Testing Laboratory 3787

RADIO TEST REPORT

FCC ID	:	2ABLK-GPR2022XX
Equipment	:	GigaPro p6dx, GigaPro p6lx
Brand Name	:	Calix
Model Name	:	p6dx GPR2022H, p6lx GPR2022LH
Applicant	:	Calix Inc. 1035 N. McDowell Blvd. Petaluma, CA94954 U.S.A.
Standard	:	47 CFR FCC Part 15.247

The product was received on Jan. 22, 2024, and testing was started from Jan. 22, 2024 and completed on Jul. 29, 2024. We, Sporton International Inc. Hsinchu Laboratory, would like to declare that the tested sample has been evaluated in accordance with the procedures given in ANSI C63.10-2013 and shown compliance with the applicable technical standards.

The test results in this variant report apply exclusively to the tested model / sample. Without written approval of Sporton International Inc. Hsinchu Laboratory, the test report shall not be reproduced except in full.

Approved by: Sam Chen

Sporton International Inc. Hsinchu Laboratory
No.8, Ln. 724, Bo'ai St., Zhubei City, Hsinchu County 302010, Taiwan (R.O.C.)

Table of Contents

History of this test report

Report No.	Version	Description	Issued Date
FR430430-01AA	01	Initial issue of report	Sep. 04, 2024

Summary of Test Result

Report Clause	Ref Std. Clause	Test Items	Result (PASS/FAIL)	Remark
1.1.2	15.203	Antenna Requirement	PASS	-
3.1	15.207	AC Power-line Conducted Emissions	PASS	-
3.2	15.247(d)	Emissions in Restricted Frequency Bands	PASS	-

Conformity Assessment Condition:

1. The test results (PASS/FAIL) with all measurement uncertainty excluded are presented against the regulation limits or in accordance with the requirements stipulated by the applicant/manufacturer who shall bear all the risks of non-compliance that may potentially occur if measurement uncertainty is taken into account.
2. The measurement uncertainty please refer to each test result in the chapter "Measurement Uncertainty".

Disclaimer:

The product specifications of the EUT presented in the test report that may affect the test assessments are declared by the manufacturer who shall take full responsibility for the authenticity.

Reviewed by: Sam Chen
Report Producer: Cathy Chiu

1 General Description

1.1 Information

1.1.1 RF General Information

Frequency Range (MHz)	IEEE Std. 802.11	Ch. Frequency (MHz)	Channel Number
2400-2483.5	b, g, n (HT20), VHT20, ax (HEW20)	2412-2462	1-11 [11]
2400-2483.5	n (HT40), VHT40, ax (HEW40)	2422-2452	3-9 [7]

Band	Mode	BWch (MHz)	Nant
2.4-2.4835GHz	802.11b	20	2TX
2.4-2.4835GHz	802.11g	20	2TX
2.4-2.4835GHz	802.11n HT20	20	2TX
2.4-2.4835GHz	802.11n HT20-BF	20	2TX
2.4-2.4835GHz	VHT20	20	2TX
2.4-2.4835GHz	VHT20-BF	20	2TX
2.4-2.4835GHz	802.11ax HEW20	20	2TX
2.4-2.4835GHz	802.11ax HEW20-BF	20	2TX
2.4-2.4835GHz	802.11n HT40	40	2TX
2.4-2.4835GHz	802.11n HT40-BF	40	2TX
2.4-2.4835GHz	VHT40	40	2TX
2.4-2.4835GHz	VHT40-BF	40	2TX
2.4-2.4835GHz	802.11ax HEW40	40	2TX
2.4-2.4835GHz	802.11ax HEW40-BF	40	2TX

Note:
- 11b mode uses a combination of DSSS-DBPSK, DQPSK, CCK modulation.
- 11g, HT20 and HT40 use a combination of OFDM-BPSK, QPSK, 16QAM, 64QAM modulation.
- VHT20, VHT40 use a combination of OFDM-BPSK, QPSK, 16QAM, 64QAM, 256QAM modulation.
- HEW20, HEW40 use a combination of OFDMA-BPSK, QPSK, 16QAM, 64QAM, 256QAM, 1024QAM modulation.
- BWch is the nominal channel bandwidth.

1.1.2 Antenna Information

For EUT 1:

Ant.	Port	Brand Name	Model Name	Antenna Type	Connector	Gain (dBi)	
						2.4GHz	5GHz
1	1	HLt	6NS1293	Sector	I-PEX	-	9.10
2	2	HLt	6NS1293	Sector	I-PEX	-	9.20
3	3	HLt	6NS1293	Sector	I-PEX	-	9.20
4	4	HLt	6NS1293	Sector	I-PEX	-	9.20
5	1	HLt	6NS1293	Sector	I-PEX	8.60	-
6	2	HLt	6NS1293	Sector	I-PEX	8.60	-

For EUT 2:

Ant.	Port	Brand Name	Model Name	Antenna Type	Connector	Gain (dBi)
						LoRa
7	1	HL Tronics	P-0809-02PN	Dipole	N Type	2

Note 1: The above information was declared by manufacturer.

Note 2: Directional gain information

Type	Maximum Output Power	Power Spectral Density
Non-BF	Directional gain = Max.gain + array gain. For power measurements on IEEE 802.11 devices Array Gain = 0 dB (i.e., no array gain) for N ANT ≤ 4	$Directional Gain = 10 \cdot \log\left[\frac{\sum_{j=1}^{N_{sum}}\left[\sum_{k=1}^{N_{ANT}} g_{j,k}\right]^2}{N_{ANT}}\right]$
BF	$Directional Gain = 10 \cdot \log\left[\frac{\sum_{j=1}^{N_{sum}}\left[\sum_{k=1}^{N_{ANT}} g_{j,k}\right]^2}{N_{ANT}}\right]$	$Directional Gain = 10 \cdot \log\left[\frac{\sum_{j=1}^{N_{sum}}\left[\sum_{k=1}^{N_{ANT}} g_{j,k}\right]^2}{N_{ANT}}\right]$

Ex.

Directional Gain (NSS1) formula : $Directional Gain = 10 \cdot \log\left[\frac{\sum_{j=1}^{N_{sum}}\left[\sum_{k=1}^{N_{ANT}} g_{j,k}\right]^2}{N_{ANT}}\right]$

$NSS1(g1,1) = 10^{G1/20}$; $NSS1(g1,2) = 10^{G2/20}$; $NSS1(g1,2) = 10^{G3/20}$; $NSS1(g1,2) = 10^{G4/20}$

$gj,k = (Nss1(g1,1) + Nss1(g1,2) + Nss1(g1,3) + Nss1(g1,4))^2$

$DG = 10 \log[(Nss1(g1,1) + Nss1(g1,2) + Nss1(g1,3) + Nss1(g1,4))^2 / N_{ANT}] => 10 \log[(10^{G1/20} + 10^{G2/20} + 10^{G3/20} + 10^{G4/20})^2 / N_{ANT}]$

Where ;

2.4G G1= 8.60 dBi ;G2= 8.60 dBi

5G UNII-1 G1 = 9.10 dBi; G2 = 9.20 dBi;G3 = 9.20 dBi; G4 = 9.20 dBi

5G UNII-2A G1 = 9.10 dBi; G2 = 9.20 dBi;G3 = 9.20 dBi; G4 = 9.20 dBi

5G UNII-2C G1 = 9.10 dBi; G2 = 9.20 dBi;G3 = 9.20 dBi; G4 = 9.20 dBi

5G UNII-3 G1 = 9.10 dBi; G2 = 9.20 dBi;G3 = 9.20 dBi; G4 = 9.20 dBi

Cross-Polarized Antenna

2.4G DG = 8.60 dBi

5G UNII-1 DG = 12.21 dBi

5G UNII-2A DG = 12.21 dBi

5G UNII-2C DG = 12.21 dBi

5G UNII-3 DG = 12.21 dBi

80+80M

5G UNII-1 DG = 9.20 dBi

5G UNII-2A DG = 9.20 dBi

5G UNII-2C DG = 12.21 dBi

Note 3: **For 2.4GHz function:**

For IEEE 802.11 b/g/n/VHT/ax (2TX/2RX):

Port 1 and Port 2 can be used as transmitting/receiving antenna.

Port 1 and Port 2 could transmit/receive simultaneously.

For 5GHz function:

For IEEE 802.11 a/n/ac/ax (4TX/4RX):

Port 1~4 can be used as transmitting/receiving antenna.

Port 1~4 could transmit/receive simultaneously.

For LoRa function (1TX/1RX):

Only Port 1 can be use as transmitting antenna.

1.1.3 EUT Operational Condition

EUT Power Type	From Power Adapter or PoE			
Beamforming Function	☒	With beamforming	☐	Without beamforming
	The product has beamforming function for n/VHT/ax in 2.4GHz and n/ac/ax in 5GHz.			
Function	☒	Point-to-multipoint	☐	Point-to-point
Support RU	☒	Full RU	☐	Partial RU
Test Software Version	Others: QSPR 5.0-00202 Beamforming Mode: DOS [ver 6.1.7601]			

Note: The above information was declared by manufacturer.

