

RADIO PERFORMANCE TEST REPORT

Test Report No. : OT-232-RWD-021
Reception No. : 2212003857
Applicant : PARTRON CO., LTD
Address : 22, Samsung1-ro2-gil, Hwaseong-si, Gyeonggi-do, Hwaseong, South Korea
Manufacturer : PARTRON CO., LTD
Address : 22, Samsung1-ro2-gil, Hwaseong-si, Gyeonggi-do, Hwaseong, South Korea
Type of Equipment : HYBE REPEATER
FCC ID. : 2AD5K-HR
Model Name : HR
Multiple Model Name : N/A
Serial number : N/A
Total page of Report : 24 pages (including this page)
Date of Incoming : February 13, 2023
Date of issue : February 27, 2023

SUMMARY

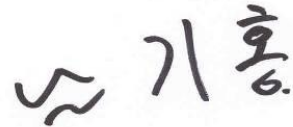
The equipment complies with the regulation; *FCC PART 15 SUBPART C Section 15.247*

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-232-RWD-021	February 27, 2023	Initial Release	All

1. VERIFICATION OF COMPLIANCE

Applicant : PARTRON CO., LTD
 Address : 22, Samsung 1-ro2-gil, Hwaseong-si, Gyeonggi-do, Hwaseong, South Korea
 Contact Person : Choi Hyung Kon / Section Chief
 Telephone No. : +82-10-9209-0111
 FCC ID : 2AD5K-HR
 Model Name : HR
 Brand Name : HYBE
 Serial Number : N/A
 Date : February 27, 2023

EQUIPMENT CLASS	DTS – DIGITAL TRNSMISSION SYSTEM
E.U.T. DESCRIPTION	HYBE REPEATER
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) (2)	Minimum 6 dB Bandwidth	Met the Limit / PASS
15.247 (b) (3)	Maximum 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
15.247 (e)	Power Spectral Density	Met the Limit / PASS
15.209	Radiated Emission Limits	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

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

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

FCC (Federal Communications Commission) - Accreditation No. KR0013

RRA (Radio Research Agency) – Designation No. KR0013

3. GENERAL INFORMATION

3.1 Product Description

The PARTRON CO., LTD, Model HR (referred to as the EUT in this report) is a HYBE REPEATER. The product specification described herein was obtained from product data sheet or user’s manual.

DEVICE TYPE	HYBE REPEATER
OPERATING FREQUENCY	2 480 MHz (Zigbee) [Only 1 channel is used.]
MODULATION TYPE	DSSS
RF OUTPUT POWER	-17.13 dBm
ANTENNA TYPE	Patch Antenna
ANTENNA GAIN	8.82 dBi
List of each Osc. or crystal Freq.(Freq. >= 1 MHz)	38.4 MHz
RATED SUPPLY VOLTAGE	DC 12.0 V

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	N/A	N/A	N/A
Adapter	ShenZhen Smart Power Technology Co., Ltd.	SMP60A-1205000-W	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
HR	PARTRON CO., LTD	HYBE REPEATER (EUT)	-
Adapter	ShenZhen Smart Power Technology Co., Ltd.	SMP60A-1205000-W	N/A
Ideapad L340	Lenovo	Notebook PC	EUT

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 2 480 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 “XZ” axis, but the worst data was recorded in this report.

