_A3.S2P - S12				
	1: 2400	-20.35	3: 5150	-22.12
	2: 2490	-20.54	4: 5925	-27.27
2.5G_A2-2.5G_A3.S2P - S12				
	1: 2400	-32.37	3: 5150	-38.04
	2: 2490	-27.92	4: 5925	-36.69

S-Parameter – Isolation for Dual Band Antennas & IOT Antenna



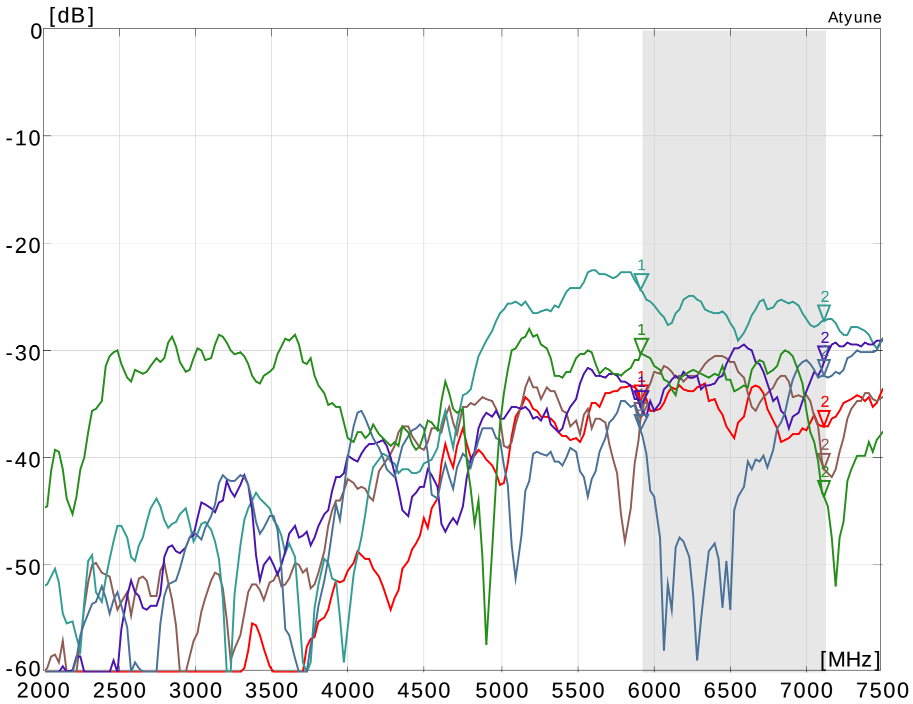
MARKERS:	MHz	dB
2.5G_A0-IOT.S2P - S12		
1:	2400	-26.22
2:	2490	-21.13
2.5G_A1-IOT.S2P - S12		
1:	2400	-26.41
2:	2490	-20.20
2.5G_A2-IOT.S2P - S12		
1:	2400	-20.16
2:	2490	-20.20
2.5G_A3-IOT.S2P - S12		
1:	2400	-29.82
2:	2490	-22.92

