



TEST REPORT

Report Number: 100636313MIN-001

Project Number: G100636313

Testing performed on the
3308 Wireless Guided Wave Radar Level Transmitter
FCC ID: LW23308A

to
47 CFR Part 15. 247:2010

For
Emerson Process Management

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

Test Authorized by:
Emerson Process Management
8200 Market Blvd.
Mail Stop PM17
Chanhassen, MN 55317

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Uri Spector

Date: February 15, 2012

Reviewed by: Norman Shpilsher
Norman Shpilsher

Date: February 15, 2012

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1.0 GENERAL DESCRIPTION

Model:	3308
Type of EUT:	Wireless Guided Wave Radar Level Transmitter
Serial Number:	N/A
FCC ID:	LW23308A
Related Submittal(s) Grants:	None
Company:	Emerson Process Management
Customer:	Mr. Merritt Pulkrabek
Address:	8200 Market Blvd. Mail Stop PM17 Chanhassen, MN 55317
Phone:	952-949-5193
Fax:	952-949-7626
e-mail:	Merritt.Pulkrabek@Emerson.com
Test Standards:	☒ 47 CFR, Part 15:2010, §15.247 ☐ RSS-210, Issue 8, 2010 ☐ RSS-Gen, Issue 3, 2010 ☒ 47 CFR, Part 15:2010, §15.107 and §15.109, Class B ☐ ICES-003, Issue 4:2004 ☐ Other
Type of radio:	☒ Stand -alone ☐ Module ☐ Hybrid
Date Sample Submitted:	February 6, 2012
Test Work Started:	February 6, 2012
Test Work Completed:	February 13, 2012
Test Sample Conditions:	☐ Damaged ☐ Poor (Usable) ☒ Good



1.1 Product Description; Test Facility

Product Description:	2.4 – 2.4835GHz Wireless Guided Wave Radar Level Transmitter
Transmitter Type:	☐ FHSS ☒ Digital Modulation ☐ WiFi ☐ Blue Tooth
Operating Frequency Range(s):	Range: From 2400 to 2483.5 MHz
Number of Channels:	15
Modulation:	QPSK
Emission Designator:	1M58G7D
Antenna(s) Info:	Antenna Type: Dipole, Omni-directional, connected internally via an MMCX connector Gain: 4.5dBi
Antenna Installation:	☐ User ☐ Professional ☒ Factory
Transmitter power configuration:	☒ Internal battery ☐ External power source ☐ 120VAC ☐ 230VAC ☐ 400VAC ☒ 3.6VDC ☐ Other: Amp. ☐ 50Hz ☐ 60Hz
Special Test Arrangement:	None
Test Facility Accreditation:	A2LA (Certificate No. 1427.01)
Test Methodology:	Measurements performed according to the procedures in ANSI C63.10-2009 and FCC DTS Measurement Guide

1.2 EUT Configuration

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

- ☐ - Standby
- ☒ - Continuous transmissions (modulated signal)
- ☒ - Continuous transmissions (un-modulated signal)
- ☐ - Continuous receiving
- ☐ - Test program (customer specific)
- ☐ -

Operating modes of the EUT:

No.	Description
1	Test was performed at low channel, middle channel, and upper channel

Cables:

No.	Type	Length	Designation	Note
1	2-wire communication cable	<10ft	USB HART cable	

Support equipment/Services:

No.	Item	Description
1	Laptop PC	Interface PCB
2	Viator HART interface	USB HART interface to control EUT

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

☐ Temperature:	-20 to +50 °C
☐ 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: None

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)	Maximum peak output power	Pass
15.247(a)	6dB bandwidth of the digital modulation system	Pass
15.247(e)	Power spectral density	Pass
15.247(d)	Antenna conducted spurious emissions	Pass
15.247(d)	Radiated spurious emissions	Pass
15.247(i)	RF Exposure Compliance	Pass
15.207	Transmitter Power Line conducted emissions	N/A
15.109	Receiver/digital device radiated emissions	Pass
15.107	Digital device conducted emissions	N/A

3.0 TEST CONDITIONS AND RESULTS

3.1 Maximum peak output power

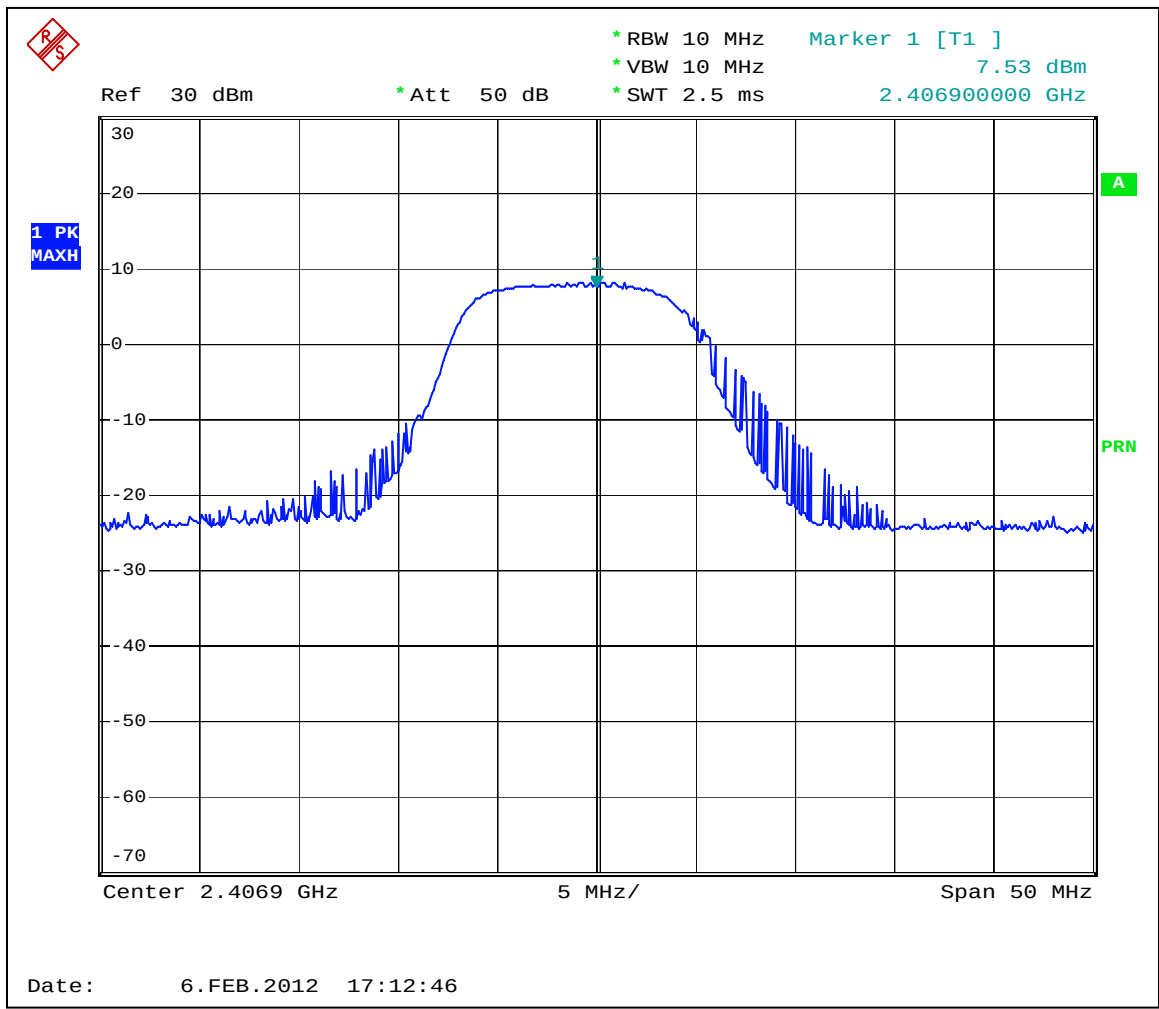
Test location: ☐ OATS ☒ Anechoic Chamber ☐ Other

Test result: **Pass**

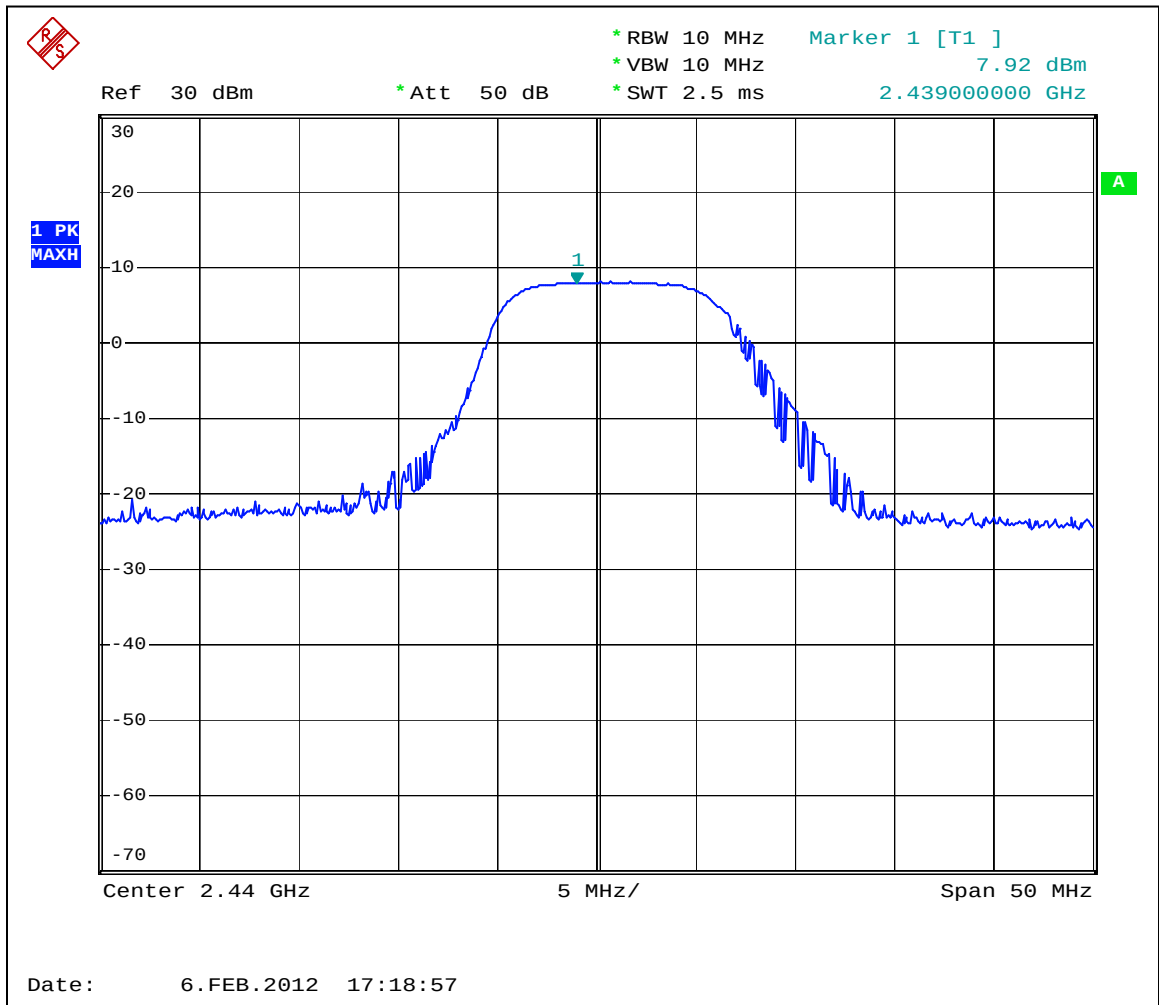
Max. Margin: 22.64dB below the limits

Power Output:	Conducted					
Frequency Range:	☐ 902-928MHz ☒ 2400-2483.5MHz ☐ 5725-5850MHz					
Low Frequency MHz	Measured power dBm	Attenuation dB	Power at Antenna dBm	Limit dBm	Limit Reduction dB	Margin dB
	7.5	0.5	8.0	30	0	-22.0
Middle Frequency MHz						
	7.9	0.5	8.4	30	0	-21.6
Upper Frequency MHz						
	7.8	0.5	8.3	30	0	-21.7
RBW:	☐ 1MHz ☐ 3MHz ☒ 10MHz					
VBW:	☐ 1MHz ☐ 3MHz ☒ 10MHz					
Antenna Gain:	☒ < 6dBi ☐ >6dBi and = dBi, Output power reduction = dB					

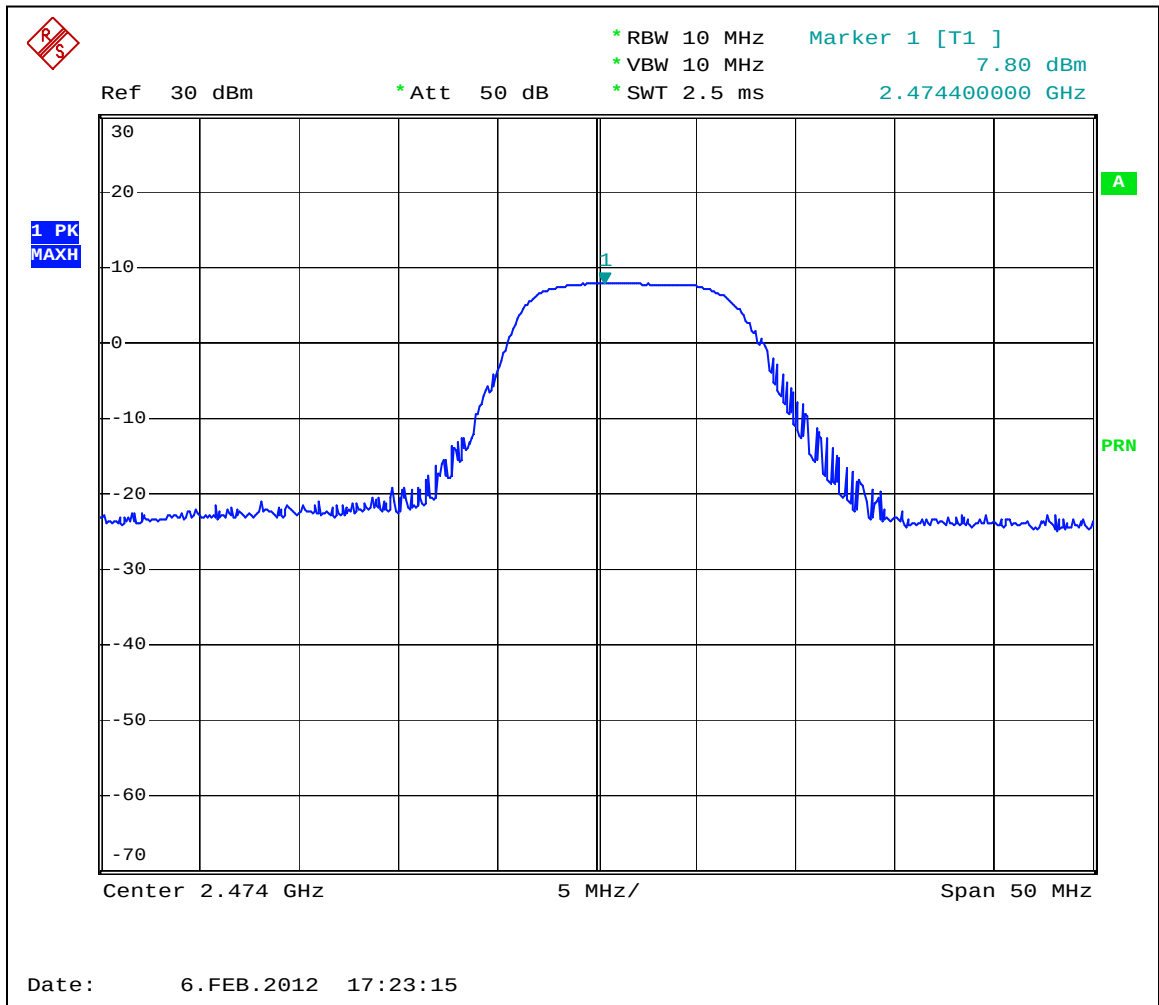
Notes: None



Graph 3.1.1



Graph 3.1.2

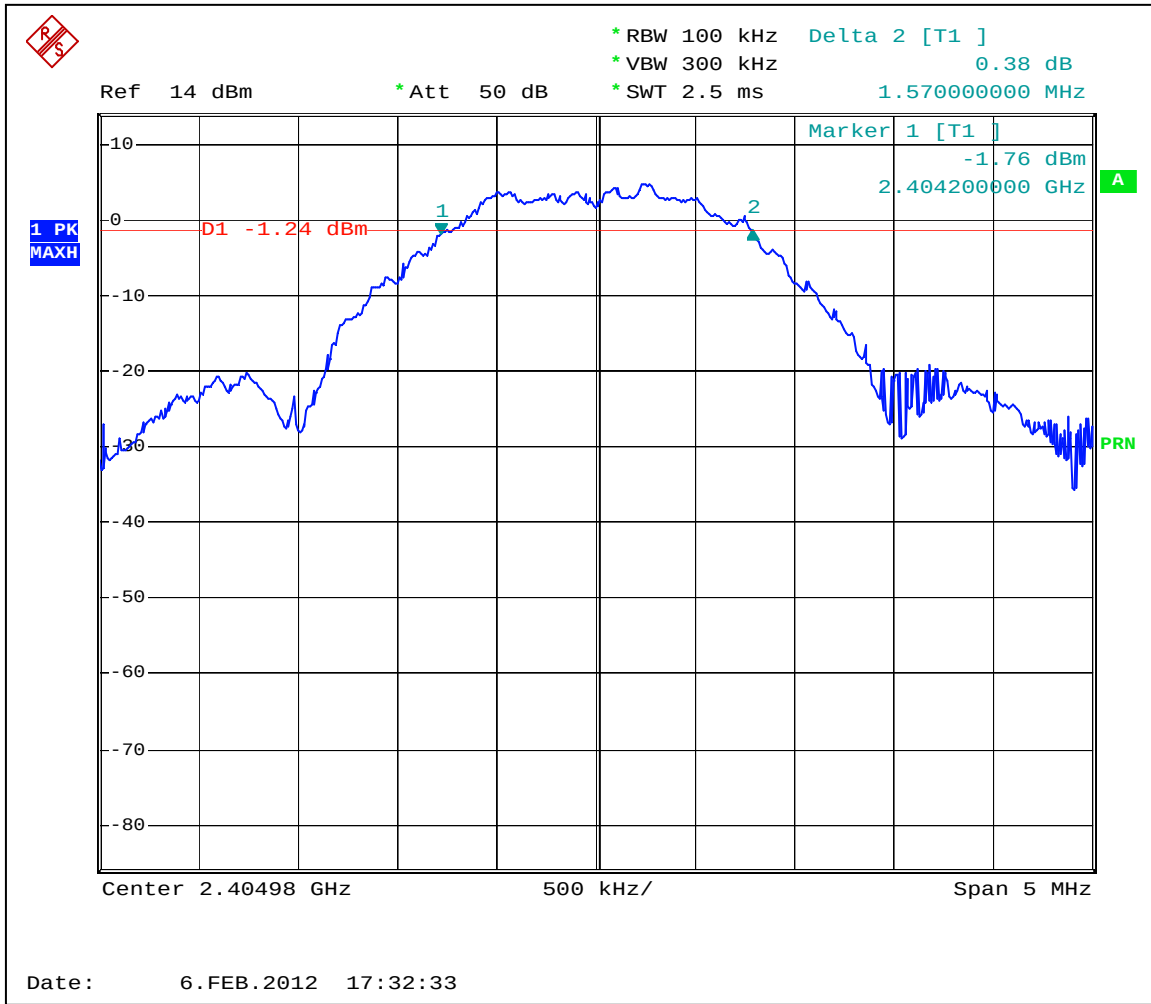


Graph 3.1.3

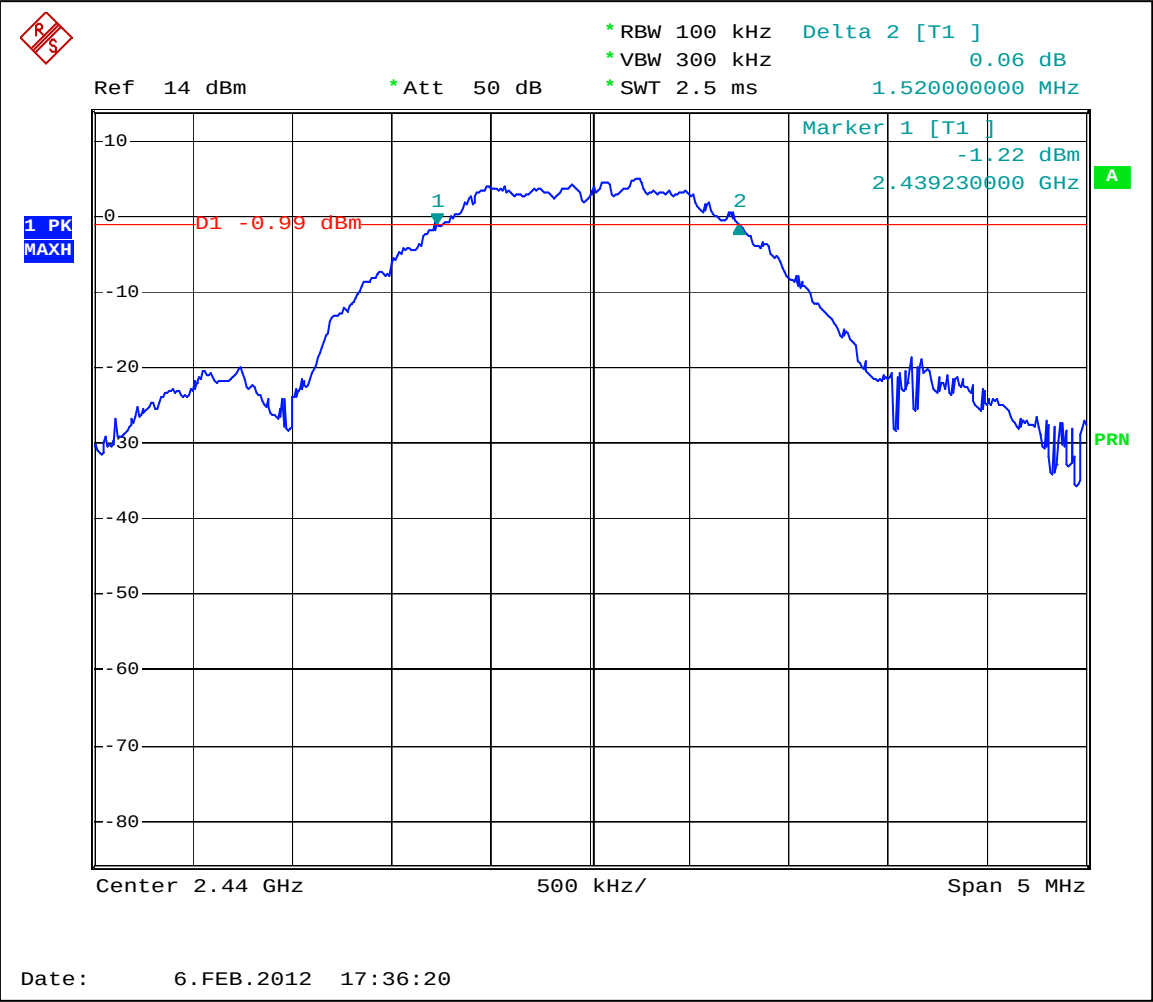
3.2 6dB bandwidth of the digital modulation

