

## FCC 47 CFR PART 15 SUBPART C

### TEST REPORT

For

**ROCCAT® Skeltr – Smart Communication RGB Gaming Keyboard**

**Model: Skeltr**

**Trade Name: ROCCAT**

*Issued to*

**ROCCAT GmbH  
Otto von Bahrenpark Paul-Dessau-Str. 3G 22761 Hamburg Germany**

*Issued by*

**Compliance Certification Services Inc.**

**No.11, Wugong 6th Rd., Wugu Dist.,  
New Taipei City 24891, Taiwan. (R.O.C.)**

**<http://www.ccsrf.com>**

**[service@ccsrf.com](mailto:service@ccsrf.com)**

**Issued Date: April 21, 2016**



**Note:** This report shall not be reproduced except in full, without the written approval of Compliance Certification Services Inc. This document may be altered or revised by Compliance Certification Services Inc. personnel only, and shall be noted in the revision section of the document.

**Revision History**

| Rev. |  | Issue Date     |  | Revisions     | Effect Page | Revised By |
|------|--|----------------|--|---------------|-------------|------------|
| 00   |  | April 21, 2016 |  | Initial Issue | ALL         | Becca Chen |

## TABLE OF CONTENTS

|                                                         |           |
|---------------------------------------------------------|-----------|
| <b>1. TEST RESULT CERTIFICATION.....</b>                | <b>4</b>  |
| <b>2. EUT DESCRIPTION .....</b>                         | <b>5</b>  |
| <b>3. TEST METHODOLOGY .....</b>                        | <b>6</b>  |
| 3.1 EUT CONFIGURATION .....                             | 6         |
| 3.2 EUT EXERCISE .....                                  | 6         |
| 3.3 GENERAL TEST PROCEDURES .....                       | 6         |
| 3.4 FCC PART 15.205 RESTRICTED BANDS OF OPERATIONS..... | 7         |
| 3.5 DESCRIPTION OF TEST MODES .....                     | 8         |
| <b>4. INSTRUMENT CALIBRATION.....</b>                   | <b>9</b>  |
| 4.1 MEASURING INSTRUMENT CALIBRATION.....               | 9         |
| 4.2 MEASUREMENT EQUIPMENT USED.....                     | 9         |
| 4.3 MEASUREMENT UNCERTAINTY .....                       | 10        |
| <b>5. FACILITIES AND ACCREDITATIONS.....</b>            | <b>11</b> |
| 5.1 FACILITIES .....                                    | 11        |
| 5.2 EQUIPMENT .....                                     | 11        |
| 5.3 TABLE OF ACCREDITATIONS AND LISTINGS .....          | 12        |
| <b>6. SETUP OF EQUIPMENT UNDER TEST .....</b>           | <b>13</b> |
| 6.1 SETUP CONFIGURATION OF EUT.....                     | 13        |
| 6.2 SUPPORT EQUIPMENT .....                             | 13        |
| <b>7. FCC PART 15.247 REQUIREMENTS .....</b>            | <b>14</b> |
| 7.1 20 DB BANDWIDTH.....                                | 14        |
| 7.2 PEAK POWER .....                                    | 17        |
| 7.3 AVERAGE POWER .....                                 | 18        |
| 7.4 BAND EDGES MEASUREMENT .....                        | 19        |
| 7.5 FREQUENCY SEPARATION .....                          | 29        |
| 7.6 NUMBER OF HOPPING FREQUENCY .....                   | 33        |
| 7.7 TIME OF OCCUPANCY (DWELL TIME) .....                | 35        |
| 7.8 RADIATED EMISSIONS .....                            | 37        |
| 7.9 POWERLINE CONDUCTED EMISSIONS.....                  | 49        |
| <b>APPENDIX I PHOTOGRAPHS OF TEST SETUP .....</b>       | <b>52</b> |

## 1. TEST RESULT CERTIFICATION

**Applicant:** ROCCAT GmbH  
Otto von Bahrenpark Paul-Dessau-Str. 3G 22761 Hamburg  
Germany

**Manufacturer:** ROCCAT GmbH  
Otto von Bahrenpark Paul-Dessau-Str. 3G 22761 Hamburg  
Germany

**Equipment Under Test:** ROCCAT® Skeltr – Smart Communication RGB Gaming  
Keyboard

**Model Number:** Skeltr

**Trade Name:** ROCCAT

**Date of Test:** April 15 ~ 18, 2016

| APPLICABLE STANDARDS         |                         |
|------------------------------|-------------------------|
| STANDARD                     | TEST RESULT             |
| FCC 47 CFR Part 15 Subpart C | No non-compliance noted |

### We hereby certify that:

The above equipment was tested by Compliance Certification Services Inc. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.10: 2013 and the energy emitted by the sample EUT tested as described in this report is in compliance with the requirements set forth in the above standards. The test results of this report relate only to the tested sample EUT identified in this report.

*Approved by:*

*Tested by:*



---

Miller Lee  
Manager  
Compliance Certification Services Inc.

---

Jason Lu  
Engineer  
Compliance Certification Services Inc.

## 2. EUT DESCRIPTION

|                              |                                                          |
|------------------------------|----------------------------------------------------------|
| <b>Product</b>               | ROCCAT® Skeltr – Smart Communication RGB Gaming Keyboard |
| <b>Model Number</b>          | Skeltr                                                   |
| <b>Model Discrepancy</b>     | N/A                                                      |
| <b>Trade Name</b>            | ROCCAT                                                   |
| <b>Received Date</b>         | March 23, 2016                                           |
| <b>Power Supply</b>          | Powered from host device via USB                         |
| <b>Frequency Range</b>       | 2402 ~ 2480 MHz                                          |
| <b>Transmit Power</b>        | -0.67dBm                                                 |
| <b>Modulation Technique</b>  | GFSK for 1Mbps                                           |
| <b>Number of Channels</b>    | 79 Channels                                              |
| <b>Antenna Specification</b> | Integrated Antenna                                       |
| <b>Antenna Designation</b>   | Gain: 1.87dBi                                            |

**Remark:**

1. The sample selected for test was engineering sample that approximated to production product and was provided by manufacturer.
2. This submittal(s) (test report) is intended for FCC: **X8DSKELTR** filing to comply with FCC Part 15C, Section 15.203, 15.207, 15.209.

### **3. TEST METHODOLOGY**

The tests documented in this report were performed in accordance with ANSI C63.10: 2013 and FCC CFR 47 2.1046, 2.1047, 2.1049, 2.1051, 2.1053, 2.1055, 2.1057, 15.207, 15.209, 15.247, DA00-705 and KDB 558074 D01 DTS Meas Guidance v03r04.

The tests documented in this report were performed in accordance with ANSI C63.10:2013.

#### **3.1 EUT CONFIGURATION**

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner that intends to maximize its emission characteristics in a continuous normal application.

#### **3.2 EUT EXERCISE**

The EUT was operated in the engineering mode to fix the TX frequency that was for the purpose of the measurements.

According to its specifications, the EUT must comply with the requirements of the Section 15.207, 15.209 and 15.247 under the FCC Rules Part 15 Subpart C.

The tests documented in this report were performed in accordance with ANSI C63.10: 2013.

#### **3.3 GENERAL TEST PROCEDURES**

##### **Conducted Emissions**

According to the requirements in ANSI C63.10: 2013 Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using CISPR Quasi-peak and average detector modes.

##### **Radiated Emissions**

The EUT is placed on a turn table, which is 1.5 m above ground plane. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna, which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the maximum emissions, exploratory radiated emission measurements were made according to the requirements in ANSI C63.10: 2013.

### 3.4 FCC PART 15.205 RESTRICTED BANDS OF OPERATIONS

- (a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

| MHz                        | MHz                 | MHz             | GHz              |
|----------------------------|---------------------|-----------------|------------------|
| 0.090 - 0.110              | 16.42 - 16.423      | 399.9 - 410     | 4.5 - 5.15       |
| <sup>1</sup> 0.495 - 0.505 | 16.69475 - 16.69525 | 608 - 614       | 5.35 - 5.46      |
| 2.1735 - 2.1905            | 16.80425 - 16.80475 | 960 - 1240      | 7.25 - 7.75      |
| 4.125 - 4.128              | 25.5 - 25.67        | 1300 - 1427     | 8.025 - 8.5      |
| 4.17725 - 4.17775          | 37.5 - 38.25        | 1435 - 1626.5   | 9.0 - 9.2        |
| 4.20725 - 4.20775          | 73 - 74.6           | 1645.5 - 1646.5 | 9.3 - 9.5        |
| 6.215 - 6.218              | 74.8 - 75.2         | 1660 - 1710     | 10.6 - 12.7      |
| 6.26775 - 6.26825          | 108 - 121.94        | 1718.8 - 1722.2 | 13.25 - 13.4     |
| 6.31175 - 6.31225          | 123 - 138           | 2200 - 2300     | 14.47 - 14.5     |
| 8.291 - 8.294              | 149.9 - 150.05      | 2310 - 2390     | 15.35 - 16.2     |
| 8.362 - 8.366              | 156.52475 -         | 2483.5 - 2500   | 17.7 - 21.4      |
| 8.37625 - 8.38675          | 156.52525           | 2655 - 2900     | 22.01 - 23.12    |
| 8.41425 - 8.41475          | 156.7 - 156.9       | 3260 - 3267     | 23.6 - 24.0      |
| 12.29 - 12.293             | 162.0125 - 167.17   | 3332 - 3339     | 31.2 - 31.8      |
| 12.51975 - 12.52025        | 167.72 - 173.2      | 3345.8 - 3358   | 36.43 - 36.5     |
| 12.57675 - 12.57725        | 240 - 285           | 3600 - 4400     | ( <sup>2</sup> ) |
| 13.36 - 13.41              | 322 - 335.4         |                 |                  |

<sup>1</sup> Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.

<sup>2</sup> Above 38.6

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

### 3.5 DESCRIPTION OF TEST MODES

The EUT (model: Skeltr) had been tested under operating and standby condition.

Software used to control the EUT for staying in continuous transmitting and receiving mode was programmed.

After verification, all tests carried out are with the worst-case test modes as shown below except radiated spurious emission below 1GHz and power line conducted emissions below 30MHz, which worst case was in normal link mode

Bluetooth packets like the follow table,

| Modulation | Data Rate | Time slots | Packet Type |
|------------|-----------|------------|-------------|
| GFSK       | 1         | 1          | DH 1        |
|            |           | 3          | DH 3        |
|            |           | 5          | DH 5        |

For test mode DH1, DH3 and DH5 were pretest. Operate DH5 at maximum dwell time and maximum duty cycle was worst than DH1 and DH3, Therefore,. worst case was DH5 in this test report.

Channel Low (2402MHz), Mid (2441MHz) and High (2480MHz) with 1Mbps data rate was chosen for full testing

The field strength of spurious emission was measured in the following position: EUT stand-up position (Z axis), lie-down position (X, Y axis). The worst emission was found in lie-down position (X axis) and the worst case was recorded.

## 4. INSTRUMENT CALIBRATION

### 4.1 MEASURING INSTRUMENT CALIBRATION

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipment, which is traceable to recognized national standards.

### 4.2 MEASUREMENT EQUIPMENT USED

#### Equipment Used for Emissions Measurement

**Remark:**

1. Each piece of equipment is scheduled for calibration once a year and Precision Dipole is scheduled for calibration once three years.
2. N.C.R. = No Calibration Request.

| Conducted Emissions Test Site        |              |           |               |                  |                 |
|--------------------------------------|--------------|-----------|---------------|------------------|-----------------|
| Name of Equipment                    | Manufacturer | Model     | Serial Number | Calibration Date | Calibration Due |
| DC Power Supplies                    | GW Instek    | SPS-3610  | GPE880163     | 01/19/2016       | 01/18/2017      |
| Power Meter                          | Anritsu      | ML2495A   | 1012009       | 07/08/2015       | 07/07/2016      |
| Power Sensor                         | Anritsu      | MA2411B   | 917072        | 07/08/2015       | 07/07/2016      |
| Signal Analyzer                      | R&S          | FSV 40    | 101073        | 07/20/2015       | 07/19/2016      |
| Spectrum Analyzer                    | Agilent      | E4446A    | US42510268    | 02/15/2016       | 02/14/2017      |
| Thermostatic/Hrgross<br>atic Chamber | TAICHY       | MHG-150LF | 930619        | 10/08/2015       | 10/07/2016      |
| Vector Signal<br>Generator           | R&S          | SMU 200A  | 102239        | 03/10/2016       | 03/09/2017      |
| AC Power Source                      | EXTECH       | 6205      | 1140845       | N.C.R            | N.C.R           |
| Software                             | N/A          |           |               |                  |                 |

| Wugu 966 Chamber A |                    |                         |               |                  |                 |
|--------------------|--------------------|-------------------------|---------------|------------------|-----------------|
| Name of Equipment  | Manufacturer       | Model                   | Serial Number | Calibration Date | Calibration Due |
| Bilog Antenna      | Sunol Sciences     | JB3                     | A030105       | 08/06/2015       | 08/05/2016      |
| EMI Test Receiver  | R&S                | ESCI                    | 100064        | 06/04/2015       | 06/03/2016      |
| Horn Antenna       | EMCO               | 3117                    | 55165         | 02/24/2016       | 02/23/2017      |
| Horn Antenna       | EMCO               | 3116                    | 26370         | 01/15/2016       | 01/14/2017      |
| K Type Cable       | Huber+Suhner       | SUCOFLEX 102            | 29406/2       | 01/12/2016       | 01/11/2017      |
| K Type Cable       | Huber+Suhner       | SUCOFLEX 102            | 22470/2       | 01/12/2016       | 01/11/2017      |
| Pre-Amplifier      | MITEQ              | AMF-6F-260400<br>-40-8P | 985646        | 01/14/2016       | 01/13/2017      |
| Pre-Amplifier      | EMCI               | EMC 012635              | 980151        | 06/05/2015       | 06/04/2016      |
| Pre-Amplifier      | EMCI               | EM330                   |               | 06/05/2015       | 06/04/2016      |
| Spectrum Analyzer  | Agilent            | E4446A                  | US42510252    | 12/08/2015       | 12/07/2016      |
| Antenna Tower      | CCS                | CC-A-1F                 | N/A           | N.C.R            | N.C.R           |
| Controller         | CCS                | CC-C-1F                 | N/A           | N.C.R            | N.C.R           |
| Turn Table         | CCS                | CC-T-1F                 | N/A           | N.C.R            | N.C.R           |
| Software           | EZ-EMC (CCS-3A1RE) |                         |               |                  |                 |

| Conducted Emission Room #B  |              |           |               |                  |                 |
|-----------------------------|--------------|-----------|---------------|------------------|-----------------|
| Name of Equipment           | Manufacturer | Model     | Serial Number | Calibration Date | Calibration Due |
| Capacitive Voltage<br>Probe | FCC          | F-CVP-1   | 100185        | 03/09/2016       | 03/08/2017      |
| EMI Test Receiver           | R&S          | ESCI      | 101073        | 09/09/2015       | 09/08/2016      |
| LISN                        | SCHWARZBECK  | NSLK 8127 | 8127-541      | 11/23/2015       | 11/22/2016      |
| LISN                        | R&S          | ENV216    | 101054        | 05/07/2015       | 05/06/2016      |
| Software                    | CCS-3A1-CE   |           |               |                  |                 |

### 4.3 MEASUREMENT UNCERTAINTY

| PARAMETER                             | UNCERTAINTY |
|---------------------------------------|-------------|
| Powerline Conducted Emission          | +/- 1.2575  |
| 3M Semi Anechoic Chamber / 30M~200M   | +/- 4.0138  |
| 3M Semi Anechoic Chamber / 200M~1000M | +/- 3.9483  |
| 3M Semi Anechoic Chamber / 1G~8G      | +/- 2.5975  |
| 3M Semi Anechoic Chamber / 8G~18G     | +/- 2.6112  |
| 3M Semi Anechoic Chamber / 18G~26G    | +/- 2.7389  |
| 3M Semi Anechoic Chamber / 26G~40G    | +/- 2.9683  |

**Remark:** This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of  $k=2$ .

## 5. FACILITIES AND ACCREDITATIONS

### 5.1 FACILITIES

All measurement facilities used to collect the measurement data are located at

- ☐ No.199, Chunghsen Road, Hsintien City, Taipei Hsien, Taiwan, R.O.C.  
Tel: 886-2-2217-0894 / Fax: 886-2-2217-1029
- ☒ No.11, Wugong 6th Rd., Wugu Dist., New Taipei City 24891, Taiwan. (R.O.C.)  
Tel: 886-2-2299-9720 / Fax: 886-2-2298-4045
- ☐ No.81-1, Lane 210, Bade 2nd Rd., Lujhu Township, Taoyuan County 33841, TAIWAN, R.O.C.  
Tel: 886-3-324-0332 / Fax: 886-3-324-5235

The sites are constructed in conformance with the requirements of ANSI C63.7, ANSI C63.10: 2013 and CISPR Publication 22.

