

FCC 47 CFR PART 15 SUBPART B (ICES-003) TEST REPORT

Test Report No. : OT-22D-RED-103
AGR No. : 2212003857
Applicant : PARTRON CO., LTD
Address : 22, Samsung1-ro2-gil, Hwaseong-si, Gyeonggi-do, South Korea
Manufacturer : PARTRON CO., LTD
Address : 22, Samsung1-ro2-gil, Hwaseong-si, Gyeonggi-do, South Korea
Type of Equipment : HYBE REPEATER
Model Name : HR
Multiple Model Name : N/A
Serial number : N/A
Total page of Report : 31 pages (including this page)
Date of Incoming : December 06, 2022
Date of Issuing : December 22, 2022

SUMMARY

The equipment complies with the requirement of *FCC CFR 47 PART 15 SUBPART B, Section 15.101. and ICES-003 Issue 7 CAN/CSA-CISPR 32:17*

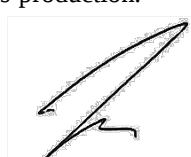
This test report contains only the results of a single test of the sample supplied for the examination.

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

Reviewed by:


 Sun-Teak, Oh / Manager
 EMC Testing Div.
 ONETECH Corp.

Approved by:


 Seung-Hyun, Park / Senior Manager
 EMC Testing Div.
 ONETECH Corp.

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Revision History

Rev. No.	Issue Report No.	Issued Date	Revisions	Section Affected
0	OT-22D-RED-103	December 22, 2022	Initial Release	All

* Please contact us (e-mail: info@onetech.co.kr) for verification of this test report.

1. VERIFICATION OF COMPLIANCE

-. Applicant : PARTRON CO., LTD
 -. Address : 22, Samsung1-ro2-gil, Hwaseong-si, Gyeonggi-do, South Korea
 -. Manufacturer : PARTRON CO., LTD
 -. Address : 22, Samsung1-ro2-gil, Hwaseong-si, Gyeonggi-do, South Korea
 -. MODEL NAME : HR
 -. SERIAL NUMBER : N/A
 -. BRAND/TRADE NAME : HYBE
 -. DATE : December 22, 2022

EQUIPMENT CLASS	Class A Digital Device
E.U.T. DESCRIPTION	HYBE REPEATER
MEASUREMENT PROCEDURES	ANSI C63.4a: 2017
TYPE OF EQUIPMENT TESTED	Pre-Production
KIND OF EQUIPMENT AUTHORIZATION REQUESTED	Certification ICES-003 Issue 7 Class A Apparatus
STANDARDS	FCC PART 15, SECTION 15.101 Canadian Standard ICES-003 Issue 7
MODIFICATIONS ON THE EQUIPMENT TO ACHIEVE COMPLIANCE	None
FINAL TEST WAS CONDUCTED ON	10 m Semi anechoic chamber

ONETECH Corp. tested the above equipment in accordance with the requirements set forth in the above standard. The test results show that equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

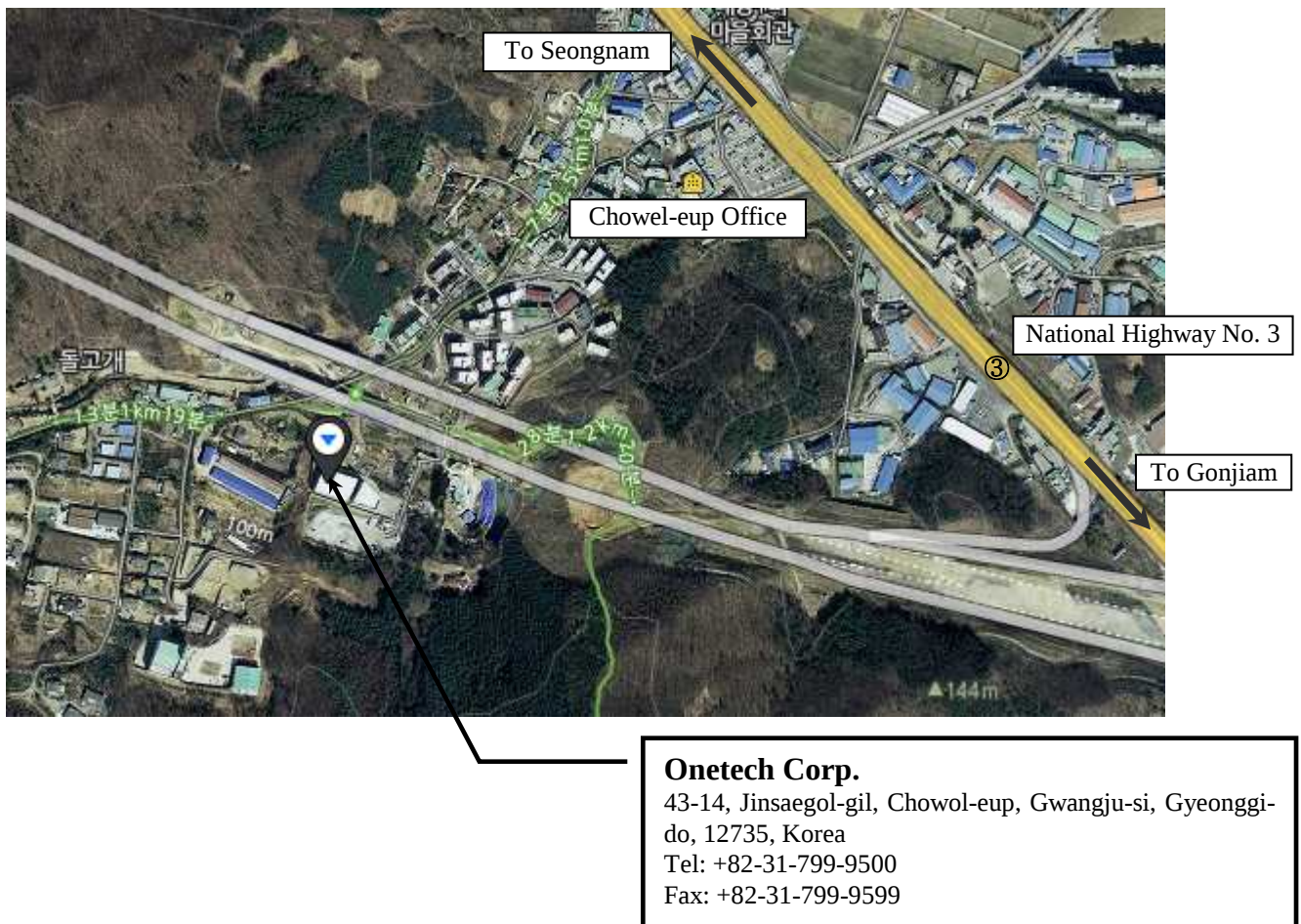
2. TEST FACILITY

The Onetech Corp. has been designated to perform equipment testing in compliance with ISO/IEC 17025 by Radio Research Agency as accreditation body. The Onetech Corp. is accredited for measuring devices subject to Declaration of Conformity (DOC) under Parts 15 & 18 as a Conformity Assessment Body (CAB) with designation number KR0013.

These measurement tests were conducted at Onetech Corp.

The 10 m semi anechoic chamber and conducted measurement facilities are located at

- 1) 43-14, Jinsaegol-gil, Chowol-eup, Gwangju-si, Gyeonggi-do, 12735, Korea.
- 2) 12-5, Jinsaegol-gil, Chowol-eup, Gwangju-si, Gyeonggi-do, 12735, Korea.



3. PRODUCT INFORMATION

3.1 Description of EUT

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

CHASSIS TYPE	Plastic & Metal
FREQUENCY RANGE	Zigbee: 2 480 MHz
USED ANTENNA	Patch Antenna (APTBTTH1CPOP)
EXTERNAL CONNECTOR	DC IN, USB C TYPE, INPUT, OUTPUT 1-4, ANTENNA

3.2 Model Differences

-. None.

3.3 Support Equipment

The model numbers for all the equipments that were used in the tested system is:

Description	Model	Manufacturer	Connected to
HYBE REPEATER (EUT)	HR	PARTRON CO., LTD	-
AC/DC ADAPTER	SMP60A-1205000-W	ShenZhen Smart Power Technology Co., Ltd	EUT
HYBE REPEATER[2]	HR	PARTRON CO., LTD	EUT
ADAPTER	SH-24122CN	Weihai TAOZI Electronics Co., Ltd.	HYBE REPEATER
Light stick	N/A	N/A	-
2.4 GHz Band Circular-Polarization Patch Antenna (EUT)	APTBTBTH1CPOP	PARTRON CO., LTD	EUT
Notebook PC	81DE	LENOVO	EUT, Notebook PC ADATPER
Notebook PC ADATPER	PA-1450	LENOVO	Notebook PC

3.4 System Configuration

DEVICE TYPE	MODEL/PART NUMBER	MANUFACTURER
HYBE REPEATER	HR	PARTRON CO., LTD
2.4 GHz Band Circular-Polarization Patch Antenna	APTBTBTH1CPOP/HPA-024	PARTRON CO., LTD

3.5 Cable Description for the EUT

-. Data Input mode

Port name	Shielded	Ferrite Bead	Metal Shell	Length (m)	Connected to
DC IN	N	Y	N	1.5	AC/DC ADAPTER
USB C TYPE	-	-	-	-	-
INPUT	N	N	N	3.0	HYBE REPEATER
OUTPUT [1 ~ 4]	N	N	N	3.0	LINE
ANTENNA	-	-	-	-	-

-. Data output mode

Port name	Shielded	Ferrite Bead	Metal Shell	Length (m)	Connected to
DC IN	N	Y	N	1.5	AC/DC ADAPTER
USB C TYPE	N	N	N	0.7	Notebook PC
INPUT	-	-	-	-	-
OUTPUT 1	N	N	N	3.0	HYBE REPEATER
OUTPUT [2 ~ 4]	N	N	N	3.0	LINE
ANTENNA	N	N	N	3.0	ANTENNA

3.6 Equipment Modifications

-. None.

3.7 Information of Measurement Software

	Chamber name	Software name	Software version
☐ -	Conducted Emission #1	Noise Terminal Voltage Measurement	2.00.0180
☐ -	Conducted Emission #2	EMC32	10.60.10
☒ -	Conducted Emission #3	Noise Terminal Voltage Measurement	2.00.0178
☐ -	Radiated Emission 10 m SAC 1	Radiated Emission Measurement	2.00.0201
☒ -	Radiated Emission 10 m SAC 2	Radiated Emission Measurement	2.00.0202
☐ -	Radiated Emission 3 m SAC	Radiated Emission Measurement	2.00.0202

4. DESCRIPTION OF TESTS

4.1 Test Methodology

Both conducted and radiated testing was performed according to the procedures in ANSI C63.4A: 2017 and CAN/CSA-CISPR 32:17

Radiated testing was performed at a distance of 10 m from EUT to the antenna.