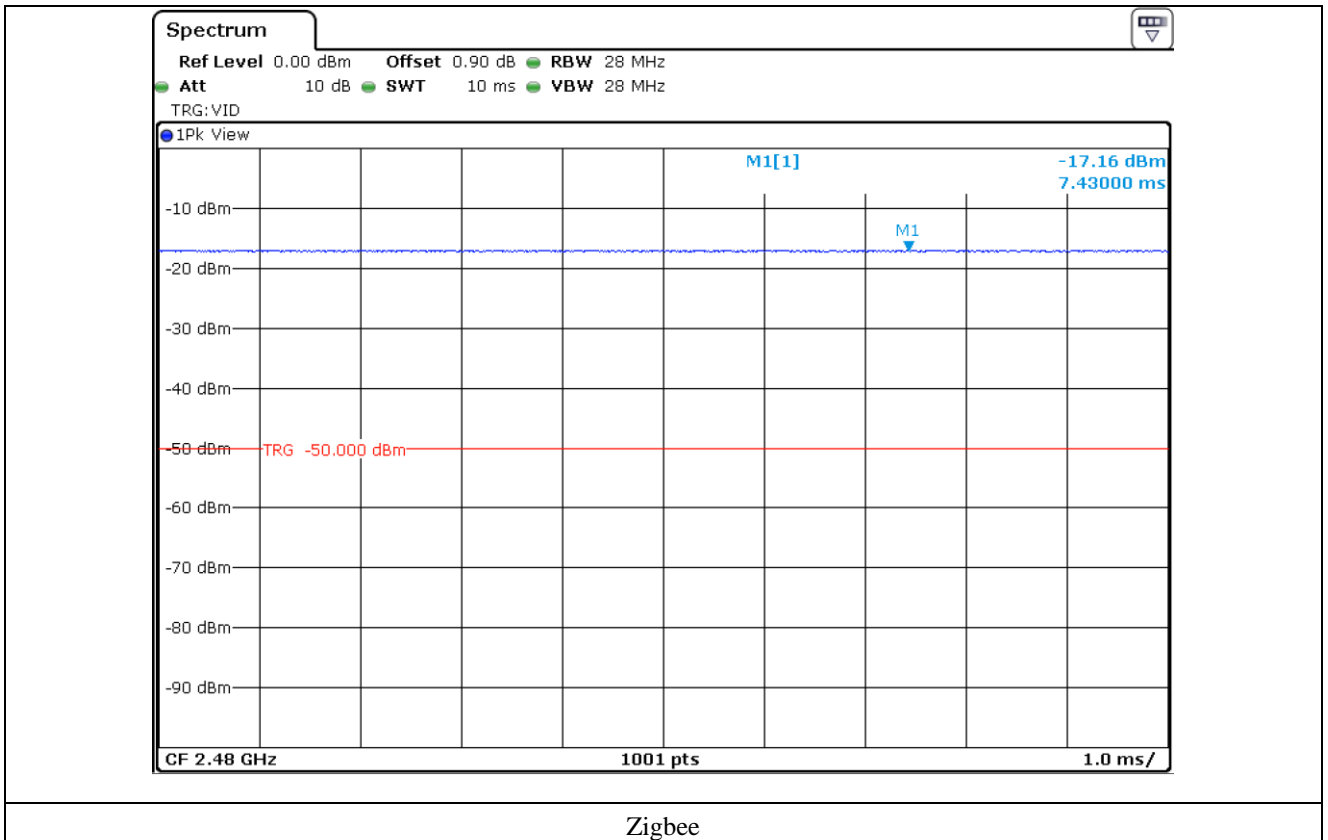
- Duty Cycle

Mode	Tx On Time [ms]	Tx Off Time [ms]	Duty Cycle [%]	Correction Factor [dB]
Zigbee	-	-	100.00	0.00

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

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

- Test Plot



5.4 Configuration of Test System

Line Conducted Test: The EUT was connected to LISN. All supporting equipment's 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 Patch Antenna on the main board in the EUT, so no consideration of replacement by the user.

6. PRELIMINARY TEST

6.1 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

6.2 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

7. MIMIMUM 6 dB BANDWIDTH

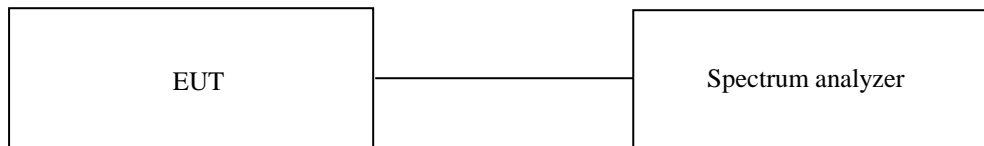
7.1 Operating environment

Temperature : 23 °C

Relative humidity : 46 % R.H.

7.2 Test set-up

The antenna output of the EUT was connected to the spectrum analyzer. The resolution bandwidth is set to 100 kHz, and peak detection was used. The 6 dB bandwidth is defined as the total spectrum over which the power is higher than the peak power minus 6 dB.



