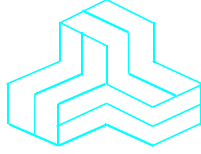


# ENGINEERING TEST REPORT



**XBee-PRO S2C OEM RF Module  
Model No.: XBEE-PRO S2C**

**FCC ID: MCQ-XBPS2C**

*Applicant:*

**Digi International Inc.**  
11001 Bren Road East  
Minnetonka, MN 55343

*In Accordance With*

**Federal Communications Commission (FCC)  
Part 15, Subpart C, Section 15.247  
Digital Modulation Systems (DTS) Operating in 2400 – 2483.5 MHz Band**

**UltraTech's File No.: DIGI-034QF15C247**

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



Date: July 6, 2010

Report Prepared by: Dan Huynh

Tested by: Mr. Hung Trinh, EMI/RFI Technician

Issued Date: July 6, 2010

Test Dates: June 10 - 28, 2010

*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

3000 Bristol Circle, Oakville, Ontario, Canada, L6H 6G4  
Tel.: (905) 829-1570 Fax.: (905) 829-8050

Website: [www.ultratech-labs.com](http://www.ultratech-labs.com), Email: [vic@ultratech-labs.com](mailto:vic@ultratech-labs.com), Email: [tri@ultratech-labs.com](mailto:tri@ultratech-labs.com)



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1309



46390-2049



NVLap Lab Code  
200093-0



SL2-IN-E-1119R



Korea KCC-RRL

CA2049

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## EXHIBIT 1. INTRODUCTION

### 1.1. SCOPE

<b>Reference:</b>	FCC Part 15, Subpart C, Section 15.247
<b>Title:</b>	Code of Federal Regulations (CFR), Title 47 – Telecommunication, Part 15
<b>Purpose of Test:</b>	Equipment Certification for Digital Modulation Systems (DTS) Transmitter Operating in the Frequency Band 2400-2483.5 MHz.
<b>Test Procedures:</b>	American National Standards Institute ANSI C63.10 - American National Standard for Testing Unlicensed Wireless Devices
<b>Environmental Classification:</b>	<input checked="" type="checkbox"/> Commercial, industrial or business environment <input checked="" type="checkbox"/> Residential environment

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

None.

### 1.3. NORMATIVE REFERENCES

Publication	Year	Title
47 CFR Parts 0-19	2009	Code of Federal Regulations (CFR), Title 47 – Telecommunication
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
KDB Publication No. 558074	2005	Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247)

## EXHIBIT 2. PERFORMANCE ASSESSMENT

### 2.1. CLIENT INFORMATION

APPLICANT	
<b>Name:</b>	Digi International Inc.
<b>Address:</b>	11001 Bren Road East Minnetonka, MN 55343 USA
<b>Contact Person:</b>	Mr. Paul Dahl Phone #: 801-765-9885 Fax #: 801-765-9895 Email Address: Paul.dahl@digi.com

MANUFACTURER	
<b>Name:</b>	Digi International Inc.
<b>Address:</b>	11001 Bren Road East Minnetonka, MN 55343 USA
<b>Contact Person:</b>	Mr. Paul Dahl Phone #: 801-765-9885 Fax #: 801-765-9895 Email Address: Paul.dahl@digi.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.

<b>Brand Name:</b>	Digi International Inc.
<b>Product Name:</b>	XBee-PRO S2C OEM RF Module
<b>Model Name or Number:</b>	XBEE-PRO S2C
<b>Serial Number:</b>	Test Sample
<b>Type of Equipment:</b>	Digital Transmission System (DTS)
<b>Input Power Supply Type:</b>	3.3 Vdc using TENMA DC Regulated Power Supply Model: 72-7295
<b>Primary User Functions of EUT:</b>	Provide wireless connectivity to end-point devices in ZigBee mesh networks.

**2.3. EUT’S TECHNICAL SPECIFICATIONS**

<b>TRANSMITTER</b>	
<b>Equipment Type:</b>	<ul style="list-style-type: none"> <li>• Mobile</li> <li>• Base Station (fixed use)</li> </ul>
<b>Intended Operating Environment:</b>	Commercial, industrial or business
<b>Power Supply Requirement:</b>	2.1 - 3.6 VDC
<b>RF Output Power Rating:</b>	For 2405-2475 MHz: 0 dBm to 19.5 dBm (1 to 89 mW) For 2480 MHz : 0 dBm (1 mW)
<b>Operating Frequency Range:</b>	2405 – 2480 MHz
<b>RF Output Impedance:</b>	50 Ω
<b>Channel Spacing:</b>	5 MHz
<b>Duty Cycle:</b>	27%
<b>Modulation Type:</b>	QPSK
<b>Oscillator Frequencies:</b>	24 MHz
<b>Antenna Connector Types:</b>	RF Pad, PCB Antenna, or U.FL Connector

**2.4. ASSOCIATED ANTENNA DESCRIPTION**

The highest gain antenna from each type of antenna was selected for testing to represent the worst case. The following antennas were selected for testing in this filing:

1. Omni-directional Antenna (P/N: A24-F15NF; Max. Antenna Gain: 15 dBi)
2. Yagi Antenna (P/N: A24-Y18NF; Max. Antenna Gain: 15 dBi)
3. Flat Panel Antenna (P/N: A24-19NF; Max. Antenna Gain: 19 dBi)
4. Integrated Whip Monopole Antenna (P/N: A24-QI; Max. Antenna Gain: 1.5 dBi)
5. Integrated PCB Antenna (P/N: 29000313; Max. Antenna Gain: 0 dBi)

**2.5. LIST OF EUT’S PORTS**

<b>Port Number</b>	<b>EUT’s Port Description</b>	<b>Number of Identical Ports</b>	<b>Connector Type</b>	<b>Cable Type (Shielded/Non-shielded)</b>
1	RF port	1	U.FL	Shielded
2	RF Pad	1	Castellated Pad	No Cable, direct connection
3	DC supply and I/O port	1	Castellated Pads	No calbe, 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 Cable
Brand name:	Digi International
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

#### 3.2. OPERATIONAL TEST CONDITIONS & ARRANGEMENT FOR TESTS

<b>Operating Modes:</b>	Each of lowest, middle and highest channel frequencies transmits continuously for emissions measurements.
<b>Special Test Software:</b>	Special software and hardware by the Applicant to operate the EUT at each channel frequency continuously. For example, the transmitter will be operated at each of the lowest, middle and highest frequencies individually continuously during testing.
<b>Special Hardware Used:</b>	The RF Module could be tested outside of the enclosure using Digi International Test Jig Cable connected to EUT.
<b>Transmitter Test Antenna:</b>	The EUT is tested with the antenna fitted in a manner typical of normal intended use as integral / non-integral antenna equipment as described with the test results.

<b>Transmitter Test Signals</b>	
<b>Frequency Band(s):</b>	2405 - 2480 MHz
<b>Frequency(ies) Tested:</b> (Near lowest, near middle & near highest frequencies in the frequency range of operation.)	2405, 2440, 2475 and 2480 MHz (Channels # 11, 18, 25 & 26)
<b>RF Power Output:</b> (measured maximum output power at antenna terminals)	19.48 dBm (89 mW) Peak
<b>Normal Test Modulation:</b>	QPSK
<b>Modulating Signal Source:</b>	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.: 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)(2)	6 dB Bandwidth	Yes
15.247(b)(3)	Peak Conducted Output Power - DTS	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(e)	Power Spectral Density	Yes
15.247(i) 1.1307, 1.1310, 2.1091 & 2.1093	RF Exposure	Yes
The digital circuit portion of the EUT has been tested and verified to comply with FCC Part 15, Subpart B, Class B Digital Devices. The engineering test report is available upon request.		

\* 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.



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## **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 ANSI C63.10; FCC KDB Publication No. 558074: Guidance on Measurements for Digital Transmission Systems.

### **5.2. MEASUREMENT UNCERTAINTIES**

The measurement uncertainties stated were calculated in accordance with requirements of UKAS Document NIS 81 with a confidence level of 95%. Please 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 MANUFACTURER**

Provide wireless connectivity to end-point devices in ZigBee mesh networks.

**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:

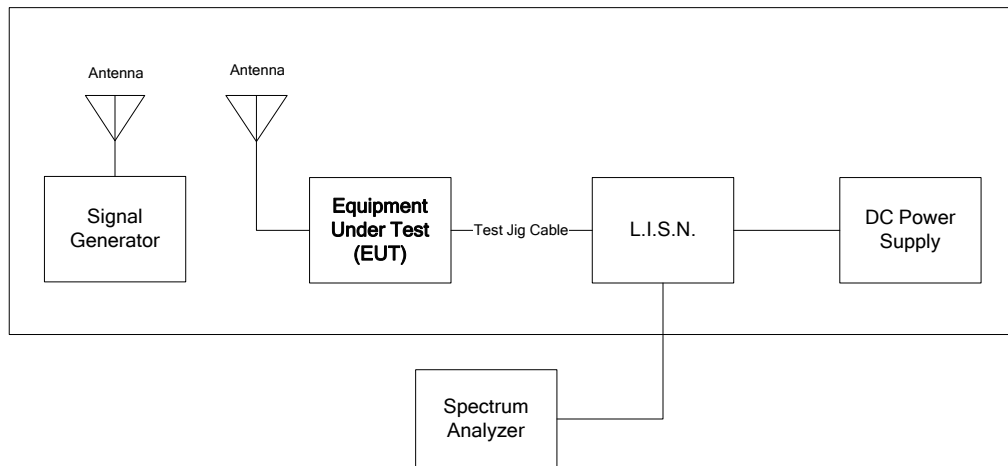
Frequency of emission (MHz)	Conducted Limits (dB $\mu$ V)		Measuring Bandwidth
	Quasi-peak	Average	
0.15–0.5 .....	66 to 56*	56 to 46*	RBW = 9 kHz
0.5–5 .....	56 .....	46	VBW $\geq$ 9 kHz for QP
5–30 .....	60 .....	50	VBW = 1 Hz for Average

\*Decreases linearly with the logarithm of the frequency

**5.5.2. Method of Measurements**

ANSI C63.4

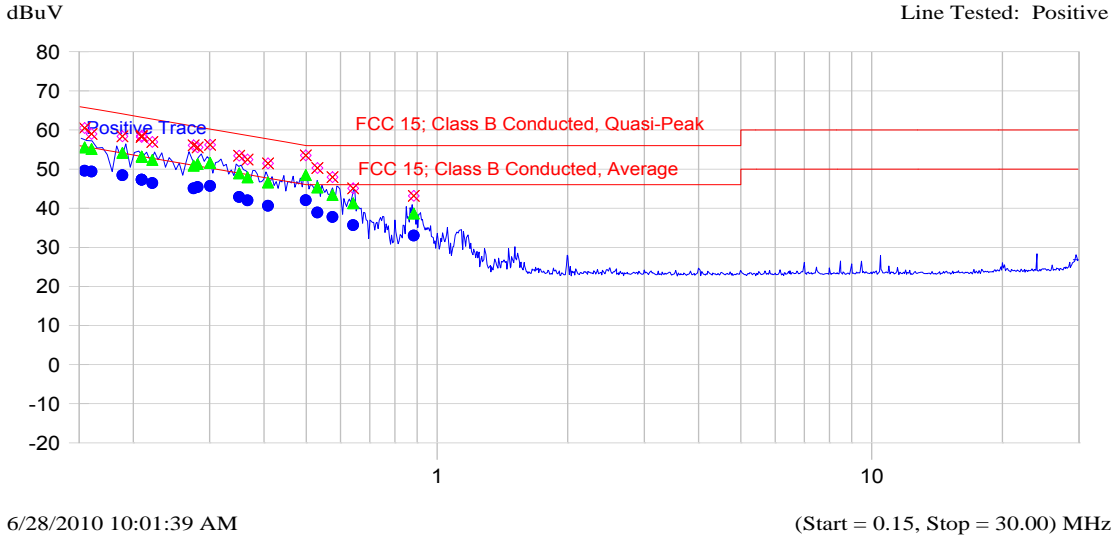
**5.5.3. Test Arrangement**



5.5.4. Test Data

Plot 5.5.4.1. Power Line Conducted Emissions (Tx Mode)  
 Line Voltage: 3.3VDC  
 Line Tested: Positive

Current Graph

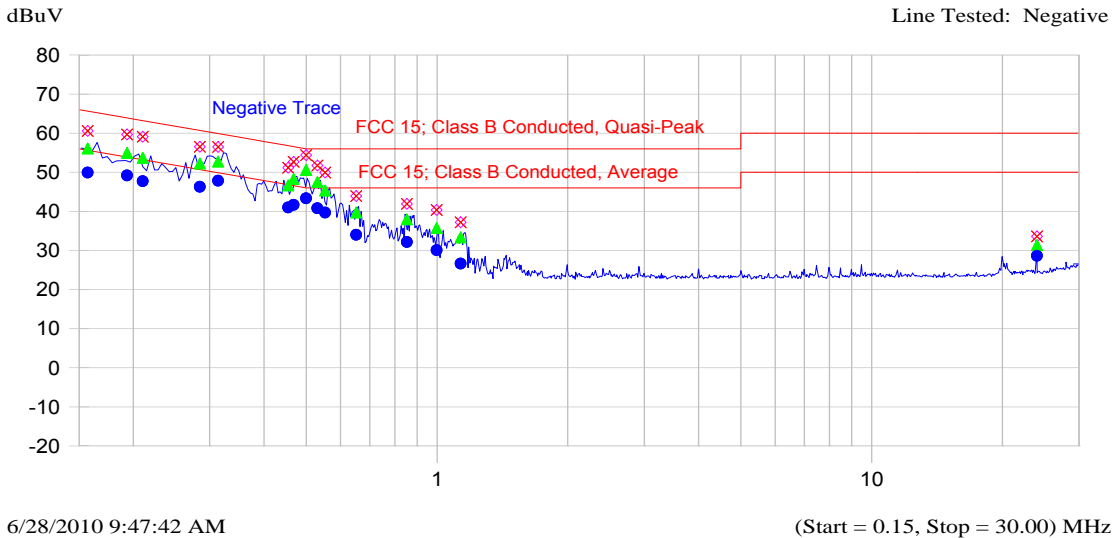


Current List

Frequency MHz	Peak dBuV	QP dBuV	Delta QP-QP dB	Limit dB	Avg dBuV	Delta Avg-Avg dB	Limit dB	Trace Name
0.160	59.0	55.1	-10.6		49.3	-6.3		Positive Trace
0.155	60.5	55.5	-10.3		49.6	-6.3		Positive Trace
0.189	58.4	54.1	-10.7		48.4	-6.5		Positive Trace
0.209	58.2	53.2	-11.1		47.3	-7.0		Positive Trace
0.209	58.5	53.1	-11.1		47.3	-7.0		Positive Trace
0.221	56.9	52.4	-11.5		46.4	-7.5		Positive Trace
0.275	56.1	50.9	-11.5		45.1	-7.3		Positive Trace
0.281	55.5	51.3	-10.9		45.4	-6.8		Positive Trace
0.301	56.2	51.6	-10.1		45.7	-5.9		Positive Trace
0.351	53.4	48.9	-11.3		42.9	-7.3		Positive Trace
0.367	52.4	47.9	-11.8		42.0	-7.7		Positive Trace
0.408	51.5	46.6	-12.0		40.6	-8.0		Positive Trace
0.499	53.5	48.5	-7.5		42.0	-4.0		Positive Trace
0.530	50.3	45.3	-10.7		38.9	-7.1		Positive Trace
0.575	47.9	43.4	-12.6		37.7	-8.3		Positive Trace
0.641	45.0	41.3	-14.7		35.7	-10.3		Positive Trace
0.884	43.1	38.6	-17.4		33.0	-13.0		Positive Trace

**Plot 5.5.4.2. Power Line Conducted Emissions (Tx Mode)**  
 Line Voltage: 3.3VDC  
 Line Tested: Negative

**Current Graph**

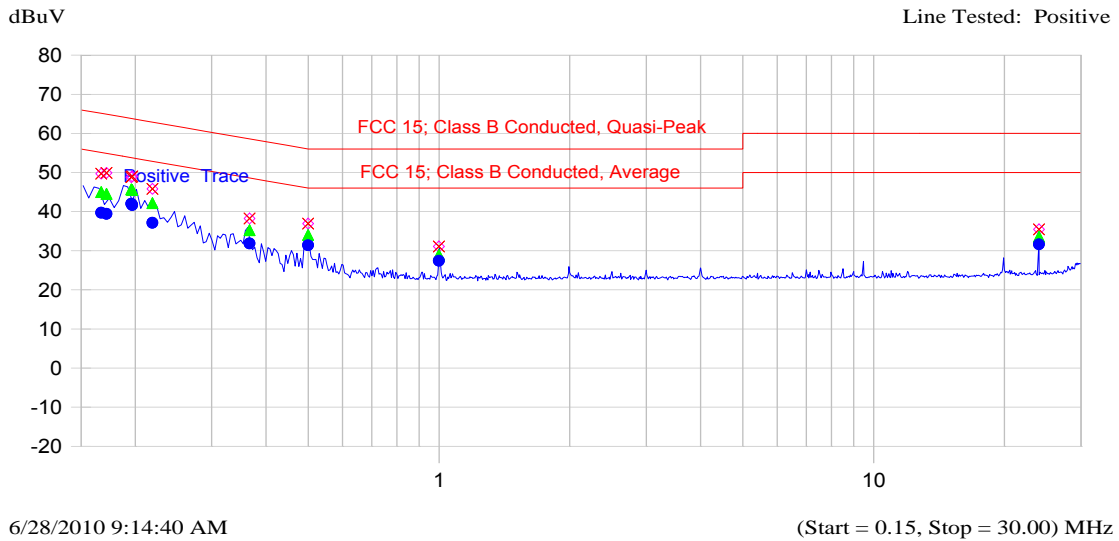


**Current List**

Frequency MHz	Peak dBuV	QP dBuV	Delta dB	QP-QP Limit	Avg dB	Delta dB	Avg-Avg Limit	Trace Name
0.157	60.6	56.1	-9.7	49.9	-5.9	Negative Trace		
0.194	59.7	54.9	-9.8	49.2	-5.6	Negative Trace		
0.210	59.1	53.7	-10.5	47.7	-6.5	Negative Trace		
0.285	56.5	52.2	-9.8	46.3	-5.8	Negative Trace		
0.313	56.5	52.7	-8.5	47.8	-3.4	Negative Trace		
0.454	51.1	46.6	-10.7	41.0	-6.3	Negative Trace		
0.467	52.6	48.3	-8.6	41.7	-5.2	Negative Trace		
0.500	54.4	50.6	-5.4	43.3	-2.7	Negative Trace		
0.530	51.7	47.5	-8.5	40.8	-5.2	Negative Trace		
0.553	49.9	45.3	-10.7	39.7	-6.3	Negative Trace		
0.652	43.9	39.7	-16.3	34.0	-12.0	Negative Trace		
0.853	41.9	38.0	-18.0	32.2	-13.8	Negative Trace		
0.998	40.3	35.7	-20.3	30.1	-15.9	Negative Trace		
1.134	37.2	33.3	-22.7	26.7	-19.3	Negative Trace		
24.001	33.6	31.4	-28.6	28.7	-21.3	Negative Trace		

**Plot 5.5.4.3. Power Line Conducted Emissions (Rx Mode)**  
 Line Voltage: 3.3VDC  
 Line Tested: Positive

**Current Graph**

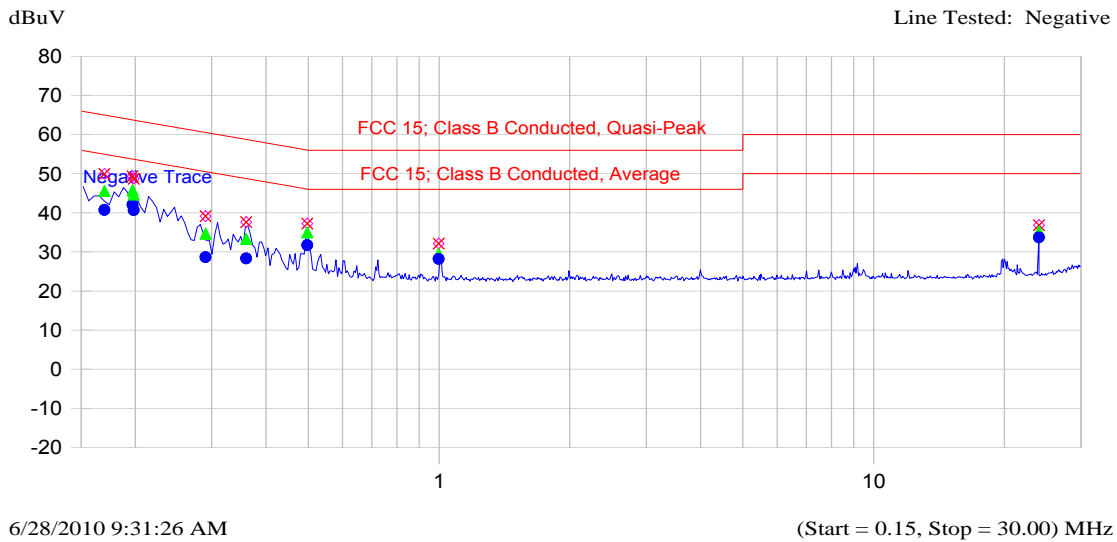


**Current List**

Frequency MHz	Peak dBuV	QP dBuV	Delta QP-QP	Limit Avg dB	Delta Avg-Avg dB	Limit dB	Trace Name
0.167	49.7	45.0	-20.5	39.7	-15.8		Positive Trace
0.172	49.9	44.5	-20.8	39.4	-15.9		Positive Trace
0.197	49.0	45.5	-19.1	41.7	-13.0		Positive Trace
0.196	48.8	45.7	-19.0	42.0	-12.6		Positive Trace
0.219	45.8	42.1	-21.8	37.1	-16.8		Positive Trace
0.367	38.3	35.2	-24.5	31.8	-17.9		Positive Trace
0.500	36.9	34.0	-22.0	31.4	-14.6		Positive Trace
0.999	31.1	28.9	-27.1	27.4	-18.6		Positive Trace
24.001	35.4	33.5	-26.5	31.6	-18.4		Positive Trace

**Plot 5.5.4.4. Power Line Conducted Emissions (Rx Mode)**  
 Line Voltage: 3.3VDC  
 Line Tested: Negative

**Current Graph**



**Current List**

Frequency MHz	Peak dBuV	QP dBuV	Delta QP-QP	Limit dB	Avg dBuV	Delta Avg-Avg	Limit dB	Trace Name
0.170	49.9	45.5	-19.9	40.7	-14.7			Negative Trace
0.197	49.3	45.7	-18.9	42.0	-12.6			Negative Trace
0.198	48.7	44.6	-20.0	40.7	-13.9			Negative Trace
0.290	39.1	34.6	-27.3	28.6	-23.3			Negative Trace
0.360	37.6	33.3	-26.6	28.3	-21.6			Negative Trace
0.498	37.2	35.0	-21.1	31.7	-14.4			Negative Trace
0.998	32.1	29.5	-26.5	28.2	-17.8			Negative Trace
24.000	36.8	35.2	-24.8	33.7	-16.3			Negative Trace

**5.6. OCCUPIED BANDWIDTH [§ 15.247(a)(2)]**

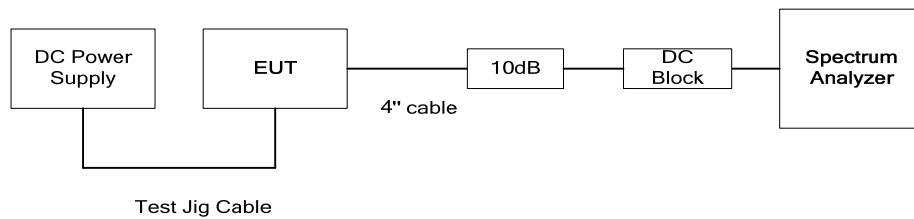
**5.6.1. Limit(s)**

For a Digital Modulation System, the minimum 6 dB bandwidth shall be at least 500 KHz.

**5.6.2. Method of Measurements**

KDB Publication No. 558074: Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247) and ANSI C63.10.

**5.6.3. Test Arrangement**

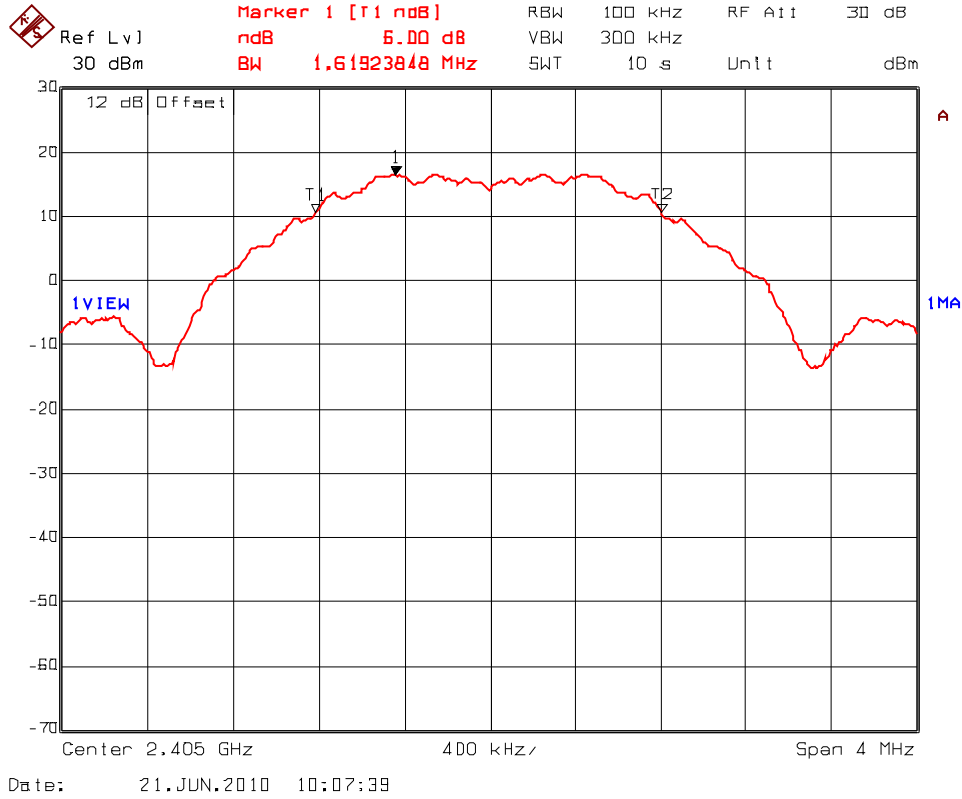


**5.6.4. Test Data**

Frequency (MHz)	6 dB Bandwidth (MHz)	99% Occupied Bandwidth (MHz)
2405	1.62	2.40
2440	1.62	2.41
2475	1.61	2.39
2480	1.64	2.41

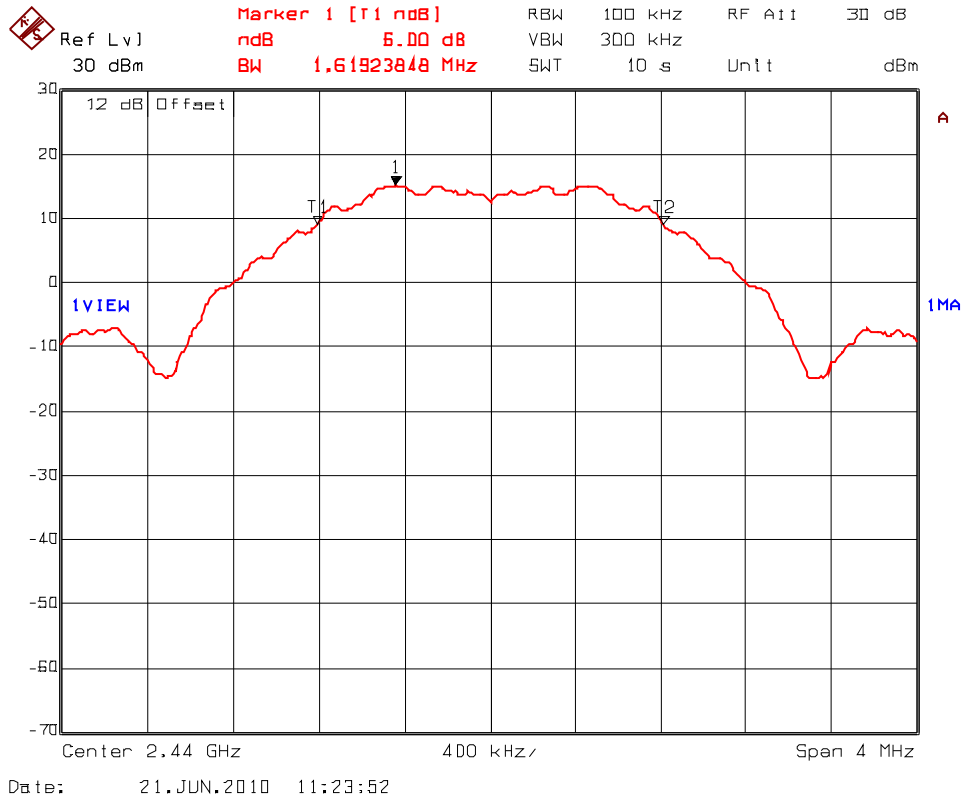
See the following plots for detailed measurements.

