ENGINEERING TEST REPORT

XBee-PRO
Model No.: XBP24
FCC ID: OUR-XBEEPRO

Applicant:

MaxStream, Inc.
355 South 520 West Suite 180
Lindon, UT 84042, USA

In Accordance With

Federal Communications Commission (FCC)
Part 15, Subpart C, Section 15.247
Digital Modulation Transmitters Operating in the
Frequency Band 2400 – 2483.5 MHz

UltraTech's File No.: DIGI-059F15C2PC

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

Date: December 14, 2011

Report Prepared by: Dharmajit Solanki	Tested by: Hung Trinh, RFI Technician
Issued Date: December 14, 2011	Test Dates: November 29 - 30, 2011

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

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

TABLE OF CONTENTS

EXHIBIT 1. INTRODUCTION

1.1. SCOPE

Reference:	FCC Part 15, Subpart C, Section 15.247
Title:	Telecommunication - Code of Federal Regulations, CFR 47, Part 15
Purpose of Test:	To gain FCC Class II Permissive Change Authorization for Digital Modulation Transmitters 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:	• Commercial, industrial or business • Residential

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

None

1.3. NORMATIVE REFERENCES

Publication	Year	Title
FCC CFR Parts 0-15	2010	Code of Federal Regulations – Telecommunication
ANSI C63.4	2009	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 KHz to 40 GHz
FCC Public Notice DA 00-705	2000	Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems
FCC Public Notice DA 00-1407	2000	Part 15 Unlicensed Modular Transmitter Approval
FCC ET Docket No. 99-231	2002	Amendment to FCC Part 15 of the Commission's Rules Regarding to Spread Spectrum Devices
FCC procedures	March 23, 2005	Measurement of Digital Transmission Systems operating under Section 15.247

EXHIBIT 2. PERFORMANCE ASSESSMENT

2.1. CLIENT INFORMATION

APPLICANT	
Name:	MaxStream, Inc.
Address:	355 South 520 West Suite 180 Lindon, UT 84042 USA
Contact Person:	Mr. Paul Dahl Phone #: (801) 701-4250 Fax #: (801) 765-9895 Email Address: paul.dahl@digi.com

MANUFACTURER	
Name:	Digi International
Address:	11001 Bren Road East Minnetonka, MN 55343 USA
Contact Person:	Mr. Paul Millett Phone #: (801) 701-4250 Fax #: (801) 765-9895 Email Address: Paul.Millett@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.

Brand Name:	MaxStream,Inc.
Product Name:	XBee-PRO
Model Name or Number:	XBP24
Serial Number:	Test Sample
Type of Equipment:	Digital Modulation Transmitter
Input Power Supply Type:	External DC Power Supply
Primary User Functions of EUT:	Wireless modem

2.3. EUT'S TECHNICAL SPECIFICATIONS

TRANSMITTER	
Equipment Type:	• Mobile • Base Station (fixed use)
Intended Operating Environment:	• Commercial, industrial or business • Residential
Power Supply Requirement:	2.8 – 3.4 Vdc
RF Output Power Rating:	From 10 mW (10 dBm) to 86 mW (19.34 dBm)
Operating Frequency Range:	2410 - 2470 MHz
RF Output Impedance:	50 Ohm
Channel Spacing:	5 MHz
Duty Cycle:	100%
6 dB bandwidth:	1.60 MHz
Modulation Type:	QPSK
Oscillator Frequencies:	16 MHz
New Antenna Type:	External Phantom Antenna Make: Laird Gain: 3.0 dBi Part No.: A24-H3UF

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	RF IN/OUT Port	1	U.FL or IPX	Shielded
2	DC Supply & I/O Port	1	Pin Header	No cable, direct connection

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:	Test Jig Cable
Brand name:	MaxStream
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 25°C
Humidity:	50% to 56%
Pressure:	105 kPa
Power input source:	2.8 – 3.4 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:	The RF Module could be tested outside of the enclosure using Test Jig connected to EUT.
Transmitter Test Antenna:	The EUT is tested with the antenna fitted in a manner typical of normal intended use as external antenna equipment as described with the test results.

Transmitter Test Signals	
Frequency Band(s):	2410 - 2470 MHz
Test Frequency(ies): (Near lowest, near middle & near highest frequencies in the frequency range of operation.)	• 2410 MHz • 2440 MHz • 2470 MHz
Transmitter Wanted Output Test Signals: Transmitter Power (measured maximum output power): Normal Test Modulation: Modulating signal source:	 86.89 mW (19.39 dBm) QPSK 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.

- Radiated Emissions were performed at the Ultratech's 3-10 TDK Semi-Anechoic Chamber situated in the Town of Oakville, province of Ontario.

The above test sites have 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 File No.: IC2049-1). Calibration Due date: April 04, 2014.

4.2. APPLICABILITY & SUMMARY OF EMC EMISSION TEST RESULTS

FCC Paragraph	Test Requirements	Compliance (Yes/No)
15.207	Power Line Conducted Emissions Measurements	Note 1*
15.247 (a)(2)	6 dB Bandwidth of a Digital Modulation System	Note 1*
15.247(b) & 1.1310	Maximum Output Power	Yes
15.247 (i), 1.1307, 1.1310, 2.1091 & 2.1093	RF Exposure Limit	Yes
15.247(c)	RF Conducted Spurious Emissions at the Transmitter Antenna Terminal	N/A
15.247(d)	Transmitted Power Spectral Density of a Digital Modulation System	Note 1*
15.247(c), 15.209 & 15.205	Transmitter Radiated Emissions	Yes

Note 1*- Refer to the Original filing.

4.3. MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

None

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

5.1. TEST PROCEDURES

This section contains test results only. Details of test methods and procedures can be found in Exhibit 8 of this report, FCC procedures: Measurement of Digital Transmission Systems Operating under Section 15.247 (March 23, 2005) and ANSI C63.4.

5.2. MEASUREMENT UNCERTAINTIES

The measurement uncertainties calculated as per CISPR 16-4-2 as shown in exhibit 6 of this report.

5.3. MEASUREMENT EQUIPMENT USED

The measurement equipment used complied with the requirements of the Standards referenced in the Methods & Procedures ANSI C63.4, FCC Section 15.247 and CISPR 16-1.

5.4. ESSENTIAL/PRIMARY FUNCTIONS AS DECLARED BY THE MANUFACTURER

Wireless data communication modem.

5.5. COMPLIANCE WITH FCC PART 15 – GENERAL TECHNICAL REQUIREMENTS

FCC Section	FCC Rules	Manufacturer's Clarification
15.203	Described how the EUT complies with the requirement that either its antenna is permanently attached, or that it employs a unique antenna connector, for every antenna proposed for use with the EUT. The exception is in those cases where EUT must be professionally installed. In order to demonstrate that professional installation is required, the following 3 points must be addressed: ➢ The application (or intended use) of the EUT ➢ The installation requirements of the EUT ➢ The method by which the EUT will be marketed	This new external antenna has U.FL female unique connector and directly connected to EUT's U.FL male connector using a 4 inch cable.
15.204	Provided the information for every antenna proposed for use with the EUT: ➢ type (e.g. yagi, patch, grid, dish, etc…), ➢ manufacturer and model number ➢ gain with reference to an isotropic radiator	Refer to Section 2.3 of this Test Report for details of antenna information.

