ENGINEERING TEST REPORT

Multi-zone Programmable CONNEX Controller
Model: 6700490100
FCC ID: Z49-00004

Applicant:

Dimplex North America Limited
1367 Industrial Road
Cambridge, ON N1R7G8

In Accordance With

Federal Communications Commission (FCC)
Part 15, Subpart C, Section 15.249
Low Power Transmitters Operating in the Frequency Band 2400 – 2483.5 MHz

UltraTech's File No.: DIEX-018_FCC15C

This Test report is Issued under the Authority of Tri M. Luu, BASc Vice President of Engineering UltraTech Group of Labs Date: September 20, 2012	
Report Prepared by: Dharmajit Solanki Issued Date: September 20, 2012	Tested by: Hung Trinh Test Dates: September 14 -19, 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.*

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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

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EXHIBIT 1. INTRODUCTION

1.1. SCOPE

Reference:	FCC Part 15, Subpart C, Section 15.249
Title:	Code of Federal Regulations (CFR), Title 47 – Telecommunication, Part 15
Purpose of Test:	Equipment Certification for for Low Power Licensed-Exempt Transmitters operating in the Frequency Band 2400–2483.5 MHz.
Test Procedures:	American National Standards Institute ANSI C63.10 - American National Standard for Testing Unlicensed Wireless Devices
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, Parts 0 to 15
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 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

EXHIBIT 2. PERFORMANCE ASSESSMENT

2.1. CLIENT INFORMATION

APPLICANT	
Name:	Dimplex North America Limited
Address:	1367 Industrial Road Cambridge, ON N1R7G8 Canada
Contact Person:	Liming Xia Phone #: 519-650-3630 x 475 Fax #: 519-650-3651 Email Address: dxia@dimplex.com

MANUFACTURER	
Name:	Dimplex North America Limited
Address:	1367 Industrial Road Cambridge, ON N1R7G8 Canada
Contact Person:	Liming Xia Phone #: 519-650-3630 x 475 Fax #: 519-650-3651 Email Address: dxia@dimplex.com

2.2. EQUIPMENT UNDER TEST (EUT) INFORMATION

The applicant supplied the following information.

Brand Name:	Dimplex North America Limited
Product Name:	Multi-zone Programmable CONNEX Controller
Model Name or Number:	6700490100
Serial Number:	Test Sample
Type of Equipment:	Low Power Transceiver
Input Power Supply Type:	DC 3V (2 AA Batteries)
Primary User Functions of EUT:	Multi-zone Programmable CONNEX ™ 7 day Controllers link wirelessly to Dimplex Linear Proportional Convectors and Precision Comfort Heaters to provide simple whole home control.

2.3. EUT'S TECHNICAL SPECIFICATIONS

TRANSMITTER	
Equipment Type:	Fixed, Mobile
Intended Operating Environment:	Residential Commercial, Industrial or Business
Power Supply Requirement:	+3.0 V DC
RF Output Power Rating:	49.26 dBµV/m Avg at 3m distance
Operating Frequency Range:	2402 – 2480 MHz
Channel Spacing:	1 MHz
20 dB Bandwidth:	700.4 kHz
Duty Cycle:	Momentary operation (< 4% as Ton is max 4 ms)
Modulation Type:	GFSK
Antenna Connector Types:	Integral antenna permanently mounted on PCB

2.4. ASSOCIATED ANTENNA DESCRIPTION

Antenna:	
Type:	PCB Antenna
Frequency Range:	2400 – 2483.5 MHz
Impedance:	50 Ohm
Gain (dBi):	0 dBi

2.5. LIST OF EUT'S PORTS

None

2.6. ANCILLARY EQUIPMENT

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:	DC 3V (2 AA Batteries)

3.2. OPERATIONAL TEST CONDITIONS & ARRANGEMENT FOR TESTS

Operating Modes:	EUT was configured to transmit continuously for emissions measurements at of lowest, middle and highest channel frequencies.
Special Test Software:	None
Special Hardware Used:	None
Transmitter Test Antenna:	The EUT tested with its permanently attached integral antenna intended in normal 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, 2440 and 2480 MHz
RF Power Output: (measured maximum output power):	49.26 dBµV/m Avg at 3m distance
Normal Test Modulation:	GFSK
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
15.207(a)	AC Power Line Conducted Emissions	N/A*
15.215(c)	20 dB Bandwidth	Yes
15.249(a), 15.209, 15.205	Transmitter Radiated Emissions, Harmonic Emissions	Yes
15.109(a), Class B	Radiated Emission from Unintentional Radiators (Digital Devices)	Yes

*Not applicable for battery operated device

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 ANSI C63.10.

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.

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 MANUACTURER

The Multi-zone Programmable CONNEX Controller designed to provide wireless communication to control a heater.

5.5. ANTENNA REQUIREMENTS [47 CFR § 15.203]

5.5.1. Requirements

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

N**otes**: This requirement does not apply to carrier current devices operated under the provisions of @ 15.211, 15.213, 15.217, 17.219 or 15.221.

5.5.2. Engineering Analysis

Antenna permanently integrated as Trace to the PCB of the device located inside the enclosure.

5.6. 20 dB BANDWIDTH [§ 15.215(c)]

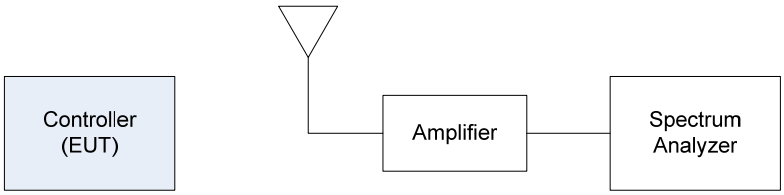
5.6.1. Limit(s)

The fundamental emission must be in the authorized bandwidth.