Plot 5.6.4.1. 6 dB Bandwidth  
Frequency: 2405 MHz

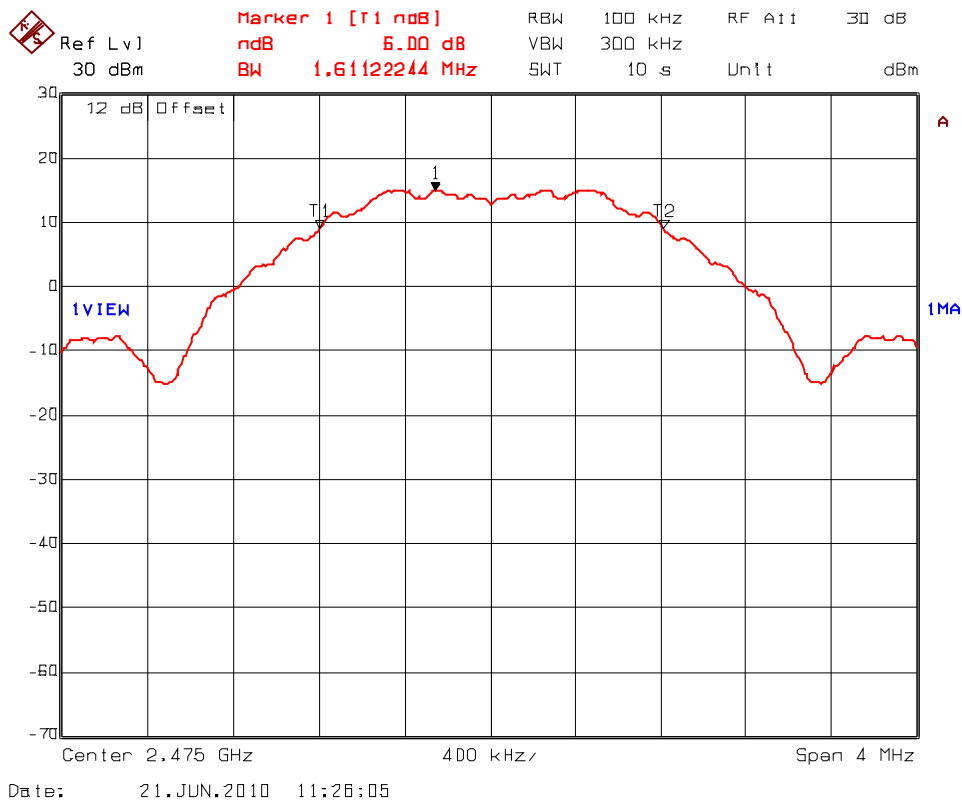




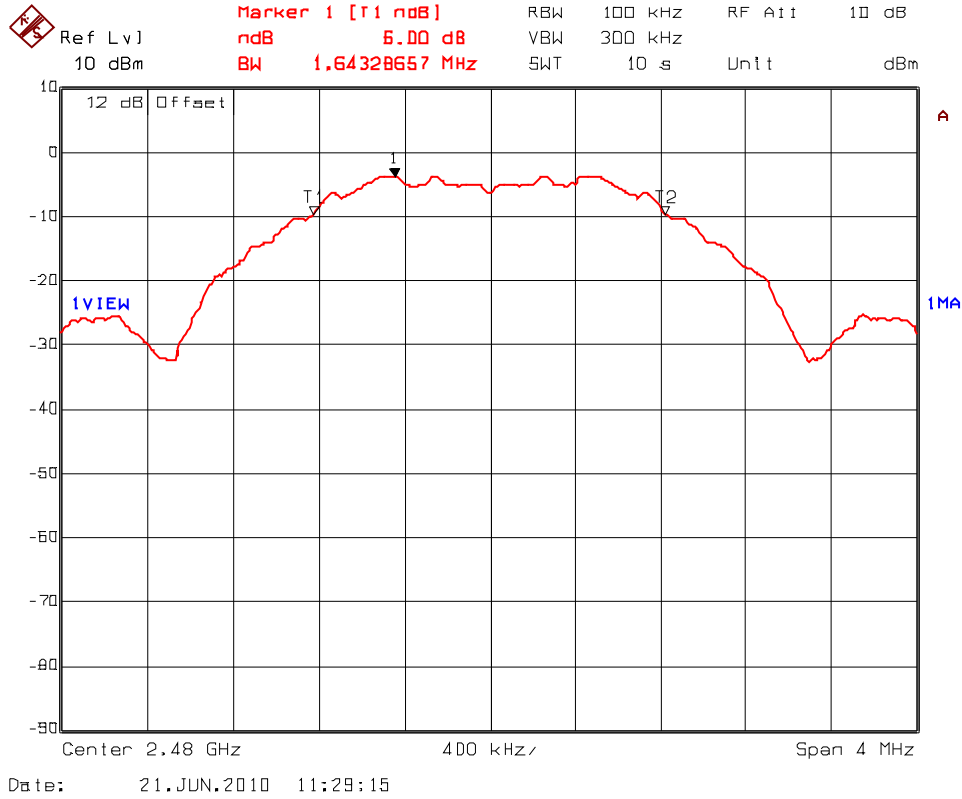
**Plot 5.6.4.2. 6 dB Bandwidth**  
 Frequency: 2440 MHz



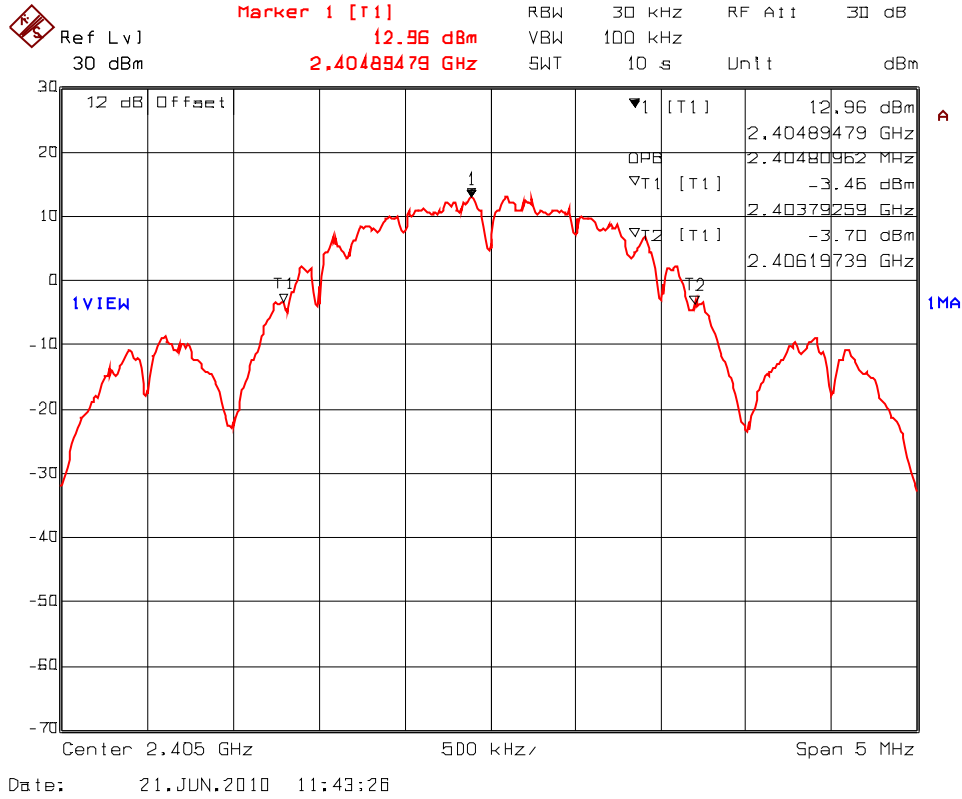
Plot 5.6.4.3. 6 dB Bandwidth  
Frequency: 2475 MHz



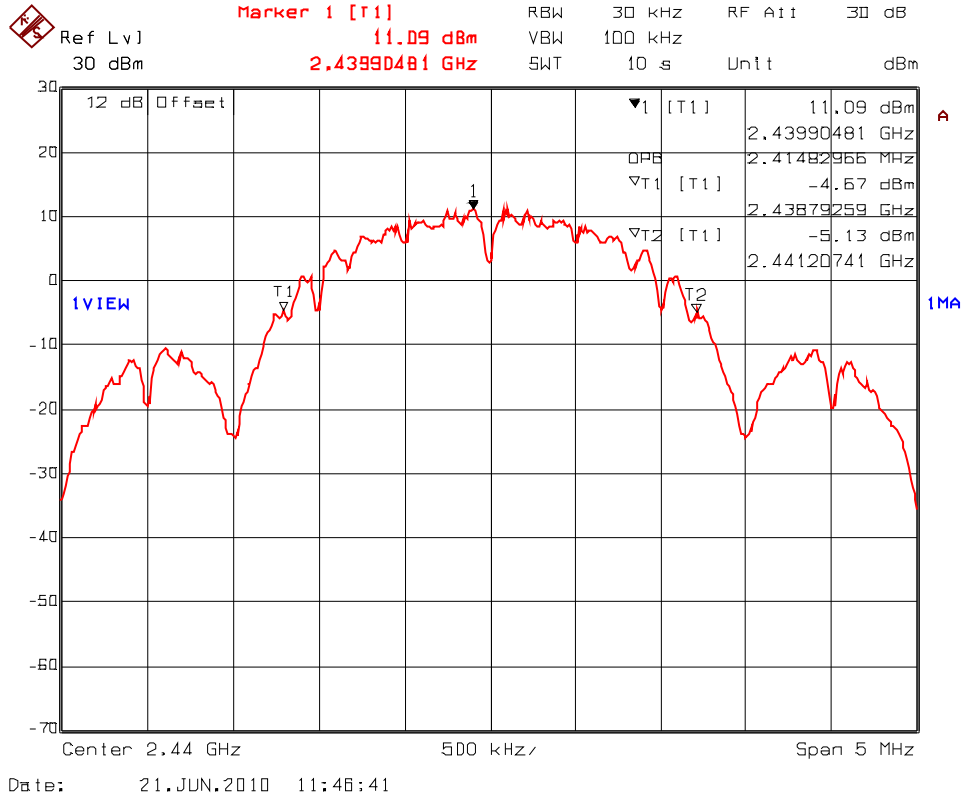
Plot 5.6.4.4. 6 dB Bandwidth  
Frequency: 2480 MHz



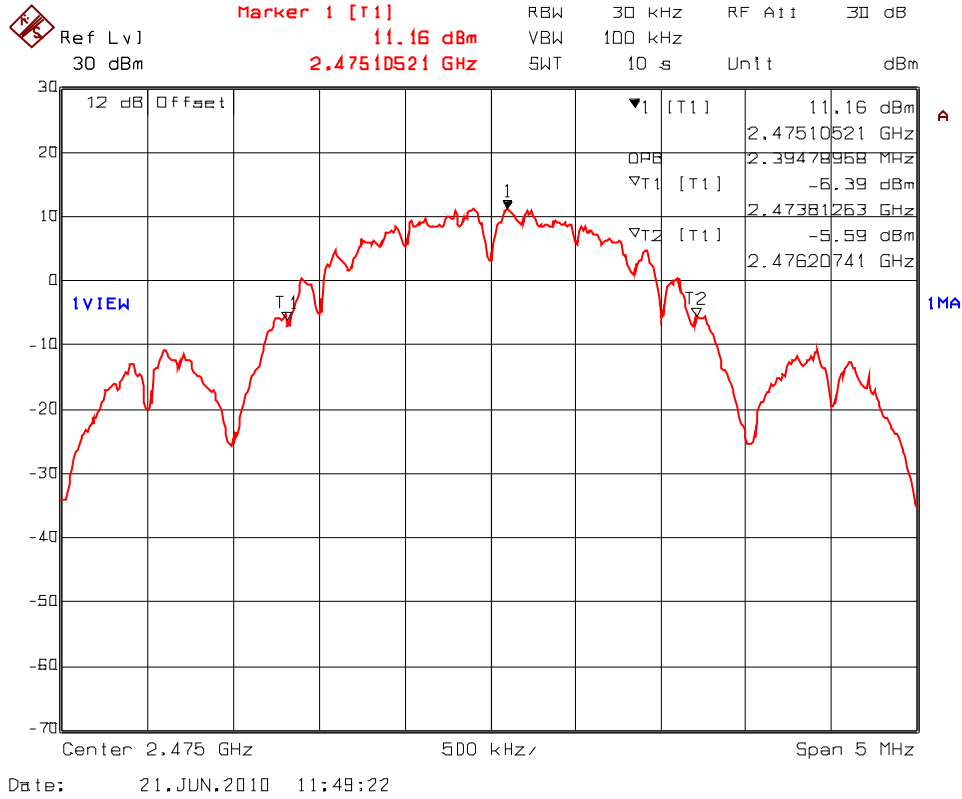
**Plot 5.6.4.5. 99% Occupied Bandwidth**  
 Frequency: 2405 MHz



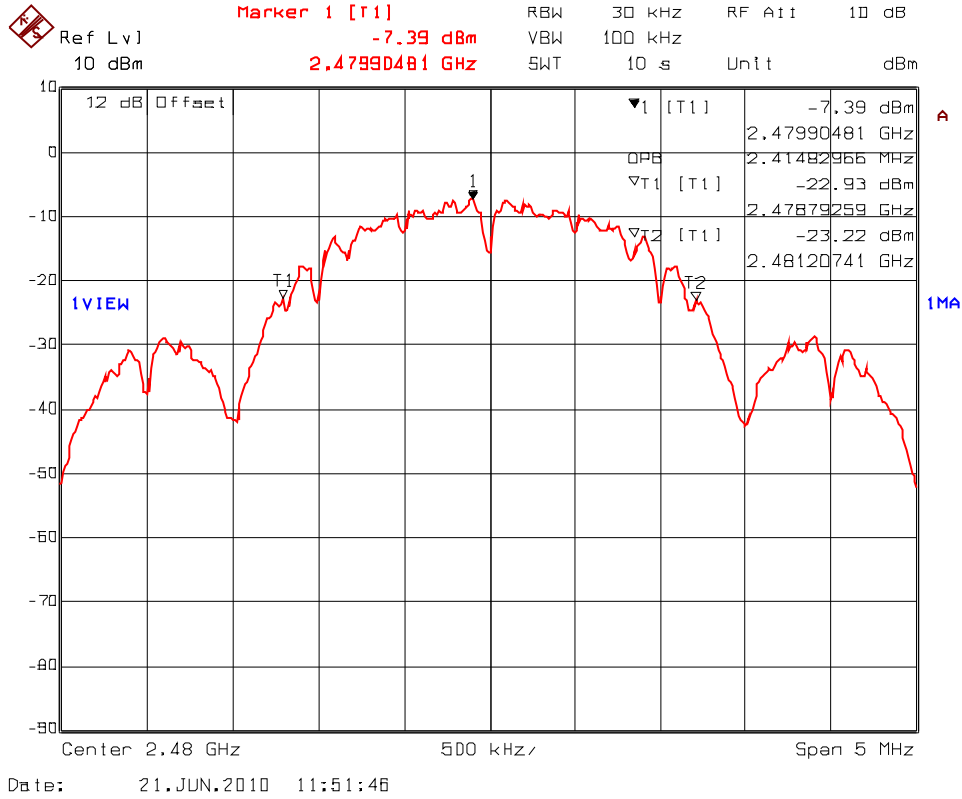
**Plot 5.6.4.6. 99% Occupied Bandwidth**  
 Frequency: 2440 MHz



**Plot 5.6.4.7. 99% Occupied Bandwidth**  
 Frequency: 2475 MHz



**Plot 5.6.4.8. 99% Occupied Bandwidth**  
**Frequency: 2480 MHz**



## 5.7. PEAK CONDUCTED OUTPUT POWER - DTS [§ 15.247(b)(3)]

### 5.7.1. Limit(s)

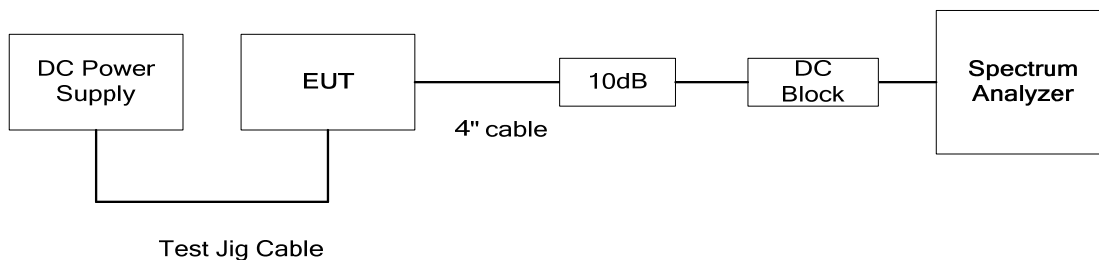
**§ 15.247(b)(3):** For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the *maximum conducted output power* is the highest total transmit power occurring in any mode.

**§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.

### 5.7.2. Method of Measurements & Test Arrangement

KDB Publication No. 558074: Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247) and ANSI C63.10.

### 5.7.3. Test Arrangement





5.7.4. Test Data

<b>Remarks:</b>					
Test method used: Power output option 1, peak measurement.					
Channel No.	Frequency (MHz)	Peak Conducted Power (dBm)	Peak EIRP <sup>(Note 1, 2)</sup> (dBm)	Peak Conducted Power Limit (dBm)	EIRP Limit (dBm)
High Power Setting DC Voltage Input of 3.3 Vdc					
11	2405	19.48	See Notes	30	36
18	2440	18.25	See Notes	30	36
25	2475	17.99	See Notes	30	36
26	2480	-0.52	See Notes	30	36
Low Power Setting, DC Voltage Input of 3.3 Vdc					
11	2405	-0.03	See Notes	30	36
18	2440	-0.64	See Notes	30	36
25	2475	-0.41	See Notes	30	36
26	2480	-0.52	See Notes	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 (antenna gain – cable loss).

Note 2: Compliance with EIRP requirements as shown in the table below:

The maximum assembly antenna gain from each type of antennas, the maximum measured peak conducted power and resulting EIRP values

Assembly #	Maximum Assembly Antenna Gain (dBi)	Maximum Power (dBm)	EIRP (dBm)
1 Omni-directional	14	19.48	33.48
2 Yagi Antenna	10.87	19.48	30.35
3 Flat Panel Antenna	8.68	19.48	28.16
4 Integrated Whip Monopole Antenna	1.5	19.48	20.98
5 Integrated PCB Antenna	0	19.48	19.48

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

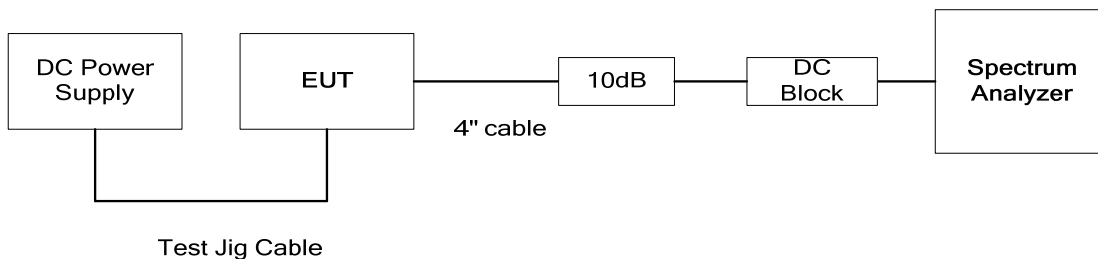
### 5.8.1. Limit(s)

**§ 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.

### 5.8.2. Method of Measurements

KDB Publication No. 558074: Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247) and ANSI C63.10.

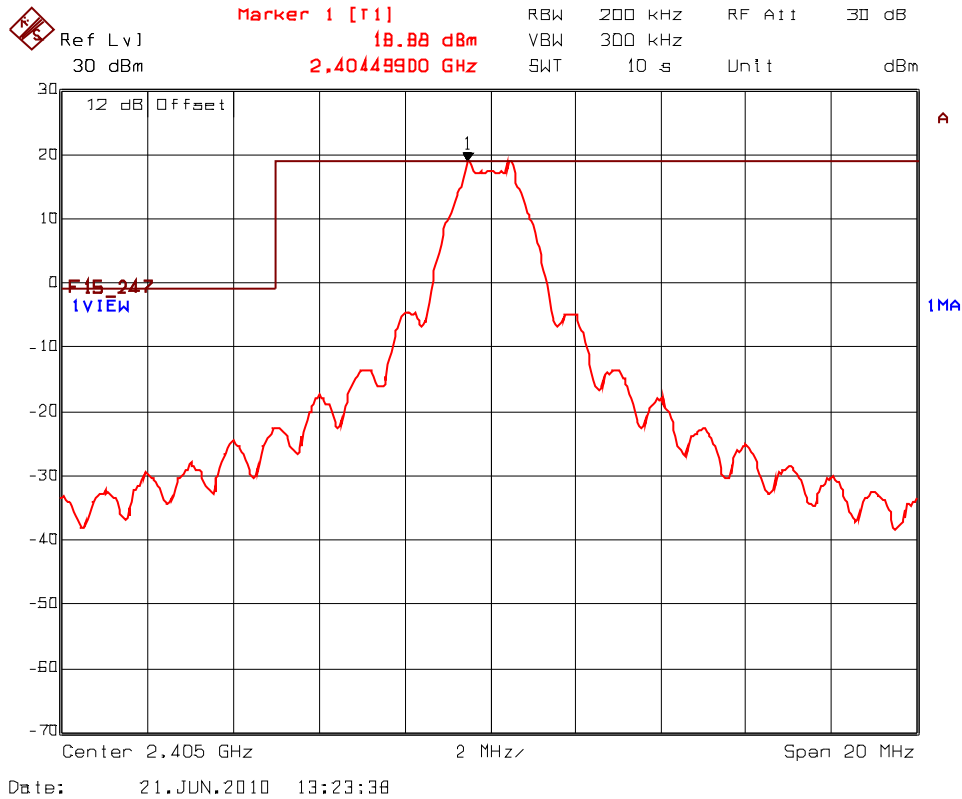
### 5.8.3. Test Arrangement



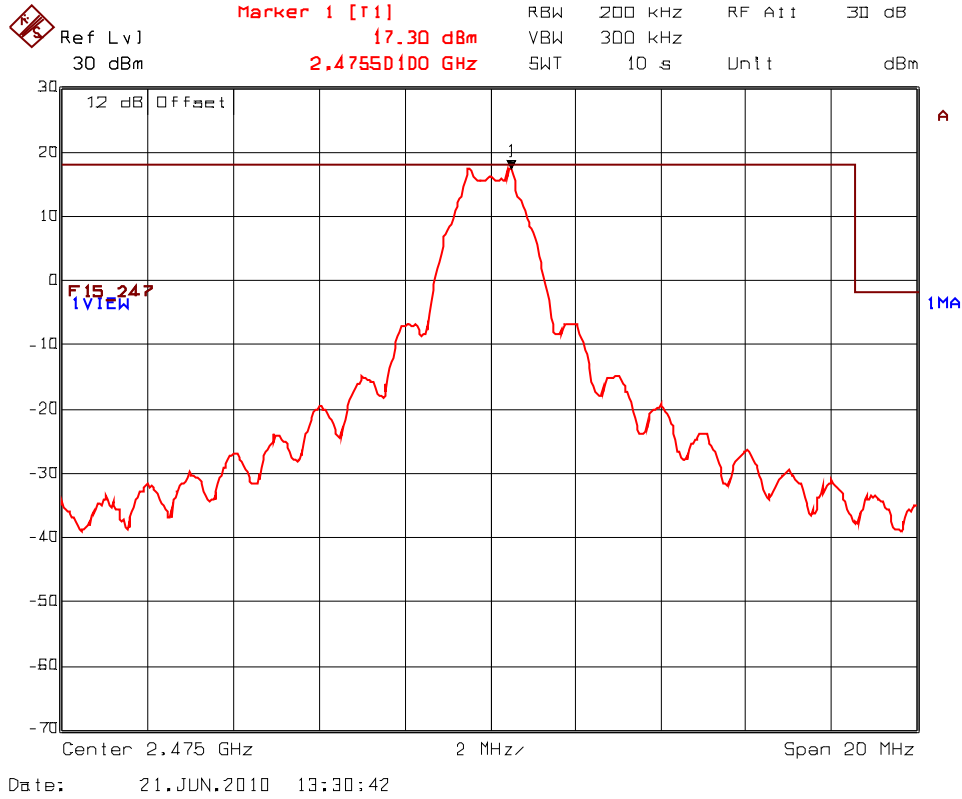
5.8.4. Test Data

5.8.4.1. Band-Edge RF Conducted Emissions

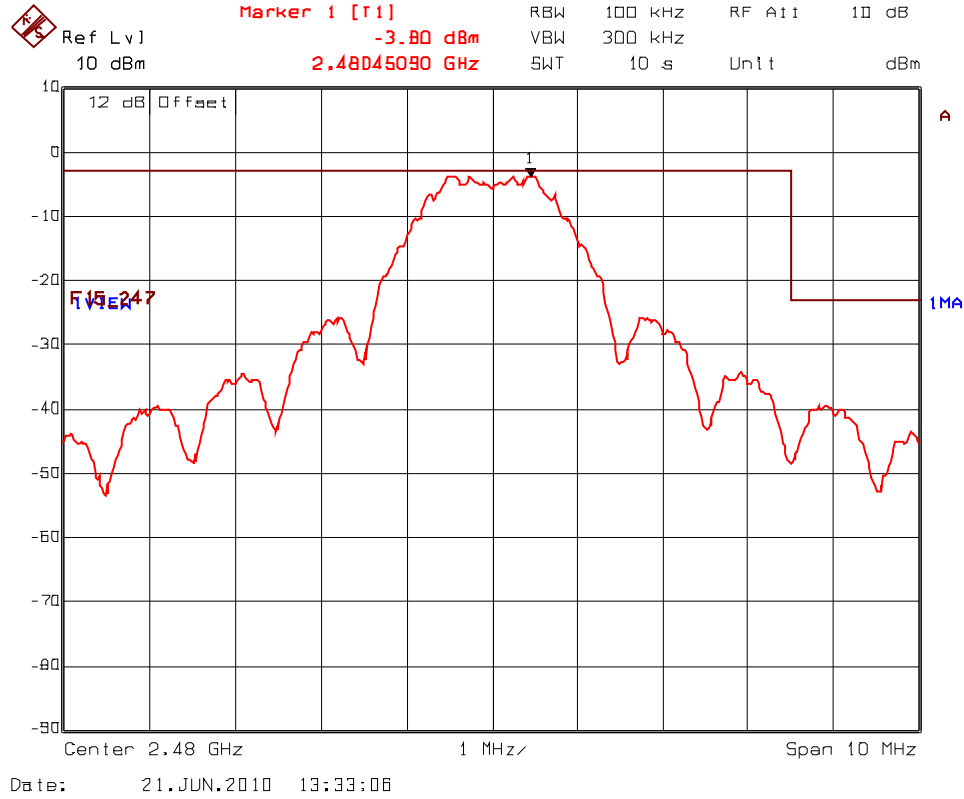
Plot 5.8.4.1.1. Band-Edge RF Conducted Emissions  
Low End of Frequency Band (2405 MHz)