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

5.6.1. Limits

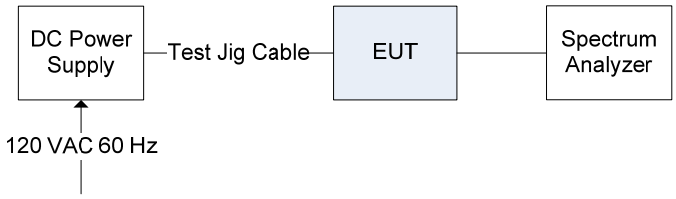
§15.247(b)(3): The maximum peak conducted output power of the transmitter shall not exceed 1 watt.

§15.247(b)(4): If the antennas of directional gain greater than 6 dBi are used, the peak power from the intentional radiator shall be reduced below, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

5.6.2. Method of Measurements

Refer to Exhibit 8, FCC Procedures for Digital Transmission Systems (March 23, 2005) and ANSI C63.4.

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	27 Sep 2012
DC-Block	Hewlett Packard	11742A	12460	0.045 - 26.5 GHz	Cal. on use

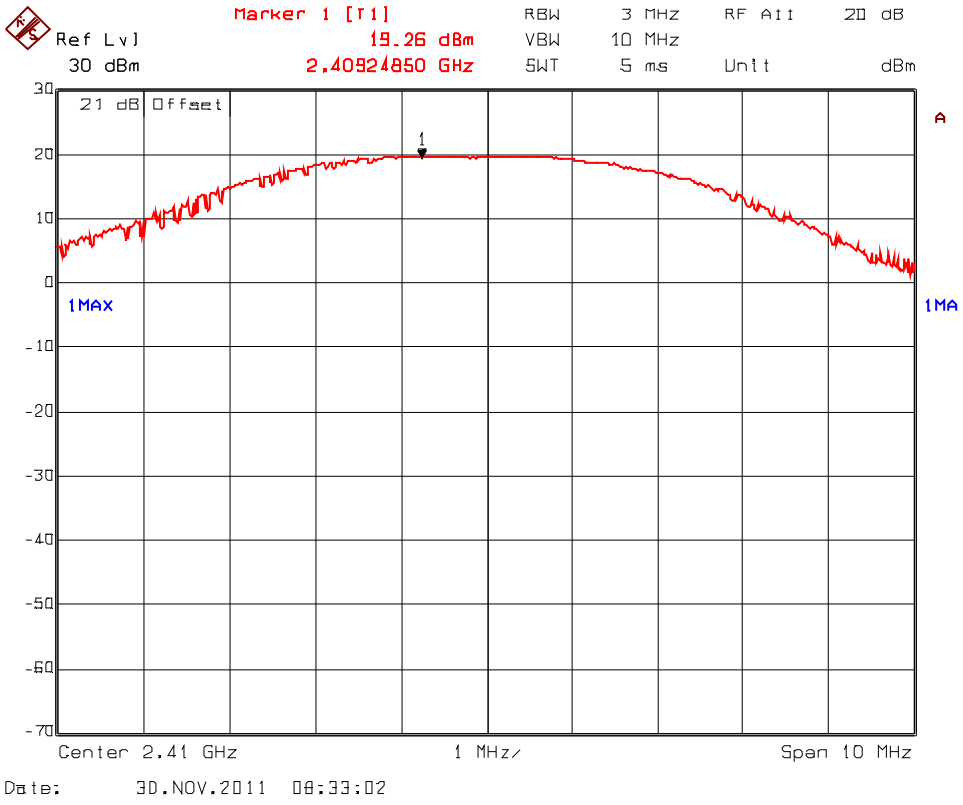
5.6.5. Test Data

5.6.5.1. EUT tested with new External Phantom Antenna (Antenna Gain = 3 dBi)

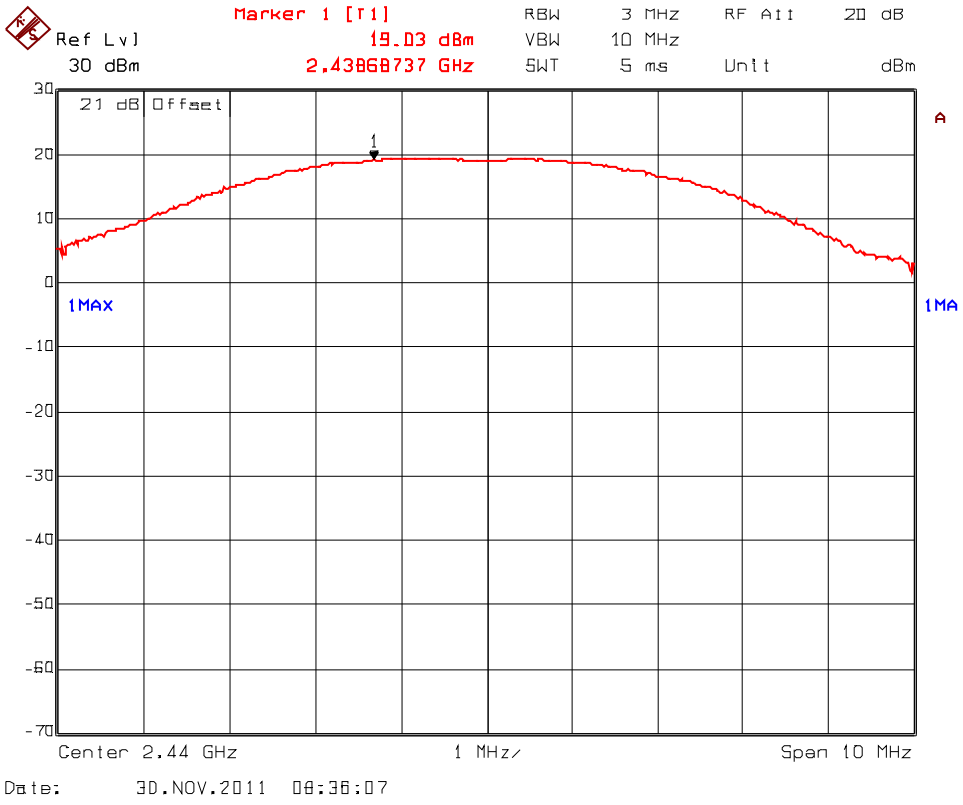
Transmitter Channel	Frequency (MHz)	Peak Power at Antenna Terminal[1] (dBm)	Calculated EIRP[2] (dBm)	Conducted Power Limit (dBm)	EIRP Limit (dBm)
Lowest	2410	19.26	22.26	30.0	36.0
Middle	2440	19.03	22.03	30.0	36.0
Highest	2470	19.39	22.39	30.0	36.0

Note 1: Conducted o/p power was measured at antenna output port
Note 2: EIRP = (Peak power at antenna terminal in dBm) + (EUT Antenna gain in dBi)

