ENGINEERING TEST REPORT

inReach
Model: DeLorme inReach 1.5
FCC ID: UTNINRCH15

Applicant:

DeLorme
Two DeLorme Drive
P.O. Box 298
Yarmouth, Maine 04096

In Accordance With

Federal Communications Commission (FCC)
Part 15, Subpart C, Section 15.247
Frequency Hopping Spread Spectrum Operating in 2400 – 2483.5 MHz Band

UltraTech's File No.: DELO-009F15C247

This Test report is Issued under the Authority of Tri M. Luu Vice President of Engineering UltraTech Group of Labs Date: April 24, 2012	
Report Prepared by: Dan Huynh Issued Date: April 24, 2012	Tested by: Mr. Hung Trinh Test Dates: April 16 & 24, 2012

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

UltraTech

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

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EXHIBIT 1. INTRODUCTION

1.1. SCOPE

Reference:	FCC Part 15, Subpart C, Section 15.247
Title:	Code of Federal Regulations (CFR), Title 47 – Telecommunication, Part 15
Purpose of Test:	Equipment Certification for Frequency Hopping Spread Spectrum 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	2011	Code of Federal Regulations (CFR), Title 47 – Telecommunication
ANSI C63.4	2009	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
ANSI C63.10	2009	American National Standard for Testing Unlicensed Wireless Devices
CISPR 22 & EN 55022	2008-09, Edition 6.0 2006	Information Technology Equipment - Radio Disturbance Characteristics - Limits and Methods of Measurement
CISPR 16-1-1 +A1 +A2	2006 2006 2007	Specification for radio disturbance and immunity measuring apparatus and methods. Part 1-1: Measuring Apparatus
CISPR 16-1-2 +A1 +A2	2003 2004 2006	Specification for radio disturbance and immunity measuring apparatus and methods. Part 1-2: Conducted disturbances
FCC Public Notice DA 00-705	2000	Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems

EXHIBIT 2. PERFORMANCE ASSESSMENT

2.1. CLIENT INFORMATION

APPLICANT	
Name:	DeLorme
Address:	Two DeLorme Drive P.O. Box 298 Yarmouth, Maine 04096 USA
Contact Person:	Noah Dionne Phone #: 207-846-7044 Fax #: 207-847-5044 Email Address: Noah.dionne@delorme.com

MANUFACTURER	
Name:	GlobalSat Technology Corporation
Address:	16F., No. 186, Jian-Yi Road, Chung-Ho City Taipei Hsien 235, Taiwan
Contact Person:	Michael Lin Phone #: 02-8226-3799 Ext. 1804 Fax #: 02-8226-3899 Email Address: michael.lin@globalsat.com.tw

2.2. EQUIPMENT UNDER TEST (EUT) INFORMATION

The following information (with the exception of the Date of Receipt) has been supplied by the applicant.

Brand Name:	DeLorme
Product Name:	inReach
Model Name or Number:	DeLorme inReach 1.5
Serial Number:	Test Sample
Type of Equipment:	Spread Spectrum Transmitter
Input Power Supply Type:	3V (2) AA Lithium batteries
Primary User Functions of EUT:	Provide wireless communication to Bluetooth devices.

2.3. EUT'S TECHNICAL SPECIFICATIONS

TRANSMITTER	
Equipment Type:	Portable
Intended Operating Environment:	Residential Commercial, industrial or business
Power Supply Requirement:	3+1.8 Vdc
RF Output Power Rating:	0.001 W
Operating Frequency Range:	2402 – 2480 MHz
RF Output Impedance:	50 Ω
Channel Spacing:	1 MHz
Duty Cycle:	100%
Modulation Type:	GFSK, π/4 DQPSK, 8-PSK
Antenna Connector Types:	Integral

2.4. ASSOCIATED ANTENNA DESCRIPTION

Antenna:	
Manufacturer:	Johanson Technologies
Type:	Ceramic Chip
Model:	2450AT43B100
Frequency Range:	2400 – 2483.5 MHz
Impedance:	50 Ohm
Gain (dBi):	1.3

2.5. LIST OF EUT'S PORTS

Port Number	EUT's Port Description	Number of Identical Ports	Connector Type	Cable Type (Shielded/Non-shielded)
1	Micro-USB	1	Micro-USB	Shielded

2.6. ANCILLARY EQUIPMENT

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

None.

EXHIBIT 3. EUT OPERATING CONDITIONS AND CONFIGURATIONS DURING TESTS

3.1. CLIMATE TEST CONDITIONS

The climate conditions of the test environment are as follows:

Temperature:	21 to 23 ^{o}C
Humidity:	45 to 58%
Pressure:	102 kPa
Power Input Source:	3V (2) AA Lithium batteries

3.2. OPERATIONAL TEST CONDITIONS & ARRANGEMENT FOR TESTS

Operating Modes:	▪ Each of lowest, middle and highest channel frequencies transmits continuously for emissions measurements. ▪ The EUT operates in normal Frequency Hopping mode for occupancy duration, and frequency separation.
Special Test Software:	Special software provided by the applicant was installed to allow the EUT to operate in hopping mode or at each channel frequency continuously. For example, the transmitter will be operated at each of 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.

Transmitter Test Signals	
Frequency Band(s):	2402 - 2480 MHz
Frequency(ies) Tested: (Near lowest, near middle & near highest frequencies in the frequency range of operation.)	2402, 2441 and 2480 MHz
RF Power Output: (measured maximum output power at antenna terminals)	0.10 dBm (1.023 mW)
Normal Test Modulation:	GFSK, π/4 DQPSK, 8-PSK
Modulating Signal Source:	Internal

EXHIBIT 4. SUMMARY OF TEST RESULTS

4.1. LOCATION OF TESTS

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

- AC Power Line Conducted Emissions were performed in UltraTech's shielded room, 24'(L) by 16'(W) by 8'(H).