**Plot 5.8.4.1.2. Band-Edge RF Conducted Emissions**  
High End of Frequency Band (2475 MHz, Full Power Level)

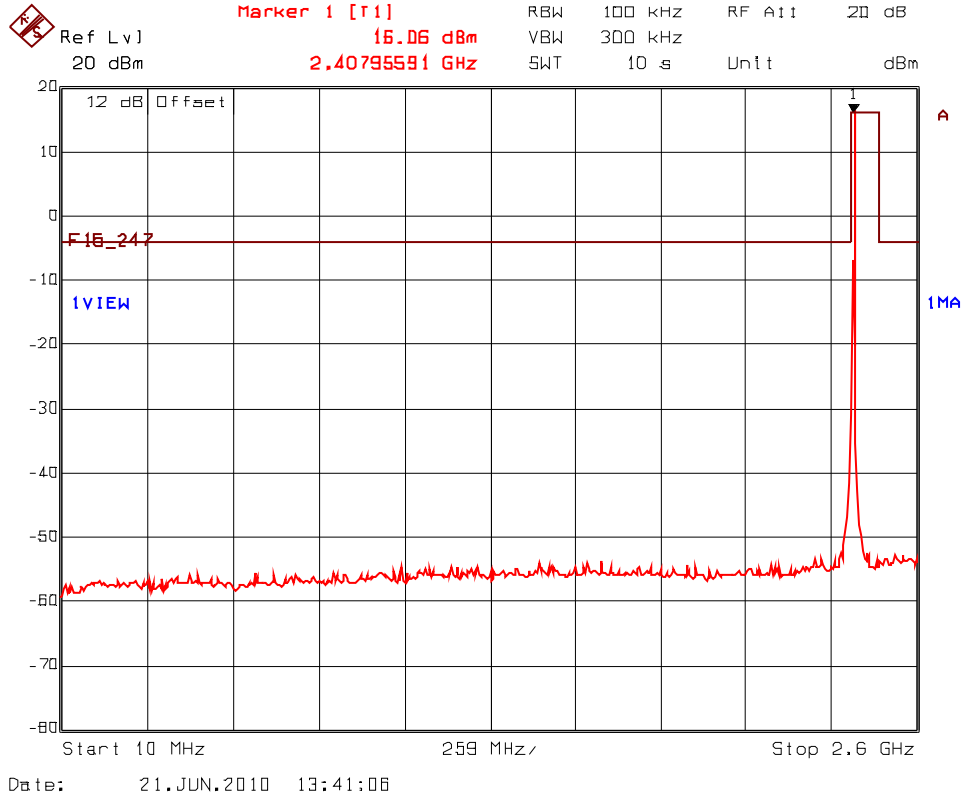


**Plot 5.8.4.1.3. Band-Edge RF Conducted Emissions**  
High End of Frequency Band (2480 MHz, at Reduced Power Level)

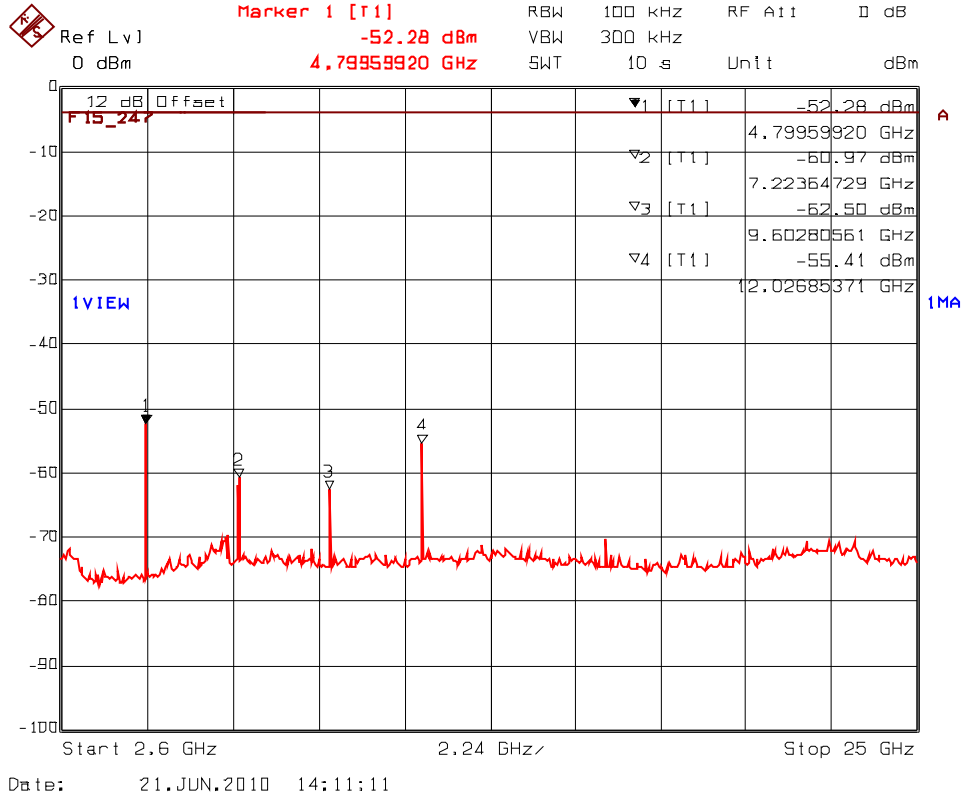


5.8.4.2. Spurious RF Conducted Emissions

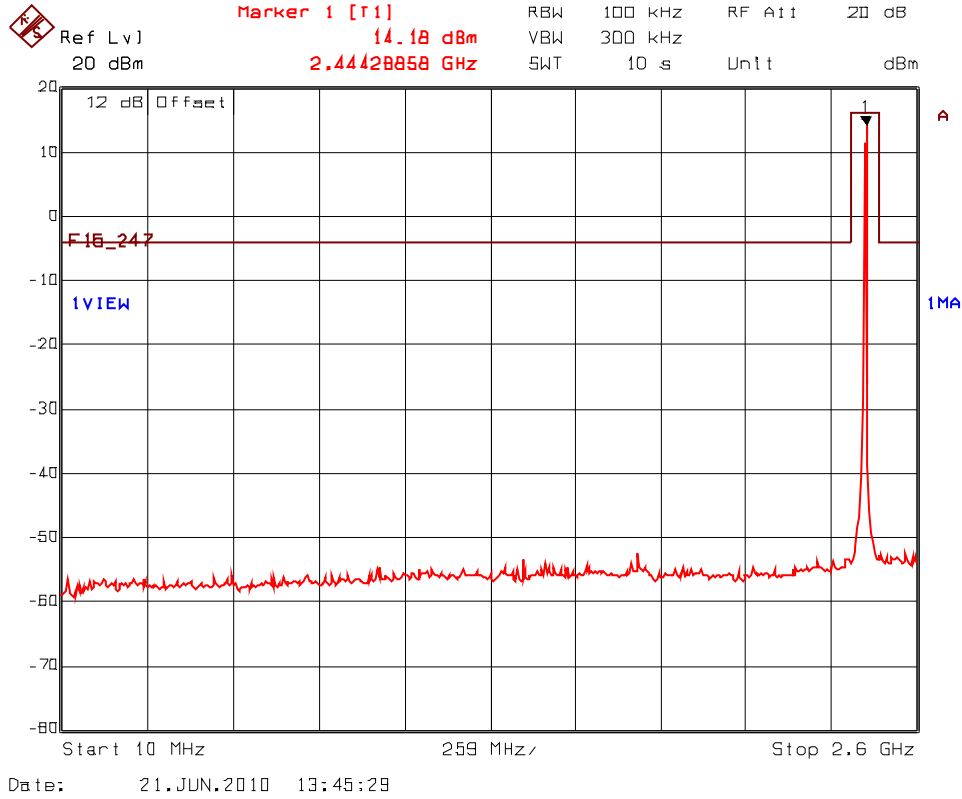
Plot 5.8.4.2.1. Spurious RF Conducted Emissions  
Transmitter Frequency: 2405 MHz, High Power



**Plot 5.8.4.2.2. Spurious RF Conducted Emissions**  
 Transmitter Frequency: 2405 MHz, High Power

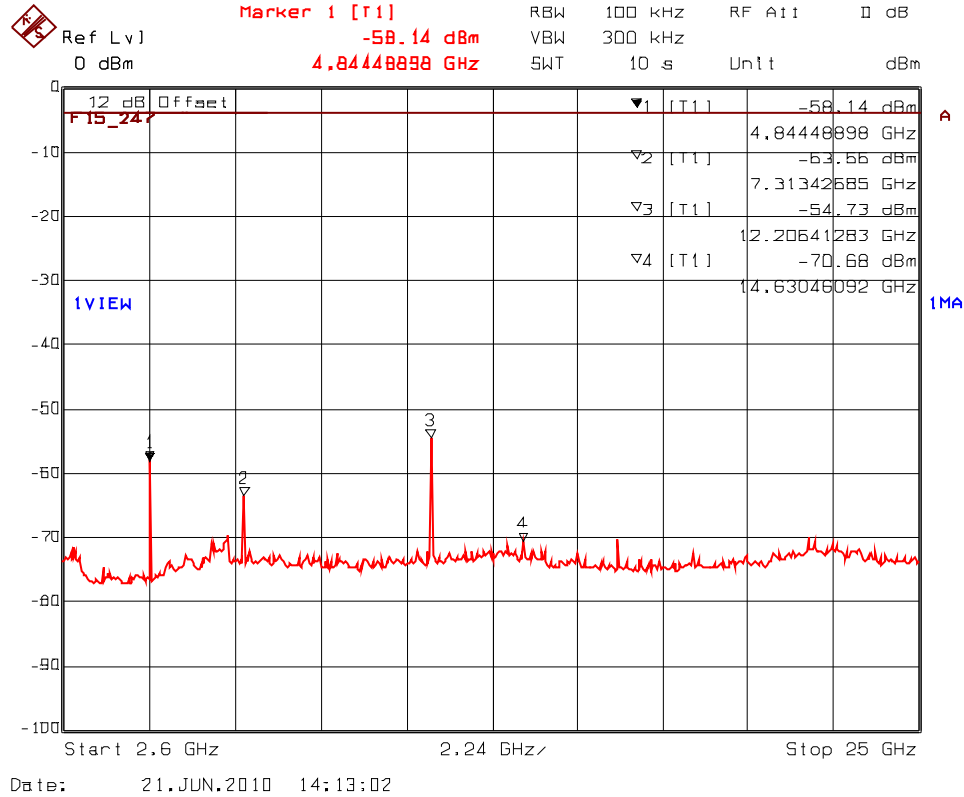


**Plot 5.8.4.2.3. Spurious RF Conducted Emissions**  
Transmitter Frequency: 2440 MHz, High Power

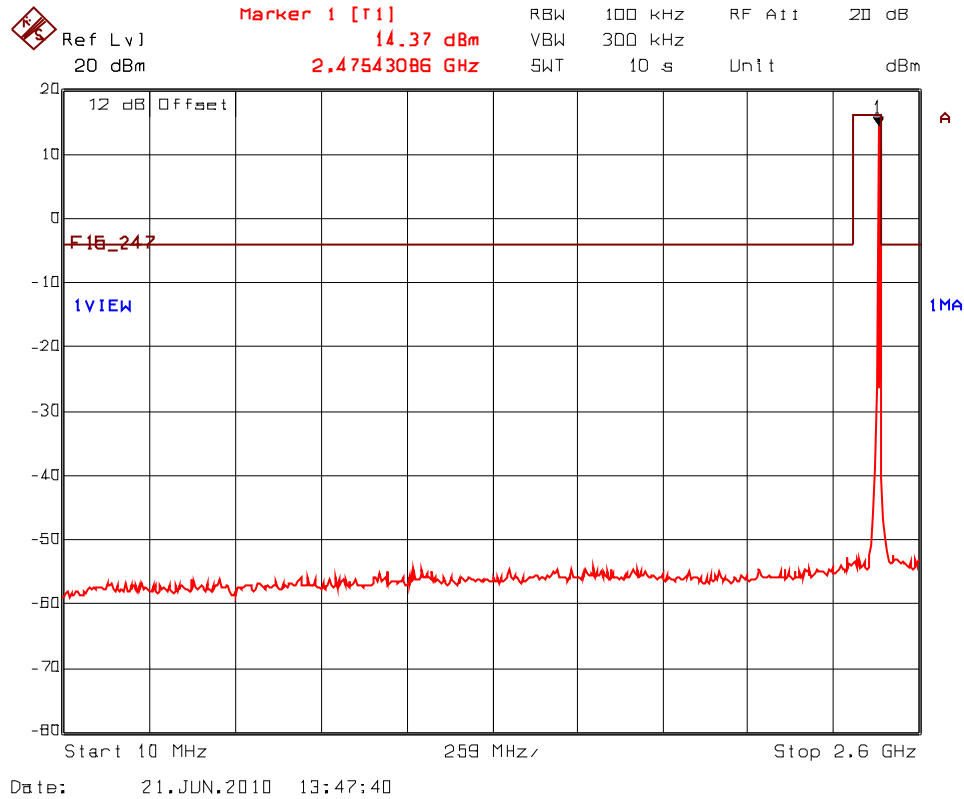




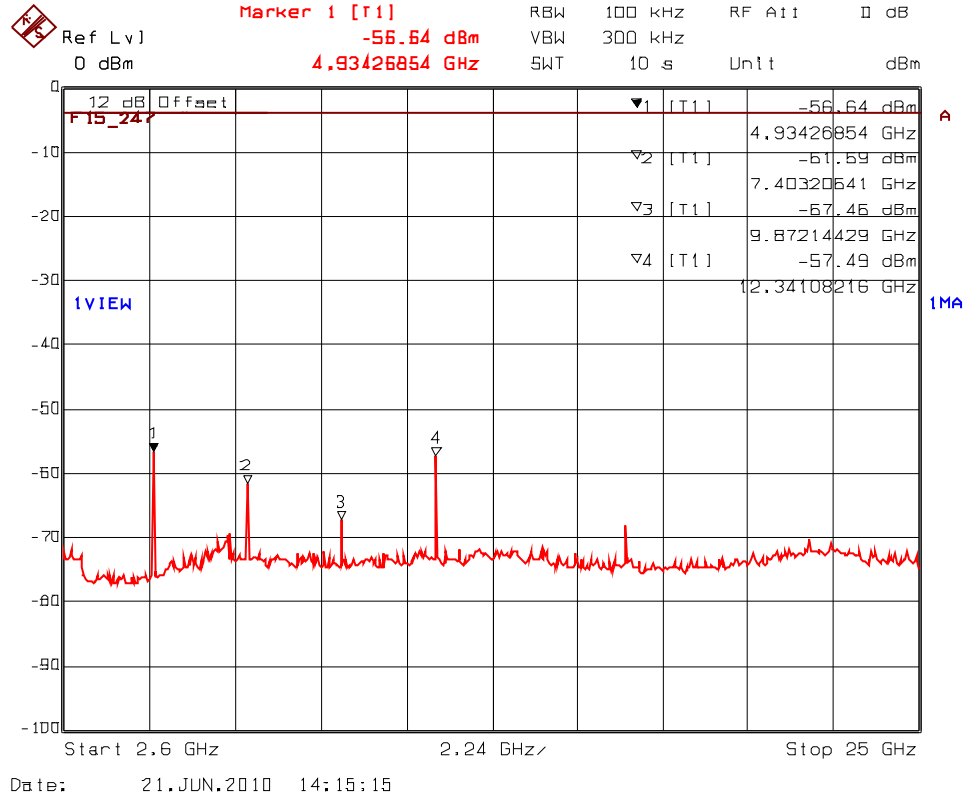
**Plot 5.8.4.2.4. Spurious RF Conducted Emissions**  
 Transmitter Frequency: 2440 MHz, High Power



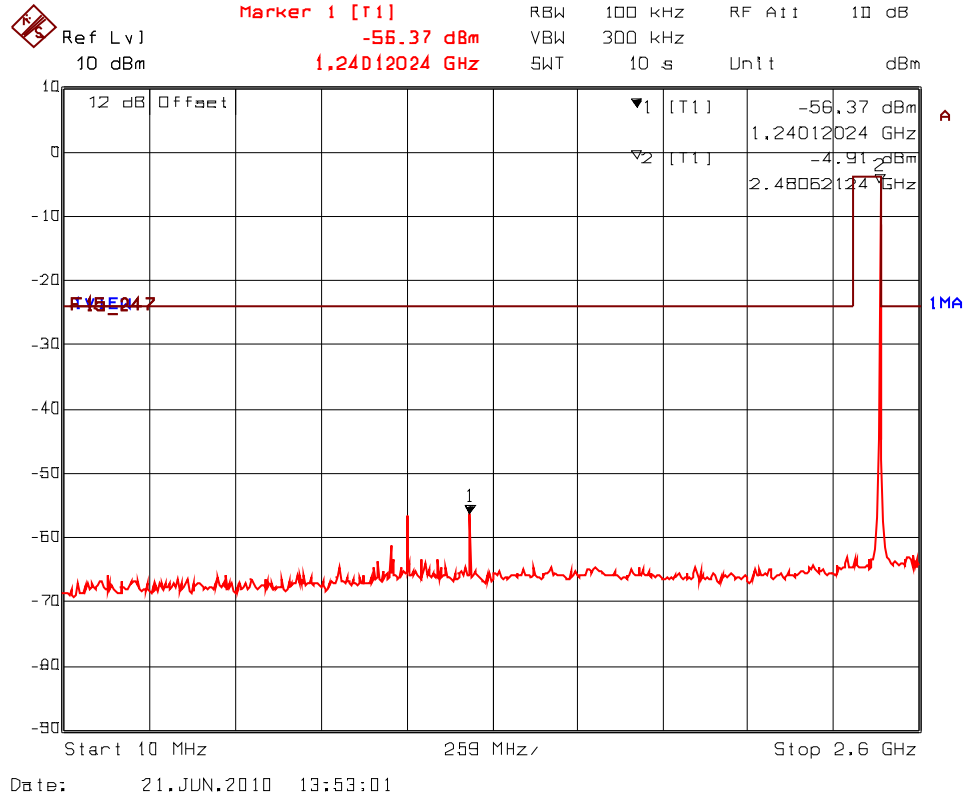
Plot 5.8.4.2.5. Spurious RF Conducted Emissions  
Transmitter Frequency: 2475 MHz, High Power



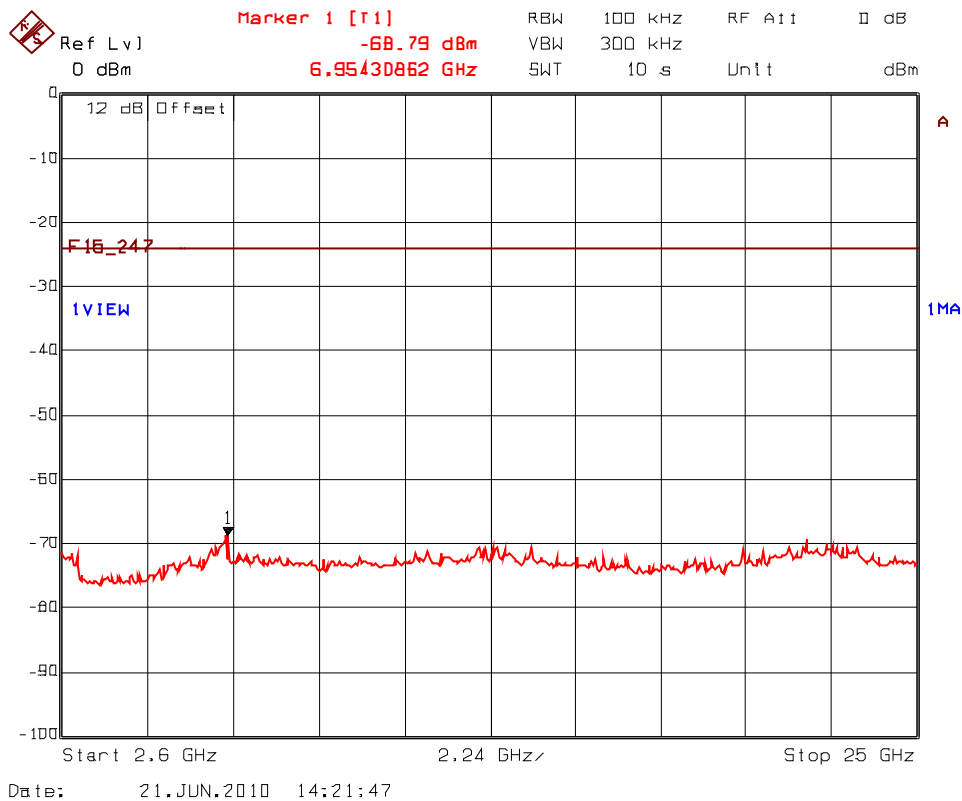
**Plot 5.8.4.2.6. Spurious RF Conducted Emissions**  
 Transmitter Frequency: 2475 MHz, High Power



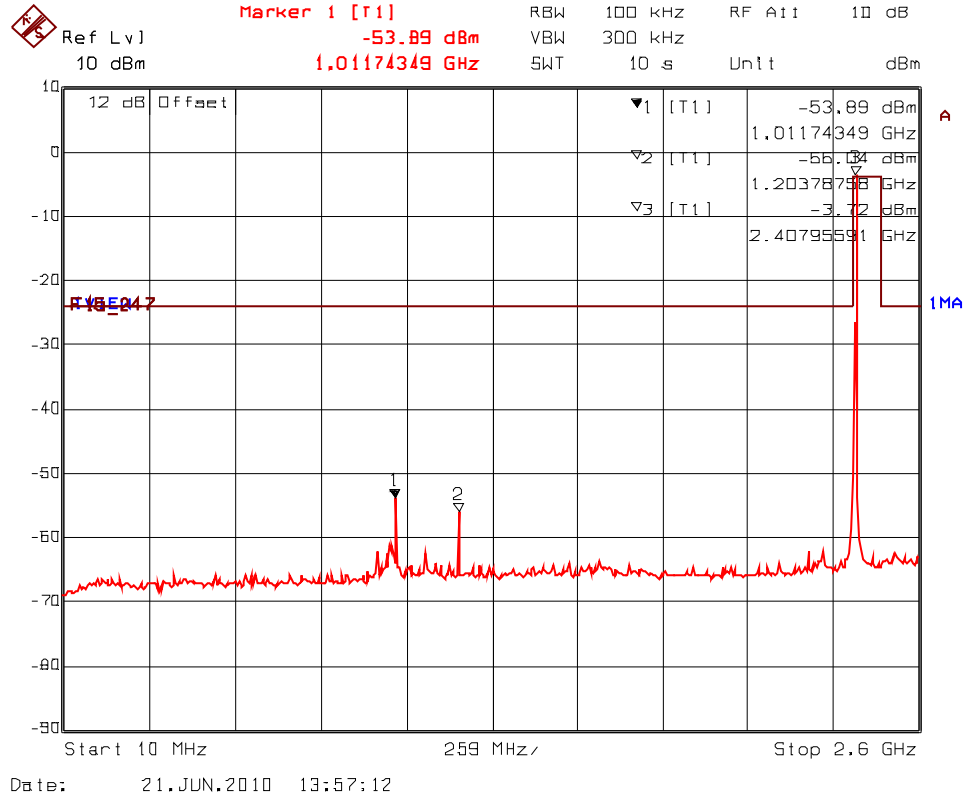
**Plot 5.8.4.2.7. Spurious RF Conducted Emissions**  
 Transmitter Frequency: 2480 MHz, High Power



