



# ANTENNA TEST REPORT

## Test Report No. 15816280H

<b>Customer</b>	Panasonic Corporation of North America
<b>Description of EUT</b>	BLE UNIT
<b>Model Number of EUT</b>	HU500030C
<b>Issue Date</b>	June 6, 2025
<b>Remarks</b>	-

<b>Representative test engineer</b>	<b>Approved by</b>
	
Tetsuro Yoshida Engineer	Shinichi Miyazono Leader

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- For test report(s) referred in this report, the latest version (including any revisions) is always referred.

## **REVISION HISTORY**

Revision	Test Report No.	Date	Page Revised Contents
- (Original)	15816280H	June 6, 2025	-

**Reference: Abbreviations (Including words undescribed in this report)**

A2LA	The American Association for Laboratory Accreditation	ICES	Interference-Causing Equipment Standard
AC	Alternating Current	IEC	International Electrotechnical Commission
AFH	Adaptive Frequency Hopping	IEEE	Institute of Electrical and Electronics Engineers
AM	Amplitude Modulation	IF	Intermediate Frequency
Amp, AMP	Amplifier	ILAC	International Laboratory Accreditation Conference
ANSI	American National Standards Institute	ISED	Innovation, Science and Economic Development Canada
Ant, ANT	Antenna	ISO	International Organization for Standardization
AP	Access Point	JAB	Japan Accreditation Board
ASK	Amplitude Shift Keying	LAN	Local Area Network
Atten., ATT	Attenuator	LIMS	Laboratory Information Management System
AV	Average	MCS	Modulation and Coding Scheme
BPSK	Binary Phase-Shift Keying	MRA	Mutual Recognition Arrangement
BR	Bluetooth Basic Rate	N/A	Not Applicable
BT	Bluetooth	NIST	National Institute of Standards and Technology
BT LE	Bluetooth Low Energy	NS	No signal detect.
BW	BandWidth	NSA	Normalized Site Attenuation
Cal Int	Calibration Interval	NVLAP	National Voluntary Laboratory Accreditation Program
CCK	Complementary Code Keying	OBW	Occupied Band Width
Ch., CH	Channel	OFDM	Orthogonal Frequency Division Multiplexing
CISPR	Comite International Special des Perturbations Radioelectriques	P/M	Power meter
CW	Continuous Wave	PCB	Printed Circuit Board
DBPSK	Differential BPSK	PER	Packet Error Rate
DC	Direct Current	PHY	Physical Layer
D-factor	Distance factor	PK	Peak
DFS	Dynamic Frequency Selection	PN	Pseudo random Noise
DQPSK	Differential QPSK	PRBS	Pseudo-Random Bit Sequence
DSSS	Direct Sequence Spread Spectrum	PSD	Power Spectral Density
EDR	Enhanced Data Rate	QAM	Quadrature Amplitude Modulation
EIRP, e.i.r.p.	Equivalent Isotropically Radiated Power	QP	Quasi-Peak
EMC	ElectroMagnetic Compatibility	QPSK	Quadri-Phase Shift Keying
EMI	ElectroMagnetic Interference	RBW	Resolution Band Width
EN	European Norm	RDS	Radio Data System
ERP, e.r.p.	Effective Radiated Power	RE	Radio Equipment
EU	European Union	RF	Radio Frequency
EUT	Equipment Under Test	RMS	Root Mean Square
Fac.	Factor	RSS	Radio Standards Specifications
FCC	Federal Communications Commission	Rx	Receiving
FHSS	Frequency Hopping Spread Spectrum	SA, S/A	Spectrum Analyzer
FM	Frequency Modulation	SG	Signal Generator
Freq.	Frequency	SVSWR	Site-Voltage Standing Wave Ratio
FSK	Frequency Shift Keying	TR	Test Receiver
GFSK	Gaussian Frequency-Shift Keying	Tx	Transmitting
GNSS	Global Navigation Satellite System	VBW	Video BandWidth
GPS	Global Positioning System	Vert.	Vertical
Hori.	Horizontal	WLAN	Wireless LAN

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## **SECTION 1: Customer Information**

Company Name	Panasonic Corporation of North America
Address	Two Riverfront Plaza, Newark, New Jersey, 07102-5490, USA
Telephone Number	+1-201-348-7760
Contact Person	Ben Botros