1.1.4 Table for Multiple Listing

EUT	Equipment Name	Model Name	Description
1	GigaPro p6dx	p6dx GPR2022H	Without certified LoRa module
2	GigaPro p6lx	p6lx GPR2022LH	With certified LoRa module

Note 1: From the above, EUT 1 has selected to execute the AC Power-line Conducted Emissions and Emissions in Restricted Frequency Bands, and EUT 2 has selected to execute the AC Power-line Conducted Emissions and Emissions in Restricted Frequency Bands below 1GHz tests.

Note 2: The above information was declared by manufacturer.

1.1.5 Table for Permissive Change

This product is an extension of original one reported under Sporton project number: FR430430AA

Below is the table for the change of the product with respect to the original one.

Modifications	Performance Checking
1. Add the EUT 2 with a certified Lora module (Equipment Name: GigaPro p6lx / Model Name: p6lx GPR2022LH / FCC ID：2AAS9-WMDS183G2)	1. AC Power-line Conducted Emissions 2. Emissions in Restricted Frequency Bands Below 1GHz
2. Add UNII-2A and UNII-2C bands for this device through SW change. 3. Change the capacitor and inductor of 2.4GHz.	1. AC Power-line Conducted Emissions 2. Emissions in Restricted Frequency Bands (For above 1GHz, only the worst-case mode was tested.)
4. Remove the manufacturer's information on test report. (Company name: Alpha Networks Inc. / Company address: No. 8, Li-Hsin 7th Rd., Hsinchu Science Park, Hsinchu 300094, Taiwan).	After evaluating, it does not affect the test.

1.1.6 Table for EUT Supports Functions

Function
AP Router
Bridge
Extender

Note: The above information was declared by manufacturer.

1.2 Applicable Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- 47 CFR FCC Part 15.247
- ANSI C63.10-2013

The following reference test guidance is not within the scope of accreditation of TAF.

- FCC KDB 558074 D01 v05r02
- FCC KDB 662911 D01 v02r01
- FCC KDB 414788 D01 v01r01

1.3 Testing Location Information

Testing Location Information	
Test Lab.：Sporton International Inc. Hsinchu Laboratory	
Hsinchu (TAF: 3787)	ADD: No.8, Ln. 724, Bo'ai St., Zhubei City, Hsinchu County 302010, Taiwan (R.O.C.) TEL: 886-3-656-9065 FAX: 886-3-656-9085 Test site Designation No. TW3787 with FCC. Conformity Assessment Body Identifier (CABID) TW3787 with ISED.

Test Condition	Test Site No.	Test Engineer	Test Environment (°C / %)	Test Date
Radiated Below 1G	03CH05-CB	Gordon Hung	22.3-23.2 / 55-58	Jan. 22, 2024~ Jul. 22, 2024
Radiated Above 1G	03CH03-CB		21.6-22.7 / 56-59	
AC Conduction	CO01-CB	Ryan Huang	22~23 / 58~60	Jul. 29, 2024

1.4 Measurement Uncertainty

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level (based on a coverage factor (k=2)

Test Date: Date Before May 28, 2024

Test Items	Uncertainty	Remark
Radiated Emission (9kHz ~ 30MHz)	3.7 dB	Confidence levels of 95%
Radiated Emission (30MHz ~ 1,000MHz)	5.1 dB	Confidence levels of 95%
Radiated Emission (1GHz ~ 18GHz)	4.1 dB	Confidence levels of 95%
Radiated Emission (18GHz ~ 40GHz)	4.2 dB	Confidence levels of 95%

Test Date: Date After May 27, 2024

Test Items	Uncertainty	Remark
Conducted Emission (150kHz ~ 30MHz)	3.8 dB	Confidence levels of 95%
Radiated Emission (9kHz ~ 30MHz)	4.1 dB	Confidence levels of 95%
Radiated Emission (30MHz ~ 1,000MHz)	4.2 dB	Confidence levels of 95%
Radiated Emission (1GHz ~ 18GHz)	4.2 dB	Confidence levels of 95%
Radiated Emission (18GHz ~ 40GHz)	4.0 dB	Confidence levels of 95%

2 Test Configuration of EUT

2.1 The Worst Case Measurement Configuration

The Worst Case Mode for Following Conformance Tests	
Tests Item	AC power-line conducted emissions
Condition	AC power-line conducted measurement for line and neutral Test Voltage: 120Vac / 60Hz
Operating Mode	CTX
1	EUT 1_WLAN 2.4GHz + Adapter
2	EUT 1_WLAN 2.4GHz + PoE
Mode 1 has been evaluated to be the worst case among Mode 1~2, thus measurement for Mode 3 will follow this same test mode.	
3	EUT 1_WLAN 5GHz + Adapter
Mode 1 has been evaluated to be the worst case among Mode 1~3, thus measurement for Mode 4 will follow this same test mode.	
4	EUT 2_WLAN 5GHz + Adapter
For operating mode 4 is the worst case and it was record in this test report.	

The Worst Case Mode for Following Conformance Tests	
Tests Item	Emissions in Restricted Frequency Bands
Test Condition	Radiated measurement If EUT consist of multiple antenna assembly (multiple antenna are used in EUT regardless of spatial multiplexing MIMO configuration), the radiated test should be performed with highest antenna gain of each antenna type.
Operating Mode < 1GHz	CTX
	After evaluating, EUT in Y axis was the worst case, so the measurement will follow this same test configuration.
1	EUT 1 in Y axis_WLAN 2.4GHz + Adapter
2	EUT 1 in Y axis_WLAN 2.4GHz + PoE
Mode 1 has been evaluated to be the worst case among Mode 1~2, thus measurement for Mode 3 will follow this same test mode.	
3	EUT 1 in Y axis_WLAN 5GHz + Adapter
Mode 1 has been evaluated to be the worst case among Mode 1~3, thus measurement for Mode 4 will follow this same test mode.	
4	EUT 2 in Y axis_WLAN 2.4GHz + Adapter
For operating mode 1 is the worst case and it was record in this test report.	

Operating Mode > 1GHz	CTX
	After evaluating, EUT in Y axis was the worst case, so the measurement will follow this same test configuration.
1	EUT 1 in Y axis (For above 1GHz, only the worst-case mode was tested.)

The Worst Case Mode for Following Conformance Tests	
Tests Item	Simultaneous Transmission Analysis - Co-location RF Exposure Evaluation
Operating Mode	
1	EUT 1_WLAN 2.4GHz + WLAN 5GHz
2	EUT 2_WLAN 2.4GHz + WLAN 5GHz + LoRa
Refer to Sporton Test Report No.: FA430430-01 for Co-location RF Exposure Evaluation.	

Note 1: The PoE and Adapter are for measurement only, would not be marketed.
The PoE and Adapter information as below:

Power	Brand	Model
PoE	DELTA	ADH-90AR B
Adapter	Amigo	AMS157-1203000F3U

2.2 EUT Operation during Test

non-beamforming mode:

The EUT was programmed to be in continuously transmitting mode.

beamforming mode:

During the test, the following programs under WIN 7 were executed.
The program was executed as follows:
1. During the test, the EUT operation to normal function.
2. Executed command fixed test channel under DOS.
3. Executed "Lantest.exe" to link with the remote workstation to transmit and receive packet by Client and transmit duty cycle no less than 98%.

2.3 Accessories

Accessories
Wall-mounted rack*1
Sealing Collar 1*1
Sealing Collar 2*1

2.4 Support Equipment

For AC Conduction:

Support Equipment				
No.	**Equipment**	**Brand Name**	**Model Name**	**FCC ID**
A	LAN NB	DELL	E6430	N/A
B	GONP SFP	Calix	100-05950	N/A
C	Adapter	Amigo	AMS157-1203000F3U	N/A

For Radiated (below 1GHz) and Radiated (above 1GHz) <Non-beamforming mode>:

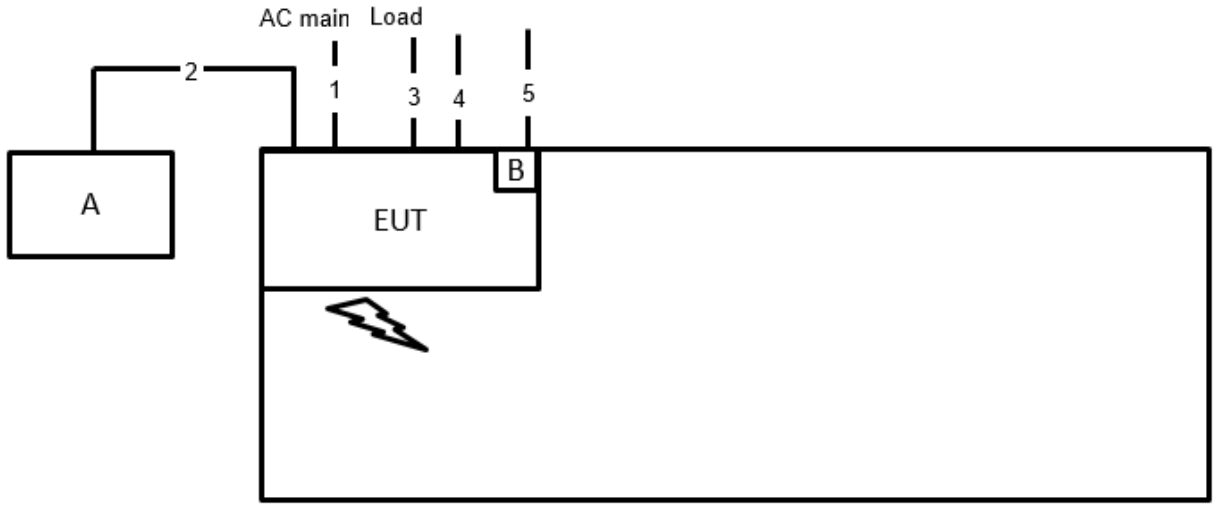
Support Equipment				
No.	**Equipment**	**Brand Name**	**Model Name**	**FCC ID**
A	NB	DELL	E4300	N/A
D	Adapter	Amigo	AMS157-1203000F3U	N/A