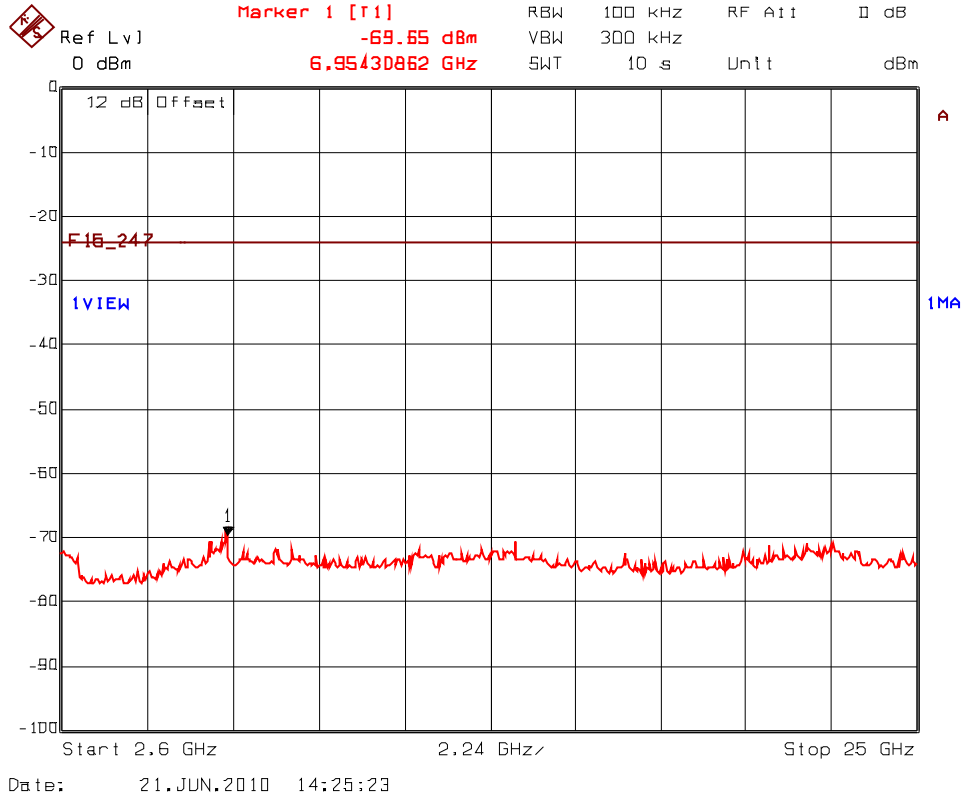
**Plot 5.8.4.2.8. Spurious RF Conducted Emissions**  
Transmitter Frequency: 2480 MHz, High Power



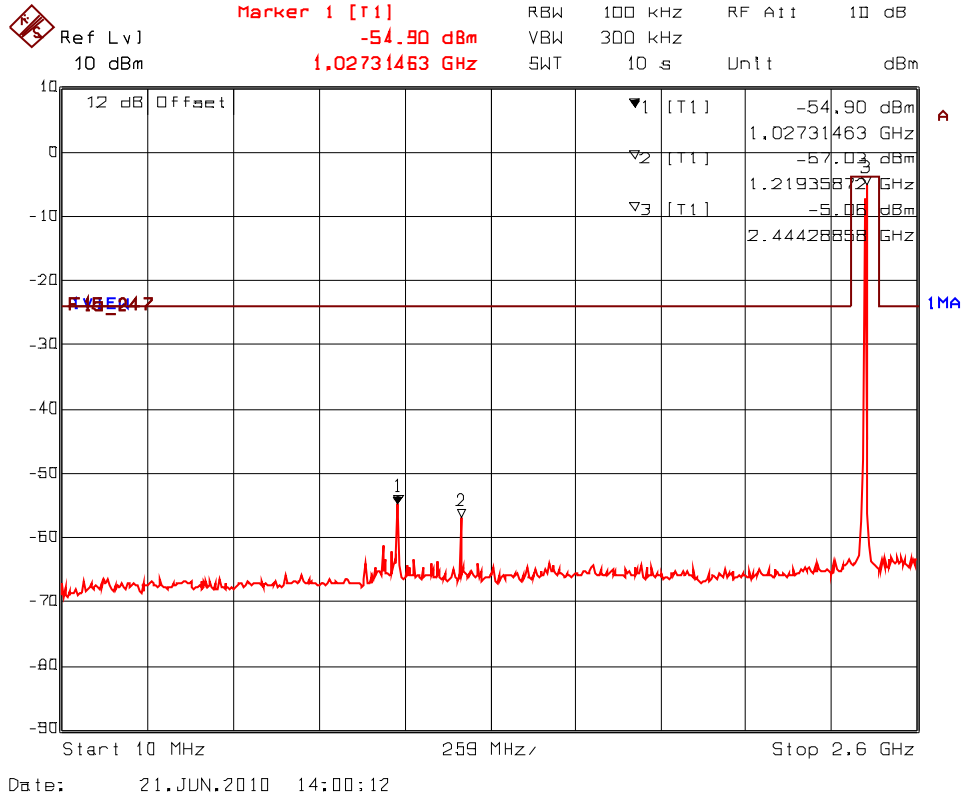
**Plot 5.8.4.2.9. Spurious RF Conducted Emissions**  
 Transmitter Frequency: 2405 MHz, Low Power



**Plot 5.8.4.2.10. Spurious RF Conducted Emissions**  
Transmitter Frequency: 2405 MHz, Low Power

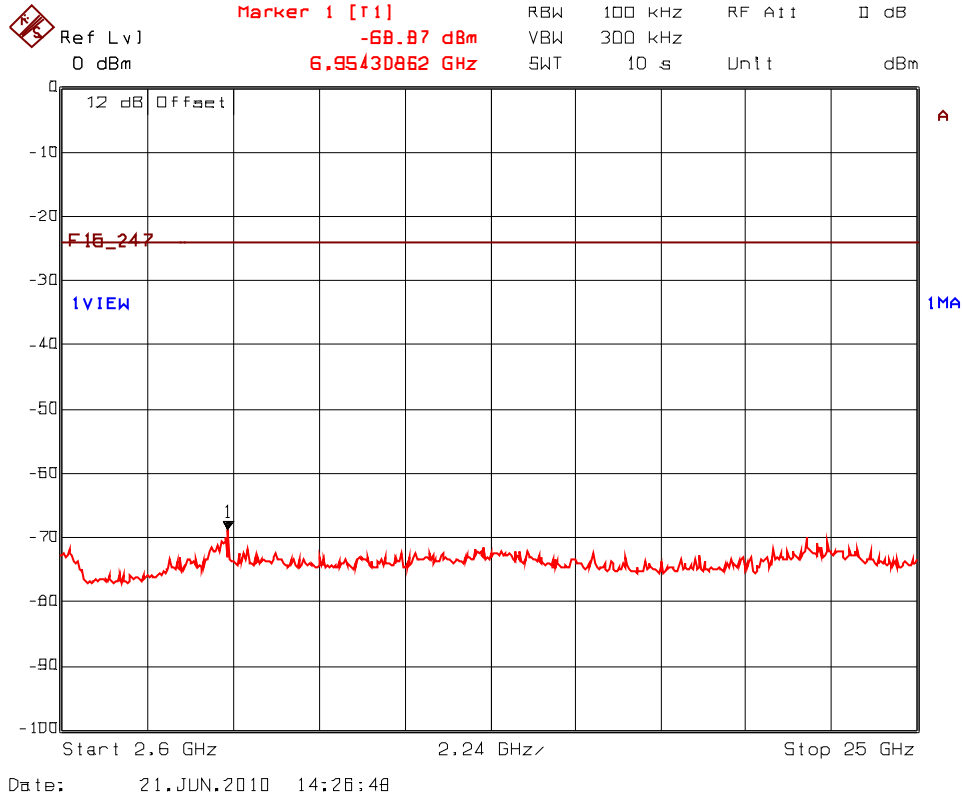


**Plot 5.8.4.2.11. Spurious RF Conducted Emissions**  
 Transmitter Frequency: 2440 MHz, Low Power





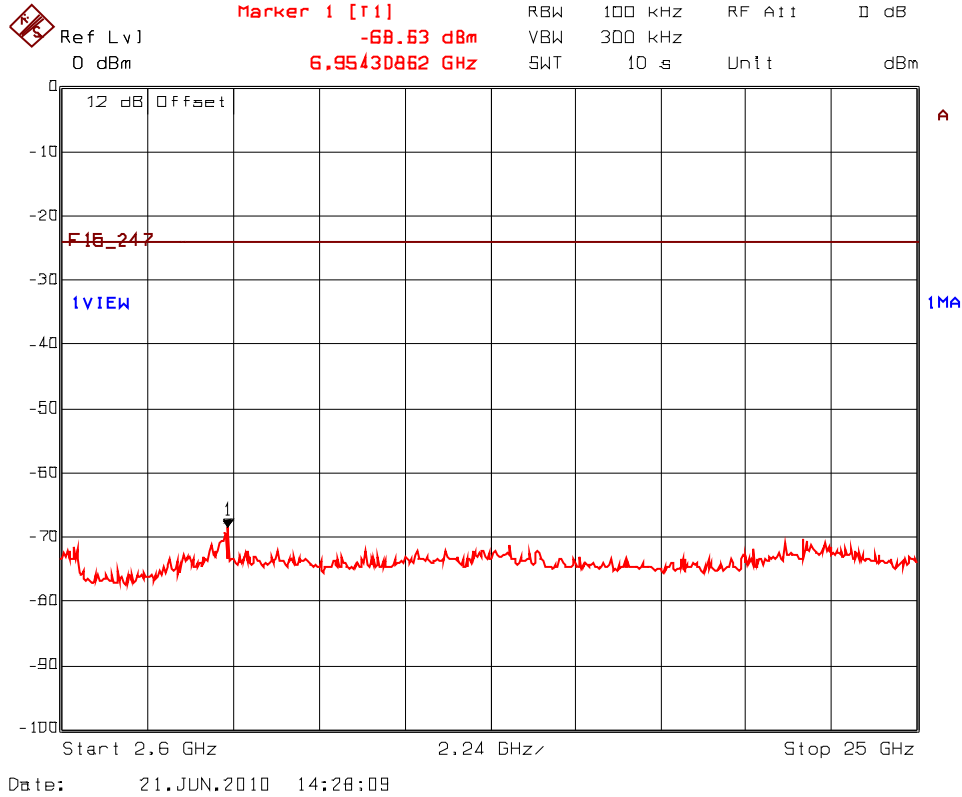
**Plot 5.8.4.2.12. Spurious RF Conducted Emissions**  
Transmitter Frequency: 2440 MHz, Low Power



**Plot 5.8.4.2.13. Spurious RF Conducted Emissions**  
 Transmitter Frequency: 2475 MHz, Low Power



**Plot 5.8.4.2.14. Spurious RF Conducted Emissions**  
Transmitter Frequency: 2475 MHz, Low Power



**ULTRATECH GROUP OF LABS**

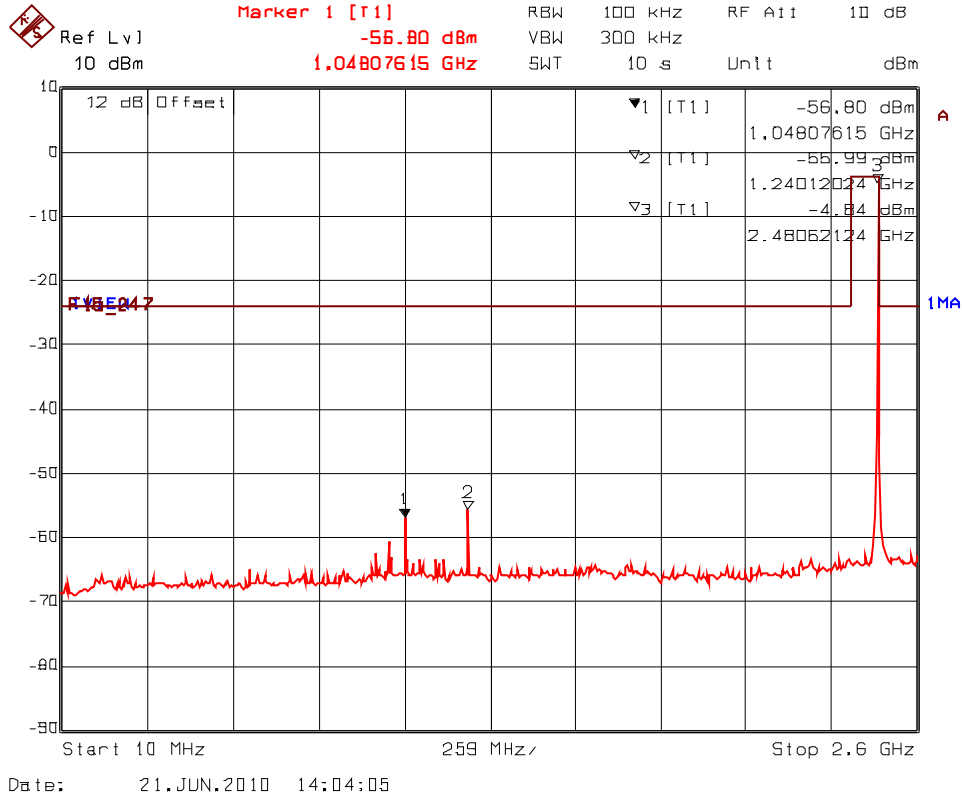
3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4  
Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: [yic@ultratech-labs.com](mailto:yic@ultratech-labs.com), Website: <http://www.ultratech-labs.com>

File #: DIGI-034QF15C247

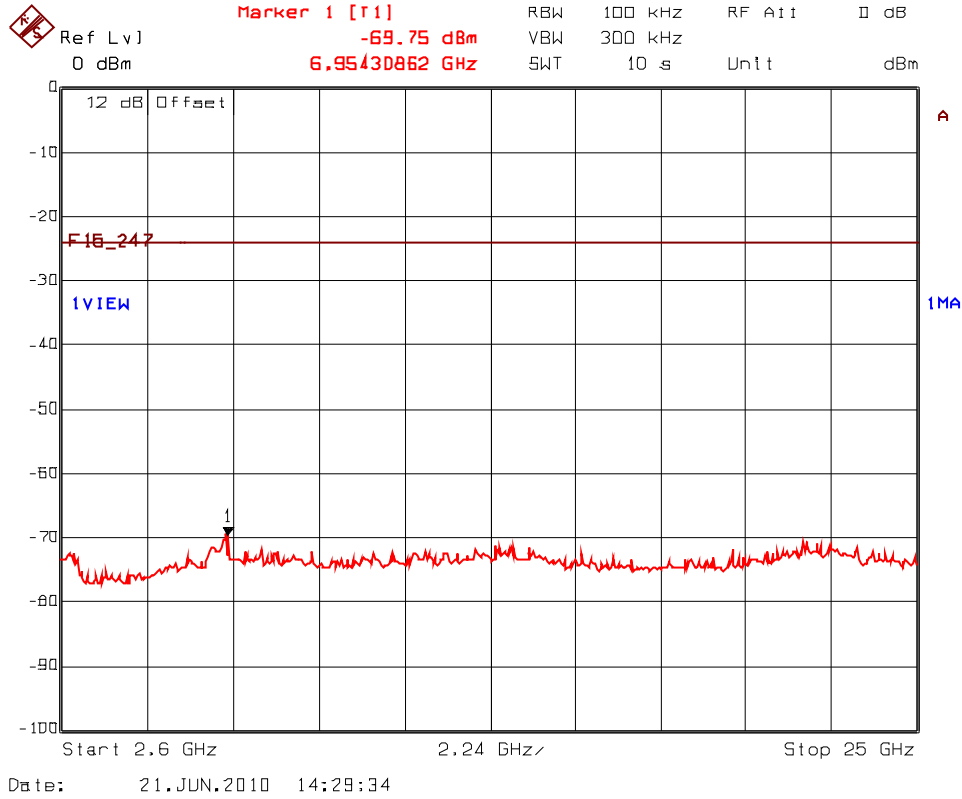
July 6, 2010

All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)

**Plot 5.8.4.2.15. Spurious RF Conducted Emissions**  
 Transmitter Frequency: 2480 MHz, Low Power



**Plot 5.8.4.2.16. Spurious RF Conducted Emissions**  
Transmitter Frequency: 2480 MHz, Low Power



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

**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. 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
<sup>1</sup> 0.495–0.505 .....	16.69475–16.69525	608–614	5.35–5.46
2.1735–2.1905 .....	16.80425–16.80475	960–1240	7.25–7.75
4.125–4.128 .....	25.5–25.67	1300–1427	8.025–8.5
4.17725–4.17775 .....	37.5–38.25	1435–1626.5	9.0–9.2
4.20725–4.20775 .....	73–74.6	1645.5–1646.5	9.3–9.5
6.215–6.218 .....	74.8–75.2	1660–1710	10.6–12.7
6.26775–6.26825 .....	108–121.94	1718.8–1722.2	13.25–13.4
6.31175–6.31225 .....	123–138	2200–2300	14.47–14.5
8.291–8.294 .....	149.9–150.05	2310–2390	15.35–16.2
8.362–8.366 .....	156.52475–156.52525	2483.5–2500	17.7–21.4
8.37625–8.38675 .....	156.7–156.9	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	( <sup>2</sup> )
13.36–13.41 .....			

<sup>1</sup> Until February 1, 1999, this restricted band shall be 0.490–0.510 MHz.  
<sup>2</sup> Above 38.6

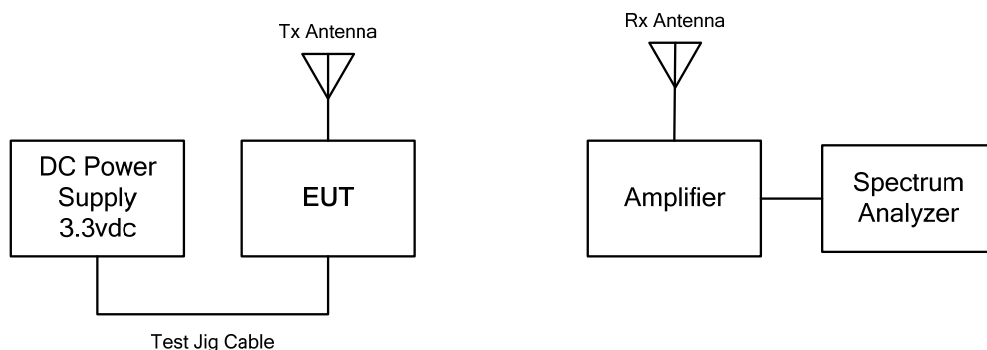
**Section 15.209(a)**  
**-- Field Strength Limits within Restricted Frequency Bands --**

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

### 5.9.2. Method of Measurements

KDB Publication No. 558074: Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247) and ANSI C63.10.

### 5.9.3. Test Arrangement



#### 5.9.4. Test Data

##### 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.
- A duty cycle correction factor of 27% (-11.37dB) shall be applied to a measurement made with an average detector.
- Band-edges compliance condition: EUT connected to antennas via antenna feedline must have a minimum cable loss as specified in the test configurations and the following table.

Antenna Type	Maximum Antenna Gain (dBi)	Minimum Cable Loss (dB)	
		2405 - 2475 MHz	2480 MHz
Omni Directional Antenna	15	1	1
Yagi Antenna	15	4.13	4.13
Flat Panel Antenna	19	10.32	10.32
Integrated Monopole Antenna	1.5	N/A	N/A
Integrated PCB Antenna	0	N/A	N/A



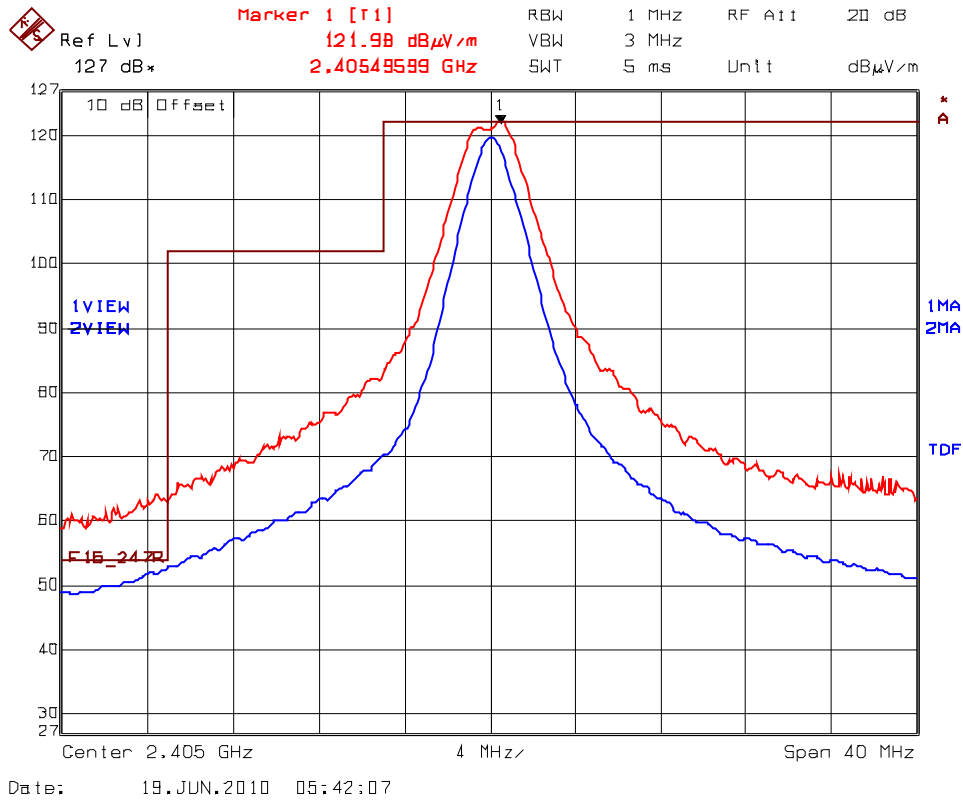
5.9.4.1. EUT with Omni Directional Antenna [15 dBi Gain with 1 dB Cable Loss]

Fundamental Frequency:		2405 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
2405	120.97	--	V	--	--	--	--
2405	121.98	--	H	--	--	--	--
4810	57.71	36.39	V	54.0	102.0	-17.6	Pass*
4810	57.62	36.30	H	54.0	102.0	-17.7	Pass*
12025	61.62	38.47	V	54.0	102.0	-15.5	Pass*
12025	65.87	42.15	H	54.0	102.0	-11.9	Pass*

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

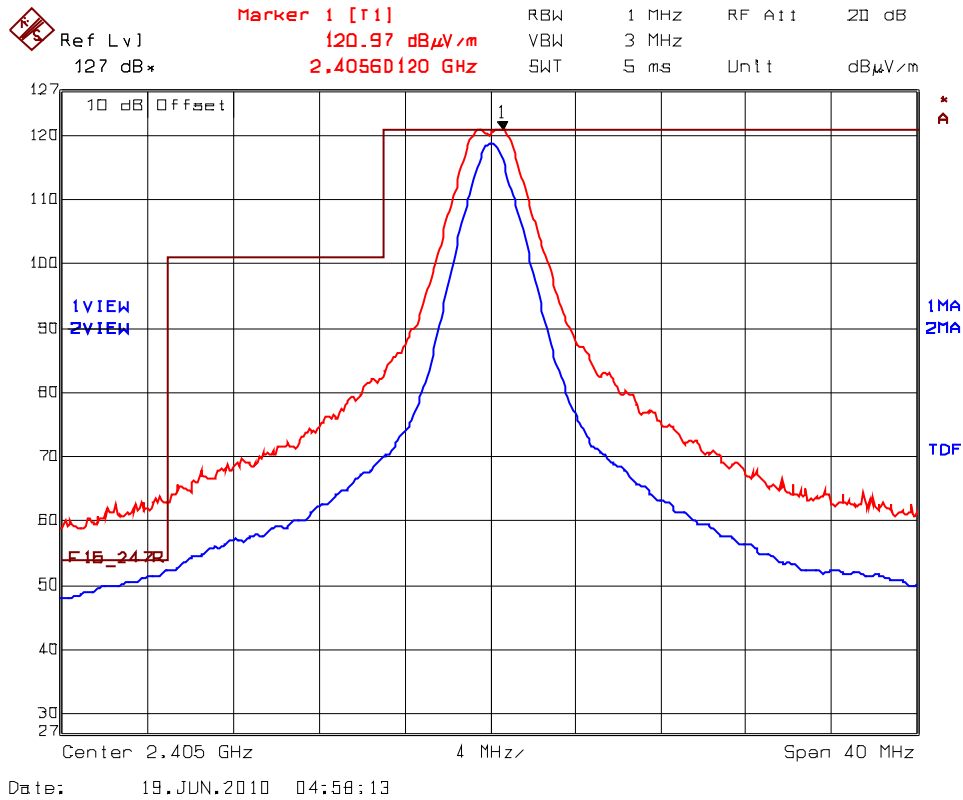
See the following test data plots for band-edge emissions.

**Plot 5.9.4.1.1. Band-Edge RF Radiated Emissions @ 3 m**  
 Low End of Frequency Band, 2405 MHz  
 Rx Antenna Orientation: Horizontal



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

**Plot 5.9.4.1.2. Band-Edge RF Radiated Emissions @ 3 m**  
 Low End of Frequency Band, 2405 MHz  
 Rx Antenna Orientation: Vertical



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

Fundamental Frequency: 2440 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
2440	121.21	--	V	--	--	--	--
2440	121.20	--	H	--	--	--	--
4880	59.40	38.23	V	54.0	101.2	-15.8	Pass*
4880	59.49	38.45	H	54.0	101.2	-15.6	Pass*
7320	66.25	43.84	V	54.0	101.2	-10.2	Pass*
7320	69.87	46.75	H	54.0	101.2	-7.3	Pass*
12200	64.11	39.61	V	54.0	101.2	-14.4	Pass*
12200	66.25	43.42	H	54.0	101.2	-10.6	Pass*

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

Fundamental Frequency: 2475 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
2475	123.28	--	V	--	--	--	--
2475	120.11	--	H	--	--	--	--
4950	62.18	41.77	V	54.0	103.3	-12.2	Pass*
4950	63.73	43.49	H	54.0	103.3	-10.5	Pass*
7425	67.84	44.83	V	54.0	103.3	-9.2	Pass*
7425	70.11	47.10	H	54.0	103.3	-6.9	Pass*
12375	61.54	37.73	V	54.0	103.3	-16.3	Pass*
12375	64.25	40.90	H	54.0	103.3	-13.1	Pass*

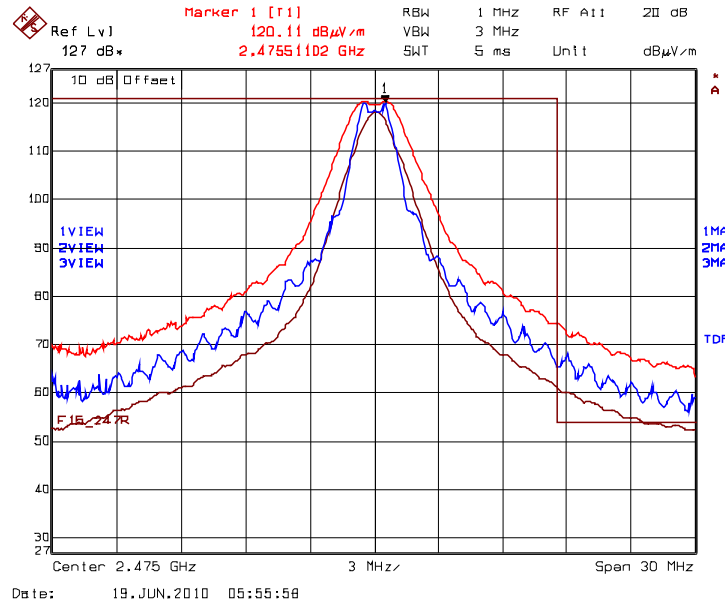
\*Field strength of emissions appearing within restricted frequency bands shall not exceed the limits in § 15.209.

