



## FCC / IC Test Report

**FOR:**

**Philips Respironics Inc.**

**Philips Dream Station**

**Continuous Airway Pressure Device with Bluetooth Radio (LE)**  
(limited single modular approval of the Bluetooth modular transmitter)

**FCC ID: THO1116426**

**IC ID: 3234B-1116426**

**47 CFR Part 15.247**

**RSS-210 Issue 8 & RSS-Gen Issue 4**

**TEST REPORT #: EMC\_PHIL4-00-14001\_15.247\_BTLE**

**DATE: 2015-06-17**



**FCC listed  
A2LA Accredited**

**IC recognized #  
3462B**

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**1 Assessment**

The following device was evaluated against the applicable criteria specified in FCC rules Parts 15.247 of Title 47 of the Code of Federal Regulations and the relevant IC standard RSS-210 issue 8, Annex 8. No deviations were ascertained.

| Company                  | Description   | Model #                          |
|--------------------------|---|----------------------------------|
| Philips Respironics Inc. | Continuous Airway Pressure Device with Bluetooth Radio (LE) | 700x110 (US)<br>700x120 (Canada) |

**Responsible for Testing Laboratory:**

Franz Engert

2015-06-17      Compliance      (Compliance Manager)

| Date | Section | Name | Signature |
|------|---------|------|-----------|
|------|---------|------|-----------|

**Responsible for the Report:**

Kris Lasarov

2015-06-17      Compliance      (EMC Engineer)

| Date | Section | Name | Signature |
|------|---------|------|-----------|
|------|---------|------|-----------|

The test results of this test report relate exclusively to the test item specified in Section 3. 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>Compliance Manager:</b>         | Franz Engert   |
| <b>Responsible Project Leader:</b> | Yu-Chien Ho  |

### 2.2 Identification of the Client

|                          |                            |
|--------------------------|----------------------------|
| <b>Client Firm/Name:</b> | Philips Respironics Inc.   |
| <b>Street Address:</b>   | 1740 Golden Mile Highway   |
| <b>City/Zip Code</b>     | Monroeville, PA 15146      |
| <b>Country</b>           | USA                        |
| <b>Contact Person:</b>   | Jonathan Kurtz             |
| <b>Phone No.</b>         | 724-387-7578               |
| <b>e-mail:</b>           | Jonathan.Kurtz@Philips.com |

### 2.3 Identification of the Manufacturer

|                               |  |
|-------------------------------|--|
| <b>Manufacturer's Name:</b>   | Respironics Inc. (Philips Respironics) |
| <b>Manufacturers Address:</b> | 1001 Murry Ridge Lane                  |
| <b>City/Zip Code</b>          | Murrysville, PA 15668                  |
| <b>Country</b>                | USA                                    |

### 3 Equipment under Test (EUT)

#### 3.1 Specification of the Equipment under Test

|   |  |
|---|--|
| <b>Marketing Name / Model No:</b>                   | 700x110 (US)<br>700x120 (Canada)   |
| <b>HW Version :</b>                                 | 00   |
| <b>FCC-ID :</b>                                     | THO1116426   |
| <b>IC-ID:</b>                                       | 3234B-1116426  |
| <b>Product Description:</b>                         | Continuous Airway Pressure Device with Bluetooth BDR/EDR and LE Radio<br><b>Note: subject to this test / test report is the LE (low energy, DTS) function of Bluetooth radio located on the motherboard of the host device (the Philips Dream Station), for limited single modular approval acc. FCC part 15.212).</b> |
| <b>Frequency Range / number of channels:</b>        | Nominal band: 2400 – 2483.5;<br>Center to center: 2402 (Ch.0) – 2480 (Ch.39), 40 channels  |
| <b>Type(s) of Modulation:</b>                       | GFSK   |
| <b>Modes of Operation:</b>                          | Bluetooth LE   |
| <b>Antenna Information as declared:</b>             | Internal, PIFA PCB, peak gain= 1.5 dBi (typ.)  |
| <b>Max. Output Powers:</b>                          | 6.34 dBm (peak, conducted)   |
| <b>Power Supply/ Rated Operating Voltage Range:</b> | host (Dream Station): AC/DC Adapter; Input:100-240V~50-60 Hz, 2.0-1.0 A; Output: 12 V, 6.67 A;<br>the Bluetooth chip is supplied by 3.3V acc. to documentation;  |
| <b>operating temperature range</b>                  | 5- 35°C (acc. host manual)   |
| <b>Prototype / Production unit</b>                  | Production   |
| <b>Other Radios included in the device:</b>         | none (the Bluetooth BDR/EDR function is part of the functional scope of the Bluetooth radio)   |

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

| EUT # | Serial Number | HW Version | SW Version  | Notes/Comments   |
|-------|---------------|------------|-------------|------------------|
| 1     | JPP251765ADA8 | 00         | B0.0.0.2061 | Radiated Sample  |
| 2     | JPP25184192FB | 00         | B0.0.0.2061 | Conducted Sample |

**3.3 Identification of Accessory equipment**

| AE # | Type          | Manufacturer                | Model             | Serial Number |
|------|---------------|-----------------------------|-------------------|---------------|
| 1    | Humidifier    | Philips<br>Respironics Inc. | DSXH              | HPP10019330E7 |
| 2    | AC/DC Adapter | Delta Electronics<br>Inc.   | MDS-080AAS12<br>A | 70HW512001W   |

**3.4 Environmental conditions during Test:**

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

Ambient Temperature: 20-25°C

Relative humidity: 40-60%

**3.5 Dates of Testing:**

2015/03/09 – 2015/03/23

**3.6 Testing Notes:**

The EUT was set to the required test modes (channel, etc) by special test SW (EZRasp Communicator) which will not be available to end-users in production samples.

**3.7 Test mode of operation with multiple modulations:**

| Mode         | Data rate (Mbps) | Modulation scheme |
|--------------|------------------|-------------------|
| Bluetooth LE | 1.0              | GFSK              |



#### **4 Subject of Investigation**

The objective of the evaluation documented in this report was to assess if the performance of the EUT meets the relevant requirements specified in FCC rules Part 15.247 of Title 47 of the Code of Federal Regulations and Radio Standard Specification RSS-210 Issue 8, Annex 8 of Industry Canada.

This test report is to support a request for new equipment authorization (limited single modular acc. to Part 15.212) under the **FCC ID THO1116426 and the IC certification number 3234B-1116426 / model no. 1116426.**

All testing was performed on the product referred to in Section 3 as EUT.

**Testing procedures are based on FCC KDB558074 D01, 2014-06-05, “Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247” and ANSI C63.10:2013 for DTS systems.**

The tests were performed with the EUT transmitter sets to low, mid and high channels where required. For radiated measurements, all data in this report shows the worst case between horizontal and vertical antenna polarizations and for all orientations of the EUT.

**5 Summary of Measurement Results**

| Test Specification                                    | Test Case                               | Temperature and Voltage Conditions | Mode             | Pass | Fail | NA | NP | Result   |
|---|---|------------------------------------|------------------|------|------|----|----|----------|
| §15.247(e)<br>RSS-210 A8.2(b)                         | Power Spectral Density                  | Nominal                            | IEEE 802.15 (LE) | ■    | □    | □  | □  | Complies |
| §15.247(a)(1)<br>RSS-210 A8.2(a)                      | Emission Bandwidth                      | Nominal                            | IEEE 802.15 (LE) | ■    | □    | □  | □  | Complies |
| §15.247(b)(1)<br>RSS-210 A8.4(4)                      | Maximum Conducted Output Power and EIRP | Nominal                            | IEEE 802.15 (LE) | ■    | □    | □  | □  | Complies |
| §15.247(d)<br>RSS-210 A8.5                            | Band edge compliance                    | Nominal                            | IEEE 802.15 (LE) | ■    | □    | □  | □  | Complies |
| §15.247(d)<br>§15.209<br>RSS-210 A8.5<br>RSS-Gen 6.13 | TX Spurious emissions- Radiated         | Nominal                            | IEEE 802.15 (LE) | ■    | □    | □  | □  | Complies |
| §15.207(a)<br>RSS-Gen 8.8                             | AC Conducted Emissions                  | Nominal                            | IEEE 802.15 (LE) | ■    | □    | □  | □  | Complies |

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

## 6 Measurements

### 6.1 Radiated Measurement Procedure

Ref: ANSI C63.10 (2013)

#### **Section 5.4: Measurements around the EUT**

Measurements shall be made at a test site that incorporates a turntable allowing EUT rotation of 0° through 360°, except where the EUT is so large that a suitable turntable is not readily available. A remotely controlled turntable shall be installed at the test site to support the EUT and facilitate determination of the direction of maximum radiation for each EUT emission frequency. Continuous azimuth searches shall be made. The maximum field strength at the frequency being measured shall be reported in the test report.<sup>32</sup> See ANSI C63.4 for details of the test site, turntable, and antenna positioner. Where a continuous azimuth search cannot be made, as is the case for example where the EUT is so large that a suitable turntable is not readily available, frequency scans of the EUT field strength with both polarizations of the measuring antenna shall be made, starting with a minimum of 16 azimuth angles around the EUT, nominally spaced by 22.5°, in characterizing the EUT radio-noise profile. If directional EUT radiation patterns are suspected, especially above 1 GHz then additional and smaller azimuth angles shall be examined.

#### **Section 5.3.2: Test distance for frequencies below 30 MHz**

Radiated emissions limits are usually defined at a specific distance from the EUT. Where possible, measurements shall be made at the distance specified in the limits. This might not be possible in all cases, however, due to the physical limitations of the test facility, physical access problems at the required distance (especially for measurements that must be made in situ or on-site), or levels of ambient noise or other radiated signals present at the time and location where measurements are made. See 6.4.3 for more information about antenna selection, location, and test distance. If measurements cannot practically be made at the EUT limit distance, then they may be made at a different distance (usually closer) and extrapolated to the limit distance using one of the procedures described in 6.4.4, 6.4.5, or 7.7, depending on the EUT source and size.<sup>31</sup> The test report shall specify the extrapolation method used to determine compliance of the EUT.

#### **Section 5.3.3: Test distance for frequencies at or above 30 MHz**

Measurements may be performed at a distance other than the limit distance provided they are not performed in the near field and the emissions to be measured can be detected by the measurement equipment (see 4.3.4). Measurements shall not be performed at a distance greater than 30 m for frequencies above 30 MHz, unless it can be further demonstrated that measurements at a distance of 30 m or less are impractical. Measurements from 18 GHz to 40 GHz are typically made at distances significantly less than 3 m from the EUT. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade of distance (inverse of linear distance for field-strength measurements or inverse of linear distance-squared for power-density measurements).

## ANSI C63.10 (2013)

### Section 6.6.4.2: Exploratory radiated emissions 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 and, if applicable, the EUT configuration that produces the maximum level of emissions. The frequencies of maximum emission may be determined by manually positioning the antenna close to the EUT, and then moving the antenna over all sides of the EUT while observing a spectral display. It is advantageous to have prior knowledge of the frequencies of emissions, although this may be determined from such a near-field scan. The near-field scan shall only be used to determine the frequency but not the amplitude of the emissions. Where exploratory measurements are not adequate to determine the worst-case operating modes and are used only to identify the frequencies of the highest emissions, additional preliminary tests can be required.

Preliminary tests shall be performed following the procedures in 6.3 on a site meeting the requirements of 5.2. For emissions from the EUT, the maximum level shall be determined by rotating the EUT and its antenna through 0° to 360°. For each mode of operation required to be tested, the frequency spectrum (based on findings from exploratory measurements) shall be monitored.

### Section 6.6.4.3: Final radiated emissions measurements

The final measurements are performed on a site meeting the requirements of 5.2. Using the orientation and equipment arrangement of the EUT based on the measurement results found during the preliminary (exploratory) measurements per 6.6.4.2, the EUT arrangement, appropriate modulation, and modes of operation that produce the emissions that have the highest amplitude relative to the limit shall be selected for the final measurement. The final measurement shall follow all the procedures in 6.3 with the EUT operating on frequencies per 5.6. For each mode selected, record the frequency and amplitude of the highest fundamental emission (if applicable), as well as the frequency and amplitude of the six highest spurious emissions relative to the limit. Emissions more than 20 dB below the limit do not need to be reported.

Measurements are performed with the EUT rotated from 0° to 360°; the antenna height scanned in accordance with 6.6.3.1, 6.6.3.2, or 6.6.3.3, as appropriate; and the antenna rotated to repeat the measurements for both the horizontal and vertical antenna polarizations. Variations in cable or wire placement shall be explored to maximize the measured emissions.

## 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.

**6.2 Sample Calculations for Radiated Measurements**

**6.2.1 Field Strength Measurements:**

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

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

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

Eg:

| Frequency (MHz) | Measured SA (dBμV) | Cable Loss (dB) | Antenna Factor Correction (dB) | Field Strength Result (dBμV/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.

**6.2.2 Measurement Uncertainty**

|   | Uncertainty in dB radiated <30MHz | Uncertainty in in dB radiated 30MHz - 1GHz | Uncertainty in dB radiated > 1GHz | Uncertainty in dB Conducted measurement |
|---|-----------------------------------|--|-----------------------------------|---|
| <b>standard deviation k=1</b>                           | 2.48                              | 1.93                                       | 2.16                              | 0.63                                    |
| <b>95% confidence interval in dB</b>                    | 4.86                              | 3.79                                       | 4.23                              | 1.24                                    |
| <b>95% confidence interval in dB in delta to Result</b> | +/-2.5 dB                         | +/-2.0 dB                                  | +/- 2.3dB                         | +/-0.7dB                                |

### **6.3 Conducted Emissions Procedure AC mains**

**Ref: ANSI C63.10 (2013)**

#### **Section 6.2: Standard test method for ac power-line conducted emissions from unlicensed wireless devices**

##### **Section 6.2.1: General considerations**

AC power-line conducted emission measurements shall be made, unless otherwise specified, over the frequency range from 150 kHz to 30 MHz, to determine the line-to-ground radio-noise voltage that is conducted from all of the EUT current-carrying power input terminals that are directly (or indirectly via separate transformers or power supplies) connected to a public power network. These measurements may also be required between 9 kHz and 150 kHz.

If the EUT normally receives power from another device that in turn connects to the public utility ac power lines, measurements shall be made on that device with the EUT in operation to demonstrate that the device continues to comply with the appropriate limits while providing the EUT with power. If the EUT is operated only from internal or dedicated batteries, with no provisions for connection to the public utility ac power lines (600 VAC or less) to operate the EUT (such as an adapter), then ac power-line conducted measurements are not required.

For direct current (dc) powered devices where the ac power adapter is not supplied with the device, an “off-the-shelf” unmodified ac power adapter shall be used. If the device is supposed to be installed in a host (e.g., the device is a module or PC card), then it is tested in a typical compliant host (see also 5.10.3).

##### **Section 6.2.2: Measurement requirements**

The LISN housing, measuring instrument case, reference ground plane, vertical conducting plane, if used, shall be bonded together.

Measured levels of ac power-line conducted emission shall be the emission voltages from the voltage probe, where permitted, or across the 50  $\Omega$  LISN port (to which the EUT is connected), where permitted, terminated into a 50  $\Omega$  measuring instrument. All emission voltage and current measurements shall be made on each current-carrying conductor at the plug end of the EUT power cord by the use of mating plugs and receptacles on the LISN, if used. Equipment shall be tested with power cords that are normally supplied or recommended by the manufacturer and that have electrical and shielding characteristics that are the same as those cords normally supplied or recommended by the manufacturer. For those measurements using a LISN, the 50  $\Omega$  measuring port is terminated by a measuring instrument having 50  $\Omega$  input impedance. All other ports are terminated in 50  $\Omega$  loads.

**ANSI C63.10 (2013)****Section 6.2.4: Exploratory ac power-line conducted emission measurements**

Exploratory tests shall be run with the modulating signal(s) specified in 5.12 applied to the EUT. Antenna(s) can be integral or detachable. If detachable, the antenna(s) shall be attached during the test. On any one convenient frequency specified in 5.5 and 5.6, exploratory measurements shall be used to identify the frequency of the emission that has the highest amplitude relative to the limit by operating the EUT in a range of typical modes of operation, cable positions, and with a typical system equipment configuration and arrangement. For each mode of operation and for each ac power current-carrying conductor, cable manipulation shall be performed within the range of likely configurations. For this measurement or series of measurements, the frequency spectrum of interest shall be monitored looking for the emission that has the highest amplitude relative to the limit. Once that emission is found for each current-carrying conductor of each power cord associated with the EUT (but not the cords associated with non-EUT equipment in the overall system), the one configuration and arrangement and mode of operation that produces the emission closest to the limit over all of the measured conductors shall be recorded.

