

RADIO PERFORMANCE TEST REPORT

Test Report No. : OT-24O-RWD-027
Reception No. : 2408002643
Applicant : NTT Sonority Inc.
Address : 3-20-2, Nishishinjuku, Shinjuku-ku, Tokyo, 163-1432, Japan
Manufacturer : KH Electron Phils. Corp.
Address : 5416 Claro M. Recto Highway, Clark Freeport Zone, Pampanga, Philippine
Type of Equipment : wireless on-ear speakers
FCC ID. : 2A58O-MBN002
Model Name : MBN002
Multiple Model Name : N/A
Serial number : N/A
Total page of Report : 32 pages (including this page)
Date of Incoming : August 20, 2024
Date of issue : October 15, 2024

SUMMARY

The equipment complies with the regulation; **FCC PART 15 SUBPART C Section 15.247**

This test report only contains the result of a single test of the sample supplied for the examination.

It is not a generally valid assessment of the features of the respective products of the mass-production.

This report is not correlated with the "KS Q ISO/IEC 17025 and KOLAS accreditation" of Korean Laboratory Accreditation Scheme.





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※ Please refer to the Annex section for All test plots

Revision History

Rev. No.	Issue Report No.	Issued Date	Revisions	Section Affected
0	OT-24O-RWD-027	October 15, 2024	Initial Release	All

1. VERIFICATION OF COMPLIANCE

Applicant : NTT Sonority Inc.
 Address : 3-20-2, Nishishinjuku, Shinjuku-ku, Tokyo, 163-1432, Japan
 Contact Person : Akira Nakagawa / General Manager
 Telephone No. : +81-80-8231-5126
 FCC ID : 2A58O-MBN002
 Model Name : MBN002
 Brand Name : N/A
 Serial Number : N/A
 Date : October 15, 2024

EQUIPMENT CLASS	DSS – PART 15 SPREAD SPECTRUM TRANSMITTER
E.U.T. DESCRIPTION	wireless on-ear speakers
THIS REPORT CONCERNS	Original Grant
MEASUREMENT PROCEDURES	ANSI C63.10: 2013
TYPE OF EQUIPMENT TESTED	Pre-Production
KIND OF EQUIPMENT AUTHORIZATION REQUESTED	Certification
EQUIPMENT WILL BE OPERATED UNDER FCC RULES PART(S)	FCC PART 15 SUBPART C Section 15.247 KDB 558074 D01 15.247 Meas Guidance v05r02
Modifications on the Equipment to Achieve Compliance	None
Final Test was Conducted On	3 m, Semi Anechoic Chamber

-. The above equipment was tested by ONETECH Corp. for compliance with the requirement set forth in the FCC Rules and Regulations. This said equipment in the configuration described in this report, shows the maximum emission levels emanating from equipment are within the compliance requirements.

2. TEST SUMMARY

2.1 Test items and results

SECTION	TEST ITEMS	RESULTS
15.247 (a) (1)	Carrier Frequency Separation	Met the Limit / PASS
15.247 (a) (1) (iii)	Minimum Number of Hopping Channels	Met the Limit / PASS
15.247 (a) (1) (iii)	Average Time of Occupancy	Met the Limit / PASS
15.247 (b) (1)	Maximum Peak Conducted Output Power	Met the Limit / PASS
15.247 (d)	100 kHz Bandwidth Outside the Frequency Band	Met the Limit / PASS
15.247 (d)	Radiated Emission which fall in the Restricted Band	Met the Limit / PASS
15.209	Radiated Emission Limits, General Requirement	Met the Limit / PASS
15.207	Conducted Limits	Met the Limit / PASS
15.203	Antenna Requirement	Met requirement / PASS

2.2 Additions, deviations, exclusions from standards

No additions, deviations or exclusions have been made from standard.

2.3 Related Submittal(s) / Grant(s)

Original submittal only

2.4 Purpose of the test

To determine whether the equipment under test fulfills the requirements of the regulation stated in FCC PART 15 SUBPART C Section 15.247.

2.5 Test Methodology

Both conducted and radiated testing was performed according to the procedures in ANSI C63.10: 2013. Radiated testing was performed at a distance of 3 m from EUT to the antenna.

2.6 Test Facility

The Onetech Corp. has been designated to perform equipment testing in compliance with ISO/IEC 17025.

The Electromagnetic compatibility measurement facilities are located at 43-14, Jinsaegol-gil, Chowol-eup, Gwangju-si, Gyeonggi-do, 12735, Korea

-. Site Filing:

VCCI (Voluntary Control Council for Interference) – Registration No. R-20122/ C-14617/ G-10666/ T-11842

-. Lab Accreditation:

KOLAS (Korea Laboratory Accreditation Scheme) - Accreditation NO. KT085

ISED (Innovation, Science and Economic Development Canada) – Registration No. Site# 3736A-3

FCC (Federal Communications Commission) - Accreditation No. KR0013

RRA (Radio Research Agency) – Designation No. KR0013

3. GENERAL INFORMATION

3.1 Product Description

The NTT Sonority Inc., Model MBN002 (referred to as the EUT in this report) is a wireless on-ear speakers. The product specification described herein was obtained from product data sheet or user's manual.

Device Type	wireless on-ear speakers		
Temperature Range	0 °C ~ 45 °C		
OPERATING FREQUENCY	Bluetooth LE	2 402 MHz ~ 2 480 MHz	
	Bluetooth	2 402 MHz ~ 2 480 MHz	
MODULATION TYPE	Bluetooth LE	GFSK for 1 Mbps, 2 Mbps	
	Bluetooth	GFSK for 1Mbps, $\pi/4$ -DQPSK for 2Mbps, 8-DPSK for 3Mbps	
RF OUTPUT POWER	Bluetooth LE	1 Mbps	4.19 dBm
		2 Mbps	4.69 dBm
	Bluetooth	1 Mbps	4.41 dBm
		2 Mbps	7.37 dBm
		3 Mbps	7.89 dBm
ANTENNA TYPE	Chip Antenna		
ANTENNA GAIN	1.77 dBi		
List of each Osc. or crystal Freq.(Freq. $\geq$ 1 MHz)	40 MHz		

3.2 Alternative type(s)/model(s); also covered by this test report.

-. None

4. EUT MODIFICATIONS

-. None

5. SYSTEM TEST CONFIGURATION

5.1 Justification

This device was configured for testing in a typical way as a normal customer is supposed to be used. During the test, the following components were installed inside of the EUT.