4.2 Test Condition

The test conditions of the noted test mode(s) in this test report are;

-. Test Voltage / Frequency

: AC 120 V / 60 Hz (AC/DC ADAPTER)

-. Test condition

Test Mode		Operating States
1	Data Input mode	Communication data of the notebook PC was received from the communication HYBE REPEATER[2], and an operation state was checked through a front LED.
2	Data Output mode	a) The communication data with the Notebook PC was transmitted to the communication HYBE REPEATER[2], and the operation and wireless communication(zigbee) state were checked through the light stick LED.

4.3 Conducted Emission

The EUT was placed on a non-conductive 1.0 m × 1.5 m table, which is 0.8 m in height above the reference ground plane and 0.4 m away from the vertical conducting plane (over 2 m × 2 m) that is bonded to the reference ground plane.

The power of EUT is fed through a 50 Ω/ 50 μH + 5 Ω LISN and all support equipment is powered from another LISN. Powers to the LISN are filtered by high-current high insertion loss power line filter.

Sufficient time for EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition.

The RF output of the LISN was connected to the EMI test receiver.

Exploratory measurements were conducted to identify the highest emission by operating the EUT in a range of typical modes of operation, cable positions, system configuration and arrangement.

Based on exploratory measurements, the final measurements were conducted at the worst test conditions.

Exploratory measurements were scanned using Peak mode of EMI Test receiver from 150 kHz to 30 MHz with 20 ms sweep time. The final measurements were measured with Quasi-Peak and CISPR Average mode.

The bandwidth of EMI Test Receiver was set to 9 kHz. Interface cables were connected to the available interface ports of the test unit. Excess cable lengths were bundled at center with 30 cm ~ 40 cm.

4.4 Radiated Emission

Exploratory Radiated measurements were conducted at the 10 m semi anechoic chamber in order to identify the highest emission by operating the EUT in a range of typical modes of operation, cable positions, system configuration and arrangement.

Based on exploratory measurements, the final measurements were conducted at the worst test conditions.

Final measurements were made at 10 m semi anechoic chamber that complies with CISPR 16/ANSI C63.4/ ICES-003.

Exploratory measurements were scanned using Peak mode of EMI Test receiver and final measurements were measured with Quasi-Peak mode (Below 1 GHz) and Peak & CISPR Average mode (Above 1 GHz).

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.

5. FINAL RESULT OF MEASUREMENT

Exploratory measurement was done in normal operation mode. And the final measurement was selected for the maximized emission level.

5.1 Conducted Emission Test

5.1.1 Operating Environment

Temperature : 21.6 °C
Relative humidity : 49.5 % R.H.

5.1.2 Test Setup

The Power that the EUT has been inserted in was placed on an insulator above the reference ground plane. The power of Power was fed through a $50\ \Omega / 50\ \mu\text{H} + 5\ \Omega$ LISN. The ground plane was electrically bonded to the reference ground system and all power lines were filtered from ambient.

5.1.3 Measurement uncertainty

Conducted emission, quasi-peak detection : $\pm 1.9\ \text{dB}$
Conducted emission, CISPR-average detection : $\pm 1.9\ \text{dB}$

Measurement uncertainty is calculated in accordance with CISPR 16-4-2. The measurement uncertainty is given with a confidence of 95 % with the coverage factor, $k = 2$.

5.1.4 Limit

Frequency of Emission (MHz)	Conducted Limit (dB μ V)	
	Quasi-peak	CISPR Average
0.15 ~ 0.5	79	66
0.5 ~ 30	73	60
* Decreases with the logarithm of the frequency		

5.1.5 Test Equipment used

Model Number	Manufacturer	Description	Serial Number	Last Cal. (Interval)
■ - ESCI	Rohde & Schwarz	Test Receiver	101420	Mar. 08, 2022 (1Y)
■ - LT32C/10	Afj Instruments	LISN	32032039322	Mar. 21, 2022 (1Y)
■ - 3825/2	EMCO	AMN	9109-1867	Mar. 08, 2022 (1Y)
■ - 11947A	Hewlett Packard	Transient Limiter	3107A02762	Mar. 08, 2022 (1Y)

All test equipment used is calibrated on a regular basis.

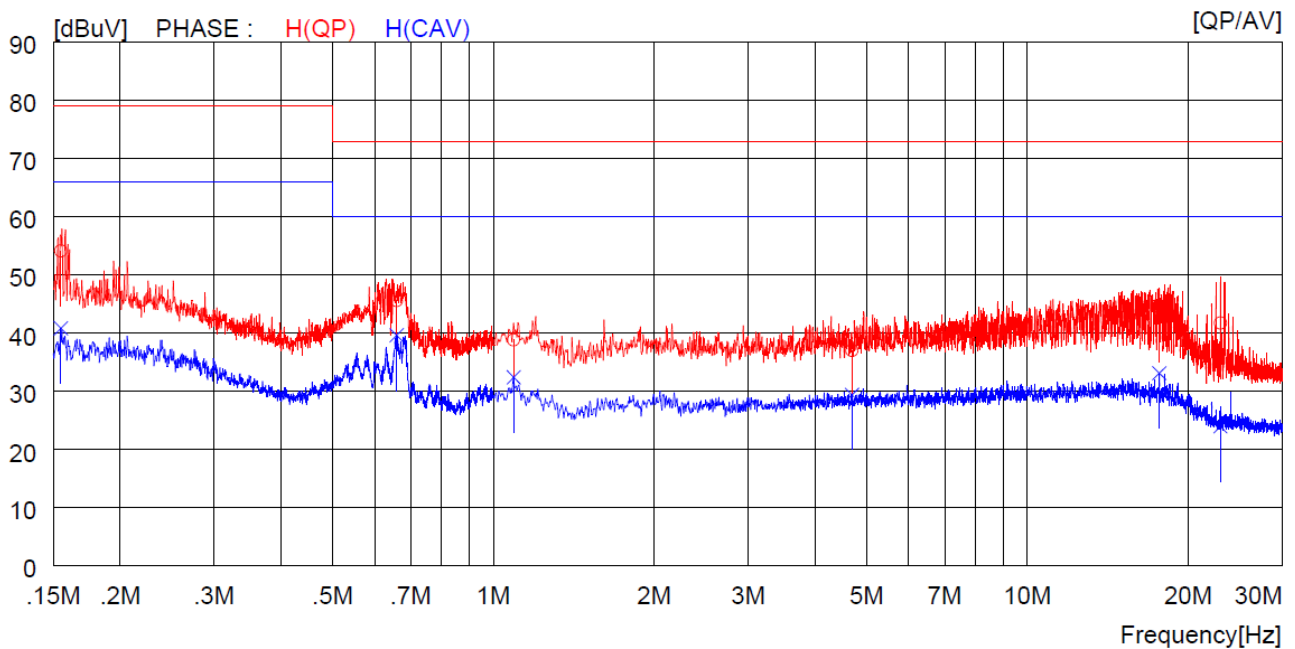
5.1.6 Test Data

-. Test Result : Pass

김지섭

Tested by: Ji-Sup, Kim / Engineer

Test Mode 1			
Frequency range	: 0.15 MHz ~ 30 MHz	Test Date	: December 19, 2022
Resolution bandwidth	: 9 kHz	Tested Line	: Hot Line

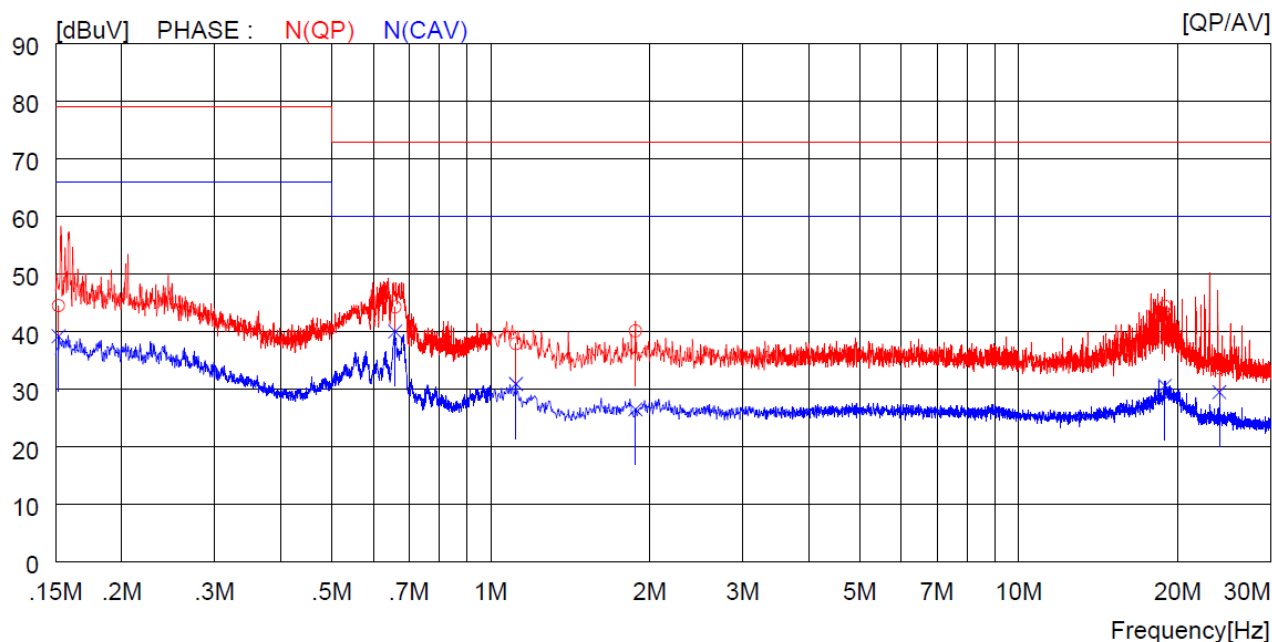


NO	FREQ [MHz]	READING		C. FACTOR [dB]	RESULT		LIMIT		MARGIN		PHASE
		QP [dBuV]	AV [dBuV]		QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	
1	0.15500	32.5	----	21.6	54.1	----	79.0	----	24.9	----	H (QP)
2	0.65900	24.1	----	21.5	45.6	----	73.0	----	27.4	----	H (QP)
3	1.09200	17.3	----	21.5	38.8	----	73.0	----	34.2	----	H (QP)
4	4.69200	15.2	----	21.8	37.0	----	73.0	----	36.0	----	H (QP)
5	17.66000	23.1	----	21.4	44.5	----	73.0	----	28.5	----	H (QP)
6	22.99000	20.5	----	21.2	41.7	----	73.0	----	31.3	----	H (QP)
7	0.15500	----	19.2	21.6	----	40.8	----	66.0	----	25.2	H (CAV)
8	0.65900	----	18.1	21.5	----	39.6	----	60.0	----	20.4	H (CAV)
9	1.09200	----	10.9	21.5	----	32.4	----	60.0	----	27.6	H (CAV)
10	4.69200	----	7.6	21.8	----	29.4	----	60.0	----	30.6	H (CAV)
11	17.66000	----	11.7	21.4	----	33.1	----	60.0	----	26.9	H (CAV)
12	22.99000	----	2.8	21.2	----	24.0	----	60.0	----	36.0	H (CAV)