S-Parameter – Isolation for 6G Antennas & IOT Antenna



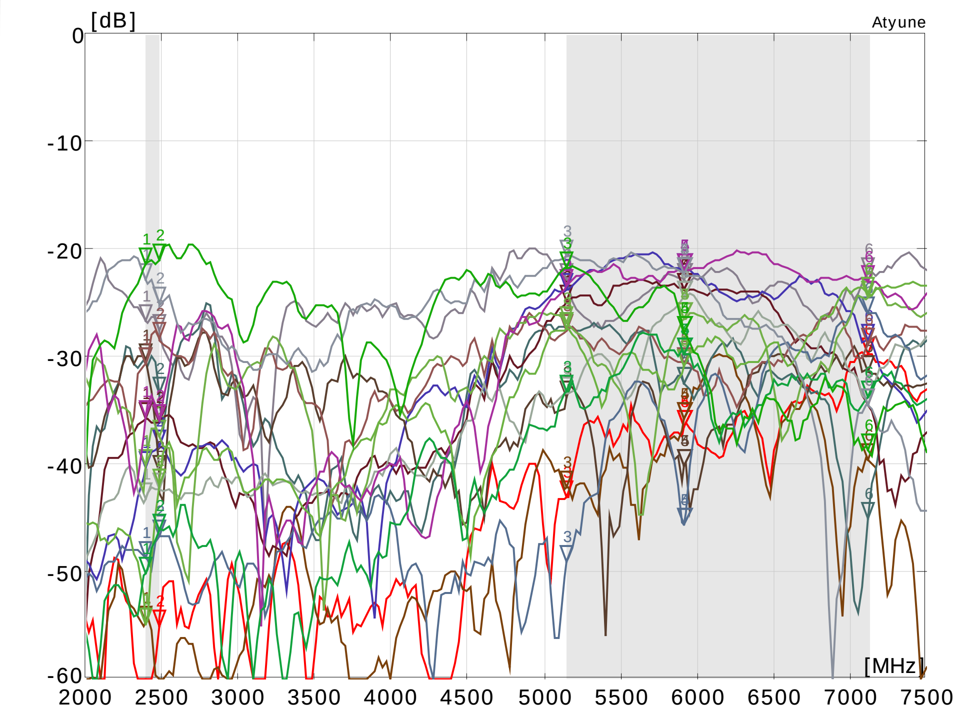
MARKERS:	MHz	dB
6G_A0-IOT.S2P - S12		
1:	2400	-47.67
2:	2490	-45.50
6G_A1-IOT.S2P - S12		
1:	2400	-50.26
2:	2490	-51.74
6G_A2-IOT.S2P - S12		
1:	2400	-45.81
2:	2490	-40.76
6G_A3-IOT.S2P - S12		
1:	2400	-39.10
2:	2490	-34.10

S-Parameter – Isolation for 6G Antennas



MARKERS:	MHz	dB
6G_A0-6G_A1.S2P - S12		
1:	5925	-34.68
2:	7125	-36.98
6G_A0-6G_A2.S2P - S12		
1:	5925	-36.31
2:	7125	-41.05
6G_A0-6G_A3.S2P - S12		
1:	5925	-24.29
2:	7125	-27.12
6G_A1-6G_A2.S2P - S12		
1:	5925	-35.21
2:	7125	-31.01
6G_A1-6G_A3.S2P - S12		
1:	5925	-37.31
2:	7125	-32.32
6G_A2-6G_A3.S2P - S12		
1:	5925	-30.32
2:	7125	-43.54

S-Parameter – Isolation for Dual Band Antennas & 6G Antennas



MARKERS:	MHz	dB	MHz	dB	MHz	dB
2.5G_A0-6G_A0.S2P - S12						
	1: 2400	-66.01	3: 5150	-43.07	5: 5925	-36.40
	2: 2490	-54.93	4: 5925	-36.40	6: 7125	-29.77
2.5G_A0-6G_A1.S2P - S12						
	1: 2400	-54.56	3: 5150	-42.15	5: 5925	-35.67
	2: 2490	-62.11	4: 5925	-35.67	6: 7125	-39.55
2.5G_A0-6G_A2.S2P - S12						
	1: 2400	-26.66	3: 5150	-22.89	5: 5925	-22.88
	2: 2490	-27.47	4: 5925	-22.88	6: 7125	-22.25
2.5G_A0-6G_A3.S2P - S12						
	1: 2400	-30.56	3: 5150	-27.28	5: 5925	-32.38
	2: 2490	-33.27	4: 5925	-32.38	6: 7125	-45.08
2.5G_A1-6G_A0.S2P - S12						
	1: 2400	-35.74	3: 5150	-24.89	5: 5925	-23.73
	2: 2490	-36.09	4: 5925	-23.73	6: 7125	-34.54
2.5G_A1-6G_A1.S2P - S12						
	1: 2400	-40.28	3: 5150	-23.81	5: 5925	-21.94
	2: 2490	-38.33	4: 5925	-21.94	6: 7125	-28.44
2.5G_A1-6G_A2.S2P - S12						
	1: 2400	-30.36	3: 5150	-33.67	5: 5925	-40.04
	2: 2490	-40.60	4: 5925	-40.04	6: 7125	-31.30
2.5G_A1-6G_A3.S2P - S12						
	1: 2400	-30.61	3: 5150	-27.54	5: 5925	-30.57
	2: 2490	-28.24	4: 5925	-30.57	6: 7125	-28.77
2.5G_A2-6G_A0.S2P - S12						
	1: 2400	-43.16	3: 5150	-33.29	5: 5925	-24.53
	2: 2490	-42.31	4: 5925	-24.53	6: 7125	-33.81
2.5G_A2-6G_A1.S2P - S12						
	1: 2400	-48.55	3: 5150	-49.04	5: 5925	-45.57
	2: 2490	-46.62	4: 5925	-45.57	6: 7125	-25.87
2.5G_A2-6G_A2.S2P - S12						
	1: 2400	-40.12	3: 5150	-26.73	5: 5925	-26.52
	2: 2490	-37.33	4: 5925	-26.52	6: 7125	-24.49
2.5G_A2-6G_A3.S2P - S12						
	1: 2400	-35.57	3: 5150	-23.39	5: 5925	-21.87
	2: 2490	-35.83	4: 5925	-21.87	6: 7125	-22.96
2.5G_A3-6G_A0.S2P - S12						
	1: 2400	-54.79	3: 5150	-27.41	5: 5925	-30.78
	2: 2490	-41.84	4: 5925	-30.78	6: 7125	-24.17
2.5G_A3-6G_A1.S2P - S12						
	1: 2400	-50.14	3: 5150	-33.21	5: 5925	-29.68
	2: 2490	-46.06	4: 5925	-29.68	6: 7125	-33.81
2.5G_A3-6G_A2.S2P - S12						
	1: 2400	-22.89	3: 5150	-20.66	5: 5925	-22.34
	2: 2490	-24.96	4: 5925	-22.34	6: 7125	-34.49
2.5G_A3-6G_A3.S2P - S12						
	1: 2400	-21.28	3: 5150	-21.66	5: 5925	-27.71
	2: 2490	-20.92	4: 5925	-27.71	6: 7125	-38.62

