



TEST REPORT

Report Number: 100481024MIN-006

Project Number: G100481024

Testing performed on the

Inspector 07

FCC ID: A47-AML

Industry Canada ID: 10049A-AML

to

47 CFR Part 15. 249:2010

RSS- 210, Issue 8, 2010

For

Subsurface Instruments, Inc.

Test Performed by:

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Oakdale, MN 55128 USA

Test Authorized by:

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Prepared by:

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Richard Blonigen

Date: February 23, 2012

Reviewed by:

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Norman Shpilsher

Date: February 23, 2012

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1.0 GENERAL DESCRIPTION

Model:	Inspector 07
Type of EUT:	Radar Transmitter
Intertek Sample ID:	MIN1109191607-001
FCC ID:	A47-AML
Industry Canada ID:	10049A-AML
Related Submittal(s) Grants:	None
Company:	Subsurface Instruments, Inc.
Customer:	Mr. Martin Menghini
Address:	1841-C Plane Park Drive De Pere, WI 54115, USA
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Test Standards:	☒ 47 CFR, Part 15:2010, §15.249 ☒ RSS-210, Issue 8, 2010 ☐ RSS-Gen, Issue 3, 2010 ☐ 47 CFR, Part 15:2010, §15.107 and §15.109, Class ☐ ICES-003, Issue 4:2004 ☐ Other
Type of radio:	☐ Stand -alone ☐ Module ☐ Hybrid
Date Sample Submitted:	September 30, 2011
Test Work Started:	September 30, 2011
Test Work Completed:	October 5, 2011
Test Sample Conditions:	☐ Damaged ☐ Poor (Usable) ☒ Good



1.1 Product Description; Test Facility

Product Description:	Radar Transmitter
Operating Frequency	2450 MHz
Modulation:	FM
Emission Designator:	27M0F3N
Antenna(s) Info:	Integral Antenna
Antenna Installation:	☐ User ☐ Professional ☒ Factory
Transmitter Power Configuration:	☒ Internal battery (4 type C) ☐ External power source ☐ 120VAC ☐ 230VAC ☐ 400VAC ☐ [REDACTED] VDC ☐ Other: [REDACTED] [REDACTED] 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 C63.10-2009

1.2 EUT Configuration

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

- ☐ - Standby
- ☒ - Continuous normal operation
- ☐ - Continuous un-modulated
- ☐ - Test program (customer specific)
- ☐ -

Operating modes of the EUT:

No.	Description
1	EUT has one transmitting frequency and transmits and receives simultaneously. Therefore, testing was performed with EUT powered on and transmitting and receiving simultaneously.

Cables:

No.	Type	Length	Designation	Note
1	N/A			
2				

Support equipment/Services:

No.	Item	Description
1	N/A	
2		

1.3 Environmental conditions

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

☐ Normal

Temperature: 15-35 ° C

Humidity: 30-60 %

Atmospheric pressure: 86-106 kPa

1.4 Measurement uncertainty

The expanded uncertainty ($k = 2$) for radiated emissions from 30 to 1000 MHz has been determined to be: ± 4 dB at 10m and ± 5.4 dB at 3m

The expanded uncertainty ($k = 2$) for conducted emissions from 150 kHz to 30 MHz 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
15.249(a) / RSS-210 A2.9(a)	Field strength of fundamental	Pass
15.249(a) / RSS-210 A2.9(a)	Field strength of harmonics	Pass
15.249(d) / RSS-210 A2.9(b)	Field strength of spurious emissions	Pass
15.215(c) / RSS- Gen 4.6.1	Bandwidth of the emission	Pass
15.207/RSS-Gen 7.2.2	Transmitter Power Line conducted emissions	N/A



3.0 TEST CONDITIONS AND RESULTS

3.1 Field strength of fundamental

Test location: ☐ OATS ☒ Anechoic Chamber ☐ Other

Test distance: ☐ 10 meters ☒ 3 meters

Frequency: 2450MHz

Test result: **Pass**

Max. Emissions margin at fundamental: 2.6 dB below the limits

Notes: None

Date:	September 30, 2011	Result: Pass
Standard:	FCC 15.249(a) / RSS-210 A2.9	
Tested by:	Richard Blonigen	
Test Point:	Enclosure with antenna	
Operation mode:	See Page 5	
Note:	The maximum emissions were detected with horizontal and vertical EUT orientation	

Table 3.1.1

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)								
Horizontal										
2450.00	V	100	28.6	6.4	0.0	54.1	89.1	114.0	-24.9	peak
2450.00	H	100	28.6	6.4	0.0	75.4	110.4	114.0	-3.6	peak
2450.00	V	100	28.6	6.4	0.0	16.9	51.9	94.0	-42.1	avg
2450.00	H	100	28.6	6.4	0.0	23.4	58.4	94.0	-35.6	avg
Vertical										
2450.00	V	100	28.6	6.4	0.0	76.4	111.4	114.0	-2.6	peak
2450.00	H	100	28.6	6.4	0.0	59.8	94.8	114.0	-19.2	peak
2450.00	V	100	28.6	6.4	0.0	23.8	58.8	94.0	-35.2	avg
2450.00	H	100	28.6	6.4	0.0	18.3	53.3	94.0	-40.7	avg
Bandedge Complianc										
2400.00	V	100	28.5	6.3	0.0	10.9	45.7	54.0	-8.3	avg
2400.00	H	100	28.5	6.3	0.0	10.9	45.7	54.0	-8.3	avg
2483.50	V	100	28.7	6.4	0.0	10.9	46.0	54.0	-8.0	avg
2483.50	H	100	28.7	6.4	0.0	11.0	46.1	54.0	-7.9	avg



3.2 Field strength of harmonics and spurious emissions

Test location: ☐ OATS ☒ Anechoic Chamber ☐ Other

Test distance: ☐ 10 meters ☒ 3 meters

Frequency range of measurements: 30MHz-25GHz

Test result: Pass

Max. margin of harmonics and spurious emissions: 4.9 dB below the limits

Notes: None

Date:	September 30 – October 5, 2011	Result: Pass
Standard:	FCC 15.249(a) and (d) / RSS-210 A2.9	
Tested by:	Richard Blonigen	
Test Point:	Enclosure with antenna	
Operation mode:	See Page 5	
Note:	No emissions above ambient noise were detected above the 5 th harmonic	

