

ENGINEERING TEST REPORT



SafePlug Outlet Control Board Model No.: 3064

FCC ID: S9C-3064

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-015_F15C247

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

Date: November 16, 2010

Report Prepared by: Dharmajit Solanki

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

Issued Date: November 16, 2010

Test Dates: October 25-28, 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, Email: vic@ultratech-labs.com, Email: tri@ultratech-labs.com



91038



1309



46390-2049



NvLap Lab Code
200093-0



SL2-IN-E-1119R



CA2049

TABLE OF CONTENTS

EXHIBIT 1. INTRODUCTION	1
1.1. SCOPE.....	1
1.2. RELATED SUBMITTAL(S)/GRANT(S)	1
1.3. NORMATIVE REFERENCES	1
EXHIBIT 2. PERFORMANCE ASSESSMENT	2
2.1. CLIENT INFORMATION.....	2
2.2. EQUIPMENT UNDER TEST (EUT) INFORMATION	2
2.3. EUT'S TECHNICAL SPECIFICATIONS	3
2.4. LIST OF EUT'S PORTS.....	3
2.5. ANCILLARY EQUIPMENT.....	4
2.6. GENERAL TEST SETUP BLOCK DIAGRAM	4
EXHIBIT 3. EUT OPERATING CONDITIONS AND CONFIGURATIONS DURING TESTS	5
3.1. CLIMATE TEST CONDITIONS	5
3.2. OPERATIONAL TEST CONDITIONS & ARRANGEMENT FOR TESTS	5
EXHIBIT 4. SUMMARY OF TEST RESULTS	6
4.1. LOCATION OF TESTS.....	6
4.2. APPLICABILITY & SUMMARY OF EMC EMISSION TEST RESULTS	6
4.3. MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES	6
EXHIBIT 5. MEASUREMENTS, EXAMINATIONS & TEST DATA FOR EMC EMISSIONS.....	7
5.1. TEST PROCEDURES.....	7
5.2. MEASUREMENT UNCERTAINTIES	7
5.3. MEASUREMENT EQUIPMENT USED	7
5.4. ESSENTIAL/PRIMARY FUNCTIONS AS DECLARED BY THE MANUFACTURER.....	7
5.5. PEAK CONDUCTED OUTPUT POWER - DTS [§ 15.247(B)(3)].....	8
5.6. TRANSMITTER SPURIOUS RADIATED EMISSIONS AT 3 METERS [§§ 15.247(D), 15.209 & 15.205]	12
5.7. DUTY CYCLE MEASUREMENT.....	22
5.8. RF EXPOSURE REQUIREMENTS [§§ 15.247(I), 1.1307(B)(1) & 2.1093]	23
EXHIBIT 6. MEASUREMENT UNCERTAINTY.....	26
6.1. LINE CONDUCTED EMISSION MEASUREMENT UNCERTAINTY (0.15-30 MHZ).....	26
6.2. RADIATED EMISSION MEASUREMENT UNCERTAINTY	27

EXHIBIT 1. INTRODUCTION

1.1. SCOPE

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

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

None.

1.3. NORMATIVE REFERENCES

Publication	Year	Title
47 CFR Parts 0-19	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, Ed 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	
Name:	OFI, Inc. (subsidiary of 2D2C Inc.)
Address:	100 Hanson Avenue Kitchener, Ontario Canada N2C 2E2
Contact Person:	Nick Jones Phone #: 519-884-3100 Fax #: 519-884-9800 Email Address: njones@safeplug.com

MANUFACTURER	
Name:	OFI, Inc. (subsidiary of 2D2C Inc.)
Address:	100 Hanson Avenue Kitchener, Ontario Canada N2C 2E2
Contact Person:	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.

Brand Name:	OFI, Inc. (subsidiary of 2D2C Inc.)
Product Name:	SafePlug Outlet Control Board
Model Name or Number:	3064
Serial Number:	Test Sample
Type of Equipment:	Digital Transmission System
Input Power Supply Type:	5 Vdc regulated \pm 5%
Primary User Functions of EUT:	Wireless data communication exchange

2.3. EUT'S TECHNICAL SPECIFICATIONS

TRANSMITTER	
Equipment Type:	Fixed based / mobile
Intended Operating Environment:	Residential, commercial, industrial or business
Power Supply Requirement:	5 Vdc regulated $\pm 5\%$
RF Output Power Rating:	5.67 dBm maximum
Operating Frequency Range:	2405 - 2480 MHz
Channel Spacing:	5 MHz
Duty Cycle:	37.83%
Antenna Description:	RainSun make Multi Layer Integral Chip Antenna, Model AN0835

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:

Ancillary Equipment # 1	
Description:	5 Vdc regulated power supply
Brand Name:	NexxTech
Model Name or Number:	1711184
Serial Number:	N/A
Cable Length & Type:	> 3 m, Non-shielded

2.6. GENERAL TEST SETUP BLOCK DIAGRAM

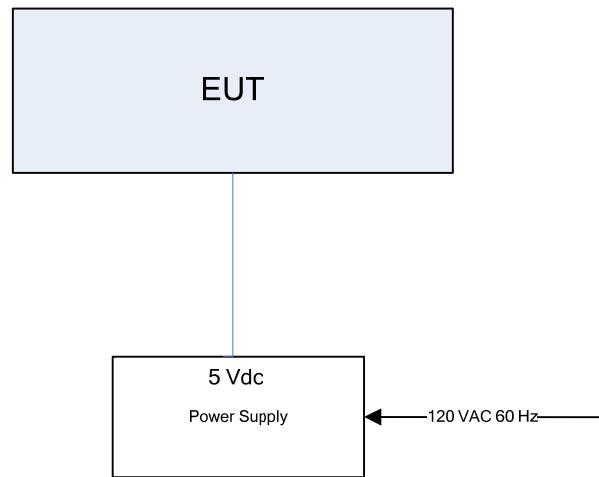


EXHIBIT 3. EUT OPERATING CONDITIONS AND CONFIGURATIONS DURING TESTS

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

Operating Modes:	Each of lowest, middle and highest channel frequencies transmits continuously for emissions measurements.
Special Test Software:	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.
Special Hardware Used:	None
Transmitter Test Antenna:	The EUT is tested with the antenna fitted in a manner typical of normal intended use as integrated PCB antenna.