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

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

Test Mode 1			
Frequency range	: 0.15 MHz ~ 30 MHz	Test Date	: December 19, 2022
Resolution bandwidth	: 9 kHz	Tested Line	: Neutral Line

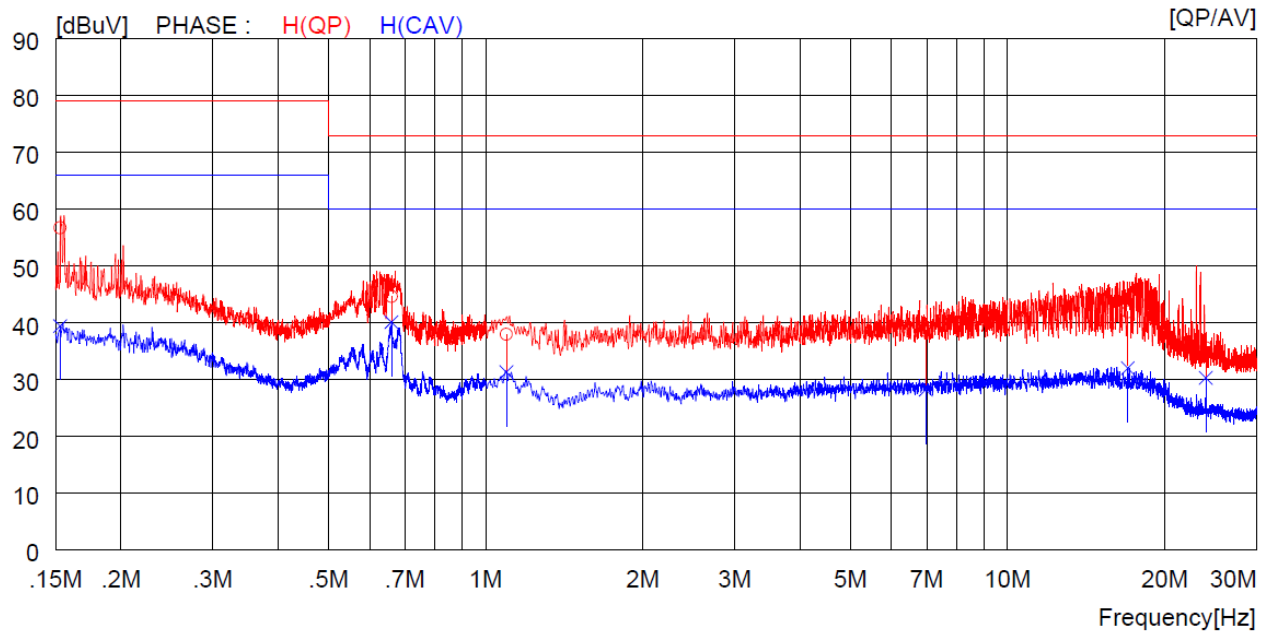


NO	FREQ [MHz]	READING		C.FACTOR [dB]	RESULT		LIMIT		MARGIN		PHASE
		QP [dBuV]	AV [dBuV]		QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	
1	0.15200	22.9	----	21.6	44.5	----	79.0	----	34.5	----	N (QP)
2	0.65900	22.8	----	21.5	44.3	----	73.0	----	28.7	----	N (QP)
3	1.11600	16.4	----	21.5	37.9	----	73.0	----	35.1	----	N (QP)
4	1.88000	18.5	----	21.6	40.1	----	73.0	----	32.9	----	N (QP)
5	18.92000	23.1	----	21.3	44.4	----	73.0	----	28.6	----	N (QP)
6	24.00000	12.5	----	21.2	33.7	----	73.0	----	39.3	----	N (QP)
7	0.15200	----	17.6	21.6	----	39.2	----	66.0	----	26.8	N (CAV)
8	0.65900	----	18.5	21.5	----	40.0	----	60.0	----	20.0	N (CAV)
9	1.11600	----	9.4	21.5	----	30.9	----	60.0	----	29.1	N (CAV)
10	1.88000	----	4.9	21.6	----	26.5	----	60.0	----	33.5	N (CAV)
11	18.92000	----	9.3	21.3	----	30.6	----	60.0	----	29.4	N (CAV)
12	24.00000	----	8.3	21.2	----	29.5	----	60.0	----	30.5	N (CAV)

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

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

Test Mode 2			
Frequency range	: 0.15 MHz ~ 30 MHz	Test Date	: December 19, 2022
Resolution bandwidth	: 9 kHz	Tested Line	: Hot Line

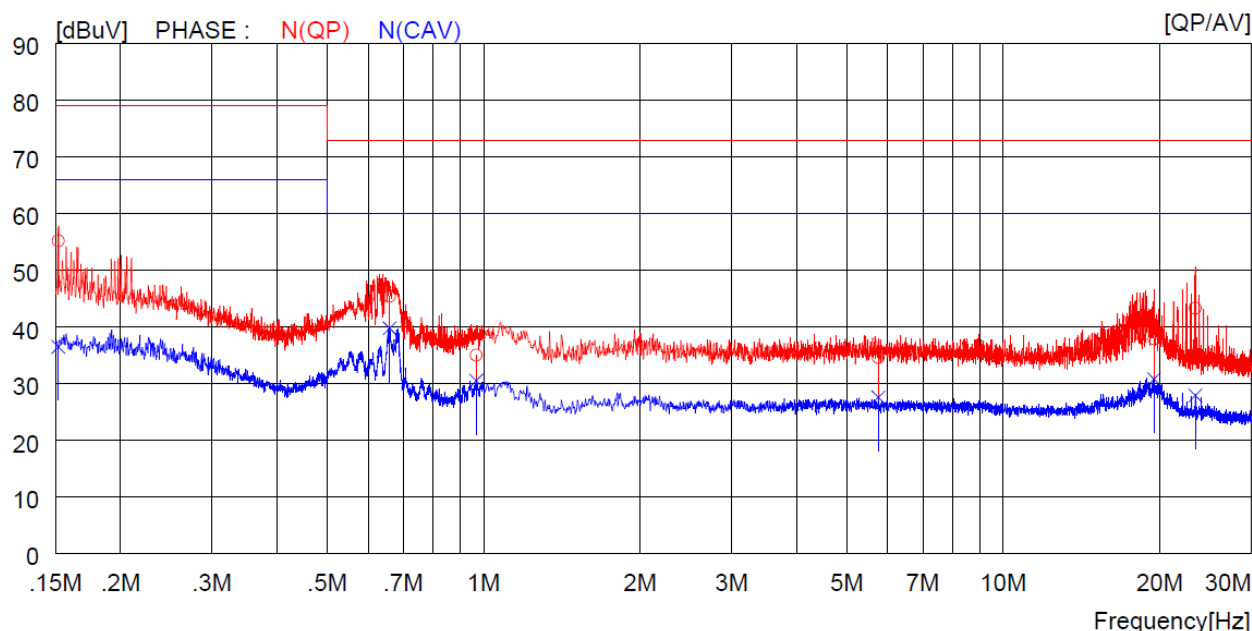


NO	FREQ [MHz]	READING		C.FACTOR [dB]	RESULT		LIMIT		MARGIN		PHASE
		QP [dBuV]	AV [dBuV]		QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	
1	0.15300	35.1	----	21.6	56.7	----	79.0	----	22.3	----	H (QP)
2	0.66000	23.1	----	21.5	44.6	----	73.0	----	28.4	----	H (QP)
3	1.09600	16.5	----	21.5	38.0	----	73.0	----	35.0	----	H (QP)
4	6.97000	16.9	----	21.7	38.6	----	73.0	----	34.4	----	H (QP)
5	17.00000	20.5	----	21.4	41.9	----	73.0	----	31.1	----	H (QP)
6	24.00000	14.4	----	21.2	35.6	----	73.0	----	37.4	----	H (QP)
7	0.15300	----	17.8	21.6	----	39.4	----	66.0	----	26.6	H (CAV)
8	0.66000	----	18.6	21.5	----	40.1	----	60.0	----	19.9	H (CAV)
9	1.09600	----	9.8	21.5	----	31.3	----	60.0	----	28.7	H (CAV)
10	6.97000	----	6.5	21.7	----	28.2	----	60.0	----	31.8	H (CAV)
11	17.00000	----	10.6	21.4	----	32.0	----	60.0	----	28.0	H (CAV)
12	24.00000	----	9.1	21.2	----	30.3	----	60.0	----	29.7	H (CAV)

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

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

Test Mode 2			
Frequency range	: 0.15 MHz ~ 30 MHz	Test Date	: December 19, 2022
Resolution bandwidth	: 9 kHz	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	0.15200	33.6	----	21.6	55.2	----	79.0	----	23.8	----	N (QP)
2	0.65900	23.9	----	21.5	45.4	----	73.0	----	27.6	----	N (QP)
3	0.96800	13.5	----	21.5	35.0	----	73.0	----	38.0	----	N (QP)
4	5.75000	12.8	----	21.8	34.6	----	73.0	----	38.4	----	N (QP)
5	19.51000	16.6	----	21.3	37.9	----	73.0	----	35.1	----	N (QP)
6	23.43000	22.1	----	21.2	43.3	----	73.0	----	29.7	----	N (QP)
7	0.15200	----	14.9	21.6	----	36.5	----	66.0	----	29.5	N (CAV)
8	0.65900	----	18.3	21.5	----	39.8	----	60.0	----	20.2	N (CAV)
9	0.96800	----	9.0	21.5	----	30.5	----	60.0	----	29.5	N (CAV)
10	5.75000	----	5.8	21.8	----	27.6	----	60.0	----	32.4	N (CAV)
11	19.51000	----	9.5	21.3	----	30.8	----	60.0	----	29.2	N (CAV)
12	23.43000	----	6.7	21.2	----	27.9	----	60.0	----	32.1	N (CAV)

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

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

5.2 Radiated Emission Test

5.2.1 Operating Environment

Temperature : 21.6 °C
Relative humidity : 49.5 % R.H.