Table 3.2.1

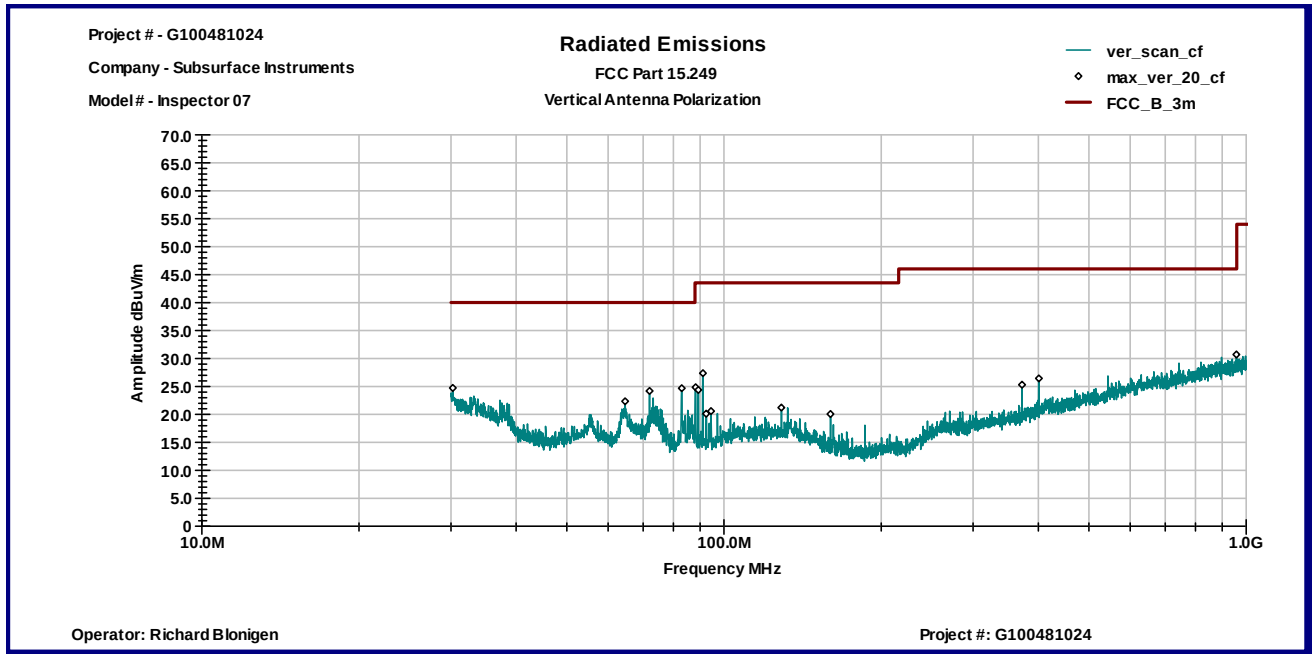
Frequency	Ant. Polarity	Peak Reading dBμV	Ant. Factor dB1/m	Total at 3m dBμV/m	QP Limit dBμV/m	Margin dB
30.246 MHz	V	4.5	20.2	24.7	40.0	-15.3
64.678 MHz	V	15.4	6.9	22.3	40.0	-17.7
72.019 MHz	V	16.5	7.7	24.2	40.0	-15.8
83.026 MHz	V	15.4	9.3	24.7	40.0	-15.3
88.227 MHz	V	14.8	10.1	24.8	43.5	-18.7
89.284 MHz	V	14.1	10.3	24.4	43.5	-19.2
91.136 MHz	V	16.8	10.6	27.4	43.5	-16.2
958.11 MHz	V	4.7	26.0	30.7	46.0	-15.3
30.105 MHz	H	9.5	20.3	29.7	40.0	-10.3
67.848 MHz	H	18.1	7.2	25.2	40.0	-14.8
68.237 MHz	H	18.9	7.2	26.0	40.0	-14.0
68.793 MHz	H	17.9	7.2	25.2	40.0	-14.9
69.739 MHz	H	17.8	7.3	25.1	40.0	-14.9
884.67 MHz	H	10.6	25.3	35.9	46.0	-10.1