7.3 Test date

February 13, 2023 ~ February 17, 2023

7.4 Test data

-. Test Result : Pass

CHANNEL	FREQUENCY (MHz)	6 dB Bandwidth (kHz)	LIMIT (kHz)	Margin (kHz)
-	2 480.00	1 648.00	500.00	1 148.00

Remark. Margin = Measured Value – Limit

8. MAXIMUM CONDUCTED(PEAK) OUTPUT POWER

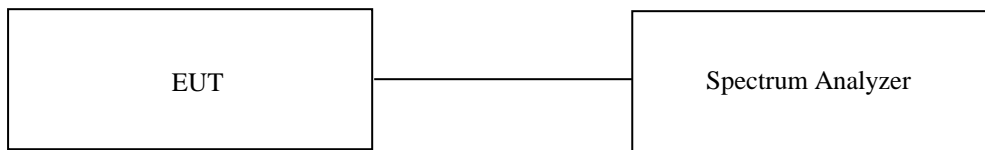
8.1 Operating environment

Temperature : 23 °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 \geq DTS Bandwidth, the video bandwidth is set to 3 times the resolution bandwidth.



8.3 Test date

February 13, 2023 ~ February 17, 2023

8.4 Test data

-. Test Result : Pass
 -. Duty Cycle : 100 %

CHANNEL	FREQUENCY (MHz)	MEASURED VALUE (dBm)	LIMIT (dBm)	MARGIN (dB)
-	2 480.00	-17.13	27.18	44.31

Remark. Margin = Limit – Measured Value

Remark. The antennas gain greater than 6 dBi are used, the conducted output power shall be reduced below the amount in dB that the directional gain of the antenna exceeds 6 dBi.

9. 100 kHz BANDWIDTH OUTSIDE THE FREQUENCY BAND

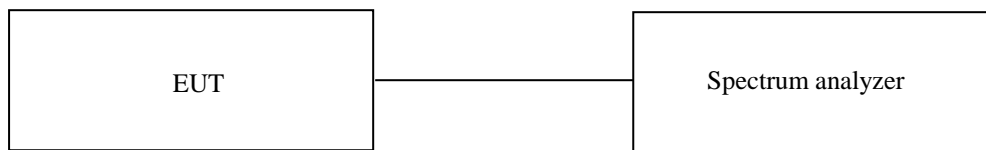
9.1 Operating environment

Temperature : 23 °C

Relative humidity : 46 % R.H.

9.2 Test set-up for conducted measurement

The antenna output of the EUT was connected to the spectrum analyzer. The resolution bandwidth is set to 100 kHz and video bandwidth is set to 300 kHz, and peak detection was used.



9.3 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.

9.4 Test date

February 13, 2023 ~ February 17, 2023

9.5 Test data for conducted emission

Please refer to the Annex

9.6 Test data for radiated emission

9.6.1 Radiated Emission which fall in the Restricted Band

- 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 : 100 %
- Result : PASSED

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	AMP Factor	ATT (dB)	Duty Factor (dB)	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
2 337.430	52.36	Peak	H	27.48	5.74	44.97	5.77	-	46.38	74.00	27.62
2 354.410	40.55	Average	H	27.33	5.74	44.96	5.77	-	34.43	54.00	19.57
2 351.690	52.65	Peak	V	27.31	5.74	44.96	5.77	-	46.51	74.00	27.49
2 347.450	40.56	Average	V	27.34	5.74	44.96	5.77	-	34.45	54.00	19.55
2 497.690	52.99	Peak	H	27.51	5.89	44.90	5.77	-	47.26	74.00	26.74
2 488.300	41.15	Average	H	27.55	5.90	44.90	5.77	-	35.47	54.00	18.53
2 492.800	52.42	Peak	V	27.53	5.89	44.90	5.77	-	46.71	74.00	27.29
2 498.590	40.99	Average	V	27.51	5.89	44.90	5.77	-	35.26	54.00	18.74

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

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

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

9.6.2 Spurious & Harmonic Radiated Emission

- 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 : 100 %
- Result : PASSED

Frequency (MHz)	Reading (dBµV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	AMP Factor	Duty Factor (dB)	Total (dBµV/m)	Limits (dBµV/m)	Margin (dB)
4 958.840	56.24	Peak	H	31.35	9.07	44.69	-	51.97	74.00	22.03
4 960.910	49.88	Average	H	31.37	9.07	44.69	-	45.63	54.00	8.37
4 961.050	53.53	Peak	V	31.37	9.07	44.69	-	49.28	74.00	24.72
4 960.970	46.44	Average	V	31.37	9.07	44.69	-	42.19	54.00	11.81

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

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

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

10. POWER SPECTRAL DENSITY

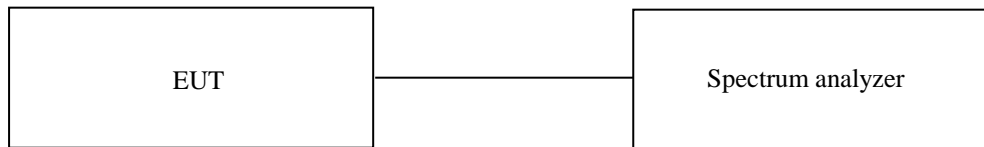
10.1 Operating environment

Temperature : 23 °C
 Relative humidity : 46 % R.H.

