ENGINEERING TEST REPORT

2.4GHz Amplified RF Module
Model: 348

FCC ID: YUS348

Applicant:

Tap Acquisition, Inc. DBA TapDynamics
4500 Westgrove Dr., Suite 215
Addison, TX 75001

In Accordance With

Federal Communications Commission (FCC)
Part 15, Subpart C, Section 15.247
Frequency Hopping Spread Spectrum Operating in 2400 – 2483.5 MHz Band

UltraTech's File No.: EVTA-001F15C247

This Test report is Issued under the Authority of Tri M. Luu Vice President of Engineering UltraTech Group of Labs Date: September 30, 2011	
Report Prepared by: Dan Huynh Issued Date: September 30, 2011	Tested by: Mr. Hung Trinh Test Dates: February 18 ~ April 6, 2011

- *The results in this Test Report apply only to the sample(s) tested, and the sample tested is randomly selected.*
- *This report must not be used by the client to claim product endorsement by NVLAP or any agency of the US Government.*

UltraTech

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FCC	VCI	Industry Canada Approved Test Facility	NVLAP	BSMI	Korea KCC-RRL
91038	1309	46390-2049	NvLap Lab Code 200093-0	SL2-IN-E-1119R	CA2049

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EXHIBIT 1. INTRODUCTION

1.1. SCOPE

Reference:	FCC Part 15, Subpart C, Section 15.247
Title:	Code of Federal Regulations (CFR), Title 47 – Telecommunication, Part 15
Purpose of Test:	Equipment Certification for Frequency Hopping Spread Spectrum Transmitter Operating in the Frequency Band 2400-2483.5 MHz.
Test Procedures:	Both conducted and radiated emissions measurements were conducted in accordance with American National Standards Institute ANSI C63.4 - American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
Environmental Classification:	[x] Commercial, industrial or business environment [x] Residential environment

1.2. RELATED SUBMITTAL(S)/GRANT(S)

None.

1.3. NORMATIVE REFERENCES

Publication	Year	Title
47 CFR Parts 0-19	2010	Code of Federal Regulations (CFR), Title 47 – Telecommunication
ANSI C63.4	2003	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
ANSI C63.10	2009	American National Standard for Testing Unlicensed Wireless Devices
CISPR 22 & EN 55022	2008-09, Edition 6.0 2006	Information Technology Equipment - Radio Disturbance Characteristics - Limits and Methods of Measurement
CISPR 16-1-1 +A1 +A2	2006 2006 2007	Specification for radio disturbance and immunity measuring apparatus and methods. Part 1-1: Measuring Apparatus
CISPR 16-1-2 +A1 +A2	2003 2004 2006	Specification for radio disturbance and immunity measuring apparatus and methods. Part 1-2: Conducted disturbances
FCC Public Notice DA 00-705	2000	Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems

EXHIBIT 2. PERFORMANCE ASSESSMENT

2.1. CLIENT INFORMATION

APPLICANT	
Name:	Tap Acquisition, Inc. DBA TapDynamics
Address:	4500 Westgrove Dr., Suite 215 Addison, TX 75001 USA
Contact Person:	Mr. Shawn C. Nielsen Phone #: 519-342-1004 Fax #: 519-886-1003 Email Address: snielsen@gabaeind.com

MANUFACTURER	
Name:	Tap Acquisition, Inc. DBA TapDynamics
Address:	4500 Westgrove Dr., Suite 215 Addison, TX 75001 USA
Contact Person:	Mr. Shawn C. Nielsen Phone #: 519-342-1004 Fax #: 519-886-1003 Email Address: snielsen@gabaeind.com

2.2. EQUIPMENT UNDER TEST (EUT) INFORMATION

The following information (with the exception of the Date of Receipt) has been supplied by the applicant.

Brand Name:	Tap Acquisition, Inc. DBA TapDynamics
Product Name:	2.4GHz Amplified RF Module
Model Name or Number:	348
Serial Number:	Test Sample
Type of Equipment:	Spread Spectrum Transmitter
Input Power Supply Type:	External power supply
Primary User Functions of EUT:	Remote control or monitoring through RF Transceiver link

2.3. EUT'S TECHNICAL SPECIFICATIONS

TRANSMITTER	
Equipment Type:	• Mobile • Base Station (fixed use)
Intended Operating Environment:	Commercial, industrial or business
Power Supply Requirement:	3.3VDC@25mA 5VDC@250mA max.
RF Output Power Rating:	25.21 dBm (332 mW) Peak
Operating Frequency Range:	2402 – 2476 MHz
RF Output Impedance:	50 Ω
Channel Spacing:	1 MHz
Duty Cycle:	100%
Modulation Type:	GFSK
Oscillator Frequencies:	16 MHz
Antenna Connector Types:	Integral

2.4. ASSOCIATED ANTENNA DESCRIPTION

Antenna:	
Manufacturer:	Fractus
Type:	Fractal Array, SMT chip
Model:	FR05-S1-N-0-001
Frequency Range:	2.4-2.5GHz
Impedance:	50 Ohm
Gain (dBi):	2.2

2.5. LIST OF EUT'S PORTS

Port Number	EUT's Port Description	Number of Identical Ports	Connector Type	Cable Type (Shielded/Non-shielded)
None.				

2.6. ANCILLARY EQUIPMENT

The EUT was tested while connected to the following representative configuration of ancillary equipment necessary to exercise the ports during tests:

Ancillary Equipment # 1	
Description:	Test Jig
Brand name:	Tap Acquisition, Inc. DBA TapDynamics
Model Name or Number:	N/A
Serial Number:	N/A
Connected to EUT's Port:	Module pin signals

EXHIBIT 3. EUT OPERATING CONDITIONS AND CONFIGURATIONS DURING TESTS

3.1. CLIMATE TEST CONDITIONS

The climate conditions of the test environment are as follows:

Temperature:	21 to 23 °C
Humidity:	45 to 58%
Pressure:	102 kPa
Power Input Source:	3.3 VDC or 5 VDC

3.2. OPERATIONAL TEST CONDITIONS & ARRANGEMENT FOR TESTS

Operating Modes:	▪ Each of lowest, middle and highest channel frequencies transmits continuously for emissions measurements. ▪ The EUT operates in normal Frequency Hopping mode for occupancy duration, and frequency separation.
Special Test Software:	Special software provided by the applicant was installed to allow the EUT to operate in hopping mode or at each channel frequency continuously. For example, the transmitter will be operated at each of lowest, middle and highest frequencies individually continuously during testing
Special Hardware Used:	Test Jig
Transmitter Test Antenna:	The EUT is tested with the antenna fitted in a manner typical of normal intended use as integral antenna equipment as described with the test results.

Transmitter Test Signals	
Frequency Band(s):	2402 - 2476 MHz
Frequency(ies) Tested: (Near lowest, near middle & near highest frequencies in the frequency range of operation.)	2402, 2439 and 2476 MHz
RF Power Output: (measured maximum output power at antenna terminals) **Normal Test Modulation:** **Modulating Signal Source:**	25.21 dBm (332 mW) Peak GFSK Internal

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EXHIBIT 4. SUMMARY OF TEST RESULTS

4.1. LOCATION OF TESTS

All of the measurements described in this report were performed at Ultratech Group of Labs located in the city of Oakville, Province of Ontario, Canada.

- AC Power Line Conducted Emissions were performed in UltraTech's shielded room, 24'(L) by 16'(W) by 8'(H).
- Radiated Emissions were performed at the Ultratech's 3-10 TDK Semi-Anechoic Chamber situated in the Town of Oakville, province of Ontario. This test site been calibrated in accordance with ANSI C63.4, and found to be in compliance with the requirements of Sec. 2.948 of the FCC Rules. The descriptions and site measurement data of the Oakville 3-10 TDK Semi-Anechoic Chamber has been filed with FCC office (FCC File No.: 31040/SIT 1300B3) and Industry Canada office (Industry Canada Site No.: 2049A-3, Expiry Date: May 1, 2011)

4.2. APPLICABILITY & SUMMARY OF EMC EMISSION TEST RESULTS

FCC Section(s)	Test Requirements	Compliance* (Yes/No)
15.203	Antenna requirements	Yes**
15.207(a)	AC Power Line Conducted Emissions	Yes
15.247(a)(1)	Provisions for Frequency Hopping Systems	Yes
15.247(b)	Peak Conducted Output Power	Yes
15.247(d)	Band-Edge and RF Conducted Spurious Emissions at the Transmitter Antenna Terminal	Yes
15.247(d), 15.209 & 15.205	Transmitter Spurious Radiated Emissions	Yes
15.247(i) 1.1307, 1.1310, 2.1091 & 2.1093	RF Exposure	Yes

***** Preliminary tests conducted with 3.3 VDC and 5 VDC supplied to the test jig board to determine the worst-case test configuration, the power measurement results indicate similar power levels. Therefore, tests conducted from this point on, except where otherwise specified, shall be performed with 3.3 VDC input to the test jig board.

** The EUT complies with the requirement; it employs a unique (non-standard) antenna connector for all external antennas proposed for use with the EUT or permanently mounted integral antenna.

4.3. MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

None.

EXHIBIT 5. MEASUREMENTS, EXAMINATIONS & TEST DATA FOR EMC EMISSIONS

5.1. TEST PROCEDURES

This section contains test results only. Details of test methods and procedures can be found in FCC Public Notice @ DA 00-705 (March 30, 2000) – Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems.

5.2. MEASUREMENT UNCERTAINTIES

The measurement uncertainties stated were calculated in accordance with the requirements of CISPR 16-4-2 @ IEC:2003 and JCGM 100:2008 (GUM 1995) – Guide to the Expression of Uncertainty in Measurement.
Refer to Exhibit 7 for Measurement Uncertainties.

5.3. MEASUREMENT EQUIPMENT USED

The measurement equipment used complied with the requirements of the Standards referenced in the Methods & Procedures ANSI C63.4 and CISPR 16-1-1.

5.4. ESSENTIAL/PRIMARY FUNCTIONS AS DECLARED BY THE MANUACTURER

Remote control or monitoring through RF Transceiver link.

5.5. AC POWER LINE CONDUCTED EMISSIONS [§15.207(a)]

5.5.1. Limit(s)

The equipment shall meet the limits of the following table:

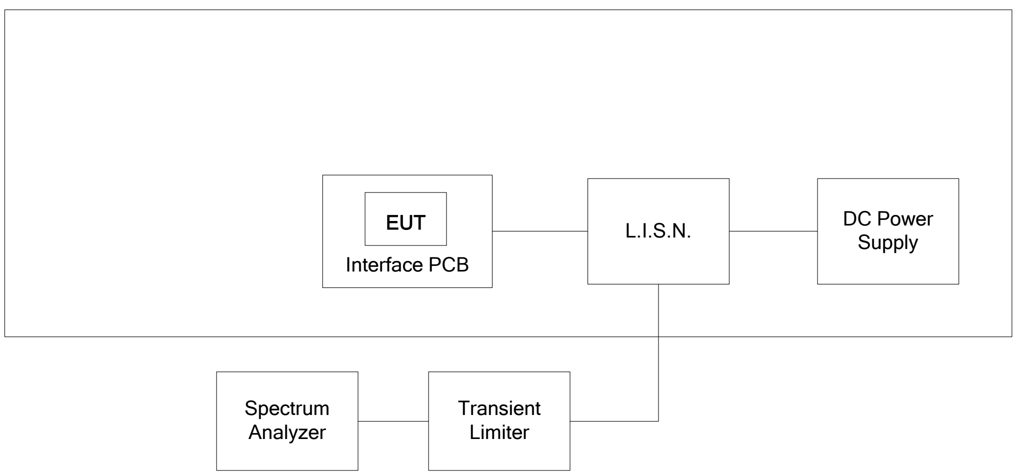
Frequency of emission (MHz)	Conducted Limit (dBμV)	
	Quasi-peak	Average
0.15–0.5	66 to 56*	56 to 46*
0.5–5	56	46
5-30 ……………………..	60 ...……………..	50

*Decreases linearly with the logarithm of the frequency

5.5.2. Method of Measurements

ANSI C63.4

5.5.3. Test Arrangement

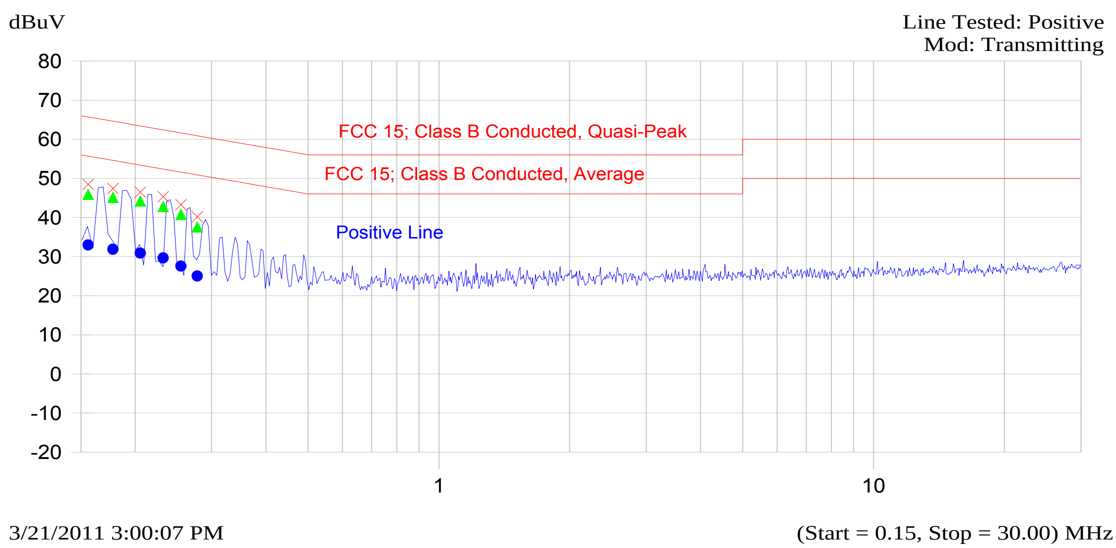


5.5.4. Test Data

Plot 5.5.4.1. Power Line Conducted Emissions, 3.3 VDC Input, Tx Mode

Line Voltage:	3.3 VDC
Line Tested:	Positive

Current Graph



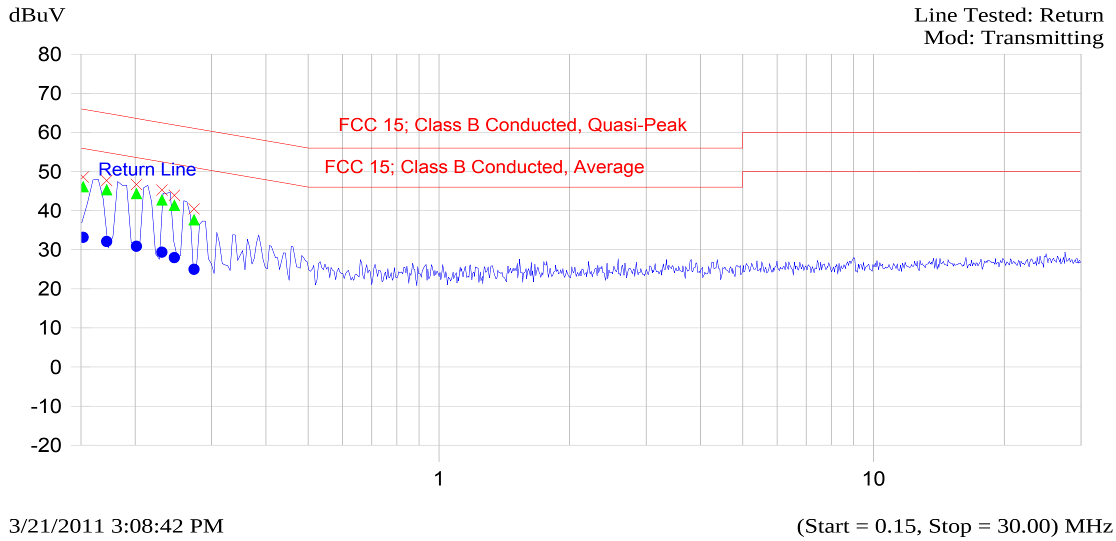
Current List

Frequency MHz	Peak dBuV	QP dBuV	Delta QP-QP Limit dB	Avg dBuV	Delta Avg-Avg Limit dB	Trace Name
0.156	48.5	45.9	-19.9	33.0	-22.9	Positive Line
0.178	47.4	45.1	-20.0	31.8	-23.4	Positive Line
0.206	46.4	44.2	-20.2	30.9	-23.5	Positive Line
0.232	45.3	42.8	-20.8	29.6	-24.0	Positive Line
0.255	43.2	40.8	-22.2	27.6	-25.4	Positive Line
0.278	40.1	37.6	-24.7	25.0	-27.2	Positive Line

Plot 5.5.4.2. Power Line Conducted Emissions, 3.3 VDC Input, Tx Mode

Line Voltage:	3.3 VDC
Line Tested:	Return

Current Graph



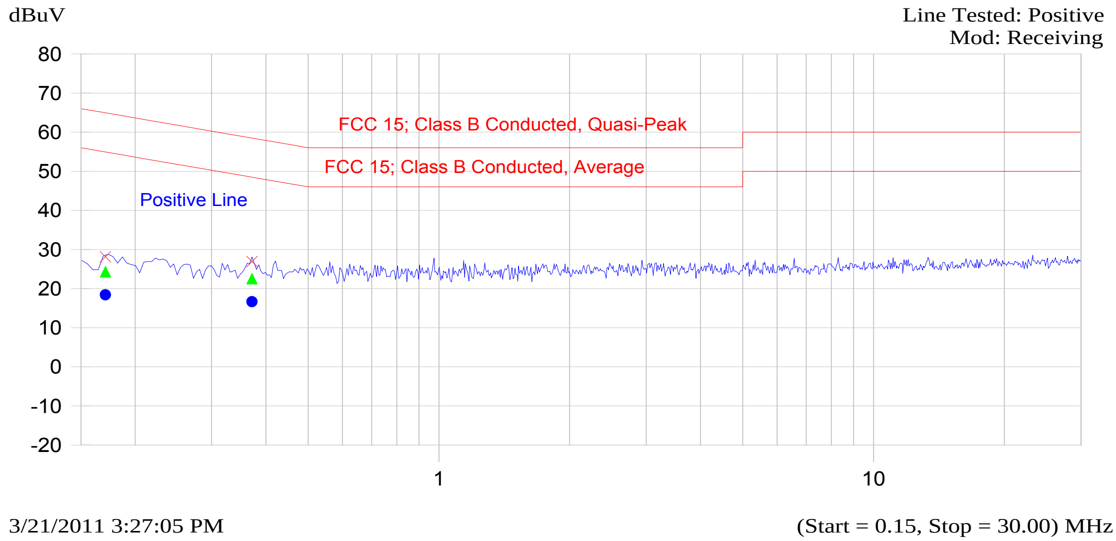
Current List

Frequency MHz	Peak dBuV	QP dBuV	Delta QP-QP Limit dB	Avg dBuV	Delta Avg-Avg Limit dB	Trace Name
0.152	48.6	46.1	-19.8	33.1	-22.8	Return Line
0.172	47.7	45.4	-20.0	32.1	-23.3	Return Line
0.201	46.7	44.3	-20.2	30.8	-23.6	Return Line
0.231	45.3	42.7	-20.9	29.3	-24.3	Return Line
0.246	43.9	41.4	-21.8	28.0	-25.2	Return Line
0.273	40.4	37.6	-24.8	25.0	-27.4	Return Line

