# 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 : DRTFCC1905-0178
2. Customer
   - Name : BLUEBIRD INC.
   - Address : (Dogok-dong, SEI Tower 13,14) 39, Eonjuro30-gil, Gangnam-gu, Seoul South Korea
3. Use of Report : FCC Original Grant
4. Product Name / Model Name : Handheld RFID Reader / RFR900S
   FCC ID : SS4RFR900S
5. Test Method Used : ANSI C63.10-2013
   Test Specification : FCC Part 15.247
6. Date of Test : 2019.03.14 ~ 2019.04.26
7. Testing Environment : See appended test report.
8. Test Result : Refer to the attached test result.

| | | |
|---|---|---|
| Affirmation | Tested by<br>Name : SunGeun Lee (Signature) | Reviewed by<br>Name : GeunKi Son (Signature) |



**2019 . 05 . 02 .**

**DT&C Co., Ltd.**

**If this report is required to confirmation of authenticity, please contact to report@dtnc.net**

# Test Report Version

| Test Report No. | Date | Description |
|---|---|---|
| DRTFCC1905-0178 | May. 02, 2019 | Initial issue |
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# Table of Contents

# 1.General Information

## 1.1 Testing Laboratory

| **DT&C Co., Ltd.** | | |
|---|---|---|
| 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.<br>The test site complies with the requirements of § 2.948 according to ANSI C63.4-2014.<br>**- FCC MRA Accredited Test Firm No. : KR0034** | | |
| www.dtnc.net | | |
| Telephone | : | + 82-31-321-2664 |
| FAX | : | + 82-31-321-1664 |

## 1.2 Details of Applicant

| | | |
|---|---|---|
| Applicant | : | BLUEBIRD INC. |
| Address | : | (Dogok-dong, SEI Tower 13,14) 39, Eonjuro30-gil, Gangnam-gu, Seoul South Korea |
| Contact person | : | Yongsik Jang |

## 1.3 Description of EUT

| | |
|---|---|
| **EUT** | Handheld RFID Reader |
| **Model Name** | RFR900S |
| **Add Model Name** | NA |
| **Serial Number** | Identical prototype |
| **Hardware version** | Rev0.4 |
| **Software version** | RFR900-20180829 |
| **Power Supply** | DC 3.64 V |
| **Frequency Range** | 902.75 ~ 927.25 MHz |
| **Modulation Technique** | ASK |
| **Number of Channels** | 50(Channel Spacing: 500kHz) |
| **Antenna Type** | Internal Antenna (Max. PK -0.05 dBi) |

## 1.4 Declaration by the manufacturer

- N/A

## 1.5 Test conditions

| **Ambient Condition** | |
|---|---|
| ▪ Temperature | +22 ℃ ~ +25 ℃ |
| ▪ Relative Humidity | 30 % ~ 35 % |

## 1.6 Test Equipment List

| Type | Manufacturer | Model | Cal.Date (yy/mm/dd) | Next.Cal.Date (yy/mm/dd) | S/N |
|---|---|---|---|---|---|
| Spectrum Analyzer | Agilent Technologies | N9020A | 18/07/06 | 19/07/06 | US47360812 |
| Spectrum Analyzer | Agilent Technologies | N9020A | 18/12/19 | 19/12/19 | MY48011700 |
| DC Power Supply | Agilent Technologies | 66332A | 18/07/02 | 19/07/02 | US37473422 |
| Multimeter | FLUKE | 17B | 18/12/18 | 19/12/18 | 26030065WS |
| Signal Generator | Rohde Schwarz | SMBV100A | 18/12/19 | 19/12/19 | 255571 |
| Signal Generator | ANRITSU | MG3695C | 18/12/10 | 19/12/10 | 173501 |
| Thermohygrometer | BODYCOM | BJ5478 | 18/12/27 | 19/12/27 | 120612-1 |
| Thermohygrometer | BODYCOM | BJ5478 | 18/07/09 | 19/07/09 | N/A |
| HYGROMETER | TESTO | 608-H1 | 19/01/31 | 20/01/31 | 34862883 |
| Loop Antenna | Schwarzbeck | FMZB1513 | 18/01/30 | 20/01/30 | 1513-128 |
| BILOG ANTENNA | Schwarzbeck | VULB 9160 | 18/07/13 | 20/07/13 | 3359 |
| Horn Antenna | ETS-Lindgren | 3115 | 19/01/11 | 21/01/11 | 9202-3820 |
| Horn Antenna | Schwarzbeck | BBHA 9120C | 17/12/04 | 19/12/04 | 9120C-561 |
| PreAmplifier | tsj | MLA-0118-J01-45 | 18/12/19 | 19/12/19 | 17138 |
| PreAmplifier | tsj | MLA-10K01-B01-27 | 18/10/31 | 19/10/31 | 2005354 |
| Attenuator | Aeroflex/Weinschel | 86-10-11 | 18/07/04 | 19/07/04 | 408 |
| Attenuator | SMAJK | SMAJK-2-3 | 18/07/04 | 19/07/04 | 4 |
| Attenuator | Aeroflex/Weinschel | 56-3 | 18/07/02 | 19/07/02 | Y2370 |
| Attenuator | SRTechnology | F01-B0606-01 | 18/07/02 | 19/07/02 | 13092403 |
| Attenuator | Hefei Shunze | SS5T2.92-10-40 | 18/07/03 | 19/07/03 | 16012202 |
| Band Pass Filter | Wainwright Instruments | WRCT800/960.0-2/40-8SSK | 18/07/05 | 19/07/05 | 32 |
| High Pass Filter | Wainwright Instruments | WHNX8.0/26.5-6SS | 18/07/03 | 19/07/03 | 3 |
| High Pass Filter | Wainwright Instruments | WHKX12-935-1000-15000-40SS | 18/07/02 | 19/07/02 | 8 |
| High Pass Filter | Wainwright Instruments | WHKX10-2838-3300-18000-60SS | 18/07/02 | 19/07/02 | 1 |
| Power Meter & Wide Bandwidth Sensor | Anritsu | MA2411B MA2490A | 18/12/19 | 19/12/19 | 1306053 1249303 |
| EMI Test Receiver | Rohde Schwarz | ESW44 | 18/08/06 | 20/08/06 | 101645 |
| EMI Test Receiver | Rohde Schwarz | ESCI7 | 19/01/30 | 20/01/30 | 100910 |
| PULSE LIMITER | Rohde Schwarz | ESH3-Z2 | 18/09/27 | 19/09/27 | 101333 |
| LISN | SCHWARZBECK | NNLK 8121 | 18/03/20<br>19/03/19 | 19/03/20<br>20/03/19 | 06183 |
| Cable | HUBER+SUHNER | SUCOFLEX 106 | 18/06/25 | 19/06/25 | G-01 |
| Cable | HUBER+SUHNER | SUCOFLEX 104 | 18/06/25 | 19/06/25 | G-02 |
| Cable | HUBER+SUHNER | SUCOFLEX 104 | 18/06/25 | 19/06/25 | G-03 |
| Cable | Junkosha | MWX241 | 18/06/25 | 19/06/25 | G-04 |
| Cable | Junkosha | MWX241 | 18/06/25 | 19/06/25 | G-07 |
| Cable | DT&C | Cable | 18/07/06 | 19/07/06 | G-13 |
| Cable | DT&C | Cable | 18/07/06 | 19/07/06 | G-14 |
| Cable | HUBER+SUHNER | SUCOFLEX 104 | 18/07/06 | 19/07/06 | G-15 |
| Cable | DT&C | Cable | 18/07/06 | 19/07/06 | RF-55 |

Note 1: The measurement antennas were calibrated in accordance to the requirements of ANSI C63.5-2017
Note 2: The cable is not a regular calibration item, so it has been calibrated by DT & C itself.

## 1.7 Summary of Test Results

| FCC Part RSS Std. | Parameter | Limit (Using in 902-928 MHz) | Test Condition | Status Note 1 |
|---|---|---|---|---|
| 15.247(a) RSS-247(5.1) | Carrier Frequency Separation | >= 25 kHz or >= 20 dB BW, whichever is greater. | Conducted | C |
| | Number of Hopping Frequencies | >= 50 hops, if 20 dB BW < 250kHz<br>>= 25 hops, if 20 dB BW >= 250kHz | | C |
| | 20 dB Bandwidth | < 500 kHz | | C |
| | Dwell Time | =< 0.4 seconds | | C |
| 15.247(b) RSS-247(5.4) | Transmitter Output Power | **For FCC**<br>=< 1 Watt , if CHs >= 50<br>=< 0.25 W, if CHs >= 25, < 50<br>**For IC**<br>if CHs >= 50<br>=< 1 Watt For Conducted Power<br>=< 4 Watt For e.i.r.p,<br>if CHs >= 25, < 50<br>=< 0.25 W For Conducted Power.<br>=< 1 Watt For e.i.r.p | | C |
| 15.247(d) RSS-247(5.5) | Conducted Spurious Emissions | The radiated emission to any 100 kHz of out-band shall be at least 20 dB below the highest in-band spectral density. | | C |
| RSS Gen(6.6) | Occupied Bandwidth (99 %) | N/A | | NA |
| 15.247(d) 15.205 & 209 RSS-247(5.5) RSS-Gen (8.9 & 8.10) | Radiated Spurious Emissions | FCC 15.209 Limits | Radiated | C Note3 |
| 15.207 RSS-Gen(8.8) | AC Conducted Emissions | FCC 15.207 Limits | AC Line Conducted | C |
| 15.203 RSS-Gen(8.3) | Antenna Requirements | FCC 15.203 | - | C |

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

Note 2: For radiated emission tests below 30 MHz were performed on semi-anechoic chamber which is correlated with OATS.

Note 3: This test item was performed in each axis and the worst case data was reported.

## 1.8 Conclusion of worst-case and operation mode

The field strength of spurious emission was measured in three orthogonal EUT positions(X-axis, Y-axis and Z-axis).

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** | 914.75 | 914.75 |
| **Highest Channel** | 927.25 | 927.25 |

# 2. Maximum Peak Output Power Measurement

## 2.1 Test Setup

Refer to the APPENDIX I.

