



TEST REPORT

Report Number: 100991914MIN-002

Project Number: G100991914

Testing performed on the
3308A Wireless Guided Wave Radar Level Transmitter
FCC ID: LW23308A
Industry Canada ID: 2731A-3308A

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

Prepared by: U. Spector
Uri Spector

Date: January 14, 2013

Reviewed by: S. Khazon
Simon Khazon

Date: January 14, 2013

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1.0 GENERAL DESCRIPTION

Model:	3308A
Type of EUT:	Wireless Guided Wave Radar Level Transmitter
Serial Number:	N/A
FCC ID:	LW23308A
Industry Canada ID:	2731A-3308A
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:	<input checked="" type="checkbox"/> 47 CFR, Part 15:2010, §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 15:2010, §15.107 and §15.109, Class B <input checked="" type="checkbox"/> ICES-003, Issue 4:2004 <input type="checkbox"/> Other [REDACTED]
Type of radio:	<input checked="" type="checkbox"/> Stand -alone <input type="checkbox"/> Module <input type="checkbox"/> Hybrid
Date Sample Submitted:	February 6, 2012 and December 17, 2012
Test Work Started:	February 6, 2012 and December 17, 2012
Test Work Completed:	February 13, 2012 and January 4, 2013
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:	2.4 – 2.4835GHz Wireless Guided Wave Radar Level Transmitter
Transmitter Type:	<input type="checkbox"/> FHSS <input checked="" type="checkbox"/> Digital Modulation <input type="checkbox"/> WiFi <input type="checkbox"/> 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:	<input type="checkbox"/> User <input type="checkbox"/> Professional <input checked="" type="checkbox"/> Factory
Transmitter power configuration:	<input checked="" type="checkbox"/> Internal battery <input type="checkbox"/> External power source <input type="checkbox"/> 120VAC <input type="checkbox"/> 230VAC <input type="checkbox"/> 400VAC <input checked="" type="checkbox"/> 3.6VDC <input type="checkbox"/> Other: <input type="text"/> <input type="text"/> Amp. <input type="checkbox"/> 50Hz <input type="checkbox"/> 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)
- [REDACTED]

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).

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

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

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

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

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

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

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

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) / RSS-210 A8.4	Maximum peak output power	Pass
15.247(a) / RSS-210 A8.2	6dB bandwidth of the digital modulation system and Emissions Bandwidth	Pass
15.247(e) / RSS-210 A8.2	Power spectral density	Pass
15.247(d) / RSS-210 A8.5	Antenna conducted spurious 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	N/A
15.109 / ICES-003	Receiver/digital device radiated emissions	Pass
15.107 / ICES-003	Digital device conducted emissions	N/A



3.0 TEST CONDITIONS AND RESULTS

3.1 Maximum peak output power

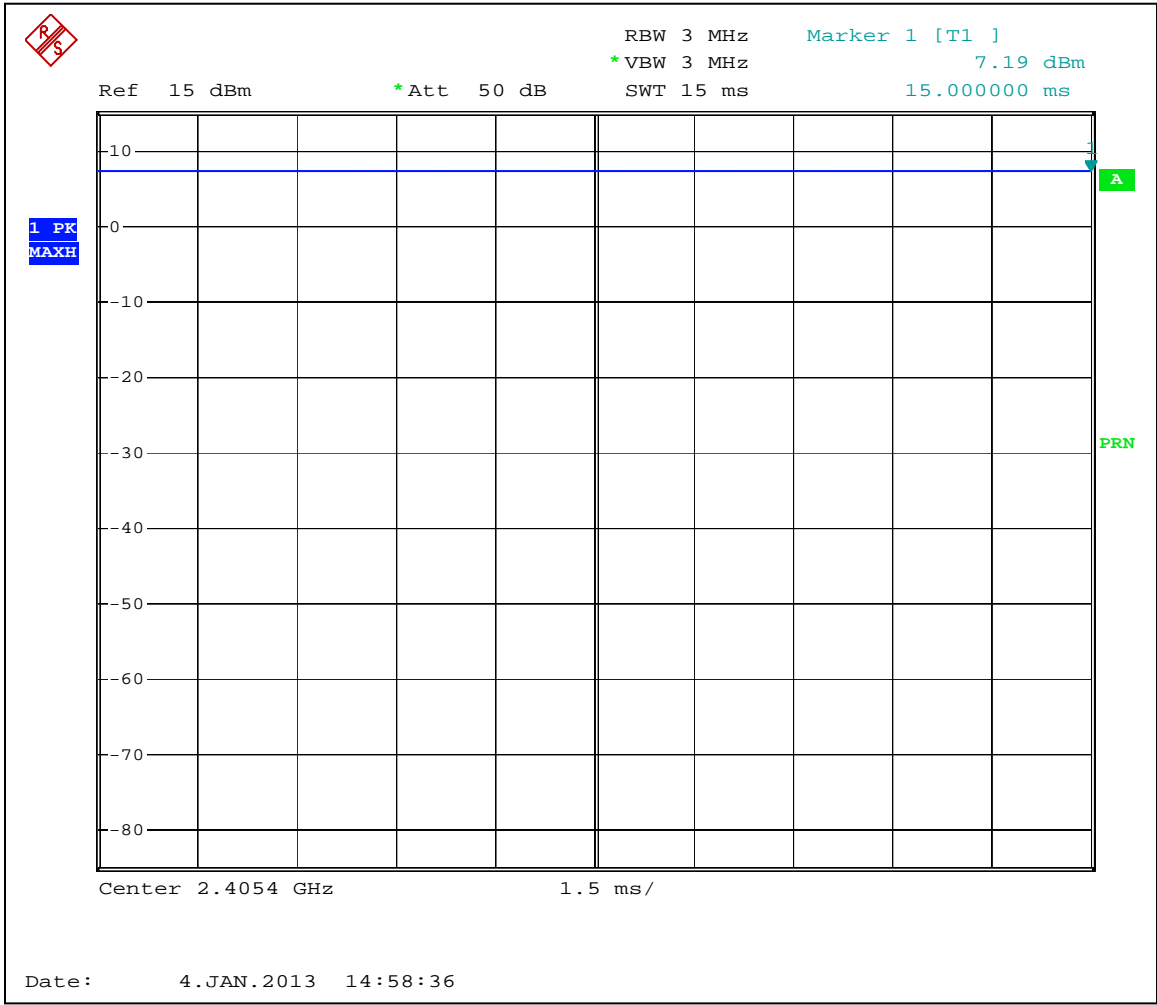
Test location: OATS Anechoic Chamber Other

Test result: **Pass**

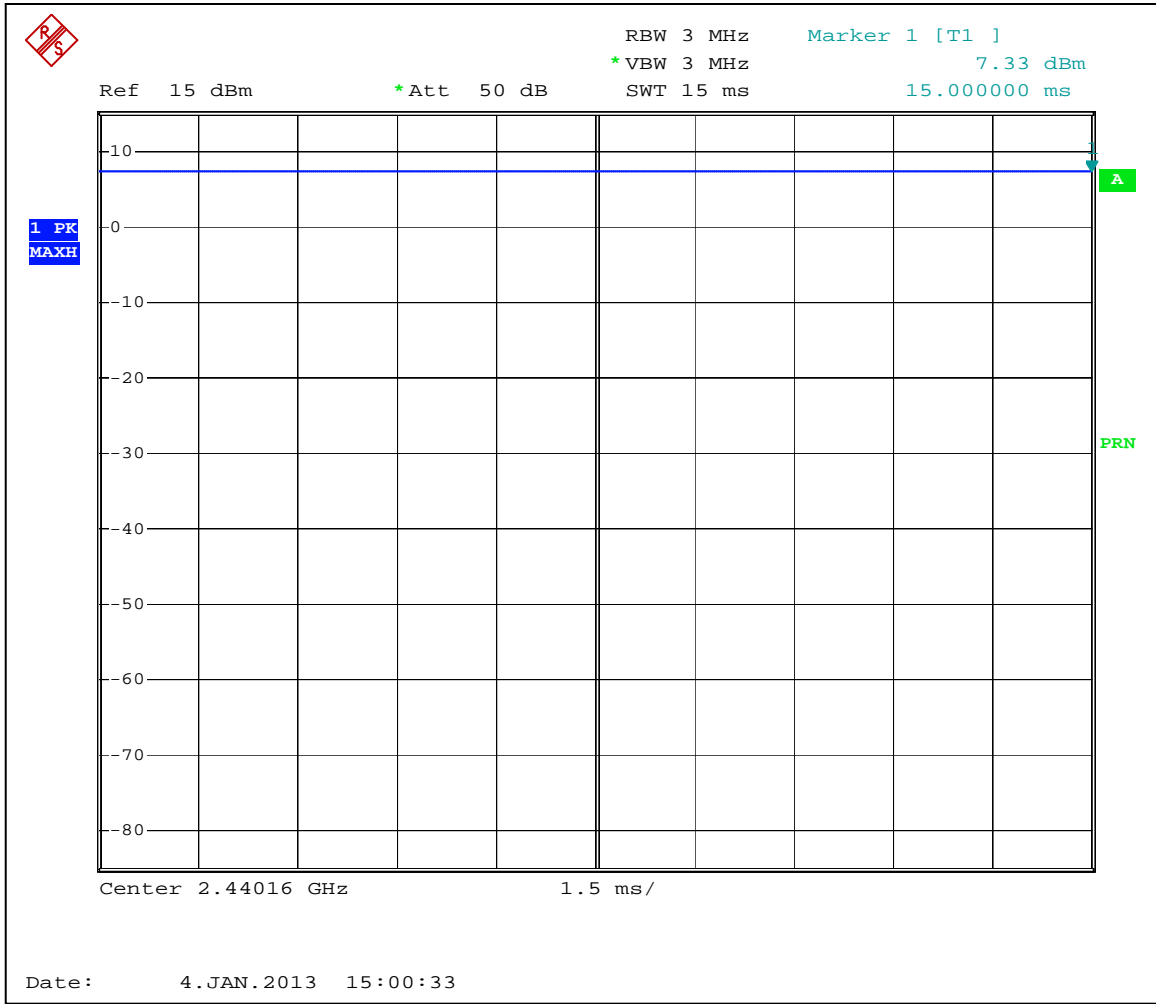
Max. Margin: 22.1dB below the limits

Power Output:	Conducted					
Frequency Range:	<input type="checkbox"/> 902-928MHz		<input checked="" type="checkbox"/> 2400-2483.5MHz		<input type="checkbox"/> 5725-5850MHz	
Low Frequency MHz	Measured power dBm	Attenuation dB	Power at Antenna dBm	Limit dBm	Limit Reduction dB	Margin dB
2405.4	7.2	1.3	8.5	30	0	-21.5
Middle Frequency MHz						
2440.2	7.3	1.3	8.6	30	0	-21.4
Upper Frequency MHz						
2475.0	6.6	1.3	7.9	30	0	-22.1
RBW:	<input type="checkbox"/> 1MHz	<input checked="" type="checkbox"/> 3MHz	<input type="checkbox"/> 10MHz			
VBW:	<input type="checkbox"/> 1MHz	<input checked="" type="checkbox"/> 3MHz	<input type="checkbox"/> 10MHz			
Antenna Gain:	<input checked="" type="checkbox"/> < 6dBi <input type="checkbox"/> >6dBi <input type="checkbox"/> dBi, Output power reduction = <input type="checkbox"/> dB					

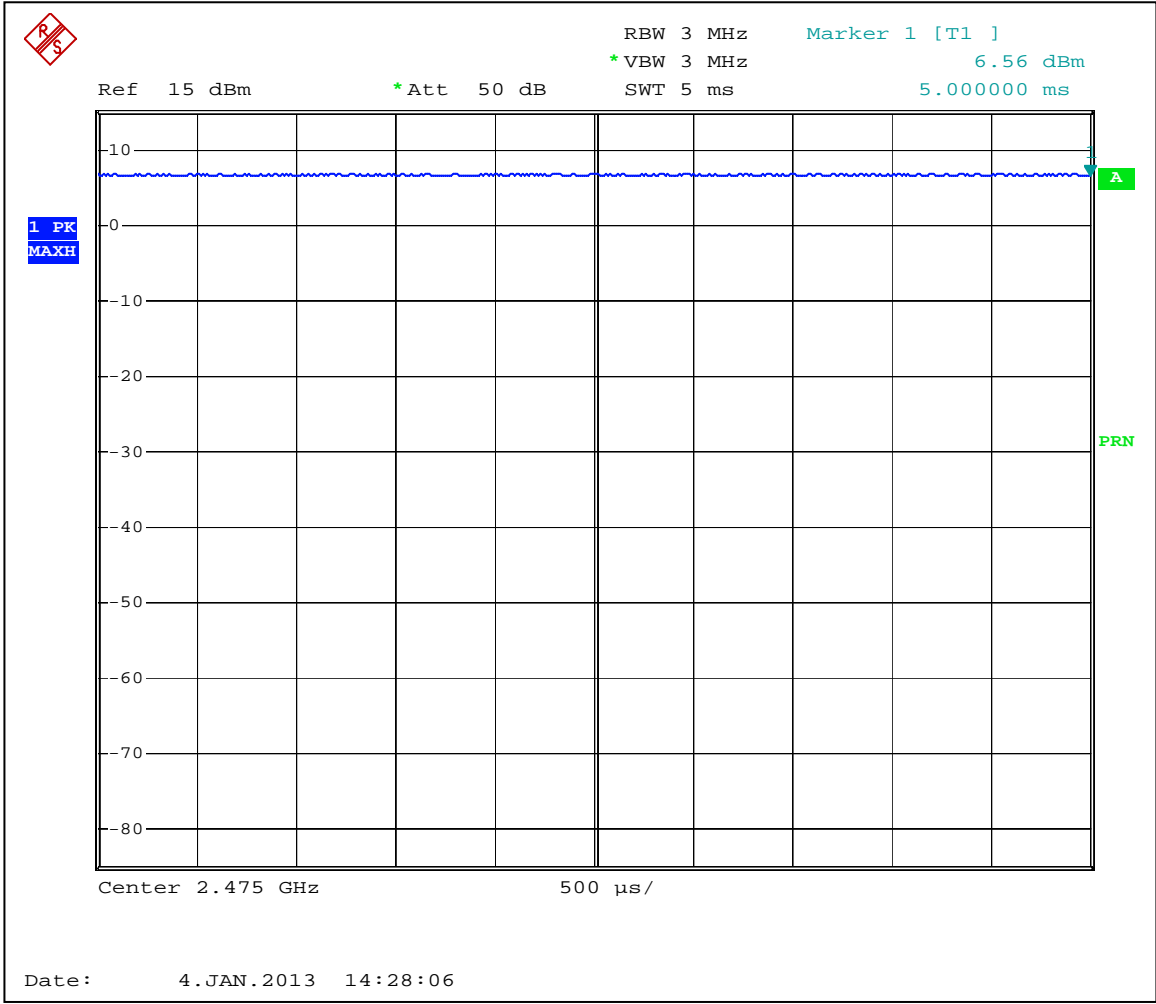
Notes: The maximum peak conducted output power limit is 1 W, or 30dBm
 Graphs 3.1.1 to 3.1.3 show the conducted output power



Graph 3.1.1



Graph 3.1.2



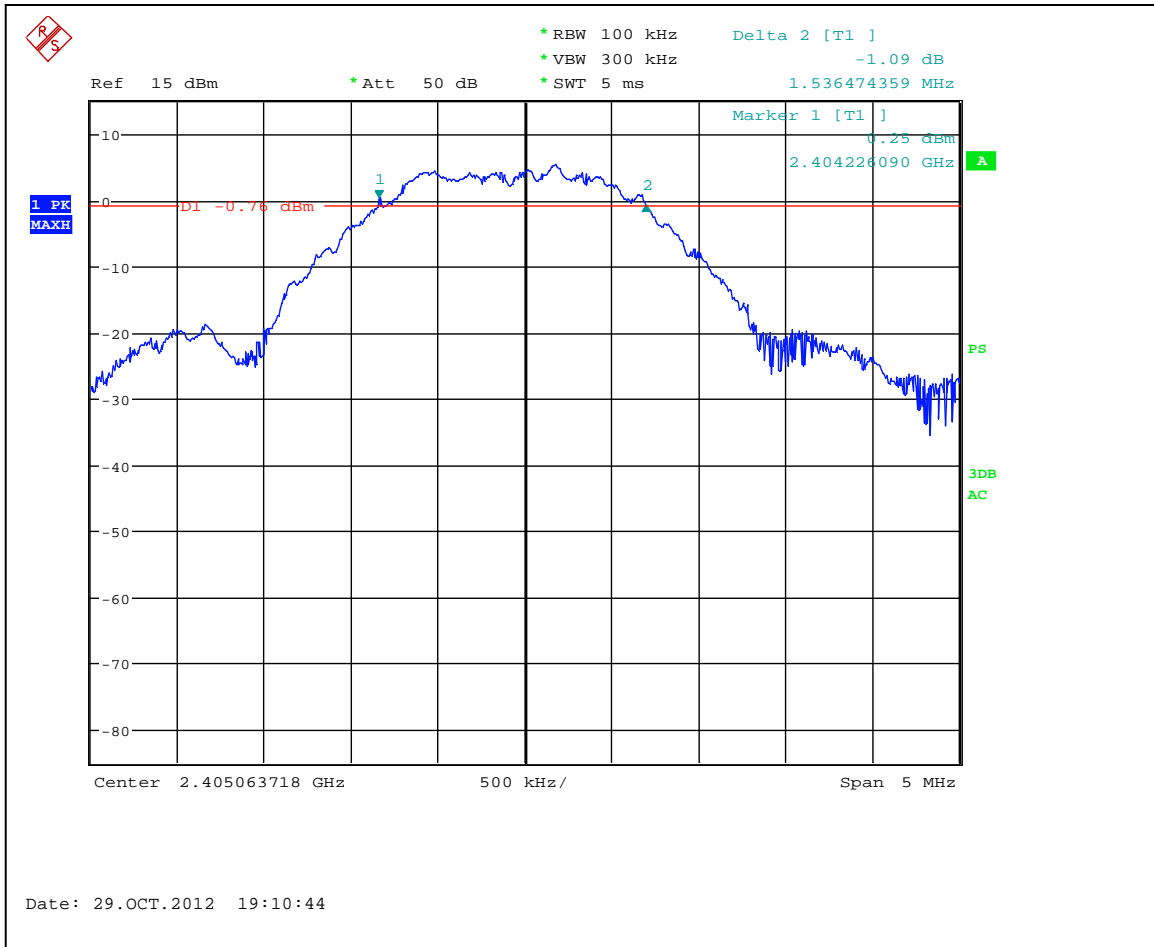
Graph 3.1.3



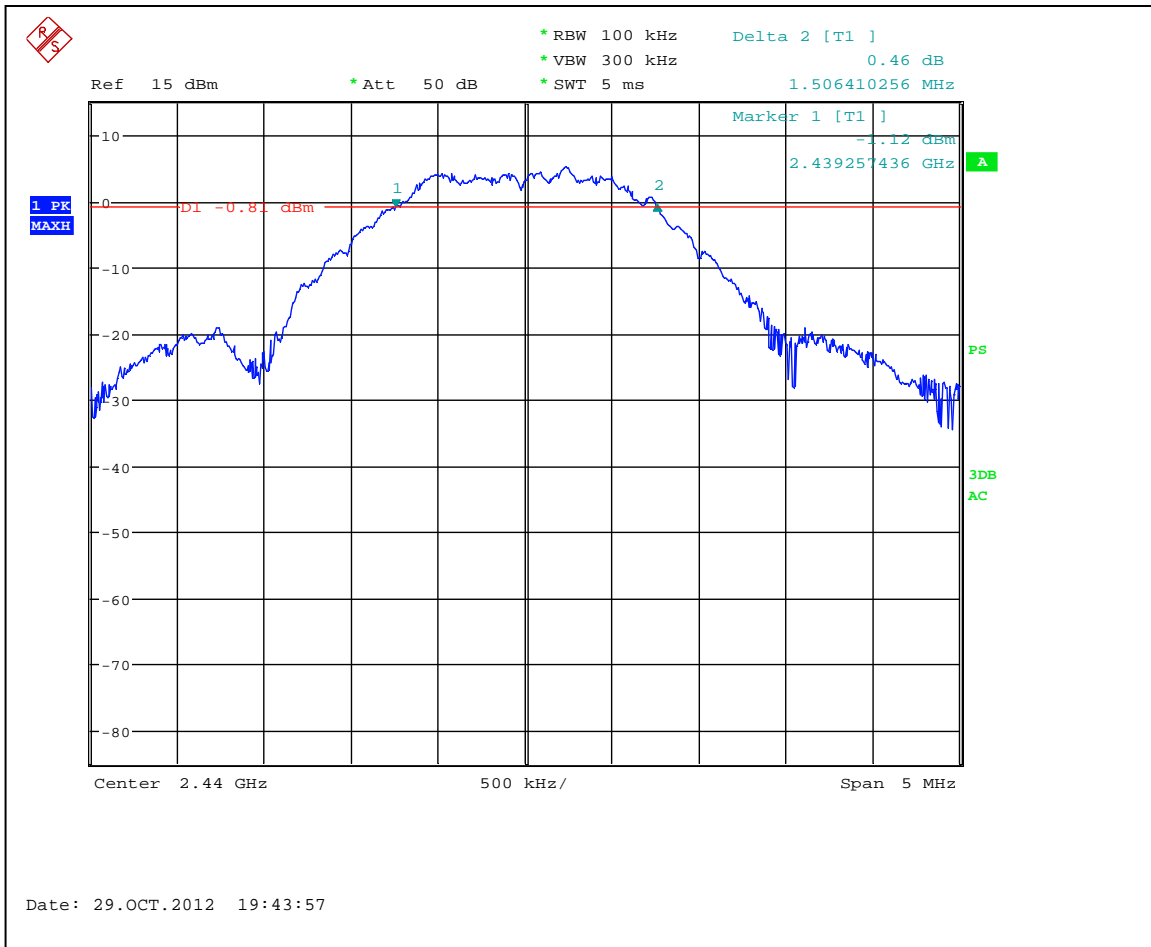
3.2 6dB bandwidth of the digital modulation

