ENGINEERING TEST REPORT

TMX24120 Radio Module
Model: TMX24120
FCC ID: SU5-TMX24120

Applicant:

VideoComm Technologies (1156488 Ontario Inc.)
1016C Sutton Drive Unit 6
Burlington, Ontario
Canada L7L 6B8

In Accordance With

Federal Communications Commission (FCC)
Part 15, Subpart C, Section 15.247 Frequency Hopping Spread Spectrum (FHSS)

UltraTech's File No.: VCT-009F15C247

This Test report is Issued under the Authority of
Tri M. Luu
Vice President of Engineering
UltraTech Group of Labs

Date: November 5, 2012

Report Prepared by: Dan Huynh	Tested by: Mr. Hung Trinh
Issued Date: November 5, 2012	Test Dates: August 30 – September 25, 2012

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 91038 | VCCI 1309 | Industry Canada / Industrie Canada Approved Test Facility 46390-2049 | NVLAP NvLap Lab Code 200093-0 | BSMI SL2-IN-E-1119R | Korea KCC-RRL 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 (FHSS) Transmitter.
Test Procedures:	▪ ANSI C63.4-2009 ▪ FCC Public Notice DA 00-705 ▪ ANSI C63.10
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	2011	Code of Federal Regulations (CFR), Title 47 – Telecommunication
ANSI C63.4	2009	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
FCC ET Docket No. 99-231	2002	Amendment to FCC Part 15 of the Commission's Rules Regarding to Spread Spectrum Devices

EXHIBIT 2. PERFORMANCE ASSESSMENT

2.1. CLIENT INFORMATION

APPLICANT	
Name:	VideoComm Technologies (1156488 Ontario Inc.)
Address:	1016C Sutton Drive Unit 6 Burlington, Ontario Canada L7L 6B8
Contact Person:	Jeff Johnson Phone #: (905) 336-9665 Fax #: (905) 336-9662 Email Address: jeff@videotransmitters.com

MANUFACTURER	
Name:	KINGWAVE TECHNOLOGY Co. Ltd.
Address:	18F-3, No. 186, Jian-Yi Road Chung-Ho City, TAIPEI TAIWAN
Contact Person:	Ken Shih Phone #: 1+ (886) – 2 – 8227-1868 Fax #: 1+ (886) – 2 – 8227-1878 Email Address: KEN@KINGWAVE.COM.TW

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:	VideoComm Technologies (1156488 Ontario Inc.)
Product Name:	TMX24120 Radio Module
Model Name or Number:	TMX24120
Serial Number:	Test Sample
Type of Equipment:	Spread Spectrum Transmitter
Input Power Supply Type:	External Regulated DC Sources
Primary User Functions of EUT:	Spread Spectrum OEM Transceiver

2.3. EUT'S TECHNICAL SPECIFICATIONS

TRANSMITTER	
Equipment Type:	▪ Mobile ▪ Base Station (fixed use)
Intended Operating Environment:	▪ Commercial, industrial or business environment ▪ Residential environment
Power Supply Requirement:	5 VDC
RF Output Power Rating:	0.1242 W
Operating Frequency Range:	2403 – 2478 MHz (for point-to-multipoint operation) 2403 – 2473 MHz (for fixed, point-to-point operation)
RF Output Impedance:	50 Ohm
Duty Cycle:	Continuous
Modulation Type:	16-QAM, BPSK and QPSK,
Antenna Connector Type:	SMA

2.4. ASSOCIATED ANTENNA DESCRIPTIONS

Antenna Type	Maximum Gain (dBi)
Omni-directional antenna	12
Panel antenna	20.5
Parabolic antenna	24
The highest gain antenna from each of the above antenna types were selected for testing to represents the worst-case. Refer to user manual for antennas list information.	

2.5. LIST OF EUT'S PORTS

Port Number	EUT's Port Description	Number of Identical Ports	Connector Type	Cable Type (Shielded/Non-shielded)
1	RF IN/OUT Port	1	SMA	Shielded coaxial cable
2	DC Supply & I/O Port	1	Pin Header	No cable, direct connection

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:	Videocomm Technologies
Model Name or Number:	N/A
Connected to EUT's Port:	I/O Port

Ancillary Equipment # 2	
Description:	AC/DC Adapter
Brand name:	Videocomm Technologies
Model Name or Number:	GFP151U-120125-1
Connected to EUT's Port:	Test Jig Board of the EUT

Ancillary Equipment # 3	
Description:	Laptop
Brand name:	HP
Model Name or Number:	Pavilion zd8000
Connected to EUT's Port:	Test Jig of the EUT

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°C
Humidity:	51%
Pressure:	102 kPa
Power Input Source:	12 VDC to test jig

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 & Hardware:	Special software provided by the Applicant to operate the EUT at each channel frequency continuously and in the range of typical modes of operation.
Transmitter Test Antenna:	The EUT is tested with the antenna fitted in a manner typical of normal intended use as non-integral antenna equipment as described with the test results.

Transmitter Test Signals	
Frequency Band(s):	▪ 2403 - 2478 MHz for Point to Multipoint with Omni-directional antenna ▪ 2403 - 2473 MHz for Point to Point with Panel and Parabolic antennas
Frequency(ies) Tested: (Near lowest, near middle & near highest frequencies in the frequency range of operation.)	▪ 2403 MHz, 2438 MHz and 2478 MHz ▪ 2403 MHz, 2438 MHz and 2473 MHz
RF Power Output: (measured maximum output power at antenna terminals)	0.124 W (conducted)
Normal Test Modulation:	16-QAM, QPSK and BPSK
Modulating Signal Source:	Internal

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.: 91038) and Industry Canada office (Industry Canada File No.: 2049A-3). Expiry Date: 2014-04-04.

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)	Provisions for Frequency Hopping Systems	Yes
15.247(b)(1)	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	RF Exposure	Yes

4.3. MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

None.

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

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

5.1.1. Limit(s)

The equipment shall meet the limits of the following table:

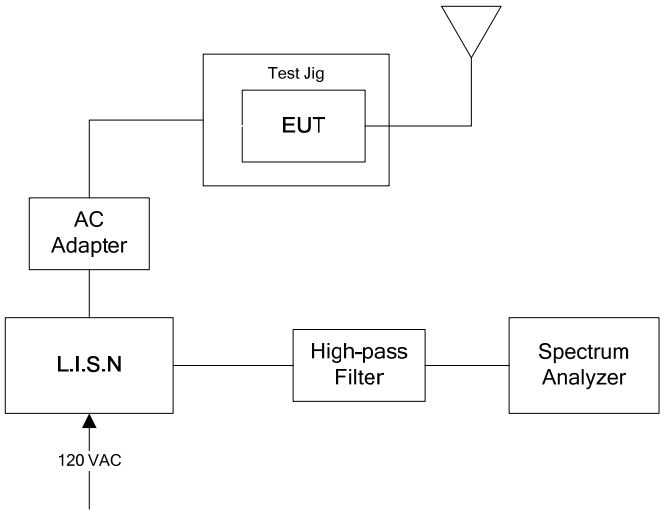
Frequency of emission (MHz)	Conducted Limits (dBμV)	
	Quasi-peak	Average
0.15–0.5 .....……..	66 to 56*	56 to 46*
0.5–5 .....……..	56	46
5-30 ……..……..	60 ……..……..	50

*Decreases linearly with the logarithm of the frequency

5.1.2. Method of Measurements

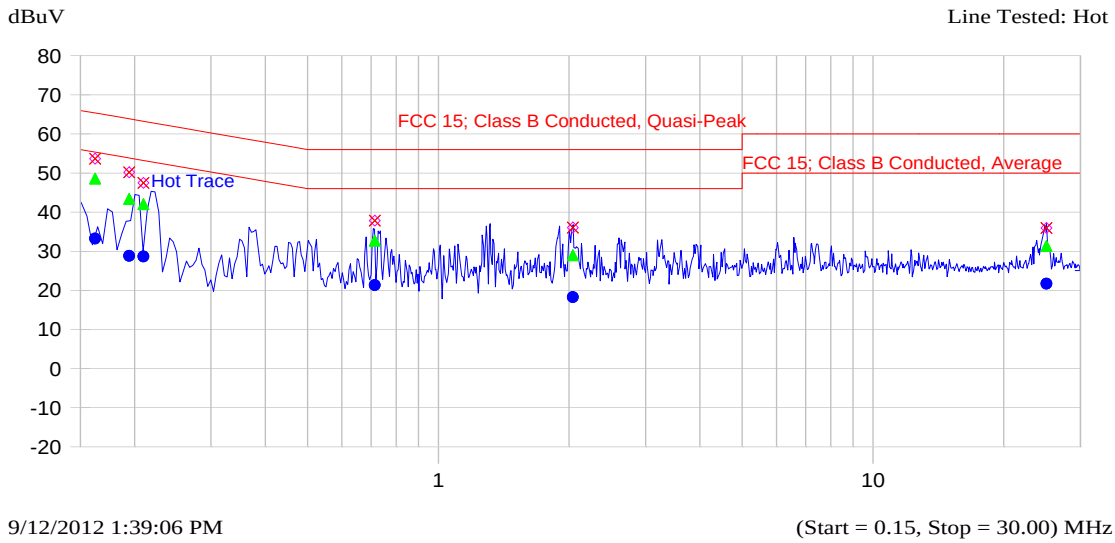
ANSI C63.4-2009

5.1.3. Test Arrangement



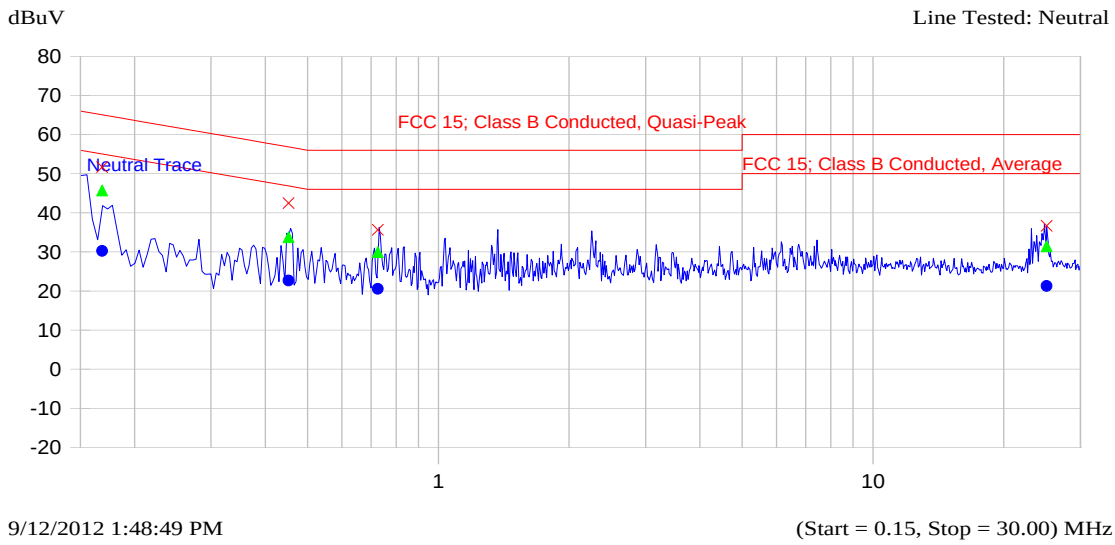
5.1.4. Test Data

Plot 5.1.4.1. Power Line Conducted Emissions; Line Voltage: 120 VAC; Line Tested: Hot



Frequency MHz	Peak dBuV	QP dBuV	Delta QP-QP Limit dB	Avg dBuV	Delta Avg-Avg Limit dB	Trace Name
0.162	53.7	48.6	-17.1	33.2	-22.4	Hot Trace
0.194	50.2	43.4	-21.3	28.8	-25.9	Hot Trace
0.210	47.5	42.0	-22.2	28.7	-25.6	Hot Trace
0.714	37.8	32.7	-23.3	21.3	-24.7	Hot Trace
2.041	36.0	29.0	-27.0	18.3	-27.7	Hot Trace
25.076	36.0	31.3	-28.7	21.7	-28.3	Hot Trace

Plot 5.1.4.2. Power Line Conducted Emissions; Line Voltage: 120 VAC; Line Tested: Neutral



Frequency MHz	Peak dBuV	QP dBuV	Delta QP-QP Limit dB	Avg dBuV	Delta Avg-Avg Limit dB	Trace Name
0.169	51.7	45.7	-19.8	30.2	-25.2	Neutral Trace
0.452	42.5	33.7	-23.6	22.7	-24.6	Neutral Trace
0.726	35.6	30.0	-26.0	20.5	-25.5	Neutral Trace
25.101	36.7	31.4	-28.6	21.3	-28.7	Neutral Trace

5.2. 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.	See Operational Description
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	Required professionally installation.
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 proposed antenna list.
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)	Describe how the EUT complies with the requirement that it be designed to be capable of operating as a true frequency hopping system	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

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

5.3.1. Limit

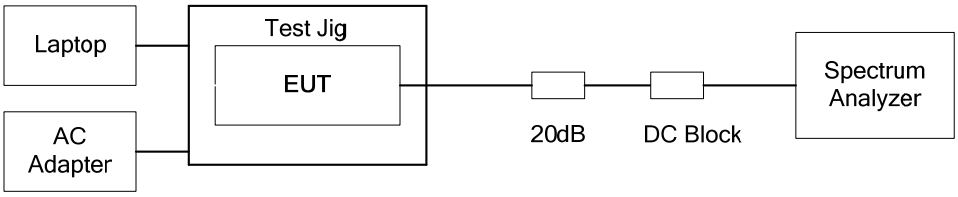
§ 15.247(a)(1): Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier 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.

5.3.2. Method of Measurements

FCC Public Notice DA 00-705 and ANSI C63.10-2009.

5.3.3. Test Arrangement



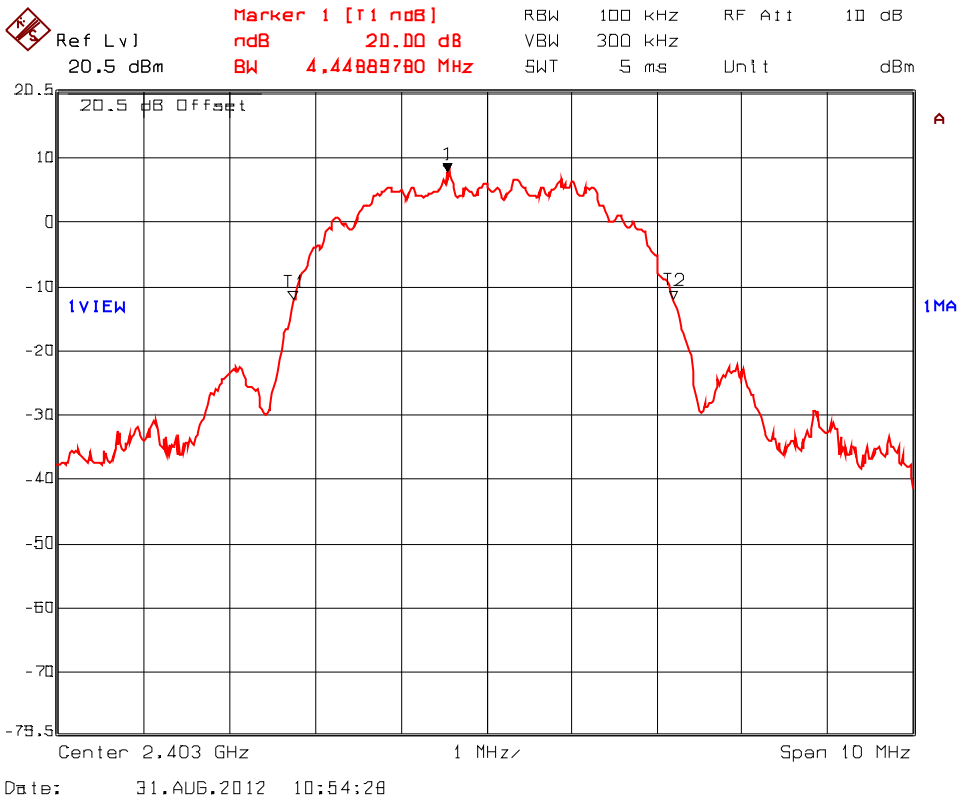
5.3.4. Test Data

Test Description	FCC Specification	Measured Values	Comments
Frequency Hopping Systems Requirements	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.	--	See Note 1
20 dB BW of the hopping channel	--	4.55 MHz	See Note 2
Channel Hopping Frequency Separation	Minimum of 25 kHz or 20dB BW whichever is greater or 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	5 MHz	See Note 2
Number hopping frequencies	Shall use at least 15 channels	≥15 hopping frequencies	See Note 1 and 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	14.98 ms, maximum	See Note 2

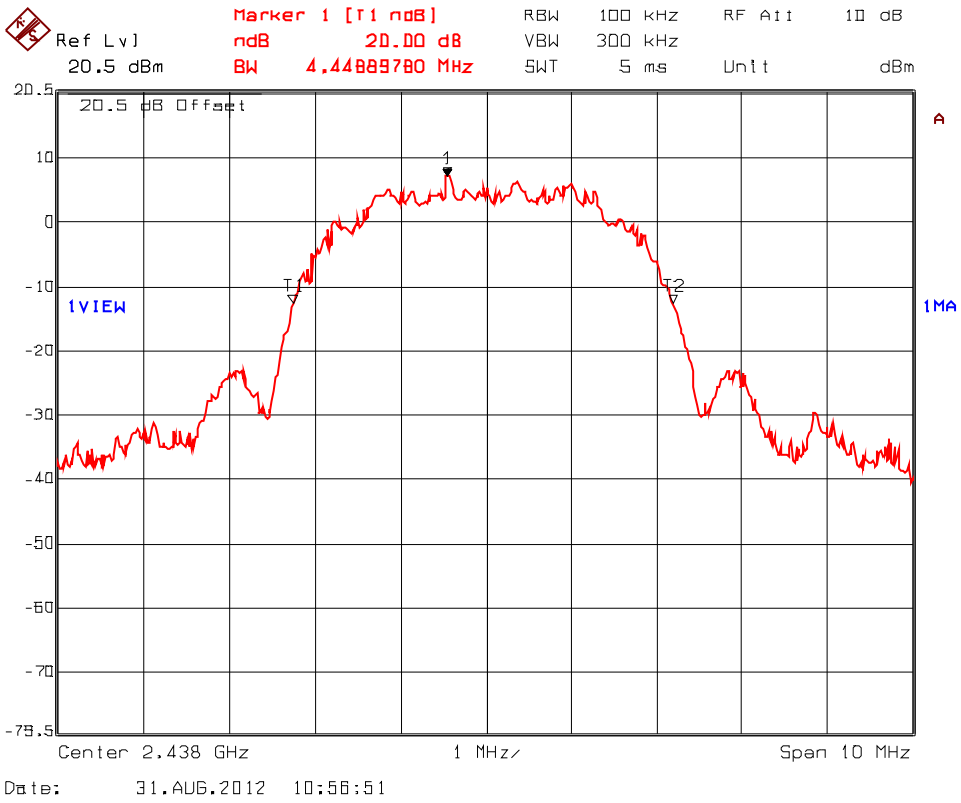
Note 1: See operational description exhibit for details.

Note 2: See the following plots for details.

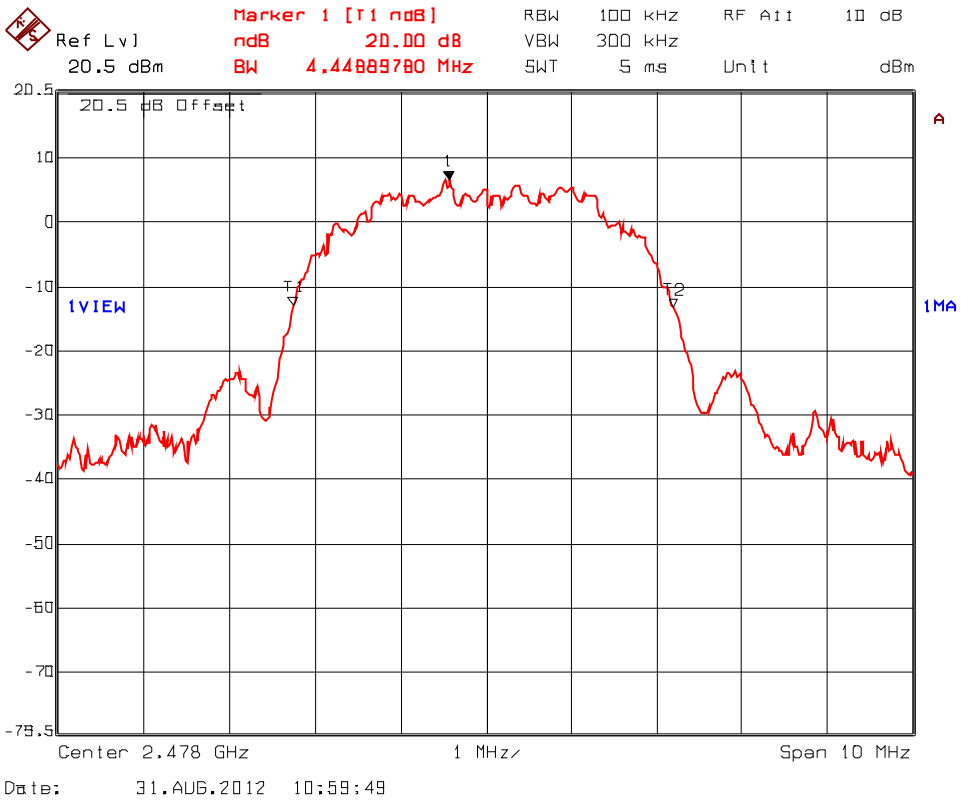
Plot 5.3.4.1. 20 dB Bandwidth, 2403 MHz, 16-QAM



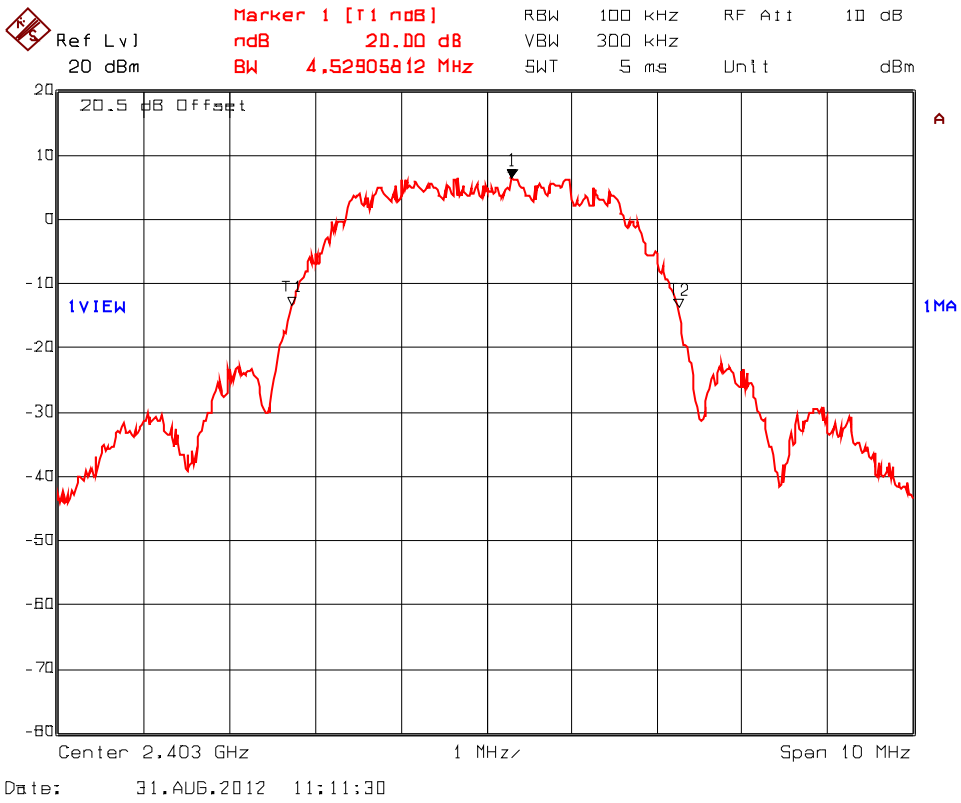
Plot 5.3.4.2. 20 dB Bandwidth, 2438 MHz, 16-QAM



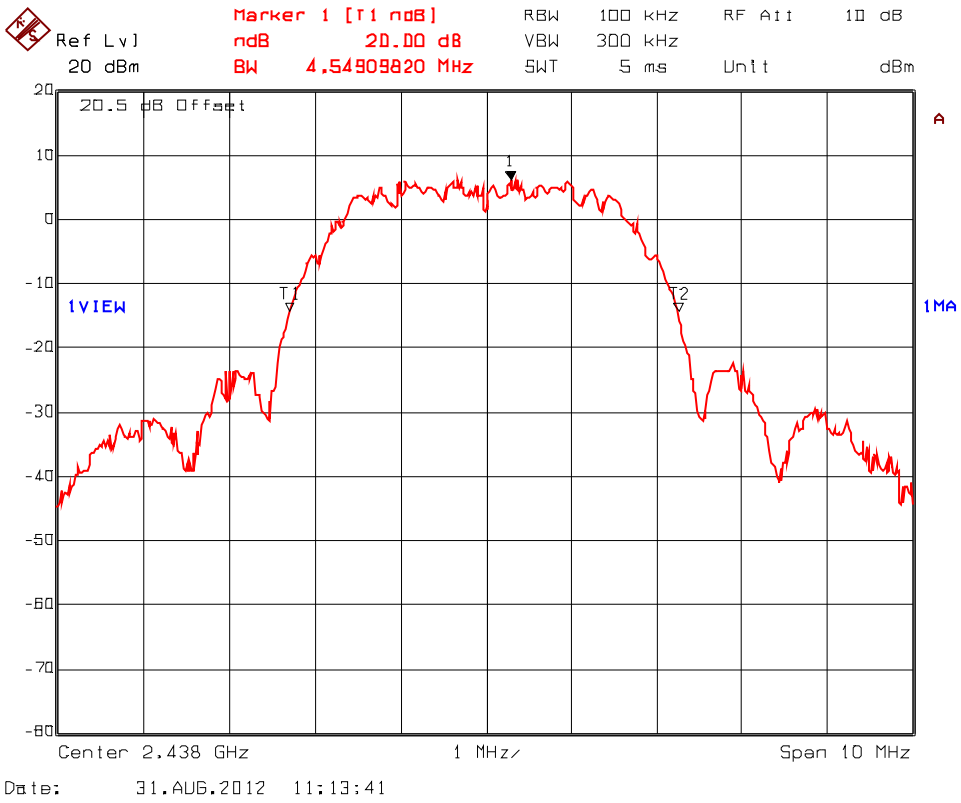
Plot 5.3.4.3. 20 dB Bandwidth, 2478 MHz, 16-QAM



