

# ENGINEERING TEST REPORT



## SafePlug Outlet Control Board Model No.: 3063

**FCC ID: S9C-3063**

*Applicant:*

**OFI, Inc. (subsidiary of 2D2C Inc.)**  
100 Hanson Avenue  
Kitchener, ON  
Canada N2C 2E2

*In Accordance With*

**Federal Communications Commission (FCC)**  
Part 15, Subpart C, Section 15.247  
Digital Modulation Systems (DTS) Operating in 2405 - 2480 MHz Band

UltraTech's File No.: OFI-010F15C247

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

Date: June 10, 2010



Report Prepared by: Dan Huynh

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

Issued Date: June 10, 2010

Test Dates: June 03-08, 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

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NvLap Lab Code  
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SL2-IN-E-1119R



Korea KCC-RRL

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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>	Both conducted and radiated emissions measurements were conducted in accordance with American National Standards Institute ANSI C63.4 - American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
<b>Environmental Classification:</b>	[ 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	2009	Code of Federal Regulations – Telecommunication
ANSI C63.4	2003	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
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)
KDB Publication No. 447498	2008	Mobile and Portable Device RF Exposure Procedure and Equipment Authorization Policies

## EXHIBIT 2. PERFORMANCE ASSESSMENT

### 2.1. CLIENT INFORMATION

APPLICANT	
<b>Name:</b>	OFI, Inc. (subsidiary of 2D2C Inc.)
<b>Address:</b>	100 Hanson Avenue Kitchener, Ontario Canada N2C 2E2
<b>Contact Person:</b>	Nick Jones Phone #: 519-884-3100 Fax #: 519-884-9800 Email Address: njones@safeplug.com

MANUFACTURER	
<b>Name:</b>	OFI, Inc. (subsidiary of 2D2C Inc.)
<b>Address:</b>	100 Hanson Avenue Kitchener, Ontario Canada N2C 2E2
<b>Contact Person:</b>	Nick Jones Phone #: 519-884-3100 Fax #: 519-884-9800 Email Address: njones@safeplug.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>	OFI, Inc. (subsidiary of 2D2C Inc.)
<b>Product Name:</b>	SafePlug Outlet Control Board
<b>Model Name or Number:</b>	3063
<b>Serial Number:</b>	Test Sample
<b>Type of Equipment:</b>	Digital Transmission System
<b>Input Power Supply Type:</b>	5 Vdc regulated $\pm 1\%$
<b>Primary User Functions of EUT:</b>	Wireless data communication exchange

## 2.3. EUT'S TECHNICAL SPECIFICATIONS

TRANSMITTER	
<b>Equipment Type:</b>	Fixed based / mobile
<b>Intended Operating Environment:</b>	Residential, commercial, industrial or business
<b>Power Supply Requirement:</b>	5 Vdc regulated $\pm 5\%$
<b>RF Output Power Rating:</b>	6.7 dBm maximum
<b>Operating Frequency Range:</b>	2405 - 2480 MHz
<b>Channel Spacing:</b>	5 MHz
<b>Duty Cycle:</b>	100%
<b>6 dB bandwidth:</b>	1.53 MHz
<b>Modulation Type:</b>	16-ary orthogonal
<b>Antenna Description:</b>	Integral etched circuit board trace "F", gain = 3.2 dBi maximum

## 2.4. LIST OF EUT'S PORTS

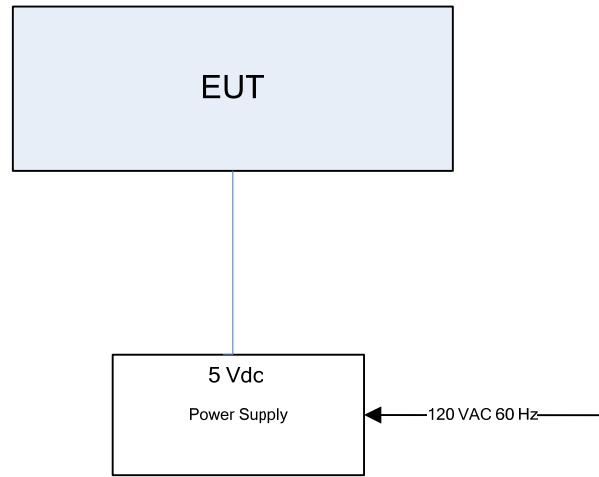
Port Number	EUT's Port Description	Number of Identical Ports	Connector Type	Cable Type (Shielded/Non-shielded)
1	0-5 V analog input	3	Solder pin	Direct board to board / no cable
2	12 V relay drive	2	Solder pin	Direct board to board / no cable
3	12 V power in	1	Solder pin	Direct board to board / no cable
4	5 V power in	1	Solder pin	Direct board to board / no cable
5	Firmware download port	For manufacturing use only		
6	Firmware download port	For manufacturing use only		

## 2.5. ANCILLARY EQUIPMENT

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

<b>Ancillary Equipment # 1</b>	
Description:	5 Vdc regulated power supply
Brand Name:	N/A
Model Name or Number:	171184
Serial Number:	N/A
Cable Length & Type:	> 3 m, Non-shielded

## 2.6. GENERAL TEST SETUP BLOCK DIAGRAM



## 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:	5 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>	None
<b>Transmitter Test Antenna:</b>	The EUT is tested with the antenna fitted in a manner typical of normal intended use as integrated PCB antenna.

<b>Transmitter Test Signals</b>	
<b>Frequency Band(s):</b>	2405 - 2480 MHz
<b>RF Power Output:</b>	6.70 dBm max.
<b>Normal Test Modulation:</b>	16-ary orthogonal
<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.: 91038) and Industry Canada office (Industry Canada File No.: 2049A-3). Expiry Date: 2011-05-01.

### 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)	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
<b>SafePlug Outlet Control Board, Model No.: 3063, by OFI, Inc. (subsidiary of 2D2C Inc.)</b> has also been tested and found to comply with <b>FCC Part 15, Subpart B - Class B Digital Devices</b> . The engineering test report has been documented and kept on file, it is available upon request.		

\* This device has integral antenna inside EUT enclosure.

\*\* The power line conducted emission and Digital Apparatus test results are documented in the OFI-010FCC15C225 report.

### 4.3. MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

N/A

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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 C63.4; 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

To provide data communication link

## 5.5. OCCUPIED BANDWIDTH [§ 15.247(a)(2)]

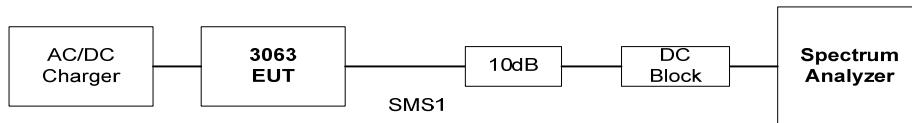
### 5.5.1. Limit(s)

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

### 5.5.2. Method of Measurements

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

### 5.5.3. Test Arrangement



### 5.5.4. Test Equipment List

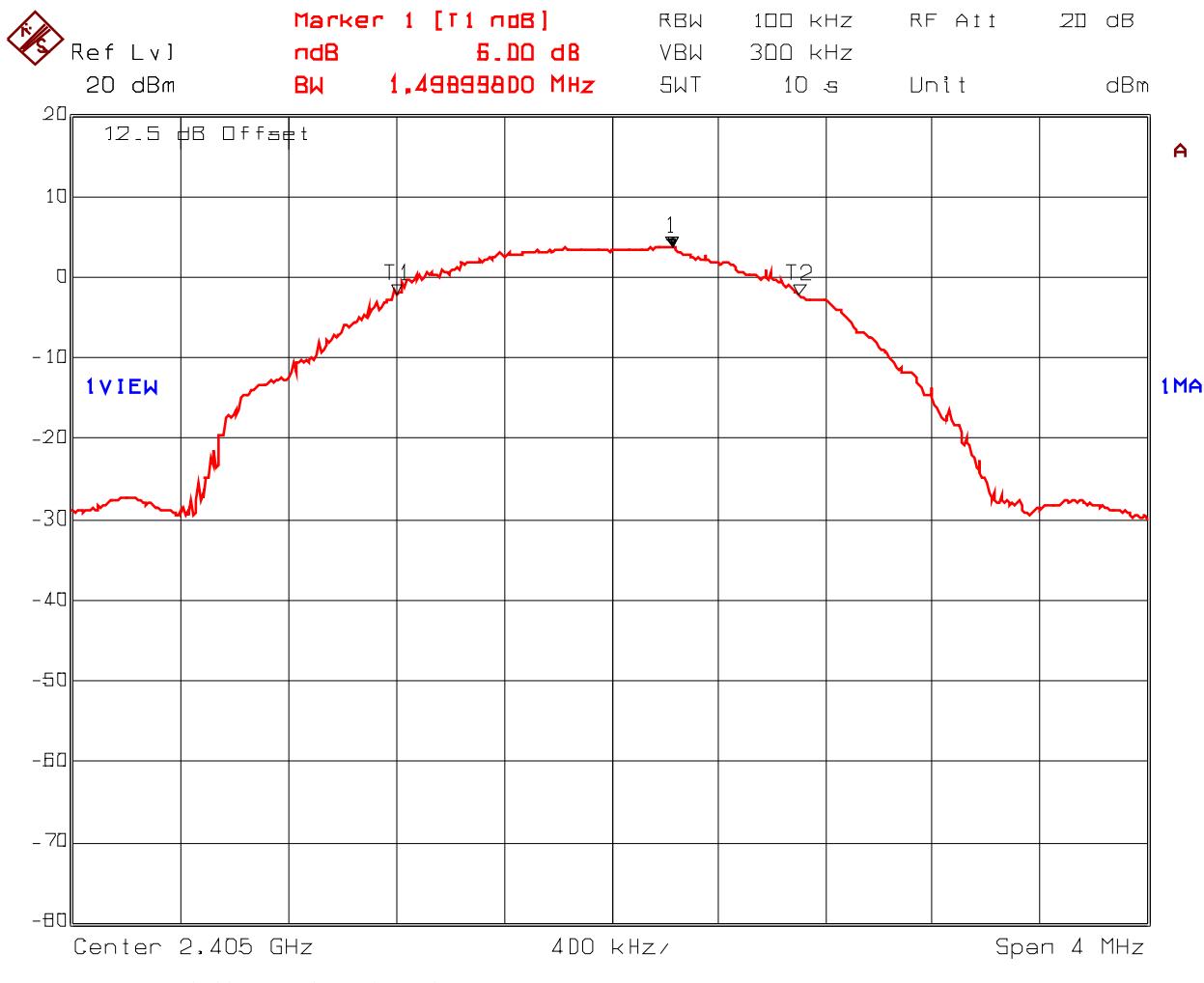
Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range	Calibration Due Date
Spectrum Analyzer	Rohde & Schwarz	FSEK30	100077	20 Hz – 40 GHz with external mixer	August 10, 2010
DC Block	Hewlett Packard	11742A	12460	0.045 – 26.5 GHz	N/A
Attenuator	Narda	4768-10	-	DC - 40 GHz	N/A

### 5.5.5. Test Data

Frequency (MHz)	Modulation	6dB Bandwidth (MHz)
2405	16-ary orthogonal	1.50
2445	16-ary orthogonal	1.53
2480	16-ary orthogonal	1.51

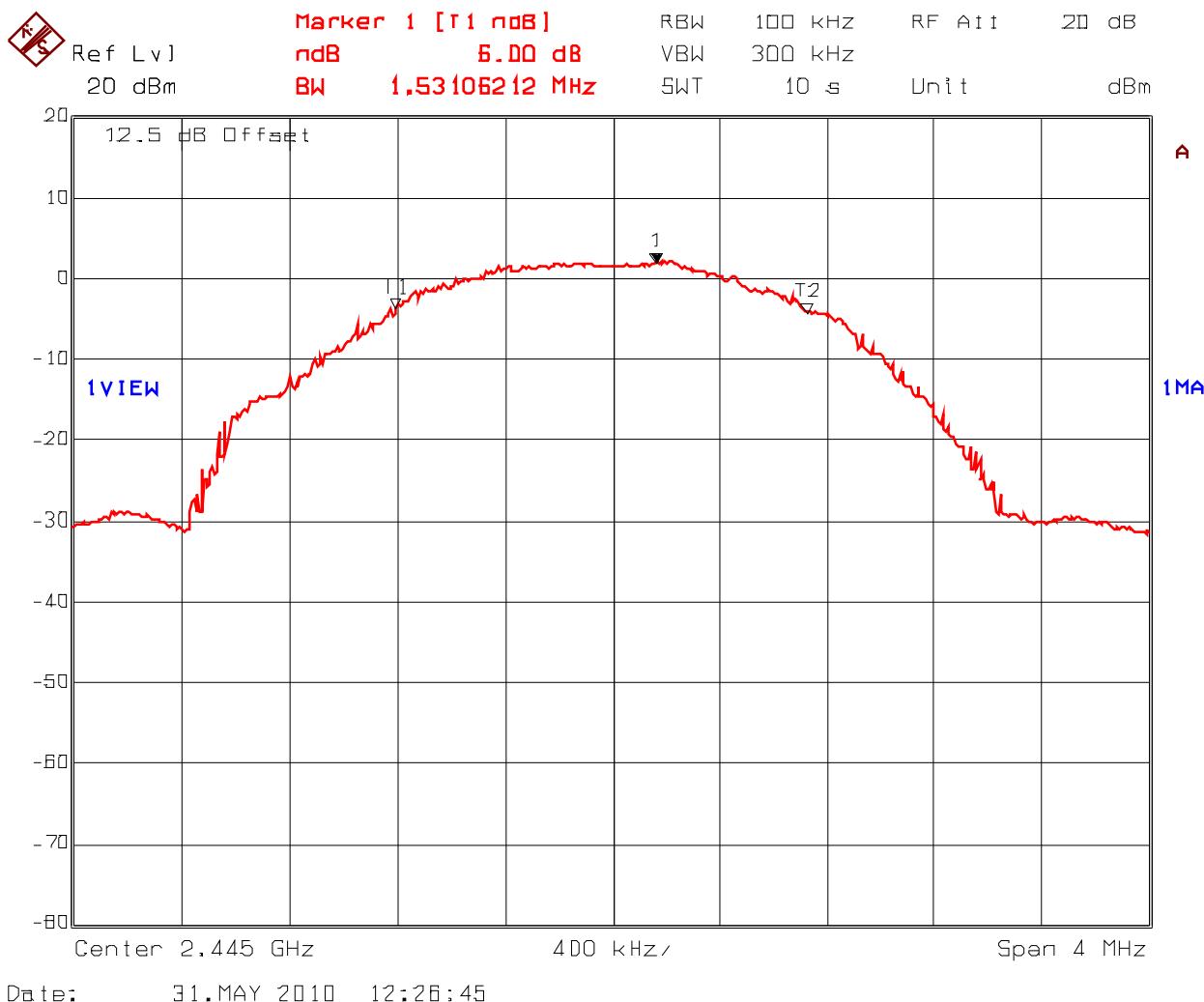
See the following plots for detailed measurements.