The information provided by the customer is as follows;

- Customer, Description of EUT, Model Number of EUT on the cover and other relevant pages
- Operating/Test Mode(s) (Mode(s)) on all the relevant pages
- SECTION 1: Customer Information
- SECTION 2: Equipment Under Test (EUT) other than the Receipt Date and Test Date
- SECTION 4: Operation of EUT during testing

## **SECTION 2: Equipment Under Test (EUT)**

### **Identification of EUT**

Description	BLE UNIT
Manufacturer	Panasonic Automotive Systems Co., Ltd.
Model Number	HU500030C
Serial Number	1S No300, 1S No302, 1S No313
Frequency of Operation	2402 MHz to 2480 MHz
Receipt Date	May 21 and 22, 2025
Test Date	May 22 and 23, 2025
Antenna Type	Pattern Antenna

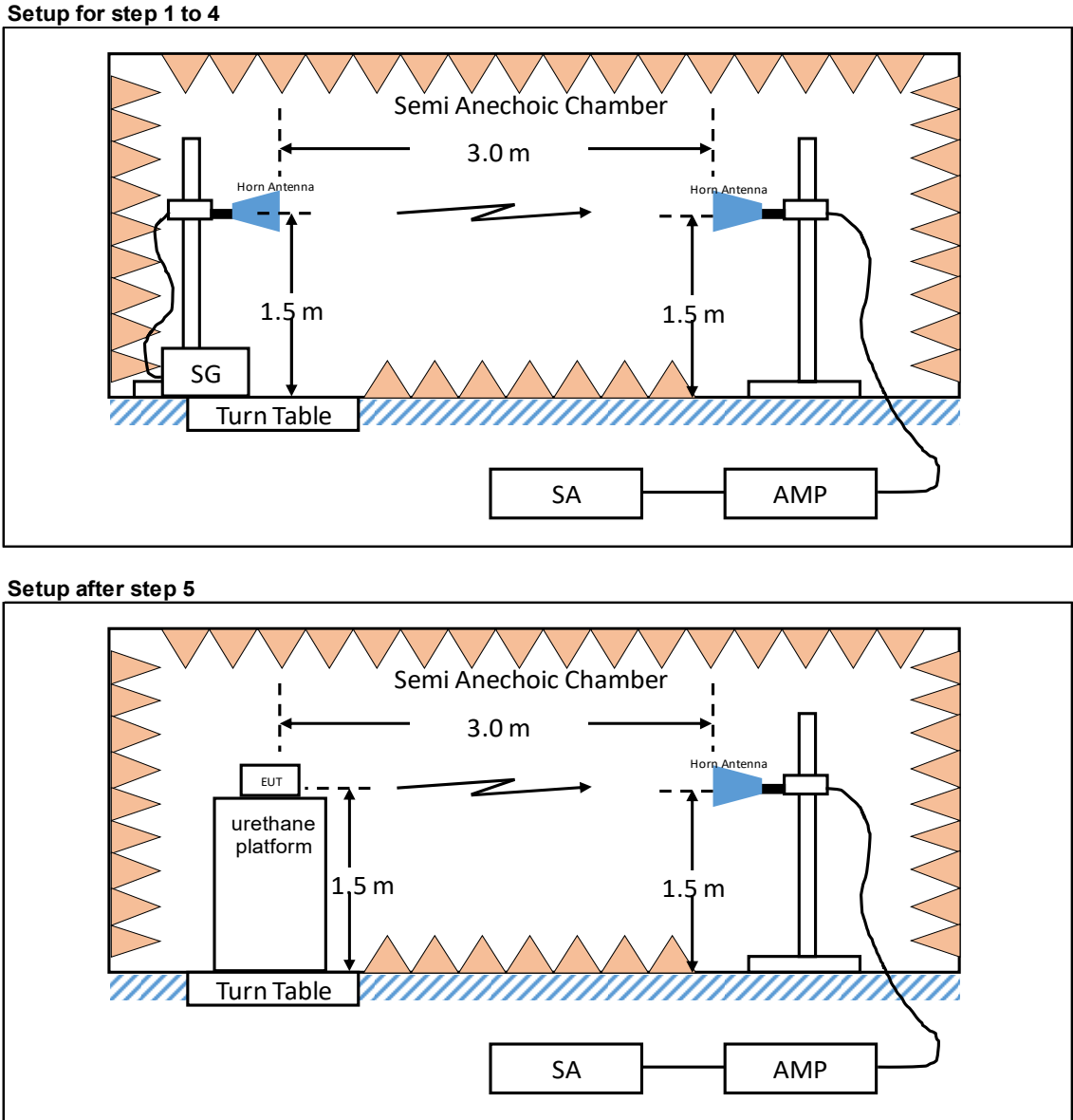
For the shape of the antenna is refer to Internal Photo.

