TEST REPORT

Report Number:102271213DEN-001A
Project Number: G102271213

Report Issue Date: October 27, 2015

Product Designation: **Model: 31570014**

Standards: **FCC Part 15 Subpart C (15.247)**
Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz
IC RSS-247, Issue 1: 2015
IC RSS-GEN, Issue 4: 2014

Tested by:	Client:
Intertek Testing Services NA, Inc.	Ampt
1795 Dogwood St. Suite 200	4850 Innovation Drive
Louisville, CO 80027	Fort Collins, CO 80525

Report prepared by	Report reviewed by
Michael Spataro	Ollie Moyrong
Engineering Team Leader	Engineering Manager

TABLE OF CONTENTS

1 Introduction and Conclusion

The tests indicated in section 2.0 were performed on the product constructed as described in section 3.0. The remaining test sections are the verbatim text from the actual data sheets used during the investigation. These test sections include the test name, the specified test Method, a list of the actual Test Equipment Used, documentation Photos, Results and raw Data. No additions, deviations, or exclusions have been made from the standard(s) unless specifically noted.

Based on the results of our investigation, we have concluded **the product tested complies with the requirements of the standard(s) indicated.** The results obtained in this test report pertain only to the item(s) tested.

1.1 Test Methodology

All measurements were performed according to the procedures in the following documents:

- ANSI C63.10: 2013 – ANSI Standard for Testing Unlicensed Wireless Devices
- A temporary antenna port was utilized for conducted port measurements.
- The EUT incorporates both FHSS and DTS transmission techniques, this report covers only the DTS requirements.

1.2 Test Facility

Intertek Denver's testing facilities are located at 1795 Dogwood St. Suite 200 Louisville, CO 80027. The testing facility is ISO17025:2005 accredited by A2LA, our lab code is 2506.02, our VCCI registration numbers are. R-1643, C-1752 and T-1558, our FCC designation no. US1121 and our IC lab no. 2042N.

Testing contained in this test report may not be covered under the laboratories scope of accreditation.
A note will be placed in the specific test section for testing not coved under the laboratories scope.

2 Test Summary

TEST SECTION	TESTS	FCC/IC REFERENCE	TEST DATE	RESULT
5	AC Voltage Variation	FCC 15.31(e)	9/30/2015	Pass
6	Antenna Requirement	FCC 15.203	10/1/2015	Pass
7	DTS Requirement	FCC 15.247(a) RSS-247 5.2	10/1/2015	Pass
8	6dB Bandwidth	FCC 15.247(a)(2) RSS-247 5.2(1)	9/30/2015	Pass
9	RF Conducted Output Power (includes requirements for antenna gain > 6dBi)	FCC 15.247(b)(3)(4) RSS-247 5.4(4)	9/30/2015	Pass
10	RF Conducted Spurious Emissions (-20dBc) Includes Band Edge	FCC 15.247(d) RSS-247 5.5	9/30/2015	Pass
11	Transmitter Radiated Spurious Emissions (Restricted Bands – Band Edge)	FCC 15.247(d) FCC 15.209/15.205 RSS-247 5.5 RSS-Gen 8.10	10/2/2015	Pass
12	Power Spectral Density (PSD)	FCC 15.247(e) RSS-247 5.2(2)	9/30/2015	Pass
13	Radiated Emissions – Digital Receiver	FCC 15.109 RSS-Gen 7.1	Note 3	NA
14	Tx AC Line Conducted Emissions	FCC 15.207 RSS-Gen 8.8	Note 1	NA
15	RF Exposure Requirement	FCC 15.247(i) FCC 15.1.1307(b)(1) RSS 102	10/2/2015	Pass
16	Duty Cycle/ Duty Cycle Correction Factor	FCC 15.35(c) RSS-Gen 6.10	Note 2	NA

Notes:
1) The product is DC-powered only.
2) No duty cycle correction was utilized for this report
3) Unintentional and receiver spurious are covered under test report 102271213DEN-001

Description of Product Under Test

Model:	31570014
Type of EUT:	DC to DC 1000V String Converter
Serial Number:	0815K000002
FCC ID:	X3R-31570014
Industry Canada ID:	8399A-31570014
Related Submittal(s) Grants:	NA
Company:	Ampt LLC
Customer:	Ampt LLC
Address:	4850 Innovation Drive Fort Collins, CO 80525
Phone:	+1(970)-372-6960
Fax:	+1(970)-225-0483
e-mail:	Robin.richardson@ampt.com
Test Standards:	☒ 47 CFR, Part 15C:§15.247 DTS ☒ RSS–247, Issue 1, 2015 ☒ RSS-Gen, Issue 4, 2014 ☐ 47 CFR, Part 15C:§15.207 ☐ Other
Type of radio:	☒ Stand -alone ☐ Module ☐ Hybrid
Date Sample Submitted:	9/22/2015
Test Work Started:	9/30/2015
Test Work Completed:	10/1/2015
Test Sample Conditions:	☐ Damaged ☐ Poor (Usable) ☒ Good

Product Description:	Combines power from two input strings to one output string while ensuring the output string voltage does not exceed the maximum system voltage. The intentional radiator can operate as a FHSS device with a data rate of 12kbps or as a DTS with a data rate of 500kbps.This test report covers only the DTS parameters.
Transmitter Type:	☐ FHSS ☒ Digital Modulation ☐ WiFi ☐ Blue Tooth
Operating Frequency Range(s):	2.41 – 2.4745 GHz
Number of Channels:	500
Modulation:	MSK
Antenna(s) Info:	Integral Trace antenna
Rated Power:	1.8 mW (conducted)
Antenna Installation:	☐ User ☐ Professional ☒ Factory
Transmitter power configuration:	☐ Internal battery ☒ External power source
Special Test Arrangement:	NA
Test Facility Accreditation:	A2LA (Certificate No. 2506.01)
Test Methodology:	Measurements performed according to the procedures in ANSI C63.10-2013

2.1 Product Description - Detailed

Description of Equipment Under Test (provided by client)
Combines power from two input strings to one output string while ensuring the output string voltage does not exceed the maximum system voltage.

Equipment Under Test Power Configuration			
Rated Voltage	Rated Current	Rated Frequency	Number of Phases
Input: 700Vdc Output: 1000Vdc	8.0A x 2 (inputs) Output: 11.2kWdc	DC	---

Descriptions of EUT Exercising
☐ Standby/Idle Mode
☒ Continuous transmission, un-modulated carrier (CW)
☒ Continuous transmission, modulated carrier (CW) utilizing worst-case data rate
☒ Continuous Receive Mode

Note: The chosen mode of operation described above is dependent upon the specific test to be performed.

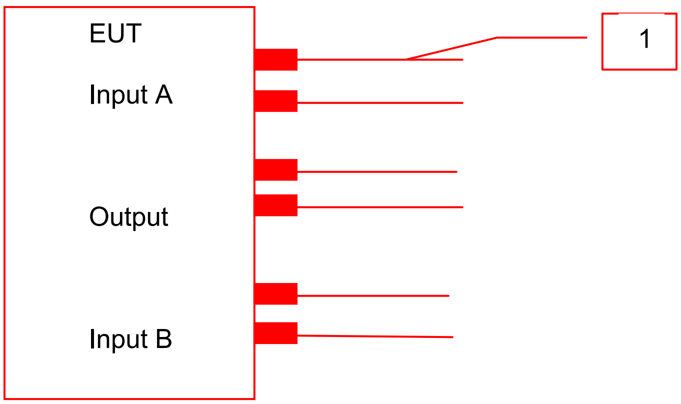
3 System setup including cable interconnection details, support equipment and simplified block diagram

3.1 Method:

Record the details of EUT cabling, document the support equipment, and show the interconnections in a block diagram.

3.2 EUT Block Diagram:

Note: None



3.4 Antenna Specifications:

2.4 GHz					
Model	**Type**	**Gain (dBi)**	**Beamwidth (degrees)**	**Polarization**	**Datasheet**
NA	Integral Trace	1	NA	Horizontal	NA

3.5 Determination of RF Power supplied to antenna input for testing

Per FCC 15.247(b)(4)(i): Systems operating in the 2400-2483.5 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

Antenna tested: Integral trace antenna, no data sheet.

Support Data:

ID	Description/ Function	Shield Type	Length	Connector	Connection	Ferrites
1	DC power	NA	>3m	NA	DC	NA

Support Equipment			
Description	Manufacturer	Model Number	Serial Number
Laptop	Dell	NA	NA

Notes: Only DC power needed to power the radio was supplied for this testing.

3.6 Photograph: Product Tested

4 AC Voltage Variation/ Battery Requirement

4.1 Method:

The test methods used comply with ANSI C63.10.

This testing was performed at Intertek Denver, located at 1795 Dogwood St. Suite 200, Louisville, CO 80027.

4.2 Test Requirement/Specification:

- ANSI C63.10:2013, Section 6.8.2/15.31(e)

4.3 Test Equipment Used:

Asset ID	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DEN-073	EMI Receiver (10Hz – 26.5GHz)	RHODE & SCHWARZ	ESU 26	100265	12/10/2014	12/10/2015
DEN-206	RF Conducted Port Cable	-----	True Blue	14-11-401	12/23/2014	12/23/2015
18891	AC Power Supply	Pacific Power	360AMXT	0165	VBU	VBU
DEN-136	DMM	Fluke	87 V	20100152	5/18/2015	5/18/2016

4.4 Results:

There is no significant difference in the radiated field strength of the fundamental frequency with respect to varying the ac voltage. Therefore, all measurements will be taken using the nominal rated voltage of the product.

4.5 Test Data:

FREQ	LEVEL	DET	CABLE	FINAL	RBW
MHz	dBm	Qp Av Pk	+ [dB]	= [dBuV]	(MHz)
AC @ Nominal Voltage – 120 VAC / 60 Hz					
2410.0	0.00	0.00	0.00	0.00	0.00
AC @ 115% Nominal Voltage – 138 VAC / 60 Hz					
2410.0	0.00	0.00	0.00	0.00	0.00
AC @ 85% Nominal Voltage – 102 VAC / 60 Hz					
2410.0	-0.01	-0.01	-0.01	-0.01	-0.01

For testing of the intentional transmitter the EUT was supplied with power from an external power adapter connected to the AC mains.

5 Antenna Requirement

Unless otherwise stated no deviations were made from FCC Part 15.203.

This testing was performed at Intertek Denver, located at 1795 Dogwood St. Suite 200, Louisville, CO 80027.

5.1 Test Requirement/Specification

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. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.
The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

5.2 Results:

The sample tested was found to comply.

The product incorporates an integral trace antenna that is not accessible to the user.

6 DTS Requirement

Unless otherwise stated no deviations were made from FCC Part 15.247.

This testing was performed at Intertek Denver, located at 1795 Dogwood St. Suite 200, Louisville, CO 80027.

6.1 Test Requirement/Specification

Operation under the provisions of this Section is limited to digitally-modulated intentional radiators.

- FCC 15.247(a)(2)

6.2 Results:

The sample tested was found to comply.

The product incorporates the following digital modulations and data rates.

- MSK @ 500kbps

7 DTS Bandwidth (6dB Bandwidth)

7.1 Method:

The test methods used comply with ANSI C63.10. Unless otherwise stated no deviations were made from FCC 15.247 or RSS-247.

This testing was performed at Intertek Denver, located at 1795 Dogwood St. Suite 200, Louisville, CO 80027.

7.2 Test Requirement/Specification

- 15.247(a)(1)
- RSS-247 5.2(1)

7.3 Test Equipment Used:

Asset ID	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DEN-073	EMI Receiver (10Hz – 26.5GHz)	RHODE & SCHWARZ	ESU 26	100265	12/10/2014	12/10/2015
DEN-206	RF Conducted Port Cable	-----	True Blue	14-11-401	12/23/2014	12/23/2015
SW-6	Software for Radiated and Conducted emissions.	Intertek	OATS vba	V. 3.0	VBU	VBU

7.4 Results:

The sample tested was found to comply.

7.5 Test Summary:

Frequency Range:	☐ 902-928MHz ☒ 2400-2483.5MHz ☐ 5725-5850MHz			
Low Frequency Channel (kHz)	**Middle Frequency Channel (kHz)**	**Upper Frequency Channel (kHz)**	**Limit (kHz)**	**Result**
506	506	503	>500kHz	**Pass**
Span:	5MHz			
RBW:	☐ 3kHz ☐ 30kHz ☒ 100kHz ☐ other kHz			
VBW:	☐ 3kHz ☐ 10kHz ☐ 100kHz ☒ other 300kHz			

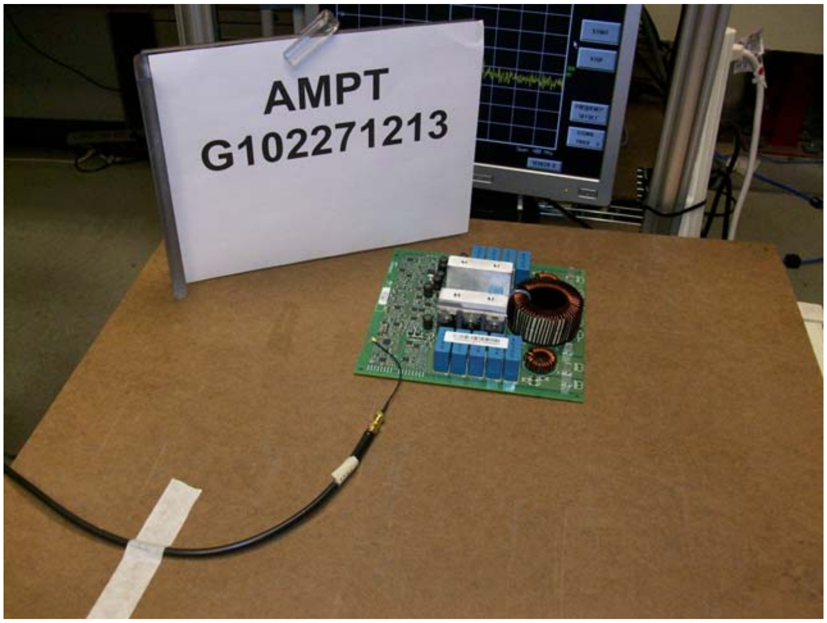
7.6 Test Method:

- ANSI C63.10:2013, Section 11.8

7.7 Notes:

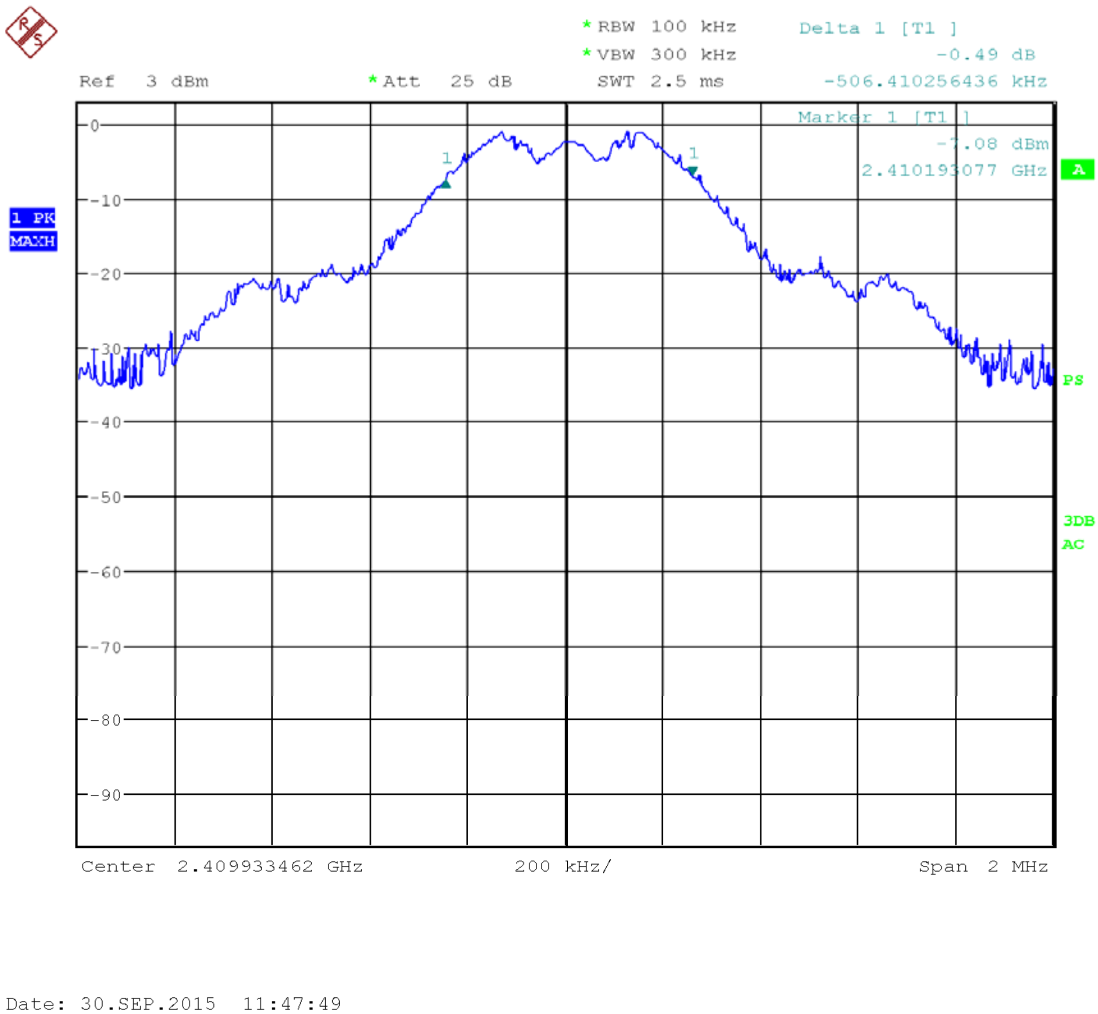
1. The limit for RSS-247 is identical to the limit for FCC 15.247.