For Radiated (above 1GHz) <Beamforming mode>:

Support Equipment				
No.	**Equipment**	**Brand Name**	**Model Name**	**FCC ID**
A	NB	DELL	E4300	N/A
B	Client	Alpha	WAP-AX13	N/A
C	NB	DELL	E4300	N/A
D	Adapter	Amigo	AMS157-1203000F3U	N/A

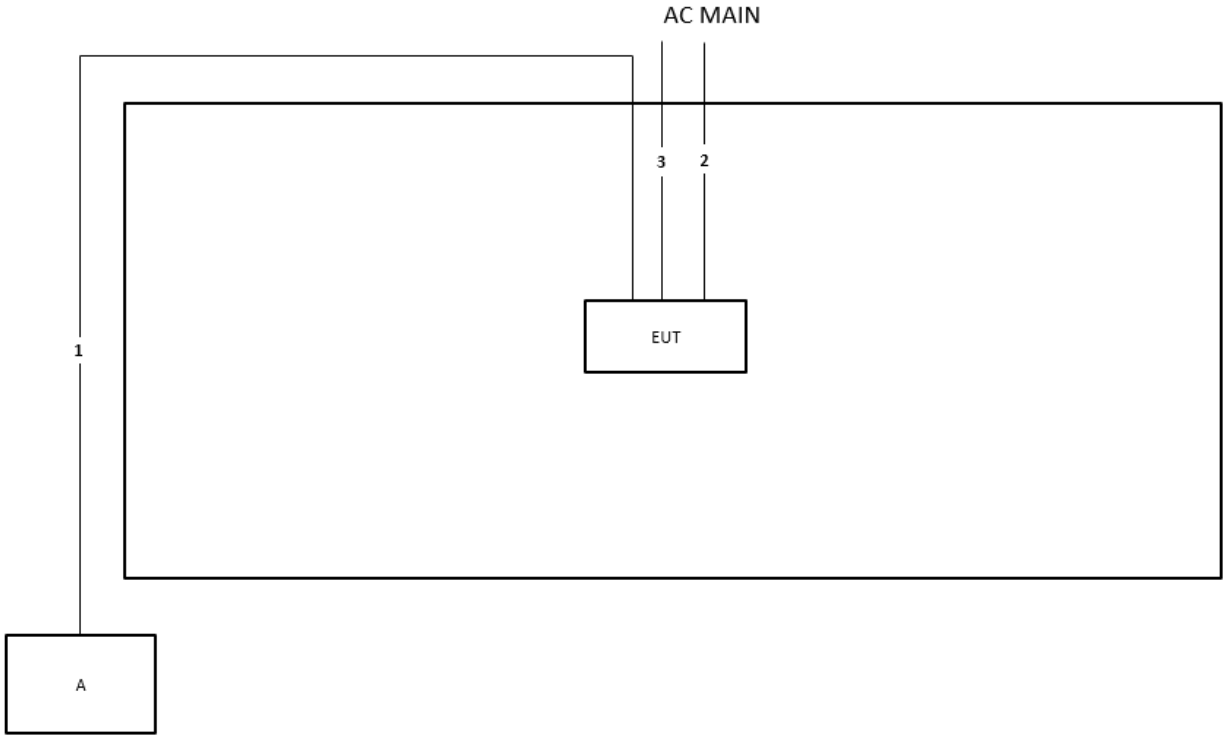
2.5 Test Setup Diagram

Test Setup Diagram – AC Line Conducted Emission Test



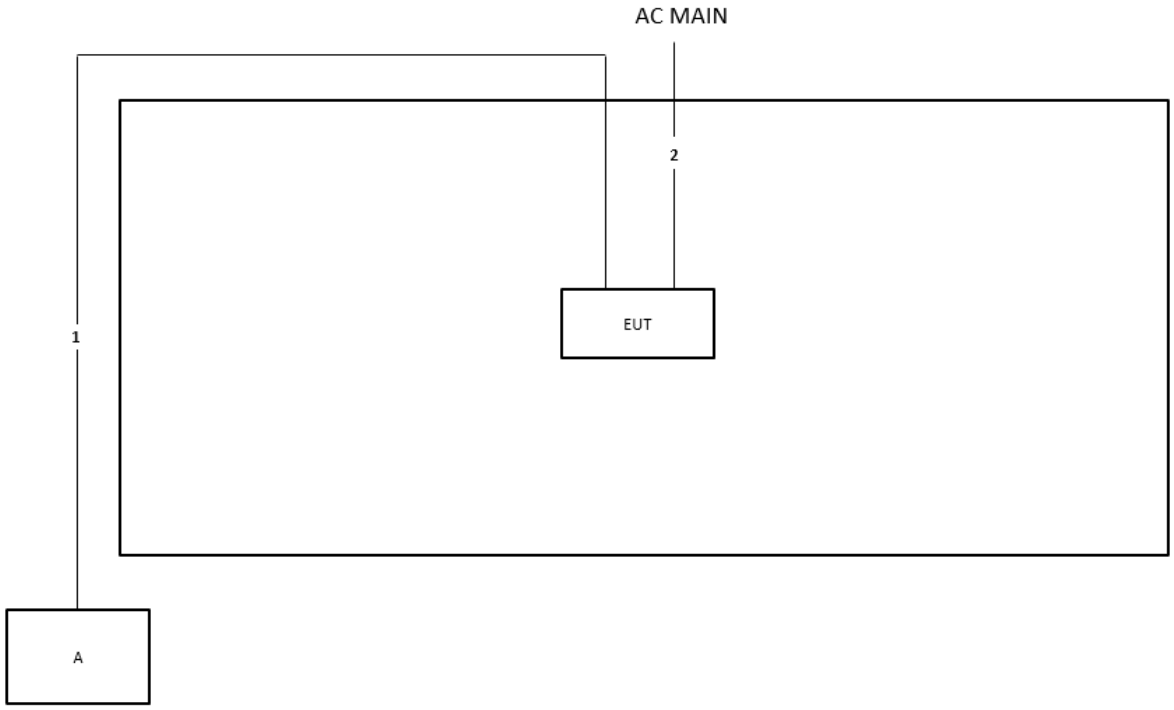
Item	Connection	Shielded	Length
1	Power cable	No	4.6m
2	RJ-45 cable	No	10m
3	RJ-45 cable	No	1.5m
4	GND cable	No	1.5m
5	Fiber cable	No	3m

Test Setup Diagram - Radiated Test < 1GHz



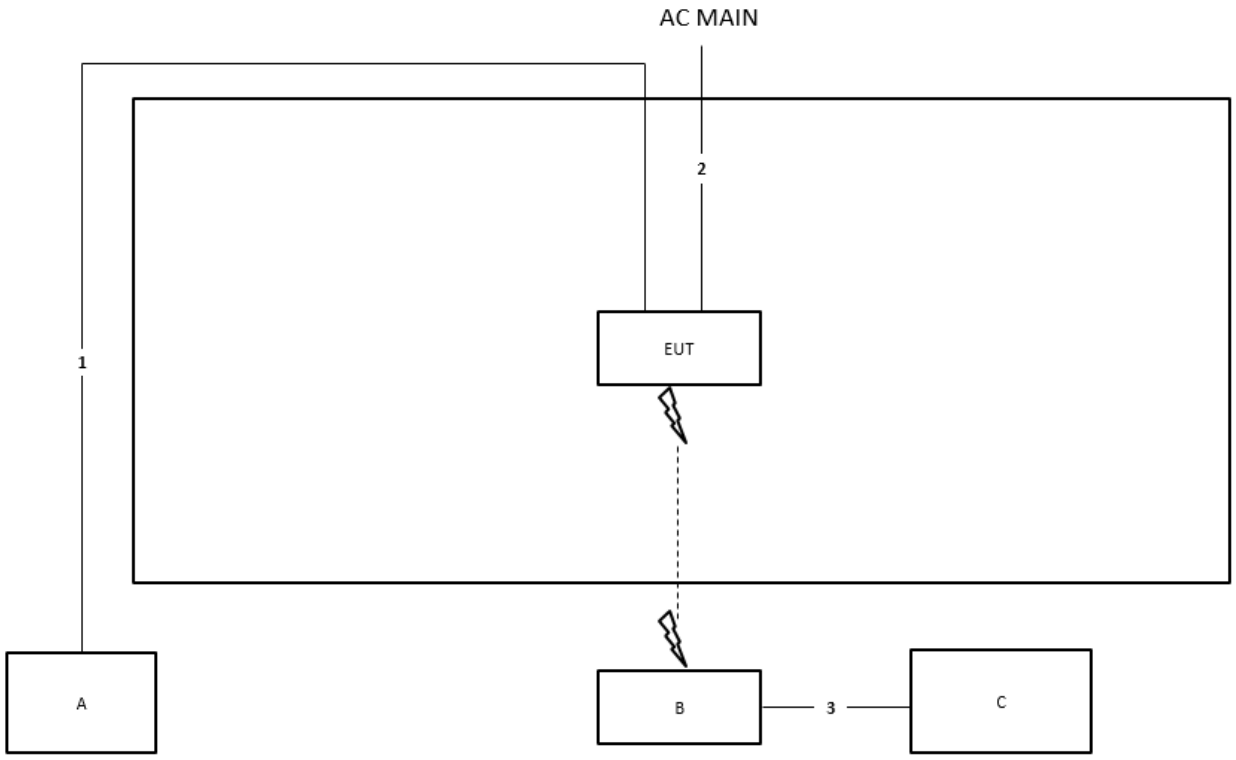
Item	Connection	Shielded	Length
1	RJ-45 cable	No	10m
2	Power cable	No	4.6m
3	GND cable	No	2m