Low Frequency Channel kHz	Middle Frequency Channel kHz	Upper Frequency Channel kHz	Minimum Bandwidth kHz	Result
1536.47	1506.41	1578.52	500	Pass
RBW:	<input checked="" type="checkbox"/> 100kHz <input type="checkbox"/> other [redacted] kHz			
VBW:	<input checked="" type="checkbox"/> 300kHz <input type="checkbox"/> 300kHz <input type="checkbox"/> other [redacted] kHz			

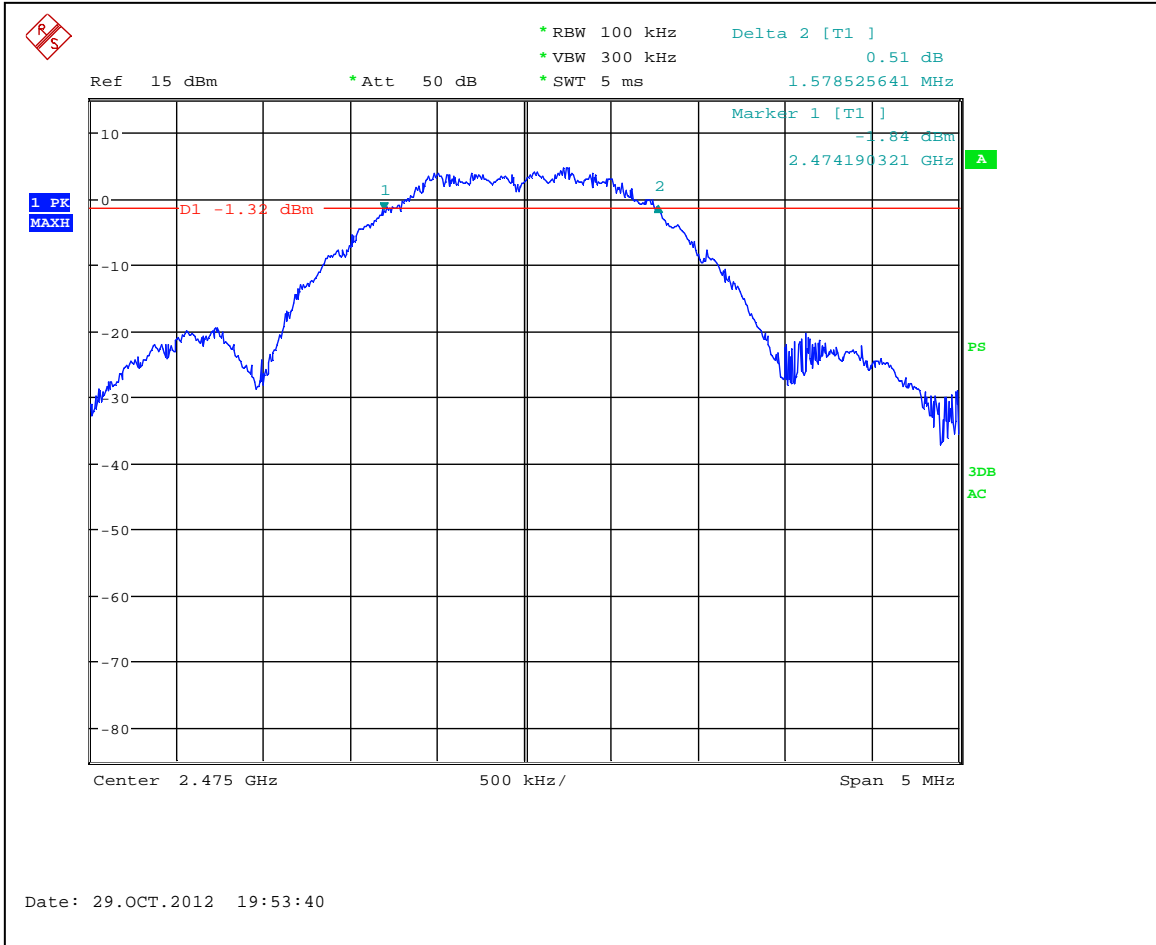
Notes:



Graph 3.2.1



Graph 3.2.2

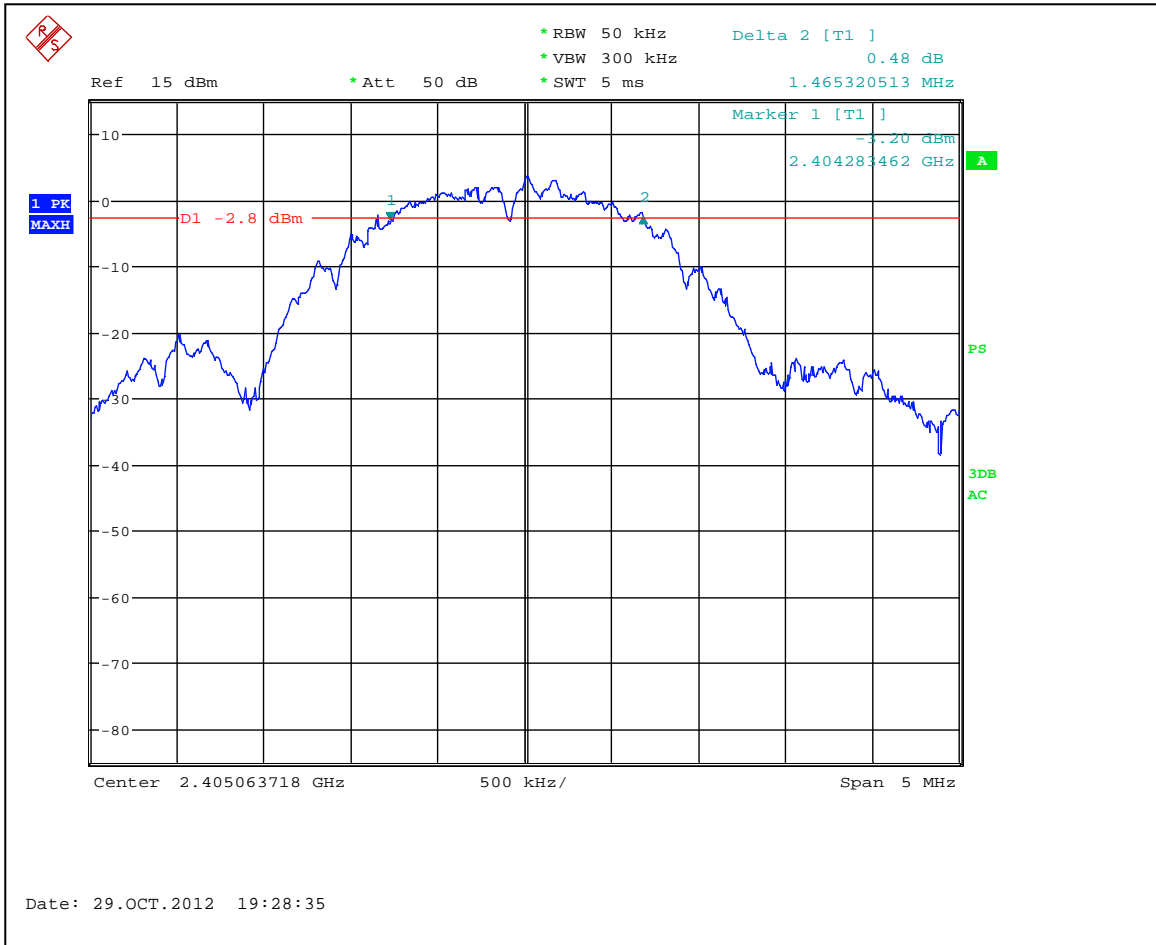


Graph 3.2.3

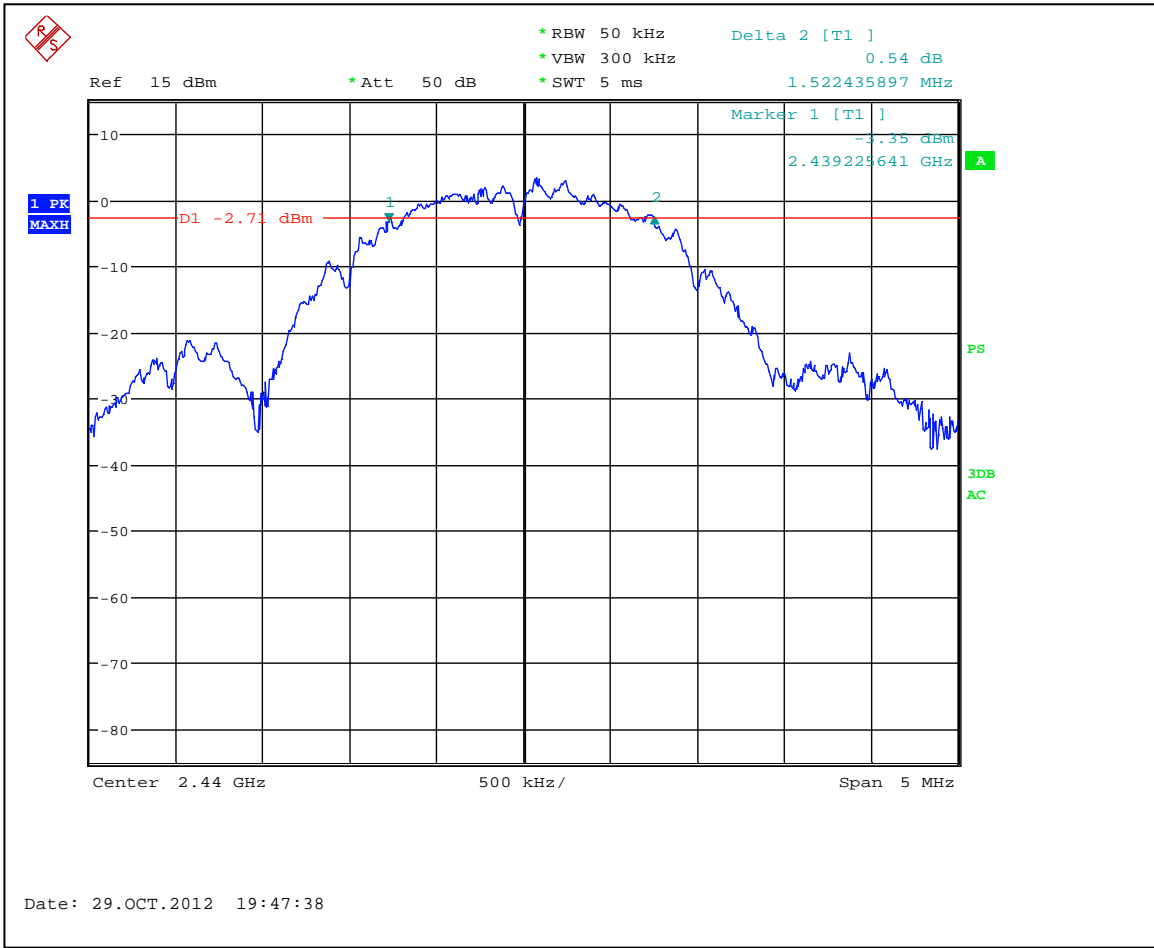


3.2.1 Emission bandwidth (EBW) of the digital modulation

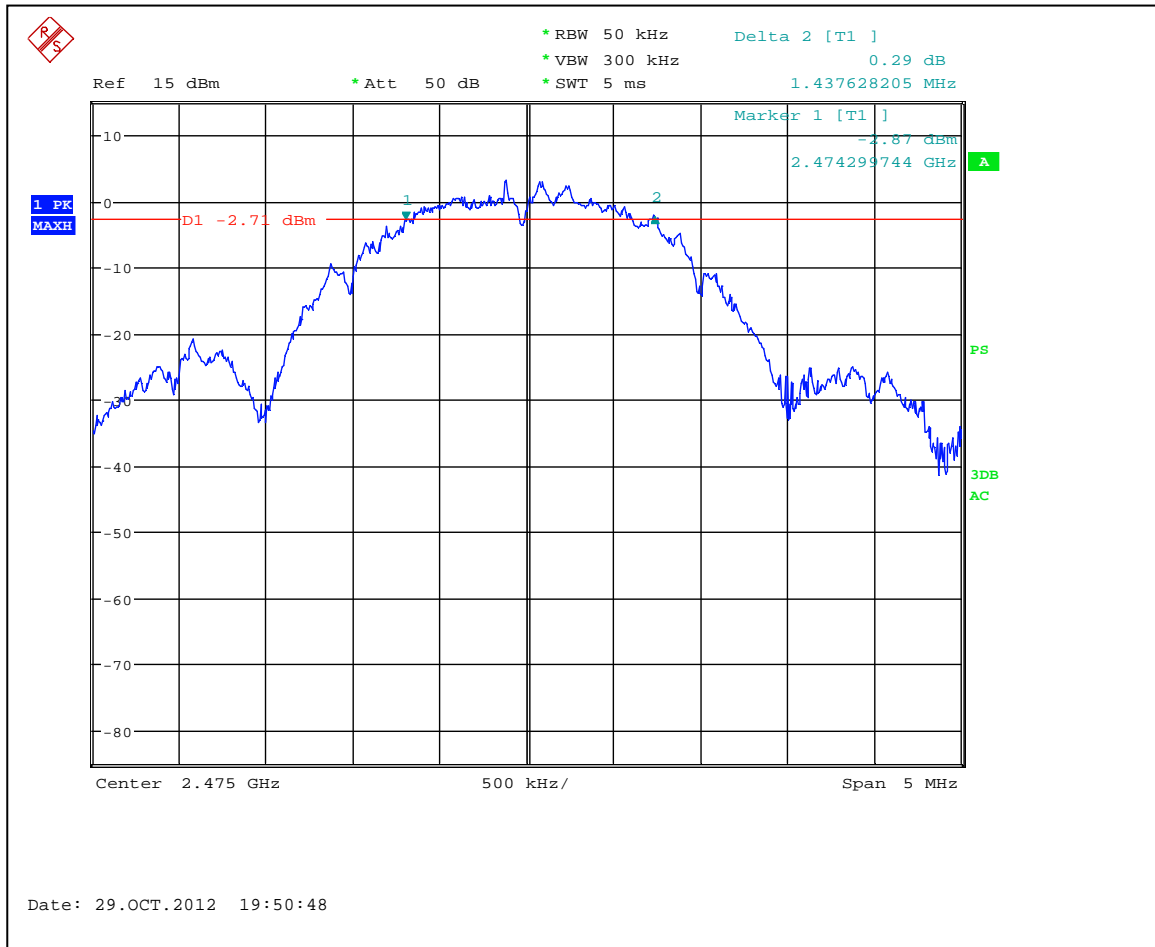
Low Frequency Channel kHz	Middle Frequency Channel kHz	Upper Frequency Channel kHz	Minimum Bandwidth kHz	Result
1465.32	1522.43	1437.62	500	Pass
RBW:	<input checked="" type="checkbox"/> 50kHz <input type="checkbox"/> other [redacted] kHz			
VBW:	<input checked="" type="checkbox"/> 300kHz <input type="checkbox"/> 300kHz <input type="checkbox"/> other [redacted] kHz			



