



TEST REPORT

Report Number: 100426626MIN-001R

Project Number: G100426626

Testing performed on the
P2T3P-120V

FCC ID: WCGP2T3P
Industry Canada ID: 8751A-P2T3P

to
47 CFR Part 15. 247:2009
RSS- 210, Issue 8, 2010

For
Packet Power LLC.

Test Performed by:
Intertek Testing Services NA, Inc.
7250 Hudson Blvd., Suite 100
Oakdale, MN 55128 USA

Test Authorized by:
Packet Power LLC
233 Park Ave, Suite 303
Minneapolis, MN 55415, USA

Prepared by: Uri Spector
Uri Spector

Date: September 13, 2011

Reviewed by: Simon Khazon
Simon Khazon

Date: September 13, 2011

This report is for the exclusive use of Intertek's Client and is provided pursuant to the agreement between Intertek and its Client. Intertek's responsibility and liability are limited to the terms and conditions of the agreement. Intertek assumes no liability to any party, other than to the Client in accordance with the agreement, for any loss, expense or damage occasioned by the use of this report. Only the Client is authorized to copy or distribute this report and then only in its entirety. Any use of the Intertek name or one of its marks for the sale or advertisement of the tested material, product or service must first be approved in writing by Intertek. The observations and test results in this report are relevant only to the sample tested. This report by itself does not imply that the material, product, or service is or has ever been under an Intertek certification program. This report must not be used to claim product endorsement by A2LA, NIST nor any other agency of the U.S. Government.



TABLE OF CONTENTS

1.0 GENERAL DESCRIPTION..... 3

1.1 Product Description; Test Facility.....4

1.3 Environmental conditions5

1.4 Measurement uncertainty.....6

1.5 Field Strength Calculation6

2.0 TEST SUMMARY..... 7

3.0 TEST CONDITIONS AND RESULTS..... 8

3.1 Maximum peak output power8

3.2 Hopping channel carrier frequencies separation..... 10

3.3 20dB bandwidth of the hopping channel 12

3.4 Number of hopping frequencies 16

3.5 Average time of occupancy of hopping frequency 18

3.6 Radiated spurious emissions21

3.7 RF Exposure Compliance33

3.8 Transmitter power line conducted emissions34

3.9 Receiver/digital device radiated emissions37

3.10 Digital device conducted emissions40

4.0 TEST EQUIPMENT..... 43

1.0 GENERAL DESCRIPTION

Model:	P2T3P-120V
Type of EUT:	Power Monitoring Node
Serial Number:	N/A
FCC ID:	WCGP2T3P
Industry Canada ID:	8751A-P2T3P
Related Submittal(s) Grants:	None
Company:	Packet Power LLC.
Customer:	Mr. Steve VanTassel
Address:	233 Park Ave, Suite 303 Minneapolis, MN 55415, USA
Phone:	(612) 396-8704
e-mail:	steve@packetpower.com
Test Standards:	<input checked="" type="checkbox"/> 47 CFR, Part 15:2009, §15.247 <input checked="" type="checkbox"/> RSS-210, Issue 8, 2010 <input checked="" type="checkbox"/> RSS-Gen, Issue 3, 2010 <input checked="" type="checkbox"/> 47 CFR, Part 15:2009, §15.107 and §15.109, Class B <input checked="" type="checkbox"/> ICES-003, Issue 4:2004 <input type="checkbox"/> Other
Type of radio:	<input type="checkbox"/> Stand -alone <input checked="" type="checkbox"/> Module <input type="checkbox"/> Hybrid
Date Sample Submitted:	June 20, 2011
Test Work Started:	June 21, 2011
Test Work Completed:	June 24, 2011
Test Sample Conditions:	<input type="checkbox"/> Damaged <input type="checkbox"/> Poor (Usable) <input checked="" type="checkbox"/> Good



1.1 Product Description; Test Facility

Product Description:	Transmitter Power Monitoring Node
Transmitter Type:	<input checked="" type="checkbox"/> FHSS <input type="checkbox"/> Digital Modulation <input type="checkbox"/> WiFi <input type="checkbox"/> Blue Tooth
Operating Frequency Range(s):	From 902 to 928MHz
Number of Channels:	64
Modulation:	GFSK
Emission Designator:	207KF1DBF
Antenna(s) Info:	Type: Wire soldered to the PCB board Gain: 0.5 dBi
Power settings:	Level 2 (+6dBm)
Antenna Installation:	<input type="checkbox"/> User <input type="checkbox"/> Professional <input checked="" type="checkbox"/> Factory
Transmitter power configuration:	<input type="checkbox"/> Internal battery <input checked="" type="checkbox"/> External power source <input checked="" type="checkbox"/> 120VAC <input type="checkbox"/> 230VAC <input type="checkbox"/> 400VAC <input type="checkbox"/> [] VDC <input type="checkbox"/> Other: [] [] Amp. <input type="checkbox"/> 50Hz <input checked="" type="checkbox"/> 60Hz
Special Test Arrangement:	
Test Facility Accreditation:	A2LA (Certificate No. 1427.01)
Test Methodology:	Measurements performed according to the procedures in ANSI C63.10-2009 and FCC Public Notice DA 00-705

1.2 EUT Configuration

The equipment under test was operated during the measurement under the following conditions:

- ☒ - Standby
- ☒ - Continuous transmissions with hopping function enabled
- ☒ - Continuous transmissions with hopping function disabled (modulated signal)
- ☐ - Continuous transmissions with hopping function disabled (un-modulated signal)
- ☐ - Continuous receiving
- ☐ - Test program (customer specific)
- ☐ -

Operating modes of the EUT:

No.	Description
1	P3Debug software on the HP laptop was used to exercise P2T3P-120V. EUT has 64 channels of operation; testing consisted of a lower, middle, and upper channel transmitting continuously with one channel being transmitted at a given time, or hopping function enabled.
2	Standby / Receiving mode was used for FCC Part 15.107 / 109 and ICES-003 testing

Cables:

No.	Type	Length	Designation	Note
1	2-wire Unshielded	>2m	AC power	

Support equipment/Services:

No.	Item	Description
1	HP Laptop computer	
2		

1.3 Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

☒ **Normal**

Temperature:	+15 to +35 ° C
Humidity:	20-75 %
Atmospheric pressure:	86-106 kPa

☐ **Extreme**

<input type="checkbox"/> Temperature:	-20 to +50 ° C
<input type="checkbox"/> Supply voltage:	85% to +115%

1.4 Measurement uncertainty

The expanded uncertainty ($k = 2$) for radiated measurements has been determined to be:

± 4 dB at 10m and ± 5.4 dB at 3m

The expanded uncertainty ($k = 2$) for conducted measurements at antenna terminal has been determined to be:

± 1.0 dB

The expanded uncertainty ($k = 2$) for line conducted measurements has been determined to be:

± 2.6 dB

1.5 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured emissions reading on the EMI Receiver.

The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CF - AG$$

Where: FS = Field Strength in dB(μ V/m)

RA = Receiver Amplitude in dB(μ V)

CF = Cable Attenuation Factor in dB

AF = Antenna Factor in dB(m^{-1})

AG = Amplifier Gain in dB

Assume a receiver reading of 48.1 dB(μ V) is obtained. The antenna factor of 7.4 dB(m^{-1}) and cable factor of 1.6 dB is added and amplifier gain of 16.0 dB is subtracted giving field strength of 41.1 dB(μ V/m).

$$RA = 48.1 \text{ dB}(\mu\text{V})$$

$$AF = 7.4 \text{ dB}(m^{-1})$$

$$CF = 1.6 \text{ dB}$$

$$AG = 16.0 \text{ dB}$$

$$FS = RA + AF + CF - AG$$

$$FS = 48.1 + 7.4 + 1.6 - 16.0$$

$$FS = 41.1 \text{ dB}(\mu\text{V}/m)$$

General notes:

2.0 TEST SUMMARY

Referring to the performance criteria and the operating mode during the tests specified in this report, the equipment complies with the requirements according to the following standards.

TEST SPECIFICATION	TEST PARAMETERS	RESULT
15.247(b), (c) / RSS-210 A8.4	Maximum peak output power	Pass
15.247(e) / RSS-210 A8.1	Hopping channel carrier frequencies separation	Pass
15.247(a) / RSS-210 A8.1	20dB bandwidth of the hopping channel	Pass
15.247(e) / RSS-210 A8.1	Number of hopping frequencies	Pass
15.247(e) / RSS-210 A8.1	Average time of occupancy of hopping frequency	Pass
15.247(d) / RSS-210 A8.5	Antenna conducted spurious and band edge emissions	Pass
15.247(d) / RSS-210 A8.5	Radiated spurious emissions	Pass
15.247(i) / RSS- Gen 5.5	RF Exposure Compliance	Pass
15.207 / RSS-Gen 7.2.2	Transmitter Power Line conducted emissions	Pass
15.109 / ICES-003	Receiver/digital device radiated emissions	Pass
15.107 / ICES-003	Digital device conducted emissions	Pass

3.0 TEST CONDITIONS AND RESULTS

3.1 Maximum peak output power

Test location: ☐ OATS ☒ Anechoic Chamber ☐ Other

Test result: **Pass**

Max. Margin: -36.0dB below the limits

Power Output:	Radiated						
Distance:	<input checked="" type="checkbox"/> 3m <input type="checkbox"/> 10m						
Frequency Range:	<input checked="" type="checkbox"/> 902-928MHz <input type="checkbox"/> 2400-2483.5MHz <input type="checkbox"/> 5725-5850MHz						
Low Frequency 902.36MHz	Measured field		Tx Peak Power		Limit dBm	Limit Reduction dB	Margin dB
	dBµV/m	V/m	W	dBm			
Vertical Antenna	89.7	0.03055	0.00025	-6.0	30	0	-36.0
Horizontal Antenna	83.3	0.01462	0.000057	-12.4	30	0	-42.4
Middle Frequency 915.16MHz							
Vertical Antenna	88.9	0.02786	0.000207	-6.8	30	0	-36.8
Horizontal Antenna	83.9	0.01567	0.000066	-11.8	30	0	-41.8
Upper Frequency 927.58MHz							
Vertical Antenna	87.9	0.02483	0.000165	-7.8	30	0	-37.8
Horizontal Antenna	84.9	0.01758	0.000083	-10.8	30	0	-40.8
RBW:	<input checked="" type="checkbox"/> 1MHz <input type="checkbox"/> 3MHz <input type="checkbox"/> 10MHz						
VBW:	<input checked="" type="checkbox"/> 1MHz <input type="checkbox"/> 3MHz <input type="checkbox"/> 10MHz						
Antenna Gain:	<input checked="" type="checkbox"/> < 6dBi <input type="checkbox"/> >6dBi and = <input type="text"/> dBi, Output power reduction = <input type="text"/> dB						

Notes: The Maximum Peak Output Power was calculated from equation
 $P = (E \times d)^2 / 30G$, where
P is the power in watts;
E is the measured field strength in V/m;
d is the measurement distance, d = 3m;
G is the numerical antenna gain of the transmitter G = 0.5dBi , or G = 1.122 (numerical)



Date:	June 21, 2011	Result: Pass
Tested by:	Uri Spector	
Standard:	FCC Part 15.247	
Test Point:	Emissions at Fundamental	
Operation mode:	See page 5	
Note:	None	

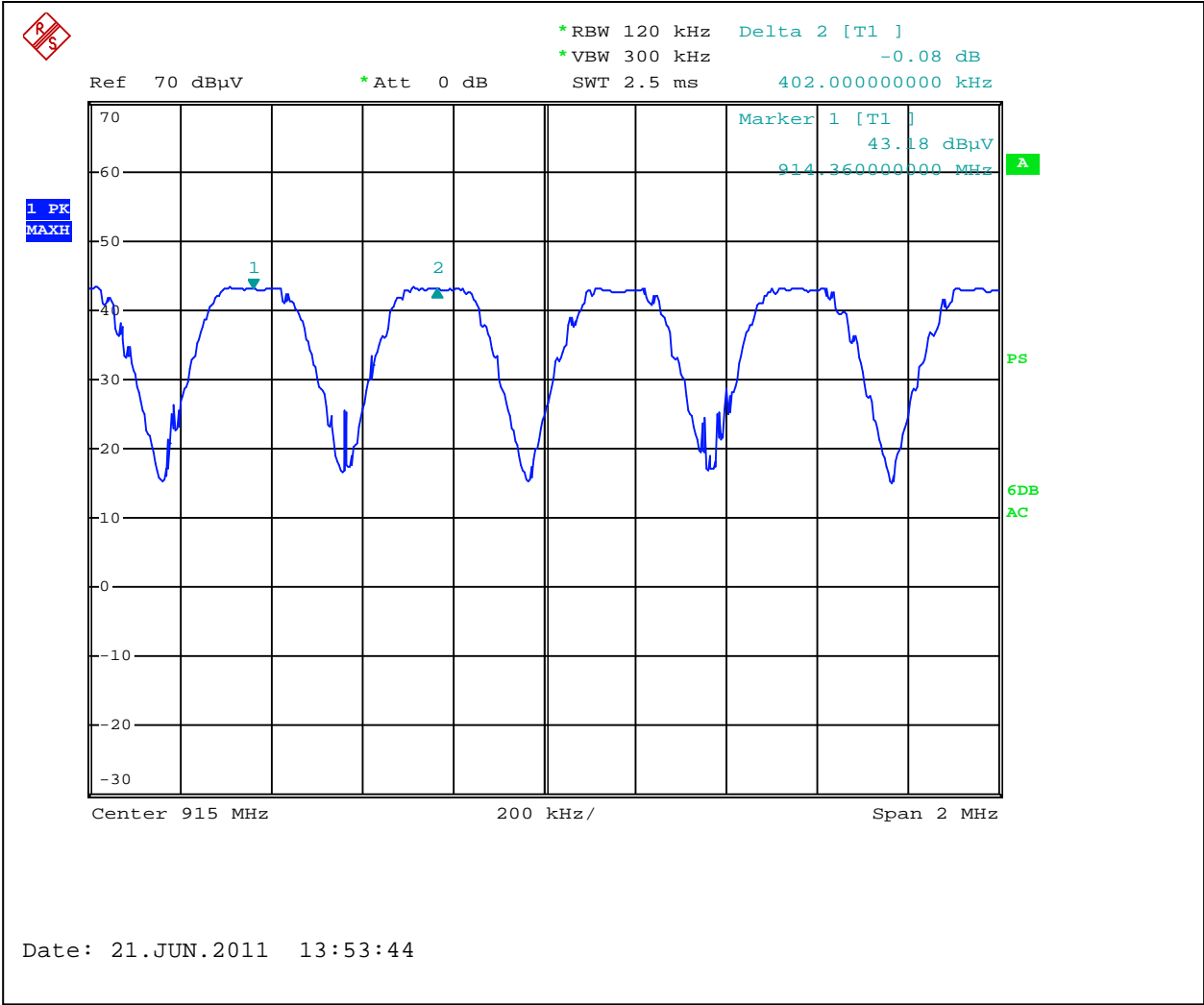
Table 3.1.1

Frequency MHz	Antenna		Ant. CF dB1/m	Cable loss dB	Pre-amp Gain (dB)	Peak Reading dBμV	Total @ 3m dBμV/m	Limit dBμV/m	Margin dB	Comments
	Polarity	Hts(cm)								
902.36MHZ										
902.36	V	143	21.9	3.6	0.0	64.2	89.7	N/A	N/A	
902.36	H	130	21.9	3.6	0.0	57.8	83.3	N/A	N/A	
915.16MHZ										
915.16	V	147	22.0	3.6	0.0	63.3	88.9	N/A	N/A	
915.16	H	182	22.0	3.6	0.0	58.3	83.9	N/A	N/A	
927.58MHZ										
927.58	V	138	22.1	3.7	0.0	62.2	87.9	N/A	N/A	
927.58	H	192	22.1	3.7	0.0	59.2	84.9	N/A	N/A	