### 5.2 EQUIPMENT

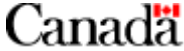
Radiated emissions are measured with one or more of the following types of linearly polarized antennas: tuned dipole, biconical, log periodic, bi-log, ridged waveguide, horn and/or Loop. Spectrum analyzers with pre-selectors and quasi-peak detectors are used to perform radiated measurements.

Conducted emissions are measured with Line Impedance Stabilization Networks and EMI Test Receivers.

Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements.

All receiving equipment conforms to CISPR Publication 16-1, "Radio Interference Measuring Apparatus and Measurement Methods."

### 5.3 TABLE OF ACCREDITATIONS AND LISTINGS

| Country | Agency          | Scope of Accreditation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Logo                                                                                                              |
|---------|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|
| USA     | FCC             | 3M Semi Anechoic Chamber (FCC MRA: TW1039) to perform FCC Part 15 measurements                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <br>FCC MRA: TW1039            |
| Taiwan  | TAF             | LP0002, RTTE01, FCC Method-47 CFR Part 15 Subpart C, D, E, RSS-247, RSS-310<br>IDA TS SRD, AS/NZS 4268, AS/NZS 4771, TS 12.1 & 12.2, ETSI EN 300 440-1, ETSI EN 300 440-2, ETSI EN 300 328, ETSI EN 300 220-1, ETSI EN 300 220-2, ETSI EN 301 893, ETSI EN 301 489-1/3/7/17<br>FCC OET Bulletin 65 + Supplement C, EN 50360, EN 50361, EN 50371, RSS 102, EN 50383, EN 50385, EN 50392, IEC 62209, CNS 14958-1, CNS 14959<br>FCC Method -47 CFR Part 15 Subpart B<br>IEC / EN 61000-3-2, IEC / EN 61000-3-3, IEC / EN 61000-4-2/3/4/5/6/8/11 | <br>Testing Laboratory<br>1309 |
| Canada  | Industry Canada | 3M Semi Anechoic Chamber (IC 2324G-1 / IC 2324G-2) to perform                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <br>IC 2324G-1<br>IC 2324G-2   |

\* No part of this report may be used to claim or imply product endorsement by A2LA or any agency of the US Government.

## 6. SETUP OF EQUIPMENT UNDER TEST

### 6.1 SETUP CONFIGURATION OF EUT

See test photographs attached in Appendix I for the actual connections between EUT and support equipment.

### 6.2 SUPPORT EQUIPMENT

| No. | Device Type                     | Brand | Model | Series No.                 | FCC ID       | Data Cable | Power Cord                                                                |
|-----|---------------------------------|-------|-------|----------------------------|--------------|------------|---------------------------------------------------------------------------|
| 1   | Notebook PC<br>(For Radiated)   | DELL  | PP19L | GK102 A00                  | QDS-BRCM1021 | N/A        | AC I/P:<br>Unshielded, 1.8m<br>DC O/P:<br>Unshielded, 1.8m<br>with a core |
| 2   | Notebook PC<br>(For Conduction) | Acer  | Z01   | LXAKJ0Y0538<br>2307ADC2513 | DOC          | N/A        | AC I/P:<br>Unshielded, 1.8m<br>DC O/P:<br>Unshielded, 1.8m<br>with a core |

**Remark:**

1. All the equipment/cables were placed in the worst-case configuration to maximize the emission during the test.
2. Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.

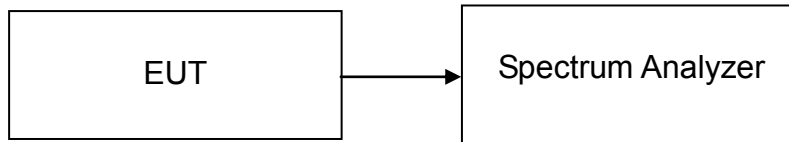
## 7. FCC PART 15.247 REQUIREMENTS

### 7.1 20 dB Bandwidth

#### LIMIT

None; for reporting purposes only.

#### Test Configuration



#### TEST PROCEDURE

1. Place the EUT on the table and set it in the transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set the spectrum analyzer as RBW=30 kHz, VBW = 100 kHz, Sweep = 3.2 ms.
4. Mark the peak frequency and 20dB (upper and lower) frequency.
5. Repeat until all the rest channels are investigated.

#### TEST RESULTS

*No non-compliance noted.*

#### Test Data

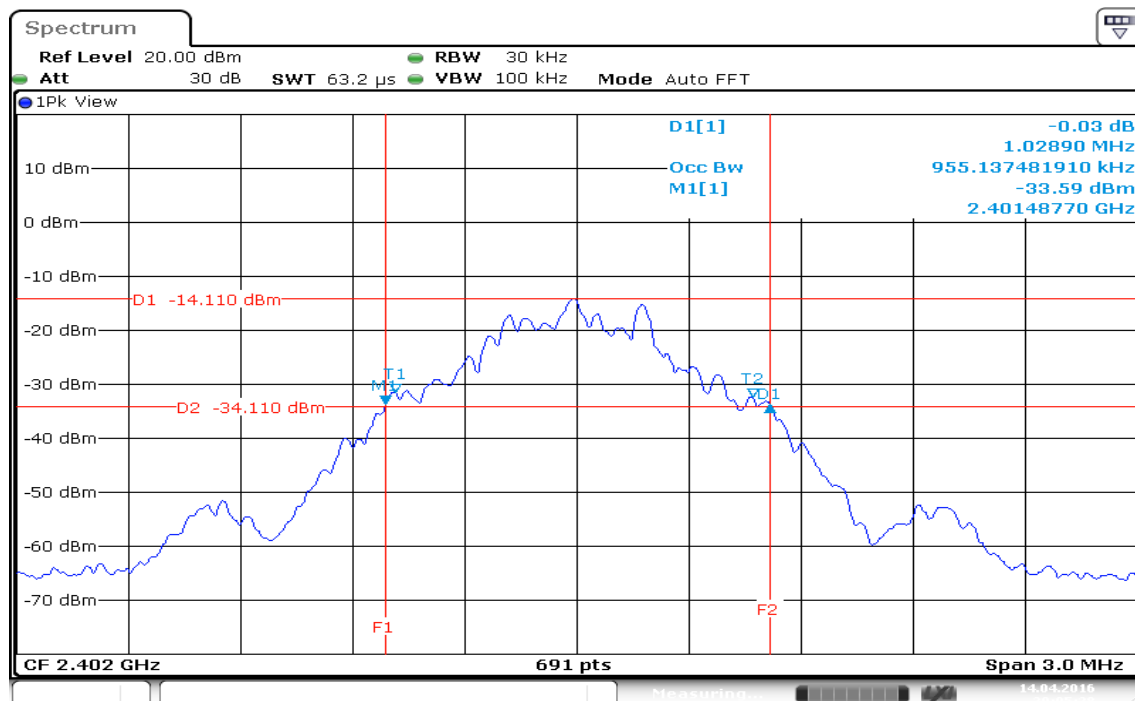
**For GFSK / DH5**

| Channel | Frequency (MHz) | 20dB Bandwidth (MHz) |
|---------|-----------------|----------------------|
| Low     | 2402            | 1.0289               |
| Mid     | 2441            | 1.0289               |
| High    | 2480            | 1.0333               |

## Test Plot

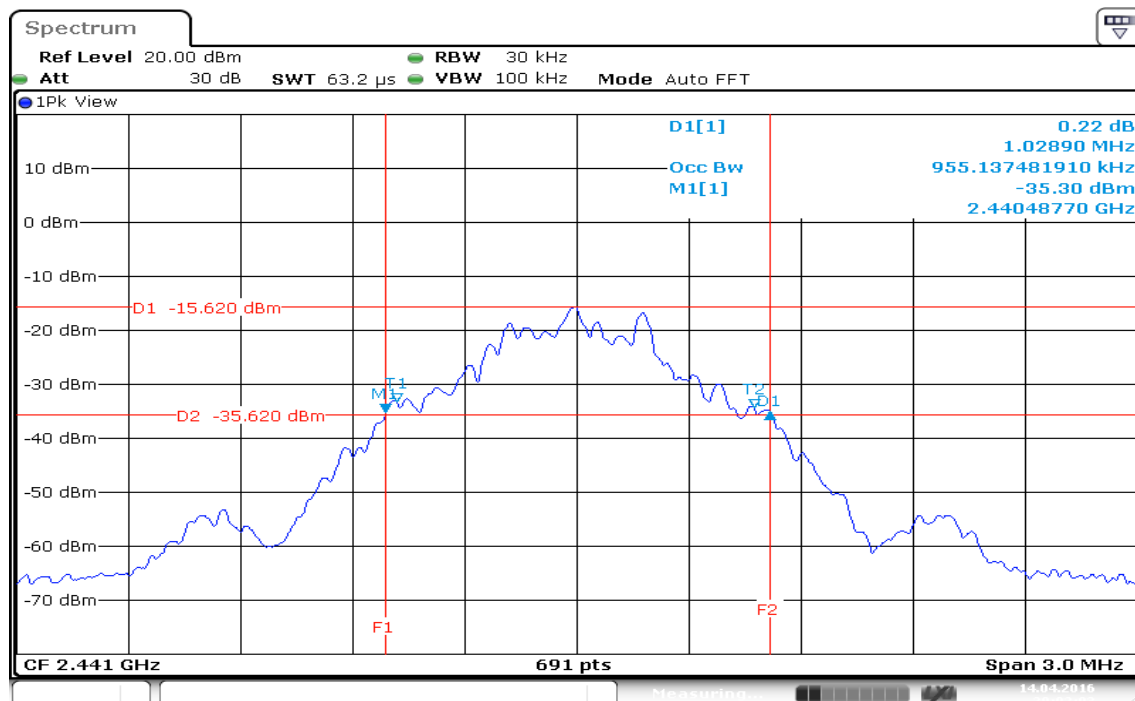
For GFSK / DH5

20dB Bandwidth (CH Low)



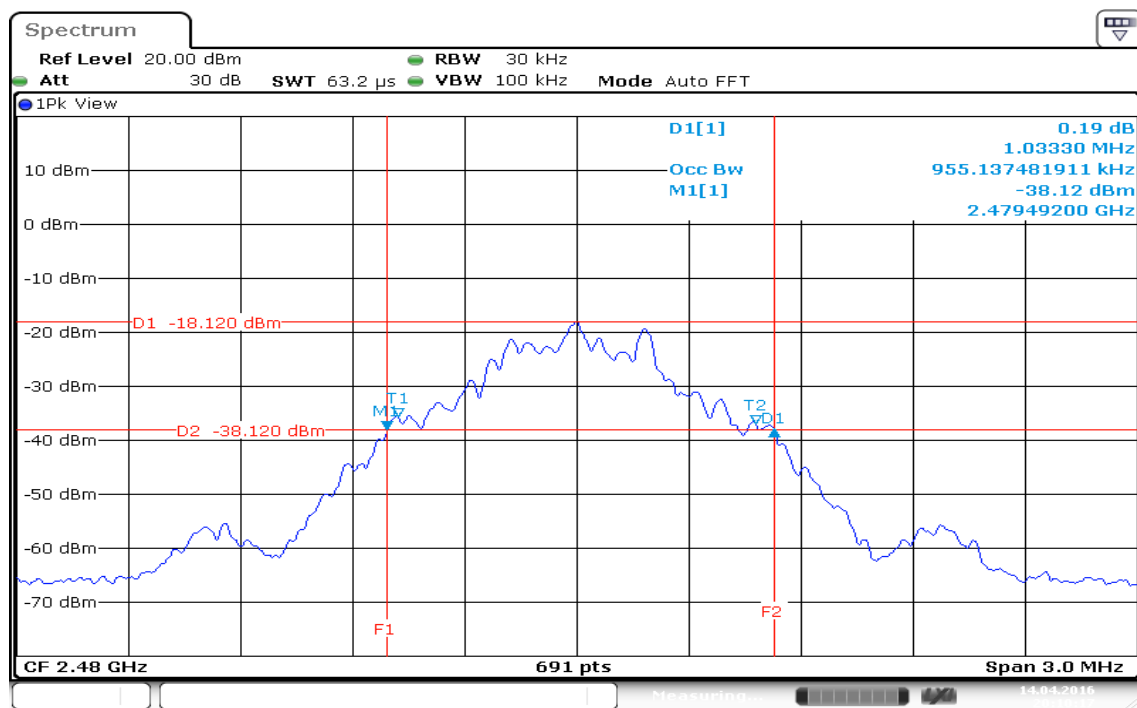
Date: 14.APR.2016 20:05:28

20dB Bandwidth (CH Mid)



Date: 14.APR.2016 20:02:03

## 20dB Bandwidth (CH High)



Date: 14.APR.2016 20:10:17

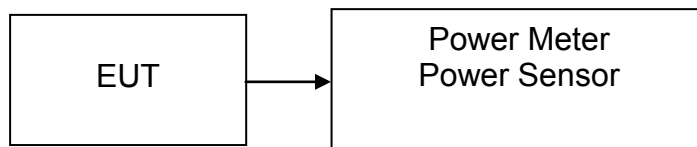
## 7.2 PEAK POWER

### LIMIT

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

1. According to §15.247(a)(1) & RSS-247, Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.
2. According to §15.247(b)(3) & RSS 247, for systems using digital modulation in the bands of 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz: 1 Watt.

### Test Configuration



### TEST PROCEDURE

The transmitter output is connected to the Power Meter. The Power Meter is set to the peak power detection.

### TEST RESULTS

*No non-compliance noted.*

#### Test Data

**For GFSK / DH5**

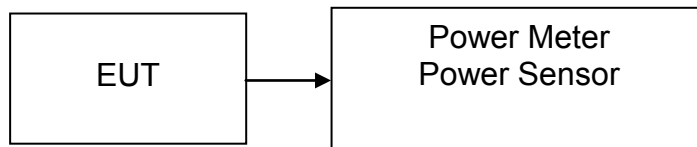
| Channel | Frequency (MHz) | Output Power (dBm) | Output Power (W) | Limit (W) | Result |
|---------|-----------------|--------------------|------------------|-----------|--------|
| Low     | 2402            | -1.08              | 0.0008           | 0.125     | PASS   |
| Mid     | 2441            | -0.85              | 0.0008           |           | PASS   |
| High    | 2480            | <b>*-0.67</b>      | 0.0009           |           | PASS   |

## 7.3 AVERAGE POWER

### LIMIT

None; for reporting purposes only.

### Test Configuration



### TEST PROCEDURE

The transmitter output is connected to the Power Meter. The Power Meter is set to the average power detection.

### TEST RESULTS

*No non-compliance noted.*

#### Test Data

**For GFSK / DH5**

| Channel | Frequency (MHz) | Output Power (dBm) | Output Power (W) |
|---------|-----------------|--------------------|------------------|
| Low     | 2402            | -1.23              | 0.0008           |
| Mid     | 2441            | -0.88              | 0.0008           |
| High    | 2480            | <b>*-0.72</b>      | 0.0008           |

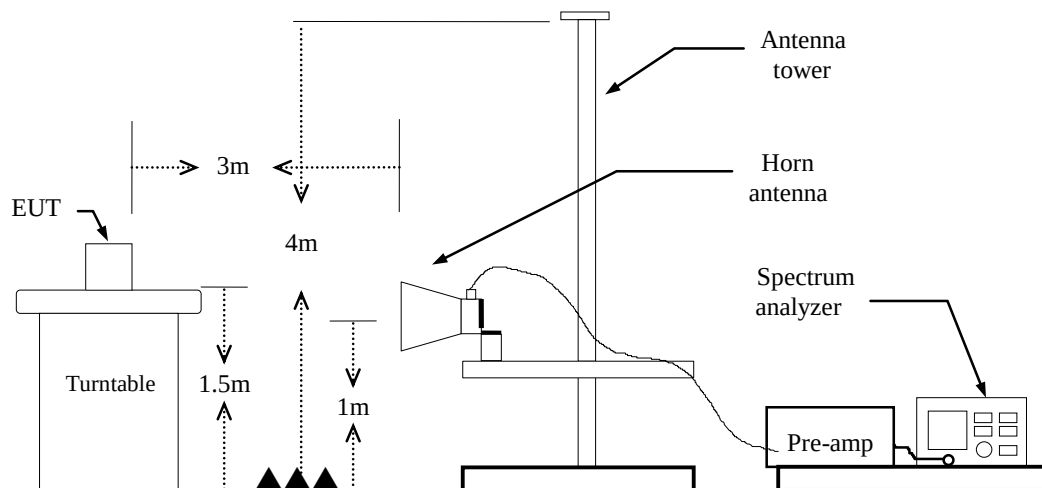
## 7.4 BAND EDGES MEASUREMENT

### LIMIT

According to §15.247(d) & RSS-247, in any 100 kHz bandwidth outside the frequency bands in which the spread spectrum 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. 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 Section 15.205(c)).

