



TEST REPORT

Report Number: 100193912MIN-001

Project Number: G100193912

Testing performed on the
708 Wireless Acoustic Transmitter

FCC ID: LW2RM708
Industry Canada ID: 2731A-RM708

to
47 CFR Part 15. 247:2009
RSS- 210, Issue 7, 2007

For
Emerson Process Management

Test Performed by:
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1.0 GENERAL DESCRIPTION

Model:	708
Type of EUT:	Wireless Acoustic Transmitter
Serial Number:	N/A
FCC ID:	LW2RM708
Industry Canada ID:	2731A-RM708
Related Submittal(s) Grants:	None
Company:	Emerson Process Management
Customer:	Mr. Scott Hofmeister
Address:	Emerson Process Management 8200 Market Blvd. Mail Stop PM17 Chanhassen, MN 55317
Phone:	952-949-7322
Fax:	952-949-7626
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Test Standards:	☒ 47 CFR, Part 15:2009, §15.247 ☒ RSS-210, Issue 7, 2007 ☒ RSS-Gen, Issue 2, 2007 ☒ 47 CFR, Part 15:2009, §15.107 and §15.109, Class B ☐ Other
Type of radio:	☒ Stand -alone ☐ Module ☐ Hybrid
Date Sample Submitted:	August 24, 2010
Test Work Started:	August 24, 2010
Test Work Completed:	August 30, 2010
Test Sample Conditions:	☐ Damaged ☐ Poor (Usable) ☒ Good



1.1 Product Description; Test Facility

Product Description:	2.4 – 2.4835GHz Acoustic Monitor Transceiver
Transmitter Type:	☐ FHSS ☒ Digital Modulation ☐ WiFi ☐ Blue Tooth
Operating Frequency Range(s):	Range: From 2400 to 24835 MHz
Number of Channels:	16
Modulation:	QPSK
Emission Designator:	1M49G7D
Antenna(s) Info:	Antenna Type: Omni directional Gain: 1.6dBi Connector Type: Solder direct to circuit board via coax
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:	As a hand-held device the EUT was rotated through three orthogonal axes to determine and tested with the maximum emissions
Test Facility Accreditation:	A2LA (Certificate No. 1427.01)
Test Methodology:	Measurements performed according to the procedures in ANSI C63.4-2003 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 (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		

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
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	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

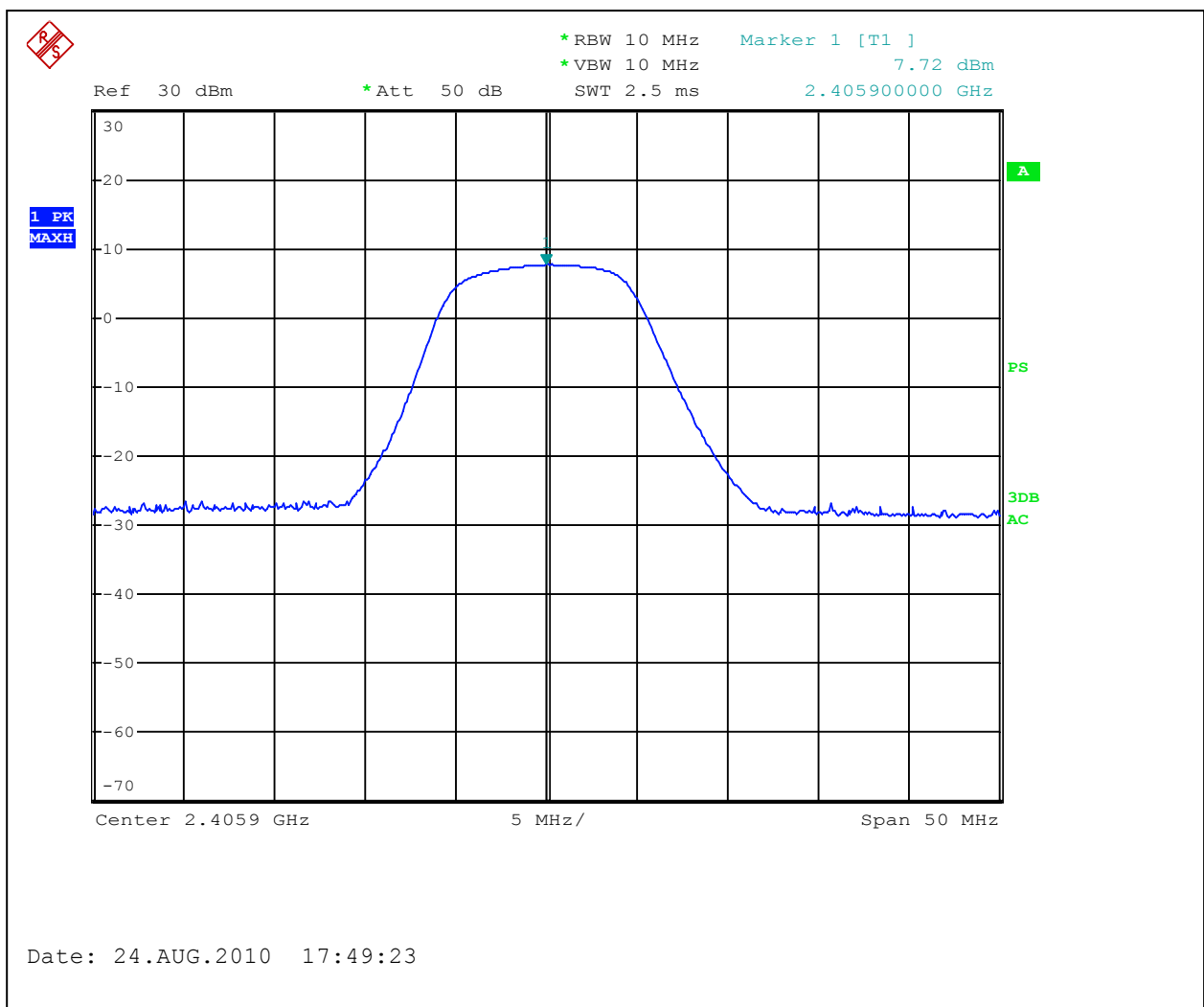
Test location: ☐ OATS ☐ Anechoic Chamber ☒ Other

Test result: **Pass**

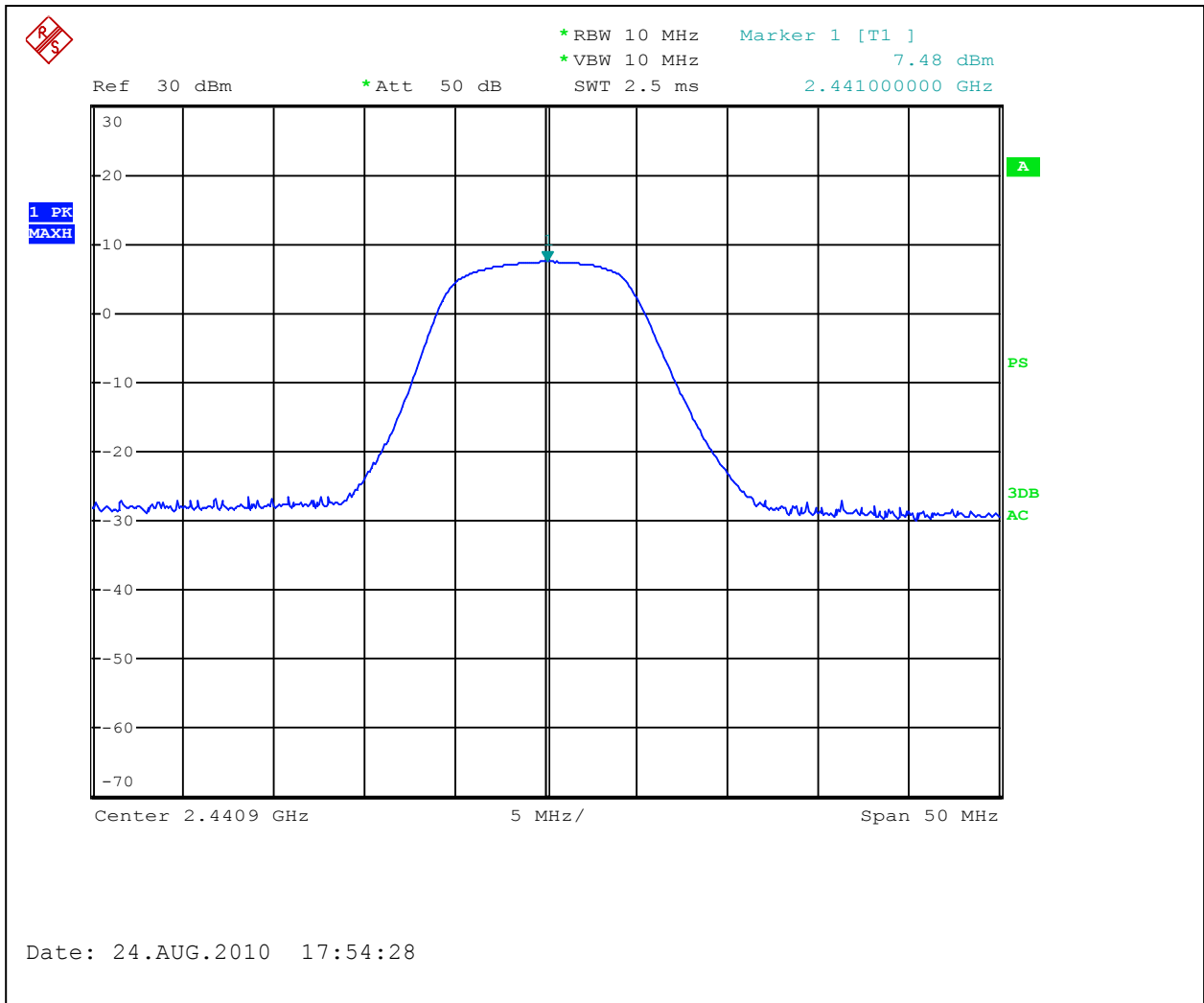
Max. Margin: 22.03dB below the limits

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
	7.72	0.25	7.97	30	0	-22.03
Middle Frequency MHz						
	7.48	0.25	7.73	30	0	-22.27
Upper Frequency MHz						
	7.14	0.25	7.39	30	0	-22.61
RBW:	☐ 1MHz ☐ 3MHz ☒ 10MHz					
VBW:	☐ 1MHz ☐ 3MHz ☒ 10MHz					
Antenna Gain:	☒ < 6dBi ☐ >6dBi and = dBi, Output power reduction = dB					

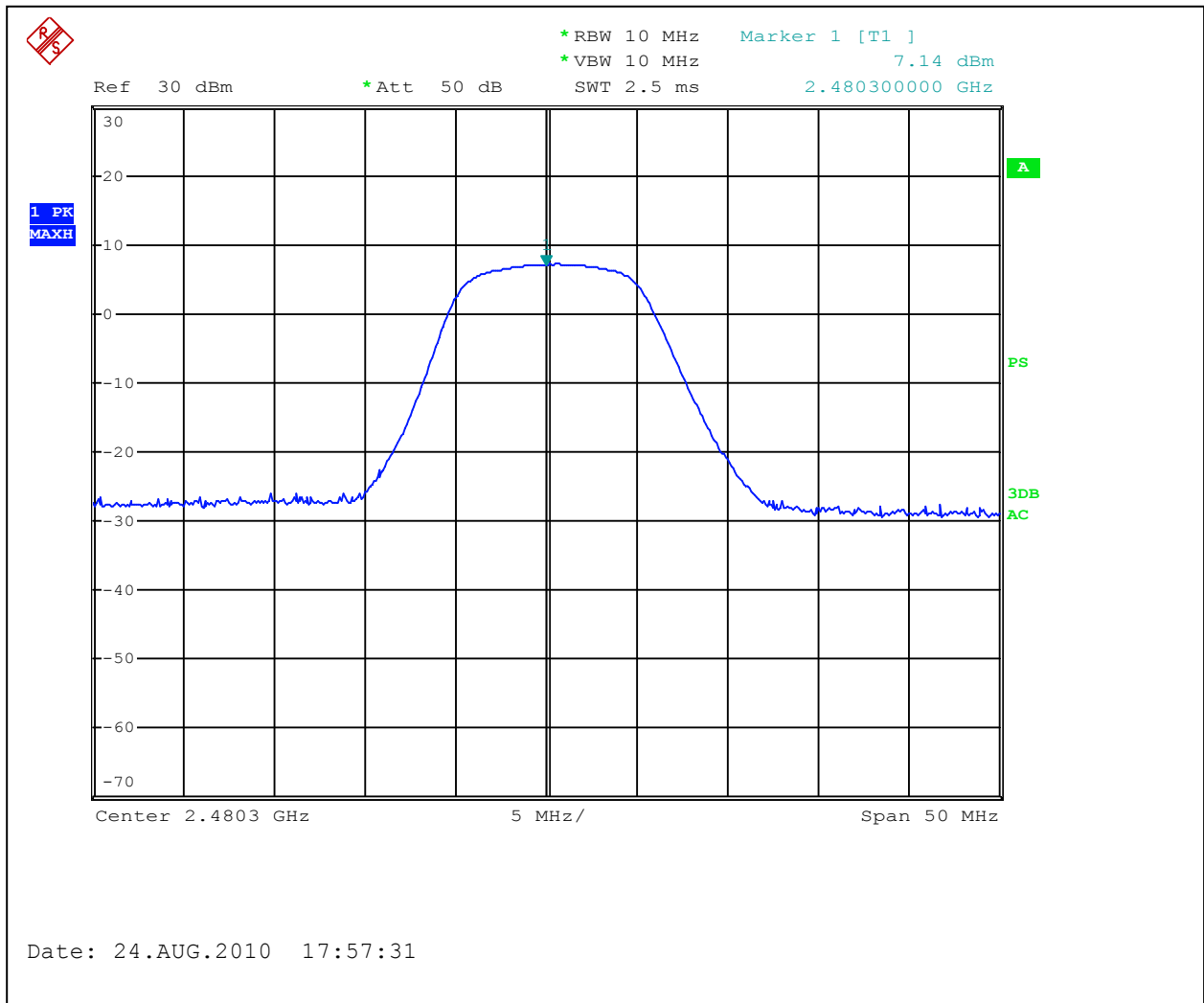
Notes: The maximum peak conducted output power limit is 1 W, or 30dBm
 Graphs 3.1.1 to 3.1.3 show the conducted output power



Graph 3.1.1



Graph 3.1.2

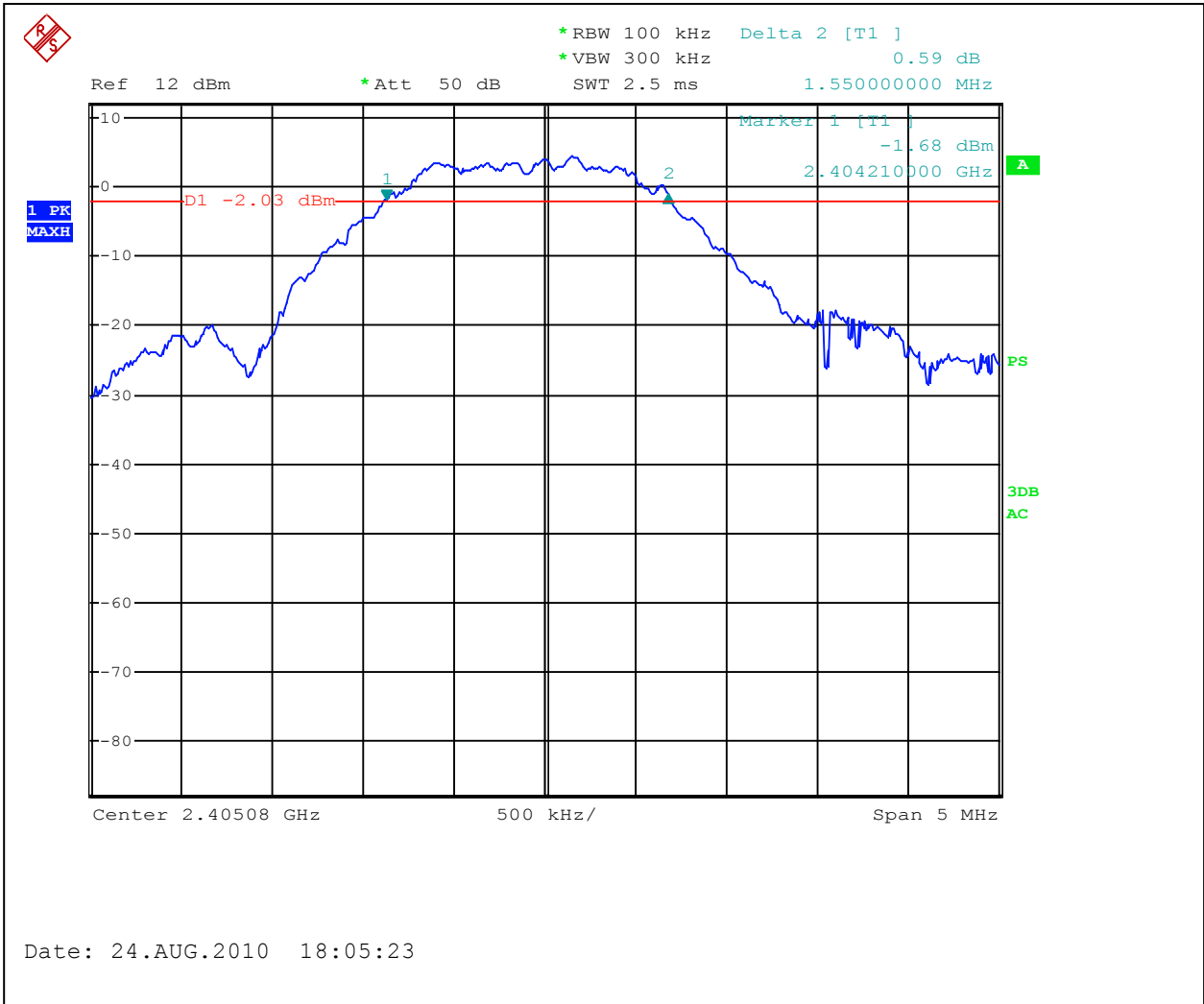


Graph 3.1.3

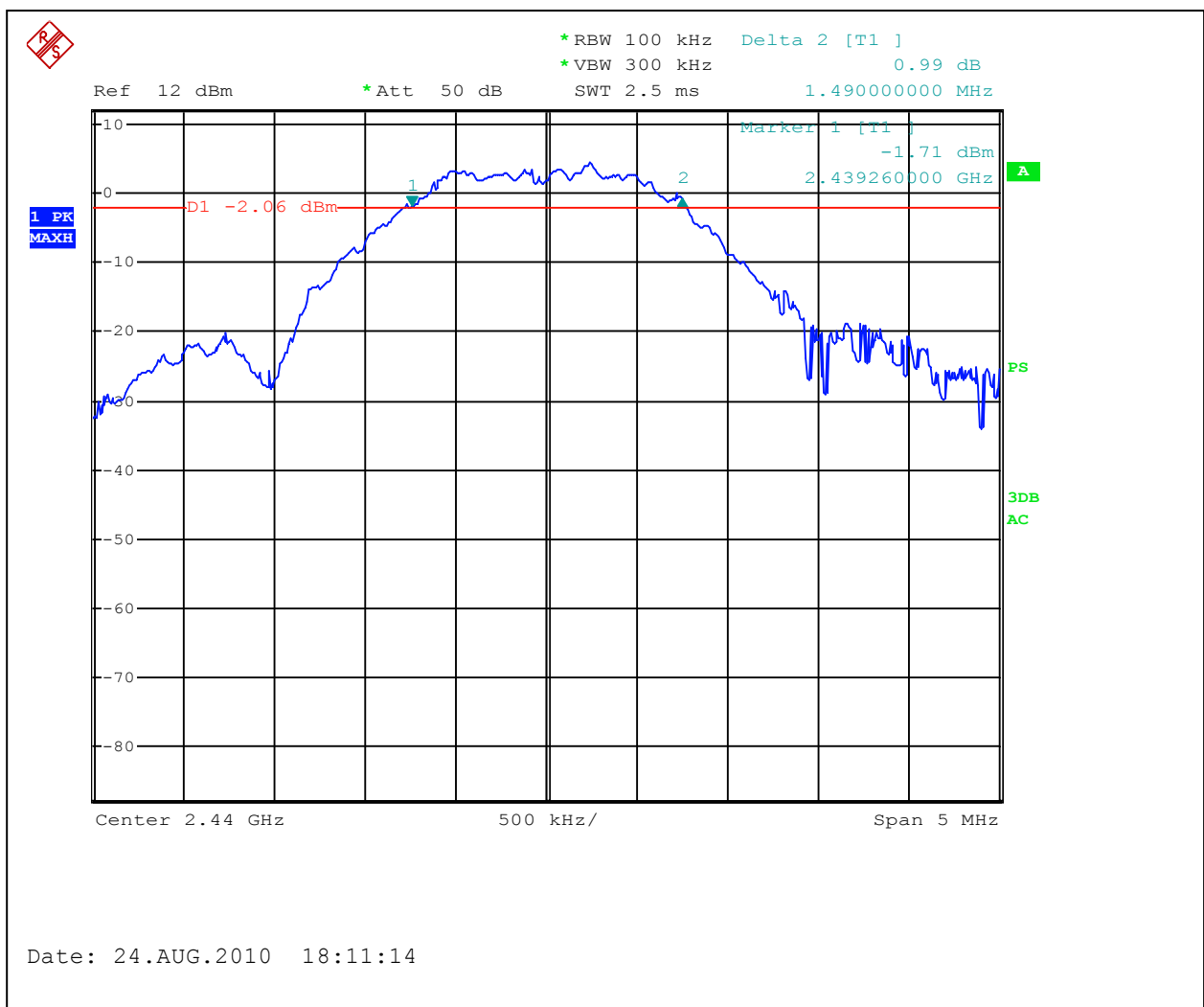
3.2 6dB bandwidth of the digital modulation