Graph 3.2.1.1



Graph 3.2.1.2



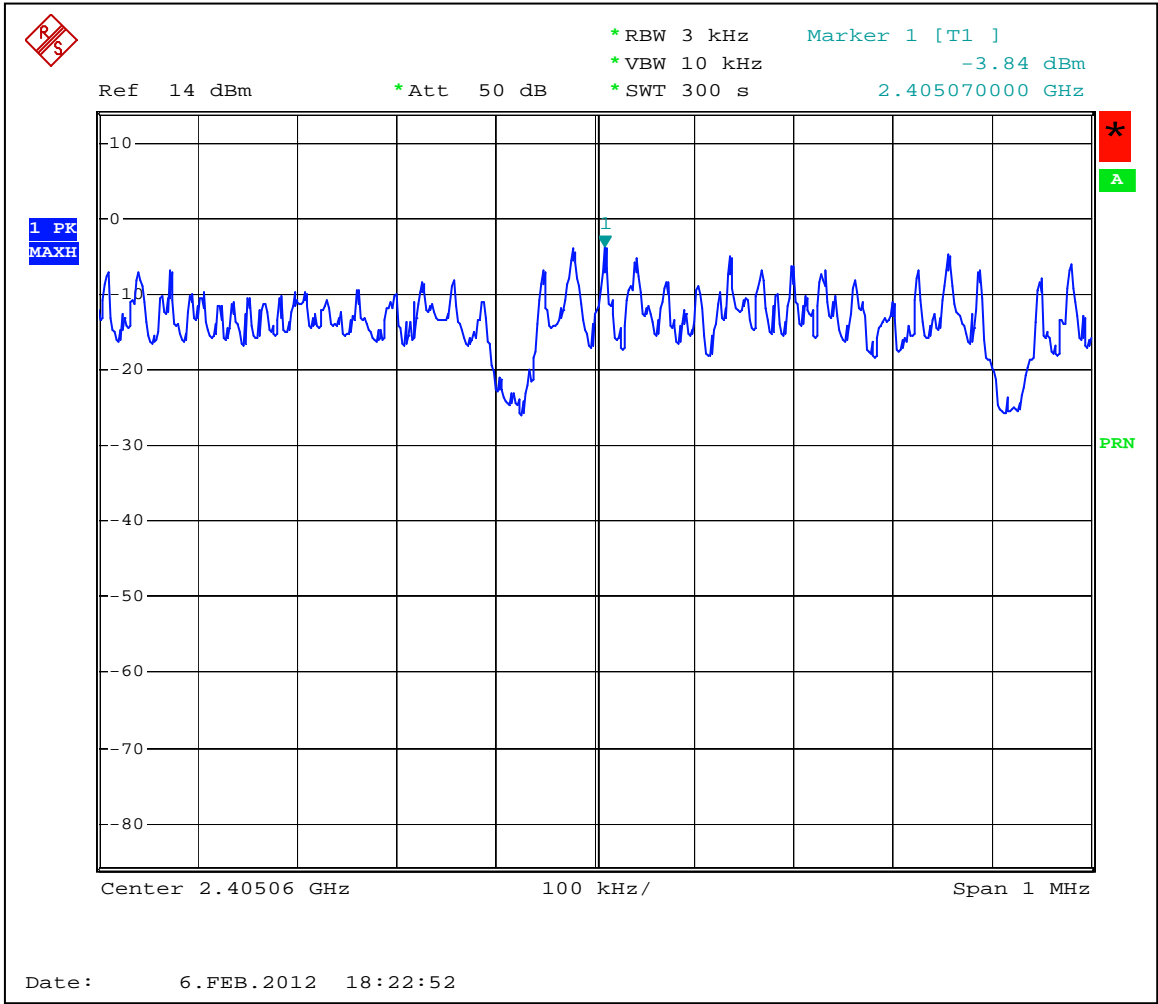
Graph 3.2.1.3



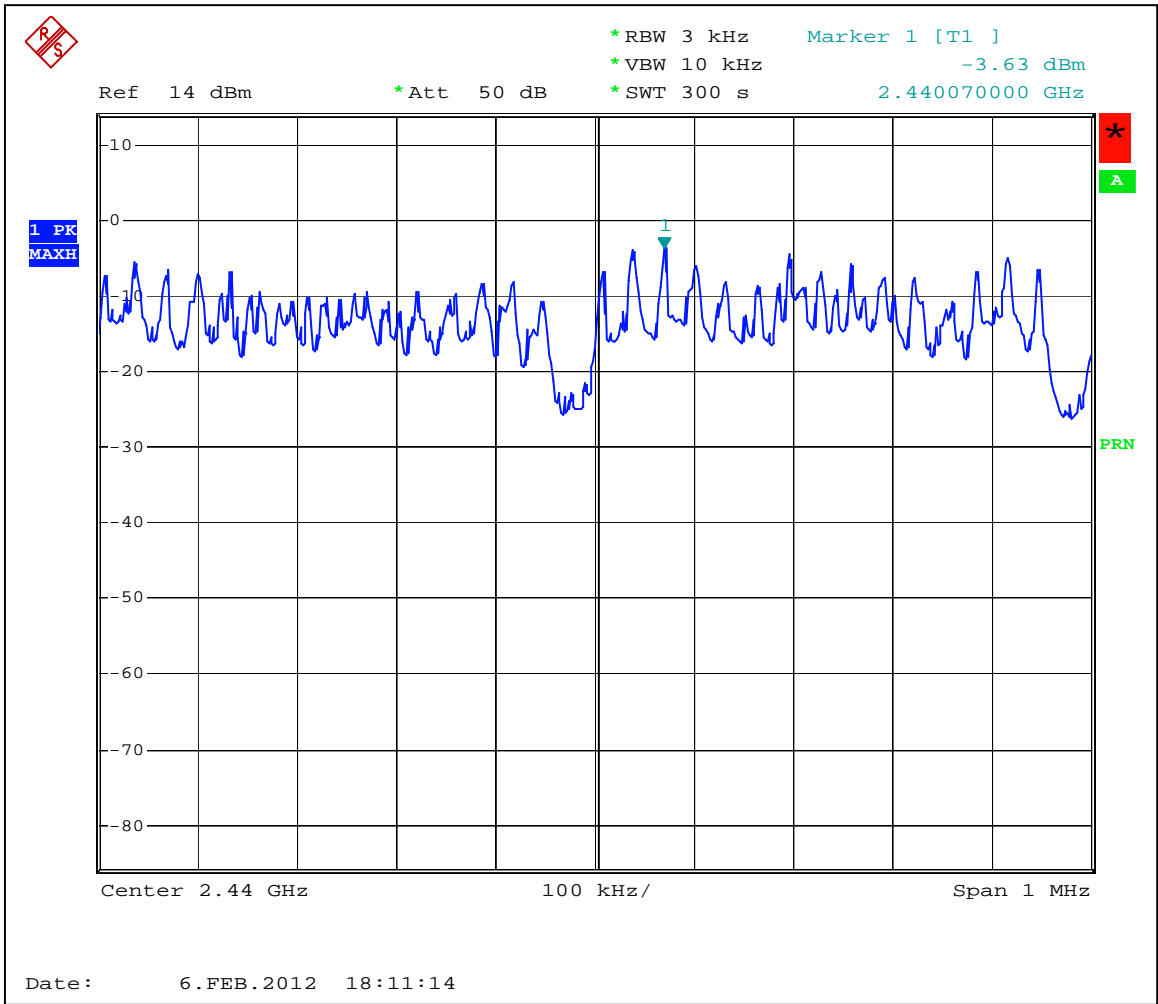
3.3 Power spectral density

Power Output:	<input checked="" type="checkbox"/> Conducted <input type="checkbox"/> 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:	<input checked="" type="checkbox"/> RBW=3KHz <input checked="" type="checkbox"/> VBW=10KHz <input checked="" type="checkbox"/> Span=1MHz <input checked="" type="checkbox"/> Sweep=300sec			
Antenna Gain:	<input checked="" type="checkbox"/> < 6dBi and = [] dBi <input type="checkbox"/> >6dBi and = [] dBi, limit reduction = [] dB			

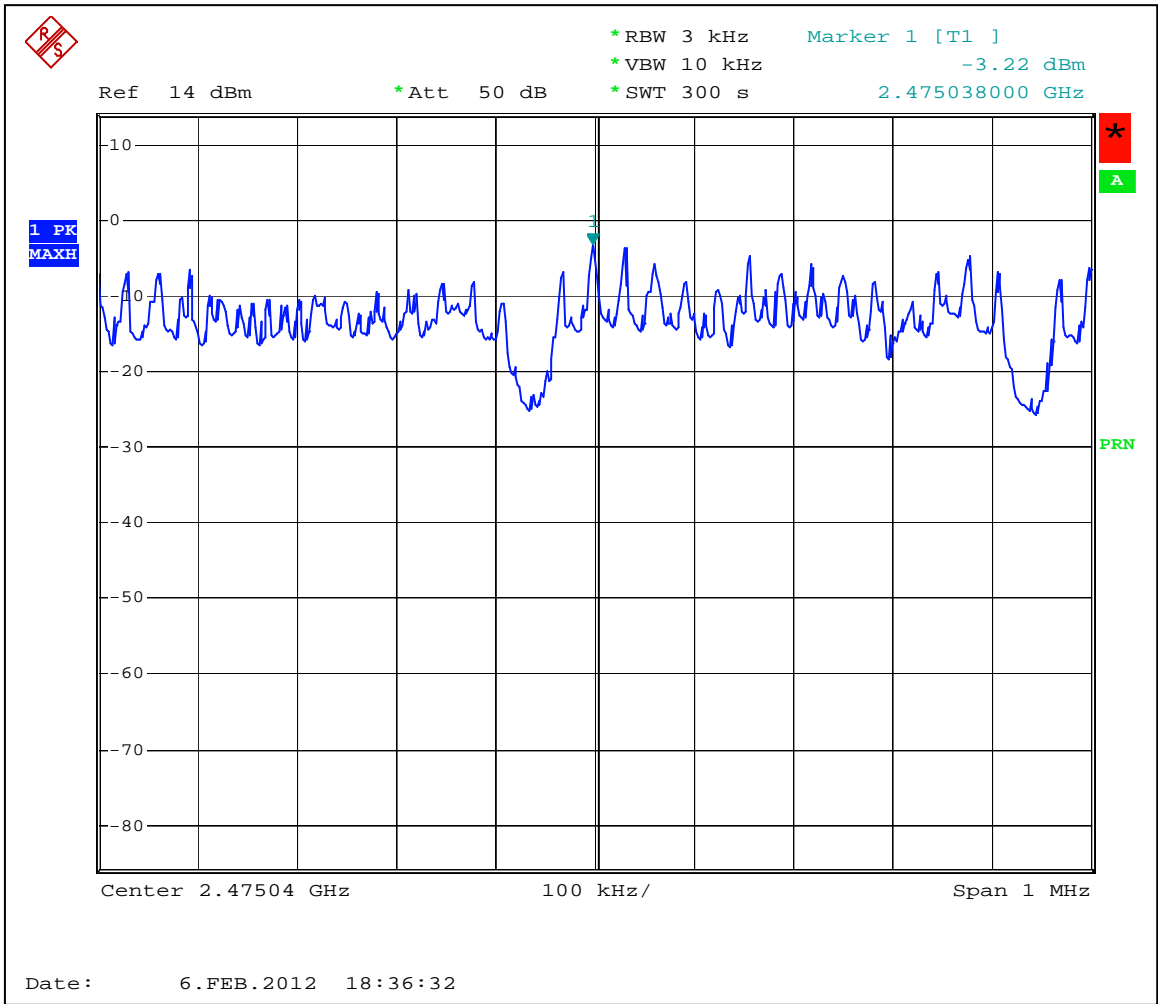
Notes: The Power Spectral Density was calculated adding the cable/attenuator loss of 0.5dB from the measured density value.



Graph 3.3.1



Graph 3.3.2



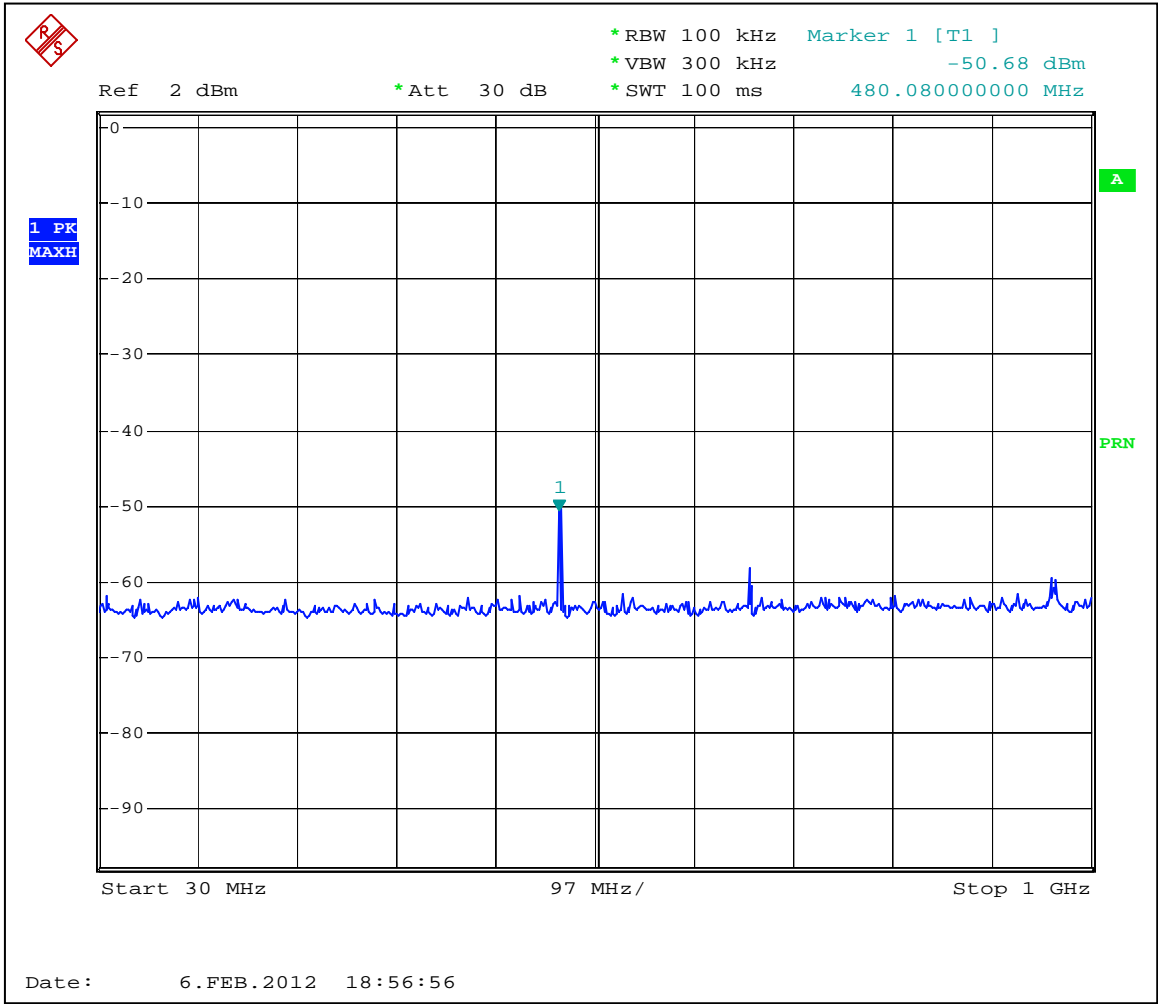
Graph 3.3.3



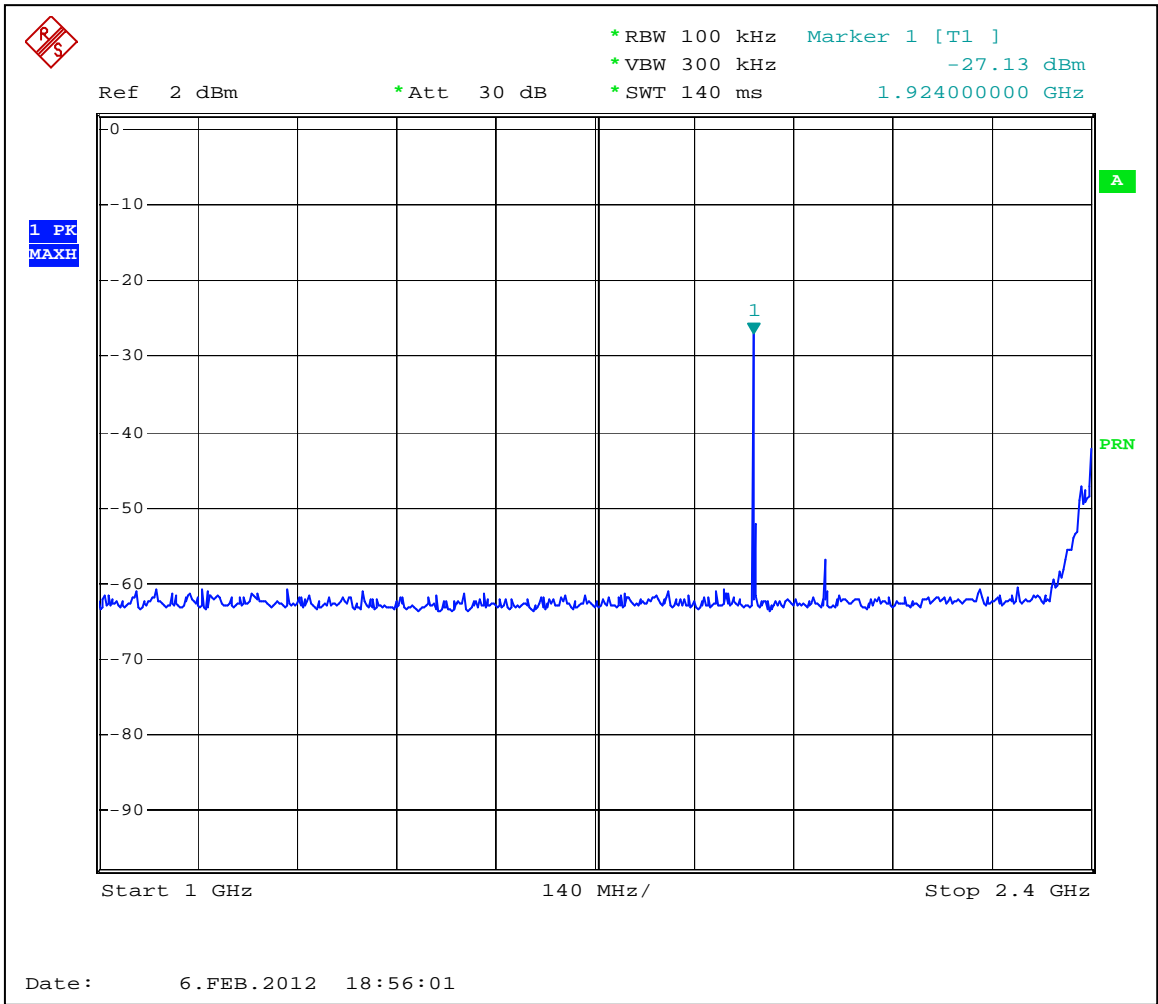
3.4 Antenna conducted spurious emissions

	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:	<input checked="" type="checkbox"/> RBW=100KHz		
Minimum Allowed Attenuation:	<input checked="" type="checkbox"/> 20dB <input type="checkbox"/> 30dB (for digital systems with conducted power measured using RMS averaging over a time interval)		

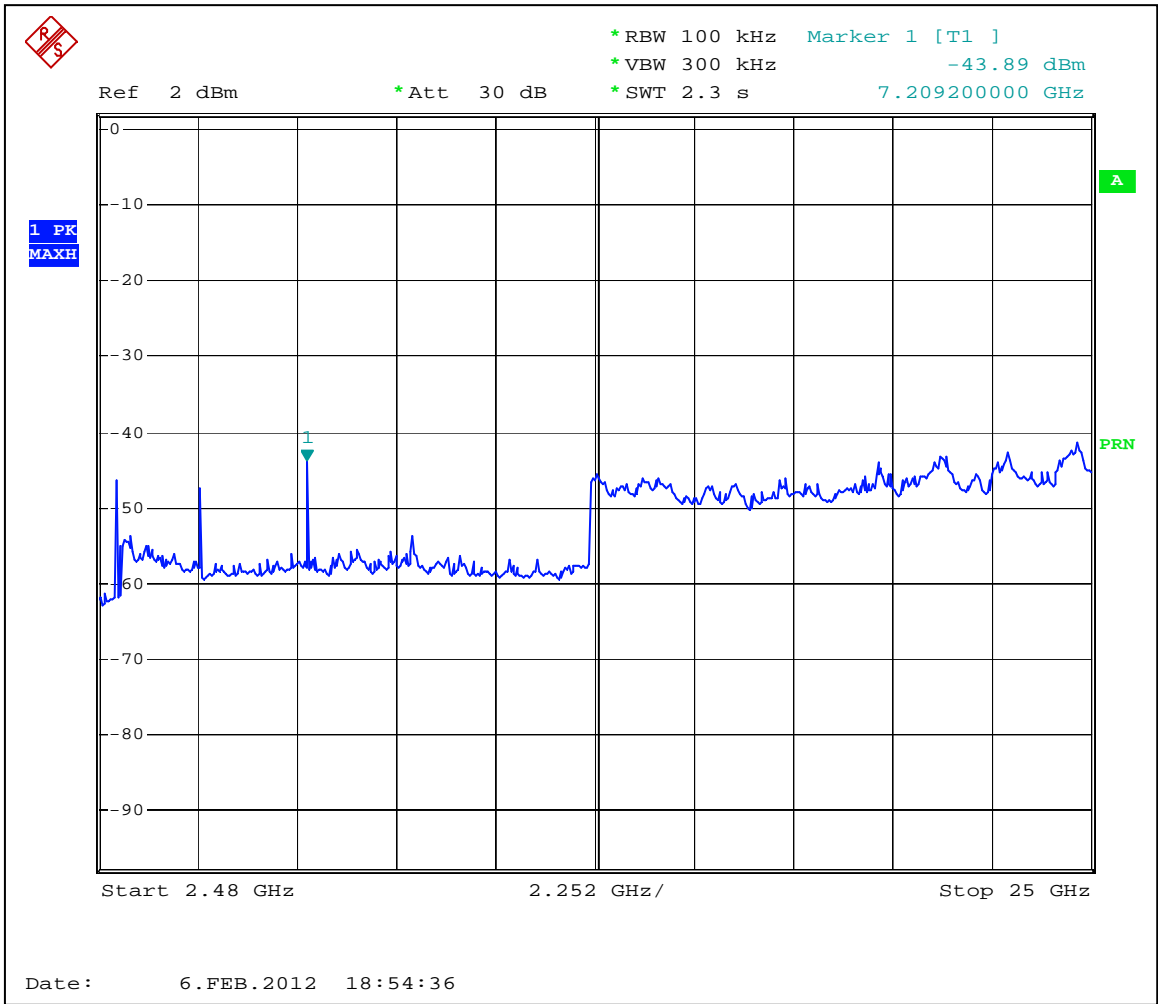
Notes: Test was performed in frequency range from 30MHz to 25GHz
Graphs 3.4.1 to 3.4.3 show the Antenna Conducted Spurious Emissions for channel 0
Graphs 3.4.4 to 3.4.6 show the Antenna Conducted Spurious Emissions for channel 7
Graphs 3.4.7 to 3.4.9 show the Antenna Conducted Spurious Emissions for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



