

# 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

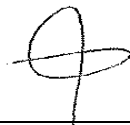
## SUMMARY

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.

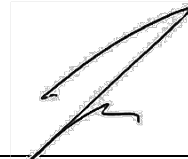
It is not a general valid assessment of the features of the respective products of the mass-production.

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<br>ICES-003 Issue 7 Class A Apparatus               |
| STANDARDS  | FCC PART 15, SECTION 15.101<br>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.

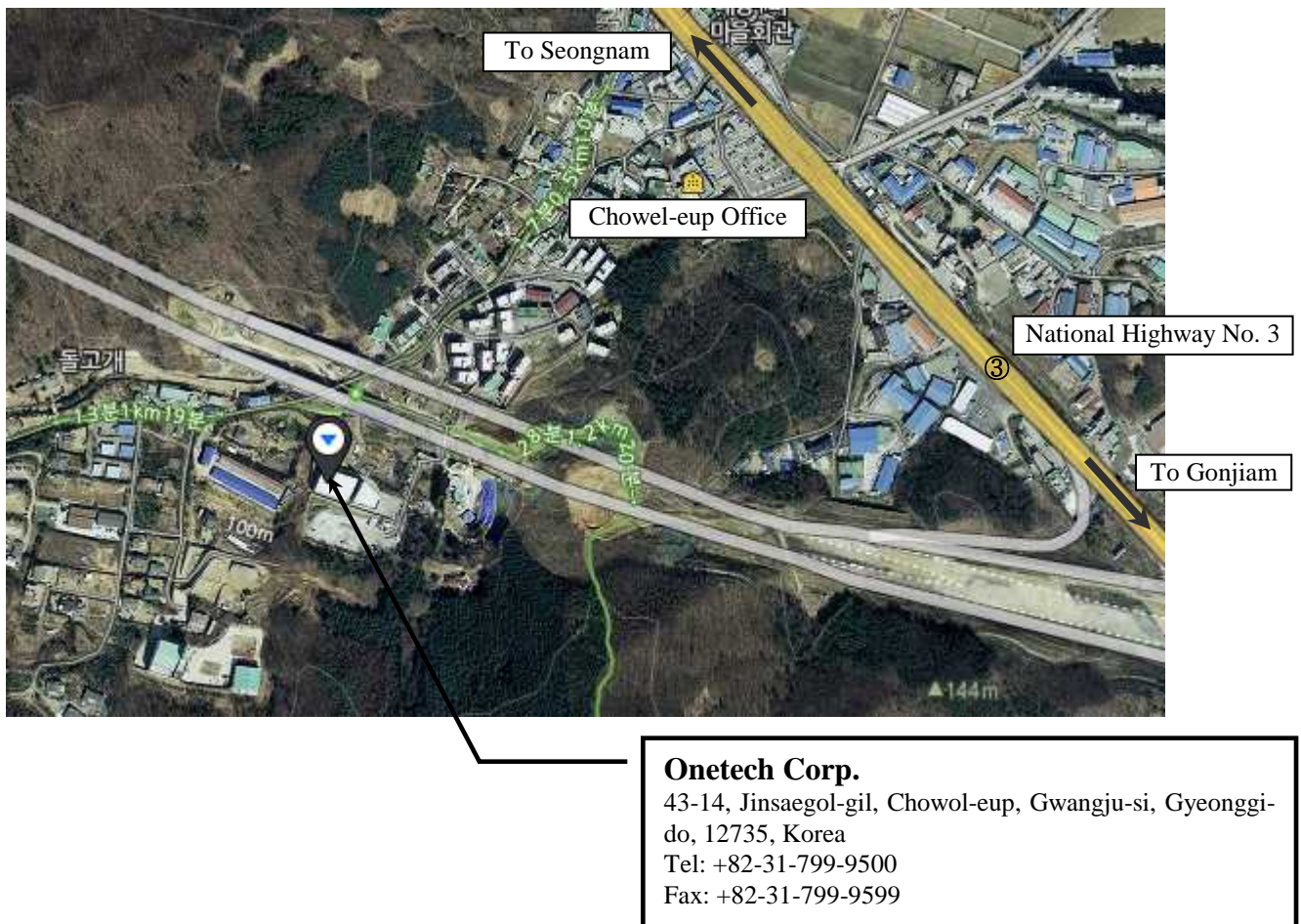
## 2. TEST FACILITY

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 (APTBT1CPOP)                    |
| 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) | APTBT1CPOP       | 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 | APTBT1CPOP/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 |
|---------------------------------------|------------------------------|------------------------------------|------------------|
| <input type="checkbox"/> -            | Conducted Emission #1        | Noise Terminal Voltage Measurement | 2.00.0180        |
| <input type="checkbox"/> -            | Conducted Emission #2        | EMC32                              | 10.60.10         |
| <input checked="" type="checkbox"/> - | Conducted Emission #3        | Noise Terminal Voltage Measurement | 2.00.0178        |
| <input type="checkbox"/> -            | Radiated Emission 10 m SAC 1 | Radiated Emission Measurement      | 2.00.0201        |
| <input checked="" type="checkbox"/> - | Radiated Emission 10 m SAC 2 | Radiated Emission Measurement      | 2.00.0202        |
| <input type="checkbox"/> -            | 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 Ω / 50 μ H + 5 Ω 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 : ± 1.9 dB  
 Conducted emission, CISPR-average detection : ± 1.9 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 (dBμV) |               |
|-----------------------------|------------------------|---------------|
|                             | 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.