Transmitter Test Signals	
Frequency Band(s):	2405 - 2480 MHz
RF Power Output:	5.67 dBm max.
Modulating Signal Source:	Internal

EXHIBIT 4. SUMMARY OF TEST RESULTS

4.1. LOCATION OF TESTS

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

- AC Power Line Conducted Emissions were performed in UltraTech's shielded room, 24'(L) by 16'(W) by 8'(H).
- Radiated Emissions were performed at the Ultratech's 3-10 TDK Semi-Anechoic Chamber situated in the Town of Oakville, province of Ontario. This test site been calibrated in accordance with ANSI C63.4, and found to be in compliance with the requirements of Sec. 2.948 of the FCC Rules. The descriptions and site measurement data of the Oakville 3-10 TDK Semi-Anechoic Chamber has been filed with FCC office (FCC File No.: 91038) and Industry Canada office (Industry Canada File No.: 2049A-3). Expiry Date: 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 ¹
15.207(a)	Power Line Conducted Emissions	Yes ²
15.247(a)(2)	6 dB Bandwidth	Yes ³
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 ³
15.247(d), 15.209 & 15.205	Transmitter Spurious Radiated Emissions	Yes
15.247(e)	Power Spectral Density	Yes ³
15.247(i) 1.1307, 1.1310, 2.1091 & 2.1093	RF Exposure	Yes

1 This device has integral antenna mounted on the PCB

2 The Power line conducted emission and Digital apparatus test results are documented in OFI-15Q_F15C225 report.

3 For test results refer to the original module (FCC ID: YCMDZZBSA) test report submitted with this filing.

4.3. MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

N/A

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 the requirements of CISPR 16-4-2 @ IEC:2003 and JCGM 100:2008 (GUM 1995) – Guide to the Expression of Uncertainty in Measurement with a confidence level of 95%. Please refer to Exhibit 6 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. PEAK CONDUCTED OUTPUT POWER - DTS [§ 15.247(b)(3)]

5.5.1. Limit(s)

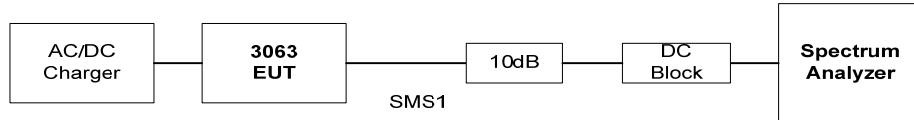
§ 15.247(b)(3):

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.

5.5.2. Method of Measurements & Test Arrangement

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

5.5.3. Test Arrangement



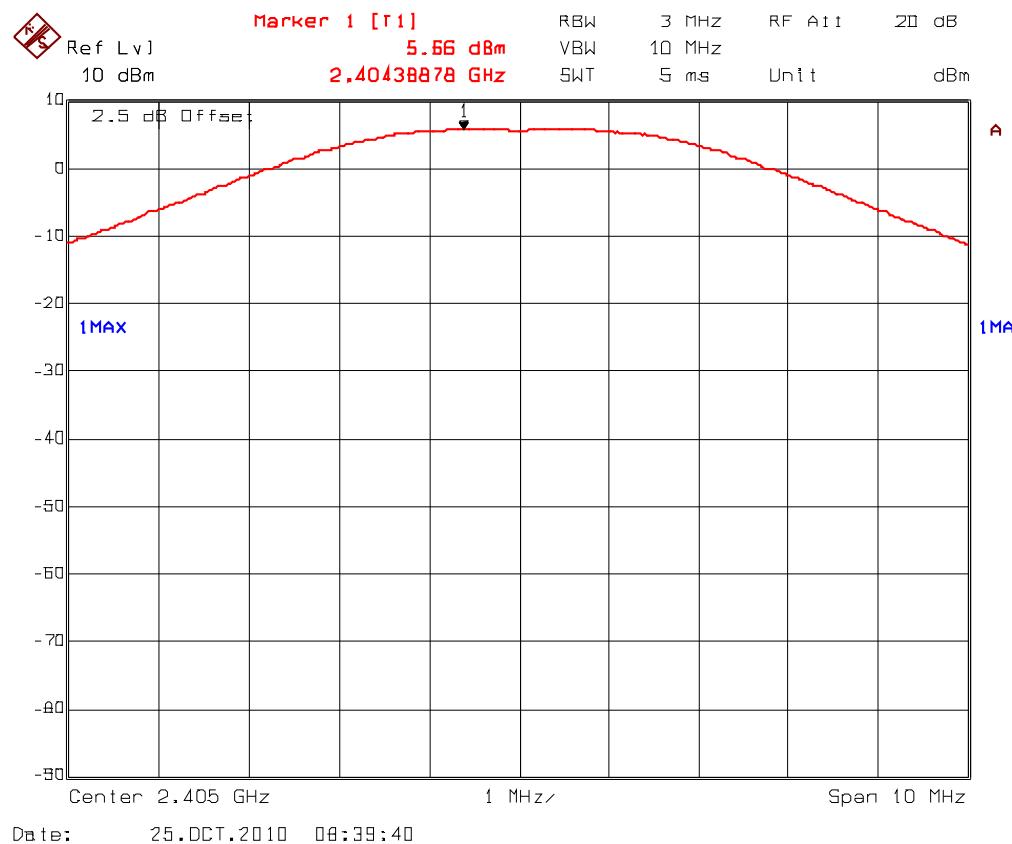
5.5.4. Test Equipment List

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 14, 2011
DC Block	Hewlett Packard	11742A	12460	0.045 – 26.5 GHz	N/A
Attenuator	Narda	4768-10	-	DC - 40 GHz	N/A