**Section 6.2.5: Final ac power-line conducted emission measurements**

Based on the exploratory tests of the EUT performed in 6.2.4, the one EUT cable configuration and arrangement and mode of operation that produced the emission with the highest amplitude relative to the limit is selected for the final measurement, while applying the appropriate modulating signal to the EUT. If the EUT is relocated from an exploratory test site to a final test site, the highest emissions shall be remaximized at the final test location before final ac power-line conducted emission measurements are performed. The final test on all current-carrying conductors of all of the power cords to the equipment that comprises the EUT (but not the cords associated with other non-EUT equipment in the system) is then performed for the full frequency range for which the EUT is being tested for compliance without further variation of the EUT arrangement, cable positions, or EUT mode of operation. If the EUT is composed of equipment units that have their own separate ac power connections (e.g., floor-standing equipment with independent power cords for each shelf that are able to connect directly to the ac power network), then each current-carrying conductor of one unit is measured while the other units are connected to a second (or more) LISN(s). All units shall be measured separately. If a power strip is provided by the manufacturer, to supply all of the units making up the EUT, only the conductors in the power cord of the power strip shall be measured.

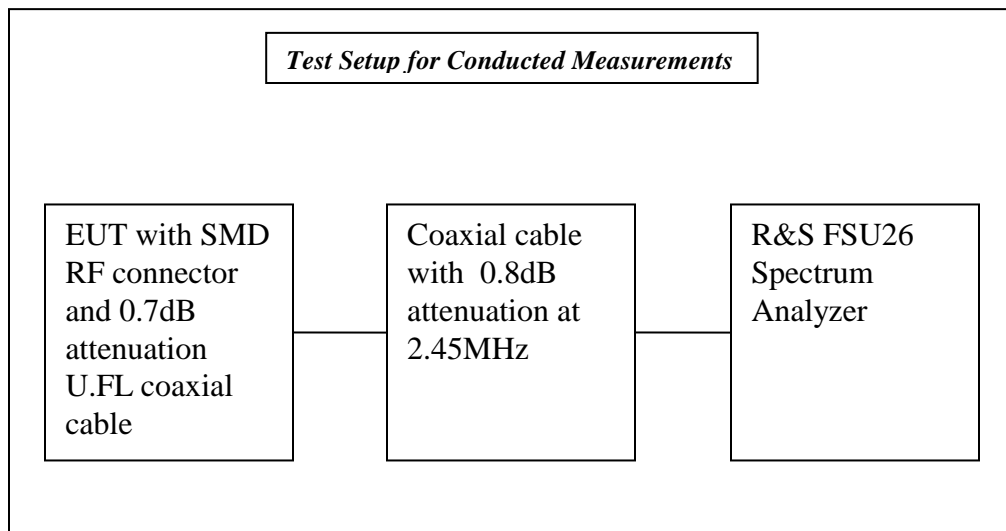
If the EUT operates above 30 MHz and uses a detachable antenna, then these measurements shall be made with a representative antenna connected to the antenna output terminals. These tests shall be made with the antenna connected and, if adjustable, fully extended.

Record the six highest EUT emissions relative to the limit of each of the current-carrying conductors of the power cords of the equipment that comprises the EUT over the frequency range specified by the procuring or regulatory agency.

## 6.4 RF Conducted Measurement at 50Ohm connector

### 6.4.1 Measurement procedure

Reference: 558074 D01 DTS Meas Guidance v03r03. FCC 15.247.



1. Connect the equipment as shown in the above diagram.
2. Adjust the settings of the SA according to the latest KDB.
3. Offset the SA for the attenuation as stated above. Use network analyzer to determine unknown attenuation.
4. Do not offset for antenna gains and duty cycles at SA. Account for these factors in result summary.
5. Antenna gains shall be considered for Average and Peak measurements. Duty cycles shall be considered for Average measurements only.
6. Measurements are to be performed for low, middle and high channels, with all modulation schemes GFSK,  $\pi/4$ DQPSK and 8-DPSK and with hopping on/off as per the requirements in the latest KDB.
7. Make sure to measure the duty cycle for every mode of operation where corrections are needed as it is likely to change.
8. On timing measurements make sure to use 30000 sweep points for optimum resolution and make sweep time as short as possible.
9. Measure all emissions with the mode that delivered the highest output power (worst case).

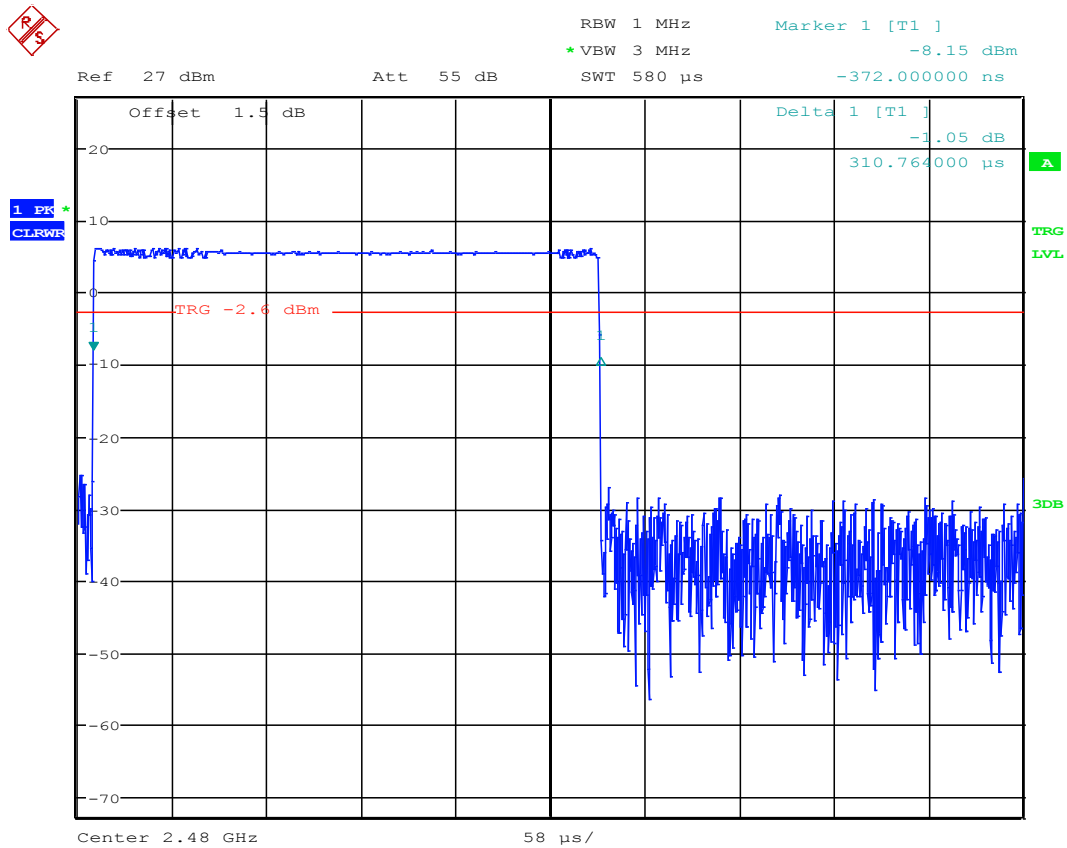


**6.4.2 Measurement Uncertainty:**

|   | <b>Uncertainty in<br/>dB Conducted<br/>measurement</b> |
|---|--|
| <b>standard deviation k=1</b>                               | 0.63   |
| <b>95% confidence interval<br/>in dB</b>                    | 1.24   |
| <b>95% confidence interval<br/>in dB in delta to Result</b> | +/-0.7dB   |

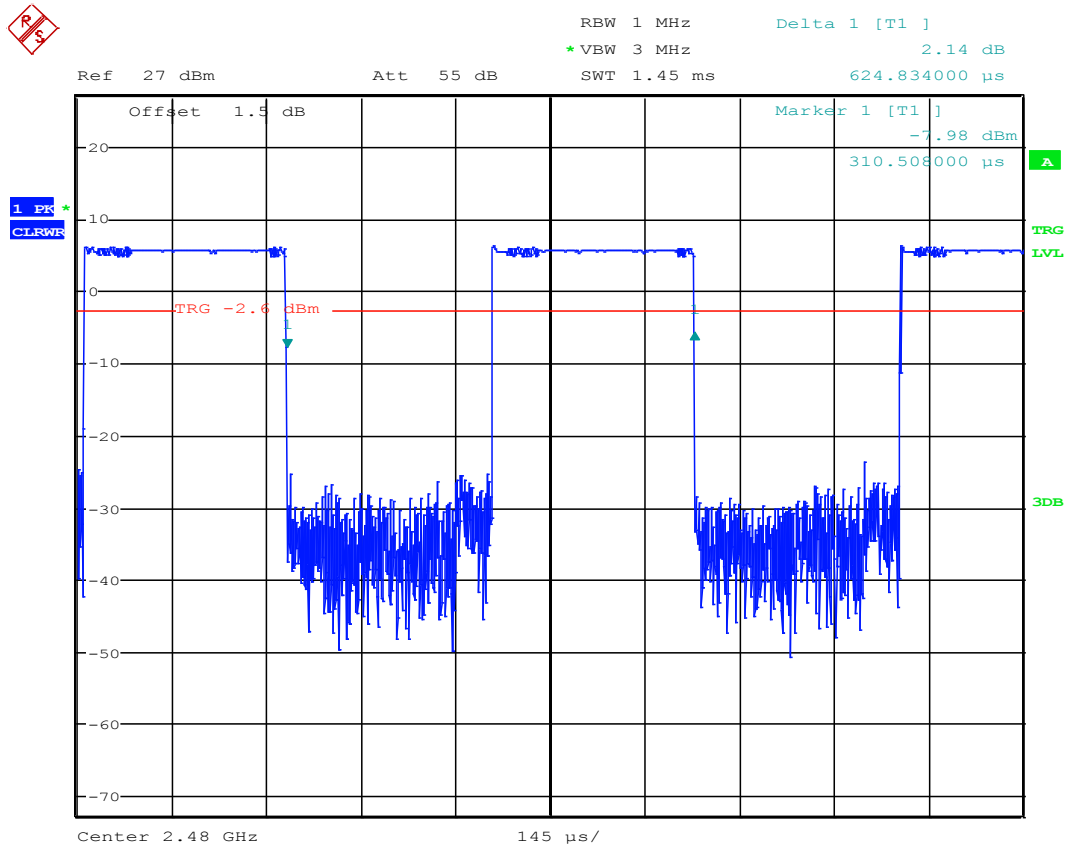
### 6.4.3 Duty Cycle evaluation

#### 6.4.3.1 Duty Cycle: Tx ON



Date: 16.JUN.2015 12:46:55

### 6.4.3.2 Duty Cycle: Tx ON + OFF



Date: 16.JUN.2015 12:49:49

### 6.4.3.3 Duty Cycle Correction Factor

$$10\lg(\text{TXon}+\text{TXoff})/\text{TXon} = 10\lg 625/311 = 3\text{dB}$$

**7 Maximum Peak Conducted Output Power**

**7.1 Limits:**

**Maximum Peak Output Power:**

FCC §15.247 (b)(1): 1W

IC RSS-210 issue 8, annex 8.4(2): 1W

**EIRP:**

IC RSS-210 issue 8, annex 8.4(2): 4W

**7.2 Test Conditions:**

Tnom: 22°C; Vnom: 120 VAC

**7.3 Test Procedure:**

Measurement according to FCC KDB 558074 D01 DTS Meas Guidance v03r02 section 9.1.1

**Spectrum Analyzer settings:**

|                  |   |
|------------------|---|
| Centre Frequency | The center frequency of the channel under test. |
| RBW              | ≥ DTS bandwidth                                 |
| VBW              | ≥ 3 x RBW                                       |
| Span             | ≥ 3 x RBW                                       |
| Sweep time       | Auto couple                                     |
| Detector         | peak  |
| Trace Mode       | Max hold  |

**Antenna Gain (dBi):**

2.4 – 2.48GHz: 1.5 dBi.

**7.4 Measurement Verdict:**

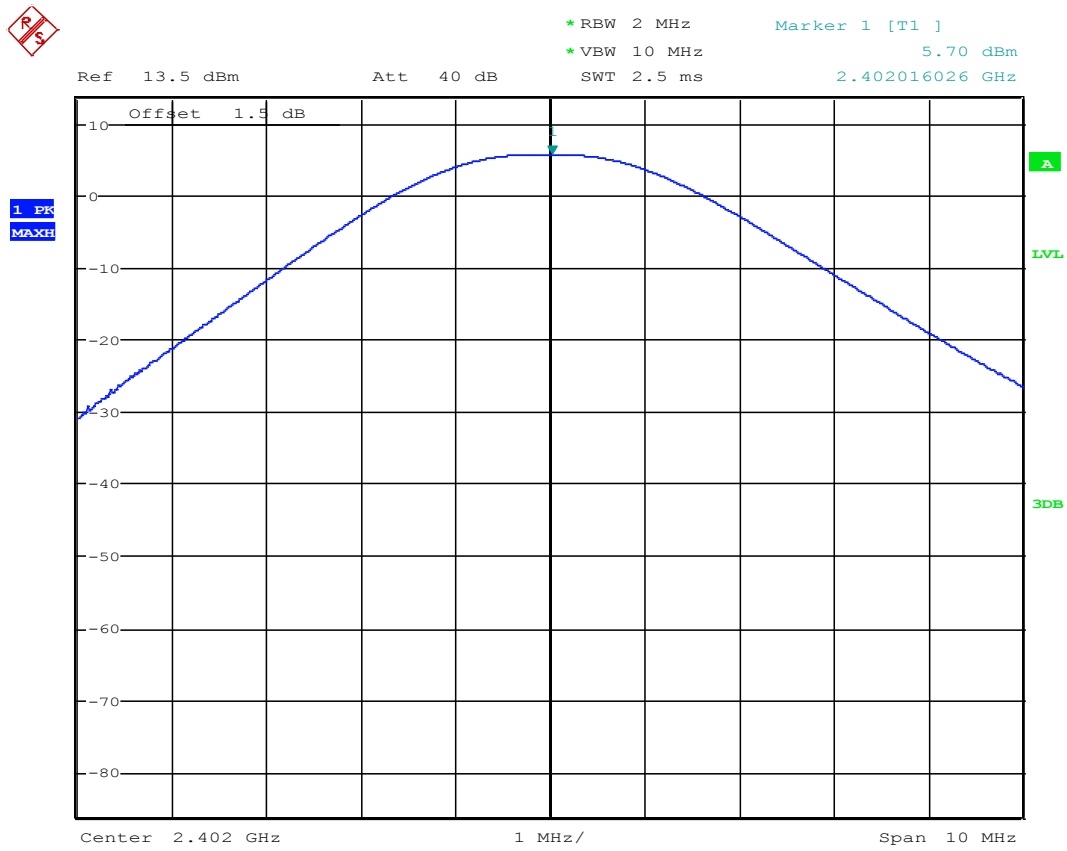
Pass

**7.5 Test Result:**

| <b>Maximum Peak Conducted Output Power (dBm)</b> |                                |                                 |                                 |
|--|--------------------------------|---------------------------------|---------------------------------|
| <b>Modulation /Packet Type</b>                   | <b>Channel 0<br/>(2402MHz)</b> | <b>Channel 19<br/>(2440MHz)</b> | <b>Channel 39<br/>(2480MHz)</b> |
| <b>GFSK</b>                                      | 5.7 dBm                        | 6.02 dBm                        | <b>6.34 dBm</b>                 |