5.2.2 Test Setup

The radiated emissions measurements were on 10 m semi anechoic chamber. The EUT and all local support equipments were placed on a non-conductive turntable approximately 0.8 m above the ground plane.

The frequency spectrum from 30 MHz to 24 000 MHz 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.

5.2.3 Measurement uncertainty

Radiated emission electric field intensity, 30 MHz ~ 1 000 MHz : ± 4.5 dB

Radiated emission electric field intensity, 1 000 MHz ~ 18 000 MHz : ± 6.0 dB

Radiated emission electric field intensity, 18 000 MHz ~ 24 000 MHz : ± 6.0 dB

Measurement uncertainty is calculated in accordance with CISPR 16-4-2. The measurement uncertainty is given with a confidence of 95 % with the coverage factor, $k = 2$.

5.2.4 Limit

Frequency of Emission (MHz)	Resolution bandwidth	Field strength @ 10 m (dB μ V/m)	
30 ~ 88 88 ~ 216 216 ~ 960 Above 960	120 kHz	Quasi-peak	
		39.0	
		43.5	
		46.0	
		49.5	
Frequency of Emission (MHz)	Resolution bandwidth	Field strength @ 3 m (dB μ V/m)	
> 1 000	1 MHz	Peak Limit	CISPR Average Limit
		79.54	59.54

-. ICES-003

Frequency of Emission (MHz)	Resolution bandwidth	Field strength @ 3 m (dB μ V/m)	Field strength @ 10 m (dB μ V/m)
		Quasi-peak	Quasi-peak
30 ~ 88	120 kHz	50.0	40.0
88 ~ 216		54.0	43.5
216 ~ 230		56.9	46.4
230 ~ 960		57.0	47.0
960 ~ 1 000		60.0	49.5

5.2.5 Test Equipment used

Model Number	Manufacturer	Description	Serial Number	Last Cal. (Interval)
■ - ESW	Rohde & Schwarz	Test Receiver	101851	Mar. 08, 2022 (1Y)
■ - VULB9163	Schwarzbeck	Trilog Broadband Antenna	9163-225	Sep. 14, 2022 (2Y)
■ - 3115	ETS-LINDGREN	Horn Antenna	34823	Aug. 12, 2022 (1Y)
■ - SAS-574	A.H. System	Horn Antenna	676	Oct. 19, 2022 (1Y)
■ - 8447D	Hewlett Packard	Amplifier	2944A07777	Mar. 08, 2022 (1Y)
■ - PAM-118A	Com-Power	Pre-Amplifier	18040081	Oct. 13, 2022 (1Y)
■ - PAM-840A	Com-Power	Amplifier	461339	Oct. 13, 2022 (1Y)
■ - CO3000	Innco Systems GmbH	Controller	CO3000/1015	N/A
■ - DT5000	Innco Systems GmbH	Turn Table	N/A	N/A
■ - MA4000-EP	Innco Systems GmbH	Antenna Master	MA4000/508	N/A
■ - MA4640-XPET	Innco Systems GmbH	Antenna Master	MA4640/592	N/A

All test equipment used is calibrated on a regular basis.

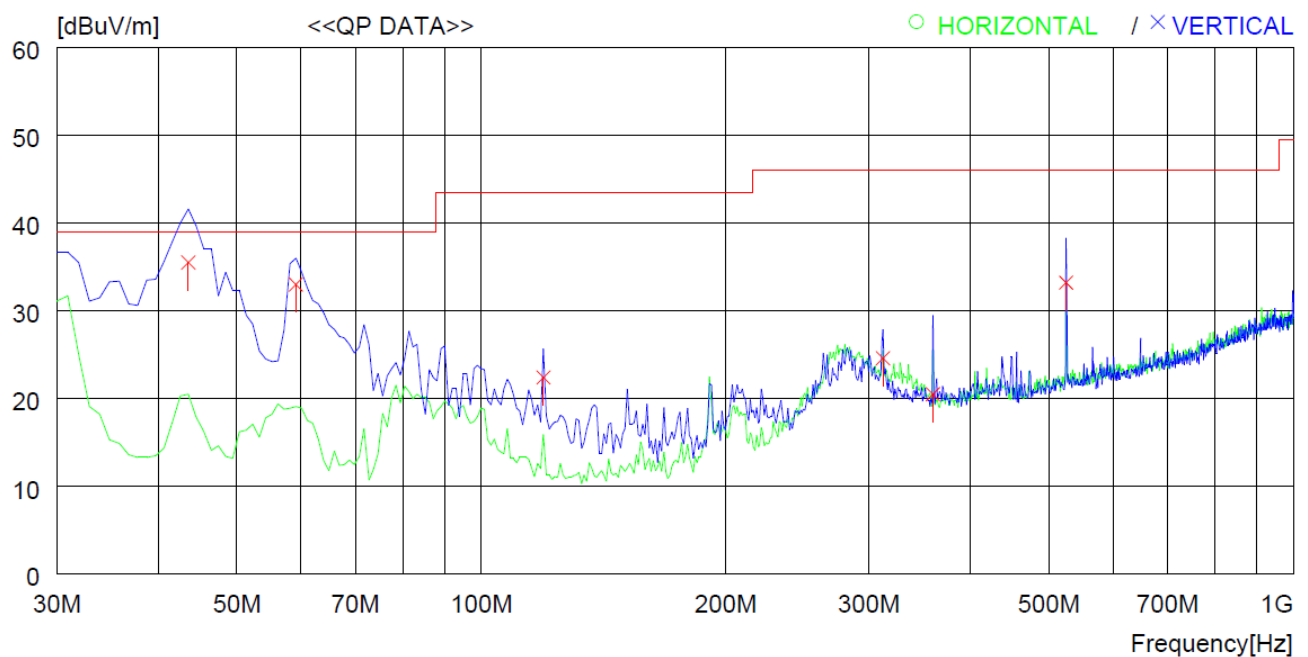
5.2.6 Test Data

-. Test Result : Pass

김지섭

Tested by: Ji-Sup, Kim / Engineer

Test Mode 1			
Frequency range	: 30 MHz ~ 1 000 MHz	Test Date	: December 16, 2022
Resolution bandwidth	: 120 kHz	Measurement distance	: 10 m
Detector Mode	: Quasi-Peak	Applied Standards	: FCC Part 15 Subpart B



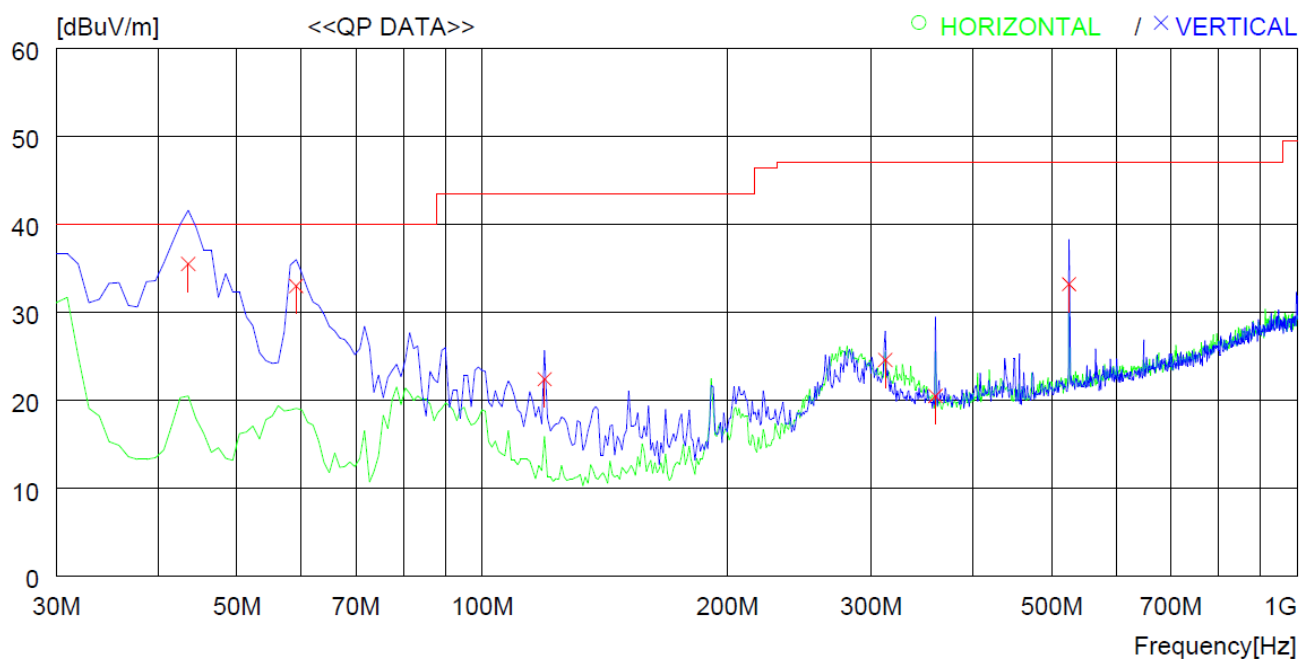
No.	FREQ	READING	ANT	LOSS	GAIN	RESULT	LIMIT	MARGIN	ANTENNA	TABLE
	[MHz]	QP	FACTOR							
		[dBuV]	[dB]	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dB]	[cm]	[DEG]
----- Vertical -----										
1	43.580	47.3	14.0	2.5	28.3	35.5	39.0	3.5	100	13
2	59.100	45.1	13.3	2.9	28.3	33.0	39.0	6.0	100	0
3	119.240	36.3	10.1	4.2	28.2	22.4	43.5	21.1	100	0
4	312.270	31.1	13.8	7.0	27.3	24.6	46.0	21.4	300	264
5	359.800	25.5	15.0	7.5	27.5	20.5	46.0	25.5	100	0
6	524.700	34.4	17.8	9.5	28.5	33.2	46.0	12.8	200	8

Remark: Margin (dB) = Limit – Result

Result = Reading Quasi-Peak + Antenna Factor + Loss – Gain

Loss and Gain in above table means Cable Loss and Pre-amplifier gain.