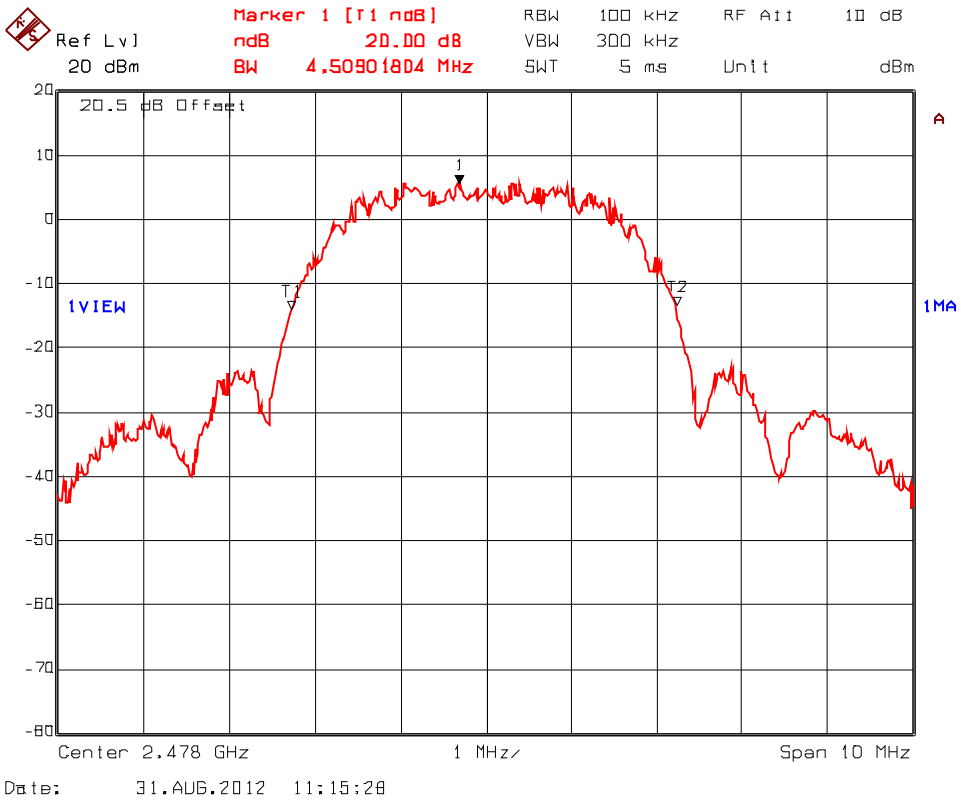
Plot 5.3.4.4. 20 dB Bandwidth, 2403 MHz, BPSK



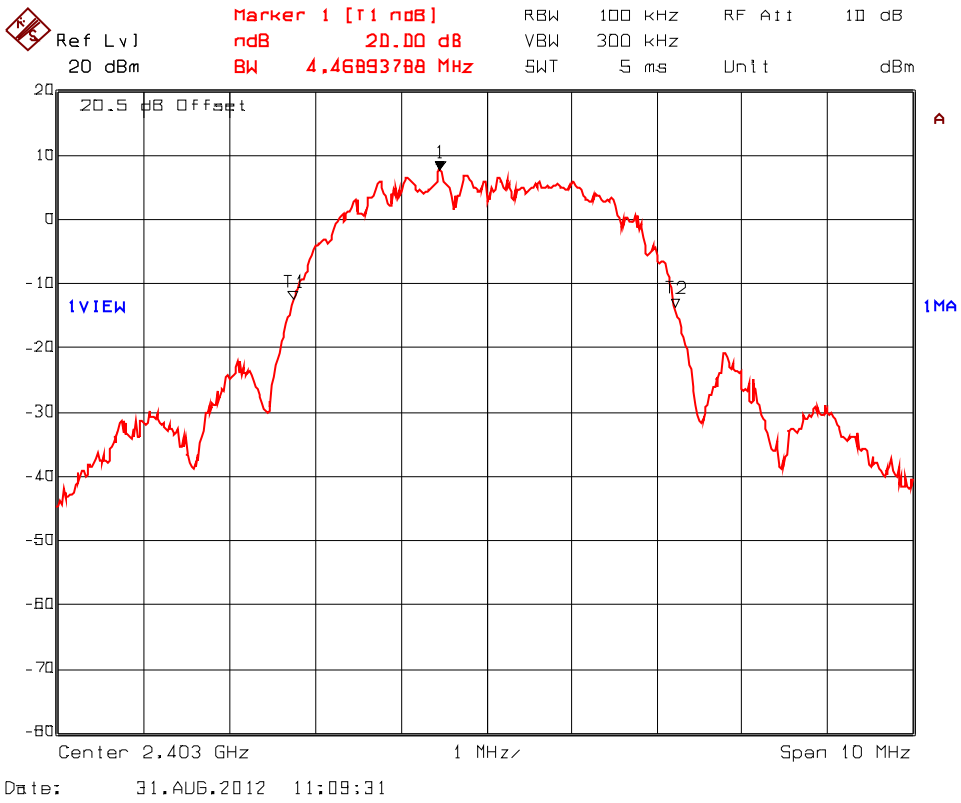
Plot 5.3.4.5. 20 dB Bandwidth, 2438 MHz, BPSK



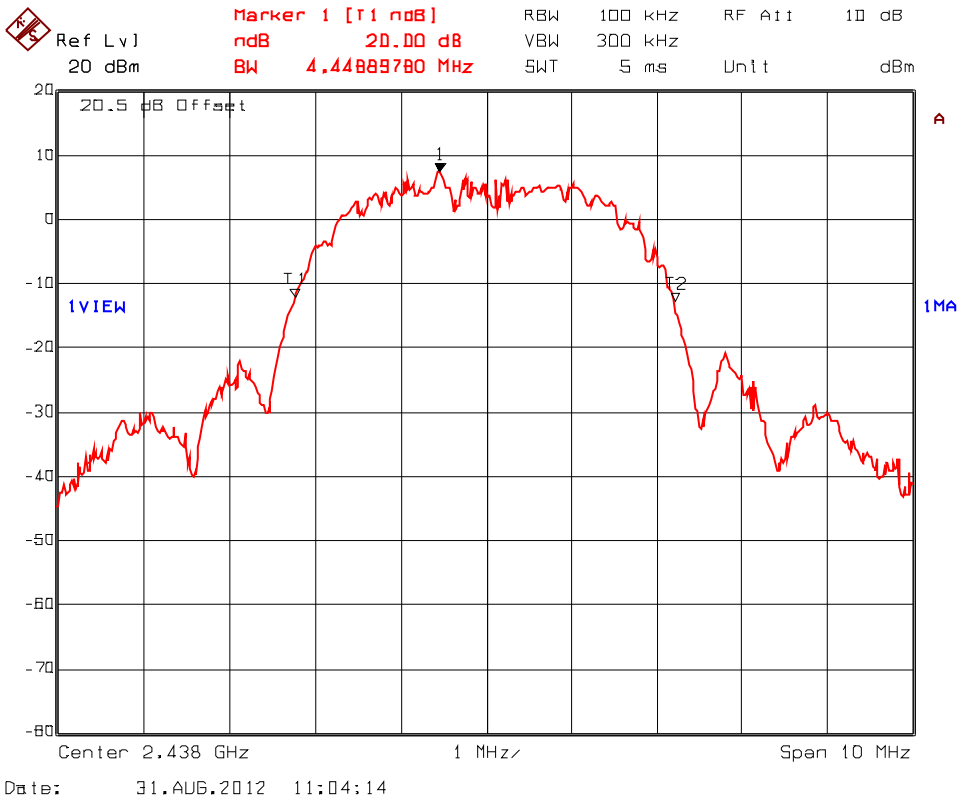
Plot 5.3.4.6. 20 dB Bandwidth, 2478 MHz, BPSK



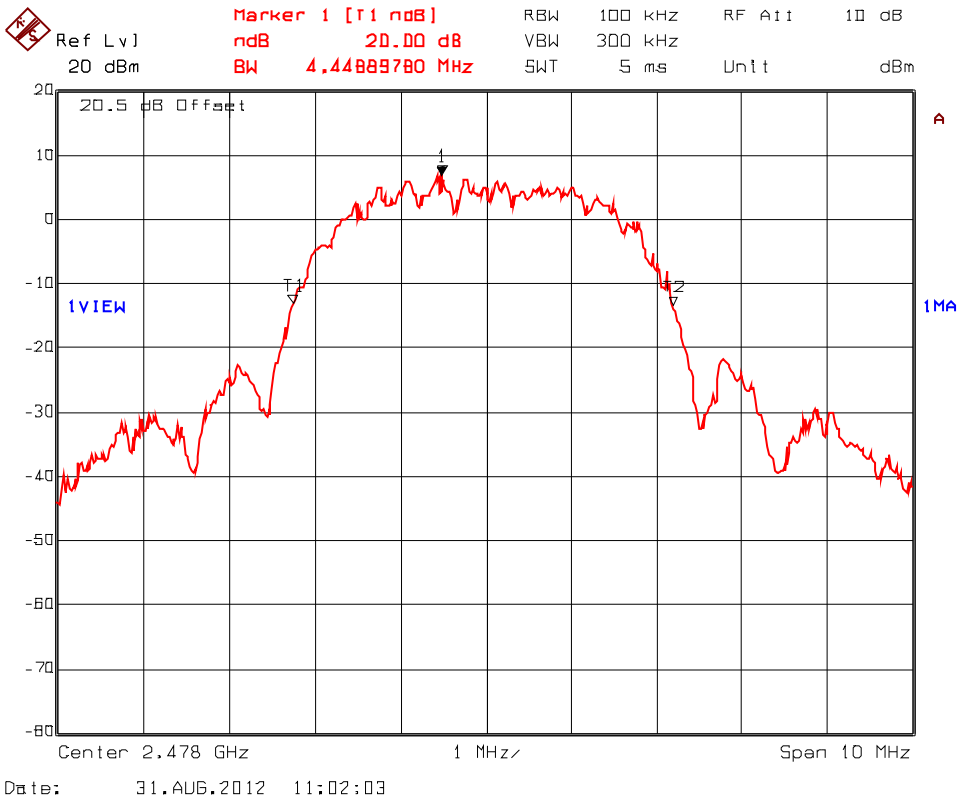
Plot 5.3.4.7. 20 dB Bandwidth, 2403 MHz, QPSK



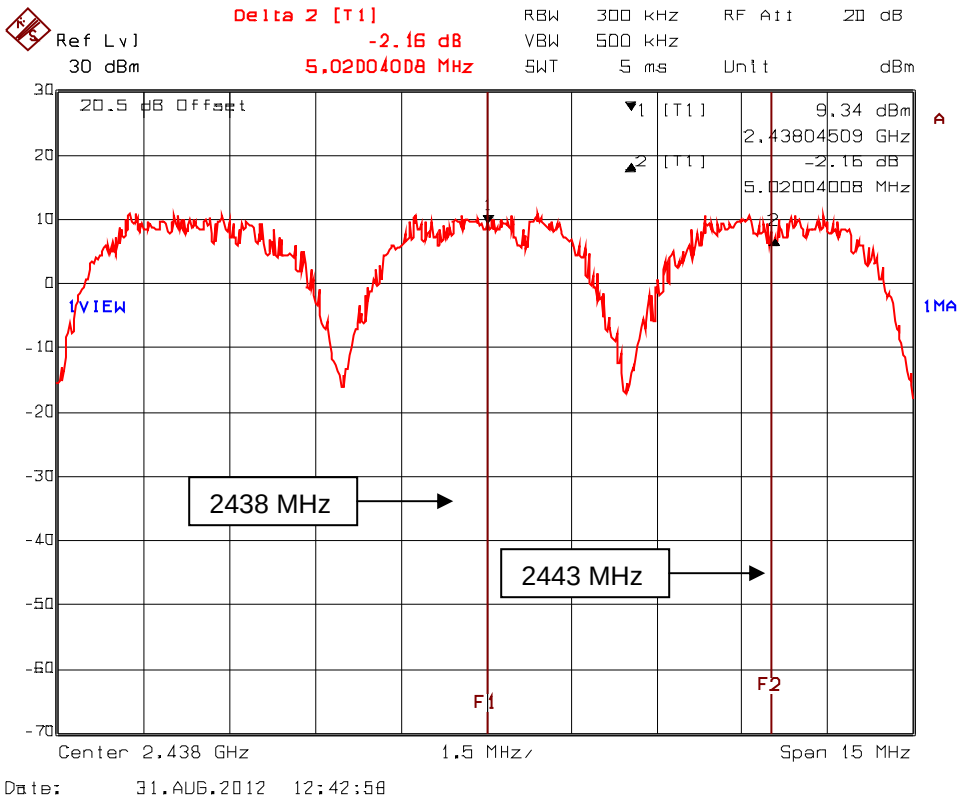
Plot 5.3.4.8. 20 dB Bandwidth, 2438 MHz, QPSK



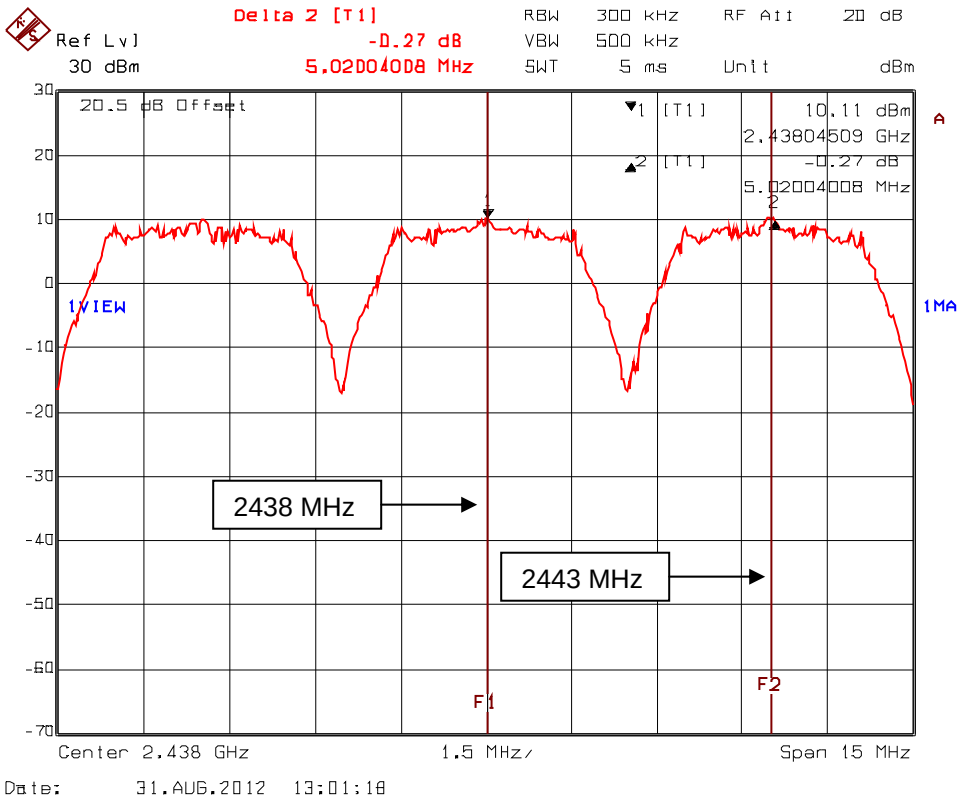
Plot 5.3.4.9. 20 dB Bandwidth, 2478 MHz, QPSK



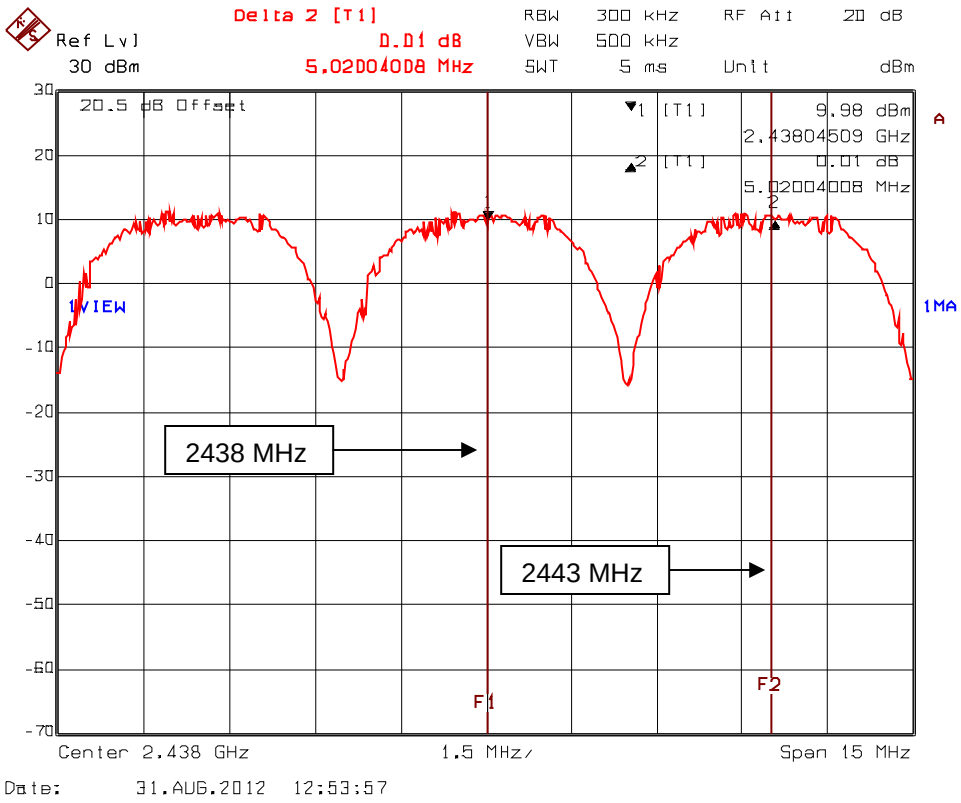
Plot 5.3.4.10. Carrier Frequency Separation, 16-QAM



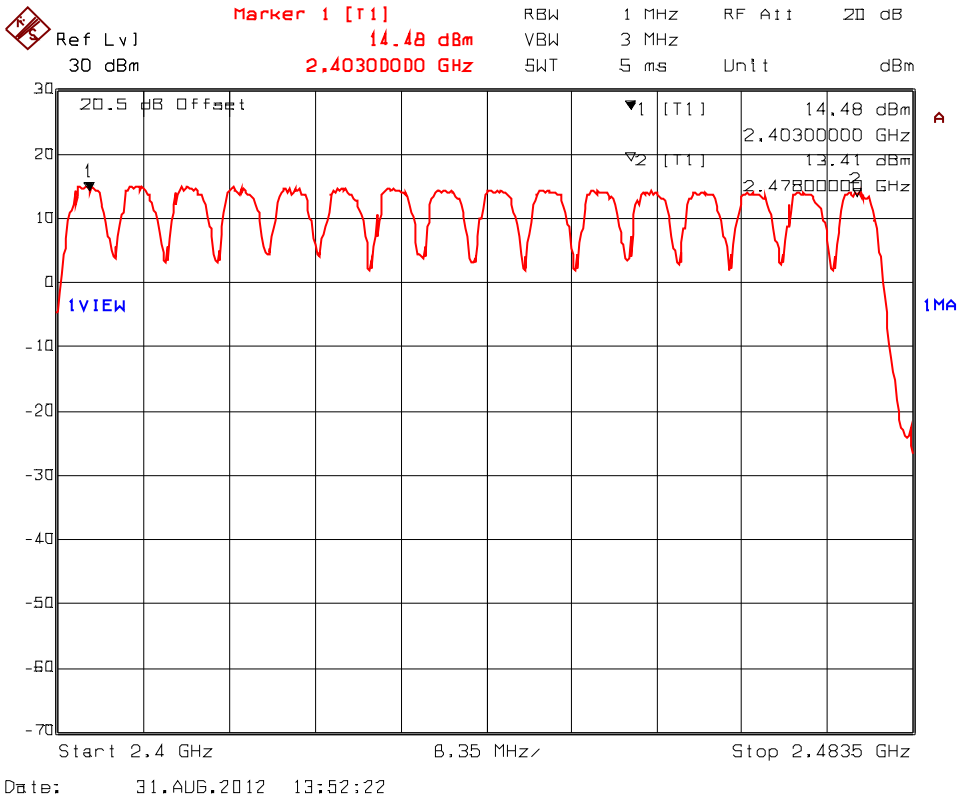
Plot 5.3.4.11. Carrier Frequency Separation, BPSK



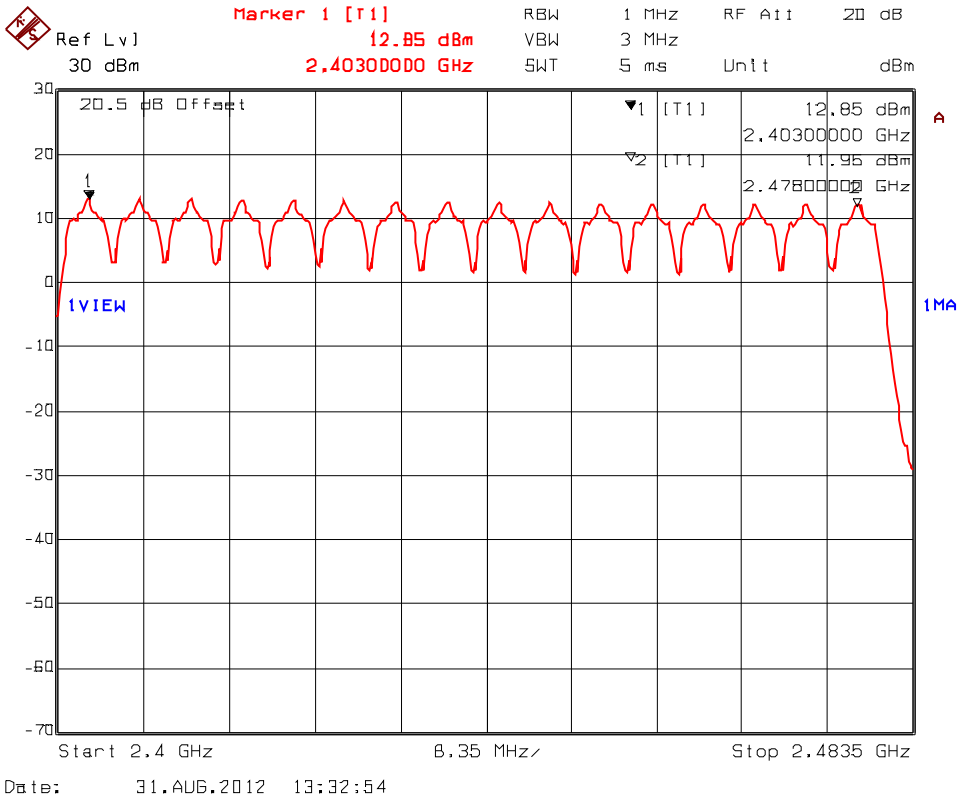
Plot 5.3.4.12. Carrier Frequency Separation, QPSK



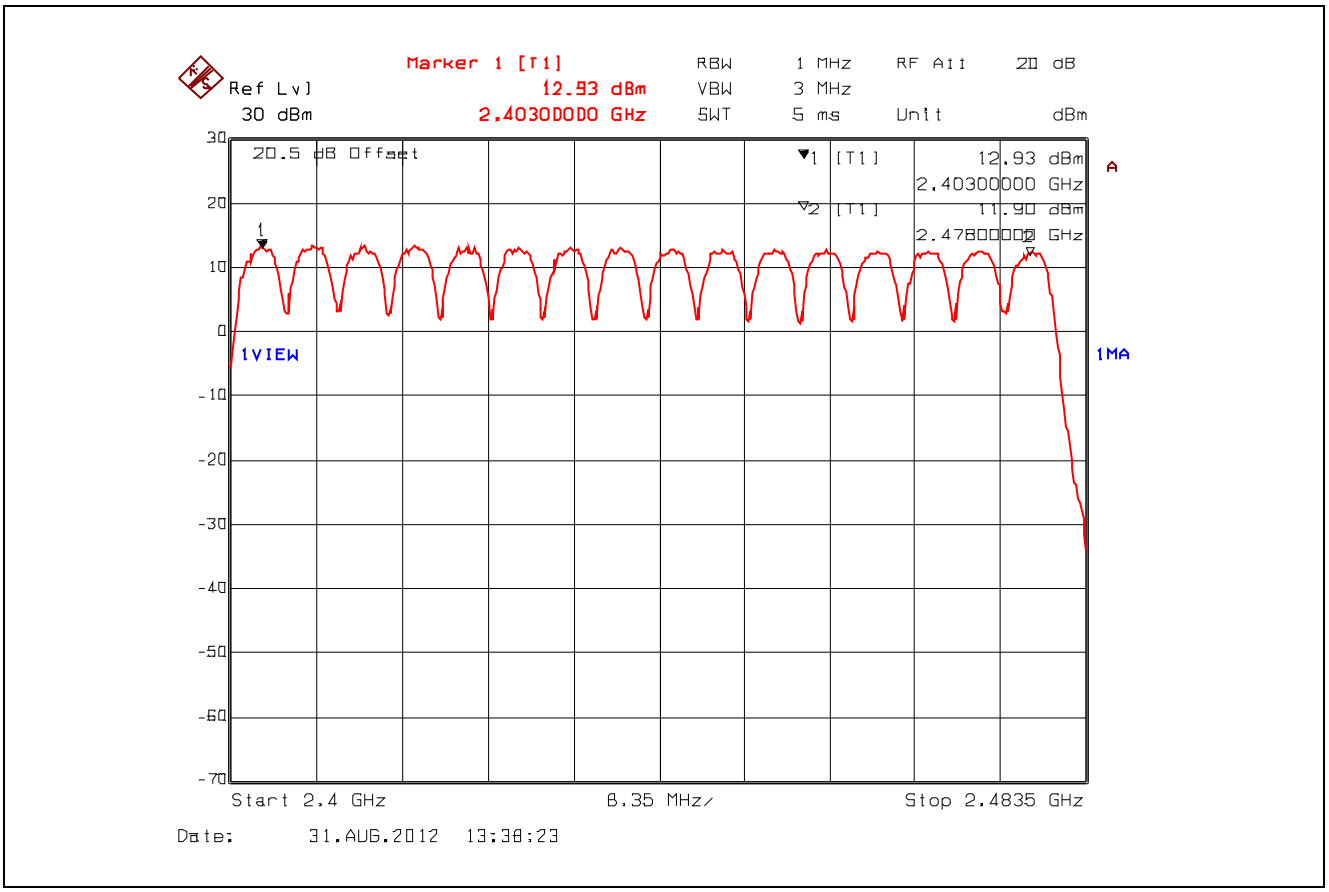
Plot 5.3.4.13. Number of Hopping Frequencies, 16-QAM
16 Hopping Channels from 2403-2478 MHz