5.6.2. Method of Measurements

ANSI C63.10; 2009

5.6.3. Test Arrangement

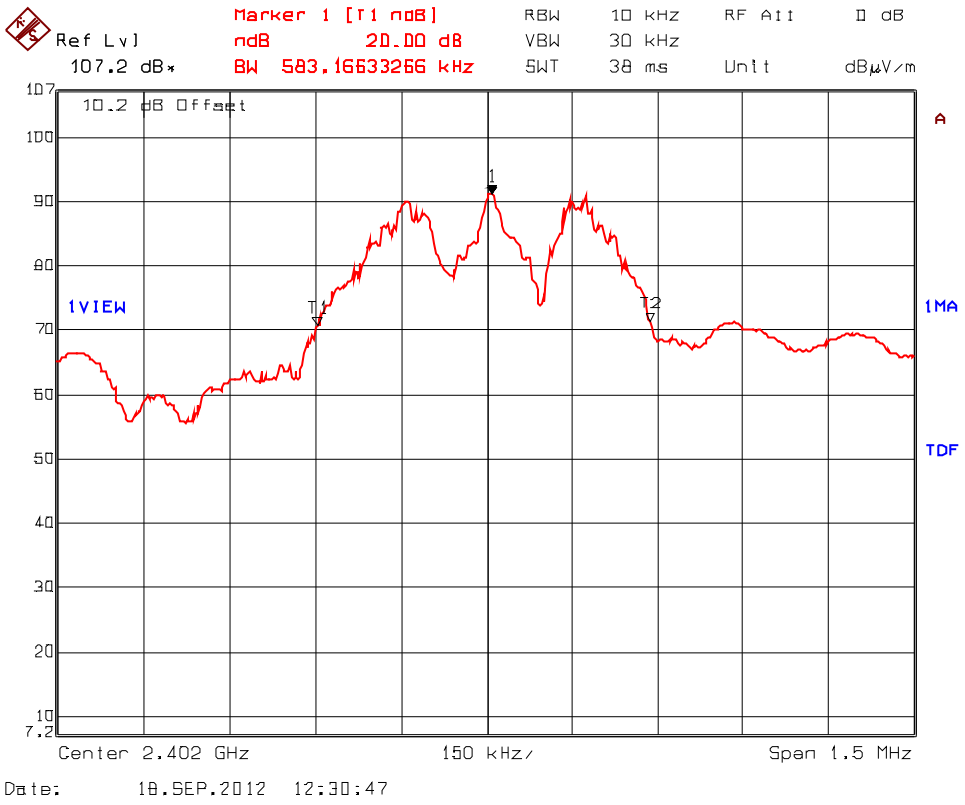


5.6.4. Test Data

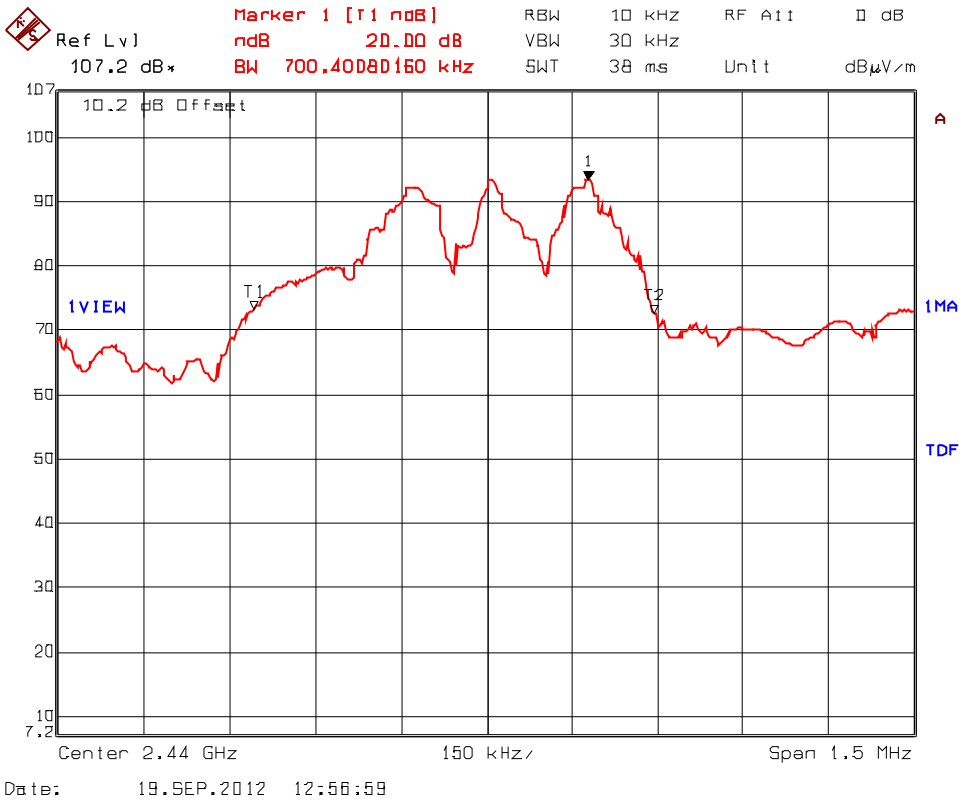
Frequency (MHz)	20 dB Bandwidth (kHz)
2402	583.17
2440	700.40
2480	694.39

See the following plots for detailed measurements.