- Radiated Emissions were performed at the Ultratech's 3-10 TDK Semi-Anechoic Chamber situated in the Town of Oakville, province of Ontario. This test site been calibrated in accordance with ANSI C63.4, and found to be in compliance with the requirements of Sec. 2.948 of the FCC Rules. The descriptions and site measurement data of the Oakville 3-10 TDK Semi-Anechoic Chamber has been filed with FCC office (FCC File No.: 91038) and Industry Canada office (Industry Canada File No.: 2049A-3). Expiry Date: 2014-04-04.

4.2. APPLICABILITY & SUMMARY OF EMC EMISSION TEST RESULTS

FCC Section(s)	Test Requirements	Compliance (Yes/No)
15.203	Antenna requirements	Yes (See Note 1)
15.207(a)	AC Power Line Conducted Emissions	N/A
15.247(a)(1), (g) & (h)	Frequency Hopping Systems	Yes (See Note 2)
15.247(b)	Peak Conducted Output Power	Yes
15.247(d)	Band-Edge and RF Conducted Spurious Emissions at the Transmitter Antenna Terminal	Yes (See Note 2)
15.247(d), 15.209 & 15.205	Transmitter Spurious Radiated Emissions	Yes
15.247(i) & 2.1093	RF Exposure	Yes (See Note 3)
Note 1: The EUT complies with the requirement; it employs a permanently mounted integral antenna. Note 2: See original module test report. Note 3: See SAR test report.		

4.3. MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

None.

EXHIBIT 5. TEST DATA

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

5.1.1. Limit(s)

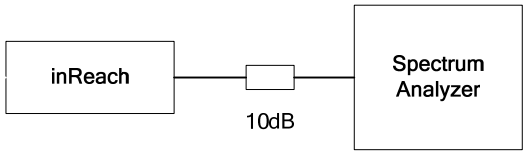
The maximum peak conducted output power of the intentional radiator shall not exceed the following:

§ 15.247(b)(1) For frequency hopping systems operating in the 2400–2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725–5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400–2483.5 MHz band: 0.125 watts.

