



TEST REPORT

Report Number: 101673336MIN-003

Project Number: G101673336

Testing performed on the
248DX

FCC ID: LW2248DX

Industry Canada ID: 2731A-248DX

to

47 CFR Part 15.247:2013

RSS- 210, Issue 8, 2010

RSS-Gen, Issue 3, 2010

47 CFR, Part 15:2013, §15.107 and §15.109, Class / ICES-003, Issue 5:2012

For

Emerson Process Management

Test Performed by:
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Test Authorized by:
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Date: June 6, 2014

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Simon Khazon

Date: June 6, 2014

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TABLE OF CONTENTS

1.0	GENERAL DESCRIPTION.....	3
1.1	Product Description; Test Facility	4
1.3	Environmental conditions.....	5
1.4	Measurement uncertainty	6
1.5	Field Strength Calculation.....	6
2.0	TEST SUMMARY.....	7
3.0	TEST CONDITIONS AND RESULTS.....	8
3.1	6dB DTS bandwidth of the digital modulation	8
3.2	Maximum peak output power.....	12
3.3	Power spectral density	16
3.4	Antenna conducted spurious emissions.....	20
3.5	Radiated spurious emissions.....	29
3.6	RF Exposure Compliance	46
3.7	Transmitter power line conducted emissions	47
3.8	Receiver/digital device radiated emissions.....	48
3.9	Digital device conducted emissions.....	52
4.0	TEST EQUIPMENT.....	53
5.0	REVISION HISTORY.....	54



1.0 GENERAL DESCRIPTION

Model:	248DX
Type of EUT:	Temperature transmitter
Serial Number:	N/A
FCC ID:	LW2248DX
Industry Canada ID:	2731A-248DX
Related Submittal(s) Grants:	None
Company:	Emerson Process Management
Customer:	Mr. Merritt Pulkrabek
Address:	8200 Market Blvd., Mail Stop SB4L Chanhassen, MN 55317
Phone:	(952) 949-5193
Fax:	(952) 949-7626
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Test Standards:	☒ 47 CFR, Part 15:2013, §15.247 ☒ RSS-210, Issue 8, 2010 ☒ RSS-Gen, Issue 3, 2010 ☒ 47 CFR, Part 15:2013, §15.107 and §15.109, Class B ☒ ICES-003, Issue 5:2012 ☐ Other
Type of radio:	☐ Stand -alone ☐ Module ☐ Hybrid
Date Sample Submitted:	June 2, 2014
Test Work Started:	June 2, 2014
Test Work Completed:	June 5, 2014
Test Sample Conditions:	☐ Damaged ☐ Poor (Usable) ☒ Good



1.1 Product Description; Test Facility

Product Description:	2.4 – 2.4835GHz Transceiver
Transmitter Type:	☐ FHSS ☒ Digital Modulation ☐ WiFi ☐ Blue Tooth
Operating Frequency Range(s):	From 2404.9 – 2474.8MHz
Number of Channels:	16
Modulation:	QPSK
Emission Designator:	1M53G7D
Antenna(s) Info:	Antenna Type: Omni directional Trace antenna Gain: 2dBi
Antenna Installation:	☐ User ☐ Professional ☒ Factory
Transmitter power configuration:	☐ Internal battery ☐ External power source ☐ 120VAC ☐ 230VAC ☐ 400VAC ☒ 3VDC ☐ 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 558074 D01 DTS Measurement Guidance

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	Wire	0.25m	Thermocouple wire	

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:



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
5.247(a) / RSS-210 A8.2	6dB DTS bandwidth of the digital modulation	Pass
15.247(b), (c) / RSS-210 A8.4	Maximum peak output power	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

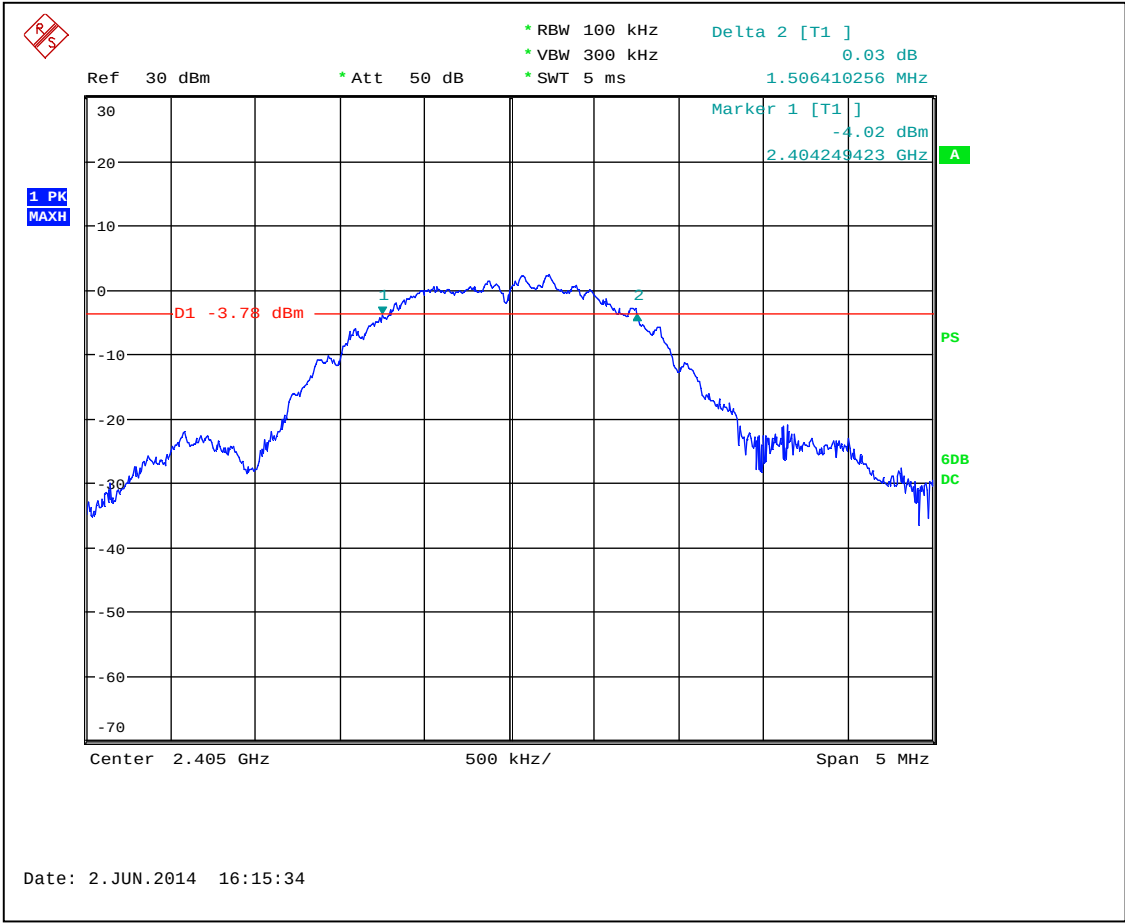


3.0 TEST CONDITIONS AND RESULTS

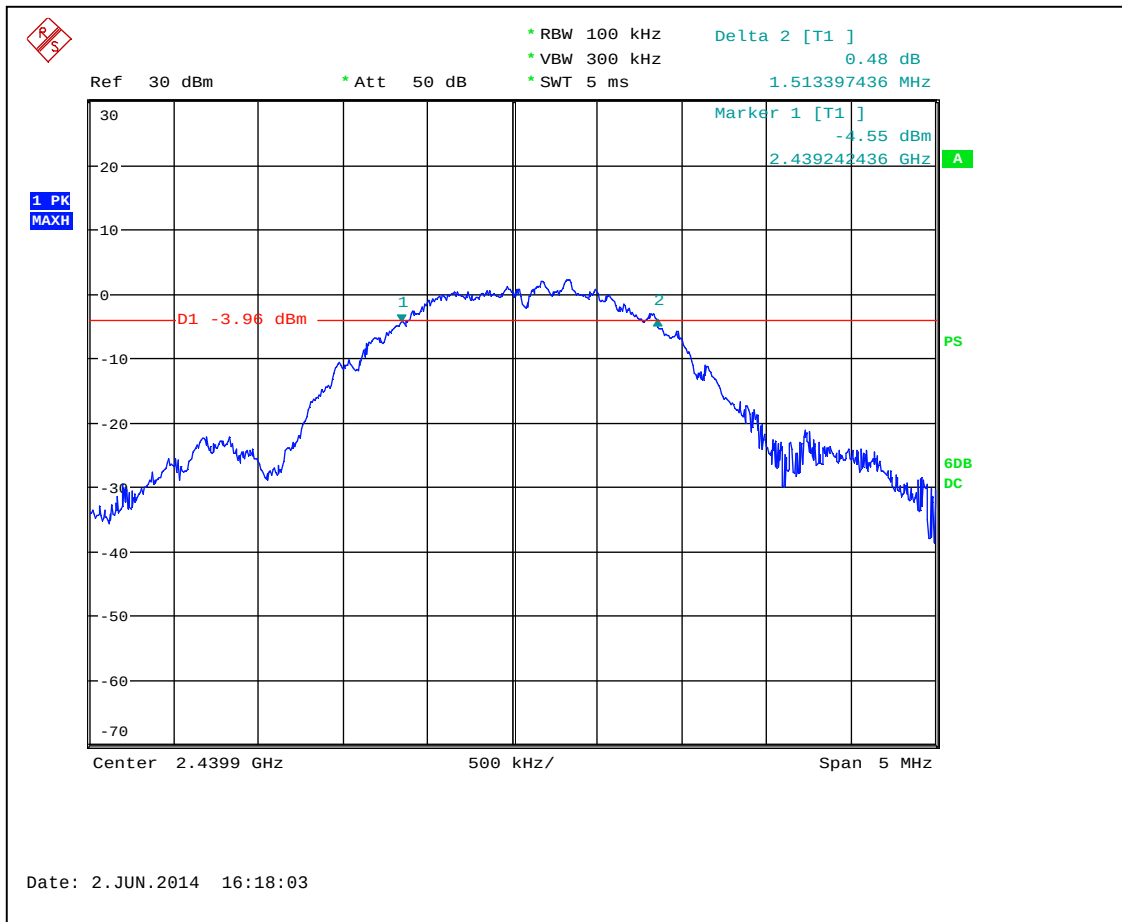
3.1 6dB DTS bandwidth of the digital modulation

Low Frequency Channel kHz	Middle Frequency Channel kHz	Upper Frequency Channel kHz	Minimum Bandwidth kHz	Result
1506.41	1513.39	1530.44	500	Pass
RBW: ☒ 100kHz VBW: ☒ 300kHz				

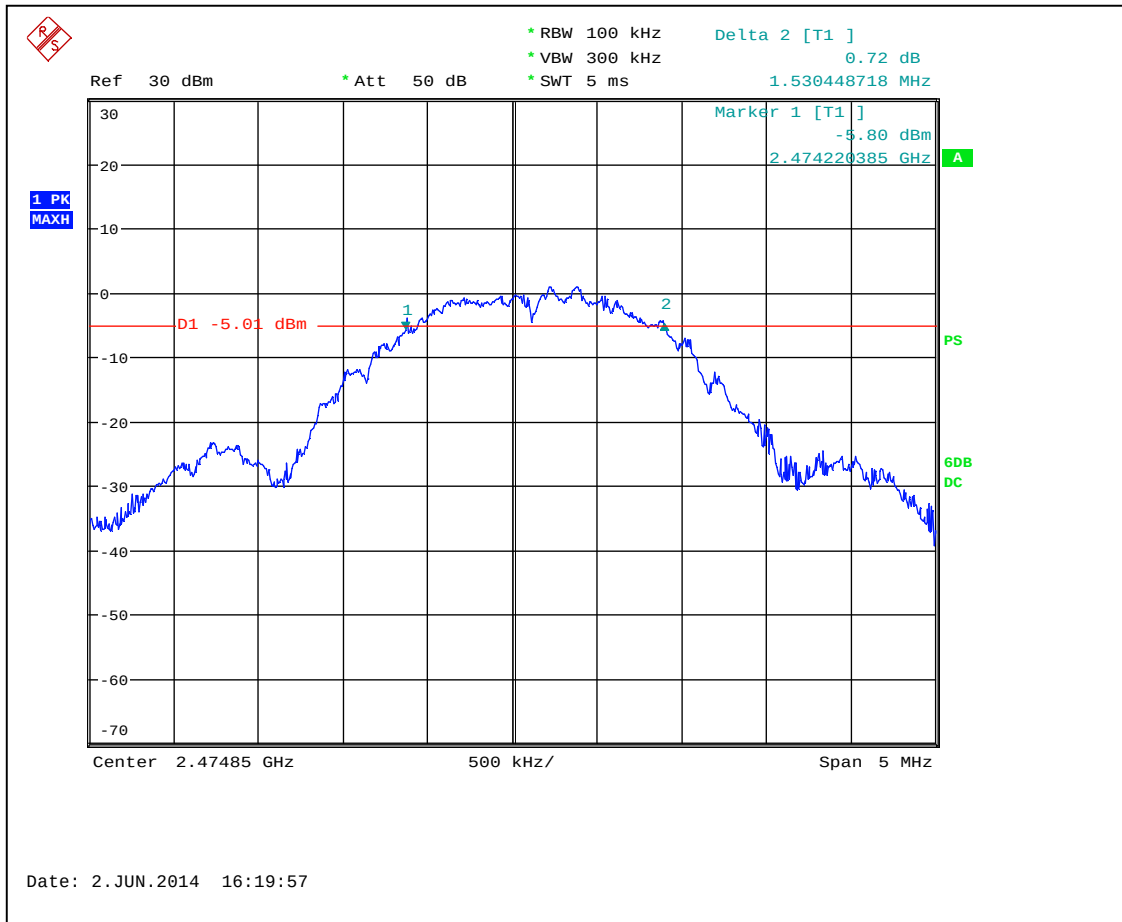
Notes: Graphs 3.1.1 to 3.1.3 show the 6dB bandwidth



Graph 3.1.1



Graph 3.1.2



Graph 3.1.3



3.2 Maximum peak output power

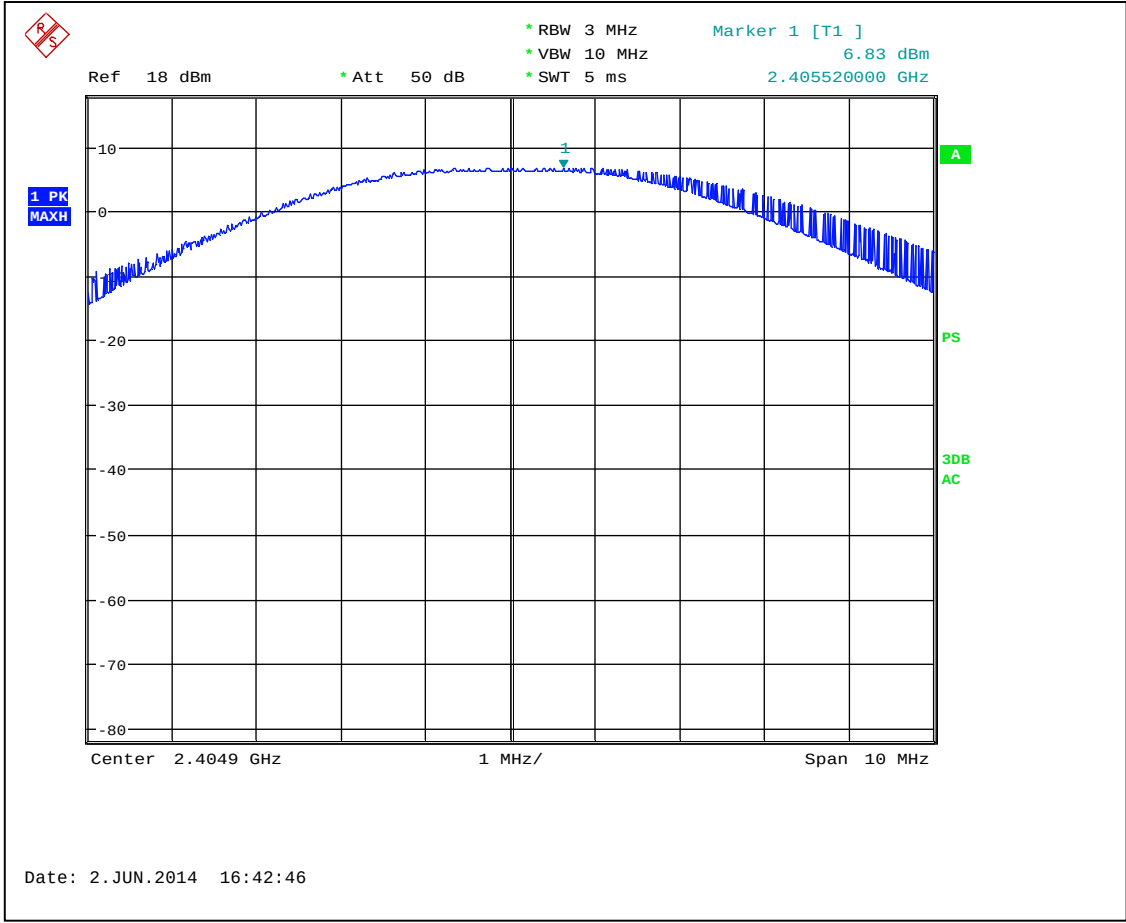
Test location: ☐ OATS ☒ Anechoic Chamber ☐ Other