## 2.2 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.

### ▣ IC Requirements

1. RSS-247(5.4)(a), For FHSS operating in the band 902-928 MHz, the maximum peak conducted output power shall not exceed 1.0 W, and the e.i.r.p. shall not exceed 4 W if the hopset uses 50 or more hopping channels; the maximum peak conducted output power shall not exceed 0.25 W and the e.i.r.p. shall not exceed 1 W if the hopset uses less than 50 hopping channels.

## 2.3 Test Procedure

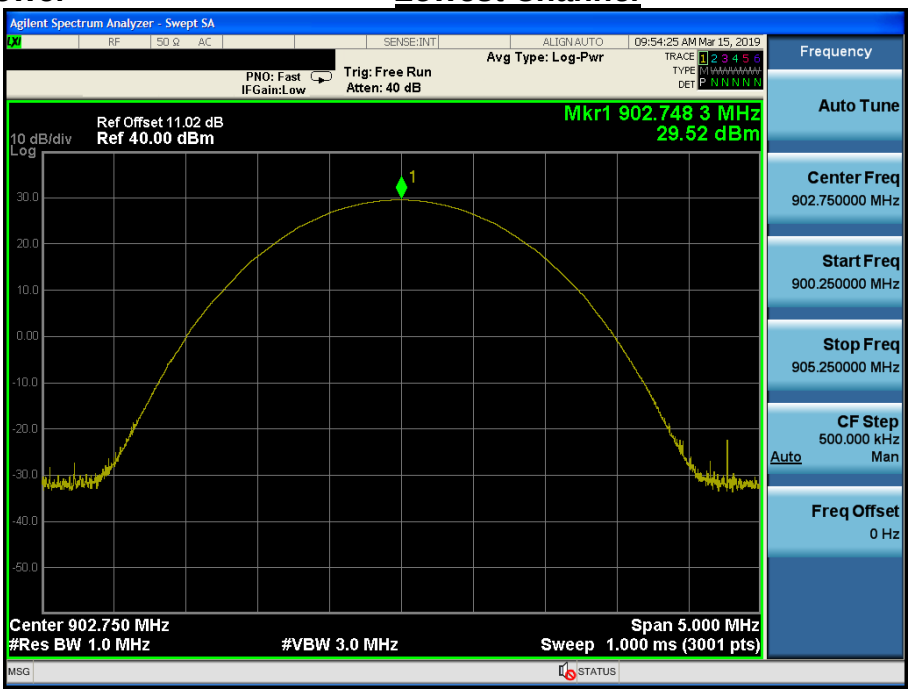
1. The RF output power was measured with a spectrum analyzer connected to the RF Antenna connector (conducted measurement) while EUT was operating in transmit mode at the appropriate center frequency, A spectrum analyzer was used to record the shape of the transmit signal.
2. The peak output power of 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 ≥ 20 dB BW
   VBW ≥ RBW
   Sweep = auto
   Detector function = peak
   Trace = max hold

## 2.4 Test Results

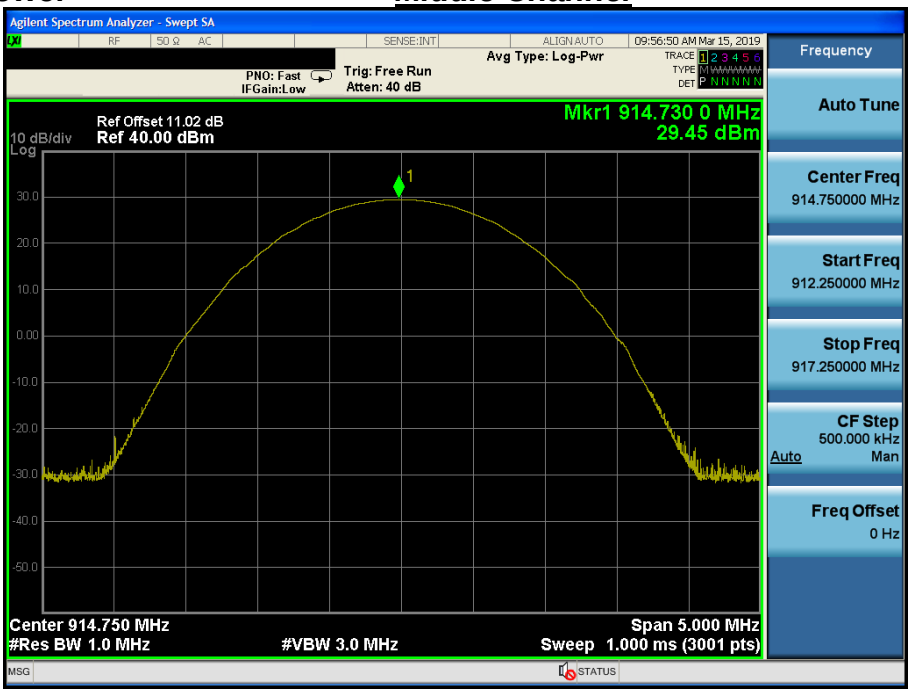
| Tested Channel | Peak Output Power | |
|---|---|---|
| | dBm | mW |
| **Lowest** | **29.520** | **895.365** |
| **Middle** | 29.450 | 881.049 |
| **Highest** | 29.220 | 835.603 |

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

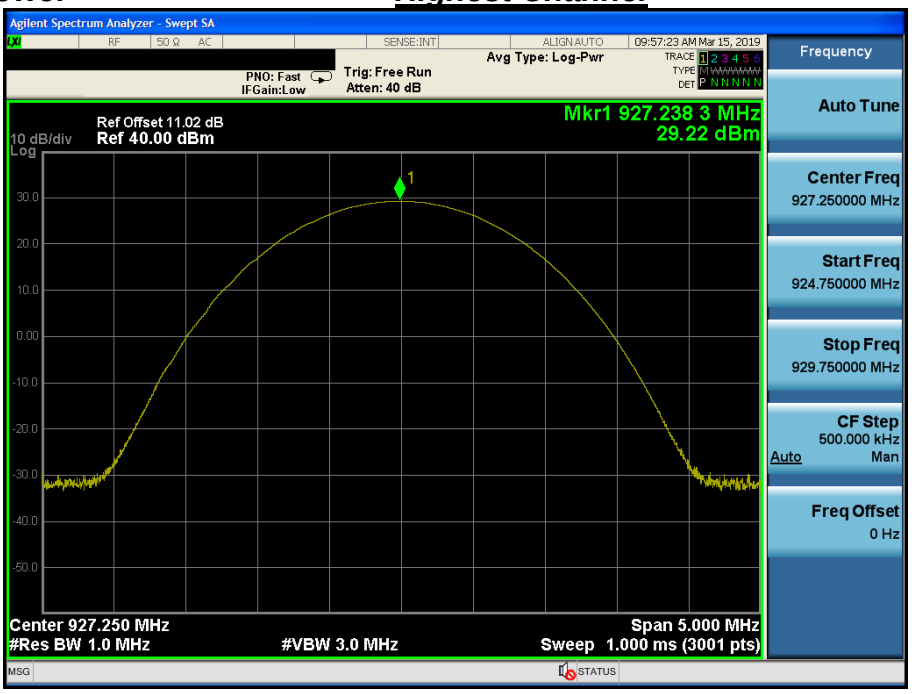
## Peak Output Power ***Lowest Channel***




## Peak Output Power ***Middle Channel***



**Peak Output Power** ***Highest Channel***



# 3. 20dBc BW

## 3.1 Test Setup

Refer to the APPENDIX I.

## 3.2 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.

## 3.3 Test Procedure

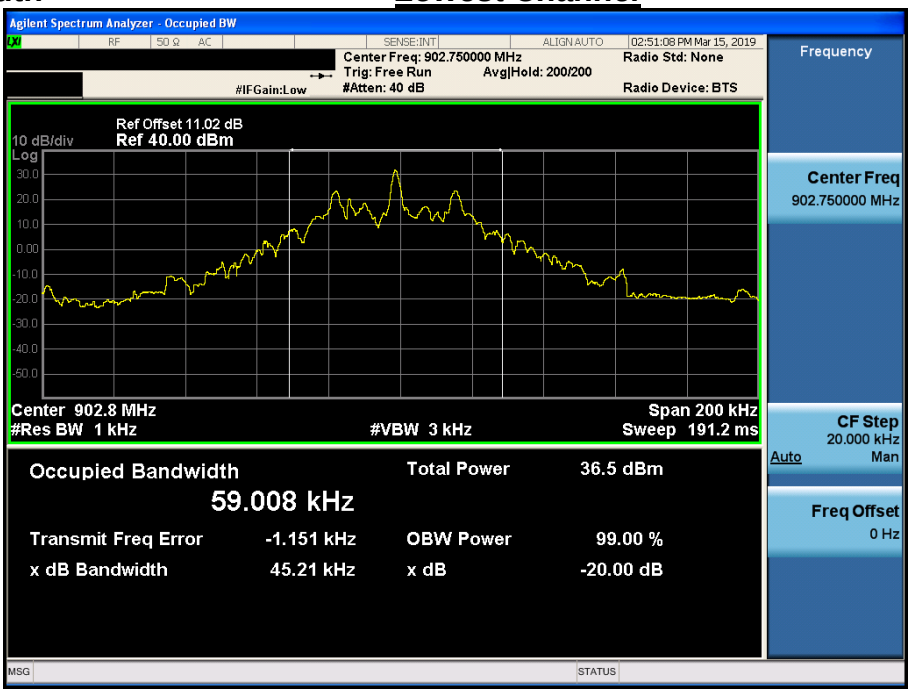
1. The 20 dB bandwidth were measured with a spectrum analyzer connected to RF antenna Connector (conducted measurement) while EUT was operating in transmit mode. The analyzer center frequency was set to the EUT carrier frequency, using the analyzer.
2. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using below setting: RBW shall be in the range of 1% to 5% of the 20 dB bandwidth and VBW ≥ 3 × RBW, Span = between two times and five times the 20 dB bandwidth.