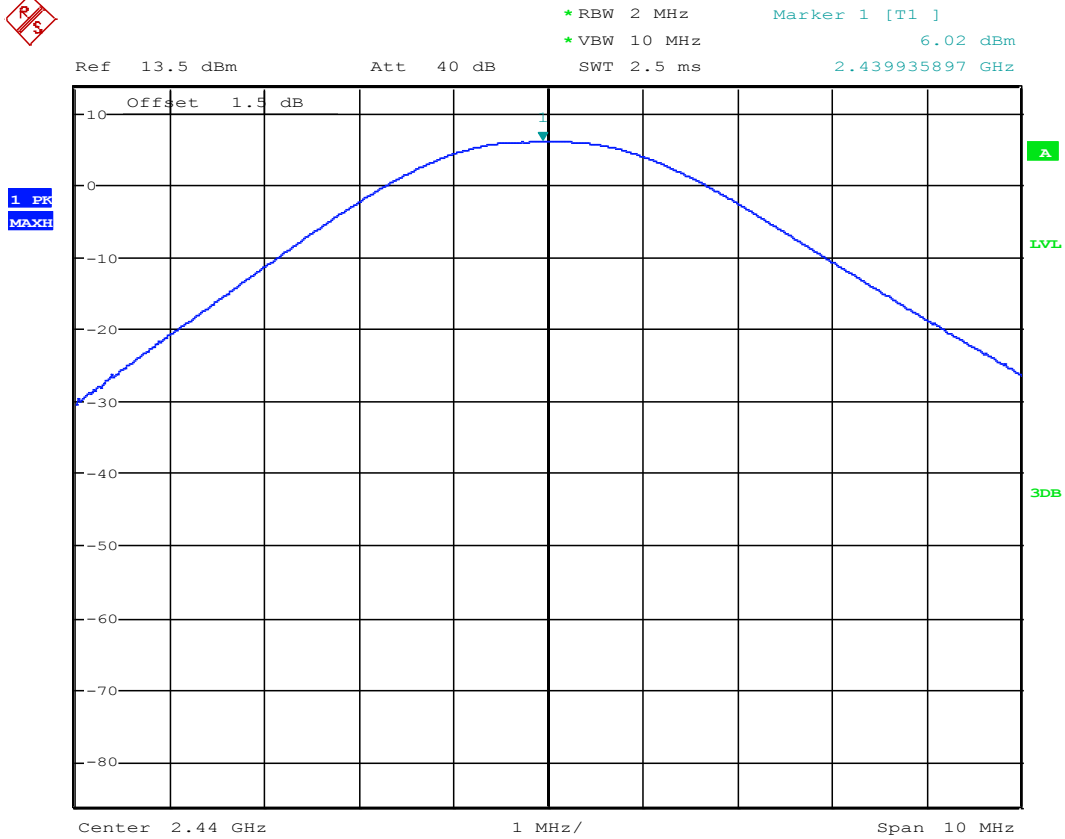
### 7.6 Measurement Plots:

#### 7.6.1 Ch.0, 2402 MHz, GFSK



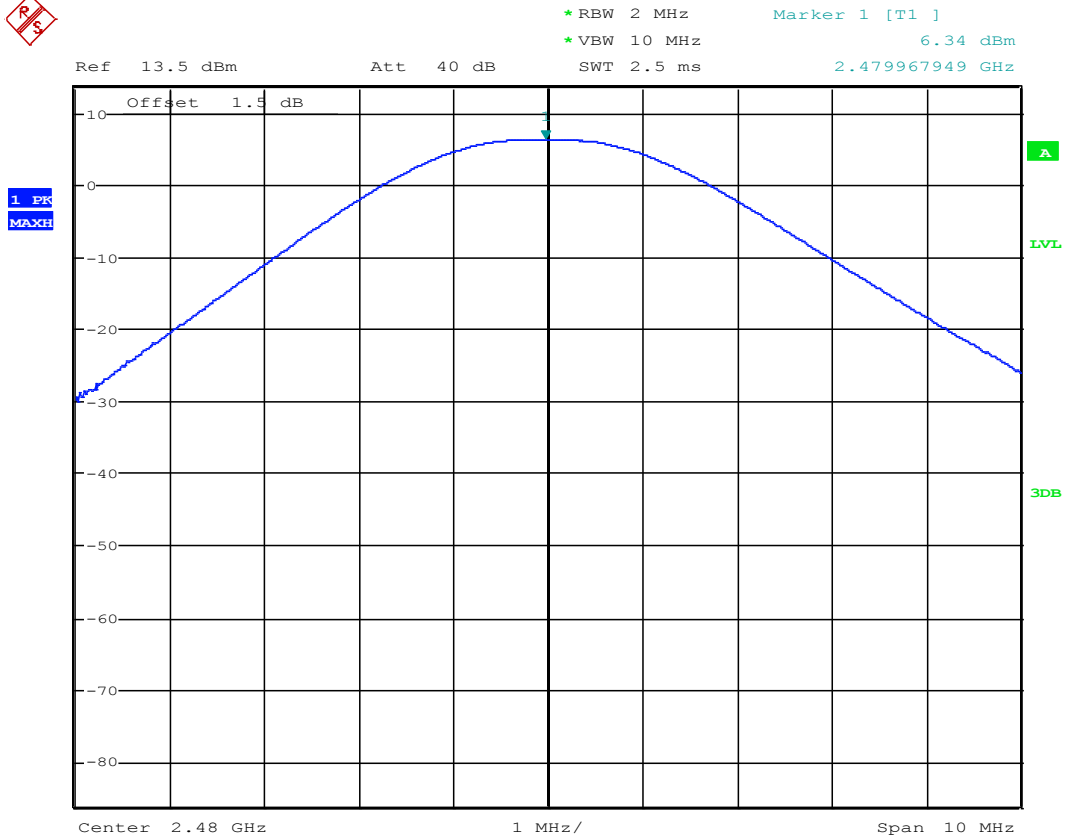
Date: 10.MAR.2015 14:23:17

### 7.6.2 Ch.19, 2440 MHz, GFSK



Date: 10.MAR.2015 14:28:36

### 7.6.3 Ch.39, 2480 MHz, GFSK



Date: 10.MAR.2015 14:31:39



**8 Power Spectral Density**

**8.1 Limits:**

§ 15.247 (e) & 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 8 dBm in any 3 kHz band during any time interval of continuous transmission.

**8.2 Test Conditions:**

Tnom: 21°C; Vnom: 120 VAC

**8.3 Test Procedure:**

Measurement according to FCC KDB 558074 D01 V03r02 section 10.2

**Spectrum Analyzer settings:**

|                  |  |
|------------------|--|
| Centre Frequency | The center frequency of the channel under test.        |
| RBW              | $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$ . |
| VBW              | $\geq 3 \times \text{RBW}$                             |
| Span             | 1.5 x Ch BW  |
| Sweep time       | Auto couple  |
| Detector         | peak   |
| Trace Mode       | Max hold   |

Allow trace to fully stabilize. Use the peak marker function to determine the maximum amplitude level within the RBW. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

**8.4 Measurement Verdict:**

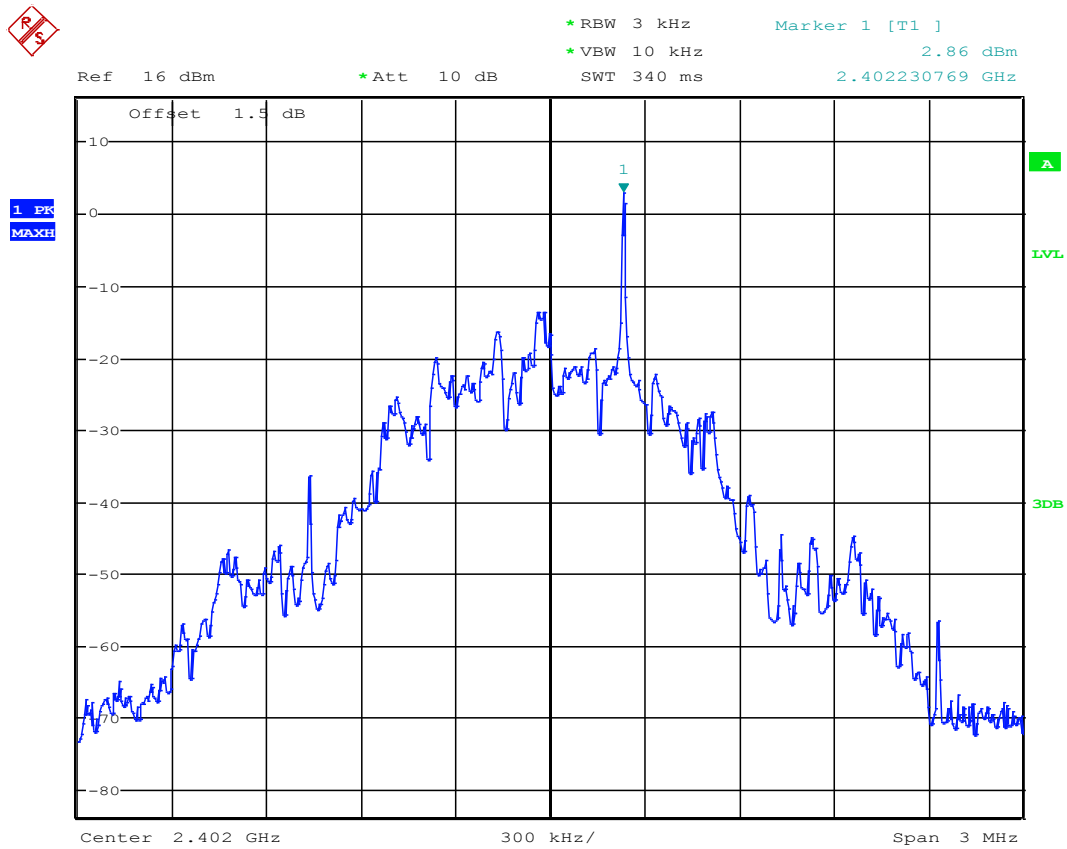
Pass

**8.5 Test Result:**

| Power Spectral Density (Peak PSD) (dBm) |                 |                 |                 |
|---|-----------------|-----------------|-----------------|
| Modulation /Packet Type                 | Frequency (MHz) |                 |                 |
|   | 2402 Channel 0  | 2440 Channel 19 | 2480 Channel 39 |
| 802.15 (BTLE)                           | 2.86 dBm        | 3.35 dBm        | 3.62 dBm        |

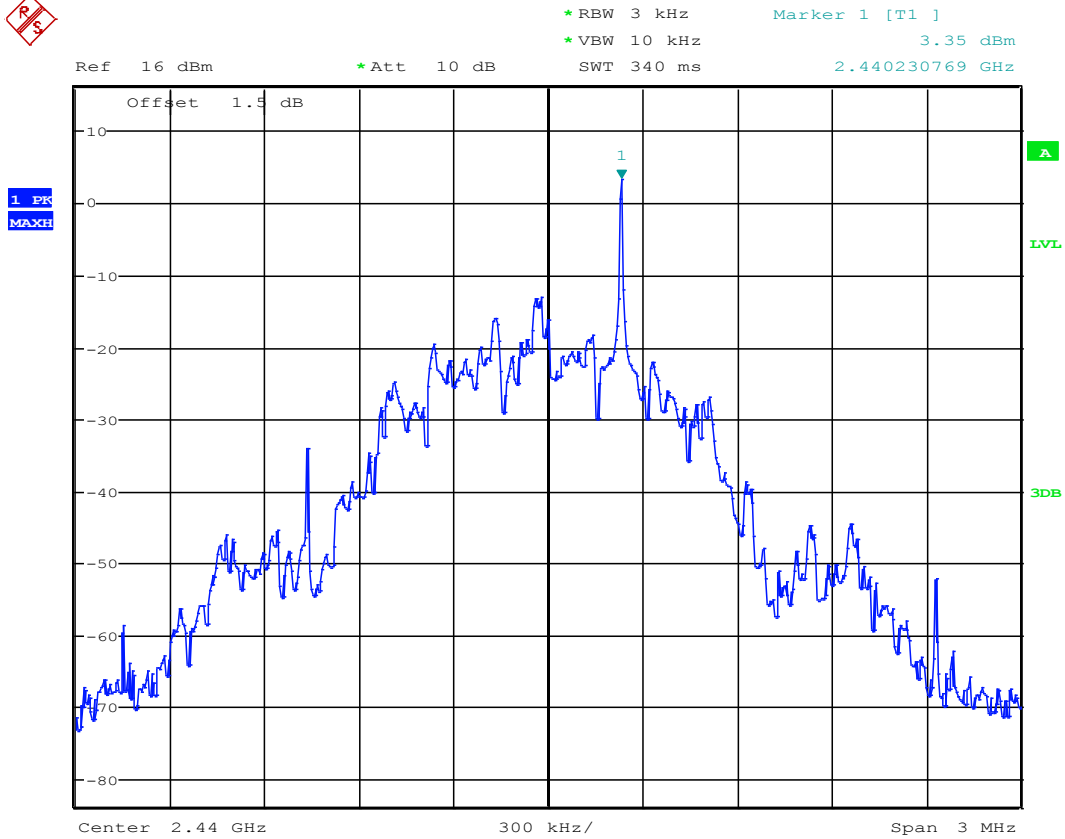
### 8.6 Measurement Plots:

#### 8.6.1 Ch.0, 2402 MHz



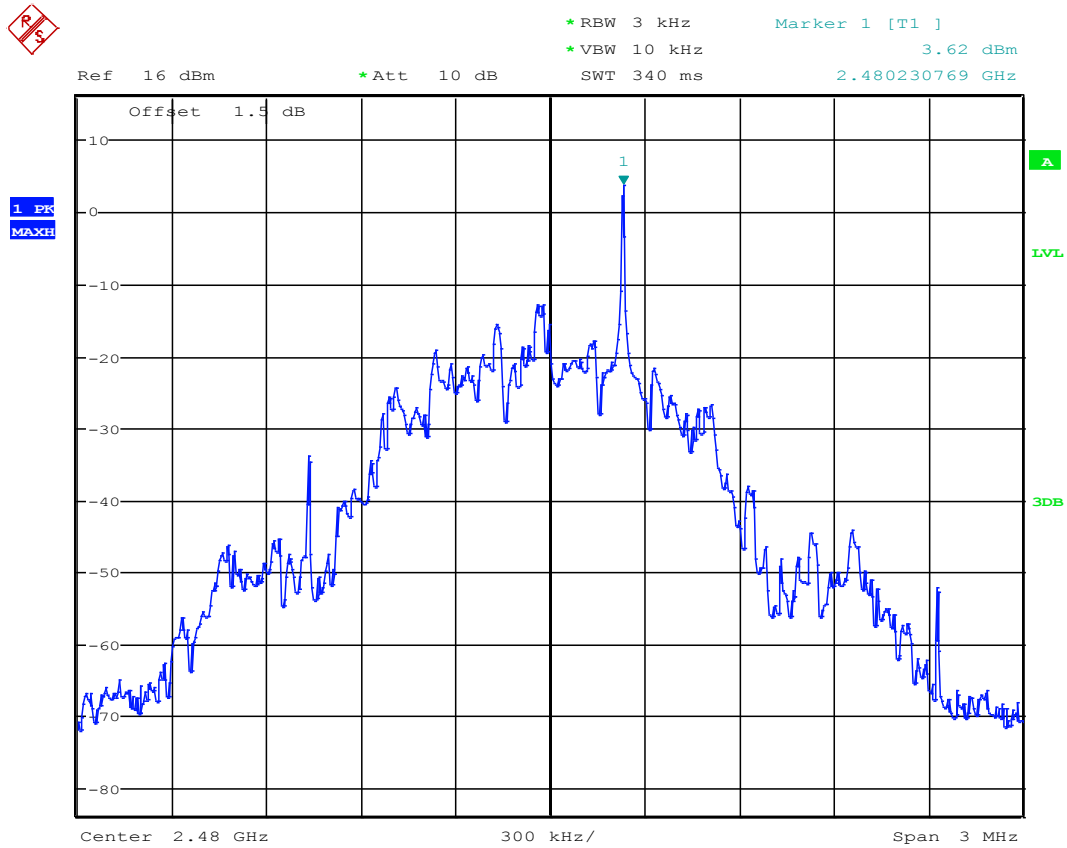
Date: 11.MAR.2015 13:16:06

### 8.6.2 Ch.19, 2440 MHz,



Date: 11.MAR.2015 13:15:38

### 8.6.3 Ch.39, 2480 MHz,



Date: 11.MAR.2015 13:14:56

**9 Band Edge Compliance at Restricted and Non-restricted Band Edges**

**9.1 Limits:**

**9.1.1 For Restricted Bands**

§15.209/15.205 & RSS-GEN Issue 4. Sections 8.9 and 8.10

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

| MHz                        | MHz                   | MHz             | GHz              |
|----------------------------|-----------------------|-----------------|------------------|
| 0.090 - 0.110              | 16.42 - 16.423        | 399.9 - 410     | 4.5 - 5.15       |
| <sup>1</sup> 0.495 - 0.505 | 16.69475 - 16.69525   | 608 - 614       | 5.35 - 5.46      |
| 2.1735 - 2.1905            | 16.80425 - 16.80475   | 960 - 1240      | 7.25 - 7.75      |
| 4.125 - 4.128              | 25.5 - 25.67          | 1300 - 1427     | 8.025 - 8.5      |
| 4.17725 - 4.17775          | 37.5 - 38.25          | 1435 - 1626.5   | 9.0 - 9.2        |
| 4.20725 - 4.20775          | 73 - 74.6             | 1645.5 - 1646.5 | 9.3 - 9.5        |
| 6.215 - 6.218              | 74.8 - 75.2           | 1660 - 1710     | 10.6 - 12.7      |
| 6.26775 - 6.26825          | 108 - 121.94          | 1718.8 - 1722.2 | 13.25 - 13.4     |
| 6.31175 - 6.31225          | 123 - 138             | 2200 - 2300     | 14.47 - 14.5     |
| 8.291 - 8.294              | 149.9 - 150.05        | 2310 - 2390     | 15.35 - 16.2     |
| 8.362 - 8.366              | 156.52475 - 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              |                       |                 |                  |

\*PEAK LIMIT= 74dB $\mu$ V/m @ 3m (-21.2 dBm)

\*AVG. LIMIT = 54dB $\mu$ V/m @ 3m (-41.2 dBm)

### **9.1.2 For Non-Restricted Bands**

#### **FCC15.247 (d)**

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §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)).

