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## Report On

Application for Grant of Equipment Authorization of the  
Watkins Manufacturing Corporation  
WH4711 Digital Wireless Audio Module

FCC Part 15 Subpart C §15.247  
IC RSS-Gen and RSS-210 Issue 8 December 2010

**Report No. SC1210271B**

**August 2013**




**REPORT ON** Radio Testing of the  
Watkins Manufacturing Corporation  
Digital Wireless Audio Module

**TEST REPORT NUMBER** SC1210271B

**PREPARED FOR** Watkins Manufacturing Corporation  
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Chip R. Fleury  
**Name**  
Authorized Signatory

**DATED** August 12, 2013



**Revision History**

| SC1210271B<br>Watkins Manufacturing Corporation<br>WH4711 Digital Wireless Audio Module |                 |              |        |                |                    |
|---|-----------------|--------------|--------|----------------|--------------------|
| DATE  | OLD REVISION    | NEW REVISION | REASON | PAGES AFFECTED | APPROVED BY        |
| 08/12/2013  | Initial Release |              |        |                | Ferdinand Custodio |
|   |                 |              |        |                |                    |
|   |                 |              |        |                |                    |
|   |                 |              |        |                |                    |
|   |                 |              |        |                |                    |



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## **SECTION 1**

### **REPORT SUMMARY**

Radio Testing of the  
Watkins Manufacturing Corporation  
Digital Wireless Audio Module



## 1.1 INTRODUCTION

The information contained in this report is intended to show verification of the Watkins Manufacturing Corporation Digital Wireless Audio Module to the requirements of FCC Part 15 Subpart C §15.247 and IC RSS-Gen and RSS-210 Issue 8 December 2010.

|                               |   |
|-------------------------------|---|
| 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                  | Watkins Manufacturing Corporation   |
| Model Number(s)               | WH4711  |
| FCC ID Number                 | LDL-7X01DA11  |
| IC Number                     | 7322A-7X01DA11  |
| Serial Number(s)              | N/A   |
| Number of Samples Tested      | 1   |
| Test Specification/Issue/Date | <ul style="list-style-type: none"><li>• FCC Part 15 Subpart C §15.247 (October 9, 2012).</li><li>• RSS-210 - Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment (Issue 8, December 2010).</li><li>• RSS-Gen - General Requirements and Information for the Certification of Radio Apparatus (Issue 3, December 2010).</li></ul> |
| Start of Test                 | October 29, 2012  |
| Finish of Test                | October 31, 2012  |
| Name of Engineer(s)           | Ferdinand S. Custodio<br>Lan Sayasane   |
| Related Document(s)           | <ul style="list-style-type: none"><li>• DA 00-705 (March 30, 2000) Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems.</li><li>• ANSI C63.10-2009 (American National Standard for Testing Unlicensed Wireless Devices.</li><li>• Supporting documents for EUT certification are separate exhibits.</li></ul>               |



## 1.2 BRIEF SUMMARY OF RESULTS

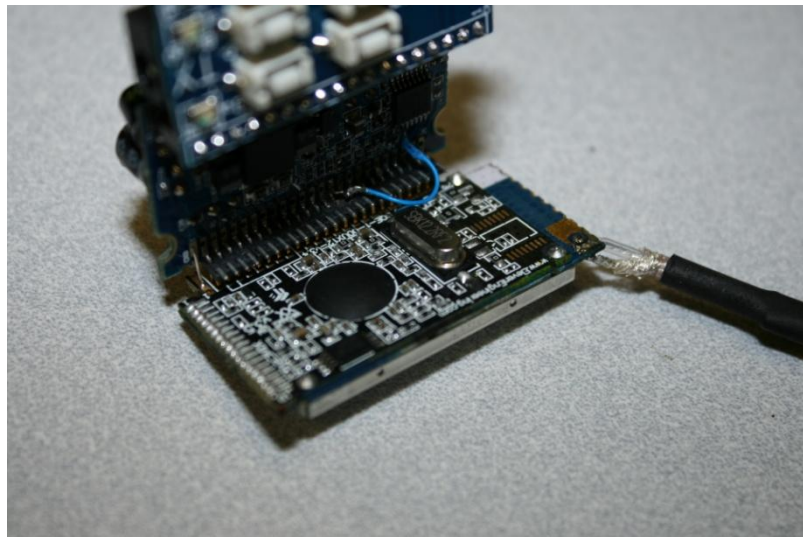
A brief summary of the tests carried out in accordance with FCC Part 15 Subpart C §15.247 with cross-reference to the corresponding IC RSS standard is shown below.

| Section | §15.247 Spec Clause | RSS             | Test Description                               | Result    | Comments/<br>Base Standard |
|---------|---------------------|-----------------|--|-----------|----------------------------|
| 2.1     | §15.207 (a)         | RSS-Gen 7.2.4   | Conducted Emissions                            | Compliant |                            |
| 2.2     | §15.247(a)(1)       | RSS-210 A8.1(b) | Carrier Frequency Separation                   | Compliant |                            |
| 2.3     | §15.247(a)(1)(iii)  | RSS-210 A8.1(d) | Number of Hopping Frequencies                  | Compliant |                            |
| 2.4     | §15.247(a)(1)(iii)  | RSS-210 A8.1(d) | Time of Occupancy (Dwell Time)                 | Compliant |                            |
| 2.5     | §15.215(c)          | RSS-210 A8.1(a) | 20 dB Bandwidth                                | Compliant |                            |
| 2.6     | §15.247(b)(1)       | RSS-210 A8.4(2) | Peak Output Power                              | Compliant |                            |
| 2.7     | §15.247(d)          | RSS-210 A8.5    | Band-edge Compliance of RF Conducted Emissions | Compliant |                            |
| 2.8     | §15.247(d)          | RSS-210 A8.5    | Spurious RF Conducted Emissions                | Compliant |                            |
| 2.9     | §15.247(d)          | RSS-210 2.2     | Spurious Radiated Emissions                    | Compliant |                            |
| 2.10    |                     | RSS-Gen 6.0     | Receiver Spurious Emissions                    | Compliant |                            |

### 1.3 PRODUCT INFORMATION

#### 1.3.1 Technical Description

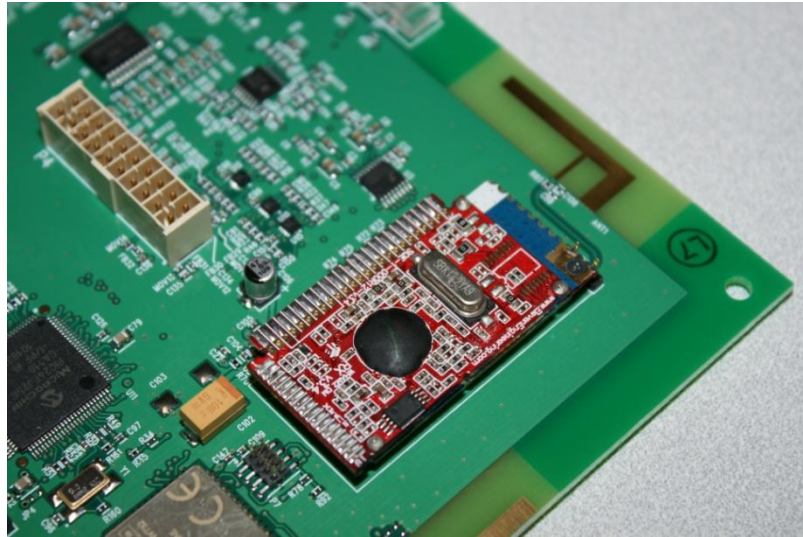
The Equipment Under Test (EUT) is a Watkins Manufacturing Corporation Digital Wireless Audio Module as shown in the photograph below. The module is manufactured by Eleven Engineering and will be certified with Watkins Manufacturing Corporation antenna. For conducted antenna port measurements, the manufacturer provided sample with temporary SMA connector mounted on an interface board for powering the module at the same time allowing downloading of test firmware.



**Equipment Under Test**



In order to verify the EUT with the PCB antenna for radiated emissions, the actual PCB where the module will be installed was utilized. During evaluation, the PCB is simulating a development board providing power to the module and programming interface. Future application covered under this certification will require the use of the same antenna.



**Equipment Under Test with PCB antenna**



### 1.3.2 EUT General Description

|                                 |   |
|---------------------------------|---|
| EUT Description                 | Digital Wireless Audio Module   |
| Model Name                      | MR-284  |
| Model Number(s)                 | WH4711  |
| Rated Voltage                   | 3.63 VDC  |
| Output Power                    | 32 mW (15.05 dBm peak conducted)  |
| Frequency Range                 | 2403.328 MHz to 2479.104 MHz in the 2400 MHz to 2483.5 MHz Band   |
| Number of Operating Frequencies | 20  |
| Channels Verified               | Channel 0 (Low Channel 2403.328 MHz)<br>Channel 19(Mid Channel 2442.240 MHz)<br>Channel 37 (High Channel 2479.104MHz) |
| Modulation Used                 | FHSS  |

### 1.3.3 Antenna Details

|                       |   |
|-----------------------|---|
| Model                 | Wireless Audio Antenna  |
| Manufacturer          | Watkins Mfg. Corp.  |
| Antenna Type          | 2.45 GHz Planar inverted F top loaded monopole                      |
| Antenna Gain (Peak)   | 0 dBi   |
| EUT Antenna Connector | N/A (printed type - multiple wavelength ground plane/counterpoise). |
| Maximum Dimensions    | 8.5852mm x 23.876mm   |

**1.4 EUT TEST CONFIGURATION**

**1.4.1 Test Configuration Description**

| Test Configurations | Description   |
|---------------------|---|
| A                   | Antenna port conducted measurement. Manufacturer provided a SMA test port for conducted measurements (Test Mode). |
| B                   | Antenna port conducted measurement. Manufacturer provided a SMA test port for conducted measurements (FHSS Mode). |
| C                   | Radiated emissions test configuration. EUT configured to transmit on the built-in integral antenna.               |

**1.4.2 EUT Exercise Software**

The manufacturer provided programming software (XInLoader.exe) to load test firmware to the EUT. Hopping and Non-hopping modes are supported. TX power can't be adjusted.

**1.4.3 Support Equipment and I/O cables**

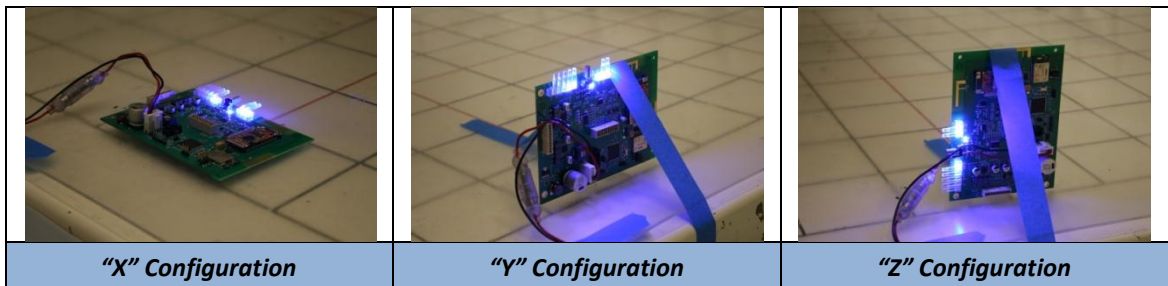
| Manufacturer                      | Equipment/Cable        | Description  |
|-----------------------------------|------------------------|--|
| Watkins Manufacturing Corporation | Amplifier Board        | EP3. This is the PCB where the module and antenna being certified are installed.   |
| CUI Inc.                          | Switching Power Supply | 3A-621DA12 12VDC 5.0A AC Adapter   |
| Watkins Manufacturing Corporation | Custom cable           | Audio and power cable for the Wireless Music System Amplifier/Receiver (1327401-1) |

**1.4.4 Worst Case Configuration**

Worst-case configuration used in this test report based from Peak Output Power measurements:

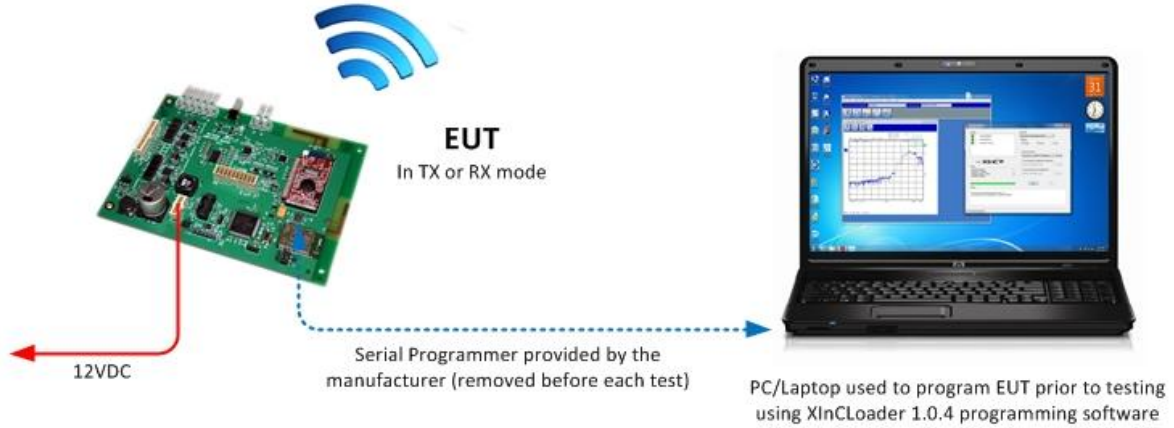
| Channel     | Frequency    |
|-------------|--------------|
| Mid Channel | 2442.240 MHz |

The EUT uses an integral PCB antenna. For radiated measurements X, Y and Z orientations were verified. Worst case position is "X".

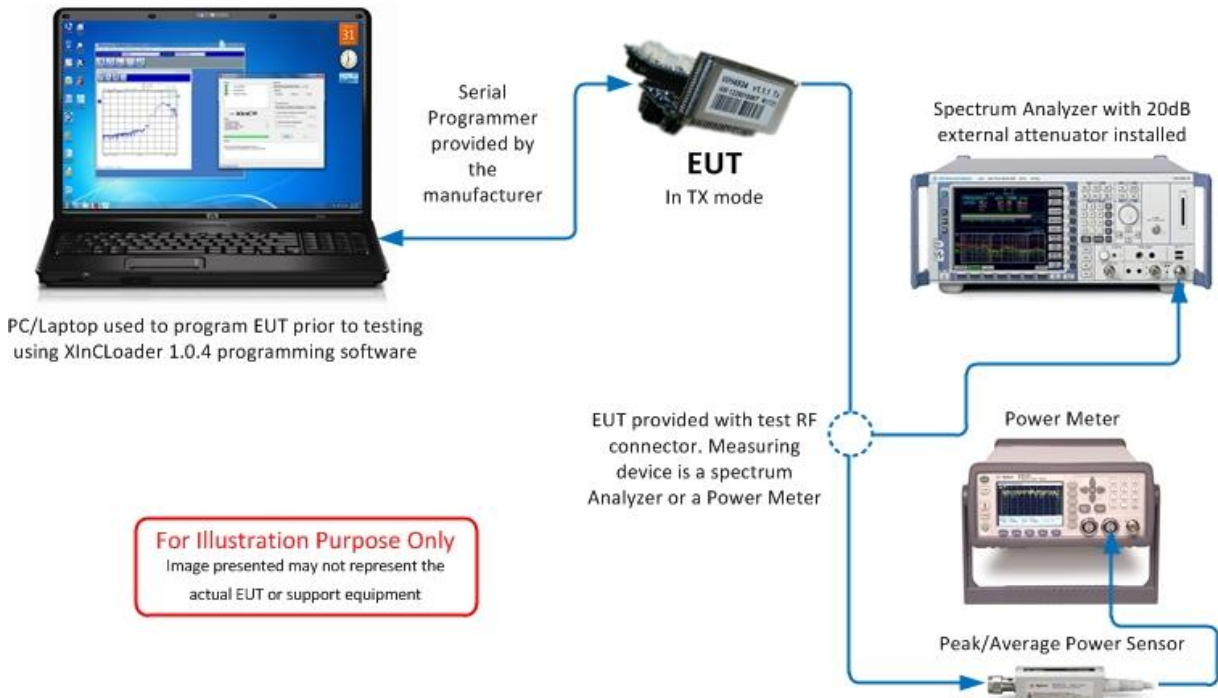


### 1.4.5 Simplified Test Configuration Diagram

#### Radiated Test Configuration



#### Conducted Antenna Port Test Configuration





**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 N/A           |                        |                          |
| N/A                         |                        |                          |

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 C63.4-2009, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz.

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 C63.4-2009. The test modes were adapted according to the Operating Instructions provided by the manufacturer/client.

**1.8 TEST FACILITY**

**1.8.1 FCC – Registration No.: US5296**

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 §2.498 of the FCC rules. The acceptance letter from the FCC is maintained in our files and the Registration is US5296.

**1.8.2 Industry Canada (IC) Registration No.: 3067A**

The 10m Semi-anechoic chamber of TUV SUD America Inc. (San Diego), has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No. 3067A.



## **SECTION 2**

### **TEST DETAILS**

Radio Testing of the  
Watkins Manufacturing Corporation  
Digital Wireless Audio Module



**2.1 CONDUCTED EMISSIONS**

**2.1.1 Specification Reference**

Part 15 Subpart C §15.207(a)

**2.1.2 Standard Applicable**

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 μH/50 ohms line impedance stabilization network (LISN).

| Frequency of emission (MHz) | Conducted limit (dBμV) |           |
|-----------------------------|------------------------|-----------|
|                             | Quasi-peak             | Average   |
| 0.15–0.5                    | 66 to 56*              | 56 to 46* |
| 0.5–5                       | 56                     | 46        |
| 5–30                        | 60                     | 50        |

*\*Decreases with the logarithm of the frequency.*

**2.1.3 Equipment Under Test and Modification State**

Serial No: N/A / Test Configuration A

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

October 29, 2012/LTS

**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**

Ambient Temperature      21.1°C  
 Relative Humidity          42.2%  
 ATM Pressure                99.7 kPa

**2.1.7 Additional Observations**

- The EUT is an RF module. To show general compliance to the present requirement, the EUT was verified using the DC input power of the EUT.
- The EUT was verified using worst case configuration when transmitting. Receive mode is also verified.