## 3.4 Test Results

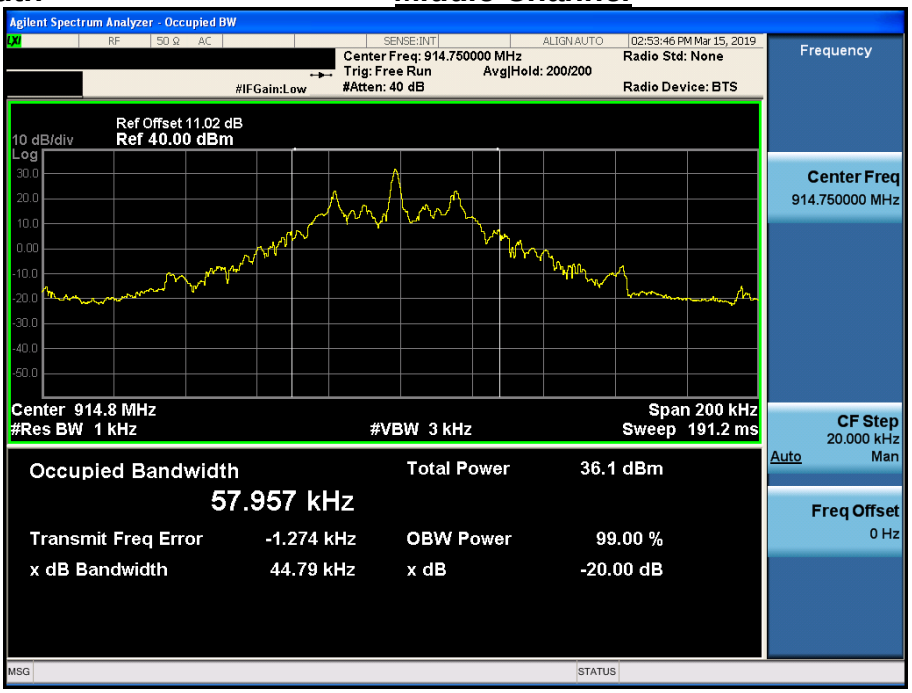
| Frequency (MHz) | Tested Channel | 20dBc BW (kHz) |
|---|---|---|
| **902.75** | **Lowest** | 45.21 |
| **914.75** | **Middle** | 44.79 |
| **927.25** | **Highest** | 45.34 |

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

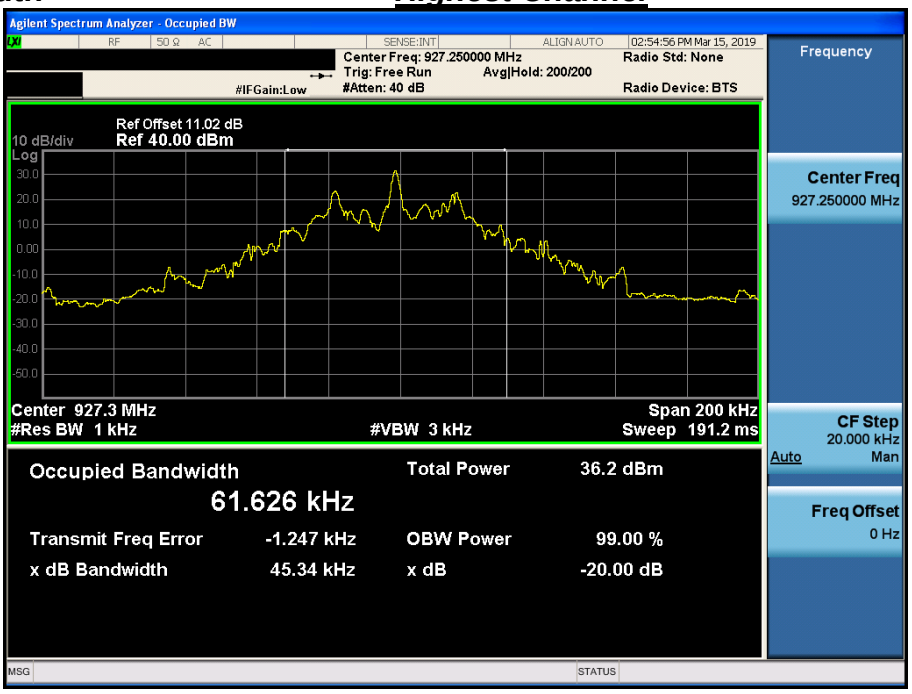
## 20dBc Bandwidth ***Lowest Channel***




## 20dBc Bandwidth ***Middle Channel***



## 20dBc Bandwidth ***Highest Channel***



# 4. Carrier Frequency Separation

## 4.1 Test Setup

Refer to the APPENDIX I.

## 4.2 Limit

Limit : ≥ 25 kHz or ≥ 20 dB BW whichever is greater.

## 4.3 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.

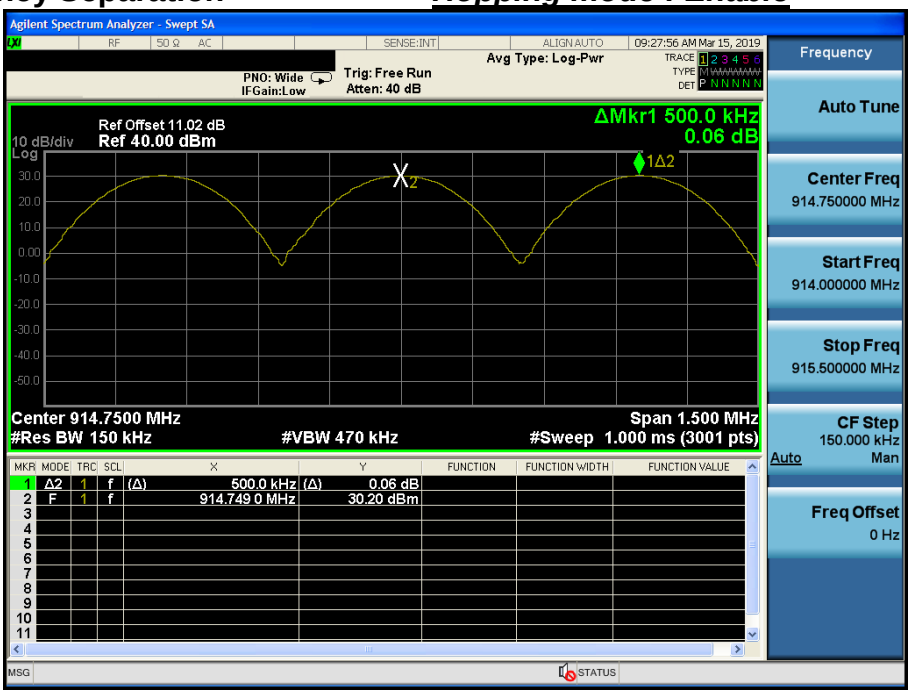
VBW ≥ RBW Sweep = auto

Detector function = peak Trace = max hold

## 4.4 Test Results

| Hopping Mode | Peak of center channel (MHz) | Peak of adjacent Channel (MHz) | Test Result (kHz) |
|---|---|---|---|
| **Enable** | 914.749 | 915.249 | 500 |

**Carrier Frequency Separation** ***Hopping mode : Enable***



# 5. Number of Hopping Frequencies

## 5.1 Test Setup

Refer to the APPENDIX I.

## 5.2 Limit

Limit: >= 50 hops

## 5.3 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 = 30 MHz Start Frequency = 899.75 MHz, Stop Frequency = 929.75 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 ≥ RBW Sweep = auto

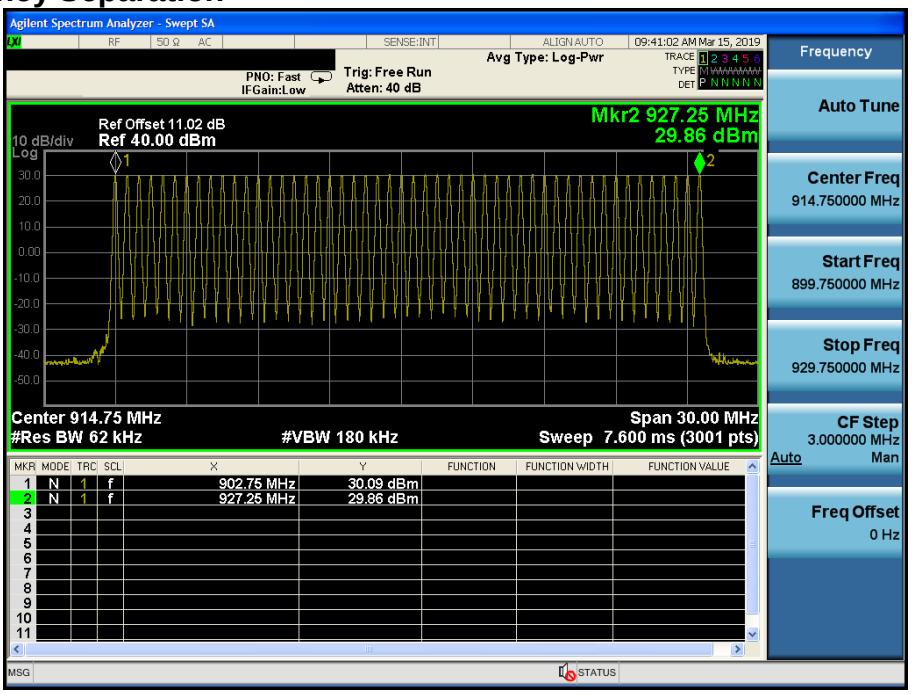
Detector function = peak Trace = max hold

## 5.4 Test Results

| Hopping mode | Test Result (Total Hops) |
|---|---|
| Enable | 50 |

***Hopping mode : Enable***

**Carrier Frequency Separation**



# 6. Time of Occupancy (Dwell Time)

## 6.1 Test Setup

Refer to the APPENDIX I.