Low Frequency Channel kHz	Middle Frequency Channel kHz	Upper Frequency Channel kHz	Minimum Bandwidth kHz	Result
1570	1520	1580	500	Pass
RBW:	☒ 100kHz ☐ other kHz			
VBW:	☐ 100kHz ☒ 300kHz ☐ other kHz			

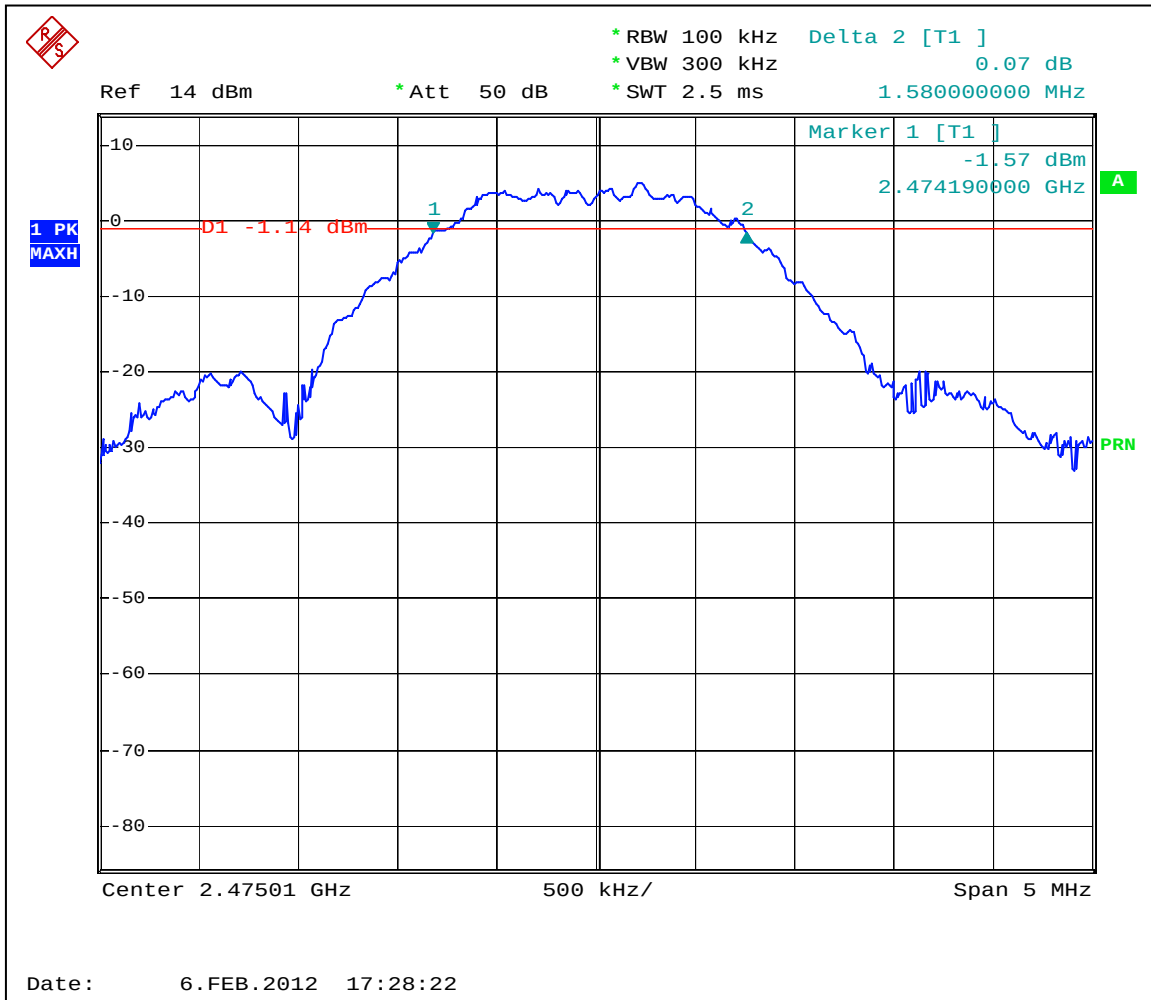
Notes: _____



Graph 3.2.1



Graph 3.2.2

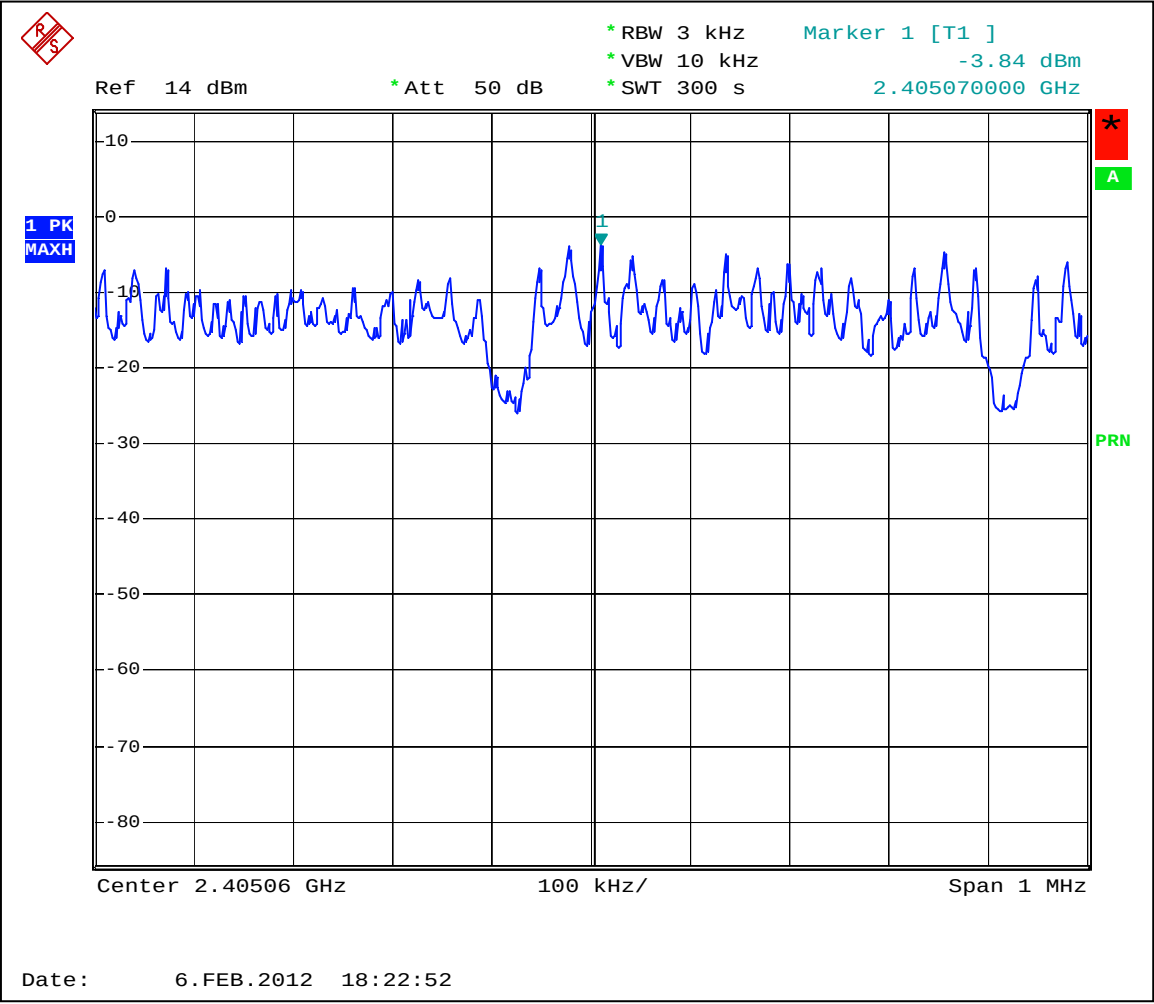


Graph 3.2.3

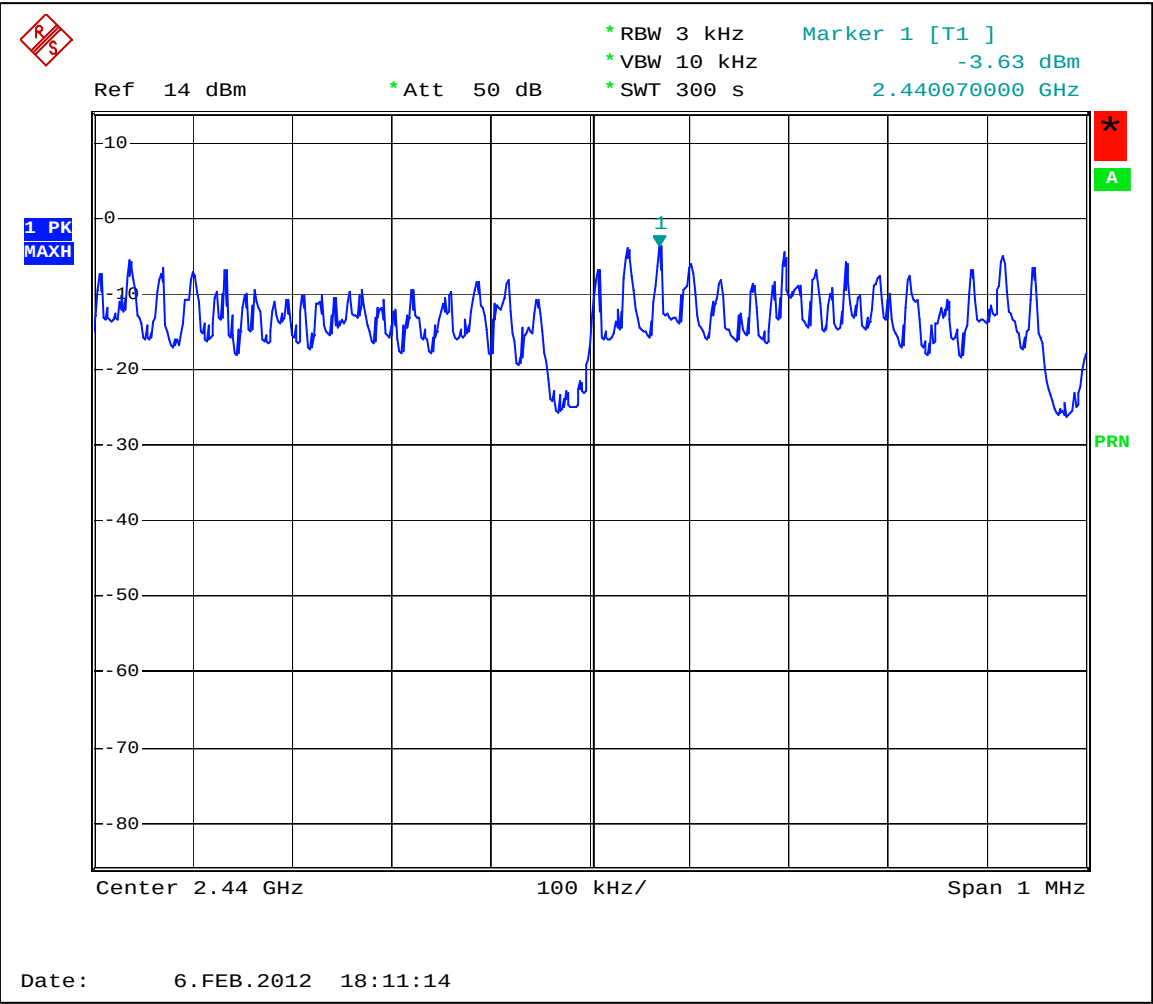
3.3 Power spectral density

Power Output:	☒ Conducted ☐ Radiated			
	Measured Density dBm	Power Spectral Density dBm	Limit dBm	Margin dB
Low Frequency Channel	-3.8	-3.3	8	-11.3
Middle Frequency Channel	-3.6	-3.1	8	-11.1
Upper Frequency Channel	-3.2	-2.7	8	-10.7
Analyzer Settings:	☒ RBW=3KHz ☒ VBW=10KHz ☒ Span=1MHz ☒ Sweep=300sec			
Antenna Gain:	☒ < 6dBi and = dBi ☐ >6dBi and = dBi, limit reduction = dB			

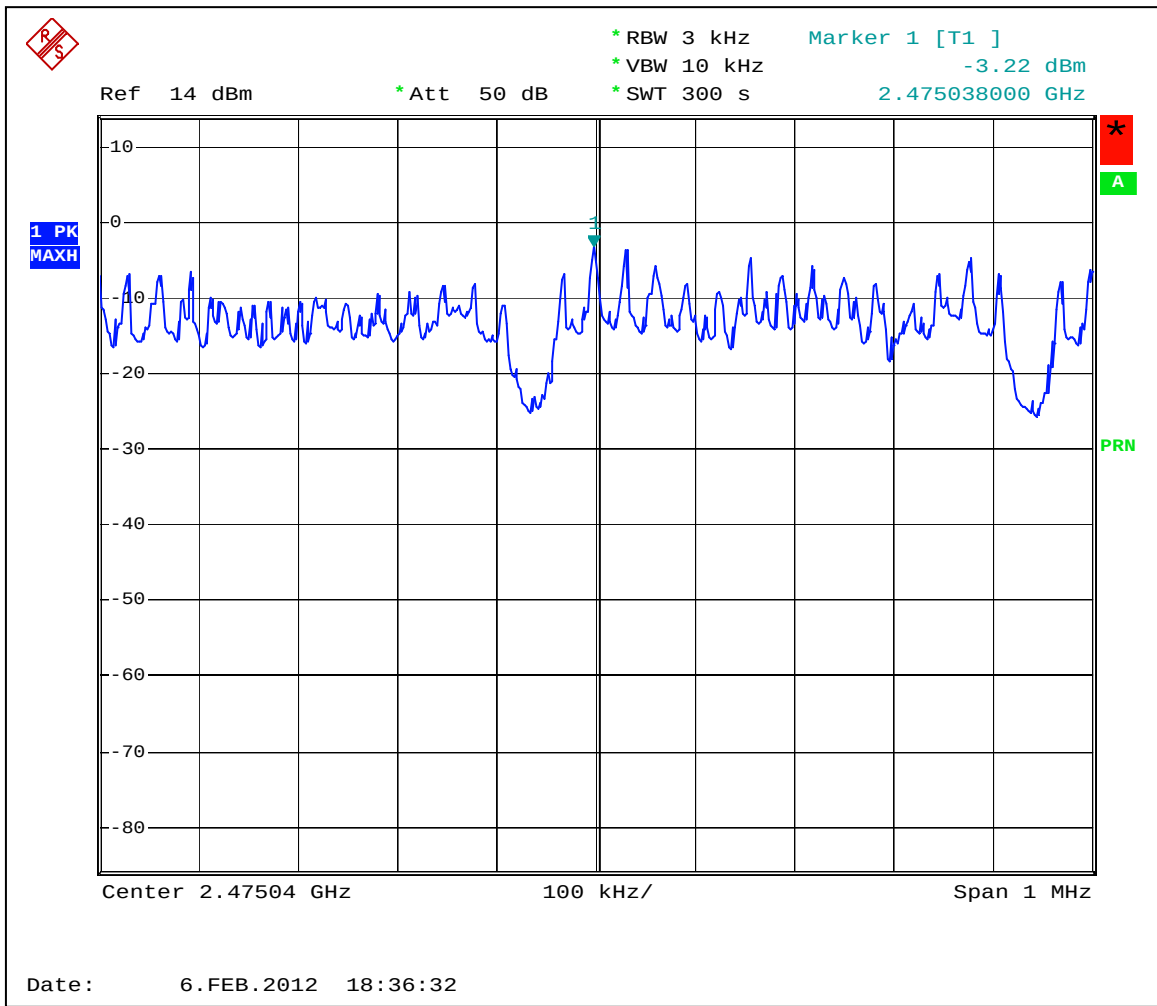
Notes: The Power Spectral Density was calculated adding the cable/attenuator loss of 0.5dB from the measured density value.



Graph 3.3.1



Graph 3.3.2

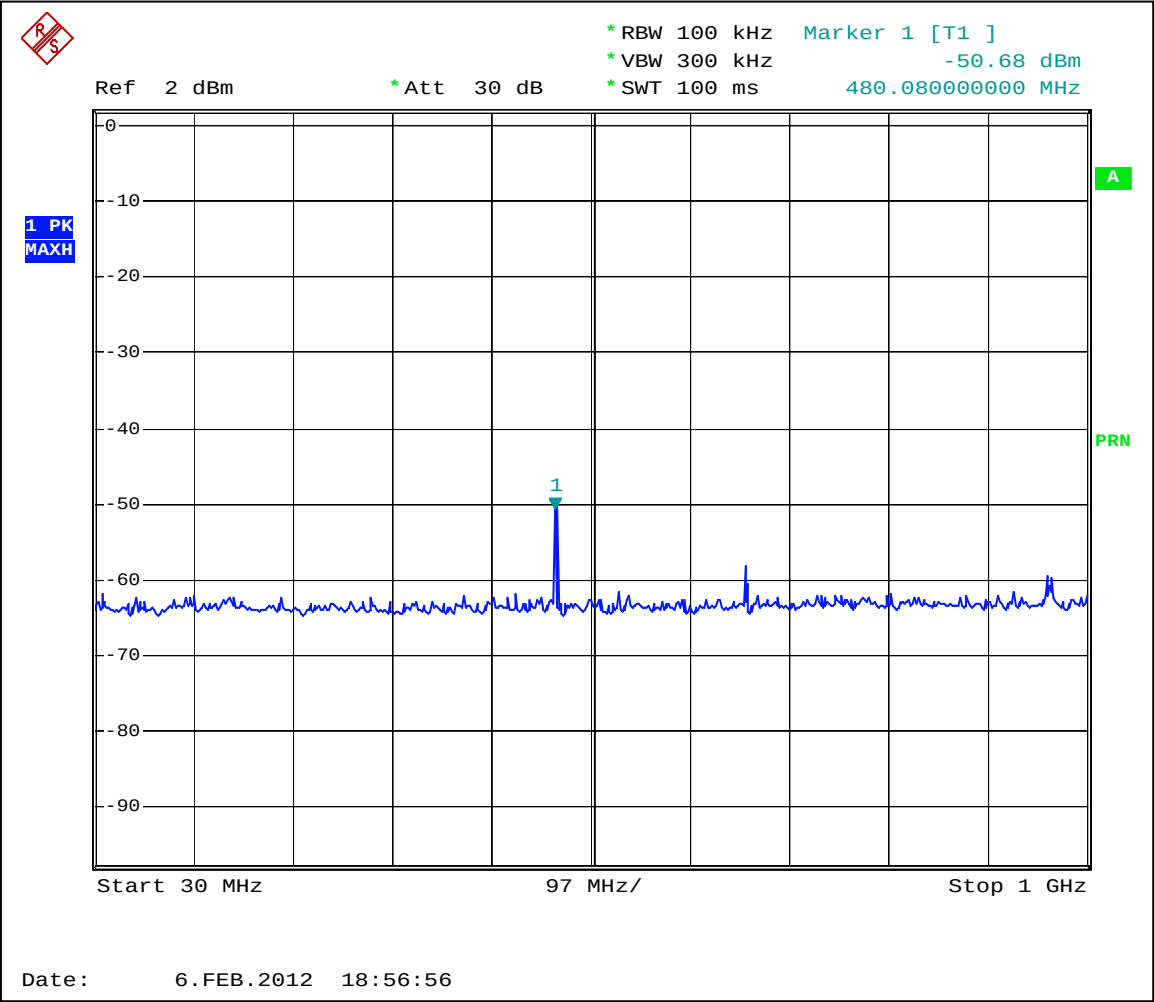


Graph 3.3.3

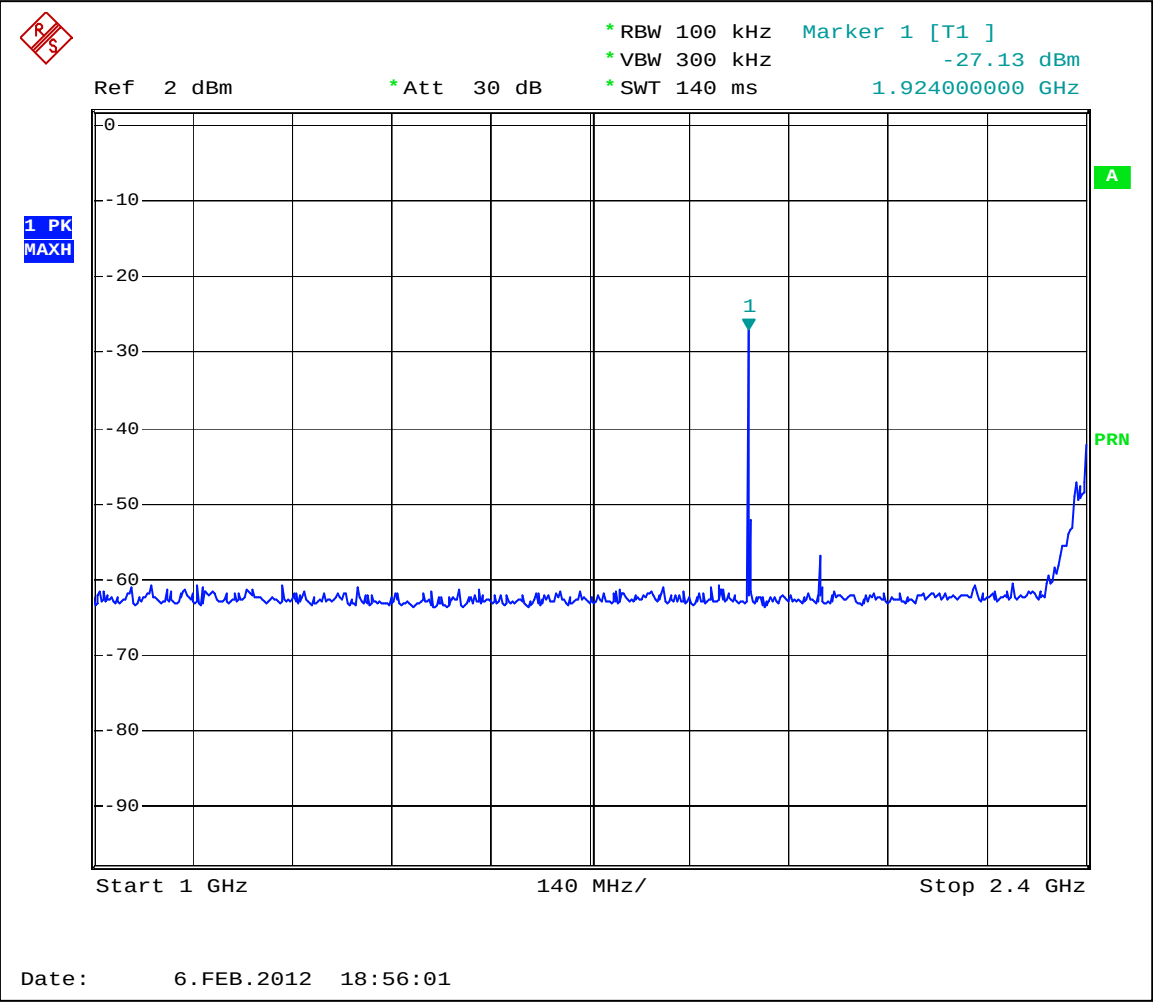
3.4 Antenna conducted spurious emissions