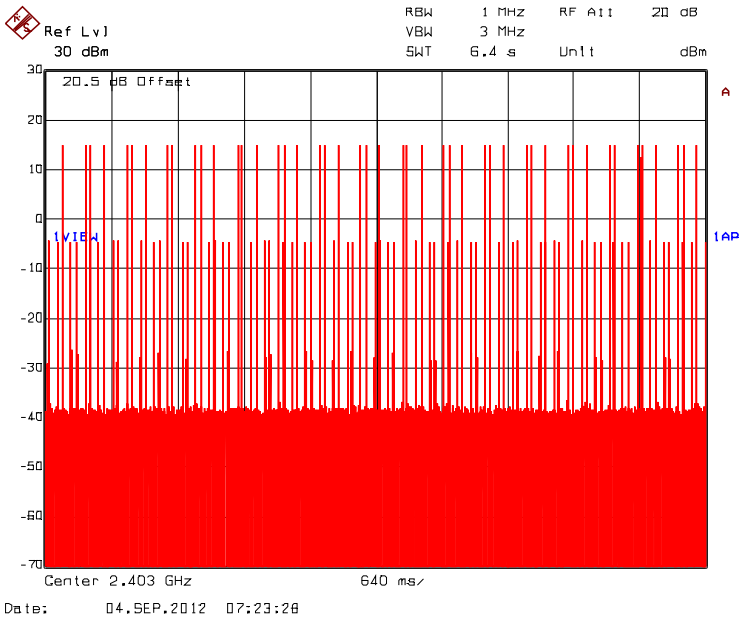
Plot 5.3.4.14. Number of Hopping Frequencies, BPSK
16 Hopping Channels from 2403-2478 MHz



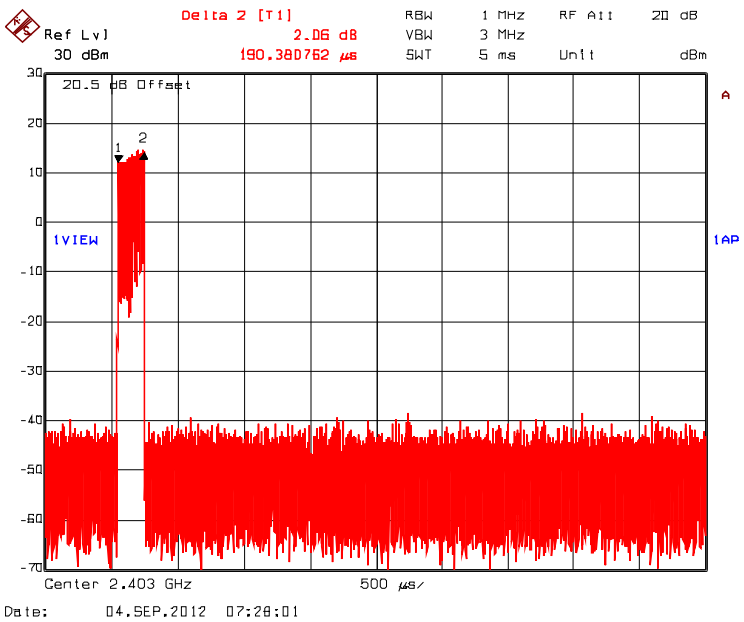
Plot 5.3.4.15. Number of Hopping Frequencies, QPSK
16 Hopping Channels from 2403-2478 MHz



Plot 5.3.4.16. Time of Occupancy, 2403 MHz, 16-QAM

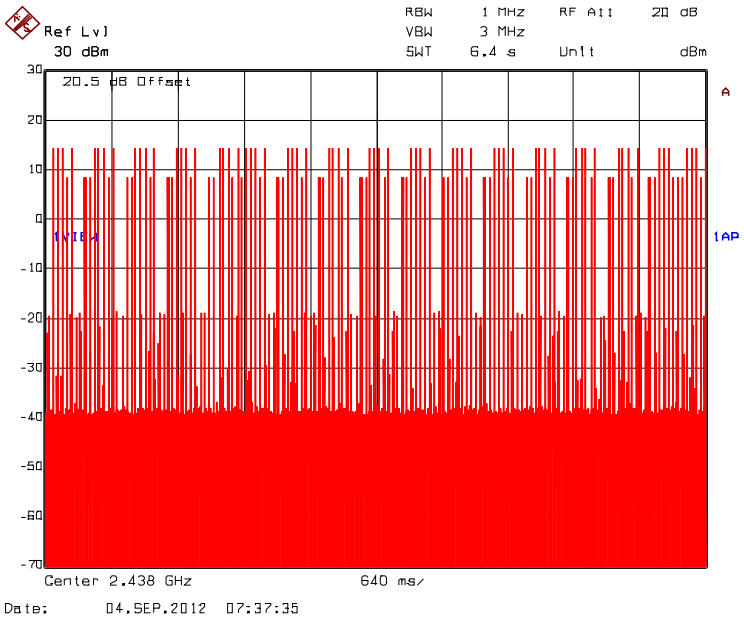


Plot 5.3.4.17. Time of Occupancy, 2403 MHz, 16-QAM, Dwell Time @ 2403 MHz = 190.380762 µs

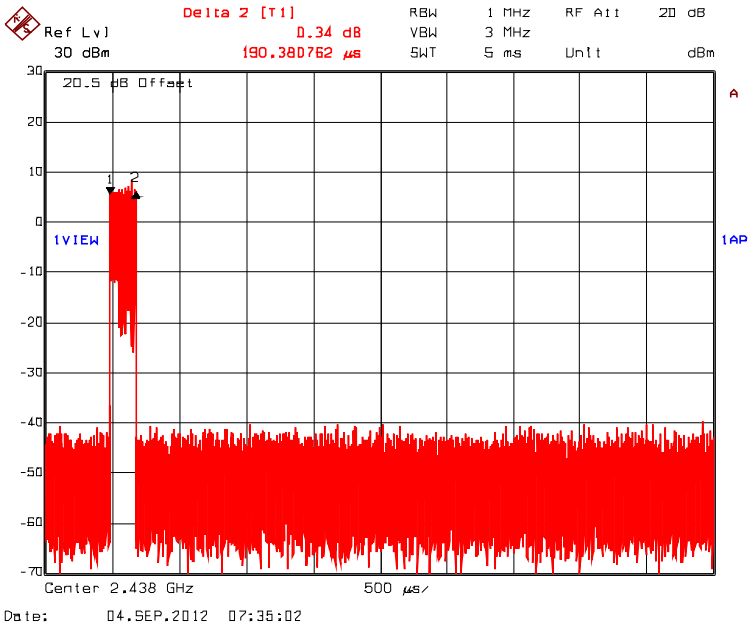


Average time of occupancy = (Dwell Time @ 2403 MHz) x (number of hops within a period)
= 190.380762 µs x 47
= 8.95 ms

Plot 5.3.4.18. Time of Occupancy, 2438 MHz, 16-QAM

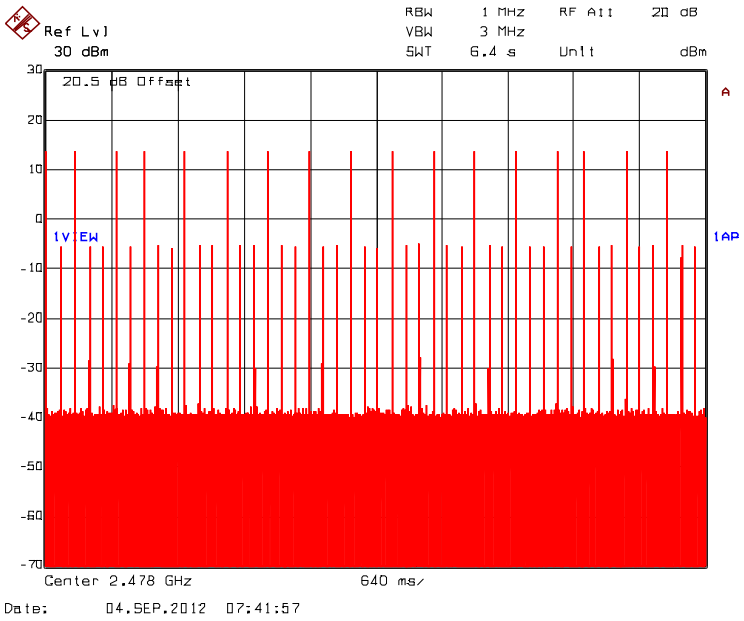


Plot 5.3.4.19. Time of Occupancy, 2438 MHz, 16-QAM, Dwell Time @ 2438 MHz = 190.380762 µs

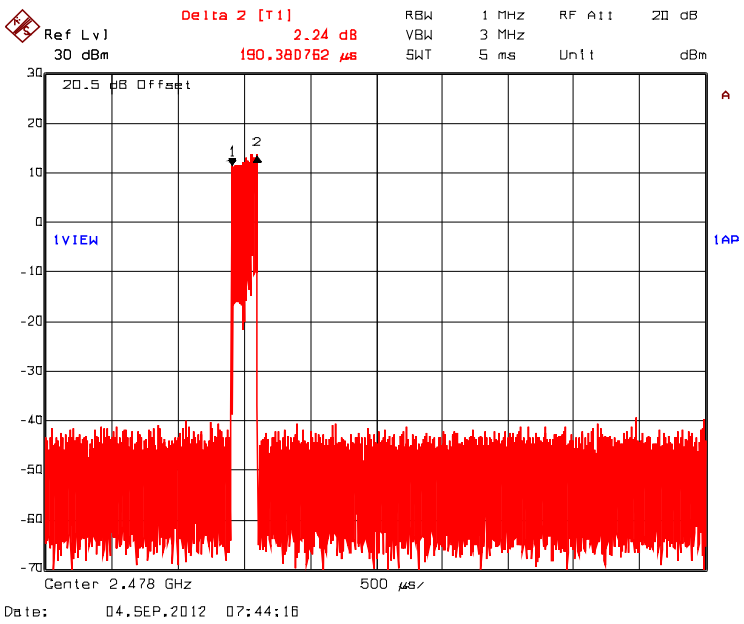


Average time of occupancy = (Dwell Time @ 2438 MHz) x (number of hops within a period)
= 190.380762 µs x 66
= 12.57 ms

Plot 5.3.4.20. Time of Occupancy, 2478 MHz, 16-QAM

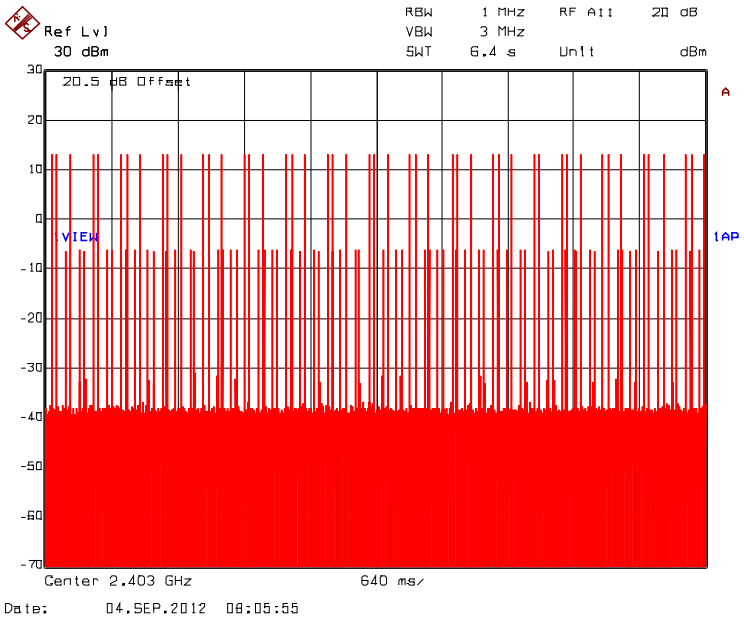


Plot 5.3.4.21. Time of Occupancy, 2478 MHz, 16-QAM, Dwell Time @ 2478 MHz = 190.380762 µs

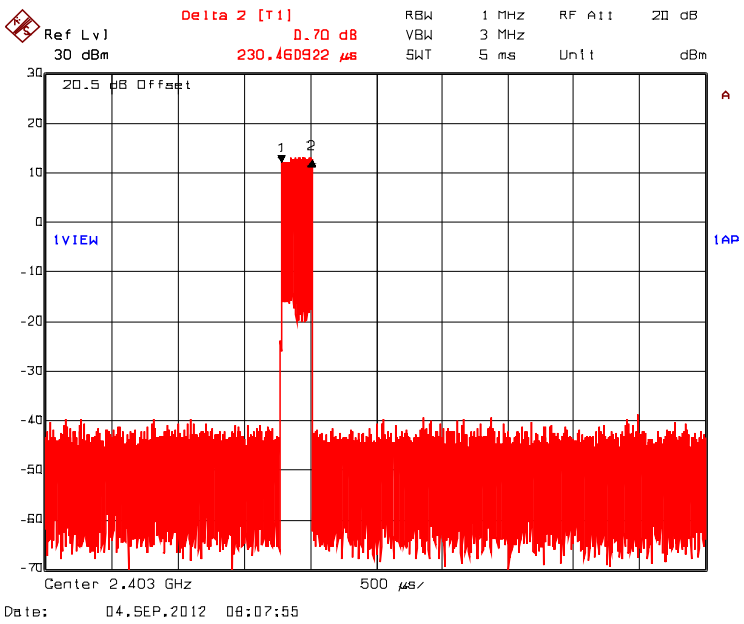


Average time of occupancy = (Dwell Time @ 2478 MHz) x (number of hops within a period)
= 190.380762 µs x 17
= 3.24 ms

Plot 5.3.4.22. Time of Occupancy, 2403 MHz, BPSK

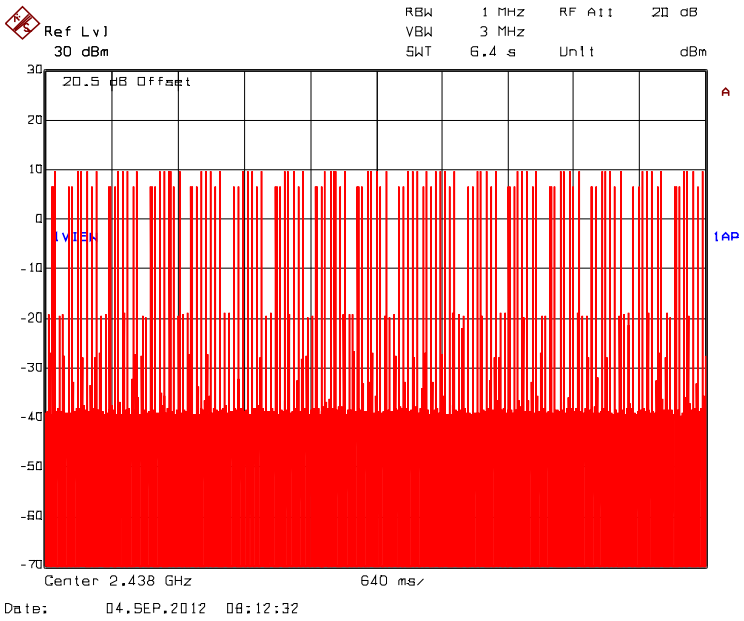


Plot 5.3.4.23. Time of Occupancy, 2403 MHz, BPSK, Dwell Time @ 2403 MHz = 230.460922 µs

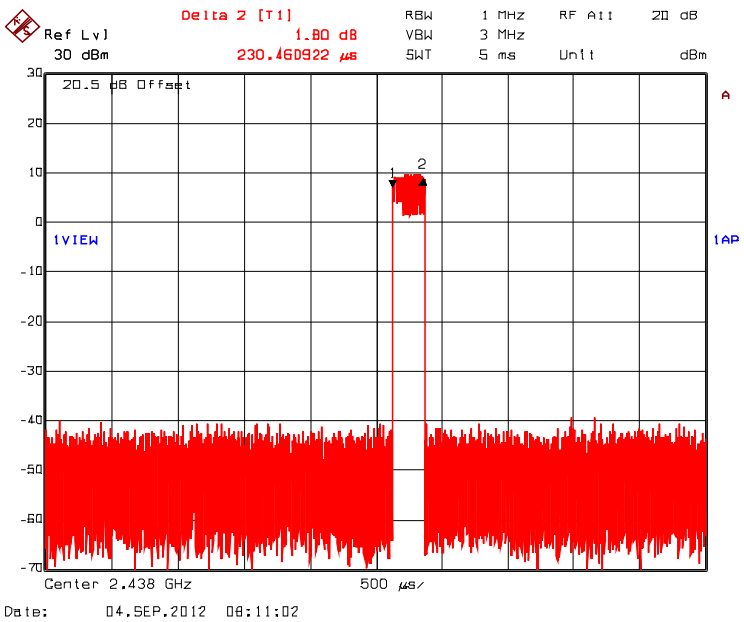


Average time of occupancy = (Dwell Time @ 2403 MHz) x (number of hops within a period)
= 230.460922 µs x 49
= 11.29 ms

Plot 5.3.4.24. Time of Occupancy, 2438 MHz, BPSK

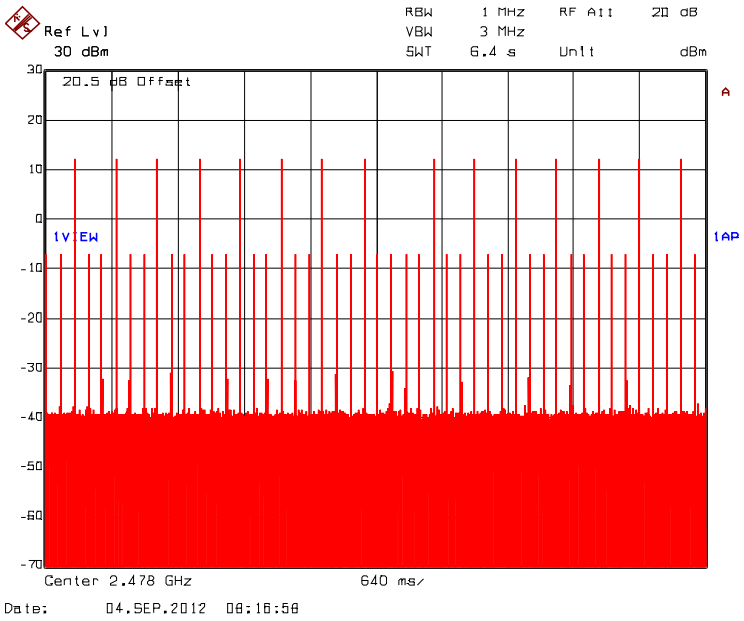


Plot 5.3.4.25. Time of Occupancy, 2438 MHz, BPSK, Dwell Time @ 2438 MHz = 230.460922 µs

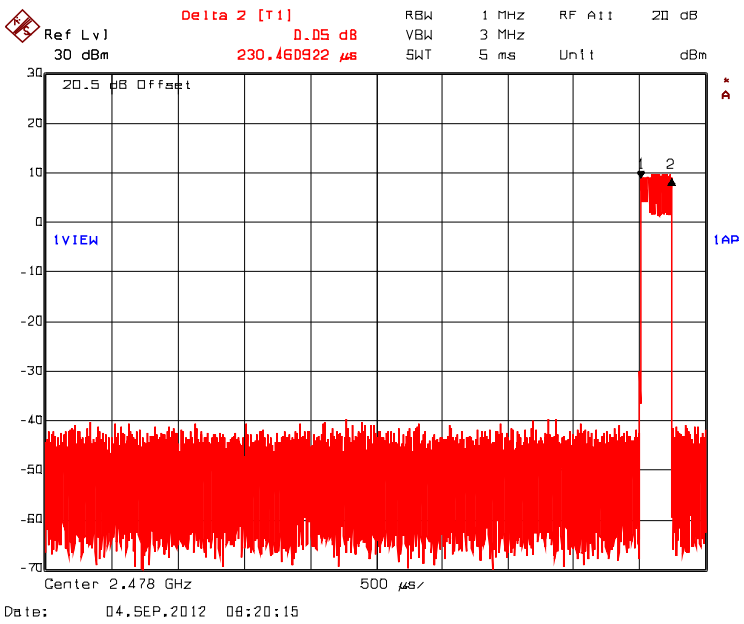


Average time of occupancy = (Dwell Time @ 2438 MHz) x (number of hops within a period)
= 230.460922 µs x 65
= 14.98 ms

Plot 5.3.4.26. Time of Occupancy, 2478 MHz, BPSK

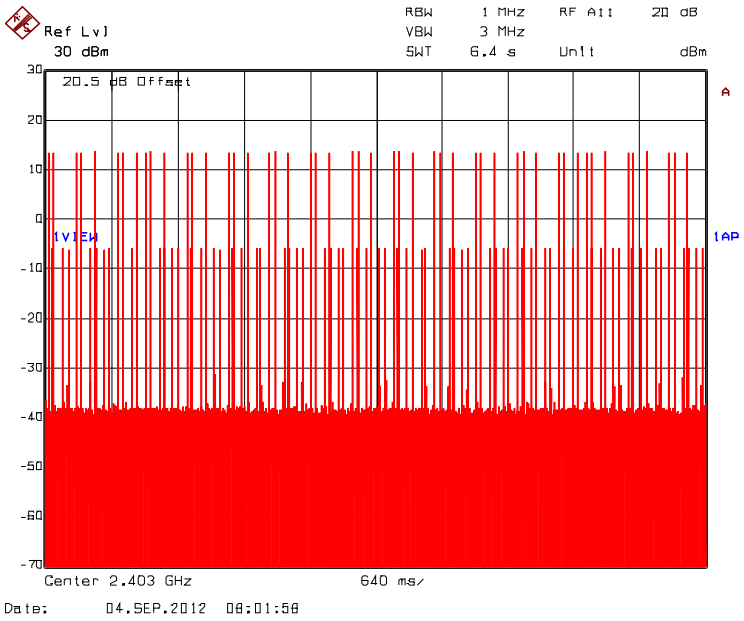


Plot 5.3.4.27. Time of Occupancy, 2478 MHz, BPSK, Dwell Time @ 2478 MHz = 230.460922 µs

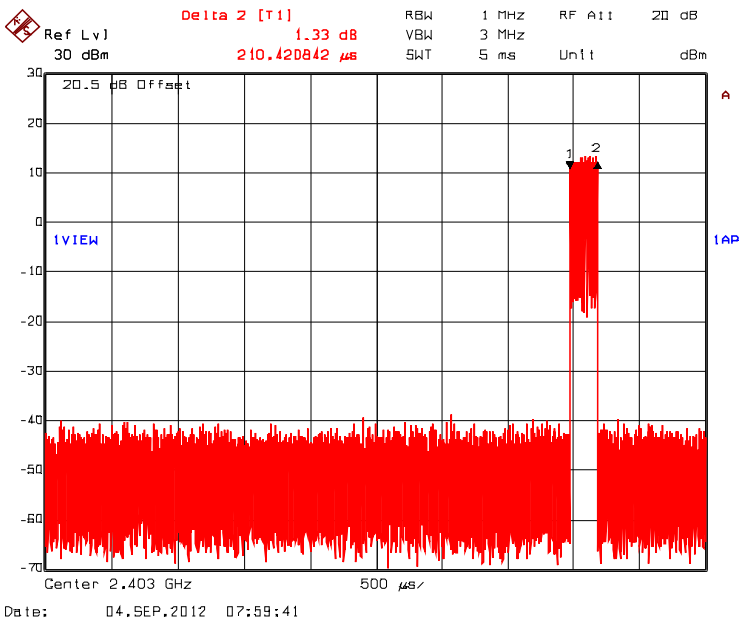


Average time of occupancy = (Dwell Time @ 2478 MHz) x (number of hops within a period)
= 230.460922 µs x 15
= 3.46 ms

Plot 5.3.4.28. Time of Occupancy, 2403 MHz, QPSK

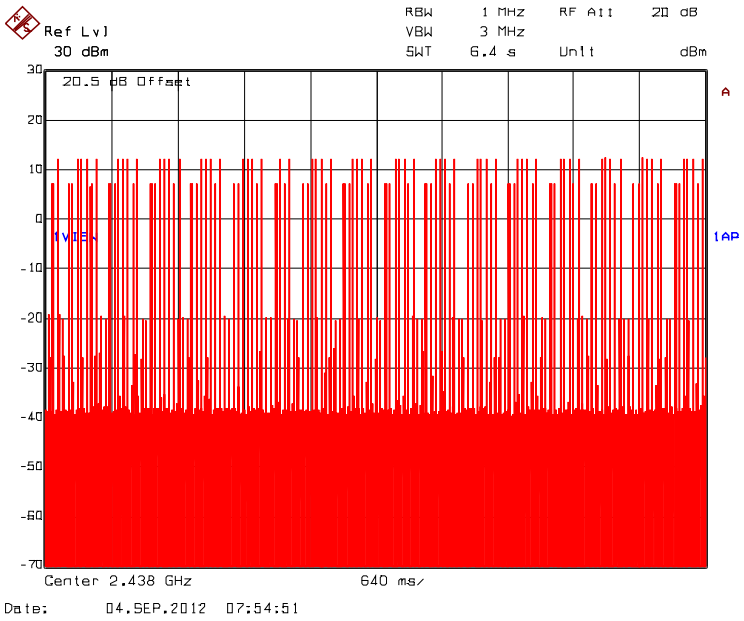


Plot 5.3.4.29. Time of Occupancy, 2403 MHz, QPSK, Dwell Time @ 2403 MHz = 210.420842 µs