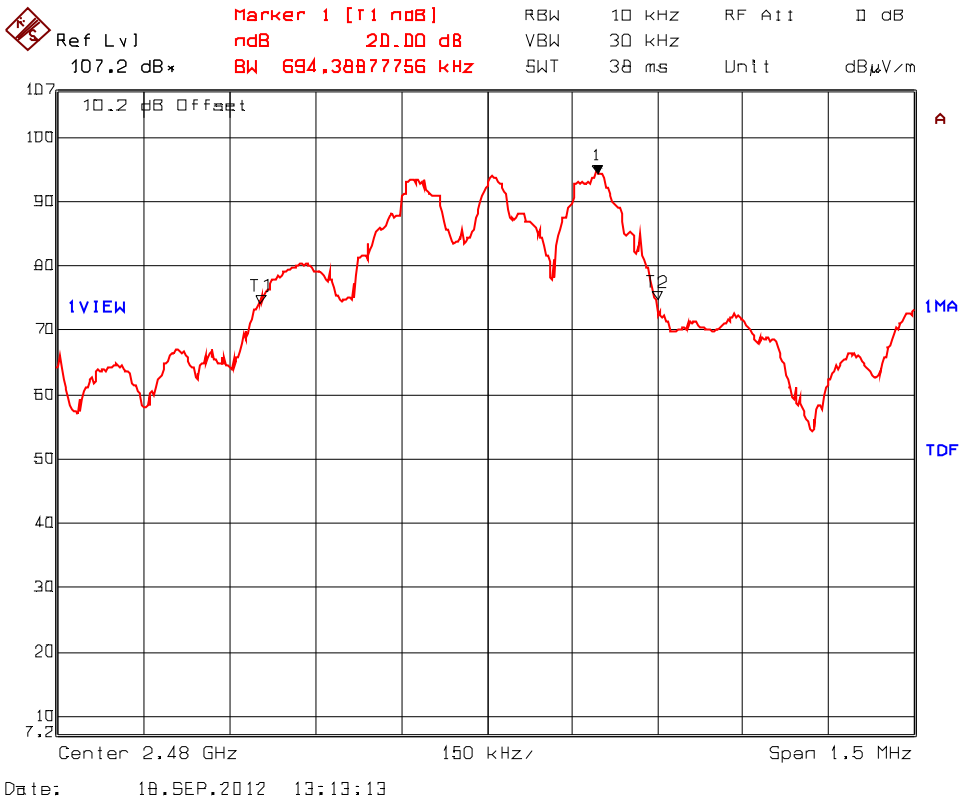
Plot 5.6.4.1. 20 dB Bandwidth
Test Frequency: 2402 MHz



Plot 5.6.4.2. 20 dB Bandwidth
Test Frequency: 2440 MHz



Plot 5.6.4.3. 20 dB Bandwidth
Test Frequency: 2480 MHz



5.7. FUNDAMETAL FIELD STRENGTH AND HAROMIC EMISSIONS (RADIATED AT 3m) [47 CFR §§ 15.249(a), 15.209 & 15.205]

5.7.1. Limits

(a) The Field Strength of emissions from intentional radiators operated within 2400–2483.5 MHz band shall comply with the following:

Fundamental Frequency (MHz)	Field Strength of Fundamental (mV/m)	Field Strength of Harmonics (μV/m)
2400–2483.5 MHz	50	500

(c) Field strength limits specified at a distance of 3 meters.

(d) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in § 15.209, whichever is the lesser attenuation.

(e) As shown in § 15.35(b), for frequencies above 1000 MHz, the field strength limits in paragraphs (a) and (b) of this section are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. For point-to-point operation under paragraph (b) of this section, the peak field strength shall not exceed 2500 millivolts/meter at 3 meters along the antenna azimuth.

- The fundamental frequency shall not fall within any restricted frequency band specified in 15.205. All rf other emissions that fall in the restricted bands shall not exceed the general radiated emission limits specified in at 15.209(a).

47 CFR 15.205 – 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
.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.			

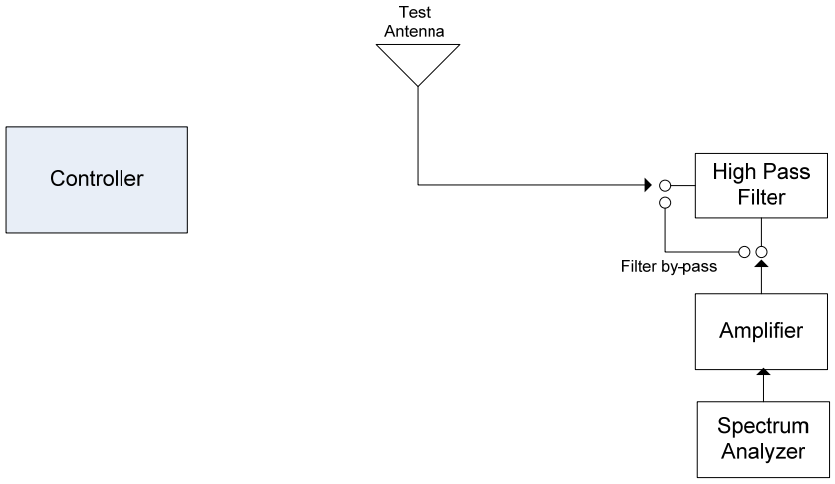
[1]Until February 1, 1999, this restricted band shall be 0.490–0.510 MHz.
[2]Above 38.6

47 CFR 15.209(a) - Field Strength Limits within Restricted Frequency Bands		
Frequency (MHz)	**Field Strength Limits (μV/m)**	**Distance (Meters)**
0.009 - 0.490 0.490 - 1.705 1.705 - 30.0 30 – 88 88 – 216 216 – 960 Above 960	2,400 / F (KHz) 24,000 / F (KHz) 30 100 150 200 500	300 30 30 3 3 3 3

5.7.2. Method of Measurements

Refer to ANSI C63.10 and ANSI C63.4 for measurement methods.

5.7.3. Test Arrangement



5.7.4. Test Data

Remarks:

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

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

Frequency (MHz)	Peak E-Field @3m (dBµV/m)	Average E-Field @3m (dBµV/m)	Antenna Plane (H/V)	Field Strength Limit of Fundamental/Harmonic Peak/Avg (dBµV/m)	Field Strength Limit of § 15.209 (dBµV/m)	Worst case Margin (dB)
2402	95.81	47.36	V	114 / 94	--	-18.2
2402	93.95	46.52	H	114 / 94	--	-20.1
4804	59.98	37.70	V	74 / 54	54.0	-16.3
4804	61.19	37.13	H	74 / 54	54.0	-16.9
7206	51.58	37.84	V	74 / 54	54.0	-16.2
7206	53.22	38.42	H	74 / 54	54.0	-15.6

