

## TEST REPORT

**Report Number: 3193115MPK-008**

**Project Number: 3193115**

**Report Date: November 22, 2009**

**Testing performed on the  
PhaseNet Radio Receiver™  
Model: PhaseNet Radio Receiver  
FCC ID: U3DPHASENETR  
IC : 5349C-PHASENETR**

**to**

**FCC Part 15.247 and RSS-210 Issue 7  
For**

### **S&C Electric Company**

Test Performed by:  
Intertek  
1365 Adams Court  
Menlo Park, CA 94025


Test Authorized by:  
S&C Electric Company  
Automation Systems Division  
1135 Atlantic Avenue  
Alameda, CA 94501-1176 USA

Prepared by:

  
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Krishna K Vemuri

**Date:** November 22, 2009

Reviewed by:

  
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Ollie Moyrong

**Date:** November 22, 2009

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**Report No. 3193115MPK-008**

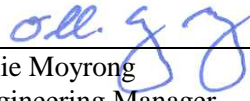
<b>Equipment Under Test:</b>	PhaseNet Radio Receiver <sup>TM</sup>
<b>Trade Name:</b>	S&C Electric Company
<b>Model No.:</b>	PhaseNet Radio Receiver
<b>FCC ID:</b>	U3DPHASENETR
<b>IC:</b>	5349C-PHASENETR
<b>Applicant:</b>	S&C Electric Company
<b>Contact:</b>	Mr. Dave Munoz
<b>Address:</b>	Automation Systems Division 1135 Atlantic Avenue Alameda, CA 94501-1176
<b>Country</b>	USA
<b>Tel. Number:</b>	714-247-8579
<b>Fax number:</b>	714-247-8678
<b>Applicable Regulation:</b>	FCC Part 15, Subpart C and RSS-210 Issue 7
<b>Test Site Location:</b>	ITS – Site 1 1365 Adams Drive Menlo Park, CA 94025
<b>Date of Test:</b>	November 09 to 13, 2009

*We attest to the accuracy of this report:*



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Krishna K Vemuri  
Test Engineer



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Ollie Moyrong  
Engineering Manager

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## 1.0 Introduction

The Equipment under Test (EUT) is a device with one IEEE 802.15.4 transceiver operating in the 2.4GHz frequency band.

This report is designed to show compliance of the 2.4 GHz transceiver with FCC Part 15.247 and RSS-210 requirements.

### 1.1 Summary of Tests

TEST	REFERENCE FCC 17.247	REFERENCE RSS-210	RESULTS
Output power	15.247(b)(3)	A8.4(4)	Complies
6-dB Bandwidth	15.247(a)(2)	A8.2(a)	Complies
Power Spectral Density	15.247(e)	A8.2(b)	Complies
Out-of-band Antenna Conducted Emission	15.247(d)	A8.5	Complies
Out-of-Band Radiated Emission (except emissions in Restricted Bands)	15.247(d)	A8.5	Complies
Radiated Emission in Restricted Bands	15.247(d), 15.205	2.2	Complies
RF exposure	15.247(i)	RSS-102	Complies
AC Conducted Emission	15.207	RSS-GEN	Complies
Radiated Emission from Digital Parts and receiver	15.109	ICES-003	Complies

## 2.0 General Description

### 2.1 Product Description

PhaseNet Radio Receiver can receive a variety of data from multiple transmitters using the IEEE 802.15.4 standard communications protocol.

#### Overview of the EUT

<b>Applicant</b>	S&C Electric Company Automation Systems Division 1135 Atlantic Avenue Alameda, CA 94501-1176 USA
<b>Manufacturer name &amp; address</b>	S&C Electric Company Automation Systems Division 1135 Atlantic Avenue Alameda, CA 94501-1176 USA
<b>Model No.</b>	PhaseNet Radio Receiver
<b>FCC Identifier</b>	U3DPHASENETR
<b>IC Number</b>	5349C-PHASENETR
<b>Use of Product</b>	Receiving multiple sensor information or other data for application on the electrical power grid
<b>Type of Transmission</b>	IEEE 802.15.4
<b>Rated RF Output</b>	0.37 mW
<b>Frequency Range</b>	2405-2480 MHz
<b>Number of Channel(s)</b>	16
<b>Modulation Type</b>	Offset-Quadrature Phase Shift Keying (O-QPSK)
<b>Data Rate</b>	250Kbps
<b>Antenna(s) type &amp; Gain</b>	On-board antenna, Gain: 3.3dBi or External antenna, Phantom Antenna, Permanent mount/NGP connector, Gain: 3dBi

A pre-production version of the sample was received on November 09, 2009 in good condition. As declared by the Applicant, it is identical to production units.

Test start date November 09, 2009

Test end date: November 13, 2009

### 2.2 Related Submittal(s) Grants

None.

### 2.3 Test Methodology

Radiated and AC Line conducted emissions measurements were performed according to the procedures in ANSI C63.4 (2003). Radiated tests were performed at an antenna to EUT distance of 3 meters, unless stated otherwise in the "**Data Sheet**" of this Application. All other measurements were made in accordance with the procedures described in DA 00-705.

### 2.4 Test Facility

Then radiated emission test site and conducted measurement facility used to collect the data is 10m semi-anechoic chamber located in Menlo Park, California. This test facility and site measurement data have been fully placed on file with the FCC.

## 3.0 System Test Configuration

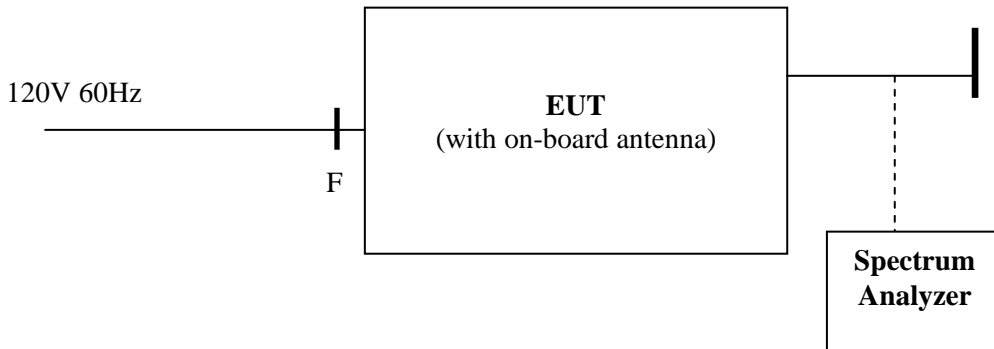
### 3.1 Support Equipment

None. The EUT is a stand-alone system.

### 3.2 Block Diagram of Test Setup

The diagram shown below details the interconnection of the EUT and support equipment. For specific layout, refer to the test configuration photograph in the relevant section of this report.

On-board antenna and external antenna was used for Radiated Measurements.  
Antennas were removed for Conducted Measurements



**F:** Wurth Elektronik Ferrite, Part#742 712 22.

<b>S</b> = Shielded <b>U</b> = Unshielded	<b>F</b> = With Ferrite <b>m</b> = Length in Meters
--	--

### 3.3 Justification

For radiated emission measurements the EUT is placed on a non-conductive table. The EUT is wired to transmit full power.

EUT was controlled manually to set the radio in different channels during the tests.

The following are the channel numbers and channel frequencies tested.

<b>Channel Selected</b>	<b>Channel number</b>	<b>Frequency MHz</b>
Lower test channel	Channel 00	2405MHz
Middle test channel	Channel 07	2440MHz
Upper test channel	Channel 15	2480MHz

EUT can be operated with On-board antenna or External antenna. Hence all radiated measurements were performed separately with On-board antenna and External antenna. Both antennas were removed during all conducted measurements.

### 3.4 Software Exercise Program

None.

### 3.5 Mode of Operation During Test

The EUT was set at one of channels (low, middle, high) during the tests.

### 3.6 Modifications Required for Compliance

No modifications were installed by Intertek Testing Services during compliance testing in order to bring the product into compliance (Please note that this list does not include changes made specifically by S&C Electric Company prior to compliance testing).



## 4.0 Measurement Results

### 4.1 Conducted Output Power at Antenna Terminals FCC 15.247(b)(3)

#### Requirements

For systems operating in the 2400-2483.5 MHz band using digital modulation, the maximum peak output power is 1 watt (30 dBm), the conducted power limit is based on the use of antenna with directional gain that do not exceed 6dBi. If the transmitting antenna of directional gain greater than 6dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated value as in FCC 15.247(b)(4)(i).

#### Procedure

The antenna port of the EUT was connected to the input of a spectrum analyzer. Power was read directly and cable loss correction was added to the reading to obtain the power at the EUT antenna terminal.

#### Test Results

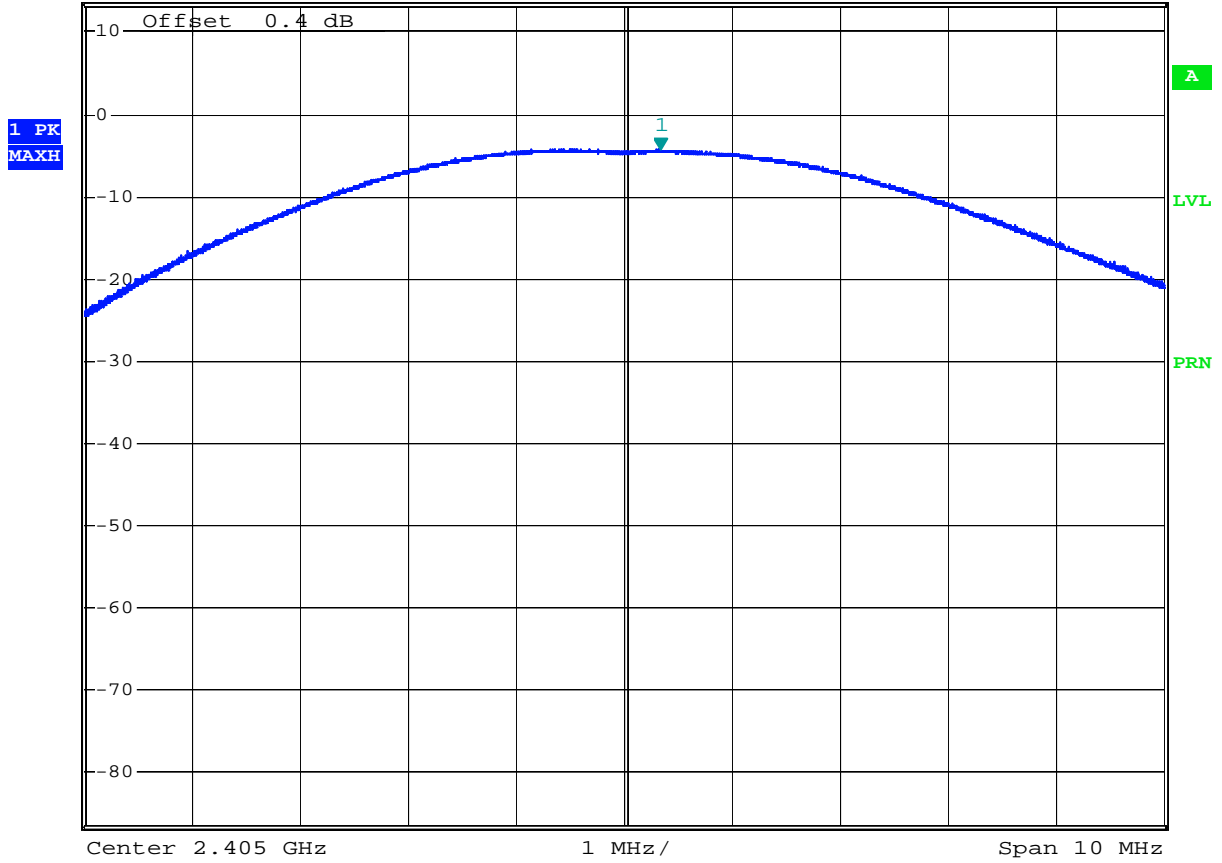
Frequency (MHz)	Output in dBm	Output in mW	Plot number
2405	-4.3	0.37	1.1
2440	-4.9	0.32	1.2
2475	-5.2	0.30	1.3
2480	-9.9	0.10	1.4

Notes: The EUT's antenna has less than 6 dBi gain.

Plot 1.1



\*RBW 3 MHz      Marker 1 [T1 ]  
 \*VBW 3 MHz      -4.34 dBm  
 Ref 13.4 dBm      Att 50 dB      SWT 40 ms      2.405330000 GHz

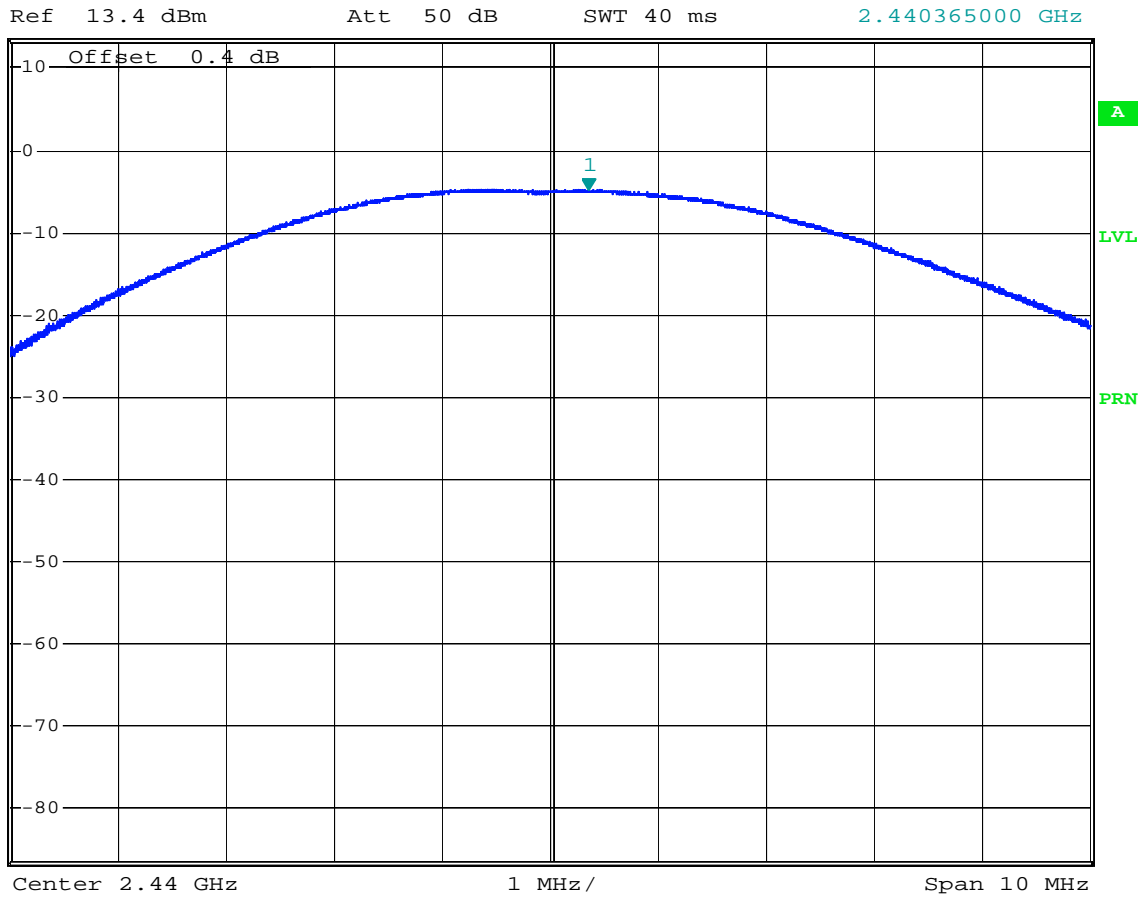


Comment: Conducted output power  
 Date: 10.NOV.2009 15:26:23

Plot 1.2



\*RBW 3 MHz      Marker 1 [T1 ]  
\*VBW 3 MHz      -4.87 dBm  
SWT 40 ms      2.440365000 GHz



Comment: Conducted output power  
Date: 10.NOV.2009 15:25:25

Plot 1.3

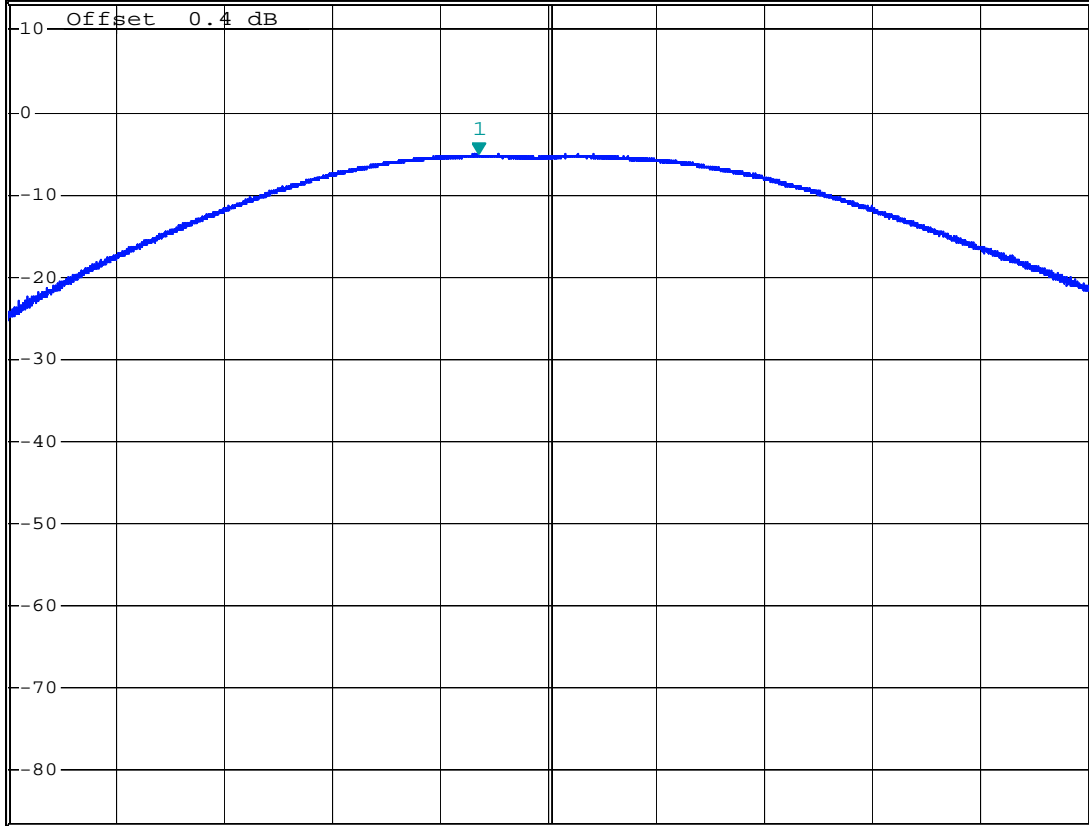


\*RBW 3 MHz      Marker 1 [T1 ]  
\*VBW 3 MHz      -5.19 dBm  
SWT 40 ms      2.474350000 GHz

Ref 13.4 dBm

Att 50 dB

1 PK  
MAXH



Center 2.475 GHz

1 MHz/

Span 10 MHz

Comment: Conducted output power  
Date: 10.NOV.2009 15:28:38

Plot 1.4

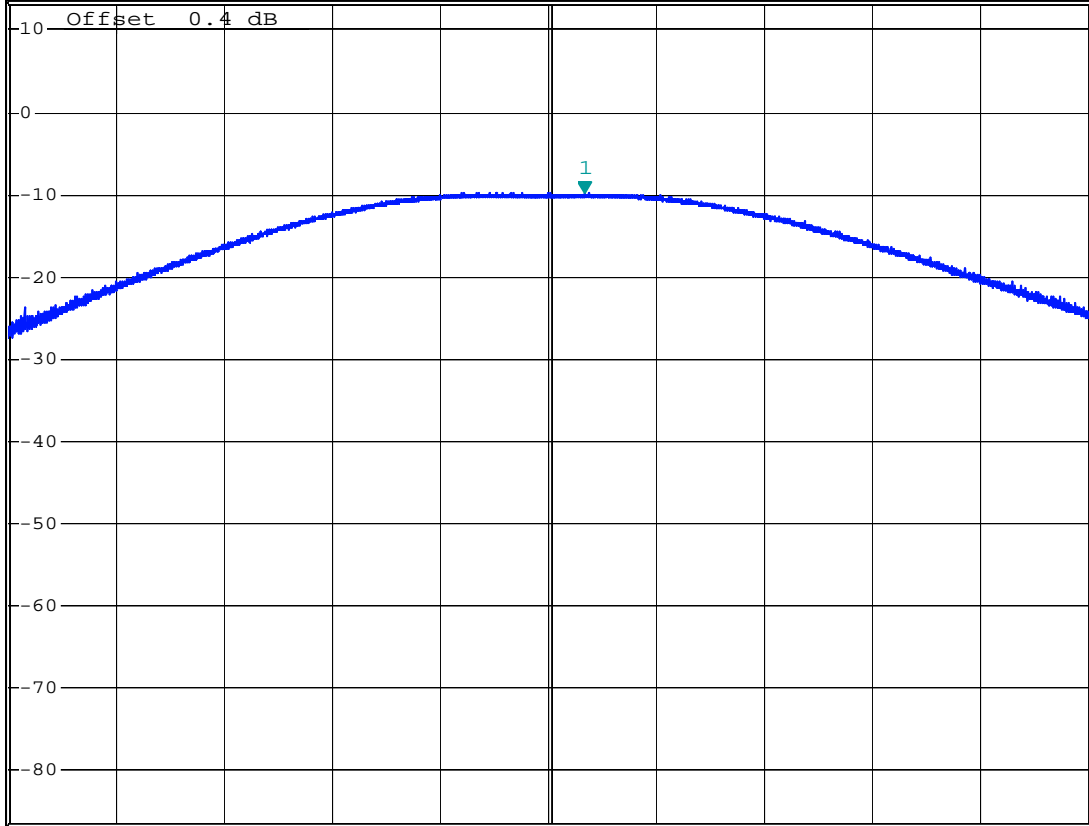


\*RBW 3 MHz      Marker 1 [T1 ]  
 \*VBW 3 MHz      -9.86 dBm  
 SWT 40 ms      2.480337500 GHz

Ref 13.4 dBm

Att 50 dB

1 PK  
 MAXH



Comment: Conducted output power  
 Date: 10.NOV.2009 15:24:04

4.2 6-dB Bandwidth  
FCC 15.247(a)(2)

Requirements

For systems operating in the 2400-2483.5 MHz band using digital modulation, the minimum 6-dB Bandwidth shall be at least 500kHz.