7.8 Setup Photographs: Conducted Port

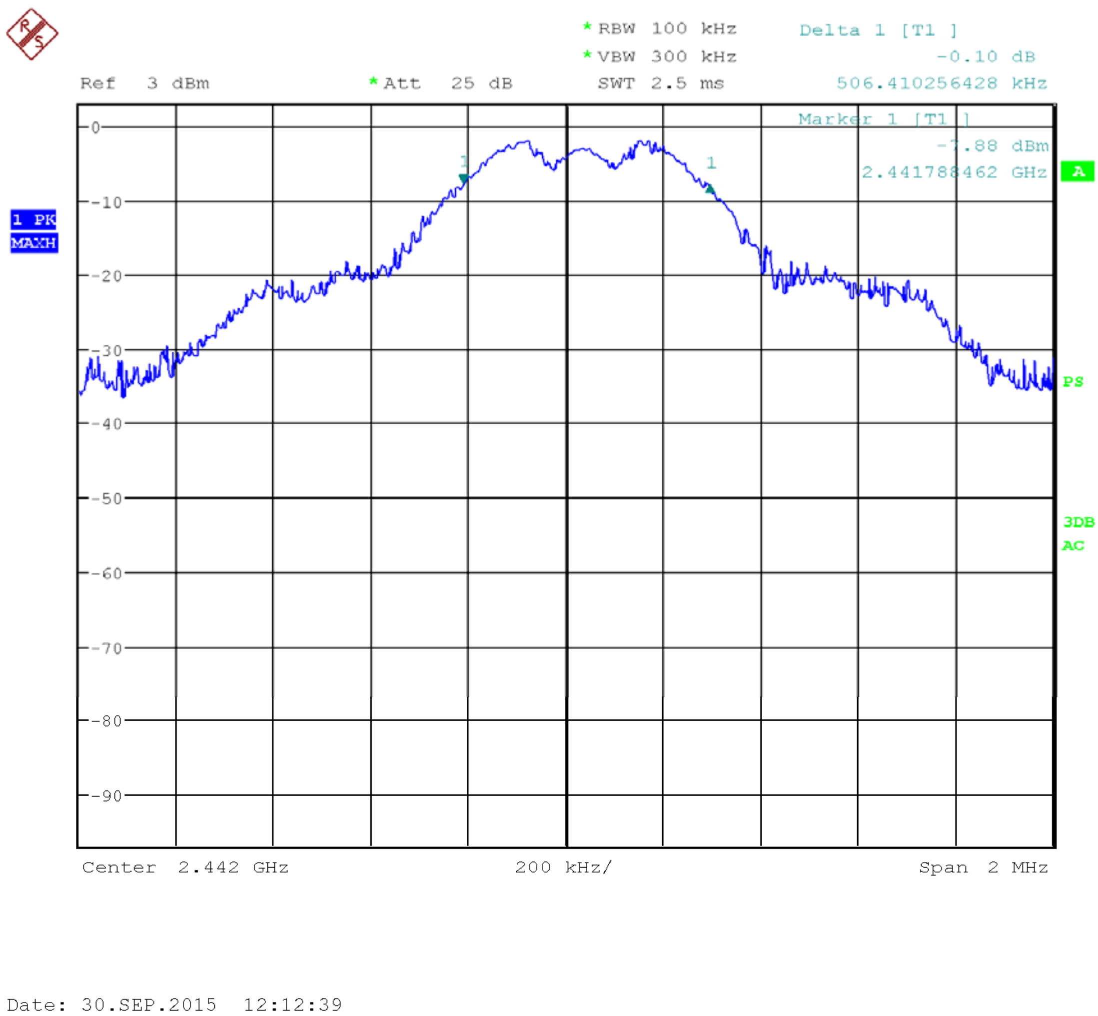


7.9 Plots: 6 dB Bandwidth

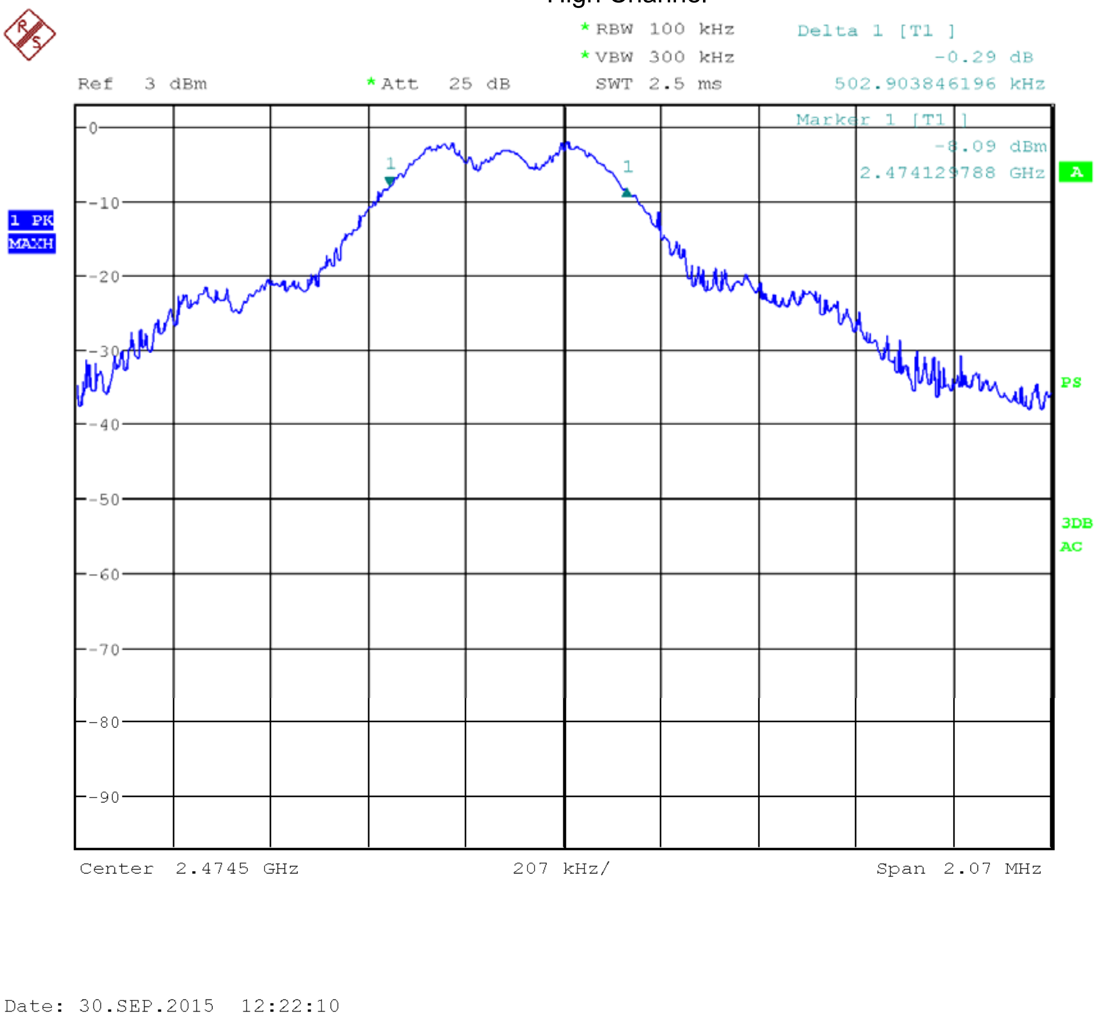
Low Channel



Mid Channel


*RBW 100 kHz
*VBW 300 kHz
Ref 3 dBm
*Att 25 dB
SWT 2.5 ms
Delta 1 [T1]
-0.10 dB
506.410256428 kHz
Marker 1 [T1]
-7.88 dBm
2.441788462 GHz
1 PK
MAXH
A
PS
3DB
AC
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
Center 2.442 GHz
200 kHz/
Span 2 MHz
Date: 30.SEP.2015 12:12:39

High Channel



8 RF Conducted Output Power

8.1 Method:

The test methods used comply with ANSI C63.10 section 6.10.1. Unless otherwise stated no deviations were made from FCC 15.247 or RSS-247.

This testing was performed at Intertek Denver, located at 1795 Dogwood St. Suite 200, Louisville, CO 80027.

8.2 Test Requirement/Specification:

The maximum peak conducted output power

Fundamental Frequency	Output power (Watts)
2400-2483.5 MHz	1

- FCC 15.247(b)(1)
- RSS-247 5.4(4)

8.3 Test Equipment Used:

Asset ID	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DEN-073	EMI Receiver (10Hz – 26.5GHz)	RHODE & SCHWARZ	ESU 26	100265	12/10/2014	12/10/2015
DEN-206	RF Conducted Port Cable	-----	True Blue	14-11-401	12/23/2014	12/23/2015
SW-6	Software for Radiated and Conducted emissions.	Intertek	OATS vba	V. 3.0	VBU	VBU

8.4 Results:

The sample tested was found to comply.

8.5 Test Summary:

Fundamental	Conducted port					
Frequency Range:	☐ 902-928MHz ☒ 2400-2483.5MHz ☐ 5725-5850MHz					
Low Frequency MHz	**Measured Power (dBm)**	**Correction Cable/Atten (dB)**	**Final Corrected (dBm)**	**Standard Limit (dBm)**	**Limit Reduction (dB)**	**Margin (dB)**
2410	-0.07	2.5	2.43	30	NA	27.57
Mid Frequency MHz						
2442	-0.99	2.5	1.51	30	NA	28.49
High Frequency MHz						
2474.5	-1.11	2.6	1.49	30	NA	28.89
RBW: **VBW:**	☐ 3kHz ☐ 300kHz ☐ 500kHz ☐ 1MHz ☒ 3MHz ☐ 10MHz ☐ 30kHz ☐ 1MHz ☐ 1MHz ☐ 3 MHz ☒ 10MHz ☐ 10MHz					
Antenna Gain:	☒ < 6dBi ☐ >6dBi and = dBi, Output power reduction = dB					

8.6 Test Method:

- ANSI C63.10:2013, Section 11.9

8.7 Notes:

1. The limit for RSS-247 is identical to the limit for FCC 15.247.

Limit is 1W

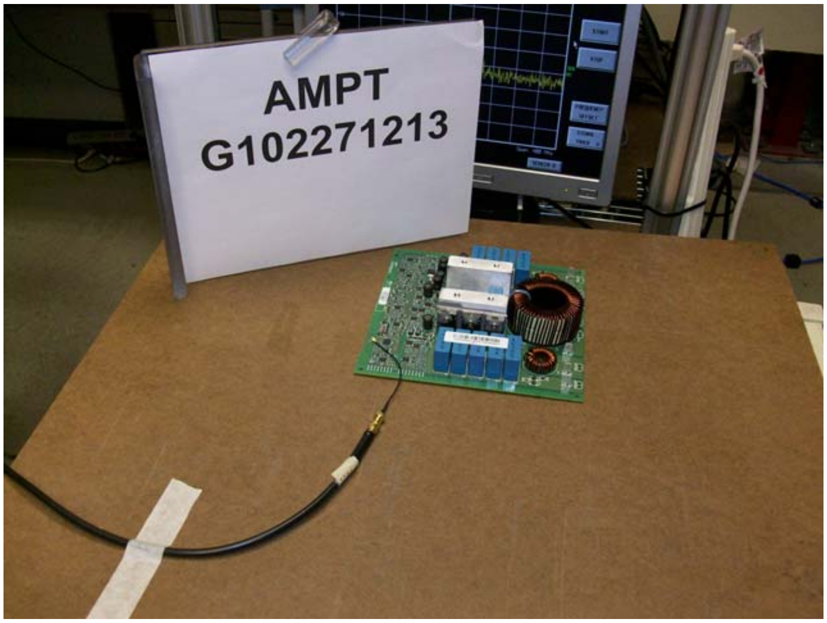
Worst Case Fundamental

2.43 dBm = 0.00175W

Delta

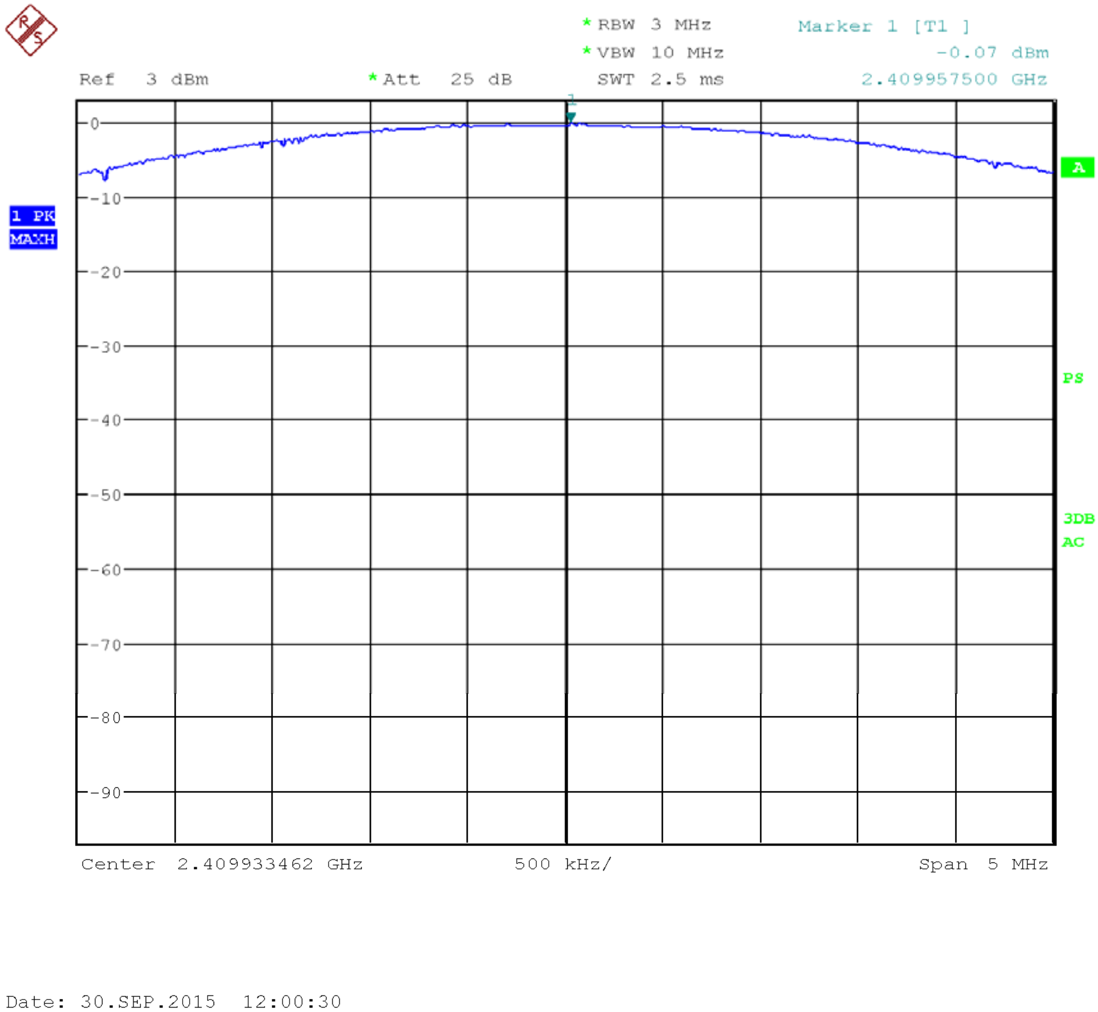
0.00175 – 1 = -0.998W

8.8 Setup Photographs: Conducted Port

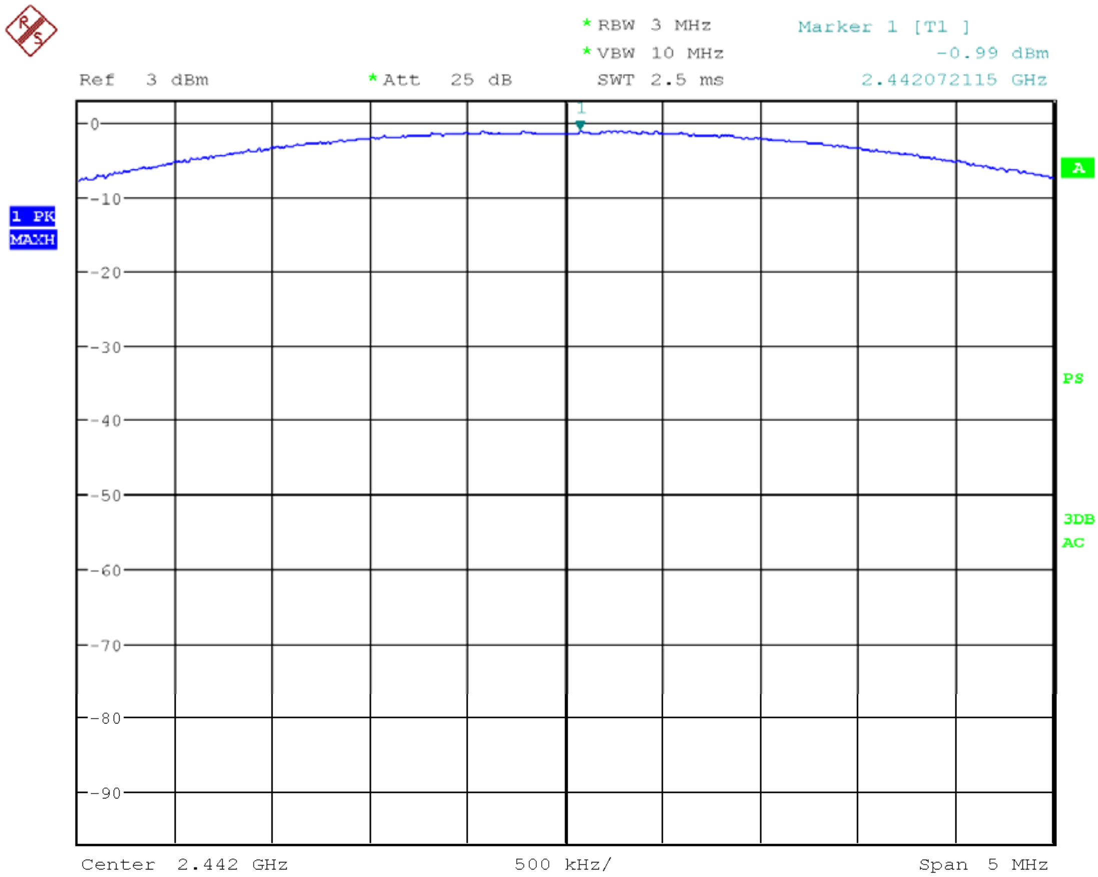


8.9 Plots:

Low Channel

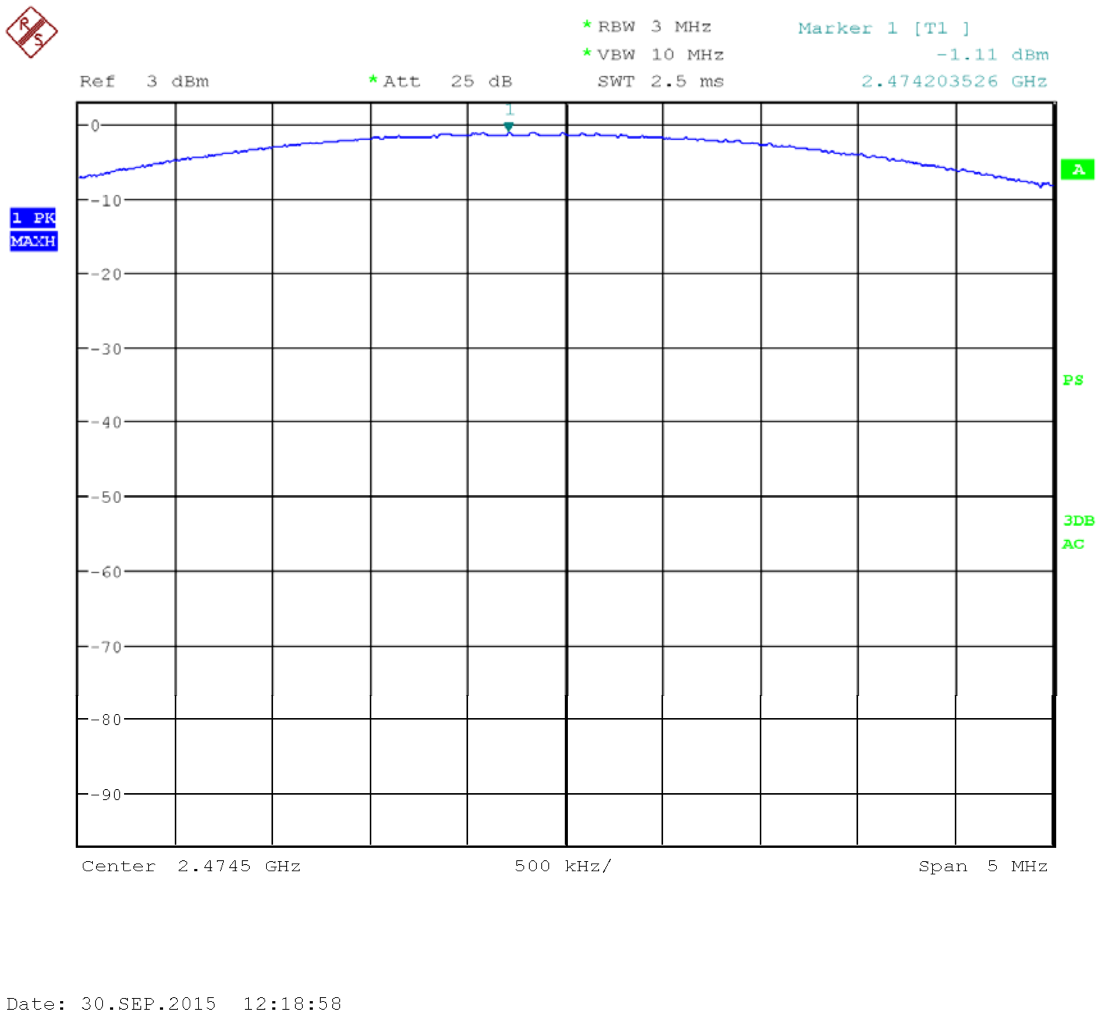


Mid Channel



Date: 30.SEP.2015 12:17:09

High Channel



9 RF Conducted Spurious Emissions (-20dBc) – Including Band Edge

9.1 Method:

The test methods used comply with ANSI C63.4. Unless otherwise stated no deviations were made from FCC 15.247 & RSS-247.

This testing was performed at Intertek Denver, located at 1795 Dogwood St. Suite 200, Louisville, CO 80027.