Radiated Measurements

Antenna Realized Efficiency (%) – 2.4 GHz Wi-Fi Antennas

Frequency (MHz)	Ant0_2G4 (%)	Ant1_2G4 (%)	Ant2_2G4 (%)	Ant3_2G4 (%)
2400	70.0	70.9	71.4	72.4
2410	70.5	70.9	71.5	73.7
2420	70.1	70.3	71.4	72.4
2430	70.7	70.4	72.0	72.8
2440	72.0	70.4	72.5	74.2
2450	72.8	70.7	72.7	75.3
2460	74.0	71.9	73.6	76.9
2470	73.5	71.9	72.9	76.9
2480	73.6	72.1	72.6	76.7
2490	73.6	72.8	72.2	77.1
Average	72.1	71.2	72.3	74.9

Antenna Realized Efficiency (%) – 5 GHz Wi-Fi Antennas

Airgain

Frequency (MHz)	Ant0_5G (%)	Ant1_5G (%)	Ant2_5G (%)	Ant3_5G (%)
5150	71.6	69.4	69.8	74.9
5200	71.6	70.9	69.2	75.4
5300	73.8	69.9	72.5	75.0
5400	72.8	68.3	71.3	70.2
5500	73.5	71.2	73.6	73.1
5600	71.2	69.3	71.5	70.9
5700	72.9	73.5	72.8	76.1
5800	70.0	69.6	70.1	71.5
5850	71.0	70.2	71.4	73.1
Average	72.0	70.3	71.3	73.3

Antenna Realized Efficiency (%) – 6 GHz Wi-Fi Antennas

Airgain

Frequency (MHz)	Ant0_6G (%)	Ant1_6G (%)	Ant2_6G (%)	Ant3_6G (%)
5925	65.3	64.0	68.0	67.3
6000	66.4	65.8	67.0	68.1
6100	71.6	69.3	71.4	72.9
6200	66.5	69.1	67.0	70.5
6300	66.2	69.7	67.2	70.1
6400	64.7	70.3	68.3	69.8
6500	67.1	70.4	67.8	68.9
6600	65.8	68.4	66.0	67.6
6700	64.6	69.3	67.1	69.2
6800	63.4	67.7	65.8	66.5
6900	66.6	70.0	67.8	69.3
7125	62.8	65.6	61.6	65.9
Average	65.9	68.3	67.1	68.8

Antenna Peak Realized Gain – 2.4 GHz Wi-Fi Antennas

Frequency (MHz)	Ant0_2G4 (dBi)	Ant1_2G4 (dBi)	Ant2_2G4 (dBi)	Ant3_2G4 (dBi)
2400	4.0	3.2	2.4	3.6
2410	4.0	3.8	2.8	3.8
2420	4.0	4.3	2.9	4.1
2430	4.0	4.6	2.8	4.6
2440	4.1	4.6	2.7	4.9
2450	4.2	4.6	2.8	4.8
2460	4.3	4.6	2.9	4.9
2470	4.2	4.5	3.0	4.8
2480	4.3	4.5	3.1	4.8
2490	4.3	4.5	3.0	4.9