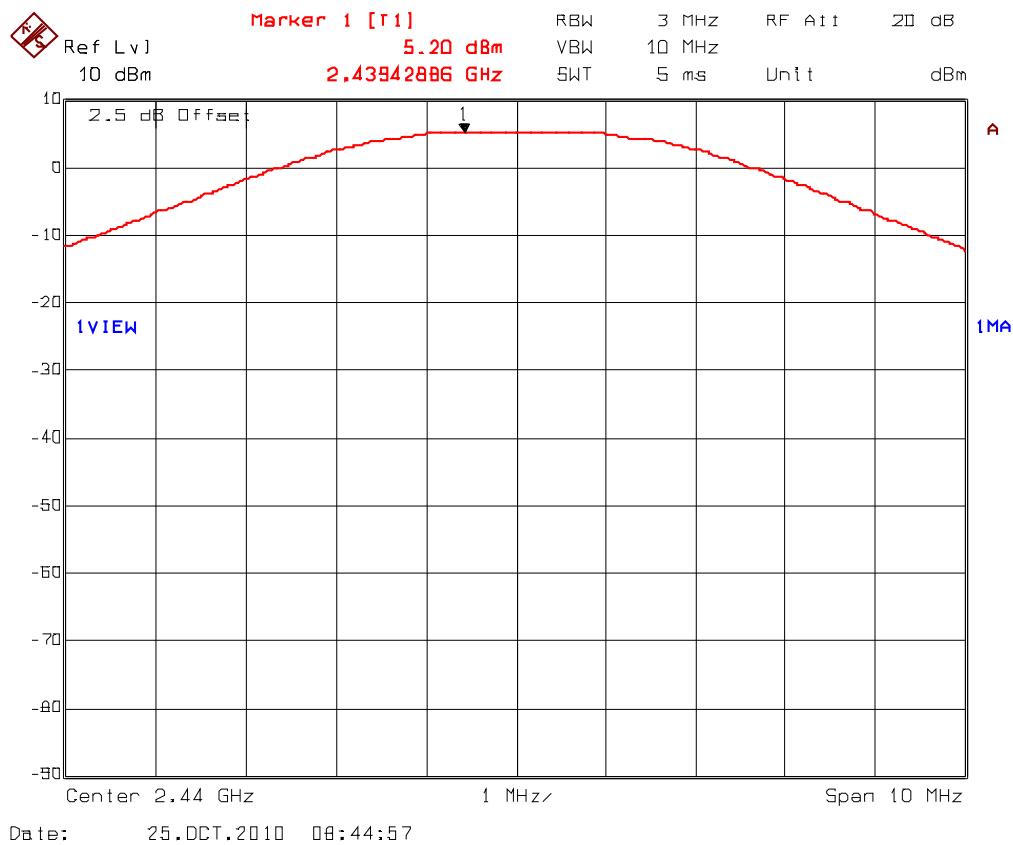
5.5.5. Test Data

Channel	Frequency (MHz)	Power Output (dBm)	Limit (dBm)
11	2405	5.66	30
19	2440	5.20	30
26	2480	4.57	30

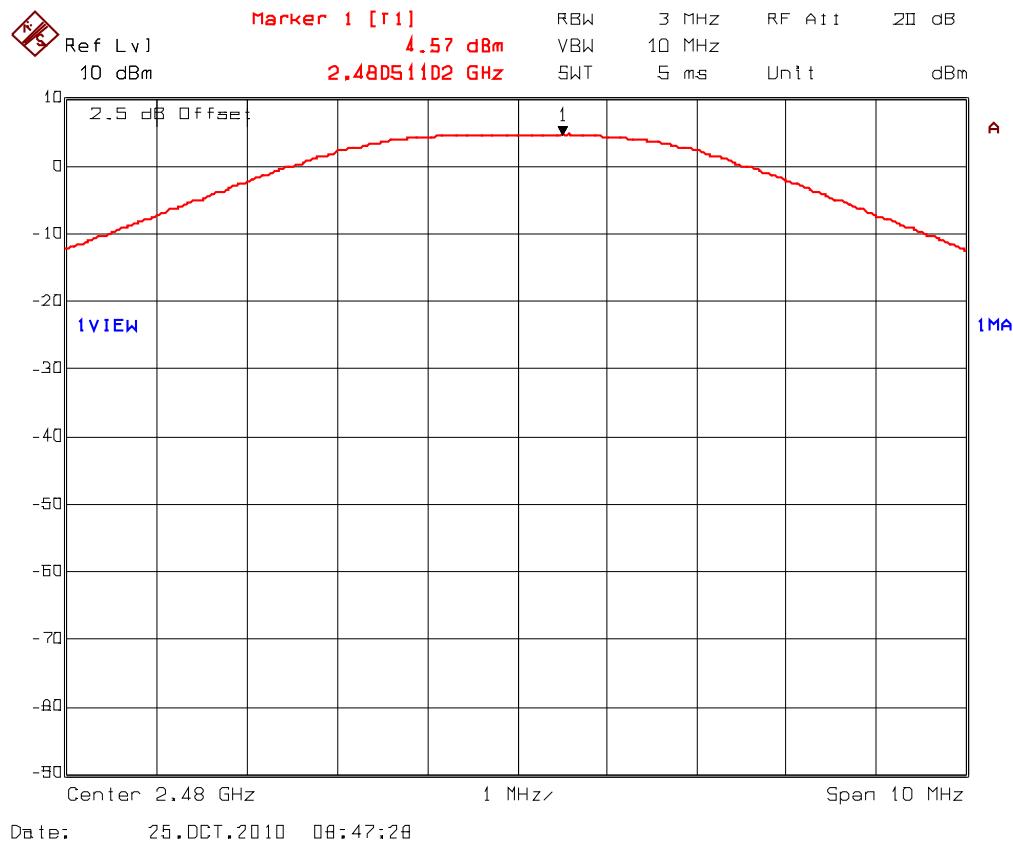
Plot #1: Peak Output Power
Frequency: 2405 MHz



Plot #2: Peak Output Power
Frequency: 2440 MHz



Plot #3: Peak Output Power
Frequency: 2480 MHz



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

5.6.1. Limit(s)

§ 15.247 (d): In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

Section 15.205(a) - Restricted Bands of Operation

MHz	MHz	MHz	GHz
0.090–0.110	16.42–16.423	399.9–410	4.5–5.15
1.0495–0.505	16.69475–16.69525	608–614	5.35–5.46
2.1735–2.1905	16.80425–16.80475	960–1240	7.25–7.75
4.125–4.128	25.5–25.67	1300–1427	8.025–8.5
4.17725–4.17775	37.5–38.25	1435–1626.5	9.0–9.2
4.20725–4.20775	73–74.6	1645.5–1646.5	9.3–9.5
6.215–6.218	74.8–75.2	1660–1710	10.6–12.7
6.26775–6.26825	108–121.94	1718.8–1722.2	13.25–13.4
6.31175–6.31225	123–138	2200–2300	14.47–14.5
8.291–8.294	149.9–150.05	2310–2390	15.35–16.2
8.362–8.366	156.52475–156.52525	2483.5–2500	17.7–21.4
8.37625–8.38675	156.7–156.9	2655–2900	22.01–23.12
8.41425–8.41475	162.0125–167.17	3260–3267	23.6–24.0
12.29–12.293	167.72–173.2	3332–3339	31.2–31.8
12.51975–12.52025	240–285	3345.8–3358	36.43–36.5
12.57675–12.57725	322–335.4	3600–4400	(²)
13.36–13.41.			