9.2 Test Requirement/Specification:

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

- 15.247(d)
- RSS-247 5.5

Frequency Range:	☐ 902-928MHz ☒ 2400-2483.5MHz ☐ 5725-5850MHz		
Left Antenna	**Output Power with 100 kHz Bandwidth dBm**	**Minimum Allowed Attenuation dB**	**Limit dB**
Low Frequency Channel	-1.12	20	-21.12
Mid Frequency Channel	-2.24	20	-22.24
Upper Frequency Channel	-2.58	20	-22.58
Analyzer Settings:	☒ RBW=100KHz		
Minimum Allowed Attenuation:	☒ 20dB ☐ 30dB (for digital systems with conducted power measured using RMS averaging over a time interval)		

9.3 Test Equipment Used:

Asset ID	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DEN-073	EMI Receiver (10Hz – 26.5GHz)	RHODE & SCHWARZ	ESU 26	100265	12/10/2014	12/10/2015
DEN-206	RF Conducted Port Cable	-----	True Blue	14-11-401	12/23/2014	12/23/2015
SW-6	Software for Radiated and Conducted emissions.	Intertek	OATS vba	V. 3.0	VBU	VBU

9.4 Results:

The sample tested was found to comply.

9.5 Test Method:

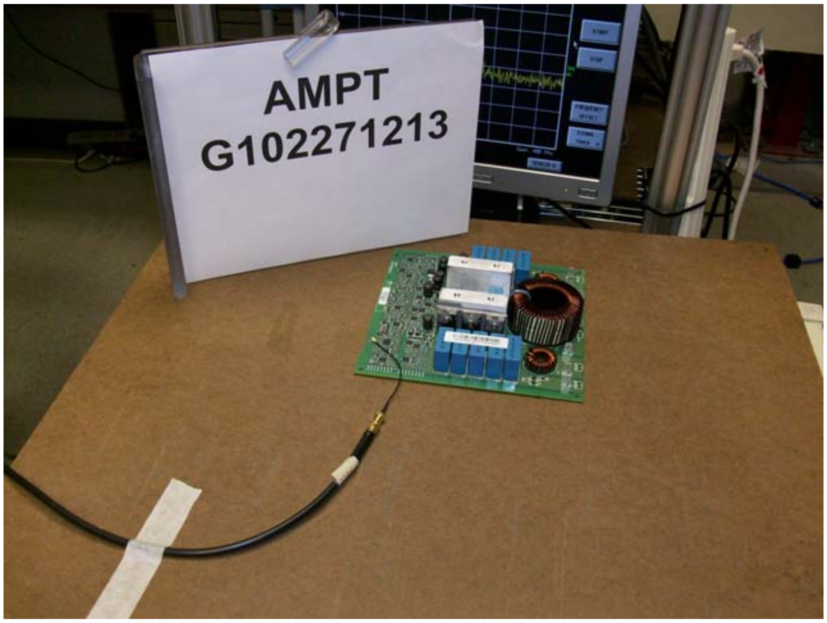
- ANSI C63.10: 2013, Clause 11.13

9.6 Test Data:

Test Report #:	**G102271213**	Test Area:	CC1		Temperature:	23.2	°C
Test Method:	FCC 15.247	Test Date:	9/30/205		Relative Humidity:	31.5	%
EUT Model #:	31570014	EUT Power:	12 VDC		Air Pressure:	82.9	kPa
EUT Serial #:	0815K000002						
Manufacturer:	Ampt				Level Key		
EUT Description:	DC to DC string converter				Pk – Peak		
Notes:					Qp – Quasi Peak		
					Av - Average		

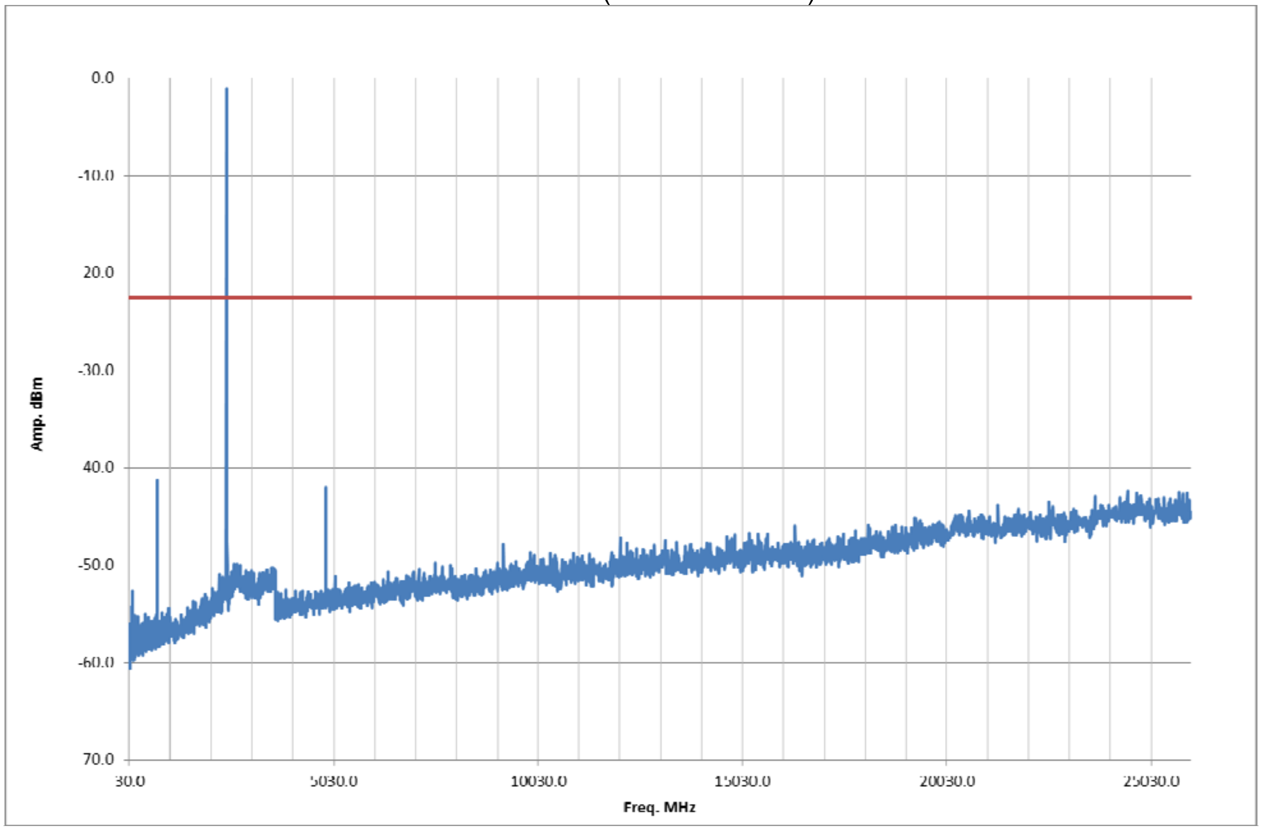
FREQ MHz	LEVEL dBm	DET Qp Av Pk	Limit dBm	DELTA dB	RBW (MHz)
Low Channel Spurious					
1913.4615	- 33.14	Pk	-21.12	12.02	0.1
4820.2051	- 41.97	Pk	-21.12	20.85	0.1
Mid Channel Spurious					
4884.6154	- 41.52	Pk	-22.24	19.28	0.1
High Channel Spurious					
4948.7179	- 45.50	Pk	-22.58	22.92	0.1

9.7 Setup Photographs:

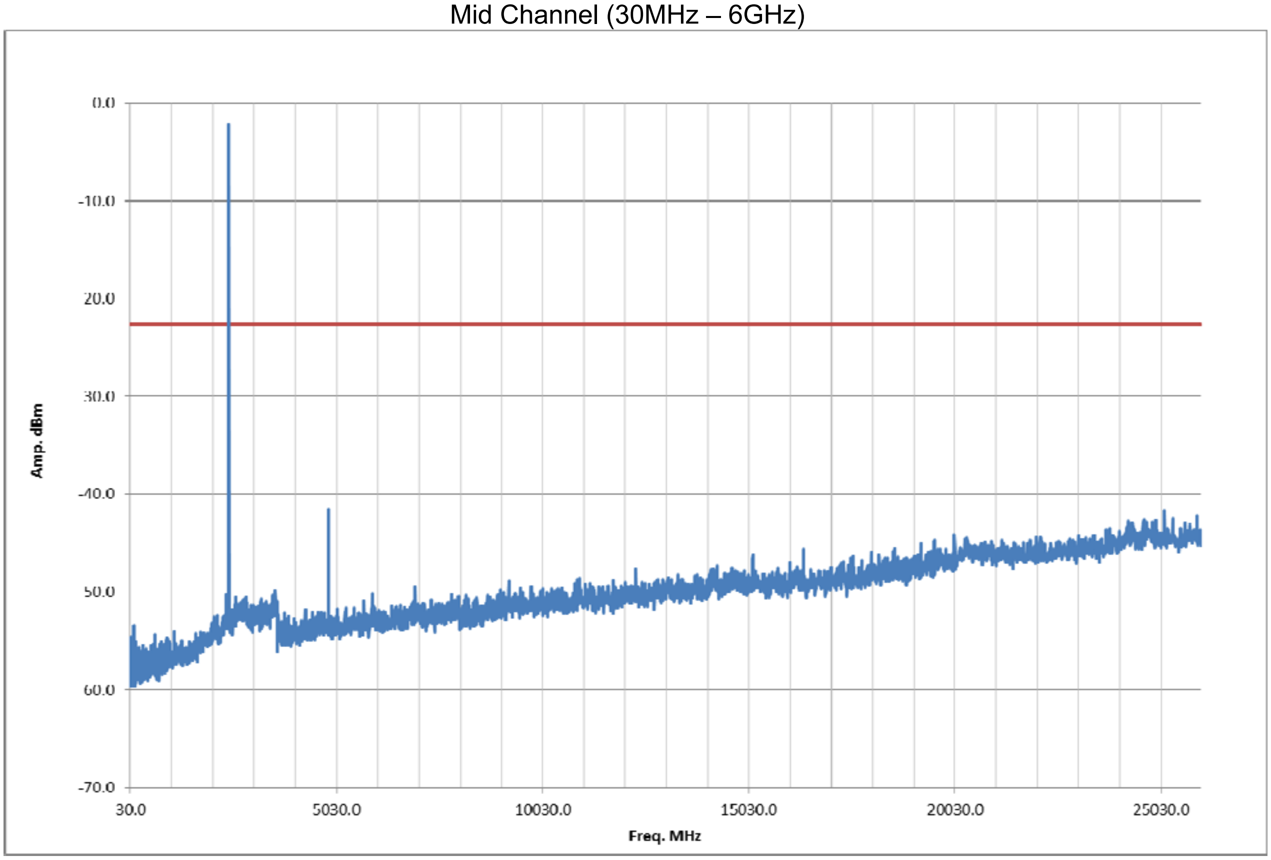


9.8 Plots:

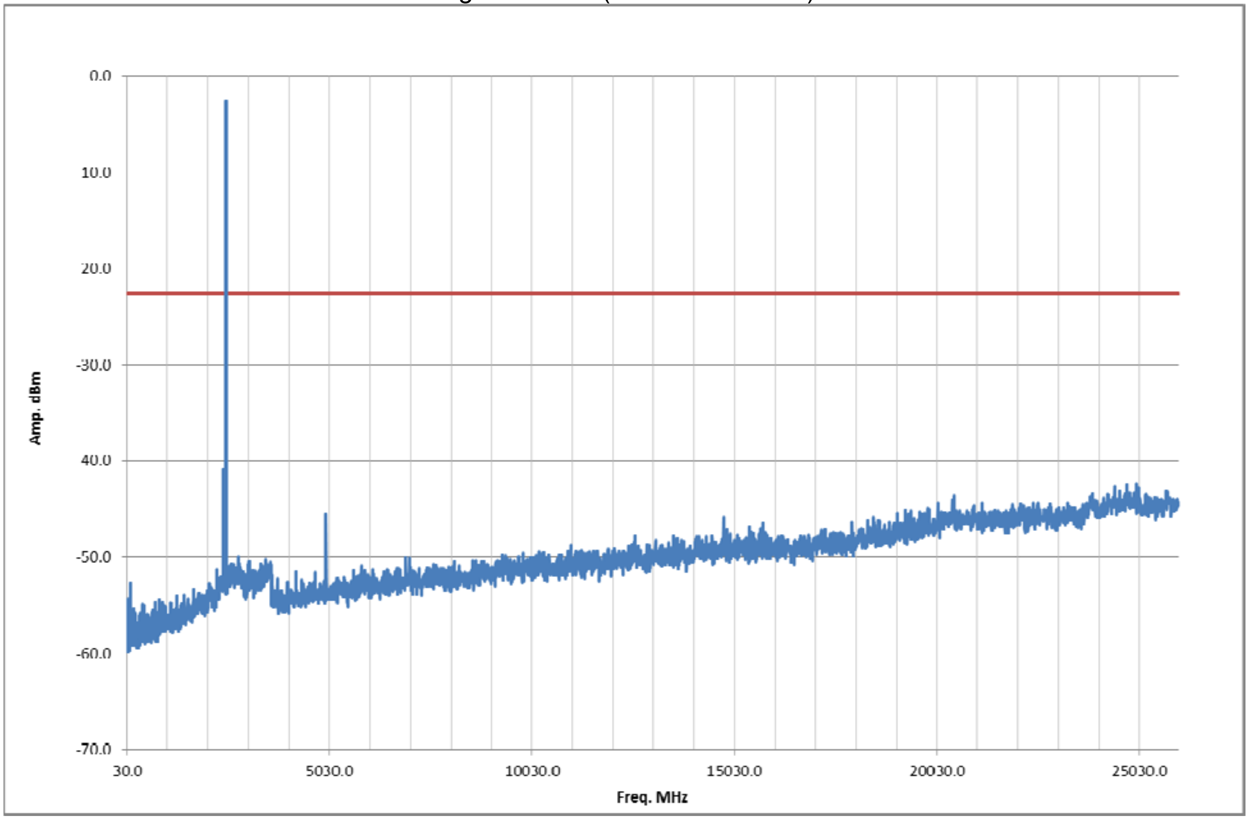
Low Channel (30MHz – 26GHz)



Mid Channel (30MHz – 6GHz)

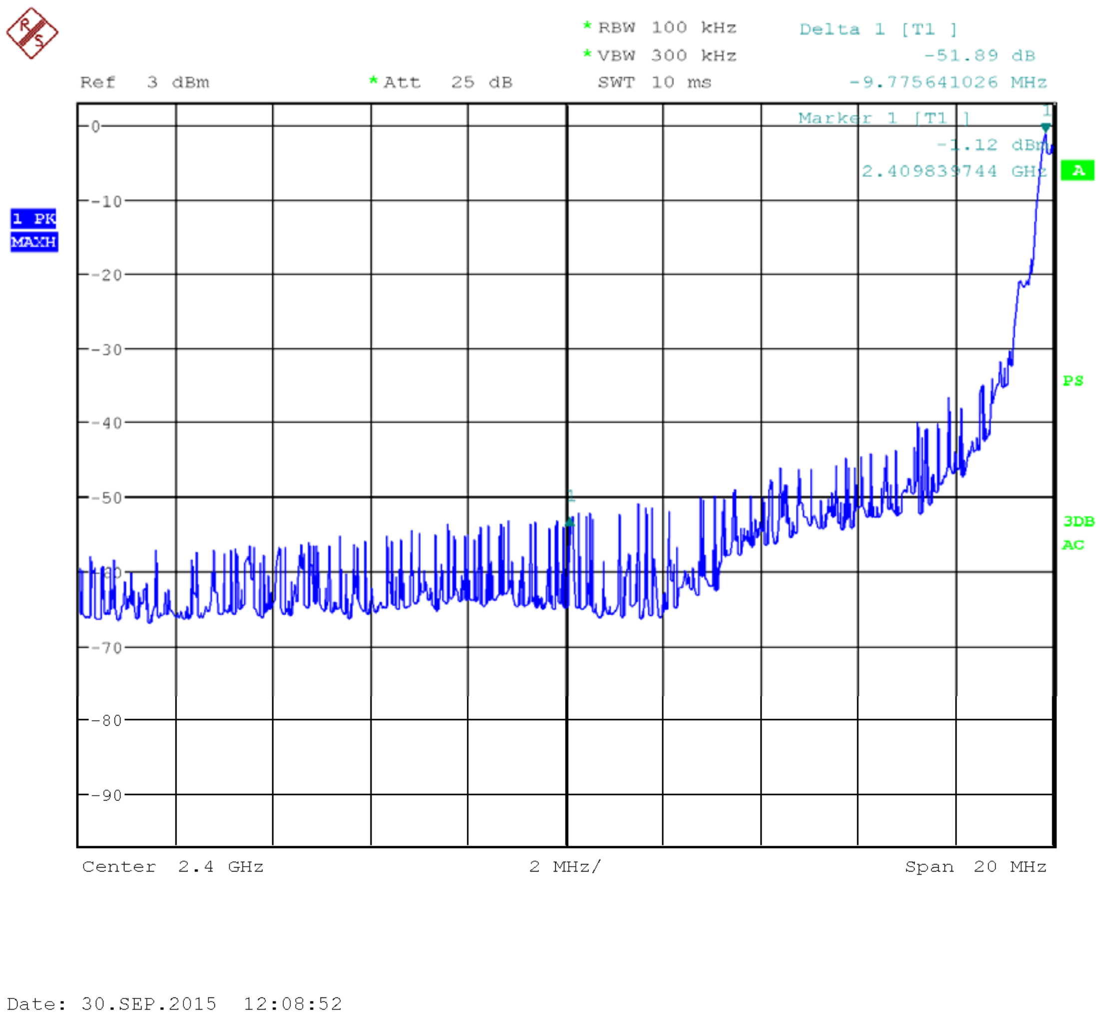


High Channel (30MHz – 26GHz)

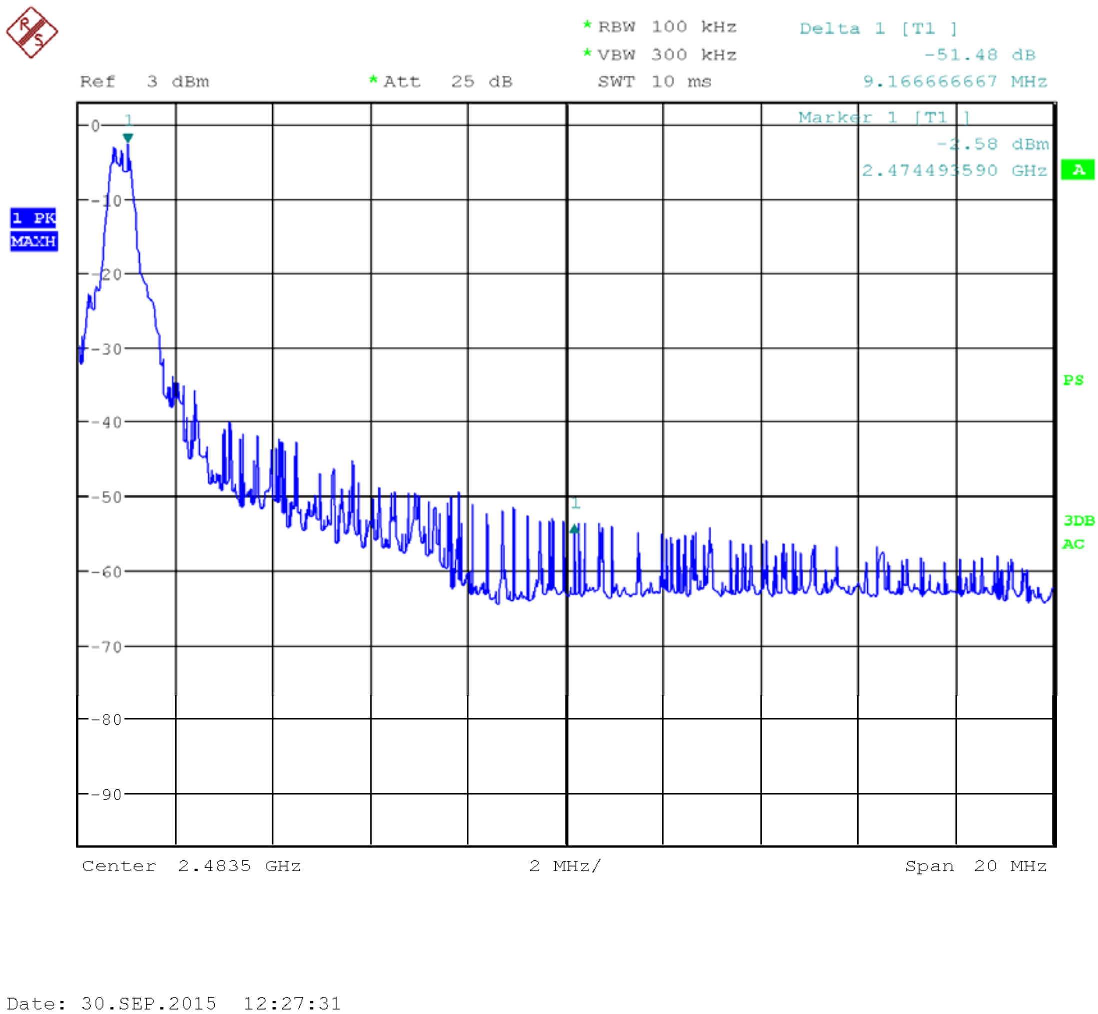


9.9 Band Edge

Low Channel



High Channel



10 Spurious and Band Edge/Restricted Band Emissions - Radiated

10.1 Method

The test methods used comply with ANSI C63.4. Unless otherwise stated no deviations were made from FCC 15.247 and RSS-247.