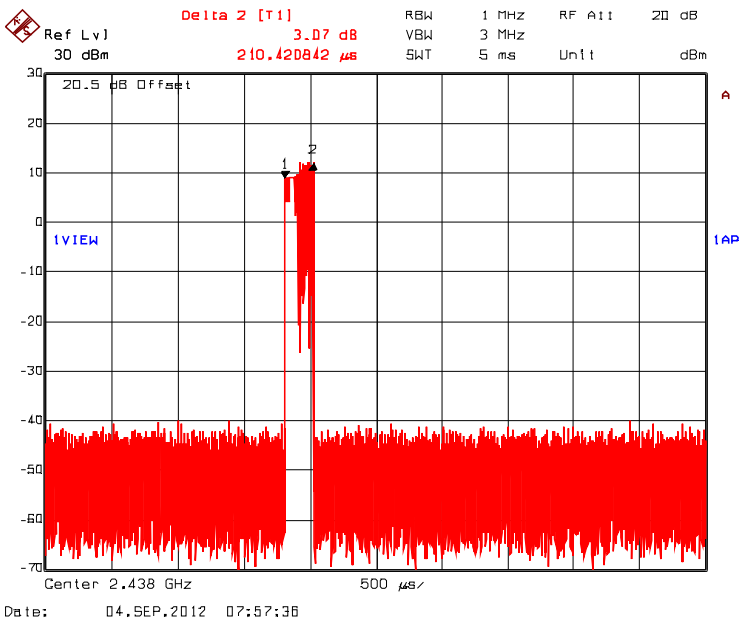


Average time of occupancy = (Dwell Time @ 2403 MHz) x (number of hops within a period)
= 210.420842 µs x 50
= 10.52 ms

Plot 5.3.4.30. Time of Occupancy, 2438 MHz, QPSK

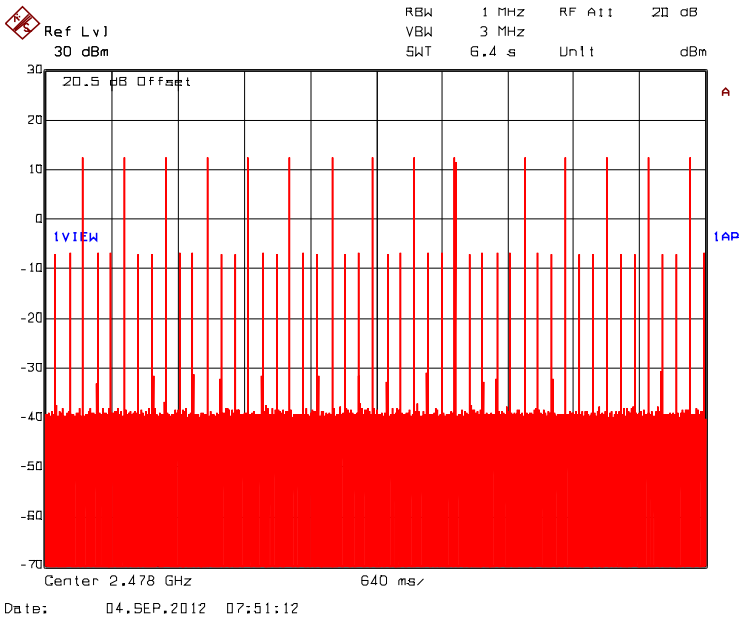


Plot 5.3.4.31. Time of Occupancy, 2438 MHz, QPSK, Dwell Time @ 2438 MHz = 210.420842 µs

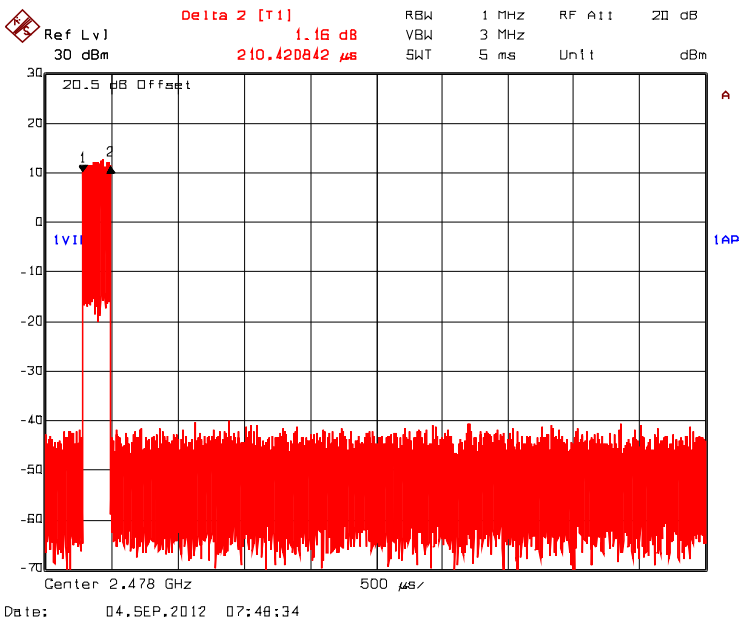


Average time of occupancy = (Dwell Time @ 2438 MHz) x (number of hops within a period)
= 210.420842 µs x 61
= 12.84 ms

Plot 5.3.4.32. Time of Occupancy, 2478 MHz, QPSK



Plot 5.3.4.33. Time of Occupancy, 2478 MHz, QPSK, Dwell Time @ 2478 MHz = 210.420842 µs



Average time of occupancy = (Dwell Time @ 2478 MHz) x (number of hops within a period)
= 210.420842 µs x 15
= 3.16 ms

5.4. PEAK CONDUCTED OUTPUT POWER [§ 15.247(b)(2)]

5.4.1. Limit

§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.

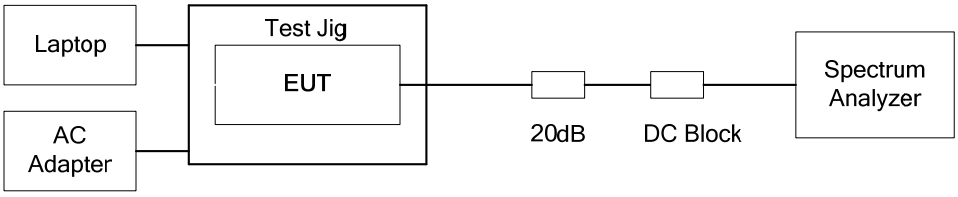
§15.247(b)(4): The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

§15.247(b)(4)(i): Systems operating in the 2400–2483.5 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

5.4.2. Method of Measurements

FCC Public Notice DA 00-705 and ANSI C63.10.

5.4.3. Test Arrangement



5.4.4. Test Data

Operating Mode	Frequency (MHz)	Peak Output Power at Antenna Terminal		Peak Output Power Limit	
		(dBm)	(mW)	(dBm)	(mW)
16-QAM, software power setting 8	2403	20.94	124.17	21	125
	2438	20.17	103.99	21	125
	2473	20.09	102.09	21	125
	2478	20.04	100.93	21	125
BPSK, software power setting 8	2403	18.91	77.80	21	125
	2438	18.32	67.92	21	125
	2473	18.21	66.22	21	125
	2478	18.20	66.07	21	125
QPSK, software power setting 8	2403	19.15	82.22	21	125
	2438	18.91	77.80	21	125
	2473	18.89	77.45	21	125
	2478	18.67	73.62	21	125

NOTE 1: Except as provided in NOTE 2, the EIRP shall not exceed 36 dBm for all proposed antennas.

NOTE 2: For fixed, point-to-point operation for all proposed antennas, the power shall be reduced as specified in §15.247(b)(4)(i).

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

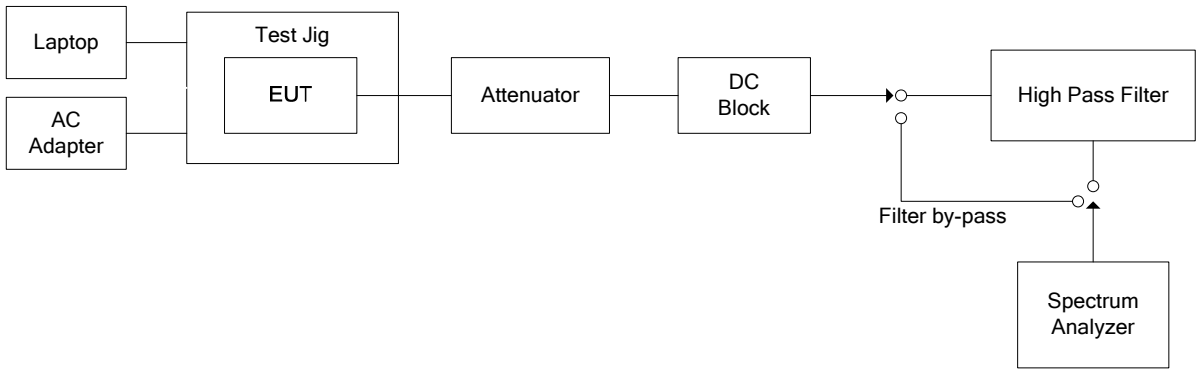
5.5.1. Limit

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

5.5.2. Method of Measurements

FCC Public Notice DA 00-705 and ANSI C63.10

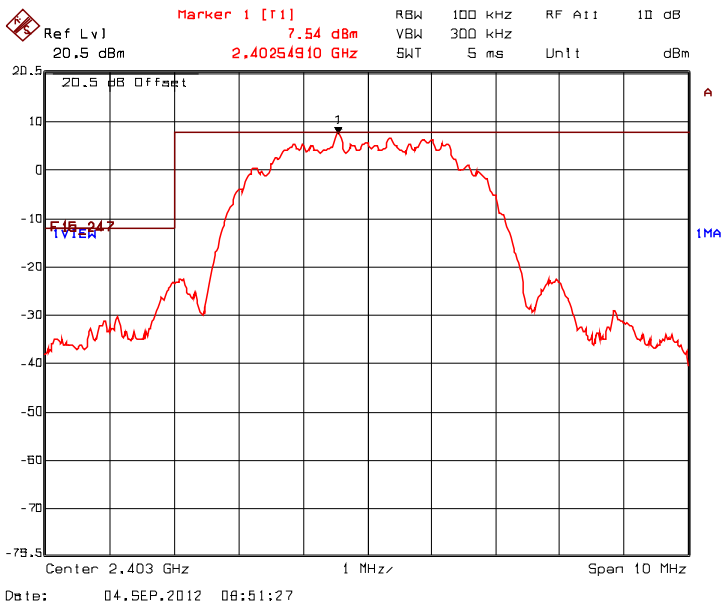
5.5.3. Test Arrangement



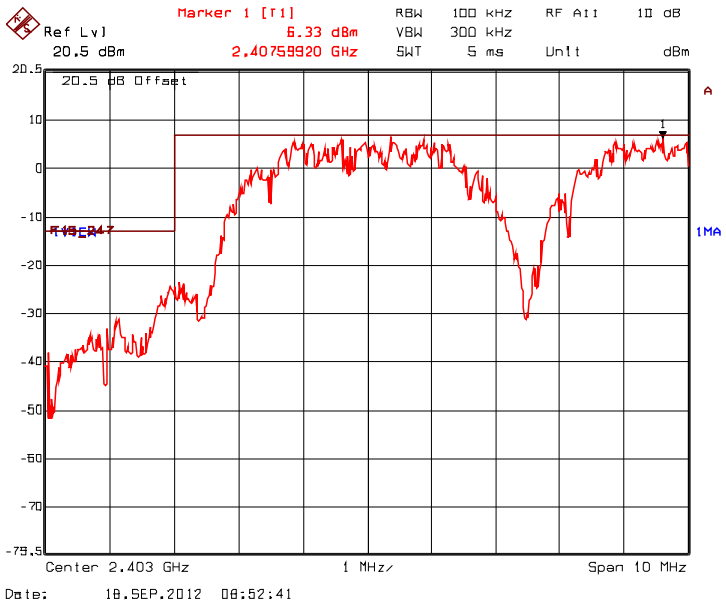
5.5.4. Test Data

5.5.4.1. Band-Edge RF Conducted Emissions

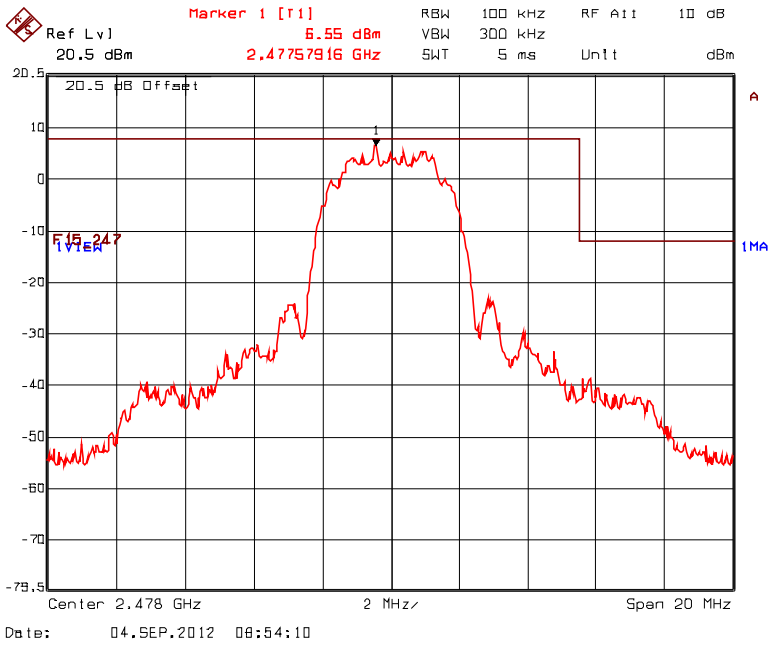
Plot 5.5.4.1.1. Band-Edge RF Conducted Emissions, Lower Band-edge, Single Frequency Mode, 16-QAM



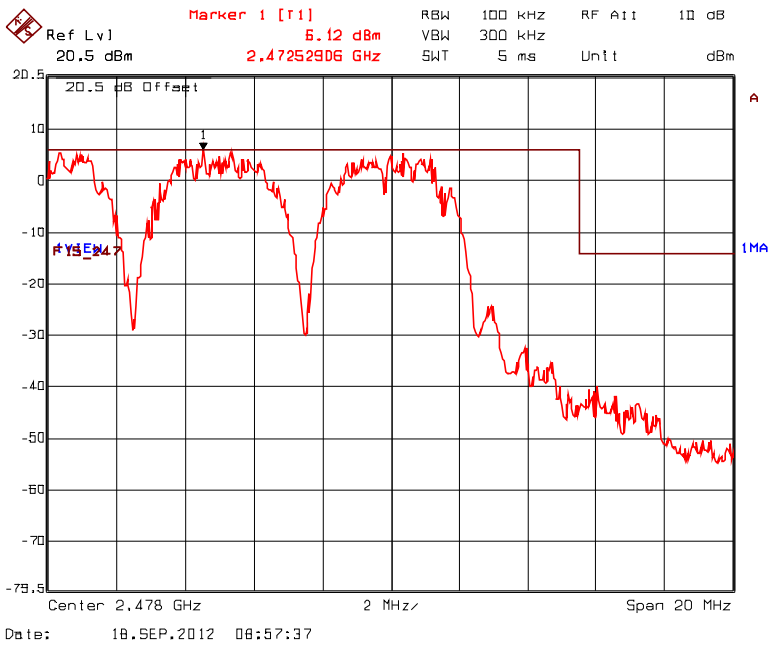
Plot 5.5.4.1.2. Band-Edge RF Conducted Emissions, Lower Band-edge, Hopping Mode, 16-QAM



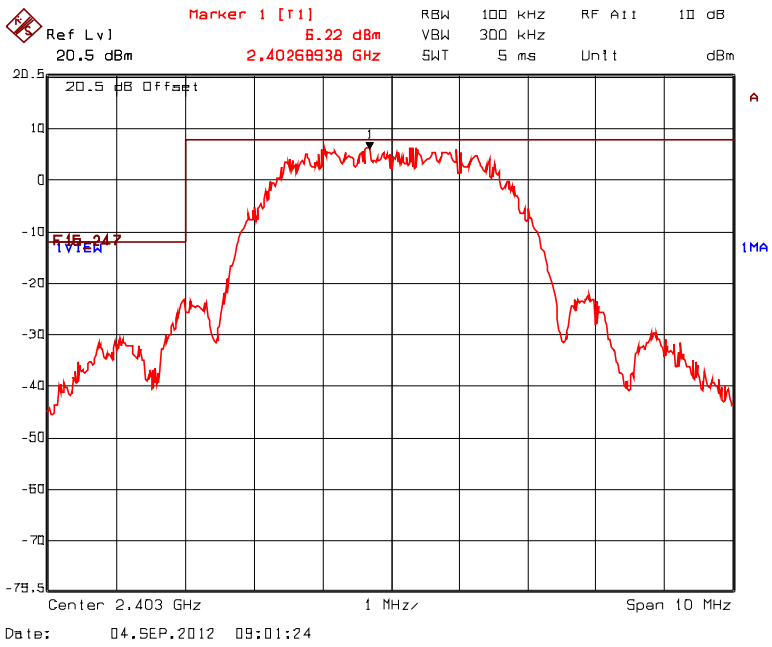
Plot 5.5.4.1.3. Band-Edge RF Conducted Emissions, Upper Band-edge, Single Frequency Mode, 16-QAM



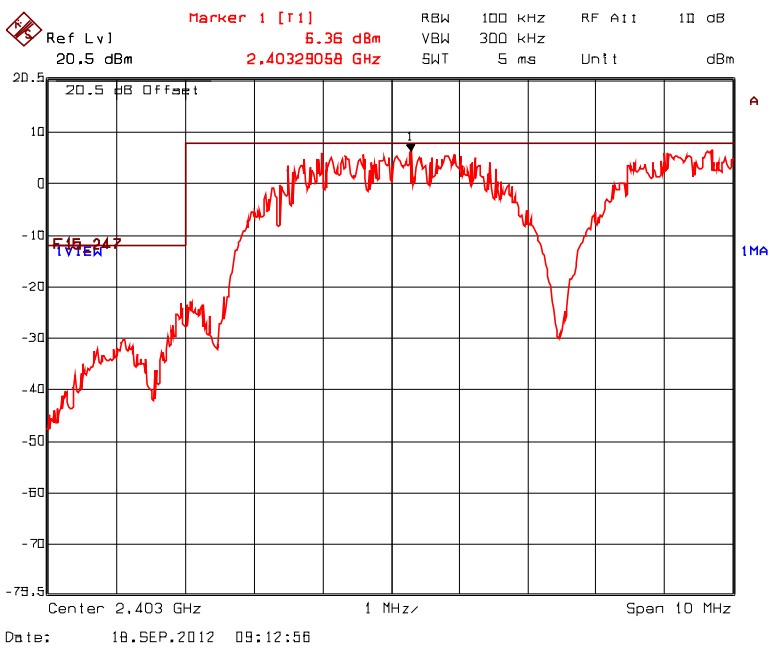
Plot 5.5.4.1.4. Band-Edge RF Conducted Emissions, Upper Band-edge, Hopping Mode, 16-QAM



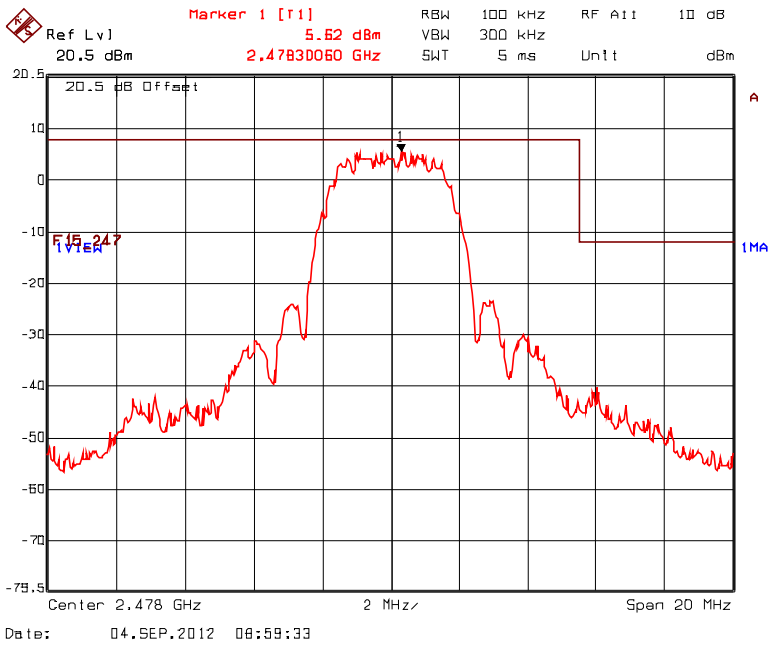
Plot 5.5.4.1.5. Band-Edge RF Conducted Emissions, Lower Band-edge, Single Frequency Mode, BPSK



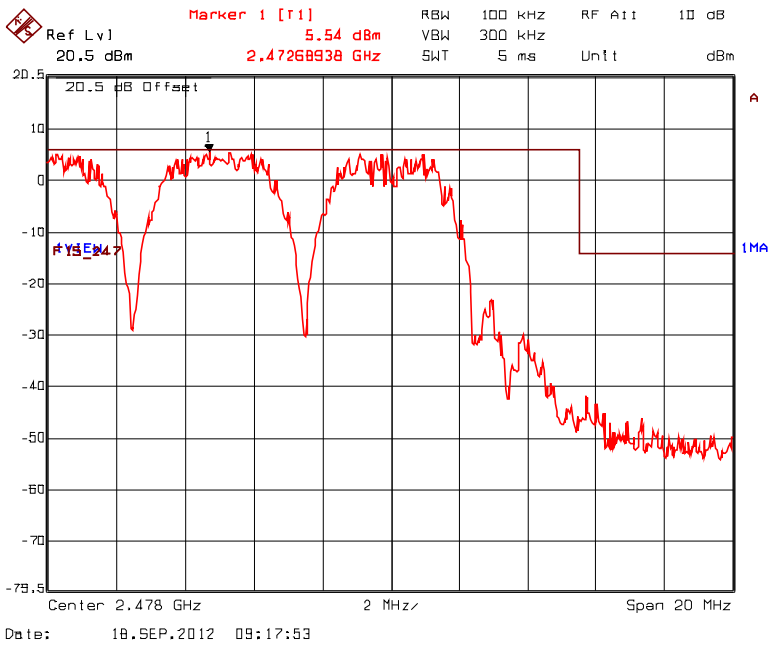
Plot 5.5.4.1.6. Band-Edge RF Conducted Emissions, Lower Band-edge, Hopping Mode, BPSK



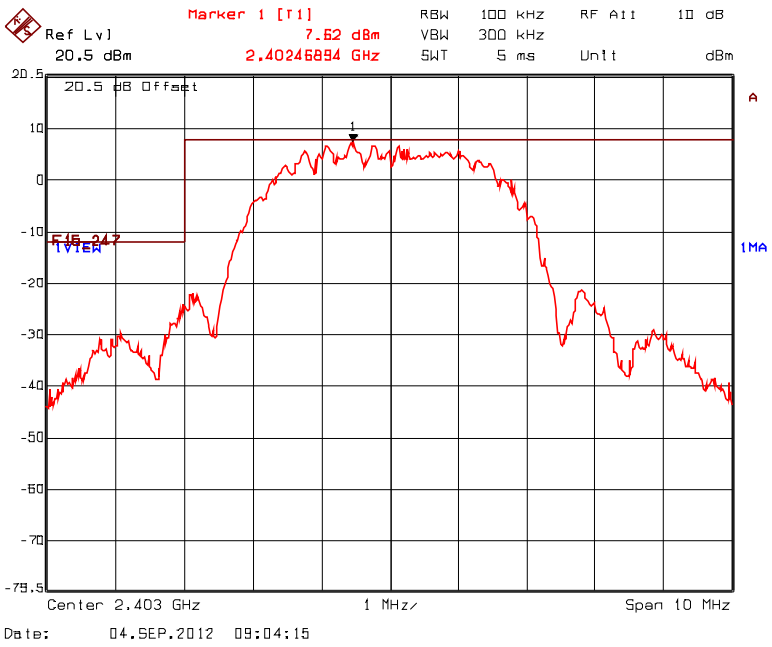
Plot 5.5.4.1.7. Band-Edge RF Conducted Emissions, Upper Band-edge, Single Frequency Mode, BPSK



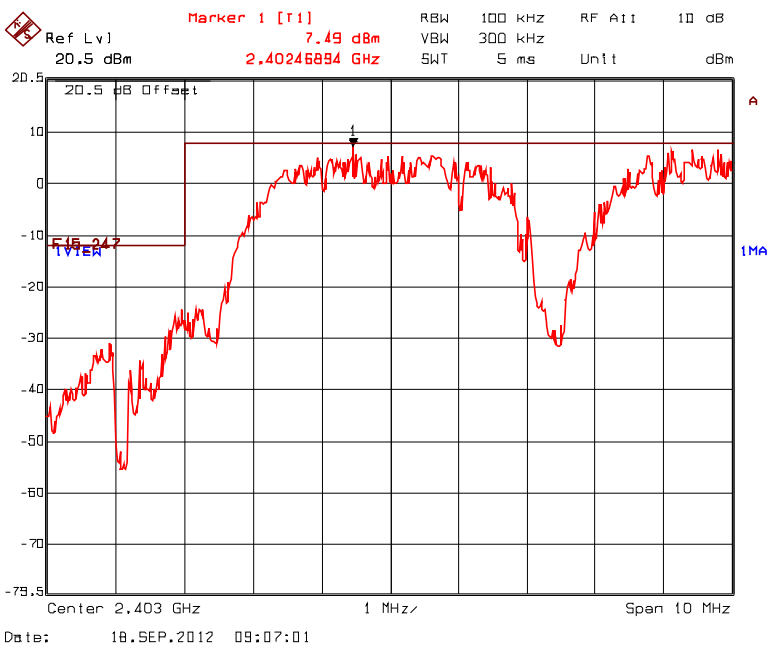
Plot 5.5.4.1.8. Band-Edge RF Conducted Emissions, Upper Band-edge, Hopping Mode, BPSK



