

# ELECTROMAGNETIC EMISSION COMPLIANCE REPORT FOR LOW-POWER, NON-LICENSED TRANSMITTER

**Test Report No.** : OT-19D-RWD-007  
**AGR No.** : A198A-365  
**Applicant** : ZTACOM.Co.,Ltd  
**Address** : B.910.Doosan The Land Tower 152, Magokseo-ro, Gangseo-Gu, Seoul, 07788, South Korea  
**Manufacturer** : ZTACOM.Co.,Ltd  
**Address** : Unit1301, 165, Magokjungang-ro, Gangseo-gu, Seoul, Republic of Korea  
**Type of Equipment** : GPS Tracker & Messenger  
**FCC ID.** : 2AUFQZLD-300U  
**Model Name** : ZLD-300U  
**Multiple Model Name** : N/A  
**Serial number** : N/A  
**Total page of Report** : 35 pages (including this page)  
**Date of Incoming** : November 02, 2019  
**Date of issue** : December 02, 2019

## SUMMARY

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

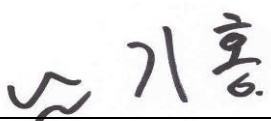
This test report only contains the result of a single test of the sample supplied for the examination.

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

Reviewed by:

  
 Tae-Ho, Kim / Senior Manager  
 ONETECH Corp.

Approved by:

  
 Ki-Hong, Nam / Chief Engineer  
 ONETECH Corp.

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**Revision History**

| Rev. No. | Issue Report No. | Issued Date       | Revisions       | Section Affected |
|----------|------------------|-------------------|-----------------|------------------|
| 0        | OT-19D-RWD-007   | December 02, 2019 | Initial Release | All              |
|          |                  |                   |                 |                  |
|          |                  |                   |                 |                  |

## 1. VERIFICATION OF COMPLIANCE

Applicant : ZTACOM.Co.,Ltd

Address : B.910.Doosan The Land Tower 152, Magokseo-ro, Gangseo-Gu, Seoul, 07788, South Korea

Contact Person : Byungmin Park / Director of Technology

Telephone No. : +82-10-3620-7652

FCC ID : 2AUFQZLD-300U

Model Name : ZLD-300U

Brand Name : -

Serial Number : N/A

Date : December 02, 2019

|                                                         |                                                                                |
|---------------------------------------------------------|--------------------------------------------------------------------------------|
| EQUIPMENT CLASS                                         | DTS – DIGITAL TRNSMISSION SYSTEM                                               |
| E.U.T. DESCRIPTION                                      | GPS Tracker & Messenger                                                        |
| THIS REPORT CONCERNS                                    | Original Grant                                                                 |
| MEASUREMENT PROCEDURES                                  | ANSI C63.10: 2013                                                              |
| TYPE OF EQUIPMENT TESTED                                | Pre-Production                                                                 |
| KIND OF EQUIPMENT<br>AUTHORIZATION REQUESTED            | Certification                                                                  |
| EQUIPMENT WILL BE OPERATED<br>UNDER FCC RULES PART(S)   | FCC PART 15 SUBPART C Section 15.247<br>558074 D01 15.247 Meas Guidance v05r02 |
| Modifications on the Equipment to<br>Achieve Compliance | None                                                                           |
| Final Test was Conducted On                             | 3 m, Semi Anechoic Chamber                                                     |

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

## 2. TEST SUMMARY

### 2.1 Test items and results

| SECTION        | TEST ITEMS                                          | RESULTS                |
|----------------|-----------------------------------------------------|------------------------|
| 15.247 (a) (2) | Minimum 6 dB Bandwidth                              | Met the Limit / PASS   |
| 15.247 (b) (3) | Maximum Peak Conducted Output Power                 | Met the Limit / PASS   |
| 15.247 (d)     | 100 kHz Bandwidth Outside the Frequency Band        | Met the Limit / PASS   |
| 15.247 (d)     | Radiated Emission which fall in the Restricted Band | Met the Limit / PASS   |
| 15.247 (e)     | Peak Power Spectral Density                         | Met the Limit / PASS   |
| 15.209         | Radiated Emission Limits                            | Met the Limit / PASS   |
| 15.207         | Conducted Limits                                    | Met the Limit / PASS   |
| 15.203         | Antenna Requirement                                 | Met requirement / PASS |

### 2.2 Additions, deviations, exclusions from standards

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

### 2.3 Related Submittal(s) / Grant(s)

Original submittal only

### 2.4 Purpose of the test

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

### 2.5 Test Methodology

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

### 2.6 Test Facility

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

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

-. Site Filing:

VCCI (Voluntary Control Council for Interference) – Registration No. R-4112/ C-14617/ G-10666 / T-1842

IC (Industry Canada) – Registration No. Site# 3736A-3

-. Site Accreditation:

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

FCC (Federal Communications Commission) - Accreditation No. KR0013

RRA (Radio Research Agency) – Designation No. KR0013

### 3. GENERAL INFORMATION

#### 3.1 Product Description

The ZTACOM.Co.,Ltd, Model ZLD-300U (referred to as the EUT in this report) is an GPS Tracker & Messenger, Product specification information described herein was obtained from product data sheet or user's manual.

|                                                       |                                                    |                       |
|-------------------------------------------------------|----------------------------------------------------|-----------------------|
| DEVICE TYPE                                           | GPS Tracker & Messenger                            |                       |
| Temperature Range                                     | -20 °C ~ +50 °C                                    |                       |
| Rated Supply Voltage                                  | DC 3.7 V                                           |                       |
| OPERATING FREQUENCY                                   | LoRa                                               | 903 MHz ~ 927 MHz     |
|                                                       | Bluetooth LE                                       | 2 402 MHz ~ 2 480 MHz |
| MODULATION TYPE                                       | LoRa                                               | CSS                   |
|                                                       | Bluetooth LE                                       | GFSK                  |
| RF OUTPUT POWER                                       | LoRa                                               | 17.07 dBm             |
|                                                       | Bluetooth LE                                       | 2.31 dBm              |
| NUMBER OF CHANNEL                                     | LoRa                                               | 41 Channel            |
|                                                       | Bluetooth LE                                       | 40 Channel            |
| ANTENNA TYPE                                          | LoRa : FPCB Antenna<br>Bluetooth LE : Chip Antenna |                       |
| ANTENNA GAIN                                          | LoRA : -2.9 dBi<br>Bluetooth : 3.1 dBi             |                       |
| List of each Osc. or crystal<br>Freq.(Freq. >= 1 MHz) | 24 MHz, 26 MHz                                     |                       |

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

-. None

### 4. EUT MODIFICATIONS

-. None

## 5. SYSTEM TEST CONFIGURATION

### 5.1 Justification

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

| DEVICE TYPE | MANUFACTURER                              | MODEL/PART NUMBER | FCC ID |
|-------------|-------------------------------------------|-------------------|--------|
| Main Board  | ZTACOM.Co.,Ltd                            | MESI_PLUS_MP      | N/A    |
| DC Battery  | Shenzhen BENZO Energy technology Co., Ltd | UF 502535         | N/A    |

### 5.2 Peripheral equipment

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

| Model                       | Manufacturer                                | Description                   | Connected to |
|-----------------------------|---------------------------------------------|-------------------------------|--------------|
| ZLD-300U                    | ZTACOM.Co.,Ltd                              | GPS Tracker & Messenger (EUT) | -            |
| CC2640R2<br>Development Kit | TEXAS INSTRUMENTS                           | Jig Board                     | EUT          |
| Ideapad 330                 | LENOVO                                      | Notebook PC                   | -            |
| PA-1450-55LR                | LITE-ON TECHNOLOGY<br>(CHANGZHOU) Co., Ltd. | AC Adapter                    |              |

### 5.3 Mode of operation during the test

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

For final testing, the EUT was set at 903 MHz, 915 MHz, and 927 MHz to get a maximum emission levels from the EUT. The EUT was moved throughout the XY, XZ, and YZ planes and the worst case is “XZ” axis, but the worst data was recorded in this report.



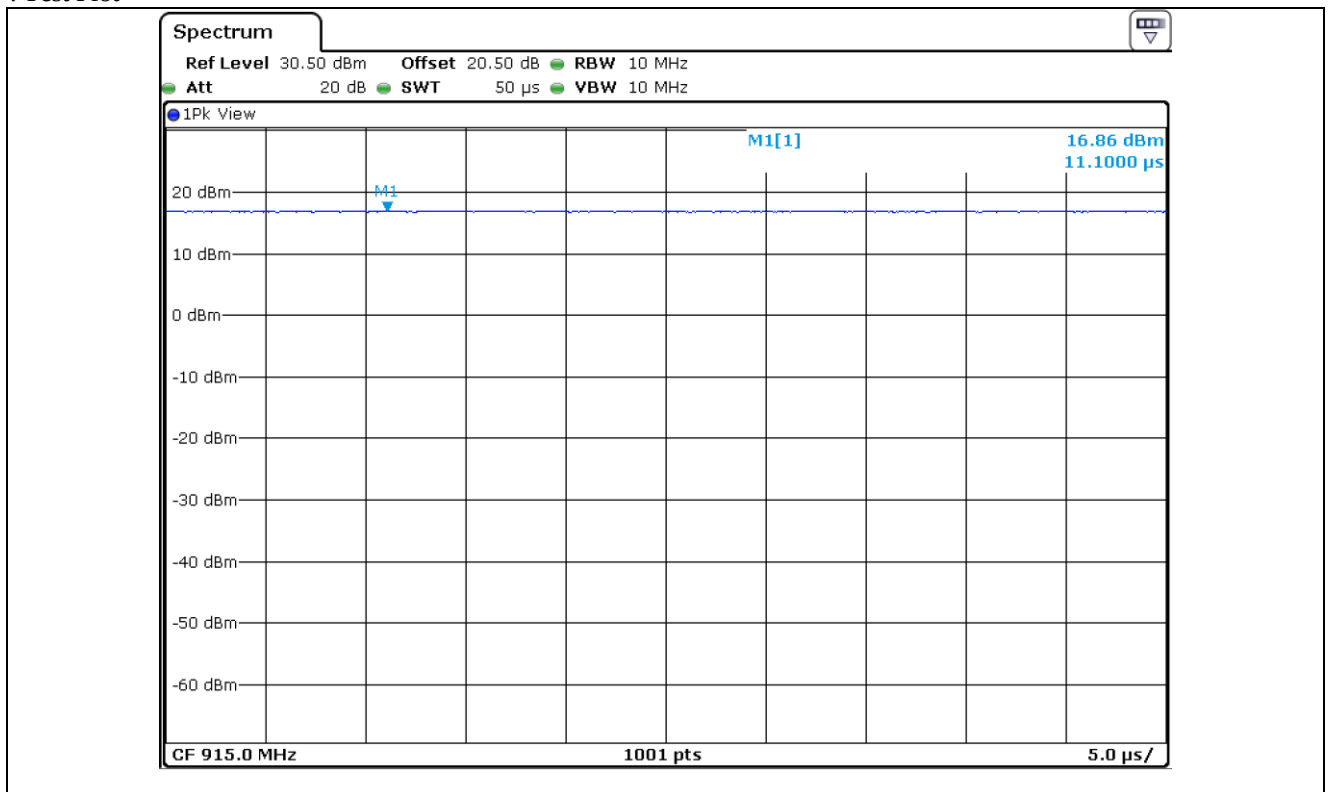
### -. Duty Cycle

| Mode | Tx On Time<br>[ ms ] | Tx Off Time<br>[ ms ] | Duty Cycle<br>[ % ] | Correction Factor<br>[ dB ] |
|------|----------------------|-----------------------|---------------------|-----------------------------|
| LoRa | -                    | -                     | 100.00              | -                           |