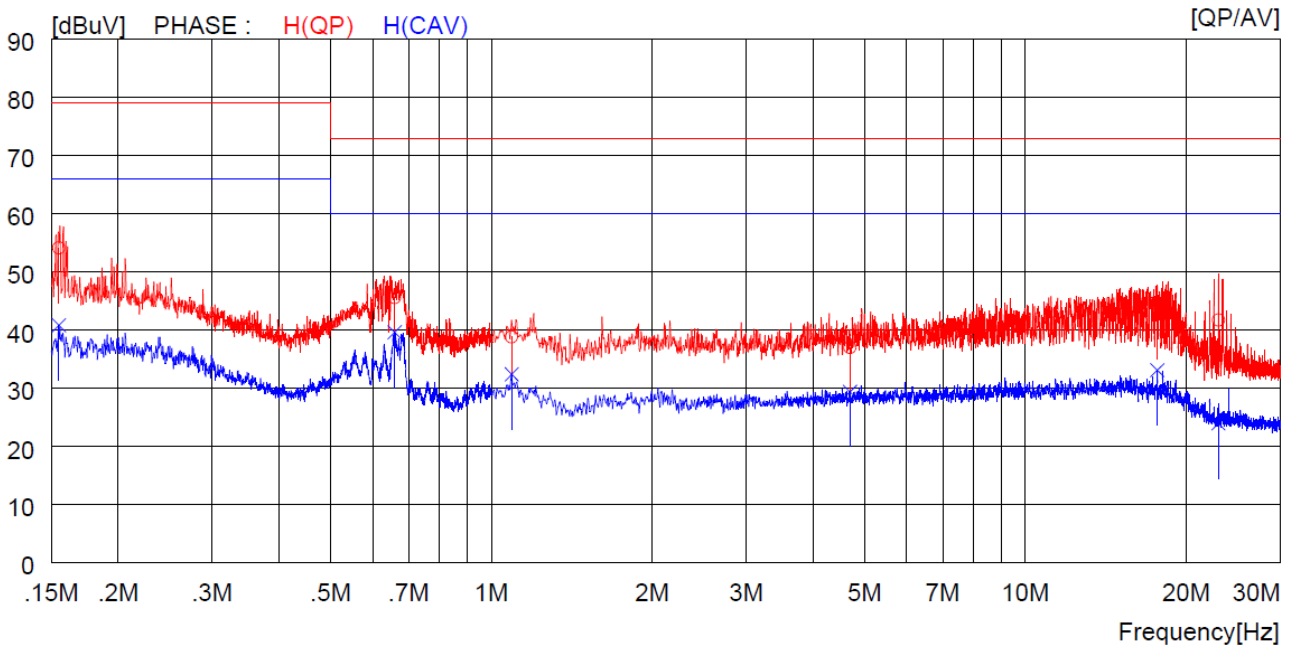
5.1.6 Test Data

- 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          |

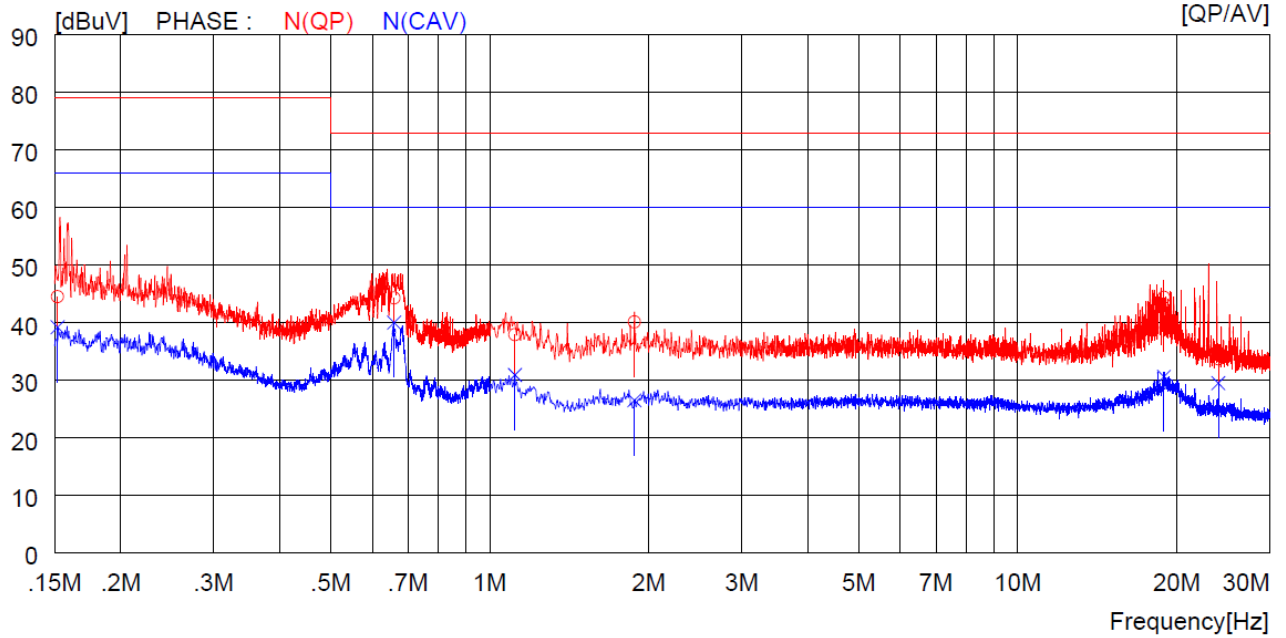


| NO | FREQ<br>[MHz] | READING      |              | C. FACTOR<br>[dB] | RESULT       |              | LIMIT        |              | MARGIN       |              | PHASE   |
|----|---------------|--------------|--------------|-------------------|--------------|--------------|--------------|--------------|--------------|--------------|---------|
|    |               | QP<br>[dBuV] | AV<br>[dBuV] |                   | QP<br>[dBuV] | AV<br>[dBuV] | QP<br>[dBuV] | AV<br>[dBuV] | QP<br>[dBuV] | AV<br>[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      |

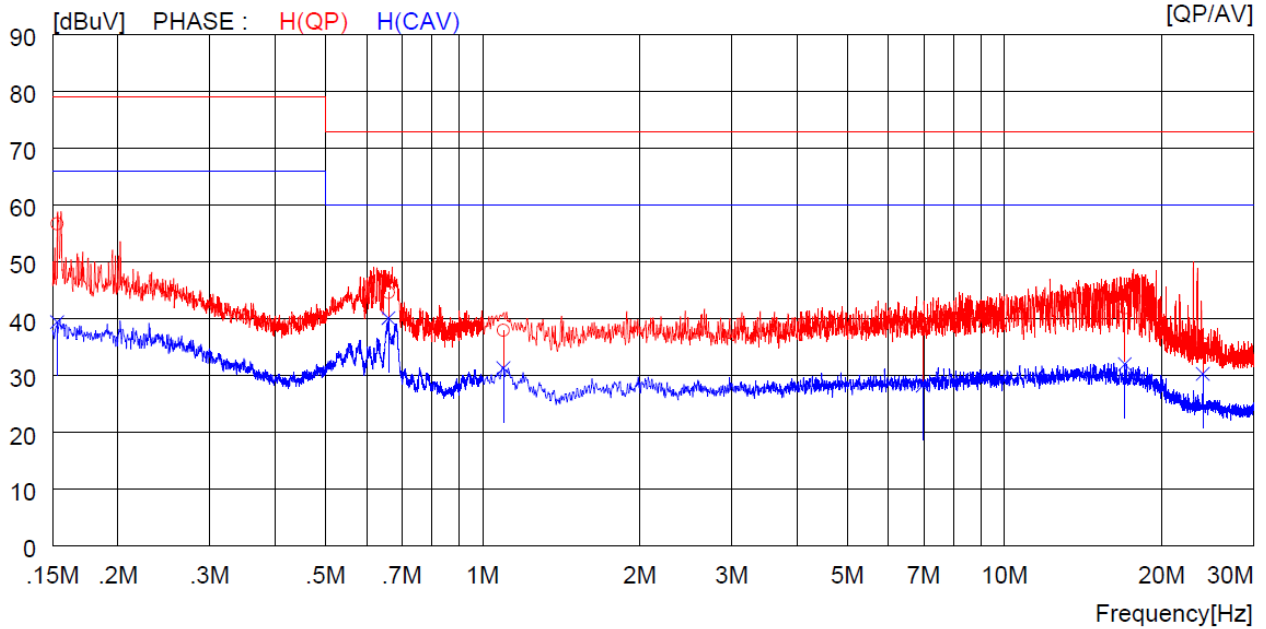


| NO | FREQ<br>[MHz] | READING      |              | C. FACTOR<br>[dB] | RESULT       |              | LIMIT        |              | MARGIN       |              | PHASE  |
|----|---------------|--------------|--------------|-------------------|--------------|--------------|--------------|--------------|--------------|--------------|--------|
|    |               | QP<br>[dBuV] | AV<br>[dBuV] |                   | QP<br>[dBuV] | AV<br>[dBuV] | QP<br>[dBuV] | AV<br>[dBuV] | QP<br>[dBuV] | AV<br>[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          |