Test Setup Diagram - Radiated Test > 1GHz <Non-beamforming mode>



Item	Connection	Shielded	Length
1	RJ-45 cable	No	10m
2	Power cable	No	4.6m

Test Setup Diagram - Radiated Test > 1GHz <Beamforming mode>



Item	Connection	Shielded	Length
1	RJ-45 cable	No	10m
2	Power cable	No	4.6m
3	RJ-45 cable	No	10m

3 Transmitter Test Result

3.1 AC Power-line Conducted Emissions

3.1.1 AC Power-line Conducted Emissions Limit

AC Power-line Conducted Emissions Limit		
Frequency Emission (MHz)	**Quasi-Peak**	**Average**
0.15-0.5	66 - 56 *	56 - 46 *
0.5-5	56	46
5-30	60	50
Note 1: * Decreases with the logarithm of the frequency.		

3.1.2 Measuring Instruments

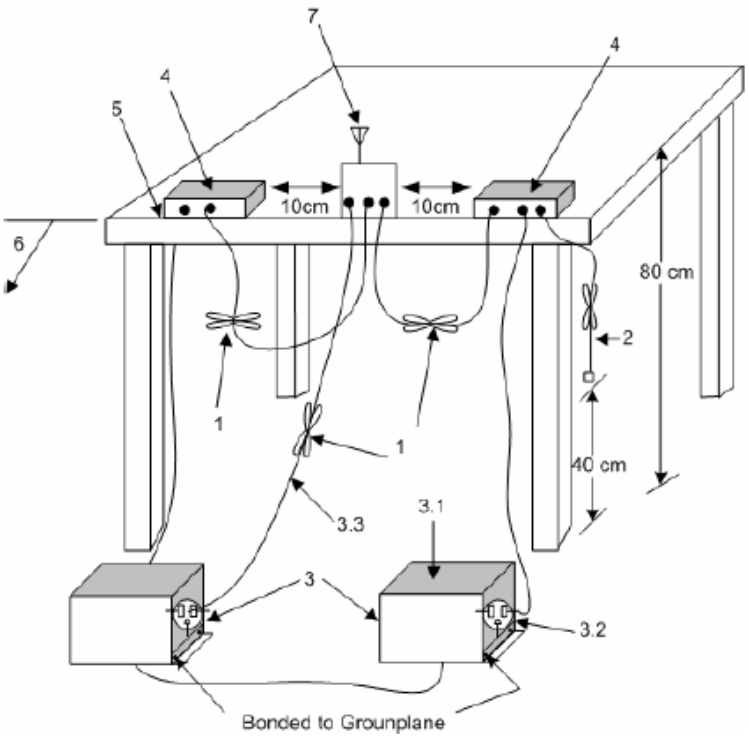
Refer a test equipment and calibration data table in this test report.

3.1.3 Test Procedures

Test Method
☒ Refer as ANSI C63.10-2013, clause 6.2 for AC power-line conducted emissions.

3.1.4 Test Setup

AC Power-line Conducted Emissions



1—Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 cm to 40 cm long.
2—The I/O cables that are not connected to an accessory shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m.
3—EUT connected to one LISN. Unused LISN measuring port connectors shall be terminated in 50 Ω loads. LISN may be placed on top of, or immediately beneath, reference ground plane.
3.1—All other equipment powered from additional LISN(s).
3.2—A multiple-outlet strip may be used for multiple power cords of non-EUT equipment.
3.3—LISN at least 80 cm from nearest part of EUT chassis.
4—Non-EUT components of EUT system being tested.
5—Rear of EUT, including peripherals, shall all be aligned and flush with edge of tabletop.
6—Edge of tabletop shall be 40 cm removed from a vertical conducting plane that is bonded to the ground plane.
7—Antenna can be integral or detachable. If detachable, then the antenna shall be attached for this test.

3.1.5 Measurement Results Calculation

The measured Level is calculated using:

a. Corrected Reading: LISN Factor (LISN) + Attenuator (AT/AUX) + Cable Loss (CL) + Read Level (Raw) = Level

b. Margin = -Limit + Level

3.1.6 Test Result of AC Power-line Conducted Emissions

Refer as Appendix A

3.2 Emissions in Restricted Frequency Bands

3.2.1 Emissions in Restricted Frequency Bands Limit

Restricted Band Emissions Limit			
Frequency Range (MHz)	**Field Strength (uV/m)**	**Field Strength (dBuV/m)**	**Measure Distance (m)**
0.009~0.490	2400/F(kHz)	48.5 - 13.8	300
0.490~1.705	24000/F(kHz)	33.8 - 23	30
1.705~30.0	30	29	30
30~88	100	40	3
88~216	150	43.5	3
216~960	200	46	3
Above 960	500	54	3

Note 1: Test distance for frequencies at or above 30 MHz, measurements may be performed at a distance other than the limit distance provided they are not performed in the near field and the emissions to be measured can be detected by the measurement equipment. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade (inverse of linear distance for field-strength measurements, inverse of linear distance-squared for power-density measurements).

Note 2: Test distance for frequencies at below 30 MHz, measurements may be performed at a distance closer than the EUT limit distance; however, an attempt should be made to avoid making measurements in the near field. When performing measurements below 30 MHz at a closer distance than the limit distance, the results shall be extrapolated to the specified distance by either making measurements at a minimum of two or more distances on at least one radial to determine the proper extrapolation factor or by using the square of an inverse linear distance extrapolation factor (40 dB/decade). The test report shall specify the extrapolation method used to determine compliance of the EUT.

Note 3: Using the distance of 1m during the test for above 18 GHz, and the test value to correct for the distance factor at 3m.

3.2.2 Measuring Instruments

Refer a test equipment and calibration data table in this test report.

