

# TEST REPORT



**Dt&C Co., Ltd.**

42, Yurim-ro, 154Beon-gil, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea, 17042  
Tel : 031-321-2664, Fax : 031-321-1664

1. Report No : DRTFCC2403-0036

2. Customer

• Name: KC industrial Co.,Ltd.

• Address: 19F, 534, Teheran-ro, Gangnam-gu, Seoul South Korea

3. Use of Report : FCC Certification

4. Product Name / Model Name : UHF RFID READER / R-5710

FCC ID : 2ARHHR5710

5. FCC Regulation(s): Part 15.247

Test Method used: ANSI C63.10-2013, KDB 558074D01v05r02

6. Date of Test : 2024.03.15 ~ 2024.03.18

7. Location of Test : ☒ Permanent Testing Lab ☐ On Site Testing

8. Testing Environment : See appended test report.

9. Test Result : Refer to the attached test result.

The results shown in this test report refer only to the sample(s) tested unless otherwise stated.  
This test report is not related to KOLAS accreditation.

|             |                   |                                                                                                    |                   |                                                                                                      |
|-------------|-------------------|----------------------------------------------------------------------------------------------------|-------------------|------------------------------------------------------------------------------------------------------|
| Affirmation | Tested by         | <br>(Signature) | Technical Manager | <br>(Signature) |
|             | Name : SeokHo Han |                                                                                                    | Name : JaeJin Lee |                                                                                                      |

2024 . 03 . 29 .

**Dt&C Co., Ltd.**

If this report is required to confirmation of authenticity, please contact to [report@dtnc.net](mailto:report@dtnc.net)

## Test Report Version

| Test Report No. | Date          | Description   | Revised by | Reviewed by |
|-----------------|---------------|---------------|------------|-------------|
| DRTFCC2403-0036 | Mar. 29, 2024 | Initial issue | SeokHo Han | JaeJin Lee  |
|                 |               |               |            |             |
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## 1. General Information

### 1.1. Description of EUT

|                                        |                                           |
|----------------------------------------|-------------------------------------------|
| Equipment Class                        | Part 15 Spread Spectrum Transmitter (DSS) |
| Product Name                           | UHF RFID READER                           |
| Model Name                             | R-5710                                    |
| Add Model Name                         | -                                         |
| Firmware Version Identification Number | 9.1.0.8                                   |
| EUT Serial Number                      | NA                                        |
| Power Supply                           | DC: 7.26 V                                |
| Frequency Range                        | 902.75 - 927.25 MHz                       |
| Modulation Type                        | ASK                                       |
| Number of Channels                     | 50(Channel Spacing: 500kHz)               |
| Antenna Type                           | CIRCULARLY POLARIZED ANTENNA              |
| Antenna Gain                           | PK : 0 dBi                                |

### 1.2. Declaration by the manufacturer

- N/A

### 1.3. Testing Laboratory

|                                                                                                                                                                                      |   |                  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|------------------|
| <b>Dt&amp;C Co., Ltd.</b>                                                                                                                                                            |   |                  |
| The 3 m test site and conducted measurement facility used to collect the radiated data are located at the 42, Yurim-ro, 154beon-gil, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea 17042. |   |                  |
| The test site complies with the requirements of Part 2.948 according to ANSI C63.4-2014.                                                                                             |   |                  |
| - FCC & IC MRA Designation No. : KR0034                                                                                                                                              |   |                  |
| - ISED#: 5740A                                                                                                                                                                       |   |                  |
| <a href="http://www.dtnc.net">www.dtnc.net</a>                                                                                                                                       |   |                  |
| Telephone                                                                                                                                                                            | : | + 82-31-321-2664 |
| FAX                                                                                                                                                                                  | : | + 82-31-321-1664 |

### 1.4. Testing Environment

| Ambient Condition   |                 |
|---------------------|-----------------|
| ▪ Temperature       | +20 °C ~ +22 °C |
| ▪ Relative Humidity | +39 % ~ +42 %   |

### 1.5. Measurement Uncertainty

The measurement uncertainties shown below were calculated in accordance with requirements of ANSI C63.4-2014 and ANSI C63.10-2013. All measurement uncertainty values are shown with a coverage factor of  $k = 2$  to indicate a 95 % level of confidence.

| Parameter                          | Measurement uncertainty                               |
|------------------------------------|-------------------------------------------------------|
| Antenna-port conducted emission    | 0.9 dB (The confidence level is about 95 %, $k = 2$ ) |
| AC power-line conducted emission   | 3.4 dB (The confidence level is about 95 %, $k = 2$ ) |
| Radiated emission (1 GHz Below)    | 5.0 dB (The confidence level is about 95 %, $k = 2$ ) |
| Radiated emission (1 GHz ~ 18 GHz) | 4.8 dB (The confidence level is about 95 %, $k = 2$ ) |
| Radiated emission (18 GHz Above)   | 5.7 dB (The confidence level is about 95 %, $k = 2$ ) |

## 1.7. Test Equipment List

| Type                                | Manufacturer           | Model                         | Cal.Date<br>(yy/mm/dd) | Next.Cal.Date<br>(yy/mm/dd) | S/N               |
|-------------------------------------|------------------------|-------------------------------|------------------------|-----------------------------|-------------------|
| Spectrum Analyzer                   | Agilent Technologies   | N9020A                        | 23/12/15               | 24/12/15                    | MY50110097        |
| Spectrum Analyzer                   | Agilent Technologies   | N9020A                        | 23/12/15               | 24/12/15                    | MY48010133        |
| Spectrum Analyzer                   | Agilent Technologies   | N9020A                        | 23/06/23               | 24/06/23                    | US47360812        |
| DC Power Supply                     | H.P                    | 66332A                        | 23/12/15               | 24/12/15                    | US37471368        |
| Multimeter                          | FLUKE                  | 17B+                          | 23/12/15               | 24/12/15                    | 36390701WS        |
| Signal Generator                    | Rohde Schwarz          | SMBV100A                      | 23/12/15               | 24/12/15                    | 255571            |
| Signal Generator                    | ANRITSU                | MG3695C                       | 23/12/15               | 24/12/15                    | 173501            |
| Thermohygrometer                    | BODYCOM                | BJ5478                        | 23/12/15               | 24/12/15                    | 120612-1          |
| Thermohygrometer                    | BODYCOM                | BJ5478                        | 23/12/15               | 24/12/15                    | 120612-2          |
| Thermohygrometer                    | BODYCOM                | BJ5478                        | 23/06/23               | 24/06/23                    | N/A               |
| Loop Antenna                        | ETS-Lindgren           | 6502                          | 23/11/09               | 24/11/09                    | 00060496          |
| Hybrid Antenna                      | Schwarzbeck            | VULB 9160                     | 23/12/15               | 24/12/15                    | 3362              |
| Horn Antenna                        | ETS-Lindgren           | 3117                          | 23/06/23               | 24/06/23                    | 00143278          |
| PreAmplifier                        | tsj                    | MLA-0118-B01-40               | 23/12/15               | 24/12/15                    | 1852267           |
| PreAmplifier                        | H.P                    | 8447D                         | 23/12/15               | 24/12/15                    | 2944A07774        |
| Band Reject Filter                  | Wainwright Instruments | WRCT800/960.0-2/40-8SSK       | 23/06/23               | 24/06/23                    | 32                |
| High Pass Filter                    | Wainwright Instruments | WHKX12-935-1000-15000-40SS    | 23/06/23               | 24/06/23                    | 8                 |
| High Pass Filter                    | Wainwright Instruments | WHKX10-2838-3300-18000-60SS   | 23/06/23               | 24/06/23                    | 1                 |
| High Pass Filter                    | Wainwright Instruments | WHNX8.0/26.5-6SS              | 23/06/23               | 24/06/23                    | 3                 |
| Attenuator                          | Hefei Shunze           | SS5T2.92-10-40                | 23/06/23               | 24/06/23                    | 16012202          |
| Attenuator                          | Aeroflex/Weinschel     | 56-3                          | 23/06/23               | 24/06/23                    | Y2370             |
| Attenuator                          | SMAJK                  | SMAJK-2-3                     | 23/06/23               | 24/06/23                    | 3                 |
| Attenuator                          | SMAJK                  | SMAJK-2-3                     | 23/06/23               | 24/06/23                    | 2                 |
| Attenuator                          | Aeroflex/Weinschel     | 86-10-11                      | 23/06/23               | 24/06/23                    | 408               |
| Power Meter & Wide Bandwidth Sensor | Anritsu                | ML2488B<br>MA2472A            | 23/06/23               | 24/06/23                    | 0910025<br>001872 |
| EMI Test Receiver                   | ROHDE&SCHWARZ          | ESR7                          | 24/01/29               | 25/01/29                    | 100910            |
| PULSE LIMITER                       | Rohde Schwarz          | ESH3-Z2                       | 23/08/21               | 24/08/21                    | 101333            |
| LISN                                | SCHWARZBECK            | NSLK 8128 RC                  | 23/10/26               | 24/10/26                    | 8128 RC-387       |
| Cable                               | DT&C                   | Cable                         | 23/01/03               | 24/01/03                    | G-2               |
| Cable                               | HUBER+SUHNER           | SUCOFLEX 100                  | 23/01/03               | 24/01/03                    | G-3               |
| Cable                               | DT&C                   | Cable                         | 23/01/03               | 24/01/03                    | G-4               |
| Cable                               | OMT                    | YSS21S                        | 23/01/03               | 24/01/03                    | G-5               |
| Cable                               | Junkosha               | MWX241                        | 23/01/03               | 24/01/03                    | mmW-1             |
| Cable                               | Junkosha               | MWX241                        | 23/01/03               | 24/01/03                    | mmW-4             |
| Cable                               | HUBER+SUHNER           | SUCOFLEX100                   | 23/01/03               | 24/01/03                    | M-01              |
| Cable                               | HUBER+SUHNER           | SUCOFLEX100                   | 23/01/03               | 24/01/03                    | M-02              |
| Cable                               | JUNFLON                | MWX241                        | 23/01/03               | 24/01/03                    | M-03              |
| Cable                               | JUNFLON                | J12J101757-00                 | 23/01/03               | 24/01/03                    | M-07              |
| Cable                               | HUBER+SUHNER           | SUCOFLEX106                   | 23/01/03               | 24/01/03                    | M-09              |
| Cable                               | DT&C                   | Cable                         | 23/01/03               | 24/01/03                    | RFC-69            |
| Test Software                       | tsj                    | Noise Terminal Measurement    | NA                     | NA                          | Version 2.00.0190 |
| Test Software                       | tsj                    | Radiated Emission Measurement | NA                     | NA                          | Version 2.00.0185 |

Note1: The measurement antennas were calibrated in accordance to the requirements of ANSI C63.5-2017.

Note2: The cable is not a regular calibration item, so it has been calibrated by DT & C itself.

## 1.8. Conclusion of worst-case and operation mode

### Tested frequency information,

- Hopping Function: Enable

|              | TX Frequency (MHz)  | RX Frequency (MHz)  |
|--------------|---------------------|---------------------|
| Hopping Band | 902.75 ~ 927.25 MHz | 902.75 ~ 927.25 MHz |

- Hopping Function: Disable

| Channel         | TX Frequency (MHz) | RX Frequency (MHz) |
|-----------------|--------------------|--------------------|
| Lowest Channel  | 902.75             | 902.75             |
| Middle Channel  | 915.25             | 915.25             |
| Highest Channel | 927.25             | 927.25             |

### Operation test setup for EUT

- Test Software Version: RFID\_TCM\_1.0.0.1
- Power setting: 29 dBm

## 2. Antenna Requirement

### ■ According to FCC 47 CFR §15.203

“An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.”