Table 3.2.2

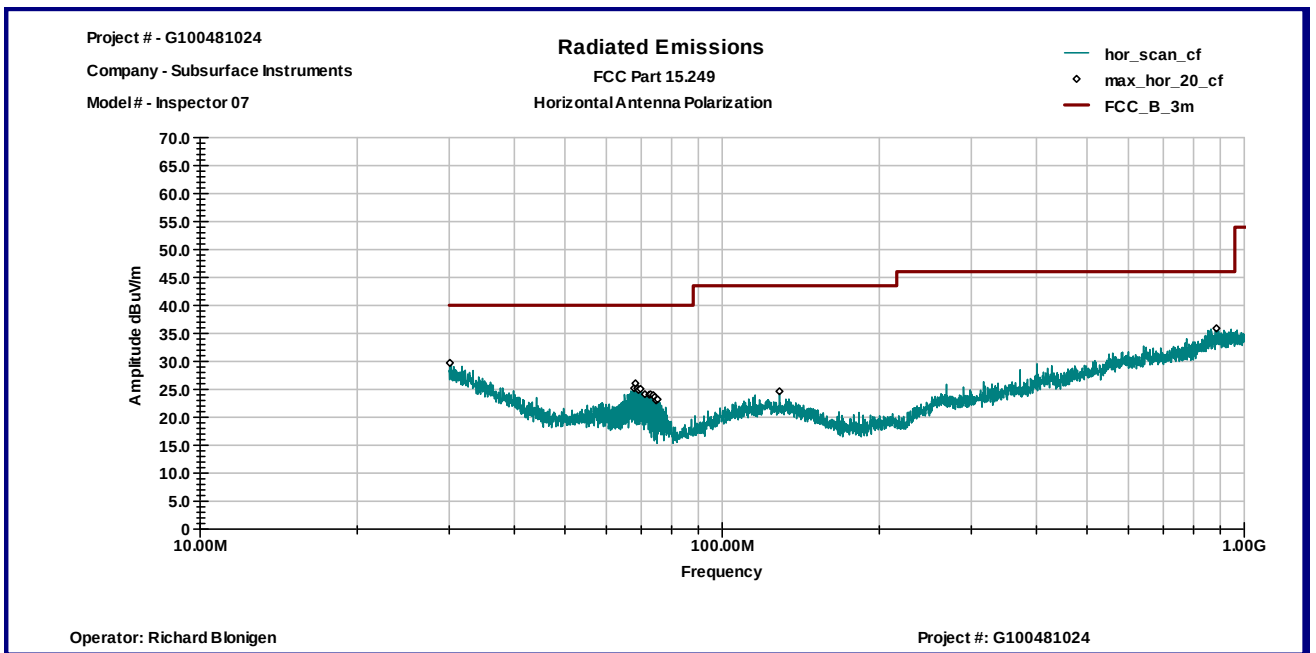
Frequency MHz	Antenna		Ant. CF dB1/m	Cable loss dB	Pre-amp Gain (dB)	Peak Reading dBμV	Total @ 3m dBμV/m	Limit dBμV/m	Margin dB	Comments
	Polarity	Hts(cm)								
4900.00	V	100	33.4	8.1	36.6	61.3	66.2	74.0	-7.8	peak
4900.00	H	100	33.4	8.1	36.6	64.2	69.1	74.0	-4.9	peak
7350.00	V	100	36.2	9.0	41.2	47.7	51.7	74.0	-22.3	peak
7350.00	H	100	36.2	9.0	41.2	39.7	43.7	74.0	-30.3	peak
9800.00	V	100	38.3	9.9	40.8	39.6	47.0	74.0	-27.0	peak
9800.00	H	100	38.3	9.9	40.8	42.6	50.0	74.0	-24.0	peak
12250.00	V	100	39.2	10.9	41.2	38.3	47.2	74.0	-26.8	peak
12250.00	H	100	39.2	10.9	41.2	40.8	49.6	74.0	-24.4	peak
Average										
4900.00	V	100	33.4	8.1	36.6	26.3	31.2	54.0	-22.8	avg
4900.00	H	100	33.4	8.1	36.6	27.1	32.0	54.0	-22.0	avg