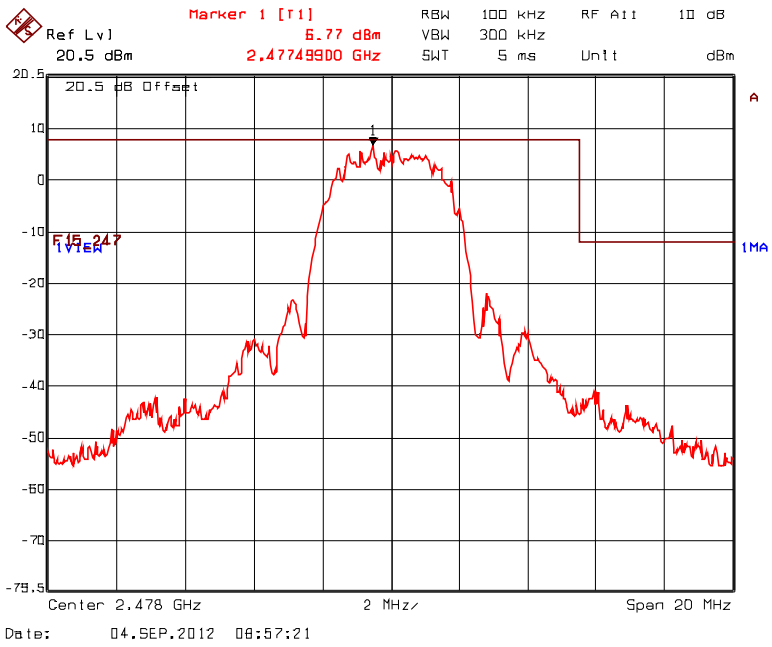
Plot 5.5.4.1.9. Band-Edge RF Conducted Emissions, Lower Band-edge, Single Frequency Mode, QPSK



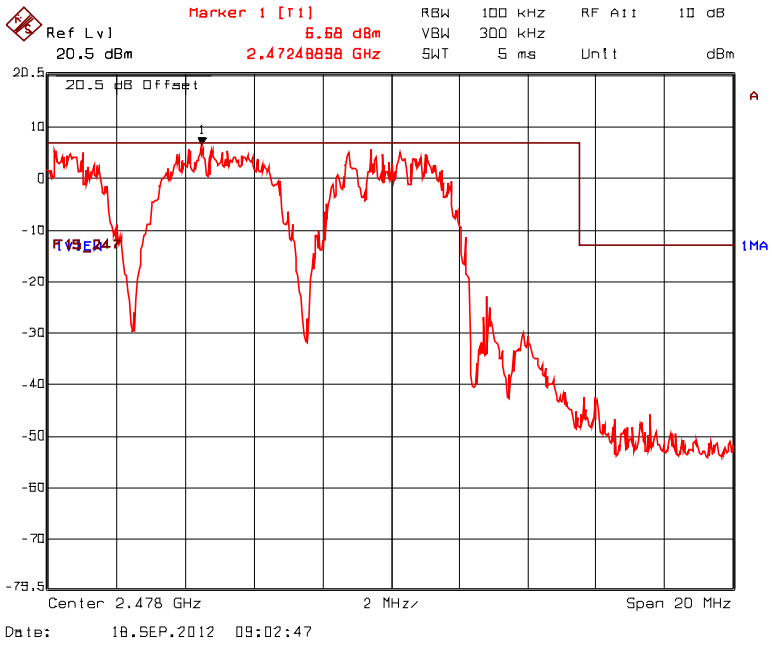
Plot 5.5.4.1.10. Band-Edge RF Conducted Emissions, Lower Band-edge, Hopping Mode, QPSK



Plot 5.5.4.1.11. Band-Edge RF Conducted Emissions, Upper Band-edge, Single Frequency Mode, QPSK



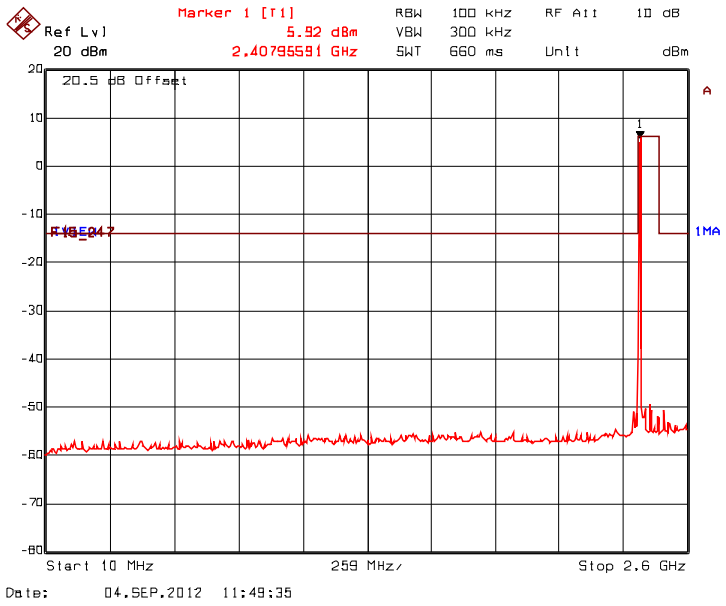
Plot 5.5.4.1.12. Band-Edge RF Conducted Emissions, Upper Band-edge, Hopping Mode, QPSK



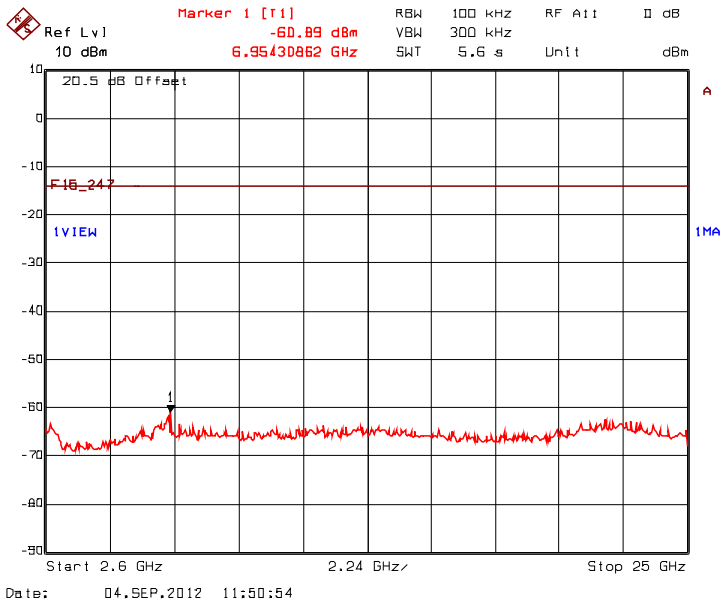
5.5.4.2. Spurious RF Conducted Emissions

Remark: The power output of signal from 16-QAM modulation has the highest power output, therefore it was selected as a final test configuration for worst-case.

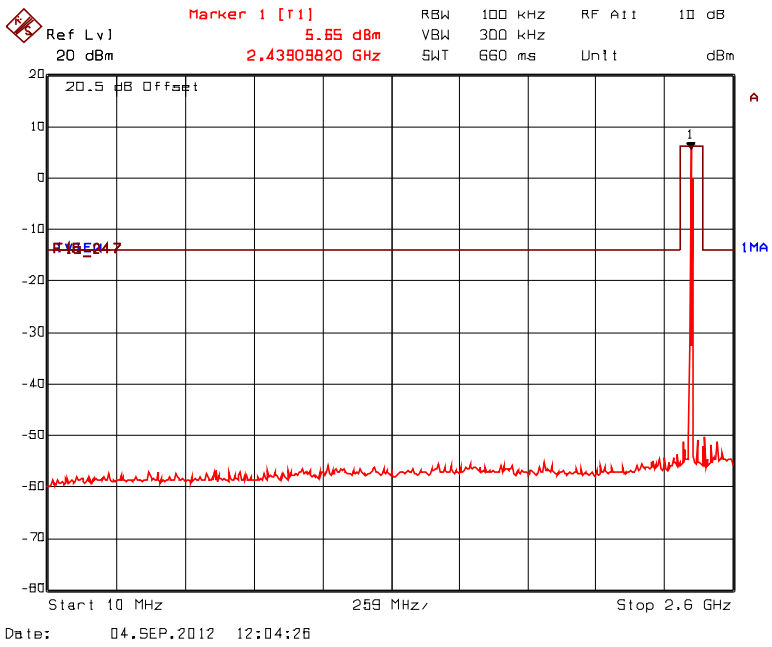
Plot 5.5.4.2.1. Spurious RF Conducted Emissions, 2403 MHz, 16-QAM, 10 MHz – 2.6 GHz



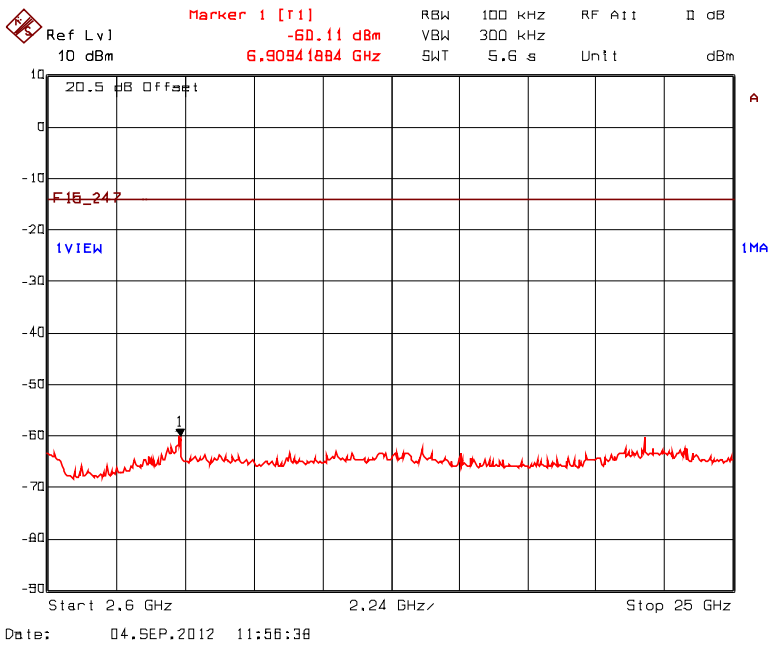
Plot 5.5.4.2.2. Spurious RF Conducted Emissions, 2403 MHz, 16-QAM, 2.6 GHz - 25 GHz



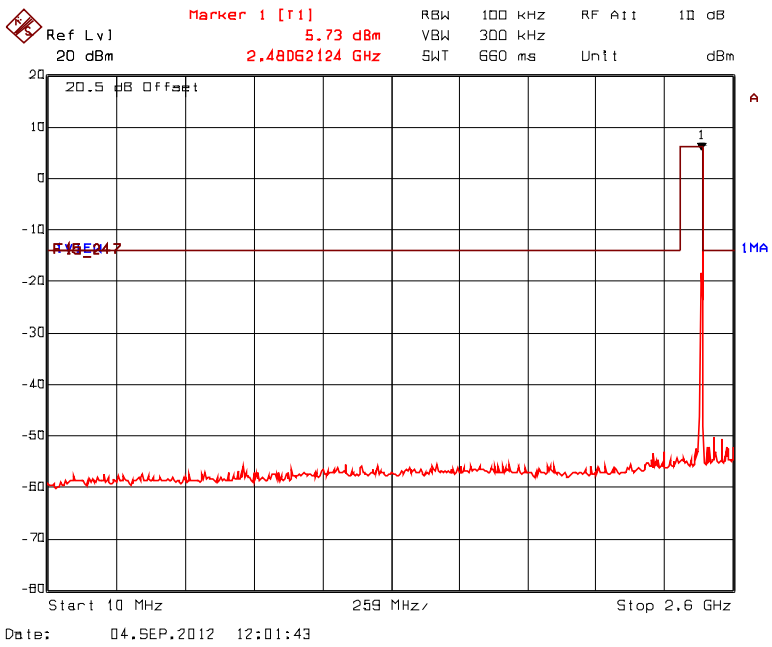
Plot 5.5.4.2.3. Spurious RF Conducted Emissions, 2438 MHz, 16-QAM, 10 MHz – 2.6 GHz



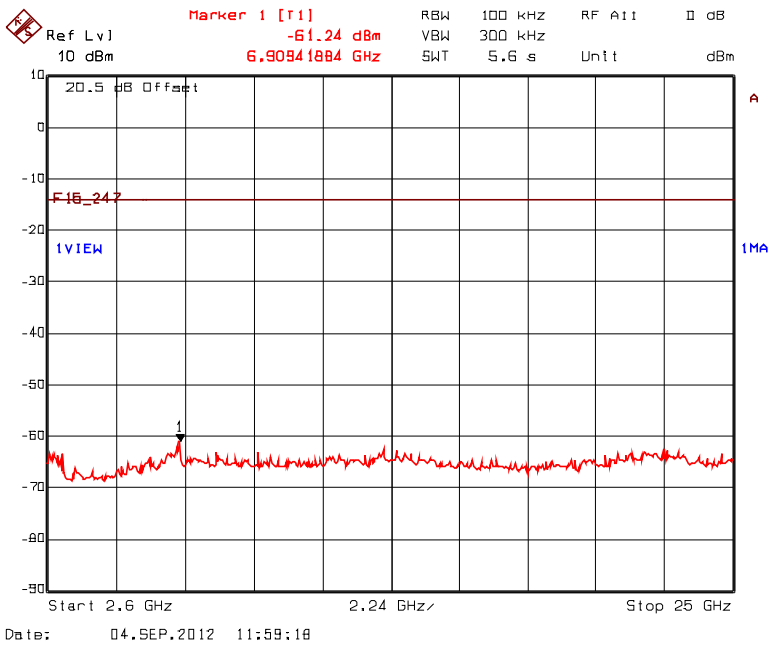
Plot 5.5.4.2.4. Spurious RF Conducted Emissions, 2438 MHz, 16-QAM, 2.6 GHz - 25 GHz



Plot 5.5.4.2.5. Spurious RF Conducted Emissions, 2478 MHz, 16-QAM, 10 MHz – 2.6 GHz



Plot 5.5.4.2.6. Spurious RF Conducted Emissions, 2478 MHz, 16-QAM, 2.6 GHz - 25 GHz



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

5.6.1. Limit

§ 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	2655–2900	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

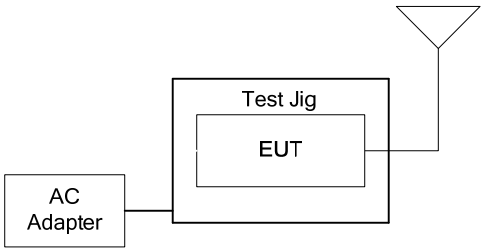
Section 15.209(a) - Field Strength Limits within Restricted Frequency Bands

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

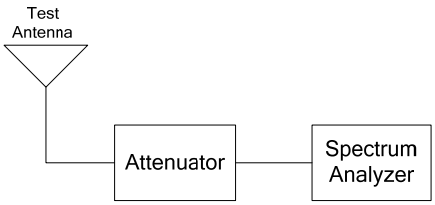
5.6.2. Method of Measurements

FCC Public Notice DA 00-705, ANSI C63.10 and ANSI 63.4 procedures.

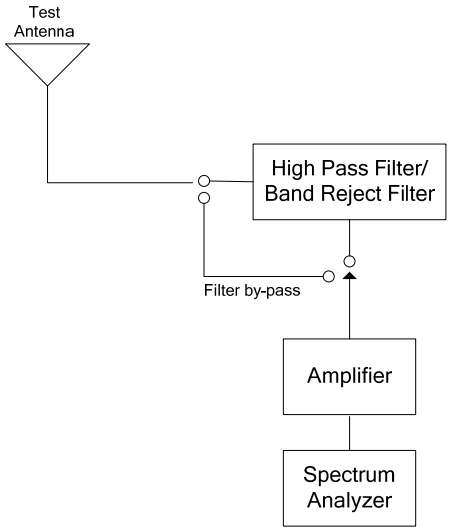
5.6.3. Test Arrangement



For Fundamental and Band-edge



For Spurious and Harmonics



5.6.4. Test Data

Remark(s):

- 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 with 16-QAM modulation.

5.6.4.1. EUT with 12 dBi Omni-directional Antenna and 1.31 dB Assembly Cable Loss

5.6.4.1.1. Spurious Radiated Emissions

Fundamental Frequency:	2403 MHz
Software Power Setting:	8
Frequency Test 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
2403	118.84	--	V	--	--	--	--
2403	118.61	--	H	--	--	--	--
4806	54.66	34.08	H	54.0	98.8	-19.9	Pass*
All other spurious emissions and harmonics are more than 20 dB below the applicable limit.							

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

Fundamental Frequency:	2438 MHz
Software Power Setting:	8
Frequency Test 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
2438	117.56	--	V	--	--	--	--
2438	117.32	--	H	--	--	--	--
30-25000	*	*	V/H	*	97.6	*	Pass
*All spurious emissions/harmonics are more than 20 dB below the applicable limit.							

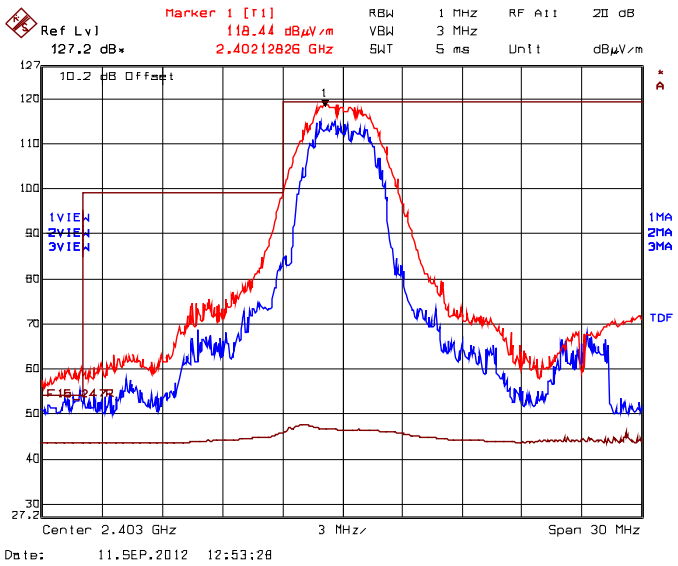
Fundamental Frequency:	2478 MHz
Software Power Setting:	8
Frequency Test Range:	30 MHz – 25 GHz

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
2478	117.12	--	V	--	--	--	--
2478	116.74	--	H	--	--	--	--
30-25000	*	*	V/H	*	97.1	*	Pass

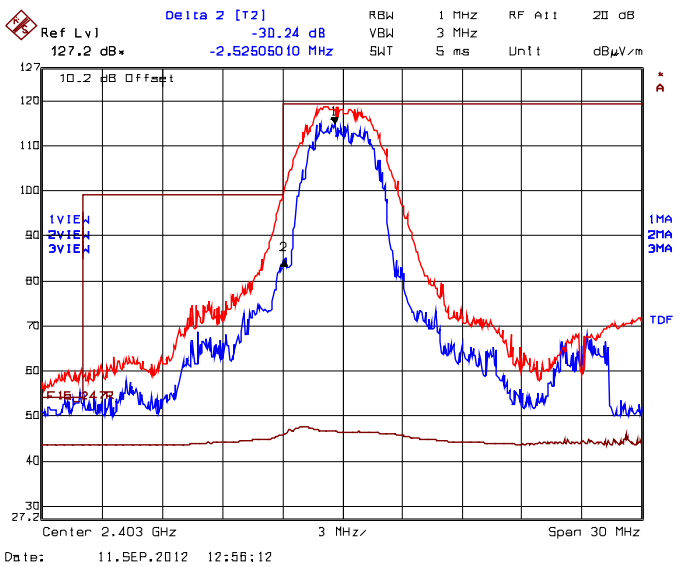
*All spurious emissions/harmonics are more than 20 dB below the applicable limit.

5.6.4.1.2. Band-Edge RF Radiated Emissions

Plot 5.6.4.1.2.1. Band-Edge RF Radiated Emissions at 3 m, Horizontal Polarization
Lower Band-edge, 2403 MHz, Power Setting 8, 16-QAM

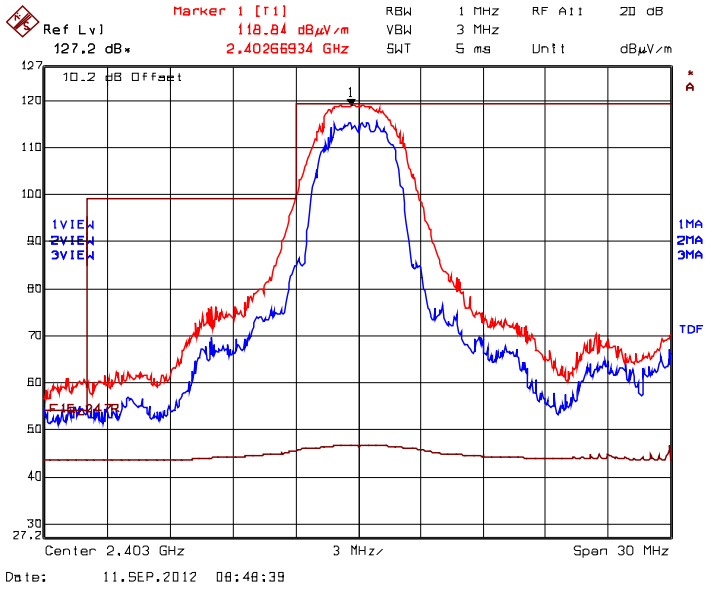


Plot 5.6.4.1.2.2. Band-Edge RF Radiated Emissions at 3 m, Horizontal Polarization
Lower Band-edge, 2403 MHz, Power Setting 8, 16-QAM

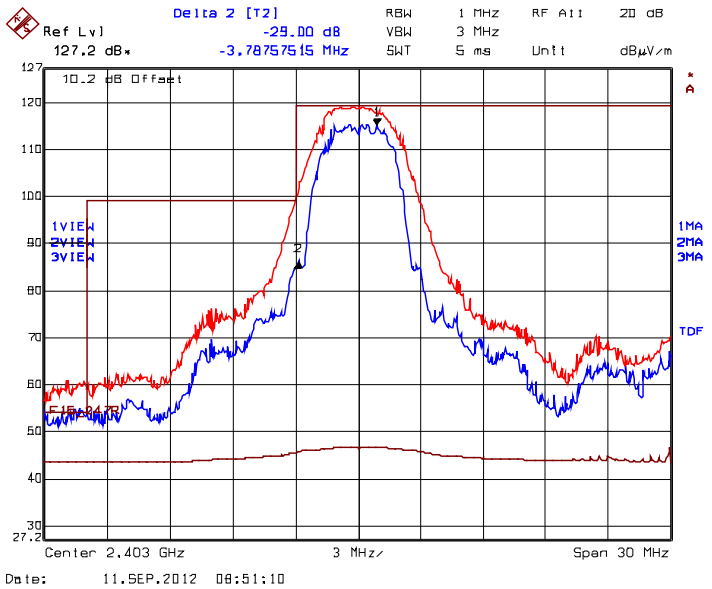


Trace 1: RBW = 1 MHz, VBW = 3 MHz
Trace 2: RBW = 300 kHz, VBW = 1 MHz, Delta (Peak to Band-Edge): 30.24 dB
Trace 3: RBW = 1 MHz, VBW = 10 Hz
Peak Band-Edge at 2400 MHz: Peak = 118.44 dBµV/m – 30.24 dB = 88.20 dBµV/m (limit 98.44 dBµV/m)

Plot 5.6.4.1.2.3. Band-Edge RF Radiated Emissions at 3 m, Vertical Polarization
Lower Band-edge, 2403 MHz, Power Setting 8, 16-QAM

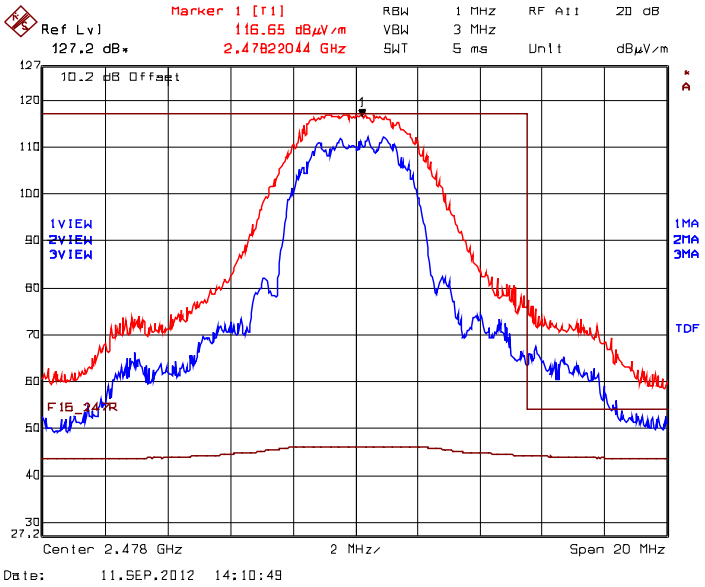


Plot 5.6.4.1.2.4. Band-Edge RF Radiated Emissions at 3 m, Vertical Polarization
Lower Band-edge, 2403 MHz, Power Setting 8, 16-QAM

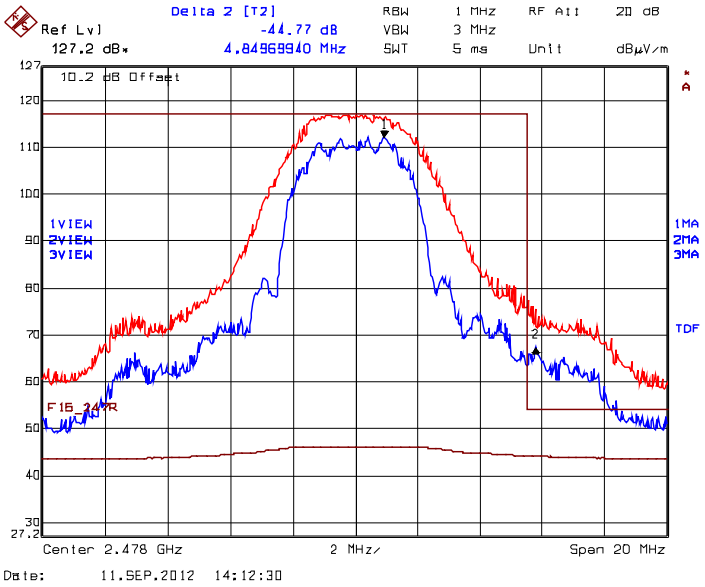


Trace 1: RBW = 1 MHz, VBW = 3 MHz
Trace 2: RBW = 300 kHz, VBW = 1 MHz, Delta (Peak to Band-Edge): 29.00 dB
Trace 3: RBW = 1 MHz, VBW = 10 Hz
Peak Band-Edge at 2400 MHz: Peak = 118.84 dBµV/m – 29.00 dB = 89.84 dBµV/m (limit 98.84 dBµV/m)

Plot 5.6.4.1.2.5. Band-Edge RF Radiated Emissions at 3 m, Horizontal Polarization
Upper Band-edge, 2478 MHz, Power Setting 8, 16-QAM