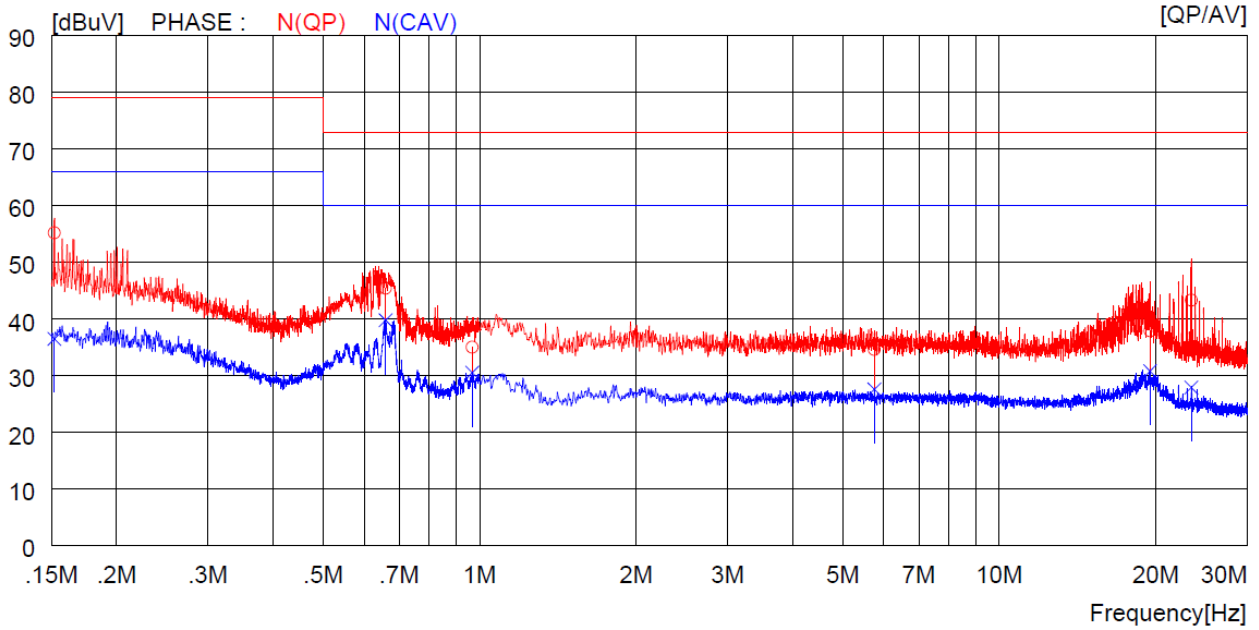


| NO | FREQ<br>[MHz] | READING      |              | C. FACTOR<br>[dB] | RESULT       |              | LIMIT        |              | MARGIN       |              | PHASE   |
|----|---------------|--------------|--------------|-------------------|--------------|--------------|--------------|--------------|--------------|--------------|---------|
|    |               | QP<br>[dBuV] | AV<br>[dBuV] |                   | QP<br>[dBuV] | AV<br>[dBuV] | QP<br>[dBuV] | AV<br>[dBuV] | QP<br>[dBuV] | AV<br>[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<br>[MHz] | READING      |              | C. FACTOR<br>[dB] | RESULT       |              | LIMIT        |              | MARGIN       |              | PHASE   |
|----|---------------|--------------|--------------|-------------------|--------------|--------------|--------------|--------------|--------------|--------------|---------|
|    |               | QP<br>[dBuV] | AV<br>[dBuV] |                   | QP<br>[dBuV] | AV<br>[dBuV] | QP<br>[dBuV] | AV<br>[dBuV] | QP<br>[dBuV] | AV<br>[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 (dBμV/m) |                     |
|-----------------------------|----------------------|--------------------------------|---------------------|
|                             |                      | Quasi-peak                     |                     |
| 30 ~ 88                     | 120 kHz              | 39.0                           |                     |
| 88 ~ 216                    |                      | 43.5                           |                     |
| 216 ~ 960                   |                      | 46.0                           |                     |
| Above 960                   |                      | 49.5                           |                     |
| Frequency of Emission (MHz) | Resolution bandwidth | Field strength @ 3 m (dBμV/m)  |                     |
|                             |                      | Peak Limit                     | CISPR Average Limit |
| > 1 000                     | 1 MHz                | 79.54                          | 59.54               |

-. ICES-003

| Frequency of Emission<br>(MHz) | Resolution<br>bandwidth | Field strength @ 3 m<br>(dB $\mu$ V/m) | Field strength @ 10 m<br>(dB $\mu$ 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.