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

Correction Factor :  $10 * \log(1 / (\text{Duty Cycle} / 100))$

### -. Test Plot



-. Channel List

| LoRa    |                 |         |                 | Bluetooth LE |                 |         |                 |
|---------|-----------------|---------|-----------------|--------------|-----------------|---------|-----------------|
| Channel | Frequency [MHz] | Channel | Frequency [MHz] | Channel      | Frequency [MHz] | Channel | Frequency [MHz] |
| 200     | 903.00          | 221     | 915.60          | 0            | 2 402.00        | 21      | 2 444.00        |
| 201     | 903.60          | 222     | 916.20          | 1            | 2 404.00        | 22      | 2 446.00        |
| 202     | 904.20          | 223     | 916.80          | 2            | 2 406.00        | 23      | 2 448.00        |
| 203     | 904.80          | 224     | 917.40          | 3            | 2 408.00        | 24      | 2 450.00        |
| 204     | 905.40          | 225     | 918.00          | 4            | 2 410.00        | 25      | 2 452.00        |
| 205     | 906.00          | 226     | 918.60          | 5            | 2 412.00        | 26      | 2 454.00        |
| 206     | 906.60          | 227     | 919.20          | 6            | 2 414.00        | 27      | 2 456.00        |
| 207     | 907.20          | 228     | 919.80          | 7            | 2 416.00        | 28      | 2 458.00        |
| 208     | 907.80          | 229     | 920.40          | 8            | 2 418.00        | 29      | 2 460.00        |
| 209     | 908.40          | 230     | 921.00          | 9            | 2 420.00        | 30      | 2 462.00        |
| 210     | 909.00          | 231     | 921.60          | 10           | 2 422.00        | 31      | 2 464.00        |
| 211     | 909.60          | 232     | 922.20          | 11           | 2 424.00        | 32      | 2 466.00        |
| 212     | 910.20          | 233     | 922.80          | 12           | 2 426.00        | 33      | 2 468.00        |
| 213     | 910.80          | 234     | 923.40          | 13           | 2 428.00        | 34      | 2 470.00        |
| 214     | 911.40          | 235     | 924.00          | 14           | 2 430.00        | 35      | 2 472.00        |
| 215     | 912.00          | 236     | 924.60          | 15           | 2 432.00        | 36      | 2 474.00        |
| 216     | 912.60          | 237     | 925.20          | 16           | 2 434.00        | 37      | 2 476.00        |
| 217     | 913.20          | 238     | 925.80          | 17           | 2 436.00        | 38      | 2 478.00        |
| 218     | 913.80          | 239     | 926.40          | 18           | 2 438.00        | 39      | 2 480.00        |
| 219     | 914.40          | 240     | 927.00          | 19           | 2 440.00        | -       | -               |
| 220     | 915.00          | -       | -               | 20           | 2 442.00        | -       | -               |

## 5.4 Configuration of Test System

- Line Conducted Test:** The EUT was tested in a Charging & Transmitter mode. The EUT was connected to USB and the Power of USB was Connected to DC Adaptor. All supporting equipments were connected to another LISN. Preliminary Power line Conducted Emission test was performed by using the procedure in ANSI C63.10: 2013 to determine the worse operating conditions.
- Radiated Emission Test:** Preliminary radiated emissions test were conducted using the procedure in ANSI C63.10: 2013 to determine the worse operating conditions. Final radiated emission tests were conducted at 3 meter Semi Anechoic Chamber.
- The turntable was rotated through 360 degrees and the EUT was tested by positioned three orthogonal planes to obtain the highest reading on the field strength meter. Once maximum reading was determined, the search antenna was raised and lowered in both vertical and horizontal polarization.

## 5.5 Antenna Requirement

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

### Antenna Construction:

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

## 6. PRELIMINARY TEST

### 6.1 AC Power line Conducted Emissions Tests

During Preliminary Test, the following operating mode was investigated.

| Operation Mode              | The Worse operating condition (Please check one only) |
|-----------------------------|-------------------------------------------------------|
| Charging & Transmitter Mode | X                                                     |

### 6.2 General Radiated Emissions Tests

During Preliminary Test, the following operating mode was investigated.

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

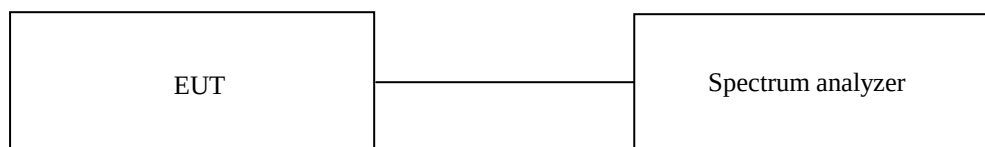
## 7. MINIMUM 6 dB BANDWIDTH

### 7.1 Operating environment

Temperature : 23 °C  
Relative humidity : 45 % R.H.

### 7.2 Test set-up

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

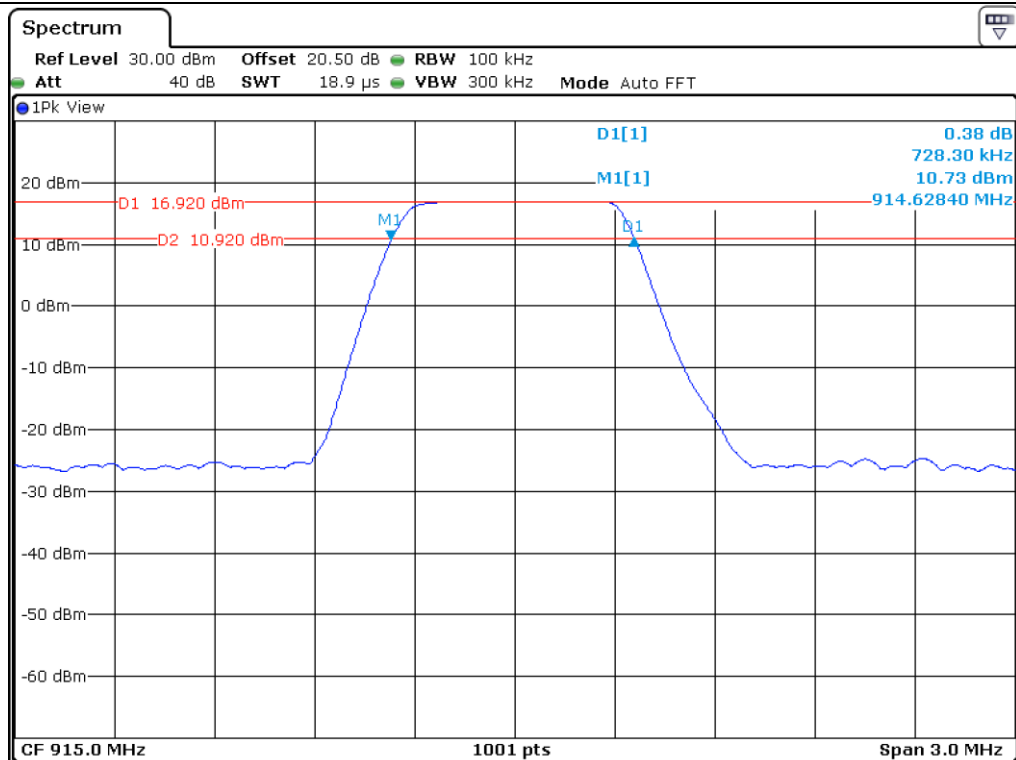


### 7.3 Test equipment used

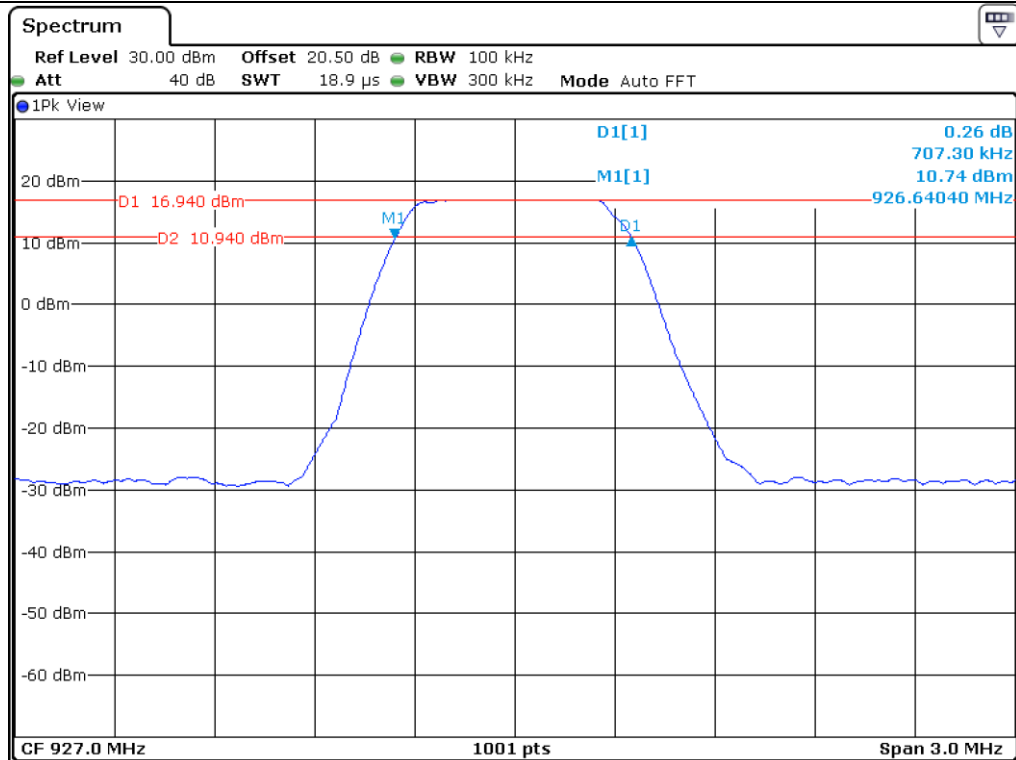
|     | Model Number | Manufacturer    | Description     | Serial Number | Last Cal.          |
|-----|--------------|-----------------|-----------------|---------------|--------------------|
| ■ - | FSV40        | Rohde & Schwarz | Signal Analyzer | 101009        | Mar. 11, 2019 (1Y) |

All test equipment used is calibrated on a regular basis.





Middle Channel



High Channel

## 8. MAXIMUM PEAK OUTPUT POWER

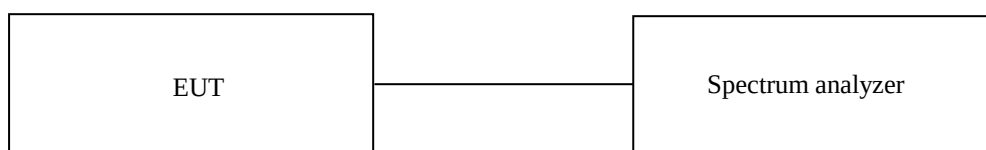
### 8.1 Operating environment

Temperature : 23 °C  
Relative humidity : 45 % R.H.