5.1.2. Method of Measurements & Test Arrangement

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

5.1.3. Test Arrangement



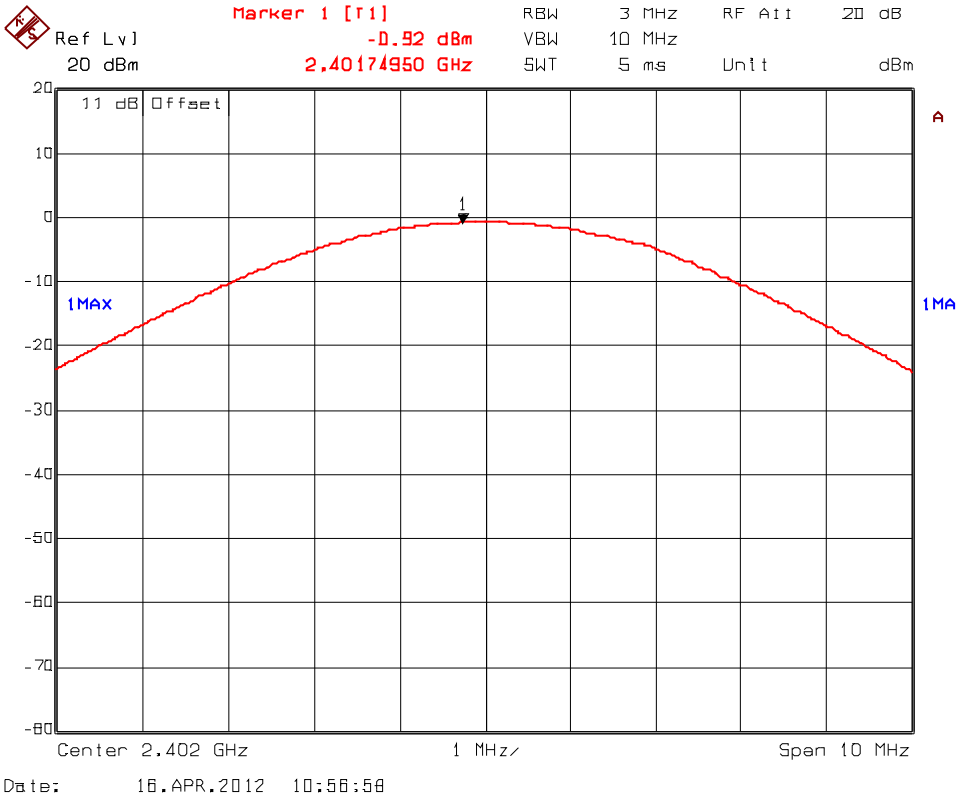
5.1.4. Test Data

Remark(s): Test software power setting: 14

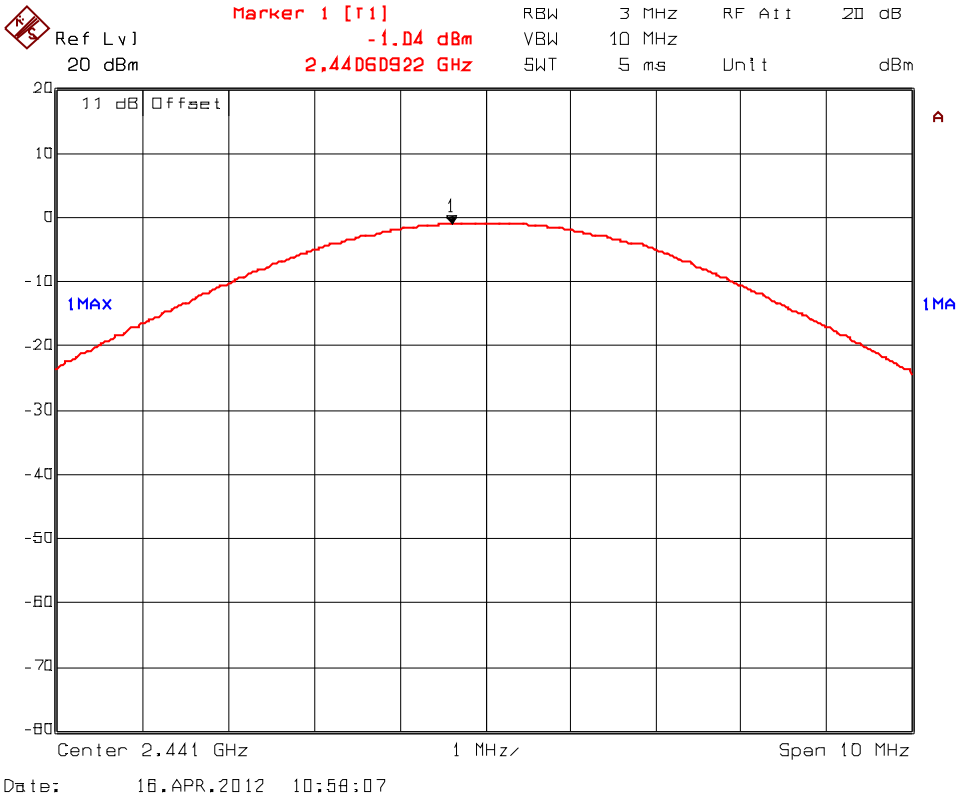
Modulation	Frequency (MHz)	Peak Conducted Power (dBm)	Peak EIRP[Note 1, 2] (dBm)	Peak Conducted Power Limit (dBm)	EIRP Limit (dBm)
GFSK	2402	-0.92	0.38	30	36
	2441	-1.04	0.26	30	36
	2480	-1.28	0.02	30	36
π/4-DQPSK	2402	-0.28	1.02	30	36
	2441	-0.28	1.02	30	36
	2480	-0.41	0.89	30	36
8-PSK	2402	-0.02	1.28	30	36
	2441	0.10	1.40	30	36
	2480	-0.02	1.28	30	36

Note 1: The Peak EIRP is calculated as the sum of Peak Conducted Power in dBm and antenna assembly gain of EUT in dBi (antenna gain – cable loss).
Note 2: The maximum assembly antenna gain: 1.3 dBi

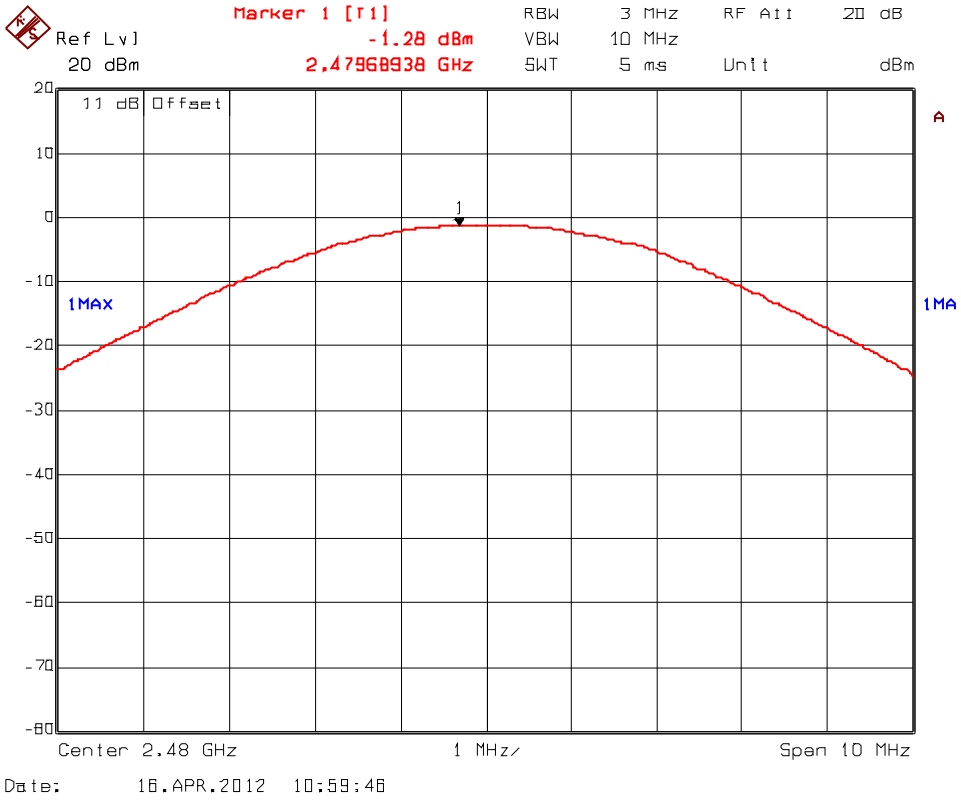
Plot 5.1.4.1. Peak Output Power, 2402 MHz, GFSK



