



# FCC/IC Test Report

**FOR:**

**Harman International**

**Model Number: VP3 NA, VP4 NA, VP3 CA, VP4 CA**

**Product Description: Automotive Infotainment Unit**

**FCC ID: QNG-BE2800**

**IC ID: 6434C-BE2800**

**47 CFR Part 15.247 for DTS Systems**

**IC RSS-210 Issue 8**

**TEST REPORT #: EMC\_HARMA\_018\_11001\_BE2800\_DTS\_Rev1**

**DATE: 2012-09-06**



**FCC listed  
A2LA Accredited**

**IC recognized #  
3462B**

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## 1 Assessment

The following equipment (and as identified in Ch.3 of this test report) was evaluated against the applicable criteria specified in FCC CFR47 Part 15.247 and Industry Canada Radio Standard Specification RSS 210 Issue 8,  
 and no deviations were ascertained during the course of the tests performed.

| Company              | Description                  | Model #                           |
|----------------------|------------------------------|-----------------------------------|
| Harman International | Automotive Infotainment Unit | VP3 NA, VP4 NA,<br>VP3 CA, VP4 CA |

### Responsible for Testing Laboratory:

| 2012-09-06 | Compliance | Sajay Jose<br>(Lab Manager) |           |
|------------|------------|-----------------------------|-----------|
| Date       | Section    | Name                        | Signature |

### Responsible for the Report:

| 2012-09-06 | Compliance | Josie Sabado<br>(EMC Test Engineer) |           |
|------------|------------|-------------------------------------|-----------|
| Date       | Section    | Name                                | Signature |

The test results of this test report relate exclusively to the test item specified in Section3.

CETECOM Inc. USA does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item. The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of CETECOM Inc. USA.

## 2 Administrative Data

### 2.1 Identification of the Testing Laboratory Issuing the Test Report

|                          |                                                        |
|--------------------------|--------------------------------------------------------|
| <b>Company Name:</b>     | CETECOM Inc.                                           |
| <b>Department:</b>       | Compliance                                             |
| <b>Address:</b>          | 411 Dixon Landing Road<br>Milpitas, CA 95035<br>U.S.A. |
| <b>Telephone:</b>        | +1 (408) 586 6200                                      |
| <b>Fax:</b>              | +1 (408) 586 6299                                      |
| <b>Test Lab Manager:</b> | Sajay Jose                                             |
| <b>Test Engineer:</b>    | Josie Sabado                                           |

### 2.2 Identification of the Client

|                        |                            |
|------------------------|----------------------------|
| <b>Client:</b>         | Harman International       |
| <b>Street Address:</b> | 26500 Haggerty Road        |
| <b>City/Zip Code</b>   | Farmington Hills, MI 48331 |
| <b>Country</b>         | USA                        |
| <b>Contact Person:</b> | Shain E. Chmura            |
| <b>Phone No.</b>       | +1 (248) 592-3157          |
| <b>e-mail:</b>         | schmura@harman.com         |

### 2.3 Identification of the Manufacturer

Same as Client.

### 2.4 Environmental conditions during Test:

The following environmental conditions were maintained during the course of testing:

Ambient Temperature: 20-25°C

Relative humidity: 40-60%

### 2.5 Dates of Testing:

May 23, 2012-May 29, 2012.

### 3 Equipment under Test (EUT)

#### 3.1 Specification of the Equipment under Test

|                                                         |                                                                                                                                                                                           |
|---------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Marketing Name:</b>                                  | Uconnect                                                                                                                                                                                  |
| <b>Model No:</b>                                        | VP3 NA, VP4 NA, VP3 CA, VP4 CA                                                                                                                                                            |
| <b>FCC-ID:</b>                                          | QNG-BE2800                                                                                                                                                                                |
| <b>IC ID:</b>                                           | 6434C-BE2800                                                                                                                                                                              |
| <b>Product Description:</b>                             | Automotive Infotainment Unit                                                                                                                                                              |
| <b>Frequency Range of test/<br/>number of channels:</b> | 802.11 b/g: 2412 – 2462 MHz / 11 Channels                                                                                                                                                 |
| <b>Type(s) of Modulation:</b>                           | 802.11 b/g: DSSS and OFDM respectively.                                                                                                                                                   |
| <b>Antenna Gain<br/>Information:</b>                    | Gain (Stated by manufacturer):<br>Low Channel: -1.98 dBi<br>Mid Channel: -1.69 dBi<br>High Channel: -1.38 dBi                                                                             |
| <b>Max. Output Powers:</b>                              | Conducted (Measured):<br>g mode: 20.64 dBm<br><br>Radiated –EIRP (Calculated):<br>g mode: 19.26 dBm                                                                                       |
| <b>Other radios supported<br/>in the device:</b>        | EVDO Band Class 0: 824.7 – 848.31 MHz / 656 Channels<br>EVDO Band Class 1: 1851.25 – 1908.75 MHz / 906 Channels<br>Bluetooth: 2402 – 2480 MHz / 79 Channels<br>GPS: 1.575 GHz / 1 Channel |
| <b>Operating Voltage:</b>                               | 12 VDC                                                                                                                                                                                    |
| <b>Rated Operating<br/>temperature range:</b>           | -40°C to 85°C                                                                                                                                                                             |
| <b>Prototype / Production<br/>unit:</b>                 | Pre-Production                                                                                                                                                                            |

### 3.2 Identification of the Equipment Under Test (EUT)

| EUT # | Serial Number  | HW Version | SW Version | Model | Notes/Comments                    |
|-------|----------------|------------|------------|-------|-----------------------------------|
| 1     | T00BE349170251 | PV         | 11.48.1    | VP3   | Radiated Unit                     |
| 2     | T00BE349170252 | PV         | 11.48.1    | VP3   | Conducted Power Verification Unit |

### 3.3 Identification of Accessory Equipment

| AE # | Type             | Manufacturer | Model | Serial Number |
|------|------------------|--------------|-------|---------------|
| 1    | Cellular Antenna | Wilson       | N/A   | N/A           |
| 2    | GPS Antenna      | N/A          | N/A   | N/A           |

### 3.4 Identification of Support Test Equipment

| STE # | Type                    | Manufacturer       | Model        | Serial Number           |
|-------|-------------------------|--------------------|--------------|-------------------------|
| 1     | Laptop                  | IBM                | ThinkPad T41 | 55274-641-4106881-23841 |
| 2     | Optical CAN Transceiver | SonTec Electricity | OPTOCAN 2000 | CAN 12/133HS            |
| 3     | Optical CAN Transceiver | SonTec Electricity | OPTOCAN 2000 | CAN 12/134HS            |
| 4     | Vehicle Interface       | EEPOD LLC          | MCS1         | N/A                     |

#### 4 Subject of Investigation

The objective of the measurements applied by CETECOM Inc. was to establish compliance of the EUT as described under Ch. 3 of this Test Report, with the applicable criteria specified in

- FCC CFR47 Parts 15.247, 15.209
- Industry Canada Radio Standard Specifications RSS-210 Issue 8, RSS-Gen Issue 3

This test report is to support a request for new equipment authorization under the FCC ID: **QNG-BE2800** and IC ID: **6434C-BE2800**.

The device was configured with a manufacturer provided test SW, capable of setting the unit in different supported modulation schemes, data rates and channels of operation.

The EUT was tested on low, mid and high channels in 802.11b, and 802.11g modes.

Worst case test modes of operation, as described below, is based on the max output power for different data rates and modulations, as taken from the WLAN module certification data.

| Mode    | Data rate (Mbps) | Modulation scheme |
|---------|------------------|-------------------|
| 802.11b | 1.0              | BPSK              |
| 802.11g | 6.0              | BPSK              |

The product comes in two variants- VP3 and VP4. All testing was performed on VP3 Variant. The only hardware difference between VP3 and VP4 is the flash NAND memory size (8GB on VP3 and 16GB on VP4). Both variants use the same software, but certain non-radio relevant features are disabled on VP3. Based on this declaration from the manufacturer, testing was only performed on VP3 variant, and deemed sufficient to establish compliance of VP4 variant to the applicable requirements. Further, the “NA” variant is for North American Market and “CA” variant for Canadian market, with no HW/SW differences.

Test data is leveraged from the sister product with FCC ID: QNG-BE2801, since the relevant HW is the same on both products.

## 5 Summary of Measurement Results

| Test Specification                   | Test Case                            | Temperature and Voltage Conditions | Mode               | Pass | Fail | NA | NP | Result     |
|--------------------------------------|--------------------------------------|------------------------------------|--------------------|------|------|----|----|------------|
| §15.247(e)<br>RSS210 A8.2(b)         | Power Spectral Density               | Nominal                            | 802.11b<br>802.11g | ■    | □    | □  | □  | Complies   |
| §15.247(a)(1)<br>RSS210 A8.1(b)      | Carrier Frequency Separation         | Nominal                            | -                  | □    | □    | ■  | □  | See Note 1 |
| §15.247(a)(1)<br>RSS210 A8.1(d)      | Number of Hopping Channels           | Nominal                            | -                  | □    | □    | ■  | □  | See Note 1 |
| §15.247(a)(1)(iii)<br>RSS210 A8.3(1) | Time of occupancy                    | Nominal                            | -                  | □    | □    | ■  | □  | See Note 1 |
| §15.247(a)(1)<br>RSS210 A8.2(a)      | Spectrum Bandwidth                   | Nominal                            | 802.11b<br>802.11g | ■    | □    | □  | □  | Complies   |
| §15.247(b)(1)<br>RSS210 A8.4(2)      | Maximum Output Power                 | Nominal                            | 802.11b<br>802.11g | ■    | □    | □  | □  | Complies   |
| §15.247(d)<br>RSS210 A8.5            | Band edge compliance-Conducted       | Nominal                            | 802.11b<br>802.11g | □    | □    | □  | ■  | See Note 2 |
| §15.247(d)<br>RSS210 A8.5            | Band edge compliance-Radiated        | Nominal                            | 802.11b<br>802.11g | ■    | □    | □  | □  | Complies   |
| §15.247(d)<br>RSS210 A8.5            | TX Spurious emissions-Conducted      | Nominal                            | 802.11b<br>802.11g | ■    | □    | □  | □  | Complies   |
| §15.247(d)<br>RSS210 A8.5            | TX Spurious emissions-Radiated       | Nominal                            | 802.11g            | ■    | □    | □  | □  | Complies   |
| §15.209(a)<br>RSS Gen                | TX Spurious Emissions Radiated<30MHz | Nominal                            | 802.11g            | ■    | □    | □  | □  | Complies   |

**Note:** NA= Not Applicable; NP= Not Performed.

1. Test only applicable to frequency hopping systems.
2. Band Edge compliance-conducted is NOT PERFORMED as the device passes radiated measurement.

## **6 Measurements**

### **6.1 Radiated Measurement Procedure**

### **6.2 Measurement Method:**

All radiated and conducted testing is performed according to guidelines in FCC publication KDB558074 D01: Measurement Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under 15.247, Jan 2012.

### **6.3 Radiated Measurement Procedure**

#### **ANSI C63.4 (2009) Section 8.3.1.1: Exploratory radiated emission measurements**

Exploratory radiated measurements shall be performed at the measurement distance or at a closer distance than that specified for compliance to determine the emission characteristics of the EUT. At near distances, for EUTs of comparably small size, it is relatively easy to determine the spectrum signature of the EUT and, if applicable, the EUT configuration that produces the maximum level of emissions. A shielded room may be used for exploratory testing, but may have anomalies that can lead to significant errors in amplitude measurements.

Broadband antennas and a spectrum analyzer or a radio-noise meter with a panoramic display are often useful in this type of testing. It is recommended that either a headset or loudspeaker be connected as an aid in detecting ambient signals and finding frequencies of significant emission from the EUT when the exploratory and final testing is performed in an OATS with strong ambient signals. Caution should be taken if either antenna height between 1 and 4 meters or EUT azimuth is not fully explored. Not fully exploring these parameters during exploratory testing may require complete testing at the OATS or semi-anechoic chamber when the final full spectrum testing is conducted.

The EUT should be set up in its typical configuration and arrangement, and operated in its various modes. For tabletop systems, cables or wires should be manipulated within the range of likely arrangements. For floor-standing equipment, the cables or wires should be located in the same manner as the user would install them and no further manipulation is made. For combination EUTs, the tabletop and floor-standing portions of the EUT shall follow the procedures for their respective setups and cable manipulation. If the manner of cable installation is not known, or if it changes with each installation, cables or wires for floor-standing equipment shall be manipulated to the extent possible to produce the maximum level of emissions.

For each mode of operation required to be tested, the frequency spectrum shall be monitored. Variations in antenna height between 1 and 4 m, antenna polarization, EUT azimuth, and cable or wire placement (each variable within bounds specified elsewhere) shall be explored to produce the emission that has the highest amplitude relative to the limit. A step-by-step technique for determining this emission can be found in Annex C.

When measuring emissions above 1 GHz, the frequencies of maximum emission shall be determined by manually positioning the antenna close to the EUT and by moving the antenna over all sides of the EUT while observing a spectral display. It will be advantageous to have prior knowledge of the frequencies of emissions above 1 GHz. If the EUT is a device with dimensions approximately equal to that of the measurement antenna beamwidth, the measurement antenna shall be aligned with the EUT.

**ANSI C63.4 (2009) Section 8.3.1.2: Final radiated emission measurements**

Based on the measurement results in 8.3.1.1, the one EUT, cable and wire arrangement, and mode of operation that produces the emission that has the highest amplitude relative to the limit is selected for the final measurement. The final measurement is then performed on a site meeting the requirements of 5.3, 5.4, or 5.5 as appropriate without variation of the EUT arrangement or EUT mode of operation. If the EUT is relocated from an exploratory test site to a final test site, the highest emission shall be remaximized at the final test location before final radiated emissions measurements are performed. However, antenna height and polarity and EUT azimuth are to be varied. In addition, the full frequency spectrum (for the range to be checked for meeting compliance) shall be investigated.

This investigation is performed with the EUT rotated 360°, the antenna height scanned between 1 m and 4 m, and the antenna rotated to repeat the measurements for both the horizontal and vertical antenna polarizations. During the full frequency spectrum investigation, particular focus should be made on those frequencies found in exploratory testing that were used to find the final test configuration, mode of operation, and arrangement (associated with achieving the least margin with respect to the limit). This full spectrum test constitutes the compliance measurement.

For measurements above 1 GHz, use the cable, EUT arrangement, and mode of operation determined in the exploratory testing to produce the emission that has the highest amplitude relative to the limit. Place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the antenna in the “cone of radiation” from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response. The antenna may have to be higher or lower than the EUT, depending on the EUT’s size and mounting height, but the antenna should be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane. If the transmission line for the measurement antenna restricts its range of height and polarization, the steps needed to ensure the correct measurement of the maximum emissions, shall be described in detail in the report of measurements. Data collected shall satisfy the report requirements of Clause 10.

**NOTES**

1— Where limits are specified by agencies for both average and peak (or quasi-peak) detection, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement.

2—Use of waveguide and flexible waveguide may be necessary at frequencies above 10 GHz to achieve usable signal-to noise ratios at required measurement distances. If so, it may be necessary to restrict the height search of the antenna, and special care should be taken to ensure that maximum emissions are correctly measured.

3—All presently known devices causing emissions above 10 GHz are physically small compared with the beam-widths of typical horn antennas used for EMC measurements. For such EUTs and frequencies, it may be preferable to vary the height and polarization of the EUT instead of the receiving antenna to maximize the measured emissions.

Measurement Uncertainty:  $\pm 3\text{dB}$

## 6.4 Sample Calculations for Radiated Measurements

### 6.4.1.1 Field Strength Measurements:

Measurements from the Spectrum Analyzer/ Receiver is used to calculate the Field Strength, taking into account the following parameters:

1. Measured reading in dB $\mu$ V
2. Cable Loss between the receiving antenna and SA in dB and
3. Antenna Factor in dB/m

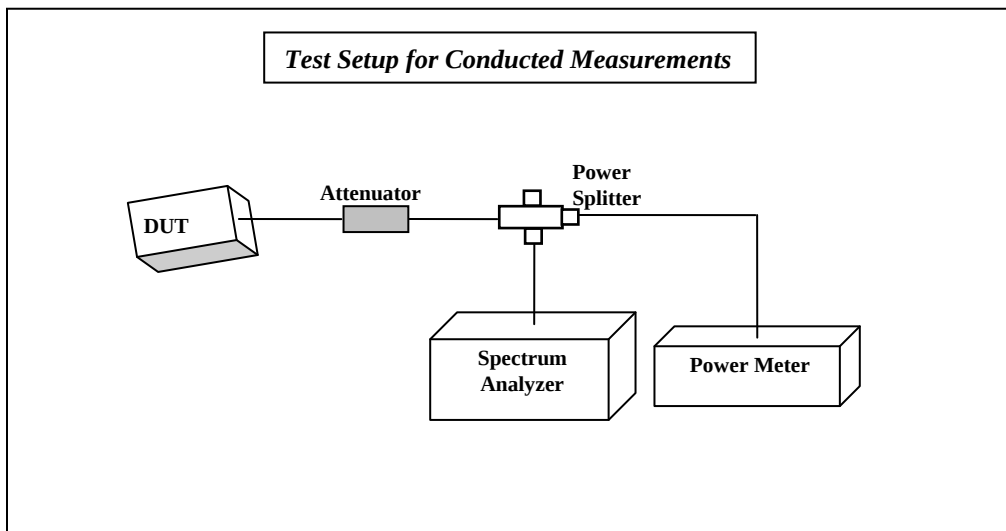
FS (dB $\mu$ V/m)= Measured Value on SA (dB $\mu$ V)+ Cable Loss (dB)+ Antenna Factor (dB/m)

Eg:

| Frequency (MHz) | Measured SA (dB $\mu$ V) | Cable Loss (dB) | Antenna Factor Correction (dB) | Field Strength Result (dB $\mu$ V/m) |
|-----------------|--------------------------|-----------------|--------------------------------|--------------------------------------|
| 1000            | 80.5                     | 3.5             | 14                             | 98.0                                 |

All radiated measurement plots in this report are taken from a test SW that calculates the Field Strength based on the above equation.

## 6.5 Conducted Measurement Procedure



1. Connect the equipment as shown in the above diagram.
2. A test SW provided by the manufacturer is used to control the different modulations, data rates and max output power configurations.
3. Measurements are to be performed with the EUT set to the low, middle and high channels for 802.11b and 802.11g modes.

