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# Report On

Application for Grant of Equipment Authorization of the  
NX35-C200 Vehicle Tracking System

FCC Part 15 Subpart C §15.247 (DTS)  
RSS-247 Issue 2 February 2017

**Report No. JT72130952-0817B**

**October 2017**

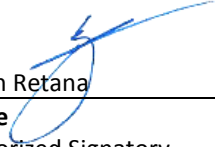


**REPORT ON** Radio Testing of the  
NX35-C200 Vehicle Tracking System

**TEST REPORT NUMBER** JT72130952-0817B

**PREPARED FOR** Novatel Wireless Inc  
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Title: EMC/Senior Wireless Test Engineer

**DATED** October 17, 2017



## Revision History

| JT72130952-0817B<br>NX35-C200 Vehicle Tracking System |              |                 |        |                |                       |
|-------------------------------------------------------|--------------|-----------------|--------|----------------|-----------------------|
| DATE                                                  | OLD REVISION | NEW REVISION    | REASON | PAGES AFFECTED | APPROVED BY           |
| 10/17/2017                                            |              | Initial Release |        |                | Ferdinand S. Custodio |
|                                                       |              |                 |        |                |                       |
|                                                       |              |                 |        |                |                       |
|                                                       |              |                 |        |                |                       |
|                                                       |              |                 |        |                |                       |

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## **SECTION 1**

### **REPORT SUMMARY**

Radio Testing of the  
NX35-C200 Vehicle Tracking System

## 1.1 INTRODUCTION

The information contained in this report is intended to show verification of the NX35-C200 Vehicle Tracking System to the requirements of FCC Part 15 Subpart C §15.247 and RSS-247 Issue 2 February 2017.

|                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|-------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Objective                     | To perform Radio Testing to determine the Equipment Under Test's (EUT's) compliance with the Test Specification, for the series of tests carried out.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Manufacturer                  | Ctrack                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Model Number(s)               | NX35-C200                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| FCC ID Number                 | PKRNVWNX35C200                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| IC Number                     | 3229A-NX35C200                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Serial Number(s)              | EMC Sample 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Number of Samples Tested      | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Test Specification/Issue/Date | <ul style="list-style-type: none"><li>• FCC Part 15 Subpart C §15.247 (October 1, 2016).</li><li>• RSS-247 Issue 2 February 2017 - Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices.</li><li>• RSS-Gen Issue 4 November 2014 – General Requirements for Compliance of Radio Apparatus.</li><li>• 558074 D01 DTS Meas Guidance v04 (April 05, 2017) Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247.</li><li>• ANSI C63.10-2013. American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices</li></ul> |
| Start of Test                 | October 04, 2017                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Finish of Test                | October 05, 2017                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Name of Engineer(s)           | Ivan Retana                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Related Document(s)           | None. Supporting documents for EUT certification are separate exhibits.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |

## 1.2 BRIEF SUMMARY OF RESULTS

A brief summary of the tests carried out in accordance with FCC Part 15 Subpart C §15.247 with cross-reference to the corresponding IC RSS standard is shown below.

| Section | §15.247 Spec Clause | RSS                  | Test Description                                      | Result           | Comments/<br>Base Standard |
|---------|---------------------|----------------------|-------------------------------------------------------|------------------|----------------------------|
| 2.1     | §15.247(b)(3)       | RSS-247 5.4(d)       | Maximum Conducted Output Power                        | Compliant        |                            |
| 2.2     | §15.207(a)          | RSS-Gen 8.8          | Conducted Emissions                                   | N/A <sup>1</sup> |                            |
| 2.3     |                     | RSS-Gen 6.6          | 99% Emission Bandwidth                                | Compliant        |                            |
| 2.4     | §15.247(a)(2)       | RSS-247 5.2(a)       | Minimum 6 dB RF Bandwidth                             | Compliant        |                            |
| 2.5     | §15.247(d)          | RSS-247 5.5          | Out-of-Band Emissions - Conducted                     | Compliant        |                            |
| 2.6     | §15.247(d)          | RSS-247 5.5          | Band-edge Compliance of RF Conducted Emissions        | Compliant        |                            |
| 2.7     | §15.247(d)          | RSS-Gen 8.9 and 8.10 | Spurious Radiated Emissions                           | Compliant        |                            |
| 2.8     | §15.247(e)          | RSS-247 5.2(b)       | Power Spectral Density for Digitally Modulated Device | Compliant        |                            |

**Test Notes:**

- 1 Test Not Applicable. EUT is a battery-operated device.

### 1.3 PRODUCT INFORMATION

#### 1.3.1 Technical Description

The Equipment Under Test (EUT) was a NX35-C200 Vehicle Tracking System. The NX35 device is designed to accurately track position and other data of vehicles or assets and report this data to a data centre. The NX35 is used to gather information relevant to fleet management services, to plot a vehicle position on a map and also to follow the route taken by a vehicle during a journey. The position and speed of the vehicle is sampled using GNSS (Global Navigation Satellite System) and reported through a GSM modem data link with industry standard communication protocols.

#### 1.3.2 EUT General Description

|                    |                                                                                                                                   |
|--------------------|-----------------------------------------------------------------------------------------------------------------------------------|
| EUT Description    | NX35-C200 Vehicle Tracking System                                                                                                 |
| Model Number(s)    | NX35-C200                                                                                                                         |
| Rated Voltage      | 6.0 – 32.0VDC                                                                                                                     |
| Mode Verified      | Bluetooth Low Energy (BT LE)                                                                                                      |
| Capability         | CDMA 1xRTT 800/1900MHz, GPS/GNSS, and Bluetooth/BLE                                                                               |
| Primary Unit (EUT) | <input checked="" type="checkbox"/> Production<br><input type="checkbox"/> Pre-Production<br><input type="checkbox"/> Engineering |
| Antenna Gain       | 2.3 dBi                                                                                                                           |

#### 1.3.3 Maximum Peak Conducted Output Power

| Mode         | Frequency Range (MHz) | Output Power (dBm) | Output Power (mW) |
|--------------|-----------------------|--------------------|-------------------|
| Bluetooth LE | 2402 – 2480           | 5.4                | 3.47              |



## 1.4 EUT TEST CONFIGURATION

### 1.4.1 Test Configuration Description

| Test Configuration | Description                                                                                                                                                                                     |
|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Default            | EUT connected to a support laptop via a USB to RS232 cable to enable BLE transmit mode. Tools and software were provided by the manufacturer and was used to configure RF parameter of the EUT. |

### 1.4.2 EUT Exercise Software

None. No special software used to exercise the EUT.  
 Commands were sent through a Terminal applications, TeraTerm and CMD.

### 1.4.3 Support Equipment and I/O cables

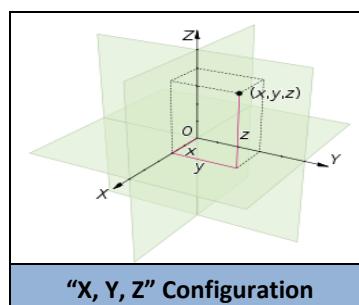
| Manufacturer | Equipment/Cable | Description                                                  |
|--------------|-----------------|--------------------------------------------------------------|
| Apple        | Support Laptop  | Support laptop used to configure EUT RF parameter setting    |
| Treadnet     | USB to RS232    | Interface communication board between EUT and support laptop |

### 1.4.4 Worst Case Configuration

Worst-case configuration used in this test report as per maximum conducted output power measurements:

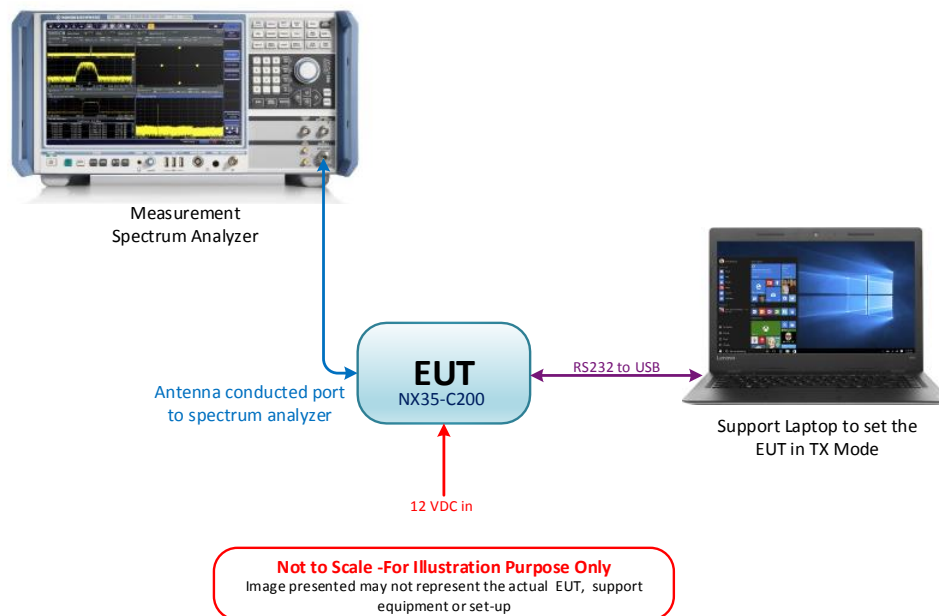
| Mode         | Channel                | Data Length |
|--------------|------------------------|-------------|
| Bluetooth LE | 2440 MHz (Mid Channel) | 10          |

For radiated measurements X, Y and Z orientations were verified. Worst case position is "X".

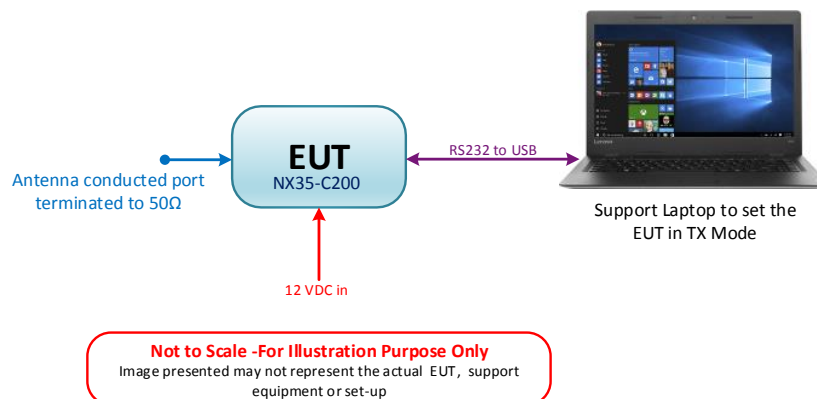


#### 1.4.5 Simplified Test Configuration Diagram

##### Conducted Port Setup



##### Radiated Spurious Emissions Setup



## 1.5 DEVIATIONS FROM THE STANDARD

No deviations from the applicable test standards or test plan were made during testing.

## 1.6 MODIFICATION RECORD

| Description of Modification | Modification Fitted By | Date Modification Fitted |
|-----------------------------|------------------------|--------------------------|
| Serial Number: EMC Sample 1 |                        |                          |
| None                        | —                      | —                        |

The table above details modifications made to the EUT during the test programme. The modifications incorporated during each test (if relevant) are recorded on the appropriate test pages.

## 1.7 TEST METHODOLOGY

All measurements contained in this report were conducted with ANSI C63.10-2013. American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

For conducted and radiated emissions, the equipment under test (EUT) was configured to measure its highest possible emission level. This level was based on the maximized cable configuration from exploratory testing per ANSI C63.4-2014. The test modes were adapted according to the Operating Instructions provided by the manufacturer/client.

## 1.8 TEST FACILITY LOCATION

### 1.8.1 TÜV SÜD America Inc. (Mira Mesa)

10040 Mesa Rim Road, San Diego, CA 92121-2912 (32.901268,-117.177681). Phone: 858 678 1400 Fax: 858-546 0364

### 1.8.2 TÜV SÜD America Inc. (Rancho Bernardo)

16936 Via Del Campo, San Diego, CA 92127-1708 (33.018644,-117.092409). Phone: 858 678 1400 Fax: 858 546 0364.

## 1.9 TEST FACILITY REGISTRATION

### 1.9.1 FCC – Designation No.: US1146

TUV SUD America Inc. (San Diego), is an accredited test facility with the site description report on file and has met all the requirements specified in §2.948 of the FCC rules. The acceptance letter from the FCC is maintained in our files and the Designation is US1146.



**1.9.2 Innovation, Science and Economic Development Canada Registration (ISED) No.: 3067A-1 & 22806-1**

The 10m Semi-anechoic chamber of TÜV SÜD America Inc. (San Diego Rancho Bernardo) has been registered by Certification and Engineering Bureau of Innovation, Science and Economic Development Canada (ISED) for radio equipment testing with Registration No. 3067A-1.

The 3m Semi-anechoic chamber of TÜV SÜD America Inc. (San Diego Mira Mesa) has been registered by Certification and Engineering Bureau of Innovation, Science and Economic Development Canada (ISED) for radio equipment testing with Registration No. 22806-1.



## **SECTION 2**

### **TEST DETAILS**

Radio Testing of the  
NX35-C200 Vehicle Tracking System



## **2.1 MAXIMUM CONDUCTED OUTPUT POWER**

### **2.1.1 Specification Reference**

Part 15 Subpart C §15.247(b)(3) and RSS-247 5.4(d)

### **2.1.2 Standard Applicable**

(3) For systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

### **2.1.3 Equipment Under Test and Modification State**

Serial No: EMC Sample 1 / Default Test Configuration

### **2.1.4 Date of Test/Initial of test personnel who performed the test**

October 04, 2017 / IR

### **2.1.5 Test Equipment Used**

The major items of test equipment used for the above tests are identified in Section 3.1.

