Electromagnetic Compatibility Test Report

Prepared in accordance with

FCC Part 15C, RSS-210 Issue 8

On

ZIGBEE – TRANSMITTER/RECEIVER

Limited Modular Device

Consert, Inc.
4700 Falls of Neuse Road, Suite 340
Raleigh, NC 27609 USA

Prepared by:

TUV Rheinland of North America, Inc.

Manufacturer's statement - attestation

The manufacturer; Consert, Incorporated, as the responsible party for the equipment tested, hereby affirms:

a) That he has reviewed and concurs that the test shown in this report are reflective of the operational characteristics of the device for which certification is sought;

b) That the device in this test report will be representative of production units;

c) That all changes (in hardware and software/firmware) to the subject device will be reviewed.

d) That any changes impacting the attributes, functionality or operational characteristics documented in this report will be communicated to the body responsible for approving (certifying) the subject equipment.

Thi Phan	
Printed name of official	Signature of official
4700 Falls of Neuse Road, Suite 340 Raleigh, NC 27609 USA	30 November 2011
Address	Date
919-855-1060	Tphan@consert.com
Telephone number	Email address of official

Client:	consert COMMUNICATE·CONTROL·CONSERVE 4700 Falls of Neuse Road, Suite 340 Raleigh, NC 27609 USA	Thi Phan 919-855-1060 Tphan@consert.com	
Identification:	ZIGBEE - transmitter/receiver	***Serial No.:***	000FAF
Test item:	Limited Modular Device	***Date tested:***	7 July 2011
Testing location:	TUV Rheinland of North America 762 Park Avenue Youngsville, NC 27596-9470 U.S.A.	Tel: (919) 554-3668 Fax: (919) 554-3542	
Test specification:	**Emissions:** FCC Part 15, Subpart C, RSS-210 Issue 8: FCC Part 15.207(a) and RSS-GEN FCC Parts 15.247(d), 15.205, 15.209, 15.215(c) and RSS-210 A8.5 and RSS-GEN 7.2.1 FCC Part 15.247(a)(2) and RSS-210 A1.1.3, FCC Part 15.247 and RSS-210 Annex 8, FCC Part 15.247(b)(3) and RSS-210 A8.4(4), FCC Part 15.247(d) and RSS-210 2.2, FCC Parts 15.109(a) and RSS-GEN, FCC Part 15.107(b) and RSS-GEN FCC Parts 15.247(i) and RSS-102, Issue 4,		
Test Result	**The above product was found to be Compliant to the above test standard(s)**		
tested by: Mark Ryan		***reviewed by:*** Michael Moranha	
6 December 2010 ***Signature***		12 December 2011 ***Signature***	
Other Aspects:	**None**		

Abbreviations: OK, Pass, Compliant, Complies = passed
Fail, Not Compliant, Does Not Comply = failed
N/A = not applicable

FC	NVLAP	**Industry Canada**
90552 and 100881	**NVLAP Lab Code (200094-0)**	**IC-2932H**

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1 General Information

1.1 Scope

This report is intended to document the status of conformance with the requirements of the FCC Part 15C, RSS-210 Issue 8 based on the results of testing performed on 7 July 2011 on the ZIGBEE - transmitter/receiver, Model No. Limited Modular Device, manufactured by Consert, Inc. This report only applies to the specific samples tested under the stated test conditions. It is the responsibility of the manufacturer to assure that additional production units of this model are manufactured with identical or EMI equivalent electrical and mechanical components. This report is further intended to document changes and modifications to the EUT throughout its life cycle. All documentation will be included as a supplement.

1.2 Purpose

Testing was performed to evaluate the EMC performance of the EUT (Equipment Under Test) in accordance with the applicable requirements, procedures, and criteria defined in the application of regulations and application of standards listed in this report.

1.3 *Summary of Test Results*

Applicant	Consert, Inc. 4700 Falls of Neuse Road, Suite 340 Raleigh, NC 27609 USA	**Tel**	919-855-1060	**Contact**	Thi Phan
		Fax	919-606-8978	**e-mail**	Tphan@consert.com
Description	ZIGBEE - transmitter/receiver	**Model (Name\Number)**	Limited Modular Device		
Serial Number	000FAF	**Test Voltage/Freq.**	120VAC / 60 Hz		
Test Date Completed:	7 July 2011	**Test Engineer**	Mark Ryan		

Standards	Description	Severity Level or Limit	Worst Case	Test Result
FCC Part 15, Subpart C Standard	Radio Frequency Devices-Subpart C: Intentional Radiators	See called out parts below	See Below	**Complies**
RSS-210 Issue 8 Standard	Low-Power Licence-exempt Radiocommunication Devices Category I Equipment	See called out parts below	See Below	**Complies**
FCC Part 15.247 and RSS-210 Annex 8	Operation within the band 2400 to 2483.5 MHz	See called out parts below	See Below	Complies
FCC Parts 15.247(d), 15.205, 15.209, 15.215(c) and RSS-210 A8.5 and RSS-GEN 7.2.1	Out-of-Band Spurious and Harmonic Emissions (EUT in Transmit Mode)	Below the applicable limits	52.03 dBµV	Complies
FCC Part 15.207(a) and RSS-GEN	Conducted Emissions on AC Mains	150kHz - 30MHz	61.70 dBµV	Complies
FCC Part 15.247(d) and RSS-210 2.2	Band Edge Radiated Emission	Per requirements of the standard	Below Limits	Complies
FCC Part 15.247(b)(3) and RSS-210 A8.4(4)	Conducted Output Power	Shall not exceed 1.0 Watts (30dBm)	19.73dBm	Complies
FCC Part 15.247(a)(2) and RSS-210 A1.1.3	Occupied Bandwidth	6 dB ≥ 500 kHz 20 dB 99% BW ≤ 0.5% of freq. (12 MHz)	1.65 MHz 2.68 MHz 2.51 MHz	Complies
FCC Part 15.247(e) and RSS-210, Section A8.2(b)	Peak Power Spectrial Denesity	≤ 8 dBm in any 3 kHz	5.34 dBm	Complies
FCC Part 15.31(e)	Voltage Requirements	Output at 0.85% and 1.15% of Nominal Voltage	0Δ	Complies
FCC Parts 15.109(a) and RSS-GEN	Radiated Emissions while EUT in Receive Mode	Below limit of section 15.109(a) Class B	27.40 dBµV	Complies
FCC Part 15.107(b) and RSS-GEN	Conducted Emissions on AC Mains in Receive Mode	Class B, 150kHz - 30MHz	49.34 dBµV	Complies
FCC Parts 15.247(i) and RSS-102, Issue 4	RF Exposure	MPE Requirements for FCC: MPE Requirements for IC:	<1 mW/cm^2 <10 W/m^2	Complies

2 Laboratory Information

2.1 Accreditations and Endorsements

2.1.1 US Federal Communications Commission

TUV Rheinland of North America located at 762 Park Avenue, Youngsville, NC 27596-9470 is accredited by the commission for performing testing services for the general public on a fee basis. This laboratory test facilities have been fully described in reports submitted to and accepted by the FCC (Registration No 90552 and 100881). The laboratory scope of accreditation includes: Title 47 CFR Part 15, and 18. The accreditation is updated every 3 years.

2.1.2 NIST / NVLAP

Program, which is administered under the auspices of the National Institute of Standards and Technology. The laboratory has been assessed and accredited in accordance with ISO Standard 17025:2005 (Lab code: 200094-0). The scope of laboratory accreditation includes emission and immunity testing. The accreditation is updated annually.

2.1.3 Industry Canada

Registration No.: IC-2932H The OATS has been accepted by Industry Canada to perform testing to 3 and to 10m, based on the test procedures described in ANSI C63.10-2009.

2.1.4 Japan – VCCI

The Voluntary Control Council for Interference by Information Technology Equipment (VCCI) is a group that consists of Information Technology Equipment (ITE) manufacturers and EMC test laboratories. The purpose of the Council is to take voluntary control measures against electromagnetic interference from Information Technology Equipment, and thereby contribute to the development of a socially beneficial and responsible state of affairs in the realm of Information Technology Equipment in Japan. TUV Rheinland at the 762 Park Ave. Youngsville, N.C 27596 address has been assessed and approved in accordance with the Regulations for Voluntary Control Measures. (Registration No. R-1174, R-1679, C-1790 and C-1791).

2.1.5 Sample Calculation – radiated & conducted emissions

The field strength is calculated by subtracting the Amplifier Gain and adding the Cable Loss and Antenna Correction Factor to the measured reading. The basic equation is as follows:

Field Strength (dBμV/m) = RAW - AMP + CBL + ACF

Where: RAW = Measured level before correction (dBμV)

AMP = Amplifier Gain (dB)

CBL = Cable Loss (dB)

ACF = Antenna Correction Factor (dB/m)

$$\mu V/m = 10^{\frac{dB\mu V/m}{20}}$$

Sample radiated emissions calculation @ 30 MHz

Measurement +Antenna Factor–Amplifier Gain+Cable loss=Radiated Emissions (dBuV/m)

25 dBuV/m + 17.5 dB – 20 dB + 1.0 dB = 23.5 dBuV/m

2.2 Measurement Uncertainty Emissions

	U_{lab}	U_{cispr}
Radiated Disturbance @ 10m		
30 MHz – 1,000 MHz	3.3 dB	5.2 dB
Conducted Disturbance @ Mains Terminals		
150 kHz – 30 MHz	1.18 dB	3.6 dB
Disturbance Power		
30 MHz – 300 MHz	3.88 dB	4.5 dB
Temperature measurement	**Humidity measurements**	**DC Voltage measurements**
± 4. 0 %	± 4. 0 %	± 0.5 %

2.3 Calibration Traceability

All measurement instrumentation is traceable to the National Institute of Standards and Technology (NIST). Measurement method complies with ANSI/NCSL Z540-1-1994 and ISO Standard 17025:2005. Equipment calibration records are kept on file at the test facility.

2.4 Measurement Equipment Used

Equipment	Manufacturer	Model #	Serial/Inst #	Last Cal dd/mm/yy	Next Cal dd/mm/yy
Radiated Emissions (5 Meter Chamber and Bench top)					
Amplifier, preamp	Agilent Technologies	8449B	3008A01480	01-Feb-11	01-Feb-12
Antenna Horn 1-18GHz	EMCO	3115	2236	13-Dec10	13-Dec-12
Antenna Horn 1-18GHz	EMCO	3115	5770	18-Aug-10	18-Aug-12
Ant. BiconiLog	Chase	CBL6140A	1108	24-Aug-11	24-Aug-12
Receiver, EMI	Rohde & Schwarz	ESIB40	100043	01-Aug-11	01-Aug-12
Spectrum Analyzer	Agilent Tec.	E7405A	US39440157	06-Dec-10	06-Dec-11
Cable, Coax	MicroCaox	MKR300C-0-0-1200-500500	002	16-Dec-10	16-Dec-11
Cable, Coax	Andrew	FSJ1-50A	003	16-Dec-10	16-Dec-11
Cable, Coax	Andrew	FSJ1-50A	030	16-Dec-10	16-Dec-11
Cable, Coax	Andrew	FSJ1-50A	045	16-Dec-10	16-Dec-11
High Pass Filter	Micro-tronics	BRM50702	049	20-Jan-11	20-Jan-12
Conducted Emissions (AC/DC and Signal I/O)					
LISN 15-18 (NSLK 8126)	Schwarzbeck Mess-Electronik	NSLK 8126	003885	21-Jan-11	21-Jan-12
Transient Limiter	Schaffner	CFL-9206	1649	01-Aug-11	01-Aug-12
Receiver, EMI	Rohde & Schwarz	ESH 3	860905/005	15-Dec-10	15-Dec-11
Spectrum Analyzer	Agilent Tec.	E7405A	US39440157	06-Dec-10	06-Dec-11
Cable, Coax	Pasternack	RG-223	051	16-Dec-10	16-Dec-11
General Laboratory Equipment					
Generator, Noise	York University	CNE III	Ser/98/66	CNR II	CNR II
Meter, Multi	Fluke	179	90580752	06-Dec-10	06-Dec-11
Power Supply, AC	California Instruments	3001ix	53354	07-Dec-10	07-Dec-11
Meter, Temp/Humid/Barom	Davis Instruments	7400	PB00205A13	1-Jan-11	1-Jan-12

3 Product Information

3.1 Product Description

See Description in the test plan in Appendix A of this report

3.2 Equipment Modifications

The Internal setting of the transmitter chipset has to be set at -6 in order to pass the harmonic requirements of part 15.205. This is set by the manufacturer, and cannot be changed after the configuration is set.

4 Radiated and AC Power Conducted Emissions

4.1 Spurious Emissions Outside the band - FCC 15.247(d), RSS-210 A8.5

In any 100kHz 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 desired power, based on either RF conducted or radiated measurements. Conducted antenna port measurements are provided below to show that the EUT meets these requirements at the band edges.

4.1.1 Over View of Test

Results	**Complies** (as tested per this report)					**Date**	30 June – 7July 2011
Standard	FCC Parts 15.205, 15.209, 15.215(c), 15.247(d), RSS-210 A8.5, and RSS-GEN 7.2.1						
Product Model	Limited Modular Device			**Serial#**	000FAF		
Test Set-up	Tested in a 5m Semi Anechoic chamber, placed on a 1.0m x 1.5m non-conductive table 80cm above the ground plane on a turn-table.						
EUT Powered By	120VAC / 60 Hz	**Temp**	75 ºF	**Humidity**	40%	**Pressure**	999 mbar
Perf. Criteria	(Below Limit)			**Perf. Verification**	Readings Under Limit		
Mod. to EUT	None			**Test Performed By**	Mark Ryan		

4.1.2 Test Procedure

Testing was performed in accordance with 47 CFR Part 15, ANSI C63.10:2009, RSS-GEN Issue 2. These test methods are listed under the laboratory's NVLAP Scope of Accreditation. This test measures the levels emanating from the EUT, thus evaluating the potential for the EUT to cause radio frequency interference to other electronic devices.

4.1.3 Deviations

There were no deviations from the test methodology listed in the test plan for the radiated emission test.

4.1.4 Final Test

All final radiated spurious emissions measurements were below (in compliance) the limits.

The worst –case emissions are shown below. All other emissions are on file at TUV Rheinland.

4.1.4.1 Emissions Outside the Frequency Band

In any 100kHz 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 desired power, based on either RF conducted or radiated measurements. Conducted antenna port measurements are provided below to show that the EUT meets these requirements at the band edges.

Radiated Emissions – Orientation 1
Upright

Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)
Ch 11										
2405.00	H	1.4	135	79.91	0.00	5.71	28.57	114.19	NA	NA
2405.00	H	1.4	135	73.40	0.00	5.71	28.57	107.68	NA	NA
2405.00	V	1.0	85	77.66	0.00	5.71	28.57	111.94	NA	NA
2405.00	V	1.0	85	71.06	0.00	5.71	28.57	105.34	NA	NA
CH 18:										
2440.00	H	1.2	134	79.06	0.00	5.77	28.69	113.52	NA	NA
2440.00	H	1.2	134	73.70	0.00	5.77	28.69	108.16	NA	NA
2440.00	V	1.3	84	76.53	0.00	5.77	28.69	110.99	NA	NA
2440.00	V	1.3	84	71.16	0.00	5.77	28.69	105.62	NA	NA
CH 25:										
2480.00	H	1.2	142	77.03	0.00	5.83	28.83	111.69	NA	NA
2480.00	H	1.2	142	70.25	0.00	5.83	28.83	104.91	NA	NA
2480.00	V	1.5	90	75.77	0.00	5.83	28.83	110.43	NA	NA
2480.00	V	1.5	90	69.05	0.00	5.83	28.83	103.71	NA	NA

Spec Margin = E-Field Value - Limit, E-Field Value = FIM Value - Amp Gain + Cable Loss + ANT Factor ± Uncertainty

Combined Standard Uncertainty $u_c(y)$ = ± 1.6dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: EUT is standing up. Peak level in **black**, average in **red**.

The highlighted emission is the highest power measured.

This orientation was worst case on all channels. Channel 18 was worst case (average measurements).

Radiated Emissions – Orientation 2 - On back (door up)										
Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)
Ch 11										
2405.00	H	1.7	358	75.77	0.00	5.71	28.57	110.05	NA	NA
2405.00	H	1.7	358	69.16	0.00	5.71	28.57	103.44	NA	NA
2405.00	V	1.0	81	73.84	0.00	5.71	28.57	108.12	NA	NA
2405.00	V	1.0	81	67.14	0.00	5.71	28.57	101.42	NA	NA
CH 18:										
2440.00	H	1.5	5	76.28	0.00	5.77	28.69	110.74	NA	NA
2440.00	H	1.5	5	70.98	0.00	5.77	28.69	105.44	NA	NA
2440.00	V	1.1	83	73.45	0.00	5.77	28.69	107.91	NA	NA
2440.00	V	1.1	83	68.02	0.00	5.77	28.69	102.48	NA	NA
CH 25:										
2480.00	H	1.3	5	73.71	0.00	5.83	28.83	108.37	NA	NA
2480.00	H	1.3	5	66.91	0.00	5.83	28.83	101.57	NA	NA
2480.00	V	1.0	62	72.11	0.00	5.83	28.83	106.77	NA	NA
2480.00	V	1.0	62	65.27	0.00	5.83	28.83	99.93	NA	NA
Spec Margin = E-Field Value - Limit, E-Field Value = FIM Value - Amp Gain + Cable Loss + ANT Factor ± Uncertainty										
Combined Standard Uncertainty $u_c(y)$ = ± 1.6dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence										
Notes: EUT is standing up. Peak level in black, average in red.										

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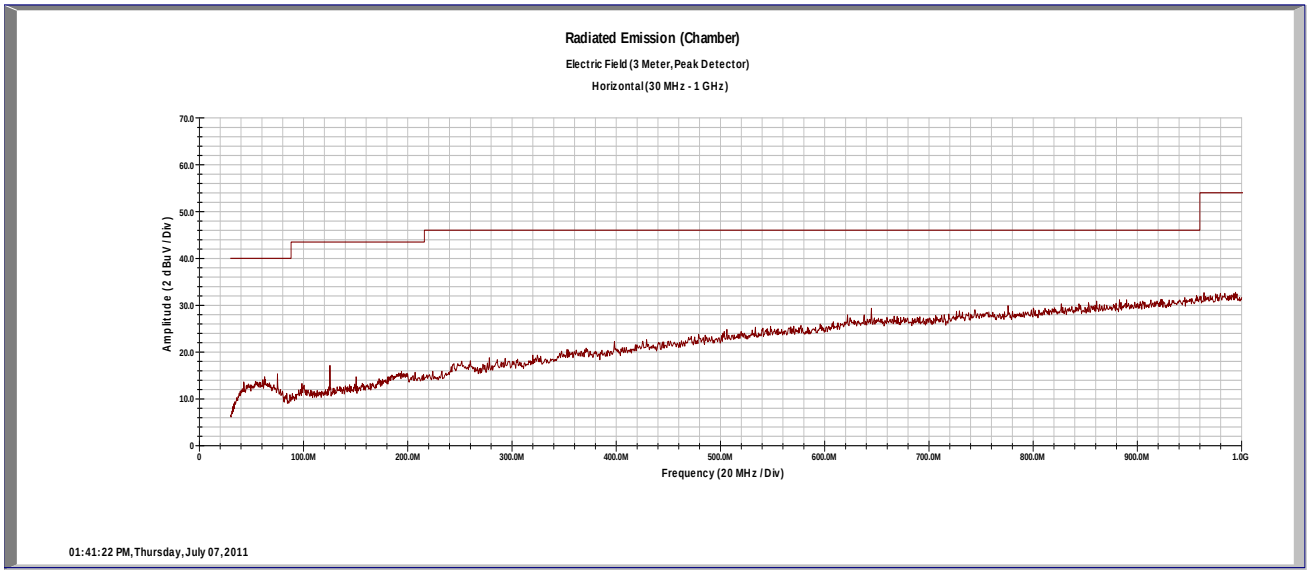
Radiated Emissions – Orientation 3 - On end										
Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)
Ch 11										
2405.00	H	1.0	332	78.04	0.00	5.71	28.57	112.32	NA	NA
2405.00	H	1.0	332	71.36	0.00	5.71	28.57	105.64	NA	NA
2405.00	V	1.0	160	75.52	0.00	5.71	28.57	109.80	NA	NA
2405.00	V	1.0	160	68.87	0.00	5.71	28.57	103.15	NA	NA
CH 18:										
2440.00	H	1.0	48	77.79	0.00	5.77	28.69	112.25	NA	NA
2440.00	H	1.0	48	72.46	0.00	5.77	28.69	106.92	NA	NA
2440.00	V	1.2	222	77.15	0.00	5.77	28.69	111.61	NA	NA
2440.00	V	1.2	222	71.85	0.00	5.77	28.69	106.31	NA	NA
Ch 25:										
2480.00	H	1.0	52	75.40	0.00	5.83	28.83	110.06	NA	NA
2480.00	H	1.0	52	68.65	0.00	5.83	28.83	103.31	NA	NA
2480.00	V	1.3	241	72.92	0.00	5.83	28.83	107.58	NA	NA
2480.00	V	1.3	241	66.11	0.00	5.83	28.83	100.77	NA	NA
Spec Margin = E-Field Value - Limit, E-Field Value = FIM Value - Amp Gain + Cable Loss + ANT Factor ± Uncertainty										
Combined Standard Uncertainty $u_c(y)$ = ± 1.6dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence										
Notes:										