- Measurement was done using EMC32 V8.53 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 2.1.8 for sample computation.

**2.1.8 Sample Computation (Conducted Emission – Quasi Peak)**

|  |                                |             |
|--|--------------------------------|-------------|
| Measuring equipment raw measurement (db $\mu$ V) @ 150kHz                  |                                | 5.5         |
| Correction Factor (dB)   | Asset# 8607 (20 dB attenuator) | 19.9        |
|  | Asset# 1177 (cable)            | 0.15        |
|  | Asset# 1176 (cable)            | 0.35        |
|  | Asset# 1171 (LISN)             | 0.30        |
| <b>Reported QuasiPeak Final Measurement (db<math>\mu</math>V) @ 150kHz</b> |                                | <b>26.2</b> |

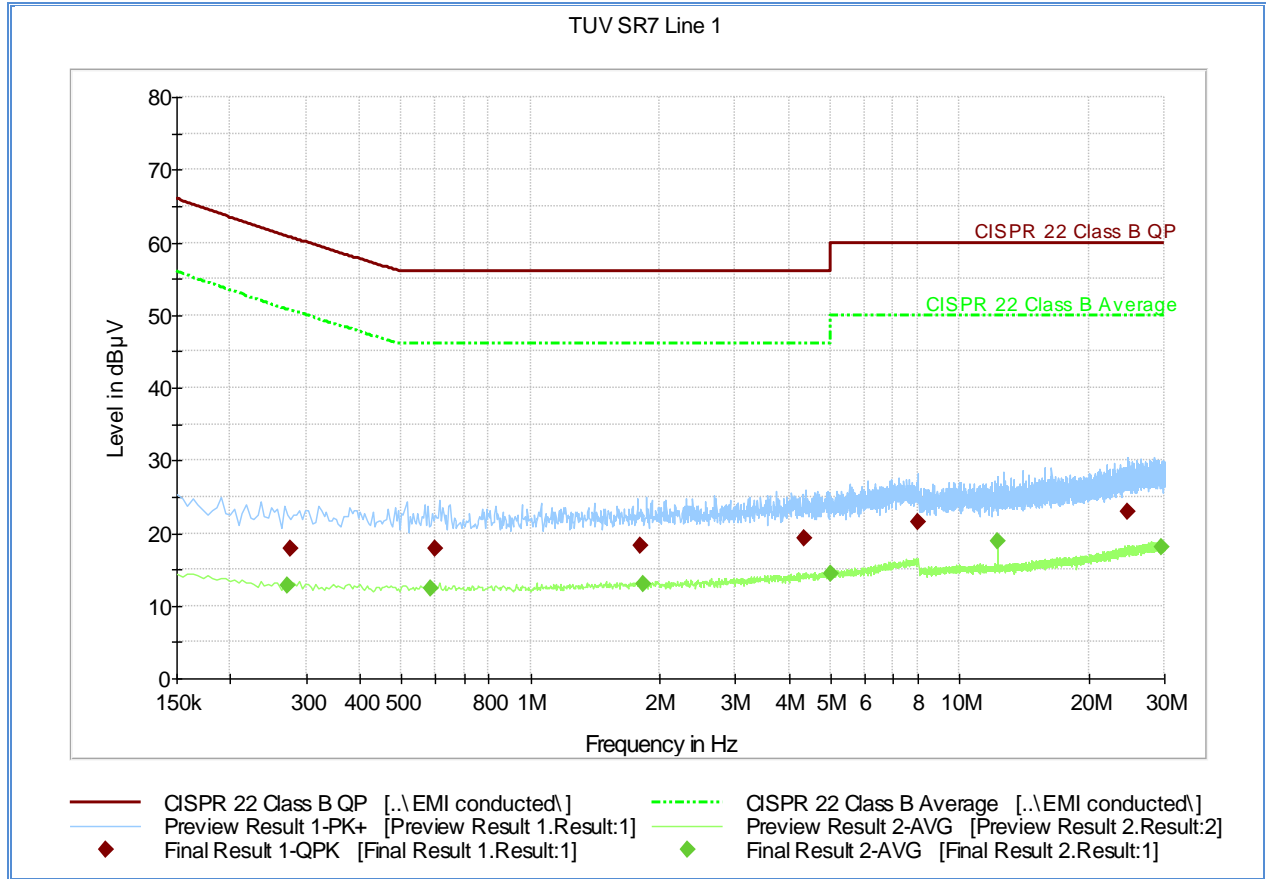
**2.1.9 Test Results**

Compliant. See attached plots and tables.





**2.1.10 Line 1 (EUT in TX Mode)**



**Quasi Peak**

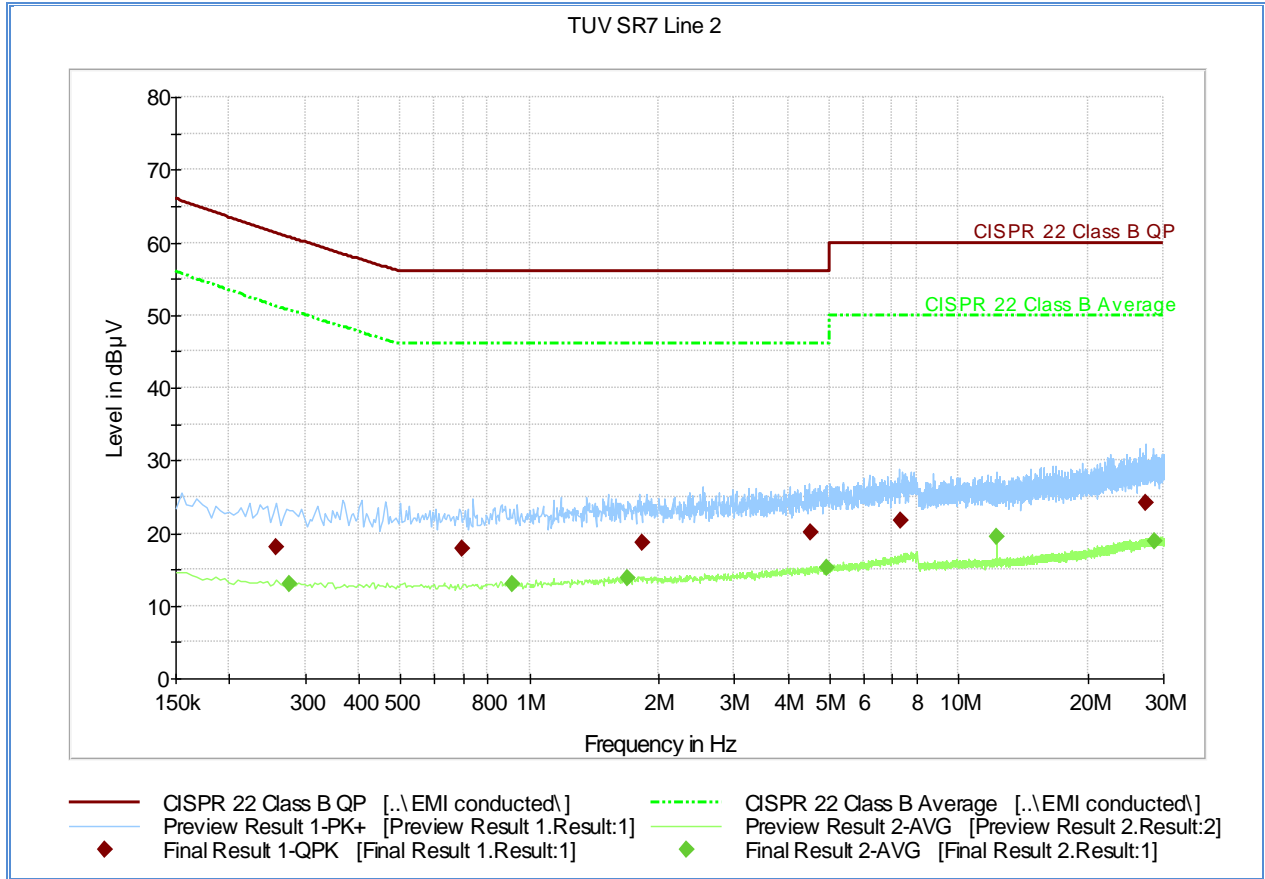
| Frequency (MHz) | QuasiPeak (dBµV) | Meas. Time (ms) | Bandwidth (kHz) | Filter | Line | Corr. (dB) | Margin - QPK (dB) | Limit - QPK (dBµV) |
|-----------------|------------------|-----------------|-----------------|--------|------|------------|-------------------|--------------------|
| 0.276000        | 17.9             | 1000.0          | 9.000           | Off    | L1   | 19.4       | 42.8              | 60.7               |
| 0.600000        | 17.9             | 1000.0          | 9.000           | Off    | L1   | 19.4       | 38.2              | 56.0               |
| 1.801500        | 18.2             | 1000.0          | 9.000           | Off    | L1   | 20.0       | 37.8              | 56.0               |
| 4.344000        | 19.3             | 1000.0          | 9.000           | Off    | L1   | 20.4       | 36.7              | 56.0               |
| 7.975000        | 21.4             | 1000.0          | 9.000           | Off    | L1   | 20.5       | 38.6              | 60.0               |
| 24.666000       | 22.9             | 1000.0          | 9.000           | Off    | L1   | 21.0       | 37.1              | 60.0               |

**Average**

| Frequency (MHz) | Average (dBµV) | Meas. Time (ms) | Bandwidth (kHz) | Filter | Line | Corr. (dB) | Margin - Ave (dB) | Limit - Ave (dBµV) |
|-----------------|----------------|-----------------|-----------------|--------|------|------------|-------------------|--------------------|
| 0.271500        | 12.7           | 1000.0          | 9.000           | Off    | L1   | 19.4       | 38.1              | 50.8               |
| 0.586500        | 12.5           | 1000.0          | 9.000           | Off    | L1   | 19.4       | 33.5              | 46.0               |
| 1.837500        | 13.1           | 1000.0          | 9.000           | Off    | L1   | 20.0       | 32.9              | 46.0               |
| 4.992000        | 14.4           | 1000.0          | 9.000           | Off    | L1   | 20.4       | 31.6              | 46.0               |
| 12.286500       | 18.9           | 1000.0          | 9.000           | Off    | L1   | 20.5       | 31.1              | 50.0               |
| 29.427000       | 18.1           | 1000.0          | 9.000           | Off    | L1   | 21.3       | 31.9              | 50.0               |



2.1.11 Line 2 (EUT in TX Mode)



Quasi Peak

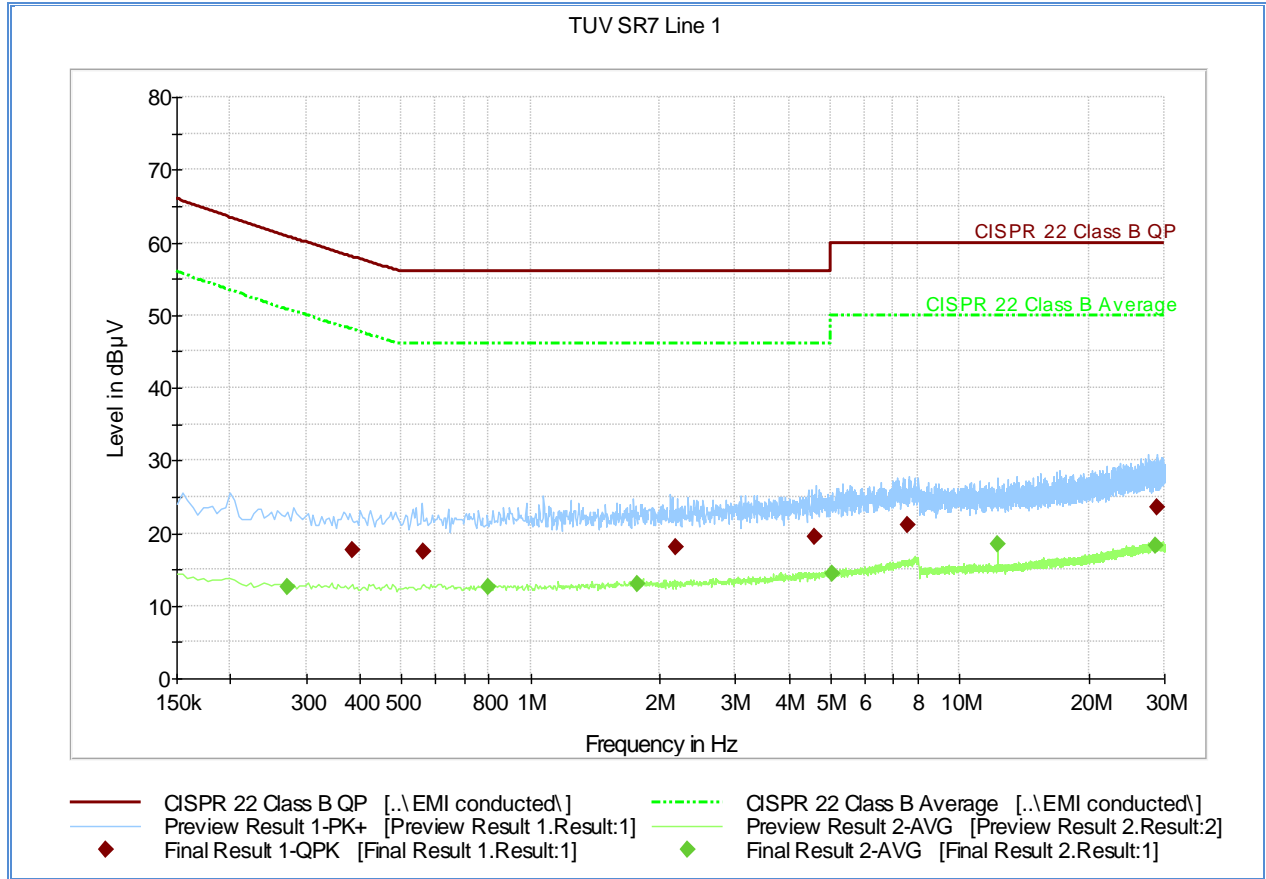
| Frequency (MHz) | QuasiPeak (dBµV) | Meas. Time (ms) | Bandwidth (kHz) | Filter | Line | Corr. (dB) | Margin - QPK (dB) | Limit - QPK (dBµV) |
|-----------------|------------------|-----------------|-----------------|--------|------|------------|-------------------|--------------------|
| 0.258000        | 18.1             | 1000.0          | 9.000           | Off    | N    | 19.5       | 43.2              | 61.3               |
| 0.694500        | 17.9             | 1000.0          | 9.000           | Off    | N    | 19.8       | 38.1              | 56.0               |
| 1.833000        | 18.7             | 1000.0          | 9.000           | Off    | N    | 20.6       | 37.3              | 56.0               |
| 4.528500        | 20.2             | 1000.0          | 9.000           | Off    | N    | 21.1       | 35.8              | 56.0               |
| 7.300500        | 21.7             | 1000.0          | 9.000           | Off    | N    | 21.2       | 38.3              | 60.0               |
| 27.307500       | 24.2             | 1000.0          | 9.000           | Off    | N    | 21.9       | 35.8              | 60.0               |

Average

| Frequency (MHz) | Average (dBµV) | Meas. Time (ms) | Bandwidth (kHz) | Filter | Line | Corr. (dB) | Margin - Ave (dB) | Limit - Ave (dBµV) |
|-----------------|----------------|-----------------|-----------------|--------|------|------------|-------------------|--------------------|
| 0.276000        | 13.0           | 1000.0          | 9.000           | Off    | N    | 19.5       | 37.6              | 50.7               |
| 0.915000        | 12.9           | 1000.0          | 9.000           | Off    | N    | 20.0       | 33.1              | 46.0               |
| 1.698000        | 13.7           | 1000.0          | 9.000           | Off    | N    | 20.5       | 32.3              | 46.0               |
| 4.929000        | 15.1           | 1000.0          | 9.000           | Off    | N    | 21.2       | 30.9              | 46.0               |
| 12.286500       | 19.6           | 1000.0          | 9.000           | Off    | N    | 21.3       | 30.4              | 50.0               |
| 28.495500       | 18.9           | 1000.0          | 9.000           | Off    | N    | 22.0       | 31.1              | 50.0               |