Low Frequency Channel kHz	Middle Frequency Channel kHz	Upper Frequency Channel kHz	Minimum Bandwidth kHz	Result
1550	1490	1500	500	Pass
RBW: ☒ 100kHz ☐ other kHz VBW: ☐ 100kHz ☒ 300kHz ☐ other kHz				

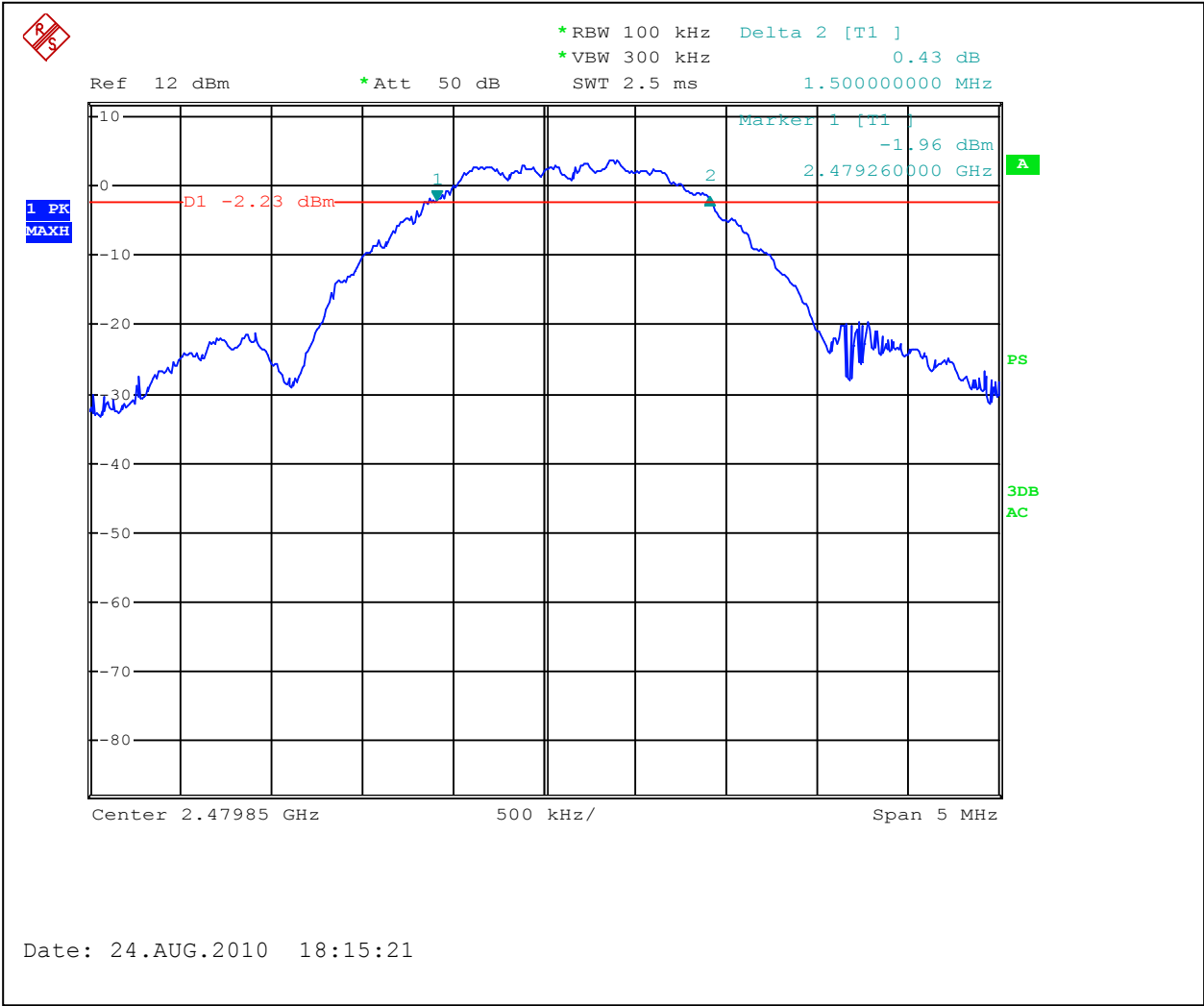
Notes: Graphs 3.2.1 to 3.2.3 show the 6dB bandwidth



Graph 3.2.1



Graph 3.2.2

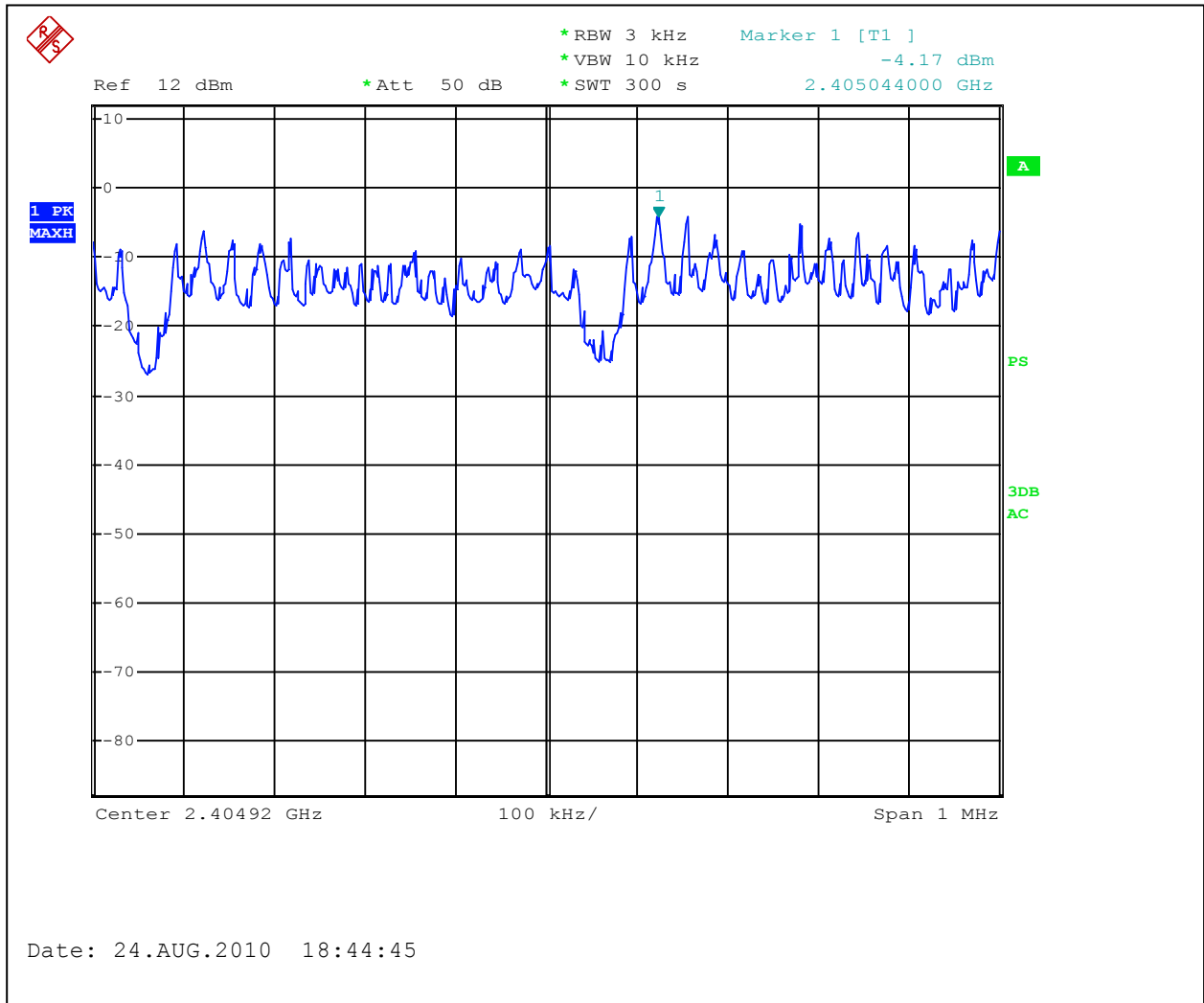


Graph 3.2.3

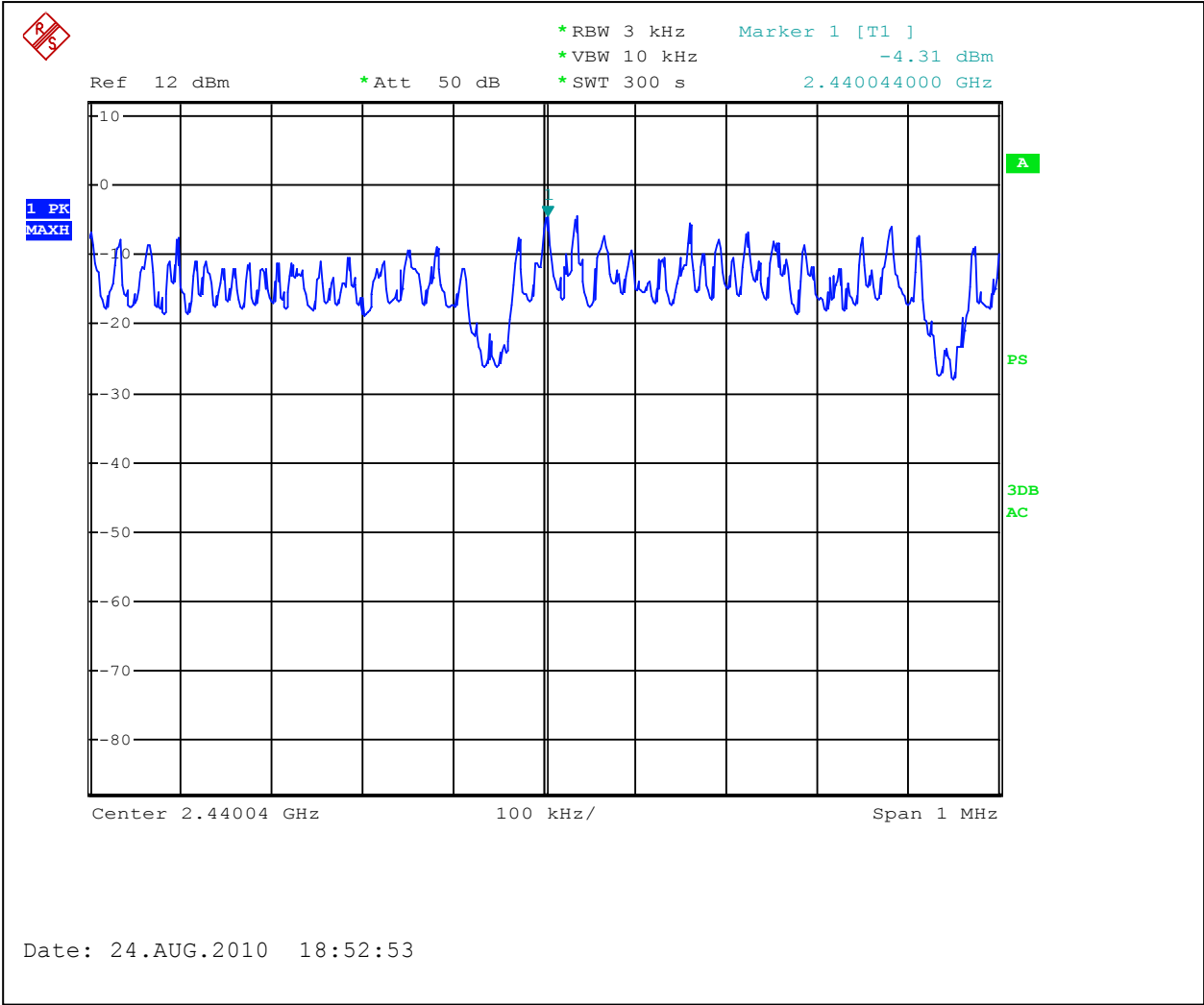
3.3 Power spectral density

Power Output:	☐ Conducted ☐ Radiated			
	Measured Density dBm	Power Spectral Density dBm	Limit dBm	Margin dB
Low Frequency Channel	-4.17	-3.92	8	-11.92
Middle Frequency Channel	-4.31	-4.06	8	-12.06
Upper Frequency Channel	-5.07	-4.82	8	-12.82
Analyzer Settings:	☒ RBW=3KHz ☒ VBW=10KHz ☐ Span=1MHz ☒ Sweep=300sec			
Antenna Gain:	☒ < 6dBi and = 1.6dBi ☐ >6dBi and = dBi, limit reduction = dB			

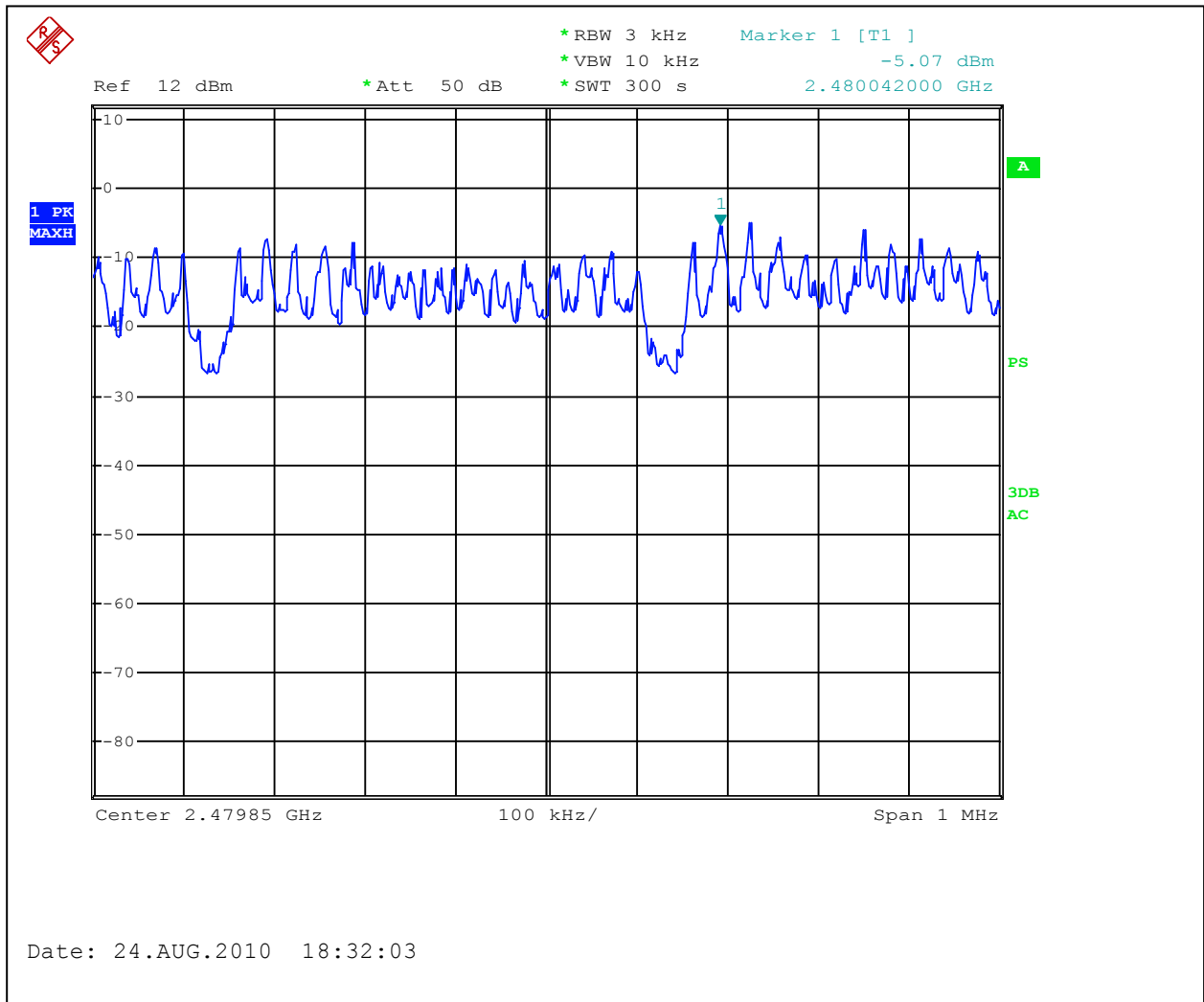
Notes: The Power Spectral Density was calculated adding the cable/attenuator loss of 0.25 dB from the measured density value.
 Graphs 3.3.1 to 3.3.3 show the Power Spectral Density.