This testing was performed at Intertek Denver, located at 1795 Dogwood St. Suite 200, Louisville, CO 80027.

10.2 Test Requirement/ Specification:

Radiated emissions which fall in the restricted bands, as defined in FCC Part 15.205(a), must also comply with the radiated emission limits specified in Part 15.209(a) and Part 15.205(c). Measurements in the restricted bands include both peak detector and average detector measurements.
Measurements in non-restricted bands include peak detector measurements.

Unwanted emissions below 1GHz must comply with the general field strength limits defined in FCC Part 15.209, when measured with a quasi-peak detector.

FCC part 15.209	
Freq. MHz	Amp. dBuV/m @ 3 m
30	40
88	40
88	43.5
216	43.5
216	46
960	46
960	54
40000	54

10.3 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
18912	9 kHz- 1.3GHz Pre Amp	Hewlett-Packard	8447F	3113A05545	5/19/2015	5/18/2016
19936	Bilog Antenna 30MHz - 6GHz	Sunol Sciences	JB6	A050707-1	12/29/2014	12/29/2015
DEN-073	EMI Receiver	ROHDE & SCHWARZ	ESU 26	100265	12/10/2014	12/10/2015
DEN-203	Radiated Cable (1)	Teledyne	90-206-072	14-11-402	12/23/2014	12/23/2015
DEN-204	Radiated Cable (2)	Teledyne	90-206-072	14-11-401	12/23/2014	12/23/2015
DEN-205	Radiated Cable (3)	Teledyne	14-11-401	14-11-401	12/23/2014	12/23/2015
DEN-032	4-18 GHz LNA	NARDA	DBL-0618N615	031	04/29/2015	04/29/2016
18887	Horn Antenna 1-18GHz	EMCO	3115	9205-3886	03/26/2015	03/26/2016
DEN-207	10GHz – 40GHz Amplifier	Miteq	JS44-18004000-40-8P	1909634	09/14/2015	09/14/2016
DEN-200	10-40GHz DRG Horn Antenna	ETS Lindgren	3116C	00168529	9/22/2014	9/22/2015
18906	Amplifier	Mini-Circuits Lab	ZHL-42	N052792-2	05/01/2015	05/01/2016

10.4 Test Procedure:

The Resolution Bandwidth is 120 kHz or greater for frequencies 30 MHz -1000 MHz and 1 MHz for frequencies above 1000 MHz. The Video Bandwidth was at least 3x the RBW.

The EUT is placed on a plastic turntable that is 80 cm in height for testing <1GHz and 150cm for testing >1GHz. If the EUT attaches to peripherals, they are connected and operational (as typical as possible). During testing, all cables are manipulated to produce worst-case emissions. The signal is maximized by rotating the turntable through a 360º rotation. The antenna height is varied from 1-4 meters. Both vertical and horizontal antenna configurations are utilized in the testing.

Radiated emissions 30MHz to 18GHz are taken at 3-meter antenna-to-product test distance.

Radiated emissions 18 to 40 GHz are taken at 1.5-meter antenna-to-product test distance. All emissions are extrapolated to 3 meters using the extrapolation factor of 20 dB/decade of distance.

Data is included for the worst-case configuration - the configuration which resulted in the highest emission levels.

ANSI C63.10: 2013 – Clause 11.13

10.5 Test Results:

The sample tested was found to Comply.

10.6 Test Data – Worst-Case Measurements

Test Report #:	**G102271213**	Test Area:	CC1	Temperature:	23.2	°C
Test Method:	FCC 15.247	Test Date:	9/30/205	Relative Humidity:	31.5	%
EUT Model #:	31570014	EUT Power:	12 VDC	Air Pressure:	82.9	kPa
EUT Serial #:	0815K000002					
Manufacturer:	Ampt			Level Key		
EUT Description:	DC to DC string converter			Pk – Peak		
Notes:				Qp – Quasi Peak		
				Av - Average		

FREQ	LEVEL	DET	CABLE	ANT	PREAMP	FINAL	POL	HT	AZ	DELTA1	DELTA2	RBW
MHz	dBuV	Qp Av Pk Rms	+ [dB]	+ [dB/m]	- [dB]	= [dBuV]	(V/H)	(m)	(DEG)	FCC 15.209 >1GHz Av	FCC 15.209 >1GHz Pk	(MHz)
Axis 1 Low channel Bandedge												
2390.00	48.20	**Pk**	3.56	28.18	38.04	41.91	V	1.00	0.0	NA	- 32.09	1.0
2390.00	36.17	**Av**	3.56	28.18	38.04	29.88	V	1.00	0.0	- 24.10	NA	1.0
2390.00	49.55	**Pk**	3.56	28.18	38.04	43.26	H	1.00	0.0	NA	- 30.74	1.0
2390.00	36.13	**Av**	3.56	28.18	38.04	29.84	H	2.00	0.0	- 24.14	NA	1.0
Axis 1 High channel Bandedge												
2483.50	48.85	**Pk**	3.63	28.38	38.04	42.83	V	1.90	0.0	NA	- 31.17	1.0
2483.50	36.31	**Av**	3.63	28.38	38.04	30.29	V	1.90	0.0	- 23.69	NA	1.0
2483.50	48.38	Pk	3.63	28.38	38.04	42.36	H	3.10	285.0	NA	- 31.64	1.0
2483.50	36.35	Av	3.63	28.38	38.04	30.33	H	3.10	285.0	- 23.65	NA	1.0
Axis 2 Low channel Bandedge												
2390.00	49.63	**Pk**	3.56	28.18	38.04	43.34	V	1.50	0.0	NA	- 30.66	1.0
2390.00	36.94	**Av**	3.56	28.18	38.04	30.65	V	1.50	0.0	- 23.33	NA	1.0
2390.00	49.09	**Pk**	3.56	28.18	38.04	42.80	H	1.50	0.0	NA	- 31.20	1.0
2390.00	36.16	**Av**	3.56	28.18	38.04	29.87	H	1.50	0.0	- 24.11	NA	1.0
Axis 2 High channel Bandedge												
2483.50	51.39	**Pk**	3.63	28.38	38.04	45.37	V	1.50	0.0	NA	- 28.63	1.0
2483.50	39.42	**Av**	3.63	28.38	38.04	33.40	V	1.50	0.0	- 20.58	NA	1.0
2483.50	49.20	**Pk**	3.63	28.38	38.04	43.18	H	1.50	0.0	NA	- 30.82	1.0
2483.50	36.21	**Av**	3.63	28.38	38.04	30.19	H	1.50	0.0	- 23.79	NA	1.0
Axis 3 Low channel Bandedge												
2390.00	48.48	**Pk**	3.56	28.18	38.04	42.19	H	1.50	0.0	NA	- 31.81	1.0
2390.00	36.20	**Av**	3.56	28.18	38.04	29.91	H	1.50	0.0	- 24.07	NA	1.0
2390.00	49.75	**Pk**	3.56	28.18	38.04	43.46	V	1.50	0.0	NA	- 30.54	1.0
2390.00	36.54	**Av**	3.56	28.18	38.04	30.25	V	1.50	0.0	- 23.73	NA	1.0

Axis 3 High channel Bandedge												
2483.50	50.39	**Pk**	3.63	28.38	38.04	44.37	V	1.50	0.0	NA	- 29.63	1.0
2483.50	38.19	**Av**	3.63	28.38	38.04	32.17	V	1.50	0.0	- 21.81	NA	1.0
2483.50	49.79	**Pk**	3.63	28.38	38.04	43.77	H	1.50	0.0	NA	- 30.23	1.0
2483.50	36.74	**Av**	3.63	28.38	38.04	30.72	H	1.50	0.0	- 23.26	NA	1.0
Axis 1 Low channel												
4819.96	54.81	**Pk**	5.19	32.87	38.25	54.61	V	3.20	10.0	NA	- 19.39	1.0
4819.96	50.54	**Av**	5.19	32.87	38.25	50.34	V	3.20	10.0	- 3.64	NA	1.0
4819.96	52.02	**Av**	5.19	32.87	38.25	51.82	H	3.20	0.0	- 2.16	NA	1.0
4819.96	55.12	**Pk**	5.19	32.87	38.25	54.92	H	3.20	0.0	NA	- 19.08	1.0
12050.00	38.54	**Av**	8.49	39.23	47.12	39.13	V	1.00	0.0	- 14.85	NA	1.0
12050.00	38.53	**Av**	8.49	39.23	47.12	39.12	H	1.00	0.0	- 14.86	NA	1.0
12050.00	51.29	**Pk**	8.49	39.23	47.12	51.88	V	1.00	0.0	NA	- 22.12	1.0
12050.00	51.19	**Pk**	8.49	39.23	47.12	51.78	H	1.00	0.0	NA	- 22.22	1.0
Axis 1 Mid channel												
4883.66	54.80	**Pk**	5.22	32.96	39.01	53.98	H	2.10	0.0	NA	- 20.02	1.0
4883.66	51.53	**Av**	5.22	32.96	39.01	50.71	H	2.10	0.0	- 3.27	NA	1.0
4883.66	49.18	**Av**	5.22	32.96	39.01	48.36	V	3.20	80.0	- 5.62	NA	1.0
4883.66	53.05	**Pk**	5.22	32.96	39.01	52.23	V	3.20	80.0	NA	- 21.77	1.0
7325.46	44.36	**Av**	6.50	36.71	47.40	40.17	V	2.40	80.0	- 13.81	NA	1.0
7325.46	54.85	**Pk**	6.50	36.71	47.40	50.66	V	2.40	80.0	NA	- 23.34	1.0
7325.46	45.54	**Av**	6.50	36.71	47.40	41.35	H	2.30	40.0	- 12.63	NA	1.0
7325.46	54.71	**Pk**	6.50	36.71	47.40	50.52	H	2.30	40.0	NA	- 23.48	1.0
12210.00	37.75	**Av**	8.57	39.01	47.08	38.25	H	1.50	0.0	- 15.73	NA	1.0
12210.00	37.74	**Av**	8.57	39.01	47.08	38.24	V	2.40	80.0	- 15.74	NA	1.0
12210.00	50.31	**Pk**	8.57	39.01	47.08	50.81	H	1.50	0.0	NA	- 23.19	1.0
12210.00	51.35	**Pk**	8.57	39.01	47.08	51.85	V	2.40	80.0	NA	- 22.15	1.0
Axis 1 High channel												
4948.76	55.53	**Pk**	5.26	33.09	39.78	54.10	V	2.30	286.0	NA	- 19.90	1.0
4948.76	52.14	**Av**	5.26	33.09	39.78	50.71	V	2.30	286.0	- 3.27	NA	1.0
4948.76	50.25	**Av**	5.26	33.09	39.78	48.82	H	3.10	285.0	- 5.16	NA	1.0
4948.76	54.62	**Pk**	5.26	33.09	39.78	53.19	H	3.10	285.0	NA	- 20.81	1.0
7423.12	42.08	**Av**	6.55	36.82	47.25	38.20	V	1.00	0.0	- 15.78	NA	1.0
7423.12	45.09	**Av**	6.55	36.82	47.25	41.21	H	1.30	0.0	- 12.77	NA	1.0
7423.12	52.96	**Pk**	6.55	36.82	47.25	49.08	V	1.00	0.0	NA	- 24.92	1.0
7423.12	54.54	**Pk**	6.55	36.82	47.25	50.66	H	1.30	0.0	NA	- 23.34	1.0
12372.00	38.20	**Av**	8.66	38.89	46.85	38.90	V	1.00	0.0	- 15.08	NA	1.0
12372.00	38.20	**Av**	8.66	38.89	46.85	38.90	H	1.00	0.0	- 15.08	NA	1.0
12372.00	52.96	**Pk**	8.66	38.89	46.85	53.66	V	1.00	0.0	NA	- 20.34	1.0
12372.00	50.81	**Pk**	8.66	38.89	46.85	51.51	H	1.00	0.0	NA	- 22.49	1.0
Axis 2 Low channel												
4819.99	54.75	**Pk**	5.19	32.87	38.26	54.55	H	1.20	48.0	NA	- 19.45	1.0
4819.97	51.22	**Av**	5.19	32.87	38.25	51.02	V	1.40	21.0	- 2.96	NA	1.0
4819.97	54.42	**Pk**	5.19	32.87	38.25	54.22	V	1.40	21.0	NA	- 19.78	1.0
4819.99	50.86	**Av**	5.19	32.87	38.26	50.66	H	1.20	48.0	- 3.32	NA	1.0
12050.00	38.53	**Av**	8.49	39.23	47.12	39.12	H	1.50	0.0	- 14.86	NA	1.0

12050.00	38.43	**Av**	8.49	39.23	47.12	39.02	V	1.50	0.0	- 14.96	NA	1.0
12050.00	50.32	**Pk**	8.49	39.23	47.12	50.91	H	1.50	0.0	NA	- 23.09	1.0
12050.00	50.65	**Pk**	8.49	39.23	47.12	51.24	V	1.50	0.0	NA	- 22.76	1.0
Axis 2 Mid channel												
4883.64	54.36	**Pk**	5.22	32.96	39.01	53.54	V	1.50	0.0	NA	- 20.46	1.0
4883.64	50.82	**Av**	5.22	32.96	39.01	50.00	V	1.50	0.0	- 3.98	NA	1.0
4883.64	50.49	**Av**	5.22	32.96	39.01	49.67	H	1.40	50.0	- 4.31	NA	1.0
7325.47	43.78	**Av**	6.50	36.71	47.40	39.59	H	2.30	0.0	- 14.39	NA	1.0
7325.47	54.46	**Pk**	6.50	36.71	47.40	50.27	H	2.30	0.0	NA	- 23.73	1.0
7325.47	54.49	**Pk**	6.50	36.71	47.40	50.30	H	1.40	50.0	NA	- 23.70	1.0
7325.47	45.90	**Av**	6.50	36.71	47.40	41.71	V	1.40	112.0	- 12.27	NA	1.0
7325.47	54.41	**Pk**	6.50	36.71	47.40	50.22	V	1.40	112.0	NA	- 23.78	1.0
12210.00	37.67	**Av**	8.57	39.01	47.08	38.17	V	1.50	0.0	- 15.81	NA	1.0
12210.00	37.77	**Av**	8.57	39.01	47.08	38.27	H	1.50	0.0	- 15.71	NA	1.0
12210.00	50.05	**Pk**	8.57	39.01	47.08	50.55	V	1.50	0.0	NA	- 23.45	1.0
12210.00	51.13	**Pk**	8.57	39.01	47.08	51.63	H	1.50	0.0	NA	- 22.37	1.0
Axis 2 High channel												
4948.84	55.27	**Pk**	5.26	33.09	39.78	53.84	H	3.40	283.0	NA	- 20.16	1.0
4948.84	52.06	**Av**	5.26	33.09	39.78	50.63	H	3.40	283.0	- 3.35	NA	1.0
4948.84	52.90	**Av**	5.26	33.09	39.78	51.47	V	1.50	10.0	- 2.51	NA	1.0
4948.84	56.28	**Pk**	5.26	33.09	39.78	54.85	V	1.50	10.0	NA	- 19.15	1.0
7423.28	43.90	**Av**	6.55	36.82	47.25	40.02	H	2.00	283.0	- 13.96	NA	1.0
7423.28	45.22	**Av**	6.55	36.82	47.25	41.34	V	3.70	23.0	- 12.64	NA	1.0
7423.28	54.10	**Pk**	6.55	36.82	47.25	50.22	H	2.00	283.0	NA	- 23.78	1.0
7423.28	55.27	**Pk**	6.55	36.82	47.25	51.39	V	3.70	23.0	NA	- 22.61	1.0
12372.00	38.26	**Av**	8.66	38.89	46.85	38.96	H	1.50	0.0	- 15.02	NA	1.0
12372.00	38.37	**Av**	8.66	38.89	46.85	39.07	V	1.50	0.0	- 14.91	NA	1.0
12372.00	50.58	**Pk**	8.66	38.89	46.85	51.28	H	1.50	0.0	NA	- 22.72	1.0
12372.00	51.91	**Pk**	8.66	38.89	46.85	52.61	V	1.50	0.0	NA	- 21.39	1.0
Axis 3 Low channel												
4819.99	55.06	**Pk**	5.19	32.87	38.26	54.86	V	2.00	338.0	NA	- 19.14	1.0
4819.99	51.82	**Av**	5.19	32.87	38.26	51.62	V	2.00	338.0	- 2.36	NA	1.0
4819.99	53.77	**Av**	5.19	32.87	38.26	53.57	H	2.10	90.0	- 0.41	NA	1.0
4819.99	56.57	**Pk**	5.19	32.87	38.26	56.37	H	2.10	90.0	NA	- 17.63	1.0
12050.00	38.74	**Av**	8.49	39.23	47.12	39.33	V	1.50	0.0	- 14.65	NA	1.0
12050.00	38.70	**Av**	8.49	39.23	47.12	39.29	H	1.50	0.0	- 14.69	NA	1.0
12050.00	51.76	**Pk**	8.49	39.23	47.12	52.35	V	1.50	0.0	NA	- 21.65	1.0
12050.00	52.04	**Pk**	8.49	39.23	47.12	52.63	H	1.50	0.0	NA	- 21.37	1.0
Axis 3 Mid channel												
4883.64	55.93	**Pk**	5.22	32.96	39.01	55.11	H	2.10	120.0	NA	- 18.89	1.0
4883.64	52.97	**Av**	5.22	32.96	39.01	52.15	H	2.10	120.0	- 1.83	NA	1.0
4883.64	50.29	**Av**	5.22	32.96	39.01	49.47	V	2.30	269.0	- 4.51	NA	1.0
4883.64	54.11	**Pk**	5.22	32.96	39.01	53.29	V	2.30	269.0	NA	- 20.71	1.0
7325.47	48.65	**Av**	6.50	36.71	47.40	44.46	H	2.40	120.0	- 9.52	NA	1.0
7325.47	45.12	**Av**	6.50	36.71	47.40	40.93	V	1.90	0.0	- 13.05	NA	1.0
7325.47	56.22	**Pk**	6.50	36.71	47.40	52.03	H	2.40	120.0	NA	- 21.97	1.0
7325.47	55.08	**Pk**	6.50	36.71	47.40	50.89	V	1.90	0.0	NA	- 23.11	1.0

12210.00	37.80	**Av**	8.57	39.01	47.08	38.30	H	1.50	0.0	- 15.68	NA	1.0
12210.00	37.86	**Av**	8.57	39.01	47.08	38.36	V	1.50	0.0	- 15.62	NA	1.0
12210.00	51.43	**Pk**	8.57	39.01	47.08	51.93	H	1.50	0.0	NA	- 22.07	1.0
12210.00	50.49	**Pk**	8.57	39.01	47.08	50.99	V	1.50	0.0	NA	- 23.01	1.0
Axis 3 High channel												
4948.84	54.16	**Pk**	5.26	33.09	39.78	52.73	V	3.10	352.0	NA	- 21.27	1.0
4948.84	49.67	**Av**	5.26	33.09	39.78	48.24	V	3.10	352.0	- 5.74	NA	1.0
4948.84	54.45	**Av**	5.26	33.09	39.78	53.02	H	1.60	140.0	- 0.96	NA	1.0
4948.84	57.37	**Pk**	5.26	33.09	39.78	55.94	H	1.60	140.0	NA	- 18.06	1.0
7423.28	47.78	**Av**	6.55	36.82	47.25	43.90	V	1.20	85.0	- 10.08	NA	1.0
7423.28	48.92	**Av**	6.55	36.82	47.25	45.04	H	2.60	30.0	- 8.94	NA	1.0
7423.28	55.81	**Pk**	6.55	36.82	47.25	51.93	V	1.20	85.0	NA	- 22.07	1.0
7423.28	56.46	**Pk**	6.55	36.82	47.25	52.58	H	2.60	30.0	NA	- 21.42	1.0
12372.00	38.46	**Av**	8.66	38.89	46.85	39.16	V	1.50	0.0	- 14.82	NA	1.0
12372.00	38.46	**Av**	8.66	38.89	46.85	39.16	H	1.50	0.0	- 14.82	NA	1.0
12372.00	51.82	**Pk**	8.66	38.89	46.85	52.52	V	1.50	0.0	NA	- 21.48	1.0
12372.00	51.05	**Pk**	8.66	38.89	46.85	51.75	H	1.50	0.0	NA	- 22.25	1.0

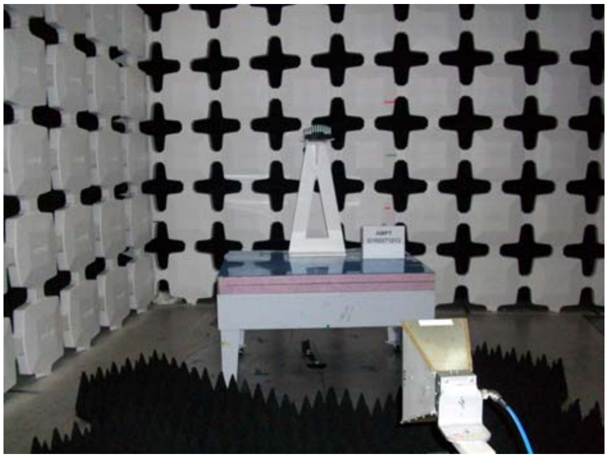
Notes:

1) The highest signals – as determined from pre-scan plots – were fully-maximized and measured.
2) The notch filter was not used during band edge plots/measurements.