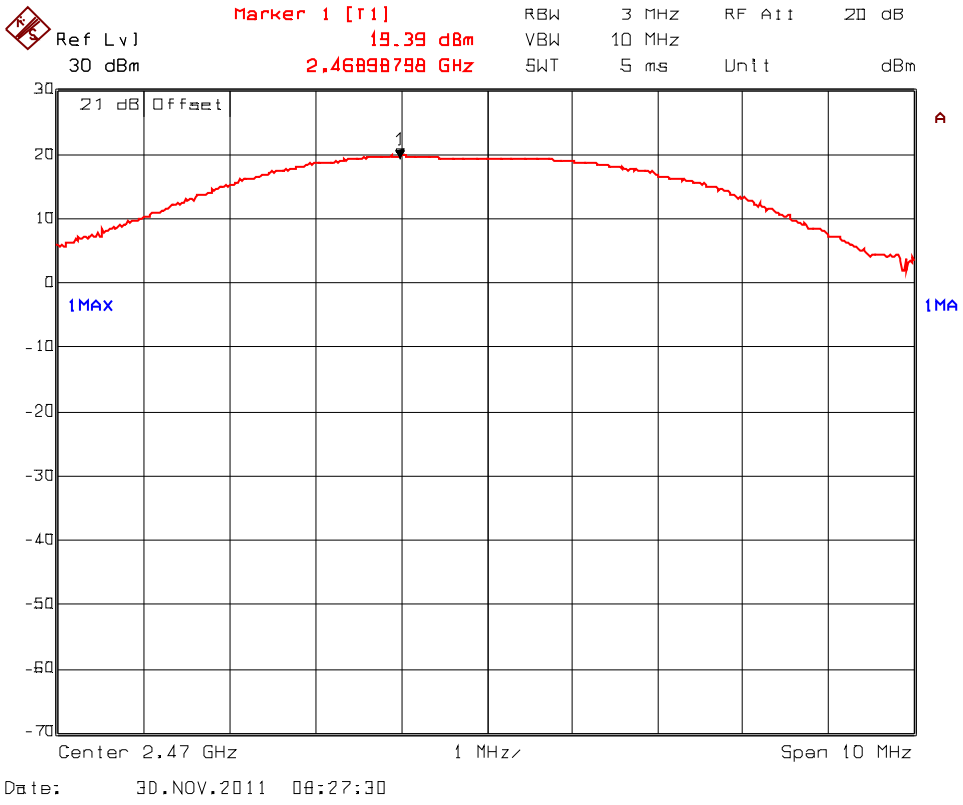
Plot# 1: Peak Conducted Output Power
Test Frequency: 2410 MHz



Plot# 2: Peak Conducted Output Power
Test Frequency: 2440 MHz



Plot# 3: Peak Conducted Output Power
Test Frequency: 2470 MHz



5.7. RF EXPOSURE REQUIREMENTS [§§ 15.247 (i), 1.1310]

5.7.1. Limits

§ 15.247 (i): Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines. See § 1.1307 (b) (1).

§ 1.1310: The criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in 1.1307(b).

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3–3.0	614	1.63	*(100)	6
3.0–30	1842/f	4.89/f	*($900/f^2$)	6
30–300	61.4	0.163	1.0	6
300–1500			f/300	6
1500–100,000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3–1.34	614	1.63	*(100)	30
1.34–30	824/f	2.19/f	*($180/f^2$)	30
30–300	27.5	0.073	0.2	30
300–1500			f/1500	30
1500–100,000			1.0	30

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

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

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

5.7.2. Method of Measurements

Refer to FCC @ 1.1310, 2.1091 and Public Notice DA 00-705 (March 30, 2000).

Spread spectrum transmitters operating under Section 15.247 are categorically excluded from routine environmental evaluation for 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 the public (users and nearby persons) does not exceed the Commission's RF exposure guidelines (see Sections 1.1307, 2.1091 and 2.1093). Unless a device operates at substantially low output 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.

- 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:

$S = PG/4\Pi r^2 = EIRP/4\Pi r^2$

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

$r = \sqrt{PG/4\Pi S}$

- For portable transmitters (see Section 2.1093), or devices designed to operate next to a person's body, compliance is determined with respect to the SAR limit (define in the body tissues) for near-field exposure conditions. If the maximum average output power, operating condition configurations and exposure conditions are comparable to those of existing cellular and PCS phones., an SAR evaluation may be required in order to determine if such a device complies with SAR limit. When SAR evaluation data is not available, and the additional supporting information cannot assure compliance, the Commission may request that an SAR evaluation be performed, as provided for in Section 1.1307(d).

5.7.3. MPE Evaluation

Evaluation of RF Exposure Compliance Requirements for Base Unit	
RF Exposure Requirements	**Compliance with FCC Rules**
Minimum calculated separation distance between antenna and persons required: ***3.7 cm**	Manufacturer's instruction for separation distance between antenna and persons required: **20 cm**
Antenna installation and device operating instructions for installers (professional/unskilled users), and the parties responsible for ensuring compliance with the RF exposure requirement	Antenna installation and device operating instructions shall be provided to end users 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	Please refer to User's Manual for RF Exposure Information.
Any other RF exposure related issues that may affect MPE compliance	None.

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

RF EXPOSURE DISTANCE LIMITS: $r = (PG/4\Pi S)^{1/2} = (EIRP/4\Pi S)^{1/2}$

$S = 1.0\ mW/cm^2$

EIRP = 22.39 dBm = 173.4 mW

$r = (EIRP/4\Pi S)^{1/2} = (173.4/4\Pi(1.0))^{1/2} = 3.7$ cm

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

5.8.1. Limits

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.

In addition, radiated emissions, which fall in the restricted band, as defined in Section 15.205 (a), must also comply with the radiated emission limits specified in section 15.209 (a).

Remarks:

- Applies to harmonics/spurious emissions that fall in the restricted bands listed in Section 15.205. The maximum permitted average field strength is listed in Section 15.209.
- The emission limits as specified above are based on measurement instrument employing an average detector. The provisions in Section 15.35 for limiting peak emissions apply.

FCC 47 CFR 15.205(a) - Restricted Frequency Bands

MHz	MHz	MHz	GHz
0.090 - 0.110	162.0125 - 167.17	2310 - 2390	9.3 - 9.5
0.49 – 0.51	167.72 - 173.2	2483.5 - 2500	10.6 - 12.7
2.1735 - 2.1905	240 - 285	2655 - 2900	13.25 - 13.4
8.362 - 8.366	322 - 335.4	3260 - 3267	14.47 - 14.5
13.36 - 13.41	399.9 - 410	3332 - 3339	14.35 - 16.2
25.5 – 25.67	608 - 614	3345.8 - 3358	17.7 - 21.4
37.5 – 38.25	960 - 1240	3600 - 4400	22.01 - 23.12
73 - 75.4	1300 - 1427	4500 - 5250	23.6 - 24.0
108 – 121.94	1435 - 1626.5	5350 - 5460	31.2 - 31.8
123 – 138	1660 - 1710	7250 - 7750	36.43 - 36.5
149.9 – 150.05	1718.8 - 1722.2	8025 - 8500	Above 38.6
156.7 – 156.9	2200 - 2300	9000 - 9200	

FCC 47 CFR 15.209(a)
-- Field Strength Limits within Restricted Frequency Bands --

FREQUENCY (MHz)	FIELD STRENGTH LIMITS (microvolts/m)	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

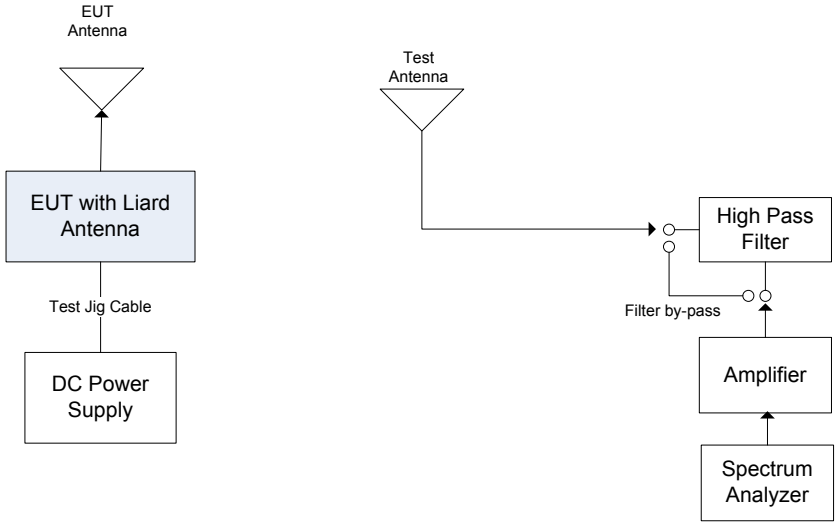
5.8.2. Method of Measurements

Refer to Exhibit 8, FCC procedures for Digital Transmission Systems (March 23, 2005) and ANSI C3.4 for detailed radiated emissions measurement procedures.