#### **RSS-210 A8.5**

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.

### **9.2 Test Conditions**

Tnom: 20°C; Vnom: 120 VAC

### 9.3 Test Procedure

Measurement according to FCC KDB 558074 D01 v03r02 section 11/12.

According to 558074 D01 DTS Meas Guidance v03r032 dBi gain are used for pass fail evaluation against EIRP/field strength limit for restricted band.

#### **Spectrum Analyzer settings non restricted band edge:**

|                  |   |
|------------------|---|
| Centre Frequency | Band Edge   |
| Span             | Wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation. |
| RBW              | 100kHz  |
| VBW              | ≥ RBW   |
| Sweep time       | Auto  |
| Detector         | Peak  |
| Trace Mode       | Max hold  |

#### **Spectrum Analyzer settings for restricted band:**

| Peak Measurement |                                |
|------------------|--------------------------------|
| Start Frequency  | Band Edge                      |
| Span             | From Start Frequency to 2.5GHz |
| RBW              | 1 MHz                          |
| VBW              | 3MHz                           |
| Sweep time       | Auto                           |
| Detector         | Peak                           |
| Trace Mode       | Max hold                       |

| Average Measurement |  |
|---------------------|--|
| Centre Frequency    | The center frequency of the channel under test |
| Span                | From Start Frequency to 2.5GHz                 |
| RBW                 | 1 MHz  |
| VBW                 | 3MHz   |
| Sweep time          | Auto   |
| Detector            | Average  |
| Trace Mode          | Average over at least 100bursts                |

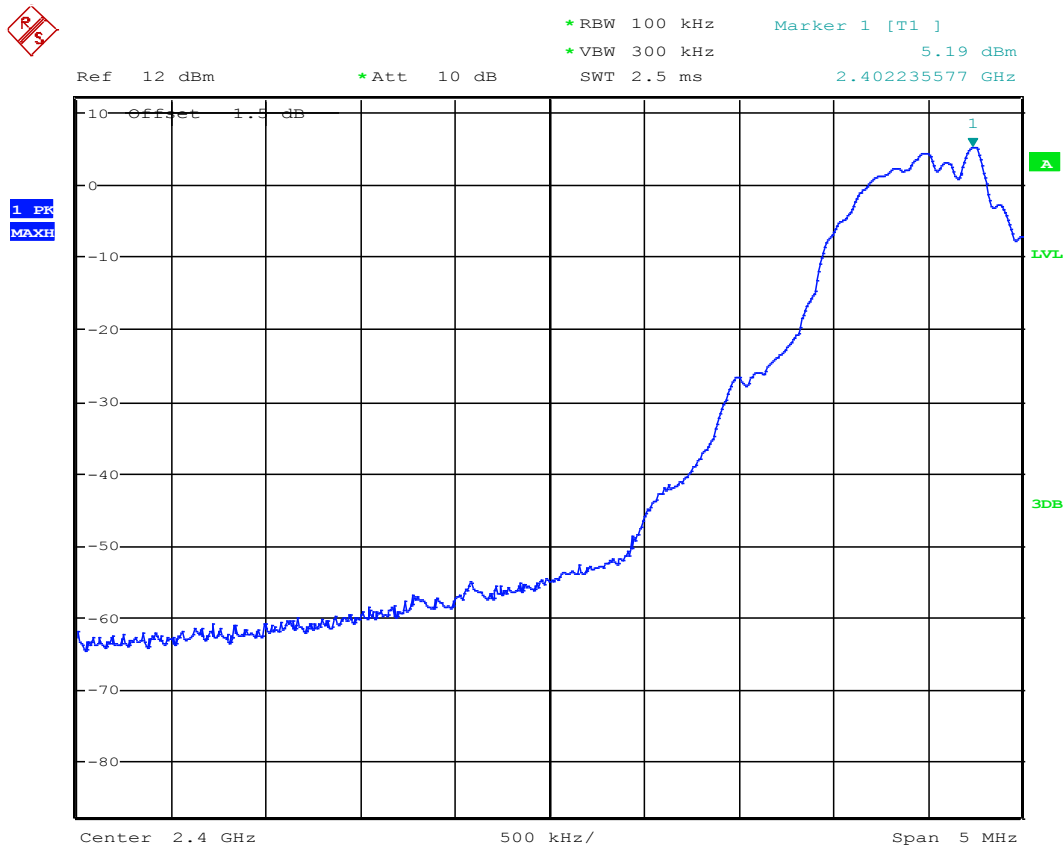
#### 9.4 **Measurement Verdict:**

Pass



### 9.5 Measurement Plots:

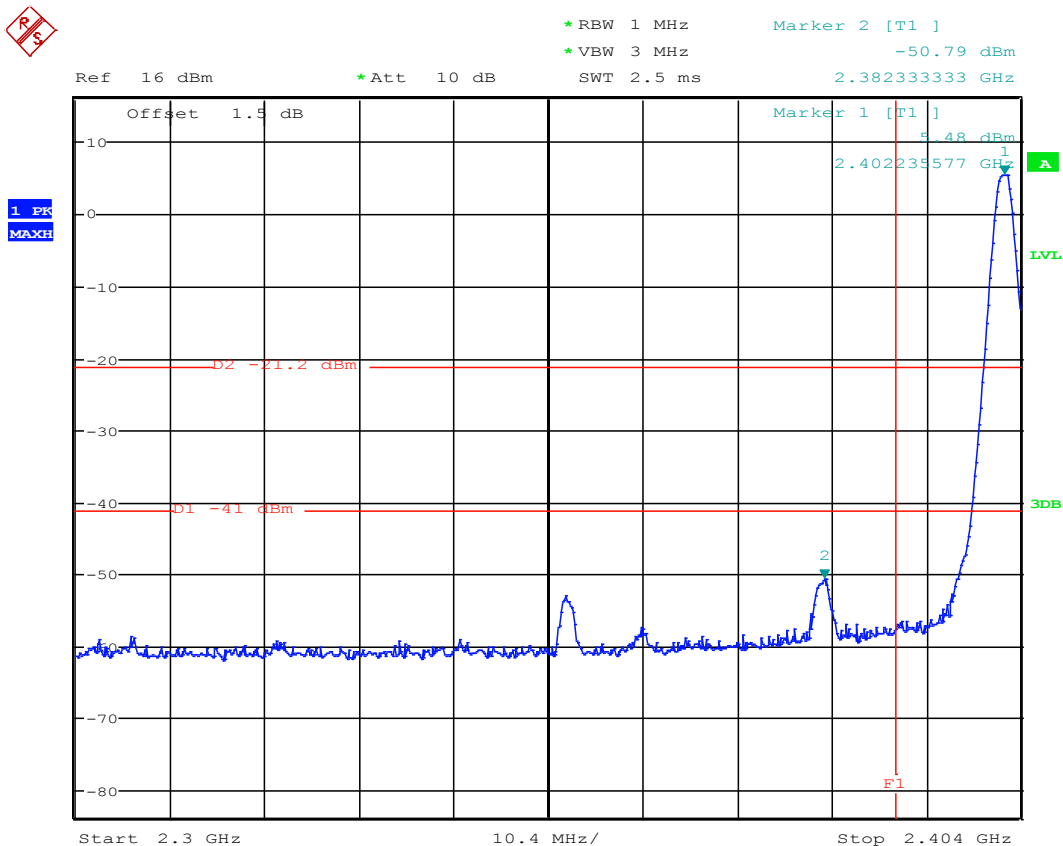
#### 9.5.1 Lower non-restricted Band Edge



Date: 11.MAR.2015 11:03:52

Delta TX signal max to Band Edge > 50dB, Pass

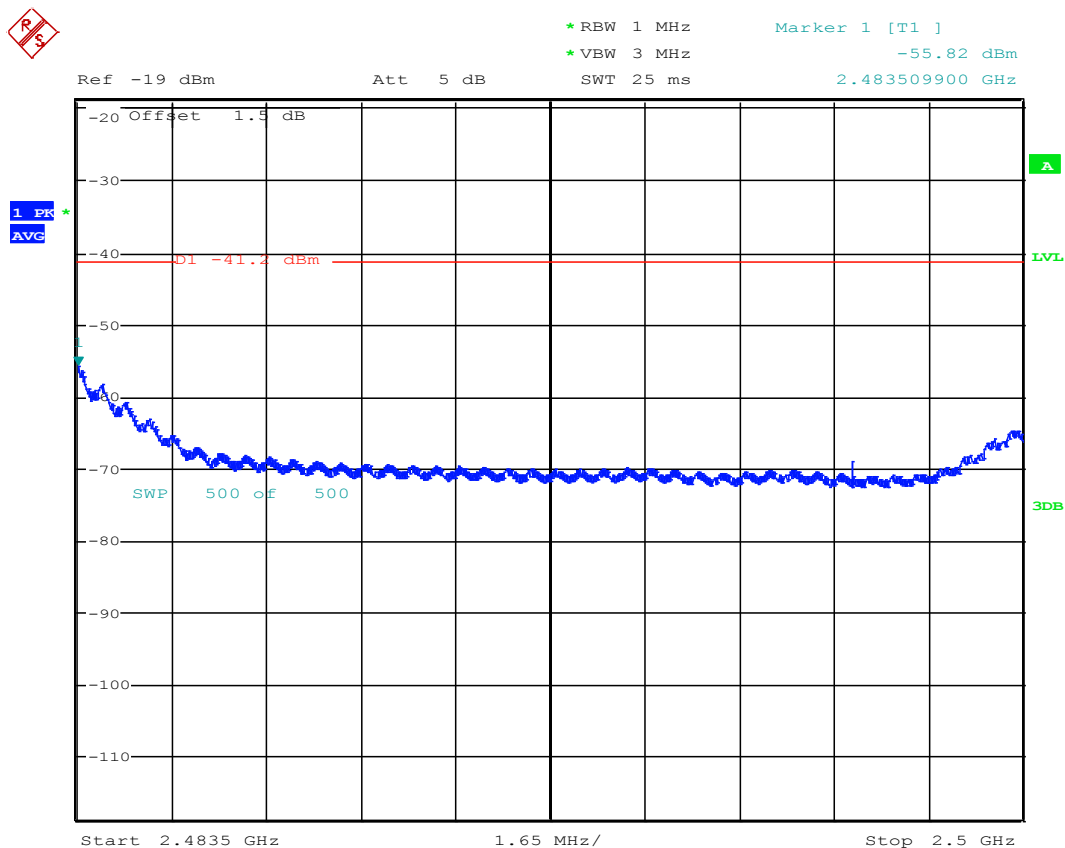
### 9.5.2 Lower non-Restricted Band Edge, peak, against restricted limits



Date: 11.MAR.2015 11:08:43

Margin to the limit 35dB > antenna gain: +2dBi, PASS

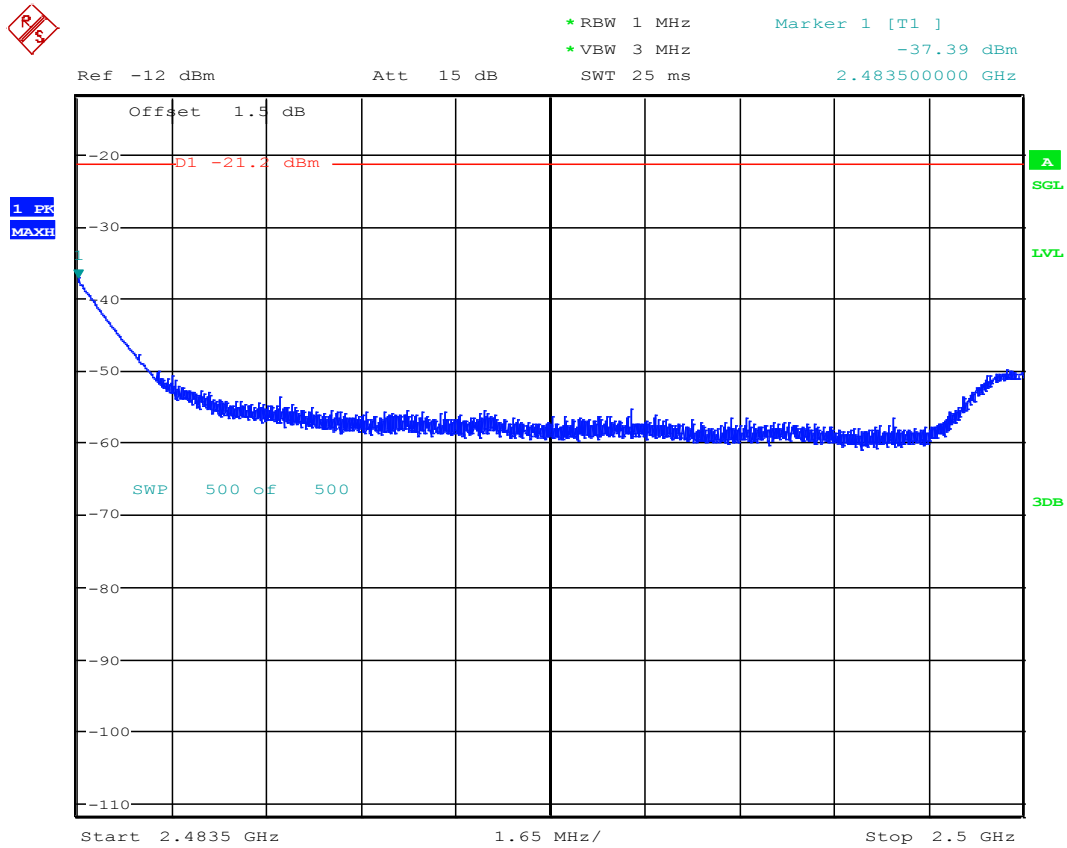
### 9.5.3 Upper, restricted Band Edge, highest channel, 50% duty cycle, average



Date: 16.JUN.2015 12:42:45

Margin to the limit 15dB > antenna gain: +2dBi+ DC correction 3dB, PASS

### 9.5.4 Upper, restricted Band Edge, Hopping Enabled peak



Date: 16.JUN.2015 12:33:16

Margin to the limit 15dB > antenna gain: +2dBi, PASS

**10 Emission Bandwidth (6dB), Occupied Bandwidth (99%)**

**10.1 Limits:**

§15.247 (a) (2)

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

**10.2 Test Conditions:**

Tnom: 21°C; Vnom: 120 VAC

**10.3 Test Procedure**

Measurement according to FCC KDB 558074 D01 v03r02 section 8.1

**For 6dB bandwidth:**

**Spectrum Analyzer settings:**

|                  |  |
|------------------|--|
| Centre Frequency | The centre frequency of the channel under test       |
| Span             | Wide enough to capture the entire emission bandwidth |
| RBW              | 100 KHz  |
| VBW              | ≥ 3xRBW  |
| Sweep time       | Auto   |
| Detector         | Peak   |
| Trace Mode       | Max hold   |

Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the peak level measured in the fundamental emission.

**For 99% bandwidth:**

Use the occupied bandwidth in the measurement function of the spectrum analyzer with power bandwidth setting at 99%.