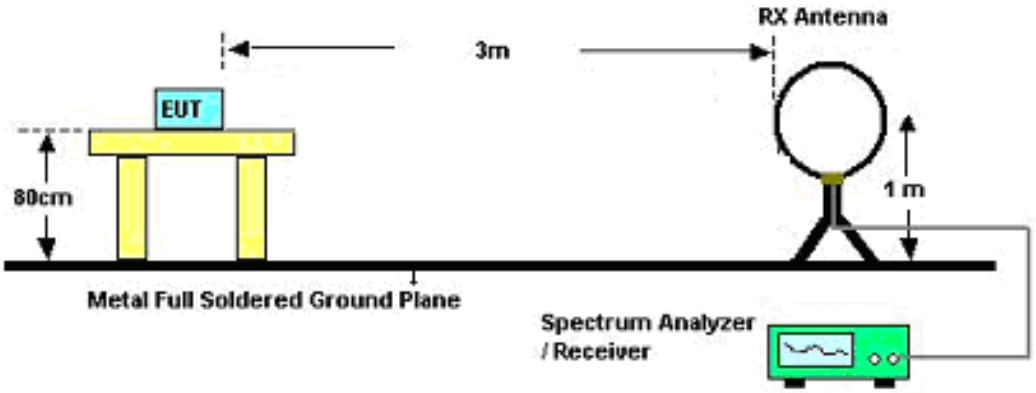
3.2.3 Test Procedures

Test Method
▪ The average emission levels shall be measured in [duty cycle ≥ 98 or duty factor].
▪ Refer as ANSI C63.10, clause 6.10.3 band-edge testing shall be performed at the lowest frequency channel and highest frequency channel within the allowed operating band.
▪ For the transmitter unwanted emissions shall be measured using following options below:
▪ Refer as FCC KDB 558074, clause 8.6 for unwanted emissions into restricted bands.
☐ Refer as FCC KDB 558074, clause 8.6 & C63.10 clause 11.12.2.5.1(trace averaging for duty cycle ≥98%).
☐ Refer as FCC KDB 558074, clause 8.6 & C63.10 clause 11.12.2.5.2(trace averaging + duty factor).
☒ Refer as FCC KDB 558074, clause 8.6 & C63.10 clause 11.12.2.5.3(Reduced VBW≥1/T).
☐ Refer as ANSI C63.10, clause 11.12.2.5.3 (Reduced VBW). VBW ≥ 1/T, where T is pulse time.
☐ Refer as ANSI C63.10, clause 7.5 average value of pulsed emissions.
☒ Refer as FCC KDB 558074, clause 8.6 & C63.10 clause 11.12.2.4 measurement procedure peak limit.
▪ For the transmitter band-edge emissions shall be measured using following options below:
▪ Refer as FCC KDB 558074 clause 8.7 & C63.10 clause 11.13.1, When the performing peak or average radiated measurements, emissions within 2 MHz of the authorized band edge may be measured using the marker-delta method described below.
▪ Refer as FCC KDB 558074, clause 8.7 (ANSI C63.10, clause 6.10.6) for marker-delta method for band-edge measurements.
▪ Refer as FCC KDB 558074, clause 8.7 for narrower resolution bandwidth (100kHz) using the band power and summing the spectral levels (i.e., 1 MHz).
▪ For conducted unwanted emissions into restricted bands (absolute emission limits). Devices with multiple transmit chains using options given below: (1) Measure and sum the spectra across the outputs or (2) Measure and add 10 log(N) dB
▪ For FCC KDB 662911 The methodology described here may overestimate array gain, thereby resulting in apparent failures to satisfy the out-of-band limits even if the device is actually compliant. In such cases, compliance may be demonstrated by performing radiated tests around the frequencies at which the apparent failures occurred.

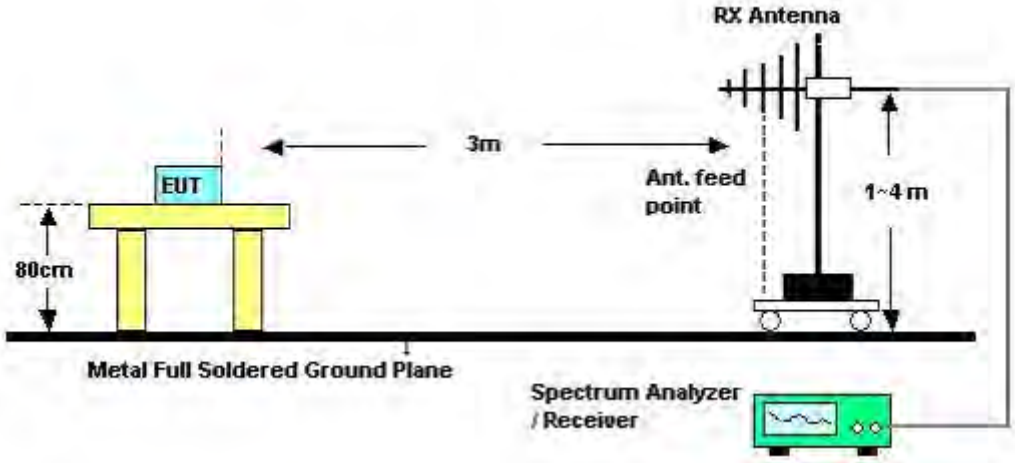
3.2.4 Test Setup

Radiated - Emissions in Restricted Frequency Bands

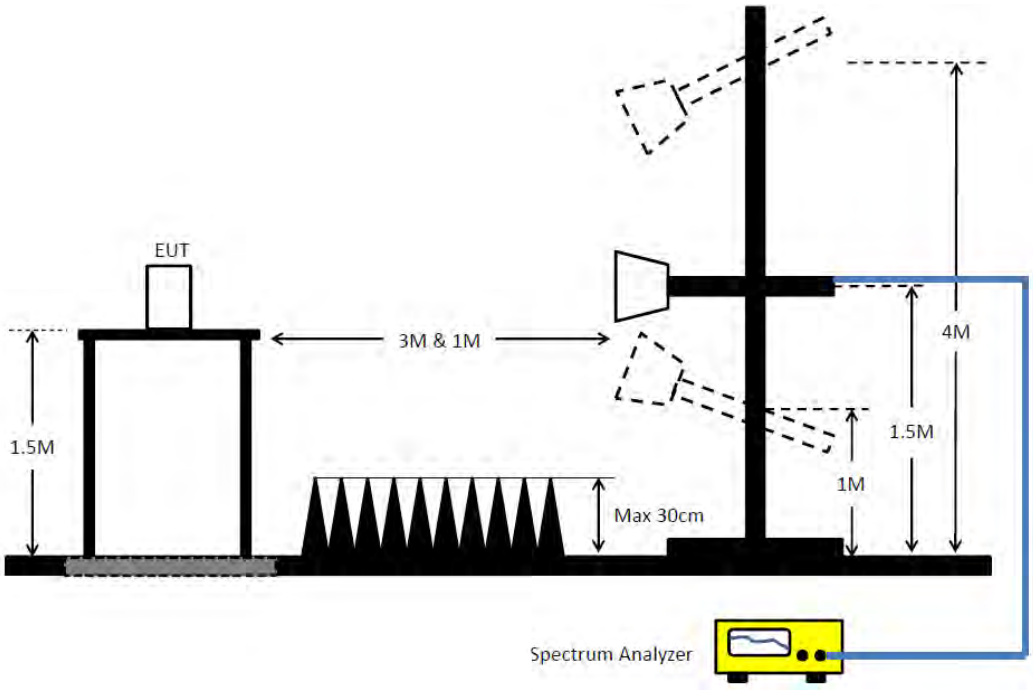
9kHz ~30MHz



30MHz~1GHz



Above 1GHz



3.2.5 Measurement Results Calculation

The measured Level is calculated using:
Corrected Reading: Antenna factor (AF) + Cable loss (CL) + Read level (Raw) - Preamp factor (PA)(if applicable) = Level.

3.2.6 Emissions in Restricted Frequency Bands (Below 30MHz)

There is a comparison data of both open-field test site and alternative test site - semi-Anechoic chamber according to KDB414788 Radiated Test Site, and the result came out very similar.
All amplitude of spurious emissions that are attenuated by more than 20 dB below the permissible value has no need to be reported.
The radiated emissions were investigated from 9 kHz or the lowest frequency generated within the device, up to the 10th harmonic or 40 GHz, whichever is appropriate.

3.2.7 Test Result of Emissions in Restricted Frequency Bands

Refer as Appendix B

4 Test Equipment and Calibration Data

Instrument	Brand	Model No.	Serial No.	Characteristics	Calibration Date	Calibration Due Date	Remark
EMI Receiver	Agilent	N9038A	My52260123	9kHz ~ 8.4GHz	Mar. 01, 2024	Feb. 28, 2025	Conduction (CO01-CB)
LISN	F.C.C.	FCC-LISN-50 -16-2	04083	150kHz ~ 100MHz	Feb. 19, 2024	Feb. 18, 2025	Conduction (CO01-CB)
LISN	Schwarzbeck	NSLK 8127	8127647	9kHz ~ 30MHz	Apr. 24, 2024	Apr. 23, 2025	Conduction (CO01-CB)
Pulse Limiter	Rohde&Schwarz	ESH3-Z2	100430	9kHz ~ 30MHz	Feb. 08, 2024	Feb. 07, 2025	Conduction (CO01-CB)
COND Cable	Woken	Cable	Low cable-CO01	9kHz ~ 30MHz	Oct. 17, 2023	Oct. 16, 2024	Conduction (CO01-CB)
Software	SPORTON	SENSE	V5.10	-	N.C.R.	N.C.R.	Conduction (CO01-CB)
Loop Antenna	Teseq	HLA 6121	65417	9kHz - 30 MHz	Oct. 13, 2023	Oct. 12, 2024	Radiation (03CH05-CB)
3m Semi Anechoic Chamber NSA	TDK	SAC-3M	03CH05-CB	30 MHz ~ 1 GHz	Aug. 02, 2023	Aug. 01, 2024	Radiation (03CH05-CB)
Bilog Antenna with 6dB Attenuator	TESEQ & EMCI	CBL 6112D & N-6-06	35236 & AT-N0610	30MHz ~ 2GHz	Mar. 24, 2023	Mar. 23, 2024	Radiation (03CH05-CB)
Bilog Antenna with 6dB Attenuator	TESEQ & EMCI	CBL 6112D & N-6-06	35236 & AT-N0610	30MHz ~ 2GHz	Mar. 23, 2024	Mar. 22, 2025	Radiation (03CH05-CB)
Amplifier	EMCI	EMC330N	980331	20MHz ~ 3GHz	May 03, 2023	May 02, 2024	Radiation (03CH05-CB)
Amplifier	EMCI	EMC330N	980331	20MHz ~ 3GHz	May 02, 2024	May 01, 2025	Radiation (03CH05-CB)
Spectrum Analyzer	R&S	FSP40	100304	9kHz ~ 40GHz	Apr. 18, 2023	Apr. 17, 2024	Radiation (03CH05-CB)
Spectrum Analyzer	R&S	FSP40	100304	9kHz ~ 40GHz	Apr. 17, 2024	Apr. 16, 2025	Radiation (03CH05-CB)
EMI Test Receiver	R&S	ESCS	826547/017	9kHz ~ 2.75GHz	Jun. 13, 2023	Jun. 12, 2024	Radiation (03CH05-CB)
EMI Test Receiver	R&S	ESCS	826547/017	9kHz ~ 2.75GHz	Jun. 13, 2024	Jun. 12, 2025	Radiation (03CH05-CB)
RF Cable-low	Woken	RG402	Low Cable-04+23	30MHz~1GHz	Dec. 06, 2023	Dec. 05, 2024	Radiation (03CH05-CB)
Test Software	SPORTON	SENSE	V5.10	-	N.C.R.	N.C.R.	Radiation (03CH05-CB)
3m Semi Anechoic Chamber VSWR	TDK	SAC-3M	03CH03-CB	1GHz ~18GHz 3m	May 04, 2023	May 03, 2024	Radiation (03CH03-CB)