Graph 3.3.1



Graph 3.3.2

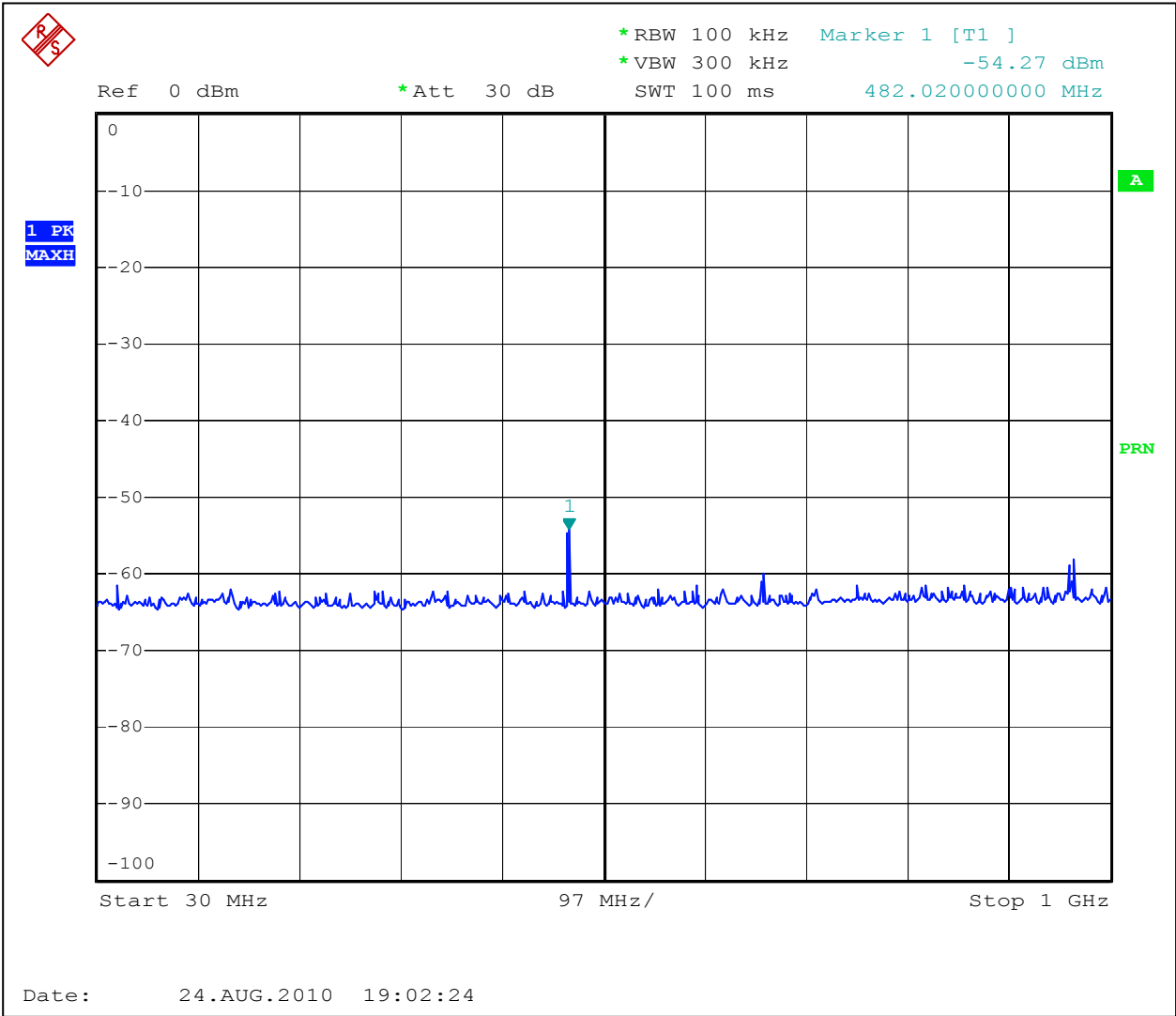


Graph 3.3.3

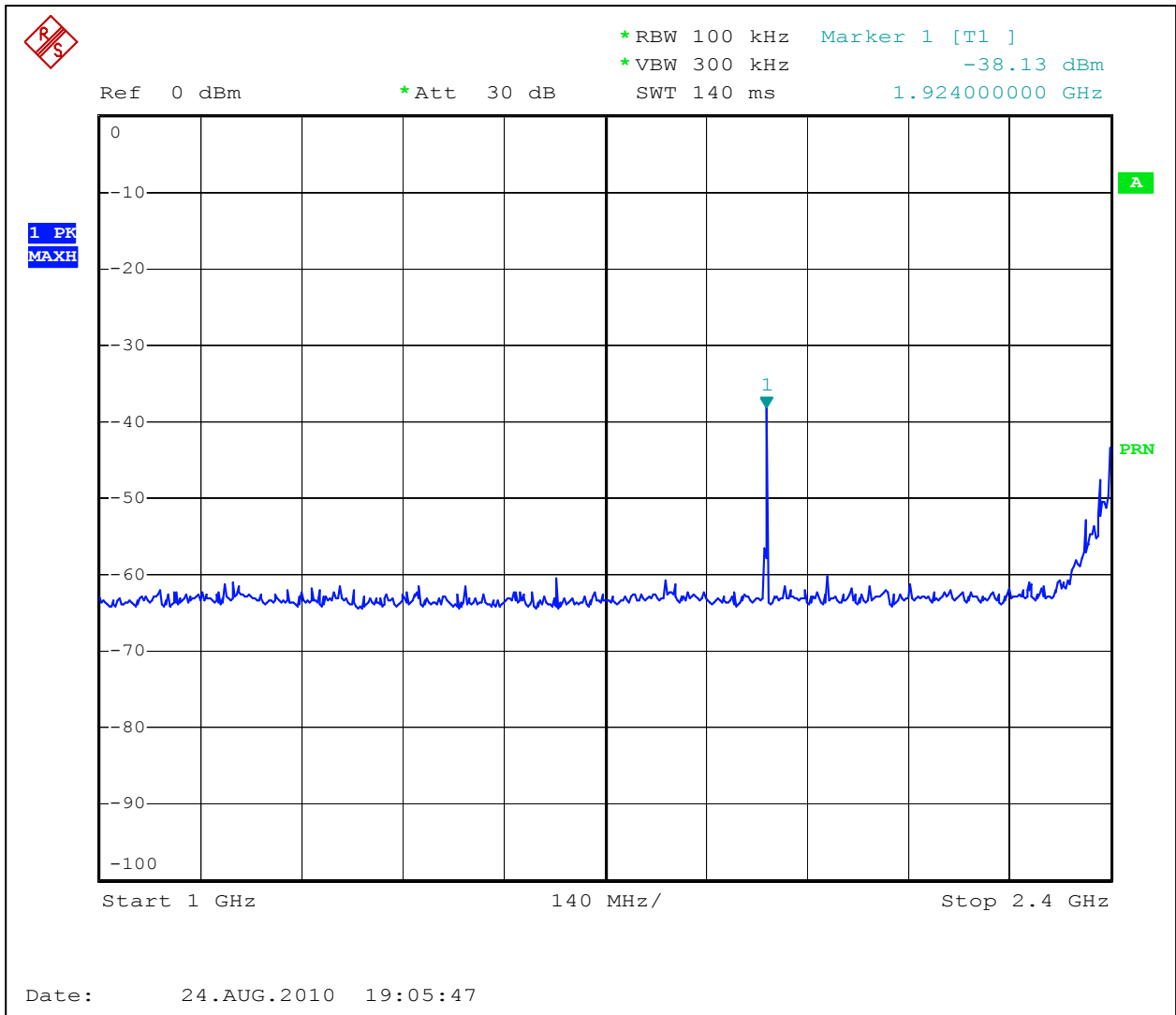
3.4 Antenna conducted spurious emissions

	Minimum Measured Attenuation dB	Minimum Allowed Attenuation dB	Margin dB
Low Frequency Channel	45.85	20	-25.85
Middle Frequency Channel	39.51	20	-19.51
Upper Frequency Channel	40.39	20	-20.39
Analyzer Settings:	☒ RBW=100KHz		
Minimum Allowed Attenuation:	☒ 20dB ☐ 30dB (for digital systems with conducted power measured using RMS averaging over a time interval)		

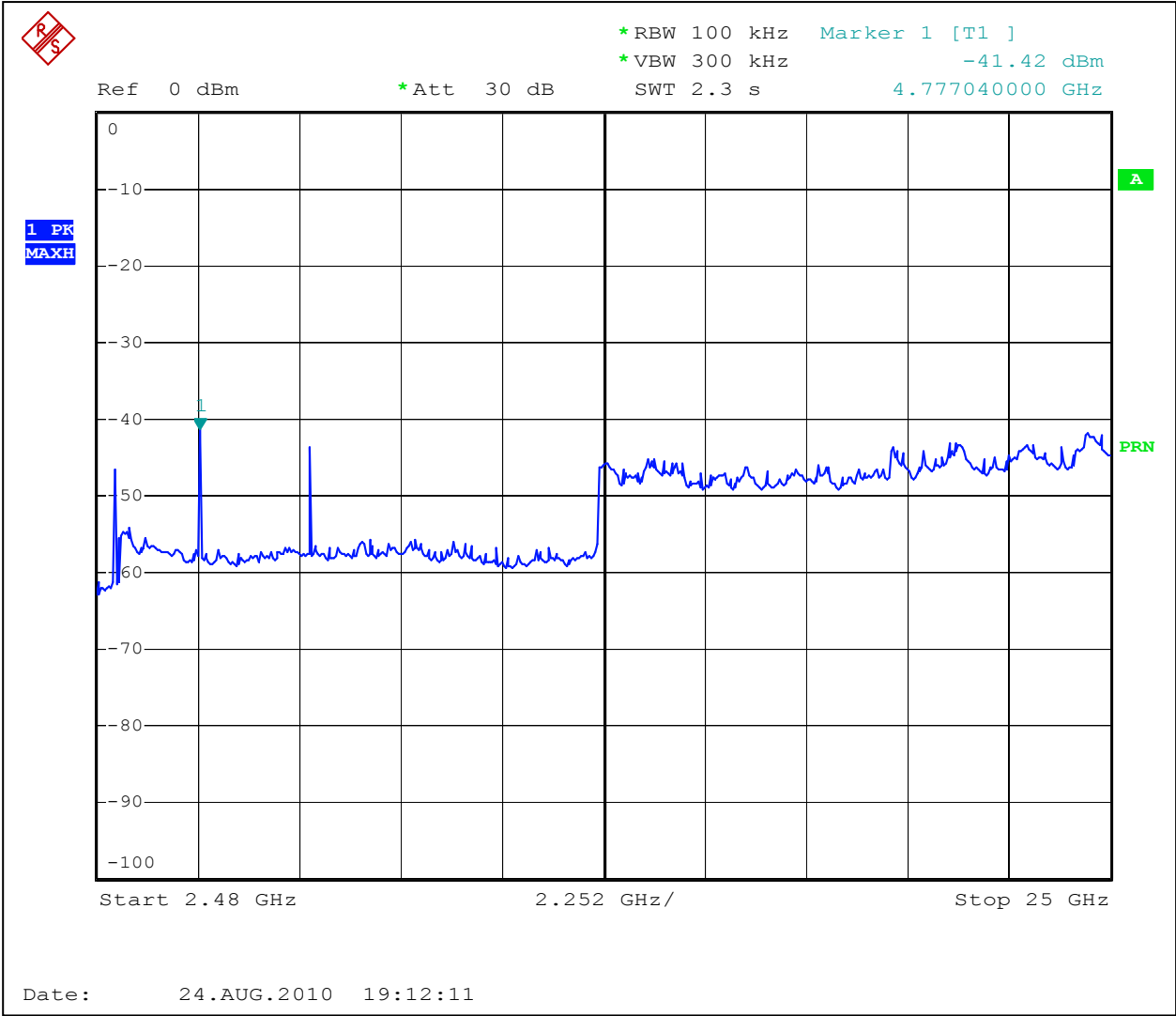
Notes: Test was performed in frequency range from 30MHz to 25GHz
 Graphs 3.4.1 to 3.4.3 show the Antenna Conducted Spurious Emissions for channel 0
 Graphs 3.4.4 to 3.4.6 show the Antenna Conducted Spurious Emissions for channel 7
 Graphs 3.4.7 to 3.4.9 show the Antenna Conducted Spurious Emissions for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