Procedure

The antenna port of the EUT was connected to the input of a spectrum analyzer. The spectrum analyzer resolution bandwidth was set to approximately 1% of the total emission bandwidth,  $VBW > RBW$ . The 6-dB Bandwidth was measured by using the DELTA MARKER function of the analyzer.

In addition, the occupied bandwidth (99%) was measured.

Test Results

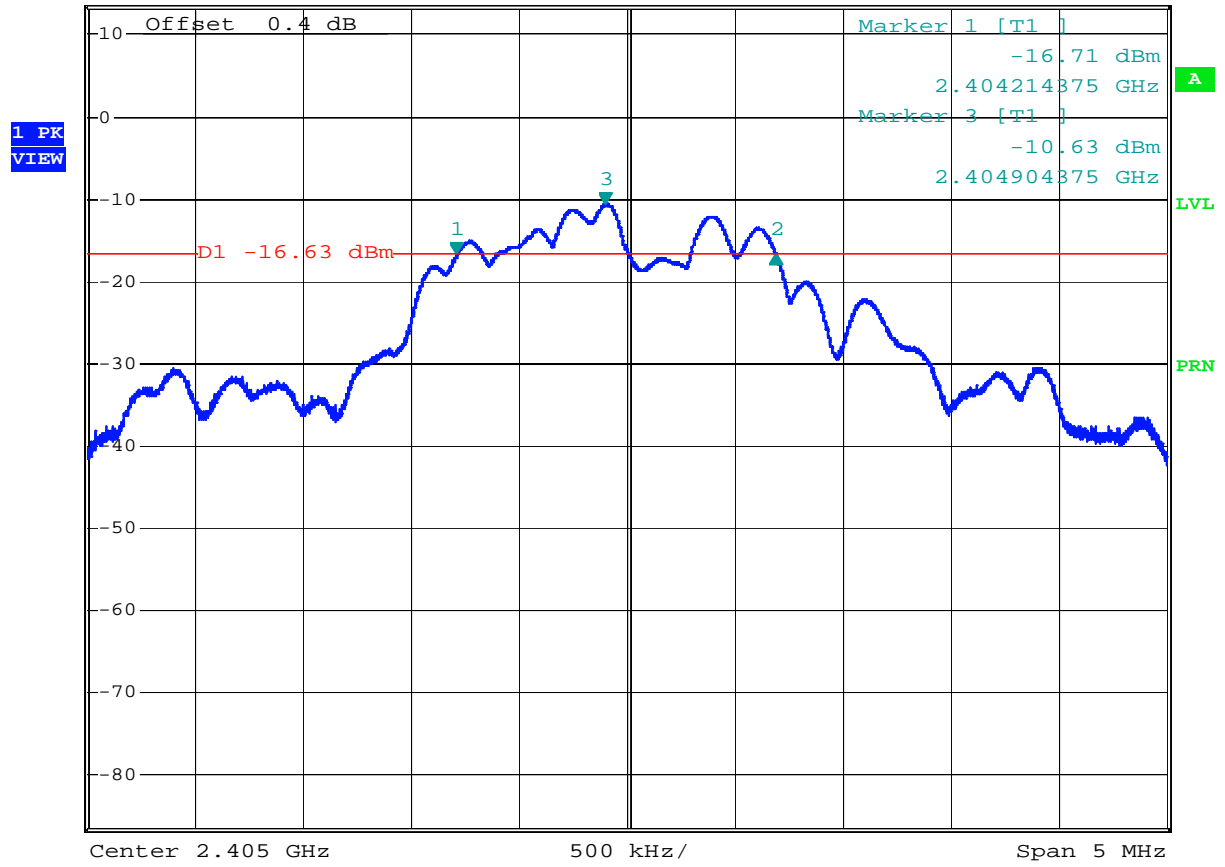
Frequency (MHz)	6-dB channel bandwidth (MHz)	Plot
2405	2.404	2.1
2440	2.439	2.2
2480	2.479	2.3

Frequency (MHz)	Occupied bandwidth (MHz)	Plot
2405	2.761	2.4
2440	2.703	2.5
2480	2.631	2.6

Plot 2.1



\*RBW 100 kHz Delta 2 [T1 ]  
 \*VBW 100 kHz -0.07 dB  
 Ref 13.4 dBm Att 50 dB SWT 40 ms 1.475000000 MHz

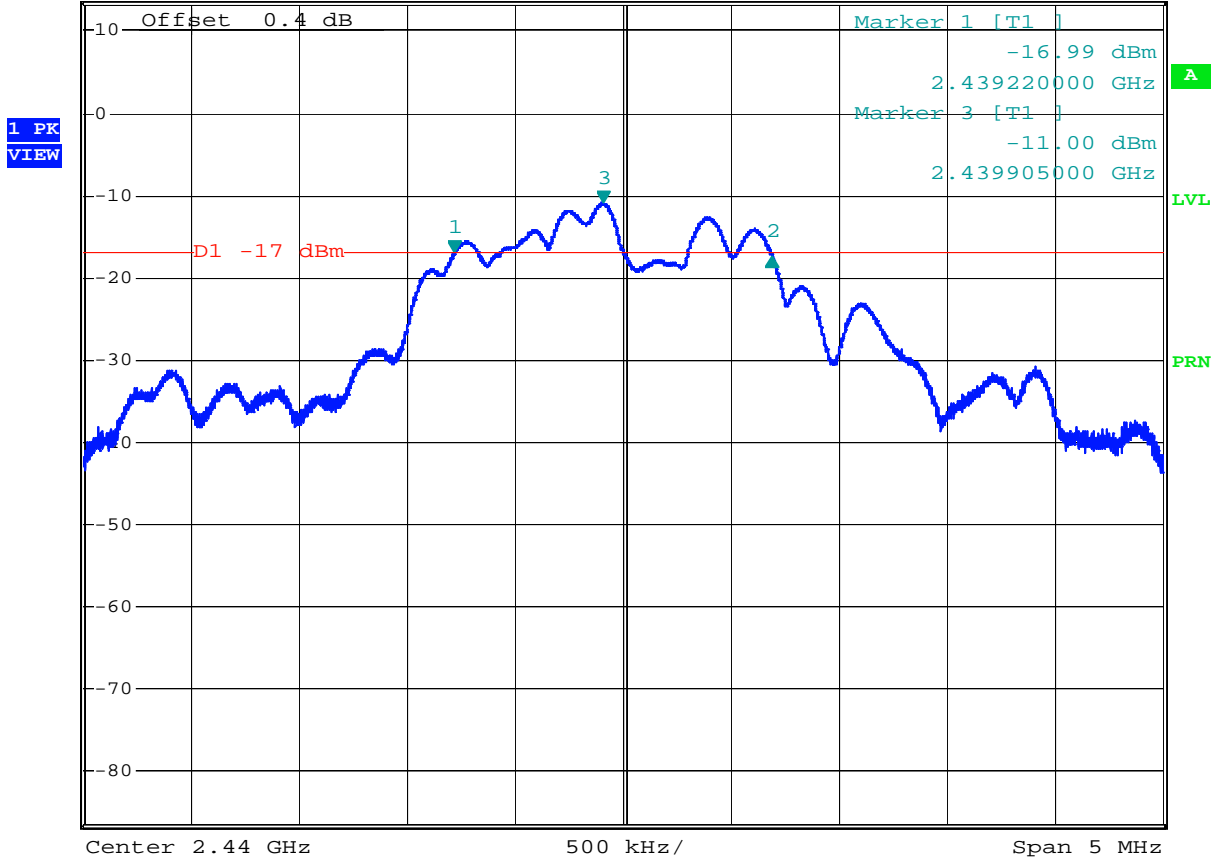


Comment: 6dB Bandwidth  
 Date: 10.NOV.2009 15:36:55



Plot 2.2

\*RBW 100 kHz Delta 2 [T1 ]  
 \*VBW 100 kHz -0.48 dB  
 Ref 13.4 dBm Att 50 dB SWT 40 ms 1.470000000 MHz



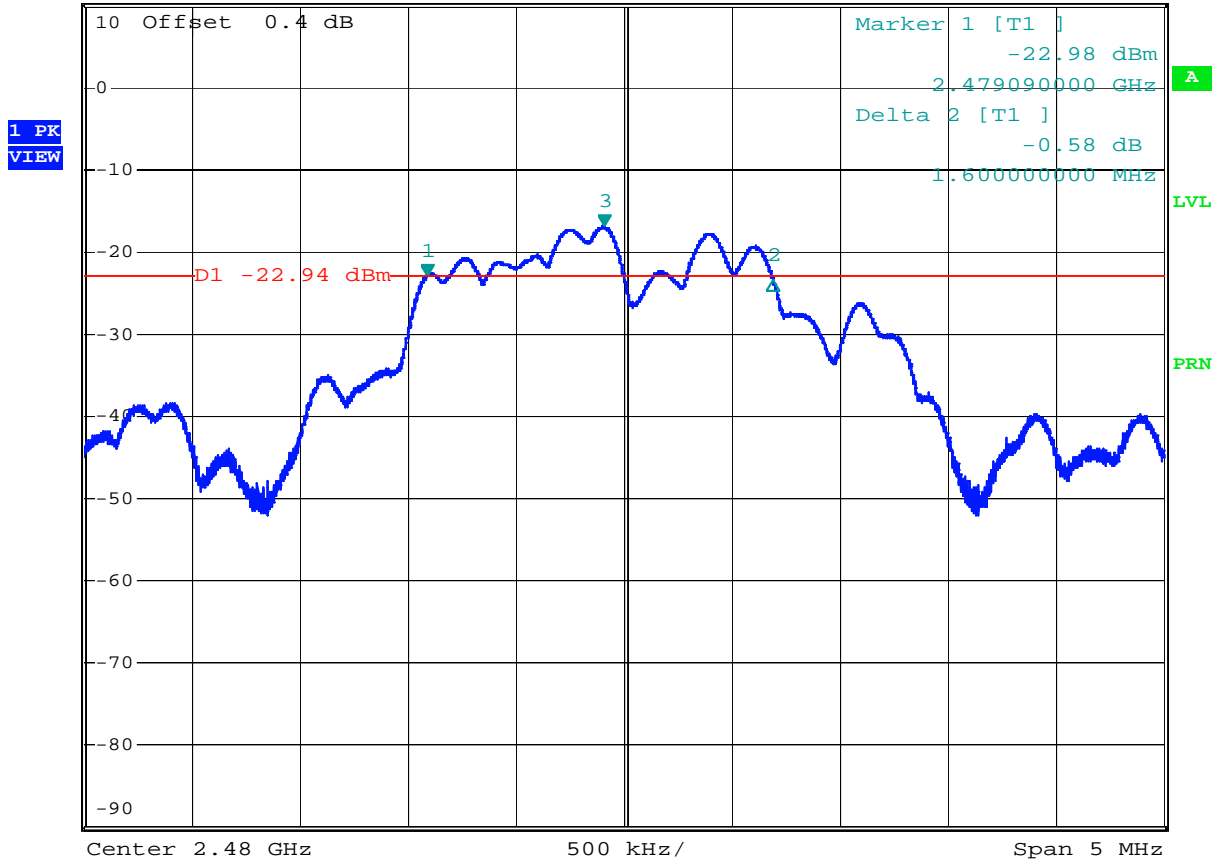
Comment: 6dB Bandwidth  
 Date: 10.NOV.2009 15:39:56



Plot 2.3



\*RBW 100 kHz    Marker 3 [T1 ]  
 \*VBW 100 kHz                    -16.94 dBm  
 Ref 10 dBm                    Att 40 dB                    SWT 40 ms                    2.479908125 GHz



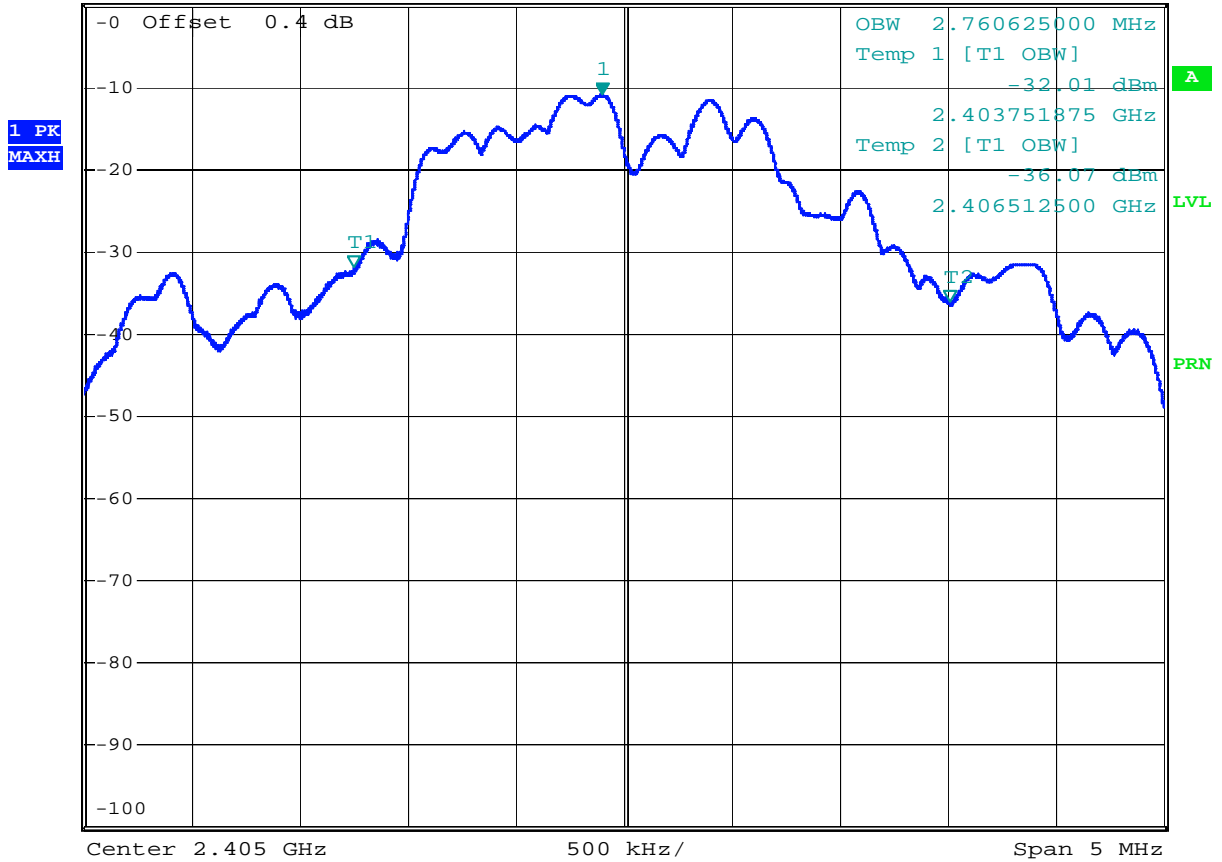
Comment: 6dB Bandwidth  
 Date: 10.NOV.2009 15:43:20

Plot 2.4



\*RBW 100 kHz    Marker 1 [T1 ]  
 \*VBW 100 kHz                                 -10.98 dBm

Ref 0 dBm                                 Att 20 dB                                 SWT 40 ms                                 2.404898750 GHz



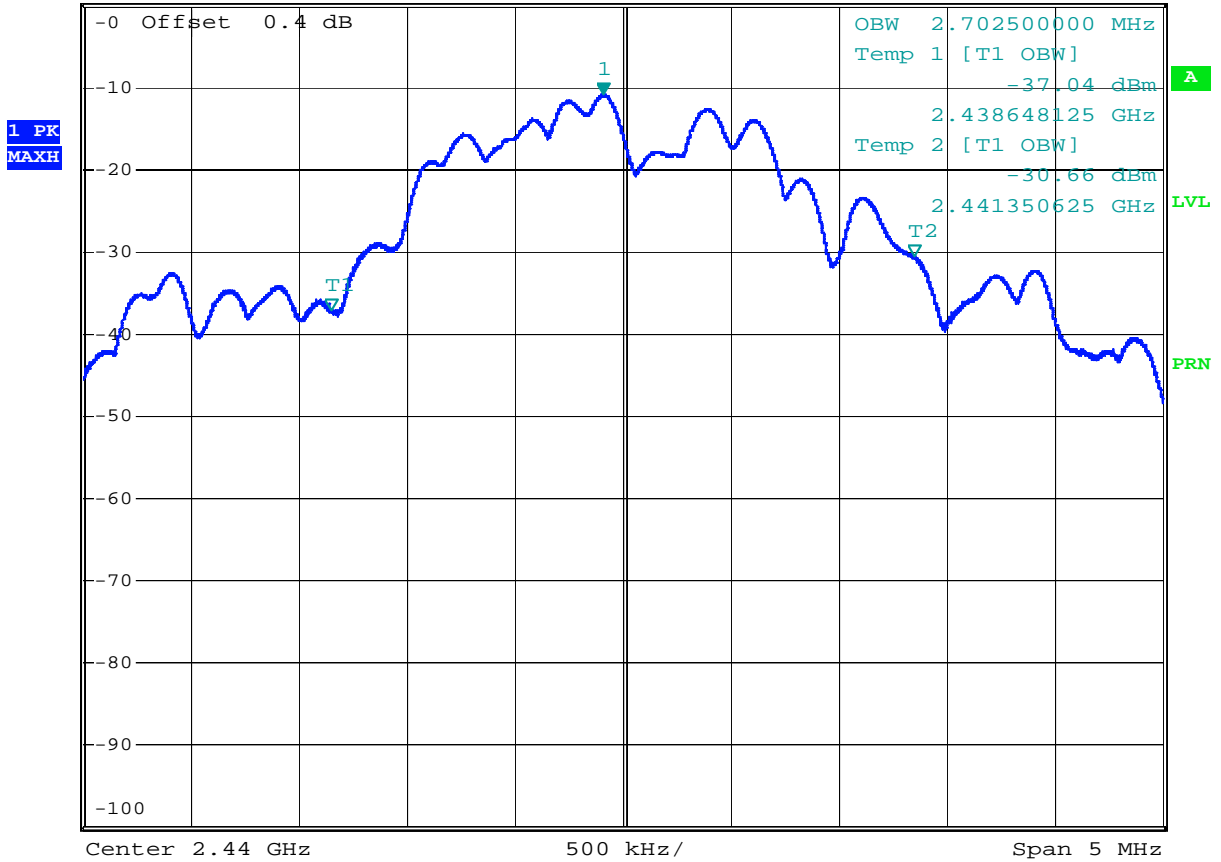
Comment: Occupied Bandwidth

Date: 10.NOV.2009 15:48:53



Plot 2.5

\*RBW 100 kHz    Marker 1 [T1 ]  
 \*VBW 100 kHz                    -10.97 dBm  
 Ref 0 dBm                    Att 20 dB                    SWT 40 ms                    2.439908750 GHz