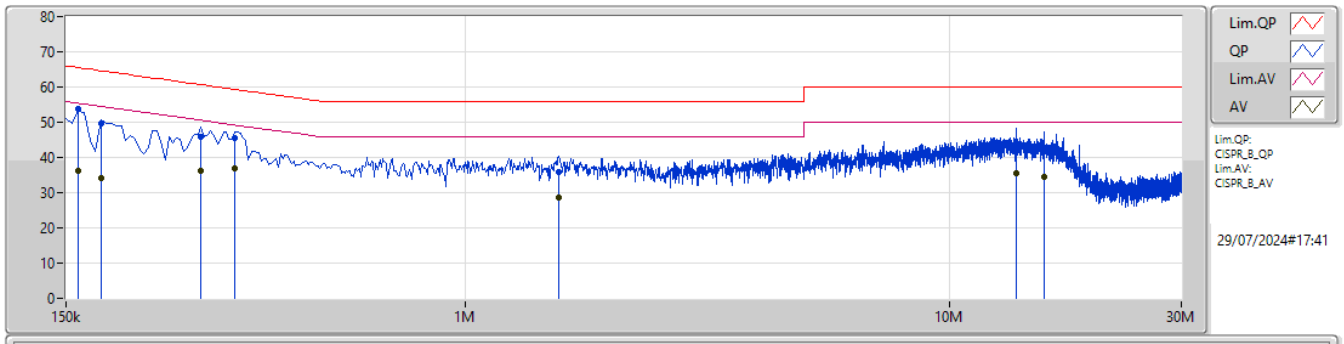
Instrument	Brand	Model No.	Serial No.	Characteristics	Calibration Date	Calibration Due Date	Remark
3m Semi Anechoic Chamber VSWR	TDK	SAC-3M	03CH03-CB	1GHz ~18GHz 3m	May 03, 2024	May 02, 2025	Radiation (03CH03-CB)
Horn Antenna	ETS·Lindgren	3115	6821	750MHz~18GHz	Feb. 03, 2023	Feb. 02, 2024	Radiation (03CH03-CB)
Horn Antenna	ETS·Lindgren	3115	6821	750MHz~18GHz	Jan. 24, 2024	Jan. 23, 2025	Radiation (03CH03-CB)
Horn Antenna	Schwarzbeck	BBHA 9170	BBHA9170252	15GHz ~ 40GHz	Sep. 04, 2023	Sep. 03, 2024	Radiation (03CH03-CB)
Pre-Amplifier	Agilent	8449B	3008A02097	1GHz ~ 26.5GHz	Jun. 30, 2023	Jun. 29, 2024	Radiation (03CH03-CB)
Pre-Amplifier	Agilent	8449B	3008A02097	1GHz ~ 26.5GHz	Jun. 29, 2024	Jun. 28, 2025	Radiation (03CH03-CB)
Pre-Amplifier	SGH	SGH184	20221107-3	18GHz ~ 40GHz	Nov. 24, 2023	Nov. 23, 2024	Radiation (03CH03-CB)
Spectrum Analyzer	R&S	FSP40	100019	9kHz ~ 40GHz	Jun. 12, 2023	Jun. 11, 2024	Radiation (03CH03-CB)
Spectrum Analyzer	R&S	FSP40	100019	9kHz ~ 40GHz	Jun. 11, 2024	Jun. 10, 2025	Radiation (03CH03-CB)
RF Cable-high	Woken	RG402	High Cable-20+29	1GHz ~ 18GHz	Feb. 21, 2024	Feb. 20, 2025	Radiation (03CH03-CB)
RF Cable-high	Woken	RG402	High Cable-20+29	1GHz ~ 18GHz	Feb. 29, 2024	Feb. 28, 2025	Radiation (03CH03-CB)
RF Cable-high	Woken	RG402	High Cable-29	1GHz ~ 18GHz	Feb. 21, 2024	Feb. 20, 2025	Radiation (03CH03-CB)
RF Cable-high	Woken	RG402	High Cable-29	1GHz ~ 18GHz	Feb. 29, 2024	Feb. 28, 2025	Radiation (03CH03-CB)
High Cable	Woken	WCA0929M	40G#5+6	1GHz ~ 40 GHz	Jan. 11, 2024	Jan. 10, 2025	Radiation (03CH03-CB)
Test Software	SPORTON	SENSE	V5.10	-	N.C.R.	N.C.R.	Radiation (03CH03-CB)

Note: Calibration Interval of instruments listed above is one year.
NCR means Non-Calibration required.

Summary

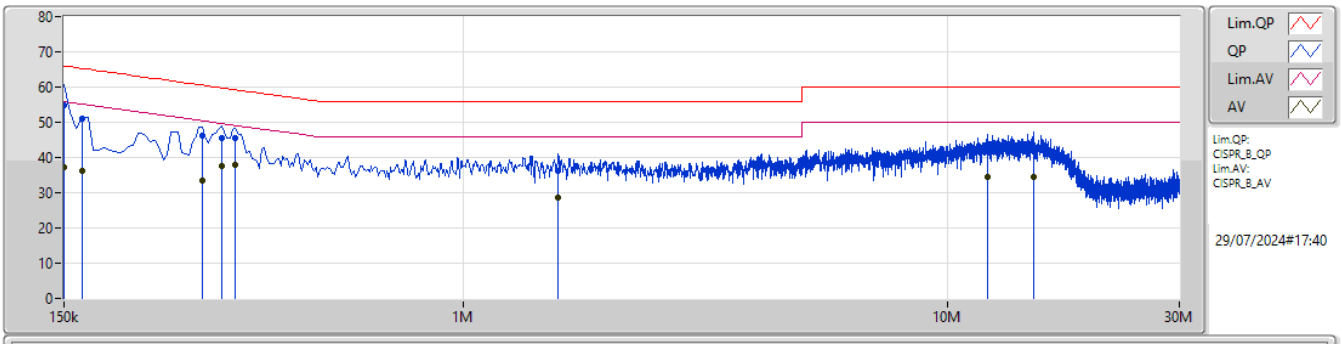
Mode	Result	Type	Freq (Hz)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Condition
Mode 4	Pass	QP	150k	54.78	66.00	-11.22	Neutral

Mode 4



Type	Freq	Level	Limit	Margin	Factor	Condition	Comment	Raw	LISN	CL	AT
	(Hz)	(dBuV)	(dBuV)	(dB)	(dB)			(dBuV)	(dB)	(dB)	(dB)
QP	159k	53.73	65.52	-11.79	9.93	Line	"Worst"	43.80	0.05	0.02	9.86
AV	159k	36.05	55.52	-19.47	9.93	Line	-	26.12	0.05	0.02	9.86
QP	177k	49.65	64.62	-14.97	9.93	Line	-	39.72	0.05	0.02	9.86
AV	177k	34.09	54.62	-20.53	9.93	Line	-	24.16	0.05	0.02	9.86
QP	285k	45.93	60.67	-14.74	9.94	Line	-	35.99	0.05	0.02	9.87
AV	285k	36.34	50.67	-14.33	9.94	Line	-	26.40	0.05	0.02	9.87
QP	334.5k	45.54	59.35	-13.81	9.95	Line	-	35.59	0.05	0.02	9.88
AV	334.5k	36.93	49.35	-12.42	9.95	Line	-	26.98	0.05	0.02	9.88
QP	1.554M	35.99	56.00	-20.01	10.03	Line	-	25.96	0.08	0.05	9.90
AV	1.554M	28.71	46.00	-17.29	10.03	Line	-	18.68	0.08	0.05	9.90
QP	13.664M	42.84	60.00	-17.16	10.42	Line	-	32.42	0.31	0.17	9.94
AV	13.664M	35.55	50.00	-14.45	10.42	Line	-	25.13	0.31	0.17	9.94
QP	15.603M	41.62	60.00	-18.38	10.49	Line	-	31.13	0.34	0.19	9.96
AV	15.603M	34.53	50.00	-15.47	10.49	Line	-	24.04	0.34	0.19	9.96

