# TEST REPORT

**Report Number: 101220625MPK-006A**
**Project Number: G101220625**
**July 30, 2013**

**Testing performed on the**
**Livescribe 3 Smartpen**
**Model: V1110**
**FCC ID: CKD-00072**
**IC: 10240A-00072**
**to**

**FCC Part 15 Subpart C (15.247)**
**Industry Canada RSS-210 Issue 8, Annex 8**

**for**
## Livescribe, Inc.

| Test Performed by: | Test Authorized by: |
|---|---|
| Intertek | Livescribe, Inc. |
| 1365 Adams Court | 7677 Oakport St. 12th Floor |
| Menlo Park, CA 94025 USA | Oakland, CA 94621, USA |

Prepared by: _____ **Date:** July 30, 2013
Krishna K Vemuri

Reviewed by: _____ **Date:** July 30, 2013
Jason Centers

# Report No. 101220625MPK-006A

| | |
|---|---|
| **Equipment Under Test**: | Livescribe 3 Smartpen |
| **Trade Name**: | 3 SMARTPEN |
| **Model Number**: | V1110 |
| **Serial Numbers**: | 66 and 61 |
| | |
| **Applicant**: | Livescribe, Inc. |
| **Contact**: | Thomas L Davenport |
| **Address**: | Livescribe, Inc.<br>7677 Oakport St. 12th Floor<br>Oakland, CA 94621 |
| **Country** | USA |
| | |
| **Tel. Number**: | (510) 553-4925 |
| **Email:** | tdavenport@livescribe.com |
| | |
| **Applicable Regulation**: | FCC Part 15 Subpart C (15.247)<br>Industry Canada RSS-210 Issue 8, Annex 8 |
| | |
| **Date of Test**: | July 05 to 29, 2013 |

***We attest to the accuracy of this report:***

Krishna K Vemuri
EMC Senior Staff Engineer

Jason Centers
Senior Project Engineer

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## 1.0 Summary of Tests

| Test | Reference FCC | Reference Industry Canada | Result |
|---|---|---|---|
| **RF Output Power** | 15.247(b)(3) | RSS-210, A8.4 | Complies |
| **6 dB Bandwidth** | 15.247(a)(2) | RSS-210, A8.2 | Complies |
| **Power Density** | 15.247(e) | RSS-210, A8.2b | Complies |
| **Out of Band Antenna Conducted Emission** | 15.247(d) | RSS-210, A8.5 | Complies |
| **Transmitter Radiated Emissions** | 15.247(d), 15.209, 15.205 | RSS-210, A8.5 | Complies |
| **AC Line Conducted Emission** | 15.207 | RSS-GEN | Complies |
| **Antenna Requirement** | 15.203 | RSS-GEN | Complies. |
| **RF Exposure** | 15.247(i), 2.1093(d) | RSS-102 | Complies (note 1) |

Note 1. Compliance with the SAR requirements is considered without testing because the RF power of channel is below SAR Test Exclusion Threshold. The SAR Test Exclusion Threshold (TET in mW) was calculated according to the KDB 447498, sec 4.3.1.1) using formula:

$$TET = 3 \times d / \sqrt{f_{(GHz)}}$$

where d = 5 mm – is the minimum test separation distance. At f = 2.45 GHz, TET = 9.6 mW (10 mW if rounded).

**EUT receive date:** July 05, 2013
**EUT receive condition:** The pre-production version of the EUT was received in good condition with no apparent damage. As declared by the Applicant, it is identical to the production units.
**Test start date:** July 05, 2013
**Test completion date:** July 29, 2013
The test results in this report pertain only to the item tested.

## 2.0 General Information

### 2.1 Product Description

The model: V1110, hereinafter – Equipment Under Test (EUT), is a Livescribe 3 Smartpen. It consists of one Bluetooth Low Energy (LE) transmitter operating at 2.4 GHz.

Information about the 2.4GHz radio, installed in the model V1110, is presented below:

| | |
|---|---|
| **Applicant** | Livescribe, Inc. |
| **Model No.** | V1110 |
| **FCC Identifier** | CKD-00072 |
| **IC Identifier** | 10240A-00072 |
| **Use of Product** | Livescribe 3 Smartpen (Blutooth LE Pen) |
| **IEEE Reference standard** | 802.15.1 Bluetooth Low Energy (LE) |
| **Type of transmission** | Direct Sequence Spread Spectrum (DSSS) |
| **Modes** | Single mode (Classic Bluetooth mode is not supported_ |
| **Rated RF Output** | 1.10 dBm (peak) |
| **Frequency Range** | 2402 – 2480 MHz |
| **Type of modulation** | GFSK |
| **Number of Channel(s)** | 40 (from 0 to 39) |
| **Duty Cycle** | 66.7% |
| **Antenna(s) & Gain** | Internal antenna, 1.38'' long 0.81mm micro-coax cable, Pattern near Isotropic, 1-3 dBi peak gain, U.FL-LP(V)-04N1T Hirose equivalent |
| **Manufacturer Name & Address** | Livescribe, Inc.<br>7677 Oakport St. 12th Floor<br>Oakland, CA 94621, USA |

## 2.2 Related Submittal(s) Grants

None.

## 2.3 Test Facility

The test site used to collect the radiated data is site 1 (10-m semi-anechoic chamber). This test facility and site measurement data have been fully placed on file with the FCC, IC and A2LA accredited.

## 2.4 Test Methodology

Antenna conducted measurements were performed according to the FCC documents "Guidance for Performing Compliance Measurement on Digital Transmission Systems (DTS) Operating under §15.247" (KDB 558074), and RSS-210, RSS-GEN, and

Radiated emissions and AC mains conducted emissions measurements were performed according to the procedures in ANSI C63.10. Radiated tests were performed at an antenna to EUT distance of 3 meters, unless stated otherwise in the "Data Sheet" of this report.

## 2.5 Measurement Uncertainty

Compliance with the limits was based on the results of the measurements and doesn't take into account the measurement uncertainty.

Estimated Measurement Uncertainty

| Measurement | Expanded Uncertainty (k=2) | | |
|---|---|---|---|
| | 0.15 MHz – 1 GHz | 1 GHz – 2.5 GHz | > 2.5 GHz |
| RF Power and Power Density – antenna conducted | - | 0.7 dB | - |
| Unwanted emissions - antenna conducted | 1.1 dB | 1.3 dB | 1.9 dB |
| Bandwidth – antenna conducted | - | 30 Hz | - |
| Radiated emissions | 4.2 dB | 3.4 dB | 4.4 dB |
| AC mains conducted emissions | 2.4 dB | - | - |

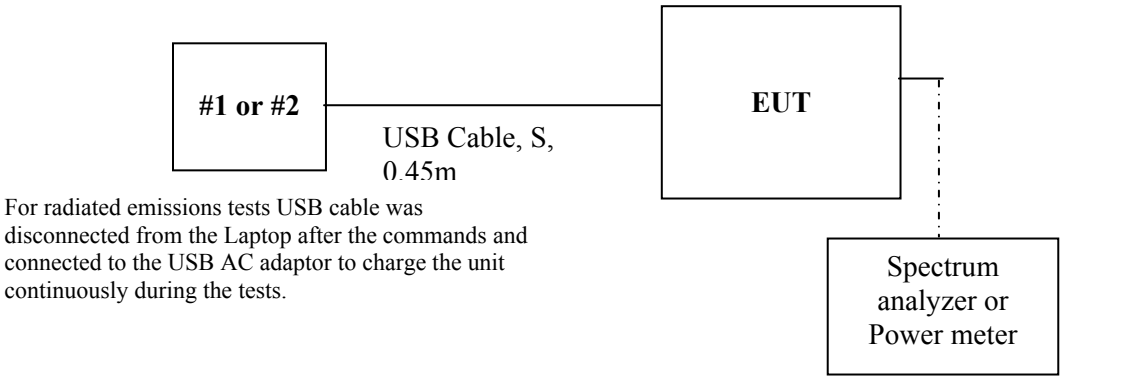
## 3.0 System Test Configuration

### 3.1 Support Equipment

| Item # | Description | Model No. | Serial No. |
|---|---|---|---|
| 1 | Lenova Laptop | ThinkPad T410 | 3000990 |
| 2 | HTC, USBAC adapter | TC U250 | Not Labeled |

### 3.2 Block Diagram of Test Setup

Antenna was removed and co-axial connector with a cable was installed for Conducted Measurements. Internal antenna was used for Radiated Measurements.




For radiated emissions tests USB cable was disconnected from the Laptop after the commands and connected to the USB AC adaptor to charge the unit continuously during the tests.

| | |
|---|---|
| **S** = Shielded<br>**U** = Unshielded | **F** = With Ferrite<br>**m** = Length in Meters |

## 3.3 Justification

For radiated emission measurements the EUT is placed on a non-conductive table. The EUT is attached to peripherals and they are connected and operational (as typical as possible). The EUT is wired to transmit full power. During testing, all cables are manipulated to produce worst-case emissions.

## 3.4 Software Exercise Program

The EUT exercise program used during radiated and conducted testing was provided by Livescribe, Inc.

## 3.5 Mode of Operation during Test

During transmitter testing, the transmitter was setup to transmit at maximum RF power on low, middle and high frequencies/channels.

## 3.5 Modifications Required for Compliance

Intertek installed no modifications during compliance testing in order to bring the product into compliance.

## 3.6 Additions, Deviations and Exclusions from Standards

No additions, deviations or exclusions from the standard were made.

## 4.0 Measurement Results

4.1 6-dB Bandwidth and Occupied Bandwidth
FCC Rule: 15.247(a)(2); RSS-210 A8.2 and RSS-GEN;

4.1.1 Requirement

The minimum 6-dB bandwidth shall be at least 500 kHz

4.1.2 Procedure

The Procedure described in the FCC Publication 558074 was used.
The antenna port of the EUT was connected to the input of a spectrum analyzer (SA). For each RF output channel investigated, the spectrum analyzer center frequency was set to the channel carrier. A PEAK output reading was taken, a DISPLAY line was drawn 6 dB lower than PEAK level. The 6-dB bandwidth was determined from where the channel output spectrum intersected the display line.

The occupied bandwidth was measured using the built-in spectrum analyzer function for 99% power bandwidth measurement.

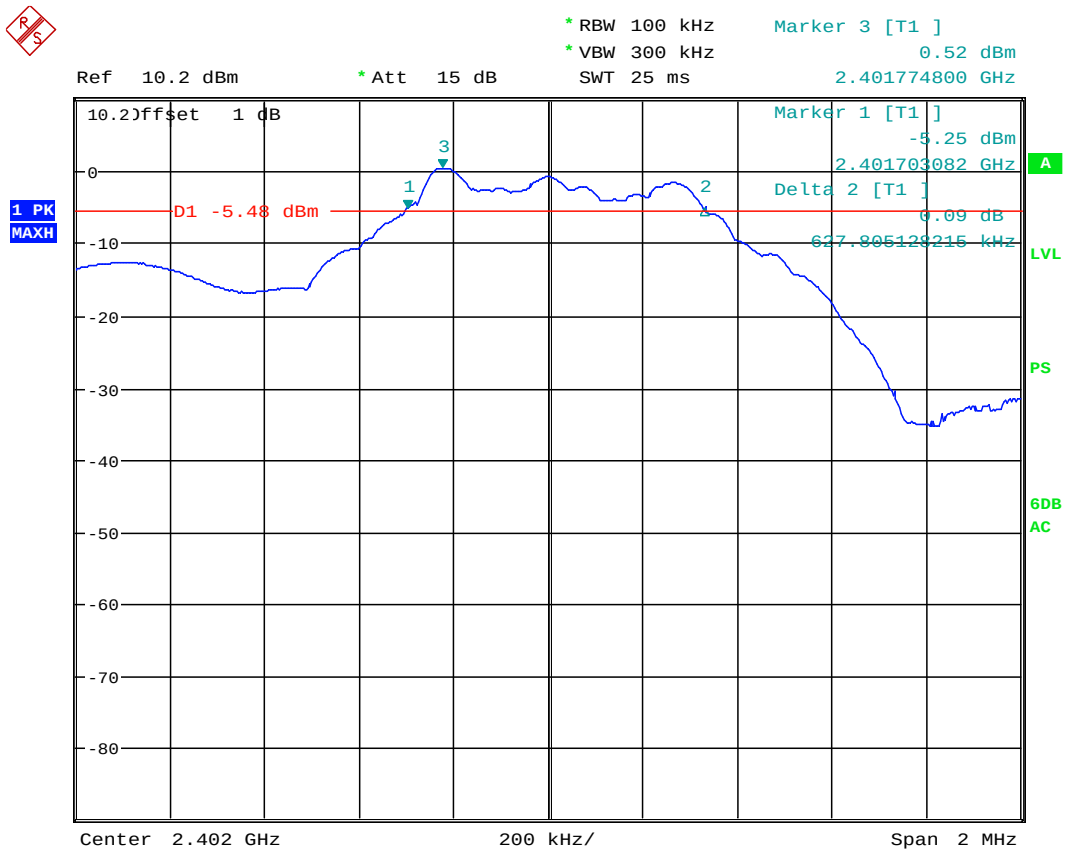
4.1.3 Test Result

| Frequency (MHz) | 6-dB bandwidth * FCC 15.247, kHz | 6-dB bandwidth ** RSS-GEN, kHz | Occupied bandwidth, RSS-GEN, kHz | Plot |
|---|---|---|---|---|
| 2402 | 627.8 | | | 1.1 |
| | | 625.0 | 1570.0 | 1.4, 1.7 |
| 2440 | 634.6 | | | 1.2 |
| | | 644.2 | 1517.0 | 1.5, 1.8 |
| 2480 | 628.2 | | | 1.3 |
| | | 621.8 | 1388.0 | 1.6, 1.9 |