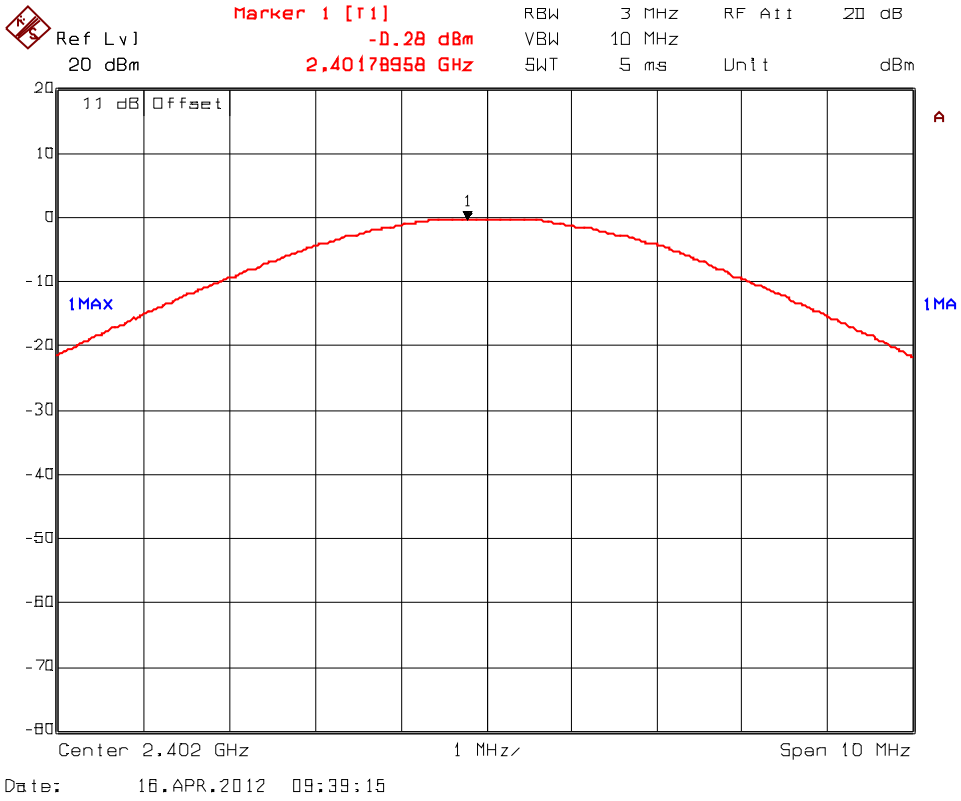
Plot 5.1.4.2. Peak Output Power, 2441 MHz, GFSK



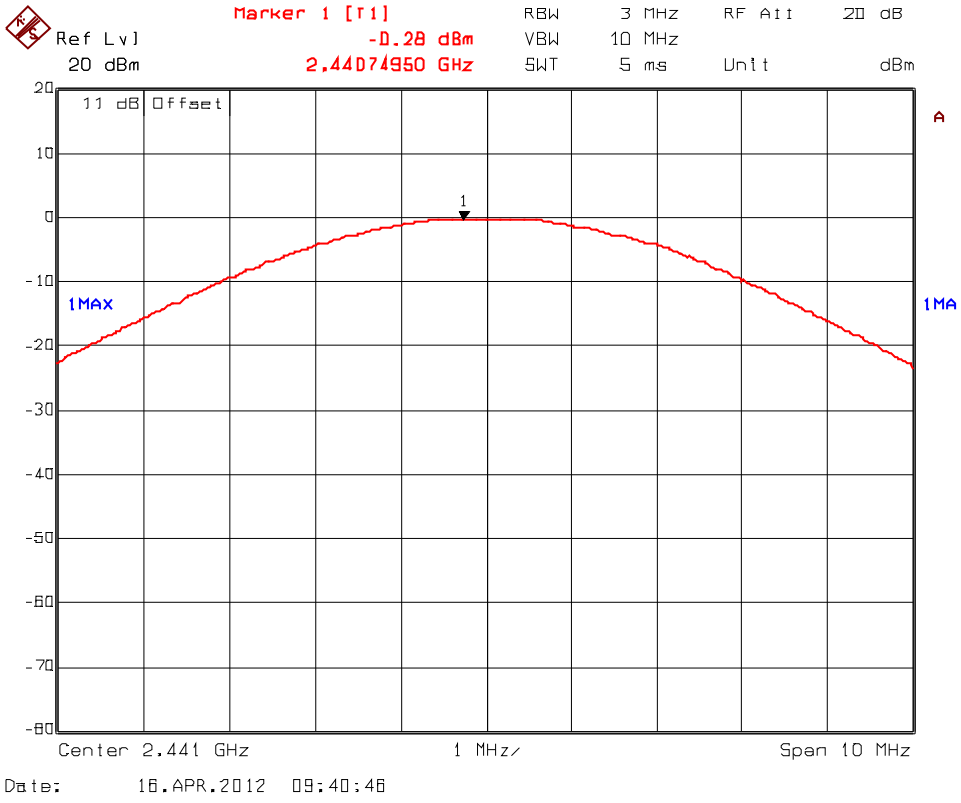
Plot 5.1.4.3. Peak Output Power, 2480 MHz, GFSK