The following measurement procedures were also applied:

- Applies to harmonics/spurious that fall in the restricted bands listed in Section 15.205. The maximum permitted average field strength is listed in Section 15.209. Pre-Amp and high-pass filter are used for this measurement.
- For measurement below 1 GHz, set RBW = 100 KHz, VBW ≥ 100 KHz, SWEEP=AUTO.
- For measurement above 1 GHz, set RBW = 1 MHz, VBW = 1 MHz (Peak) & VBW = 10 Hz (Average), SWEEP=AUTO.
- If the emission is pulsed, modified the unit for continuous operation, then use the settings above for measurements, then correct the reading by subtracting the peak-average correction factor derived from the appropriate duty cycle calculation. See Section 15.35(b) and (c).

5.8.3. Test Arrangement



5.8.4. 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	27 Sep 2012
Spectrum Analyzer	Rohde & Schwarz	ESU40	100037	20 Hz – 40 GHz	15 Mar 2012
RF Amplifier	Hewlett Packard	84498	3008A00769	1 – 26.5 GHz	17 Feb 2012
RF Amplifier	AH System	PAM-0118	225	20 MHz – 18 GHz	15 Mar 2012
High Pass Filter	K & L	11SH10-4000/T12000	4	Cut off 2.4 GHz	Cal. on use
Horn Antenna	Emco	3115	6570	1 – 18 GHz	22 Feb 2012
Biconi-Log Antenna	Emco	3142C	00034792	26 – 3000 MHz	26 April 2012
Horn Antenna	Emco	3160-09	00118385	18 – 26.5 GHz	30 May 2012

5.8.5. Test Data

5.8.5.1. EUT tested with new External Phantom Antenna (Antenna Gain = 3 dBi)

Fundamental Frequency: 2410 MHz
Modulation: Digital Modulation
Frequency Test Range: 30 MHz - 25 GHz

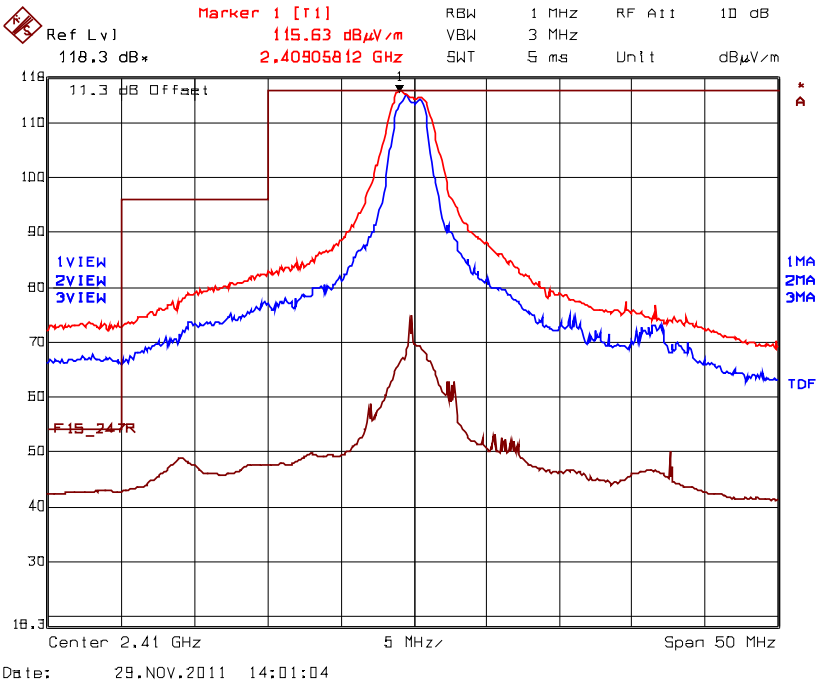
Frequency (MHz)	RF Peak Level (dBµV/m)	RF Avg Level (dBµV/m)	Antenna Plane (H/V)	Limit* 15.209 (dBµV/m)	Limit 15.247 (dBµV/m)	Margin (dB)	Pass/ Fail
2410	113.54	--	V	--	--	--	--
2410	115.63	--	H	--	--	--	--
4820*	55.34	39.13	V	54.0	95.6	-14.9	Pass
4820*	49.15	33.94	H	54.0	95.6	-20.0	Pass
7230	55.10	41.12	V	54.0	95.6	-54.5	Pass
7230	53.20	39.00	H	54.0	95.6	-56.6	Pass
30 - 25000	--	--	V	54.0	95.6	--	Pass
30 - 25000	--	--	H	54.0	95.6	--	Pass
No other spurious emissions were found from 30 MHz to 25 GHz. See test data plots (4 & 5) for band-edge emissions.							

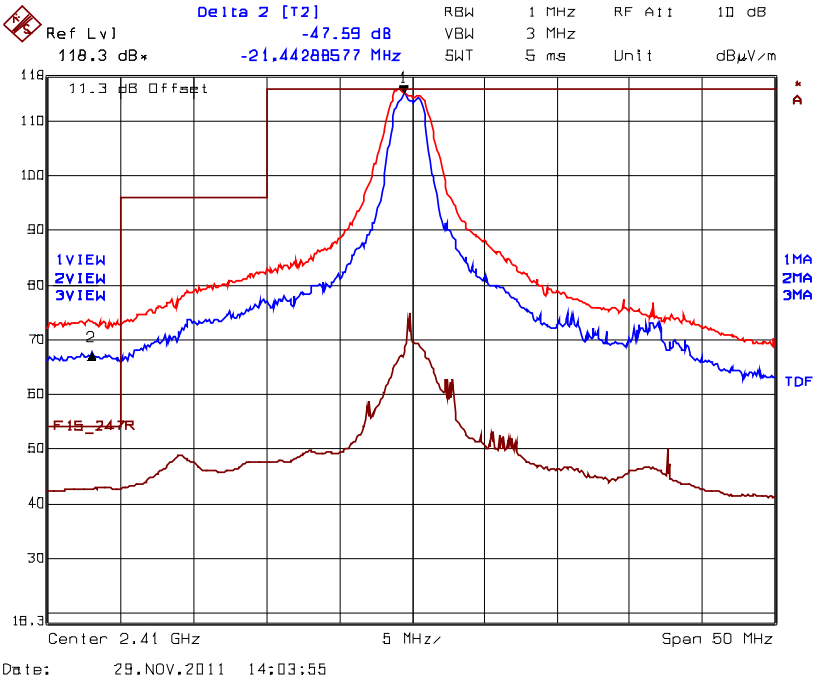
* Emission limit within the restricted frequency band.