3.2 Hopping channel carrier frequencies separation

Frequency Range:	<input checked="" type="checkbox"/> 902-928MHz <input type="checkbox"/> 2400-2483.5MHz <input type="checkbox"/> 5725-5850MHz			
Measured Separation (kHz)	Limit (kHz)		Result	
402	25		Pass	
Limit:	<input checked="" type="checkbox"/> 25kHz <input type="checkbox"/> 20dB channel bandwidth <input type="checkbox"/> 2/3 of 20dB channel bandwidth			
Span:	2MHz			
RBW:	<input type="checkbox"/> 3kHz	<input type="checkbox"/> 10kHz	<input type="checkbox"/> 100kHz	<input checked="" type="checkbox"/> other 120kHz
VBW:	<input type="checkbox"/> 3kHz	<input type="checkbox"/> 10kHz	<input type="checkbox"/> 100kHz	<input checked="" type="checkbox"/> other 300kHz

Notes:

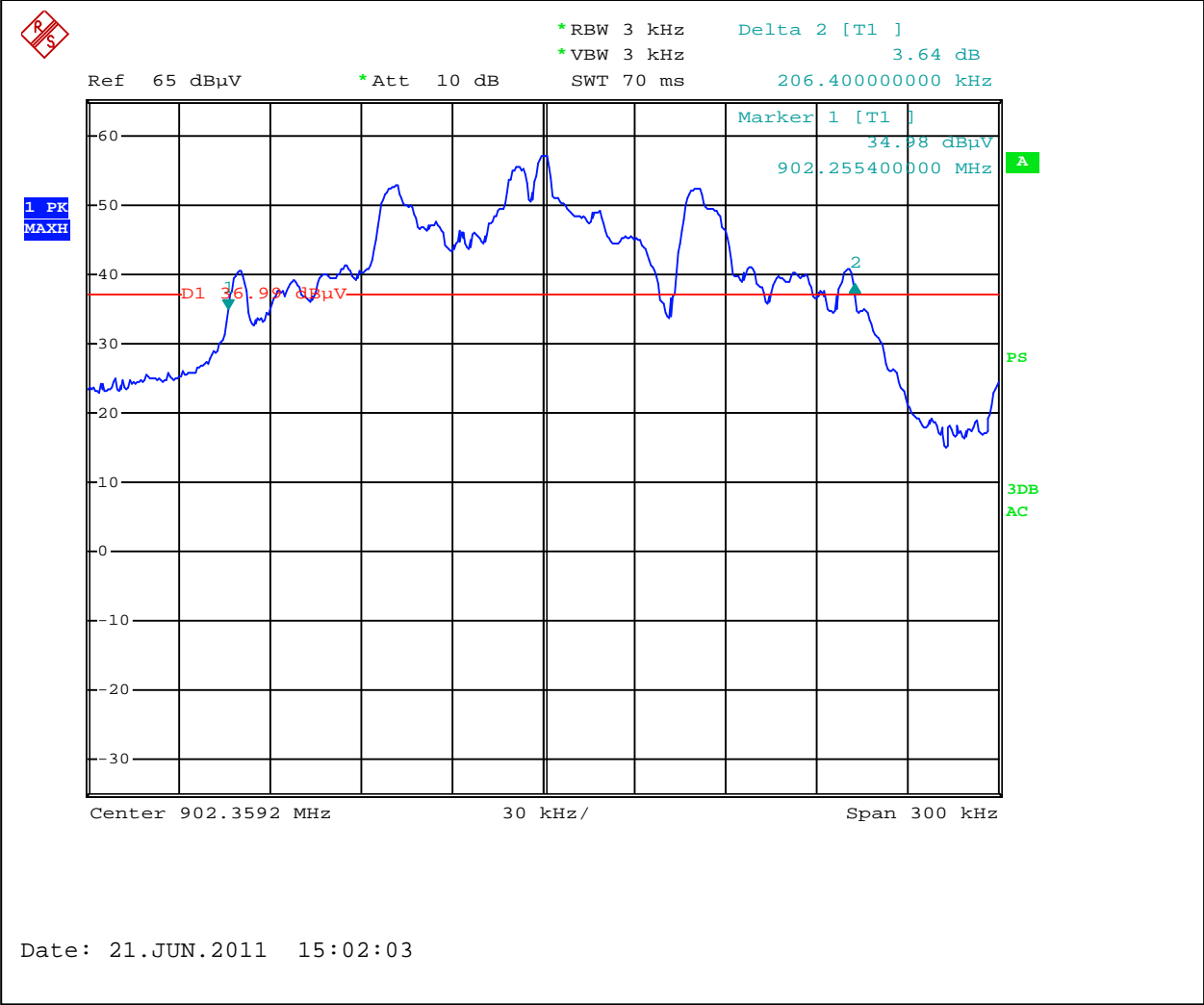


Graph 3.2.1

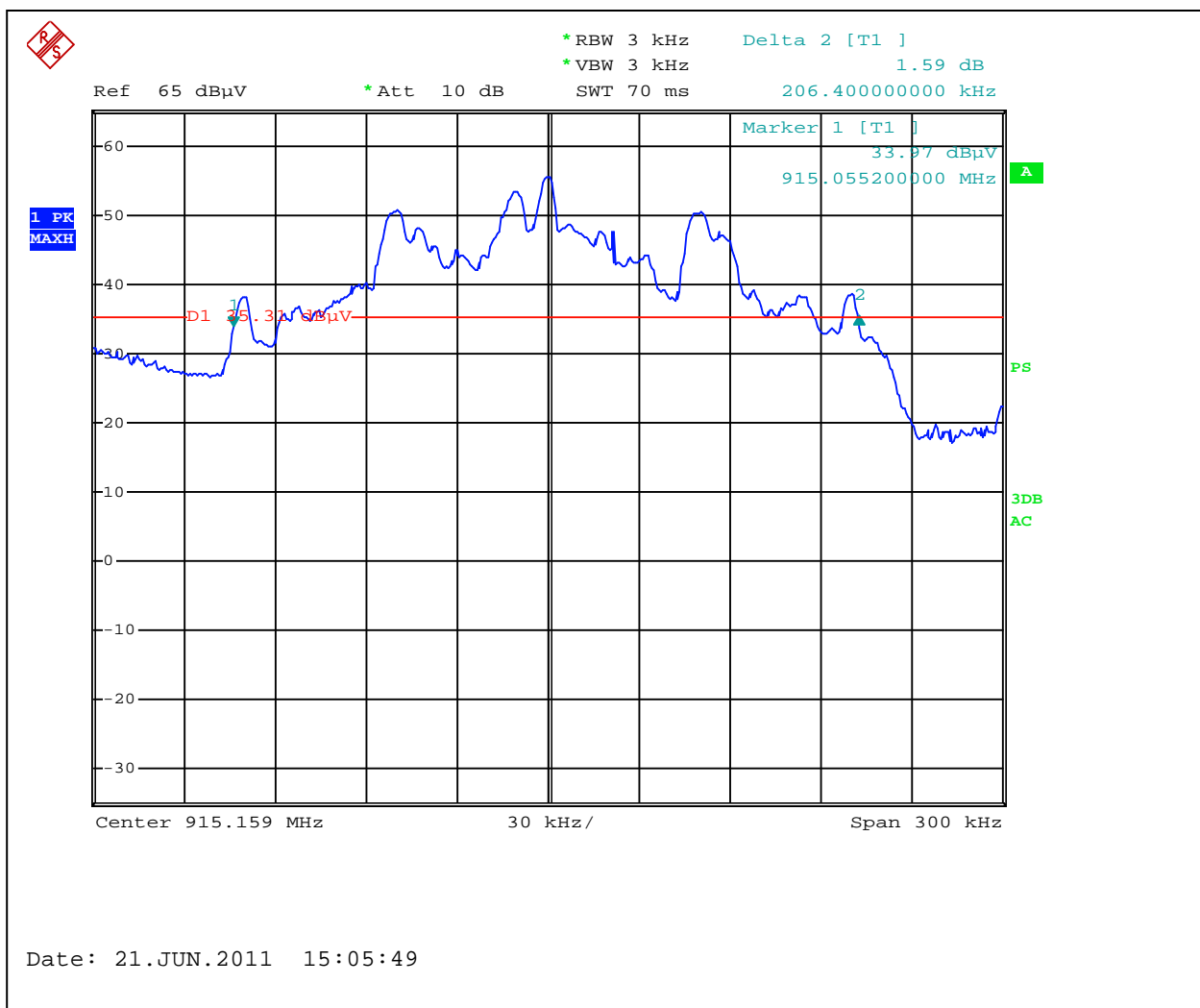
3.3 20dB bandwidth of the hopping channel

Frequency Range:	<input checked="" type="checkbox"/> 902-928MHz <input type="checkbox"/> 2400-2483.5MHz <input type="checkbox"/> 5725-5850MHz			
Low Frequency Channel (kHz)	Middle Frequency Channel (kHz)	Upper Frequency Channel (kHz)	Limit (kHz)	Result
206.4	206.4	207	500	Pass
Span:	300kHz			
RBW:	<input checked="" type="checkbox"/> 3kHz <input type="checkbox"/> 10kHz <input type="checkbox"/> 100kHz <input type="checkbox"/> other <input type="text"/> kHz			
VBW:	<input checked="" type="checkbox"/> 3kHz <input type="checkbox"/> 10kHz <input type="checkbox"/> 100kHz <input type="checkbox"/> other <input type="text"/> kHz			

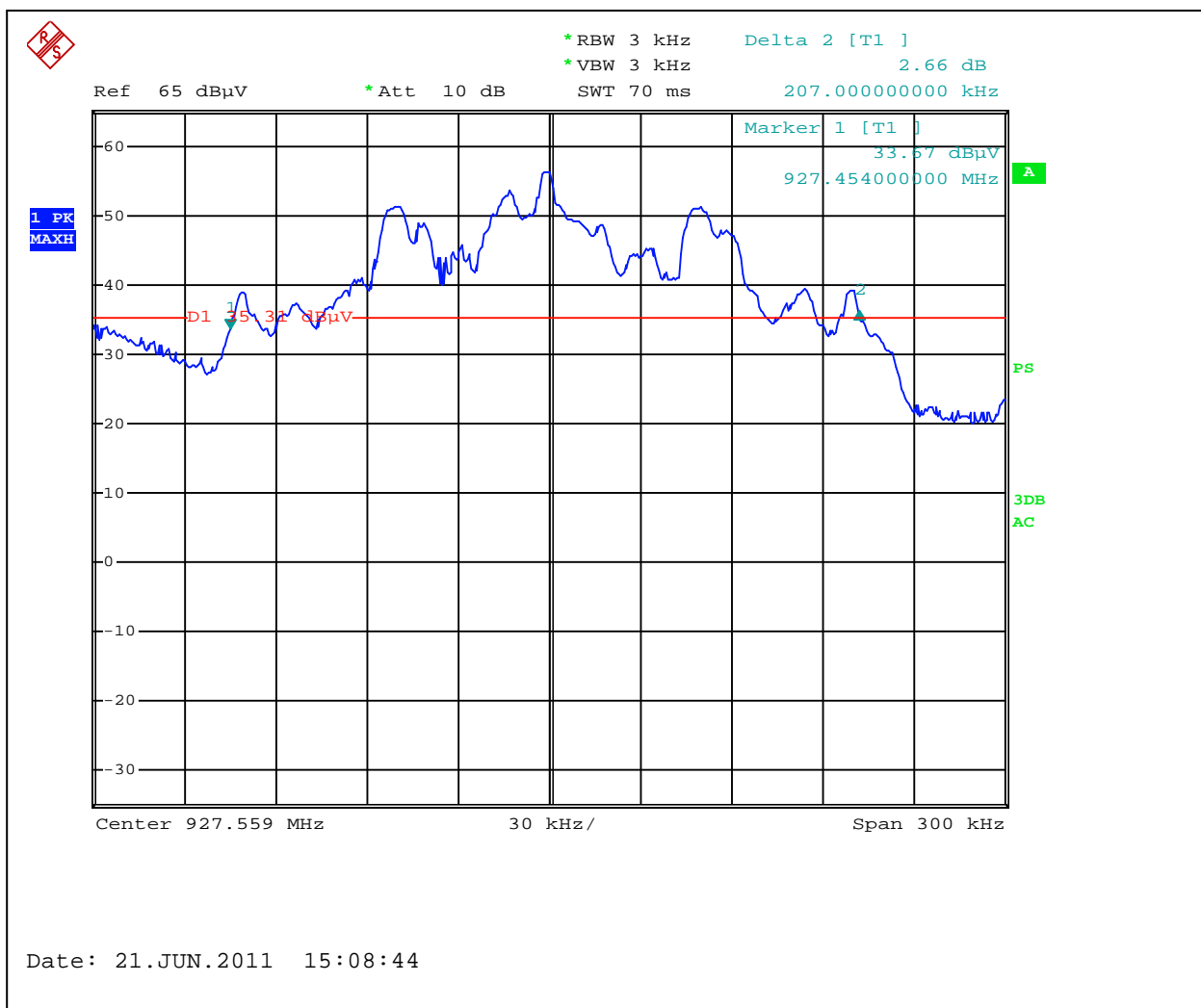
Notes:



Graph 3.3.1



Graph 3.3.2

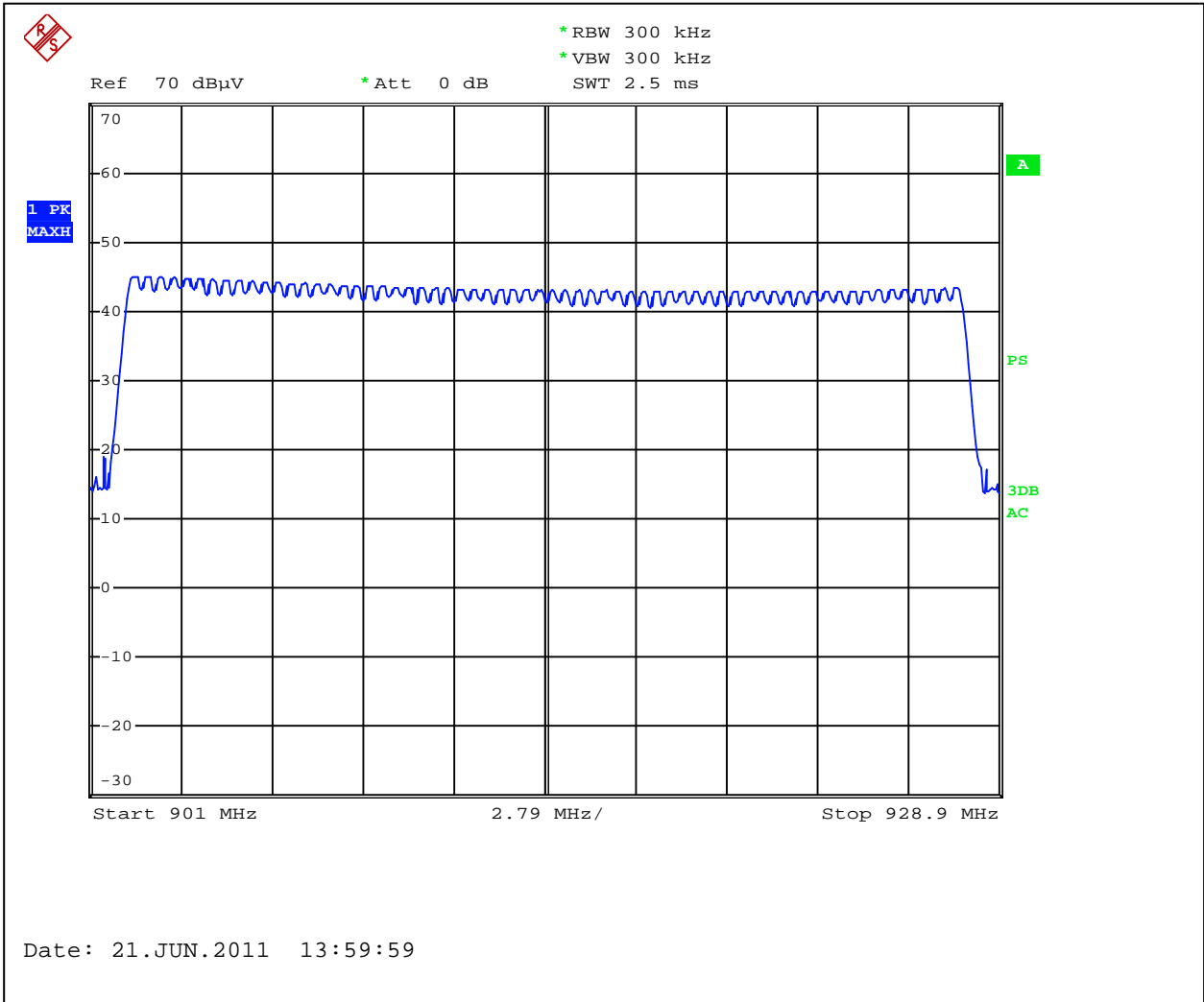


Graph 3.3.3

3.4 Number of hopping frequencies

Frequency Range:	<input checked="" type="checkbox"/> 902-928MHz <input type="checkbox"/> 2400-2483.5MHz <input type="checkbox"/> 5725-5850MHz	
Measured Number	Requirements	Result
64	50	Pass
Channel 20dB Bandwidth:	<input checked="" type="checkbox"/> <250kHz <input type="checkbox"/> ≥250kHz	