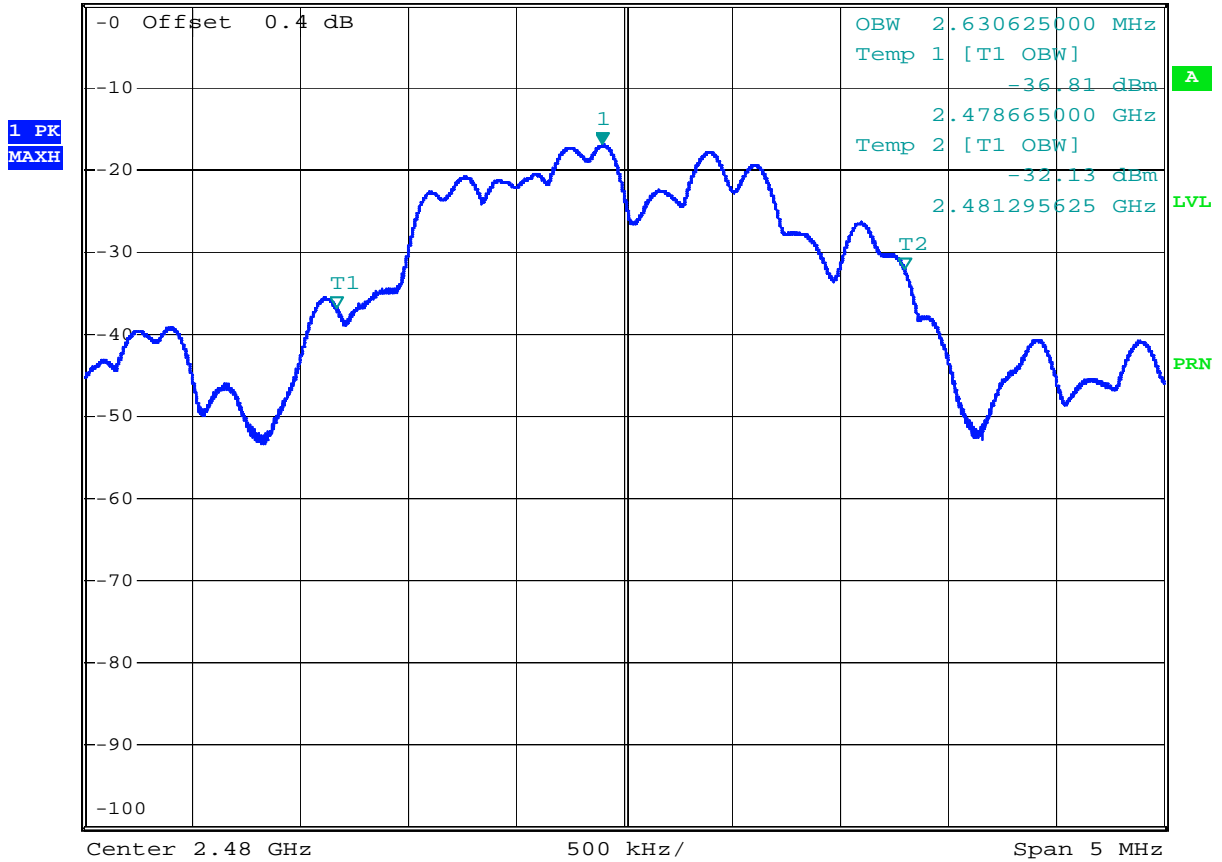


Comment: Occupied Bandwidth  
 Date: 10.NOV.2009 15:47:26

Plot 2.6



\*RBW 100 kHz    Marker 1 [T1 ]  
 \*VBW 100 kHz                    -17.04 dBm  
 Ref 0 dBm                    Att 20 dB                    SWT 40 ms                    2.479898750 GHz



Comment: Occupied Bandwidth  
 Date: 10.NOV.2009 15:46:22

#### 4.3 Out-of Band-Conducted Emissions FCC 15.247(d)

##### Requirement

In any 100 kHz bandwidth outside the EUT pass-band, the RF power shall be at least 20 dB below that of the maximum in-band 100 kHz emission.

##### 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 out-of-band emission measurements were performed. The out-of-band emissions were measured from 30 MHz to 25 GHz.

##### Test Result

Refer to the following plots for the test result:

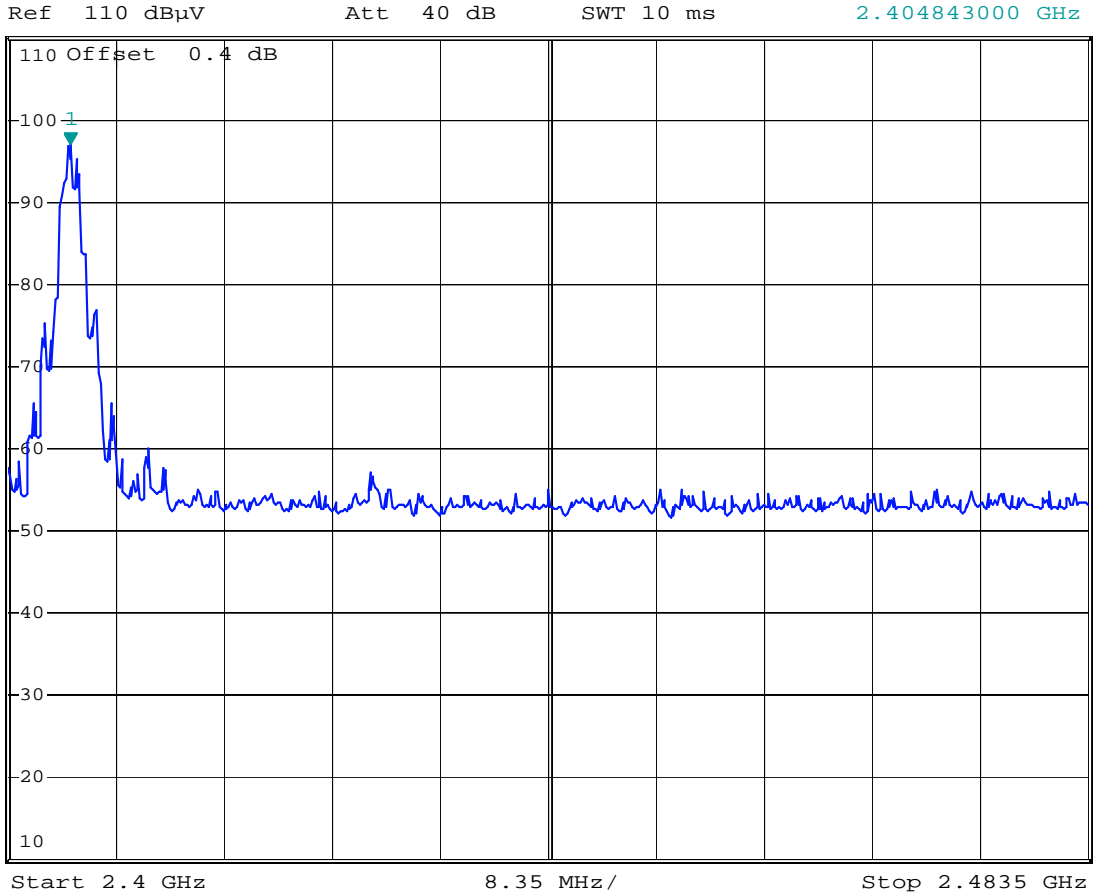
Description	Comments	Plot number
In-band Emissions, F=2405 MHz		6.1
In-band Emissions, F=2441 MHz		6.5
In-band Emissions, F=2480 MHz		6.9
Emissions on the low band-edge frequency	Fixed channel, 2405 MHz	6.13
Emissions on the high band-edge frequency	Fixed channel, 2480 MHz	6.14
Out-of-band low Channel Emissions	Fixed channel, 2405 MHz	6.2 – 6.4
Out-of-band middle Channel Emissions	Fixed channel, 2441 MHz	6.6 – 6.8
Out-of-band high Channel Emissions	Fixed channel, 2480 MHz	6.10 – 6.12

The attenuation is more than 20 dB.

Plot 3.1



\*RBW 100 kHz    Marker 1 [T1 ]  
\*VBW 100 kHz                    96.91 dBµV  
SWT 10 ms                            2.404843000 GHz

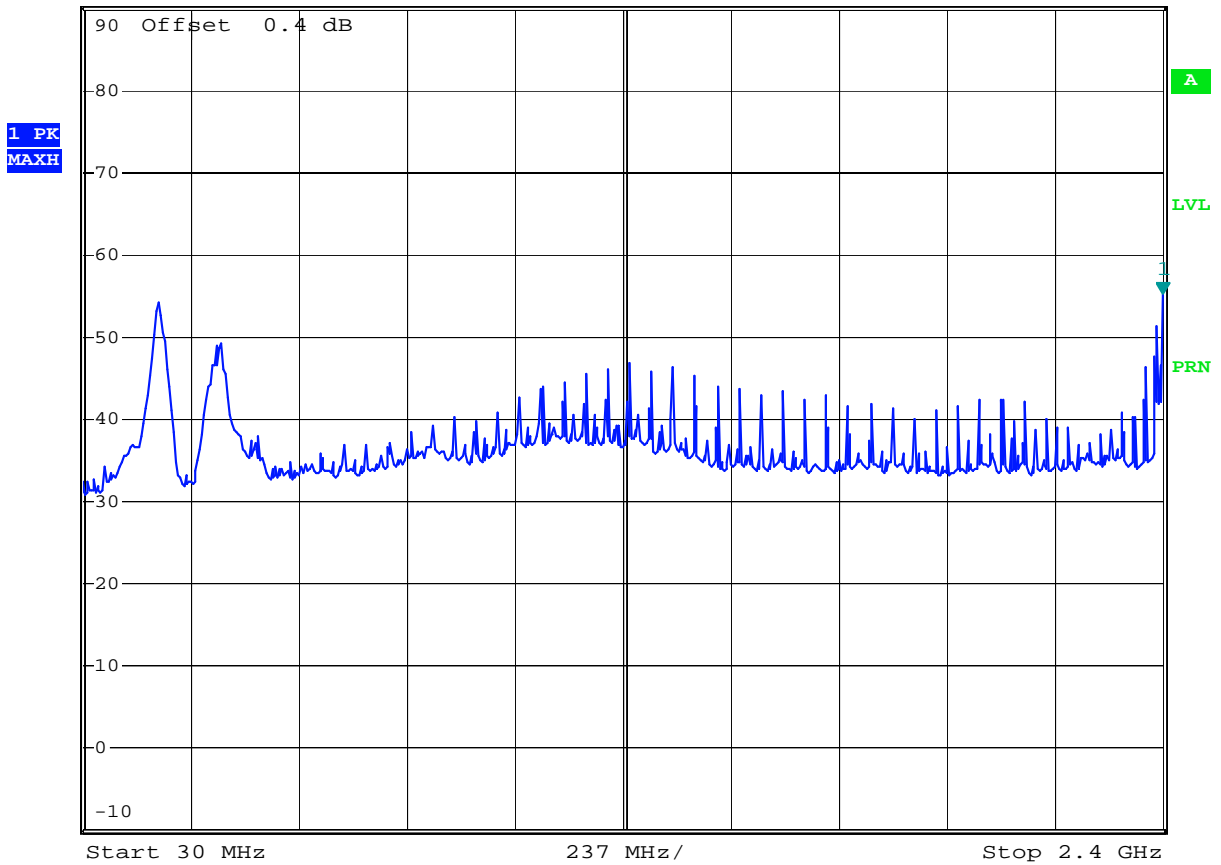


Comment: In-band emissions, Freq 2405 MHz  
Date: 11.NOV.2009 08:19:49



Plot 3.2

\*RBW 100 kHz    Marker 1 [T1 ]  
\*VBW 100 kHz                    55.30 dBμV  
Ref 90 dBμV                    Att 20 dB                    SWT 240 ms                    2.40000000 GHz

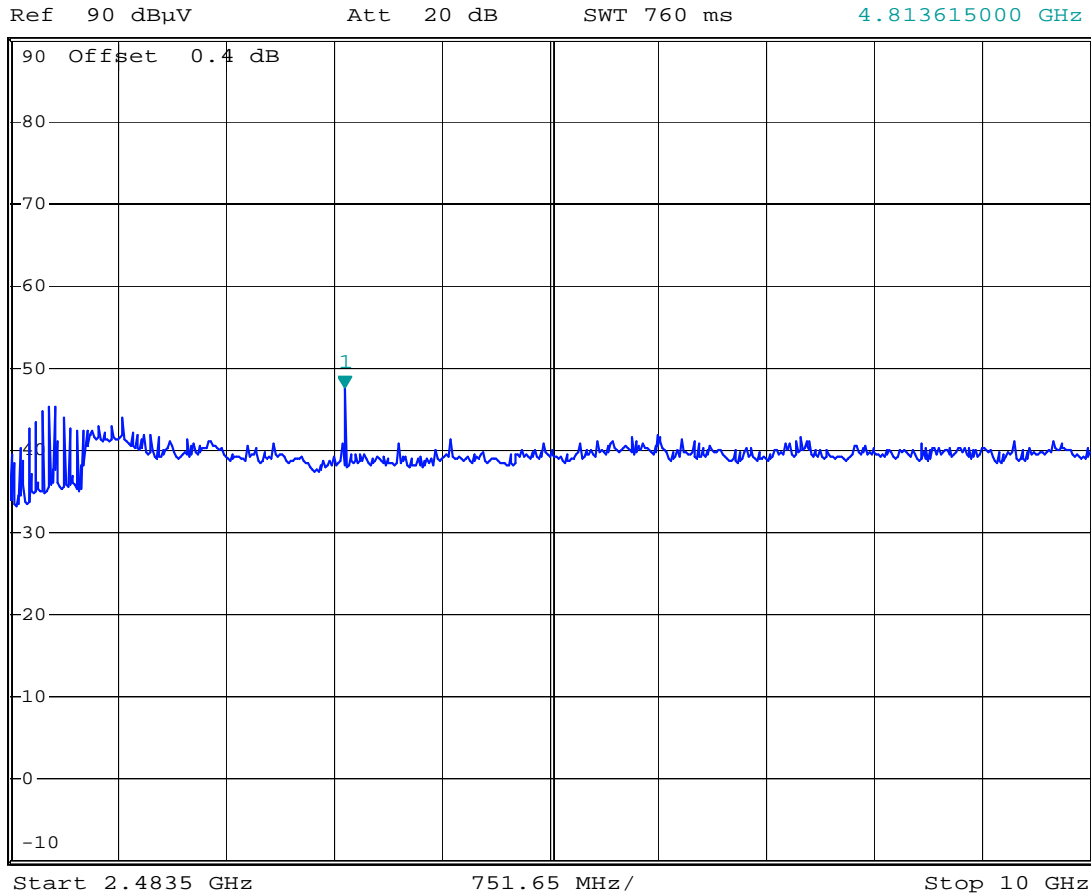


Comment: Spurious emissions, Freq 2405 MHz  
Date: 11.NOV.2009 08:21:06



Plot 3.3

\*RBW 100 kHz    Marker 1 [T1 ]  
\*VBW 100 kHz                    47.74 dBμV  
SWT 760 ms                        4.813615000 GHz



Comment: Spurious emissions, Freq 2405 MHz  
Date: 11.NOV.2009 08:21:49

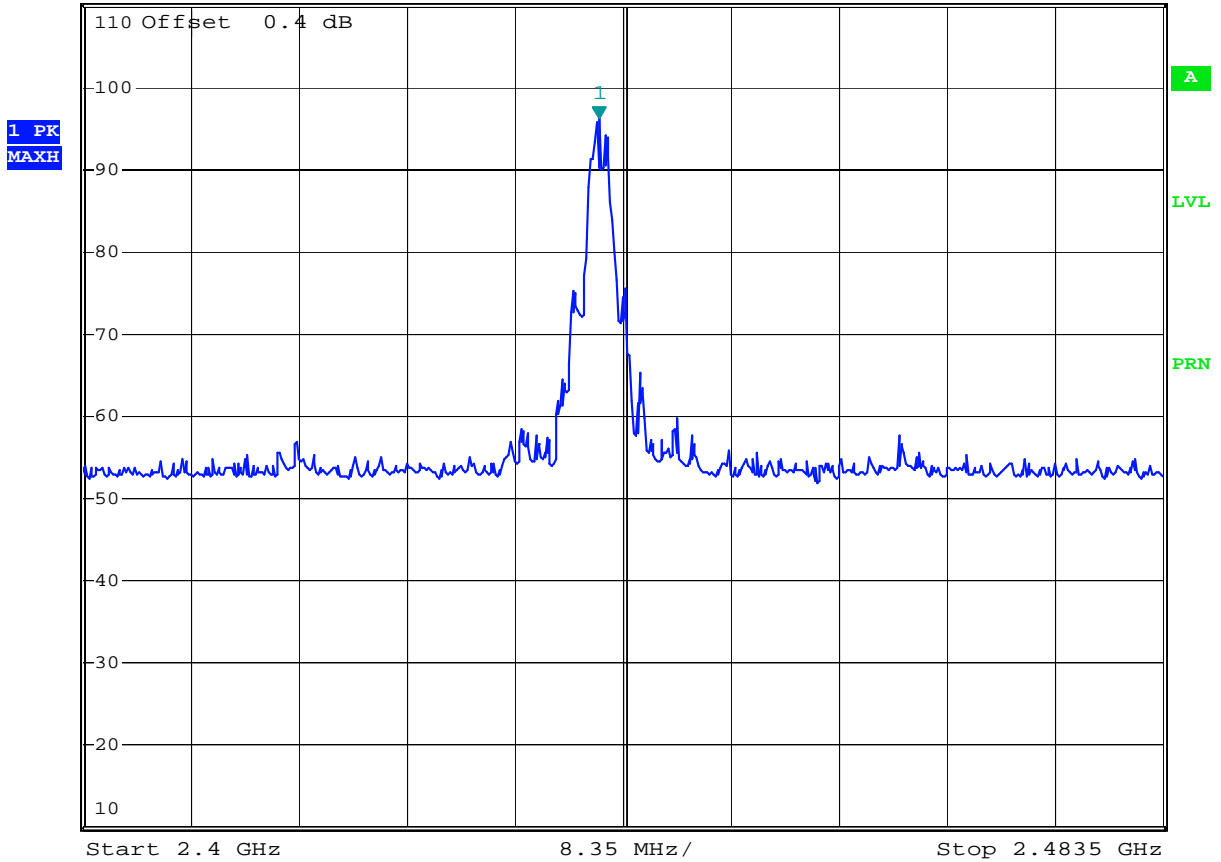






Plot 3.5

\*RBW 100 kHz    Marker 1 [T1 ]  
 \*VBW 100 kHz                    96.33 dBμV  
 Ref 110 dBμV                    Att 40 dB                    SWT 10 ms                    2.439913000 GHz