	Minimum Measured Attenuation dB	Minimum Allowed Attenuation dB	Margin dB
Low Frequency Channel	34.6	20	-14.6
Middle Frequency Channel	42.3	20	-22.3
Upper Frequency Channel	40.7	20	-20.7
Analyzer Settings:	☒ RBW=100KHz		
Minimum Allowed Attenuation:	☒ 20dB ☐ 30dB (for digital systems with conducted power measured using RMS averaging over a time interval)		

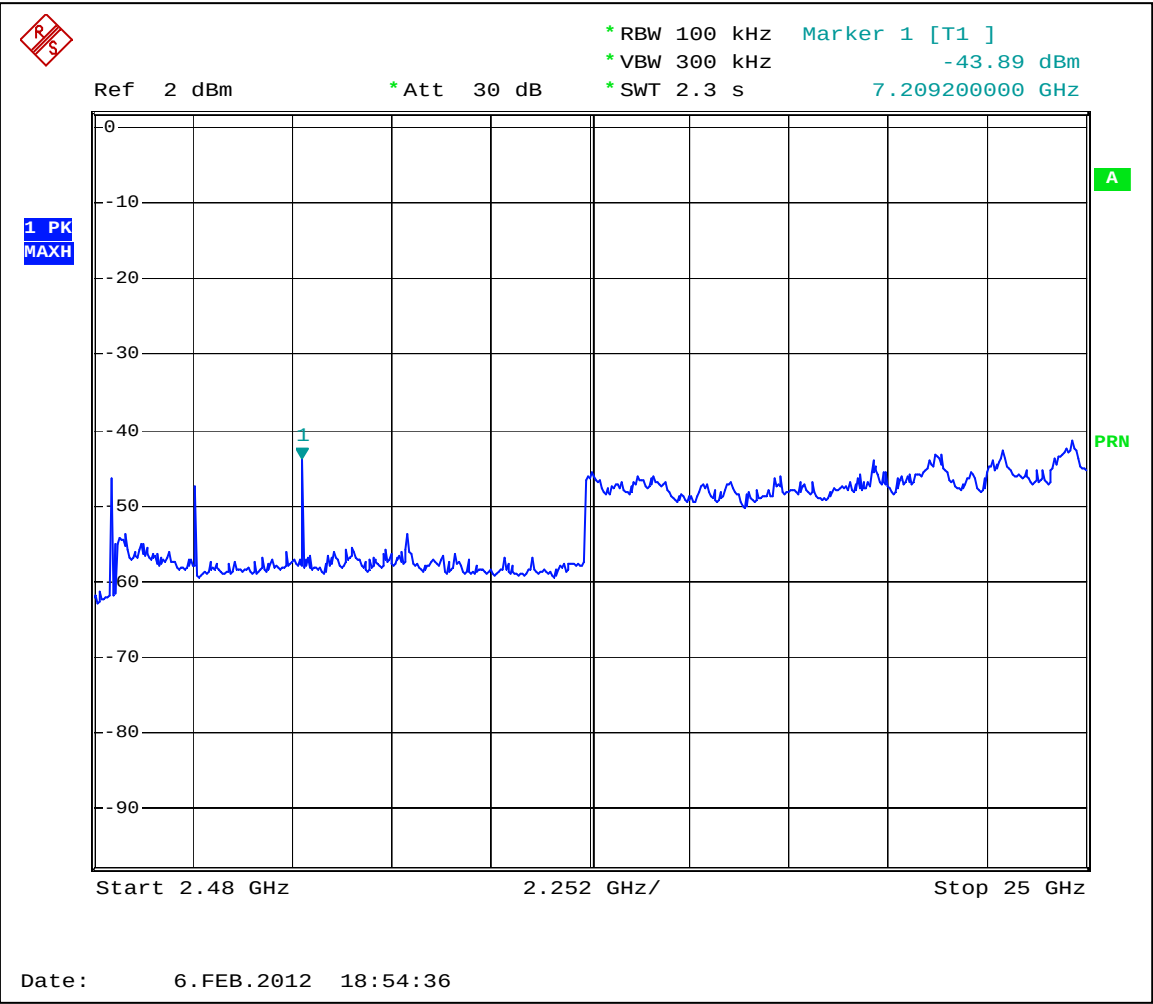
Notes: Test was performed in frequency range from 30MHz to 25GHz
 Graphs 3.4.1 to 3.4.3 show the Antenna Conducted Spurious Emissions for channel 0
 Graphs 3.4.4 to 3.4.6 show the Antenna Conducted Spurious Emissions for channel 7
 Graphs 3.4.7 to 3.4.9 show the Antenna Conducted Spurious Emissions for channel 15
 Graph 3.4.10 shows band edge compliance at 2400MHz
 Graph 3.4.11 shows band edge compliance at 2483.5MHz