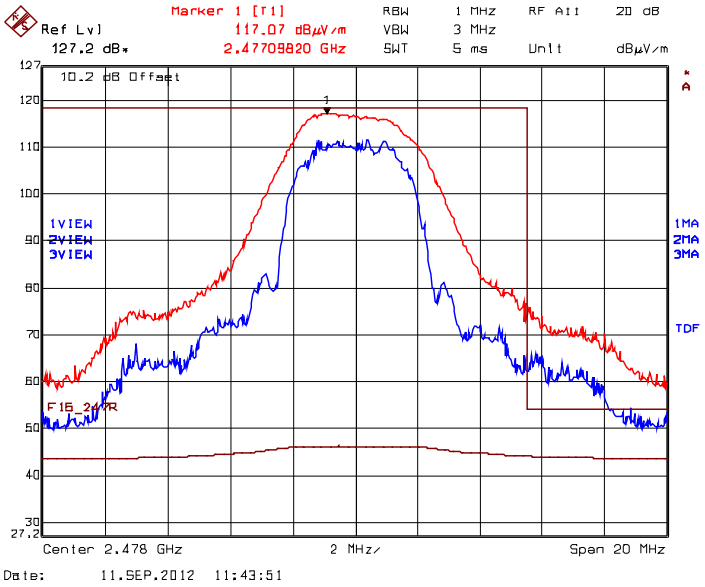


Plot 5.6.4.1.2.6. Band-Edge RF Radiated Emissions at 3 m, Horizontal Polarization
Upper Band-edge, 2478 MHz, Power Setting 8, 16-QAM

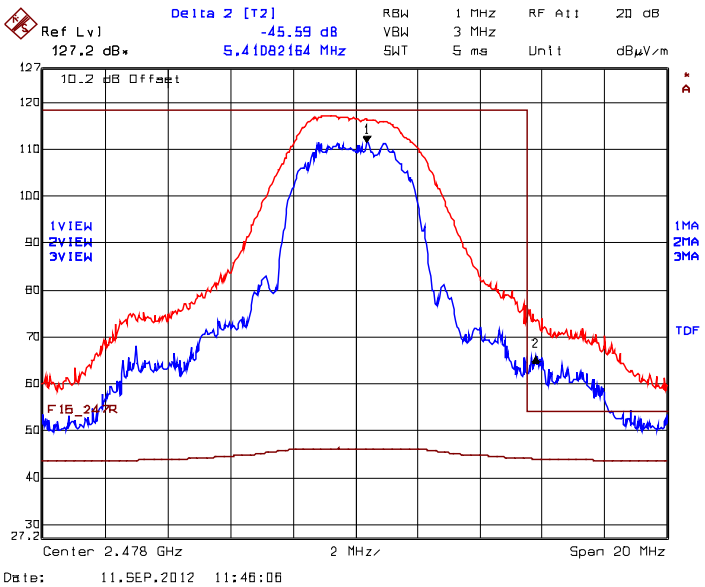


Trace 1: RBW = 1 MHz, VBW = 3 MHz
Trace 2: RBW = 200 kHz, VBW = 1 MHz, Delta (Peak to Band-Edge): 44.77 dB
Trace 3: RBW = 1 MHz, VBW = 10 Hz
Peak Band-Edge at 2483.5 MHz: Peak = 116.65 dBµV/m – 44.77dB= 71.88 dBµV/m (limit 74 dBµV/m)

Plot 5.6.4.1.2.7. Band-Edge RF Radiated Emissions at 3 m, Vertical Polarization
Upper Band-edge, 2478 MHz, Power Setting 8, 16-QAM

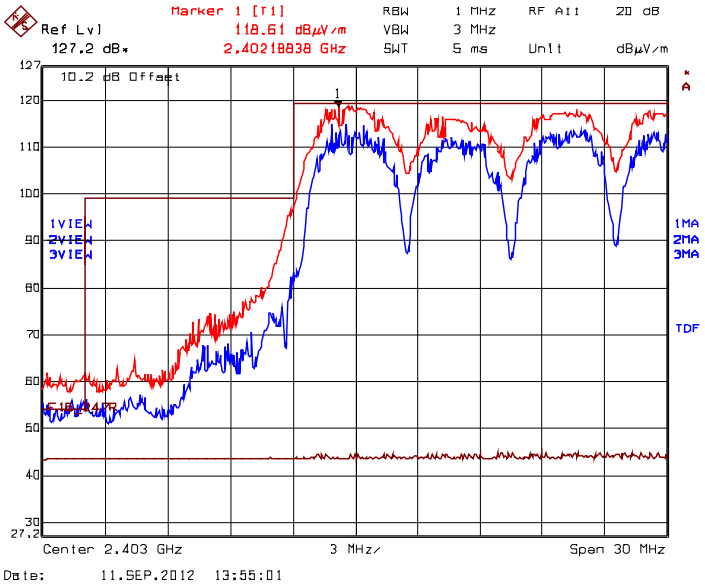


Plot 5.6.4.1.2.8. Band-Edge RF Radiated Emissions at 3 m, Vertical Polarization
Upper Band-edge, 2478 MHz, Power Setting 8, 16-QAM

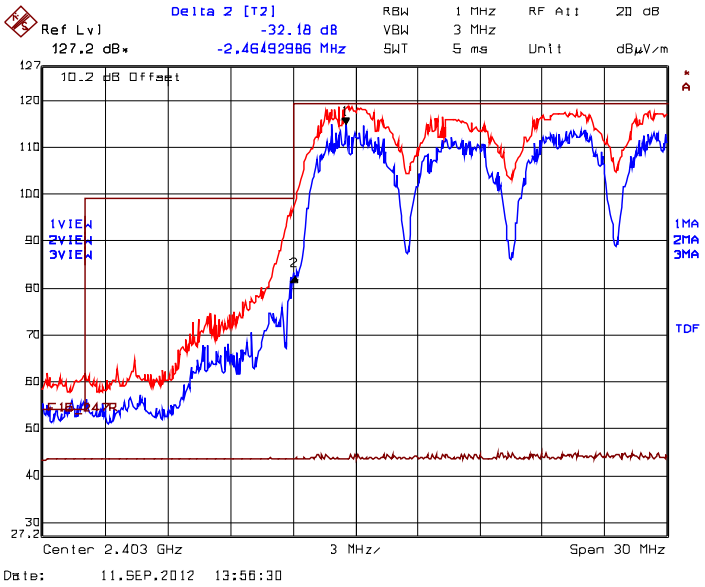


Trace 1: RBW = 1 MHz, VBW = 3 MHz
Trace 2: RBW = 200 kHz, VBW = 1 MHz, Delta (Peak to Band-Edge): 45.59 dB
Trace 3: RBW = 1 MHz, VBW = 10 Hz
Peak Band-Edge at 2483.5 MHz: Peak = 117.07 dBµV/m – 45.59 dB = 71.48 dBµV/m (limit 74 dBµV/m)

Plot 5.6.4.1.2.9. Band-Edge RF Radiated Emissions at 3 m, Horizontal Polarization
Lower Band-edge, Hopping Mode, Power Setting 8, 16-QAM

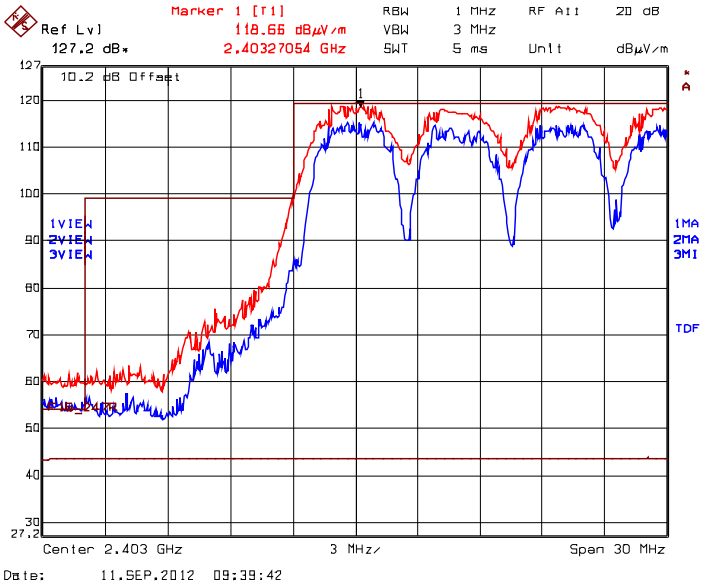


Plot 5.6.4.1.2.10. Band-Edge RF Radiated Emissions at 3 m, Horizontal Polarization
Lower Band-edge, Hopping Mode, Power Setting 8, 16-QAM

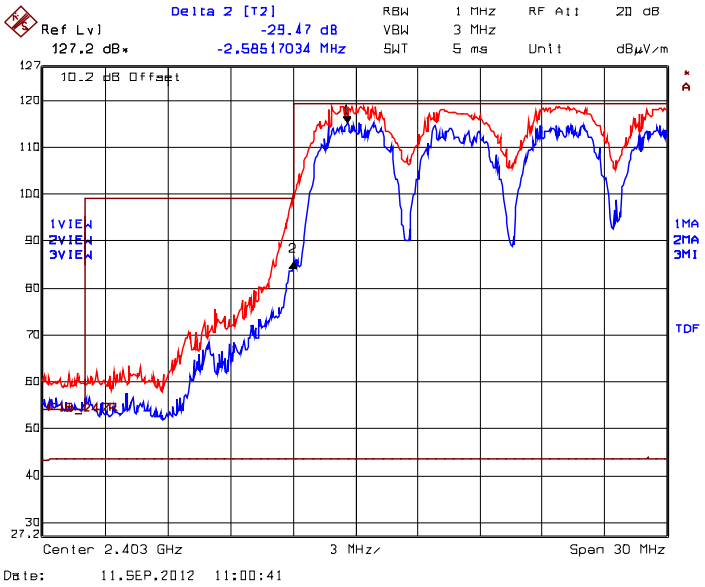


Trace 1: RBW = 1 MHz, VBW = 3 MHz
Trace 2: RBW = 300 kHz, VBW = 1 MHz, Delta (Peak to Band-Edge): 32.18 dB
Trace 3: RBW = 1 MHz, VBW = 10 Hz
Peak Band-Edge at 2400 MHz: Peak = 118.61dBµV/m – 32.18 dB = 86.43 dBµV/m (limit 98.61 dBµV/m)

Plot 5.6.4.1.2.11. Band-Edge RF Radiated Emissions at 3 m, Vertical Polarization
Lower Band-edge, Hopping Mode, Power Setting 8, 16-QAM

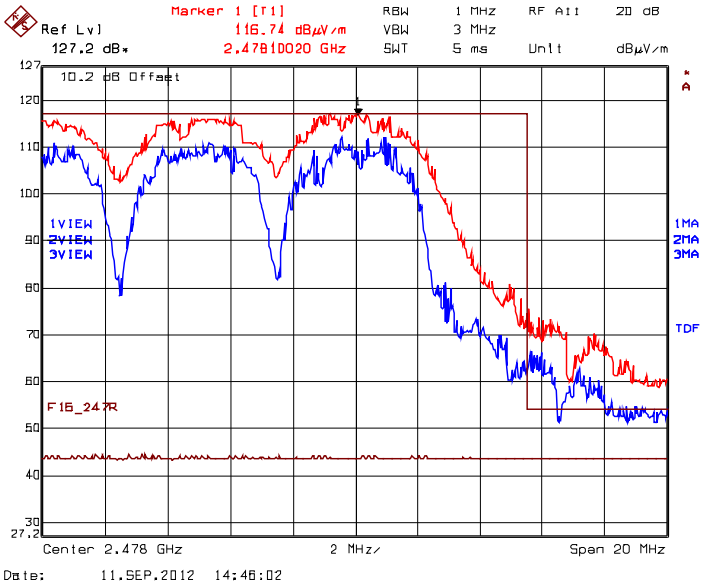


Plot 5.6.4.1.2.12. Band-Edge RF Radiated Emissions at 3 m, Vertical Polarization
Lower Band-edge, Hopping Mode, Power Setting 8, 16-QAM

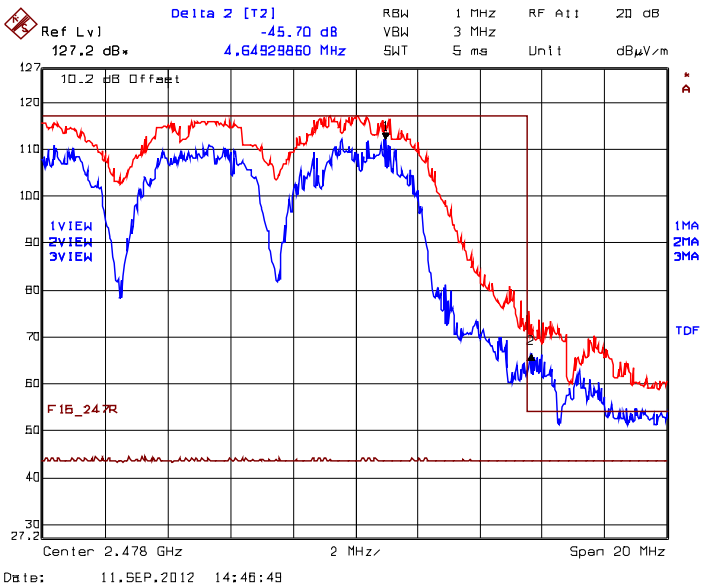


Trace 1: RBW = 1 MHz, VBW = 3 MHz
Trace 2: RBW = 300 kHz, VBW = 1 MHz, Delta (Peak to Band-Edge): 29.47 dB
Trace 3: RBW = 1 MHz, VBW = 10 Hz
Peak Band-Edge at 2400 MHz: Peak = 118.66 dBµV/m – 29.47dB = 89.19 dBµV/m (limit 98.66 dBµV/m)

Plot 5.6.4.1.2.13. Band-Edge RF Radiated Emissions at 3 m, Horizontal Polarization
Upper Band-edge, Hopping Mode, Power Setting 8, 16-QAM

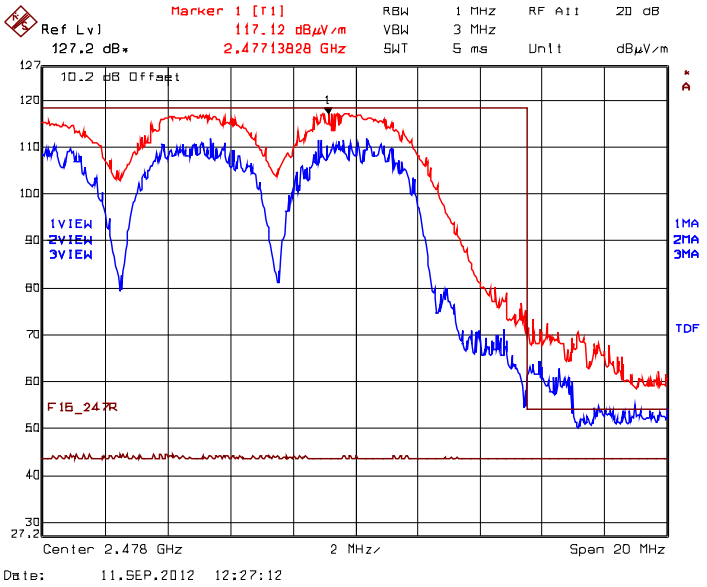


Plot 5.6.4.1.2.14. Band-Edge RF Radiated Emissions at 3 m, Horizontal Polarization
Upper Band-edge, Hopping Mode, Power Setting 8, 16-QAM

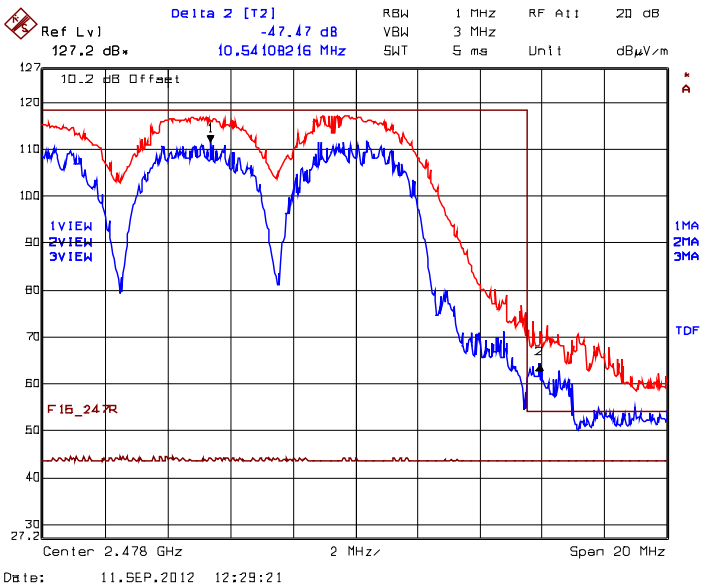


Trace 1: RBW = 1 MHz, VBW = 3 MHz
Trace 2: RBW = 200 kHz, VBW = 1 MHz, Delta (Peak to Band-Edge): 45.70 dB
Trace 3: RBW = 1 MHz, VBW = 10 Hz
Peak Band-Edge at 2483.5 MHz: Peak = 116.74 dBµV/m – 45.70 dB = 71.04 dBµV/m (limit 74 dBµV/m)

Plot 5.6.4.1.2.15. Band-Edge RF Radiated Emissions at 3 m, Vertical Polarization
Upper Band-edge, Hopping Mode, Power Setting 8, 16-QAM



Plot 5.6.4.1.2.16. Band-Edge RF Radiated Emissions at 3 m, Vertical Polarization
Upper Band-edge, Hopping Mode, Power Setting 8, 16-QAM



Trace 1: RBW = 1 MHz, VBW = 3 MHz
Trace 2: RBW = 200 kHz, VBW = 1 MHz, Delta (Peak to Band-Edge): 47.47 dB
Trace 3: RBW = 1 MHz, VBW = 10 Hz
Peak Band-Edge at 2483.5 MHz: Peak = 117.12 dBµV/m – 47.47 dB = 69.65 dBµV/m (limit 74 dBµV/m)

5.6.4.2. EUT with 20.5 dBi Panel Antenna and 2.31 dB Assembly Cable Loss

5.6.4.2.1. Spurious Radiated Emissions

Fundamental Frequency:	2403 MHz						
Software Power Setting:	8						
Frequency Test 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**
2403	126.98	--	V	--	--	--	--
2403	126.47	--	H	--	--	--	--
4806	53.78	34.06	V	54.0	107.0	-19.9	Pass*
4806	54.04	34.23	H	54.0	107.0	-19.8	Pass*
All other spurious emissions and harmonics are more than 20 dB below the applicable limit.							

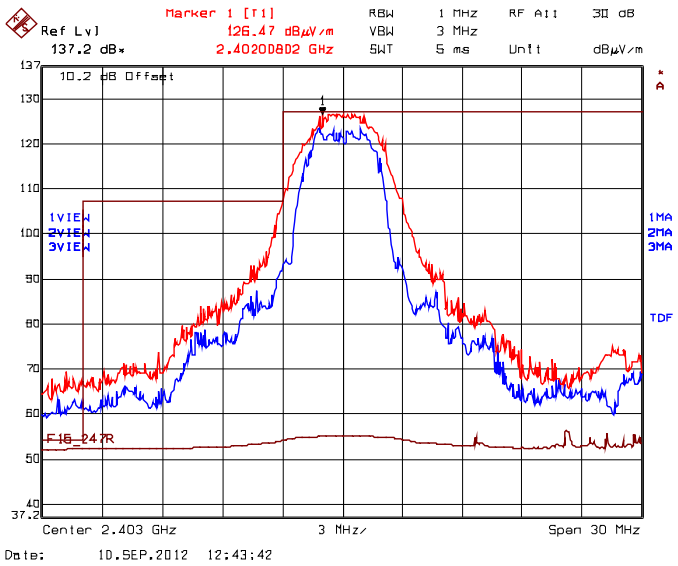
*Field strength of emissions appearing within restricted frequency bands shall not exceed the limits in § 15.209.

Fundamental Frequency:	2438 MHz						
Software Power Setting:	8						
Frequency Test 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**
2438	127.08	--	V	--	--	--	--
2438	125.47	--	H	--	--	--	--
30-25000	*	*	V/H	*	107.1	*	Pass
*All spurious emissions/harmonics are more than 20 dB below the applicable limit.							

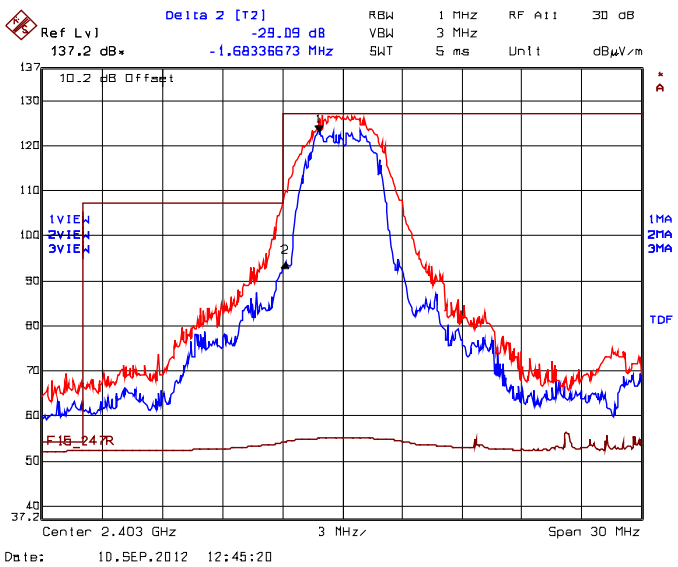
Fundamental Frequency:	2473 MHz						
Software Power Setting:	8						
Frequency Test Range:	30 MHz – 25 GHz						
Frequency (MHz)	**RF Peak Level (dBµV/m)**	**RF Avg Level (dBµV/m)**	**Antenna Plane (H/V)**	**Limit 15.209 (dBµV/m)**	**Limit 15.247 (dBµV/m)**	**Margin (dB)**	**Pass/ Fail**
2473	127.11	--	V	--	--	--	--
2473	125.35	--	H	--	--	--	--
30-25000	*	*	V/H	*	107.1	*	Pass
*All spurious emissions/harmonics are more than 20 dB below the applicable limit.							

5.6.4.2.2. Band-Edge RF Radiated Emissions

Plot 5.6.4.2.2.1. Band-Edge RF Radiated Emissions at 3 m, Horizontal Polarization
Lower Band-edge, 2403 MHz, Power Setting 8, 16-QAM

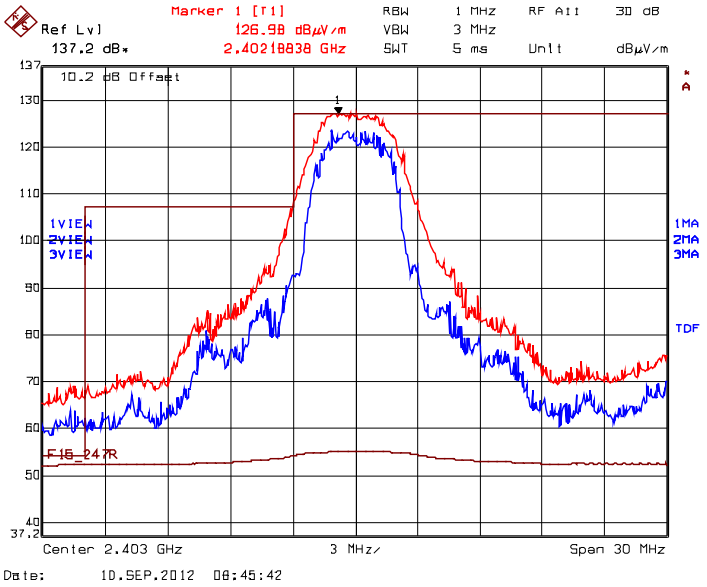


Plot 5.6.4.2.2.2. Band-Edge RF Radiated Emissions at 3 m, Horizontal Polarization
Lower Band-edge, 2403 MHz, Power Setting 8, 16-QAM

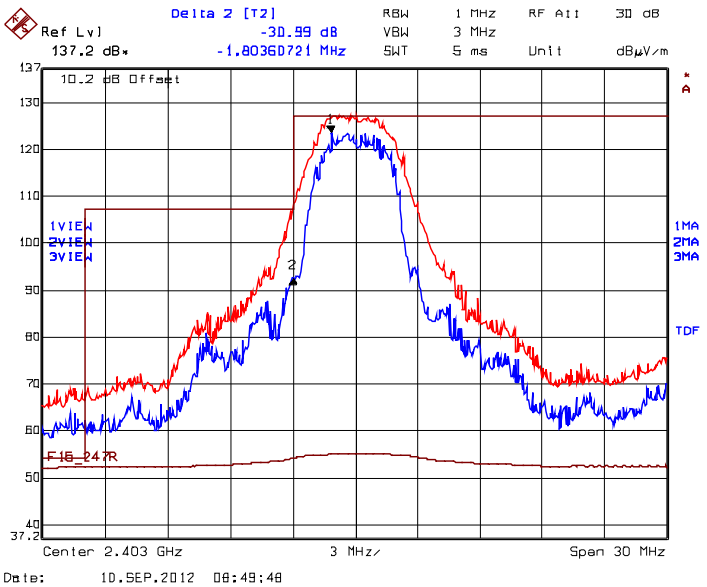


Trace 1: RBW = 1 MHz, VBW = 3 MHz
Trace 2: RBW = 300 kHz, VBW = 1 MHz, Delta (Peak to Band-Edge): 29.09 dB
Trace 3: RBW = 1 MHz, VBW = 10 Hz
Peak Band-Edge at 2400 MHz: Peak = 126.47 dBµV/m – 29.09 dB = 97.38 dBµV/m (limit 106.47 dBµV/m)

Plot 5.6.4.2.2.3. Band-Edge RF Radiated Emissions at 3 m, Vertical Polarization
Lower Band-edge, 2403 MHz, Power Setting 8, 16-QAM