### **2.1.6 Environmental Conditions**

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

|                     |          |
|---------------------|----------|
| Ambient Temperature | 25.2 °C  |
| Relative Humidity   | 48.2%    |
| ATM Pressure        | 99.0 kPa |

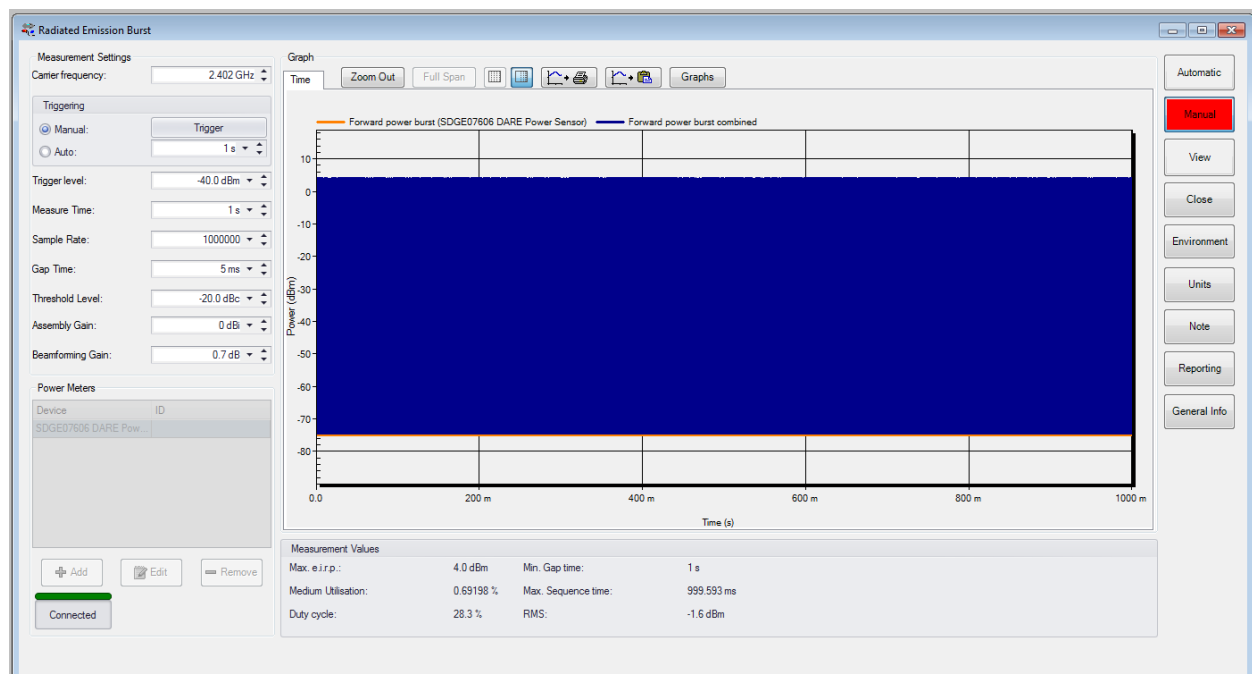
### **2.1.7 Additional Observations**

- This is a conducted test (Maximum peak conducted output power) using direct connection to a power meter.
- An offset of 0.7dB was added to compensate for the cable used from the antenna port to the power sensor.
- Test methodology is per Clause 9.1.2 of KDB 558074 D01 DTS Meas Guidance v03r05 (April 08, 2016) Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247.

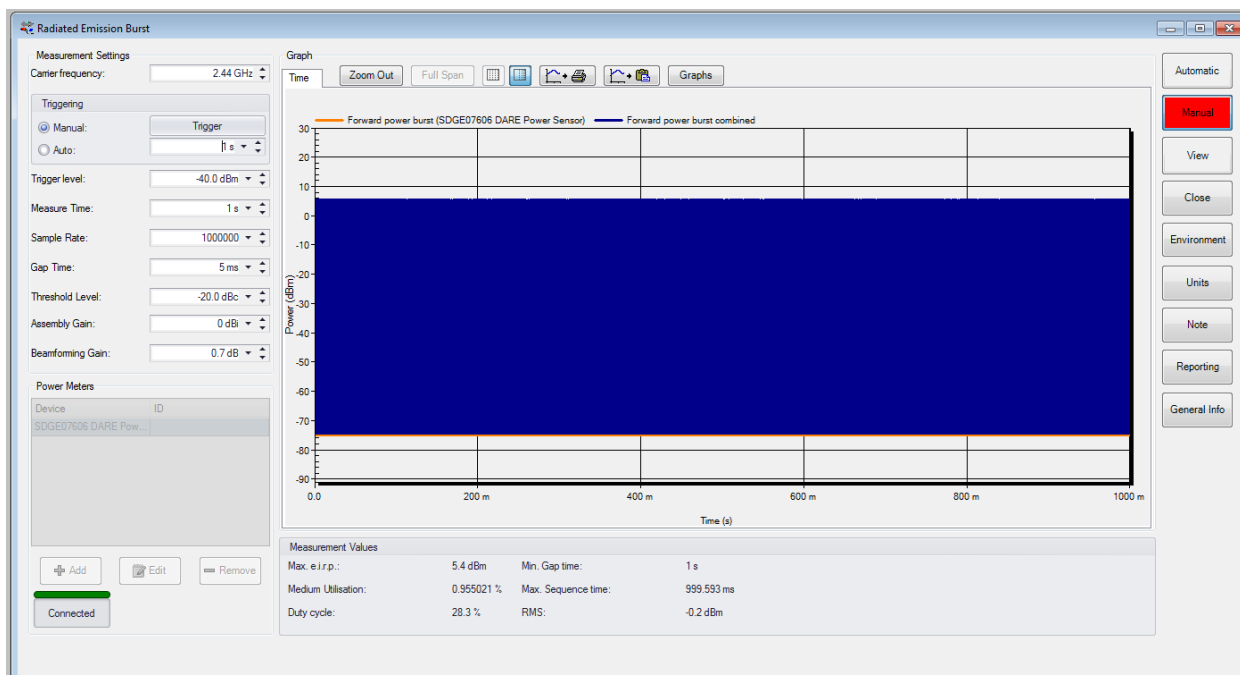
## 2.1.8 Test Results

| Bluetooth Low Energy (LE)                                                         | Channel  | Modulation | Measured Average Power (dBm) |
|-----------------------------------------------------------------------------------|----------|------------|------------------------------|
|  | 2402 MHz | GFSK       | 4.0                          |
|                                                                                   | 2440 MHz |            | 5.4                          |
|                                                                                   | 2480 MHz |            | 5.0                          |

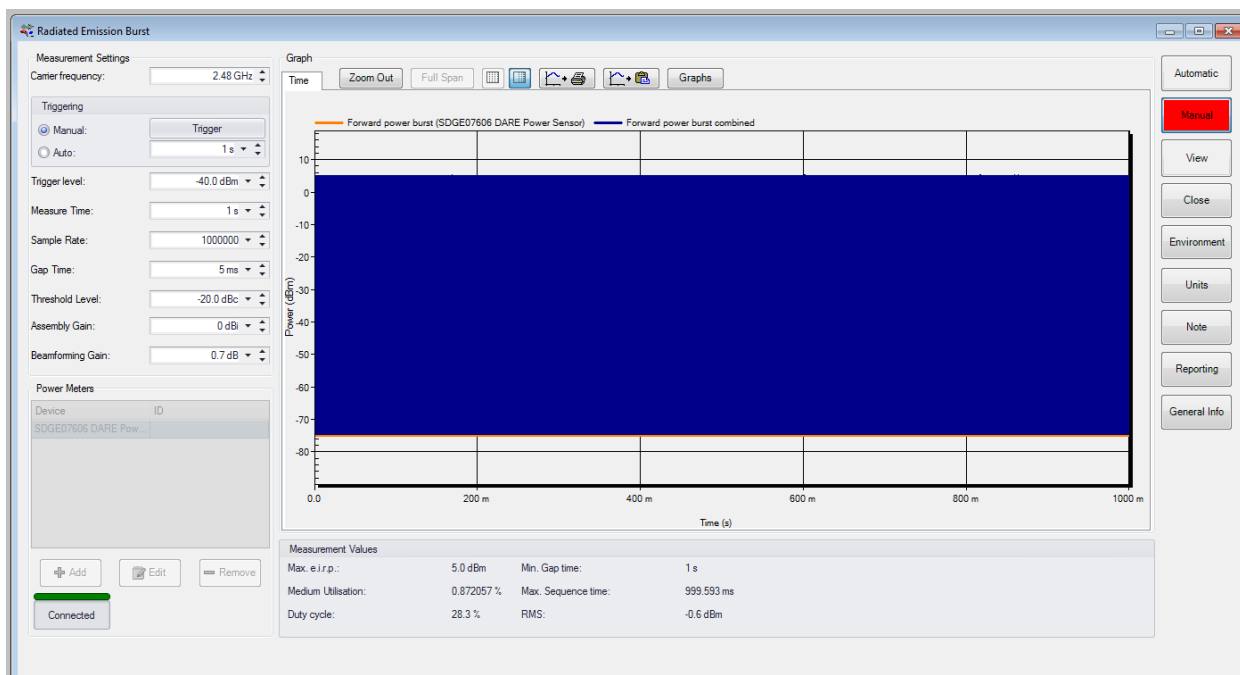
## 2.1.9 Test Plots



Low Channel BT LE



Mid Channel BT LE



High Channel BT LE



## **2.2 99% EMISSION BANDWIDTH**

### **2.2.1 Specification Reference**

RSS-Gen Clause 6.6

### **2.2.2 Standard Applicable**

The emission bandwidth (x dB) is defined as the frequency range between two points, one above and one below the carrier frequency, at which the spectral density of the emission is attenuated x dB below the maximum in-band spectral density of the modulated signal. Spectral density (power per unit bandwidth) is to be measured with a detector of resolution bandwidth in the range of 1% to 5% of the anticipated emission bandwidth, and a video bandwidth at least 3x the resolution bandwidth.

When the occupied bandwidth limit is not stated in the applicable RSS or reference measurement method, the transmitted signal bandwidth shall be reported as the 99% emission bandwidth, as calculated or measured.

- The transmitter shall be operated at its maximum carrier power measured under normal test conditions.
- • The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts.
- • 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 3x RBW.

Note: Video averaging is not permitted.

A peak, or peak hold, may be used in place of the sampling detector as this may produce a wider bandwidth than the actual bandwidth (worst-case measurement). Use of a peak hold may be necessary to determine the occupied bandwidth if the device is not transmitting continuously.

The trace data points are recovered and are directly summed in linear power level terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached and that frequency recorded. The process is repeated for the highest frequency data points (starting at the highest frequency, at the right side of the span, and going down in frequency). This frequency is then recorded.

The difference between the two recorded frequencies is the 99% occupied bandwidth.

### **2.2.3 Equipment Under Test and Modification State**

Serial No: EMC Sample 1 / Default Test Configuration

### **2.2.4 Date of Test/Initial of test personnel who performed the test**

October 04, 2017 / IR

### **2.2.5 Test Equipment Used**

The major items of test equipment used for the above tests are identified in Section 3.1.

#### 2.2.6 Environmental Conditions/ Test Location

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

|                     |          |
|---------------------|----------|
| Ambient Temperature | 25.2 °C  |
| Relative Humidity   | 48.2%    |
| ATM Pressure        | 99.0 kPa |

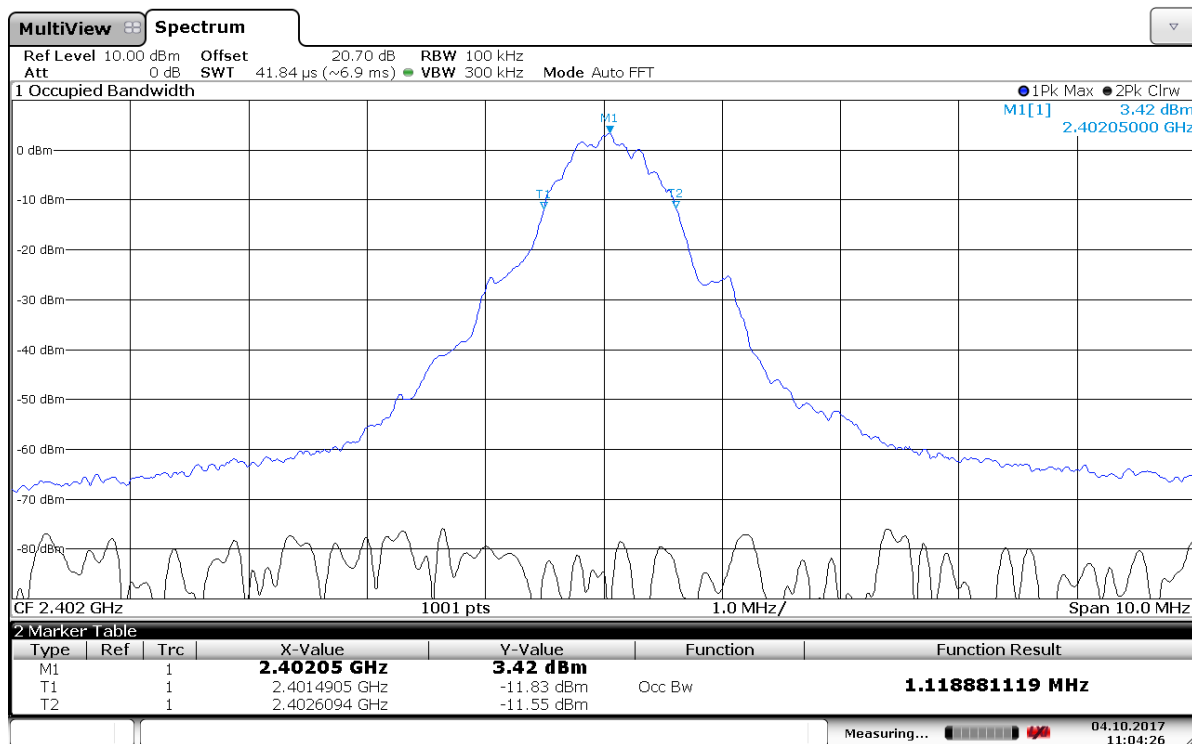
#### 2.2.7 Additional Observations

- This is a conducted test.
- An offset of 20.7dB was added to compensate for the external attenuator and cable used from the antenna port to the spectrum analyzer.
- Span is wide enough to capture the channel transmission.
- RBW is 1% of the span.
- VBW is 3X RBW.
- Sweep is auto.
- Detector is peak.
- The % Power Bandwidth setting in the spectrum analyzer was set to 99% (default).
- The Channel Bandwidth measurement function of the spectrum analyzer was used for this test.