Spec analyzer settings:
RBW: 3 MHz, VBW: 3 MHz, Sweep: Auto, Detector: Peak, Span: 0

Radiated Emissions – 30 MHz to 1000 MHz

Horizontal, no load



Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)

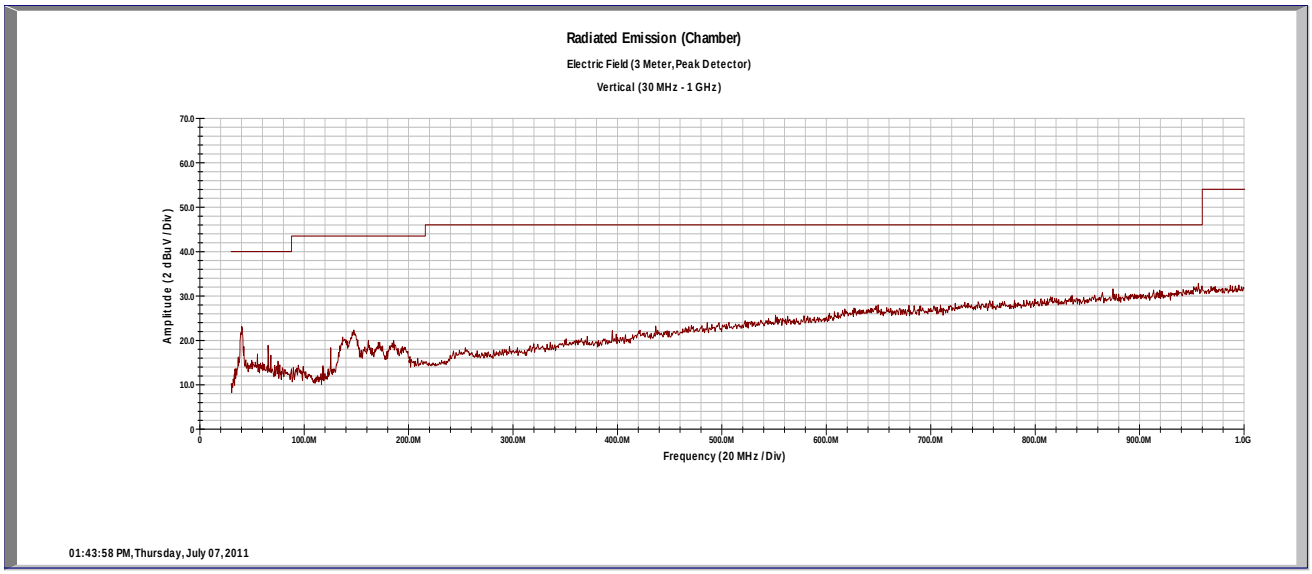
Spec Margin = E-Field Value - Limit, E-Field Value = FIM Value - Amp Gain + Cable Loss + ANT Factor ± Uncertainty

Combined Standard Uncertainty $u_c(y)$ = ± 1.6dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: No load, vertical, was worst case
All emissions are below the limits of part15.209

Radiated Emissions – 30 MHz to 1000 MHz

Vertical, no load



Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)
39.60	V	1.0	122	6.98	0.00	0.68	8.72	16.38	40.00	-23.62
40.52	V	1.2	40	8.30	0.00	0.68	8.94	17.93	40.00	-22.07
137.48	V	1.0	140	4.13	0.00	1.27	8.10	13.50	43.50	-30.00
146.20	V	1.0	105	6.02	0.00	1.31	8.49	15.82	43.50	-27.68

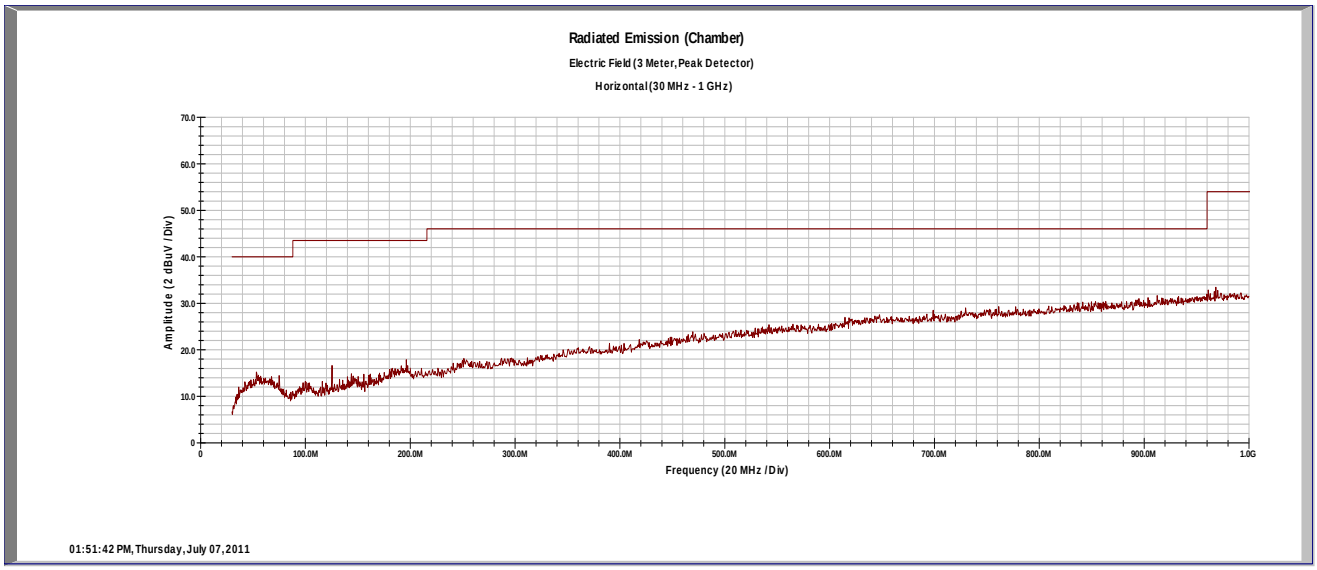
Spec Margin = E-Field Value - Limit, E-Field Value = FIM Value - Amp Gain + Cable Loss + ANT Factor ± Uncertainty

Combined Standard Uncertainty $u_c(y)$ = ± 1.6dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: No load, vertical, was worst case. All emissions were more than 20dB below the limit, or were below the noise floor of the instrumentation.
All emissions are below the limits of part15.209

Radiated Emissions – 30 MHz to 1000 MHz

Horizontal, load



Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)

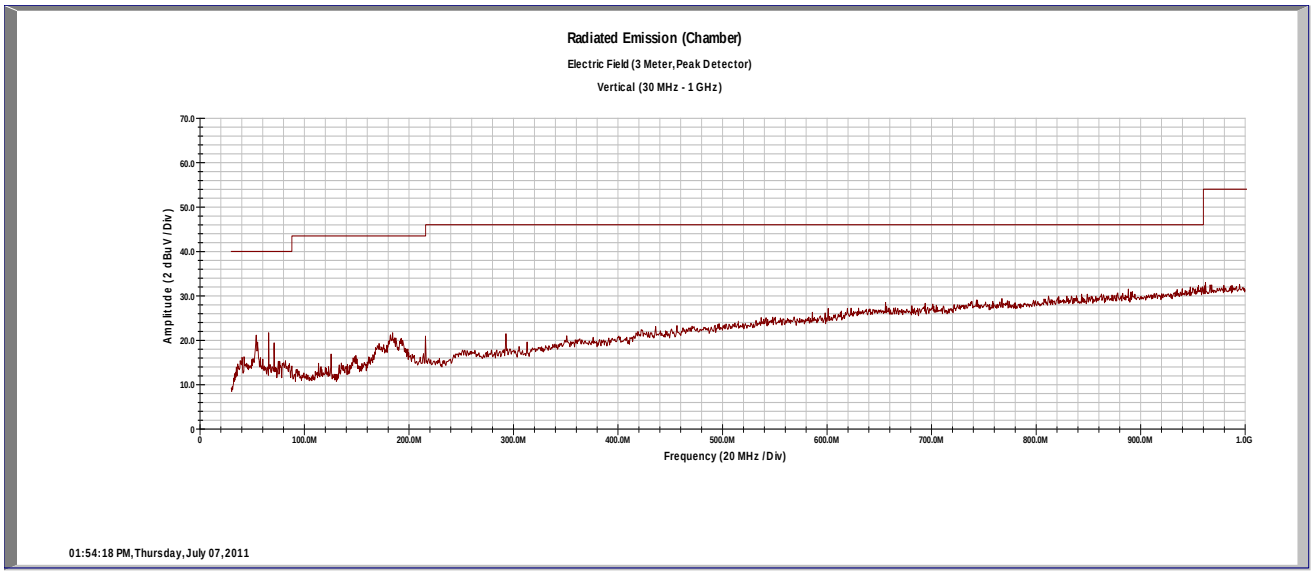
Spec Margin = E-Field Value - Limit, E-Field Value = FIM Value - Amp Gain + Cable Loss + ANT Factor ± Uncertainty

Combined Standard Uncertainty $u_c(y)$ = ± 1.6dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: No load, vertical, was worst case
All emissions are below the limits of parts15.209 and 15.35(a)

Radiated Emissions – 30 MHz to 1000 MHz

Vertical, load



Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)

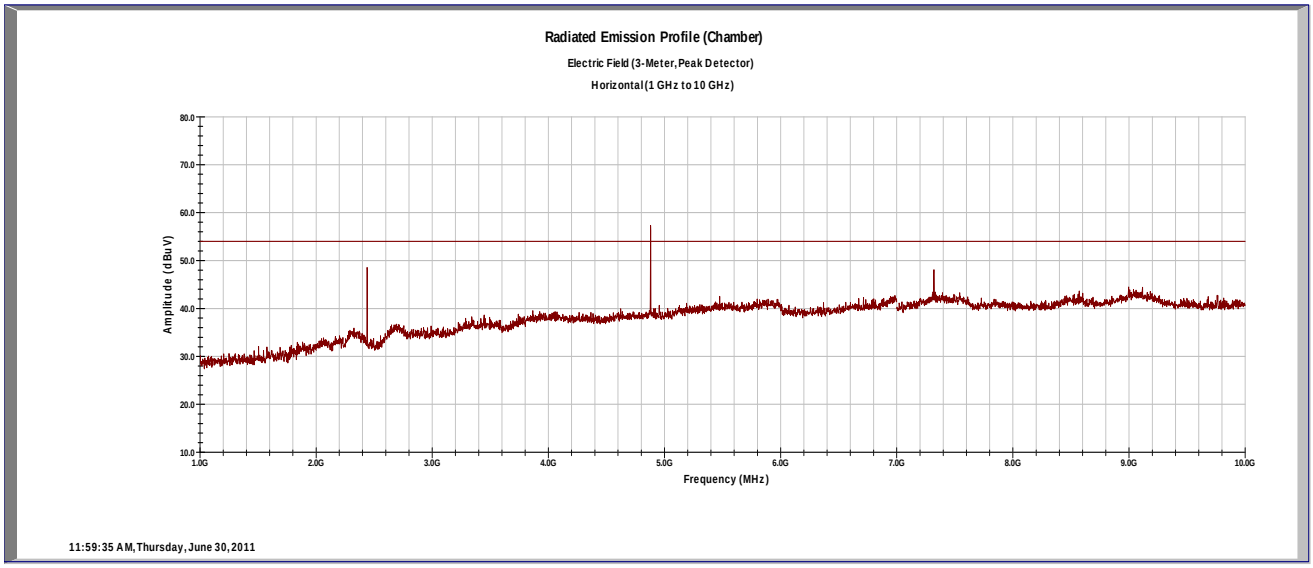
Spec Margin = E-Field Value - Limit, E-Field Value = FIM Value - Amp Gain + Cable Loss + ANT Factor ± Uncertainty

Combined Standard Uncertainty $u_c(y)$ = ± 1.6dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: No load, vertical, was worst case
All emissions are below the limits of parts15.209 and 15.35(a)

Worst Case Radiated Emissions Channel 18 – 1 to 10 GHz

Horizontal, -6 power setting



Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)
4880.00	H	1.1	135	41.59	34.38	11.68	33.14	52.03	54.00	-1.97
4880.00	H	1.1	135	49.97	34.38	11.68	33.14	60.41	74.00	-13.59
7320.00	**H**	**1.0**	**305**	**30.29**	**33.79**	**15.02**	**36.94**	**48.47**	**54.00**	**-5.53**
7320.00	H	1.0	305	42.18	33.79	15.02	36.94	60.36	74.00	-13.64

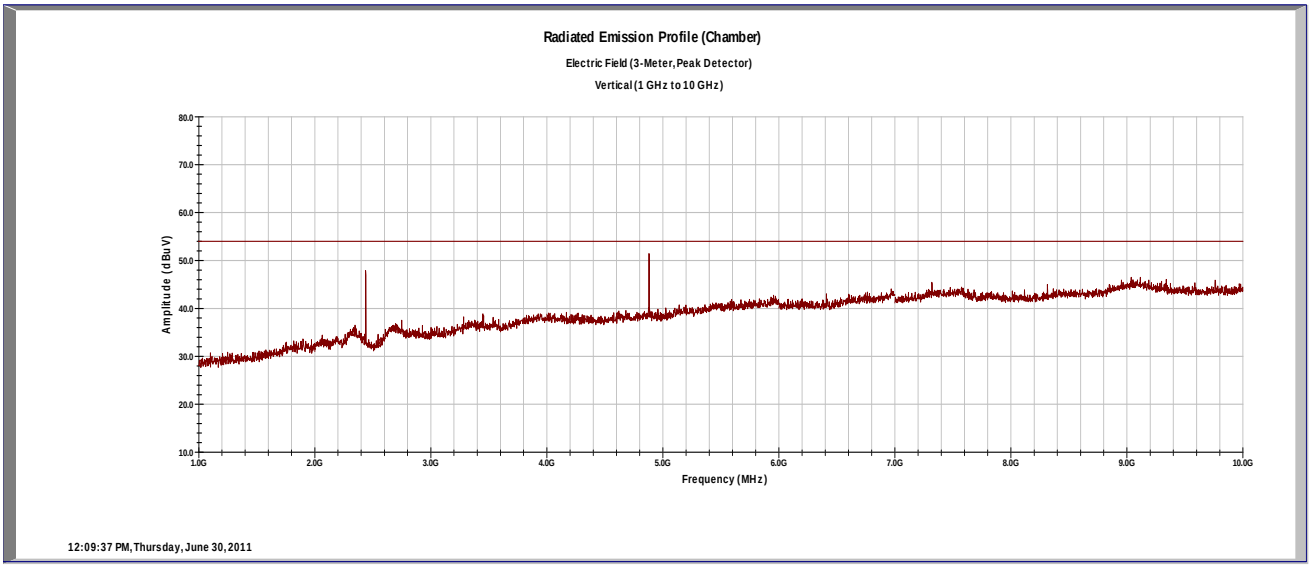
Spec Margin = E-Field Value - Limit, E-Field Value = FIM Value - Amp Gain + Cable Loss + ANT Factor ± Uncertainty

Combined Standard Uncertainty $u_c(y)$ = ± 1.6dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: a Notch filter was used for the fundamental
The **Green** emissions are using the Average detector
The **Blue** emissions are using the Peak detector
Highlighted signal is the worst case emission
All emissions are below the limits of parts15.209, 15.205 and 15.35(b)

Radiated Emissions – 1 to 10 GHz

Vertical, -6 power setting



Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)
4880.00	V	1.0	61	38.34	34.38	11.68	33.14	48.78	54.00	-5.22
4880.00	H	1.0	61	47.14	34.38	11.68	33.14	57.58	74.00	-16.42

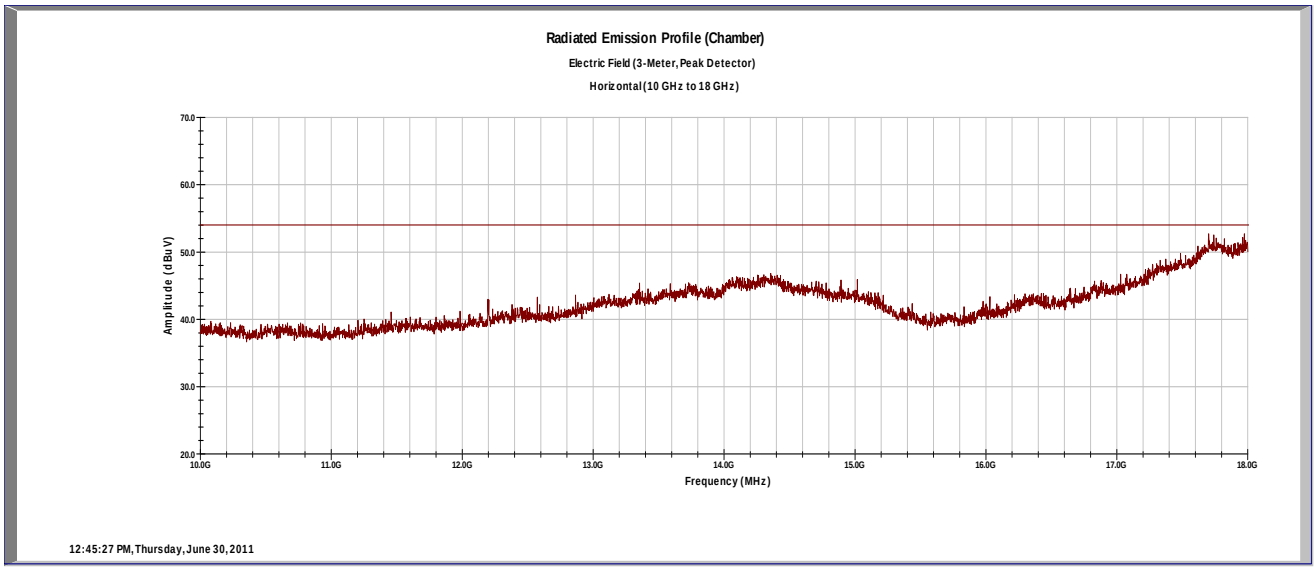
Spec Margin = E-Field Value - Limit, E-Field Value = FIM Value - Amp Gain + Cable Loss + ANT Factor ± Uncertainty

Combined Standard Uncertainty $u_c(y)$ = ± 1.6dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: a Notch filter was used for the fundamental
The **Green** emissions are using the Average detector
The **Blue** emissions are using the Peak detector
All emissions are below the limits of parts15.209, 15.205 and 15.35(b)

Radiated Emissions – 10 to 18 GHz

Horizontal



Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)

Spec Margin = E-Field Value - Limit, E-Field Value = FIM Value - Amp Gain + Cable Loss + ANT Factor ± Uncertainty

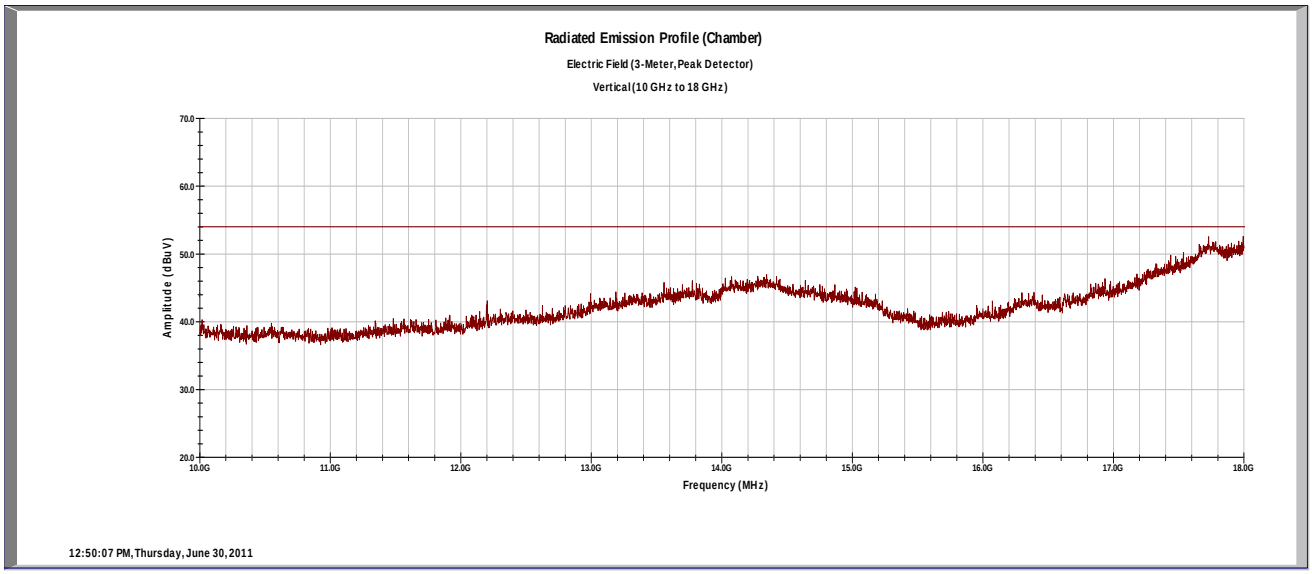
Combined Standard Uncertainty $u_c(y)$ = ± 1.6dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: a Notch filter was used for the fundamental