**The antenna is attached on the device by means of unique connector.  
Therefore this E.U.T complies with the requirement of Part 15.203**

### 3. Summary of Test Results

| FCC Part                      | Parameter                         | Limit<br>(Using in 902-928 MHz)                                                                                      | Test Condition    | Status<br>Note 1   |
|-------------------------------|-----------------------------------|----------------------------------------------------------------------------------------------------------------------|-------------------|--------------------|
| 15.247(a)                     | Carrier Frequency Separation      | $\geq 25$ kHz or<br>$\geq 20$ dB BW, whichever is greater.                                                           | Conducted         | C                  |
|                               | Number of Hopping Frequencies     | $\geq 50$ hops, if 20 dB BW < 250kHz<br>$\geq 25$ hops, if 20 dB BW $\geq 250$ kHz                                   |                   | C                  |
|                               | 20 dB Bandwidth                   | < 500 kHz                                                                                                            |                   | C                  |
|                               | Dwell Time                        | $\leq 0.4$ seconds                                                                                                   |                   | C                  |
| 15.247(b)                     | Transmitter Output Power          | <b>For FCC</b><br>$\leq 1$ Watt, if CHs $\geq 50$<br>$\leq 0.25$ W, if CHs $\geq 25$ , < 50                          |                   | C                  |
| 15.247(d)                     | Unwanted Emissions (Conducted)    | The radiated emission to any 100 kHz of out-band shall be at least 20 dB below the highest in-band spectral density. |                   | C                  |
| 15.247(d)<br>15.205<br>15.209 | Unwanted Emissions (Radiated)     | FCC 15.209 Limits (Reference to section 9)                                                                           | Radiated          | C <sup>Note2</sup> |
| 15.207                        | AC Power Line Conducted Emissions | FCC 15.207 Limits (Reference to section 10)                                                                          | AC Line Conducted | C                  |
| 15.203                        | Antenna Requirements              | FCC 15.203 (Reference to section 2)                                                                                  | -                 | C                  |

Note 1: C = Comply NC = Not Comply NT = Not Tested NA = Not Applicable

Note 2: This test item was performed in three orthogonal EUT positions and the worst case data was reported.

## 4. Maximum Peak Output Power Measurement

### 4.1. Test Setup

Refer to the APPENDIX I.

### 4.2. Limit

#### ■ FCC Requirements

The maximum peak output power of the intentional radiator shall not exceed the following :

1. §15.247(b)(2), For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels, as permitted under paragraph (a)(1)(i) of this section.

### 4.3. Test Procedure

1. The RF output power was measured with a spectrum analyzer connected to the RF Antenna connector (conducted measurement) while EUT was operating in transmit mode at the appropriate center frequency, A spectrum analyzer was used to record the shape of the transmit signal.

2. The peak output power of the fundamental frequency was measured with the spectrum analyzer using;

Span = approximately 5 times of the 20 dB bandwidth, centered on a hopping channel

RBW  $\geq$  20 dB BW

VBW  $\geq$  RBW

Sweep = auto

Detector function = peak

Trace = max hold

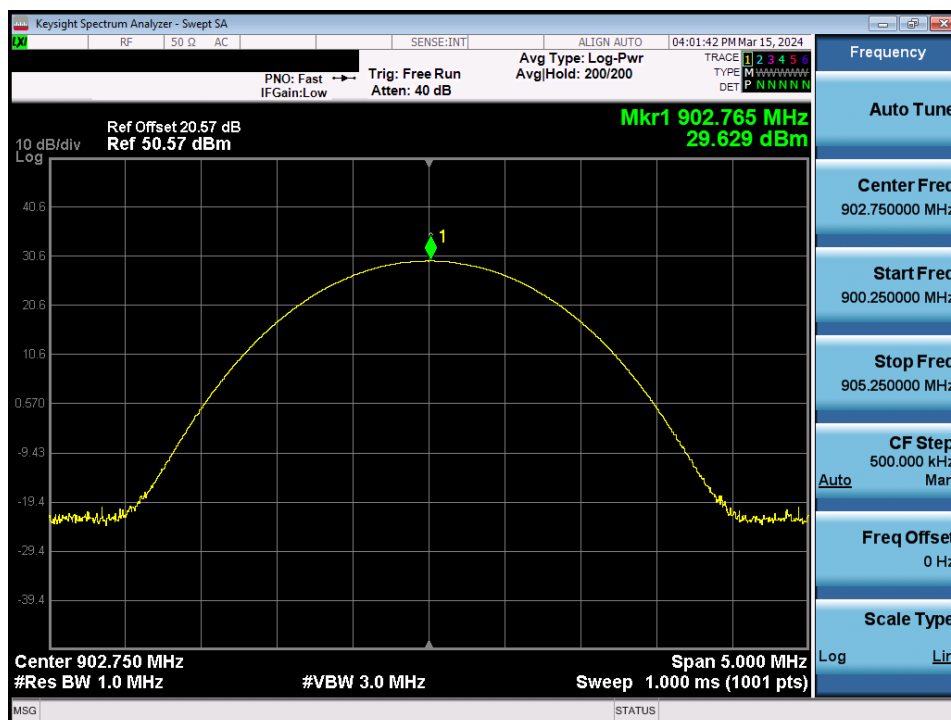
### 4.4. Test Results

| Tested Channel | Burst Average Output Power |        | Peak Output Power |        |
|----------------|----------------------------|--------|-------------------|--------|
|                | dBm                        | mW     | dBm               | mW     |
| Lowest         | 28.66                      | 734.51 | 29.63             | 918.33 |
| Middle         | 28.61                      | 726.11 | 29.66             | 924.70 |
| Highest        | 28.94                      | 783.43 | <b>29.80</b>      | 954.99 |

Note 1: See next pages for actual measured spectrum plots.

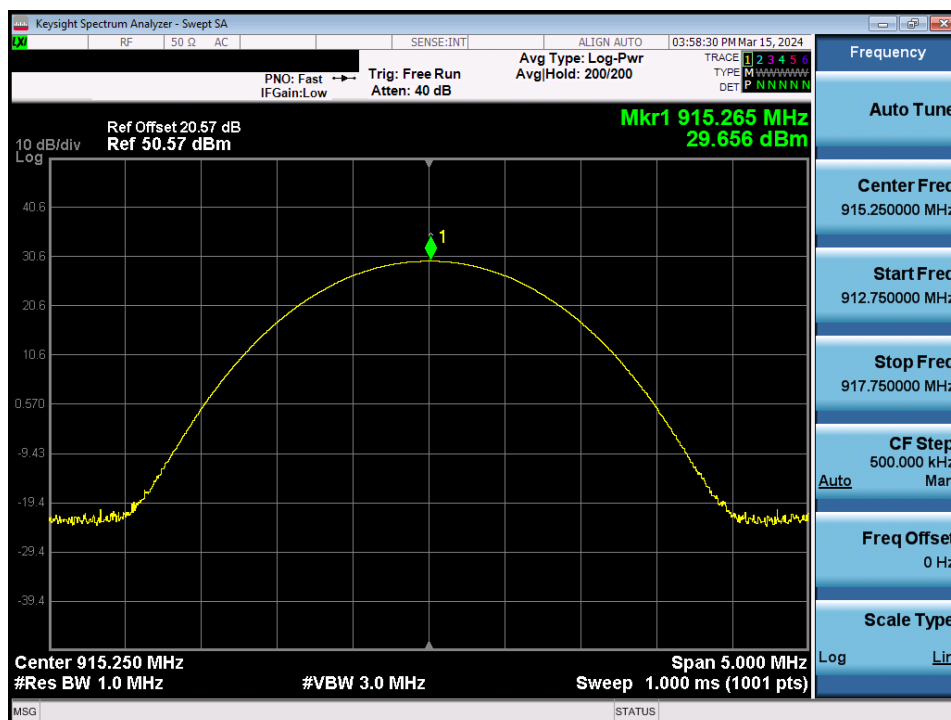
## Peak Output Power

TM 1 Test Channel : Lowest



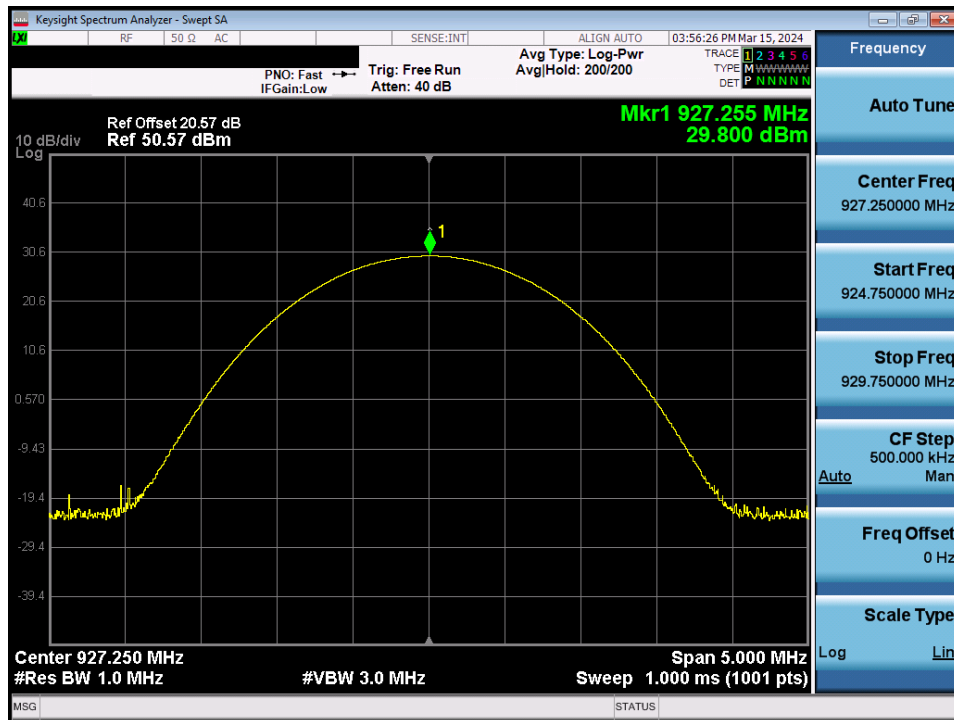
## Peak Output Power

TM 1 Test Channel : Middle



# Peak Output Power

TM 1 Test Channel : Highest



## 5. 20dB BW

### 5.1. Test Setup

Refer to the APPENDIX I.

### 5.2. Limit

For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

### 5.3. Test Procedure

1. The 20 dB bandwidth were measured with a spectrum analyzer connected to RF antenna Connector (conducted measurement) while EUT was operating in transmit mode. The analyzer center frequency was set to the EUT carrier frequency, using the analyzer.
2. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using below setting:

RBW = 1% to 5% of the 20 dB BW

VBW  $\geq 3 \times$  RBW

Span = between two times and five times the 20 dB bandwidth

Sweep = auto

Detector function = peak

Trace = max hold

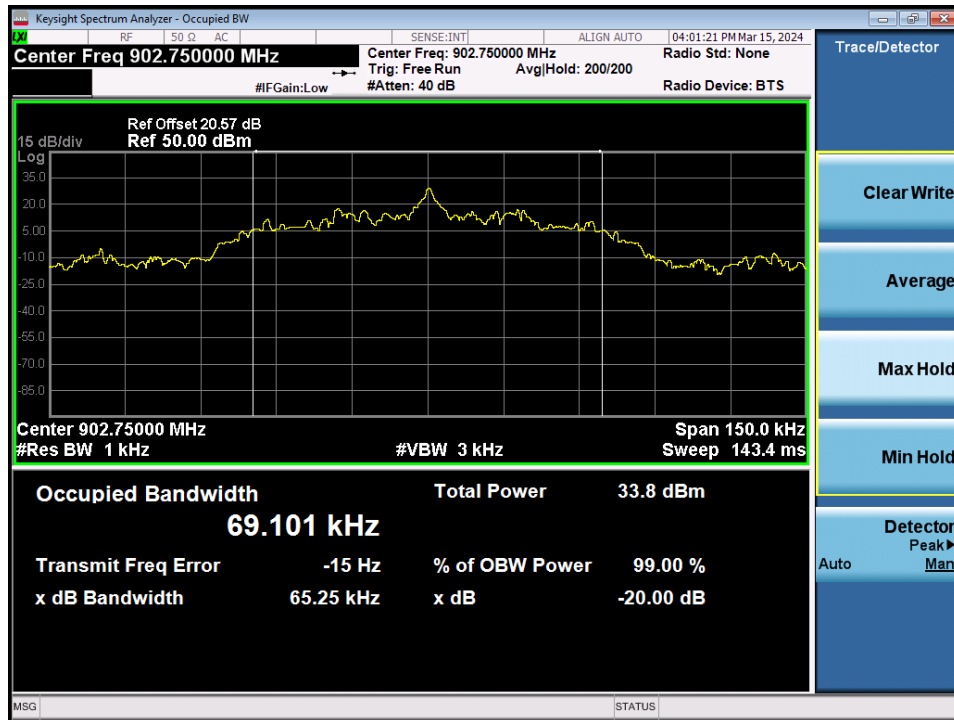
### 5.4. Test Results

| Tested Channel | 20dB BW (kHz) |
|----------------|---------------|
| Lowest         | 65.25         |
| Middle         | 64.69         |
| Highest        | 64.32         |

Note 1: See next pages for actual measured spectrum plots.