10.2 Test set-up

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

The resolution bandwidth is set to $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$, the video bandwidth is set to 3 times the resolution bandwidth.



10.3 Test date

February 13, 2023 ~ February 17, 2023

10.4 Test data

-. Test Result : Pass
 -. Duty Cycle : 100 %

CHANNEL	FREQUENCY (MHz)	MEASURED VALUE (dBm)	LIMIT (dBm / 3 kHz)	MARGIN (dB)
-	2 480.00	-32.72	8.00	40.72

Remark. Margin = Limit – Measured Value

11. RADIATED EMISSION TEST

11.1 Operating environment

Temperature : 23 °C

Relative humidity : 46 % R.H.

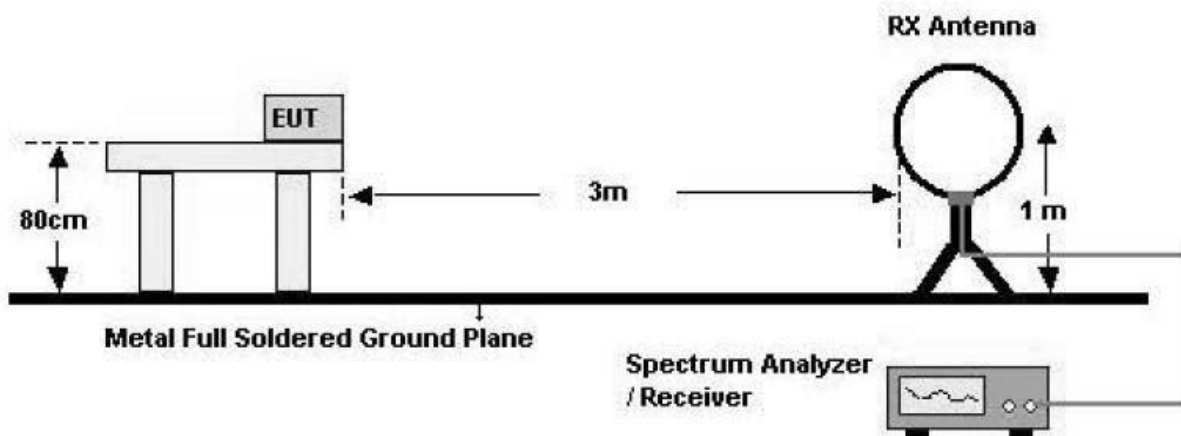
11.2 Test set-up

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.

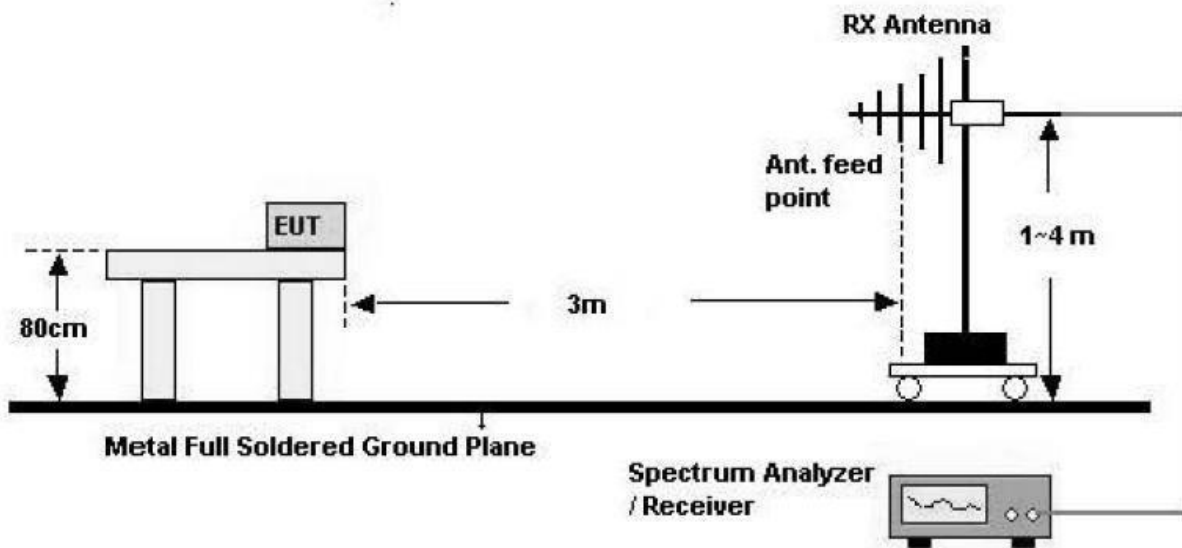
The frequency spectrum from 30 MHz to 26.5 GHz was scanned and emission levels maximized at each frequency recorded. The system was rotated 360°, and the antenna was varied in height between 1.0 m and 4.0 m in order to determine the maximum emission levels. This procedure was performed for both horizontal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