2.1.12 Line 1 (EUT in RX Mode)



Quasi Peak

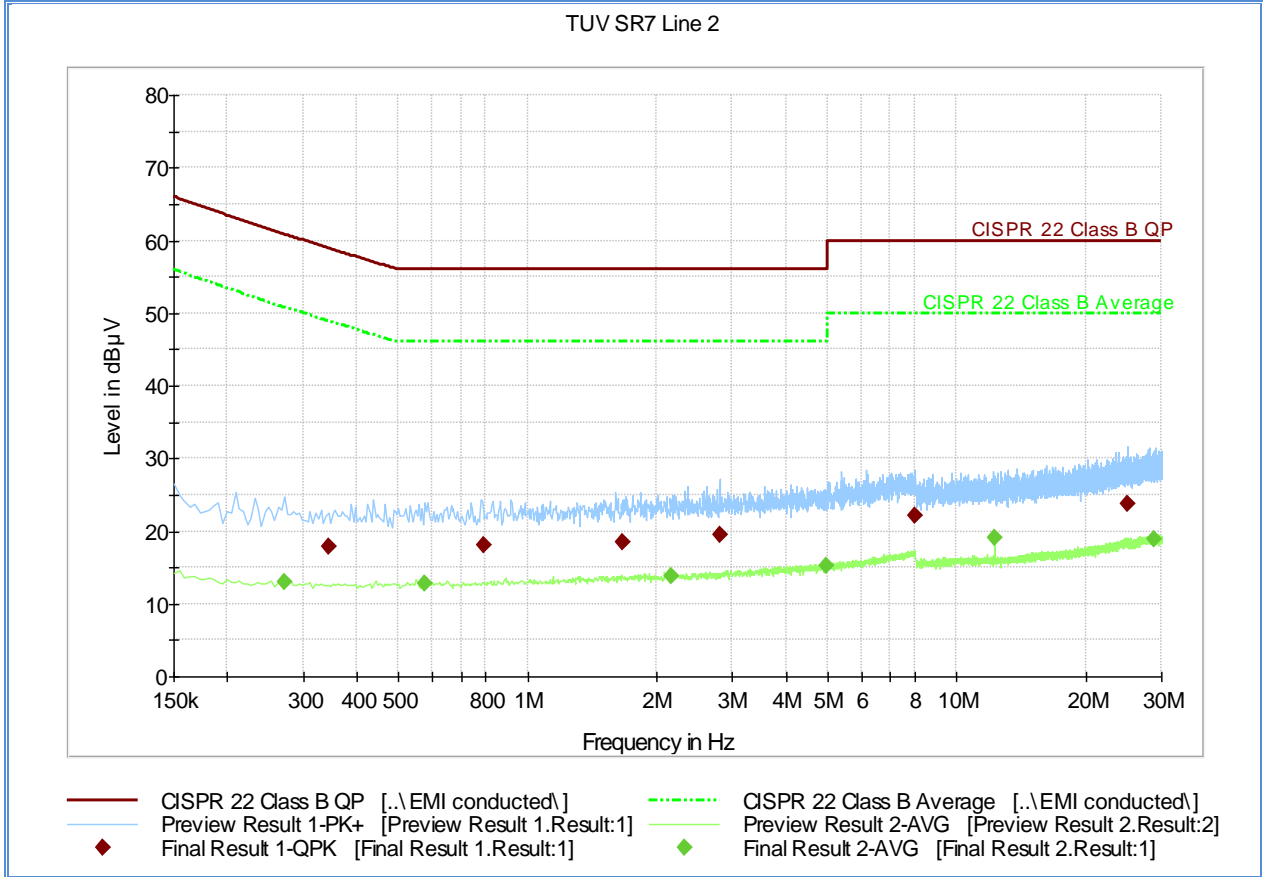
| Frequency (MHz) | QuasiPeak (dBµV) | Meas. Time (ms) | Bandwidth (kHz) | Filter | Line | Corr. (dB) | Margin - QPK (dB) | Limit - QPK (dBµV) |
|-----------------|------------------|-----------------|-----------------|--------|------|------------|-------------------|--------------------|
| 0.384000        | 17.6             | 1000.0          | 9.000           | Off    | L1   | 19.4       | 40.4              | 58.1               |
| 0.564000        | 17.4             | 1000.0          | 9.000           | Off    | L1   | 19.4       | 38.6              | 56.0               |
| 2.179500        | 18.1             | 1000.0          | 9.000           | Off    | L1   | 20.0       | 37.9              | 56.0               |
| 4.587000        | 19.4             | 1000.0          | 9.000           | Off    | L1   | 20.4       | 36.6              | 56.0               |
| 7.543500        | 21.2             | 1000.0          | 9.000           | Off    | L1   | 20.5       | 38.8              | 60.0               |
| 28.819500       | 23.6             | 1000.0          | 9.000           | Off    | L1   | 21.3       | 36.4              | 60.0               |

Average

| Frequency (MHz) | Average (dBµV) | Meas. Time (ms) | Bandwidth (kHz) | Filter | Line | Corr. (dB) | Margin - Ave (dB) | Limit - Ave (dBµV) |
|-----------------|----------------|-----------------|-----------------|--------|------|------------|-------------------|--------------------|
| 0.271500        | 12.7           | 1000.0          | 9.000           | Off    | L1   | 19.4       | 38.2              | 50.8               |
| 0.798000        | 12.5           | 1000.0          | 9.000           | Off    | L1   | 19.5       | 33.5              | 46.0               |
| 1.774500        | 13.1           | 1000.0          | 9.000           | Off    | L1   | 19.9       | 32.9              | 46.0               |
| 5.037000        | 14.4           | 1000.0          | 9.000           | Off    | L1   | 20.4       | 35.6              | 50.0               |
| 12.286500       | 18.5           | 1000.0          | 9.000           | Off    | L1   | 20.5       | 31.5              | 50.0               |
| 28.581000       | 18.2           | 1000.0          | 9.000           | Off    | L1   | 21.3       | 31.8              | 50.0               |



2.1.13 Line 2 (EUT in RX Mode)



Quasi Peak

| Frequency (MHz) | QuasiPeak (dBµV) | Meas. Time (ms) | Bandwidth (kHz) | Filter | Line | Corr. (dB) | Margin - QPK (dB) | Limit - QPK (dBµV) |
|-----------------|------------------|-----------------|-----------------|--------|------|------------|-------------------|--------------------|
| 0.343500        | 17.9             | 1000.0          | 9.000           | Off    | N    | 19.5       | 41.0              | 58.9               |
| 0.789000        | 18.0             | 1000.0          | 9.000           | Off    | N    | 19.9       | 38.0              | 56.0               |
| 1.662000        | 18.6             | 1000.0          | 9.000           | Off    | N    | 20.5       | 37.4              | 56.0               |
| 2.818500        | 19.4             | 1000.0          | 9.000           | Off    | N    | 20.9       | 36.6              | 56.0               |
| 7.984500        | 22.1             | 1000.0          | 9.000           | Off    | N    | 21.2       | 37.9              | 60.0               |
| 24.999000       | 23.8             | 1000.0          | 9.000           | Off    | N    | 21.8       | 36.2              | 60.0               |

Average

| Frequency (MHz) | Average (dBµV) | Meas. Time (ms) | Bandwidth (kHz) | Filter | Line | Corr. (dB) | Margin - Ave (dB) | Limit - Ave (dBµV) |
|-----------------|----------------|-----------------|-----------------|--------|------|------------|-------------------|--------------------|
| 0.271500        | 12.9           | 1000.0          | 9.000           | Off    | N    | 19.5       | 37.9              | 50.8               |
| 0.577500        | 12.8           | 1000.0          | 9.000           | Off    | N    | 19.7       | 33.2              | 46.0               |
| 2.170500        | 13.9           | 1000.0          | 9.000           | Off    | N    | 20.7       | 32.1              | 46.0               |
| 4.960500        | 15.1           | 1000.0          | 9.000           | Off    | N    | 21.2       | 30.9              | 46.0               |
| 12.286500       | 19.1           | 1000.0          | 9.000           | Off    | N    | 21.3       | 30.9              | 50.0               |
| 28.770000       | 18.9           | 1000.0          | 9.000           | Off    | N    | 22.0       | 31.1              | 50.0               |



## **2.2 CARRIER FREQUENCY SEPARATION**

### **2.2.1 Specification Reference**

Part 15 Subpart C §15.247(a)(1)

### **2.2.2 Standard Applicable**

(1) 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. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

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

Serial No: N/A / Test Configuration B

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

October 29, 2012/FSC

### **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**

|                     |          |
|---------------------|----------|
| Ambient Temperature | 21.3°C   |
| Relative Humidity   | 41.2%    |
| ATM Pressure        | 99.6 kPa |

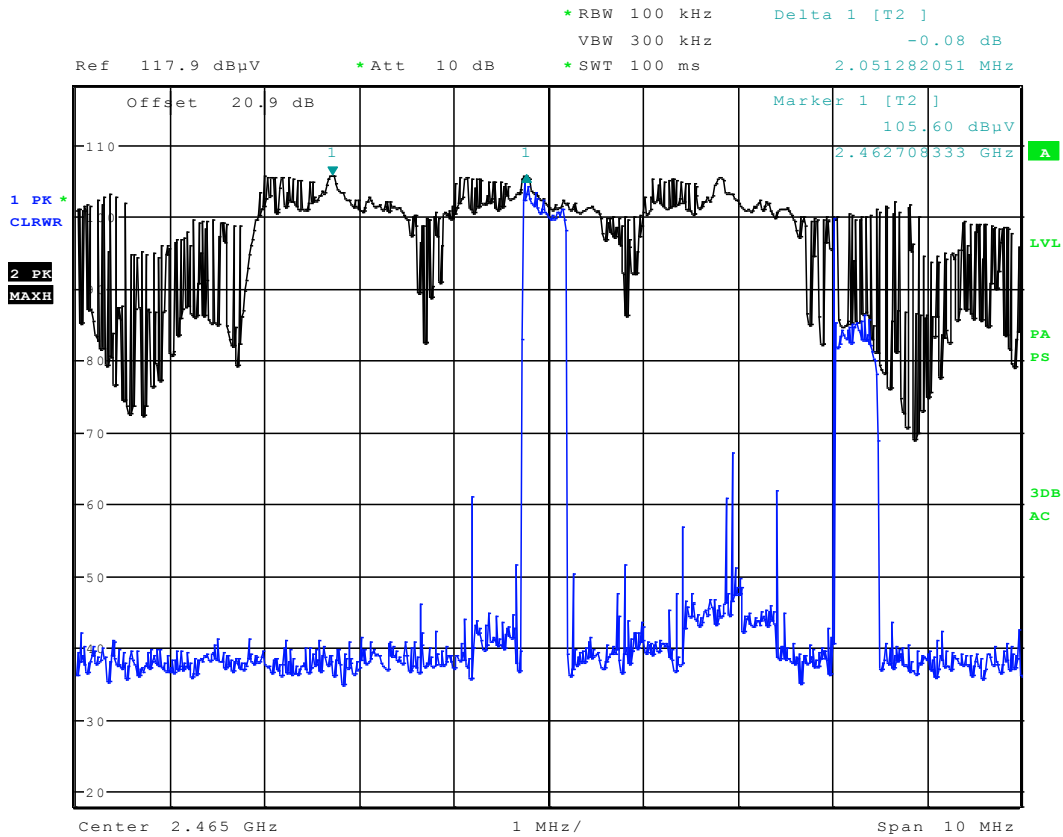
### **2.2.7 Additional Observations**

- Hopping function enabled.
- Span is wide enough to capture the peaks of two adjacent channels.
- RBW is 1% of the span.
- VBW is 3x RBW
- Sweep is auto



- Detector is peak.
- Trace is max hold.
- An offset of 20.9dB was added to compensate for the external attenuator and cable used.
- Marker-delta function is used between the peaks of the adjacent channels.
- Limit used is 1.952 MHz (worst case 20 dB Bandwidth. See Section 2.5 for details).

**2.2.8 Test Results**



Date: 29.OCT.2012 12:51:10

**Observed carrier frequency separation = 2.05 MHz (Complies. Greater than 20 dB bandwidth of 1.952 MHz)**



## **2.3 NUMBER OF HOPPING FREQUENCIES**

### **2.3.1 Specification Reference**

Part 15 Subpart C §15.247(a)(1)(iii)

### **2.3.2 Standard Applicable**

(iii) Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels. 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. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

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

Serial No: N/A / Test Configuration B

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

October 29, 2012/FSC

### **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**

|                     |          |
|---------------------|----------|
| Ambient Temperature | 21.3°C   |
| Relative Humidity   | 41.2%    |
| ATM Pressure        | 99.6 kPa |

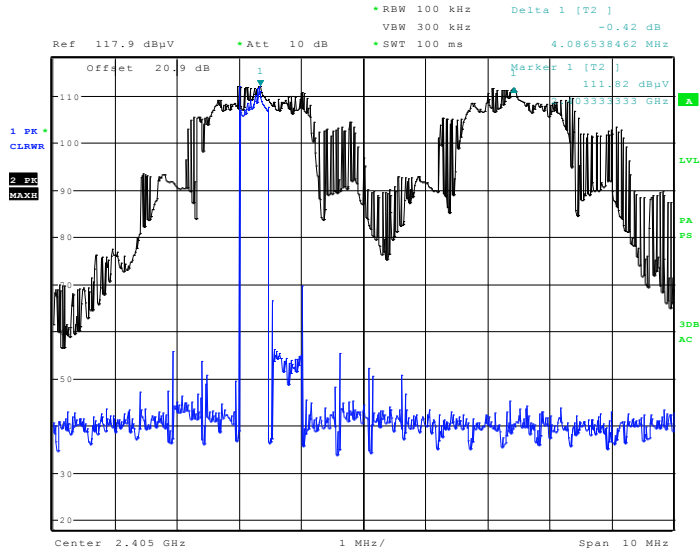
### **2.3.7 Additional Observations**

- Hopping function enabled.
- Span is wide enough to capture the channels of interests.
- The span was broken up to sections in order to clearly show all of the hopping frequencies.
- RBW is 1% of the span.
- VBW is 3x RBW
- Sweep is auto
- Detector is peak.
- Trace is max hold.
- An offset of 20.9dB was added to compensate for the external attenuator and cable used.

**2.3.8 Test Results**

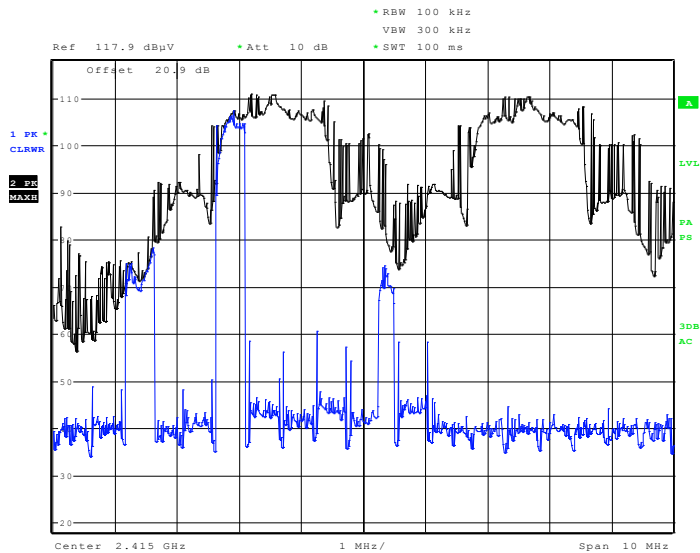
Observed Number of Hopping Frequencies is

$$\begin{aligned}
 &= 20 \\
 &= \text{Plot \#1} + \text{Plot \#2} + \text{Plot \#3} + \text{Plot \#4} + \text{Plot \#5} + \text{Plot \#6} + \text{Plot \#7} + \text{Plot \#8} \\
 &= 2 + 2 + 4 + 1 + 2 + 3 + 3 + 3
 \end{aligned}$$