No emissions were seen above the noise floor of the instrumentation.
All emissions are below the limits of parts15.209, 15.205 and 15.35(b)

Radiated Emissions – 10 to 18 GHz

Vertical



Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)

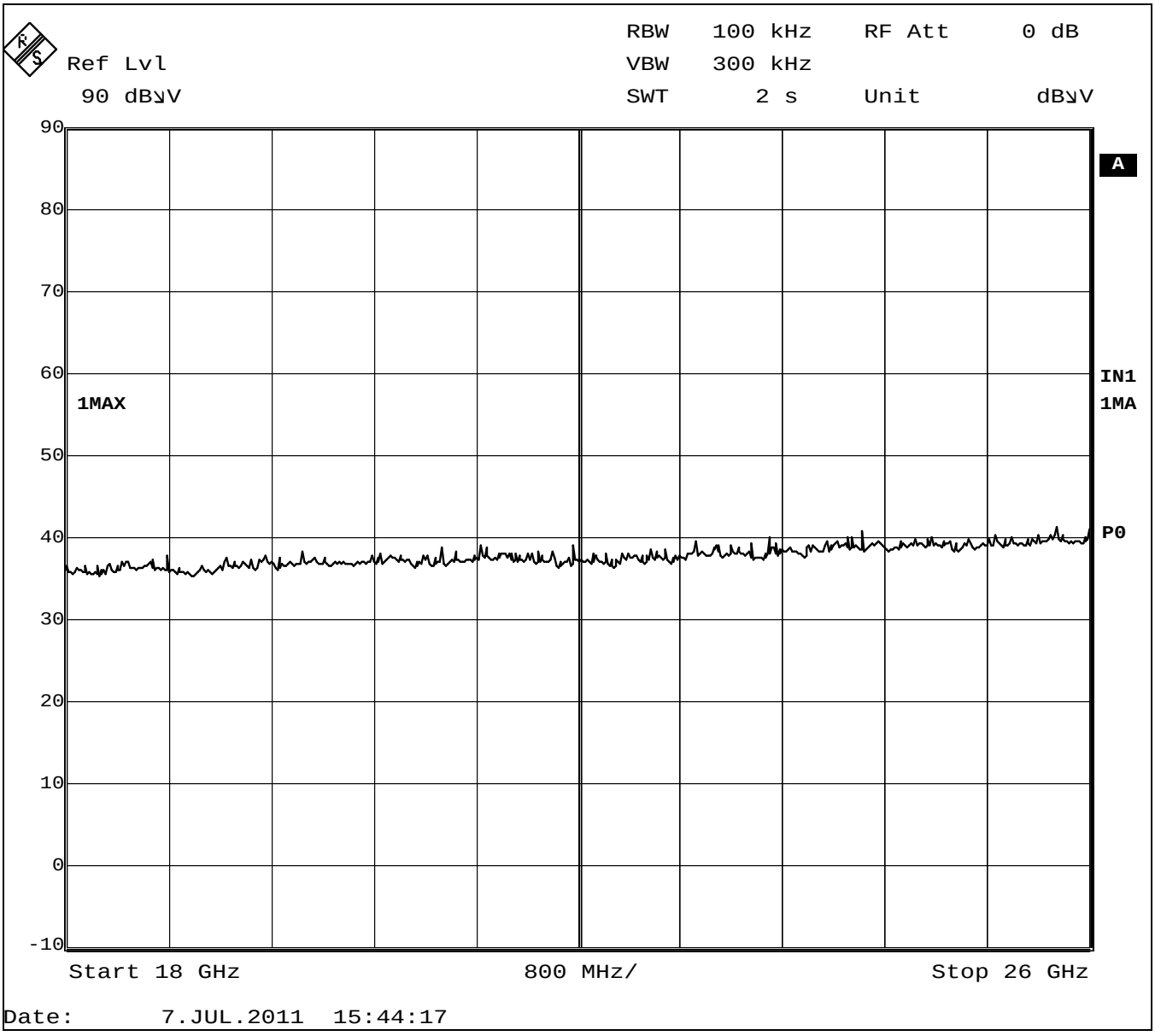
Spec Margin = E-Field Value - Limit, E-Field Value = FIM Value - Amp Gain + Cable Loss + ANT Factor ± Uncertainty

Combined Standard Uncertainty $u_c(y)$ = ± 1.6dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: a Notch filter was used for the fundamental TX CH 25
No emissions were seen above the noise floor of the instrumentation.
All emissions are below the limits of parts15.209, 15.205 and 15.35(b)

Radiated Emissions – 18 to 25 GHz

Investigatory scan



An investigatory scan was made from 18 – 26GHz with a hand-held horn antenna in close proximity (~20cm) to the EUT, looking for any emissions. There were no emissions above the noise floor observed as seen in the plot above. An Agilent 8449B preamp was used.

See test setup photo.

4.1 Conducted Emissions on AC Mains

This test measures the electromagnet levels of spurious signals generated by the EUT on the AC power line that may affect the performance of other near by electronic equipment.

4.1.1 Over View of Test

Results	**Complies** (as tested per this report)				**Date**	28 June 2011	
Standard	FCC Part 15.207(a) and RSS-GEN						
Product Model	Limited Modular Device			**Serial#**	000FAF		
Test Set-up	Tested in shielded room. EUT placed on table, see test plans for details						
EUT Powered By	120-230V/60Hz	**Temp**	75º F	**Humidity**	46%	**Pressure**	998 mbar
Frequency Range	150 kHz – 30 MHz						
Perf. Criteria	(Below Limit)	**Perf. Verification**	Readings Under Limit for L1 & Neutral				
Mod. to EUT	None	**Test Performed By**	Mark Ryan				

4.1.2 Test Procedure

Conducted emissions tests were performed using the procedures of ANSI C63.4 including methods for signal maximizations and EUT configuration. The photos included with the report show the EUT in its maximized configuration.

The frequency range from 150Khz – 30Mhz was investigated for conducted emissions.

Conducted Emissions measurements were performed in either the shielded room or ground plane location (with attached vertical ground plane) using procedures specified in the test plan and standard.

4.1.3 Deviations

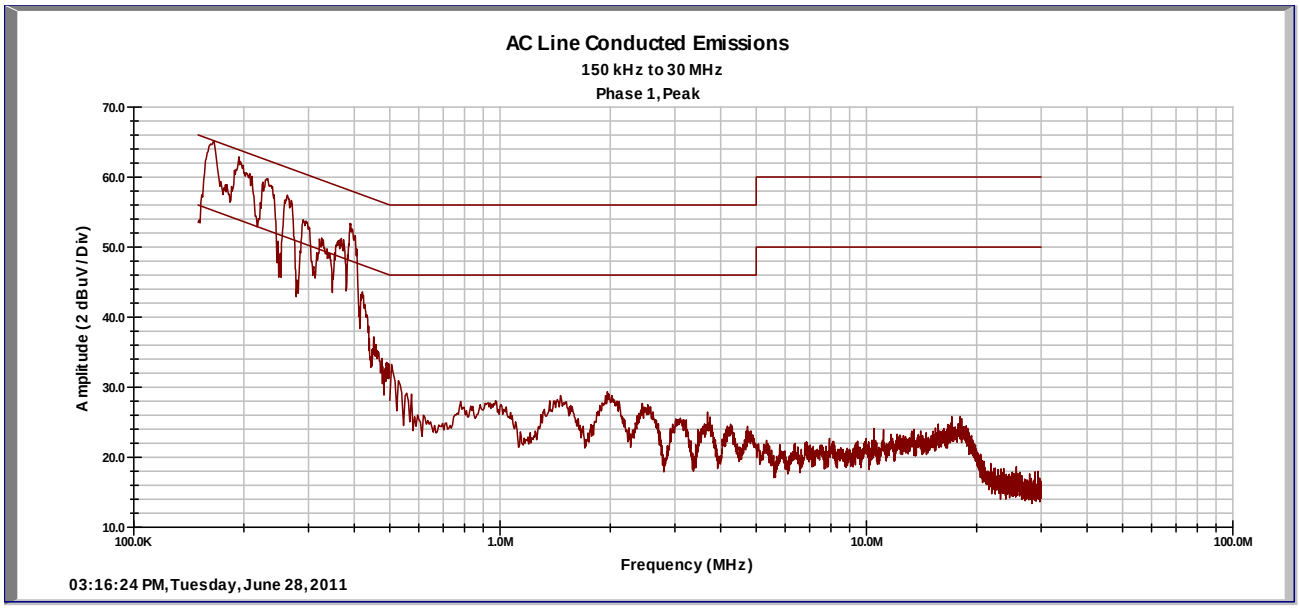
There were no deviations from the test methodology listed in the test plan for the conducted emission test.

4.1.4 Final Test

All final conducted emissions measurements were below (in compliance) the limits. It lists the final measurement data under the worst case operating modes, configurations, and/or cable positions. It also reflects the results including any modifications and/or special accessories.

4.1.5 Final Graphs and Tabulated Data

Conducted Emissions @ 120V/60Hz – TX Mode
Line 1



Freq (MHz)	ID (1,2,3,N)	Quasi (dBuV)	Ave (dBuV)	Loss (dB)	T Limiter (dB)	Limit (dBuV)	Limit (dBuV)	Margin (dB)	Margin (dB)
0.16	1	51.88	37.29	0.03	9.88	65.46	55.46	-3.67	-8.26
0.19	1	48.99	32.98	0.03	9.89	63.82	53.82	-4.91	-10.92
0.23	1	46.44	27.98	0.03	9.89	62.42	52.42	-6.07	-14.53
0.39	1	39.12	21.72	0.04	9.90	57.97	47.97	-8.92	-16.32
1.98	1	16.04	11.11	0.09	9.97	56.00	46.00	-29.90	-24.83
18.04	1	9.96	4.92	0.28	10.36	60.00	50.00	-39.39	-34.43

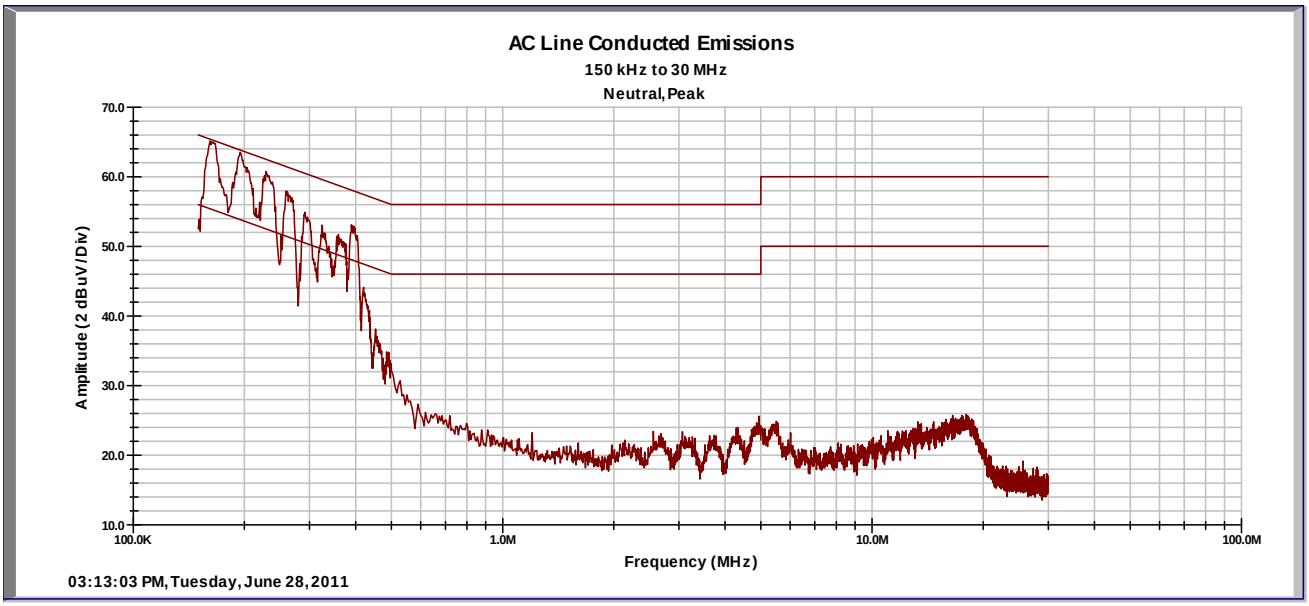
Quasi Spec Margin = Quasi FIM + Cable Loss + LISN CF - Quasi Limit ± Uncertainty
Ave Spec Margin = Ave FIM + Cable Loss + LISN CF - Ave Limit ± Uncertainty

Combined Standard Uncertainty $u_c(y)$ = ± 1.2dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes:

Conducted Emissions @ 120V /60Hz – TX Mode

Neutral



Freq (MHz)	ID (1,2,3,N)	Quasi (dBuV)	Ave (dBuV)	Loss (dB)	T Limiter (dB)	Limit (dBuV)	Limit (dBuV)	Margin (dB)	Margin (dB)
0.16	N	51.80	36.70	0.03	9.87	65.36	55.36	-3.66	-8.76
0.19	N	48.19	32.07	0.03	9.88	63.85	53.85	-5.75	-11.87
0.23	N	45.37	27.05	0.03	9.87	62.45	52.45	-7.17	-15.49
0.39	N	38.96	18.14	0.04	9.88	58.03	48.03	-9.15	-19.97
4.99	N	10.60	5.62	0.15	10.10	56.00	46.00	-35.15	-30.13
18.03	N	10.00	5.04	0.28	10.24	60.00	50.00	-39.48	-34.44

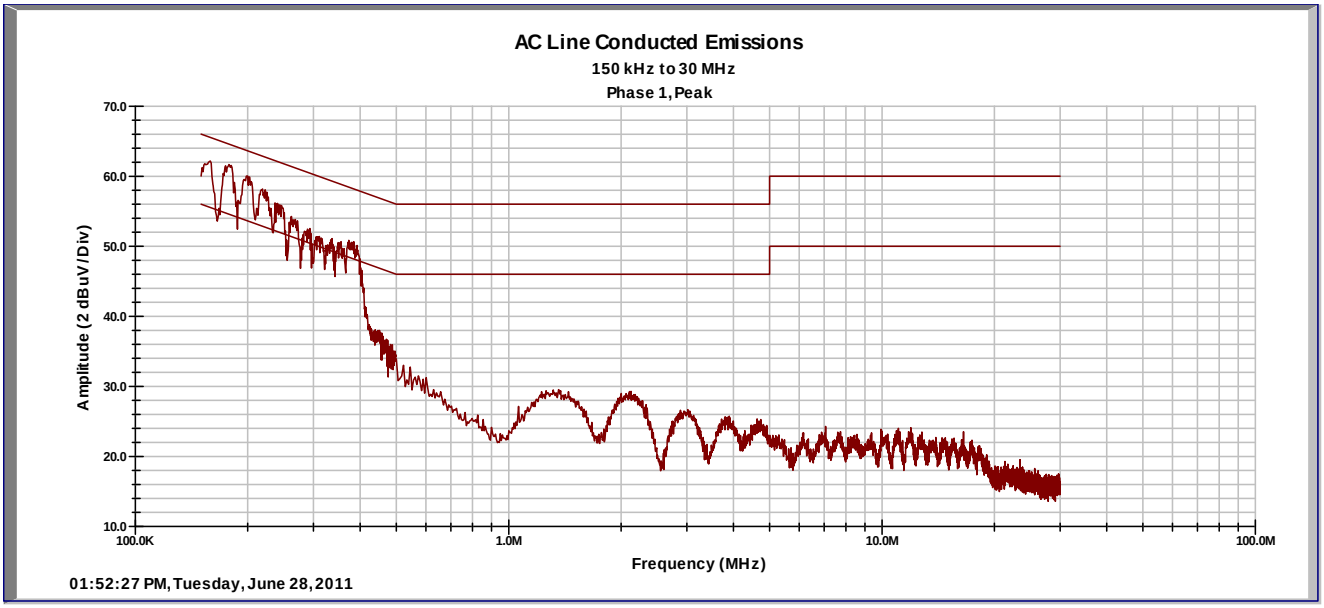
Quasi Spec Margin = Quasi FIM + Cable Loss + LISN CF - Quasi Limit ± Uncertainty
Ave Spec Margin = Ave FIM + Cable Loss + LISN CF - Ave Limit ± Uncertainty

Combined Standard Uncertainty $u_c(y)$ = ± 1.2dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes:

Conducted Emissions @ 220V/60Hz – TX Mode

Line 1



Freq (MHz)	ID (1,2,3,N)	Quasi (dBuV)	Ave (dBuV)	Loss (dB)	T Limiter (dB)	Limit (dBuV)	Limit (dBuV)	Margin (dB)	Margin (dB)
0.16	1	49.12	31.82	0.03	9.88	65.73	55.73	-6.70	-14.00
0.33	1	37.22	15.95	0.04	9.89	59.51	49.51	-12.36	-23.63
1.31	1	16.77	18.12	0.07	9.94	56.00	46.00	-29.23	-17.88
2.11	1	16.51	12.33	0.09	9.97	56.00	46.00	-29.43	-23.61
2.98	1	13.66	9.35	0.11	10.01	56.00	46.00	-32.22	-26.53
11.92	1	8.69	4.04	0.23	10.42	60.00	50.00	-40.66	-35.31

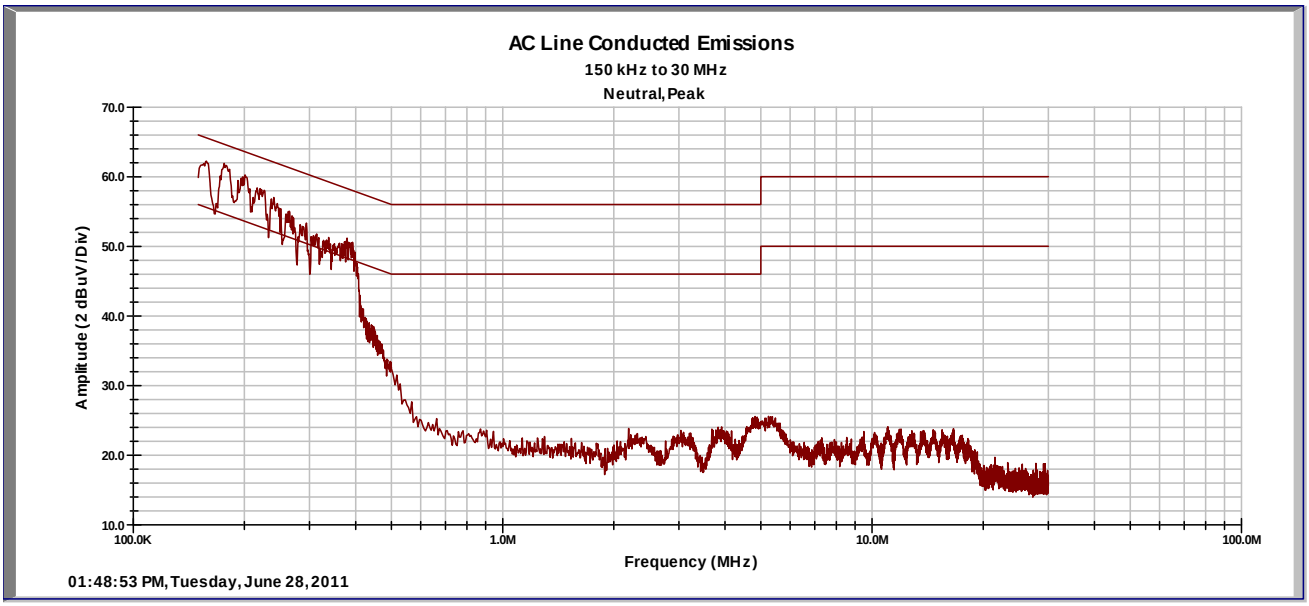
Quasi Spec Margin = Quasi FIM + Cable Loss + LISN CF - Quasi Limit ± Uncertainty
Ave Spec Margin = Ave FIM + Cable Loss + LISN CF - Ave Limit ± Uncertainty

Combined Standard Uncertainty $u_c(y)$ = ± 1.2dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes:

Conducted Emissions @ 220V/60Hz – TX Mode

Neutral



Freq (MHz)	ID (1,2,3,N)	Quasi (dBuV)	Ave (dBuV)	Loss (dB)	T Limiter (dB)	Limit (dBuV)	Limit (dBuV)	Margin (dB)	Margin (dB)
0.16	N	47.66	29.02	0.03	9.87	65.52	55.52	-7.96	-16.60
0.33	N	39.78	17.74	0.04	9.88	59.45	49.45	-9.75	-21.79
2.29	N	8.70	3.67	0.10	9.99	56.00	46.00	-37.22	-32.25
3.80	N	9.32	4.50	0.13	10.04	56.00	46.00	-36.51	-31.33
4.92	N	11.70	7.17	0.15	10.10	56.00	46.00	-34.06	-28.59
11.73	N	8.89	4.20	0.23	10.36	60.00	50.00	-40.52	-35.21