## **SECTION 3: Test Procedures**

### **3.1 Test Procedures for Antenna Pattern and Gain**

Test configuration	EUT was placed on a platform of nominal size, 0.5 m by 0.5 m, raised 1.5 m above the conducting ground plane. The measurements were performed for both vertical and horizontal antenna polarization with the Spectrum Analyzer. The setup are shown in Figure 1.
Test procedure	<p>Step 1 The tests have been measured in semi anechoic chamber at the distance of 3 m between the Substitution Antenna and the measuring Antenna, both Antennas were placed for the height 1.5 m. The Substitution Antenna has been connected to the Signal Generator.</p> <p>Step 2 The output power of the Signal Generator was setting value calculated by compensating the finite difference in the Antenna gain of Substitution Antenna.</p> <p>Step 3 The electric field strength at the distance of 3 m is received via the measurement antenna, and the reference value at that time is measured with a spectrum analyzer.</p> <p>Step 4 The measurements were performed for both vertical and horizontal antenna polarization.</p> <p>Step 5 Exchanged the Substitution Antenna to the EUT.</p> <p>Step 6 The EUT was rotated a full revolution and recorded the electric field strength for each degree.</p> <p>Step 7 Calculate and record the difference from the value recorded in Step 6 to the value recorded in Step 3.</p> <p>Step 8 The measurement in steps 5 to 7 repeated with both vertical and horizontal antenna polarization, each position of XY, YZ and ZX-plane of EUT.</p> <p>Step 9 Then the results of Step 8 were recorded.</p> <p>Step 10 Calculate the difference between step 9 and the Output Power of EUT, and recorded the calculated results.</p>

Figure 1: Test Setup



SG: Signal Generator  
SA: Spectrum Analyzer  
AMP: Pre Amplifier

3.2 Test Procedures for Conducted Output Power

Conducted Output Power was measured with a Power Meter (peak detect).  
The test data is reference data for Antenna Pattern and Gain test.

### 3.3 Test Location

UL Japan, Inc. Ise EMC Lab.  
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 Japan  
Telephone: +81-596-24-8999

\*A2LA Certificate Number: 5107.02 / FCC Test Firm Registration Number: 884919

ISED Lab Company Number: 2973C / CAB identifier: JP0002

Test site	Width x Depth x Height (m)	Size of reference ground plane (m) / horizontal conducting plane	Other rooms	Maximum measurement distance
No.1 semi-anechoic chamber	19.2 x 11.2 x 7.7	7.0 x 6.0	No.1 Power source room	10 m
No.2 semi-anechoic chamber	7.5 x 5.8 x 5.2	4.0 x 4.0	-	3 m
No.3 semi-anechoic chamber	12.0 x 8.5 x 5.9	6.8 x 5.75	No.3 Preparation room	3 m
No.3 shielded room	4.0 x 6.0 x 2.7	N/A	-	-
No.4 semi-anechoic chamber	12.0 x 8.5 x 5.9	6.8 x 5.75	No.4 Preparation room	3 m
No.4 shielded room	4.0 x 6.0 x 2.7	N/A	-	-
No.5 semi-anechoic chamber	6.0 x 6.0 x 3.9	6.0 x 6.0	-	-
No.5 measurement room	6.4 x 6.4 x 3.0	6.4 x 6.4	-	-
No.6 shielded room	4.0 x 4.5 x 2.7	4.0 x 4.5	-	-
No.6 measurement room	4.75 x 5.4 x 3.0	4.75 x 4.15	-	-
No.7 shielded room	4.7 x 7.5 x 2.7	4.7 x 7.5	-	-
No.8 measurement room	3.1 x 5.0 x 2.7	3.1 x 5.0	-	-
No.9 measurement room	8.8 x 4.6 x 2.8	2.4 x 2.4	-	-
No.10 shielded room	3.8 x 2.8 x 2.8	3.8 x 2.8	-	-
No.11 measurement room	4.0 x 3.4 x 2.5	N/A	-	-
No.12 measurement room	2.6 x 3.4 x 2.5	N/A	-	-
Large Chamber	16.9 x 22.1 x 10.17	16.9 x 22.1	-	10 m
Small Chamber	5.3 x 6.69 x 3.59	5.3 x 6.69	-	-