¹Until February 1, 1999, this restricted band shall be 0.490–0.510 MHz.

²Above 38.6

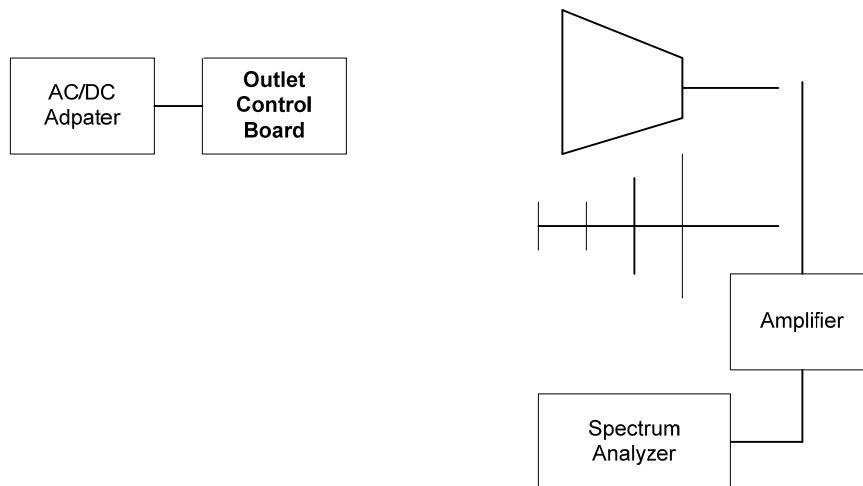
Section 15.209(a) -- Field Strength Limits within Restricted Frequency Bands --

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

5.6.2. Method of Measurements

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

5.6.3. Test Arrangement



5.6.4. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Operating Range	Calibration Due
EMI-Test Receiver	Rohde & Schwarz	ESU40	100037	20 Hz- 40 GHz Build in amplifier	09 Mar 2011
Spectrum Analyzer	Rohde & Schwarz	FSEK30	100077	20 Hz- 40 GHz	14 Aug 2011
Loop Antenna	Emco	6502	2611	10 kHz – 30 MHz	8 Aug 2011
Biconi-Log Antenna	Emco	3142C	00026873	26 – 3000 MHz	18 April 2011
Horn Antenna	Emco	3155	9701-6570	1 – 18 GHz	20 Nov 2010
DRG Horn	ETS-Lindgren	3117	00119425	1 – 18 GHz	13 Jan 2011

5.6.5. 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.

5.6.5.1. Transmitter Radiated Spurious Emissions

Fundamental Frequency: Channel Frequency: 2405 MHz Test Frequency Range: 30 MHz – 25 GHz							
Frequency (MHz)	RF Peak Level (dB μ V/m)	RF Avg Level (dB μ V/m)	Antenna Plane (H/V)	Limit 15.209 (dB μ V/m)	Limit 15.247 (dB μ V/m)	Margin (dB)	Pass/Fail
2405	99.7	--	V	--	--	--	--
2405	97.8	--	H	--	--	--	--
4810*	50.3	38.3	V	54.0	79.7	-15.7	Pass
4810*	47.5	34.8	H	54.0	79.7	-19.8	Pass
7215	51.0	38.4	V	N/A	79.7	-41.3	Pass
7215	50.9	37.6	H	N/A	79.7	-42.1	Pass
12025*	56.3	43.8	V	54.0	79.7	-10.2	Pass
12025*	56.7	44.5	H	54.0	79.7	-9.5	Pass
No other significant spurious emissions from the transmitter were found in the frequency range from 30 MHz - 25 GHz							

* Restricted band freq.

Fundamental Frequency: Channel Frequency: 2440 MHz Test Frequency Range: 30 MHz – 25 GHz							
Frequency (MHz)	RF Peak Level (dB μ V/m)	RF Avg Level (dB μ V/m)	Antenna Plane (H/V)	Limit 15.209 (dB μ V/m)	Limit 15.247 (dB μ V/m)	Margin (dB)	Pass/Fail
2440	100.7	--	V	--	--	--	--
2440	97.1	--	H	--	--	--	--
No other significant spurious emissions from the transmitter were found in the frequency range from 30 MHz - 25 GHz							

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, Website: <http://www.ultratech-labs.com>

File #: OFI-015_F15C247
 November 16, 2010

Fundamental Frequency:		Channel Frequency: 2480 MHz					
Test Frequency Range:		30 MHz – 25 GHz					
<hr/>							
Frequency (MHz)	RF Peak Level (dB μ V/m)	RF Avg Level (dB μ V/m)	Antenna Plane (H/V)	Limit 15.209 (dB μ V/m)	Limit 15.247 (dB μ V/m)	Margin (dB)	Pass/Fail
2480	102.6	--	V	--	--	--	--
2480	99.6	--	H	--	--	--	--
4960*	48.5	36.2	V	N/A	82.6	-46.4	Pass
4960*	47.3	34.4	H	N/A	82.6	-48.2	Pass

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

* Restricted band freq.