Test result: **Pass**

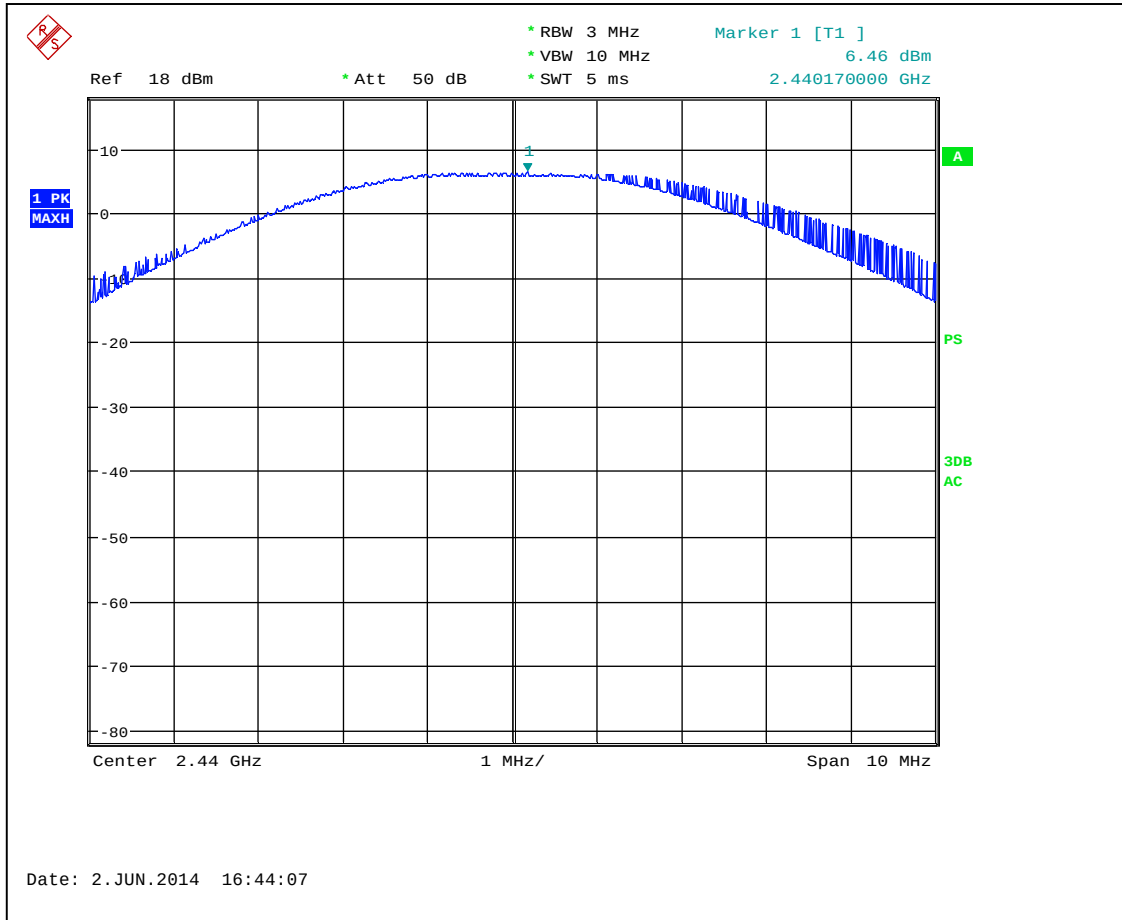
Max. Margin: 21.07dB below the limits

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
2404.90	6.83	2.1	8.93	30	0	-21.07
Middle Frequency MHz						
2440.00	6.46	2.1	8.56	30	0	-21.44
Upper Frequency MHz						
2474.80	5.60	2.1	7.70	30	0	-22.30
RBW:	☐ 1MHz ☒ 3MHz ☐ 10MHz					
VBW:	☐ 1MHz ☐ 3MHz ☒ 10MHz					
Antenna Gain:	☒ < 6dBi ☐ >6dBi and = dBi, Output power reduction = dB					

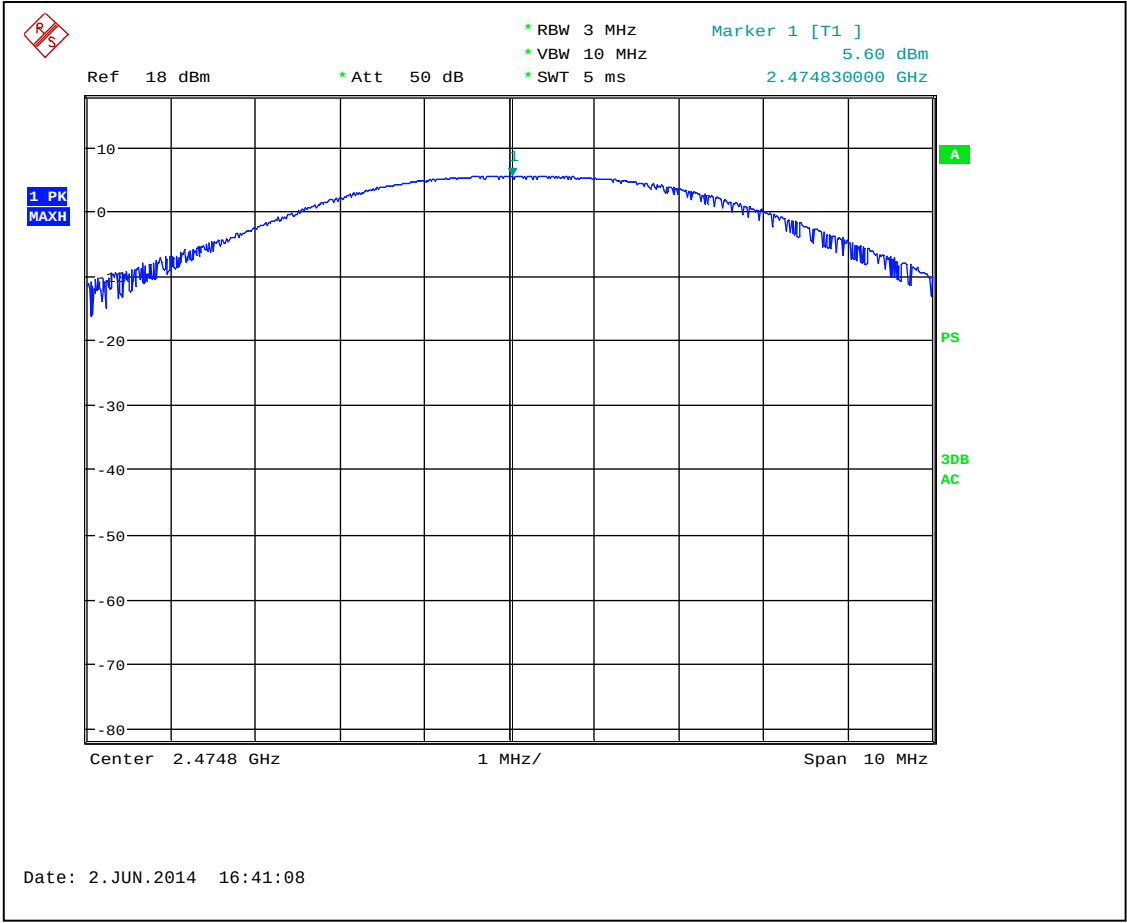
Notes:



Graph 3.2.1



Graph 3.2.2



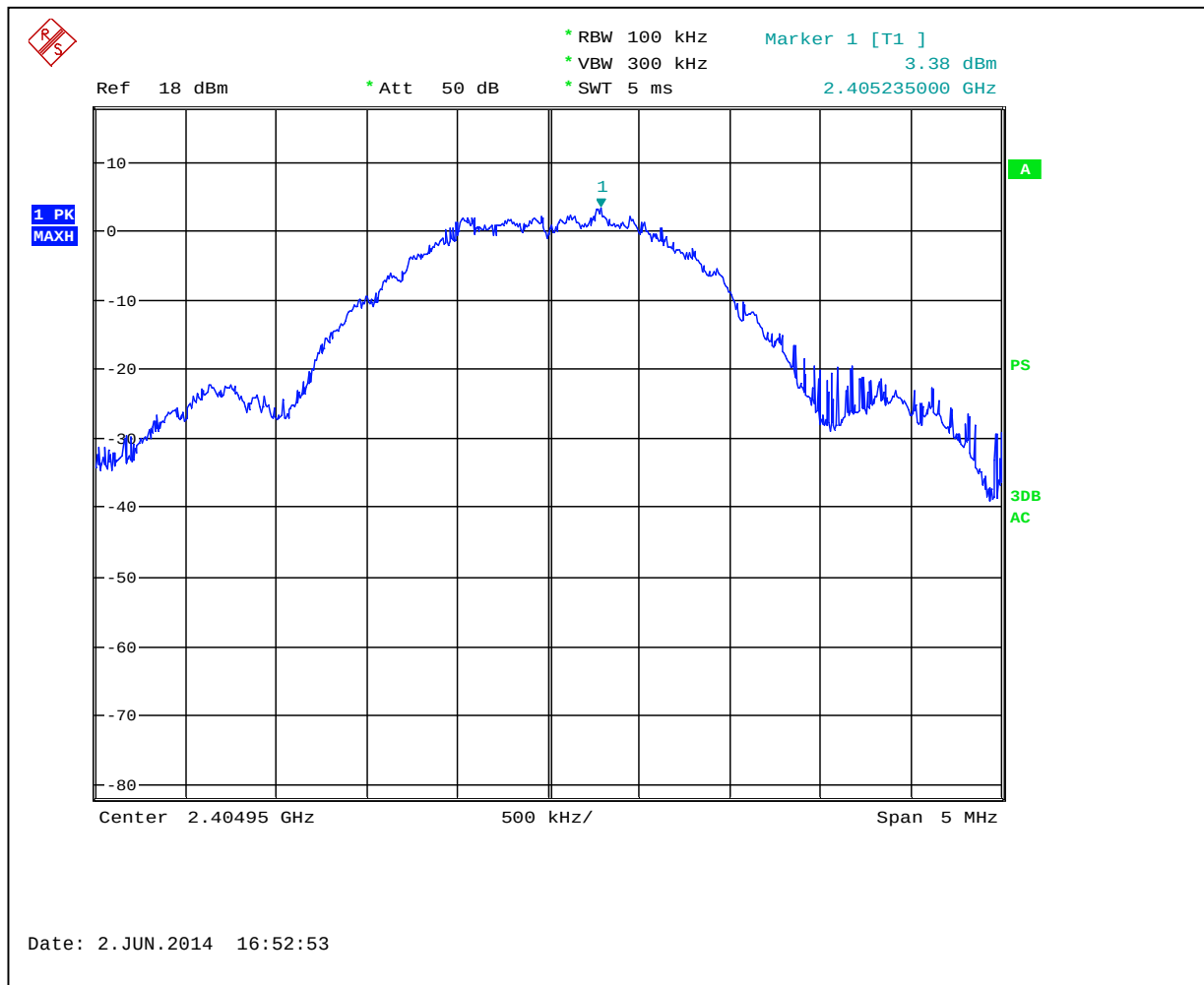
Graph 3.2.3



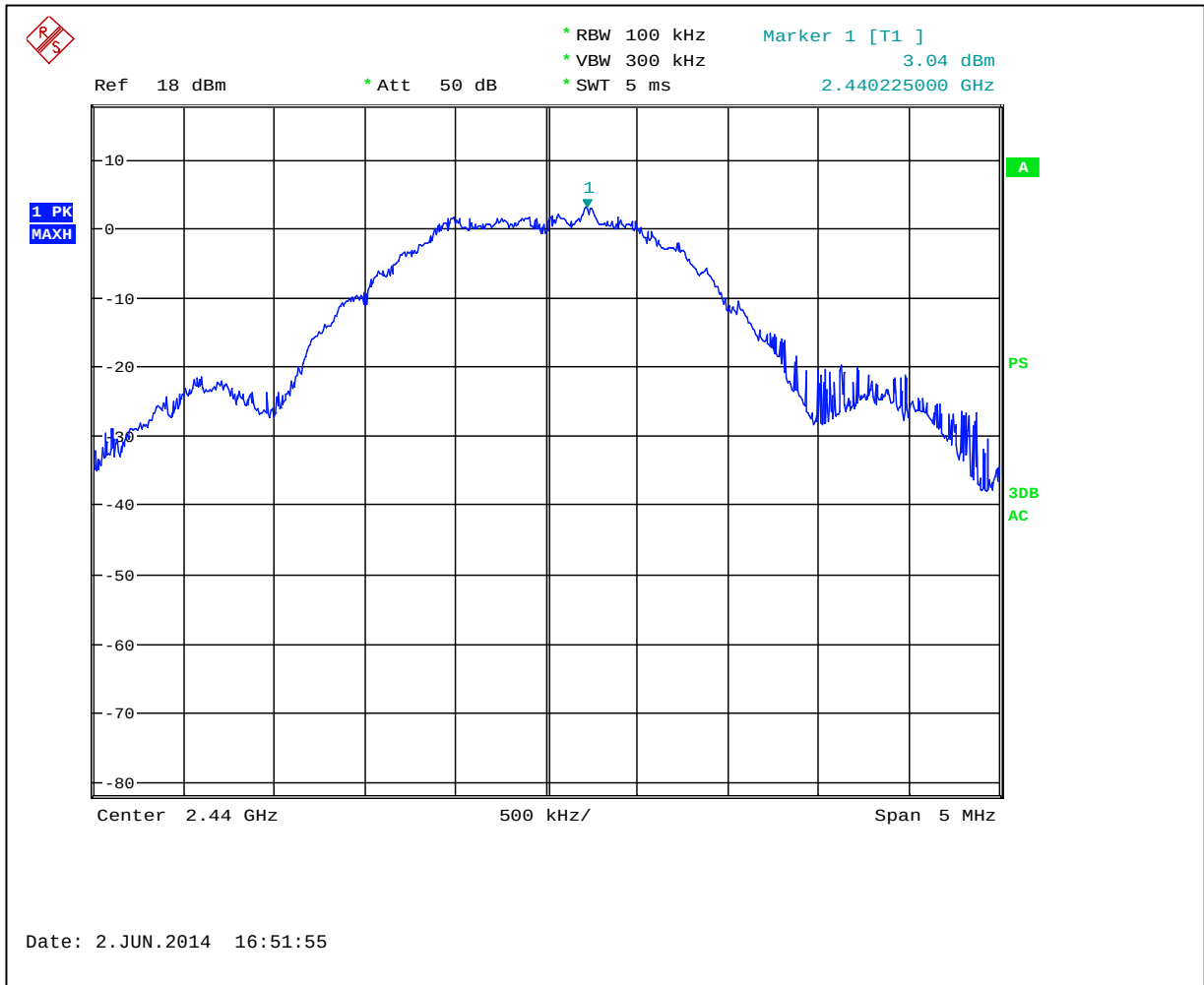
3.3 Power spectral density

Power Output:	☒ Conducted ☐ Radiated			
	Measured Density dBm	Power Spectral Density dBm	Limit dBm	Margin dB
Low Frequency Channel	3.38	5.48	8	-2.52
Middle Frequency Channel	3.04	5.14	8	-3.86
Upper Frequency Channel	2.23	4.33	8	-3.67
Analyzer Settings:	☒ RBW=100KHz ☒ VBW=300KHz ☒ Span=5MHz ☒ Sweep=Auto			
Antenna Gain:	☒ < 6dBi and = 2dBi ☐ >6dBi and = dBi, limit reduction = dB			

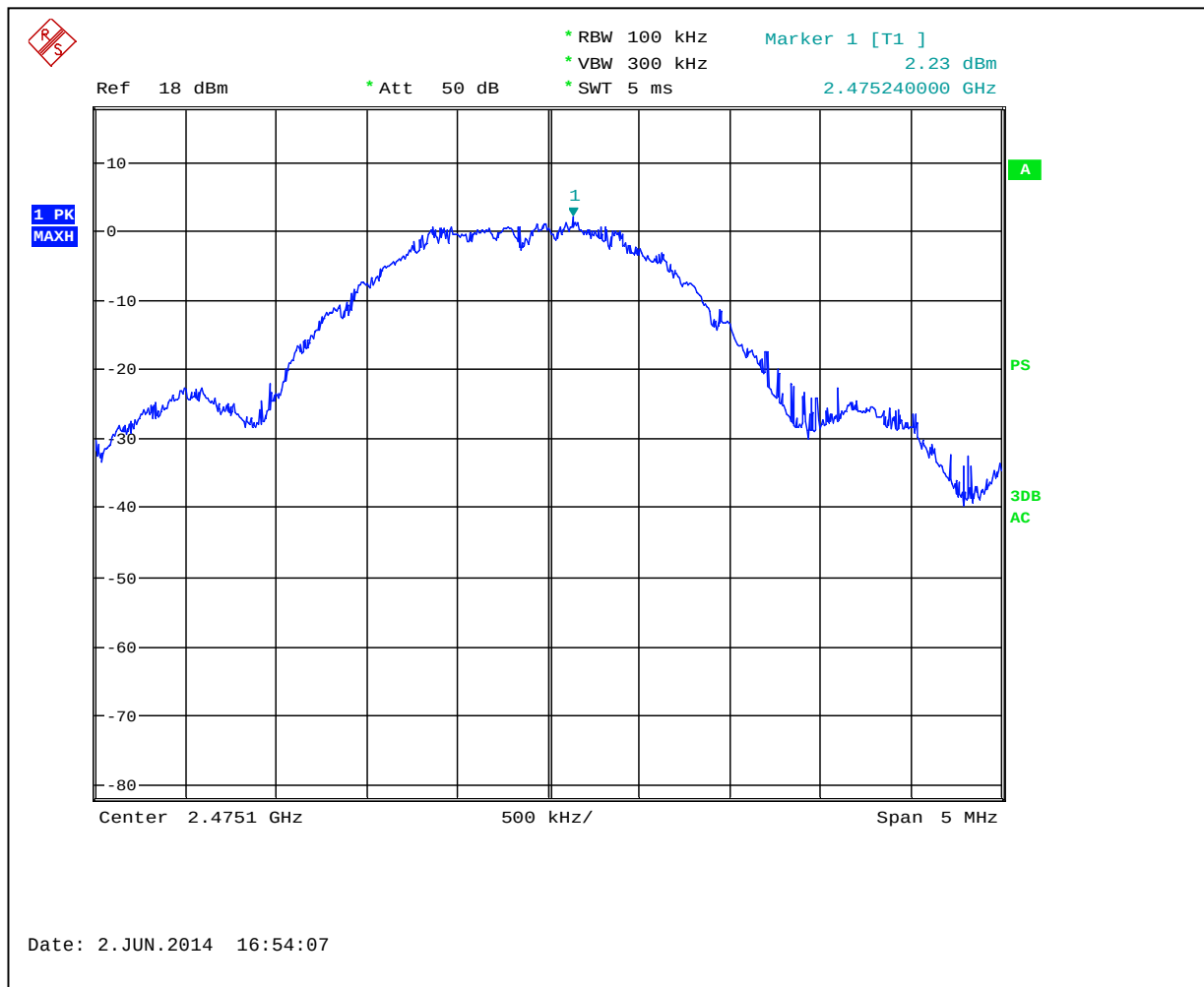
Notes: The Power Spectral Density was calculated adding the cable/attenuator loss of 2.1 dB from the measured density value.
Graphs 3.3.1 to 3.3.3 show the Power Spectral Density