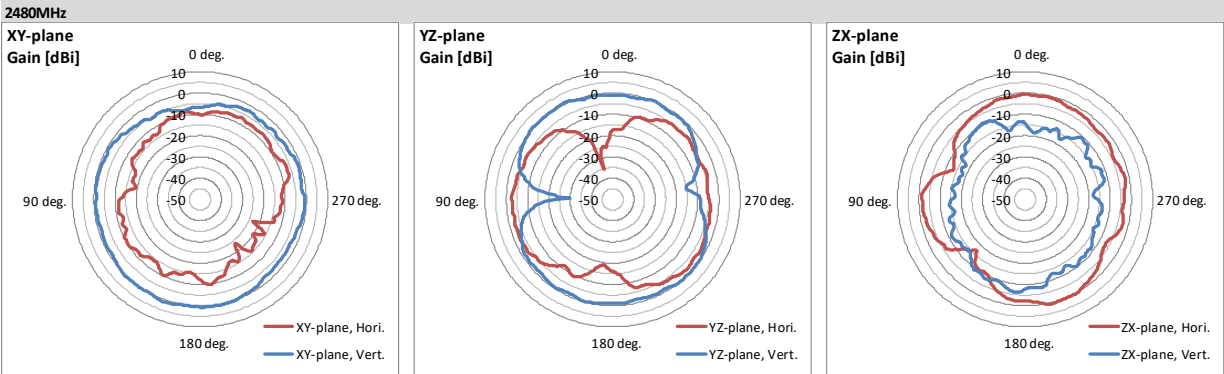
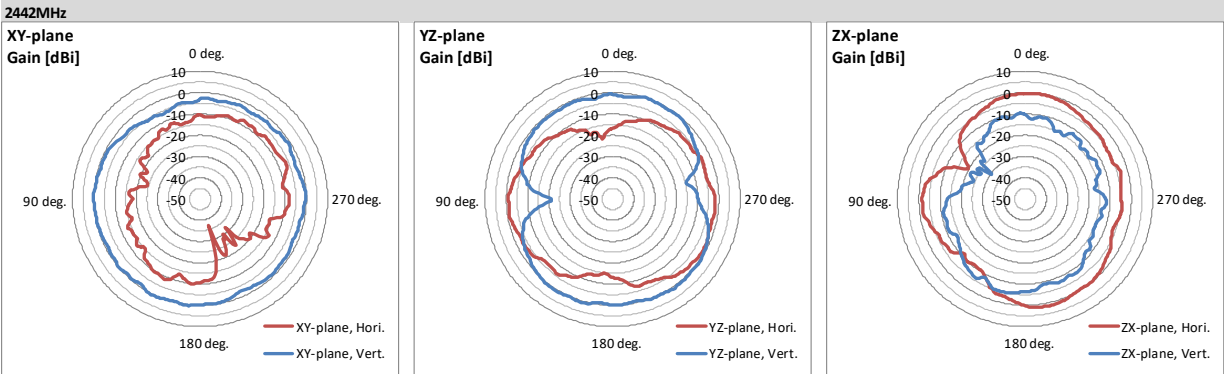
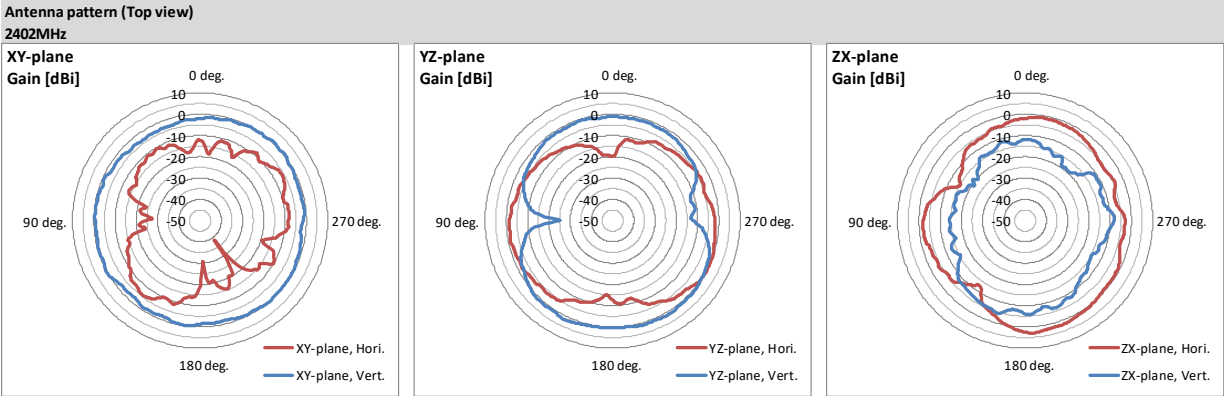
### 3.4 Test Data, Test Instruments, and Test Set Up