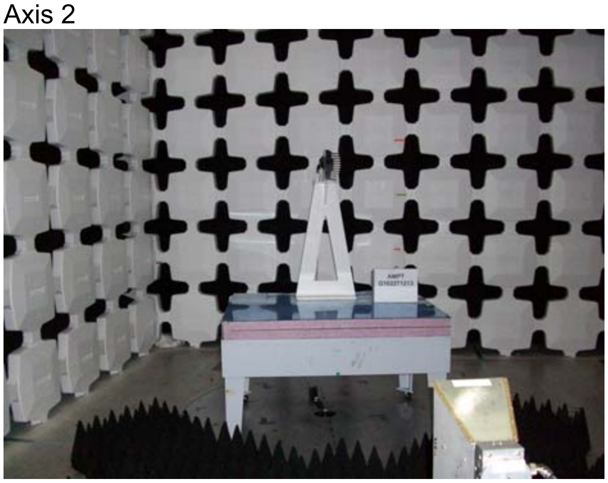
Deviations, Additions, or Exclusions: None

10.7 Setup Photographs:

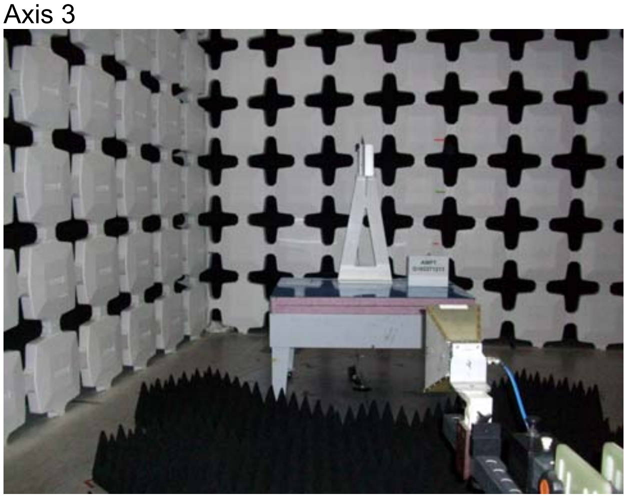
Axis 1



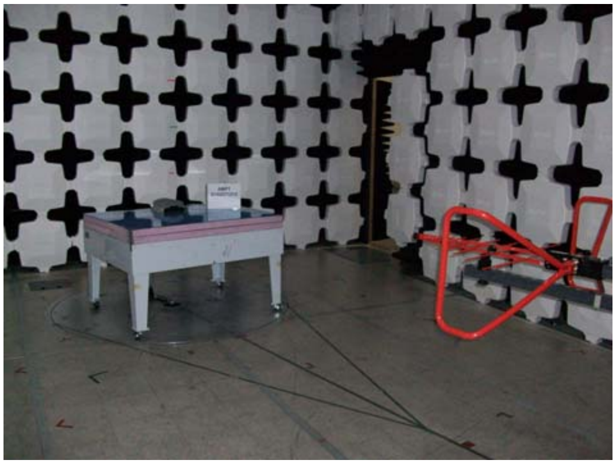
Axis 2



Axis 3

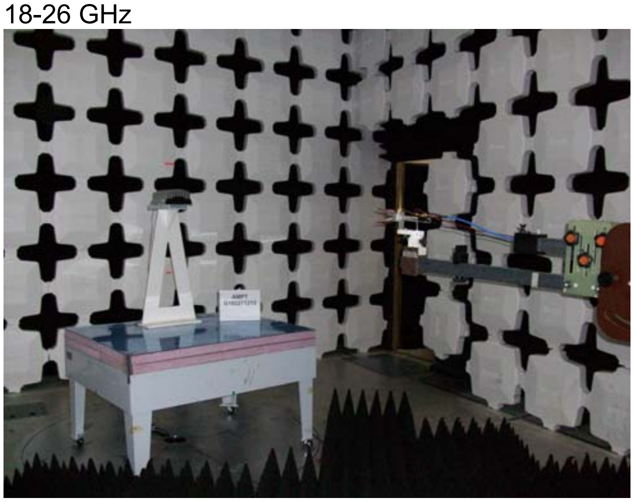


30 -1000 MHz



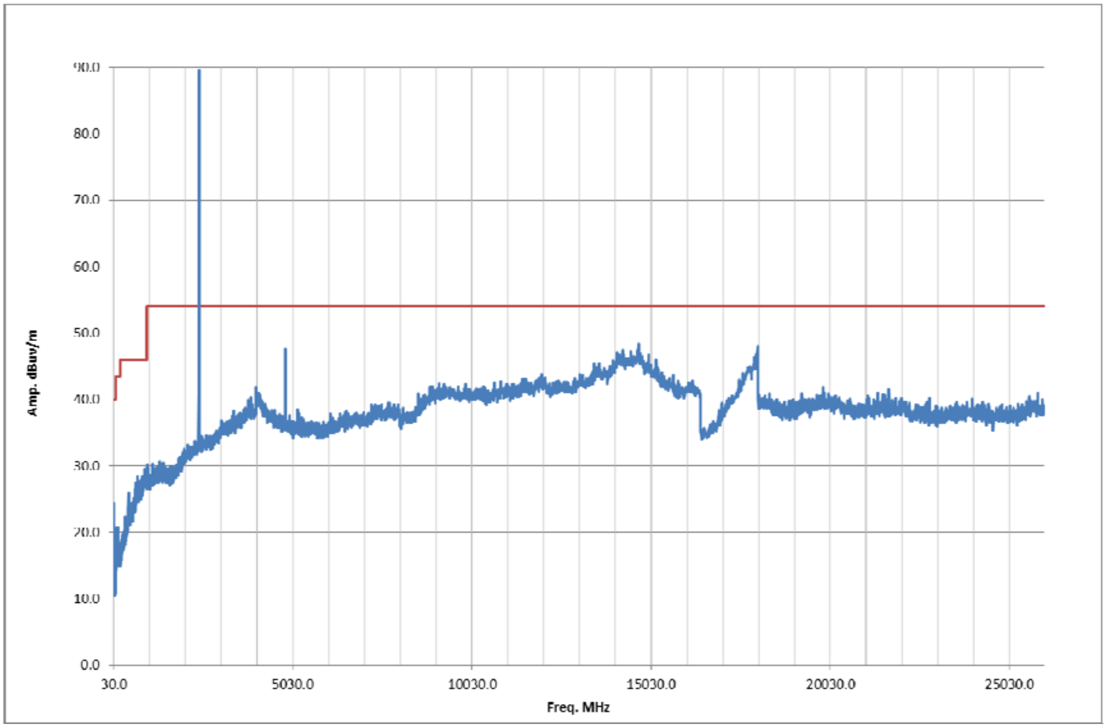
1-18 GHz

18-26 GHz

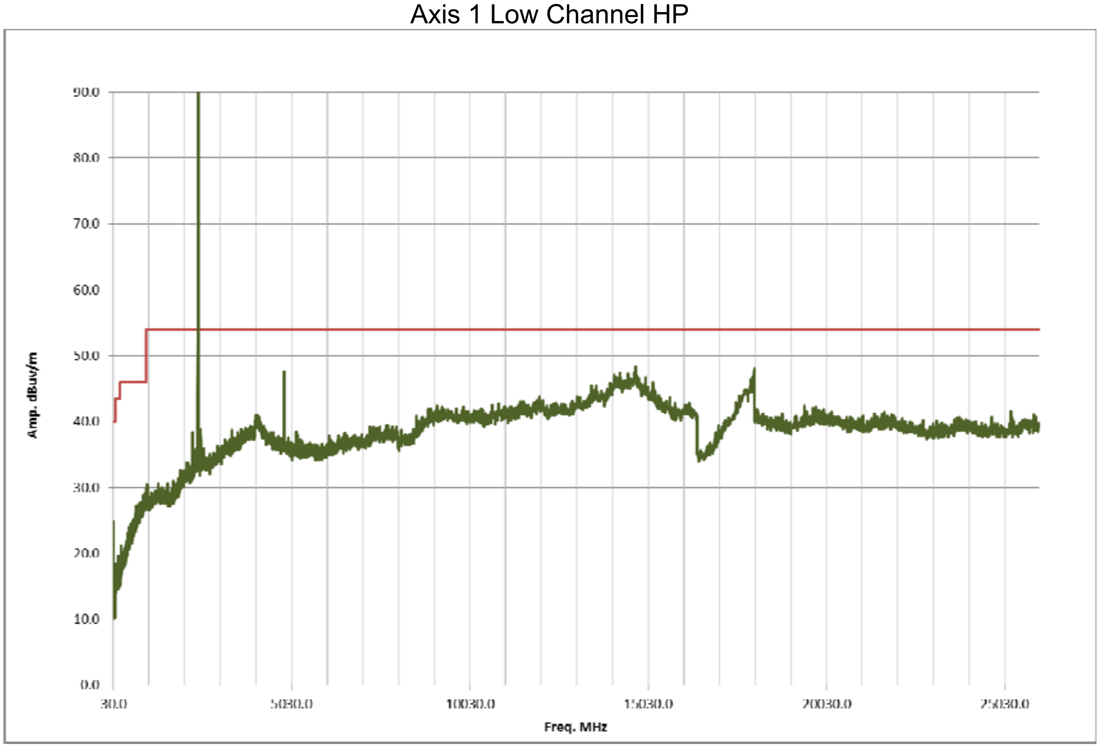


10.8 Plots:

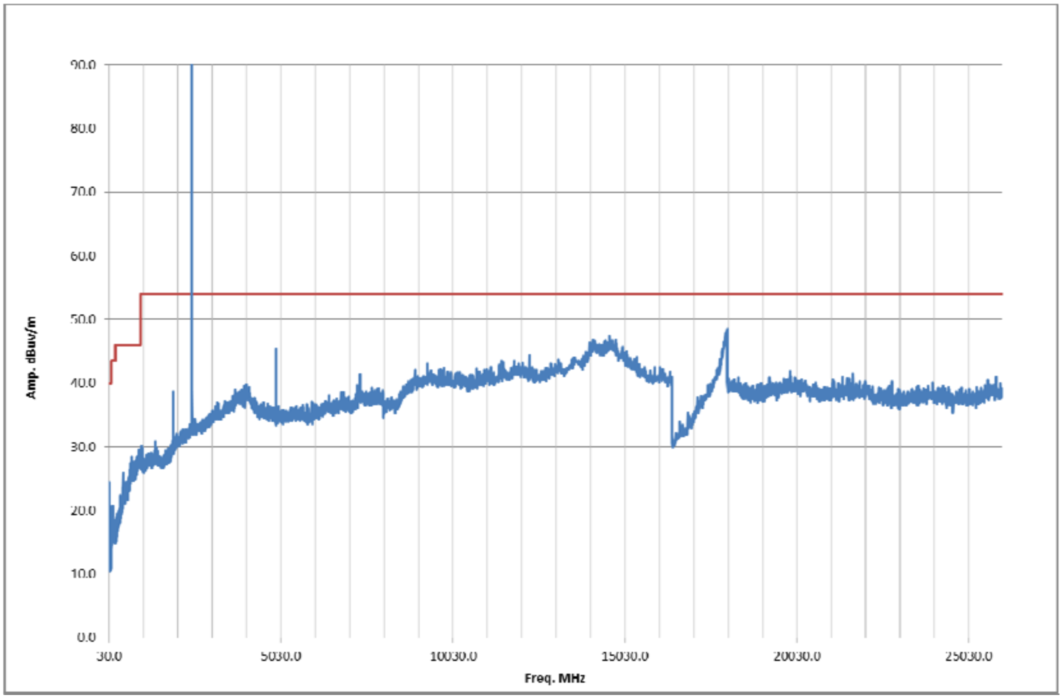
Axis 1 Low Channel VP



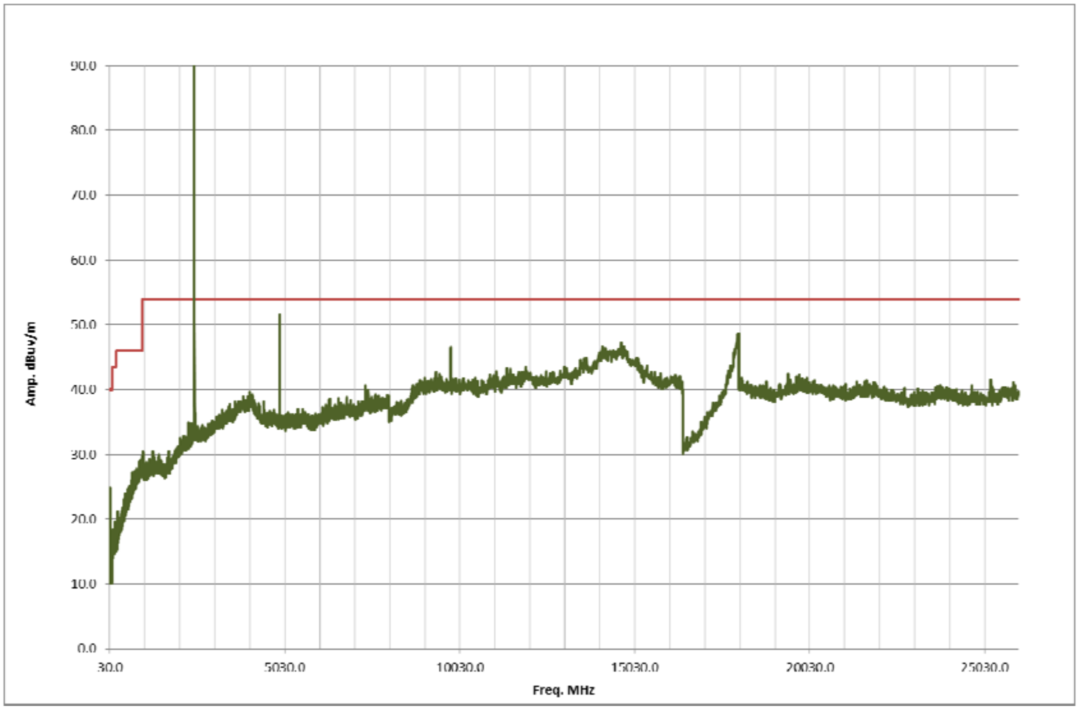
Axis 1 Low Channel HP