* Measurements were performed with spectrum analyzer's resolution bandwidth of 100 kHz
** Measurements were performed with spectrum analyzer's resolution bandwidth of 10 kHz

| Results | Complies |
|---|---|

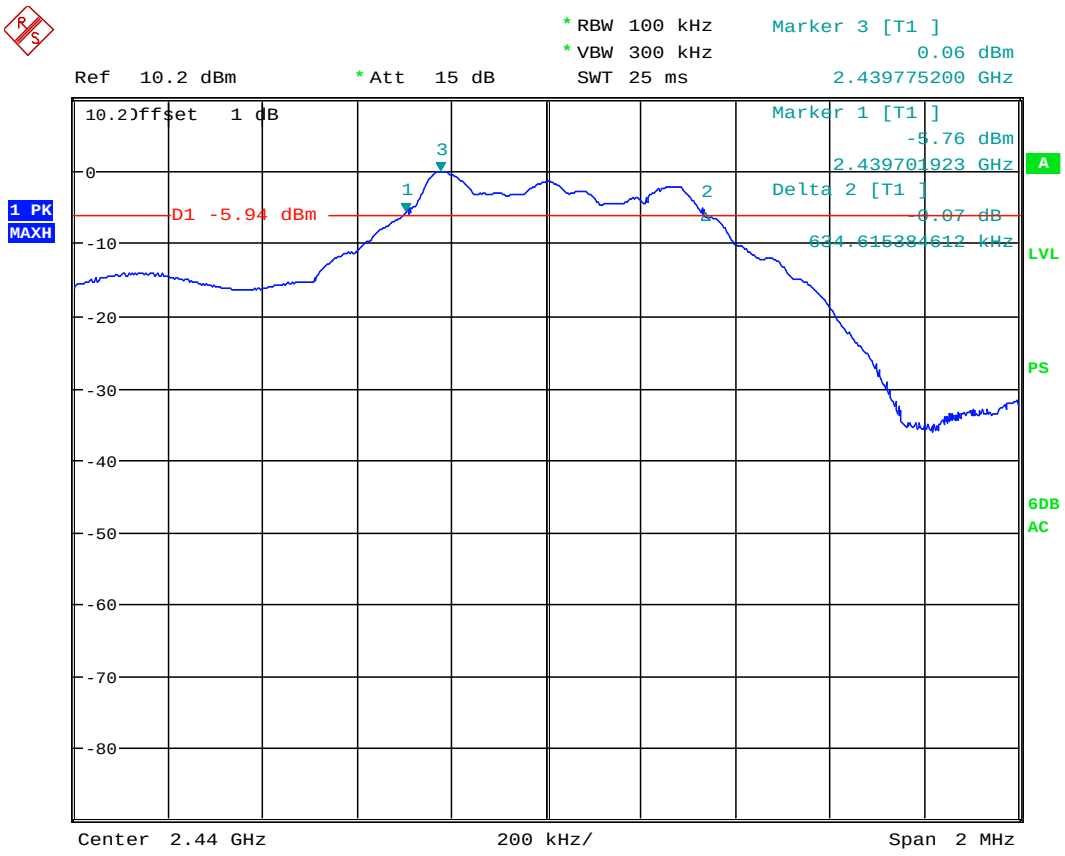
Plot 1. 1




6-dB bandwidth

Date: 6.JUL.2013 17:37:45

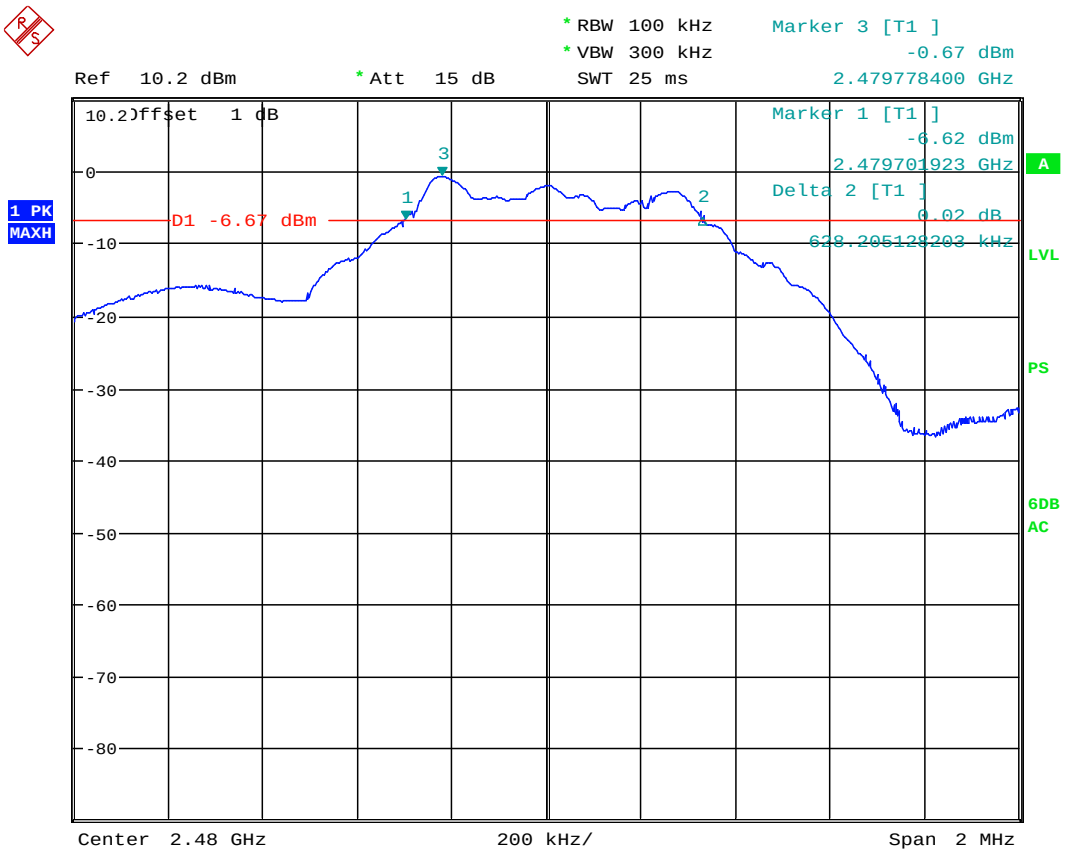
Plot 1. 2




6-dB bandwidth

Date: 6.JUL.2013 17:40:55

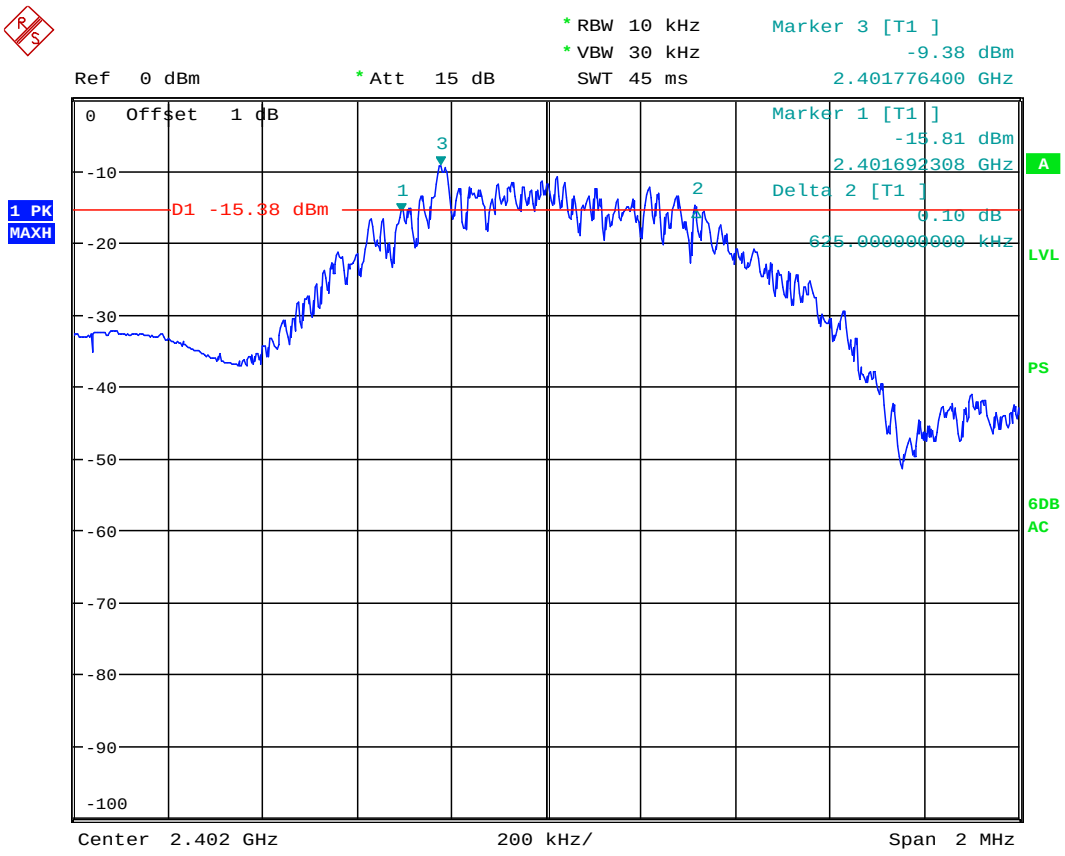
Plot 1. 3




6-dB bandwidth

Date: 6.JUL.2013 17:43:37

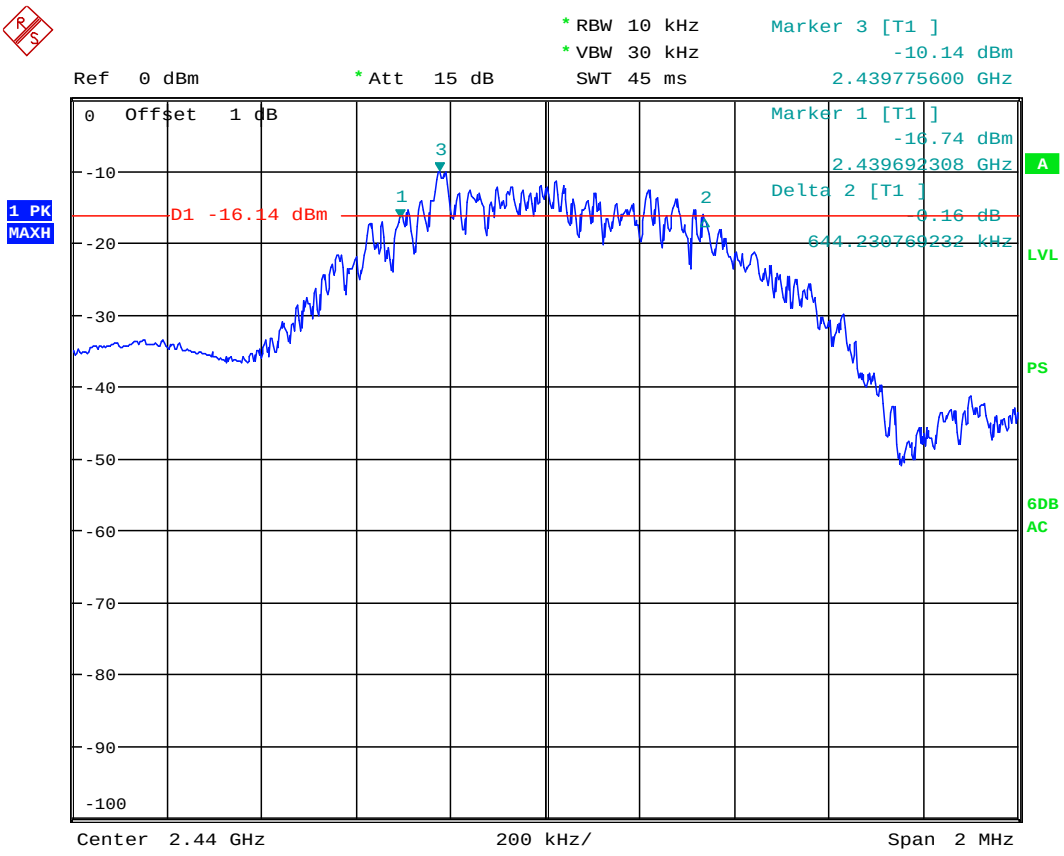
Plot 1. 4




6-dB bandwidth

Date: 6.JUL.2013 17:53:08

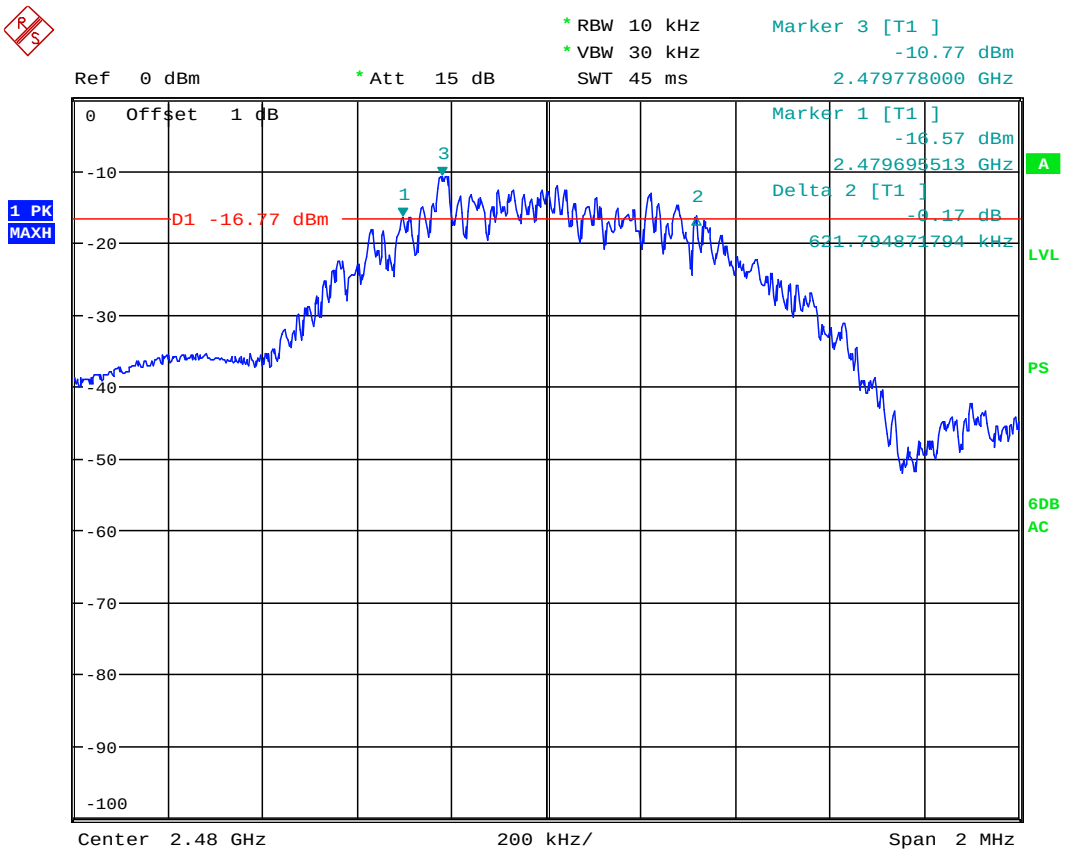
Plot 1.5




6-dB bandwidth

Date: 6.JUL.2013 17:58:47

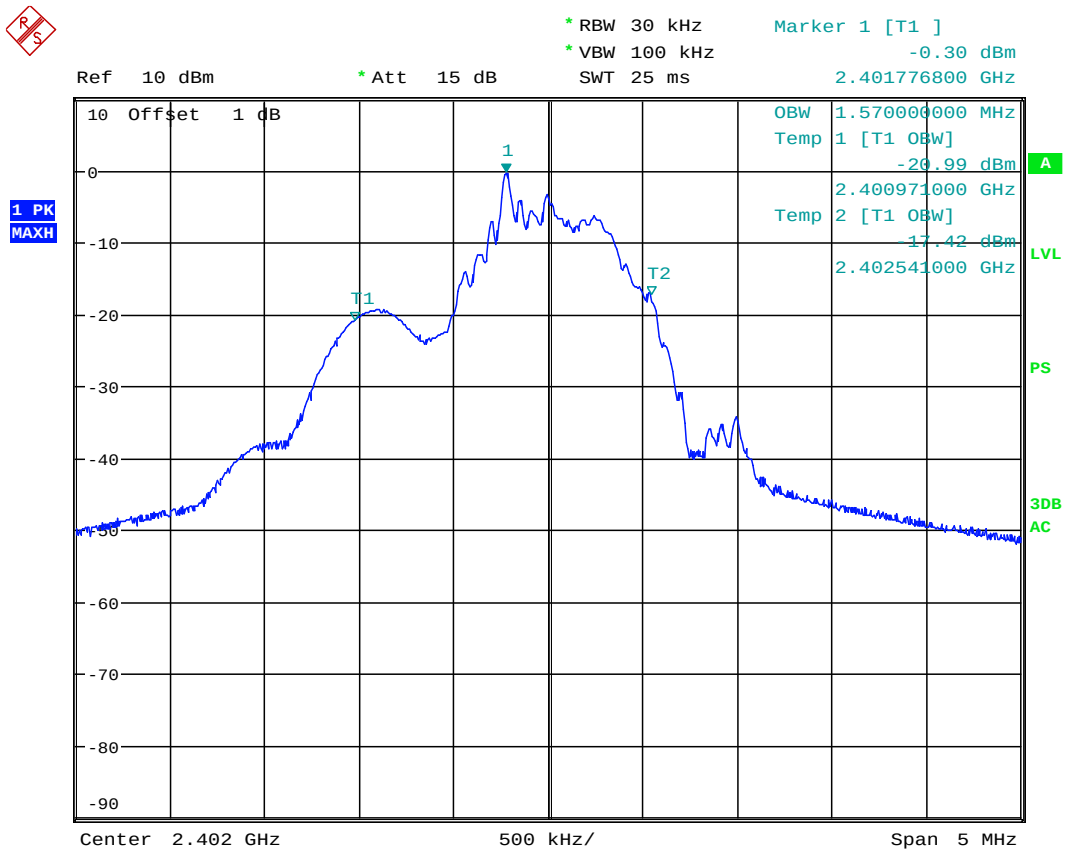
Plot 1.6




6-dB bandwidth

Date: 6.JUL.2013 18:00:46

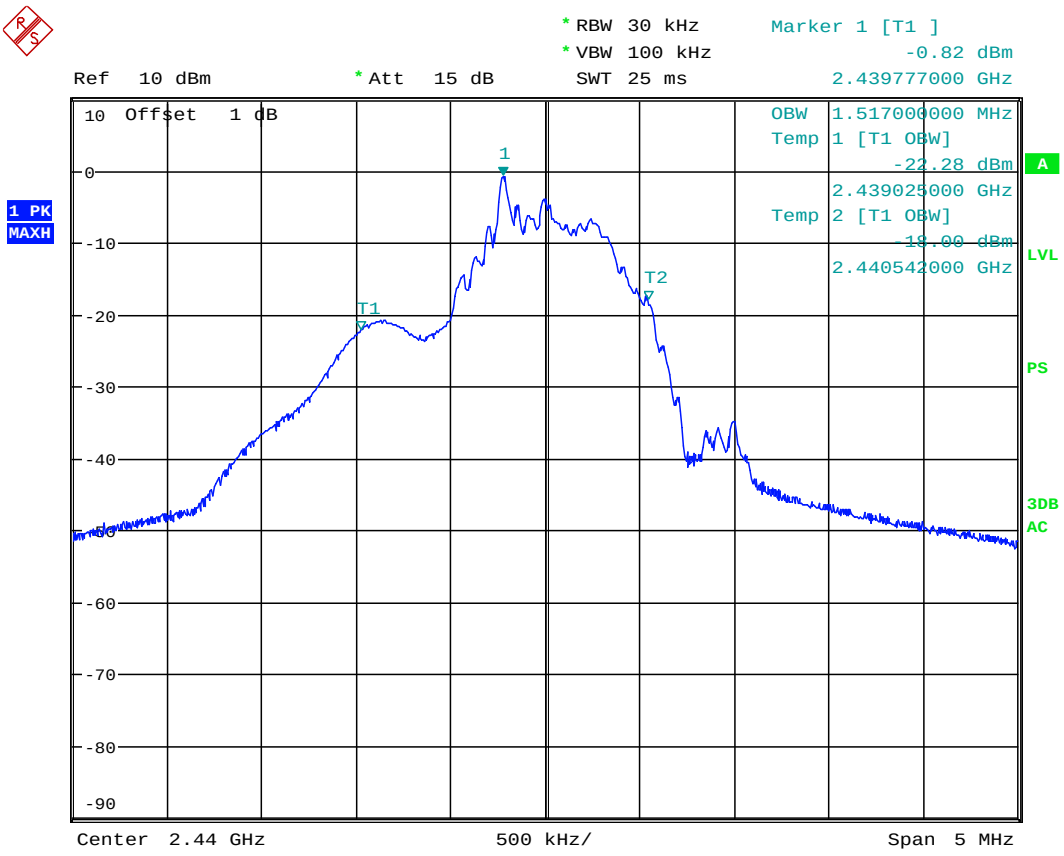
Plot 1.7




Occupied bandwidth

Date: 6.JUL.2013 18:07:42

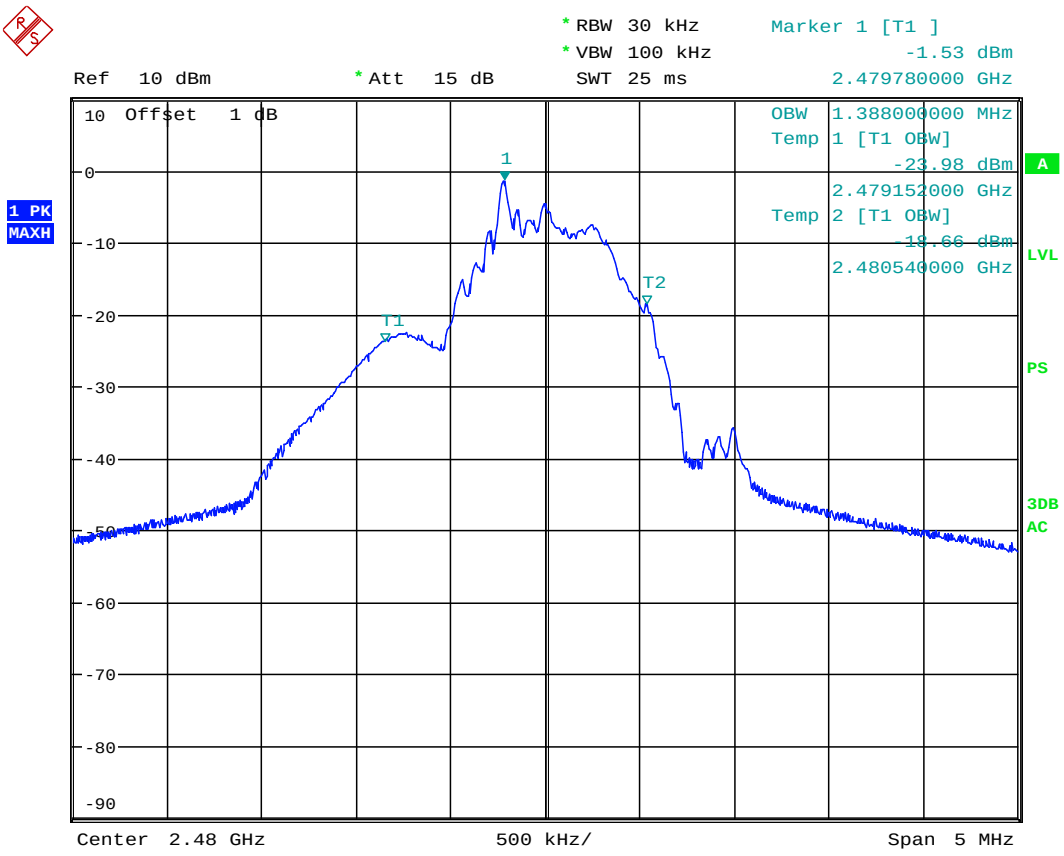
Plot 1.8




Occupied bandwidth