Refer to APPENDIX.

**APPENDIX 1: Test Data**

**Antenna Pattern and Gain**

Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.3
Date	May 22, 2025
Temperature / Humidity	20 deg. C / 60 % RH
Engineer	Tetsuro Yoshida
Mode	1S No300



Antenna gain [UNIT: dBi]				
Peak				
Frequency [MHz]	2402.0	2442.0	2480.0	
Peak gain	2.9	1.6	1.2	
Average (Average true value for every 1 degree angle)				
Frequency [MHz]	2402.0	2442.0	2480.0	
XY-plane	Hori.	-11.4	-11.7	-11.0
	Vert.	-1.1	-1.5	-1.6
	Avg (H/V)	-3.7	-4.1	-4.1
YZ-plane	Hori.	-4.5	-5.2	-5.7
	Vert.	-1.4	-1.6	-1.7
	Avg (H/V)	-2.7	-3.0	-3.3
ZX-plane	Hori.	-2.4	-2.9	-3.1
	Vert.	-10.7	-10.7	-12.0
	Avg (H/V)	-4.8	-5.2	-5.6
Total		-3.7	-4.0	-4.2

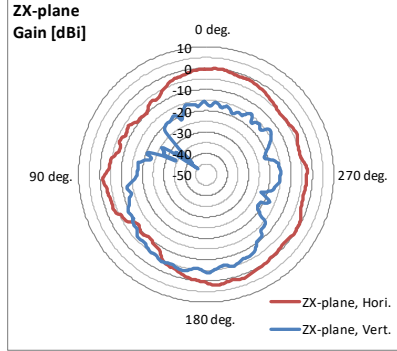
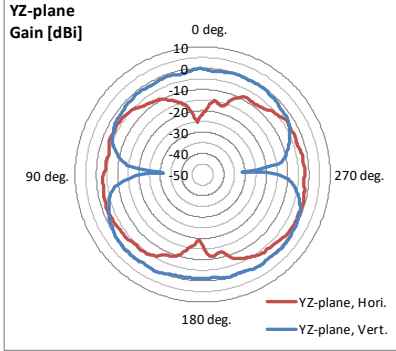
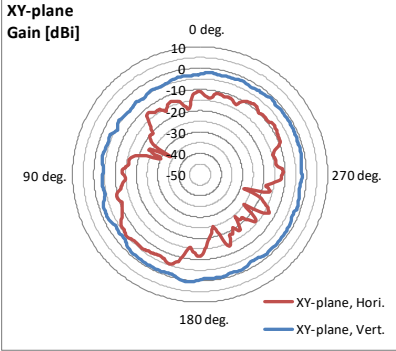
Hori. indicates the results received with horizontal polarization.  
Vert. indicates the results received with vertical polarization.