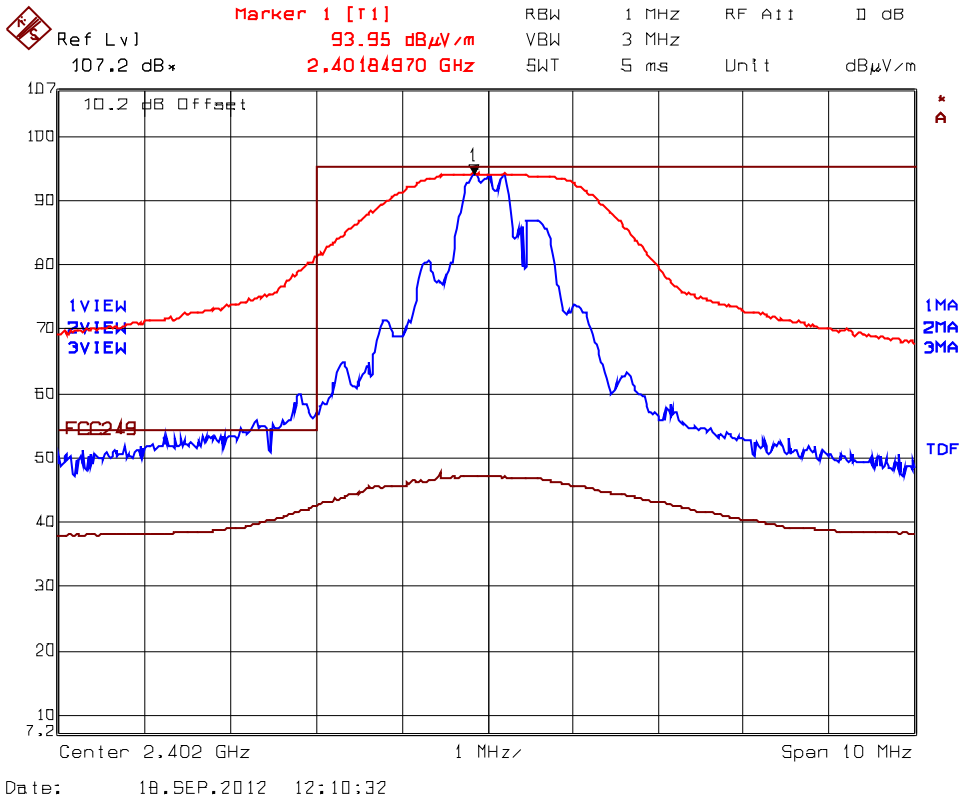
Test Frequency:: 2440 MHz
Test Frequency Range: 30 MHz – 25 GHz

Frequency (MHz)	Peak E-Field @3m (dBµV/m)	Average E-Field @3m (dBµV/m)	Antenna Plane (H/V)	Field Strength Limit of Fundamental/Harmonic (dBµV/m)	Field Strength Limit of § 15.209 (dBµV/m)	Worst case Margin (dB)
2440	98.03	48.87	V	114 / 94	--	-16.0
2440	95.69	48.53	H	114 / 94	--	-18.3
4880	61.49	37.64	V	74 / 54	54.0	-16.4
4880	60.25	37.18	H	74 / 54	54.0	-16.8
7320	53.14	38.39	V	74 / 54	54.0	-15.6
7320	54.11	38.45	H	74 / 54	54.0	-15.5

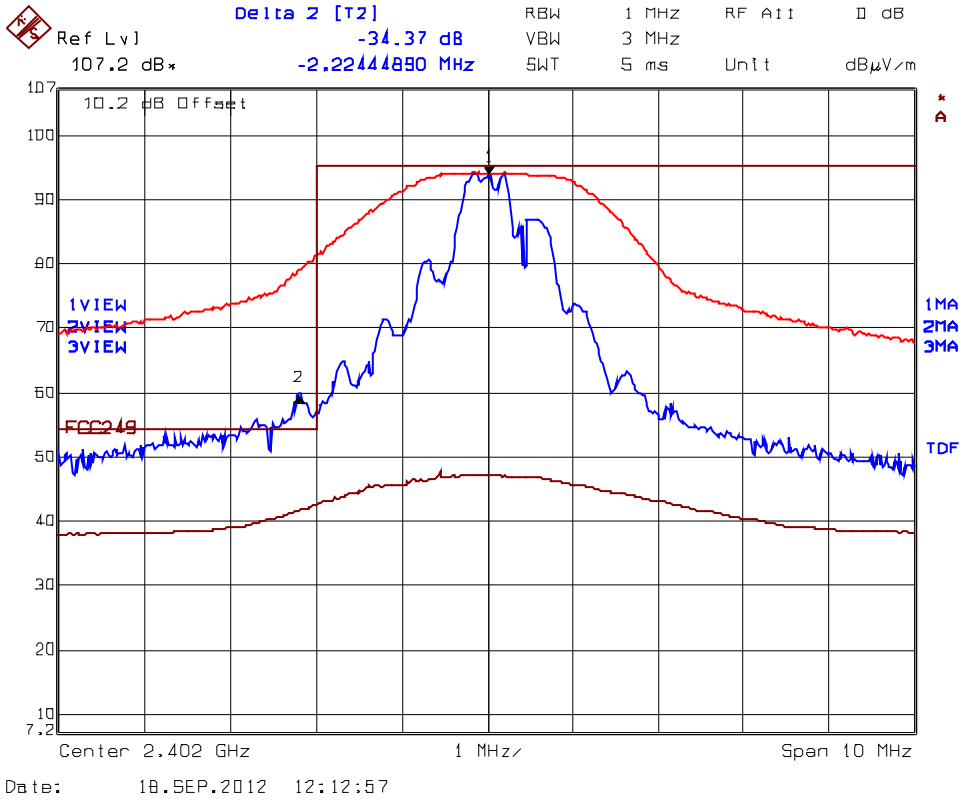
Test Frequency:: 2480 MHz
Test Frequency Range: 30 MHz – 25 GHz