Plot 5.5.4.3. Power Line Conducted Emissions, 3.3 VDC Input, Rx Mode

Line Voltage:	3.3 VDC
Line Tested:	Positive

Current Graph



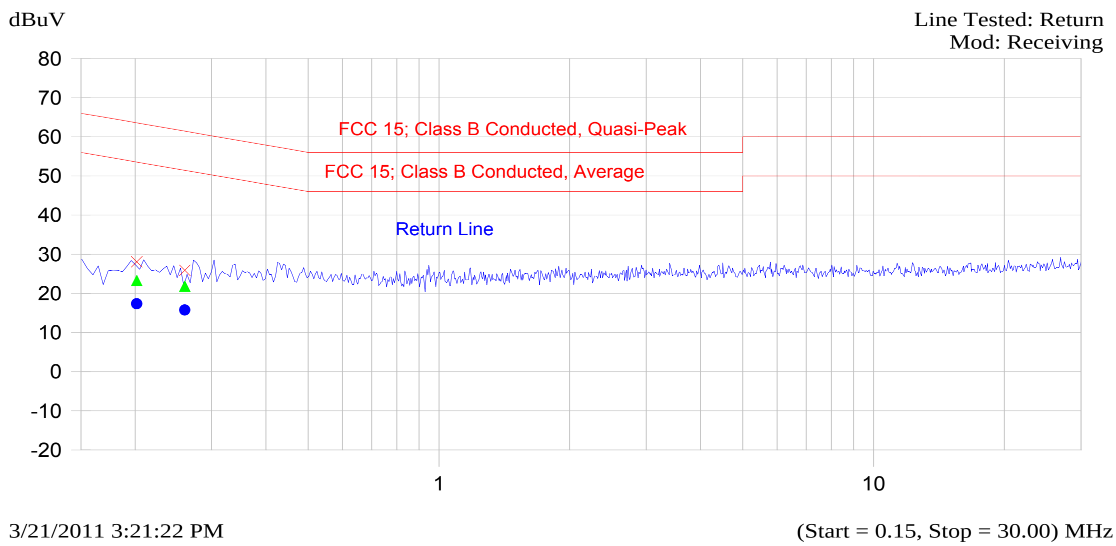
Current List

Frequency MHz	Peak dBuV	QP dBuV	Delta QP-QP Limit dB	Avg dBuV	Delta Avg-Avg Limit dB	Trace Name
0.171	28.1	24.3	-41.1	18.4	-37.0	Positive Line
0.371	26.9	22.5	-37.1	16.6	-33.0	Positive Line

Plot 5.5.4.4. Power Line Conducted Emissions, 3.3 VDC Input, Rx Mode

Line Voltage: 3.3 VDC
Line Tested: Return

Current Graph



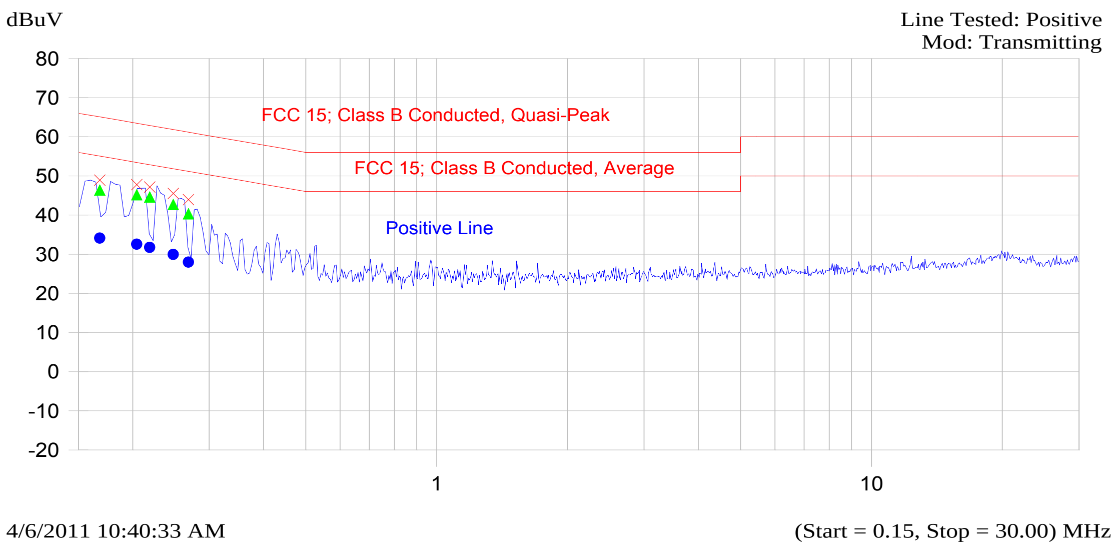
Current List

Frequency MHz	Peak dBuV	QP dBuV	Delta QP-QP Limit dB	Avg dBuV	Delta Avg-Avg Limit dB	Trace Name
0.202	28.0	23.3	-41.2	17.4	-37.1	Return Line
0.260	25.9	21.8	-41.0	15.7	-37.1	Return Line

Plot 5.5.4.5. Power Line Conducted Emissions, 5 VDC Input, Tx Mode

Line Voltage:	5 VDC
Line Tested:	Positive

Current Graph



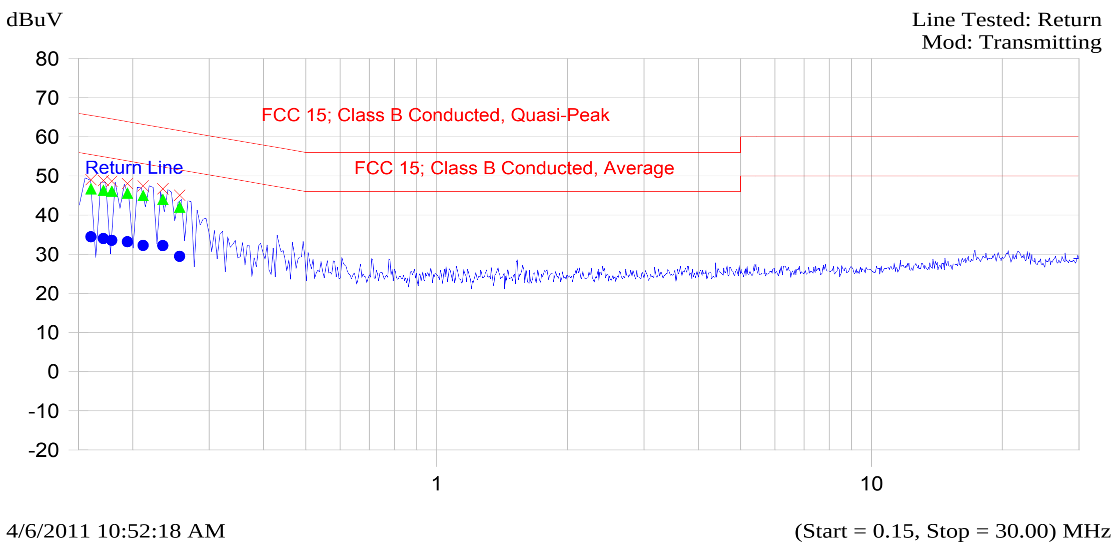
Current List

Frequency MHz	Peak dBuV	QP dBuV	Delta QP-QP Limit dB	Avg dBuV	Delta Avg-Avg Limit dB	Trace Name
0.168	48.9	46.4	-19.1	34.1	-21.4	Positive Line
0.204	47.8	45.2	-19.2	32.5	-21.9	Positive Line
0.219	47.2	44.6	-19.4	31.7	-22.3	Positive Line
0.248	45.5	42.7	-20.4	29.9	-23.2	Positive Line
0.269	43.9	40.3	-22.2	28.0	-24.6	Positive Line

Plot 5.5.4.6. Power Line Conducted Emissions, 5 VDC Input, Tx Mode

Line Voltage:	5 VDC
Line Tested:	Return

Current Graph



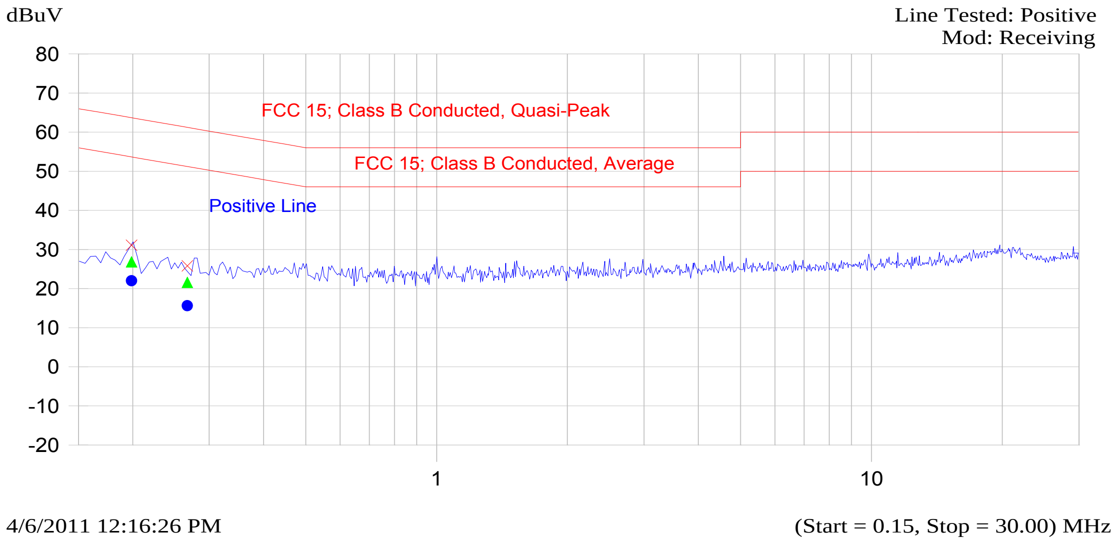
Current List

Frequency MHz	Peak dBuV	QP dBuV	Delta QP-QP Limit dB	Avg dBuV	Delta Avg-Avg Limit dB	Trace Name
0.145	49.7	47.4		35.3		Return Line
0.160	49.0	46.7	-19.0	34.4	-21.3	Return Line
0.171	48.8	46.3	-19.1	34.0	-21.4	Return Line
0.179	48.6	46.1	-19.1	33.5	-21.6	Return Line
0.195	48.0	45.6	-19.1	33.2	-21.5	Return Line
0.211	47.4	45.0	-19.2	32.2	-22.0	Return Line
0.235	46.7	44.0	-19.5	32.2	-21.4	Return Line
0.257	45.1	42.0	-20.9	29.4	-23.4	Return Line

Plot 5.5.4.7. Power Line Conducted Emissions, 5 VDC Input, Rx Mode

Line Voltage:	5 VDC
Line Tested:	Positive

Current Graph



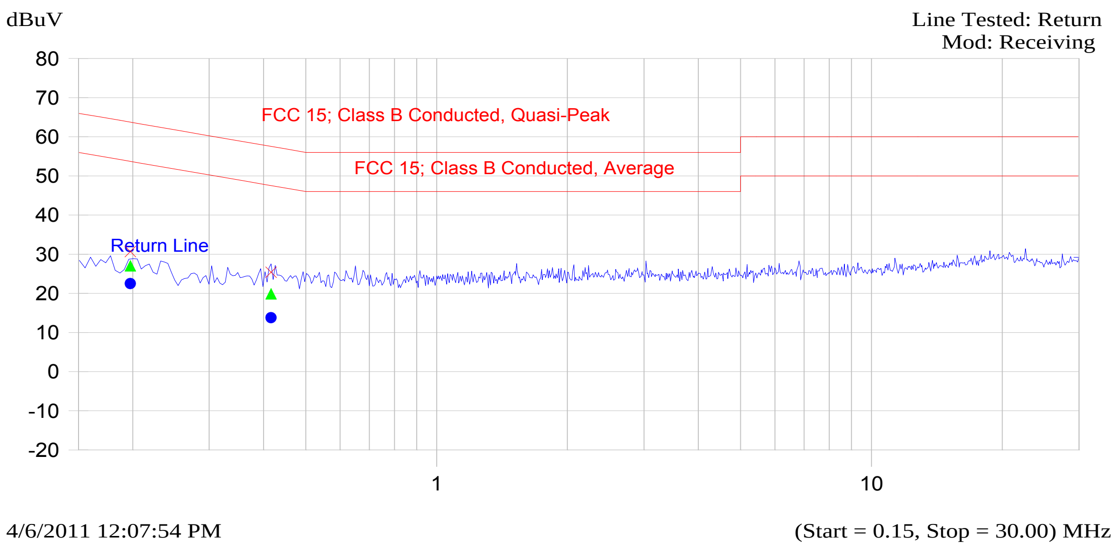
Current List

Frequency MHz	Peak dBuV	QP dBuV	Delta QP-QP Limit dB	Avg dBuV	Delta Avg-Avg Limit dB	Trace Name
0.199	31.1	26.8	-37.7	22.0	-32.6	Positive Line
0.267	25.8	21.6	-41.0	15.6	-37.0	Positive Line

Plot 5.5.4.8. Power Line Conducted Emissions, 5 VDC Input, Rx Mode

Line Voltage:	5 VDC
Line Tested:	Return

Current Graph



Current List

Frequency MHz	Peak dBuV	QP dBuV	Delta QP-QP Limit dB	Avg dBuV	Delta Avg-Avg Limit dB	Trace Name
0.198	30.7	27.0	-37.6	22.5	-32.1	Return Line
0.416	25.4	19.9	-38.5	13.8	-34.5	Return Line

5.6. COMPLIANCE WITH FCC PART 15 – GENERAL TECHNICAL REQUIREMENTS

FCC Section	FCC Rules	Manufacturer's Clarification
15.31	The hoping function must be disabled for tests, which should be performed with the EUT transmitting on the number of frequencies specified in this Section. The measurements made at the upper and lower ends of the band of operation should be made with the EUT tuned to the highest and lowest available channels.	The hoping function was disabled for tests
15.203	Described how the EUT complies with the requirement that either its antenna is permanently attached, or that it employs a unique antenna connector, for every antenna proposed for use with the EUT. The exception is in those cases where EUT must be professionally installed. In order to demonstrate that professional installation is required, the following 3 points must be addressed: ➢ The application (or intended use) of the EUT ➢ The installation requirements of the EUT ➢ The method by which the EUT will be marketed	Integral antenna.
15.204	Provided the information for every antenna proposed for use with the EUT: ➢ type (e.g. Yagi, patch, grid, dish, etc…), ➢ manufacturer and model number ➢ gain with reference to an isotropic radiator	See user manual
15.247(a)	Description of how the EUT meets the definition of a frequency hopping spread spectrum, found in Section 2.1. Based on the technical description.	See Operational Description
15.247(a)	Pseudo Frequency Hopping Sequence: Describe how the hopping sequence is generated. Provide an example of the hopping sequence channels, in order to demonstrate that the sequence meets the requirements specified in the definition of a frequency hopping spread spectrum system, found in Section 2.1	See Operational Description

FCC Section	FCC Rules	Manufacturer's Clarification
15.247(a)	Equal Hopping Frequency Use: Describe how each individual EUT meets the requirement that each of its hopping channels is used equally on average (e.g. that each new transmission event begins on the next channel in the hopping sequence after final channel used in the previous transmission events).	See Operational Description
15.247(g)	Frequency hopping spread spectrum systems are not required to employ all available hopping channels during each transmission. However, the system, consisting of both the transmitter and the receiver, must be designed to comply with all of the regulations in this section should the transmitter be presented with a continuous data (or information) stream. In addition, a system employing short transmission bursts must comply with the definition of a frequency hopping system and must distribute its transmissions over the minimum number of hopping channels specified in this section.	See Operational Description
15.247(h)	Describe how the EUT complies with the requirement that it not have the ability to coordinated with other FHSS is an effort to avoid the simultaneous occupancy of individual hopping frequencies by multiple transmitters	See Operational Description
Public Notice DA 00-705	System Receiver Input Bandwidth: Describe how the associated receiver(s) complies with the requirement that its input bandwidth (either RF or IF) matches the bandwidth of the transmitted signal.	See Operational Description
Public Notice DA 00-705	System Receiver Hopping Capability: Describe how the associated receiver(s) has the ability to shift frequencies in synchronization with the transmitted signals	See Operational Description

5.7. PROVISIONS FOR FREQUENCY HOPPING SYSTEMS [§ 15.247(a)(1)]

5.7.1. Limit(s)

§ 15.247(a)(1): Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

§ 15.247(a)(1)((iii) Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

5.7.2. Method of Measurements

FCC Public Notice DA 00-705

Carrier Frequency Separation:

The hopping function of the EUT is enabled. Use the spectrum analyzer setting as follows:
- Span = wide enough to capture the peaks of two adjacent channels
- RBW = 1% of the span
- VBW ≥ RBW
- Sweep = Auto
- Detector = peak
- Trace = max hold

Number of hopping frequency:

The hopping function of the EUT is enabled. Use the spectrum analyzer setting as follows:
- Span = the frequency band of operation
- RBW = 1% of the span
- VBW ≥ RBW
- Sweep = Auto
- Detector = peak
- Trace = max hold

Time of Occupancy (Dwell Time):

The hopping function of the EUT is enabled. Use the spectrum analyzer setting as follows:

- Span = 0 Hz centered on a hopping channel
- RBW = 1 MHz
- VBW $\geq$ RBW
- Sweep = as necessary to capture the entire dwell time per hopping channel
- Detector = peak
- Trace = max hold

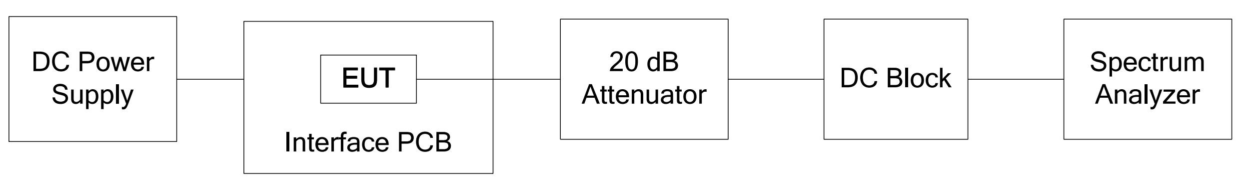
If possible, use the marker-delta function to determine the dwell time. If this value varies with different modes of operation (e.g. date rate modulation format, etc.), repeat this test for each variation. The limit is specified in one of the subparagraphs of this Section. Submit this plot(s). An oscilloscope may be used instead of a spectrum analyzer.