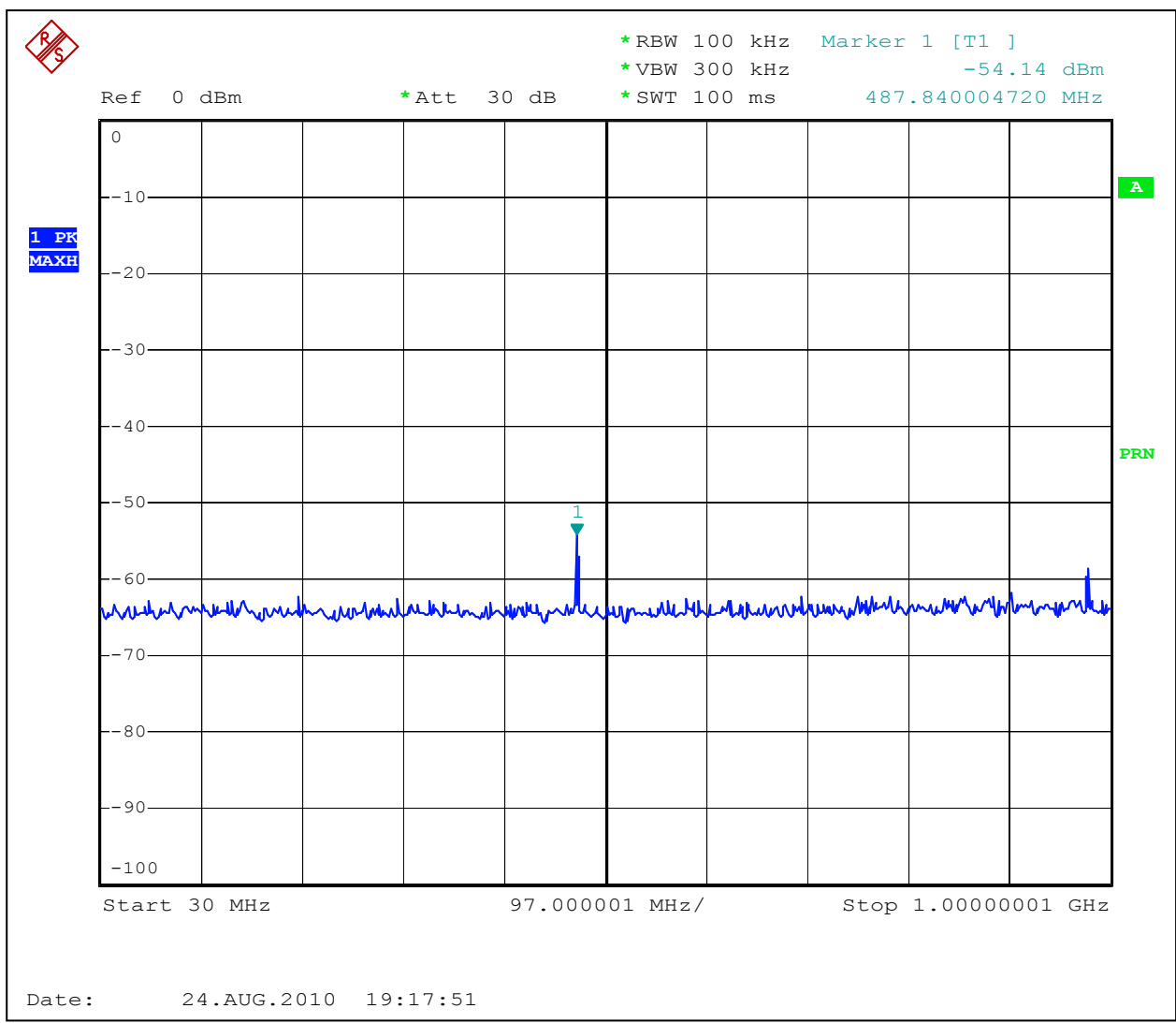
Graph 3.4.1



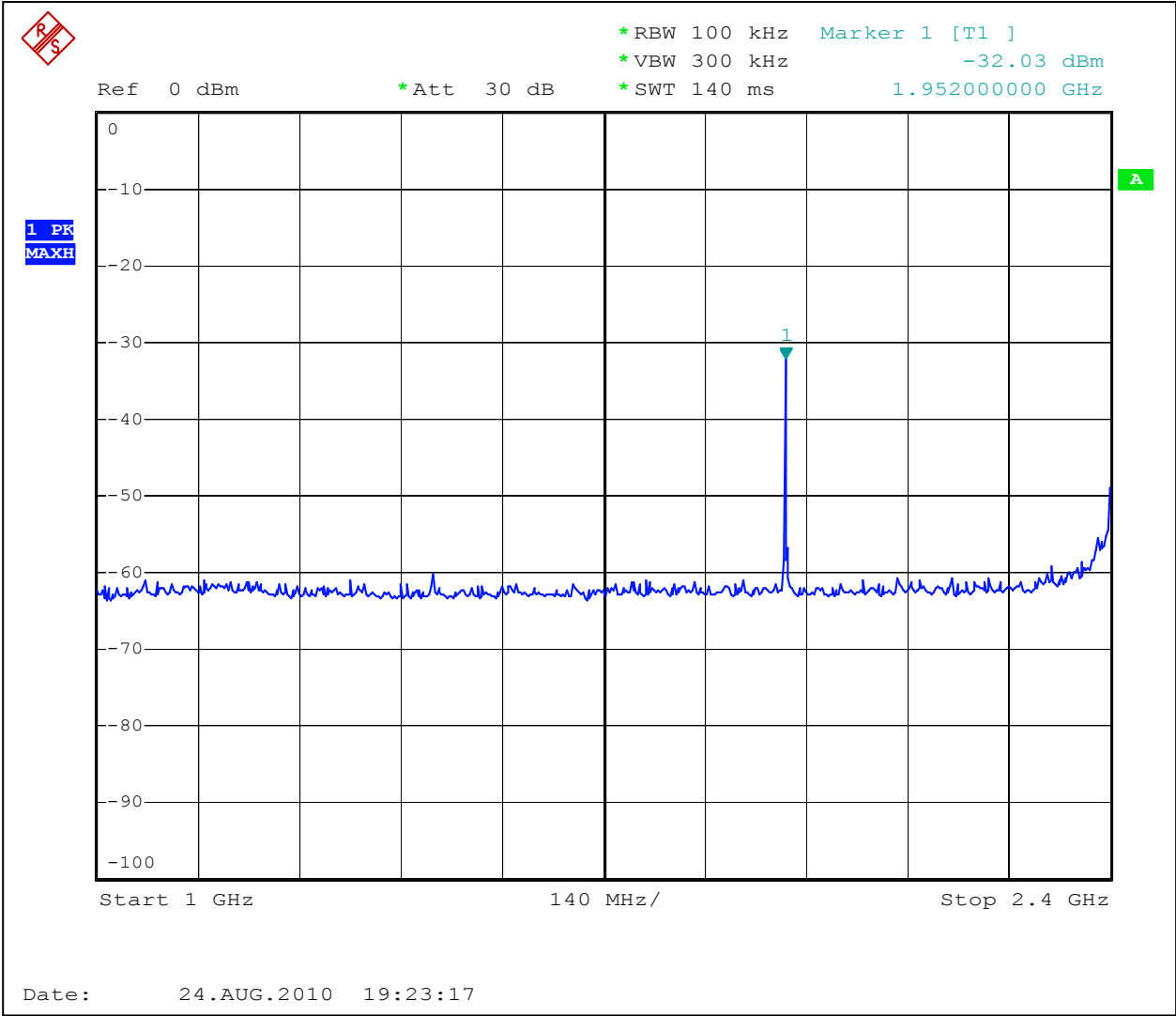
Graph 3.4.2



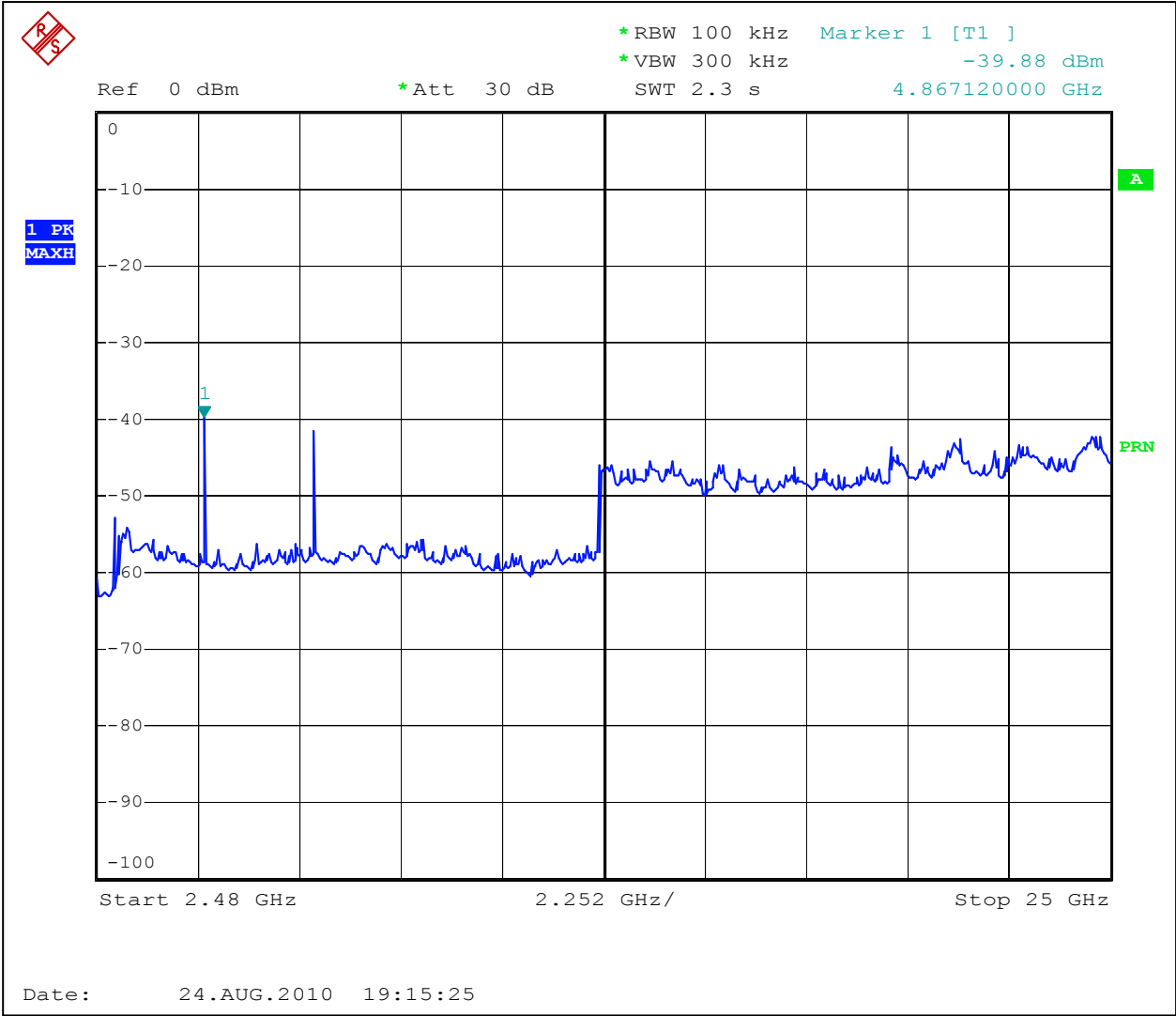
Graph 3.4.3



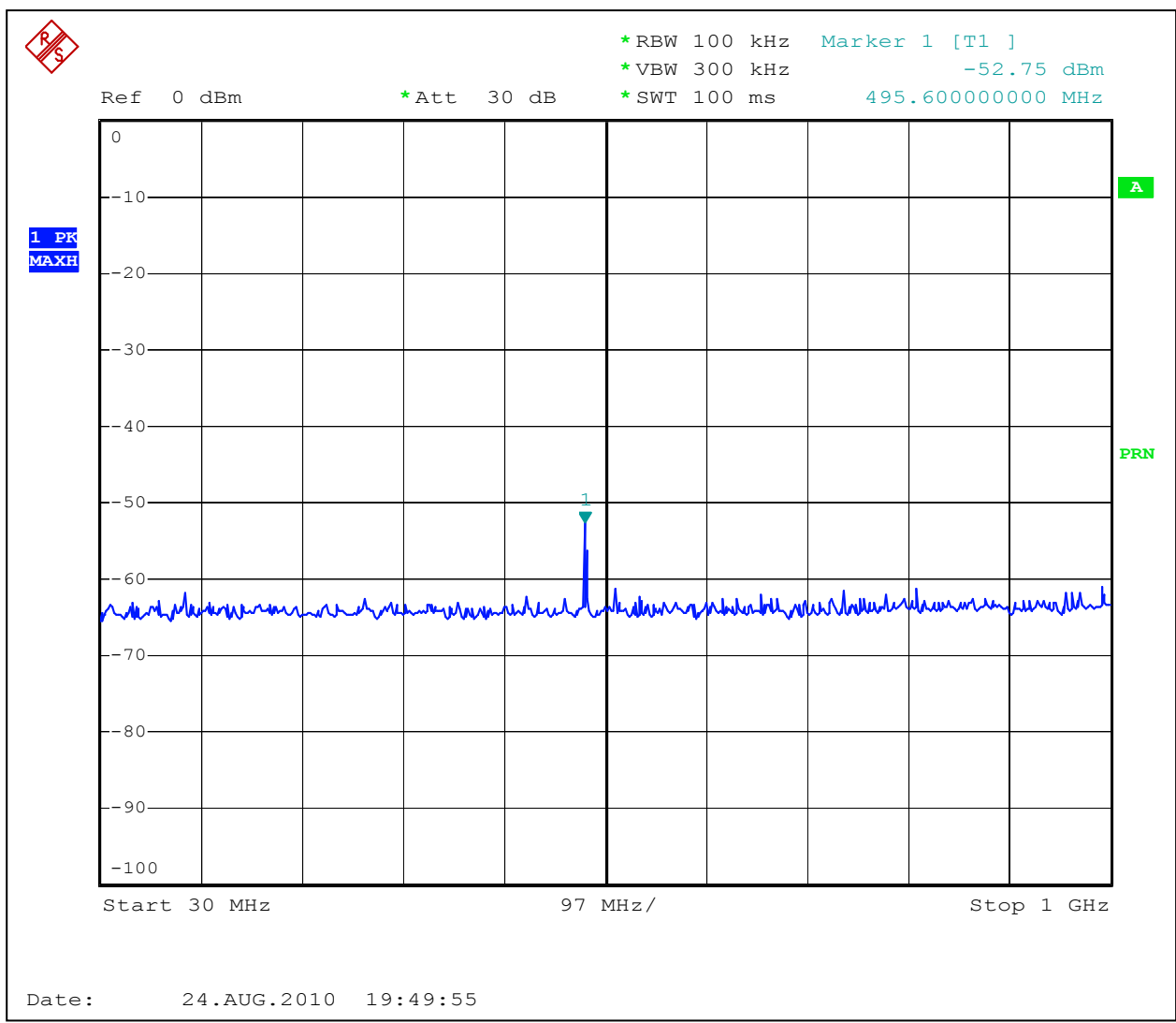
Graph 3.4.4



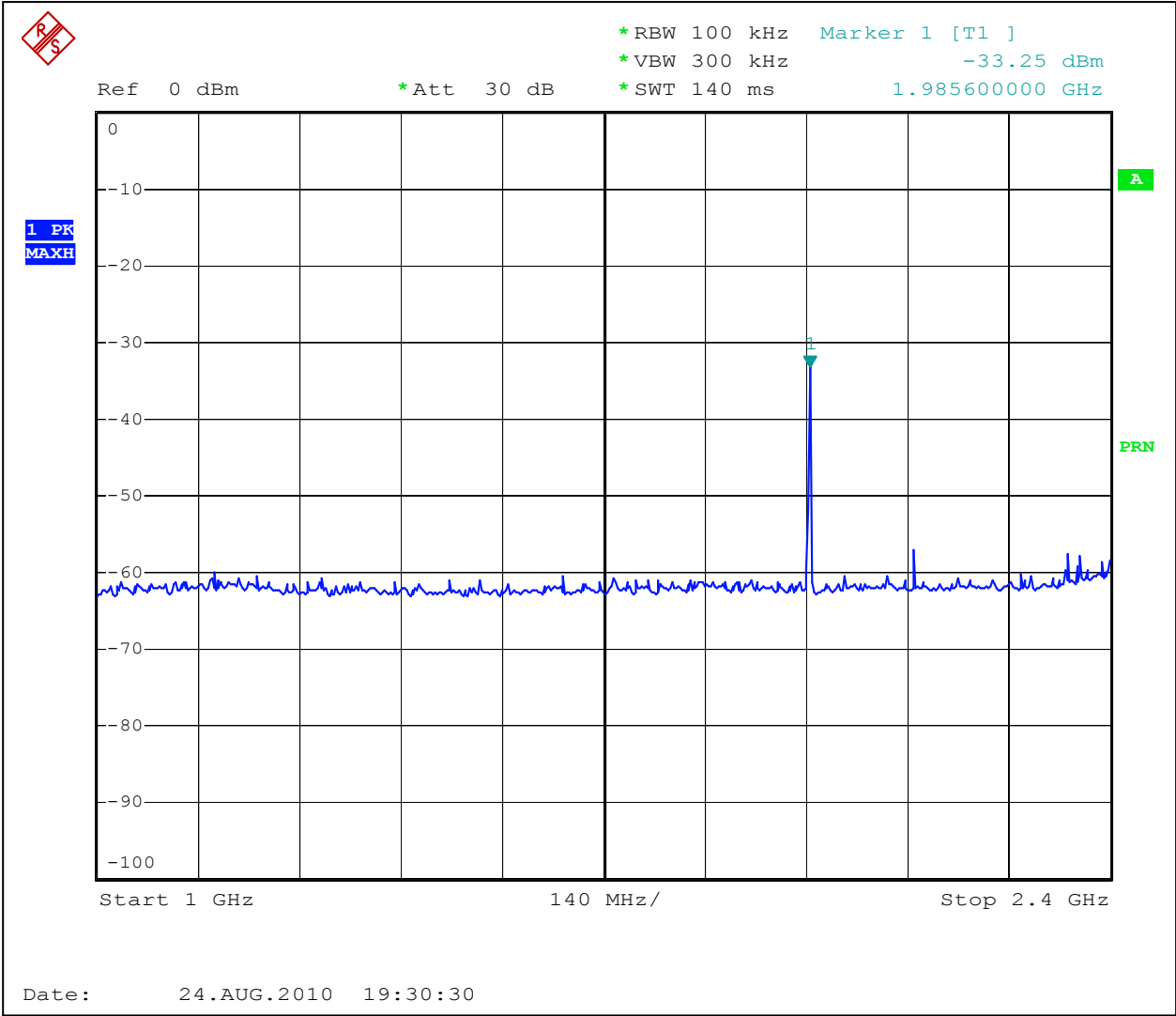
Graph 3.4.5



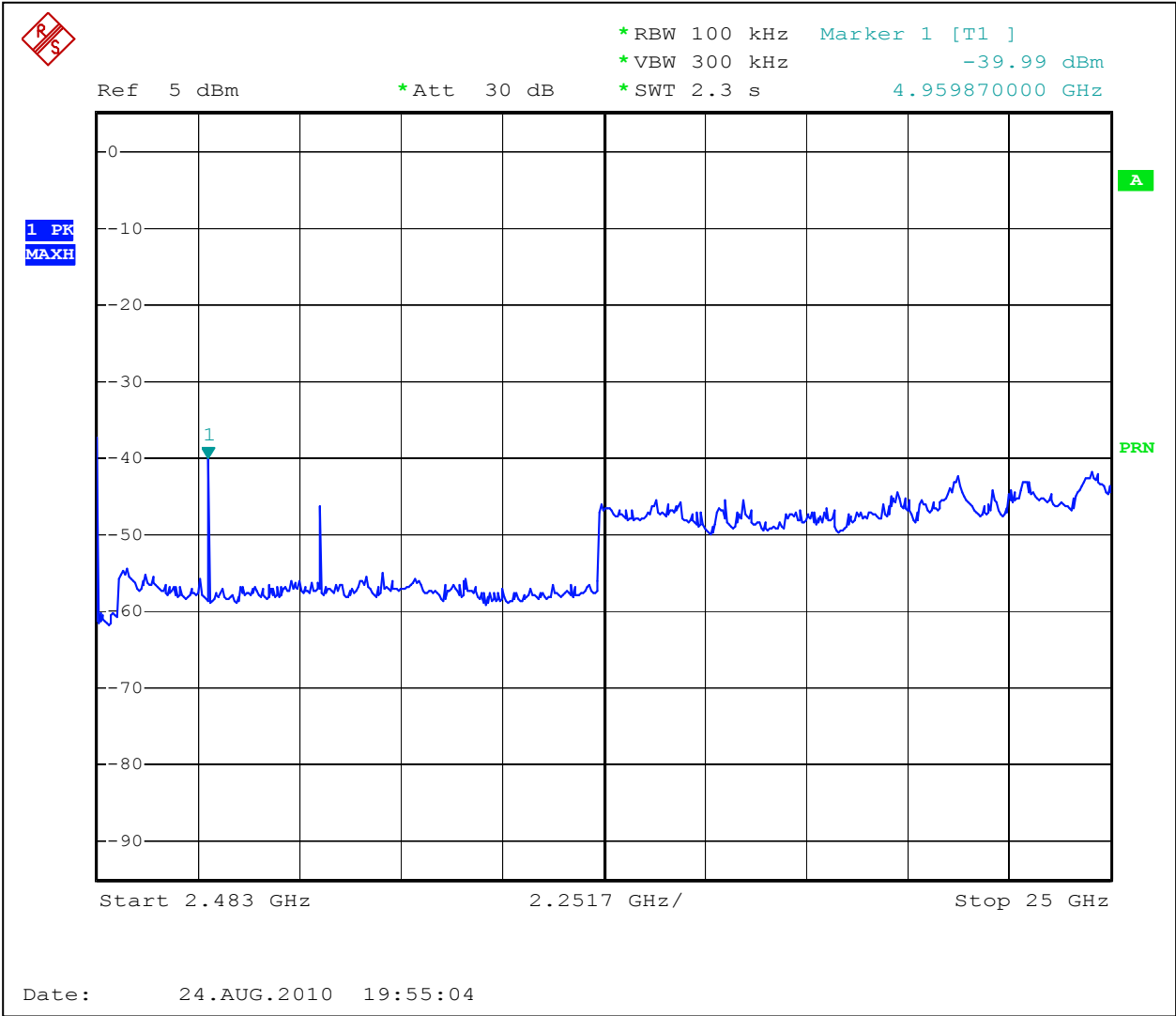
Graph 3.4.6



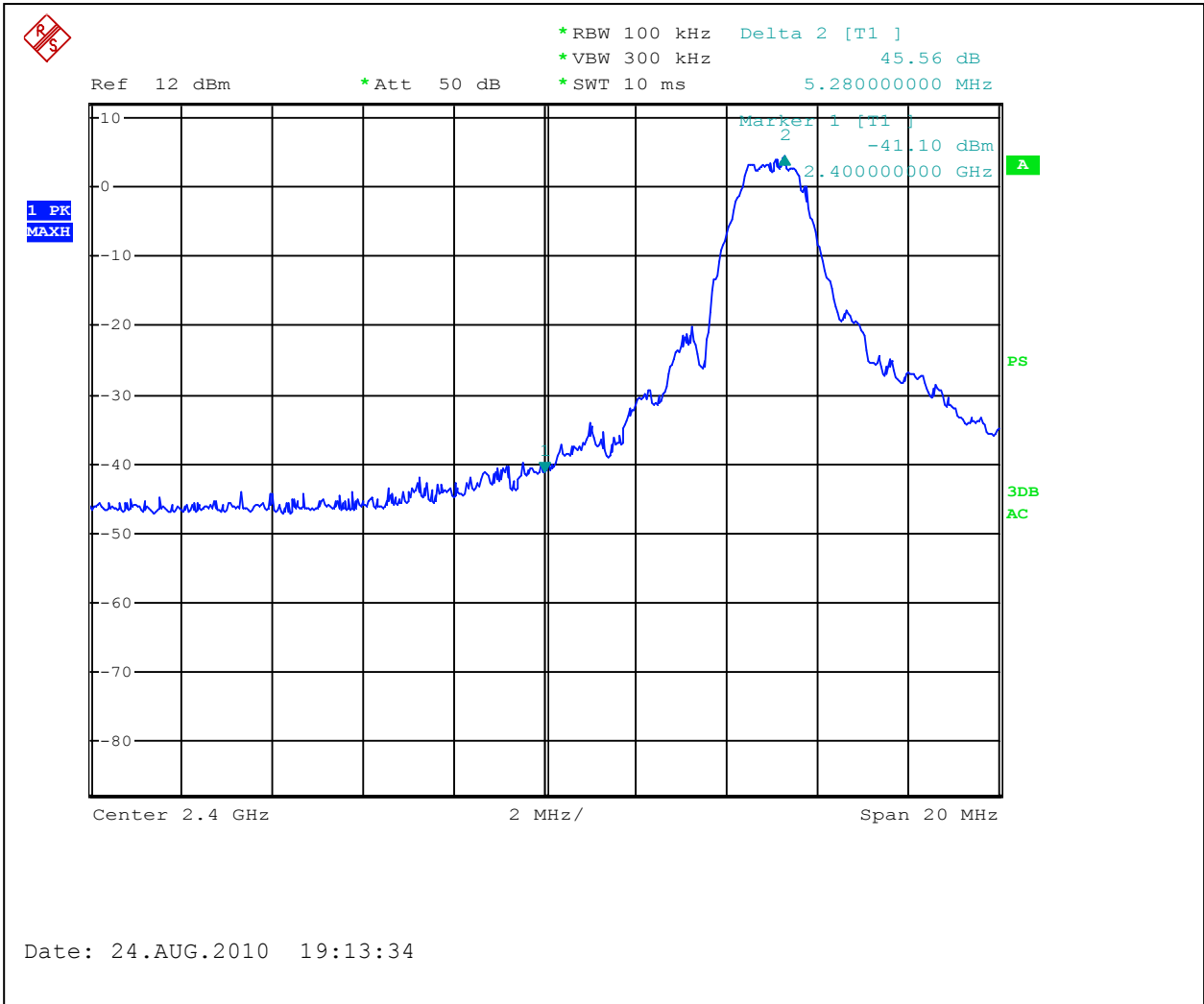
Graph 3.4.7



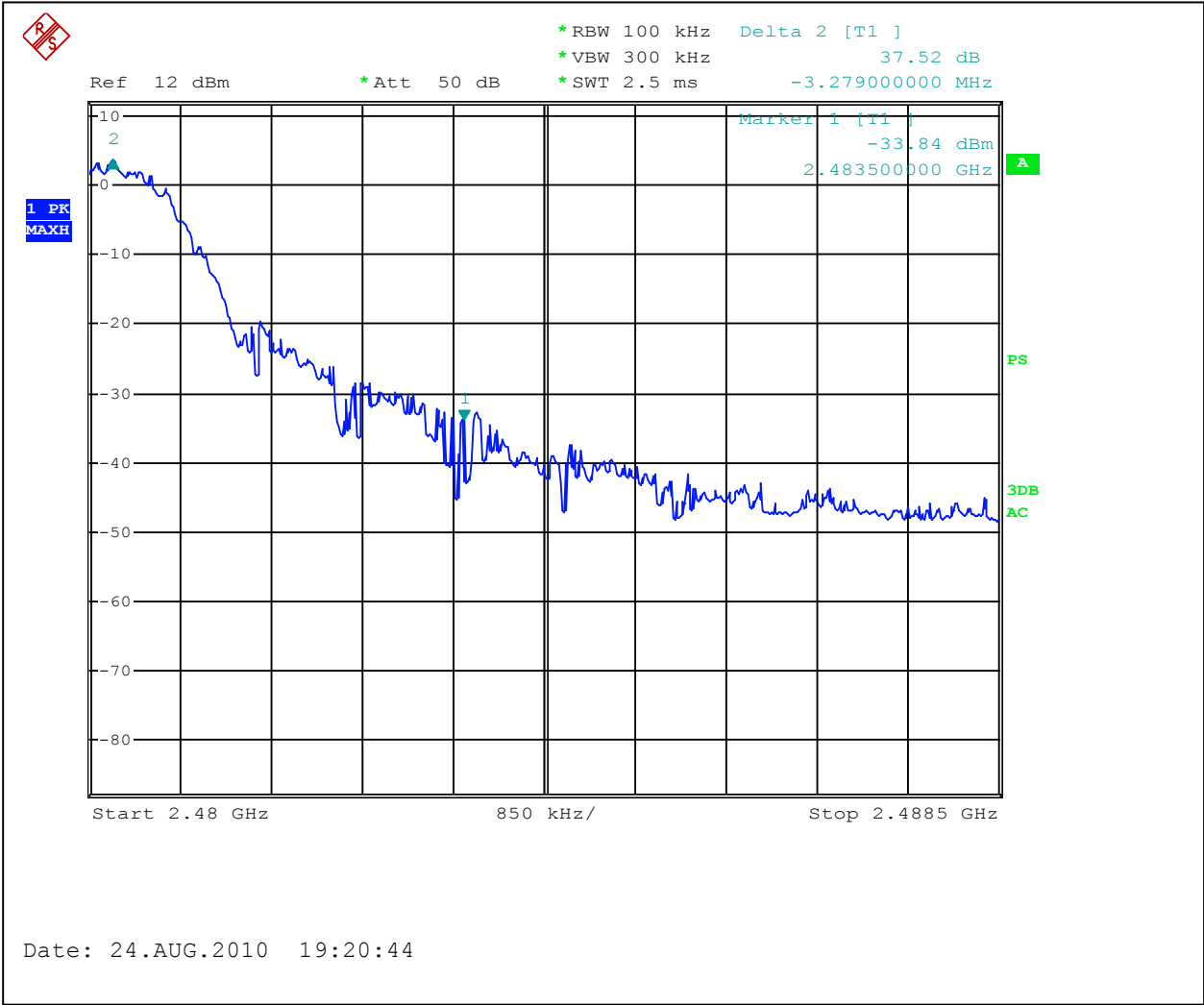
Graph 3.4.8



Graph 3.4.9



Graph 3.4.9



Graph 3.4.10



3.5 Radiated spurious emissions

Test location: ☐ OATS ☒ Anechoic Chamber ☐ Other

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

Test result: **Pass**

Max. Margin: 7.5dB below the limits

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

Date:	August 25-31, 2010	Result: Pass
Standard:	FCC part 15.247(d)	
Tested by:	Uri Spector	
Test Point:	Low frequency channel	
Operation mode:	See Page 5	
Note:		

Table 3.5.1

Frequency	Ant. Polarity	Peak Reading dBμV	Ant.Factor dB1/m	Total at 3m dBμV/m	QP Limit dBμV/m	Margin dB
Channel 0						
121.64 MHz	V	13.7	14.0	27.6	43.5	-15.9
274.92 MHz	V	16.2	15.3	31.5	46.0	-14.5
120.89 MHz	H	12.7	14.0	26.7	43.5	-16.8
Channel 7						
124.62 MHz	V	12.6	13.8	26.4	43.5	-17.1
511.95 MHz	V	15.8	20.7	36.4	46.0	-9.6
122.83 MHz	H	12.3	13.9	26.2	43.5	-17.3
Channel 15						
120.89 MHz	V	12.4	14.0	26.4	43.5	-17.1
274.28 MHz	V	16.5	15.3	31.7	46.0	-14.3
116.27 MHz	H	12.2	13.9	26.0	43.5	-17.5
511.95 MHz	H	15.7	20.7	36.4	46.0	-9.7