Fundamental Frequency: 2480 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
2480	102.16	--	V	--	--	--	--
2480	101.11	--	H	--	--	--	--
30 -25000	*	*	V/H	*	82.2	*	Pass

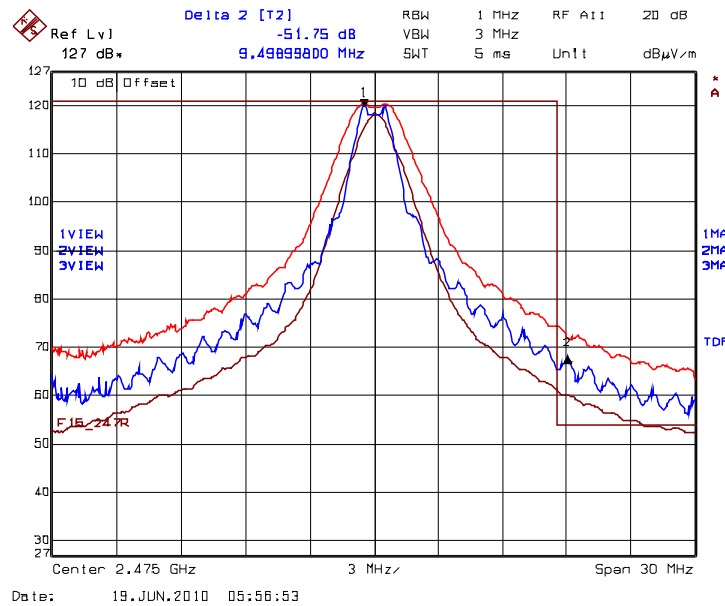
\*The spurious emissions from intentional radiators are more than 20 dB below the specified limit.

See the following test data plots for band-edge emissions.

**Plot 5.9.4.1.3. Band-Edge RF Radiated Emissions @ 3 m**  
 High End of Frequency Band, 2475 MHz, Rx Antenna Orientation: Horizontal

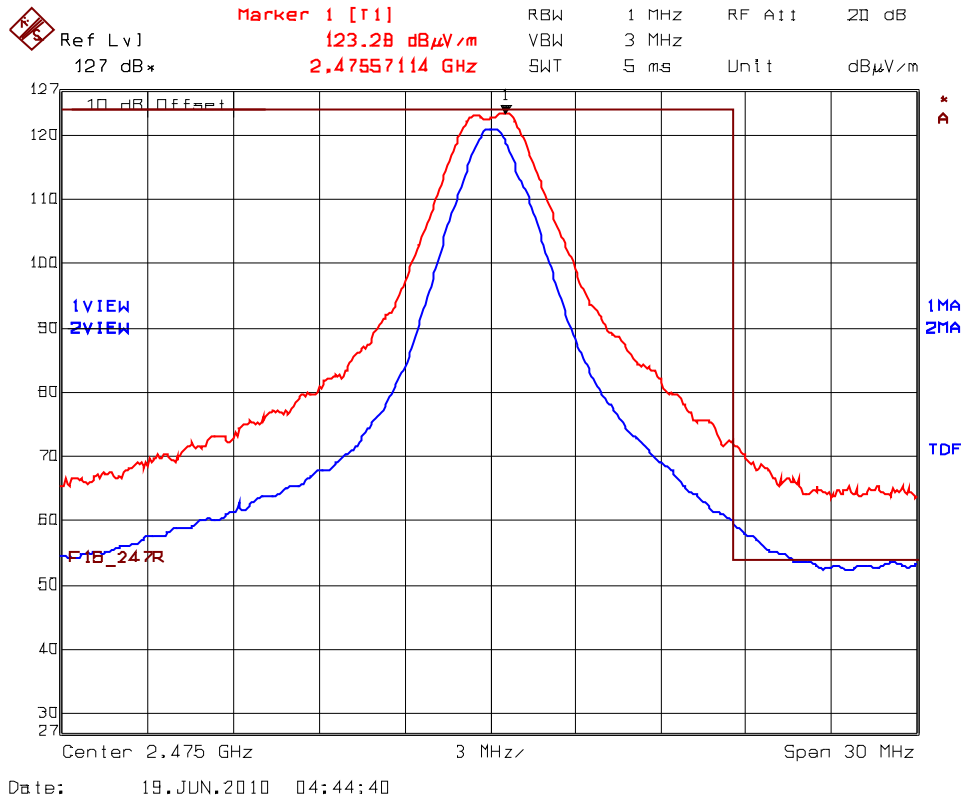


**Plot 5.9.4.1.4. Band-Edge RF Radiated Emissions @ 3 m**  
 High End of Frequency Band, 2475 MHz, Rx Antenna Orientation: Horizontal



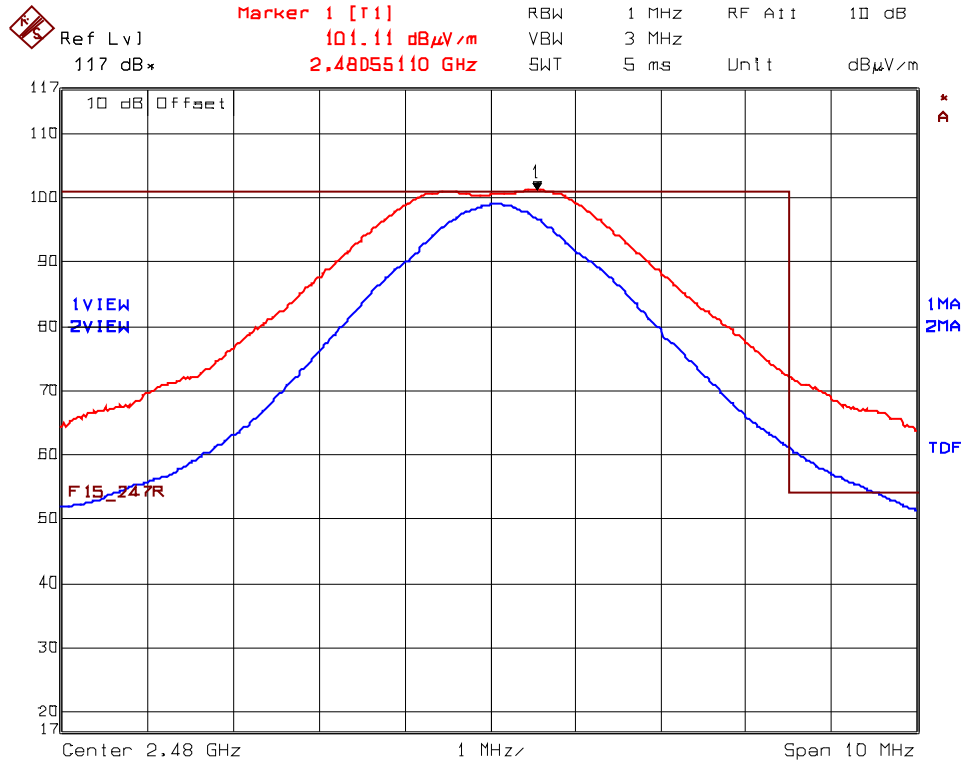
Trace 1: RBW = 1 MHz, VBW = 3 MHz  
 Trace 2: RBW = 300 kHz, VBW = 500 kHz, Delta (Peak to Band-Edge): 51.75 dB  
 Trace 3: RBW = 1 MHz, VBW = 10 Hz  
 Peak Band-Edge at 2483.5 MHz:  $Pea_k = 120.11 \text{ dB}\mu\text{V/m} - 51.75 \text{ dB} = 68.36 \text{ dB}\mu\text{V/m}$  (limit 74 dBµV/m)  
 Average:  $61.24 \text{ dB}\mu\text{V/m} - 11.37 \text{ dB} = 49.87 \text{ dB}\mu\text{V/m}$  (limit 54 dBµV/m)

**Plot 5.9.4.1.5. Band-Edge RF Radiated Emissions @ 3 m**  
 High End of Frequency Band, 2475 MHz  
 Rx Antenna Orientation: Vertical



Trace 1: RBW = 1 MHz, VBW = 3 MHz  
 Trace 2: RBW = 1 MHz, VBW = 10 Hz  
 Peak 2483.5 MHz: 72.26 dBµV/m  
 Average: 59.81 dBµV /m - 11.37 dB = 48.44 dBµV/m (limit 54 dBµV/m)

**Plot 5.9.4.1.6. Band-Edge RF Radiated Emissions @ 3 m**  
 High End of Frequency Band, 2480 MHz  
 Rx Antenna Orientation: Horizontal

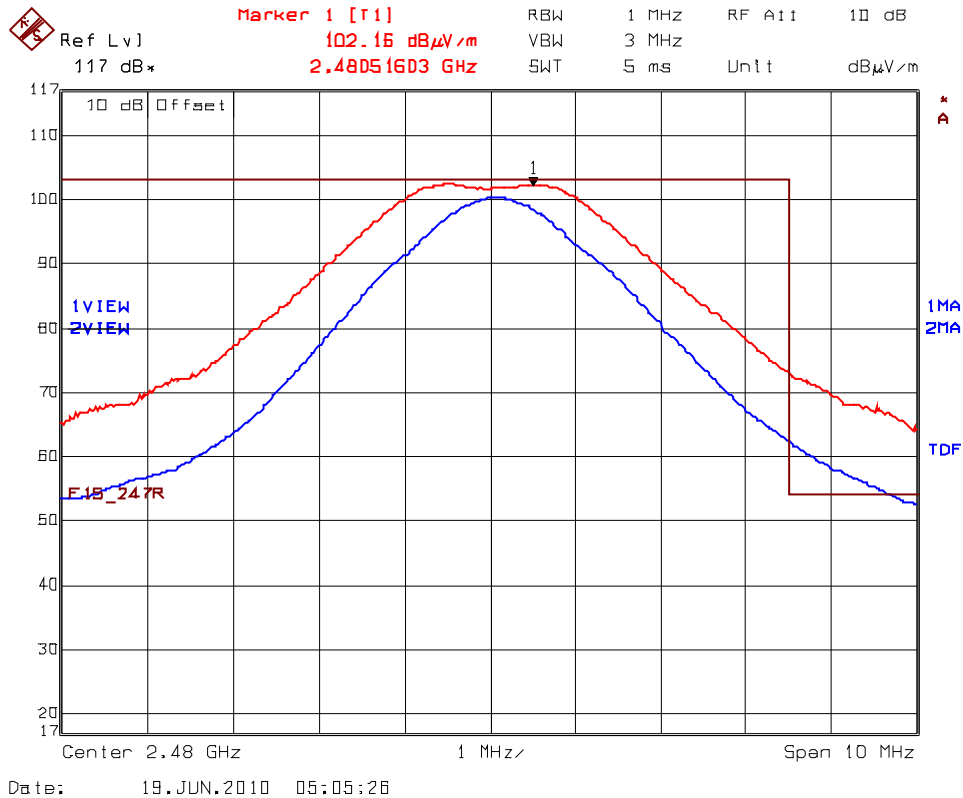


Date: 19 JUN 2010 06:06:49

Trace 1: RBW = 1 MHz, VBW = 3 MHz  
 Trace 2: RBW = 1 MHz, VBW = 10 Hz  
 Peak 2483.5 MHz: 71.77 dBμV/m  
 Average: 60.85 dBμV/m - 11.37 dB = 49.48 dBμV/m (limit 54 dBμV/m)



**Plot 5.9.4.1.7. Band-Edge RF Radiated Emissions @ 3 m**  
 High End of Frequency Band, 2480 MHz  
 Rx Antenna Orientation: Vertical



Trace 1: RBW = 1 MHz, VBW = 3 MHz  
 Trace 2: RBW = 1 MHz, VBW = 10 Hz  
 Peak 2483.5 MHz: 72.87 dBμV/m  
 Average: 62.09 dBμV/m - 11.37 dB = 50.72 dBμV/m (limit 54 dBμV/m)

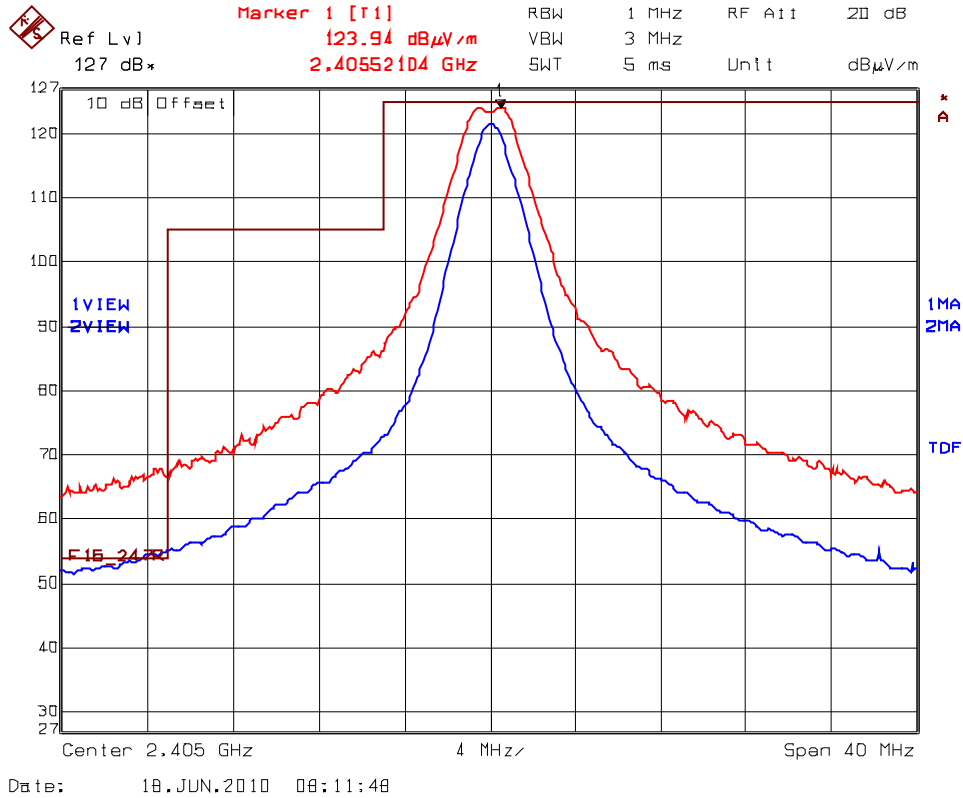
**5.9.4.2. EUT with Yagi Antenna [15 dBi Gain with 4.13 dB Cable Loss]**

Fundamental Frequency:		2405 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
2405	123.07	--	V	--	--	--	--
2405	123.94	--	H	--	--	--	--
4810	58.23	36.70	V	54.0	103.9	-17.3	Pass*
4810	58.64	38.65	H	54.0	103.9	-15.4	Pass*
12025	68.26	44.98	V	54.0	103.9	-9.0	Pass*
12025	68.97	44.87	H	54.0	103.9	-9.1	Pass*

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

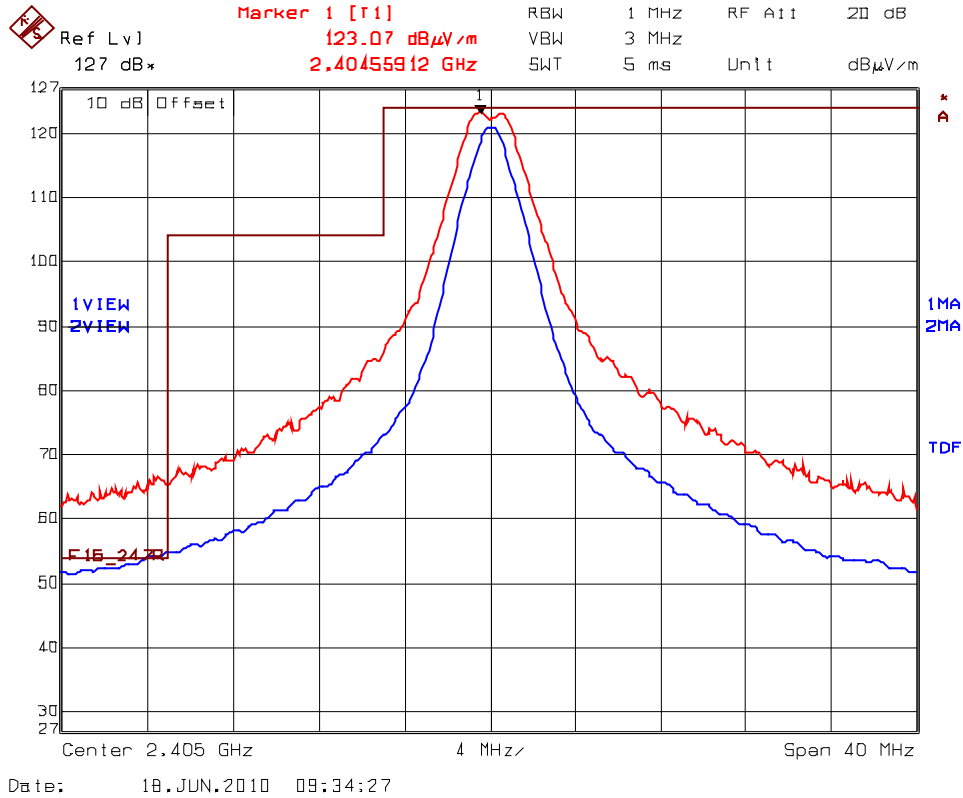
See the following test data plots for band-edge emissions.

**Plot 5.9.4.2.1. Band-Edge RF Radiated Emissions @ 3 m**  
Low End of Frequency Band, 2405 MHz  
Rx Antenna Orientation: Horizontal



Trace 1: RBW = 1 MHz, VBW = 3 MHz  
Trace 2: RBW = 1 MHz, VBW = 10 Hz  
Average value at 2390 MHz: 55.23 dBµV/m - 11.37 dB = 43.86 dBµV/m

**Plot 5.9.4.2.2. Band-Edge RF Radiated Emissions @ 3 m**  
 Low End of Frequency Band, 2405 MHz  
 Rx Antenna Orientation: Vertical



Trace 1: RBW = 1 MHz, VBW = 3 MHz  
 Trace 2: RBW = 1 MHz, VBW = 10 Hz  
 Average value at 2390 MHz: 54.89 dBµV/m - 11.37 dB = 43.52 dBµV/m

Fundamental Frequency: 2440 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
2440	123.17	--	V	--	--	--	--
2440	123.26	--	H	--	--	--	--
4880	58.65	37.18	V	54.0	103.3	-16.8	Pass*
4880	59.53	38.64	H	54.0	103.3	-15.4	Pass*
7320	68.31	45.52	V	54.0	103.3	-8.5	Pass*
7320	68.27	45.66	H	54.0	103.3	-8.3	Pass*
12200	68.67	45.72	V	54.0	103.3	-8.3	Pass*
12200	69.00	45.79	H	54.0	103.3	-8.2	Pass*

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

Fundamental Frequency: 2475 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
2475	123.91	--	V	--	--	--	--
2475	124.06	--	H	--	--	--	--
4950	63.20	42.61	V	54.0	104.1	-11.4	Pass*
4950	61.09	40.49	H	54.0	104.1	-13.5	Pass*
7425	70.62	47.49	V	54.0	104.1	-6.5	Pass*
7425	70.41	47.15	H	54.0	104.1	-6.8	Pass*
12375	66.17	43.13	V	54.0	104.1	-10.9	Pass*
12375	66.98	43.60	H	54.0	104.1	-10.4	Pass*

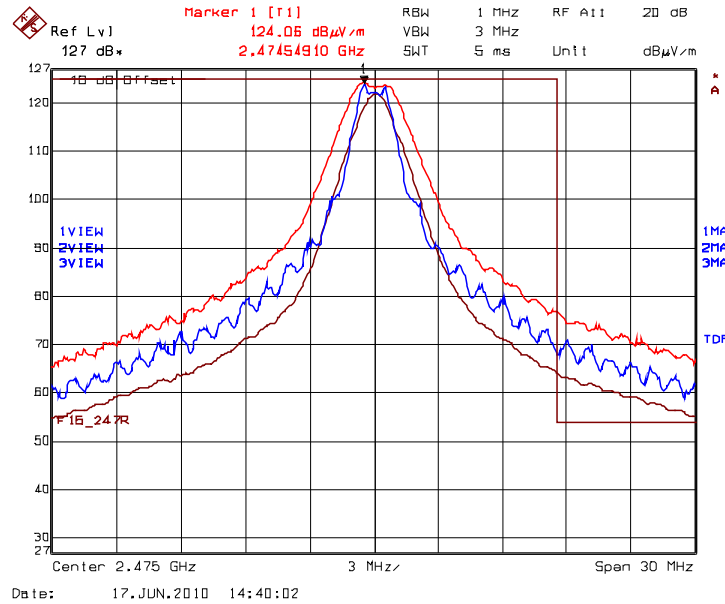
\*Field strength of emissions appearing within restricted frequency bands shall not exceed the limits in § 15.209.

Fundamental Frequency: 2480 MHz							
Test Frequency Range: 30 MHz – 25 GHz							
Frequency (MHz)	RF Peak Level (dB $\mu$ V/m)	RF Avg Level (dB $\mu$ V/m)	Antenna Plane (H/V)	Limit 15.209 (dB $\mu$ V/m)	Limit 15.247 (dB $\mu$ V/m)	Margin (dB)	Pass/Fail
2480	104.92	--	V	--	--	--	--
2480	105.27	--	H	--	--	--	--
30 -25000	*	*	V/H	*	85.3	*	Pass

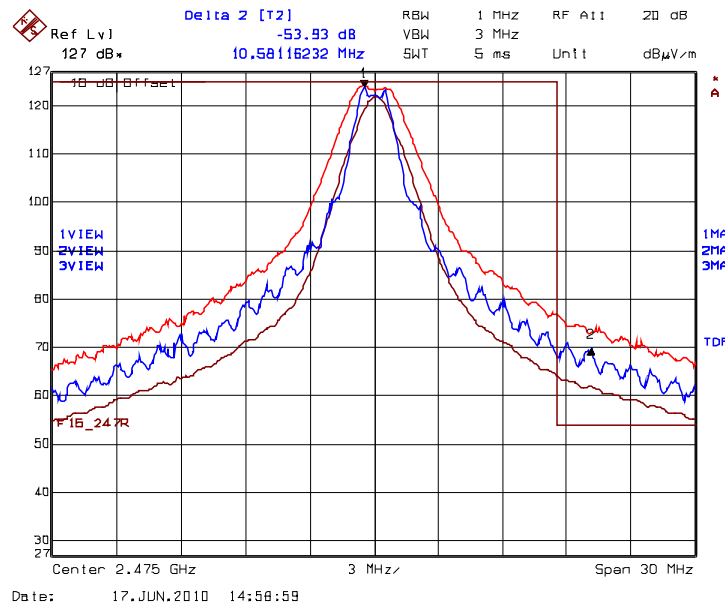
\*The spurious emissions from intentional radiators are more than 20 dB below the specified limit.

See the following test data plots for band-edge emissions.

**Plot 5.9.4.2.3. Band-Edge RF Radiated Emissions @ 3 m**  
 High End of Frequency Band, 2475 MHz, Rx Antenna Orientation: Horizontal

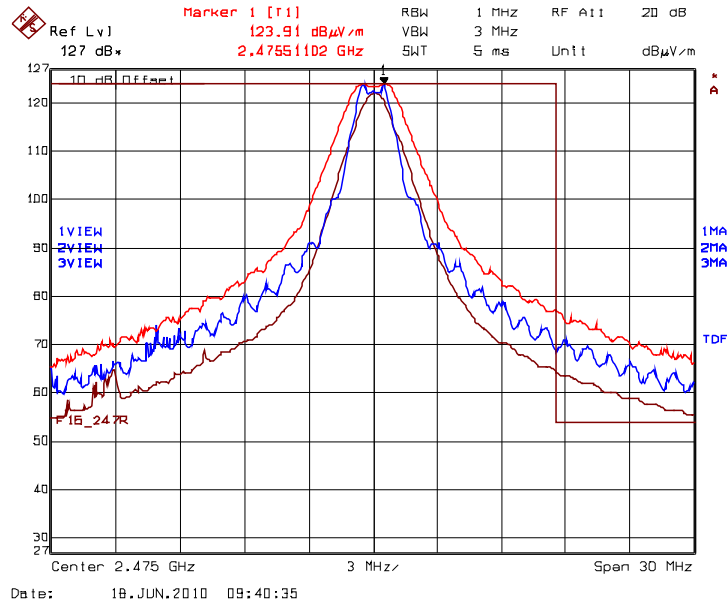


**Plot 5.9.4.2.4. Band-Edge RF Radiated Emissions @ 3 m**  
 High End of Frequency Band, 2475 MHz, Rx Antenna Orientation: Horizontal

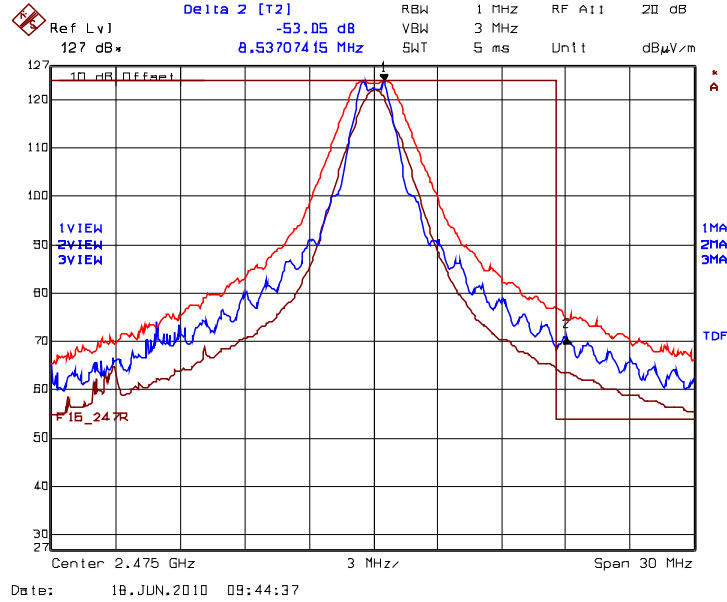


Trace 1: RBW = 1 MHz, VBW = 3 MHz  
 Trace 2: RBW = 300 kHz, VBW = 500 kHz, Delta (Peak to Band-Edge): 53.93 dB  
 Trace 3: RBW = 1 MHz, VBW = 10 Hz  
 Peak Band-Edge at 2483.5 MHz: Peak = 124.06dBuV/m - 53.93 dB = 70.13 dBµV/m (limit 74 dBµV/m)  
 Average: 64.35 dBµV/m - 11.37 dB = 52.98 dBµV/m (limit 54 dBµV/m)

**Plot 5.9.4.2.5. Band-Edge RF Radiated Emissions @ 3 m**  
 High End of Frequency Band, 2475 MHz, Rx Antenna Orientation: Vertical