### Test Configuration

#### For Radiated



## **TEST PROCEDURE**

### **For Radiated**

1. The EUT is placed on a turntable, which is 1.5m above the ground plane.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emission.
4. Set the spectrum analyzer in the following setting in order to capture the lower and upper band-edges of the emission:
  - (a) PEAK: RBW=1MHz / VBW=3MHz / Sweep=AUTO
  - (b) AVERAGE: RBW=1MHz,  
if duty cycle  $\geq 98\%$ , VBW=10Hz.  
if duty cycle  $< 98\%$  VBW=1/T.  
**BT:** = 79%, VBW= 360Hz
5. Repeat the procedures until all the PEAK and AVERAGE versus POLARIZATION are measured.
6. Result = Spectrum Reading + cable loss(spectrum to Amp) - Amp Gain + Cable loss(Amp to receive Ant)+ Receive Ant

### **For Un-restricted Band Emissions**

The peak output power procedure is used to measure the fundamental emission power to demonstrate compliance to requirements, then the peak conducted output power measured within any 100 kHz outside the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum measured in-band peak PSD level.

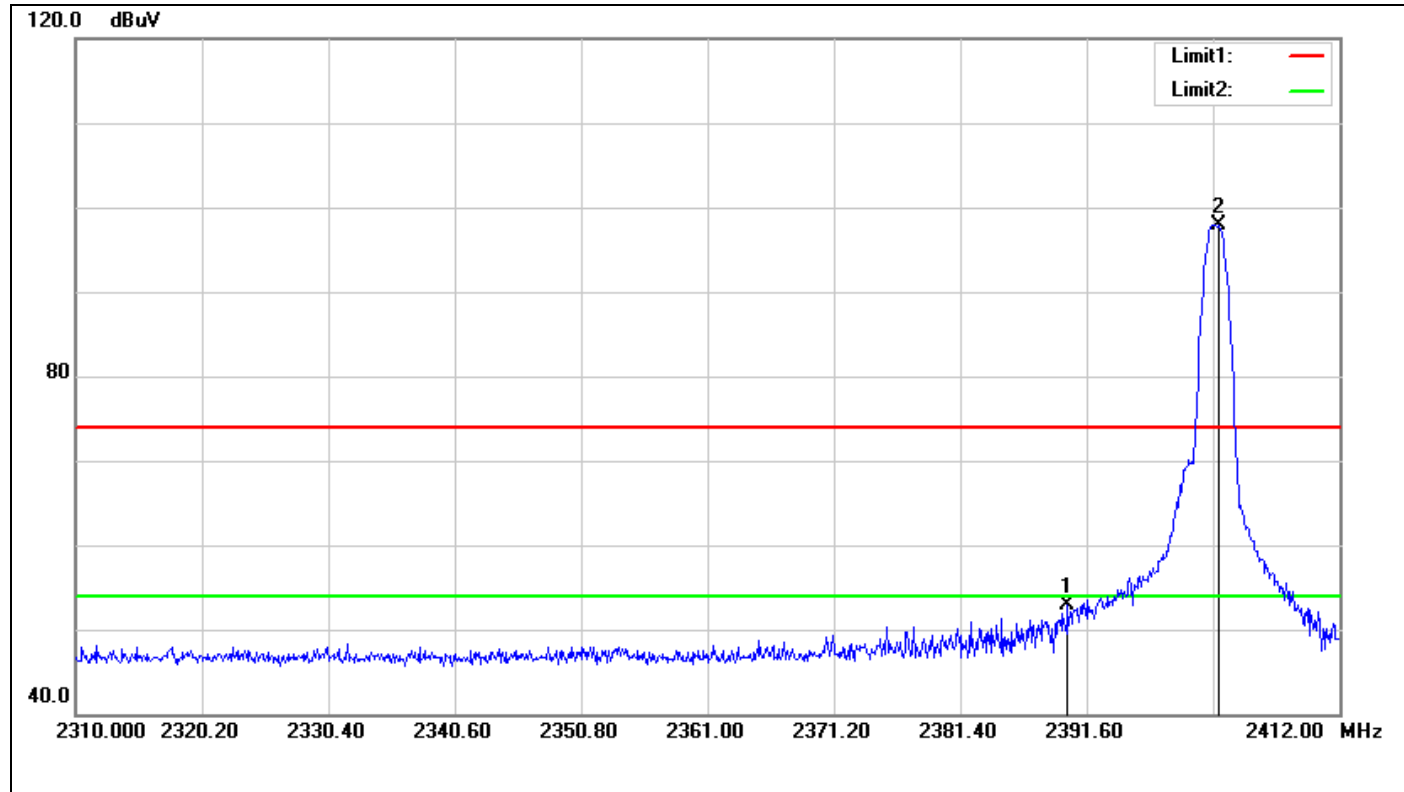
## **TEST RESULTS**

Refer to attach spectrum analyzer data chart.

For GFSK / DH5

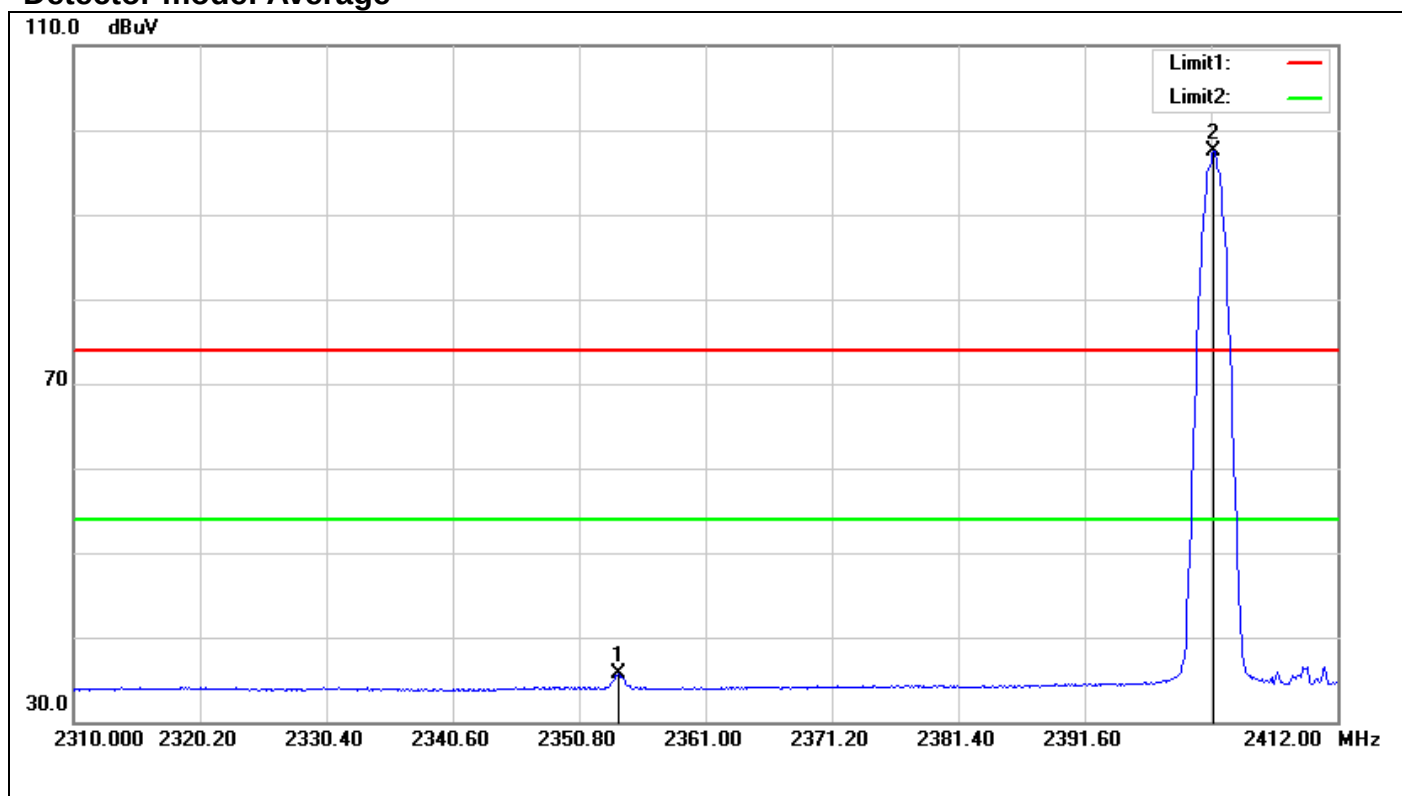
Band Edges (CH Low)

Detector mode: Peak



| No. | Frequency | Reading | Correct    | Result | Limit  | Margin | Remark |
|-----|-----------|---------|------------|--------|--------|--------|--------|
|     | (MHz)     | (dBuV)  | Factor(dB) | (dBuV) | (dBuV) | (dB)   |        |
| 1   | 2390.000  | 55.39   | -2.49      | 52.90  | 74.00  | -21.10 | peak   |
| 2   | 2402.208  | 100.26  | -2.41      | 97.85  | --     | --     | peak   |

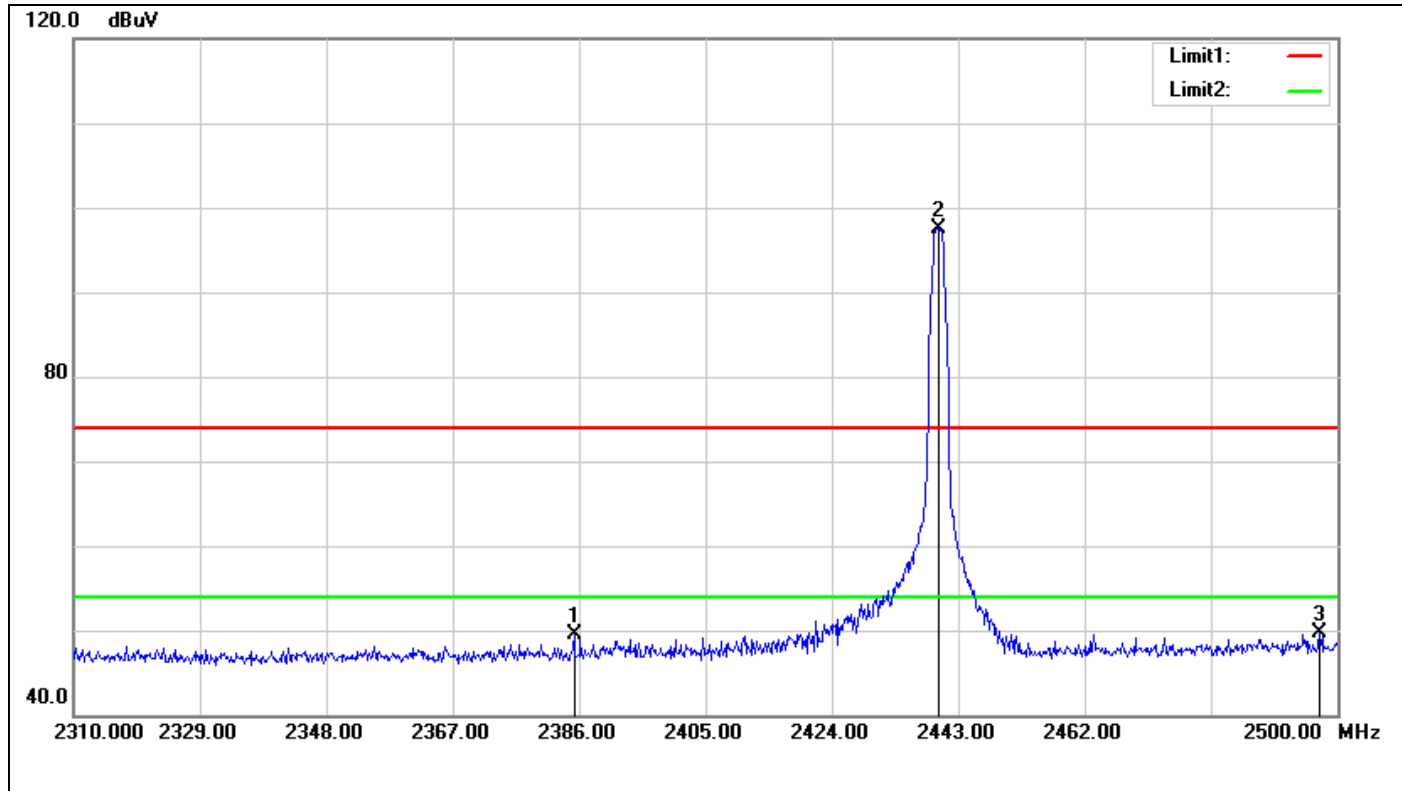
**Detector mode: Average**



| No. | Frequency<br>(MHz) | Reading<br>(dBuV) | Correct<br>Factor(dB) | Result<br>(dBuV) | Limit<br>(dBuV) | Margin<br>(dB) | Remark |
|-----|--------------------|-------------------|-----------------------|------------------|-----------------|----------------|--------|
| 1   | 2353.962           | 38.50             | -2.80                 | 35.70            | 54.00           | -18.30         | AVG    |
| 2   | 2402.004           | 99.92             | -2.41                 | 97.51            | --              | --             | AVG    |

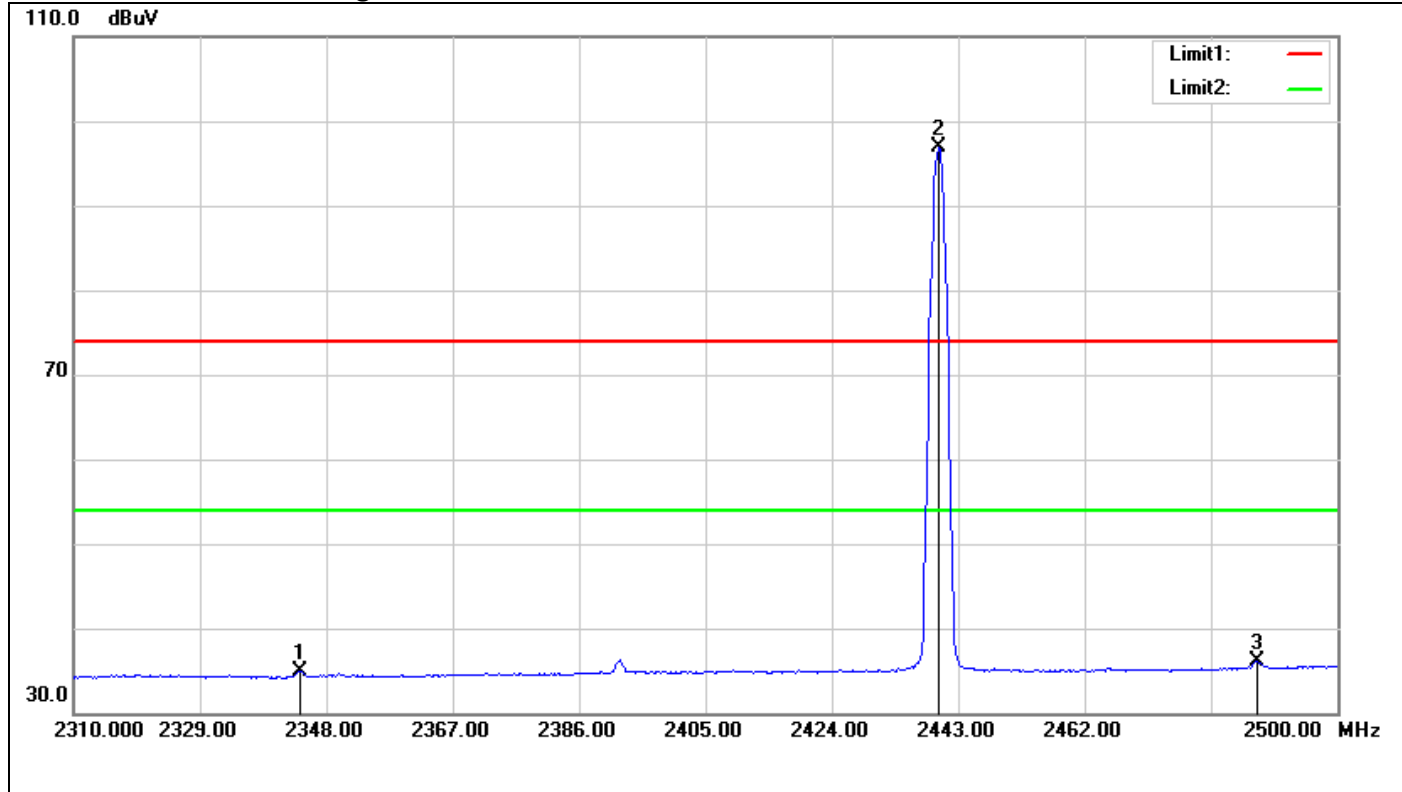
## Band Edges (CH Mid)