Quasi Spec Margin = Quasi FIM + Cable Loss + LISN CF - Quasi Limit ± Uncertainty
Ave Spec Margin = Ave FIM + Cable Loss + LISN CF - Ave Limit ± Uncertainty

Combined Standard Uncertainty $u_c(y)$ = ± 1.2dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes:

4.2 Band Edge

4.2.1 Test Over View

Results	**Complies** (as tested per this report)				**Date**	08 June 2011	
Standard	FCC Part 15.247(d), RSS 210, 2.2						
Product Model	Limited Modular Device			**Serial#**	000FAF		
Test Set-up	Radiated Emission at 3m Distance						
EUT Powered By	120VAC / 60 Hz	**Temp**	76º F	**Humidity**	46%	**Pressure**	1002 mbar
Perf. Criteria	(Below Limit)		**Perf. Verification**		Readings Under Limit		
Mod. to EUT	None		**Test Performed By**		Mark Ryan		

4.2.2 Test Procedure

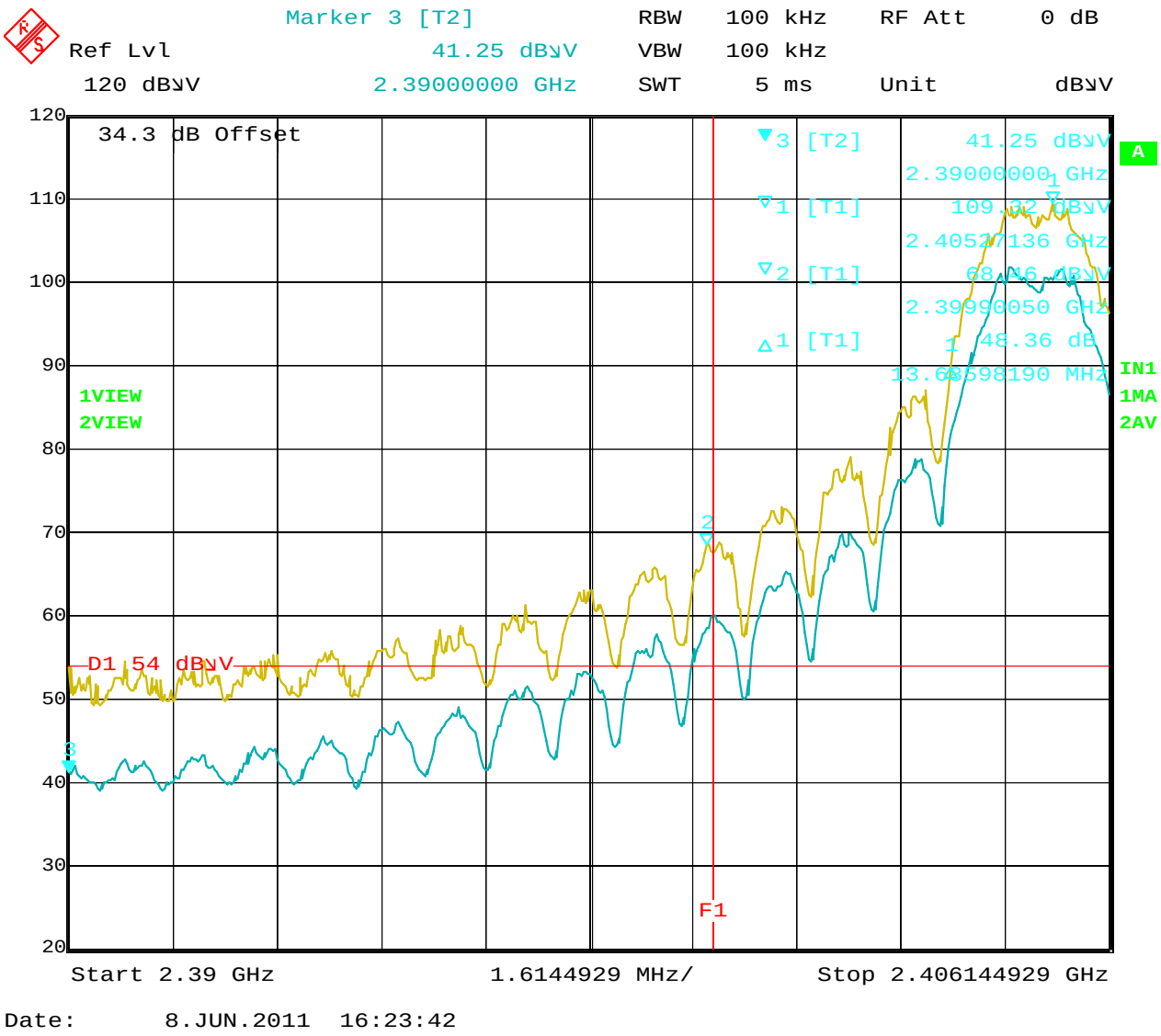
Intentional radiators operating under the alternative provisions to the general emission limits must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

4.2.3 Deviations

There were no deviations from the test methodology listed in the test plan for the Radiated Immunity test.

4.2.4 Final Test

The EUT met the performance criteria requirement as specified in the standards.



Notes: Measured using the Peak detector. Band Edge is at 2.4 GHz (Marker 3).

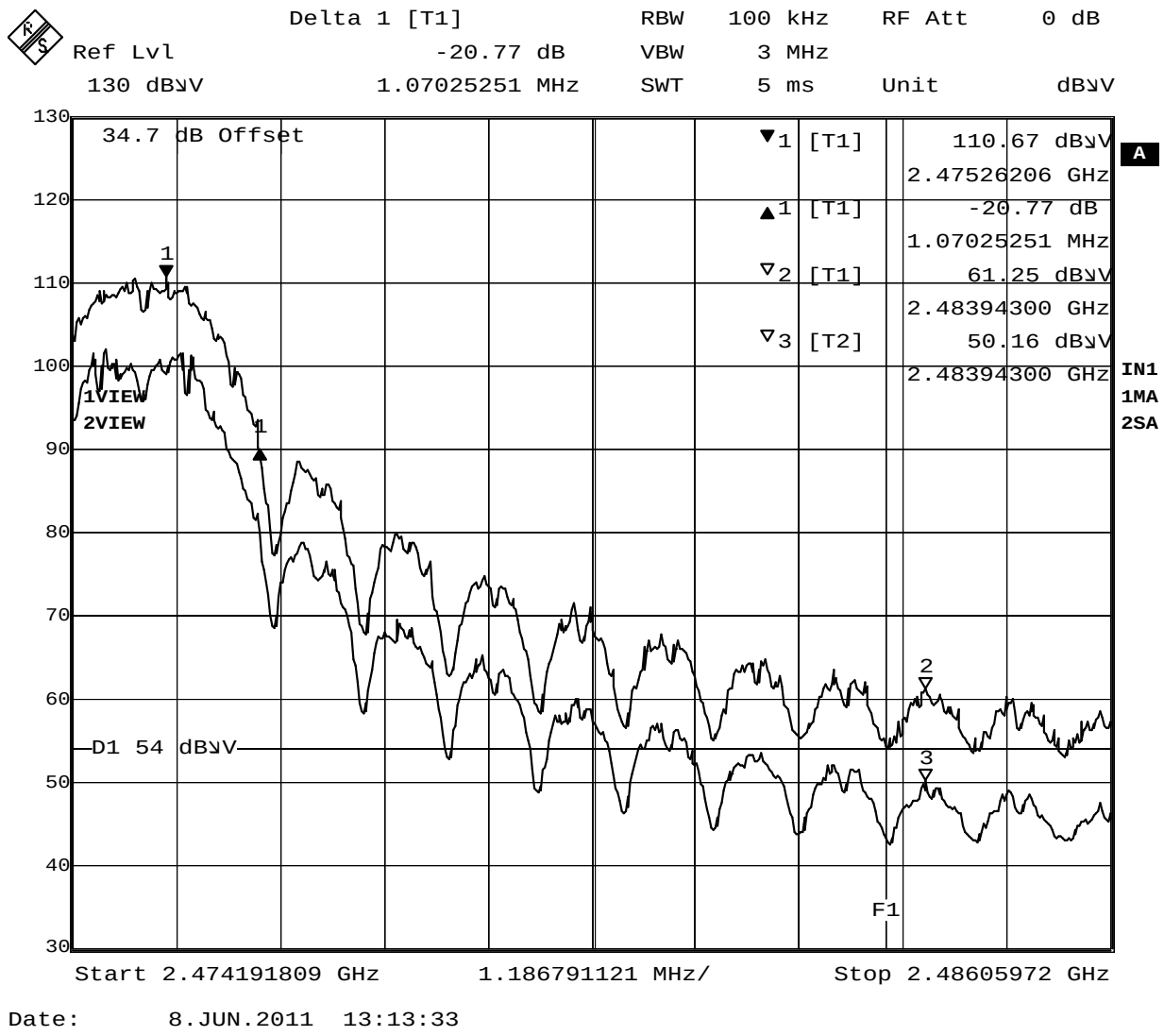
The nearest restricted band (2390MHz) is 10 MHz below the band edge

At the lowest channel, the 20dB down point is at 2403.72 MHz.

The band edge (Line F1) is at 2400 MHz

Figure 1: Lower Band Edge Measurement (Radiated Emission)

The EUT is compliant with the rules.



Note: Measured using the Peak and Average detectors.

Band edge (Line F1) at 2483.5 MHz is also the start of a restricted band, so the rules of 15.205 apply.

The 20dB down point is inside the band at 2476.69MHz.
The highest peak above the band edge is at 2.483.95 MHz:

Peak = 61.65 dBµV/m which is 12.35 dB below the 74 dBµV/m limit.
Average = 50.16 dBµV/m which is 3.84 dB below the 54 dBµV/m limit.

Figure 2: Upper Band Edge Measurement (Radiated Emission)

The EUT is compliant with the rules.

5 Antenna Port Conducted Emissions

For conducted tests, the emissions were measured at the antenna port.

Testing was performed in accordance with 47 CFR Part 15, ANSI C63.10:2009, RSP-100 Issue 9. These test methods are listed under the laboratory's NVLAP Scope of Accreditation. This test measures the levels emanating from the EUT, thus evaluating the potential for the EUT to cause radio frequency interference to other electronic devices.

5.1 Conducted Output Power, FCC 15.247(b)(3) and RSS-210 A8.4(4)

5.1.1 For systems using digital modulation in the 2400–2483.5 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.

5.1.2 Test Over View

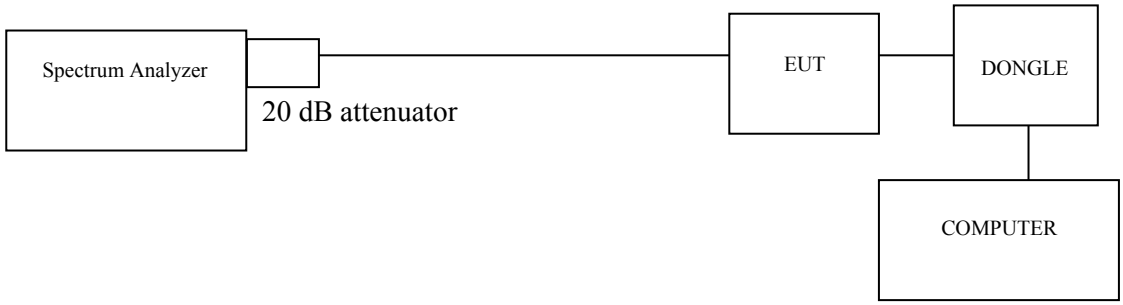
Results	**Complies** (as tested per this report)					**Date**	30 June 2011
Standard	FCC Part 15.247(b)(3) and RSS-210 A8.4(4)						
Product Model	Limited Modular Device			**Serial#**	000FAF		
Test Set-up	Direct Measurement from antenna port						
EUT Powered By	120VAC / 60 Hz	**Temp**	74º F	**Humidity**	44%	**Pressure**	1001mbar
Perf. Criteria	(Below Limit)		**Perf. Verification**		Readings Under Limit		
Mod. to EUT	None		**Test Performed By**		Mark Ryan		

5.1.3 Test Procedure

The peak output power was measured at the low, mid and high band frequencies. The measurement was made using a direct connection between the RF output of the EUT and the spectrum analyzer. The cable loss and the attenuator was measured and added in the reference level offset in the spectrum analyzer. The spectrum analyzer's resolution bandwidth was greater than the 20dB bandwidth of the modulated carrier and the video bandwidth was equal to the resolution bandwidth.

Wires were soldered onto the battery terminals of the EUT and connected to an adjustable power supply.

Test Setup:



5.1.4 Deviations

There were no deviations from the test methodology listed in the test plan for the Surge Immunity test.

5.1.5 Final Test

The EUT met the performance criteria requirement as specified in the test plan of this report and in the standards.

5.1.6 Peak Power Output

Peak Output Conducted Power Measurements

Emission Freq (MHz)	Value (dBm)	Spec Limit (dBm)	Spec Margin (dB)
2405.00 (f_L)	19.65	30	-10.35
2440.00 (f_M)	**19.73**	**30**	**-10.27**
2480.00 (f_H)	19.34	30	-10.66

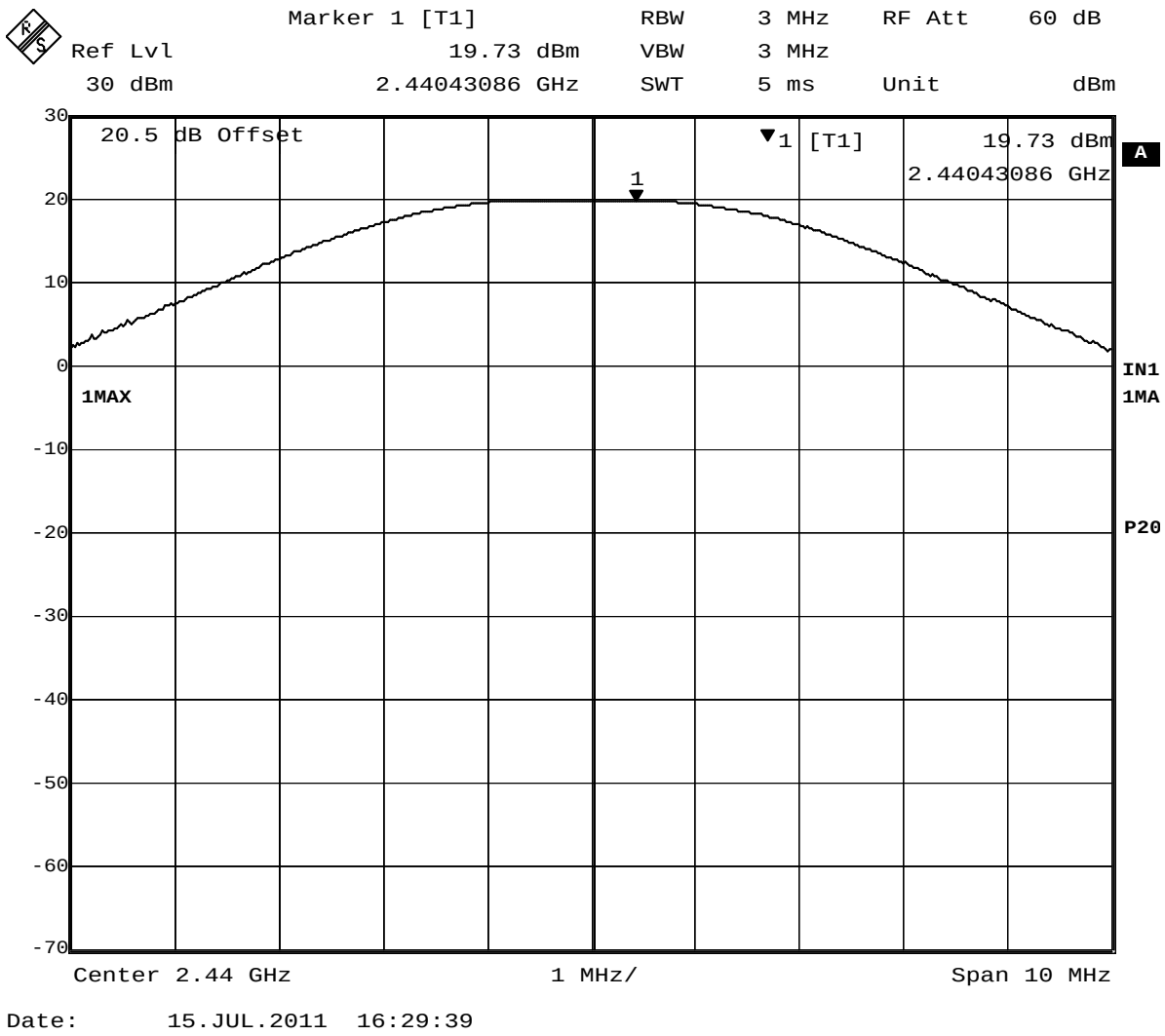


Figure 3 – Highest Peak Conducted Power Output for EUT.

Graphs of the other frequencies are on file at the manufacturer and at TUV.

Antenna Gain

The Antenna used is below 6dBi gain.

The EUT is also compliant to FCC Part 15.247(b)(4)

Results

As tested, the EUT was found to be compliant to the requirements of the test standard.

5.2 Peak Power Spectral Density

5.2.1 Test Over View

Results	**Complies** (as tested per this report)				**Date**	30 June 2011	
Standard	FCC Part 15.247(e) and RSS 210 A8.2(b)						
Product Model	Limited Modular Device			**Serial#**	000FAF		
Test Set-up	Direct Measurement from antenna port						
EUT Powered By	120VAC / 60 Hz	**Temp**	74º F	**Humidity**	32%	**Pressure**	1010mbar
Perf. Criteria	Below Limit (10dBm)		**Perf. Verification**		≤8 dBm in any 3 kHz		
Mod. to EUT	None		**Test Performed By**		Mark Ryan		

5.2.2 Test Procedure

Using the methods of ANSI C63.10:1999, section 6.11.2.3 were used.

5.2.3 Deviations

There were no deviations from the test methodology listed in the test plan for the Radiated Immunity test.

5.2.4 Final Test

The EUT met the performance criteria requirement as specified in the test plan of this report and in the standards.

Power Spectral Density Measurements

Emission Freq (MHz)	Corrected Value (dBm)	Spec Limit (dBm)	Spec Margin (dB)
2405.00 (f_L)	**5.34**	**+8**	**-2.66**
2440.00 (f_M)	4.87	+8	-3.13
2480.00 (f_H)	4.20	+8	-3.80

Note: worst Case PSD measurement plots are shown below; the other plots are on file at TUV Rheinland.

