



TEST REPORT

Report Number: 100990646MIN-001

Project Number: G100990646

Testing performed on the
52WM MiniTemp
FCC ID: RYR52WM
Industry Canada ID: 10878A-52WM

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

For
Therm-O-Disc Inc.

Test Performed by:
Intertek Testing Services NA, Inc.
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Oakdale, MN 55128 USA

Test Authorized by:
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Date: February 8, 2013

Reviewed by: Simon Khazon
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Date: February 8, 2013

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1.0 GENERAL DESCRIPTION

Model:	52WM
Type of EUT:	MiniTemp Temperature Sensor
Intertek Sample ID:	MIN1301310822-007
FCC ID:	RYR52WM
Industry Canada ID:	10878A-52WM
Related Submittal(s) Grants:	None
Company:	Therm-O-Disc Inc.
Customer:	Mr. Tuong Nguyen
Address:	1320 South Main Street Mansfield, OH 44907 USA
Phone:	(419) 525-8382
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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 5:2012 ☐ Other
Type of radio:	☒ Stand -alone ☐ Module ☐ Hybrid
Date Sample Submitted:	January 29, 2013
Test Work Started:	January 30, 2013
Test Work Completed:	February 5, 2013
Test Sample Conditions:	☐ Damaged ☐ Poor (Usable) ☒ Good



1.1 Product Description; Test Facility

Product Description:	2.4GHz MiniTemp Temperature Sensor
Transmitter Type:	☐ FHSS ☒ Digital Modulation ☐ WiFi ☐ Blue Tooth
Operating Frequency Range(s):	From 2400 to 2483.5 MHz
Number of Channels:	16
Modulation:	O-QPSK
Emission Designator:	1M56G1D
Antenna(s) Info:	Antenna Type: Omnidirectional Chip Antenna Gain: 1.7dBi ☒ RF connector provided
Antenna Installation:	☐ User ☐ Professional ☒ Factory
Transmitter power configuration:	☒ Internal battery ☐ External power source ☐ 230VAC ☐ 400VAC ☒ 7.2VDC from ☐ Other:  ☐ 50Hz ☐ 60Hz
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)
- ☒ - See below

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	None			

Note: According to the manufacturer the USB port is used for service only.

Support equipment/Services:

No.	Item	Description
1	None	

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 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