Frequency (MHz)	Peak E-Field @3m (dBµV/m)	Average E-Field @3m (dBµV/m)	Antenna Plane (H/V)	Field Strength Limit of Fundamental/Harmonic (dBµV/m)	Field Strength Limit of § 15.209 (dBµV/m)	Worst case Margin (dB)
2480	99.23	49.26	V	114 / 94	--	-14.8
2480	95.95	49.05	H	114 / 94	--	-18.1
4960	59.61	37.12	V	74 / 54	54.0	-16.9
4960	56.73	36.68	H	74 / 54	54.0	-17.3
7440	56.82	40.07	V	74 / 54	54.0	-13.9
7440	52.36	39.11	H	74 / 54	54.0	-14.9

Plot 5.7.4.1. Band-Edge RF Radiated Emissions @ 3 m, Continuous Mode
Low End of Frequency Band, 2402 MHz, Rx Antenna Orientation: Horizontal

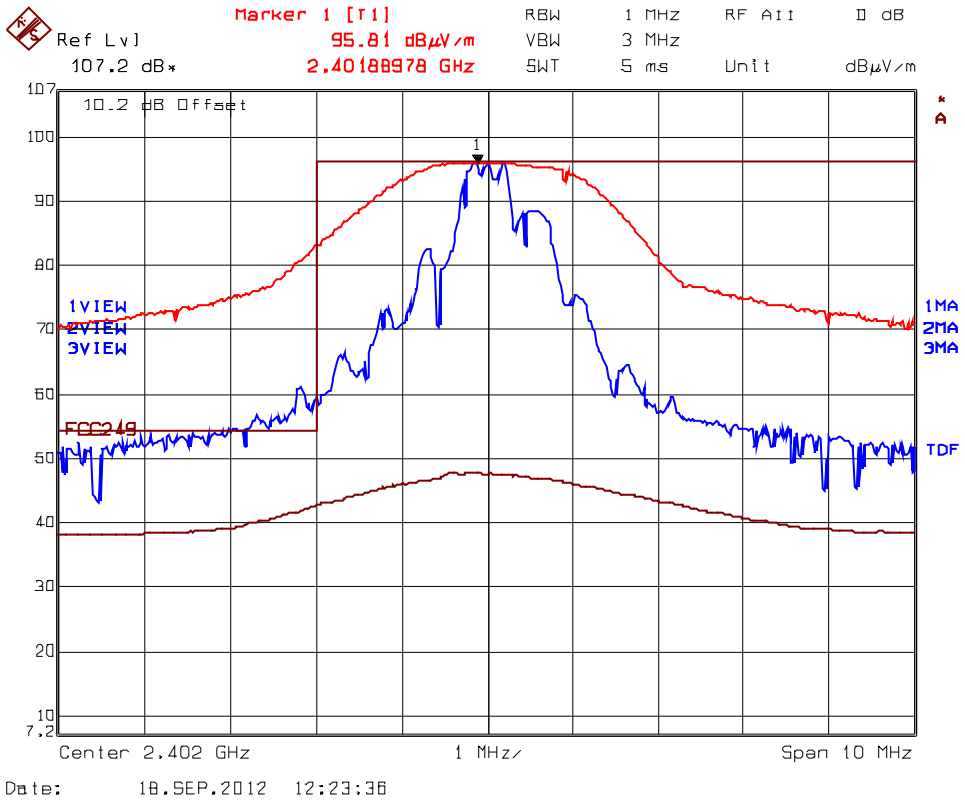


Plot 5.7.4.2. Band-Edge RF Radiated Emissions @ 3 m, Continuous Mode
Low End of Frequency Band, 2402 MHz, Rx Antenna Orientation: Horizontal

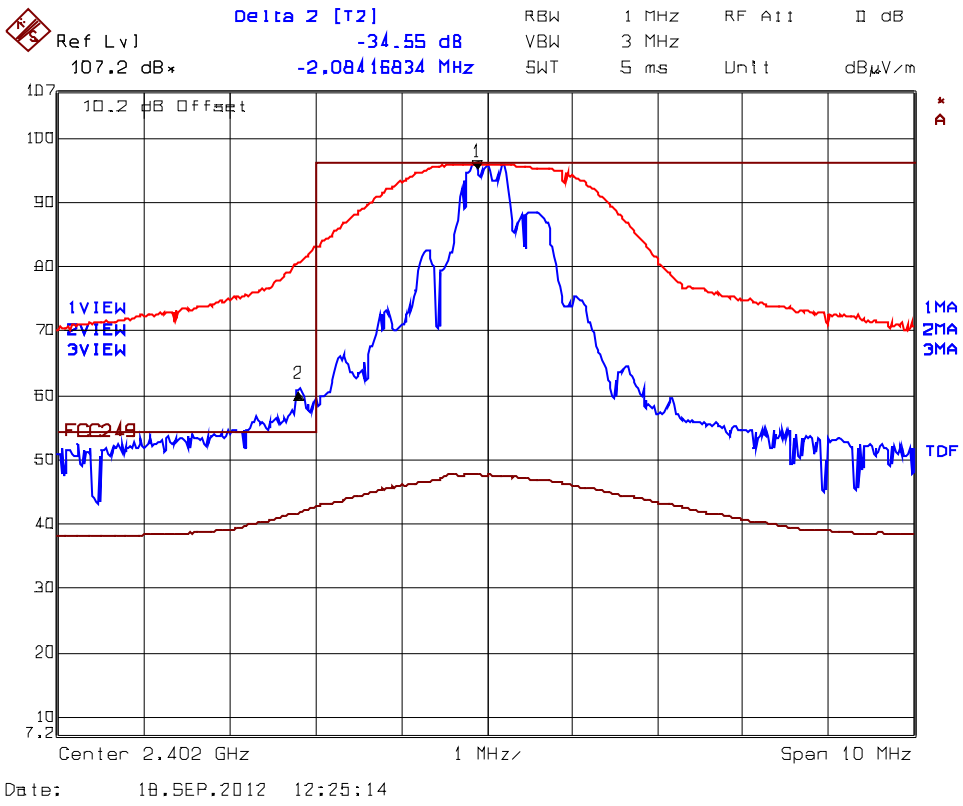


Trace 1: RBW= 1 MHz, VBW= 3 MHz
Trace 2: RBW= 100 kHz, VBW= 300 kHz, Delta (Peak to Band-Edge): 34.37dB
Trace 3: RBW= 1 MHz, VBW= 10 Hz
Peak Band-Edge at 2400 MHz: Peak= 93.95dBuV/m – 34.37dB= 59.56dBuV/m < 74.0 (Peak Limit)