5.2.5 Final Data

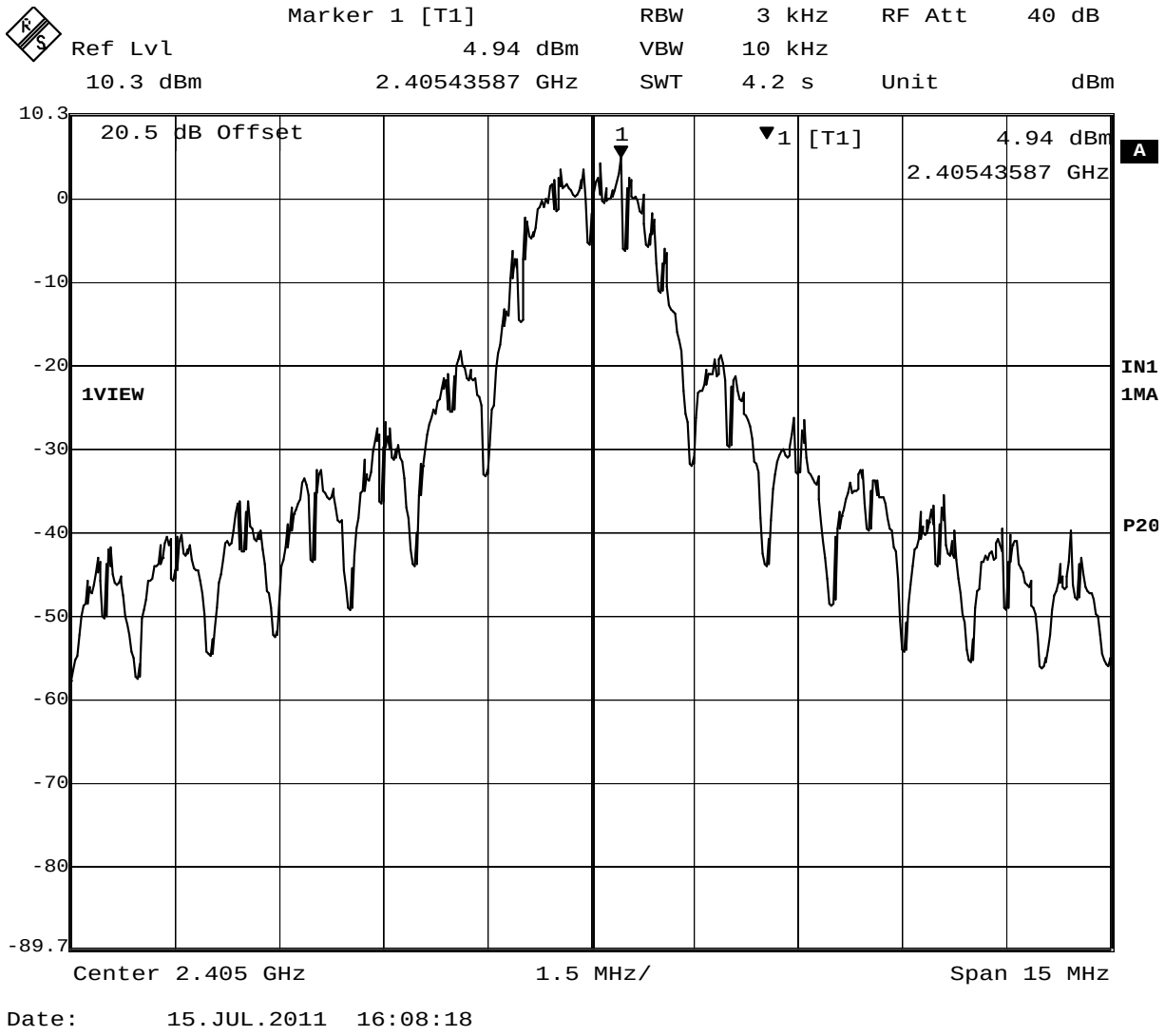


Figure 4: Peak Reference Frequency

Spectrum Analyzer Parameters:
RBW= 3kHz
Span= 15MHz
VBW= 10kHz
LOG dB/div.= 10dB
Sweep = Auto
Detector = Peak Detector, max hold

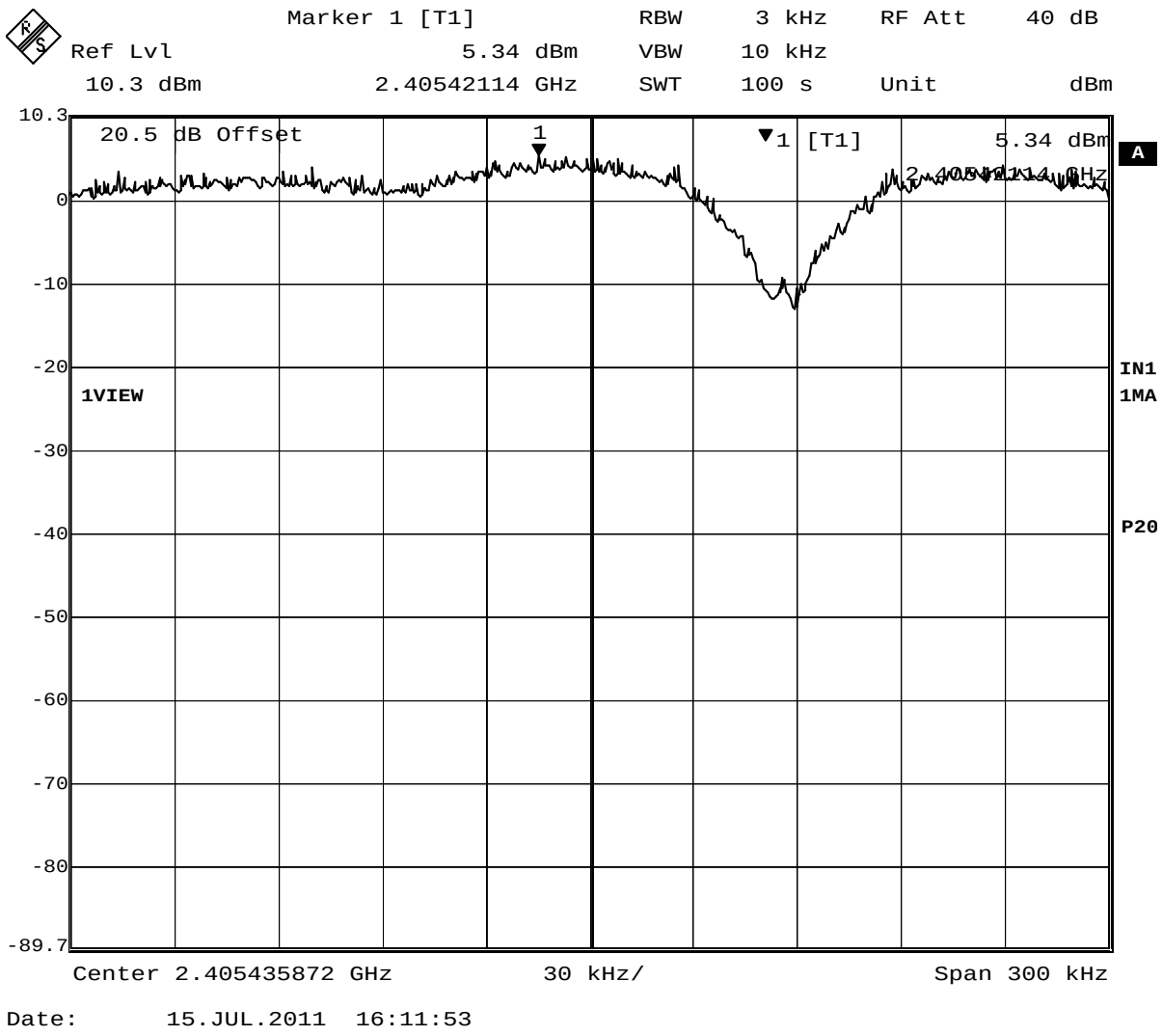


Figure 5: Worst Case Power Spectral Density measurement

Spectrum Analyzer Parameters:
RBW= 3kHz
Span= 300kHz
VBW= 10kHz
LOG dB/div.= 10dB
Sweep = 100 Seconds
Detector = Peak Detector, max hold

5.3 Occupied Bandwidth

Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

5.3.1 Test Over View

Results	**Complies** (as tested per this report)				**Date**	30 June 2011	
Standard	FCC Part 15.247(a)(2)						
Product Model	Limited Modular Device			**Serial#**	000FAF		
Test Set-up	Direct Measurement from antenna port						
EUT Powered By	120VAC / 60 Hz	**Temp**	74º F	**Humidity**	40%	**Pressure**	1000 mbar
Perf. Criteria	(Below Limit)		**Perf. Verification**		Readings Under Limit		
Mod. to EUT	None		**Test Performed By**		Mark Ryan		

5.3.2 Test Procedure

Minimum allowed 6dB Bandwidth = 500 kHz

5.3.3 Deviations

There were no deviations from the test methodology listed in the test plan for the Radiated Immunity test.

5.3.4 Final Test

6dB Band width is 1.65 MHz which is > 500 kHz

The EUT met the performance criteria requirement as specified in the standards.

6 dB Band width

Emission Freq (MHz)	Value (MHz)	Minimum Bandwidth (MHz)	Spec Margin (MHz)
2405.00 (f_L)	**1.65**	**0.50**	**1.15**
2440.00 (f_M)	1.60	0.50	1.10
2480.00 (f_H)	1.61	0.50	1.11

Note: worst Case PSD measurement plots are shown below; the other plots are on file at TUV Rheinland.

5.3.5 Final Data

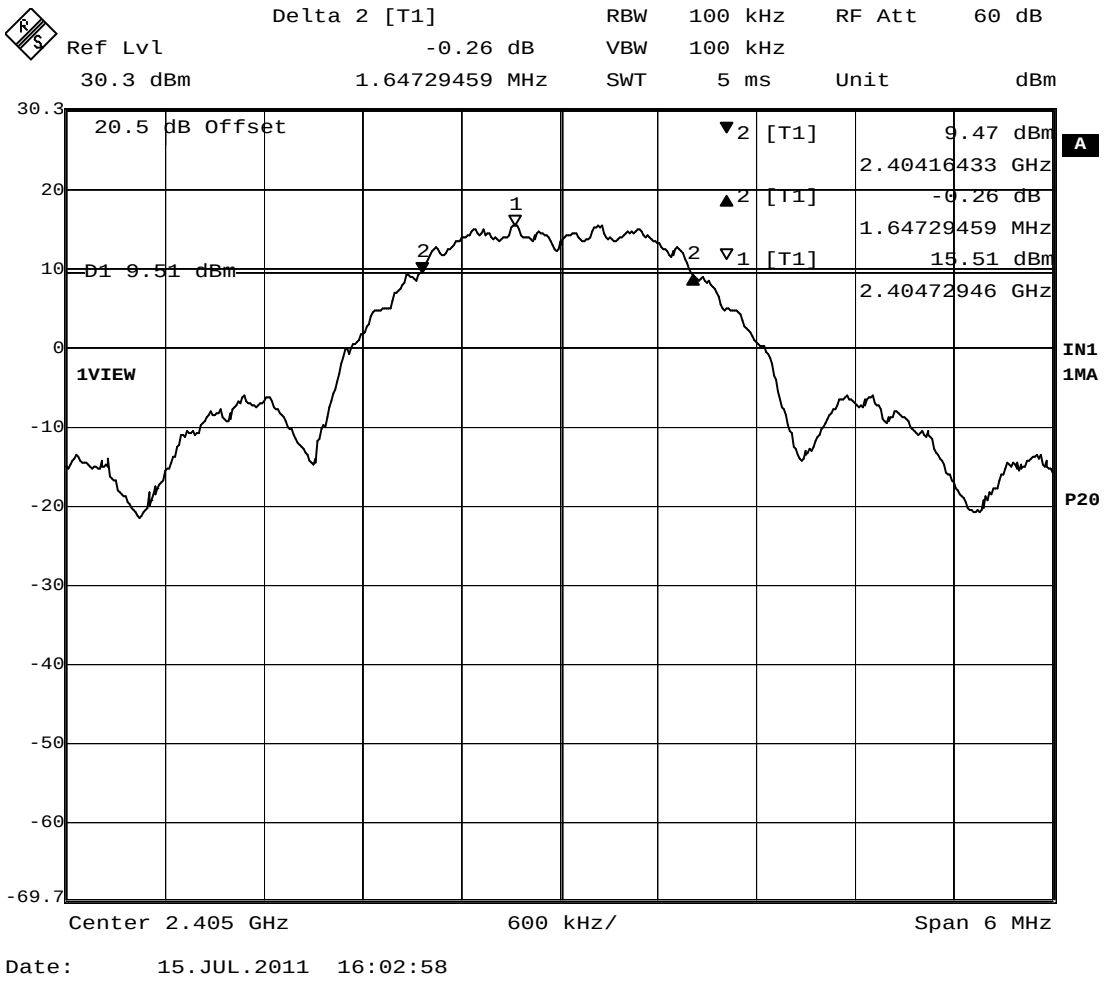


Figure 6: 6dB Occupied Bandwidth

Note: The above plot is the worst case.

6dB Band width is 1.65 MHz which is > 500 kHz

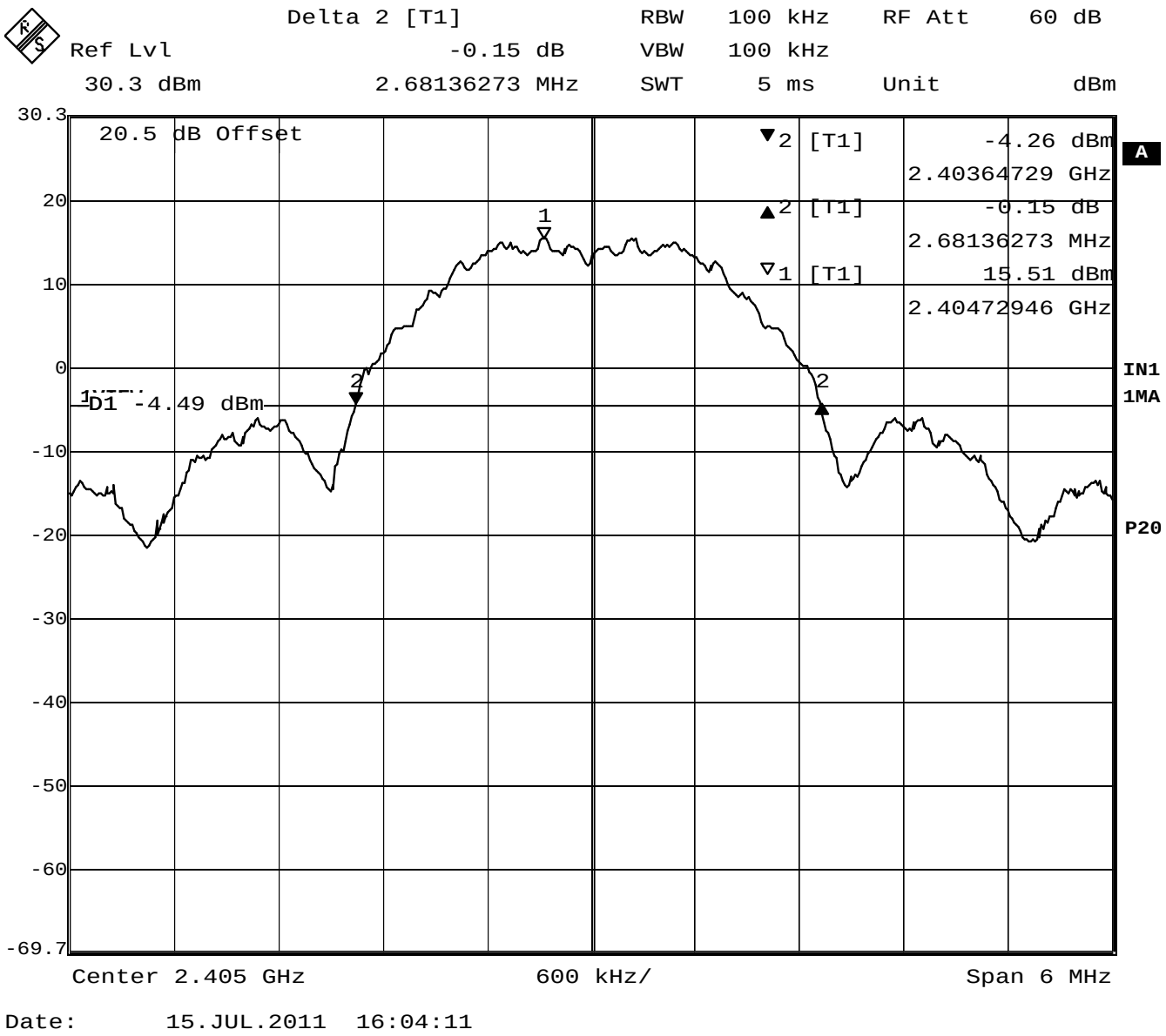


Figure 7: 20 dB Occupied Bandwidth

Note: The above plot is the worst case.

20dB Band width is 2.68 MHz

5.4 99% Power Bandwidth

For the purpose of Section A1.1, the 99% bandwidth shall be no wider than .25% of the center frequency for devices operating between 70-900MHz. Foe devices operating above 900 MHz, the emission shall be no wider than 0.5% of the center frequency.

5.4.1 Test Over View

Results	**Complies** (as tested per this report)					**Date**	20 June 2011
Standard	RSS-210 Section A1.1.3						
Product Model	Limited Modular Device			**Serial#**	000FAF		
Test Set-up	Direct Measurement from antenna port						
EUT Powered By	120VAC / 60 Hz	**Temp**	74º F	**Humidity**	32%	**Pressure**	1010mbar
Perf. Criteria	(Below Limit)		**Perf. Verification**		Readings Under Limit		
Mod. to EUT	None		**Test Performed By**		Mark Ryan		

5.4.2 Test Procedure

Using the procedures of RSS-GEN section 4.6.1, the 1 kHz resolution bandwidth is 1% of the 1 MHz span. The Video bandwidth is 3 times that of the resolution bandwidth.

The limit of the bandwidth would be 0.5% of 2.4 GHz or 12 MHz.

5.4.3 Deviations

There were no deviations from the test methodology listed in the test plan for the Electrical Fast transients (EFT) Immunity test.

5.4.4 Final Results

The measured 99% bandwidth is 2.41 MHz, which is well below the 12 MHz limit.

The EUT met the performance criteria requirement as specified in the test plan of this report and in the standards.

5.4.5 Final Data

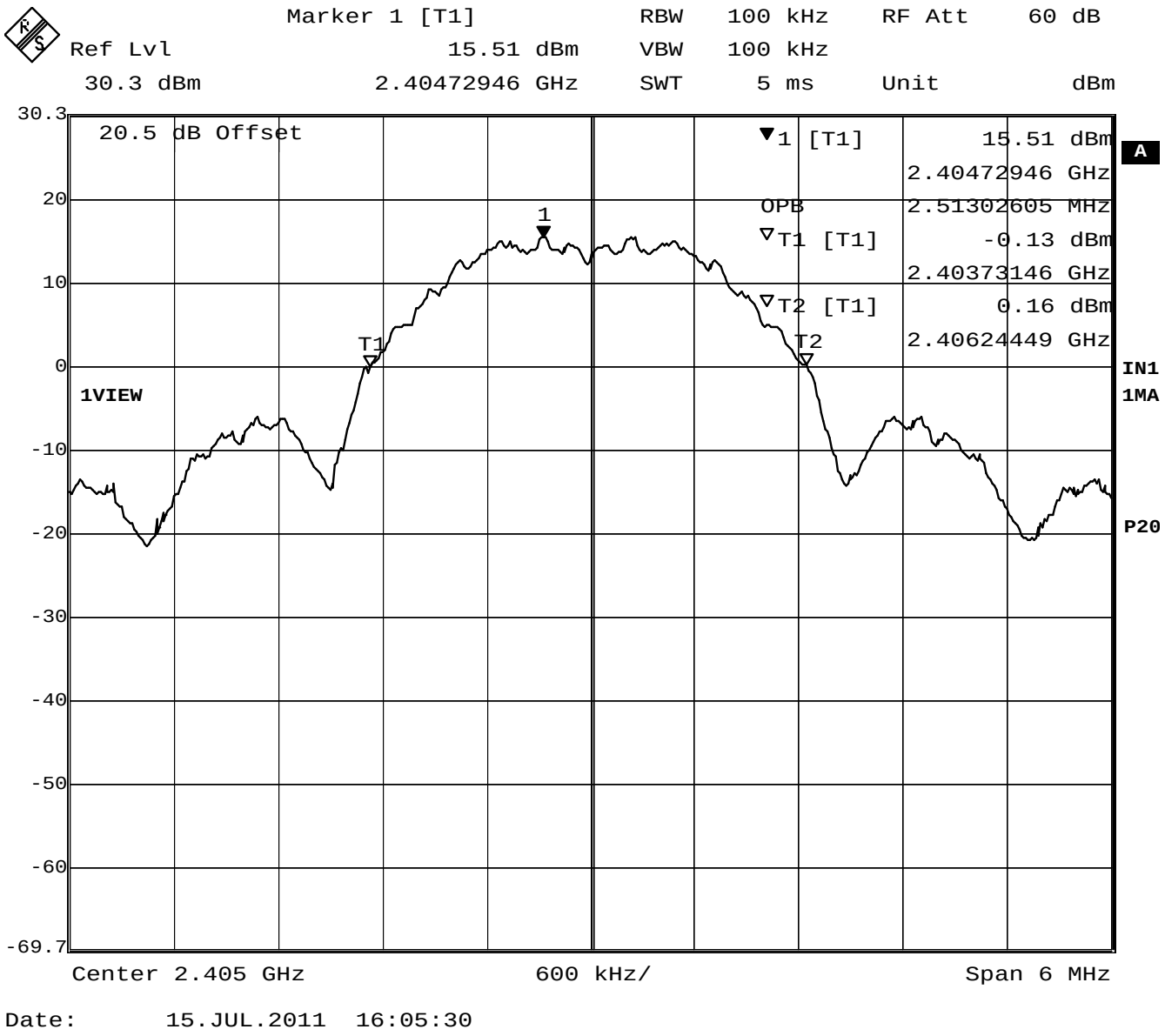


Figure 8 – 99% Power Bandwidth = 2.51 MHz

The EUT is compliant to the requirements of RSS-210 A1.1.3

5.5 Voltage Requirements FCC Part 15.31(e)

FCC Part 15.31 states that for intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage. For battery operated equipment, the equipment tests shall be performed using a new battery.