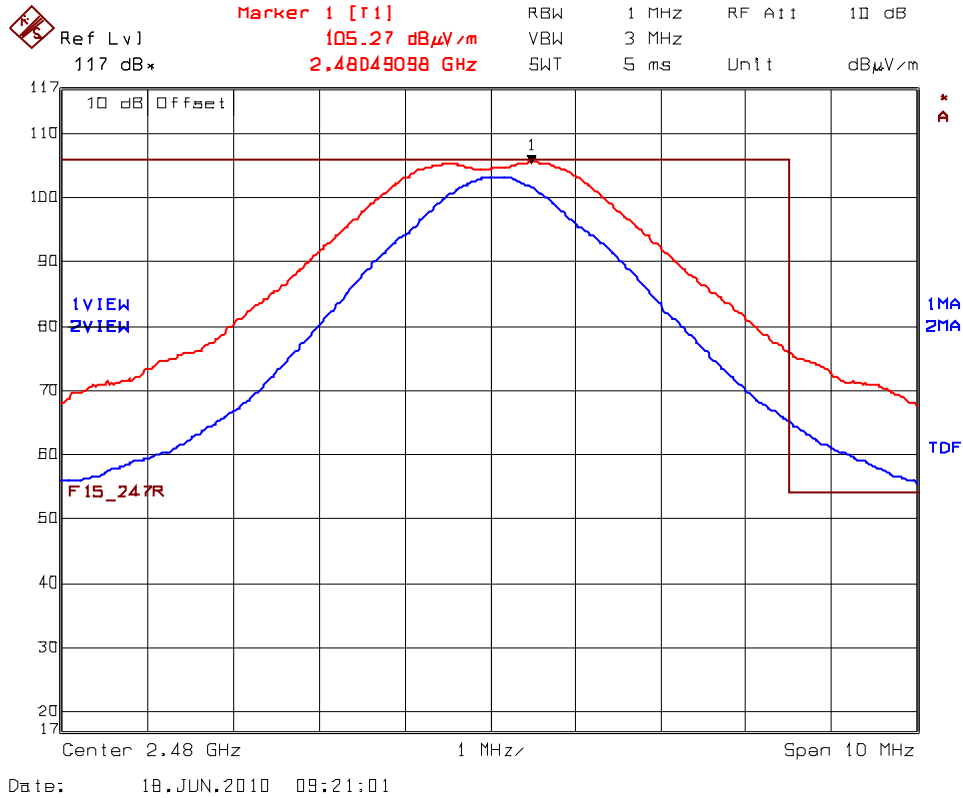
**Plot 5.9.4.2.6. Band-Edge RF Radiated Emissions @ 3 m**  
 High End of Frequency Band, 2475 MHz, Rx Antenna Orientation: Vertical



Trace 1: RBW = 1 MHz, VBW = 3 MHz  
 Trace 2: RBW = 300 kHz, VBW = 500 kHz, Delta (Peak to Band-Edge): 53.05 dB  
 Trace 3: RBW = 1 MHz, VBW = 10 Hz  
 Peak Band-Edge at 2483.5 MHz: Peak = 123.91 dBµV/m - 53.05 dB = 70.86 dBµV/m (limit 74 dBµV/m)  
 Average: 64.43 dBµV/m - 11.37 dB = 53.06 dBµV/m (limit 54 dBµV/m)

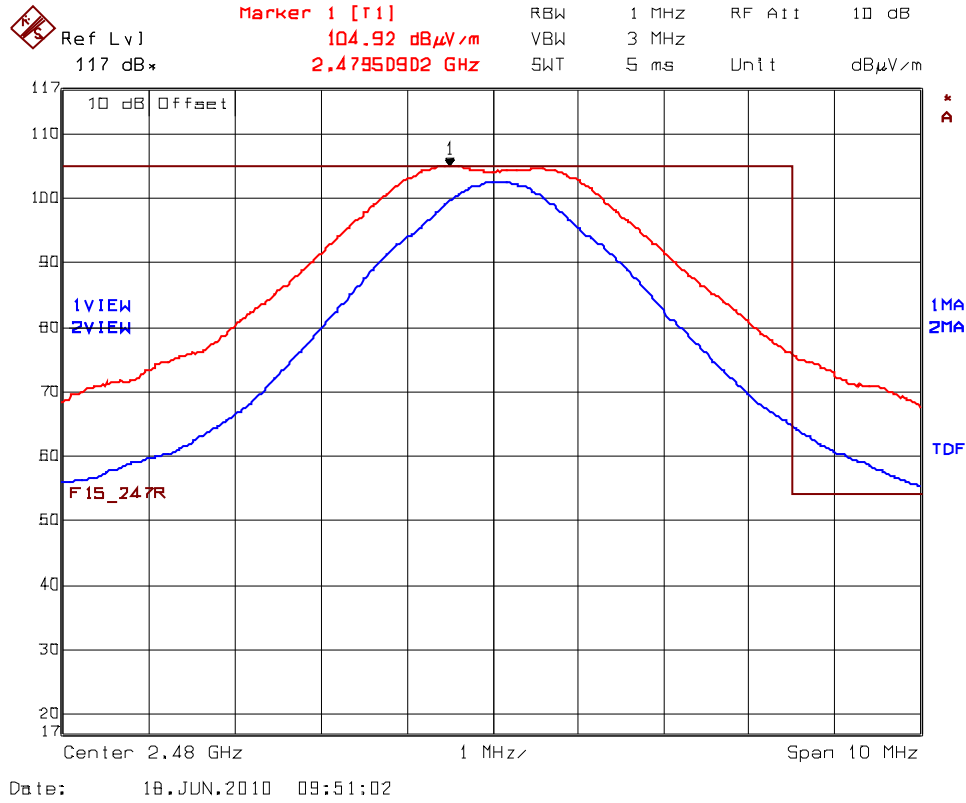


**Plot 5.9.4.2.7. Band-Edge RF Radiated Emissions @ 3 m**  
 High End of Frequency Band, 2480 MHz  
 Rx Antenna Orientation: Horizontal



Trace 1: RBW = 1 MHz, VBW = 3 MHz  
 Trace 2: RBW = 1 MHz, VBW = 10 Hz  
 Average value at 2483.5 MHz: 64.80 dBµV/m - 11.37 dB = 53.43 dBµV/m

**Plot 5.9.4.2.8. Band-Edge RF Radiated Emissions @ 3 m**  
 High End of Frequency Band, 2480 MHz  
 Rx Antenna Orientation: Vertical



Trace 1: RBW = 1 MHz, VBW = 3 MHz  
 Trace 2: RBW = 1 MHz, VBW = 10 Hz  
 Average value at 2483.5 MHz: 64.56 dBµV/m - 11.37 dB = 53.19 dBµV/m

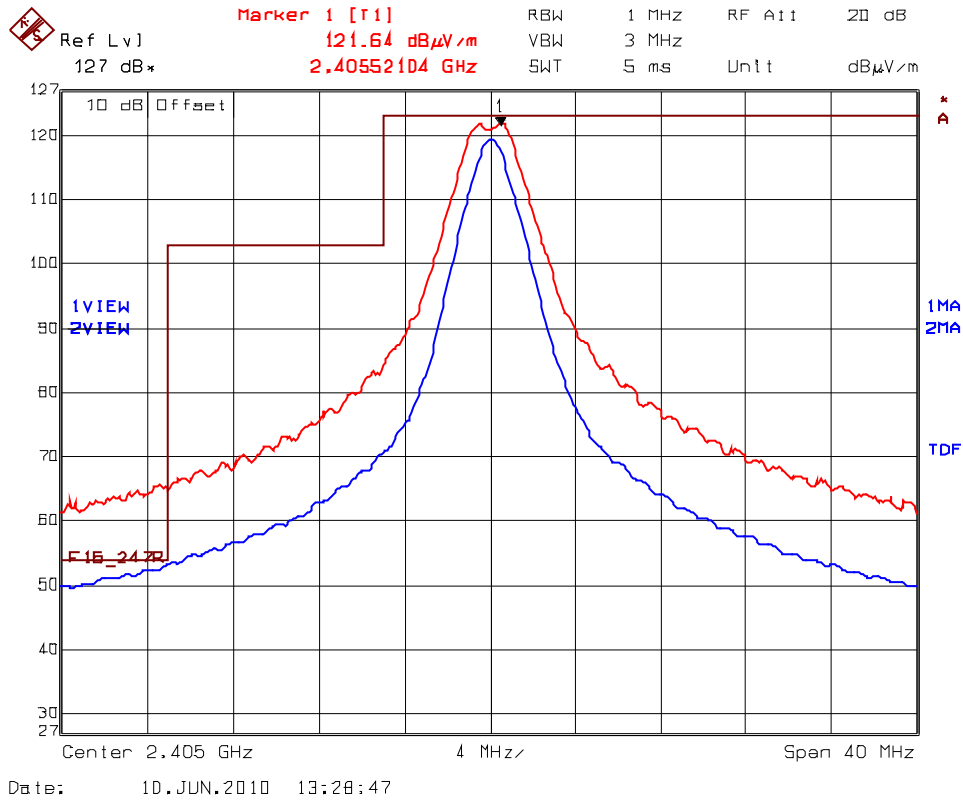
**5.9.4.3. EUT with Flat Panel Antenna [19 dBi Gain with 10.32 dB Cable Loss]**

Fundamental Frequency: 2405 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
2405	122.30	--	V	--	--	--	--
2405	121.64	--	H	--	--	--	--
4810	68.07	48.36	V	54.0	102.3	-5.6	Pass*
4810	66.81	46.81	H	54.0	102.3	-7.2	Pass*
12025	61.31	37.36	V	54.0	102.3	-16.6	Pass*
12025	65.21	42.67	H	54.0	102.3	-11.3	Pass*

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

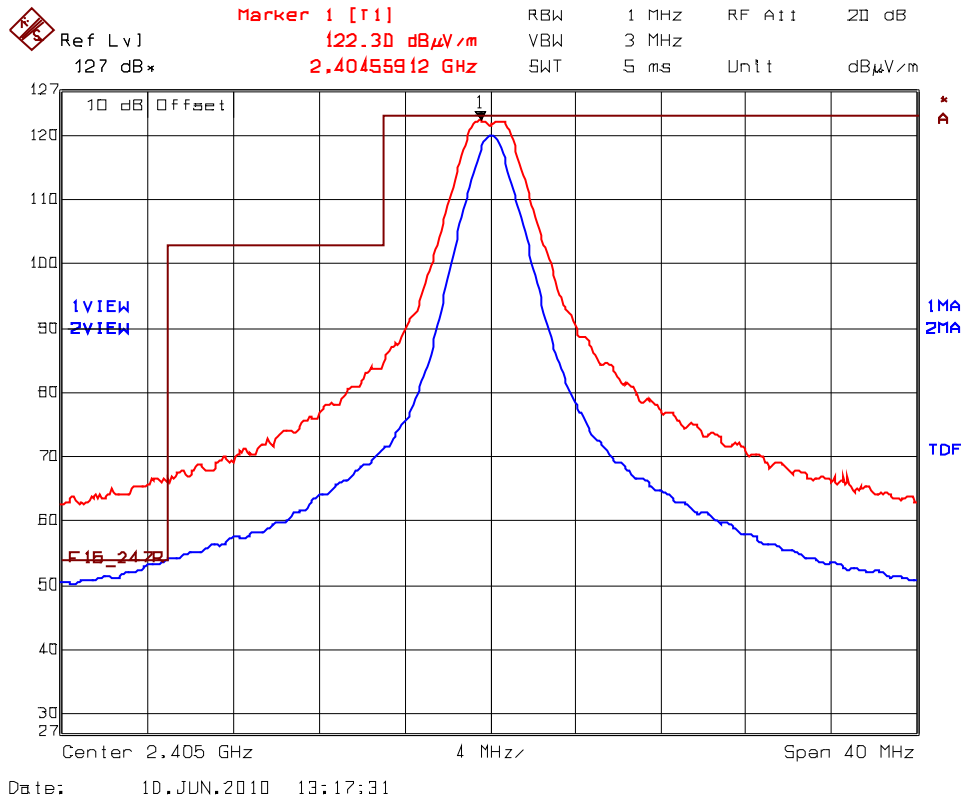
See the following test data plots for band-edge emissions.

**Plot 5.9.4.3.1. Band-Edge RF Radiated Emissions @ 3 m**  
 Low End of Frequency Band, 2405 MHz  
 Rx Antenna Orientation: Horizontal



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

**Plot 5.9.4.3.2. Band-Edge RF Radiated Emissions @ 3 m**  
 Low End of Frequency Band, 2405 MHz  
 Rx Antenna Orientation: Vertical



Trace 1: RBW = 1 MHz, VBW = 3 MHz  
 Trace 2: RBW = 1 MHz, VBW = 10 Hz  
 Average reading at 2390 MHz: 54.13 dBµV/m - 11.37 dB = 42.76 dBµV/m

Fundamental Frequency: 2440 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
2440	122.48	--	V	--	--	--	--
2440	121.86	--	H	--	--	--	--
4880	65.85	45.70	V	54.0	102.5	-8.3	Pass*
4880	66.23	45.94	H	54.0	102.5	-8.1	Pass*
7320	68.45	45.90	V	54.0	102.5	-8.1	Pass*
7320	66.25	43.84	H	54.0	102.5	-10.2	Pass*
12200	59.51	34.62	V	54.0	102.5	-19.4	Pass*
12200	62.66	39.52	H	54.0	102.5	-14.5	Pass*

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

Fundamental Frequency: 2475 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
2475	122.45	--	V	--	--	--	--
2475	121.85	--	H	--	--	--	--
4950	68.78	48.82	V	54.0	102.5	-5.2	Pass*
4950	64.31	44.41	H	54.0	102.5	-9.6	Pass*
7425	67.06	43.51	V	54.0	102.5	-10.5	Pass*
7425	70.03	47.21	H	54.0	102.5	-6.8	Pass*
12375	61.23	37.40	V	54.0	102.5	-16.6	Pass*
12375	60.38	37.07	H	54.0	102.5	-16.9	Pass*

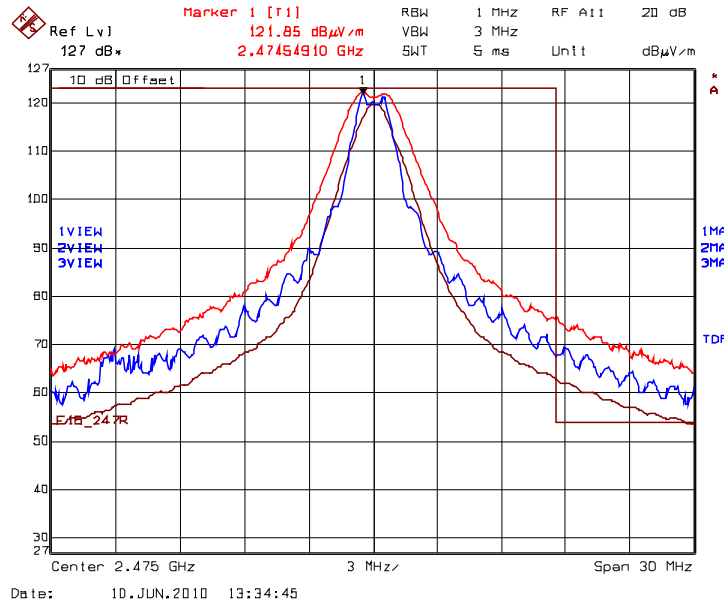
\*Field strength of emissions appearing within restricted frequency bands shall not exceed the limits in § 15.209.

Fundamental Frequency: 2480 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
2480	104.72	--	V	--	--	--	--
2480	104.77	--	H	--	--	--	--
30 -25000	*	*	V/H	*	84.8	*	Pass

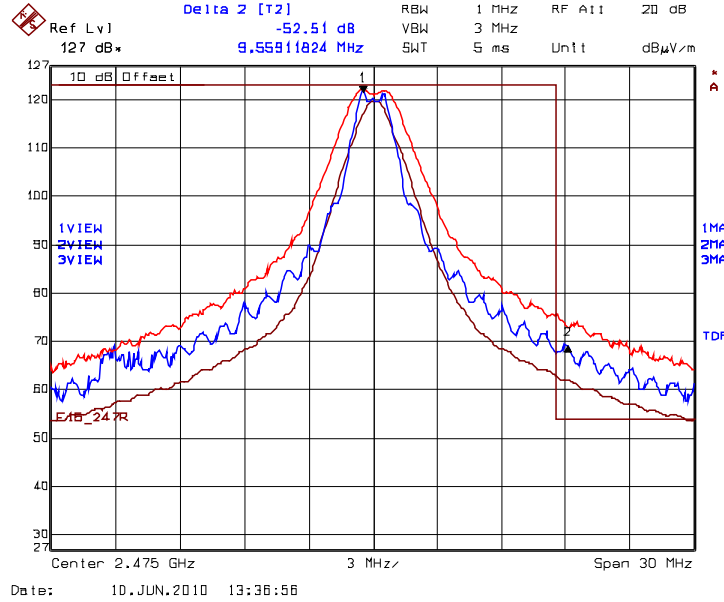
\*The spurious emissions from intentional radiators are more than 20 dB below the specified limit.

See the following test data plots for band-edge emissions.

**Plot 5.9.4.3.3. Band-Edge RF Radiated Emissions @ 3 m**  
 High End of Frequency Band, 2475 MHz, Rx Antenna Orientation: Horizontal



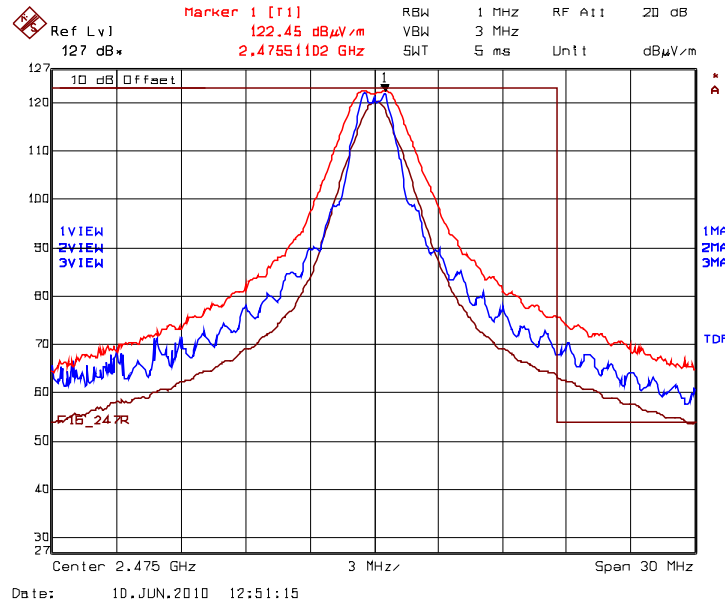
**Plot 5.9.4.3.4. Band-Edge RF Radiated Emissions @ 3 m**  
 High End of Frequency Band, 2475 MHz, Rx Antenna Orientation: Horizontal



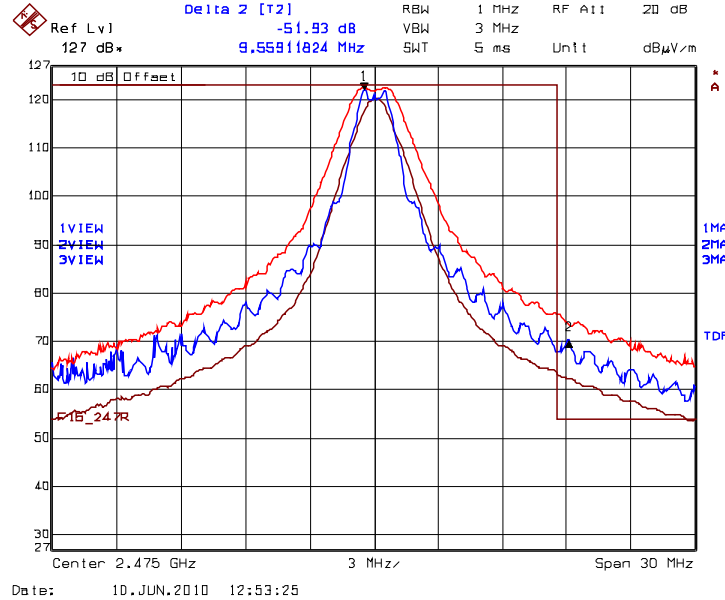
Trace 1: RBW = 1 MHz, VBW = 3 MHz  
 Trace 2: RBW = 300 kHz, VBW = 500 kHz, Delta (Peak to Band-Edge): 52.51 dB  
 Trace 3: RBW = 1 MHz, VBW = 10 Hz  
 Peak Band-Edge at 2483.5 MHz: Peak = 121.85 dBµV/m - 52.51 dB = 69.34 dBµV/m (limit 74 dBµV/m)  
 Average: 62.85 dBµV/m - 11.37 dB = 51.48 dBµV/m (limit 54 dBµV/m)



**Plot 5.9.4.3.5. Band-Edge RF Radiated Emissions @ 3 m**  
 High End of Frequency Band, 2475 MHz, Rx Antenna Orientation: Vertical

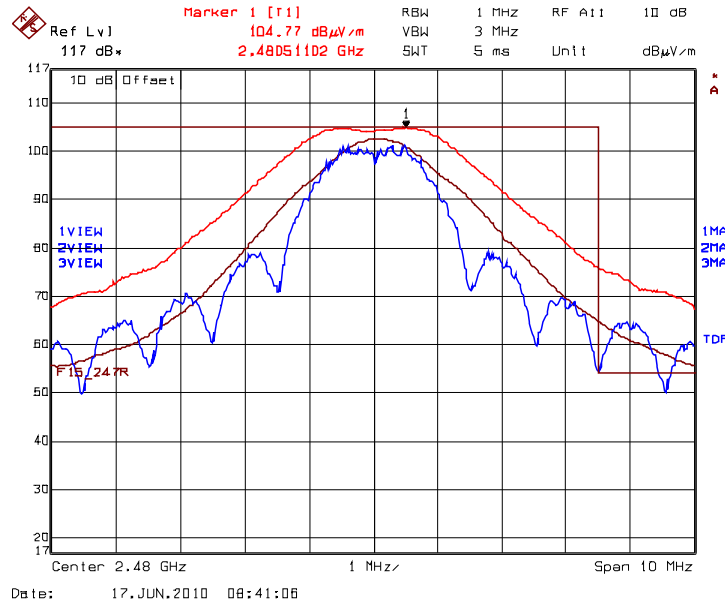


**Plot 5.9.4.3.6. Band-Edge RF Radiated Emissions @ 3 m**  
 High End of Frequency Band, 2475 MHz, Rx Antenna Orientation: Vertical

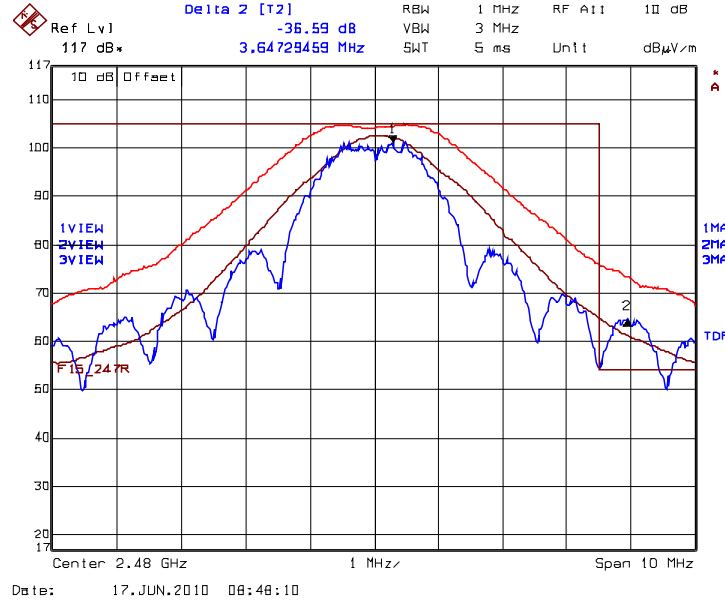


Trace 1: RBW = 1 MHz, VBW = 3 MHz  
 Trace 2: RBW = 300 kHz, VBW = 500 kHz, Delta (Peak to Band-Edge): 51.93 dB  
 Trace 3: RBW = 1 MHz, VBW = 10 Hz  
 Peak Band-Edge at 2483.5 MHz: Peak = 122.45 dBµV/m - 51.93 dB = 70.52 dBµV/m (limit 74 dBµV/m)  
 Average: 63.31 dBµV/m - 11.37 dB = 51.94 dBµV/m (limit 54 dBµV/m)

**Plot 5.9.4.3.7. Band-Edge RF Radiated Emissions @ 3 m**  
 High End of Frequency Band, 2480 MHz, Rx Antenna Orientation: Horizontal



**Plot 5.9.4.3.8. Band-Edge RF Radiated Emissions @ 3 m**  
 High End of Frequency Band, 2480 MHz, Rx Antenna Orientation: Horizontal



Trace 1: RBW = 1 MHz, VBW = 3 MHz

Trace 2: RBW = 100 kHz, VBW = 300 kHz, Delta (Peak to Band-Edge): 36.59 dB

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

Peak Band-Edge at 2483.5 MHz: Peak = 104.77 dBµV/m - 36.59 dB = 68.18 dBµV/m (limit 74 dBµV/m)

Average: 64.72 dBµV/m - 11.37 dB = 53.35 dBµV/m (limit 54 dBµV/m)

**ULTRATECH GROUP OF LABS**

3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4

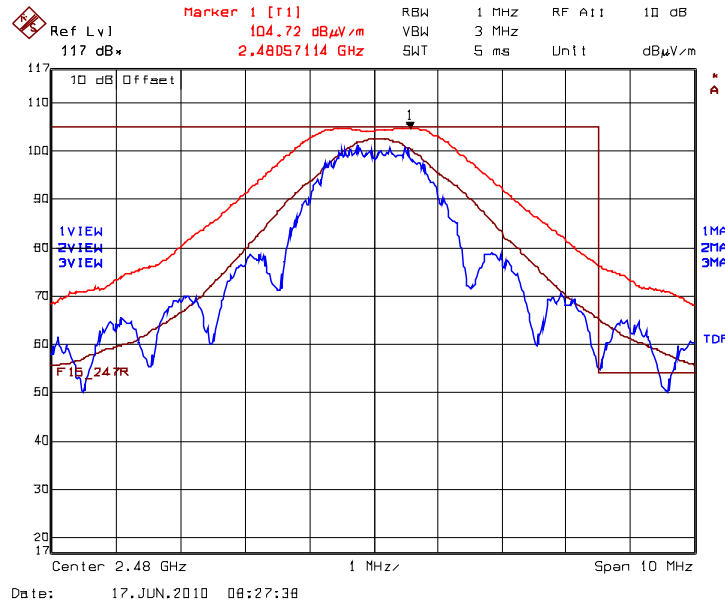
Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: [vic@ultratech-labs.com](mailto:vic@ultratech-labs.com), Website: <http://www.ultratech-labs.com>