Detector mode: Peak



| No. | Frequency<br>(MHz) | Reading<br>(dBuV) | Correct<br>Factor(dB) | Result<br>(dBuV) | Limit<br>(dBuV) | Margin<br>(dB) | Remark |
|-----|--------------------|-------------------|-----------------------|------------------|-----------------|----------------|--------|
| 1   | 2385.240           | 51.94             | -2.53                 | 49.41            | 74.00           | -24.59         | peak   |
| 2   | 2440.150           | 99.80             | -2.21                 | 97.59            | --              | --             | peak   |
| 3   | 2497.340           | 51.55             | -1.88                 | 49.67            | 74.00           | -24.33         | peak   |

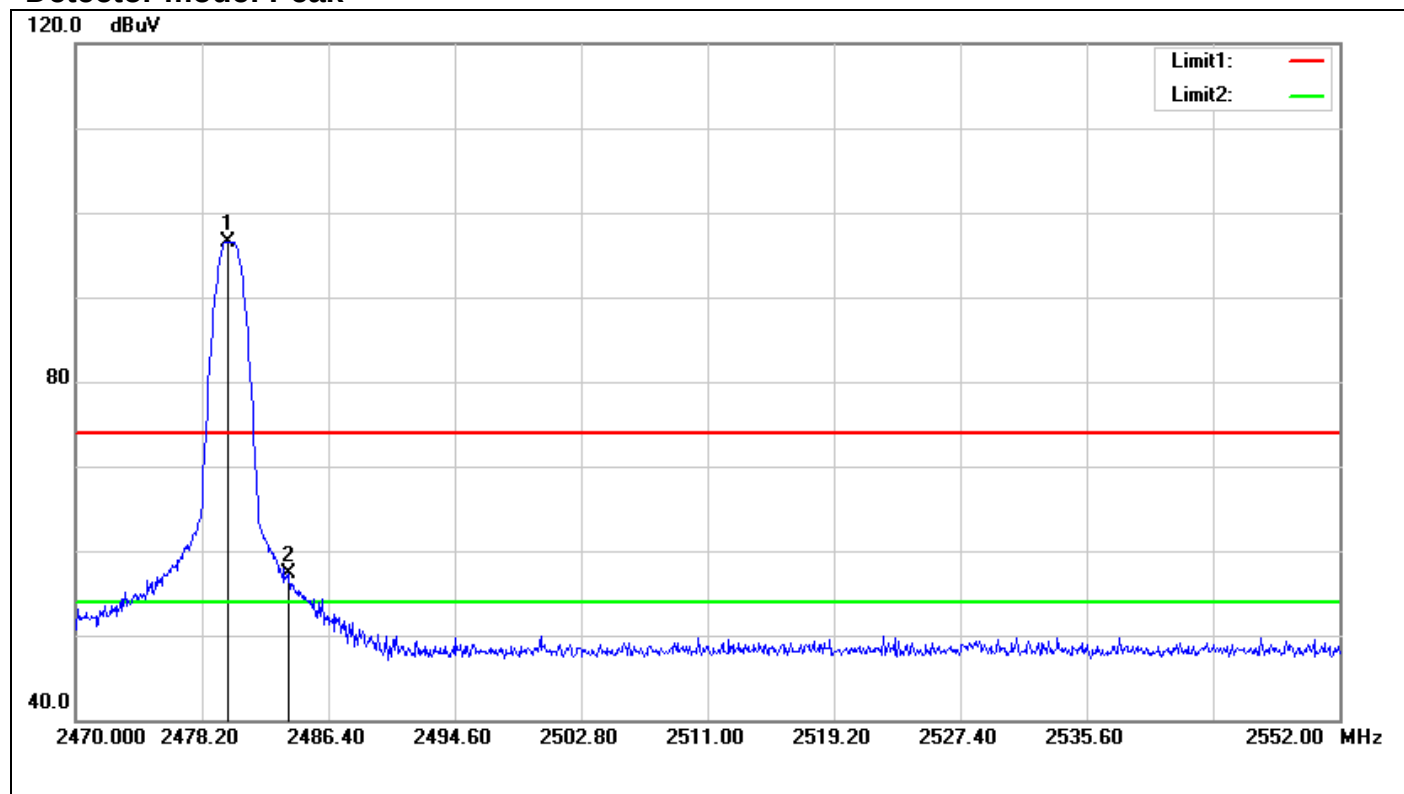
**Detector mode: Average**



| No. | Frequency<br>(MHz) | Reading<br>(dBuV) | Correct<br>Factor(dB) | Result<br>(dBuV) | Limit<br>(dBuV) | Margin<br>(dB) | Remark |
|-----|--------------------|-------------------|-----------------------|------------------|-----------------|----------------|--------|
| 1   | 2344.010           | 37.81             | -2.90                 | 34.91            | 54.00           | -19.09         | AVG    |
| 2   | 2440.150           | 99.05             | -2.21                 | 96.84            | --              | --             | AVG    |
| 3   | 2487.840           | 38.12             | -1.95                 | 36.17            | 54.00           | -17.83         | AVG    |

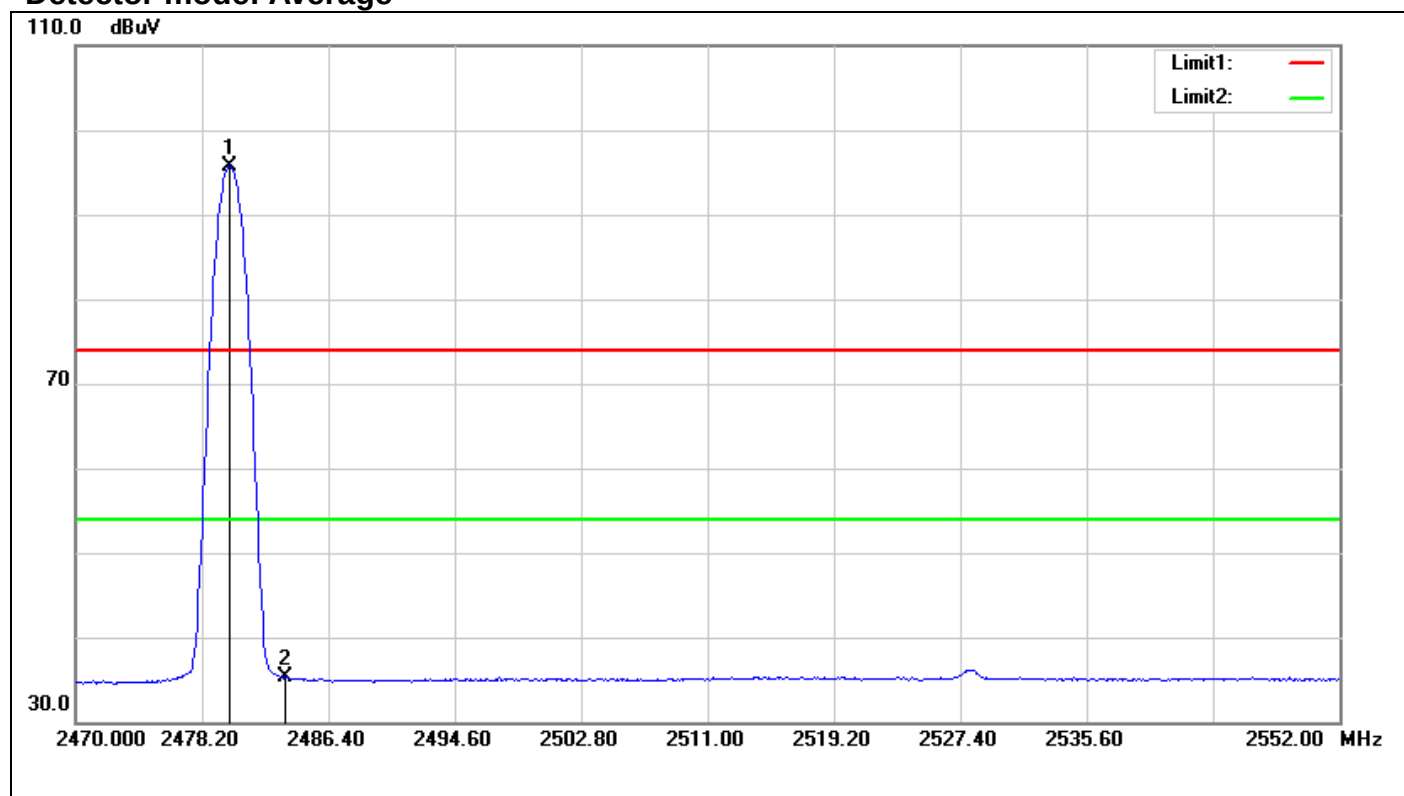
## Band Edges (CH High)

Detector mode: Peak



| No. | Frequency | Reading | Correct    | Result | Limit  | Margin | Remark |
|-----|-----------|---------|------------|--------|--------|--------|--------|
|     | (MHz)     | (dBuV)  | Factor(dB) | (dBuV) | (dBuV) | (dB)   |        |
| 1   | 2479.840  | 98.58   | -2.03      | 96.55  | --     | --     | peak   |
| 2   | 2483.776  | 59.37   | -1.99      | 57.38  | 74.00  | -16.62 | peak   |

**Detector mode: Average**

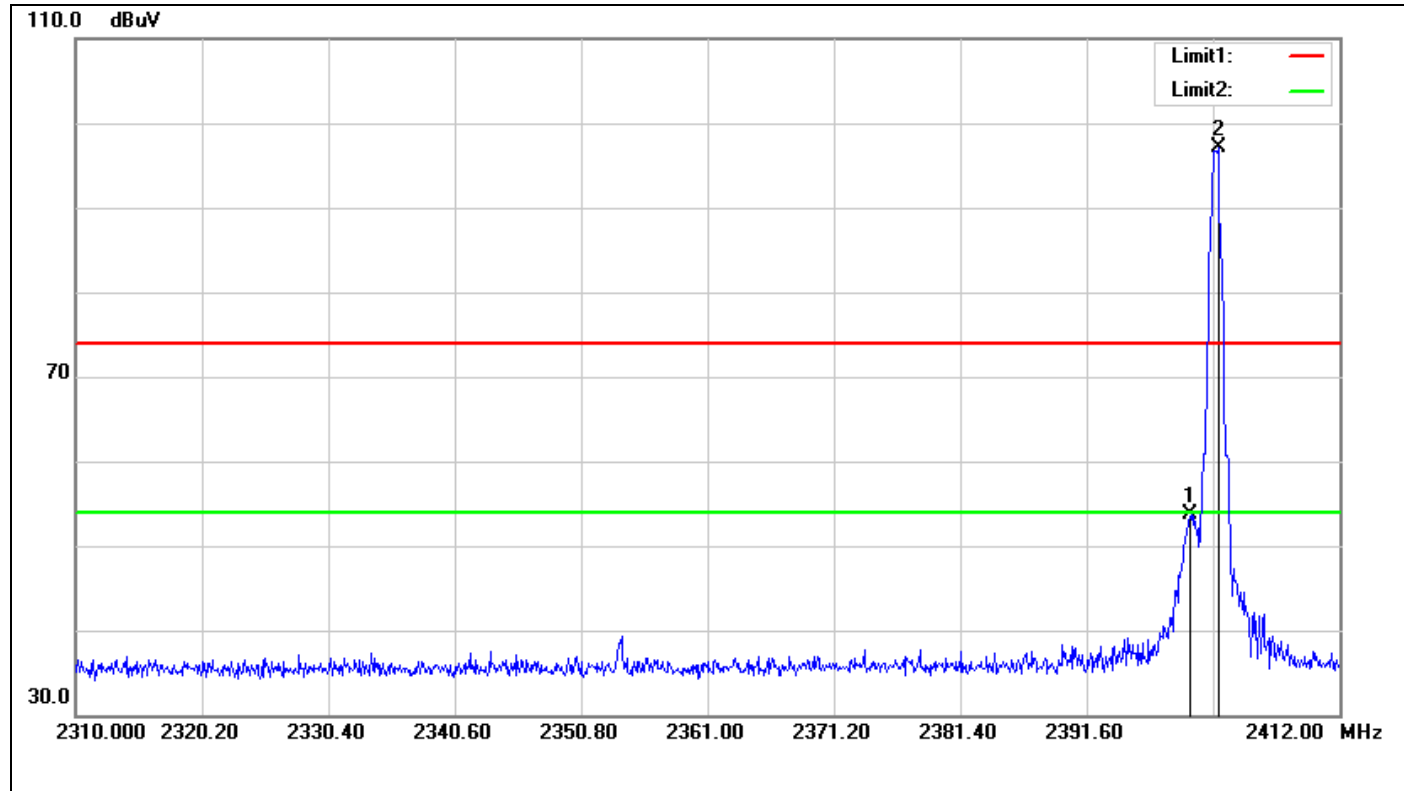


| No. | Frequency<br>(MHz) | Reading<br>(dBuV) | Correct<br>Factor(dB) | Result<br>(dBuV) | Limit<br>(dBuV) | Margin<br>(dB) | Remark |
|-----|--------------------|-------------------|-----------------------|------------------|-----------------|----------------|--------|
| 1   | 2480.004           | 97.71             | -2.03                 | 95.68            | --              | --             | AVG    |
| 2   | 2483.612           | 37.25             | -1.99                 | 35.26            | 54.00           | -18.74         | AVG    |

## Test Plot

### For GFSK

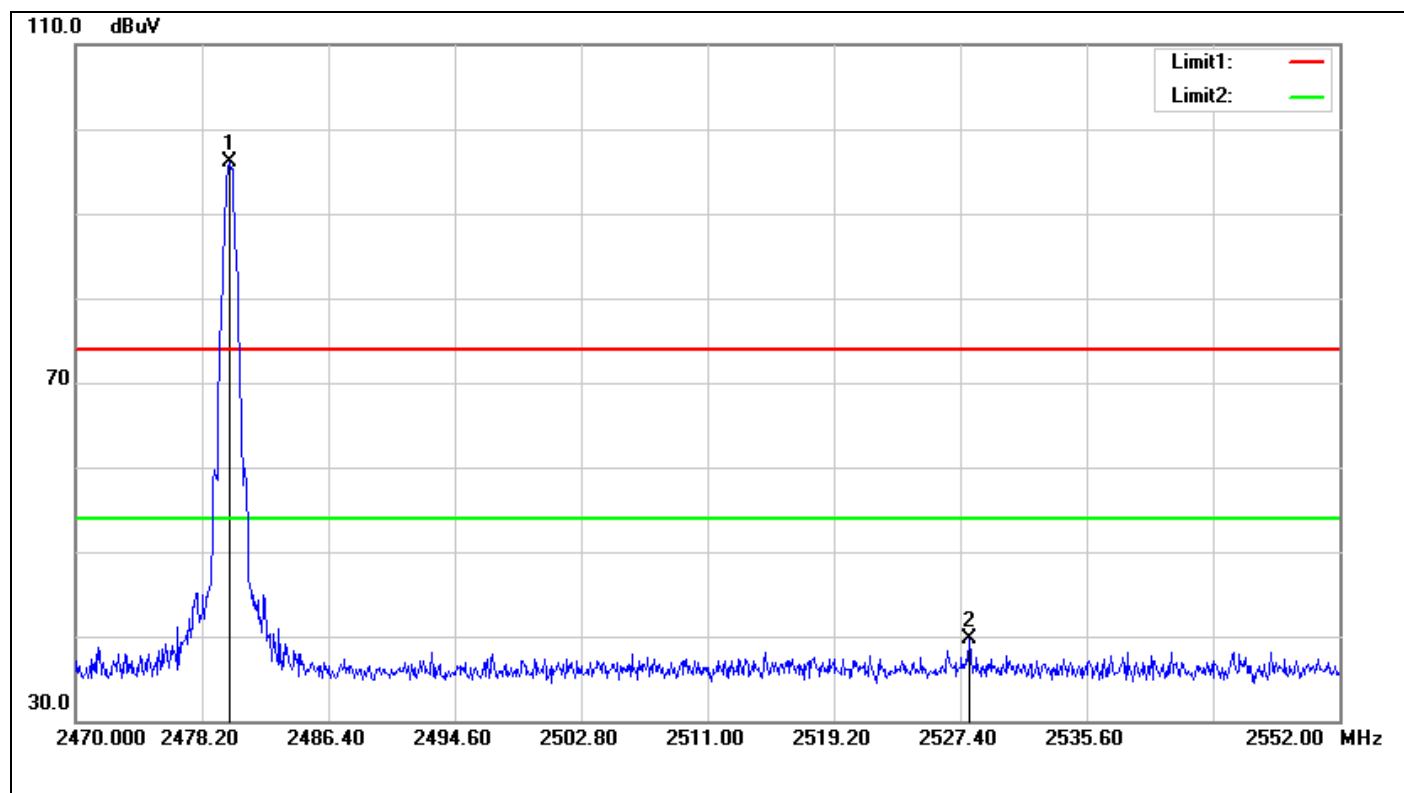
### Un-restricted Band Emissions / CH Low



| No. | Frequency<br>(MHz) | Reading<br>(dBuV) | Correct<br>Factor(dB) | Result<br>(dBuV) | Remark |
|-----|--------------------|-------------------|-----------------------|------------------|--------|
| 1   | 2400.000           | 56.14             | -2.41                 | 53.73            | peak   |
| 2   | 2402.208           | 99.48             | -2.41                 | 97.07            | peak   |

**Note:** Spurious emission levels that exceed the level of 20 dB below the applicable limit.

## Un-restricted Band Emissions / CH High



| No. | Frequency | Reading | Correct    | Result | Remark |
|-----|-----------|---------|------------|--------|--------|
|     | (MHz)     | (dBuV)  | Factor(dB) | (dBuV) |        |
| 1   | 2480.004  | 98.11   | -2.03      | 96.08  | peak   |
| 2   | 2527.974  | 41.45   | -1.79      | 39.66  | peak   |

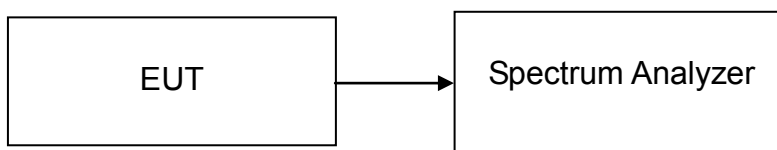
**Note:** Spurious emission levels that exceed the level of 20 dB below the applicable limit.