20 dB Bandwidth:

Use the spectrum analyzer setting as follows:

- Span = approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel
- RBW = 1% of the 20 dB bandwidth
- VBW $\geq$ RBW
- Sweep = auto
- Detector = peak
- Trace = max hold
- The transmitter shall be transmitting at its maximum data rate.
- Allow the trace to stabilize.
- Use the marker-to-peak function to set the marker to the peak of the emission.
- Use the marker-delta function to measure 20 dB down on both sides of the emission.
- The 20 dB BW is the delta reading in frequency between two markers.

5.7.3. Test Arrangement



5.7.4. Test Data

Test Description	FCC Specification	Measured Values	Comments
Receiver Input Bandwidth and Hopping Capability	The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.	--	See Note 1
20 dB BW of the hopping channel	--	230.46 kHz	See Note 2
Channel Hopping Frequency Separation	Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.	1 MHz	See Note 2
Number hopping frequencies	Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.	75 hopping frequencies	See Note 2
Average Time of Occupancy	The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.	211.25 ms in a period of 30s	See Note 2

Note 1: See operational description exhibit for details.

Note 2: See the following plots for details.

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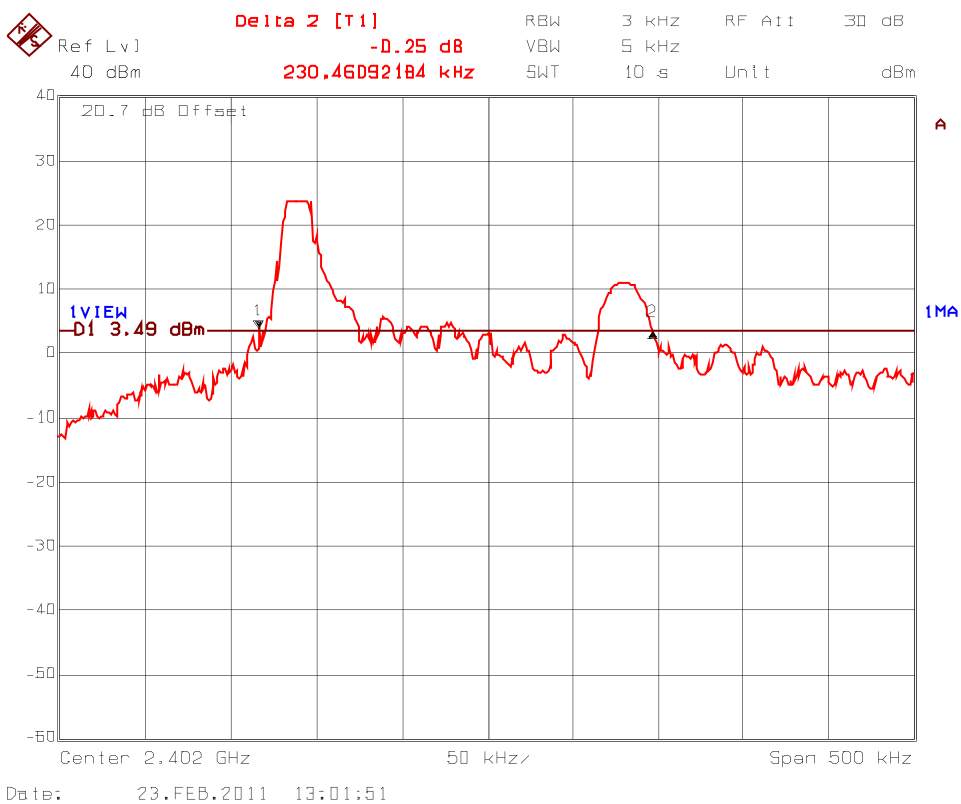
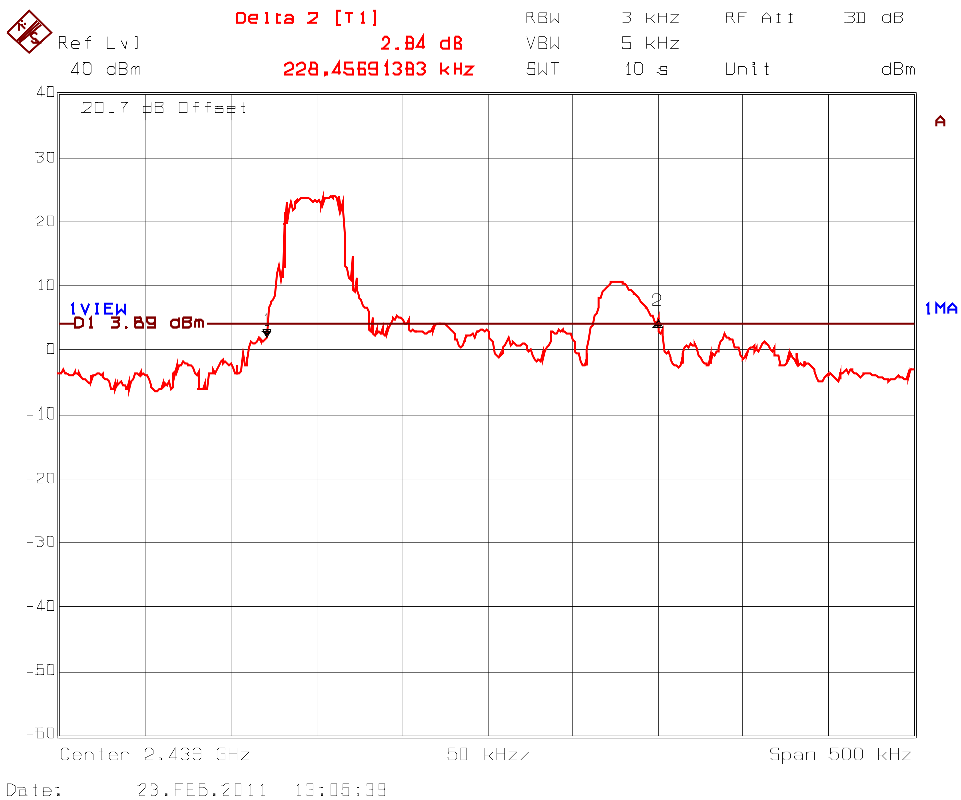
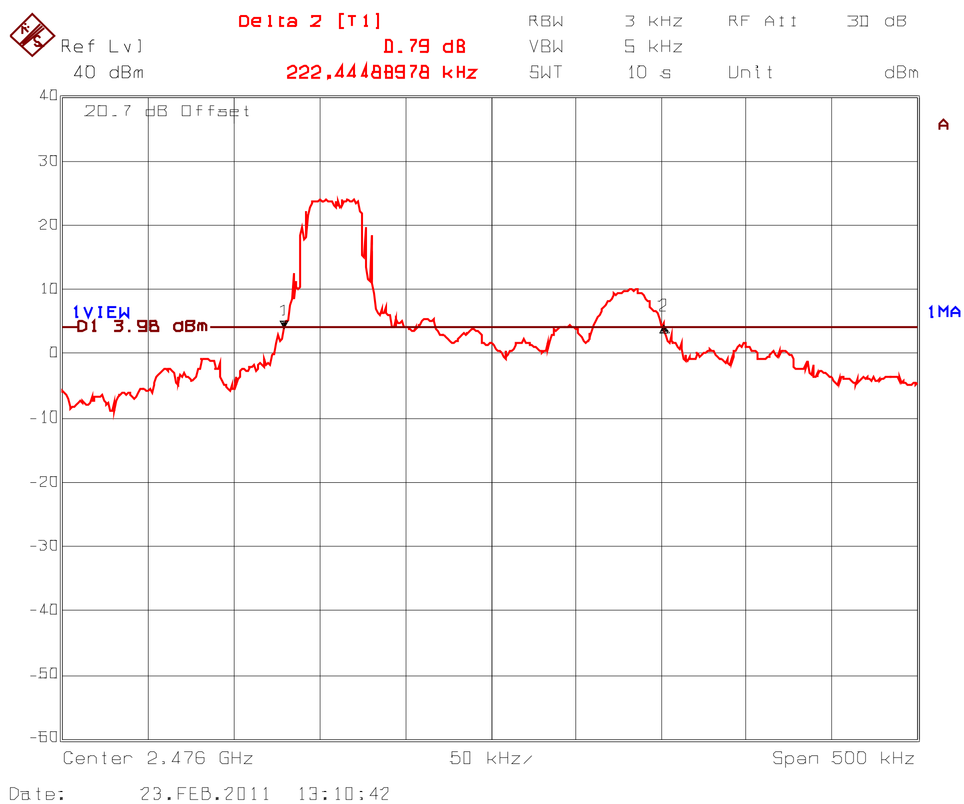
Plot 5.7.4.1. 20 dB Bandwidth
Test Frequency: 2402 MHz



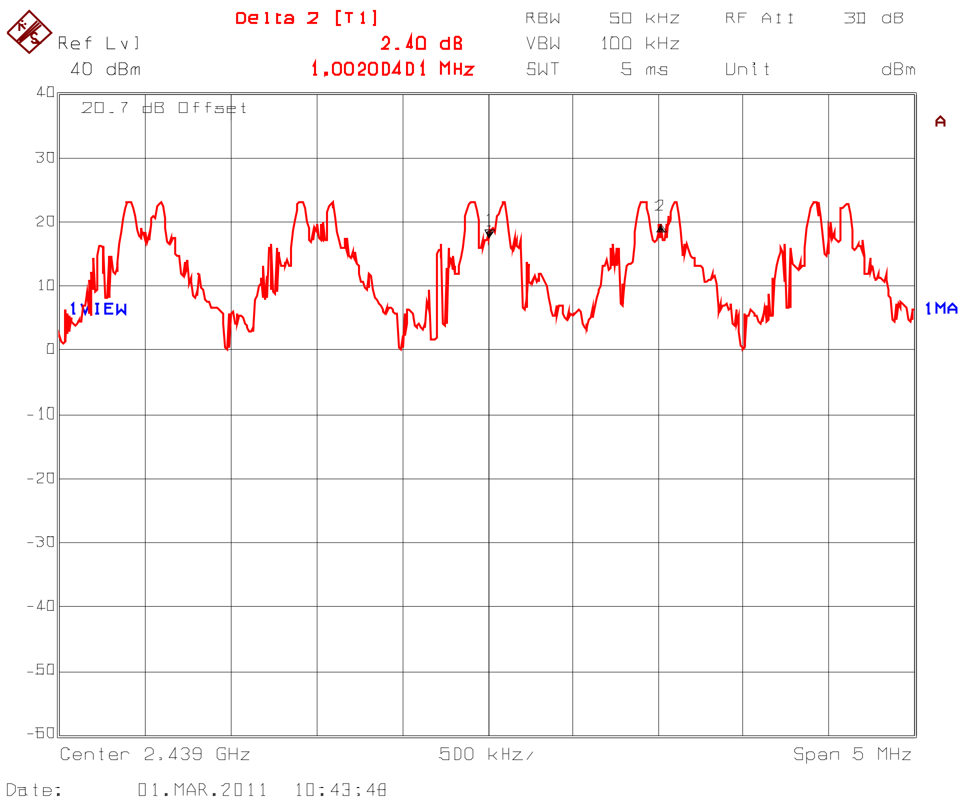
Plot 5.7.4.2. 20 dB Bandwidth
Test Frequency: 2439 MHz



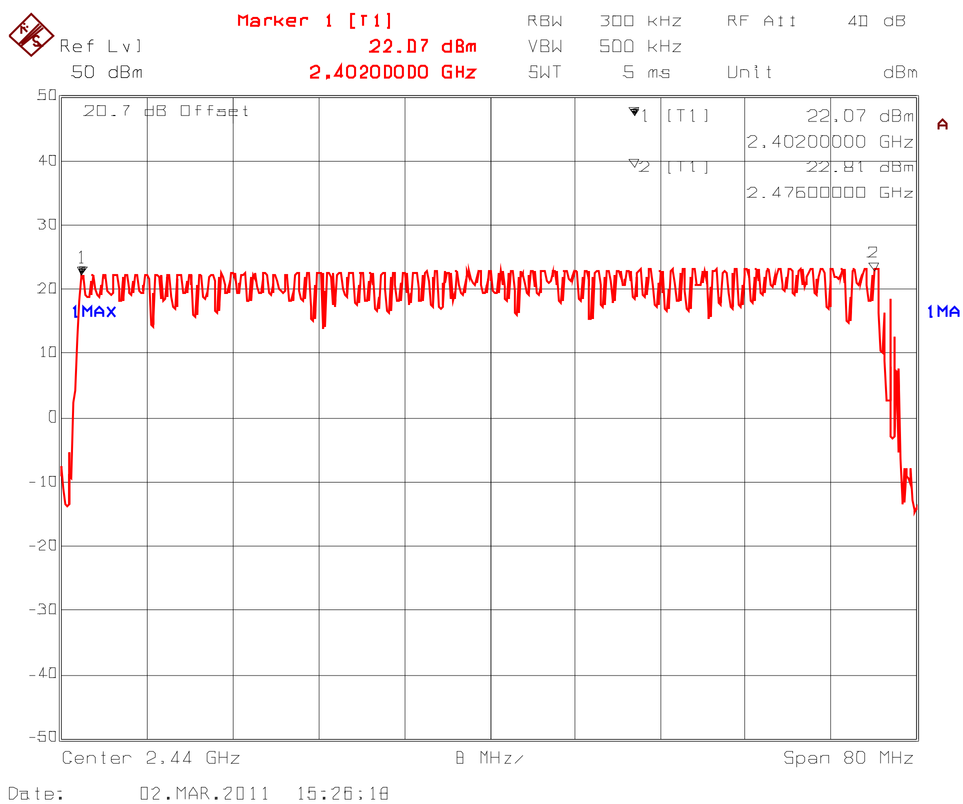
Plot 5.7.4.3. 20 dB Bandwidth
Test Frequency: 2476 MHz



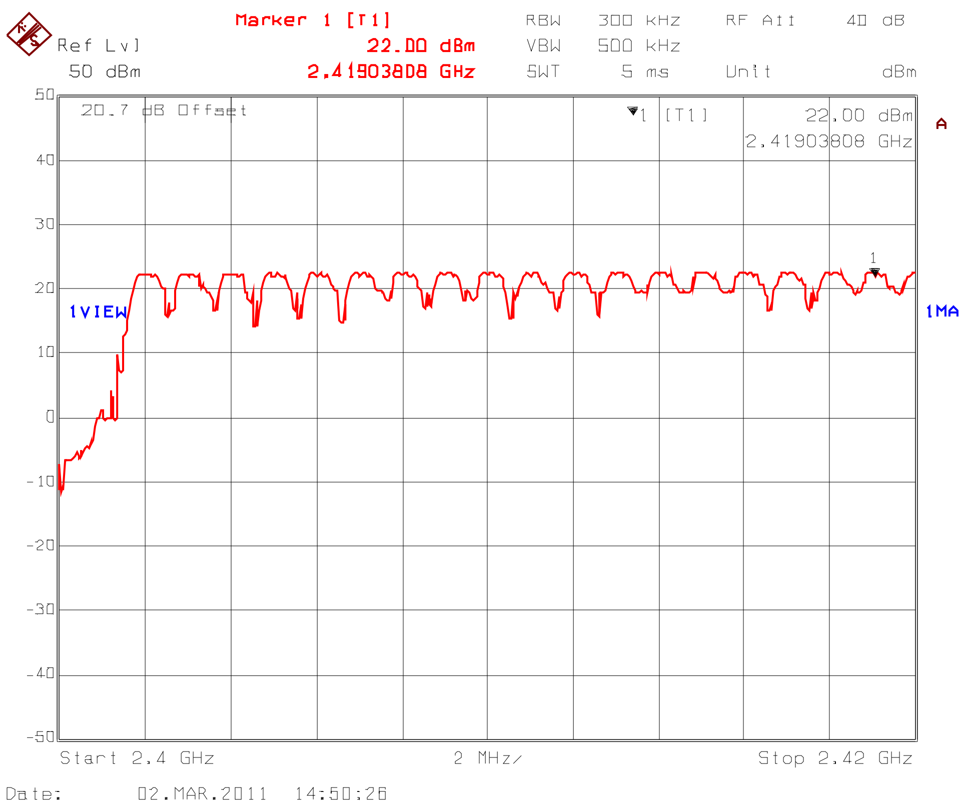
Plot 5.7.4.4. Carrier Frequency Separation



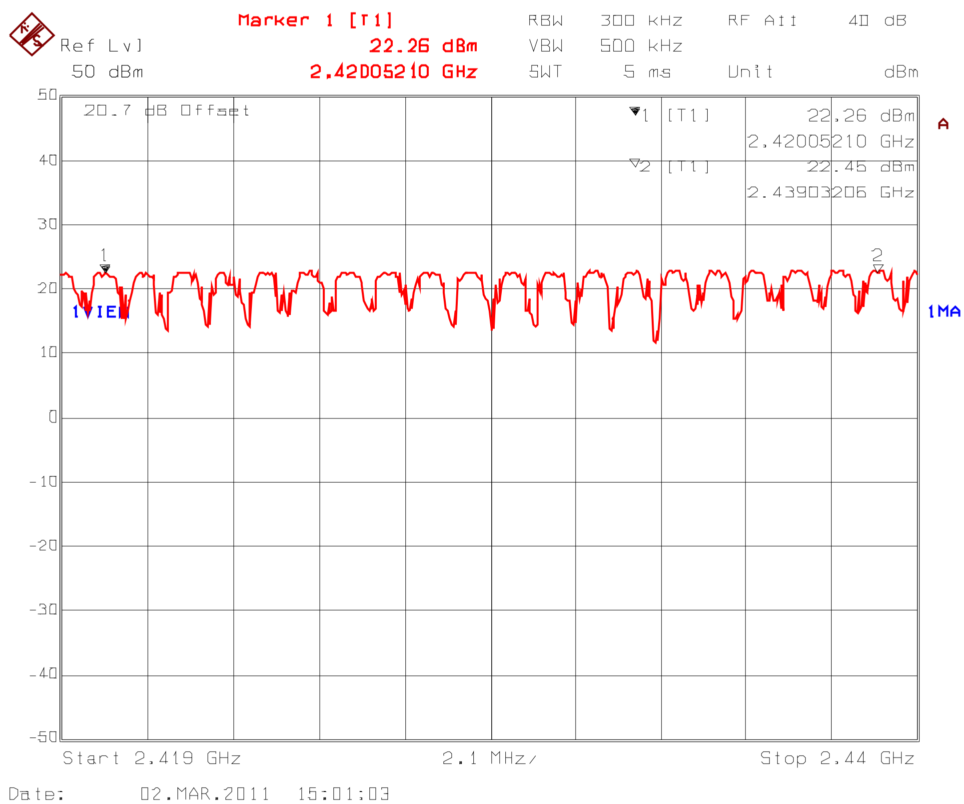
Plot 5.7.4.5. Number of Hopping Frequencies
75 hopping channels from 2402 - 2475 MHz