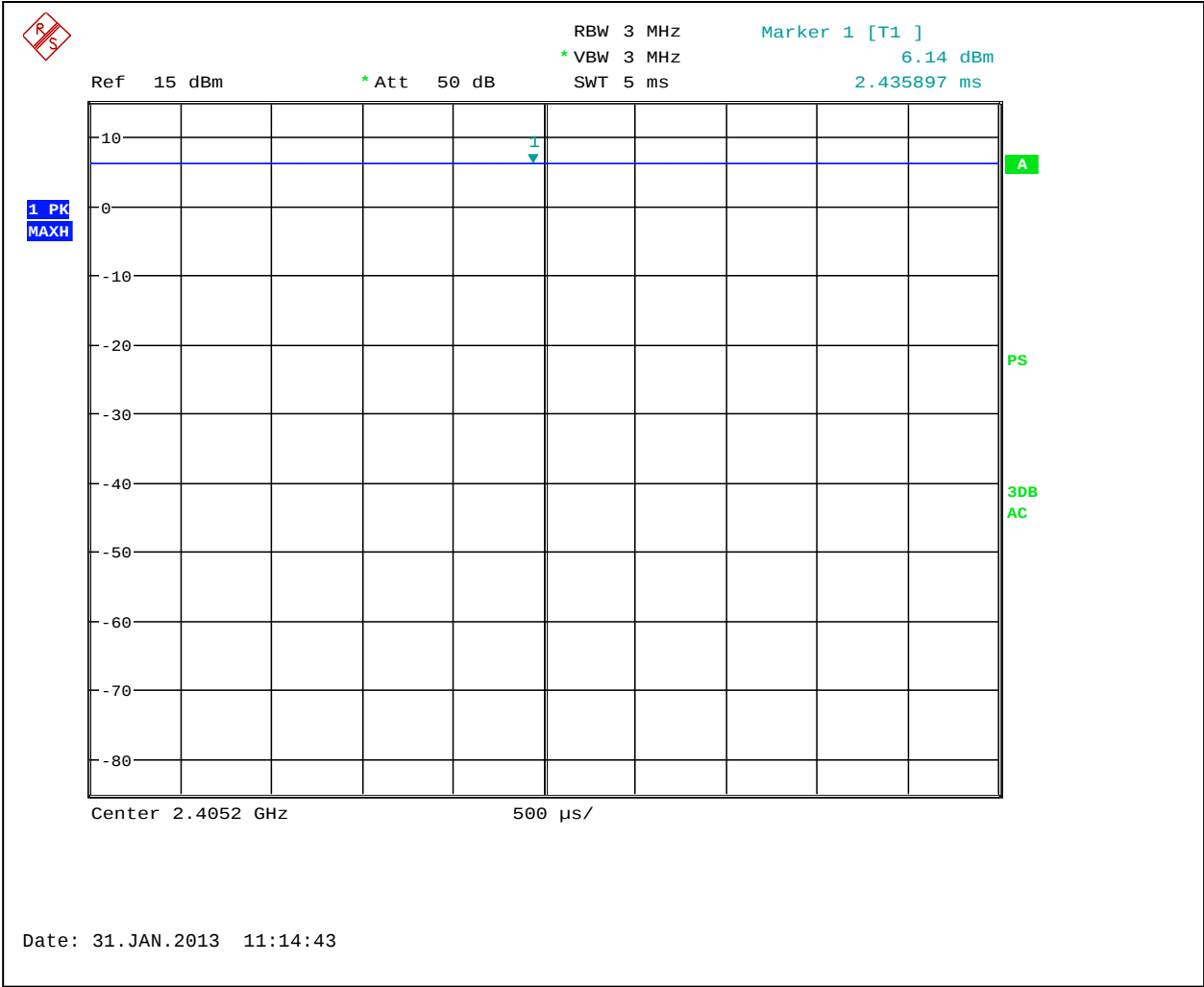
3.1 Maximum peak output power

Test result: Pass

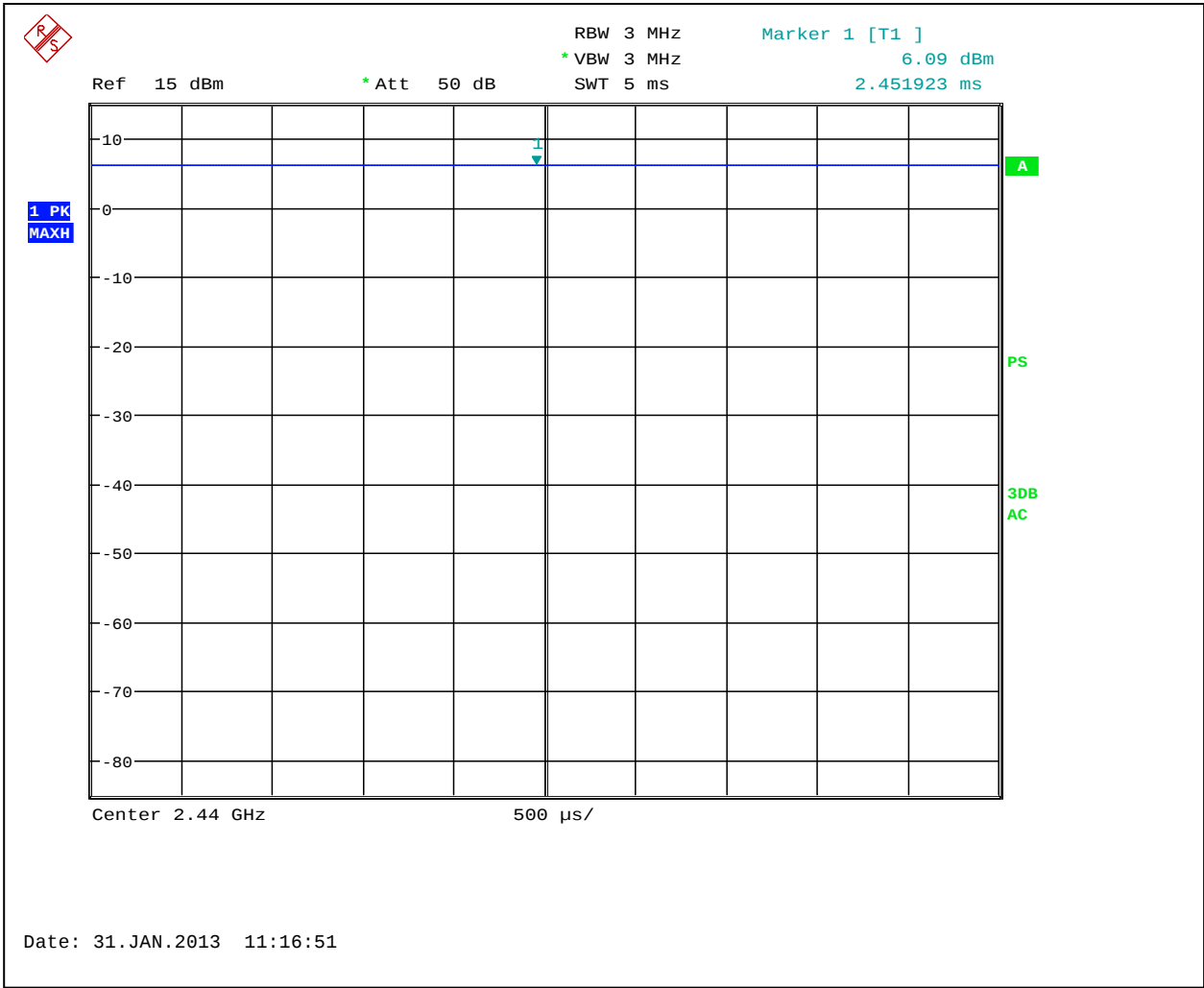
Max. Margin: 22.56dB below the limits

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
2405.20	6.14	1.3	7.44	30	0	-22.56
Middle Frequency MHz						
2440.00	6.09	1.3	7.39	30	0	-22.61
Upper Frequency MHz						
2474.90	6.07	1.3	7.37	30	0	-22.63
RBW:	☐ 1MHz ☒ 3MHz ☐ 10MHz					
VBW:	☐ 1MHz ☒ 3MHz ☐ 10MHz					
Antenna Gain:	☒ < 6dBi ☐ >6dBi and = dBi, Output power reduction = dB					