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

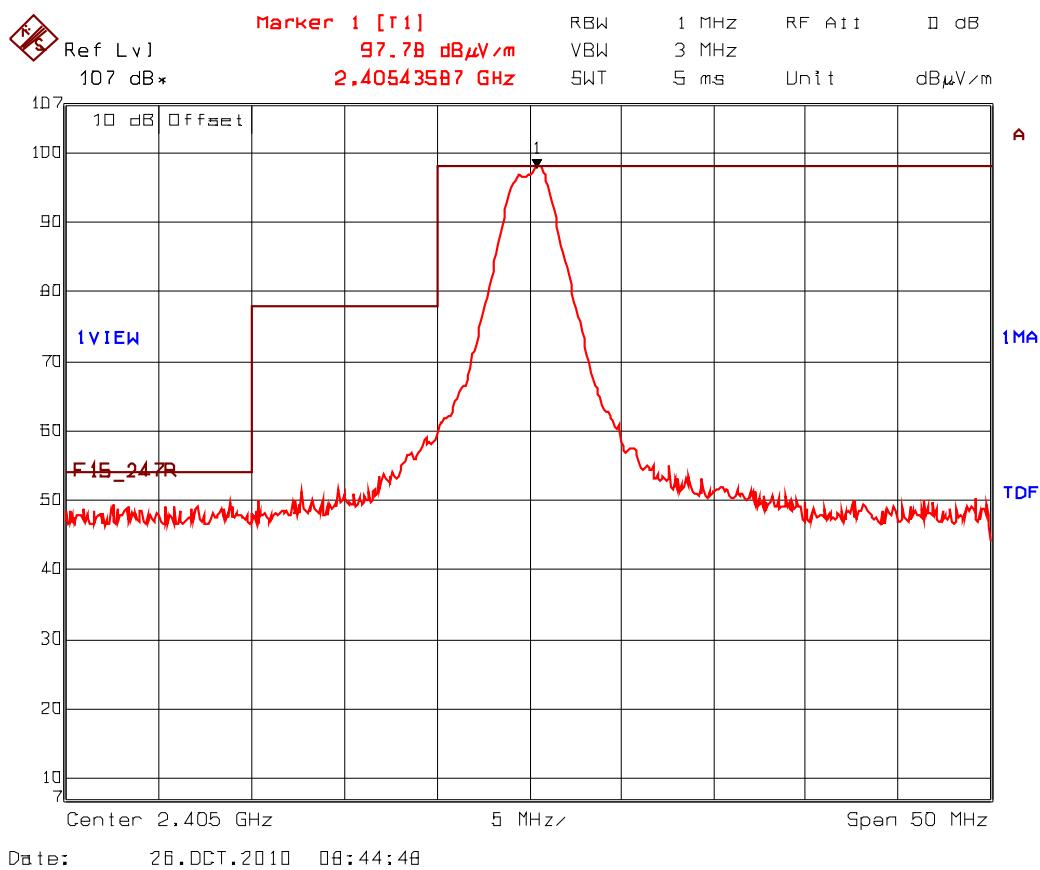
ULTRATECH GROUP OF LABS

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

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

File #: OFI-015_F15C247
November 16, 2010

Plot # 4: 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



ULTRATECH GROUP OF LABS

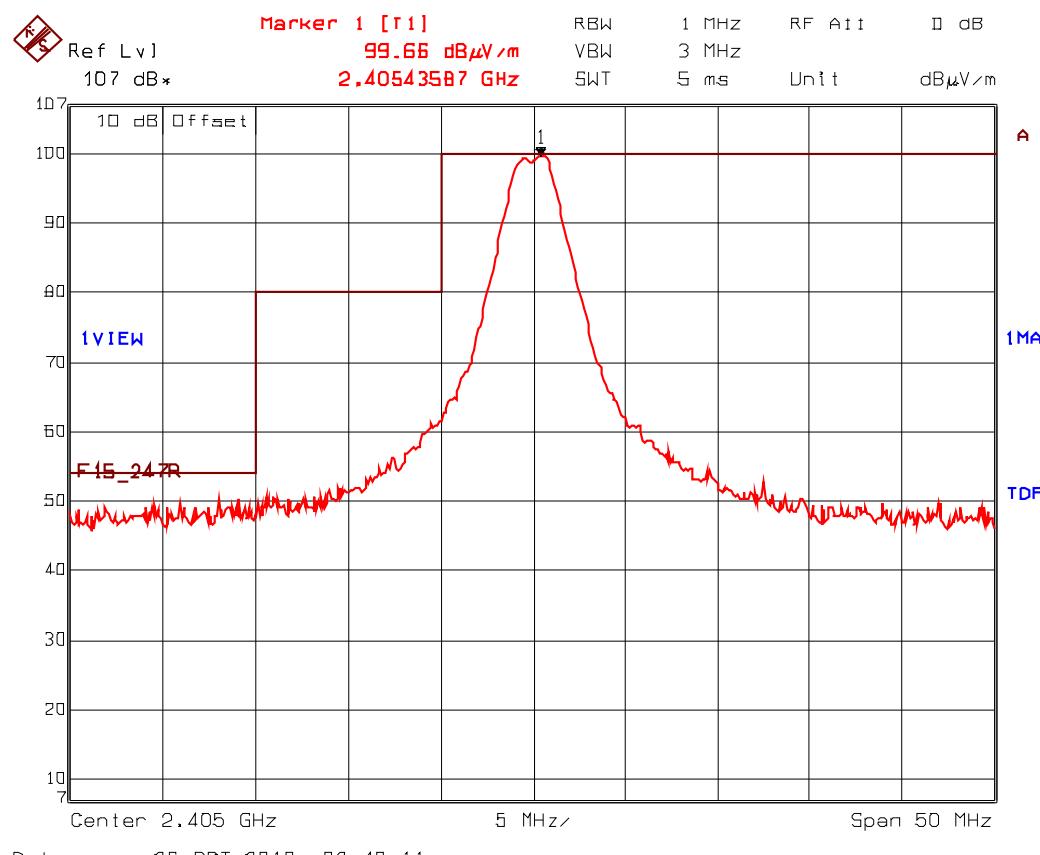
3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4