Notes:



Graph 3.4.1

3.5 Average time of occupancy of hopping frequency

Frequency Range:	<input checked="" type="checkbox"/> 902-928MHz <input type="checkbox"/> 2400-2483.5MHz <input type="checkbox"/> 5725-5850MHz		
Measured / Calculated Time sec	Period sec	Limit sec	Result
0.046	20	0.4	Pass
Period:	<input type="checkbox"/> 10s <input checked="" type="checkbox"/> 20s <input type="checkbox"/> 30s <input type="checkbox"/> 0.4s multiplied by the channel number		
Channel 20dB Bandwidth:	<input checked="" type="checkbox"/> <250kHz <input type="checkbox"/> ≥250kHz		

Time of occupancy calculation:

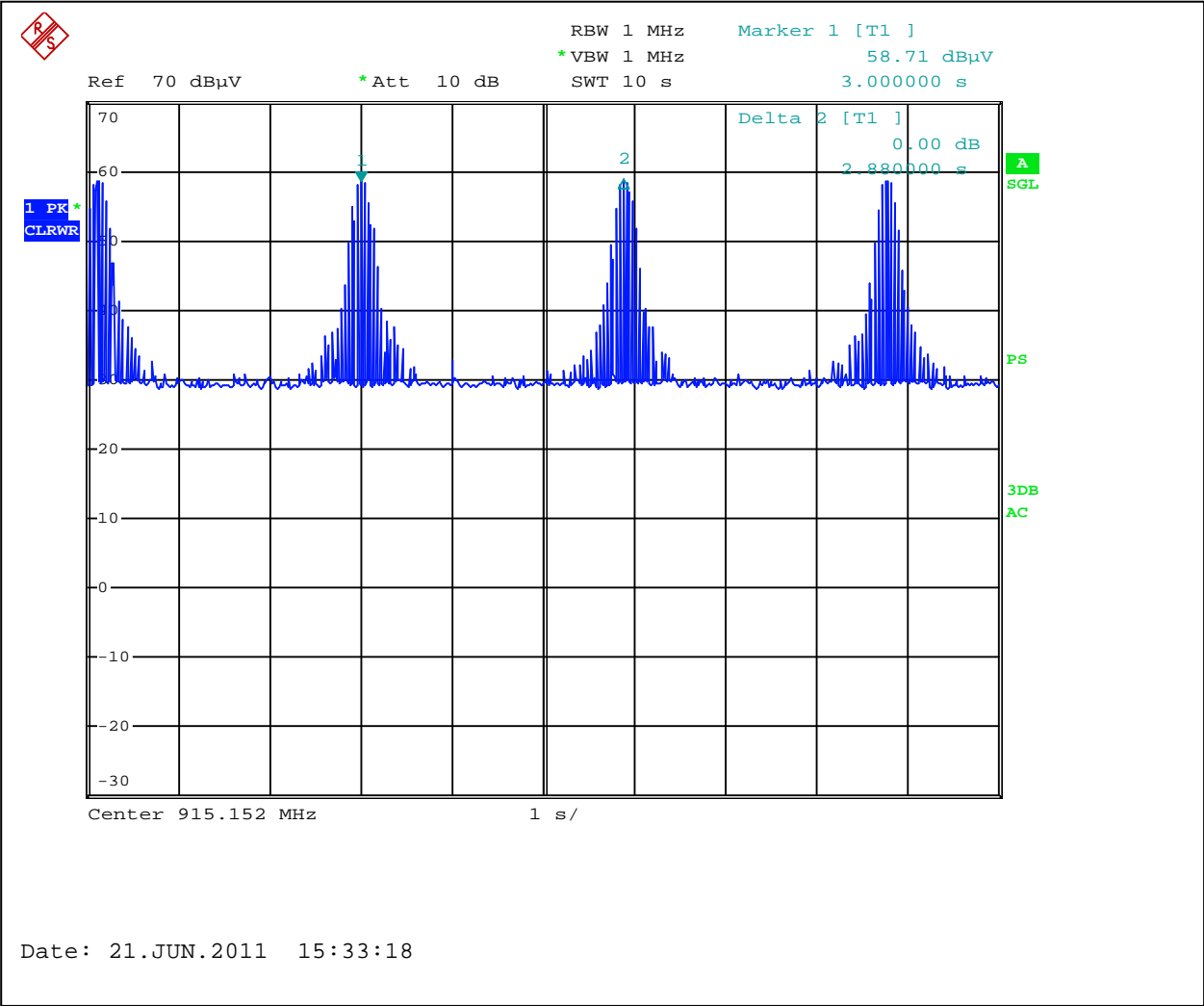
The minimum measured repetition of the channel occupancy (repetition) = 2.88 sec

Single occupancy duration (single duration) = 6.6 msec

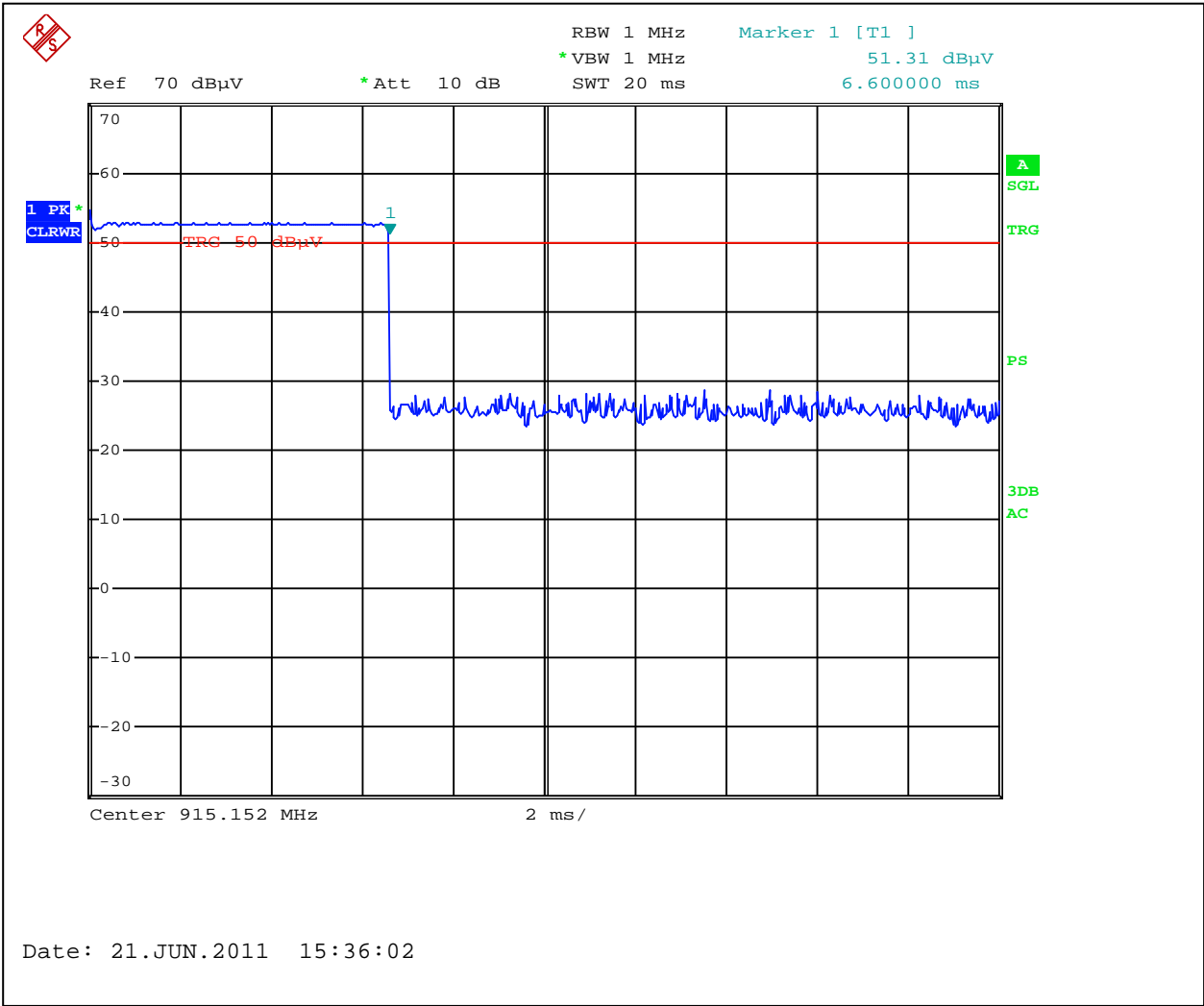
Period = 20 sec

Time of occupancy = (single duration) x (period) / (repetition) = 6.6ms x 20 / 2.88 (sec) = 0.046 sec

Notes:



Graph 3.5.1



Graph 3.5.2



3.6 Radiated spurious emissions

Test location: ☐ OATS ☒ Anechoic Chamber ☐ Other

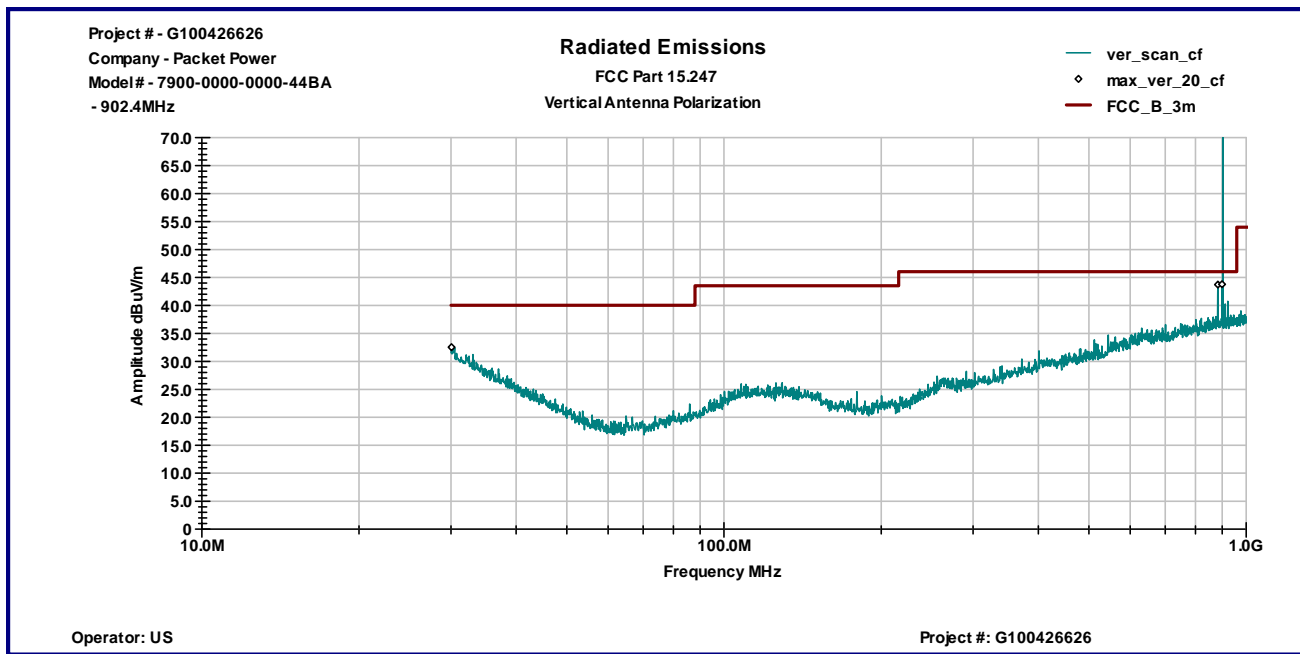
Test distance: ☐ 10 meters ☒ 3 meters

Test result: **Pass**

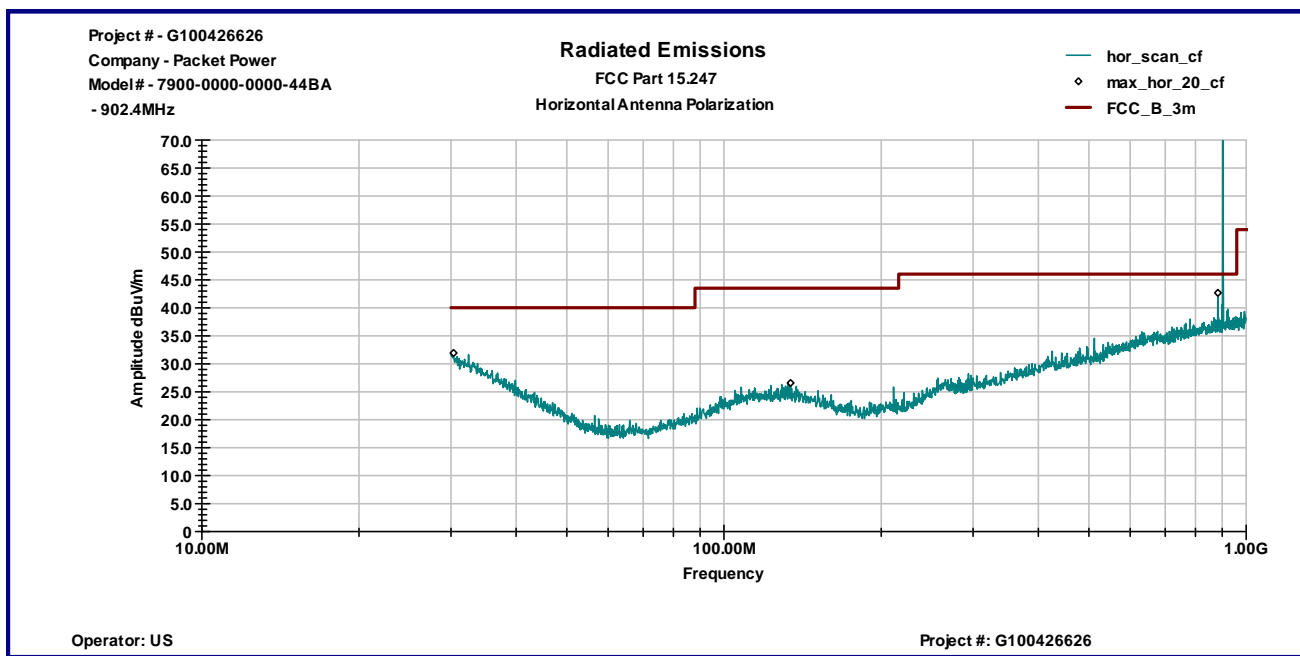
Max. Margin: dB below the limits

Notes:

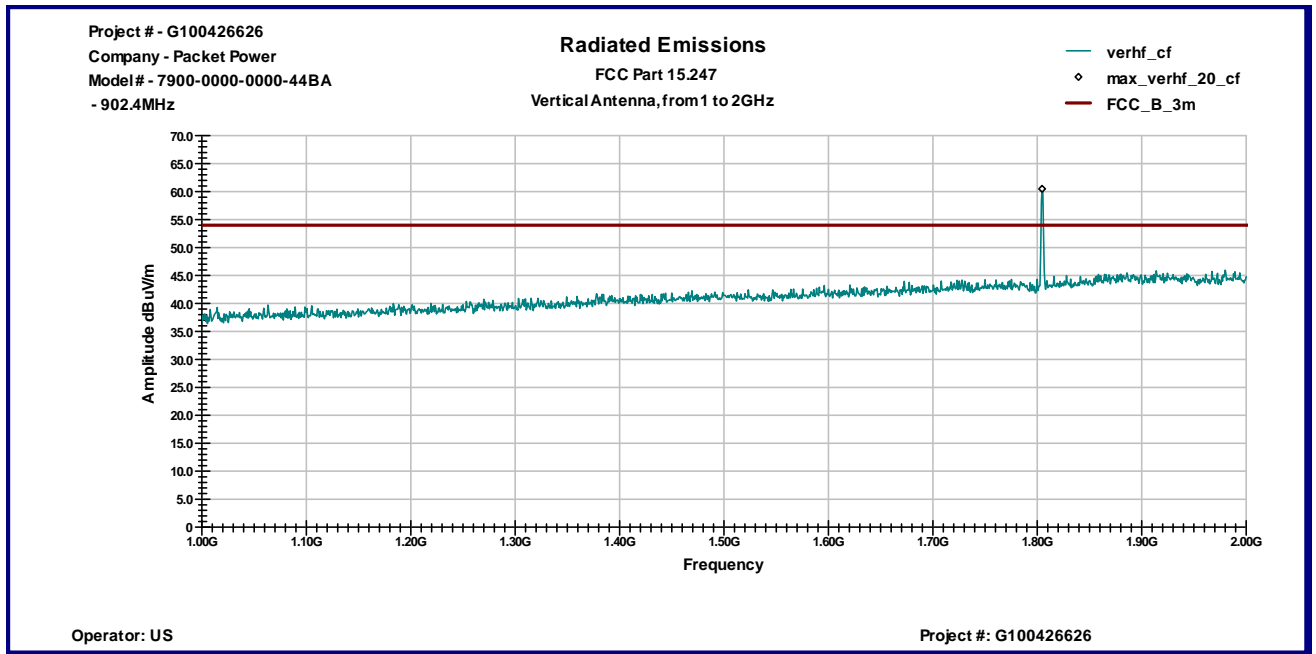
1. No emissions related to transmitter module were detected above ambient in the frequency range 30MHz-10GHz (see Graphs 3.6.1-3.6.18).
 2. Emissions at fundamental frequencies were excluded.
 3. The frequencies 1.8046GHz to 1.8553GHz are outside the restricted band of operation per FCC 15.205.
-