5.5.1 Over View of Test

Results	**Complies** (as tested per this report)	**Date**	30 June 2011
Standard	FCC Part 15.31(e)		
Product Model	Limited Modular Device	**Serial#**	000FAF
Test Set-up	Tested in shielded room. EUT placed on table, see test plans for details		
Mod. to EUT	None	**Test Performed By**	Mark Ryan

5.5.2 Test Procedure

Since this module could be used in many different applications, including battery operation, the manufacturer selected that worst-case testing suite to be performed. The power source test was performed using the ±15% of rated voltage

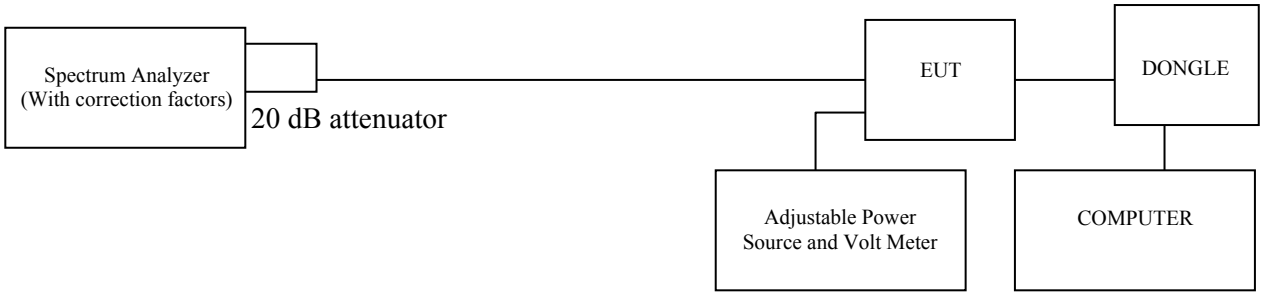
Manufacturer Rated voltage: 100V – 250VAC, 50/60Hz,

The test will be performed at ±15% of rated voltage.

Notes: The Power supply built into the module is a regulated supply that is made to handle a wide variation in AC voltage.

This test was performed at the same time as the peak conducted power measurements were made.

Test Setup:



Reference at nominal temperature; +20º C

Volts	P(dBm)	Frequency in Hz	Δ to nominal Power (dB)	Δ to nominal Frequency (Hz)
85	19.73	2,440,430.860	0.00	0
120	19.73	2,440,430.860	0.00	0
276	19.73	2,440,430.860	0.00	0

Notes: No change in frequency or power noted
The Highlighted measurements are used as the reference.

Nominal Rated Voltage (V_{Nom}):	120	Volts
+15% of Maximum Rated Voltage (V_{max}):	276	Volts
-15% of Minimum Rated Voltage (V_{min}):	85	Volts

5.5.3 Final Test

As tested, the EUT was found to be compliant to the requirements of the test standard.

6 Emissions in Receive Mode.

6.1 Radiated Emissions in Receive Mode

This test measures the electromagnetic levels of spurious signals generated by the EUT that radiated from the EUT and may affect the performance of other nearby electronic equipment.

6.1.1 Over View of Test

Results	**Complies** (as tested per this report)				**Date**	20 June 2011	
Standard	FCC Parts 15.109(a) and RSS-GEN						
Product Model	Limited Modular Device			**Serial#**	000FAF		
Configuration	See test plan for details						
Test Set-up	Tested in a 5m Semi Anechoic chamber, placed on a 1.0m x 1.5m non-conductive table 80cm above the ground plane on a turn-table. See test plans for details						
EUT Powered By	120VAC / 60 Hz	**Temp**	74º F	**Humidity**	43%	**Pressure**	1000mbar
Frequency Range	30 MHz to 13 GHz @ 3m						
Perf. Criteria	(Below Limit)			**Perf. Verification**	Readings Under Limit		
Mod. to EUT	None			**Test Performed By**	Mark Ryan		

6.1.2 Test Procedure

Radiated and FCC emissions tests were performed using the procedures of ANSI C63.4:2003 including methods for signal maximizations and EUT configuration. The photos included with the report show the EUT in its maximized configuration.

The frequency range from 30 MHz to 13 GHz was investigated for radiated emissions.

Radiated emission testing was performed at a distance of 3 meters in a 5 meter semi-anechoic chamber.

6.1.3 Deviations

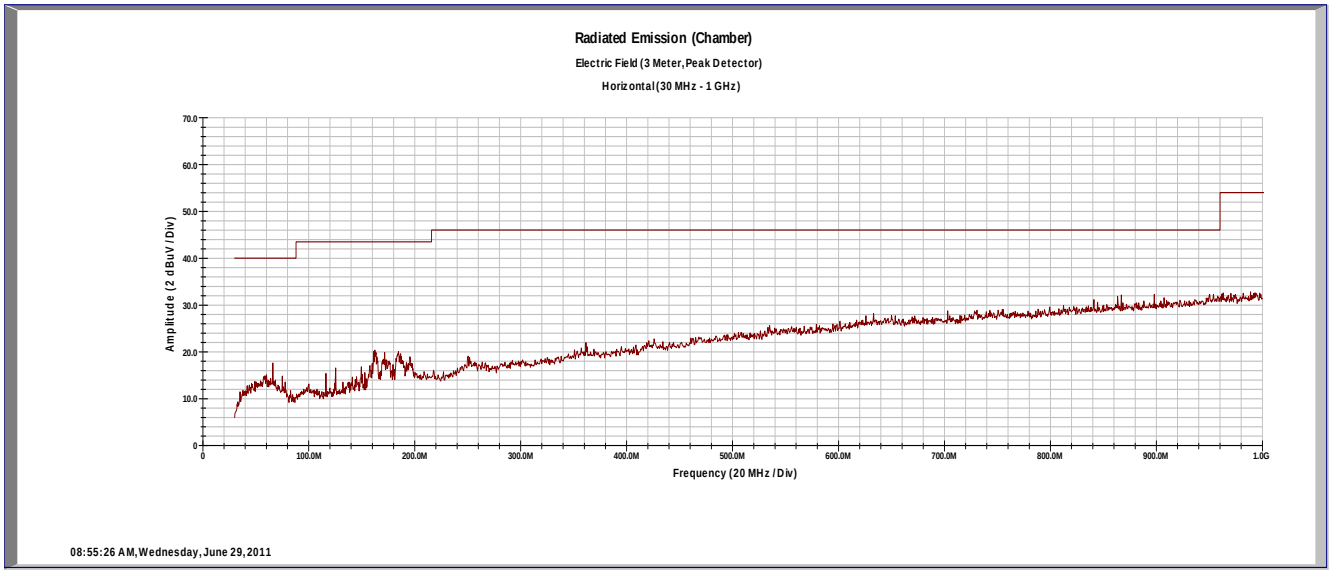
There were no deviations from the test methodology listed in the test plan for the radiated emission test.

6.1.4 Final Test

All final radiated emissions measurements were below (in compliance) the limits.

6.1.5 Final Graphs and Tabulated Data

Radiated Emissions Receive Mode w/ load – 30MHz to 1 GHz
Horizontal



Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)
162.64	H	1.6	342	3.68	0.00	1.39	10.90	15.97	43.50	-27.53
171.20	H	1.7	350	1.82	0.00	1.42	9.87	13.12	43.50	-30.38
184.68	H	1.6	0	1.71	0.00	1.48	10.23	13.43	43.50	-30.07

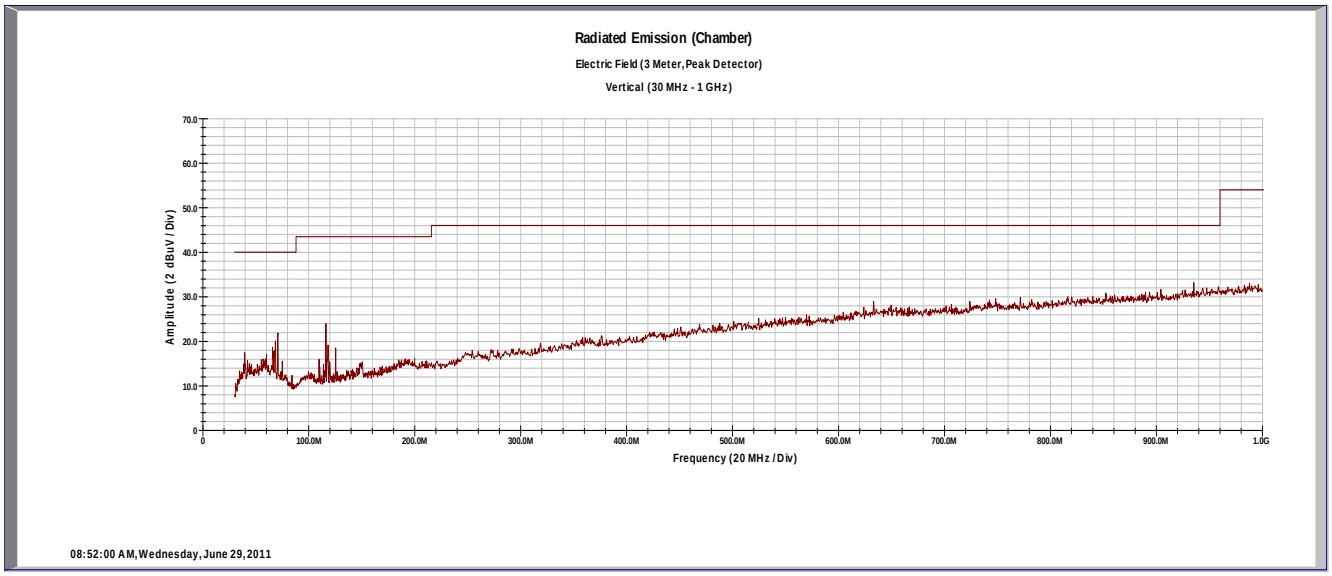
Spec Margin = E-Field Value - Limit, E-Field Value = FIM Value - Amp Gain + Cable Loss + ANT Factor ± Uncertainty

Combined Standard Uncertainty $u_c(y)$ = ± 1.6dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes:

Radiated Emissions Receive Mode w/ load – 30MHz to 1 GHz

Vertical



Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)
75.16	V	1.0	0	3.56	0.00	0.94	7.71	12.20	40.00	-27.80
116.12	V	1.0	260	0.12	0.00	1.16	6.57	7.85	43.50	-35.65
935.36	V	1.0	320	1.32	0.00	3.54	22.54	27.40	46.00	-18.60

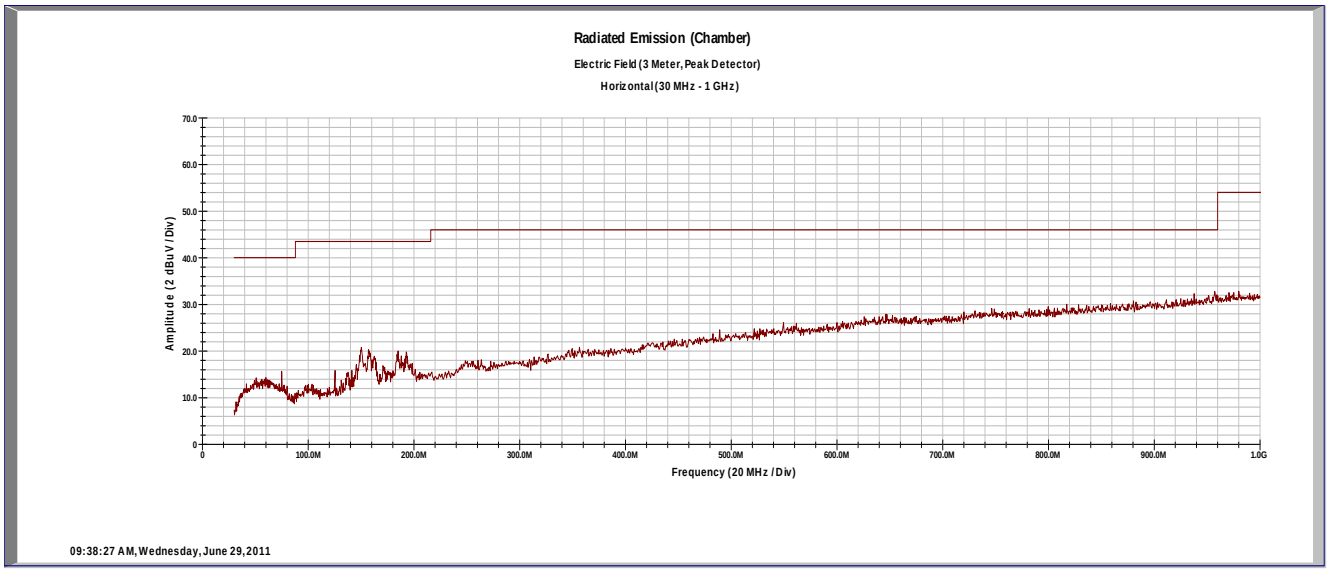
Spec Margin = E-Field Value - Limit, E-Field Value = FIM Value - Amp Gain + Cable Loss + ANT Factor ± Uncertainty

Combined Standard Uncertainty $u_c(y)$ = ± 1.6dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes:

Radiated Emissions Receive Mode no load – 30MHz to 1 GHz

Horizontal



Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)
150.32	H	1.8	5	6.01	0.00	1.33	8.69	16.03	43.50	-27.47

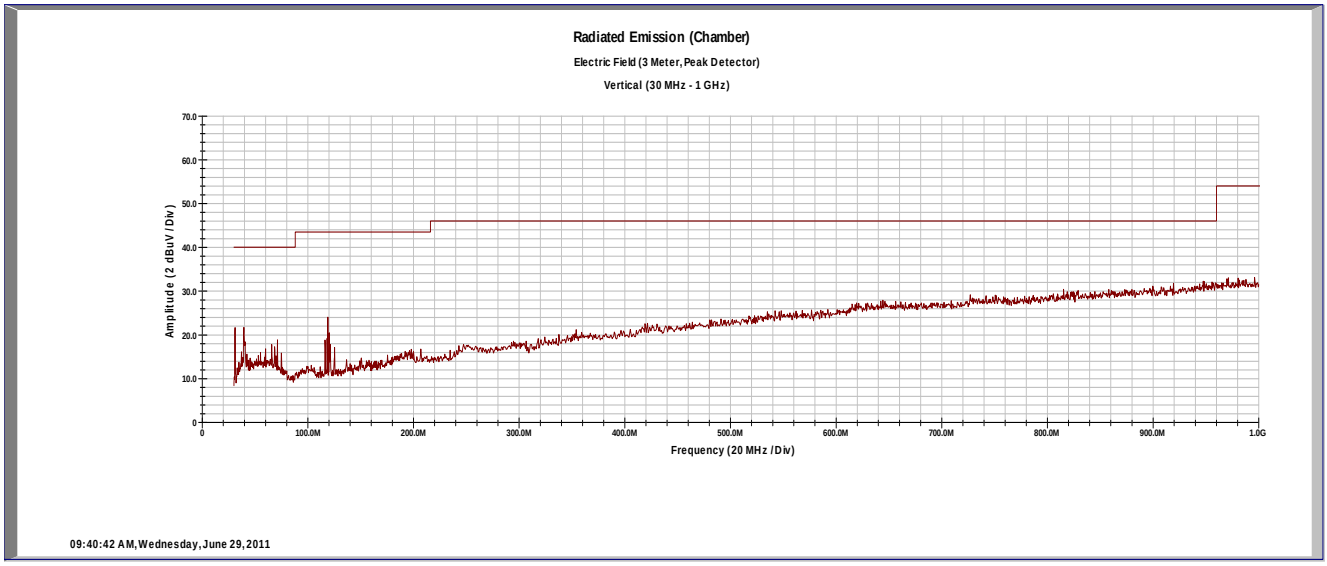
Spec Margin = E-Field Value - Limit, E-Field Value = FIM Value - Amp Gain + Cable Loss + ANT Factor ± Uncertainty

Combined Standard Uncertainty $u_c(y)$ = ± 1.6dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes:

Radiated Emissions Receive Mode no load – 30MHz to 1 GHz

Vertical



Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)

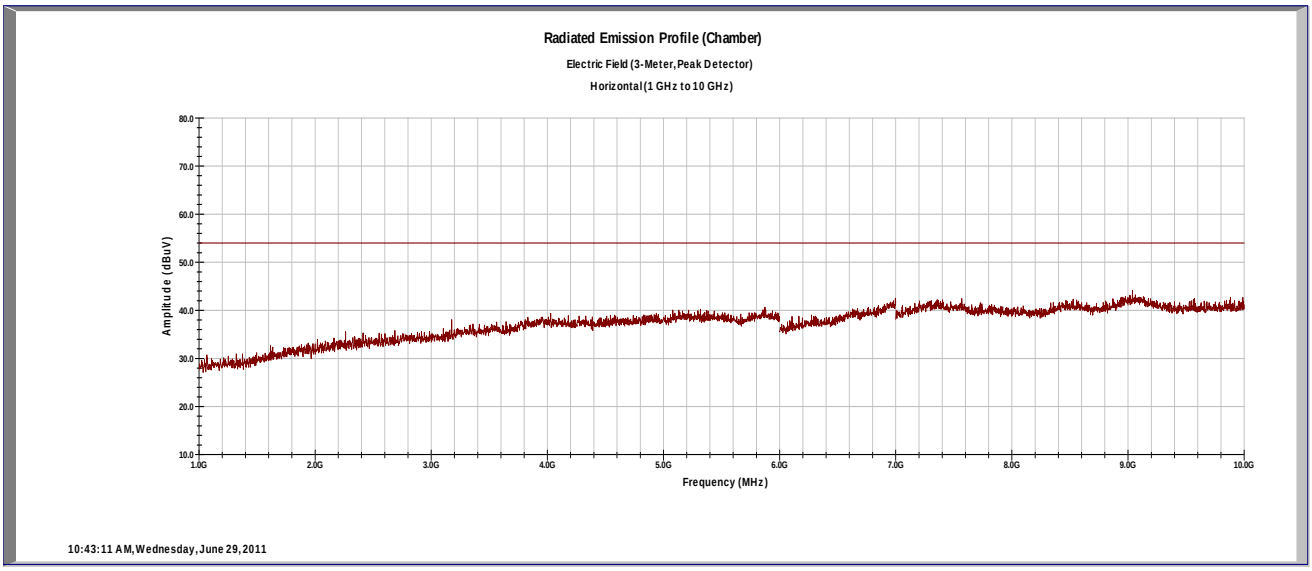
Spec Margin = E-Field Value - Limit, E-Field Value = FIM Value - Amp Gain + Cable Loss + ANT Factor ± Uncertainty

Combined Standard Uncertainty $u_c(y)$ = ± 1.6dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes:

Radiated Emissions Receive Mode w/ load – 1 GHz to 10 GHz

Horizontal



Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)

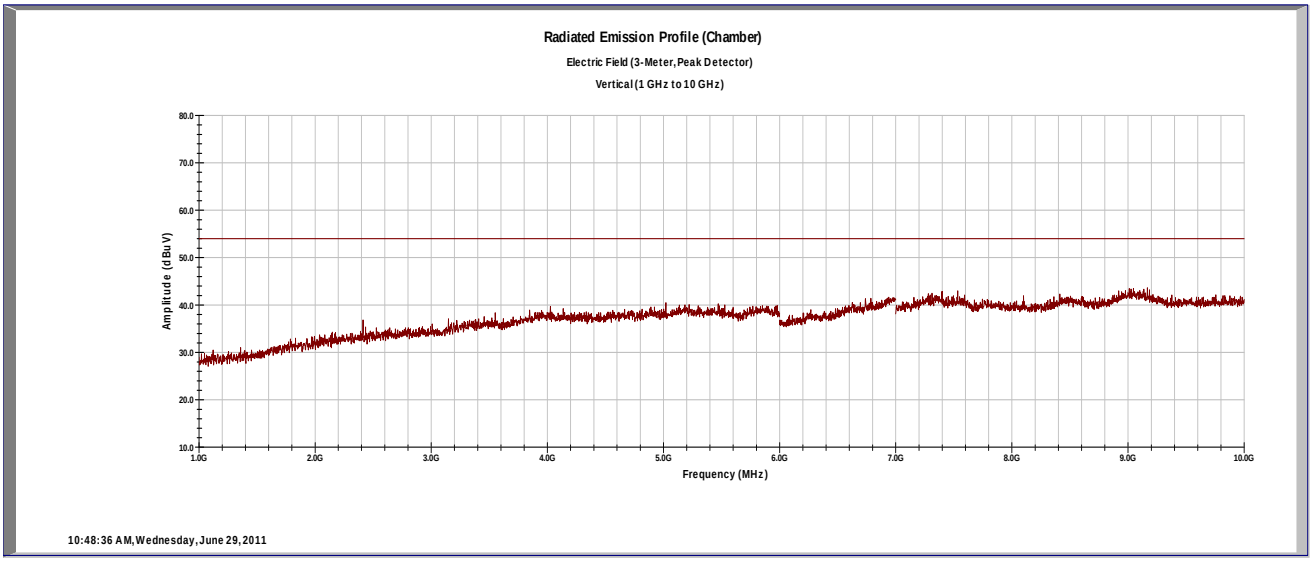
Spec Margin = E-Field Value - Limit, E-Field Value = FIM Value - Amp Gain + Cable Loss + ANT Factor ± Uncertainty

Combined Standard Uncertainty $u_c(y)$ = ± 1.6dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: All emissions are either more than 20dB below the limit, or below the noise floor of the receiver.