**10.4 Measurement Verdict:**

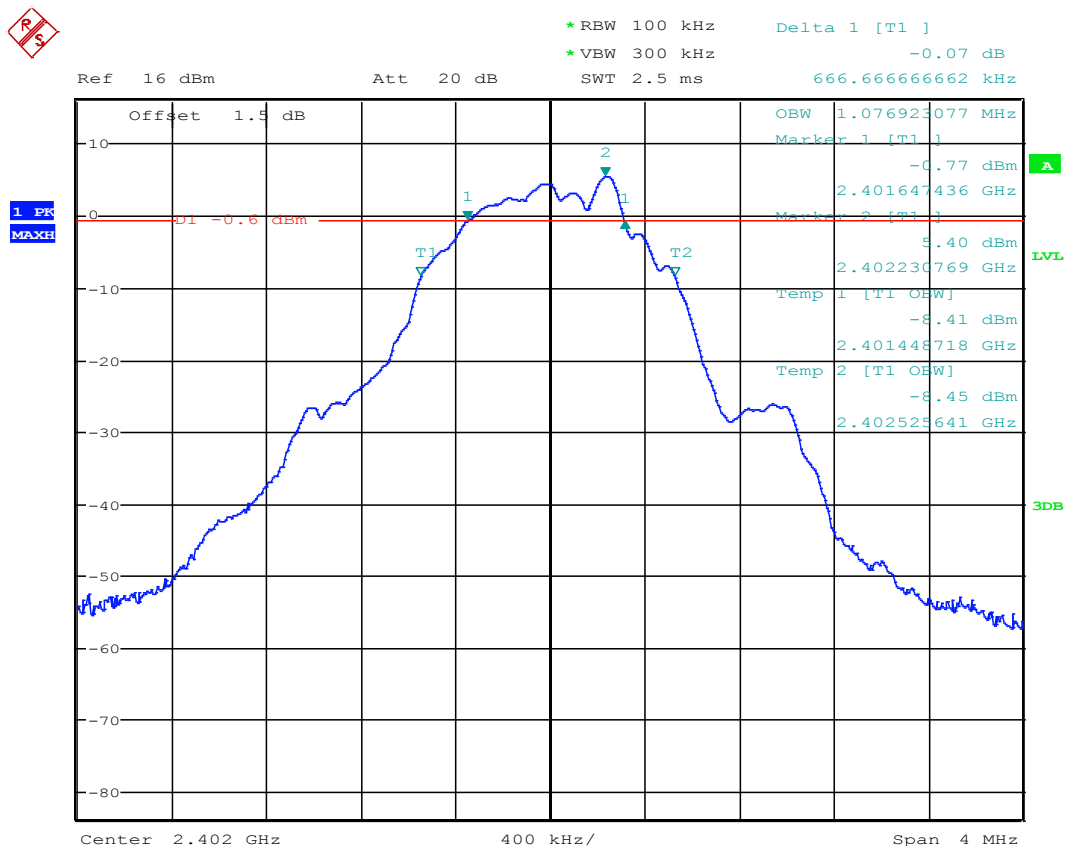
Pass

**10.5 Test Results:**

| <b>6dB Bandwidth / 99% Bandwidth</b> |                            |                  |                             |                  |                             |                  |
|--------------------------------------|----------------------------|------------------|-----------------------------|------------------|-----------------------------|------------------|
| <b>Modulation /Packet Type</b>       | <b>Channel 0 (2402MHz)</b> |                  | <b>Channel 19 (2440MHz)</b> |                  | <b>Channel 39 (2480MHz)</b> |                  |
|                                      | <b>6dB (MHz)</b>           | <b>99% (MHz)</b> | <b>6dB (MHz)</b>            | <b>99% (MHz)</b> | <b>6dB (MHz)</b>            | <b>99% (MHz)</b> |
| GFSK                                 | 0.667                      | 1.08             | 0.667                       | 1.08             | 0.673                       | 1.08             |

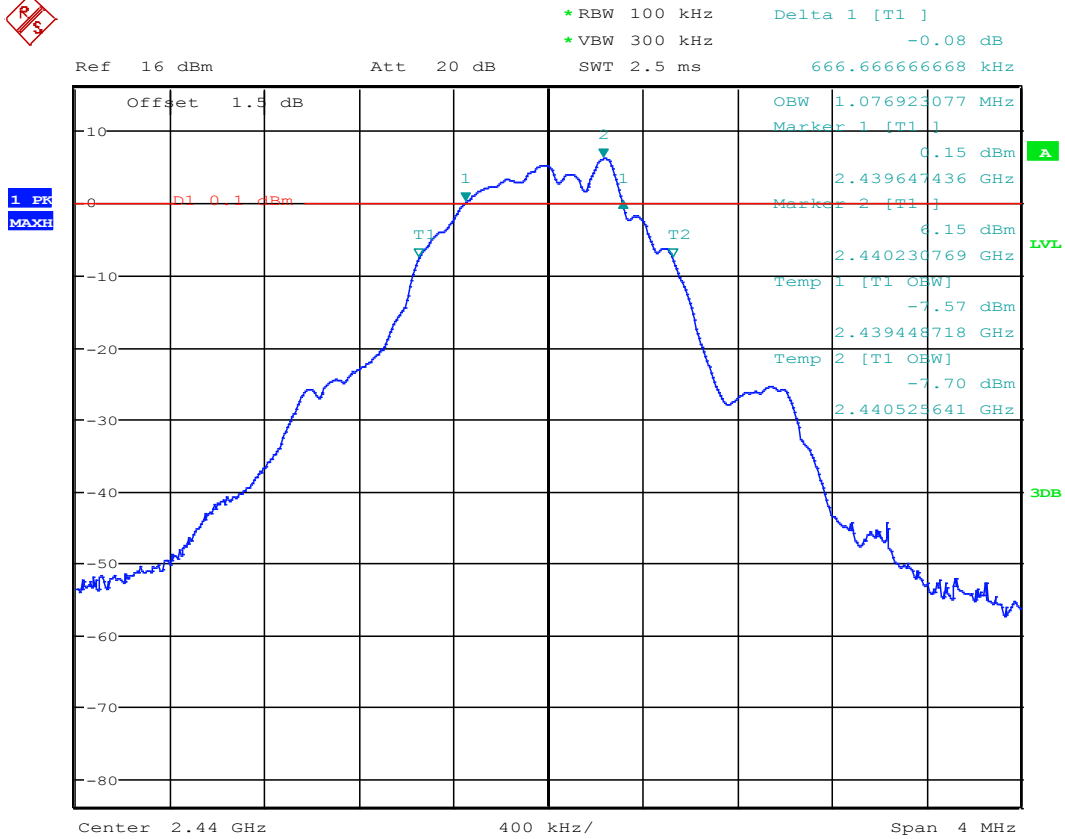
### 10.6 Measurement Plots:

#### 10.6.1 Ch.0, 2402 MHz, GFSK



Date: 12.JUN.2015 12:45:21

### 10.6.2 Ch.19, 2440 MHz, GFSK



Date: 12.JUN.2015 12:44:08

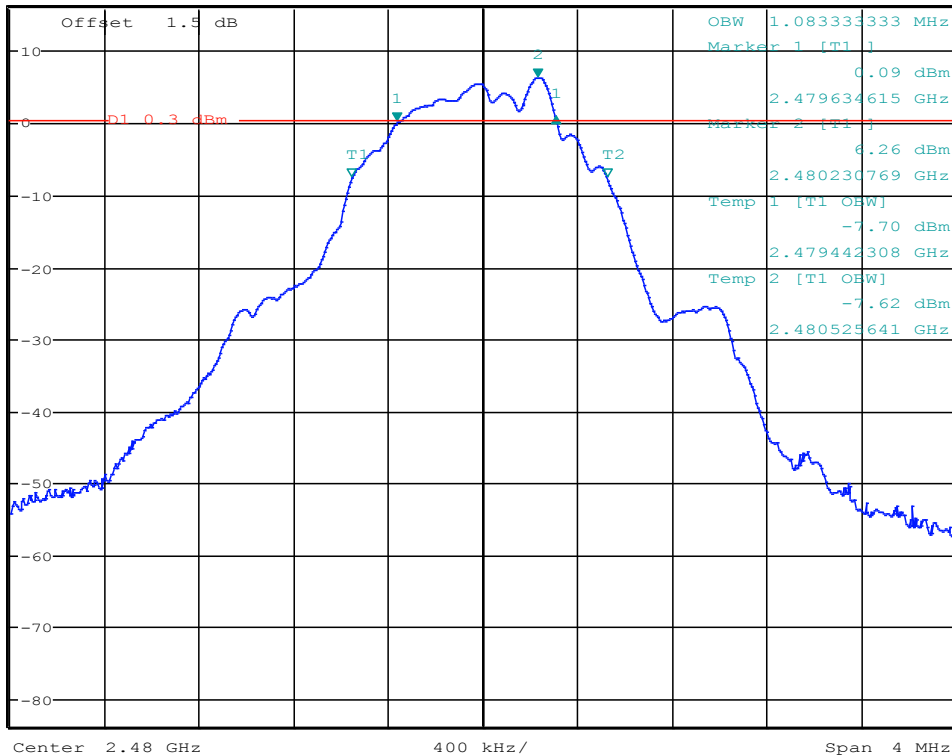


**10.6.3 Ch.39, 2480 MHz, GFSK**



\*RBW 100 kHz      Delta 1 [T1 ]      0.65 dB  
 \*VBW 300 kHz  
 Ref 16 dBm      Att 20 dB      SWT 2.5 ms      673.076923071 kHz

1 PK  
 MAXH



A

LVL

3DB

## 11 Transmitter Spurious Emissions

### 11.1 Limits:

#### §15.247/15.205/15.209 & RSS-210 A8.5 / RSS-Gen 8.9/ 8.10 (restricted bands)

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

| MHz                        | MHz                   | MHz             | GHz              |
|----------------------------|-----------------------|-----------------|------------------|
| 0.090 - 0.110              | 16.42 - 16.423        | 399.9 - 410     | 4.5 - 5.15       |
| <sup>1</sup> 0.495 - 0.505 | 16.69475 - 16.69525   | 608 - 614       | 5.35 - 5.46      |
| 2.1735 - 2.1905            | 16.80425 - 16.80475   | 960 - 1240      | 7.25 - 7.75      |
| 4.125 - 4.128              | 25.5 - 25.67          | 1300 - 1427     | 8.025 - 8.5      |
| 4.17725 - 4.17775          | 37.5 - 38.25          | 1435 - 1626.5   | 9.0 - 9.2        |
| 4.20725 - 4.20775          | 73 - 74.6             | 1645.5 - 1646.5 | 9.3 - 9.5        |
| 6.215 - 6.218              | 74.8 - 75.2           | 1660 - 1710     | 10.6 - 12.7      |
| 6.26775 - 6.26825          | 108 - 121.94          | 1718.8 - 1722.2 | 13.25 - 13.4     |
| 6.31175 - 6.31225          | 123 - 138             | 2200 - 2300     | 14.47 - 14.5     |
| 8.291 - 8.294              | 149.9 - 150.05        | 2310 - 2390     | 15.35 - 16.2     |
| 8.362 - 8.366              | 156.52475 - 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              |                       |                 |                  |

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)).

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

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

**Table 1:**

| Frequency of emission (MHz) | Field strength @ 3m ( $\mu$ V/m) | Field strength @ 3m (dB $\mu$ V/m) |
|-----------------------------|----------------------------------|------------------------------------|
| 30–88                       | 100                              | 40dB $\mu$ V/m                     |
| 88–216                      | 150                              | 43.5 dB $\mu$ V/m                  |
| 216–960                     | 200                              | 46 dB $\mu$ V/m                    |
| Above 960                   | 500                              | 54 dB $\mu$ V/m                    |

**Table 2:**

| Frequency of emission (MHz) | Field strength ( $\mu\text{V/m}$ ) / (dBuV/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 / (29.5)                                   | 30                       |

Radiated spurious emissions shall be measured for the transmit frequencies, transmit power, and data rate for the lowest, middle and highest channel in each frequency band of operation and for the highest gain antenna for each antenna type, and using the appropriate parameters and test requirements described in 5.4.

**The highest (or worst-case) data rate shall be recorded for each measurement.**

.

## 11.2 Test Conditions

Tnom: 23°C; Vnom: 120 VAC

### **11.3 Test Procedure:**

Measurement according to ANSI C63.10:2013 (also refer to section 6.1 in this test report)

#### **Analyzer Settings:**

From 9 KHz – 30 MHz

**RBW** = 9 KHz

**Detector:** Peak

From 30 MHz – 1 GHz

**Detector** = Peak / Quasi-Peak

**RBW**=120 KHz (<1GHz)

Above 1 GHz

**Detector** = Peak / Average

**RBW**= 1MHz

**Test mode:** Modulation: GFSK.

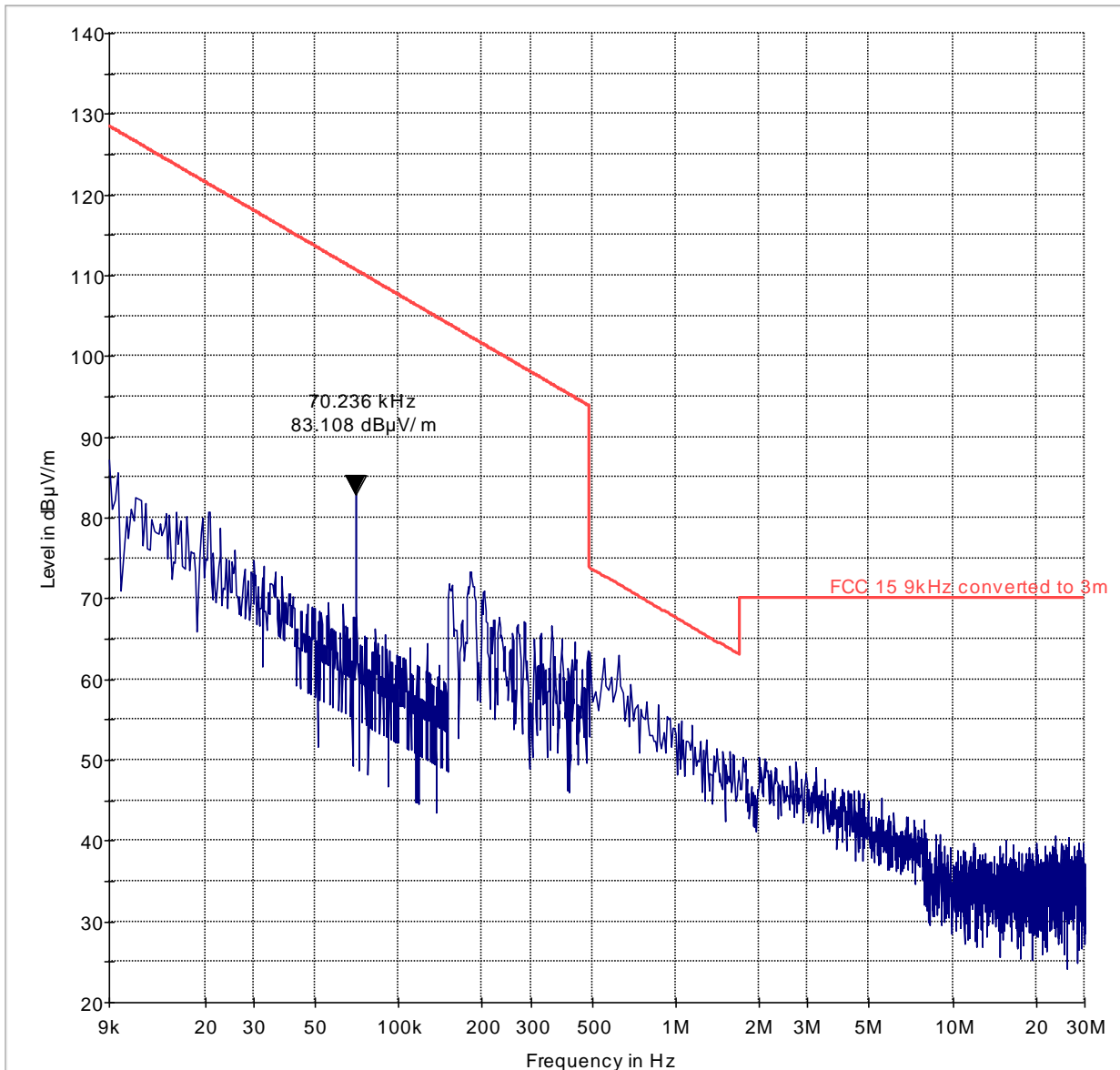
Plots reported here represent the worst case emissions for horizontal and vertical antenna polarizations and for three orientations of the EUT.

### **11.4 Test Verdict:**

Pass.