#### 2.2.8 Test Results (For reporting purposes only)

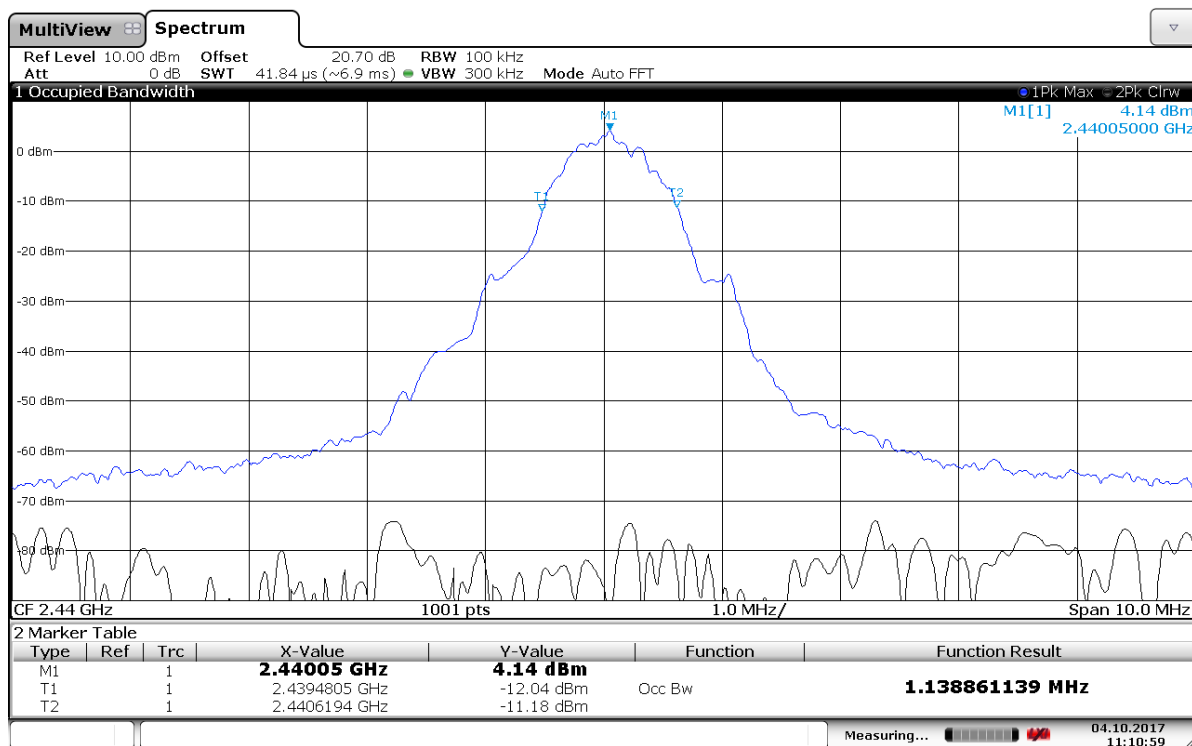
| Mode         | Channel  | Measured 99% Bandwidth (MHz) |
|--------------|----------|------------------------------|
| Bluetooth LE | 2402 MHz | 1.118                        |
|              | 2440 MHz | 1.138                        |
|              | 2480 MHz | 1.138                        |

## 2.2.9 Test Results Plots



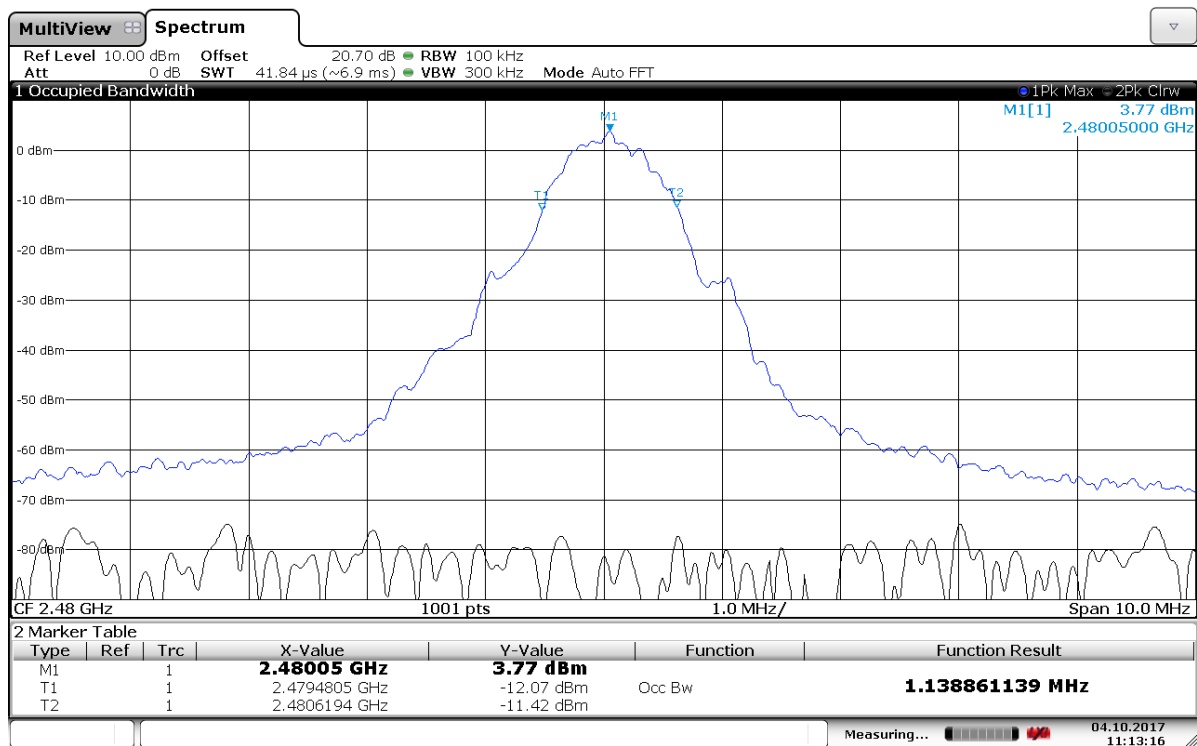
Date: 4.OCT.2017 11:04:25

### Low Channel BT LE



Date: 4.OCT.2017 11:10:59

### Mid Channel BT LE



Date: 4.OCT.2017 11:13:16

### High Channel BT LE

## **2.3 MINIMUM 6 dB RF BANDWIDTH**

### **2.3.1 Specification Reference**

Part 15 Subpart C §15.247(a)(2) and RSS-247 5.2(a)

### **2.3.2 Standard Applicable**

(2) Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

### **2.3.3 Equipment Under Test and Modification State**

Serial No: EMC Sample 1 / Default Test Configuration

### **2.3.4 Date of Test/Initial of test personnel who performed the test**

October 04, 2017 / IR

### **2.3.5 Test Equipment Used**

The major items of test equipment used for the above tests are identified in Section 3.1.

### **2.3.6 Environmental Conditions/ Test Location**

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

|                     |          |
|---------------------|----------|
| Ambient Temperature | 25.2 °C  |
| Relative Humidity   | 48.2%    |
| ATM Pressure        | 99.0 kPa |

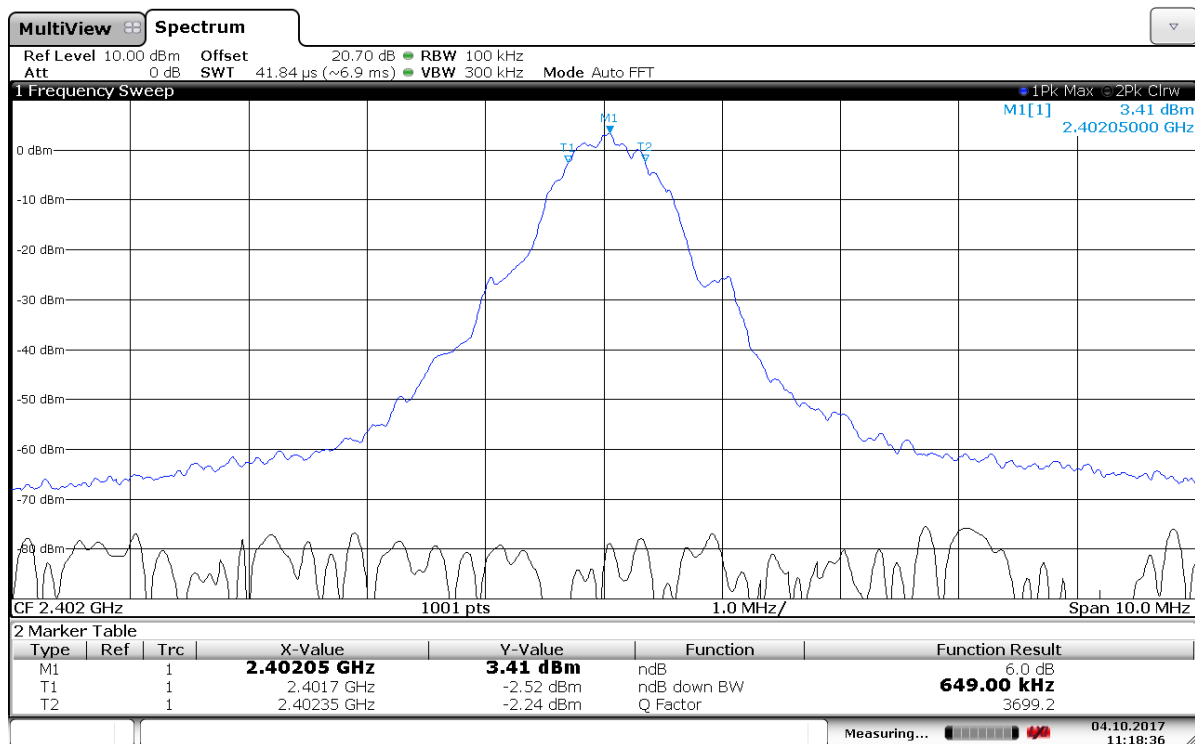
### **2.3.7 Additional Observations**

- This is a conducted test.
- An offset 20.7dB was added to compensate for the external attenuator and cable used from the antenna port to the spectrum analyser.
- Span is wide enough to capture the channel transmission.
- RBW was set to 100 kHz while VBW is  $\geq 3X$  RBW.
- Sweep is auto while Detector used is peak.
- The “n” dB down marker function of the spectrum analyzer was used for this test.