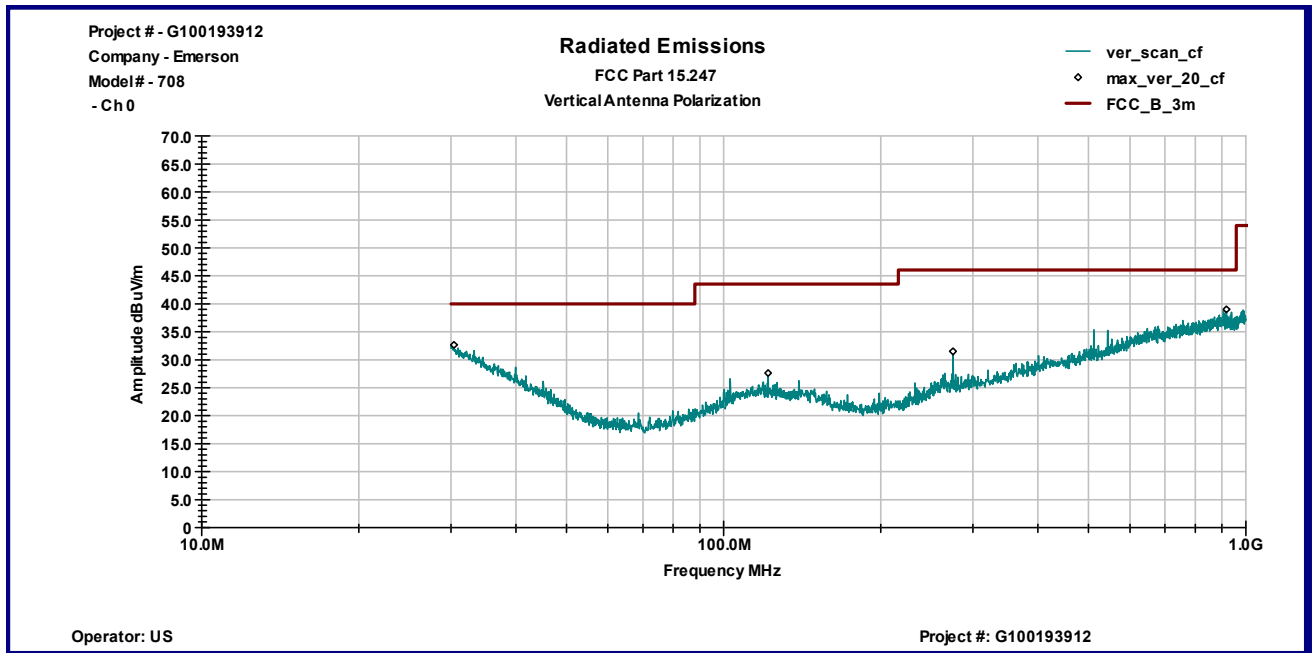
Table 3.5.2

Frequency MHz	Antenna		Ant. CF dB1/m	Cable loss dB	Pre-amp Gain (dB)	Reading dBμV	Total @ 3m dBμV/m	AVG Limit dBμV/m	Margin dB	Comments
	Polarity	Hts(cm)								
	Channel 0									
1198.00	V	100	24.4	2.5	0.0	18.9	45.8	54.0	-8.2	Peak measurement
1209.00	V	100	24.4	2.5	0.0	18.0	44.9	54.0	-9.1	Peak measurement
4811.00	V	120	33.0	4.9	41.8	34.6	30.7	54.0	-23.3	
4811.00	H	138	33.0	4.9	41.8	37.3	33.4	54.0	-20.6	
7216.40	V	109	35.8	6.2	41.3	31.7	32.3	54.0	-21.7	
7216.40	H	100	35.8	6.2	41.3	31.2	31.8	54.0	-22.1	
	Channel 7									
4880.80	V	123	33.1	4.9	41.8	32.9	29.2	54.0	-24.8	
4880.80	H	126	33.1	4.9	41.8	35.0	31.3	54.0	-22.7	
7321.34	V	112	36.0	6.2	41.2	30.3	31.4	54.0	-22.6	
7321.34	H	109	36.0	6.2	41.2	31.1	32.2	54.0	-21.8	
	Channel 15									
4959.04	V	119	33.2	5.0	41.7	32.5	29.0	54.0	-24.9	
4959.04	H	111	33.2	5.0	41.7	31.2	27.7	54.0	-26.3	
7438.56	V	113	36.3	6.3	41.0	29.4	30.9	54.0	-23.1	
7438.56	H	100	36.3	6.3	41.0	30.8	32.4	54.0	-21.6	

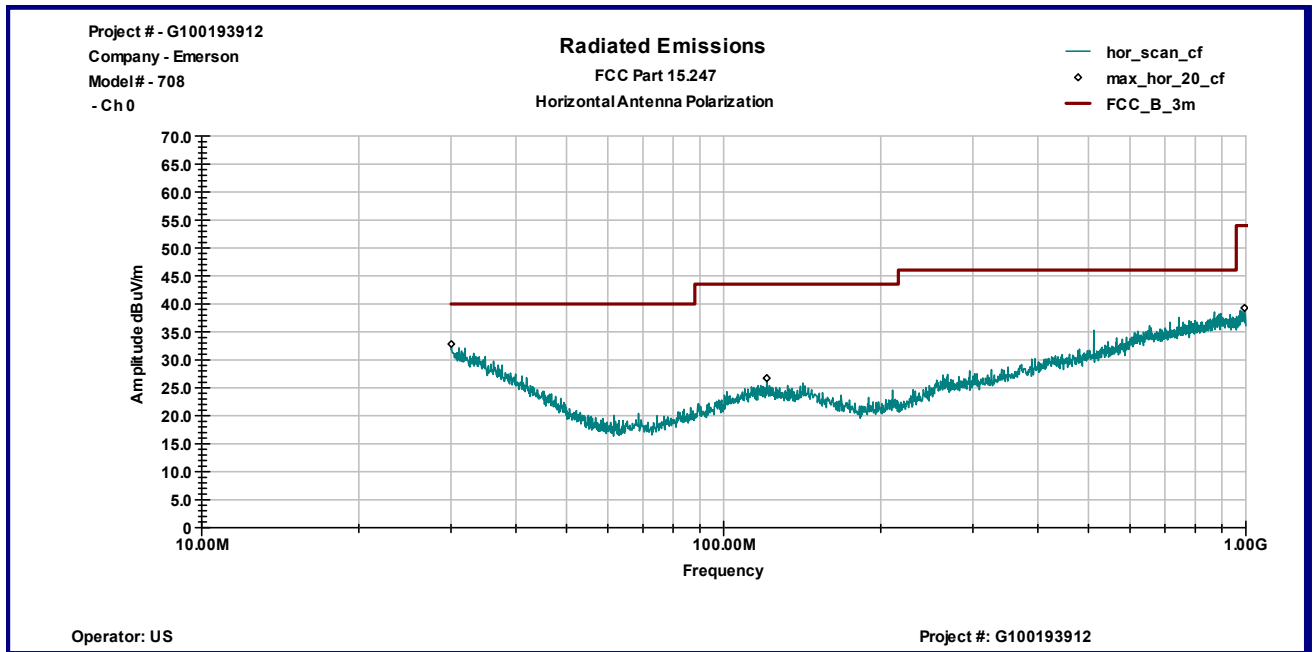
- Note:**
1. Measurements were taken using an Average Value (RBW 1MHz, VBW 10Hz), or Peak detector when commented.
 2. The table shows the 2nd and 3rd harmonic in restricted band of operation per FCC 15.205
 3. The Frequencies from 1.923GHz to 1.985GHz and the 4th harmonic are outside restricted band of operation per FCC 15.205.
 4. No emissions were detected above ambient at 5th and above harmonics

Table 3.5.3

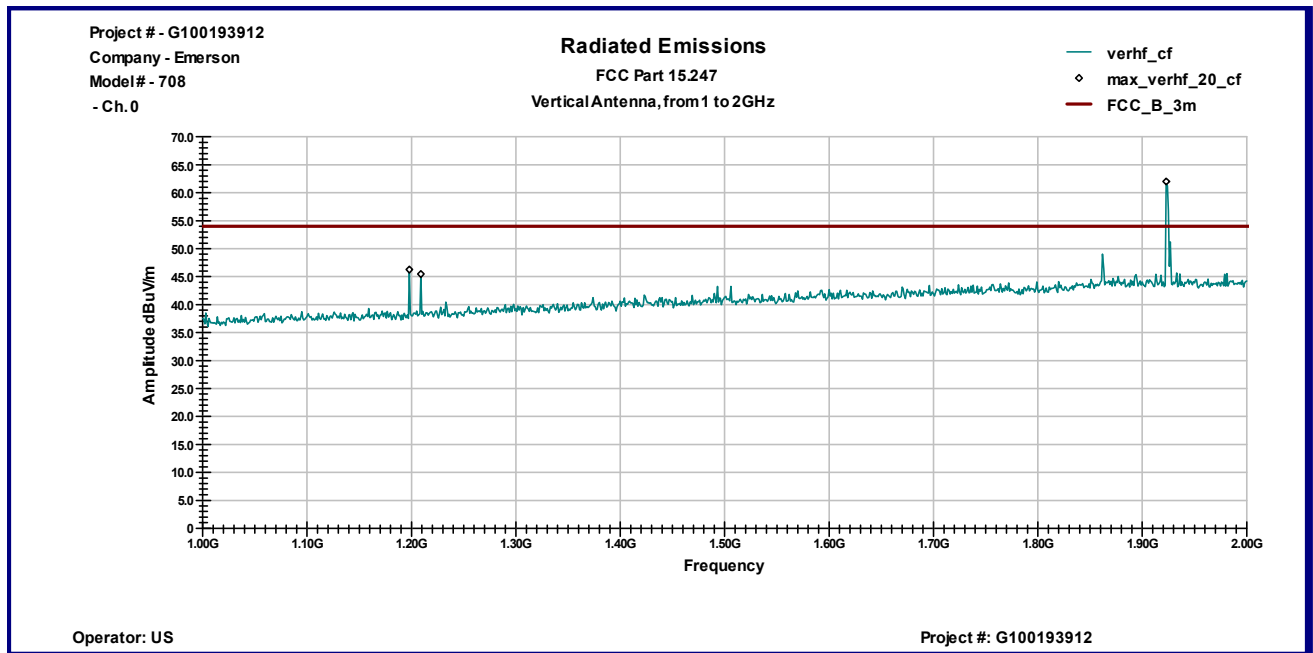
Frequency MHz	Antenna Polarity	Reading dBμV	Total C.F. dB1/m	Pre-Amp. Gain (dB)	Total at 3m dBμV/m	Peak Limit dBμV/m	Margin dB
Channel 0							
4.8114 GHz	V	61.7	39.4	39.8	61.3	74.0	-12.7
7.2152 GHz	V	49.4	43.5	40.0	52.8	74.0	-21.2
4.8114 GHz	H	63.0	39.4	39.8	62.6	74.0	-11.4
7.2152 GHz	H	49.2	43.5	40.0	52.6	74.0	-21.4
Channel 7							
4.8805 GHz	V	56.8	39.5	39.8	56.6	74.0	-17.4
7.321 GHz	V	55.6	43.8	39.9	59.5	74.0	-14.5
4.8805 GHz	H	62.3	39.5	39.8	62.1	74.0	-11.9
7.321 GHz	H	56.2	43.8	39.9	60.1	74.0	-13.9
Channel 15							
4.9595 GHz	V	60.8	39.7	39.7	60.8	74.0	-13.2
7.438 GHz	V	54.9	44.1	39.8	59.2	74.0	-14.8
4.9595 GHz	H	66.5	39.7	39.7	66.5	74.0	-7.5
7.438 GHz	H	55.0	44.1	39.8	59.3	74.0	-14.7