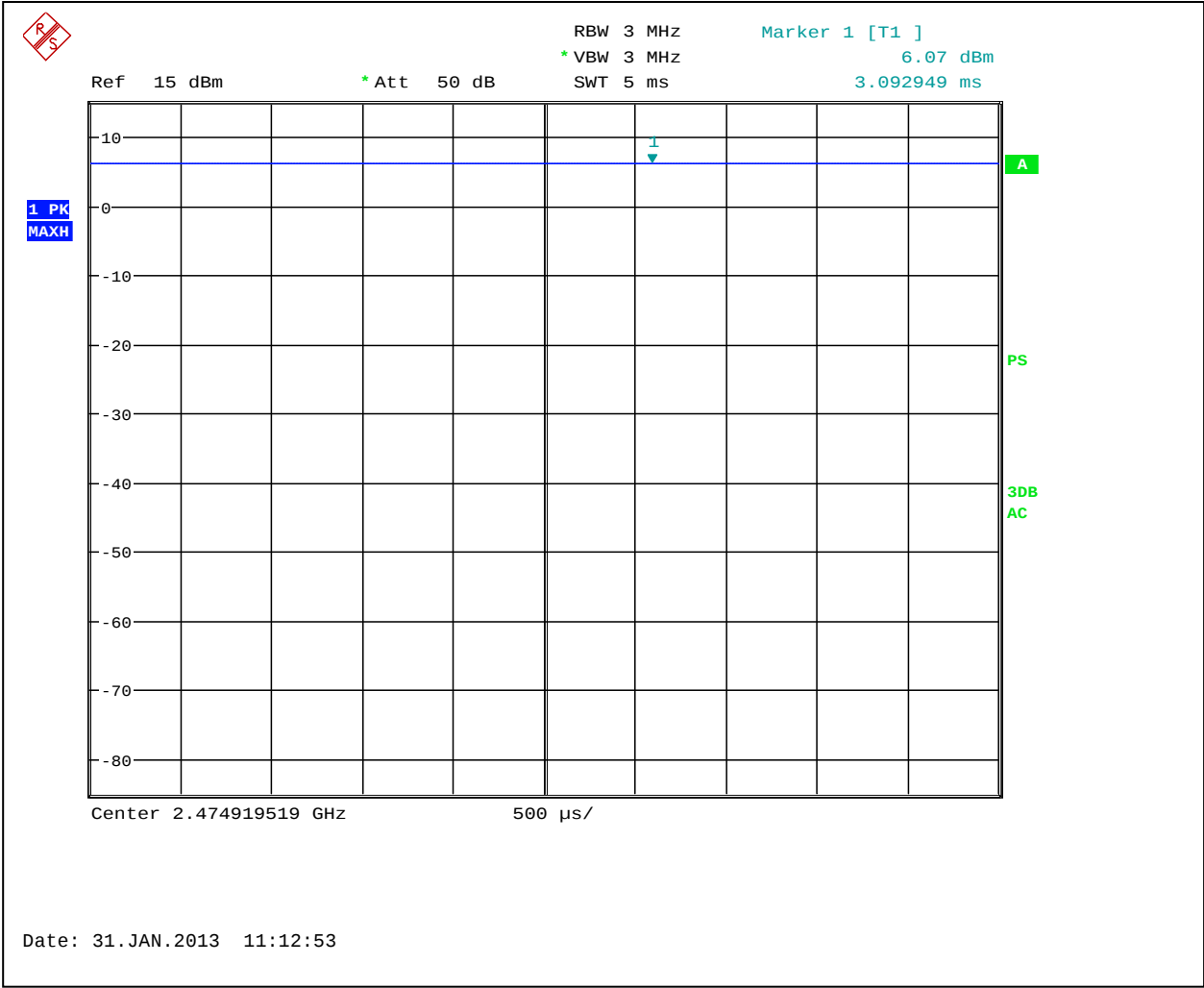
Notes: None



Graph 3.1.1



Graph 3.1.2

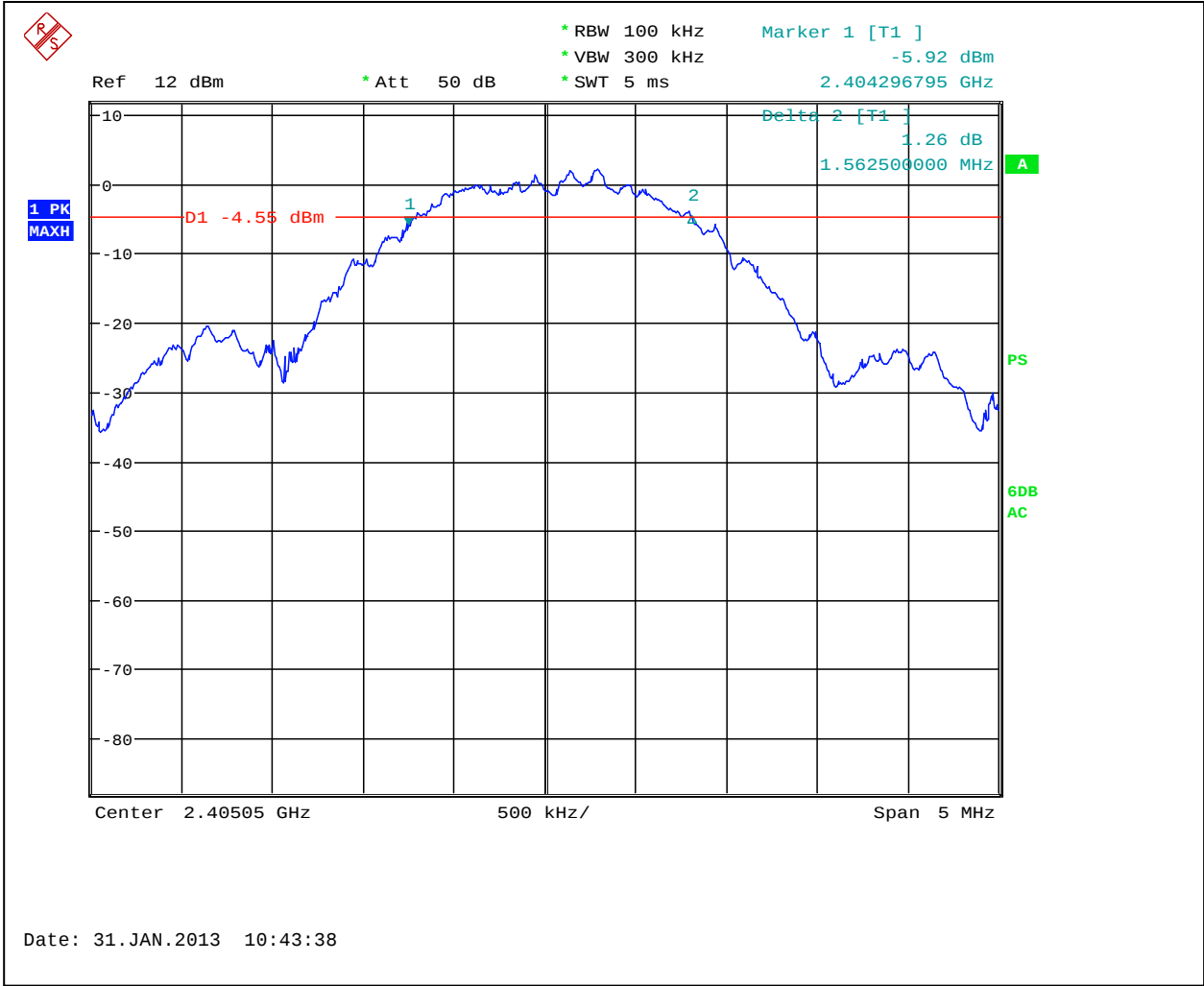


Graph 3.1.3

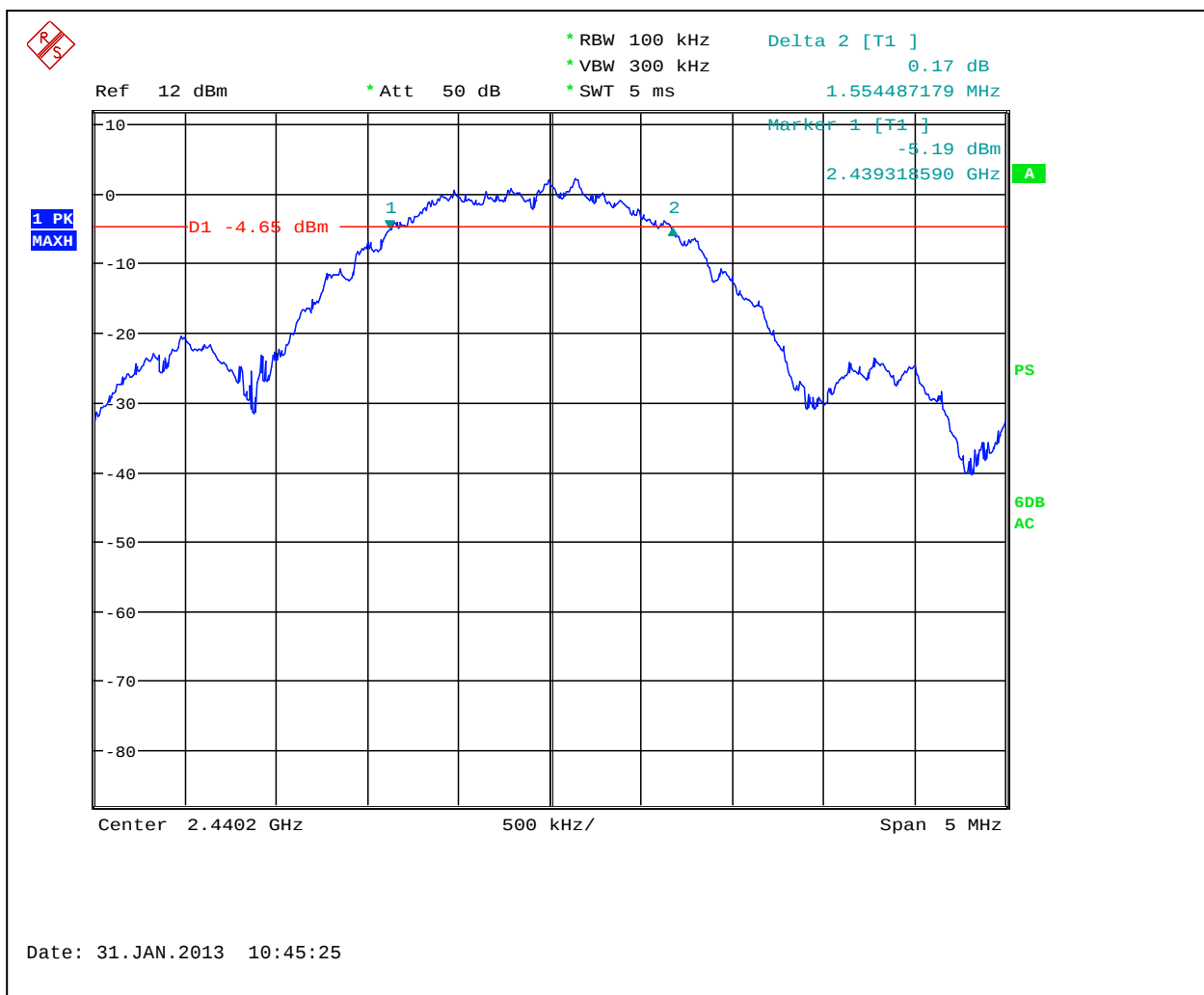
3.2 6dB bandwidth of the digital modulation

Low Frequency Channel kHz	Middle Frequency Channel kHz	Upper Frequency Channel kHz	Minimum Bandwidth kHz	Result
1562.5	1554.5	1530.4	500	Pass
RBW: ☒ 100kHz ☐ other kHz VBW: ☒ 300kHz ☐ 300kHz ☐ other kHz				