## 2.3.8 Test Results

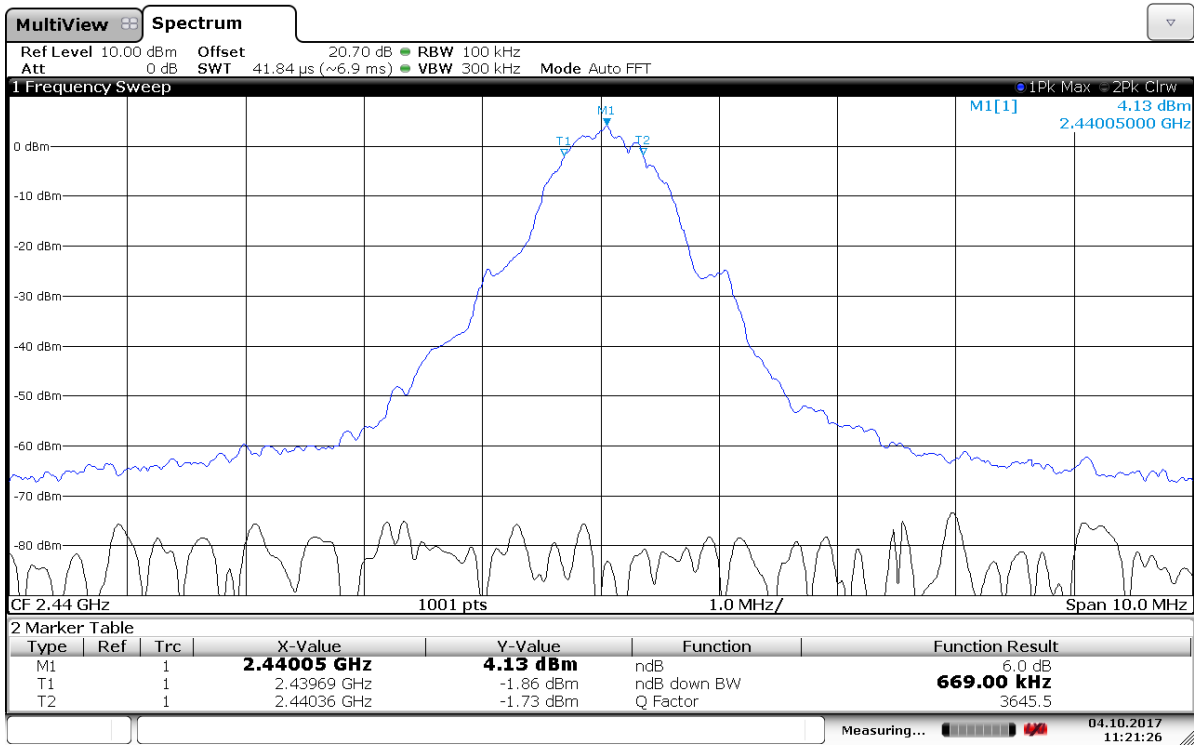
| Mode         | Channel  | Measured Bandwidth (MHz) | Minimum Bandwidth (MHz) | Compliance |
|--------------|----------|--------------------------|-------------------------|------------|
| Bluetooth LE | 2402 MHz | 0.649                    | 0.500                   | Complies   |
|              | 2440 MHz | 0.669                    | 0.500                   | Complies   |
|              | 2480 MHz | 0.699                    | 0.500                   | Complies   |

## 2.3.9 Test Results Plots



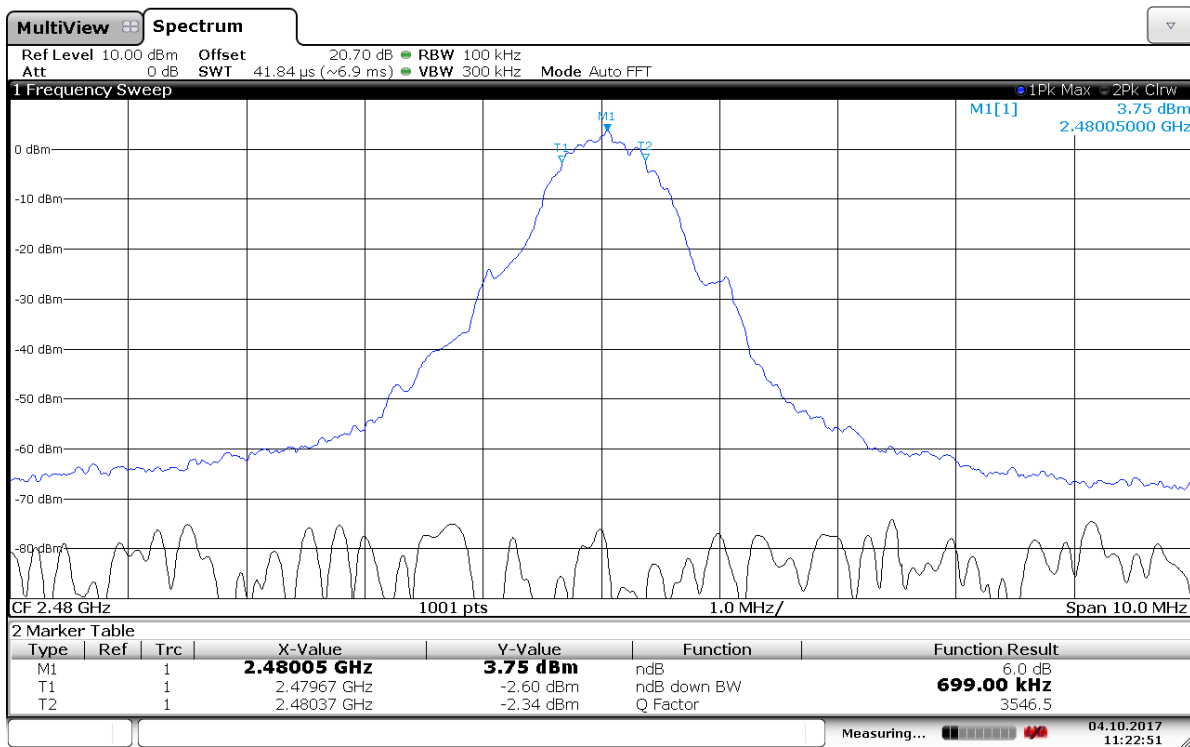
Date: 4.OCT.2017 11:18:36

Low Channel BT LE



Date: 4.OCT.2017 11:21:25

### Mid Channel BT LE



Date: 4.OCT.2017 11:22:51

### High Channel BT LE

## **2.4 OUT-OF-BAND EMISSIONS - CONDUCTED**

### **2.4.1 Specification Reference**

Part 15 Subpart C §15.247(d) and RSS-247 5.5

### **2.4.2 Standard Applicable**

(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 §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

### **2.4.3 Equipment Under Test and Modification State**

Serial No: EMC Sample 1 / Default Test Configuration

### **2.4.4 Date of Test/Initial of test personnel who performed the test**

October 04, 2017 / IR

### **2.4.5 Test Equipment Used**

The major items of test equipment used for the above tests are identified in Section 3.1.

### **2.4.6 Environmental Conditions/ Test Location**

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

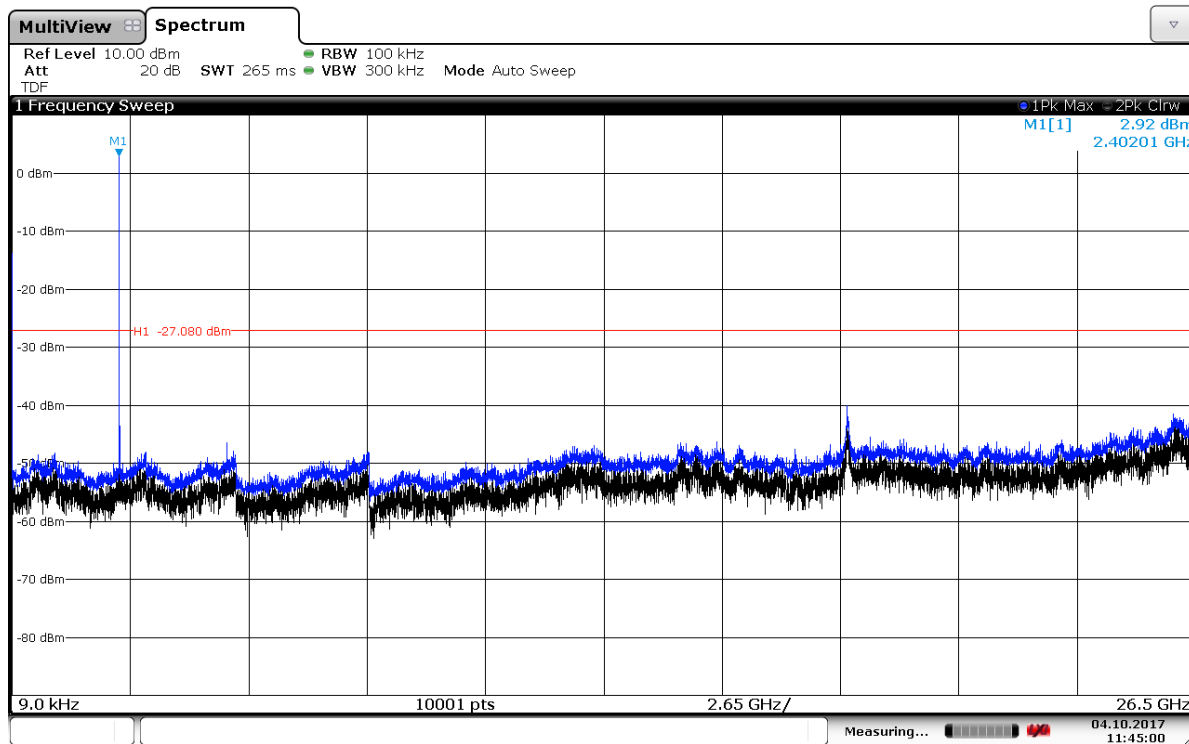
|                     |          |
|---------------------|----------|
| Ambient Temperature | 25.2 °C  |
| Relative Humidity   | 48.2%    |
| ATM Pressure        | 99.0 kPa |

### **2.4.7 Additional Observations**

- This is a conducted test.
- A Transducer Factor (TDF) was set for the external attenuator and cable used from the antenna port to the spectrum analyzer.
- RBW is 100kHz.VBW is 3X RBW.
- Sweep is auto. Detector is peak. Trace is max hold.
- Initial scan was performed to determine the highest level of the desired power within the band. Limit (display line) was drawn 30dB below this level (worst case).
- Spectrum was searched from 9 kHz up to 26.5GHz.

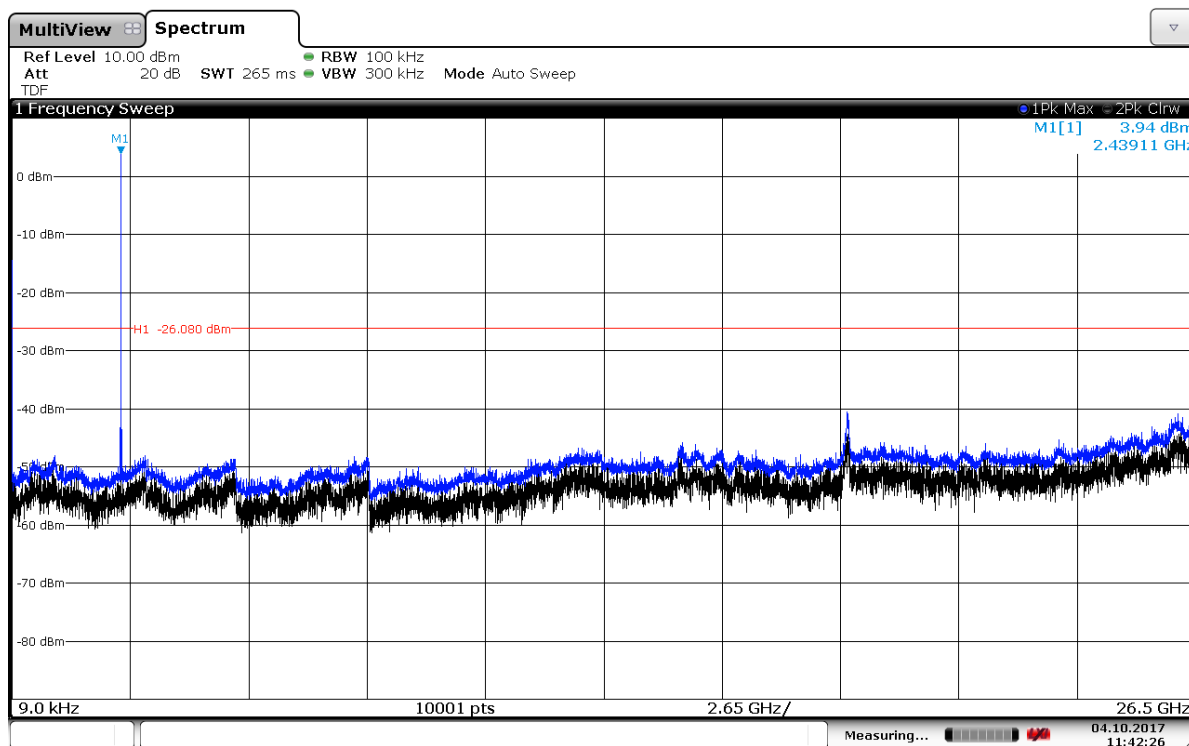


## 2.4.8 Test Results Plots



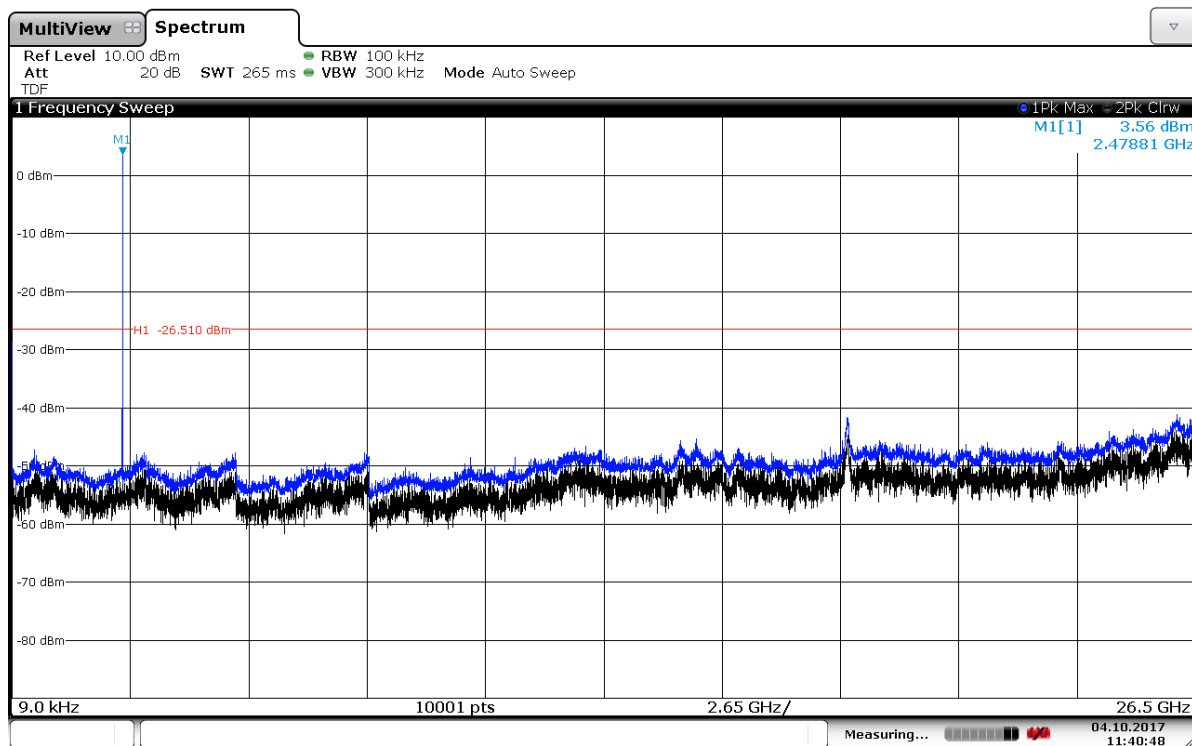
Date: 4.OCT.2017 11:44:59

Low Channel BT LE



Date: 4.OCT.2017 11:42:27

Mid Channel BT LE



Date: 4. OCT. 2017 11:40:48

### High Channel BT LE



## **2.5 BAND-EDGE COMPLIANCE OF RF CONDUCTED EMISSIONS**

### **2.5.1 Specification Reference**

Part 15 Subpart C §15.247(d) and RSS-247 5.5

### **2.5.2 Standard Applicable**

(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 §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

### **2.5.3 Equipment Under Test and Modification State**

Serial No: EMC Sample 1 / Default Test Configuration

### **2.5.4 Date of Test/Initial of test personnel who performed the test**

October 05, 2017 / IR

### **2.5.5 Test Equipment Used**

The major items of test equipment used for the above tests are identified in Section 3.1.