## 6.2 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.

## 6.3 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 = 914.75 MHz Span = zero

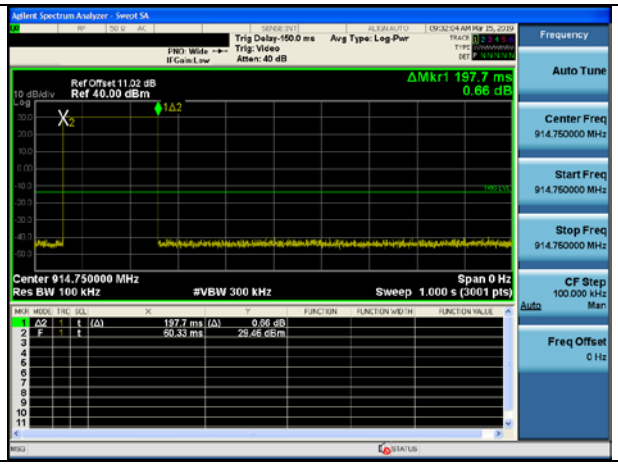
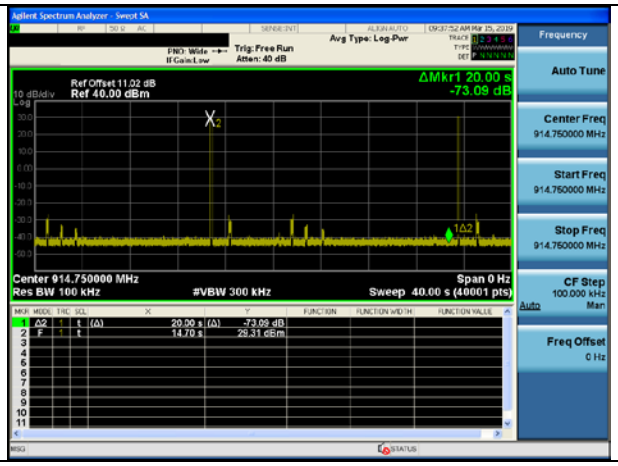
RBW = 100 kHz (RBW shall be ≤ channel spacing and where possible RBW should be set >> 1 / T, where T is the expected dwell time per channel)

VBW ≥ RBW Detector function = peak

Trace = max hold

## 6.4 Test Results

| Channel Frequency (MHz) | Length (ms) | Number | Dwell Time (ms) |
|---|---|---|---|
| **914.75** | 197.7 | 1 | 197.7 |

| Length | Period |
|---|---|
|  |  |

# 7. Transmitter Radiated Spurious Emissions and Conducted Spurious Emission

## 7.1 Test Setup

Refer to the APPENDIX I.

## 7.2 Limit

According to §15.247(d), 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 this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in section §15.209(a) is not required. In addition, radiated emission which in the restricted band, as define in section §15.205(a), must also comply the radiated emission limits specified in section §15.209(a) (see section §15.205(c))

According to § 15.209(a), except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table

| Frequency (MHz) | Limit (uV/m) | Measurement Distance (meter) |
|---|---|---|
| 0.009 ~ 0.490 | 2400/F (kHz) | 300 |
| 0.490 ~ 1705 | 24000/F (kHz) | 30 |
| 1705 ~ 30.0 | 30 | 30 |
| 30 ~ 88 | 100 ** | 3 |
| 88 ~ 216 | 150 ** | 3 |
| 216 ~ 960 | 200 ** | 3 |
| Above 960 | 500 | 3 |

** Except as provided in 15.209(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.

According to § 15.205(a) and (b), only spurious emissions are permitted in any of the frequency bands listed below :

| MHz | MHz | MHz | MHz | GHz | GHz |
|---|---|---|---|---|---|
| 0.009 ~ 0.110 | 8.41425 ~ 8.41475 | 108 ~ 121.94 | 1300 ~ 1427 | 4.5 ~ 5.15 | 14.47 ~ 14.5 |
| 0.495 ~ 0.505 | 12.29 ~ 12.293 | 123 ~ 138 | 1435 ~ 1626.5 | 5.35 ~ 5.46 | 15.35 ~ 16.2 |
| 2.1735 ~ 2.1905 | 12.51975 ~ 12.52025 | 149.9 ~ 150.05 | 1645.5 ~ 1646.5 | 7.25 ~ 7.75 | 17.7 ~ 21.4 |
| 4.125 ~ 4.128 | 12.57675 ~ 12.57725 | 156.52475 ~ 156.52525 | 1660 ~ 1710 | 8.025 ~ 8.5 | 22.01 ~ 23.12 |
| 4.17725 ~ 4.17775 | 13.36 ~ 13.41 | 156.7 ~ 156.9 | 1718.8 ~ 1722.2 | 9.0 ~ 9.2 | 23.6 ~ 24.0 |
| 4.20725 ~ 4.20775 | 16.42 ~ 16.423 | 162.0125 ~ 167.17 | 2200 ~ 2300 | 9.3 ~ 9.5 | 31.2 ~ 31.8 |
| 6.215 ~ 6.218 | 16.69475 ~ 16.69525 | 167.72 ~ 173.2 | 2310 ~ 2390 | 10.6 ~ 12.7 | 36.43 ~ 36.5 |
| 6.26775 ~ 6.26825 | 16.80425 ~ 16.80475 | 240 ~ 285 | 2483.5 ~ 2500 | 13.25 ~ 13.4 | Above 38.6 |
| 6.31175 ~ 6.31225 | 25.5 ~ 25.67 | 322 ~ 335.4 | 2655 ~ 2900 | | |
| 8.291 ~ 8.294 | 37.5 ~ 38.25 | 399.90 ~ 410 | 3260 ~ 3267 | | |
| 8.362 ~ 8.366 | 73 ~ 74.6 | 608 ~ 614 | 3332 ~ 3339 | | |
| 8.37625 ~ 8.38675 | 74.8 ~ 75.2 | 960 ~ 1240 | 3345.8 ~ 3358 | | |
| | | | 3600 ~ 4400 | | |

The field strength of emissions appearing within these frequency bands shall not exceed the limits shown in §15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in §15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in §15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in §15.35 apply to these measurements.

## 7.3 Test Procedures

### 7.3.1 Test Procedures for Radiated Spurious Emissions

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.

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

NOTE 2. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 1 MHz for Peak detection and frequency above 1 GHz.

NOTE 3. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 1 kHz for Average detection (AV) at frequency above 1 GHz.

### 7.3.2 Test Procedures for Conducted Spurious Emissions

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 : 40001**

**Frequency range : 30 MHz ~ 10 GHz**
**RBW = 1 MHz, VBW = 3 MHz, SWEEP TIME = AUTO, DETECTOR = PEAK, TRACE = MAX HOLD, SWEEP POINT : 40001**

**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 = 2001 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.

## 7.4 Test Results

### 7.4.1 Radiated Emission

### 9kHz ~ 1GHz Data

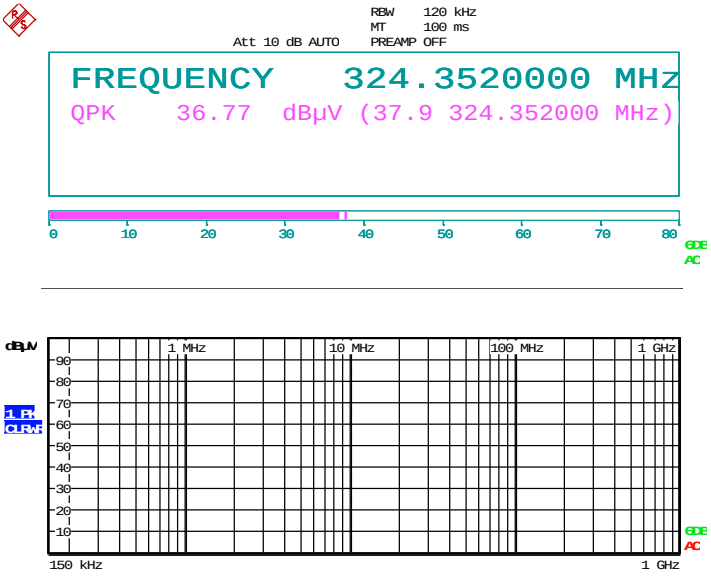
▪ Lowest Channel

| Frequency (MHz) | ANT Pol | EUT Position (Axis) | Detector Mode | Reading (dBuV) | T.F (dB/m) | D.C.F. (dB) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|
| 55.22 | V | Y | PK | 33.90 | -7.60 | N/A | 26.30 | 40.00 | 13.70 |
| 312.27 | H | Y | PK | 36.00 | -6.90 | N/A | 29.10 | 46.00 | 16.90 |
| 323.91 | H | Y | PK | 46.90 | -6.80 | N/A | 40.10 | 46.00 | 5.90 |
| 324.35 | H | Y | QP | 37.90 | -6.80 | N/A | 31.10 | 46.00 | 14.90 |
| 336.52 | H | Y | PK | 38.20 | -6.50 | N/A | 31.70 | 46.00 | 14.30 |
| 348.16 | H | Y | PK | 37.10 | -6.30 | N/A | 30.80 | 46.00 | 15.20 |
| 635.28 | V | Y | PK | 35.40 | -0.80 | N/A | 34.60 | 46.00 | 11.40 |
| 840.91 | H | Y | PK | 32.60 | 2.50 | N/A | 35.10 | 46.00 | 10.90 |
| - | - | - | - | - | - | - | - | - | - |

**Note.**

1. Exploratory testing has been performed to determine the emissions characteristic of EUT.
   And low channel was selected for final testing and reported.
2. No other spurious and harmonic emissions were reported greater than listed emissions above table.
3. Above listed point data is the worst case data.
4. Sample Calculation.
   Margin = Limit – Result / Result = Reading + T.F+ DCF / T.F = AF + CL – AG
   Where, T.F = Total Factor, AF = Antenna Factor, CL = Cable Loss, AG = Amplifier Gain,
   DCF = Duty Cycle Correction Factor