Date: 6.JUL.2013 18:09:13

Plot 1.9




Occupied bandwidth

Date: 6.JUL.2013 18:10:52

## 4.2 Maximum Peak Conducted Output Power at Antenna Terminals
FCC Rule: 15.247(b)(3); RSS-210 A8.4;

### 4.2.1 Requirement

For antennas with gains of 6 dBi or less, maximum allowed transmitter output is 1 watt or 30 dBm.
For antennas with gains greater than 6 dBi, transmitter output level must be decreased appropriately, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

### 4.2.2 Procedure

The antenna port of the EUT was connected to the input of a spectrum analyzer/power meter to measure the Maximum Conducted Transmitter Output Power.

The procedure described in FCC Publication 558074, was used. Specifically, section 9.1.1 for Maximum Peak Conducted Output Power, with the spectrum analyzer's peak detector and Resolution Bandwidth RBW > DTS Bandwidth.

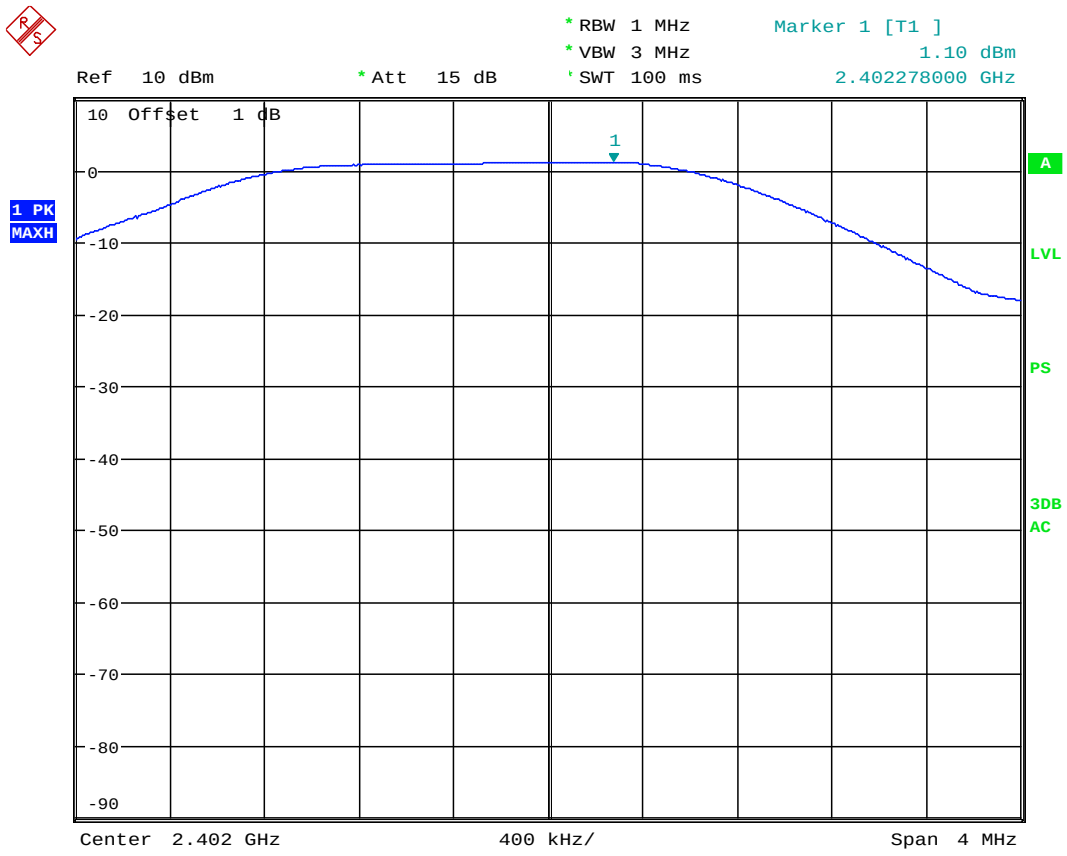
### 4.3.3 Test Result

Refer to the following plots 2.1 – 2.3 for the test details.