- Test Configuration

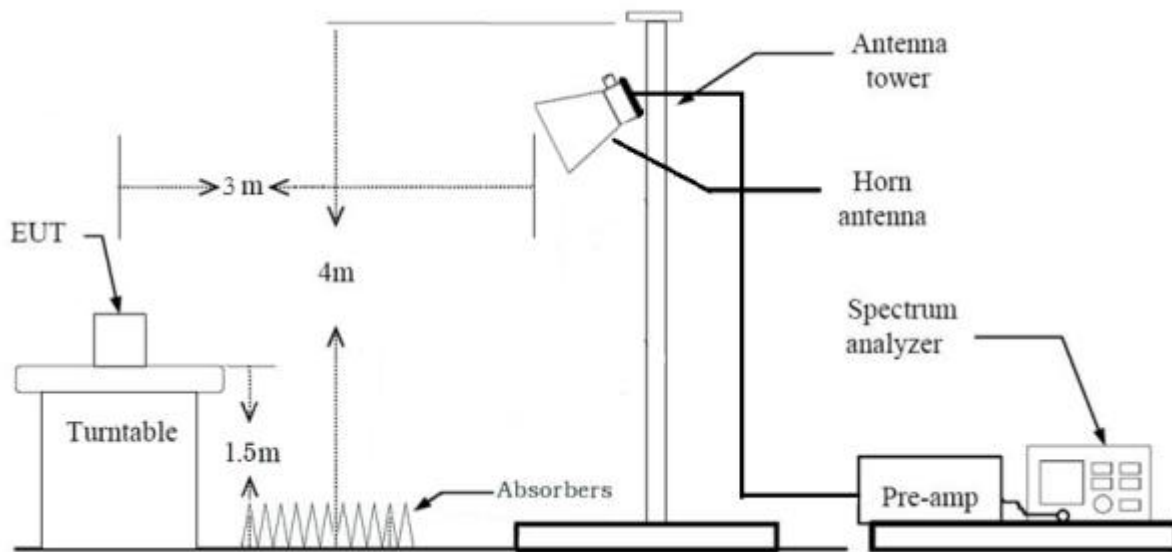
1. Below 30 MHz



2. 30 MHz - 1 GHz



3. Above 1 GHz



11.3 Test Date

February 13, 2023 ~ February 17, 2023

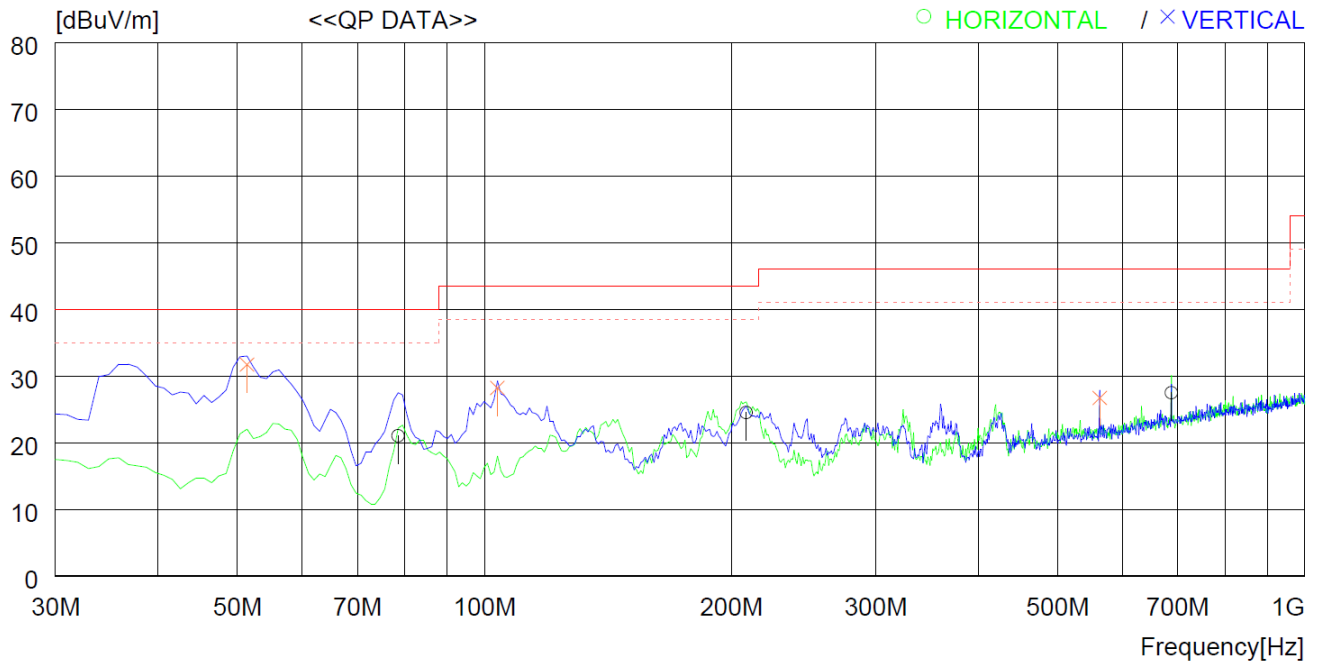
11.4 Test data for 30 MHz ~ 1 000 MHz

Limits apply to : FCC CFR 47, PART 15, SUBPART C, SECTION 15.247

Result : PASSED

EUT : HYBE REPEATER

Detector : CISPR Quasi-Peak (6 dB Bandwidth: 120 kHz)



No.	FREQ [MHz]	READING QP [dBuV]	ANT FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
----- Horizontal -----										
1	78.500	38.7	13.2	1.1	32.0	21.0	40.0	19.0	400	294
2	208.480	38.9	15.8	1.8	32.0	24.5	43.5	19.0	200	359
3	687.655	31.2	25.2	3.4	32.3	27.5	46.0	18.5	400	359
----- Vertical -----										
4	51.340	50.0	12.8	0.9	32.0	31.7	40.0	8.3	100	83
5	103.720	43.0	15.9	1.3	32.0	28.2	43.5	15.3	100	16
6	562.529	32.1	23.7	3.1	32.2	26.7	46.0	19.3	400	116

11.5 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
- Operating mode : Transmitting mode

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

11.6 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
- Operating mode : Transmitting mode

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

12. CONDUCTED EMISSION TEST

12.1 Operating environment

Temperature : 23 °C

Relative humidity : 46 % R.H.