**Plot #1: 6 dB Bandwidth**  
Frequency: 2405 MHz; Modulation: 16-ary orthogonal

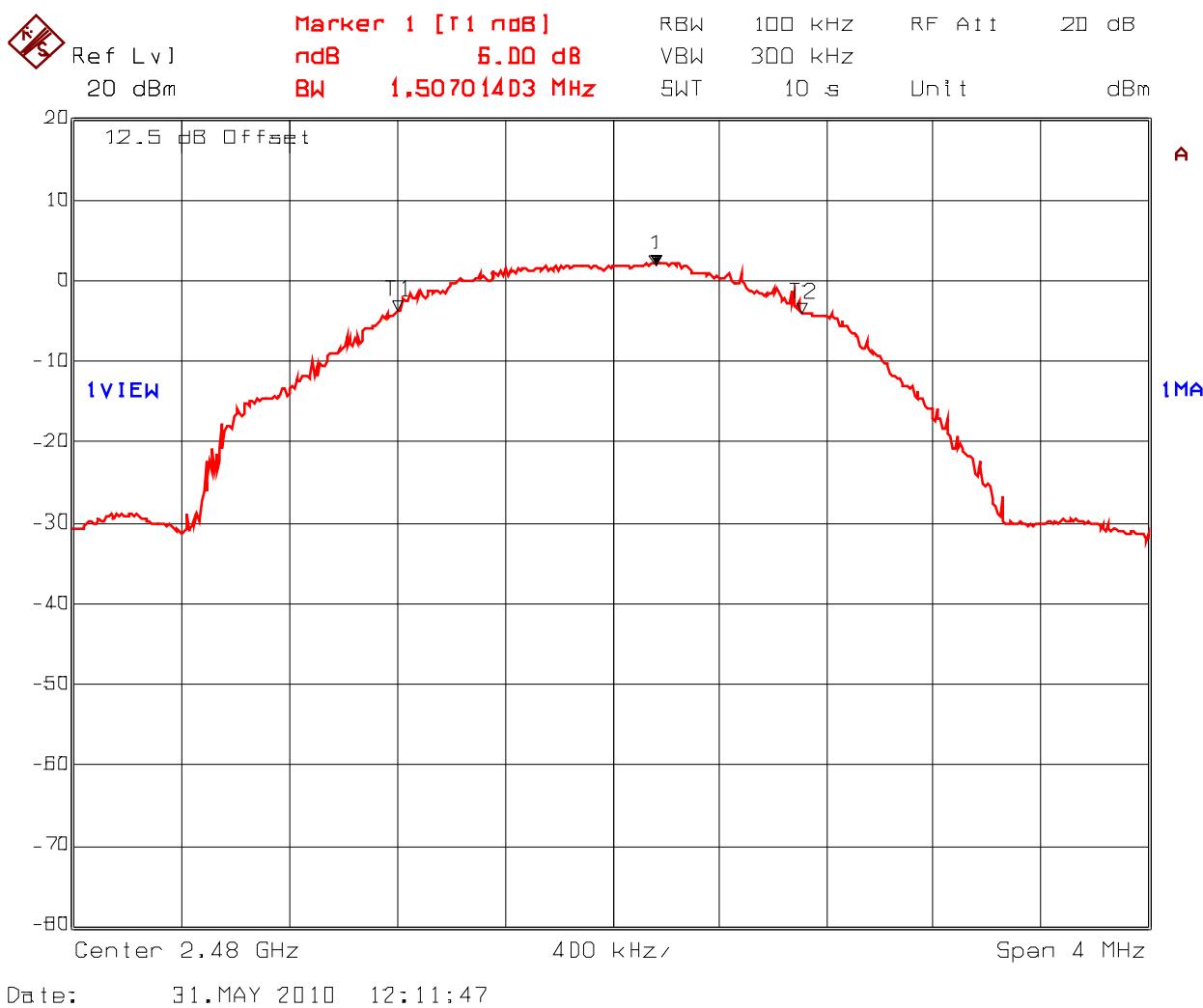


**Plot # 2: 6 dB Bandwidth**

Frequency: 2445 MHz; Modulation: 16-ary orthogonal



**Plot #3: 6 dB Bandwidth**  
Frequency: 2480 MHz; Modulation: 16-ary orthogonal



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

### 5.6.1. 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.

### 5.6.2. Method of Measurements & Test Arrangement

Refer to FCC KDB Publication No. 558074, Power Option method 1 and ANSI C63.4 for measurement methods.

### 5.6.3. Test Arrangement



### 5.6.4. Test Equipment List

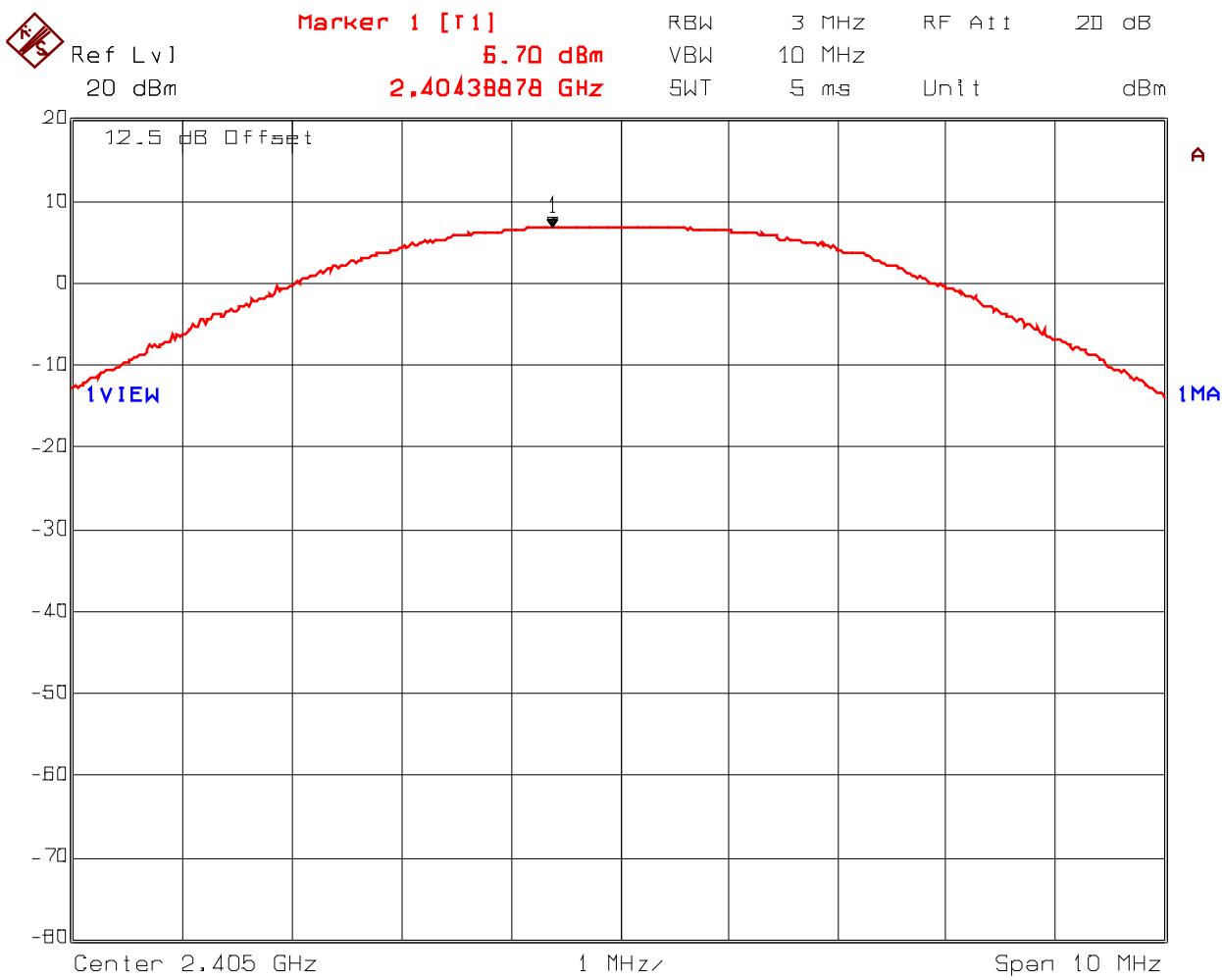
Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range	Calibration Due Date
Spectrum Analyzer	Rohde & Schwarz	FSEK30	100077	20 Hz – 40 GHz with external mixer	August 10, 2010
DC Block	Hewlett Packard	11742A	12460	0.045 – 26.5 GHz	N/A
Attenuator	Narda	4768-10	-	DC - 40 GHz	N/A

### 5.6.5. Test Data

Max Conducted O/P Power (dBm)		
2405 MHz (CH11)	2445 MHz (CH19)	2480 MHz (CH26)
6.70	5.00	5.12