Plot 5.7.4.3. Band-Edge RF Radiated Emissions @ 3 m, Continuous Mode
Low End of Frequency Band, 2402 MHz, Rx Antenna Orientation: Vertical

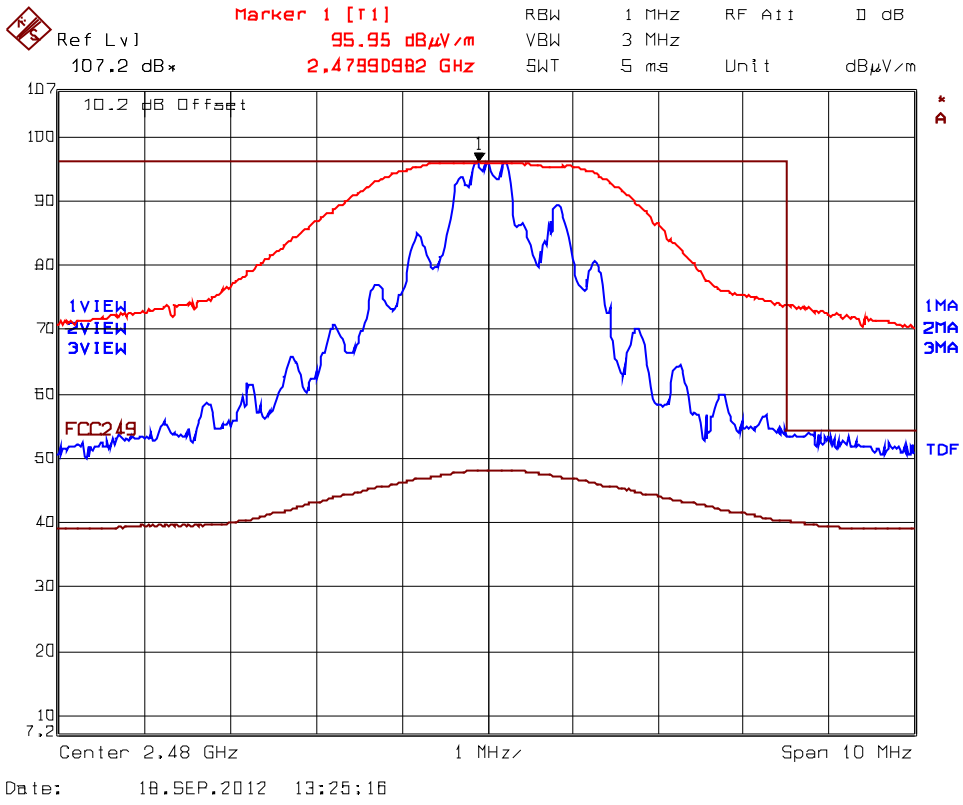


Plot 5.7.4.4. Band-Edge RF Radiated Emissions @ 3 m, Continuous Mode
Low End of Frequency Band, 2402 MHz, Rx Antenna Orientation: Vertical

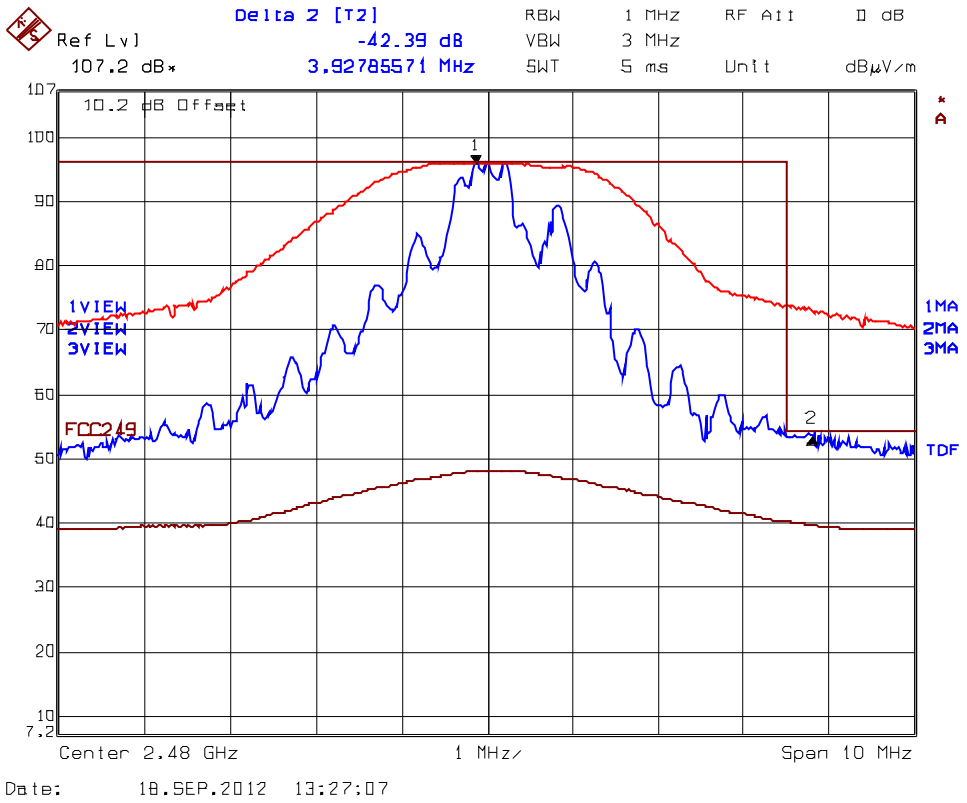


Trace 1: RBW= 1 MHz, VBW= 3 MHz
Trace 2: RBW= 100 kHz, VBW= 300 kHz, Delta (Peak to Band-Edge): 34.55dB
Trace 3: RBW= 1 MHz, VBW= 10 Hz
Peak Band-Edge at 2400 MHz: Peak= 95.81dBuV/m – 34.55dB= 61.26dBuV/m < 74.0 (Peak Limit)