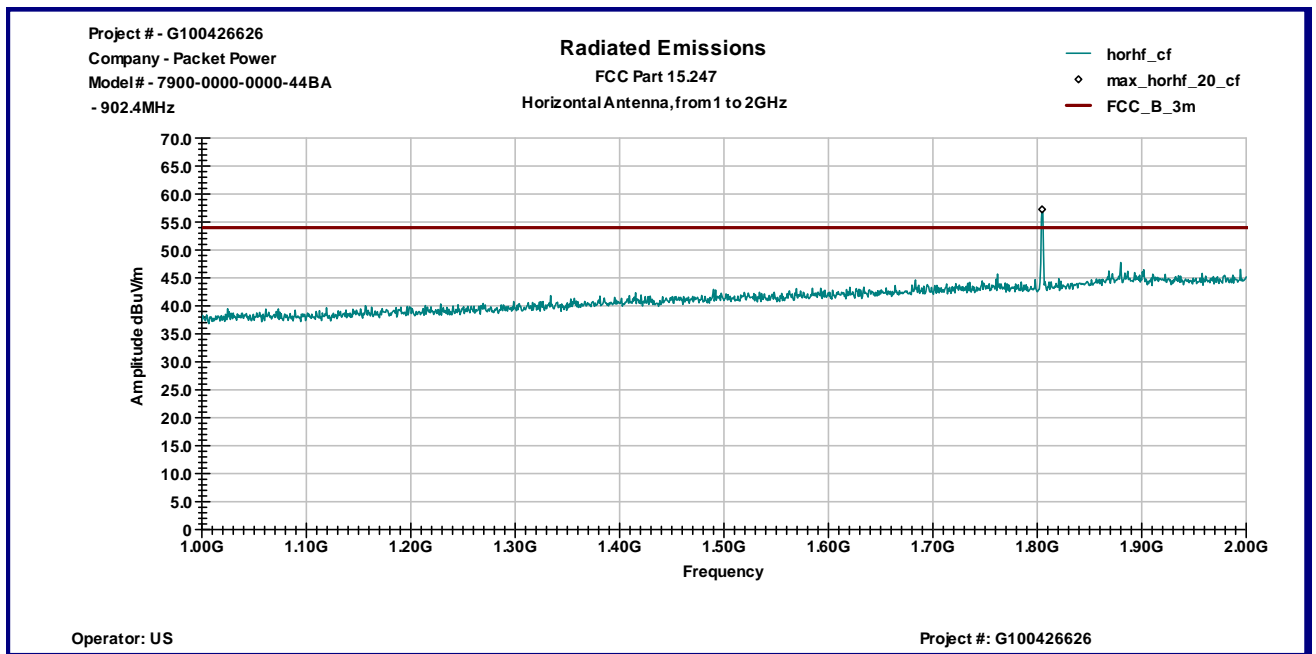
Graph 3.6.1



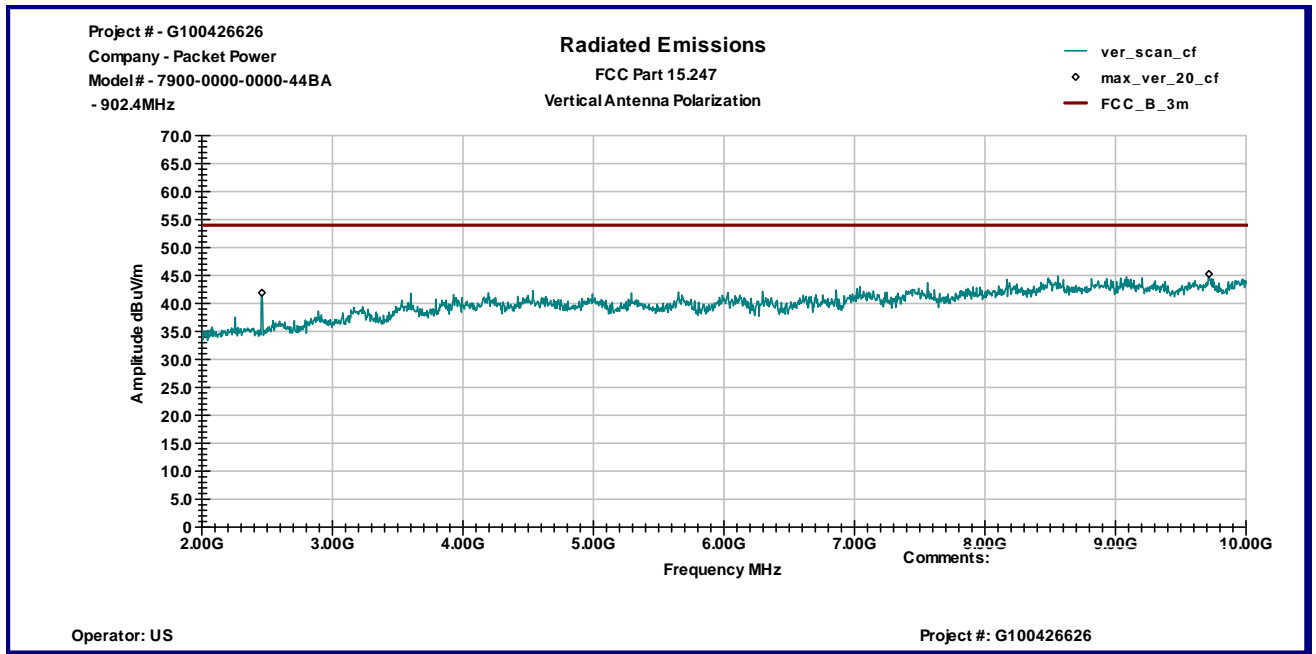
Graph 3.6.2



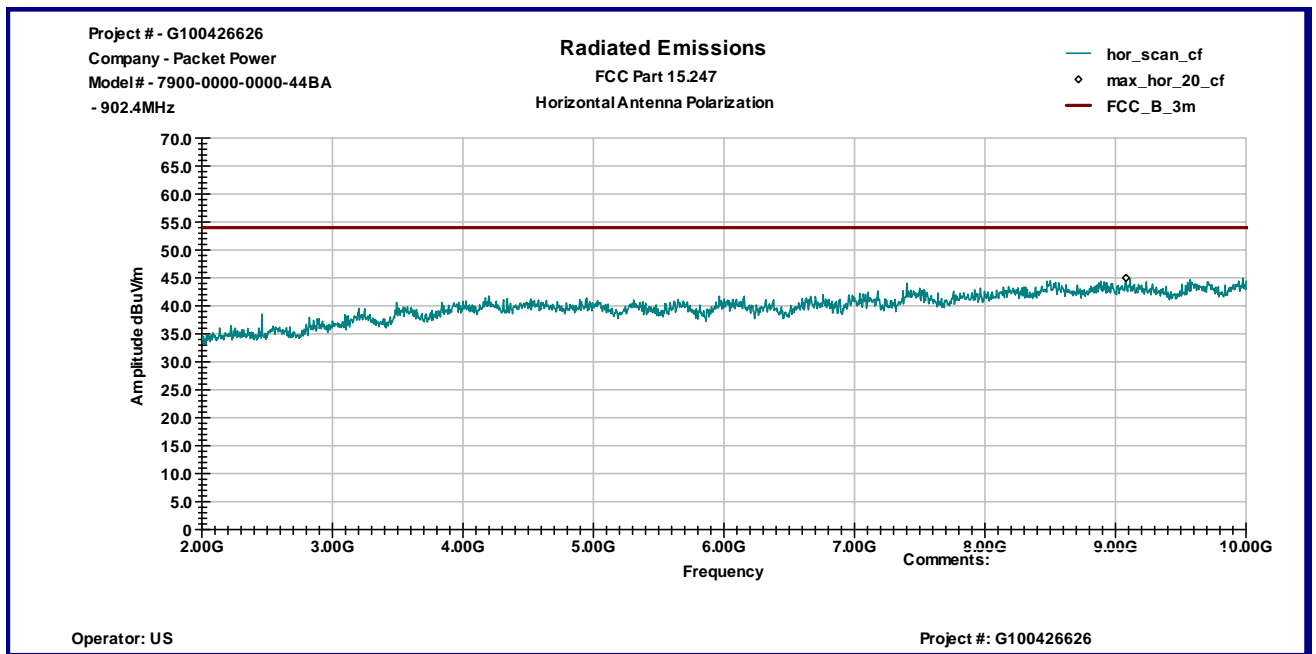
Graph 3.6.3



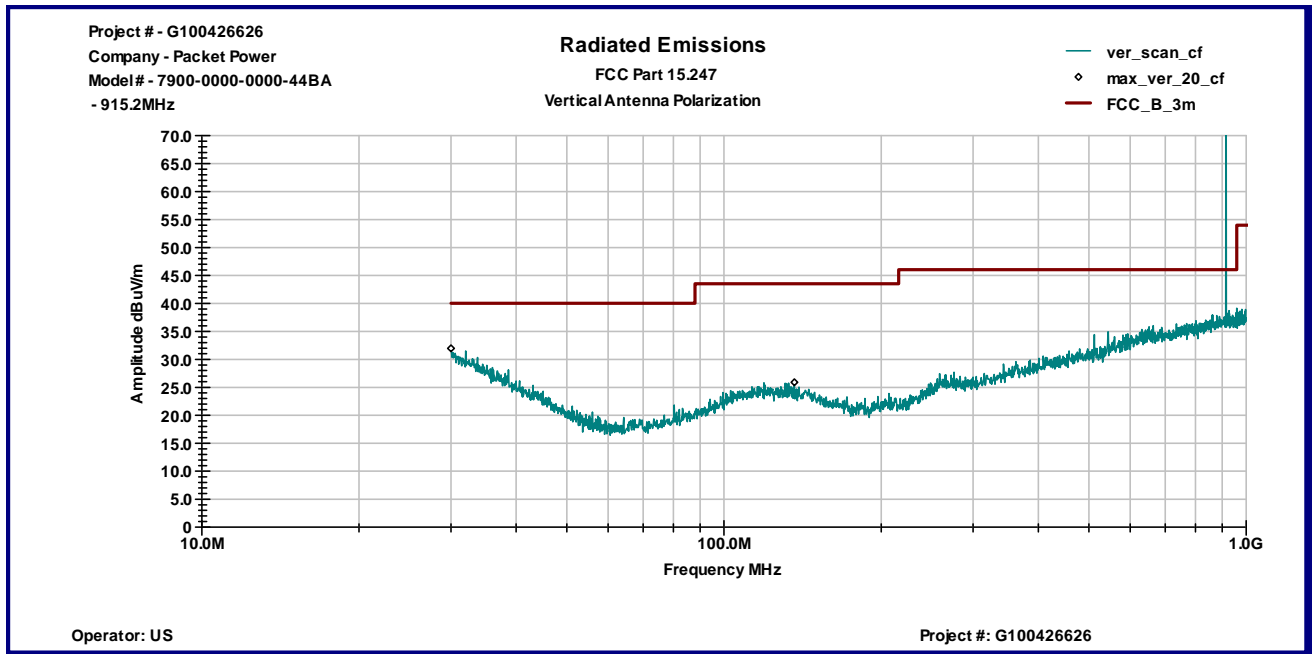
Graph 3.6.4



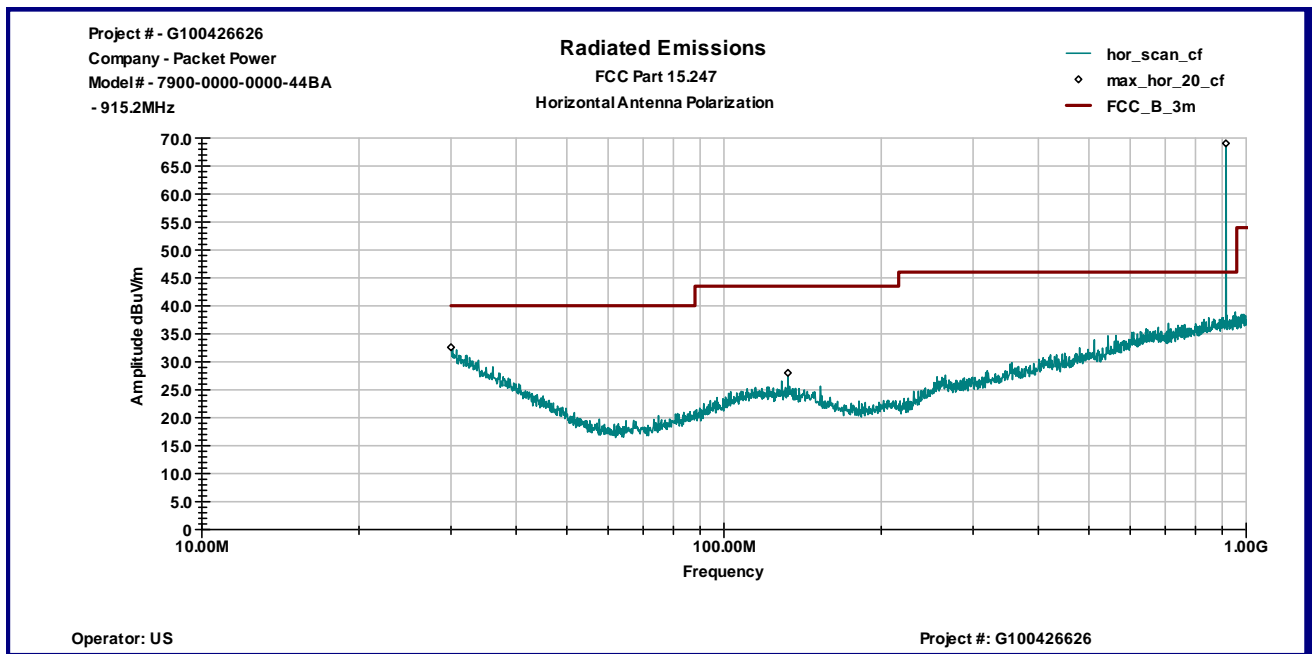
Graph 3.6.5



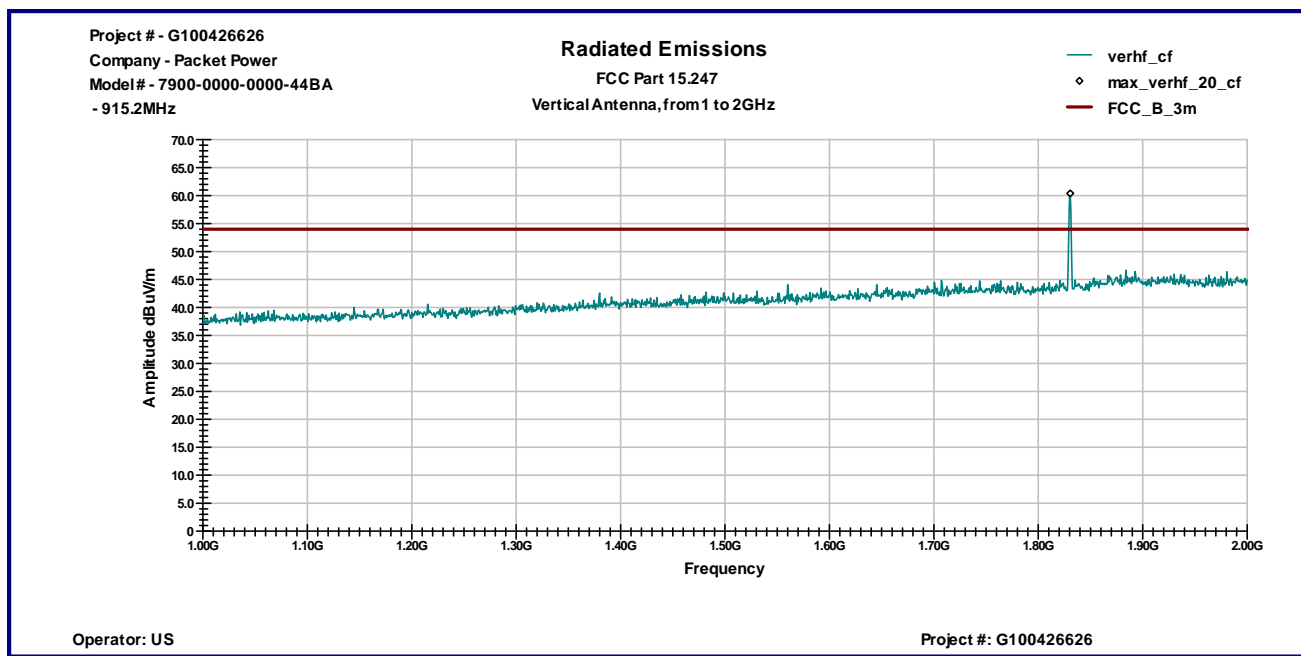
Graph 3.6.6



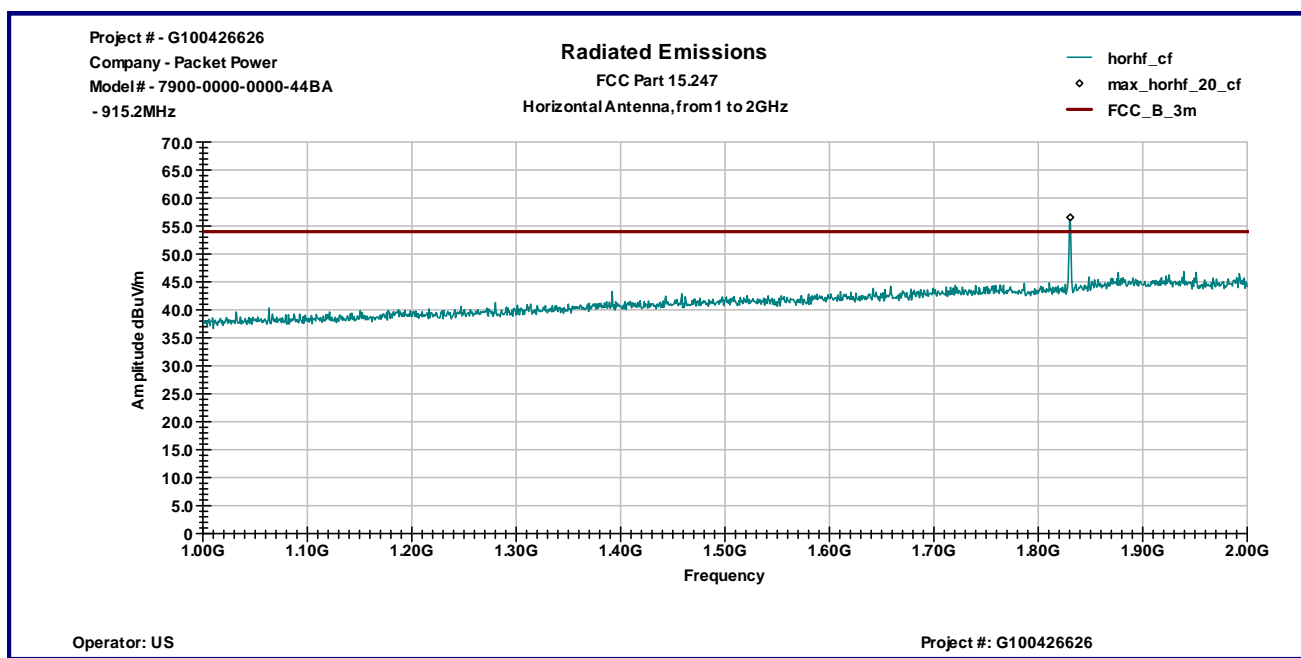
Graph 3.6.7



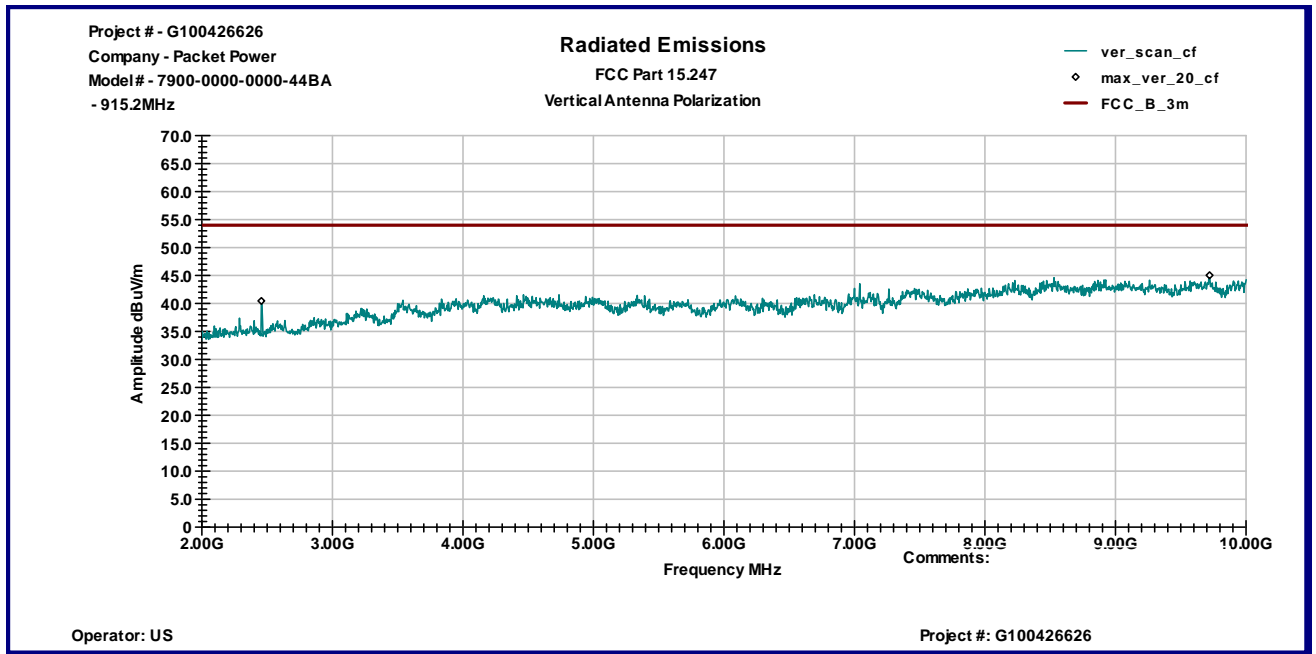
Graph 3.6.8



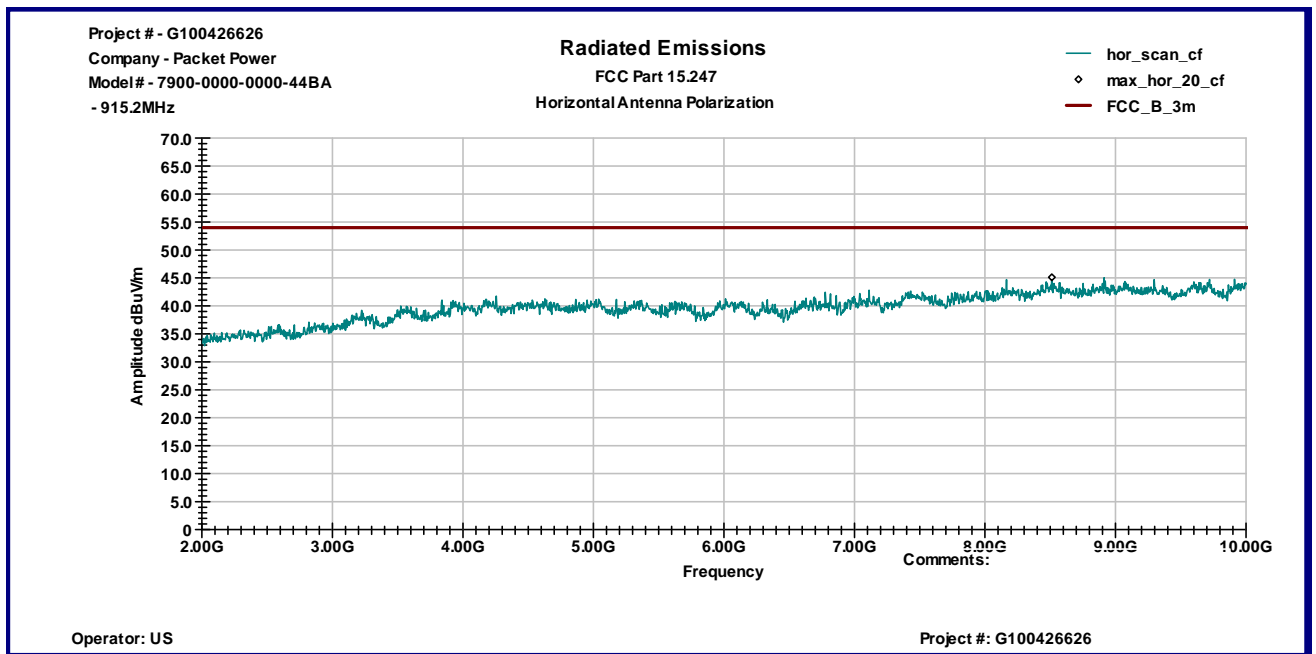
Graph 3.6.9



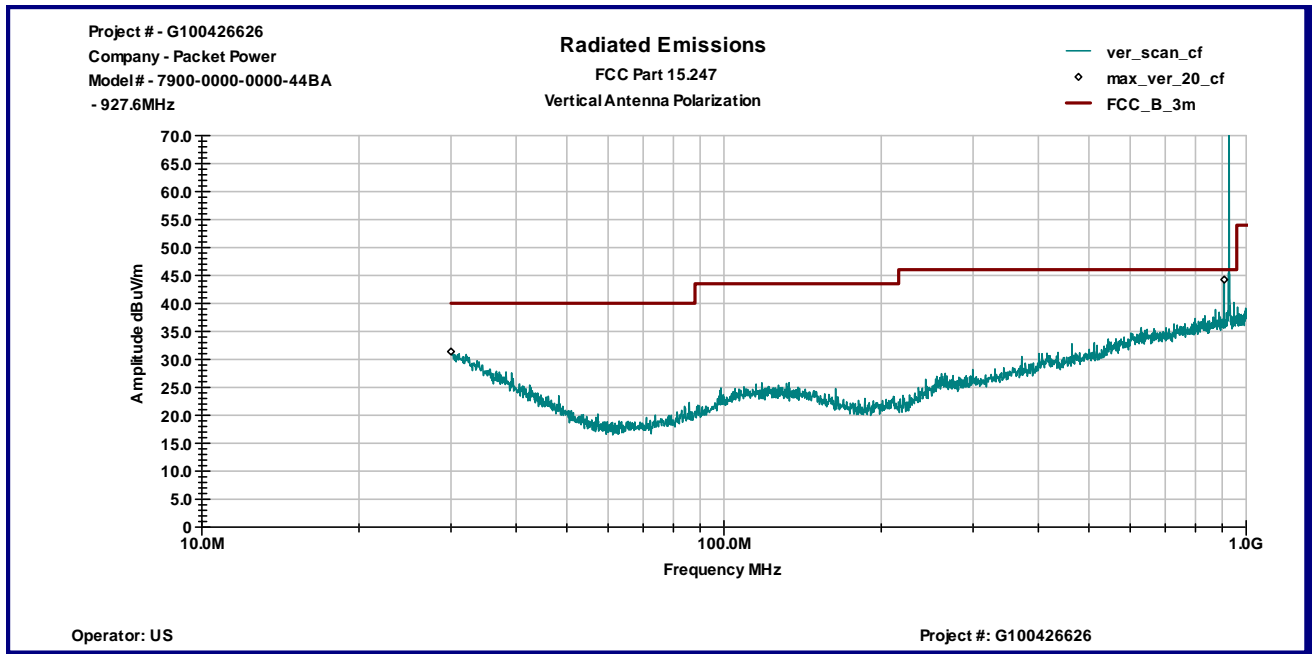
Graph 3.6.1 0



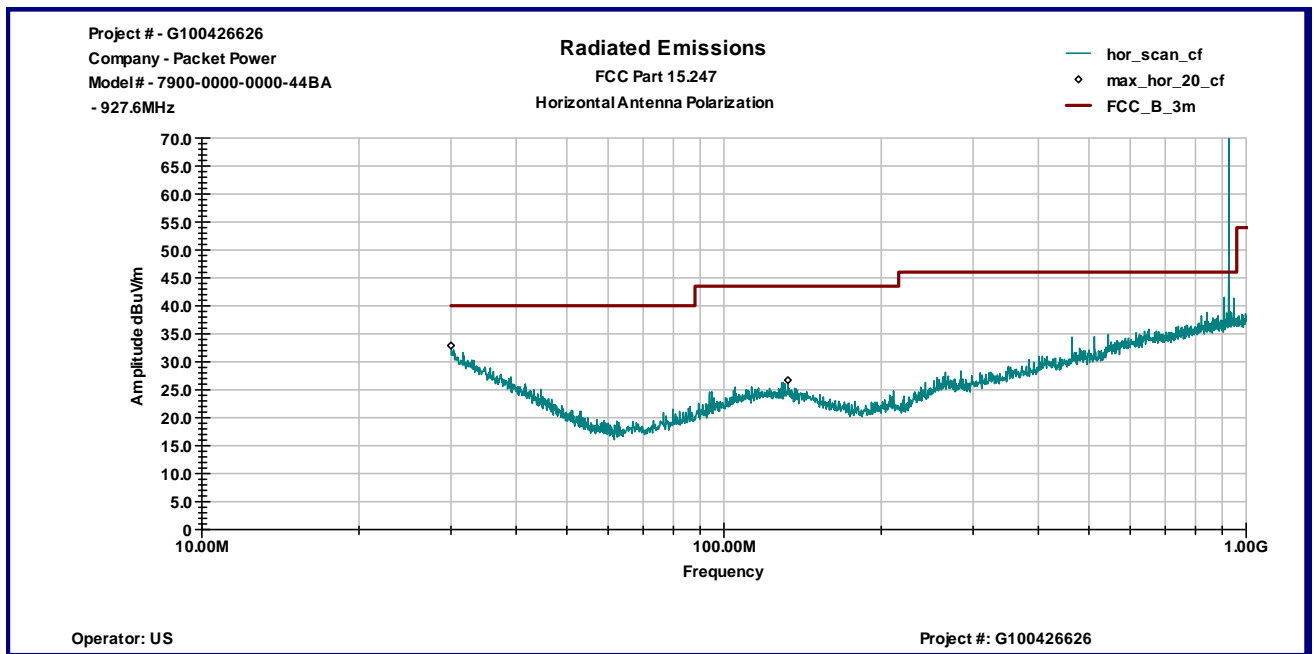
Graph 3.6.11



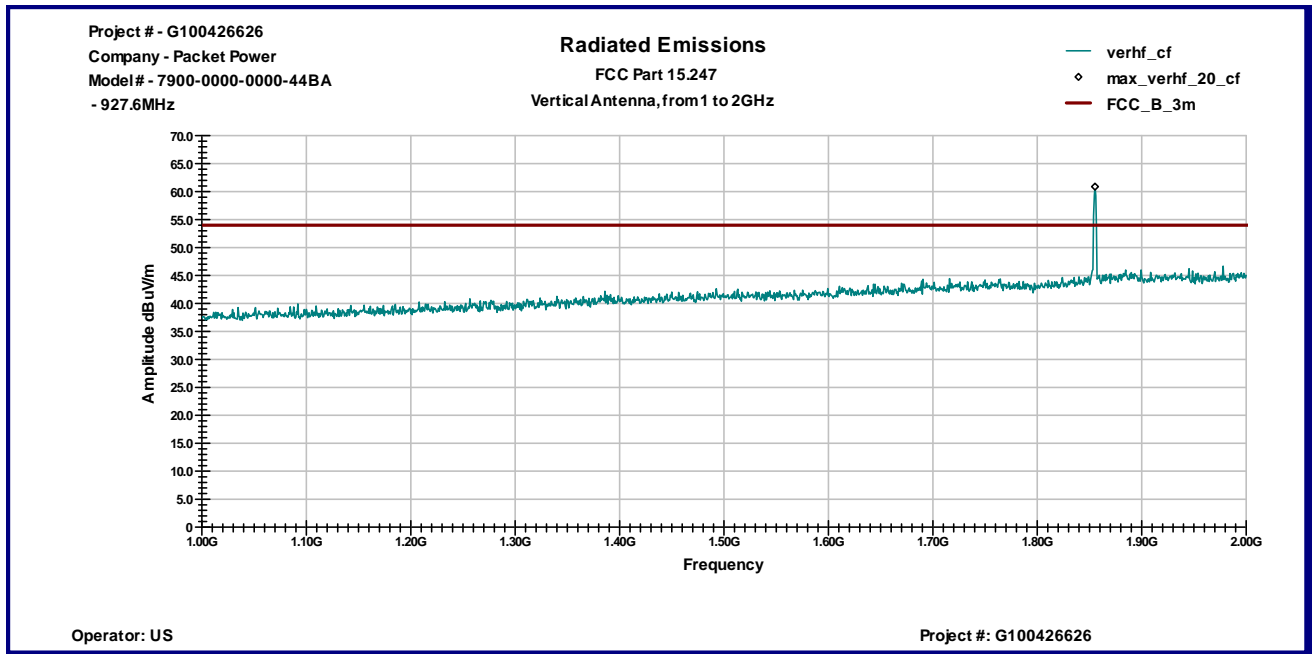
Graph 3.6.12



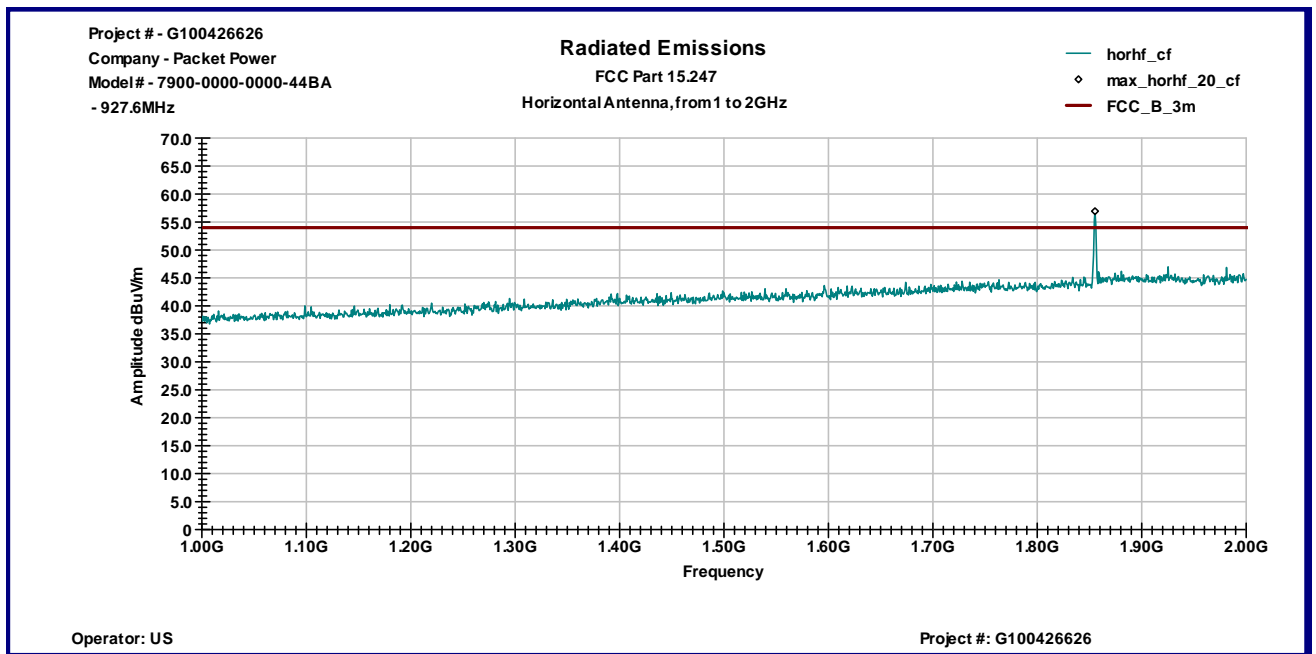
Graph 3.6.13



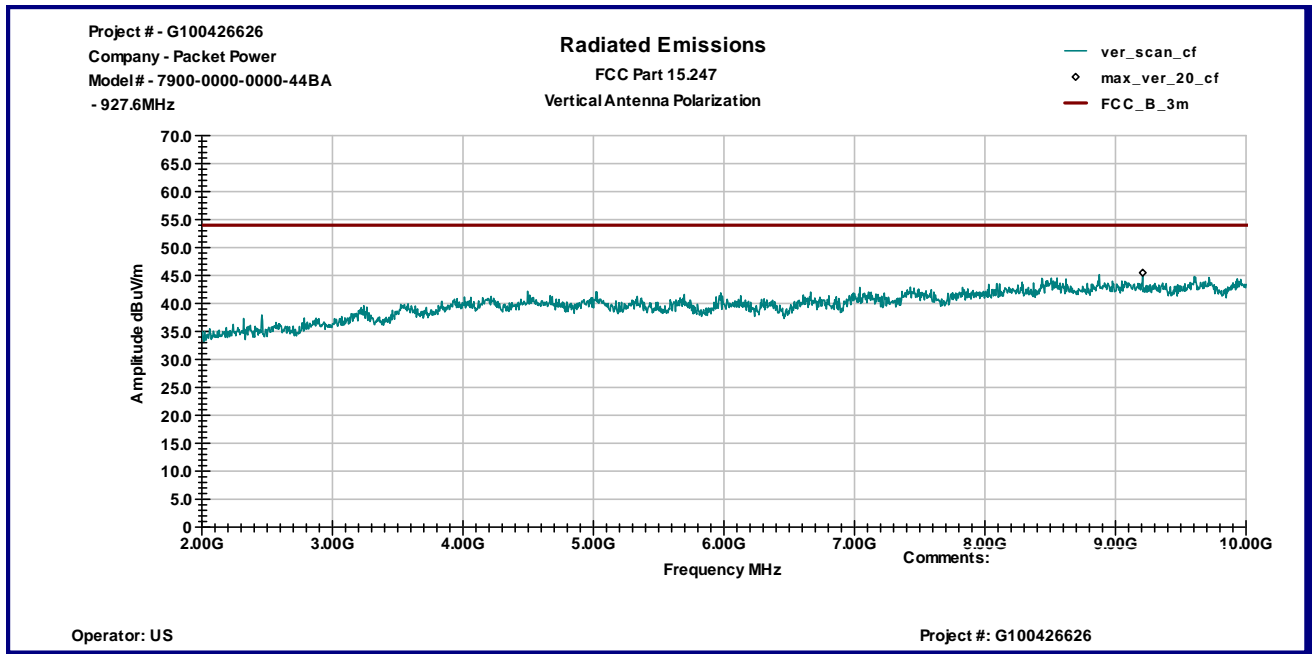
Graph 3.6.14



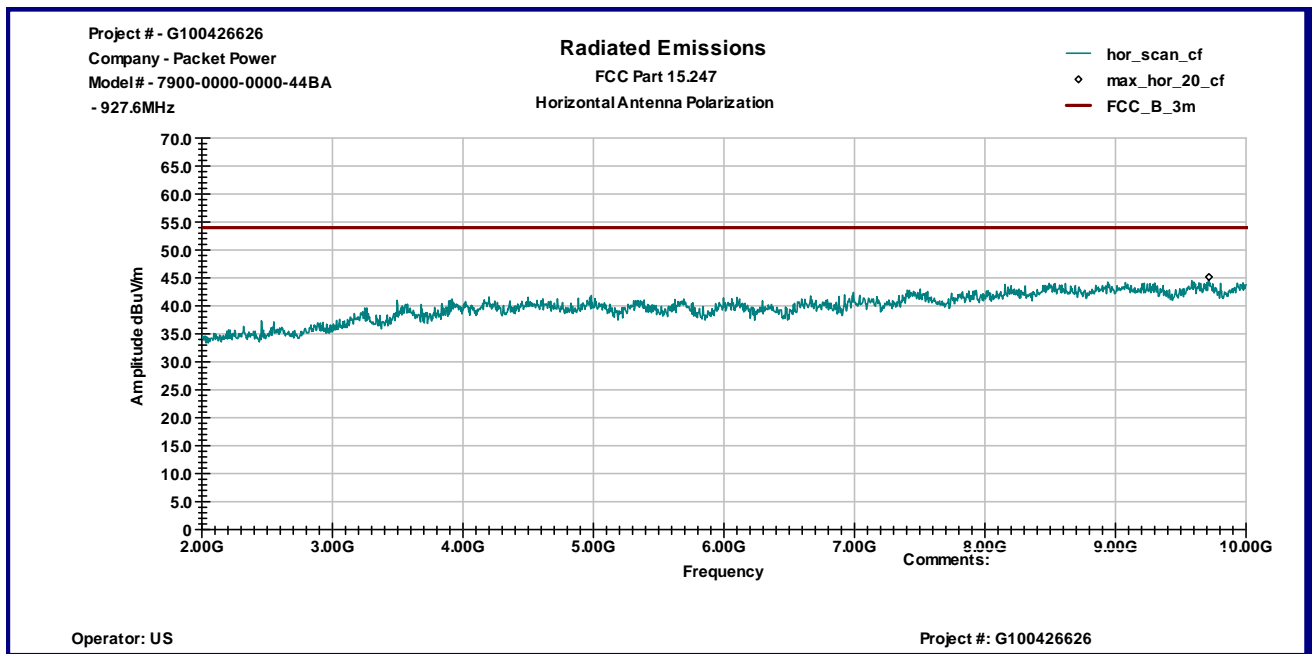
Graph 3.6.15



Graph 3.6.16

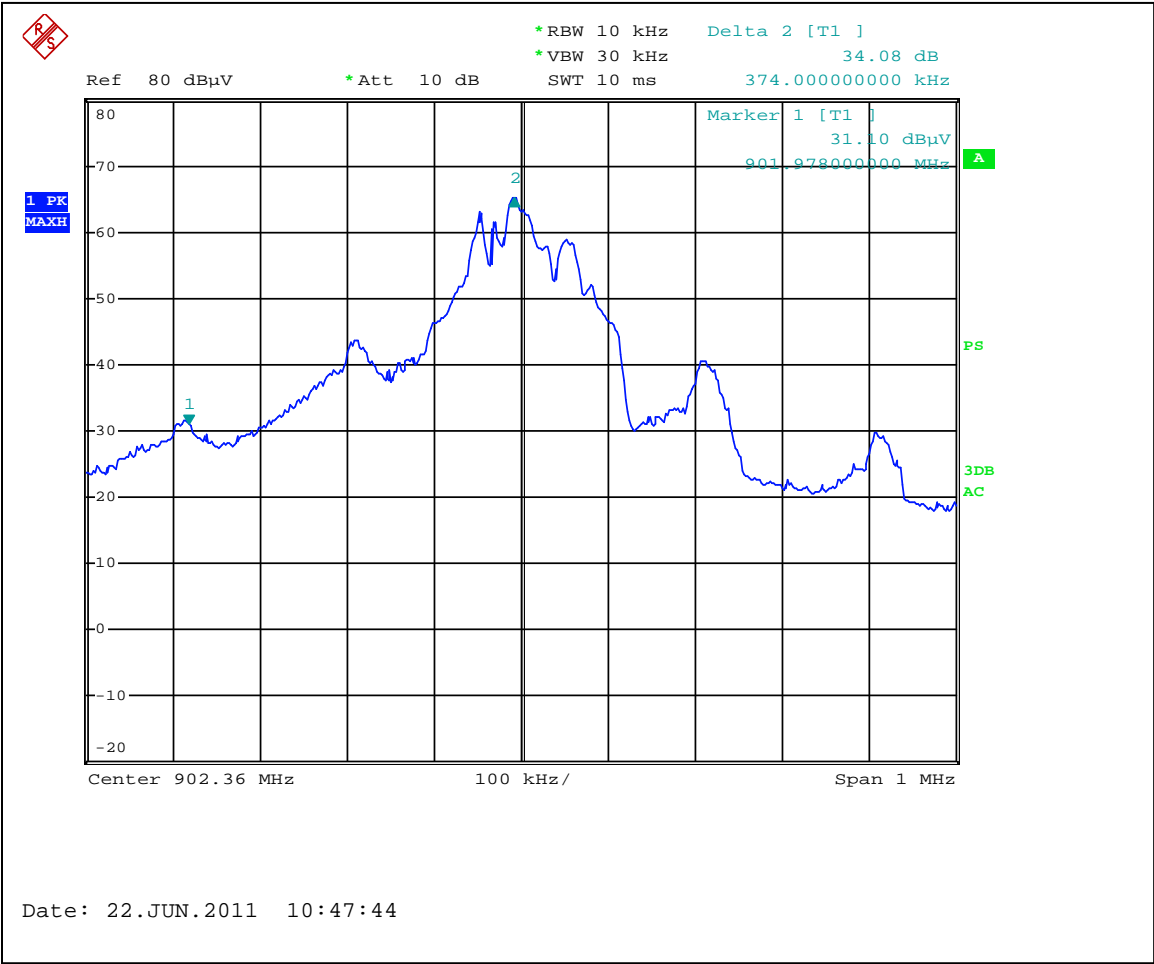


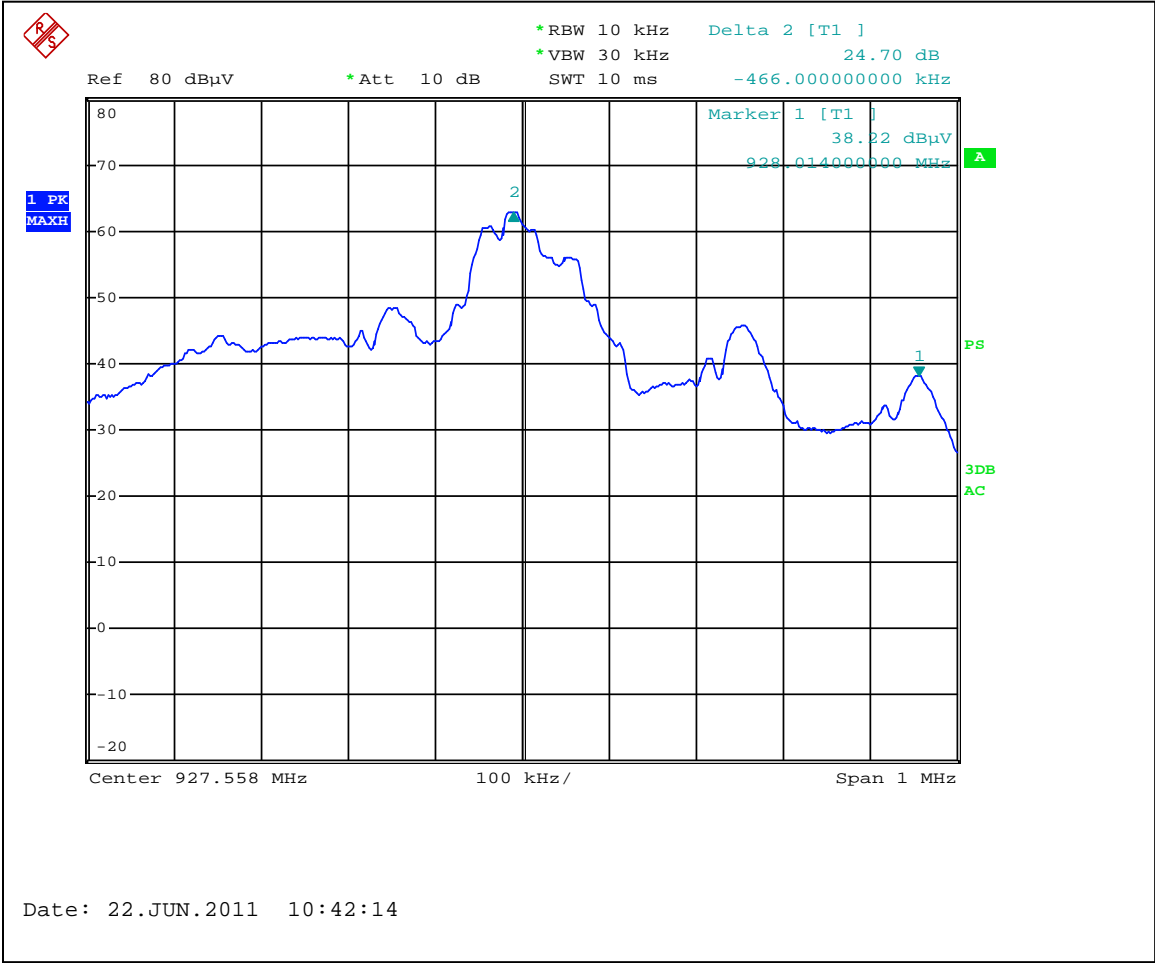