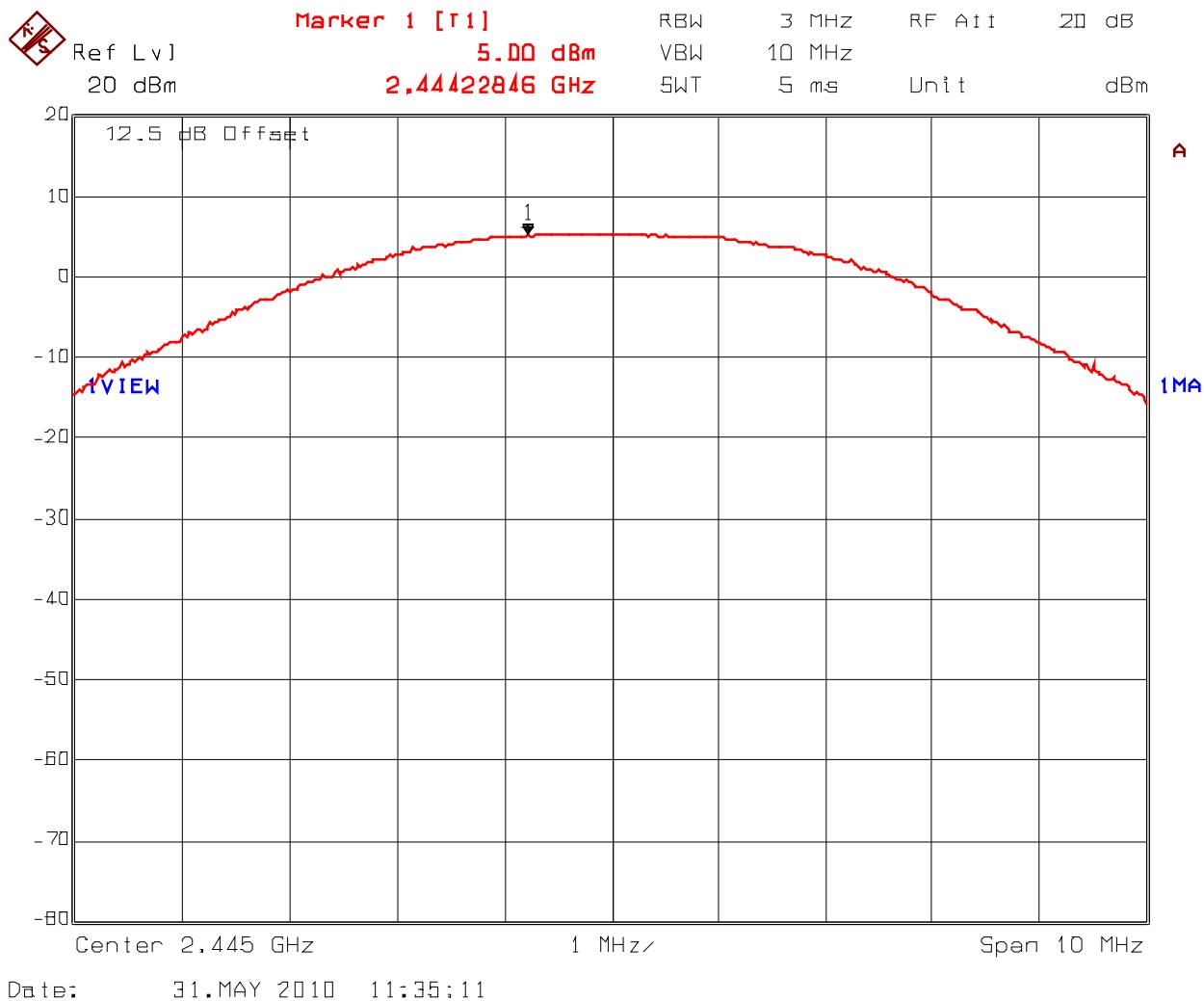
**Plot #4: Peak Output Power**

Frequency: 2405 MHz; Modulation: 16-ary orthogonal



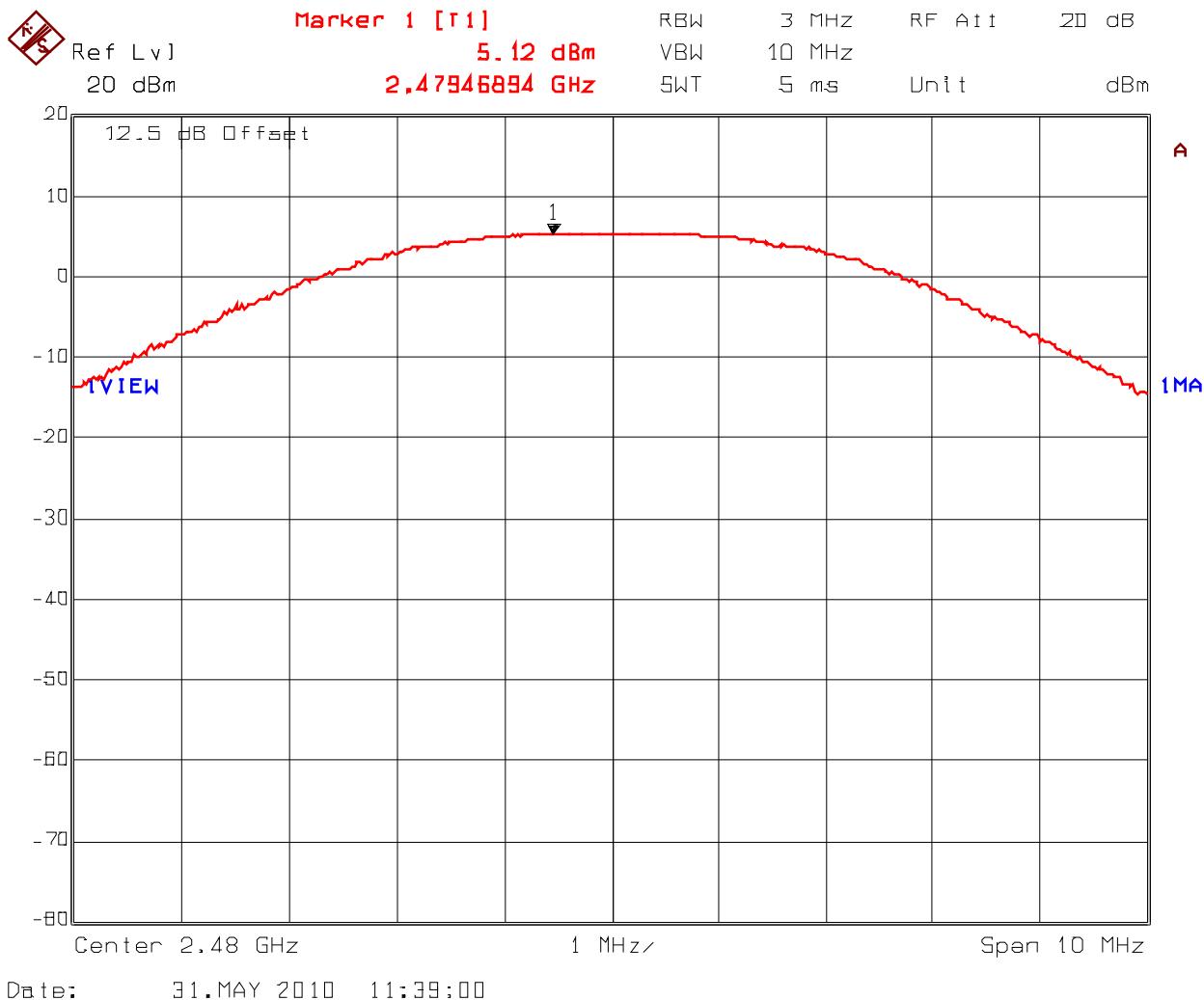
Date: 31.MAY 2010 10:07:45

**Plot #5: Peak Output Power**  
Frequency: 2445 MHz; Modulation: 16-ary orthogonal



## Plot #6: Peak Output Power

Frequency: 2480 MHz; Modulation: 16-ary orthogonal



Date: 31.MAY.2010 11:39:00

ULTRATECH GROUP OF LABS

3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4  
Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: [vic@](mailto:vic@)

File #: OFI-010F15C247

June 10, 2010

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

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

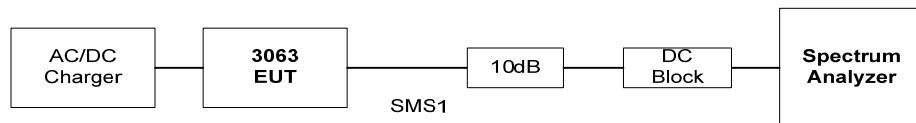
### 5.7.1. Limit(s)

**§ 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.

### 5.7.2. Method of Measurements

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

### 5.7.3. Test Arrangement



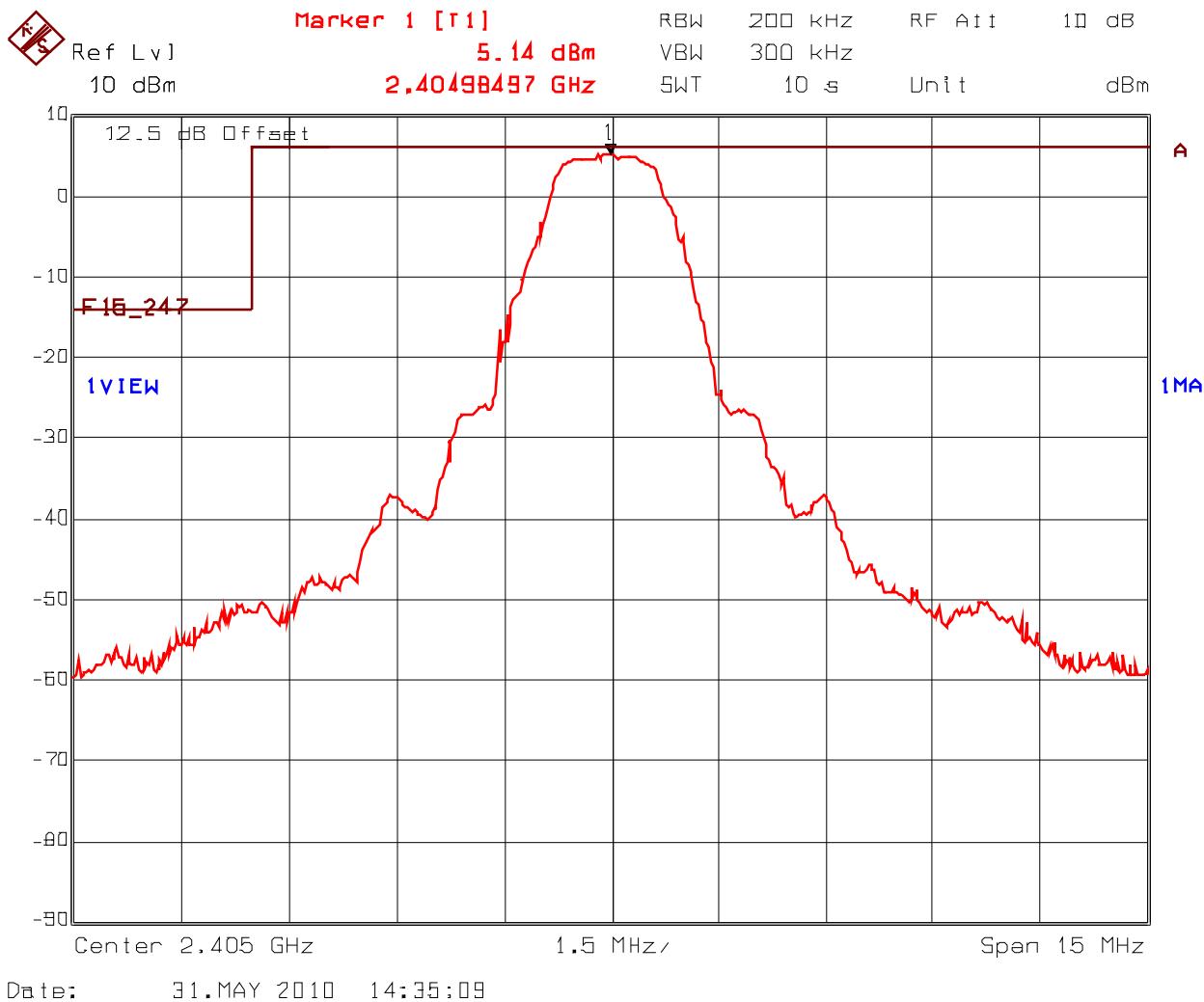
### 5.7.4. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range	Calibration Due Date
Spectrum Analyzer	Rohde & Schwarz	FSEK30	100077	20 Hz – 40 GHz with external mixer	August 10, 2010
DC Block	Hewlett Packard	11742A	12460	0.045 – 26.5 GHz	N/A
Attenuator	Narda	4768-10	-	DC - 40 GHz	N/A
High Pass Filter	K & L	11SH10-4000/T12000	4	Cut off 3.4 GHz	N/A