**Lowest & X axis & Hor** **Detector Mode : QP**




Date: 19.MAR.2019 15:35:50

## 1 ~ 10GHz Data

▪ Lowest Channel

| Frequency (MHz) | ANT Pol | EUT Position (Axis) | Detector Mode | Reading (dBuV) | T.F (dB/m) | D.C.F. (dB) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|
| 1805.561 | V | Y | PK | 55.50 | -0.69 | N/A | 54.81 | 74.00 | 19.19 |
| 1805.506 | V | Y | AV | 48.56 | -0.69 | N/A | 47.87 | 54.00 | 6.13 |
| 2708.66 | V | Y | PK | 52.59 | 4.14 | N/A | 56.73 | 74.00 | 17.27 |
| 2708.064 | V | Y | AV | 41.55 | 4.14 | N/A | 45.69 | 54.00 | 8.31 |
| 3611.015 | V | X | PK | 55.29 | -1.60 | N/A | 53.69 | 74.00 | 20.31 |
| 3610.912 | V | X | AV | 49.26 | -1.60 | N/A | 47.66 | 54.00 | 6.34 |
| 4513.59 | V | Y | PK | 53.85 | 0.36 | N/A | 54.21 | 74.00 | 19.79 |
| 4513.801 | V | Y | AV | 47.94 | 0.36 | N/A | 48.30 | 54.00 | 5.70 |
| 5416.542 | V | Y | PK | 49.34 | 3.93 | N/A | 53.27 | 74.00 | 20.73 |
| 5416.417 | V | Y | AV | 39.33 | 3.93 | N/A | 43.26 | 54.00 | 10.74 |
| 6319.65 | V | Y | PK | 48.66 | 4.90 | N/A | 53.56 | 74.00 | 20.44 |
| 6319.526 | V | Y | AV | 37.55 | 4.90 | N/A | 42.45 | 54.00 | 11.55 |

▪ Middle Channel

| Frequency (MHz) | ANT Pol | EUT Position (Axis) | Detector Mode | Reading (dBuV) | T.F (dB/m) | D.C.F. (dB) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|
| 1829.290 | V | Y | PK | 55.03 | -0.25 | N/A | 54.78 | 74.00 | 19.22 |
| 1829.420 | V | Y | AV | 46.04 | -0.25 | N/A | 45.79 | 54.00 | 8.21 |
| 2744.504 | V | Y | PK | 53.04 | 4.20 | N/A | 57.24 | 74.00 | 16.76 |
| 2744.301 | V | Y | AV | 43.61 | 4.20 | N/A | 47.81 | 54.00 | 6.19 |
| 3659.165 | V | X | PK | 53.04 | -1.35 | N/A | 51.69 | 74.00 | 22.31 |
| 3659.055 | V | X | AV | 46.19 | -1.35 | N/A | 44.84 | 54.00 | 9.16 |
| 4573.704 | V | Y | PK | 53.87 | 0.54 | N/A | 54.41 | 74.00 | 19.59 |
| 4573.844 | V | Y | AV | 49.51 | 0.54 | N/A | 50.05 | 54.00 | 3.95 |
| 5487.983 | V | Y | PK | 50.05 | 3.97 | N/A | 54.02 | 74.00 | 19.98 |
| 5488.595 | V | Y | AV | 40.79 | 3.97 | N/A | 44.76 | 54.00 | 9.24 |
| 6403.599 | V | Y | PK | 49.98 | 4.96 | N/A | 54.94 | 74.00 | 19.06 |
| 6403.236 | V | Y | AV | 40.65 | 4.96 | N/A | 45.61 | 54.00 | 8.39 |

**Note.**

1. No other spurious and harmonic emissions were reported greater than listed emissions above table.
2. Above listed point data is the worst case data.
3. Sample Calculation.
   Margin = Limit – Result / Result = Reading + T.F+ DCF / T.F = AF + CL – AG
   Where, T.F = Total Factor, AF = Antenna Factor, CL = Cable Loss, AG = Amplifier Gain,
   DCF = Duty Cycle Correction Factor

▪ Highest Channel

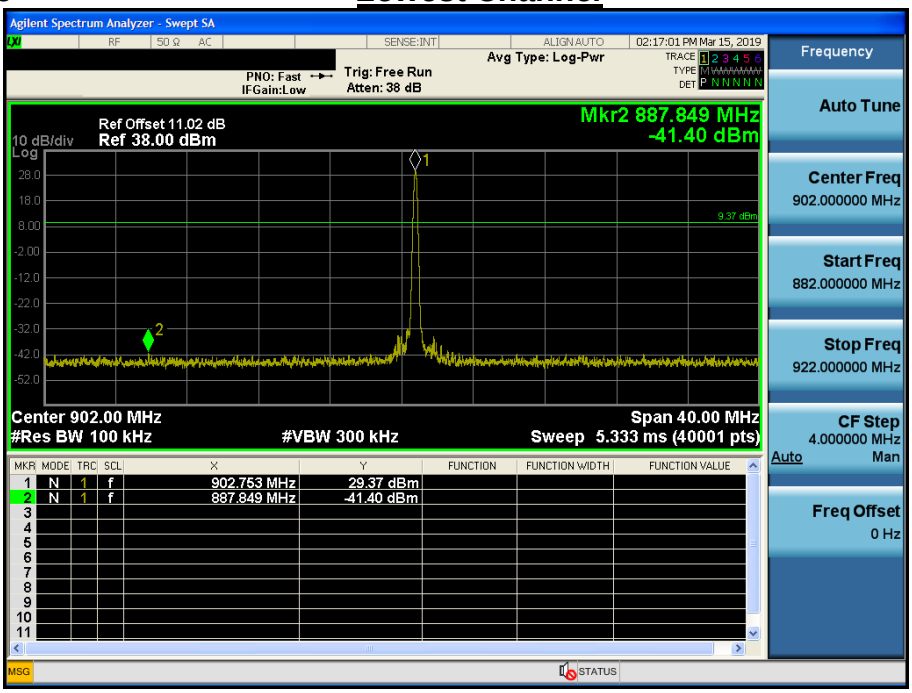
| Frequency (MHz) | ANT Pol | EUT Position (Axis) | Detector Mode | Reading (dBuV) | T.F (dB/m) | D.C.F. (dB) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|
| 1854.352 | V | Y | PK | 54.56 | 0.19 | N/A | 54.75 | 74.00 | 19.25 |
| 1854.573 | V | Y | AV | 46.51 | 0.19 | N/A | 46.70 | 54.00 | 7.30 |
| 2781.495 | V | Y | PK | 53.30 | 4.09 | N/A | 57.39 | 74.00 | 16.61 |
| 2781.638 | V | Y | AV | 46.37 | 4.09 | N/A | 50.46 | 54.00 | 3.54 |
| 3708.872 | V | X | PK | 52.96 | -0.90 | N/A | 52.06 | 74.00 | 21.94 |
| 3709.081 | V | X | AV | 44.05 | -0.90 | N/A | 43.15 | 54.00 | 10.85 |
| 4636.404 | V | Y | PK | 53.82 | 0.80 | N/A | 54.62 | 74.00 | 19.38 |
| 4636.258 | V | Y | AV | 47.64 | 0.80 | N/A | 48.44 | 54.00 | 5.56 |
| 5563.910 | V | Y | PK | 49.72 | 3.72 | N/A | 53.44 | 74.00 | 20.56 |
| 5563.469 | V | Y | AV | 41.12 | 3.72 | N/A | 44.84 | 54.00 | 9.16 |
| 6490.876 | V | Y | PK | 48.85 | 5.08 | N/A | 53.93 | 74.00 | 20.07 |
| 6490.828 | V | Y | AV | 38.98 | 5.08 | N/A | 44.06 | 54.00 | 9.94 |

**Note.**

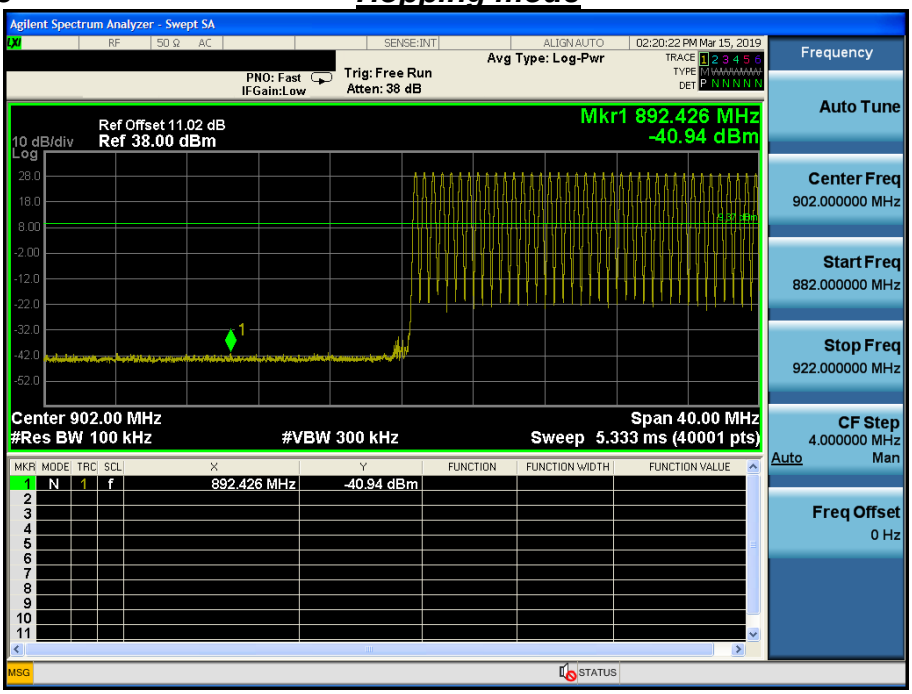
1. No other spurious and harmonic emissions were reported greater than listed emissions above table.
2. Above listed point data is the worst case data.
3. Sample Calculation.
   Margin = Limit – Result / Result = Reading + T.F+ DCF / T.F = AF + CL – AG
   Where, T.F = Total Factor, AF = Antenna Factor, CL = Cable Loss, AG = Amplifier Gain,
   DCF = Duty Cycle Correction Factor