Mode 4

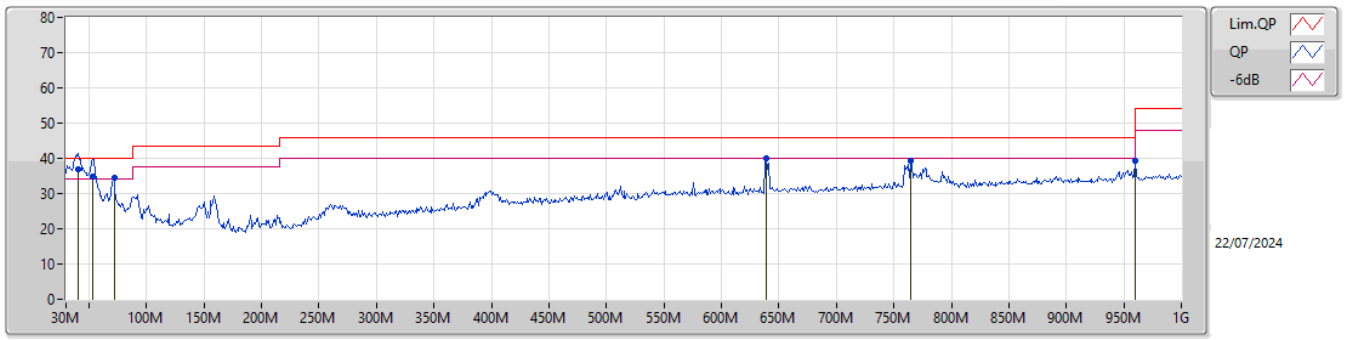


Type	Freq	Level	Limit	Margin	Factor	Condition	Comment	Raw	LISN	CL	AT
	(Hz)	(dBuV)	(dBuV)	(dB)	(dB)			(dBuV)	(dB)	(dB)	(dB)
QP	150k	54.78	66.00	-11.22	9.94	Neutral	"Worst"	44.84	0.05	0.02	9.87
AV	150k	37.27	56.00	-18.73	9.94	Neutral	-	27.33	0.05	0.02	9.87
QP	163.5k	51.17	65.27	-14.10	9.93	Neutral	-	41.24	0.05	0.02	9.86
AV	163.5k	36.11	55.27	-19.16	9.93	Neutral	-	26.18	0.05	0.02	9.86
QP	289.5k	46.09	60.53	-14.44	9.94	Neutral	-	36.15	0.05	0.02	9.87
AV	289.5k	33.37	50.53	-17.16	9.94	Neutral	-	23.43	0.05	0.02	9.87
QP	316.5k	45.57	59.80	-14.23	9.95	Neutral	-	35.62	0.05	0.02	9.88
AV	316.5k	37.42	49.80	-12.38	9.95	Neutral	-	27.47	0.05	0.02	9.88
QP	339k	45.56	59.23	-13.67	9.95	Neutral	-	35.61	0.05	0.02	9.88
AV	339k	37.77	49.23	-11.46	9.95	Neutral	-	27.82	0.05	0.02	9.88
QP	1.568M	36.30	56.00	-19.70	10.02	Neutral	-	26.28	0.07	0.05	9.90
AV	1.568M	28.73	46.00	-17.27	10.02	Neutral	-	18.71	0.07	0.05	9.90
QP	12.066M	42.12	60.00	-17.88	10.31	Neutral	-	31.81	0.22	0.16	9.93
AV	12.066M	34.57	50.00	-15.43	10.31	Neutral	-	24.26	0.22	0.16	9.93
QP	14.996M	41.87	60.00	-18.13	10.37	Neutral	-	31.50	0.24	0.18	9.95
AV	14.996M	34.63	50.00	-15.37	10.37	Neutral	-	24.26	0.24	0.18	9.95

Summary

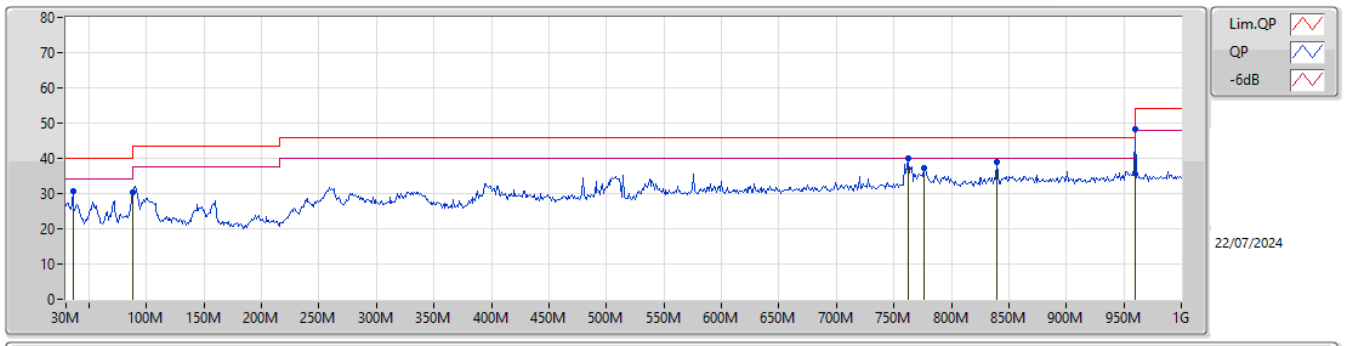
Mode	Result	Type	Freq (Hz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Condition
Mode 1	Pass	QP	40.67M	36.87	40.00	-3.13	Vertical

Mode 1



Type	Freq	Level	Limit	Margin	Factor	Dist	Condition	Azimuth	Height	Comment	Raw	AF	CL	PA
	(Hz)	(dBuV/m)	(dBuV/m)	(dB)	(dB/m)	(m)		(°)	(m)		(dBuV)	(dB/m)	(dB)	(dB)
QP	40.67M	36.87	40.00	-3.13	-11.72	3	Vertical	264	1.00	"Worst"	48.59	18.67	1.17	31.56
QP	53.28M	34.95	40.00	-5.05	-17.08	3	Vertical	256	1.25	-	52.03	13.26	1.31	31.65
PK	71.71M	34.32	40.00	-5.68	-17.69	3	Vertical	145	1.25	-	52.01	12.51	1.50	31.70
PK	639.16M	39.85	46.00	-6.15	-2.77	3	Vertical	141	1.50	-	42.62	24.76	4.77	32.30
PK	764.29M	39.47	46.00	-6.53	-1.53	3	Vertical	16	1.25	-	41.00	25.54	5.29	32.36
PK	960M	39.15	54.00	-14.85	0.43	3	Vertical	0	1.25	-	38.72	26.72	6.02	32.31

Mode 1



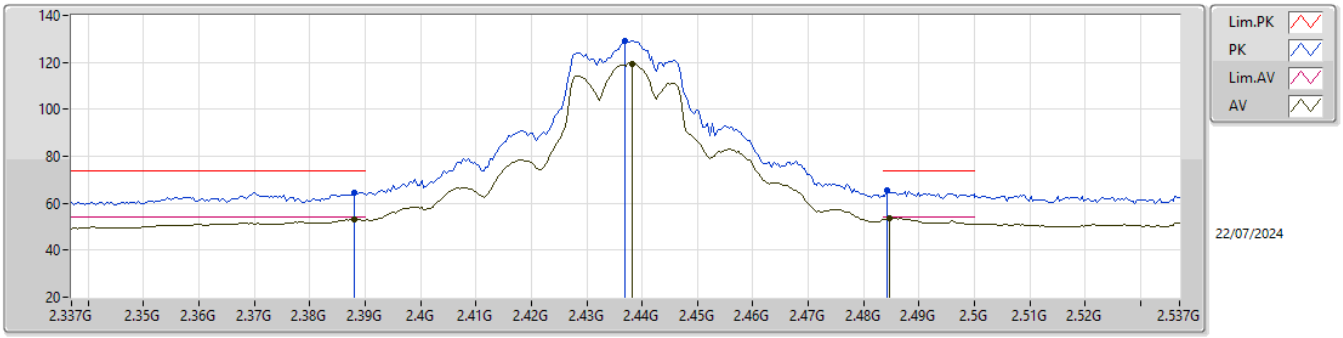
Type	Freq	Level	Limit	Margin	Factor	Dist	Condition	Azimuth	Height	Comment	Raw	AF	CL	PA
	(Hz)	(dBuV/m)	(dBuV/m)	(dB)	(dB/m)	(m)		(°)	(m)		(dBuV)	(dB/m)	(dB)	(dB)
PK	35.82M	30.55	40.00	-9.45	-9.13	3	Horizontal	27	2.00	-	39.68	21.27	1.10	31.50
PK	88M	30.37	43.50	-13.13	-15.49	3	Horizontal	230	2.00	-	45.86	14.58	1.66	31.73
PK	762.35M	39.85	46.00	-6.15	-1.55	3	Horizontal	161	1.25	-	41.40	25.53	5.28	32.36
PK	775.93M	37.17	46.00	-8.83	-1.40	3	Horizontal	158	1.50	-	38.57	25.62	5.33	32.35
PK	839.95M	38.92	46.00	-7.08	-0.82	3	Horizontal	360	1.50	-	39.74	25.93	5.57	32.32
PK	960M	48.36	54.00	-5.64	0.43	3	Horizontal	23	1.50	"Worst"	47.93	26.72	6.02	32.31

Summary

Mode	Result	Type	Freq (Hz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Dist (m)	Condition	Azimuth (°)	Height (m)	Comments
2.4-2.4835GHz	-	-	-	-	-	-	-	-	-	-	-
802.11ax HEW20_Nss1,(MCS0)_2TX	Pass	AV	2.3894G	53.97	54.00	-0.03	3	Vertical	0	1.80	-