Test Mode 1			
Frequency range	: 30 MHz ~ 1 000 MHz	Test Date	: December 16, 2022
Resolution bandwidth	: 120 kHz	Measurement distance	: 10 m
Detector Mode	: Quasi-Peak	Applied Standards	: ICES-003 Issue 7



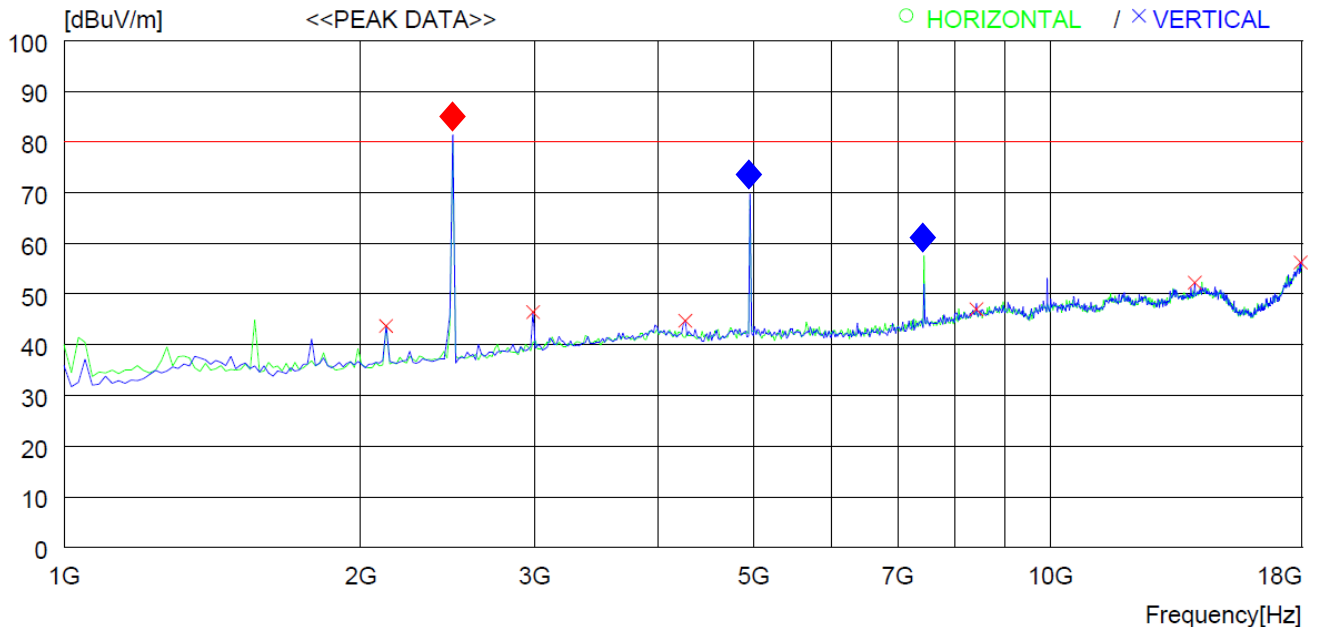
No.	FREQ	READING	ANT	LOSS	GAIN	RESULT	LIMIT	MARGIN	ANTENNA	TABLE
	[MHz]	QP	FACTOR							
		[dBuV]	[dB]	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dB]	[cm]	[DEG]
----- Vertical -----										
1	43.580	47.3	14.0	2.5	28.3	35.5	40.0	4.5	100	13
2	59.100	45.1	13.3	2.9	28.3	33.0	40.0	7.0	100	0
3	119.240	36.3	10.1	4.2	28.2	22.4	43.5	21.1	100	0
4	312.270	31.1	13.8	7.0	27.3	24.6	47.0	22.4	300	264
5	359.800	25.5	15.0	7.5	27.5	20.5	47.0	26.5	100	0
6	524.700	34.4	17.8	9.5	28.5	33.2	47.0	13.8	200	8

Remark: Margin (dB) = Limit – Result

Result = Reading Quasi-Peak + Antenna Factor + Loss – Gain

Loss and Gain in above table means Cable Loss and Pre-amplifier gain.

Test Mode 1			
Frequency range	: 1 GHz ~ 18 GHz	Test Date	: December 16, 2022
Resolution bandwidth	: 1 MHz	Measurement distance	: 3 m
Detector Mode	: Peak		



No.	FREQ [MHz]	READING PEAK [dBuV]	ANT FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
----- Vertical -----										
1	2122.000	52.8	27.5	3.2	39.8	43.7	80.0	36.3	100	292
2	2989.000	52.6	30.0	3.9	40.1	46.4	80.0	33.6	100	204
3	4264.000	47.8	32.5	4.8	40.4	44.7	80.0	35.3	100	359
4	8412.000	44.4	38.2	4.8	40.4	47.0	80.0	33	100	359
5	14005.000	43.9	41.5	8.7	41.9	52.2	80.0	27.8	100	359
6	17932.000	40.8	47.5	10.2	42.3	56.2	80.0	23.8	100	1

Remark: Margin (dB) = Limit – Result

Result = Reading Peak + Antenna Factor + Loss – Gain

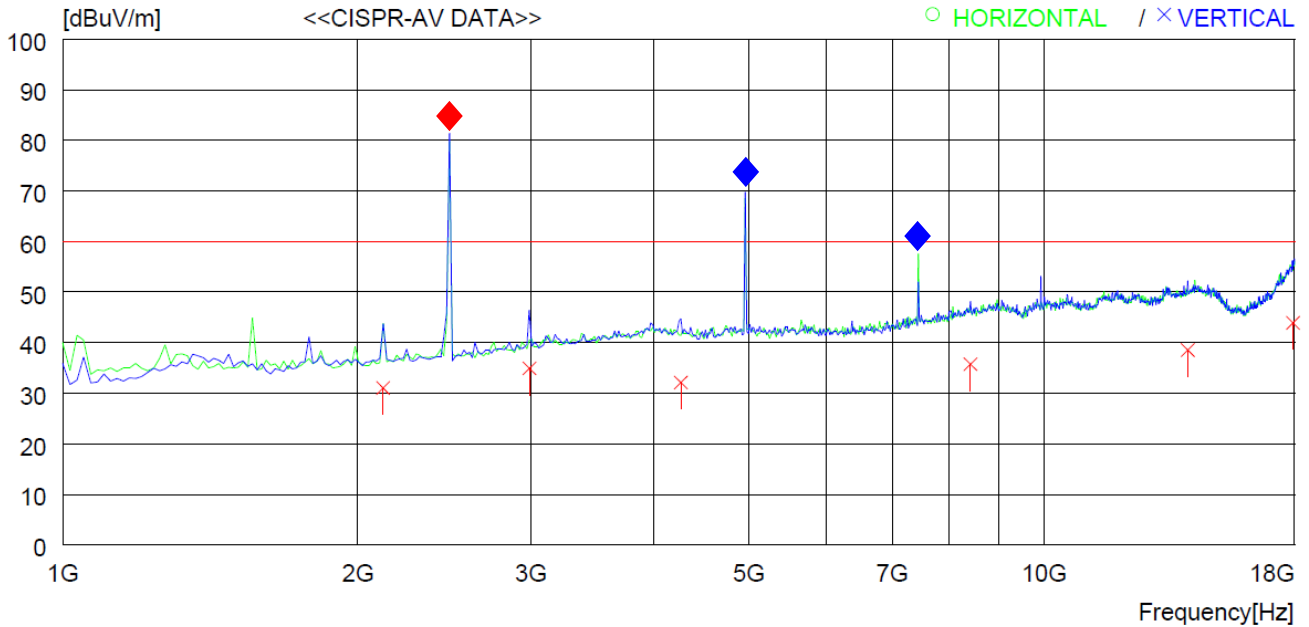
Loss and Gain in above table means Cable Loss and Pre-amplifier gain.

* Radiated emissions (Tx/Rx frequencies) from the transceiver shall be ignored.

Zigbee: 2 480 MHz

* Exclusion band Carrier Frequency: ◆ - Exclusion band Harmonic Frequency: ◆

Test Mode 1			
Frequency range	: 1 GHz ~ 18 GHz	Test Date	: December 16, 2022
Resolution bandwidth	: 1 MHz	Measurement distance	: 3 m
Detector Mode	: CISPR Average		



No.	FREQ	READING	ANT	LOSS	GAIN	RESULT	LIMIT	MARGIN	ANTENNA	TABLE
	[MHz]	CAV	FACTOR	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dB]	[cm]	[DEG]
----- Vertical -----										
1	2122.157	40.1	27.5	3.2	39.8	31.0	60.0	29.0	200	292
2	2989.744	41.1	30.0	3.9	40.1	34.9	60.0	25.1	100	204
3	4264.941	35.2	32.5	4.8	40.4	32.1	60.0	27.9	300	359
4	8412.258	31.9	38.2	6.5	40.9	35.7	60.0	24.3	300	359
5	14005.510	30.2	41.5	8.7	41.9	38.5	60.0	21.5	200	359
6	17932.360	28.5	47.5	10.2	42.3	43.9	60.0	16.1	100	1

Remark: Margin (dB) = Limit – Result

Result = Reading CISPR-Average + Antenna Factor + Loss – Gain

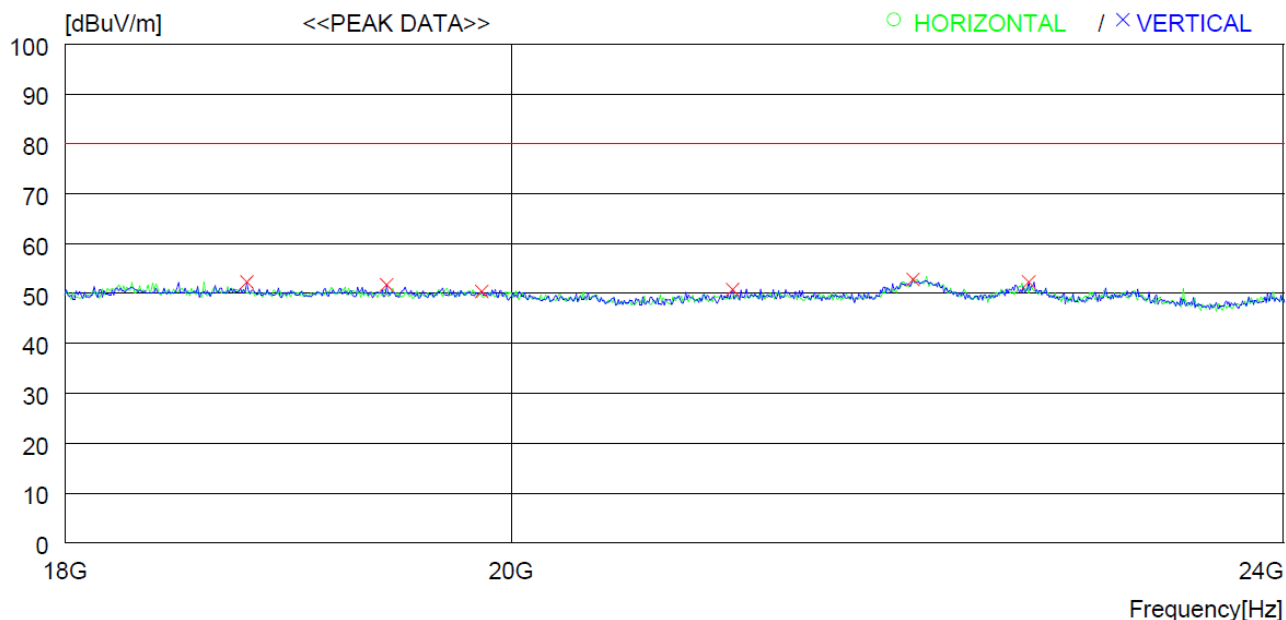
Loss and Gain in above table means Cable Loss and Pre-amplifier gain.