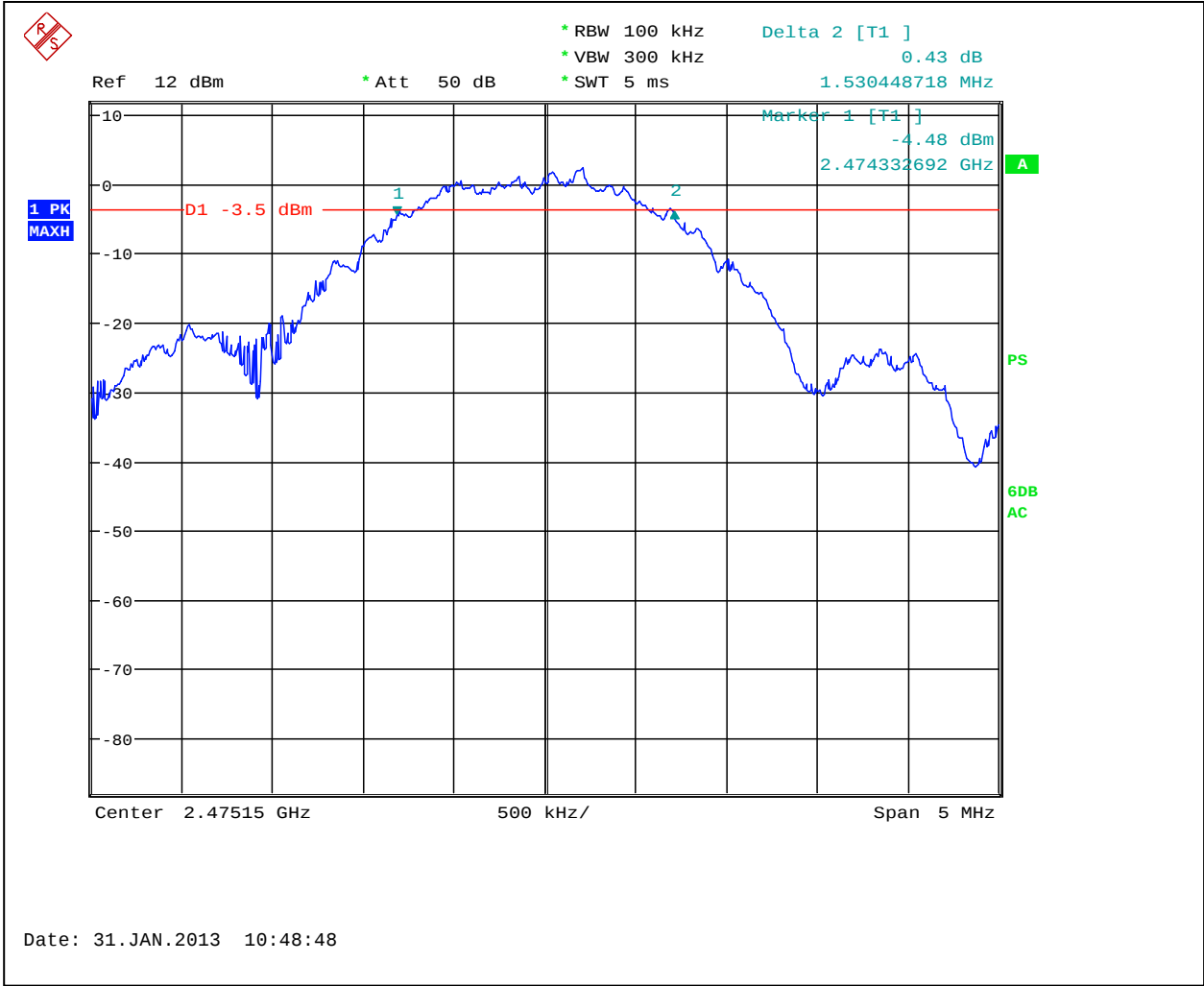
Notes: None



Graph 3.2.1



Graph 3.2.2



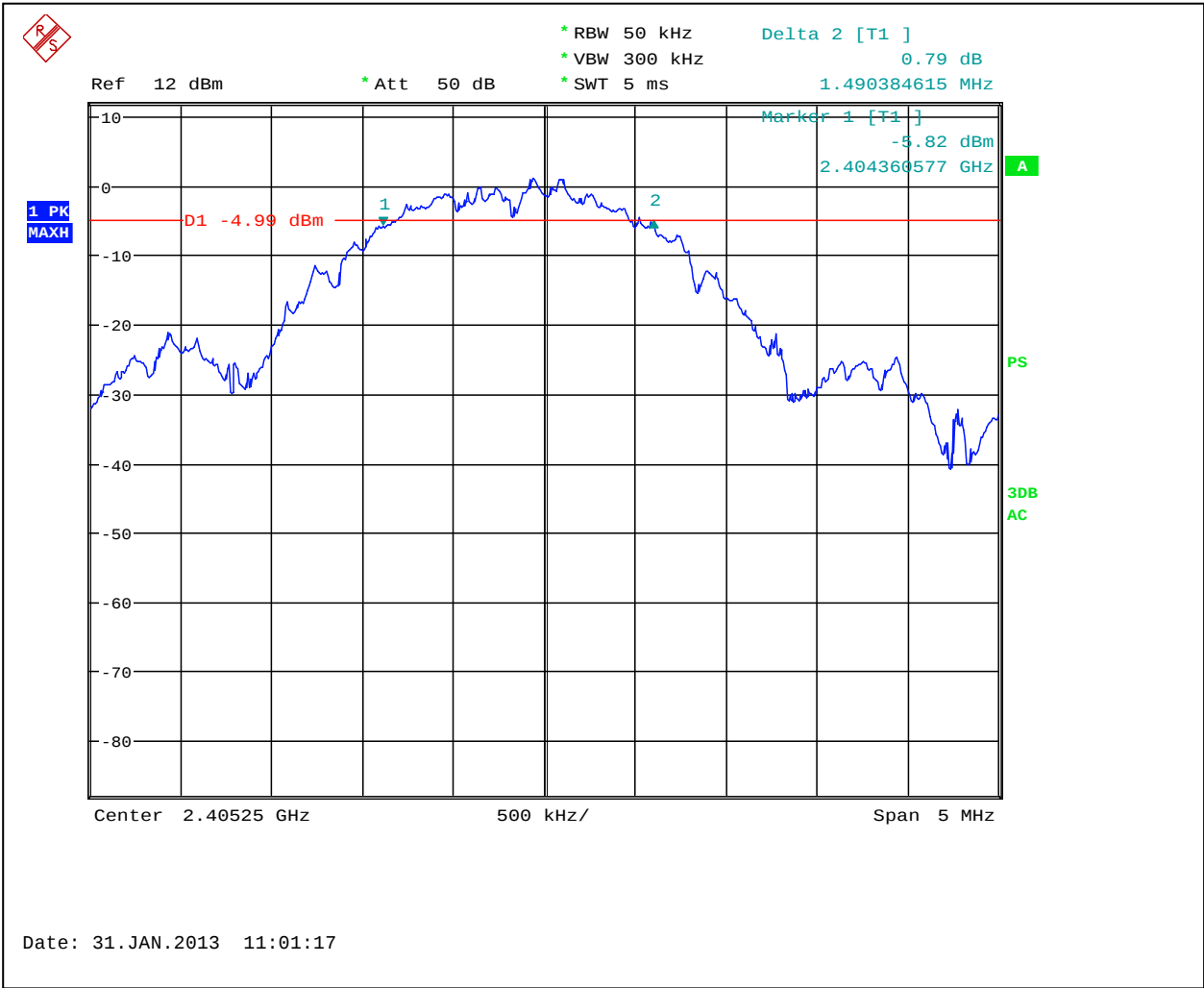
Graph 3.2.3



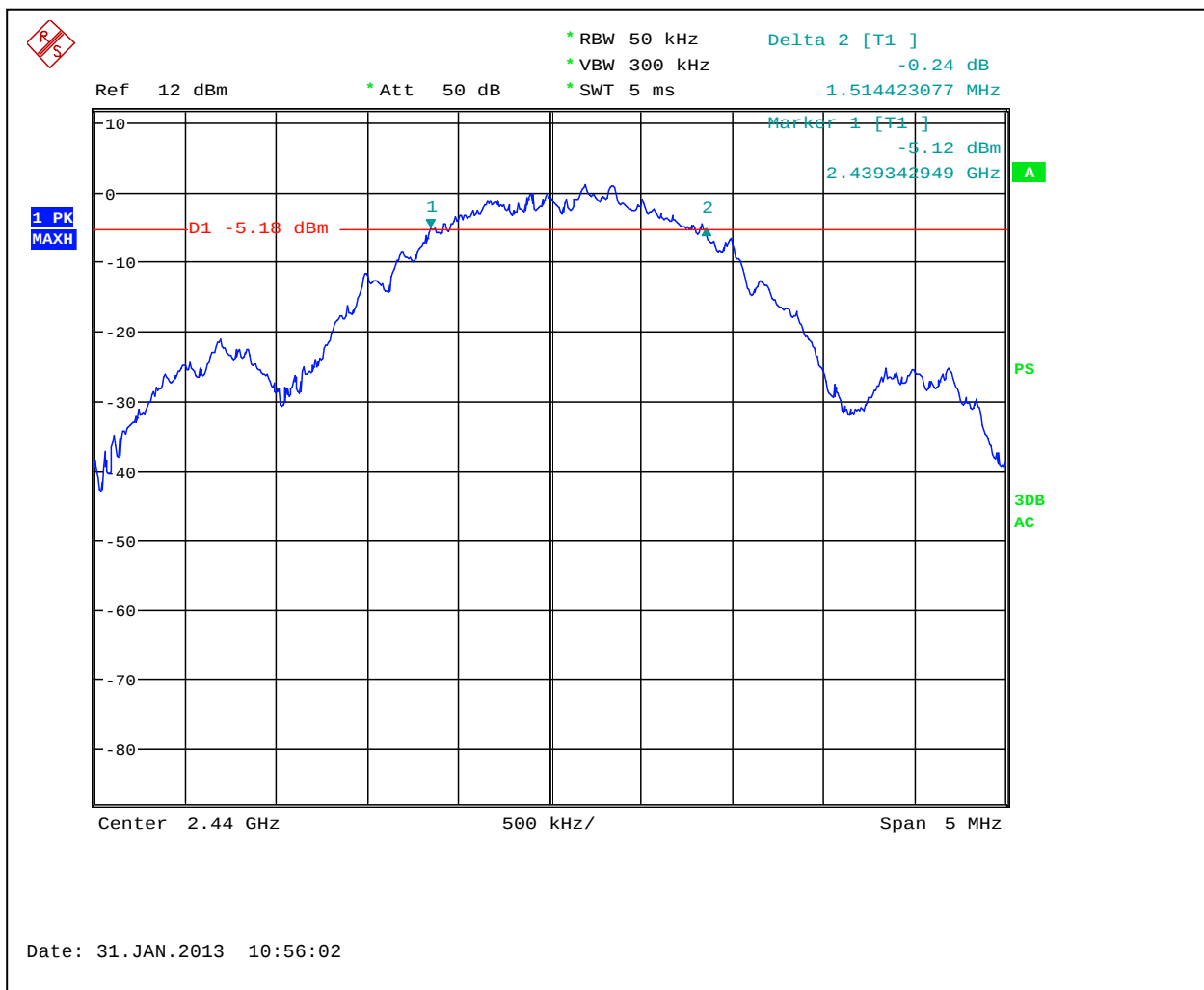
3.2.1 Emission bandwidth (EBW) of the digital modulation

Low Frequency Channel kHz	Middle Frequency Channel kHz	Upper Frequency Channel kHz	Minimum Bandwidth kHz	Result
1490.4	1514.4	1530.4	500	Pass
RBW:	☒ 50kHz ☐ other kHz			
VBW:	☒ 300kHz ☐ 300kHz ☐ other kHz			