## 7.5 FREQUENCY SEPARATION

### LIMIT

According to §15.247(a)(1) & RSS-247, Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

### Test Configuration



### TEST PROCEDURE

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set center frequency of spectrum analyzer = middle of hopping channel.
4. Set the spectrum analyzer as RBW = 100 kHz, VBW = 300 kHz, Span = 3.0MHz.
5. Max hold, mark 3 peaks of hopping channel and record the 3 peaks frequency.

## **TEST RESULTS**

*No non-compliance noted*

### **Test Data**

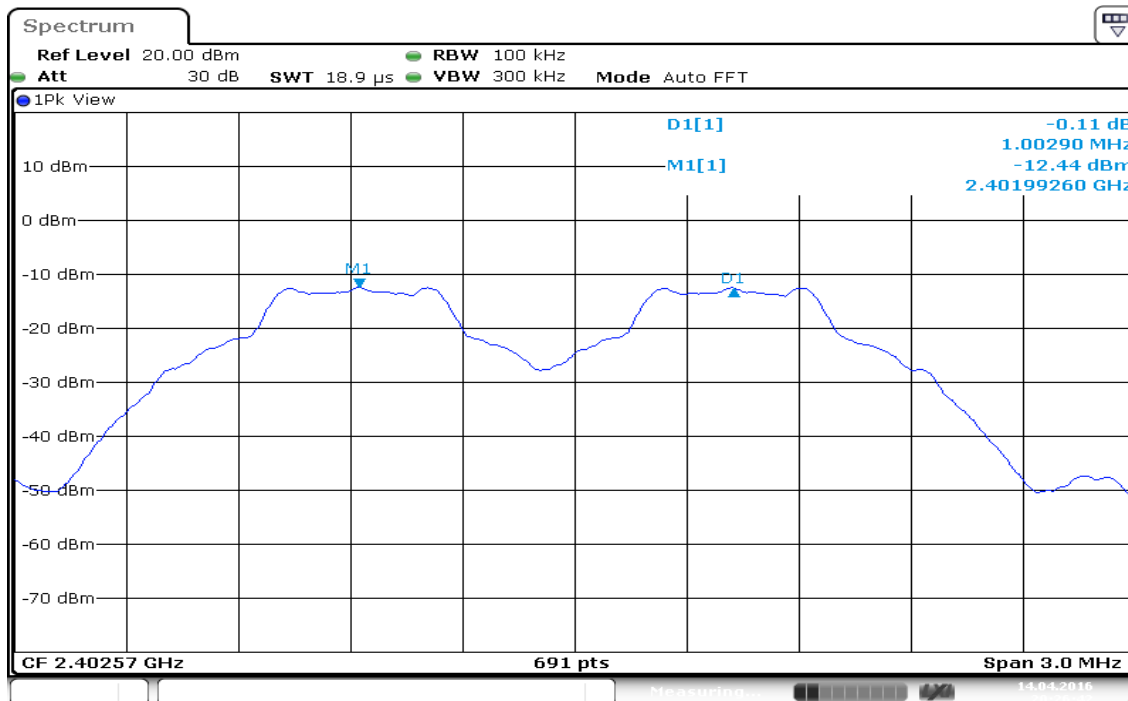
#### **For GFSK**

| Channel | Channel Separation (MHz) | two-thirds of the 20 dB bandwidth (MHz) | Channel Separation Limit            | Result |
|---------|--------------------------|-----------------------------------------|-------------------------------------|--------|
| Low     | 1.0029                   | 0.6859                                  | > two-thirds of the 20 dB bandwidth | Pass   |
| Mid     | 1.0029                   | 0.6859                                  | > two-thirds of the 20 dB bandwidth | Pass   |
| High    | 1.0029                   | 0.6889                                  | > two-thirds of the 20 dB bandwidth | Pass   |

## Test Plot

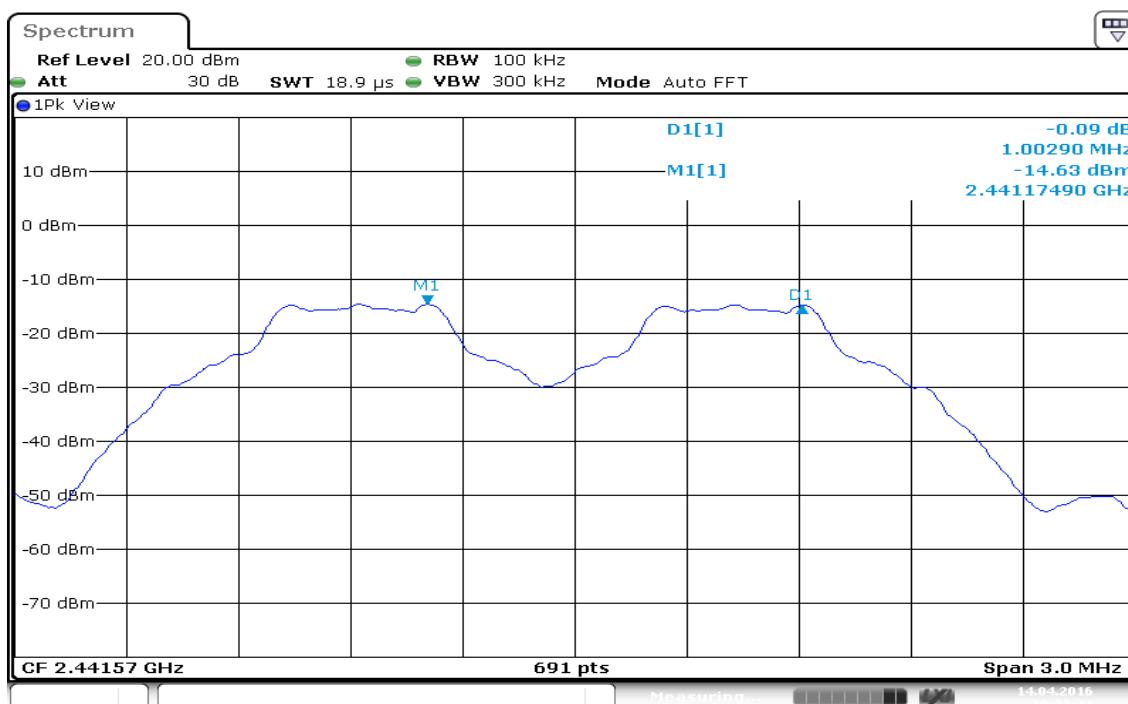
For GFSK / DH5

### Measurement of Channel Separation / (CH Low)



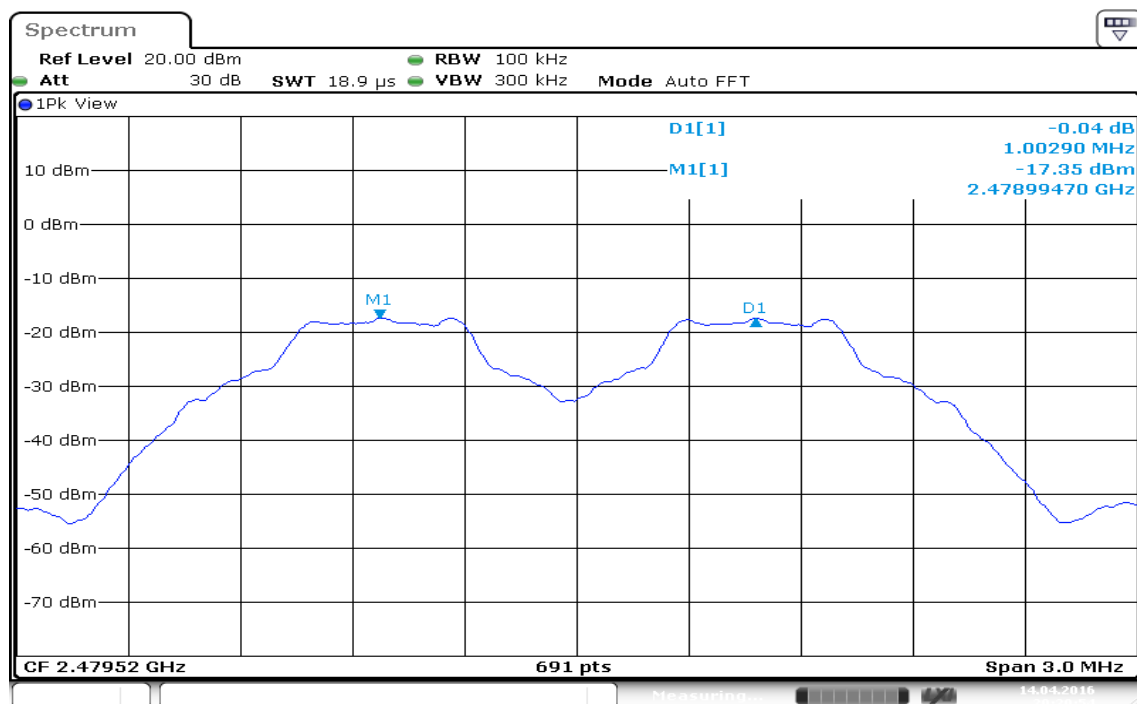
Date: 14.APR.2016 20:26:42

### Measurement of Channel Separation / (CH Mid)



Date: 14.APR.2016 20:22:32

## Measurement of Channel Separation / (CH High)



Date: 14.APR.2016 20:20:54

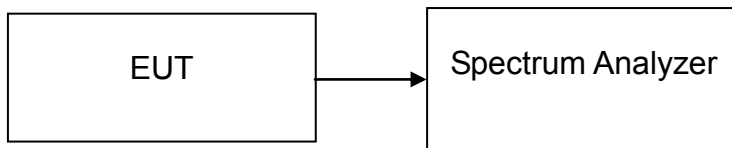
## 7.6 NUMBER OF HOPPING FREQUENCY

### LIMIT

According to §15.247(a)(1)(ii), Frequency hopping systems operating in the 2400MHz-2483.5 MHz bands shall use at least 75 hopping frequencies.

According to §15.247(a)(1)(iii) & RSS-247, Frequency hopping systems operating in the 2400MHz-2483.5 MHz bands shall use at least 15 hopping frequencies.

### Test Configuration



### TEST PROCEDURE

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set spectrum analyzer Start=2400MHz, Stop = 2430.5MHz, Sweep = auto  
Start=2430.5MHz, Stop = 2460.5MHz, Sweep = auto and Start=2460.5MHz, Stop = 2485.5MHz, Sweep = auto.
4. Set the spectrum analyzer as RBW, VBW=510kHz.
5. Max hold, view and count how many channel in the band.

### TEST RESULTS

*No non-compliance noted*

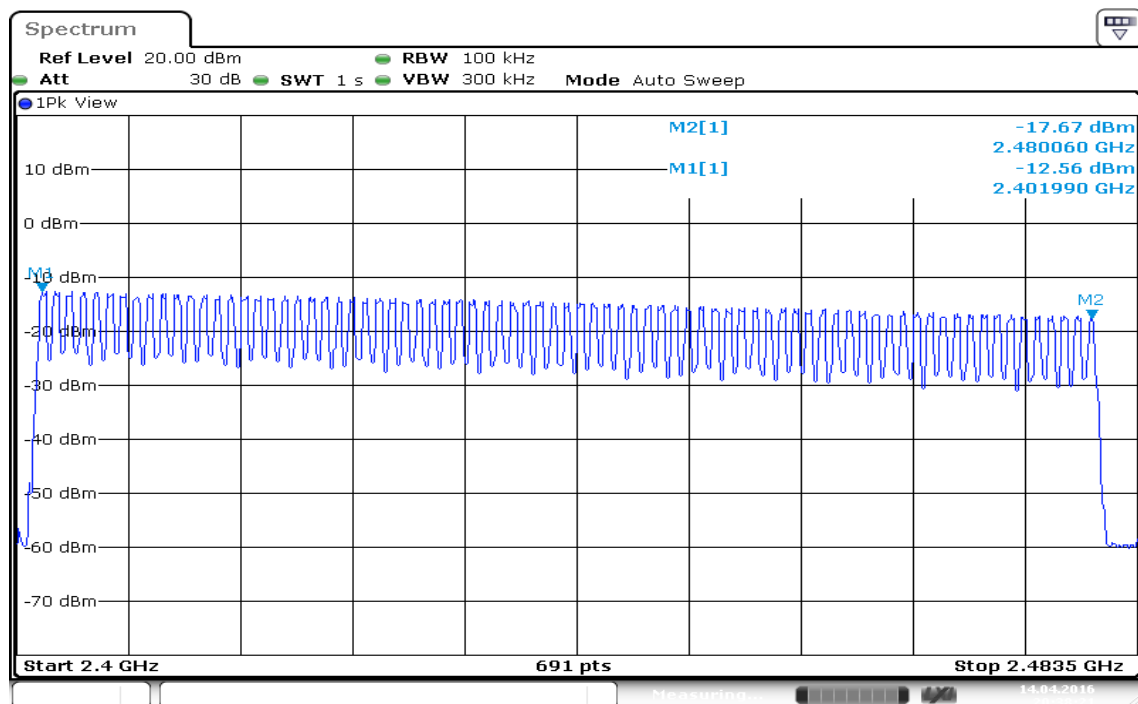
#### Test Data

| Result (No. of CH) | Limit (No. of CH) | Result |
|--------------------|-------------------|--------|
| 79                 | >15               | PASS   |

## Test Plot

For GFSK

## Channel Number



Date: 14.APR.2016 20:38:21

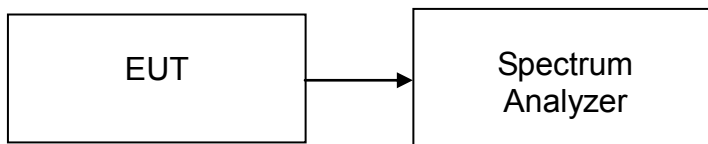
## 7.7 TIME OF OCCUPANCY (DWELL TIME)

### LIMIT

According to §15.247(a)(1)(iii), Frequency hopping systems operating in the 2400MHz-2483.5 MHz bands. The average time of occupancy on any channels shall not greater than 0.4 s within a period 0.4 s multiplied by the number of hopping channels employed.

According to RSS-247, the average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Transmissions on particular hopping frequencies may be avoided or suppressed provided that a minimum of 15 hopping channels are used.

### Test Configuration



### TEST PROCEDURE

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set center frequency of spectrum analyzer = operating frequency.
4. Set the spectrum analyzer as RBW, VBW=1MHz, Sweep = 1 ms.
5. Repeat above procedures until all frequency measured were complete.