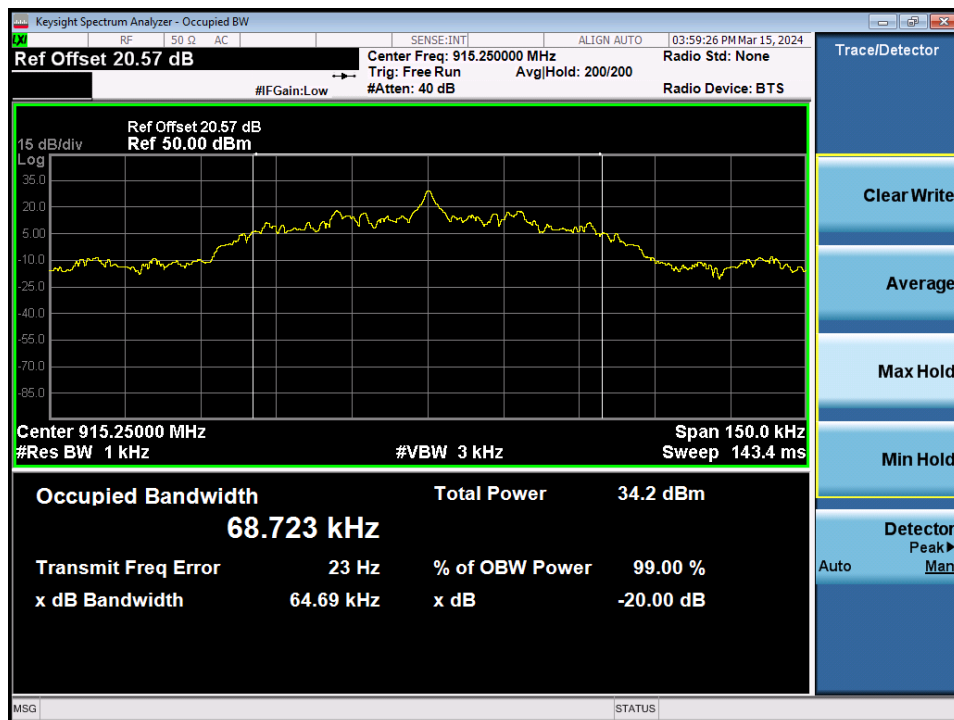
20 dB BW

TM 1 Test Channel : Lowest



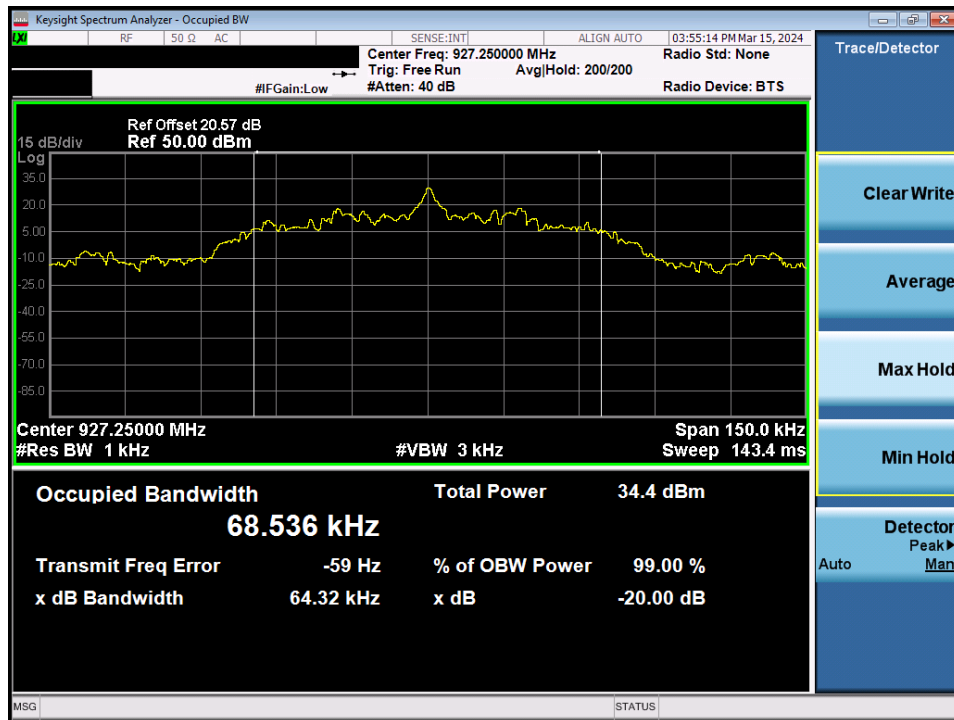
20 dB BW

TM 1 Test Channel : Middle



20 dB BW

TM 1 Test Channel : Highest



## 6. Carrier Frequency Separation

### 6.1. Test Setup

Refer to the APPENDIX I.

### 6.2. Limit

Limit :  $\geq 25$  kHz or  $\geq 20$  dB BW whichever is greater.

### 6.3. Procedure

The carrier frequency separation was measured with a spectrum analyzer connected to the antenna terminal, while EUT had its hopping function enabled.

After the trace being stable, the reading value between the peaks of the adjacent channels using the marker-delta function was recorded as the measurement results.

The spectrum analyzer is set to :

Span = wide enough to capture the peaks of two adjacent channels

RBW = Start with the RBW set to approximately 30% of the channel spacing; adjust as necessary to best identify the center of each individual channel.

VBW  $\geq$  RBW

Sweep = auto

Detector function = peak

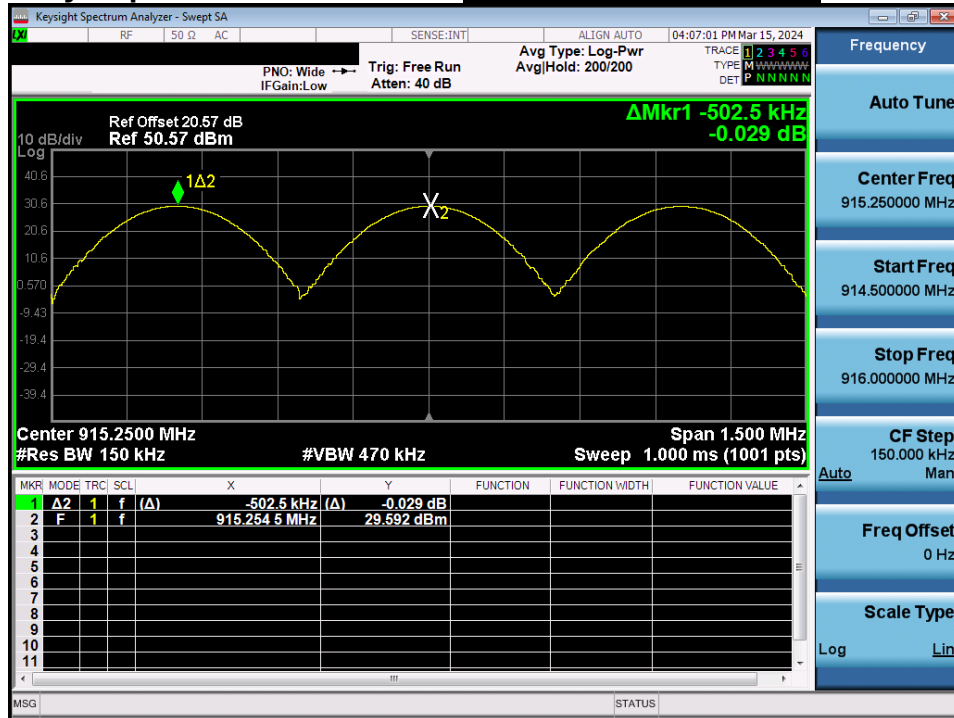
Trace = max hold

### 6.4. Test Results

| Test Mode | Hopping Mode | Peak of center channel (MHz) | Peak of adjacent Channel (MHz) | Test Result (kHz) |
|-----------|--------------|------------------------------|--------------------------------|-------------------|
| TM 1      | Enable       | 915.254                      | 914.752                        | -502.50           |

# Carrier Frequency Separation

*Hopping mode : Enable*



## 7. Number of Hopping Frequencies

### 7.1. Test Setup

Refer to the APPENDIX I.

### 7.2. Limit

Limit:  $\geq 50$  hops

### 7.3. Procedure

The number of hopping frequencies was measured with a spectrum analyzer connected to the antenna terminal, while EUT had its hopping function enabled.

To get higher resolution, two frequency ranges for FH mode within the 902 ~ 928 MHz were examined.

The spectrum analyzer is set to :

Span = 34.5 MHz

Start Frequency = 897.75 MHz, Stop Frequency = 932.25 MHz

RBW = To identify clearly the individual channels, set the RBW to less than 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller.

VBW  $\geq$  RBW

Sweep = auto

Detector function = peak

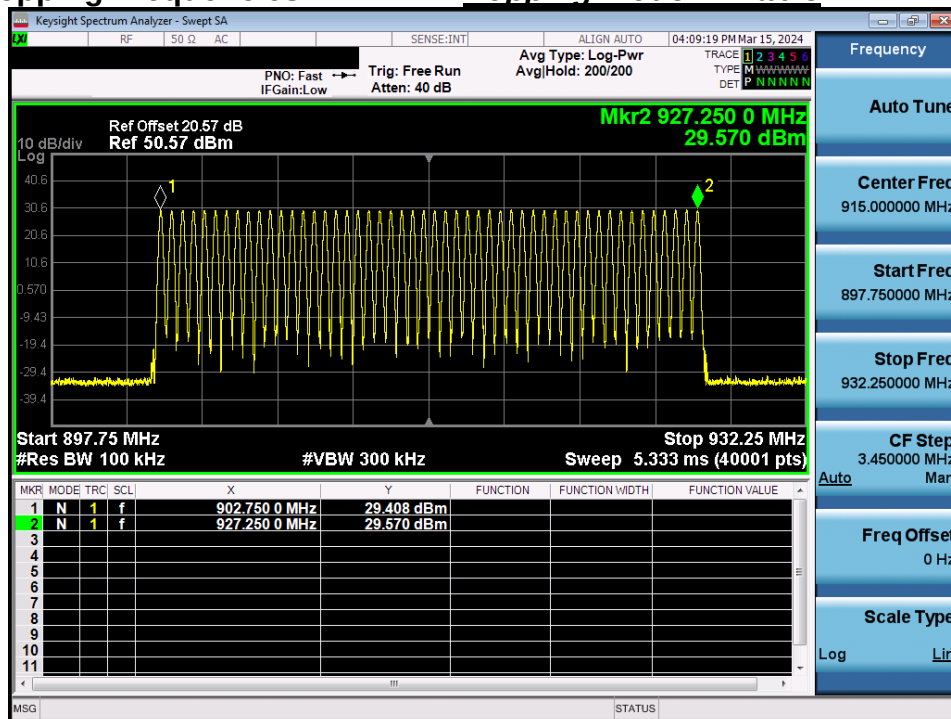
Trace = max hold

### 7.4. Test Results

| Test Mode | Hopping mode | Test Result<br>(Total Hops) |
|-----------|--------------|-----------------------------|
| TM 1      | Enable       | 50                          |

# Number of Hopping Frequencies

**Hopping mode : Enable**



## 8. Time of Occupancy (Dwell Time)

### 8.1. Test Setup

Refer to the APPENDIX I.