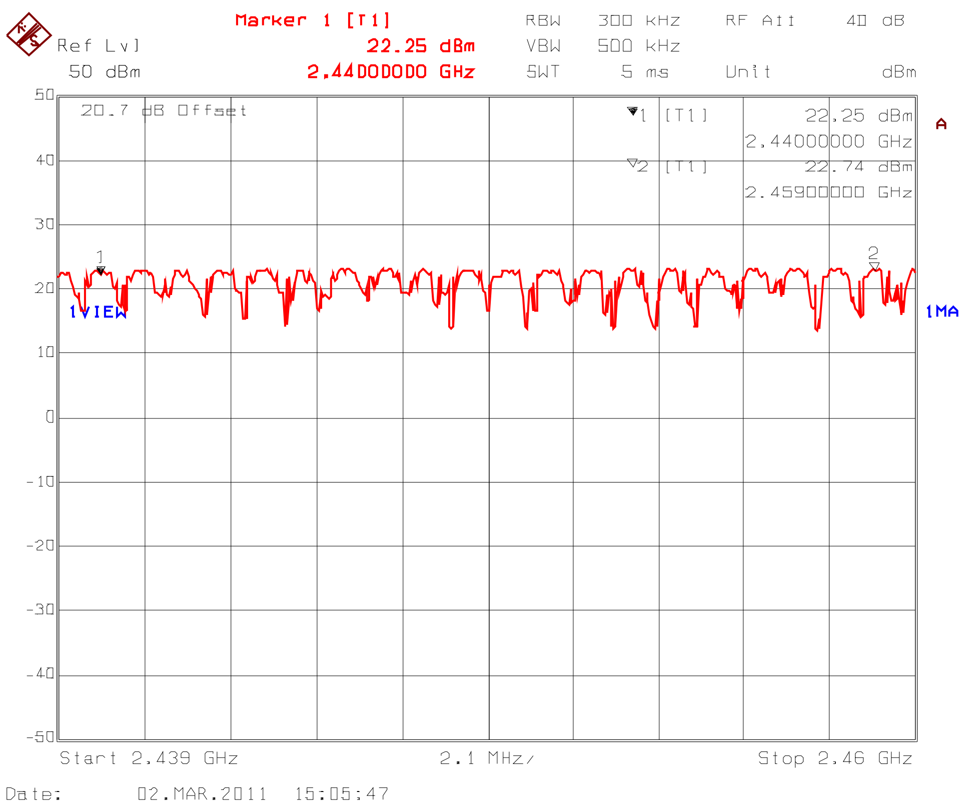
Plot 5.7.4.6. Number of Hopping Frequencies
18 hopping channels from 2400 - 2419 MHz



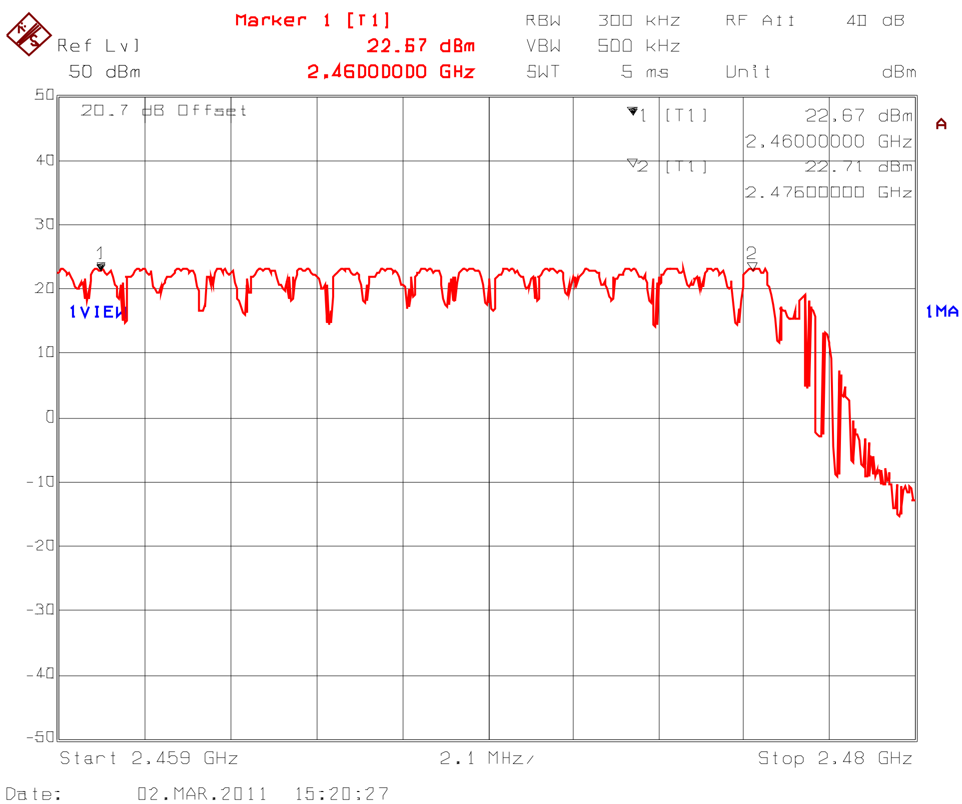
Plot 5.7.4.7. Number of Hopping Frequencies
20 hopping channels from 2420 - 2439 MHz



Plot 5.7.4.8. Number of Hopping Frequencies
20 hopping channels from 2440 - 2459 MHz

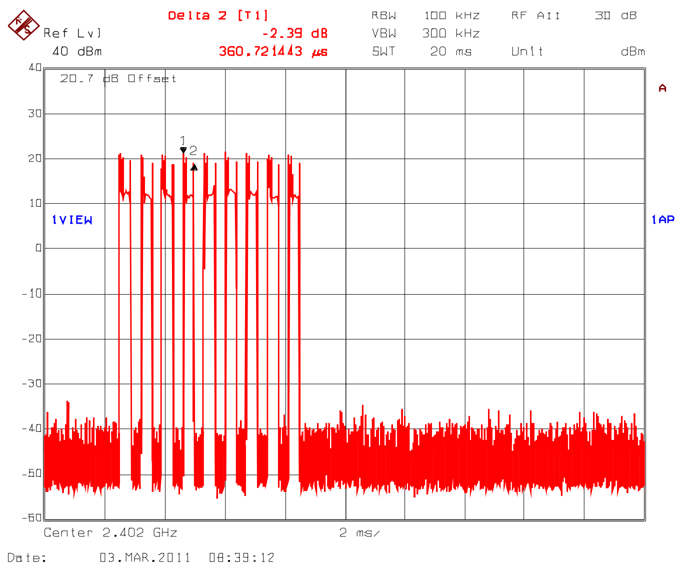


Plot 5.7.4.9. Number of Hopping Frequencies
17 hopping channels from 2460 - 2475 MHz



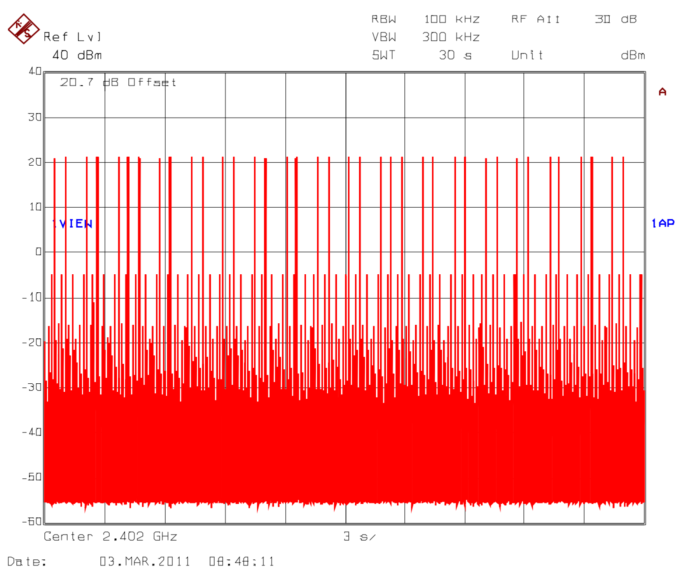
Plot 5.7.4.10. Time of Occupancy

Test Frequency:	2402 MHz
Dwell Time:	360.72 μs x 9 pulses = 3246.48μs = 3.25 ms



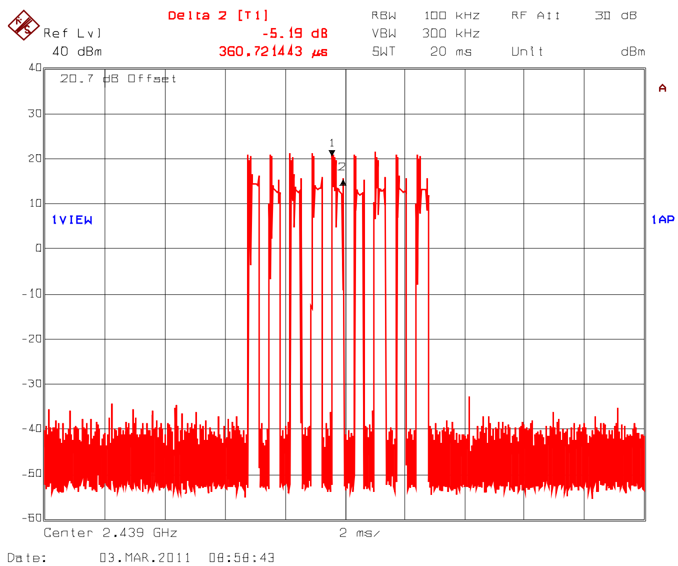
Plot 5.7.4.11. Time of Occupancy

Test Frequency:	2402 MHz
Average Time of Occupancy in 30 s:	= (Dwell Time @ 2402 MHz) x (number of hops in 30 s) = 3.25 ms x 45 = 146.25 ms



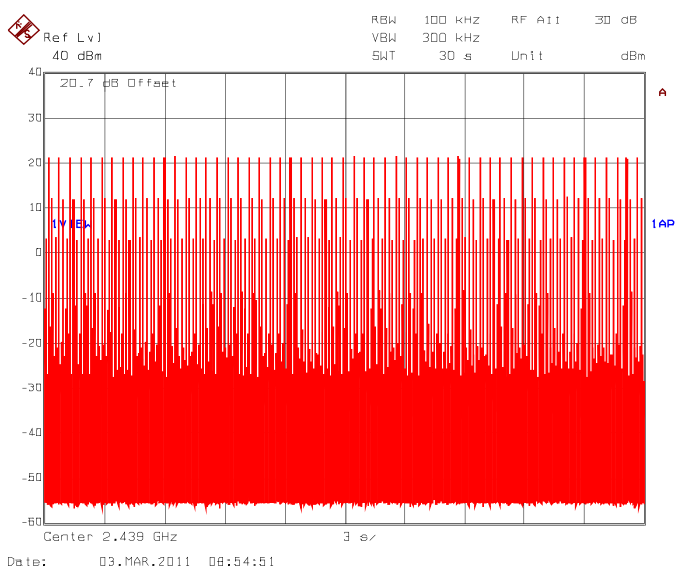
Plot 5.7.4.12. Time of Occupancy

Test Frequency:	2439 MHz
Dwell Time:	360.72µs x 9 pulses = 3246.48 µs = 3.25 ms



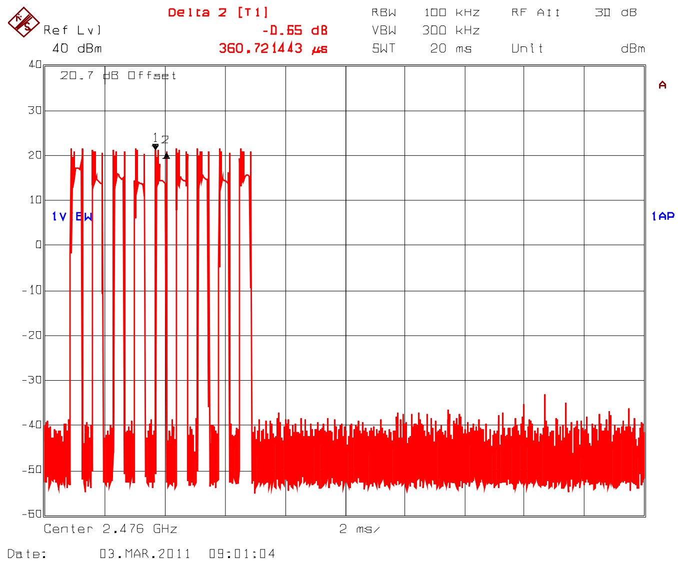
Plot 5.7.4.13. Time of Occupancy

Test Frequency:	2439 MHz
Average Time of Occupancy in 30 s:	= (Dwell Time @ 2439 MHz) x (number of hops in 30 s) = 3.25 ms x 60 = 195.00 ms



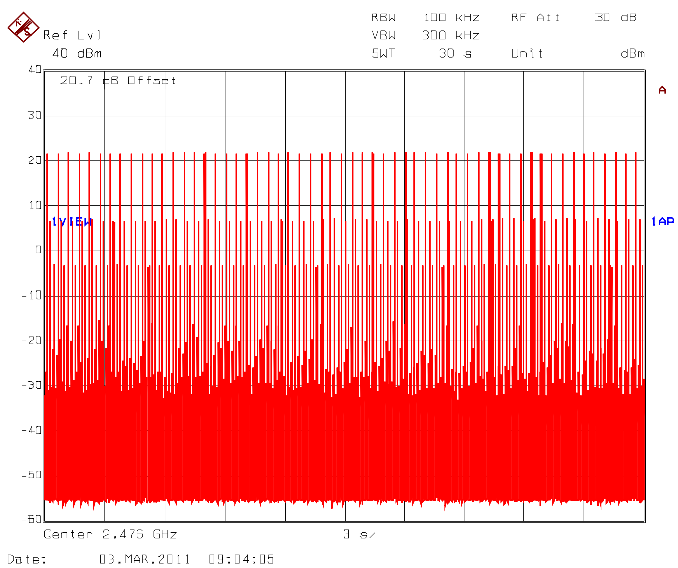
Plot 5.7.4.14. Time of Occupancy

Test Frequency:	2476 MHz
Dwell Time:	360.72μs x 9 pulses = 3246.48 μs = 3.25 ms



Plot 5.7.4.15. Time of Occupancy

Test Frequency:	2476 MHz
Average Time of Occupancy in 30 s:	= (Dwell Time @ 2476 MHz) x (number of hops in 30 s) = 3.25 ms x 65 = 211.25 ms



5.8. PEAK CONDUCTED OUTPUT POWER [§ 15.247(b)]

5.8.1. Limit(s)

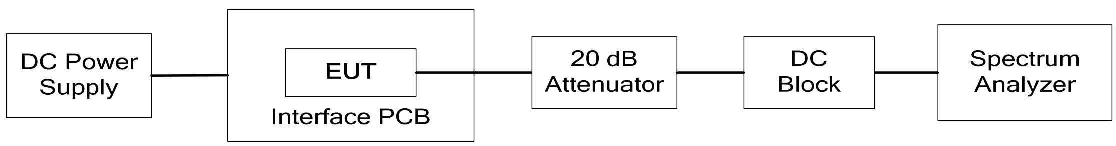
The maximum peak conducted output power of the intentional radiator shall not exceed the following:

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

5.8.2. Method of Measurements & Test Arrangement

FCC Public Notice DA 00-705

5.8.3. Test Arrangement

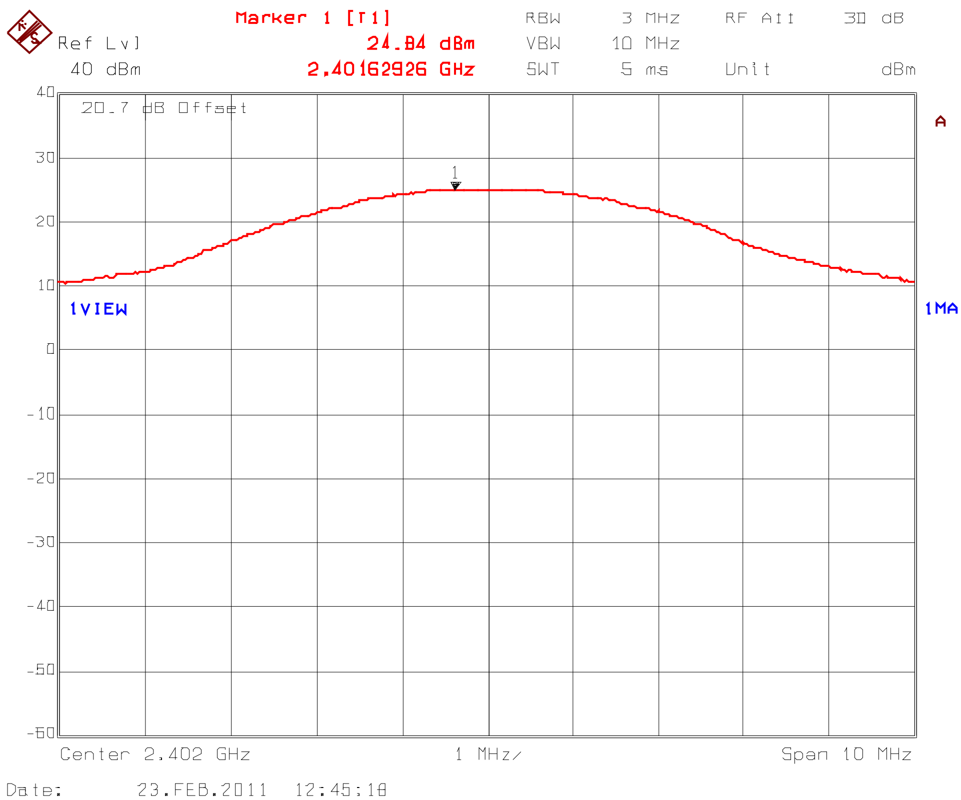


5.8.4. Test Data

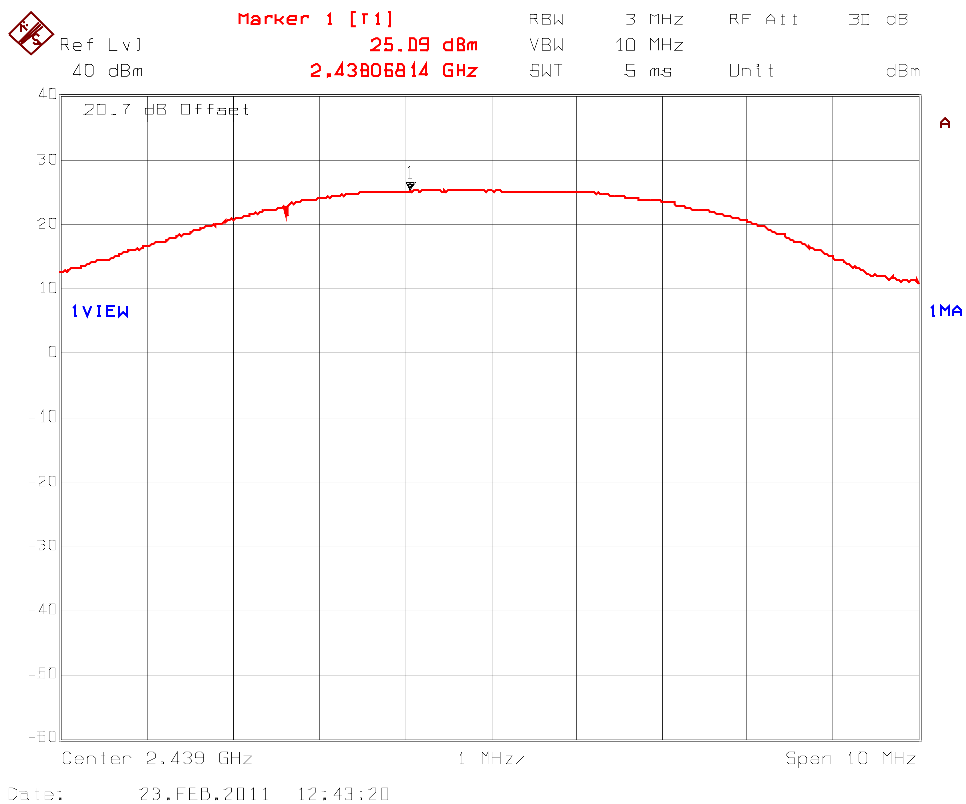
Frequency (MHz)	Peak Conducted Power (dBm)	Peak EIRP(Note 1) (dBm)	Peak Conducted Power Limit (dBm)	EIRP Limit (dBm)
2402	24.84	27.04	30	36
2439	25.09	27.29	30	36
2476	25.21	27.41	30	36

Note 1: The Peak EIRP is calculated as the sum of Peak Conducted Power in dBm and antenna assembly gain of EUT in dBi.