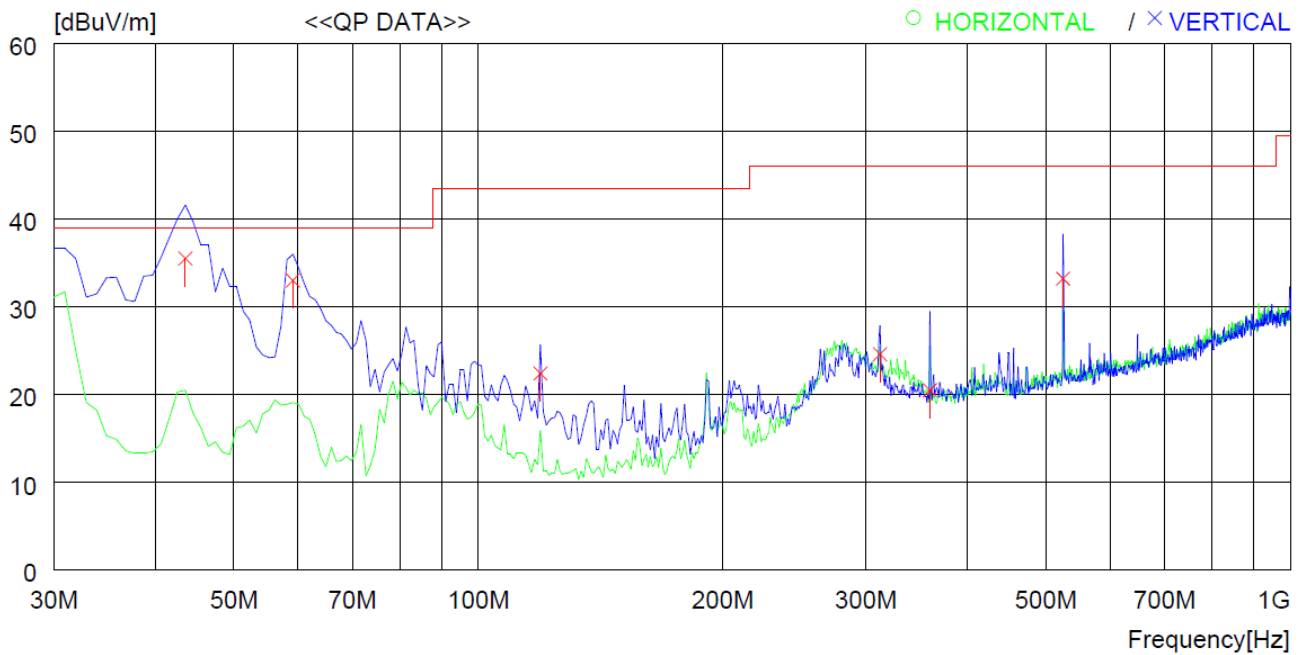
5.2.6 Test Data

- 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 |



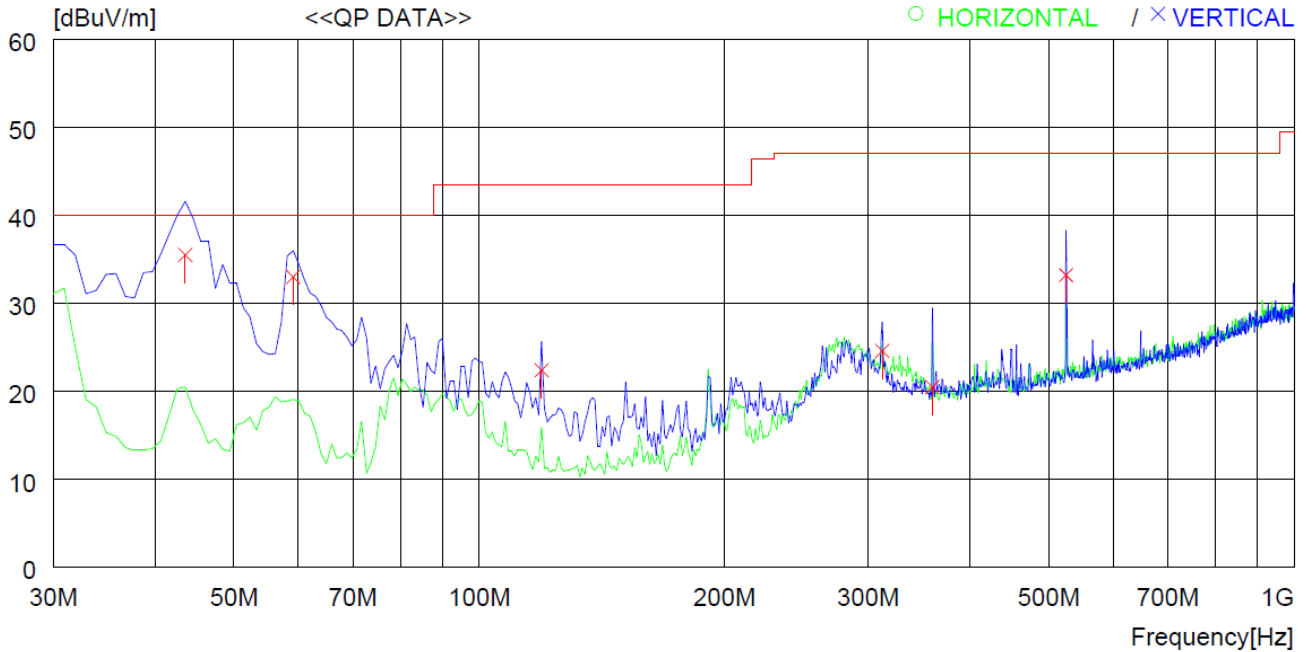
| No.                  | FREQ<br>[MHz] | READING<br>QP<br>[dBuV] | ANT<br>FACTOR<br>[dB] | LOSS<br>[dB] | GAIN<br>[dB] | RESULT<br>[dBuV/m] | LIMIT<br>[dBuV/m] | MARGIN<br>[dB] | ANTENNA<br>[cm] | TABLE<br>[DEG] |
|----------------------|---------------|-------------------------|-----------------------|--------------|--------------|--------------------|-------------------|----------------|-----------------|----------------|
| ----- 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  |



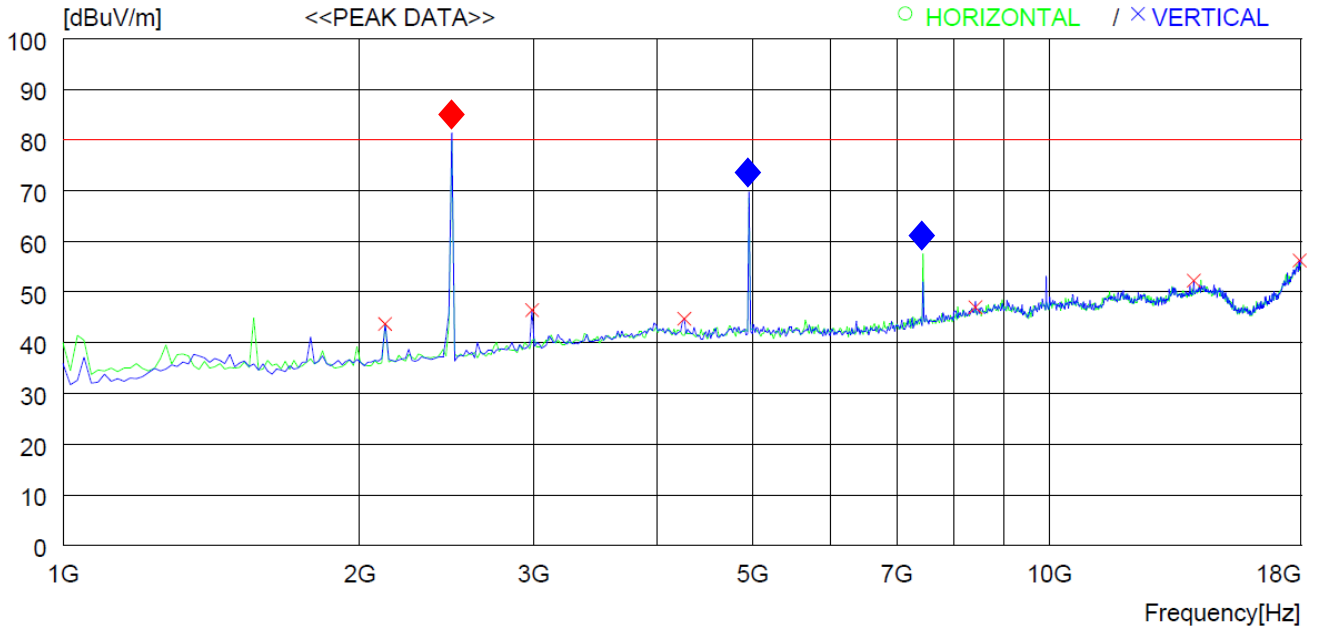
| No.                  | FREQ<br>[MHz] | READING<br>QP<br>[dBuV] | ANT<br>FACTOR<br>[dB] | LOSS<br>[dB] | GAIN<br>[dB] | RESULT<br>[dBuV/m] | LIMIT<br>[dBuV/m] | MARGIN<br>[dB] | ANTENNA<br>[cm] | TABLE<br>[DEG] |
|----------------------|---------------|-------------------------|-----------------------|--------------|--------------|--------------------|-------------------|----------------|-----------------|----------------|
| ----- 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 [dBuV] | ANT PEAK 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

$$\text{Result} = \text{Reading Peak} + \text{Antenna Factor} + \text{Loss} - \text{Gain}$$