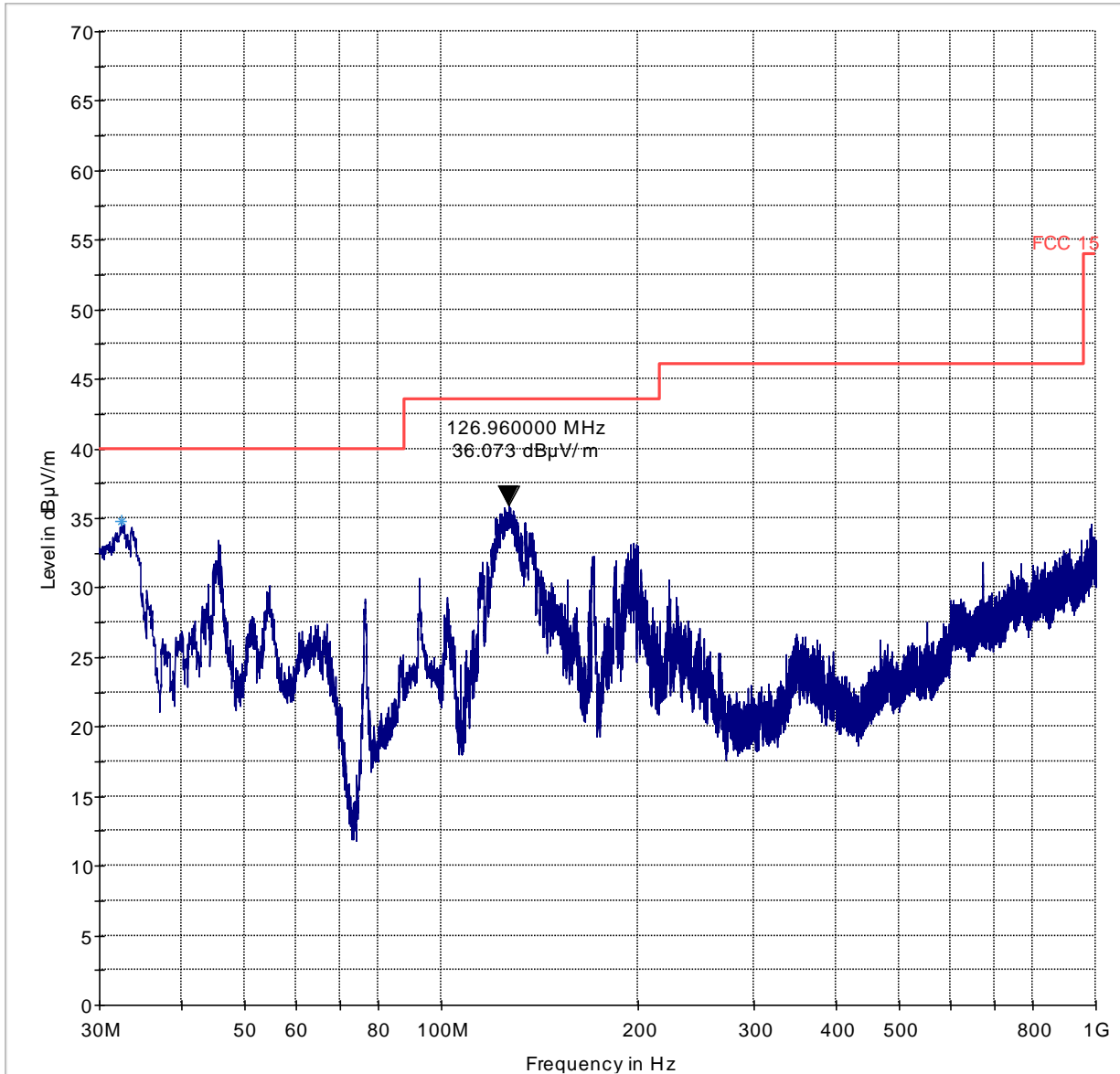
### 11.5 Measurement plots:

#### 11.5.1 9 KHz – 30 MHz: Ch.19, 2440 MHz,



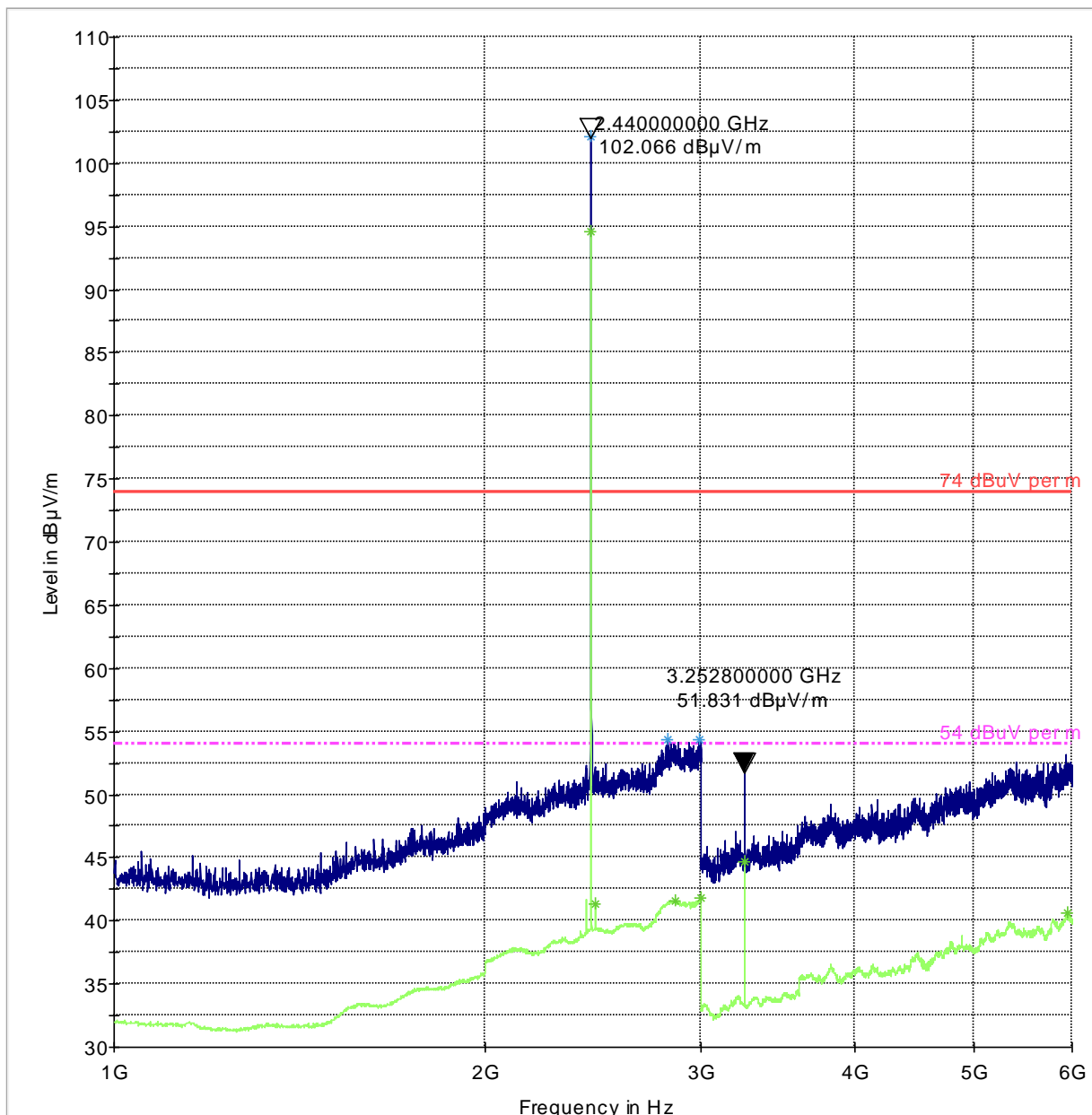
— FCC 15 9kHz converted to 3m — Preview Result 1-PK+

**11.5.2 30 MHz – 1 GHz: Ch. 19, 2440 MHz,**



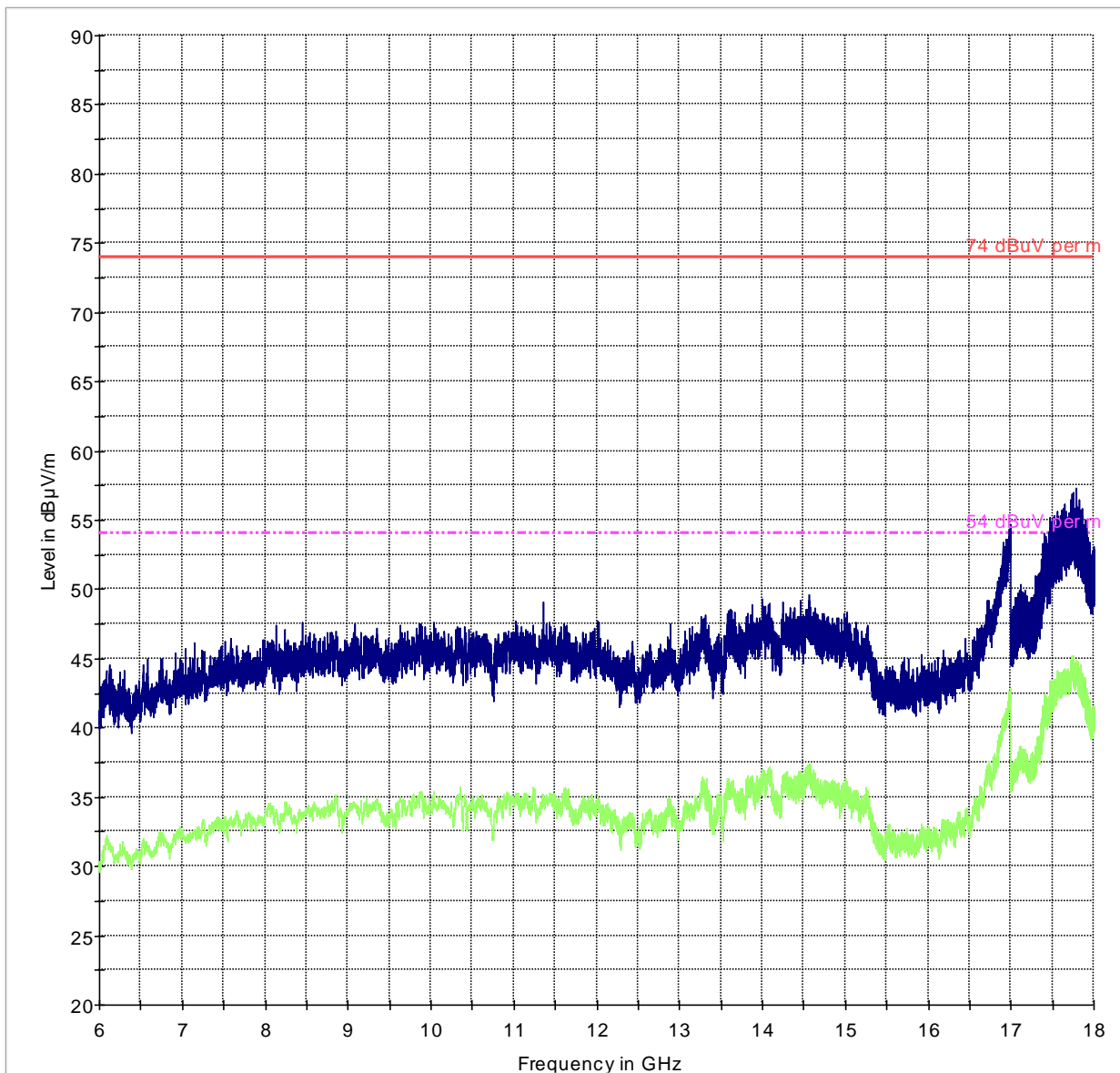
— FCC 15      — Preview Result 1-PK+      \* Data Reduction Result 1 [2]-PK+

**11.5.3 1 GHz – 6 GHz: Ch. 19, 2440 MHz,**



- 74 dBuV per m
- Preview Result 1-PK+
- \* Data Reduction Result 1 [3]-PK+
- - - 54 dBuV per m
- Preview Result 2-AVG
- \* Data Reduction Result 2 [3]-AVG

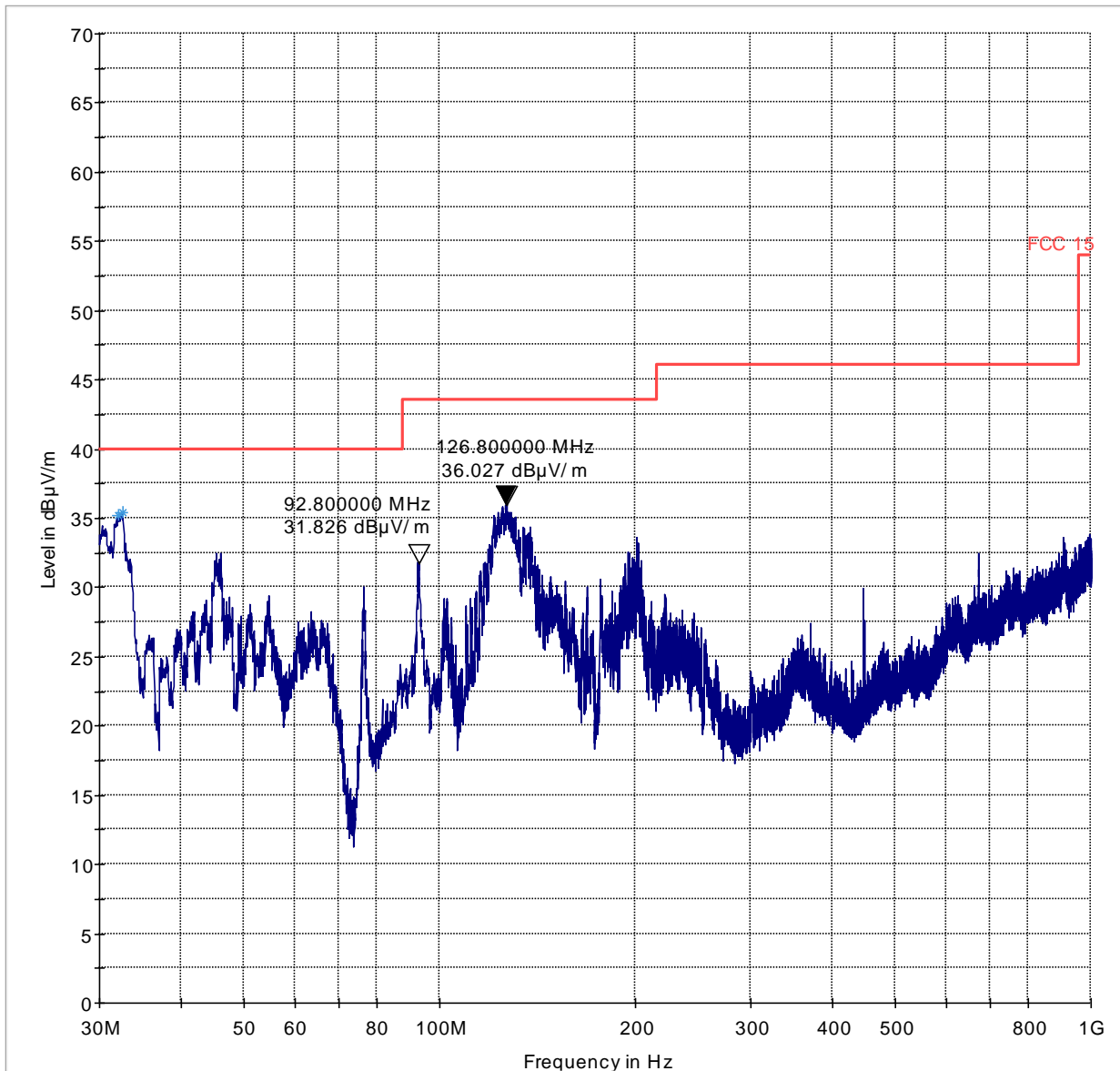
**11.5.4 6 GHz – 18 GHz: Ch. 19, 2440 MHz,**