### 8.2 Test set-up

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

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



### 8.3 Test equipment used

| Model Number | Manufacturer    | Description     | Serial Number | Last Cal.          |
|--------------|-----------------|-----------------|---------------|--------------------|
| ■ - FSV40    | Rohde & Schwarz | Signal Analyzer | 101009        | Mar. 11, 2019 (1Y) |

All test equipment used is calibrated on a regular basis.



## 8.4 Test Data

-. Test Date : November 13, 2019 ~ November 15, 2019

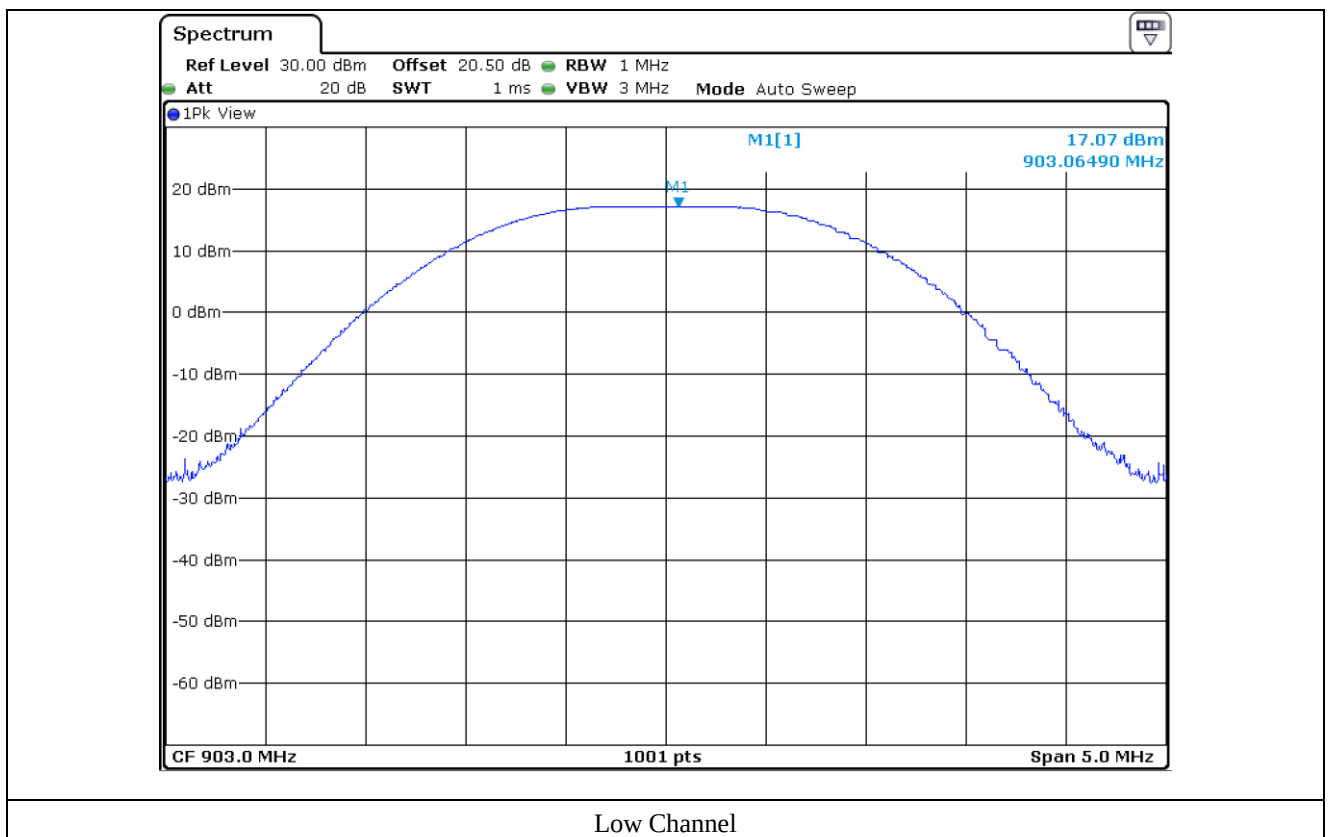
-. Test Result : Pass

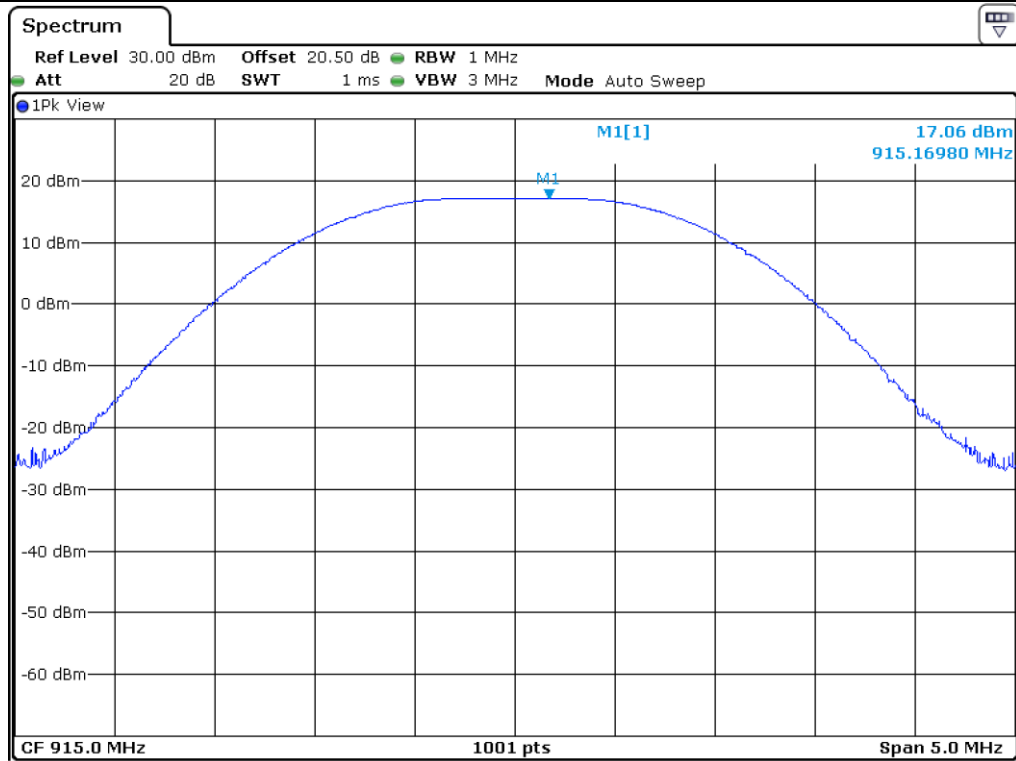
| CHANNEL | FREQUENCY<br>(MHz) | MEASURED VALUE<br>(dBm) | LIMIT<br>(dBm) | MARGIN<br>(dB) |
|---------|--------------------|-------------------------|----------------|----------------|
| Low     | 903.00             | 17.07                   | 30.00          | 12.93          |
| Middle  | 915.00             | 17.06                   | 30.00          | 12.94          |
| High    | 927.00             | 17.06                   | 30.00          | 12.94          |

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

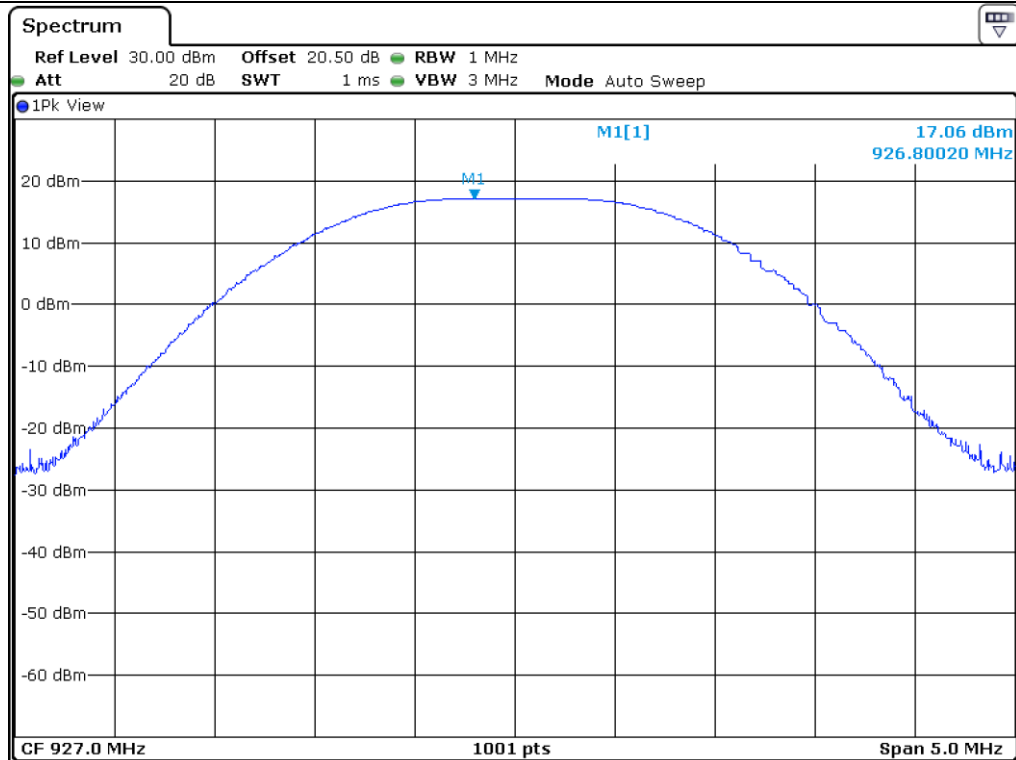


Tested by: Hyung-Kwon, Oh / Assistant Manager





Middle Channel



High Channel

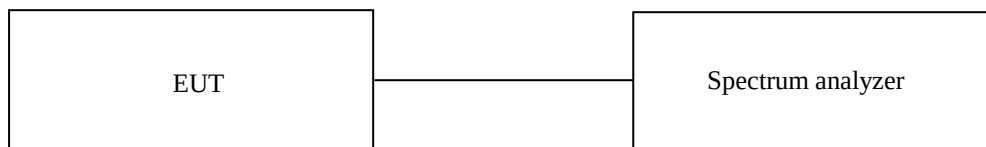
## 9. 100 kHz BANDWIDTH OUTSIDE THE FREQUENCY BAND

### 9.1 Operating environment

Temperature : 23 °C  
Relative humidity : 45 % R.H.

### 9.2 Test set-up for conducted measurement

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



### 9.3 Test set-up for radiated measurement

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

The frequency spectrum from up to 10 GHz was scanned and emission levels maximized at each frequency recorded.