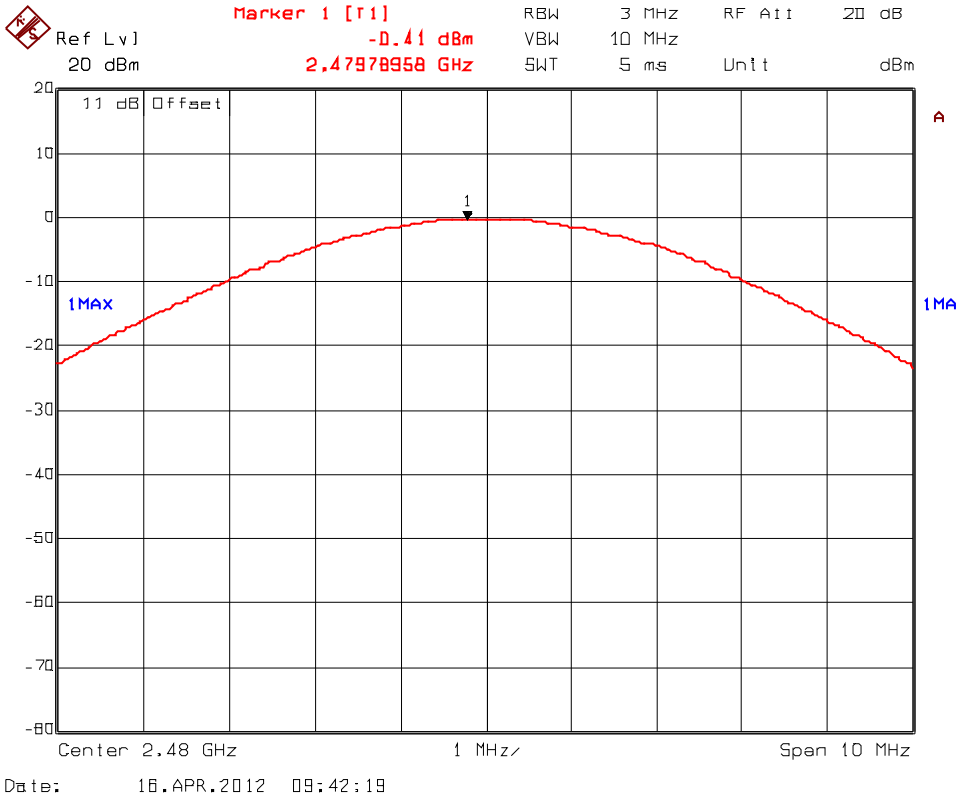
Plot 5.1.4.4. Peak Output Power, 2402 MHz, π/4-DQPSK



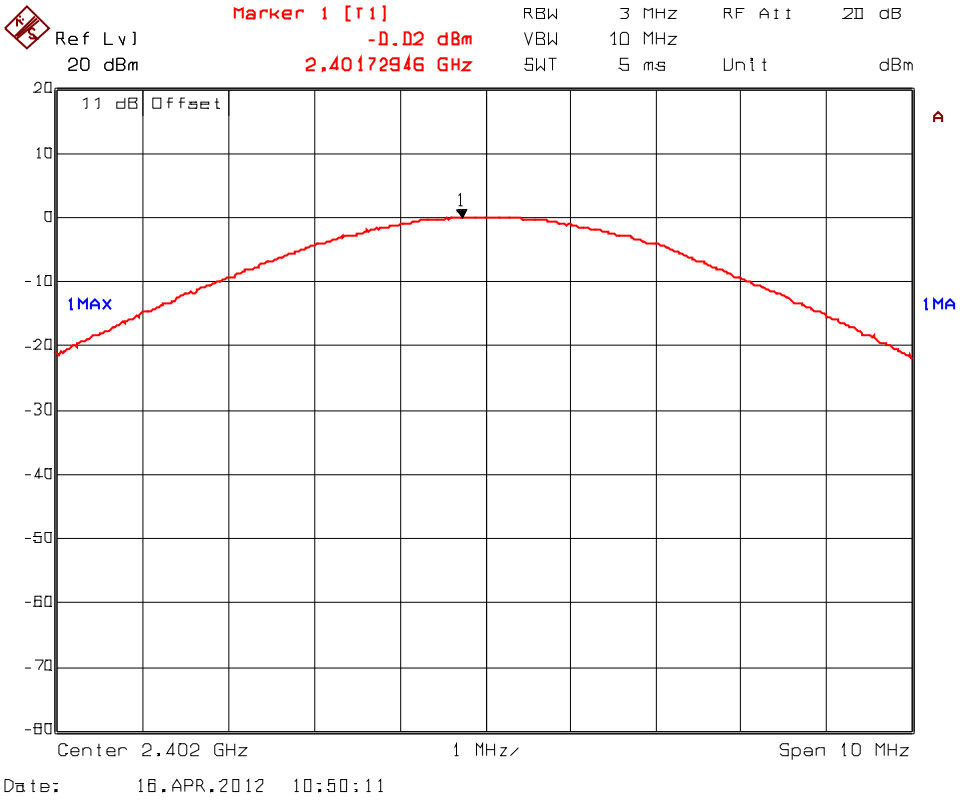
Plot 5.1.4.5. Peak Output Power, 2441 MHz, π/4-DQPSK



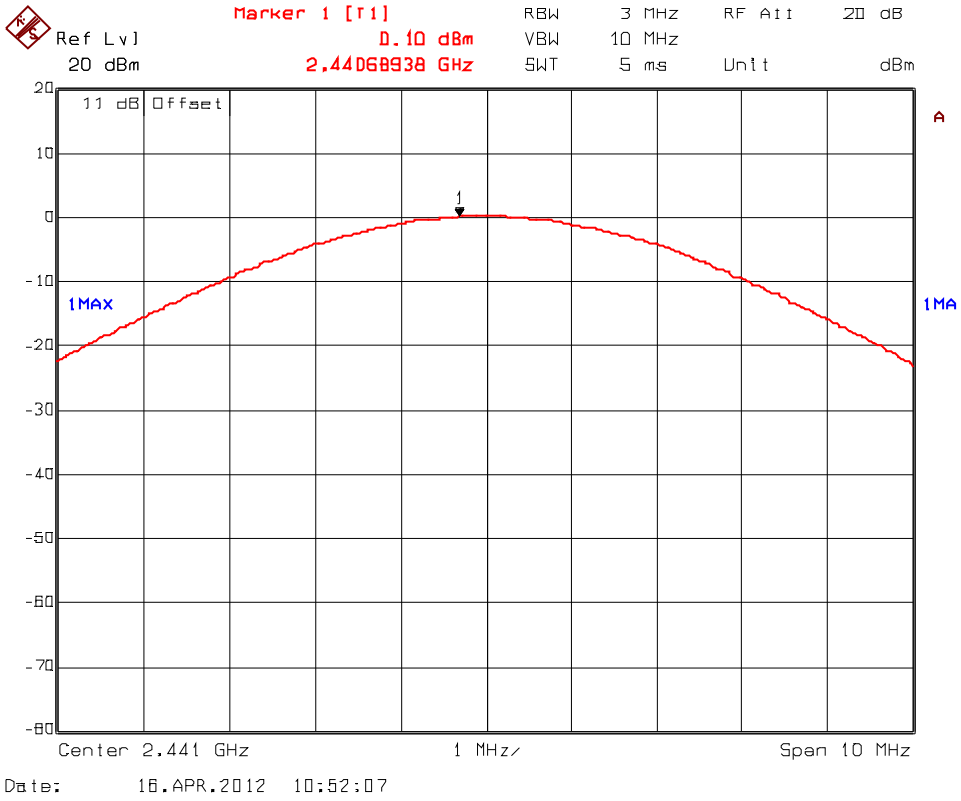
Plot 5.1.4.6. Peak Output Power, 2480 MHz, π/4-DQPSK