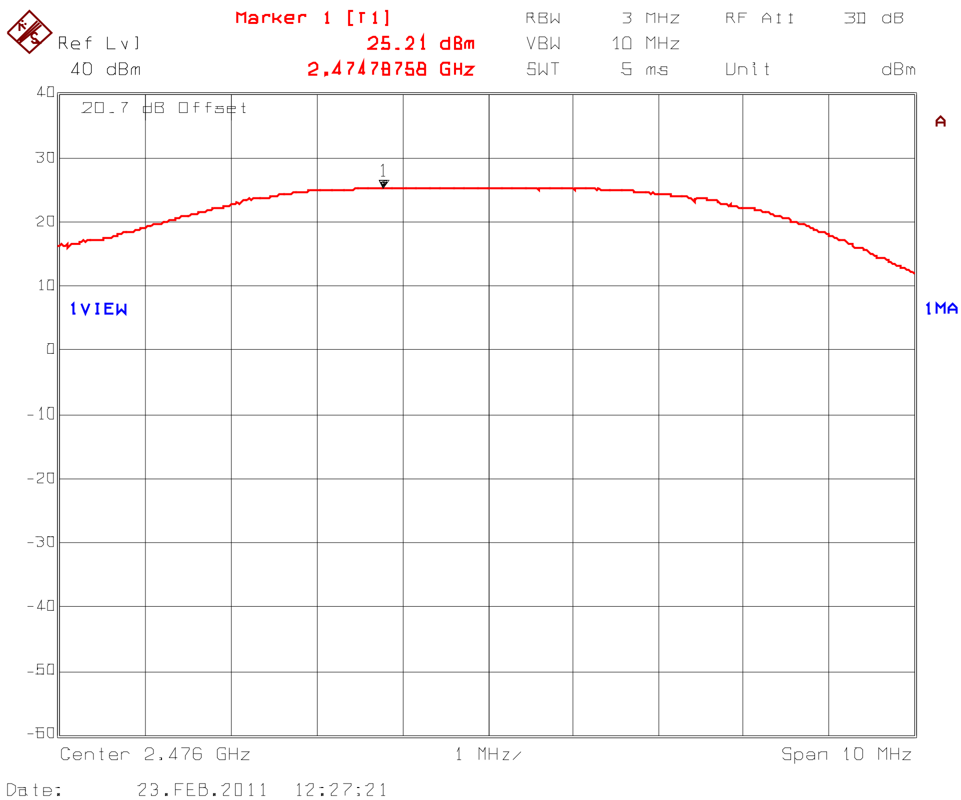
Plot 5.8.4.1. Peak Output Power at 2402 MHz, 3.3 VDC Input



Plot 5.8.4.2. Peak Output Power at 2439 MHz, 3.3 VDC Input



Plot 5.8.4.3. Peak Output Power at 2476 MHz, 3.3 VDC Input



5.9. TRANSMITTER BAND-EDGE & SPURIOUS CONDUCTED EMISSIONS [§ 15.247(d)]

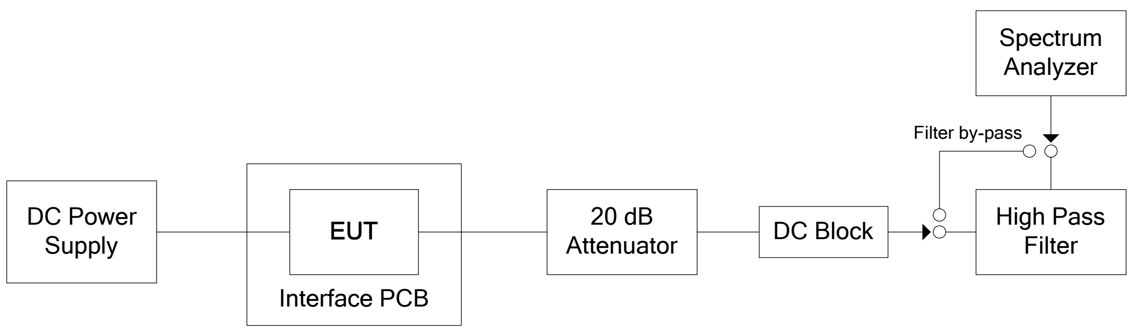
5.9.1. Limit(s)

§ 15.247 (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.

5.9.2. Method of Measurements

FCC Public Notice DA 00-705

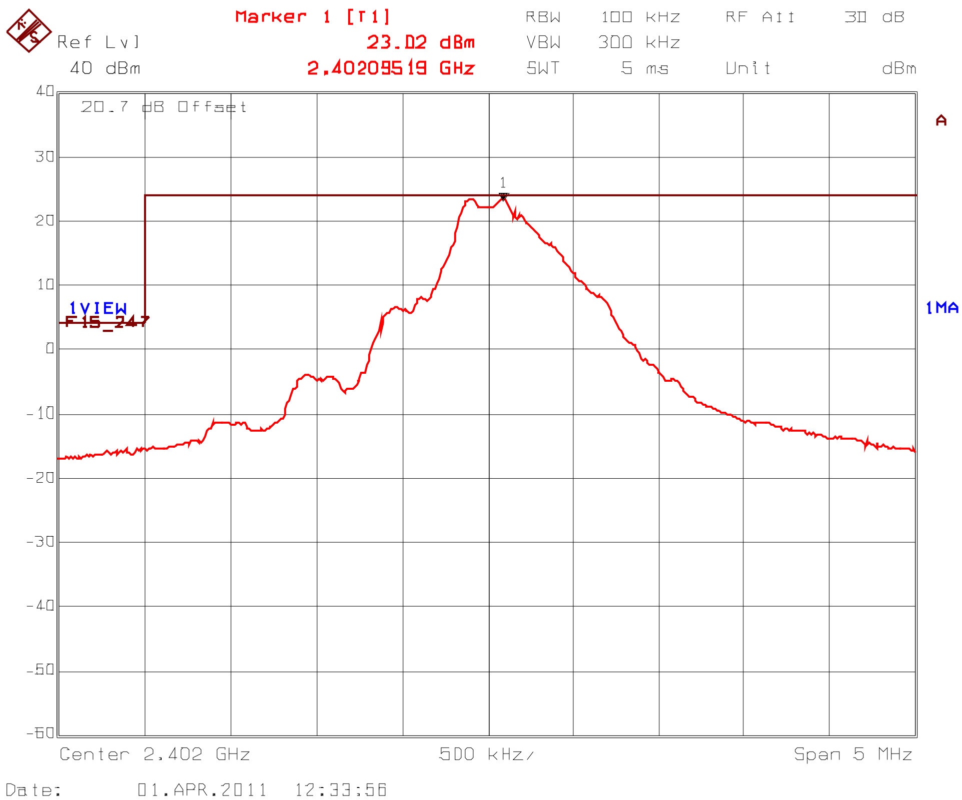
5.9.3. Test Arrangement



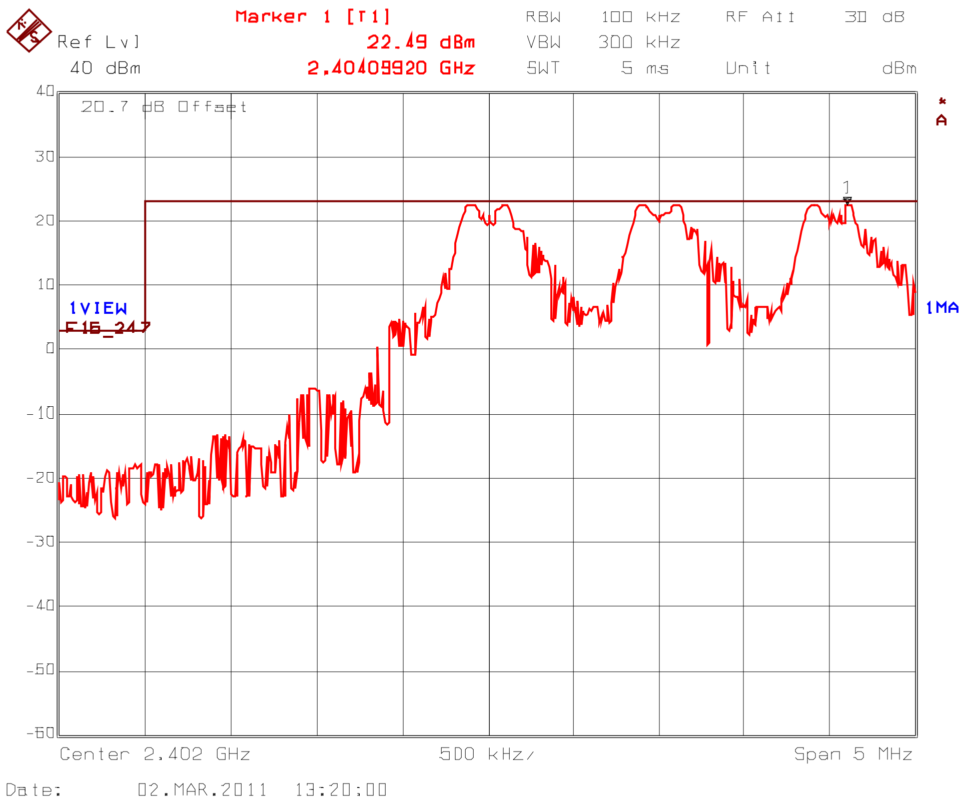
5.9.4. Test Data

5.9.4.1. Band-Edge RF Conducted Emissions

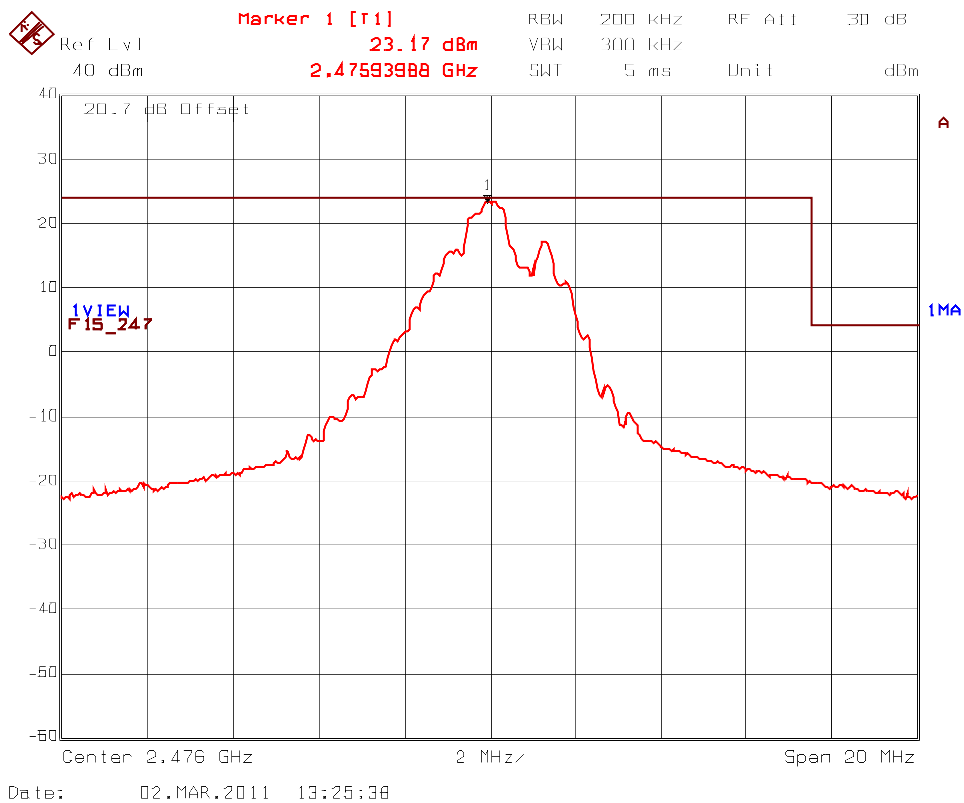
Plot 5.9.4.1.1. Band-Edge RF Conducted Emissions
Low End of Frequency Band
Single Frequency Mode



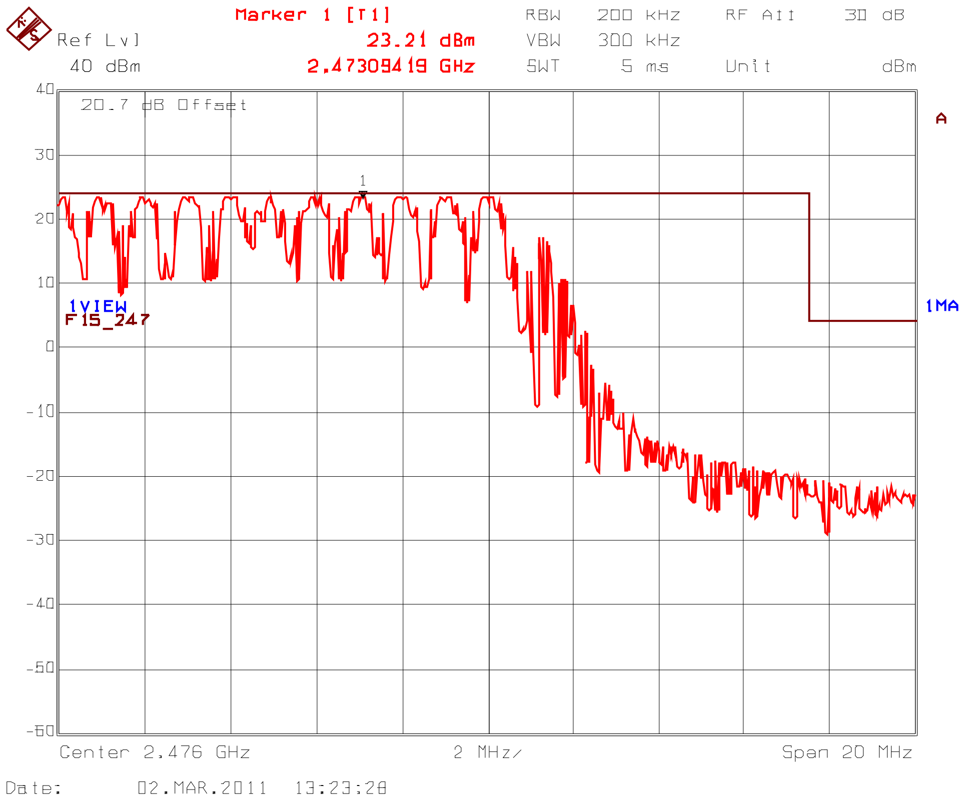
Plot 5.9.4.1.2. Band-Edge RF Conducted Emissions
Low End of Frequency Band
Pseudorandom Channel Hopping Mode



Plot 5.9.4.1.3. Band-Edge RF Conducted Emissions
High End of Frequency Band
Single Frequency Mode

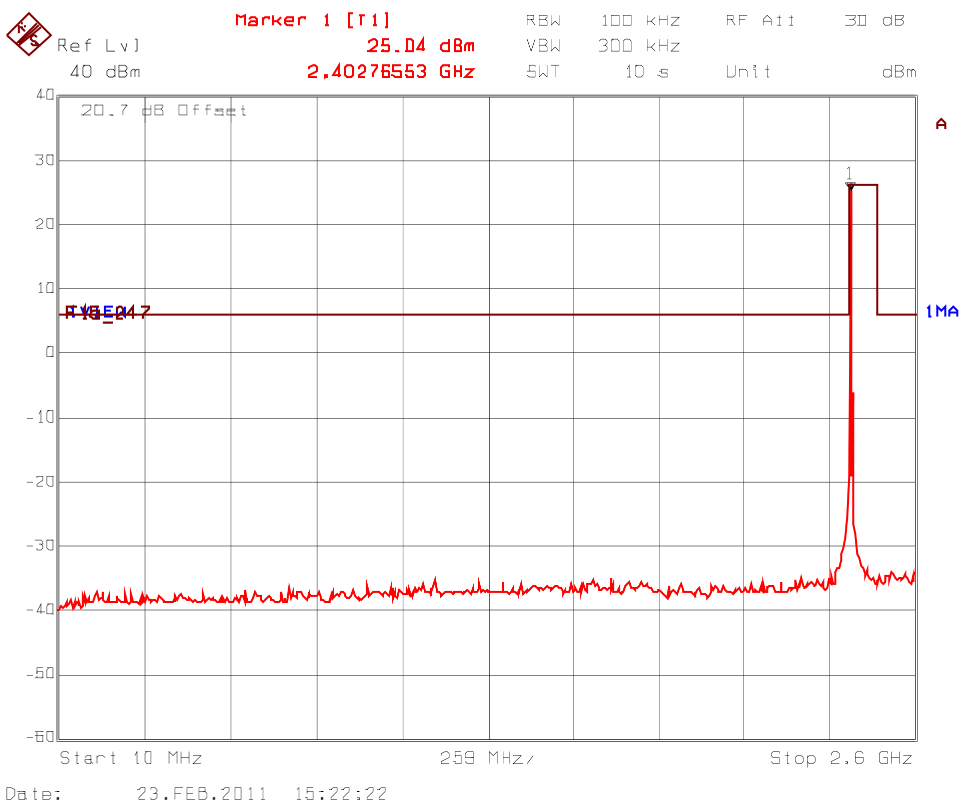


Plot 5.9.4.1.4. Band-Edge RF Conducted Emissions
High End of Frequency Band
Pseudorandom Channel Hopping Mode