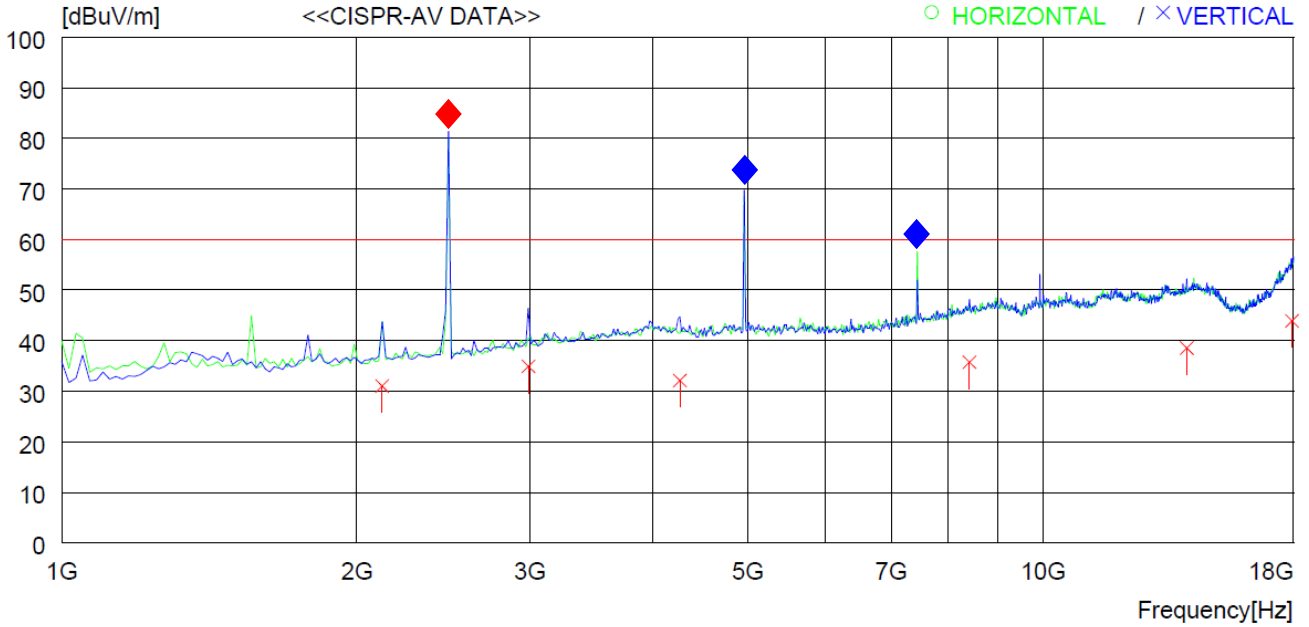
Loss and Gain in above table means Cable Loss and Pre-amplifier gain.

\* 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 [MHz] | READING CAV [dBuV] | ANT FACTOR [dB] | LOSS [dB] | GAIN [dB] | RESULT [dBuV/m] | LIMIT [dBuV/m] | MARGIN [dB] | ANTENNA [cm] | TABLE [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

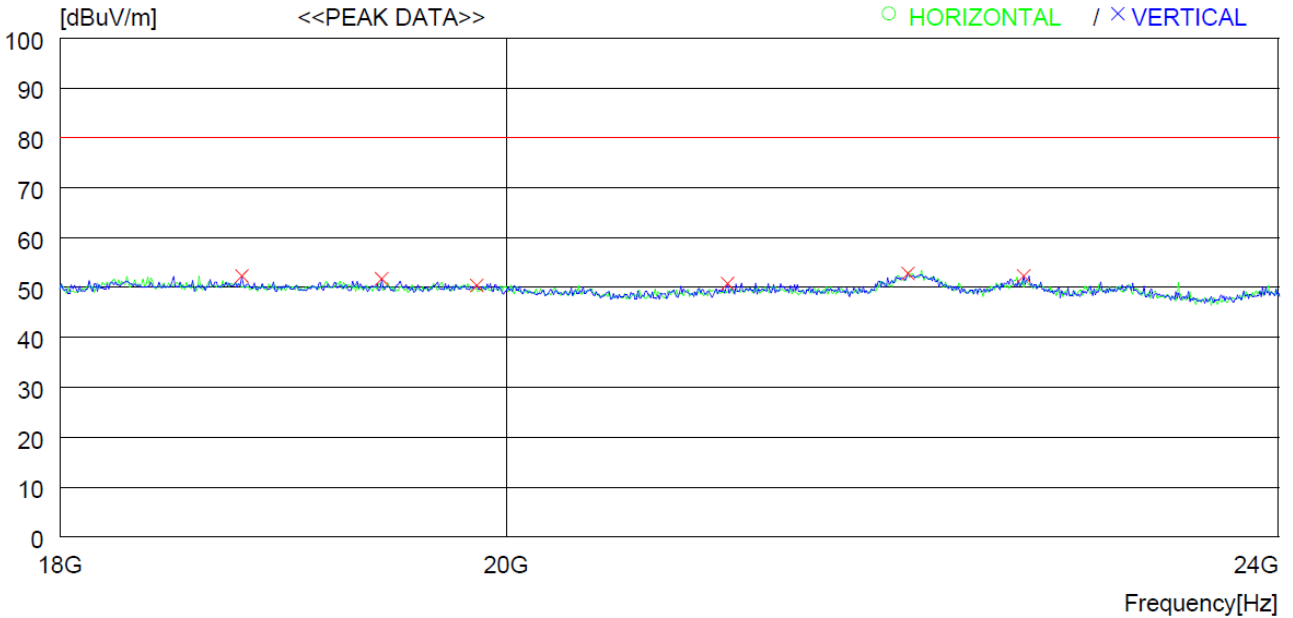
Loss and Gain in above table means Cable Loss and Pre-amplifier gain.

\* 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              |                               |