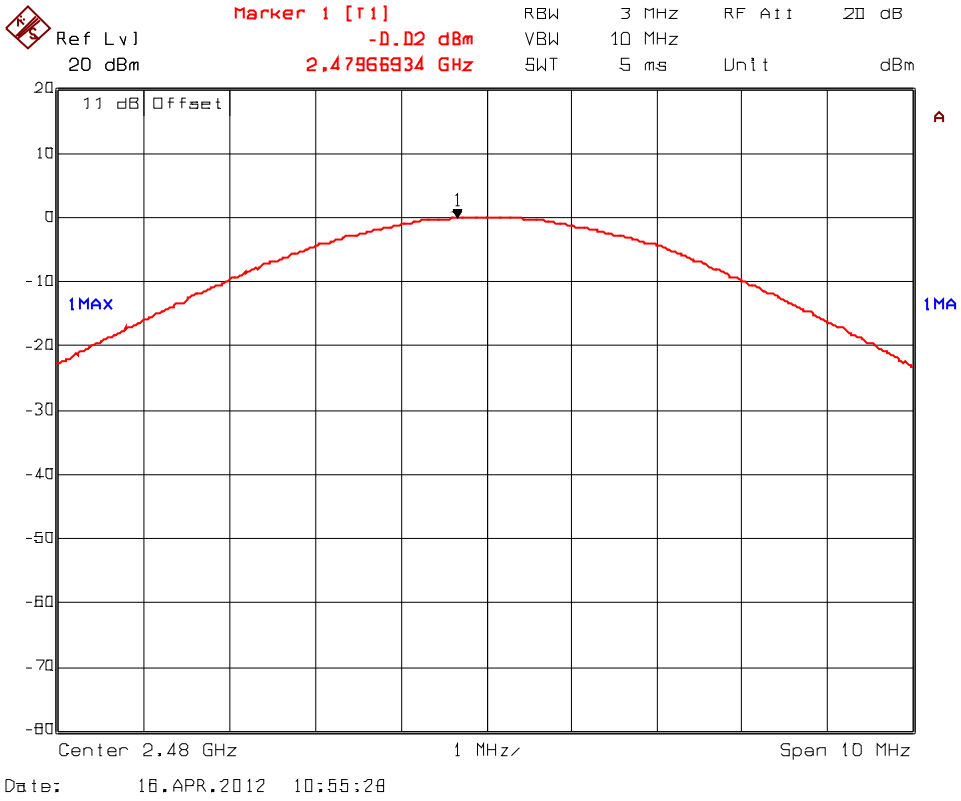
5.1.4.7. Peak Output Power, 2402 MHz, 8-PSK



Plot 5.1.4.8. Peak Output Power, 2441 MHz, 8-PSK



Plot 5.1.4.9. Peak Output Power, 2480 MHz, 8-PSK



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

5.2.1. 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] 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	2690–2900	22.01–23.12
8.41425–8.41475	162.0125–167.17	3260–3267	23.6–24.0
12.29–12.293	167.72–173.2	3332–3339	31.2–31.8
12.51975–12.52025	240–285	3345.8–3358	36.43–36.5
12.57675–12.57725	322–335.4	3600–4400	[2]
13.36–13.41			

[1] Until February 1, 1999, this restricted band shall be 0.490–0.510 MHz.
[2] Above 38.6

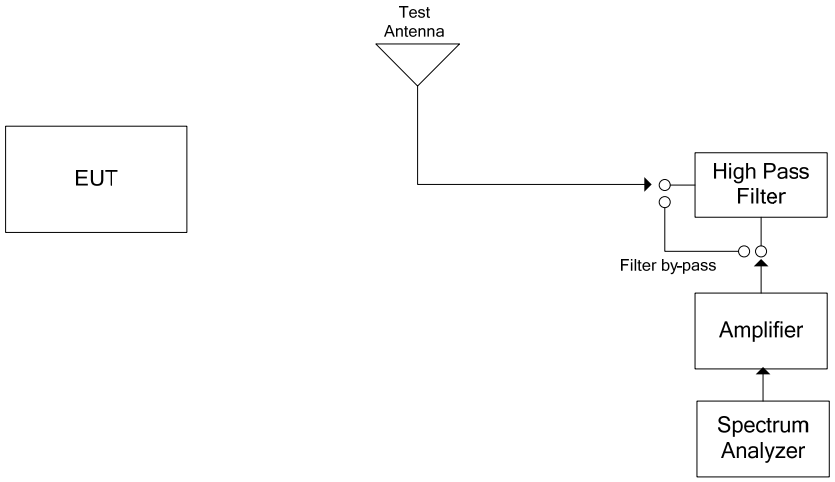
Section 15.209(a) - Radiated Emission Limits; General Requirements