Graph 3.3.1



Graph 3.3.2



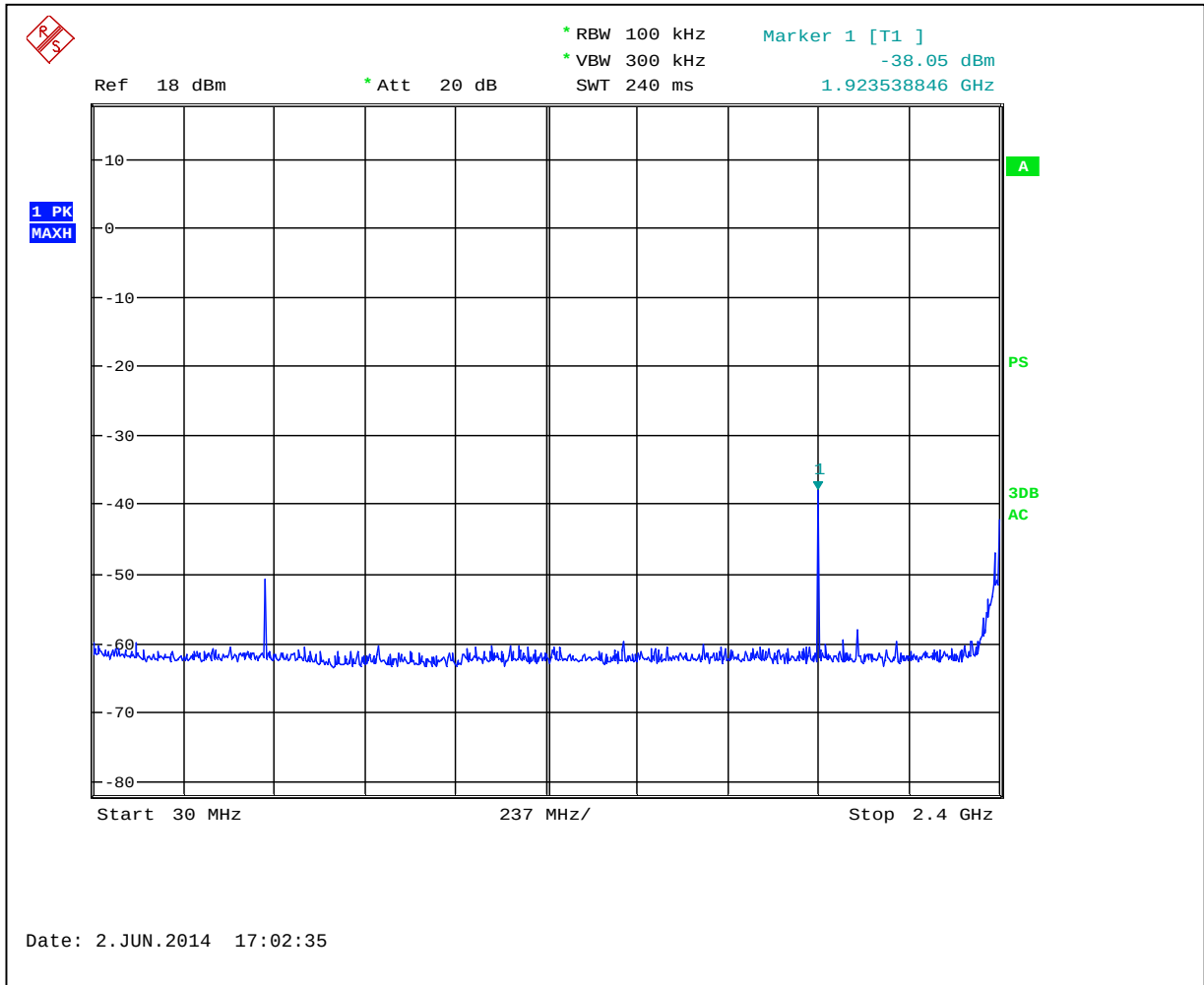
Graph 3.3.3



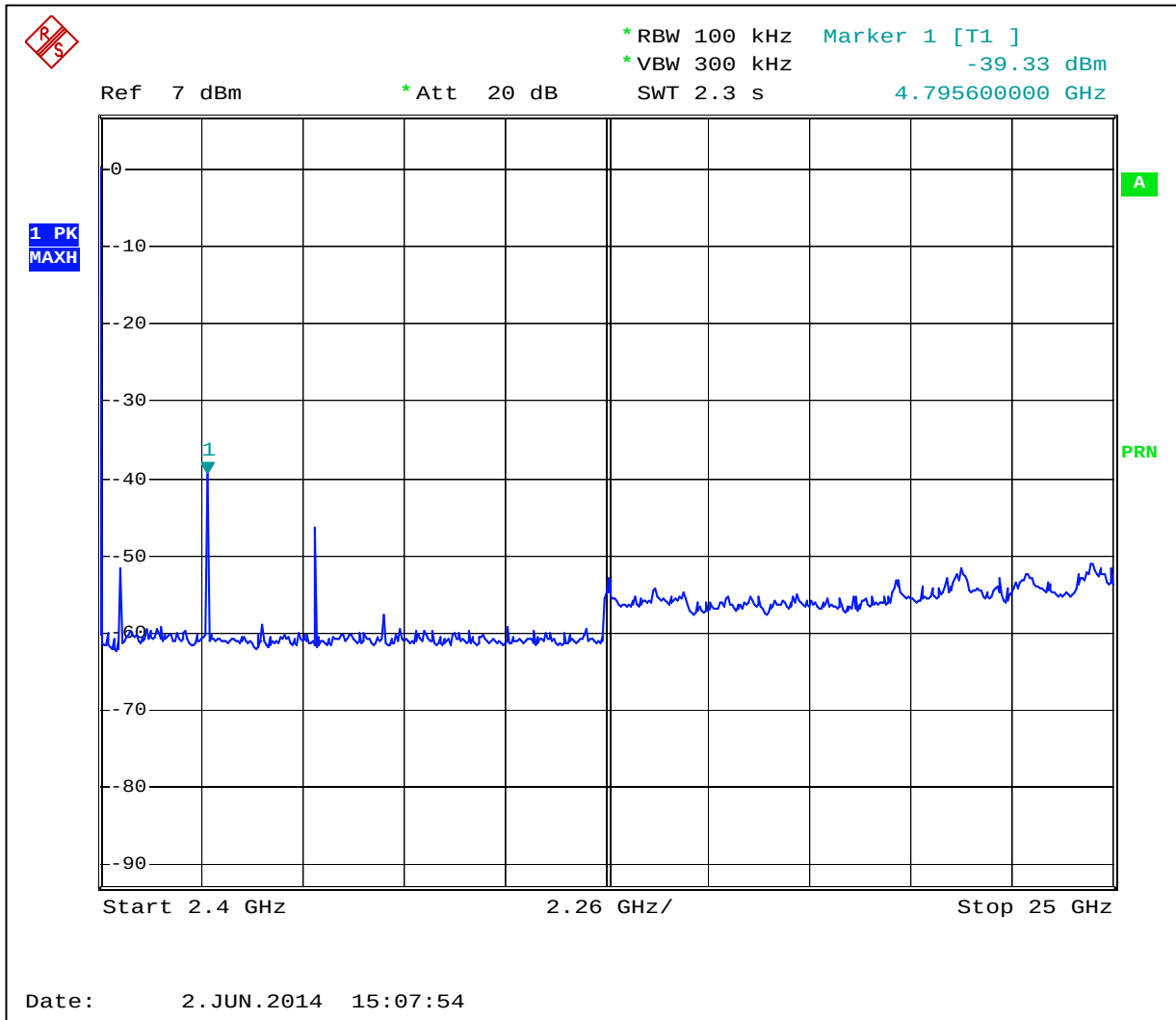
3.4 Antenna conducted spurious emissions

	Minimum Measured Attenuation dB	Minimum Allowed Attenuation dB	Margin dB
Low Frequency Channel	44.9	20	-24.9
Middle Frequency Channel	46.5	20	-26.5
Upper Frequency Channel	39.0	20	-19.0
Analyzer Settings:	☒ RBW=100KHz		
Minimum Allowed Attenuation:	☒ 20dB ☐ 30dB (for digital systems with conducted power measured using RMS averaging over a time interval)		

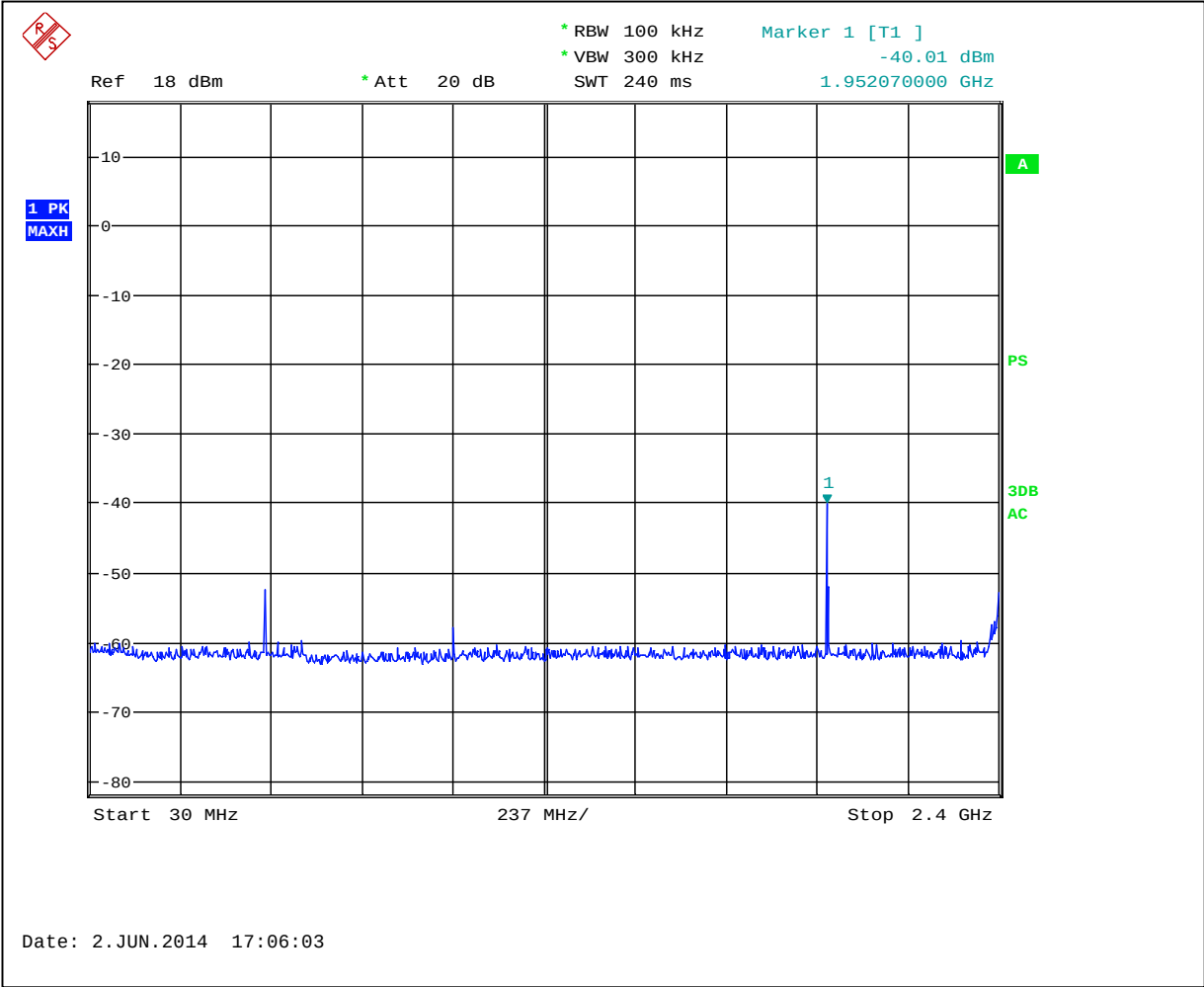
Notes: Test was performed in frequency range from 30MHz to 25GHz
Graphs 3.4.1 to 3.4.2 show the Antenna Conducted Spurious Emissions for channel 0
Graphs 3.4.3 to 3.4.4 show the Antenna Conducted Spurious Emissions for channel 7
Graphs 3.4.5 to 3.4.6 show the Antenna Conducted Spurious Emissions for channel 14
Graph 3.4.7 shows band edge compliance at 2400MHz
Graph 3.4.8 shows band edge compliance at 2483.5MHz