| Frequency, MHz | Conducted Power (peak), dBm | Conducted Power (peak), mW | Plot |
|---|---|---|---|
| 2402 | 1.10 | 1.288 | 2.1 |
| 2440 | 0.63 | 1.156 | 2.2 |
| 2480 | -0.11 | 0.975 | 2.3 |

| Results | Complies |
|---|---|

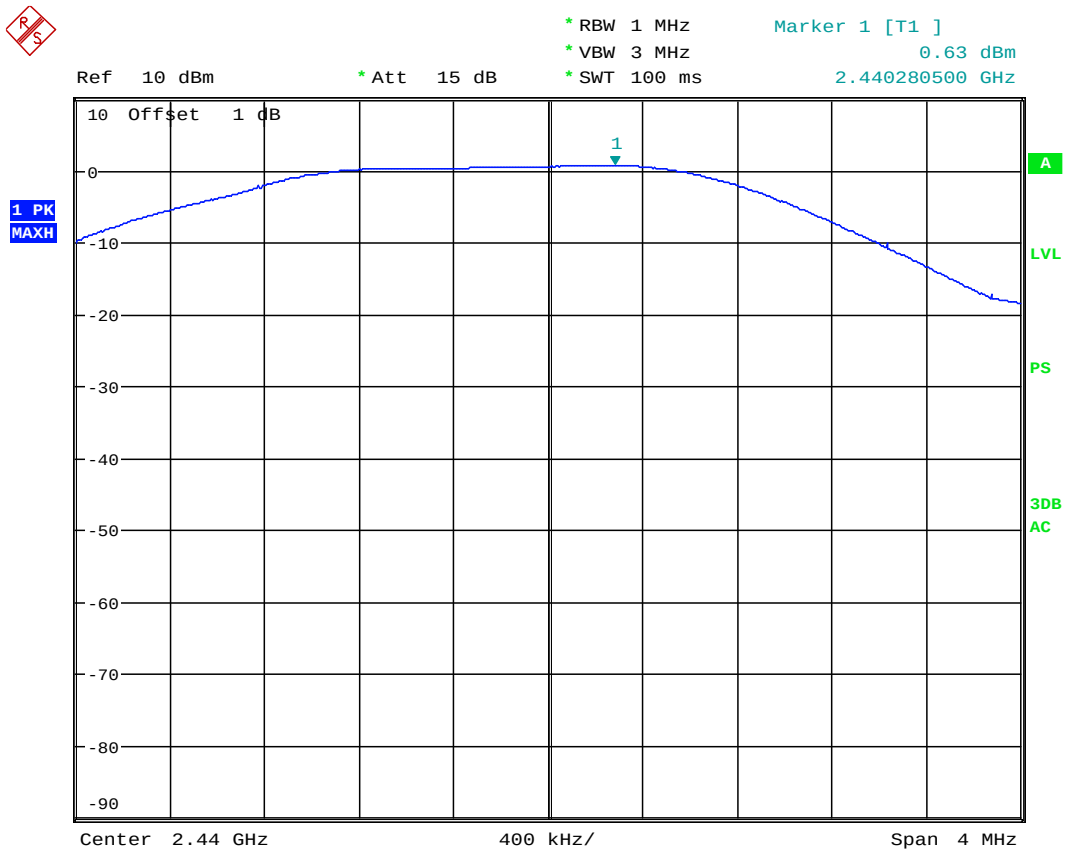
Plot 2. 1




Maximum Peak Conducted Power

Date: 7.JUL.2013 09:20:20

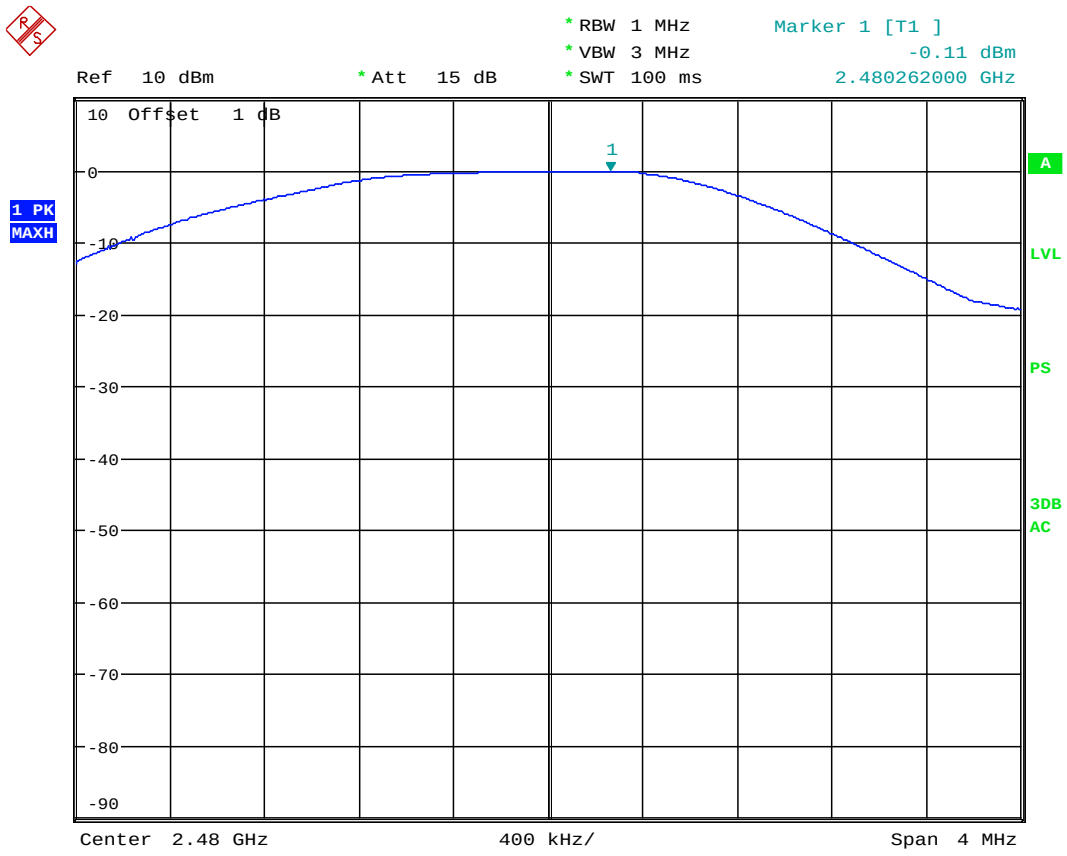
Plot 2. 2




Maximum Peak Conducted Power

Date: 7.JUL.2013 09:22:34

Plot 2. 3




Maximum Peak Conducted Power

Date: 7.JUL.2013 09:25:05

## 4.3 Maximum Power Spectral Density
FCC: 15.247 (e); RSS-210 A8.2b;

### 4.3.1 Requirement

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

### 4.3.2 Procedure

The antenna port of the EUT was connected to the input of a spectrum analyzer to measure the Transmitter Power Density (PSD).

The procedure described in FCC Publication 558074 was used. Specifically, section 10.2, Peak PSD**,** with peak detector and max hold trace mode. Spectrum analyzer resolution bandwidth was set to 3 kHz and span to at least 1.5 times the DTS (6 dB) channel bandwidth.

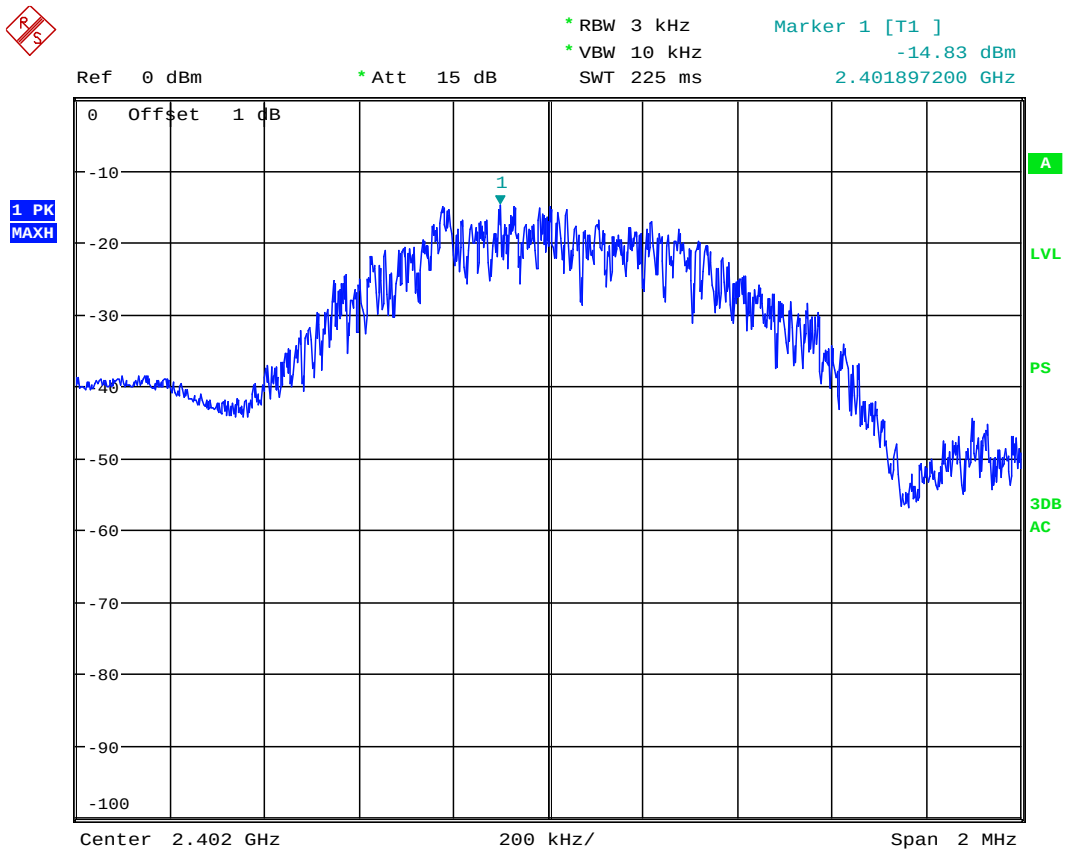
### 4.3.3 Test Result

Refer to the following plots for the test result

| Frequency, MHz | Maximum Power Spectral Density, dBm | Maximum Power Spectral Density Limit, dBm | Margin, dB | Plot |
|---|---|---|---|---|
| 2402 | - 14.8 | 8.0 | -22.8 | 3.1 |
| 2440 | - 15.3 | 8.0 | -23.3 | 3.2 |
| 2480 | - 15.7 | 8.0 | -23.7 | 3.3 |