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

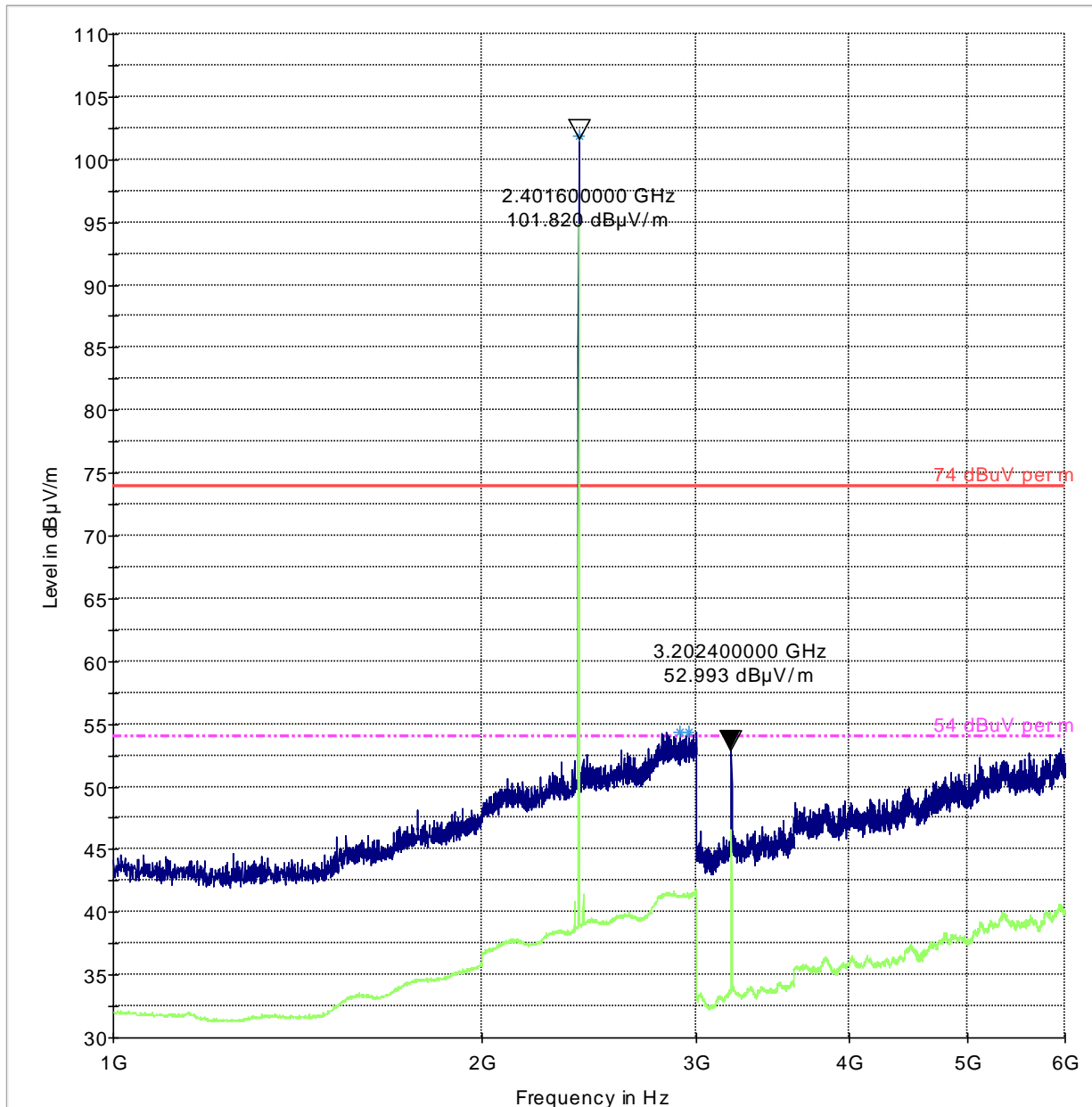


**11.5.5 30 MHz – 1 GHz: Ch. 0, 2402 MHz,**



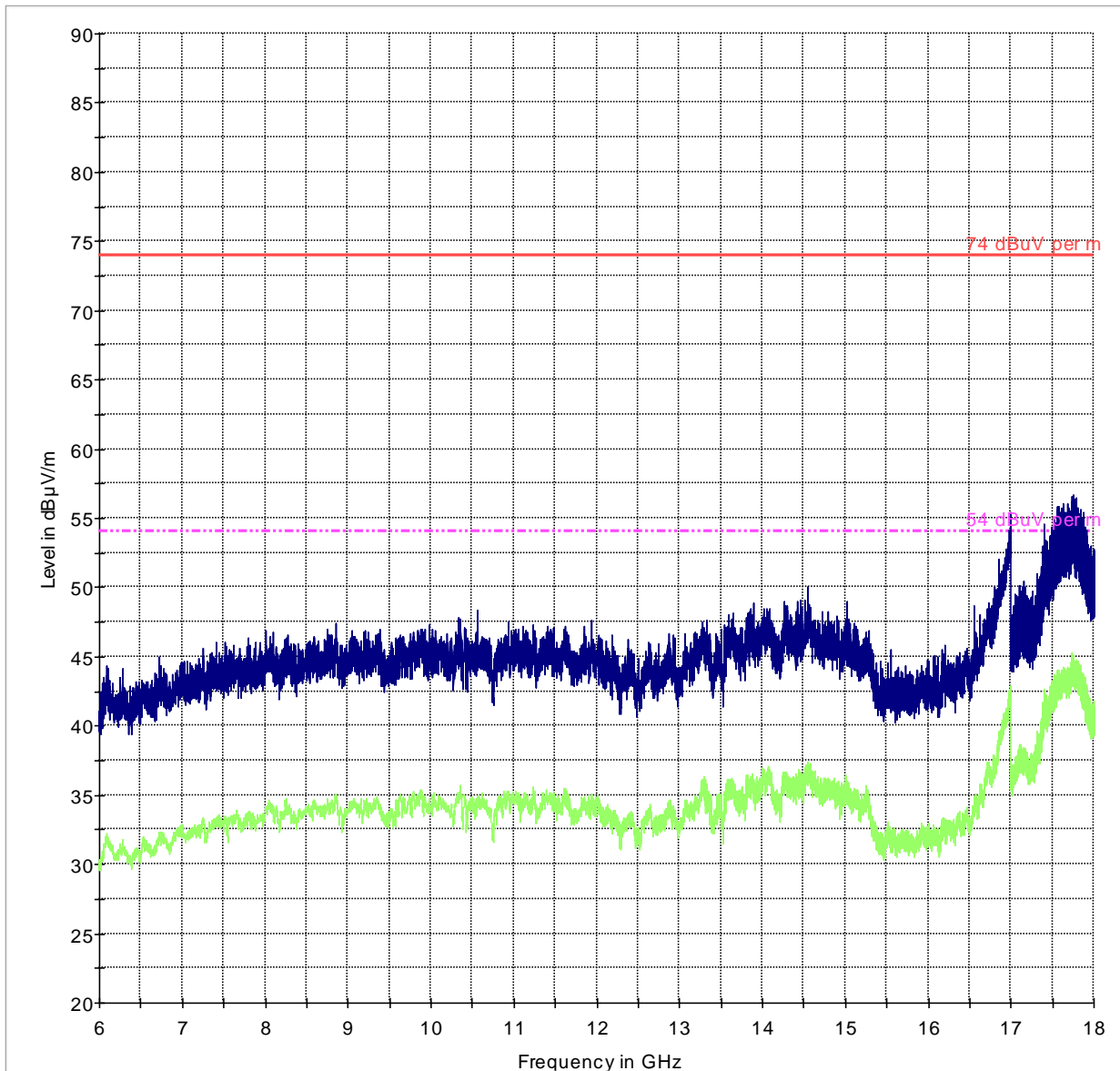
— FCC 15    — Preview Result 1-PK+    \* Data Reduction Result 1 [2]-PK+

**11.5.6 1 GHz – 6 GHz: Ch. 0, 2402 MHz,**



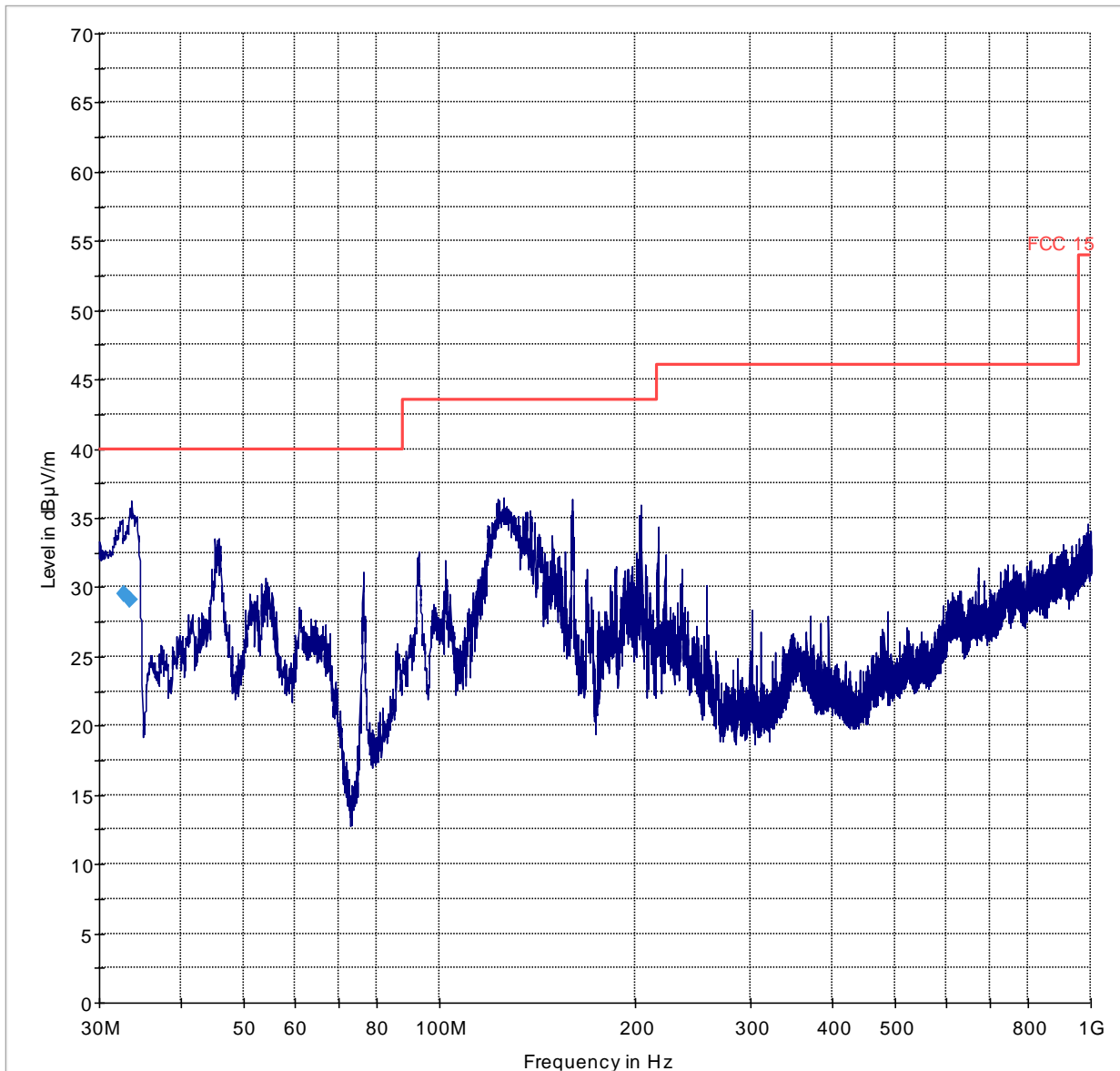
- 74 dBuV per m
- Preview Result 1-PK+
- \* Data Reduction Result 1 [3]-PK+
- - - 54 dBuV per m
- Preview Result 2-AVG

**11.5.7 6 GHz – 18 GHz: Ch. 0, 2402 MHz,**



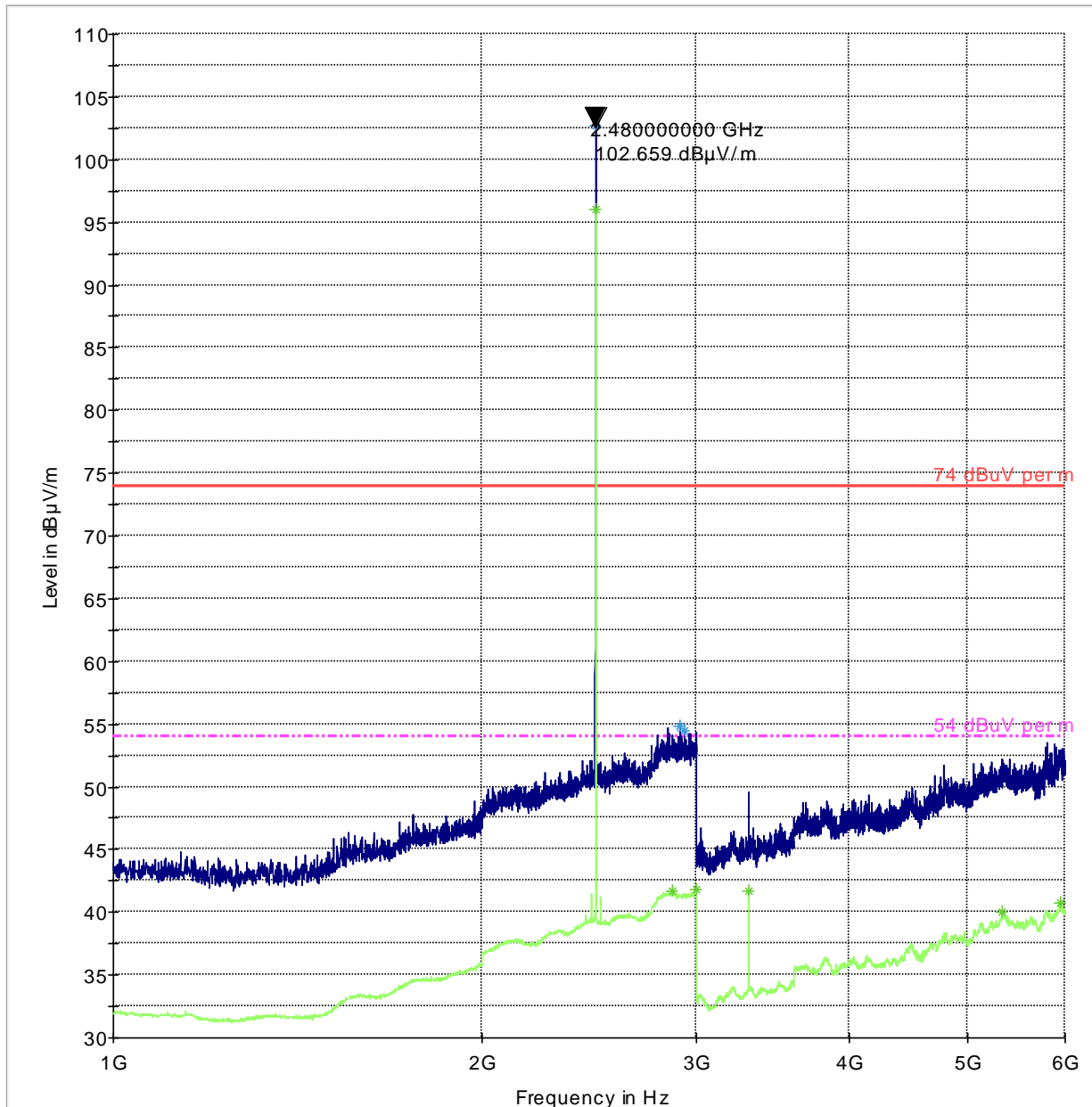
— 74 dBµV per m    - - - 54 dBµV per m    — Preview Result 1-PK+    — Preview Result 2-AVG

**11.5.8 30 MHz – 1 GHz: Ch. 39, 2480 MHz,**



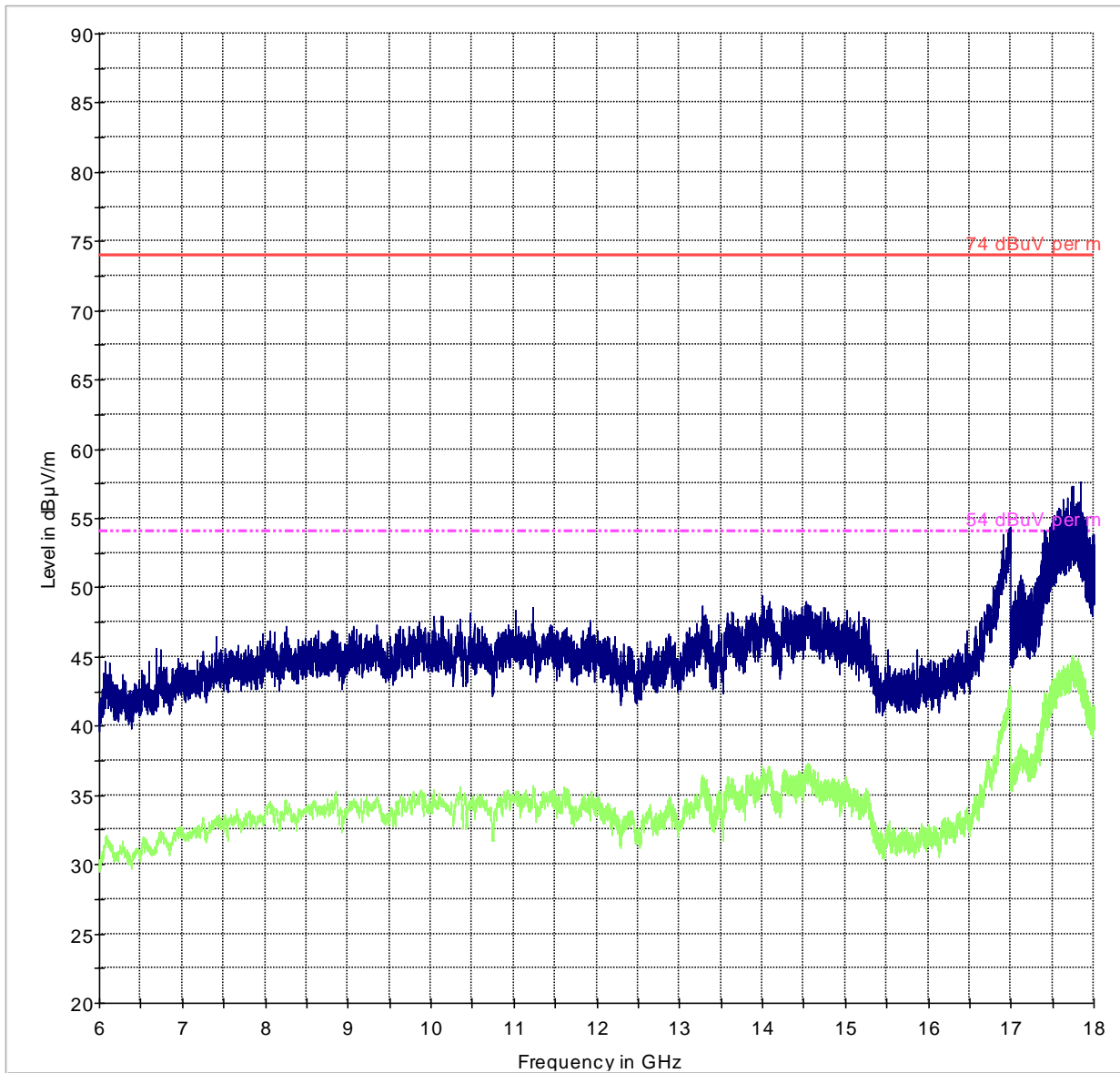
— FCC 15      — Preview Result 1-PK+      ◆ Final Result 1-QPK

**11.5.9 1 GHz – 6 GHz: Ch. 39, 2480 MHz,**



- 74 dBuV per m
- Preview Result 1-PK+
- - - 54 dBuV per m
- Preview Result 2-AVG
- \* Data Reduction Result 1 [3]-PK+
- \* Data Reduction Result 2 [3]-AVG

**11.5.106 GHz – 18 GHz: Ch. 39, 2480 MHz,**



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

## 12 AC Power Line Conducted Emissions

The purpose of this test is to measure unwanted radio frequency currents induced in any AC conductor external to the equipment which could conduct interference to other equipment via the AC electrical network.