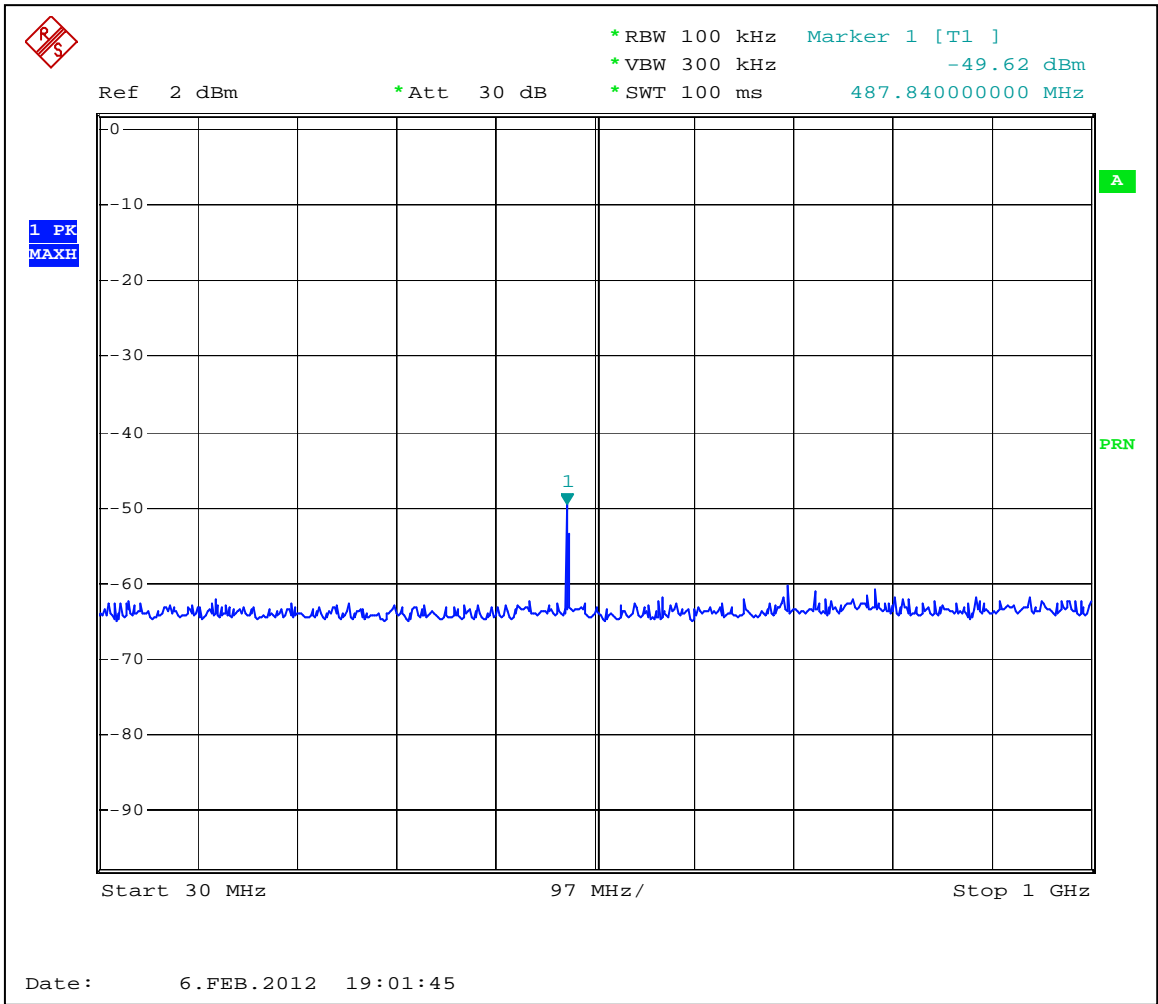
Graph 3.4.1



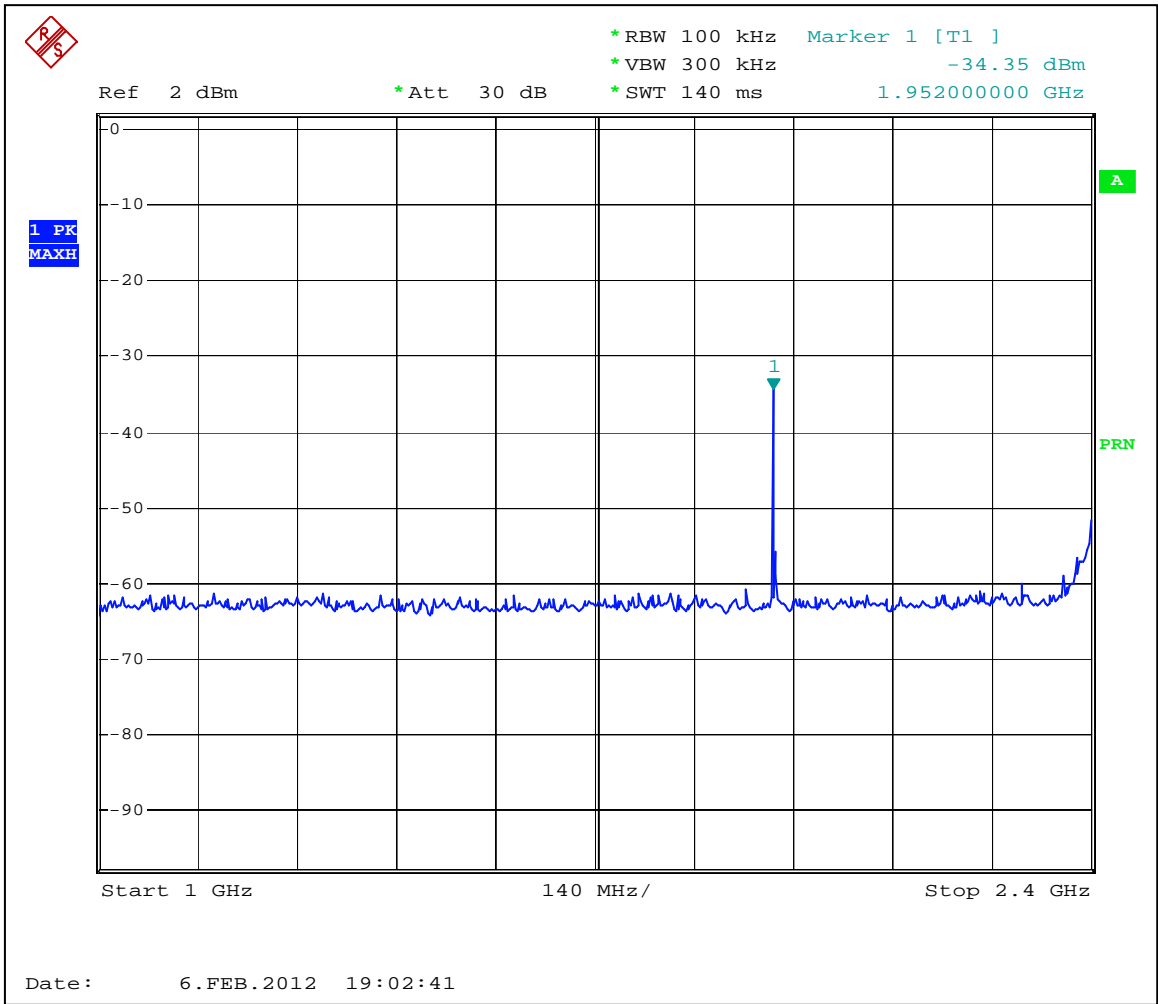
Graph 3.4.2



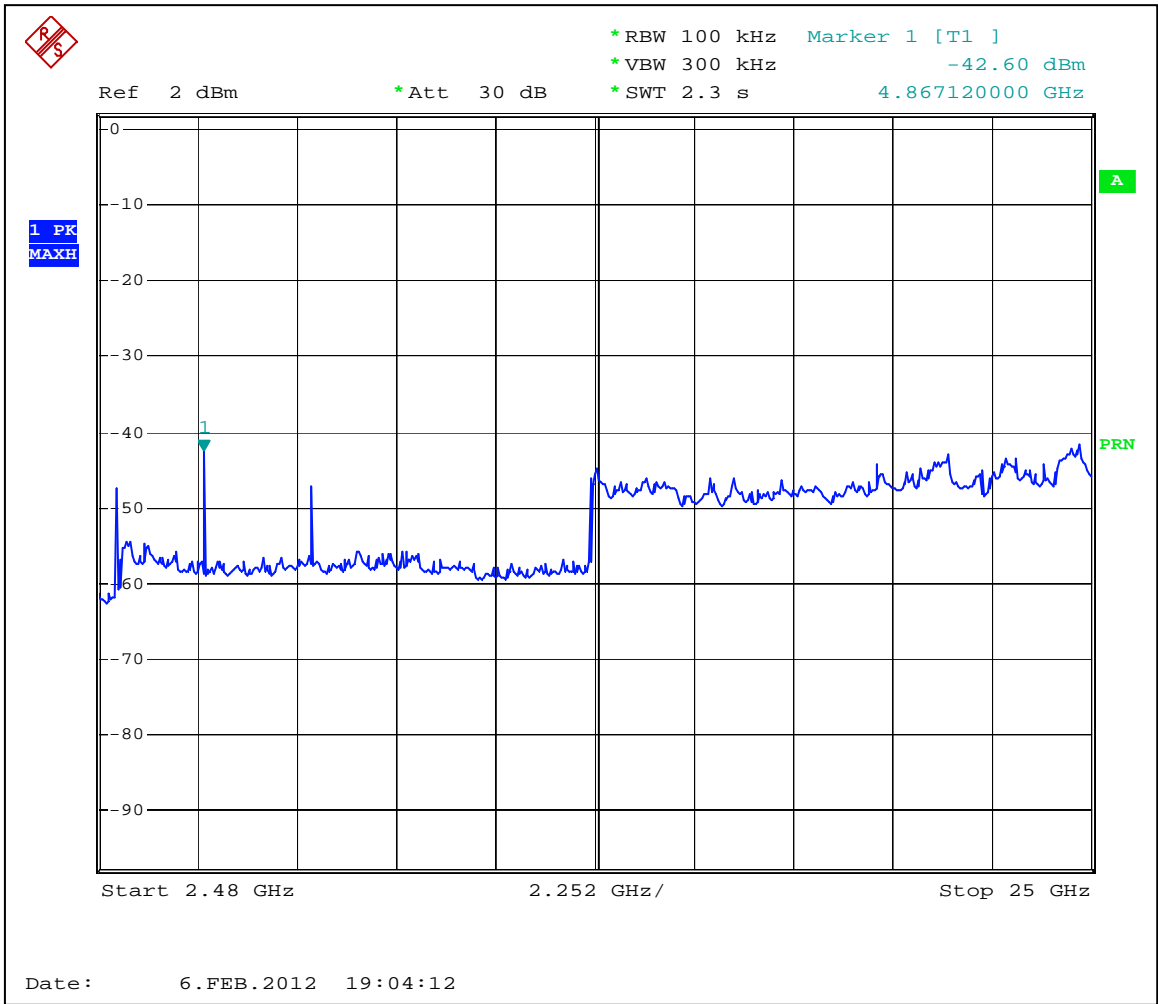
Graph 3.4.3



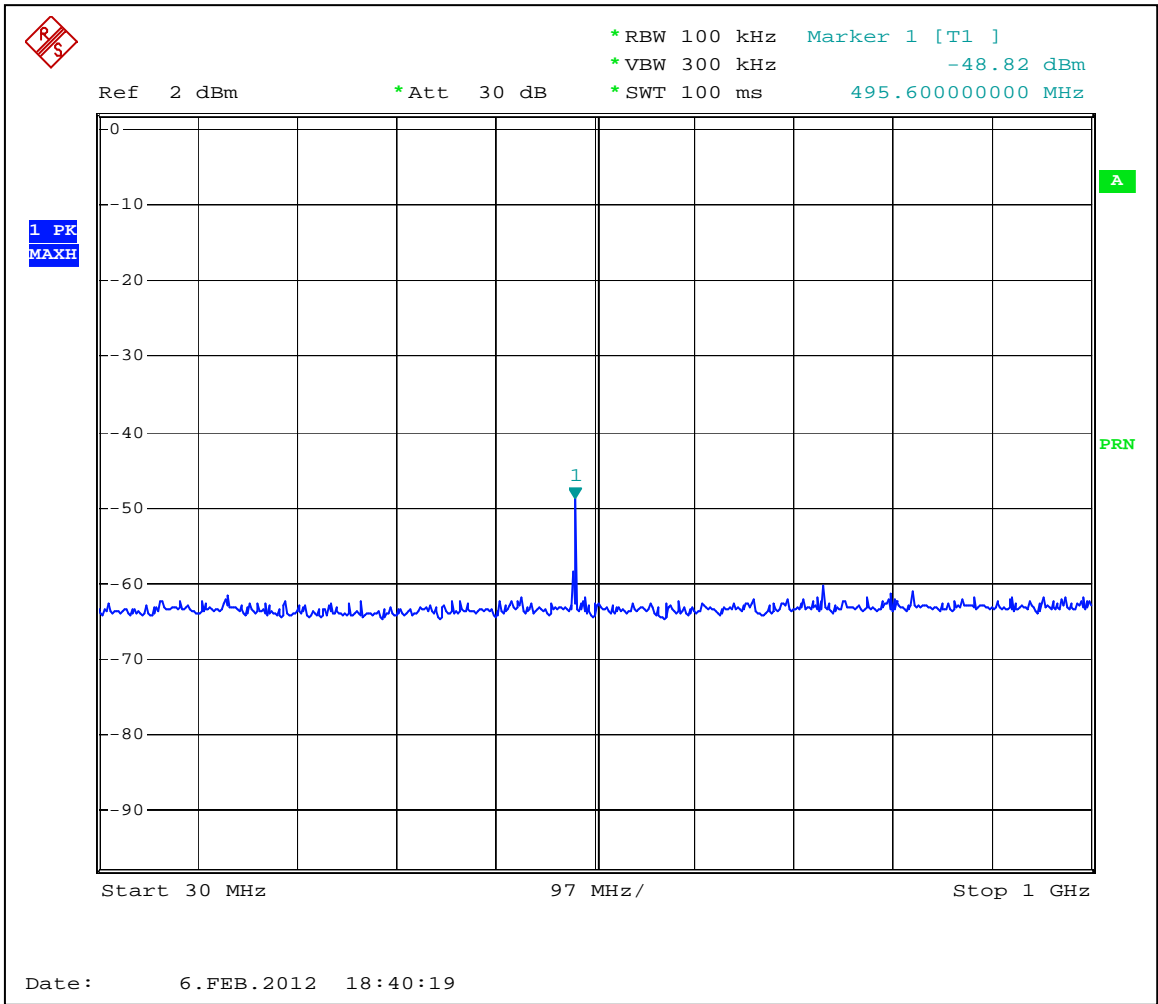
Graph 3.4.4



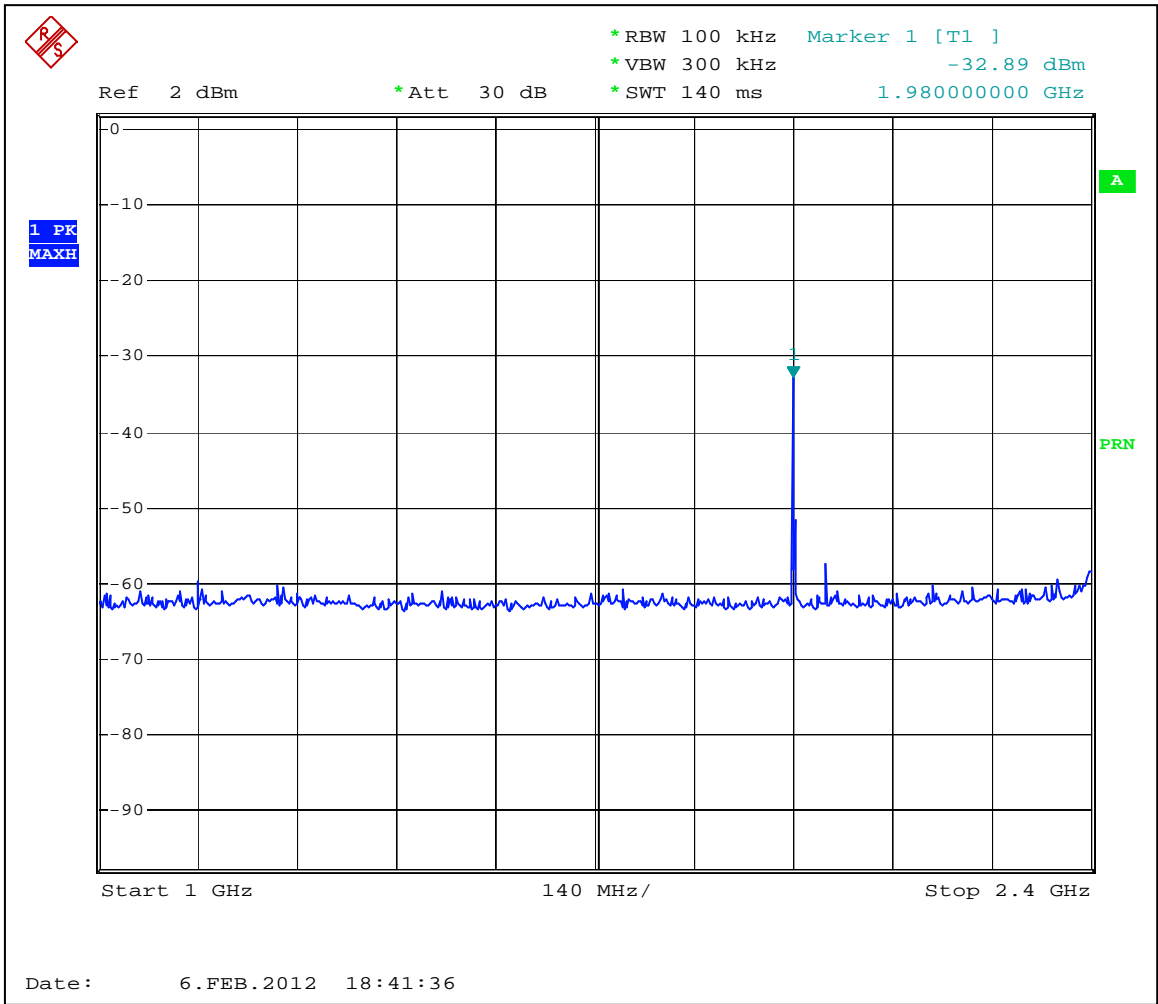
Graph 3.4.5



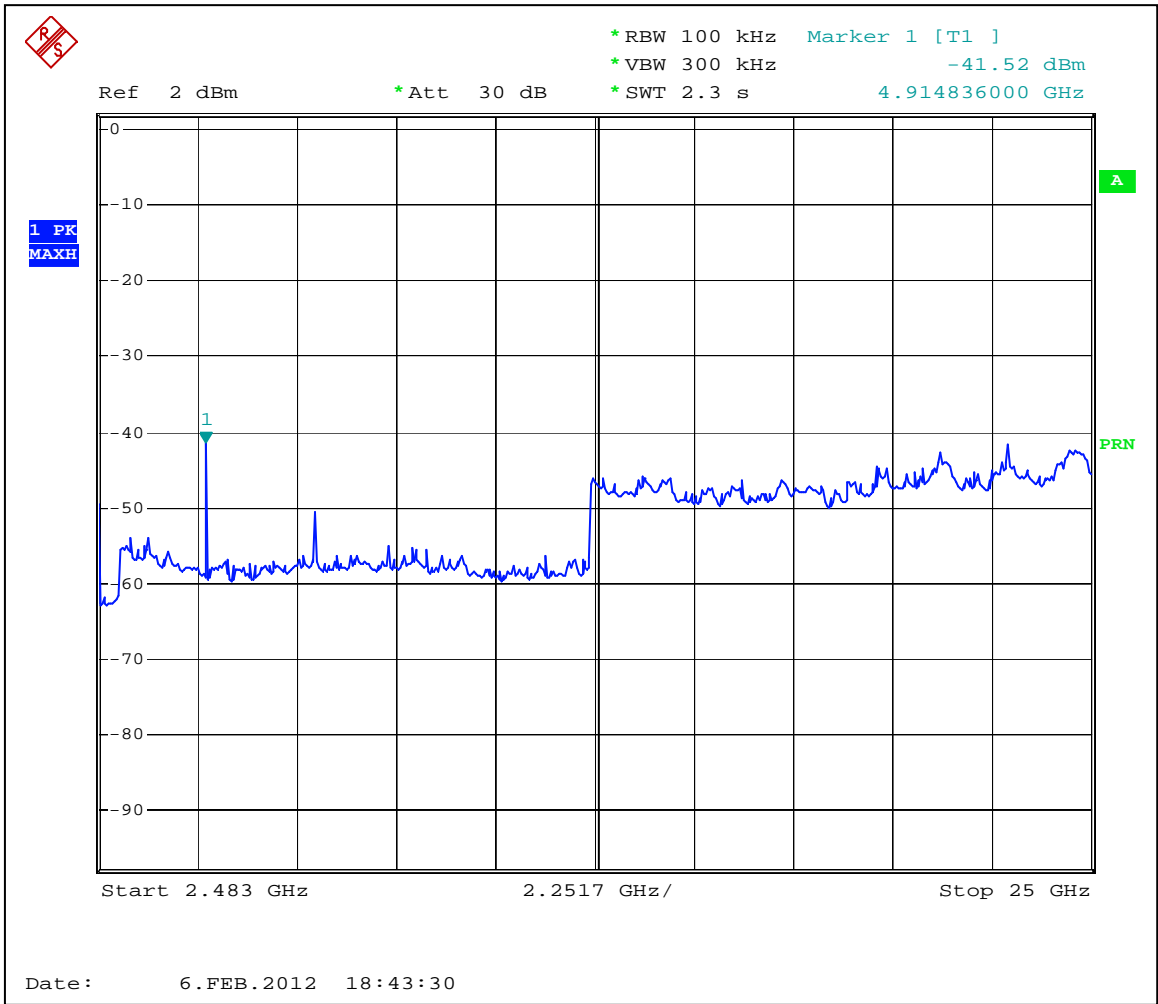
Graph 3.4.6



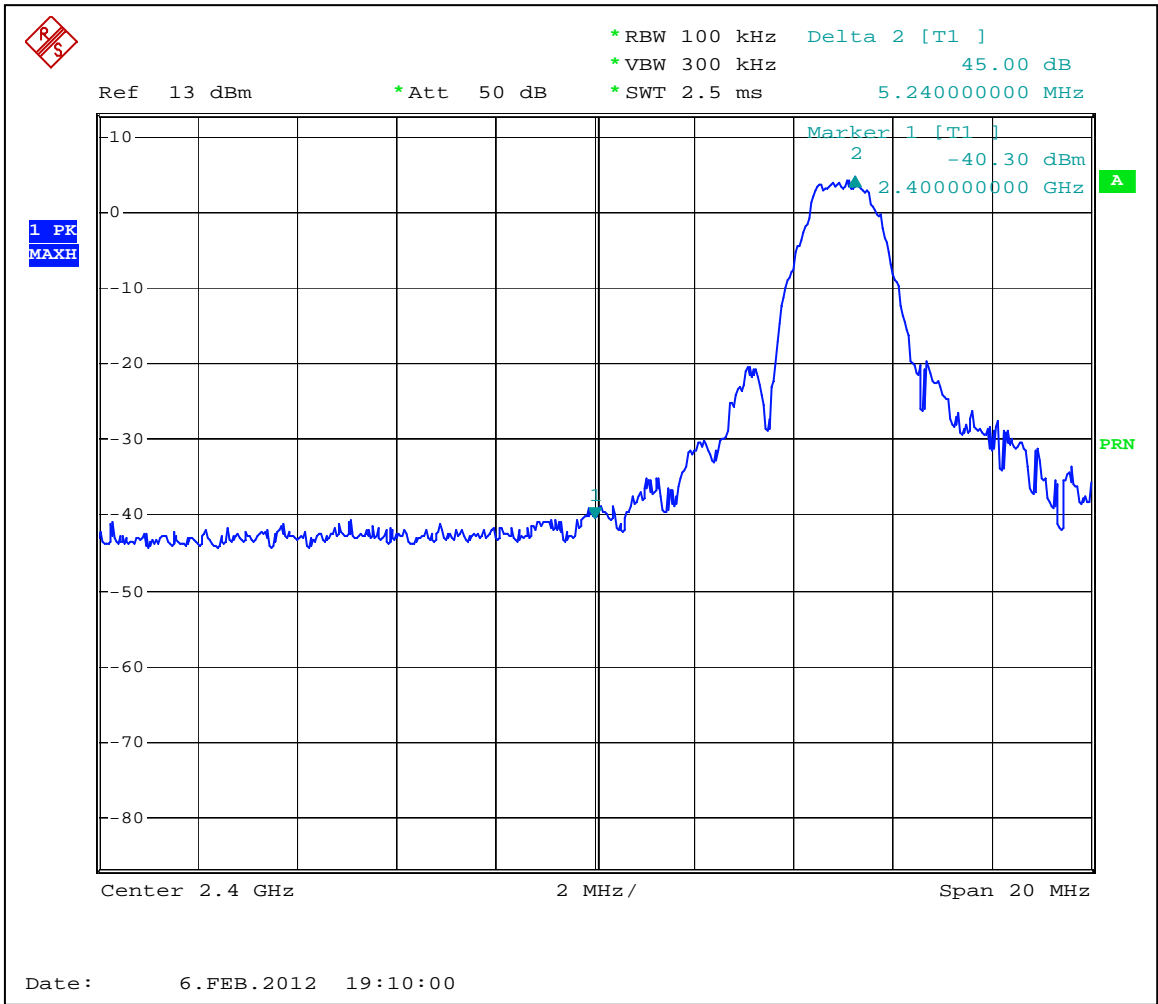
Graph 3.4.7



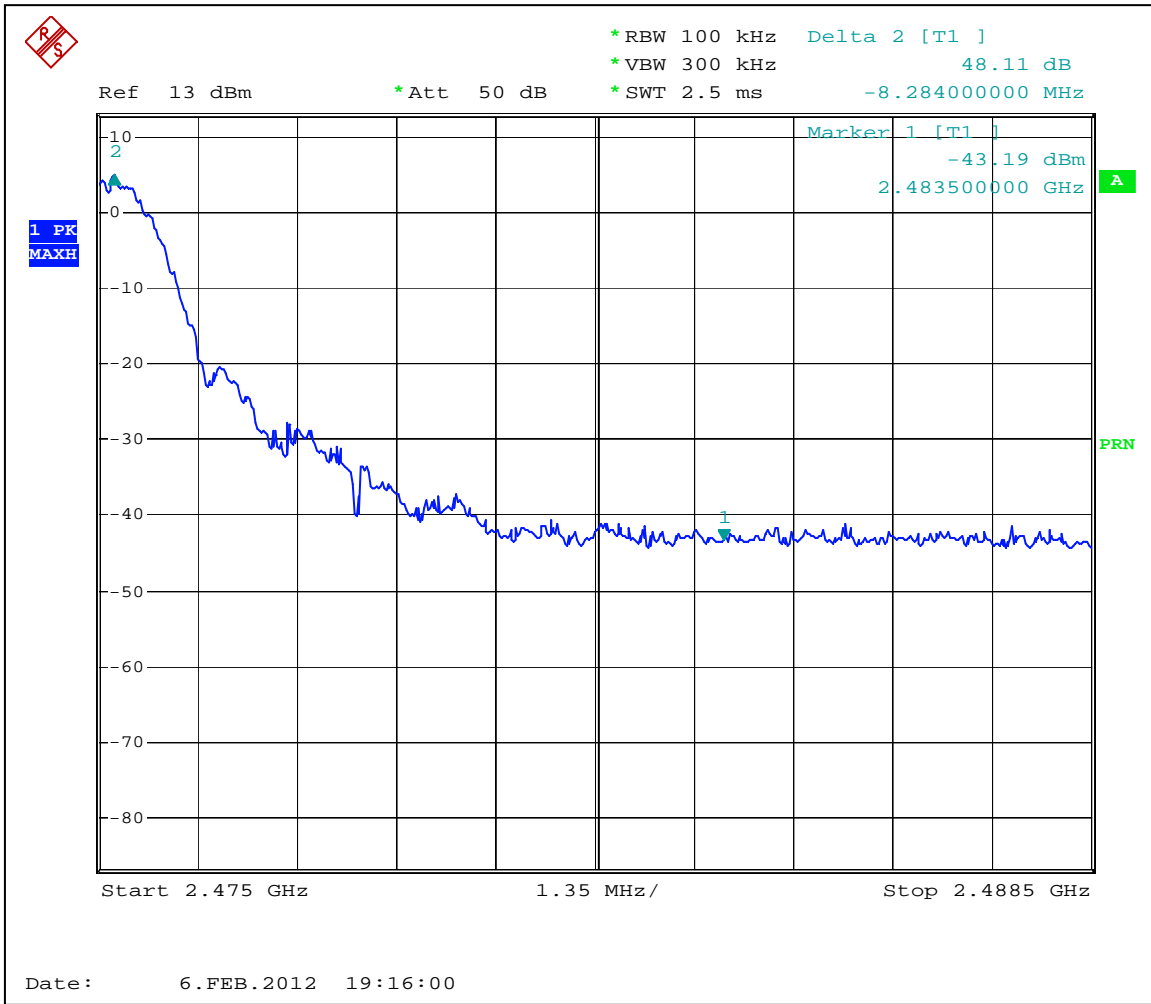
Graph 3.4.8



Graph 3.4.9



Graph 3.4.10



Graph 3.4.11



3.5 Radiated spurious emissions

Test location: OATS Anechoic Chamber Other

Test distance: 10 meters 3 meters

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

Test result: **Pass**

Max. Margin: 17.4dB below the limits

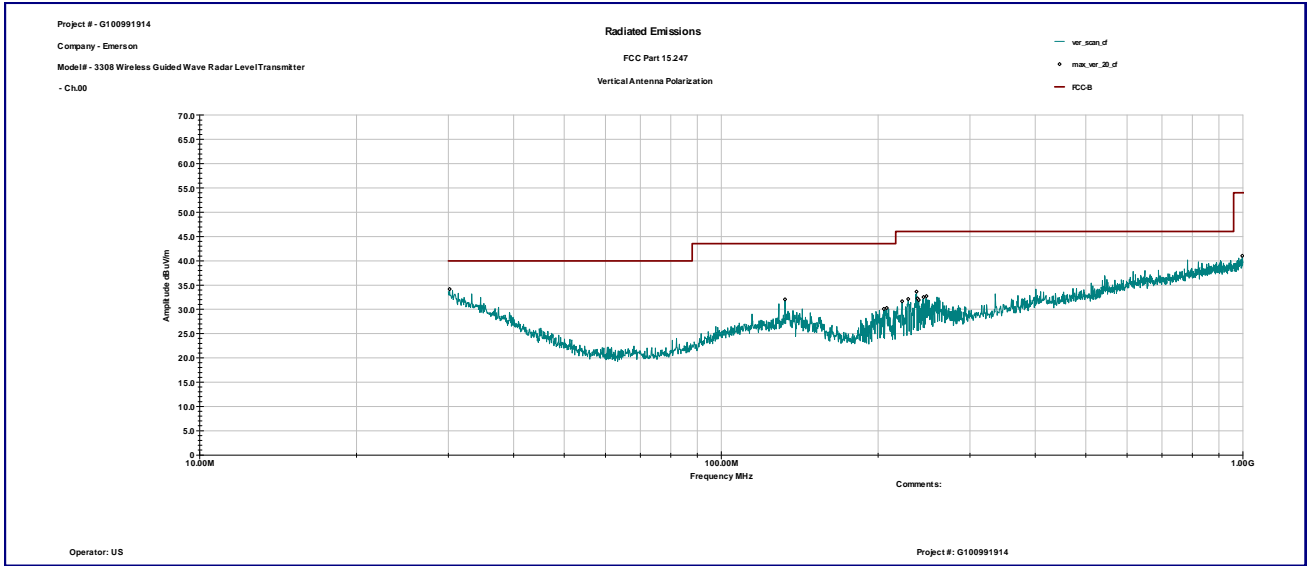
Notes: None



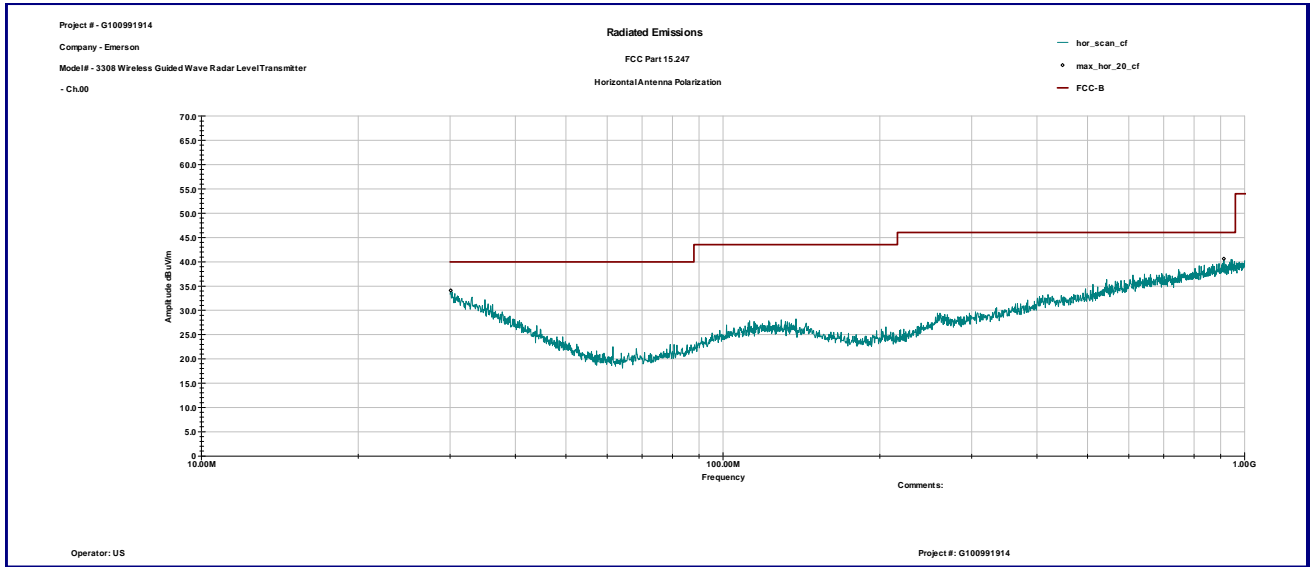
Date:	December 19, 2012	Result: Pass
Standard:	FCC part 15.247(d)	
Tested by:	Uri Spector	
Test Point:	Enclosure with antenna	
Operation mode:	See Page 5	