### 8.2. Limit

For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

### 8.3. Test Procedure

The dwell time was measured with a spectrum analyzer connected to the antenna terminal, while EUT had its hopping function enabled.

The spectrum analyzer is set to :

Center frequency = 915.25 MHz

Span = zero

RBW = 100 kHz (RBW shall be  $\leq$  channel spacing and where possible RBW should be set  $\gg 1 / T$ , where T is the expected dwell time per channel)

VBW  $\geq$  RBW

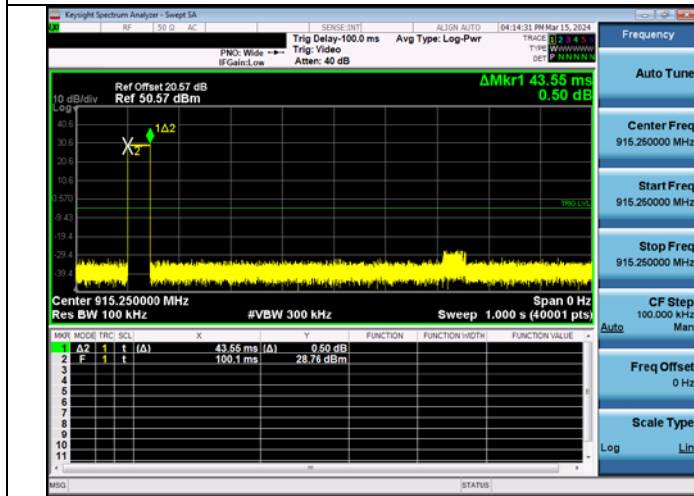
Detector function = peak

Trace = max hold

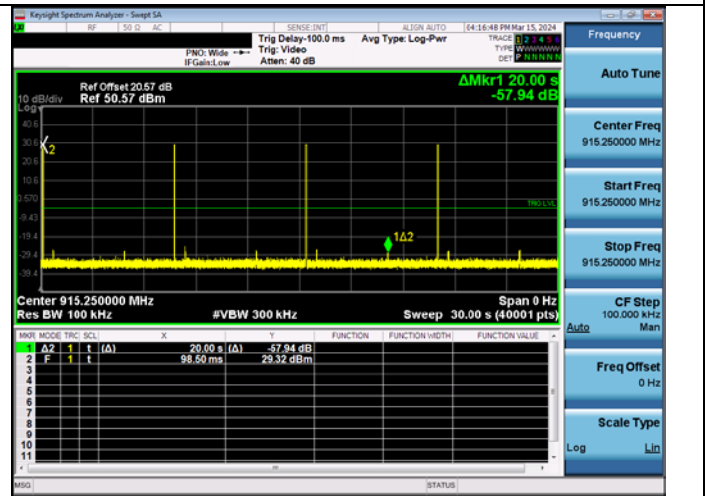
### 8.4. Test Results

| Test Mode | Hopping channels | Length (ms) | Number | Dwell Time (ms) |
|-----------|------------------|-------------|--------|-----------------|
| TM 1      | 50               | 43.550      | 3.000  | 130.650         |

### Length(Hopping Mode)



### Period(Hopping Mode)



## 9. Unwanted Emissions

### 9.1. Test Setup

Refer to the APPENDIX I.

### 9.2. Limit

#### Part 15.247(d), Part 15.205, Part 15.209

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of Part 15.247 the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

#### - Part 15.209: General requirements

| Frequency (MHz) | FCC Limit (uV/m) | Measurement Distance (m) |
|-----------------|------------------|--------------------------|
| 0.009 – 0.490   | 2 400 / F (kHz)  | 300                      |
| 0.490 – 1.705   | 24 000 / F (kHz) | 30                       |
| 1.705 – 30.0    | 30               | 30                       |

| Frequency (MHz) | FCC Limit (uV/m) | Measurement Distance (m) |
|-----------------|------------------|--------------------------|
| 30 ~ 88         | 100 **           | 3                        |
| 88 ~ 216        | 150 **           | 3                        |
| 216 ~ 960       | 200 **           | 3                        |
| Above 960       | 500              | 3                        |

\*\*Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g., §§15.231 and 15.241.

#### - Part 15.205(a): Restricted band of operation

| MHz                 | MHz                   | MHz                     | MHz               | GHz          | GHz           |
|---------------------|-----------------------|-------------------------|-------------------|--------------|---------------|
| 0.009 ~ 0.110       | 8.414 25 ~ 8.414 75   | 108 ~ 121.94            | 1 300 ~ 1 427     | 4.5 ~ 5.15   | 14.47 ~ 14.5  |
| 0.495 ~ 0.505       | 12.29 ~ 12.293        | 123 ~ 138               | 1 435 ~ 1 626.5   | 5.35 ~ 5.46  | 15.35 ~ 16.2  |
| 2.173 5 ~ 2.190 5   | 12.519 75 ~ 12.520 25 | 149.9 ~ 150.05          | 1 645.5 ~ 1 646.5 | 7.25 ~ 7.75  | 17.7 ~ 21.4   |
| 4.125 ~ 4.128       | 12.576 75 ~ 12.577 25 | 156.524 75 ~ 156.525 25 | 1 660 ~ 1 710     | 8.025 ~ 8.5  | 22.01 ~ 23.12 |
| 4.177 25 ~ 4.177 75 | 13.36 ~ 13.41         | 156.7 ~ 156.9           | 1 718.8 ~ 1 722.2 | 9.0 ~ 9.2    | 23.6 ~ 24.0   |
| 4.207 25 ~ 4.207 75 | 16.42 ~ 16.423        | 162.012 5 ~ 167.17      | 2 200 ~ 2 300     | 9.3 ~ 9.5    | 31.2 ~ 31.8   |
| 6.215 ~ 6.218       | 16.694 75 ~ 16.695 25 | 167.72 ~ 173.2          | 2 310 ~ 2 390     | 10.6 ~ 12.7  | 36.43 ~ 36.5  |
| 6.267 75 ~ 6.268 25 | 16.804 25 ~ 16.804 75 | 240 ~ 285               | 2 483.5 ~ 2 500   | 13.25 ~ 13.4 | Above 38.6    |
| 6.311 75 ~ 6.312 25 | 25.5 ~ 25.67          | 322 ~ 335.4             | 2 655 ~ 2 900     |              |               |
| 8.291 ~ 8.294       | 37.5 ~ 38.25          | 399.90 ~ 410            | 3 260 ~ 3 267     |              |               |
| 8.362 ~ 8.366       | 73 ~ 74.6             | 608 ~ 614               | 3 332 ~ 3 339     |              |               |
| 8.376 25 ~ 8.386 75 | 74.8 ~ 75.2           | 960 ~ 1 240             | 3 345.8 ~ 3 358   |              |               |
|                     |                       |                         | 3 600 ~ 4 400     |              |               |

## 9.3. Test Procedures

### 9.3.1. Test Procedures (Radiated)

1. The EUT is placed on a non-conductive table. For emission measurements at or below 1 GHz, the table height is 80 cm. For emission measurements above 1 GHz, the table height is 1.5 m.  
The table was rotated 360 degrees to determine the position of the highest radiation.
2. During performing radiated emission below 1 GHz, the EUT was set 3 meters away from the interference receiving antenna, which was mounted on the top of a variable-height antenna tower. During performing radiated emission above 1 GHz, the EUT was set 1 or 3 meter away from the interference-receiving antenna.
3. For measurements above 1GHz absorbers are placed on the floor between the turn table and the antenna mast in such a way so as to maximize the reduction of reflections. For measurements below 1 GHz, the absorbers are removed.
4. The antenna is a broadband antenna, and its height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
5. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the table was turned from 0 degrees to 360 degrees to find the maximum reading.
6. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
7. If the emission level of the EUT in peak mode was 10 dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10 dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

### Measurement Instrument Setting

- Frequencies less than or equal to 1 000 MHz

The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Quasi-peak detection (QP) at frequency below 1 GHz.

- Frequencies above 1 000 MHz

Peak Measurement

RBW = 1 MHz, VBW = 3 MHz, Detector = Peak, Sweep time = Auto, Trace mode = Max Hold until the trace stabilizes

Average Measurement > 1GHz

RBW = 1MHz, VBW = Reduce the video bandwidth until no significant variations in the displayed signal are observed in subsequent traces, provided the video bandwidth is no less than 1 Hz. (Actual VBW setting: 30Hz)

Detector = Peak, Sweep Time = Auto, Trace Mode = Max Hold until the trace stabilizes

### 9.3.2. Test Procedures (Conducted)

1. The transmitter output was connected to the spectrum analyzer.
2. The **reference level** of the fundamental frequency was measured with the spectrum analyzer using RBW = 100 kHz, VBW = 300 kHz.
3. The conducted spurious emission was tested each ranges were set as below.

**Frequency range : 9 kHz ~ 30 MHz**

RBW = 100 kHz, VBW = 300 kHz, SWEEP TIME = AUTO, DETECTOR = PEAK, TRACE = MAX HOLD, SWEEP POINT : 40 001

**Frequency range : 30 MHz ~ 10 GHz**

RBW = 1 MHz, VBW = 3 MHz, SWEEP TIME = AUTO, DETECTOR = PEAK, TRACE = MAX HOLD, SWEEP POINT : 40 001

**LIMIT LINE** = 20 dB below of the reference level of above measurement procedure Step 2. (RBW = 100 kHz, VBW = 300 kHz)

If the emission level with above setting was close to the limit (ie, less than 3 dB margin) then zoom scan is required using RBW = 100 kHz, VBW = 300 kHz, SPAN = 100 MHz and BINS = 2 001 to get accurate emission level within 100 kHz BW.

Also the path loss for conducted measurement setup was used as described on the Appendix I of this test report.