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

5.2.2. Method of Measurements

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

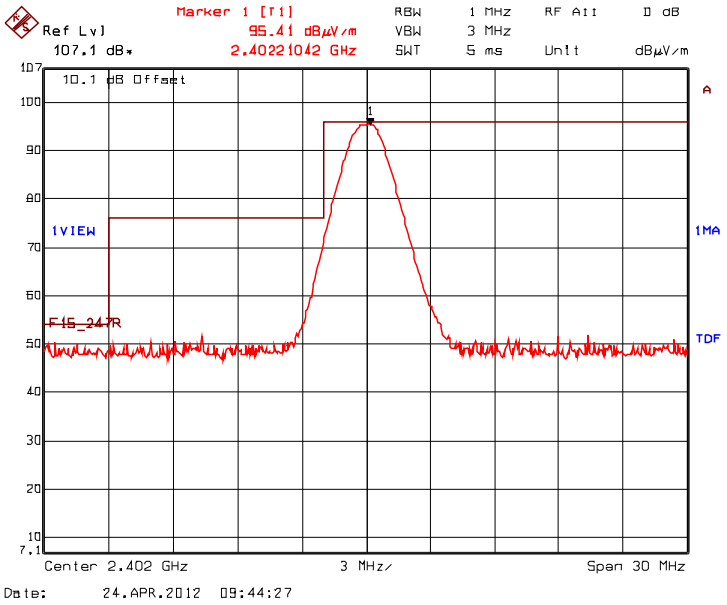
5.2.3. Test Arrangement



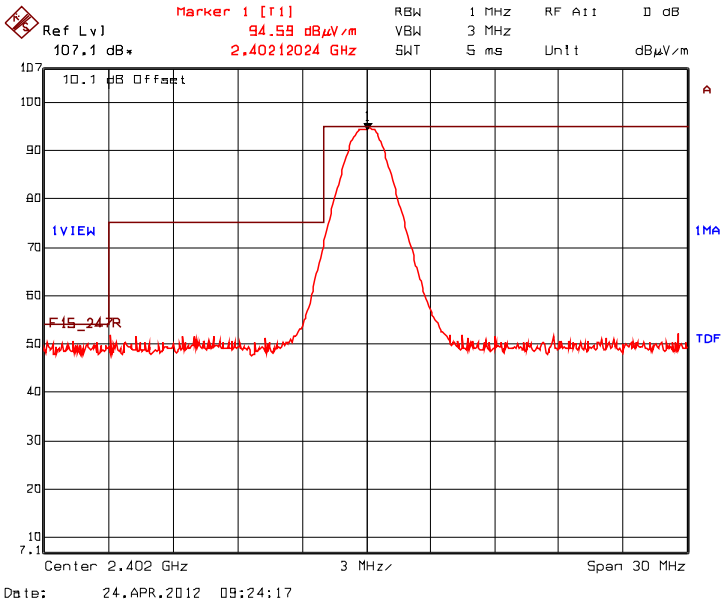
5.2.4. Test Data

5.2.4.1. Band-Edge RF Radiated Emissions Test Results

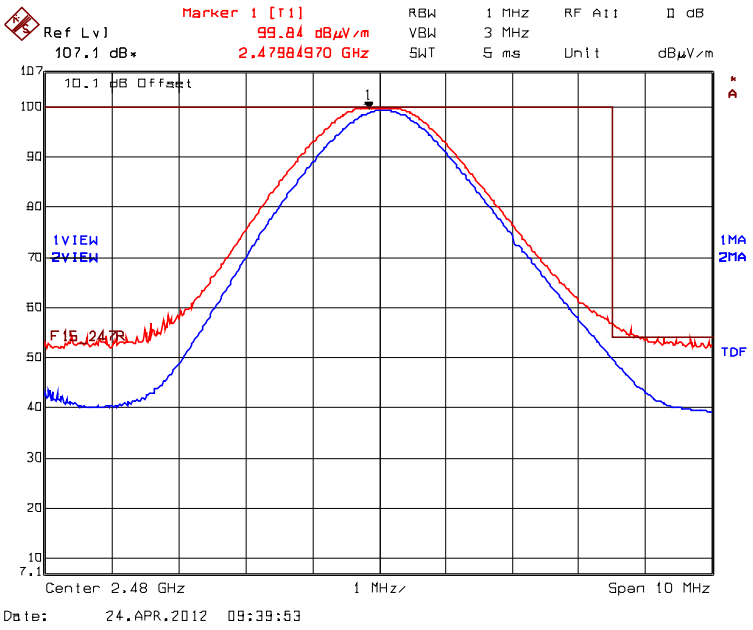
Plot 5.2.4.1.1. Band-Edge RF Radiated Emissions @ 3 m, Continuous Mode
Low End of Frequency Band, 2402 MHz, Rx Antenna Orientation: Horizontal



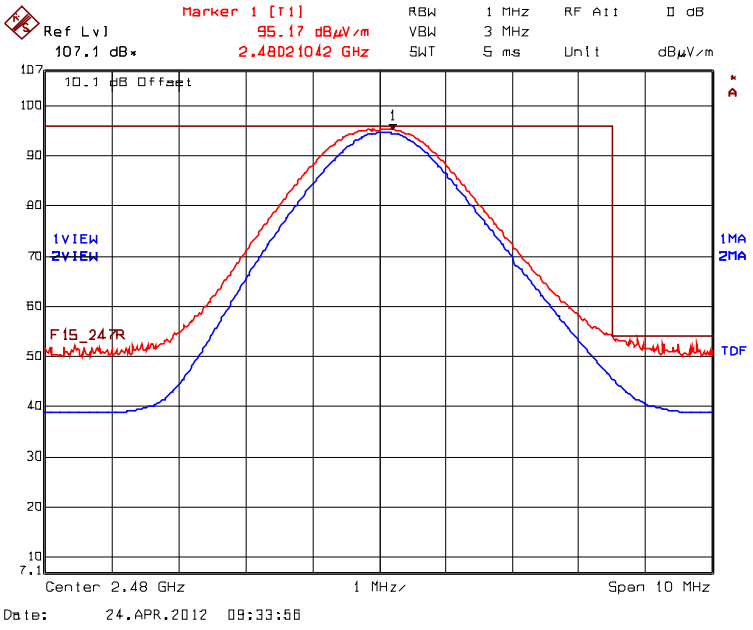
Plot 5.2.4.1.2. Band-Edge RF Radiated Emissions @ 3 m, Continuous Mode
Low End of Frequency Band, 2402 MHz, Rx Antenna Orientation: Vertical