| Results | Complies |
|---|---|

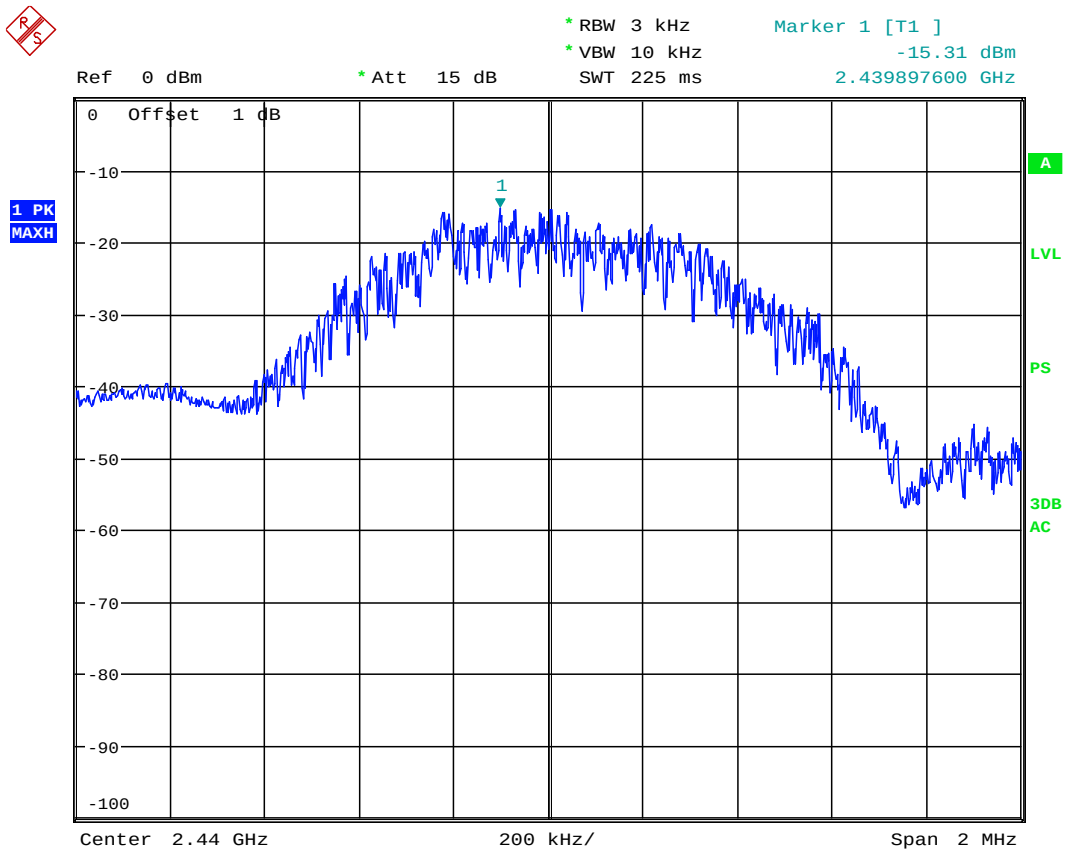
Plot 3. 1




Maximum Power Spectral Density

Date: 6.JUL.2013 18:34:44

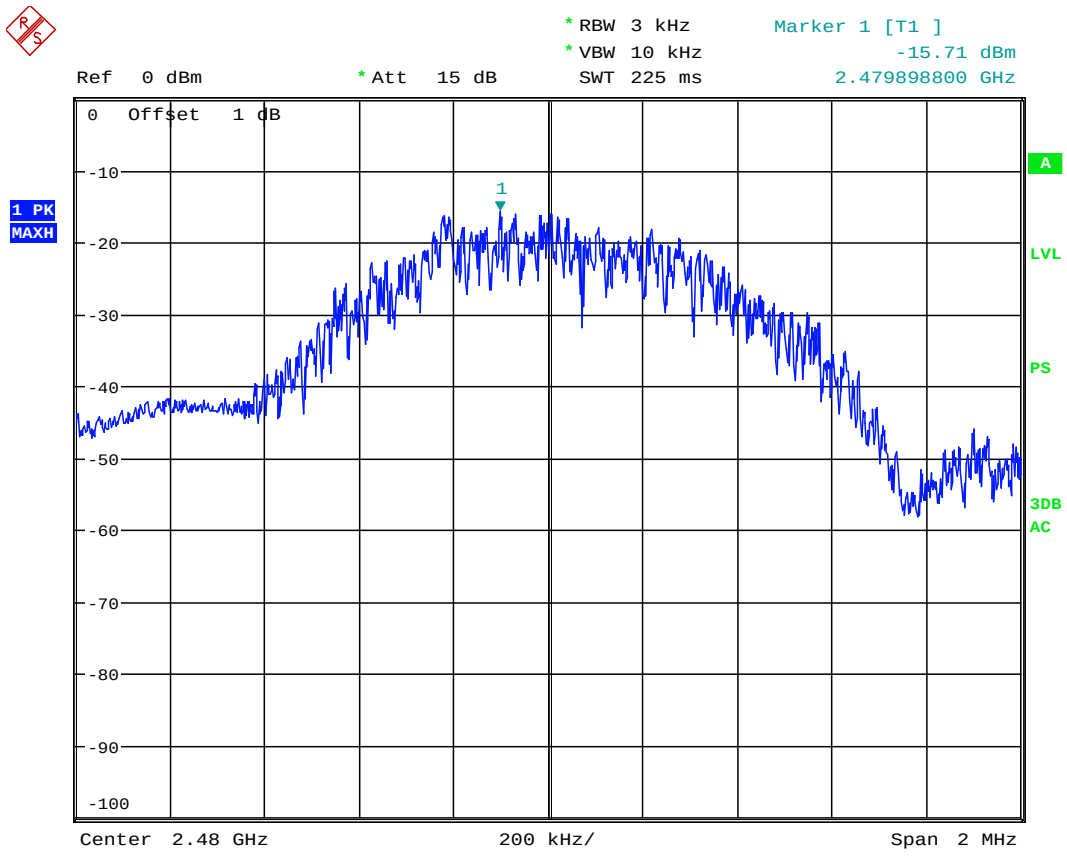
Plot 3. 2




Maximum Power Spectral Density

Date: 6.JUL.2013 18:37:06

Plot 3. 3




Maximum Power Spectral Density

Date: 6.JUL.2013 18:38:29

## 4.4 Unwanted Conducted Emissions
FCC: 15.247(d); RSS-210 A8.5;

### 4.4.1 Requirement

In any 100 kHz bandwidth outside the EUT pass-band, the RF power shall be below the maximum in-band 100 kHz emissions by at least 20 dB (if peak power of in-band emission is measured) or 30 dB (if average power of in-band emission is measured).

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)

### 4.4.2 Procedure

A spectrum analyzer was connected to the antenna port of the transmitter. Analyzer Resolution Bandwidth was set to 100 kHz. For each channel investigated, the in-band and unwanted peak emission measurements (with max hold) were performed. For the wideband scan, Spectrum Analyzer setting of number of points 30000 was used.

The unwanted emissions were measured from 30 MHz to 25 GHz.

### 4.4.3 Test Result

The test results are summarized in The Table 4.1.

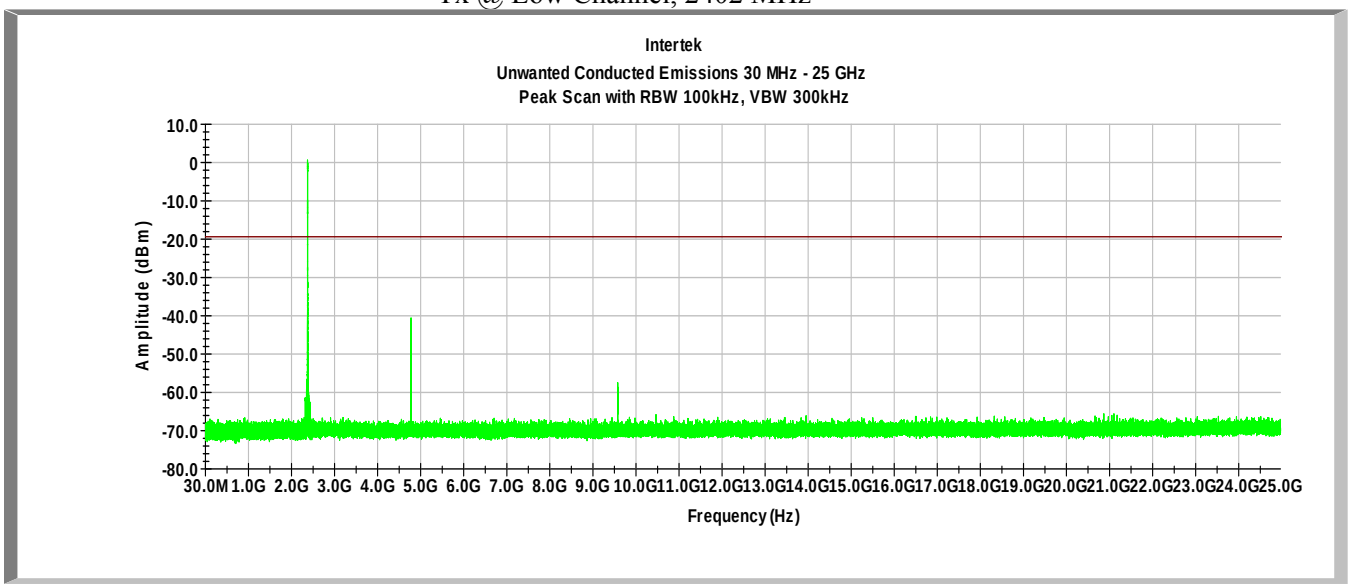
Table 4.1
**Unwanted Conducted Emissions**

| Frequency, MHz | In-band Emissions dBm | Worst case Unwanted Emissions, dBm | Unwanted Emissions Attenuation, dB | Margin to 20 dB Attenuation Limit, dB |
|---|---|---|---|---|
| 2402 | 0.6 | -37.9 | 38.5 | -18.5 |
| 2440 | 0.1 | -39.7 | 39.8 | -19.8 |
| 2480 | -0.5 | -40.4 | 39.9 | -19.9 |

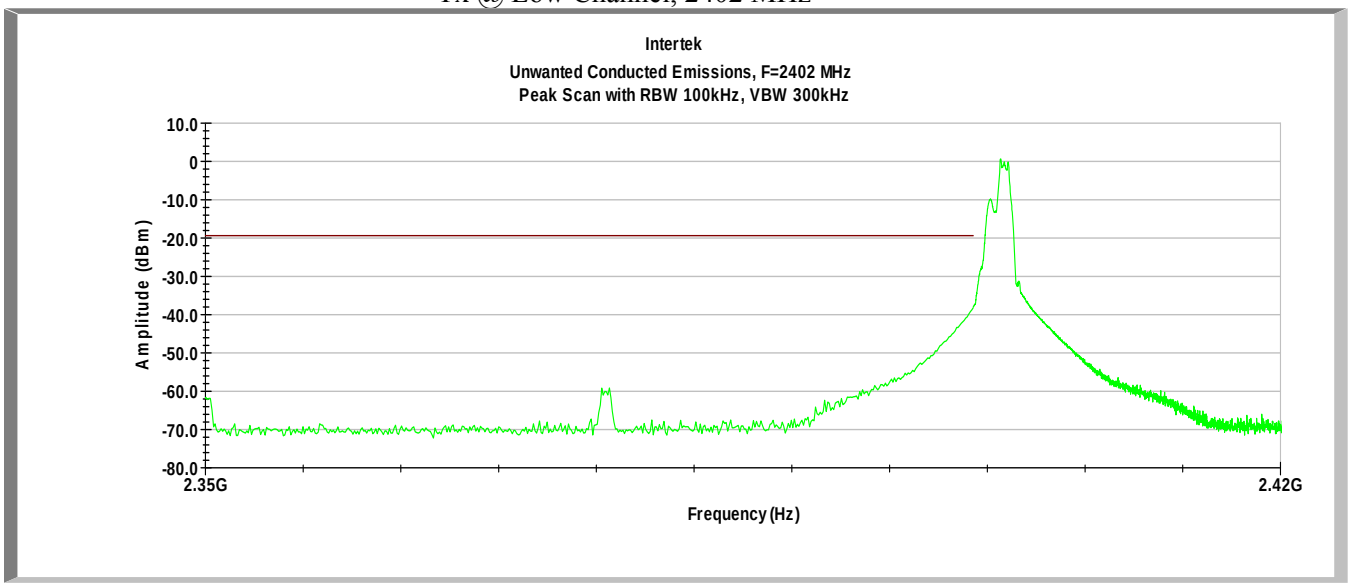
See plots 4.1 – 4.5 for details.