Note:	Measurements were taken using an Average detector, or peak detector when commented. Emissions at fundamental frequency, spurious emissions and harmonics outside restricted band of operation per FCC 15.205, and spurious emissions not related with transmitter operations were excluded from the Table.	

Table 3.2.1

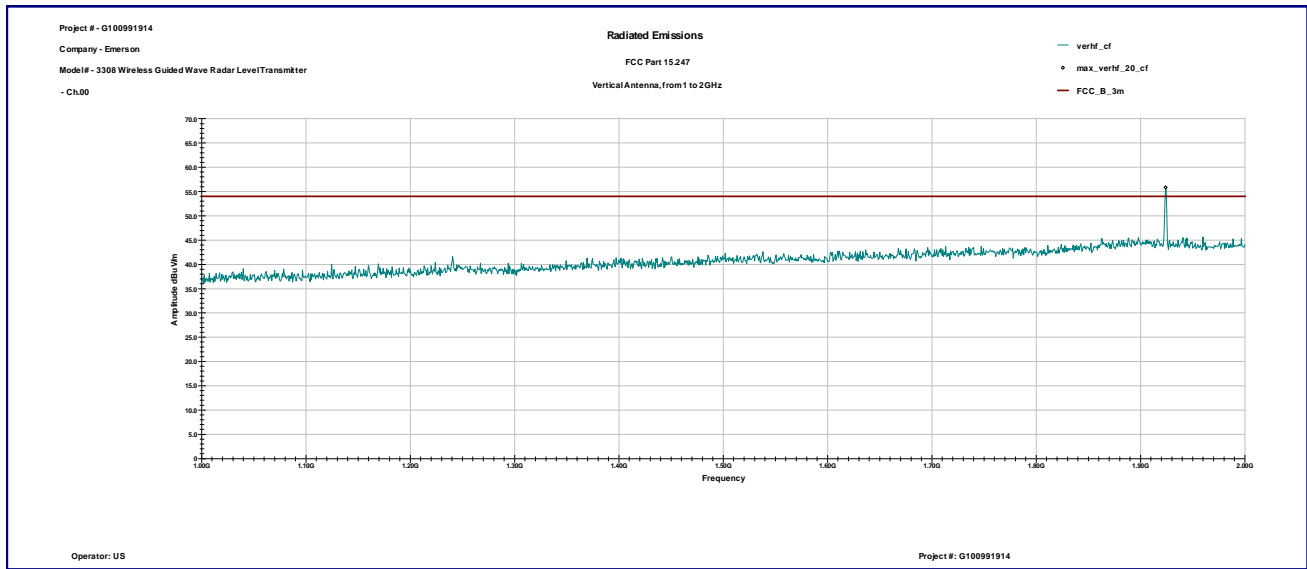
Frequency MHz	Antenna		Ant. CF dB1/m	Cable loss dB	Pre-amp Gain (dB)	Reading dBµV	Total @ 3m dBµV/m	Limit dBµV/m	Margin dB	Comments
	Polarity	Hts(cm)								
Channel 0										
7216.00	V	165	35.7	4.9	41.5	57.4	56.6	74.0	-17.4	Peak
7216.00	V	165	35.7	4.9	41.5	29.1	28.3	54.0	-25.7	AVG
Channel 7										
4880.92	V	223	33.1	4.2	42.0	57.9	53.1	74.0	-20.9	Peak
4880.92	V	223	33.1	4.2	42.0	29.2	24.4	54.0	-29.6	AVG
7321.52	V	229	36.0	5.0	41.4	55.1	54.7	74.0	-19.3	Peak
7321.52	V	229	36.0	5.0	41.4	29.0	28.6	54.0	-25.4	AVG
Channel 14										
4950.92	V	204	33.1	4.2	41.9	57.3	52.7	74.0	-21.3	Peak
4950.92	V	204	33.1	4.2	41.9	30.7	26.1	54.0	-27.9	AVG