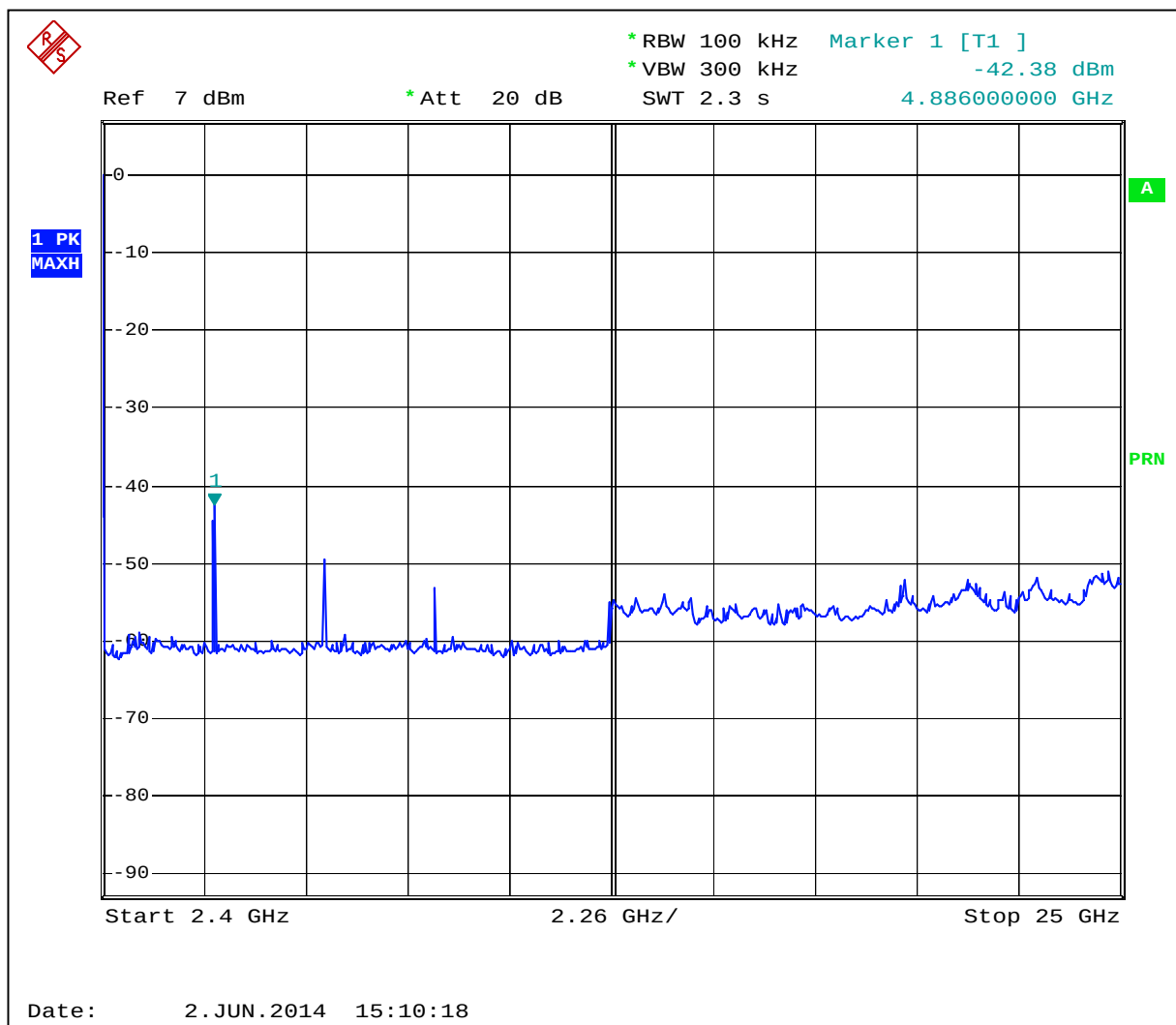
Graph 3.4.1



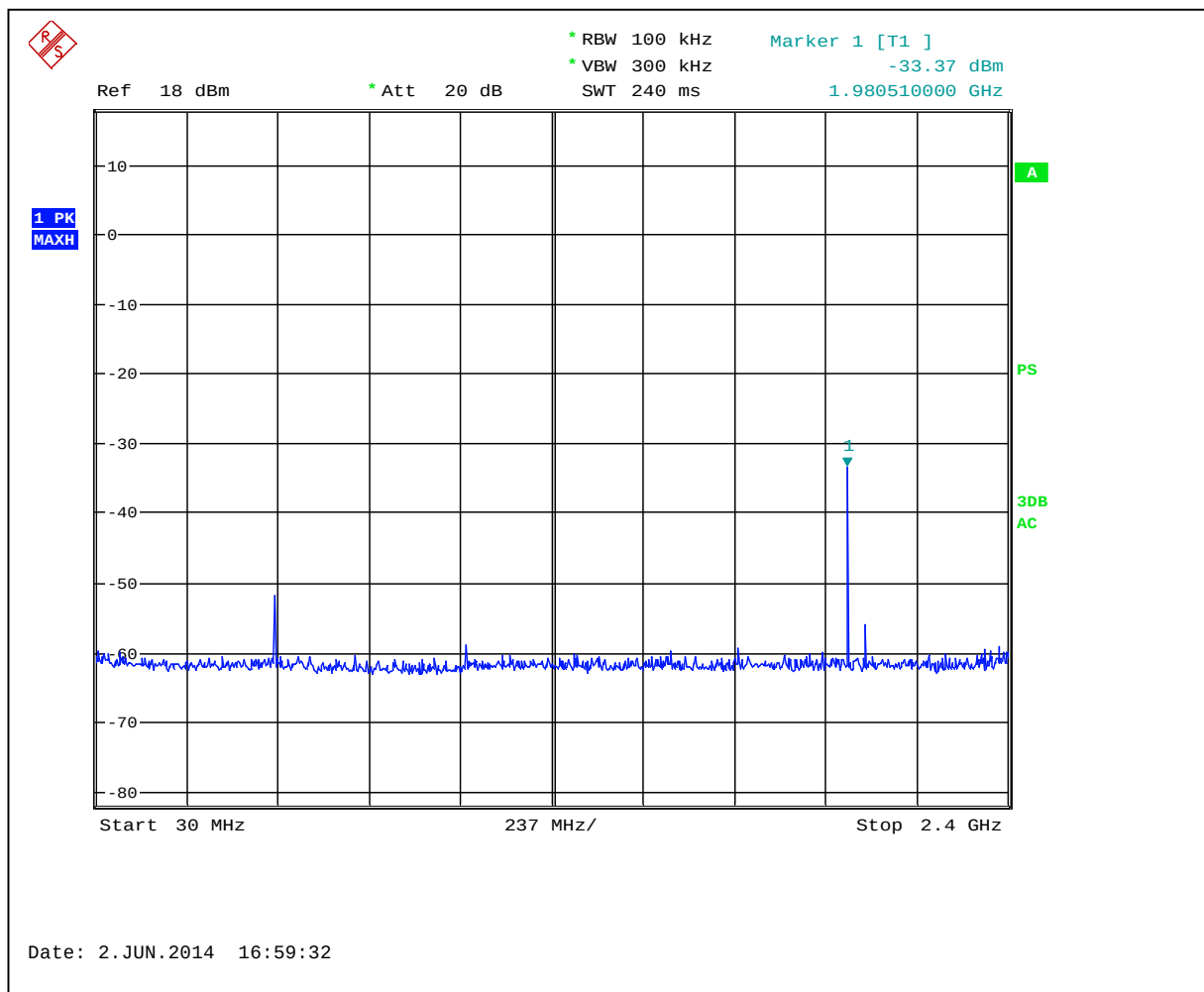
Graph 3.4.2



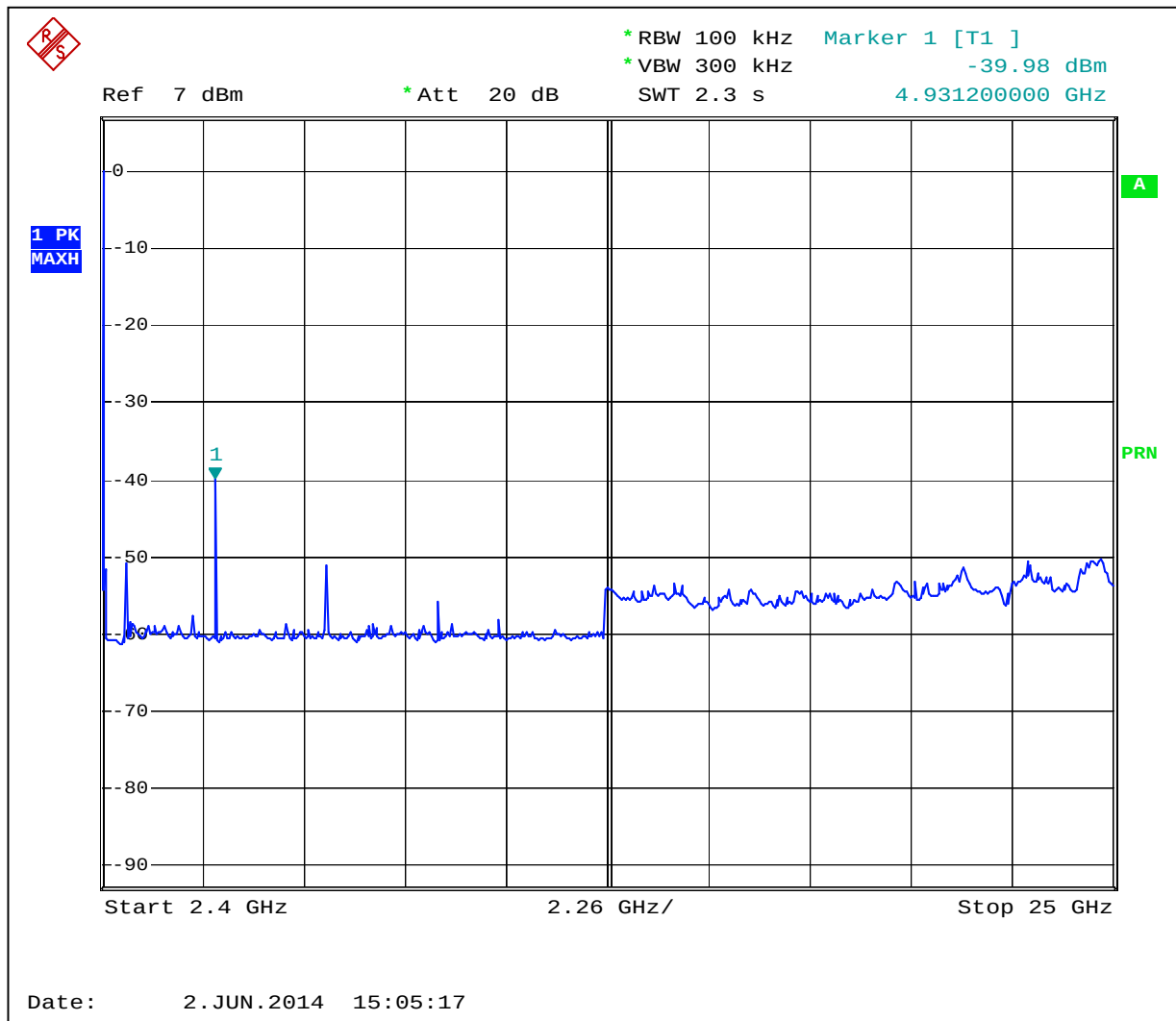
Graph 3.4.3



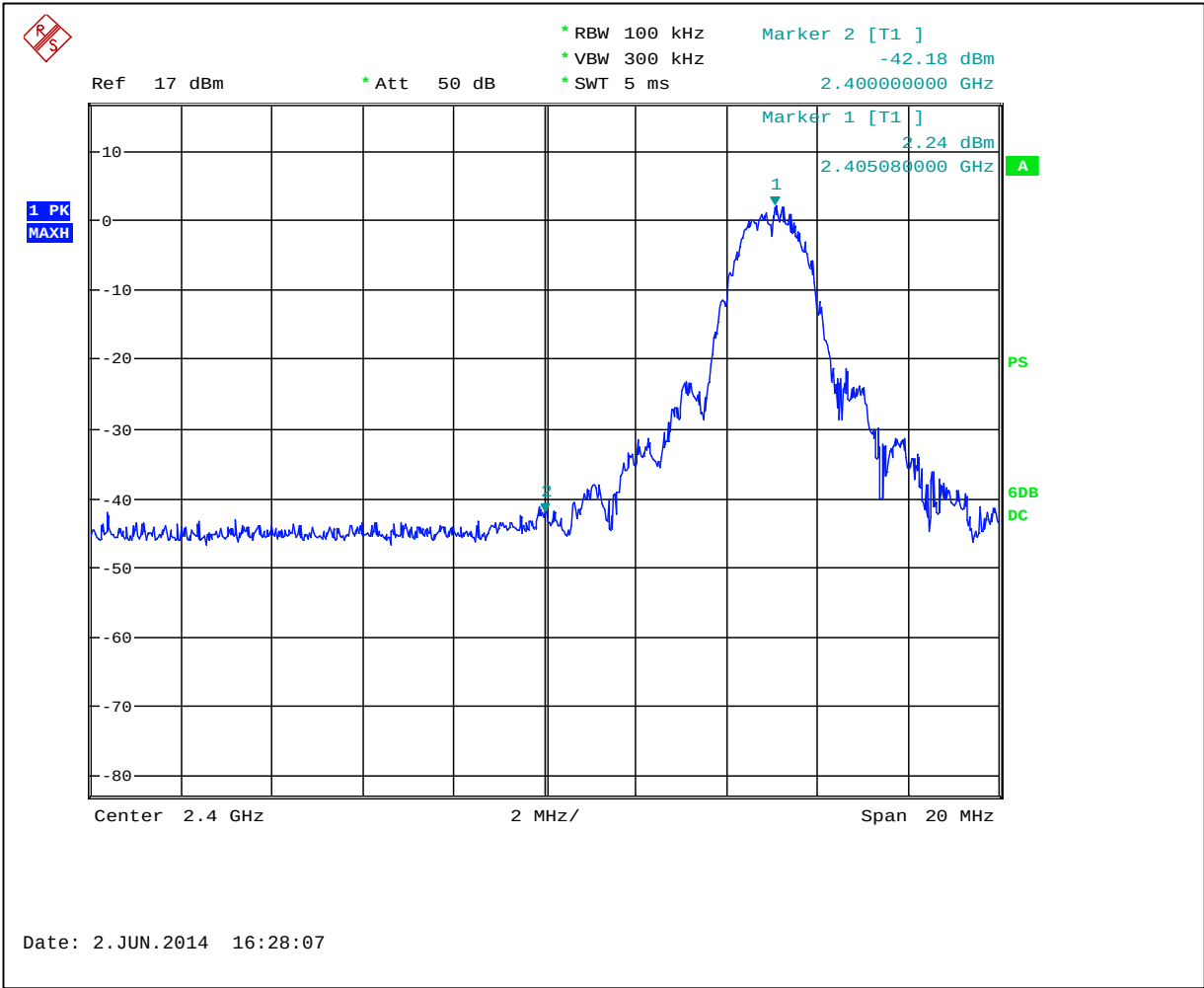
Graph 3.4.4



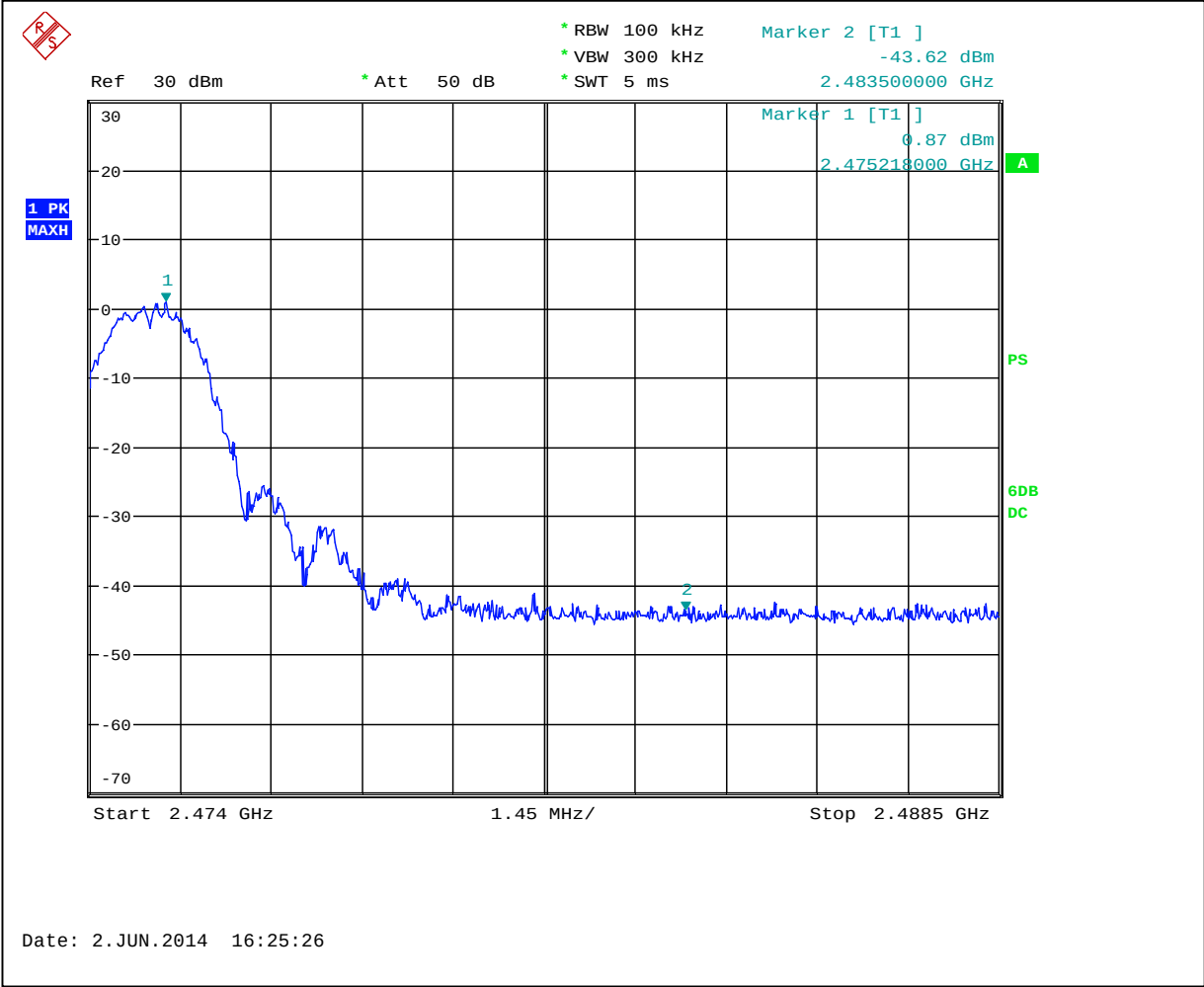
EMC Report No: 101673336MIN-003 FCC ID: LW2248DX IC ID: 2731A-248DX Page 25 of 54



Graph 3.4.6



Graph 3.4.7



Graph 3.4.8



3.5 Radiated spurious emissions

Test location: ☐ OATS ☒ Anechoic Chamber ☐ Other

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

Test result: **Pass**

Max. Margin: 1.7dB below the limits

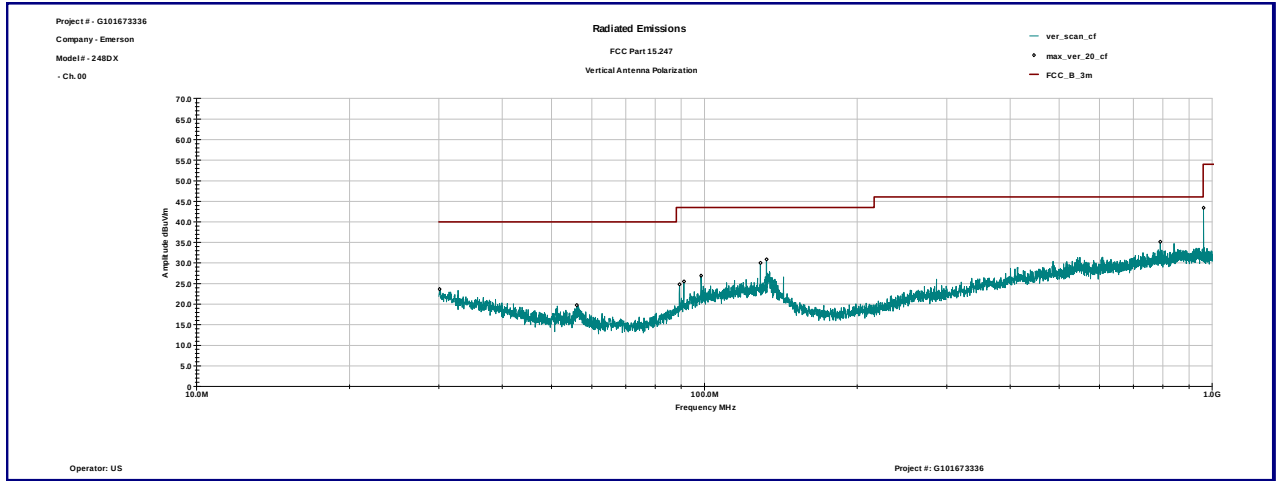
Notes: The table 3.5.1 shows the spurious and harmonics emissions in restricted band of operation per FCC 15.205.
Emissions not related with transmission operation, at fundamental frequencies and outside restricted band of operation per FCC 15.205 were excluded from the table.