Plot 5.7.4.5. Band-Edge RF Radiated Emissions @ 3 m, Continuous Mode
High End of Frequency Band, 2480 MHz, Rx Antenna Orientation: Horizontal

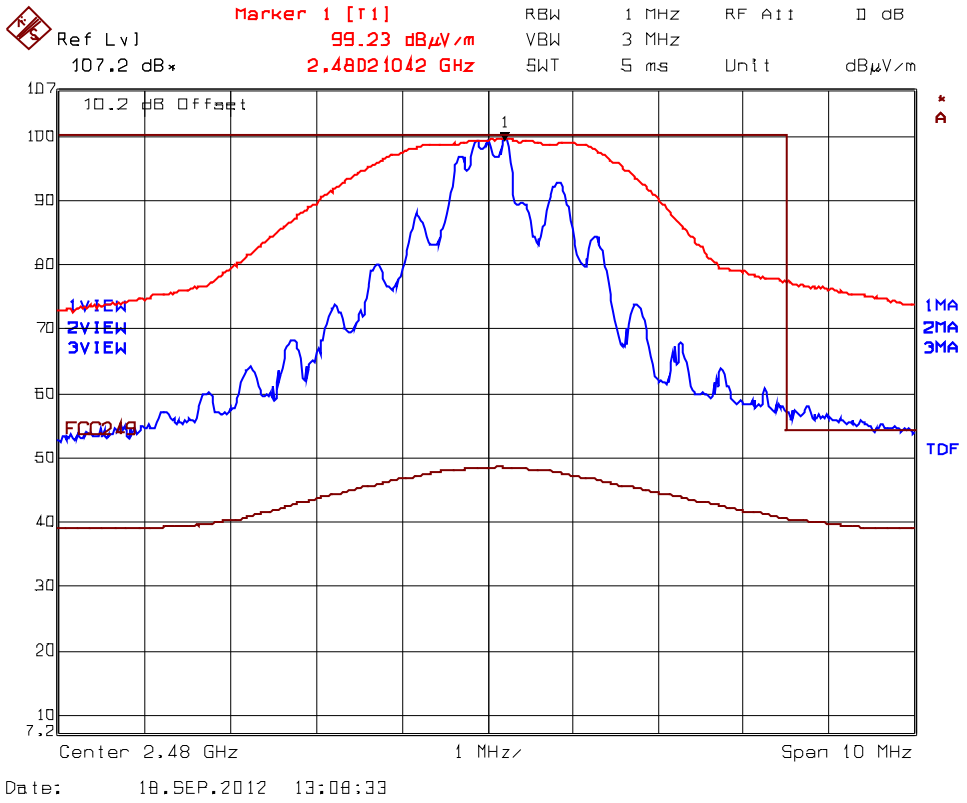


Plot 5.7.4.6. Band-Edge RF Radiated Emissions @ 3 m, Continuous Mode
High End of Frequency Band, 2480 MHz, Rx Antenna Orientation: Horizontal

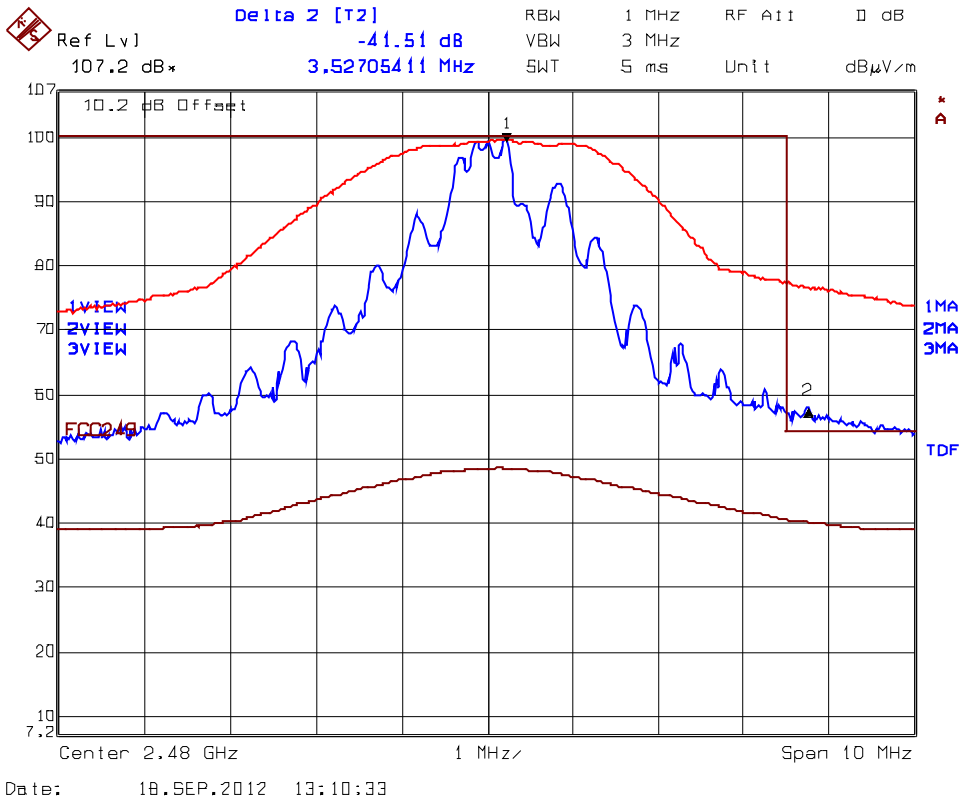


Trace 1: RBW= 1 MHz, VBW= 3 MHz
Trace 2: RBW= 100 kHz, VBW= 300 kHz, Delta (Peak to Band-Edge):42.39dB
Trace 3: RBW= 1 MHz, VBW= 10 Hz
Peak Band-Edge at 2483.5 MHz: Peak= 95.95dBuV/m – 42.39dB= 53.56dBuV/m < 74.0 (Peak Limit)