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

File #: OFI-015_F15C247
November 16, 2010

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

Plot # 5: 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



Plot # 6: 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

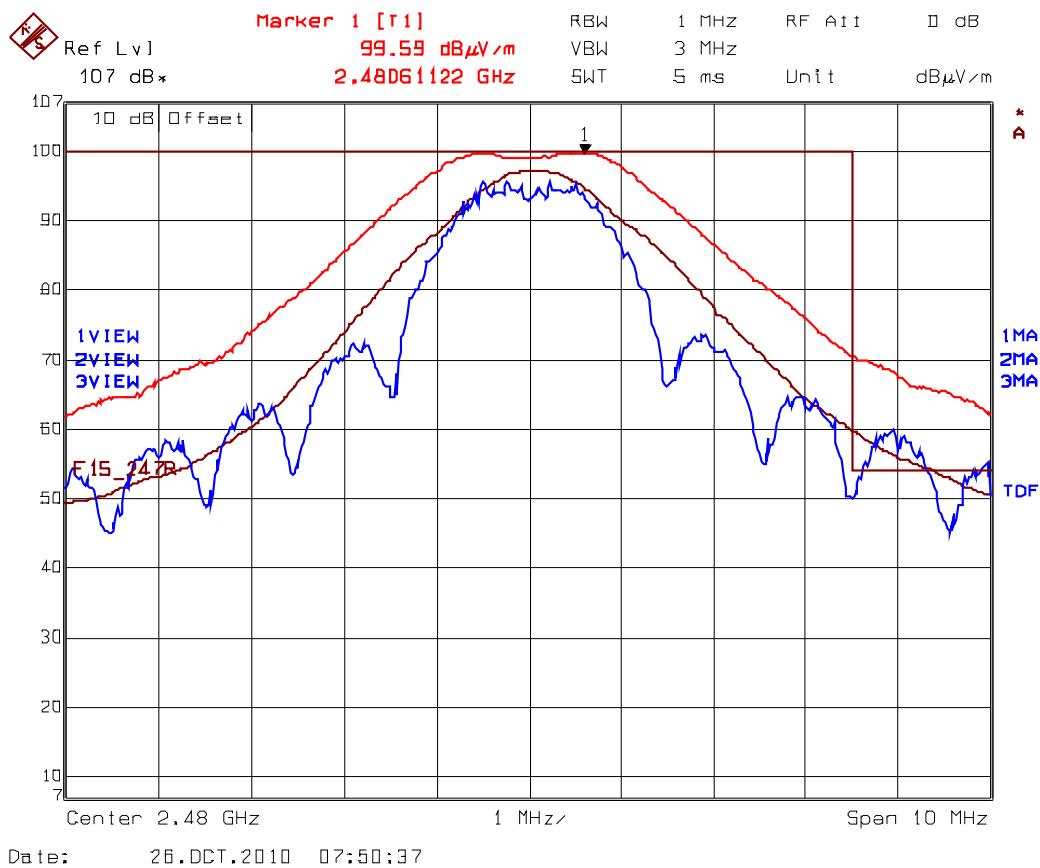
Trace 1: RBW= 1 MHz, VBW= 3 MHz

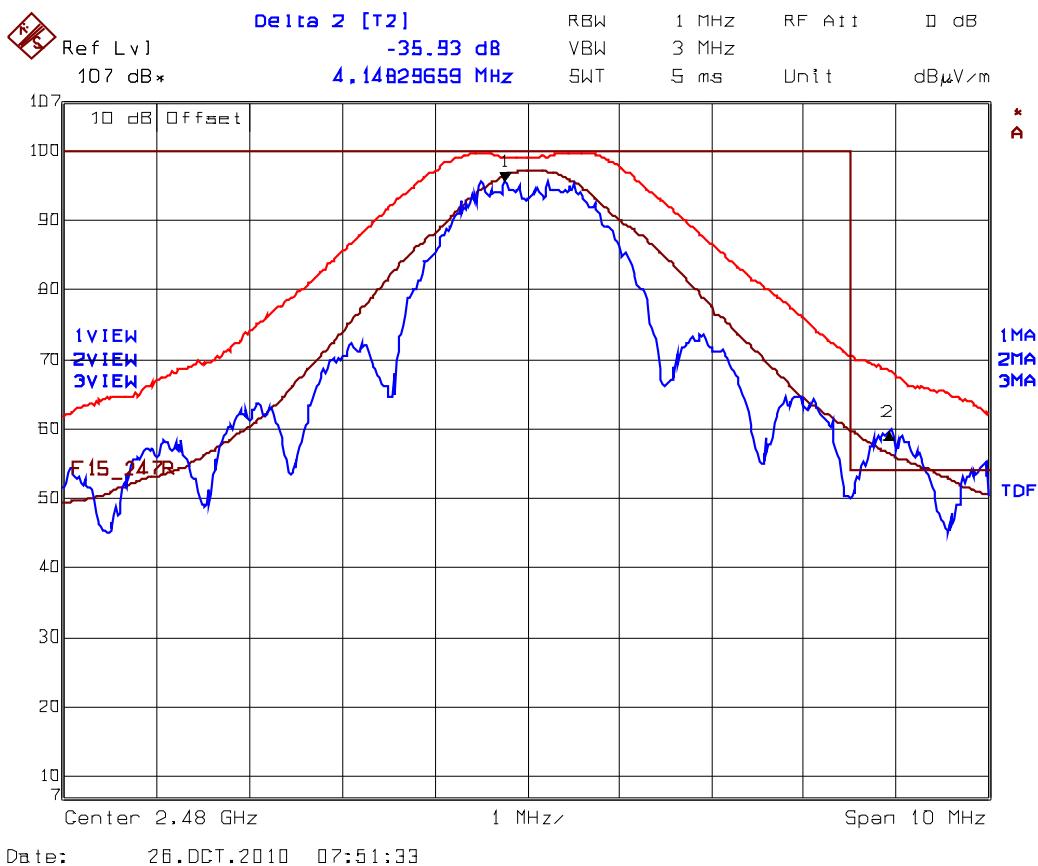
Trace 2: RBW= 100 kHz, VBW= 300 kHz, Delta (Peak to Band-Edge): 35.93dB

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

Peak Band-Edge at 2483.5 MHz: Peak= 99.59dB_μV/m – 35.93dB= 63.66dB_μV/m (limit 74dB_μV/m)

Average: 59.72dB_μV/m – 8.44dB= 51.28dB_μV/m (limit 54dB_μV/m)