Radiated Emissions Receive Mode w/ load – 1 GHz to 10 GHz

Vertical



Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)

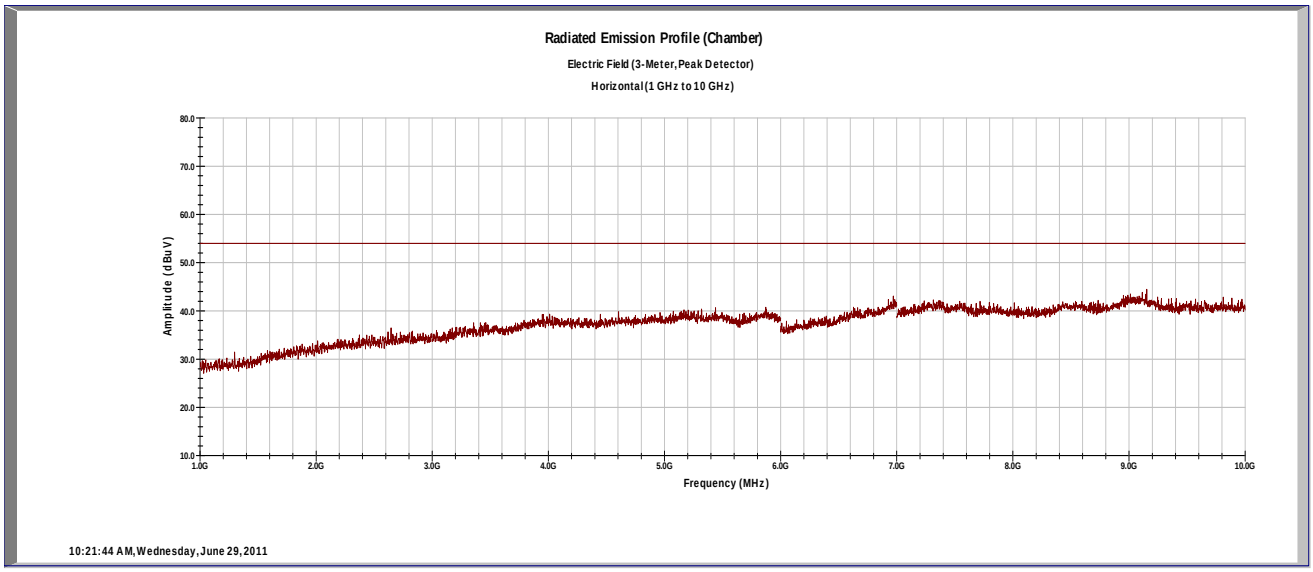
Spec Margin = E-Field Value - Limit, E-Field Value = FIM Value - Amp Gain + Cable Loss + ANT Factor ± Uncertainty

Combined Standard Uncertainty $u_c(y)$ = ± 1.6dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: All emissions are either more than 20dB below the limit, or below the noise floor of the receiver.

Radiated Emissions Receive Mode w/o load – 1 GHz to 10 GHz

Horizontal



Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)

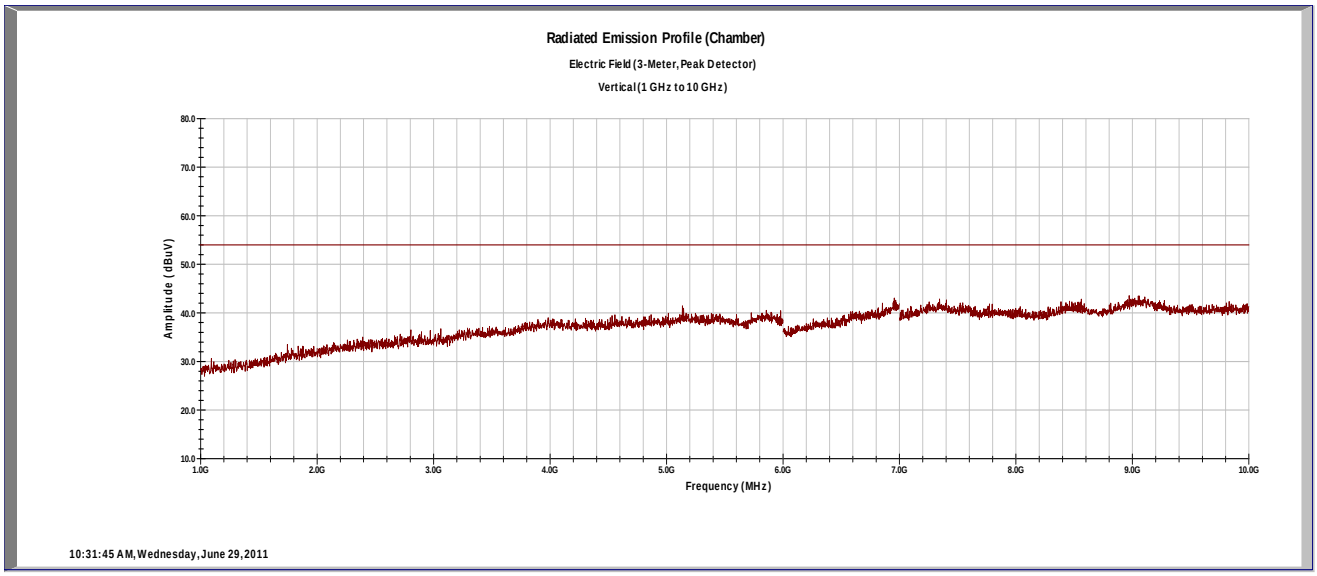
Spec Margin = E-Field Value - Limit, E-Field Value = FIM Value - Amp Gain + Cable Loss + ANT Factor ± Uncertainty

Combined Standard Uncertainty $u_c(y)$ = ± 1.6dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: All emissions are either more than 20dB below the limit, or below the noise floor of the receiver.

Radiated Emissions Receive Mode w/o load – 1 GHz to 10 GHz

Vertical



Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)

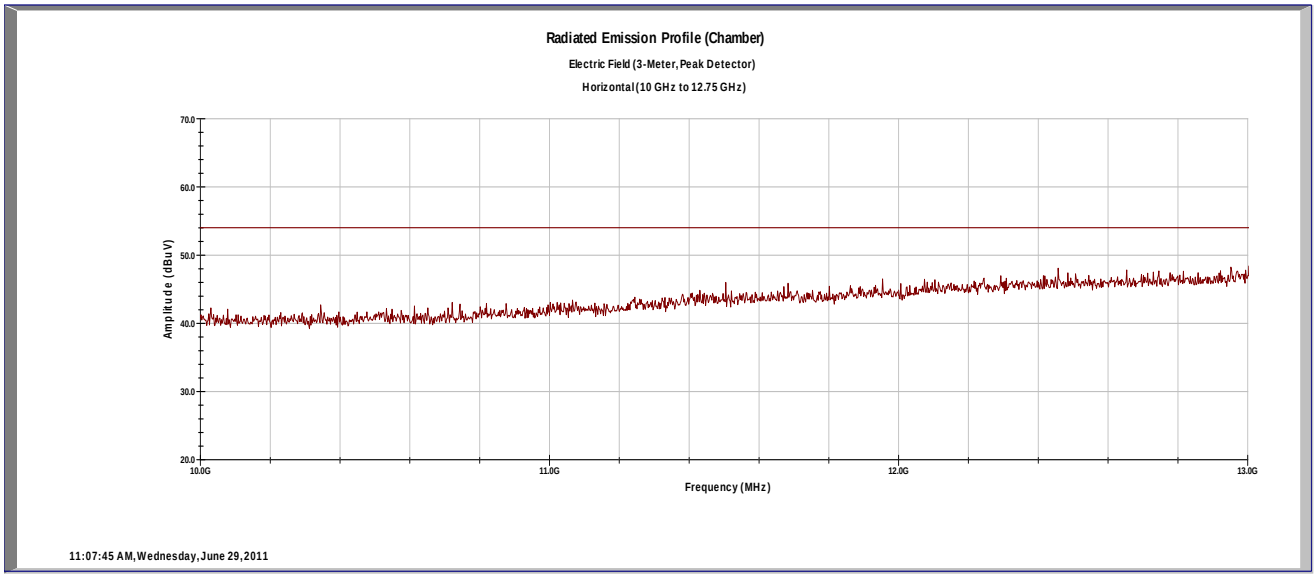
Spec Margin = E-Field Value - Limit, E-Field Value = FIM Value - Amp Gain + Cable Loss + ANT Factor ± Uncertainty

Combined Standard Uncertainty $u_c(y)$ = ± 1.6dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: All emissions are either more than 20dB below the limit, or below the noise floor of the receiver.

Radiated Emissions Receive Mode w/ load – 10 GHz to 13 GHz

Horizontal



Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)

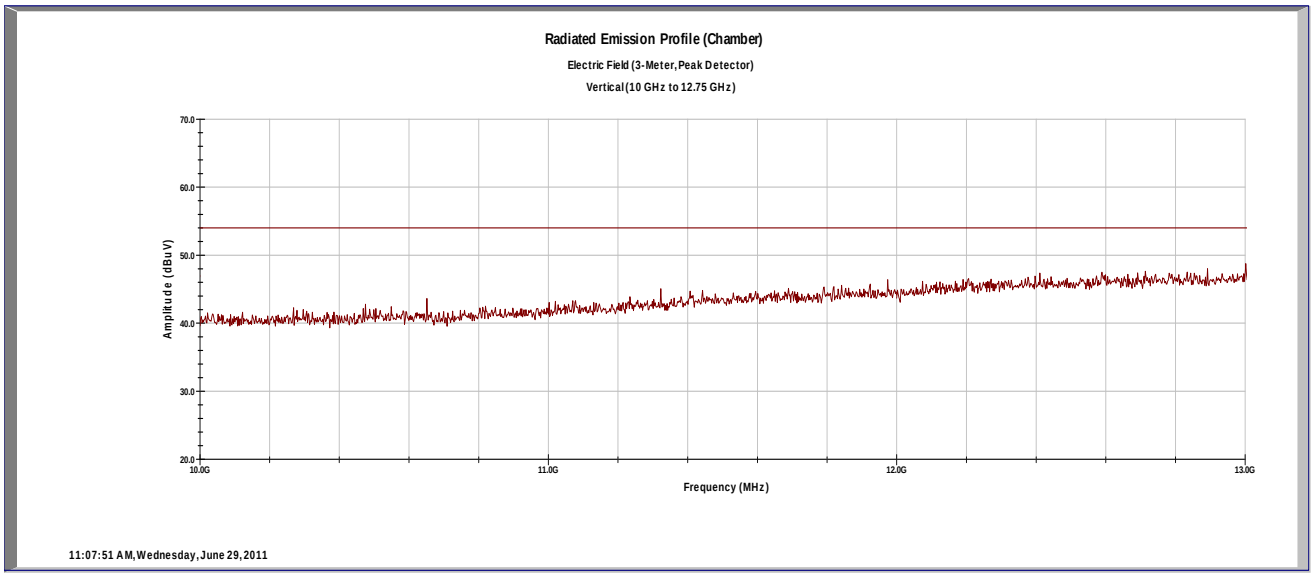
Spec Margin = E-Field Value - Limit, E-Field Value = FIM Value - Amp Gain + Cable Loss + ANT Factor ± Uncertainty

Combined Standard Uncertainty $u_c(y)$ = ± 1.6dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: All emissions are either more than 20dB below the limit, or below the noise floor of the receiver.

Radiated Emissions Receive Mode w/ load – 10 GHz to 13 GHz

Vertical



Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)

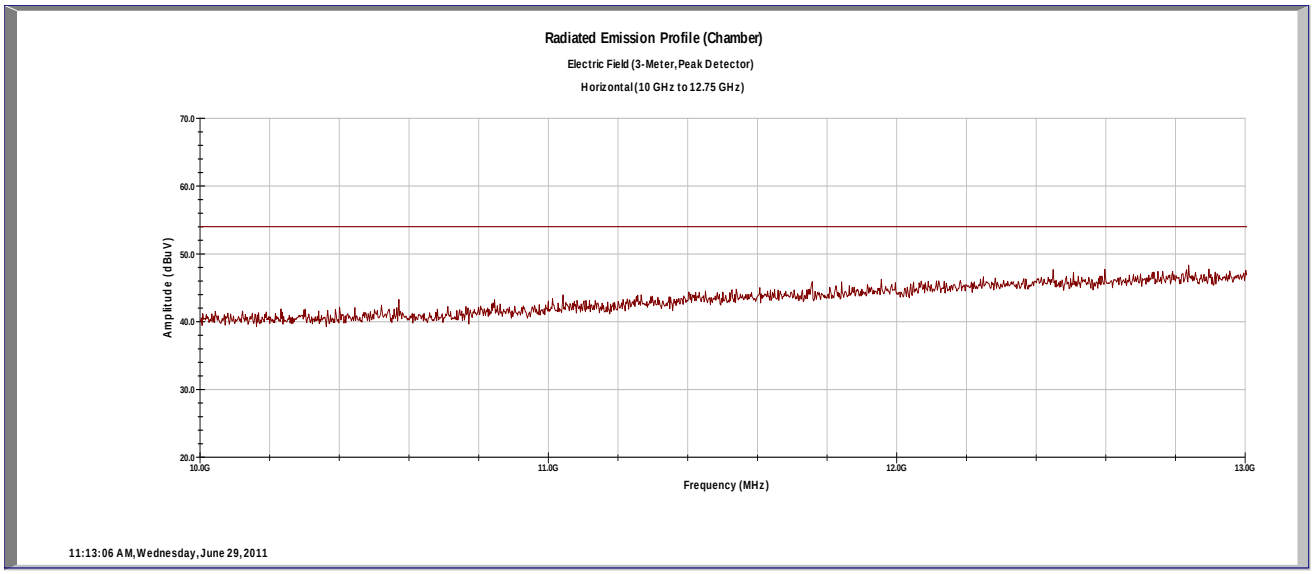
Spec Margin = E-Field Value - Limit, E-Field Value = FIM Value - Amp Gain + Cable Loss + ANT Factor ± Uncertainty

Combined Standard Uncertainty $u_c(y)$ = ± 1.6dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: All emissions are either more than 20dB below the limit, or below the noise floor of the receiver.

Radiated Emissions Receive Mode w/o load – 10 GHz to 13 GHz

Horizontal



Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)

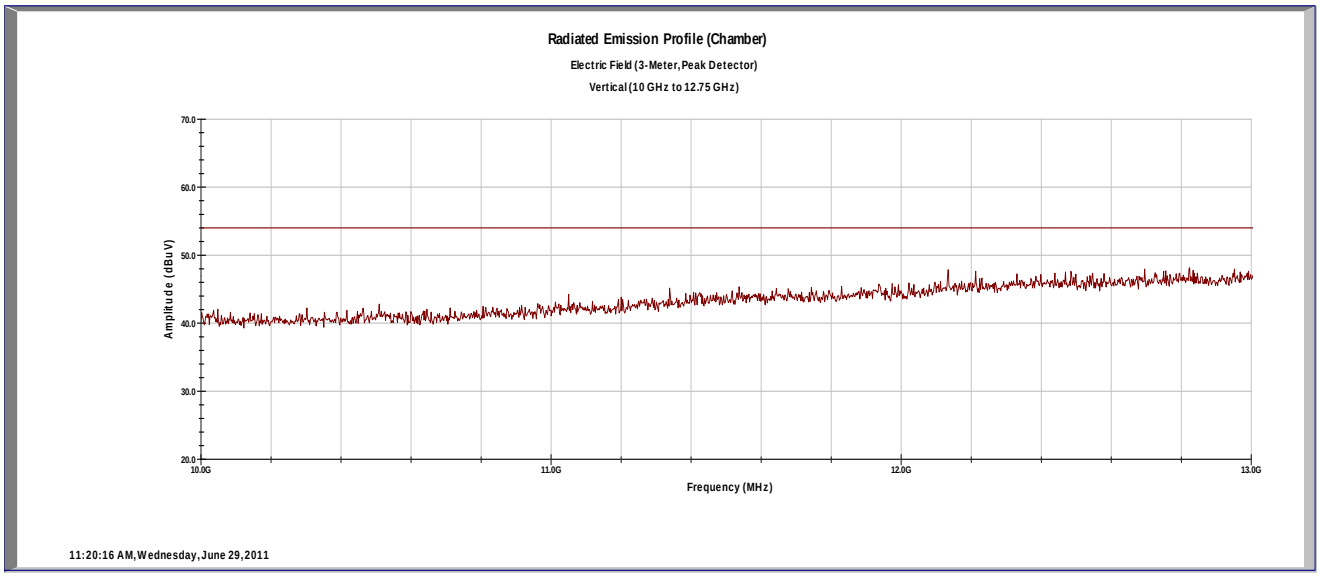
Spec Margin = E-Field Value - Limit, E-Field Value = FIM Value - Amp Gain + Cable Loss + ANT Factor ± Uncertainty

Combined Standard Uncertainty $u_c(y)$ = ± 1.6dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: All emissions are either more than 20dB below the limit, or below the noise floor of the receiver.

Radiated Emissions Receive Mode w/o load – 10 GHz to 13 GHz

Vertical



Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)

Spec Margin = E-Field Value - Limit, E-Field Value = FIM Value - Amp Gain + Cable Loss + ANT Factor ± Uncertainty

Combined Standard Uncertainty $u_c(y)$ = ± 1.6dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: All emissions are either more than 20dB below the limit, or below the noise floor of the receiver.

6.2 Conducted Emissions on AC Mains in Receive Mode

This test measures the electromagnet levels of spurious signals generated by the EUT on the AC power line that may affect the performance of other near by electronic equipment.

6.2.1 Over View of Test

Results	**Complies** (as tested per this report)				**Date**	28 June 2011	
Standard	FCC Part 15.107(b) and RSS-GEN						
Product Model	Limited Modular Device			**Serial#**	00FAF		
Test Set-up	Tested in shielded room. EUT placed on table, see test plans for details						
EUT Powered By	120-230V/60Hz	**Temp**	75º F	**Humidity**	46%	**Pressure**	998 mbar
Frequency Range	150 kHz – 30 MHz						
Perf. Criteria	(Below Limit)	**Perf. Verification**	Readings Under Limit for L1 & Neutral				
Mod. to EUT	None	**Test Performed By**	Mark Ryan				

6.2.2 Test Procedure

Conducted emissions tests were performed using the procedures of ANSI C63.4 including methods for signal maximizations and EUT configuration. The photos included with the report show the EUT in its maximized configuration.

The frequency range from 150Khz – 30Mhz was investigated for conducted emissions.

Conducted Emissions measurements were performed in either the shielded room or ground plane location (with attached vertical ground plane) using procedures specified in the test plan and standard.

6.2.3 Deviations

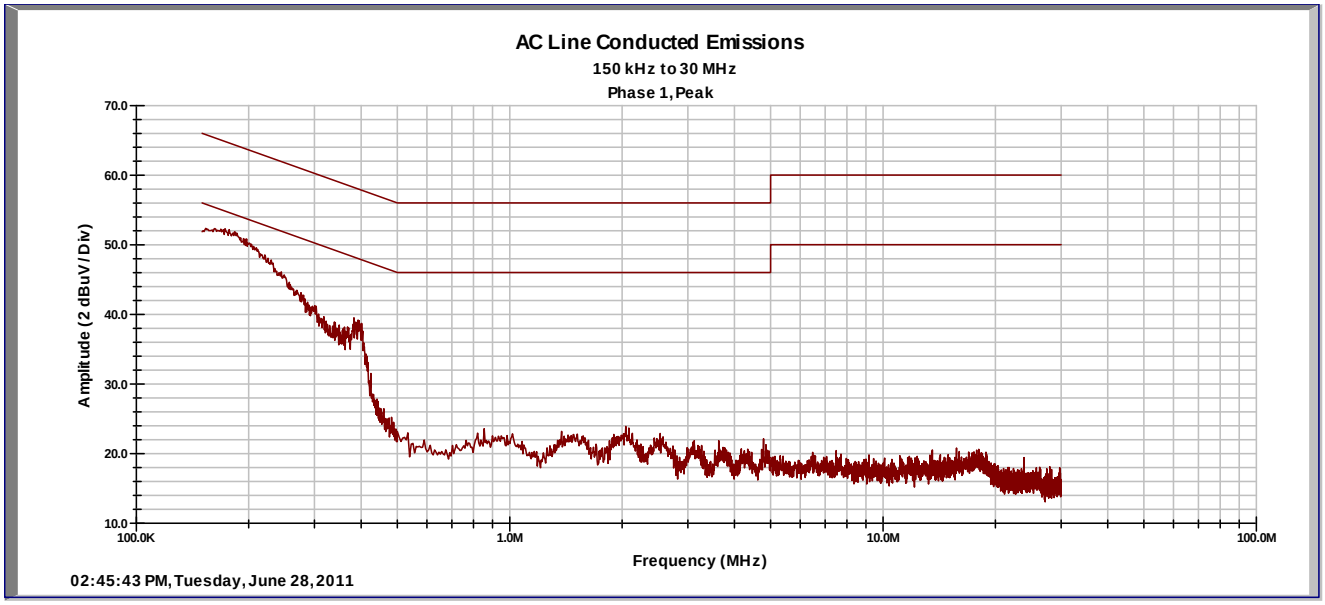
There were no deviations from the test methodology listed in the test plan for the conducted emission test.

6.2.4 Final Test

All final conducted emissions measurements were below (in compliance) the limits. It lists the final measurement data under the worst case operating modes, configurations, and/or cable positions. It also reflects the results including any modifications and/or special accessories.