DEVICE TYPE	MANUFACTURER	MODEL/PART NUMBER	FCC ID
Main Board	KH Electron Phils. Corp.	03PB001-0399-01	N/A

5.2 Peripheral equipment

Defined as equipment needed for correct operation of the EUT, but not considered as tested:

Model	Manufacturer	Description	Connected to
MBN002	KH Electron Phils. Corp.	wireless on-ear speakers (EUT)	
HP ProBook 450 G7	HP	Notebook PC	EUT
TPN-LA15	Lite-On Technology Corp.	AC Adapter	

5.3 Mode of operation during the test

For the testing, software used to control the EUT for staying in continuous transmitting is programmed.

For final testing, the EUT was set at 2 402 MHz, 2 441MHz, and 2 480 MHz to get a maximum emission levels from the EUT. The EUT was moved throughout the XY, XZ, and YZ planes and the worst case is “XY” axis, but the worst data was recorded in this report.

-. Frequency / Channel Operations

Channel	Frequency
0	2 402
39	2 441
78	2 480

-. Duty Cycle

Mode	Tx On Time [ms]	Tx Off Time [ms]	Duty Cycle [%]	Correction Factor [dB]
Bluetooth [1 Mbps]	2.887	0.863	76.99	1.14
Bluetooth [2 Mbps]	2.892	0.858	77.12	1.13
Bluetooth [3 Mbps]	2.894	0.856	77.18	1.12

Note – Duty Cycle : (Tx On Time / (Tx On Time + Tx Off Time)) * 100

Correction Factor : 10 * Log(1 / (Duty Cycle / 100))

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OTC-TRF-RF-001(0)

ONETECH Corp.: 43-14, Jinsaegol-gil, Chowol-eup, Gwangju-si, Gyeonggi-do, 12735, Korea (TEL: 82-31-799-9500, FAX: 82-31-799-9599)

5.4 Configuration of Test System

Line Conducted Test: The EUT was tested in the Transmitting mode. All supporting equipment were connected to another LISN. Preliminary Power line Conducted Emission test was performed by using the procedure in ANSI C63.10: 2013 to determine the worse operating conditions.

Radiated Emission Test: Preliminary radiated emissions test were conducted using the procedure in ANSI C63.10: 2013 to determine the worse operating conditions. Final radiated emission tests were conducted at 3 meter Semi Anechoic Chamber.

The turntable was rotated through 360 degrees and the EUT was tested by positioned three orthogonal planes to obtain the highest reading on the field strength meter. Once maximum reading was determined, the search antenna was raised and lowered in both vertical and horizontal polarization.

5.5 Antenna Requirement

For intentional device, according to section 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

Antenna Construction:

The antenna of the EUT is a Chip Antenna on the main board in the EUT, so no consideration of replacement by the user.

6. MEASUREMENT UNCERTAINTY

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.10-2013.

All measurement uncertainty values are shown with a coverage factor of $k = 2$ to indicate a 95 % level of confidence.

The measurement data shown herein meets or exceeds the U_{CISPR} measurement uncertainty values specified in CISPR 16-4-2 and, thus, can be compared directly to specified limits to determine compliance.

Parameter	Expanded Uncertainty (dB)
Conducted Output Power	0.90
Conducted Spurious Emission < 26.5 GHz	1.26
Power Spectral Density	1.20
Line Conducted Disturbance (150 kHz ~ 30 MHz)	2.00
Radiated Disturbance (9 kHz ~ 30 MHz)	3.30
Radiated Disturbance (30 MHz ~ 1 GHz)	4.42
Radiated Disturbance (1 GHz ~ 18 GHz)	5.10
Radiated Disturbance (18 GHz ~ 40 GHz)	5.65

7. PRELIMINARY TEST

7.1 AC Power line Conducted Emissions Tests

During Preliminary Test, the following operating mode was investigated.

Operation Mode	The Worse operating condition (Please check one only)
Transmitting Mode	X

7.2 General Radiated Emissions Tests

During Preliminary Test, the following operating mode was investigated.

Operation Mode	The Worse operating condition (Please check one only)
Transmitting Mode	X

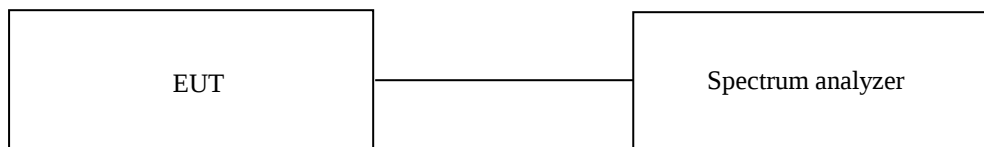
8. MINIMUM 20 dB BANDWIDTH

8.1 Operating environment

Temperature : 25 °C
Relative humidity : 46 % R.H.

8.2 Test set-up

The antenna output of the EUT was connected to the spectrum analyzer. The resolution bandwidth is set to 20 kHz, and peak detection was used. The 20 dB bandwidth is defined as the total spectrum over which the power is higher than the peak power minus 20 dB.



8.3 Test Date

August 23, 2024 ~ September 24, 2024

8.4 Test data for 1 Mbps

CHANNEL	FREQUENCY (MHz)	20 dB Bandwidth (kHz)
Low	2 402.00	934.14
Middle	2 441.00	933.89
High	2 480.00	939.01

8.5 Test data for 2 Mbps

CHANNEL	FREQUENCY (MHz)	20 dB Bandwidth (kHz)
Low	2 402.00	1 238.53
Middle	2 441.00	1 233.92
High	2 480.00	1 233.66

8.6 Test data for 3 Mbps

CHANNEL	FREQUENCY (MHz)	20 dB Bandwidth (kHz)
Low	2 402.00	1 248.77
Middle	2 441.00	1 248.77
High	2 480.00	1 263.62

9. HOPPING FREQUENCY SEPARATION

9.1 Operating environment

Temperature : 25 °C
Relative humidity : 46 % R.H.

9.2 Test set-up

The antenna output of the EUT was connected to the spectrum analyzer. The frequency span is set to 5 MHz. The analyzer is set to peak hold then a pseudo-random hopping sequence of the transmitter is captured. The mark delta function was used to measure the frequency separation between two adjacent hopping channels.