Date: 29.OCT.2012 12:36:31

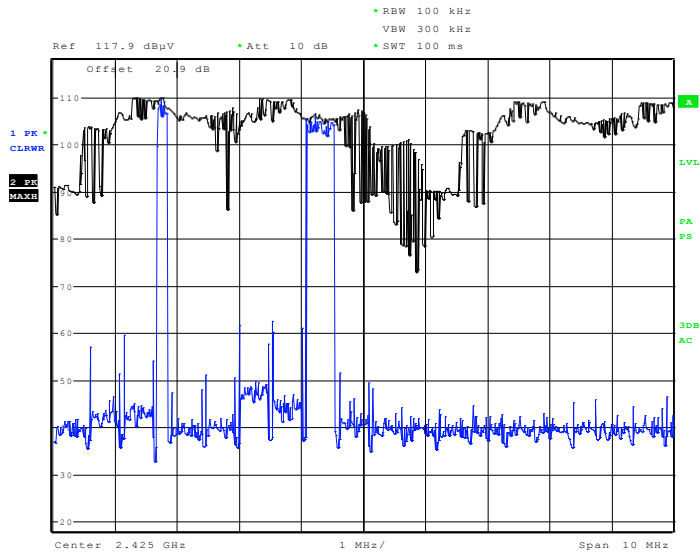
**Plot #1**



Date: 29.OCT.2012 12:36:14

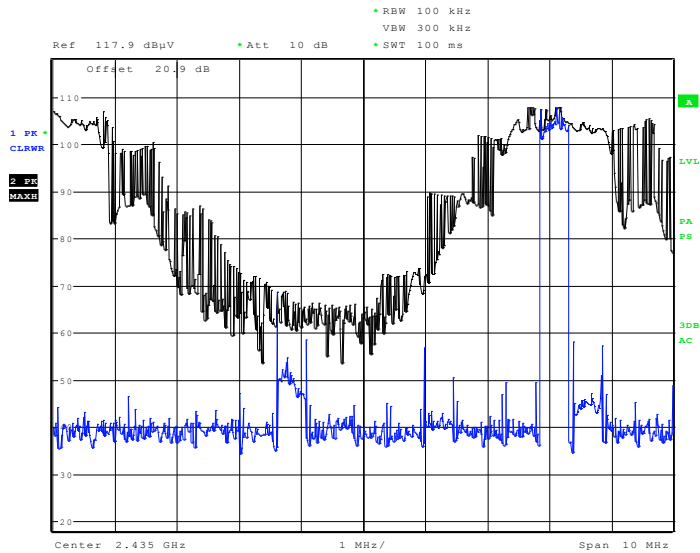
**Plot #2**





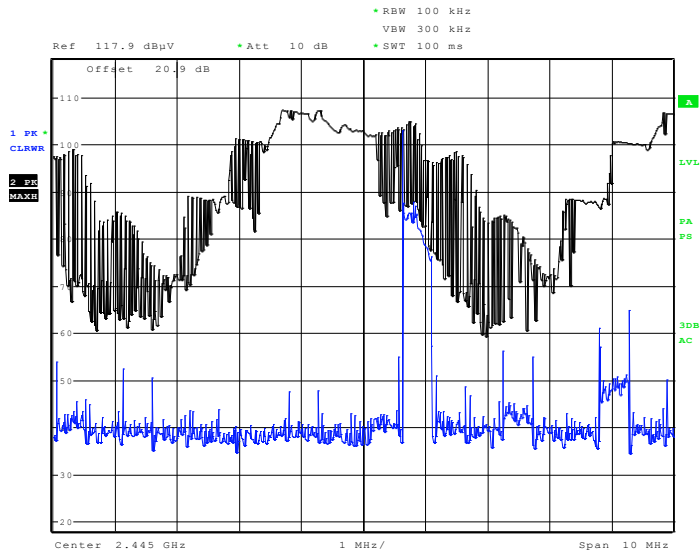
Date: 29.OCT.2012 12:41:40

Plot #3



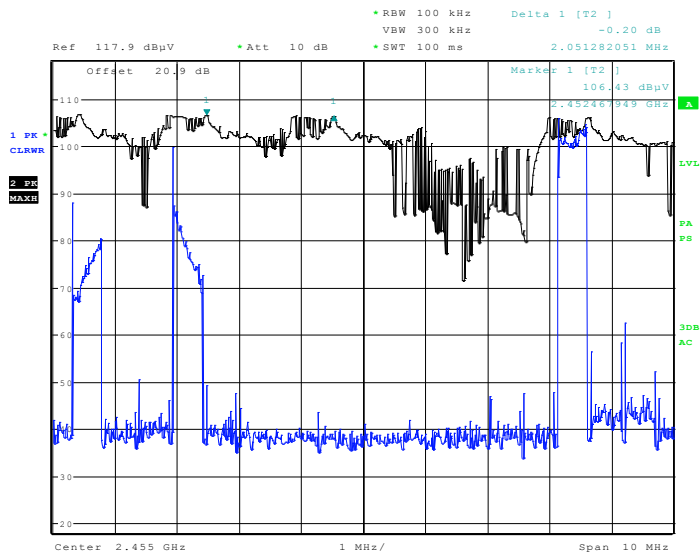
Date: 29.OCT.2012 12:43:24

Plot #4



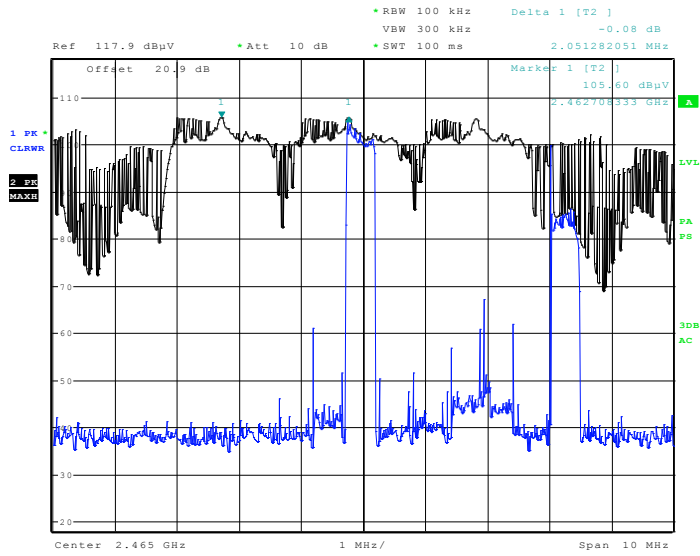
Date: 29.OCT.2012 12:46:16

Plot #5



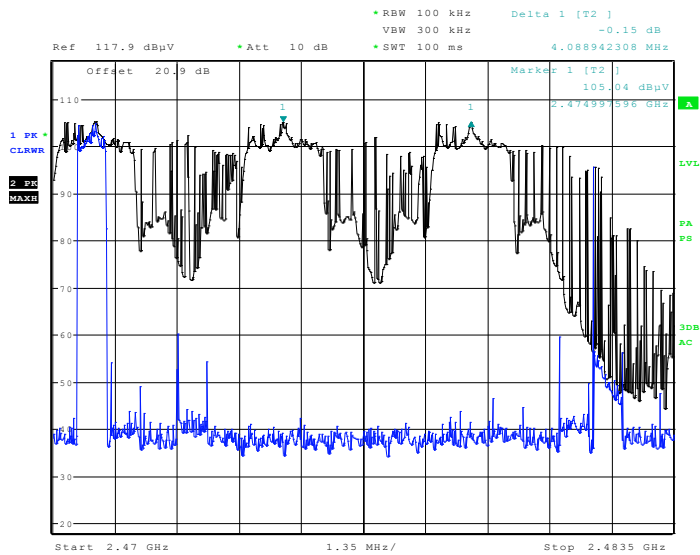
Date: 29.OCT.2012 12:48:53

Plot #6



Date: 29.OCT.2012 12:51:10

Plot #7



Date: 29.OCT.2012 12:54:09

Plot #8



## **2.4 TIME OF OCCUPANCY (DWELL TIME)**

### **2.4.1 Specification Reference**

Part 15 Subpart C §15.247(a)(1)(iii)

### **2.4.2 Standard Applicable**

(iii) Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels. 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. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

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

Serial No: N/A / Test Configuration B

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

October 29, 2012/FSC

### **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**

|                     |          |
|---------------------|----------|
| Ambient Temperature | 21.3°C   |
| Relative Humidity   | 41.2%    |
| ATM Pressure        | 99.6 kPa |

### **2.4.7 Additional Observations**

- Hopping function enabled.
- Span = zero span, centered on a hopping channel.
- RBW is 1MHz.
- VBW is 3x RBW
- Detector is peak.
- A single pulse is first measured. This measurement is then used to compute the average time of occupancy in the required period (no. of channels x 0.4 second).



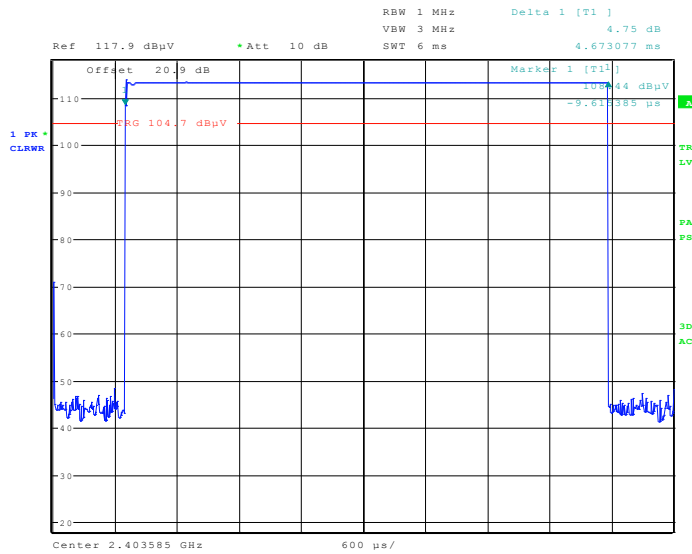
**2.4.8 Test Results**

Width of single pulse = 4.67 ms  
 Observed occurrence = 10 pulses/second  
 Required period = 20 channels x 0.4 second  
 = 8 seconds

Average time of occupancy = Pulse width x  $\frac{10 \text{ pulses}}{\text{second}}$  x 8 seconds  
 = 0.00467 second x 10 x 24.8  
 = 0.3736 second

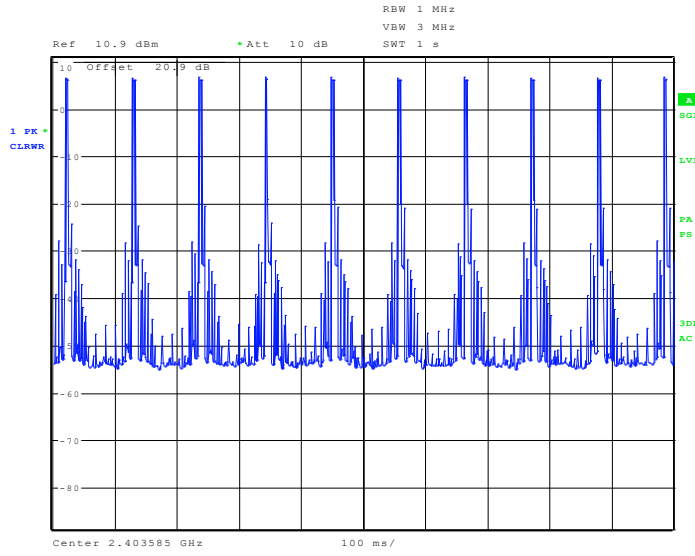
Compliance = **Complies.** 0.3736 second < 0.4 second

**2.4.9 Test Results Plots**



Date: 29.OCT.2012 13:30:07

**Width of single pulse (4.67ms)**



Date: 29.OCT.2012 13:34:46

**10 pulses/1 second**



## **2.5 20 dB BANDWIDTH**

### **2.5.1 Specification Reference**

Part 15 Subpart C §15.215(c)

### **2.5.2 Standard Applicable**

(c) Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

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

Serial No: N/A / Test Configuration A

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

October 29, 2012/FSC

### **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**

|                     |          |
|---------------------|----------|
| Ambient Temperature | 21.3°C   |
| Relative Humidity   | 41.2%    |
| ATM Pressure        | 99.6 kPa |

### **2.5.7 Additional Observations**

- This is a conducted test.
- An offset of 20.9dB was added to compensate for the external attenuator and cable used.
- Span is approximately 2 to 3 times the expected 20dB bandwidth.
- RBW is  $\geq 1\%$  of the expected 20dB bandwidth.
- VBW is  $\geq$  RBW.
- Sweep is auto.



- Detector is peak.
- Trace is max hold.
- “n dB down” (20dB) marker function of the spectrum analyzer was used for this test.

**2.5.8 Test Results**

| Channel                   | Frequency (MHz) | Measured 20dB Bandwidth (MHz) |
|---------------------------|-----------------|-------------------------------|
| Low Channel (Channel 0)   | 2403.328        | 1.952                         |
| Mid Channel (Channel 19)  | 2442.240        | 1.894                         |
| High Channel (Channel 37) | 2479.104        | 1.875                         |

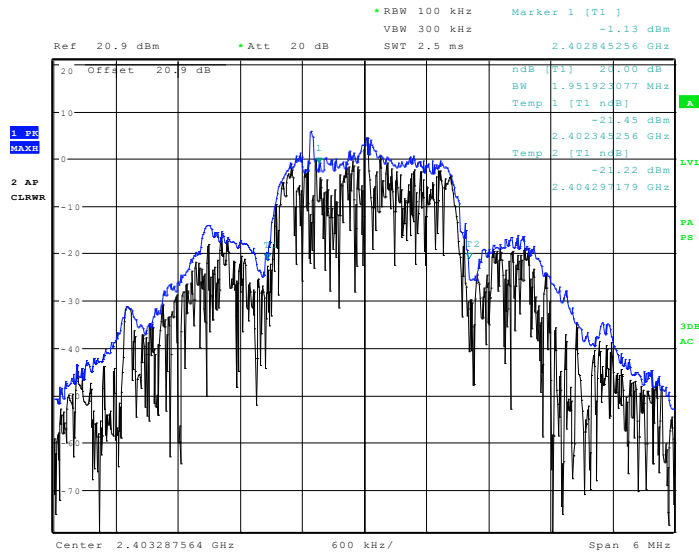
**Worst case configuration (Low Channel using Symbol 0)**

2403.328 MHz – (20dB BW/2) = 2402.352 MHz (within the frequency band - **Compliant**)

**Worst case configuration (High Channel using Symbol 1)**

2479.104 MHz + (20dB BW/2) = 2480.0415 MHz (within the frequency band - **Compliant**)

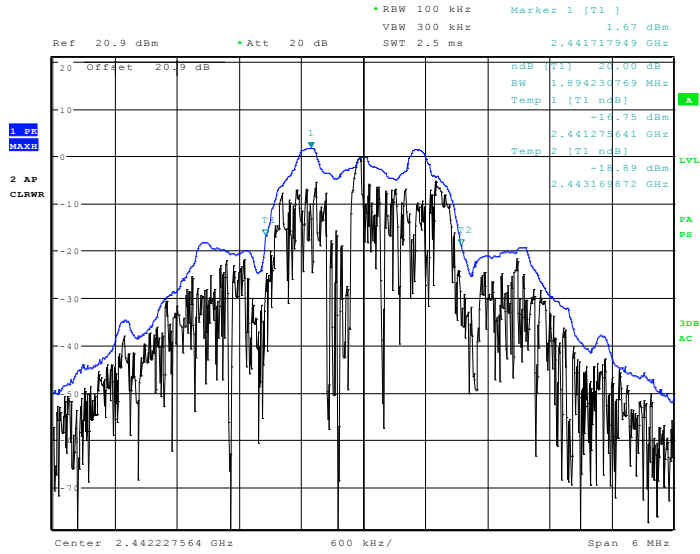
**2.5.9 Test Results Plots**



Date: 29.OCT.2012 14:35:24

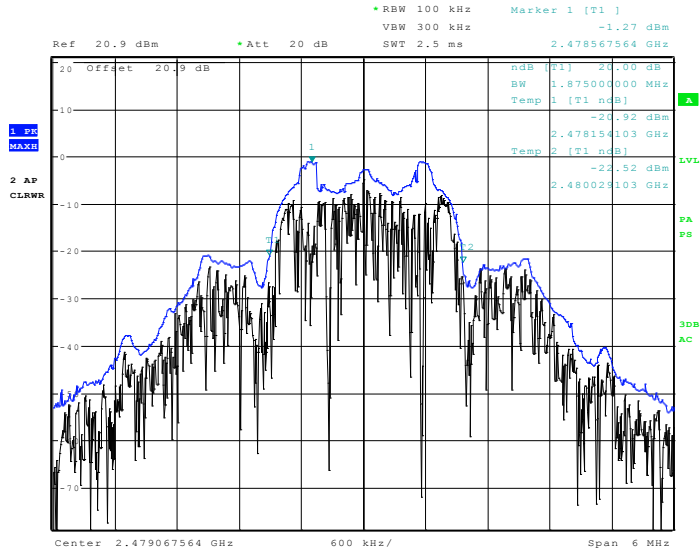
**Low Channel**





Date: 29.OCT.2012 14:38:51

### Mid Channel



Date: 29.OCT.2012 14:41:36

### High Channel



**2.6 PEAK OUTPUT POWER**

**2.6.1 Specification Reference**

Part 15 Subpart C §15.247(b)(1)

**2.6.2 Standard Applicable**

(1) For frequency hopping systems operating in the 2400–2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725–5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400–2483.5 MHz band: 0.125 watts.

**2.6.3 Equipment Under Test and Modification State**

Serial No: N/A / Test Configuration A

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

October 30, 2012/FSC

**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**

|                     |          |
|---------------------|----------|
| Ambient Temperature | 22.6°C   |
| Relative Humidity   | 43.8%    |
| ATM Pressure        | 99.8 kPa |

**2.6.7 Additional Observations**

This is a conducted test using a Peak Power Meter.

**2.6.8 Test Results**

| Channel      | Frequency (MHz) | Measured Peak Output Power (dBm) | Measured Peak Output Power (Watts) | Limit (Watt) |
|--------------|-----------------|----------------------------------|------------------------------------|--------------|
| Low Channel  | 2403.2          | 14.57                            | 0.027                              | 0.125        |
| Mid Channel  | 2442.2          | 15.05                            | 0.032                              | 0.125        |
| High Channel | 2479.0          | 13.83                            | 0.024                              | 0.125        |



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

### **2.7.1 Specification Reference**

Part 15 Subpart C §15.247(d)

### **2.7.2 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)).

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

Serial No: N/A / Test Configuration A and B

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

October 30, 2012/FSC

### **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**

|                     |          |
|---------------------|----------|
| Ambient Temperature | 22.6°C   |
| Relative Humidity   | 43.8%    |
| ATM Pressure        | 99.8 kPa |

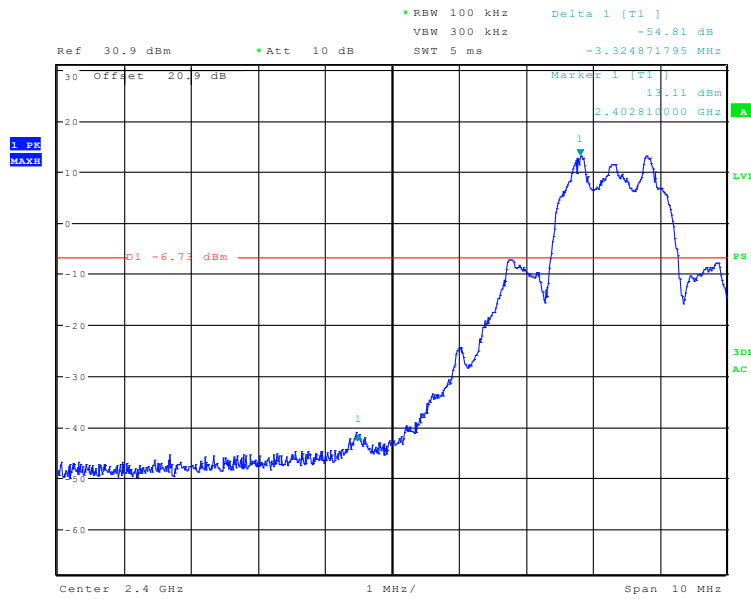
### **2.7.7 Additional Observations**

- This is a conducted test.
- An offset of 20.9dB was added to compensate for the external attenuator and cable used.
- Span is wide enough to capture the peak level of the emission operating on the channel closest to the bandedge.
- RBW is  $\geq 1\%$  of the span.
- VBW is  $\geq$  RBW.
- Sweep is auto.



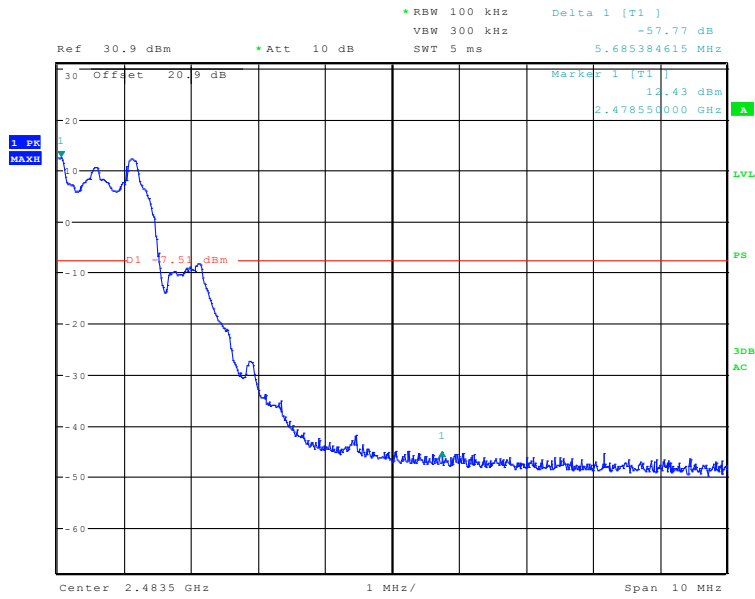
- Detector is peak.
- Trace is max hold.
- Trace allowed to stabilize. Marker-delta function used to verify compliance.
- Limit is 20dBc.
- Both Hopping and Non-Hopping mode verified.