Graph 3.2.1

Vertical antenna polarization

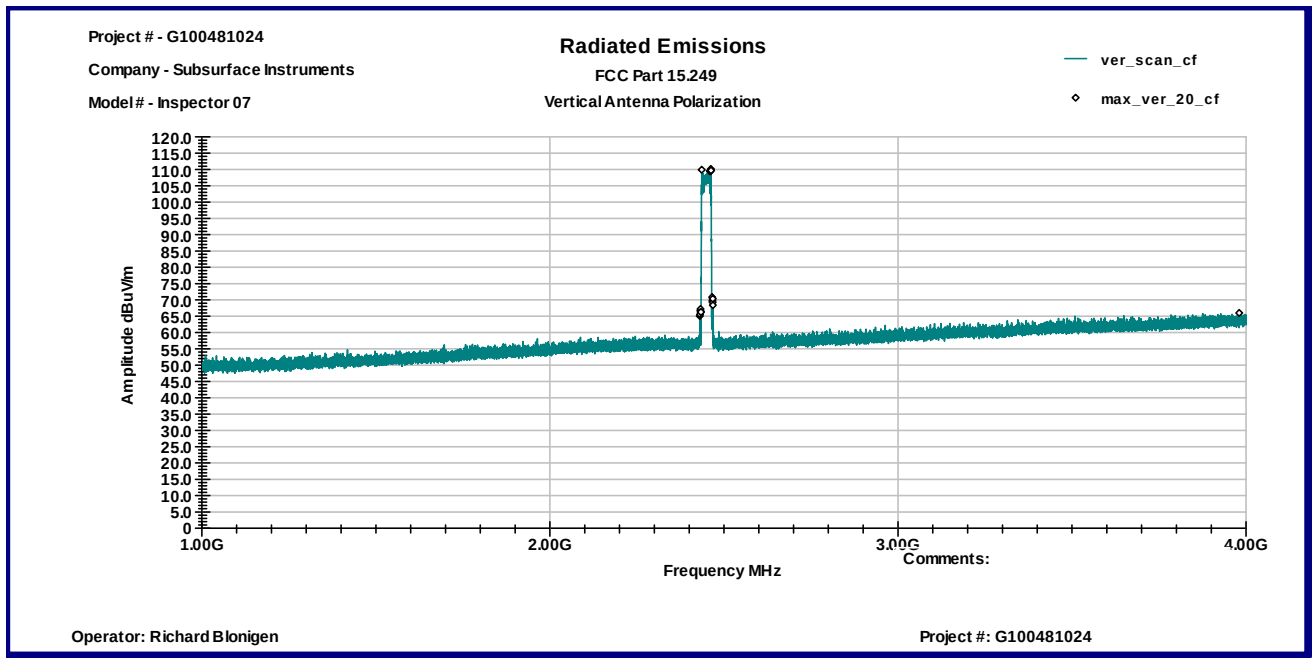


Horizontal antenna polarization

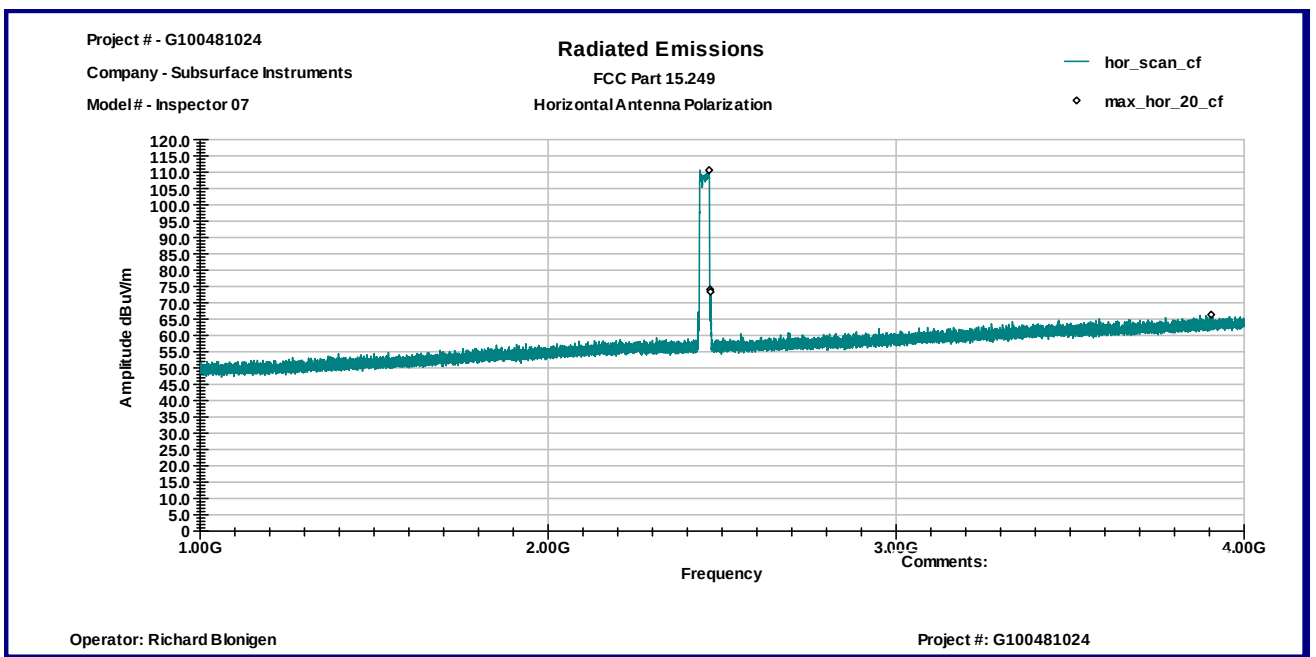


Graph 3.2.2

Vertical antenna polarization

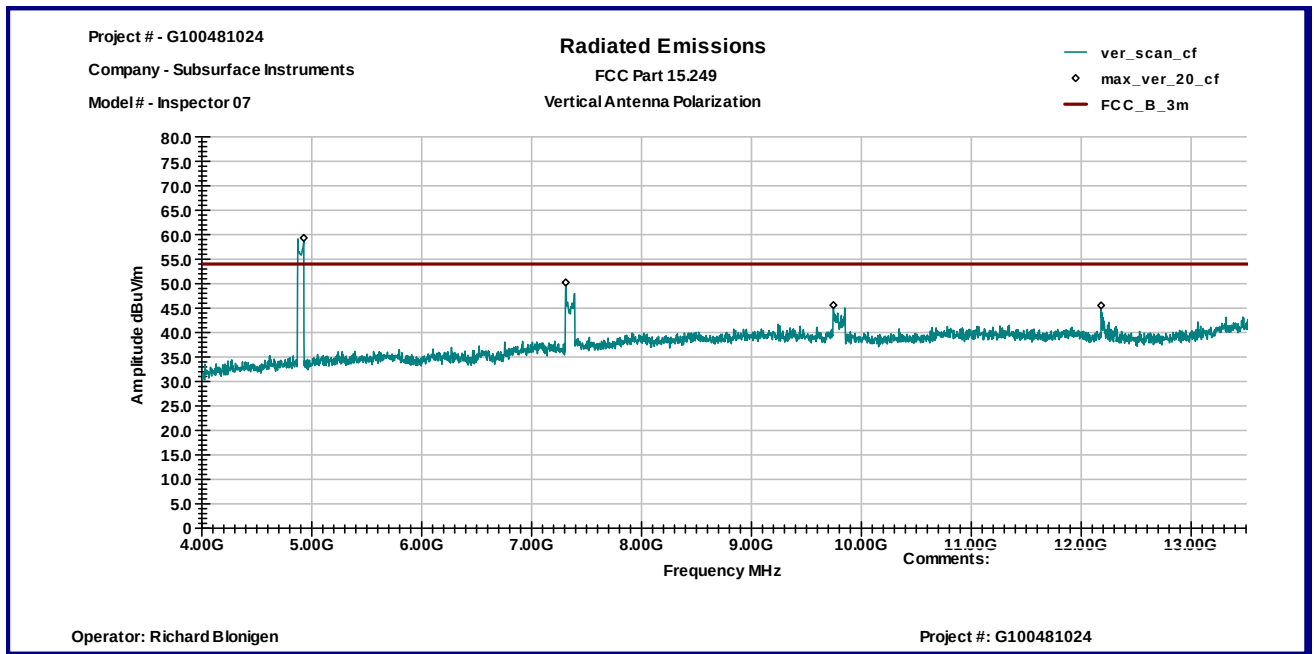