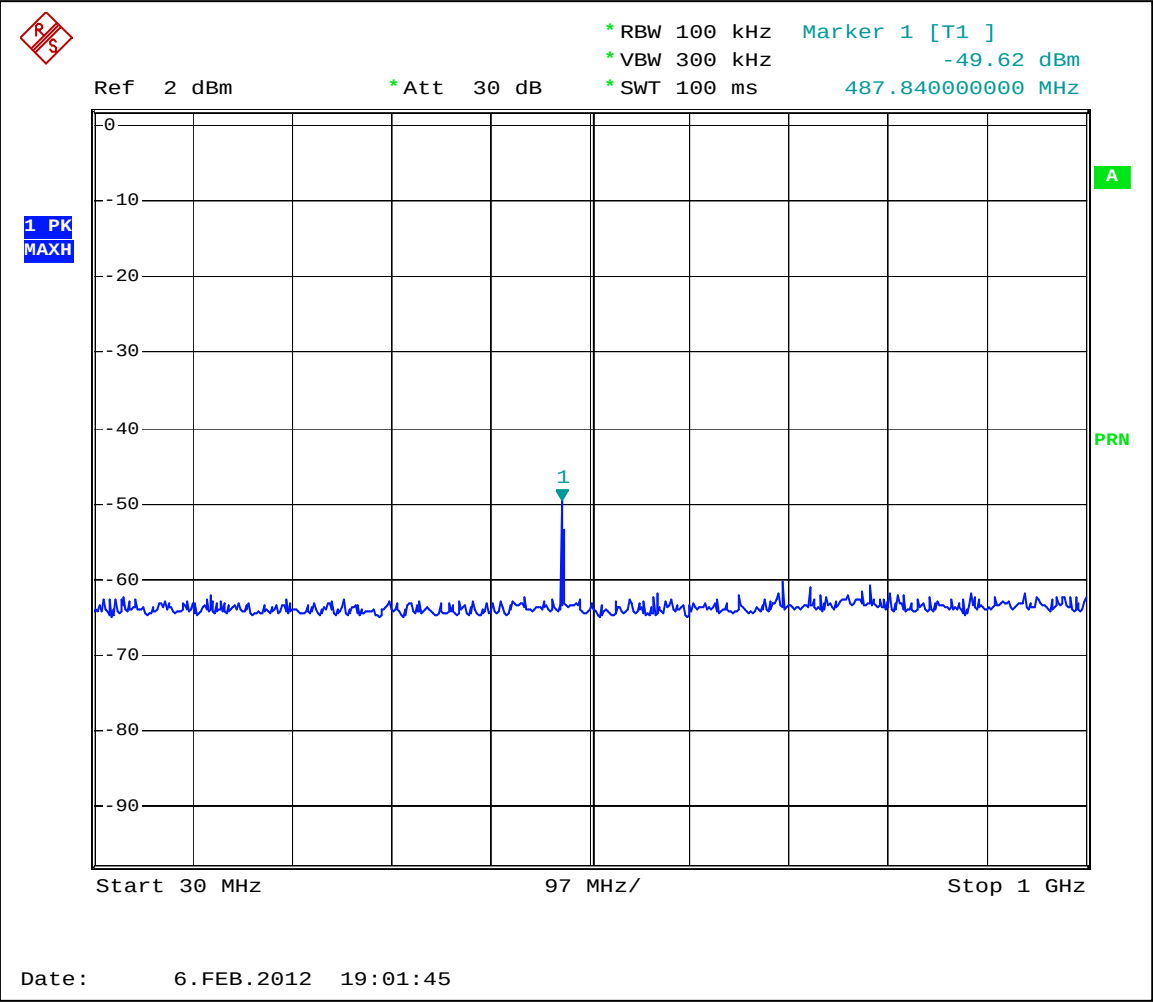
Graph 3.4.1



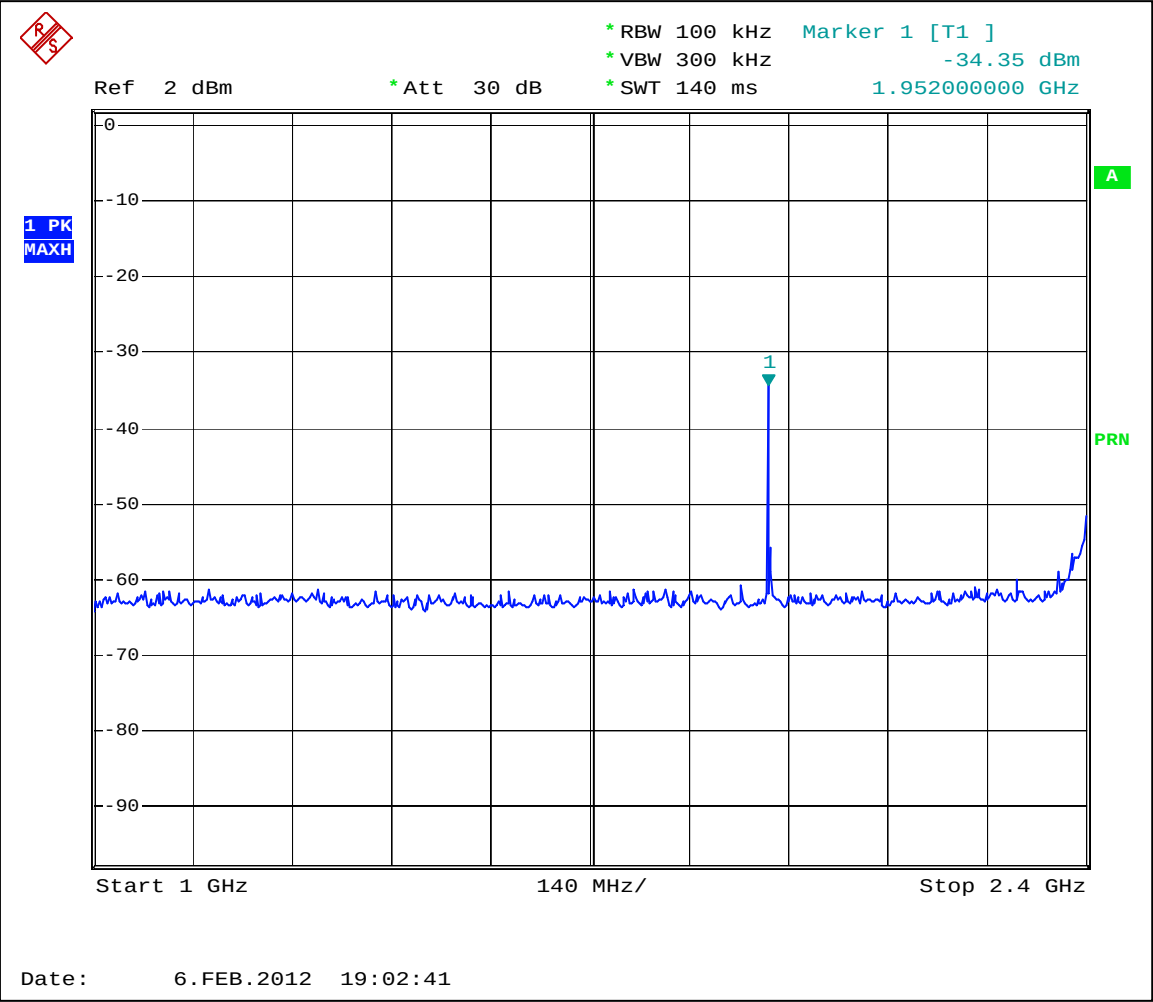
Graph 3.4.2



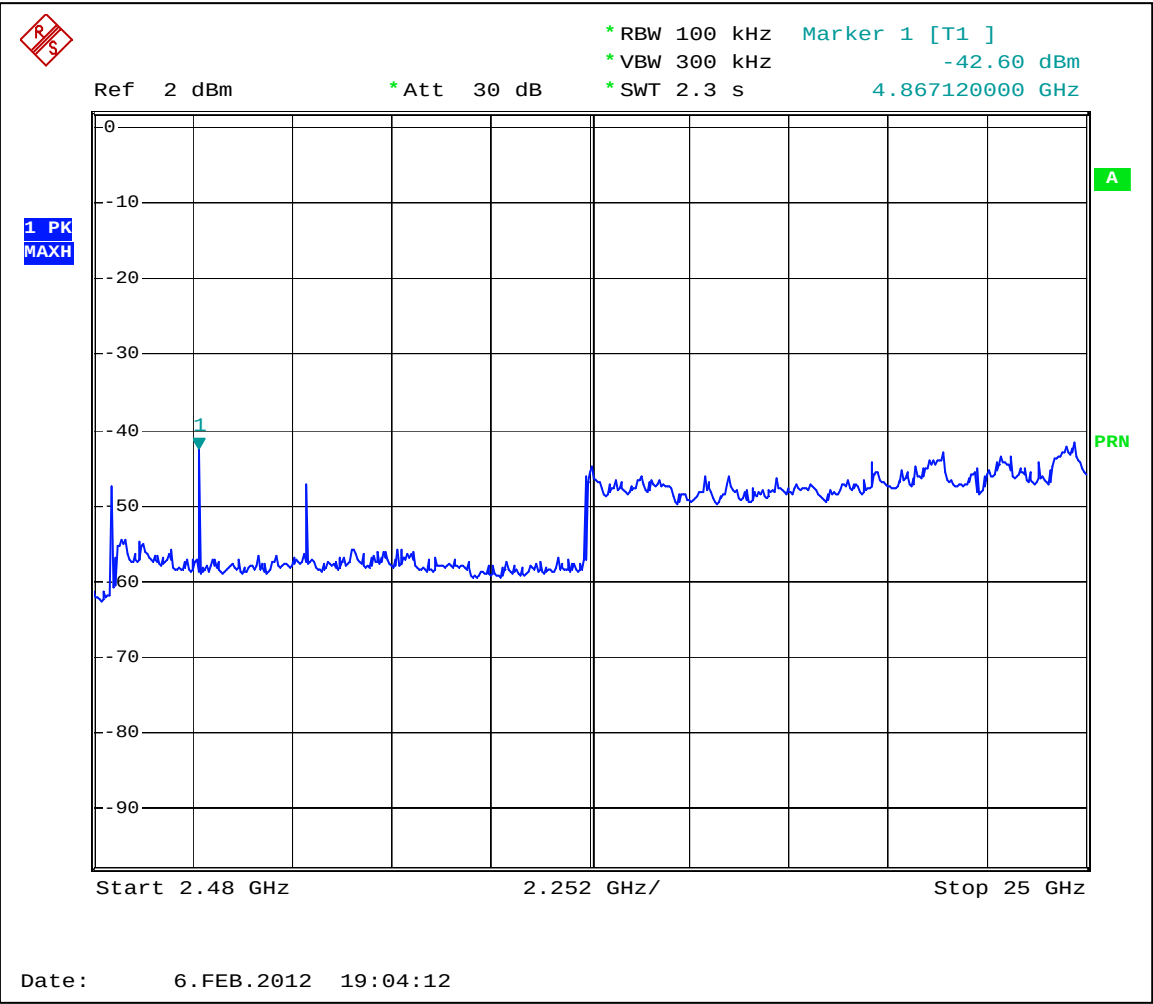
Graph 3.4.3



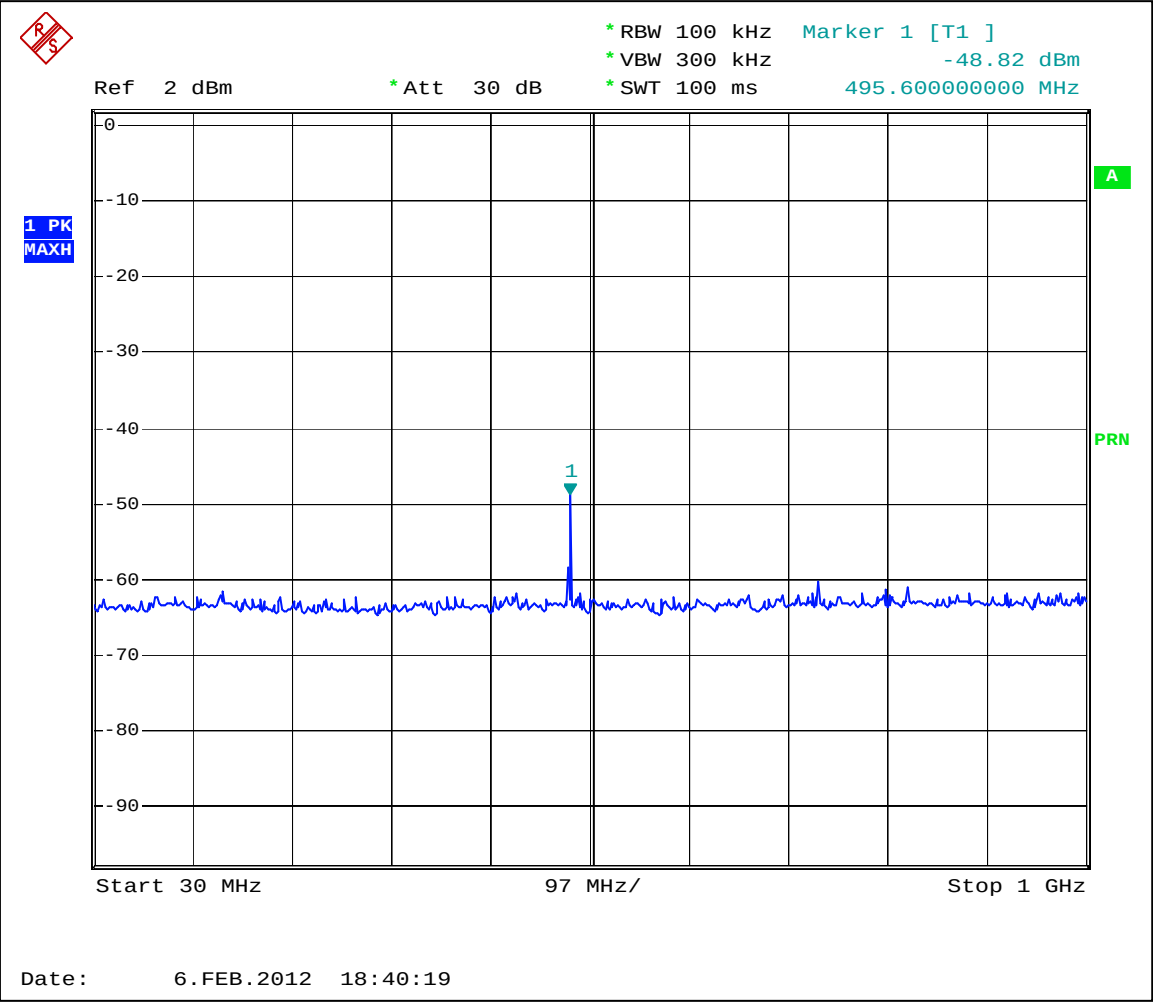
Graph 3.4.4



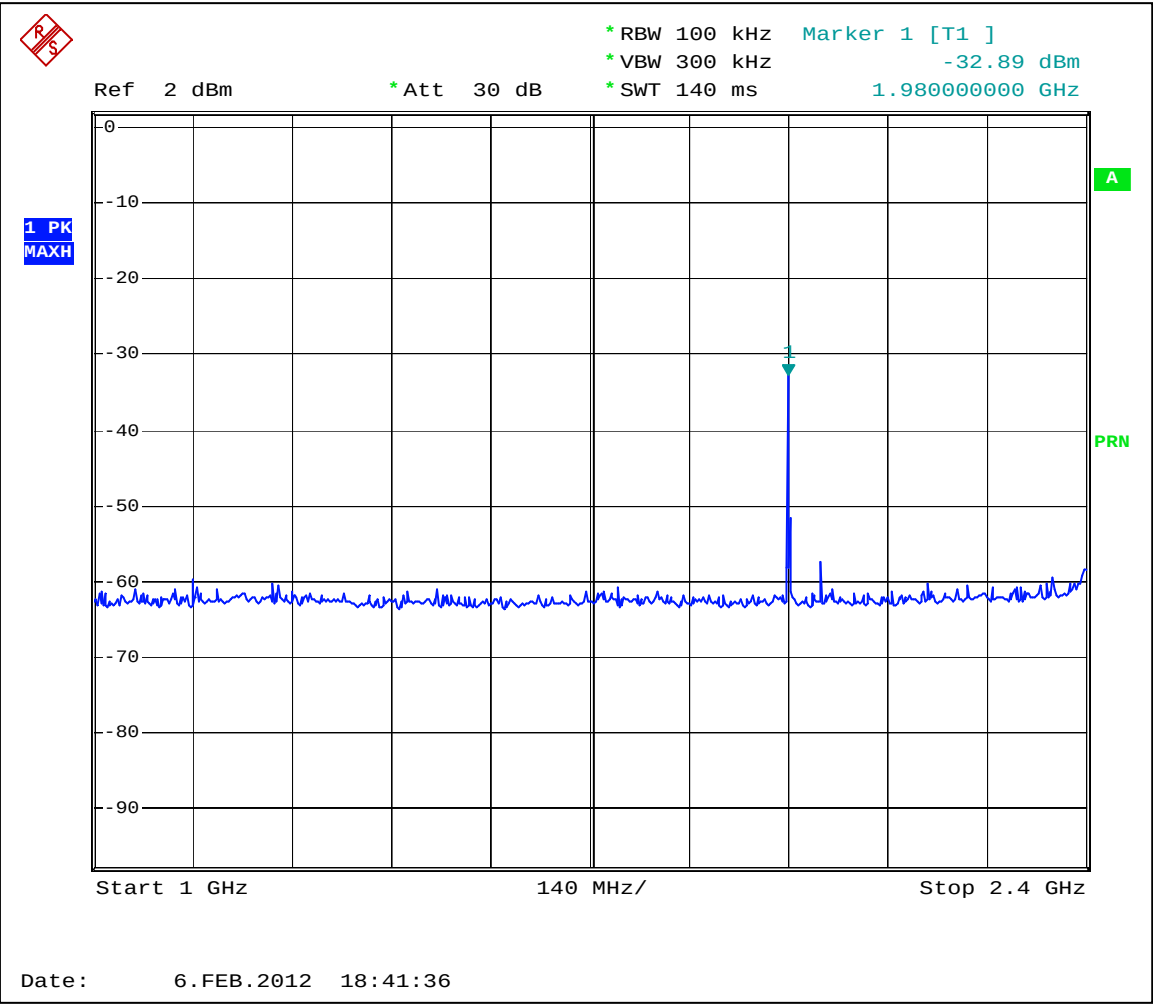
Graph 3.4.5



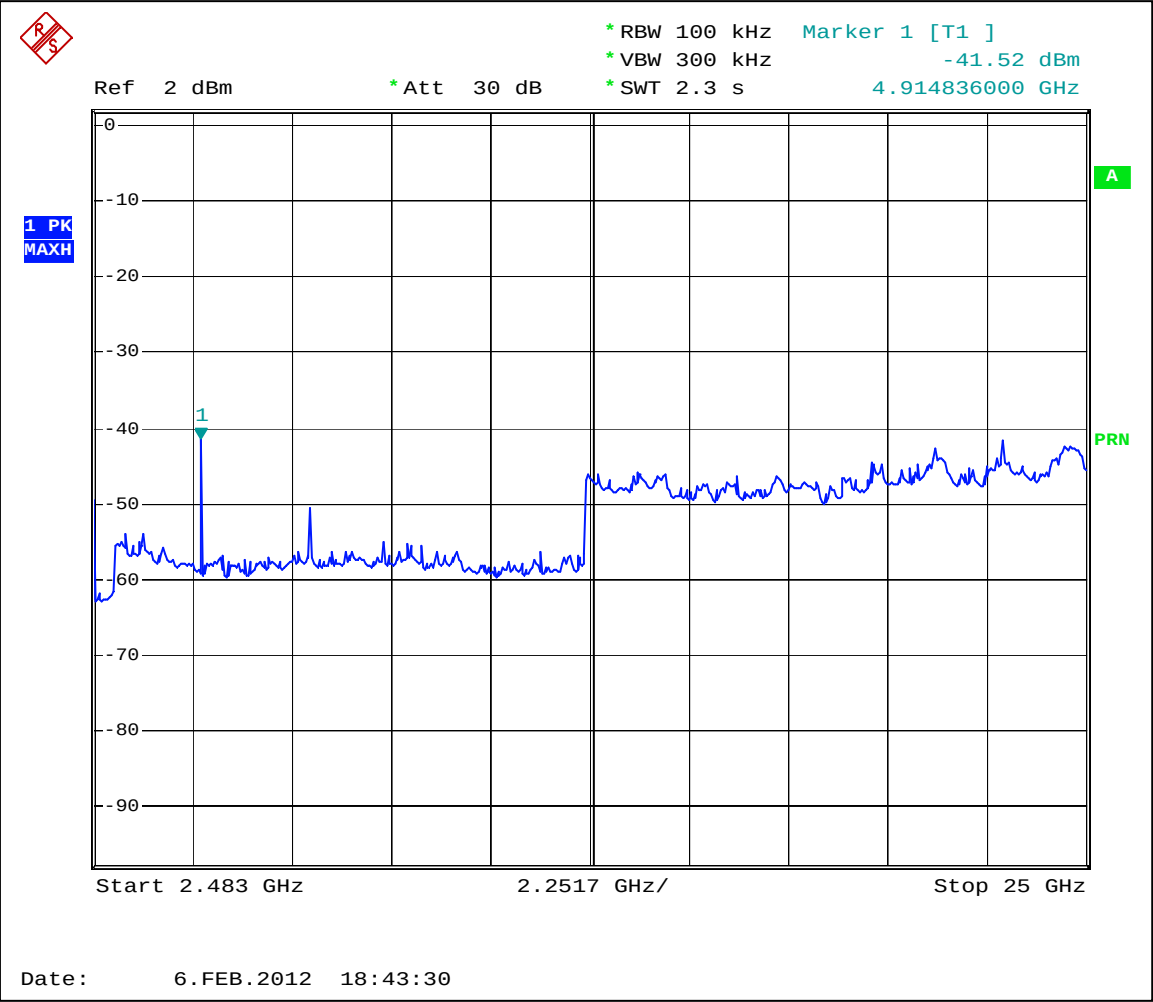
Graph 3.4.6



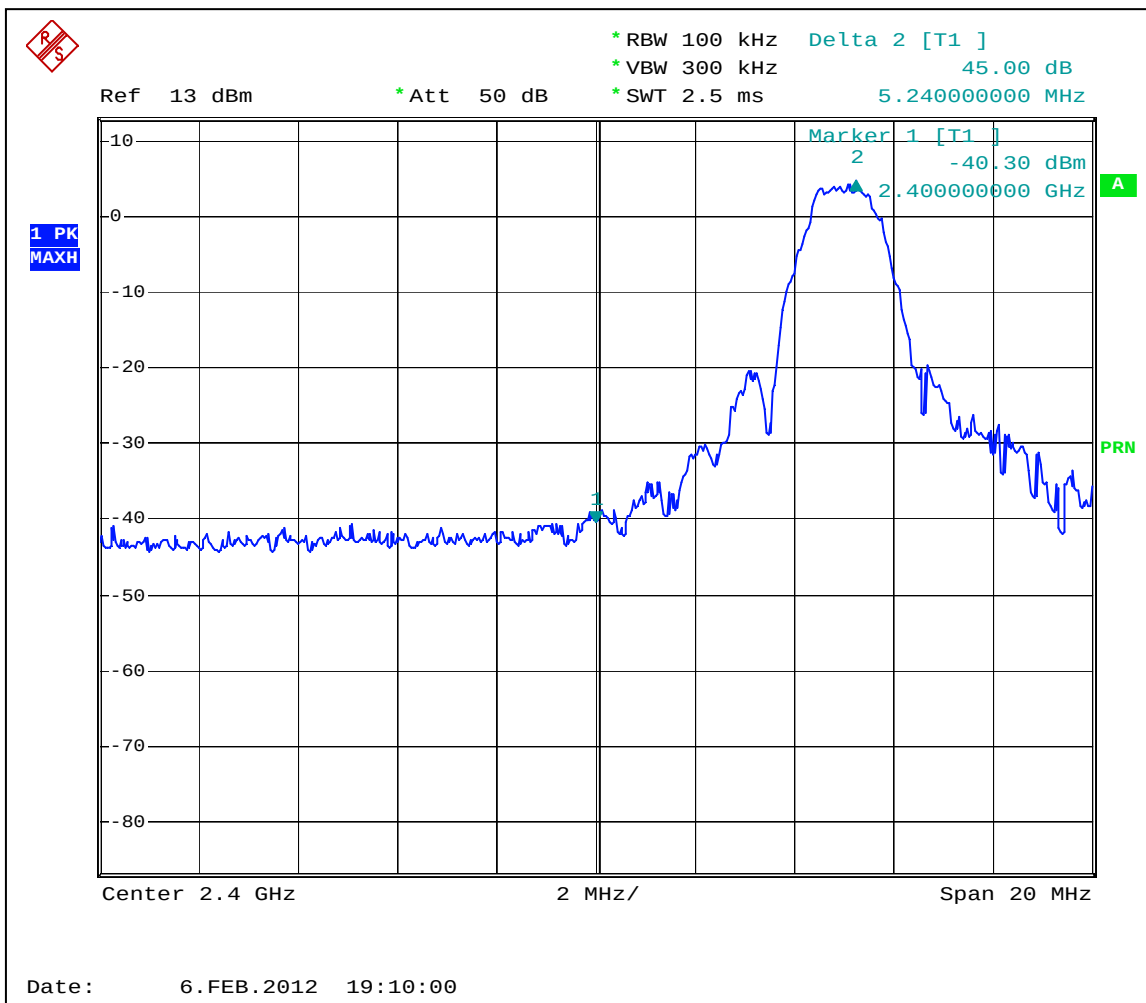
Graph 3.4.7



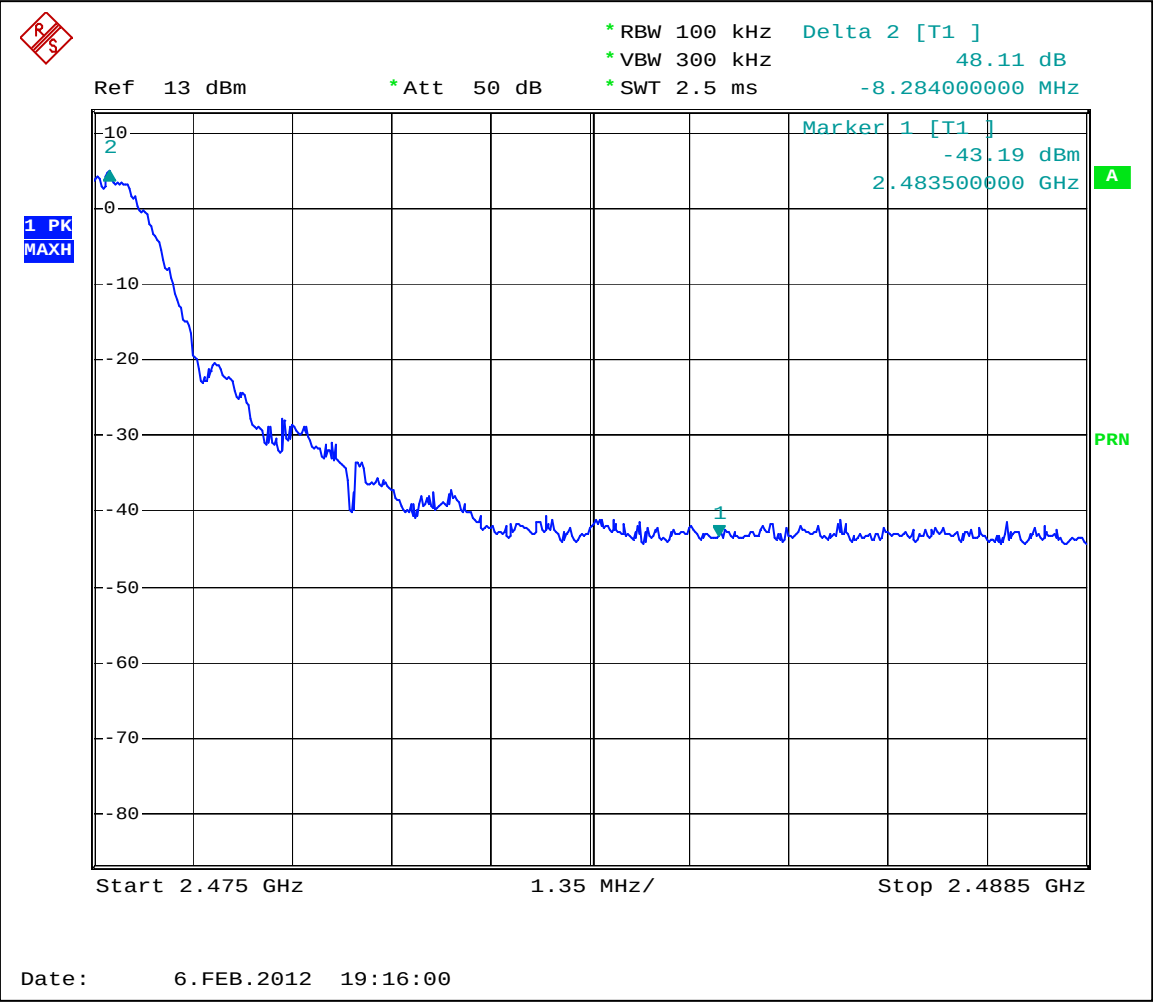
Graph 3.4.8



Graph 3.4.9



Graph 3.4.10



Graph 3.4.11



3.5 Radiated spurious emissions

Test location: ☐ OATS ☒ Anechoic Chamber ☐ Other

Frequency Range: 30MHz to 25GHz (10th Harmonic)

Test result: **Pass**

Max. Margin: 5.2dB below the limits

Notes: Tables 3.5.1, 3.5.2, 3.5.3 and Graphs 3.5.1-3.5.24 show radiated spurious and the 2nd and 3rd harmonic in restricted band of operation per FCC 15.205. Fundamental frequencies were excluded.
No emissions were detected above ambient at 5th and above harmonics.

Date:	February 7, 2012	Result: Pass
Standard:	FCC part 15.247(d)	
Tested by:	Uri Spector	
Test Point:	Enclosure	
Operation mode:	See Page 5	
Note:	None	

Table 3.5.1

Frequency	Ant. Polarity	Peak Reading dBμV	Ant.Factor dB1/m	Total at 3m dBμV/m	Limit dBμV/m	Margin dB
Channel 0						
197.76 MHz	V	18.9	11.9	30.8	43.5	-12.7
216.25 MHz	V	18.9	12.0	30.9	46.0	-15.2
398.7 MHz	V	14.9	18.7	33.6	46.0	-12.4
962.16 MHz	V	14.6	25.9	40.5	54.0	-13.5
30.346 MHz	H	7.6	20.1	27.7	40.0	-12.3
117.31 MHz	H	11.9	13.8	25.7	43.5	-17.8
212.87 MHz	H	12.6	12.0	24.6	43.5	-18.9
962.16 MHz	H	11.2	25.9	37.2	54.0	-16.8
Channel 7						
329.78 MHz	V	15.7	16.8	32.5	46.0	-13.5
333.59 MHz	V	21.1	16.8	37.9	46.0	-8.1
336.36 MHz	V	24.0	16.9	40.8	46.0	-5.2
341.56 MHz	V	19.7	17.0	36.7	46.0	-9.3
357.49 MHz	V	17.3	17.8	35.1	46.0	-10.9
976.3 MHz	V	13.8	26.2	40.0	54.0	-14.0
30.242 MHz	H	8.2	20.2	28.4	40.0	-11.6
202.26 MHz	H	15.6	12.2	27.8	43.5	-15.7
212.07 MHz	H	17.0	12.1	29.1	43.5	-14.4
461.39 MHz	H	11.9	19.9	31.8	46.0	-14.2
995.4 MHz	H	9.8	26.4	36.2	54.0	-17.8
Channel 14						
310.39 MHz	V	16.7	16.3	33.0	46.0	-13.1
333.59 MHz	V	19.2	16.8	36.0	46.0	-10.0
335.33 MHz	V	23.1	16.9	40.0	46.0	-6.1
341.91 MHz	V	19.0	17.0	36.0	46.0	-10.0
360.26 MHz	V	17.3	17.9	35.2	46.0	-10.8
404.25 MHz	V	13.8	19.0	32.8	46.0	-13.2
990.1 MHz	V	12.7	26.3	39.0	54.0	-15.0
30.97 MHz	H	8.0	19.8	27.8	40.0	-12.2
212.07 MHz	H	15.2	12.1	27.3	43.5	-16.2
218.98 MHz	H	15.3	12.1	27.4	46.0	-18.6
339.14 MHz	H	13.3	16.9	30.2	46.0	-15.8
989.74 MHz	H	10.4	26.3	36.7	54.0	-17.3

Table 3.5.2
Peak Readings

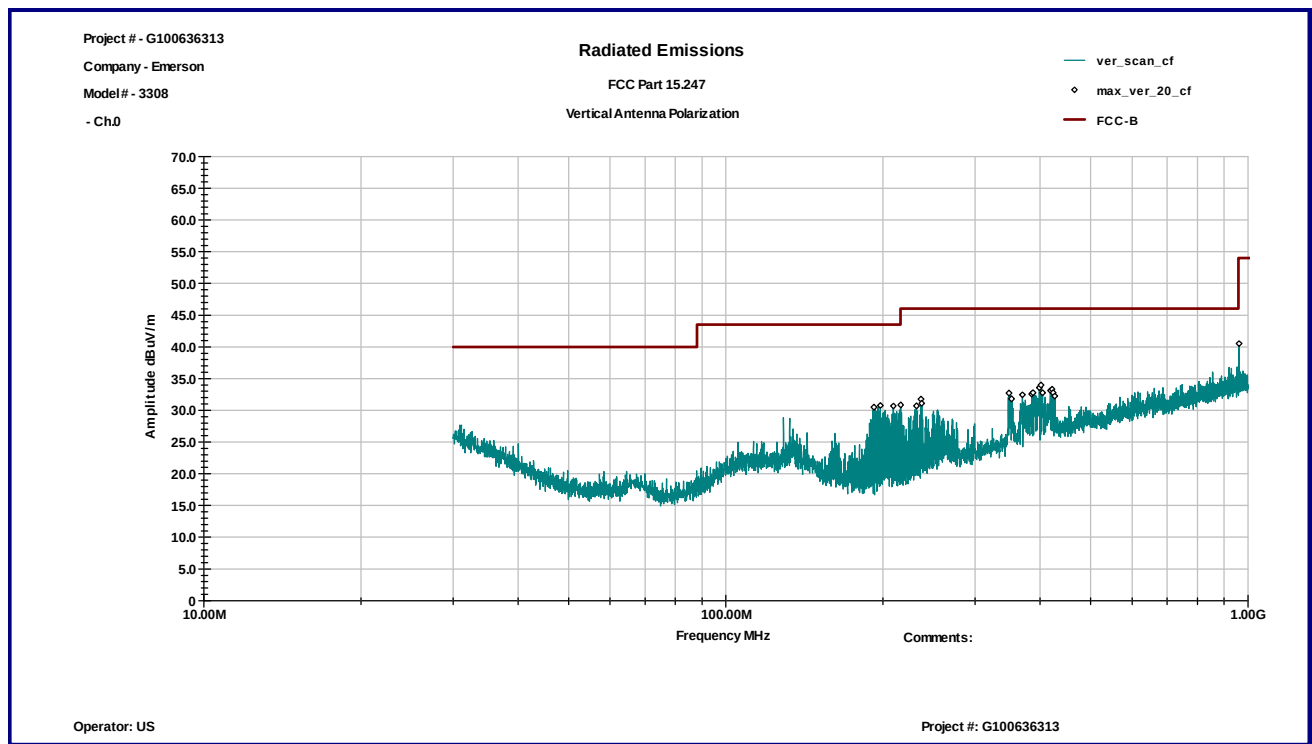
Frequency MHz	Antenna Polarity	Peak Reading dB μ V	Total C.F. dB1/m	Pre-Amp. Gain (dB)	Total at 3m dB μ V/m	Limit dB μ V/m	Margin dB
Channel 0							
7.216 GHz	V	57.6	40.8	41.5	56.9	74.0	-17.1
4.816 GHz	H	48.3	37.3	42.0	43.6	74.0	-30.4
7.216 GHz	H	48.8	40.8	41.5	48.2	74.0	-25.8
9.624 GHz	H	44.6	44.0	40.9	47.6	74.0	-26.4
Channel 7							
4.88 GHz	V	59.7	37.5	42.0	55.2	74.0	-18.8
7.32 GHz	V	55.6	41.1	41.4	55.3	74.0	-18.7
4.88 GHz	H	50.4	37.4	42.0	45.9	74.0	-28.1
7.32 GHz	H	48.4	41.1	41.4	48.1	74.0	-25.9
9.768 GHz	H	45.9	44.2	41.1	49.0	74.0	-25.0
Channel 14							
4.952 GHz	V	68.8	37.7	41.9	64.5	74.0	-9.5
7.424 GHz	V	57.8	41.4	41.2	58.0	74.0	-16.0
4.952 GHz	H	55.0	37.6	41.9	50.7	74.0	-23.4
7.424 GHz	H	50.4	41.4	41.2	50.5	74.0	-23.5
9.904 GHz	H	47.3	44.4	41.3	50.4	74.0	-23.6