### 2.7.8 Test Results



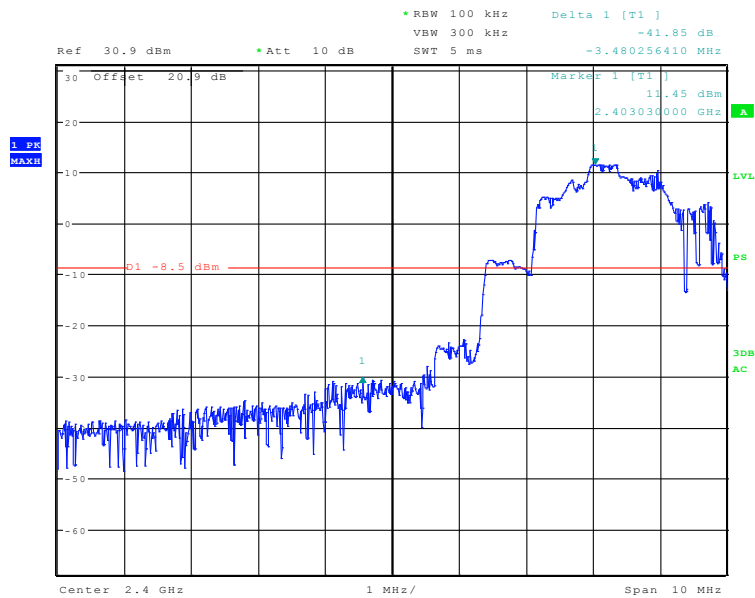
Date: 30.OCT.2012 14:29:51

#### Lower Band-Edge (Low Channel Non-Hopping)



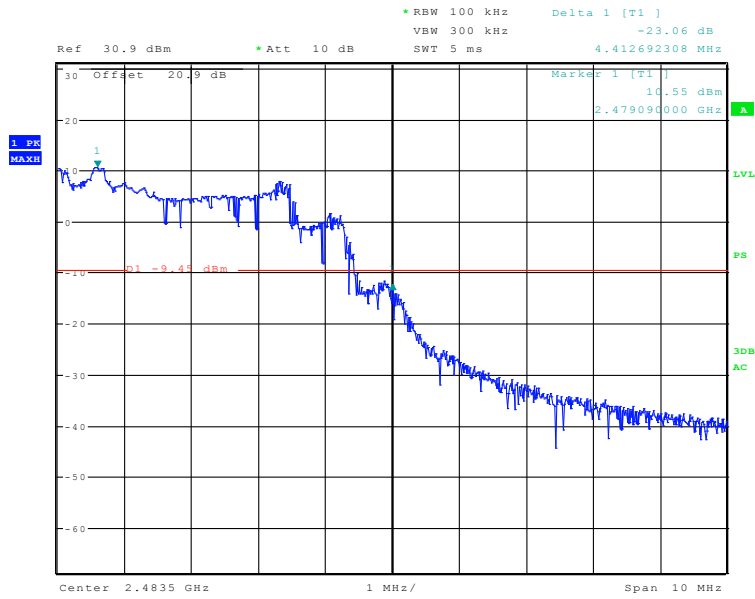
Date: 30.OCT.2012 14:33:41

**Upper Band-Edge (Non-Hopping)**



Date: 30.OCT.2012 14:39:12

**Lower Band-Edge (Hopping Mode)**



Date: 30.OCT.2012 14:36:20

### Upper Band-Edge (Hopping Mode)



## **2.8 SPURIOUS RF CONDUCTED EMISSIONS**

### **2.8.1 Specification Reference**

Part 15 Subpart C §15.247(d)

### **2.8.2 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)).

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

Serial No: N/A / Test Configuration A

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

October 29 and 30, 2012/FSC and LTS

### **2.8.5 Test Equipment Used**

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

### **2.8.6 Environmental Conditions**

|                     |                |
|---------------------|----------------|
| Ambient Temperature | 23.5-23.7 °C   |
| Relative Humidity   | 47.4-48.3 %    |
| ATM Pressure        | 99.1- 99.7 kPa |

### **2.8.7 Additional Observations**

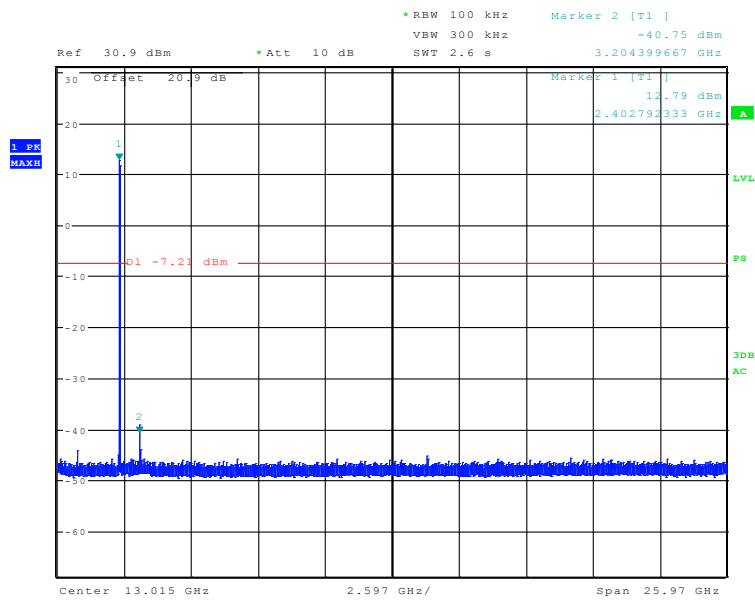
- This is a conducted test.
- An offset of 20.9dB was added to compensate for the external attenuator and cable used.
- Span is from 30MHz up to 26GHz (to cover 10<sup>th</sup> harmonic of the High Channel).
- Sweep point setting of the spectrum analyzer is set to maximum (30001).
- RBW is 100kHz.
- VBW is ≥ RBW.
- Sweep is auto.
- Detector is peak.



- Trace is max hold.
- Trace allowed to stabilize. Marker-delta function used to verify compliance.
- Limit is 20dBc
- All modulation modulation verified.

### 2.8.8 Test Results

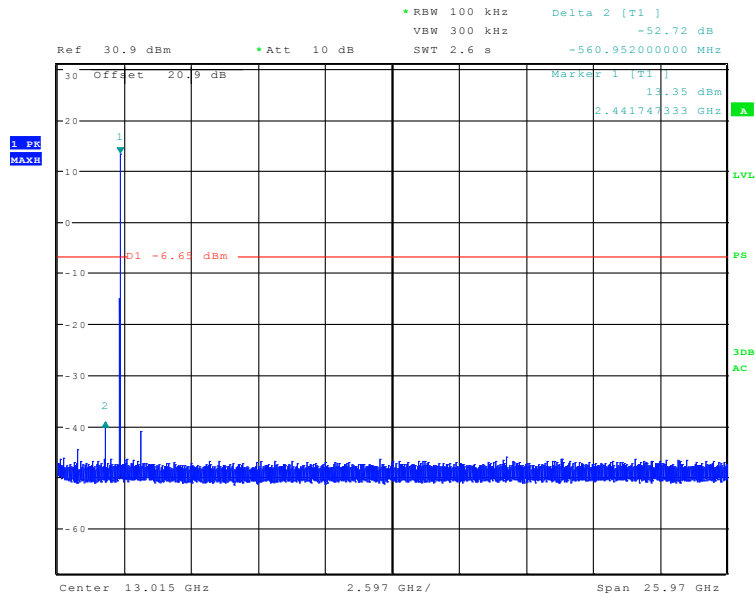
See attached plots.



Date: 29.OCT.2012 17:01:23

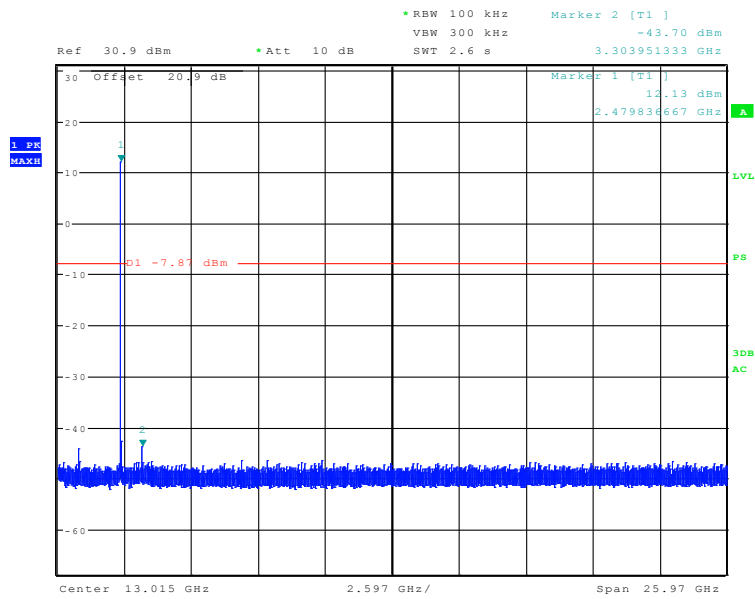
### Low Channel





Date: 29.OCT.2012 17:15:07

Mid Channel



Date: 30.OCT.2012 08:55:44

### High Channel



## **2.9 SPURIOUS RADIATED EMISSIONS**

### **2.9.1 Specification Reference**

Part 15 Subpart C §15.247(d)

### **2.9.2 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)).

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

Serial No: N/A / Test Configuration B

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

October 31, 2012/FSC

### **2.9.5 Test Equipment Used**

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

### **2.9.6 Environmental Conditions**

|                     |          |
|---------------------|----------|
| Ambient Temperature | 23.6 °C  |
| Relative Humidity   | 49.3 %   |
| ATM Pressure        | 99.8 kPa |

### **2.9.7 Additional Observations**

- This is a radiated test. The spectrum was searched from 30MHz to the 10<sup>th</sup> harmonic.
- 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).
- Test procedure is consistent with those specified under C63.10.
- 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 2.9.8 for sample computation.



**2.9.8 Sample Computation (Radiated Emission)**

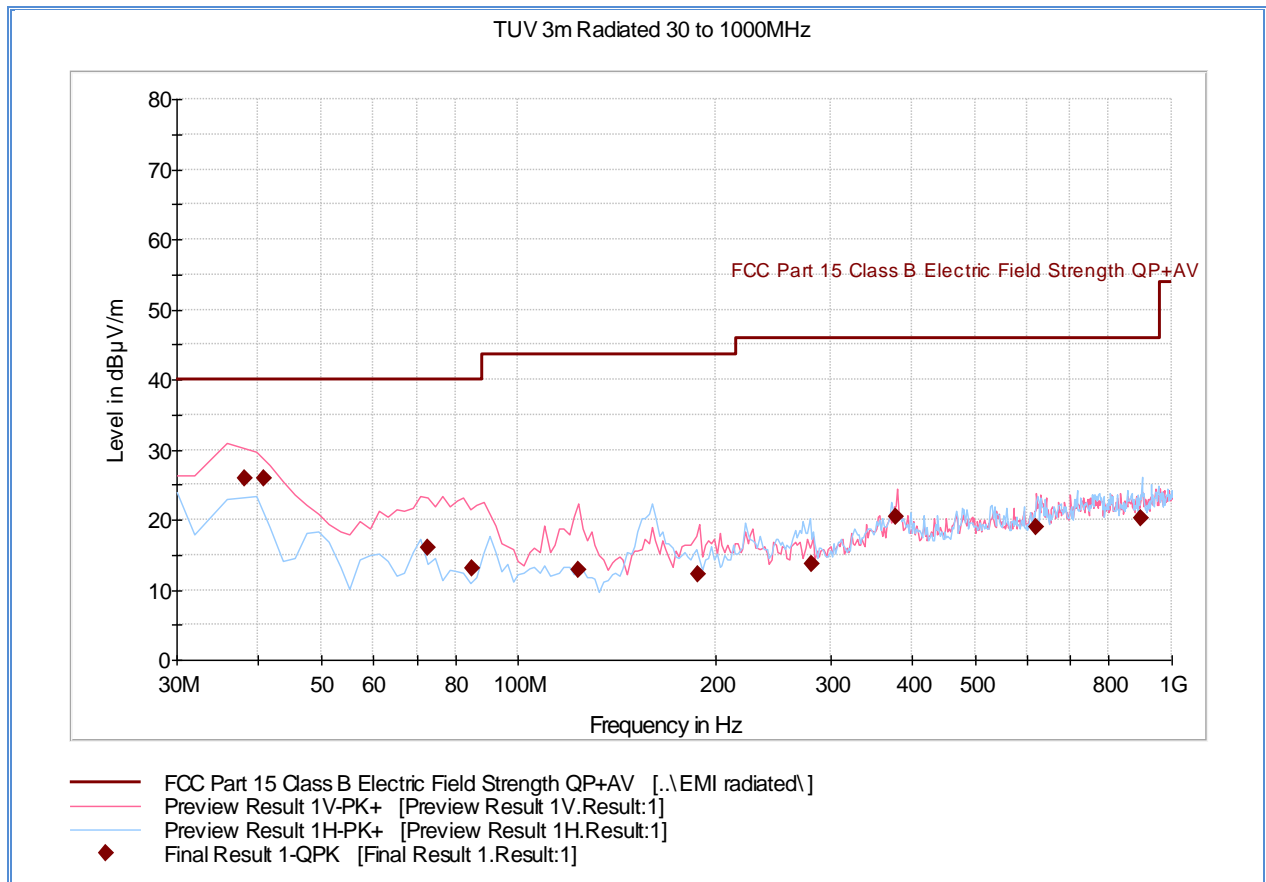
|   |                            |       |
|---|----------------------------|-------|
| Measuring equipment raw measurement (db $\mu$ V) @ 30 MHz   |                            | 24.4  |
| Correction Factor (dB)                                      | Asset# 1066 (cable)        | 0.3   |
|   | Asset#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

**2.9.9 Test Results**

See attached plots.



**2.9.10 Test Results Below 1GHz (Receive Mode)**

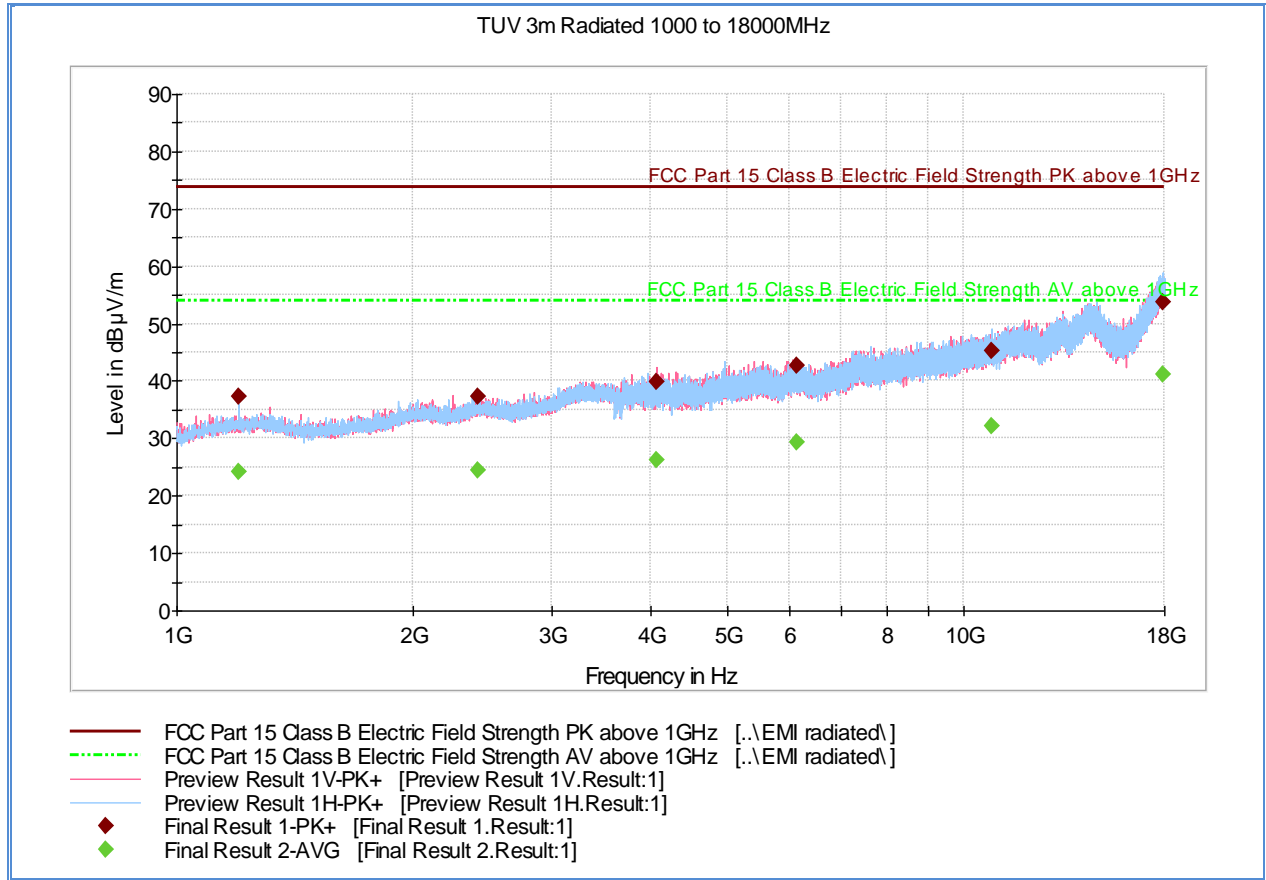


**Quasi Peak Data**

| Frequency (MHz) | QuasiPeak (dBµV/m) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Polarization | Azimuth (deg) | Corr. (dB) | Margin (dB) | Limit (dBµV/m) |
|-----------------|--------------------|-----------------|-----------------|-------------|--------------|---------------|------------|-------------|----------------|
| 38.111663       | 25.9               | 1000.0          | 120.000         | 100.0       | V            | 310.0         | -16.2      | 14.1        | 40.0           |
| 40.727214       | 25.8               | 1000.0          | 120.000         | 100.0       | V            | 340.0         | -17.4      | 14.2        | 40.0           |
| 72.461643       | 15.9               | 1000.0          | 120.000         | 100.0       | V            | 255.0         | -21.9      | 24.1        | 40.0           |
| 85.012745       | 13.2               | 1000.0          | 120.000         | 210.0       | V            | 308.0         | -21.2      | 26.8        | 40.0           |
| 123.426613      | 12.8               | 1000.0          | 120.000         | 100.0       | V            | 139.0         | -20.7      | 30.7        | 43.5           |
| 187.918798      | 12.2               | 1000.0          | 120.000         | 130.0       | V            | 264.0         | -16.4      | 31.3        | 43.5           |
| 280.577635      | 13.6               | 1000.0          | 120.000         | 400.0       | H            | 14.0          | -12.5      | 32.4        | 46.0           |
| 377.059800      | 20.3               | 1000.0          | 120.000         | 100.0       | V            | 123.0         | -8.6       | 25.7        | 46.0           |
| 619.621884      | 19.0               | 1000.0          | 120.000         | 100.0       | V            | 264.0         | -3.2       | 27.0        | 46.0           |