Horizontal antenna polarization

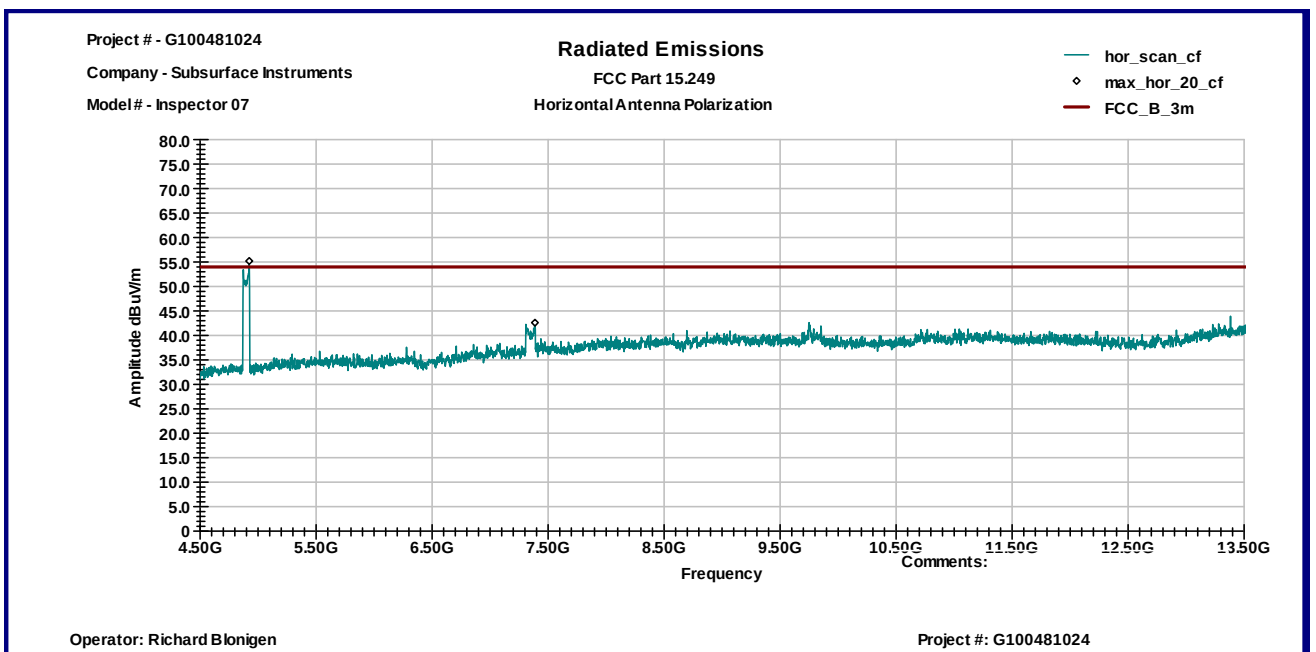


Graph 3.2.3

Vertical antenna polarization

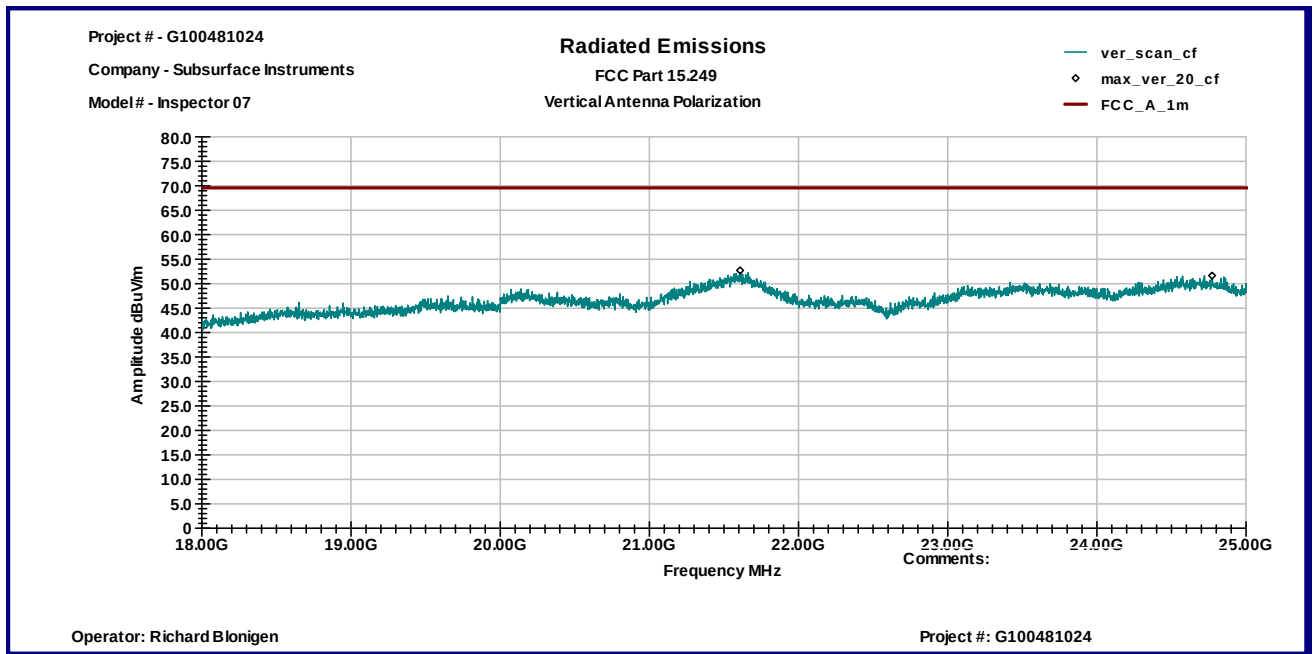


Horizontal antenna polarization

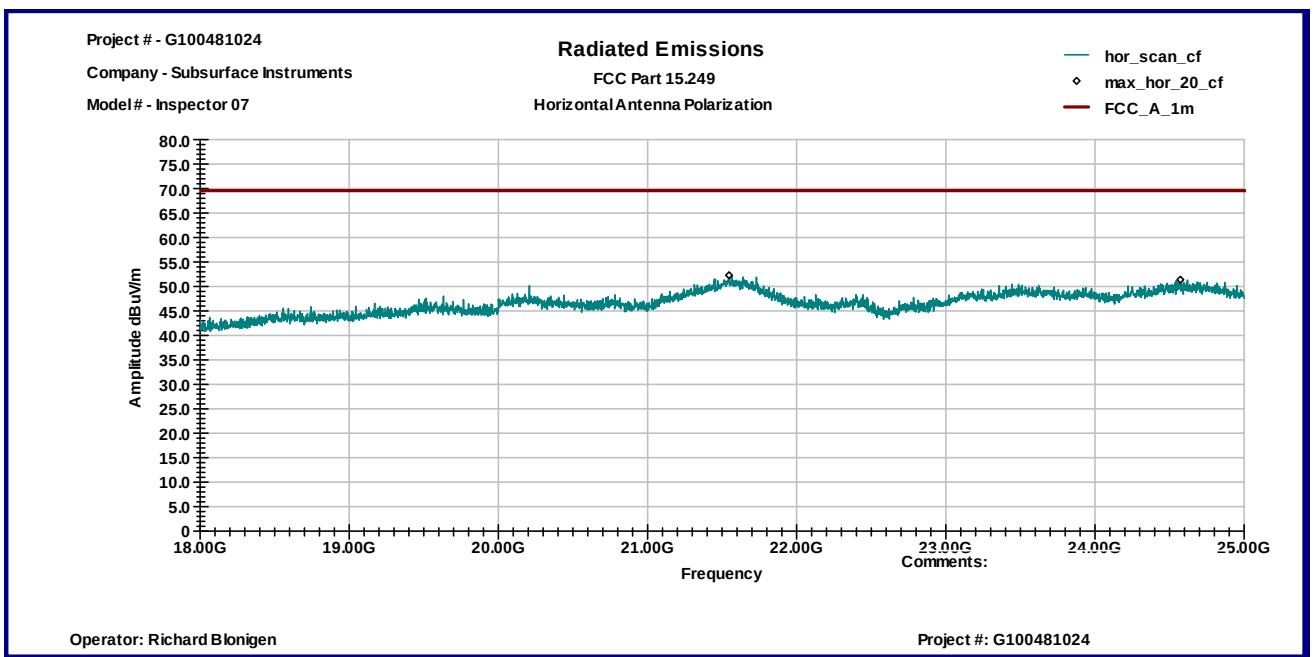


Graph 3.2.4

Vertical antenna polarization