9.3 Test Date

August 23, 2024 ~ September 24, 2024

9.4 Test data for 1 Mbps

-. Test Result : Pass

MEASURED VLAUE (kHz)	Two-third of 20 dB Bandwidth (kHz)	LIMIT
999.00	622.59	Separated by a minimum of 622.59 kHz

9.5 Test data for 2 Mbps

-. Test Result : Pass

MEASURED VLAUE (kHz)	Two-third of 20 dB Bandwidth (kHz)	LIMIT
1 004.00	822.61	Separated by a minimum of 822.61 kHz

9.6 Test data for 3 Mbps

-. Test Result : Pass

MEASURED VLAUE (kHz)	Two-third of 20 dB Bandwidth (kHz)	LIMIT
1 004.00	832.51	Separated by a minimum of 832.51 kHz

10. NUMBER OF HOPPING CHANNELS

10.1 Operating environment

Temperature : 25 °C
Relative humidity : 46 % R.H.

10.2 Test set-up

The antenna output of the EUT was connected to the spectrum analyzer. The frequency span is set to 100 MHz and the resolution bandwidth is set to 100 kHz. The analyzer is set to peak hold and then complete pseudo-random hopping sequence of the transmitter is captured.



10.3 Test Date

August 23, 2024 ~ September 24, 2024

10.4 Test data for 1 Mbps

-. Test Result : Pass

Data Transfer Rate	Measured value (Number)	Limit (Number)	Margin (Number)
1 Mbps	79	Minimum of 15	64

10.5 Test data for 2 Mbps

-. Test Result : Pass

Data Transfer Rate	Measured value (Number)	Limit (Number)	Margin (Number)
2 Mbps	79	Minimum of 15	64

10.6 Test data for 3 Mbps

-. Test Result : Pass

Data Transfer Rate	Measured value (Number)	Limit (Number)	Margin (Number)
3 Mbps	79	Minimum of 15	64

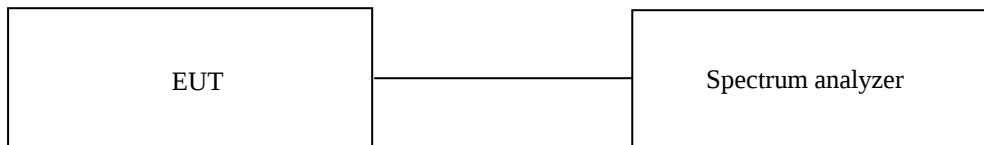
11. TIME OF OCCUPANCY

11.1 Operating environment

Temperature : 25 °C
Relative humidity : 46 % R.H.

11.2 Test set-up

The antenna output of the EUT was connected to the spectrum analyzer. The transmitter is set to operate in its normal frequency hopping mode. The center frequency of the spectrum analyzer is set to one of hopping channels near the center of the operating band and span is set to zero Hz. The sweep time is set to display one complete pulse. The mark delta function is used to measure the duration of the pulses.



11.3 Test Date

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10.4 Test data for 1 Mbps

The system makes worst case 1 600 hops per second or 1 time slot has a length of 625 μs with 79 channels.

For DH1 packet type, the EUT needs 1 time slot for transmitting and 1 time slot for receiving and for DH3 packet type, the EUT needs 3 times slots for transmitting and 1 time slot for receiving, and DH5 packet needs 5 times slots for transmitting and 1 time slot for receiving. So The EUT has each channel for 10.13 times per second (= 1 600/2/79) for DH1, and 5.06 times (= 1 600/4/79) for DH3, and 3.38 times (= 1 600/6/79) for DH5.

Packet Type	Pulse Time (ms)	Hops per second with channels	Period Time (ms)	Total Dwell Time (ms)	Limit (ms)	Test Result
DH1	0.38	10.13	31.60	122.72	400.00	PASS
DH3	1.64	5.06	31.60	262.07	400.00	
DH5	2.89	3.38	31.60	308.35	400.00	

Total dwell time is calculated as following.

Total Dwell Time = Pulse time * Hops per second with channels * period time

11.5 Test data for 2 Mbps

The system makes worst case 1 600 hops per second or 1 time slot has a length of 625 μ s with 79 channels.

For DH1 packet type, the EUT needs 1 time slot for transmitting and 1 time slot for receiving and for DH3 packet type, the EUT needs 3 times slots for transmitting and 1 time slot for receiving, and DH5 packet needs 5 times slots for transmitting and 1 time slot for receiving. So The EUT has each channel for 10.13 times per second ($= 1\ 600/2/79$) for DH1, and 5.06 times ($= 1\ 600/4/79$) for DH3, and 3.38 times ($= 1\ 600/6/79$) for DH5.

Packet Type	Pulse Time (ms)	Hops per second with channels	Period Time (ms)	Total Dwell Time (ms)	Limit (ms)	Test Result
DH1	0.39	10.13	31.60	125.69	400.00	PASS
DH3	1.64	5.06	31.60	262.85	400.00	
DH5	2.89	3.38	31.60	308.82	400.00	

Total dwell time is calculated as following.

Total Dwell Time = Pulse time * Hops per second with channels * period time

11.6 Test data for 3 Mbps

The system makes worst case 1 600 hops per second or 1 time slot has a length of 625 μ s with 79 channels.

For DH1 packet type, the EUT needs 1 time slot for transmitting and 1 time slot for receiving and for DH3 packet type, the EUT needs 3 times slots for transmitting and 1 time slot for receiving, and DH5 packet needs 5 times slots for transmitting and 1 time slot for receiving. So The EUT has each channel for 10.13 times per second ($= 1\ 600/2/79$) for DH1, and 5.06 times ($= 1\ 600/4/79$) for DH3, and 3.38 times ($= 1\ 600/6/79$) for DH5.

Packet Type	Pulse Time (ms)	Hops per second with channels	Period Time (ms)	Total Dwell Time (ms)	Limit (ms)	Test Result
DH1	0.39	10.13	31.60	125.52	400.00	PASS
DH3	1.64	5.06	31.60	262.68	400.00	
DH5	2.89	3.38	31.60	309.05	400.00	

Total dwell time is calculated as following.

Total Dwell Time = Pulse time * Hops per second with channels * period time

12. MAXIMUM PEAK OUTPUT POWER

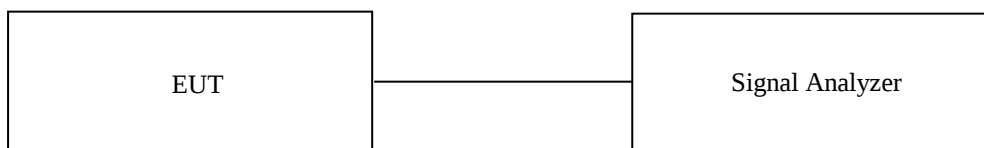
12.1 Operating environment

Temperature : 25 °C
Relative humidity : 46 % R.H.