Graphs 3.5.1 to 3.5.10 show Radiated Spurious Emissions for channel 0
Graphs 3.5.11 to 3.5.20 show Radiated Spurious Emissions for channel 7
Graphs 3.5.21 to 3.3.30 show Radiated Spurious Emissions for channel 14

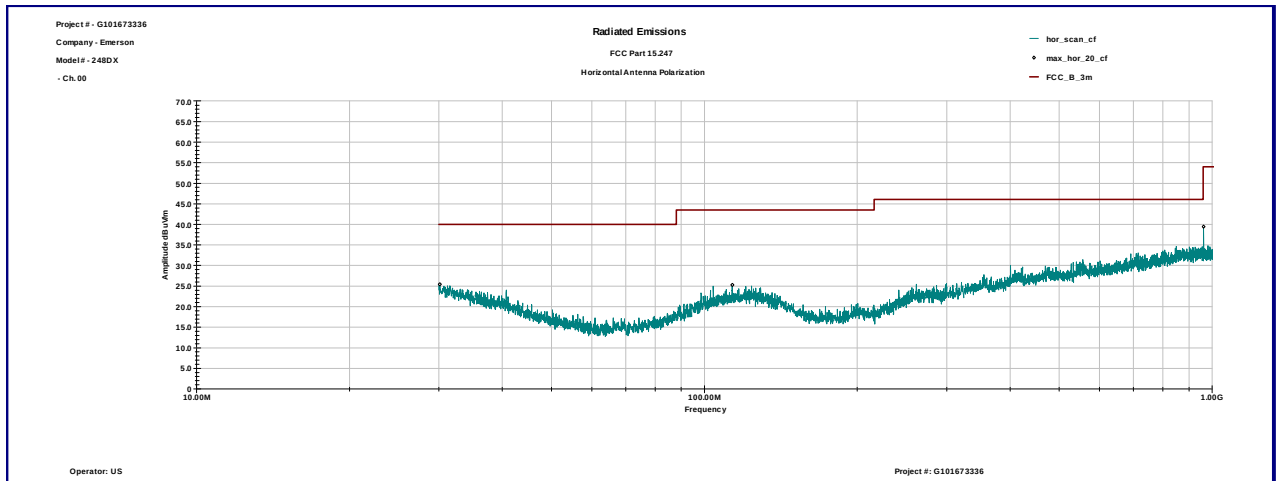
Date:	June 3-4, 2014	Result: Pass
Standard:	FCC part 15.247(d)	
Tested by:	Uri Spector	
Test Point:	Enclosure with Antenna	
Operation mode:	See Page 5	
Note:	None	

Table 3.5.1

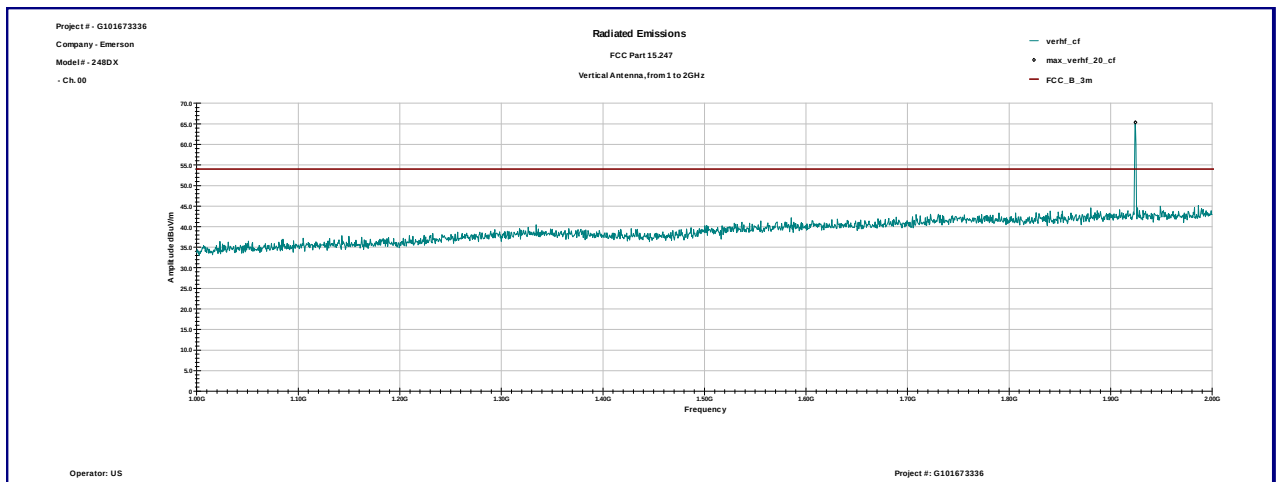
Frequency MHz	Antenna		Ant. CF dB1/m	Cable loss dB	Pre-amp Gain (dB)	Reading dBμV	Total @ 3m dBμV/m	Limit dBμV/m	Margin dB	Comments
	Polarity	Hts(cm)								
Channel 0										
962.15	V	100	22.2	2.7	0.0	19.7	44.6	54.0	-9.4	Peak
962.15	V	100	22.2	2.7	0.0	14.6	39.5	54.0	-14.5	Peak
4810.96	V	124	33.1	4.1	42.1	60.0	55.1	74.0	-18.9	Peak
4810.96	H	100	33.1	4.1	42.1	61.9	57.0	74.0	-17.0	Peak
7216.44	V	123	35.8	5.3	41.3	64.3	64.1	74.0	-9.9	Peak
7216.44	H	171	35.8	5.3	41.3	59.4	59.2	74.0	-14.8	Peak
19243.84	V	106	44.6	8.5	48.7	49.6	54.0	74.0	-20.0	Peak
19243.84	H	100	44.6	8.5	48.7	51.7	56.1	74.0	-17.9	Peak
4810.96	V	124	33.1	4.1	42.1	36.1	31.2	54.0	-22.8	AVG
4810.96	H	100	33.1	4.1	42.1	36.7	31.8	54.0	-22.2	AVG
7216.44	V	123	35.8	5.3	41.3	37.5	37.3	54.0	-16.7	AVG
7216.44	H	171	35.8	5.3	41.3	33.1	32.9	54.0	-21.1	AVG
19243.84	V	106	44.6	8.5	48.7	33.9	38.3	54.0	-15.7	AVG
19243.84	H	100	44.6	8.5	48.7	34.6	39.0	54.0	-15.0	AVG
Channel 7										
976.30	V	100	22.4	2.7	0.0	12.2	37.3	54.0	-16.7	Peak
4888.10	V	100	33.2	4.1	42.1	60.2	55.4	74.0	-18.6	Peak
4888.10	H	145	33.2	4.1	42.1	60.1	55.3	74.0	-18.7	Peak
7318.44	V	100	36.1	5.3	41.2	61.8	62.0	74.0	-12.0	Peak
7318.44	H	100	36.1	5.3	41.2	57.8	58.0	74.0	-16.0	Peak
19520.00	H	100	45.0	8.6	48.5	47.3	52.4	54.0	-1.7	Peak
4888.10	V	100	33.2	4.1	42.1	35.6	30.8	54.0	-23.2	AVG
4888.10	H	145	33.2	4.1	42.1	35.4	30.6	54.0	-23.4	AVG
7318.44	V	100	36.1	5.3	41.2	33.8	34.0	54.0	-20.0	AVG
7318.44	H	100	36.1	5.3	41.2	30.2	30.4	54.0	-23.6	AVG
Channel 14										
4950.92	V	100	33.2	4.1	42.0	56.7	52.0	54.0	-2.0	Peak
4950.92	H	100	33.2	4.1	42.0	55.0	50.3	54.0	-3.7	Peak
7426.48	V	100	36.3	5.4	41.1	60.7	61.3	74.0	-12.7	Peak
7426.48	H	158	36.3	5.4	41.1	56.6	57.2	74.0	-16.8	Peak
7426.48	V	100	36.3	5.4	41.1	33.5	34.1	54.0	-19.9	AVG
7426.48	H	158	36.3	5.4	41.1	31.2	31.8	54.0	-22.2	AVG