File #: DIGI-034QF15C247

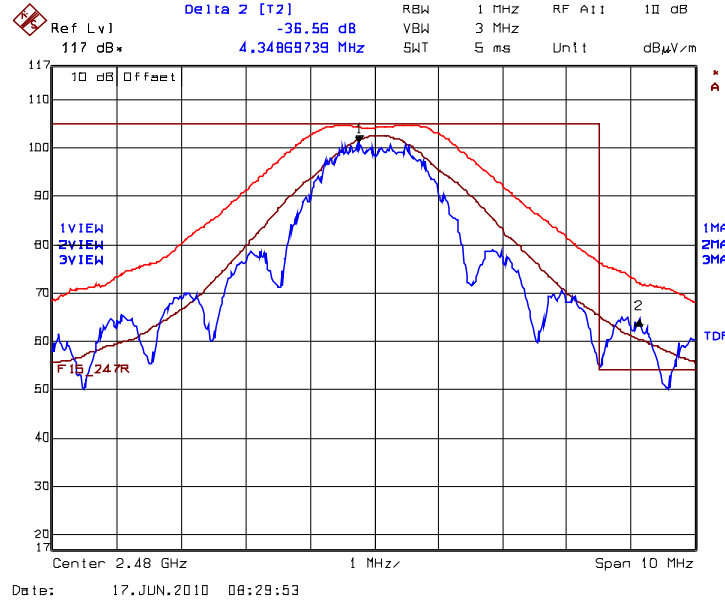
July 6, 2010

All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)

**Plot 5.9.4.3.9. Band-Edge RF Radiated Emissions @ 3 m**  
 High End of Frequency Band, 2480 MHz, Rx Antenna Orientation: Vertical



**Plot 5.9.4.3.10. Band-Edge RF Radiated Emissions @ 3 m**  
 High End of Frequency Band, 2480 MHz, Rx Antenna Orientation: Vertical



Trace 1: RBW = 1 MHz, VBW = 3 MHz  
 Trace 2: RBW = 100 kHz, VBW = 300 kHz, Delta (Peak to Band-Edge): 36.56 dB  
 Trace 3: RBW = 1 MHz, VBW = 10 Hz  
 Peak Band-Edge at 2483.5 MHz: Peak = 104.72 dBµV/m - 36.56 dB = 68.16 dBµV/m (limit 74 dBµV/m)  
 Average: 64.93 dBµV/m - 11.37 dB = 53.56 dBµV/m (limit 54 dBµV/m)

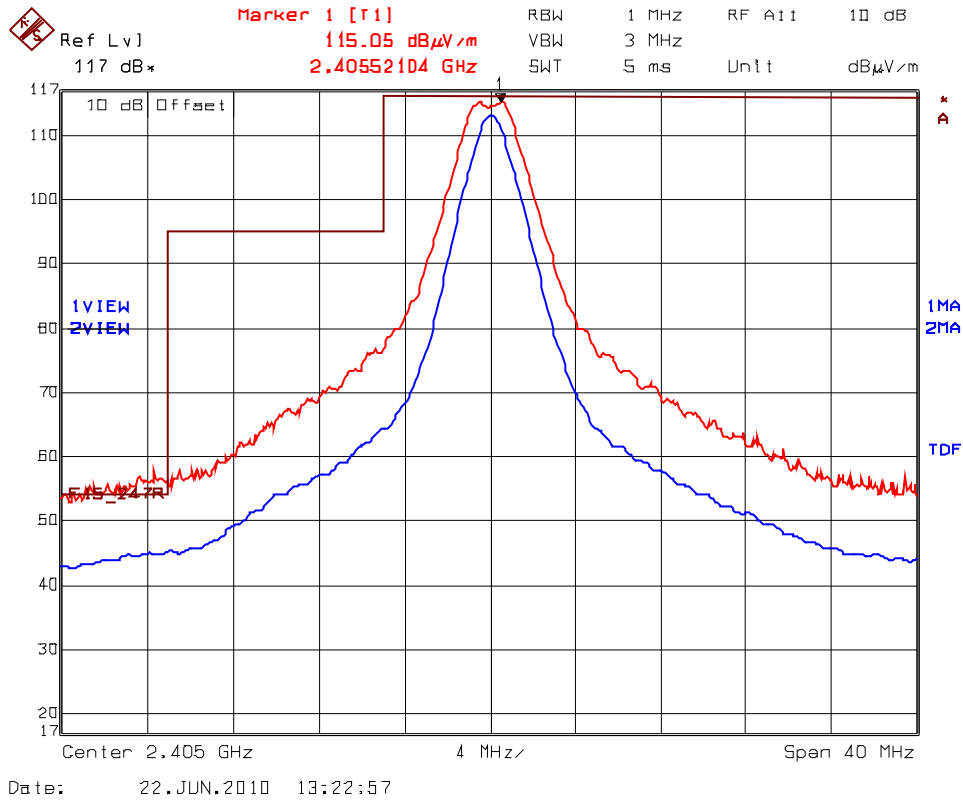
**5.9.4.4. EUT with Integrated Whip Monopole Antenna (1.5 dBi Gain)**

Fundamental Frequency:		2405 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
2405	114.22	--	V	--	--	--	--
2405	115.05	--	H	--	--	--	--
4810	55.99	35.20	V	54.0	95.1	-18.8	Pass*
4810	57.64	36.13	H	54.0	95.1	-17.9	Pass*
12025	67.84	44.23	V	54.0	95.1	-9.8	Pass*
12025	68.73	44.96	H	54.0	95.1	-9.0	Pass*

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

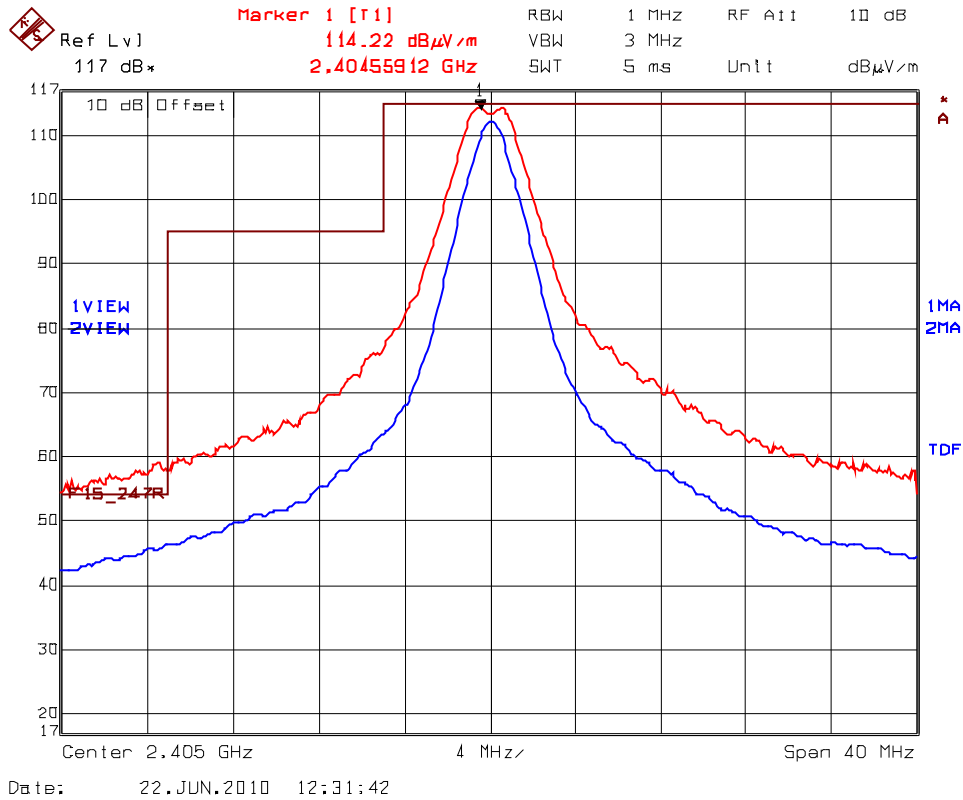
See the following test data plots for band-edge emissions.

**Plot 5.9.4.4.1. Band-Edge RF Radiated Emissions @ 3 m**  
Low End of Frequency Band, 2405 MHz  
Rx Antenna Orientation: Horizontal



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

**Plot 5.9.4.4.2. Band-Edge RF Radiated Emissions @ 3 m**  
 Low End of Frequency Band, 2405 MHz  
 Rx Antenna Orientation: Vertical



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

Fundamental Frequency: 2440 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
2440	116.42	--	V	--	--	--	--
2440	115.06	--	H	--	--	--	--
12200	67.43	44.44	V	54.0	96.4	-9.6	Pass*
12200	69.54	46.79	H	54.0	96.4	-7.2	Pass*

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

Fundamental Frequency: 2475 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
2475	115.00	--	V	--	--	--	--
2475	113.78	--	H	--	--	--	--
12375	67.49	44.49	V	54.0	95.0	-9.5	Pass*
12375	71.57	48.06	H	54.0	95.0	-5.9	Pass*

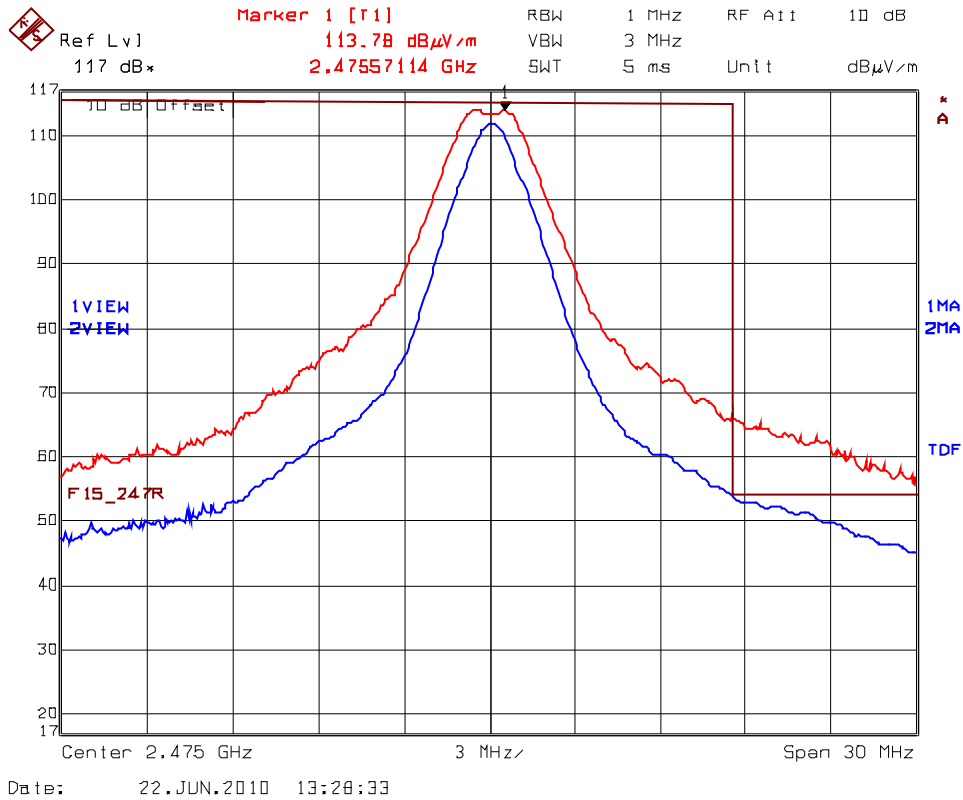
\*Field strength of emissions appearing within restricted frequency bands shall not exceed the limits in § 15.209.

Fundamental Frequency: 2480 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
2480	95.88	--	V	--	--	--	--
2480	95.61	--	H	--	--	--	--
30-25000	*	*	V/H	*	75.9	*	Pass

\*The spurious emissions from intentional radiators are more than 20 dB below the specified limit.

See the following test data plots for band-edge emissions.

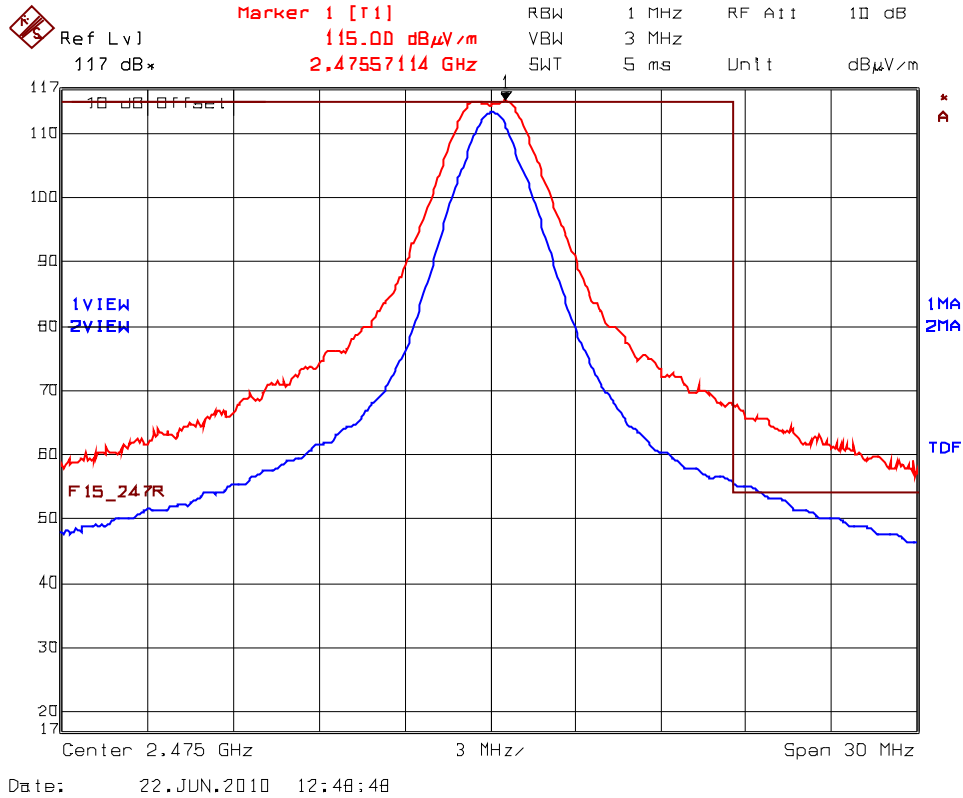
**Plot 5.9.4.4.3. Band-Edge RF Radiated Emissions @ 3 m**  
 High End of Frequency Band, 2475 MHz  
 Rx Antenna Orientation: Horizontal



Trace 1: RBW = 1 MHz, VBW = 3 MHz  
 Trace 2: RBW = 1 MHz, VBW = 10 Hz  
 Average 2483.5 MHz: 54.14 dBµV/m - 11.37 dB = 42.77 dBµV/m (limit 54 dBµV/m)



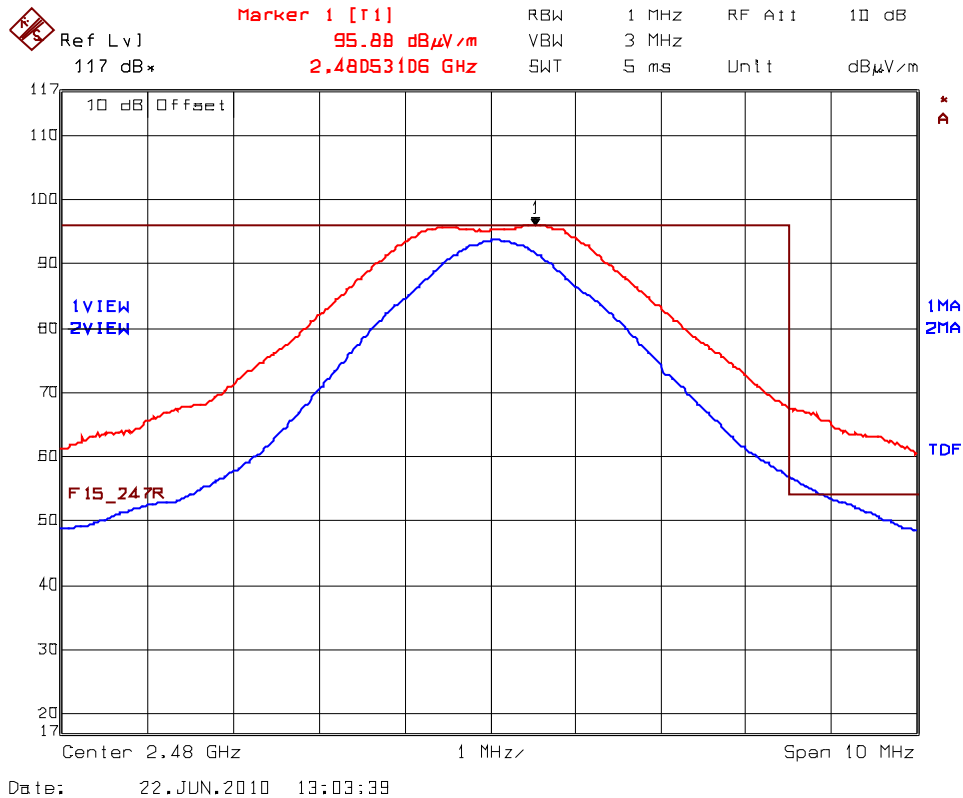
**Plot 5.9.4.4.4. Band-Edge RF Radiated Emissions @ 3 m**  
 High End of Frequency Band, 2475 MHz  
 Rx Antenna Orientation: Vertical



Trace 1: RBW = 1 MHz, VBW = 3 MHz  
 Trace 2: RBW = 1 MHz, VBW = 10 Hz  
 Average 2483.5 MHz: 55.62 dBµV/m - 11.37 dB = 44.25 dBµV/m (limit 54 dBµV/m)



**Plot 5.9.4.4.6. Band-Edge RF Radiated Emissions @ 3 m**  
 High End of Frequency Band, 2480 MHz  
 Rx Antenna Orientation: Vertical



Trace 1: RBW = 1 MHz, VBW = 3 MHz  
 Trace 2: RBW = 1 MHz, VBW = 10 Hz  
 Average 2483.5 MHz: 56.82 dBµV/m - 11.37 dB = 45.45 dBµV/m (limit 54 dBµV/m)

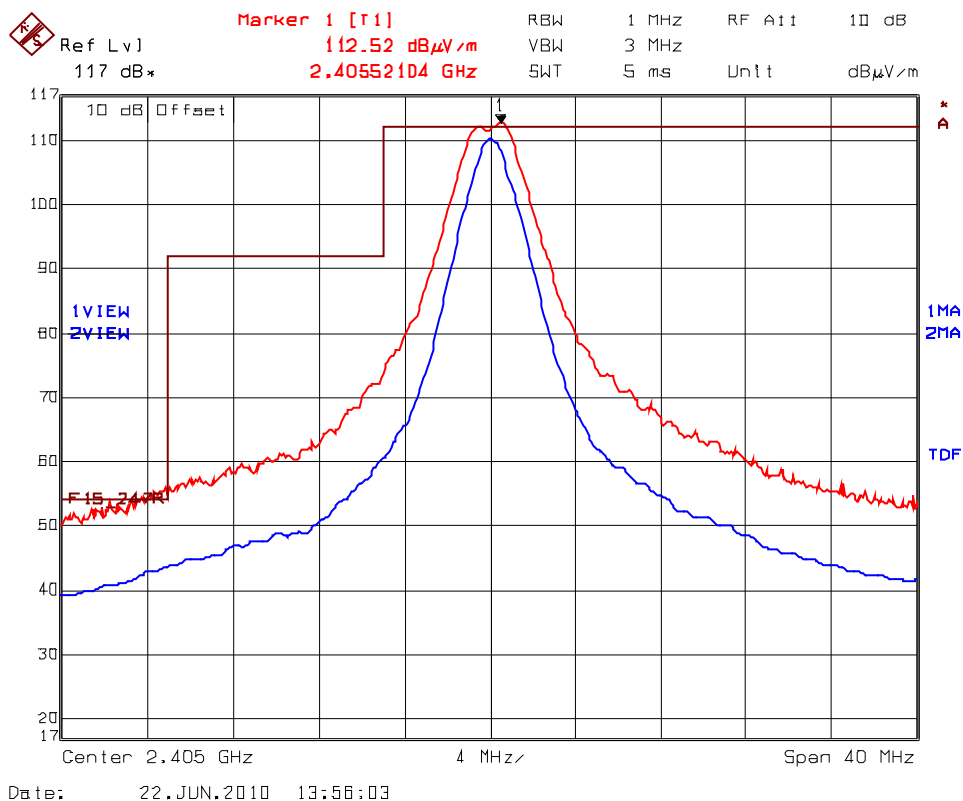
**5.9.4.5. EUT with Integrated PCB Antenna (0 dBi Gain)**

Fundamental Frequency:		2405 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
2405	111.17	--	V	--	--	--	--
2405	112.52	--	H	--	--	--	--
4810	67.22	47.14	V	54.0	92.5	-6.9	Pass*
4810	65.97	44.08	H	54.0	92.5	-9.9	Pass*
12025	61.11	35.20	V	54.0	92.5	-18.8	Pass*
12025	62.23	36.15	H	54.0	92.5	-17.9	Pass*

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

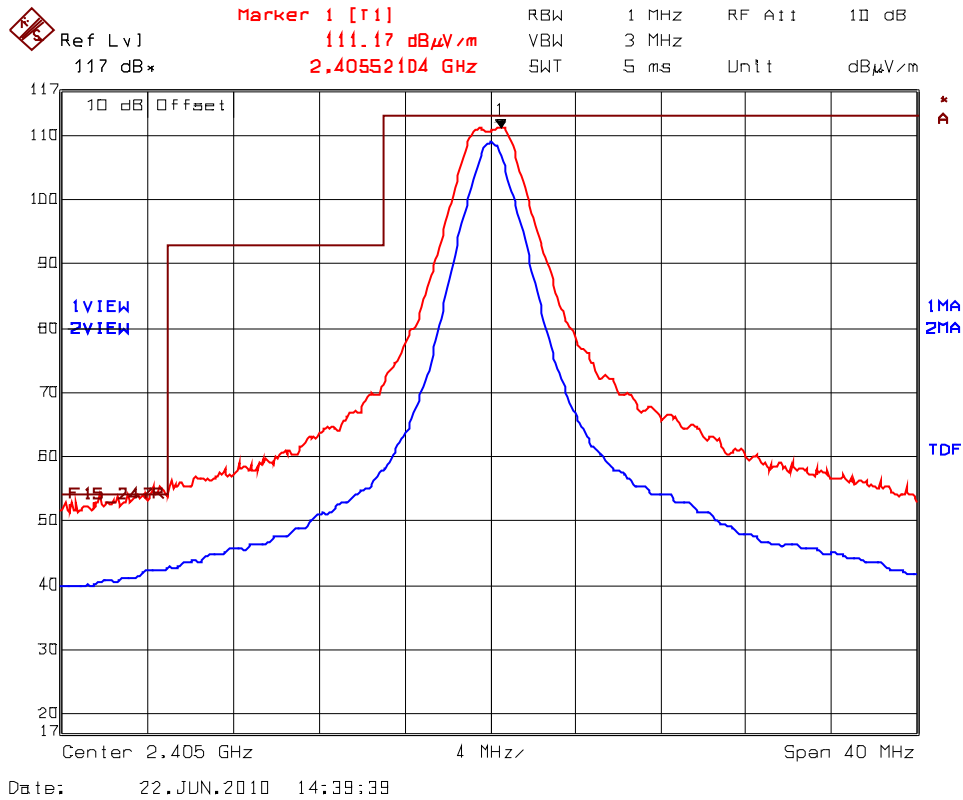
See the following test data plots for band-edge emissions.

**Plot 5.9.4.5.1. Band-Edge RF Radiated Emissions @ 3 m**  
Low End of Frequency Band, 2405 MHz  
Rx Antenna Orientation: Horizontal



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

**Plot 5.9.4.5.2. Band-Edge RF Radiated Emissions @ 3 m**  
 Low End of Frequency Band, 2405 MHz  
 Rx Antenna Orientation: Vertical



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

Fundamental Frequency:		2440 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
2440	112.47	--	V	--	--	--	--
2440	114.00	--	H	--	--	--	--
12200	60.46	37.12	H	54.0	94.0	-16.9	Pass*

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

Fundamental Frequency:		2475 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
2475	112.88	--	V	--	--	--	--
2475	112.86	--	H	--	--	--	--
12375	58.60	34.57	V	54.0	92.9	-19.4	Pass*
12375	58.63	34.78	H	54.0	92.9	-19.2	Pass*

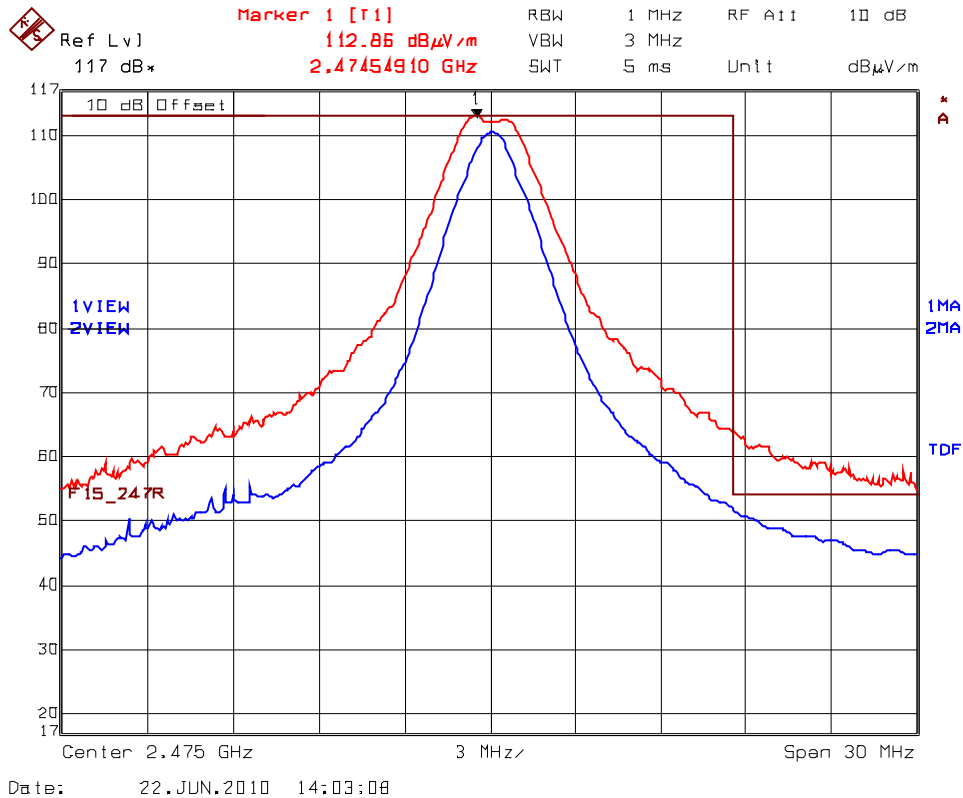
\*Field strength of emissions appearing within restricted frequency bands shall not exceed the limits in § 15.209.

Fundamental Frequency:		2480 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
2480	91.85	--	V	--	--	--	--
2480	93.42	--	H	--	--	--	--
30-25000	*	*	V/H	*	73.4	*	Pass

\*The spurious emissions from intentional radiators are more than 20 dB below the specified limit.

See the following test data plots for band-edge emissions.