* Radiated emissions (Tx/Rx frequencies) from the transceiver shall be ignored.

Zigbee: 2 480 MHz

* Exclusion band Carrier Frequency: ◆ - Exclusion band Harmonic Frequency: ◆

Test Mode 1			
Frequency range	: 18 GHz ~ 24 GHz	Test Date	: December 16, 2022
Resolution bandwidth	: 1 MHz	Measurement distance	: 3 m
Detector Mode	: Peak		



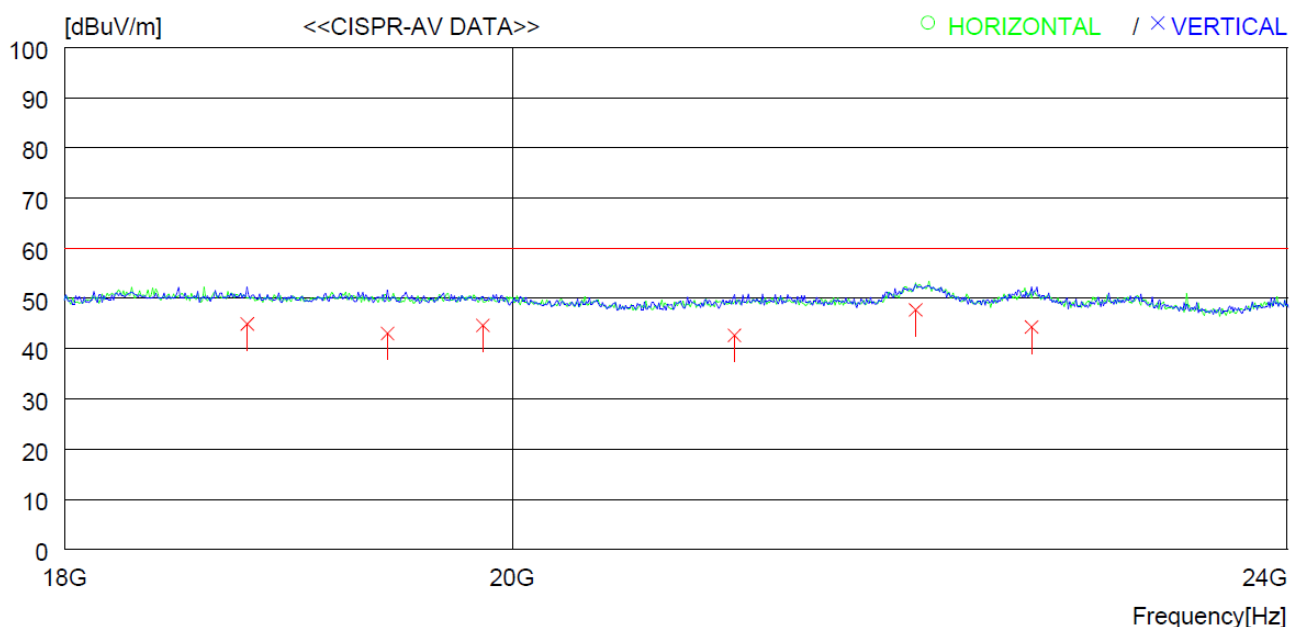
No.	FREQ [MHz]	READING [dBuV]	ANT PEAK FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
----- Vertical -----										
1	18791.000	41.9	40.3	10.2	40.1	52.3	80.0	27.7	100	230
2	19421.000	42.3	40.2	10.2	41.0	51.7	80.0	28.3	100	78
3	19862.000	41.0	40.3	10.6	41.5	50.4	80.0	29.6	100	128
4	21073.000	41.9	40.2	11.0	42.3	50.8	80.0	29.2	100	342
5	21990.000	44.4	40.2	11.1	42.9	52.8	80.0	27.2	100	1
6	22599.000	44.2	40.1	11.0	43.0	52.3	80.0	27.7	100	318

Remark: Margin (dB) = Limit – Result

Result = Reading Peak + Antenna Factor + Loss – Gain

Loss and Gain in above table means Cable Loss and Pre-amplifier gain.

Test Mode 1			
Frequency range	: 18 GHz ~ 24 GHz	Test Date	: December 16, 2022
Resolution bandwidth	: 1 MHz	Measurement distance	: 3 m
Detector Mode	: CISPR Average		



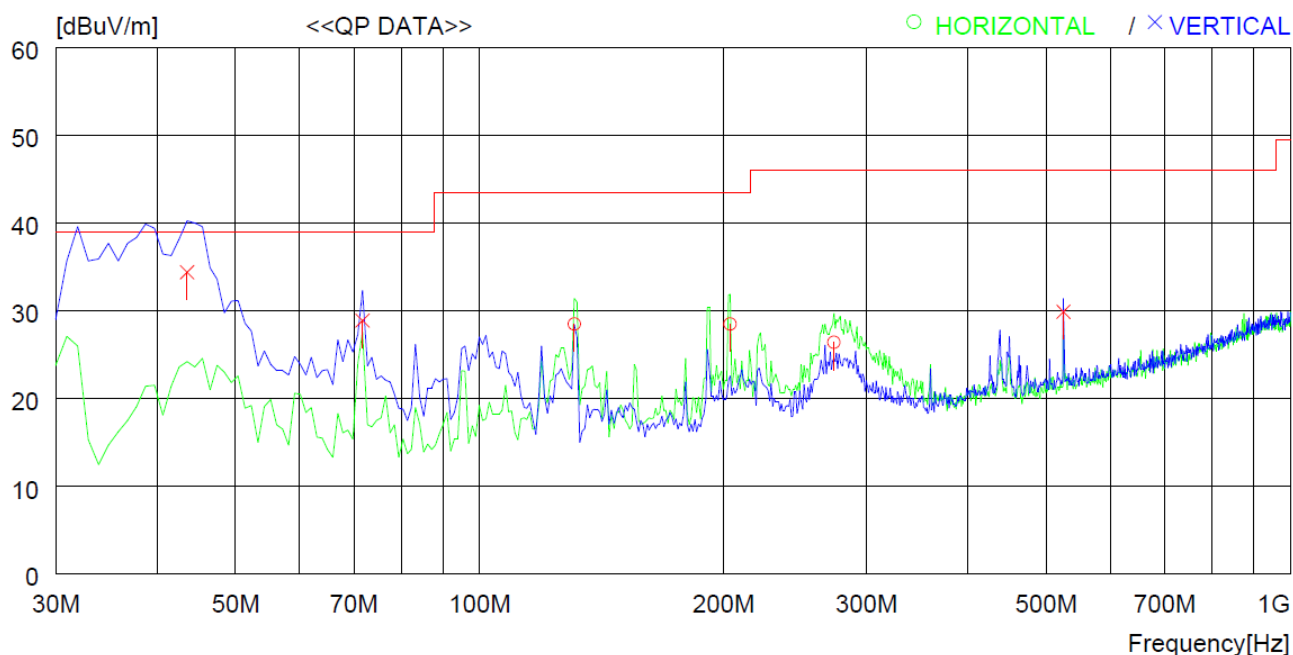
No.	FREQ	READING	ANT	LOSS	GAIN	RESULT	LIMIT	MARGIN	ANTENNA	TABLE
	[MHz]	CAV	FACTOR	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dB]	[cm]	[DEG]
----- Vertical -----										
1	18791.150	34.5	40.3	10.2	40.1	44.9	60.0	15.1	100	230
2	19421.850	33.6	40.2	10.2	41.0	43.0	60.0	17.0	200	78
3	19862.600	35.2	40.3	10.6	41.5	44.6	60.0	15.4	300	128
4	21073.140	33.7	40.2	11.0	42.3	42.6	60.0	17.4	100	342
5	21990.780	39.3	40.2	11.1	42.9	47.7	60.0	12.3	300	1
6	22599.250	36.2	40.1	11.0	43.0	44.3	60.0	15.7	100	318

Remark: Margin (dB) = Limit – Result

Result = Reading CISPR-Average + Antenna Factor + Loss – Gain

Loss and Gain in above table means Cable Loss and Pre-amplifier gain.