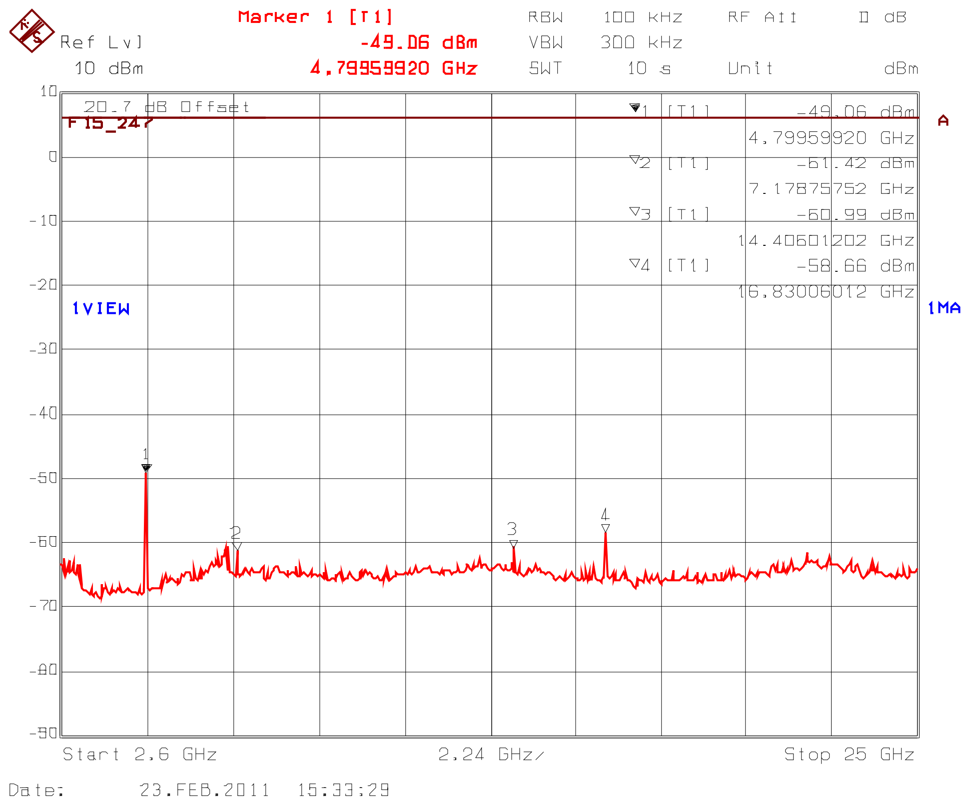


5.9.4.2. Spurious RF Conducted Emissions

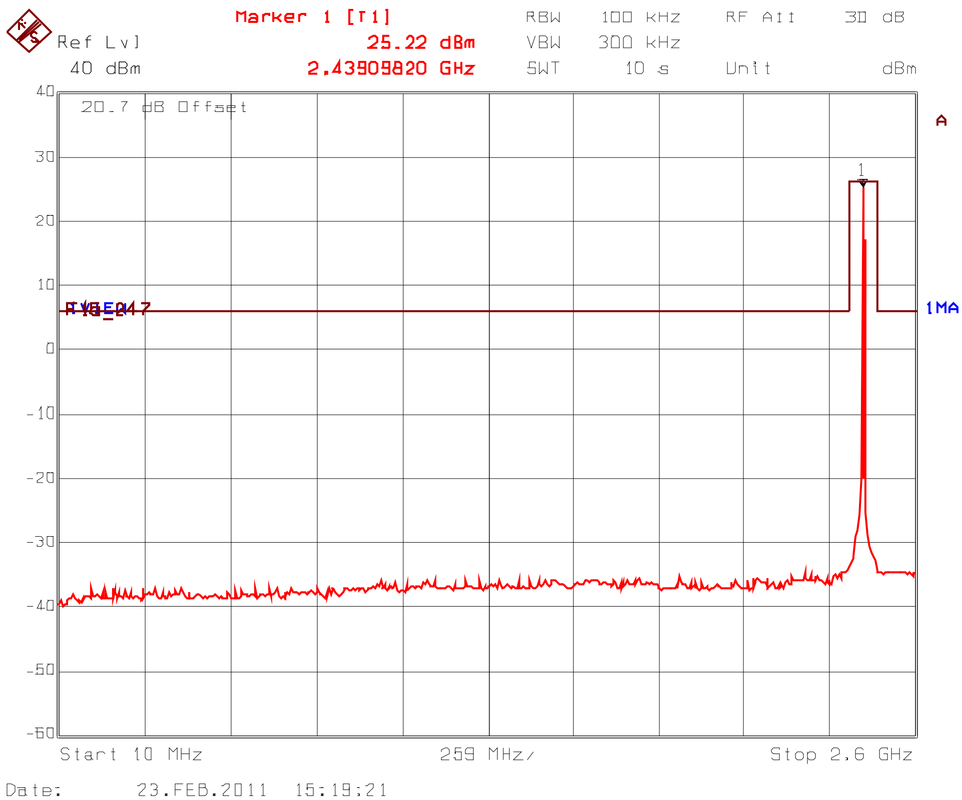
Plot 5.9.4.2.1. Spurious RF Conducted Emissions, 10 MHz - 2.6 GHz
Transmitter Frequency: 2402 MHz



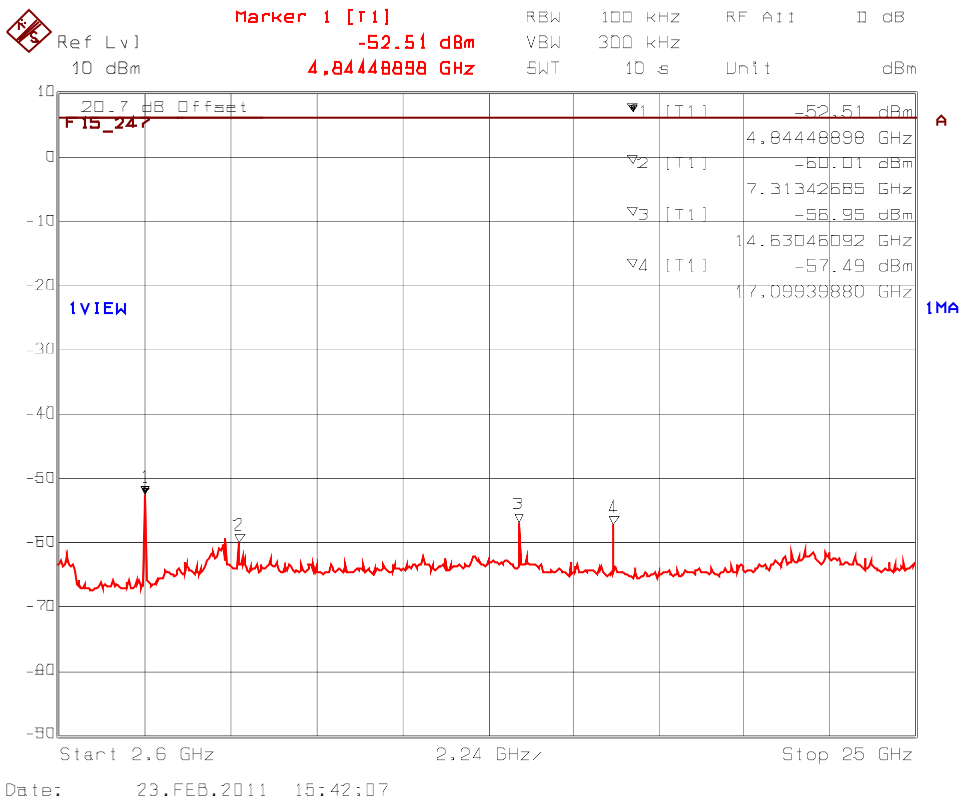
Plot 5.9.4.2.2. Spurious RF Conducted Emissions, 2.6 GHz - 25 GHz
Transmitter Frequency: 2402 MHz



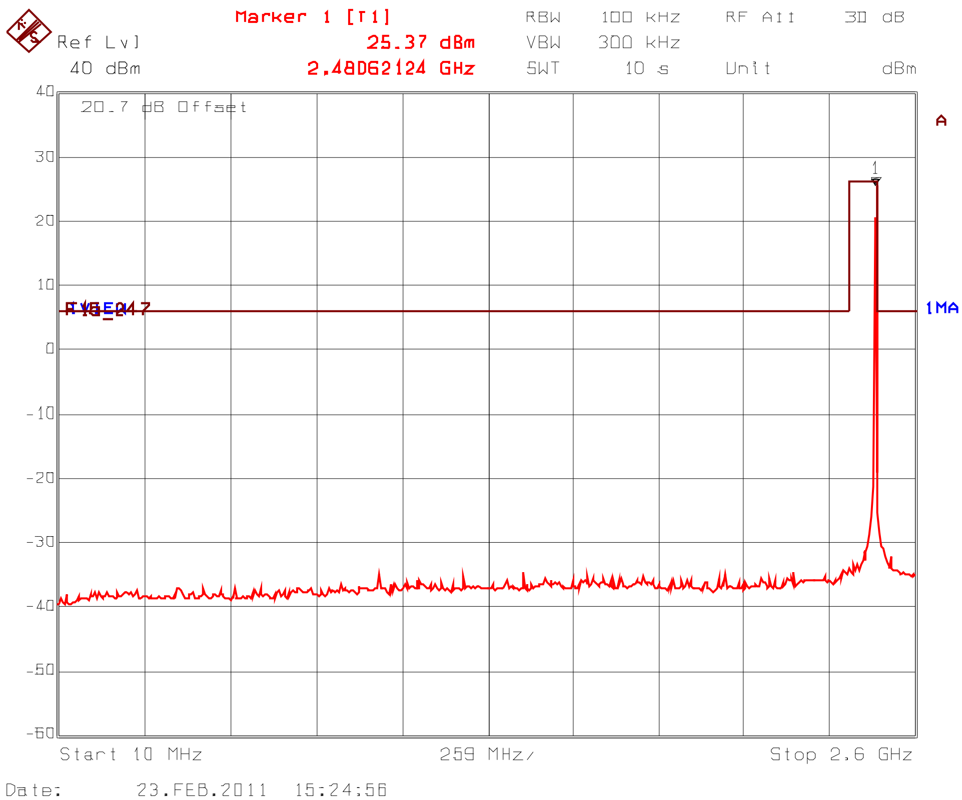
Plot 5.9.4.2.3. Spurious RF Conducted Emissions, 10 MHz - 2.6 GHz
Transmitter Frequency: 2439 MHz



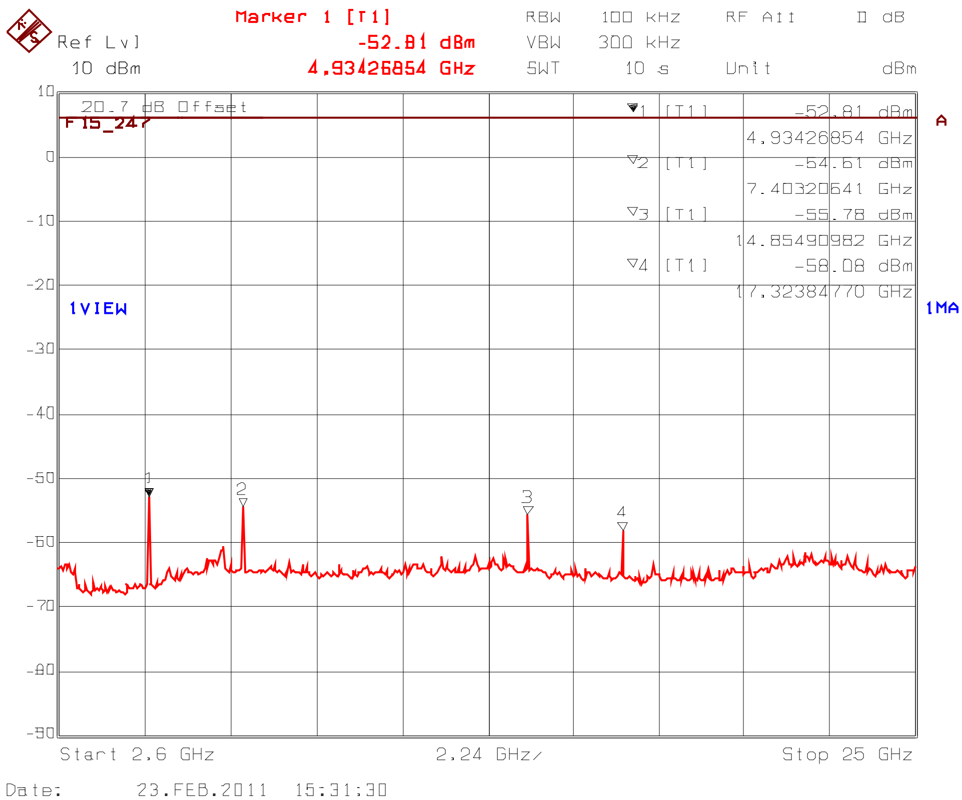
Plot 5.9.4.2.4. Spurious RF Conducted Emissions, 2.6 GHz - 25 GHz
Transmitter Frequency: 2439 MHz



Plot 5.9.4.2.5. Spurious RF Conducted Emissions, 10 MHz - 2.6 GHz
Transmitter Frequency: 2476 MHz



Plot 5.9.4.2.6. Spurious RF Conducted Emissions, 2.6 GHz - 25 GHz
Transmitter Frequency: 2476 MHz



5.10. TRANSMITTER SPURIOUS RADIATED EMISSIONS AT 3 METERS [§§ 15.247(d), 15.209 & 15.205]

5.10.1. Limit(s)

§ 15.247 (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 Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

Section 15.205(a) - Restricted Bands of Operation

MHz	MHz	MHz	GHz
0.090–0.110	16.42–16.423	399.9–410	4.5–5.15
[1] 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	(2)
13.36–13.41			

[1] Until February 1, 1999, this restricted band shall be 0.490–0.510 MHz.
[2] Above 38.6

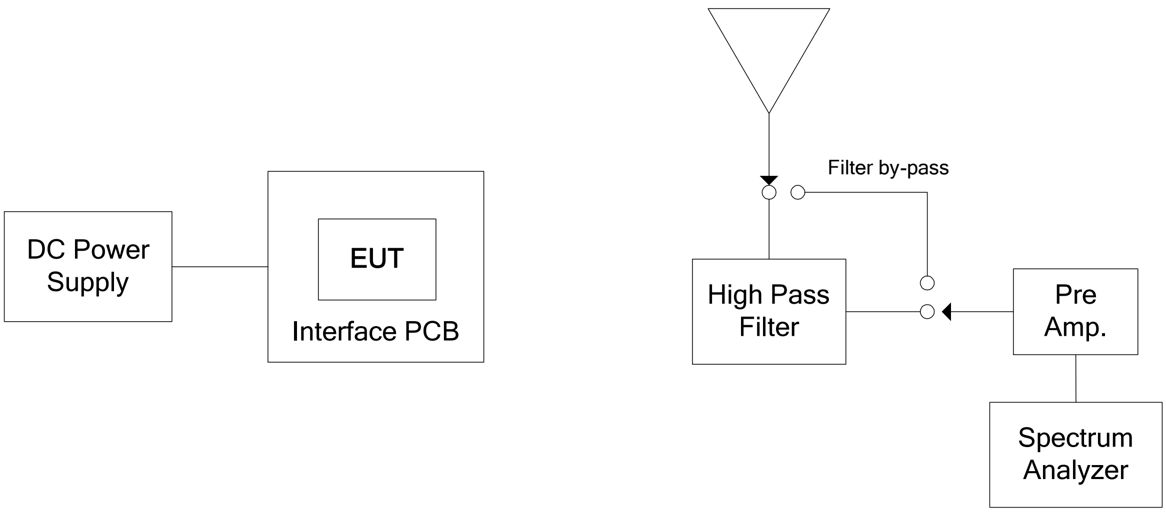
Section 15.209(a) - Radiated Emission Limits; General Requirements

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009 - 0.490	2,400 / F (kHz)	300
0.490 - 1.705	24,000 / F (kHz)	30
1.705 - 30.0	30	30
30 – 88	100	3
88 – 216	150	3
216 – 960	200	3
Above 960	500	3

5.10.2. Method of Measurements

FCC Public Notice DA 00-705

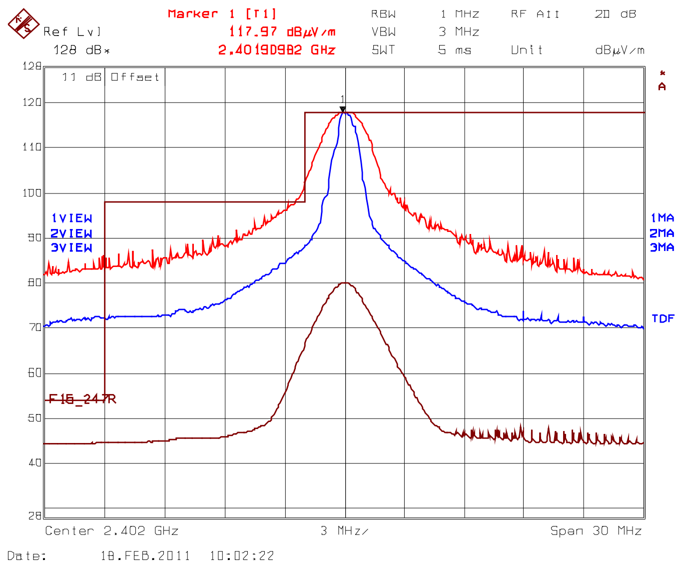
5.10.3. Test Arrangement



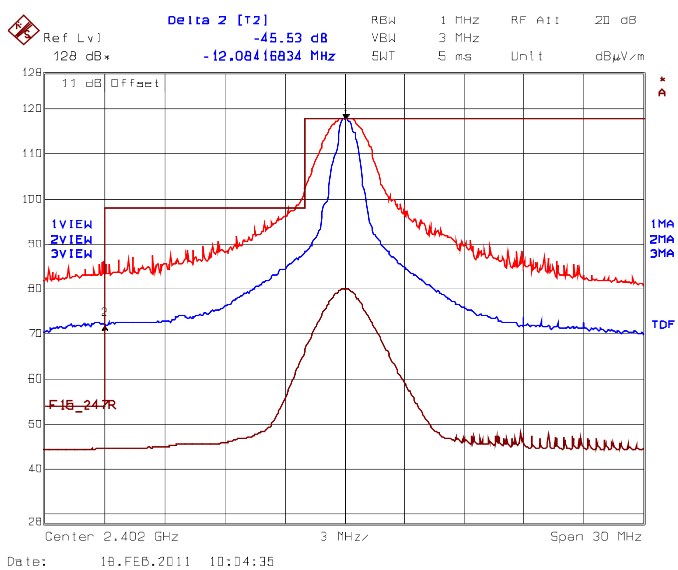
5.10.4. Test Data

5.10.4.1. Band-Edge RF Radiated Emissions Test Results

Plot 5.10.4.1.1. Band-Edge RF Radiated Emissions @ 3 m, Horizontal Rx Antenna Orientation
Low End of Frequency Band, Single Frequency Mode