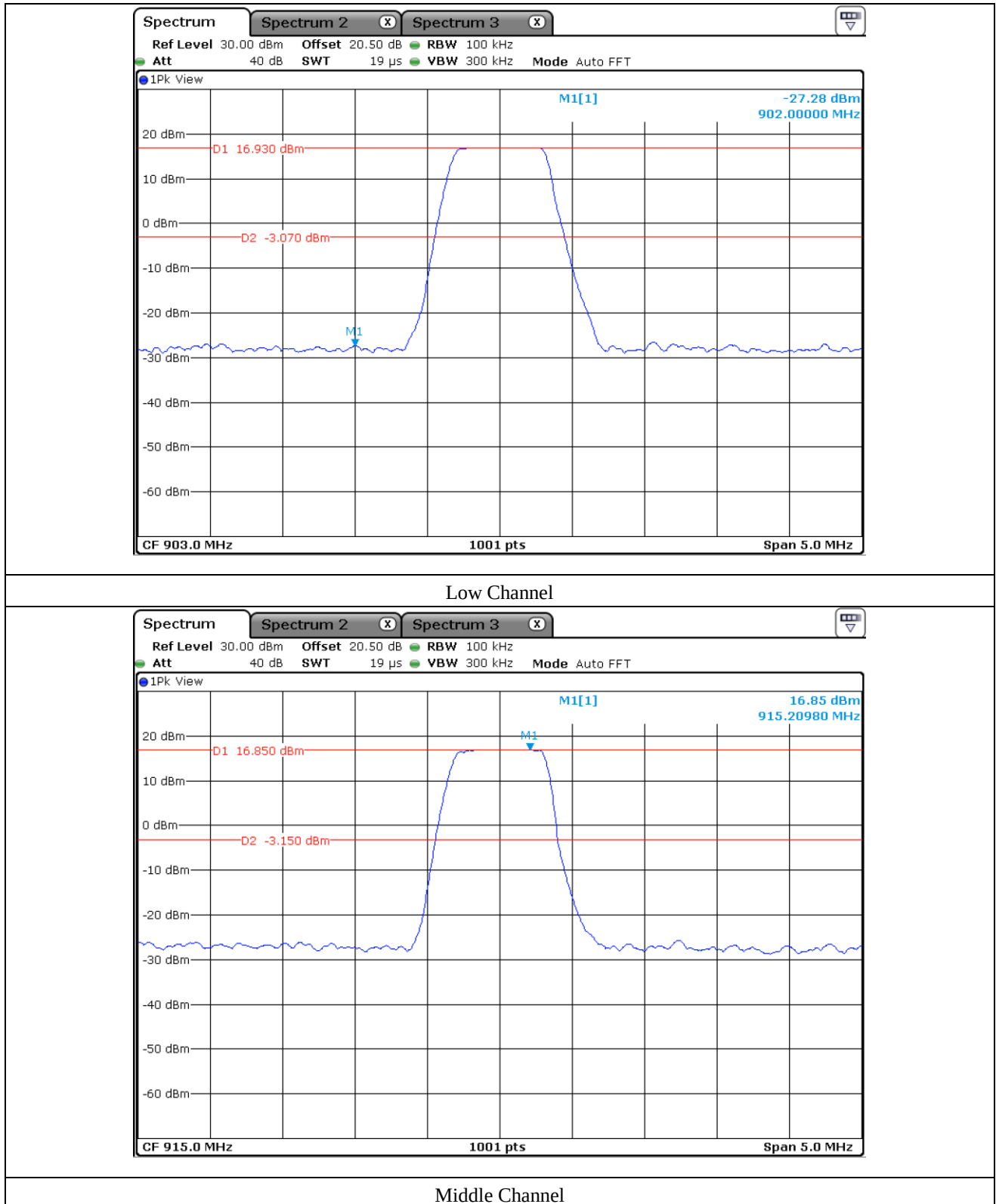
The system was rotated 360°, and the antenna was varied in the height between 1.0 m and 4.0 m in order to determine the maximum emission levels. This procedure was performed for horizontal and vertical polarization of the receiving antenna.

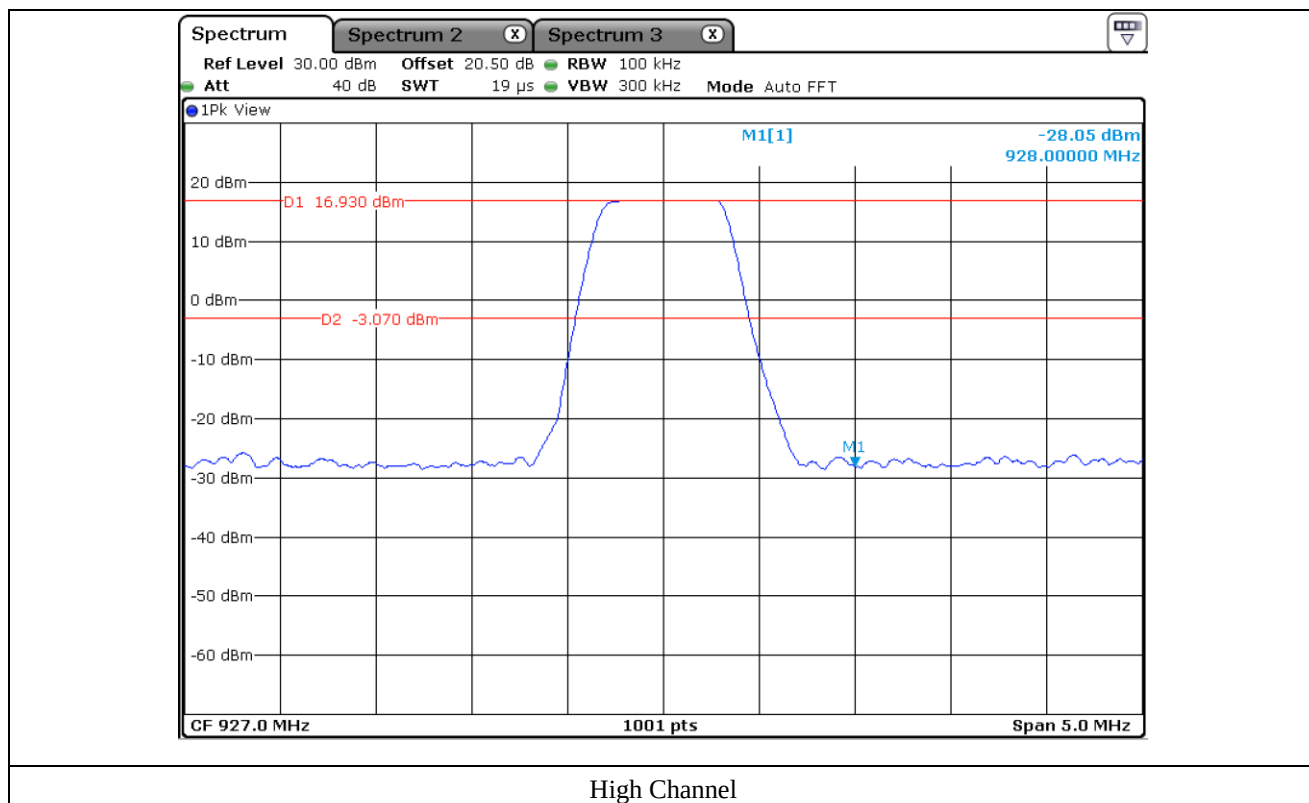
### 9.4 Test equipment used

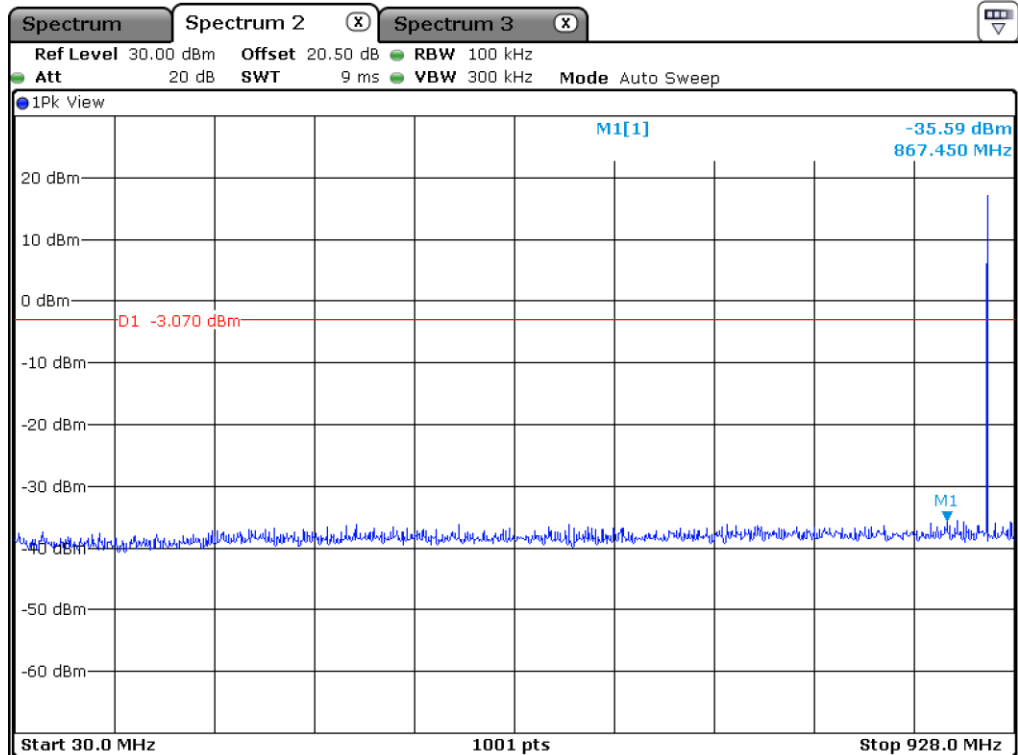
|     | Model Number | Manufacturer      | Description              | Serial Number | Last Cal.          |
|-----|--------------|-------------------|--------------------------|---------------|--------------------|
| ■ - | FSV40        | Rohde & Schwarz   | Signal Analyzer          | 101009        | Mar. 11, 2019 (1Y) |
| ■ - | ESU          | Rohde & Schwarz   | EMI Test Receiver        | 100261        | Mar. 28, 2019 (1Y) |
| -   | 310N         | Sonoma Instrument | Pre-Amplifier            | 312545        | Mar. 18, 2019 (1Y) |
| -   | BBV9718      | Schwarzbeck       | Amplifier                | 310           | Mar. 28, 2019 (1Y) |
| ■   | DT3000-3t    | Innco System      | Turn Table               | DT3000/093    | N/A                |
| ■ - | MA-4000XPET  | Innco System      | Antenna Master           | MA4000/509    | N/A                |
| ■ - | VULB9163     | Schwarzbeck       | TRILOG Broadband Antenna | 777           | Apr. 13, 2018 (2Y) |
| ■ - | BBHA 9120D   | Schwarzbeck       | Horn Antenna             | 9120D-1366    | Jul. 16, 2019 (1Y) |
| ■ - | BBHA 9170    | Schwarzbeck       | Horn Antenna             | BBHA9170179   | Jan. 16, 2019 (1Y) |

All test equipment used is calibrated on a regular basis.