## 6.6 Fundamental Emission Output Power

### 6.6.1 Limits:

#### 6.6.1.1 §15.247 (b)(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.

#### 6.6.1.2 RSS 210- A8.4(2)

Nominal Peak Output Power < 30 dBm (1W)

EIRP < 36dBm

### 6.6.2 Test Conditions:

Tnom: 22°C; Vnom: 12 VDC

### 6.6.3 Test Procedure:

Measurement according to FCC KDB 558074 v01, section 5.2.1.2 – Measurement Procedure PK2

#### Spectrum Analyzer settings:

RBW=1MHz, VBW=3MHz, Detector: Peak- Max Hold.

Sweep Time: Auto

Span=b mode: 13 MHz; g mode: 20 MHz

#### Antenna Gain (dBi):

Low Channel: -1.98 dBi

Mid Channel: -1.69 dBi

High Channel: -1.38 dBi

#### 6.6.4 Test Result:

| Measured Maximum Peak Conducted Output Power (dBm) |                   |                   |                    |
|----------------------------------------------------|-------------------|-------------------|--------------------|
| Mode                                               | Frequency (MHz)   |                   |                    |
|                                                    | 2412<br>Channel 1 | 2437<br>Channel 6 | 2462<br>Channel 11 |
| 802.11b                                            | 18.52             | 18.53             | 19.22              |
| 802.11g                                            | 19.51             | 19.36             | 20.64              |
| Measurement Uncertainty: $\pm 0.5$ dB              |                   |                   |                    |

| Calculated Maximum Peak Radiated Output Power (dBm) |                   |                   |                    |
|-----------------------------------------------------|-------------------|-------------------|--------------------|
| Mode                                                | Frequency (MHz)   |                   |                    |
|                                                     | 2412<br>Channel 1 | 2437<br>Channel 6 | 2462<br>Channel 11 |
| 802.11b                                             | 16.54             | 16.84             | 17.84              |
| 802.11g                                             | 17.53             | 17.67             | 19.26              |
| Measurement Uncertainty: $\pm 3$ dB                 |                   |                   |                    |

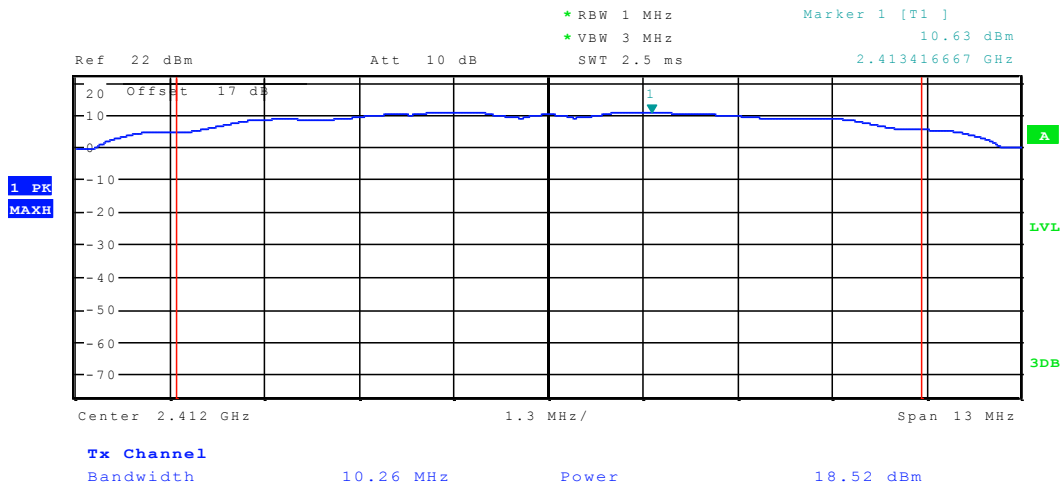
**Note:** Radiated EIRP is calculated as  
*Conducted Measurement + Antenna Gain*

##### 6.6.4.1 Test Verdict:

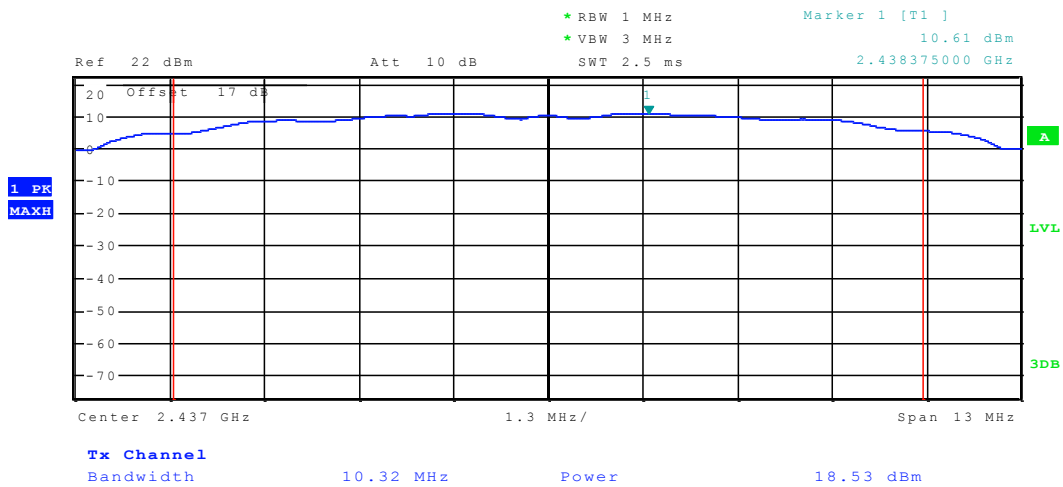
Pass.

## 6.6.5 Test Data/plots:

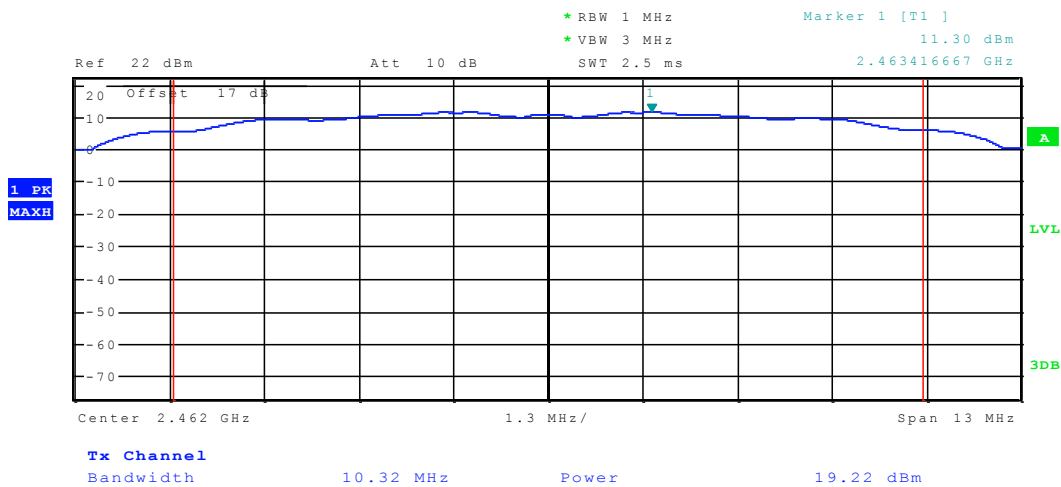
### Conducted Peak Power 802.11b 2412 MHz



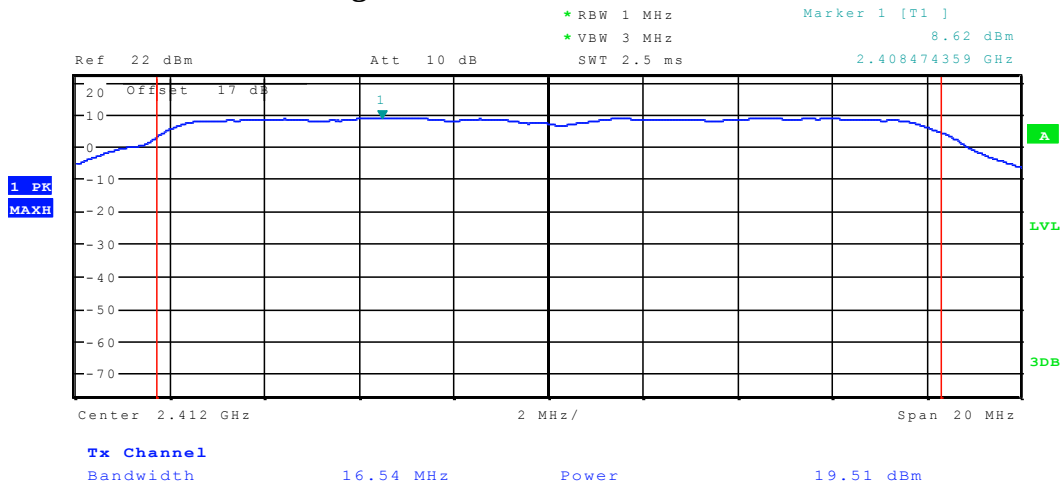
### Conducted Peak Power 802.11b 2437 MHz



### Conducted Peak Power 802.11b 2462 MHz

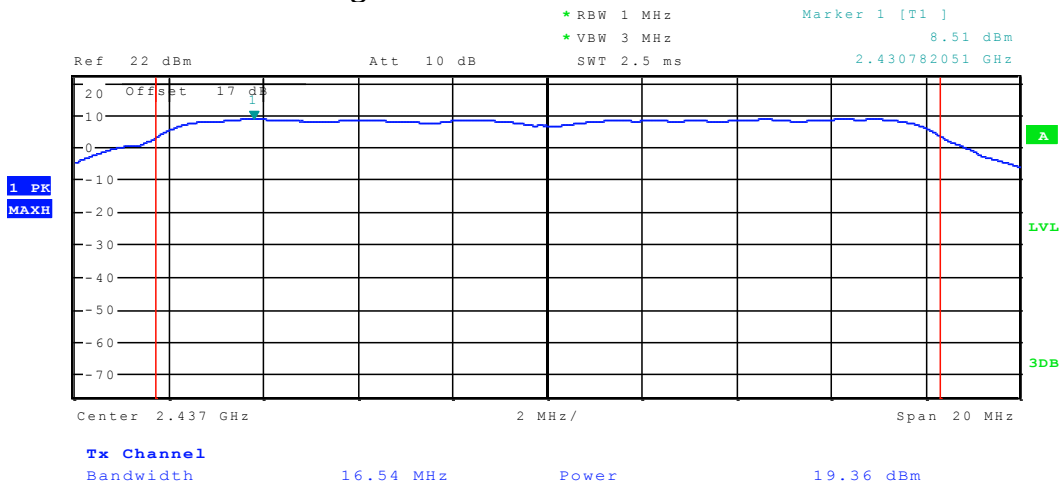


### Conducted Peak Power 802.11g 2412 MHz

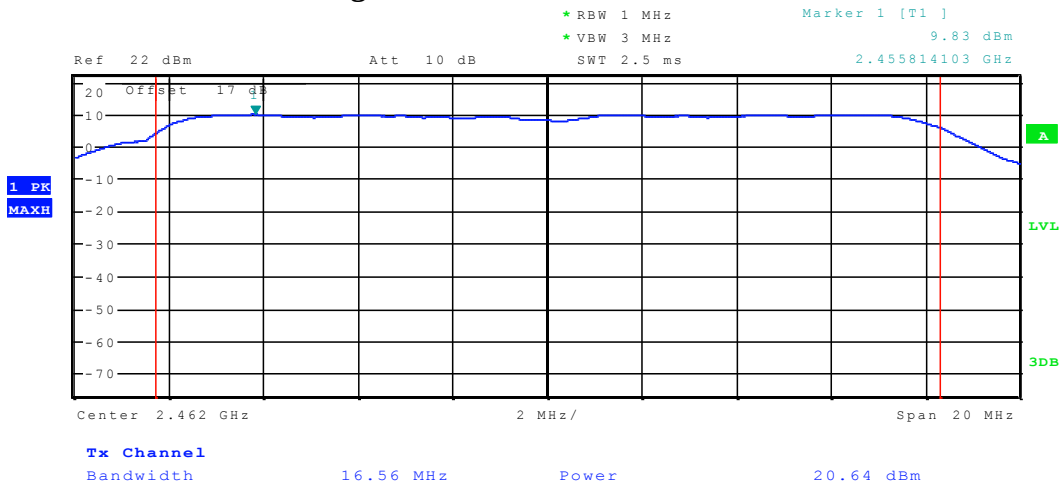




Conducted Peak Power 802.11g 2437 MHz



Conducted Peak Power 802.11g 2462 MHz



## 6.7 Emission Bandwidth

### 6.7.1 Limits:

6.7.1.1 §15.247 (a)(2)

6.7.1.2 RSS 210- A8.2(a)

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.

### 6.7.2 Test Conditions:

Tnom: 25°C; Vnom: 12 VDC

### 6.7.3 Test Procedure:

Measurement according to FCC KDB 558074 v01, section 5.1.1 – EBW Measurement Procedure

#### **Spectrum Analyzer settings:**

RBW=300kHz, VBW=1MHz, Detector: Peak- Max hold;

Sweep Time: Auto

Span=40MHz

### 6.7.4 Test Result:

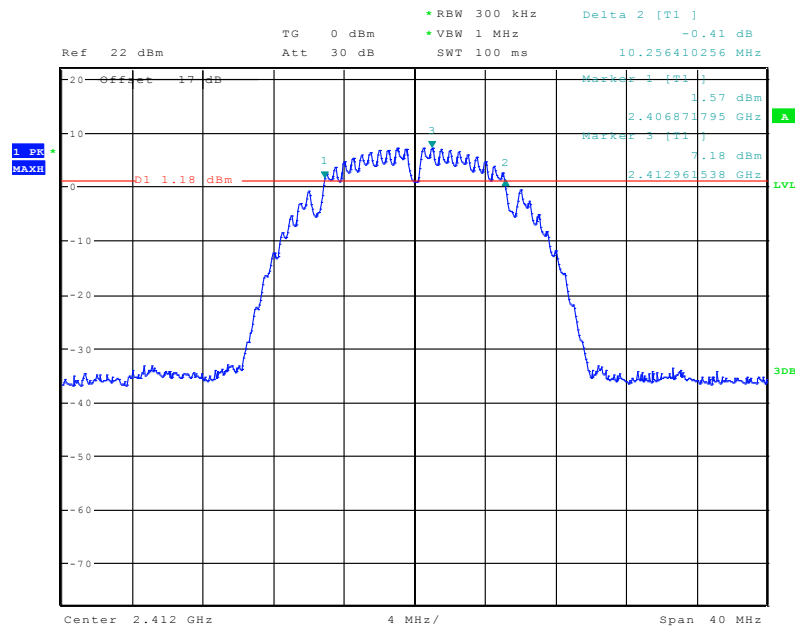
| Occupied Bandwidth (MHz)          |                   |              |                   |              |                    |              |
|-----------------------------------|-------------------|--------------|-------------------|--------------|--------------------|--------------|
| Mode                              | Frequency (MHz)   |              |                   |              |                    |              |
|                                   | 2412<br>Channel 1 |              | 2437<br>Channel 6 |              | 2462<br>Channel 11 |              |
|                                   | 6dB               | 20dB/<br>99% | 6dB               | 20dB/<br>99% | 6dB                | 20dB/<br>99% |
| <b>802.11b</b>                    | 10.26             | 13.91        | 10.32             | 13.91        | 10.32              | 13.91        |
| <b>802.11g</b>                    | 16.54             | 16.99        | 16.54             | 17.05        | 16.56              | 17.12        |
| Measurement Uncertainty: ±100 kHz |                   |              |                   |              |                    |              |

#### 6.7.4.1 Measurement Result

Pass.

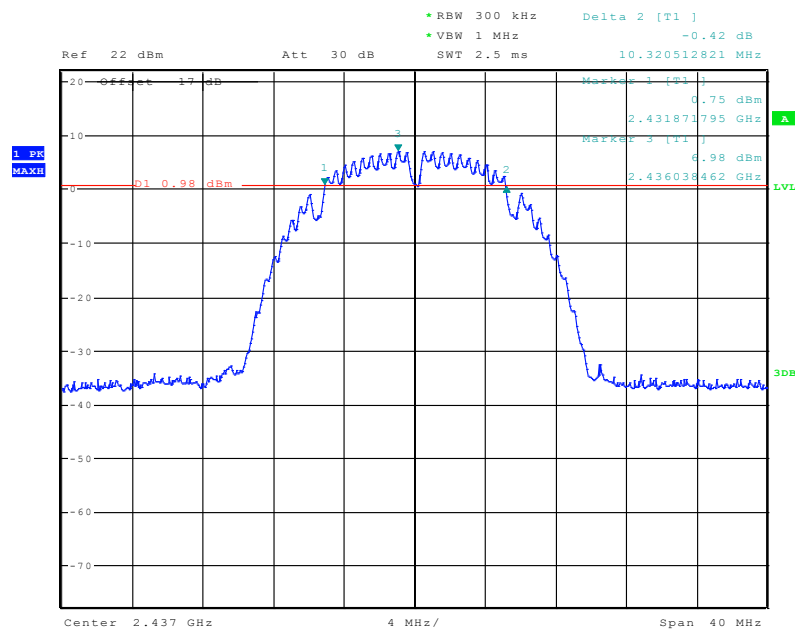
## 6.7.5 Test Data/plots:

### 6dB Bandwidth 802.11b 2412 MHz



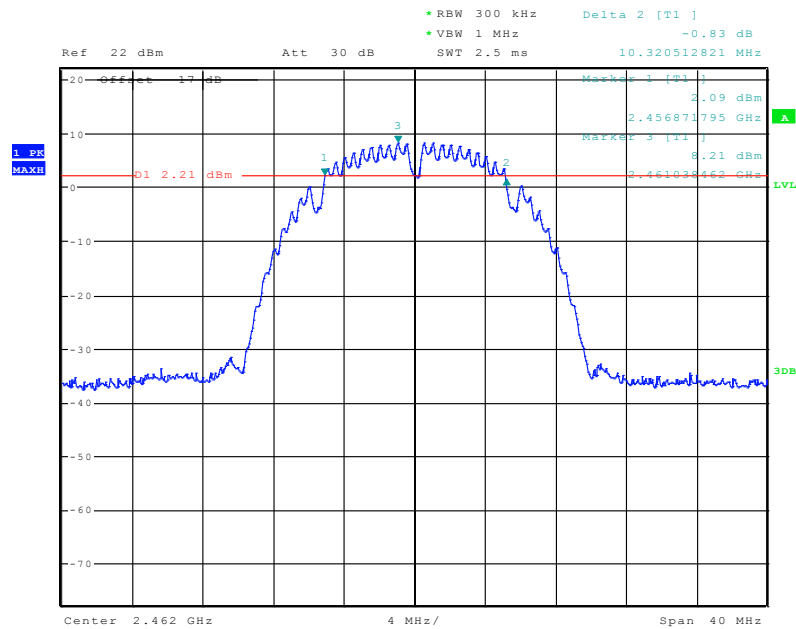
Date: 11.JUN.2012 16:10:02

### 6dB Bandwidth 802.11b 2437 MHz



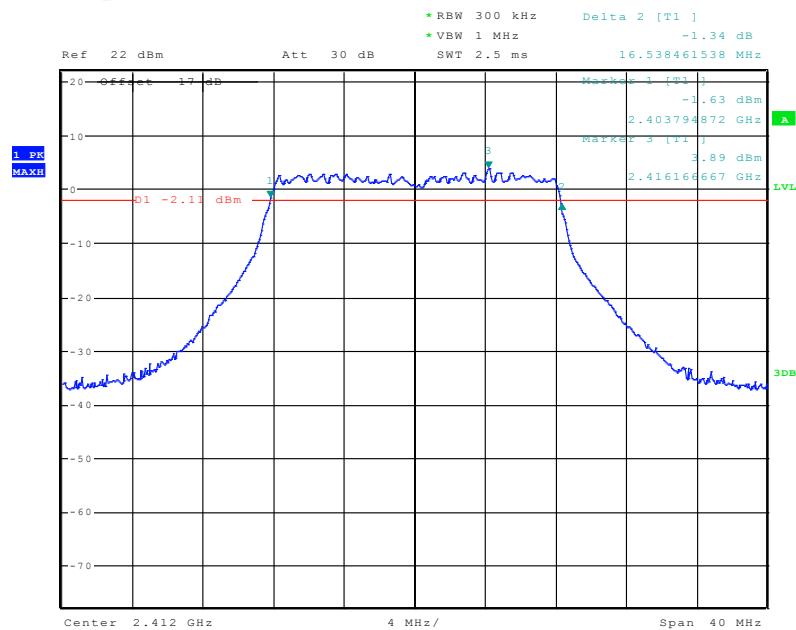
Date: 11.JUN.2012 17:58:53

## 6dB Bandwidth 802.11b 2462 MHz



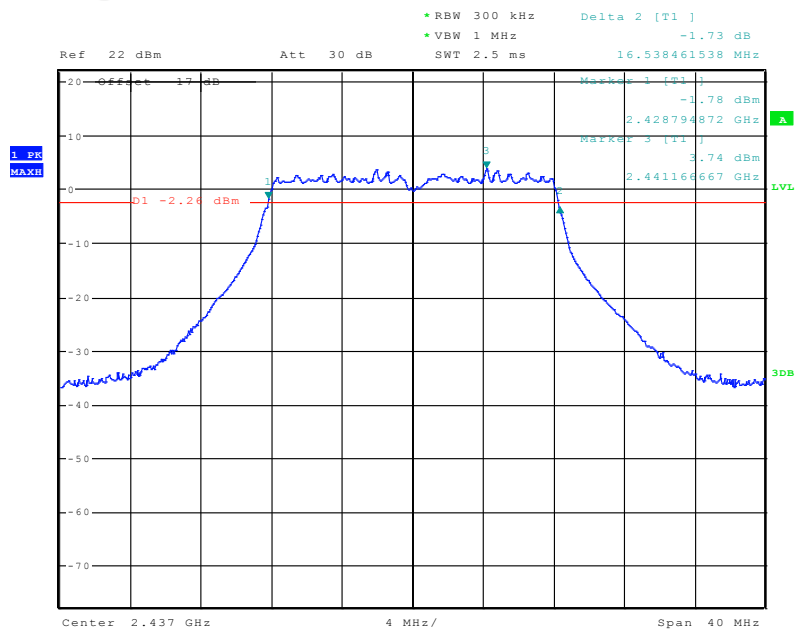
Date: 11.JUN.2012 18:15:24

## 6dB Bandwidth 802.11g 2412 MHz



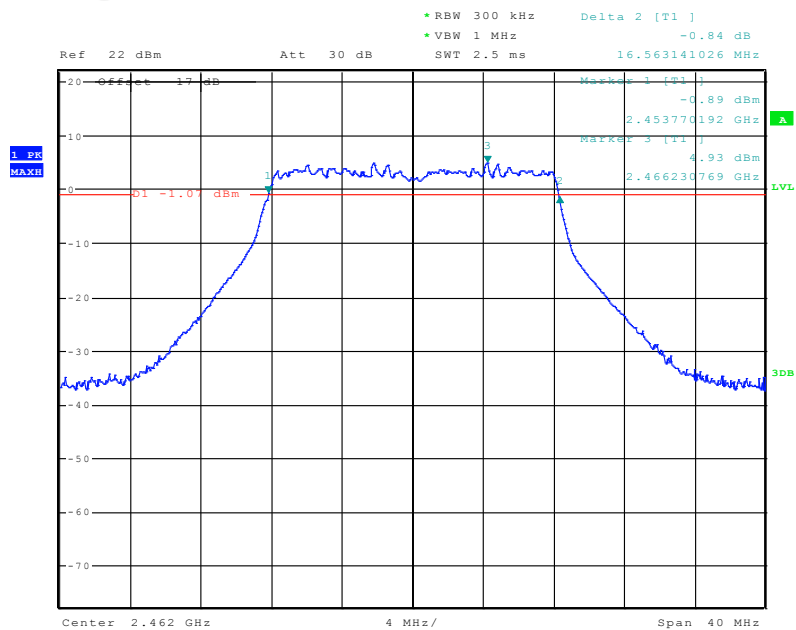
Date: 11.JUN.2012 18:30:04

## 6dB Bandwidth 802.11g 2437 MHz



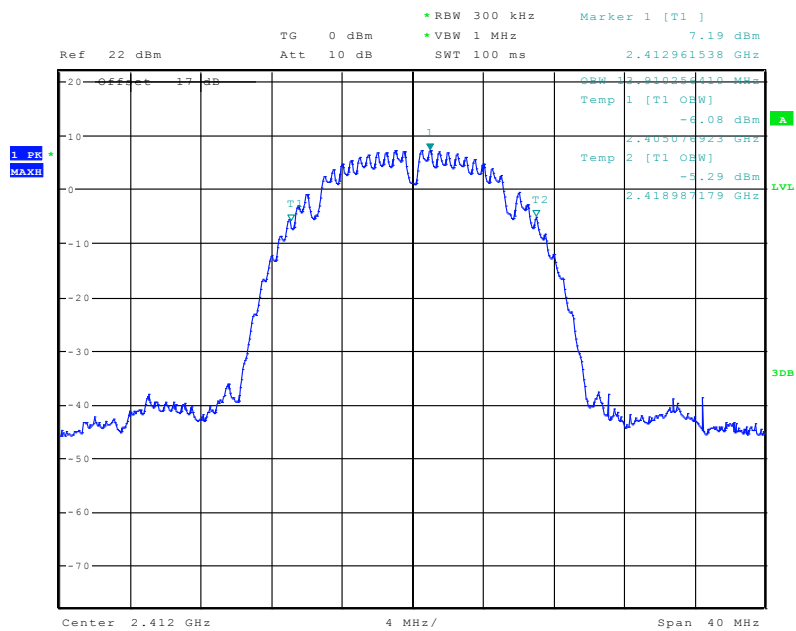
Date: 11.JUN.2012 19:00:26

## 6dB Bandwidth 802.11g 2462 MHz



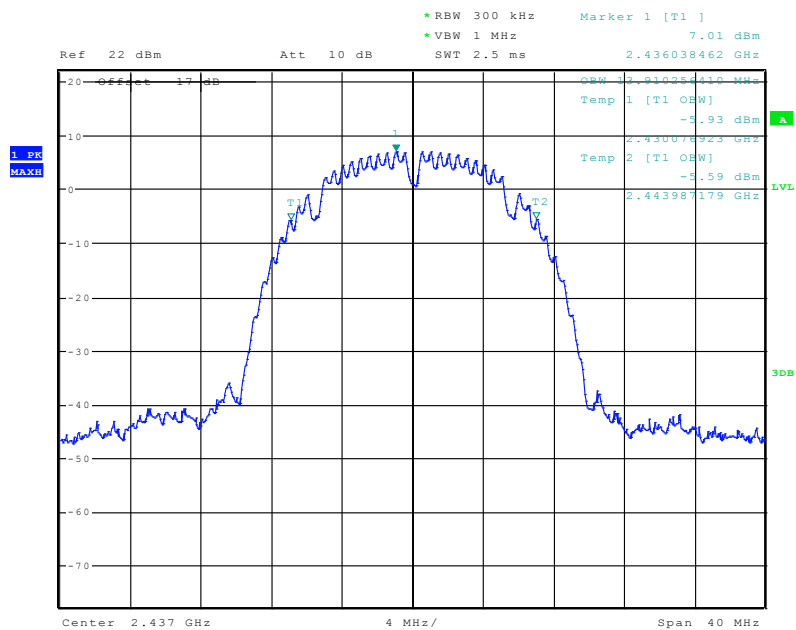
Date: 11.JUN.2012 19:12:37

## 20dB Bandwidth 802.11b 2412 MHz



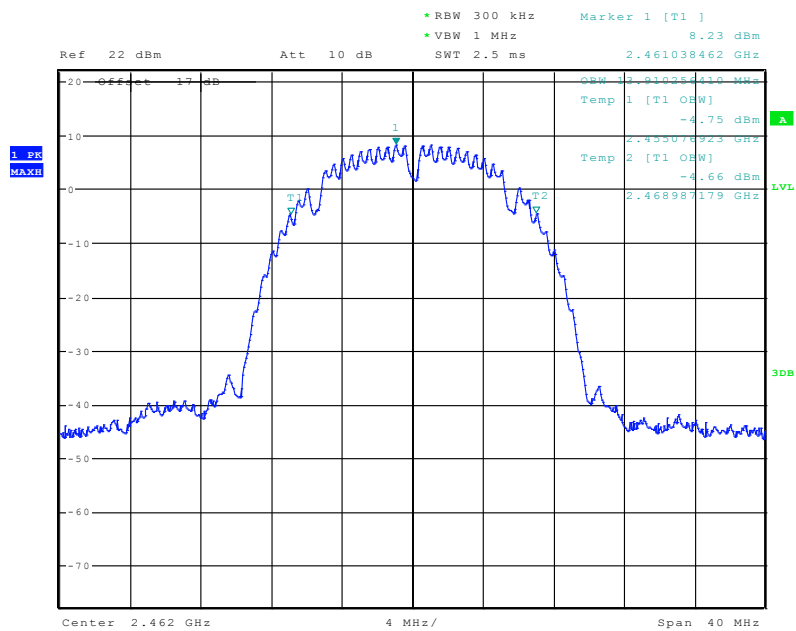
Date: 11.JUN.2012 16:11:14

## 20dB Bandwidth 802.11b 2437 MHz



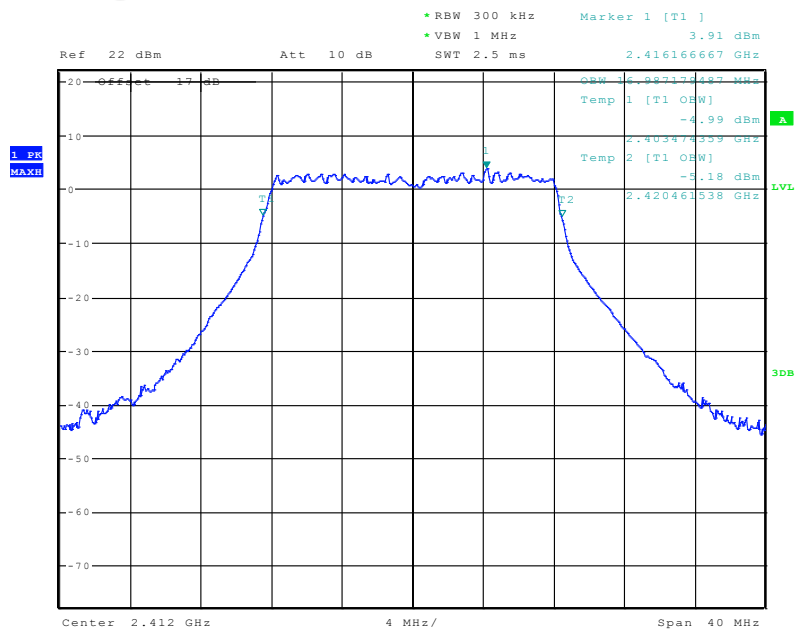
Date: 11.JUN.2012 18:00:00

## 20dB Bandwidth 802.11b 2462 MHz



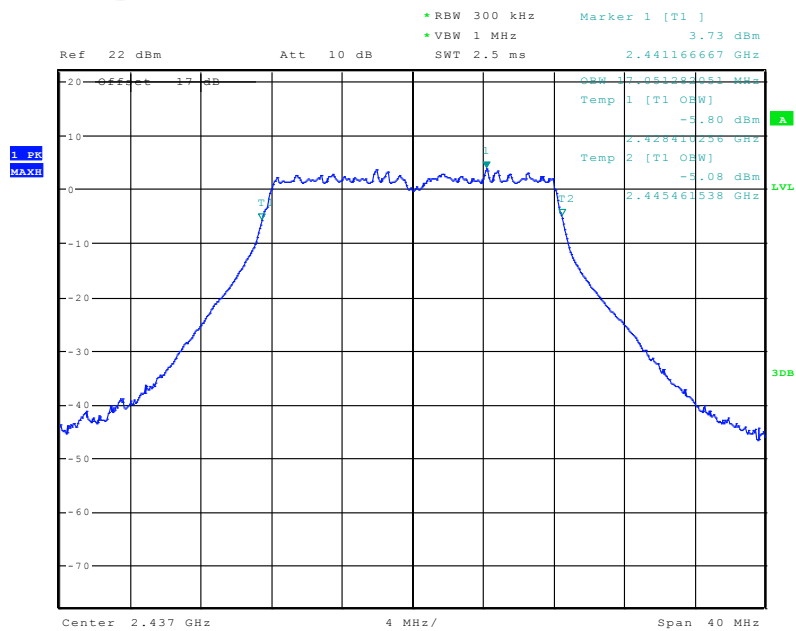
Date: 11.JUN.2012 18:16:40

## 20dB Bandwidth 802.11g 2412 MHz



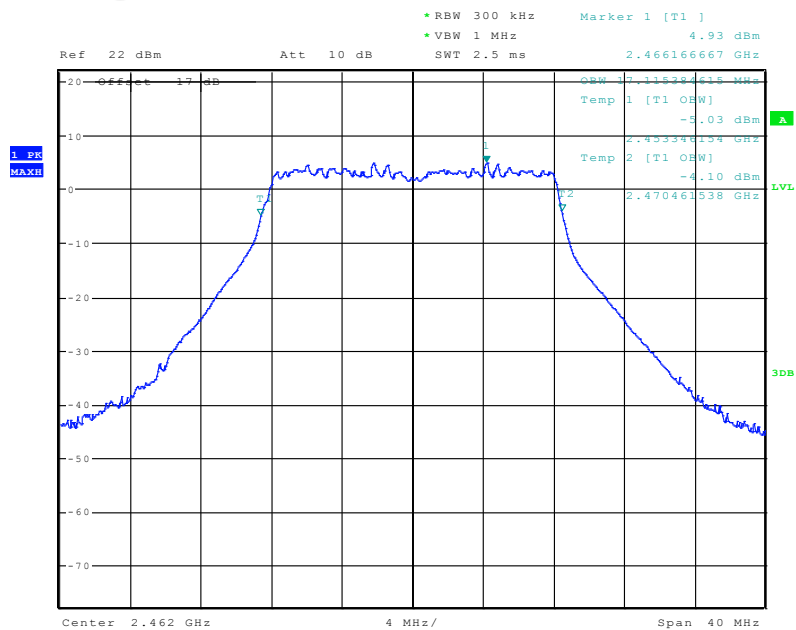
Date: 11.JUN.2012 18:31:14

## 20dB Bandwidth 802.11g 2437 MHz



Date: 11.JUN.2012 19:01:41

## 20dB Bandwidth 802.11g 2462 MHz



Date: 11.JUN.2012 19:13:57

## 6.8 Maximum Power Spectral Density Level in the Fundamental Emission

### 6.8.1 Limits:

6.8.1.1 § 15.247 (e)

6.8.1.2 RSS 210- A8.2(b)

For digitally modulated systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3 kHz band during any time interval of continuous transmission.

### 6.8.2 Test procedure:

1. Determine the highest peak level for a sweep with RBW=100k VBW=300kHz and Span = 5-30% greater than the EBW.
2. Scale the max. observed peak power level to an equivalent level in 3 kHz by adjusting the measured power by a bandwidth correction factor (BWCF) where:  $BWCF = 10\log(3\text{kHz}/100\text{kHz} = -15.2 \text{ dB})$ .

### 6.8.3 Test Conditions:

Tnom: 22°C; Vnom: 12 VDC

### 6.8.4 Test results:

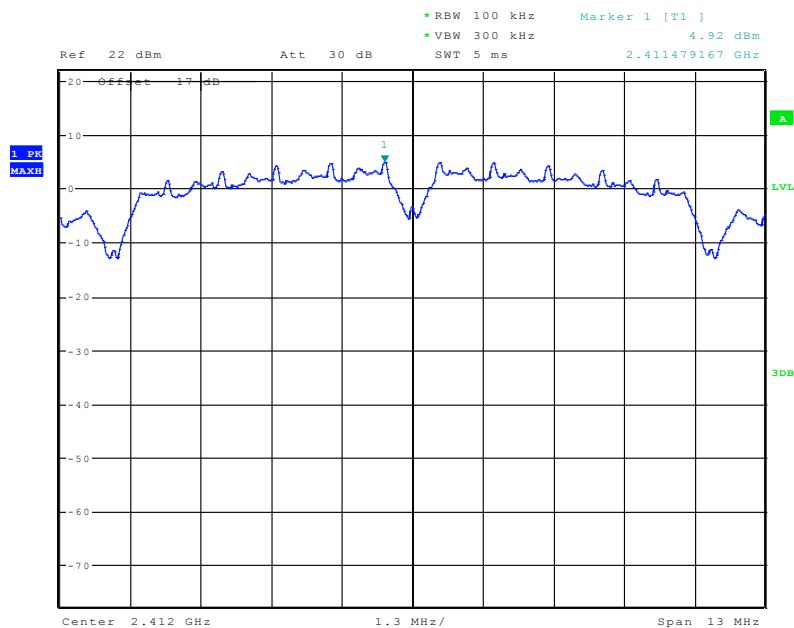
| Corrected Power Spectral Density (dBm)      |                   |                   |                    |
|---------------------------------------------|-------------------|-------------------|--------------------|
| Mode                                        | Frequency (MHz)   |                   |                    |
|                                             | 2412<br>Channel 1 | 2437<br>Channel 6 | 2462<br>Channel 11 |
| 802.11b                                     | -10.28            | -10.21            | -9.53              |
| 802.11g                                     | -17.32            | -17.39            | -16.28             |
| Measurement Uncertainty: $\pm 0.5\text{dB}$ |                   |                   |                    |

#### 6.8.4.1 Measurement Result

Pass.