**Antenna Pattern and Gain**

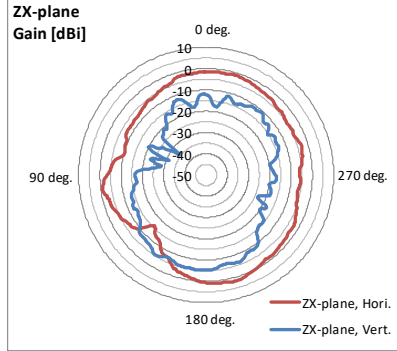
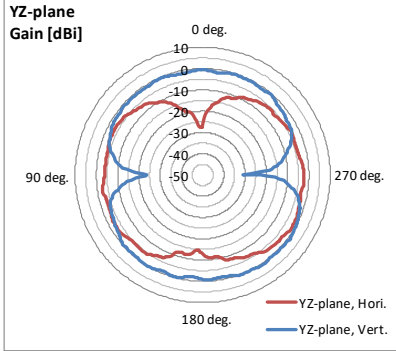
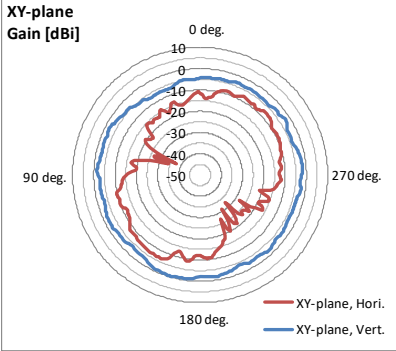
Test place Ise EMC Lab.  
Semi Anechoic Chamber No.3  
Date May 23, 2025  
Temperature / Humidity 21 deg. C / 59 % RH  
Engineer Tetsuro Yoshida  
Mode 1S No302

Antenna pattern (Top view)

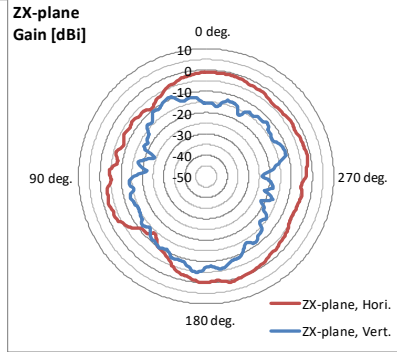
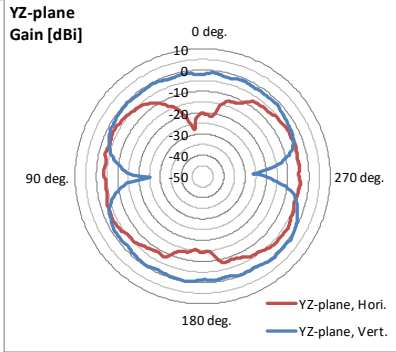
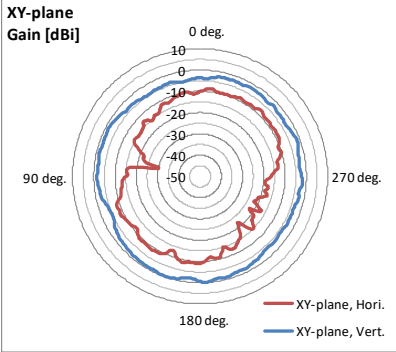
2402MHz



2442MHz



2480MHz



Antenna gain [UNIT: dBi]

Peak			
Frequency [MHz]	2402.0	2442.0	2480.0
Peak gain	2.3	1.9	1.0

Average (Average true value for every 1 degree angle)				
Frequency [MHz]	2402.0	2442.0	2480.0	
XY-plane	Hori.	-11.3	-11.6	-11.4
	Vert.	-2.2	-2.9	-2.4
	Avg (H/V)	-4.7	-5.4	-4.9
YZ-plane	Hori.	-4.8	-5.2	-6.0
	Vert.	-1.6	-1.7	-1.9
	Avg (H/V)	-2.9	-3.1	-3.5
ZX-plane	Hori.	-2.4	-3.0	-3.2
	Vert.	-10.4	-11.1	-12.0
	Avg (H/V)	-4.8	-5.4	-5.7
Total		-4.0	-4.5	-4.6