### TEST RESULTS

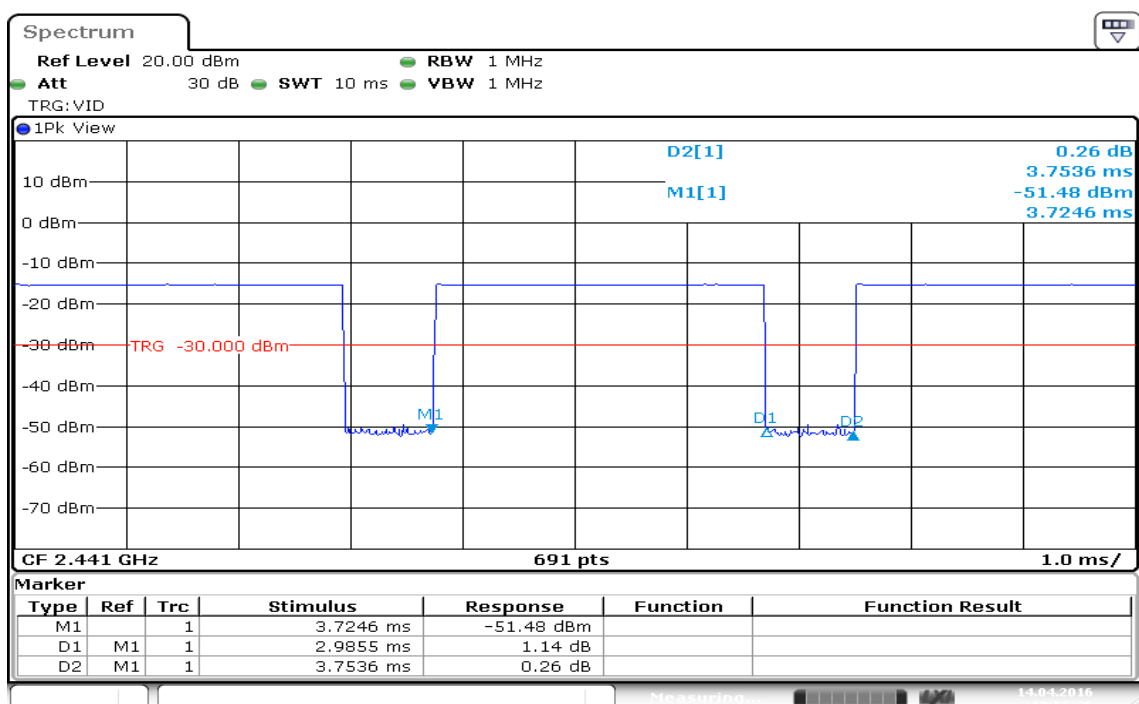
*No non-compliance noted*

**Test Data**

| Time of Occupancy (Dwell Time) |                 |                             |                    |               |                       |        |
|--------------------------------|-----------------|-----------------------------|--------------------|---------------|-----------------------|--------|
| Mode                           | Frequency (MHz) | Pulse Time Per Hopping (ms) | Number of pulse in | Dwell Time IN | Dwell Time Limits (s) | Result |
|                                |                 |                             | (0.4 * N sec)      | (0.4 * N sec) |                       |        |
| BR-1Mbps                       | 2402            | 2.99                        | 106.67             | 0.3189        | 0.4                   | Pass   |
| AFH: DH5                       | 2402            | 2.99                        | 53.33              | 0.1595        | 0.4                   |        |

Non-AFH: DH5 Packet permit maximum  $1600 / 79 / 6 = 3.37$  hops per second in each channel (5 time slots RX, 1 time slot TX). So, the dwell time is the time duration of the pulse times  $3.37 * 0.4 * 79 = 106.6$

AFH: DH5 Packet permit maximum  $800 / 20 / 6 = 6.666$  hops per second in each channel (5 time slots RX, 1 time slot TX). So, the dwell time is the time duration of the pulse times  $6.666 * 0.4 * 20 = 53.33$



Date: 14.APR.2016 19:56:36

## 7.8 RADIATED EMISSIONS

### LIMIT

All spurious emissions shall comply with the limits of §15.209(a) and RSS-Gen Table 2 & Table 5.

#### **RSS-Gen Table 2 & Table 5: General Field Strength Limits for Transmitters and Receivers at Frequencies Above 30 MHz** <sup>(Note)</sup>

| Frequency (MHz) | Field Strength<br>microvolts/m at 3 metres (watts, e.i.r.p.) |              |
|-----------------|--------------------------------------------------------------|--------------|
|                 | Transmitters                                                 | Receivers    |
| 30-88           | 100 (3 nW)                                                   | 100 (3 nW)   |
| 88-216          | 150 (6.8 nW)                                                 | 150 (6.8 nW) |
| 216-960         | 200 (12 nW)                                                  | 200 (12 nW)  |
| Above 960       | 500 (75 nW)                                                  | 500 (75 nW)  |

**Note:** \*Measurements for compliance with limits in the above table may be performed at distances other than 3 metres, in accordance with Section 7.2.7.

Transmitting devices are not permitted in Table 1 bands or, unless stated otherwise, in TV bands (54-72 MHz, 76-88 MHz, 174-216 MHz, 470-608 MHz and 614-806 MHz).

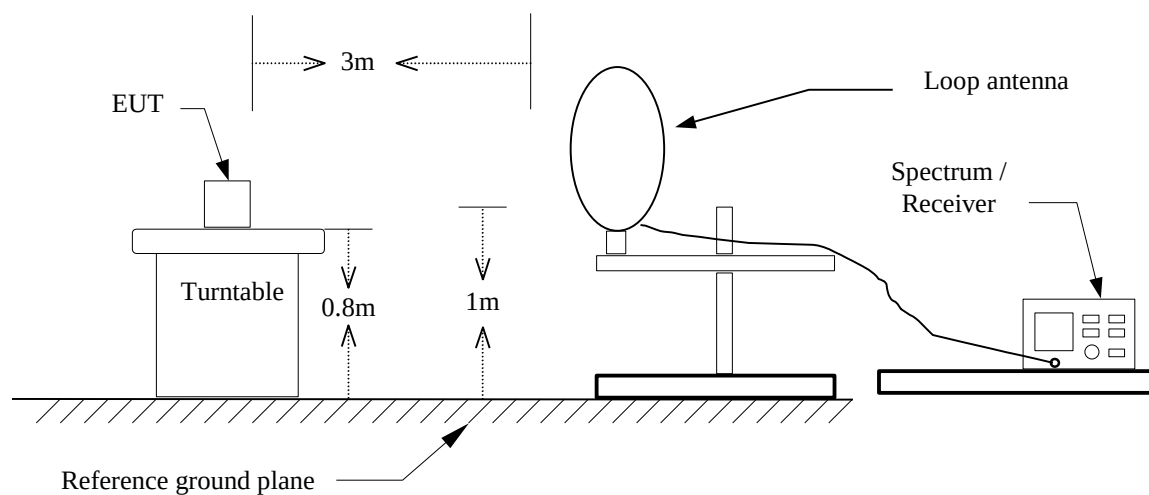
#### **RSS-Gen Table 6: General Field Strength Limits for Transmitters at Frequencies Below 30 MHz (Transmit)**

| Frequency     | Field Strength (microvolts/m) | Magnetic H-Field (microamperes/m) | Measurement Distance (metres) |
|---------------|-------------------------------|-----------------------------------|-------------------------------|
| 9-490 kHz     | 2,400/F (F in kHz)            | 2,400/377F (F in kHz)             | 3000                          |
| 490-1,705 kHz | 24,000/F (F in kHz)           | 24,000/377F (F in kHz)            | 30                            |
| 1.705-30 MHz  | 30                            | N/A                               | 30                            |

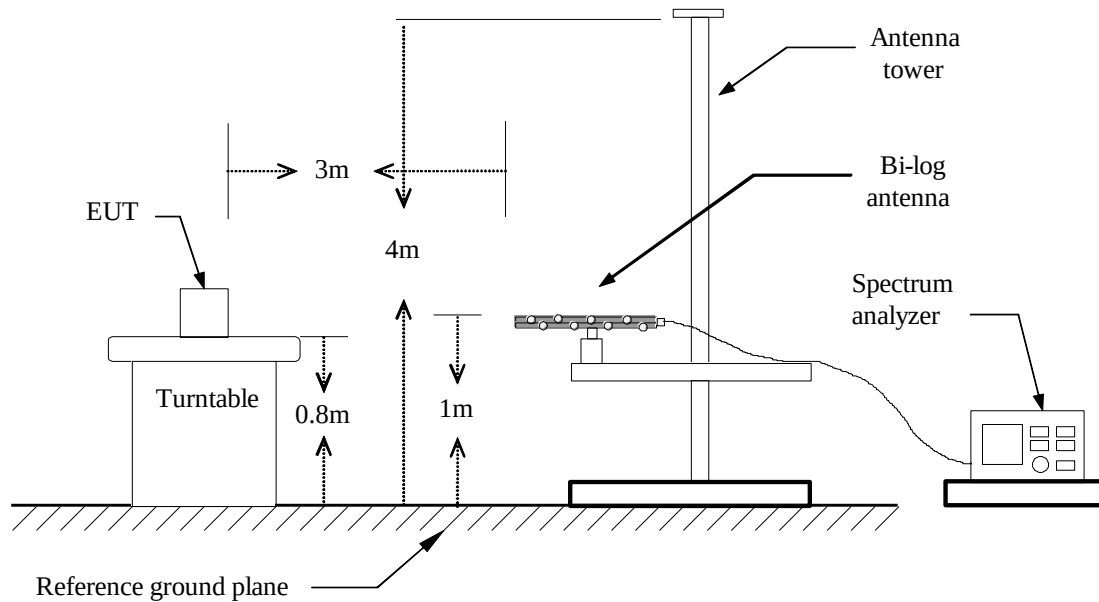
**Note:** The emission limits for the bands 9-90 kHz and 110-490 kHz are based on measurements employing an average detector.

## Test Configuration

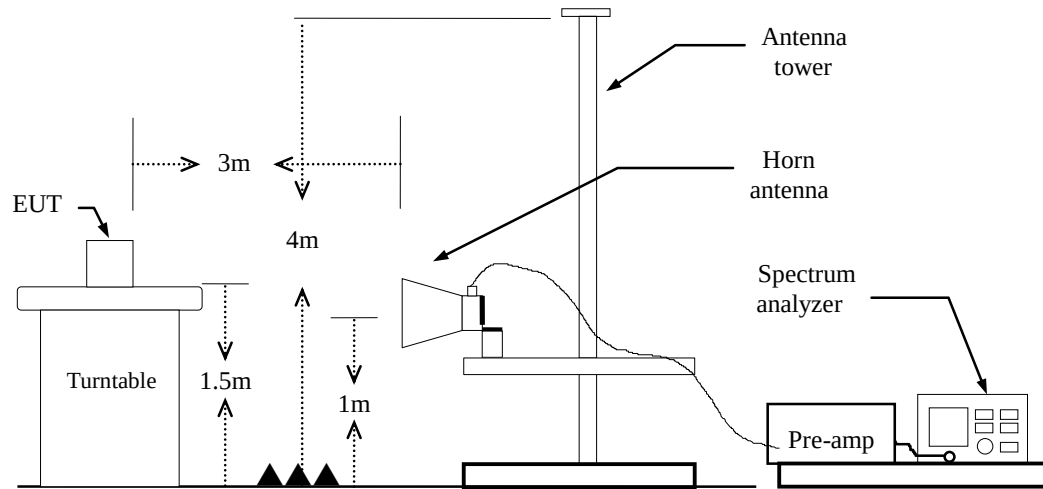
**9kHz ~ 30MHz**



**30MHz ~ 1GHz**



## Above 1 GHz



## **TEST PROCEDURE**

1. The EUT is placed on a turntable, Above 1 GHz is 1.5m high and below 1 GHz is 0.8m high above ground plane.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
6. Set the spectrum analyzer in the following setting as:

Below 1GHz:

RBW=100kHz / VBW=300kHz / Sweep=AUTO

Above 1GHz:

(a) PEAK: RBW=1MHz / VBW=3MHz / Sweep=AUTO

(b) AVERAGE: RBW=1MHz,  
if duty cycle  $\geq 98\%$ , VBW=10Hz.  
if duty cycle  $< 98\%$  VBW=1/T.

**BT:** = 79%, VBW= 360Hz

7. Repeat above procedures until the measurements for all frequencies are complete.
8. Result = Spectrum Reading + cable loss(spectrum to Amp) - Amp Gain + Cable loss(Amp to receive Ant)+ Receive Ant

**Note:** We checked every harmonics frequencies from Fundamental frequencies with reduced VBW, and we mark a point to prove pass or not if we find any emission. For this case, there are no emissions hidden in the noise floor.

## TEST RESULTS

### Below 1GHz

Operation Mode: Normal Link

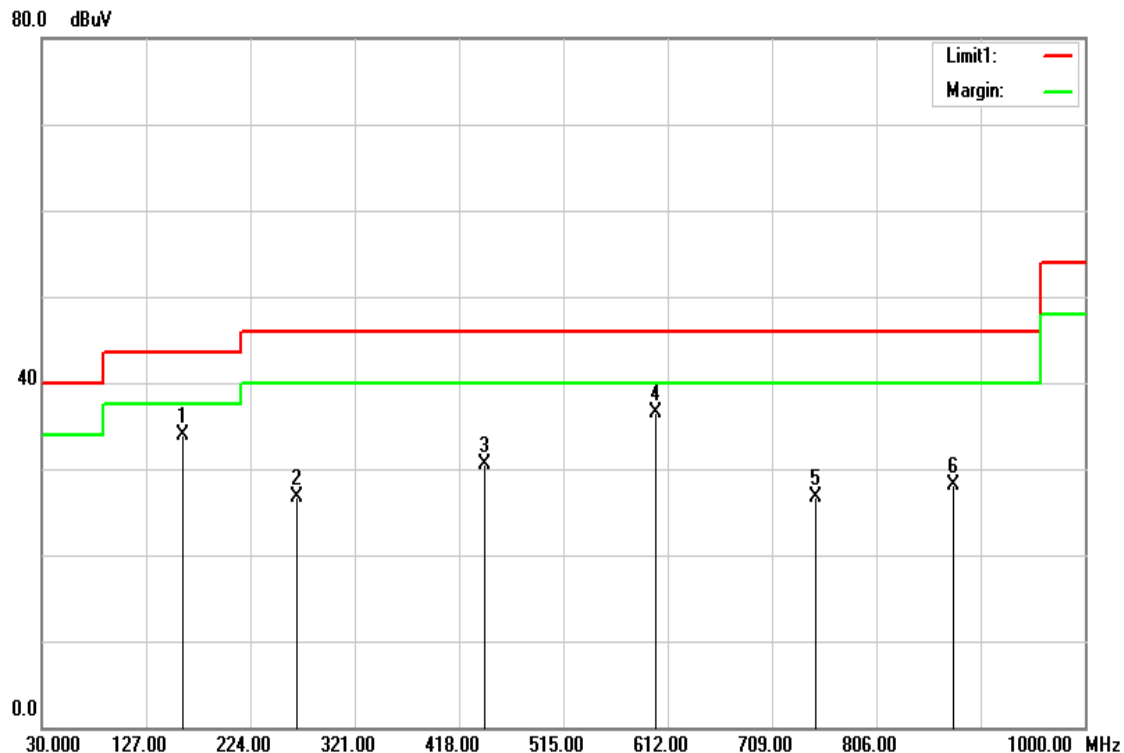
Test Date: April 18, 2016

Temperature: 27°C

Tested by: Jason Lu

Humidity: 53% RH

Polarity: Ver.