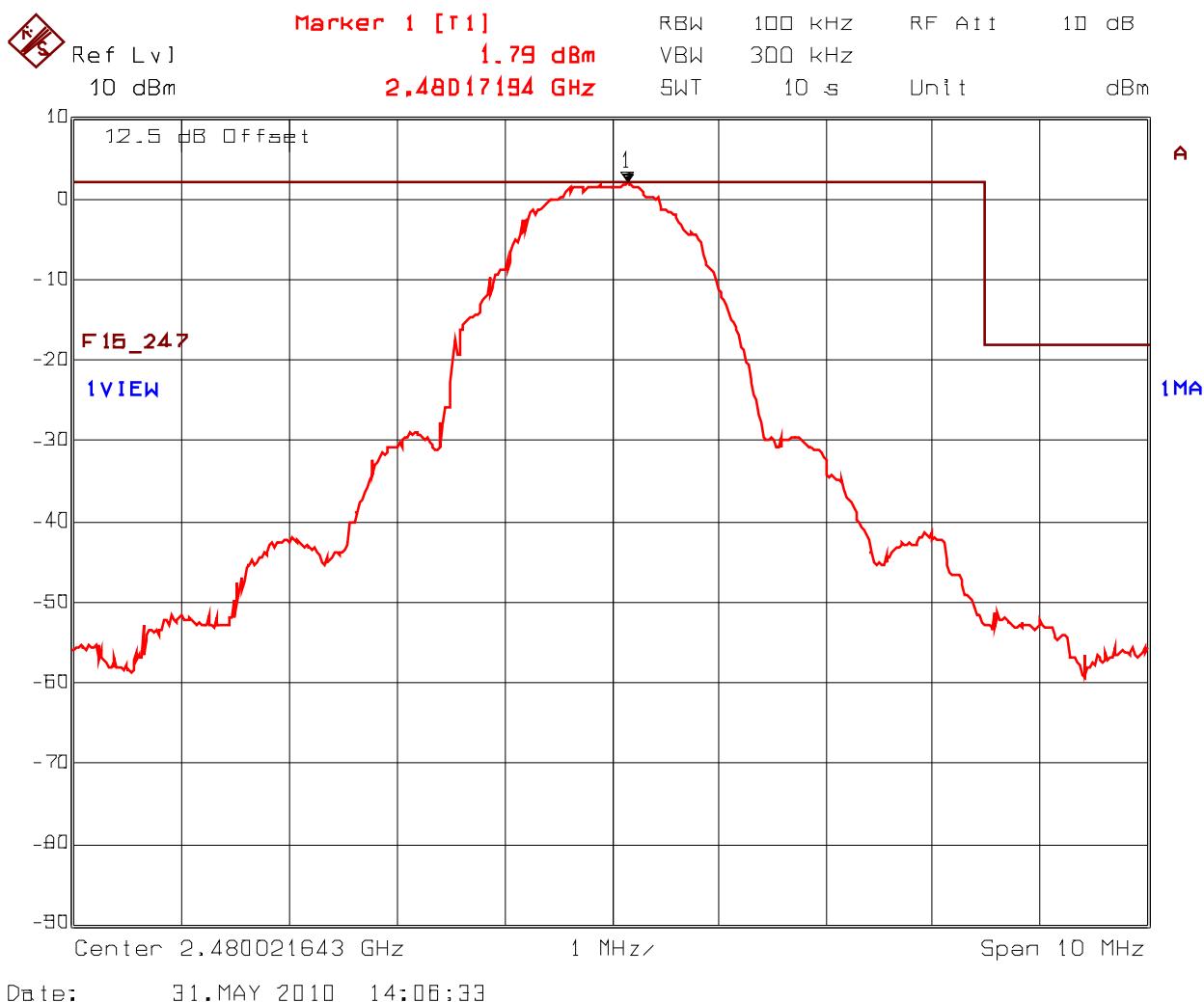
### 5.7.5. Test Data

**Plot #7: Conducted Band-edge Emissions**

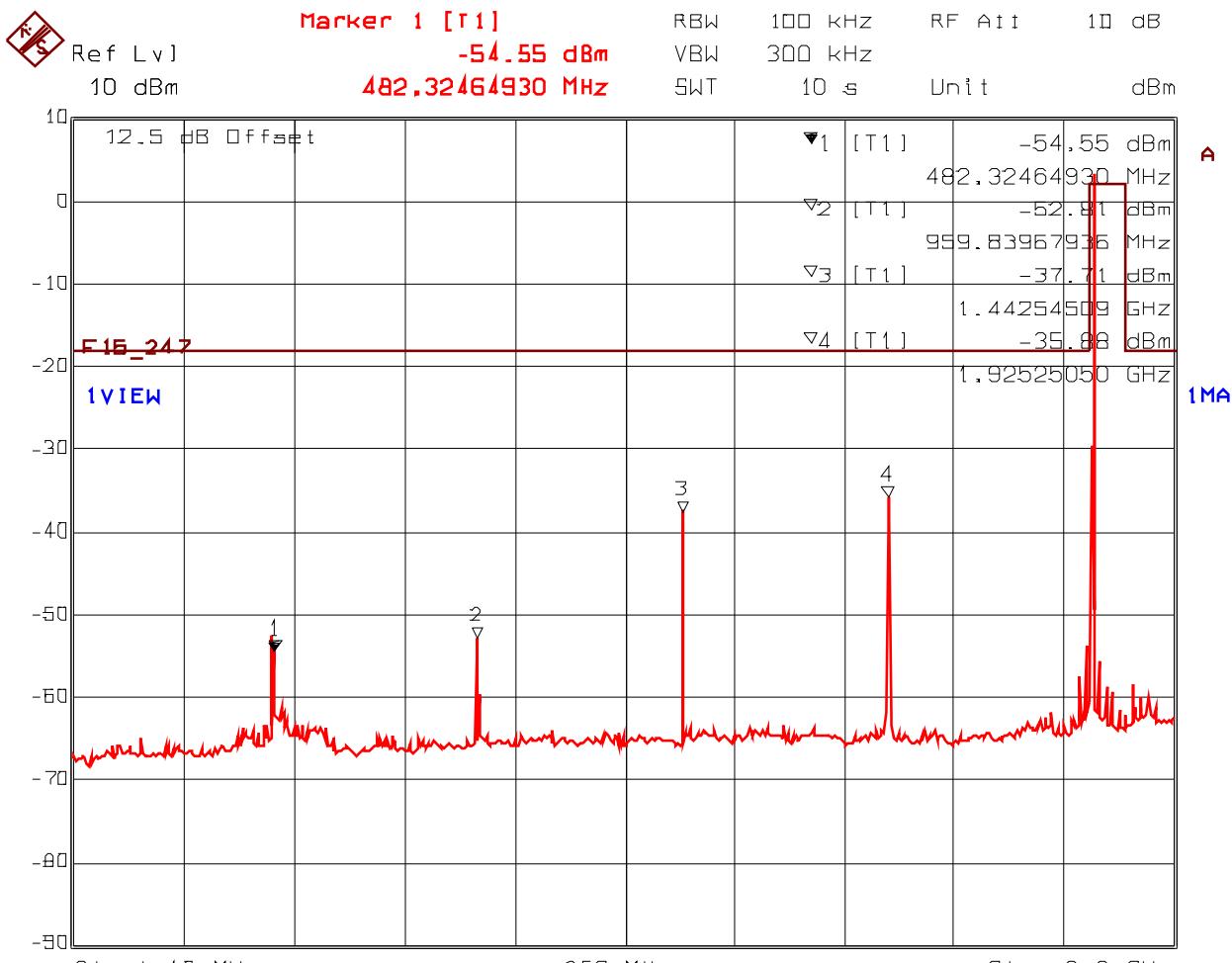
Lowest Channel Frequency: 2405 MHz; Modulation: 16-ary orthogonal