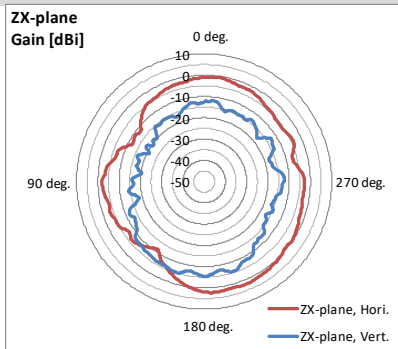
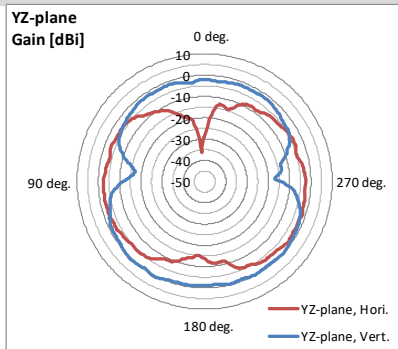
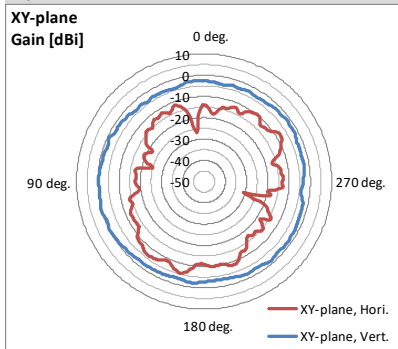
Hori. indicates the results received with horizontal polarization,  
Vert. indicates the results received with vertical polarization.

## Antenna Pattern and Gain

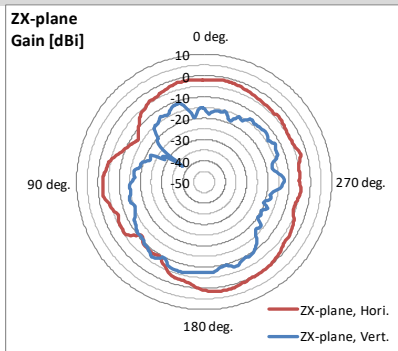
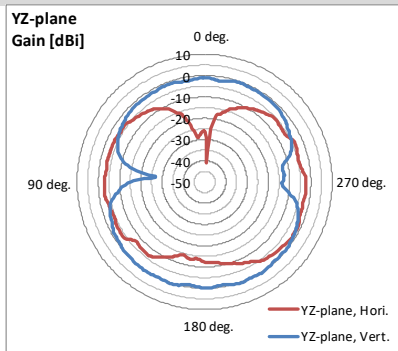
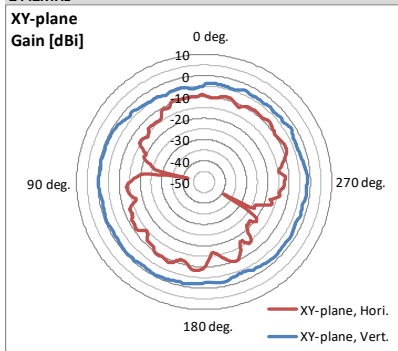
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.3
Date	May 22, 2025
Temperature / Humidity	20 deg. C / 60 % RH
Engineer	Tetsuro Yoshida
Mode	1S No313

**Antenna pattern (Top view)**

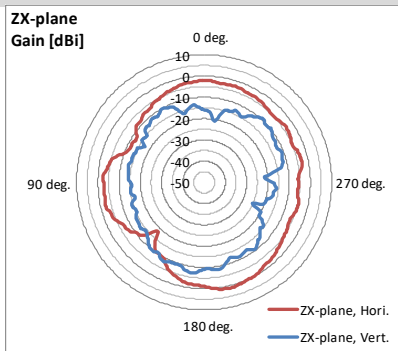
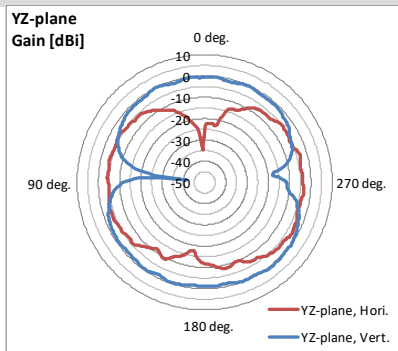
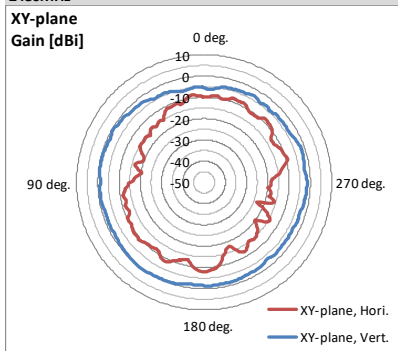
**2402MHz**