Graph 3.6.17



Graph 3.6.18

Bandedge Compliance





3.7 RF Exposure Compliance

The maximum measured power, P is -6.0dBm

The antenna gain, G is 0.5dBi

The maximum EIRP power = P + G

EIRP = -6.0 + 0.5 = -5.5dBm, or 0.00028W

The limits for Maximum Permissible Exposure (MPE) for transmitter operating at 2.4Hz, MPE is $1\text{mW}/\text{cm}^2$, or $10\text{W}/\text{m}^2$

$S = 10\text{W}/\text{m}^2$

The Power Density is related to EIRP with the equation:

$S = \text{EIRP} / 4\pi D^2$, or $10 = 0.00028 / 4\pi D^2$,

The minimum safe separation distance, D = 0.15cm, which is below 20cm



3.8 Transmitter power line conducted emissions

Test location: ☐ OATS ☒ Anechoic Chamber ☐ Other

Test result: **Pass**

Frequency range: 0.15MHz-30MHz

Max. Emissions margin: 14.5dB below the limits

Notes: None

Date:	June 23, 2011	Result: Pass
Tested by:	Uri Spector	
Standard:	FCC Part 15.207	
Test Point:	AC Power Line	
Operation mode:	See page 5	
Note:	None	

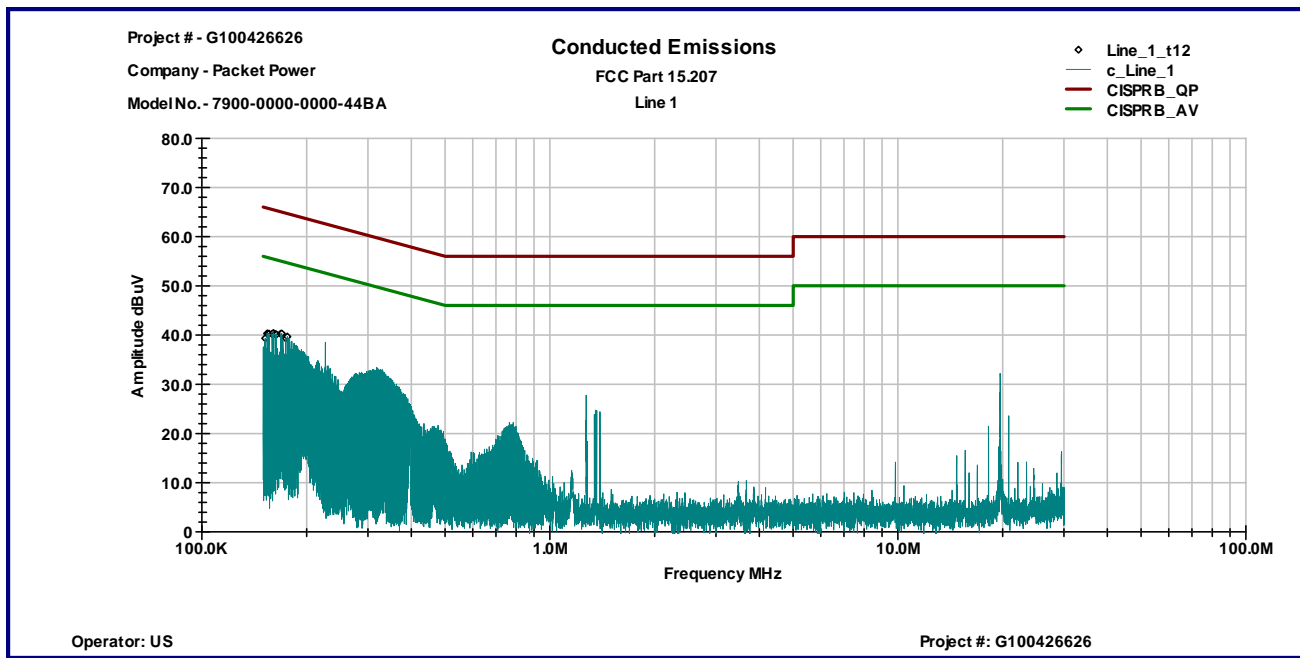
Table 3.8.1

Line 1

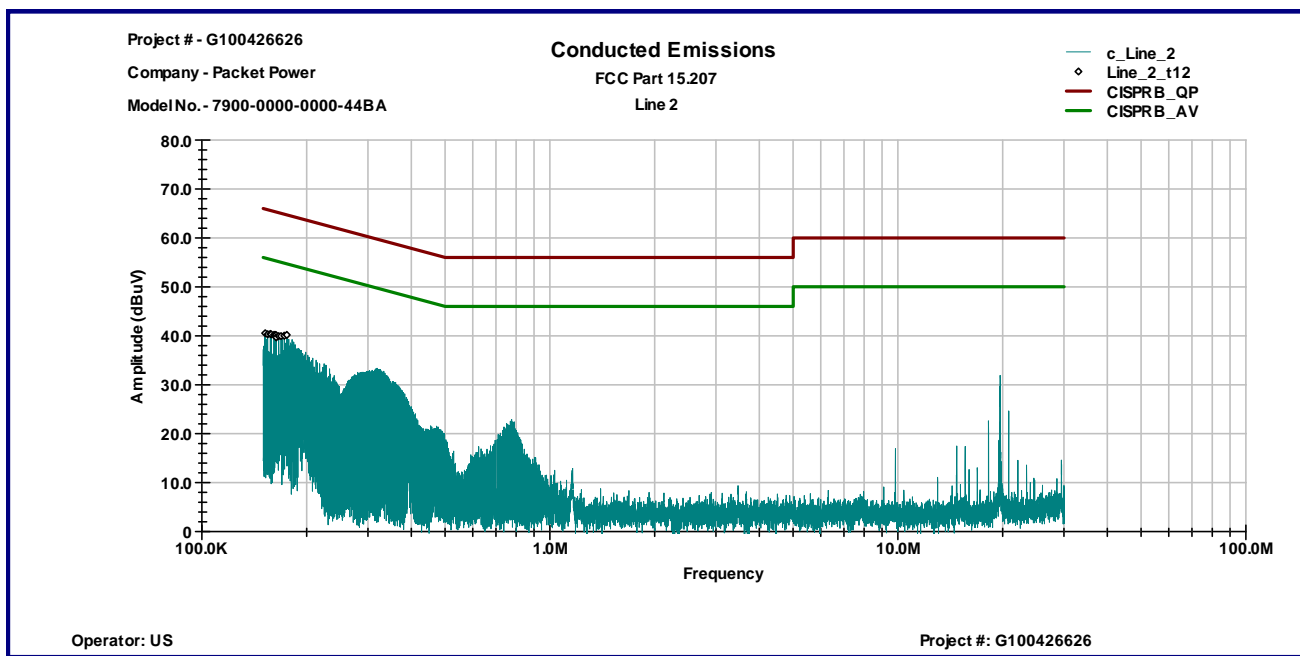
Frequency	Peak dBμV	QP Limit dBμV	AVG Limit dBμV	QP Margin dB	AVG Margin dB
152.1 KHz	39.3	65.9	55.9	-26.5	-16.5
154.66 KHz	40.3	65.8	55.8	-25.5	-15.5
159.17 KHz	40.2	65.5	55.5	-25.3	-15.3
160.49 KHz	40.4	65.4	55.4	-25.0	-15.0
163.75 KHz	40.1	65.3	55.3	-25.2	-15.2
169.57 KHz	40.3	65.0	55.0	-24.7	-14.7
174.16 KHz	39.3	64.8	54.8	-25.4	-15.4
176.1 KHz	39.7	64.7	54.7	-25.0	-15.0

Line 2

Frequency	Peak dBμV	QP Limit dBmV	AVG Limit dBmV	QP Margin dB	AVG Margin dB
152.02 KHz	40.5	65.9	55.9	-25.4	-15.4
157.22 KHz	40.4	65.6	55.6	-25.2	-15.2
158.23 KHz	40.3	65.6	55.6	-25.3	-15.3
162.43 KHz	40.2	65.3	55.3	-25.1	-15.1
163.44 KHz	40.1	65.3	55.3	-25.2	-15.2
168.88 KHz	39.9	65.0	55.0	-25.1	-15.1
172.53 KHz	40.0	64.8	54.8	-24.8	-14.8
175.4 KHz	40.2	64.7	54.7	-24.5	-14.5