Plot # 7: 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

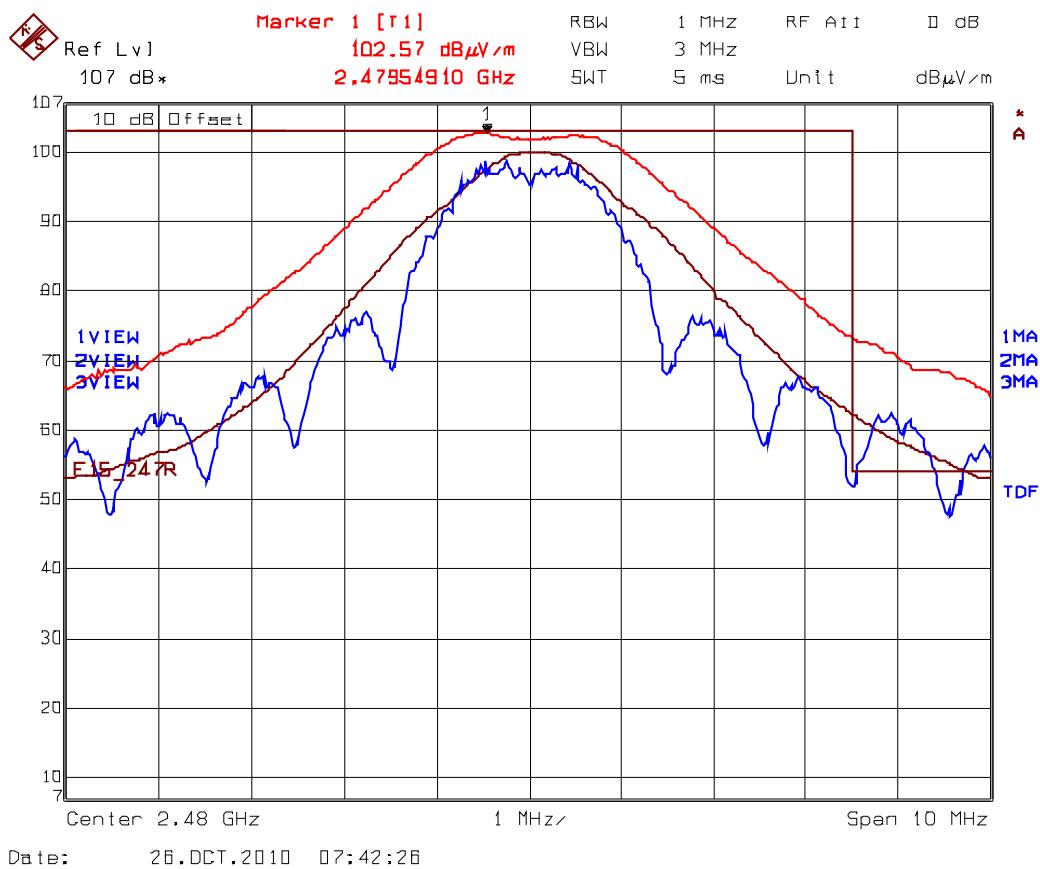
Trace 1: RBW= 1 MHz, VBW= 3 MHz

Trace 2: RBW= 100 kHz, VBW= 300 kHz, Delta (Peak to Band-Edge): 36.30dB

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

Peak Band-Edge at 2483.5 MHz: Peak= 102.57dB_{µV/m} – 36.30dB= 66.27dB_{µV/m} (limit 74dB_{µV/m})

Average: 62.17dB_{µV/m} – 8.44dB= 53.73dB_{µV/m} (limit 54dB_{µV/m})