Horizontal antenna polarization



3.3 Bandwidth of Emissions

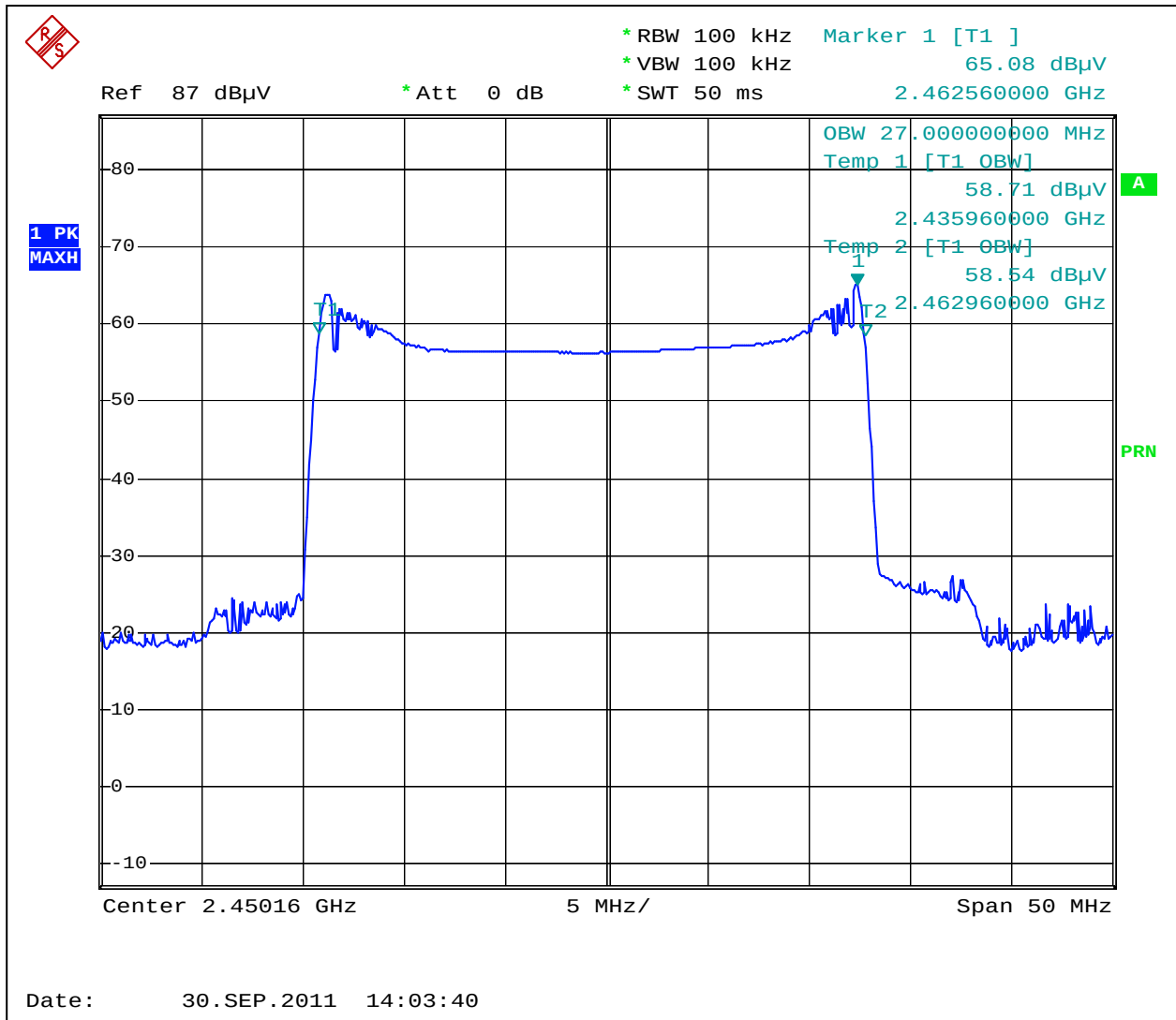
Center Frequency of operation MHz	Measured 20dB bandwidth kHz	Measured 99% bandwidth kHz
2450 (vertical)	27700	27000
2450 (horizontal)	27900	27000