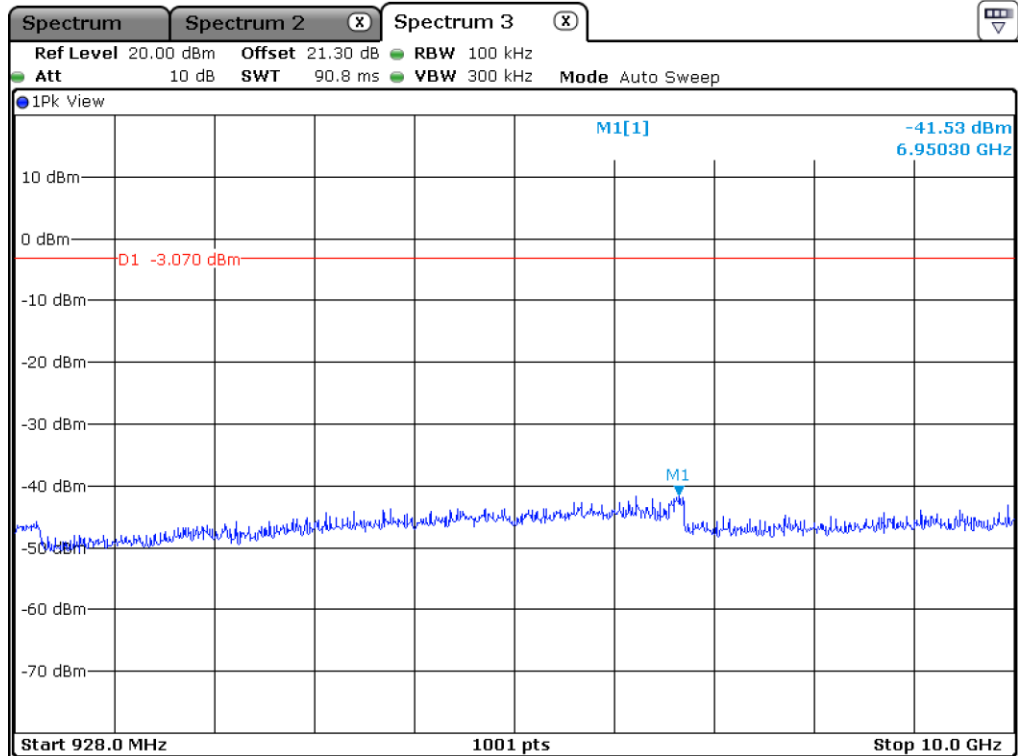
## 9.5 Test Data for conducted emission



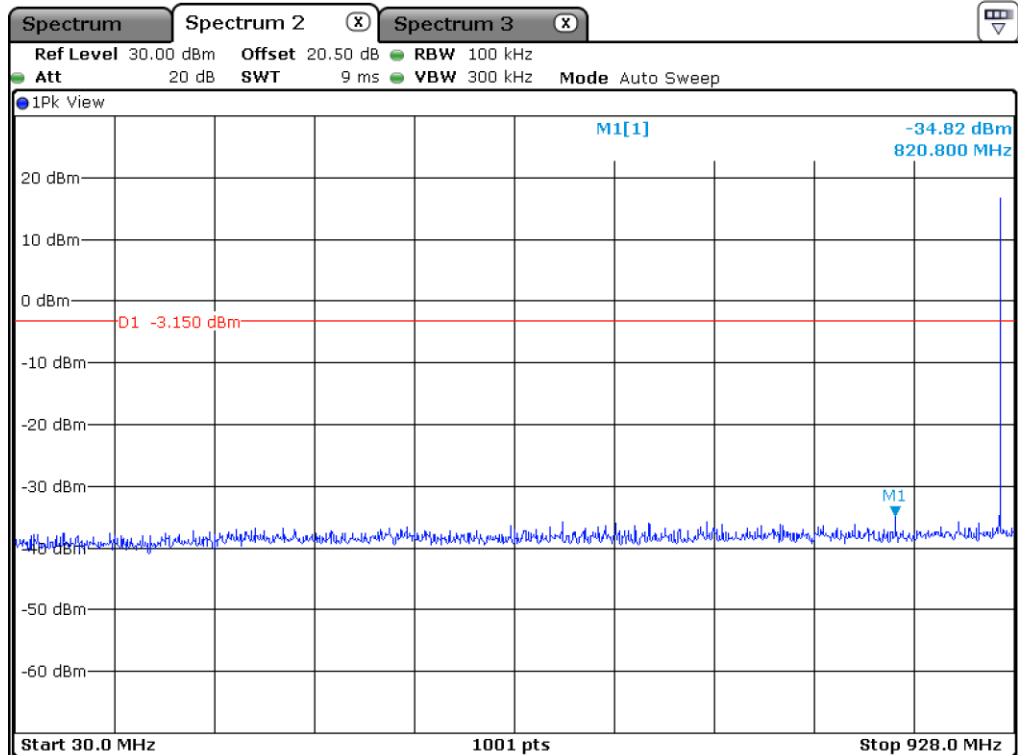




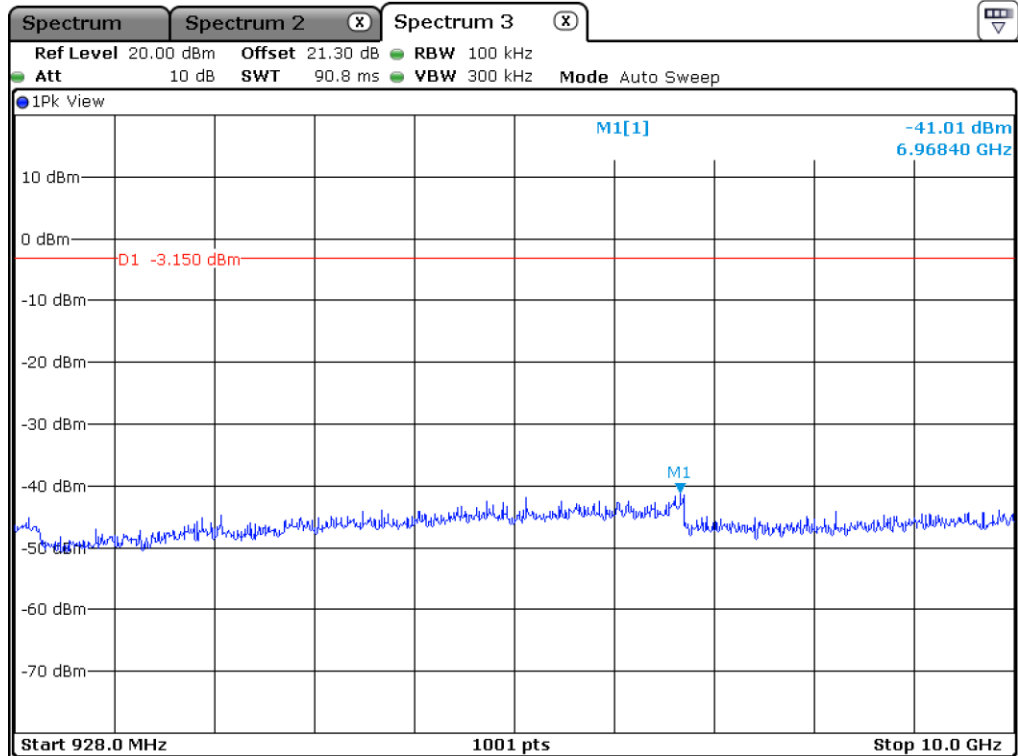
### Low Channel



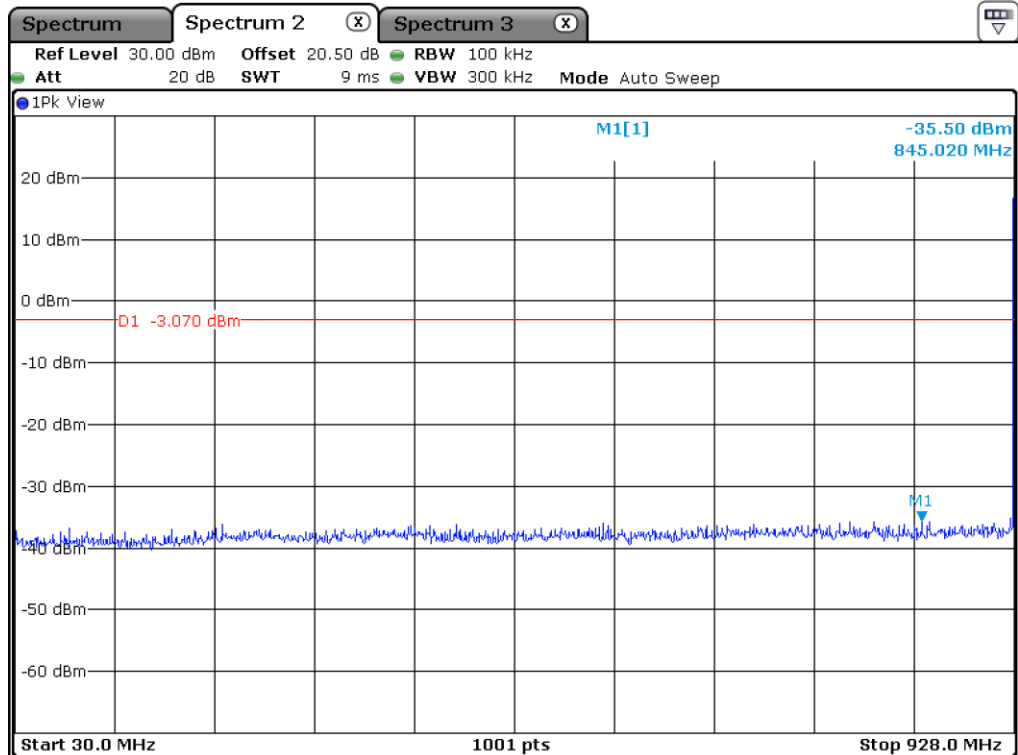
### Low Channel



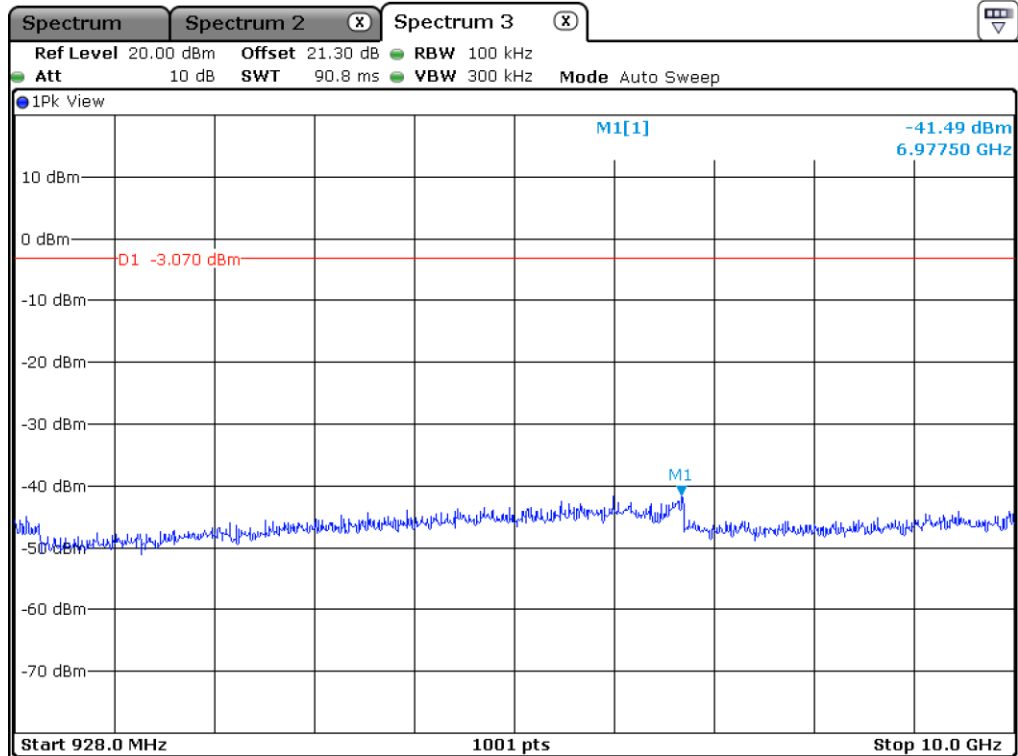
Middle Channel



Middle Channel



### High Channel



### High Channel



## 9.6 Test data for radiated emission

### 9.6.1 Spurious & Harmonic Radiated Emission

- . Test Date : November 13, 2019 ~ November 15, 2019
- . Resolution bandwidth : 1 MHz and Peak Detector for Peak Mode  
1 MHz and RMS Detector for Average Mode
- . Video bandwidth : 3 MHz for Peak and Average Mode
- . Frequency range : 1 GHz ~ 10.0 GHz
- . Measurement distance : 3 m
- . Duty Cycle : 100.00 %
- . Result : PASSED