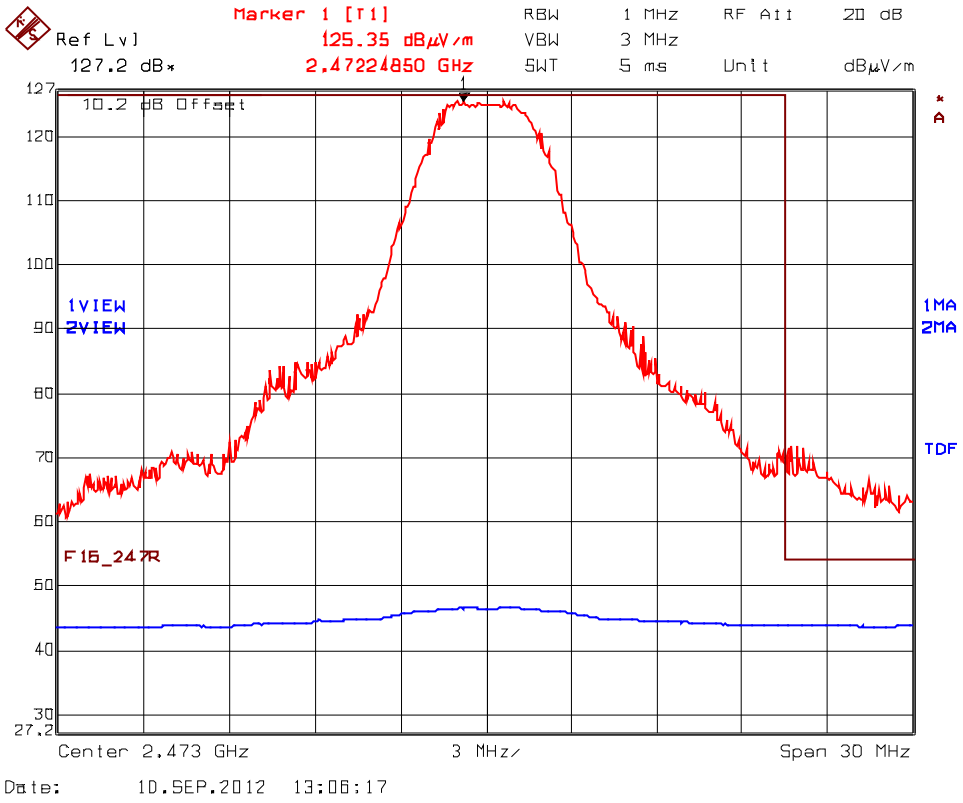


Plot 5.6.4.2.2.4. Band-Edge RF Radiated Emissions at 3 m, Vertical Polarization
Lower Band-edge, 2403 MHz, Power Setting 8, 16-QAM



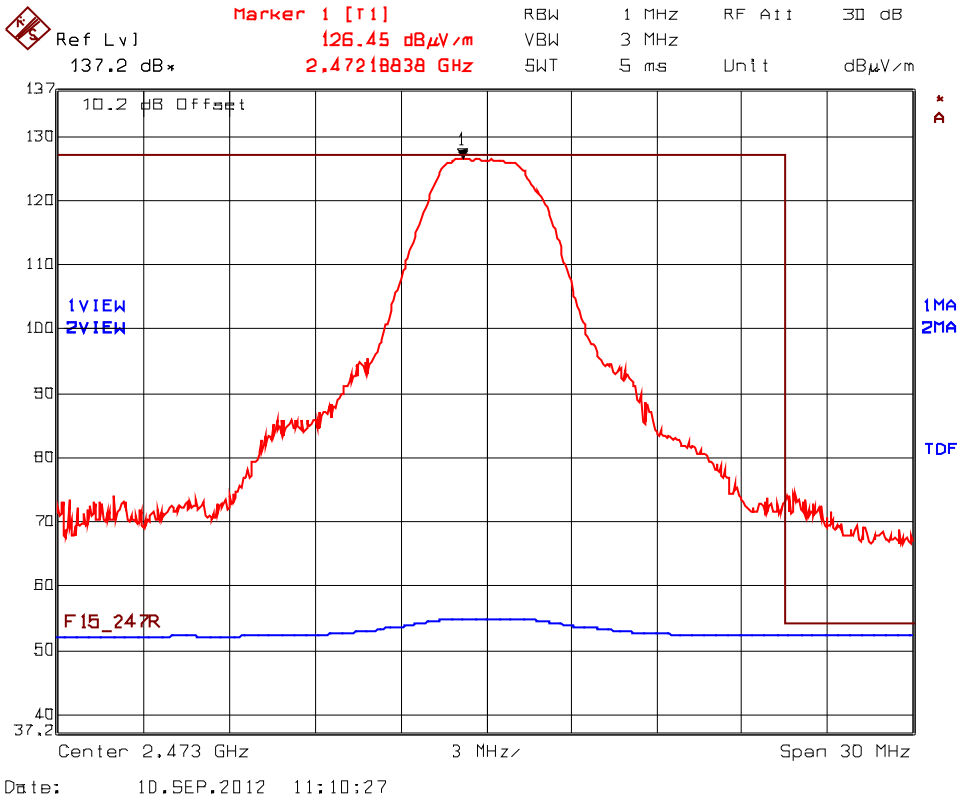
Trace 1: RBW = 1 MHz, VBW = 3 MHz
Trace 2: RBW = 300 kHz, VBW = 1 MHz, Delta (Peak to Band-Edge): 30.99 dB
Trace 3: RBW = 1 MHz, VBW = 10 Hz
Peak Band-Edge at 2400 MHz: Peak = 126.98 dBµV/m – 30.99 dB = 95.99 dBµV/m (limit 106.98 dBµV/m)

Plot 5.6.4.2.2.5. Band-Edge RF Radiated Emissions at 3 m, Horizontal Polarization
Upper Band-edge, 2473 MHz, Power Setting 8, 16-QAM



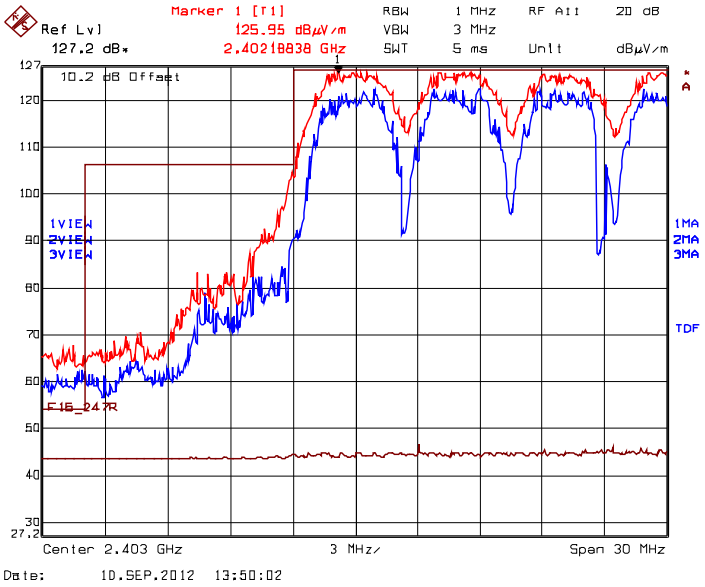
Trace 1: RBW = 1 MHz, VBW = 3 MHz
Trace 2: RBW = 1 MHz, VBW = 10 Hz

Plot 5.6.4.2.2.6. Band-Edge RF Radiated Emissions at 3 m, Vertical Polarization
Upper Band-edge, 2473 MHz, Power Setting 8, 16-QAM

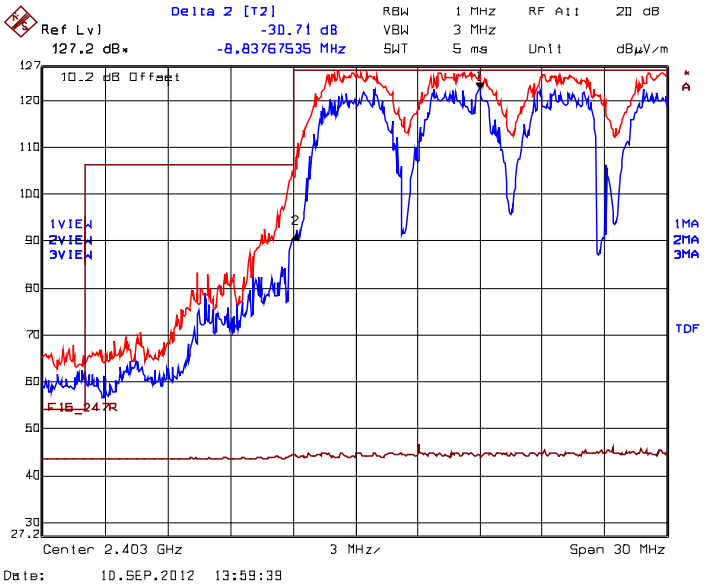


Trace 1: RBW = 1 MHz, VBW = 3 MHz
Trace 2: RBW = 1 MHz, VBW = 10 Hz

Plot 5.6.4.2.2.7. Band-Edge RF Radiated Emissions at 3 m, Horizontal Polarization
Lower Band-edge, Hopping Mode, Power Setting 8, 16-QAM

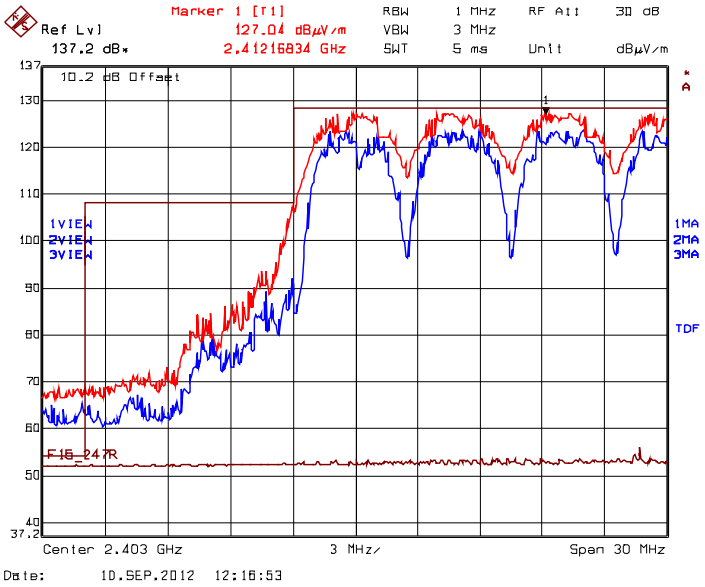


Plot 5.6.4.2.2.8. Band-Edge RF Radiated Emissions at 3 m, Horizontal Polarization
Lower Band-edge, Hopping Mode, Power Setting 8, 16-QAM

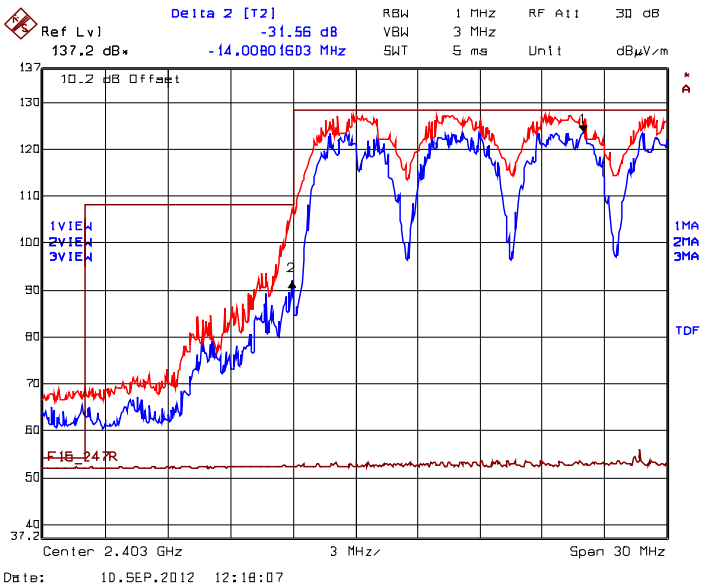


Trace 1: RBW = 1 MHz, VBW = 3 MHz
Trace 2: RBW = 300 kHz, VBW = 1 MHz, Delta (Peak to Band-Edge): 30.71 dB
Trace 3: RBW = 1 MHz, VBW = 10 Hz
Peak Band-Edge at 2400 MHz: Peak = 125.95 dBµV/m – 30.71 dB = 95.24 dBµV/m (limit 105.95 dBµV/m)

Plot 5.6.4.2.2.9. Band-Edge RF Radiated Emissions at 3 m, Vertical Polarization
Lower Band-edge, Hopping Mode, Power Setting 8, 16-QAM

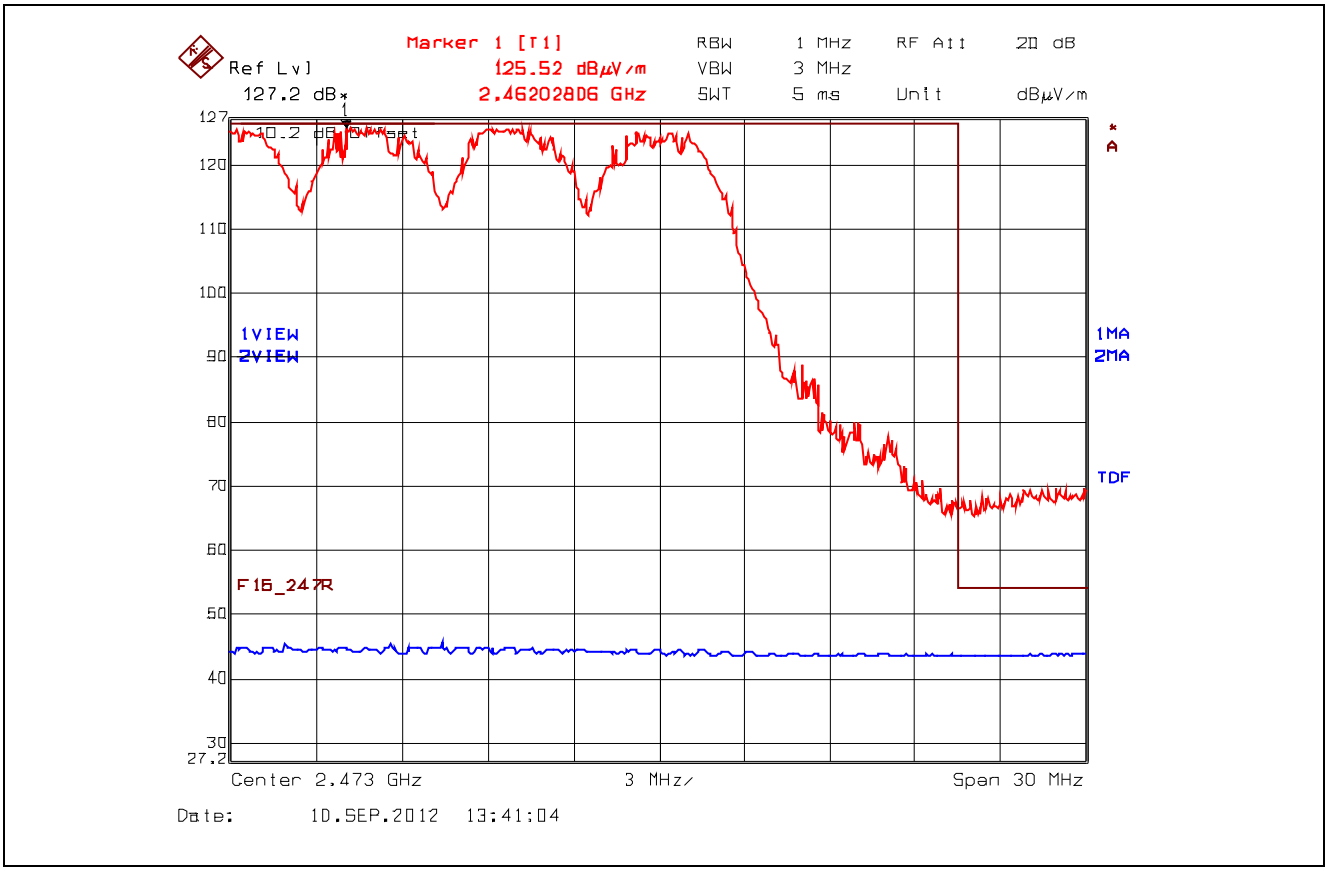


Plot 5.6.4.2.2.10. Band-Edge RF Radiated Emissions at 3 m, Vertical Polarization
Lower Band-edge, Hopping Mode, Power Setting 8, 16-QAM



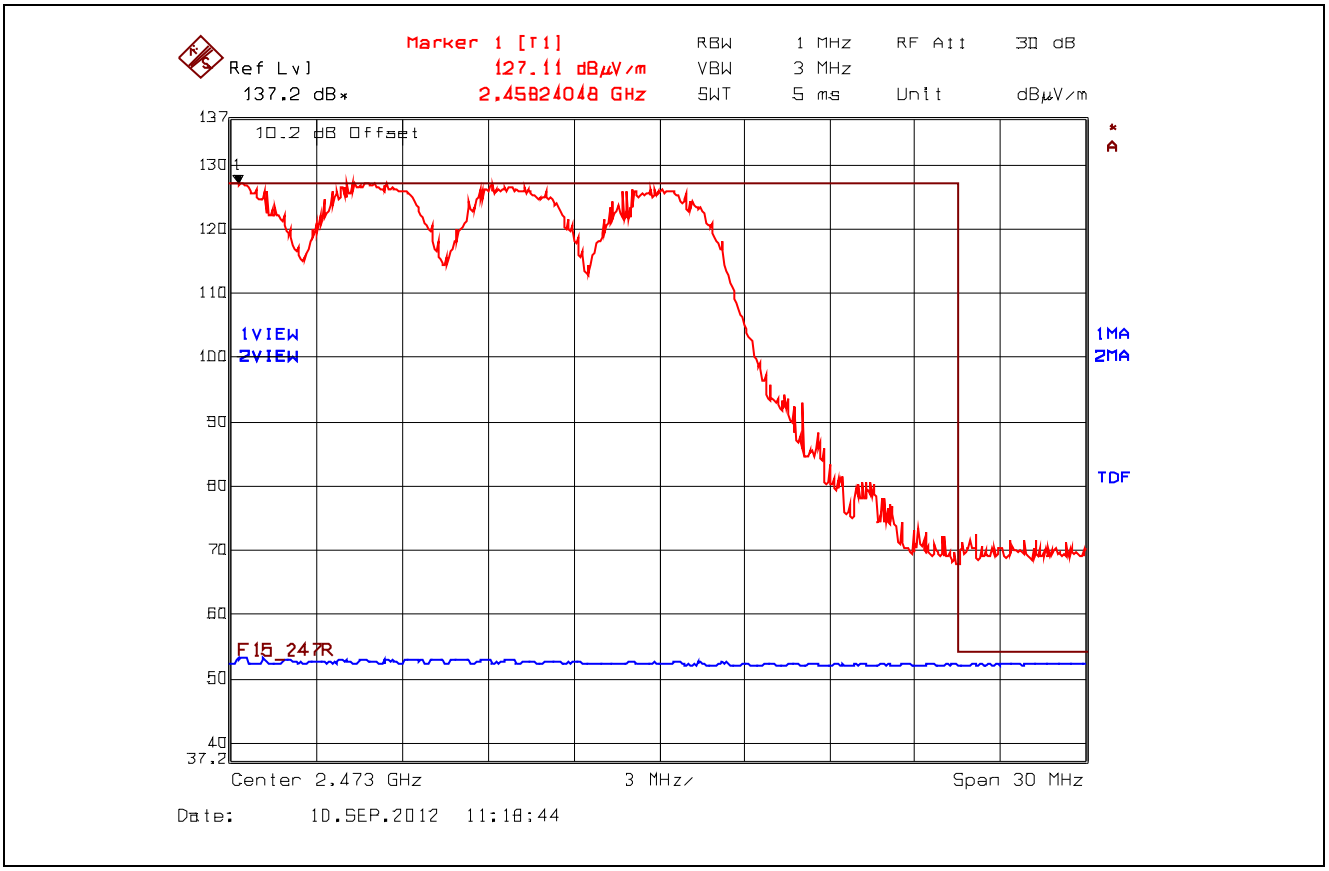
Trace 1: RBW = 1 MHz, VBW = 3 MHz
Trace 2: RBW= 300 kHz, VBW = 1 MHz, Delta (Peak to Band-Edge): 31.56 dB
Trace 3: RBW = 1 MHz, VBW = 10 Hz
Peak Band-Edge at 2400 MHz: Peak = 127.04 dBµV/m – 31.56 dB = 95.48 dBµV/m (limit 107.04 dBµV/m)

Plot 5.6.4.2.2.11. Band-Edge RF Radiated Emissions at 3 m, Horizontal Polarization
Upper Band-edge, Hopping Mode, Power Setting 8, 16-QAM



Trace 1: RBW = 1 MHz, VBW = 3 MHz
Trace 2: RBW = 1 MHz, VBW = 10 Hz

Plot 5.6.4.2.2.12. Band-Edge RF Radiated Emissions at 3 m, Vertical Polarization
Upper Band-edge, Hopping Mode, Power Setting 8, 16-QAM



Trace 1: RBW = 1 MHz, VBW = 3 MHz
Trace 2: RBW = 1 MHz, VBW = 10 Hz

5.6.4.3. EUT with 24 dBi Parabolic Antenna and 3.31 dB Assembly Cable Loss

5.6.4.3.1. Spurious Radiated Emissions

Fundamental Frequency:	2403 MHz
Software Power Setting:	8
Frequency Test 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
2403	127.52	--	V	--	--	--	--
2403	127.45	--	H	--	--	--	--
30-25000	*	*	V/H	*	107.5	*	Pass

*All spurious emissions/harmonics are more than 20 dB below the applicable limit.

Fundamental Frequency:	2438 MHz
Software Power Setting:	8
Frequency Test 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
2438	127.05	--	V	--	--	--	--
2438	126.85	--	H	--	--	--	--
30-25000	*	*	V/H	*	107.1	*	Pass

*All spurious emissions/harmonics are more than 20 dB below the applicable limit.

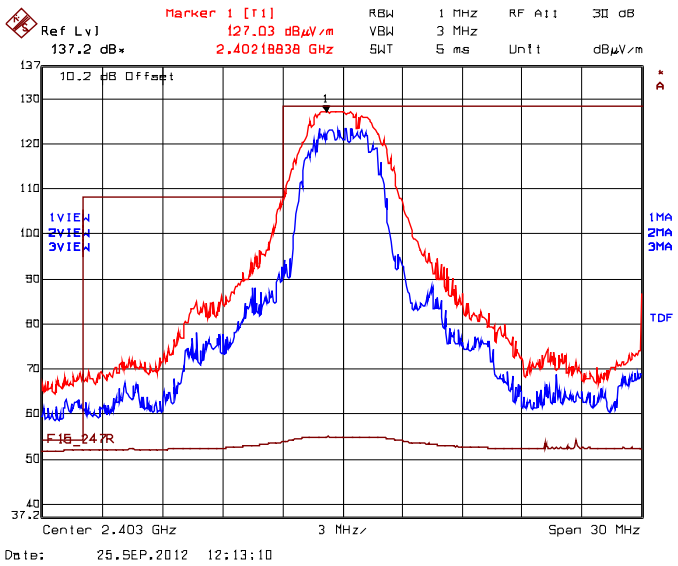
Fundamental Frequency:	2473 MHz
Software Power Setting:	8
Frequency Test Range:	30 MHz – 25 GHz

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
2473	126.97	--	V	--	--	--	--
2473	126.59	--	H	--	--	--	--
30-25000	*	*	V/H	*	107.0	*	Pass

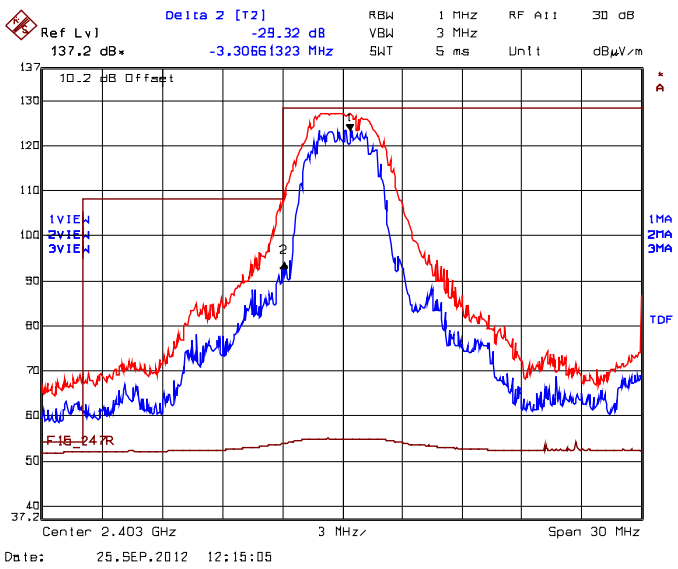
*All spurious emissions/harmonics are more than 20 dB below the applicable limit.