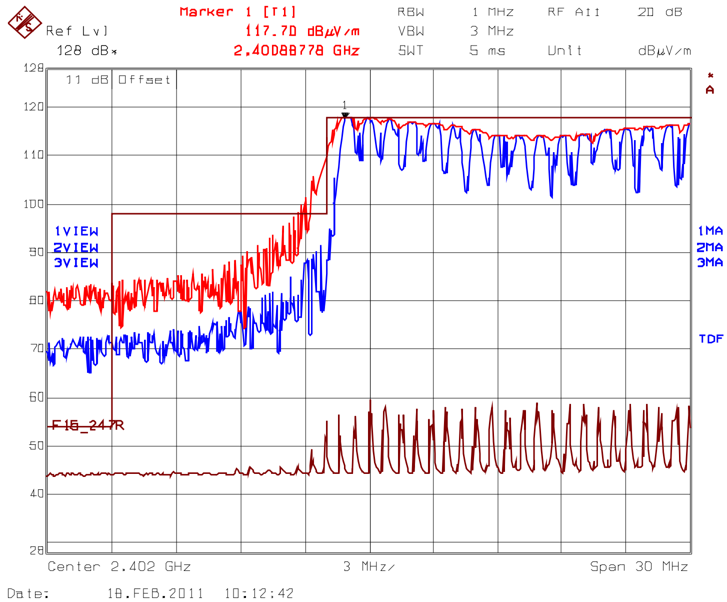


Plot 5.10.4.1.2. Band-Edge RF Radiated Emissions @ 3 m, Horizontal Rx Antenna Orientation
Low End of Frequency Band, Single Frequency Mode

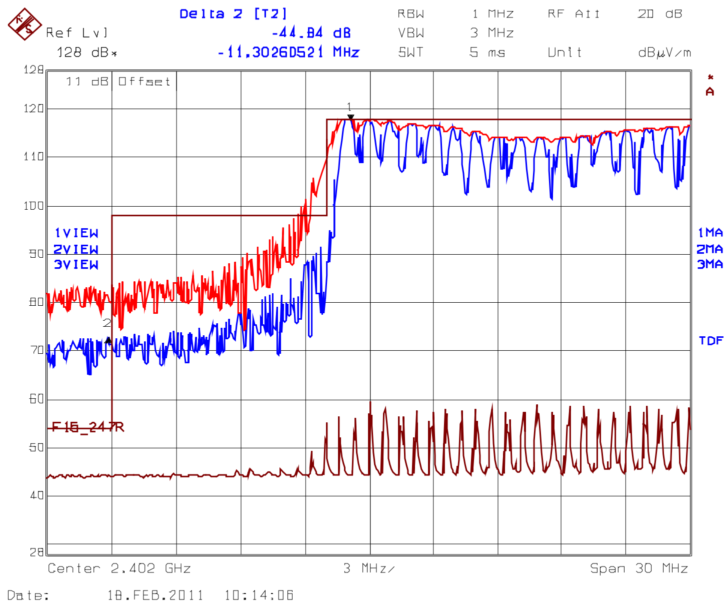


Trace 1: RBW = 1 MHz, VBW = 3 MHz
Trace 2: RBW= 300 kHz, VBW= 500 kHz, Delta (Peak to Band-Edge): 45.53 dB
Trace 3: RBW = 1 MHz, VBW = 10 Hz
Peak Band-Edge at 2390 MHz: Peak = 117.97dBµV/m – 45.53 dB = 72.44 dBµV/m (limit 74dBµV/m)

Plot 5.10.4.1.3. Band-Edge RF Radiated Emissions @ 3 m, Horizontal Rx Antenna Orientation
Low End of Frequency Band, Pseudorandom Channel Hopping Mode

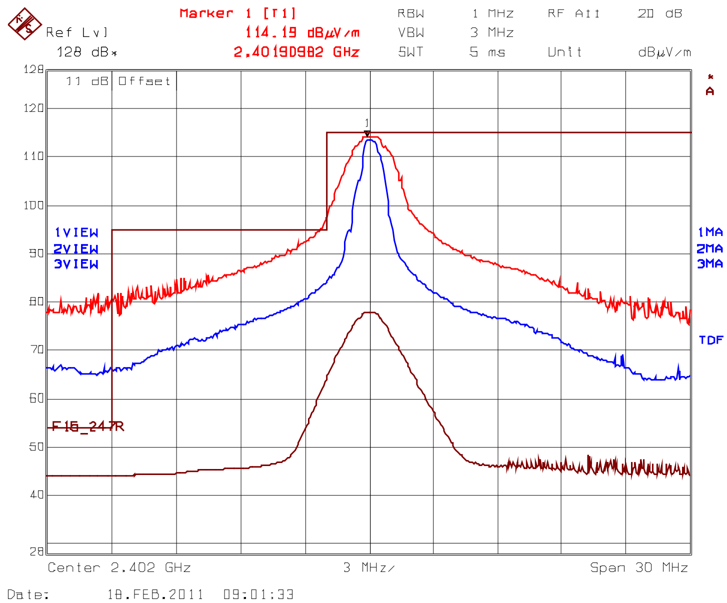


Plot 5.10.4.1.4. Band-Edge RF Radiated Emissions @ 3 m, Horizontal Rx Antenna Orientation
Low End of Frequency Band, Pseudorandom Channel Hopping Mode

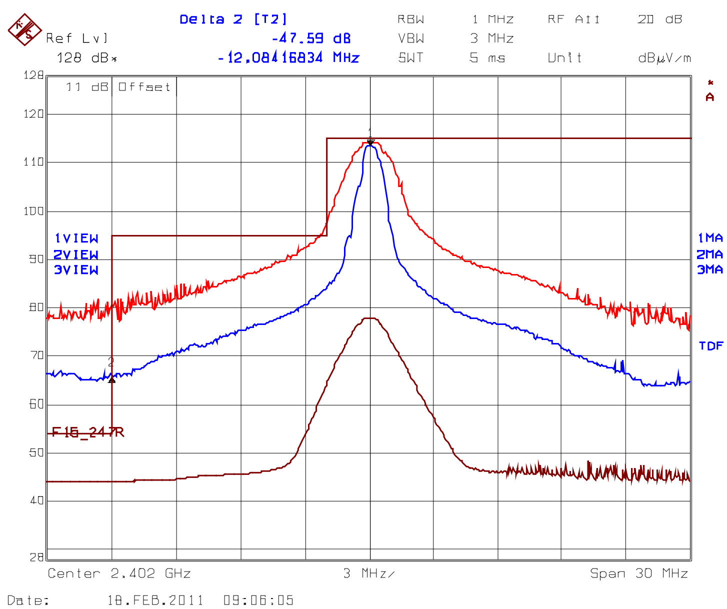


Trace 1: RBW = 1 MHz, VBW = 3 MHz
Trace 2: RBW = 300 kHz, VBW = 500 kHz, Delta (Peak to Band-Edge): 44.84 dB
Trace 3: RBW = 1 MHz, VBW = 10 Hz
Peak Band-Edge at 2390 MHz: Peak = 117.70 dBµV/m – 44.84dB = 72.86 dBµV/m (limit 74 dBµV/m)

Plot 5.10.4.1.5. Band-Edge RF Radiated Emissions @ 3 m, Vertical Rx Antenna Orientation
Low End of Frequency Band, Single Frequency Mode

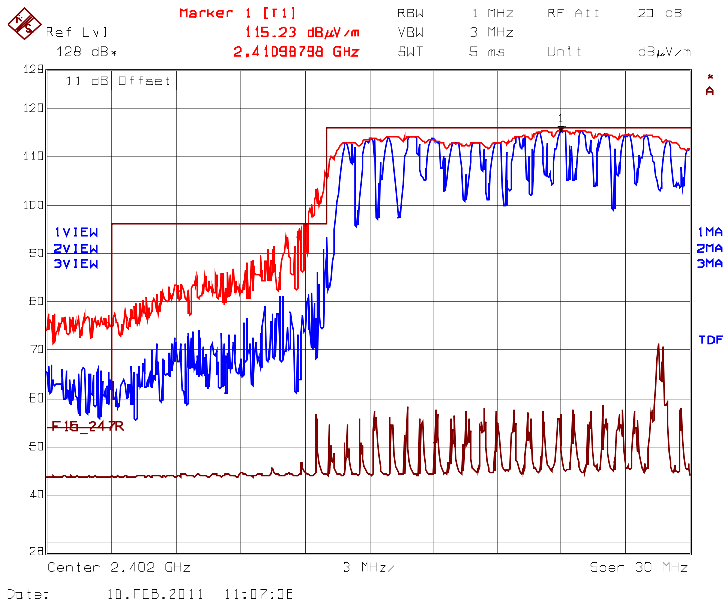


Plot 5.10.4.1.6. Band-Edge RF Radiated Emissions @ 3 m, Vertical Rx Antenna Orientation
Low End of Frequency Band, Single Frequency Mode

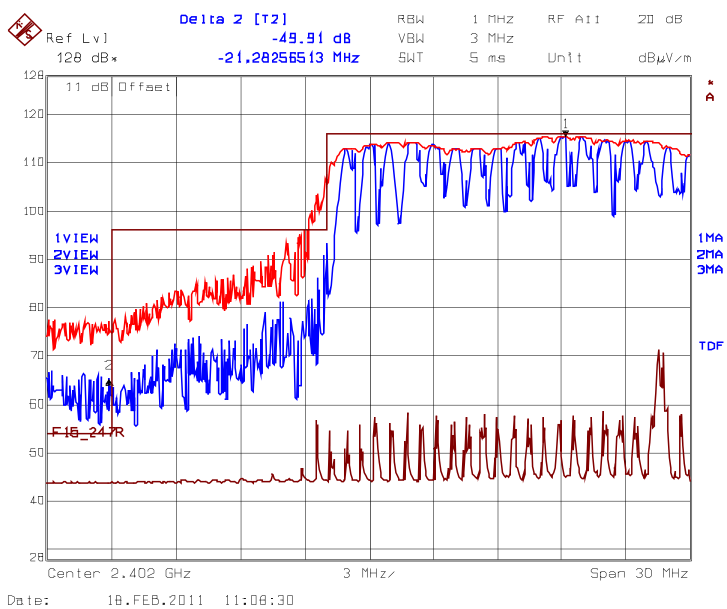


Trace 1: RBW = 1 MHz, VBW = 3 MHz
Trace 2: RBW = 300 kHz, VBW = 500 kHz, Delta (Peak to Band-Edge): 47.59 dB
Trace 3: RBW = 1 MHz, VBW = 10 Hz
Peak Band-Edge at 2390 MHz: Peak = 114.19 dBµV/m – 47.59 dB= 66.60 dBµV/m (limit 74 dBµV/m)

Plot 5.10.4.1.7. Band-Edge RF Radiated Emissions @ 3 m, Vertical Rx Antenna Orientation
Low End of Frequency Band, Pseudorandom Channel Hopping Mode

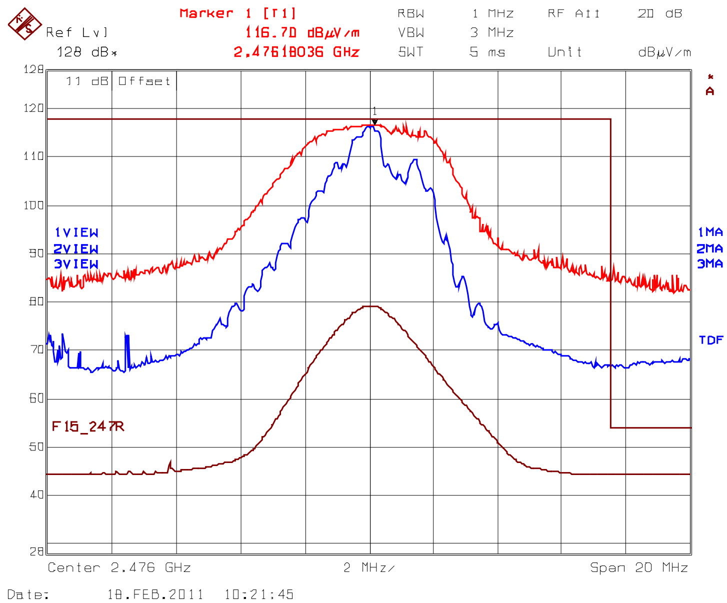


Plot 5.10.4.1.8. Band-Edge RF Radiated Emissions @ 3 m, Vertical Rx Antenna Orientation
Low End of Frequency Band, Pseudorandom Channel Hopping Mode

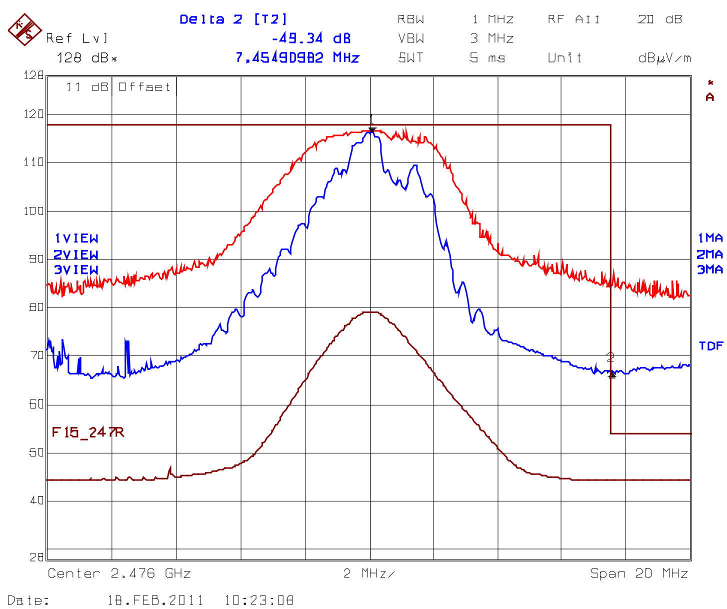


Trace 1: RBW = 1 MHz, VBW = 3 MHz
Trace 2: RBW = 300 kHz, VBW = 500 kHz, Delta (Peak to Band-Edge): 49.91 dB
Trace 3: RBW = 1 MHz, VBW = 10 Hz
Peak Band-Edge at 2390 MHz: Peak= 115.23 dBµV/m – 49.91 dB = 65.32 dBµV/m (limit 74 dBµV/m)

Plot 5.10.4.1.9. Band-Edge RF Radiated Emissions @ 3 m, Horizontal Rx Antenna Orientation
High End of Frequency Band, Single Frequency Mode

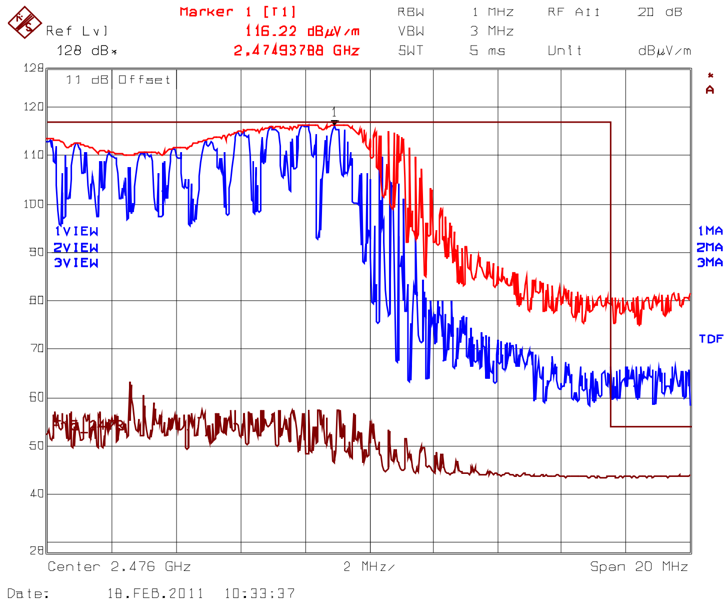


Plot 5.10.4.1.10. Band-Edge RF Radiated Emissions @ 3 m, Horizontal Rx Antenna Orientation
High End of Frequency Band, Single Frequency Mode

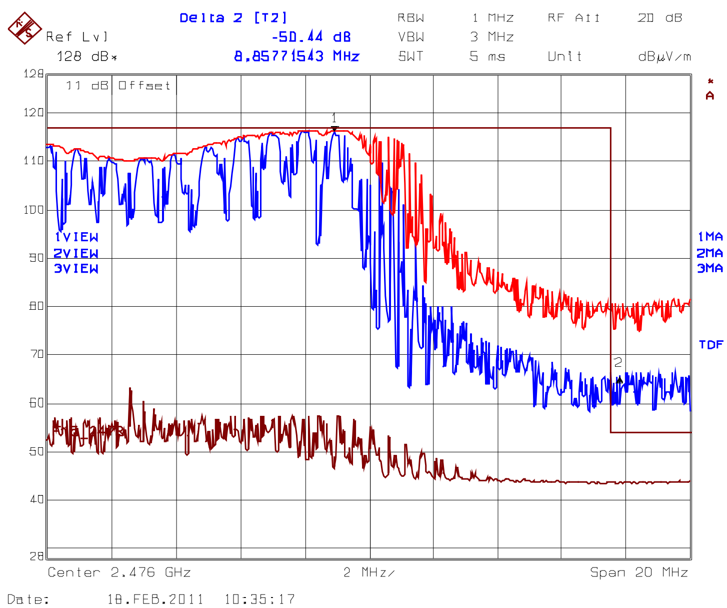


Trace 1: RBW = 1 MHz, VBW = 3 MHz
Trace 2: RBW = 200 kHz, VBW = 300 kHz, Delta (Peak to Band-Edge): 49.34 dB
Trace 3: RBW = 1 MHz, VBW = 10 Hz
Peak Band-Edge at 2483.5 MHz: Peak = 116.70 dBµV/m – 49.34 dB = 67.36 dBµV/m (limit 74 dBµV/m)