12.2 Test set-up

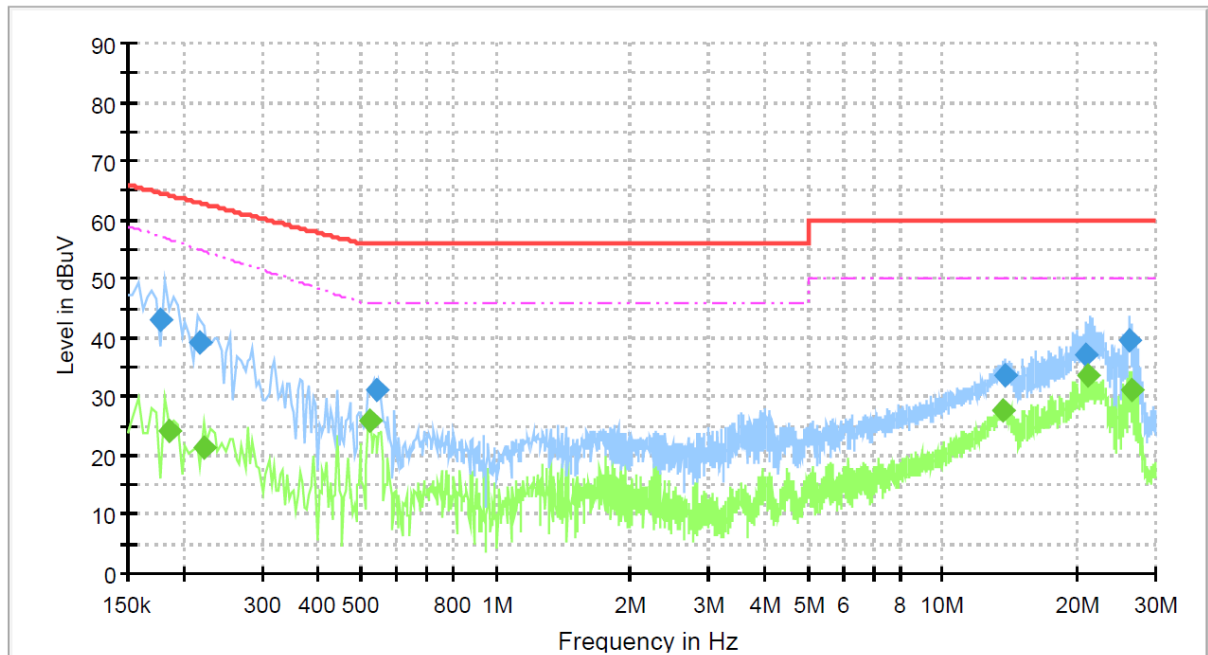
The EUT was placed on a wooden table, 0.8 m height above the floor. Power was fed to the EUT through a 50 Ω / 50 μ H + 5 Ω Artificial Mains Network (AMN). The ground plane was electrically bonded to the reference ground system and all power lines were filtered from ambient.

12.3 Test Date

February 13, 2023 ~ February 17, 2023

12.4 Test data

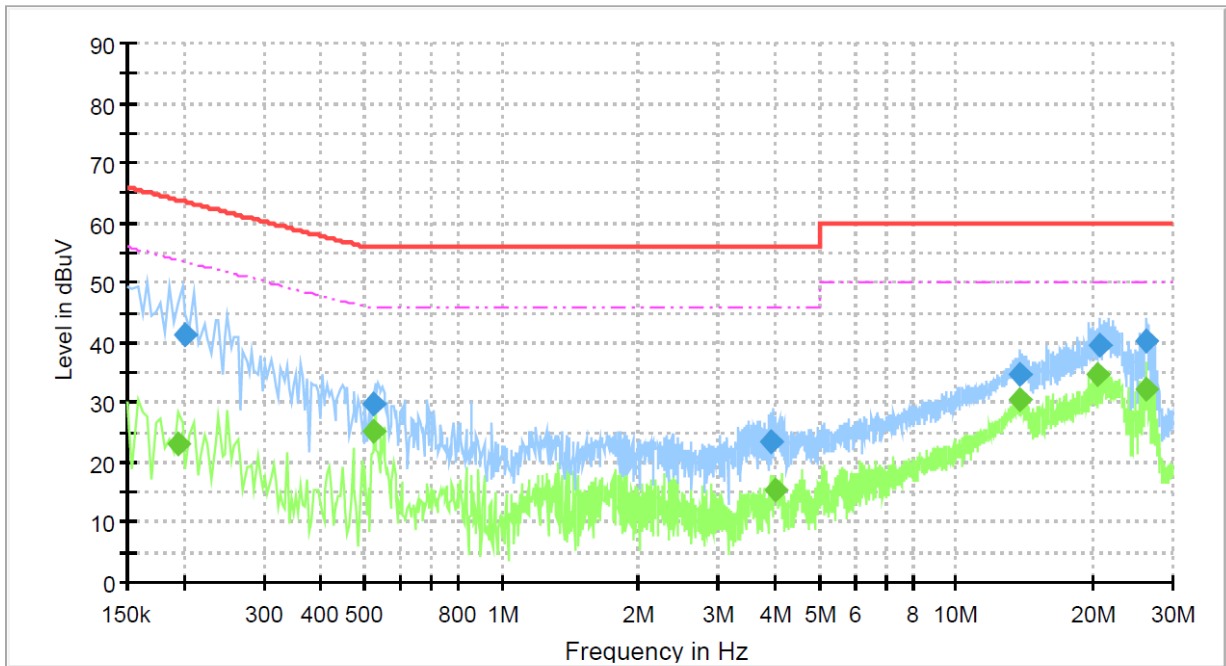
- Resolution bandwidth : 9 kHz
- Frequency range : 0.15 MHz ~ 30 MHz
- Tested Line : HOT LINE