2.4-2.4835GHz_802.11ax HEW20_Nss1,(MCS0)_2TX

2437MHz_TX

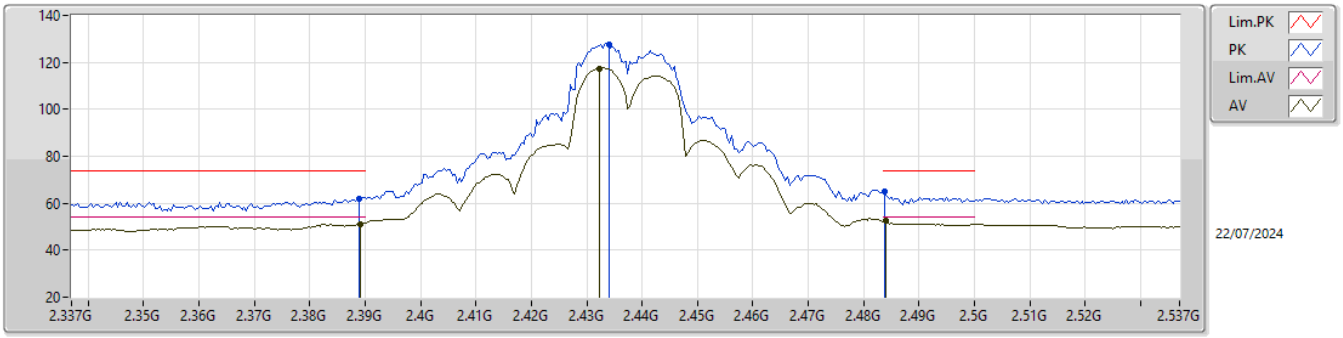


EUT Y_2TX
Setting 29
03-E-S-5

Type	Freq	Level	Limit	Margin	Raw	Dist	Condition	Azimuth	Height	Comment	AF	CL	PA
	(Hz)	(dBuV/m)	(dBuV/m)	(dB)	(dBuV)	(m)		(°)	(m)		(dB)	(dB)	(dB)
PK	2.388G	64.72	74.00	-9.28	32.07	3	Vertical	349	1.71	-	28.28	4.37	-
AV	2.388G	52.94	54.00	-1.06	20.29	3	Vertical	349	1.71	-	28.28	4.37	-
PK	2.4368G	129.31	Inf	-Inf	96.61	3	Vertical	349	1.71	-	28.30	4.40	-
AV	2.4382G	119.10	Inf	-Inf	86.40	3	Vertical	349	1.71	-	28.30	4.40	-
PK	2.4841G	65.42	74.00	-8.58	32.65	3	Vertical	349	1.71	-	28.34	4.43	-
AV	2.4846G	53.71	54.00	-0.29	20.93	3	Vertical	349	1.71	-	28.35	4.43	-

2.4-2.4835GHz_802.11ax HEW20_Nss1,(MCS0)_2TX

2437MHz_TX

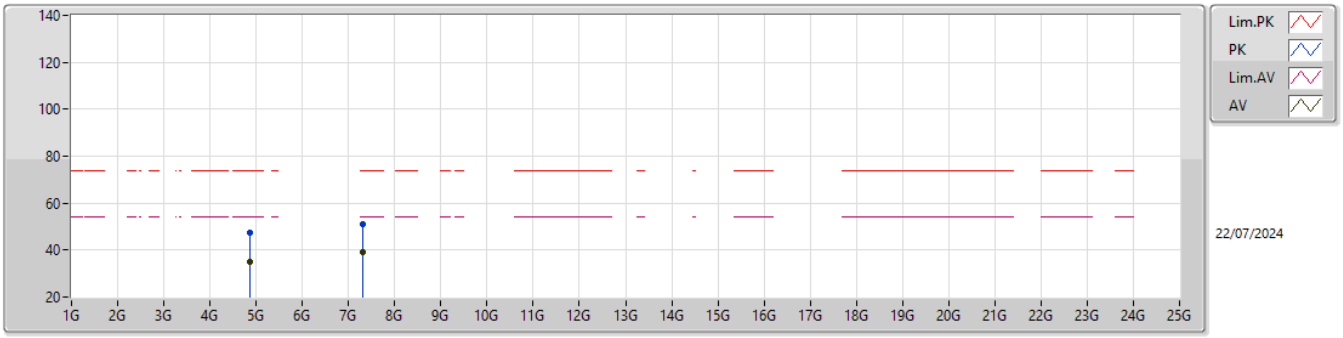


EUT Y_2TX
Setting 29
03-E-S-5

Type	Freq	Level	Limit	Margin	Raw	Dist	Condition	Azimuth	Height	Comment	AF	CL	PA
	(Hz)	(dBuV/m)	(dBuV/m)	(dB)	(dBuV)	(m)		(°)	(m)		(dB)	(dB)	(dB)
PK	2.3889G	61.74	74.00	-12.26	29.08	3	Horizontal	332	1.12	-	28.29	4.37	-
AV	2.3891G	51.09	54.00	-2.91	18.43	3	Horizontal	332	1.12	-	28.29	4.37	-
PK	2.4341G	127.74	Inf	-Inf	95.04	3	Horizontal	332	1.12	-	28.30	4.40	-
AV	2.4322G	117.29	Inf	-Inf	84.59	3	Horizontal	332	1.12	-	28.30	4.40	-
PK	2.4838G	64.91	74.00	-9.09	32.14	3	Horizontal	332	1.12	-	28.34	4.43	-
AV	2.4839G	52.33	54.00	-1.67	19.56	3	Horizontal	332	1.12	-	28.34	4.43	-

2.4-2.4835GHz_802.11ax HEW20_Nss1,(MCS0)_2TX

2437MHz_TX

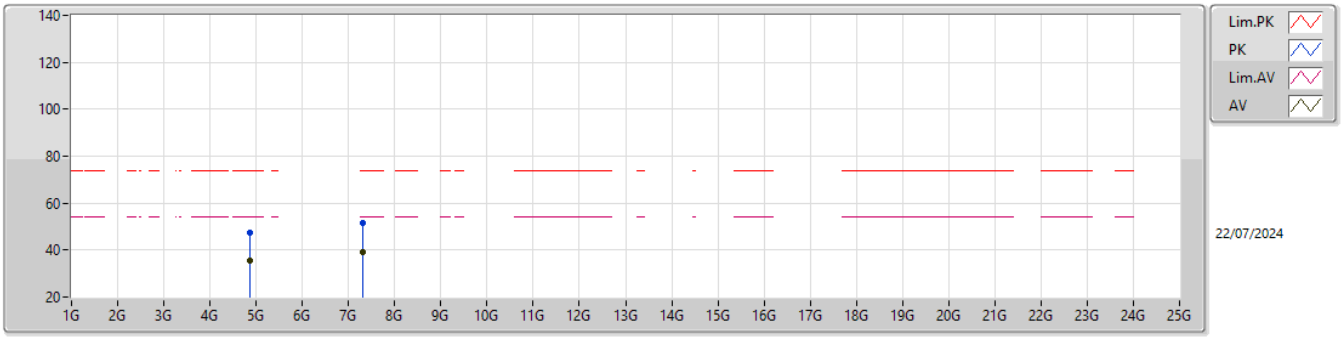


EUT Y_2TX
Setting 29
03-E-S-5

Type	Freq	Level	Limit	Margin	Raw	Dist	Condition	Azimuth	Height	Comment	AF	CL	PA
	(Hz)	(dBuV/m)	(dBuV/m)	(dB)	(dBuV)	(m)		(°)	(m)		(dB)	(dB)	(dB)
PK	4.87423G	47.66	74.00	-26.34	43.28	3	Vertical	159	2.12	-	33.35	6.36	35.33
AV	4.87421G	35.02	54.00	-18.98	30.64	3	Vertical	159	2.12	-	33.35	6.36	35.33
PK	7.31072G	51.02	74.00	-22.98	40.95	3	Vertical	88	1.59	-	36.74	8.48	35.15
AV	7.31081G	39.29	54.00	-14.71	29.22	3	Vertical	88	1.59	-	36.74	8.48	35.15

2.4-2.4835GHz_802.11ax HEW20_Nss1,(MCS0)_2TX

2437MHz_TX



EUT Y_2TX
Setting 29
03-E-S-5

Type	Freq	Level	Limit	Margin	Raw	Dist	Condition	Azimuth	Height	Comment	AF	CL	PA
	(Hz)	(dBuV/m)	(dBuV/m)	(dB)	(dBuV)	(m)		(°)	(m)		(dB)	(dB)	(dB)
PK	4.87437G	47.42	74.00	-26.58	43.04	3	Horizontal	23	1.28	-	33.35	6.36	35.33
AV	4.87374G	35.28	54.00	-18.72	30.90	3	Horizontal	23	1.28	-	33.35	6.36	35.33
PK	7.31141G	51.45	74.00	-22.55	41.37	3	Horizontal	55	2.35	-	36.75	8.48	35.15
AV	7.31065G	39.15	54.00	-14.85	29.08	3	Horizontal	55	2.35	-	36.74	8.48	35.15