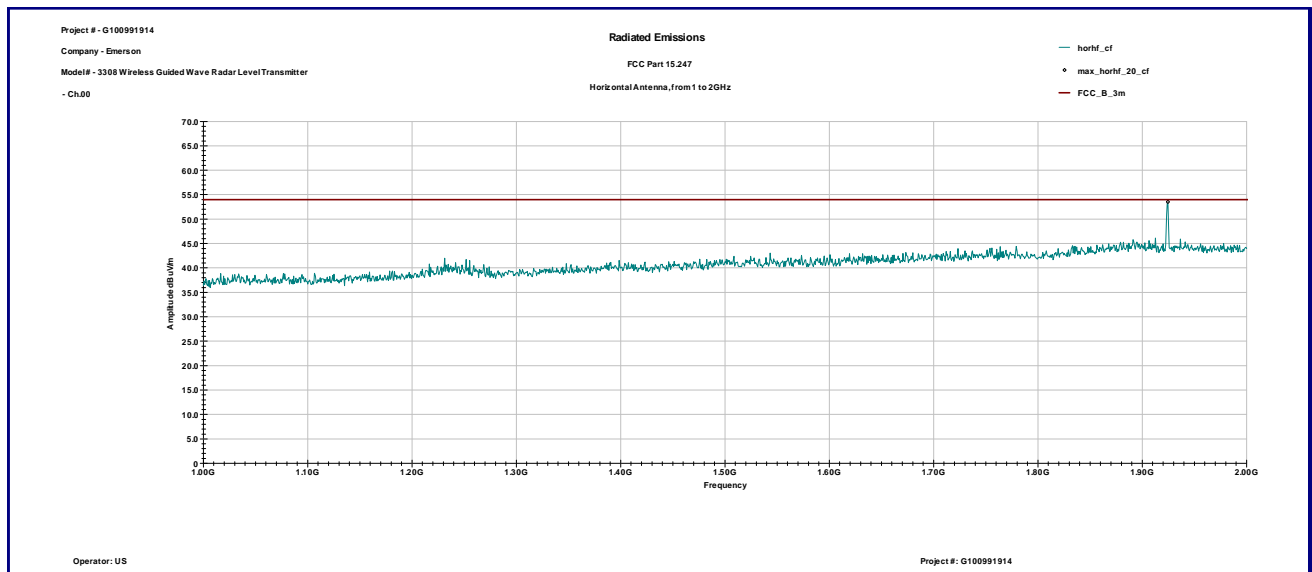
Graph 3.2.1



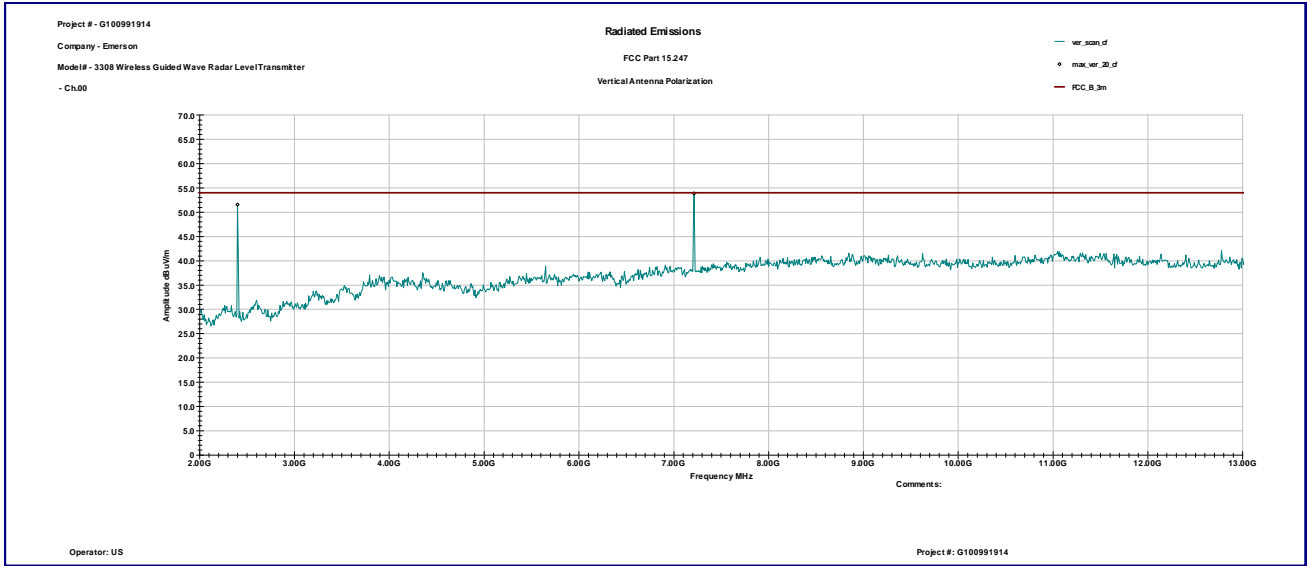
Graph 3.2.2



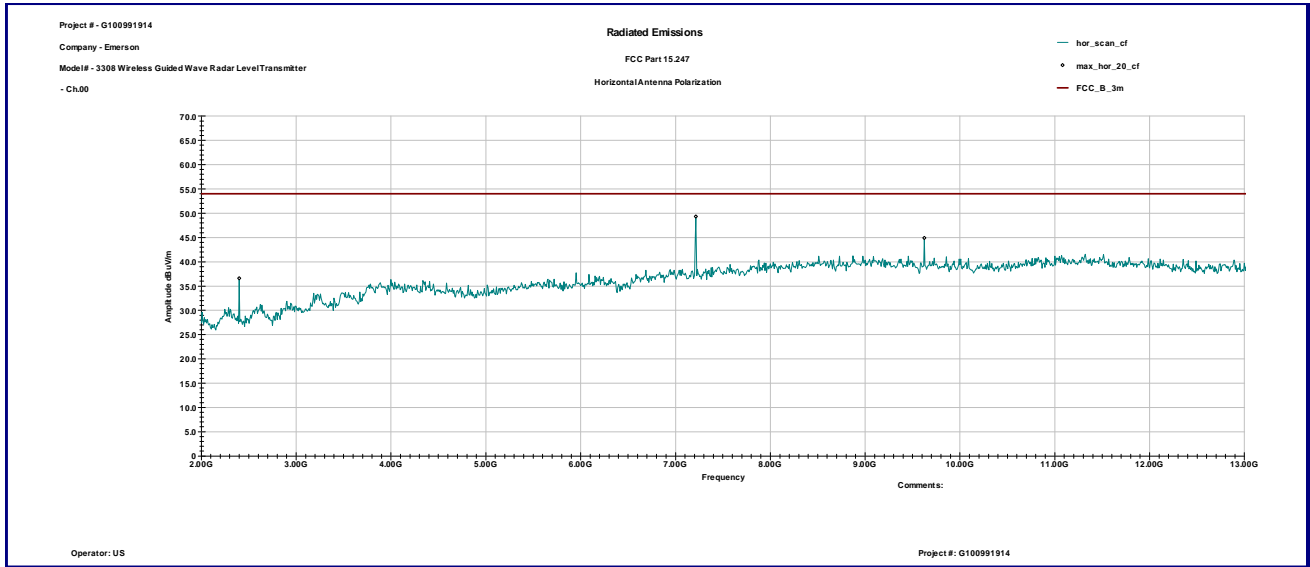
Graph 3.2.3



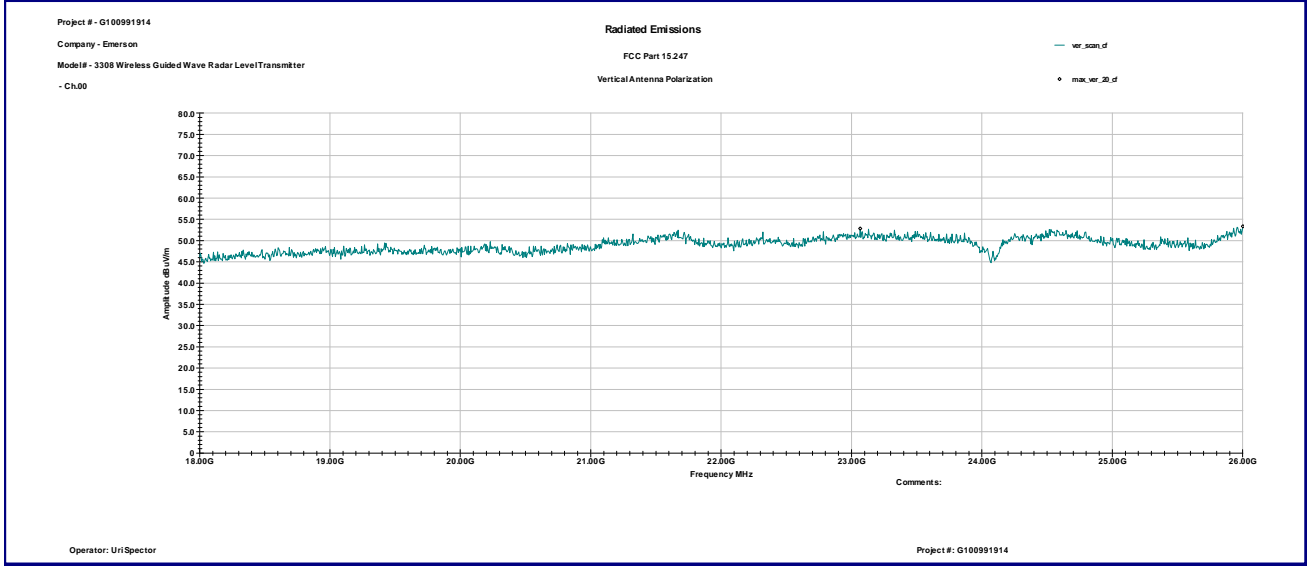
Graph 3.2.4



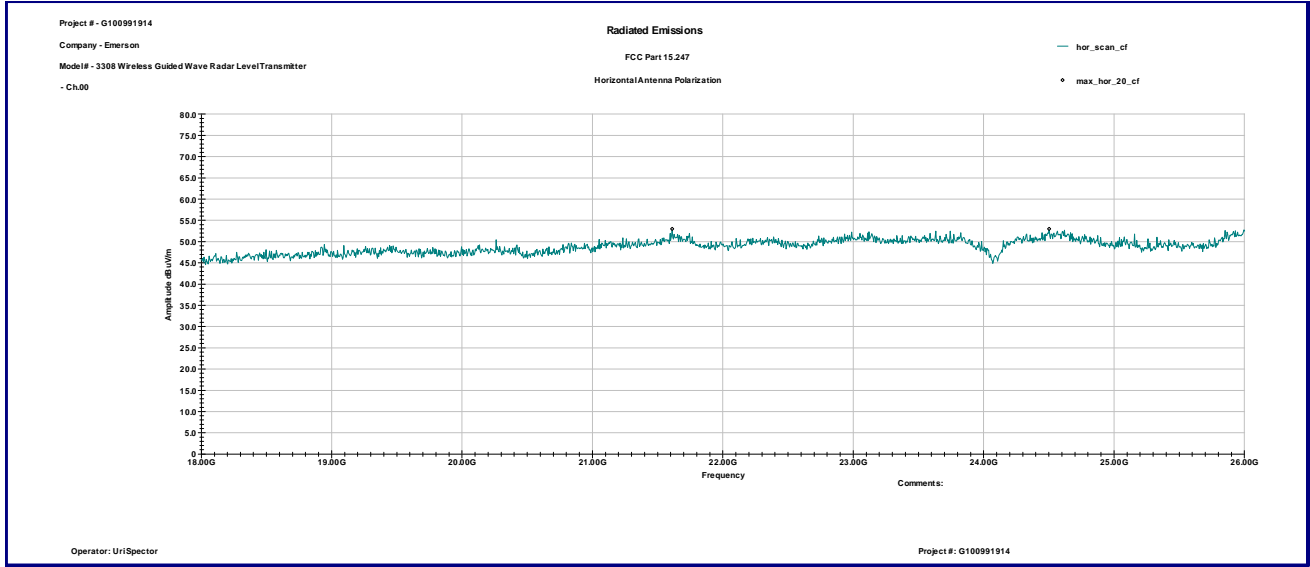
Graph 3.2.5



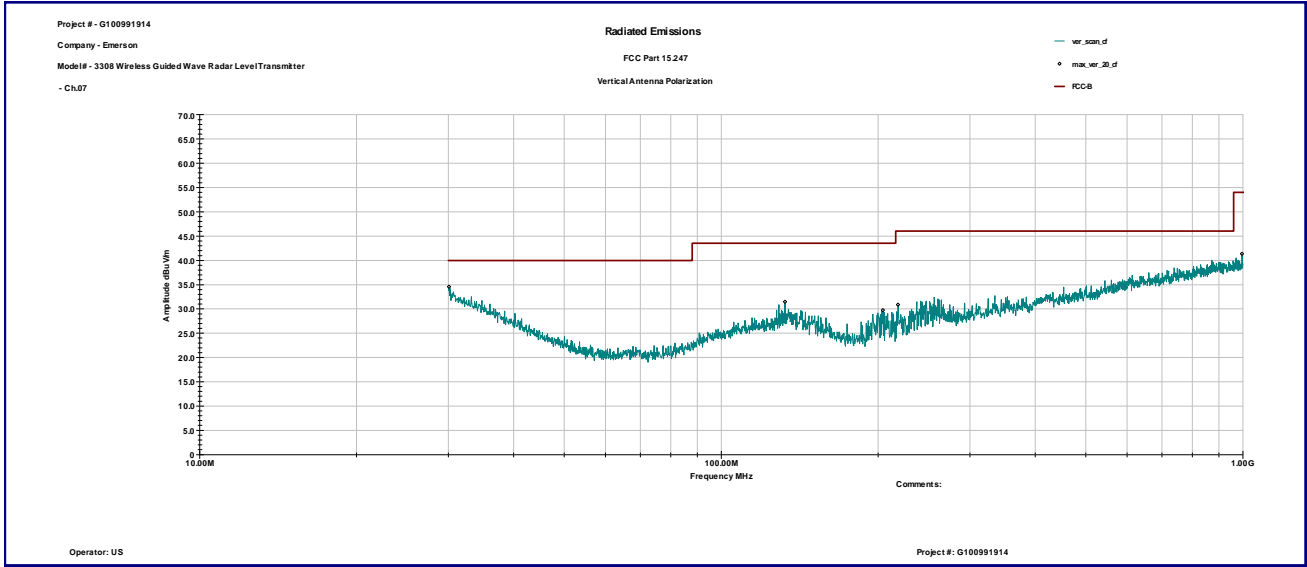
Graph 3.2.6



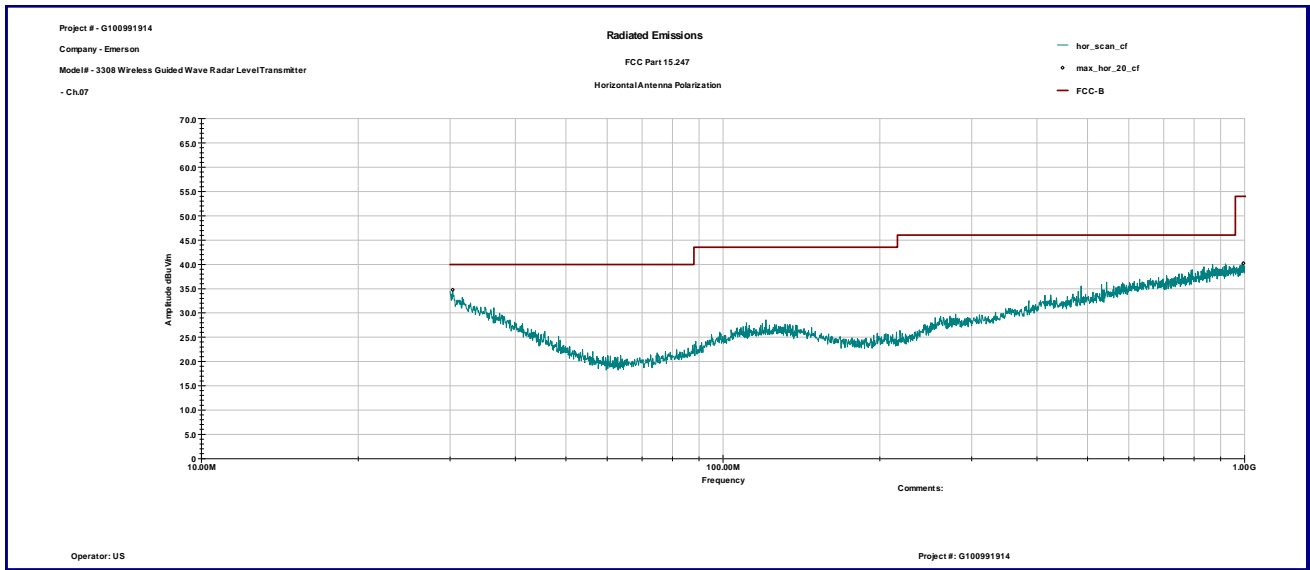
Graph 3.2.7



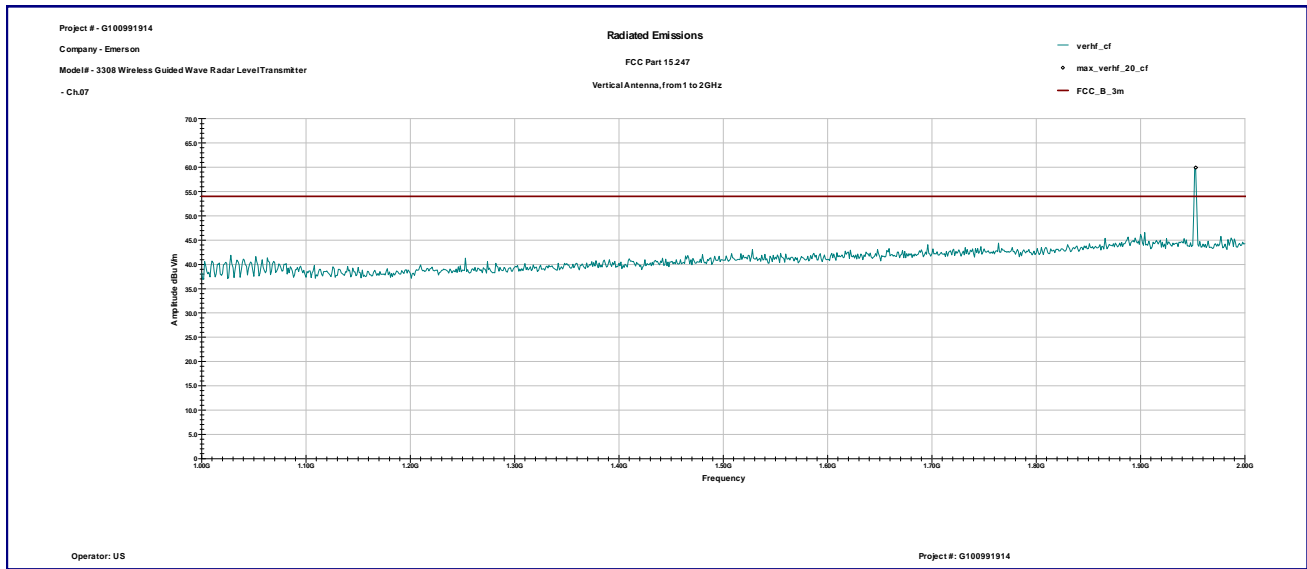
Graph 3.2.8



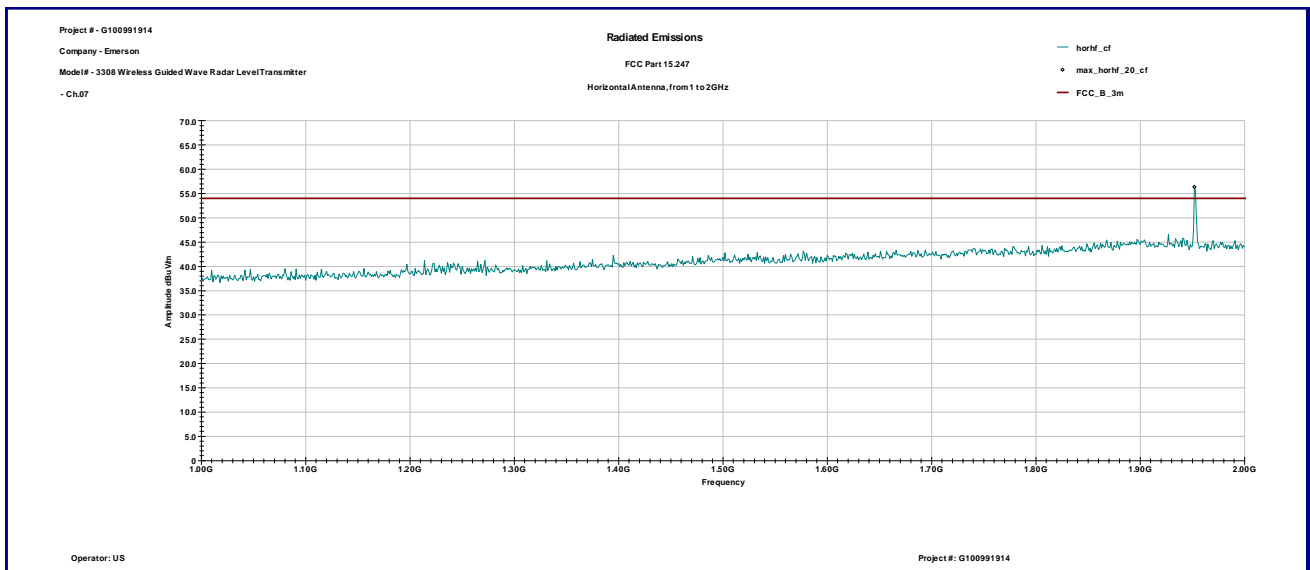
Graph 3.2.9



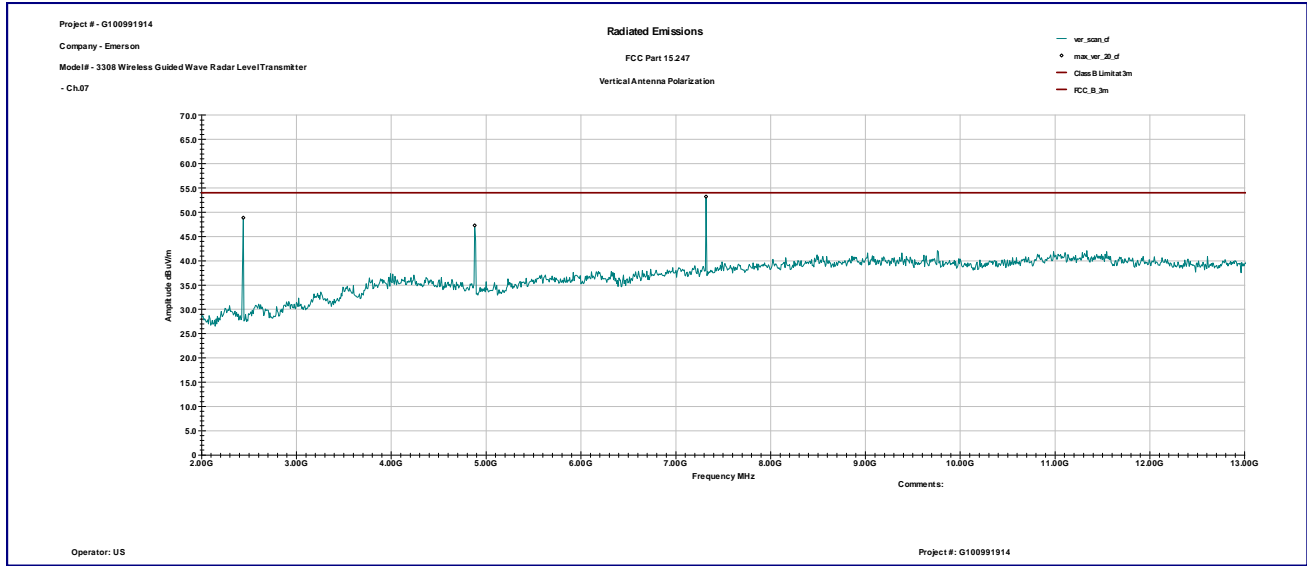
Graph 3.2.10



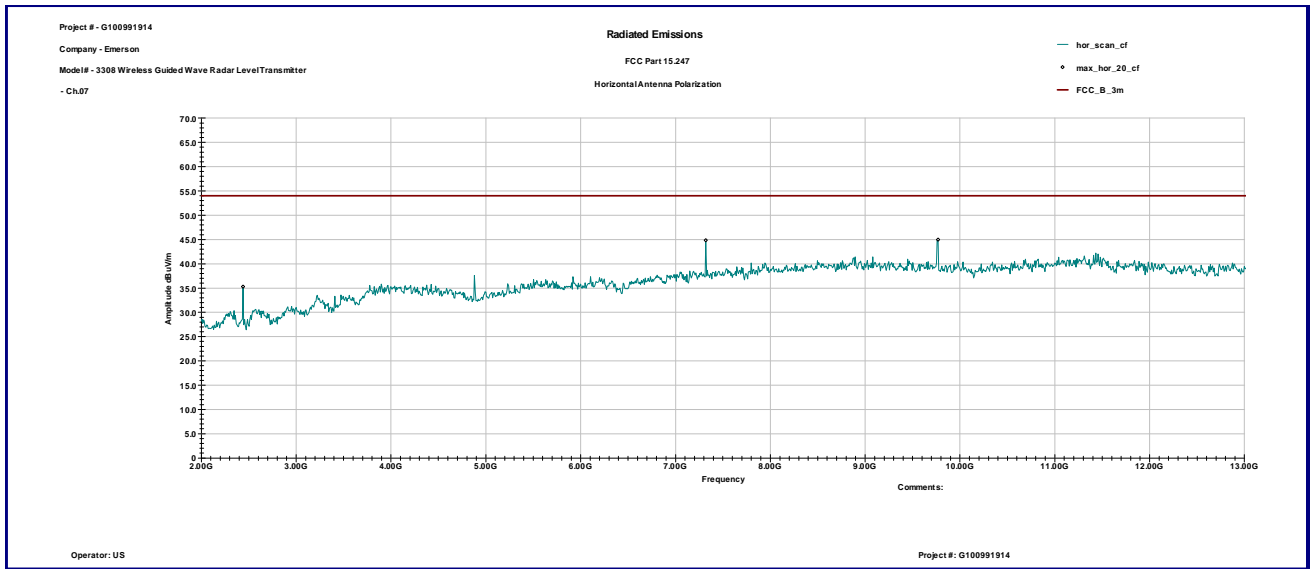
Graph 3.2.11



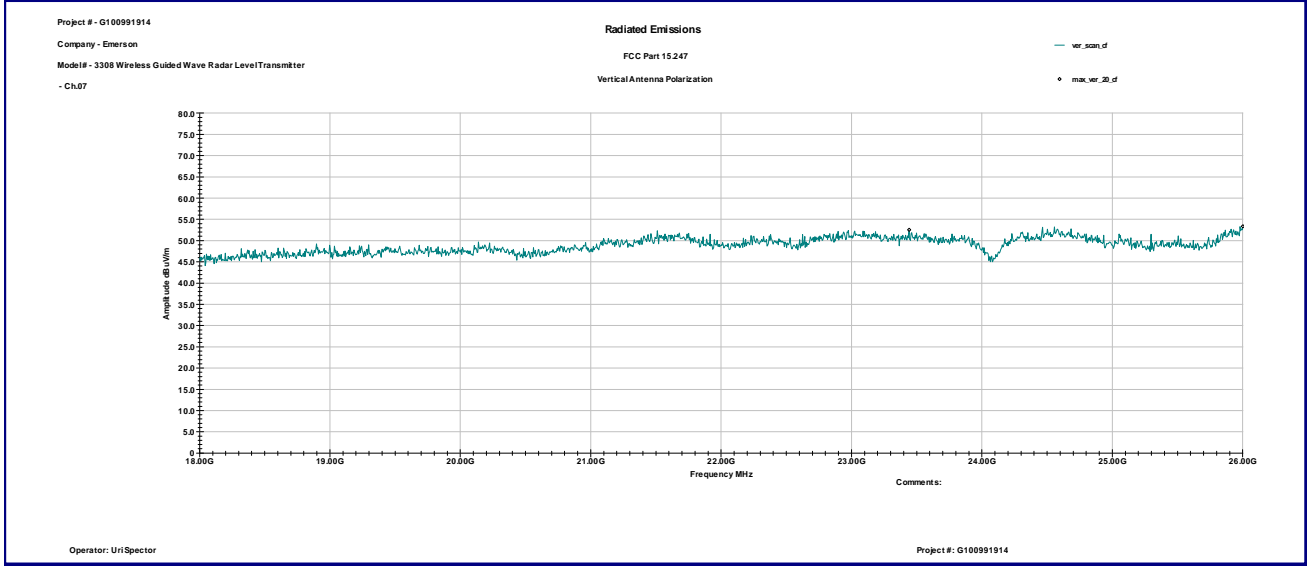
Graph 3.2.12



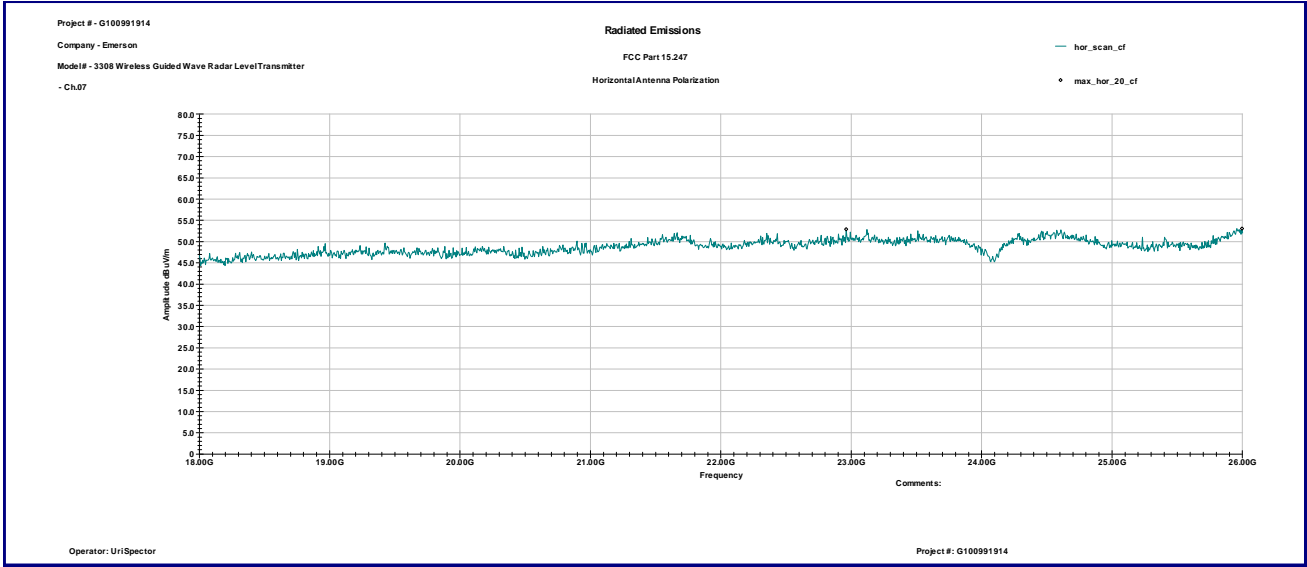
Graph 3.2.13



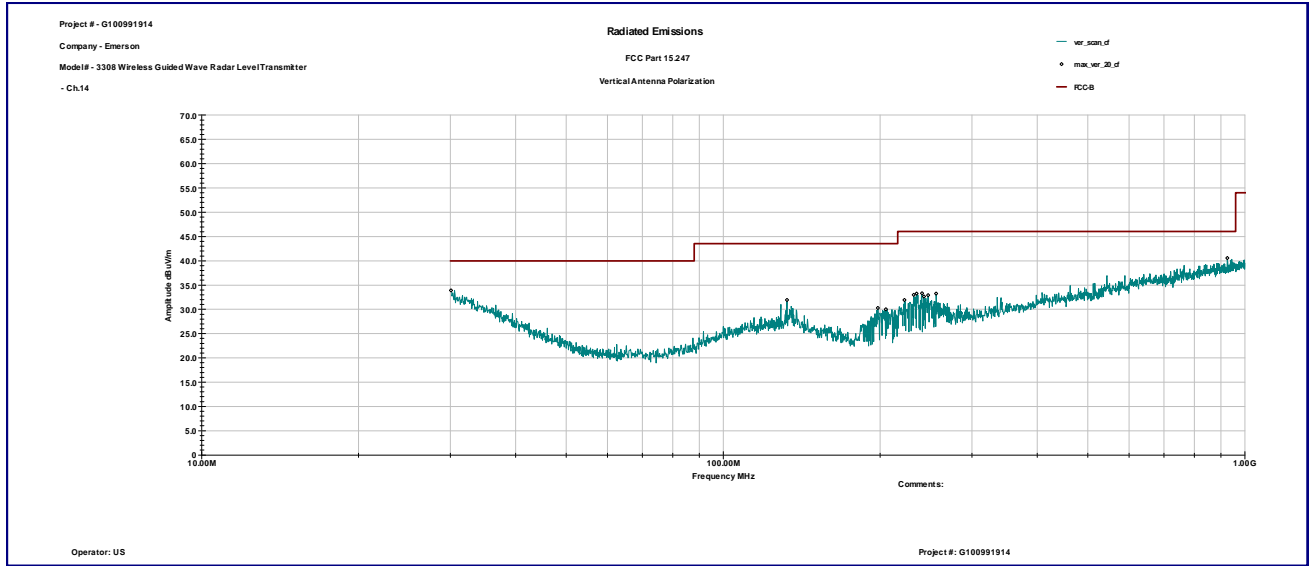
Graph 3.2.14



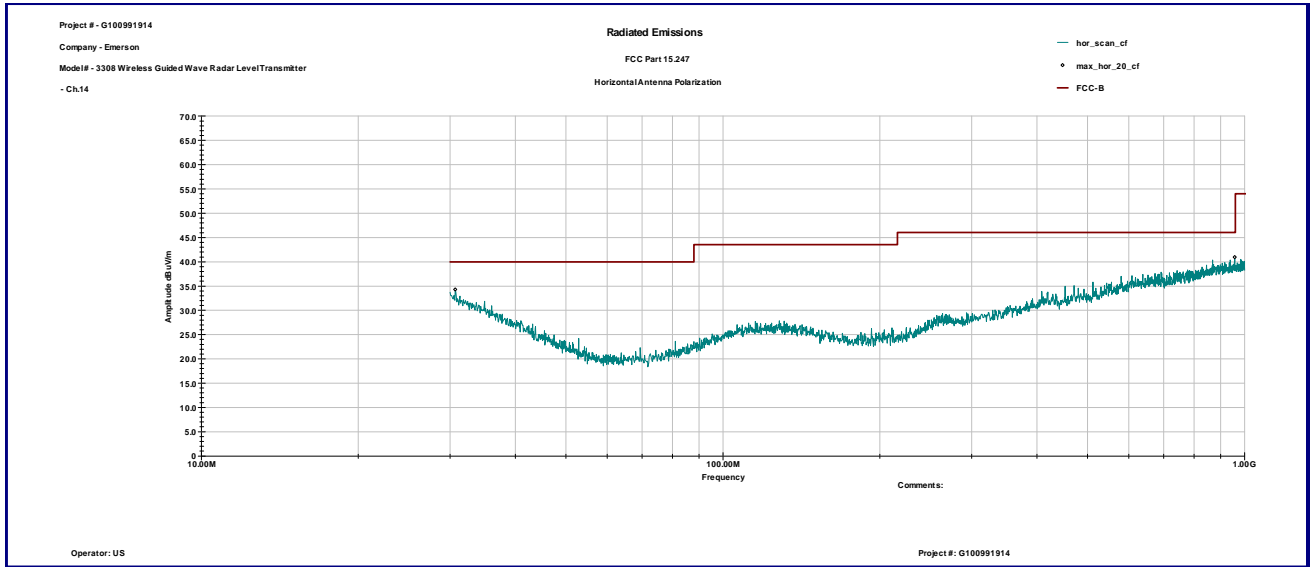
Graph 3.2.15



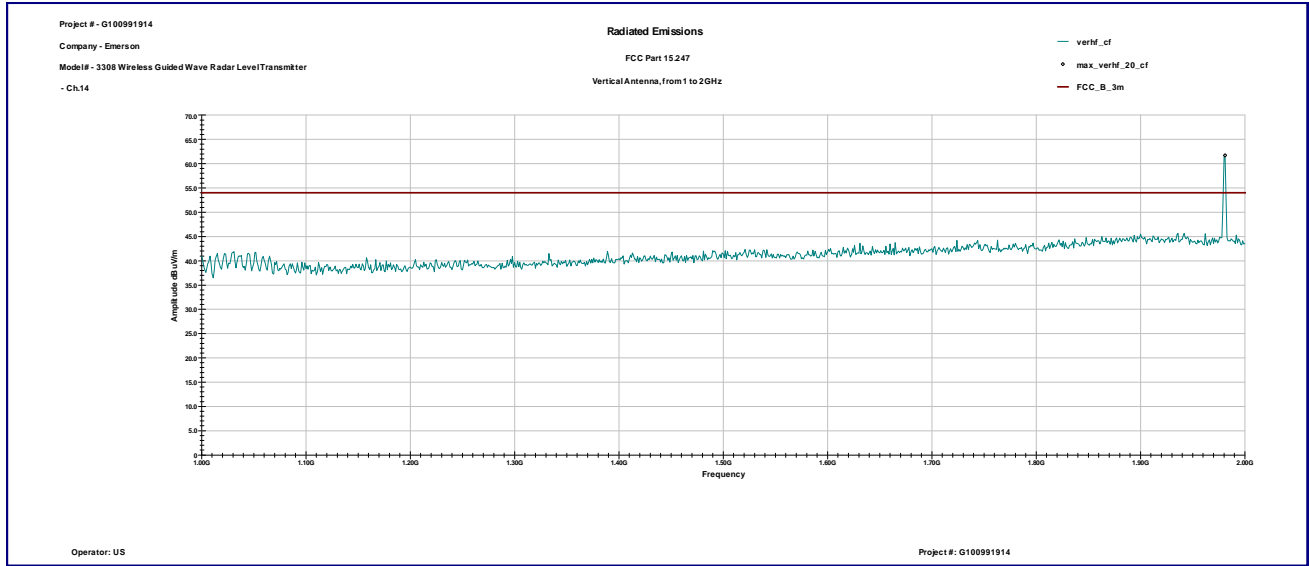
Graph 3.2.16



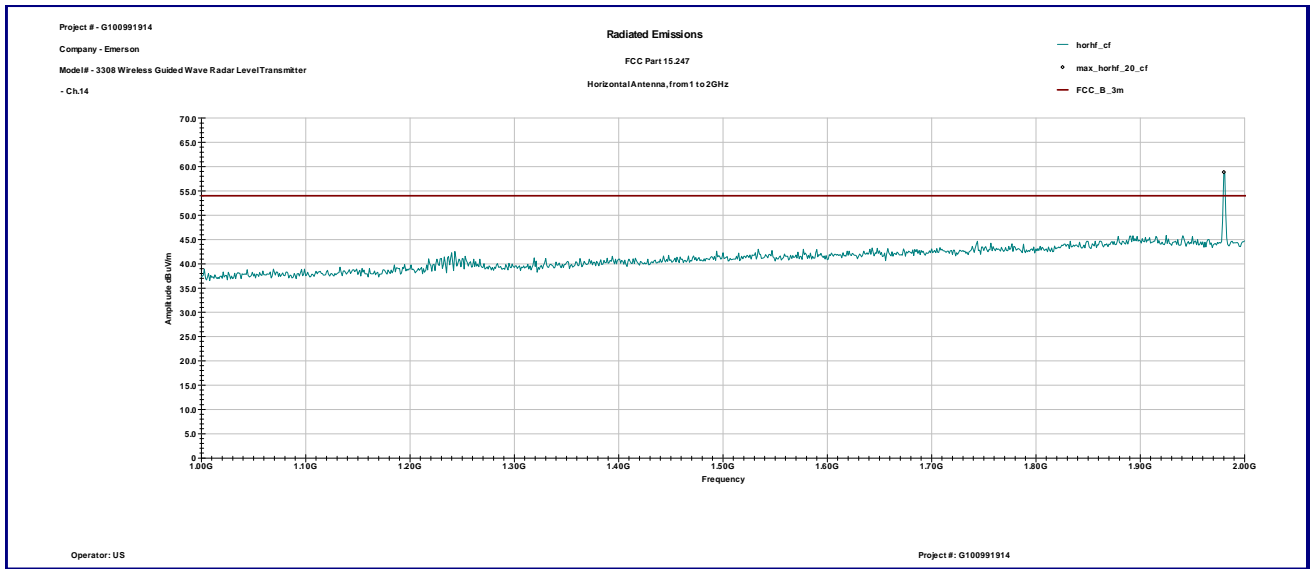
Graph 3.2.17



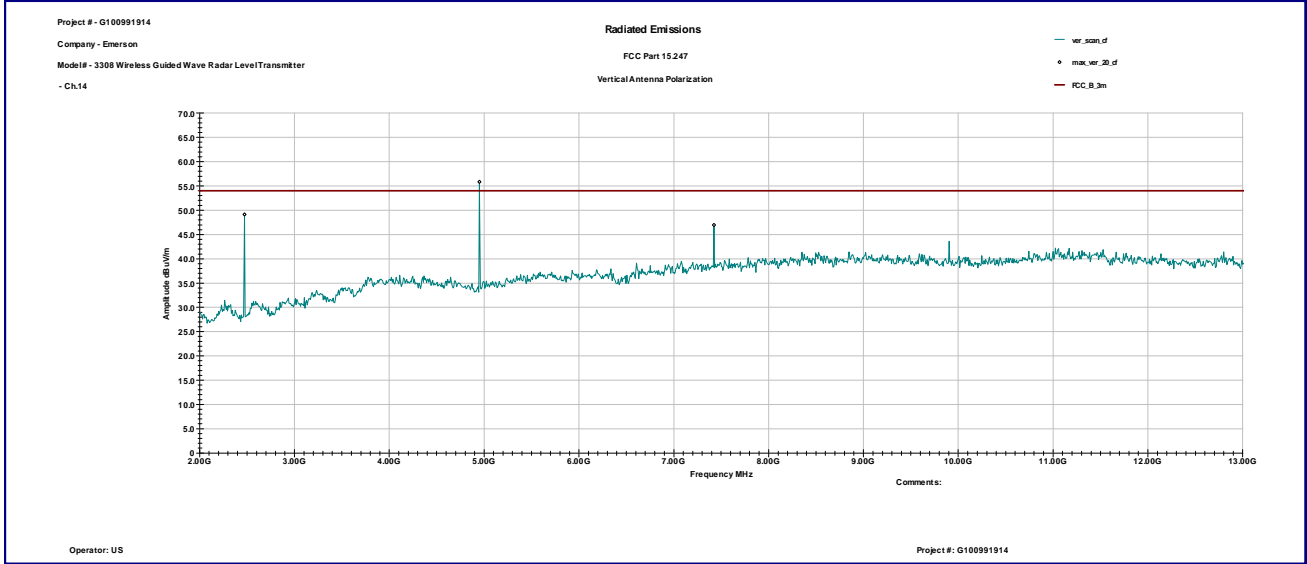
Graph 3.2.18



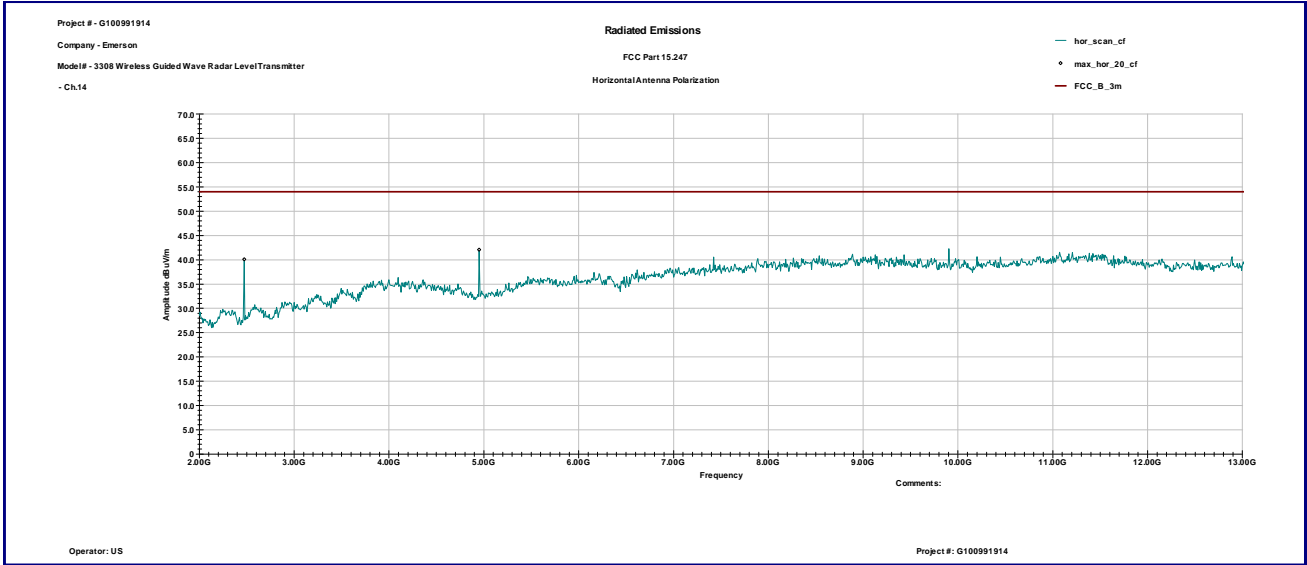
Graph 3.2.19



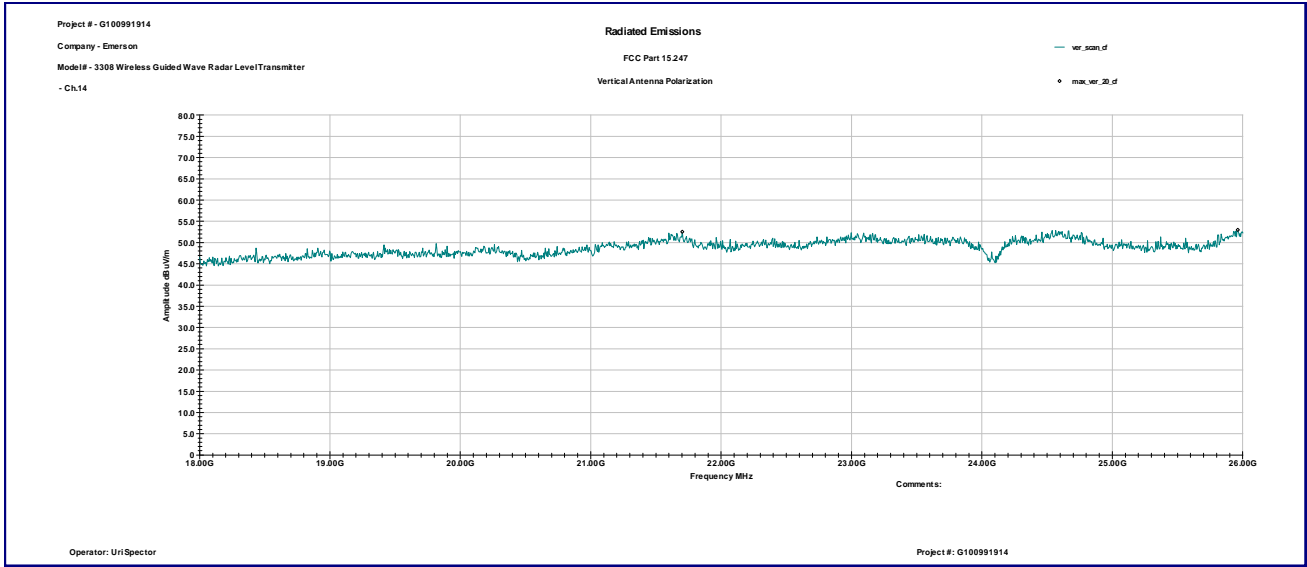
Graph 3.2.20



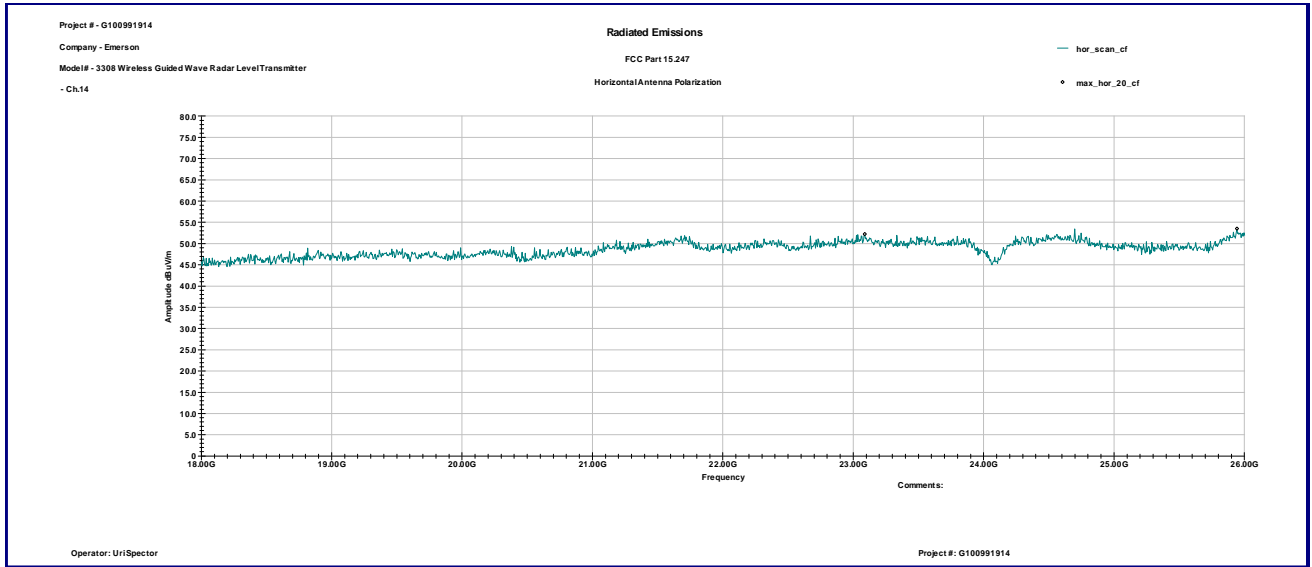
Graph 3.2.21



Graph 3.2.22



Graph 3.2.23