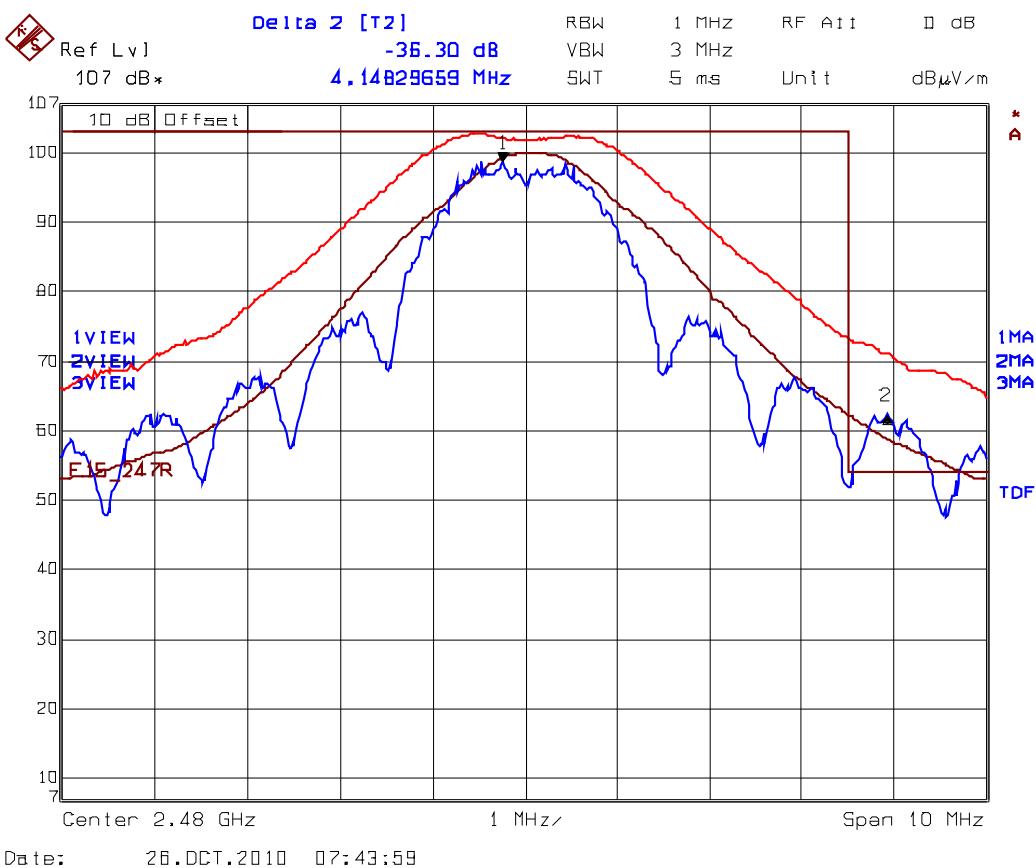
ULTRATECH GROUP OF LABS

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

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

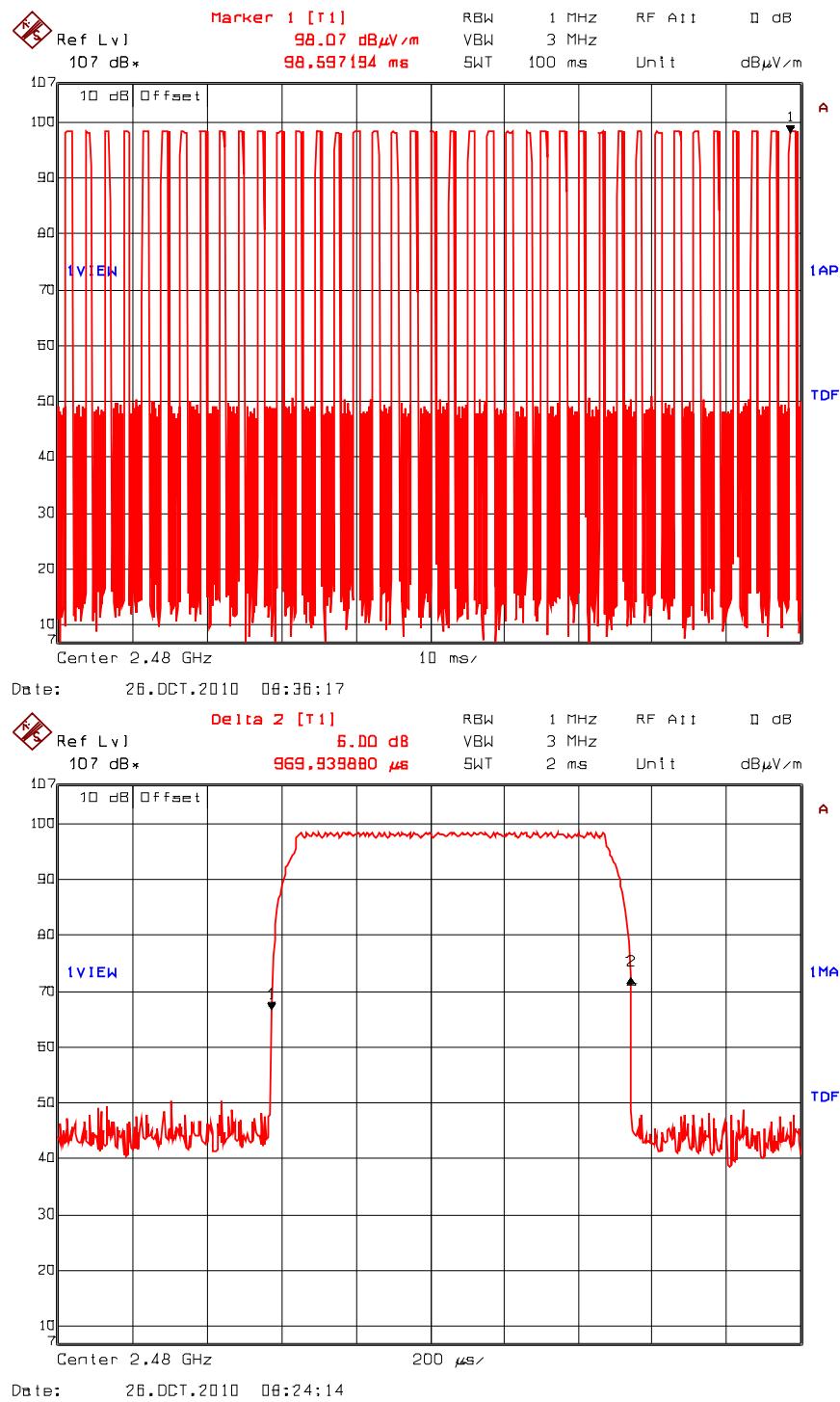
File #: OFI-015_F15C247
November 16, 2010

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



5.7. DUTY CYCLE MEASUREMENT

Time On in 100ms = $(39 * 969.9398) = 37.8276\%$
Duty Cycle = $20 * \log(0.378276) = -8.44\text{dB}$



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, Website: <http://www.ultratech-labs.com>

File #: OFI-015_F15C247
November 16, 2010

5.8. 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 ²)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3–3.0	614	1.63	*(100)	6
3.0–30	1842/f	4.89/f	*(900/f ²)	6
30–300	61.4	0.163	1.0	6
300–1500 .....	.....	.....	f/300	6
1500–100,000 .....	.....	.....	5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3–1.34	614	1.63	*(100)	30
1.34–30	824/f	2.19/f	*(180/f ²)	30
30–300	27.5	0.073	0.2	30
300–1500 .....	.....	.....	f/1500	30
1500–100,000 .....	.....	.....	1.0	30

f = frequency in MHz

* = Plane-wave equivalent power density

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

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

5.8.1. 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.

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, Website: <http://www.ultratech-labs.com>

File #: OFI-015_F15C247
November 16, 2010

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/cm²
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

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

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, Website: <http://www.ultratech-labs.com>

File #: OFI-015_F15C247
November 16, 2010

5.8.2. Test Data

Antenna Gain Limit specified by Manufacturer: 1 dBi

(¹) Lowest Frequency (MHz)	Measured Peak RF Conducted Power (dBm)	Calculated EIRP (dBm)	Exposure Condition	Calculated Minimum RF Safety Distance r (cm)*
2405	5.7	6.7	General Population	0.62

RF EXPOSURE DISTANCE LIMITS

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

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

$$(\text{Maximum EIRP Measured}) = 6.7 \text{ dBm} = 4.67 \text{ mW}$$

$$(\text{Minimum Safe Distance, } r) = \text{sqrt} (4.67 / (4 \times 3.1416 \times 1)) = 0.62 \text{ cm}$$

Evaluation of RF Exposure Compliance Requirements	
RF Exposure Requirements	Compliance with FCC Rules
Minimum calculated separation distance between antenna and persons required: 0.62 cm	Manufacturer' instruction for separation distance between antenna and persons required: 20 cm .
Antenna installation and device operating instructions for installers (professional/unskilled users), and the parties responsible for ensuring compliance with the RF exposure requirement	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"

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, Website: <http://www.ultratech-labs.com>

File #: OFI-015_F15C247
 November 16, 2010

EXHIBIT 6. MEASUREMENT UNCERTAINTY

6.1. Line Conducted Emission Measurement Uncertainty (0.15-30 MHz)

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range	Cal Due Date
EMI Receiver System/Spectrum Analyzer with built-in Amplifier	Hewlett Packard	8546A	3650A00371	9KHz-6.5GHz	January 25, 2011
Attenuator	Pasternack	PE7010-20	---	DC to 2 GHz 20dB attenuation	January 04, 2011
L.I.S.N. Used	EMCO	3810/2	2209	9 KHz – 30 MHz	August 25, 2011

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

6.2. Radiated Emission Measurement Uncertainty

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range	Cal Due Date
EMI Receiver	Rohde & Schwarz	ESU40	100037	20 Hz to 40 GHz	March 09, 2011
Pre Amplifier	AH System	PAM-0118	225	20 MHz to 18 GHz	March 08, 2011
Biconilog Antenna	EMCO	3142C	00026873	26 – 3000 MHz	April 18, 2011
Horn Antenna	EMCO	3155	6570	1GHz – 18 GHz	November 20, 2010
Semi-Anechoic Chamber	TDK	FCC: 91038 IC: 2049A-3	--	--	May 01, 2011

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

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

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