**2.9.11 Test Results Above 1GHz (Receive Mode)**



**Peak Data**

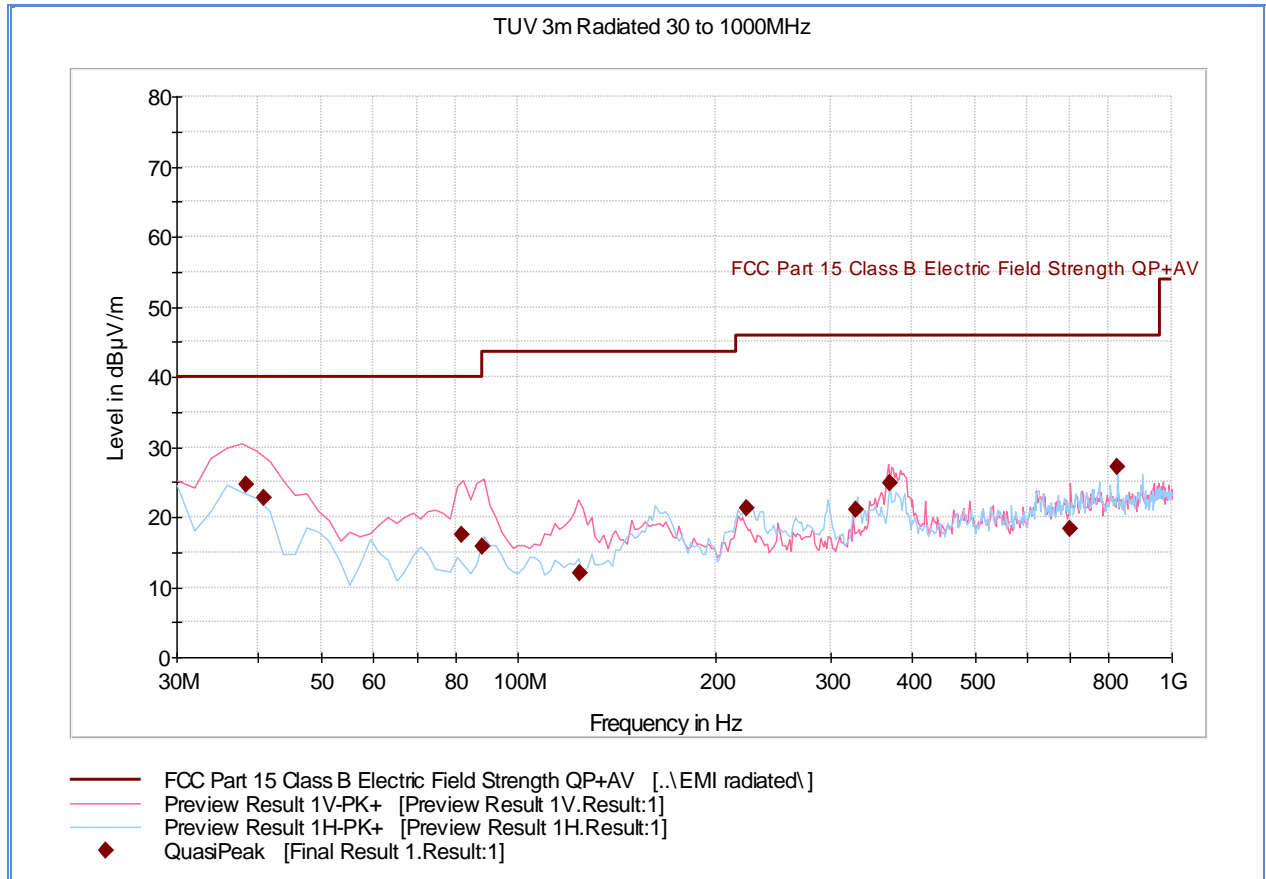
| Frequency (MHz) | MaxPeak (dBµV/m) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Polarization | Azimuth (deg) | Corr. (dB) | Margin (dB) | Limit (dBµV/m) |
|-----------------|------------------|-----------------|-----------------|-------------|--------------|---------------|------------|-------------|----------------|
| 1199.933333     | 37.3             | 1000.0          | 1000.000        | 100.0       | H            | 9.0           | -9.8       | 36.6        | 73.9           |
| 2414.713333     | 37.2             | 1000.0          | 1000.000        | 199.0       | V            | 208.0         | -4.8       | 36.7        | 73.9           |
| 4075.846667     | 39.7             | 1000.0          | 1000.000        | 240.0       | V            | 200.0         | 1.0        | 34.2        | 73.9           |
| 6131.586667     | 42.8             | 1000.0          | 1000.000        | 375.0       | H            | 169.0         | 4.8        | 31.1        | 73.9           |
| 10842.48666     | 45.3             | 1000.0          | 1000.000        | 184.0       | H            | 128.0         | 11.2       | 28.6        | 73.9           |
| 17958.04666     | 53.7             | 1000.0          | 1000.000        | 309.0       | H            | 269.0         | 21.6       | 20.2        | 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) |
|-----------------|------------------|-----------------|-----------------|-------------|--------------|---------------|------------|-------------|----------------|
| 1199.933333     | 24.2             | 1000.0          | 1000.000        | 100.0       | H            | 9.0           | -9.8       | 29.7        | 53.9           |
| 2414.713333     | 24.4             | 1000.0          | 1000.000        | 199.0       | V            | 208.0         | -4.8       | 29.5        | 53.9           |
| 4075.846667     | 26.3             | 1000.0          | 1000.000        | 240.0       | V            | 200.0         | 1.0        | 27.6        | 53.9           |
| 6131.586667     | 29.4             | 1000.0          | 1000.000        | 375.0       | H            | 169.0         | 4.8        | 24.5        | 53.9           |
| 10842.48666     | 32.2             | 1000.0          | 1000.000        | 184.0       | H            | 128.0         | 11.2       | 21.7        | 53.9           |
| 17958.04666     | 41.3             | 1000.0          | 1000.000        | 309.0       | H            | 269.0         | 21.6       | 12.6        | 53.9           |



**2.9.12 Test Results Below 1GHz (Transmit Mid Channel)**



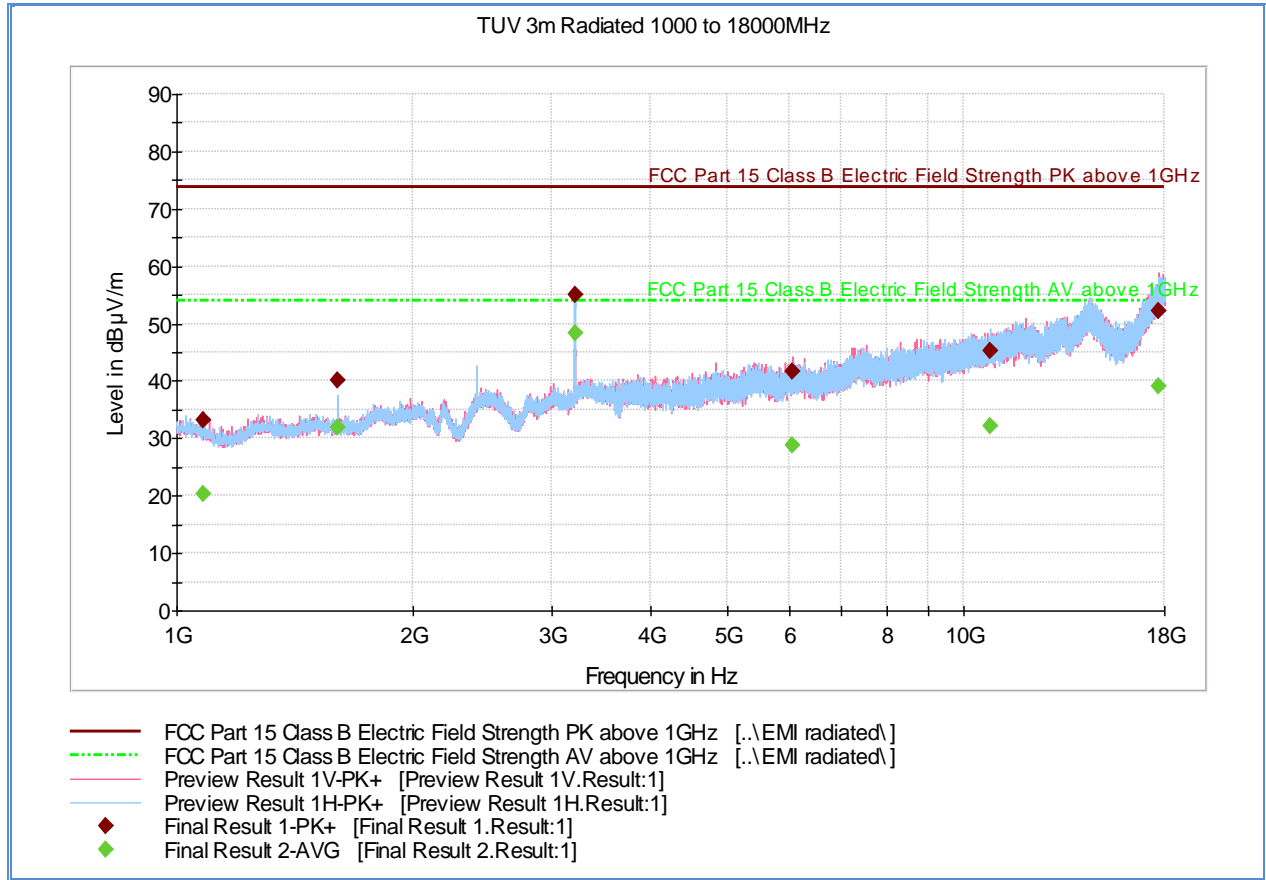
**Quasi Peak Data**

| Frequency (MHz) | QuasiPeak (dBµV/m) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Polarization | Azimuth (deg) | Corr. (dB) | Margin (dB) | Limit (dBµV/m) |
|-----------------|--------------------|-----------------|-----------------|-------------|--------------|---------------|------------|-------------|----------------|
| 38.295551       | 24.7               | 1000.0          | 120.000         | 100.0       | V            | 88.0          | -16.2      | 15.3        | 40.0           |
| 40.727214       | 22.8               | 1000.0          | 120.000         | 135.0       | V            | 154.0         | -17.4      | 17.2        | 40.0           |
| 82.044970       | 17.5               | 1000.0          | 120.000         | 117.0       | V            | 69.0          | -21.5      | 22.5        | 40.0           |
| 88.252745       | 15.8               | 1000.0          | 120.000         | 142.0       | V            | 102.0         | -20.9      | 27.7        | 43.5           |
| 124.226613      | 12.0               | 1000.0          | 120.000         | 135.0       | V            | 123.0         | -20.7      | 31.5        | 43.5           |
| 223.948778      | 21.3               | 1000.0          | 120.000         | 130.0       | H            | 79.0          | -14.9      | 24.7        | 46.0           |
| 327.998717      | 21.0               | 1000.0          | 120.000         | 100.0       | H            | 22.0          | -11.9      | 25.0        | 46.0           |
| 370.916473      | 24.8               | 1000.0          | 120.000         | 119.0       | V            | 161.0         | -8.9       | 21.2        | 46.0           |
| 697.217395      | 18.2               | 1000.0          | 120.000         | 381.0       | V            | 37.0          | -3.5       | 27.8        | 46.0           |
| 826.353988      | 27.1               | 1000.0          | 120.000         | 100.0       | H            | 80.0          | -1.3       | 18.9        | 46.0           |

**Test Notes:** Only worst case channel presented for spurious emissions below 1GHz.



**2.9.13 Test Results Above 1GHz (Low 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) |
|-----------------|------------------|-----------------|-----------------|-------------|--------------|---------------|------------|-------------|----------------|
| 1079.966667     | 33.2             | 1000.0          | 1000.000        | 308.0       | V            | 344.0         | -10.5      | 40.7        | 73.9           |
| 1601.860000     | 40.0             | 1000.0          | 1000.000        | 100.0       | H            | 260.0         | -8.9       | 33.9        | 73.9           |
| 3205.080000     | 54.9             | 1000.0          | 1000.000        | 123.0       | H            | 286.0         | -1.5       | 19.0        | 73.9           |
| 6064.926667     | 41.8             | 1000.0          | 1000.000        | 326.0       | V            | 159.0         | 4.7        | 32.1        | 73.9           |
| 10818.693333    | 45.3             | 1000.0          | 1000.000        | 365.0       | H            | 118.0         | 11.2       | 28.6        | 73.9           |
| 17661.200000    | 52.1             | 1000.0          | 1000.000        | 233.0       | V            | 45.0          | 20.4       | 21.8        | 73.9           |

**Average Data**

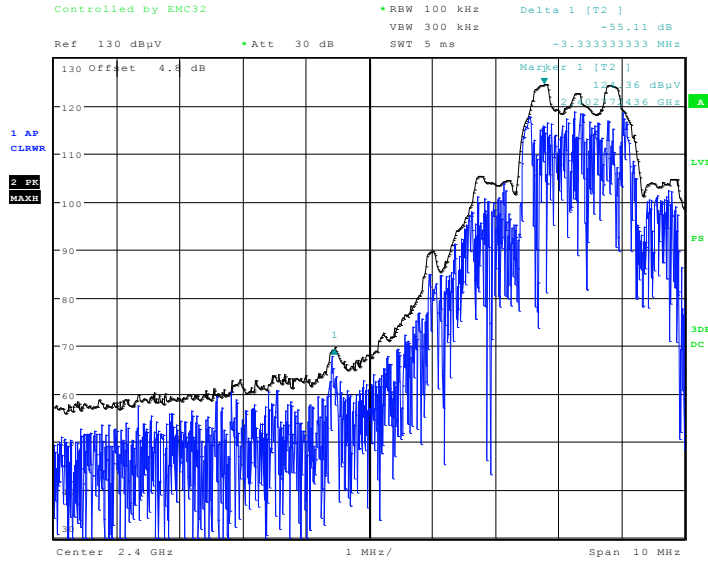
| Frequency (MHz) | Average (dBµV/m) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Polarization | Azimuth (deg) | Corr. (dB) | Margin (dB) | Limit (dBµV/m) |
|-----------------|------------------|-----------------|-----------------|-------------|--------------|---------------|------------|-------------|----------------|
| 1079.966667     | 20.3             | 1000.0          | 1000.000        | 308.0       | V            | 344.0         | -10.5      | 33.6        | 53.9           |
| 1601.860000     | 31.8             | 1000.0          | 1000.000        | 100.0       | H            | 260.0         | -8.9       | 22.1        | 53.9           |
| 3205.080000     | 48.2             | 1000.0          | 1000.000        | 123.0       | H            | 286.0         | -1.5       | 5.7         | 53.9           |
| 6064.926667     | 28.7             | 1000.0          | 1000.000        | 326.0       | V            | 159.0         | 4.7        | 25.2        | 53.9           |
| 10818.693333    | 32.2             | 1000.0          | 1000.000        | 365.0       | H            | 118.0         | 11.2       | 21.7        | 53.9           |
| 17661.200000    | 39.1             | 1000.0          | 1000.000        | 233.0       | V            | 45.0          | 20.4       | 14.8        | 53.9           |

**Test Notes:** A 2.4 GHz notch filter was used during this test to avoid overloading of the measuring instrument.





**2.9.14 Test Results Lower Band Edge (Radiated - Low Channel using 100 kHz RBW)**

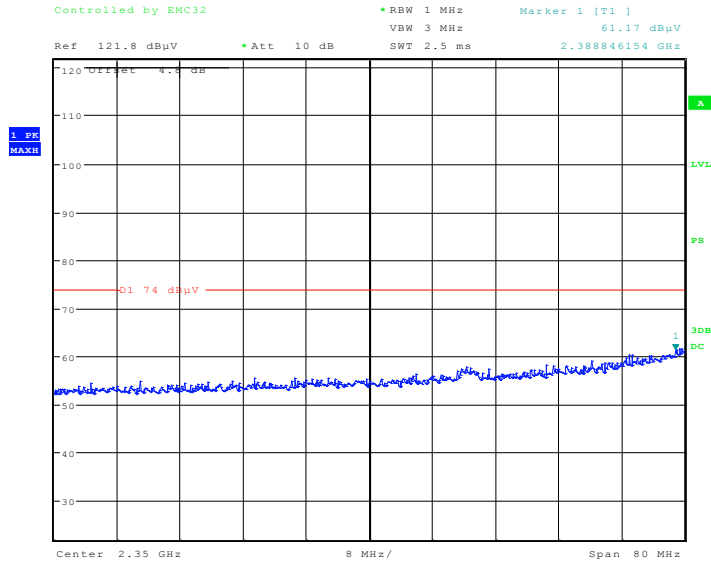


Date: 31.OCT.2012 09:12:28

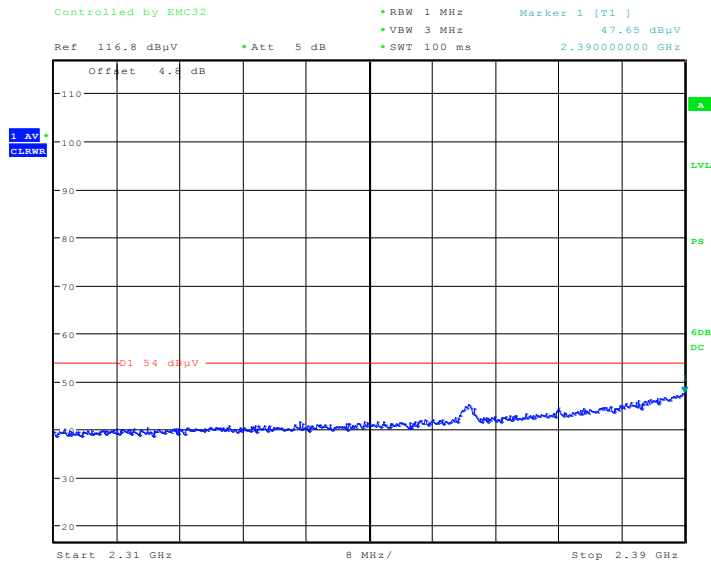
**Test Notes:** Carrier frequency (Low Channel) was maximized for this test. Correction factor of 4.8dB is from the cable, antenna and preamp used. Limit for this test is 20dBc.