Antenna Peak Realized Gain – 5 GHz Wi-Fi Antennas

Frequency (MHz)	Ant0_5G (dBi)	Ant1_5G (dBi)	Ant2_5G (dBi)	Ant3_5G (dBi)
5150	3.9	4.5	3.4	4.8
5200	4.0	4.6	3.4	5.0
5300	4.0	4.3	3.7	5.4
5400	3.6	4.0	4.4	4.9
5500	3.8	4.5	4.3	5.3
5600	4.2	3.4	4.3	5.4
5700	3.9	3.5	4.1	5.3
5800	3.6	3.3	4.1	4.8
5850	3.7	3.6	4.4	4.8

Antenna Peak Realized Gain – 6 GHz Wi-Fi Antennas

Frequency (MHz)	Ant0_6G (dBi)	Ant1_6G (dBi)	Ant2_6G (dBi)	Ant3_6G (dBi)
5925	2.7	3.3	4.8	5.0
6000	2.9	3.6	4.5	4.9
6100	4.0	3.7	4.2	4.8
6200	3.1	3.4	3.8	4.6
6300	3.3	4.3	4.5	4.8
6400	3.1	4.8	4.9	4.9
6500	3.4	4.4	4.7	4.6
6600	3.0	4.2	4.5	4.4
6700	2.8	3.9	4.5	4.8
6800	2.6	4.0	4.6	4.0
6900	2.9	3.6	4.9	3.6
7125	3.0	4.2	4.1	4.3

Antenna Realized Efficiency & Peak Gain– Additional IOT Antennas

Frequency (MHz)	Peak Gain (dBi)	Efficiency (%)
2400	3.3	69.7
2410	3.6	71.0
2420	3.6	69.9
2430	3.6	69.6
2440	3.8	69.6
2450	3.9	69.2
2460	4.0	69.8
2470	4.1	69.1
2480	4.1	69.4
2490	4.2	69.9
Average	-	69.7

Antenna System Composite Gain

Composite Gain Calculation

- The composite gain is based on FCC document 662911. Part d (ii)

d) *Unequal antenna gains, with equal transmit powers.* For antenna gains given by G_1, G_2, …, G_N dBi

(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

Reference: FCC document, "Emissions Testing of Transmitters with Multiple Outputs in the Same Band", 662911 D01 Multiple Transmitter Output v02r01

See Page 47 to Page 49 of antenna report.

A. Antenna System Description

The Equipment Under Test (EUT) consists of WiFi Antennas integrated into the for Sercomm WIFI7 for Charter unit along with the PCBA, heat spreads and other passive components. The system is evaluated in its operational configuration, including cabling, ground planes, and enclosures if applicable. The EUT is set up in its intended orientation and mounting configuration on the MVG StarLab positioning system.

- **Frequency range**: 2.4-2.49 GHz WiFi and IOT, 5.15-5.85 GHz WiFi, 5.925-7.125 GHz WiFi
- **Antenna type**: Dipole
- **Polarization**: Linear
- **Radiation pattern**: Omnidirectional (In free space and pseudo omni when integrated into the device)
- **Interface**: The I-PEX EQ connector is connected to the Center probe feed of the MVG chamber that connects to VNA via a amplification unit.

See Page 4 to Page 6 of antenna report.

B. Measurement Quantity

The primary quantity measured is **antenna gain (dBi)**, derived from measured **realized gain** for passive measurement:

- **For passive antennas**: Absolute gain (dBi) is calculated using a substitution method.

Additional measured quantities may include:

- **Radiation pattern (2D/3D)**
- **Cross-polarization discrimination**
- **Co-polar gain**

See Page 14, and Page49 to Page88 of antenna report.

C. Measurement Method

Measurements are performed using the **MVG StarLab** and SPM software Starlab is a near-field antenna measurement system, which computes far-field gain from measured near-field data using spherical near-field transformation techniques through Mv Sphere. The measurement process follows these steps:

1. **Calibration**: The system is calibrated using a standard gain antenna SH2000 and SH600.
2. **Substitution method**:
   - Measure the reference antenna gain using a known gain standard.
   - Replace the reference antenna with the EUT and measure its radiated field strength.
   - Calculate gain from the relative measurements and known standard.