Table 3.5.3
Average Value Readings

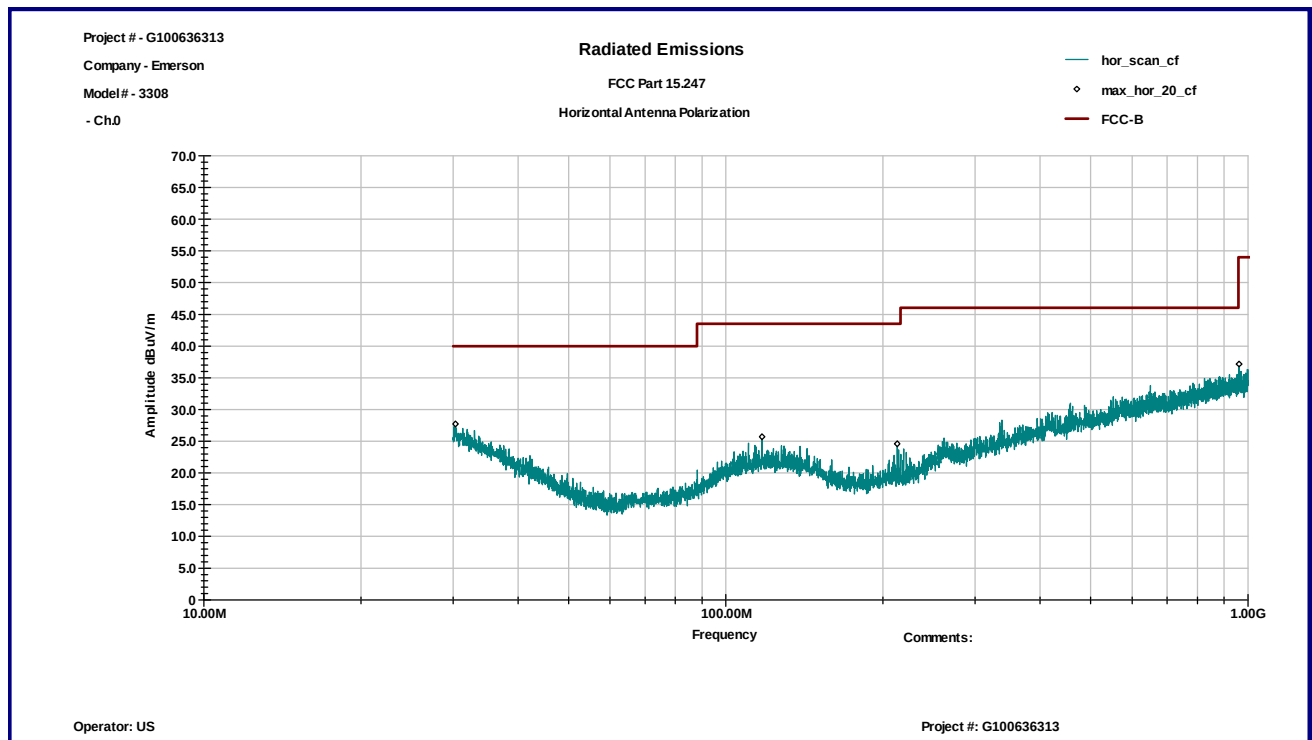
Frequency MHz	Antenna		Ant. CF dB1/m	Cable loss dB	Pre-amp Gain (dB)	Reading dBμV	Total @ 3m dBμV/m	Limit dBμV/m	Margin dB	Comments
	Polarity	Hts(cm)								
	Channel 0									
7213.40	V	100	35.9	4.9	41.5	33.0	32.3	54.0	-21.7	
7213.40	H	125	35.9	4.9	41.5	31.6	30.9	54.0	-23.1	
	Channel 7									
4878.96	V	100	33.4	4.2	42.0	34.0	29.5	54.0	-24.5	
4878.96	H	125	33.4	4.2	42.0	31.6	27.1	54.0	-26.9	
7321.52	V	100	36.1	5.0	41.4	32.1	31.8	54.0	-22.2	
7321.52	H	115	36.1	5.0	41.4	30.8	30.5	54.0	-23.5	
	Channel 14									
4948.96	V	100	33.5	4.2	41.9	37.6	33.3	54.0	-20.7	
4948.96	H	139	33.5	4.2	41.9	33.7	29.4	54.0	-24.6	
7426.44	V	100	36.4	5.0	41.2	33.7	33.8	54.0	-20.1	
7426.44	H	117	36.4	5.0	41.2	31.5	31.6	54.0	-22.3	

Comments:

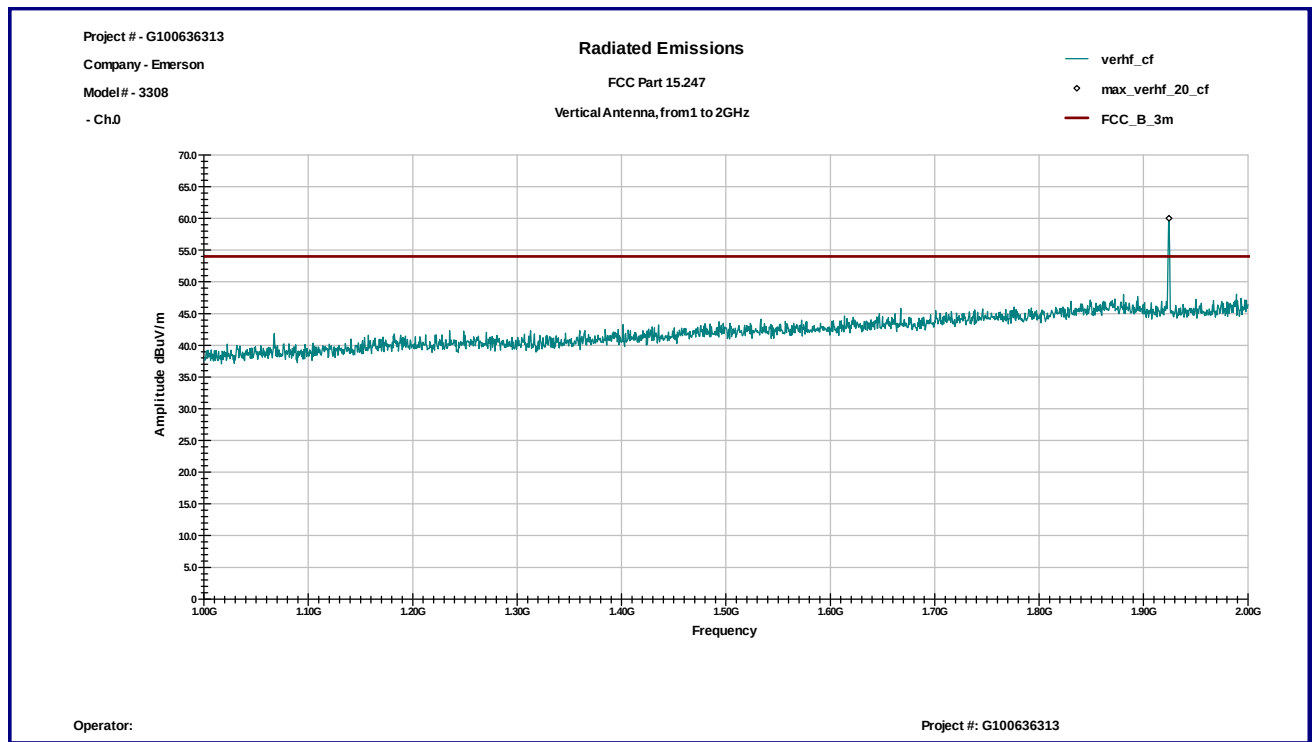
1. Measurements were taken using an Average Value (RBW 1MHz, VBW 10Hz)
2. The table shows the 2nd and 3rd harmonic in restricted band of operation per FCC 15.205
3. The Frequencies from 1.924GHz to 1.9805GHz and the 4th harmonic are outside restricted band of operation per FCC 15.205.
4. No emissions were detected above ambient at 5th and above harmonics