12.2 Test set-up

The antenna output of the EUT was connected to the spectrum analyzer.

The resolution bandwidth is set to $\geq$ DTS Bandwidth, the video bandwidth is set to 3 times the resolution bandwidth.



12.3 Test Date

August 23, 2024 ~ September 24, 2024

12.4 Test data for 1 Mbps

-. Test Result : Pass

CHANNEL	FREQUENCY (MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 402.00	4.17	21.00	16.83
MIDDLE	2 441.00	4.06	21.00	16.94
HIGH	2 480.00	4.41	21.00	16.59

Remark. Margin = Limit – Measured Value (=Receiver Reading + Cable Loss)

12.5 Test data for 2 Mbps

-. Test Result : Pass

CHANNEL	FREQUENCY (MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 402.00	7.16	21.00	13.84
MIDDLE	2 441.00	7.07	21.00	13.93
HIGH	2 480.00	7.37	21.00	13.63

Remark. Margin = Limit – Measured Value (=Receiver Reading + Cable Loss)

12.6 Test data for 3 Mbps

-. Test Result : Pass

CHANNEL	FREQUENCY (MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 402.00	7.62	21.00	13.38
MIDDLE	2 441.00	7.48	21.00	13.52
HIGH	2 480.00	7.89	21.00	13.11

Remark. Margin = Limit – Measured Value (=Receiver Reading + Cable Loss)

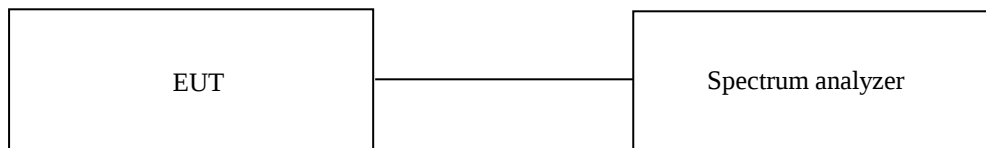
13. 100 kHz BANDWIDTH OUTSIDE THE FREQUENCY BAND

13.1 Operating environment

Temperature : 25 °C
Relative humidity : 46 % R.H.

13.2 Test set-up for conducted measurement

The antenna output of the EUT was connected to the spectrum analyzer. The resolution and video bandwidth is set to 100 kHz, and peak detection was used.



13.3 Test set-up for radiated measurement

The radiated emissions measurements were performed on the 3 m semi anechoic chamber. The EUT was placed on turntable approximately 1.5 m above the ground plane.

The frequency spectrum from 30 MHz to 26.5 GHz was scanned and maximum emission levels at each frequency recorded. The system was rotated 360°, and the antenna was varied in the height between 1.0 m and 4.0 m in order to determine the maximum emission levels. This procedure was performed for horizontal and vertical polarization of the receiving antenna.

13.4 Test Date

August 23, 2024 ~ September 24, 2024

13.5 Test data for conducted emission

For Test data for conducted emission, please refer to the Annex.

13.6 Test data for Transmitting mode radiated emission

13.6.1 Radiated Emission which fall in the Restricted Band

13.6.1.1 Test data for 1 Mbps

- Resolution bandwidth : 1 MHz and Peak Detector for Peak Mode
1 MHz and RMS Detector for Average Mode
- Video bandwidth : 3 MHz for Peak and Average Mode
- Measurement distance : 3 m
- Duty Cycle : 76.99 %
- Result : PASSED

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	AMP Gain	ATT (dB)	Duty Factor (dB)	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for Low Channel											
2 346.258	53.20	Peak	H	27.71	4.62	41.74	-	-	43.79	74.00	30.21
2 389.822	42.03	Average	H	27.54	4.65	41.74	-	1.14	33.62	54.00	20.38
2 373.738	53.47	Peak	V	27.61	4.63	41.74	-	-	43.97	74.00	30.03
2 361.974	41.06	Average	V	27.65	4.61	41.74	-	1.14	32.72	54.00	21.28
Test Data for High Channel											
2 484.266	53.42	Peak	H	27.40	4.84	41.73	-	-	43.93	74.00	30.07
2 483.886	42.33	Average	H	27.40	4.83	41.73	-	1.14	33.97	54.00	20.03
2 493.676	52.70	Peak	V	27.40	4.90	41.73	-	-	43.27	74.00	30.73
2 485.984	41.11	Average	V	27.40	4.85	41.73	-	1.14	32.77	54.00	21.23

Tabulated test data for Restricted Band

Remark: "H": Horizontal, "V": Vertical

Margin (dB) = Limits (dBμV/m) - Total Level (dBμV/m)

Total Level = Reading + Antenna Factor + Cable Loss – AMP Gain + ATT + Duty Factor

13.6.1.2 Test data for 2 Mbps

- Resolution bandwidth : 1 MHz and Peak Detector for Peak Mode
1 MHz and RMS Detector for Average Mode
- Video bandwidth : 3 MHz for Peak and Average Mode
- Measurement distance : 3 m
- Duty Cycle : 77.12 %
- Result : PASSED

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	AMP Gain	ATT (dB)	Duty Factor (dB)	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for Low Channel											
2 388.260	53.18	Peak	H	27.55	4.65	41.74	-	-	43.64	74.00	30.36
2 389.638	41.56	Average	H	27.54	4.65	41.74	-	1.13	33.14	54.00	20.86
2 360.595	52.32	Peak	V	27.66	4.61	41.74	-	-	42.85	74.00	31.15
2 389.179	41.13	Average	V	27.54	4.65	41.74	-	1.13	32.71	54.00	21.29
Test Data for High Channel											
2 498.531	52.60	Peak	H	27.40	4.92	41.73	-	-	43.19	74.00	30.81
2 484.006	42.13	Average	H	27.40	4.83	41.73	-	1.13	33.76	54.00	20.24
2 488.501	52.89	Peak	V	27.40	4.87	41.73	-	-	43.43	74.00	30.57
2 487.023	41.38	Average	V	27.40	4.86	41.73	-	1.13	33.04	54.00	20.96

Tabulated test data for Restricted Band

Remark: “H”: Horizontal, “V”: Vertical

$$\text{Margin (dB)} = \text{Limits (dB}\mu\text{V/m)} - \text{Total Level (dB}\mu\text{V/m)}$$

$$\text{Total Level} = \text{Reading} + \text{Antenna Factor} + \text{Cable Loss} - \text{AMP Gain} + \text{ATT} + \text{Duty Factor}$$