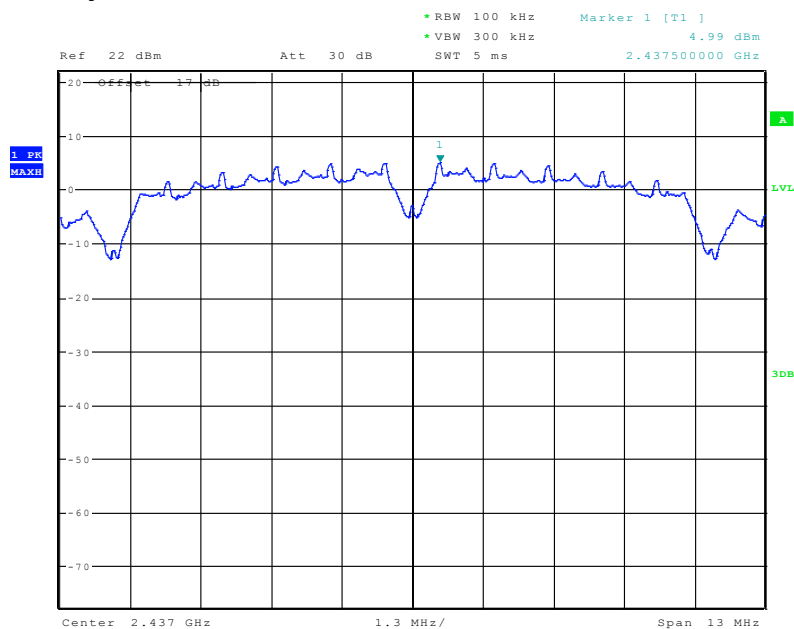
## 6.8.5 Test Data/plots:

### Power Spectral Density 802.11b 2412 MHz



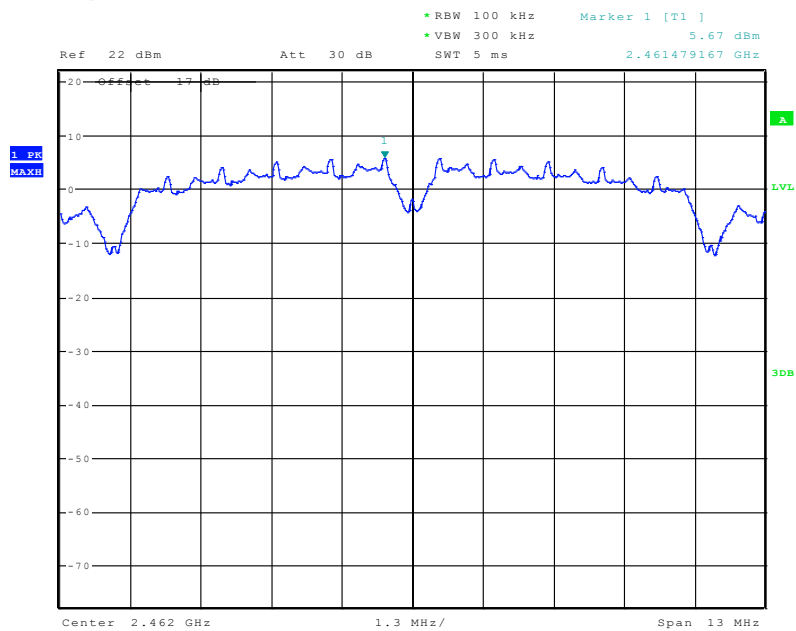
Date: 11.JUN.2012 17:26:09

### Power Spectral Density 802.11b 2437 MHz



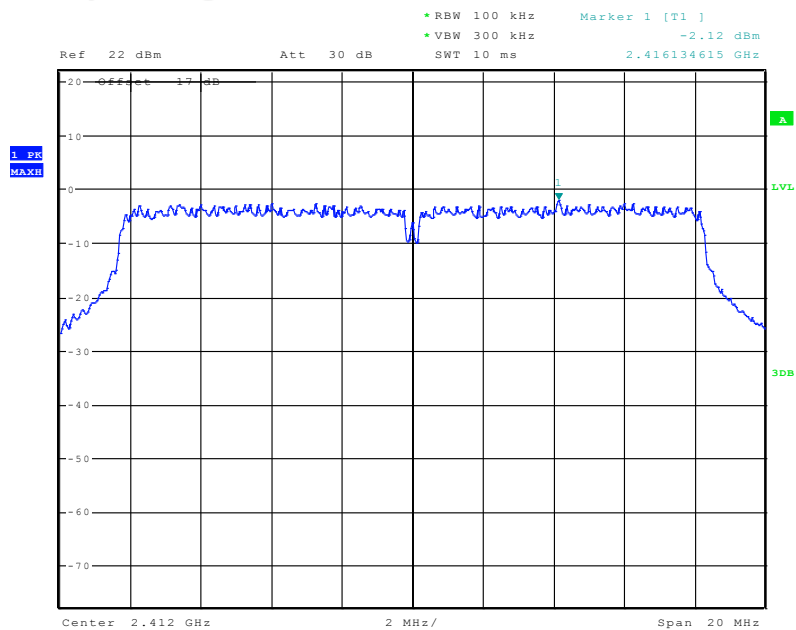
Date: 11.JUN.2012 18:04:25

## Power Spectral Density 802.11b 2462 MHz



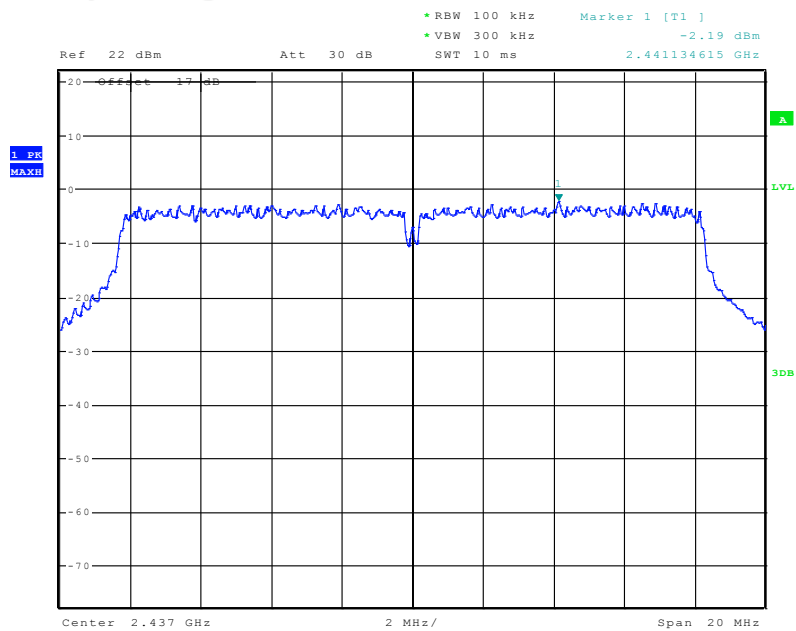
Date: 11.JUN.2012 18:21:08

## Power Spectral Density 802.11g 2412 MHz



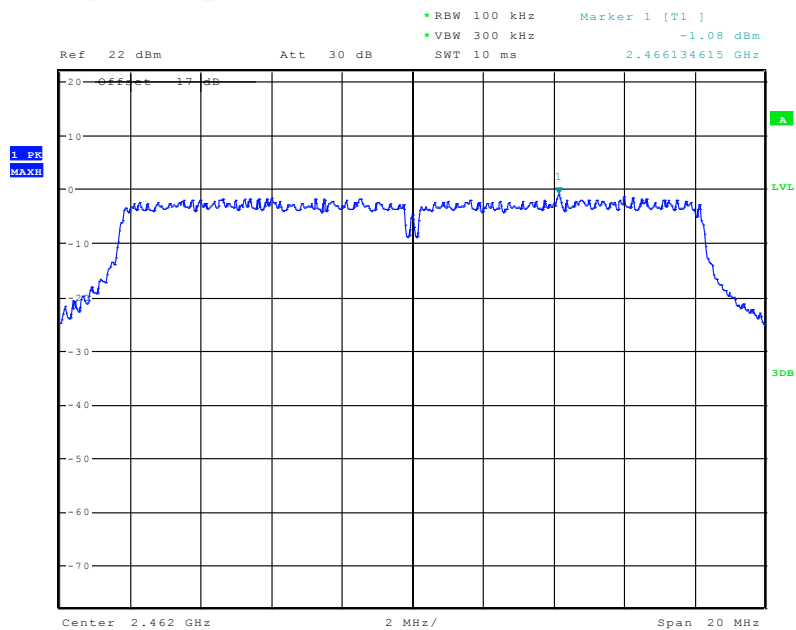
Date: 11.JUN.2012 18:37:52

## Power Spectral Density 802.11g 2437 MHz



Date: 11.JUN.2012 19:05:16

## Power Spectral Density 802.11g 2462 MHz



Date: 11.JUN.2012 19:17:37

## 6.9 Unwanted Emissions into Non-Restricted Frequency Bands- Conducted

### 6.9.1 Reference and Limits:

6.9.1.1 § 15.247 (d)

6.9.1.2 RSS 210-A8.5

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the radio frequency power that is produced 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.

30dBm for the transmitter.

-20dBc in the frequency range 30MHz- 25GHz.

### 6.9.2 Test Conditions:

Tnom: 22°C; Vnom: 12 VDC

### 6.9.3 Test Procedure:

#### Spectrum Analyzer settings:

RBW=100kHz, VBW=300kHz, Detector: Peak- Max hold;

Sweep Time: Auto

Span=Full range

### 6.9.4 Test Result:

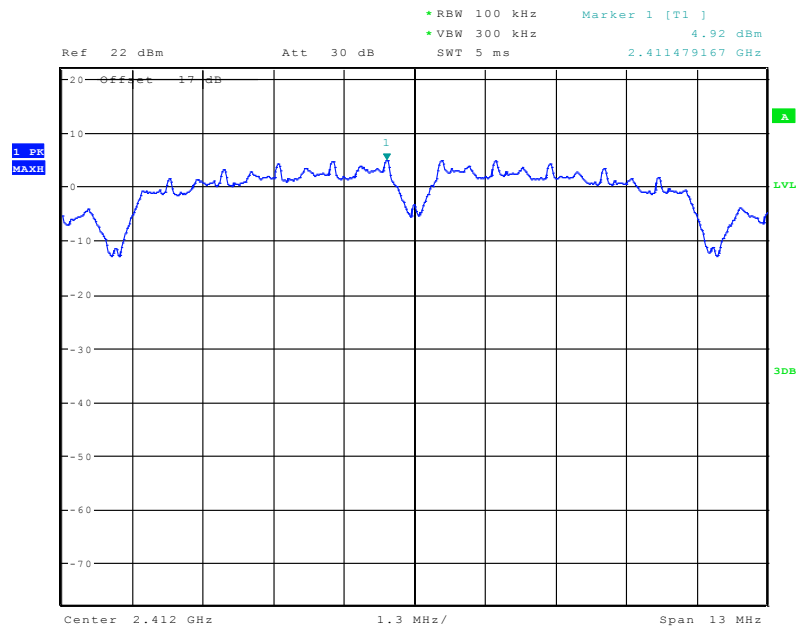
| Conducted Spurious Emissions     |                 |                                   |         |        |
|----------------------------------|-----------------|-----------------------------------|---------|--------|
| Channel                          | Frequency (MHz) | Amplitude (dBm)                   |         | Limits |
|                                  |                 | 802.11b                           | 802.11g |        |
| Low                              | 2412            | 4.92                              | -2.12   | 30dBm  |
|                                  | Spurious        | All other peaks >20dB below limit |         | -20dBc |
| Mid                              | 2437            | 4.99                              | -2.19   | 30 dBm |
|                                  | Spurious        | All other peaks >20dB below limit |         | -20dBc |
| High                             | 2462            | 5.67                              | -1.08   | 30 dBm |
|                                  | Spurious        | All other peaks >20dB below limit |         | -20dBc |
| Measurement Uncertainty: ±1.0 dB |                 |                                   |         |        |

#### 6.9.4.1 Measurement Result

Pass.

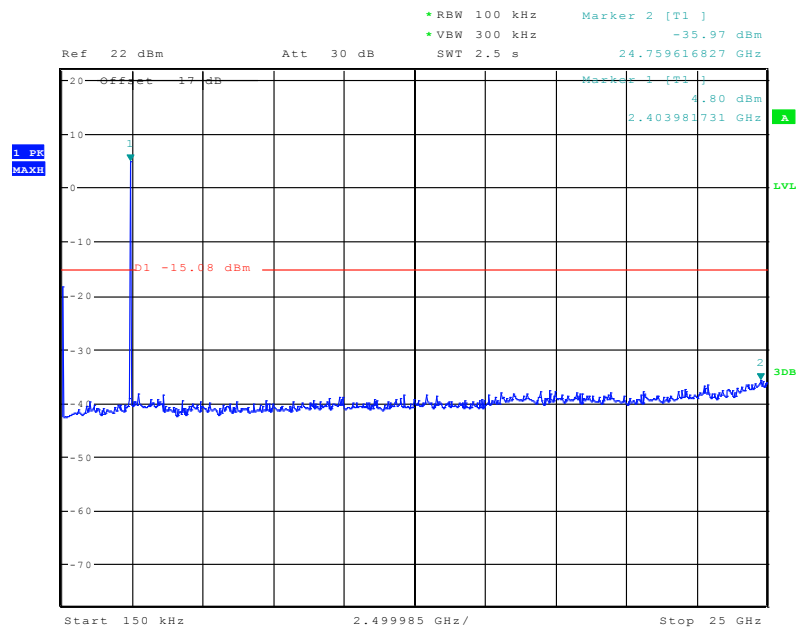
## 6.9.5 Test data/ plots:

### Conducted Spurious Emission 802.11b 2412 MHz – Reference Level



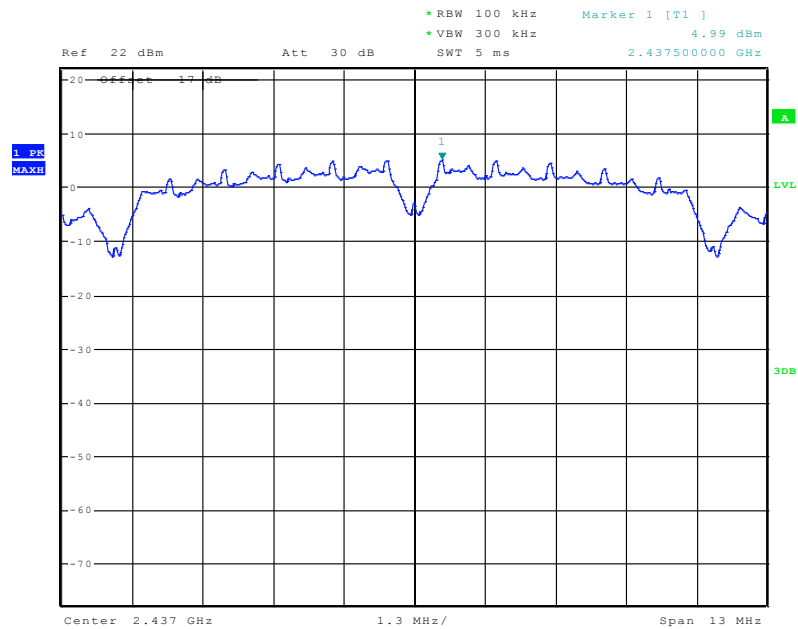
Date: 11.JUN.2012 17:26:09

### Conducted Spurious Emission 802.11b 2412 MHz – 150 kHz – 25 GHz



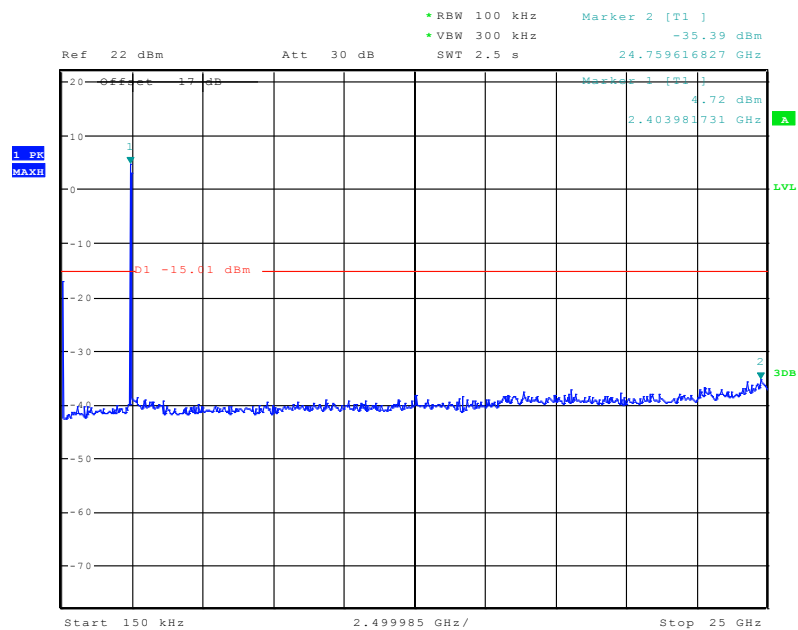
Date: 11.JUN.2012 17:34:40

## Conducted Spurious Emission 802.11b 2437 MHz – Reference Level



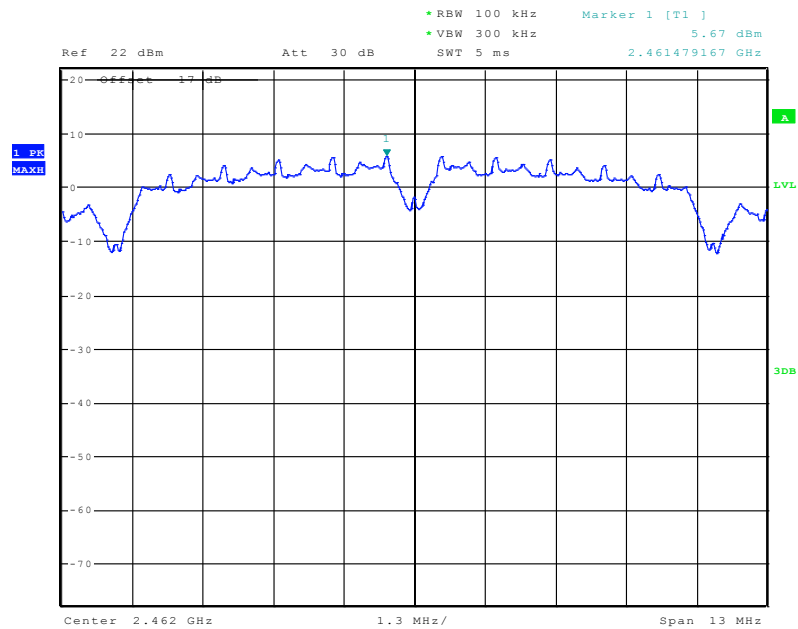
Date: 11.JUN.2012 18:04:25

## Conducted Spurious Emission 802.11b 2437 MHz – 150 kHz – 25 GHz



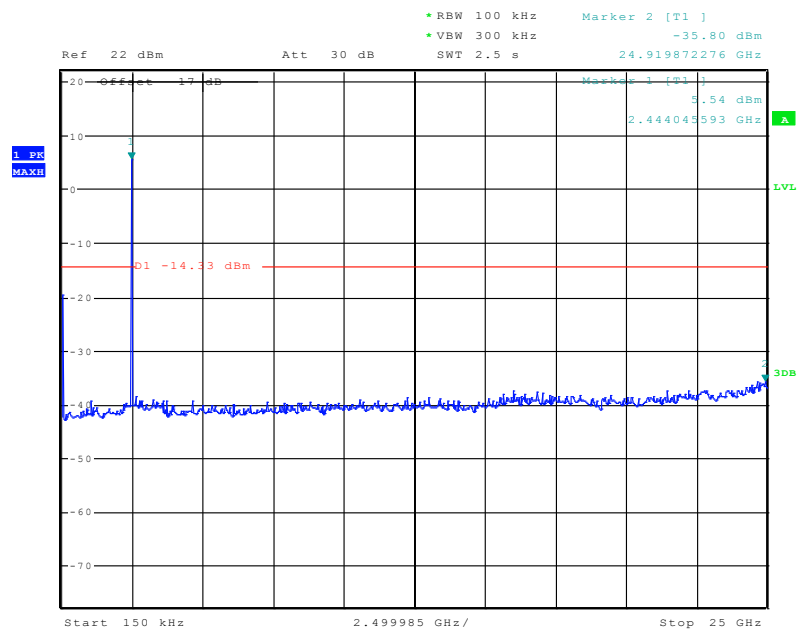
Date: 11.JUN.2012 18:10:55

## Conducted Spurious Emission 802.11b 2462 MHz – Reference Level



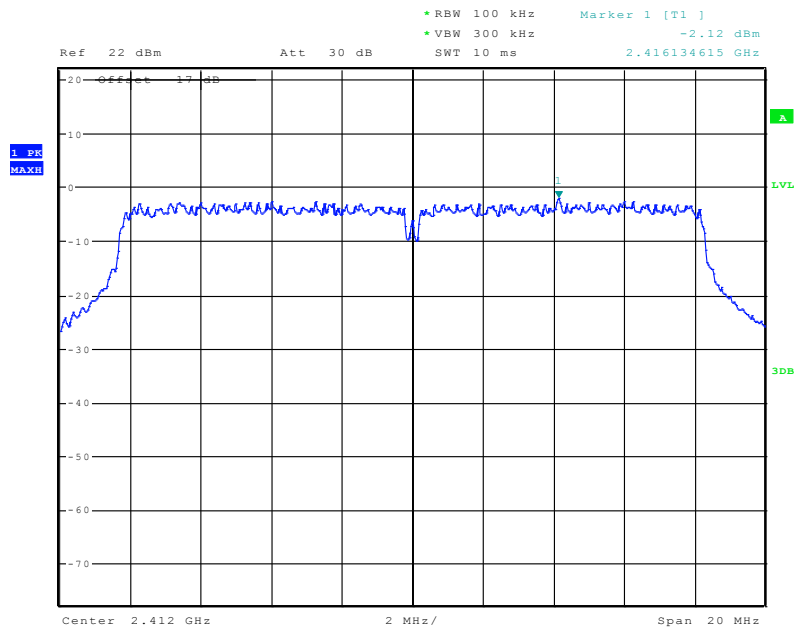
Date: 11.JUN.2012 18:21:08

## Conducted Spurious Emission 802.11b 2462 MHz – 150 kHz – 25 GHz



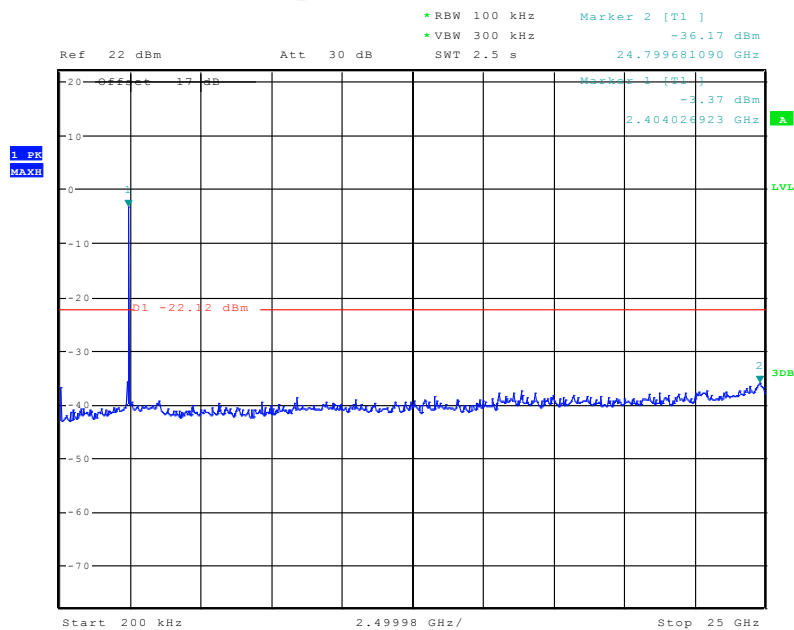
Date: 11.JUN.2012 18:25:25

## Conducted Spurious Emission 802.11g 2412 MHz – Reference Level



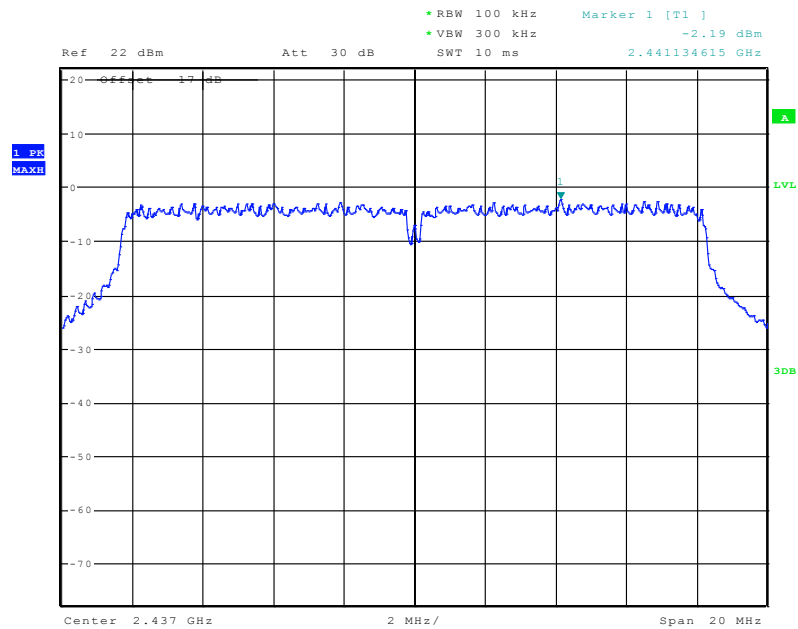
Date: 11.JUN.2012 18:37:52

## Conducted Spurious Emission 802.11g 2412 MHz – 200 kHz – 25 GHz



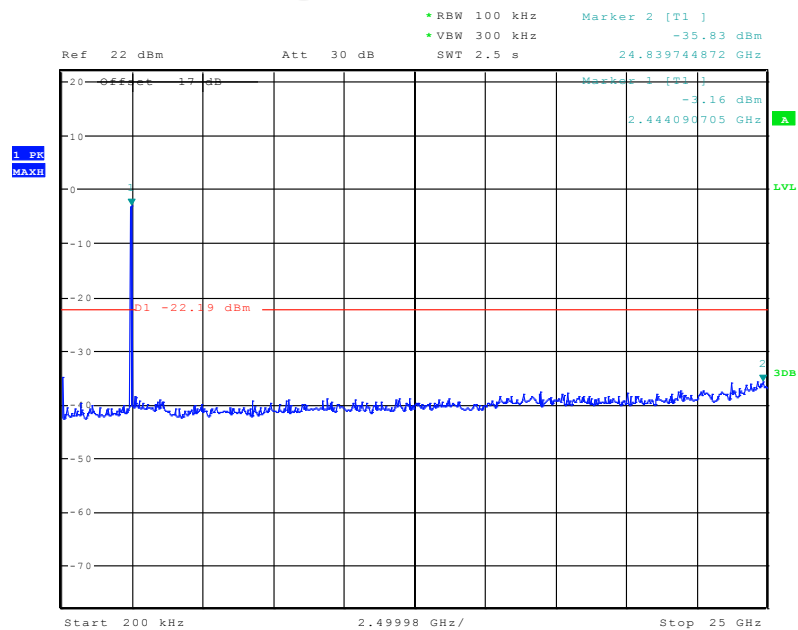
Date: 11.JUN.2012 18:42:53

## Conducted Spurious Emission 802.11g 2437 MHz – Reference Level



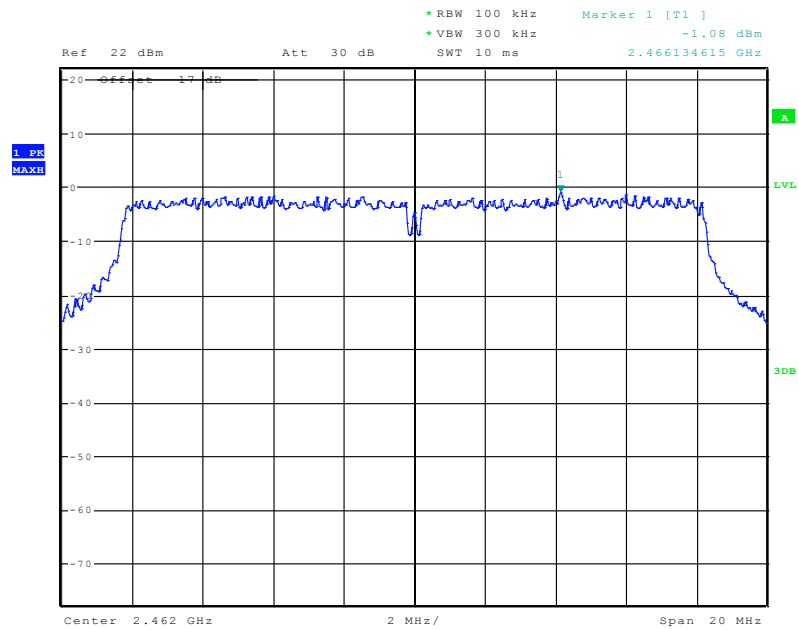
Date: 11.JUN.2012 19:05:16

## Conducted Spurious Emission 802.11g 2437 MHz – 200 kHz – 25 GHz



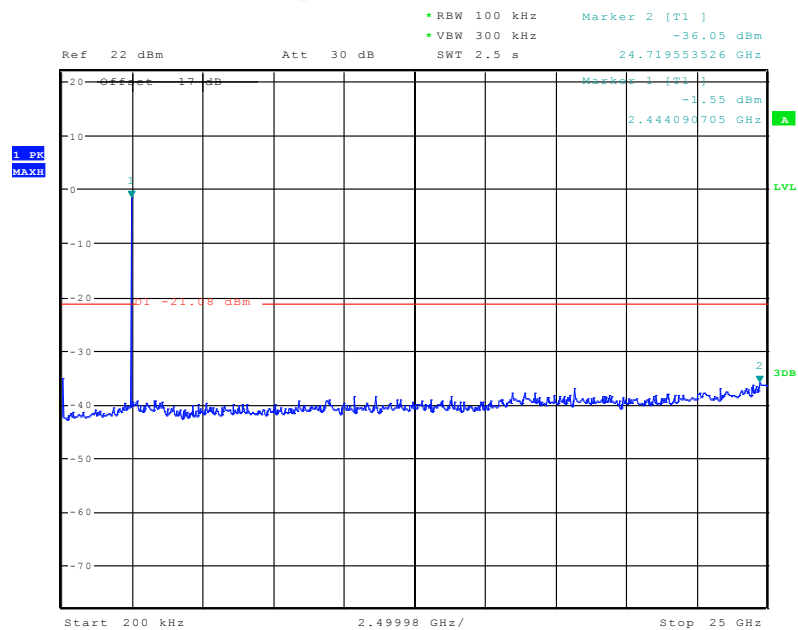
Date: 11.JUN.2012 19:08:40

## Conducted Spurious Emission 802.11g 2462 MHz – Reference Level



Date: 11.JUN.2012 19:17:37

## Conducted Spurious Emission 802.11g 2462 MHz – 200 kHz – 25 GHz



Date: 11.JUN.2012 19:20:56

## 6.10 Unwanted Emissions into Restricted Frequency Bands- Radiated

### 6.10.1 Limits: §15.247/15.205 RSS-210 A8.5

15.247 (d) 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).

15.205 (a) Only spurious emissions are permitted in any of the frequency bands listed below:

| MHz                 | MHz                   | MHz             | GHz              |
|---------------------|-----------------------|-----------------|------------------|
| 0.090 - 0.110       | 16.42 - 16.423        | 399.9 - 410     | 4.5 - 5.15       |
| 0.495 - 0.505       | 16.69475 - 16.69525   | 608 - 614       | 5.35 - 5.46      |
| 2.1735 - 2.1905     | 16.80425 - 16.80475   | 960 - 1240      | 7.25 - 7.75      |
| 4.125 - 4.128       | 25.5 - 25.67          | 1300 - 1427     | 8.025 - 8.5      |
| 4.17725 - 4.17775   | 37.5 - 38.25          | 1435 - 1626.5   | 9.0 - 9.2        |
| 4.20725 - 4.20775   | 73 - 74.6             | 1645.5 - 1646.5 | 9.3 - 9.5        |
| 6.215 - 6.218       | 74.8 - 75.2           | 1660 - 1710     | 10.6 - 12.7      |
| 6.26775 - 6.26825   | 108 - 121.94          | 1718.8 - 1722.2 | 13.25 - 13.4     |
| 6.31175 - 6.31225   | 123 - 138             | 2200 - 2300     | 14.47 - 14.5     |
| 8.291 - 8.294       | 149.9 - 150.05        | 2310 - 2390     | 15.35 - 16.2     |
| 8.362 - 8.366       | 156.52475 - 156.52525 | 2483.5 - 2500   | 17.7 - 21.4      |
| 8.37625 - 8.38675   | 156.7 - 156.9         | 2690 - 2900     | 22.01 - 23.12    |
| 8.41425 - 8.41475   | 162.0125 - 167.17     | 3260 - 3267     | 23.6 - 24.0      |
| 12.29 - 12.293      | 167.72 - 173.2        | 3332 - 3339     | 31.2 - 31.8      |
| 12.51975 - 12.52025 | 240 - 285             | 3345.8 - 3358   | 36.43 - 36.5     |
| 12.57675 - 12.57725 | 322 - 335.4           | 3600 - 4400     | ( <sup>2</sup> ) |
| 13.36 - 13.41       |                       |                 |                  |

15.209 (a) Emission Limits:

The emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

| Frequency (MHz) | Field strength (microvolts/meter) | Measurement distance (m) |
|-----------------|-----------------------------------|--------------------------|
| 0.009–0.490     | 2400/F(kHz)                       | 300                      |
| 0.490–1.705     | 24000/F(kHz)                      | 30                       |
| 1.705–30.0      | 30                                | 30                       |
| 30–88           | 100**                             | 3                        |
| 88–216          | 150**                             | 3                        |
| 216–960         | 200**                             | 3                        |
| Above 960       | 500                               | 3                        |

### **6.10.2 Test Conditions:**

Tnom: 22°C; Vnom: 12 VDC

### **6.10.3 Test Procedure:**

Peak measurements are made using a peak detector and RBW=1MHz.

\*PEAK LIMIT= 74dB $\mu$ V/m

Average measurements performed using a peak detector and according to video averaging procedure with RBW=1MHz and VBW=10Hz.