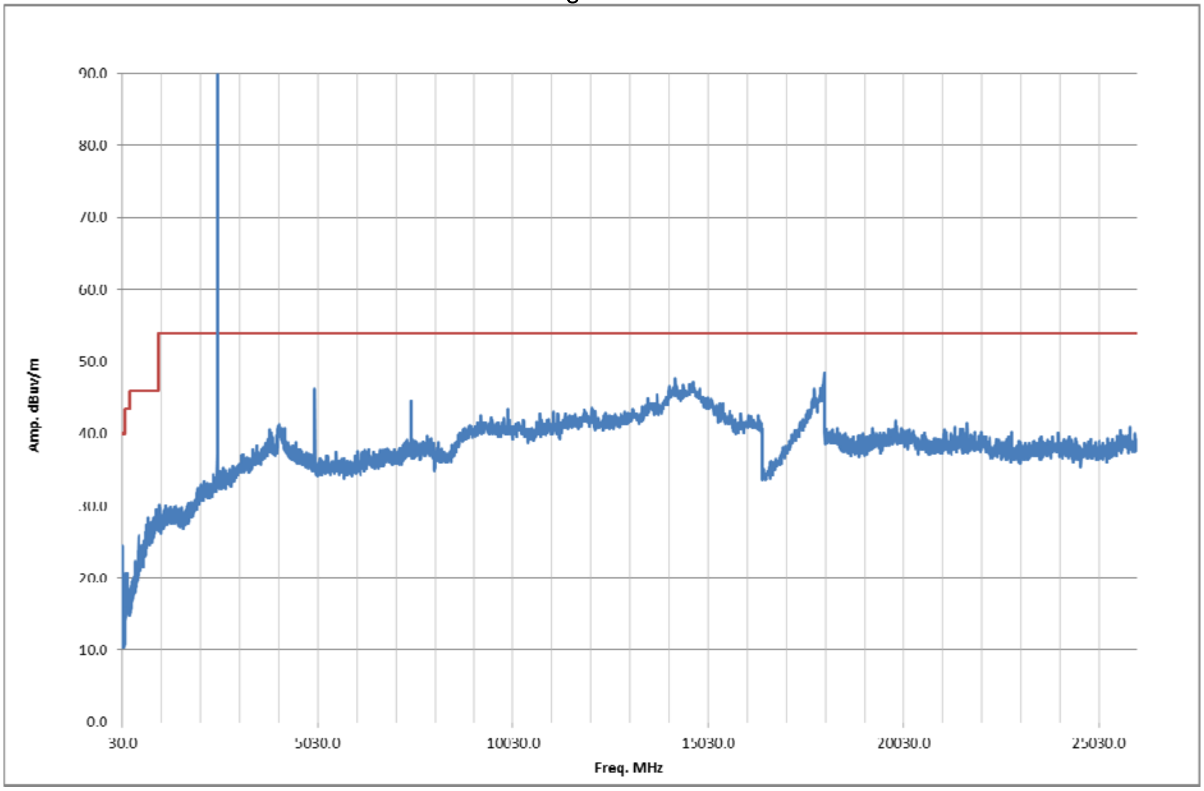
Axis 1 Mid Channel VP



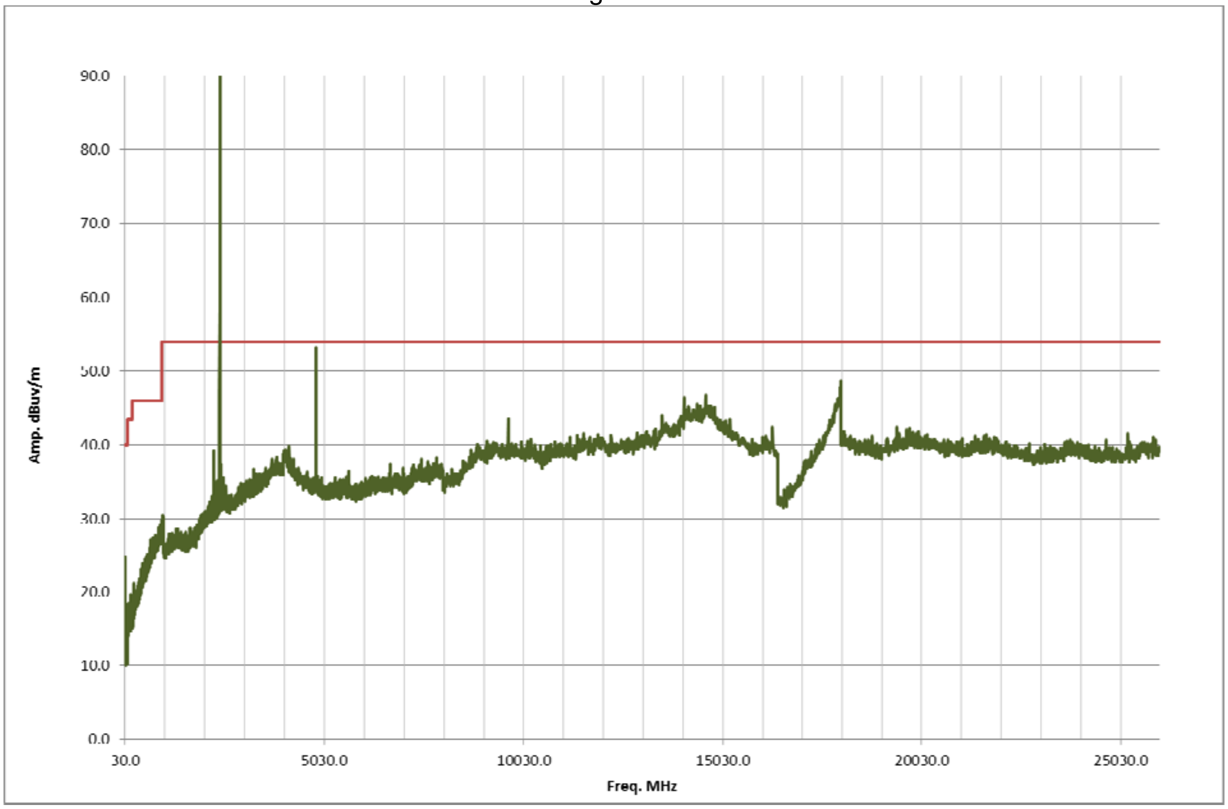
Axis 1 Mid Channel HP



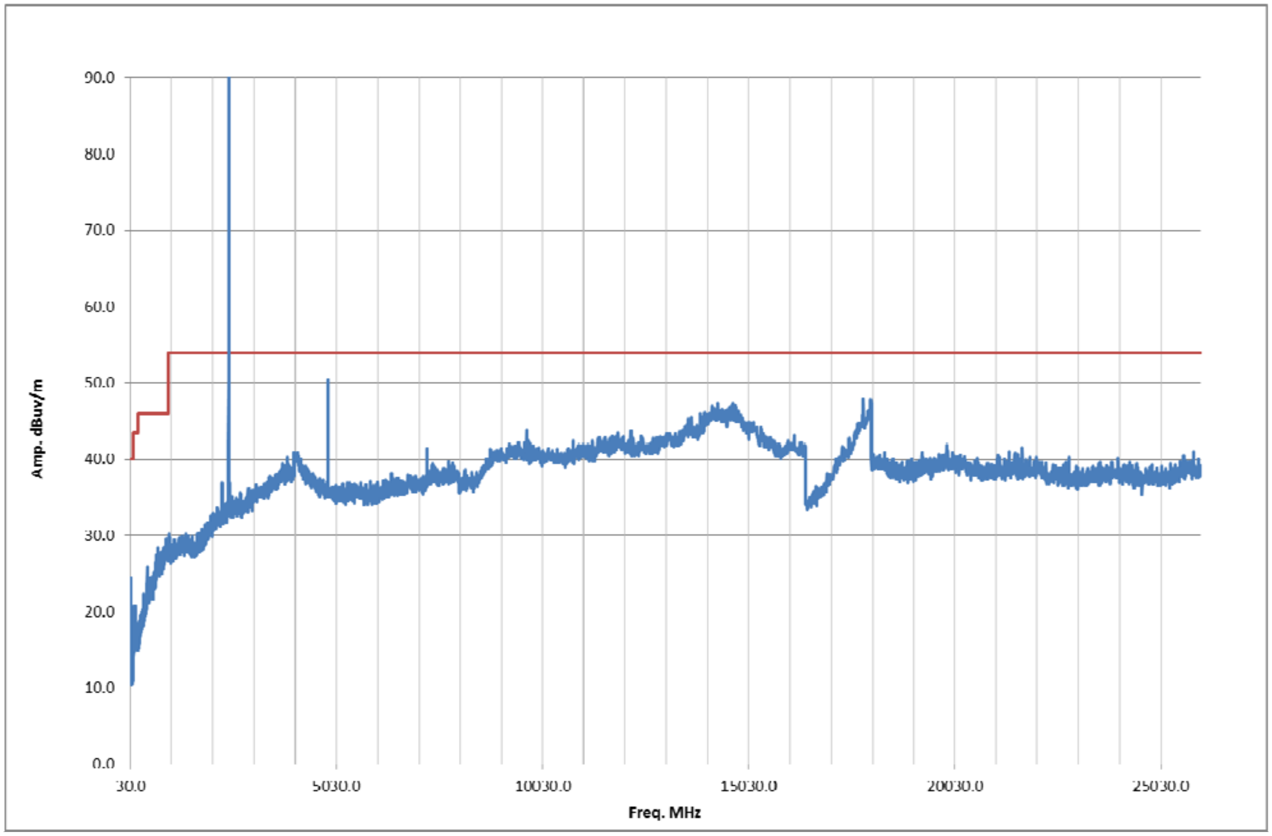
Axis 1 High Channel VP



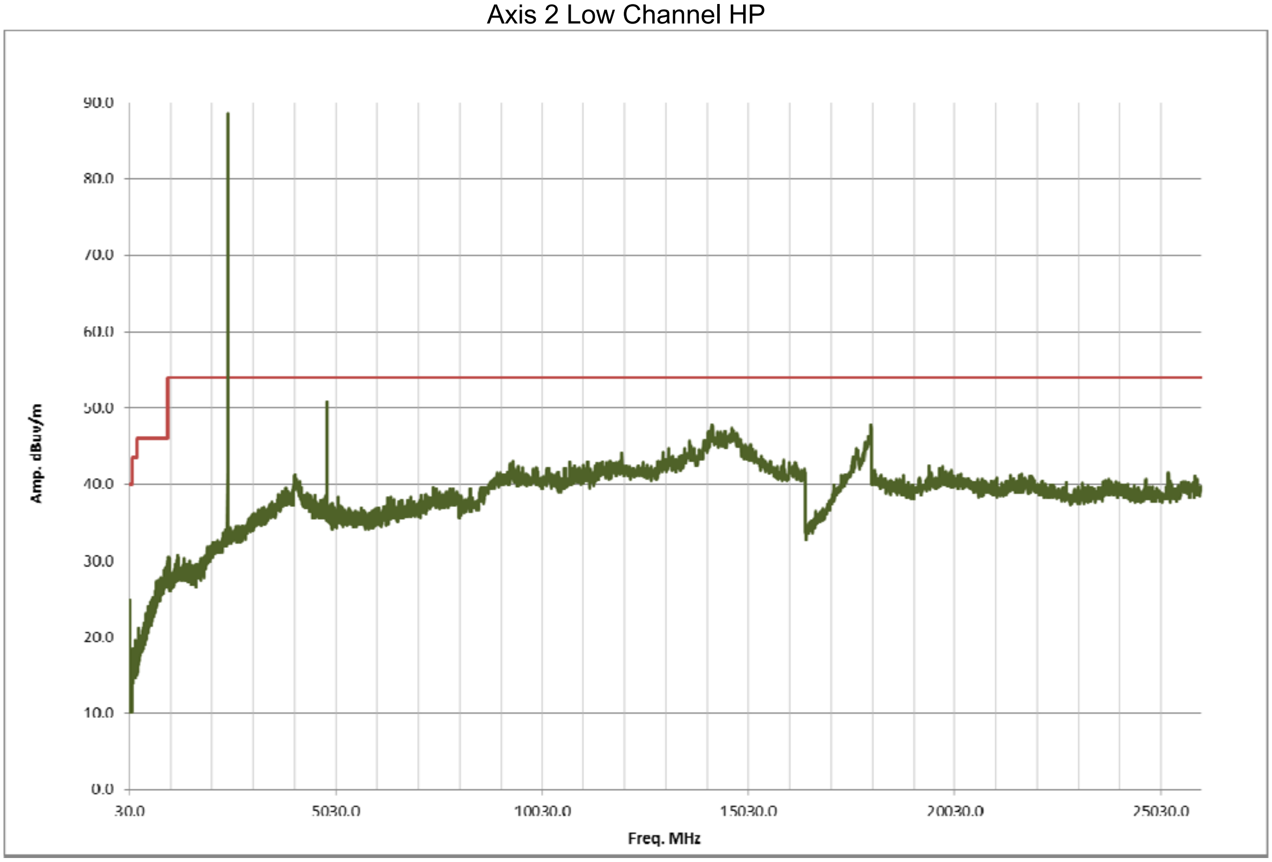
Axis 1 High Channel HP



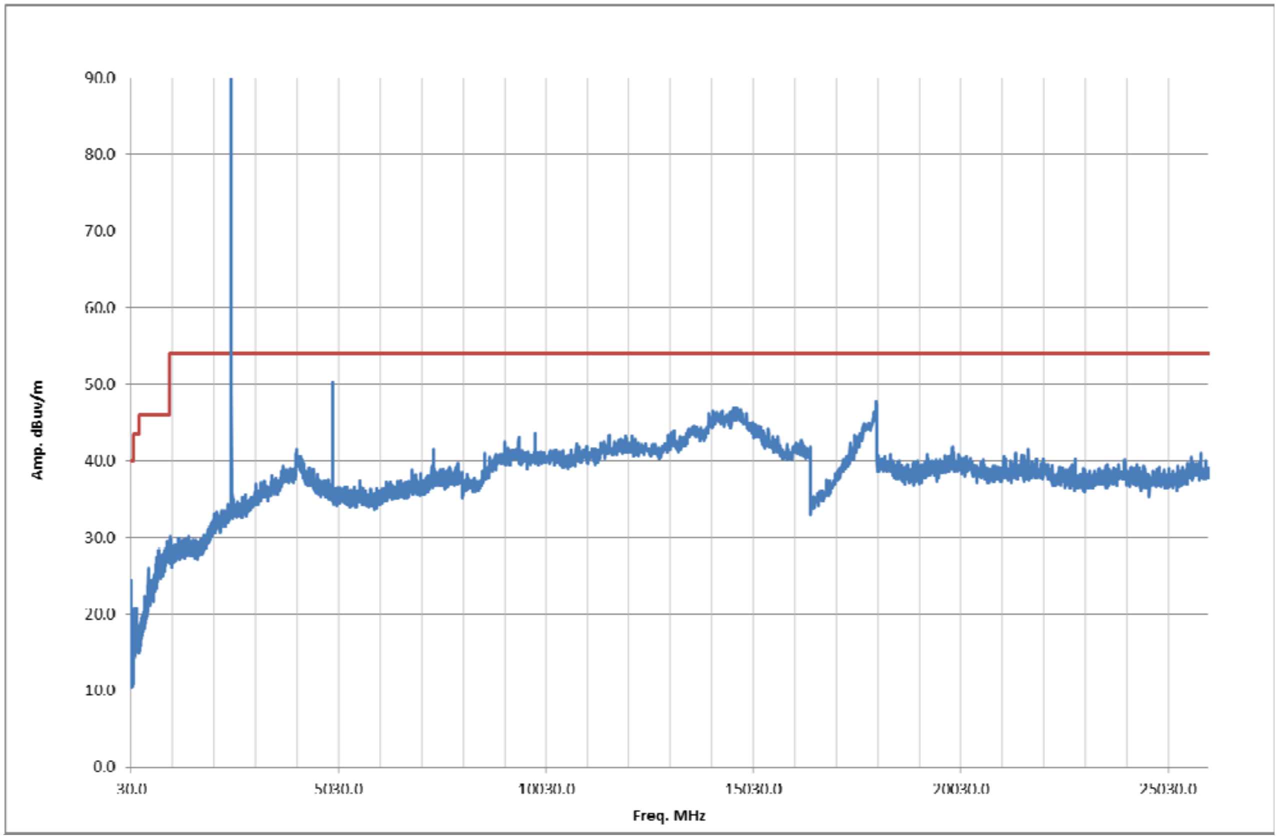
Axis 2 Low Channel VP



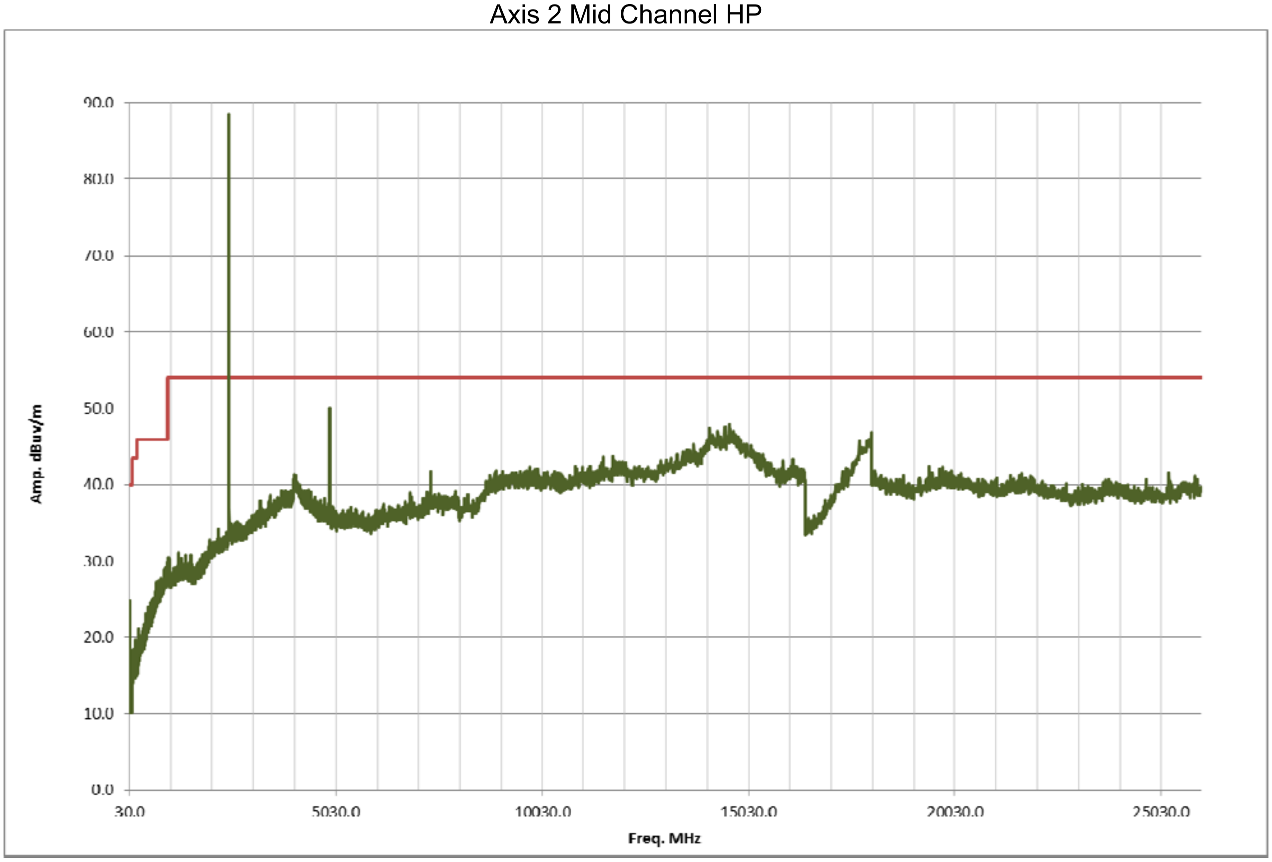
Axis 2 Low Channel HP



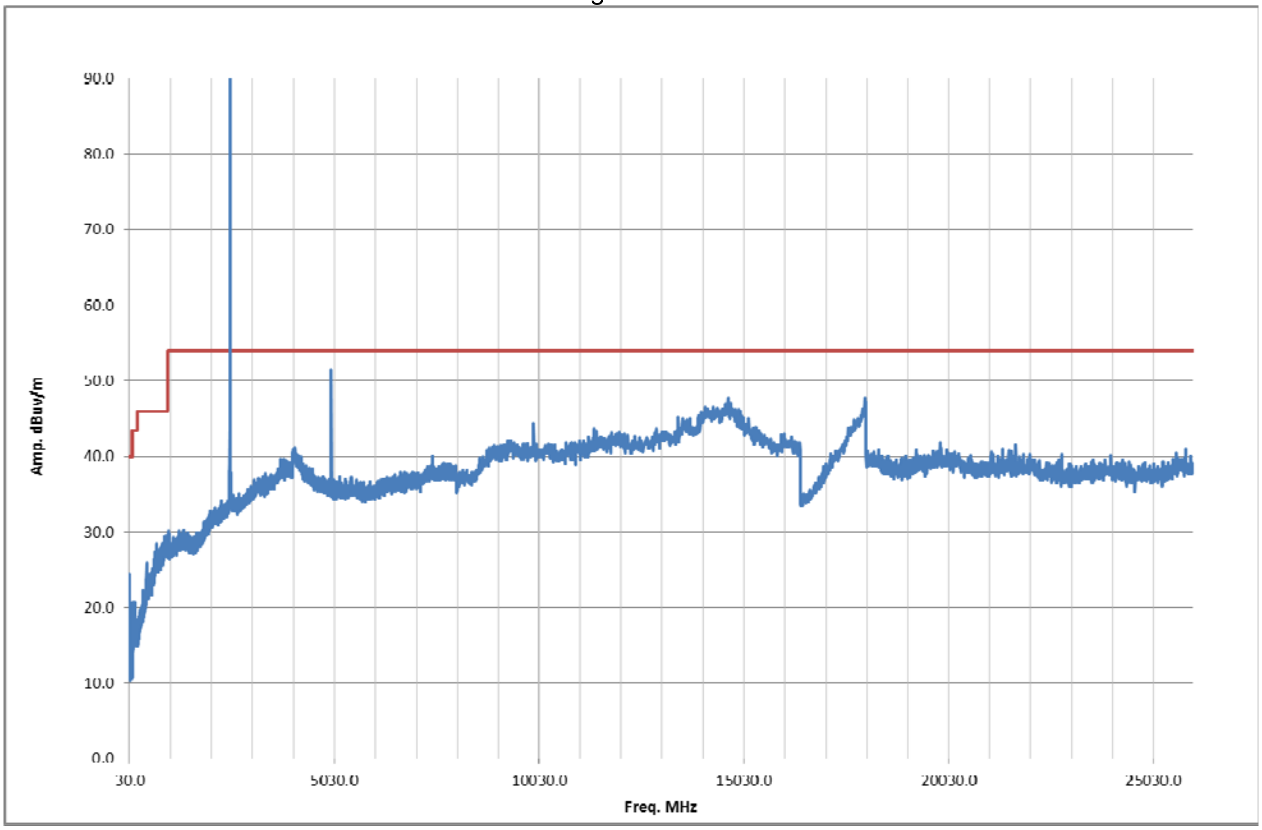
Axis 2 Mid Channel VP



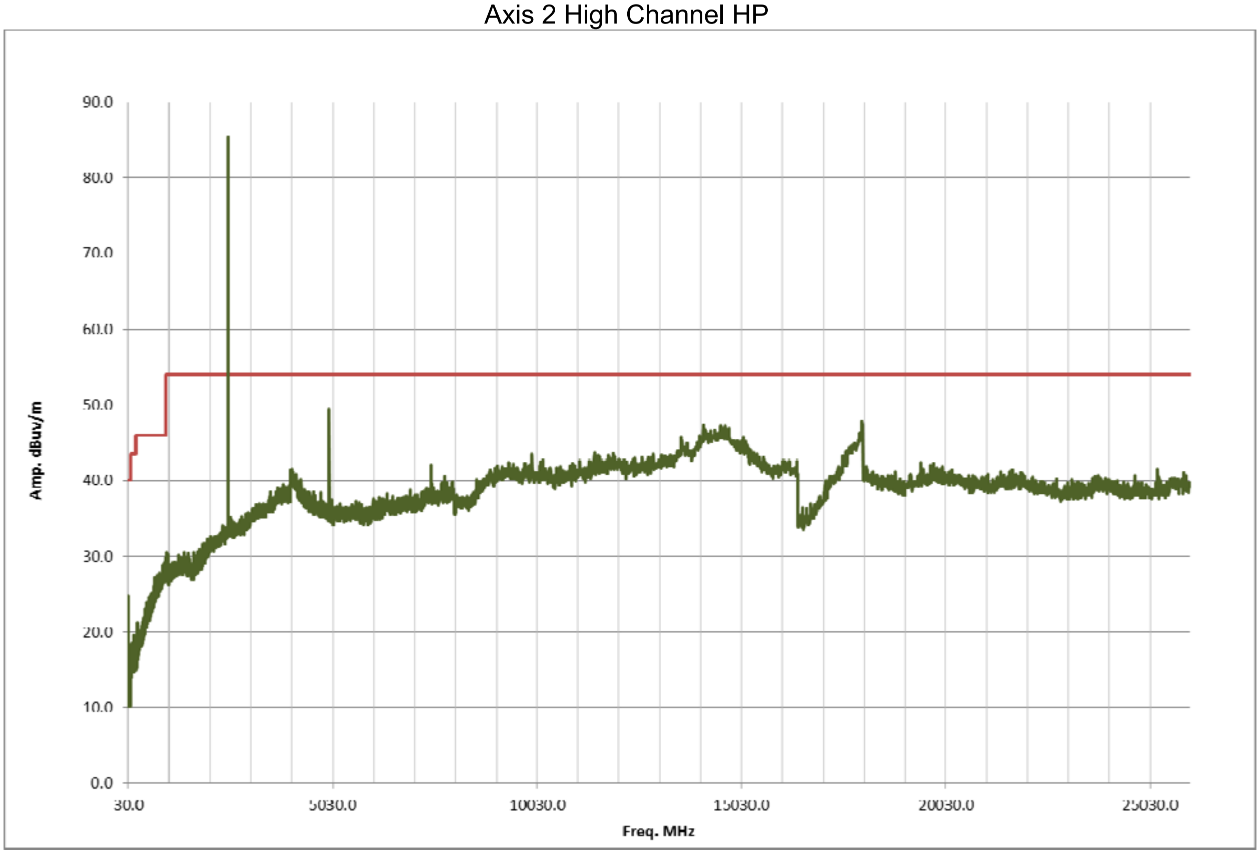
Axis 2 Mid Channel HP



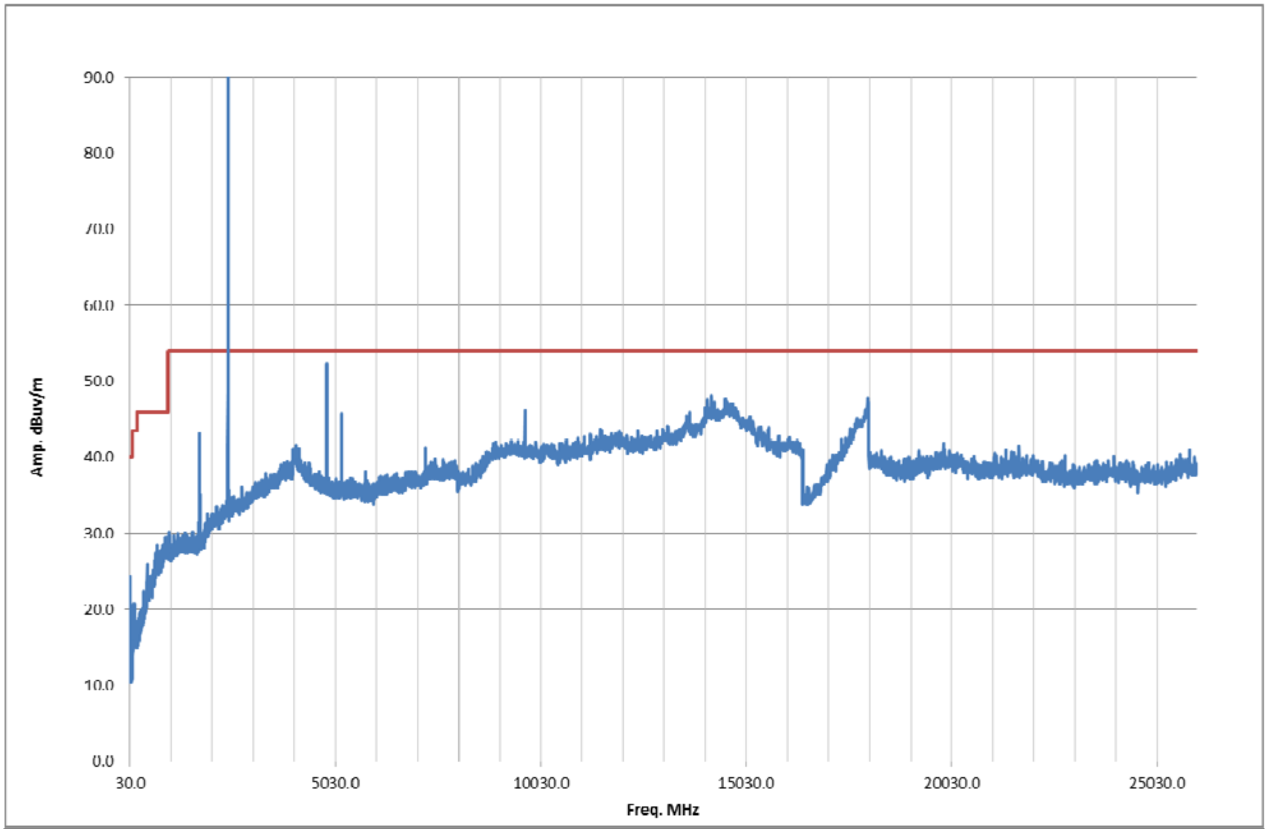