**Plot #8: Conducted Band-edge Emissions**  
Highest Channel Frequency: 2480 MHz; Modulation: 16-ary orthogonal

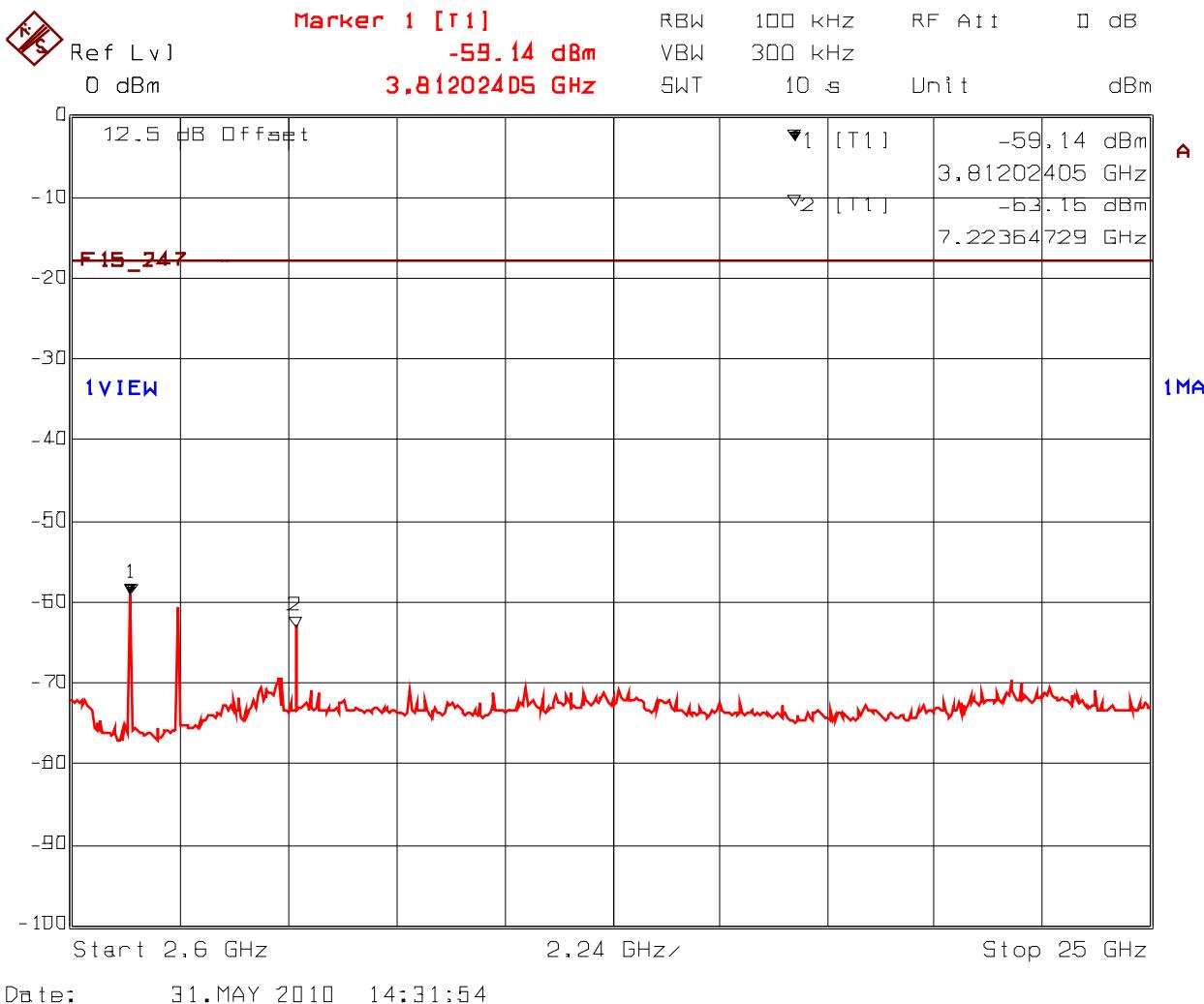


**Plot #9(a): Conducted Spurious Emissions**  
Channel Frequency: 2405 MHz; Modulation: 16-ary orthogonal



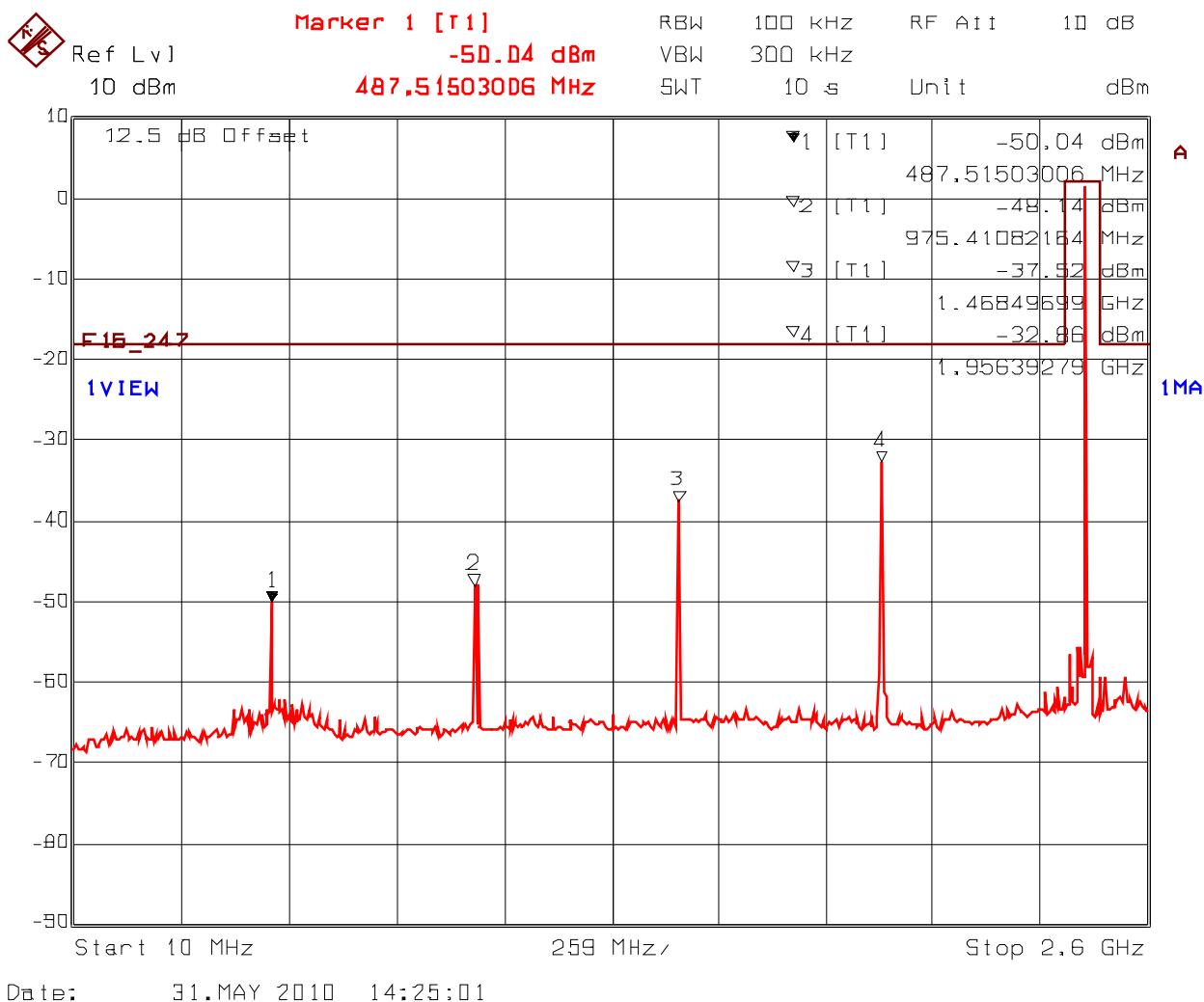
Date: 31.MAY 2010 14:29:12

**Plot #9(b): Conducted Spurious Emissions**  
Channel Frequency: 2405 MHz; Modulation: 16-ary orthogonal

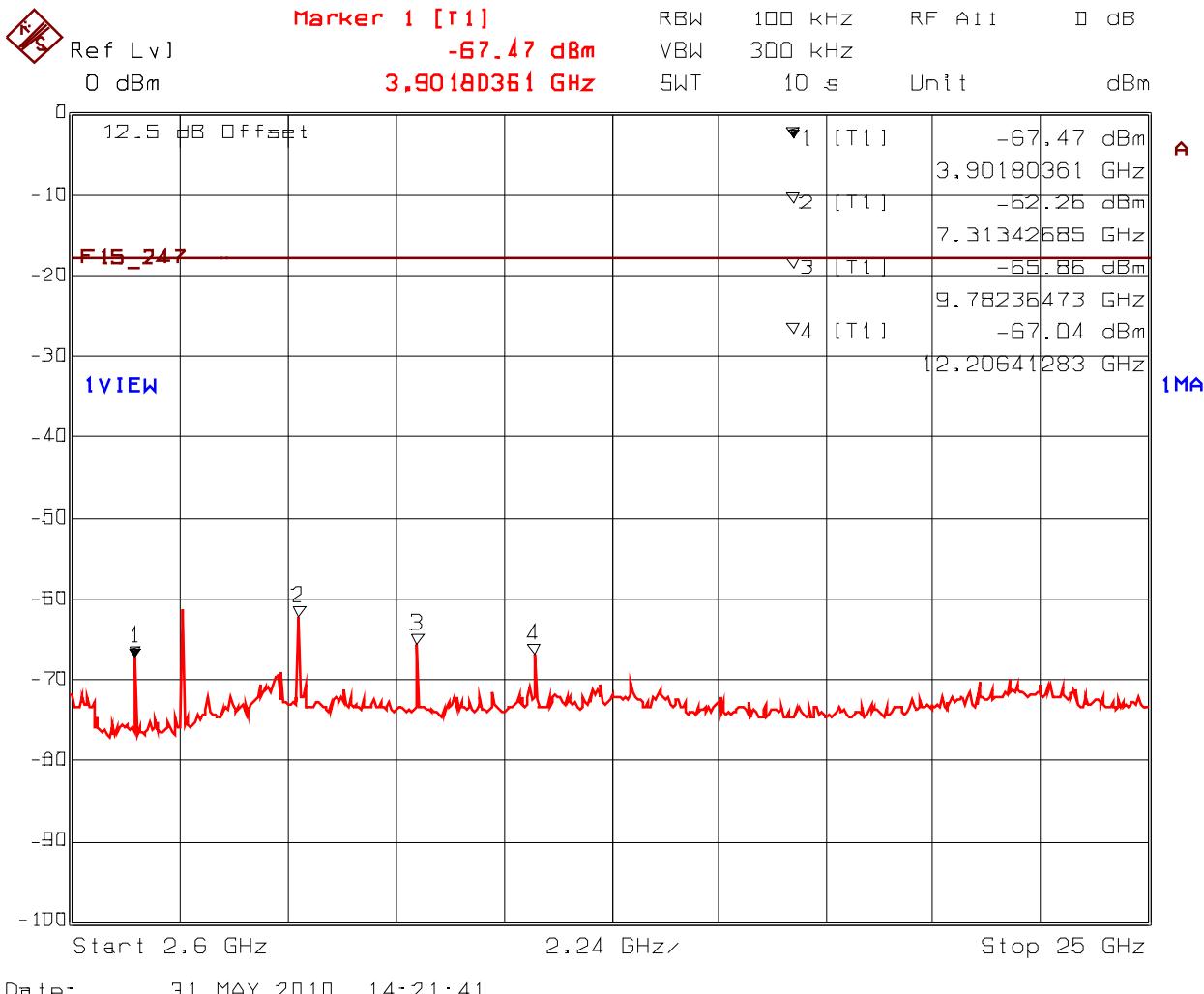


## Plot #10(a): Conducted Spurious Emissions

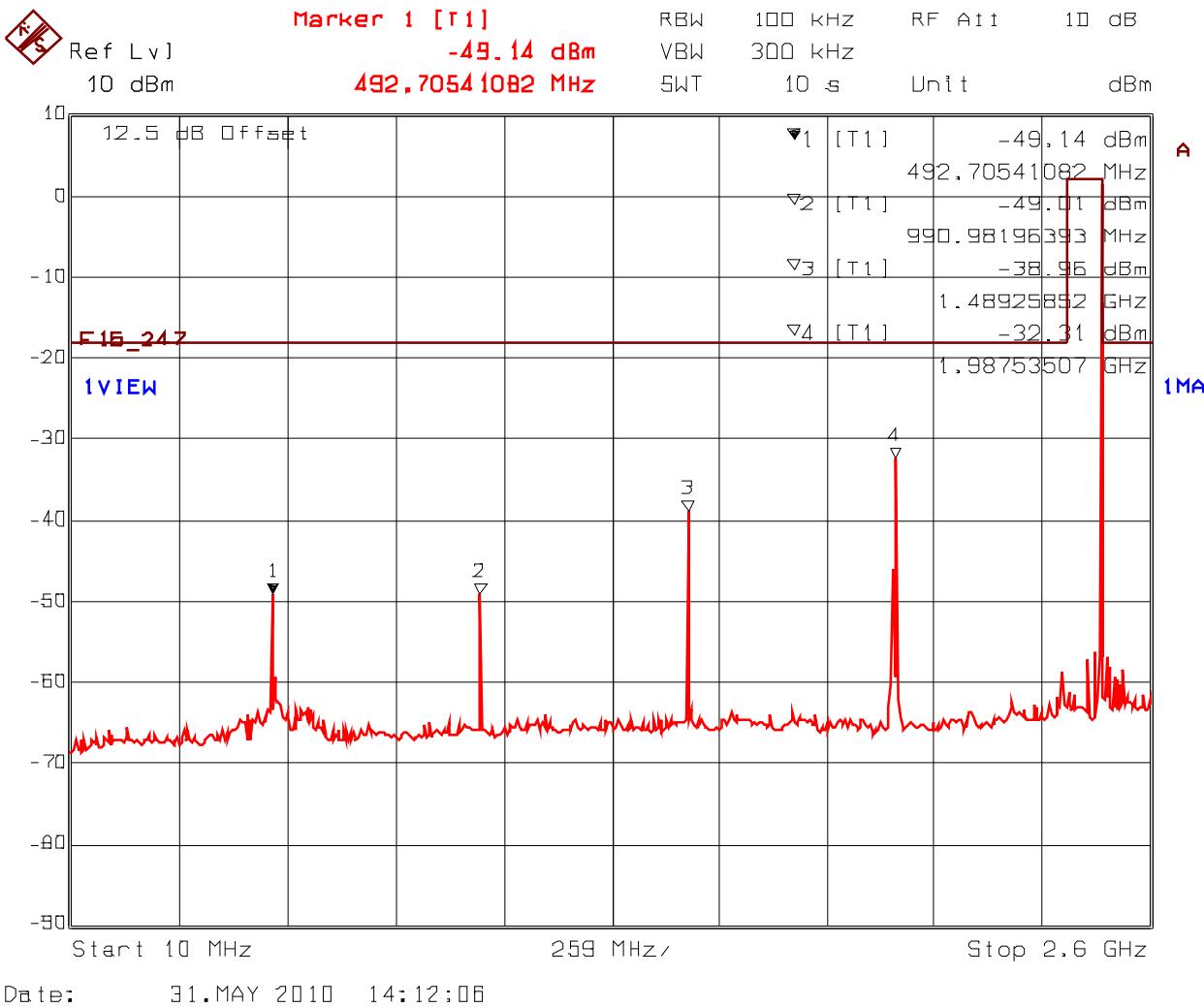
Channel Frequency: 2445 MHz; Modulation: 16-ary orthogonal



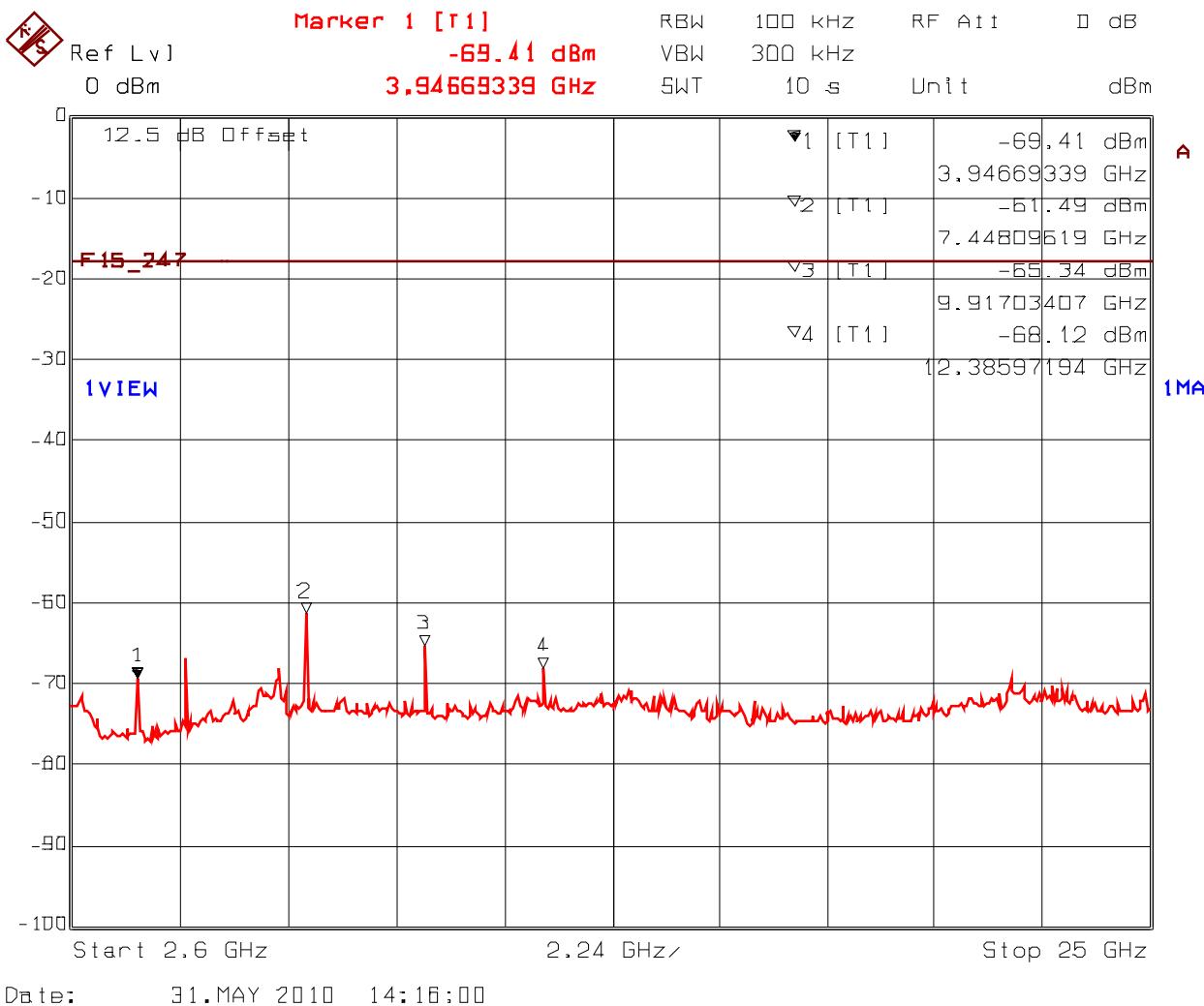
**Plot #10(b): Conducted Spurious Emissions**  
Channel Frequency: 2445 MHz; Modulation: 16-ary orthogonal



**Plot #11(a): Conducted Spurious Emissions**  
Channel Frequency: 2480 MHz; Modulation: 16-ary orthogonal



**Plot #11(b): Conducted Spurious Emissions**  
Channel Frequency: 2480 MHz; Modulation: 16-ary orthogonal



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

### 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. 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

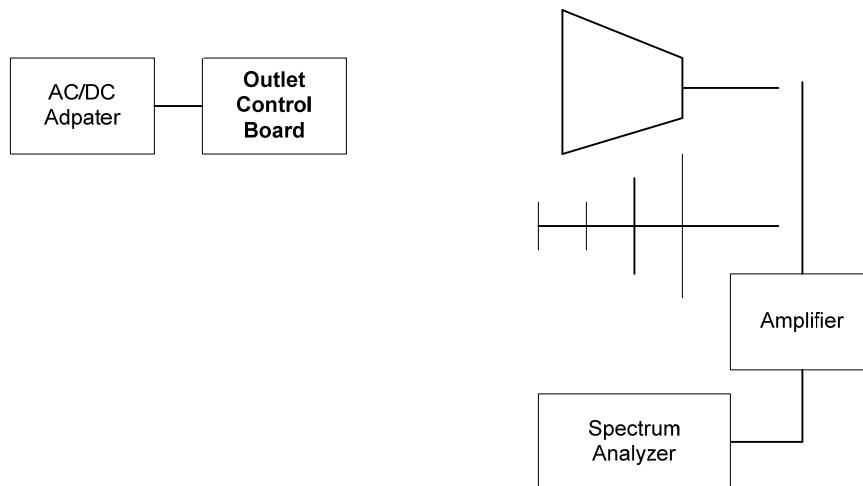
### Section 15.209(a) -- Field Strength Limits within Restricted Frequency Bands --

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

### 5.8.2. Method of Measurements

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

### 5.8.3. Test Arrangement



### 5.8.4. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Operating Range	Expired
Biconi-Log Antenna	Emco	3142	10005	0.03 – 2 GHz	18 April 2010
Horn Antenna	Emco	3155	9701-6570	1 – 18 GHz	20 Nov 2010
Horn Antenna	ETS-Lindgren	360-09	00118385	18 – 26.5 GHz	N/A
High Pass Filter	K & L	11SH10-4000/T12000	4	Cut off 2.4 GHz	N/A
Spectrum Analyzer	Rohde & Schwarz	FSEK30	100077	20 Hz – 40 GHz	10 Aug 2010
Spectrum Analyzer	Hewlett Packard	8593EM	3412A00103	9 kHz – 26.5 GHz	05 Oct. 2010
RF Amplifier	Com-Power	PA-103A	161243	10 MHz – 1 GHz	2 Nov. 2011
RF Amplifier	Hewlett Packard	84498	3008A00769	1 – 26.5 GHz	2 Nov. 2011

### 5.8.5. Test Data

#### Remark:

- All spurious emissions that are in excess of 20 dB below the specified limit are recorded below in the table.
- The 13.56 MHz radio and the 2.4 GHz radio were set to transmit continuously during radiated emission tests.

#### 5.8.5.1. Transmitter Radiated Spurious Emissions

Fundamental Frequency: Channel Frequency: 2405 MHz; Modulation: 16-ary orthogonal 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
2405	100.6	--	V	--	--	--	--
2405	105.1	--	H	--	--	--	--
4810	54.7	36.8	V	N/A	85.1	-48.3	-48.3
4810	52.9	34.9	H	N/A	85.1	-50.2	-50.2
7215	58.6	40.4	V	N/A	85.1	-44.7	-44.7
7215	60.4	40.4	H	N/A	85.1	-44.7	-44.7
No other significant spurious emissions from the transmitter were found in the frequency range from 30 MHz - 25 GHz							

Fundamental Frequency: Channel Frequency: 2445 MHz; Modulation: 16-ary orthogonal 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
2445	98.9	--	V	--	--	--	--
2445	104.1	--	H	--	--	--	--
4890	55.8	37.0	V	N/A	84.1	-47.1	Pass
4890	51.5	35.3	H	N/A	84.1	-48.8	Pass
7335	57.7	40.2	V	N/A	84.1	-43.9	Pass
7335	59.9	40.8	H	N/A	84.1	-43.3	Pass
No other significant spurious emissions from the transmitter were found in the frequency range from 30 MHz - 25 GHz							