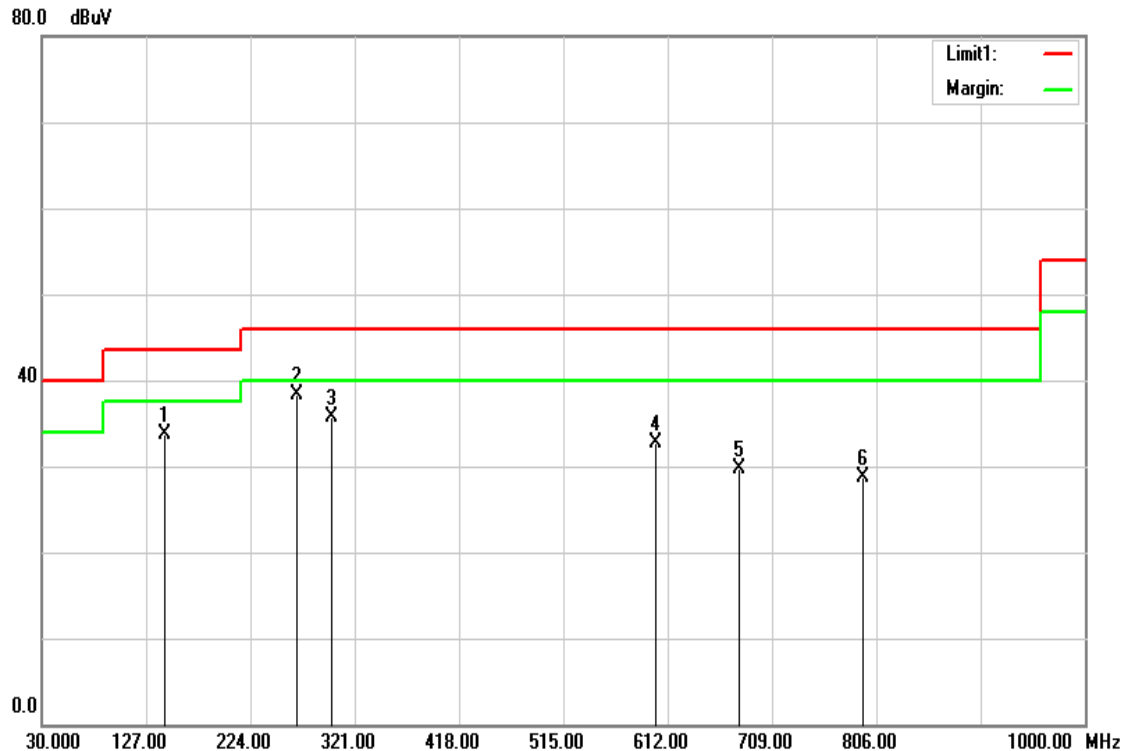
| Frequency (MHz) | Reading (dBuV) | Correction Factor (dB/m) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Remark | Ant.Pol. (H/V) |
|-----------------|----------------|--------------------------|-----------------|----------------|-------------|--------|----------------|
| 160.9500        | 50.37          | -16.41                   | 33.96           | 43.50          | -9.54       | peak   | V              |
| 266.6800        | 41.74          | -15.05                   | 26.69           | 46.00          | -19.31      | peak   | V              |
| 442.2500        | 40.91          | -10.42                   | 30.49           | 46.00          | -15.51      | peak   | V              |
| 600.3600        | 44.20          | -7.75                    | 36.45           | 46.00          | -9.55       | peak   | V              |
| 749.7400        | 31.60          | -4.93                    | 26.67           | 46.00          | -19.33      | peak   | V              |
| 877.7800        | 31.50          | -3.45                    | 28.05           | 46.00          | -17.95      | peak   | V              |

### Remark:

1. No emission found between lowest internal used/generated frequency to 30MHz (9kHz~30MHz)
2. Radiated emissions measured in frequency range from 30 MHz to 1000MHz were made with an instrument using peak/quasi-peak detector mode.
3. Quasi-peak test would be performed if the peak result were greater than the quasi-peak limit or as required by the applicant.
4. Measurements above show only up to 6 maximum emissions noted, or would be lesser, with " N/A " remark, if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.
5. Margin (dB) = Remark result (dBuV/m) – Quasi-peak limit (dBuV/m).

**Operation Mode:** Normal Link  
**Temperature:** 27°C  
**Humidity:** 53% RH

**Test Date:** April 18, 2016  
**Tested by:** Jason Lu  
**Polarity:** Hor.



| Frequency (MHz) | Reading (dBuV) | Correction Factor (dB/m) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Remark | Ant.Pol. (H/V) |
|-----------------|----------------|--------------------------|-----------------|----------------|-------------|--------|----------------|
| 144.4600        | 49.59          | -15.91                   | 33.68           | 43.50          | -9.82       | peak   | H              |
| 267.6500        | 53.36          | -14.97                   | 38.39           | 46.00          | -7.61       | peak   | H              |
| 299.6600        | 49.97          | -14.25                   | 35.72           | 46.00          | -10.28      | peak   | H              |
| 600.3600        | 40.43          | -7.75                    | 32.68           | 46.00          | -13.32      | peak   | H              |
| 678.9300        | 35.95          | -6.28                    | 29.67           | 46.00          | -16.33      | peak   | H              |
| 793.3900        | 33.31          | -4.56                    | 28.75           | 46.00          | -17.25      | peak   | H              |

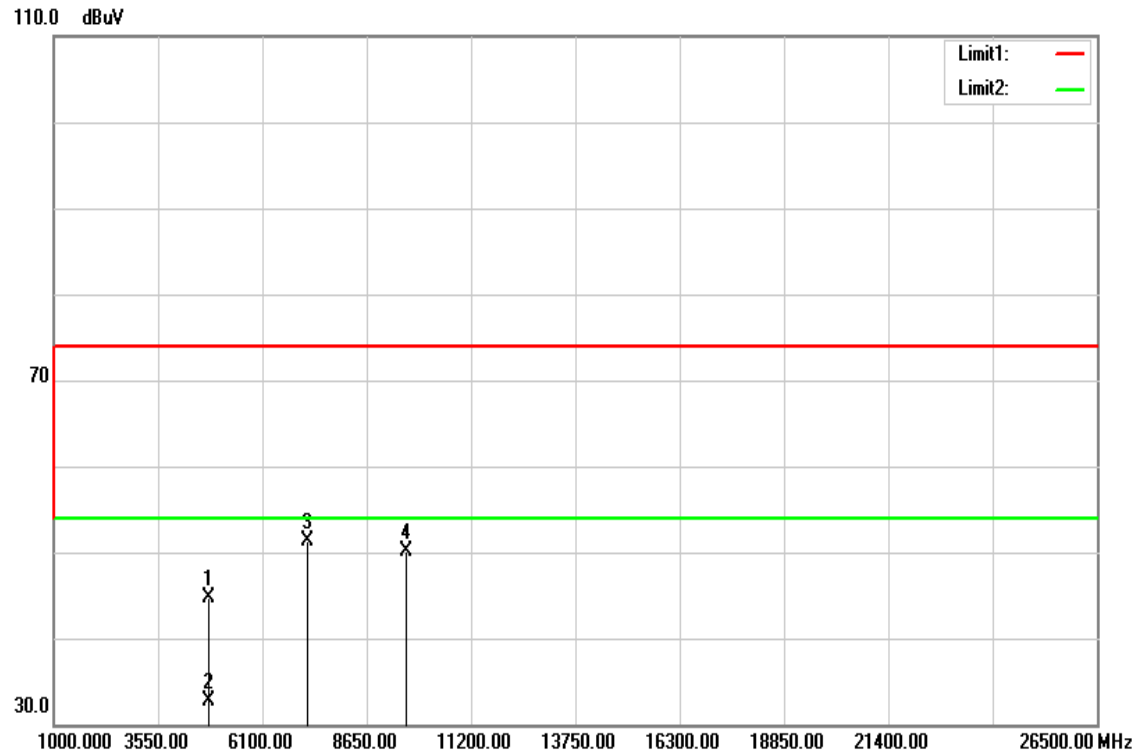
**Remark:**

1. No emission found between lowest internal used/generated frequency to 30MHz (9kHz~30MHz)
2. Radiated emissions measured in frequency range from 30 MHz to 1000MHz were made with an instrument using peak/quasi-peak detector mode.
3. Quasi-peak test would be performed if the peak result were greater than the quasi-peak limit or as required by the applicant.
4. Measurements above show only up to 6 maximum emissions noted, or would be lesser, with " N/A " remark, if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.
5. Margin (dB) = Remark result (dBuV/m) – Quasi-peak limit (dBuV/m).

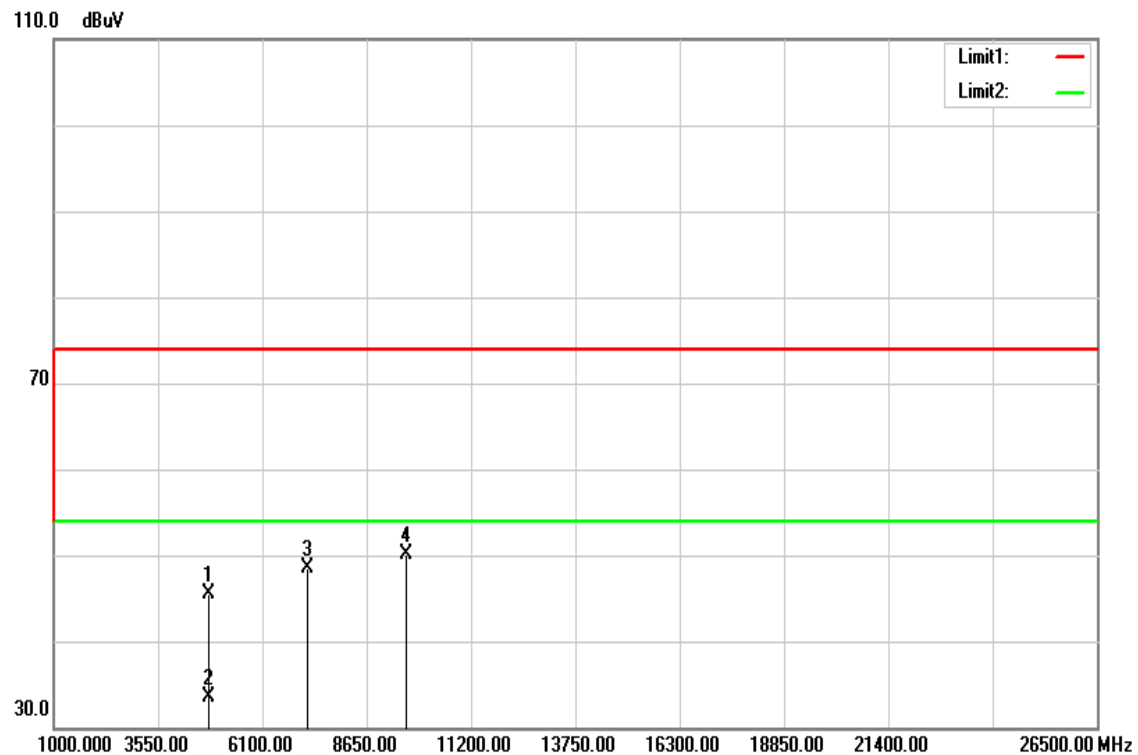
**Above 1 GHz**

**TX / GFSK / DH5 / CH Low**

**Polarity: Vertical**



**Polarity: Horizontal**



### Above 1 GHz

**Operation Mode:** TX / GFSK / DH5 / CH Low

**Test Date:** April 18, 2016

**Temperature:** 27°C

**Tested by:** Jason Lu

**Humidity:** 53 % RH

**Polarity:** Ver. / Hor.

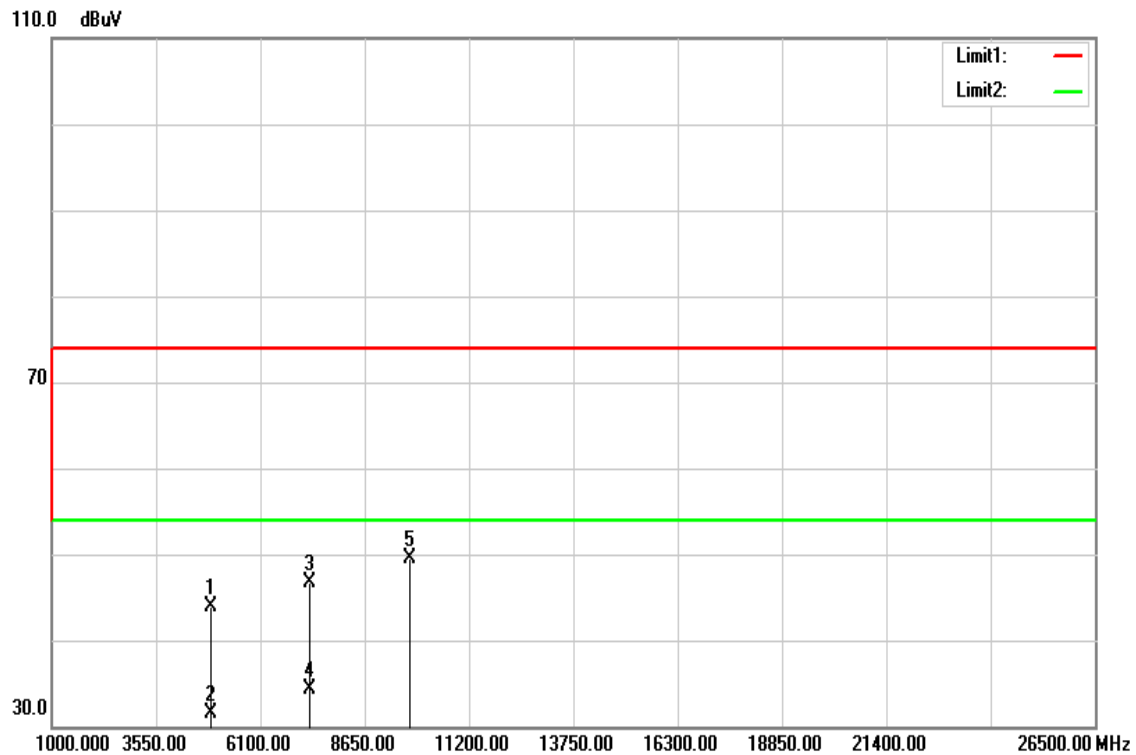
| Frequency (MHz) | Reading (dBuV) | Correction (dB/m) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Remark | Ant.Pol. (H/V) |
|-----------------|----------------|-------------------|-----------------|----------------|-------------|--------|----------------|
| 4804.000        | 39.70          | 5.04              | 44.74           | 74.00          | -29.26      | peak   | V              |
| 4804.000        | 27.59          | 5.04              | 32.63           | 54.00          | -21.37      | AVG    | V              |
| 7206.000        | 38.63          | 12.62             | 51.25           | 74.00          | -22.75      | peak   | V              |
| 9608.000        | 32.58          | 17.60             | 50.18           | 74.00          | -23.82      | peak   | V              |
| N/A             |                |                   |                 |                |             |        |                |
|                 |                |                   |                 |                |             |        |                |
| 4804.000        | 40.52          | 5.04              | 45.56           | 74.00          | -28.44      | peak   | H              |
| 4804.000        | 28.38          | 5.04              | 33.42           | 54.00          | -20.58      | AVG    | H              |
| 7206.000        | 35.93          | 12.62             | 48.55           | 74.00          | -25.45      | peak   | H              |
| 9608.000        | 32.47          | 17.60             | 50.07           | 74.00          | -23.93      | peak   | H              |
| N/A             |                |                   |                 |                |             |        |                |
|                 |                |                   |                 |                |             |        |                |

### **Remark:**

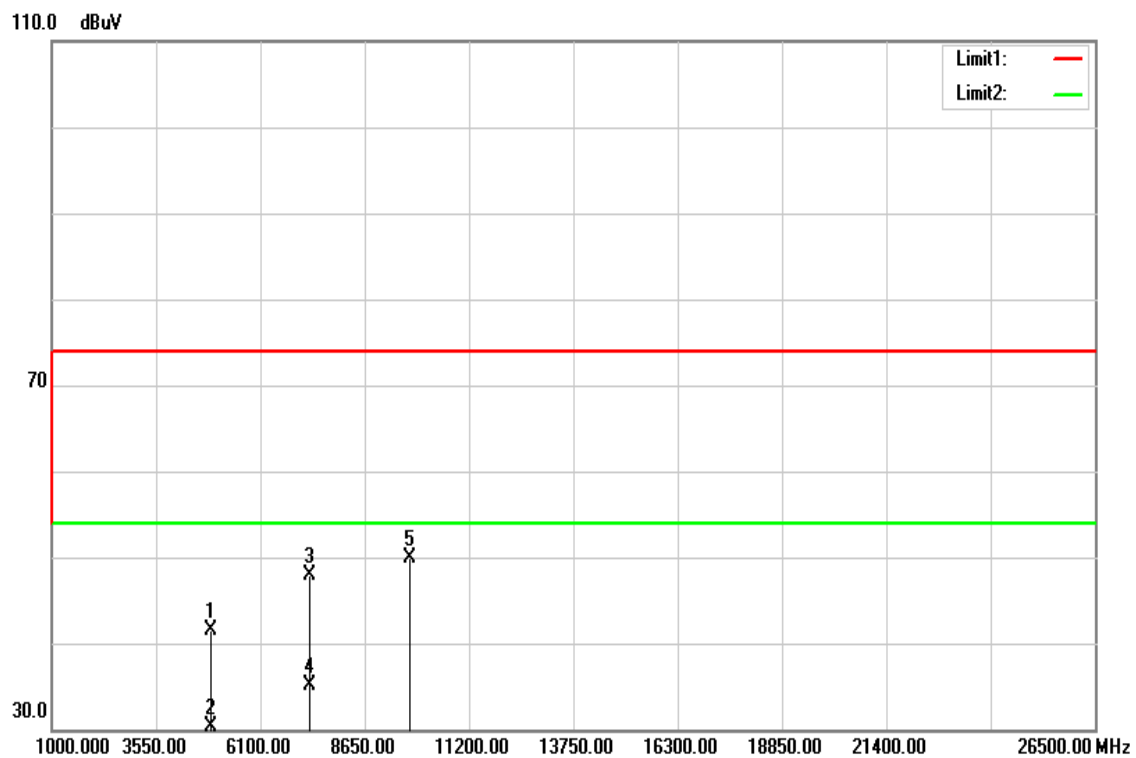
1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Radiated emissions measured in frequency above 1000MHz were made with an instrument using peak/average detector mode.
3. Average test would be performed if the peak result were greater than the average limit .
4. Data of measurement within this frequency range shown " --- " in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
5. Measurements above show only up to 6 maximum emissions noted, or would be lesser, with " N/A " remark, if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.
6. Margin (dB) = Remark result (dBuV/m) – Average limit (dBuV/m).