5.6.4.3.2. Band-Edge RF Radiated Emissions

Plot 5.6.4.3.2.1. Band-Edge RF Radiated Emissions at 3 m, Horizontal Polarization
Lower Band-edge, 2403 MHz, Power Setting 8, 16-QAM

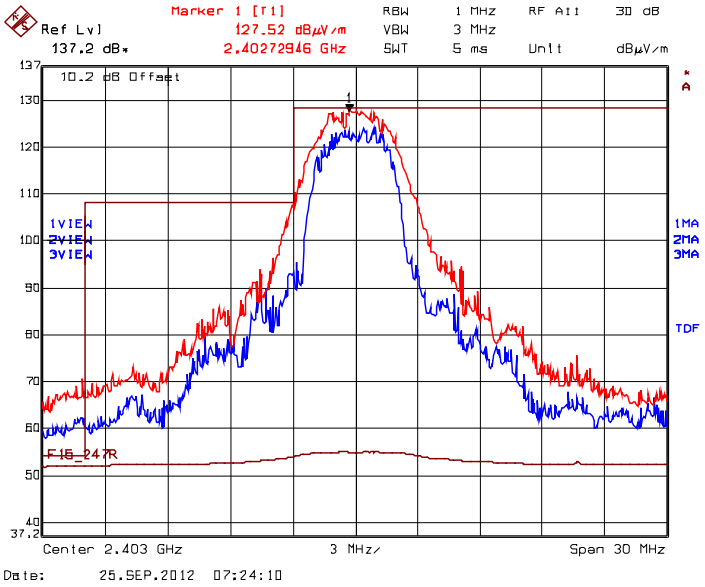


Plot 5.6.4.3.2.2. Band-Edge RF Radiated Emissions at 3 m, Horizontal Polarization
Lower Band-edge, 2403 MHz, Power Setting 8, 16-QAM

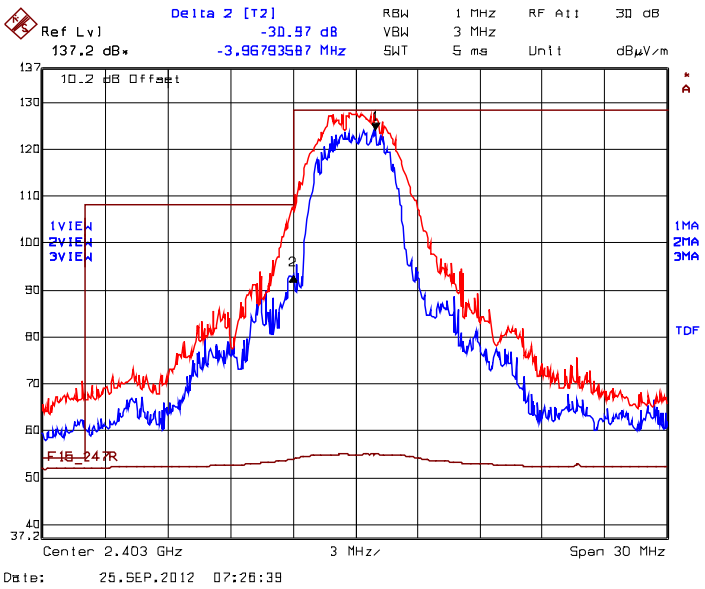


Trace 1: RBW = 1 MHz, VBW = 3 MHz
Trace 2: RBW = 300 kHz, VBW = 1 MHz, Delta (Peak to Band-Edge): 29.32 dB
Trace 3: RBW = 1 MHz, VBW = 10 Hz
Peak Band-Edge at 2400 MHz: Peak = 127.03 dBµV/m – 29.32 dB = 97.71 dBµV/m (limit 107.03 dBµV/m)

Plot 5.6.4.3.2.3. Band-Edge RF Radiated Emissions at 3 m, Vertical Polarization
Lower Band-edge, 2403 MHz, Power Setting 8, 16-QAM

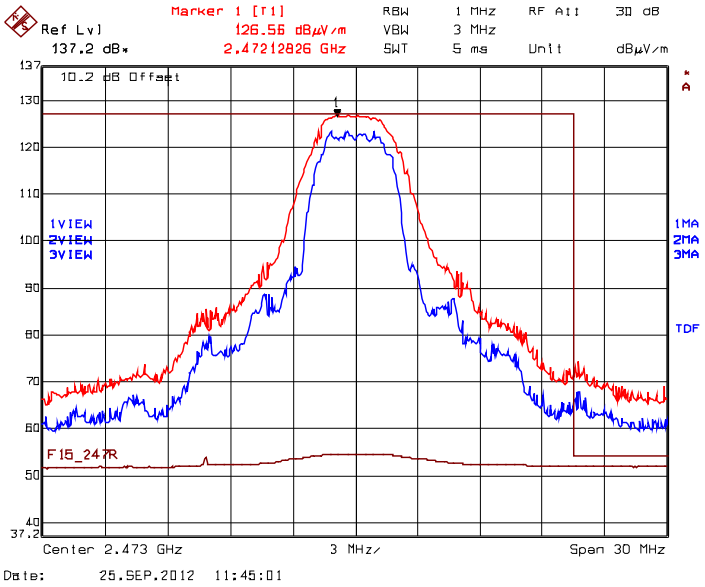


Plot 5.6.4.3.2.4. Band-Edge RF Radiated Emissions at 3 m, Vertical Polarization
Lower Band-edge, 2403 MHz, Power Setting 8, 16-QAM

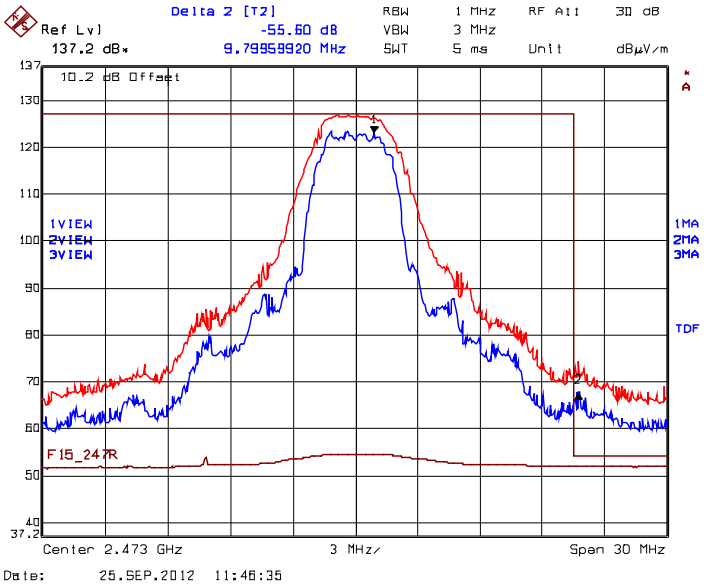


Trace 1: RBW = 1 MHz, VBW = 3 MHz
Trace 2: RBW = 300 kHz, VBW = 1 MHz, Delta (Peak to Band-Edge): 30.97 dB
Trace 3: RBW= 1 MHz, VBW = 10 Hz
Peak Band-Edge at 2400 MHz: Peak = 127.52 dBµV/m – 30.97 dB = 96.55 dBµV/m (limit 107.52 dBµV/m)

Plot 5.6.4.3.2.5. Band-Edge RF Radiated Emissions at 3 m, Horizontal Polarization
Upper Band-edge, 2473 MHz, Power Setting 8, 16-QAM

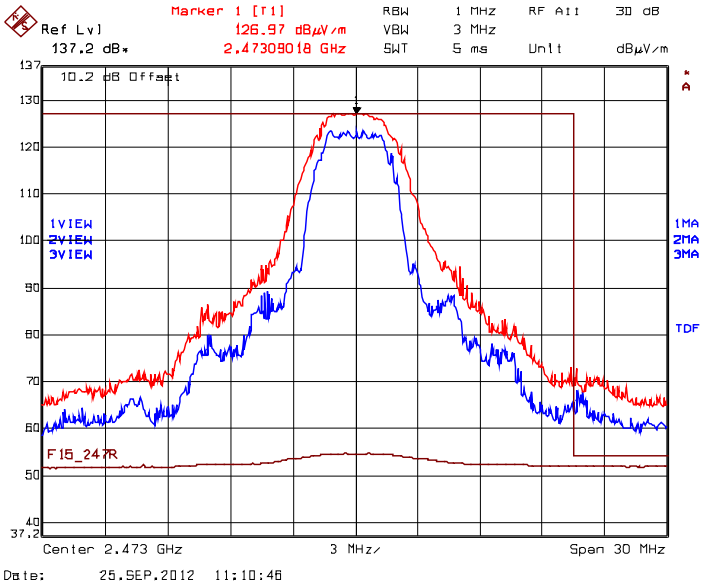


Plot 5.6.4.3.2.6. Band-Edge RF Radiated Emissions at 3 m, Horizontal Polarization
Upper Band-edge, 2473 MHz, Power Setting 8, 16-QAM

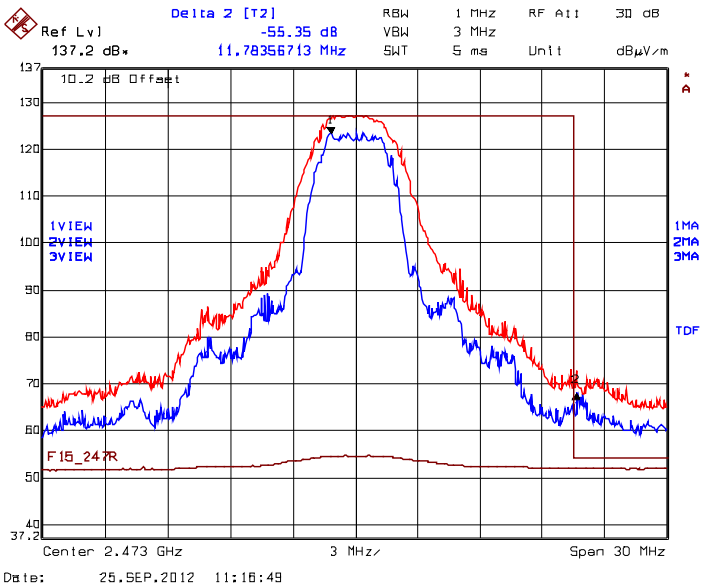


Trace 1: RBW = 1 MHz, VBW = 3 MHz
Trace 2: RBW = 300 kHz, VBW = 1 MHz, Delta (Peak to Band-Edge): 55.60 dB
Trace 3: RBW = 1 MHz, VBW = 10 Hz
Peak Band-Edge at 2483.5 MHz: Peak = 126.56 dBµV/m – 55.60 dB = 70.96 dBµV/m (limit 74 dBµV/m)

Plot 5.6.4.3.2.7. Band-Edge RF Radiated Emissions at 3 m, Vertical Polarization
Upper Band-edge, 2473 MHz, Power Setting 8, 16-QAM

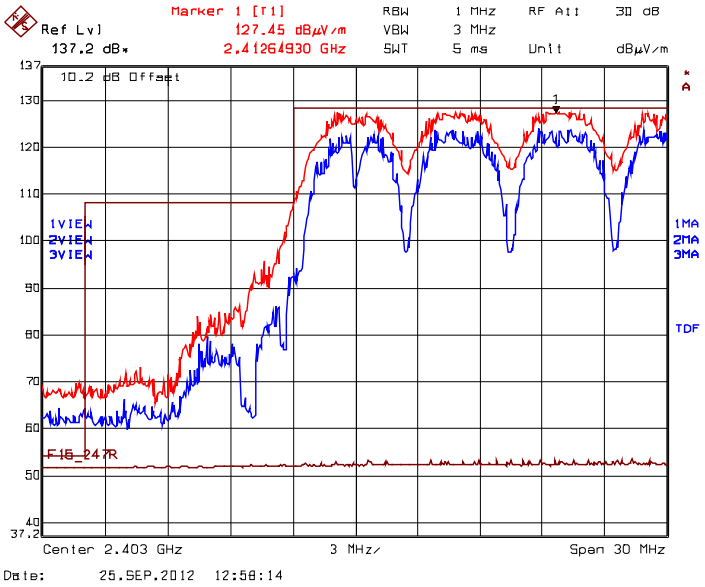


Plot 5.6.4.3.2.8. Band-Edge RF Radiated Emissions at 3 m, Vertical Polarization
Upper Band-edge, 2473 MHz, Power Setting 8, 16-QAM

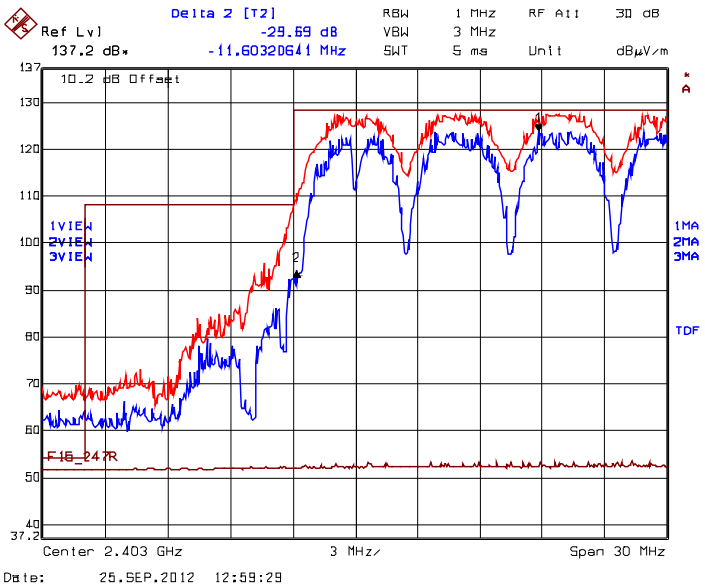


Trace 1: RBW = 1 MHz, VBW = 3 MHz
Trace 2: RBW = 300 kHz, VBW = 1 MHz, Delta (Peak to Band-Edge): 55.35 dB
Trace 3: RBW = 1 MHz, VBW = 10 Hz
Peak Band-Edge at 2483.5 MHz: Peak = 126.97 dBµV/m – 55.35 dB = 71.62 dBµV/m (limit 74 dBµV/m)

Plot 5.6.4.3.2.9. Band-Edge RF Radiated Emissions at 3 m, Horizontal Polarization
Lower Band-edge, Hopping Mode, Power Setting 8, 16-QAM

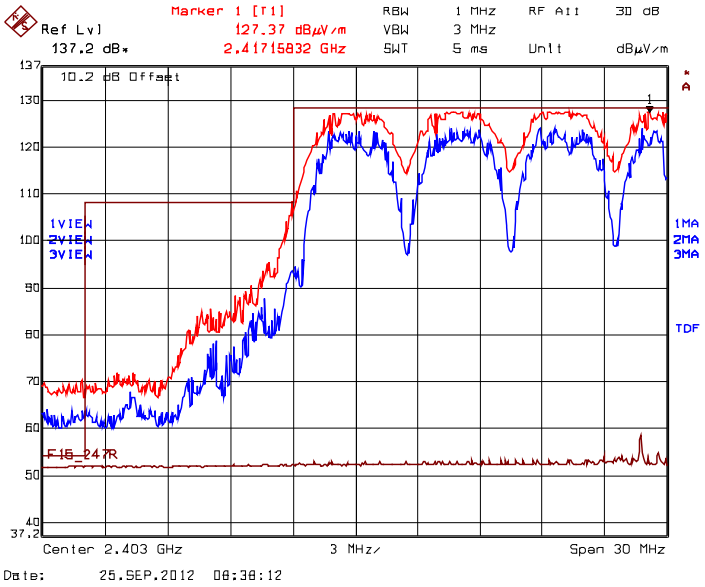


Plot 5.6.4.3.2.10. Band-Edge RF Radiated Emissions at 3 m, Horizontal Polarization
Lower Band-edge, Hopping Mode, Power Setting 8, 16-QAM

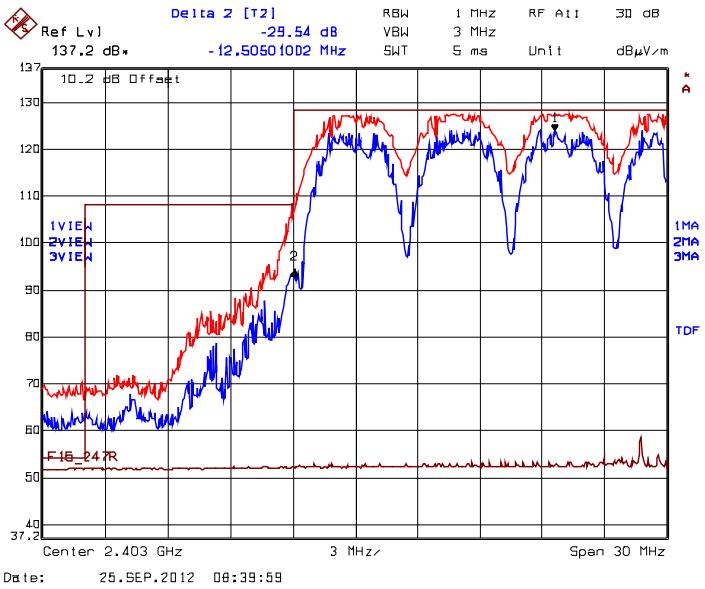


Trace 1: RBW = 1 MHz, VBW = 3 MHz
Trace 2: RBW = 300 kHz, VBW = 1 MHz, Delta (Peak to Band-Edge): 29.69 dB
Trace 3: RBW = 1 MHz, VBW = 10 Hz
Peak Band-Edge at 2400 MHz: Peak = 127.45 dBµV/m – 29.69 dB = 97.76 dBµV/m (limit 107.45 dBµV/m)

Plot 5.6.4.3.2.11. Band-Edge RF Radiated Emissions at 3 m, Vertical Polarization
Lower Band-edge, Hopping Mode, Power Setting 8, 16-QAM

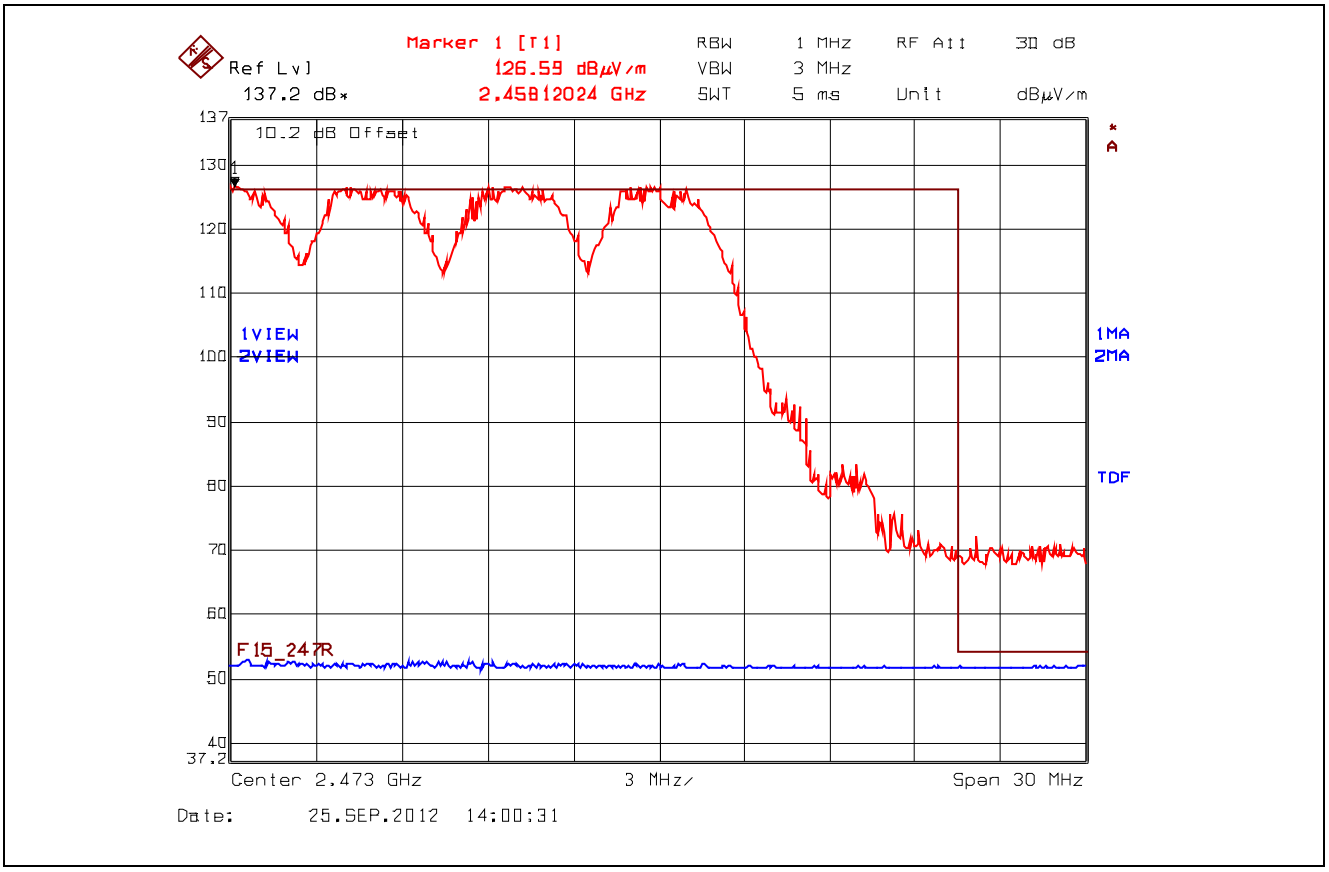


Plot 5.6.4.3.2.12. Band-Edge RF Radiated Emissions at 3 m, Vertical Polarization
Lower Band-edge, Hopping Mode, Power Setting 8, 16-QAM



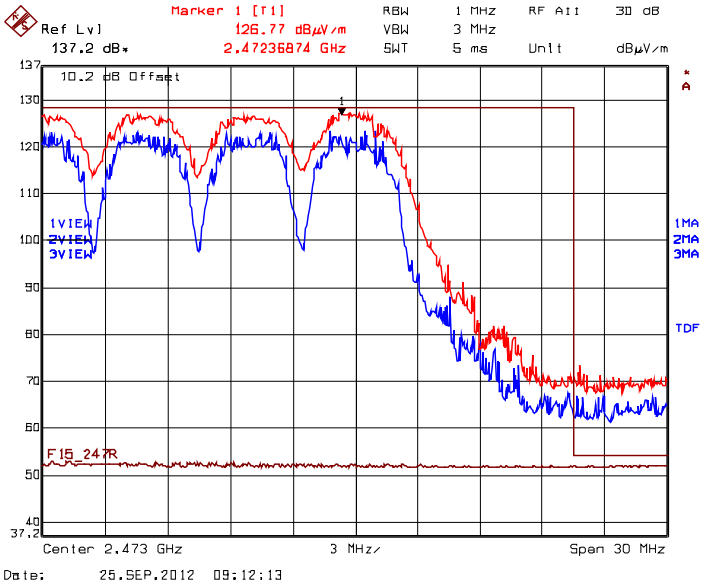
Trace 1: RBW = 1 MHz, VBW = 3 MHz
Trace 2: RBW = 300 kHz, VBW = 1 MHz, Delta (Peak to Band-Edge): 29.54 dB
Trace 3: RBW = 1 MHz, VBW = 10 Hz
Peak Band-Edge at 2400 MHz: Peak = 127.37 dBµV/m – 29.54 dB = 97.83 dBµV/m (limit 107.37 dBµV/m)

Plot 5.6.4.3.2.13. Band-Edge RF Radiated Emissions at 3 m, Horizontal Polarization
Upper Band-edge, Hopping Mode, Power Setting 8, 16-QAM

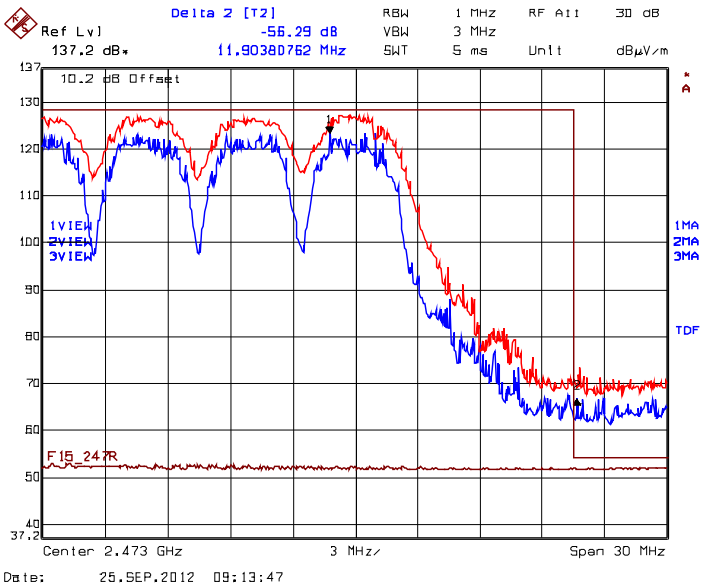


Trace 1: RBW = 1 MHz, VBW = 3 MHz
Trace 2: RBW = 1 MHz, VBW = 10 Hz

Plot 5.6.4.3.2.14. Band-Edge RF Radiated Emissions at 3 m, Vertical Polarization
Upper Band-edge, Hopping Mode, Power Setting 8, 16-QAM



Plot 5.6.4.3.2.15. Band-Edge RF Radiated Emissions at 3 m, Vertical Polarization
Upper Band-edge, Hopping Mode, Power Setting 8, 16-QAM



Trace 1: RBW = 1 MHz, VBW = 3 MHz
Trace 2: RBW = 300 kHz, VBW = 1 MHz, Delta (Peak to Band-Edge): 56.29 dB
Trace 3: RBW = 1 MHz, VBW = 10 Hz
Peak Band-Edge at 2483.5 MHz: Peak = 126.77dBµV/m – 56.29 dB = 70.48 dBµV/m (limit 74 dBµV/m)

5.7. RF EXPOSURE REQUIRMENTS [§§ 15.247(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/cm^2)	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	*($900/f^2$)	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	*($180/f^2$)	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.

5.7.1. 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

5.7.2. RF Evaluation

Evaluation of RF Exposure Compliance Requirements	
RF Exposure Requirements	**Compliance with FCC Rules**
Minimum calculated separation distance between antenna and persons required: ***36 cm**	Manufacturer' instruction for separation distance between antenna and persons required: **40 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:

RF EXPOSURE DISTANCE LIMITS

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

S = 1.0 mW/cm^2
EIRP = 42 dBm = $10^{42/10}$ mW = 15849 mW (Worst Case)

(Minimum Safe Distance, r) = $\sqrt{\frac{EIRP}{4 \cdot \pi \cdot S}} = \sqrt{\frac{15849}{4 \cdot \pi \cdot (1.0)}} \approx 35.5cm$

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	15 Feb 2013
Attenuator	Pasternack	PE7010-20	-	DC–2 GHz	09 Jan 2013
L.I.S.N	EMCO	3825/2	8907-1531	10 kHz -100 MHz	05 Apr 2013
High Pass Filter	Telemeter Electronic	MTA-HPF-150	2110465-007	9 kHz – 250 MHz	17 Aug 2013
Spectrum Analyzer	Rohde & Schwarz	FSEK20	834157	9 kHz–40 GHz	30 July 2013
Attenuator	Narda	4768-20	-	DC–40 GHz	Cal on use
DC Block	Hewlett Packard	11742A	12460	0.045–26.5 GHz	Cal on use
Spectrum Analyzer	Rohde & Schwarz	ESU40	100037	20 Hz – 40 GHz	19 Mar 2013
RF Amplifier	Hewlett Packard	84498	3008A00769	1 – 26.5 GHz	06 Aug 2013
RF Amplifier	AH System	PAM-0118	225	20 MHz – 18 GHz	16 Mar 2013
Attenuator	Pasternack	PE7024-10	-	DC–26.5 GHz	Cal on use
High Pass Filter	K & L	11SH10-4000/T12000	4	Cut off 2.4 GHz	Cal on use
Horn Antenna	ETS Lindgren	3155	6570	1 – 18 GHz	02 Apr 2013
Horn Antenna	ETS Lindgren	3160-09	00118385	18 – 26.5 GHz	30 Jul 2014
Biconi-Log Antenna	ETS Lindgren	3142B	1575	26 – 3000 MHz	04 May 2013
Band Reject Filter	Micro-Tronics	BRM50701	105	Cut off 2.4-2.4835 GHz	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