Plot# 4: Band-Edge RF Radiated Emissions, Horizontal Polarization
Low End of Frequency Band
Transmitter Frequency: 2410 MHz

Note:

- Trace 1: RBW = 1 MHz, RBW=3 MHz
- Trace 2: RBW = 500 kHz, RBW = 1 MHz, Delta (Peak to Band-Edge): 47.59 dB
- Trace 3: RBW = 1 MHz, VBW = 10 Hz
- Peak Band-Edge at 2390 MHz: Peak= 115.63dBuV/m – 47.59dB= 68.04dBuV/m

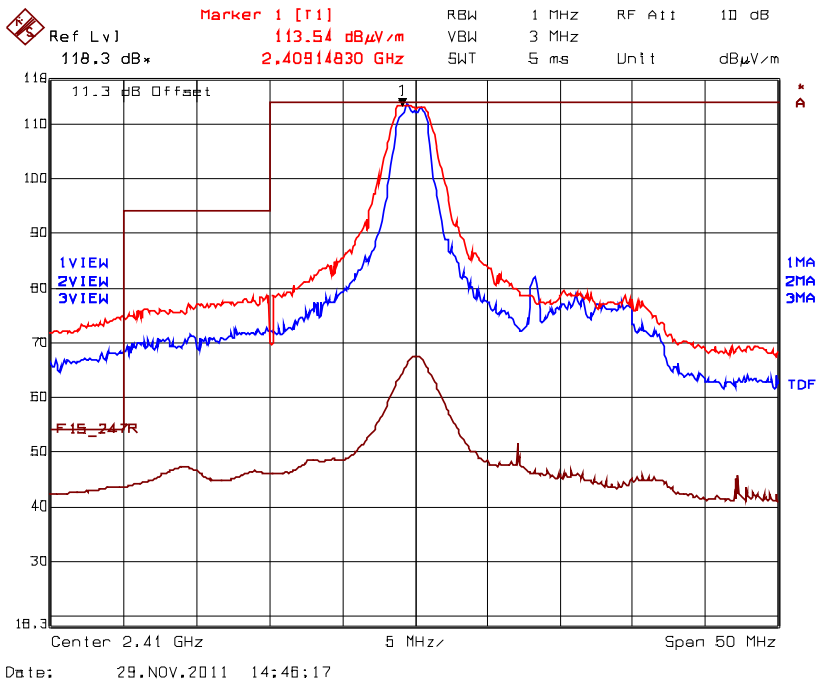


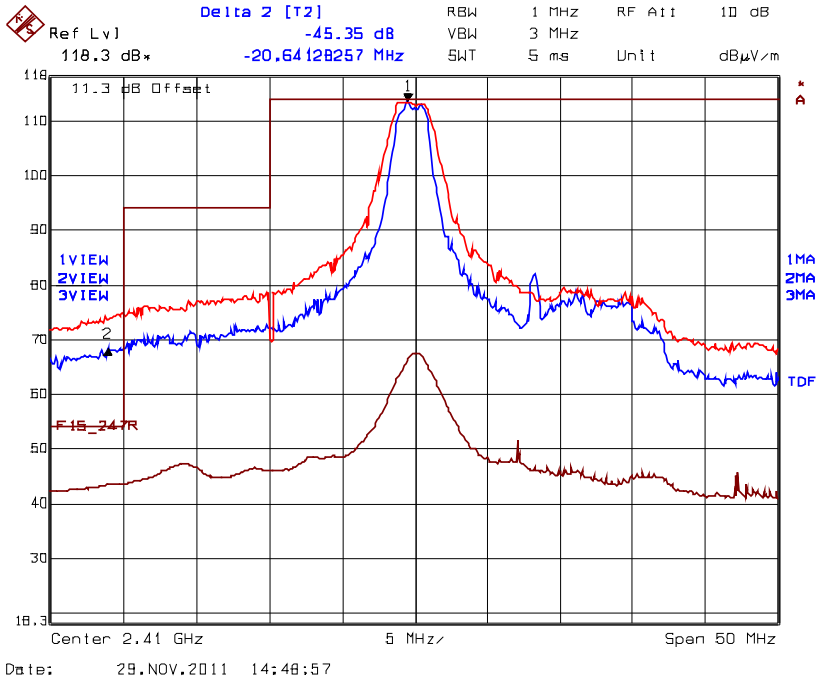


Plot# 5: Band-Edge RF Radiated Emissions, Vertical Polarization
Low End of Frequency Band
Transmitter Frequency: 2410 MHz

Note:

- Trace 1: RBW = 1 MHz, RBW=3 MHz
- Trace 2: RBW = 500 kHz, RBW = 1 MHz, Delta (Peak to Band-Edge): 45.35 dB
- Trace 3: RBW = 1 MHz, VBW = 10 Hz
- Peak Band-Edge at 2390 MHz: Peak= 113.54dBuV/m – 45.35dB= 68.19dBuV/m





Fundamental Frequency: 2440 MHz
Modulation: Digital Modulation
Frequency Test Range: 30 MHz – 25 GHz

Frequency (MHz)	RF Peak Level (dBµV/m)	RF Avg Level (dBµV/m)	Antenna Plane (H/V)	Limit* 15.209 (dBµV/m)	Limit 15.247 (dBµV/m)	Margin (dB)	Pass/ Fail
2440	113.85	--	V	--	--	--	--
2440	116.71	--	H	--	--	--	--
4880*	51.37	34.52	V	54.0	96.7	-19.5	Pass
4880*	49.49	33.30	H	54.0	96.7	-20.7	Pass
7320*	54.09	39.01	V	54.0	96.7	-15.0	Pass
7320*	53.84	39.11	H	54.0	96.7	-14.9	Pass
30 - 25000	--	--	V	54.0	96.7	--	Pass
30 - 25000	--	--	H	54.0	96.7	--	Pass
No other spurious emissions were found from 30 MHz to 25 GHz. See test data plots (4 & 5) for band-edge emissions.							

* Emission limit within the restricted frequency band.

Fundamental Frequency: 2470 MHz
Modulation: Digital Modulation
Frequency Test Range: 30 MHz – 25 GHz

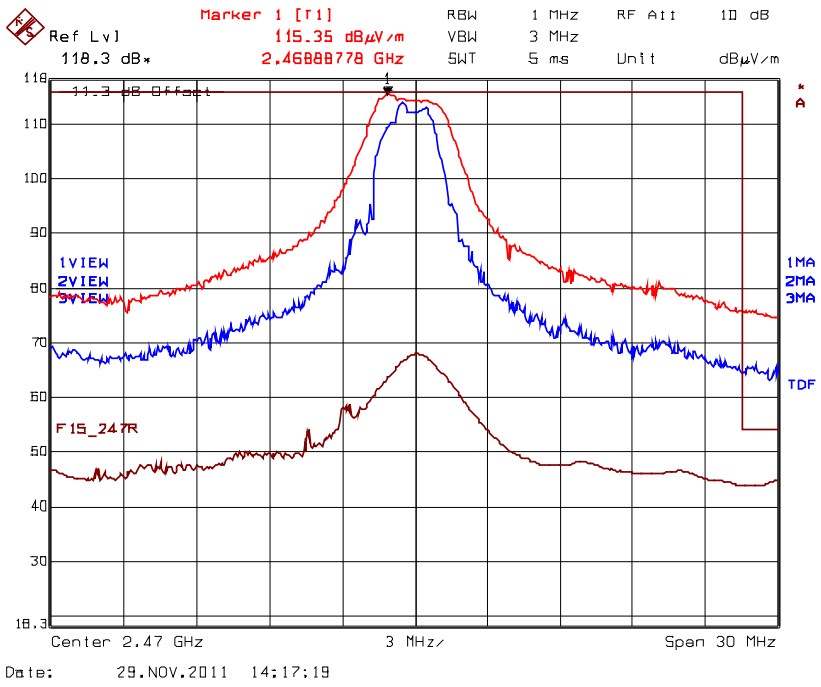
Frequency (MHz)	RF Peak Level (dBµV/m)	RF Avg Level (dBµV/m)	Antenna Plane (H/V)	Limit* 15.209 (dBµV/m)	Limit 15.247 (dBµV/m)	Margin (dB)	Pass/ Fail
2470	110.13	--	V	--	--	--	--
2470	115.35	--	H	--	--	--	--
4940*	49.07	35.15	V	54.0	95.4	-18.8	Pass
4940*	50.69	34.92	H	54.0	95.4	-19.1	Pass
7410*	53.71	39.52	V	54.0	95.4	-14.5	Pass
7410*	55.05	40.02	H	54.0	95.4	-14.0	Pass
30 - 25000	--	--	V	54.0	95.4	--	Pass
30 - 25000	--	--	H	54.0	95.4	--	Pass
No other spurious emissions were found from 30 MHz to 25 GHz. See test data plots (4 & 5) for band-edge emissions.							