Comment: In-band emissions, Freq 2440 MHz  
 Date: 11.NOV.2009 08:23:59

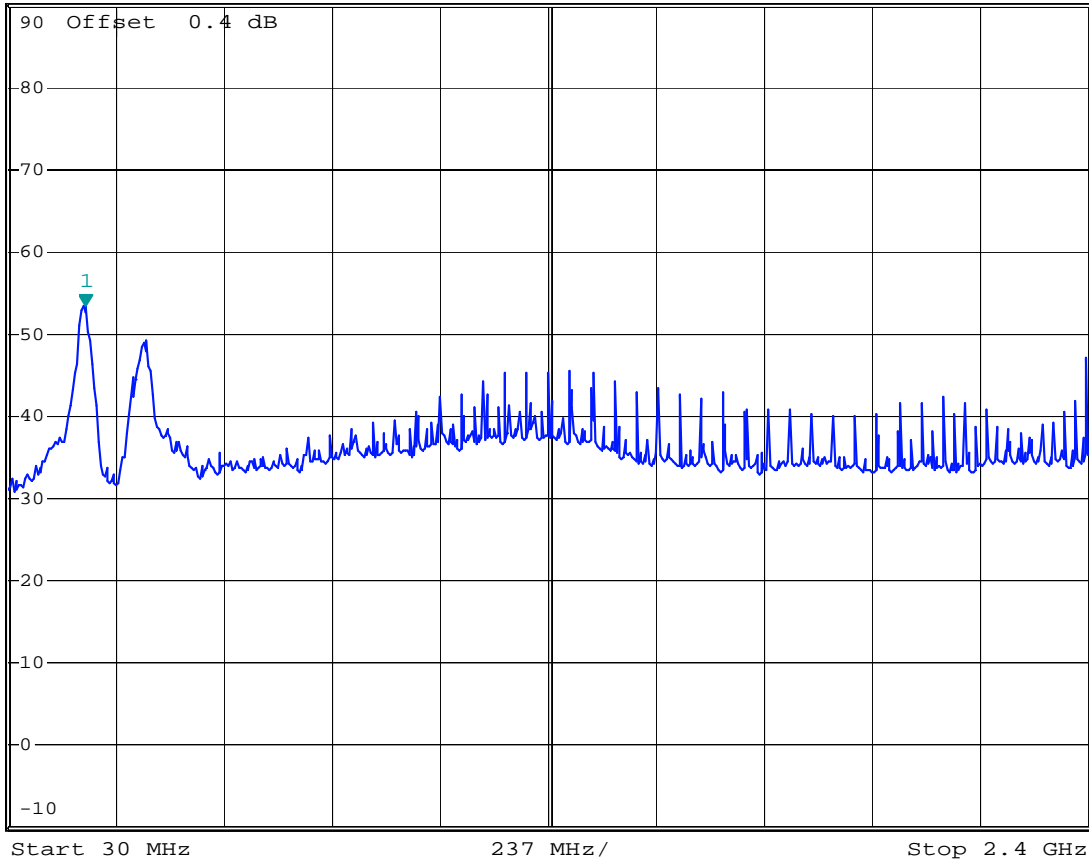
Plot 3.6



\*RBW 100 kHz    Marker 1 [T1 ]  
\*VBW 100 kHz                    53.40 dBμV  
SWT 240 ms                    200.64000000 MHz

Ref 90 dBμV                    Att 20 dB

1 PK  
MAXH

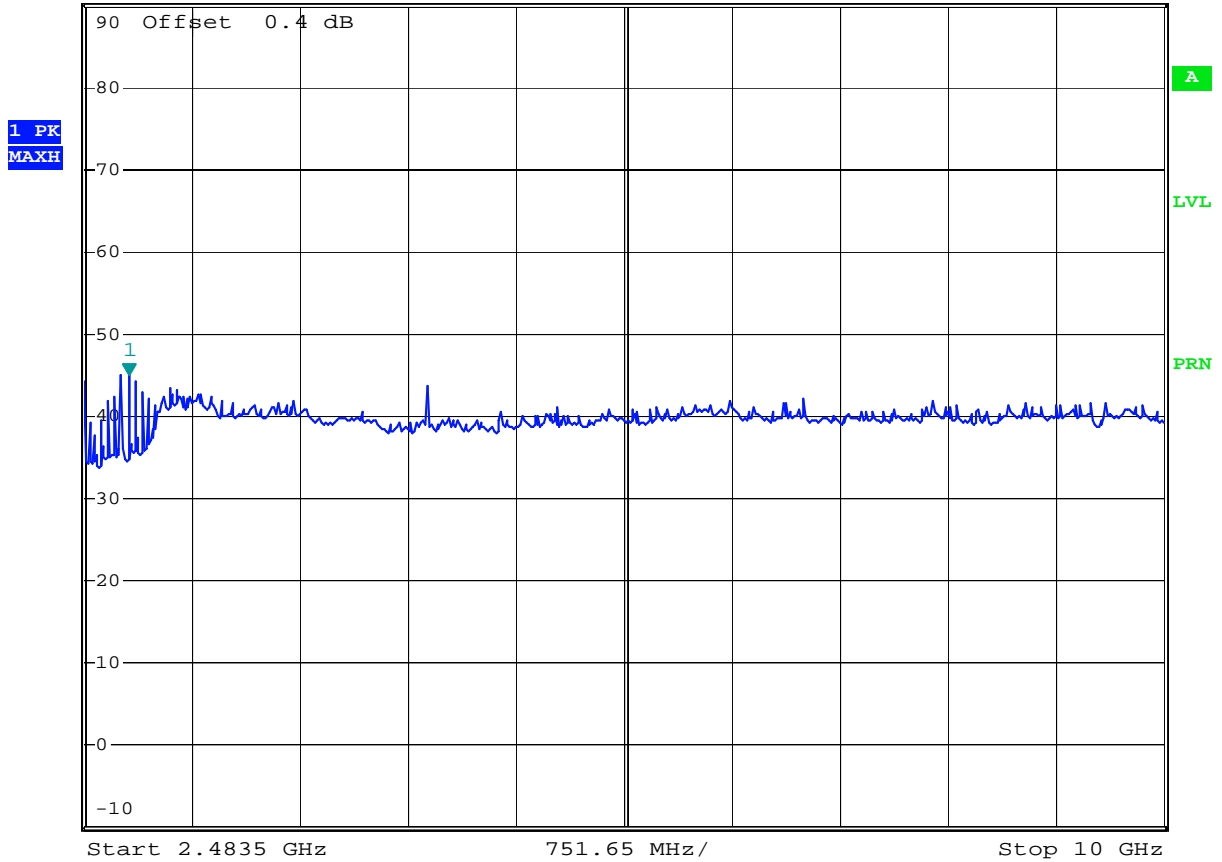


Comment: Spurious emissions, Freq 2440 MHz  
Date: 11.NOV.2009 08:24:50

Plot 3.7



\*RBW 100 kHz    Marker 1 [T1 ]  
 \*VBW 100 kHz    44.98 dBμV  
 Ref 90 dBμV    Att 20 dB    SWT 760 ms    2.799193000 GHz



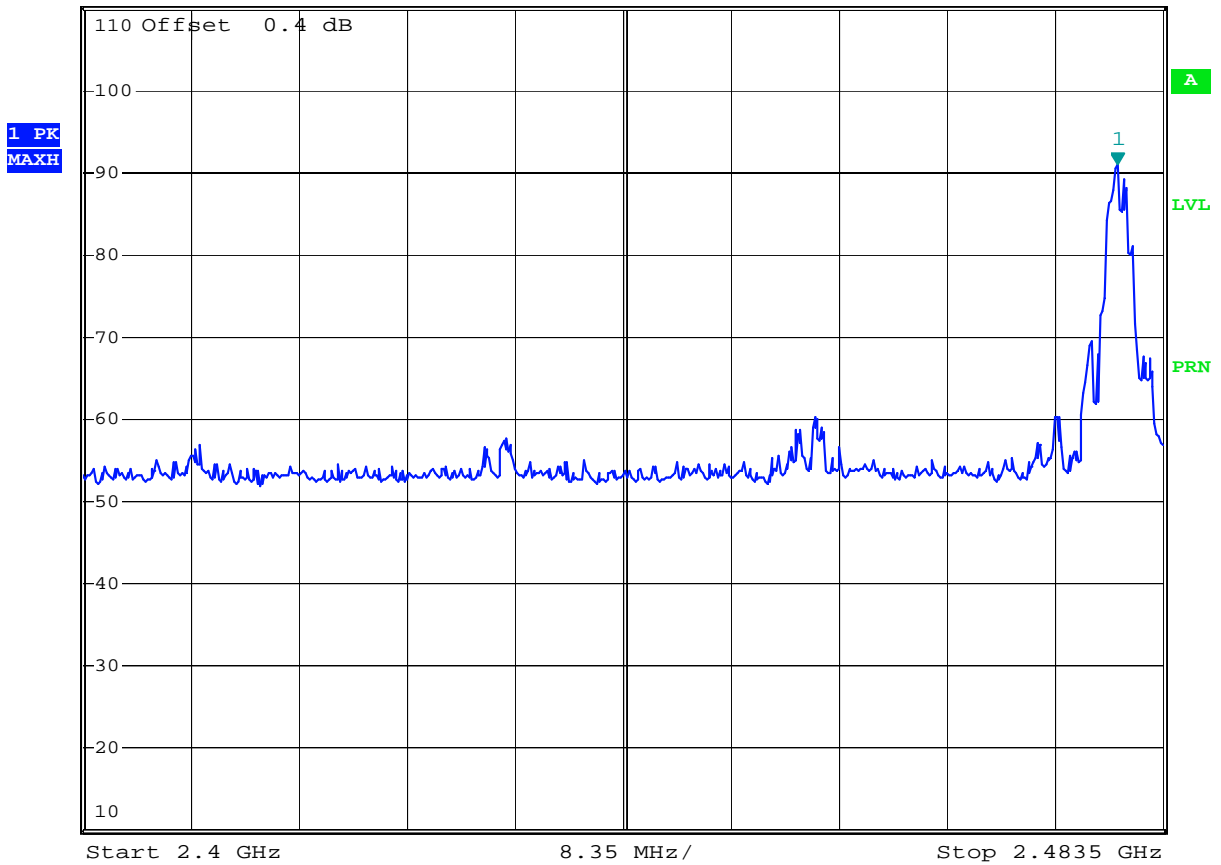
Comment: Spurious emissions, Freq 2440 MHz  
 Date: 11.NOV.2009 08:25:53



Plot 3.9



\*RBW 100 kHz    Marker 1 [T1 ]  
 \*VBW 100 kHz               90.97 dBμV  
 Ref 110 dBμV      Att 40 dB      SWT 10 ms      2.479993000 GHz



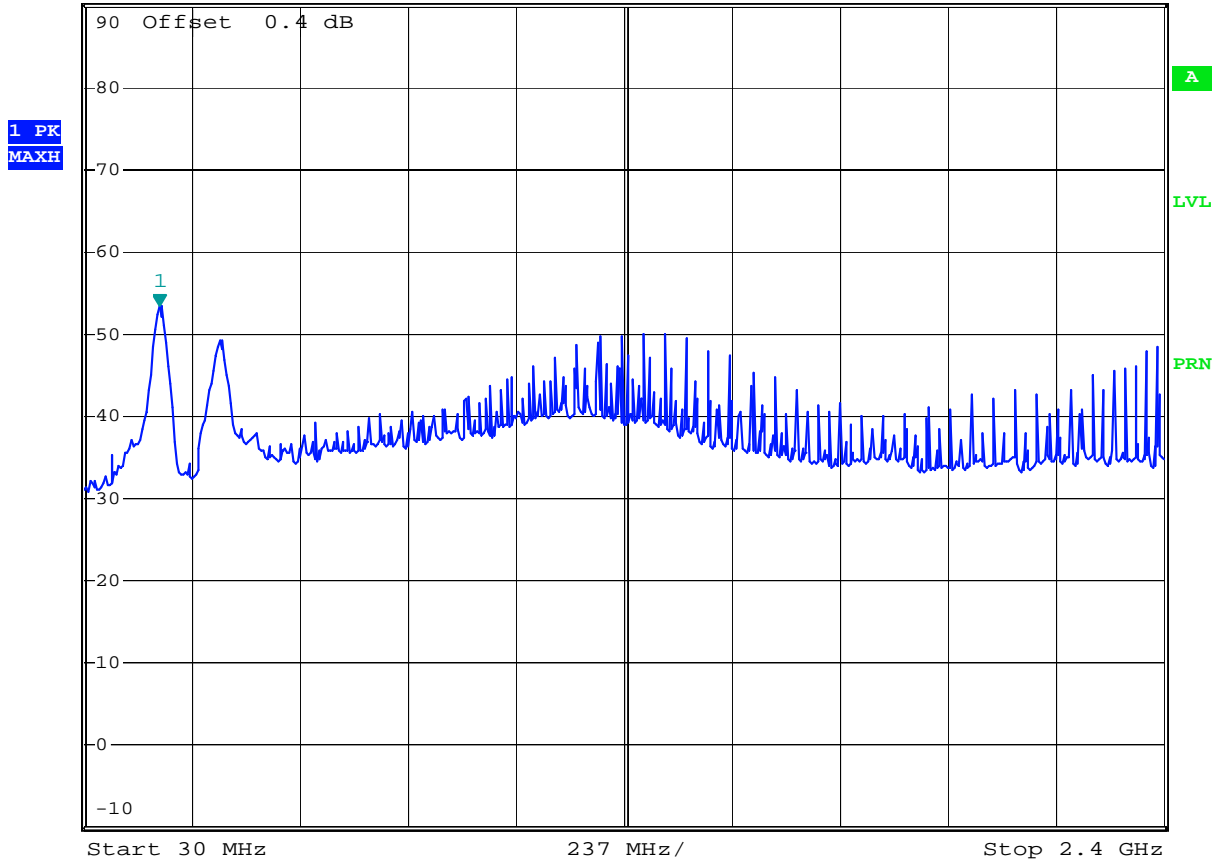
Comment: In-band emissions, Freq 2480 MHz  
 Date: 11.NOV.2009 08:35:07

Plot 3.10



\*RBW 100 kHz    Marker 1 [T1 ]  
\*VBW 100 kHz                    53.51 dBμV

Ref 90 dBμV                    Att 20 dB                    SWT 240 ms                    195.90000000 MHz



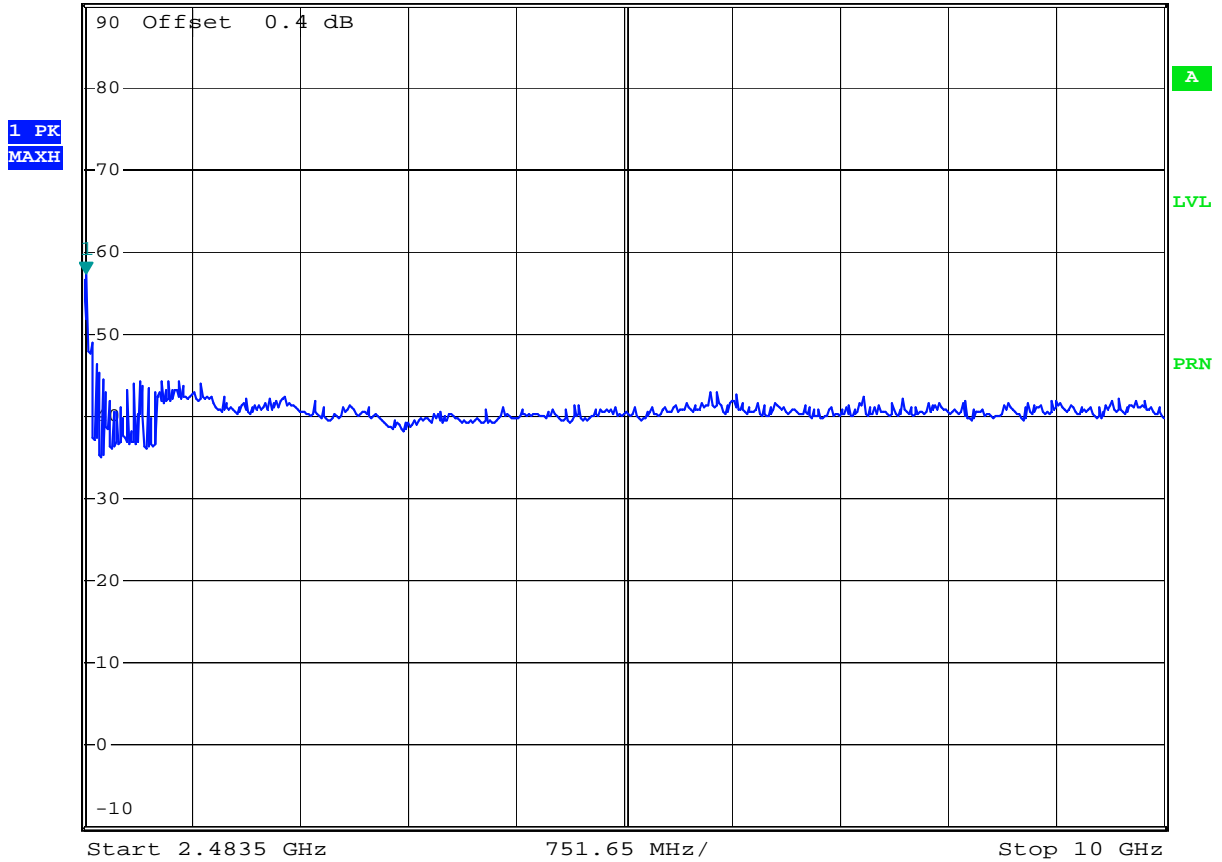
Comment: Spurious emissions, Freq 2480 MHz  
Date: 11.NOV.2009 08:36:07

## Plot 3.11



\*RBW 100 kHz    Marker 1 [T1 ]  
\*VBW 100 kHz                    57.24 dBμV

Ref 90 dBμV                    Att 20 dB                    SWT 760 ms                    2.498533000 GHz



Comment: Spurious emissions, Freq 2480 MHz  
Date: 11.NOV.2009 08:40:02

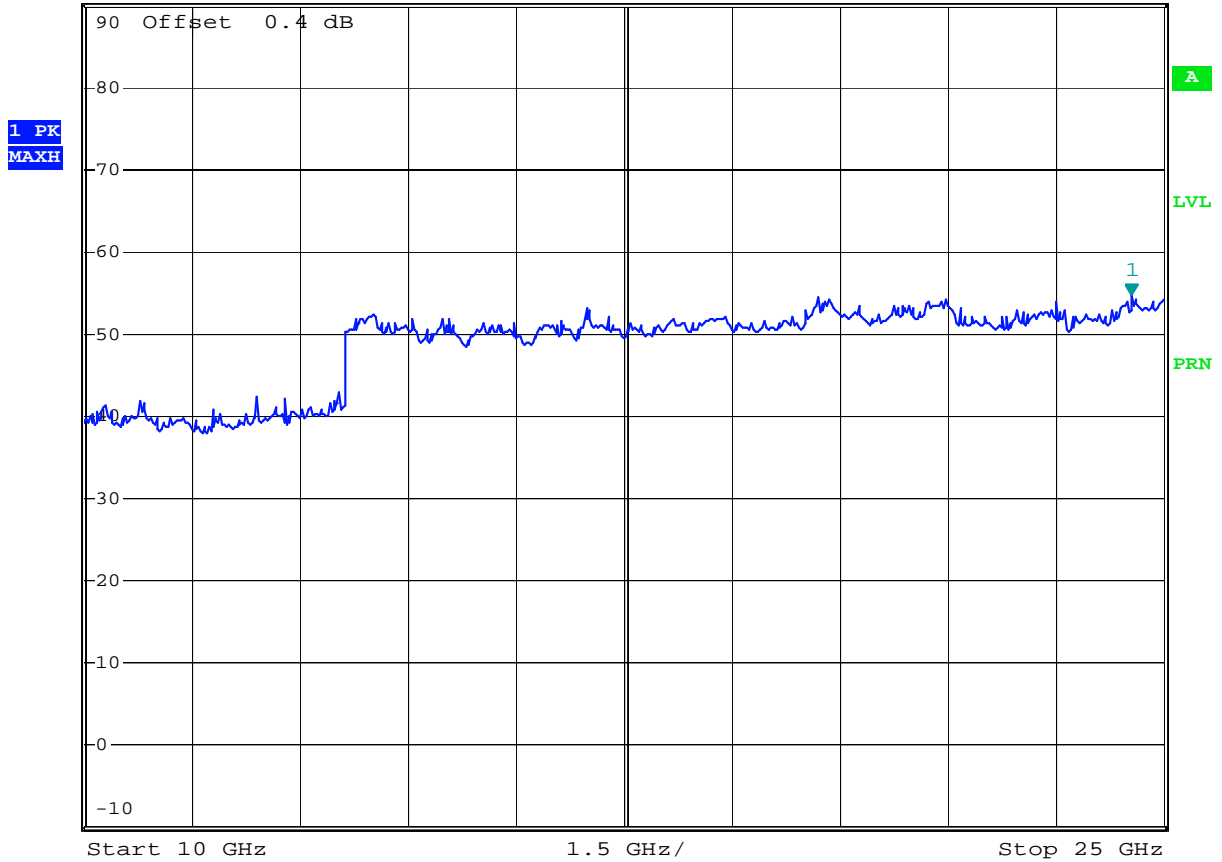


Plot 3.12



\*RBW 100 kHz    Marker 1 [T1 ]  
\*VBW 100 kHz                    54.70 dBμV

Ref 90 dBμV                    Att 20 dB                    SWT 1.5 s                    24.55000000 GHz