### **2.5.6 Environmental Conditions/ Test Location**

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

|                     |          |
|---------------------|----------|
| Ambient Temperature | 24.9 °C  |
| Relative Humidity   | 42.6%    |
| ATM Pressure        | 98.5 kPa |

### **2.5.7 Additional Observations**

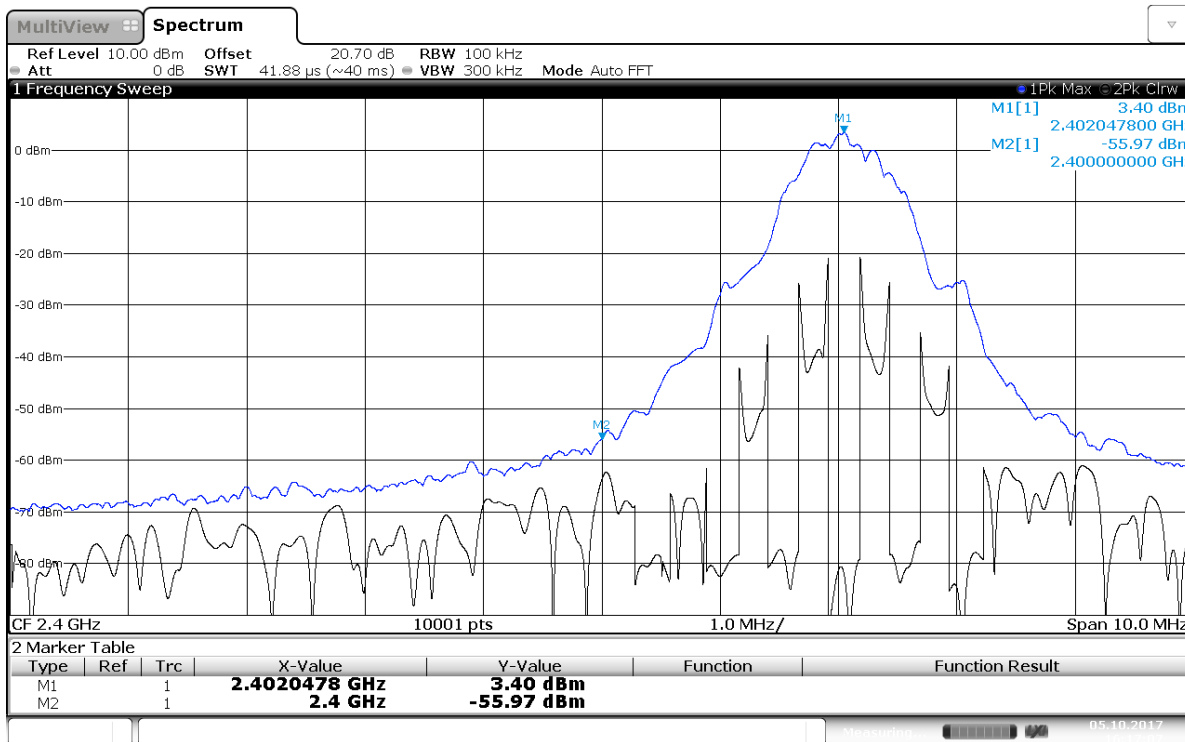
- This is a conducted test.
- An offset of 20.7dB was added to compensate for the external attenuator and cable used from the antenna port to the spectrum analyzer
- RBW is 100kHz.VBW is 3X RBW.
- Sweep is auto. Detector is peak. Trace is max hold.
- Trace was centered on the band-edge frequency.
- Span was set to encompass the band-edge frequency and the peak of the emission.



- Using Marker function, peak of the emission was determined and the delta to the band-edge frequency measured (for EUT OBW edge not within 2MHz of the authorized band edge).

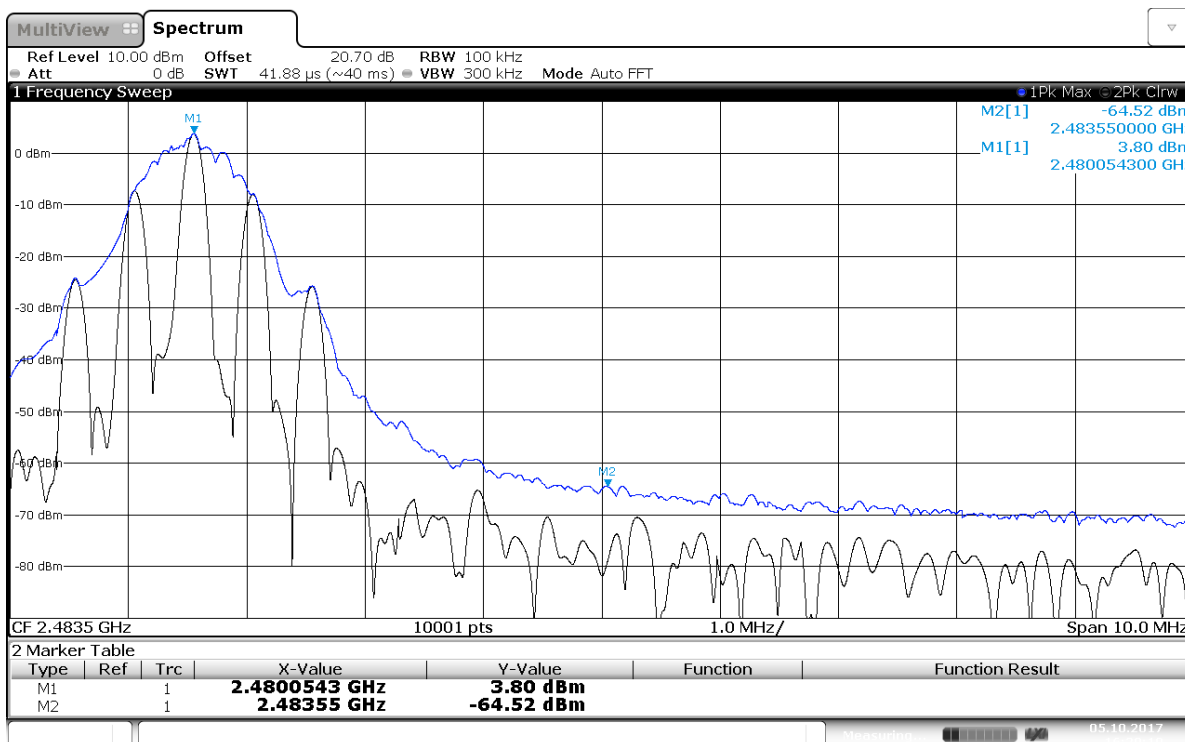
#### **2.5.8 Test Results**

**Complies.** See attached plots.



Date: 5.OCT.2017 16:17:06

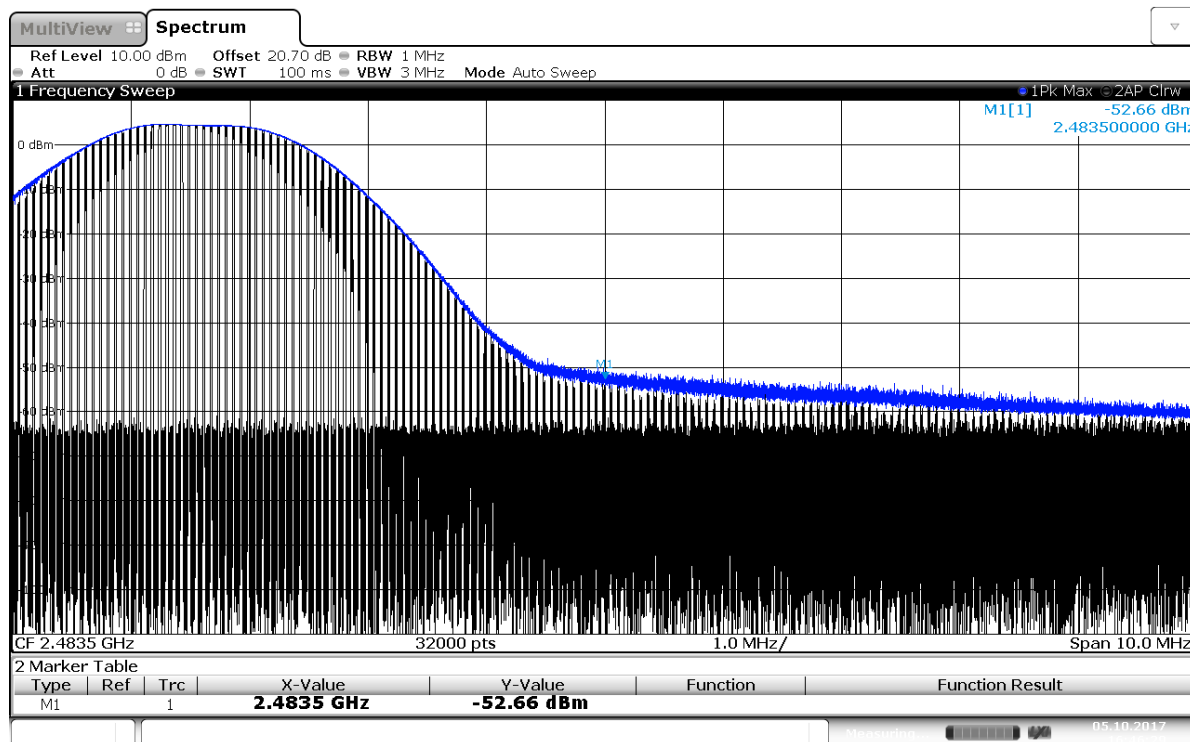
### Low Channel BT LE (2402 MHz)



Date: 5.OCT.2017 16:29:19

### High Channel BT LE (2480 MHz)

## 2.5.9 Band Edge Verification in the Restricted Band (Conducted Method)



Date: 5.OCT.2017 16:46:29

### Upper Band Edge (in Restricted Band) measurement using Peak Power measurement procedure as per Clause 12.2.4 of KDB 558074

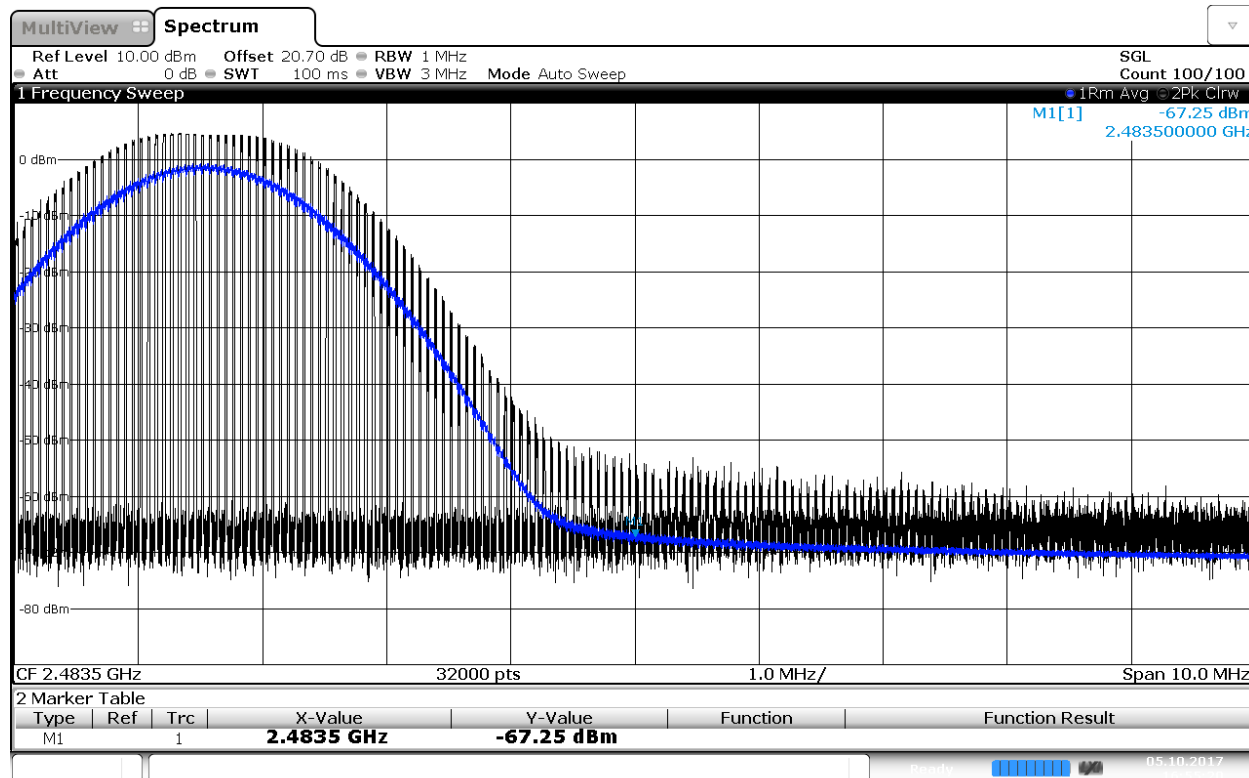
Measured Peak = -56.66 dBm, since antenna gain is 2.3dBi then EIRP is -54.66. Using the formula:

$$E = \text{EIRP} - 20\log D + 104.8$$

Where:

- E = electric field strength in dBμV/m
- EIRP = equivalent isotropic radiated power in dBm
- D = specific measurement distance in meters

E is therefore = -54.66 dBm – (20log 3 meters) + 104.8  
 = 40.59 dBμV/m @ 3 meters (**Complies** with the limit of 74 dBμV/m)



Date: 5.OCT.2017 16:55:20

**Upper Band Edge (in Restricted Band) measurement using Average Power measurement procedure as per Clause 12.2.5 of KDB 558074**

Measured RMS = -67.25 dBm, since antenna gain is 2.3 dBi then EIRP is: -64.95 . Using the formula:

$$E = \text{EIRP} - 20\log D + 104.8$$

Where:

- E = electric field strength in dB $\mu$ V/m
- EIRP = equivalent isotropic radiated power in dBm
- D = specific measurement distance in meters

E is therefore = -64.95 dBm – (20log 3 meters) + 104.8  
 = 30.30 dB $\mu$ V/m @ 3 meters (**Complies** with the limit of 54 dB $\mu$ V/m)

## **2.6 RADIATED SPURIOUS EMISSIONS**

### **2.6.1 Specification Reference**

Part 15 Subpart C §15.247(d) and RSS-Gen 8.9 and 8.10

### **2.6.2 Standard Applicable**

(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 §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

### **2.6.3 Equipment Under Test and Modification State**

Serial No: EMC Sample 1 / Default Test Configuration

### **2.6.4 Date of Test/Initial of test personnel who performed the test**

October 04, 2017 / IR

### **2.6.5 Test Equipment Used**

The major items of test equipment used for the above tests are identified in Section 3.1.

### **2.6.6 Environmental Conditions**

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

|                     |          |
|---------------------|----------|
| Ambient Temperature | 25.2 °C  |
| Relative Humidity   | 48.2%    |
| ATM Pressure        | 99.0 kPa |

### **2.6.7 Additional Observations**

- This is a radiated test. The spectrum was searched from 30MHz to the 10<sup>th</sup> harmonic.
- Test Methodology is per Clause 12.2.7 of KDB558074 D01 DTS Meas Guidance v03r05.
- There are no emissions found that do not comply to the restricted bands defined in FCC Part 15 Subpart C, 15.205 or Part 15.247(d).
- Only the worst case channel presented. Conducted port sample was presented for radiated emission test and the antenna port was terminated with 50ohm termination during evaluation for cabinet spurious emissions.



- Only noise floor measurements observed above 18GHz.
- Measurement was done using EMC32 automated software. Reported level is the actual level with all the correction factors factored in. Correction Factor column is for informational purposes only. See Section 2.6.8 for sample computation.

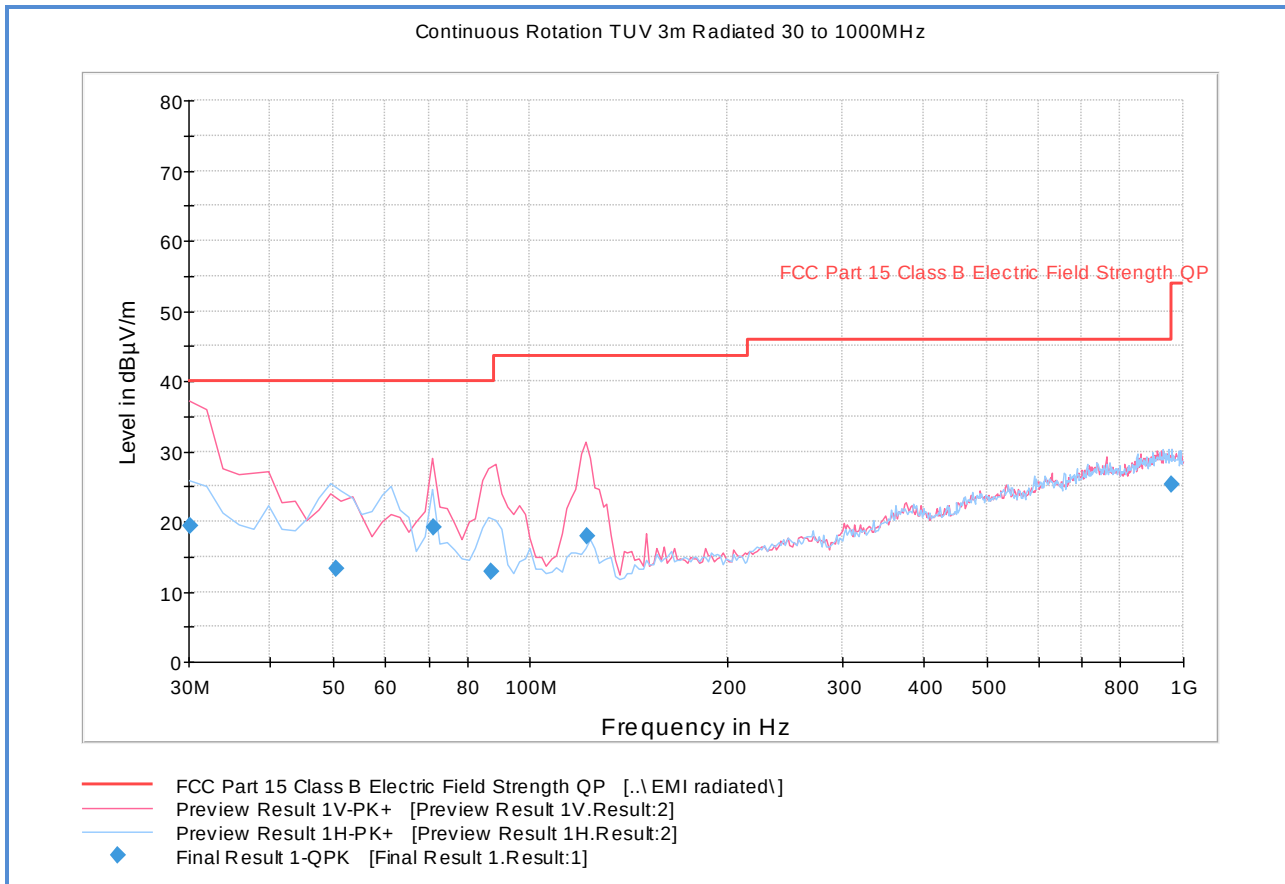
#### 2.6.8 Sample Computation (Radiated Emission)

|                                                              |                            |       |       |
|--------------------------------------------------------------|----------------------------|-------|-------|
| Measuring equipment raw measurement (dB $\mu$ V) @ 30 MHz    |                            |       | 24.4  |
| Correction Factor (dB)                                       | Asset# 1066 (cable)        | 0.3   | -12.6 |
|                                                              | Asset# 1172 (cable)        | 0.3   |       |
|                                                              | Asset# 1016 (preamplifier) | -30.7 |       |
|                                                              | Asset# 1175(cable)         | 0.3   |       |
|                                                              | Asset# 1002 (antenna)      | 17.2  |       |
| Reported Quasi Peak Final Measurement (dB $\mu$ V/m) @ 30MHz |                            |       | 11.8  |

#### 2.6.9 Test Results

See attached plots.

## 2.6.10 Test Results Below 1GHz (Worst Case Channel – Mid Channel)

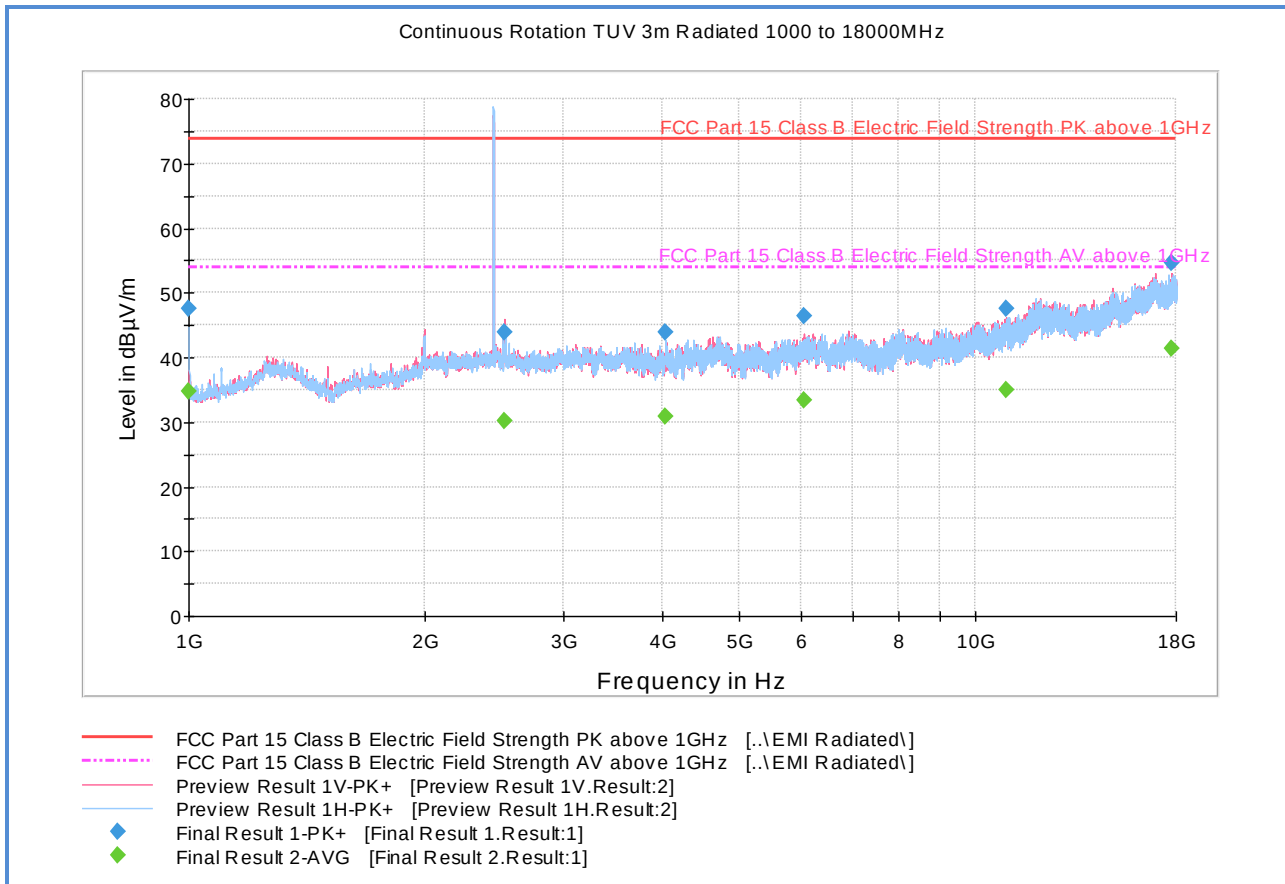


### Quasi Peak Data

| Frequency (MHz) | QuasiPeak (dBµV/m) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Polarization | Azimuth (deg) | Corr. (dB) | Margin (dB) | Limit (dBµV/m) |
|-----------------|--------------------|-----------------|-----------------|-------------|--------------|---------------|------------|-------------|----------------|
| 30.120000       | 19.3               | 1000.0          | 120.000         | 106.0       | V            | 45.0          | -6.0       | 20.7        | 40.0           |
| 50.438878       | 13.2               | 1000.0          | 120.000         | 400.0       | H            | -15.0         | -14.4      | 26.8        | 40.0           |
| 70.981643       | 19.1               | 1000.0          | 120.000         | 400.0       | V            | 186.0         | -17.0      | 20.9        | 40.0           |
| 87.036633       | 12.7               | 1000.0          | 120.000         | 200.0       | V            | 355.0         | -16.5      | 27.3        | 40.0           |
| 122.402725      | 17.9               | 1000.0          | 120.000         | 200.0       | V            | 349.0         | -15.9      | 25.6        | 43.5           |
| 959.258357      | 25.3               | 1000.0          | 120.000         | 195.0       | H            | 19.0          | 6.3        | 20.7        | 46.0           |