Test Mode 2			
Frequency range	: 30 MHz ~ 1 000 MHz	Test Date	: December 16, 2022
Resolution bandwidth	: 120 kHz	Measurement distance	: 10 m
Detector Mode	: Quasi-Peak	FCC Part 15 Subpart B	



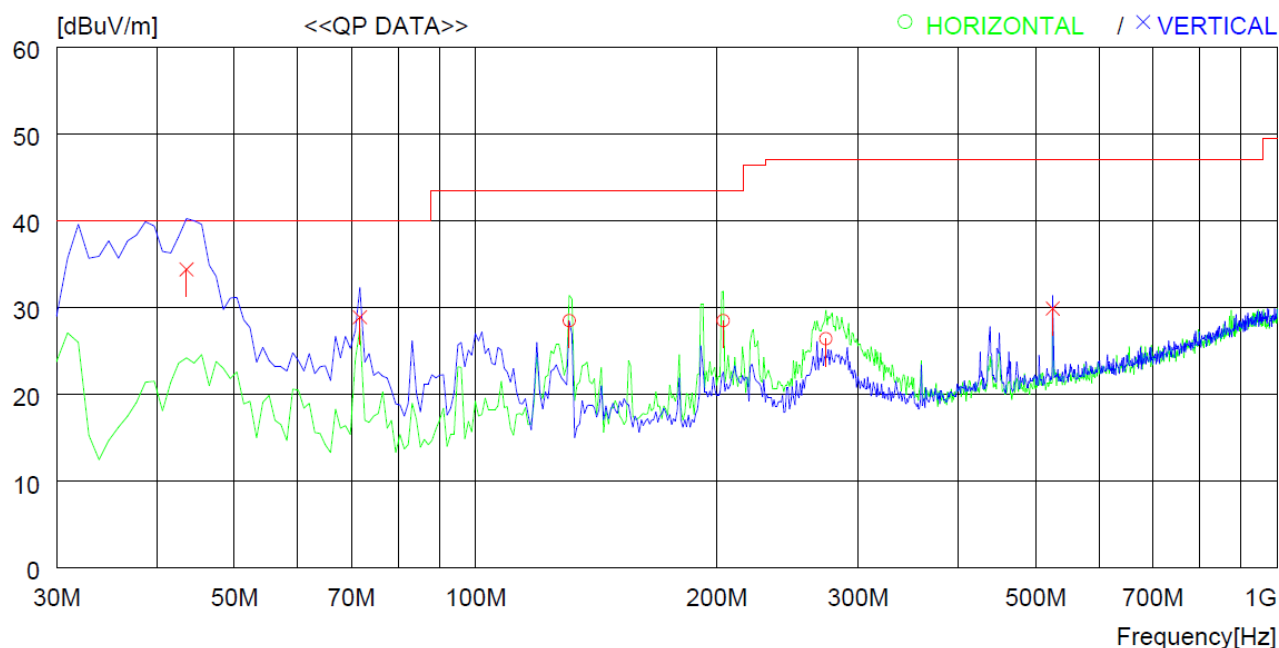
No.	FREQ	READING	ANT	LOSS	GAIN	RESULT	LIMIT	MARGIN	ANTENNA	TABLE
	[MHz]	QP	FACTOR							
		[dBuV]	[dB]	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dB]	[cm]	[DEG]
----- Horizontal -----										
1	130.880	43.2	9.1	4.4	28.2	28.5	43.5	15.0	400	213
2	203.630	40.2	10.8	5.6	28.1	28.5	43.5	15.0	400	12
3	273.470	34.4	13.1	6.4	27.5	26.4	46.0	19.6	400	132
----- Vertical -----										
4	43.580	46.2	14.0	2.5	28.3	34.4	39.0	4.6	200	247
5	71.710	44.4	9.6	3.2	28.3	28.9	39.0	10.1	100	9
6	524.700	31.1	17.8	9.5	28.5	29.9	46.0	16.1	200	0

Remark: Margin (dB) = Limit – Result

Result = Reading Quasi-Peak + Antenna Factor + Loss – Gain

Loss and Gain in above table means Cable Loss and Pre-amplifier gain.

Test Mode 2			
Frequency range	: 30 MHz ~ 1 000 MHz	Test Date	: December 16, 2022
Resolution bandwidth	: 120 kHz	Measurement distance	: 10 m
Detector Mode	: Quasi-Peak	Applied Standards	: ICES-003 Issue 7



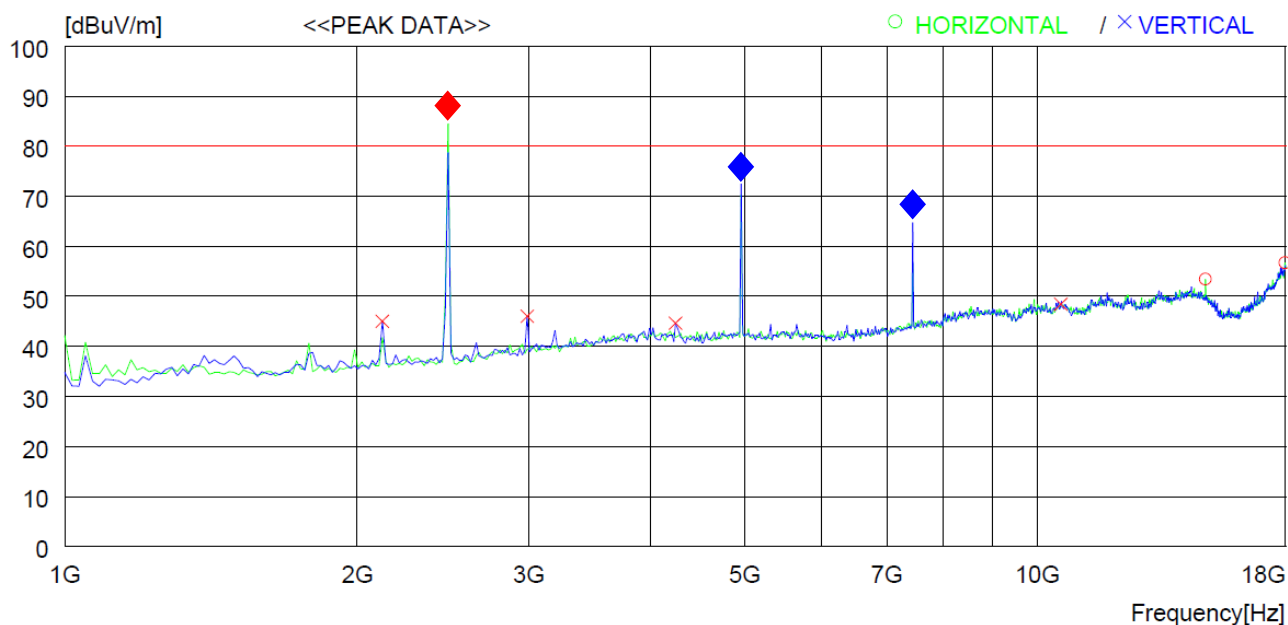
No.	FREQ	READING	ANT	LOSS	GAIN	RESULT	LIMIT	MARGIN	ANTENNA	TABLE
	[MHz]	[dBuV]	FACTOR	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dB]	[cm]	[DEG]
----- Horizontal -----										
1	130.880	43.2	9.1	4.4	28.2	28.5	43.5	15.0	400	213
2	203.630	40.2	10.8	5.6	28.1	28.5	43.5	15.0	400	12
3	273.470	34.4	13.1	6.4	27.5	26.4	47.0	20.6	400	132
----- Vertical -----										
4	43.580	46.2	14.0	2.5	28.3	34.4	40.0	5.6	200	247
5	71.710	44.4	9.6	3.2	28.3	28.9	40.0	11.1	100	9
6	524.700	31.1	17.8	9.5	28.5	29.9	47.0	17.1	200	0

Remark: Margin (dB) = Limit – Result

Result = Reading Quasi-Peak + Antenna Factor + Loss – Gain

Loss and Gain in above table means Cable Loss and Pre-amplifier gain.

Test Mode 2			
Frequency range	: 1 GHz ~ 18 GHz	Test Date	: December 16, 2022
Resolution bandwidth	: 1 MHz	Measurement distance	: 3 m
Detector Mode	: Peak		



No.	FREQ [MHz]	READING [dBuV]	ANT PEAK FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA TABLE [cm]	TABLE [DEG]
----- Horizontal -----										
1	14889.000	45.1	40.9	9.0	41.6	53.4	80.0	26.6	100	61
2	17966.000	41.1	47.7	10.2	42.3	56.7	80.0	23.3	100	311
----- Vertical -----										
3	2122.000	54.1	27.5	3.2	39.8	45.0	80.0	35	100	0
4	2989.000	52.2	30.0	3.9	40.1	46.0	80.0	34	100	0
5	4247.000	47.7	32.5	4.7	40.3	44.6	80.0	35.4	100	134
6	10571.000	44.0	38.0	7.5	41.1	48.4	80.0	31.6	100	0

Remark: Margin (dB) = Limit – Result

Result = Reading Peak + Antenna Factor + Loss – Gain

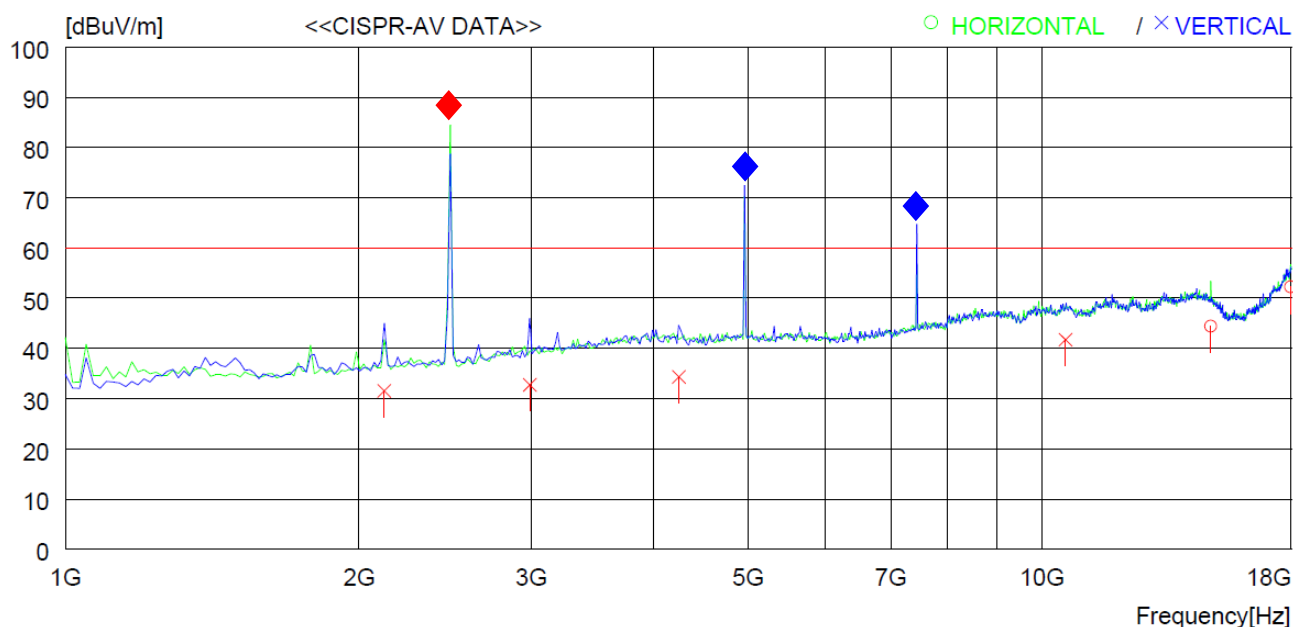
Loss and Gain in above table means Cable Loss and Pre-amplifier gain.