**2.9.15 Test Results Restricted Band (2310MHz to 2390MHz) Low Channel**



Date: 31.OCT.2012 13:02:42

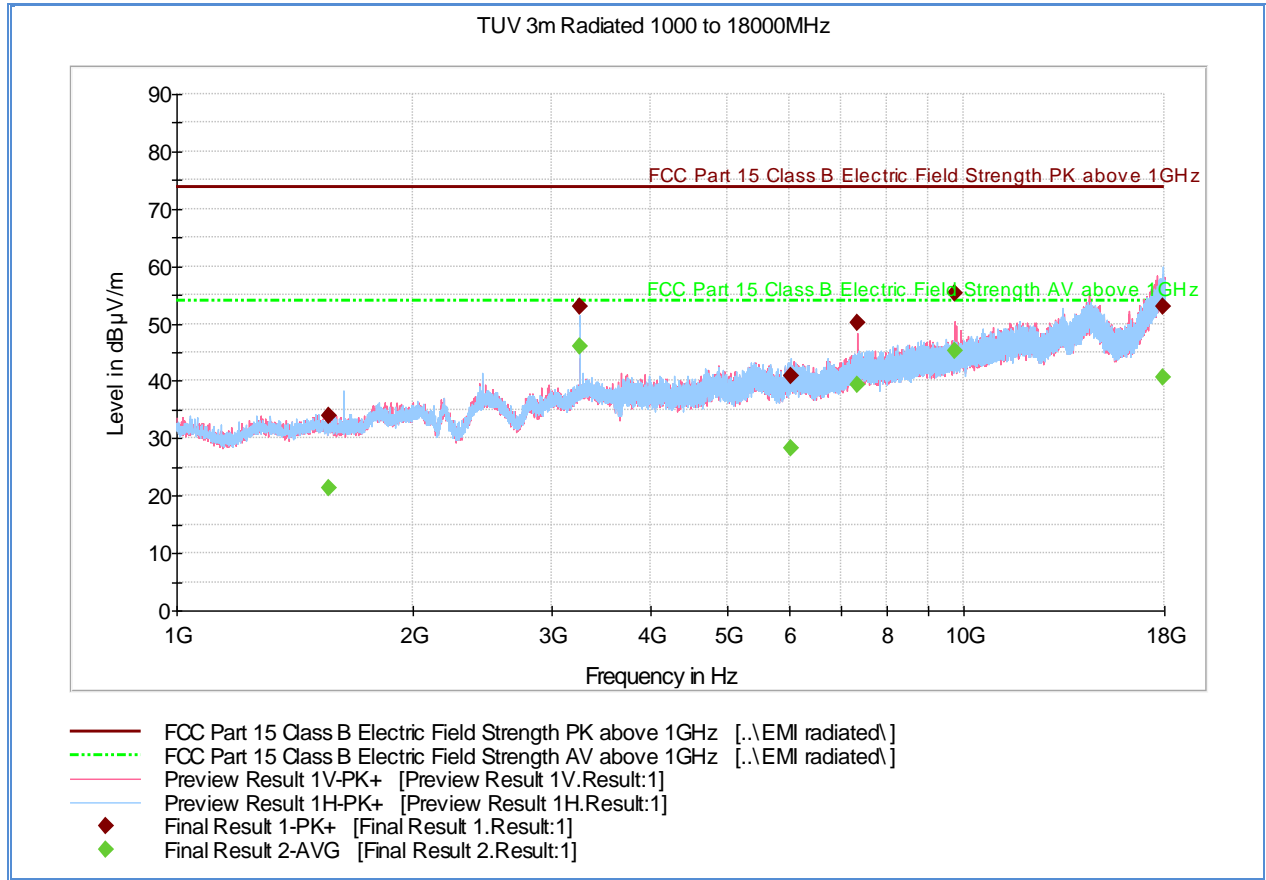


Date: 31.OCT.2012 11:58:22

**Test Notes:** Carrier frequency (Low Channel) was maximized for this test. Correction factor of 4.8dB is from the cable, antenna and preamp used.



**2.9.16 Test Results Above 1GHz (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) |
|-----------------|------------------|-----------------|-----------------|-------------|--------------|---------------|------------|-------------|----------------|
| 1562.073333     | 34.0             | 1000.           | 1000.000        | 332.0       | H            | 94.0          | -8.9       | 39.9        | 73.9           |
| 3257.053333     | 53.0             | 1000.           | 1000.000        | 120.0       | H            | 286.0         | -1.3       | 20.9        | 73.9           |
| 6024.253333     | 40.9             | 1000.           | 1000.000        | 387.0       | H            | 236.0         | 4.7        | 33.0        | 73.9           |
| 7328.473333     | 50.3             | 1000.           | 1000.000        | 110.0       | V            | 79.0          | 7.6        | 23.6        | 73.9           |
| 9766.673333     | 55.2             | 1000.           | 1000.000        | 186.0       | V            | 217.0         | 9.4        | 18.7        | 73.9           |
| 17934.693333    | 53.0             | 1000.           | 1000.000        | 385.0       | H            | 266.0         | 21.5       | 20.9        | 73.9           |

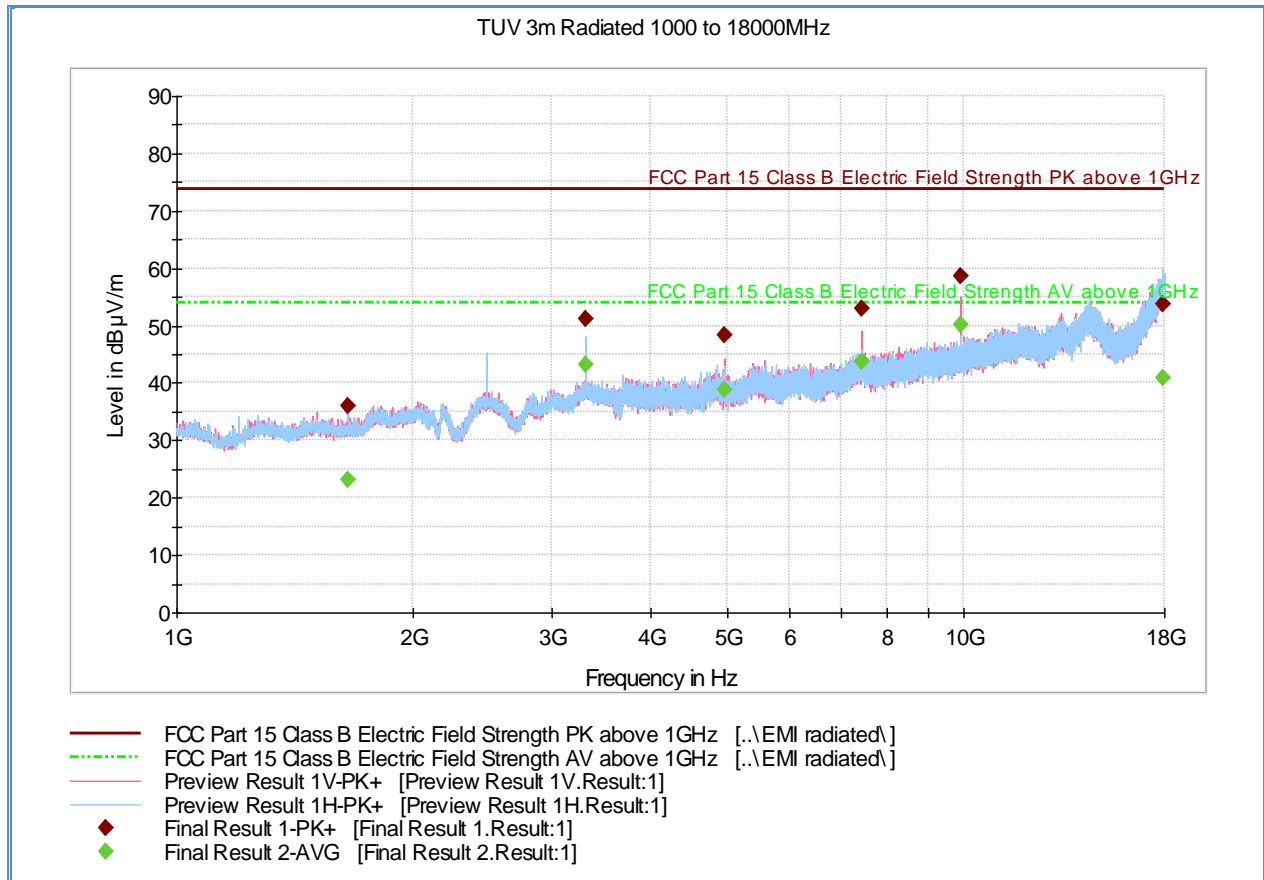
**Average Data**

| Frequency (MHz) | Average (dBµV/m) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Polarization | Azimuth (deg) | Corr. (dB) | Margin (dB) | Limit (dBµV/m) |
|-----------------|------------------|-----------------|-----------------|-------------|--------------|---------------|------------|-------------|----------------|
| 1562.073333     | 21.4             | 1000.0          | 1000.000        | 332.0       | H            | 94.0          | -8.9       | 32.5        | 53.9           |
| 3257.053333     | 45.9             | 1000.0          | 1000.000        | 120.0       | H            | 286.0         | -1.3       | 8.0         | 53.9           |
| 6024.253333     | 28.2             | 1000.0          | 1000.000        | 387.0       | H            | 236.0         | 4.7        | 25.7        | 53.9           |
| 7328.473333     | 39.4             | 1000.0          | 1000.000        | 110.0       | V            | 79.0          | 7.6        | 14.5        | 53.9           |
| 9766.673333     | 45.3             | 1000.0          | 1000.000        | 186.0       | V            | 217.0         | 9.4        | 8.6         | 53.9           |
| 17934.693333    | 40.6             | 1000.0          | 1000.000        | 385.0       | H            | 266.0         | 21.5       | 13.3        | 53.9           |

**Test Notes:** A 2.4 GHz notch filter was used during this test to avoid overloading of the measuring instrument.



**2.9.17 Test Results Above 1GHz (High Channel)**



**Peak Data**

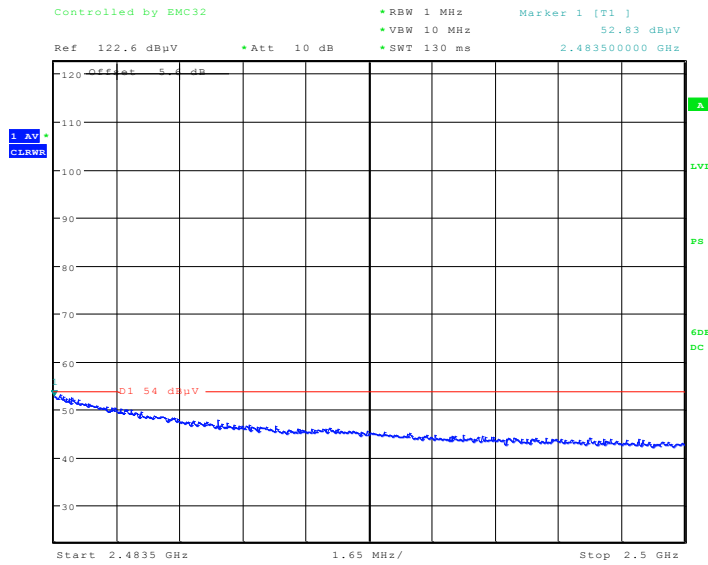
| Frequency (MHz) | MaxPeak (dBµV/m) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Polarization | Azimuth (deg) | Corr. (dB) | Margin (dB) | Limit (dBµV/m) |
|-----------------|------------------|-----------------|-----------------|-------------|--------------|---------------|------------|-------------|----------------|
| 1651.613333     | 35.9             | 1000.0          | 1000.000        | 100.0       | H            | 277.0         | -8.5       | 38.0        | 73.9           |
| 3306.273333     | 51.2             | 1000.0          | 1000.000        | 118.0       | H            | 286.0         | -1.1       | 22.7        | 73.9           |
| 4959.320000     | 48.3             | 1000.0          | 1000.000        | 115.0       | V            | 323.0         | 2.0        | 25.6        | 73.9           |
| 7435.526667     | 52.9             | 1000.0          | 1000.000        | 110.0       | V            | 308.0         | 7.5        | 21.0        | 73.9           |
| 9918.586667     | 58.6             | 1000.0          | 1000.000        | 141.0       | V            | 304.0         | 9.9        | 15.3        | 73.9           |
| 17955.940000    | 53.8             | 1000.0          | 1000.000        | 253.0       | H            | 274.0         | 21.6       | 20.1        | 73.9           |

**Average Data**

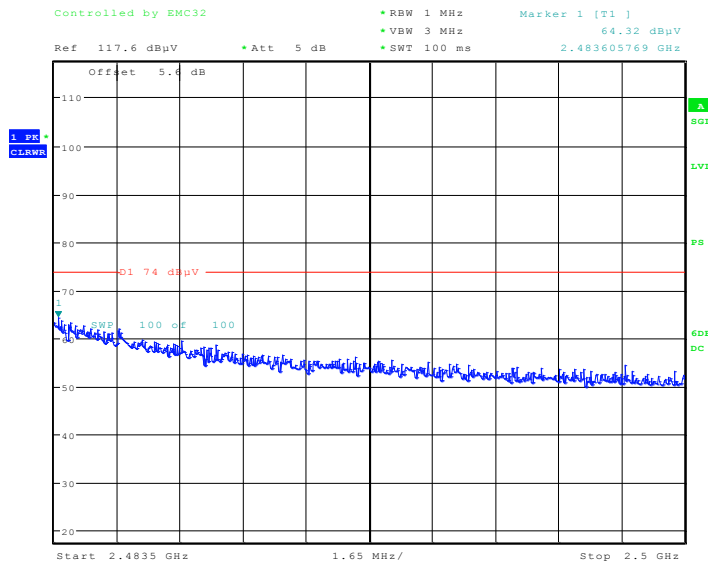
| Frequency (MHz) | Average (dBµV/m) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Polarization | Azimuth (deg) | Corr. (dB) | Margin (dB) | Limit (dBµV/m) |
|-----------------|------------------|-----------------|-----------------|-------------|--------------|---------------|------------|-------------|----------------|
| 1651.613333     | 23.2             | 1000.0          | 1000.000        | 100.0       | H            | 277.0         | -8.5       | 30.7        | 53.9           |
| 3306.273333     | 43.1             | 1000.0          | 1000.000        | 118.0       | H            | 286.0         | -1.1       | 10.8        | 53.9           |
| 4959.320000     | 38.8             | 1000.0          | 1000.000        | 115.0       | V            | 323.0         | 2.0        | 15.1        | 53.9           |
| 7435.526667     | 43.8             | 1000.0          | 1000.000        | 110.0       | V            | 308.0         | 7.5        | 10.1        | 53.9           |
| 9918.586667     | 50.1             | 1000.0          | 1000.000        | 141.0       | V            | 304.0         | 9.9        | 3.8         | 53.9           |
| 17955.940000    | 40.9             | 1000.0          | 1000.000        | 253.0       | H            | 274.0         | 21.6       | 13.0        | 53.9           |

**Test Notes:** A 2.4 GHz notch filter was used during this test to avoid overloading of the measuring instrument.

2.9.18 Test Results Restricted Band (2483.5MHz to 2500MHz)



Date: 31.OCT.2012 13:20:00



Date: 31.OCT.2012 11:50:37

**Test Notes:** Carrier frequency (High Channel) was maximized for this test. Correction factor of 5.6dB is from the cable, antenna and preamp used. Peak and Average measurement performed.



**2.10 RECEIVER SPURIOUS EMISSIONS**

**2.10.1 Specification Reference**

RSS-Gen 6.0

**2.10.2 Standard Applicable**

Receivers shall comply with the limits of spurious emissions set out in this section, measured over the frequency range determined in accordance with Section 4.10 of RSS-Gen.

**Table 2: Radiated Limits of Receiver Spurious Emissions**

| Frequency (MHz) | Field Strength (microvolts/m at 3 metres)* |
|-----------------|--|
| 30-88           | 100  |
| 88-216          | 150  |
| 216-960         | 200  |
| Above 960       | 500  |

\*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 of RSS-Gen.