Conducted Emissions @ 120V /60Hz – RX Mode

Line 1



Freq (MHz)	ID (1,2,3,N)	Quasi (dBuV)	Ave (dBuV)	Loss (dB)	T Limiter (dB)	Limit (dBuV)	Limit (dBuV)	Margin (dB)	Margin (dB)
0.16	1	38.75	18.91	0.03	9.89	65.26	55.26	-16.60	-26.44
0.39	1	23.56	8.93	0.04	9.90	57.98	47.98	-24.48	-29.11
2.00	1	8.57	2.98	0.09	9.97	56.00	46.00	-37.37	-32.96
3.14	1	6.14	0.36	0.11	10.01	56.00	46.00	-39.73	-35.51
4.38	1	4.69	0.14	0.14	10.08	56.00	46.00	-41.10	-35.65
18.03	1	3.60	0.02	0.28	10.36	60.00	50.00	-45.75	-39.33

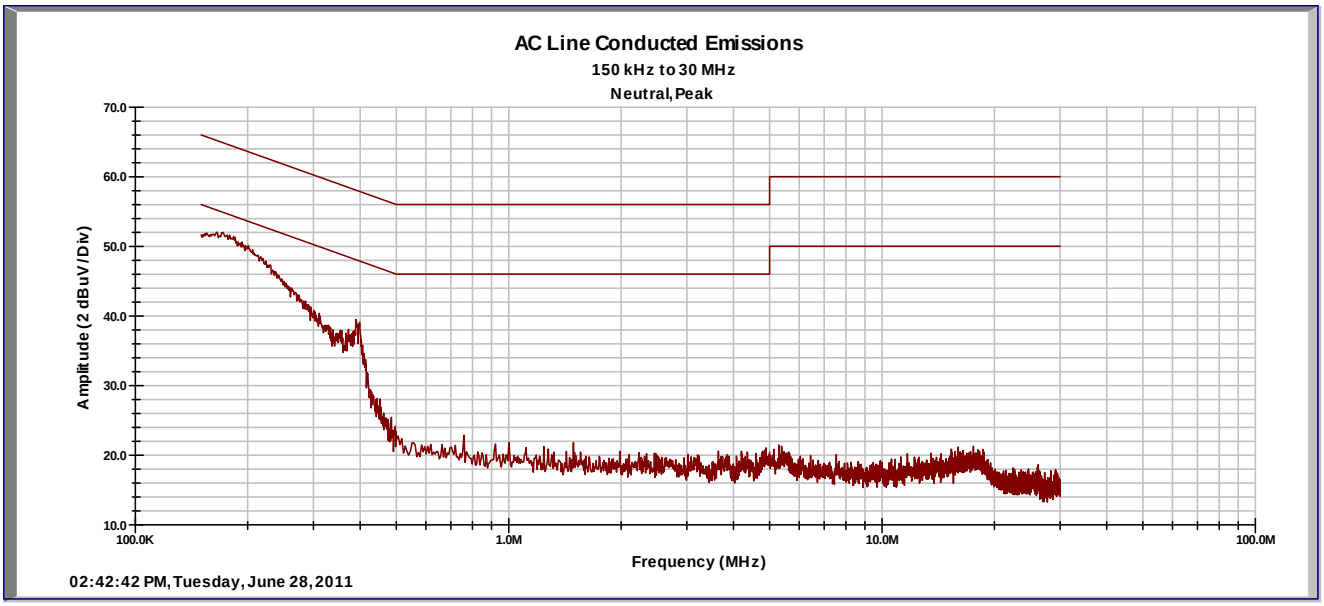
Quasi Spec Margin = Quasi FIM + Cable Loss + LISN CF - Quasi Limit ± Uncertainty
Ave Spec Margin = Ave FIM + Cable Loss + LISN CF - Ave Limit ± Uncertainty

Combined Standard Uncertainty $u_c(y)$ = ± 1.2dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes:

Conducted Emissions @ 120V /60Hz – RX Mode

Neutral



Freq (MHz)	ID (1,2,3,N)	Quasi (dBuV)	Ave (dBuV)	Loss (dB)	T Limiter (dB)	Limit (dBuV)	Limit (dBuV)	Margin (dB)	Margin (dB)
0.16	N	39.44	19.16	0.03	9.87	65.51	55.51	-16.17	-26.45
0.39	N	24.16	6.60	0.04	9.88	57.97	47.97	-23.88	-31.44
4.39	N	4.28	0.15	0.14	10.07	56.00	46.00	-41.51	-35.64
18.03	N	4.29	0.16	0.28	10.24	60.00	50.00	-45.19	-39.32

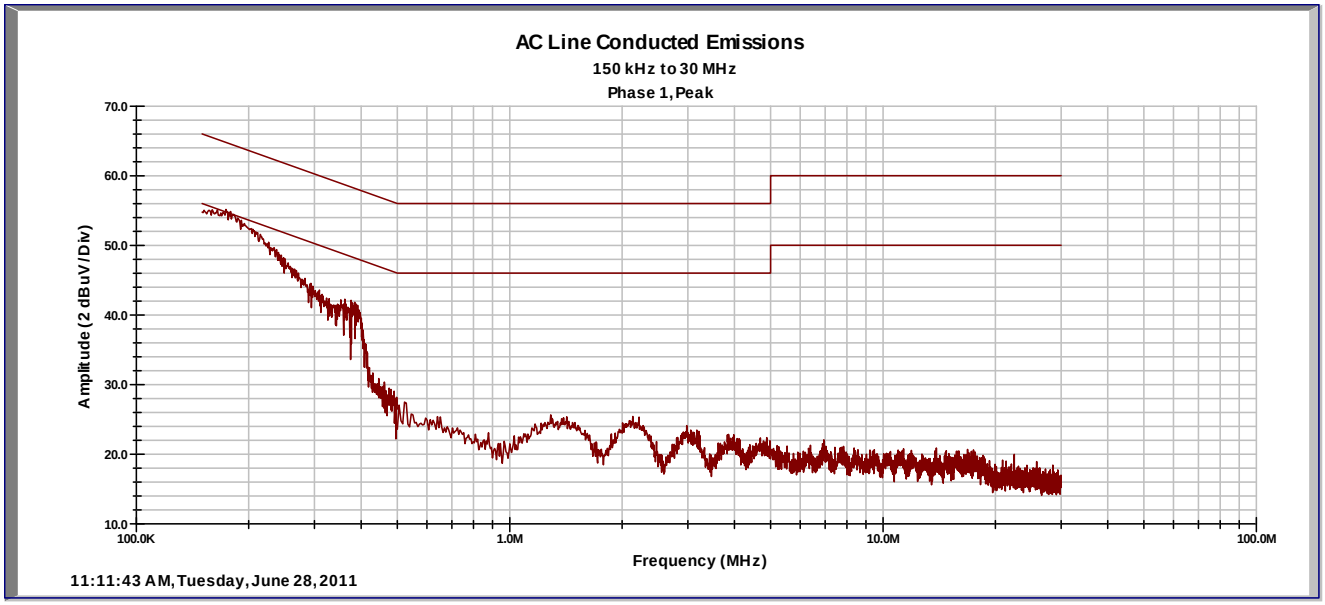
Quasi Spec Margin = Quasi FIM + Cable Loss + LISN CF - Quasi Limit ± Uncertainty
Ave Spec Margin = Ave FIM + Cable Loss + LISN CF - Ave Limit ± Uncertainty

Combined Standard Uncertainty $u_c(y)$ = ± 1.2dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes:

Conducted Emissions @ 230V/60Hz – RX Mode

Line 1



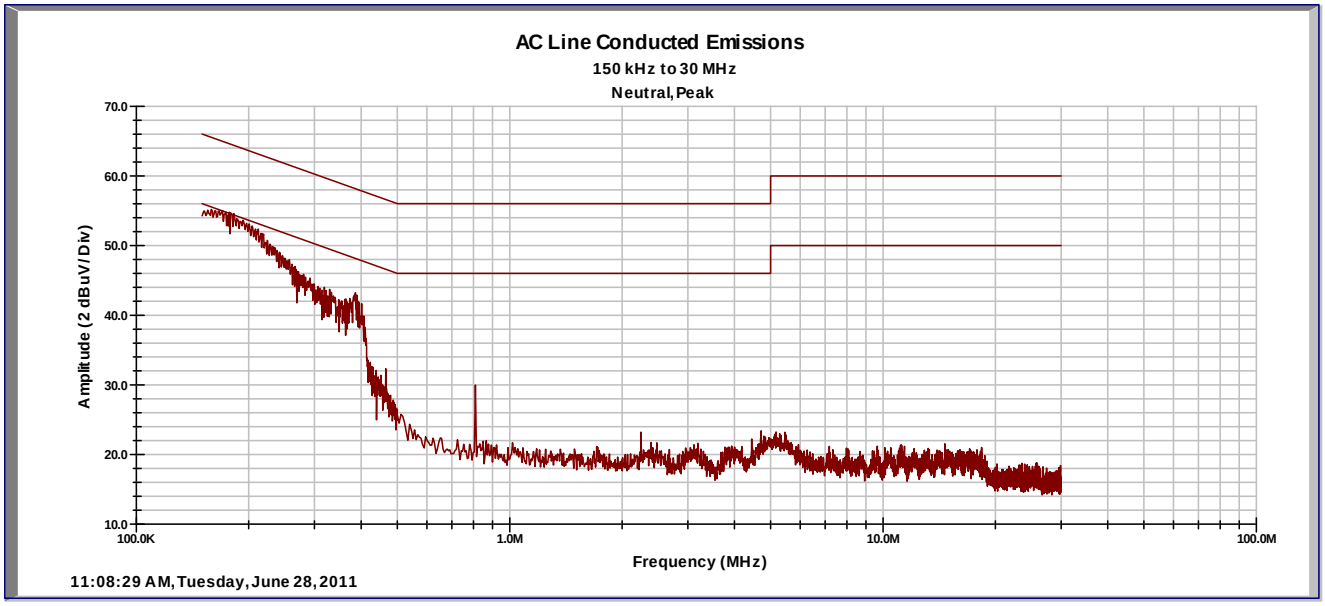
Freq (MHz)	ID (1,2,3,N)	Quasi (dBuV)	Ave (dBuV)	Loss (dB)	T Limiter (dB)	Limit (dBuV)	Limit (dBuV)	Margin (dB)	Margin (dB)
0.16	1	38.86	15.37	0.03	9.89	65.57	55.57	-16.80	-30.29
0.38	1	24.89	5.45	0.04	9.89	58.29	48.29	-23.47	-32.91
1.32	1	10.94	4.12	0.07	9.94	56.00	46.00	-35.06	-31.88
2.10	1	10.72	3.86	0.09	9.97	56.00	46.00	-35.22	-32.08
5.17	1	8.19	2.19	0.15	10.12	60.00	50.00	-41.54	-37.54
18.47	1	5.43	0.49	0.29	10.36	60.00	50.00	-43.92	-38.86

Quasi Spec Margin = Quasi FIM + Cable Loss + LISN CF - Quasi Limit ± Uncertainty
Ave Spec Margin = Ave FIM + Cable Loss + LISN CF - Ave Limit ± Uncertainty

Combined Standard Uncertainty $u_c(y)$ = ± 1.2dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes:

Conducted Emissions @ 230V/60Hz – RX Mode- Neutral



Freq (MHz)	ID (1,2,3,N)	Quasi (dBuV)	Ave (dBuV)	Loss (dB)	T Limiter (dB)	Limit (dBuV)	Limit (dBuV)	Margin (dB)	Margin (dB)
0.15	N	38.17	14.57	0.03	9.87	65.89	55.89	-17.83	-31.43
0.39	N	24.66	8.10	0.04	9.88	58.13	48.13	-23.55	-30.11
0.81	N	9.92	4.07	0.05	9.90	56.00	46.00	-36.13	-31.98
1.33	N	9.33	3.49	0.07	9.94	56.00	46.00	-36.67	-32.51
2.10	N	8.85	2.93	0.09	9.97	56.00	46.00	-37.08	-33.00
5.17	N	9.41	3.30	0.15	10.11	60.00	50.00	-40.33	-36.44
18.43	N	5.77	0.30	0.29	10.23	60.00	50.00	-43.71	-39.18

Quasi Spec Margin = Quasi FIM + Cable Loss + LISN CF - Quasi Limit ± Uncertainty
Ave Spec Margin = Ave FIM + Cable Loss + LISN CF - Ave Limit ± Uncertainty

Combined Standard Uncertainty $u_c(y)$ = ± 1.2dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes:

6.2.4.1 Sample Calculation

The signal strength is calculated by adding the LISN Correction Factor and Cable Loss to the measured reading. The basic equation is as follows:

Field Strength (dBµV/m) = FIM + CBL + LCF

Where: FIM = Field Intensity Meter (dBµV)
CBL = Cable Loss (dB)
LCF = LISN Loss (dB)

$$\mu V/m = 10^{\frac{dB\mu V/m}{20}}$$

7 RF Exposure

7.1 Exposure Requirements – FCC Parts 2.1091, 15.247(d), and RSS-102 Issue 4

FCC Part 15.247(d) states that SAR evaluation in not required if "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) of CFR 47."

RSS-102 section 2.5.1 states that a device is exempt from SAR evaluation if the frequency is "above 2.2 GHz and up to 3 GHz inclusively, and with output power (i.e. the higher of the conducted or radiated (e.i.r.p.) source-based, time-averaged output power) that is less than or equal to 20 mW for general public use…".

Test Procedure

If the antenna is located > 20cm from the user, then an MPE calculation is acceptable.

If the antenna is located < 20cm (portable / mobile / hand-held device) from the user, then SAR evaluation is required.

7.1.1 Evaluation

The EUT is a Zigbee - Modular Device and is intended to be separated from human contact by more than 20cm. Therefore the MPE calculation will be used.

7.2 MPE Calculation for FCC

In this document, we try to prove the safety of radiation harmfulness to the human body for our product. The limit for Maximum Permissible Exposure (MPE) specified in FCC 1.1310 is followed. The Gain of the antenna used in this product is measured in a Semi-Anechoic Chamber, and also the maximum total power input to the antenna is measured. Through the Friis transmission formula (see section 4.9.6) and the maximum gain of the antenna, we can calculate the distance, away from the product, where the limit of MPE is reached.

Although the Friis transmission formula is a far field assumption, the calculated result of that is an over-prediction for near field power density. We will take that as the worst case to specify the safety range.

7.2.1 RF Exposure Limit

According to FCC 1.1310 table 1: 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)

LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm^2)	Average Time (minutes)
(A)Limits For Occupational / Control Exposures				
300-1500	…	…	F/300	6
1500-100,000	…	…	5	6
(B)Limits For General Population / Uncontrolled Exposure				
300-1500	…	…	*f* /1500	6
1500-100,000	…	…	1.0	30

f = Frequency in MHz

7.2.2 EUT operating condition

The software provided by Manufacturer enabled the EUT to transmit data at lowest, middle and highest channel individually.

7.2.3 Classification

The antenna of the product, under normal use condition, is at least 20cm away from the body of the user. Warning statement to the user for keeping at least 20cm or more separation distance with the antenna should be included in users manual. Therefore, this device is classified as a **Mobile Device**.

7.2.4 Test Results

7.2.4.1 Antenna Gain

The maximum Gain of Inverted-F antenna is 3.3 dBi or 2.14 (numeric).

7.2.4.2 Output Power into Antenna & RF Exposure value at distance 20cm:

Calculations for this report are based on highest power measurement and the highest gain of the antenna. Limit for MPE (from FCC part 1.1310 table 1) is **1.0 mW/cm^2**

Highest Pout is 19.7dBm = 94 mW, highest antenna gain (in linear scale) is 2.14, R is 20cm, and f = 2400 MHz

Pd = (94*2.14) / (1600π) = **0.04 mW/cm^2**, which is well below to the 1 mW/cm^2 limit.

The Exposure time of 30 Minutes was not included nor required for this calculation.

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

7.3 Sample Calculation

The Friis transmission formula: $Pd = (Pout*G) / (4*\pi*R^2)$

Where;

Pd = power density in mW/cm2
Pout = output power to antenna in mW
G = gain of antenna in linear scale
$\pi \approx 3.1416$
R = distance between observation point and center of the radiator in cm

Ref. : David K. Cheng, *Field and Wave Electromagnetics*, Second Edition, Page 640, Eq. (11-133).

7.4 MPE Calculation for Industry Canada

7.4.1 Test Methodology

In this document, we try to prove the safety of radiation harmfulness to the human body for our product. The limit for Maximum Permissible Exposure (MPE) specified in RSS-102 section 4.2 is followed. The Gain of the antenna used in this product is measured in a Semi-Anechoic Chamber, and also the maximum total power input to the antenna is measured. Through the Friis transmission formula and the maximum gain of the antenna, we can calculate the distance, away from the product, where the limit of MPE is reached.

Although the Friis transmission formula is a far field assumption, the calculated result of that is an over-prediction for near field power density. We will take that as the worst case to specify the safety range.

7.4.2 RF Exposure Limit

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 Section 4.2 of RSS-102.

RF Field Strength Limits for Devices used by the General Public.

Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m^2)	Averaging Time (minutes)
0.003-1	280	2.19	-	6
1-10	$280/f$	$2.19/f$	-	6
10-30	28	$2.19/f$	-	6
30-300	28	0.073	2*	6
300-1500	$1.585\ f^{0.5}$	$0.0042\ f^{0.5}$	$f/150$	6
1500-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	$616000/f^{1.2}$
150000-300000	$0.158\ f^{0.5}$	$4.21 \times 10^{-4}\ f^{0.5}$	$6.67 \times 10^{-5}\ f$	$616000/f^{1.2}$

Note: f is frequency in MHz
*Power density limit is applicable at frequencies greater than 100 MHz.

7.4.3 EUT Operating condition

The software provided by Manufacturer enabled the EUT to transmit data at lowest, middle and highest channel individually.

7.4.4 Classification

The antenna of the product, under normal use condition, is at least 0.2 m away from the body of the user. Warning statement to the user for keeping at least 0.2m or more separation distance with the antenna should be included in users manual. Therefore, this device is classified as a **Mobile Device**.

7.4.5 Test Results

7.4.5.1 Antenna Gain

The maximum Gain of Inverted-F antenna is 3.3 dBi or 2.14 (numeric).

7.4.5.2 Output Power into Antenna & RF Exposure value at distance of 0.2 m:

Calculations for this report are based on highest power measurement and the highest gain of the antenna. Per the table in section 4.2 of RSS-102, the RF Field Exposure Limit is **10.0 W/m^2**

Highest Pout is 19.7dBm = 0.094 W, highest antenna gain (linear scale) is 2.14, R is 0.2m, and f = 2400 MHz

Pd = (0.094*2.14) / (0.16π) = **0.4 W/m^2**, which is well below to the 10 W/m^2 limit.

The Exposure time of 6 Minutes was not included nor required for this calculation.

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

7.4.6 Sample Calculation

The Friis transmission formula: $Pd = (Pout*G) / (4*\pi*R^2)$

Where;

Pd = power density in W/m^2
Pout = output power to antenna in W
G = gain of antenna in linear scale
$\pi \approx 3.1416$
R = distance between observation point and center of the radiator in cm

Ref. : David K. Cheng, *Field and Wave Electromagnetics*, Second Edition, Page 640, Eq. (11-133).

Appendix A

Test Plan

This test report is intended to follow this test plan outlined here in unless other wise stated in this here report. The following test plan will give details on product information, standards to be used, test set ups and refer to TUV test procedures. The test procedures will give the steps to be taken when performing the stated test. The product information below came via client, product manual, product itself and or the internet.

GENERAL INFORMATION

EUT: Display	**Zigbee - Modular Device**
Product Description:	**Measure amperage, voltage, and ohms and provide remote display capability so the user can view the measurement at a distance or outside an electrical cabinet etc.**
Model:	**Limited Modular Device**
Operation:	**A procedure was provided to the testing lab to control modulation, Frequency, and Mode of the device. Two test samples are provided; one with normal operating internal antenna, and a model with a cable connected directly to the transmitter output for conducted RF measurements.**

Test Plan Summary

Table 1: **EMC Test Plan Summary FCC& IC**

Test	Test Method ANSI C63.10	Test Parameters (from Standard)
Spurious Emission in Received Mode	CFR47 15.109, RSS-GEN Sect.7.2.3	Class B
Spurious Emission in Transmitted Mode	CFR47 15.209, RSS-GEN Sect.7.2.3	Class B
Restricted Bands of Operation	CFR47 15.205, RSS 210 Sect.2.6	Class B
AC Power Conducted Emission	CFR47 15.207, RSS-GEN Sect.7.2.2	Class B
Occupied Bandwidth	CFR47 15.247 (a2), RSS GEN Sect.4.4.1	500kHz minimum
Maximum Transmitted Power	CFR47 15.247 (b3), RSS 210 Sect. A.8.4	30dBm w/ 6dBi antenna
Peak Power Spectral Density	CFR47 15.247 (e), RSS 210 Sect. A.8.2	8dBm/ 3kHz.
Band edge Measurement	CFR47 15.247 (d), RSS 210 Sect. A.8.5	20dBr
RF Exposure	CFR47 15.247 (i), 2.1091	General Population