Processing:

- MVG software processes the near-field data, applying probe correction, filtering, and transformation to generate far-field patterns.
- 3D gain patterns, cuts, and tabulated data are generated.
- To compute Directional Gain KDB 662911 -part d (ii) is used
- This is presented in the RF report along with manual calculations

See Page 11 to Page 13, Page 15 to Page 22 and Page 40 of antenna report.

D. Measurement Environment

Measurements are conducted in the **MVG StarLab**, a compact near-field chamber providing an anechoic environment for accurate radiated measurements.

- **Chamber type**: Spherical near-field anechoic chamber
- **RF absorber**: Broadband, high-performance pyramidal absorbers to suppress reflections.
- **Measurement volume**: Designed to support EUTs up to 45 CM
- **Frequency range**: 650 MHz – 10 GHz
- **Temperature and humidity**: Controlled indoor lab environment.
- **Positioning system**: full-sphere acquisition with sub-degree angular resolution spherical ring.

See Page 8 to Page 10 of antenna report.

Composite Gain Calculation

Band	Phiº	Thetaº	Ant0	Ant1	Ant2	Ant3	Calculated Correlated Directional Gain
2.4G	30	-69	-4.34675	3.496415	-5.49365	2.500625	5.9
NII-1	84	-84	-4.29407	3.82937	-7.68709	2.82236	5.9
NII-2A	99	-105	-5.03366	2.910477	-7.67848	3.684453	5.8
NII-2C	99	-105	-4.91752	2.983267	-4.6817	1.956102	5.6
NII-3	15	-81	-0.77075	1.706377	-7.54681	1.546225	5.5

Step 1) For each antenna, measure the Theta / Phi radiation pattern.
Step 2) At each Theta / Phi coordinate, calculate the sum of all the antenna gains for Ant0+1+2+3 using the appropriate correlated formula for directional gain from KDB 662911 D01.
Step 3) The Table shows the Maximum direction gain calculated based on all the measurement coordinates of the 4x4 antenna system.

Refer to Section C of the KDB Airgain Submision ABCD RevB annex.

Antennas Composite Gain – Dual Band Wi-Fi Antennas

Airgain

Ant0+Ant1+Ant2+Ant3

Freq (MHz)	Correlated Composite Gain	
	Phi (dBi)	Theta (dBi)
2400	4.1	5.6
2410	4.3	5.8
2420	4.0	5.8
2430	3.8	5.9
2440	3.5	5.6
2450	3.7	5.2
2460	3.9	5.0
2470	3.9	4.9
2480	3.8	5.1
2490	3.7	5.2

Maximum directional gain frequency at 2430MHz

$$\text{Directional } Gain = 10\log\left(\frac{(10^{-4.34675/20}+10^{3.496415/20}+10^{-5.49365/20}+10^{2.500625/20})^2}{4}\right)$$

Gain	Phi°	Theta°
5.9	30	-69

Antennas Composite Gain – Dual Band Wi-Fi Antennas

Airgain

Ant0+Ant1+Ant2+Ant3

Freq (MHz)	Correlated Composite Gain	
	Phi (dBi)	Theta (dBi)
5150	2.8	5.9
5200	2.9	5.8
5300	4.0	5.8
5400	4.4	5.9
5500	3.9	5.6
5600	3.2	5.4
5700	3.8	5.5
5800	3.8	5.5
5850	4.1	5.3

Maximum directional gain frequency at 5150MHz

$$\text{Directional Gain} = 10\log\left(\frac{(10^{-4.29407/20}+10^{3.82937/20}+10^{-7.68709/20}+10^{2.82236/20})^2}{4}\right)$$

Gain	Phi°	Theta°
5.9	84	-84

Antennas Composite Gain – 6 GHz Wi-Fi Antennas

Airgain

Ant0+Ant1+Ant2+Ant3

Freq (MHz)	Correlated Composite Gain	
	Phi (dBi)	Theta (dBi)
5925	3.8	5.5
6000	4.4	5.9
6100	2.9	5.8
6200	3.9	5.6
6300	2.8	5.9
6400	4.1	5.6
6500	3.8	5.9
6600	4.3	5.9
6700	4.1	5.6
6800	4.0	5.8
6900	4.0	5.8
7125	4.0	5.6

Maximum directional gain frequency at 6300MHz

$$\text{Directional } Gain = 10\log\left(\frac{(10^{-3.89511/20}+10^{1.804439/20}+10^{0.016058/20}+10^{0.615835/20})^2}{4}\right)$$

Gain	Phi°	Theta°
5.9	99	81