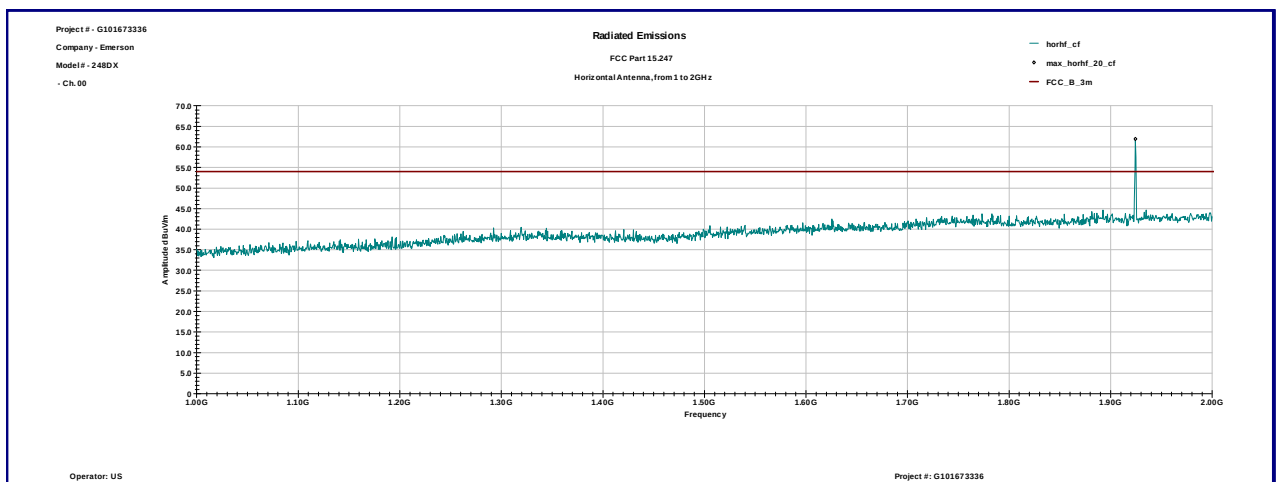
Graph 3.5.1



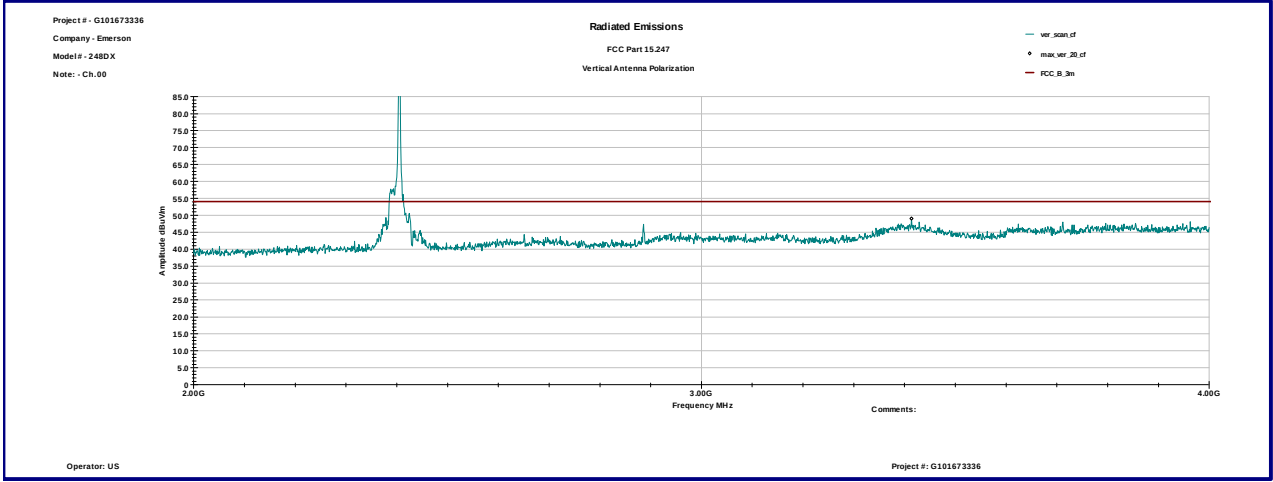
Graph 3.5.2



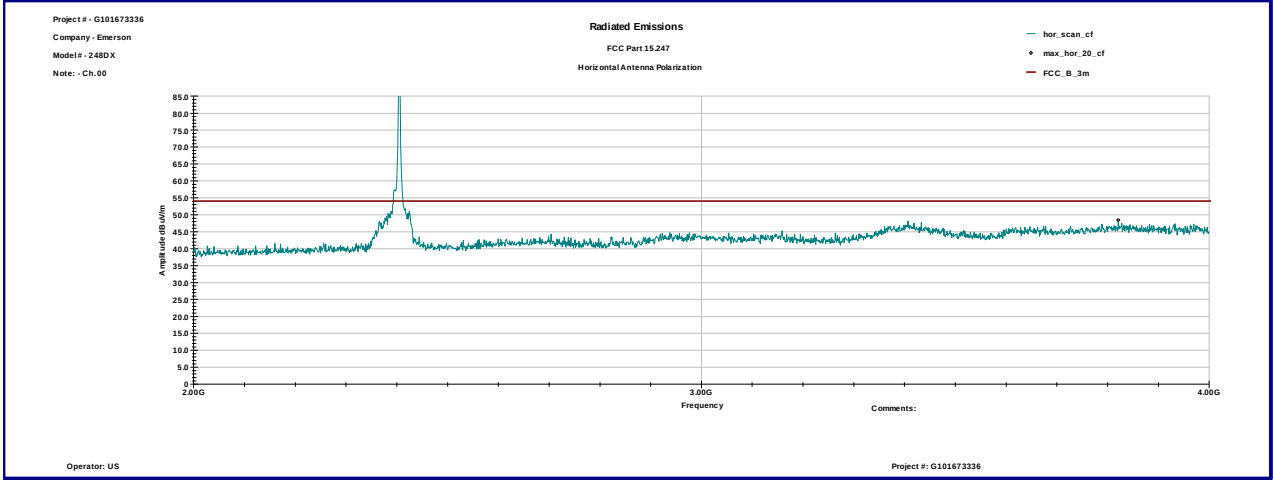
Graph 3.5.3



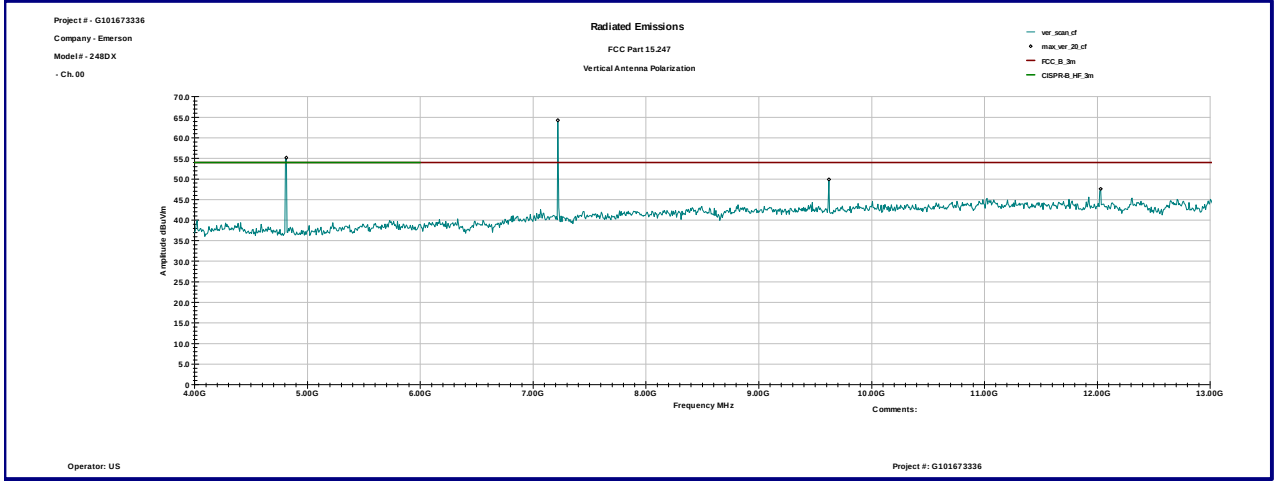
Graph 3.5.4



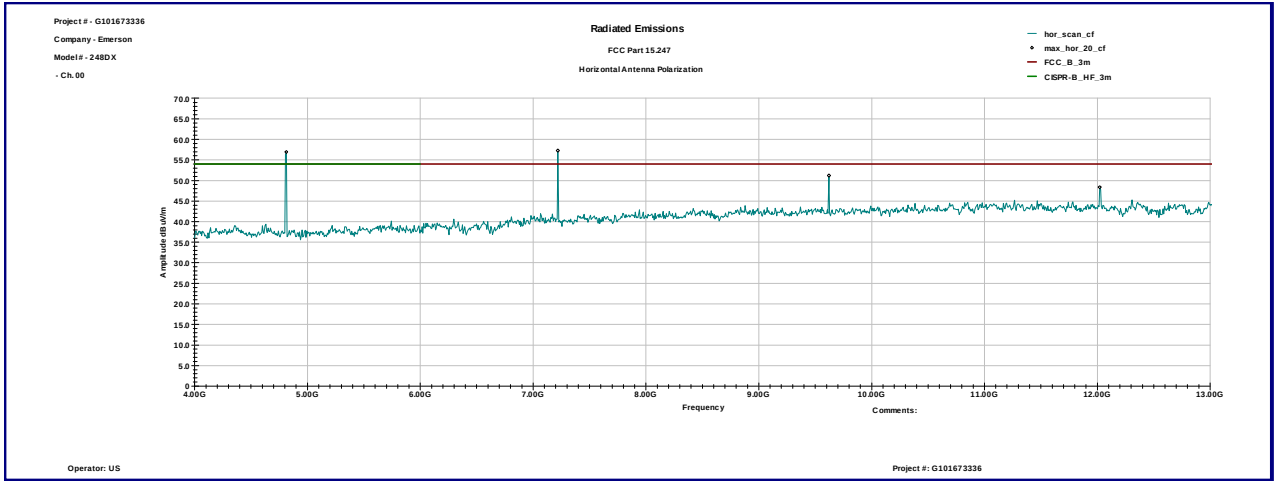
Graph 3.5.5



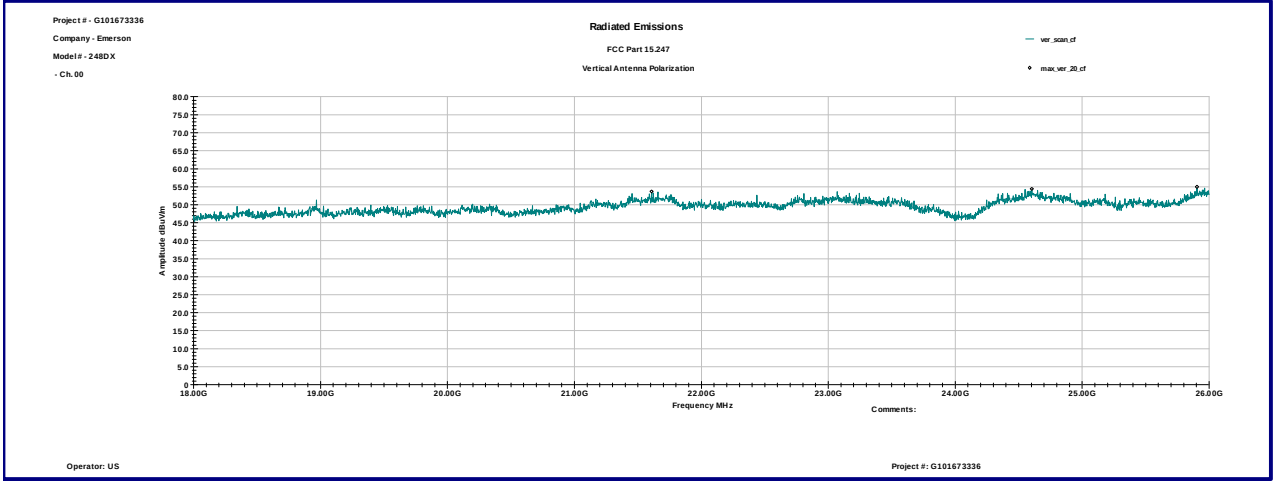
Graph 3.5.6



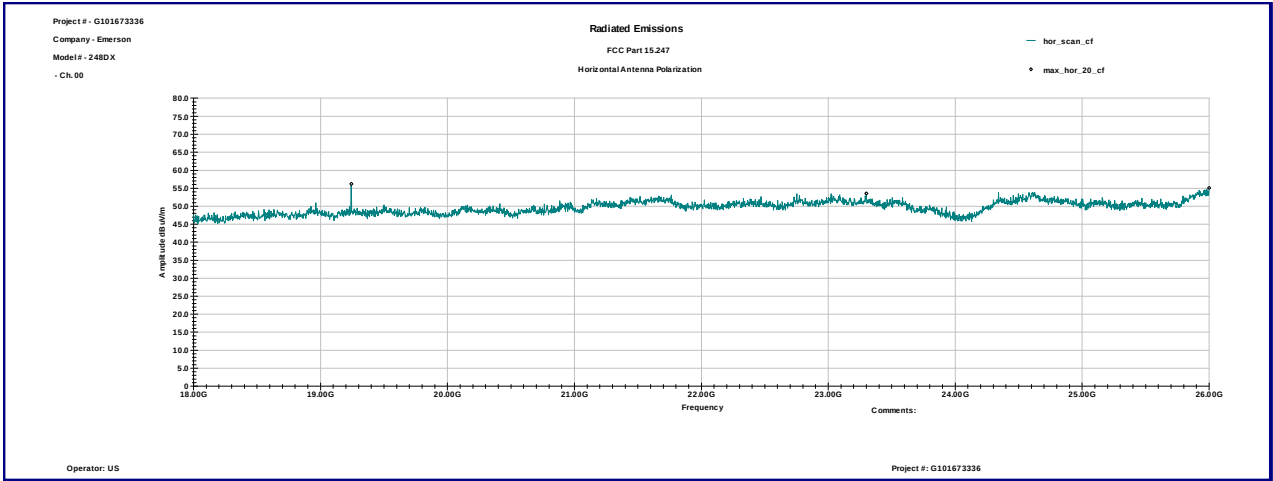
Graph 3.5.7



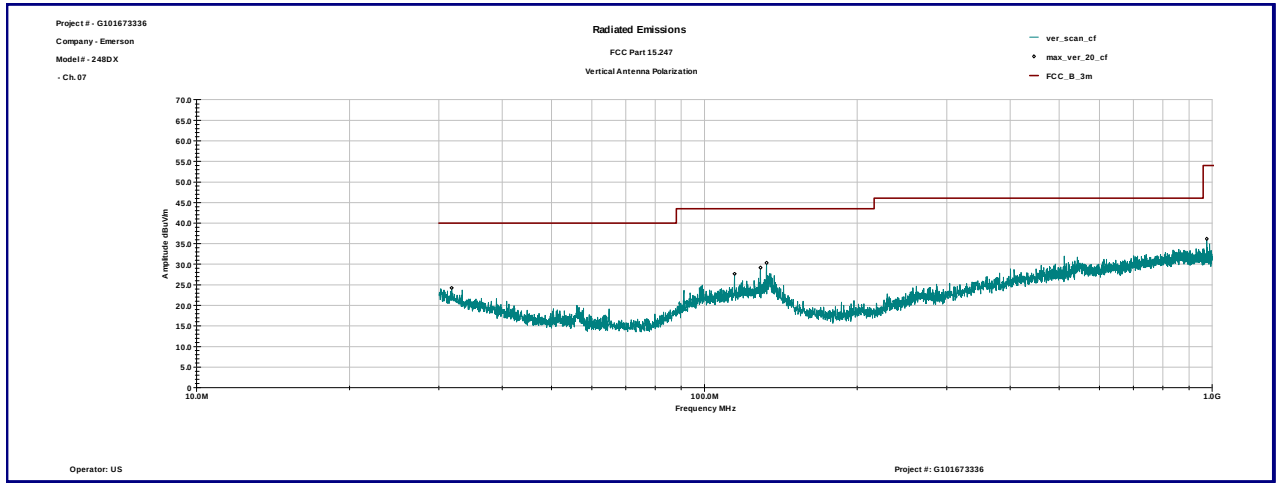
Graph 3.5.8



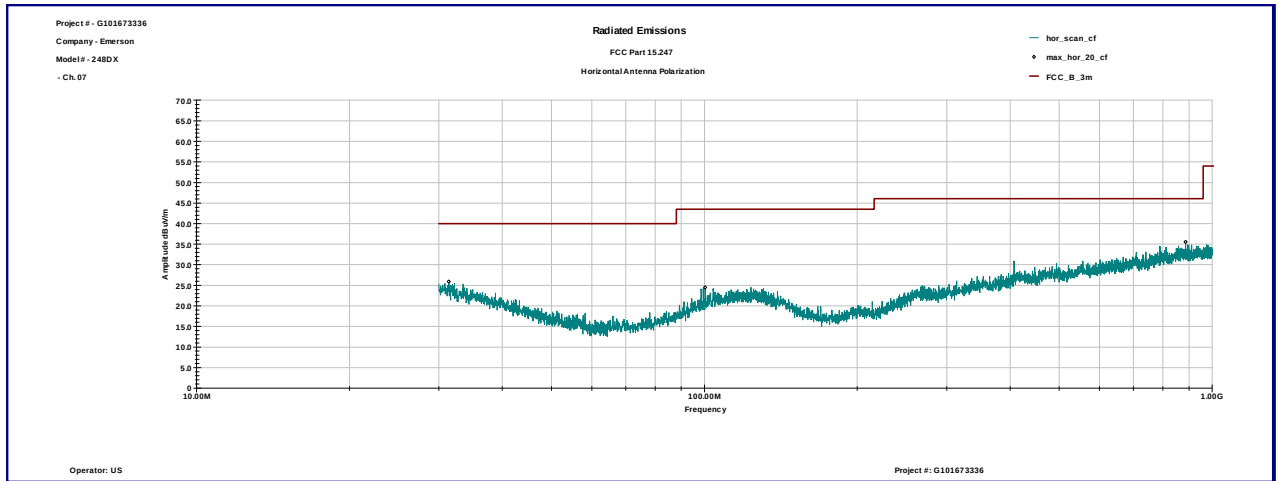
Graph 3.5.9



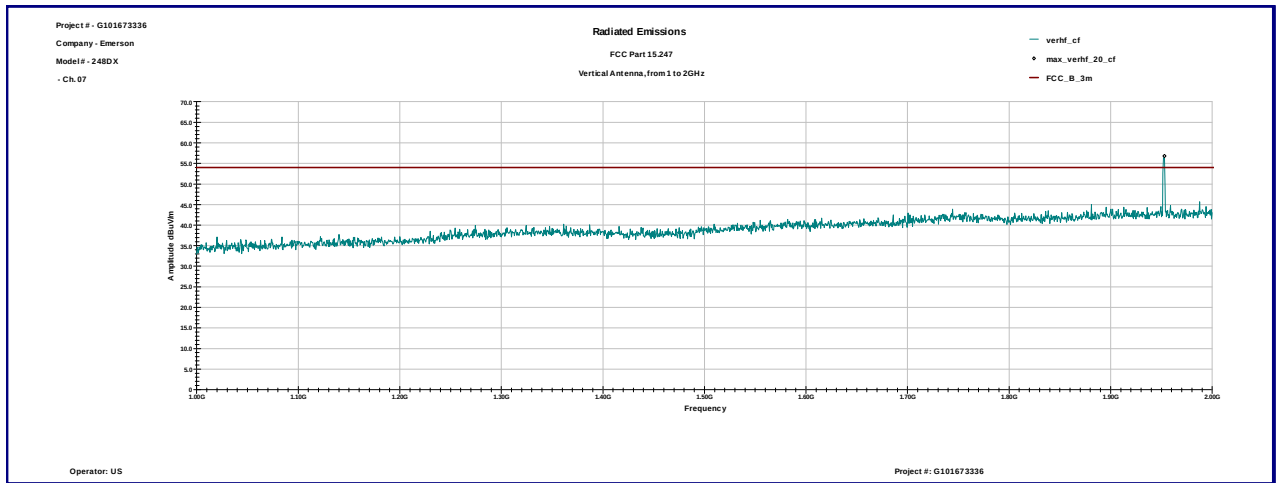
Graph 3.5.10



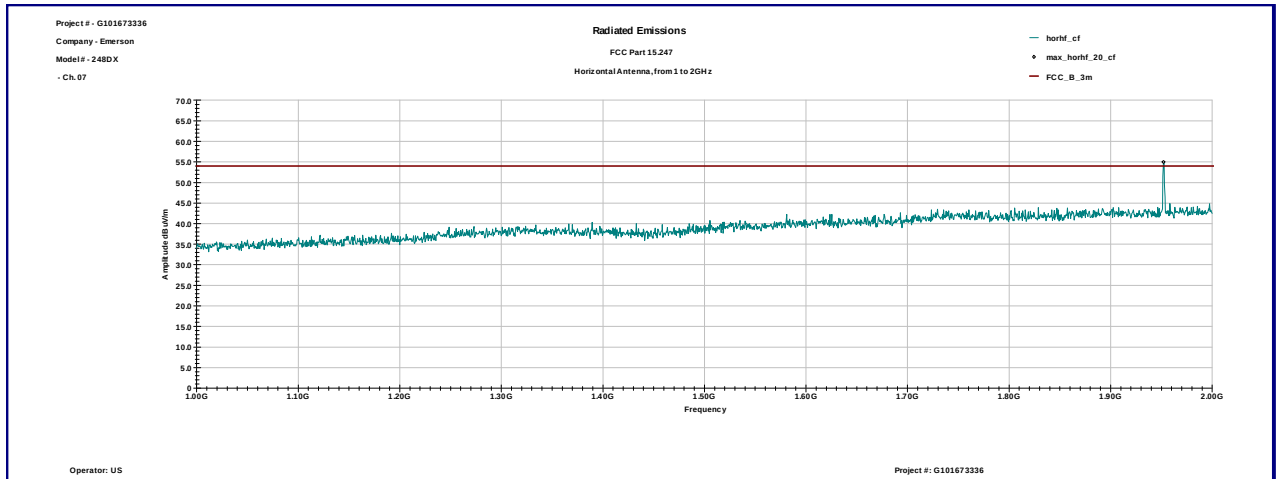
Graph 3.5.11



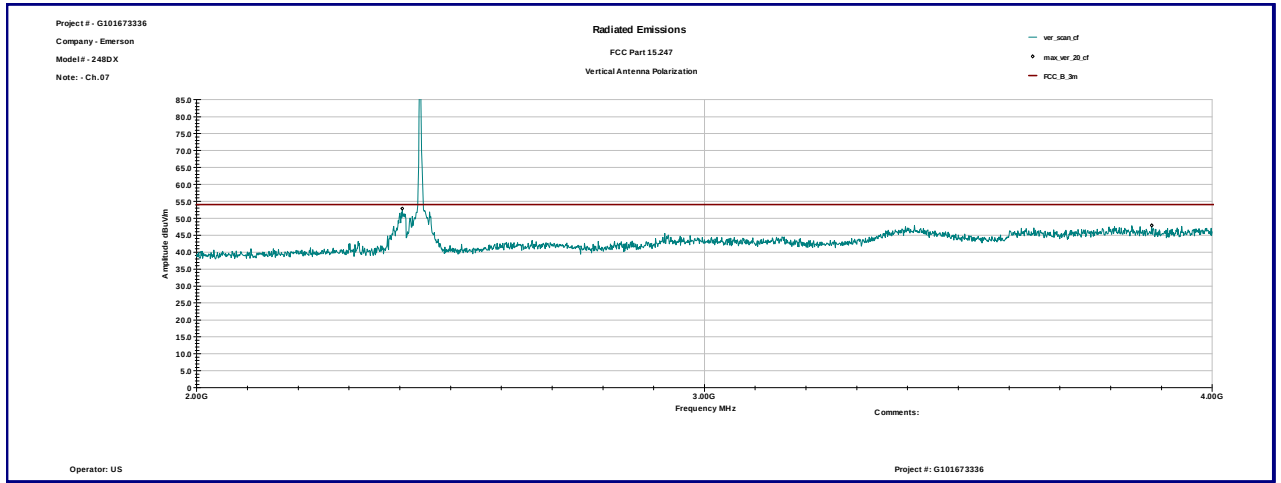
Graph 3.5.12



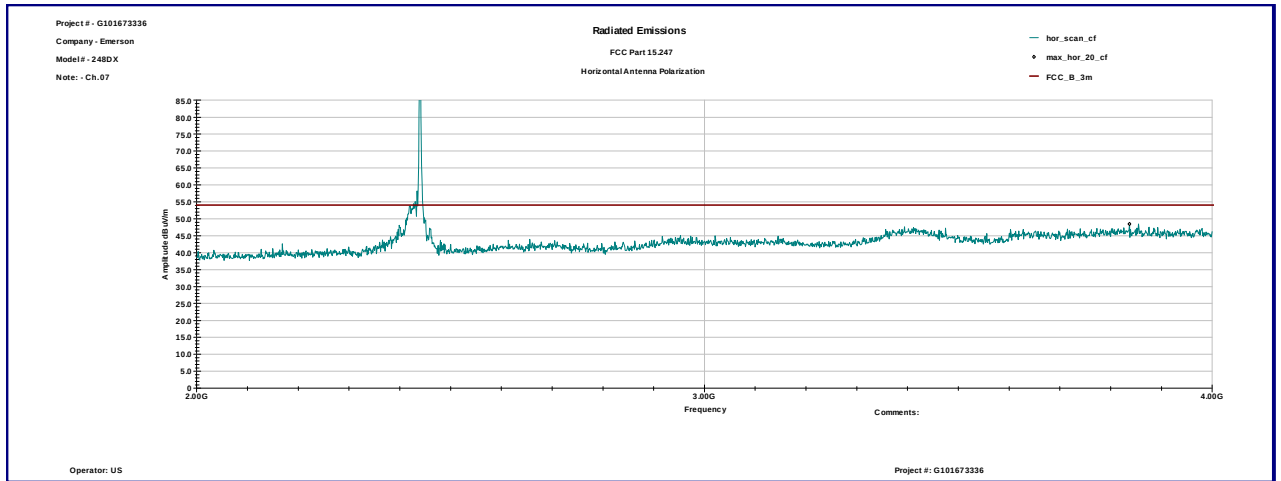
Graph 3.5.13



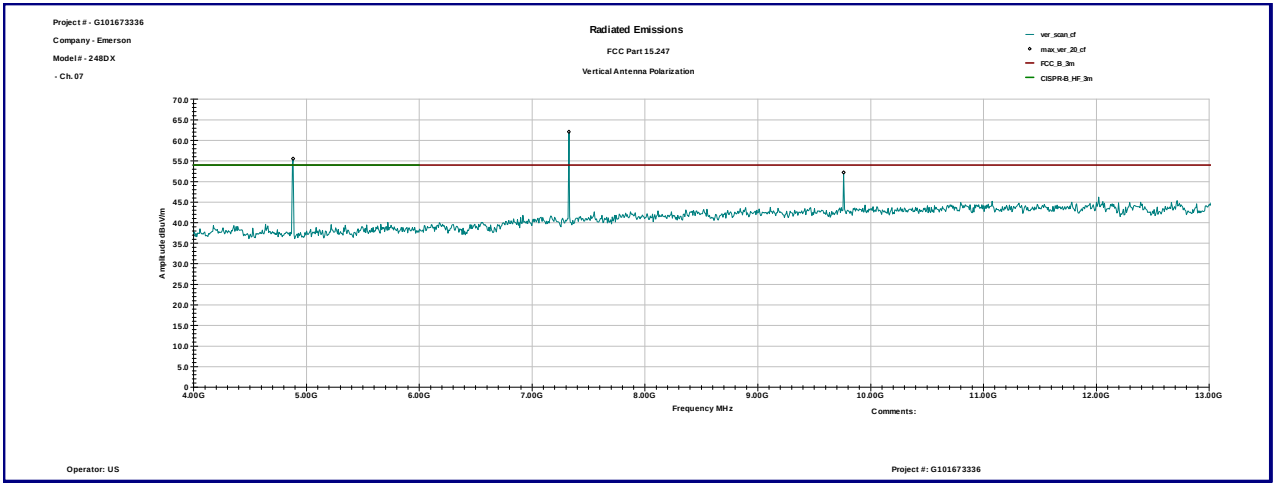
Graph 3.5.14



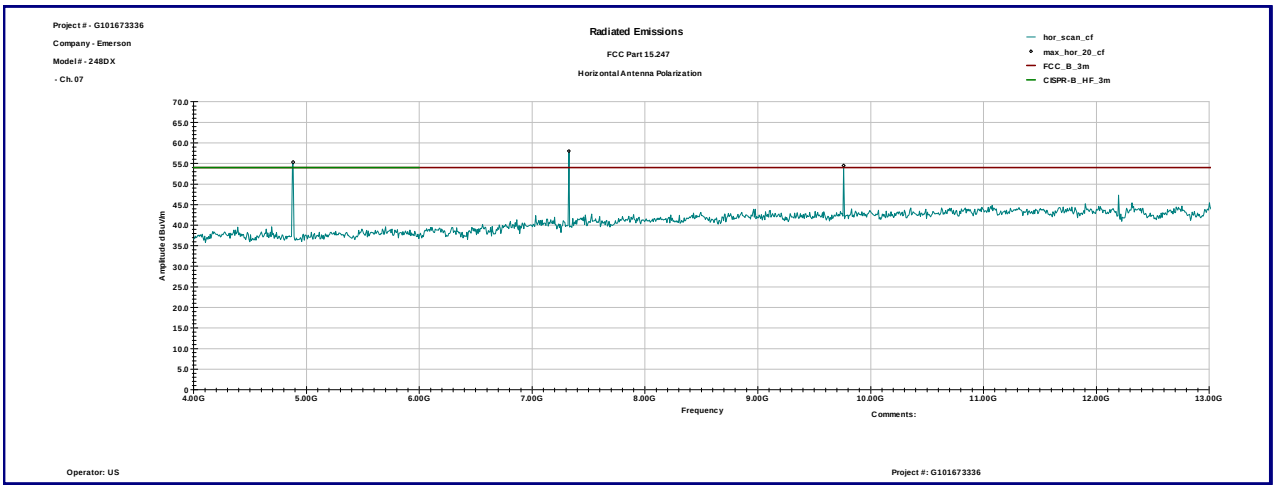
Graph 3.5.15



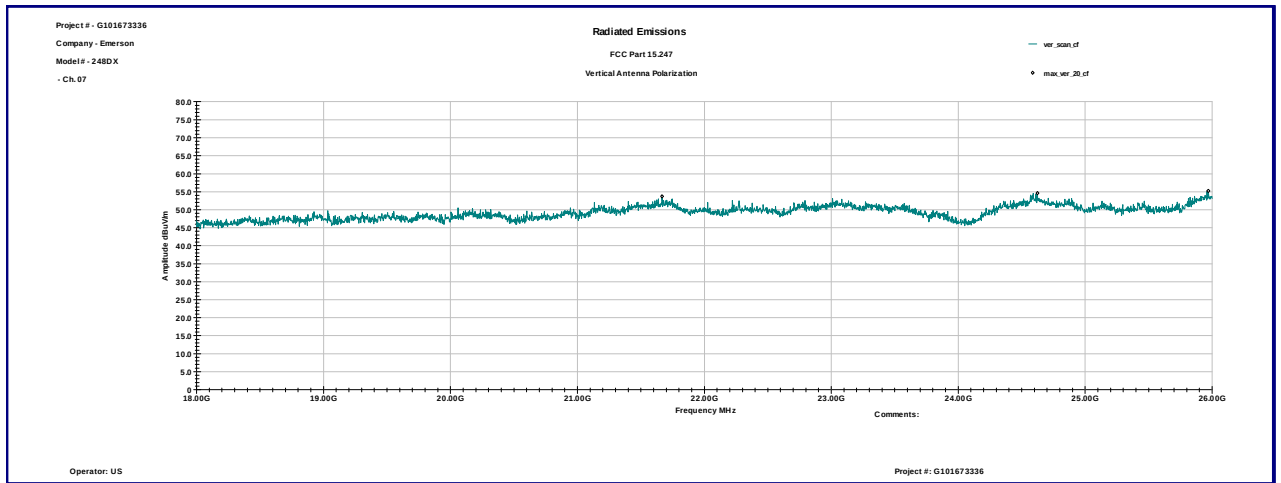
Graph 3.5.16



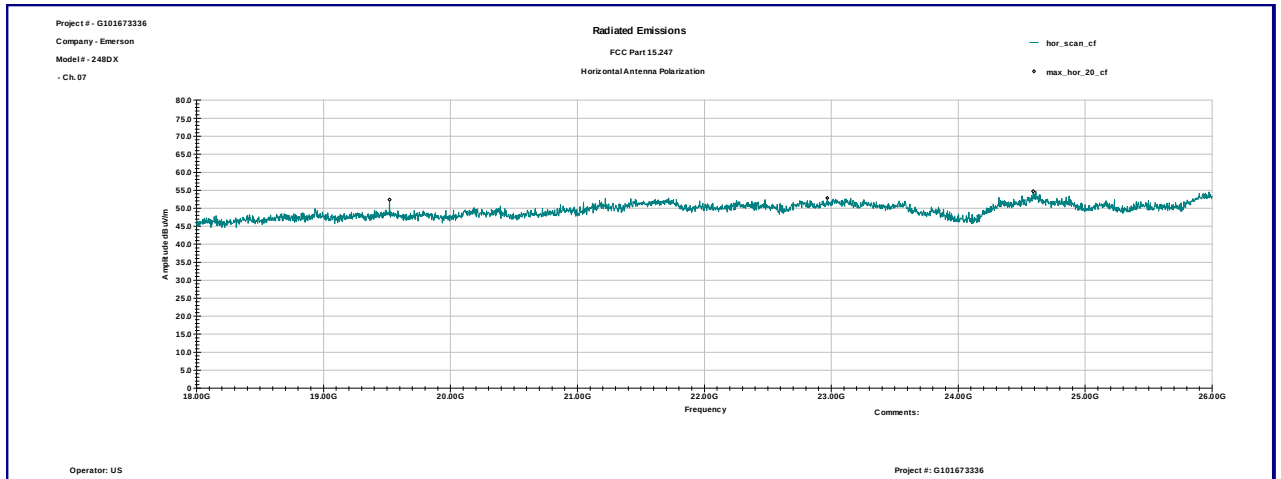
Graph 3.5.17



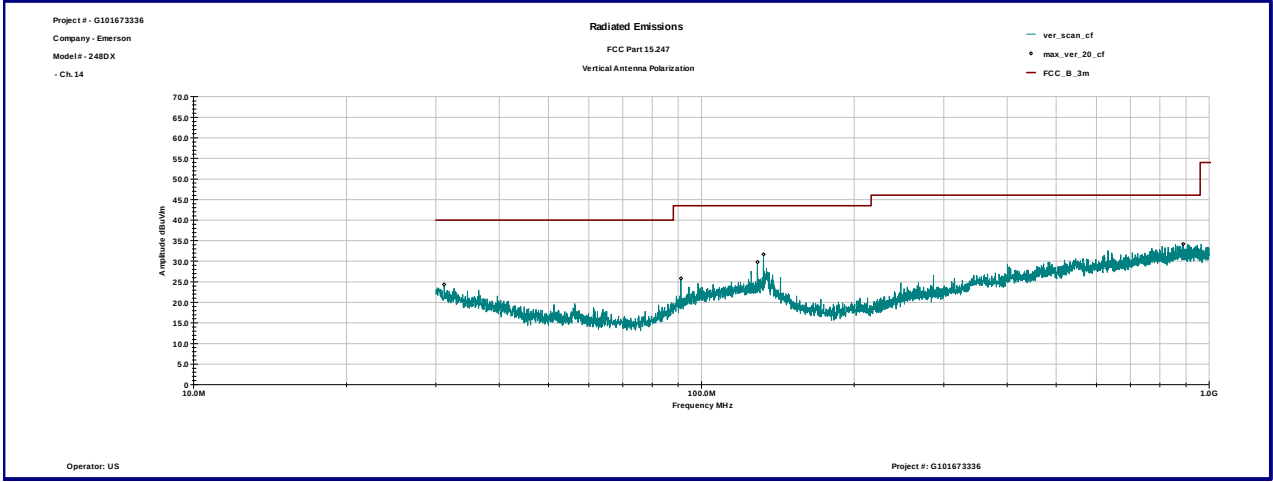
Graph 3.5.18



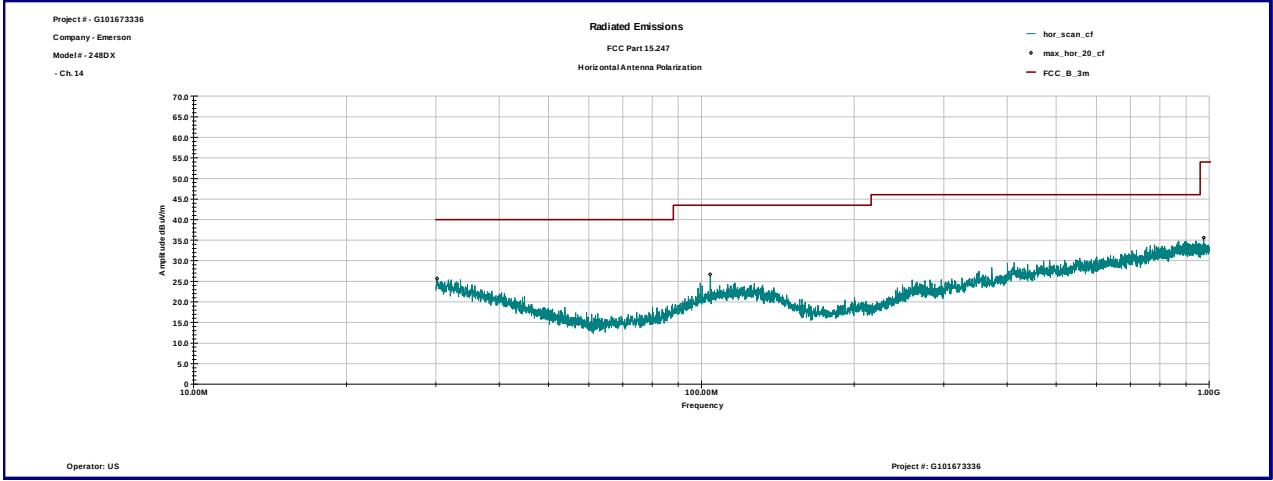
Graph 3.5.19



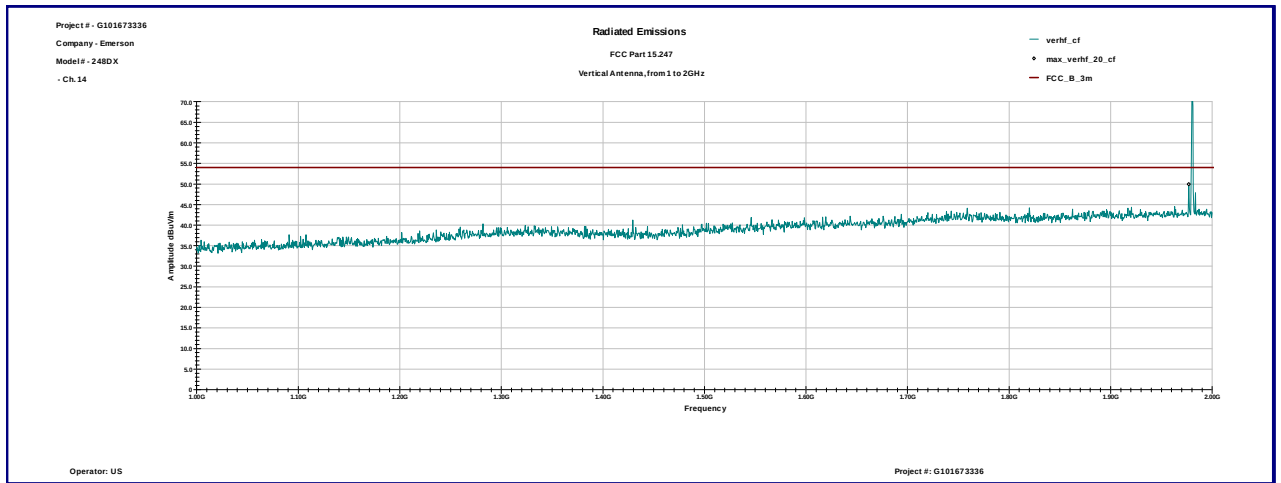
Graph 3.5.20



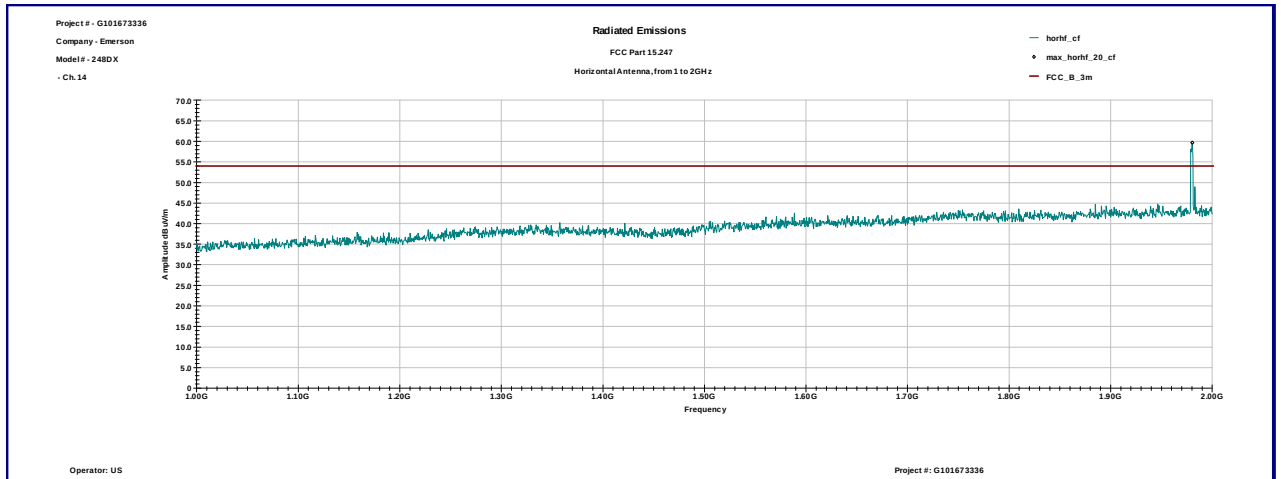
Graph 3.5.21



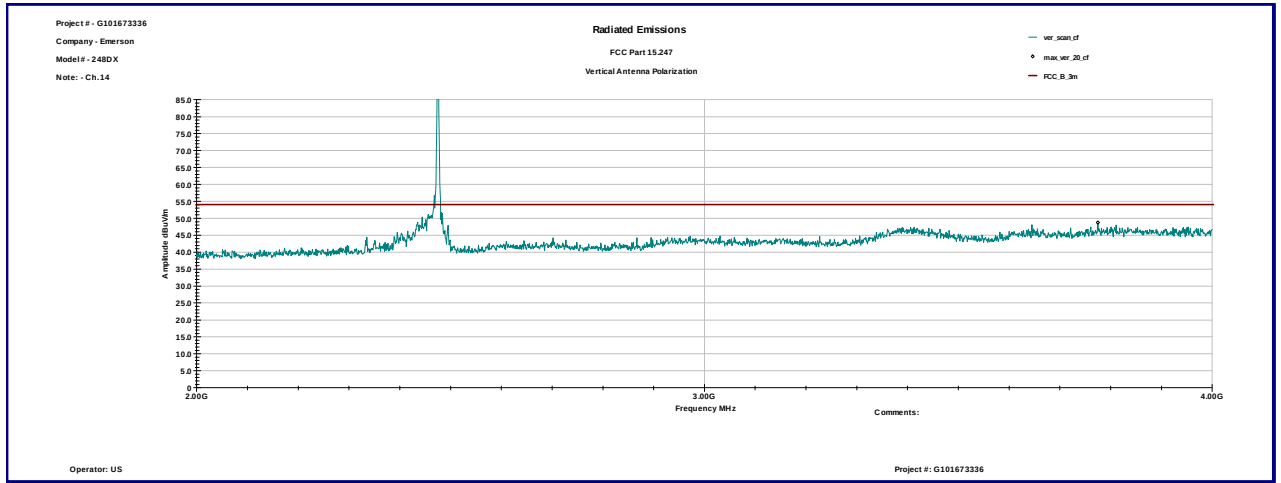
Graph 3.5.22



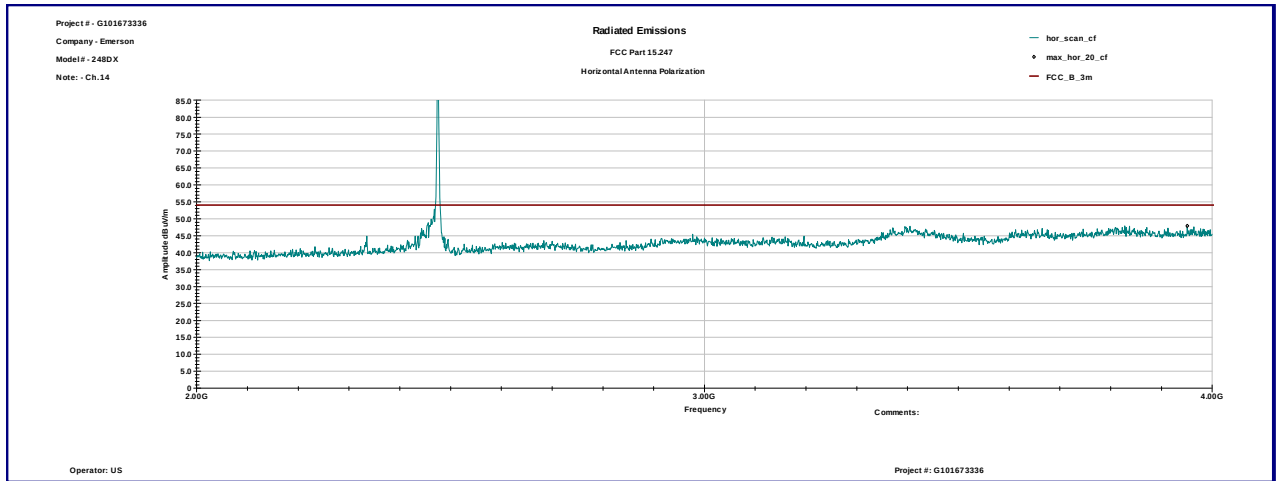
Graph 3.5.23



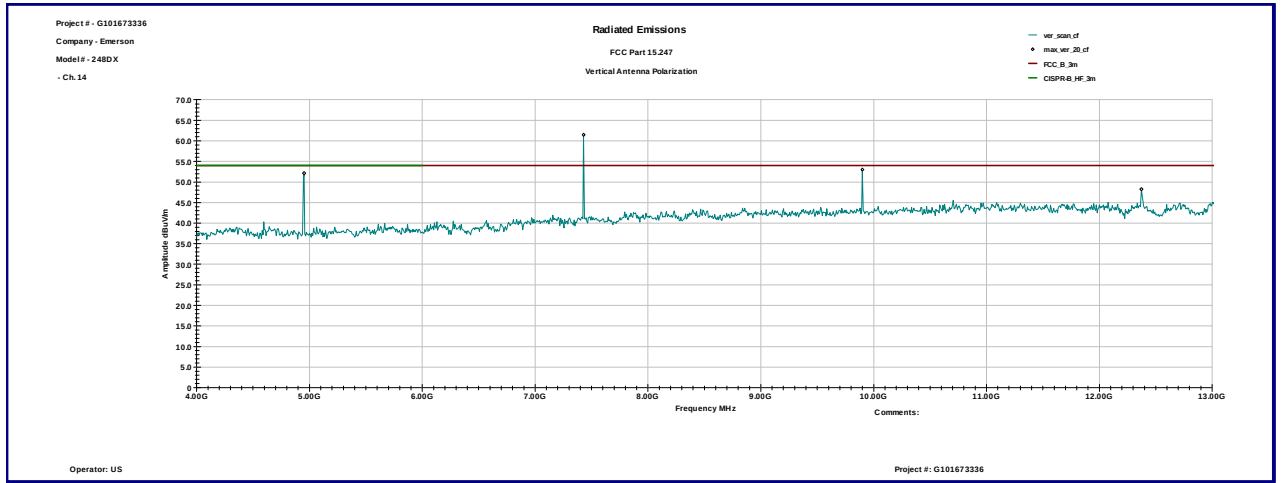