## 9.4. Test Results

### 9.4.1. Unwanted Emission (Radiated)

#### - Test Notes

- The radiated emissions below 1GHz were investigated 9 kHz to 1 GHz and the worst case data was reported.
- Information of Distance Correction Factor  
For finding emissions, measurements may be performed at a distance closer than that specified in the regulations.  
In this case, the distance factor is applied to the result.  
- Calculation of distance correction factor  
At frequencies below 30 MHz =  $40 \log(\text{tested distance} / \text{specified distance})$   
At frequencies at or above 30 MHz =  $20 \log(\text{tested distance} / \text{specified distance})$   
When distance factor is "N/A", the measurements were performed at the specified distance and distance factor is not applied.
- Sample Calculation.  
 $\text{Margin} = \text{Limit} - \text{Result} \quad / \quad \text{Result} = \text{Reading} + \text{TF} + \text{DCCF} + \text{DCF} \quad / \quad \text{TF} = \text{AF} + \text{CL} + \text{BL} + \text{AL} - \text{AG}$   
Where, TF = Total Factor, AF = Antenna Factor, CL = Cable Loss, AG = Amplifier Gain, BL = Band reject filter Loss, AL = Attenuator Loss, DCCF = Duty Cycle Correction Factor, DCF = Distance Correction Factor

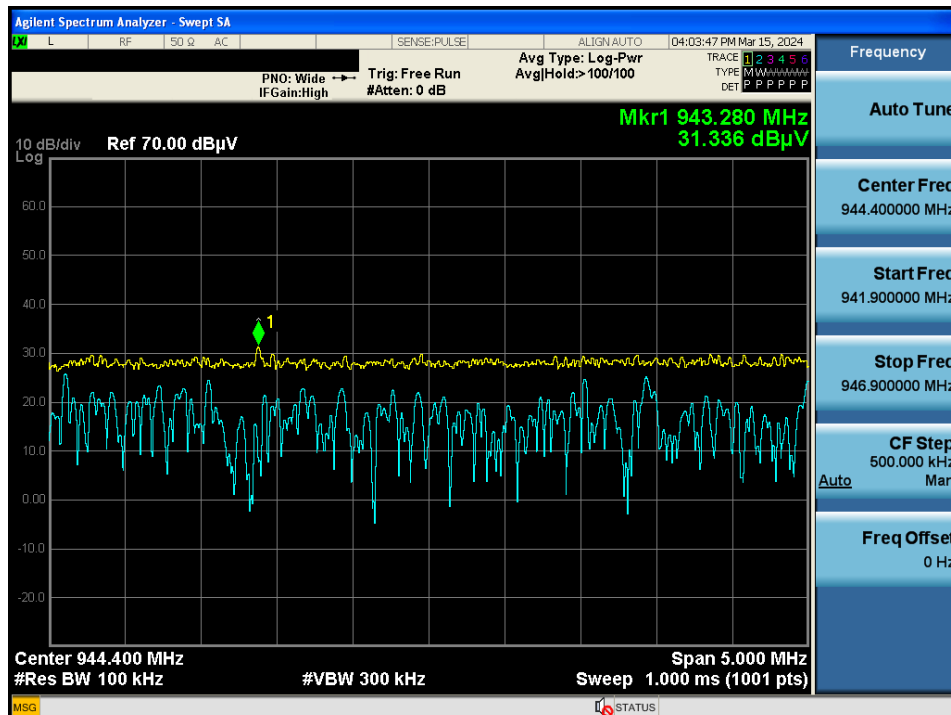
**Frequency Range : 9 kHz ~ 1 GHz\_TM 1**

#### ▪ Lowest Channel

| Frequency (MHz) | ANT Pol | EUT Position (Axis) | Detector Mode | Reading (dBuV) | TF (dB/m) | DCCF (dB) | DCF (dB) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) |
|-----------------|---------|---------------------|---------------|----------------|-----------|-----------|----------|-----------------|----------------|-------------|
| 898.76          | H       | X                   | PK            | 32.43          | 7.74      | N/A       | N/A      | 40.17           | 46.02          | 5.85        |
| 928.14          | H       | X                   | PK            | 31.20          | 8.38      | N/A       | N/A      | 39.58           | 46.02          | 6.44        |
| 943.28          | V       | X                   | PK            | 31.34          | 8.87      | N/A       | N/A      | 40.21           | 46.02          | 5.81        |

**TM1 & Lowest & X & Ver**

**Detector Mode : PK**



### ▪ Test Notes.

1. The radiated emissions above 1GHz were investigated up to 10 GHz. And no other spurious and harmonic emissions were found below listed frequencies.
2. Information of Distance Correction Factor  
For finding emissions, measurements may be performed at a distance closer than that specified in the regulations.  
In this case, the distance factor is applied to the result.  
- Calculation of distance correction factor  
At frequencies below 30 MHz =  $40 \log(\text{tested distance} / \text{specified distance})$   
At frequencies at or above 30 MHz =  $20 \log(\text{tested distance} / \text{specified distance})$   
When distance factor is "N/A", the measurements were performed at the specified distance and distance factor is not applied.
3. Sample Calculation.  
Margin = Limit – Result / Result = Reading + TF+ DCCF + DCF / TF = AF + CL + HL + AL – AG  
Where, TF = Total Factor, AF = Antenna Factor, CL = Cable Loss, AG = Amplifier Gain, HL = High Pass filter Loss, AL = Attenuator Loss, DCCF = Duty Cycle Correction Factor, DCF = Distance Correction Factor

## Frequency Range : 1 GHz ~ 10 GHz\_TM 1

### ▪ Lowest Channel

| Frequency (MHz) | ANT Pol | EUT Position (Axis) | Detector Mode | Reading (dBuV) | TF (dB/m) | DCCF (dB) | DCF (dB) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) |
|-----------------|---------|---------------------|---------------|----------------|-----------|-----------|----------|-----------------|----------------|-------------|
| 2 708.09        | H       | Z                   | PK            | 51.51          | 5.82      | N/A       | N/A      | 57.33           | 74.00          | 16.67       |
| 2 708.18        | H       | Z                   | AV            | 42.57          | 5.82      | N/A       | N/A      | 48.39           | 54.00          | 5.61        |
| 3 610.87        | V       | Y                   | PK            | 54.22          | 0.69      | N/A       | N/A      | 54.91           | 74.00          | 19.09       |
| 3 611.04        | V       | Y                   | AV            | 48.04          | 0.69      | N/A       | N/A      | 48.73           | 54.00          | 5.27        |
| 4 513.71        | H       | Y                   | PK            | 53.31          | 2.01      | N/A       | N/A      | 55.32           | 74.00          | 18.68       |
| 4 513.78        | H       | Y                   | AV            | 46.03          | 2.01      | N/A       | N/A      | 48.04           | 54.00          | 5.96        |
| 5 416.48        | V       | Z                   | PK            | 50.45          | 2.97      | N/A       | N/A      | 53.42           | 74.00          | 20.58       |
| 5 416.63        | V       | Z                   | AV            | 40.01          | 2.97      | N/A       | N/A      | 42.98           | 54.00          | 11.02       |
| 8 124.76        | H       | Y                   | PK            | 49.96          | 4.76      | N/A       | N/A      | 54.72           | 74.00          | 19.28       |
| 8 124.79        | H       | Y                   | AV            | 41.37          | 4.76      | N/A       | N/A      | 46.13           | 54.00          | 7.87        |
| 9 027.57        | H       | Y                   | PK            | 43.39          | 8.66      | N/A       | N/A      | 52.05           | 74.00          | 21.95       |
| 9 027.49        | H       | Y                   | AV            | 33.66          | 8.66      | N/A       | N/A      | 42.32           | 54.00          | 11.68       |

### ▪ Middle Channel

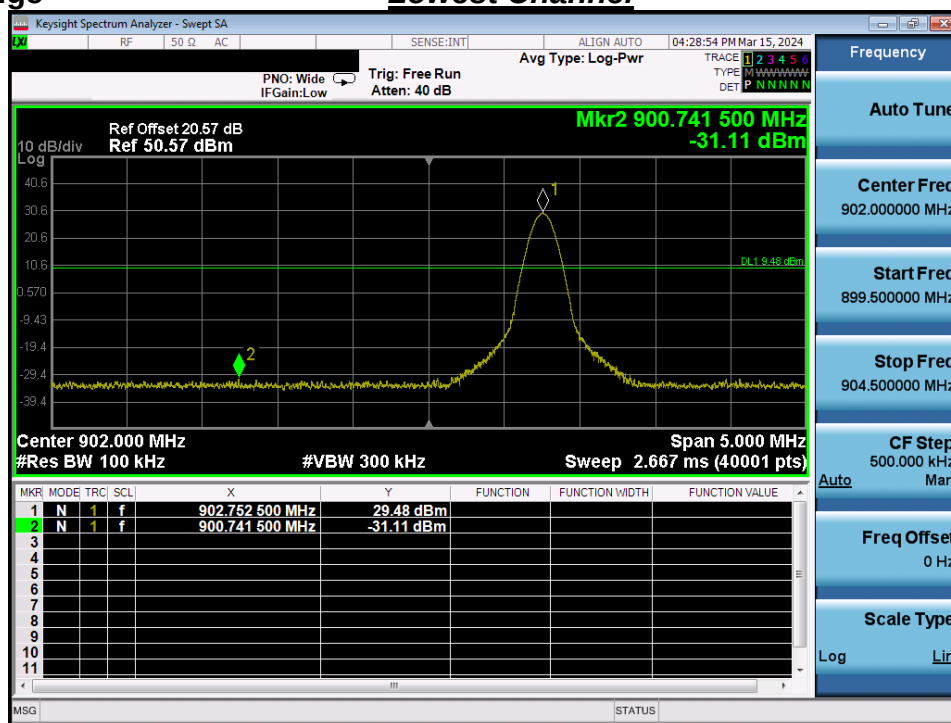
| Frequency (MHz) | ANT Pol | EUT Position (Axis) | Detector Mode | Reading (dBuV) | TF (dB/m) | DCCF (dB) | DCF (dB) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) |
|-----------------|---------|---------------------|---------------|----------------|-----------|-----------|----------|-----------------|----------------|-------------|
| 2 745.64        | H       | Z                   | PK            | 51.33          | 5.86      | N/A       | N/A      | 57.19           | 74.00          | 16.81       |
| 2 745.76        | H       | Z                   | AV            | 43.61          | 5.86      | N/A       | N/A      | 49.47           | 54.00          | 4.53        |
| 3 661.10        | V       | Y                   | PK            | 53.48          | 0.69      | N/A       | N/A      | 54.17           | 74.00          | 19.83       |
| 3 661.03        | V       | Y                   | AV            | 46.61          | 0.69      | N/A       | N/A      | 47.30           | 54.00          | 6.70        |
| 4 576.30        | H       | Y                   | PK            | 53.28          | 1.93      | N/A       | N/A      | 55.21           | 74.00          | 18.79       |
| 4 576.23        | H       | Y                   | AV            | 45.87          | 1.93      | N/A       | N/A      | 47.80           | 54.00          | 6.20        |
| 7 321.89        | V       | Z                   | PK            | 51.82          | 6.65      | N/A       | N/A      | 58.47           | 74.00          | 15.53       |
| 7 322.02        | V       | Z                   | AV            | 45.66          | 6.65      | N/A       | N/A      | 52.31           | 54.00          | 1.69        |
| 8 237.22        | H       | Y                   | PK            | 48.18          | 5.16      | N/A       | N/A      | 53.34           | 74.00          | 20.66       |
| 8 237.28        | H       | Y                   | AV            | 41.35          | 5.16      | N/A       | N/A      | 46.51           | 54.00          | 7.49        |
| 9 152.39        | H       | Y                   | PK            | 45.61          | 8.67      | N/A       | N/A      | 54.28           | 74.00          | 19.72       |
| 9 152.52        | H       | Y                   | AV            | 37.76          | 8.68      | N/A       | N/A      | 46.44           | 54.00          | 7.56        |