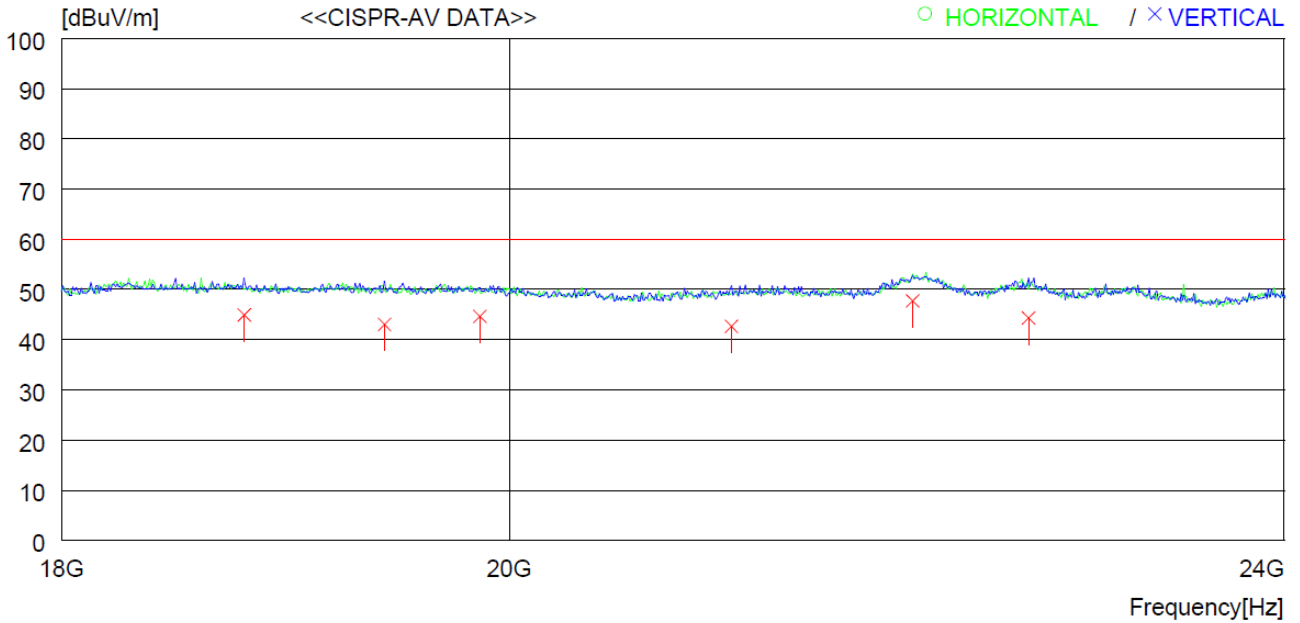
| No.                  | FREQ [MHz] | READING [dBuV] | ANT PEAK FACTOR [dB] | LOSS [dB] | GAIN [dB] | RESULT [dBuV/m] | LIMIT [dBuV/m] | MARGIN [dB] | ANTENNA [cm] | TABLE [DEG] |
|----------------------|------------|----------------|----------------------|-----------|-----------|-----------------|----------------|-------------|--------------|-------------|
| ----- 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<br>[MHz] | READING<br>CAV<br>[dBuV] | ANT<br>FACTOR<br>[dB] | LOSS<br>[dB] | GAIN<br>[dB] | RESULT<br>[dBuV/m] | LIMIT<br>[dBuV/m] | MARGIN<br>[dB] | ANTENNA<br>[cm] | TABLE<br>[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            |

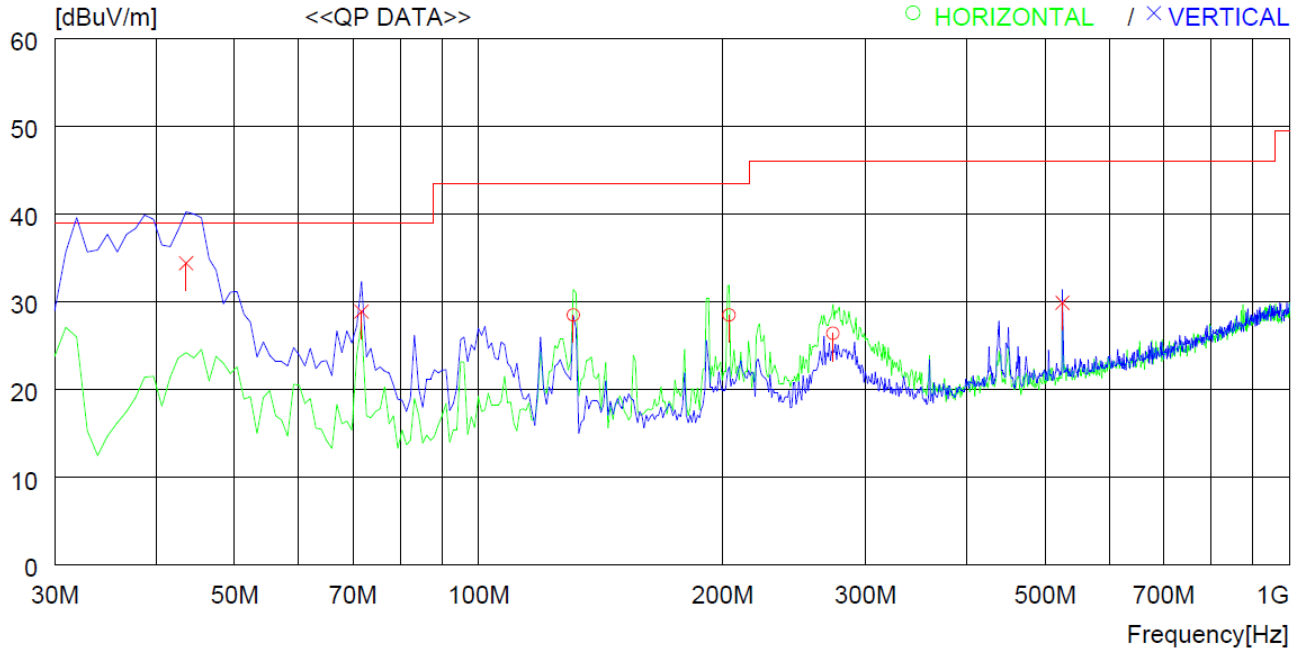
Remark: Margin (dB) = Limit – Result

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         |



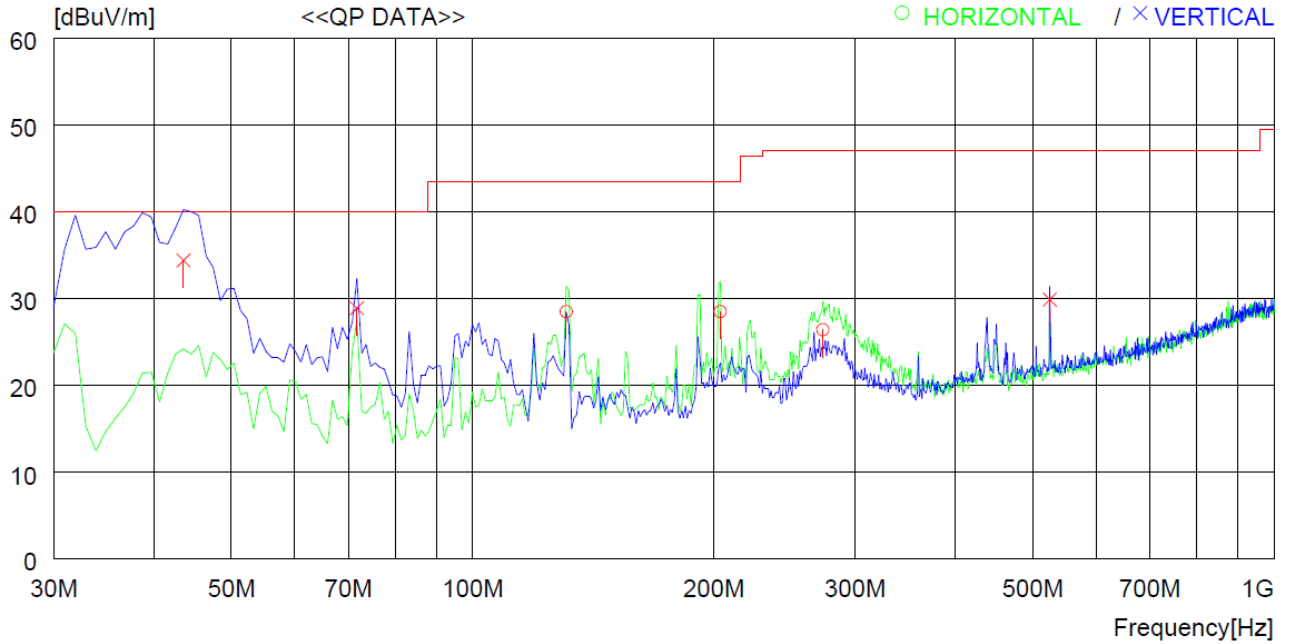
| No.                    | FREQ [MHz] | READING QP [dBuV] | ANT FACTOR [dB] | LOSS [dB] | GAIN [dB] | RESULT [dBuV/m] | LIMIT [dBuV/m] | MARGIN [dB] | ANTENNA [cm] | TABLE [DEG] |
|------------------------|------------|-------------------|-----------------|-----------|-----------|-----------------|----------------|-------------|--------------|-------------|
| ----- Horizontal ----- |            |                   |                 |           |           |                 |                |             |              |             |
| 1                      | 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  |