Graph 3.5.24



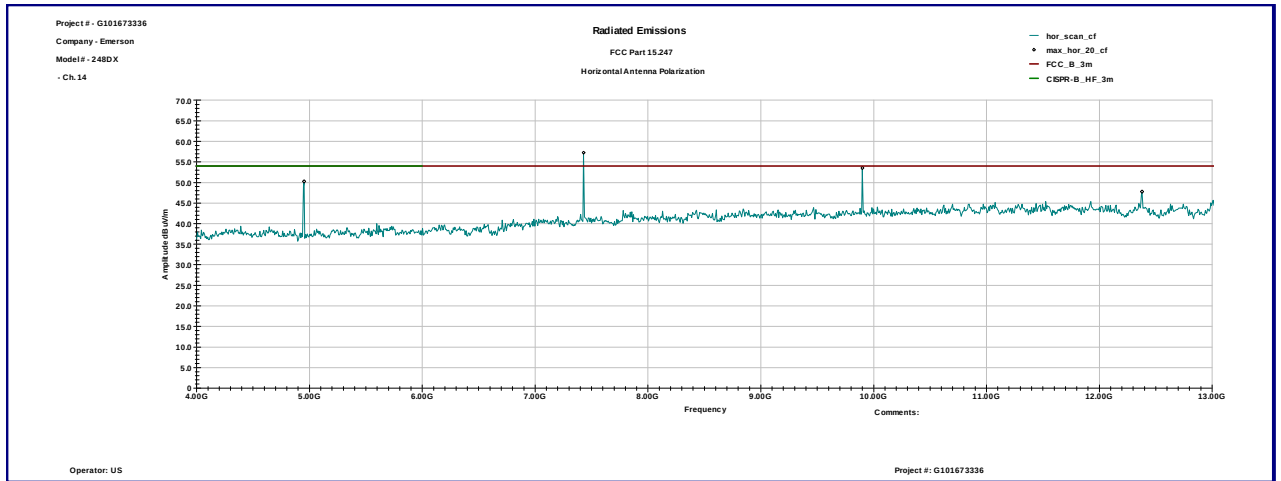
Graph 3.5.25



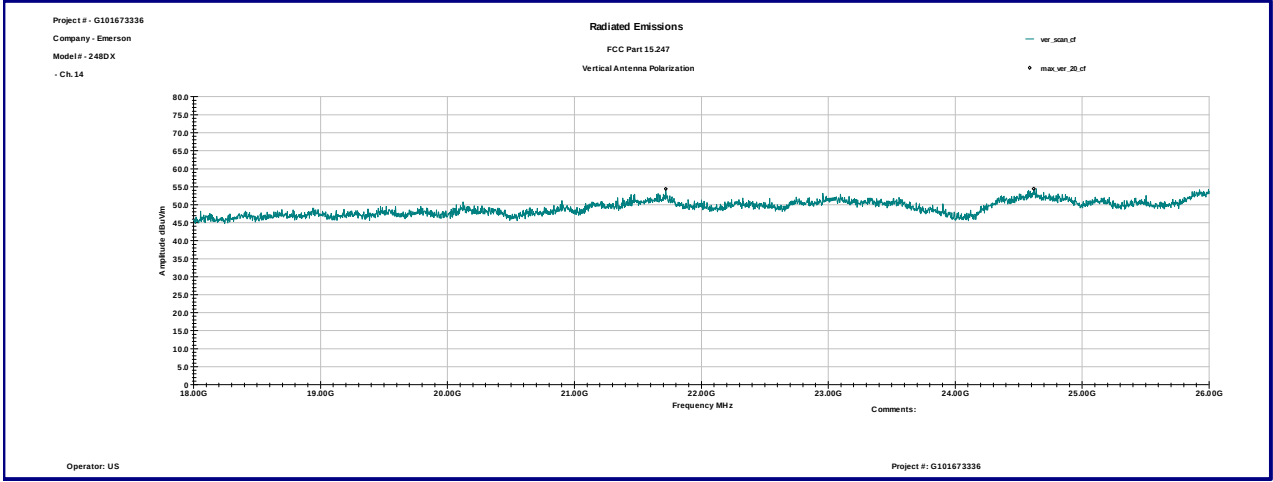
Graph 3.5.26



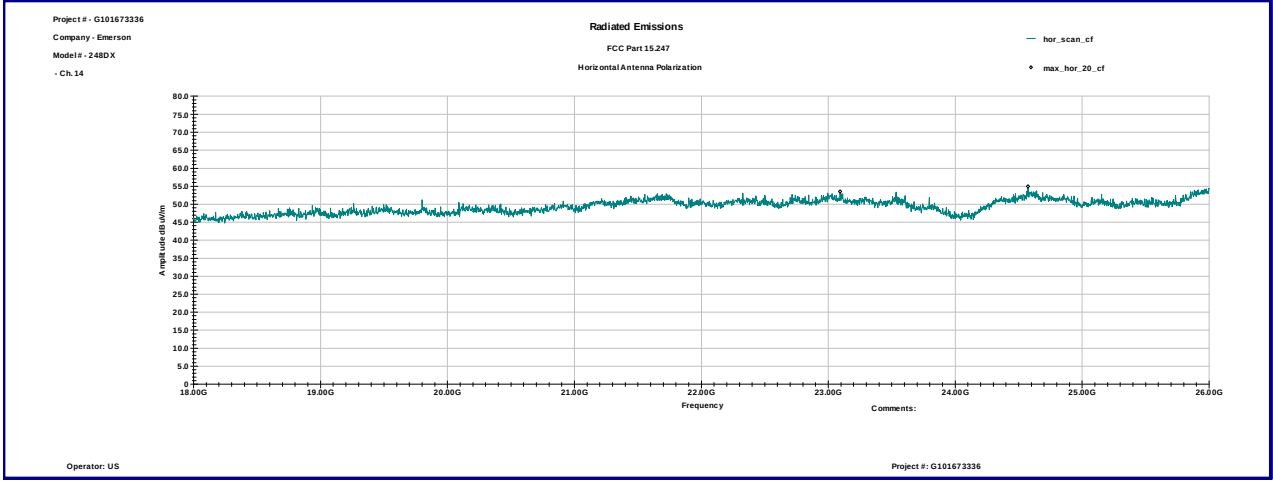
Graph 3.5.27



Graph 3.5.28



Graph 3.5.29



Graph 3.5.30



3.6 RF Exposure Compliance

The maximum measured antenna conducted power, P is 8.93dBm

The antenna gain, G is 2dBi

The maximum EIRP power = P + G

ERP = 8.93+ 2= 10.93dBm, or 0.012W

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 $10 = 0.012 / 4\pi D^2$,

The minimum safe separation distance, D = 0.97cm, which is below 20cm, or RF exposure at 20cm distance is $0.0024\text{mW}/\text{cm}^2$, which is below $1.0\text{mW}/\text{cm}^2$



3.7 Transmitter power line conducted emissions

Test location: ☐ OATS ☒ Anechoic Chamber ☐ Other

Test result: N/A

Frequency range: 0.15MHz-30MHz

Max. Emissions margin: dB below the limits

Notes: The EUT is 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 to 12.5GHz (5th Harmonic)

Test result: **Pass**

Frequency range: 30MHz-12.5GHz

Max. Emissions margin: 12.2dB below the limits

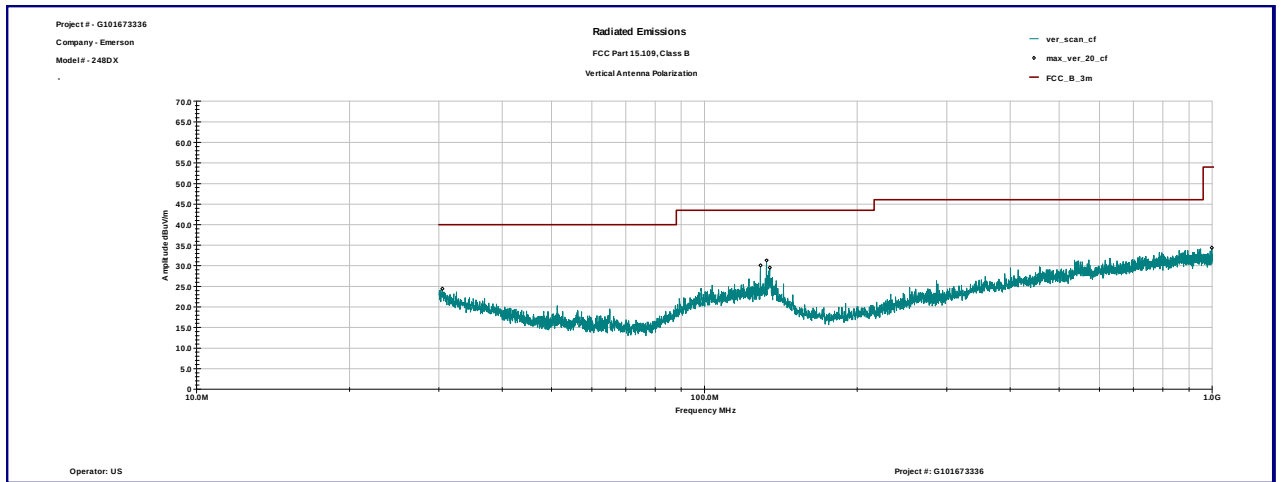
Notes: No Radiated Emissions were detected above 1GHz (see Graphs 3.8.1-3.8.4).



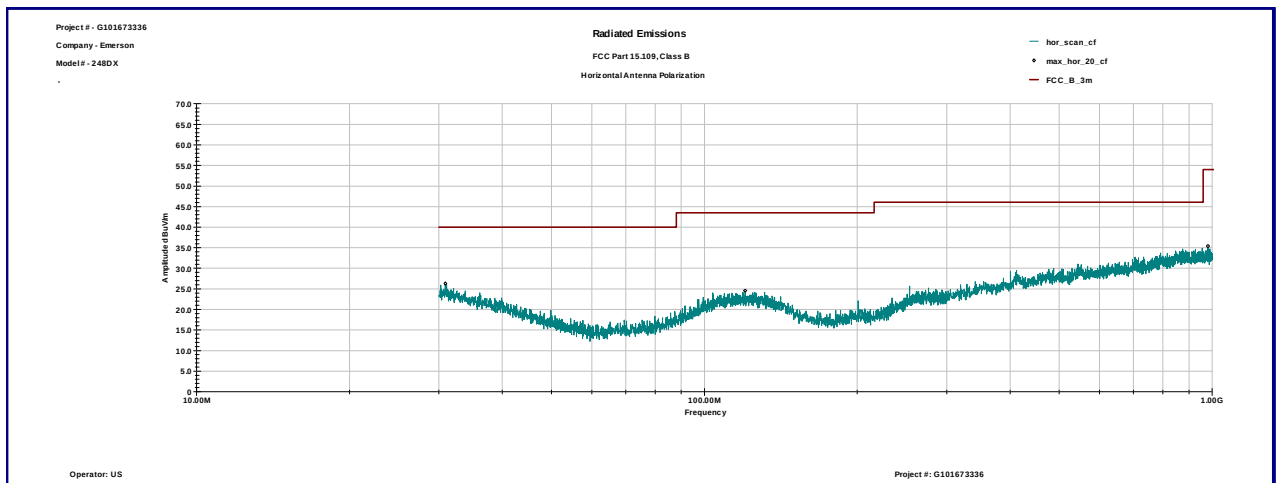
Date:	June 3-4, 2014	Result: Pass
Standard:	FCC Part 15.109, Class B	
Tested by:	Uri Spector	
Test Point:	Enclosure	