### ▪ Highest Channel

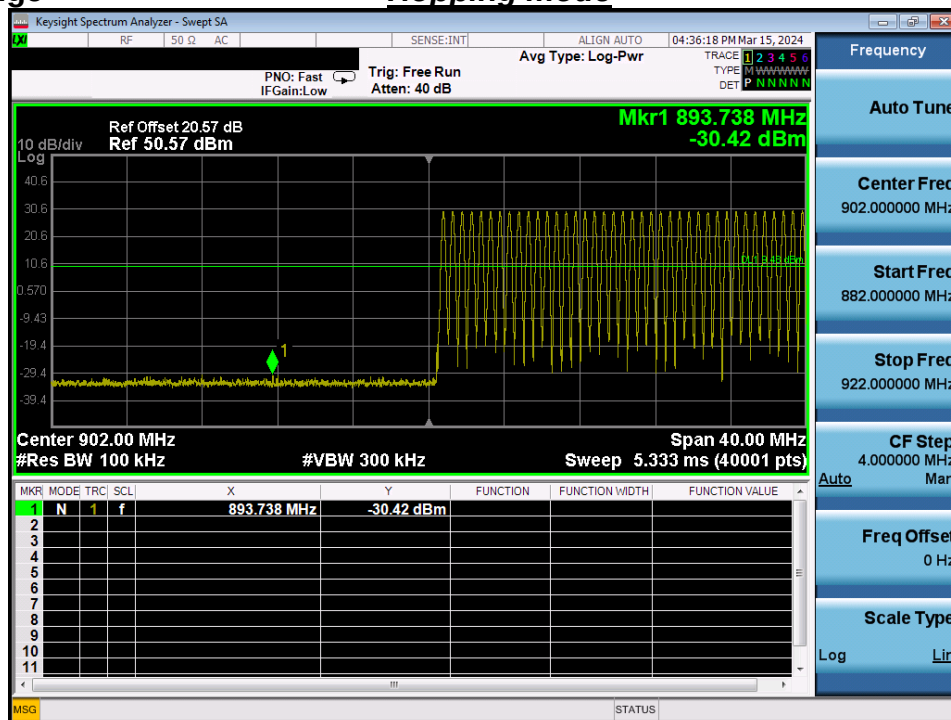
| Frequency (MHz) | ANT Pol | EUT Position (Axis) | Detector Mode | Reading (dBuV) | TF (dB/m) | DCCF (dB) | DCF (dB) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) |
|-----------------|---------|---------------------|---------------|----------------|-----------|-----------|----------|-----------------|----------------|-------------|
| 2 781.80        | H       | Z                   | PK            | 50.86          | 5.89      | N/A       | N/A      | 56.75           | 74.00          | 17.25       |
| 2 781.75        | H       | Z                   | AV            | 41.27          | 5.89      | N/A       | N/A      | 47.16           | 54.00          | 6.84        |
| 3 708.91        | V       | Y                   | PK            | 52.58          | 0.86      | N/A       | N/A      | 53.44           | 74.00          | 20.56       |
| 3 709.02        | V       | Y                   | AV            | 44.79          | 0.86      | N/A       | N/A      | 45.65           | 54.00          | 8.35        |
| 4 636.11        | H       | Y                   | PK            | 53.12          | 1.85      | N/A       | N/A      | 54.97           | 74.00          | 19.03       |
| 4 636.24        | H       | Y                   | AV            | 44.76          | 1.85      | N/A       | N/A      | 46.61           | 54.00          | 7.39        |
| 7 418.17        | V       | Z                   | PK            | 50.86          | 7.43      | N/A       | N/A      | 58.29           | 74.00          | 15.71       |
| 7 417.97        | V       | Z                   | AV            | 42.79          | 7.43      | N/A       | N/A      | 50.22           | 54.00          | 3.78        |
| 8 345.23        | H       | Y                   | PK            | 46.53          | 5.44      | N/A       | N/A      | 51.97           | 74.00          | 22.03       |
| 8 345.27        | H       | Y                   | AV            | 39.18          | 5.44      | N/A       | N/A      | 44.62           | 54.00          | 9.38        |

## 9.4.2. Unwanted Emissions (Conducted)

## Low Band-edge

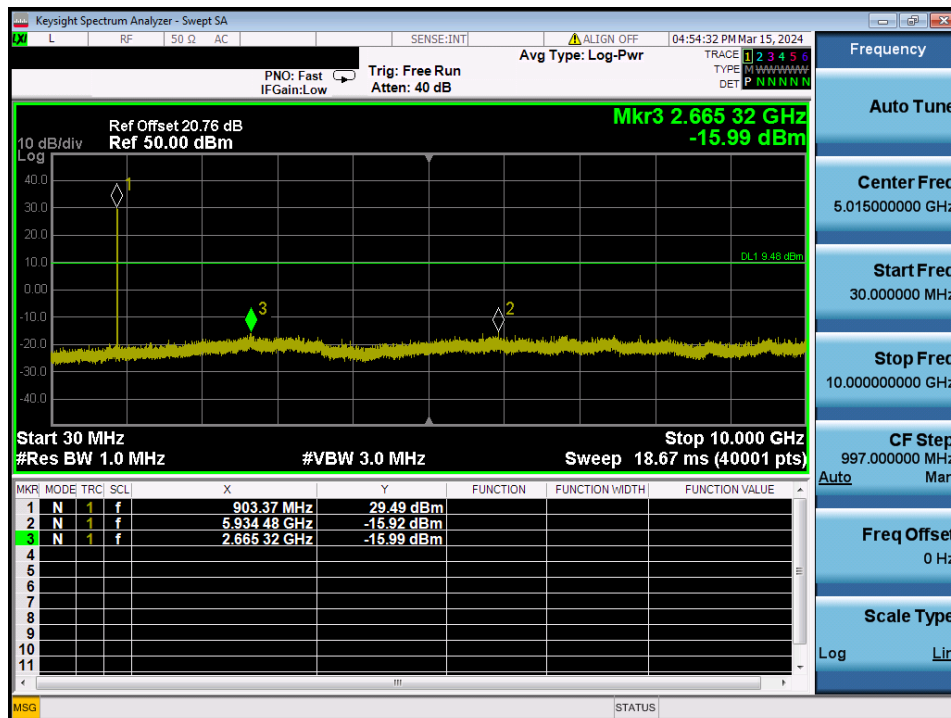
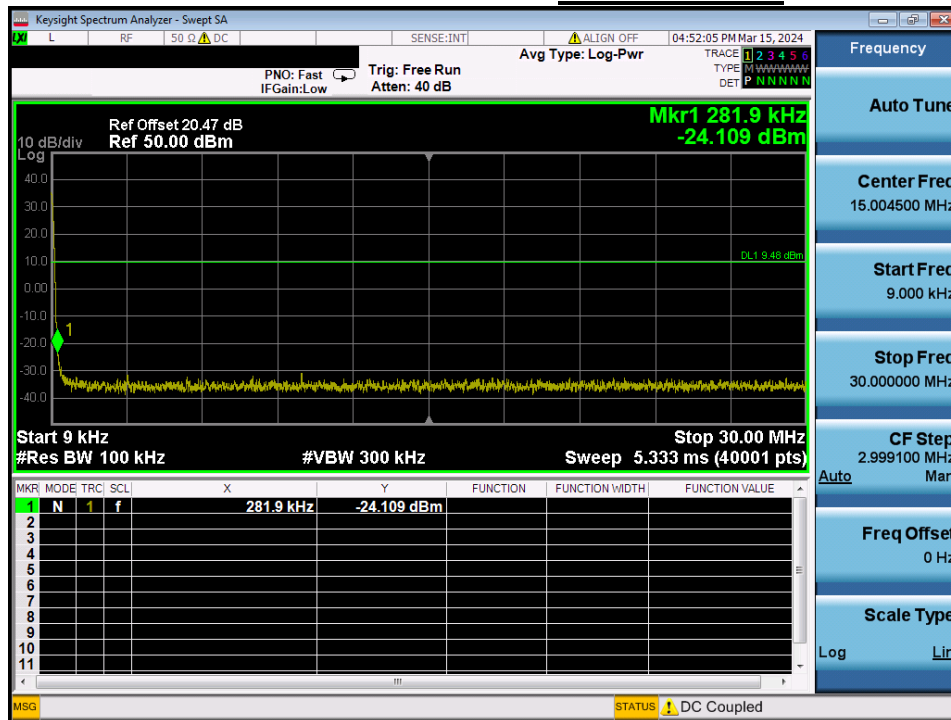
Lowest Channel

## Low Band-edge

Hopping mode

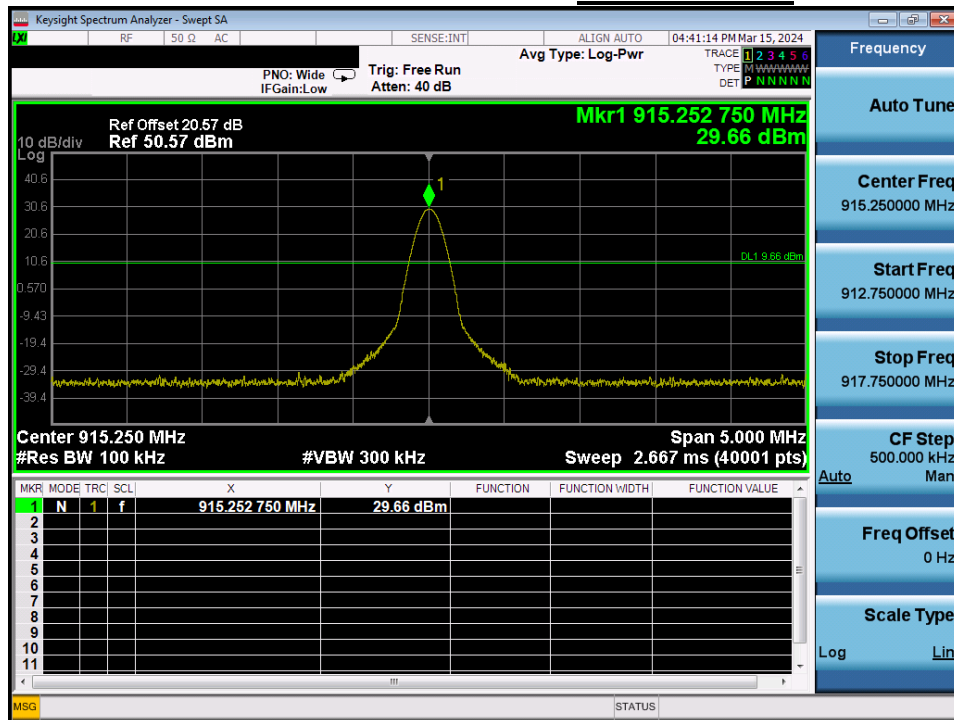
## Unwanted Emissions

## Lowest Channel



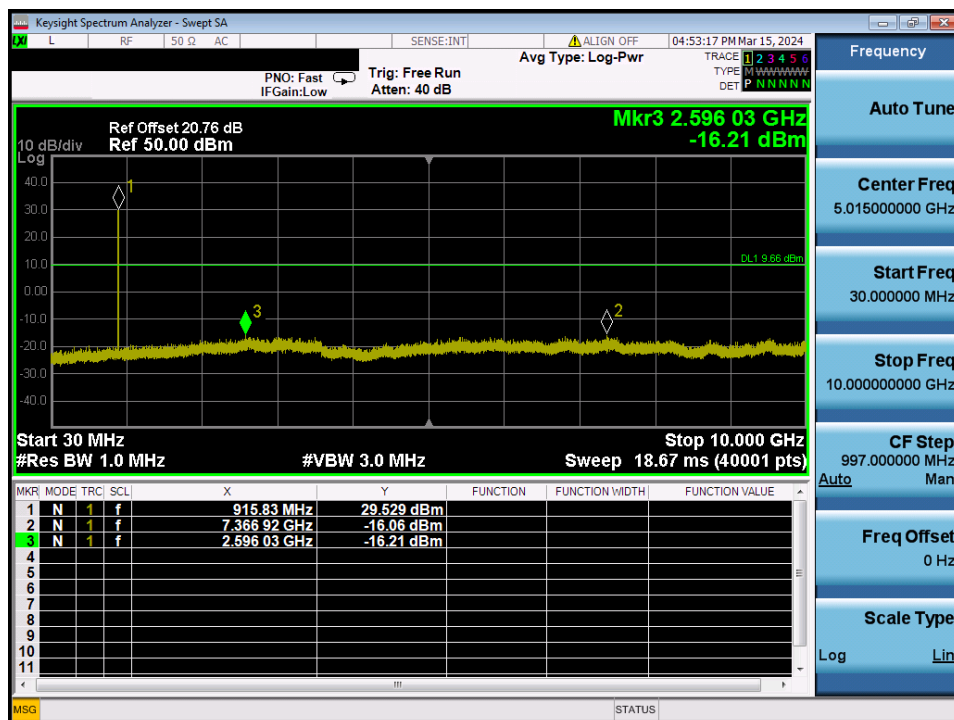
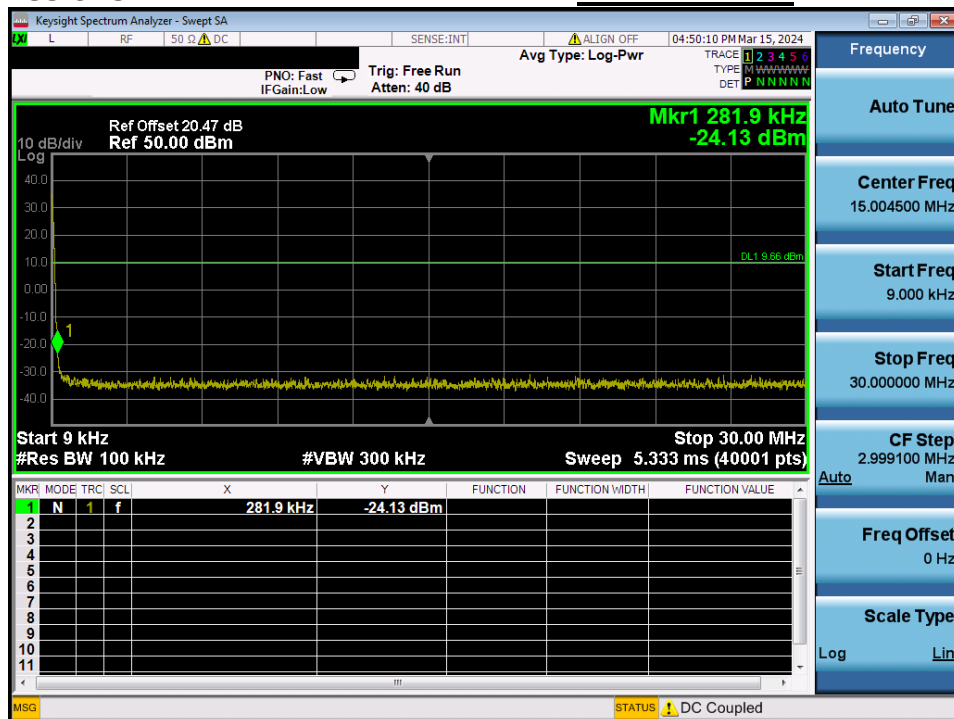
# Reference for limit