Graphs 3-3-1 and 3-3-3 show 99% bandwidth

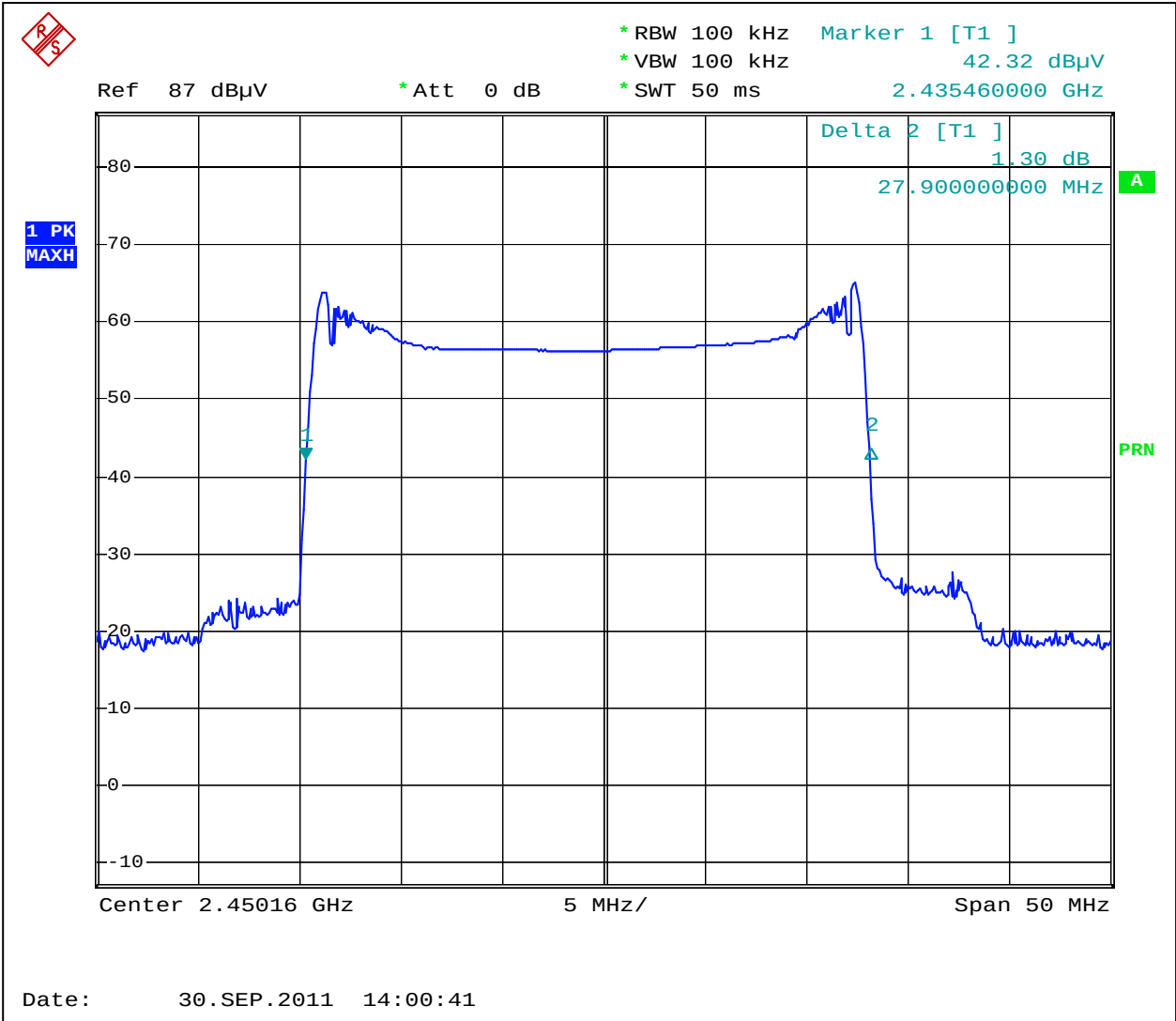
Graphs 3-3-2 and 3-3-4 show 20dB bandwidth

Notes: The bandwidth of emissions is contained within the frequency band of operation