Plot 5.2.4.1.3. Band-Edge RF Radiated Emissions @ 3 m, Continuous Mode
High End of Frequency Band, 2480 MHz, Rx Antenna Orientation: Horizontal



Plot 5.2.4.1.4. Band-Edge RF Radiated Emissions @ 3 m, Hopping Mode
High End of Frequency Band, 2480 MHz, Rx Antenna Orientation: Vertical



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

5.2.4.2. Transmitter Spurious Emissions from Bluetooth Radio

Remarks:

- All spurious emissions that are in excess of 20 dB below the specified limit shall be recorded.
- EUT shall be tested in three orthogonal positions.
- The following test results are the worst-case measurements.

Fundamental Frequency: 2402 MHz
Test Frequency Range: 30 MHz – 25 GHz

Frequency (MHz)	RF Peak Level (dBµV/m)	RF Avg Level (dBµV/m)	Antenna Plane (H/V)	Limit 15.209 (dBµV/m)	Limit 15.247 (dBµV/m)	Margin (dB)	Pass/ Fail
2402	94.59	--	V	--	--	--	--
2402	95.41	--	H	--	--	--	--
4804	51.09	44.22	V	54.0	75.4	-9.8	Pass*
4804	50.52	41.94	H	54.0	75.4	-12.1	Pass*

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

Fundamental Frequency: 2441 MHz
Test Frequency Range: 30 MHz – 25 GHz

Frequency (MHz)	RF Peak Level (dBµV/m)	RF Avg Level (dBµV/m)	Antenna Plane (H/V)	Limit 15.209 (dBµV/m)	Limit 15.247 (dBµV/m)	Margin (dB)	Pass/ Fail
2441	95.68	--	V	--	--	--	--
2441	96.54	--	H	--	--	--	--
4882	55.77	49.63	V	54.00	76.5	-4.37	Pass*
4882	52.81	48.09	H	54.00	76.5	-5.91	Pass*
7323	54.41	44.93	V	54.00	76.5	-9.07	Pass*
7323	53.89	44.33	H	54.00	76.5	-9.67	Pass*

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

Fundamental Frequency:	2480 MHz						
Test Frequency Range:	30 MHz – 25 GHz						
Frequency (MHz)	**RF Peak Level (dBµV/m)**	**RF Avg Level (dBµV/m)**	**Antenna Plane (H/V)**	**Limit 15.209 (dBµV/m)**	**Limit 15.247 (dBµV/m)**	**Margin (dB)**	**Pass/ Fail**
2480	95.17	--	V	--	--	--	--
2480	99.84	--	H	--	--	--	--
4960	51.32	44.65	V	54.0	79.8	-9.4	Pass*
4960	51.92	44.43	H	54.0	79.8	-9.6	Pass*
7440	58.41	51.58	V	54.0	79.8	-2.4	Pass*
7440	57.36	47.68	H	54.0	79.8	-6.3	Pass*
12400	57.44	44.18	V	54.0	79.8	-9.8	Pass*
12400	54.98	43.75	H	54.0	79.8	-10.3	Pass*

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

5.2.4.3. Transmitter Spurious Emissions from Co-location of Bluetooth Device and Iridium 9602 Transceiver

Test Frequencies:	2441 MHz (Bluetooth device) and 1616.01 MHz (Iridium 9602 Transceiver)						
Test Frequency Range:	30 MHz – 25 GHz						
Frequency (MHz)	**RF Peak Level (dBµV/m)**	**RF Avg Level (dBµV/m)**	**Antenna Plane (H/V)**	**Limit Table 5 (dBµV/m)**	**Limit Section A8.5 (dBµV/m)**	**Margin (dB)**	**Pass/ Fail**
*	*	*	V/H	*	*	*	Pass

* No new emissions detected in co-location mode.

EXHIBIT 6. TEST EQUIPMENT LIST

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range	Cal. Due Date
Spectrum Analyzer	Rohde & Schwarz	FSEK30	100077	20Hz–40 GHz	27 Sep 2012
Attenuator	Pasternack	PE7024-10	-	DC–26.5 GHz	Cal on use
Spectrum Analyzer	Rohde & Schwarz	ESU40	100037	20 Hz – 40 GHz	19 Mar 2013
RF Amplifier	Hewlett Packard	84498	3008A00769	1 – 26.5 GHz	1 Dec 2012
RF Amplifier	AH System	PAM-0118	225	20 MHz – 18 GHz	16 Mar 2013
High Pass Filter	K & L	11SH10-4000/T12000	4	Cut off 2400 MHz	Cal on use
Horn Antenna	EMCO	3155	5955	1 – 18 GHz	20 Feb 2013
Biconi-Log Antenna	EMCO	3142C	00034792	26 – 3000 MHz	26 April 2012
Horn Antenna	EMCO	3160-09	118385	18 – 26.5 GHz	30 May 2012

EXHIBIT 7. MEASUREMENT UNCERTAINTY

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

7.1. LINE CONDUCTED EMISSION MEASUREMENT UNCERTAINTY

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

7.2. RADIATED EMISSION MEASUREMENT UNCERTAINTY

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

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

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