Plot 5.10.4.1.11. Band-Edge RF Radiated Emissions @ 3 m, Horizontal Rx Antenna Orientation
High End of Frequency Band, Pseudorandom Channel Hopping Mode

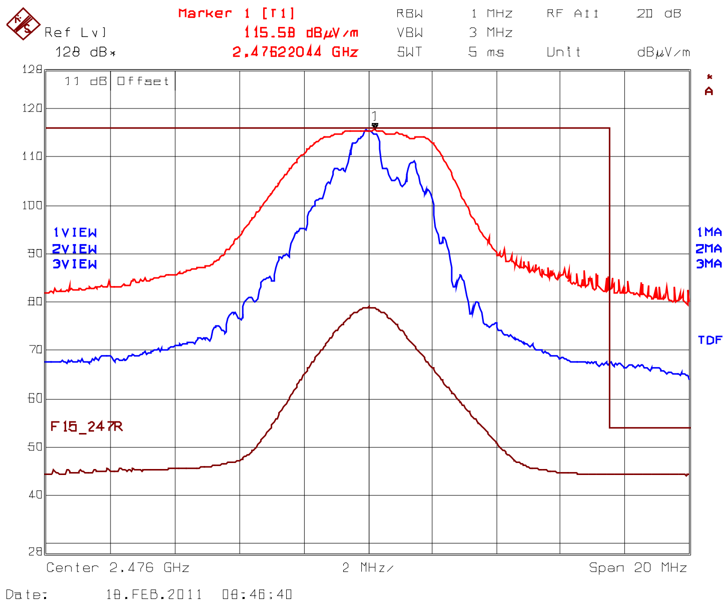


Plot 5.10.4.1.12. Band-Edge RF Radiated Emissions @ 3 m, Horizontal Rx Antenna Orientation
High End of Frequency Band, Pseudorandom Channel Hopping Mode

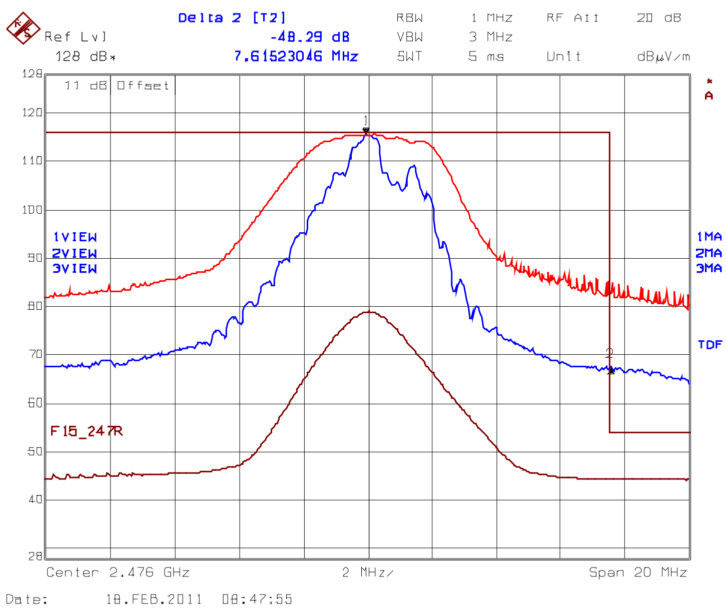


Trace 1: RBW = 1 MHz, VBW = 3 MHz
Trace 2: RBW = 200 kHz, VBW = 300 kHz, Delta (Peak to Band-Edge): 50.44 dB
Trace 3: RBW = 1 MHz, VBW = 10 Hz
Peak Band-Edge at 2483.5 MHz: Peak = 116.22 dBµV/m – 50.44 dB = 65.78 dBµV/m (limit 74 dBµV/m)

Plot 5.10.4.1.13. Band-Edge RF Radiated Emissions @ 3 m, Vertical Rx Antenna Orientation
High End of Frequency Band, Single Frequency Mode

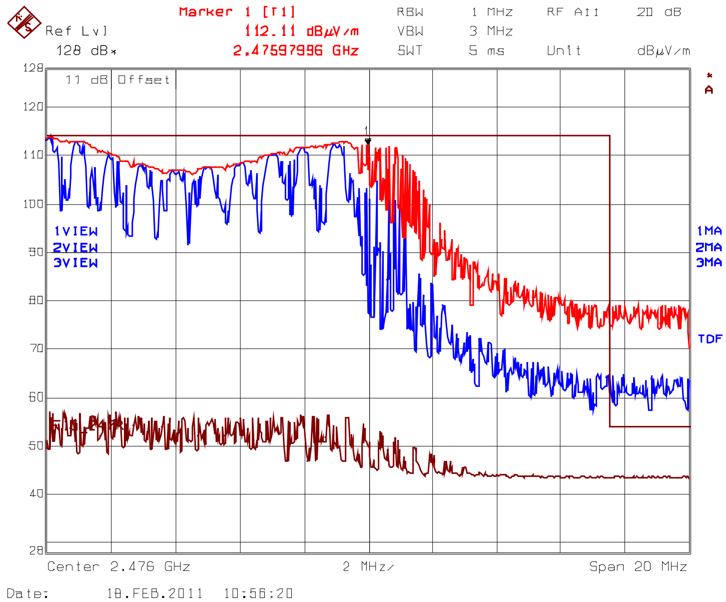


Plot 5.10.4.1.14. Band-Edge RF Radiated Emissions @ 3 m, Vertical Rx Antenna Orientation
High End of Frequency Band, Single Frequency Mode

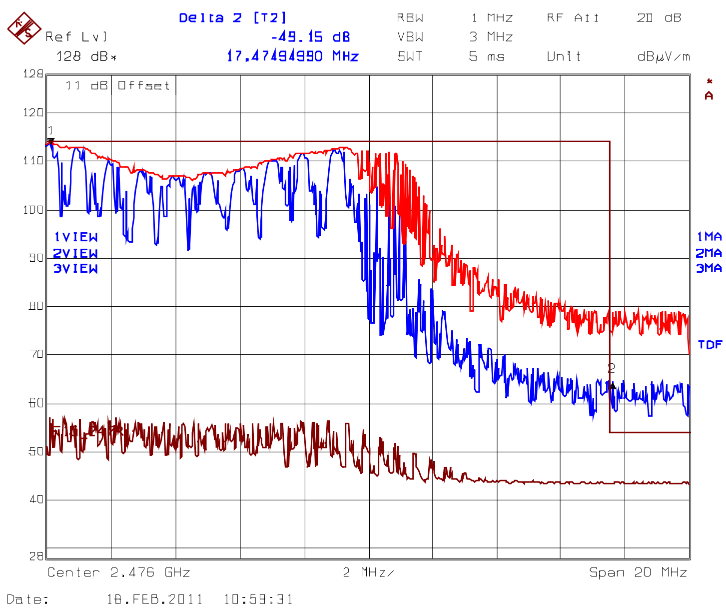


Trace 1: RBW = 1 MHz, VBW = 3 MHz
Trace 2: RBW = 200 kHz, VBW = 300 kHz, Delta (Peak to Band-Edge): 48.29 dB
Trace 3: RBW = 1 MHz, VBW = 10 Hz
Peak Band-Edge at 2483.5 MHz: Peak = 115.58 dBµV/m – 48.29 dB = 67.29 dBµV/m (limit 74 dBµV/m)

Plot 5.10.4.1.15. Band-Edge RF Radiated Emissions @ 3 m, Vertical Rx Antenna Orientation
High End of Frequency Band, Pseudorandom Channel Hopping Mode



Plot 5.10.4.1.16. Band-Edge RF Radiated Emissions @ 3 m, Vertical Rx Antenna Orientation
High End of Frequency Band, Pseudorandom Channel Hopping Mode



Trace 1: RBW = 1 MHz, VBW = 3 MHz
Trace 2: RBW = 200 kHz, VBW = 300 kHz, Delta (Peak to Band-Edge): 49.15 dB
Trace 3: RBW = 1 MHz, VBW = 10 Hz
Peak Band-Edge at 2483.5 MHz: Peak = 112.11 dBµV/m – 49.15 dB = 62.96 dBµV/m (limit 74 dBµV/m)

5.10.4.2. Spurious RF Radiated Emissions Test Results

Remarks:

- All spurious emissions that are in excess of 20 dB below the specified limit shall be recorded.
- EUT shall be tested in three orthogonal positions.
- The following test results are the worst-case measurements.

Fundamental Frequency:	2402 MHz						
Test Frequency Range:	30 MHz – 25 GHz						
Frequency (MHz)	**RF Peak Level (dBµV/m)**	**RF Avg Level (dBµV/m)**	**Antenna Plane (H/V)**	**Limit 15.209 (dBµV/m)**	**Limit 15.247 (dBµV/m)**	**Margin (dB)**	**Pass/ Fail**
2402	115.23	--	V	--	--	--	--
2402	117.97	--	H	--	--	--	--
4804	64.50	47.46	V	54.0	98.0	-6.5	Pass*
4804	63.43	47.70	H	54.0	98.0	-6.3	Pass*
19216	59.20	45.12	V	54.0	98.0	-8.9	Pass*
19216	59.62	45.51	H	54.0	98.0	-8.5	Pass*

*Field strength of emissions appearing within restricted frequency bands shall not exceed the limits in § 15.209.

Fundamental Frequency:	2439 MHz						
Test Frequency Range:	30 MHz – 25 GHz						
Frequency (MHz)	**RF Peak Level (dBµV/m)**	**RF Avg Level (dBµV/m)**	**Antenna Plane (H/V)**	**Limit 15.209 (dBµV/m)**	**Limit 15.247 (dBµV/m)**	**Margin (dB)**	**Pass/ Fail**
2439	114.19	--	V	--	--	--	--
2439	115.83	--	H	--	--	--	--
4878	62.58	46.48	V	54.0	95.8	-7.5	Pass*
4878	63.51	47.46	H	54.0	95.8	-6.5	Pass*
7317	52.58	39.46	V	54.0	95.8	-14.5	Pass*
7317	53.18	40.61	H	54.0	95.8	-13.4	Pass*
19512	61.92	47.11	V	54.0	95.8	-6.9	Pass*
19512	60.22	45.09	H	54.0	95.8	-8.9	Pass*

*Field strength of emissions appearing within restricted frequency bands shall not exceed the limits in § 15.209.

Fundamental Frequency: 2476 MHz							
Test Frequency Range: 30 MHz – 25 GHz							
Frequency (MHz)	**RF Peak Level (dBµV/m)**	**RF Avg Level (dBµV/m)**	**Antenna Plane (H/V)**	**Limit 15.209 (dBµV/m)**	**Limit 15.247 (dBµV/m)**	**Margin (dB)**	**Pass/ Fail**
2476	115.58	--	V	--	--	--	--
2476	116.70	--	H	--	--	--	--
4952	62.74	45.76	V	54.0	96.7	-8.2	Pass*
4952	63.54	46.63	H	54.0	96.7	-7.4	Pass*
7428	52.47	40.77	V	54.0	96.7	-13.2	Pass*
7428	54.73	43.11	H	54.0	96.7	-10.9	Pass*
19808	59.69	45.86	V	54.0	96.7	-8.1	Pass*
19808	56.60	43.45	H	54.0	96.7	-10.6	Pass*
22284	59.65	45.69	V	54.0	96.7	-8.3	Pass*
22284	55.51	42.33	H	54.0	96.7	-11.7	Pass*

*Field strength of emissions appearing within restricted frequency bands shall not exceed the limits in § 15.209.

5.11. RF EXPOSURE REQUIRMENTS [§§ 15.247(e)(i), 1.1310 & 2.1091]

The criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation.

FCC 47 CFR § 1.1310:

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm²)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3–3.0	614	1.63	*(100)	6
3.0–30	1842/f	4.89/f	*(900/f²)	6
30–300	61.4	0.163	1.0	6
300–1500			f/300	6
1500–100,000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3–1.34	614	1.63	*(100)	30
1.34–30	824/f	2.19/f	*(180/f²)	30
30–300	27.5	0.073	0.2	30
300–1500			f/1500	30
1500–100,000			1.0	30

f = frequency in MHz
* = Plane-wave equivalent power density

NOTE 1 TO TABLE 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

NOTE 2 TO TABLE 1: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

5.11.1. Method of Measurements

Refer to Sections 1.1310, 2.1091

In order to demonstrate compliance with MPE requirements (see Section 2.1091), the following information is typically needed:

(1) Calculation that estimates the minimum separation distance (20 cm or more) between an antenna and persons required to satisfy power density limits defined for free space.
(2) Antenna installation and device operating instructions for installers (professional/unskilled users), and the parties responsible for ensuring compliance with the RF exposure requirement
(3) Any caution statements and/or warning labels that are necessary in order to comply with the exposure limits
(4) Any other RF exposure related issues that may affect MPE compliance

Calculation Method of RF Safety Distance:

$$S = \frac{P \cdot G}{4 \cdot \pi \cdot r^2} = \frac{EIRP}{4 \cdot \pi \cdot r^2}$$

Where: P: power input to the antenna in mW
EIRP: Equivalent (effective) isotropic radiated power
S: power density mW/cm^2
G: numeric gain of antenna relative to isotropic radiator
r: distance to centre of radiation in cm

5.11.2. RF Evaluation

Evaluation of RF Exposure Compliance Requirements	
RF Exposure Requirements	**Compliance with FCC Rules**
Minimum calculated separation distance between antenna and persons required: ***6.6 cm**	Manufacturer' instruction for separation distance between antenna and persons required: **20 cm.**
Antenna installation and device operating instructions for installers (professional/unskilled users), and the parties responsible for ensuring compliance with the RF exposure requirement	Antenna installation and device operating instructions shall be provided to installers to maintain and ensure compliance with RF exposure requirements.
Caution statements and/or warning labels that are necessary in order to comply with the exposure limits	Refer to User's Manual for RF Exposure Information.
Any other RF exposure related issues that may affect MPE compliance	None.

*The minimum separation distance between the antenna and bodies of users are calculated using the following formula:

$$r = \sqrt{\frac{P \cdot G}{4 \cdot \pi \cdot S}} = \sqrt{\frac{EIRP}{4 \cdot \pi \cdot S}}$$

S = 1.0 mW/cm^2
EIRP = 27.41 dBm = $10^{(27.41/10)}$ mW = 551 mW (Worst Case)

(Minimum Safe Distance, r) = $\sqrt{\frac{EIRP}{4 \cdot \pi \cdot S}} = \sqrt{\frac{551}{4 \cdot \pi \cdot (1.0)}} \approx 6.6cm$

EXHIBIT 6. TEST EQUIPMENT LIST

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range	Cal. Due Date
Spectrum Analyzer	Agilent	E7401A	US40240432	9 kHz – 1.5 GHz	10 Jan 2012
L.I.S.N.	EMCO	3810/2	2209	9 kHz – 30 MHz	25 Aug 2011
Transient Limiter	Pasternack	PE7010-20	--	DC – 2 GHz 20 dB attenuation	18 Jan 2012
Spectrum Analyzer	Rohde & Schwarz	FSEK30	100077	20 Hz – 40 GHz	14 Aug 2011
Spectrum Analyzer	Rohde & Schwarz	ESU40	100037	20 Hz – 40 GHz	15 Mar 2012
RF Amplifier	Hewlett Packard	84498	3008A00769	1 – 26.5 GHz	17 Feb 2012
RF Amplifier	AH System	PAM-0118	225	20 MHz – 18 GHz	15 Mar 2012
High Pass Filter	K & L	11SH10-4000/T12000	4	Cut off 2.4 GHz	Cal. on use
Horn Antenna	Emco	3155	6570	1 – 18 GHz	22 Feb 2012
Horn Antenna	Emco	3155	5955	1 – 18 GHz	09 Jan 2012
Biconi-Log Antenna	Emco	3142C	00026873	26 – 3000 MHz	18 Apr 2011
Dipole Antenna	Emco	3121C	434	26 – 1000 MHz	16 Aug 2011
Signal Generator	Hewlett Packard	83752B	3610A00457	0.01 – 20 GHz	19 Oct 2011
Power Divider	Mini-Circuits	15542	0235	DC – 18 GHz	Cal. on use
Attenuator	Narda	4768-10	-	DC – 40 GHz	Cal. on use
DC Block	Hewlett-Packard	11742A	12460	0.045 – 26.5 GHz	Cal. on use
DC Power Supply	Tenma	72-7295	490300270	1 – 40vdc	Cal. on use

EXHIBIT 7. MEASUREMENT UNCERTAINTY

The measurement uncertainties stated were calculated in accordance with the requirements of CISPR 16-4-2 @ IEC:2003 and JCGM 100:2008 (GUM 1995) – Guide to the Expression of Uncertainty in Measurement.

7.1. LINE CONDUCTED EMISSION MEASUREMENT UNCERTAINTY

	Line Conducted Emission Measurement Uncertainty (150 kHz – 30 MHz):	Measured	Limit
u_c	**Combined standard uncertainty:** $u_c(y) = \sqrt{\sum_{I=1}^{m} u_i^2(y)}$	± 1.57	± 1.8
U	**Expanded uncertainty U:** $U = 2u_c(y)$	± 3.14	± 3.6

7.2. RADIATED EMISSION MEASUREMENT UNCERTAINTY

	Radiated Emission Measurement Uncertainty @ 3m, Horizontal (30-1000 MHz):	Measured	Limit
u_c	**Combined standard uncertainty:** $u_c(y) = \sqrt{\sum_{I=1}^{m} u_i^2(y)}$	± 2.15	± 2.6
U	**Expanded uncertainty U:** $U = 2u_c(y)$	± 4.30	± 5.2

	Radiated Emission Measurement Uncertainty @ 3m, Vertical (30-1000 MHz):	Measured	Limit
u_c	**Combined standard uncertainty:** $u_c(y) = \sqrt{\sum_{I=1}^{m} u_i^2(y)}$	± 2.39	± 2.6
U	**Expanded uncertainty U:** $U = 2u_c(y)$	± 4.78	± 5.2

	Radiated Emission Measurement Uncertainty @ 3 m, Horizontal & Vertical (1 – 18 GHz):	Measured	Limit
u_c	**Combined standard uncertainty:** $u_c(y) = \sqrt{\sum_{I=1}^{m} u_i^2(y)}$	± 1.87	Under consideration
U	**Expanded uncertainty U:** $U = 2u_c(y)$	± 3.75	Under consideration