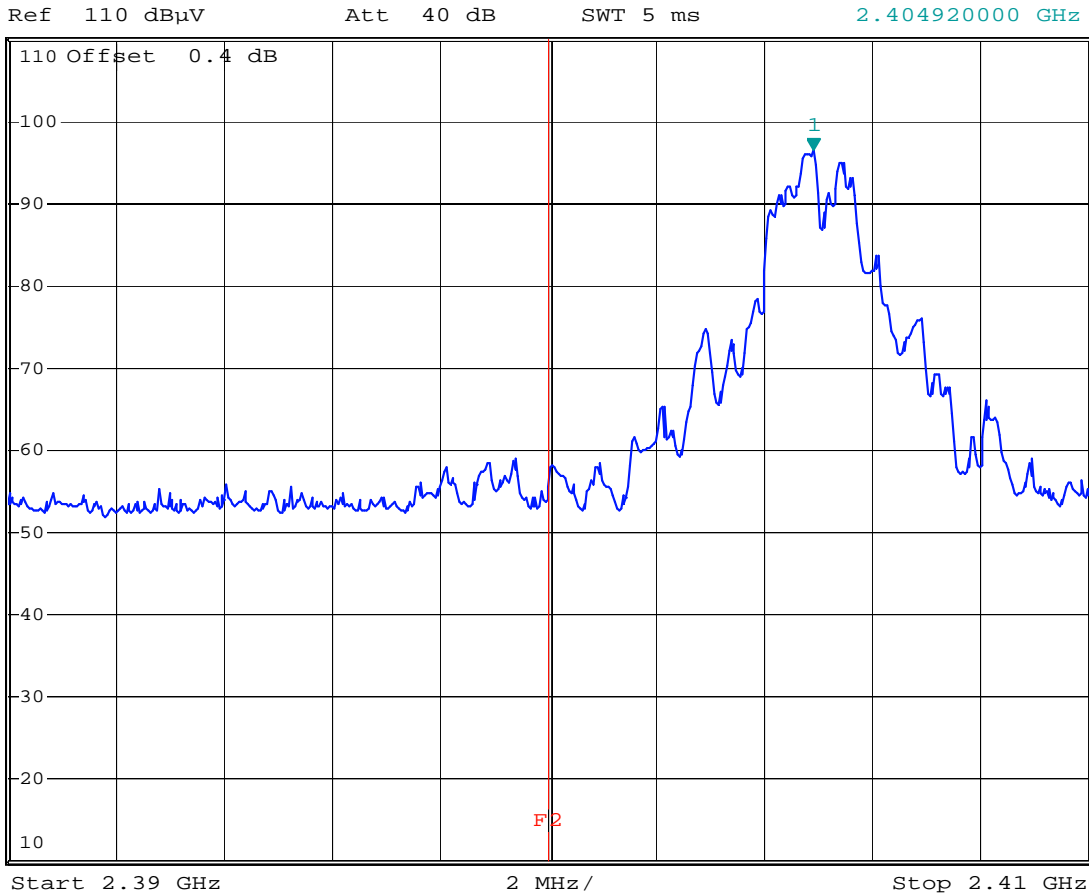


Comment: Spurious emissions, Freq 2480 MHz  
Date: 11.NOV.2009 08:41:02

Plot 3.13



\*RBW 100 kHz    Marker 1 [T1 ]  
\*VBW 100 kHz                    96.47 dBμV  
SWT 5 ms                            2.404920000 GHz

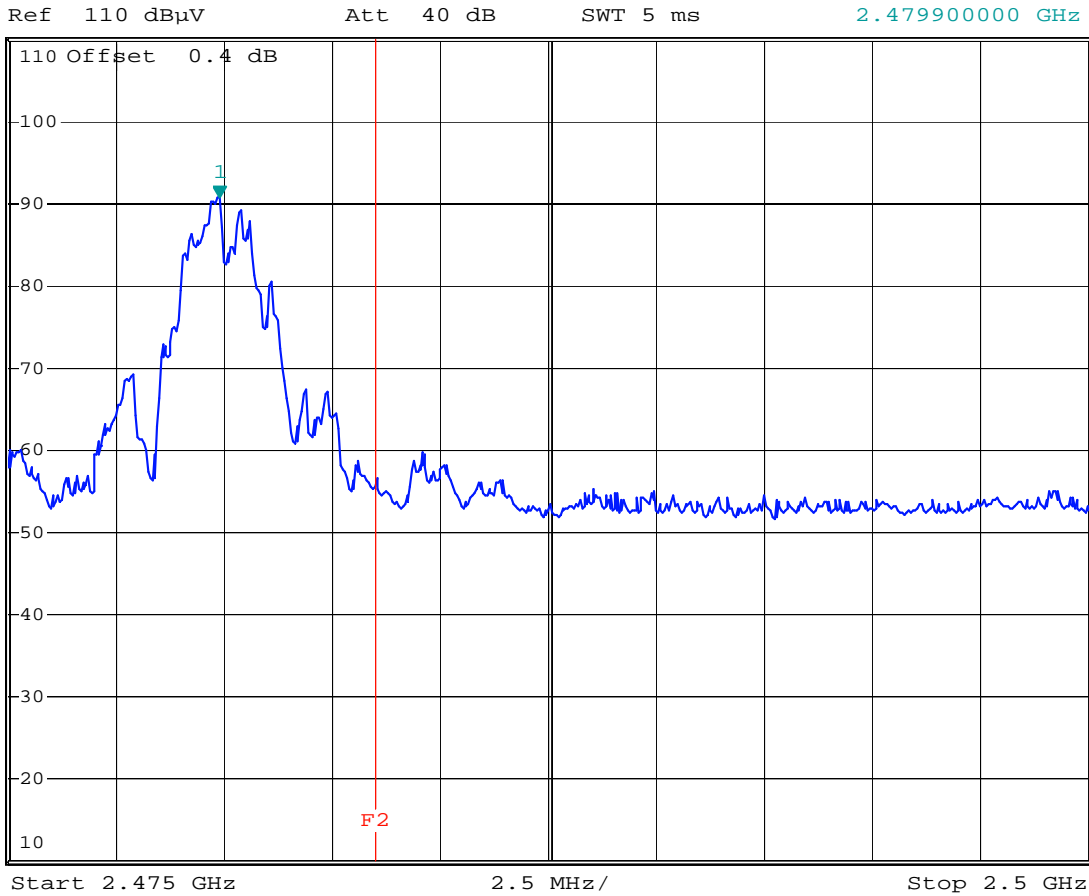


Comment: Spurious emissions, Freq 2405 MHz  
Date: 11.NOV.2009 08:44:50

Plot 3.14



\*RBW 100 kHz    Marker 1 [T1 ]  
\*VBW 100 kHz                    90.66 dBµV  
2.479900000 GHz



Comment: Spurious emissions, Freq 2480 MHz  
Date: 11.NOV.2009 08:46:02

4.4 Power Spectral Density  
FCC 15.247 (e)

Requirement

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

Procedure

A spectrum analyzer was connected to the antenna port of the transmitter. Initially investigation was performed with 10kHz RBW on the wider span for finding Peak power level. Then centered the Peak Level detected to the center of the spectrum analyzer. Final Power Spectral Density measurement was taken with 3kHz RBW on the narrower span.

Test Result

Refer to the following plots for the test result:

<b>Frequency (MHz)</b>	<b>Power Spectral Density (dBm)</b>	<b>Plot</b>
2405	-14.8	4.1, 4.2
2440	-16.1	4.3, 4.4
2480	-21.1	4.5, 4.6

Plot 4.1

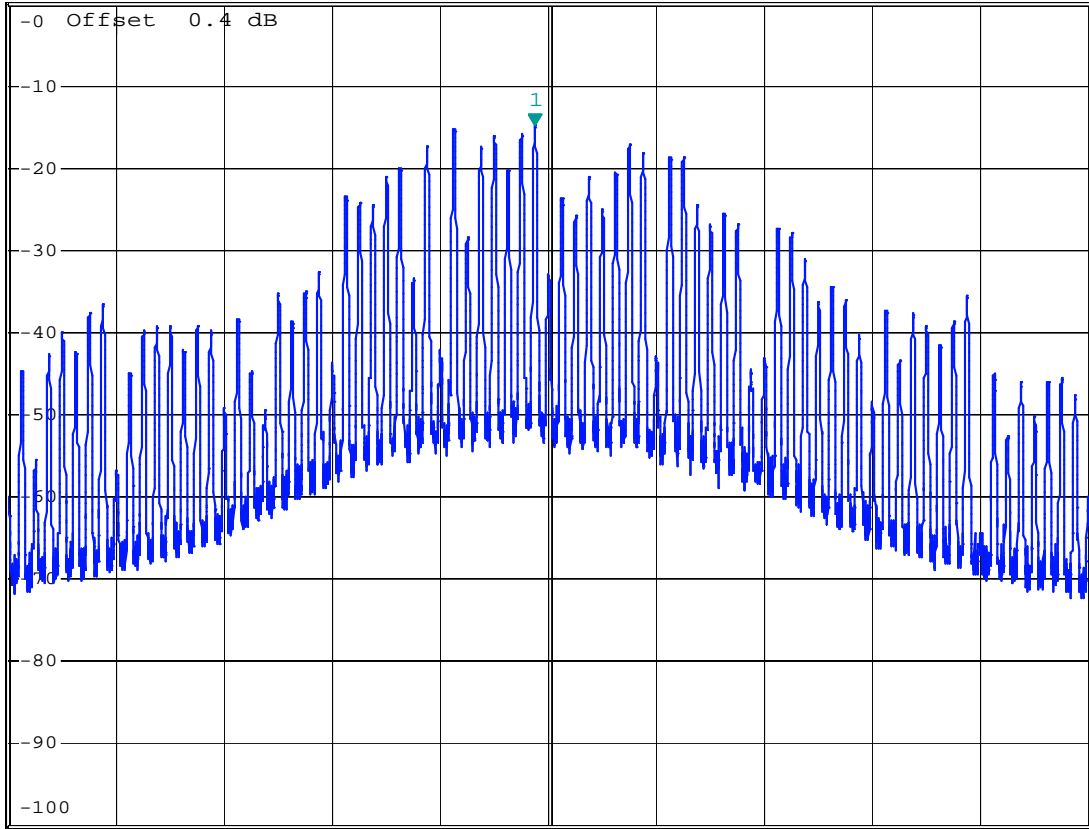


\*RBW 10 kHz    Marker 1 [T1 ]  
 \*VBW 100 kHz    -14.84 dBm  
 \*SWT 5 s    2.404940000 GHz

Ref 0 dBm

Att 30 dB

1 PK  
MAXH



Center 2.405 GHz

500 kHz/

Span 5 MHz

Comment: Power spectral density  
 Date: 10.NOV.2009 15:55:05

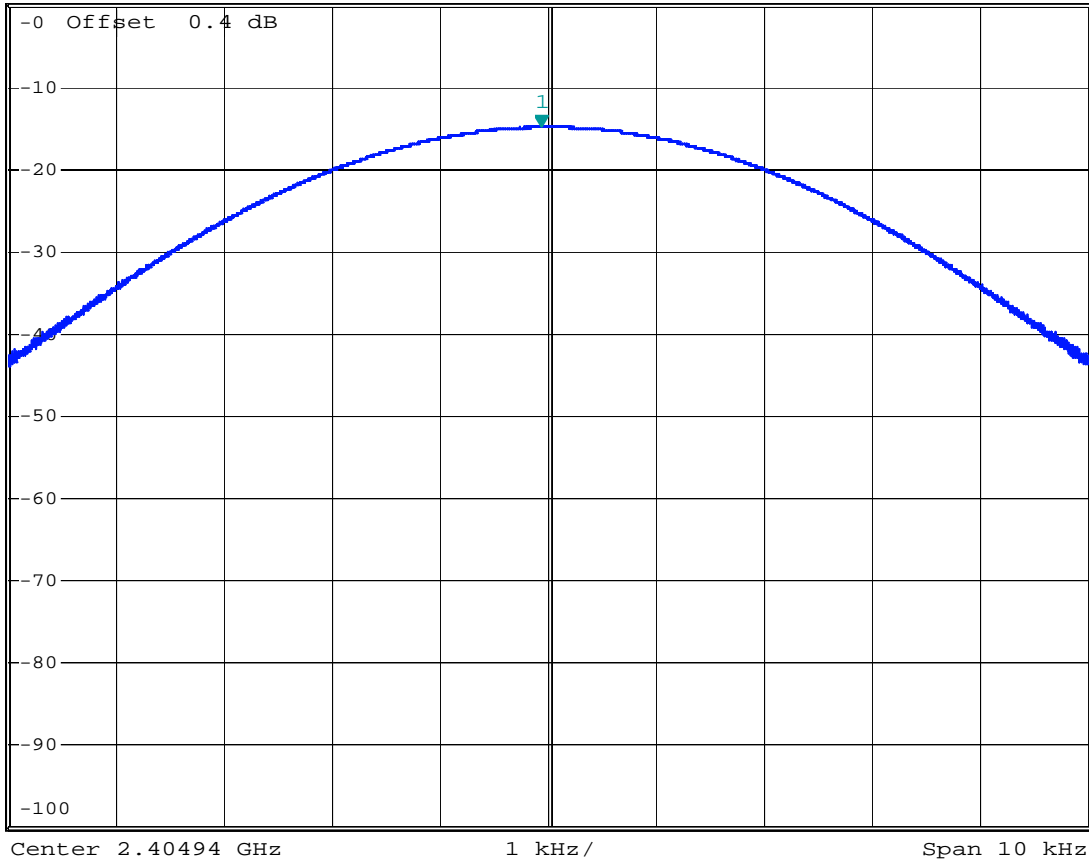
Plot 4. 2



\*RBW 3 kHz      Marker 1 [T1 ]  
\*VBW 100 kHz      -14.84 dBm  
\*SWT 5 s      2.404939940 GHz

Ref 0 dBm

Att 30 dB



Comment: Power spectral density  
Date: 10.NOV.2009 15:56:39



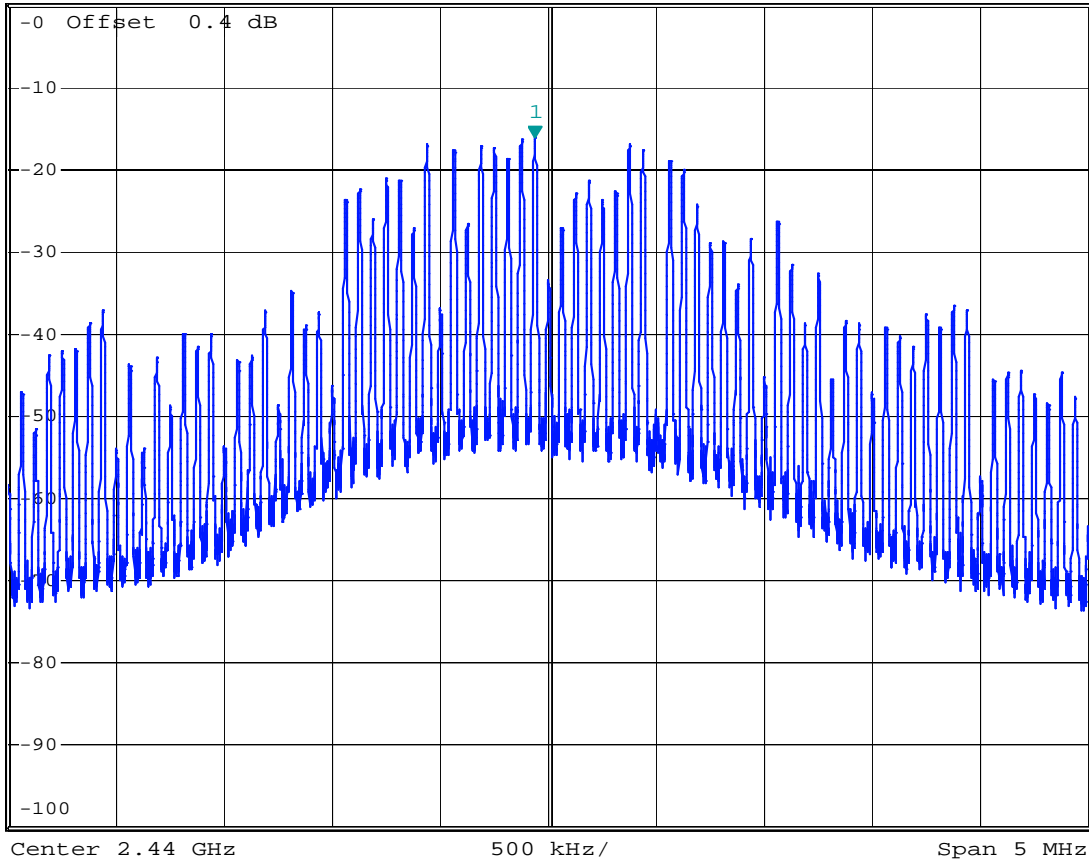
Plot 4.3

\*RBW 10 kHz    Marker 1 [T1 ]  
\*VBW 100 kHz                    -16.09 dBm  
\*SWT 5 s                            2.439940000 GHz