## Middle Channel

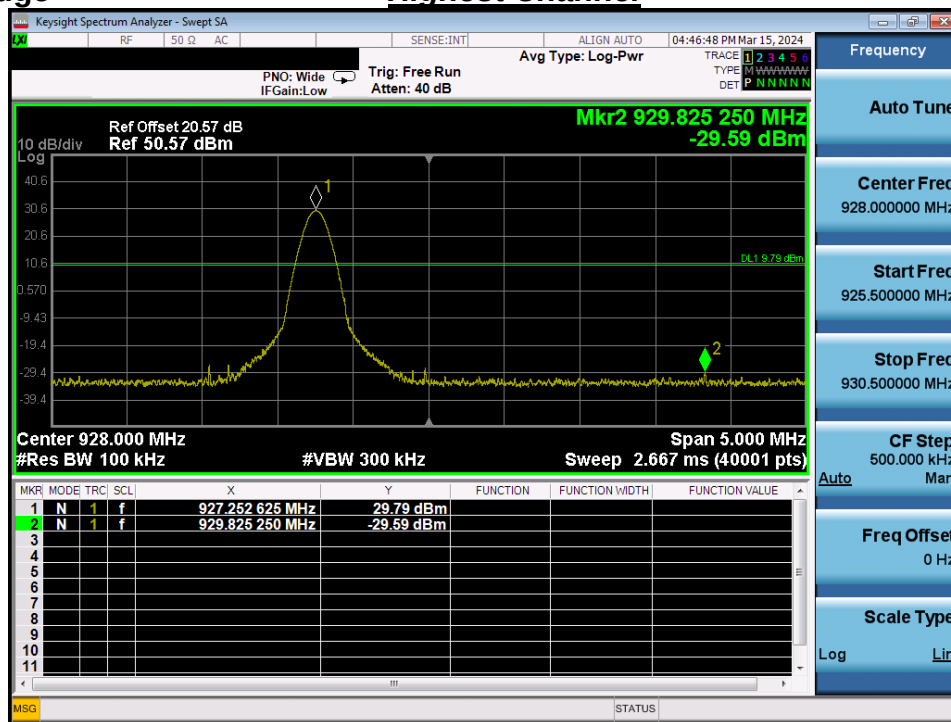


## Unwanted Emissions

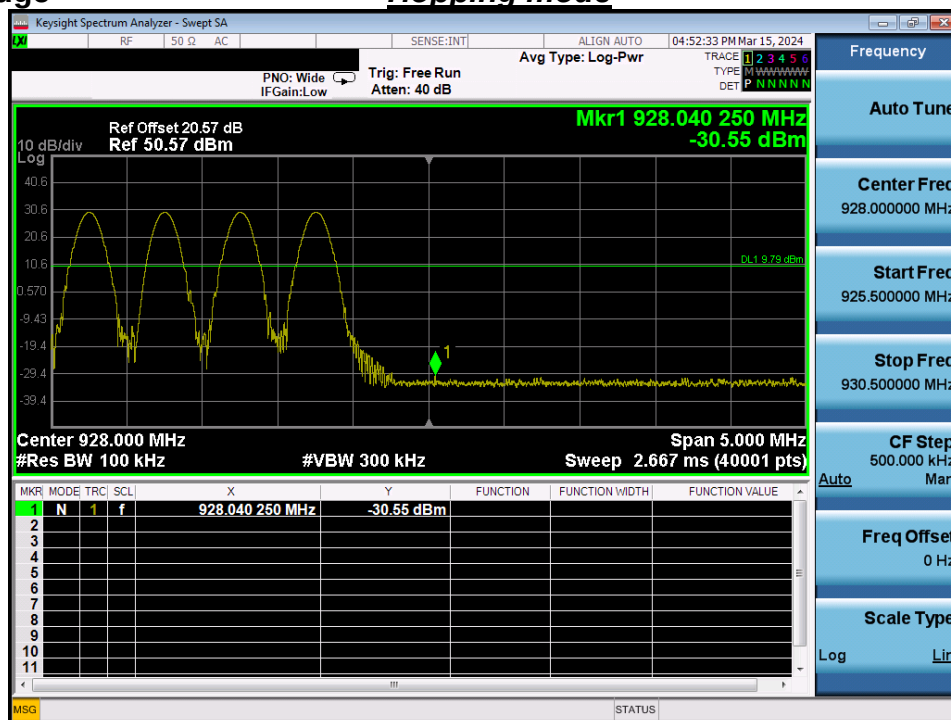
## Middle Channel



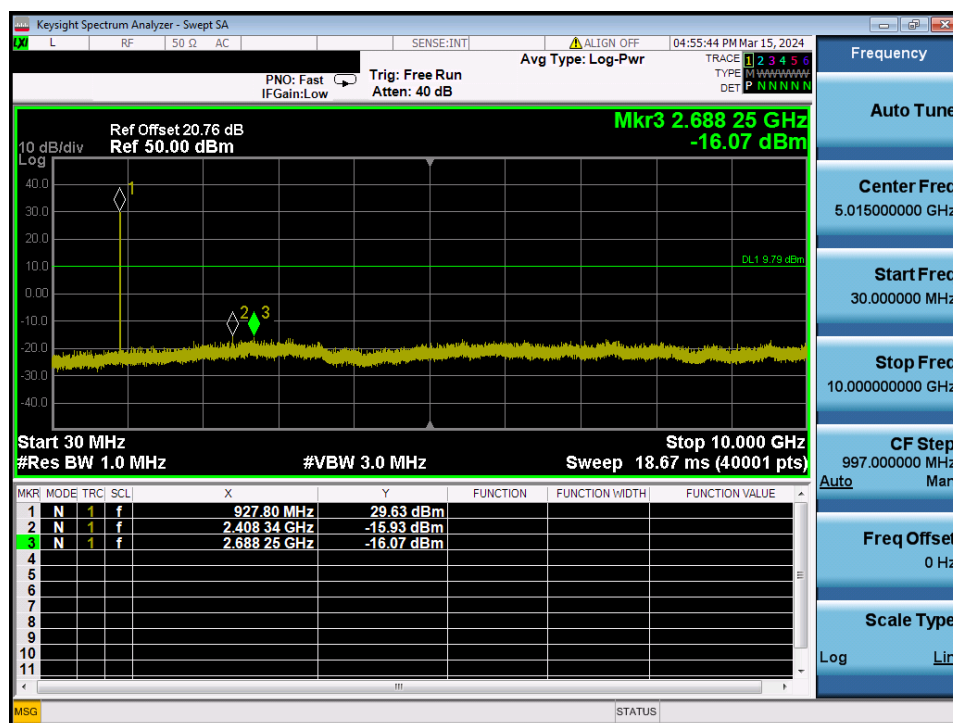
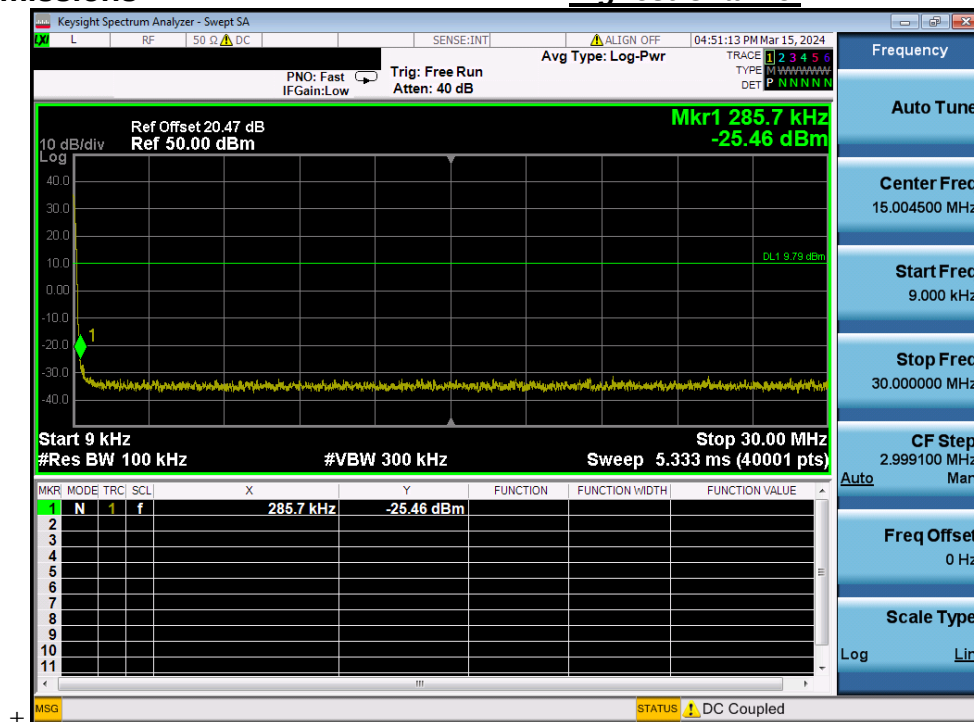
## High Band-edge

Highest Channel

## High Band-edge

Hopping mode

## Unwanted Emissions

Highest Channel

## 10. AC Power Line Conducted Emission

### 10.1. Test Setup

See test photo graphs for the actual connections between EUT and support equipment.

### 10.2. Limit

According to §15.207(a) for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50  $\mu$ H/50 ohm line impedance stabilization network (LISN).

Compliance with the provision of this paragraph shall on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower applies at the boundary between the frequency ranges.

| Frequency Range (MHz) | Conducted Limit (dBuV) |            |
|-----------------------|------------------------|------------|
|                       | Quasi-Peak             | Average    |
| 0.15 ~ 0.5            | 66 to 56 *             | 56 to 46 * |
| 0.5 ~ 5               | 56                     | 46         |
| 5 ~ 30                | 60                     | 50         |

\* Decreases with the logarithm of the frequency

### 10.3. Test Procedures

Conducted emissions from the EUT were measured according to the ANSI C63.10.