**TX / GFSK / DH5 / CH Mid**

**Polarity: Vertical**



**Polarity: Horizontal**



**Operation Mode:** TX / GFSK / DH5 / CH Mid

**Test Date:** April 18, 2016

**Temperature:** 27°C

**Tested by:** Jason Lu

**Humidity:** 53 % RH

**Polarity:** Ver. / Hor.

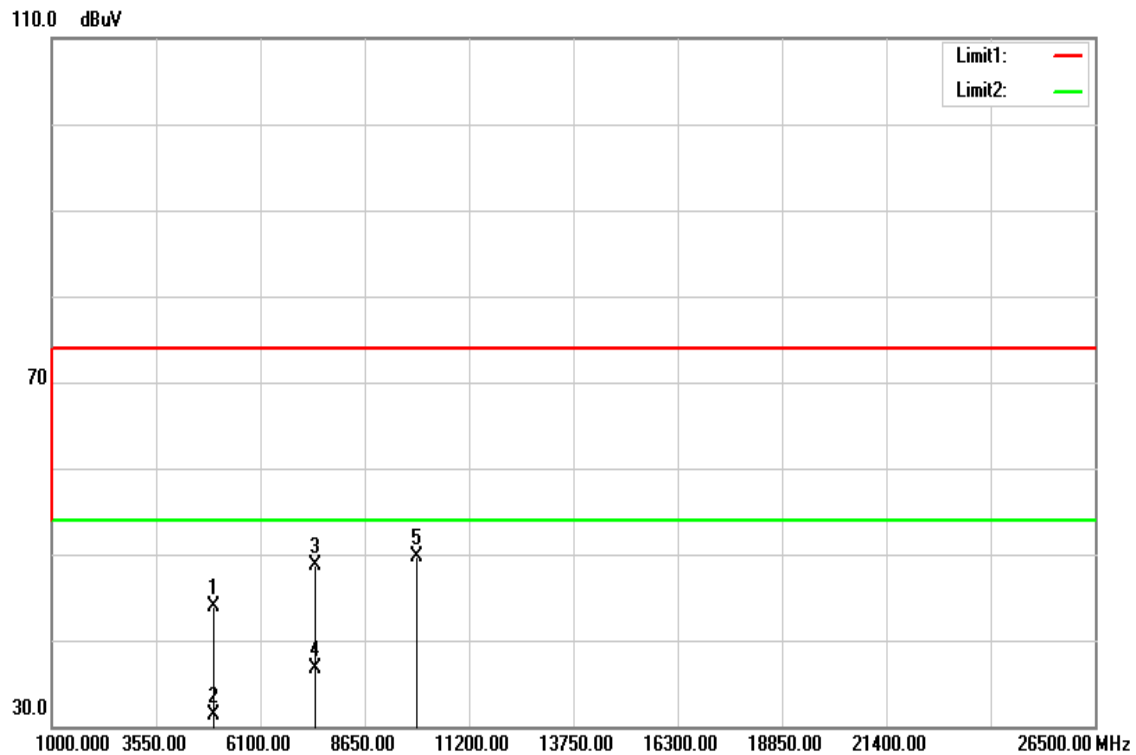
| Frequency (MHz) | Reading (dBuV) | Correction (dB/m) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Remark | Ant.Pol. (H/V) |
|-----------------|----------------|-------------------|-----------------|----------------|-------------|--------|----------------|
| 4880.000        | 38.68          | 5.25              | 43.93           | 74.00          | -30.07      | peak   | V              |
| 4880.000        | 26.23          | 5.25              | 31.48           | 54.00          | -22.52      | AVG    | V              |
| 7320.000        | 33.74          | 12.97             | 46.71           | 74.00          | -27.29      | peak   | V              |
| 7320.000        | 21.27          | 12.97             | 34.24           | 54.00          | -19.76      | AVG    | V              |
| 9760.000        | 31.89          | 17.60             | 49.49           | 74.00          | -24.51      | peak   | V              |
| N/A             |                |                   |                 |                |             |        |                |
| 4880.000        | 36.17          | 5.25              | 41.42           | 74.00          | -32.58      | peak   | H              |
| 4880.000        | 25.09          | 5.25              | 30.34           | 54.00          | -23.66      | AVG    | H              |
| 7320.000        | 34.93          | 12.97             | 47.90           | 74.00          | -26.10      | peak   | H              |
| 7320.000        | 22.22          | 12.97             | 35.19           | 54.00          | -18.81      | AVG    | H              |
| 9760.000        | 32.25          | 17.60             | 49.85           | 74.00          | -24.15      | peak   | H              |
| N/A             |                |                   |                 |                |             |        |                |

**Remark:**

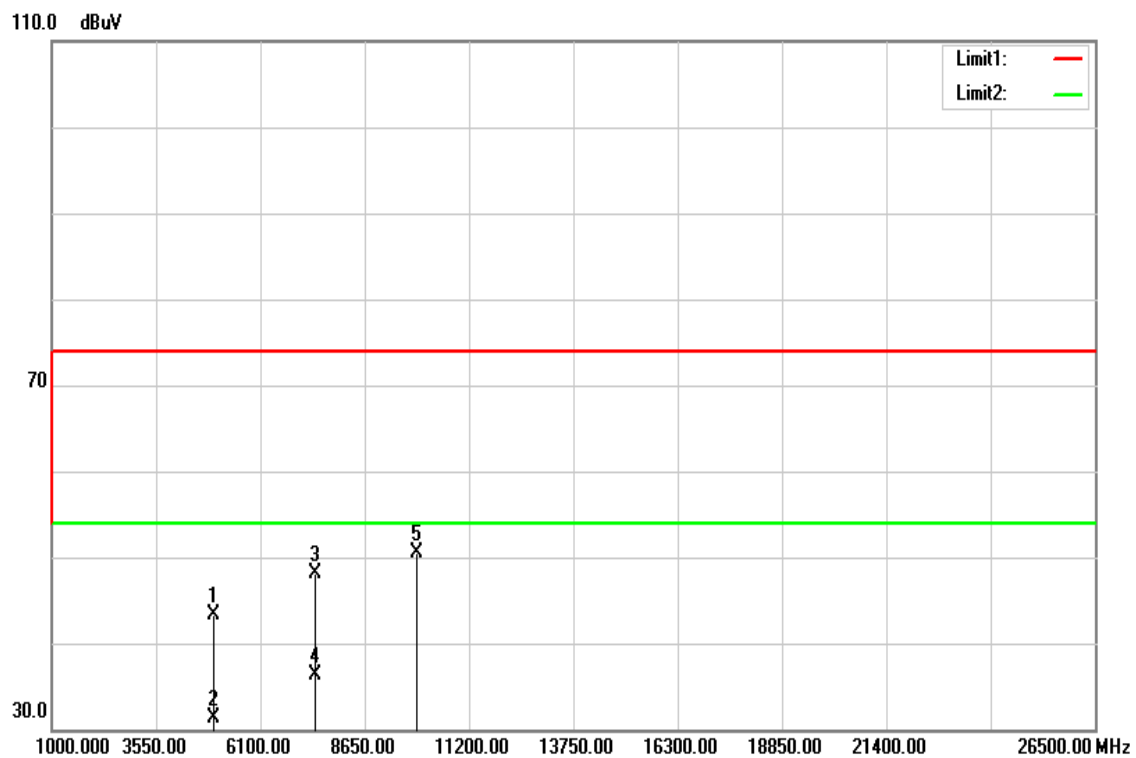
1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Radiated emissions measured in frequency above 1000MHz were made with an instrument using peak/average detector mode.
3. Average test would be performed if the peak result were greater than the average limit.
4. Data of measurement within this frequency range shown " --- " in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
5. Measurements above show only up to 6 maximum emissions noted, or would be lesser, with " N/A " remark, if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.
6.  $\text{Margin (dB)} = \text{Remark result (dBuV/m)} - \text{Average limit (dBuV/m)}$ .

**TX / GFSK / DH5 / CH High**

**Polarity: Vertical**



**Polarity: Horizontal**



**Operation Mode:** TX / GFSK / DH5 / CH High

**Test Date:** April 18, 2016

**Temperature:** 27°C

**Tested by:** Jason Lu

**Humidity:** 53 % RH

**Polarity:** Ver. / Hor.

| Frequency (MHz) | Reading (dBuV) | Correction (dB/m) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Remark | Ant.Pol. (H/V) |
|-----------------|----------------|-------------------|-----------------|----------------|-------------|--------|----------------|
| 4960.000        | 38.45          | 5.46              | 43.91           | 74.00          | -30.09      | peak   | V              |
| 4960.000        | 25.88          | 5.46              | 31.34           | 54.00          | -22.66      | AVG    | V              |
| 7440.000        | 35.33          | 13.33             | 48.66           | 74.00          | -25.34      | peak   | V              |
| 7440.000        | 23.37          | 13.33             | 36.70           | 54.00          | -17.30      | AVG    | V              |
| 9920.000        | 32.09          | 17.60             | 49.69           | 74.00          | -24.31      | peak   | V              |
| N/A             |                |                   |                 |                |             |        |                |
| 4960.000        | 37.89          | 5.46              | 43.35           | 74.00          | -30.65      | peak   | H              |
| 4960.000        | 25.79          | 5.46              | 31.25           | 54.00          | -22.75      | AVG    | H              |
| 7440.000        | 34.79          | 13.33             | 48.12           | 74.00          | -25.88      | peak   | H              |
| 7440.000        | 22.96          | 13.33             | 36.29           | 54.00          | -17.71      | AVG    | H              |
| 9920.000        | 32.84          | 17.60             | 50.44           | 74.00          | -23.56      | peak   | H              |
| N/A             |                |                   |                 |                |             |        |                |

**Remark:**

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Radiated emissions measured in frequency above 1000MHz were made with an instrument using peak/average detector mode.
3. Average test would be performed if the peak result were greater than the average limit.
4. Data of measurement within this frequency range shown " --- " in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
5. Measurements above show only up to 6 maximum emissions noted, or would be lesser, with " N/A " remark, if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.
6. Margin (dB) = Remark result (dBuV/m) – Average limit (dBuV/m).

## 7.9 POWERLINE CONDUCTED EMISSIONS

### LIMIT

According to §15.207(a) & RSS-Gen §7.2.4, except as shown in paragraphs (b) and (c) of this section, 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 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

| Frequency Range<br>(MHz) | Limits<br>(dB $\mu$ V) |           |
|--------------------------|------------------------|-----------|
|                          | Quasi-peak             | Average   |
| 0.15 to 0.50             | 66 to 56*              | 56 to 46* |
| 0.50 to 5                | 56                     | 46        |
| 5 to 30                  | 60                     | 50        |

\* Decreases with the logarithm of the frequency.

### Test Configuration

See test photographs attached in Appendix II for the actual connections between EUT and support equipment.

### TEST PROCEDURE

1. The EUT was placed on a table, which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. Repeat above procedures until all frequency measured were complete.

## **TEST RESULTS**

The initial step in collecting conducted data is a spectrum analyzer peak scan of the measurement range. Significant peaks are then marked as shown on the following data page, and these signals are then quasi-peaked.

### **Test Data**

**Operation Mode:** Normal Link      **Test Date:** April 18, 2016  
**Temperature:** 24°C      **Tested by:** Dennis Li  
**Humidity:** 50% RH

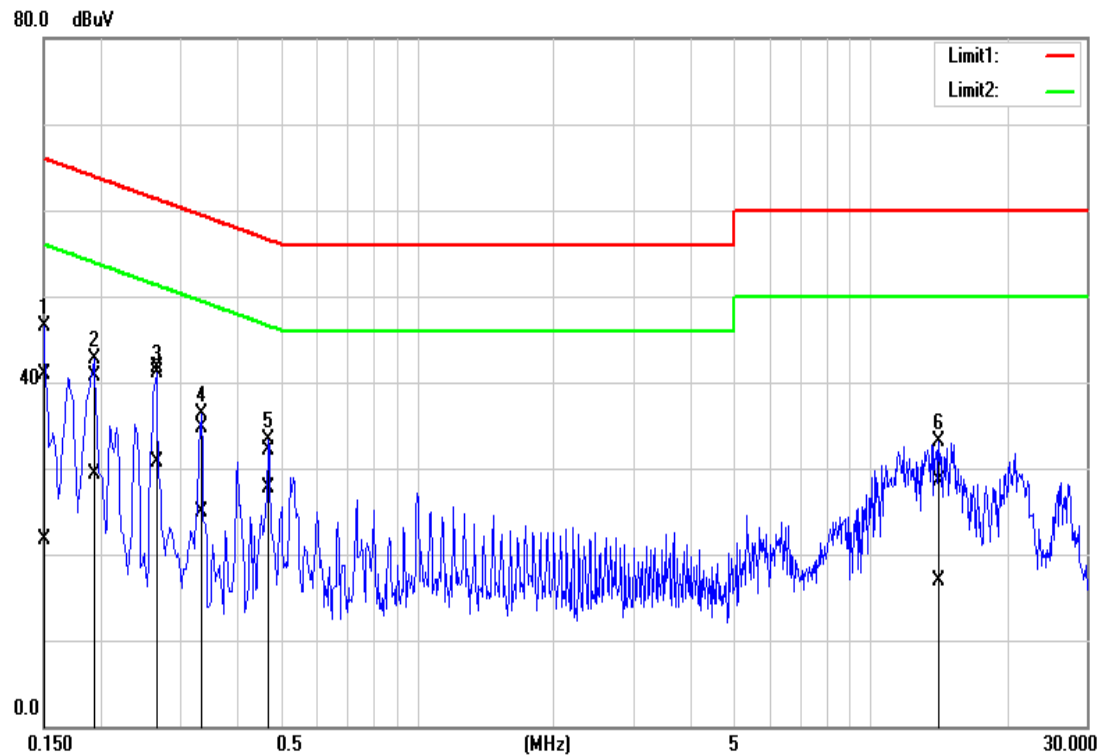
| Freq. (MHz) | QP Reading (dBuV) | AV Reading (dBuV) | Corr. factor (dB/m) | QP Result (dBuV/m) | AV Result (dBuV/m) | QP Limit (dBuV) | AV Limit (dBuV) | QP Margin (dB) | AV Margin (dB) | Note |
|-------------|-------------------|-------------------|---------------------|--------------------|--------------------|-----------------|-----------------|----------------|----------------|------|
| 0.1500      | 31.11             | 11.98             | 9.77                | 40.88              | 21.75              | 65.99           | 56.00           | -25.11         | -34.25         | L1   |
| 0.1940      | 31.00             | 19.51             | 9.76                | 40.76              | 29.27              | 63.86           | 53.86           | -23.10         | -24.59         | L1   |
| 0.2660      | 31.87             | 20.93             | 9.76                | 41.63              | 30.69              | 61.24           | 51.24           | -19.61         | -20.55         | L1   |
| 0.3339      | 24.91             | 15.12             | 9.77                | 34.68              | 24.89              | 59.35           | 49.35           | -24.67         | -24.46         | L1   |
| 0.4700      | 22.18             | 17.82             | 9.87                | 32.05              | 27.69              | 56.51           | 46.51           | -24.46         | -18.82         | L1   |
| 14.1740     | 18.48             | 6.85              | 10.09               | 28.57              | 16.94              | 60.00           | 50.00           | -31.43         | -33.06         | L1   |
| 0.1620      | 27.24             | 17.67             | 9.84                | 37.08              | 27.51              | 65.36           | 55.36           | -28.28         | -27.85         | L2   |
| 0.2020      | 40.40             | 27.43             | 9.83                | 50.23              | 37.26              | 63.52           | 53.53           | -13.29         | -16.27         | L2   |
| 0.2700      | 30.27             | 19.80             | 9.83                | 40.10              | 29.63              | 61.12           | 51.12           | -21.02         | -21.49         | L2   |
| 0.4660      | 21.30             | 17.72             | 9.92                | 31.22              | 27.64              | 56.58           | 46.58           | -25.36         | -18.94         | L2   |
| 0.5340      | 20.24             | 15.98             | 10.02               | 30.26              | 26.00              | 56.00           | 46.00           | -25.74         | -20.00         | L2   |
| 13.7820     | 18.01             | 7.63              | 10.37               | 28.38              | 18.00              | 60.00           | 50.00           | -31.62         | -32.00         | L2   |

### **Remark:**

1. Measuring frequencies from 0.15 MHz to 30MHz.
2. The emissions measured in frequency range from 0.15 MHz to 30MHz were made with an instrument using Quasi-peak detector and average detector.
3. The IF bandwidth of SPA between 0.15MHz to 30MHz was 10kHz; the IF bandwidth of Test Receiver between 0.15MHz to 30MHz was 9kHz;
4. L1 = Line One (Live Line) / L2 = Line Two (Neutral Line)

## Test Plots

### Conducted emissions (Line 1)



### Conducted emissions (Line 2)