Ref 0 dBm

Att 30 dB

1 PK  
MAXH



Comment: Power spectral density  
Date: 10.NOV.2009 16:01:30



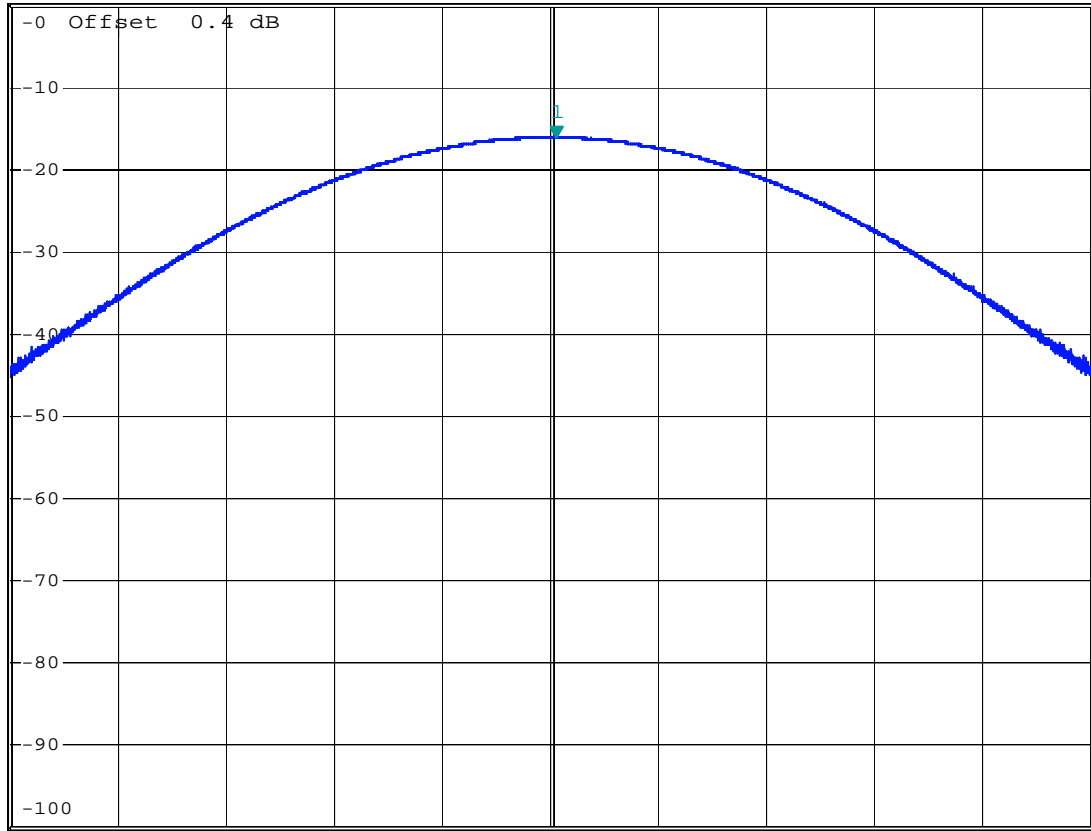
Plot 4.4

\* RBW 3 kHz      Marker 1 [T1 ]  
\* VBW 100 kHz      -16.09 dBm  
\* SWT 5 s      2.439940057 GHz

Ref 0 dBm

Att 30 dB

1 PK  
MAXH



Center 2.43994 GHz

1 kHz/

Span 10 kHz

Comment: Power spectral density  
Date: 10.NOV.2009 16:02:17





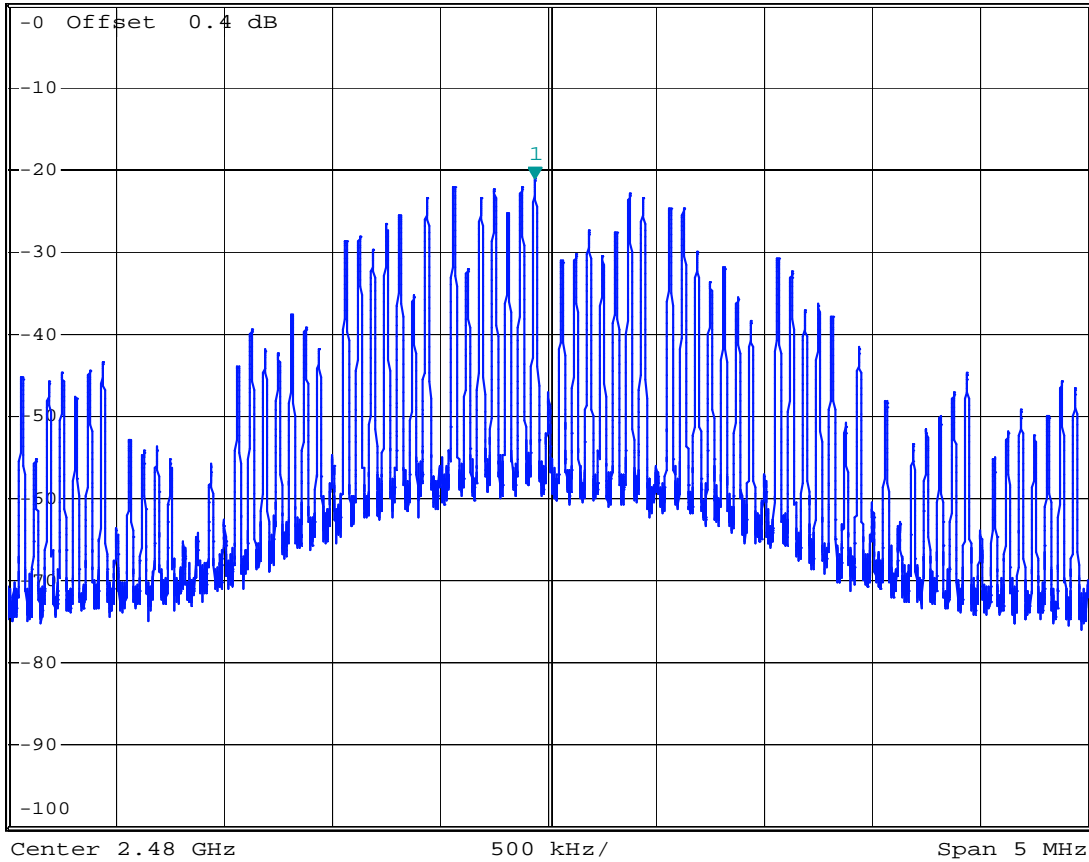
Plot 4.5

\*RBW 10 kHz    Marker 1 [T1 ]  
\*VBW 100 kHz    -21.19 dBm  
\*SWT 5 s    2.479940000 GHz

Ref 0 dBm

Att 30 dB

1 PK  
MAXH



Comment: Power spectral density  
Date: 10.NOV.2009 16:03:38



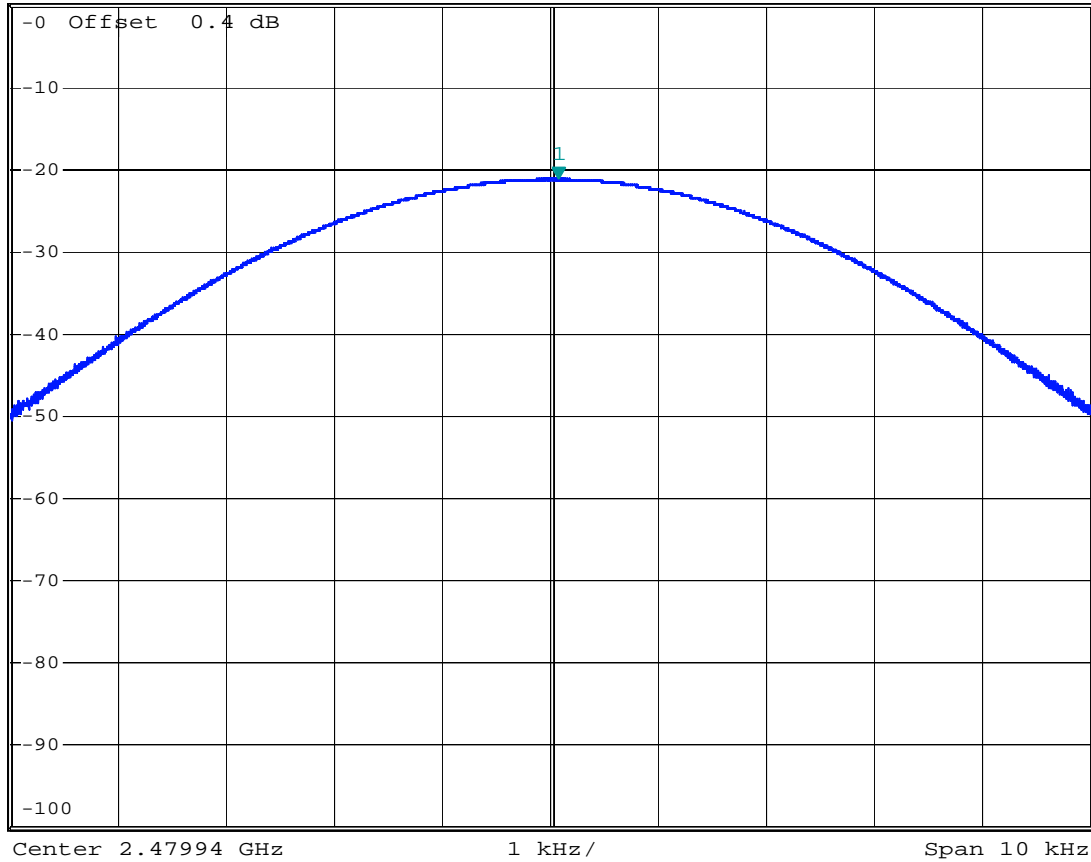
Plot 4.6

\*RBW 3 kHz      Marker 1 [T1 ]  
 \*VBW 100 kHz      -21.21 dBm  
 \*SWT 5 s      2.479940089 GHz

Ref 0 dBm

Att 30 dB

1 PK  
MAXH



Comment: Power spectral density  
 Date: 10.NOV.2009 16:05:00

#### 4.5 Transmitter Radiated Emissions FCC 15.247 (d), 15.205, 15.209

##### Procedure

Radiated emission measurements were performed from 30 MHz to 25,000 MHz. Spectrum Analyzer Resolution Bandwidth is 100 kHz or greater for frequencies 30 MHz to 1000 MHz, 1 MHz - for frequencies above 1000 MHz.

The EUT is placed on a non-conductive table. 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 three meters unless the signal level is too low for measurement at that distance. If necessary, a pre-amplifier is used and/or the test is conducted at a closer distance. All readings are extrapolated back to the equivalent three-meter reading using inverse scaling with distance.

Data is included of the worst case configuration (the configuration which resulted in the highest emission levels). A sample calculation, configuration photographs and data tables of the emissions are included.

##### 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:

$$FS = RA + AF + CF - AG$$

Where FS = Field Strength in dB( $\mu$ V/m)

RA = Receiver Amplitude (including preamplifier) in dB( $\mu$ V)

CF = Cable Attenuation Factor in dB

AF = Antenna Factor in dB

AG = Amplifier Gain in dB

Assume a receiver reading of 52.0 dB( $\mu$ V) 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( $\mu$ V/m). This value in dB( $\mu$ V/m) was converted to its corresponding level in  $\mu$ V/m.

$$RA = 52.0 \text{ dB}(\mu\text{V})$$

$$AF = 7.4 \text{ dB}(1/\text{m})$$

$$CF = 1.6 \text{ dB}$$

$$AG = 29.0 \text{ dB}$$

$$FS = 52.0 + 7.4 + 1.6 - 29.0 = 32 \text{ dB}(\mu\text{V}/\text{m})$$

$$\text{Level in } \mu\text{V}/\text{m} = \text{Common Antilogarithm } [(32 \text{ dB}\mu\text{V}/\text{m})/20] = 39.8 \mu\text{V}/\text{m}$$

## Result

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

The radiated emissions in the restricted bands near the operating band are presented on the following Plots 5.1 – 5.6. On these plots antenna factor and cable loss are included in the OFFSET of the spectrum analyzer reading, therefore the readings are field strength.

The EUT passed the test by 1.5 dB.

Test Result	
FCC Part 15.247 Radiated Emission in Restricted Bands	
Temperature: 21C	S&C Electric Company
Humidity: 50%	Model: PhaseNet Radio Receiver
Test distance = 3 m	EUT with internal antenna
Test date: November 10, 2009	

Frequency MHz	Detector	SA reading dB(uV)	Correction Factor dB	Ant. Factor dB(1/m)	Field Strength dB(uV/m)	Limit dB(uV/m)	Margin dB
Tx at 2405 MHz							
4810	Peak	41.2	-25.7	33.1	48.6	74.0	-25.4
12025	Peak	36.5	-20.9	38.2	53.8	74.0	-20.2
4810	Aver	30.5	-25.7	33.1	37.9	54.0	-16.1
12025	Aver	22.7	-20.9	38.2	40.0	54.0	-14.0
Tx at 2440 MHz							
4880	Peak	40.4	-25.2	33.4	48.6	74.0	-25.4
7320	Peak	36.1	-22.7	36.5	49.9	74.0	-24.1
12200	Peak	36.6	-21.1	38.2	53.7	74.0	-20.3
4880	Aver	29.3	-25.2	33.4	37.5	54.0	-16.5
7320	Aver	23.5	-22.7	36.5	37.3	54.0	-16.7
12200	Aver	22.3	-21.1	38.2	39.4	54.0	-14.6
Tx at 2480 MHz							
4960	Peak	40.2	-24.9	33.4	48.7	74.0	-25.3
7440	Peak	36.7	-22.6	36.4	50.5	74.0	-23.5
12400	Peak	36.8	-21.3	38.7	54.2	74.0	-19.8
4960	Aver	31.6	-25.4	33.4	39.6	54.0	-14.4
7440	Aver	23.3	-22.6	36.6	37.3	54.0	-16.7
12400	Aver	22.7	-21.3	38.7	40.1	54.0	-13.9

- a) RBW = 1 MHz, VBW = 1 MHz - for peak measurements  
RBW = 1MHz, VBW = 100 Hz - for average measurements
- b) Correction Factor: Pre-amplifier gain + Cable loss + HP-Filter loss
- c) All other emissions are 20 dB below the limit.

Test Result	
FCC Part 15.247 Radiated Emission in Restricted Bands	
Temperature: 21C	S&C Electric Company
Humidity: 50%	Model: PhaseNet Radio Receiver
Test distance = 3 m	EUT with External antenna
Test date: November 10, 2009	

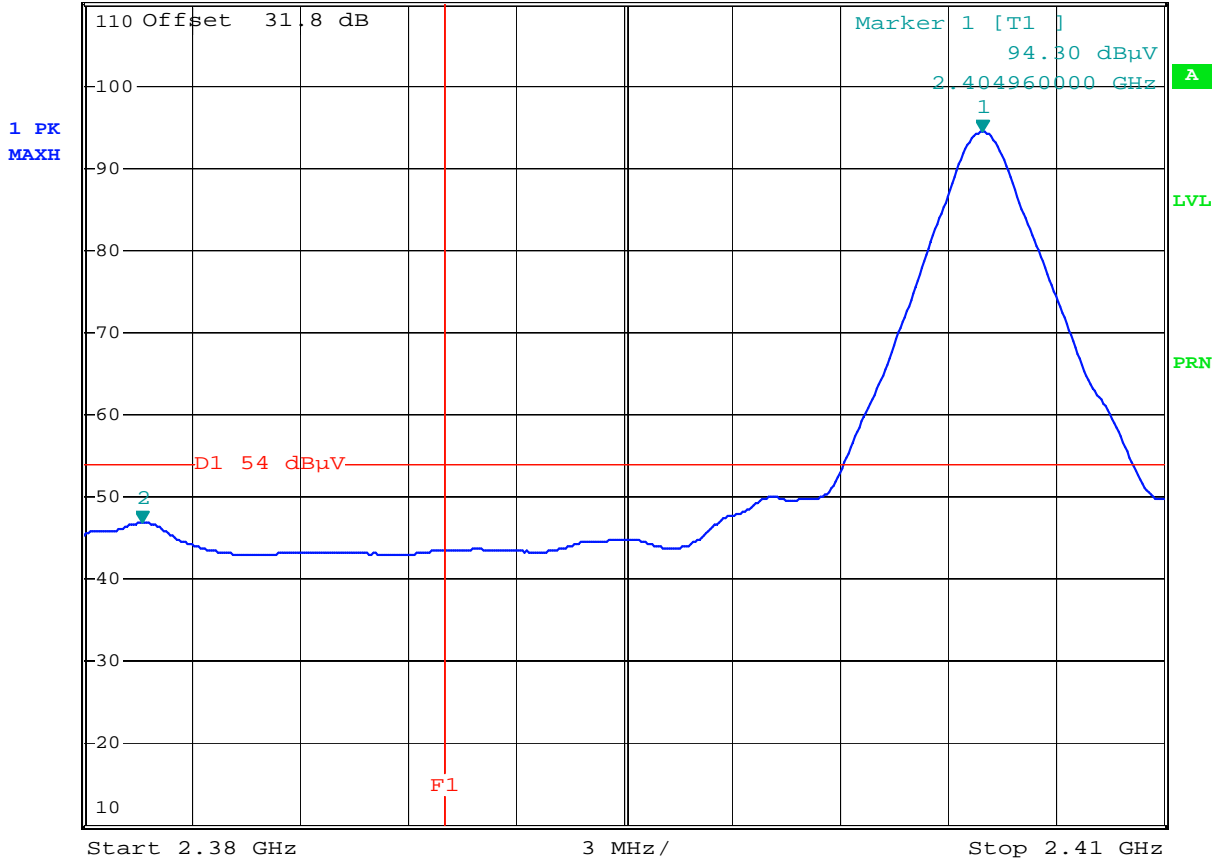
Frequency MHz	Detector	SA reading dB(uV)	Correction Factor dB	Ant. Factor dB(1/m)	Field Strength dB(uV/m)	Limit dB(uV/m)	Margin dB
Tx at 2405 MHz							
4810	Peak	41.2	-25.7	33.1	48.6	74.0	-25.4
12025	Peak	36.5	-20.9	38.2	53.8	74.0	-20.2
4810	Aver	29.2	-25.7	33.1	36.6	54.0	-17.4
12025	Aver	22.3	-20.9	38.2	39.6	54.0	-14.4
Tx at 2440 MHz							
4880	Peak	40.4	-25.2	33.4	48.6	74.0	-25.4
7320	Peak	36.8	-22.7	36.5	50.6	74.0	-23.4
12200	Peak	36.0	-21.1	38.2	53.1	74.0	-20.9
4880	Aver	31.4	-25.2	33.4	39.6	54.0	-14.4
7320	Aver	23.1	-22.7	36.5	36.9	54.0	-17.1
12200	Aver	22.8	-21.1	38.2	39.9	54.0	-14.1
Tx at 2480 MHz							
4960	Peak	41.0	-24.9	33.4	49.5	74.0	-24.5
7440	Peak	37.7	-22.6	36.4	51.5	74.0	-22.5
12400	Peak	36.4	-21.3	38.7	53.8	74.0	-20.2
4960	Aver	32.4	-25.4	33.4	40.4	54.0	-13.6
7440	Aver	23.4	-22.6	36.6	37.4	54.0	-16.6
12400	Aver	22.9	-21.3	38.7	40.3	54.0	-13.7

- d) RBW = 1 MHz, VBW = 1 MHz - for peak measurements  
RBW = 1MHz, VBW = 100 Hz - for average measurements
- e) Correction Factor: Pre-amplifier gain + Cable loss + HP-Filter loss
- f) All other emissions are 20 dB below the limit.