13.6.1.3 Test data for 3 Mbps

- Resolution bandwidth : 1 MHz and Peak Detector for Peak Mode
1 MHz and RMS Detector for Average Mode
- Video bandwidth : 3 MHz for Peak and Average Mode
- Measurement distance : 3 m
- Duty Cycle : 77.18 %
- Result : PASSED

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	AMP Gain	ATT (dB)	Duty Factor (dB)	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for Low Channel											
2 381.550	52.50	Peak	H	27.57	4.64	41.74	-	-	42.97	74.00	31.03
2 349.199	41.00	Average	H	27.70	4.60	41.74	-	1.12	32.68	54.00	21.32
2 326.222	52.82	Peak	V	27.80	4.66	41.74	-	-	43.54	74.00	30.46
2 337.710	41.14	Average	V	27.75	4.65	41.74	-	1.12	32.92	54.00	21.08
Test Data for High Channel											
2 486.783	52.86	Peak	H	27.40	4.86	41.73	-	-	43.39	74.00	30.61
2 483.646	41.15	Average	H	27.40	4.83	41.73	-	1.12	32.77	54.00	21.23
2 489.401	52.50	Peak	V	27.40	4.88	41.73	-	-	43.05	74.00	30.95
2 493.477	41.11	Average	V	27.40	4.90	41.73	-	1.12	32.80	54.00	21.20

Tabulated test data for Restricted Band

Remark: “H”: Horizontal, “V”: Vertical

$$\text{Margin (dB)} = \text{Limits (dB}\mu\text{V/m)} - \text{Total Level (dB}\mu\text{V/m)}$$

$$\text{Total Level} = \text{Reading} + \text{Antenna Factor} + \text{Cable Loss} - \text{AMP Gain} + \text{ATT} + \text{Duty Factor}$$

13.6.2 Spurious & Harmonic Radiated Emission above 1 GHz

13.6.2.1 Test data for 1 Mbps

- Resolution bandwidth : 1 MHz and Peak Detector for Peak Mode for the emissions fall in restricted band,
1 MHz and RMS Detector for Average Mode for the emissions fall in restricted band
100 kHz for Peak Mode for the emissions outside restricted band
- Video bandwidth : 3 MHz for Peak and Average Mode
- Frequency range : 1 GHz ~ 26.5 GHz
- Measurement distance : 3 m
- Duty Cycle : 76.99 %
- Result : PASSED

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	AMP Gain	Duty Factor (dB)	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for Low Channel										
4 804.025	58.78	Peak	H	31.20	9.71	46.18	-	53.51	74.00	20.49
4 803.970	54.24	Average	H	31.20	9.71	46.18	1.14	50.11	54.00	3.89
4 804.365	56.10	Peak	V	31.20	9.71	46.18	-	50.83	74.00	23.17
4 804.005	52.20	Average	V	31.20	9.71	46.18	1.14	48.07	54.00	5.93
Test Data for Middle Channel										
4 882.170	55.59	Peak	H	31.26	9.79	46.15	-	50.49	74.00	23.51
4 882.035	49.66	Average	H	31.26	9.79	46.15	1.14	45.70	54.00	8.30
4 882.035	53.95	Peak	V	31.26	9.79	46.15	-	48.85	74.00	25.15
4 882.035	48.16	Average	V	31.26	9.79	46.15	1.14	44.20	54.00	9.80
Test Data for High Channel										
4 960.320	57.79	Peak	H	31.54	9.90	46.12	-	53.11	74.00	20.89
4 960.060	52.95	Average	H	31.54	9.90	46.12	1.14	49.41	54.00	4.59
4 960.145	55.06	Peak	V	31.54	9.90	46.12	-	50.38	74.00	23.62
4 960.045	49.71	Average	V	31.54	9.90	46.12	1.14	46.17	54.00	7.83

Remark: "H": Horizontal, "V": Vertical

$$\text{Margin (dB)} = \text{Limits (dBμV/m)} - \text{Total Level (dBμV/m)}$$

$$\text{Total Level} = \text{Reading} + \text{Antenna Factor} + \text{Cable Loss} - \text{AMP Gain} + \text{Duty Factor}$$

13.6.2.2 Test data for 2 Mbps

- Resolution bandwidth : 1 MHz and Peak Detector for Peak Mode for the emissions fall in restricted band,
1 MHz and RMS Detector for Average Mode for the emissions fall in restricted band
100 kHz for Peak Mode for the emissions outside restricted band
- Video bandwidth : 3 MHz for Peak and Average Mode
- Frequency range : 1 GHz ~ 26.5 GHz
- Measurement distance : 3 m
- Duty Cycle : 77.12 %
- Result : PASSED

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	AMP Gain	Duty Factor (dB)	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for Low Channel										
4 803.735	61.02	Peak	H	31.20	9.71	46.18	-	55.75	74.00	18.25
4 803.995	53.72	Average	H	31.20	9.71	46.18	1.13	49.58	54.00	4.42
4 803.800	57.94	Peak	V	31.20	9.71	46.18	-	52.67	74.00	21.33
4 803.985	51.17	Average	V	31.20	9.71	46.18	1.13	47.03	54.00	6.97
Test Data for Middle Channel										
4 882.160	56.91	Peak	H	31.26	9.79	46.15	-	51.81	74.00	22.19
4 882.060	49.21	Average	H	31.26	9.79	46.15	1.13	45.24	54.00	8.76
4 882.215	55.46	Peak	V	31.26	9.79	46.15	-	50.36	74.00	23.64
4 882.065	48.11	Average	V	31.26	9.79	46.15	1.13	44.14	54.00	9.86
Test Data for High Channel										
4 960.410	58.76	Peak	H	31.54	9.90	46.12	-	54.08	74.00	19.92
4 960.030	51.73	Average	H	31.54	9.90	46.12	1.13	48.18	54.00	5.82
4 959.685	56.81	Peak	V	31.54	9.90	46.12	-	52.13	74.00	21.87
4 959.995	49.67	Average	V	31.54	9.90	46.12	1.13	46.12	54.00	7.88

Remark: "H": Horizontal, "V": Vertical

Margin (dB) = Limits (dBμV/m) - Total Level (dBμV/m)