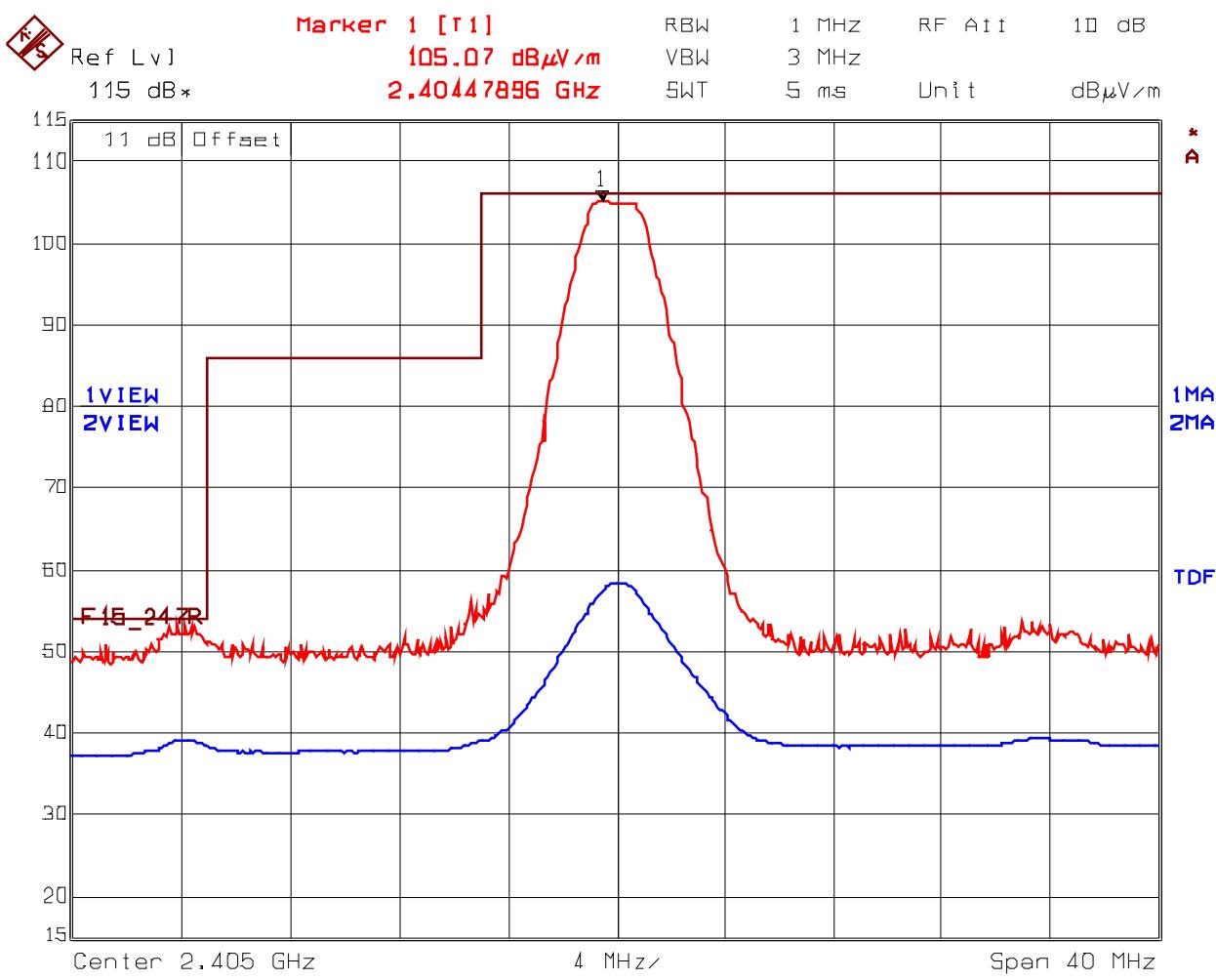
Fundamental Frequency:		Channel Frequency: 2480 MHz; Modulation: 16-ary orthogonal					
Test Frequency Range:		30 MHz – 25 GHz					
<hr/>							
Frequency (MHz)	RF Peak Level (dB $\mu$ V/m)	RF Avg Level (dB $\mu$ V/m)	Antenna Plane (H/V)	Limit 15.209 (dB $\mu$ V/m)	Limit 15.247 (dB $\mu$ V/m)	Margin (dB)	Pass/Fail
2480	94.8	--	V	--	--	--	--
2480	101.7	--	H	--	--	--	--
4960	55.1	36.8	V	N/A	81.7	-44.9	Pass
4960	51.2	34.6	H	N/A	81.7	-47.1	Pass
7440	60.2	40.2	V	N/A	81.7	-41.5	Pass
7440	62.4	41.5	H	N/A	81.7	-40.2	Pass

No other significant spurious emissions from the transmitter were found in the frequency range from 30 MHz - 25 GHz

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

**Plot # 12: Band-Edge RF Radiated Emissions @ 3 m**  
Low End of Frequency Band; Test Frequency: 2405 MHz  
Rx Antenna Orientation: Horizontal , EUT position : worst in 3 orthogonal position

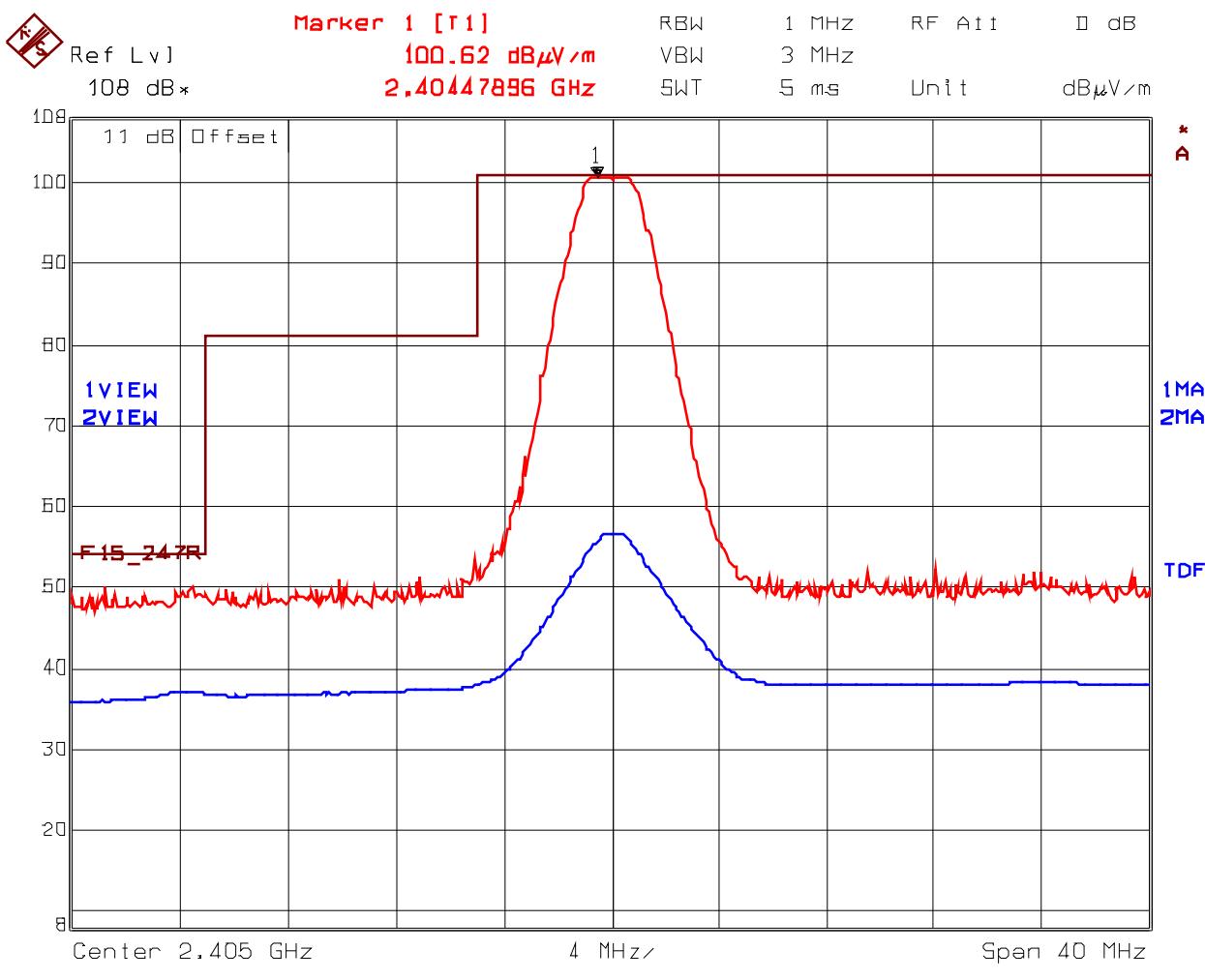
Trace 1: RBW = 1 MHz, VBW = 3 MHz; Trace 2: RBW = 1 MHz, VBW = 10 Hz



Date: 27. MAY 2010 12:57:36

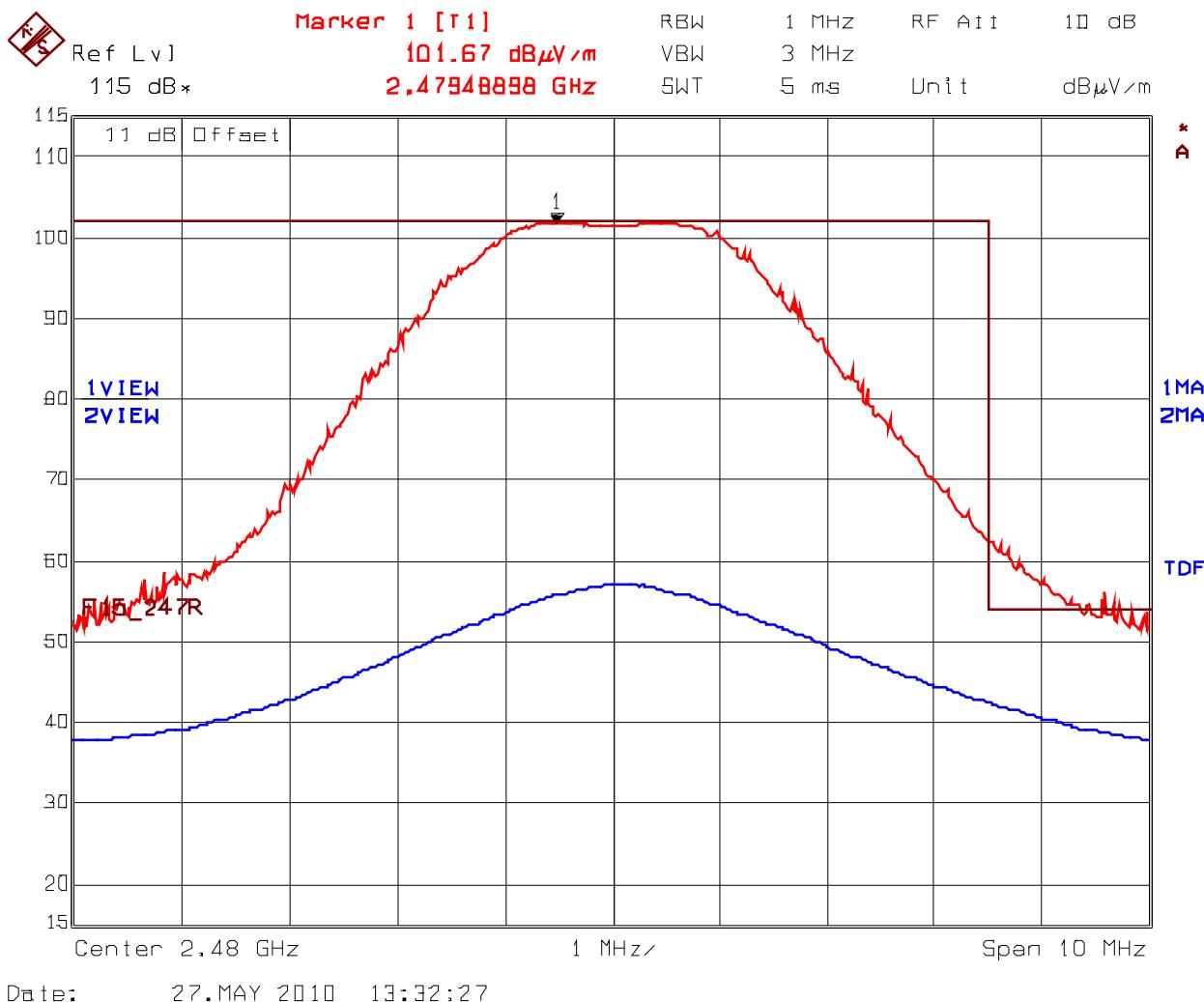
**Plot # 13: Band-Edge RF Radiated Emissions @ 3 m**  
Low End of Frequency Band; Test Frequency: 2405 MHz  
Rx Antenna Orientation: Vertical, EUT position : worst in 3 orthogonal position

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



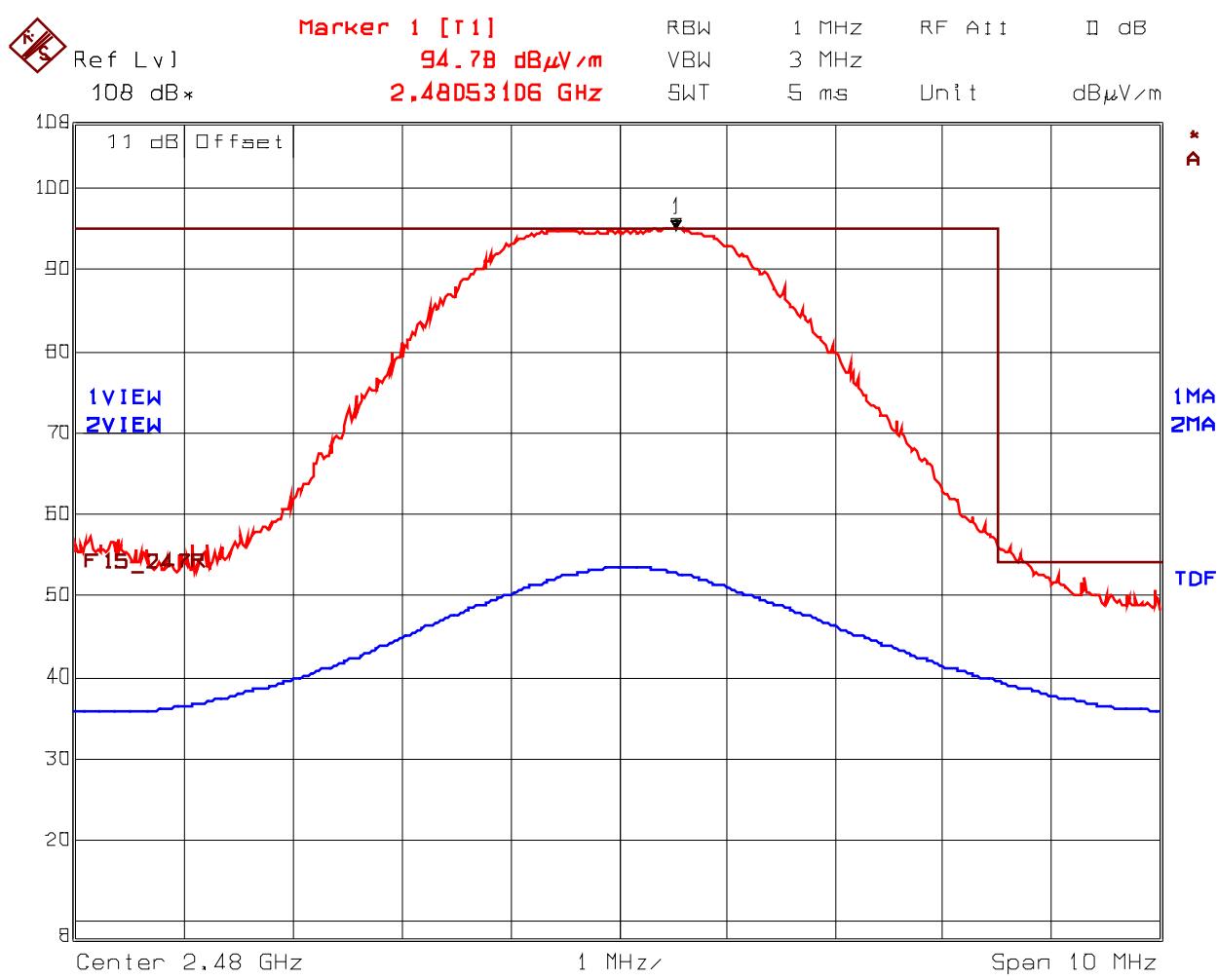
**Plot # 14: Band-Edge RF Radiated Emissions @ 3 m**  
High End of Frequency Band; Test Frequency: 2480 MHz  
Rx Antenna Orientation: Horizontal, EUT position : worst in 3 orthogonal position

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



**Plot # 15: Band-Edge RF Radiated Emissions @ 3 m**  
High End of Frequency Band; Test Frequency: 2480 MHz  
Rx Antenna Orientation: Vertical, EUT position : worst in 3 orthogonal position

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



## 5.9. POWER SPECTRAL DENSITY [§ 15.247(e)]

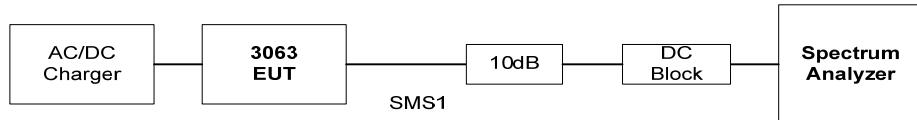
### 5.9.1. Limit(s)

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.