### 12.1 Limits:

§15.207 & RSS-Gen 8.8

(a) Except as shown in paragraphs (b) and (c) of this section of the CFR, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table (1), as measured using a 50  $\mu$ H/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

**Table 1:**

| Frequency of emission (MHz) | Conducted limit (dB $\mu$ V) |           |
|-----------------------------|------------------------------|-----------|
|                             | 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.

### 12.2 Test Conditions:

Modulation: GFSK modulation - Transmit and Receive modes of operation

Tnom: 20°C; Vnom: 120 VAC

### 12.3 Test Procedure:

Measurement according to ANSI C63.10:2013 section 6.2 and 4.1 (also refer to section 6, 6.3 in this test report)

#### **Analyzer Settings:**

**RBW** = 9 KHz (CISPR Bandwidth)

**Detector:** Quasi-Peak / Average

## **12.4 Results**

Plots shown here represent the combined worst case emissions for power lines (phases and neutral line).  
Pass.

## **12.5 Test Data**

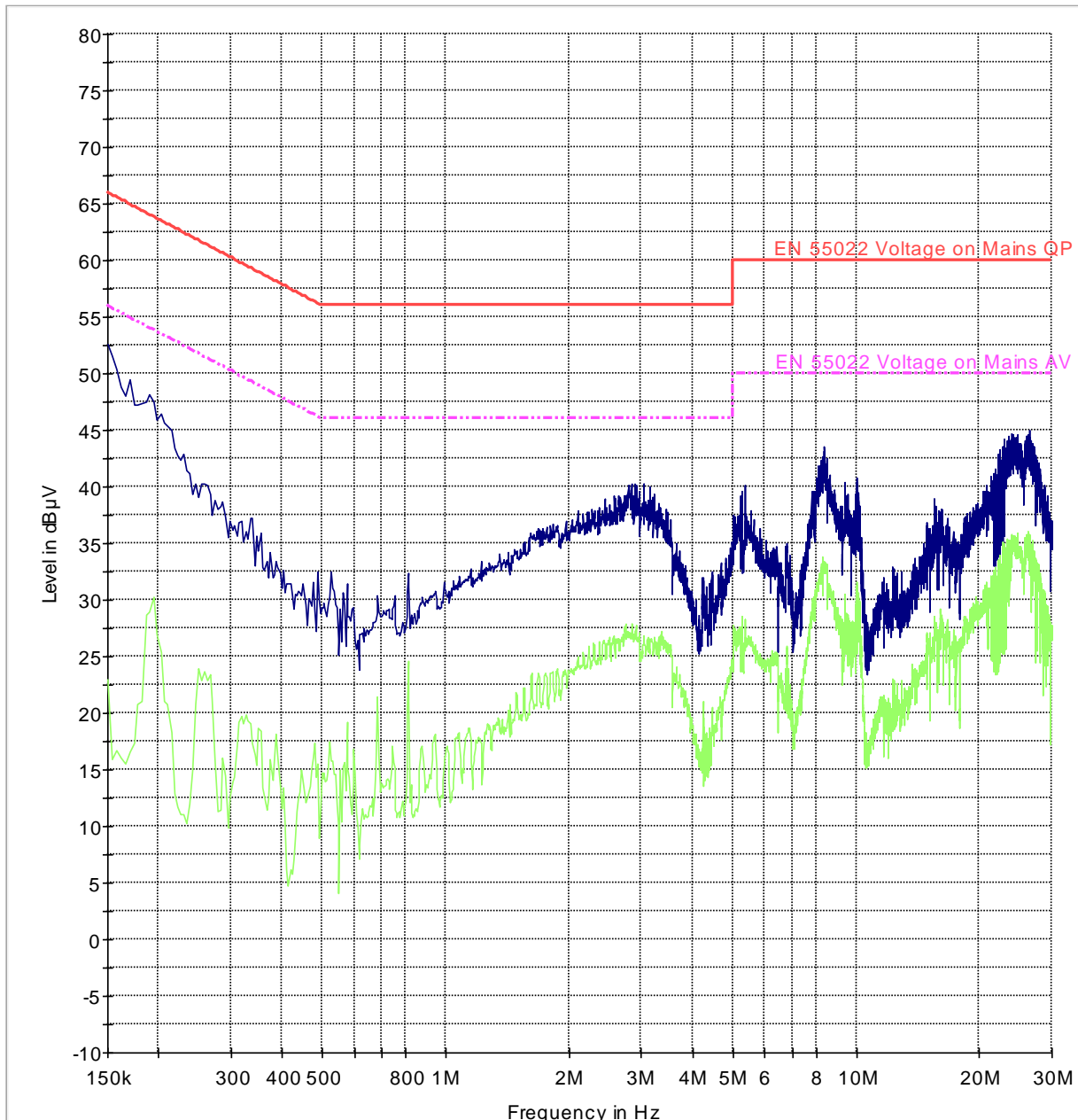
### **Conducted Emissions: 150 KHz – 30 MHz**

**Note:** All peak levels are below average limit. Final measurements are not required.



### 12.5.1 Measurement Plots:

#### Conducted Emissions: 150 KHz – 30 MHz

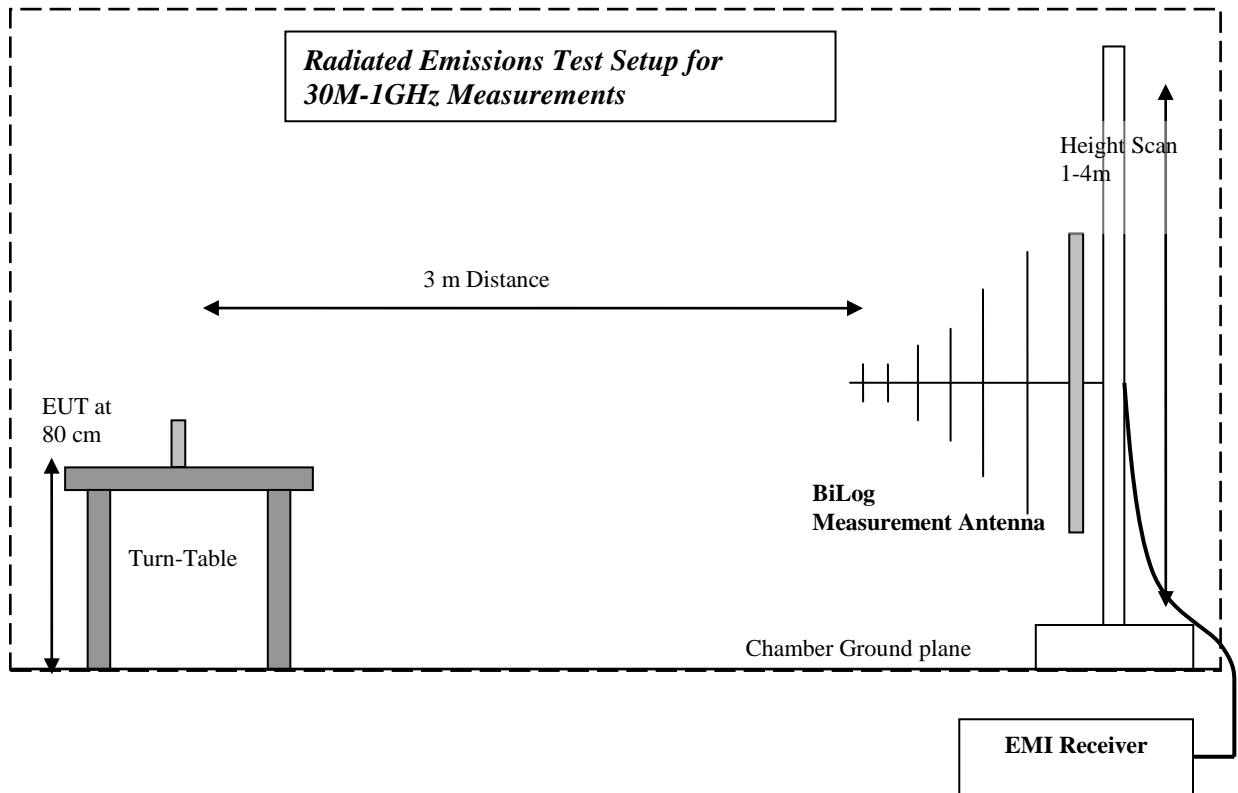


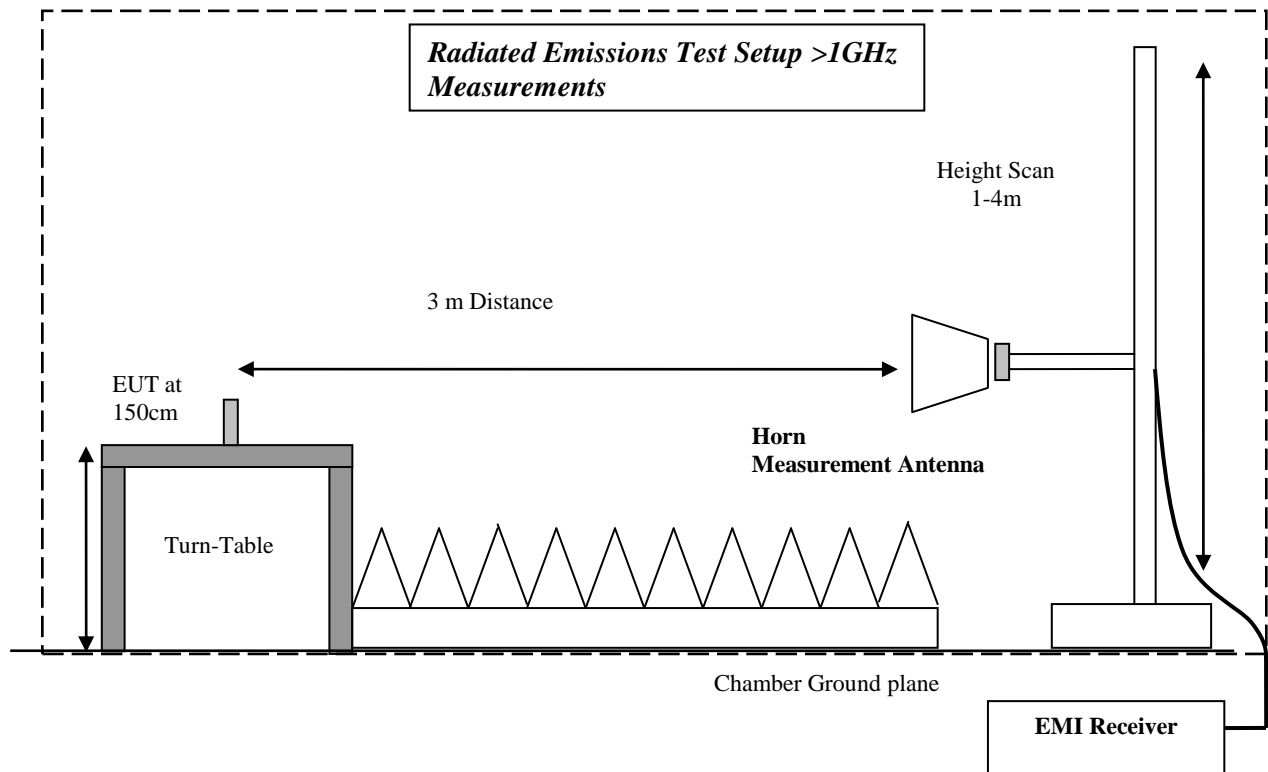
— EN 55022 Voltage on Mains QP      - - - - EN 55022 Voltage on Mains AV  
— Preview Result 1-PK+                — Preview Result 2-AVG

**13 Test Equipment and Ancillaries used for tests**

| No.                        | Equipment Name                       | Manufacturer  | Type/model   | Serial No.  | Cal Date | Cal Interval |
|----------------------------|--------------------------------------|---------------|--------------|-------------|----------|--------------|
| 3m Semi- Anechoic Chamber: |                                      |               |              |             |          |              |
| X                          | Turn table                           | EMCO          | 2075         | N/A         | N/A      | N/A          |
| X                          | MAPS Position Controller             | ETS Lindgren  | 2092         | 0004-1510   | N/A      | N/A          |
| X                          | Antenna Mast                         | EMCO          | 2075         | N/A         | N/A      | N/A          |
| X                          | Relay Switch Unit                    | Rohde&Schwarz | RSU          | 338964/001  | N/A      | N/A          |
| X                          | EMI Receiver/Analyzer                | Rohde&Schwarz | ESU 40       | 100251      | Sep 2013 | 2 Year       |
| X                          | 1500MHz HP Filter                    | Filtek        | HP12/1700    | 14c48       | N/A      | N/A          |
| X                          | 2800 MHZ HP Filter                   | Filtek        | HP12/2800    | 14C47       | N/A      | N/A          |
| X                          | Pre-Amplifier                        | Miteq         | JS40010260   | 340125      | N/A      | N/A          |
| X                          | Binconilog Antenna                   | EMCO          | 3141         | 0005-1186   | Apr 2012 | 4 Years      |
| X                          | Horn Antenna                         | EMCO          | 3115         | 35114       | Mar 2012 | 4 Years      |
| Other Equipment            |                                      |               |              |             |          |              |
|                            | Spectrum Analyzer                    | Rohde&Schwarz | FSU 8        | 200256      | Jun 2013 | 2 Years      |
| X                          | Spectrum Analyzer                    | Rohde&Schwarz | FSU 26.5     | 100189      | Jun 2013 | 2 Years      |
|                            | Spectrum Analyzer                    | Rohde&Schwarz | FSU 26.5     | 200065      | Jun 2013 | 2 Years      |
|                            | Vector Signal Generator (Interferer) | Rohde&Schwarz | SMU200A      | 101935      | Feb 2015 | 2 Years      |
|                            | Signal Generator (Blocker)           | Rohde&Schwarz | SMP04        | 100151      | Jun 2013 | 2 Years      |
| X                          | Fast Power Detector 5Ms/s            | ETS Lindgren  | 7002-006     | 00160034    | Sep 2014 | 2 Years      |
| X                          | Temperature Sensor                   | Dickson       | SM320        | 0929600     | Apr 2014 | 2 Years      |
| X                          | Temperature Chamber                  | Test Equity   | 115          | 150384      | N/A      | N/A          |
|                            | Vector Signal generator (Interferer) | Keysight      | EE4438C      | MY45094596  | Jun 2013 | 2 Years      |
|                            | WLAN AP (companion device)           | Rhode&Schwarz | CMW500       | 125754      | Jun 2013 | 2 Years      |
|                            | WLAN AP (companion device)           | Cisco         | Aironet 1260 | FTX1553E037 | N/A      | N/A          |
| X                          | DC Power Supply                      | HP            | E3610A       | KR83023316  | N/A      | N/A          |

**14 Test Setup Diagram:**





**15 Revision History**

| <b>Date</b> | <b>Report Name</b>              | <b>Changes to report</b>                                     | <b>Report prepared by</b> |
|-------------|---------------------------------|--|---------------------------|
| 2015-04-06  | EMC_PHIL4-007_14001_15.247_BTLE | 1 <sup>st</sup> Version                                      | Yu-Chien Ho               |
| 2015-06-16  | EMC_PHIL4-007_14001_15.247_BTLE | 2nd Version corrections on restricted band edge measurement. | Yu-Chien Ho               |