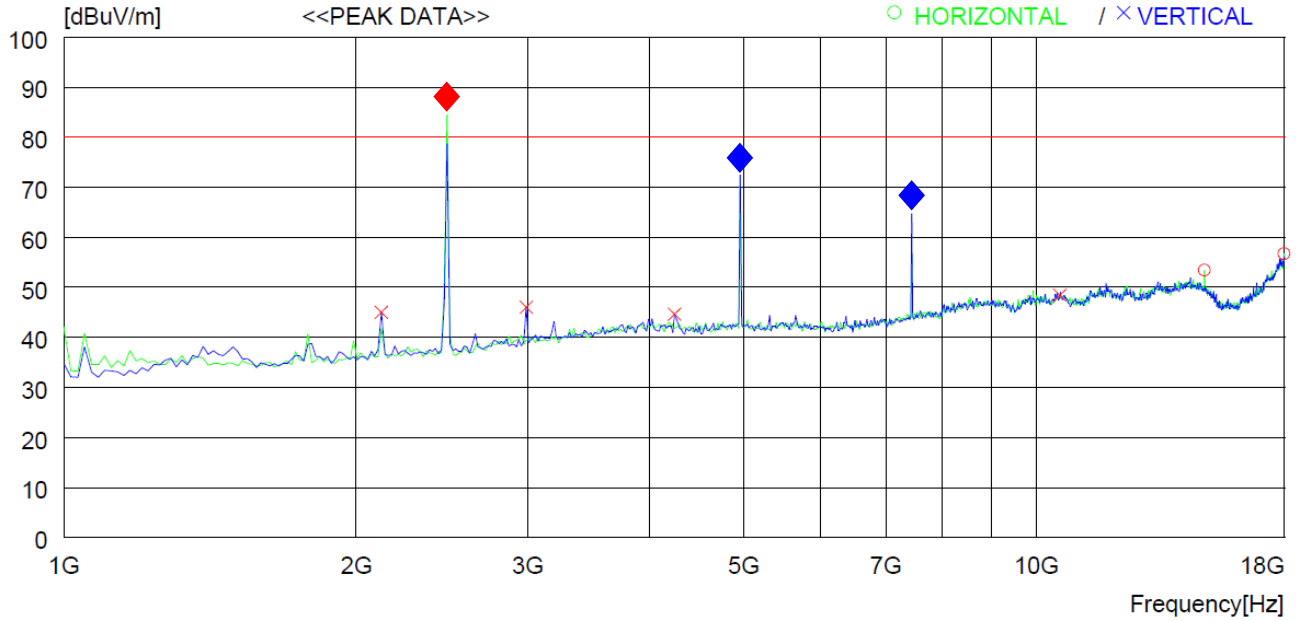
| No.                    | FREQ<br>[MHz] | READING<br>QP<br>[dBuV] | ANT<br>FACTOR<br>[dB] | LOSS<br>[dB] | GAIN<br>[dB] | RESULT<br>[dBuV/m] | LIMIT<br>[dBuV/m] | MARGIN<br>[dB] | ANTENNA<br>[cm] | TABLE<br>[DEG] |
|------------------------|---------------|-------------------------|-----------------------|--------------|--------------|--------------------|-------------------|----------------|-----------------|----------------|
| ----- 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 [cm] | TABLE [DEG] |
|------------------------|---------------|----------------|----------------------|-----------|-----------|-----------------|----------------|-------------|--------------|-------------|
| ----- Horizontal ----- |               |                |                      |           |           |                 |                |             |              |             |
| 1                      | 14889.00045.1 | 40.9           | 40.9                 | 9.0       | 41.6      | 53.4            | 80.0           | 26.6        | 100          | 61          |
| 2                      | 17966.00041.1 | 47.7           | 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                      | 10571.00044.0 | 38.0           | 38.0                 | 7.5       | 41.1      | 48.4            | 80.0           | 31.6        | 100          | 0           |

Remark: Margin (dB) = Limit – Result

$$\text{Result} = \text{Reading Peak} + \text{Antenna Factor} + \text{Loss} - \text{Gain}$$

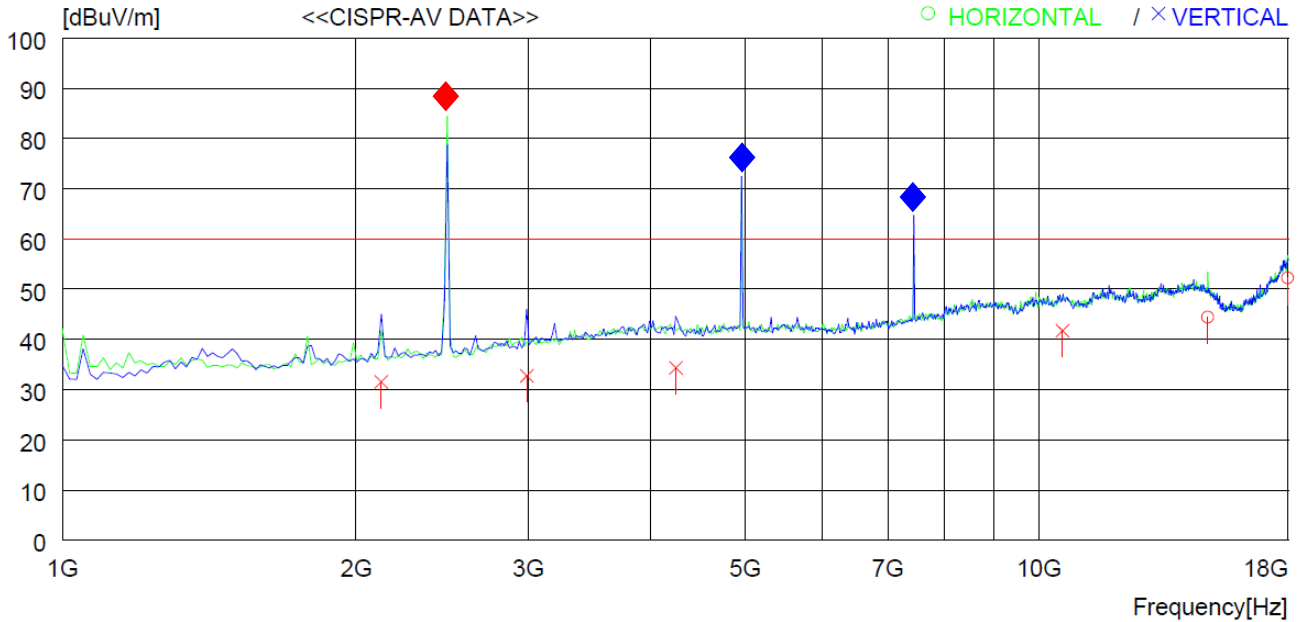
Loss and Gain in above table means Cable Loss and Pre-amplifier gain.