\*AVG. LIMIT= 54dB $\mu$ V/m

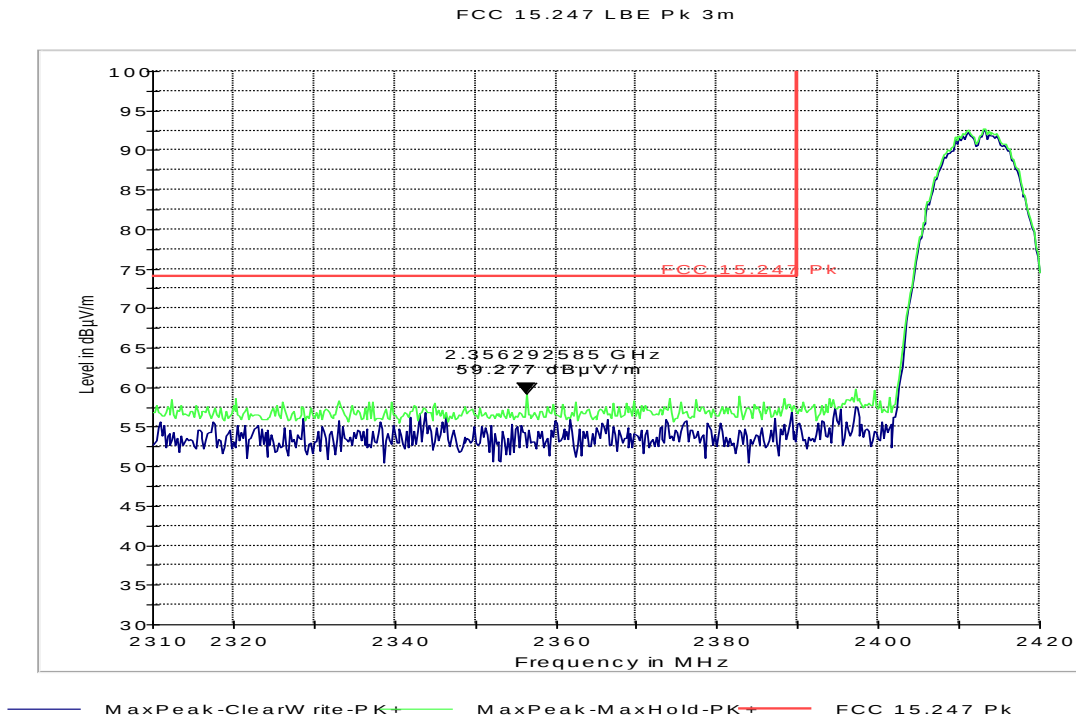
Measurement Uncertainty:  $\pm 3.0$ dB

#### **6.10.3.1 Measurement Result**

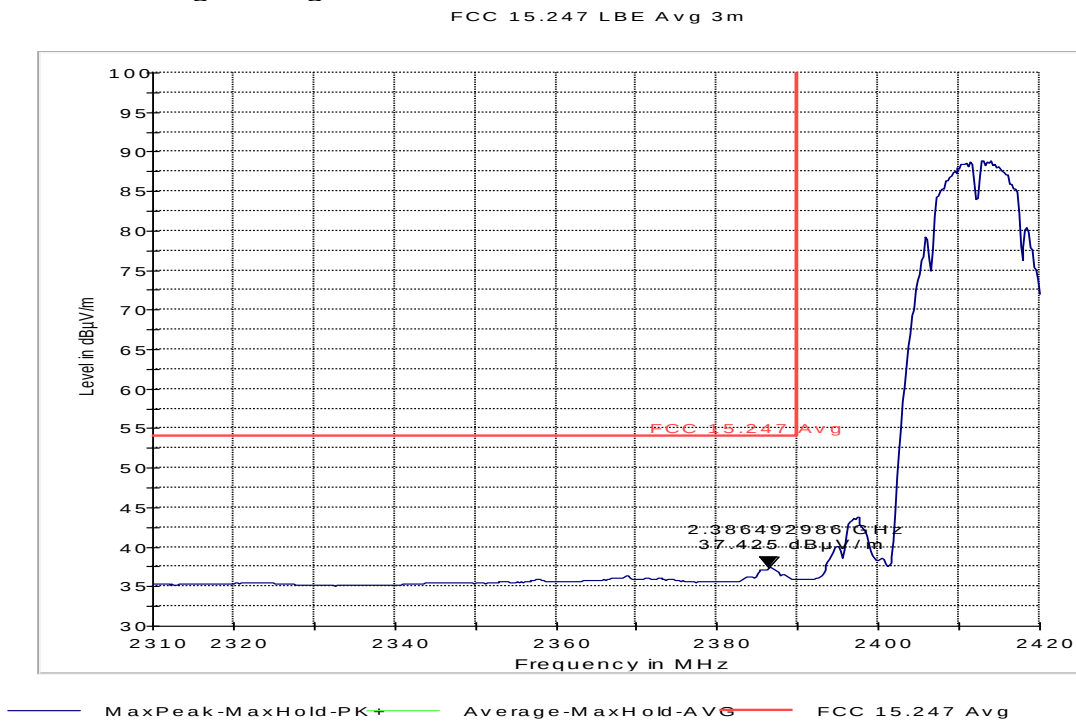
Pass.

#### 6.10.4 Test Data/plots:

##### Lower band edge peak -802.11b mode

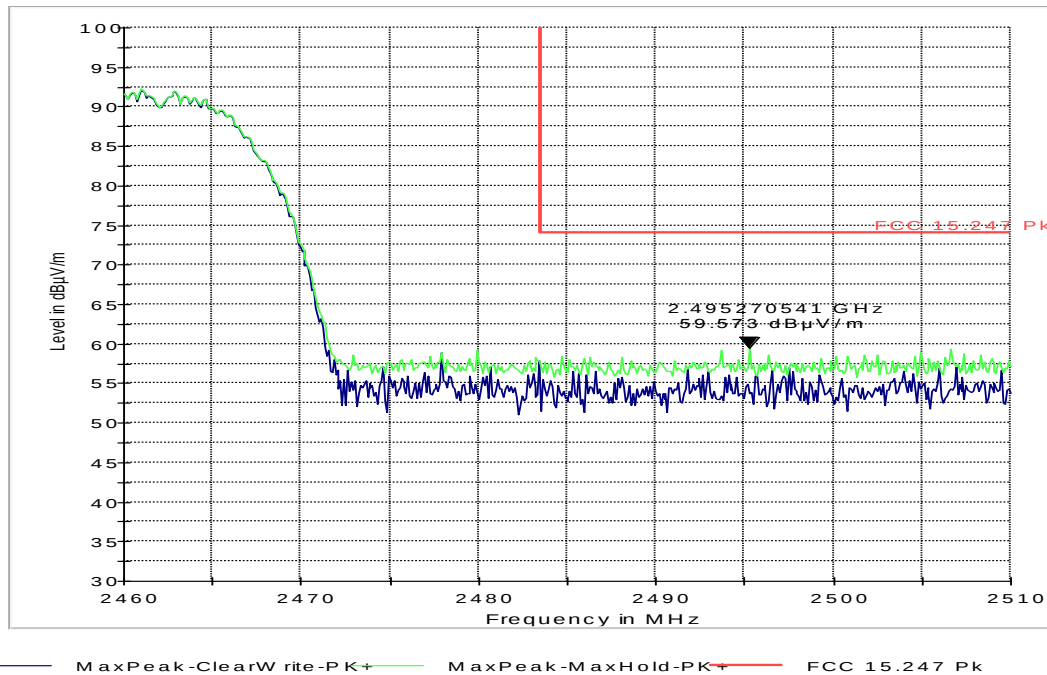


##### Lower band edge average -802.11b mode

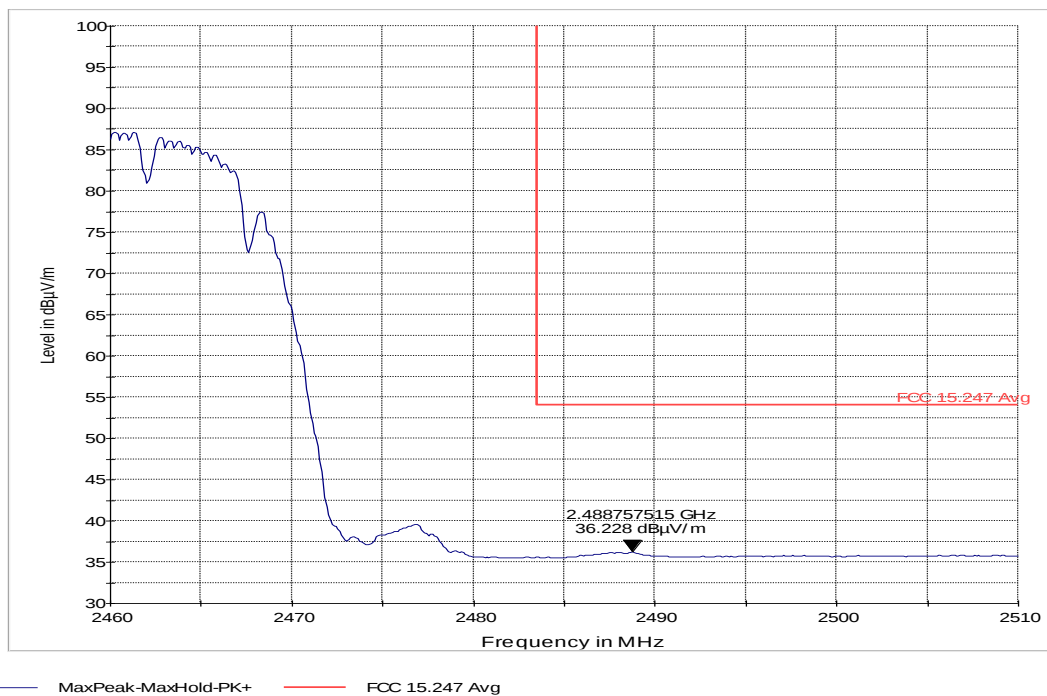


## Higher band edge peak -802.11b mode

FCC 15.247 HBE Pk 3m

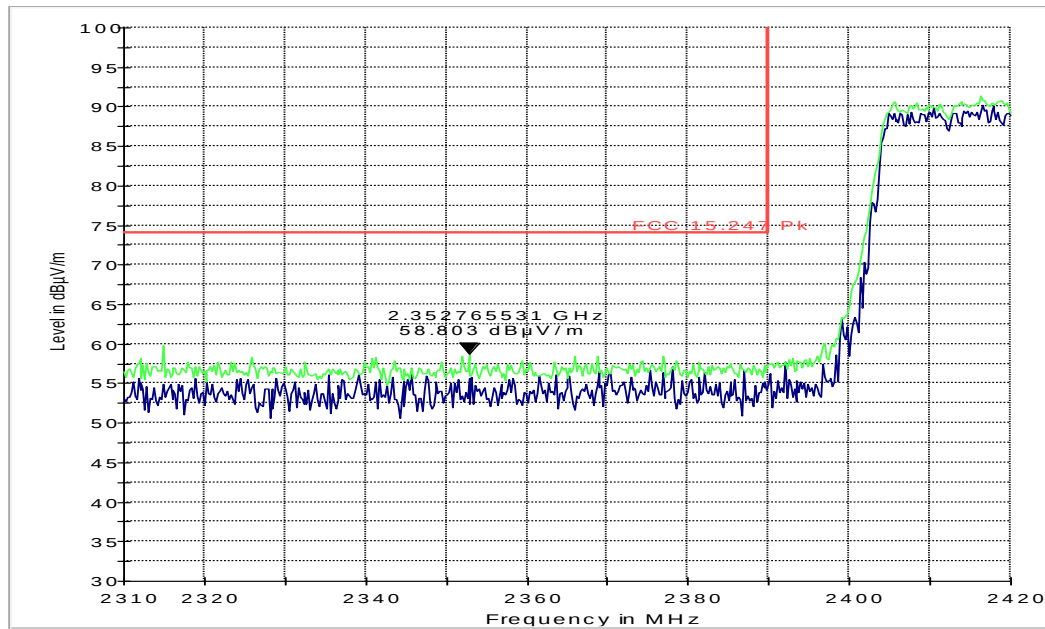


## Higher band edge average-802.11b mode



## Lower band edge peak – 802.11g mode

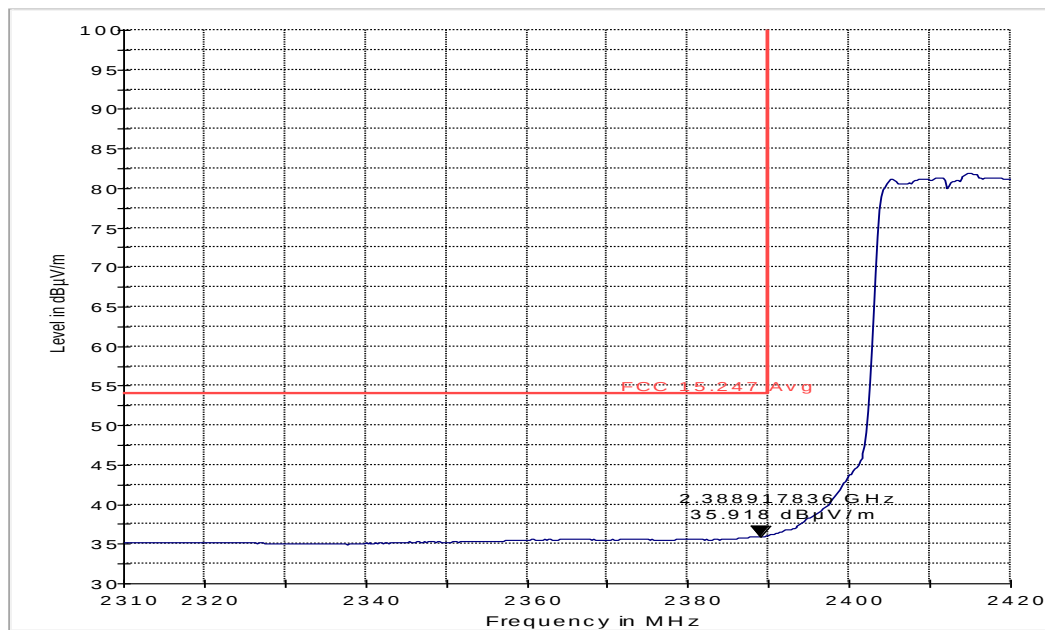
FCC 15.247 LBE Pk 3m



MaxPeak-ClearWrite-PK MaxPeak-MaxHold-PK FCC 15.247 Pk

## Lower band edge average -802.11g mode

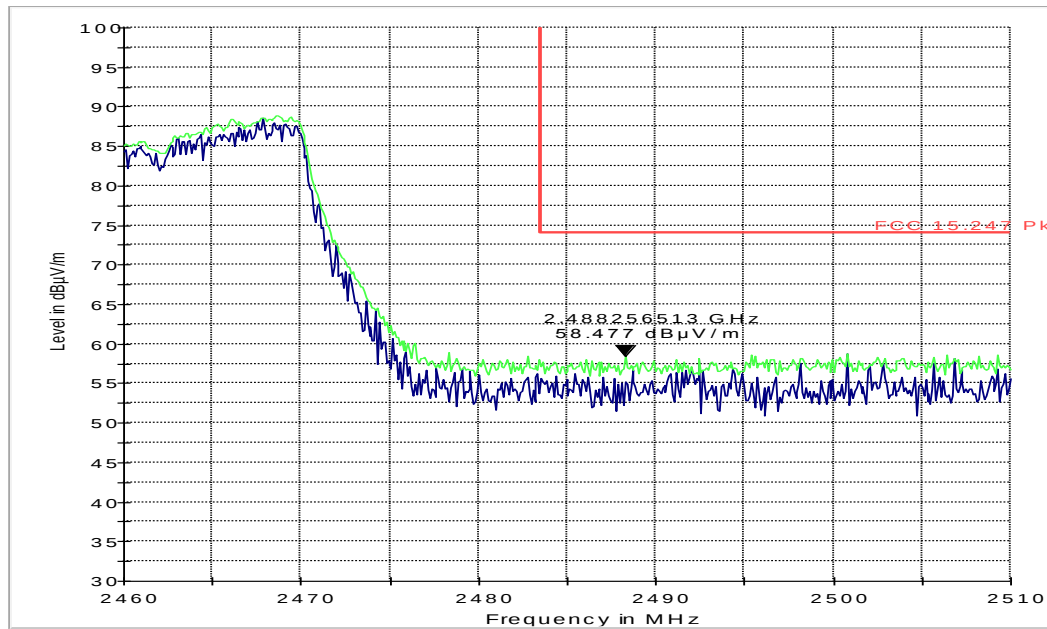
FCC 15.247 LBE Avg 3m



MaxPeak-MaxHold-PK Average-MaxHold-AVG FCC 15.247 Avg

## Higher band edge peak -802.11g mode

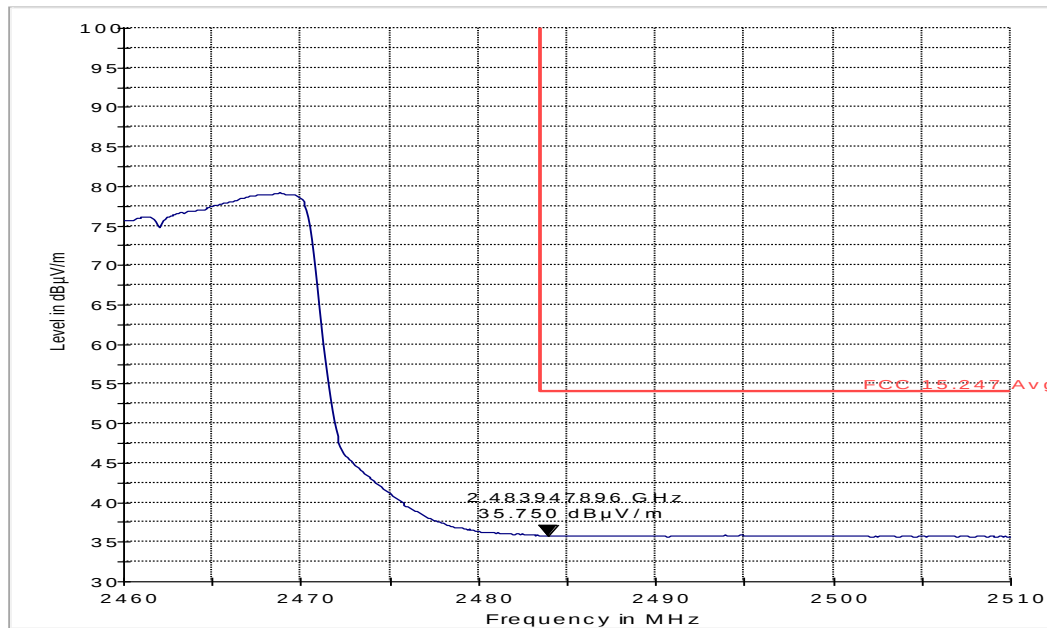
FCC 15.247 HBE Pk 3m



MaxPeak-ClearWrite-PK MaxPeak-MaxHold-PK FCC 15.247 Pk

## Higher band edge average- 802.11g mode

FCC 15.247 HBE Avg 3m



MaxPeak-MaxHold-PK FCC 15.247 Avg

## 6.11 Transmitter Spurious Emissions- Radiated

### 6.11.1 Limits:

§15.247/15.205

RSS 210-A8.5

| Frequency of emission (MHz) | Field strength (µV/m) | Measurement Distance (m) |
|-----------------------------|-----------------------|--------------------------|
| 0.009–0.490                 | 2400/F(kHz)           | 300                      |
| 0.490–1.705                 | 24000/F(kHz)          | 30                       |
| 1.705–30.0                  | 30                    | 30                       |

| Frequency of emission (MHz) | Field strength (µV/m) |
|-----------------------------|-----------------------|
| 30–88                       | 100 (40dBµV/m)        |
| 88–216                      | 150 (43.5 dBµV/m)     |
| 216–960                     | 200 (46 dBµV/m)       |
| Above 960                   | 500 (54 dBµV/m)       |

### 6.11.2 Test Conditions:

Tnom: 22°C; Vnom: 12 VDC

### 6.11.3 Test Result:

**Test mode:** 802.11g mode was used during the measurements since this mode operates with the highest output power and represents the worst case scenario for radiated measurements.

Unless mentioned otherwise, the emissions outside the limit lines in the plots are from the transmit signal.

Plots reported here represent the worse case emissions for horizontal and vertical antenna polarizations and for three orientations of the EUT.

Measurement Uncertainty: ±3.0dB

#### 6.11.3.1 Measurement Result

Pass.