Axis 2 High Channel VP



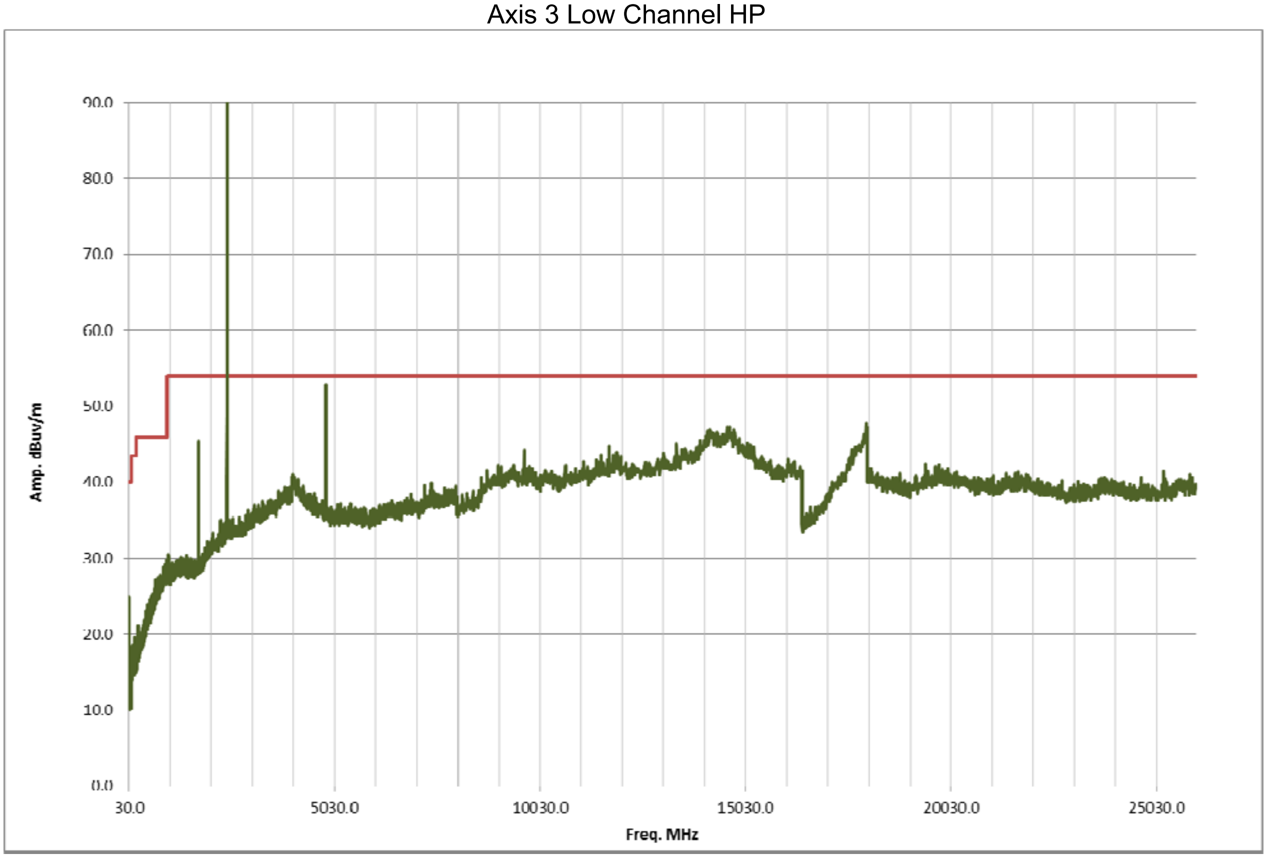
Axis 2 High Channel HP



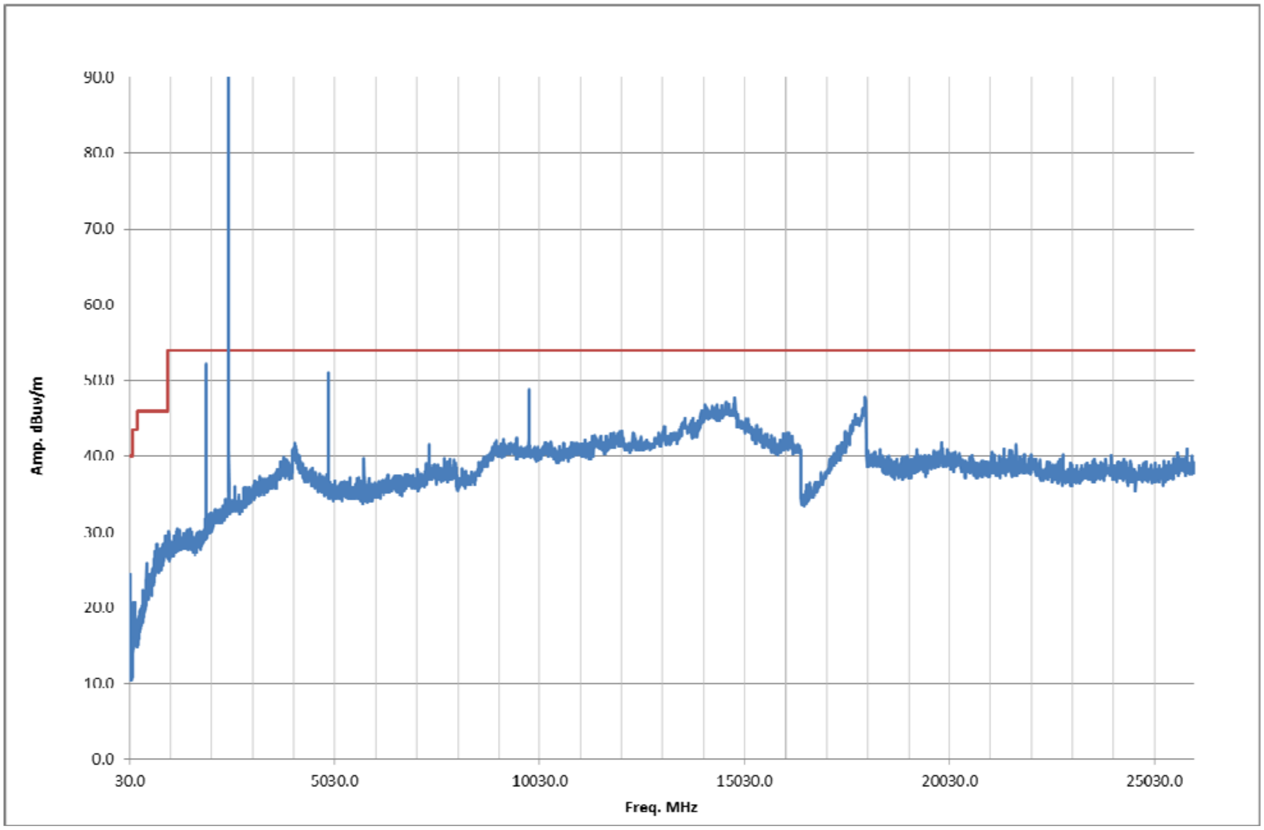
Axis 3 Low Channel VP



Axis 3 Low Channel HP

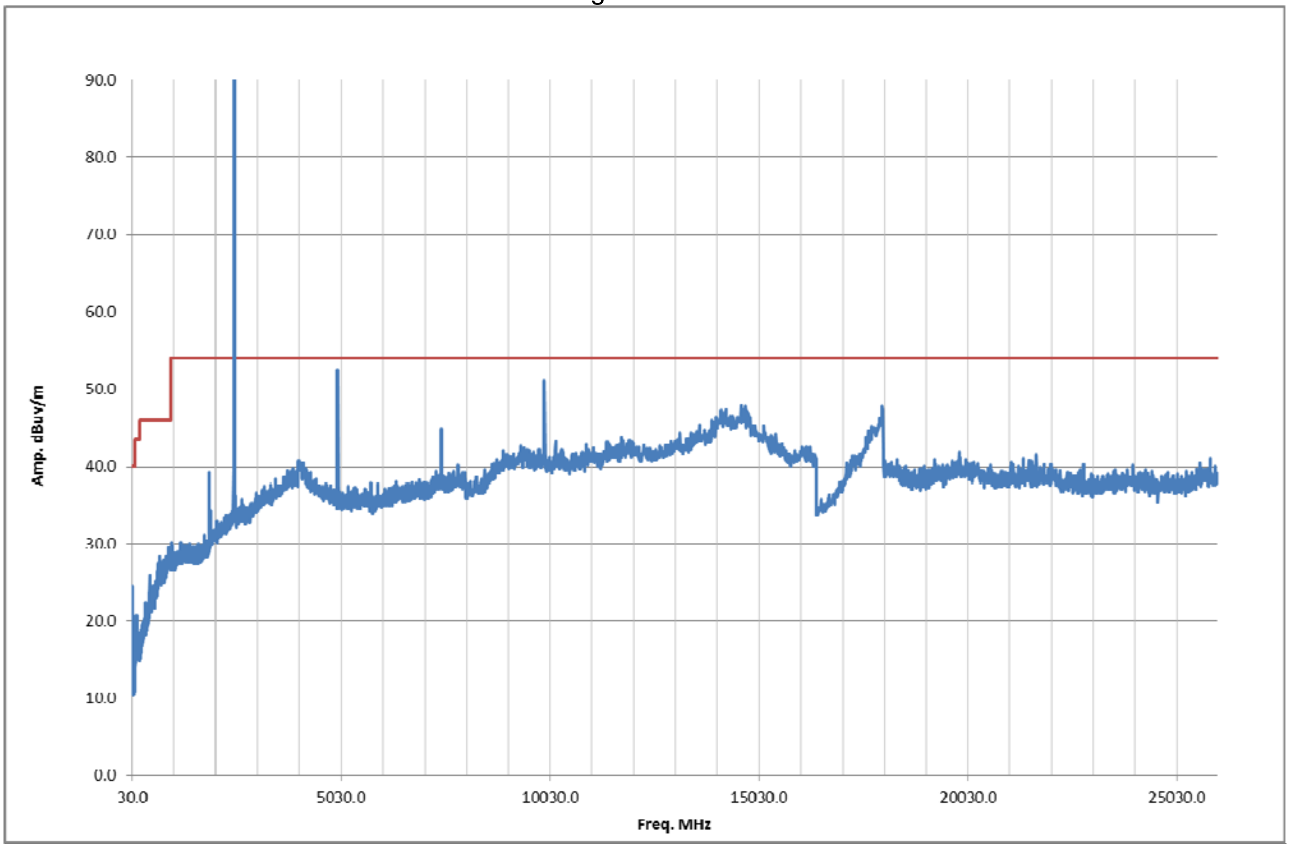


Axis 3 Mid Channel VP

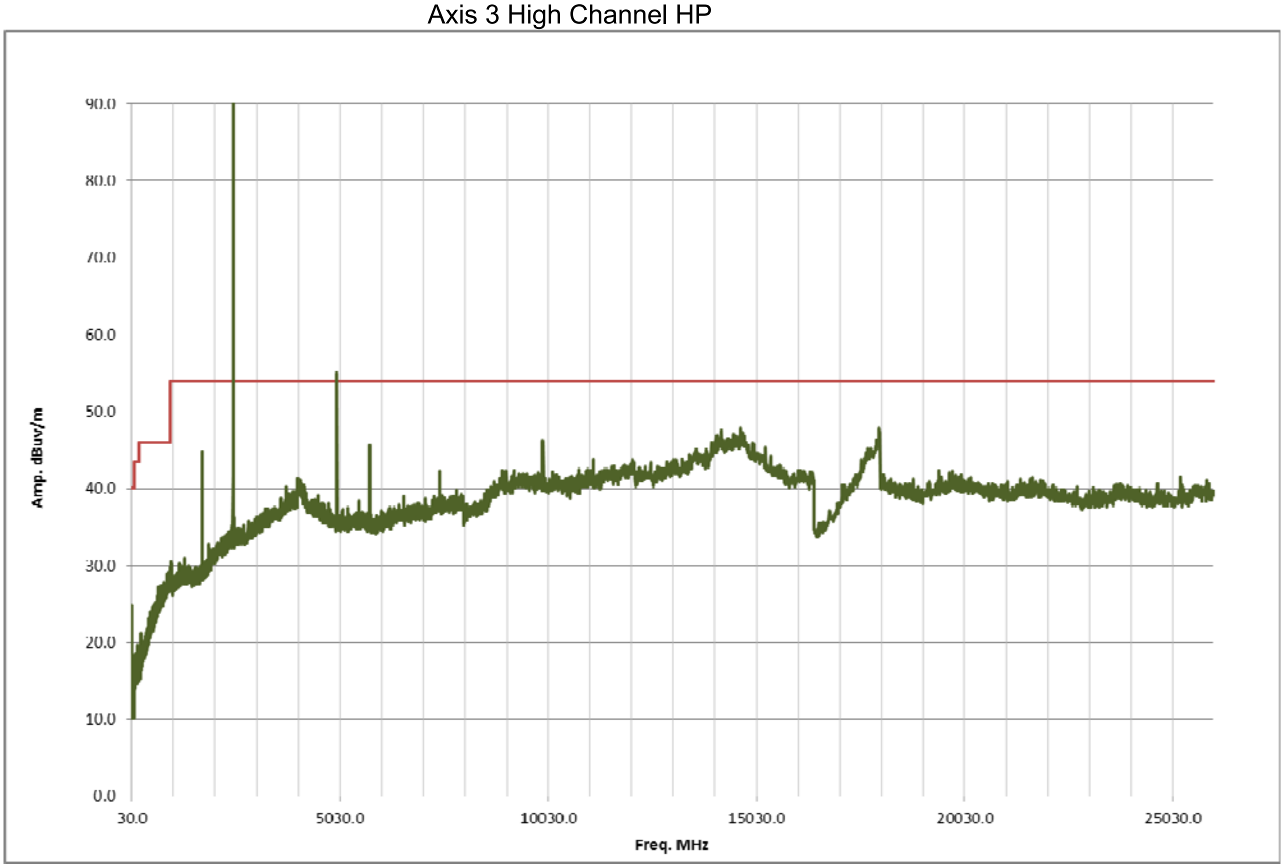


Axis 3 Mid Channel HP

Axis 3 High Channel VP



Axis 3 High Channel HP



11 Power Spectral Density – PSD

11.1 Method:

The test methods used comply with ANSI C63.10. Unless otherwise stated no deviations were made from FCC 15.247 or RSS-247.