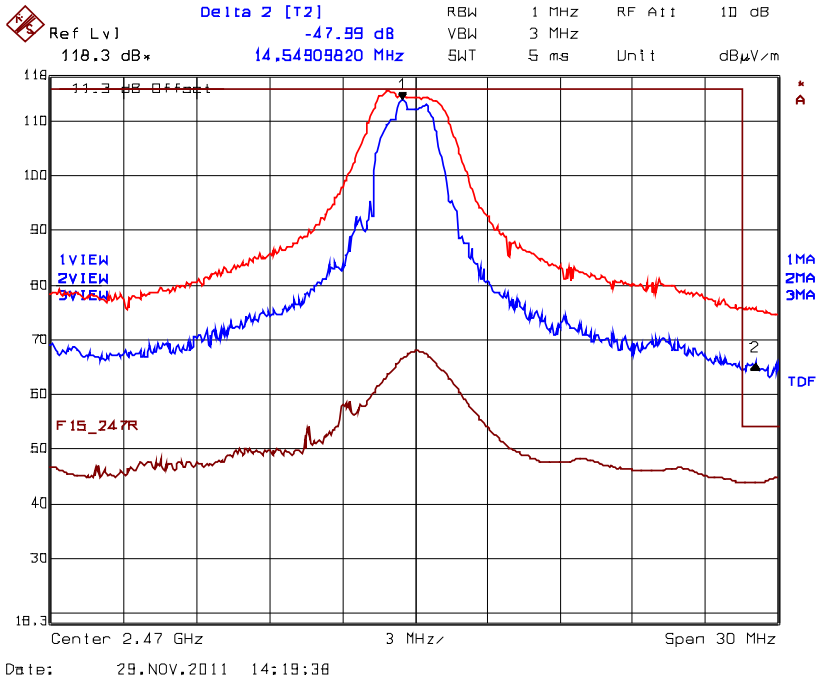
* Emission limit within the restricted frequency band.

Plot# 6: Band-Edge RF Radiated Emissions, Vertical Polarization
Upper End of Frequency Band
Transmitter Frequency: 2470 MHz

Note:

- Trace 1: RBW = 1 MHz, RBW=3 MHz
- Trace 2: RBW = 300 kHz, RBW = 500 kHz, Delta (Peak to Band-Edge): 47.99 dB
- Trace 3: RBW = 1 MHz, VBW = 10 Hz
- Peak Band-Edge at 2483.5 MHz: Peak= 115.35dBuV/m – 47.99dB= 67.37dBuV/m

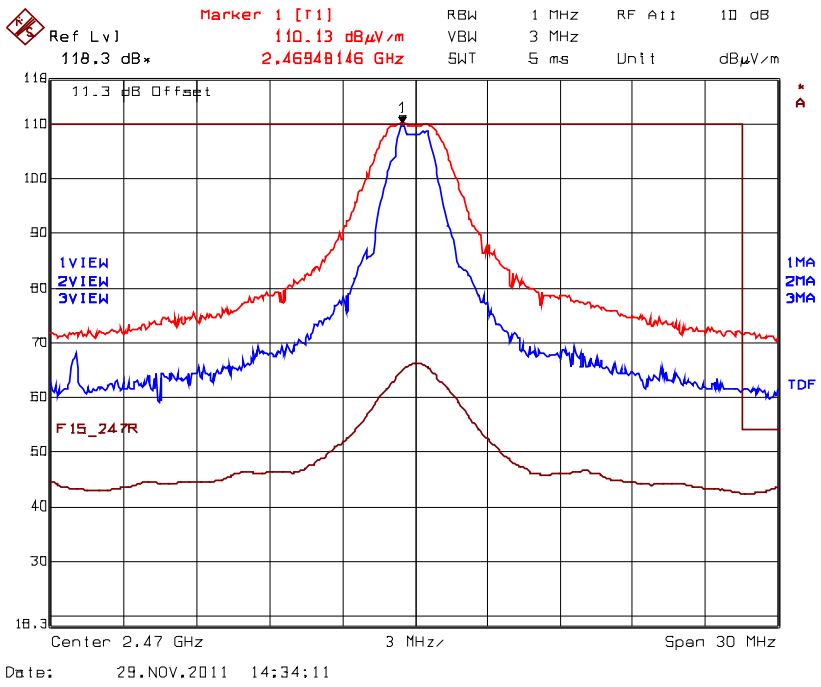




Plot# 7: Band-Edge RF Radiated Emissions, Horizontal Polarization
Upper End of Frequency Band
Transmitter Frequency: 2470 MHz

Note:

- Trace 1: RBW = 1 MHz, RBW=3 MHz
- Trace 2: RBW = 300 kHz, RBW = 500 kHz, Delta (Peak to Band-Edge): 47.85 dB
- Trace 3: RBW = 1 MHz, VBW = 10 Hz
- Peak Band-Edge at 2483.5 MHz: Peak= 110.13dBuV/m – 47.85dB= 62.28dBuV/m



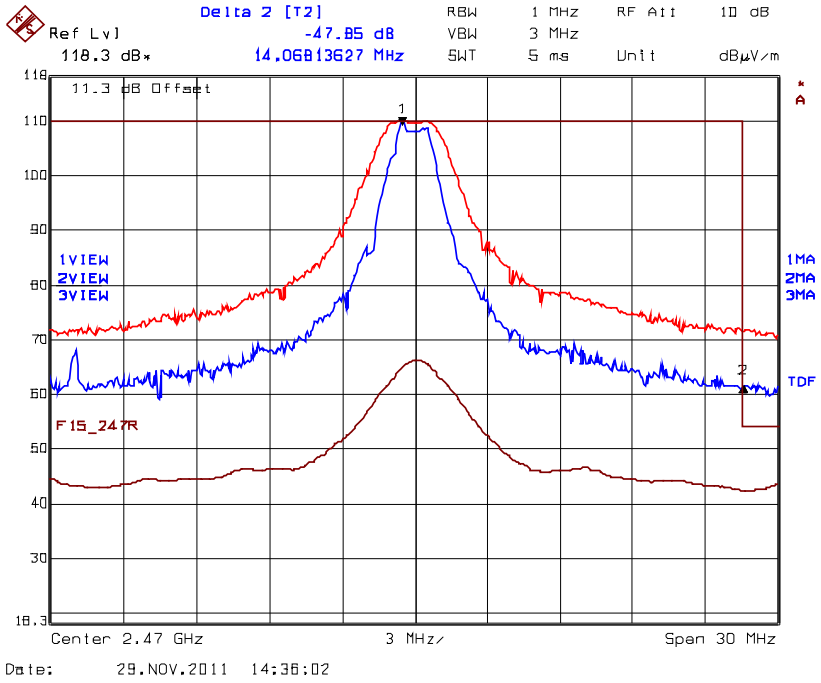


EXHIBIT 6. MEASUREMENT UNCERTAINTY

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

6.1. Radiated Emission Measurement Uncertainty

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

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

	Radiated Emission Measurement Uncertainty @ 3m, 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

EXHIBIT 7. MEASUREMENT METHODS

7.1. GENERAL TEST CONDITIONS

The following test conditions shall be applied throughout the tests covered in this report.