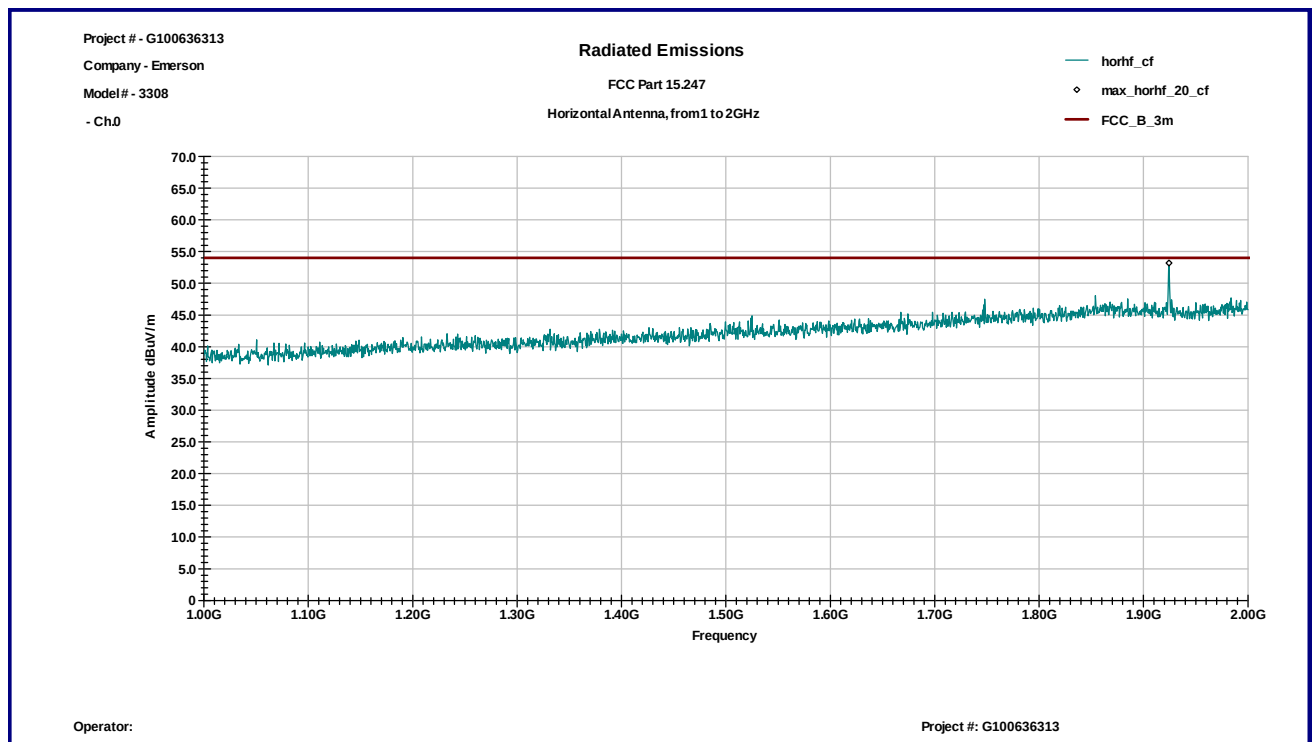
Graph 3.5.1



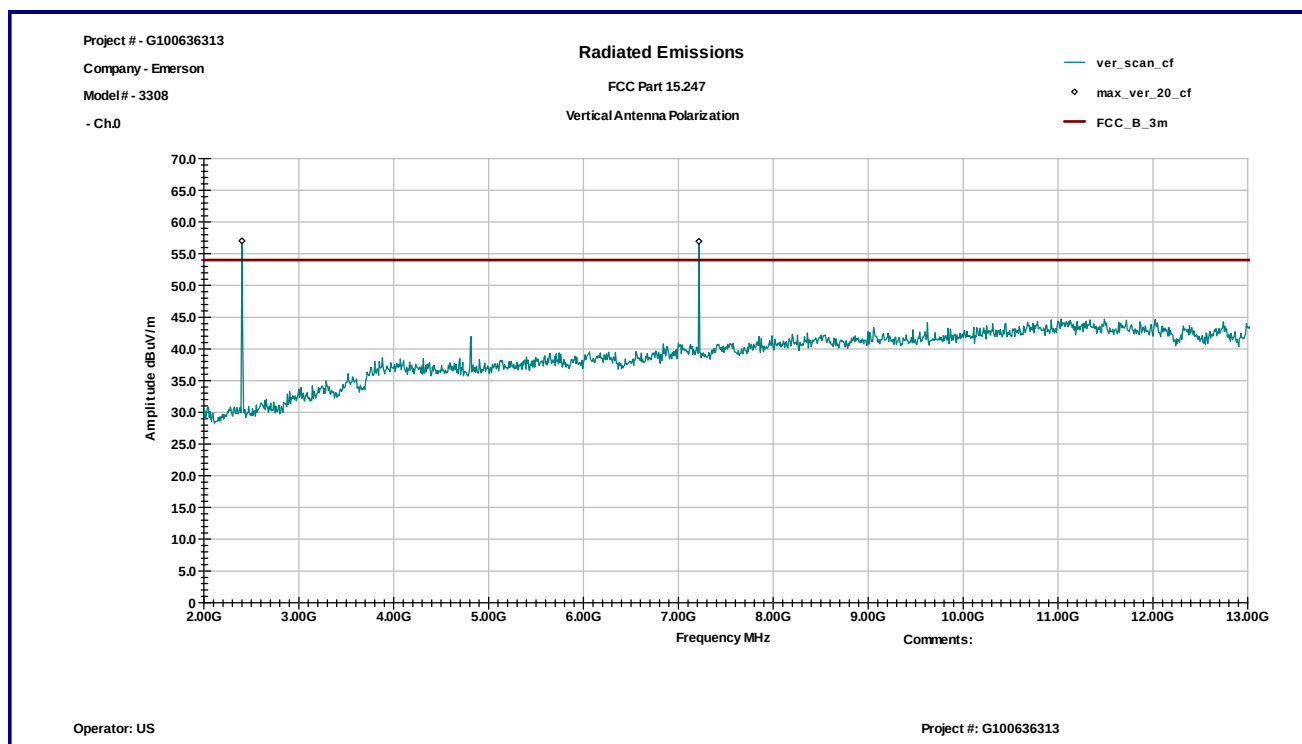
Graph 3.5.2



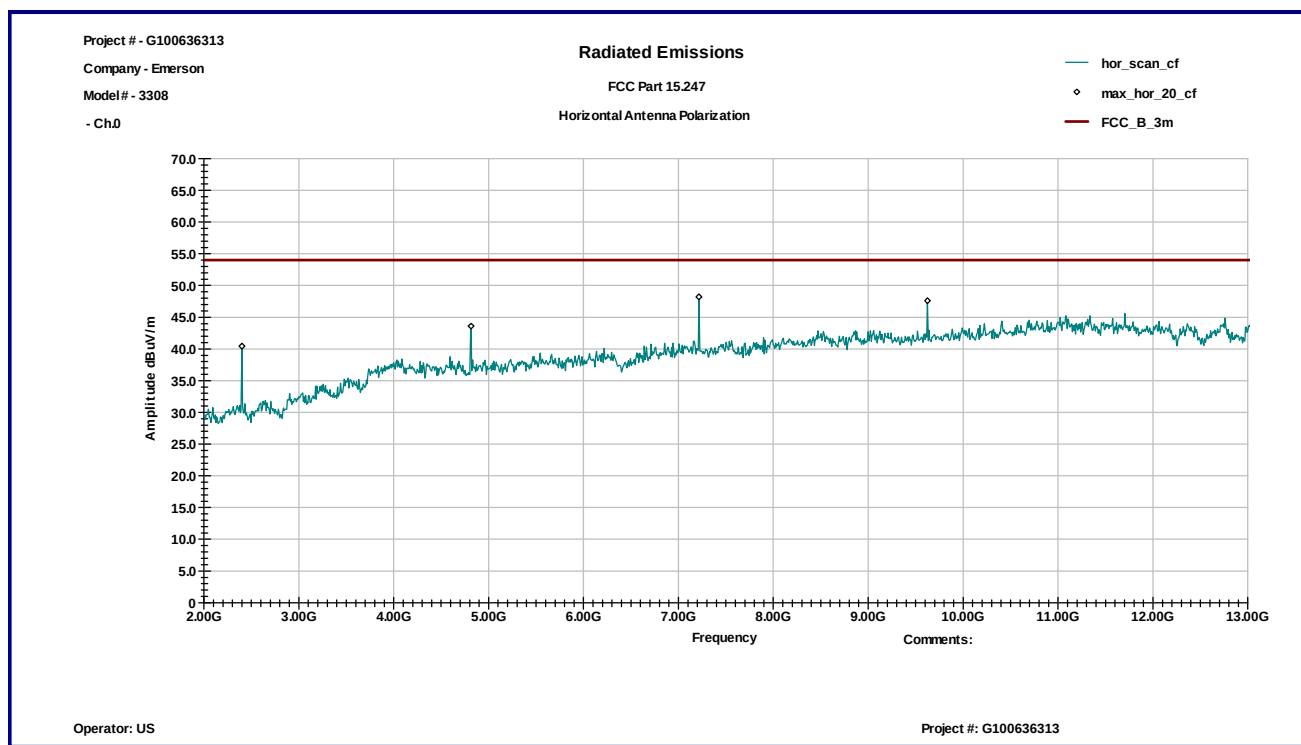
Graph 3.5.3



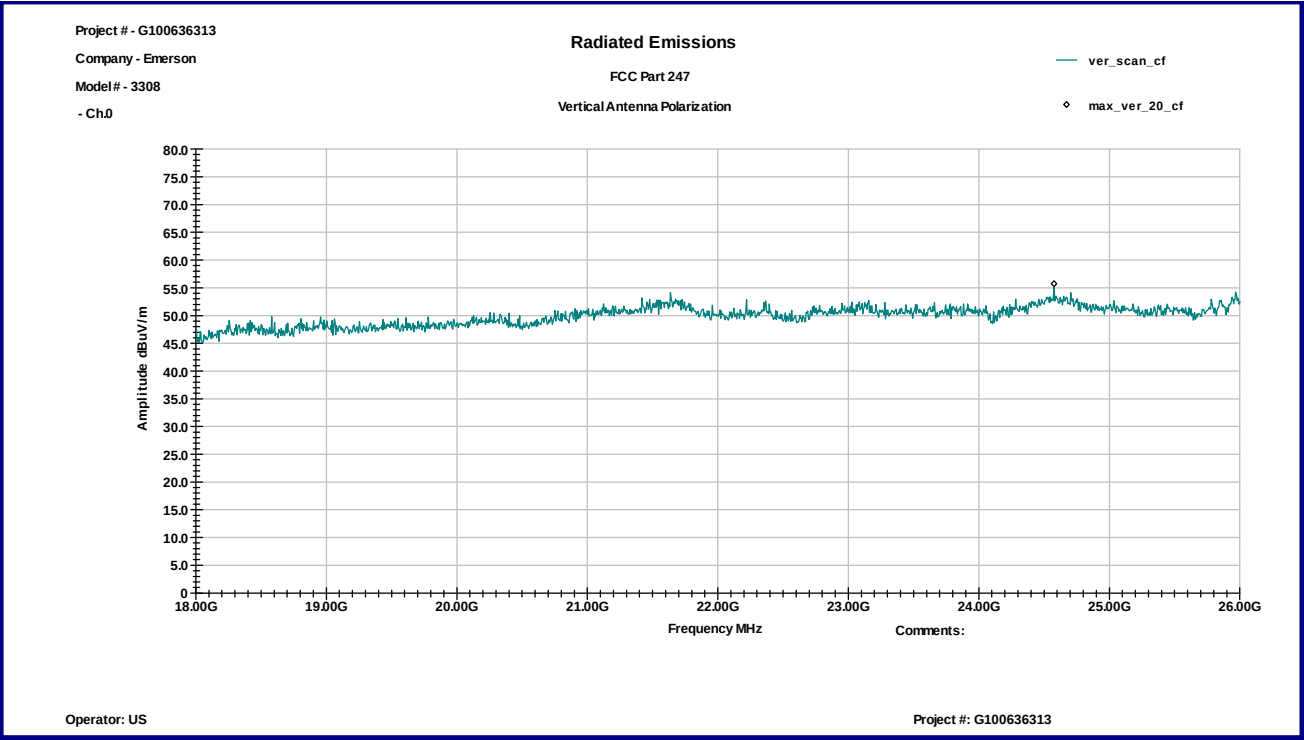
Graph 3.5.4



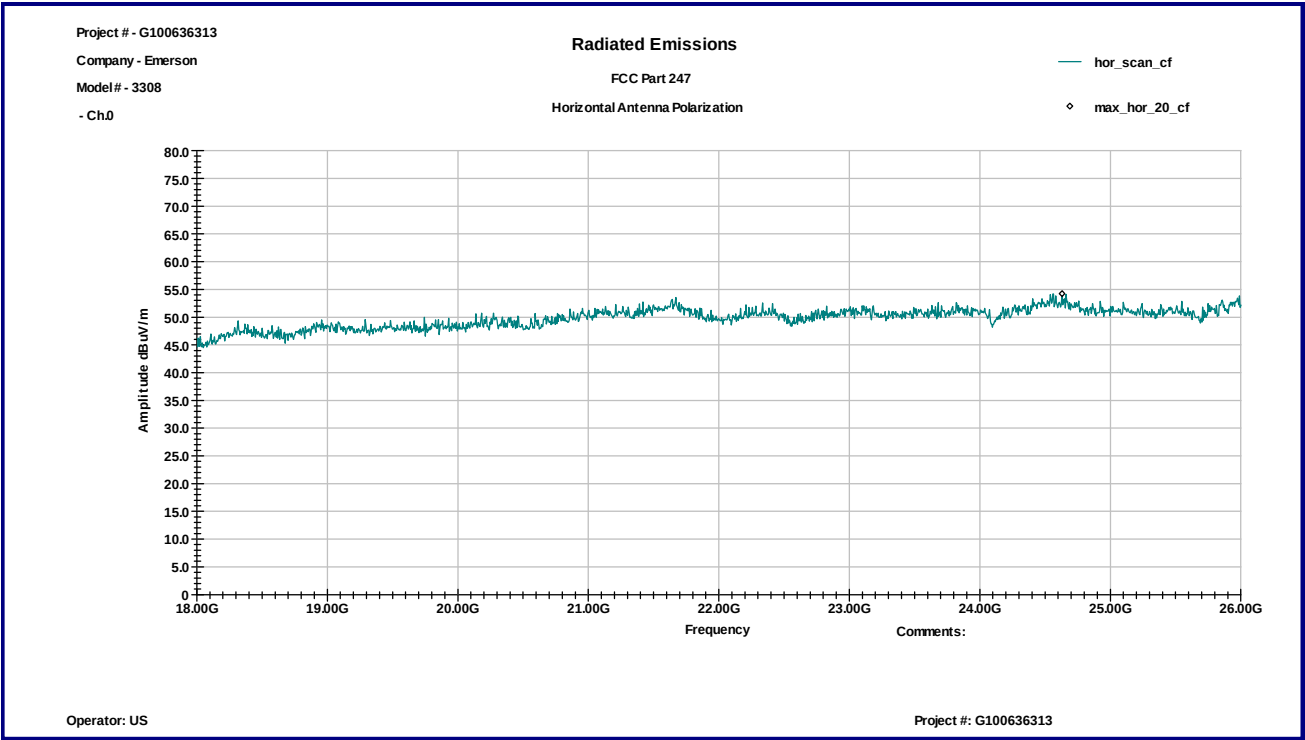
Graph 3.5.5



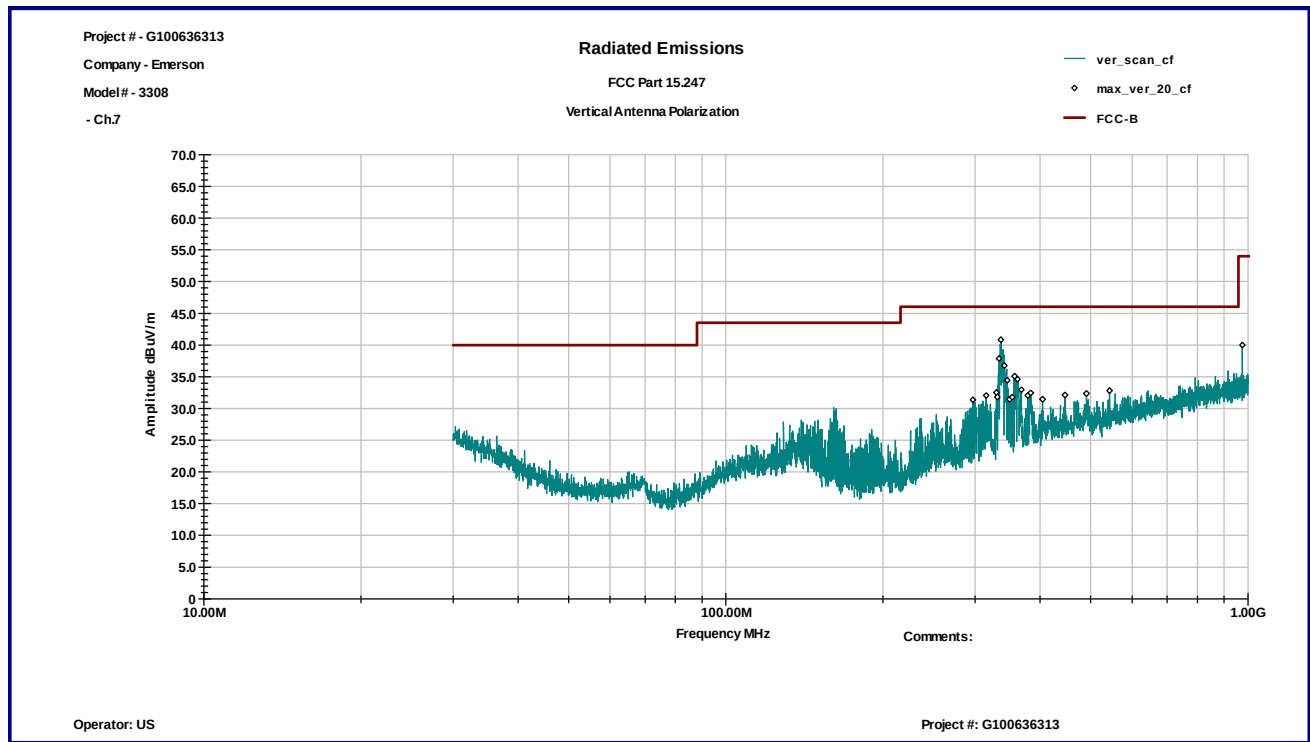
Graph 3.5.6



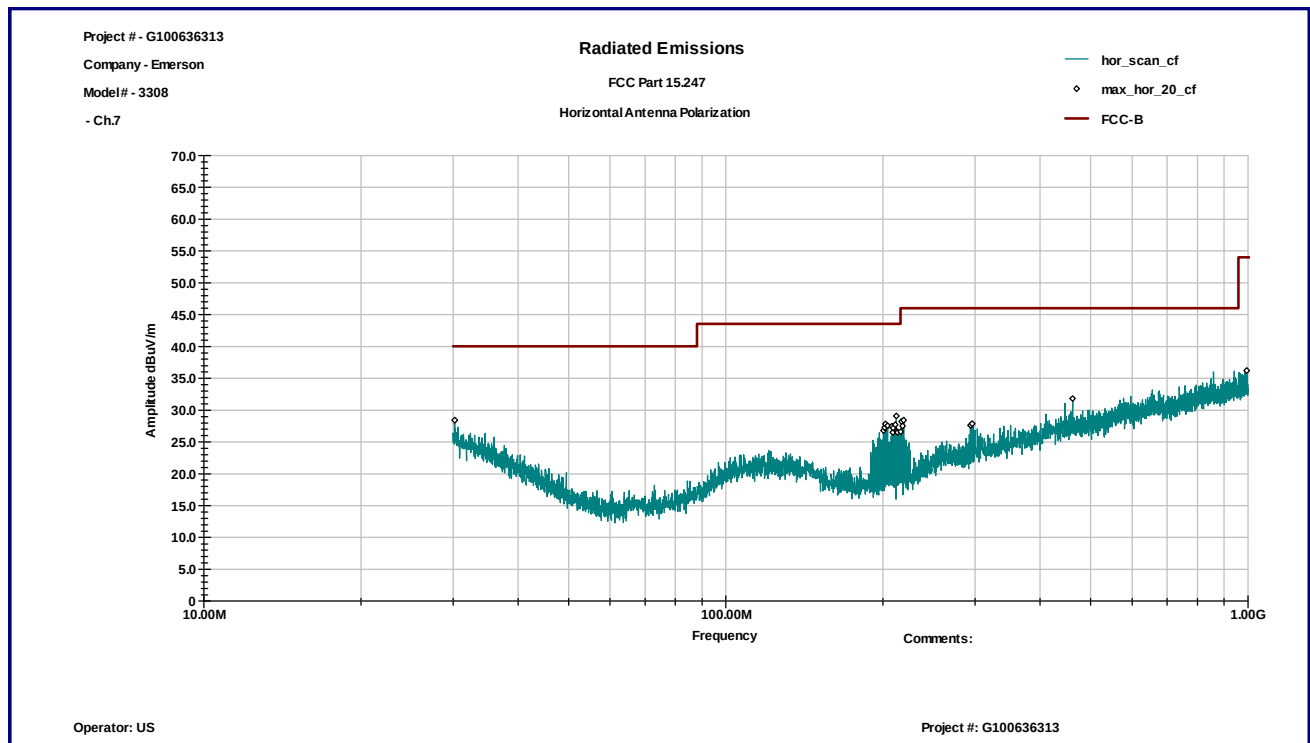
Graph 3.5.7



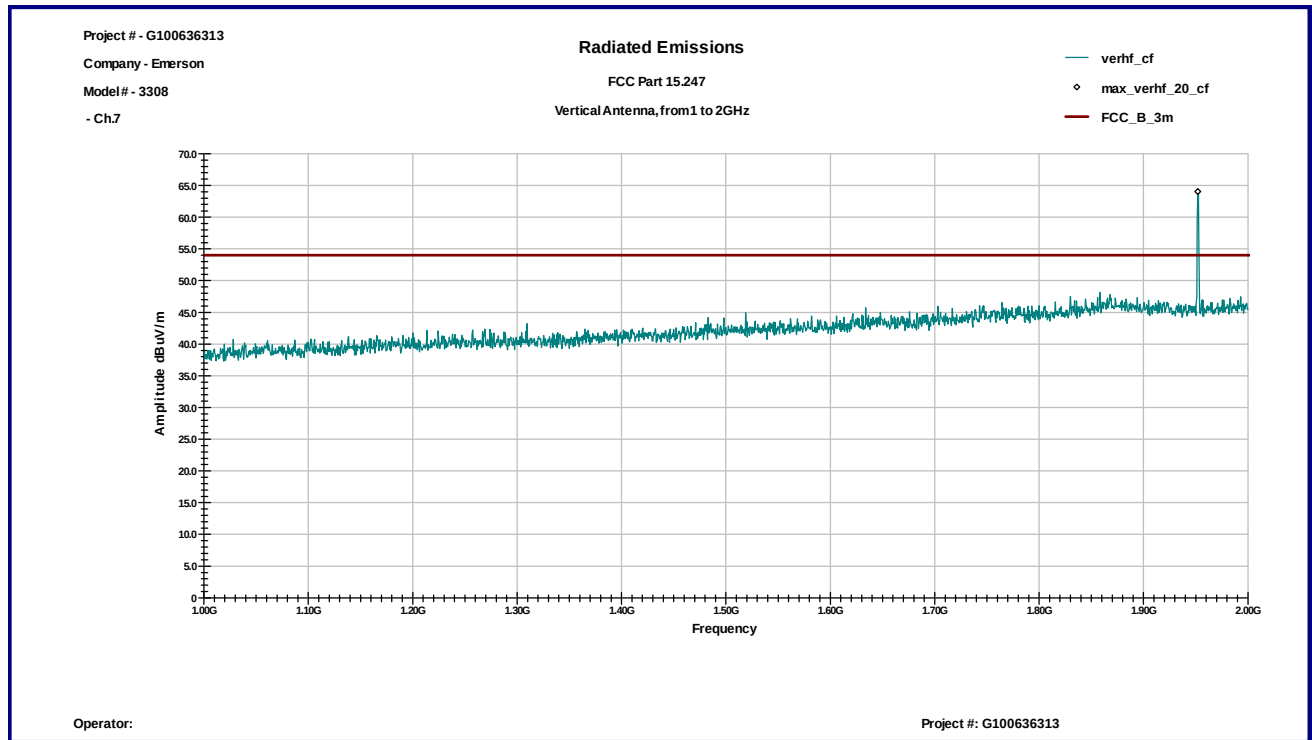
Graph 3.5.8



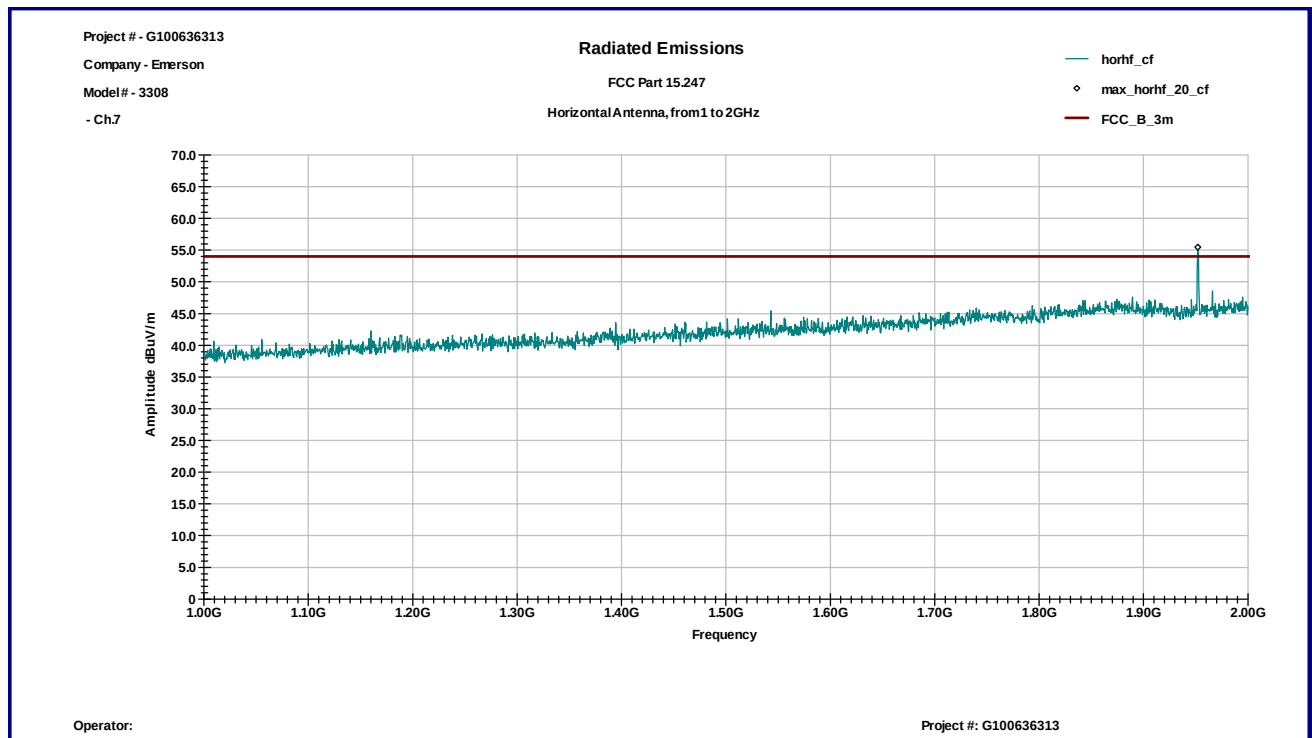
Graph 3.5.9



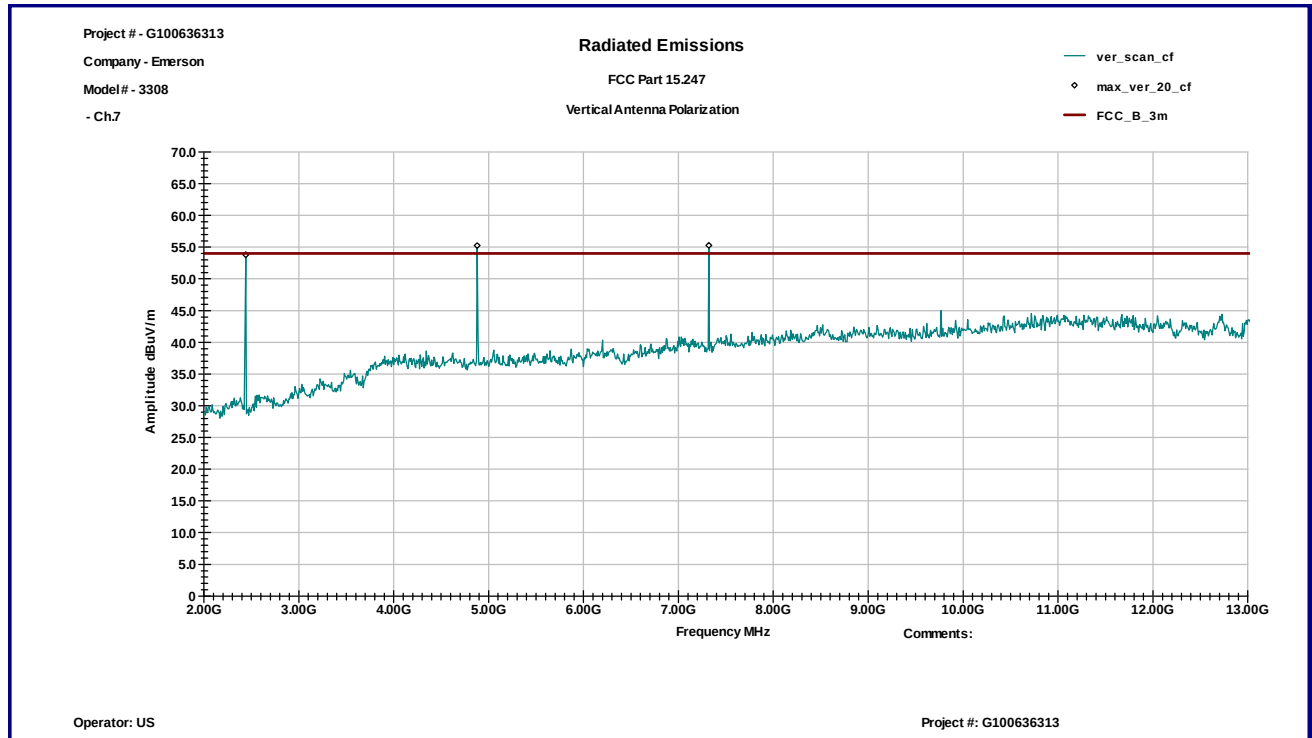
Graph 3.5.10



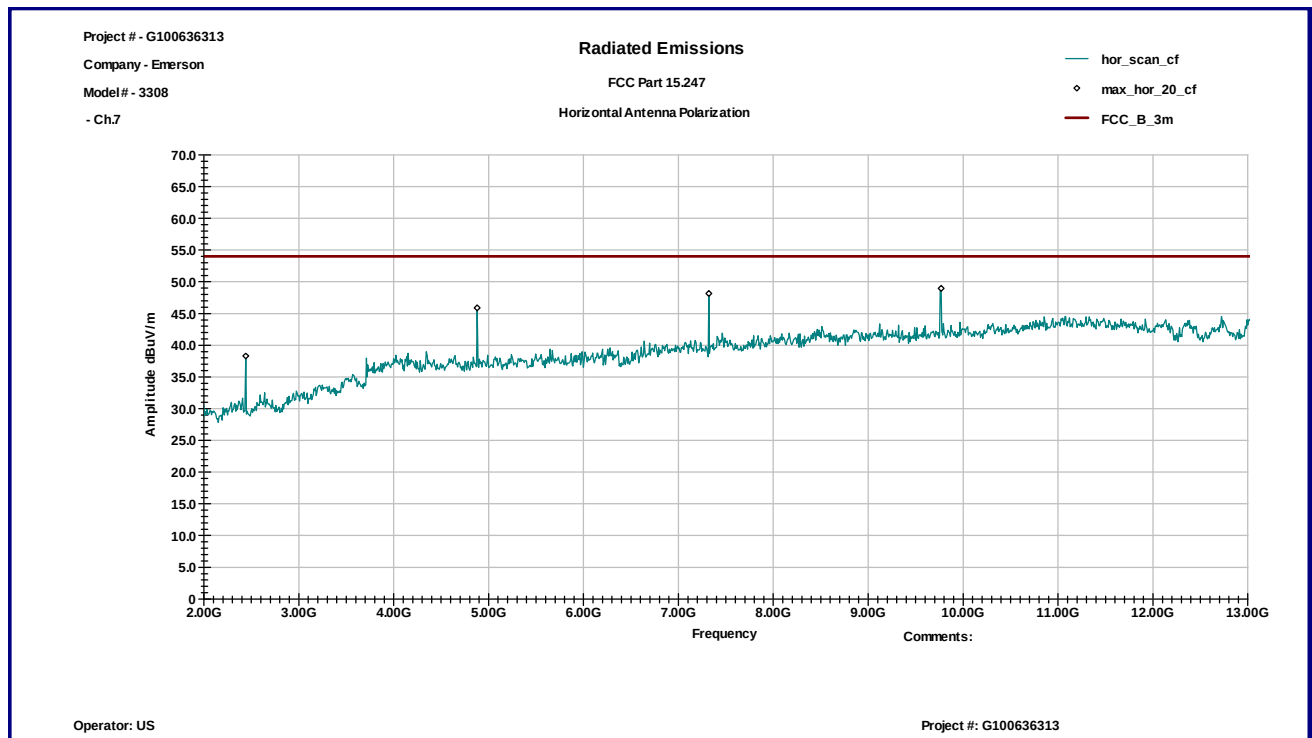
Graph 3.5.11



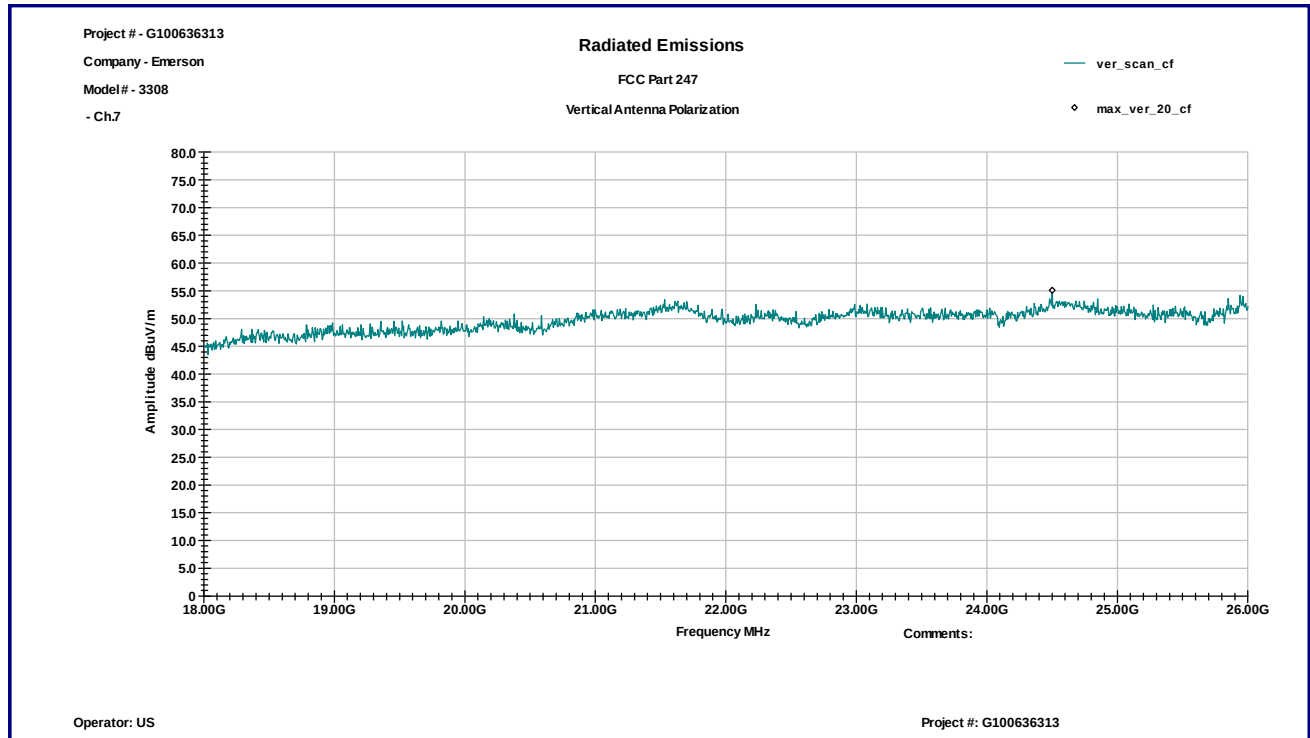
Graph 3.5.12



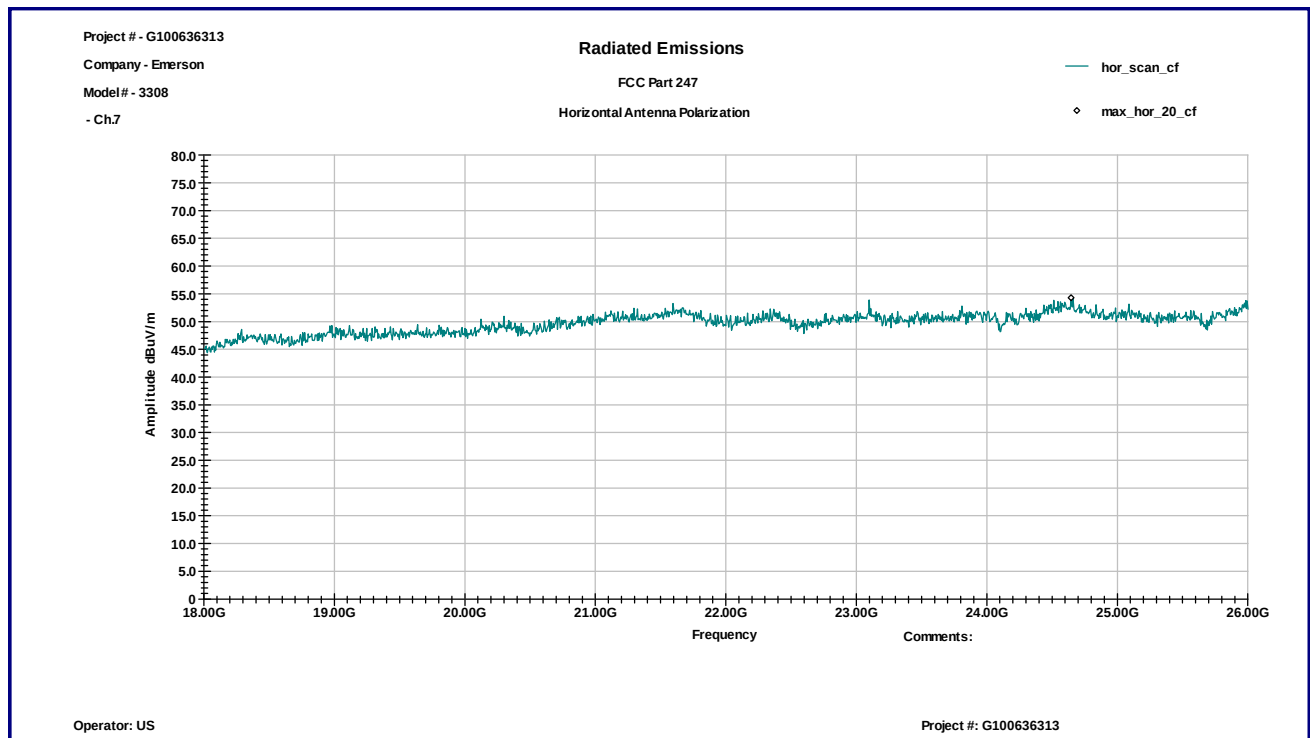
Graph 3.5.13



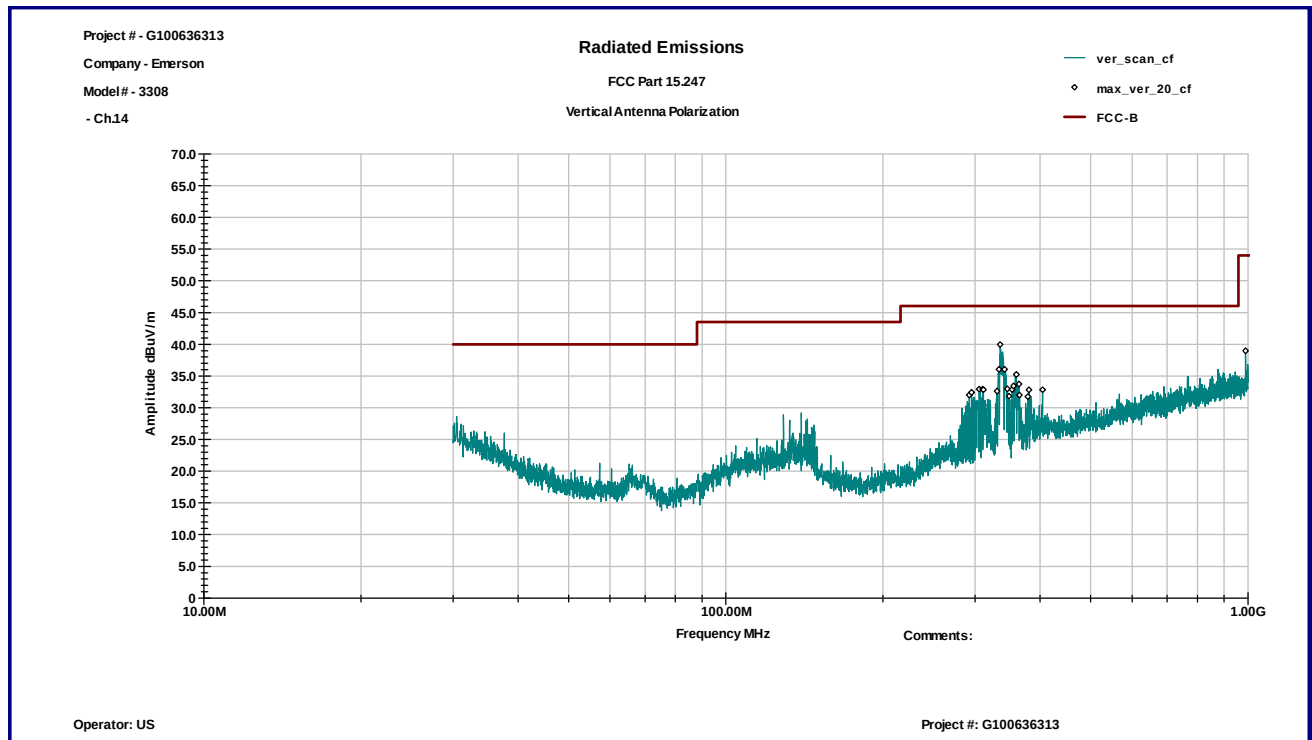
Graph 3.5.14



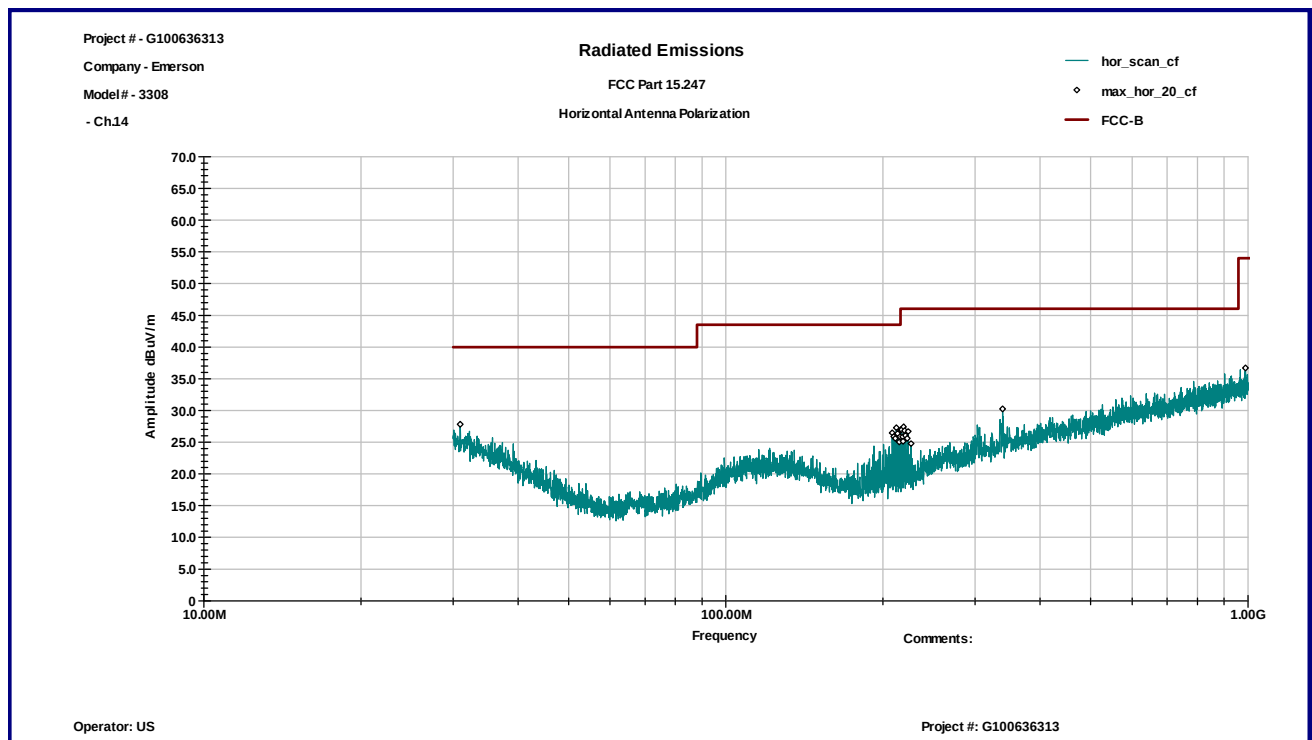
Graph 3.5.15



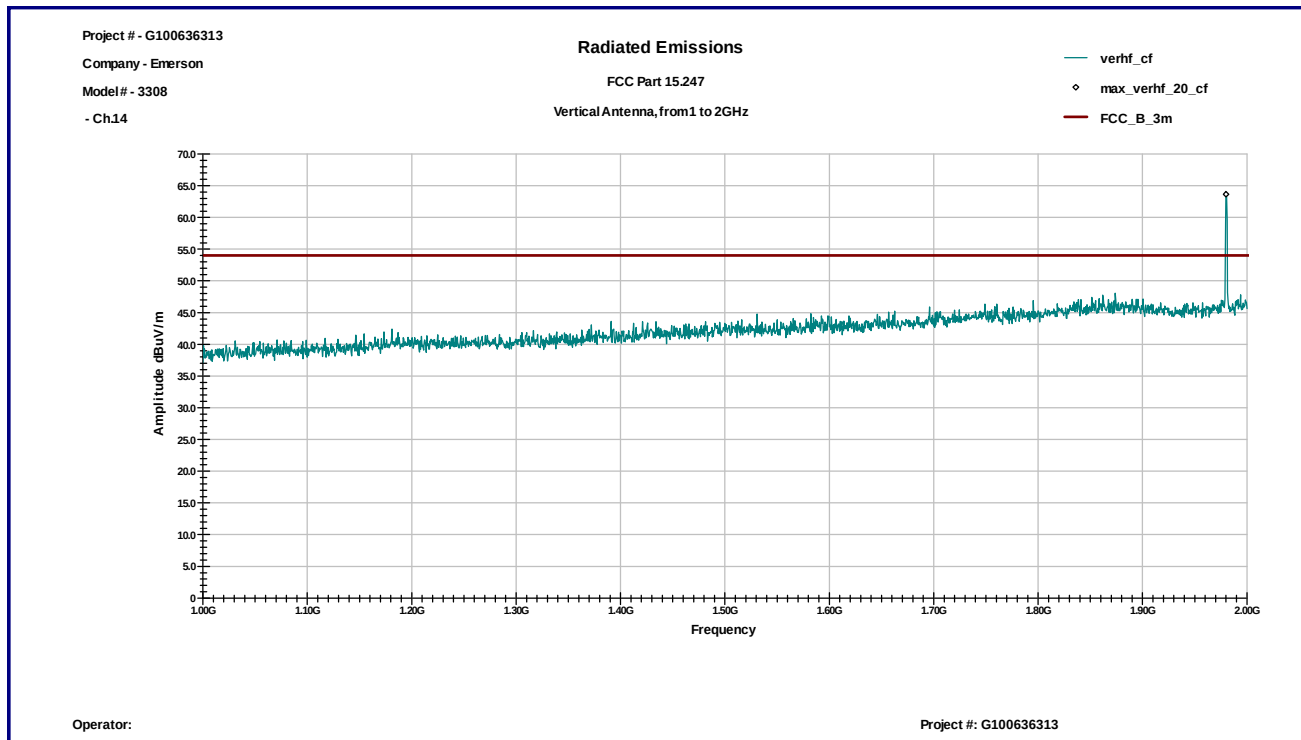
Graph 3.5.16



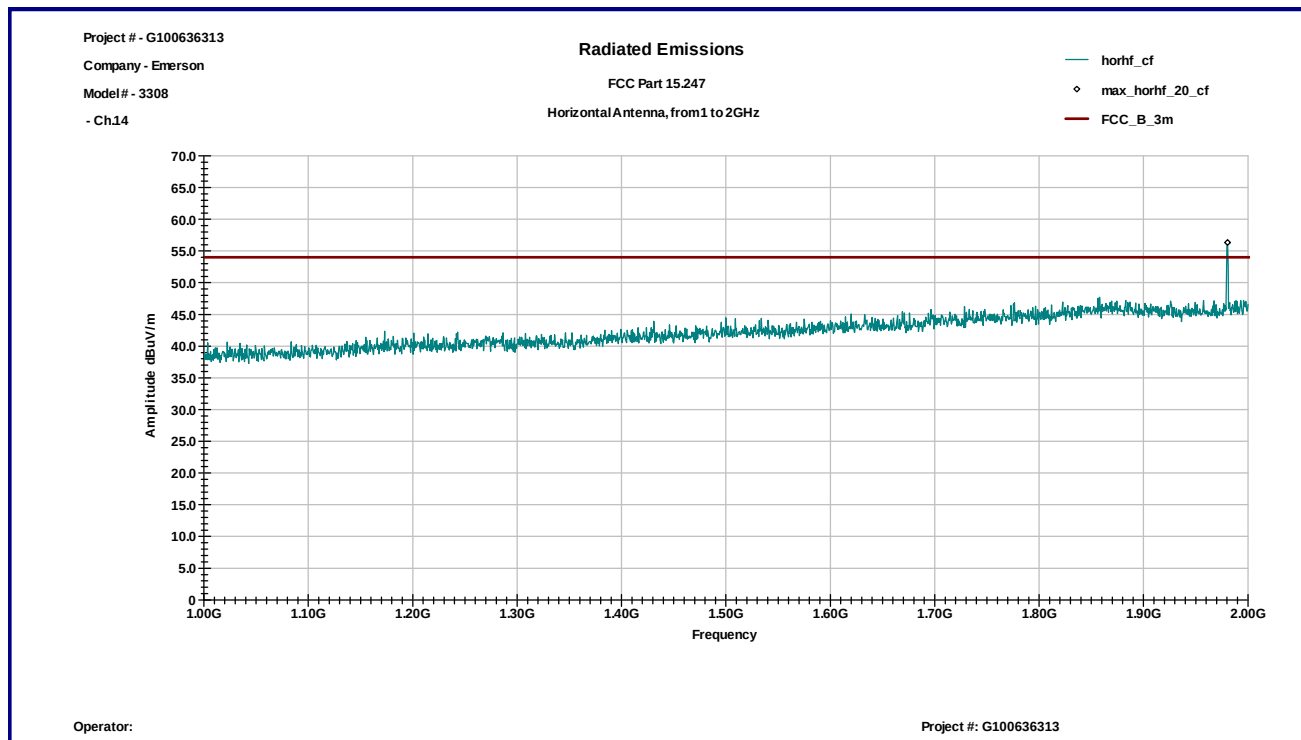
Graph 3.5.17



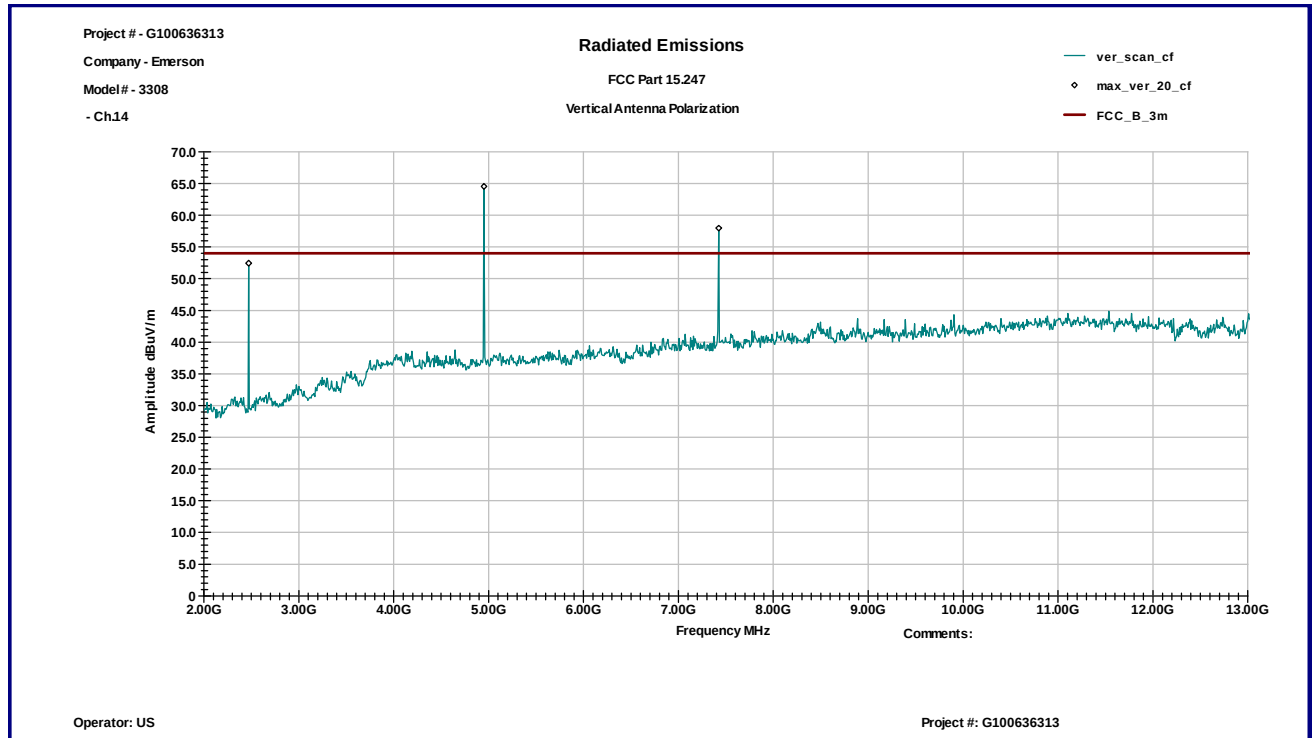
Graph 3.5.18



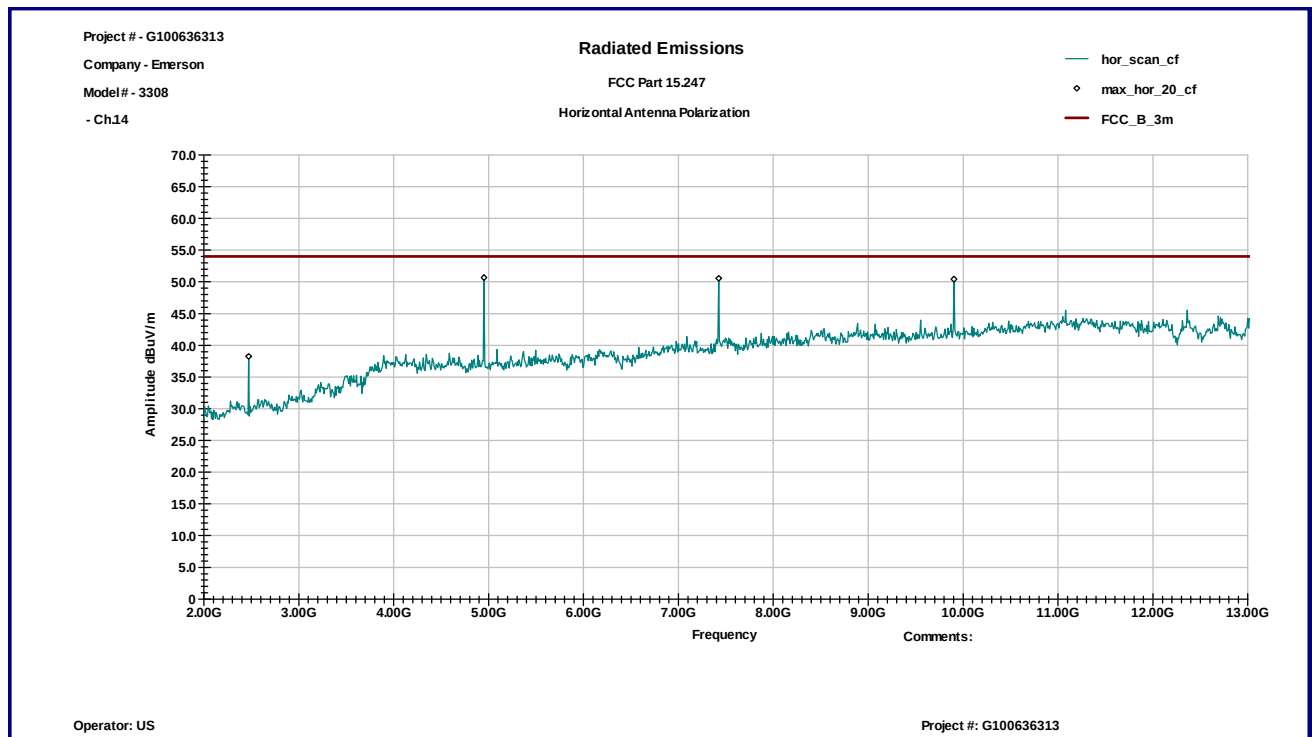
Graph 3.5.19



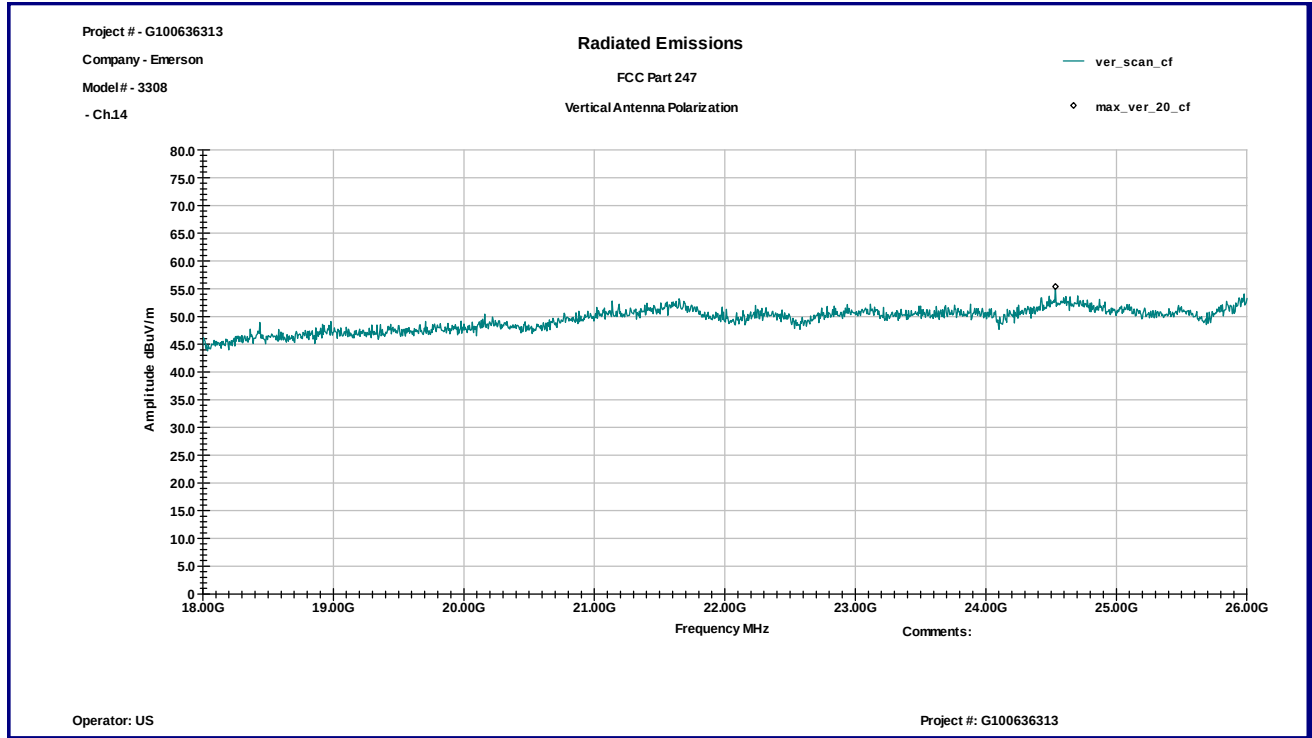
Graph 3.5.20



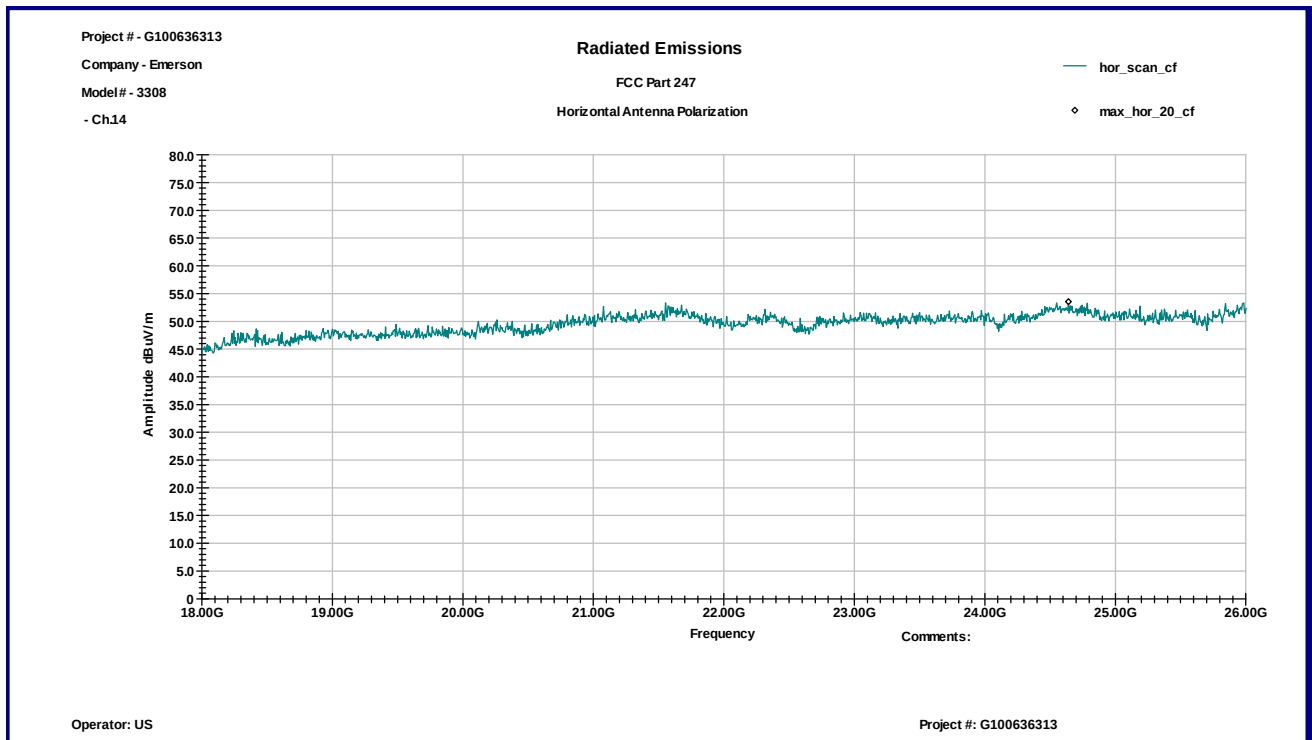
Graph 3.5.21



Graph 3.5.22



Graph 3.5.23



Graph 3.5.24

3.6 RF Exposure Compliance

The maximum measured antenna conducted power, P is 7.9dBm

The antenna gain, G is 4.5dBi

The maximum EIRP power = P + G

ERP = 7.9+ 4.5= 12.4dBm, or 0.01734W