Plot 5.1  
EUT with On-board antenna



Ref 110 dBµV      \*Att 0 dB      \*RBW 1 MHz      Marker 2 [T1 ]      46.87 dBµV  
 \*VBW 10 Hz      2.381620000 GHz  
 SWT 7.6 s



Comment: Emissions on band-edge frequency, average, freq 2405 MHz  
 Date: 9.NOV.2009 10:33:18

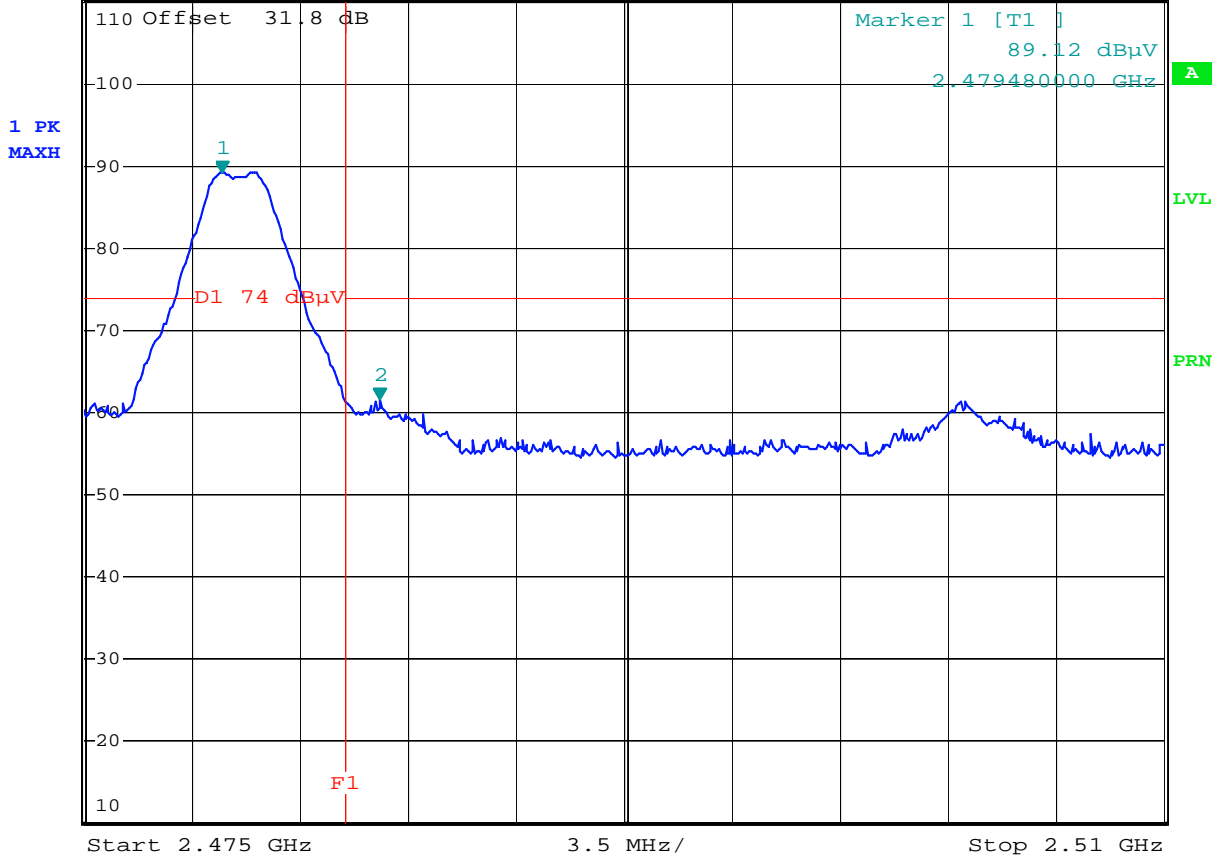




Plot 5.3  
EUT with On-board antenna



Ref 110 dB $\mu$ V      \*Att 0 dB      \*RBW 1 MHz      Marker 2 [T1 ]      61.58 dB $\mu$ V  
 \*VBW 1 MHz      2.484590000 GHz  
 SWT 2.5 ms



Comment: Emissions on band-edge frequency, peak, freq 2480 MHz  
 Date: 9.NOV.2009 10:46:36

Plot 5.4  
EUT with On-board antenna

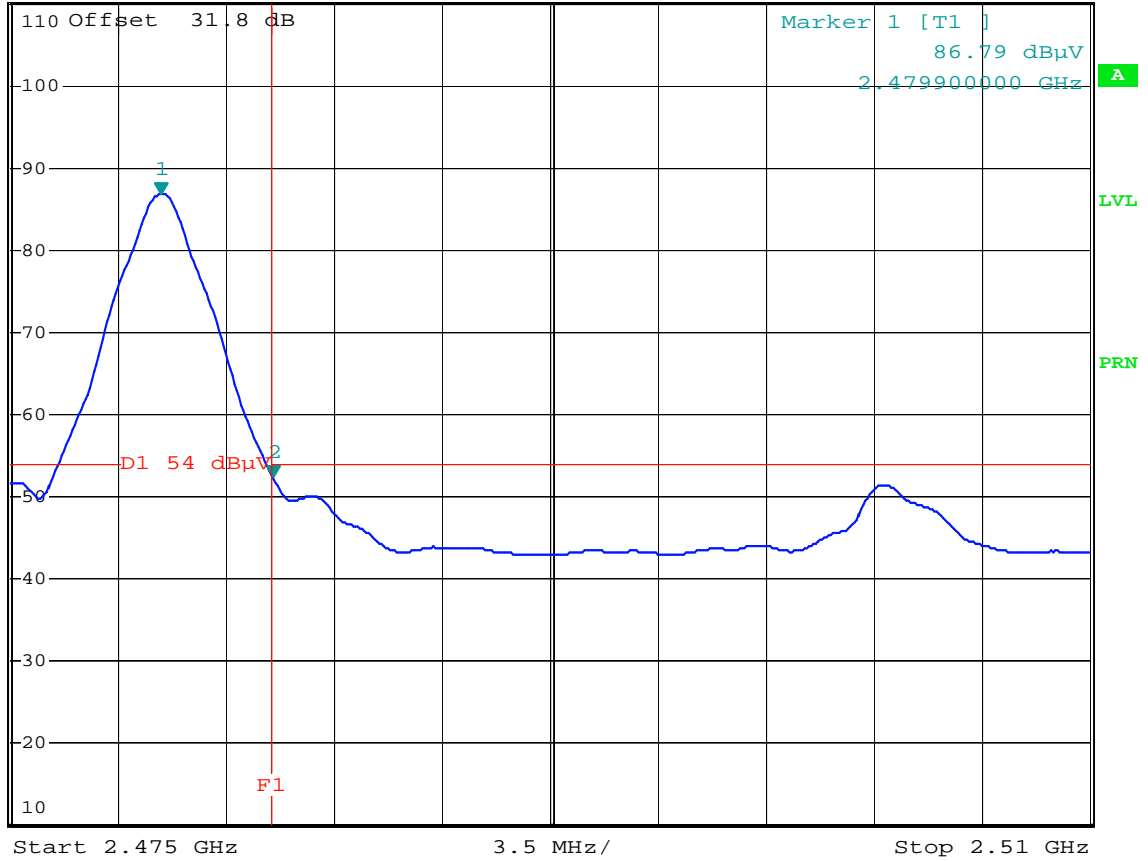


\*RBW 1 MHz      Marker 2 [T1 ]  
\*VBW 10 Hz      52.45 dBμV  
SWT 8.8 s      2.483540000 GHz

Ref 110 dBμV

\*Att 0 dB

1 PK  
MAXH

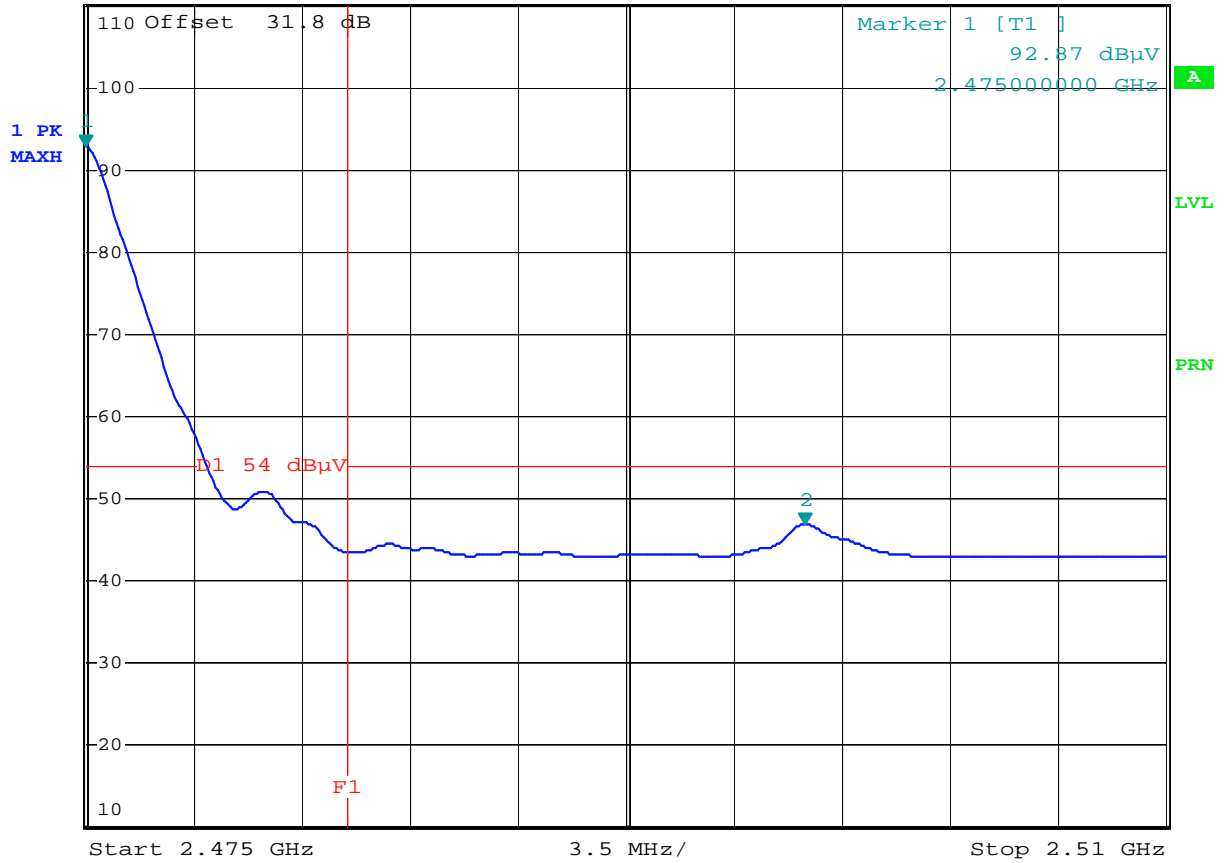


Comment: Emissions on band-edge frequency, average, freq 2480 MHz  
Date: 9.NOV.2009 10:48:13

## Plot 5.5 EUT with On-board antenna



Ref 110 dB $\mu$ V     \*Att 0 dB     \*RBW 1 MHz     Marker 2 [T1]     46.89 dB $\mu$ V  
SWT 8.8 s     2.498310000 GHz



Comment: Emissions on band-edge frequency, average, freq 2475 MHz  
Date: 9.NOV.2009 10:52:33





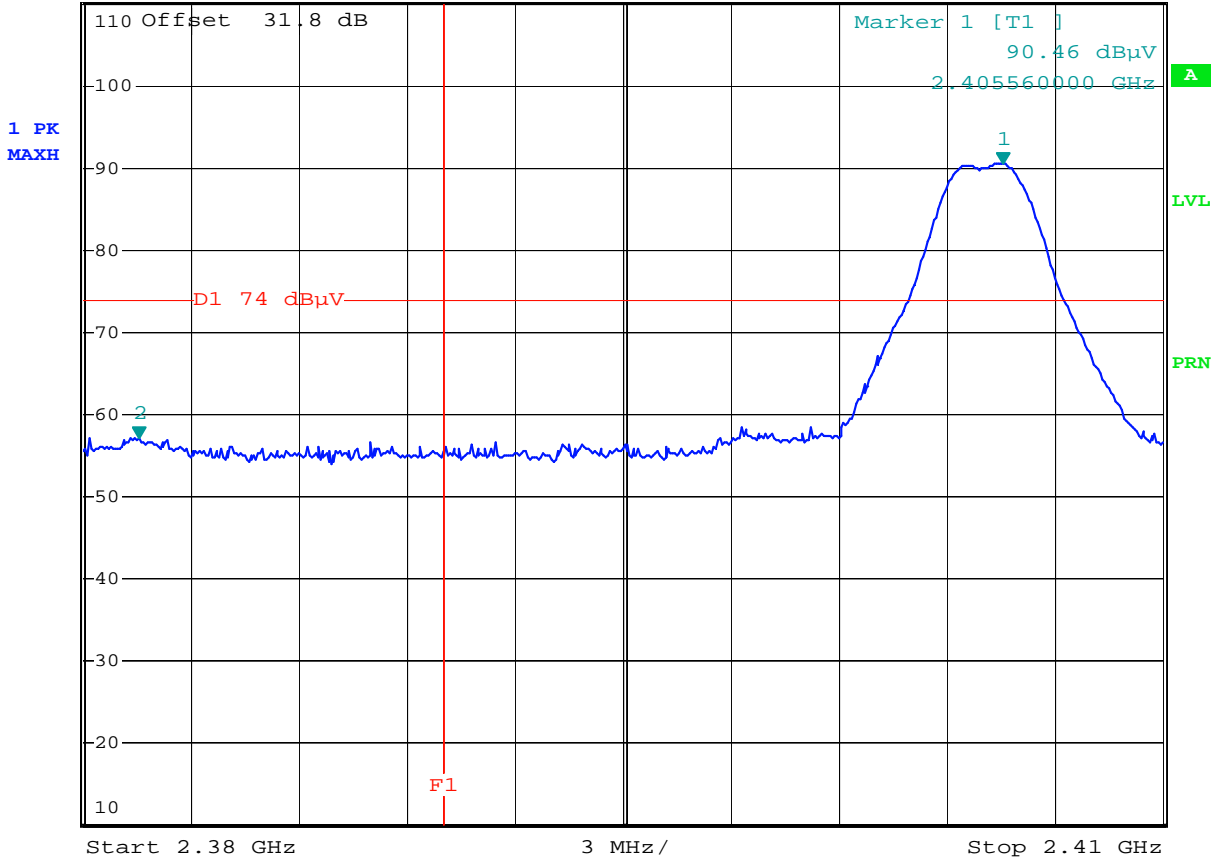
Plot 5.7  
EUT with External antenna



\*RBW 1 MHz     Marker 2 [T1 ]  
\*VBW 1 MHz     57.12 dBµV  
SWT 2.5 ms     2.381560000 GHz

Ref 110 dBµV

\*Att 0 dB



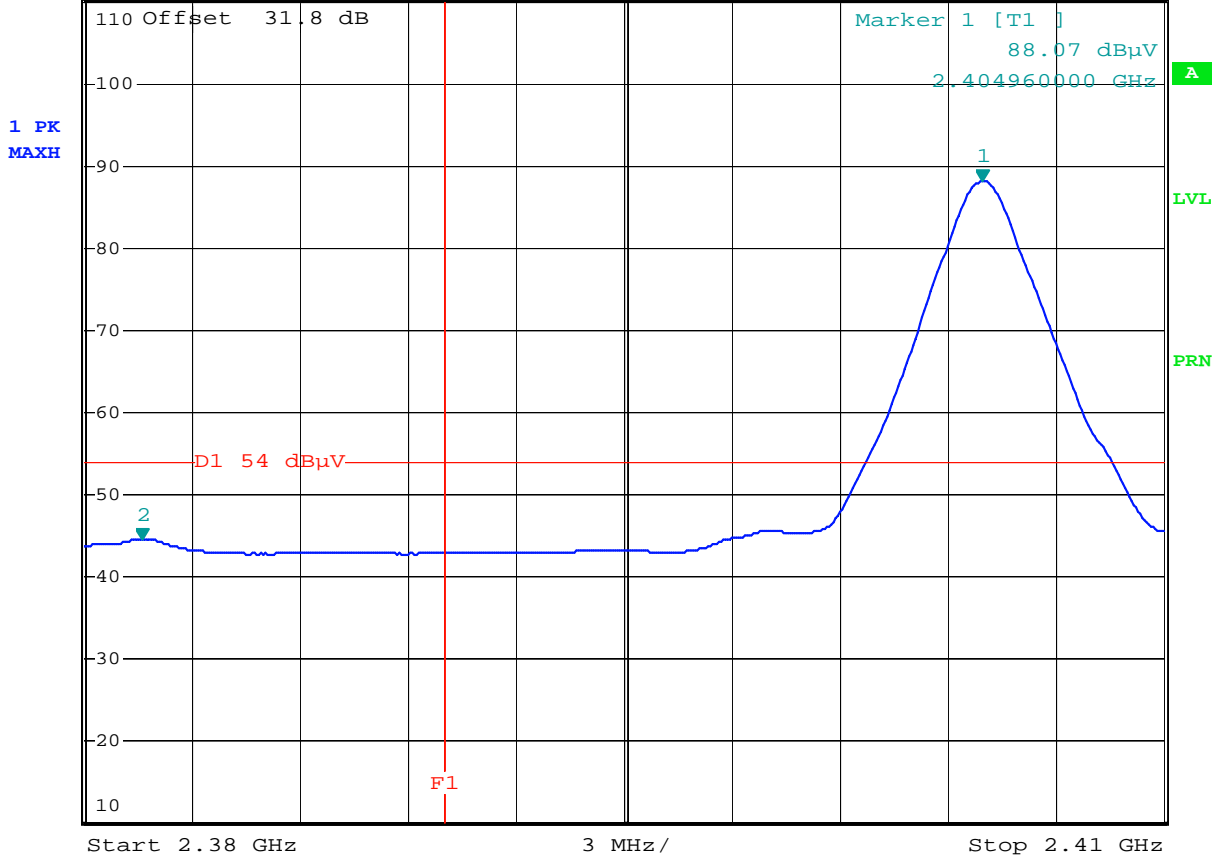
Comment: Emissions on band-edge frequency, peak, freq 2405 MHz  
Date: 9.NOV.2009 11:06:06

Plot 5.8  
EUT with External antenna



\*RBW 1 MHz      Marker 2 [T1 ]  
\*VBW 10 Hz      44.60 dBμV  
SWT 7.6 s      2.381620000 GHz

Ref 110 dBμV      \*Att 0 dB



Comment: Emissions on band-edge frequency, average, freq 2405 MHz  
Date: 9.NOV.2009 11:07:08

Plot 5.9  
EUT with External antenna

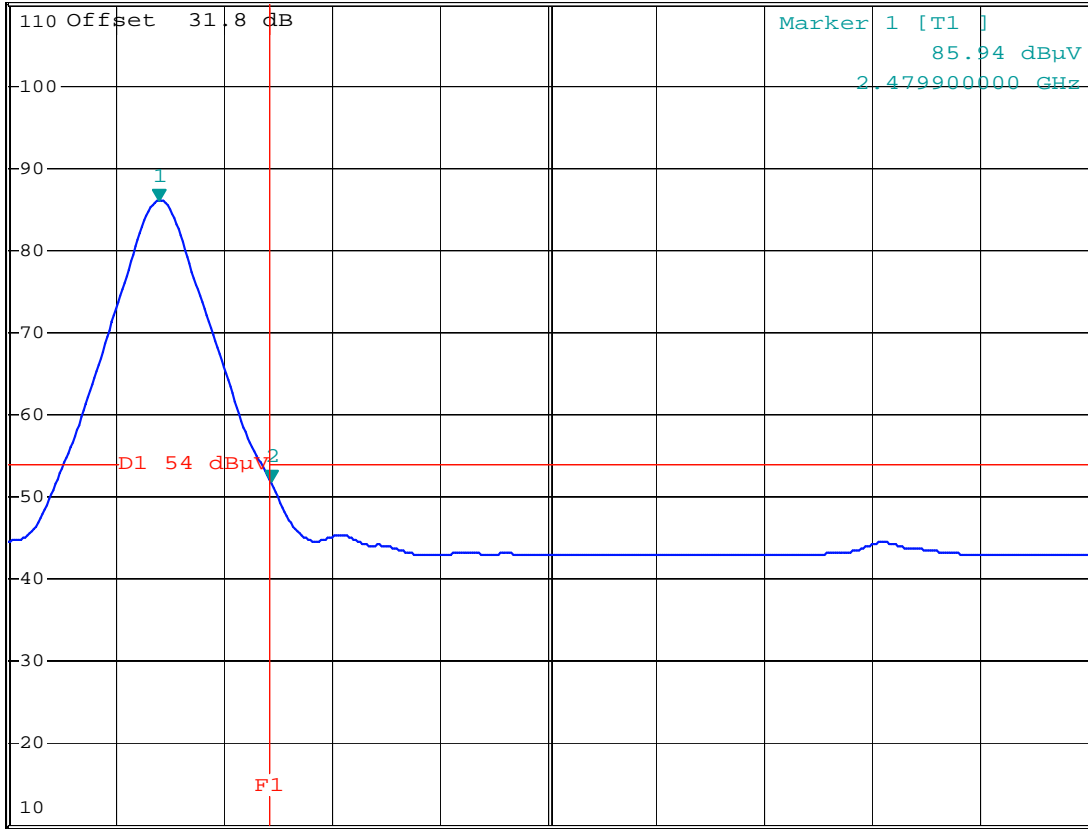


\*RBW 1 MHz      Marker 2 [T1 ]  
\*VBW 10 Hz      51.95 dBµV  
SWT 8.8 s      2.483540000 GHz