## 7.4.2 Conducted Spurious Emissions

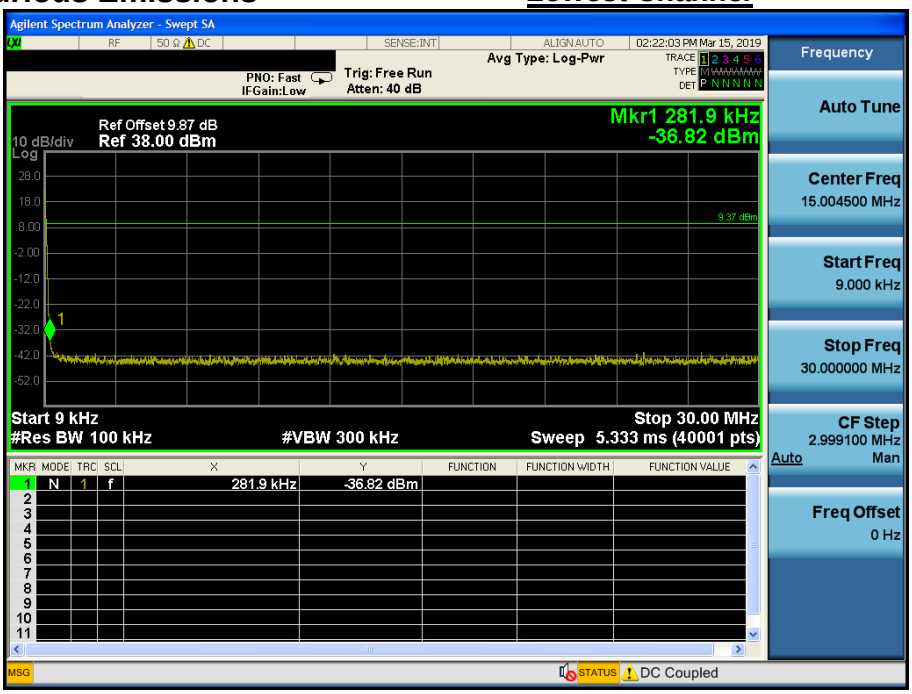
### Low Band-edge ***Lowest Channel***

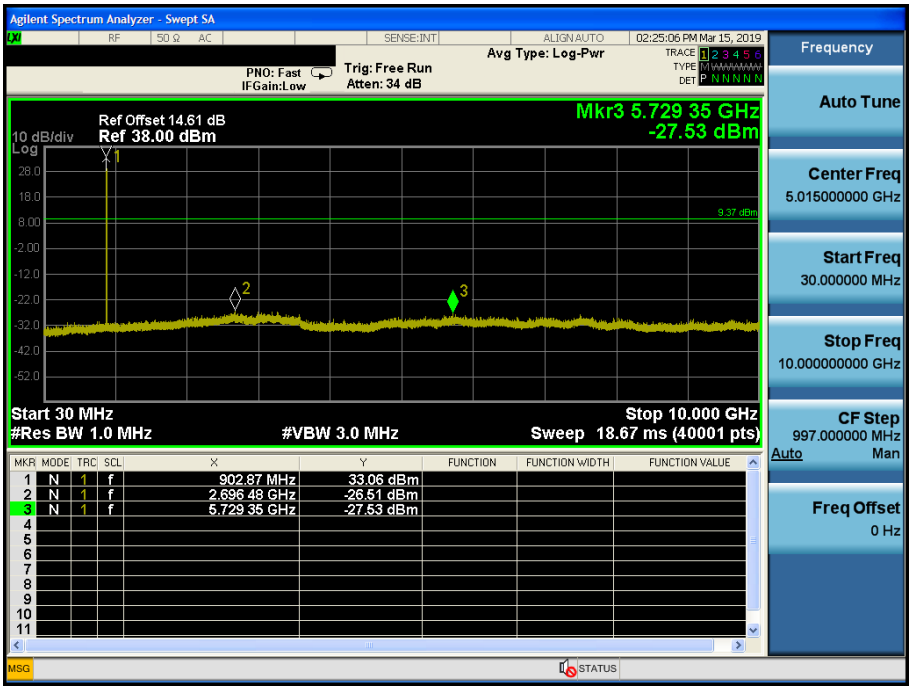



### Low Band-edge ***Hopping mode***



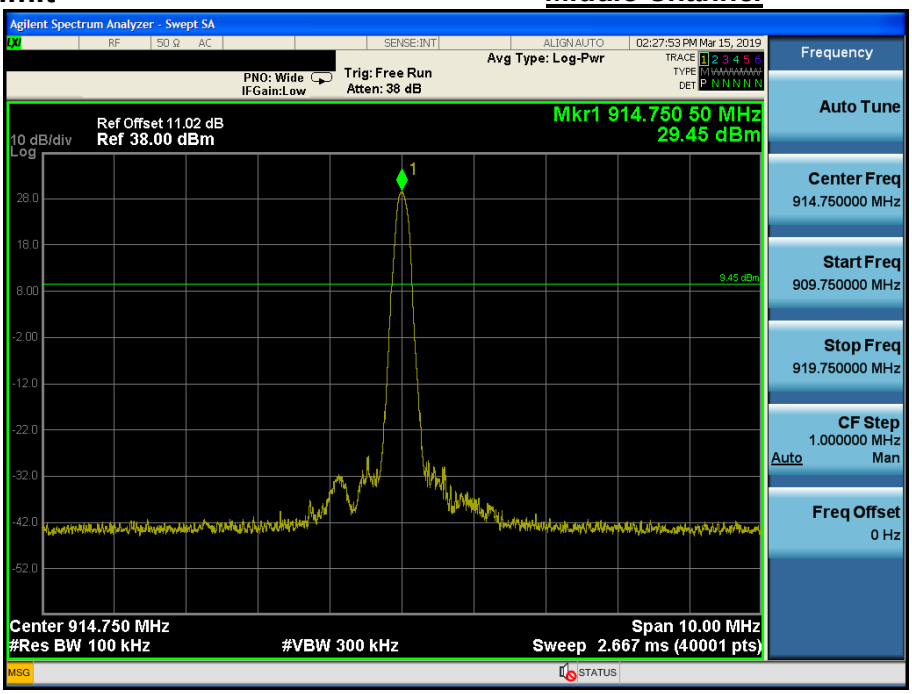
## Conducted Spurious Emissions ***Lowest Channel***