Total Level = Reading + Antenna Factor + Cable Loss – AMP Gain + Duty Factor

13.6.2.3 Test data for 3 Mbps

- Resolution bandwidth : 1 MHz and Peak Detector for Peak Mode for the emissions fall in restricted band,
1 MHz and RMS Detector for Average Mode for the emissions fall in restricted band
100 kHz for Peak Mode for the emissions outside restricted band
- Video bandwidth : 3 MHz for Peak and Average Mode
- Frequency range : 1 GHz ~ 26.5 GHz
- Measurement distance : 3 m
- Duty Cycle : 77.18 %
- Result : PASSED

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	AMP Gain	Duty Factor (dB)	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for Low Channel										
4 803.970	63.70	Peak	H	31.20	9.71	46.18	-	58.43	74.00	15.57
4 803.905	53.79	Average	H	31.20	9.71	46.18	1.12	49.64	54.00	4.36
4 803.995	57.86	Peak	V	31.20	9.71	46.18	-	52.59	74.00	21.41
4 804.020	51.70	Average	V	31.20	9.71	46.18	1.12	47.55	54.00	6.45
Test Data for Middle Channel										
4 882.120	57.50	Peak	H	31.26	9.79	46.15	-	52.40	74.00	21.60
4 882.050	49.40	Average	H	31.26	9.79	46.15	1.12	45.42	54.00	8.58
4 882.110	55.16	Peak	V	31.26	9.79	46.15	-	50.06	74.00	23.94
4 882.095	47.25	Average	V	31.26	9.79	46.15	1.12	43.27	54.00	10.73
Test Data for High Channel										
4 960.300	59.08	Peak	H	31.54	9.90	46.12	-	54.40	74.00	19.60
4 960.110	51.95	Average	H	31.54	9.90	46.12	1.12	48.39	54.00	5.61
4 960.010	56.99	Peak	V	31.54	9.90	46.12	-	52.31	74.00	21.69
4 959.965	49.31	Average	V	31.54	9.90	46.12	1.12	45.75	54.00	8.25

Remark: "H": Horizontal, "V": Vertical

Margin (dB) = Limits (dBμV/m) - Total Level (dBμV/m)

Total Level = Reading + Antenna Factor + Cable Loss – AMP Gain + Duty Factor

14. RADIATED EMISSION TEST

14.1 Operating environment

Temperature : 25 °C
Relative humidity : 46 % R.H.

14.2 Test set-up

The radiated emissions measurements were on the 3 m semi anechoic chamber. The EUT and other support equipment were placed on a non-conductive turntable above the ground plane. The interconnecting cables from outside test site were inserted into ferrite clamps at the point where the cables reach the turntable.

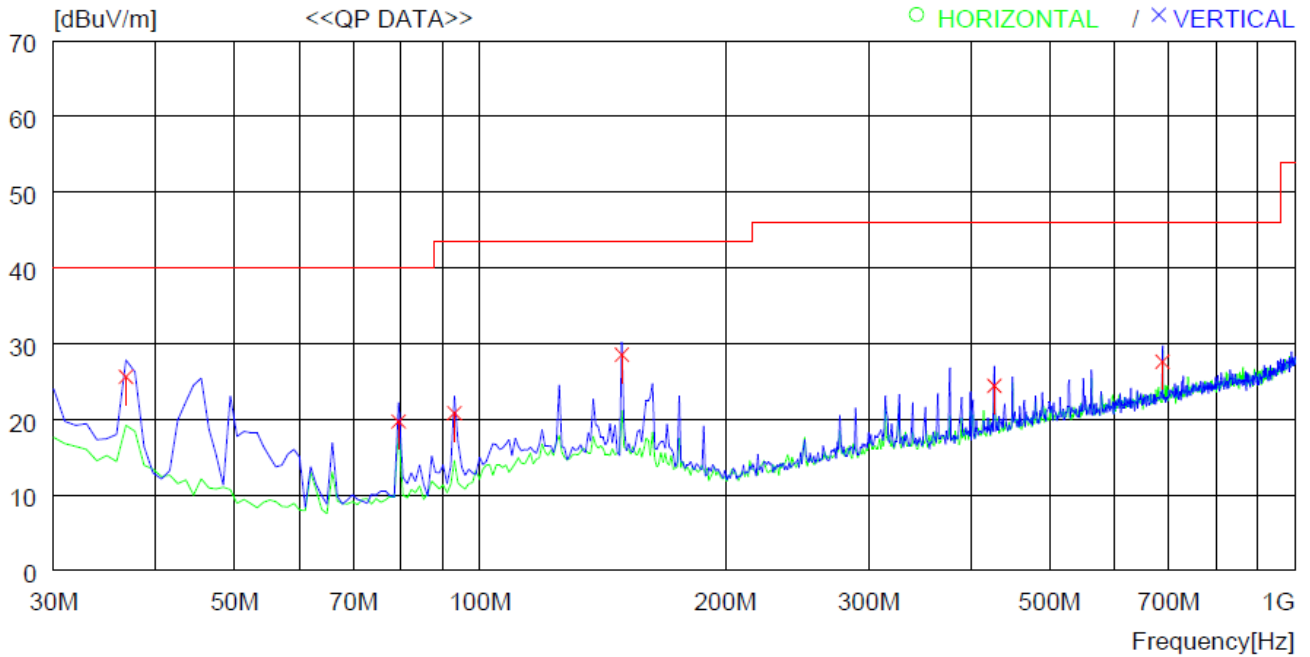
The frequency spectrum from 30 MHz to 26.5 GHz was scanned and emission levels maximized at each frequency recorded. The system was rotated 360°, and the antenna was varied in height between 1.0 m and 4.0 m in order to determine the maximum emission levels. This procedure was performed for both horizontal and vertical polarization of the receiving antenna.

14.3 Test Date

August 23, 2024 ~ September 24, 2024

14.4 Test data for 30 MHz ~ 1 000 MHz

- Resolution bandwidth : 120 kHz
- Frequency range : 30 MHz ~ 1 000 MHz
- Measurement distance : 3 m



No.	FREQ	READING	ANT	LOSS	GAIN	RESULT	LIMIT	MARGIN	ANTENNA	TABLE
	[MHz]	QP	FACTOR	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dB]	[cm]	[DEG]
----- Vertical -----										
1	36.790	38.4	18.5	0.8	32.1	25.6	40.0	14.4	300	359
2	79.470	37.1	13.4	1.2	32.0	19.7	40.0	20.3	100	253
3	93.050	37.2	14.3	1.3	32.0	20.8	43.5	22.7	100	234
4	149.310	40.3	18.7	1.6	32.1	28.5	43.5	15.0	100	359
5	427.701	32.3	21.5	2.7	32.1	24.4	46.0	21.6	100	359
6	687.655	31.2	25.4	3.4	32.4	27.6	46.0	18.4	200	0

14.5 Test data for Below 30 MHz

-. Resolution bandwidth : 200 Hz (from 9 kHz to 0.15 MHz), 9 kHz (from 0.15 MHz to 30 MHz)

-. Frequency range : 9 kHz ~ 30 MHz

-. Measurement distance : 3 m

Frequency (MHz)	Reading (dBμV)	Ant. Pol. (H/V)	Ant. Factor (dB/m)	Cable Loss	Amp Gain	Emission Level(dBμV/m)	Limits (dBμV/m)	Margin (dB)
Emission from the EUT more than 20 dB below the limit in each frequency range.								