Ref 110 dBµV

\*Att 0 dB

1 PK  
MAXH



Start 2.475 GHz

3.5 MHz/

Stop 2.51 GHz

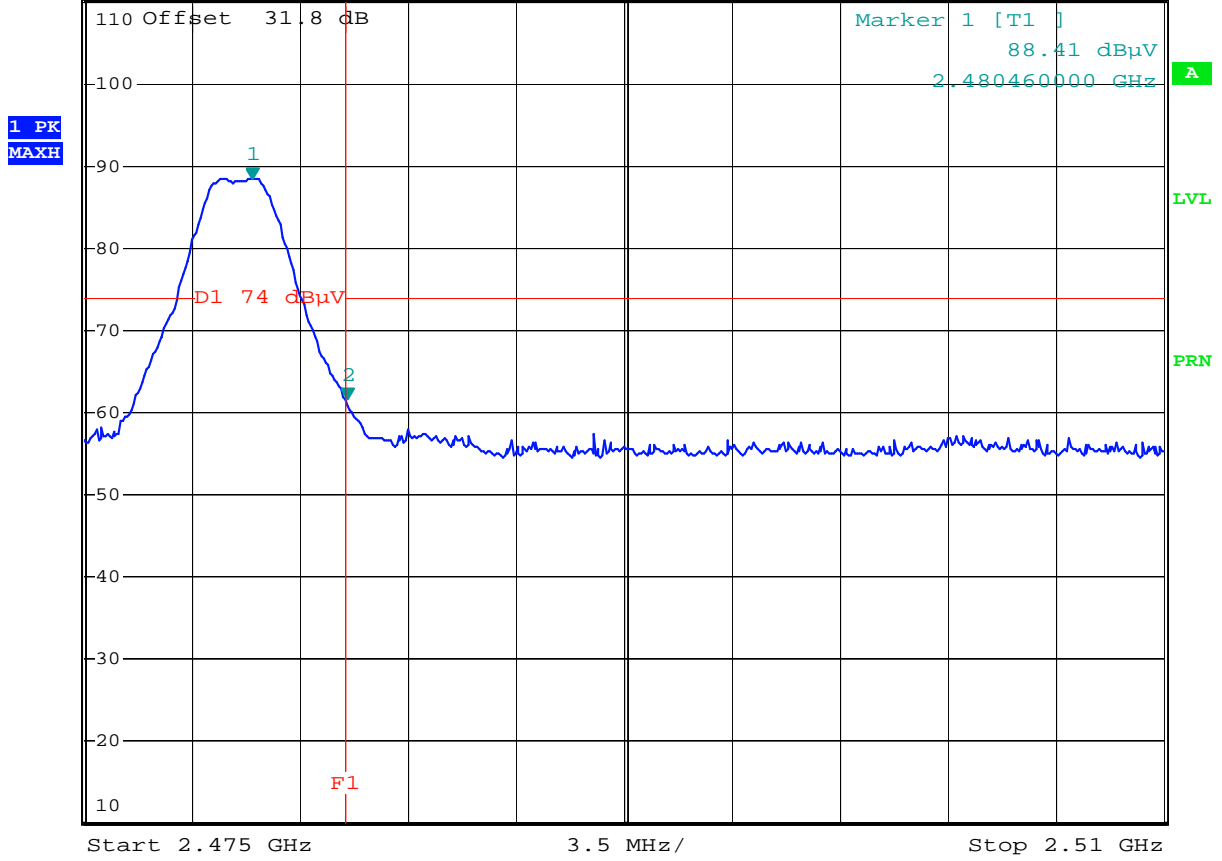
Comment: Emissions on band-edge frequency, average, freq 2480 MHz

Date: 9.NOV.2009 11:13:49

Plot 5.10  
EUT with External antenna



Ref 110 dBµV     \*Att 0 dB     \*RBW 1 MHz     Marker 2 [T1 ]     61.66 dBµV  
 SWT 2.5 ms     2.483540000 GHz



Comment: Emissions on band-edge frequency, peak, freq 2480 MHz  
 Date: 9.NOV.2009 11:16:44



4.6 Radiated Emissions from Digital Parts and Receiver  
FCC Ref: 15.109

Test Limit

*Limits for Electromagnetic Radiated Emissions, FCC Section 15.109(b) and ICES 003 \**

Frequency (MHz)	Class A at 10m dB( $\mu$ V/m)	Class B at 3m dB( $\mu$ V/m)
30-88	39	40.0
88-216	43.5	43.5
216-960	46.4	46.0
Above 960	49.5	54.0

\* According to FCC Part 15.109(g) an alternative to the radiated emission limits shown above, digital devices may be shown to comply with the limit of CISPR Pub. 22

Test Results

Radiated emission measurements were performed from 30 MHz to 1000 MHz. Spectrum Analyzer Resolution Bandwidth is 100 kHz or greater below 1000 MHz and 1 MHz - above 1000 MHz.

The EUT passed by 1.1 dB for Class B.

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

Operator: KK  
November 10, 2009

Model Number: PhaseNet Radio Receiver  
Company: S&C Electric Company

Frequency (MHz)	Peak/QP FS dB(uV/m)	Limit@3m dB(uV/m)	Margin dB	RA dB(uV)	CF dB	AG dB	DCF dB	AF dB(1/m)
380.655	41.2	46.0	-4.8	45.3	2.1	32.0	10.5	15.7
382.595	41.1	46.0	-4.9	45.2	2.1	32.0	10.5	15.8
384.697	41.6	46.0	-4.4	45.6	2.1	32.0	10.5	15.9
386.677	41.5	46.0	-4.5	45.5	2.1	32.0	10.5	15.9
390.8	41.0	46.0	-5.0	44.8	2.1	32.0	10.5	16.1
392.82	41.7	46.0	-4.3	45.5	2.1	32.0	10.5	16.2
396.862	41.4	46.0	-4.6	45.1	2.1	32.0	10.5	16.3
398.883	42.3	46.0	-3.7	45.9	2.1	32.0	10.5	16.4
400.944	41.4	46.0	-4.6	45.0	2.1	32.0	10.5	16.5
402.965	42.0	46.0	-4.0	45.5	2.1	32.0	10.5	16.5
405.067	42.7	46.0	-3.3	46.2	2.1	32.0	10.5	16.5
407.047	42.0	46.0	-4.0	45.4	2.1	32.0	10.5	16.5
409.068	40.8	46.0	-5.2	44.2	2.1	32.0	10.5	16.5
411.129	41.9	46.0	-4.1	45.2	2.1	32.0	10.5	16.5
413.15	41.7	46.0	-4.3	45.0	2.1	32.0	10.5	16.5
415.13	41.1	46.0	-4.9	44.3	2.1	32.0	10.5	16.5
417.273	41.8	46.0	-4.2	44.9	2.2	32.0	10.5	16.6
419.253	41.3	46.0	-4.7	44.4	2.2	32.0	10.5	16.8
423.335	41.2	46.0	-4.8	44.2	2.2	32.0	10.5	17.0
425.396	41.1	46.0	-4.9	44.1	2.2	32.0	10.5	17.2

Test Mode: Rx mode, EUT with External antenna  
Temperature: 20 C                      Humidity : 50 %

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

Operator: KK  
November 10, 2009

Model Number: PhaseNet Radio Receiver  
Company: S&C Electric Company

Frequency (MHz)	Peak/QP FS dB(uV/m)	Limit@3m dB(uV/m)	Margin dB	RA dB(uV)	CF dB	AG dB	DCF dB	AF dB(1/m)
39.3363	37.9	40.0	-2.1	42.2	0.6	32.0	10.5	5.5
97.6979	41.2	43.5	-2.3	51.4	1.0	32.0	10.5	6.7
99.6783	40.3	43.5	-3.2	50.2	1.0	32.0	10.5	6.7
101.74	37.9	43.5	-5.6	47.4	1.0	32.0	10.5	6.9
116.007	37.8	43.5	-5.7	47.3	1.1	32.0	10.5	6.7
118.068	40.1	43.5	-3.4	49.6	1.1	32.0	10.5	6.7
120	42.4	43.5	-1.1	51.9	1.1	32.0	10.5	7.0
122.15	39.7	43.5	-3.8	49.2	1.1	32.0	10.5	7.3
152.665	39.0	43.5	-4.5	50.9	1.3	31.9	10.5	10.9
154.726	40.6	43.5	-2.9	52.5	1.3	31.9	10.5	10.2
156.747	41.7	43.5	-1.8	53.7	1.3	31.9	10.5	9.8
158.768	40.6	43.5	-2.9	52.5	1.3	31.9	10.5	9.8
160.788	39.2	43.5	-4.3	51.1	1.3	31.9	10.5	9.7
162.89	37.5	43.5	-6.0	49.5	1.3	31.9	10.5	9.7
183.179	37.5	43.5	-6.0	47.7	1.4	31.9	10.5	10.3
185.2	38.7	43.5	-4.8	48.9	1.4	31.9	10.5	10.5
187.221	40.6	43.5	-2.9	50.7	1.4	31.9	10.5	10.7
189.282	40.7	43.5	-2.8	50.8	1.4	31.9	10.5	10.8
191.343	39.9	43.5	-3.6	49.9	1.4	31.9	10.5	10.9
193.364	37.8	43.5	-5.7	47.8	1.4	31.9	10.5	11.0

Test Mode: Rx mode, EUT with External antenna  
Temperature: 20 C                      Humidity : 50 %

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

Operator: KK  
November 10, 2009

Model Number: PhaseNet Radio Receiver  
Company: S&C Electric Company

Frequency (MHz)	Peak/QP FS dB(uV/m)	Limit@3m dB(uV/m)	Margin dB	RA dB(uV)	CF dB	AG dB	DCF dB	AF dB(1/m)
117.947	39.3	43.5	-4.2	48.8	1.1	32.0	10.5	6.7
120.008	39.1	43.5	-4.4	48.5	1.1	32.0	10.5	7.0
136.215	39.3	43.5	-4.2	49.8	1.2	32.0	10.5	8.9
138.276	38.6	43.5	-4.9	49.6	1.2	31.9	10.5	9.0
185.079	38.6	43.5	-4.9	48.8	1.4	31.9	10.5	10.5
187.1	39.3	43.5	-4.2	49.4	1.4	31.9	10.5	10.7
189.12	40.1	43.5	-3.4	50.1	1.4	31.9	10.5	10.8
191.141	39.8	43.5	-3.7	49.8	1.4	31.9	10.5	10.9
193.243	39.4	43.5	-4.1	49.3	1.4	31.9	10.5	11.0
195.223	39.8	43.5	-3.7	49.7	1.4	31.9	10.5	11.1
197.285	39.6	43.5	-3.9	49.4	1.5	31.9	10.5	11.1
199.305	39.5	43.5	-4.0	49.3	1.5	31.9	10.5	11.2
201.326	38.8	43.5	-4.7	48.5	1.5	31.9	10.5	11.3
274.521	39.1	46.0	-6.9	45.6	1.7	31.9	10.5	13.6
398.6	38.8	46.0	-7.2	42.2	2.1	32.0	10.5	16.5
404.784	38.7	46.0	-7.3	41.9	2.1	32.0	10.5	16.8
410.644	38.3	46.0	-7.7	41.4	2.1	32.0	10.5	17.0
412.746	38.7	46.0	-7.3	41.8	2.1	32.0	10.5	17.0
414.807	38.2	46.0	-7.8	41.3	2.1	32.0	10.5	17.1
416.909	38.6	46.0	-7.4	41.6	2.2	32.0	10.5	17.2

Test Mode: Rx mode, EUT with internal antenna  
Temperature: 20 C                      Humidity : 50 %

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

Operator: KK  
November 10, 2009

Model Number: PhaseNet Radio Receiver  
Company: S&C Electric Company

Frequency (MHz)	Peak/QP FS dB(uV/m)	Limit@3m dB(uV/m)	Margin dB	RA dB(uV)	CF dB	AG dB	DCF dB	AF dB(1/m)
268.499	40.5	46.0	-5.5	47.1	1.7	31.9	10.5	12.4
270.479	40.9	46.0	-5.1	47.4	1.7	31.9	10.5	12.6
272.581	42.4	46.0	-3.6	48.8	1.7	31.9	10.5	12.6
274.602	41.4	46.0	-4.6	47.8	1.7	31.9	10.5	12.5
372.248	40.2	46.0	-5.8	44.5	2.0	32.0	10.5	15.4
388.455	39.7	46.0	-6.3	43.6	2.1	32.0	10.5	16.0
390.598	41.4	46.0	-4.6	45.3	2.1	32.0	10.5	16.1
392.578	40.9	46.0	-5.1	44.7	2.1	32.0	10.5	16.2
396.66	40.7	46.0	-5.3	44.4	2.1	32.0	10.5	16.3
398.681	40.5	46.0	-5.5	44.2	2.1	32.0	10.5	16.4
400.621	40.3	46.0	-5.7	44.0	2.1	32.0	10.5	16.5
402.763	41.8	46.0	-4.2	45.4	2.1	32.0	10.5	16.5
404.784	41.1	46.0	-4.9	44.6	2.1	32.0	10.5	16.5
406.764	40.6	46.0	-5.4	44.0	2.1	32.0	10.5	16.5
408.825	40.8	46.0	-5.2	44.2	2.1	32.0	10.5	16.5
410.887	40.5	46.0	-5.5	43.9	2.1	32.0	10.5	16.5
412.867	39.7	46.0	-6.3	43.0	2.1	32.0	10.5	16.5
415.009	39.9	46.0	-6.1	43.1	2.1	32.0	10.5	16.5
416.949	41.0	46.0	-5.0	44.1	2.2	32.0	10.5	16.6
425.033	39.8	46.0	-6.2	42.8	2.2	32.0	10.5	17.1

Test Mode: Rx mode, EUT with internal antenna  
Temperature: 20 C                      Humidity : 50 %

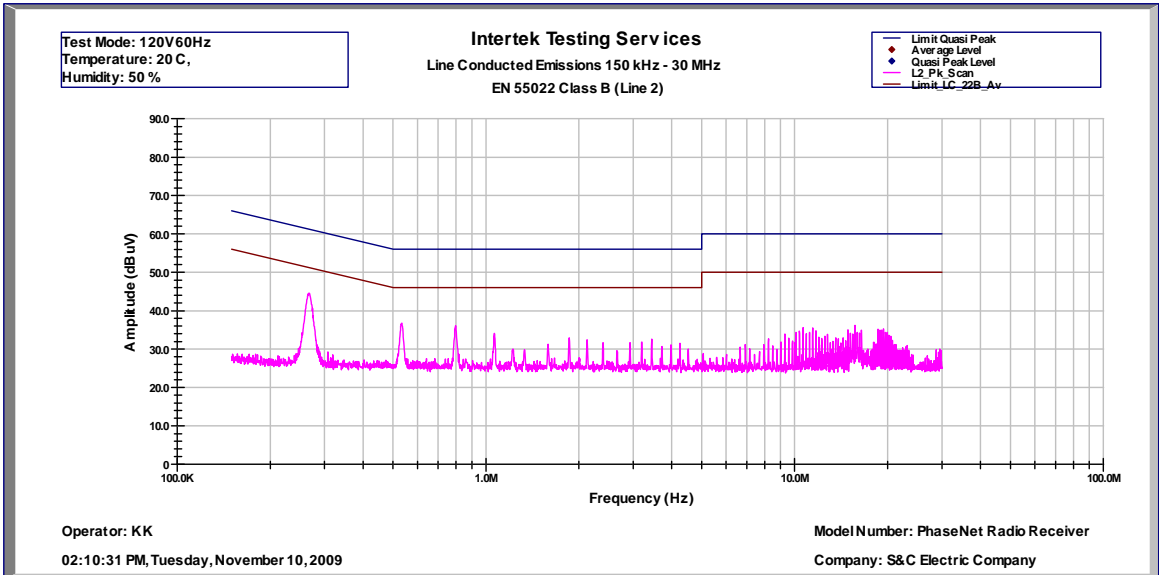
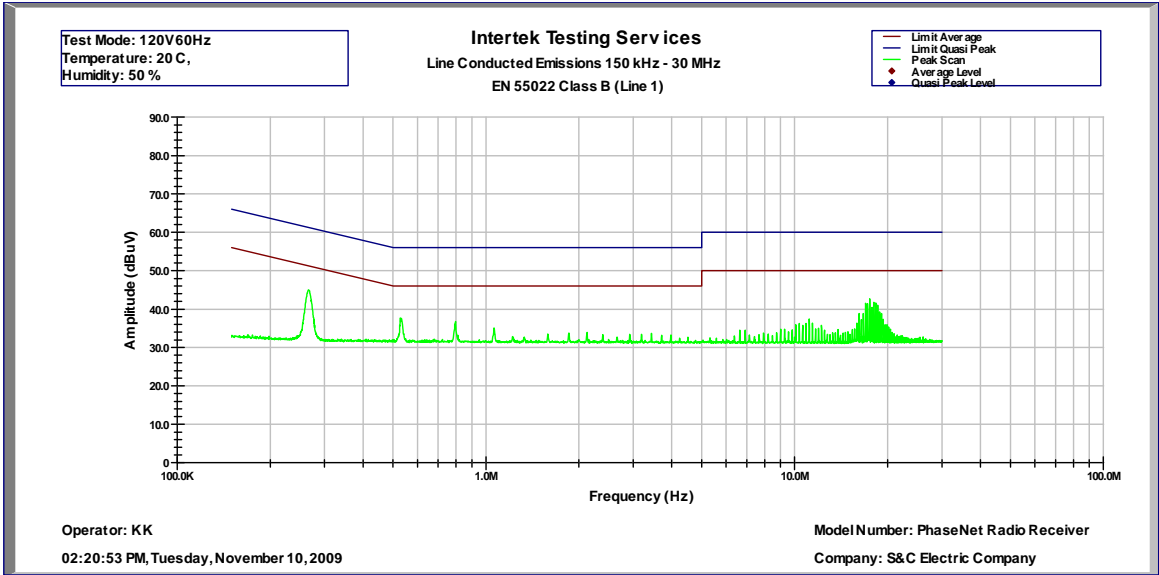
4.7 AC Line Conducted Emission  
FCC 15.207:

4.7.1 Procedure

AC line conducted emission test was performed according the ANSI C63.4 standard. The EUT was connected to AC Line through the LISN.

4.7.2 Test Result

<b>Results</b>	<b>Complies by 7.6 dB</b>
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## 5.0 RF Exposure evaluation

The EUT is a Bluetooth device used in mobile application, at least 20 cm from any body part of the user or near by persons.

The maximum conducted power is 0.37 mW; antenna is fix-mounted, 0 dBi gain. Therefore, to comply with RF Exposure Requirement, the MPE is calculated.

The maximum Peak EIRP calculated is -4.3 dBm or 0.37 mW.

The Power Density can be calculated using the formula

$$S = \text{EIRP} / 4\pi D^2$$

Where: S is Power Density in  $\text{W}/\text{m}^2$

D is the distance from the antenna.

It is considered that 20cm is the minimum distance that user can go closer to the EUT (PhaseNet Radio Receiver) which is installed inside the Console of WhiteStar Signature Remote Control system.

At 0.2 m,  $S = 0.00074 \text{ W}/\text{m}^2$ , which is below the MPE Limit of  $10 \text{ W}/\text{m}^2$



## 6.0 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
Spectrum Analyzer	Rohde&Schwarz	FSP40	036612004	12	10/16/10
BI-Log Antenna	Antenna Research	LPB-2513/A	1154	12	06/23/10
Horn Antenna	EMCO	3115	9107-3712	12	11/03/10
Pre-Amplifier	Sonoma	310N	185634	12	11/10/09
Pre-Amplifier	Miteq	AMF-4D-001180-24-10P	799159	12	07/28/10
Spectrum Analyzer	Rohde&Schwarz	FSU26	200482	12	11/20/09
Vector Signal Generator	Rohde&Schwarz	SMU200A	102499	12	04/01/10

**7.0 Document History**

<b>Revision/ Job Number</b>	<b>Writer Initials</b>	<b>Date</b>	<b>Change</b>
1.0 / 3193115	KK	November 22, 2009	Original document