| Results | Complies |
|---|---|

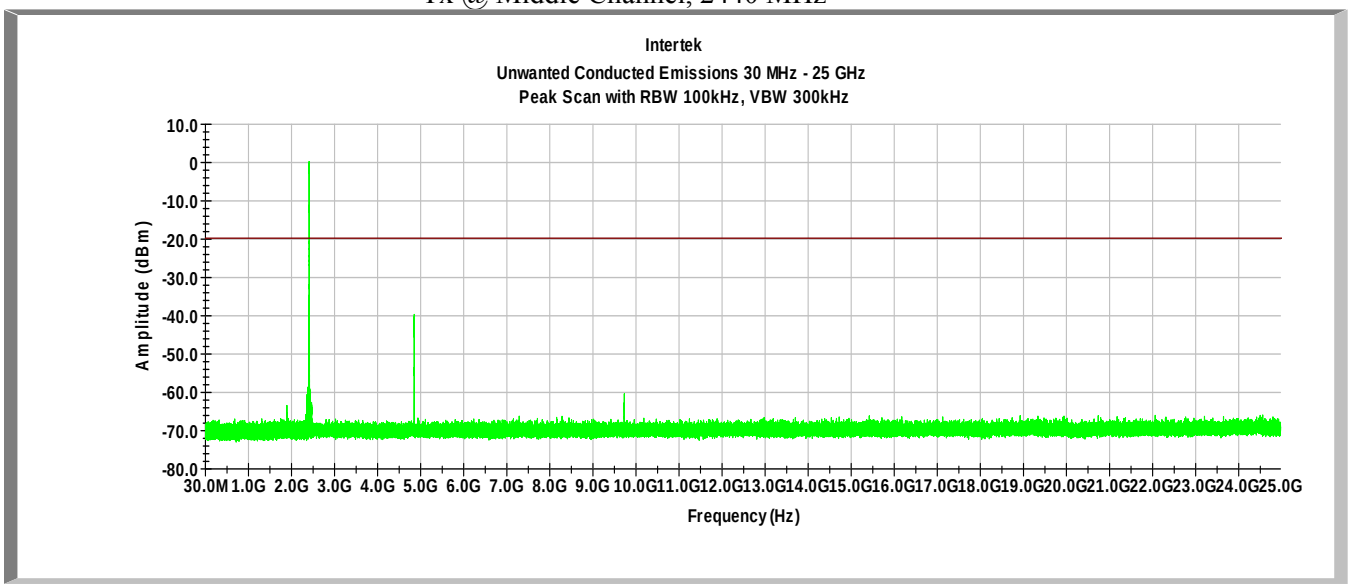
Plot 4. 1
Tx @ Low Channel, 2402 MHz



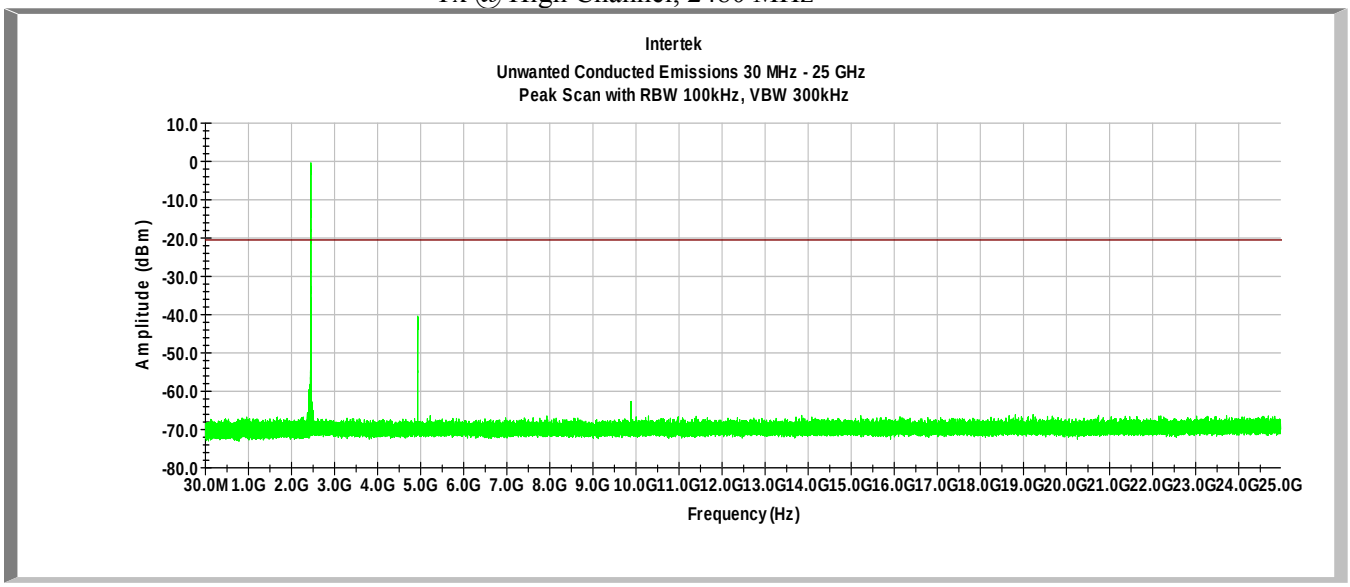

Plot 4. 2
Tx @ Low Channel, 2402 MHz



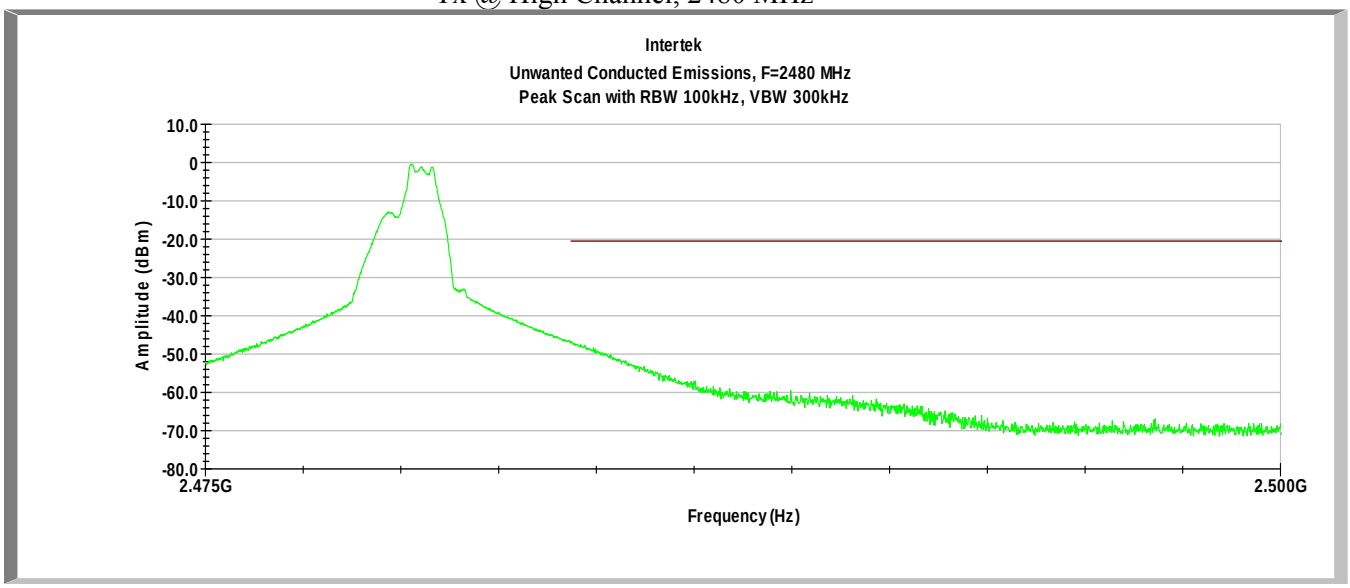
Plot 4. 3
Tx @ Middle Channel, 2440 MHz




Plot 4. 4
Tx @ High Channel, 2480 MHz



Plot 4. 5
Tx @ High Channel, 2480 MHz



## 4.5 Transmitter Radiated Emissions

FCC Rules: 15.247(d), 15.209, 15.205; RSS-210;

### 4.5.1 Requirement

Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

In any 100 kHz bandwidth outside the EUT pass-band, the RF power shall be below the maximum in-band 100 kHz emissions by at least 20 dB (if peak power of in-band emission is measured) or 30 dB (if average power of in-band emission is measured).

### 4.5.2 Procedure

Radiated emission measurements were performed from 30 MHz to 25 GHz according to the procedure described in ANSI C64.10. Spectrum Analyzer Resolution Bandwidth is 100 kHz or greater for frequencies 30 MHz to 1000 MHz, 1 MHz for frequencies above 1000 MHz. Above 1000 MHz Peak and Average measurements were performed.

The EUT is placed on a plastic turntable that is 80 cm in height. If the EUT attaches to peripherals, they are connected and operational (as typical as possible). During testing, all cables were manipulated to produce worst-case emissions. The signal is maximized through rotation. The antenna height and polarization are varied during the search for maximum signal level. The antenna height is varied from 1 to 4 meters.

Radiated emissions are taken at 10 meters for frequencies below 1 GHz and at 3 meters for frequencies above 1 GHz, except measurement at 1 meter for frequency 2390 MHz.

Radiated emissions at 2483.5 MHz were made by delta-marker method. The Field Strength at the band-edge frequency {$FS_{be}$ in dB(uV/m)} is calculated as:

$$FS_{be} = FS_0 - \Delta ,$$

where $FS_0$ is Field Strength at the fundamental frequency; $\Delta$ is delta-marker in dB.

Data included is representative of the worst-case configuration (the configuration which resulted in the highest emission levels).

4.5.3 Field Strength Calculation

Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CF – AG; if measurement is performed at a distance other than specified in the rule, a Distance Correction Factor (DCF) shall be added.

Where FS = Field Strength in dB(μV/m)
RA = Receiver Amplitude (including preamplifier) in dB(μV); AF = Antenna Factor in dB(1/m)
CF = Cable Attenuation Factor in dB; AG = Amplifier Gain in dB

Assume a receiver reading of 52.0 dB(μV) is obtained. The antennas factor of 7.4 dB(1/m) and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving field strength of 32 dB(μV/m). This value in dB(μV/m) was converted to its corresponding level in μV/m.
RA = 52.0 dB(μV)
AF = 7.4 dB(1/m)
CF = 1.6 dB
AG = 29.0 dB
FS = 52.0+7.4+1.6-29.0 = 32 dB(μV/m).
Level in μV/m = Common Antilogarithm [(32 dBμV/m)/20] = 39.8 μV/m.

4.5.3 Test Results

The data on the following pages list the significant emission frequencies, the limit and the margin of compliance.

| | |
|---|---|
| **Results** | **Complies** by 0.6 dB |

**Transmitter Radiated Emissions below 1GHz**

Intertek Testing Services
Radiated Emissions 30 MHz - 1000 MHz
FCC Part 15 Class B (QP-Vertical)

Operator: KK
14-Jul-13

Model Number: V1110
Company: Livescribe, Inc.

| Frequency | Quasi-Pk FS | Limit@3m | Margin | RA @ 10m | Cable | AG | DCF | AF |
|---|---|---|---|---|---|---|---|---|
| Hz | dB(uV/m) | dB(uV/m) | dB | dB(uV) | dB | dB | dB | dB(1/m) |
| 3.647E+07 | 29.1 | 40.0 | -10.9 | 33.2 | 0.7 | 32.1 | 10.5 | 17.2 |
| 6.880E+07 | 23.6 | 40.0 | -16.4 | 37.4 | 0.9 | 32.1 | 10.5 | 7.3 |
| 1.680E+08 | 38.4 | 43.5 | -5.1 | 50.2 | 1.5 | 32.0 | 10.5 | 9.0 |
| 1.920E+08 | 25.2 | 43.5 | -18.3 | 36.0 | 1.6 | 32.0 | 10.5 | 9.9 |
| 2.660E+08 | 28.3 | 46.0 | -17.7 | 35.7 | 1.9 | 32.0 | 10.5 | 13.1 |
| 2.895E+08 | 28.2 | 46.0 | -17.8 | 36.0 | 2.0 | 32.0 | 10.5 | 12.6 |
| 3.145E+08 | 30.9 | 46.0 | -15.1 | 37.8 | 2.1 | 32.0 | 10.5 | 13.5 |
| 3.388E+08 | 27.4 | 46.0 | -18.6 | 33.4 | 2.2 | 32.0 | 10.5 | 14.3 |
| 4.811E+08 | 29.7 | 46.0 | -16.3 | 32.9 | 2.6 | 32.1 | 10.5 | 17.2 |
| 9.604E+08 | 31.9 | 54.0 | -22.1 | 28.6 | 3.7 | 31.2 | 10.5 | 22.2 |

Test Mode: Tx @ 2402 MHz
Temp: 22.5C
Humidity: 50%

Intertek Testing Services
Radiated Emissions 30 MHz - 1000 MHz
FCC Part 15 Class B (QP-Vertical)

Operator: KK
14-Jul-13

Model Number: V1110
Company: Livescribe, Inc.

| Frequency | Quasi-Pk FS | Limit@3m | Margin | RA @ 10m | Cable | AG | DCF | AF |
|---|---|---|---|---|---|---|---|---|
| Hz | dB(uV/m) | dB(uV/m) | dB | dB(uV) | dB | dB | dB | dB(1/m) |
| 3.647E+07 | 29.2 | 40.0 | -10.8 | 33.2 | 0.7 | 32.1 | 10.5 | 17.2 |
| 6.880E+07 | 26.5 | 40.0 | -13.5 | 40.2 | 0.9 | 32.1 | 10.5 | 7.3 |
| 1.011E+08 | 26.1 | 43.5 | -17.4 | 36.6 | 1.2 | 32.1 | 10.5 | 10.5 |
| 1.680E+08 | 38.4 | 43.5 | -5.1 | 50.2 | 1.5 | 32.0 | 10.5 | 9.0 |
| 1.920E+08 | 35.0 | 43.5 | -8.5 | 45.8 | 1.6 | 32.0 | 10.5 | 9.9 |
| 2.660E+08 | 29.8 | 46.0 | -16.2 | 37.2 | 1.9 | 32.0 | 10.5 | 13.1 |
| 2.903E+08 | 28.5 | 46.0 | -17.5 | 36.4 | 2.0 | 32.0 | 10.5 | 12.6 |
| 3.145E+08 | 29.9 | 46.0 | -16.1 | 36.8 | 2.1 | 32.0 | 10.5 | 13.5 |
| 3.388E+08 | 27.1 | 46.0 | -18.9 | 33.1 | 2.2 | 32.0 | 10.5 | 14.3 |
| 4.811E+08 | 30.2 | 46.0 | -15.8 | 33.4 | 2.6 | 32.1 | 10.5 | 17.2 |
| 9.604E+08 | 31.4 | 54.0 | -22.6 | 28.1 | 3.7 | 31.2 | 10.5 | 22.2 |

Test Mode: Tx @ 2440 MHz
Temp: 22.5C
Humidity: 50%

## Transmitter Radiated Emissions below 1GHz

Intertek Testing Services
Radiated Emissions 30 MHz - 1000 MHz
FCC Part 15 Class B (QP-Vertical)

Operator: KK
14-Jul-13

Model Number: V1110
Company: Livescribe, Inc.

| Frequency | Quasi-Pk FS | Limit@3m | Margin | RA @ 10m | Cable | AG | DCF | AF |
|---|---|---|---|---|---|---|---|---|
| Hz | dB(uV/m) | dB(uV/m) | dB | dB(uV) | dB | dB | dB | dB(1/m) |
| 3.647E+07 | 28.8 | 40.0 | -11.2 | 32.8 | 0.7 | 32.1 | 10.5 | 17.2 |
| 8.901E+07 | 25.9 | 43.5 | -17.6 | 38.3 | 1.1 | 32.1 | 10.5 | 8.7 |
| 1.028E+08 | 26.5 | 43.5 | -17.0 | 36.3 | 1.2 | 32.1 | 10.5 | 11.2 |
| 1.680E+08 | 38.6 | 43.5 | -4.9 | 50.4 | 1.5 | 32.0 | 10.5 | 9.0 |
| 1.820E+08 | 24.1 | 43.5 | -19.4 | 35.5 | 1.6 | 32.0 | 10.5 | 9.4 |
| 1.920E+08 | 27.2 | 43.5 | -16.3 | 38.0 | 1.6 | 32.0 | 10.5 | 9.9 |
| 2.668E+08 | 28.4 | 46.0 | -17.6 | 35.9 | 1.9 | 32.0 | 10.5 | 13.1 |
| 3.145E+08 | 30.6 | 46.0 | -15.4 | 37.5 | 2.1 | 32.0 | 10.5 | 13.5 |
| 3.849E+08 | 27.7 | 46.0 | -18.3 | 33.3 | 2.3 | 32.0 | 10.5 | 14.8 |
| 4.811E+08 | 28.8 | 46.0 | -17.2 | 31.9 | 2.6 | 32.1 | 10.5 | 17.2 |
| 9.135E+08 | 30.5 | 46.0 | -15.5 | 27.7 | 3.6 | 31.6 | 10.5 | 22.2 |