**Test Notes:** Only worst case channel presented for cabinet spurious emissions.

## 2.6.11 Test Results Above 1GHz (Worst Case Channel – Mid Channel)



### Peak Data

| Frequency (MHz) | MaxPeak (dBµV/m) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Polarization | Azimuth (deg) | Corr. (dB) | Margin (dB) | Limit (dBµV/m) |
|-----------------|------------------|-----------------|-----------------|-------------|--------------|---------------|------------|-------------|----------------|
| 1000.000000     | 47.5             | 1000.0          | 1000.000        | 131.4       | H            | 36.0          | -7.2       | 26.4        | 73.9           |
| 2520.733333     | 43.9             | 1000.0          | 1000.000        | 384.1       | V            | 185.0         | -0.3       | 30.0        | 73.9           |
| 4031.466667     | 43.8             | 1000.0          | 1000.000        | 384.1       | H            | -7.0          | 3.3        | 30.1        | 73.9           |
| 6054.066667     | 46.3             | 1000.0          | 1000.000        | 100.4       | V            | 55.0          | 7.1        | 27.6        | 73.9           |
| 10936.300000    | 47.5             | 1000.0          | 1000.000        | 117.4       | V            | 102.0         | 14.0       | 26.4        | 73.9           |
| 17776.566667    | 54.5             | 1000.0          | 1000.000        | 367.1       | V            | 174.0         | 23.0       | 19.4        | 73.9           |

### Average Data

| Frequency (MHz) | Average (dBµV/m) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Polarization | Azimuth (deg) | Corr. (dB) | Margin (dB) | Limit (dBµV/m) |
|-----------------|------------------|-----------------|-----------------|-------------|--------------|---------------|------------|-------------|----------------|
| 1000.000000     | 34.7             | 1000.0          | 1000.000        | 131.4       | H            | 36.0          | -7.2       | 19.2        | 53.9           |
| 2520.733333     | 30.2             | 1000.0          | 1000.000        | 384.1       | V            | 185.0         | -0.3       | 23.7        | 53.9           |
| 4031.466667     | 30.8             | 1000.0          | 1000.000        | 384.1       | H            | -7.0          | 3.3        | 23.1        | 53.9           |
| 6054.066667     | 33.4             | 1000.0          | 1000.000        | 100.4       | V            | 55.0          | 7.1        | 20.5        | 53.9           |
| 10936.300000    | 34.9             | 1000.0          | 1000.000        | 117.4       | V            | 102.0         | 14.0       | 19.0        | 53.9           |
| 17776.566667    | 41.3             | 1000.0          | 1000.000        | 367.1       | V            | 174.0         | 23.0       | 12.6        | 53.9           |

**Test Notes:** Fundamental at 2.4GHz. No significant emissions observed above 10GHz. Measurements above 10GHz were noise floor figures.

## **2.7 POWER SPECTRAL DENSITY**

### **2.7.1 Specification Reference**

Part 15 Subpart C §15.247(e) and RSS-247 5.2(b)

### **2.7.2 Standard Applicable**

(e) For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

### **2.7.3 Equipment Under Test and Modification State**

Serial No: EMC Sample 1 / Default Test Configuration

### **2.7.4 Date of Test/Initial of test personnel who performed the test**

October 05, 2017 / IR

### **2.7.5 Test Equipment Used**

The major items of test equipment used for the above tests are identified in Section 3.1.

### **2.7.6 Environmental Conditions/ Test Location**

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

|                     |          |
|---------------------|----------|
| Ambient Temperature | 24.9 °C  |
| Relative Humidity   | 42.6%    |
| ATM Pressure        | 98.5 kPa |

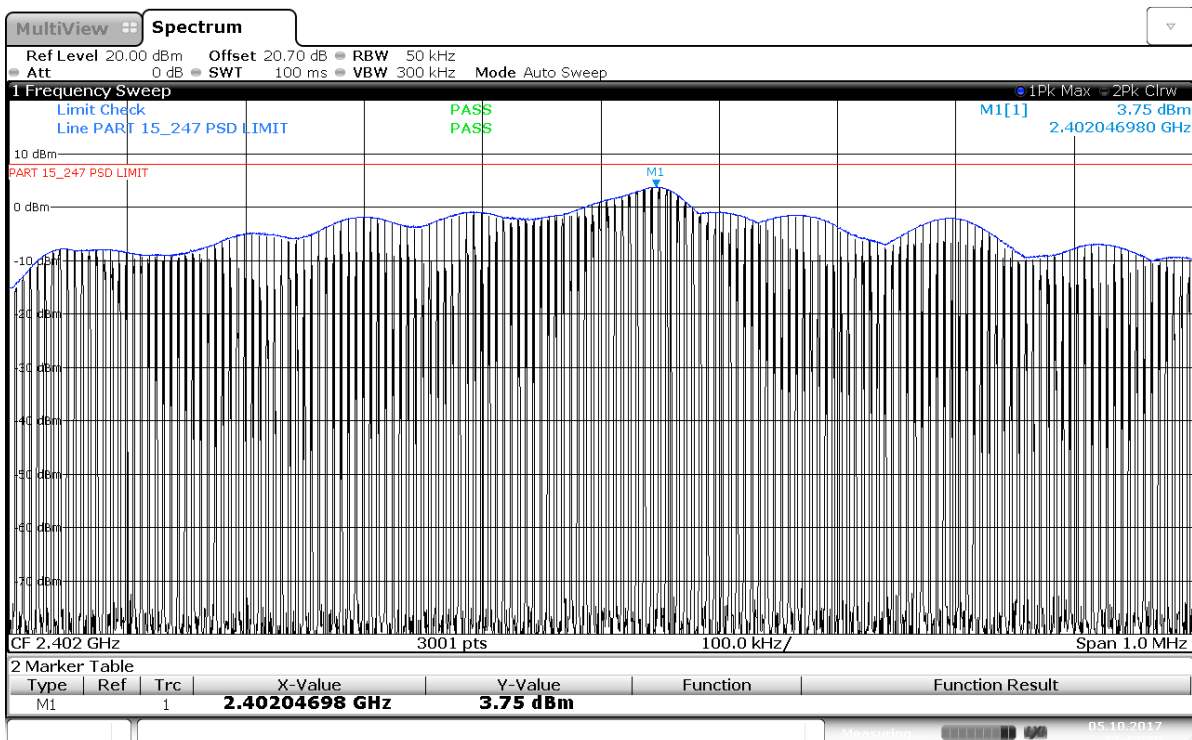
### **2.7.7 Additional Observations**

- This is a conducted test.
- Test procedure is per Section 10.2 of KDB 558074.
- Span is 1.5 times the DTS bandwidth.
- An offset of 20.7dB was added to compensate for the external attenuator and cable used from the antenna port to the spectrum analyzer.
- Set the RBW to:  $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$
- Set the VBW  $\geq 3 \times \text{RBW}$
- Detector is Peak
- Sweep time is Auto Couple.
- Trace mode is max hold
- Trace allowed to fully stabilize.
- EUT complies with 50 kHz RBW.

## 2.7.8 Test Results Summary

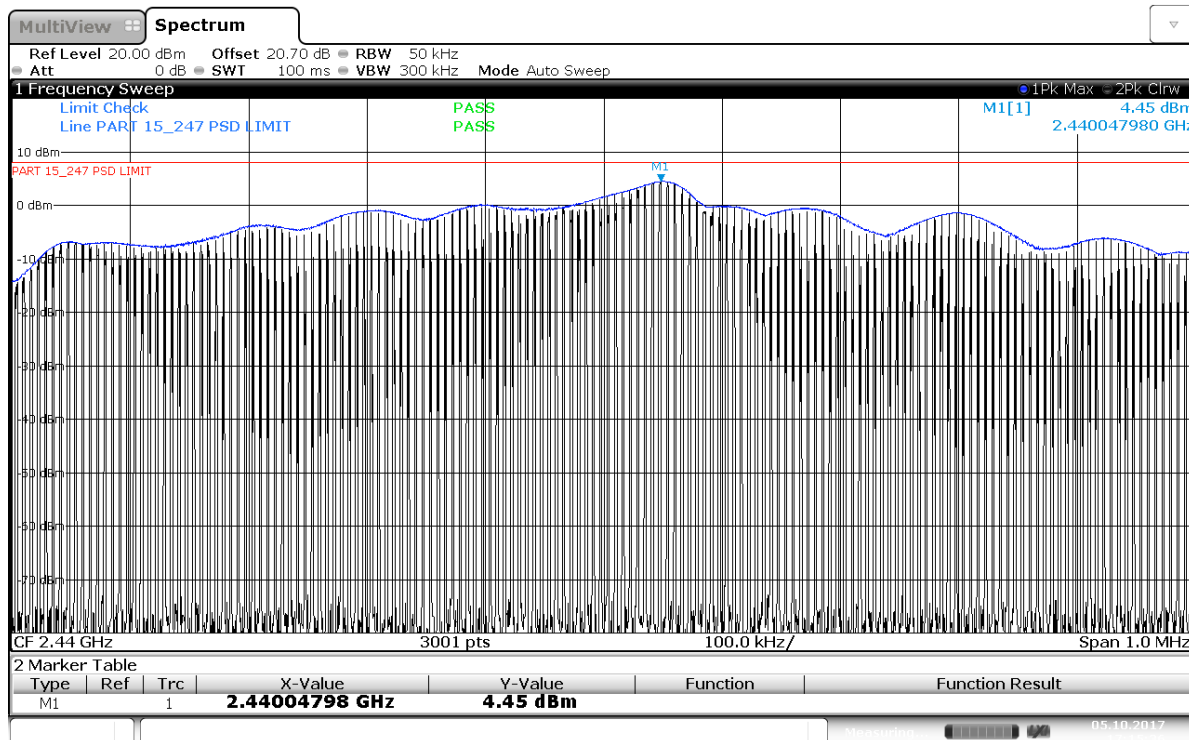
| Mode         | Channel  | Marker Reading using 50 kHz RBW (dBm) | PSD Limit (dBm) | Margin (dB) | Compliance |
|--------------|----------|---------------------------------------|-----------------|-------------|------------|
| Bluetooth LE | 2402 MHz | 3.75                                  | 8               | 4.25        | Complies   |
|              | 2440 MHz | 4.45                                  | 8               | 3.55        | Complies   |
|              | 2480 MHz | 3.76                                  | 8               | 4.24        | Complies   |

## 2.7.9 Test Results Plots



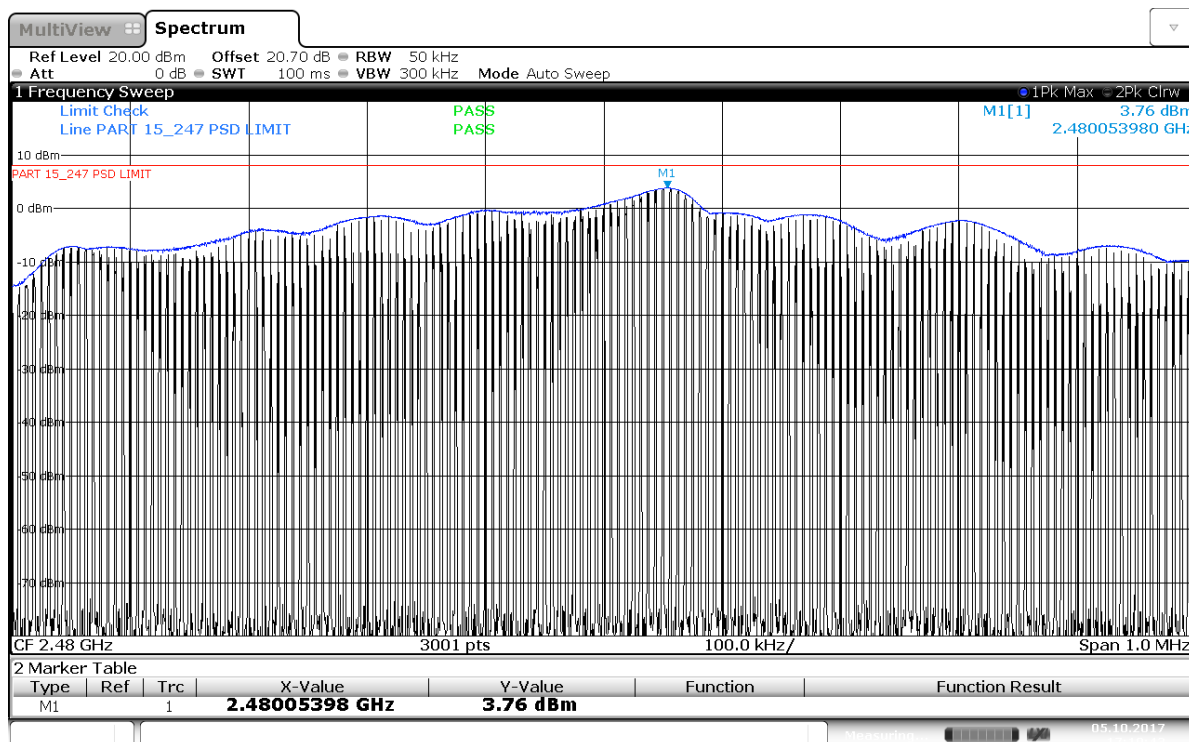
Date: 5.OCT.2017 17:13:39

Low Channel BT LE



Date: 5.OCT.2017 17:15:37

### Mid Channel BT LE



Date: 5.OCT.2017 17:10:42

### High Channel BT LE



### **SECTION 3**

#### **TEST EQUIPMENT USED**



### 3.1 TEST EQUIPMENT USED

List of absolute measuring and other principal items of test equipment.