1. The test procedure is performed in a 6.5 m  $\times$  3.5 m  $\times$  3.5 m (L  $\times$  W  $\times$  H) shielded room. The EUT along with its peripherals were placed on a 1.0 m (W)  $\times$  1.5 m (L) and 0.8 m in height wooden table and the EUT was adjusted to maintain a 0.4 meter space from a vertical reference plane.
2. The EUT was connected to power mains through a line impedance stabilization network (LISN) which provides 50 ohm coupling impedance for measuring instrument and the chassis ground was bounded to the horizontal ground plane of shielded room.
3. All peripherals were connected to the second LISN and the chassis ground also bounded to the horizontal ground plane of shielded room.
4. The excess power cable between the EUT and the LISN was bundled. The power cables of peripherals were unbundled. All connecting cables of EUT and peripherals were moved to find the maximum emission.

## 10.4. Test Results

### AC Line Conducted Emissions (Graph) = Lowest Channel

#### Results of Conducted Emission

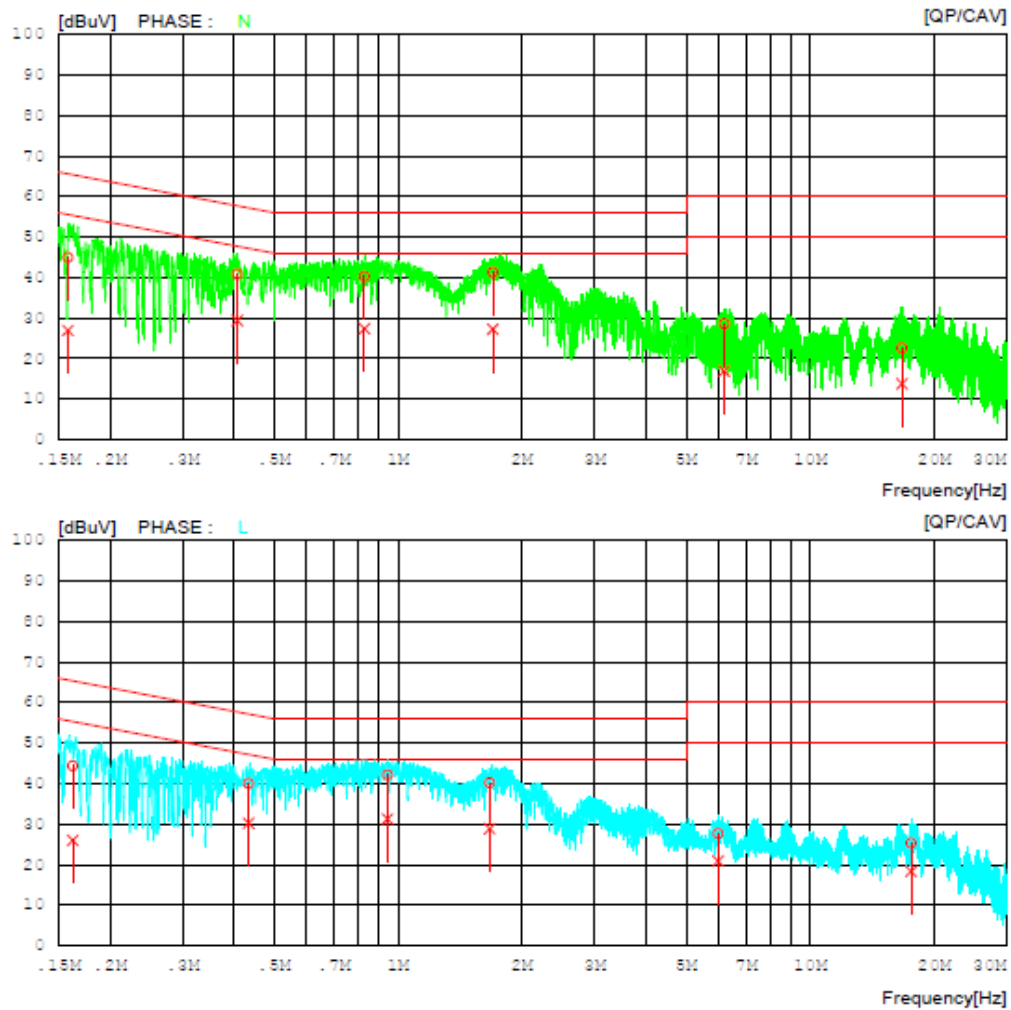
Date 2024-03-15

Order No.  
Model Name  
Temp/Humi/Atm  
Test Condition

R-5710  
21 °C / 41%  
RFID\_902.75MHz

LIMIT : FCC P15.207 AV  
FCC P15.207 QP

Lisn Factor  
1. NSLK 8128 RC-387\_N\_23.10.26  
2. NSLK 8128 RC-387\_L1\_23.10.26  
Cable Loss  
1. C1\_LISN TO RECIVER\_2023-12-11  
Pulse Limiter  
1. PULSE LIMITER\_ESH3-Z2\_101333\_2023.08.21



## AC Line Conducted Emissions (List) = Lowest Channel

Results of Conducted Emission

Date: 2024-03-15

Order No.  
Model Name R-5710  
Temp/Humi/Atm 21 °C / 41%  
Test Condition RFID\_902.75MHz

LIMIT : FCC P15.207 AV  
FCC P15.207 QP

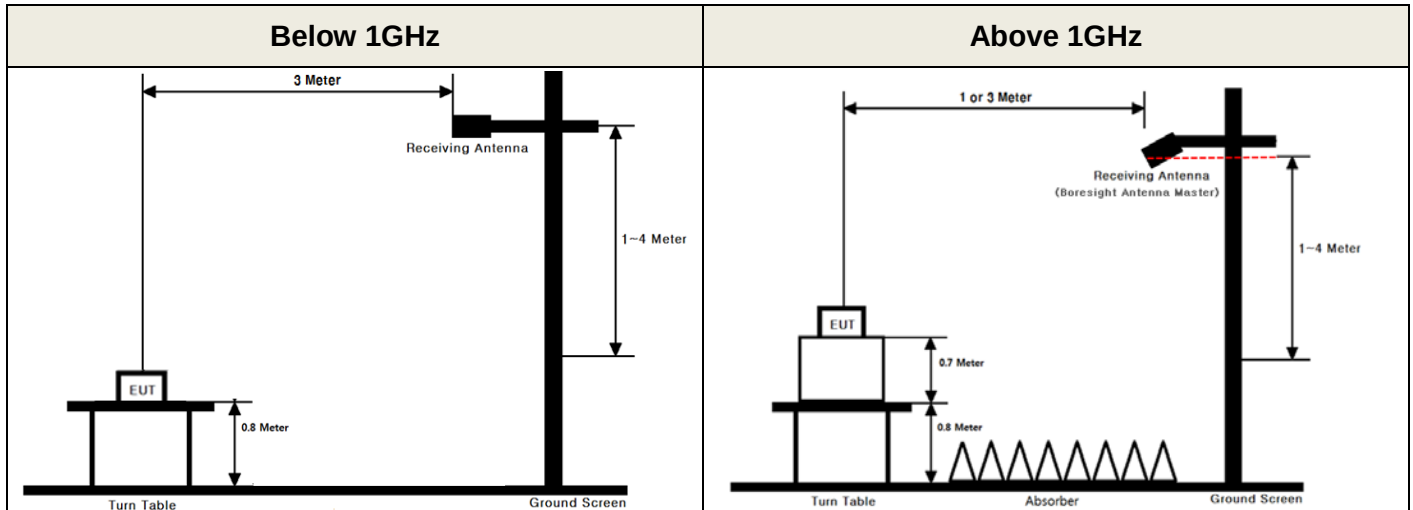
Lisn Factor  
1. NSLK 8128 RC-387\_N\_23.10.26  
2. NSLK 8128 RC-387\_L1\_23.10.26  
Cable Loss  
1. C1\_LISN TO RECIVER\_2023-12-11  
Pulse Limitter  
1. PULSE LIMITER\_ESH3-Z2\_101333\_2023.08.21

| NO | FREQ<br>[MHz] | READING      |               | C.FACTOR<br>[dB] | RESULT       |               | LIMIT        |               | MARGIN       |               | PHASE |
|----|---------------|--------------|---------------|------------------|--------------|---------------|--------------|---------------|--------------|---------------|-------|
|    |               | QP<br>[dBuV] | CAV<br>[dBuV] |                  | QP<br>[dBuV] | CAV<br>[dBuV] | QP<br>[dBuV] | CAV<br>[dBuV] | QP<br>[dBuV] | CAV<br>[dBuV] |       |
| 1  | 0.15817       | 34.95        | 16.91         | 9.99             | 44.94        | 26.90         | 55.56        | 55.56         | 20.62        | 28.66         | N     |
| 2  | 0.40746       | 30.80        | 18.41         | 10.00            | 40.80        | 28.41         | 57.70        | 47.70         | 16.90        | 18.29         | N     |
| 3  | 0.82837       | 30.25        | 17.37         | 10.01            | 40.26        | 27.38         | 56.00        | 46.00         | 15.74        | 18.62         | N     |
| 4  | 1.69840       | 31.17        | 17.16         | 10.05            | 41.22        | 27.21         | 56.00        | 46.00         | 14.78        | 18.79         | N     |
| 5  | 6.18260       | 18.33        | 6.60          | 10.25            | 28.58        | 16.85         | 60.00        | 50.00         | 31.42        | 33.15         | N     |
| 6  | 16.69440      | 12.01        | 3.18          | 10.53            | 22.54        | 13.71         | 60.00        | 50.00         | 37.46        | 36.29         | N     |
| 7  | 0.16250       | 34.36        | 16.02         | 9.99             | 44.35        | 26.01         | 55.34        | 55.34         | 20.99        | 29.33         | L     |
| 8  | 0.43373       | 30.02        | 20.21         | 10.00            | 40.02        | 30.21         | 57.18        | 47.18         | 17.16        | 16.97         | L     |
| 9  | 0.94270       | 32.04        | 21.11         | 10.12            | 42.16        | 31.23         | 56.00        | 46.00         | 13.84        | 14.77         | L     |
| 10 | 1.66740       | 30.06        | 18.67         | 10.15            | 40.21        | 28.82         | 56.00        | 46.00         | 15.79        | 17.18         | L     |
| 11 | 5.97840       | 17.39        | 10.88         | 10.25            | 27.67        | 20.86         | 60.00        | 50.00         | 32.33        | 29.14         | L     |
| 12 | 17.56040      | 14.71        | 7.72          | 10.59            | 25.30        | 18.31         | 60.00        | 50.00         | 34.70        | 31.69         | L     |

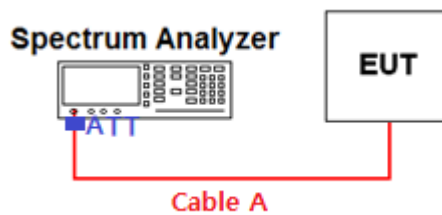
## APPENDIX I

### Test set up diagrams

#### ▪ Radiated Measurement



#### ▪ Conducted Measurement



Path loss information

| Frequency (MHz)          | Path Loss (dB) | Frequency (MHz) | Path Loss (dB) |
|--------------------------|----------------|-----------------|----------------|
| 30                       | 20.47          | 1 000           | 20.59          |
| 500                      | 20.50          | 5 000           | 20.73          |
| 902.75 & 915.25 & 927.25 | 20.57          | 10 000          | 20.76          |
| -                        | -              | -               | -              |

Note 1 : The path loss from EUT to Spectrum analyzer were measured and used for test.

Path loss ( S/A's Correction factor) = Cable A + Attenuator

## APPENDIX II

## Unwanted Emissions (Radiated) Test Plot

Middle&amp; Z &amp; Ver

Detector Mode : AV