Test Mode: Tx @ 2480 MHz
Temp: 22.5C
Humidity: 50%

## Transmitter Radiated Emissions above 1GHz

Measurement @ 2390 MHz
Tx @ 2402 MHz

| Band Edge Frequency | Antenna Polarity | Detector | Raw Amplitude | Antenna Factor | Cable Loss | DCF | FS @ 3 m | FS Limit @ 3 m | Margin |
|---|---|---|---|---|---|---|---|---|---|
| GHz | H/V | Peak / Avg | dB(uV/m) | dB(1/m) | dB | dB | dB(uV/m) | dB(uV/m) | dB |
| 2.390 | V | Peak | 27.4 * | 27.7 | 3.3 | -9.5 | 48.9 ** | 74.0/54.0 | -5.1 |

* Measured @ 1 m
** Peak FS < Average FS Limit [54 dB(uV/m)]

Measurement @ 2483.5 MHz
Tx @ 2480 MHz

| Fundamental Frequency | Antenna Polarity | SA reading at fundament. @ 3 m | Antenna Factor | Cable Loss | FS @ 3 m | Delta - Marker | FS @ band-edge frequency | Detector | FS Limit @ 3 m | Margin |
|---|---|---|---|---|---|---|---|---|---|---|
| GHz | H/V | dB(uV/m) | dB(1/m) | dB | dB(uV/m) | dB | dB(uV/m) | Peak / Avg | dB(uV/m) | dB |
| 2.480 | V | 51.0 | 28.1 | 3.4 | 82.5 | 40.1 | 42.4 * | Peak | 74.0/54.0 | -11.6 |

* Peak FS < Average FS Limit [54 dB(uV/m)]

## Transmitter Radiated Emissions above 1GHz

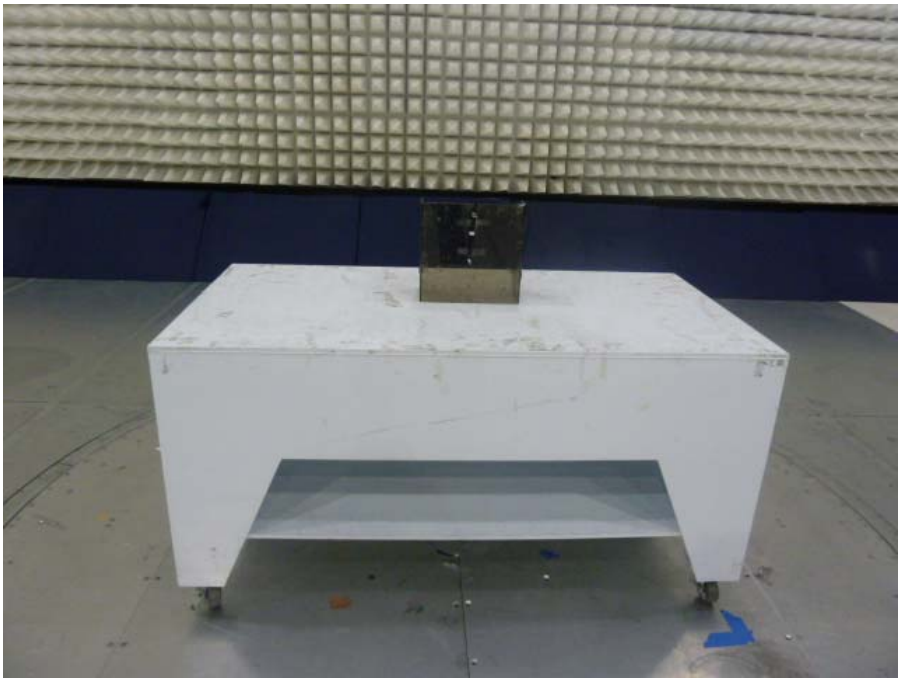
| Frequency | Antenna Polarity | Raw Amplitude @ 3 m | Preamp | Antenna Factor | Cable Loss | δ(dB)* | FS @ 3 m | Detector | FS Limit @ 3 m | Margin |
|---|---|---|---|---|---|---|---|---|---|---|
| GHz | H/V | dB(uV) | dB | dB(1/m) | dB | dB | dB(uV/m) | Peak / Avg | dB(uV/m) | dB |
| Tx @ 2402 MHz | | | | | | | | | | |
| 4.804 | V | 50.4 | 34.4 | 32.7 | 5.9 | -- | 54.6 | Peak | 74.0 | -19.4 |
| 4.804 | V | 50.4 | 34.4 | 32.7 | 5.9 | -3.5 | 51.1 | Avg | 54.0 | -2.9 |
| 12.0100 | V | 32.6 | 34.3 | 38.6 | 9.9 | -- | 46.8 | Peak | 74.0 | -27.2 |
| 12.0100 | V | 32.6 | 34.3 | 38.6 | 9.9 | -3.5 | 43.3 | Avg | 54.0 | -10.7 |
| Tx @ 2440 MHz | | | | | | | | | | |
| 4.884 | V | 52.1 | 34.3 | 32.7 | 5.9 | -- | 56.4 | Peak | 74.0 | -17.6 |
| 4.884 | V | 52.1 | 34.3 | 32.7 | 5.9 | -3.5 | 52.9 | Avg | 54.0 | -1.1 |
| 7.326 | V | 36 | 32.7 | 37.4 | 7.4 | -- | 48.1 | Peak | 74.0 | -25.9 |
| 7.326 | V | 36 | 32.7 | 37.4 | 7.4 | -3.5 | 44.6 | Avg | 54.0 | -9.4 |
| 12.210 | V | 33.1 | 34.4 | 38.3 | 10 | -- | 47 | Peak | 74.0 | -27 |
| 12.210 | V | 33.1 | 34.4 | 38.3 | 10 | -3.5 | 43.5 | Avg | 54.0 | -10.5 |
| Tx @ 2480 MHz | | | | | | | | | | |
| 4.960 | V | 52.4 | 34.2 | 32.8 | 5.9 | -- | 56.9 | Peak | 74.0 | -17.1 |
| 4.960 | V | 52.4 | 34.2 | 32.8 | 5.9 | -3.5 | 53.4 | Avg | 54.0 | -0.6 |
| 7.440 | V | 37.5 | 32.7 | 37.4 | 7.5 | -- | 49.7 | Peak | 74.0 | -24.3 |
| 7.440 | V | 37.5 | 32.7 | 37.4 | 7.5 | -3.5 | 46.2 | Avg | 54.0 | -7.8 |
| 12.400 | V | 33.4 | 34.4 | 38.4 | 10.1 | -- | 47.5 | Peak | 74.0 | -26.5 |
| 12.400 | V | 33.4 | 34.4 | 38.4 | 10.1 | -3.5 | 44.0 | Avg | 54.0 | -10.0 |

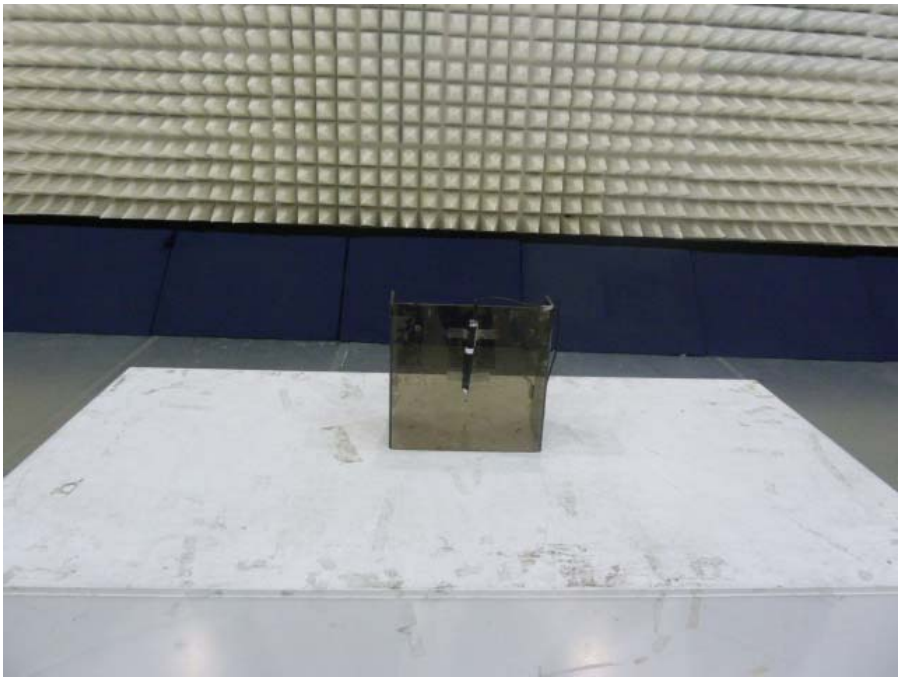
*** δ(dB) -** Duty Cycle Correction Factor. See Appendix A for Duty Cycle measurement and calculation. Duty cycle Correction Factor was applied for Average Field Strength (FS).

a) RBW = 1 MHz, VBW = 3 MHz - for peak measurements
b) Peak FS at 3m = SA reading + Cable loss + High Pass Filter loss - Pre-amplifier gain + Antenna factor.
c) Average FS at 3m = Peak FS + δ(dB)
d) Measurements made at 3 meters distance. Radiated emission measurements were performed up to 25 GHz. No other emissions were detected above the noise floor which is at least 10 dB below the limit.

4.5.4 Test setup photographs

**The following photographs show the testing configurations used.**





4.5.4 Test setup photographs

4.6 AC Line Conducted Emission
FCC: 15.207, 15.107; RSS-GEN;

4.6.1 Requirement

| Frequency Band MHz | Class B Limit dB(µV) | | Class A Limit dB(µV) | |
|---|---|---|---|---|
| | Quasi-Peak | Average | Quasi-Peak | Average |
| 0.15-0.50 | 66 to 56 * | 56 to 46 * | 79 | 66 |
| 0.50-5.00 | 56 | 46 | 73 | 60 |
| 5.00-30.00 | 60 | 50 | 73 | 60 |

*Note: *Decreases linearly with the logarithm of the frequency*
*At the transition frequency the lower limit applies.*

4.6.2 Procedure

Measurements are carried out using quasi-peak and average detector receivers in accordance with CISPR 16. An AMN is required to provide a defined impedance at high frequencies across the power feed at the point of measurement of terminal voltage and also to provide isolation of the circuit under test from the ambient noise on the power lines. An AMN as defined in CISPR 16 shall be used.

The EUT is located so that the distance between the boundary of the EUT and the closest surface of the AMN is 0.8m.

Where a flexible mains cord is provided by the manufacturer, this shall be 1m long or if in excess of 1m, the excess cable is folded back and forth as far as possible so as to form a bundle not exceeding 0.4m in length.

The EUT is arranged and connected with cables terminated in accordance with the product specification.

Conducted disturbance is measured between the phase lead and the reference ground, and between the neutral lead and the reference ground. Both measured values are reported.

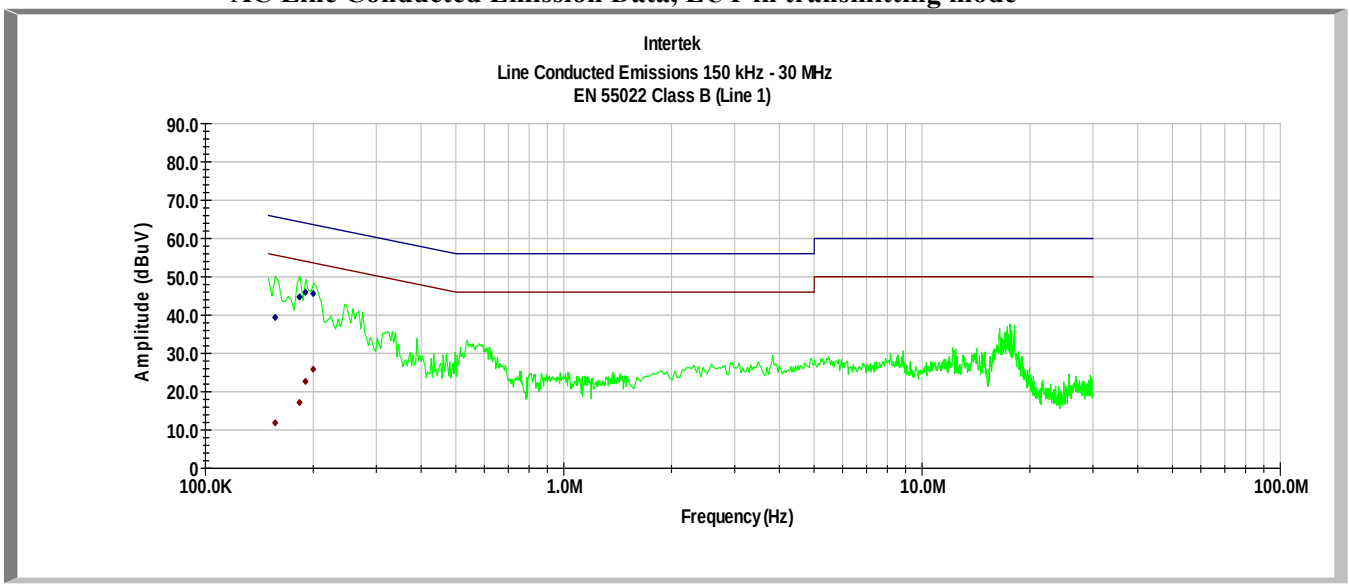
The EUT, where intended for tabletop use, is placed on a table whose top is 0.8m above the ground plane. A vertical, metal reference plane is placed 0.4m from the EUT. The vertical metal reference-plane is at least 2m by 2m. The EUT shall be kept at least 0.8m from any other metal surface or other ground plane not being part of the EUT. The table is constructed of non-conductive materials. Its dimensions are 1m by 1.5m, but may be extended for larger EUT.