| ID Number<br>(SDGE/SDRB)            | Test Equipment                                 | Type                  | Serial Number      | Manufacturer               | Cal Date | Cal Due Date |
|-------------------------------------|------------------------------------------------|-----------------------|--------------------|----------------------------|----------|--------------|
| <b>Antenna Conducted Port Setup</b> |                                                |                       |                    |                            |          |              |
| 7606                                | USB RF Power Sensor                            | RadiPower<br>RPR3006W | 14I00048SNOO<br>48 | DARE!! Instruments         | 11/30/16 | 11/30/17     |
| 7582                                | Signal/Spectrum Analyzer                       | FSW26                 | 101614             | Rhode & Schwarz            | 10/26/16 | 10/26/17     |
| 8871                                | 20dB Attenuator                                | CAT-20                | N/A                | MCL HAT-20                 | 04/26/17 | 04/26/18     |
| <b>Radiated Test Setup</b>          |                                                |                       |                    |                            |          |              |
| 1002                                | Bilog Antenna                                  | 3142C                 | 00058717           | ETS-Lindgren               | 11/06/15 | 11/06/17     |
| 1040                                | EMI Test Receiver                              | ESIB40                | 100292             | Rhode & Schwarz            | 10/07/16 | 10/07/17     |
| 1016                                | Pre-amplifier                                  | PAM-0202              | 187                | PAM                        | 02/09/17 | 02/09/18     |
| 1051                                | Double-ridged waveguide<br>horn antenna        | 3115                  | 9408-4329          | EMCO                       | 07/17/17 | 07/17/18     |
| 1049                                | EMI Test Receiver                              | ESU                   | 100133             | Rhode & Schwarz            | 07/13/17 | 07/13/18     |
| 8628                                | Pre-amplifier                                  | QLJ 01182835-JO       | 8986002            | QuinStar Technologies Inc. | 02/09/17 | 02/09/18     |
| <b>Miscellaneous</b>                |                                                |                       |                    |                            |          |              |
| 6708                                | Multimeter                                     | 34401A                | US36086974         | Hewlett Packard            | 07/05/17 | 07/05/18     |
| 7554                                | Barometer/Temperature/Hu<br>midity Transmitter | iBTHX-W               | 0400706            | Omega                      | 01/17/17 | 01/17/18     |
| -                                   | Test Software                                  | EMC32                 | V8.53              | Rhode & Schwarz            | N/A      |              |
| -                                   | Test Software                                  | RadiMotion            | V2014.2.3          | Dare Instruments           | N/A      |              |



### 3.2 MEASUREMENT UNCERTAINTY

For a 95% confidence level, the measurement uncertainties for defined systems are:

#### 3.2.1 Radiated Measurements (Below 1GHz)

| Contribution                    |                            | Probability Distribution Type | Probability Distribution $x_i$ | Standard Uncertainty $u(x_i)$ | $[u(x_i)]^2$ |
|---------------------------------|----------------------------|-------------------------------|--------------------------------|-------------------------------|--------------|
| 1                               | Receiver/Spectrum Analyzer | Rectangular                   | 0.45                           | 0.26                          | 0.07         |
| 2                               | Cables                     | Rectangular                   | 0.50                           | 0.29                          | 0.08         |
| 3                               | Preamp                     | Rectangular                   | 0.50                           | 0.29                          | 0.08         |
| 4                               | Antenna                    | Rectangular                   | 0.75                           | 0.43                          | 0.19         |
| 5                               | Site                       | Triangular                    | 3.52                           | 1.44                          | 2.07         |
| 6                               | EUT Setup                  | Rectangular                   | 1.00                           | 0.58                          | 0.33         |
| Combined Uncertainty ( $u_c$ ): |                            |                               |                                |                               | 1.68         |
| Coverage Factor (k):            |                            |                               |                                |                               | 2            |
| Expanded Uncertainty:           |                            |                               |                                |                               | 3.36         |

#### 3.2.2 Radiated Emission Measurements (Above 1GHz)

| Contribution                    |                            | Probability Distribution Type | Probability Distribution $x_i$ | Standard Uncertainty $u(x_i)$ | $[u(x_i)]^2$ |
|---------------------------------|----------------------------|-------------------------------|--------------------------------|-------------------------------|--------------|
| 1                               | Receiver/Spectrum Analyzer | Rectangular                   | 0.57                           | 0.33                          | 0.11         |
| 2                               | Cables                     | Rectangular                   | 0.70                           | 0.40                          | 0.16         |
| 3                               | Preamp                     | Rectangular                   | 0.50                           | 0.29                          | 0.08         |
| 4                               | Antenna                    | Rectangular                   | 0.37                           | 0.21                          | 0.05         |
| 5                               | Site                       | Triangular                    | 3.00                           | 1.22                          | 1.50         |
| 6                               | EUT Setup                  | Rectangular                   | 1.00                           | 0.58                          | 0.33         |
| Combined Uncertainty ( $u_c$ ): |                            |                               |                                |                               | 1.49         |
| Coverage Factor (k):            |                            |                               |                                |                               | 2            |
| Expanded Uncertainty:           |                            |                               |                                |                               | 2.99         |

#### 3.2.3 Conducted Antenna Port Measurement

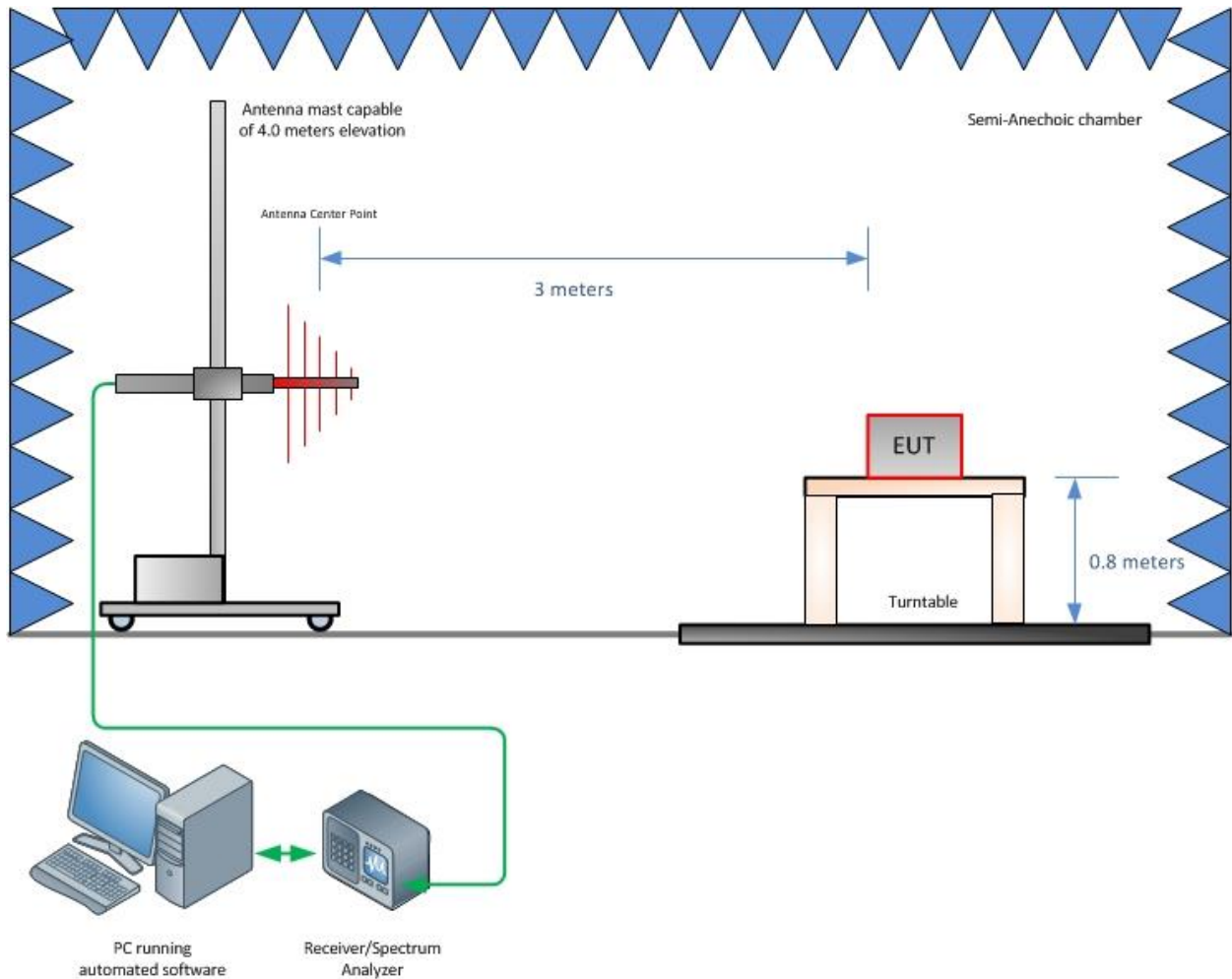
| Contribution                    |                            | Probability Distribution Type | Probability Distribution $x_i$ | Standard Uncertainty $u(x_i)$ | $[u(x_i)]^2$ |
|---------------------------------|----------------------------|-------------------------------|--------------------------------|-------------------------------|--------------|
| 1                               | Receiver/Spectrum Analyzer | Rectangular                   | 0.34                           | 0.20                          | 0.04         |
| 2                               | Cables                     | Rectangular                   | 0.30                           | 0.17                          | 0.03         |
| 3                               | EUT Setup                  | Rectangular                   | 0.50                           | 0.29                          | 0.08         |
| Combined Uncertainty ( $u_c$ ): |                            |                               |                                |                               | 0.39         |
| Coverage Factor (k):            |                            |                               |                                |                               | 1.96         |
| Expanded Uncertainty:           |                            |                               |                                |                               | 0.76         |



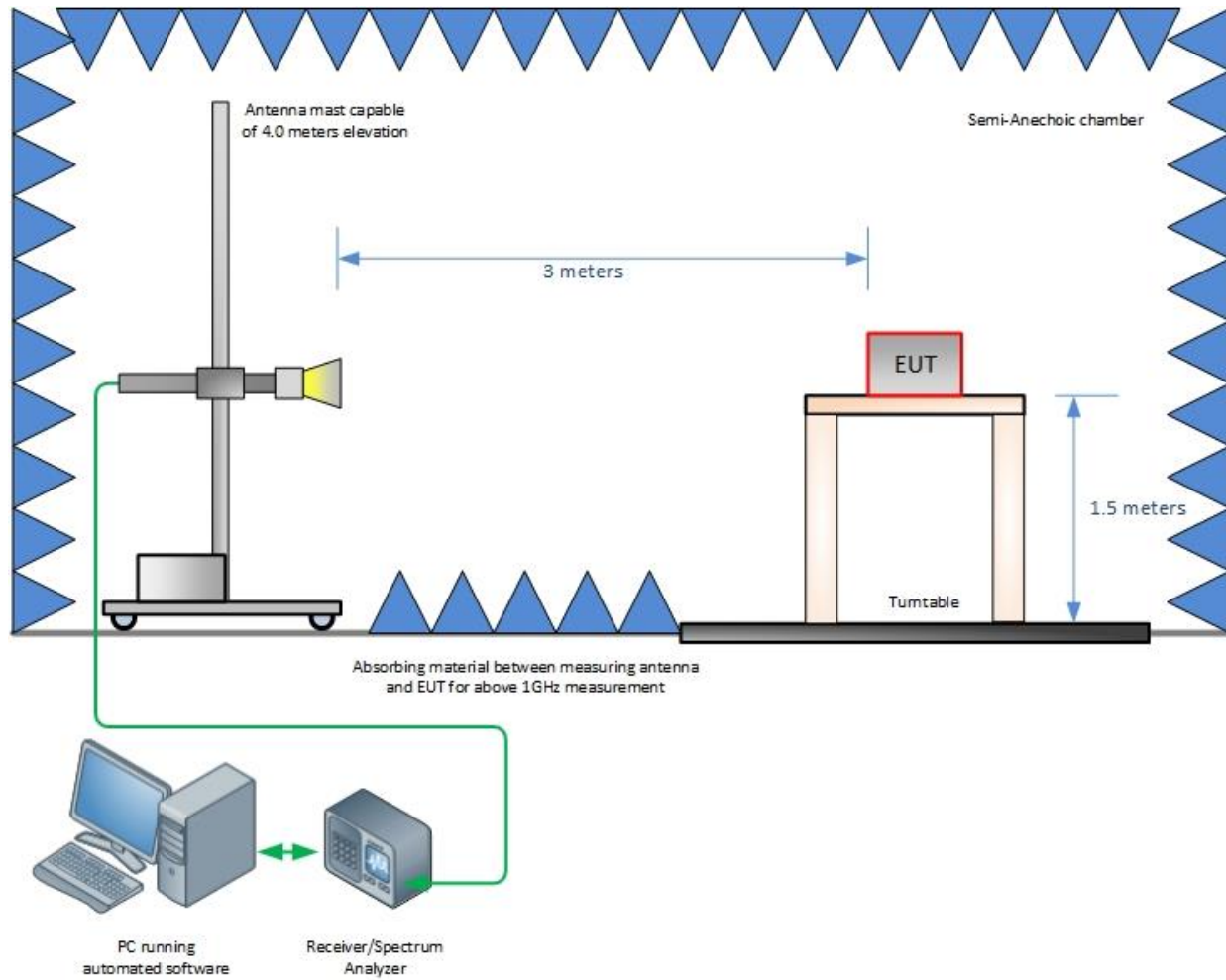
## **SECTION 4**

### **DIAGRAM OF TEST SETUP**

#### 4.1 TEST SETUP DIAGRAM



**Radiated Emission Test Setup (Below 1GHz)**



**Radiated Emission Test Setup (Above 1GHz)**



## **SECTION 5**

### **ACCREDITATION, DISCLAIMERS AND COPYRIGHT**

## 5.1 ACCREDITATION, DISCLAIMERS AND COPYRIGHT

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