| Channel | Frequency (MHz) | Reading (dBuV) | Detector Mode | Ant. Pol. (H/V) | Ant. Factor | Cable Loss | Total (dBuV/m) | Limits (dBuV/m) | Margin (dB) |
|---------|-----------------|----------------|---------------|-----------------|-------------|------------|----------------|-----------------|-------------|
| Low     | 1 806.00        | 34.77          | Peak          | H               | 24.90       | 1.59       | 61.26          | 74.00           | 12.74       |
|         |                 | 20.54          | Average       | H               |             |            | 47.03          | 54.00           | 6.97        |
|         |                 | 33.94          | Peak          | V               |             |            | 60.43          | 74.00           | 13.57       |
|         |                 | 20.17          | Average       | V               |             |            | 46.66          | 54.00           | 7.34        |
|         | 2 709.00        | 24.87          | Peak          | H               | 28.00       | 1.28       | 54.15          | 74.00           | 19.85       |
|         |                 | 11.12          | Average       | H               |             |            | 40.40          | 54.00           | 13.60       |
|         |                 | 24.99          | Peak          | V               |             |            | 54.27          | 74.00           | 19.73       |
|         |                 | 11.70          | Average       | V               |             |            | 40.98          | 54.00           | 13.02       |
|         | 3 612.00        | 18.78          | Peak          | H               | 29.40       | 1.57       | 49.75          | 74.00           | 24.25       |
|         |                 | 7.80           | Average       | H               |             |            | 38.77          | 54.00           | 15.23       |
|         |                 | 17.52          | Peak          | V               |             |            | 48.49          | 74.00           | 25.51       |
|         |                 | 6.98           | Average       | V               |             |            | 37.95          | 54.00           | 16.05       |
| Middle  | 1 830.00        | 34.14          | Peak          | H               | 24.90       | 1.59       | 60.63          | 74.00           | 13.37       |
|         |                 | 21.07          | Average       | H               |             |            | 47.56          | 54.00           | 6.44        |
|         |                 | 35.62          | Peak          | V               |             |            | 62.11          | 74.00           | 11.89       |
|         |                 | 23.18          | Average       | V               |             |            | 49.67          | 54.00           | 4.33        |
|         | 2 745.00        | 24.82          | Peak          | H               | 28.00       | 1.28       | 54.10          | 74.00           | 19.90       |
|         |                 | 11.86          | Average       | H               |             |            | 41.14          | 54.00           | 12.86       |
|         |                 | 24.53          | Peak          | V               |             |            | 53.81          | 74.00           | 20.19       |
|         |                 | 11.75          | Average       | V               |             |            | 41.03          | 54.00           | 12.97       |
|         | 3 660.00        | 17.91          | Peak          | H               | 29.40       | 1.57       | 48.88          | 74.00           | 25.12       |
|         |                 | 7.10           | Average       | H               |             |            | 38.07          | 54.00           | 15.93       |
|         |                 | 17.10          | Peak          | V               |             |            | 48.07          | 74.00           | 25.93       |
|         |                 | 7.30           | Average       | V               |             |            | 38.27          | 54.00           | 15.73       |

|      |          |       |         |   |       |      |       |       |       |
|------|----------|-------|---------|---|-------|------|-------|-------|-------|
| High | 1 854.00 | 35.37 | Peak    | H | 24.90 | 1.59 | 61.86 | 74.00 | 12.14 |
|      |          | 20.17 | Average | H |       |      | 46.66 | 54.00 | 7.34  |
|      |          | 34.05 | Peak    | V |       |      | 60.54 | 74.00 | 13.46 |
|      |          | 21.03 | Average | V |       |      | 47.52 | 54.00 | 6.48  |
|      | 2 781.00 | 26.39 | Peak    | H | 28.00 | 1.28 | 55.67 | 74.00 | 18.33 |
|      |          | 11.04 | Average | H |       |      | 40.32 | 54.00 | 13.68 |
|      |          | 25.30 | Peak    | V |       |      | 54.58 | 74.00 | 19.42 |
|      |          | 12.09 | Average | V |       |      | 41.37 | 54.00 | 12.63 |
|      | 3 708.00 | 17.91 | Peak    | H | 29.40 | 1.57 | 48.88 | 74.00 | 25.12 |
|      |          | 8.18  | Average | H |       |      | 39.15 | 54.00 | 14.85 |
|      |          | 17.03 | Peak    | V |       |      | 48.00 | 74.00 | 26.00 |
|      |          | 6.92  | Average | V |       |      | 37.89 | 54.00 | 16.11 |

Tabulated test data for Harmonic Radiated Emission

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

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

Total Level = Reading + Antenna Factor + Cable Loss



Tested by: Hyung-Kwon, Oh / Assistant Manager

## 10. PEAK POWER SPECTRUL DENSITY

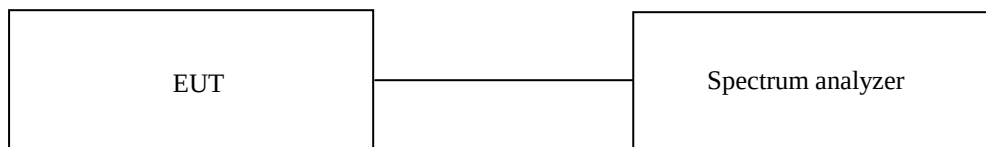
### 10.1 Operating environment

Temperature : 23 °C  
Relative humidity : 45 % R.H.

### 10.2 Test set-up

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

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



### 10.3 Test equipment used

|     | Model Number | Manufacturer    | Description     | Serial Number | Last Cal.          |
|-----|--------------|-----------------|-----------------|---------------|--------------------|
| ■ - | FSV40        | Rohde & Schwarz | Signal Analyzer | 101009        | Mar. 11, 2019 (1Y) |

All test equipment used is calibrated on a regular basis.

## 10.4 Test Data

-. Test Date : November 13, 2019 ~ November 15, 2019

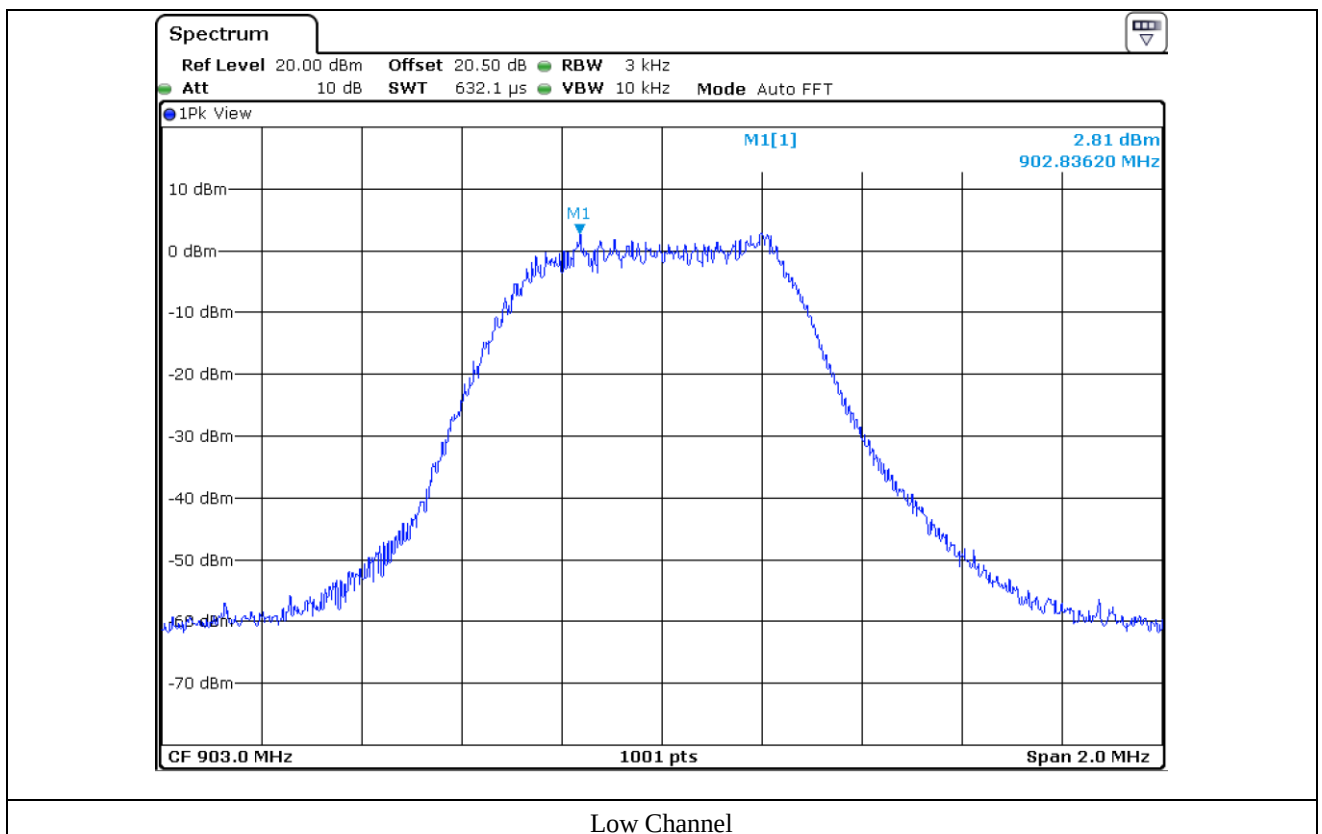
-. Test Result : Pass

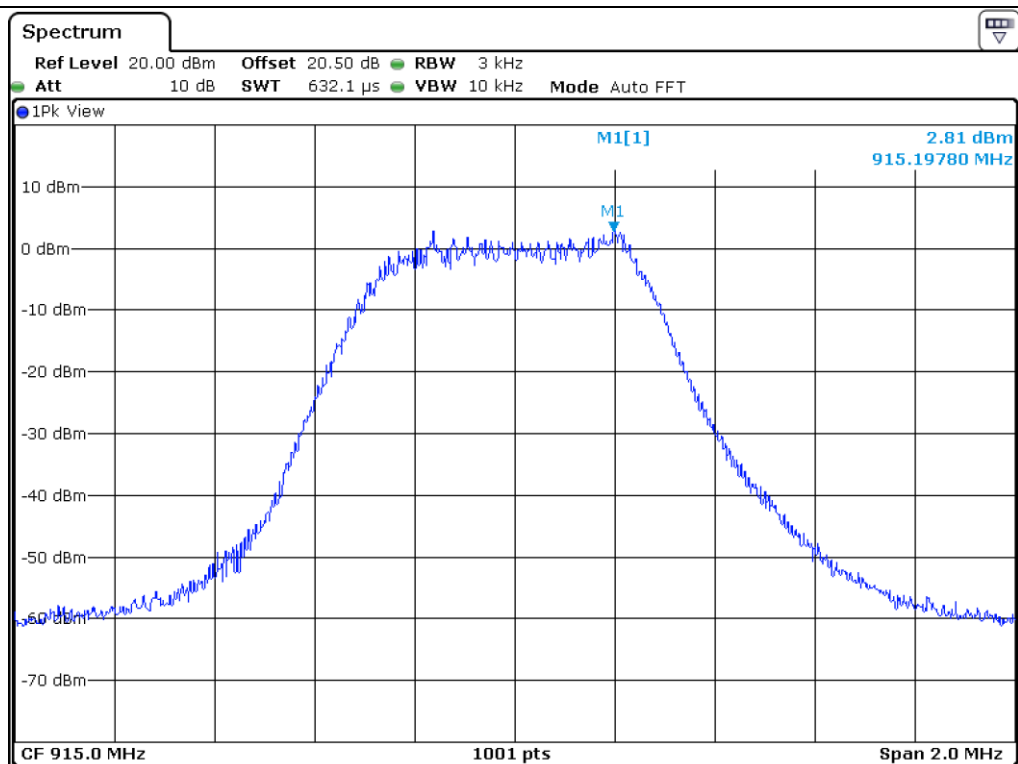
-. Operating Condition : Continuous transmitting mode

| CHANNEL | FREQUENCY(MHz) | MEASURED VLAUE (dBm) | LIMIT (dBm) | MARGIN (dB) |
|---------|----------------|----------------------|-------------|-------------|
| Low     | 903.00         | 2.81                 | 8.00        | 5.19        |
| Middle  | 915.00         | 2.81                 | 8.00        | 5.19        |
| High    | 927.00         | 2.84                 | 8.00        | 5.16        |