Graph 3.2.24



3.6 RF Exposure Compliance

The maximum measured antenna conducted power, P is 8.6dBm

The antenna gain, G is 4.5dBi

The maximum EIRP power = P + G
ERP = 8.6+ 4.5=13.1dBm, or 0.02W

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 $10 = 0.02 / 4\pi D^2$,

The minimum safe separation distance, D = 1.26cm, 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

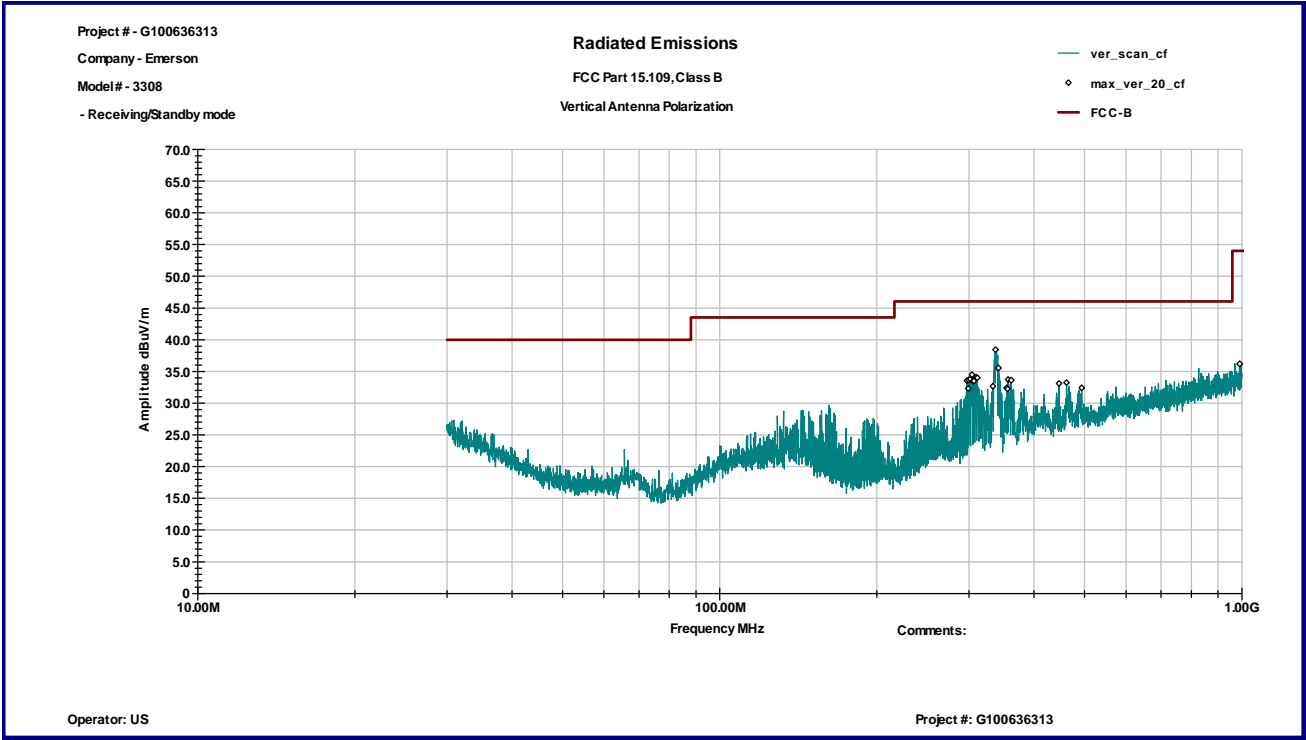
Notes: The Radiated Emissions test was performed in the Anechoic chamber at 3m measurement distance (see Table 3.8.1 and Graphs 3.8.1-3.8.4).



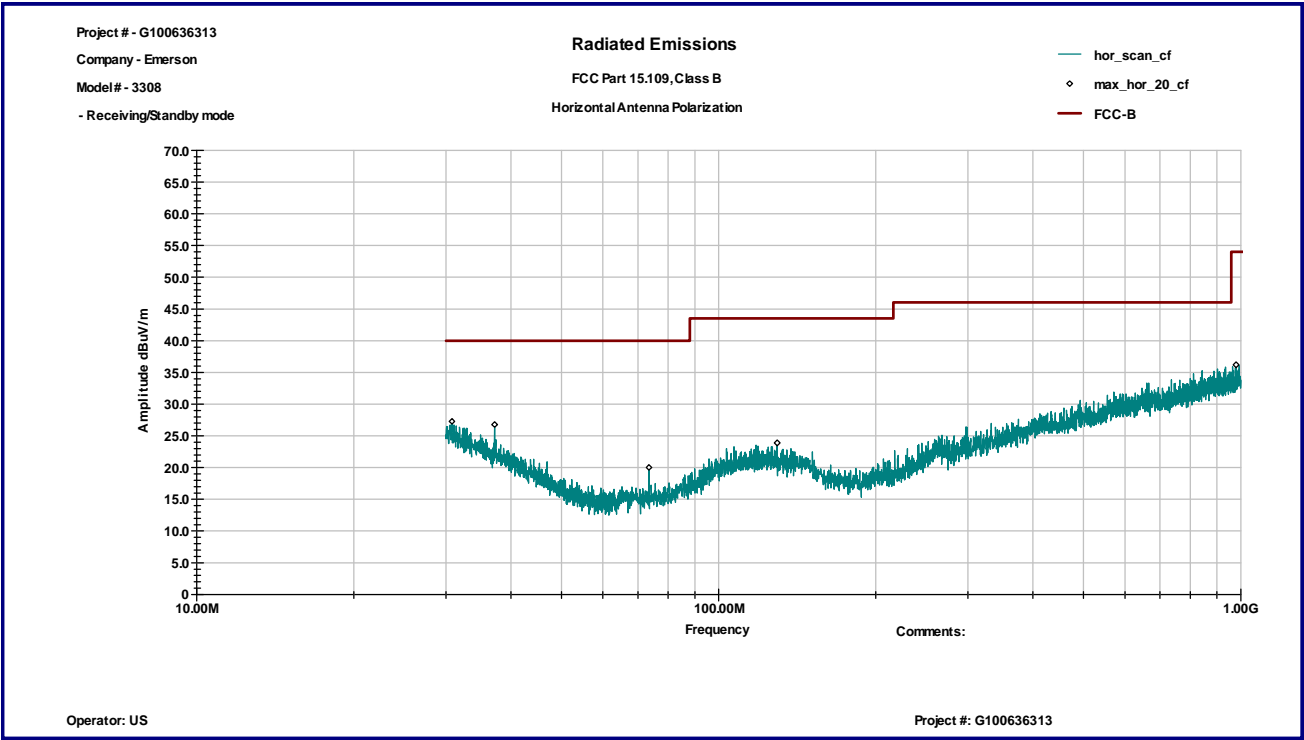
Date:	February 7, 2012	Result: Pass
Standard:	FCC Part 15.109, Class B	
Tested by:	Uri Spector	
Test Point:	Enclosure	
Operation mode:	Receiving Mode	
Note:	None	

Table 3.8.1

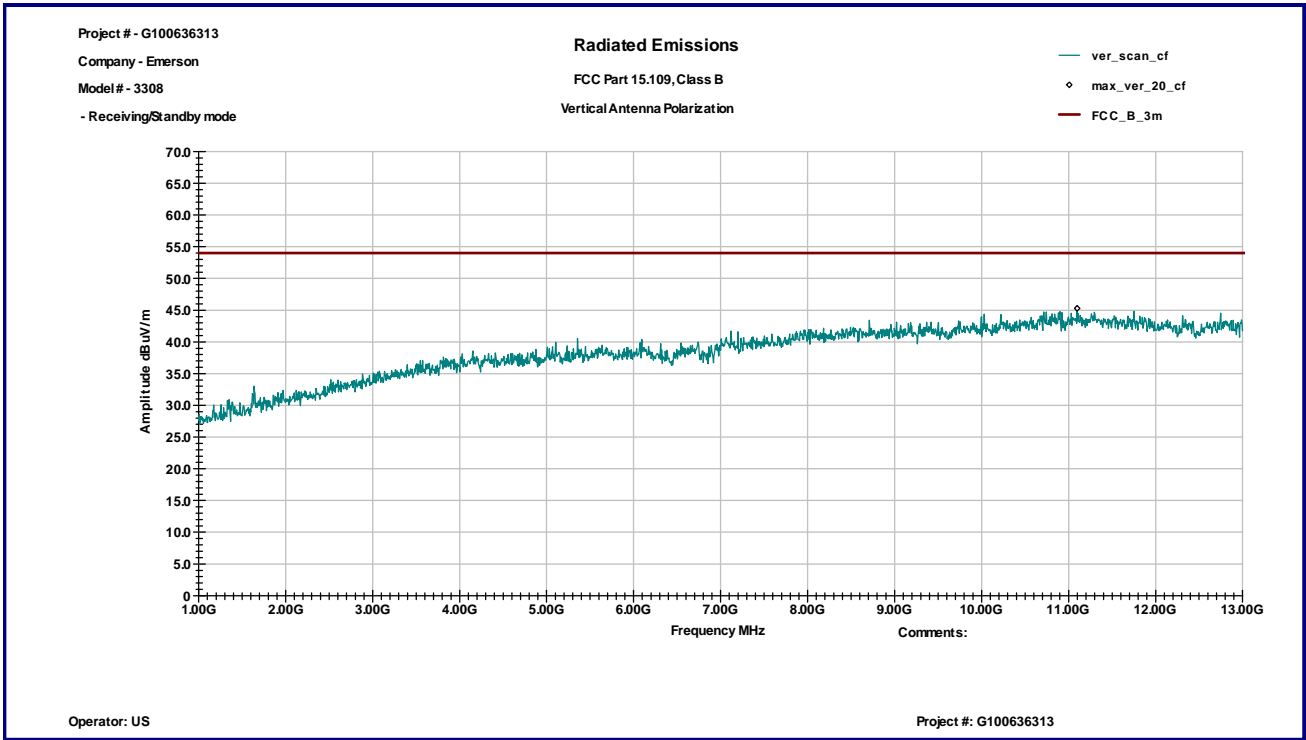
Frequency	Ant. Polarity	Peak Reading dB μ V	Ant.Factor dB1/m	Total at 3m dB μ V/m	Limit dB μ V/m	Margin dB
304.16 MHz	V	18.4	16.0	34.5	46.0	-11.5
311.43 MHz	V	17.7	16.3	34.0	46.0	-12.0
333.59 MHz	V	15.8	16.8	32.7	46.0	-13.4
337.4 MHz	V	21.5	16.9	38.4	46.0	-7.6
341.91 MHz	V	18.5	17.0	35.5	46.0	-10.5
446.5 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



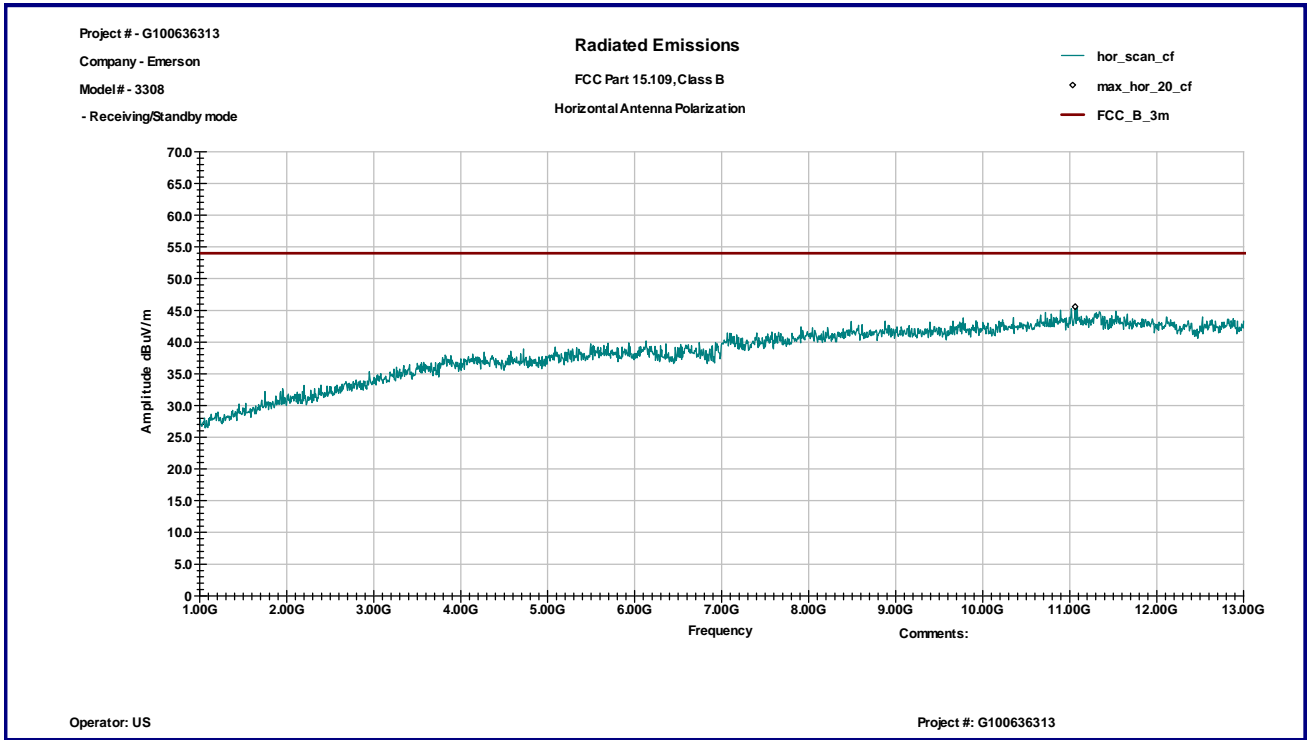