Floor standing EUT are placed on a horizontal metal ground plane and isolated from the ground plane by resting on an insulating material. The metal ground plane extends at least 0.5m beyond the boundaries of the EUT and has minimum dimensions of 2m by 2m.

Equipment setup for conducted disturbance tests followed the guidelines of ANSI C63.4.

4.6.3 Test Result

**AC Line Conducted Emission Data, EUT in transmitting mode**




Intertek Testing Services
Line Conducted Emissions 150 kHz - 30 MHz
EN 55022 Class B (Line 1)

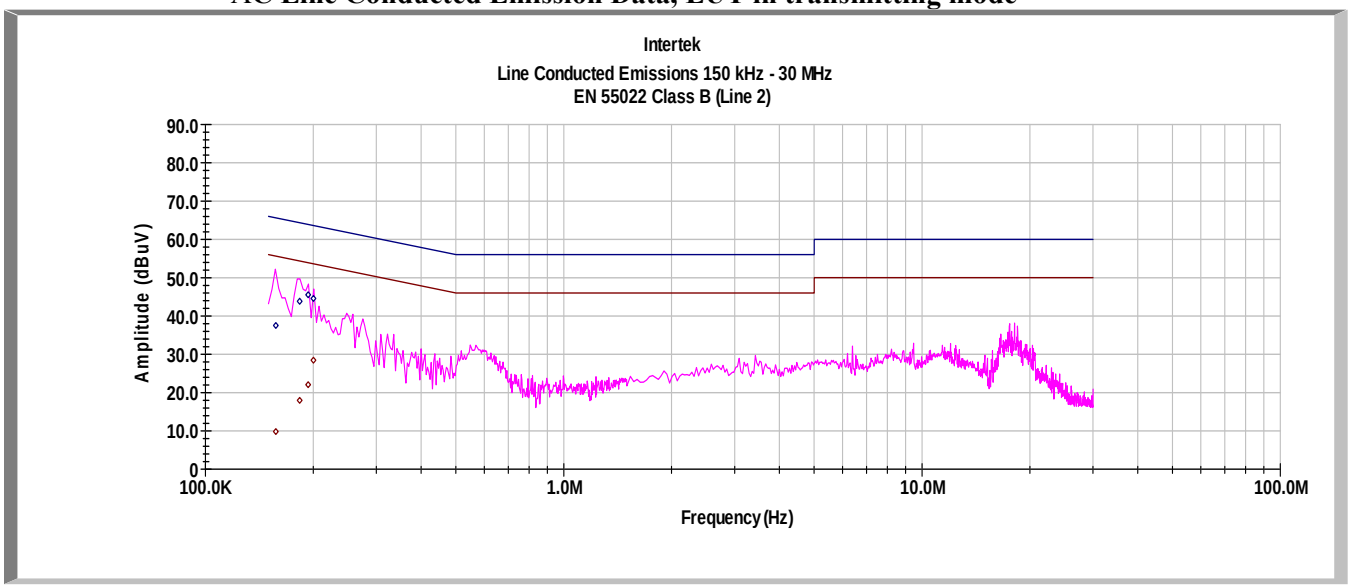
Operator: KK
19-Jul-13

Model Number: V1110
Company: Livescribe, Inc.

| Frequency | Av Level | QP Level | Av Limit | QP Limit | Av Margin | QP Margin |
|---|---|---|---|---|---|---|
| Hz | dBuV | dBuV | dBuV | dBuV | dB | dB |
| 156569 | 11.9 | 39.4 | 55.8 | 65.8 | -43.9 | -26.5 |
| 183070 | 17.2 | 44.7 | 55.1 | 65.1 | -37.9 | -20.3 |
| 190125 | 22.7 | 45.9 | 54.9 | 64.9 | -32.2 | -18.9 |
| 199818 | 25.8 | 45.6 | 54.6 | 64.6 | -28.7 | -19.0 |

Test Mode: 120V 60Hz, Transmit mode, FCC 15.207
Temp: 22.5C
Humidity: 50.5%

## AC Line Conducted Emission Data, EUT in transmitting mode




Intertek Testing Services
Line Conducted Emissions 150 kHz - 30 MHz
EN 55022 Class B (Line 1)

Operator: KK
19-Jul-13

Model Number: V1110
Company: Livescribe, Inc.

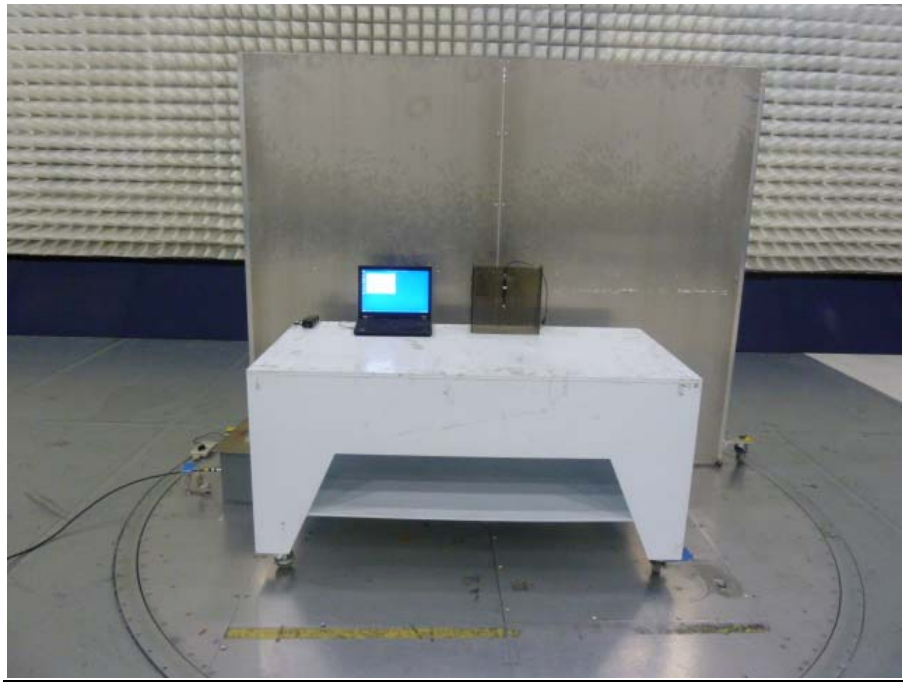
| Frequency | Av Level | QP Level | Av Limit | QP Limit | Av Margin | QP Margin |
|---|---|---|---|---|---|---|
| Hz | dBuV | dBuV | dBuV | dBuV | dB | dB |
| 157193 | 9.8 | 37.5 | 55.8 | 65.8 | -46.0 | -28.3 |
| 183244 | 18.0 | 43.8 | 55.1 | 65.1 | -37.1 | -21.2 |
| 193496 | 22.0 | 45.5 | 54.8 | 64.8 | -32.7 | -19.2 |
| 200111 | 28.4 | 44.6 | 54.6 | 64.6 | -26.1 | -20.0 |

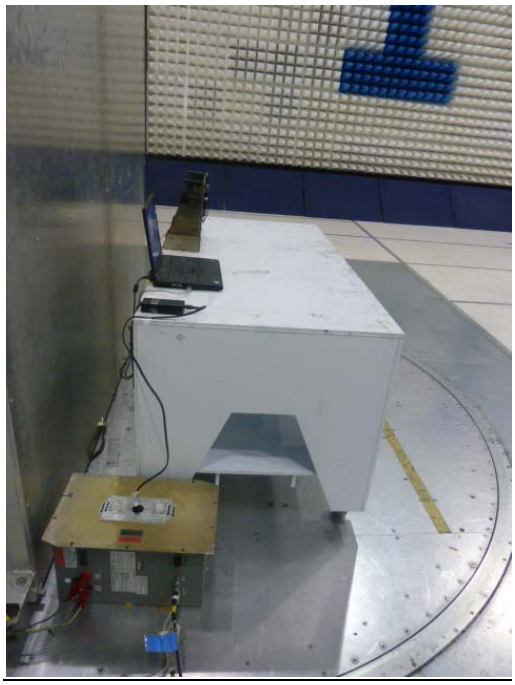
Test Mode: 120V 60Hz, Transmit mode, FCC 15.207
Temp: 22.5C
Humidity: 50.5%

| **Results** | **Complies** by 10.5dB |
|---|---|

4.6.4 Test setup photographs

**The following photographs show the testing configurations used.**





## 5.0 List of Test Equipment

Measurement equipment used for emission compliance testing utilized the equipment on the following list:

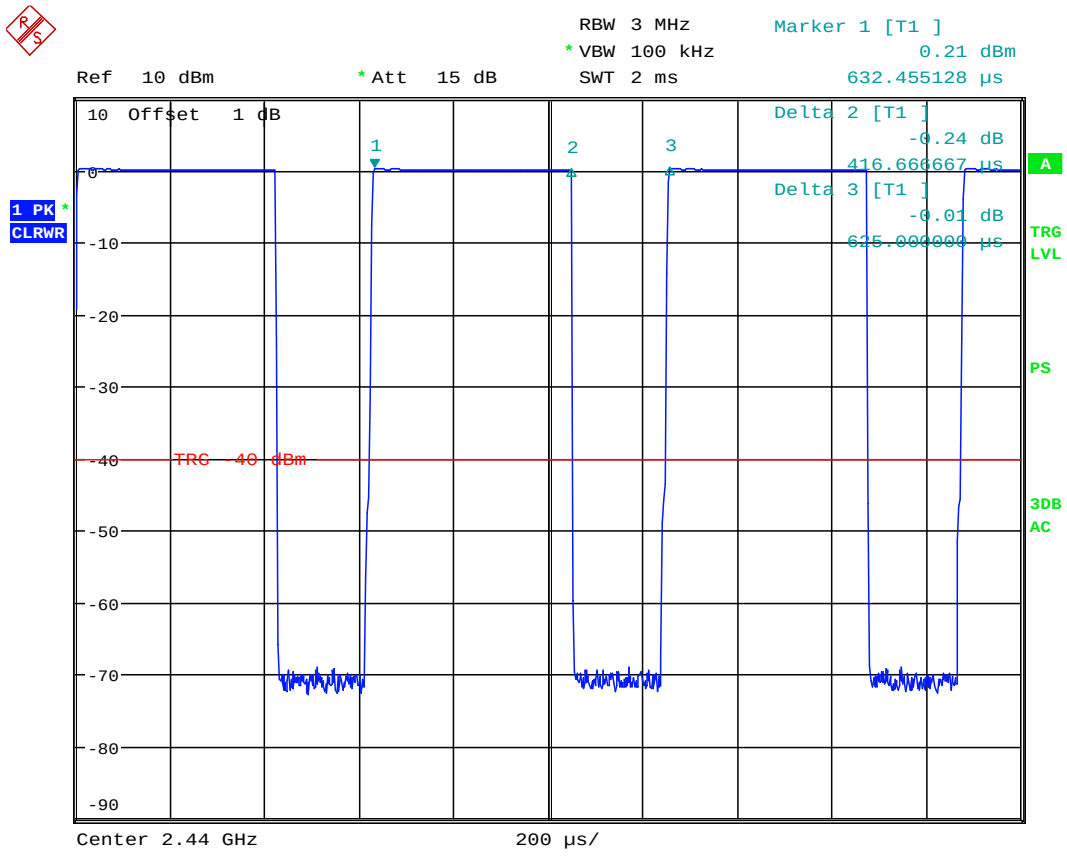
| Equipment | Manufacturer | Model/Type | Serial # | Cal Int | Cal Due |
|---|---|---|---|---|---|
| RF Filter Section | Hewlett Packard | 85460A | 3448A00267 | 12 | 03/12/14 |
| EMI Receiver | Hewlett Packard | 8546A | 3710A00373 | 12 | 03/12/14 |
| Spectrum Analyzer | Rohde&Schwarz | FSU | 200482 | 12 | 04/05/14 |
| Spectrum Analyzer | Rohde&Schwarz | FSP-40 | 100030 | 12 | 11/19/13 |
| EMI Receiver | Rohde and Schwartz | ESU | 100172 | 12 | 10/05/13 |
| BI-Log Antenna | ARA | LPB-2513/A | 1154 | 12 | 07/12/13 |
| BI-Log Antenna | Teseq | CBL 6111D | 31222 | 12 | 11/07/13 |
| Horn Antenna | EMCO | 3115 | 9107-3712 | 12 | 12/06/13 |
| Horn Antenna | EMCO | 3115 | 00126795 | 12 | 11/15/13 |
| Pyramidal Horn Antenna | EMCO | 3160-09 | Not Labeled | # | # |
| Pyramidal Horn Antenna | EMCO | 3160-10 | Not Labeled | # | # |
| Pre-Amplifier | Sonoma | 310N | 293620 | 12 | 11/20/13 |
| Pre-Amplifier | Miteq | AMF-4D-001180-24-10P | 799159 | 12 | 09/10/13 |
| Pre-Amplifier | Miteq | JSD44-18004000-30-5P | 1071636 | 12 | 05/03/14 |
| Signal Generator | Hewlett Packard | SMR40 | 100445 | 12 | 09/06/13 |
| LISN | FCC | FCC-LISN-50-50-M-H | 2011 | 12 | 02/28/14 |

# No Calibration required

## 6.0 Document History

| Revision/ Job Number | Writer Initials | Date | Change |
|---|---|---|---|
| 1.0 / G101220625 | KK | July 30, 2013 | Original document |
| | | | |

## Annex A - Duty Cycle Measurement




Duty Cycle
Date: 7.JUL.2013 09:36:42

Duty Cycle Correction Factor **δ(dB)** = 20 log (416.7/625.0) = -3.5 dB