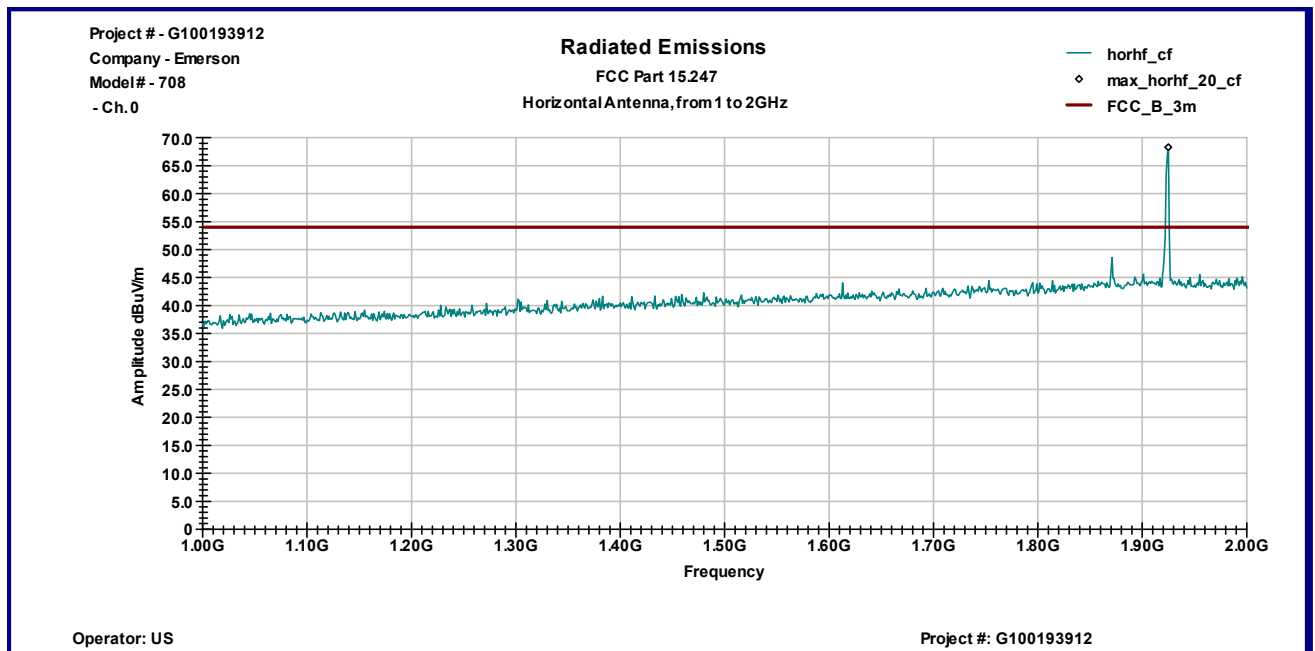
Graph 3.5.1



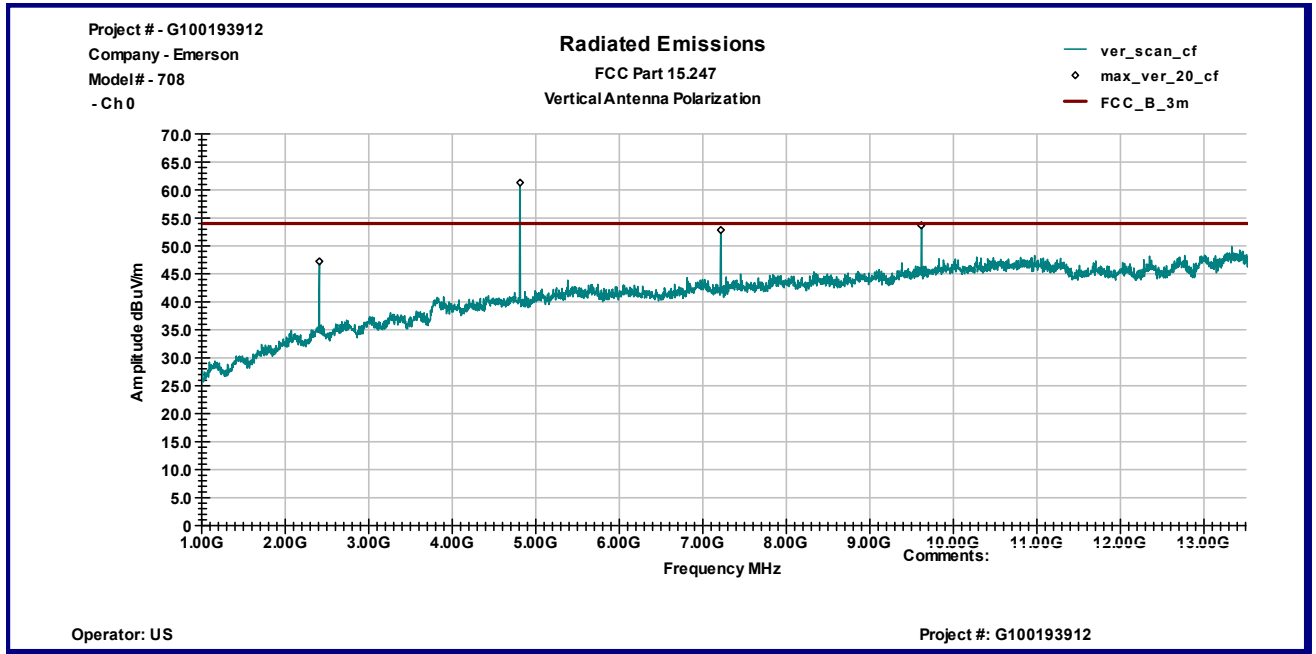
Graph 3.5.2



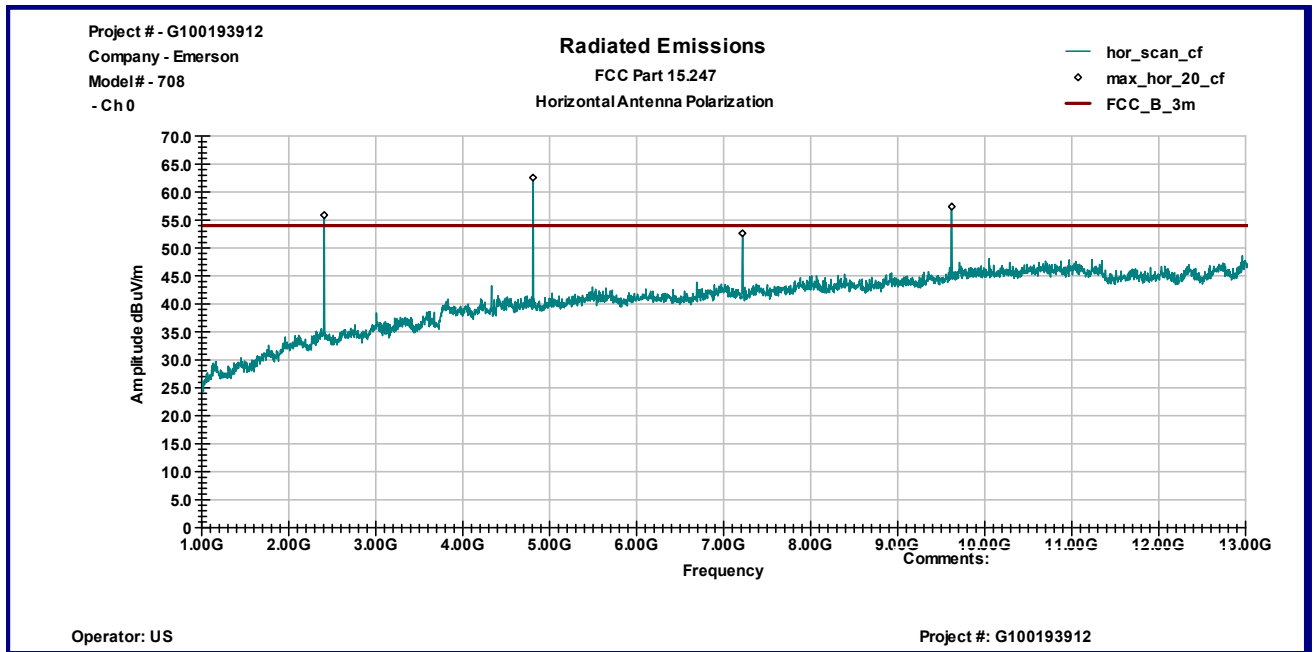
Graph 3.5.3



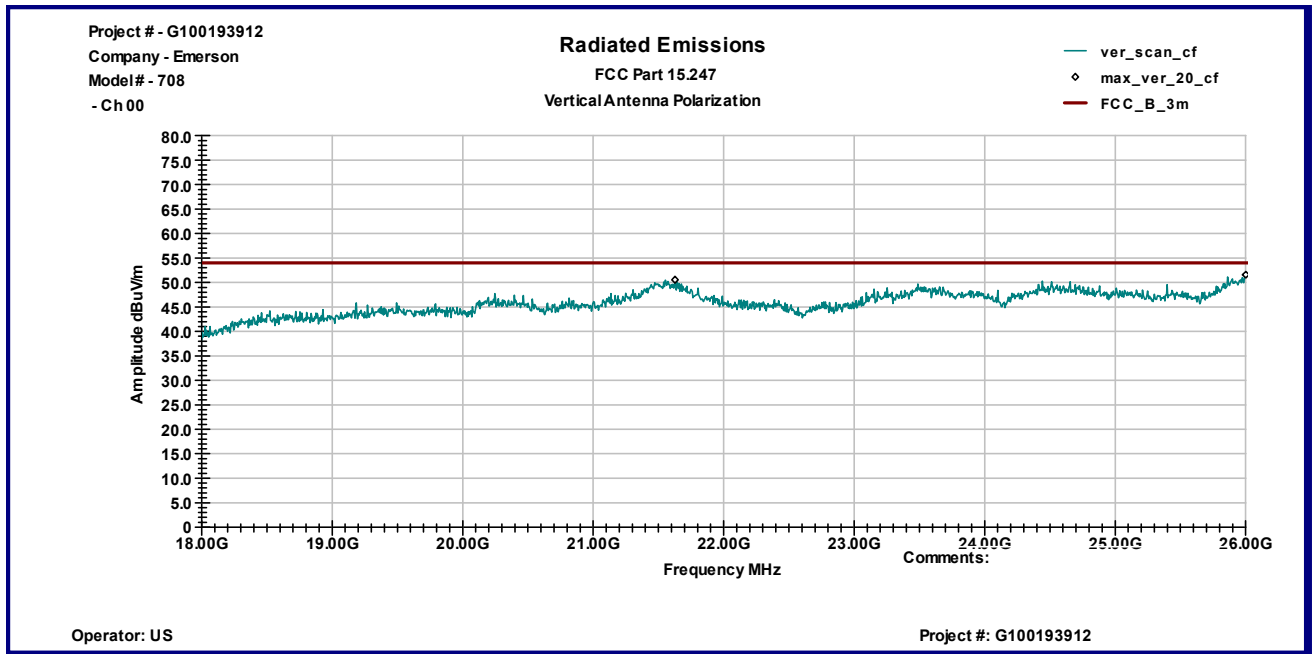
Graph 3.5.4



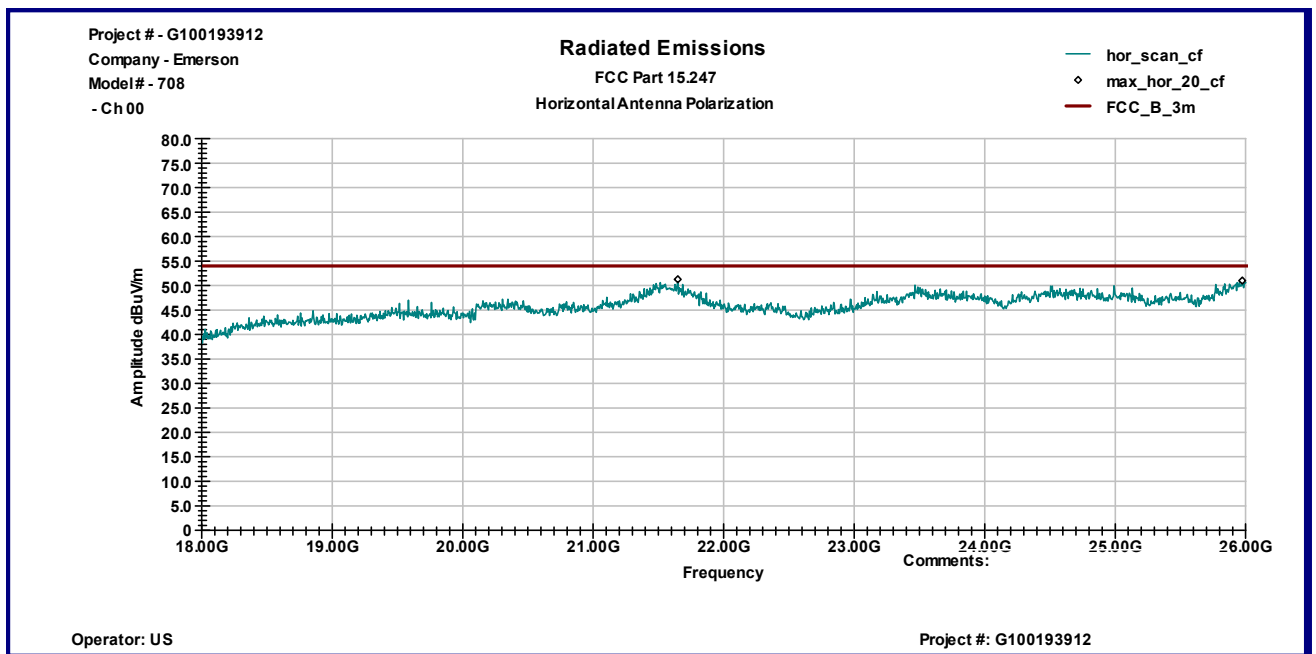
Graph 3.5.5



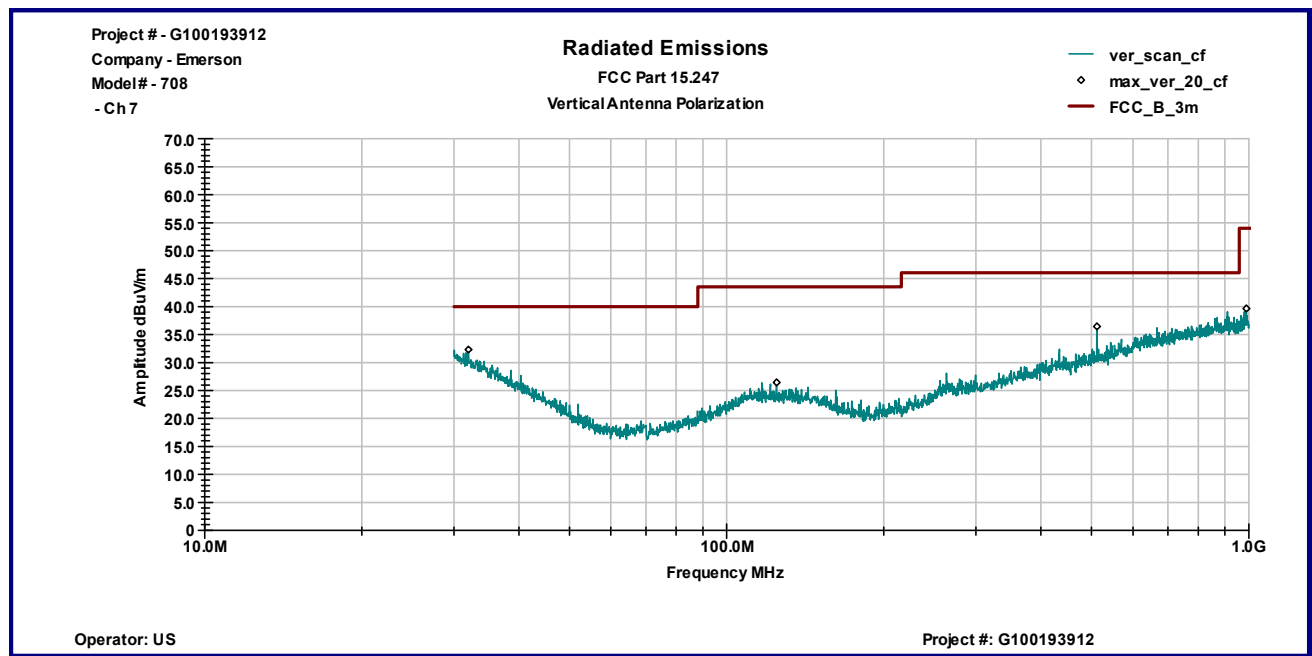
Graph 3.5.6



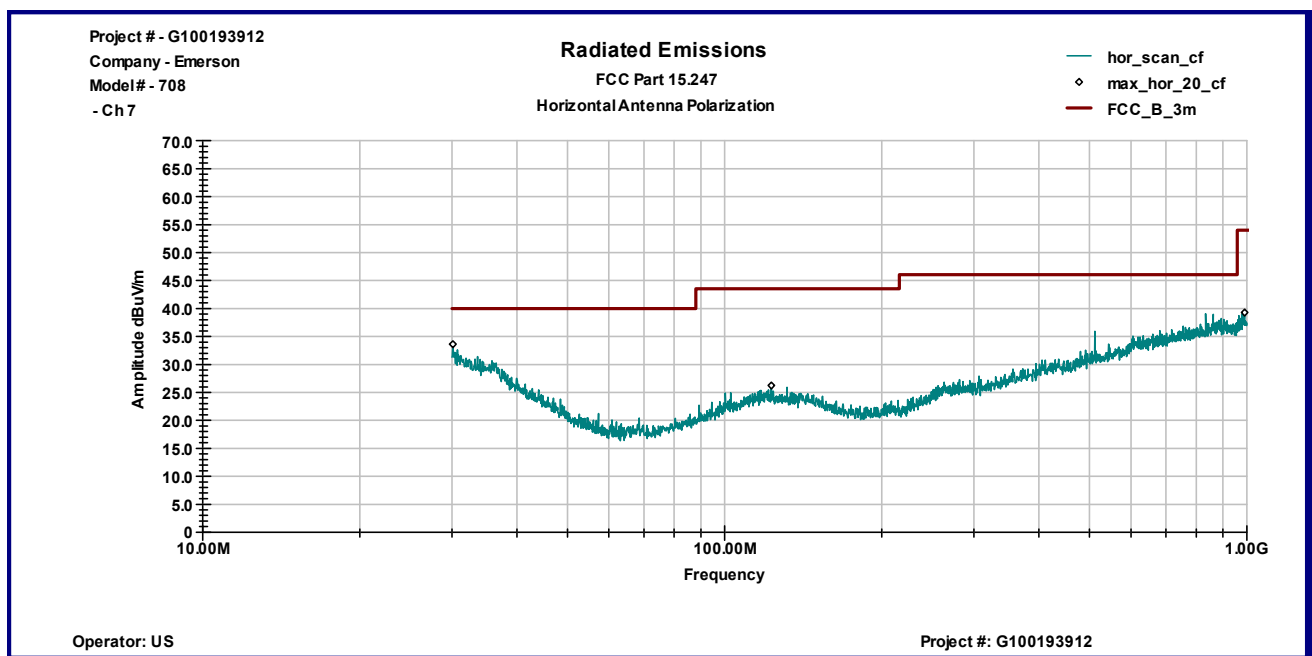
Graph 3.5.7



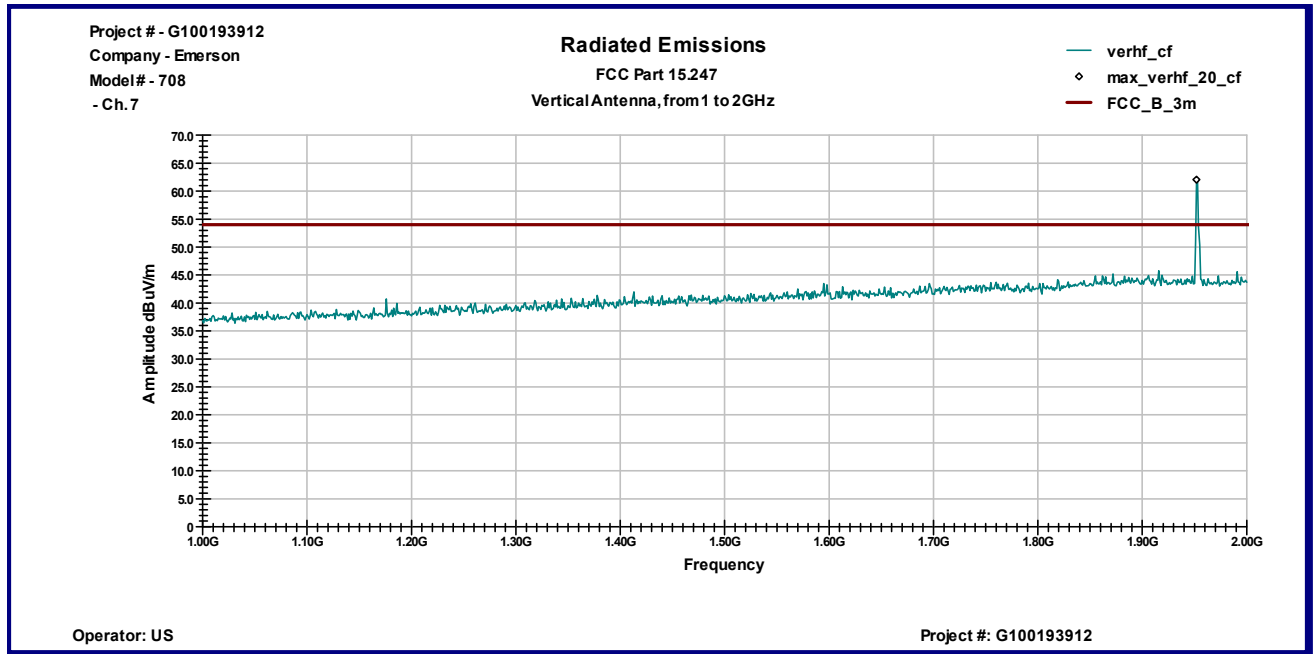
Graph 3.5.8



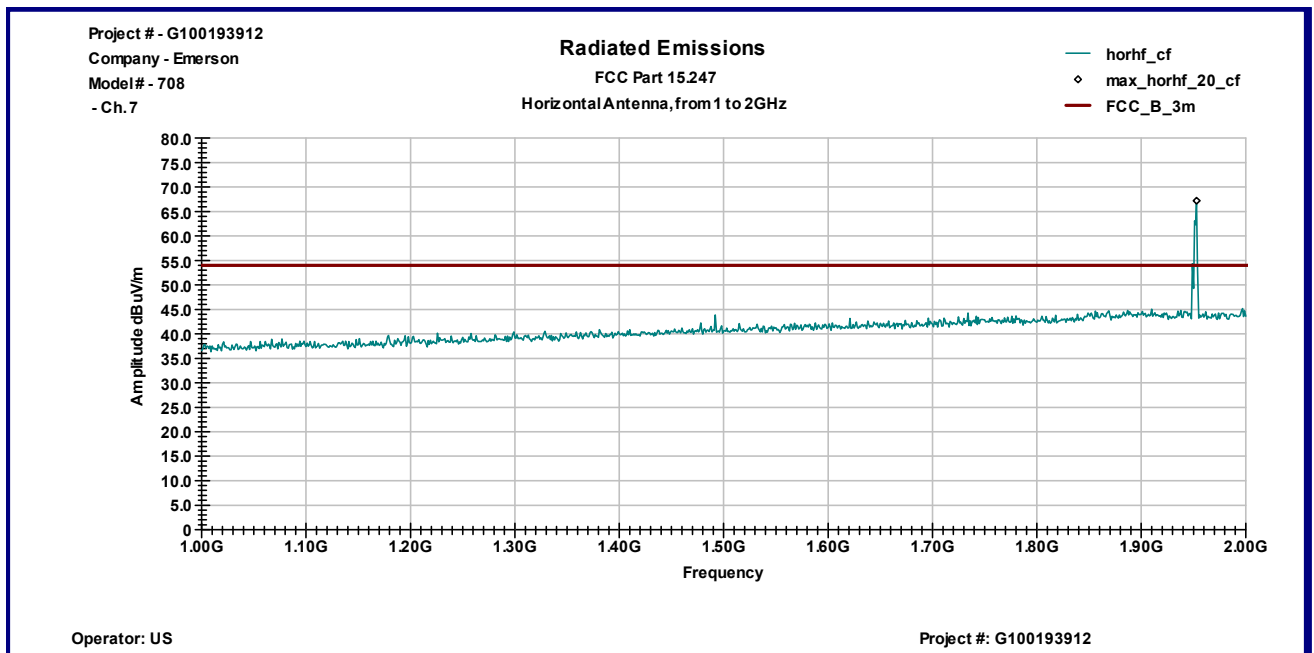
Graph 3.5.9



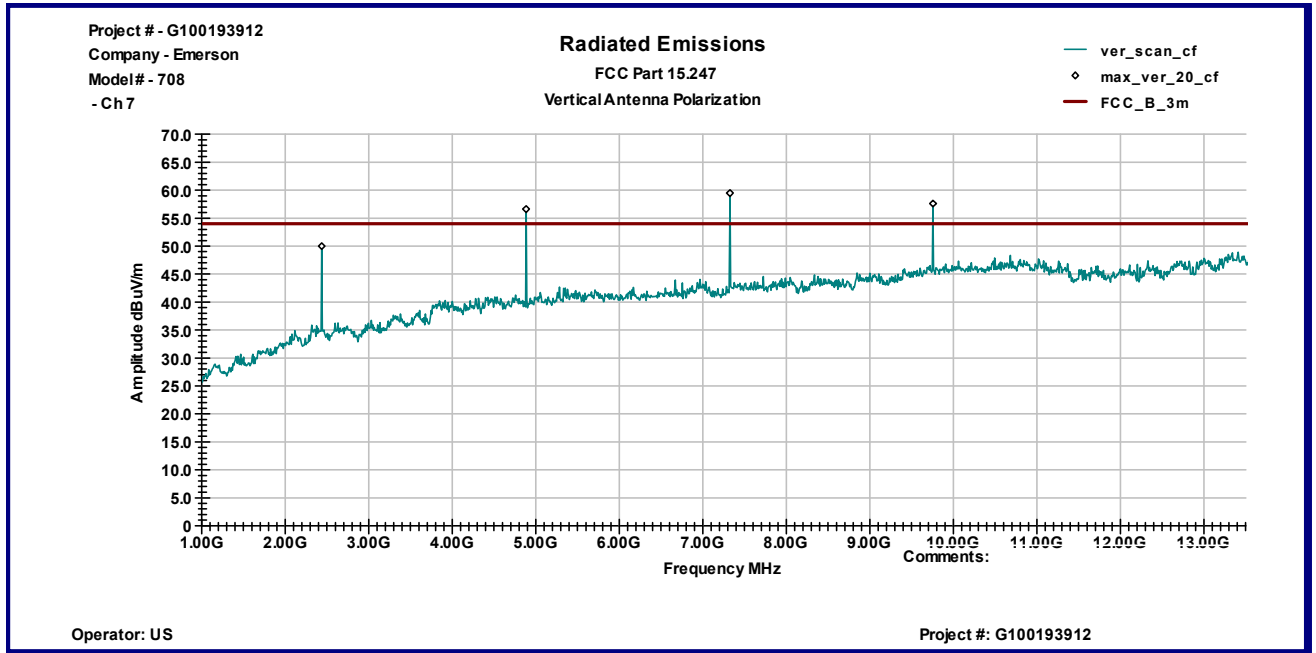
Graph 3.5.10



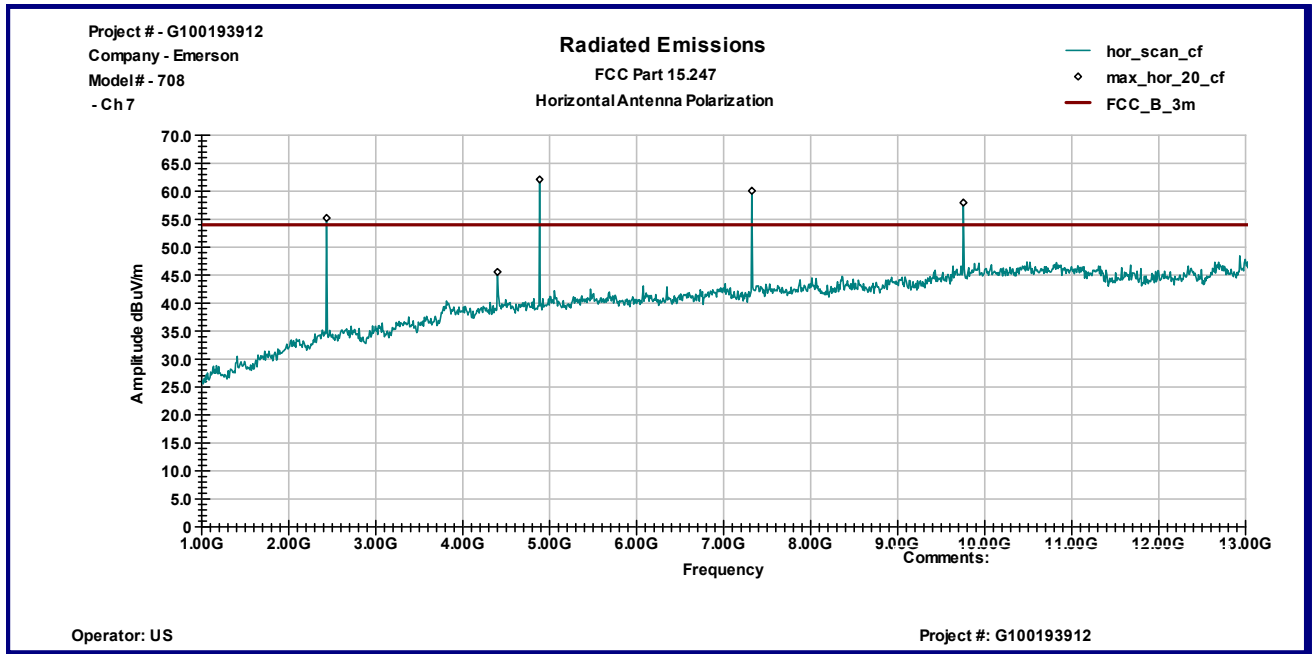
Graph 3.5.11



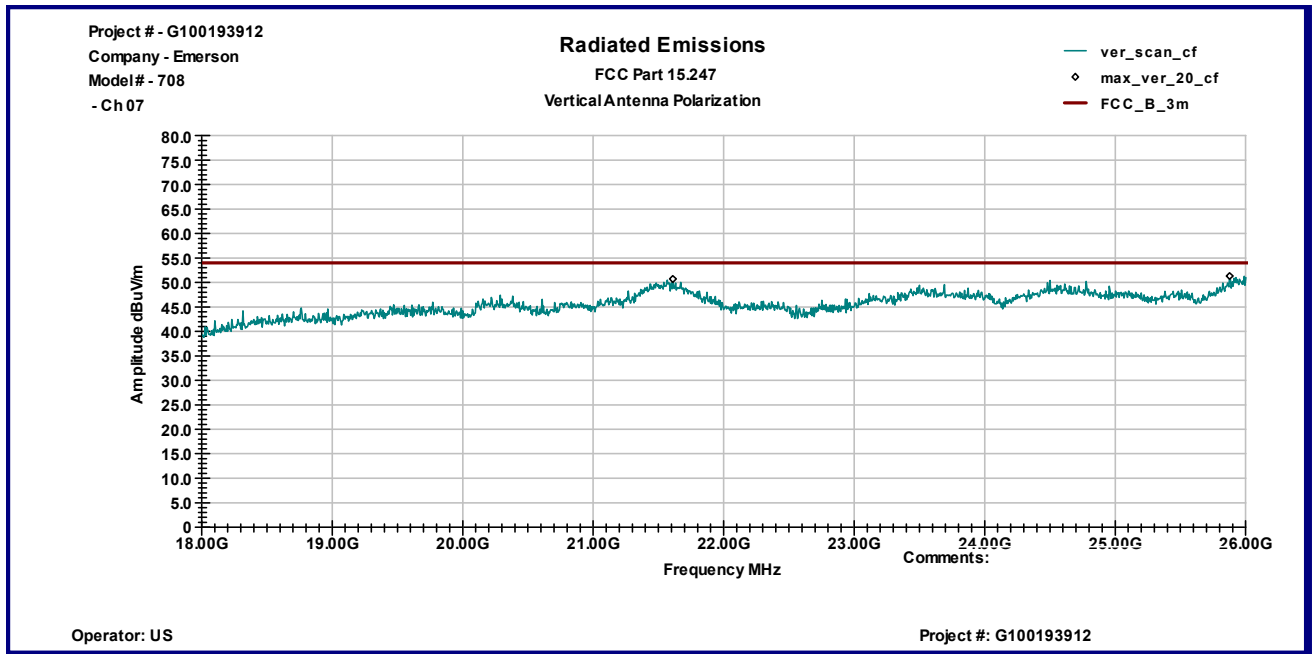
Graph 3.5.12



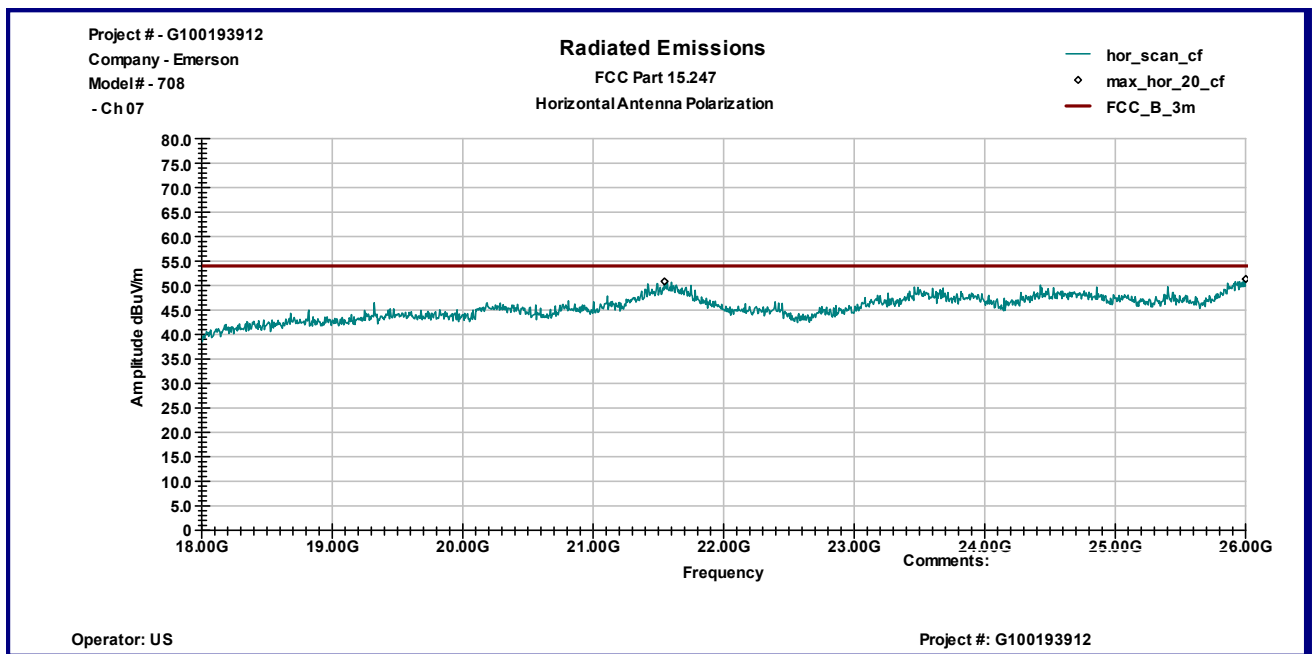
Graph 3.5.13



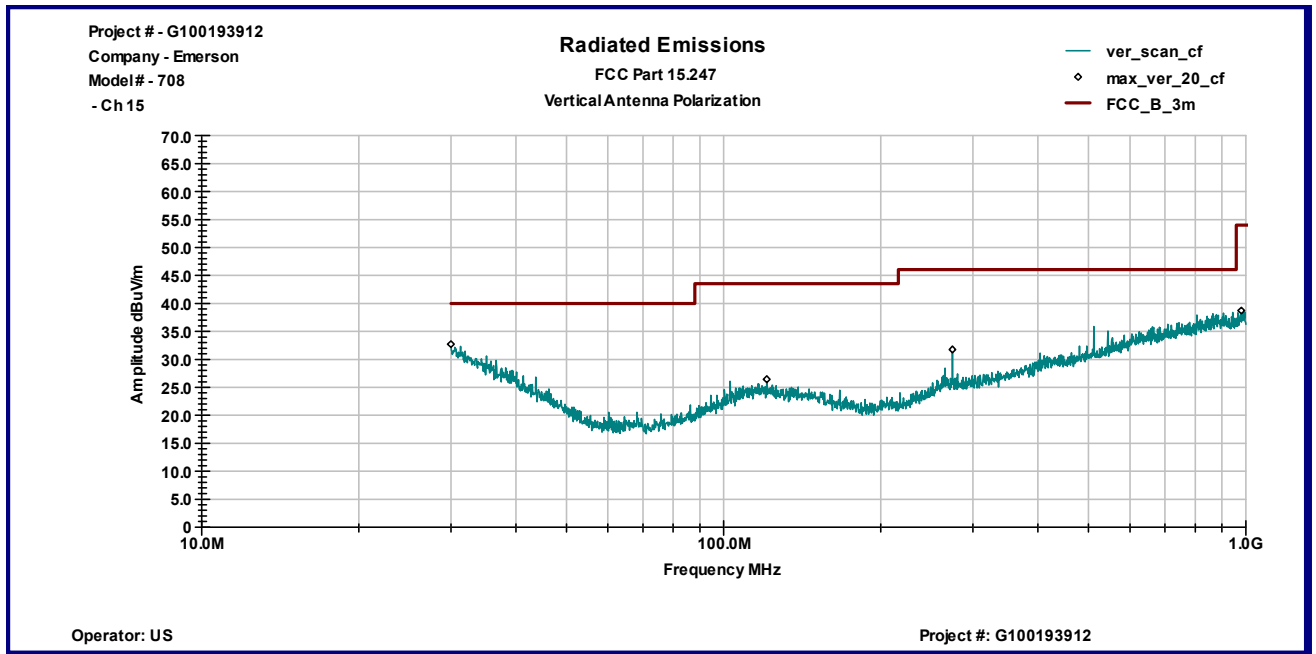
Graph 3.5.14



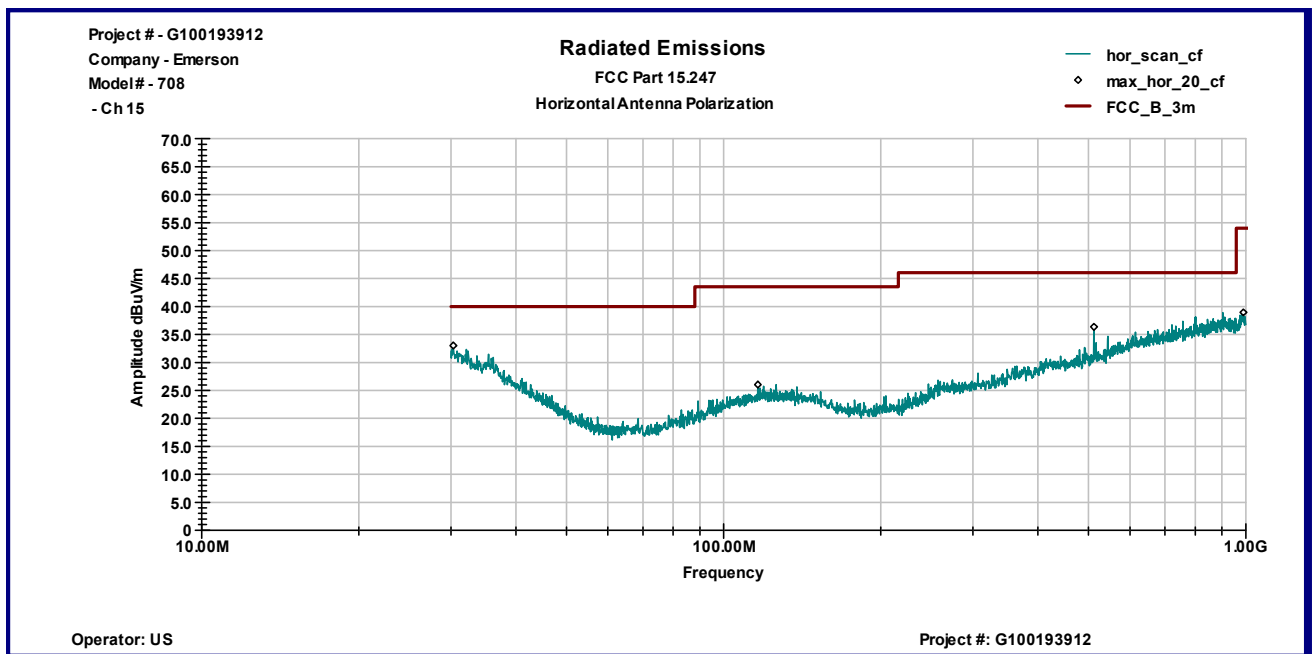
Graph 3.5.15



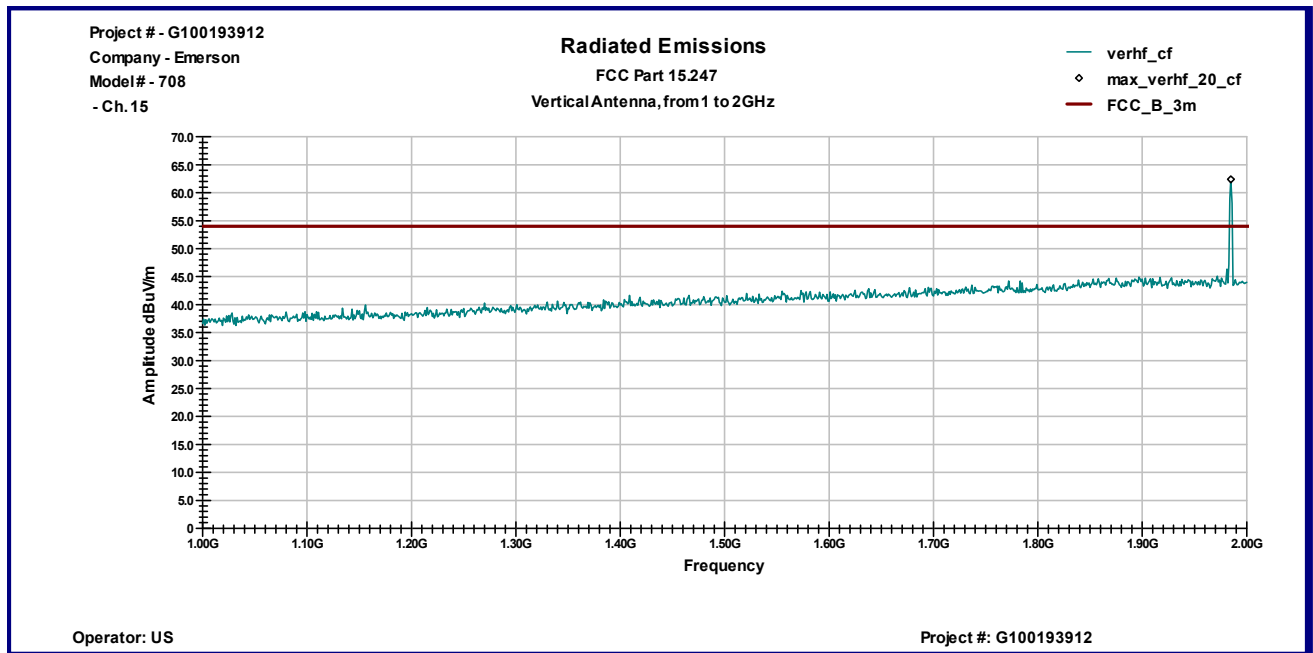
Graph 3.5.16



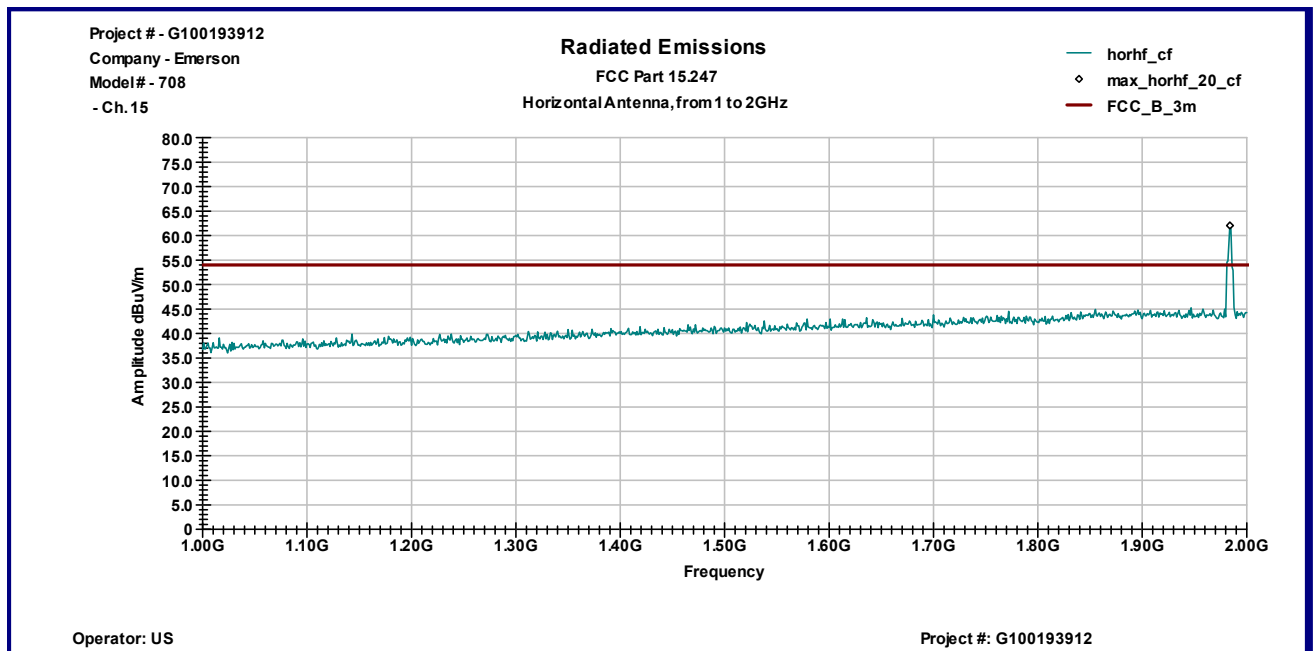
Graph 3.5.17



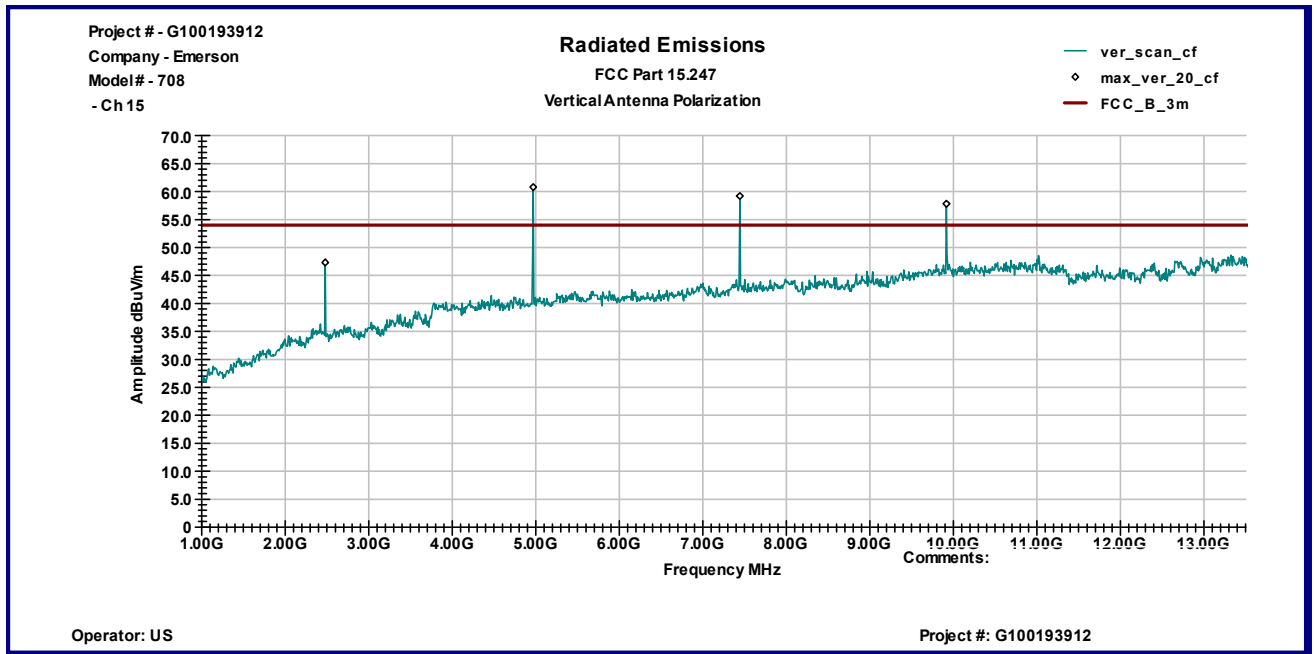
Graph 3.5.18