### 5.9.2. Method of Measurements

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

### 5.9.3. Test Arrangement



### 5.9.4. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range	Calibration Due Date
Spectrum Analyzer	Rohde & Schwarz	FSEK30	100077	20 Hz – 40 GHz with external mixer	August 10, 2010
DC Block	Hewlett Packard	11742A	12460	0.045 – 26.5 GHz	N/A
Attenuator	Narda	4768-10	-	DC - 40 GHz	N/A

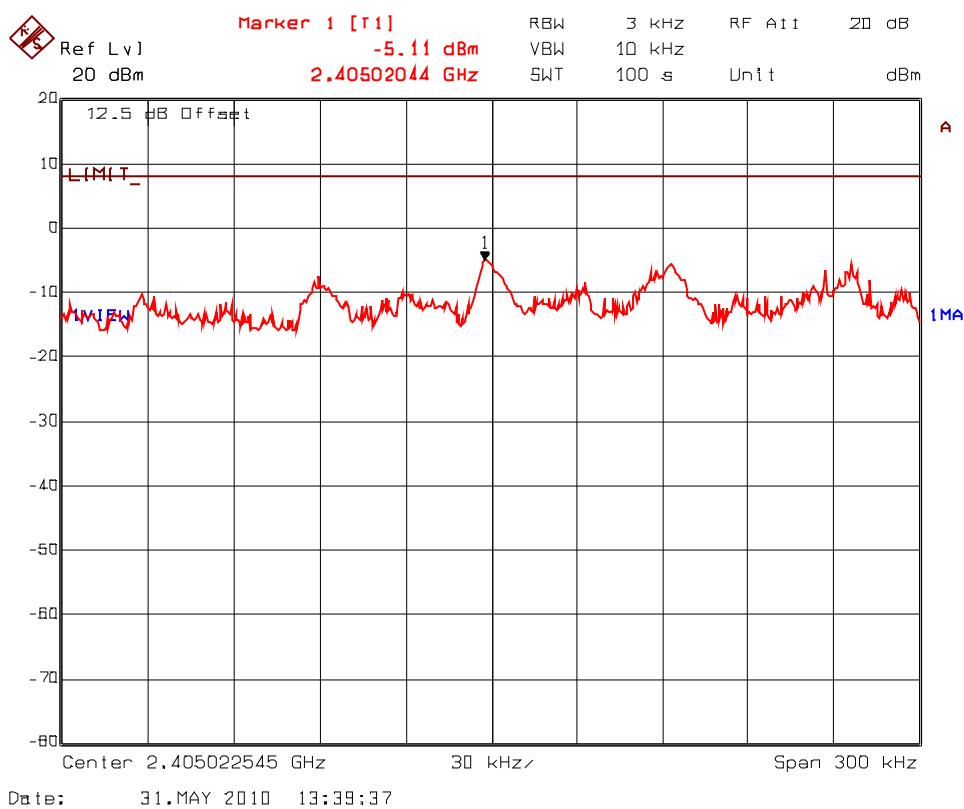
### 5.9.5. Test Data

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

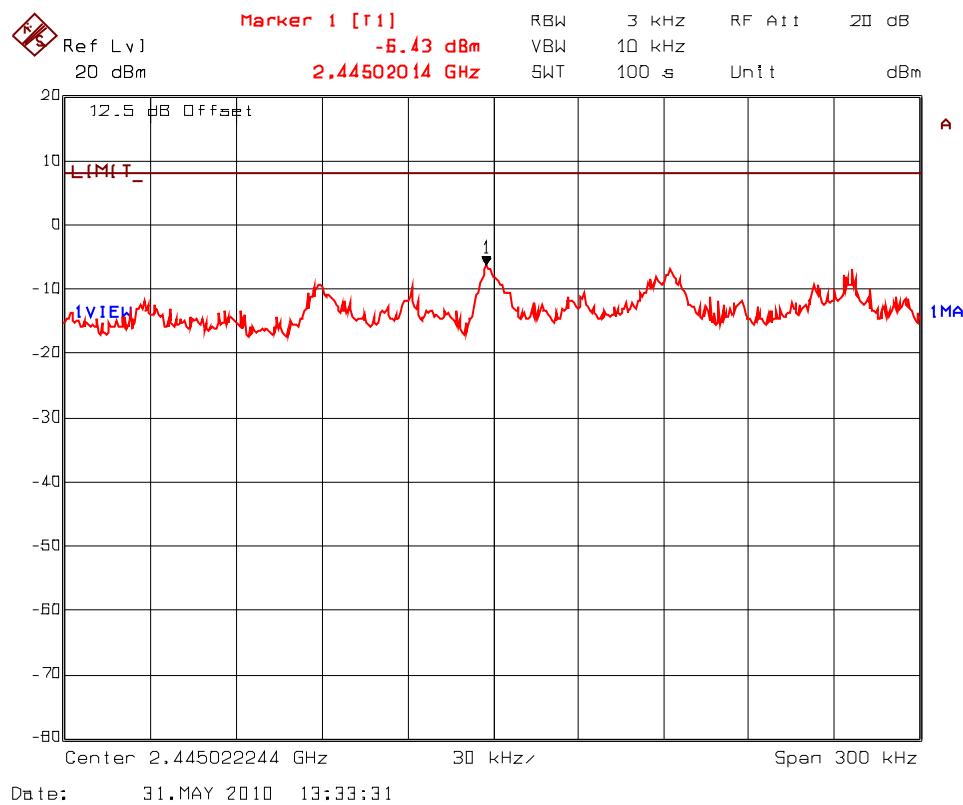
Frequency (MHz)	*PSD in 3 kHz BW dBm	Limit (dBm)	Margin (dB)	Comments (Pass/Fail)
Modulation: 16-ary orthogonal				
2405	-16.68	8	-24.68	Pass
2445	-12.82	8	-20.82	Pass
2480	-13.39	8	-21.39	Pass

\*See the following plots for measurement details.

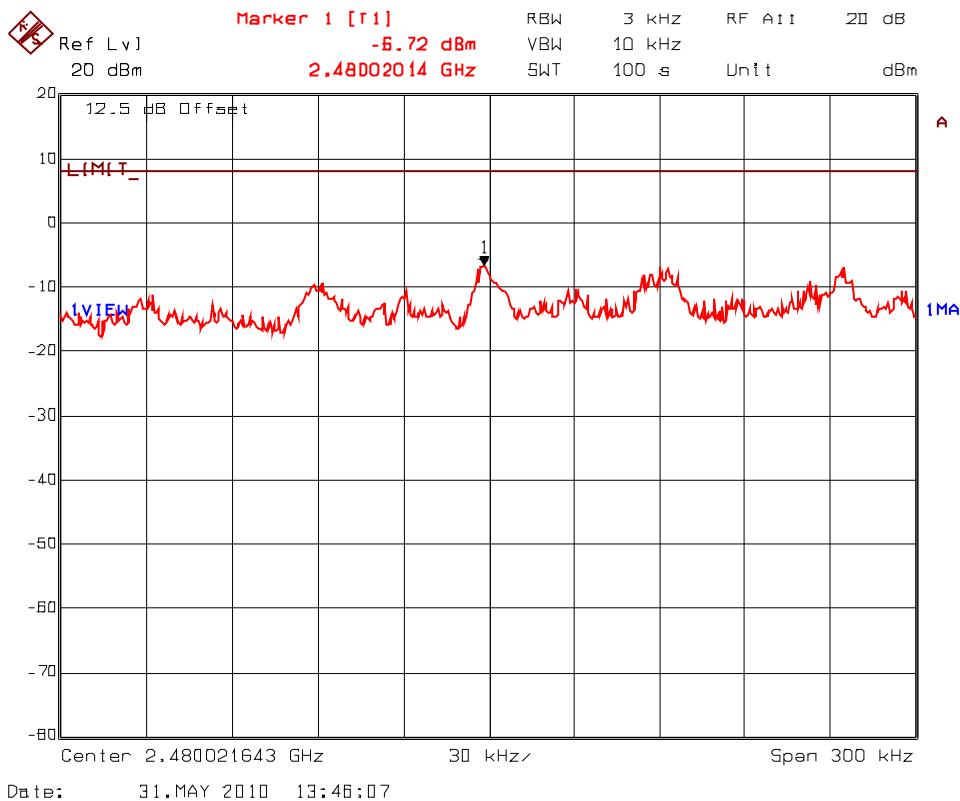
**Plot # 16:** Power Spectral Density, Frequency: 2405 MHz



**Plot # 17: Power Spectral Density, Frequency: 2445 MHz**



Plot # 18: Power Spectral Density, Frequency: 2480 MHz



## 5.10. RF EXPOSURE REQUIREMENTS [§§ 15.247(i), 1.1307(b)(1) & 2.1093]

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.

### 5.10.1. Method of Measurements

Refer to Sections 1.1310, 2.1091.

Spread spectrum transmitters operating under section 15.247 are categorically excluded from routine environmental evaluation to demonstrating RF exposure compliance with respect to MPE and/or SAR limits. These devices are not exempted from compliance (As indicated in Section 15.247(b)(4), these transmitters are required to operate in a manner that ensures that exposure to public users and nearby persons) does not exceed the Commission's RF exposure guidelines (see Section 1.1307 and 2.1093). Unless a device operates at substantially low power levels, with a low gain antenna(s), supporting information is generally needed to establish the various potential operating configurations and exposure conditions of a transmitter and its antenna(s) in order to determine compliance with the RF exposure guidelines.

Refer to FCC @ 1.1310 and 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:**

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

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

FCC radio frequency exposure limits may be exceeded at distances closer than r cm from the antenna of this device

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

### 5.10.2. Test Data

#### Antenna Gain Limit specified by Manufacturer:

( <sup>1</sup> ) Lowest Frequency (MHz)	Measured Peak RF Conducted Power (dBm)	Calculated EIRP (dBm)	Exposure Condition	Calculated Minimum RF Safety Distance r (cm)*
2405	6.7	9.9	General Population	0.88

#### RF EXPOSURE DISTANCE LIMITS

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

$$(S_{\text{Limit}}) = 1.0 \text{ mW/cm}^2$$

$$(\text{Maximum EIRP Measured}) = 9.9 \text{ dBm} = 9.77 \text{ mW}$$

$$(\text{Minimum Safe Distance, } r) = \text{sqrt}(9.77 / (4 \times 3.1416 \times 1)) = 0.88 \text{ cm}$$

Evaluation of RF Exposure Compliance Requirements	
RF Exposure Requirements	Compliance with FCC Rules
Minimum calculated separation distance between antenna and persons required: <b>0.88 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	N/A
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	User manual confirms that "The two radios co-located within the device doesn't transmit simultaneously"

## 5.11. POWERLINE CONDUCTED EMISSIONS [47 CFR 15.107(a) & 15.207]

### 5.11.1. Limits

The equipment shall meet the limits of the following table:

Test Frequency Range (MHz)	Class B Limits (dB $\mu$ V)		Measuring Bandwidth
	Quasi-Peak	Average	
0.15 to 0.5	66 to 56*	56 to 46*	RBW = 9 kHz VBW $\geq$ 9 kHz for QP VBW = 1 Hz for Average
0.5 to 5	56	46	RBW = 9 kHz VBW $\geq$ 9 kHz for QP VBW = 1 Hz for Average
5 to 30	60	50	RBW = 9 kHz VBW $\geq$ 9 kHz for QP VBW = 1 Hz for Average