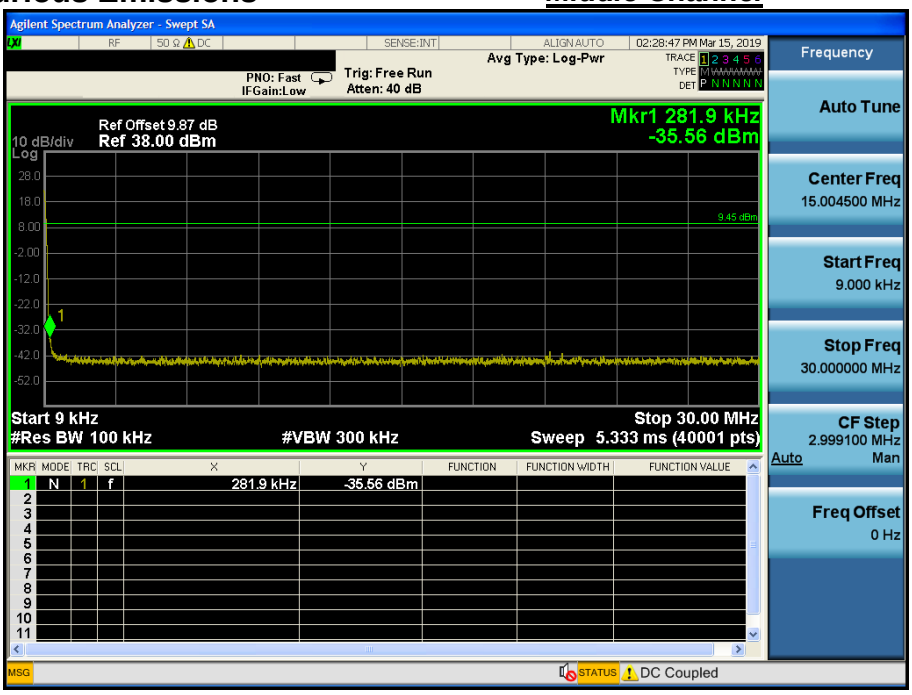



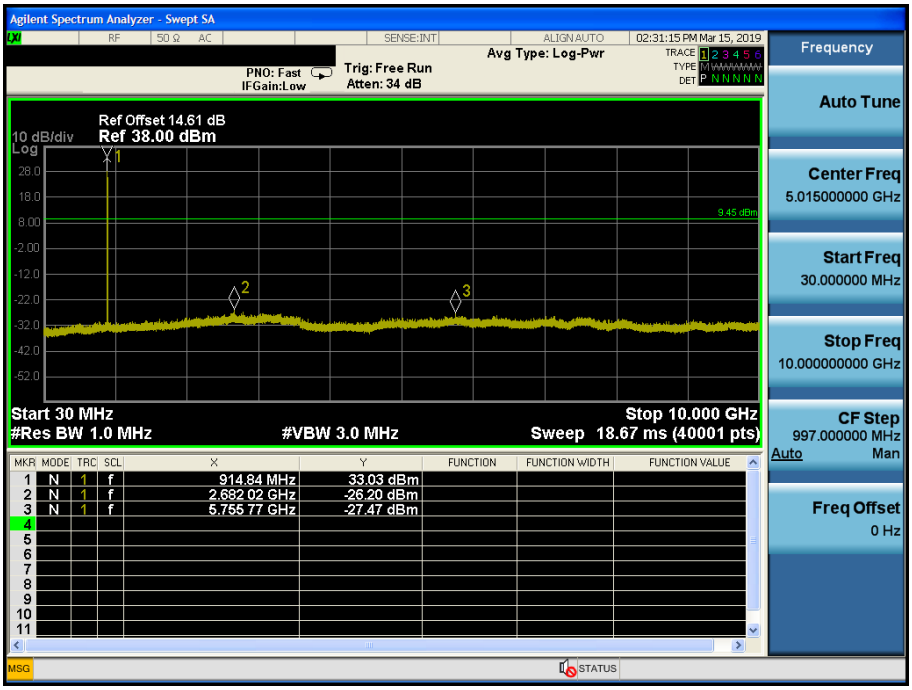
## Reference for limit

***Middle Channel***

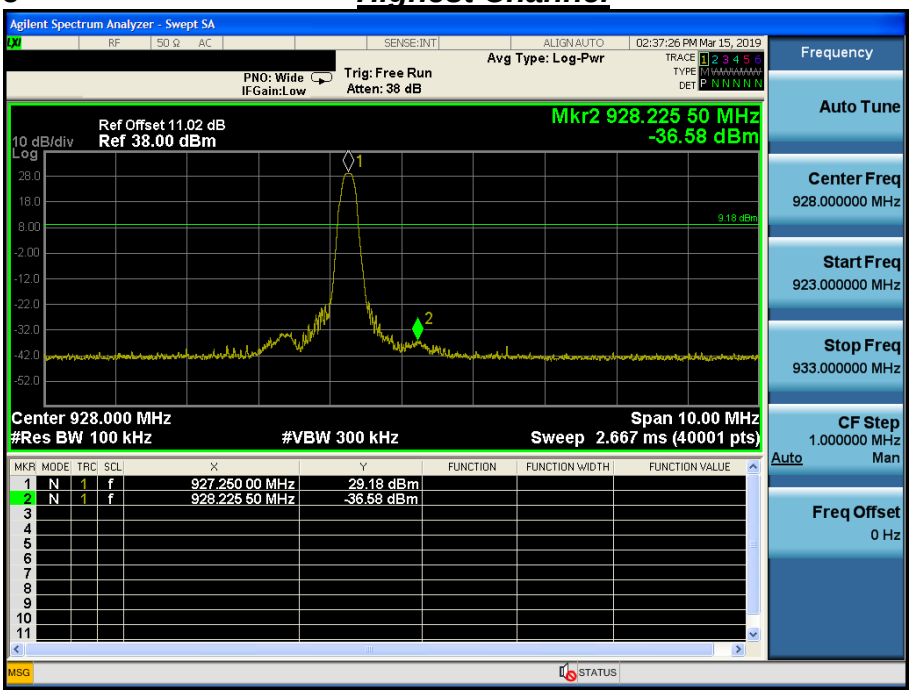


## Conducted Spurious Emissions ***Middle Channel***

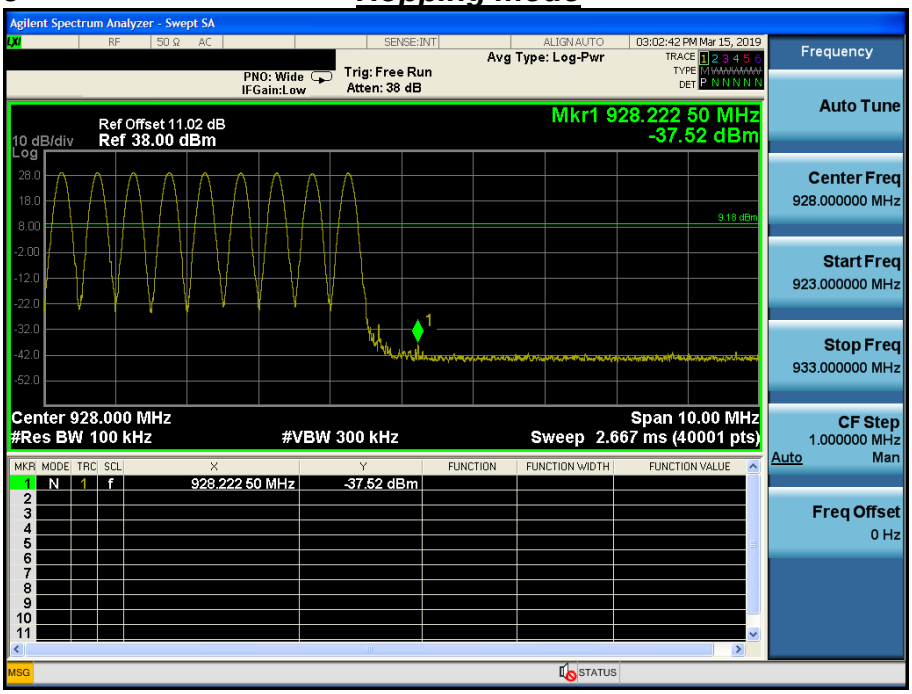


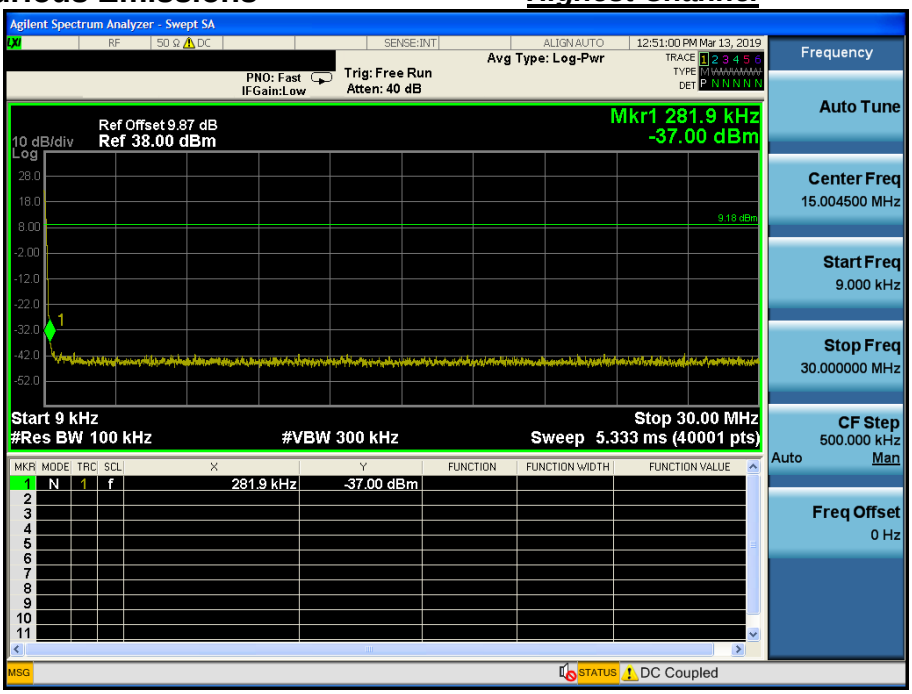
## High Band-edge ***Highest Channel***

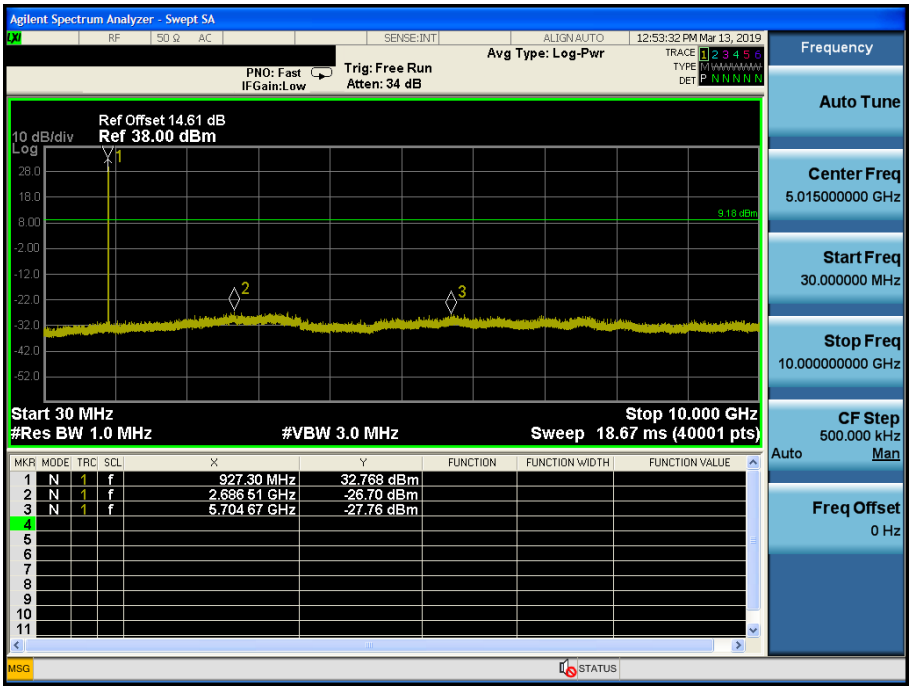



## High Band-edge ***Hopping mode***



## Conducted Spurious Emissions ***Highest Channel***



# 8. Transmitter AC Power Line Conducted Emission

## 8.1 Test Setup

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

## 8.2 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 uH/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

## 8.3 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 × 3.5 m × 3.5 m (L × W × H) shielded room. The EUT along with its peripherals were placed on a 1.0 m (W) × 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.