7.1.1. Normal temperature and humidity

- Normal temperature: +15°C to +35°C
- Relative Humidity: +20% to 75%

The actual values during tests shall be recorded in the test report.

7.1.2. Normal power source

7.1.2.1. Mains Voltage

The nominal test voltage of the equipment to be connected to mains shall be the nominal mains voltage which is the declared voltage or any of the declared voltages for which the equipment was designed. The frequency of test power source corresponding to the AC mains shall be between 59 Hz and 61 Hz.

7.1.2.2. Battery Power Source

For operation from battery power sources, the nominal test voltage shall be as declared by the equipment manufacturer. This shall be recorded in the test report.

7.1.3. Operating Condition of Equipment under Test

- All tests were carried out while the equipment operated at the following frequencies:
  - The lowest operating frequency,
  - The middle operating frequency and
  - The highest operating frequency

- Modulation were applied using the Test Data sequence
- The transmitter was operated at the highest output power, or in the case the equipment able to operate at more than one power level, at the lowest and highest output powers.

7.2. EQUIVALENT ISOTROPIC RADIATED POWER (EIRP)

7.2.1. Measurements of Transmitter Parameters (Duty Cycle & Peak Power)

- The following shall be applied to the combination(s) of the radio device and its intended antenna(e).
- I f the RF level is user adjustable, all measurements shall be made with the highest power level available to the user for that combination.
- The following method of measurement shall apply to both conducted and radiated measurements.
- The radiated measurements are performed at the Ultratech Calibrated Open Field Test Site.
- The measurement shall be performed using normal operation of the equipment with modulation.

Test procedure shall be as follows:

Step 1: Duty Cycle Measurements

- Using a spectrum analyzer with the frequency span set to 0 Hz and the sweep time set at a suitable value to capture the envelope peaks and the duty cycle of the transmitter output signal;

- The duty cycle of the transmitter, x = Tx on / (Tx on + Tx off) with 0<x<1, is measure and recorded in the test report. For the purpose of testing, the equipment shall be operated with a duty cycle that is equal or more than 0.1.

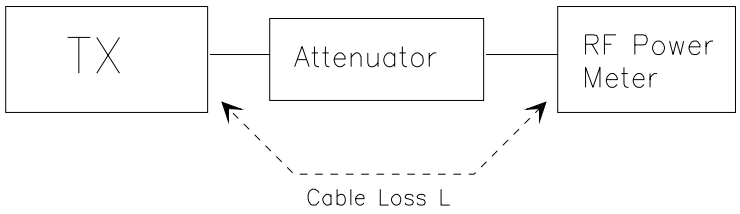
Step 2: Calculation of Peak and Average EIRP

- The peak output power of the transmitter shall be determined using a wideband, calibrated RF Peak Power Meter with the power sensor with an integration period that exceeds the repetition period of the transmitter by a factor 5 or more. The observed value shall be recorded as "P" (in dBm);

- The Average EIRP shall be calculated from the above measured power output "A", the observed duty cycle x, and the applicable antenna assembly gain "G" in dBi, according to the formula:

Peak EIRP = P + G
Average EIRP = Peak EIRP + 10log(1/x)

Figure 1



Step 3: Substitution Method. See Figure 2

(a) The measurements was performed in the absence of modulation (un-modulated)

(b) Test was performed at listed 3m open area test site (listed with FCC, IC, ITI, NVLAP, ACA & VCCI).

(c) The transmitter under test was placed at the specified height on a non-conducting turntable (80 cm height)

(d) The dipole test antenna was used and tuned to the transmitter carrier frequency.

(e) The spectrum analyzer was tuned to transmitter carrier frequency. The test antenna was lowered or raised from 1 to 4 meters until the maximum signal level was detected.

(f) The transmitter was rotated through 360^{o} about a vertical axis until a higher maximum signal was received.

(g) The test antenna was lowered or raised again from 1 to 4 meters until a maximum was obtained. This level was recorded.

(h) The substitution dipole antenna and the signal generator replaced the transmitter and antenna under test in the same position, and the substitution dipole antenna was placed in vertical polarization. The test dipole antenna was lowered or raised as necessary to ensure that the maximum signal is stilled received.

(i) The input signal to the substitution antenna was adjusted in level until an equal or a known related level to that detected from the transmitter was obtained in the test receiver. The maximum carrier radiated power is equal to the power supply by the generator.

(j) The substitution antenna gain and cable loss were added to the signal generator level for the corrected ERP level.

(k) Repeat steps (c) to (j) with the substitution antenna oriented in horizontal polarization.

(l) Actual gain of the EUT's antenna is the difference of the measured ERP and measured RF power at the RF port. Correct the antenna gain if necessary.

Figure 2

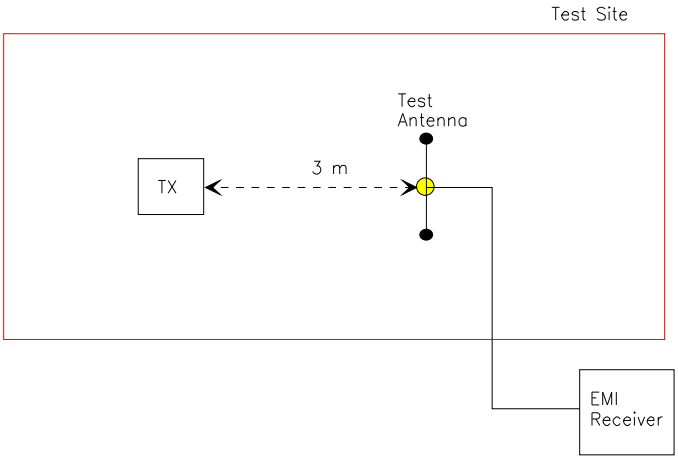
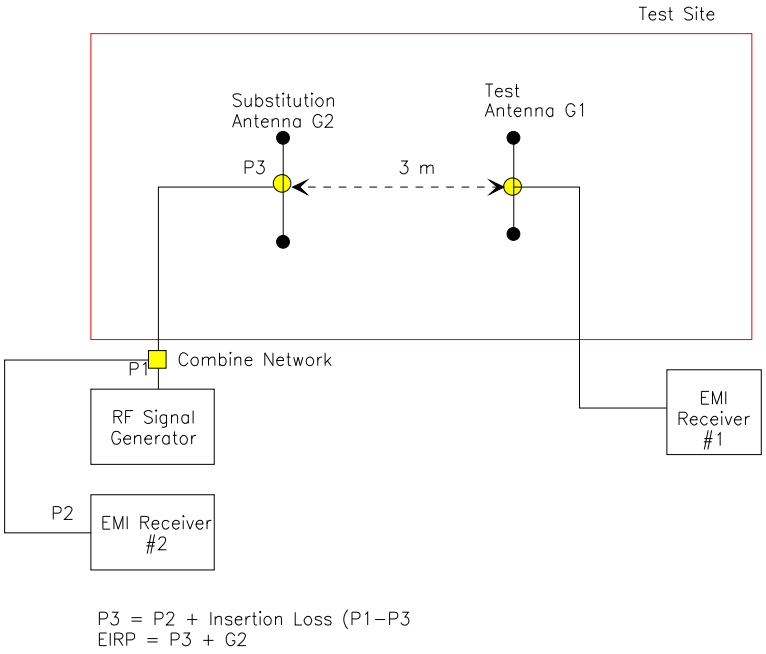


Figure 3



Use the following spectrum analyzer settings:

- Span = approximately 5 times the 20 dB BW, centered on a hopping channel
- RBW > 20 dB BW of the emission measured
- VBW = RBW
- Trace = max hold
- Allow the trace to stabilize
- Use the marker-to-marker function to set the marker to the peak of the emission.
- The indicated level is the peak output power (with the addition of the external attenuation and cable loss).
- The limit is specified in one of the subparagraph of this Section.
- Submit this plot.
- A peak responding power meter may be used instead of a spectrum analyzer.