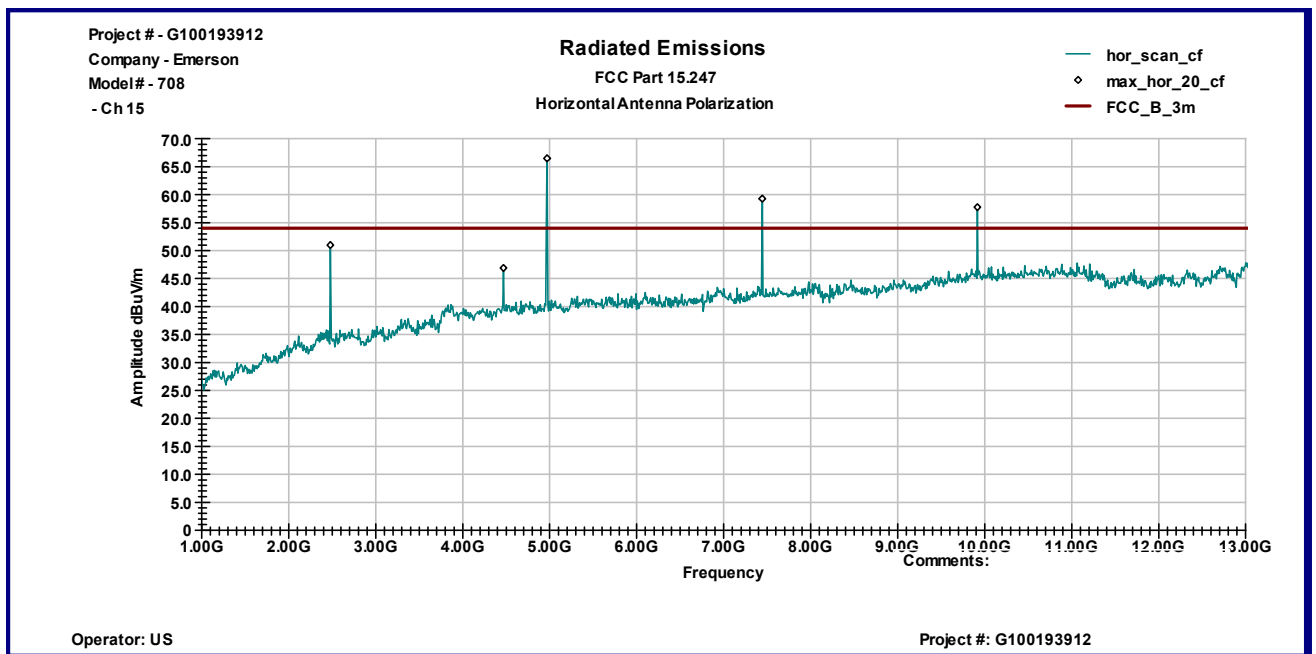
Graph 3.5.19



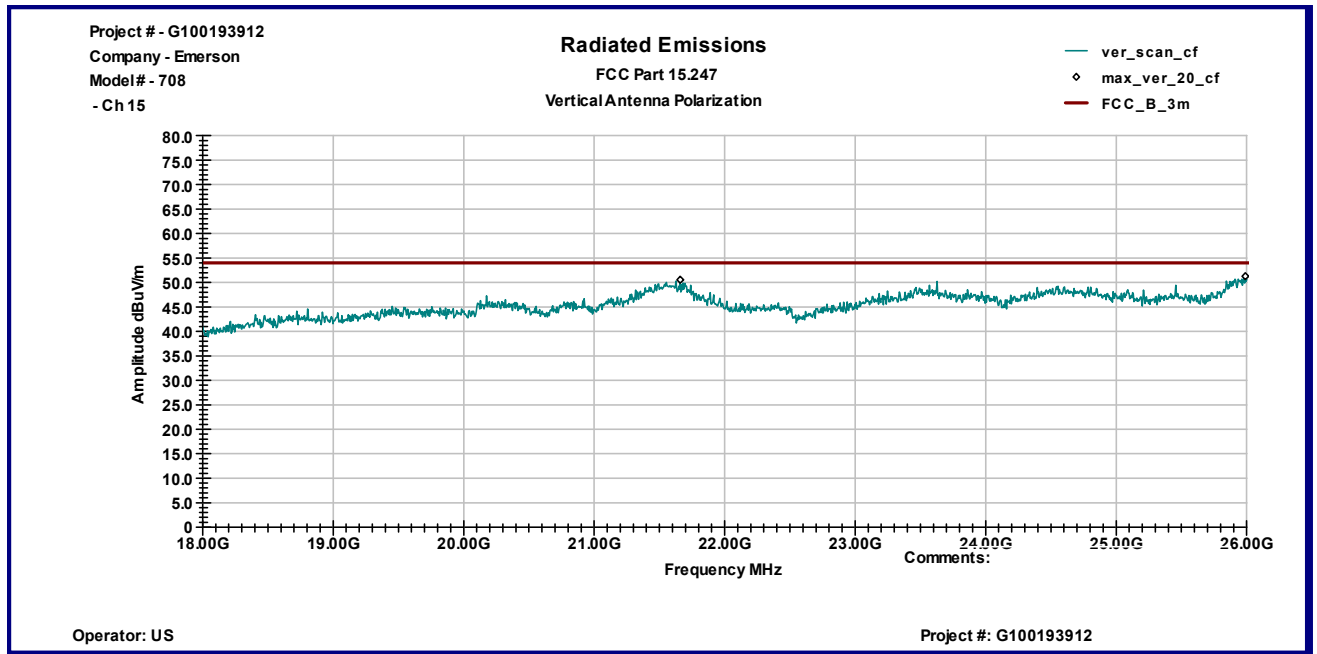
Graph 3.5.20



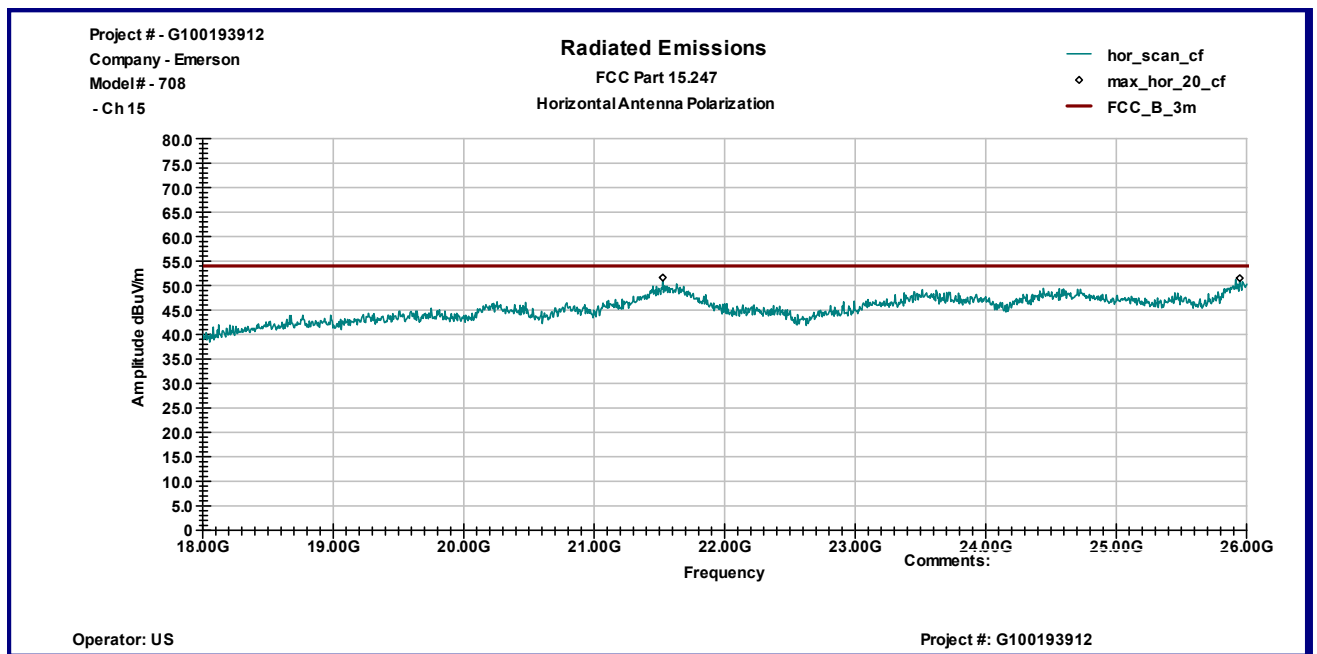
Graph 3.5.21



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 7.97dBm

The antenna gain, G is 1.6dBi

The maximum EIRP power = P + G

ERP = 7.97+ 1.6= 9.57dBm, or 0.00905W

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 $10 = 0.00905 / 4\pi D^2$,

The minimum safe separation distance, D = 0.85cm, which is below 20cm



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: 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 to 12.5GHz (5th Harmonic)

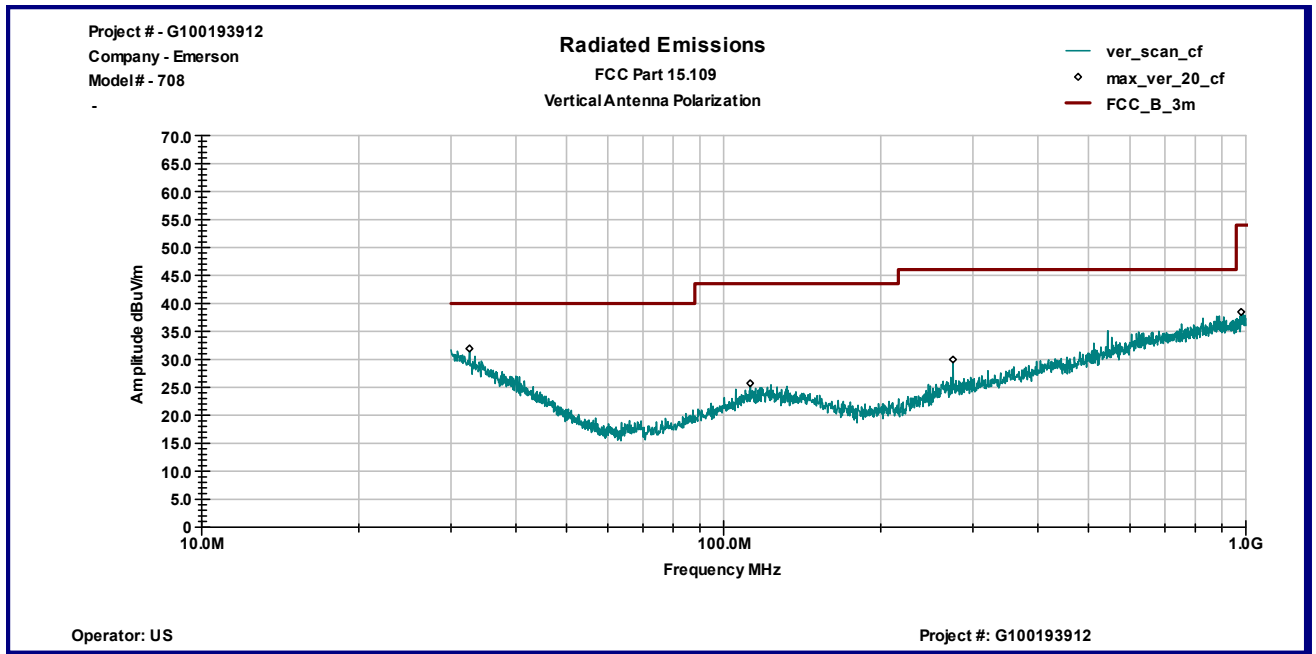
Max. Emissions margin: 16.1dB below the limits

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). No Radiated Emissions were detected in the frequency range 1GHz-12.5GHz (see Graphs 3.8.1-3.8.4)

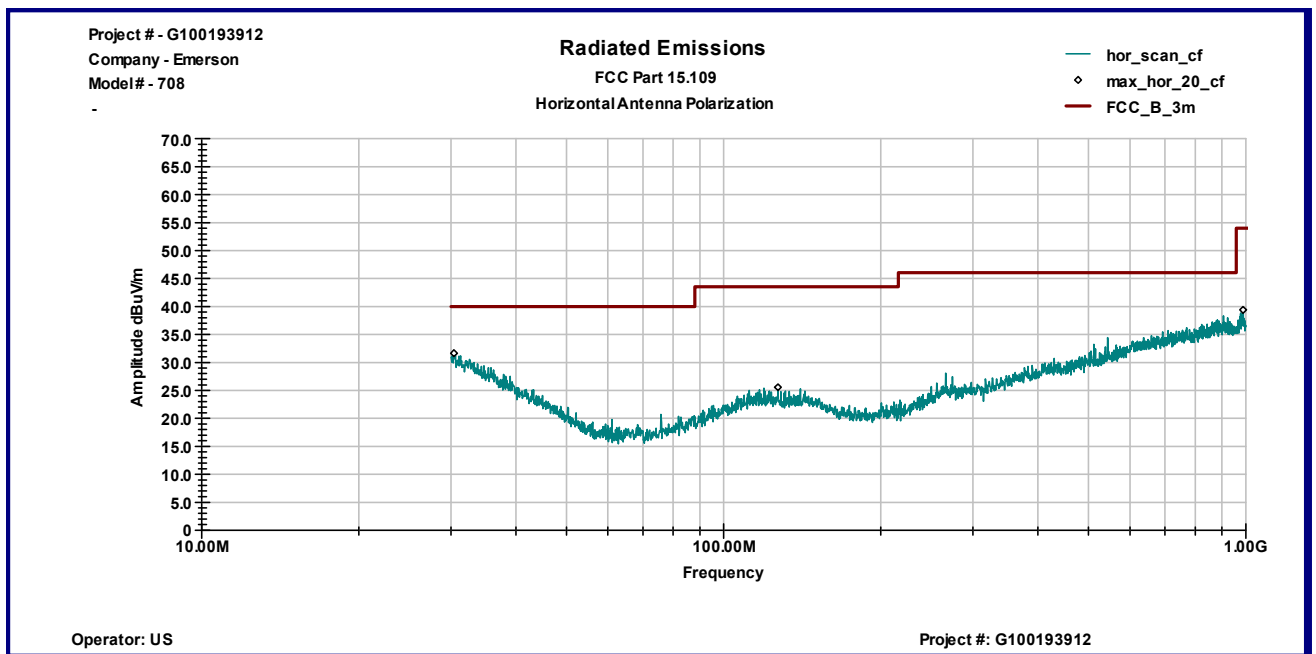
Date:	August 25, 2010	Result: Pass
Standard:	FCC Part 15.109, Class B	
Tested by:	Uri Spector	