This testing was performed at Intertek Denver, located at 1795 Dogwood St. Suite 200, Louisville, CO 80027.

11.2 Test Requirement/Specification:

For the band 2400 – 2483.5 GHz within digitally modulated systems (DTS) products, the power spectral density conducted from the intentional radiator to the antenna should not be greater than +8 dBm in any 3 kHz to 100kHz band during any time interval of continuous transmission.

Such specifications require that the same method as used to determine the conducted output power shall also be used to determine the power spectral density.

- FCC 15.247(e)
- RSS-247 5.2(2)

11.3 Test Equipment Used:

Asset ID	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DEN-073	EMI Receiver (10Hz – 26.5GHz)	RHODE & SCHWARZ	ESU 26	100265	12/10/2014	12/10/2015
DEN-206	RF Conducted Port Cable	-----	True Blue	14-11-401	12/23/2014	12/23/2015
SW-6	Software for Radiated and Conducted emissions.	Intertek	OATS vba	V. 3.0	VBU	VBU

11.4 Results:

The sample tested was found to comply.

11.5 Test Summary:

Fundamental	Conducted port Right Antenna					
Frequency Range:	☐ 902-928MHz ☒ 2400-2483.5MHz ☐ 5725-5850MHz					
Low Frequency MHz	**Measured Power (dBm)**	**Correction Cable/Atten (dB)**	**Final Corrected (dBm)**	**Standard Limit (dBm)**	**Limit Reduction (dB)**	**Margin (dB)**
2410	-0.94	2.5	1.56	8	NA	6.4
Mid Frequency MHz						
2442	-1.88	2.5	0.62	8	NA	7.4
High Frequency MHz						
2474.5	-1.85	2.6	0.75	8	NA	7.3
RBW: **VBW:**	☐ 3kHz ☐ 10kHz ☐ 30kHz ☒ 100kHz ☐ 10kHz ☐ 30kHz ☐ 100kHz ☒ 300kHz					

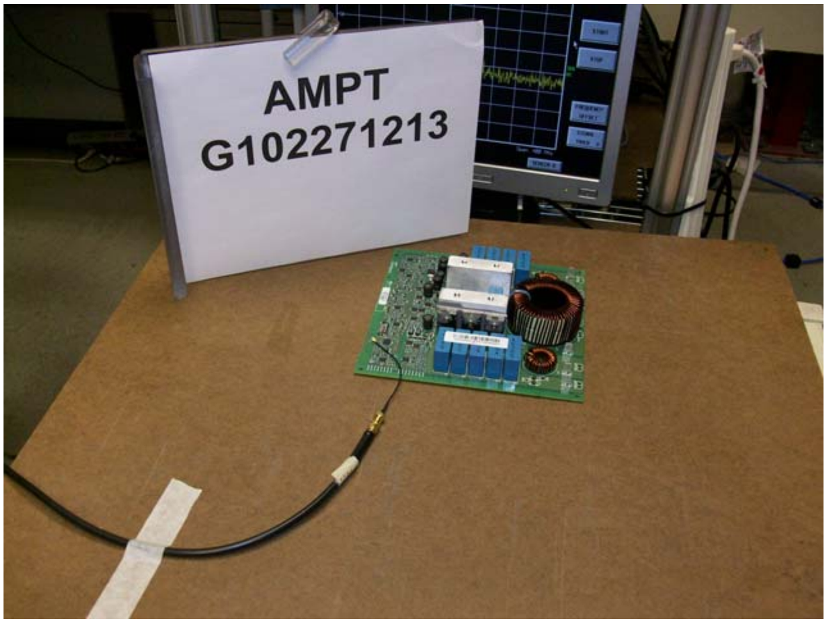
11.6 Test Method:

- ANSI C63.10:2013, Section 11.10

11.7 Notes:

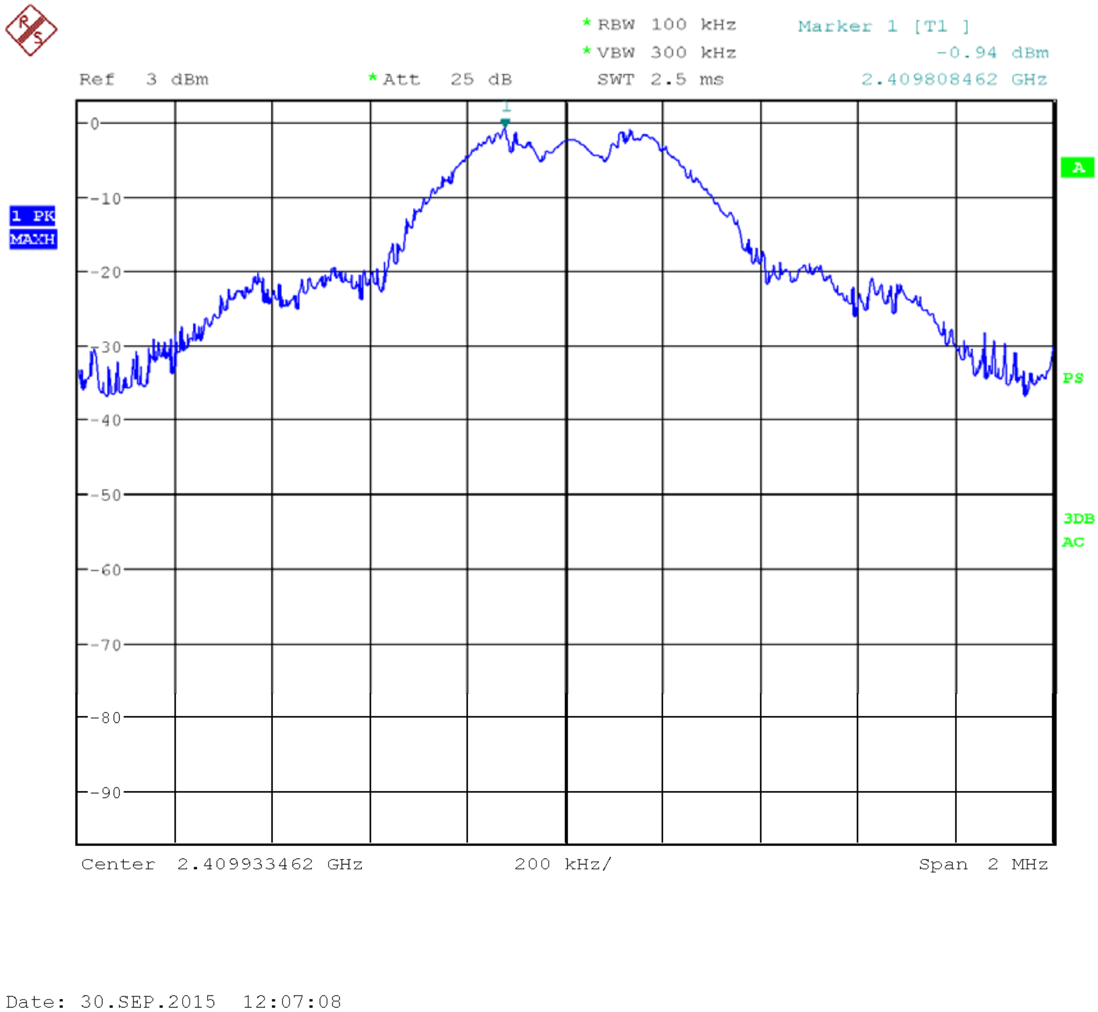
2. The limit for RSS-247 is identical to the limit for FCC 15.247.

11.8 Setup Photographs: Conducted Port

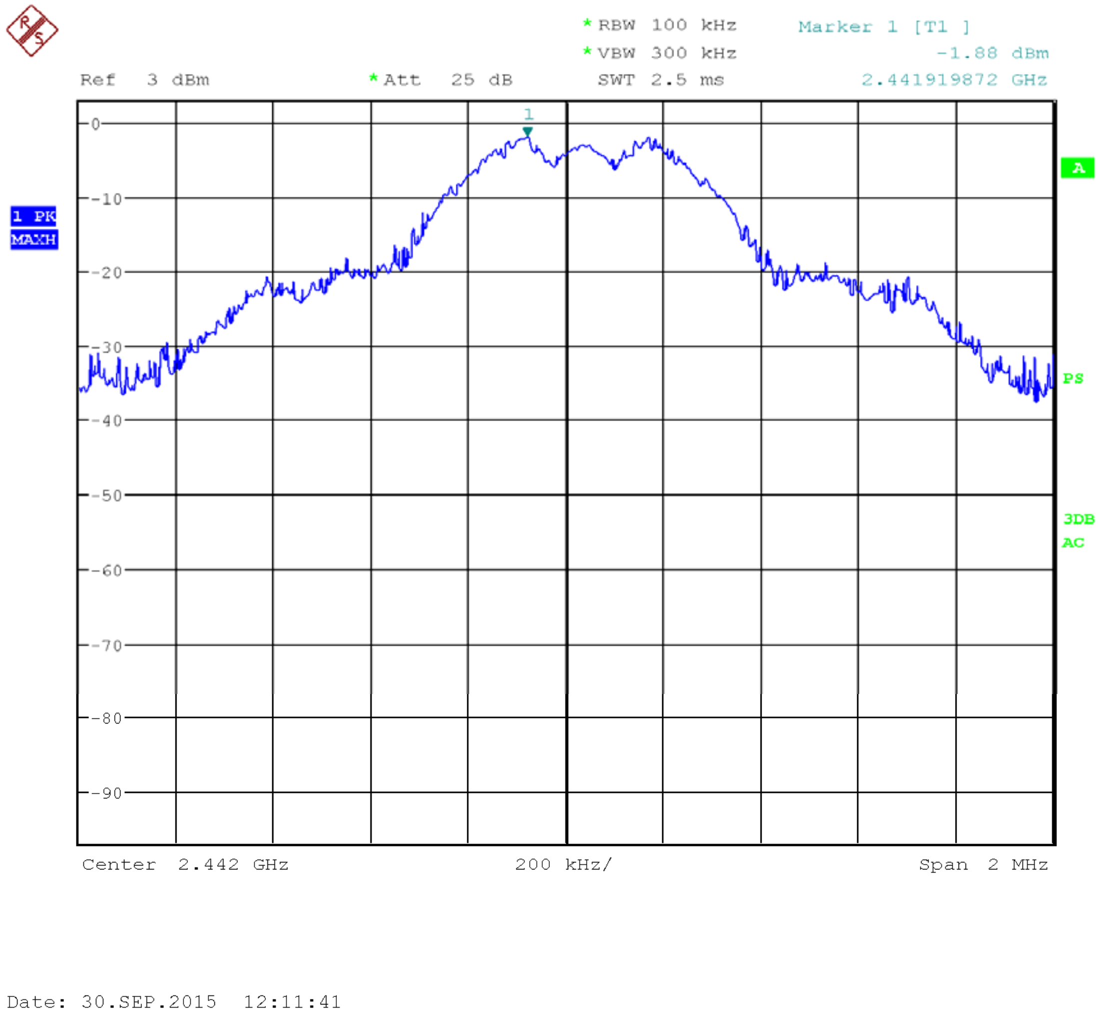


11.9 Plots:

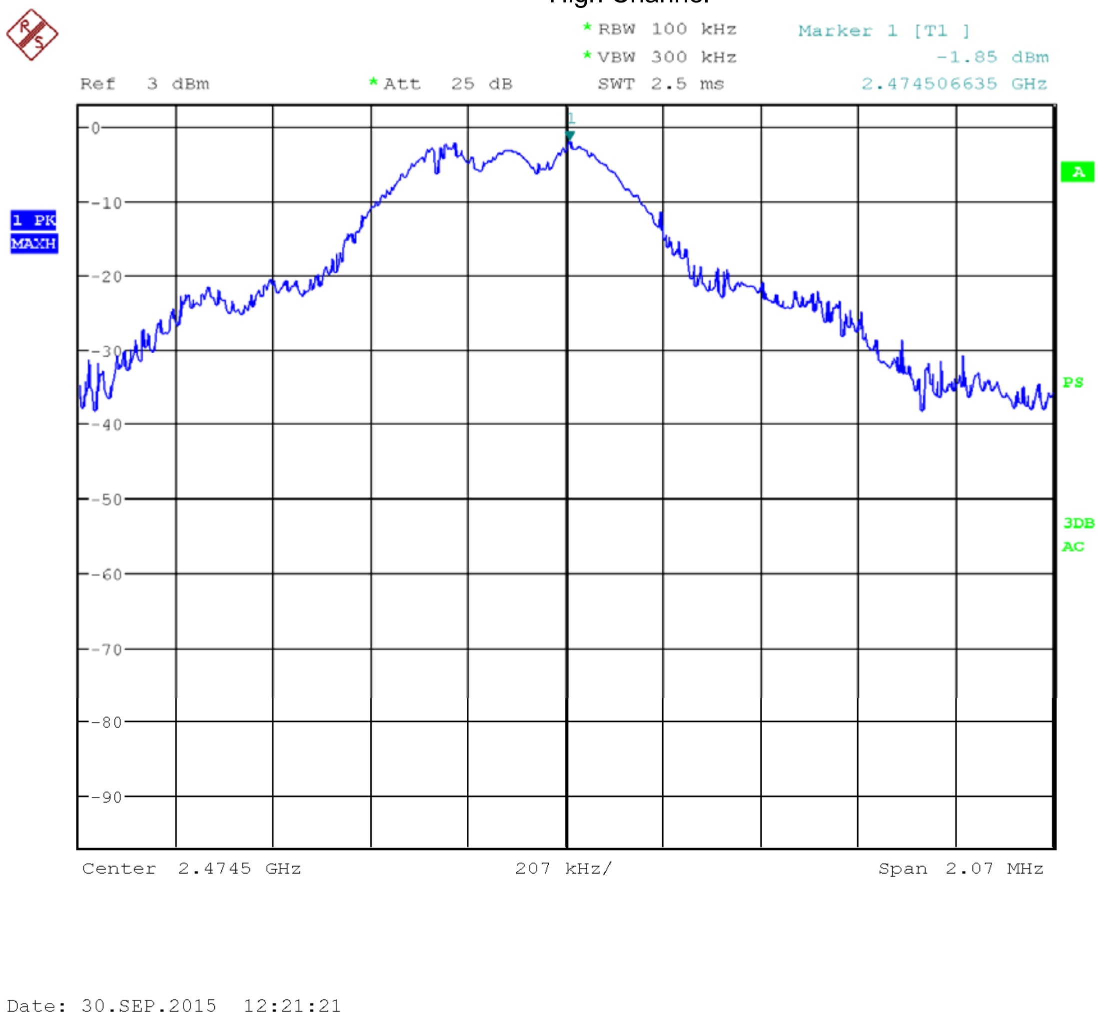
Low Channel



Mid Channel


*RBW 100 kHz
*VBW 300 kHz
Marker 1 [T1]
-1.88 dBm
Ref 3 dBm
*Att 25 dB
SWT 2.5 ms
2.441919872 GHz
1 PK
MAXH
A
PS
3DB
AC
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
1
Center 2.442 GHz
200 kHz/
Span 2 MHz
Date: 30.SEP.2015 12:11:41

High Channel



12 Radiated Emissions (Digital Part of Receiver + Rx Spurious) - NA

Testing covered by test report 102271213DEN-001.

12.1 Method:

12.2 Test Equipment Used:

12.3 Test Requirement/ Specification:

12.4 Test Procedure:

12.5 Test Results:

12.6 Setup Photographs:

12.7 Plots:

12.8 Test Data: Radiated Emissions Axis 1 – Horizontal (Product Flat on Table)

13 AC Mains Conducted Emissions - NA

EUT is not AC powered.

13.1 Method

13.2 Test Equipment Used:

13.3 Test Requirement/ Specification:

13.4 Test Procedure:

13.5 Test Results:

13.6 Setup Photographs:

13.7 Plots:

14 RF Exposure Requirement

14.1 Method

Unless otherwise stated no deviations were made from FCC Part 1.1310 or 2.1091.

This testing was performed at Intertek Denver, located at 1795 Dogwood St. Suite 200, Louisville, CO 80027.

14.2 Test Requirement/ Specification:

- Power Density Limit for Frequency Range: 1500 to 100,000 MHz = 1.0mW//cm²

14.3 Test Results:

The sample tested was found to comply.

14.4 Test Data:

RF Exposure Requirements - MPE

Project #:	**G102271213**	Test Area:	Intertek Louisville
Test Method:	FCC CFR47 Part 1.1310	Test Date:	10/1/2015
EUT Model #:	31570014		
EUT Serial #:	0815K000002		
Manufacturer:	Ampt		
EUT Description:	DC to DC string converter		
Notes:			

The following limit is from table 1 (B) Limits for General Population/Uncontrolled Exposure in FCC part 1.1310:

Power Density Limit for Frequency Range: 1500 to 100,000 MHz = 1.0 mW/cm^2

The following calculation was used to determine compliance to the above limit. The calculation is from FCC OET bulletin 65.

Power Density(S) $=PG/4\pi R^2$ or $S=EIRP/4\pi R^2$

Where:
S = power density (in appropriate units, e.g. mW/cm^2)
P = power input to the antenna (mW).
G = numeric power gain of the antenna in the direction of interest relative to an isotropic radiator.
R = distance to the center of radiation of the antenna (cm)

In this case, 20cm will be used.
==

Maximum measured rf conducted port power input to antenna = 2.51dBm = 1.78mW

Maximum typical gain declared by the manufacture = +1 dBi = 1.1 (numeric gain)

Power Density

Power (mW)	Gain (dbi)	Gain numeric	Distance (cm)	Power Density (mW/cm^2)
1.78	+1	1.1	20	0.00025

Therefore: Power Density Margin (Δ Limit) = 0.00025 – 1.0 = - 0.9997 mW/cm^2

To determine what minimum distance the product can satisfy the Power Density Limit:

R(cm) = SQRT[(P*G)/(4*π*S)] = 0.3 cm

Therefore: Distance Margin (Δ Limit) = 0.3 cm – 20 cm = -19.7 cm

==

Reference Conversion Equations:

1. Gain numeric = $10^{(dBi/10)}$

2. Gain (dBi) = 10 log(Gain numeric)

3. dBm = dBuV/m – 107 (50 ohm system)

4. dBm to Watts (W) = $10^{((dBm - 30)/10)}$

15 Duty Cycle/ Duty Cycle Correction Factor

No duty cycle correction factor was utilized during this testing – therefore, product duty cycle verification was not applicable.

15.1 Method:

15.2 Test Requirement/Specification:

15.3 Test Equipment Used:

15.4 Results:

15.5 Test Method:

15.6 Test Summary:

15.7 Plots:

15.8 Test Data:

16 Appendix A: Antenna Specifications - NA

17 Measurement Uncertainty

The measured value related to the corresponding limit will be used to decide whether the equipment meets the requirements.

The measurement uncertainty figures were calculated and correspond to a coverage factor of k = 2, providing a confidence level of respectively 95.45 % in the case where the distributions characterizing the actual measurement uncertainties are normal (Gaussian).

Measurement uncertainty Table

Parameter	Uncertainty ±	Notes
Radiated emissions, 10kHz to 30 MHz	3.4 dB	
Radiated emissions, 30 to 200 MHz HP	2.2 dB	
Radiated emissions, 30 to 200 MHz VP	3.8 dB	
Radiated emissions, 200 to 1000 MHz HP	2.8 dB	
Radiated emissions, 200 to 1000 MHz VP	2.7 dB	
Radiated emissions, 1 to 18 GHz	5.2 dB	
Conducted port emissions 10kHz to 1000 MHz	1.0 dB	
Conducted port emissions 1 – 26.5 GHz	1.6 dB	
AC mains Conducted emissions, 9kHz to 30 MHz	3.14 dB	

18 Revision History

Revision Level	Date	Report Number	Notes
0	10/27/2015	102271213DEN-001A	Original Issue
1	12/1/2015	102271213DEN-001A	Revisions requested by TCB reviewer. Page 5 - Updated RSS-GEN version and date. Page 8 – Removed note from block diagram. Page 14 – Updated high channel 6dB Bandwidth and removed “left antenna” text. Page 20 – Corrected output power summary table corrections for mid channel. Revisions By: Michael Spataro MAS Reviewed By: Son La SL