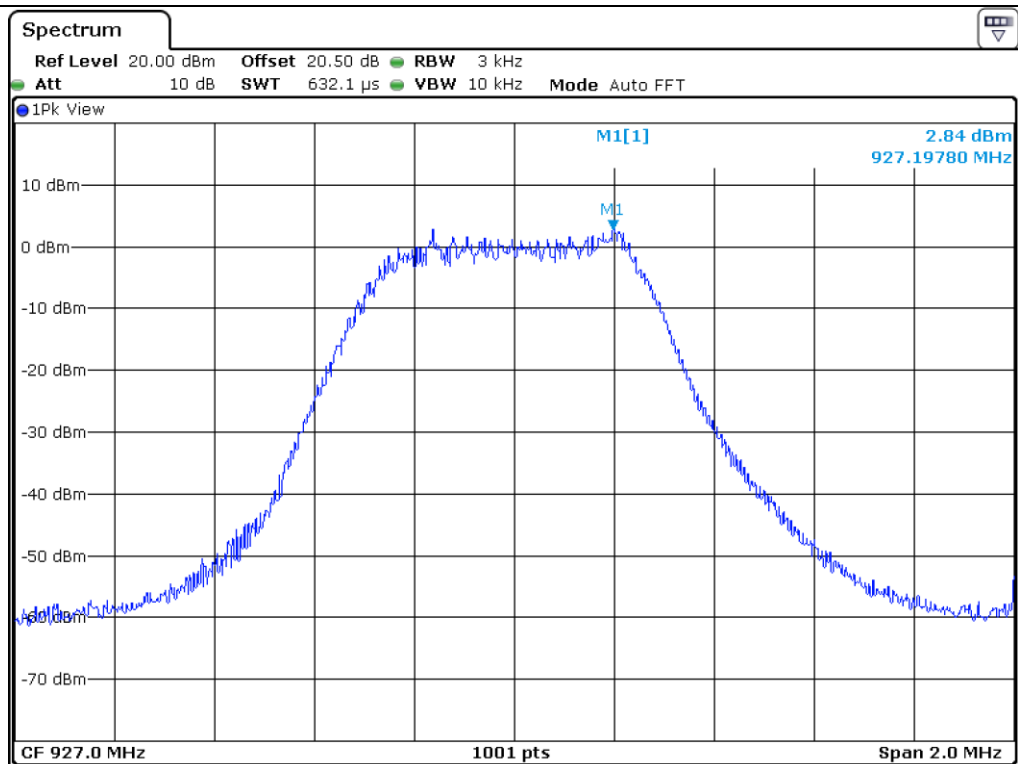
Remark. Margin = Limit – Measured value

Tested by: Hyung-Kwon, Oh / Assistant Manager





Middle Channel



High Channel

## 11. RADIATED EMISSION TEST

### 11.1 Operating environment

Temperature : 23 °C  
Relative humidity : 45 % R.H.

### 11.2 Test set-up

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

The frequency spectrum from 30 MHz to 10 GHz was scanned and emission levels maximized at each frequency recorded. The system was rotated 360°, and the antenna was varied in height between 1.0 m and 4.0 m in order to determine the maximum emission levels. This procedure was performed for both horizontal and vertical polarization of the receiving antenna.

### 11.3 Test equipment used

|     | Model Number | Manufacturer      | Description              | Serial Number | Last Cal.          |
|-----|--------------|-------------------|--------------------------|---------------|--------------------|
| ■ - | FSV40        | Rohde & Schwarz   | Signal Analyzer          | 101009        | Mar. 11, 2019 (1Y) |
| ■ - | ESU          | Rohde & Schwarz   | EMI Test Receiver        | 100261        | Mar. 28, 2019 (1Y) |
| ■ - | 310N         | Sonoma Instrument | Pre-Amplifier            | 312545        | Mar. 18, 2019 (1Y) |
| ■ - | BBV9718      | Schwarzbeck       | Amplifier                | 310           | Mar. 28, 2019 (1Y) |
| ■   | DT3000-3t    | Innco System      | Turn Table               | DT3000/093    | N/A                |
| ■ - | MA-4000XPET  | Innco System      | Antenna Master           | MA4000/509    | N/A                |
| ■ - | VULB9163     | Schwarzbeck       | TRILOG Broadband Antenna | 777           | Apr. 13, 2018 (2Y) |
| ■ - | BBHA 9120D   | Schwarzbeck       | Horn Antenna             | 9120D-1366    | Jul. 16, 2019 (1Y) |
| ■ - | BBHA 9170    | Schwarzbeck       | Horn Antenna             | BBHA9170179   | Jan. 16, 2019 (1Y) |

All test equipment used is calibrated on a regular basis.

## 11.4 Test Data

### 11.4.1 Test data for 30 MHz ~ 1 GHz

Humidity Level : 45 % R.H.

Temperature: 23 °C

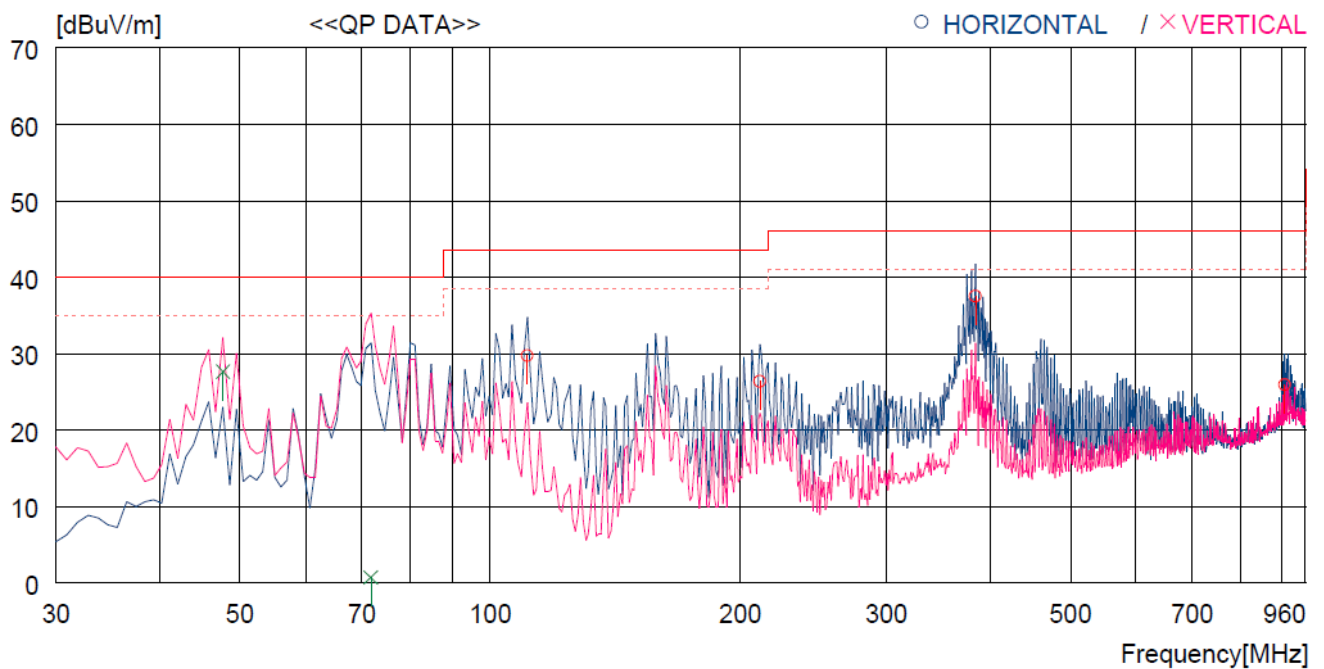
Limits apply to : FCC CFR 47, PART 15, SUBPART C, SECTION 15.247

Result : PASSED

EUT : GPS Tracker &amp; Messenger

Date: November 13, 2019 ~ November 15, 2019

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



| 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                      | 110.910 | 48.8    | 11.8   | 2.2  | 33.1 | 29.7     | 43.5     | 13.8   | 200     | 0     |
| 2                      | 211.349 | 45.5    | 11.1   | 2.8  | 33.1 | 26.3     | 43.5     | 17.2   | 200     | 359   |
| 3                      | 384.328 | 51.2    | 15.7   | 3.8  | 33.2 | 37.5     | 46.0     | 8.5    | 100     | 0     |
| 4                      | 906.054 | 28.8    | 23.6   | 5.9  | 32.4 | 25.9     | 46.0     | 20.1   | 200     | 359   |
| ----- Vertical -----   |         |         |        |      |      |          |          |        |         |       |
| 5                      | 47.670  | 44.6    | 14.6   | 1.5  | 33.1 | 27.6     | 40.0     | 12.4   | 100     | 142   |
| 6                      | 71.850  | 23.2    | 8.8    | 1.8  | 33.1 | 0.7      | 40.0     | 39.3   | 200     | 359   |

Tested by: Hyung-Kwon, Oh / Assistant Manager

#### 11.4.2 Test Data for Below 30 MHz

- . Test Date : November 13, 2019 ~ November 15, 2019
- . Resolution bandwidth : 200 Hz (from 9 kHz to 0.15 MHz), 9 kHz (from 0.15 MHz to 30 MHz)
- . Frequency range : 9 kHz ~ 30 MHz
- . Measurement distance : 3 m
- . Operating mode : Transmitting mode

| Frequency (MHz)                                 | Reading (dBμV) | Ant. Pol. (H/V) | Ant. Height (m) | Angle (°) | Ant. Factor (dB/m) | Cable Loss | Emission Level(dBμV/m) | Limits (dBμV/m) | Margin (dB) |
|-------------------------------------------------|----------------|-----------------|-----------------|-----------|--------------------|------------|------------------------|-----------------|-------------|
| It was not observed any emissions from the EUT. |                |                 |                 |           |                    |            |                        |                 |             |

#### 11.4.3 Test Data for above 1 GHz

- . Test Date : November 13, 2019 ~ November 15, 2019
- . Resolution bandwidth : 1 MHz for Peak and Average Mode
- . Video bandwidth : 1 MHz for Peak Mode, 10 Hz for Average Mode
- . Frequency range : 1 GHz ~ 10.0 GHz
- . Measurement distance : 3 m
- . Operating mode : Transmitting mode

| Frequency (MHz)                                 | Reading (dBμV) | Ant. Pol. (H/V) | Ant. Height (m) | Angle (°) | Ant. Factor (dB/m) | Cable Loss | Emission Level(dBμV/m) | Limits (dBμV/m) | Margin (dB) |
|-------------------------------------------------|----------------|-----------------|-----------------|-----------|--------------------|------------|------------------------|-----------------|-------------|
| It was not observed any emissions from the EUT. |                |                 |                 |           |                    |            |                        |                 |             |

  
 \_\_\_\_\_  
 Tested by: Hyung-Kwon, Oh / Assistant Manager



## 12. CONDUCTED EMISSION TEST

### 12.1 Operating environment

Temperature : 23 °C  
Relative humidity : 45 % R.H.