Graph 3.8.1



Graph 3.8.2



3.9 Receiver/digital device radiated emissions

Test location: ☐ OATS ☒ Anechoic Chamber

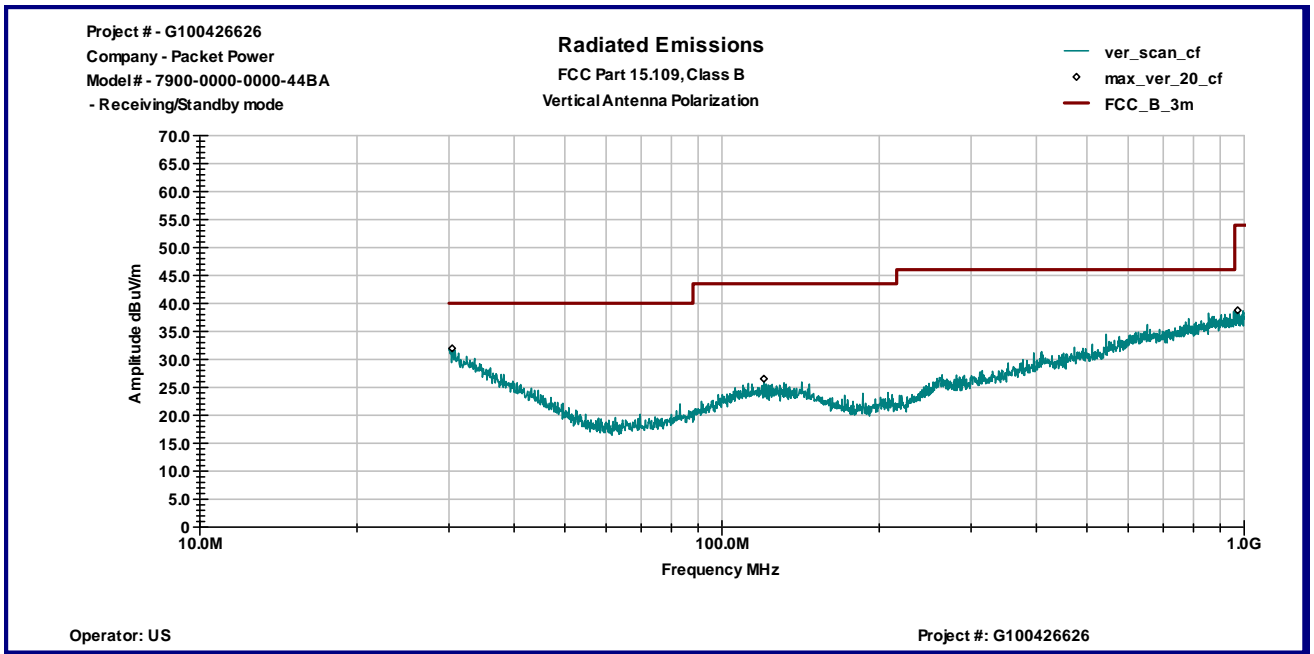
Test distance: ☐ 10 meters ☒ 3 meters

Test result: **Pass**

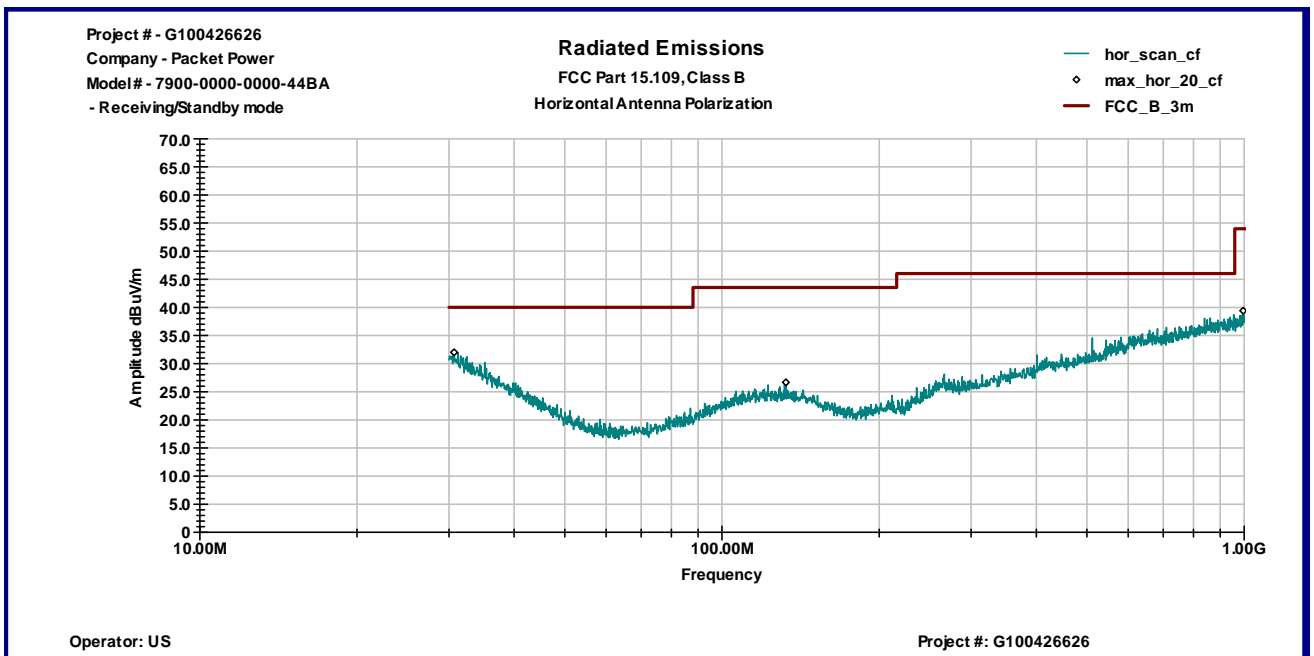
Frequency range: 30MHz-5000MHz

Max. Emissions margin: dB below the limits

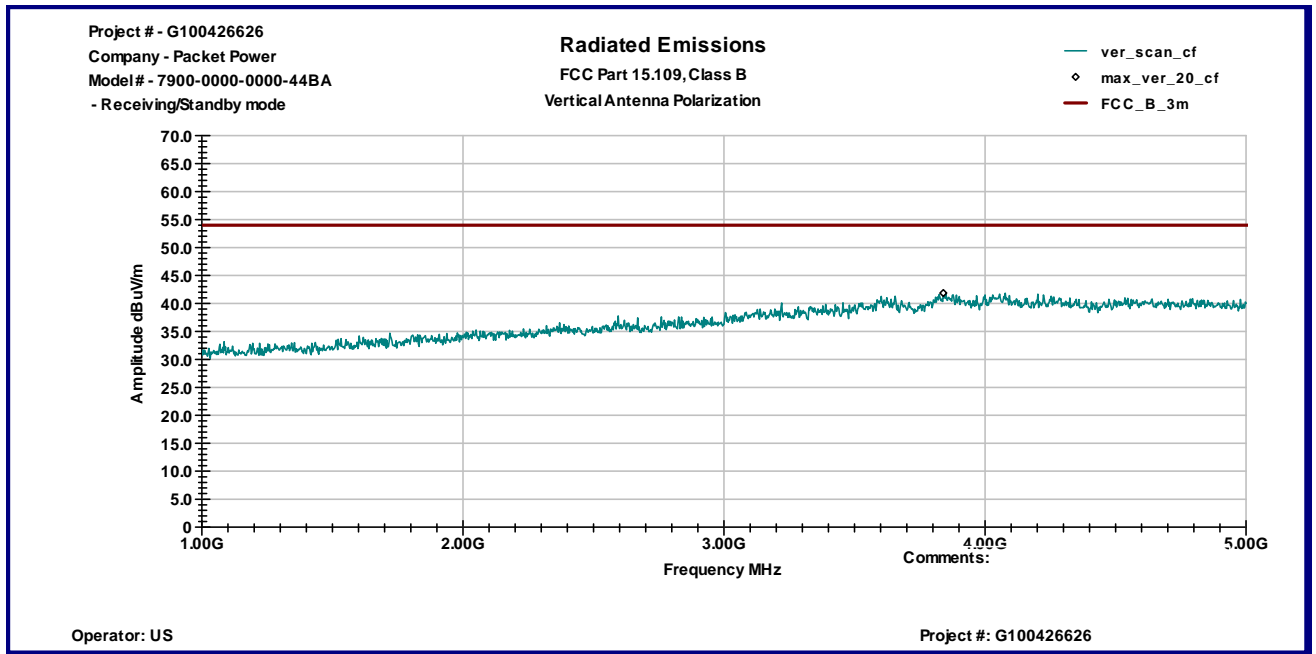
Notes: The Radiated Emissions test was performed in the Anechoic chamber at 3m measurement distance No emissions were detected above ambient in the frequency range 30MHz-5GHz (see Graphs 3.10.1-3.10.4).



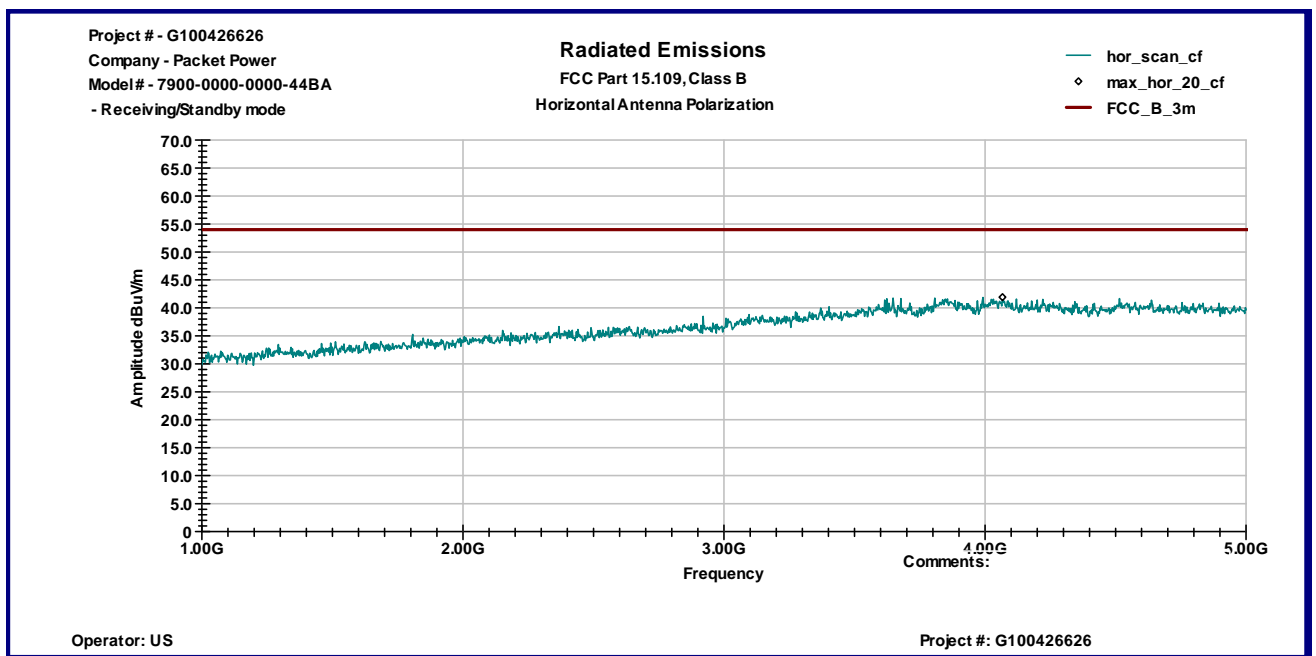
Graph 3.9.1



Graph 3.9.2



Graph 3.9.3



Graph 3.9.4



3.10 Digital device conducted emissions

Test location: ☐ OATS ☒ Anechoic Chamber ☐ Other

Test result: **Pass**

Frequency range: 0.15MHz-30MHz

Max. Emissions margin: 13.2dB below the limits

Notes: None

Date:	June 23, 2011	Result: Pass
Tested by:	Uri Spector	
Standard:	FCC Part 15.107, Class B	
Test Point:	Line 1 and Line 2	
Operation mode:	See page 5	
Note:	None	

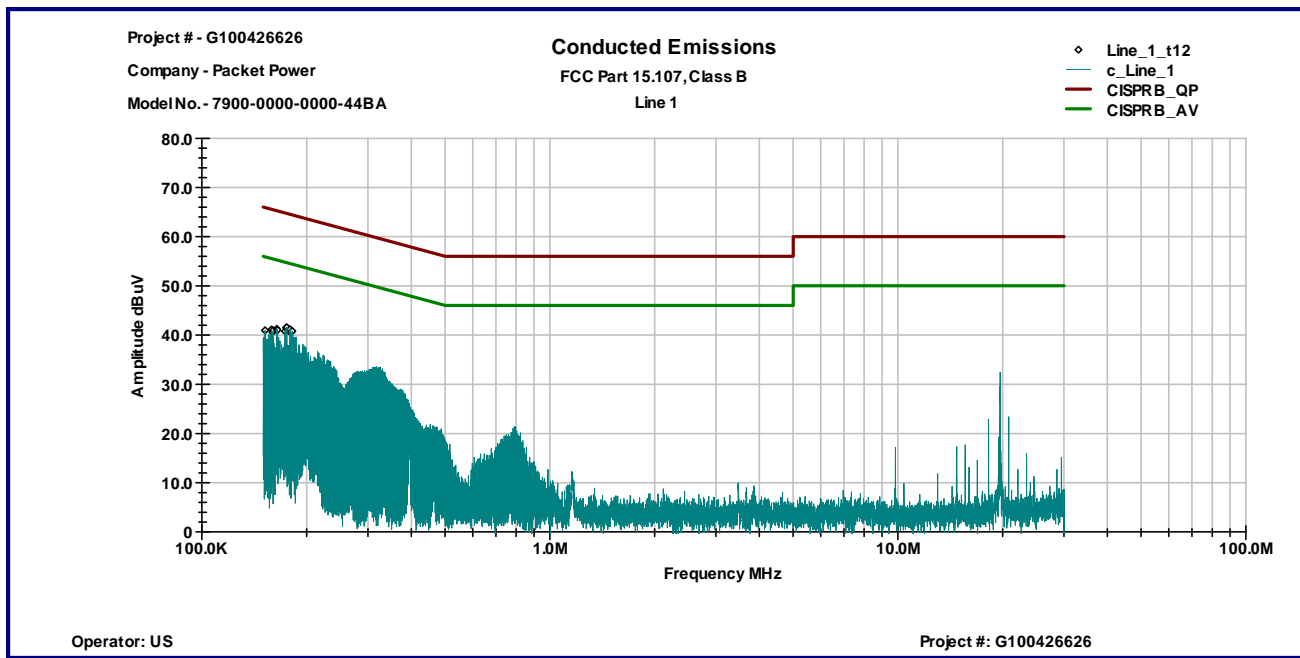
Table 3.10.1

Line 1

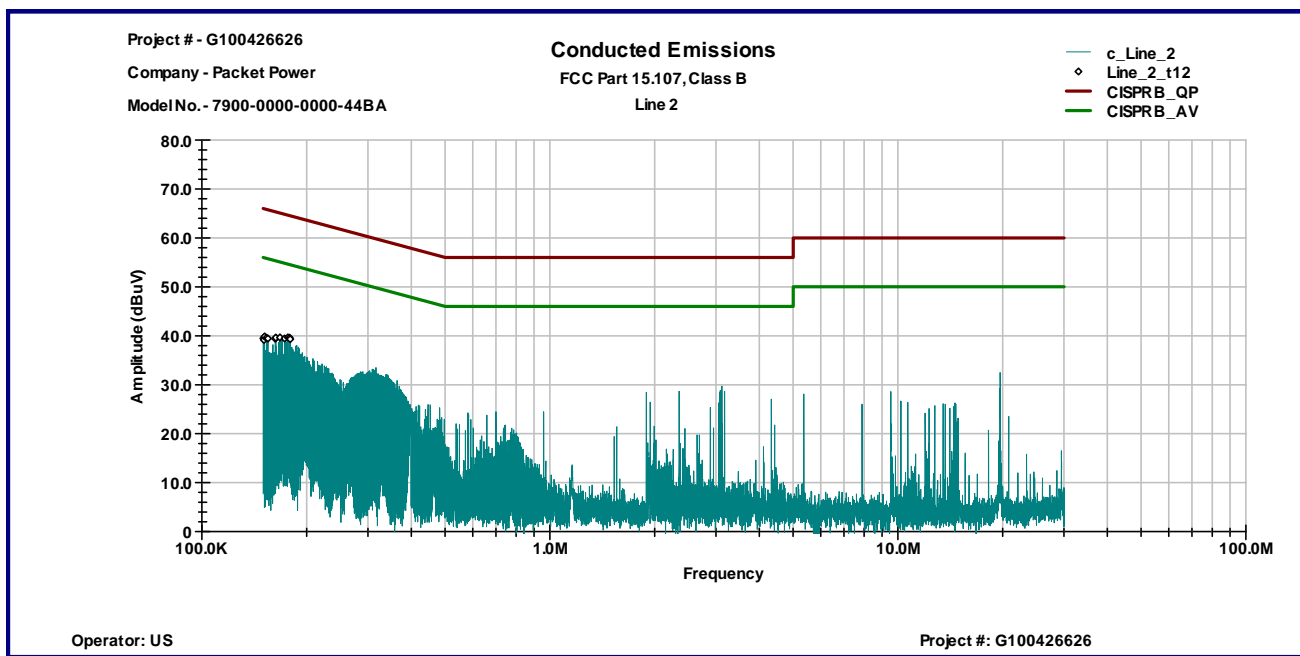
Frequency	Peak dB μ V	QP Limit dB μ V	AVG Limit dB μ V	QP Margin dB	AVG Margin dB
151.94 KHz	40.9	65.9	55.9	-25.0	-15.0
158.47 KHz	41.1	65.5	55.5	-24.4	-14.4
160.33 KHz	40.9	65.5	55.5	-24.5	-14.5
164.21 KHz	41.2	65.3	55.3	-24.0	-14.0
173.38 KHz	40.8	64.8	54.8	-24.0	-14.0
175.32 KHz	41.5	64.7	54.7	-23.2	-13.2
179.21 KHz	41.2	64.5	54.5	-23.4	-13.4
181.85 KHz	40.8	64.4	54.4	-23.6	-13.6

Line 2

Frequency	Peak dB μ V	QP Limit dBmV	AVG Limit dBmV	QP Margin dB	AVG Margin dB
151.4 KHz	39.8	65.9	55.9	-26.1	-16.1
153.42 KHz	39.6	65.8	55.8	-26.2	-16.2
154.74 KHz	39.5	65.7	55.7	-26.3	-16.3
163.13 KHz	39.6	65.3	55.3	-25.7	-15.7
167.71 KHz	39.6	65.1	55.1	-25.4	-15.4
172.91 KHz	39.5	64.8	54.8	-25.4	-15.4
176.8 KHz	39.7	64.6	54.6	-25.0	-15.0
178.74 KHz	39.6	64.5	54.5	-25.0	-15.0
179.36 KHz	39.3	64.5	54.5	-25.2	-15.2



Graph 3.10.1



Graph 3.10.2

4.0 TEST EQUIPMENT

DESCRIPTION	MANUFACTURER	MODEL	SERIAL NO.	INTERTEK ID	CAL DUE	USED
Spectrum Analyzer	R & S	FSP 40	100024	12559	12/07/2011	<input checked="" type="checkbox"/>
Spectrum Analyzer	R & S	ESCI	100358	12909	05/12/2012	<input checked="" type="checkbox"/>
Bicono-Log Antenna	Schaffner-Chase	CBL 6112 B	2468	14459	10/18/2011	<input checked="" type="checkbox"/>
Horn Antenna	EMCO	3115	9507-4513	9936	04/29/2012	<input checked="" type="checkbox"/>
LISN	Fischer Custom Communications	FCC-LISN-2 MOD.SD	316	9945	05/25/2012	<input checked="" type="checkbox"/>
Pre-Amplifier	MITEQ	AMF-5D-00501800-28-13P	1122951	13475	10/06/2011	<input checked="" type="checkbox"/>
Pre-Amplifier	MITEQ	AMF-6F-16002600-25-10P	1222383	MIN-0065	10/06/2011	<input type="checkbox"/>
Pre-Amplifier	MITEQ	AMF-6F-26004000-40-8P	13224444	MIN-0064	10/06/2011	<input type="checkbox"/>
High Pass Filter	Reactel	7HS-1G-S12	0223	15275	VBU	<input checked="" type="checkbox"/>
System	TILE! Instrument Control		Ver. 3.4.K.29	15259	VBU	<input checked="" type="checkbox"/>