13.6 Test data for above 1 GHz

-. Resolution bandwidth : 1 MHz and Peak Detector for Peak Mode

1 MHz and RMS Detector for Average Mode

-. Video bandwidth : 3 MHz for Peak and Average Mode

-. Frequency range : 1 GHz ~ 26.5 GHz

-. Measurement distance : 3 m

Frequency (MHz)	Reading (dBμV)	Ant. Pol. (H/V)	Ant. Factor (dB/m)	Cable Loss	Amp Gain	Emission Level(dBμV/m)	Limits (dBμV/m)	Margin (dB)
Emission from the EUT more than 20 dB below the limit in each frequency range.								

15. CONDUCTED EMISSION TEST

15.1 Operating environment

Temperature : 25 °C
Relative humidity : 46 % R.H.

15.2 Test set-up

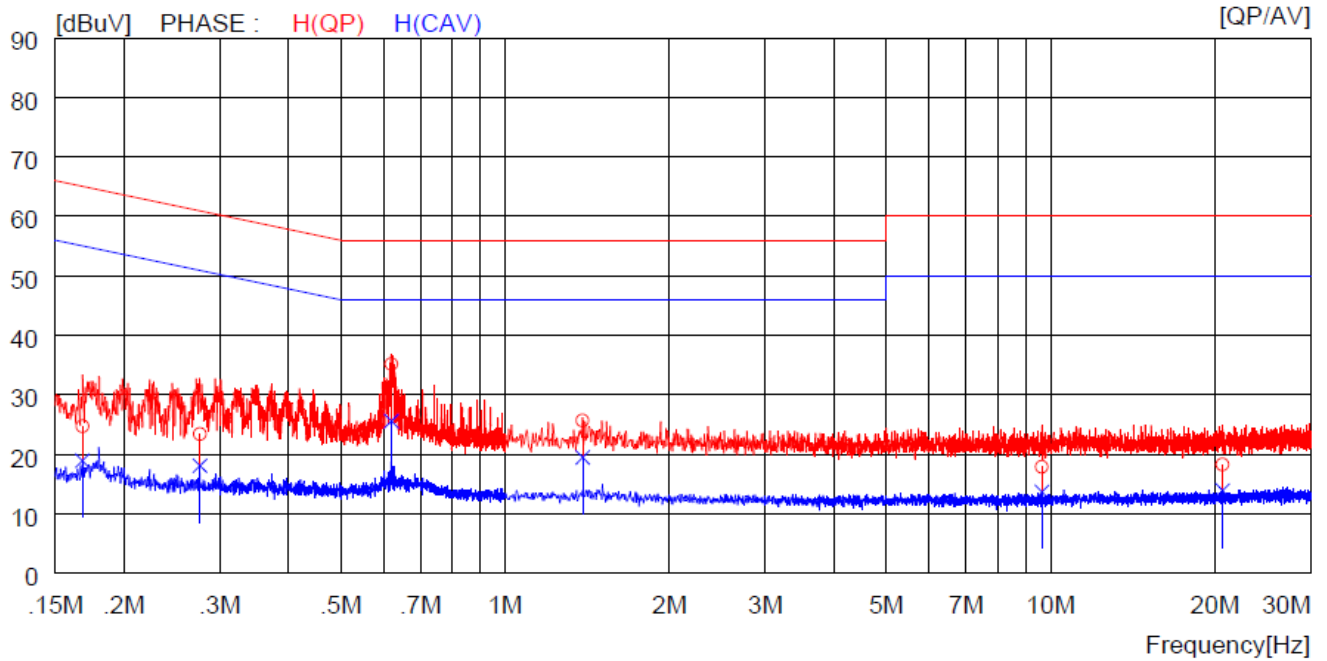
The EUT was placed on a wooden table, 0.8 m height above the floor. Power was fed to the EUT through a $50\ \Omega$ / $50\ \mu\text{H}$ + $5\ \Omega$ Artificial Mains Network (AMN). The ground plane was electrically bonded to the reference ground system and all power lines were filtered from ambient.