### 12.2 Test set-up

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

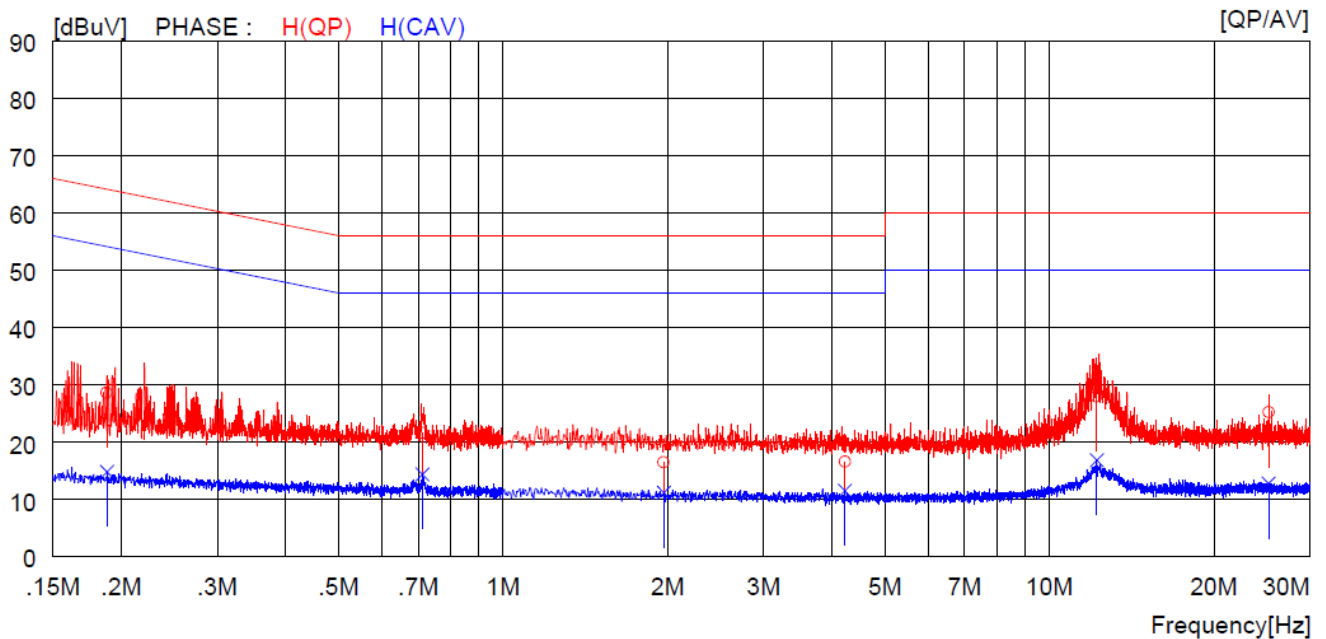
### 12.3 Test equipment used

|     | Model Number | Manufacturer    | Description   | Serial Number | Last Cal. (Interval) |
|-----|--------------|-----------------|---------------|---------------|----------------------|
| ■ - | ESCI         | Rohde & Schwarz | Test Receiver | 101012        | Oct. 22, 2019 (1Y)   |
| □ - | NSLK8128     | Schwarzbeck     | AMN           | 8128-216      | Mar. 20, 2019 (1Y)   |
| ■ - | NSLK8126     | Schwarzbeck     | AMN           | 8126-404      | Mar. 19, 2019 (1Y)   |
| □ - | 3825/2       | EMCO            | AMN           | 9109-1869     | Mar. 19, 2019 (1Y)   |
| ■ - | 3825/2       | EMCO            | AMN           | 9109-1867     | Mar. 27, 2019 (1Y)   |

All test equipment used is calibrated on a regular basis.

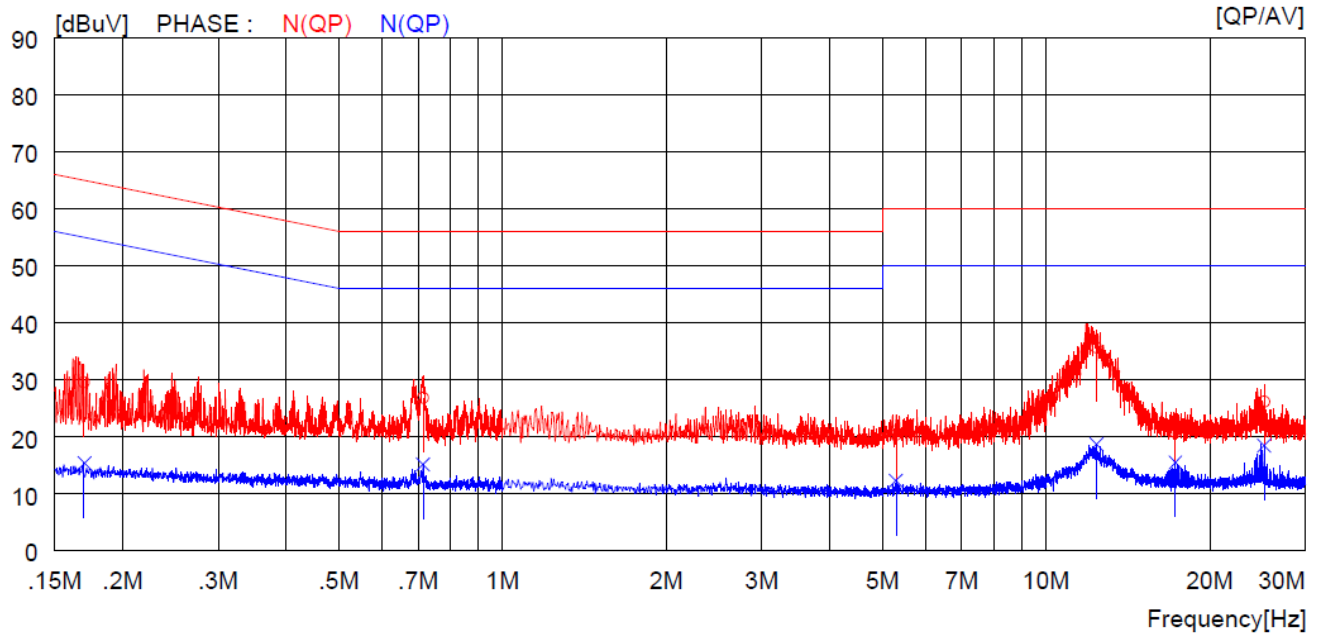
## 12.4 Test data

- Test Date : November 13, 2019 ~ November 15, 2019
- Resolution bandwidth : 9 kHz
- Frequency range : 0.15 MHz ~ 30 MHz
- 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  | 0.18800       | 18.6         | ----         | 10.0             | 28.6         | ----         | 64.1         | ----         | 35.5         | ----         | H (QP)  |
| 2  | 0.71200       | 11.6         | ----         | 10.0             | 21.6         | ----         | 56.0         | ----         | 34.4         | ----         | H (QP)  |
| 3  | 1.96800       | 6.4          | ----         | 10.1             | 16.5         | ----         | 56.0         | ----         | 39.5         | ----         | H (QP)  |
| 4  | 4.22400       | 6.5          | ----         | 10.1             | 16.6         | ----         | 56.0         | ----         | 39.4         | ----         | H (QP)  |
| 5  | 12.21000      | 17.5         | ----         | 10.5             | 28.0         | ----         | 60.0         | ----         | 32.0         | ----         | H (QP)  |
| 6  | 25.21000      | 14.5         | ----         | 10.7             | 25.2         | ----         | 60.0         | ----         | 34.8         | ----         | H (QP)  |
| 7  | 0.18800       | ----         | 4.8          | 10.0             | ----         | 14.8         | ----         | 54.1         | ----         | 39.3         | H (CAV) |
| 8  | 0.71200       | ----         | 4.4          | 10.0             | ----         | 14.4         | ----         | 46.0         | ----         | 31.6         | H (CAV) |
| 9  | 1.96800       | ----         | 1.1          | 10.1             | ----         | 11.2         | ----         | 46.0         | ----         | 34.8         | H (CAV) |
| 10 | 4.22400       | ----         | 1.4          | 10.1             | ----         | 11.5         | ----         | 46.0         | ----         | 34.5         | H (CAV) |
| 11 | 12.21000      | ----         | 6.4          | 10.5             | ----         | 16.9         | ----         | 50.0         | ----         | 33.1         | H (CAV) |
| 12 | 25.21000      | ----         | 2.1          | 10.7             | ----         | 12.8         | ----         | 50.0         | ----         | 37.2         | H (CAV) |

-. 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  | 0.17000       | 19.6         | ----         | 10.0              | 29.6         | ----         | 65.0         | ----         | 35.4         | ----         | N (QP)  |
| 2  | 0.71400       | 16.8         | ----         | 10.0              | 26.8         | ----         | 56.0         | ----         | 29.2         | ----         | N (QP)  |
| 3  | 5.29500       | 10.1         | ----         | 10.2              | 20.3         | ----         | 60.0         | ----         | 39.7         | ----         | N (QP)  |
| 4  | 12.37000      | 25.2         | ----         | 10.5              | 35.7         | ----         | 60.0         | ----         | 24.3         | ----         | N (QP)  |
| 5  | 17.30000      | 10.2         | ----         | 10.6              | 20.8         | ----         | 60.0         | ----         | 39.2         | ----         | N (QP)  |
| 6  | 25.22000      | 15.4         | ----         | 10.7              | 26.1         | ----         | 60.0         | ----         | 33.9         | ----         | N (QP)  |
| 7  | 0.17000       | ----         | 5.4          | 10.0              | ----         | 15.4         | ----         | 55.0         | ----         | 39.6         | N (CAV) |
| 8  | 0.71400       | ----         | 5.2          | 10.0              | ----         | 15.2         | ----         | 46.0         | ----         | 30.8         | N (CAV) |
| 9  | 5.29500       | ----         | 2.1          | 10.2              | ----         | 12.3         | ----         | 50.0         | ----         | 37.7         | N (CAV) |
| 10 | 12.37000      | ----         | 8.2          | 10.5              | ----         | 18.7         | ----         | 50.0         | ----         | 31.3         | N (CAV) |
| 11 | 17.30000      | ----         | 4.9          | 10.6              | ----         | 15.5         | ----         | 50.0         | ----         | 34.5         | N (CAV) |
| 12 | 25.22000      | ----         | 7.8          | 10.7              | ----         | 18.5         | ----         | 50.0         | ----         | 31.5         | N (CAV) |

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

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

Tested by: Hyung-Kwon, Oh / Assistant Manager