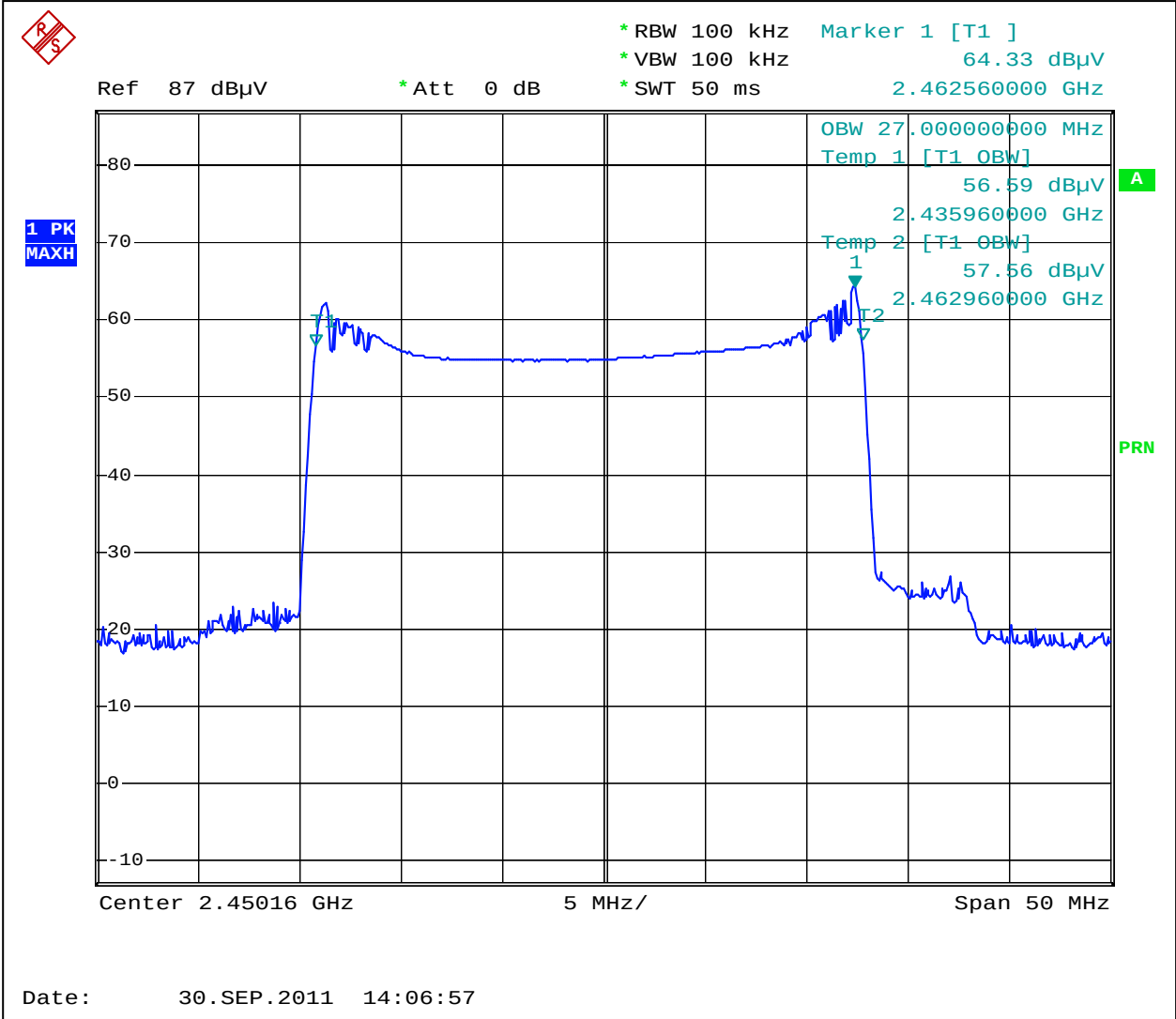
Graph 3.3.1



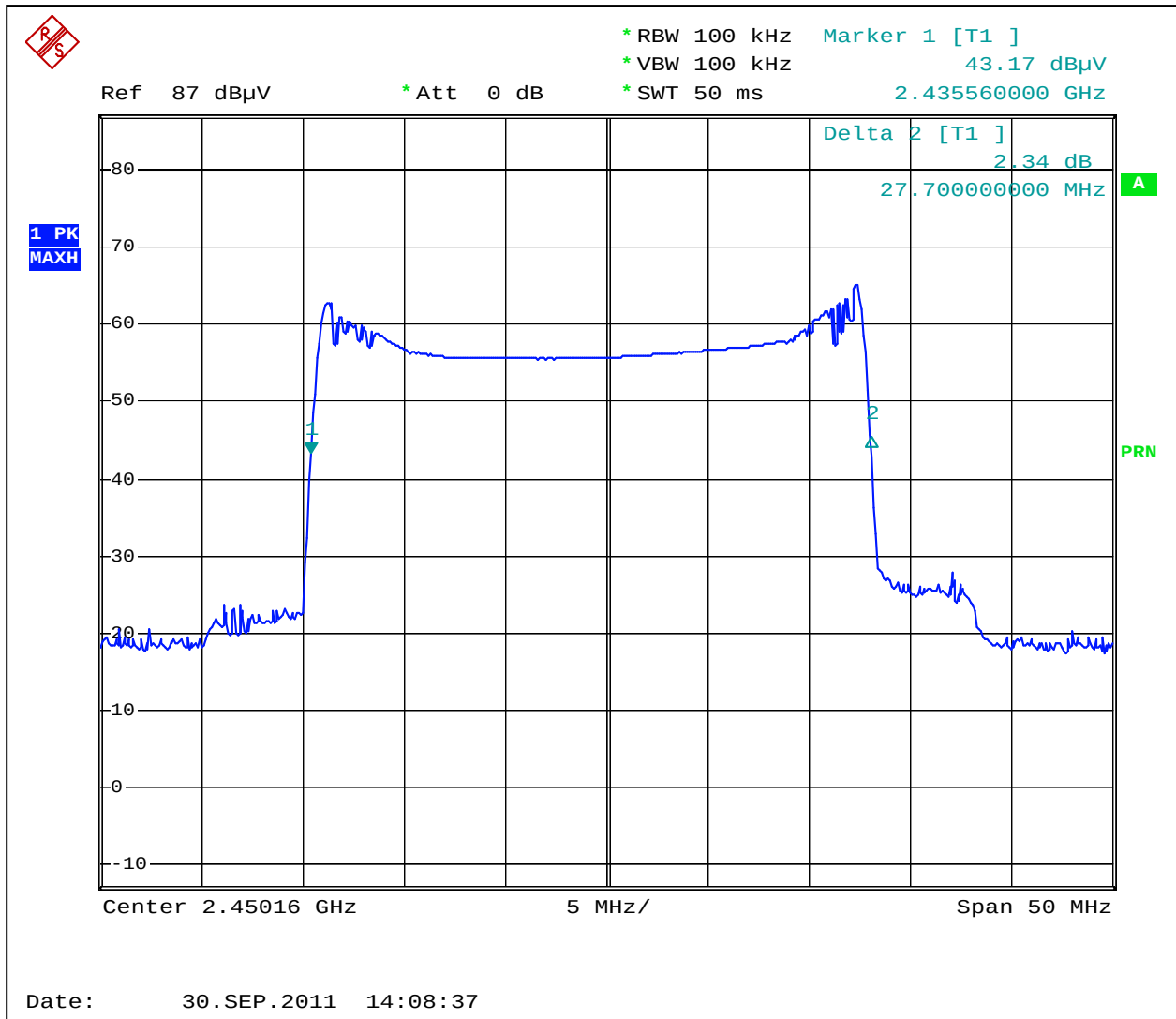
Graph 3.3.2



Graph 3.3.3



Graph 3.3.4





3.4 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: Testing is not applicable as EUT is battery operated device.



4.0 TEST EQUIPMENT

DESCRIPTION	MANUFACTURER	MODEL	SERIAL NO.	INTERTEK ID	CAL DUE	USED
Spectrum Analyzer	R & S	FSP 40	100024	12559	12/07/2011	☒
Spectrum Analyzer	R & S	ESCI	100358	12909	05/12/2012	☒
Bicono-Log Antenna	Schaffner-Chase	CBL 6112 B	2630	14459	11/22/2011	☒
Horn Antenna	EMCO	3115	9507-4513	9936	04/29/2012	☒
Waveguide Horn Antenna	EMCO	3116	9904-2423	9705	11/04/2011	☒
Pre-Amplifier	MITEQ	AMF-5D-00501800-28-13P	1122951	13475	11/06/2011	☒
Pre-Amplifier	MITEQ	AMF-6F-16002600-25-10P	1222383	MIN-0065	11/06/2011	☒
System	TILE! Instrument Control		Ver. 3.4.K.29	15259	VBV	☒