## 8.4. Test Results

### AC Line Conducted Emissions (Graph)

Results of Conducted Emission

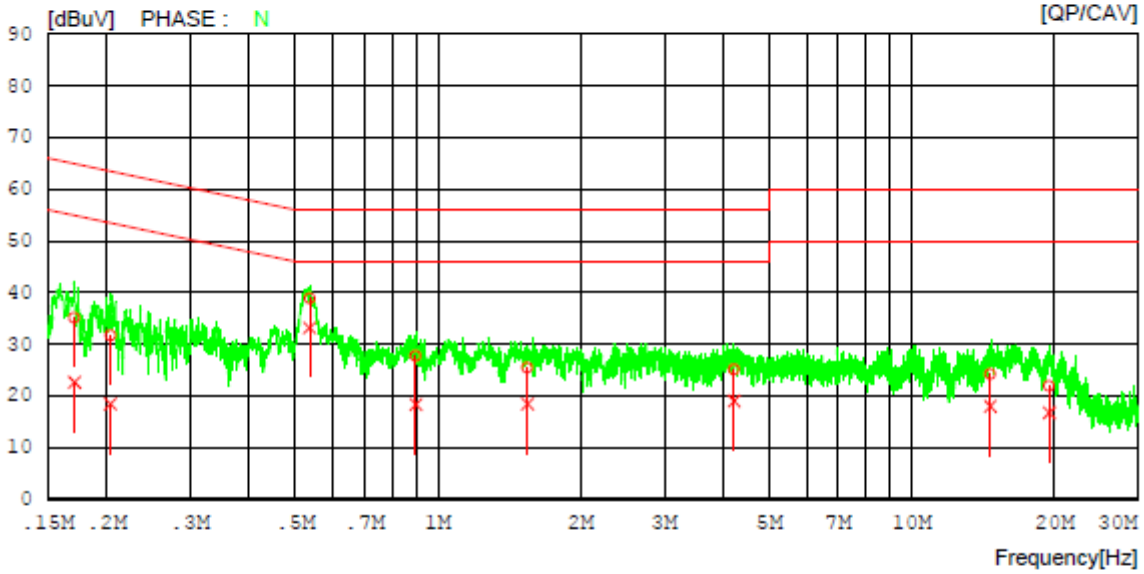
DTNC

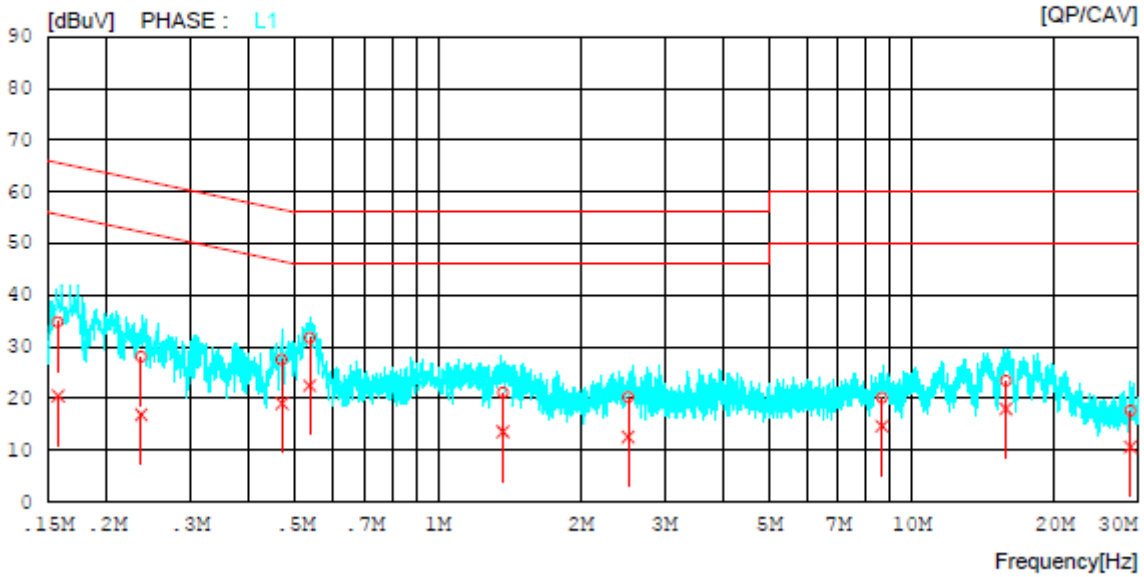
Date 2019-04-26

| | | | |
|---|---|---|---|
| Order No. | | Referrence No. | |
| Model No. | RFR900S | Power Supply | 120 V, 60 Hz |
| Serial No. | | Temp/Humi. | 23 'C / 35 % |
| Test Condition | 900MHz RFID | Operator | Sun Geun Lee |

Memo

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



## AC Line Conducted Emissions (List)

# Results of Conducted Emission

DTNC

Date 2019-04-26

| | | | |
|---|---|---|---|
| Order No. | | Referrence No. | |
| Model No. | RFR900S | Power Supply | 120 V, 60 Hz |
| Serial No. | | Temp/Humi. | 23 'C / 35 % |
| Test Condition | 900MHz RFID | Operator | Sun Geun Lee |

Memo

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

| NO | FREQ | READING QP | READING CAV | C.FACTOR | RESULT QP | RESULT CAV | LIMIT QP | LIMIT CAV | MARGIN QP | MARGIN CAV | PHASE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | [MHz] | [dBuV] | [dBuV] | [dB] | [dBuV] | [dBuV] | [dBuV] | [dBuV] | [dBuV] | [dBuV] | |
| 1 | 0.17064 | 25.23 | 12.74 | 9.94 | 35.17 | 22.68 | 64.93 | 54.93 | 29.76 | 32.25 | N |
| 2 | 0.20353 | 21.79 | 8.53 | 9.94 | 31.73 | 18.47 | 63.47 | 53.47 | 31.74 | 35.00 | N |
| 3 | 0.53590 | 28.87 | 23.23 | 9.95 | 38.82 | 33.18 | 56.00 | 46.00 | 17.18 | 12.82 | N |
| 4 | 0.89802 | 17.76 | 8.36 | 9.97 | 27.73 | 18.33 | 56.00 | 46.00 | 28.27 | 27.67 | N |
| 5 | 1.54380 | 15.46 | 8.43 | 10.01 | 25.47 | 18.44 | 56.00 | 46.00 | 30.53 | 27.56 | N |
| 6 | 4.21540 | 14.97 | 8.92 | 10.12 | 25.09 | 19.04 | 56.00 | 46.00 | 30.91 | 26.96 | N |
| 7 | 14.64580 | 13.74 | 7.54 | 10.48 | 24.22 | 18.02 | 60.00 | 50.00 | 35.78 | 31.98 | N |
| 8 | 19.51040 | 11.42 | 6.20 | 10.55 | 21.97 | 16.75 | 60.00 | 50.00 | 38.03 | 33.25 | N |
| 9 | 0.15750 | 24.78 | 10.52 | 9.94 | 34.72 | 20.46 | 65.59 | 55.59 | 30.87 | 35.13 | L1 |
| 10 | 0.23613 | 18.04 | 6.86 | 9.94 | 27.98 | 16.80 | 62.23 | 52.23 | 34.25 | 35.43 | L1 |
| 11 | 0.46783 | 17.53 | 8.99 | 9.95 | 27.48 | 18.94 | 56.55 | 46.55 | 29.07 | 27.61 | L1 |
| 12 | 0.53585 | 21.72 | 12.50 | 9.95 | 31.67 | 22.45 | 56.00 | 46.00 | 24.33 | 23.55 | L1 |
| 13 | 1.37040 | 11.07 | 3.54 | 9.99 | 21.06 | 13.53 | 56.00 | 46.00 | 34.94 | 32.47 | L1 |
| 14 | 2.51880 | 10.18 | 2.46 | 10.04 | 20.22 | 12.50 | 56.00 | 46.00 | 35.78 | 33.50 | L1 |
| 15 | 8.65600 | 9.74 | 4.32 | 10.29 | 20.03 | 14.61 | 60.00 | 50.00 | 39.97 | 35.39 | L1 |
| 16 | 15.80300 | 12.94 | 7.51 | 10.47 | 23.41 | 17.98 | 60.00 | 50.00 | 36.59 | 32.02 | L1 |
| 17 | 28.94460 | 6.85 | -0.15 | 10.70 | 17.55 | 10.55 | 60.00 | 50.00 | 42.45 | 39.45 | L1 |

# 9. Antenna Requirement

## 9.1 Procedure

Describe how the EUT complies with the requirement that either its antenna is permanently attached, or that it employs a unique antenna connector, for every antenna proposed for use with the EUT.

## 9.2 Conclusion

: **Comply**

**The antenna employs a unique antenna connector. (Refer to Internal Photo file.)**
**Therefore this EUT complies with the requirement of §15.203.**

**Minimum Standard:**

| |
|---|
| 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. 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. |

# 10. Occupied Bandwidth (99 %)

## 10.1 Test Setup

Refer to the APPENDIX I.

## 10.2 Limit

Limit : Not Applicable

## 10.3 Test Procedure

The 99 % power bandwidth was measured with a calibrated spectrum analyzer.

The resolution bandwidth (RBW) shall be in the range of 1 % to 5 % of the occupied bandwidth (OBW) and video bandwidth (VBW) shall be approximately 3 × RBW.

Spectrum analyzer plots are included on the following pages.

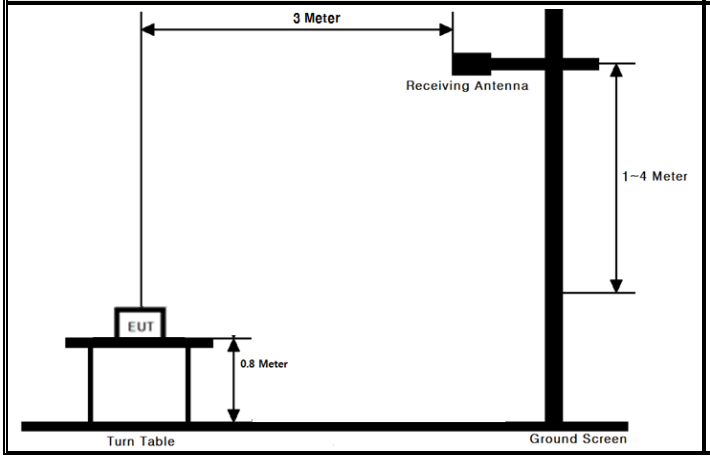
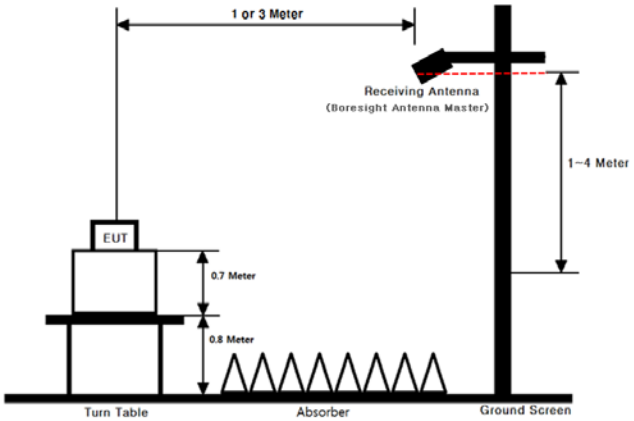
## 10.4 Test Results

**Not Applicable**

# APPENDIX I

## Test set up diagrams

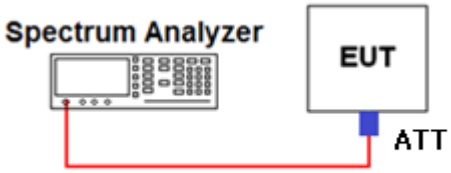
- **Radiated Measurement**

| Below 1GHz | Above 1GHz |
|---|---|
|  |  |





- **Conducted Measurement**





**Path loss information**

| Frequency (MHz) | Path Loss (dB) | Frequency (MHz) | Path Loss (dB) |
|---|---|---|---|
| 30 | 9.87 | 1000 | 11.04 |
| 500 | 10.56 | 5000 | 13.53 |
| 902.75 & 914.75 & 927.25 | 11.02 | 10000 | 14.61 |
| - | - | - | - |

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

**Highest & X & Ver** **Detector Mode : AV**