7.3. SPURIOUS EMISSIONS (CONDUCTED & RADIATED)

For both conducted and radiated measurements, the spurious emissions were scanned from the lowest frequency generated by the EUT or 10 MHz whichever is lower to 10th harmonic of the highest frequency generated by the EUT.

7.3.1. Band-edge and Spurious Emissions (Conducted)

Band-edge Compliance of RF Conducted Emissions:

Use the following spectrum analyzer settings:

- The radio was connected to the measuring equipment via a suitable attenuator.
- Span = wide enough to capture the peak level of the emission operating on the channel closest to the band-edge, as well as any modulation products which fall outside of the authorized band of operation.
- RBW = 1 % of the span
- VBW = RBW
- Sweep = auto
- Detector function = peak
- Trace = max hold
- Allow the trace to stabilize
- Set the marker on the emission at the band-edge, or on the highest modulation product outside of the band, if this level is greater than that at the band-edge
- Enable the marker-delta function, then use the marker-to-peak function to move the marker to the peak of the in-band emission.
- The marker-delta value now displayed must comply with the limit specified
- Now, using the same instrument settings, enable the hopping function of the EUT
- Allow the trace to stabilize
- Follow the same procedure listed above to determine if any spurious emissions cause by the hopping function also comply with the specify limits.
- Submit this plot

Spurious RF Conducted Emissions:
Use the following spectrum analyzer settings:

- The radio was connected to the measuring equipment via a suitable attenuator.

- Span = wide enough to capture the peak level of the in-band-emission and all spurious emissions (e.g. harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic. Typically, sevral plots are required to cover this entire span.
- RBW = 100 kHz
- VBW = RBW
- Sweep = auto
- Detector function = peak
- Trace = max hold
- Allow the trace to stabilize
- Set the marker on the any spurious emission recorded. The level displayed must comply with the limit specified in this Section.
- Submit this plot

7.3.2. Spurious Emissions (Radiated)

- The radiated emission measurements were performed at the UltraTech's 3-10 TDK Semi-Anechoic Chamber situated in the Town of Oakville, province of Ontario. The Attenuation Characteristics of TDK Semi-Anechoic Chamber have been filed with FCC and Industry Canada.
- Radiated emissions measurements were made using the following test instruments:

1. Calibrated EMCO BiconiLog antenna in the frequency range from 30 MHz to 2000 MHz.
2. Calibrated Emco Horn antennas in the frequency range above 1000 MHz (1GHz - 40 GHz).
3. The test is required for any spurious emission or modulation product that falls in a Restricted Band, as defined in Section 15.205. It must be performed with the highest gain of each type of antenna proposed for use with the EUT. Use the following spectrum analyzer settings:

   - RBW = 100 kHz for f < 1GHz and RBW = 1 MHz for f $\geq$ 1 GHz
   - VBW = RBW
   - Sweep = auto
   - Detector function = peak
   - Trace = max hold
   - Follows the guidelines in ANSI C63.4-2003 with respect to maximizing the emission by rotating the EUT, measuring the emission while the EUT is situated in three orthogonal planes (if appropriate), adjusting the measurement antenna height and polarization, etc.. A pre-amp and highpass filter are required for this test, in order to provide the measuring system with sufficient sensitivity.
   - Allow the trace to stabilize.
   - The peak reading of the emission, after being corrected by the antenna correction factor, cable loss, pre-amp gain, etc.… is the peak field strength which comply with the limit specified in Section 15.35(b)

     Calculation of Field Strength:

     The field strength is calculated by adding the calibrated antenna factor and cable factor, and subtracting the Amplifier gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

     FS = RA + AF + CF - AG

Where FS = Field Strength
RA = Receiver/Analyzer Reading
AF = Antenna Factor
CF = Cable Attenuation Factor
AG = Amplifier Gain

Example: If a receiver reading of 60.0 dBuV is obtained, the antenna factor of 7.0 dB/m and cable factor of 1.0 dB are added, and the amplifier gain of 30 dB is subtracted. The actual field strength will be:

Field Level = 60 + 7.0 + 1.0 - 30 = 38.0 dBuV/m.
Field Level = $10^{(38/20)}$ = 79.43 uV/m.

   - Submit this test data
   - Now set the VBW to 10Hz, while maintaining all of the other instrument settings. This peak level, once corrected, must comply with the limit specified in Section 15.209. If the dwell time per channel

of the hopping signal is less than 100ms, then the reading obtained may be further adjusted by a "duty cycle correction factor", derived from 10log(dwell time/100mS) in an effort to demonstrate compliance with the 15.209.

- Submit test data

Maximizing The Radiated Emissions:

- The frequencies of emissions were first detected. Then the amplitude of the emissions was measured at the specified measurement distance using required antenna height, polarization, and detector characteristics.
- During this process, cables and peripheral devices were manipulated within the range of likely configuration.
- For each mode of operation required to be tested, the frequency spectrum was monitored. Variations in antenna heights (from 1 meter to 4 meters above the ground plane), antenna polarization (horizontal plane and vertical plane), cable placement and peripheral placement were explored to produce the highest amplitude signal relative to the limit.

The maximum radiated emission for a given mode of operation was found by using the following step-by-step procedure:

Step 1: Monitor the frequency range of interest at a fixed antenna height and EUT azimuth.

Step 2: Manipulate the system cables to produce highest amplitude signal relative to the limit. Note the amplitude and frequency of the suspect signal.

Step 3: Rotate the EUT 360 degrees to maximize the suspected highest amplitude signal. If the signal or another at a different frequency is observed to exceed the previously noted highest amplitude signal by 1 dB or more, go back to the azimuth and repeat Step 2. Otherwise, orient the EUT azimuth to repeat the highest amplitude observation and proceed.

Step 4: Move the antenna over its full allowable range of travel (1 to 4 meters) to maximize the suspected highest amplitude signal. If the signal or another at a different frequency is observed to exceed the previously noted highest amplitude signal by 1 dB or more, return to Step 2 with the highest amplitude observation and proceed.

Step 5: Change the polarization of the antenna and repeat Step 2 through 4. Compare the resulting suspected highest amplitude signal with that found for the other polarization. Select and note the higher of the two signals. This signal is termed the highest observed signal with respect to the limit for this EUT operational mode.

Step 6: The effects of various modes of operation are examined. This is done by varying the equipment modes as steps 2 through 5 are being performed.

Step 7: After completing steps 1 through 6, record the final highest emission level, frequency, antenna polarization and detector mode of the measuring instrument.