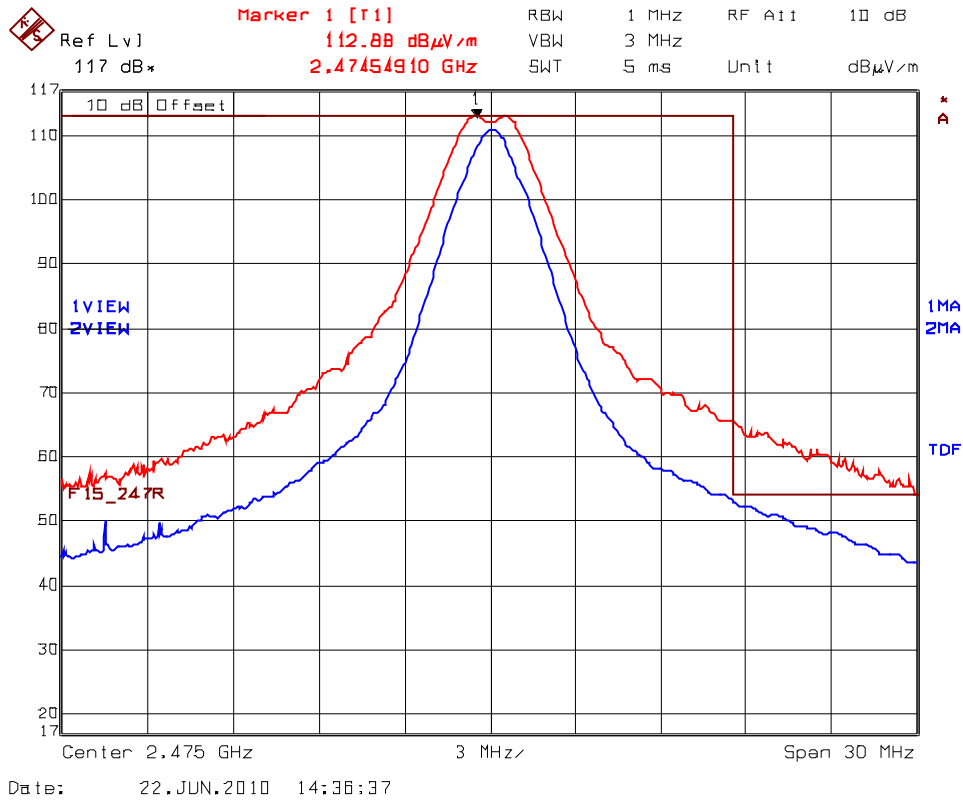
**Plot 5.9.4.5.3. Band-Edge RF Radiated Emissions @ 3 m**  
 High End of Frequency Band, 2475 MHz  
 Rx Antenna Orientation: Horizontal



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

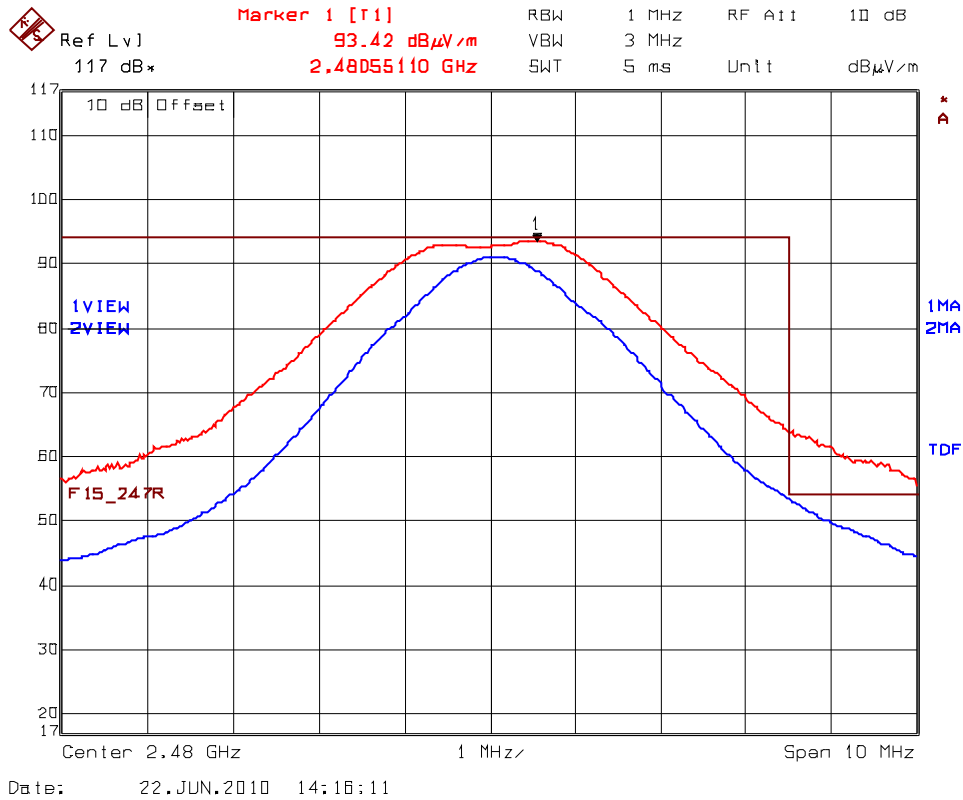


**Plot 5.9.4.5.4. Band-Edge RF Radiated Emissions @ 3 m**  
 High End of Frequency Band, 2475 MHz  
 Rx Antenna Orientation: Vertical



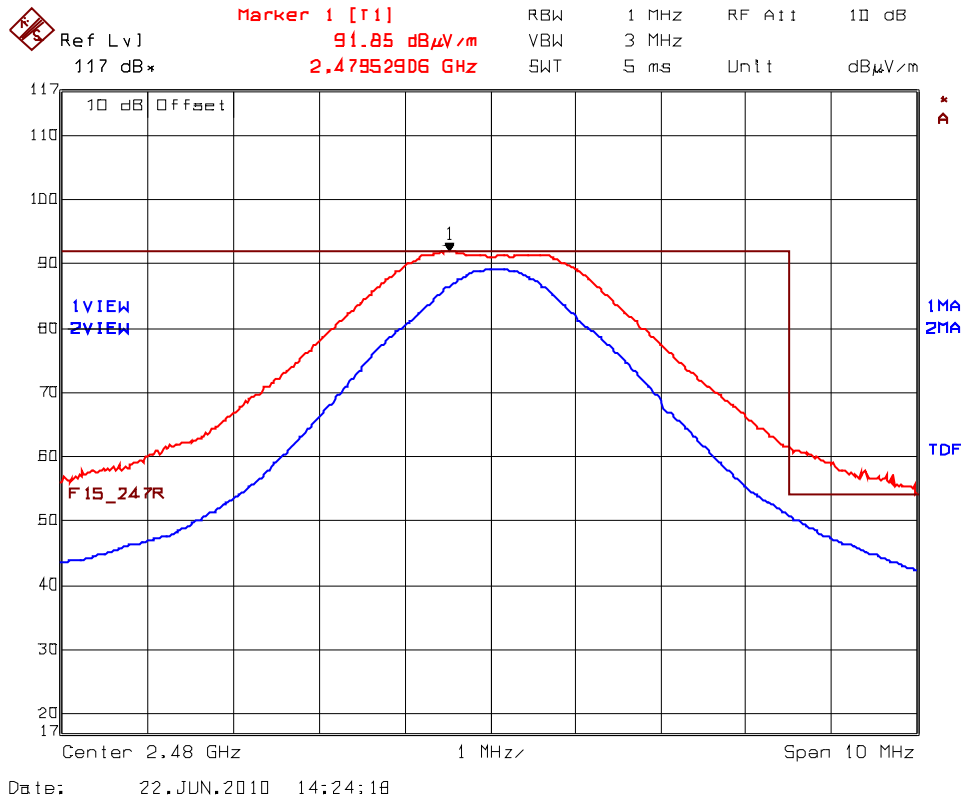
Trace 1: RBW = 1 MHz, VBW = 3 MHz  
 Trace 2: RBW = 1 MHz, VBW = 10 Hz

**Plot 5.9.4.5.5. Band-Edge RF Radiated Emissions @ 3 m**  
High End of Frequency Band, 2480 MHz  
Rx Antenna Orientation: Horizontal



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

**Plot 5.9.4.5.6. Band-Edge RF Radiated Emissions @ 3 m**  
 High End of Frequency Band, 2480 MHz  
 Rx Antenna Orientation: Vertical



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

**5.10. POWER SPECTRAL DENSITY [§ 15.247(e)]**

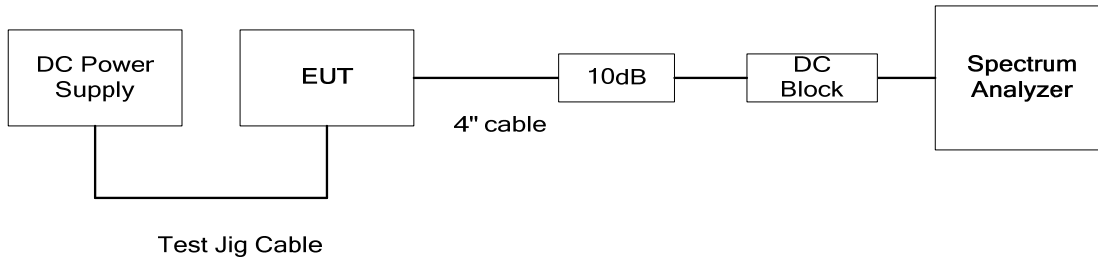
**5.10.1. Limit(s)**

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

**5.10.2. Method of Measurements**

KDB Publication No. 558074: Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247), PSD Option 1 method.

**5.10.3. Test Arrangement**



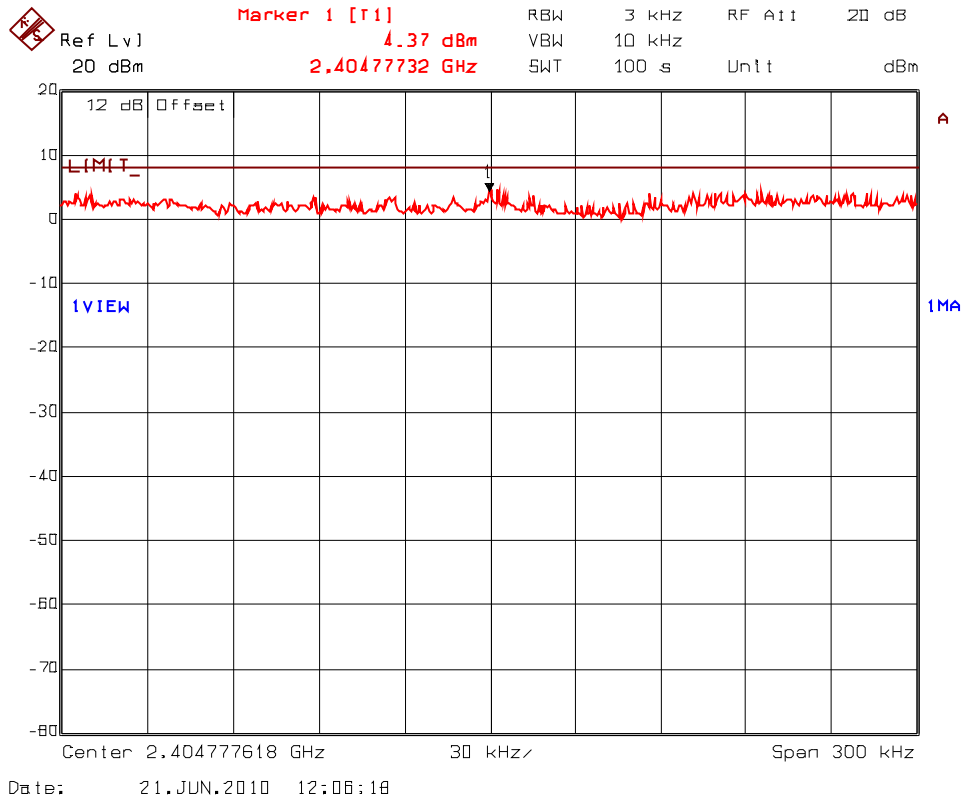
**5.10.4. Test Data**

**Remark:** Measurement method: Power spectral density (PSD) Option 1.

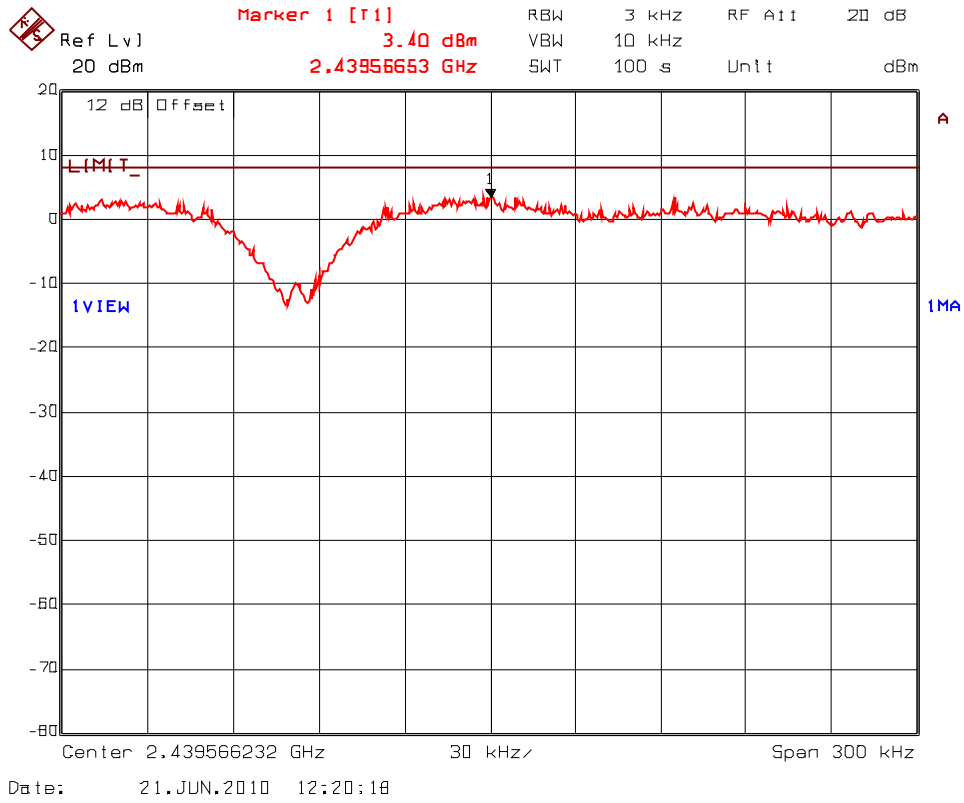
Channel	Frequency (MHz)	*PSD in 3 kHz BW (dBm)	Limit (dBm)	Margin (dB)	Results (Pass/Fail)
11	2405	4.37	8	-3.63	Pass
18	2440	3.40	8	-4.60	Pass
25	2475	3.75	8	-4.25	Pass
26	2480	-15.85	8	-23.85	Pass

\*See the following plots for measurement details.

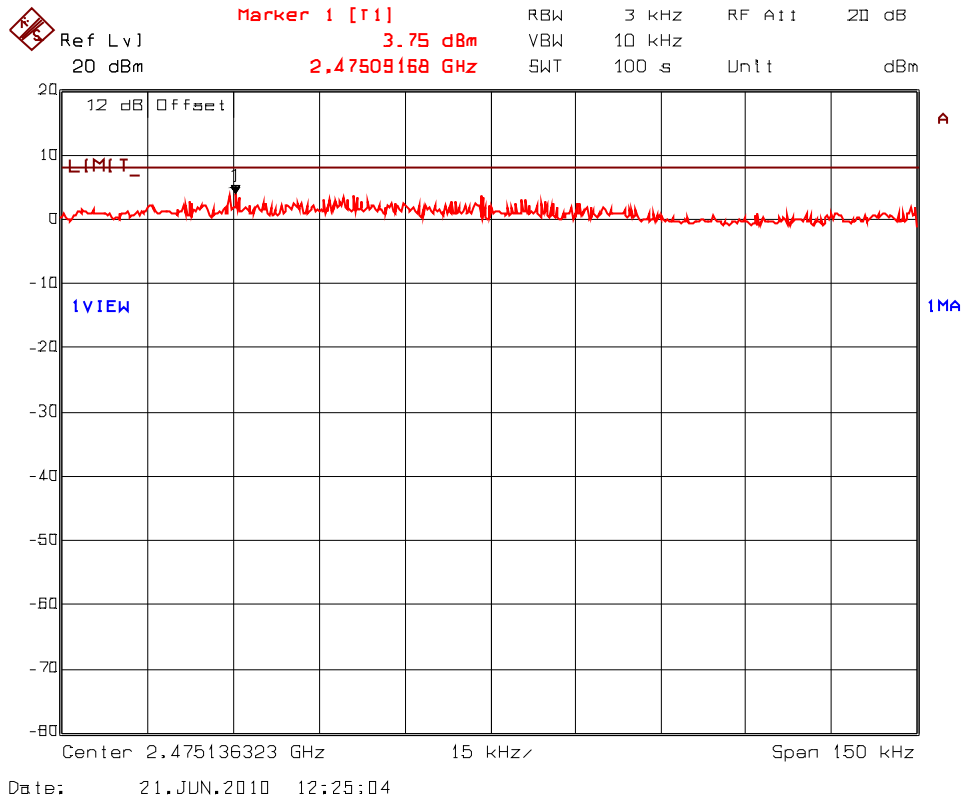
**Plot 5.10.4.1. Power Spectral Density**  
Test Frequency: 2405 MHz (CH 11)



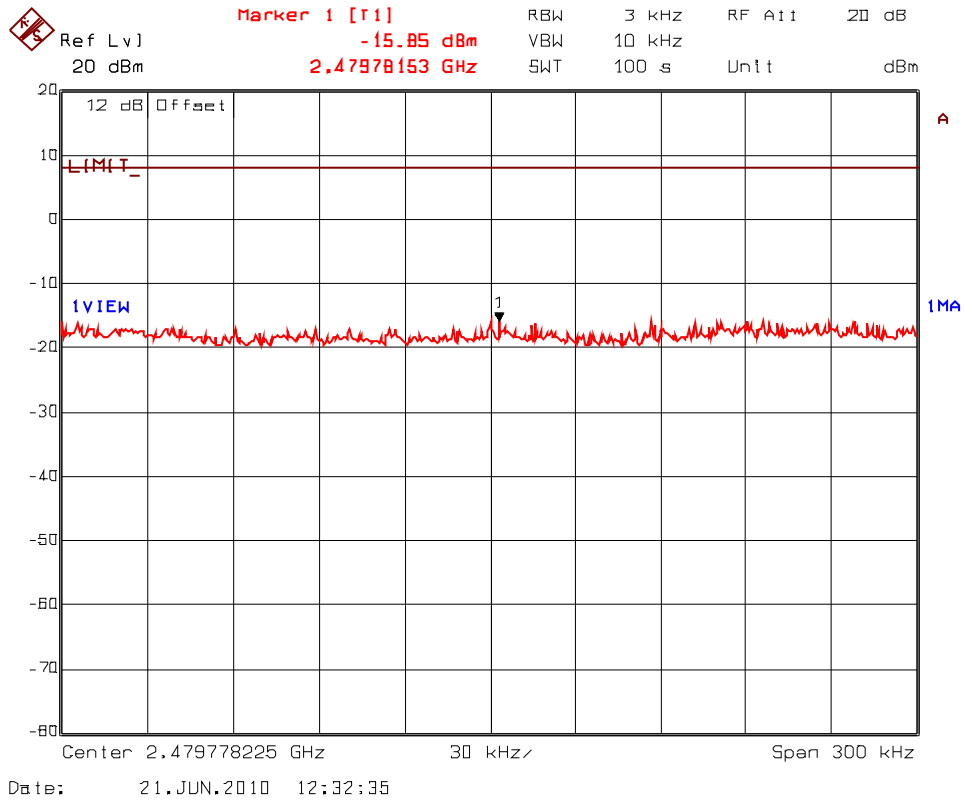
**Plot 5.10.4.2. Power Spectral Density**  
Test Frequency: 2440 MHz (CH 18)



**Plot 5.10.4.3. Power Spectral Density**  
Test Frequency: 2475 MHz (CH 25)



**Plot 5.10.4.4. Power Spectral Density**  
Test Frequency: 2480 MHz (CH 26)





**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/cm <sup>2</sup> )	Averaging time (minutes)
<b>(A) Limits for Occupational/Controlled Exposures</b>				
0.3–3.0 .....	614	1.63	*(100)	6
3.0–30 .....	1842/f	4.89/f	*(900/f <sup>2</sup> )	6
30–300 .....	61.4	0.163	1.0	6
300–1500 .....	.....	.....	f/300	6
1500–100,000 .....	.....	.....	5	6
<b>(B) Limits for General Population/Uncontrolled Exposure</b>				
0.3–1.34 .....	614	1.63	*(100)	30
1.34–30 .....	824/f	2.19/f	*(180/f <sup>2</sup> )	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<sup>2</sup>  
 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: <b>*13.3 cm</b>	Manufacturer' instruction for separation distance between antenna and persons required: <b>20 cm.</b>
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<sup>2</sup>

EIRP = 33.48 dBm = 10<sup>(33.48/10)</sup> mW = 2228 mW (Worst Case)

$$\text{(Minimum Safe Distance, r)} = \sqrt{\frac{EIRP}{4 \cdot \pi \cdot S}} = \sqrt{\frac{2228}{4 \cdot \pi \cdot (1.0)}} \approx 13.3\text{cm}$$

**EXHIBIT 6. TEST EQUIPMENT LIST**

Test Instruments	Manufacturer	Model No.	Serial No.	Operating Range
Spectrum Analyzer/ EMI Receiver	Hewlett Packard	HP 8593EM	3412A00103	9 kHz – 26.5 GHz
Transient Limiter	Hewlett Packard	11947A	310701998	9 kHz – 200 MHz 10 dB attenuation
L.I.S.N.	EMCO	3825/2	89071531	9 kHz – 200 MHz 50 Ohms / 50 µH
RF Shielded Chamber	Braden Shielding	...	...	...
Spectrum Analyzer	Rohde & Schwarz	FSEK30	100077	20 Hz – 40 GHz with external mixer
DC Block	Hewlett Packard	11742A	12460	0.045 – 26.5 GHz
Attenuator	Narda	4768-10	-	DC - 40 GHz
High Pass Filter	K & L	11SH10-4000/T12000	4	Cut off 3.4 GHz
Biconi-Log Antenna	EMCO	3142	10005	0.03 – 2 GHz
Horn Antenna	EMCO	3155	9701-6570	1 – 18 GHz
Horn Antenna	ETS-Lindgren	360-09	00118385	18 – 26.5 GHz
RF Amplifier	Com-Power	PA-103A	161243	10 MHz – 1 GHz
RF Amplifier	Hewlett Packard	84498	3008A00769	1 – 26.5 GHz
Signal Generator	Hewlett Packard	83752B	3610400457	0.01 – 20 GHz
Power Divider	Mini-Circuits	15542	0235	DC - 10 GHz
Signal Generator	Hewlett Packard	8648C	3443U00391	100 kHz-3200 MHz
Tenma DC Power Supply	Tenma	72-6153	0001526	20Vdc 10A

**ULTRATECH GROUP OF LABS**

3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4  
 Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: [vic@ultratech-labs.com](mailto:vic@ultratech-labs.com), Website: <http://www.ultratech-labs.com>

File #: DIGI-034QF15C247

July 6, 2010

*All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)*

## EXHIBIT 7. MEASUREMENT UNCERTAINTY

The measurement uncertainties stated were calculated in accordance with the requirements of NIST Technical Note 1297 and NIS 81 (1994)

### 7.1. LINE CONDUCTED EMISSION MEASUREMENT UNCERTAINTY

CONTRIBUTION (Line Conducted)	PROBABILITY DISTRIBUTION	UNCERTAINTY (dB)	
		9-150 kHz	0.15-30 MHz
EMI Receiver specification	Rectangular	$\pm 1.5$	$\pm 1.5$
LISN coupling specification	Rectangular	$\pm 1.5$	$\pm 1.5$
Cable and Input Transient Limiter calibration	Normal (k=2)	$\pm 0.3$	$\pm 0.5$
Mismatch: Receiver VRC $\Gamma_1 = 0.03$ LISN VRC $\Gamma_R = 0.8(9 \text{ kHz}) 0.2 (30 \text{ MHz})$ Uncertainty limits $20\text{Log}(1 \pm \Gamma_1 \Gamma_R)$	U-Shaped	$\pm 0.2$	$\pm 0.3$
System repeatability	Std. deviation	$\pm 0.2$	$\pm 0.05$
Repeatability of EUT	--	--	--
Combined standard uncertainty	Normal	$\pm 1.25$	$\pm 1.30$
Expanded uncertainty U	Normal (k=2)	$\pm 2.50$	$\pm 2.60$

Sample Calculation for Measurement Accuracy in 450 kHz to 30 MHz Band:

$$u_c(y) = \sqrt{\sum_{i=1}^m u_i^2(y)} = \pm \sqrt{(1.5^2 + 1.5^2)/3 + (0.5/2)^2 + (0.05/2)^2 + 0.35^2} = \pm 1.30 \text{ dB}$$

$$U = 2u_c(y) = \pm 2.6 \text{ dB}$$

## 7.2. RADIATED EMISSION MEASUREMENT UNCERTAINTY

CONTRIBUTION (Radiated Emissions)	PROBABILITY DISTRIBUTION	UNCERTAINTY (+ dB)	
		3 m	10 m
Antenna Factor Calibration	Normal (k=2)	+1.0	+1.0
Cable Loss Calibration	Normal (k=2)	+0.3	+0.5
EMI Receiver specification	Rectangular	+1.5	+1.5
Antenna Directivity	Rectangular	+0.5	+0.5
Antenna factor variation with height	Rectangular	+2.0	+0.5
Antenna phase center variation	Rectangular	0.0	+0.2
Antenna factor frequency interpolation	Rectangular	+0.25	+0.25
Measurement distance variation	Rectangular	+0.6	+0.4
Site imperfections	Rectangular	+2.0	+2.0
Mismatch: Receiver VRC $\Gamma_1 = 0.2$ Antenna VRC $\Gamma_R = 0.67(Bi) 0.3 (Lp)$ Uncertainty limits $20\text{Log}(1 \pm \Gamma_1 \Gamma_R)$	U-Shaped	+1.1 -1.25	+0.5
System repeatability	Std. Deviation	+0.5	+0.5
Repeatability of EUT		-	-
Combined standard uncertainty	Normal	+2.19 / -2.21	+1.74 / -1.72
Expanded uncertainty U	Normal (k=2)	+4.38 / -4.42	+3.48 / -3.44

Calculation for maximum uncertainty when 3m biconical antenna including a factor of k = 2 is used:

$$U = 2u_c(y) = 2x(+2.19) = +4.38 \text{ dB} \quad \text{And} \quad U = 2u_c(y) = 2x(-2.21) = -4.42 \text{ dB}$$