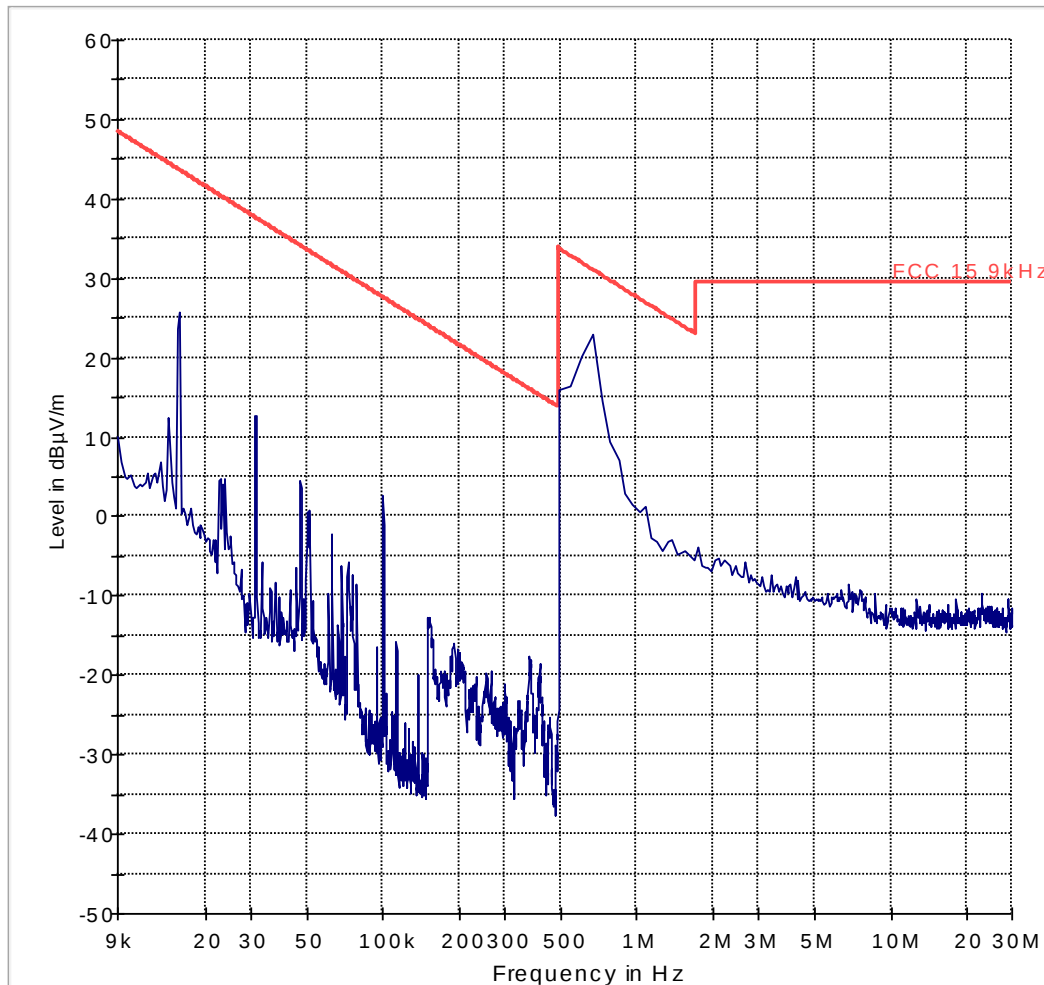
## 6.12 Test data/ plots:

### Transmitter Radiated Spurious Emission:<30MHz

Note: Worst case representation for all modes of operation in this frequency range-

Limits adjusted for 3m measurement.

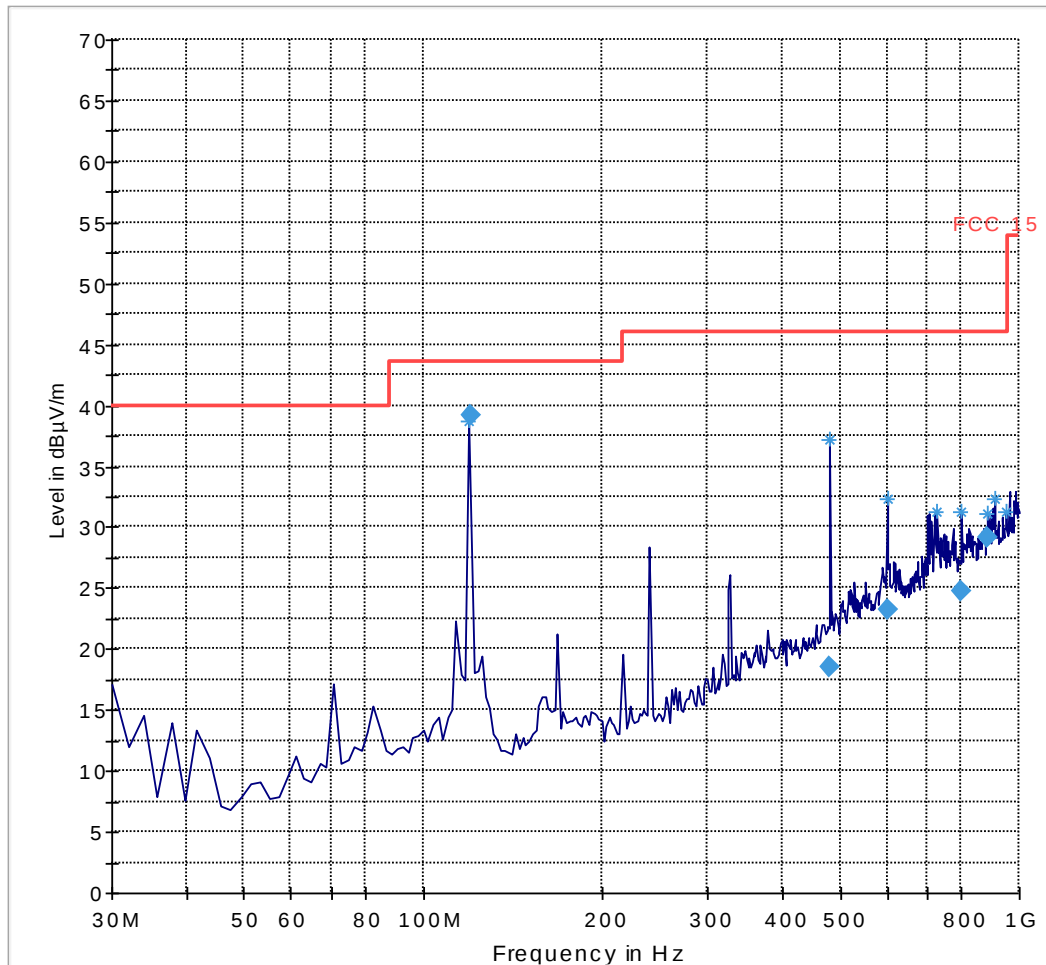
FCC 15 9kHz - 30 MHz



— FCC 15 9kHz — Preview Result 1-PK+

## Transmitter Radiated Spurious Emission- Ch1- 30M-1GHz

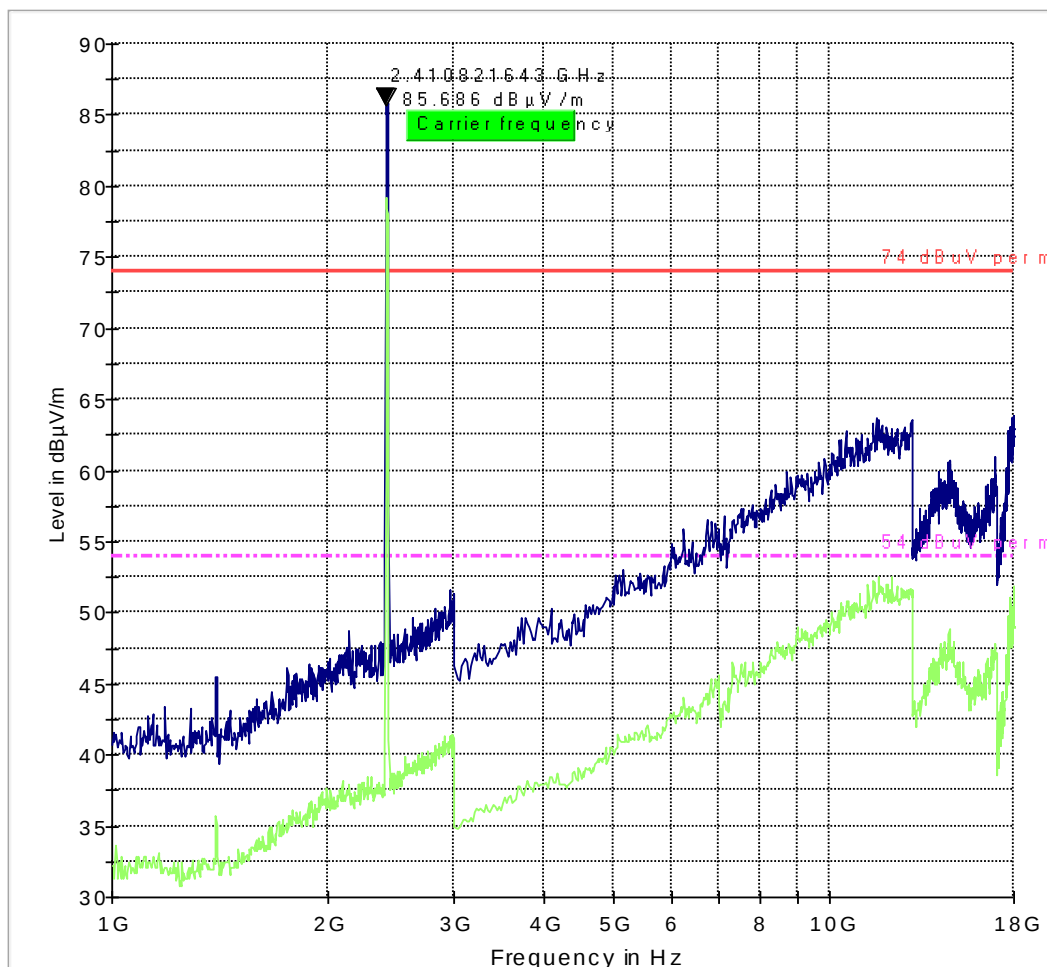
FCC 15 30-1000MHz



— FCC 15  
\* Data Reduction Result 1 [3]-PK  
— Preview Result 1-PK+  
◆ Final Measurement Result 1-QPK

## Transmitter Radiated Spurious Emission- Ch1- 1G-18GHz

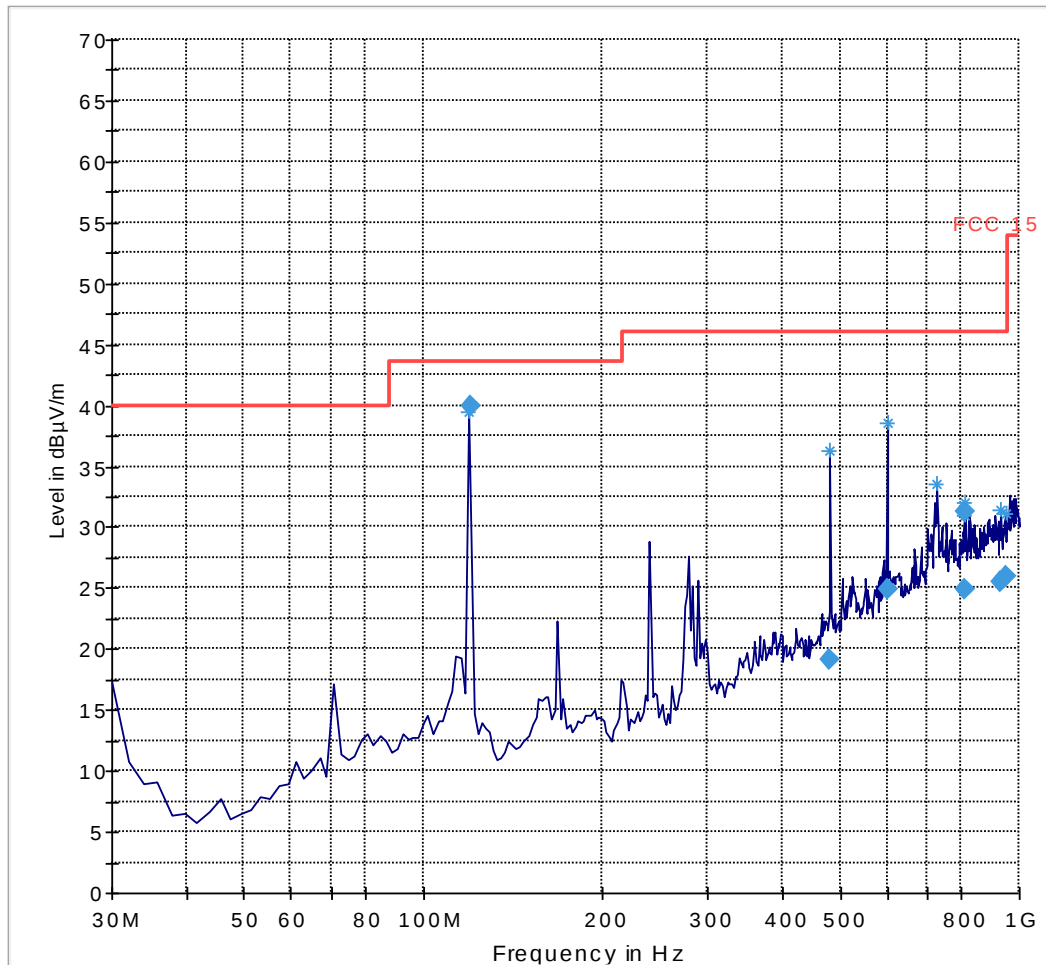
FCC 15 1-18GHz



— 74 dBuV per m      - - - 54 dBuV per m  
— Preview Result 1-PK+      — Preview Result 2-AVG

## Transmitter Radiated Spurious Emission- Ch6- 30M-1GHz

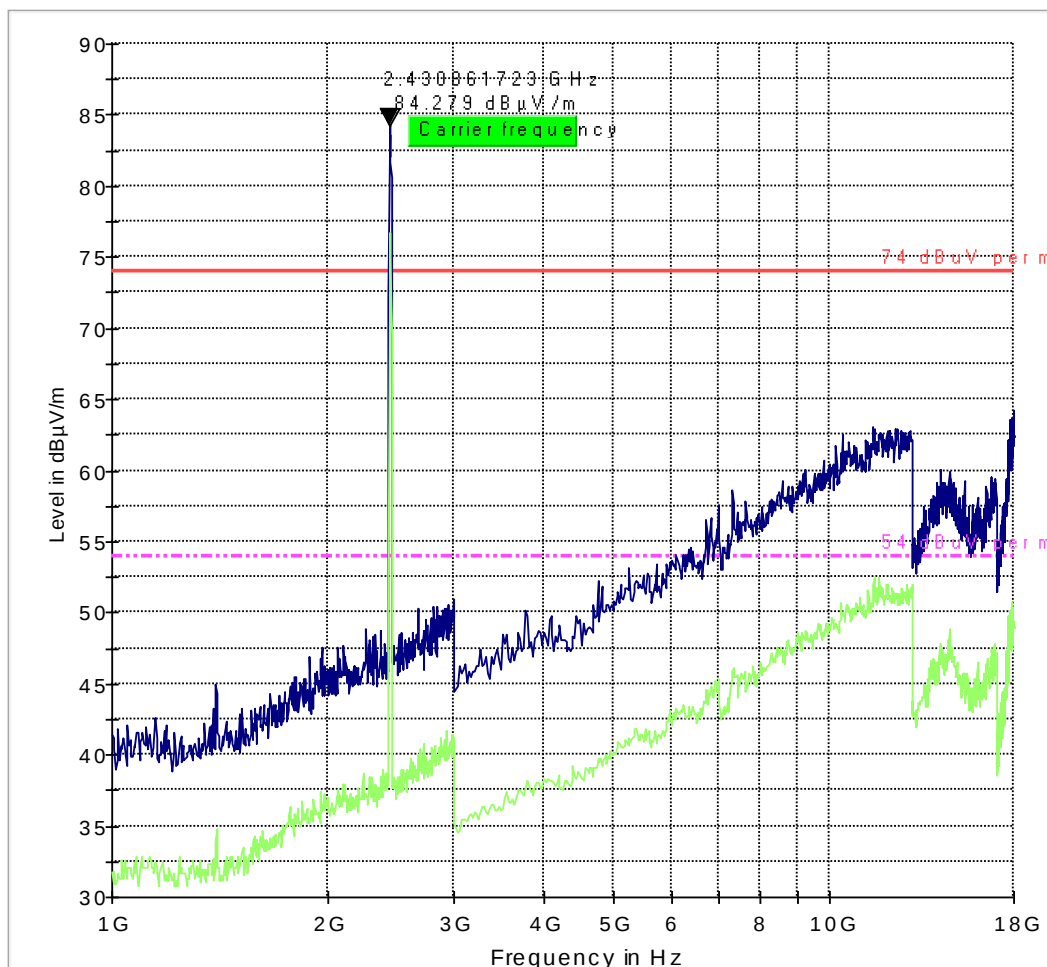
FCC 15 30-1000MHz



— FCC 15  
\* Data Reduction Result 1 [3]-PK  
— Preview Result 1-PK+  
◆ Final Measurement Result 1-QPK

## Transmitter Radiated Spurious Emission- Ch6- 1G-18GHz

FCC 15 1-18GHz

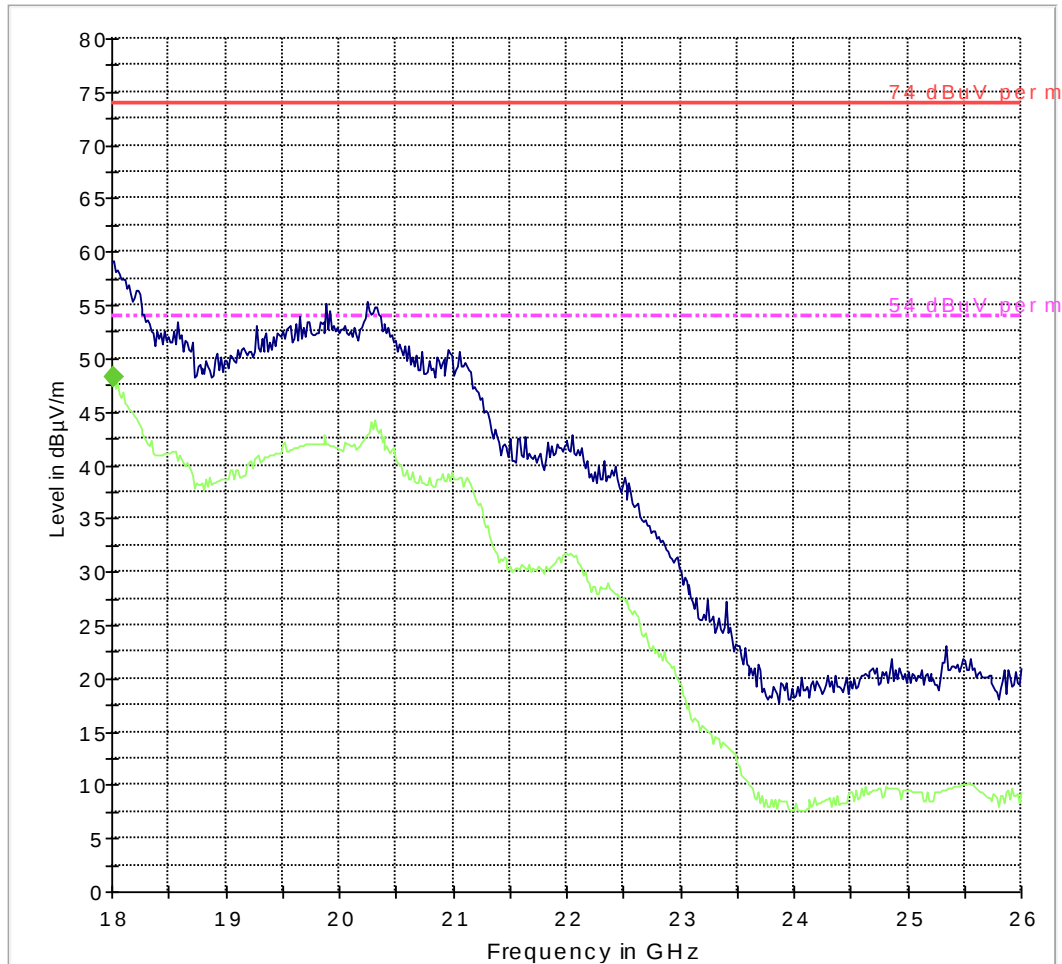


— 74 dBμV per m      - - - 54 dBμV per m  
— Preview Result 1-PK+      — Preview Result 2-AVG

## Transmitter Radiated Spurious Emission- Ch6- 18G-26GHz

NOTE: Worst case for all channels and operating modes in this frequency band.