**2442MHz**



**2480MHz**



**Antenna gain [UNIT: dBi]**

Peak			
Frequency [MHz]	2402.0	2442.0	2480.0
Peak gain	2.4	1.9	1.2

Average (Average true value for every 1 degree angle)					
Frequency [MHz]	2402.0	2442.0	2480.0		
XY-plane	Hori.	-11.9	-11.7	-11.7	
	Vert.	-2.1	-2.2	-2.0	
	Avg (H/V)	-4.7	-4.7	-4.6	
YZ-plane	Hori.	-5.2	-5.5	-6.3	
	Vert.	-2.3	-1.9	-1.9	
	Avg (H/V)	-3.5	-3.4	-3.5	
ZX-plane	Hori.	-2.3	-2.9	-3.7	
	Vert.	-11.1	-12.1	-12.3	
	Avg (H/V)	-4.8	-5.4	-6.1	
Total		-4.3	-4.4	-4.6	

Hori. indicates the results received with horizontal polarization,  
Vert. indicates the results received with vertical polarization.



## APPENDIX 2: Test Instruments

### Test Equipment

Test Item	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Cal Int
APG	141809	Power Meter	Anritsu Corporation	ML2495A	825002	2025/05/15	12
APG	141830	Power sensor	Anritsu Corporation	MA2411B	738285	2025/05/15	12
APG	141334	Attenuator(10dB)	Suhner	6810.19.A	-	2024/12/02	12
APG	142013	AC3_Semi Anechoic Chamber(SVSWR)	TDK	Semi Anechoic Chamber 3m	DA-10005	2025/04/14	24
APG	244709	Thermo-Hygrometer	HIOKI E. E. CORPORATION	LR5001	231202103	2025/01/19	12
APG	141532	DIGITAL HiTESTER	HIOKI E. E. CORPORATION	3805	051201197	2025/01/16	12
APG	142183	Measure	KOMELON	KMC-36	-	2024/10/21	12
APG	141978	Spectrum Analyzer	Keysight Technologies Inc	E4448A	MY46180899	2024/05/09*1)	12
APG	199016	Microwave Cable	Junkosha	MWX221-01000AMSDMS	2004S560	2024/10/25	12
APG	141580	MicroWave System Amplifier	Keysight Technologies Inc	83017A	MY39500779	2025/03/24	12
APG	246002	Microwave Cable	Huber+Suhner	SF103/11PC35/11P C35/1000mm / SF126E/5000mm	800674(1m) / 610205(5m)	2025/03/18	12
APG	199015	Microwave Cable	Junkosha	MWX221-05000AMSDMS	2004S559	2024/10/25	12
APG	141507	Horn Antenna 1-18GHz	Schwarzbeck Mess-Elektronik OHG	BBHA9120D	258	2024/11/11	12
APG	141514	Horn Antenna 1-18GHz	Schwarzbeck Mess-Elektronik OHG	BBHA9120D	01611	2024/06/25	12
APG	197220	Microwave cable	Huber+Suhner	SF126E/11PC35/11PC35/2000MM	537003/126E	2025/03/18	12
APG	141897	Signal Generator	Keysight Technologies Inc	N5182B	MY56200024	2025/01/24	12

\*Hyphens for Last Calibration Date and Cal Int (month) are instruments that Calibration is not required (e.g. software), or instruments checked in advance before use.

The expiration date of the calibration is the end of the expired month.

As for some calibrations performed after the tested dates, those test equipment have been controlled by means of an unbroken chains of calibrations.

All equipment is calibrated with valid calibrations. Each measurement data is traceable to the national or international standards.

Test item:

APG: Antenna Pattern and Gain