Final Result

Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.178	42.92	---	64.60	21.69	3000.0	9.0	L1	9.99
0.187	---	23.99	56.65	32.66	3000.0	9.0	L1	10.00
0.219	39.32	---	62.88	23.56	3000.0	9.0	L1	10.02
0.222	---	21.34	54.79	33.45	3000.0	9.0	L1	10.02
0.521	---	25.88	46.00	20.12	3000.0	9.0	L1	10.11
0.539	31.22	---	56.00	24.78	3000.0	9.0	L1	10.12
13.621	---	27.51	50.00	22.49	3000.0	9.0	L1	10.54
13.800	33.61	---	60.00	26.40	3000.0	9.0	L1	10.54
20.996	36.96	---	60.00	23.04	3000.0	9.0	L1	10.69
21.120	---	33.78	50.00	16.22	3000.0	9.0	L1	10.69
26.283	39.57	---	60.00	20.43	3000.0	9.0	L1	10.72
26.383	---	31.04	50.00	18.96	3000.0	9.0	L1	10.72

-. Tested Line : NEUTRAL LINE



Final Result

Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.194	---	23.25	53.89	30.64	3000.0	9.0	N	9.95
0.202	41.35	---	63.55	22.19	3000.0	9.0	N	9.95
0.521	29.65	---	56.00	26.35	3000.0	9.0	N	9.96
0.525	---	25.07	46.00	20.93	3000.0	9.0	N	9.96
3.934	23.29	---	56.00	32.71	3000.0	9.0	N	10.09
3.986	---	15.27	46.00	30.73	3000.0	9.0	N	10.09
13.803	---	30.34	50.00	19.66	3000.0	9.0	N	10.51
13.803	34.78	---	60.00	25.22	3000.0	9.0	N	10.51
20.559	---	34.72	50.00	15.28	3000.0	9.0	N	10.72
20.639	39.61	---	60.00	20.39	3000.0	9.0	N	10.72
26.140	---	32.11	50.00	17.89	3000.0	9.0	N	10.72
26.200	40.21	---	60.00	19.79	3000.0	9.0	N	10.72

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.

13. LIST OF TEST EQUIPMENT

Model Number	Manufacturer	Description	Serial Number	Last Cal.(Interval)
FSV40-N	Rohde & Schwarz	Signal Analyzer	102177	Apr. 11, 2022 (1Y)
FSVA40	Rohde & Schwarz	Signal Analyzer	101586	Apr. 21, 2022 (1Y)
ESU	Rohde & Schwarz	EMI Test Receiver	100261	Mar. 07, 2022 (1Y)
310N	Sonoma Instrument	Pre-Amplifier	392756	Oct. 13, 2022 (1Y)
SCU18	Rohde & Schwarz	Signal Conditioning unit	102266	Jul. 12, 2022 (1Y)
SCU40A	Rohde & Schwarz	Signal Conditioning unit	100436	Jan. 18, 2023 (1Y)
HPF 3GHz	Rohde & Schwarz	High Pass Filter	N/A	Jan. 16, 2023 (1Y)
FMZB 1513	Schwarzbeck	Loop Antenna	1513-235	Mar. 24, 2022 (2Y)
HLP-2008	TDK	Hybrid Antenna	131316	Mar. 07, 2022 (2Y)
BBHA9120D	Schwarzbeck	Horn Antenna	9120D-1349	Jul. 08, 2022 (1Y)
BBHA9170	Schwarzbeck	Horn Antenna	BBHA9170179	Jan. 25, 2023 (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
ESR	Rohde & Schwarz	EMI Test Receiver	102602	Mar. 14, 2022 (1Y)
ESH3Z2	Rohde & Schwarz	PULSE LIMITER	357.8810.52	Mar. 14, 2022 (1Y)
NSLK8126	Schwarzbeck	LISN	8126404	Aug. 09, 2022 (1Y)
3825/2	EMCO	AMN	9109-1869	Mar. 15, 2022 (1Y)