* Radiated emissions (Tx/Rx frequencies) from the transceiver shall be ignored.

Zigbee: 2 480 MHz

* Exclusion band Carrier Frequency: ◆ - Exclusion band Harmonic Frequency: ◆

Test Mode 2			
Frequency range	: 1 GHz ~ 18 GHz	Test Date	: December 16, 2022
Resolution bandwidth	: 1 MHz	Measurement distance	: 3 m
Detector Mode	: CISPR Average		



No.	FREQ	READING	ANT	LOSS	GAIN	RESULT	LIMIT	MARGIN	ANTENNA	TABLE
	[MHz]	[dBuV]	FACTOR	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dB]	[cm]	[DEG]
----- Horizontal -----										
1	14889.160	36.1	40.9	9.0	41.6	44.4	60.0	15.6	300	61
2	17966.260	36.6	47.7	10.2	42.3	52.2	60.0	7.8	100	311
----- Vertical -----										
3	2122.054	40.6	27.5	3.2	39.8	31.5	60.0	28.5	100	0
4	2989.166	38.9	30.0	3.9	40.1	32.7	60.0	27.3	200	0
5	4247.751	37.4	32.5	4.7	40.3	34.3	60.0	25.7	200	134
6	10571.360	37.3	38.0	7.5	41.1	41.7	60.0	18.3	100	0

Remark: Margin (dB) = Limit – Result

Result = Reading CISPR-Average + Antenna Factor + Loss – Gain

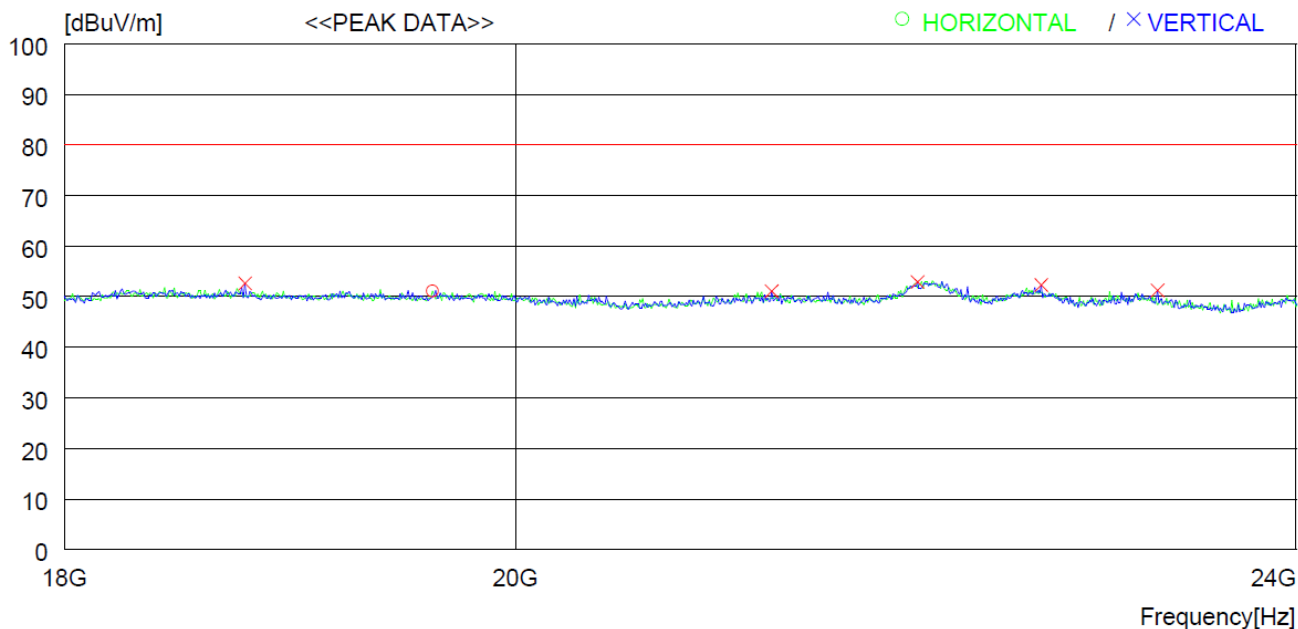
Loss and Gain in above table means Cable Loss and Pre-amplifier gain.

* Radiated emissions (Tx/Rx frequencies) from the transceiver shall be ignored.

Zigbee: 2 480 MHz

* Exclusion band Carrier Frequency: ◆ - Exclusion band Harmonic Frequency: ◆

Test Mode 2			
Frequency range	: 18 GHz ~ 24 GHz	Test Date	: December 16, 2022
Resolution bandwidth	: 1 MHz	Measurement distance	: 3 m
Detector Mode	: Peak		



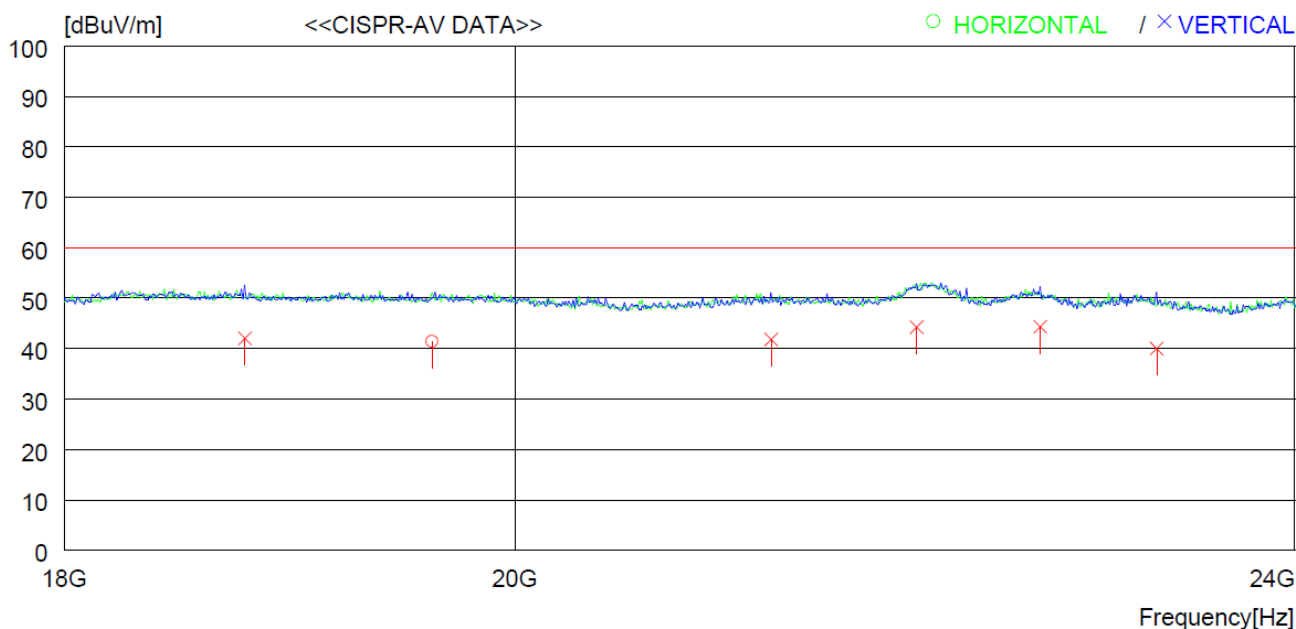
No.	FREQ [MHz]	READING [dBuV]	ANT PEAK FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
----- Horizontal -----										
1	19617.000	41.8	40.2	10.3	41.2	51.1	80.0	28.9	100	20
----- Vertical -----										
2	18777.000	42.2	40.3	10.2	40.1	52.6	80.0	27.4	100	359
3	21234.000	42.4	40.2	10.9	42.4	51.1	80.0	28.9	100	227
4	21969.000	44.5	40.2	11.1	42.9	52.9	80.0	27.1	100	359
5	22613.000	44.2	40.1	11.0	43.0	52.3	80.0	27.7	100	84
6	23236.000	43.1	40.1	11.1	43.1	51.2	80.0	28.8	100	158

Remark: Margin (dB) = Limit – Result

Result = Reading Peak + Antenna Factor + Loss – Gain

Loss and Gain in above table means Cable Loss and Pre-amplifier gain.

Test Mode 2			
Frequency range	: 18 GHz ~ 24 GHz	Test Date	: December 16, 2022
Resolution bandwidth	: 1 MHz	Measurement distance	: 3 m
Detector Mode	: CISPR Average		



No.	FREQ	READING	ANT	LOSS	GAIN	RESULT	LIMIT	MARGIN	ANTENNA	TABLE
	[MHz]	CAV	FACTOR	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dB]	[cm]	[DEG]
----- Horizontal -----										
1	19617.010	32.1	40.2	10.3	41.2	41.4	60.0	18.6	200	20
----- Vertical -----										
2	18777.750	31.6	40.3	10.2	40.1	42.0	60.0	18.0	100	359
3	21234.670	33.1	40.2	10.9	42.4	41.8	60.0	18.2	200	227
4	21969.210	35.8	40.2	11.1	42.9	44.2	60.0	15.8	100	359
5	22613.190	36.2	40.1	11.0	43.0	44.3	60.0	15.7	100	84
6	23236.940	31.9	40.1	11.1	43.1	40.0	60.0	20.0	100	158

Remark: Margin (dB) = Limit – Result

Result = Reading CISPR-Average + Antenna Factor + Loss – Gain

Loss and Gain in above table means Cable Loss and Pre-amplifier gain.

6. SAMPLE CALCULATIONS

$$\text{dB}\mu\text{V} = 20 \text{ Log}_{10} (\mu\text{V})$$

$$\text{Margin} = \text{Limit} - \text{Result}$$

-. Example 1: 0.66000 MHz

Class A Limit	= 60.0 dB μ V (CISPR-Average)
Reading	= 18.6 dB μ V
Correction Factor	= LISN + Cable Loss + Pulse Limiter
	= 21.5 dB
Total	= 40.1 dB μ V
Margin	= 60.0 dB μ V – 40.1 dB μ V
	= 19.9 dB

-. Example 2: 43.580 MHz

Class A Limit	= 39.0 dB μ V/m (Quasi-peak)
Reading	= 47.3 dB μ V
Correction Factor	= Antenna Factor (14.0 dB/m) + Cable Loss (2.5 dB) - Amp. Gain (28.3 dB)
	= 3.1 dB μ V
Total	= 35.5 dB μ V/m
Margin	= 39.0 dB μ V/m – 35.5 dB μ V/m
	= 3.5 dB