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

The Power Density is related to EIRP with the equation:

$S = \text{EIRP} / 4\pi D^2$, or $10 = 0.01734 / 4\pi D^2$,

The minimum safe separation distance, D = 1.17cm, which is below 20cm



3.7 Transmitter power line conducted emissions

Test result: N/A

Frequency range: 0.15MHz-30MHz

Max. Emissions margin:  dB below the limits

Notes: It was determined from consideration of the electrical characteristics and usage of particular apparatus that Conducted Emissions testing is inappropriate and therefore unnecessary (as battery operated equipment).



3.8 Receiver/digital device radiated emissions

Test location: ☐ OATS ☒ Anechoic Chamber

Test distance: ☐ 10 meters ☒ 3 meters

Test result: **Pass**

Frequency range: 30MHz-13000MHz

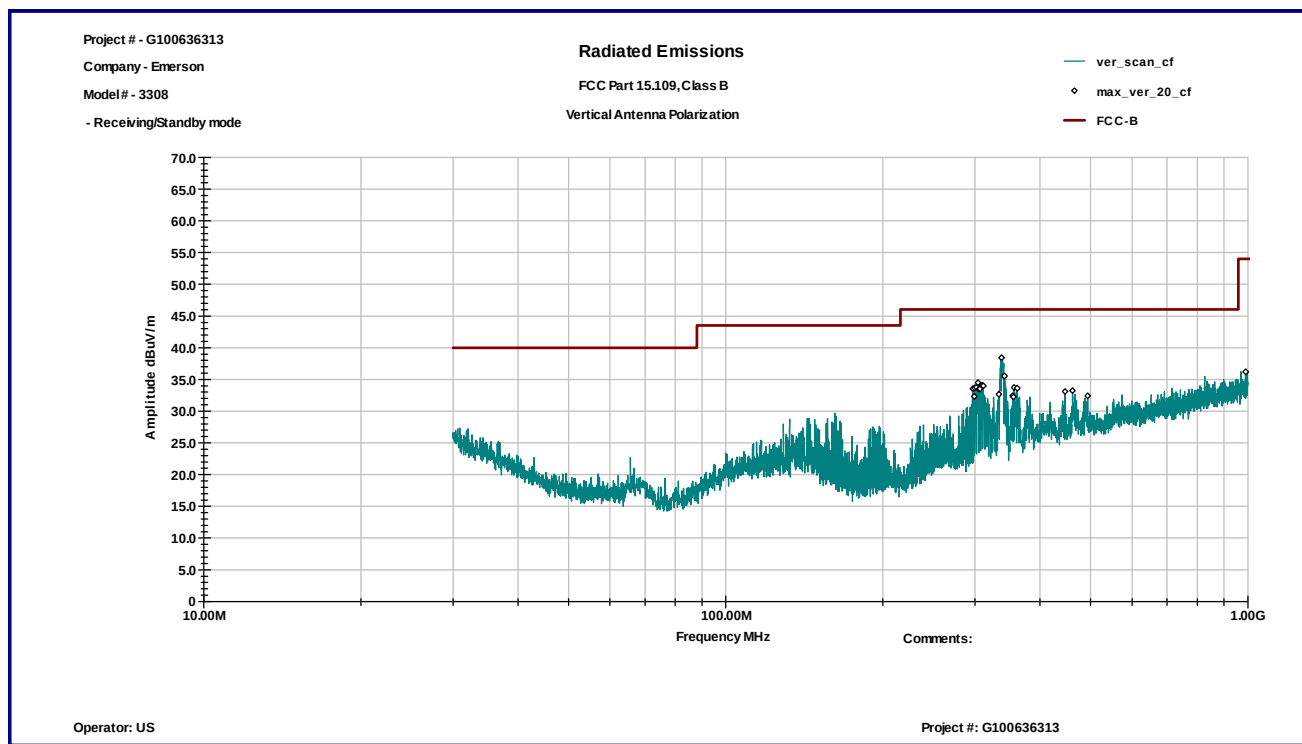
Max. Emissions margin: 7.6dB below the limits

Notes: The Radiated Emissions test was performed in the Anechoic chamber at 3m measurement distance (see Table 3.8.1 and Graphs 3.8.1-3.8.4).

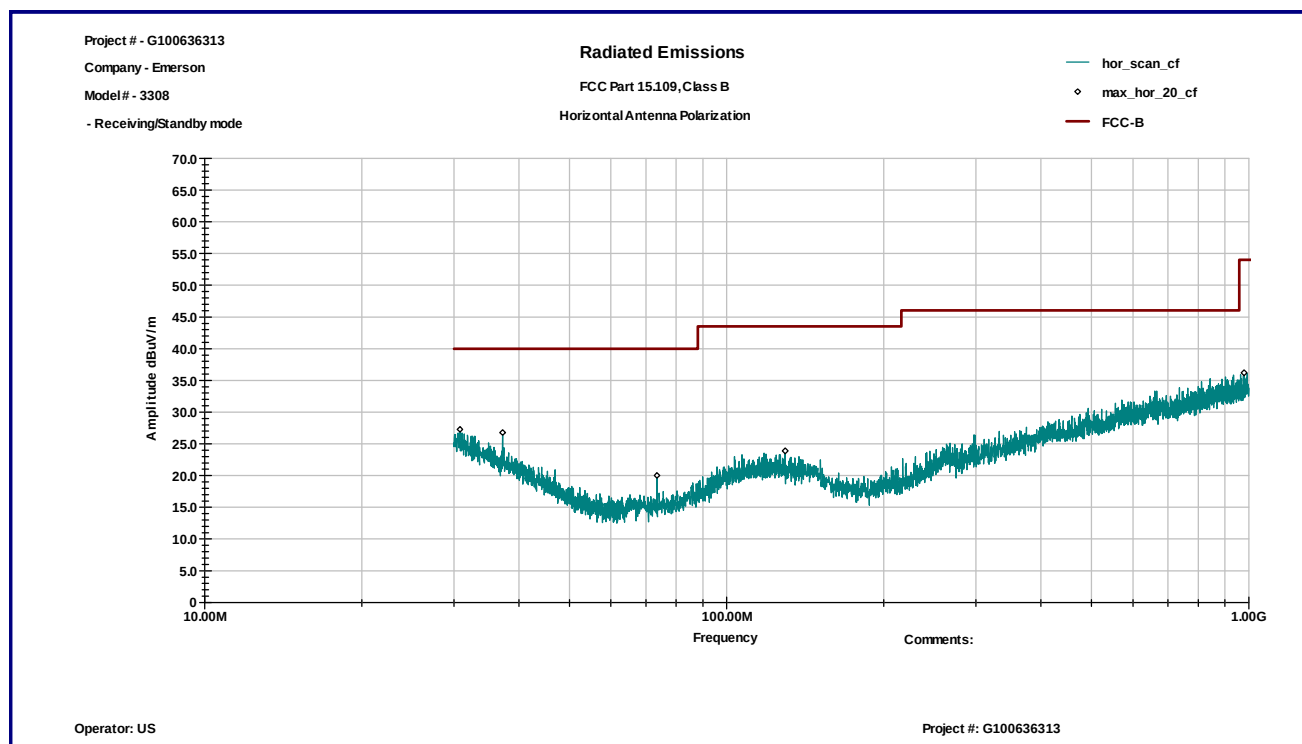
Date:	February 7, 2012	Result: Pass
Standard:	FCC Part 15.109, Class B	
Tested by:	Uri Spector	
Test Point:	Enclosure	
Operation mode:	Receiving Mode	
Note:	None	

Table 3.8.1

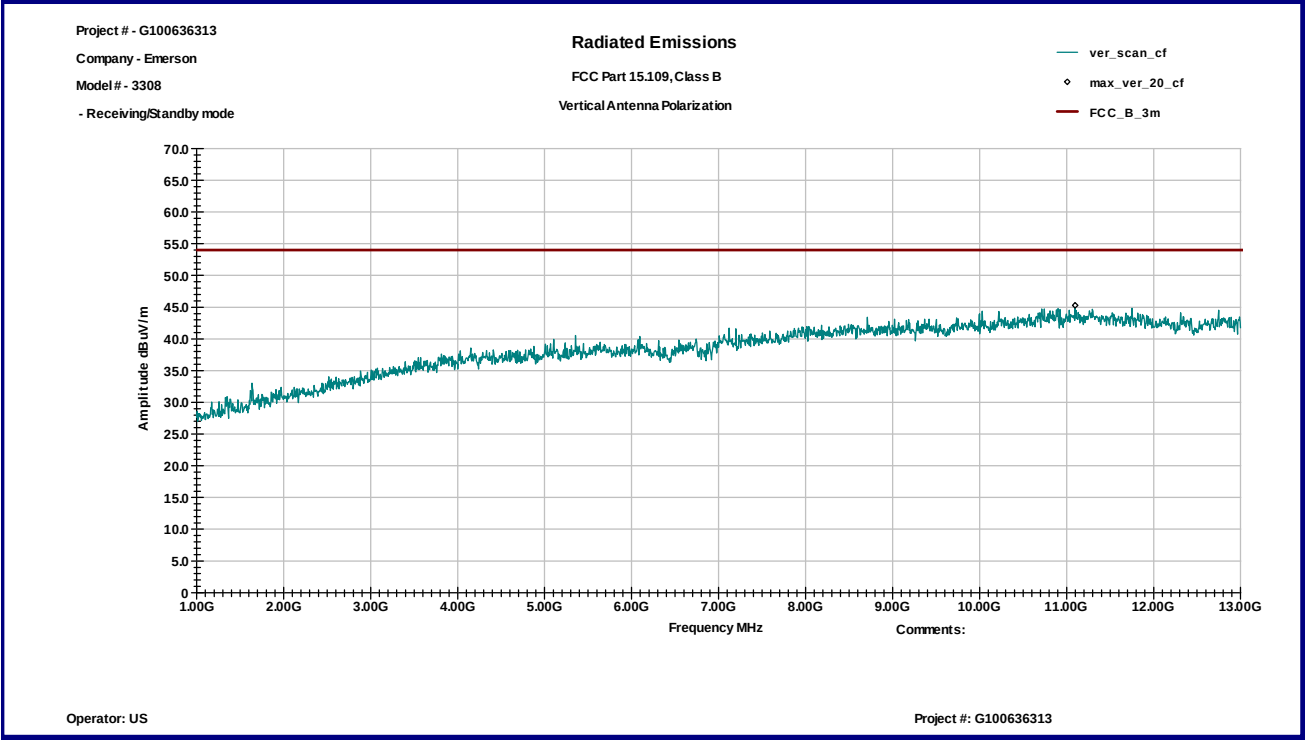
Frequency	Ant. Polarity	Peak Reading dBμV	Ant.Factor dB1/m	Total at 3m dBμV/m	Limit dBμV/m	Margin dB
304.16 MHz	V	18.4	16.0	34.5	46.0	-11.5
311.43 MHz	V	17.7	16.3	34.0	46.0	-12.0