\* 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 [MHz] | READING CAV [dBuV] | ANT FACTOR [dB] | LOSS [dB] | GAIN [dB] | RESULT [dBuV/m] | LIMIT [dBuV/m] | MARGIN [dB] | ANTENNA [cm] | TABLE [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

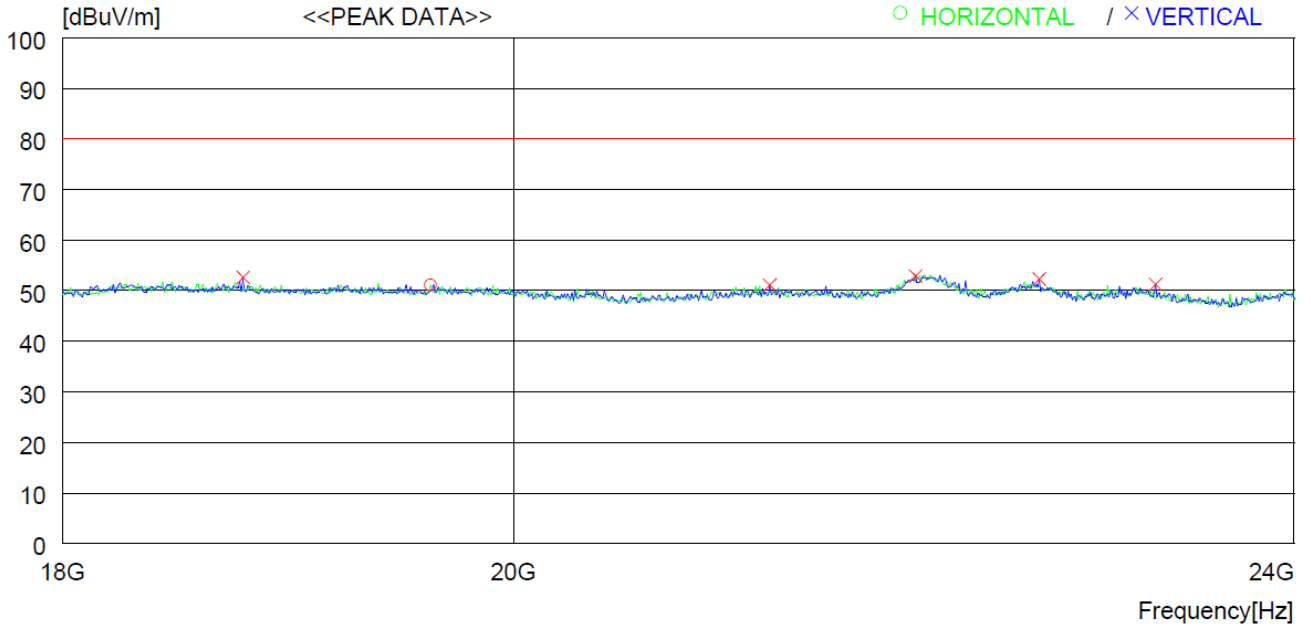
Loss and Gain in above table means Cable Loss and Pre-amplifier gain.

\* 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              |                               |



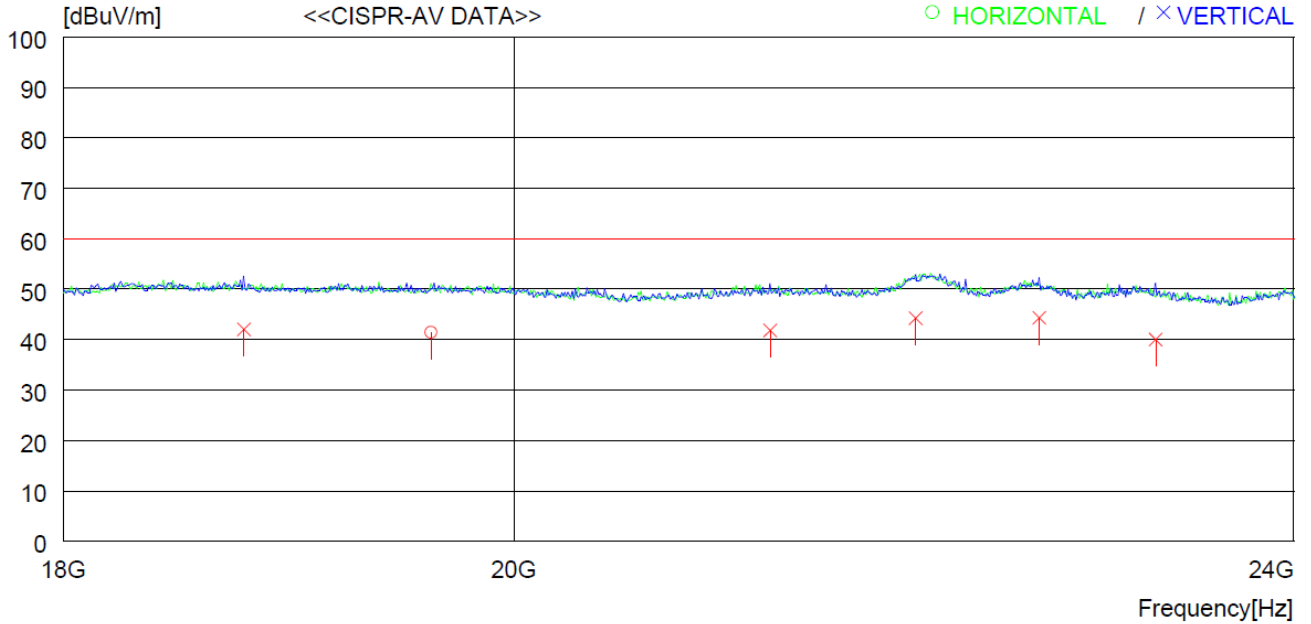
| No.                    | FREQ [MHz] | READING [dBuV] | ANT PEAK FACTOR [dB] | LOSS [dB] | GAIN [dB] | RESULT [dBuV/m] | LIMIT [dBuV/m] | MARGIN [dB] | ANTENNA [cm] | TABLE [DEG] |
|------------------------|------------|----------------|----------------------|-----------|-----------|-----------------|----------------|-------------|--------------|-------------|
| ----- 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 [MHz] | READING CAV [dBuV] | ANT FACTOR [dB] | LOSS [dB] | GAIN [dB] | RESULT [dBuV/m] | LIMIT [dBuV/m] | MARGIN [dB] | ANTENNA [cm] | TABLE [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 $\mu$ V (CISPR-Average)   |
| Reading           | = 18.6 dB $\mu$ V                   |
| Correction Factor | = LISN + Cable Loss + Pulse Limiter |
|                   | = 21.5 dB                           |
| Total             | = 40.1 dB $\mu$ V                   |
| Margin            | = 60.0 dB $\mu$ V – 40.1 dB $\mu$ V |
|                   | = 19.9 dB                           |

-. Example 2: 43.580 MHz

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