Graph 3.8.1



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: [redacted] 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

For testing performed from February 6-13, 2012

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

For testing performed from December 17, 2012 to January 4, 2013

DESCRIPTION	MANUFACTURER	MODEL	SERIAL NO.	INTERTEK ID	CAL DUE	USED
Spectrum Analyzer	R & S	FSP 40	100024	12559	11/29/2013	<input checked="" type="checkbox"/>
Spectrum Analyzer	R & S	ESCI	100358	12909	07/02/2013	<input checked="" type="checkbox"/>
Bicono-Log Antenna	Teseq	CBL6112D	32859	25289	08/09/2013	<input checked="" type="checkbox"/>
Horn Antenna	EMCO	3115	9507-4513	9936	05/16/2013	<input checked="" type="checkbox"/>
Horn Antenna	EMCO	3115	6579	15580	07/19/2013	<input checked="" type="checkbox"/>
Pre-Amplifier	MITEQ	AMF-5D-00501800-28-13P	1122951	13475	11/01/2013	<input checked="" type="checkbox"/>
Pre-Amplifier	MITEQ	AMF-6F-16002600-25-10P	1222383	MIN-0065	11/01/2013	<input checked="" type="checkbox"/>
High Pass Filter	Reactel	7HS-4G-S12	0223	015274	VBU	<input checked="" type="checkbox"/>
System	Quantum Change	TILE! Instrument Control	Ver. 3.4.K.29	15259	VBU	<input checked="" type="checkbox"/>