\* Decreasing linearly with logarithm of frequency

### 5.11.2. Method of Measurements

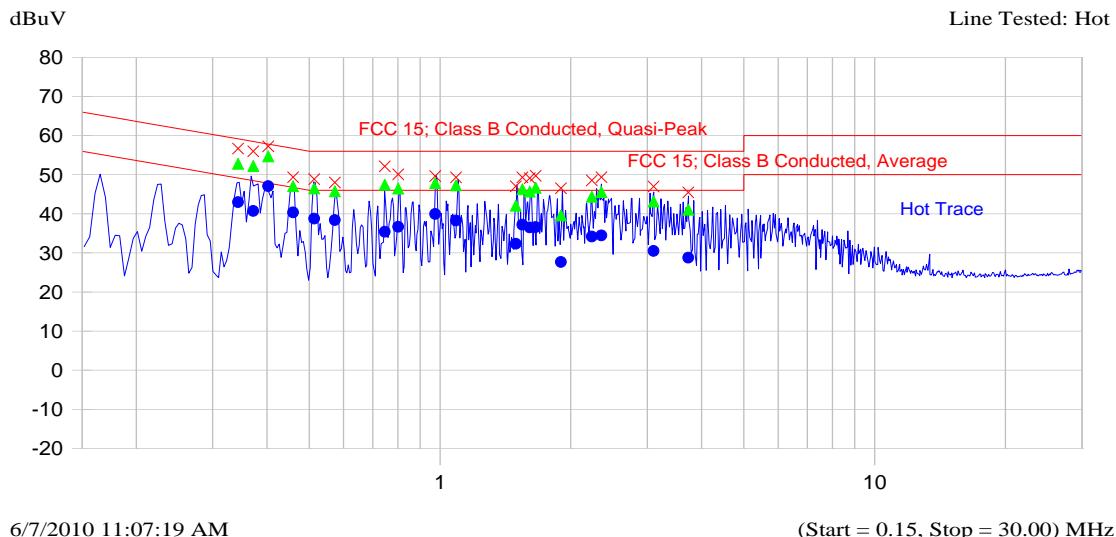
Refer to Ultratech Test Procedures, File # ULTR P001-2004 and ANSI C63.4 for measurement methods

### 5.11.3. Test Data

Plot # 3: Power Line Conducted Emission – Line tested: Hot

Test Configuration 1: EUT was on RF receiving mode, Line Voltage: 5 Vdc  
 (tests were performed using off-shelf external AC/DC adaptor)

#### Current Graph



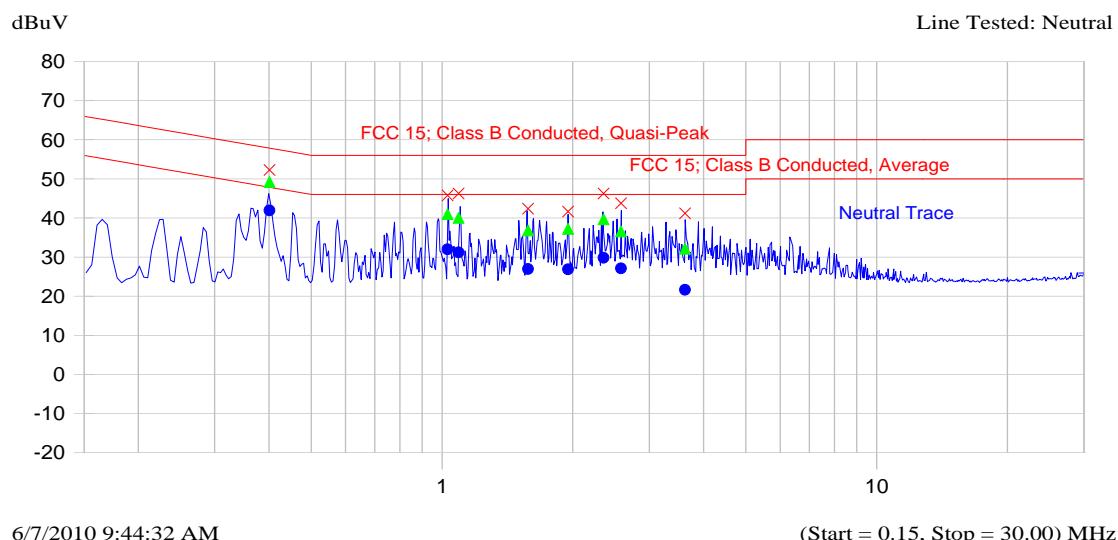
#### Current List

Frequency MHz	Peak dBuV	QP dBuV	Delta QP-QP Limit dB	Avg dBuV	Delta Avg-Avg Limit dB	Trace Name
0.343	56.6	52.8	-7.6	42.9	-7.5	Hot Trace
0.372	56.0	52.2	-7.4	40.7	-8.9	Hot Trace
0.402	57.2	54.7	-4.1	47.1	-1.7	Hot Trace
0.459	49.3	47.1	-10.1	40.3	-6.8	Hot Trace
0.513	48.9	46.5	-9.5	38.7	-7.3	Hot Trace
0.573	48.0	45.7	-10.3	38.4	-7.6	Hot Trace
0.746	52.1	47.4	-8.6	35.4	-10.6	Hot Trace
0.801	50.1	46.5	-9.5	36.7	-9.3	Hot Trace
0.974	49.6	47.8	-8.2	39.9	-6.1	Hot Trace
1.089	49.3	47.2	-8.8	38.2	-7.8	Hot Trace
1.495	47.0	42.0	-14.0	32.3	-13.7	Hot Trace
1.547	49.3	46.3	-9.7	37.2	-8.8	Hot Trace
1.608	49.1	45.7	-10.3	36.5	-9.5	Hot Trace
1.660	49.7	46.6	-9.4	36.6	-9.4	Hot Trace
1.899	46.5	39.6	-16.4	27.7	-18.3	Hot Trace
2.234	48.5	44.3	-11.7	34.2	-11.8	Hot Trace
2.352	49.4	45.5	-10.5	34.4	-11.6	Hot Trace
3.097	47.0	43.1	-12.9	30.5	-15.5	Hot Trace
3.725	45.4	41.1	-14.9	28.8	-17.2	Hot Trace

Plot # 4: Power Line Conducted Emission – Line tested: Neutral

Test Configuration 1: EUT was on RF receiving mode, Line Voltage: 5 Vdc  
(tests were performed using off-shelf external AC/DC adaptor)

Current Graph



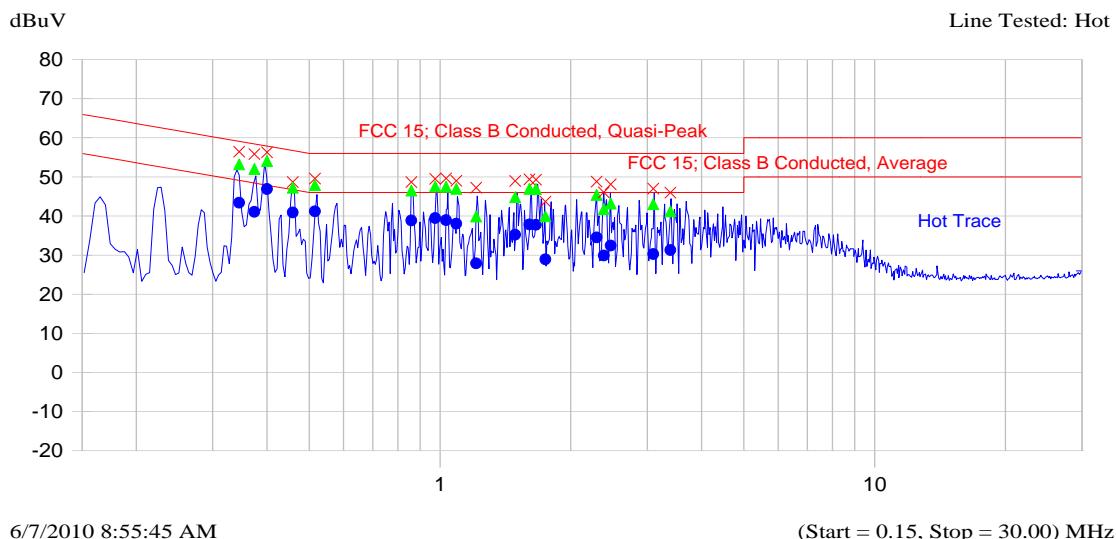
Current List

Frequency MHz	Peak dBuV	QP dBuV	Delta dB	QP-QP Limit	Avg dBuV	Delta Avg-Avg Limit dB	Trace Name
0.401	52.2	49.2	-9.6	41.9	-6.8		Neutral Trace
1.029	45.8	41.0	-15.0	32.0	-14.0		Neutral Trace
1.092	46.2	40.0	-16.0	31.2	-14.8		Neutral Trace
1.577	42.4	36.8	-19.2	26.9	-19.1		Neutral Trace
1.950	41.6	37.2	-18.8	26.9	-19.1		Neutral Trace
2.352	46.3	39.7	-16.3	29.8	-16.2		Neutral Trace
2.582	43.7	36.5	-19.5	27.1	-18.9		Neutral Trace
3.621	41.2	32.1	-23.9	21.6	-24.4		Neutral Trace

Plot # 5: Power Line Conducted Emission – Line tested: Hot

Test Configuration 2: EUT was on RF transmitting mode, Line Voltage: 5 Vdc  
(tests were performed using off-shelf external AC/DC adaptor)

## Current Graph

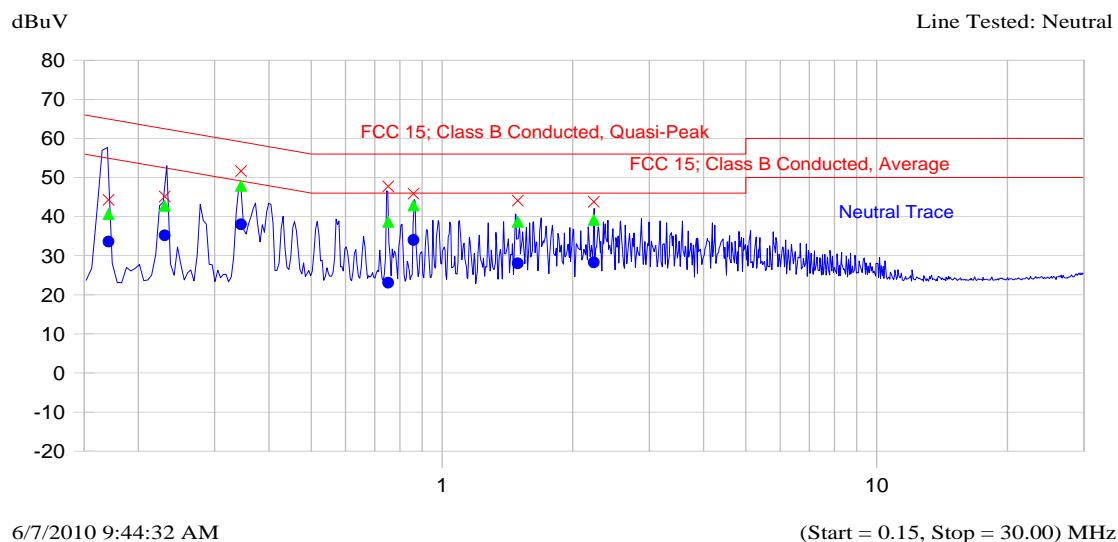


## Current List

Frequency MHz	Peak dBuV	QP dBuV	Delta dB	QP-QP Limit	Avg dBuV	Delta dB	Avg-Avg Limit	Trace Name
0.345	56.4	53.2	-7.2		43.4	-6.9		Hot Trace
0.374	55.8	52.0	-7.5		41.1	-8.5		Hot Trace
0.400	56.3	54.1	-4.7		46.9	-1.9		Hot Trace
0.458	48.6	47.2	-9.9		40.9	-6.3		Hot Trace
0.515	49.6	47.9	-8.1		41.2	-4.8		Hot Trace
0.859	48.6	46.5	-9.5		38.8	-7.2		Hot Trace
0.974	49.5	47.5	-8.5		39.5	-6.5		Hot Trace
1.032	49.6	47.5	-8.5		38.9	-7.1		Hot Trace
1.089	49.0	46.9	-9.1		38.0	-8.0		Hot Trace

Plot # 6: Power Line Conducted Emission – Line tested: Neutral  
Test Configuration 2: EUT was on RF transmitting mode, Line Voltage: 5 Vdc  
(tests were performed using off-shelf external AC/DC adaptor)

### Current Graph



### Current List

Frequency MHz	Peak dBuV	QP dBuV	Delta QP-QP Limit dB	Avg dBuV	Delta Avg-Avg Limit dB	Trace Name
0.171	44.3	40.6	-24.8	33.6	-21.8	Neutral Trace
0.230	45.1	42.8	-20.9	35.2	-18.4	Neutral Trace
0.345	51.6	47.9	-12.5	38.0	-12.4	Neutral Trace
0.751	47.7	38.7	-17.3	23.0	-23.0	Neutral Trace
0.860	45.9	42.8	-13.2	34.0	-12.0	Neutral Trace
1.494	44.1	38.7	-17.3	28.0	-18.0	Neutral Trace
2.234	43.8	39.2	-16.8	28.3	-17.7	Neutral Trace

## EXHIBIT 6. MEASUREMENT UNCERTAINTY

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

### 6.1. 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 $20\text{Log}(1+\Gamma_1\Gamma_R)$	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:

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

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

## 6.2. RADIATED EMISSION MEASUREMENT UNCERTAINTY

CONTRIBUTION (Radiated Emissions)	PROBABILITY DISTRIBUTION	UNCERTAINTY (+ dB)	
		3 m	10 m
Antenna Factor Calibration	Normal (k=2)	$\pm 1.0$	$\pm 1.0$
Cable Loss Calibration	Normal (k=2)	$\pm 0.3$	$\pm 0.5$
EMI Receiver specification	Rectangular	$\pm 1.5$	$\pm 1.5$
Antenna Directivity	Rectangular	$\pm 0.5$	$\pm 0.5$
Antenna factor variation with height	Rectangular	$\pm 2.0$	$\pm 0.5$
Antenna phase center variation	Rectangular	0.0	$\pm 0.2$
Antenna factor frequency interpolation	Rectangular	$\pm 0.25$	$\pm 0.25$
Measurement distance variation	Rectangular	$\pm 0.6$	$\pm 0.4$
Site imperfections	Rectangular	$\pm 2.0$	$\pm 2.0$
Mismatch: Receiver VRC $\Gamma_1 = 0.2$ Antenna VRC $\Gamma_R = 0.67(Bi) 0.3 (Lp)$ Uncertainty limits $20\log(1+\Gamma_1\Gamma_R)$	U-Shaped	$+1.1$ $-1.25$	$\pm 0.5$
System repeatability	Std. Deviation	$\pm 0.5$	$\pm 0.5$
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:

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