Plot 5.7.4.7. Band-Edge RF Radiated Emissions @ 3 m, Continuous Mode
High End of Frequency Band, 2480 MHz, Rx Antenna Orientation: Vertical



Plot 5.7.4.8. Band-Edge RF Radiated Emissions @ 3 m, Continuous Mode
High End of Frequency Band, 2480 MHz, Rx Antenna Orientation: Vertical



Trace 1: RBW= 1 MHz, VBW= 3 MHz
Trace 2: RBW= 100 kHz, VBW= 300 kHz, Delta (Peak to Band-Edge):41.51dB
Trace 3: RBW= 1 MHz, VBW= 10 Hz
Peak Band-Edge at 2483.5 MHz: Peak= 99.23dBuV/m – 41.51dB= 57.72dBuV/m < 74.0 (Peak Limit)

5.8. RADIATED EMISSIONS FROM UNINTENTIONAL RADIATORS (DIGITAL DEVICES) [47 CFR §15.109(a)]

5.8.1. Limit(s)

The equipment shall meet the limits of the following table:

Frequency of emission (MHz)	Class B Limits	
	(dBµV/m at 3 m)	(dBµV/m at 10 m)
30 – 88	40.0	29.5
88 – 216	43.5	33.1
216 – 960	46.0	35.6
Above 960	54.0	43.5

5.8.2. Method of Measurements

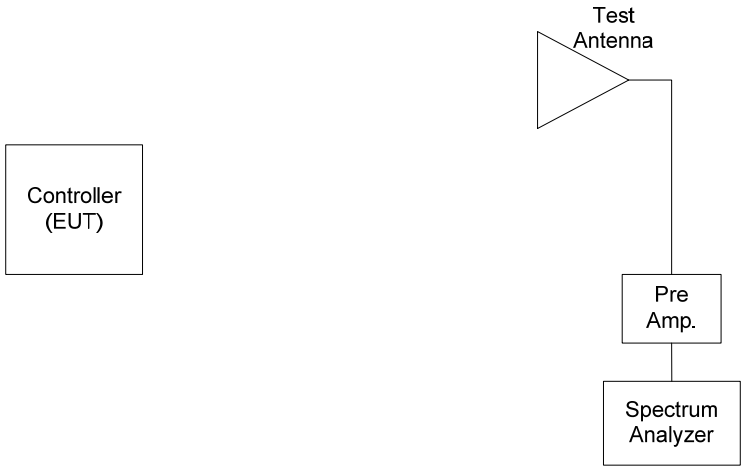
Refer to Ultratech Test Procedures ULTR-P001-2004 & ANSI C63.4 for method of measurements.
The spectrum shall be investigated from the lowest radio frequency signal generated or used in the device, without going below the lowest frequency for which a radiated emission limit is specified, up to the frequency shown in the following table:

Highest frequency generated or used in the device or on which the device operates or tunes (MHz)	Upper frequency of measurement range (MHz)
Below 1.705	30
1.705 – 108	1000
108 – 500	2000
500 -1000	5000
Above 1000	5^{th} harmonic of the highest frequency or 40 GHz, whichever is lower

5.8.3. Test Instruments

Refer to Exhibit 6 & 7 for Test Instruments & Measurement Uncertainty.

5.8.4. Test Arrangement



5.8.5. Test Data

The emissions were scanned from 30 MHz to 6 GHz at 3 meters distance and all emissions less than 20 dB below the limits were recorded.

FREQUENCY (MHz)	RF LEVEL (dBuV/m)	DETECTOR USED (PEAK/QP)	ANTENNA PLANE (H/V)	LIMIT (dBuV/m)	MARGIN (dB)	PASS/ FAIL
320.68	28.7	Peak	V	46.0	-17.3	Pass
320.68	38.5	Peak	H	46.0	-7.5	Pass
330.01	29.2	Peak	V	46.0	-16.8	Pass
330.01	38.5	Peak	H	46.0	-7.5	Pass
336.23	35.2	Peak	V	46.0	-10.8	Pass
336.23	42.5	Peak	H	46.0	**-3.5**	Pass
344.00	32.0	Peak	V	46.0	-14.0	Pass
344.00	38.3	Peak	H	46.0	-7.7	Pass
351.77	31.1	Peak	V	46.0	-14.9	Pass
351.77	36.0	Peak	H	46.0	-10.0	Pass
384.42	31.4	Peak	V	46.0	-14.6	Pass
384.42	34.7	Peak	H	46.0	-11.3	Pass

EXHIBIT 6. TEST EQUIPMENT LIST

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range	Cal. Due Date
Spectrum Analyzer	Rohde & Schwarz	ESU40	100037	20 Hz – 40 GHz	19 Mar 2013
Spectrum Analyzer	Rohde & Schwarz	FSEK30	100077	20 Hz – 40 GHz	27 Sep 2012
RF Amplifier	Hewlett Packard	84498	3008A00769	1 – 26.5 GHz	06 Aug 2013
RF Amplifier	AH System	PAM-0118	225	20 MHz – 18 GHz	16 Mar 2013
Horn Antenna	ETS-Lindgren	360-09	00118385	18 – 26.5 GHz	30 July 2014
Horn Antenna	Emco	3117	119425	1 – 18 GHz	02 Apr 2013
Biconi-Log Antenna	Emco	3142C	00026873	26 – 3000 MHz	05 May 2013
Attenuator	Narda	4768-20	-	DC – 40 GHz (2w)	Cal. on use
Attenuator	Narda	4768-10	-	DC – 40 GHz (2w)	Cal. on use
DC-Block	Hewlett Packard	11742A	12460	0.045-26.5 GHz	Cal. on use
High Pass Filter	K & L	11SH10-4000/1200	4	Cut off 2400 MHz	Cal. on use

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. 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