**2.10.3 Equipment Under Test and Modification State**

Serial No: N/A / Test Configuration B

**2.10.4 Date of Test/Initial of test personnel who performed the test**

October 31, 2012/FSC

**2.10.5 Test Equipment Used**

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

**2.10.6 Environmental Conditions**

Ambient Temperature      23.6 °C  
 Relative Humidity          49.3 %  
 ATM Pressure                99.8 kPa

**2.10.7 Additional Observations**

- This is a radiated test. The spectrum was searched from 30MHz to the 3<sup>rd</sup> harmonic (up to 10<sup>th</sup> performed).
- Result identical to Section 2.9.10 and 2.9.11 of this test report.
- EUT in RX (Receive) mode configuration.



### **SECTION 3**

#### **TEST EQUIPMENT USED**



### 3.1 TEST EQUIPMENT USED

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

| ID Number (SDGE/SDRB)        | Test Equipment                             | Type               | Serial Number | Manufacturer               | Cal Date                  | Cal Due Date |
|------------------------------|--|--------------------|---------------|----------------------------|---------------------------|--------------|
| <b>Conducted Port Setup:</b> |  |                    |               |                            |                           |              |
| 1049                         | EMI Test Receiver                          | ESU                | 100133        | Rhode & Schwarz            | 06/13/12                  | 06/13/13     |
| 7569                         | Series Power Meter                         | N1911A P-          | MY45100625    | Agilent                    | 02/24/12                  | 02/24/14     |
| 7570                         | 50MHz-18GHz Wideband Power Sensor          | N1921A             | MY45240588    | Agilent                    | 02/14/12                  | 02/24/13     |
| <b>Radiated Test Setup:</b>  |  |                    |               |                            |                           |              |
| 1002                         | Bilog Antenna                              | 3142C              | 00058717      | ETS-Lindgren               | 12/06/11                  | 12/06/12     |
| 6669                         | Double-Ridged Waveguide Horn Antenna       | 3115               | 94124364      | EMCO                       | 11/07/11                  | 11/07/12     |
| 8628                         | Pre-Amplifier                              | QLJ 01182835-JO    | 8986002       | QuinStar Technologies Inc. | 08/17/12                  | 08/17/13     |
| 1153                         | High-frequency cable                       | SucoFlex 100 SX    | N/A           | Suhner                     | 08/17/12                  | 08/17/13     |
| 8543                         | High-frequency cable                       | Micropore 19057793 | N/A           | United Microwave Products  | 08/17/12                  | 08/17/13     |
| 1040                         | EMI Test Receiver                          | ESIB40             | 100292        | Rhode & Schwarz            | 08/10/12                  | 08/10/13     |
| 1049                         | EMI Test Receiver                          | ESU                | 100133        | Rhode & Schwarz            | 06/13/12                  | 06/13/13     |
| 1016                         | Pre-Amplifier                              | PAM-0202           | 187           | PAM                        | 08/17/12                  | 08/17/13     |
| 6815                         | 2.4GHz Band Notch Filter                   | BRM50702           | 008           | Micro-Tronics              | Verified by 1049          |              |
| 1150                         | Horn Antenna                               | RA42-K-F-4B-C      | 012054-004    | CMT                        | Verified by 7546 and 1049 |              |
| 1151                         | Pre-Amplifier                              | TS-PR26            | 100026        | Rhode & Schwarz            | Verified by 7546 and 1049 |              |
| <b>Miscellaneous:</b>        |  |                    |               |                            |                           |              |
| 1072                         | DC Power Supply                            | E3610A             | KR51311519    | Hewlett Packard            | Verified by 6452          |              |
| 6452                         | Multimeter                                 | 3478A              | 2911A52177    | Hewlett Packard            | 07/16/12                  | 07/16/13     |
| 7546                         | Signal Generator                           | SMP-02             | 1035.5005.02  | Rhode & Schwarz            | 06/15/12                  | 06/15/13     |
| 7560                         | Barometer/Temperature/Humidity Transmitter | iBTHX-W            | 1240476       | Omega                      | 07/12/12                  | 07/12/13     |
|                              | Test Software                              | EMC32              | V8.53         | Rhode & Schwarz            | N/A                       |              |





### 3.2 MEASUREMENT UNCERTAINTY

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

#### 3.2.1 Radiated Emission 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                       | Rectangular                   | 3.55                           | 2.05                          | 4.20         |
| 6                               | EUT Setup                  | Rectangular                   | 1.00                           | 0.58                          | 0.33         |
| Combined Uncertainty ( $u_c$ ): |                            |                               |                                |                               | 2.23         |
| Coverage Factor (k):            |                            |                               |                                |                               | 2            |
| Expanded Uncertainty:           |                            |                               |                                |                               | 4.45         |

#### 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                       | Rectangular                   | 3.55                           | 2.05                          | 4.20         |
| 6                               | EUT Setup                  | Rectangular                   | 1.00                           | 0.58                          | 0.33         |
| Combined Uncertainty ( $u_c$ ): |                            |                               |                                |                               | 2.22         |
| Coverage Factor (k):            |                            |                               |                                |                               | 2            |
| Expanded Uncertainty:           |                            |                               |                                |                               | 4.44         |

#### 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                   | 0.57                           | 0.33                          | 0.11         |
| 2                               | Cables                     | Rectangular                   | 0.50                           | 0.29                          | 0.08         |
| 3                               | EUT Setup                  | Rectangular                   | 1.00                           | 0.58                          | 0.33         |
| Combined Uncertainty ( $u_c$ ): |                            |                               |                                |                               | 0.72         |
| Coverage Factor (k):            |                            |                               |                                |                               | 2            |
| Expanded Uncertainty:           |                            |                               |                                |                               | 1.45         |



### 3.2.4 Conducted Emissions Measurement

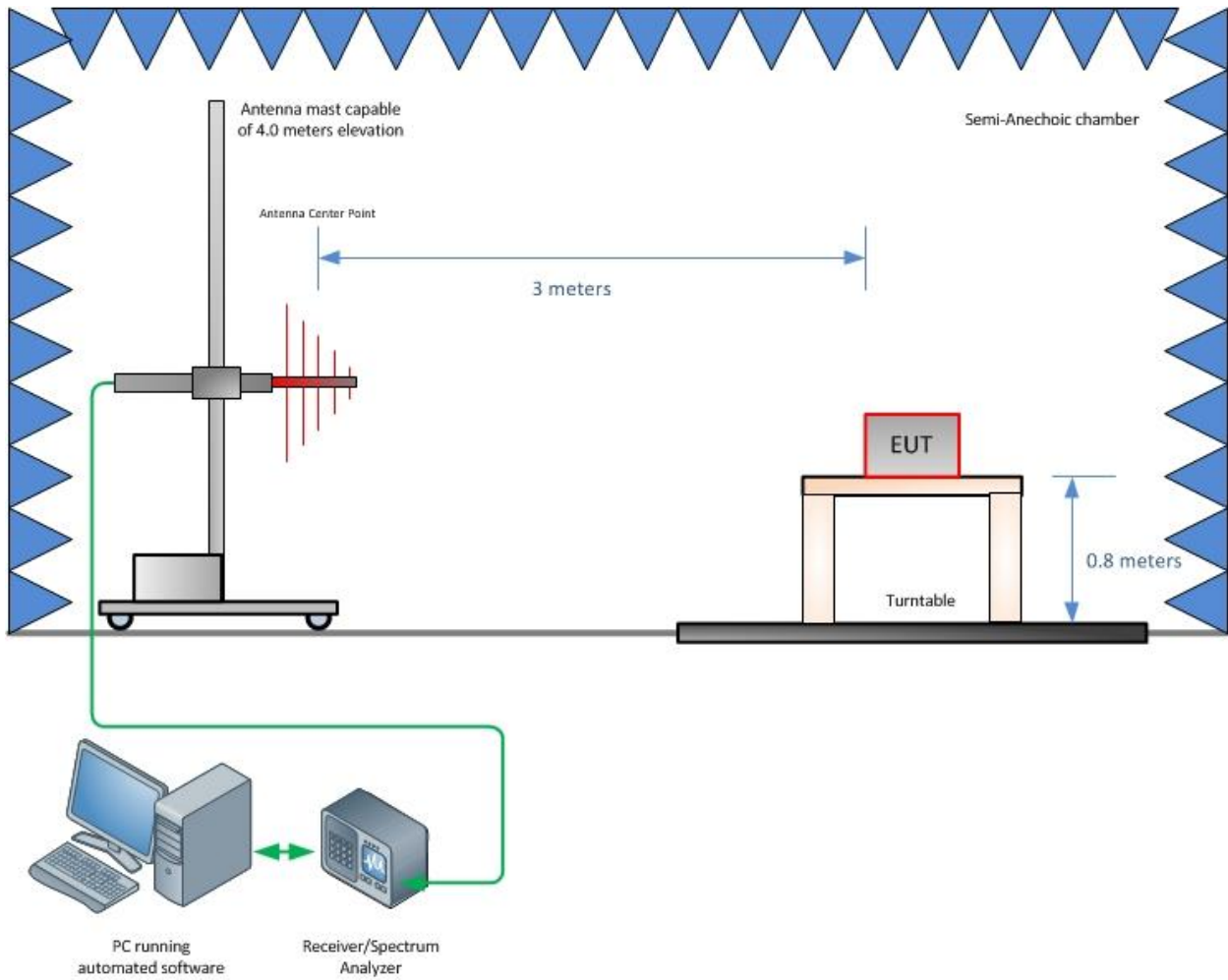
| Contribution                    |                            | Probability Distribution Type | Probability Distribution $x_i$ | Standard Uncertainty $u(x_i)$ | $[u(x_i)]^2$ |
|---------------------------------|----------------------------|-------------------------------|--------------------------------|-------------------------------|--------------|
| 1                               | Receiver/Spectrum Analyzer | Rectangular                   | 0.36                           | 0.21                          | 0.04         |
| 2                               | Cables                     | Rectangular                   | 0.50                           | 0.29                          | 0.08         |
| 3                               | LISN                       | Rectangular                   | 0.66                           | 0.38                          | 0.15         |
|                                 | Attenuator                 | Rectangular                   | 0.30                           | 0.17                          | 0.03         |
| Combined Uncertainty ( $u_c$ ): |                            |                               |                                |                               | 0.80         |
| Coverage Factor (k):            |                            |                               |                                |                               | 2            |
| Expanded Uncertainty:           |                            |                               |                                |                               | 1.59         |



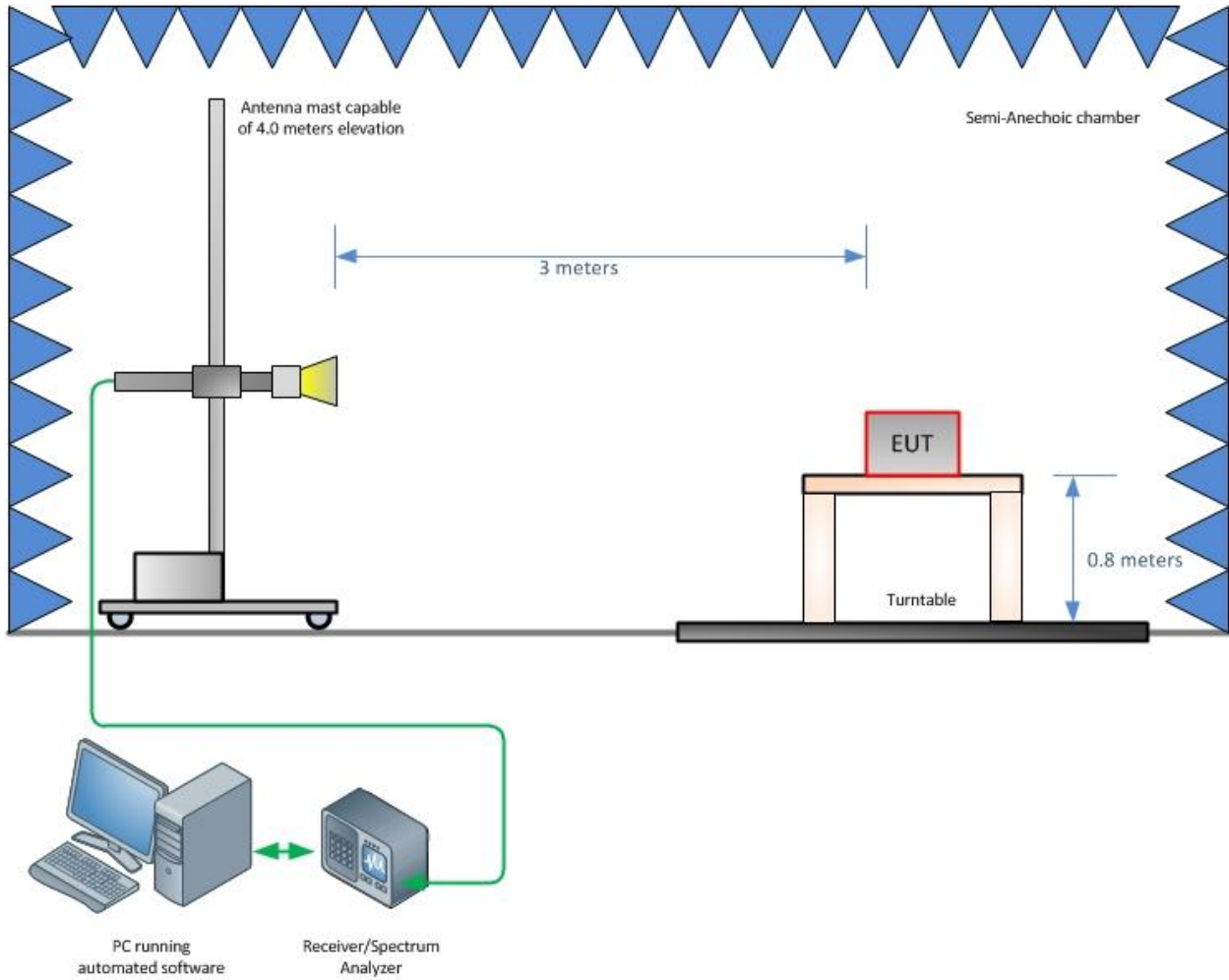
## SECTION 4

### DIAGRAM OF TEST SETUP

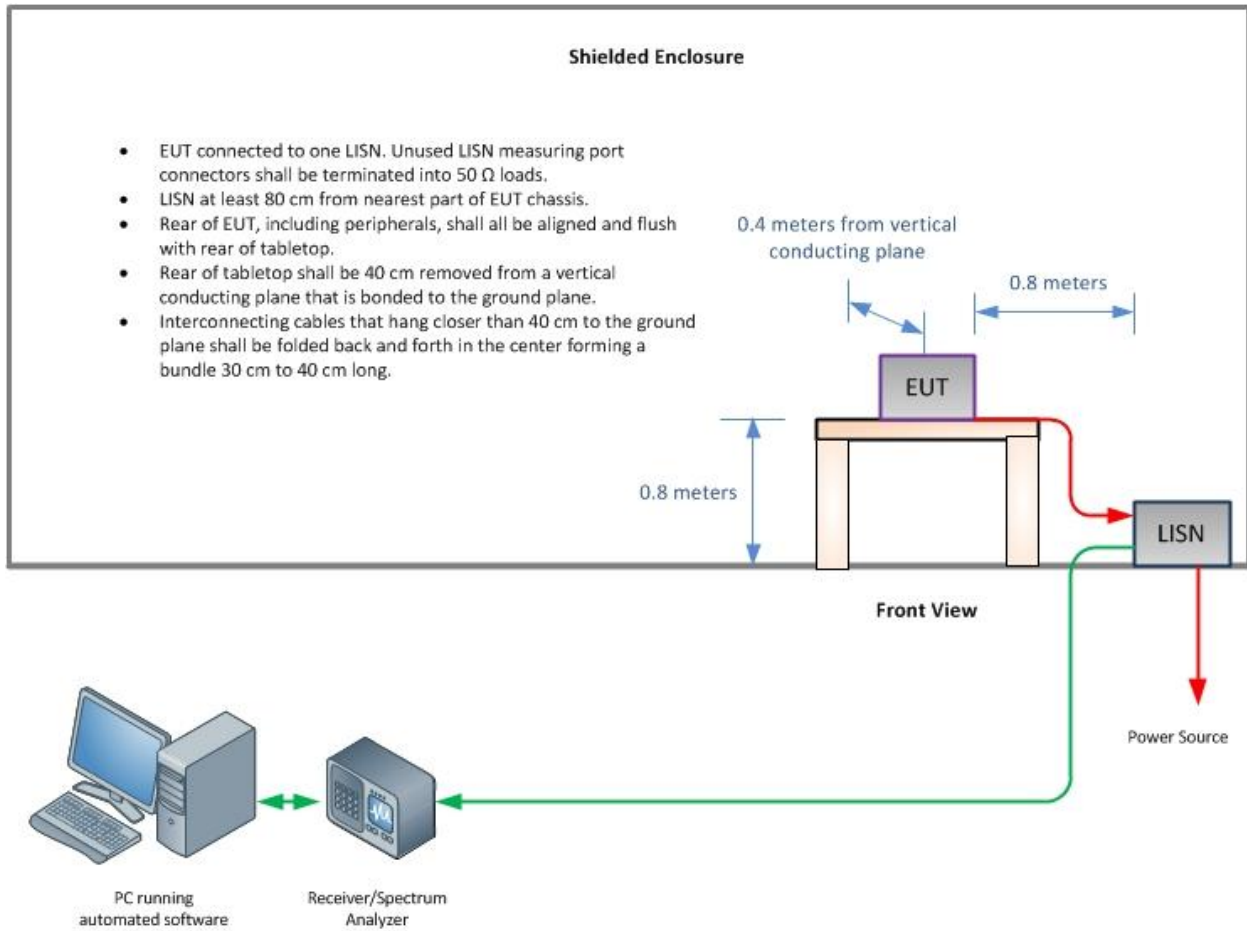
#### 4.1 TEST SETUP DIAGRAM



**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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