333.59 MHz	V	15.8	16.8	32.7	46.0	-13.4
337.4 MHz	V	21.5	16.9	38.4	46.0	-7.6
341.91 MHz	V	18.5	17.0	35.5	46.0	-10.5
446.5 MHz	V	13.5	19.6	33.1	46.0	-12.9
461.39 MHz	V	13.3	19.9	33.2	46.0	-12.8
493.6 MHz	V	11.6	20.8	32.4	46.0	-13.6
30.831 MHz	H	7.4	19.9	27.3	40.0	-12.7
37.204 MHz	H	10.5	16.3	26.8	40.0	-13.2
73.512 MHz	H	12.2	7.8	20.0	40.0	-20.0
129.4 MHz	H	10.1	13.8	23.9	43.5	-19.6



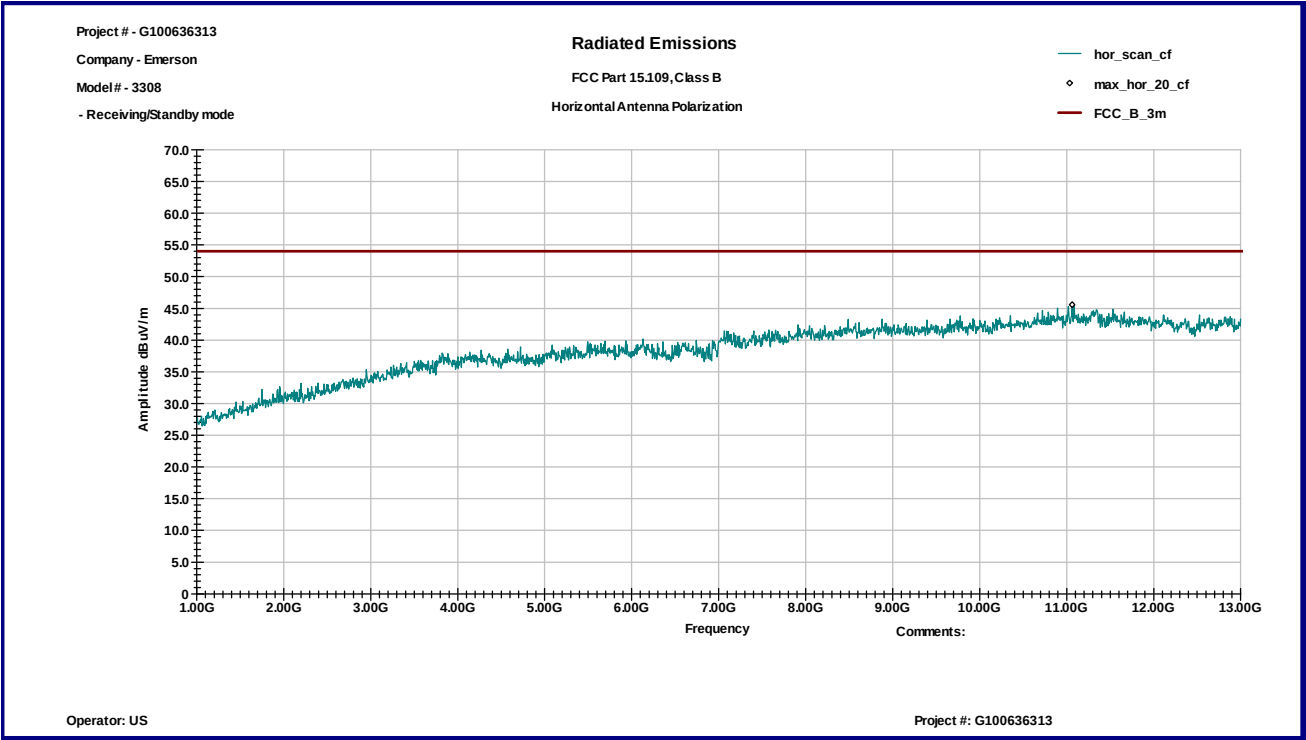
Graph 3.8.1



Graph 3.8.2



Graph 3.8.3



Graph 3.8.4



3.9 Digital device conducted emissions

Test result: N/A

Frequency range: 0.15MHz-30MHz

Max. Emissions margin:  dB below the limits

Notes: It was determined from consideration of the electrical characteristics and usage of particular apparatus that Conducted Emissions testing is inappropriate and therefore unnecessary (as battery operated equipment).



4.0 TEST EQUIPMENT

DESCRIPTION	MANUFACTURER	MODEL	SERIAL NO.	INTERTEK ID	CAL DUE	USED
Spectrum Analyzer	R & S	FSP 40	100024	12559	11/17/2012	☒
Spectrum Analyzer	R & S	ESU	100398	25283	12/09/2012	☒
Bicono-Log Antenna	Schaffner-Chase	CBL 6112 B	2468	9734	11/08/2012	☒
Pre-Amplifier	MITEQ	AMF-5D-00501800-28-13P	1402232	172081	10/31/2012	☒
Horn Antenna	EMCO	3115	6579	15580	05/25/2012	☒
Pre-Amplifier	MITEQ	AMF-6F-16002600-25-10P	1222383	MIN-0065	10/31/2012	☒
High Pass Filter	Reactel	7HS-4G-S12	0223	015274	VBV	☒
System	TILE! Instrument Control		Ver. 3.4.K.29	15259	VBV	☒