Operation mode:	Receiving mode	
Note:	None	

Table 3.8.1

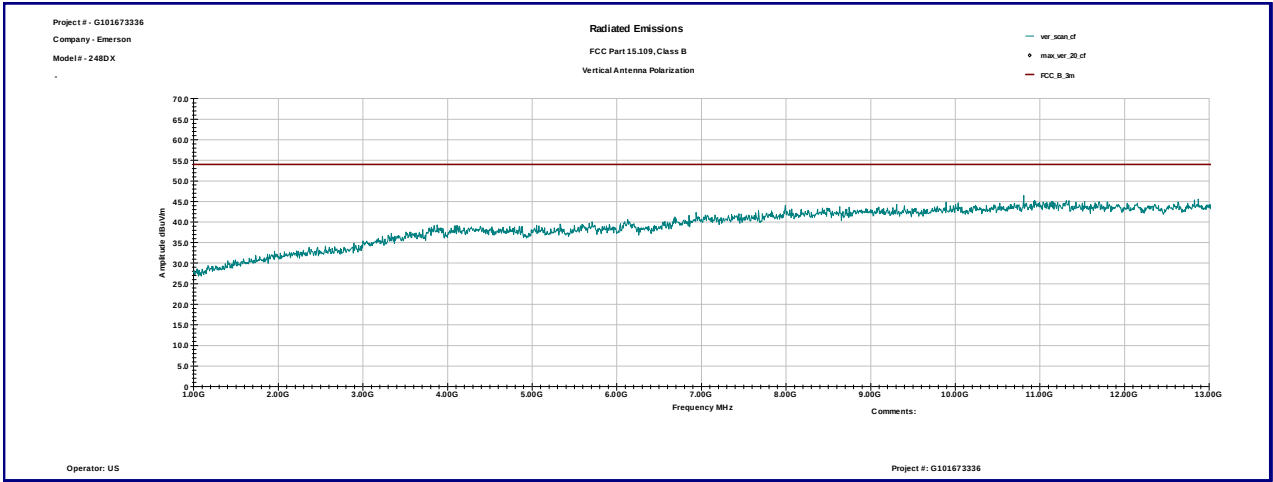
Frequency	Ant. Polarity	Peak Reading dB μ V	Total C.F. dB1/m	Total at 3m dB μ V/m	Limit dB μ V/m	Margin dB
30.485 MHz	V	6.6	20.0	24.5	40.0	-15.6
128.95 MHz	V	15.7	13.7	30.1	43.5	-13.5
132.53 MHz	V	17.2	13.5	31.3	43.5	-12.2
134.47 MHz	V	15.5	13.4	29.5	43.5	-14.0
120.37 MHz	H	10.8	13.7	24.6	43.5	-19.0



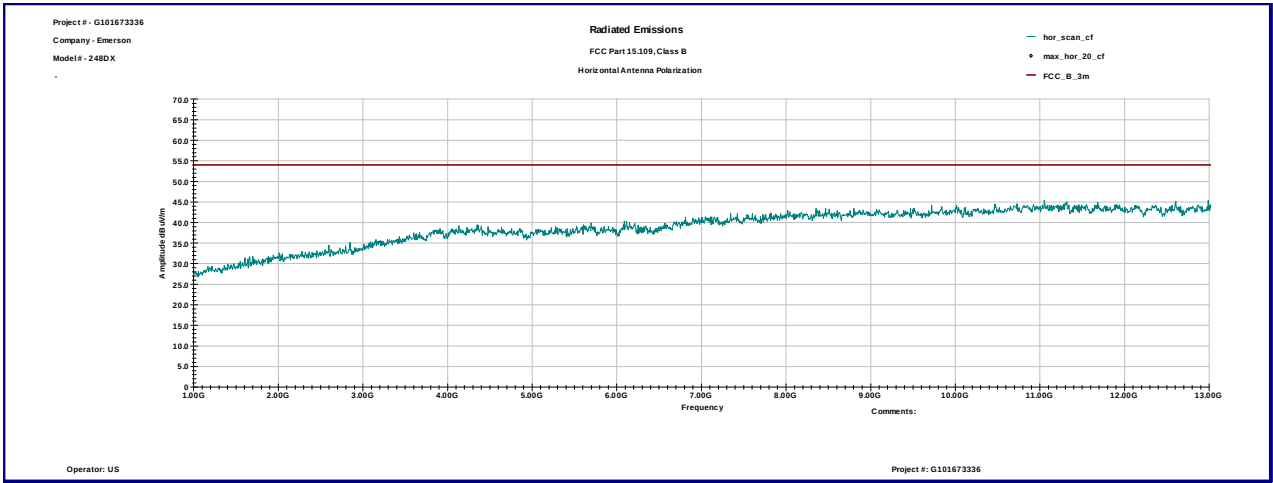
Graph 3.8.1



Graph 3.8.2



Graph 3.8.3



Graph 3.8.4



3.9 Digital device conducted emissions

Test location: ☐ OATS ☒ Anechoic Chamber ☐ Other

Test result: N/A

Frequency range: 0.15MHz-30MHz

Max. Emissions margin: dB below the limits

Notes: The EUT is 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	12/12/2014	☒
Spectrum Analyzer	R & S	ESU	100398	25283	01/07/2015	☒
Bicono-Log Antenna	Teseq	CBL6112D	32859	25289	08/30/2014	☒
Horn Antenna	EMCO	3115	6579	15580	07/18/2014	☒
Waveguide Horn Antenna	EMCO	3116	9904-2423	9705	11/12/2014	☒
Pre-Amplifier	MITEQ	AMF-5D-00501800-28-13P	1402232	172081	11/12/2014	☒
Pre-Amplifier	MITEQ	AMF-6F-16002600-25-10P	1222383	MIN-0065	11/12/2014	☒
System	Quantum Change	TILE! Instrument Control	Ver. 3.4.K.29	15259	VBU	☒



5.0 Revision History

REVISION LEVEL	DATE	REPORT NUMBER	PREPARED	REVIEWED	NOTES
0	June 6, 2014	101673336MIN-003	US	SK	Original Issue