Test Point:	Enclosure	
Operation mode:	Receiving Mode	
Note:		

Table 3.8.1

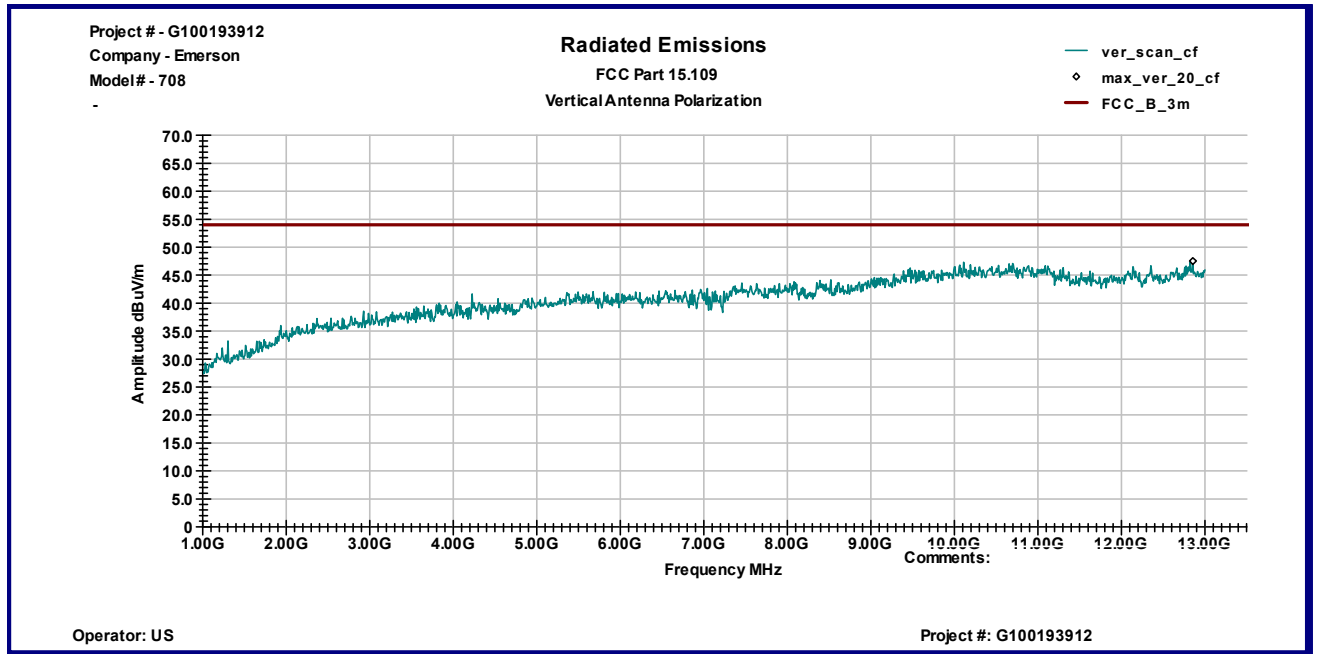
Frequency	Ant. Polarity	Peak Reading dB μ V	Ant.Factor dB1/m	Total at 3m dB μ V/m	QP Limit dB μ V/m	Margin dB
112.39 MHz	V	12.2	13.5	25.7	43.5	-17.8
274.92 MHz	V	14.7	15.3	30.0	46.0	-16.1
127.01 MHz	H	11.8	13.7	25.6	43.5	-18.0



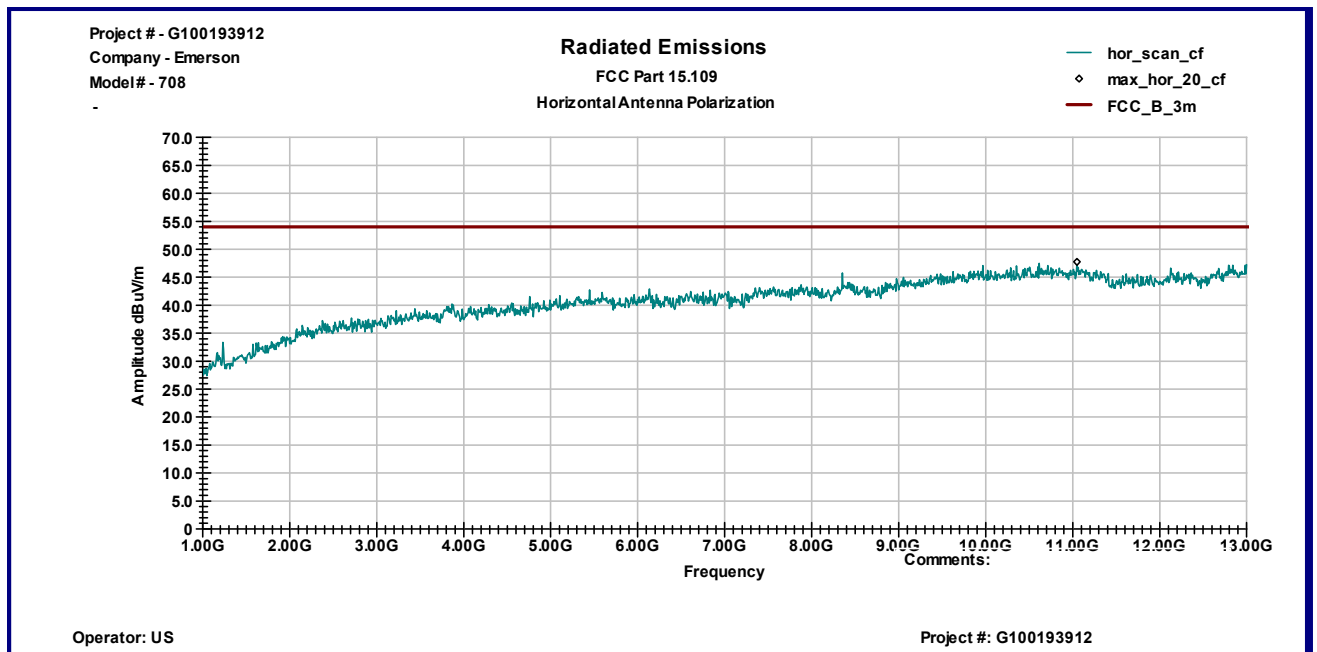
Graph 3.8.1



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: 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	09/10/2010	☒
Spectrum Analyzer	R & S	ESCI	100358	12909	07/12/2011	☒
Bicono-Log Antenna	Schaffner-Chase	CBL 6112 B	2468	14459	09/22/2010	☒
Horn Antenna	EMCO	3115	9507-4513	9936	04/13/2011	☒
Waveguide Horn Antenna	EMCO	3116	9904-2423	9705	09/06/2010	☒
Pre-Amplifier	MITEQ	AMF-5D-00501800-28-13P	1402232	172081	09/06/2010	☒
Pre-Amplifier	MITEQ	AMF-6F-16002600-25-10P	1222383	MIN-0065	09/07/2010	☒
High Pass Filter	Reactel	7HS-4G-S12	0223	015274	VBU	☒
System	TILE! Instrument Control		Ver. 3.4.K.29	15259	VBU	☒