15.3 Test Date

August 23, 2024 ~ September 24, 2024

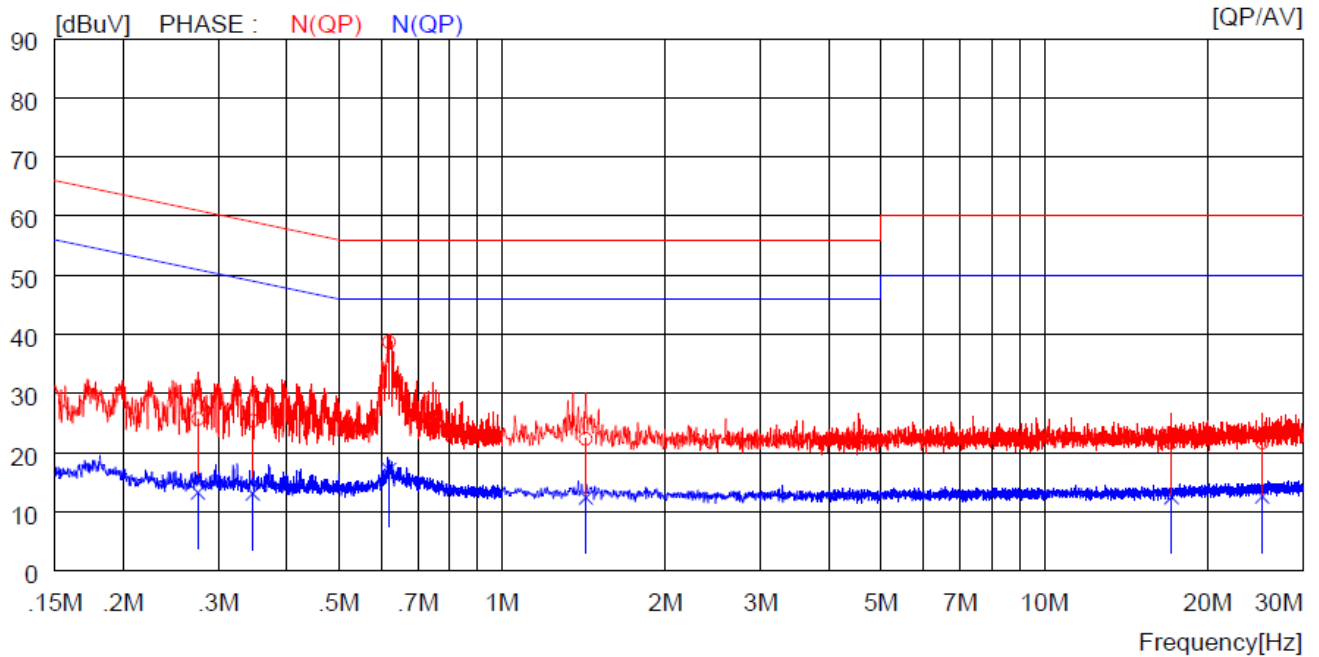
15.4 Test data

- Resolution bandwidth : 9 kHz
- Frequency range : 0.15 MHz ~ 30 MHz
- Tested Line : HOT LINE



NO	FREQ [MHz]	READING		C.FACTOR [dB]	RESULT		LIMIT		MARGIN		PHASE
		QP [dBuV]	AV [dBuV]		QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	
1	0.16800	14.6	----	10.1	24.7	----	65.1	----	40.4	----	H (QP)
2	0.27600	13.4	----	10.0	23.4	----	60.9	----	37.5	----	H (QP)
3	0.61900	25.1	----	10.1	35.2	----	56.0	----	20.8	----	H (QP)
4	1.38800	15.6	----	10.1	25.7	----	56.0	----	30.3	----	H (QP)
5	9.64500	7.6	----	10.3	17.9	----	60.0	----	42.1	----	H (QP)
6	20.68000	7.7	----	10.6	18.3	----	60.0	----	41.7	----	H (QP)
7	0.16800	----	8.9	10.1	----	19.0	----	55.1	----	36.1	H (CAV)
8	0.27600	----	8.1	10.0	----	18.1	----	50.9	----	32.8	H (CAV)
9	0.61900	----	15.5	10.1	----	25.6	----	46.0	----	20.4	H (CAV)
10	1.38800	----	9.4	10.1	----	19.5	----	46.0	----	26.5	H (CAV)
11	9.64500	----	3.4	10.3	----	13.7	----	50.0	----	36.3	H (CAV)
12	20.68000	----	3.3	10.6	----	13.9	----	50.0	----	36.1	H (CAV)

-. Tested Line : NEUTRAL LINE



NO	FREQ [MHz]	READING		C.FACTOR [dB]	RESULT		LIMIT		MARGIN		PHASE
		QP [dBuV]	AV [dBuV]		QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	
1	0.27500	15.7	----	10.0	25.7	----	61.0	----	35.3	----	N (QP)
2	0.34700	15.4	----	10.0	25.4	----	59.0	----	33.6	----	N (QP)
3	0.61900	28.6	----	10.1	38.7	----	56.0	----	17.3	----	N (QP)
4	1.42800	12.2	----	10.1	22.3	----	56.0	----	33.7	----	N (QP)
5	17.17000	11.1	----	10.6	21.7	----	60.0	----	38.3	----	N (QP)
6	25.22000	10.9	----	10.8	21.7	----	60.0	----	38.3	----	N (QP)
7	0.27500	----	3.3	10.0	----	13.3	----	51.0	----	37.7	N (CAV)
8	0.34700	----	3.1	10.0	----	13.1	----	49.0	----	35.9	N (CAV)
9	0.61900	----	7.0	10.1	----	17.1	----	46.0	----	28.9	N (CAV)
10	1.42800	----	2.3	10.1	----	12.4	----	46.0	----	33.6	N (CAV)
11	17.17000	----	1.9	10.6	----	12.5	----	50.0	----	37.5	N (CAV)
12	25.22000	----	1.8	10.8	----	12.6	----	50.0	----	37.4	N (CAV)

Remark: Margin (dB) = Limit – Level (Result)

The emission level in above table is included the transducer factor that means insertion loss (LISN), cable loss and attenuator.

16. LIST OF TEST EQUIPMENT

Model Number	Manufacturer	Description	Serial Number	Last Cal.(Interval)
FSV30	Rohde & Schwarz	Signal Analyzer	101199	Jan. 15, 2024 (1Y)
ESR3	Rohde & Schwarz	EMI Test Receiver	102602	Mar. 11, 2024 (1Y)
310N	Sonoma Instrument	Pre-Amplifier	392756	Oct. 16, 2023 (1Y)
SCU18	Rohde & Schwarz	Pre-Amplifier	102266	Jul. 04, 2024 (1Y)
SCU18	Rohde & Schwarz	Pre-Amplifier	102209	Oct. 11, 2023 (1Y)
SCU40A	Rohde & Schwarz	Pre-Amplifier	100436	Jan. 23, 2024 (1Y)
DT2000-2t	Innco System	Turn Table	N/A	N/A
MA-4640-XPET	Innco System	Antenna Master	MA4640/652/43100318/P	N/A
CO3000	Innco System	Controller	1026/40960617/P	N/A
FMZB 1513	Schwarzbeck	Loop Antenna	1513-235	Mar. 20, 2024 (2Y)
HLP-2008	TDK	Hybrid Antenna	131316	Mar. 09, 2024 (2Y)
BBHA9120D	Schwarzbeck	Horn Antenna	9120D-1349	Jul. 02, 2024 (1Y)
BBHA9170	Schwarzbeck	Horn Antenna	BBHA9170178	Jan. 04, 2024 (1Y)
HPF 3GHz	Rohde & Schwarz	High Pass Filter	N/A	Jan. 15, 2024 (1Y)
ESCI	Rohde & Schwarz	EMI TEST RECEIVER	101012	Sep. 26, 2023 (1Y)
NSLK8128	Schwarzbeck	AMN	8128216	Mar. 12, 2024 (1Y)
ESH3-Z2	Rohde & Schwarz	PULSE LIMITER	100655	Mar. 12, 2024 (1Y)