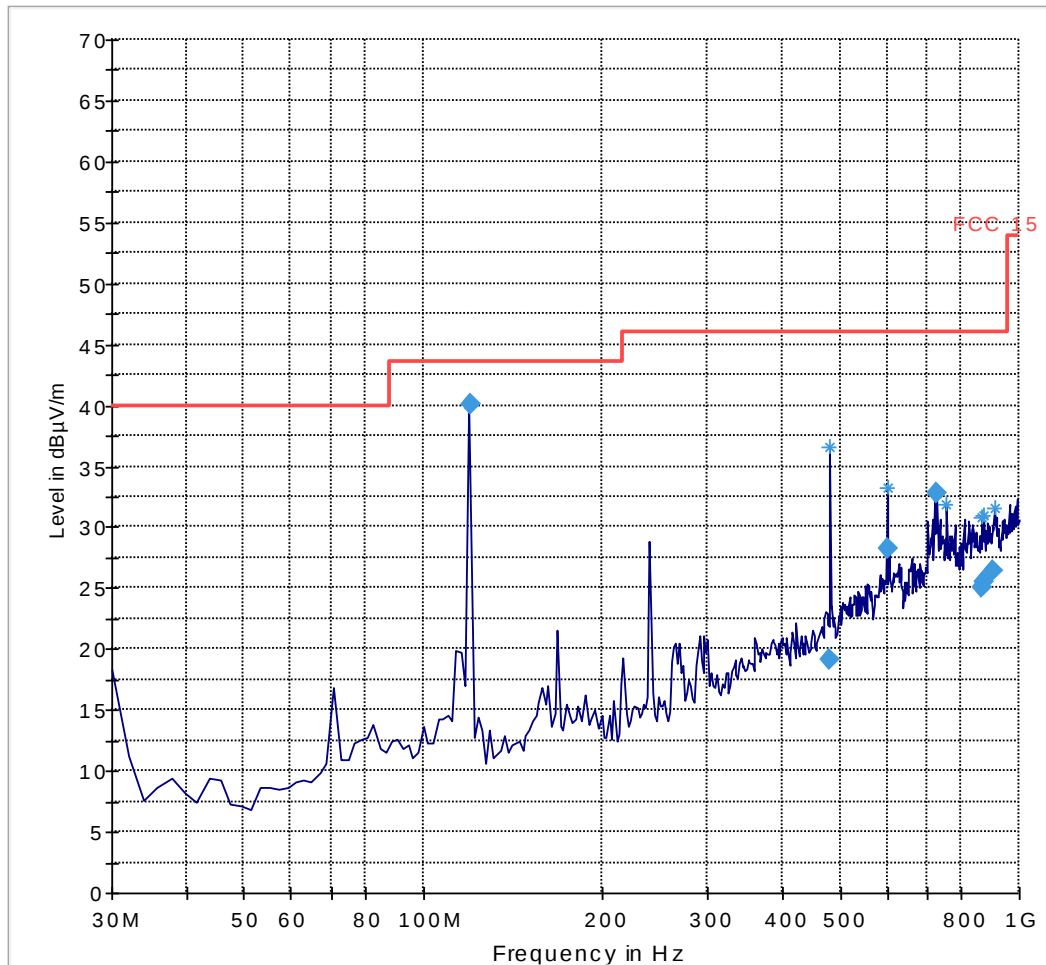
FCC 15 18-26GHz



— 74 dBuV per m      - - - 54 dBuV per m      — Preview Result 1-PK+  
— Preview Result 2-AVG      ◆ Final Result 2-AVG

## Transmitter Radiated Spurious Emission- Ch11- 30M-1GHz

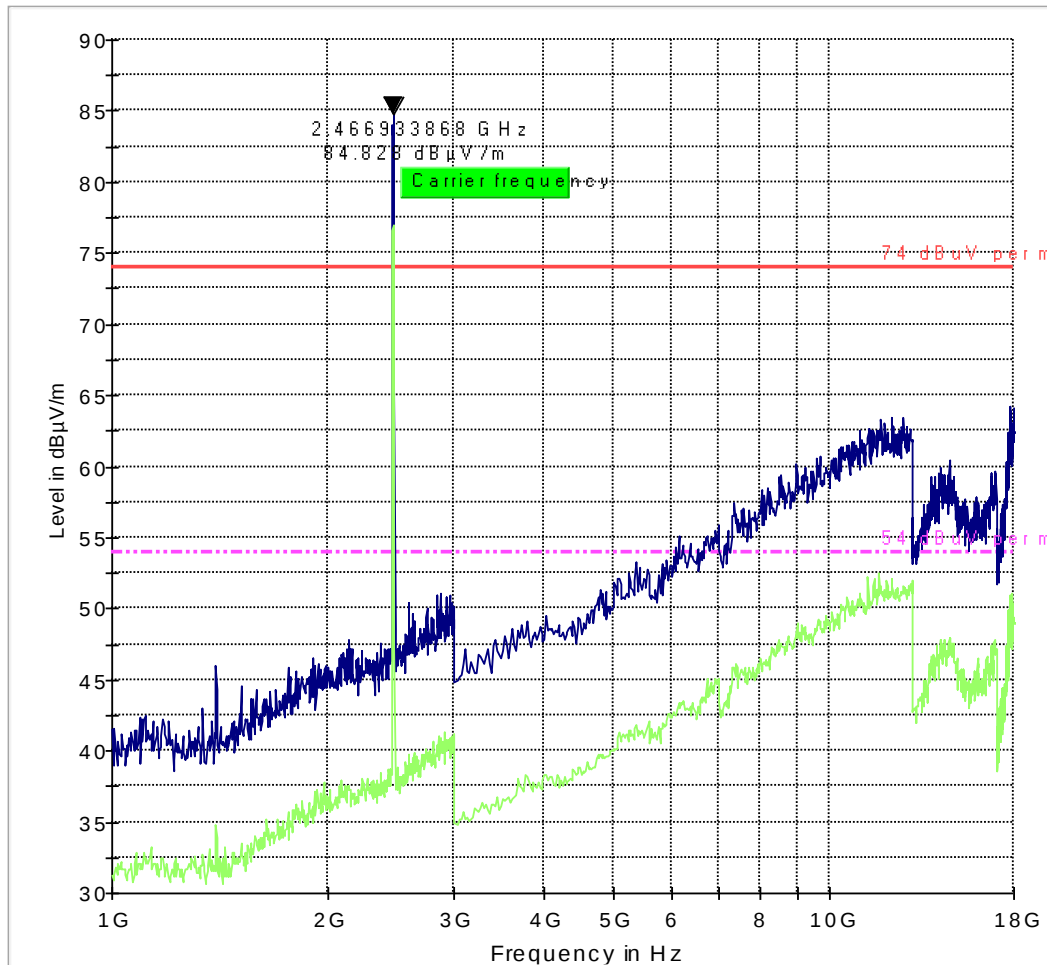
FCC 15 30-1000MHz



— FCC 15  
\* Data Reduction Result 1 [3]-PK+  
— Preview Result 1-PK+  
◆ Final Measurement Result 1-QPK

## Transmitter Radiated Spurious Emission- Ch11- 1G-18GHz

FCC 15 1-18GHz

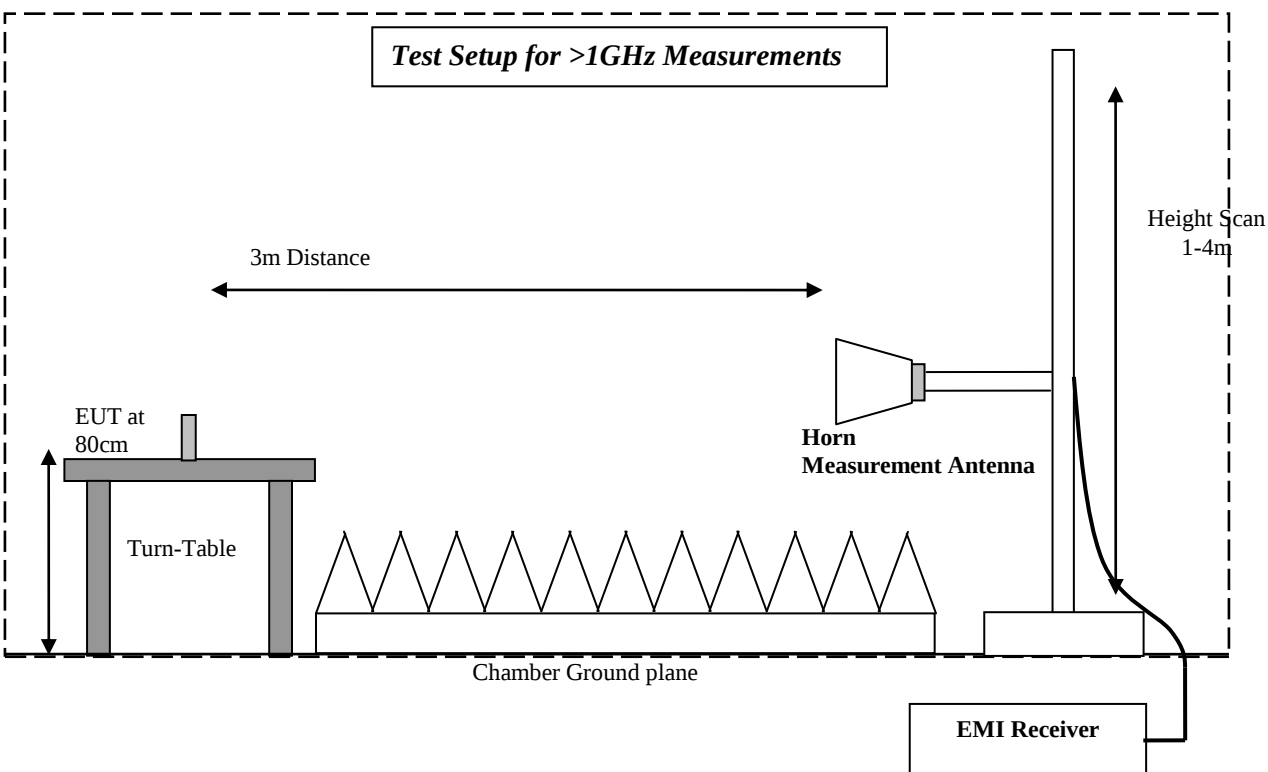
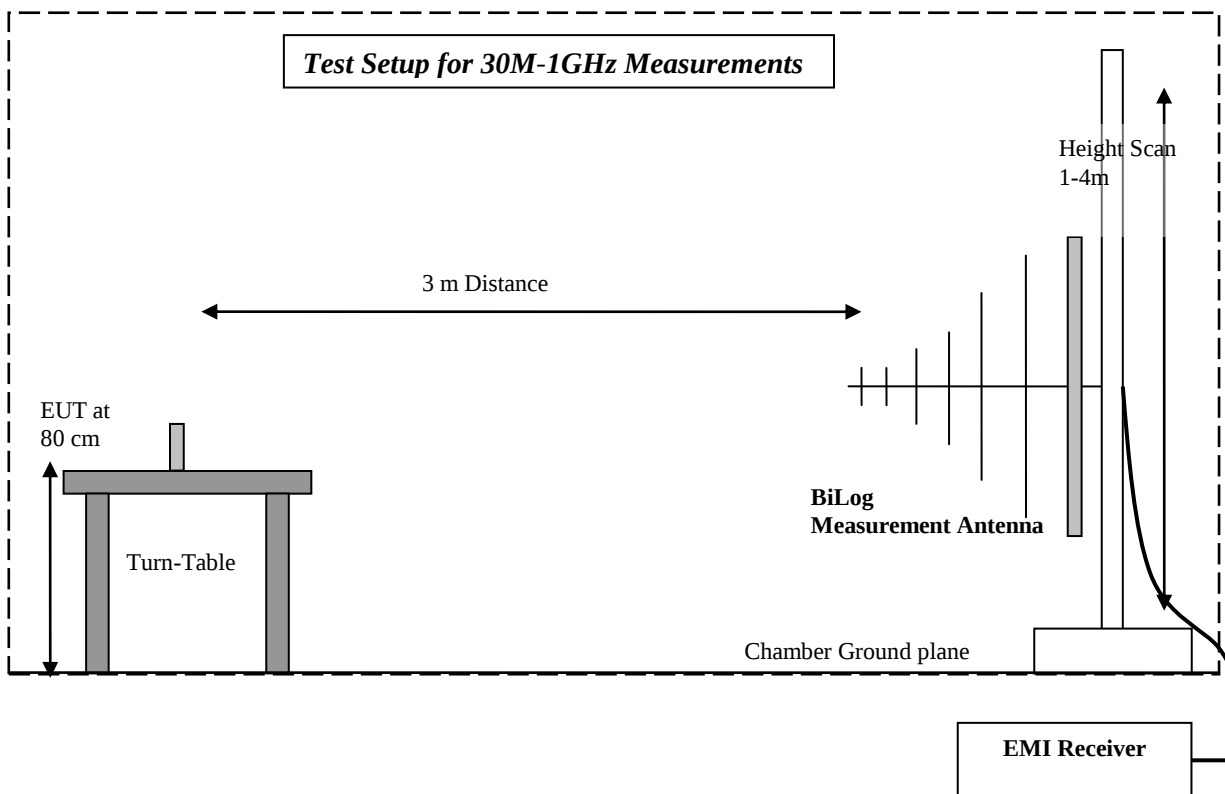


— 74 dBuV per m      - - - 54 dBuV per m  
— Preview Result 1-PK+      — Preview Result 2-AVG

## 7 Test Equipment and Ancillaries used for tests

| Instrument/Ancillary    | Model         | Manufacturer    | Serial No. | Cal Date                   | Cal Interval |
|-------------------------|---------------|-----------------|------------|----------------------------|--------------|
| EMI Receiver/Analyzer   | ESIB 40       | Rohde & Schwarz | 100107     | May 2011                   | 2 Years      |
| Spectrum Analyzer       | FSU           | Rohde & Schwarz | 200302     | May 2011                   | 2 Years      |
| Loop Antenna            | 6512          | EMCO            | 00049838   | Aug 2011                   | 3 years      |
| Biconilog Antenna       | 3141          | EMCO            | 0005-1186  | Apr 2012                   | 3 years      |
| Horn Antenna (1-18GHz)  | 3115          | ETS             | 00035111   | Apr 2012                   | 3 years      |
| Horn Antenna (1-18GHz)  | 3115          | ETS             | 00035114   | Mar 2012                   | 3 years      |
| Horn Antenna (18-40GHz) | 3116          | ETS             | 00070497   | Aug 2011                   | 3 years      |
| Communication Antenna   | IBP5-900/1940 | Kathrein        | n/a        | n/a                        | n/a          |
| High Pass Filter        | 5HC2700       | Trilithic Inc.  | 9926013    | Part of system calibration |              |
| High Pass Filter        | 4HC1600       | Trilithic Inc.  | 9922307    | Part of system calibration |              |
| 6GHz High Pass Filter   | HPM50106      | Microtronics    | 001        | Part of system calibration |              |
| Pre-Amplifier           | JS4-00102600  | Miteq           | 00616      | Part of system calibration |              |
| LISN                    | 50-25-2-08    | FCC             | 08014      | Jan 2012                   | 1 year       |
| Power Smart Sensor      | R&S           | NRP-Z81         | 100161     | May 2011                   | 2 Years      |
| DC Power Supply         | E3610A        | Hewlett Packard | KR83021224 | n/a                        | n/a          |
| Multimeter              | MM200         | Klein           | N/A        | Apr 2011                   | 2 Years      |
| Temp Hum Logger         | TM320         | Dickson         | 03280063   | Mar 2012                   | 1 Year       |
| Temp Hum Logger         | TM325         | Dickson         | 5285354    | Mar 2012                   | 1 Year       |

## 8 Test Setup Diagrams



**Test Report #:** EMC\_HARMA\_018\_11001\_BE2800\_DTS\_Rev1    FCC ID: QNG-BE2800

**Date of Report :** 2012-09-06

IC ID: 6434C-BE2800



## 9 Revision History

| Date       | Report Name                        | Changes to report                                                       | Report prepared by |
|------------|------------------------------------|-------------------------------------------------------------------------|--------------------|
| 2012-07-02 | EMC_HARMA_018_11001_BE2800_DTS     | First Version                                                           | J Sabado           |
| 2012-09-06 | EMC_HARMA_018_1100_BE2800_DTS_Rev1 | Added Section 2.4 and 2.5.<br>Added test conditions for all test cases. | J Sabado           |
|            |                                    |                                                                         |                    |