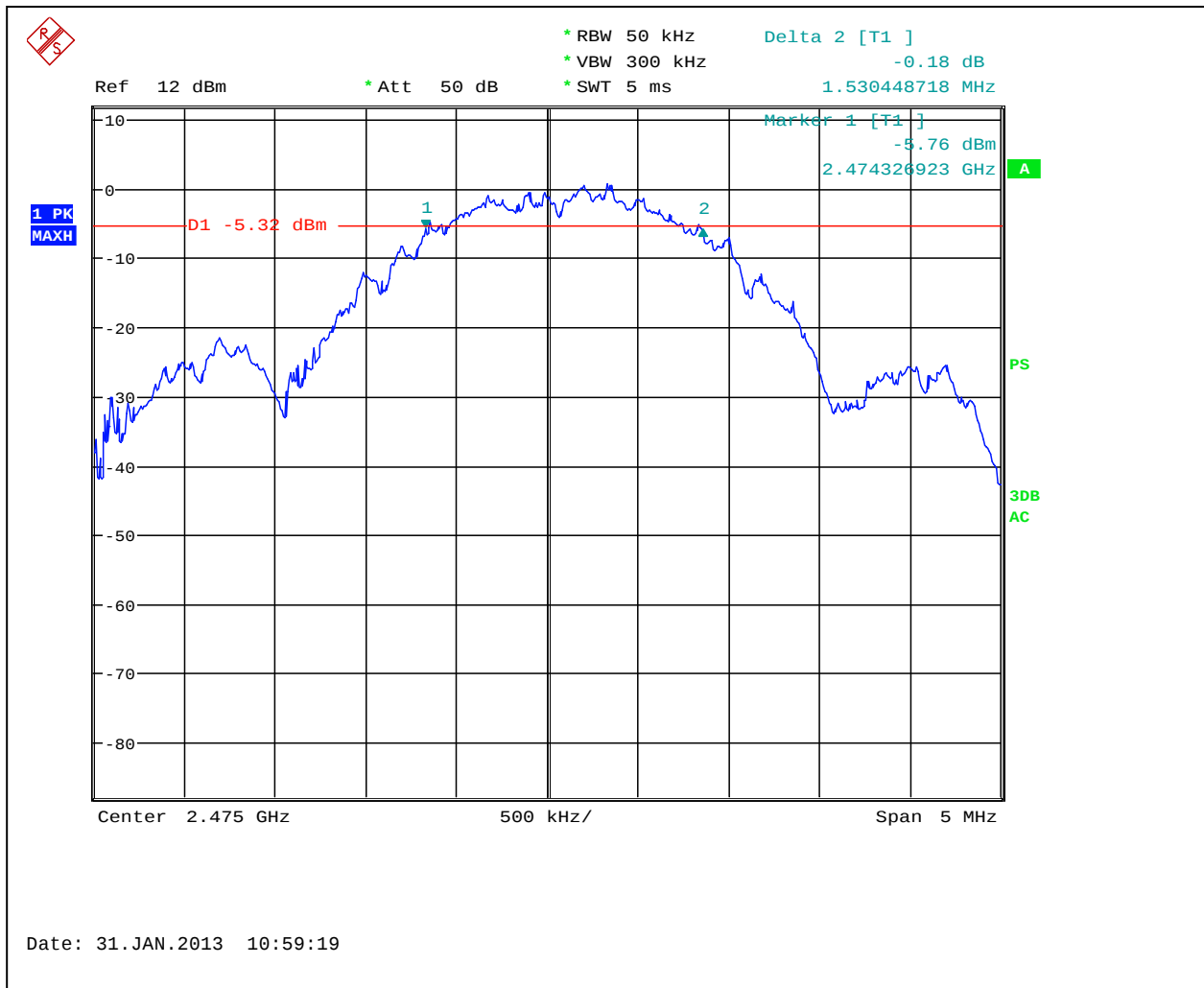
Notes: None



Graph 3.2.1.1



Graph 3.2.1.2

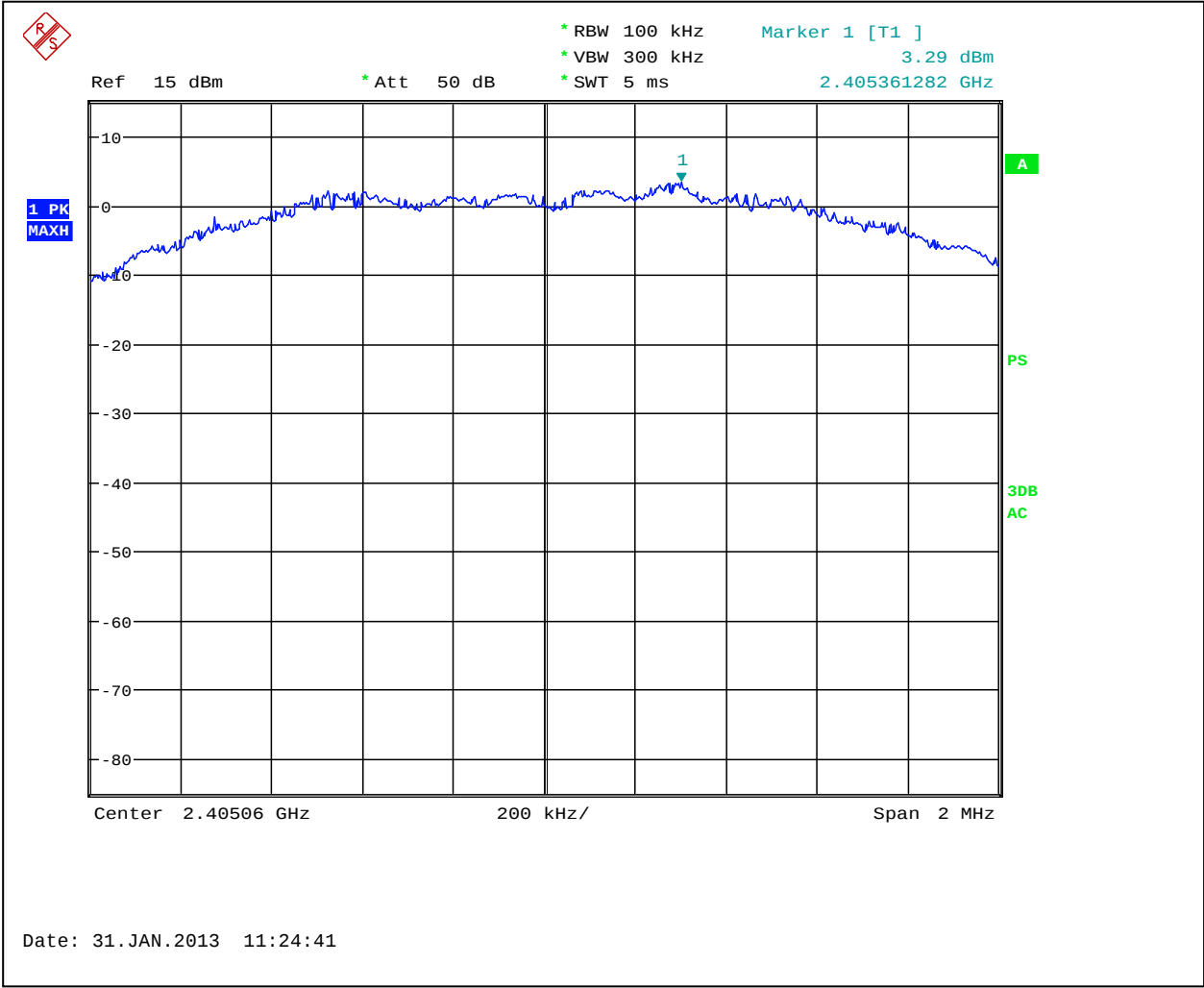


Graph 3.2.1.3

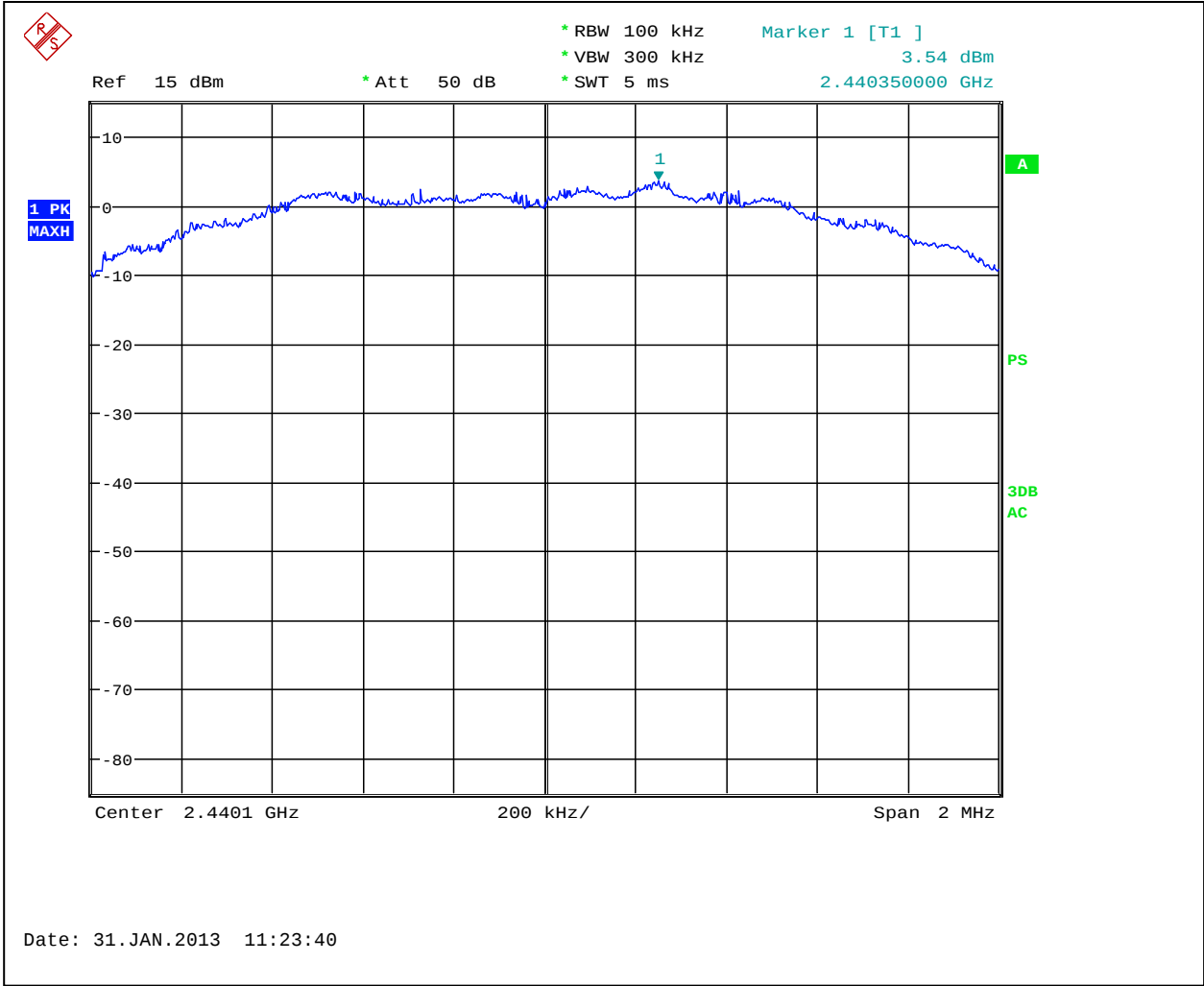
3.3 Power spectral density

Power Output:	☒ Conducted ☐ Radiated				
	Measured Density dBm	Power Spectral Density (dBm) @ RBW 100kHz	Power Spectral Density (dBm) @ RBW 3kHz	Limit dBm	Margin dB
Low Frequency Channel	3.3	4.6	-10.6	8	-18.6
Middle Frequency Channel	3.5	4.8	-10.4	8	-18.4
Upper Frequency Channel	3.2	4.5	-10.7	8	-18.7
Analyzer Settings:	☒ RBW=100KHz ☒ VBW=300KHz ☒ Span=2MHz ☒ Sweep=Auto				
Antenna Gain:	☒ < 6dBi and = dBi ☐ >6dBi and = dBi, limit reduction = dB				

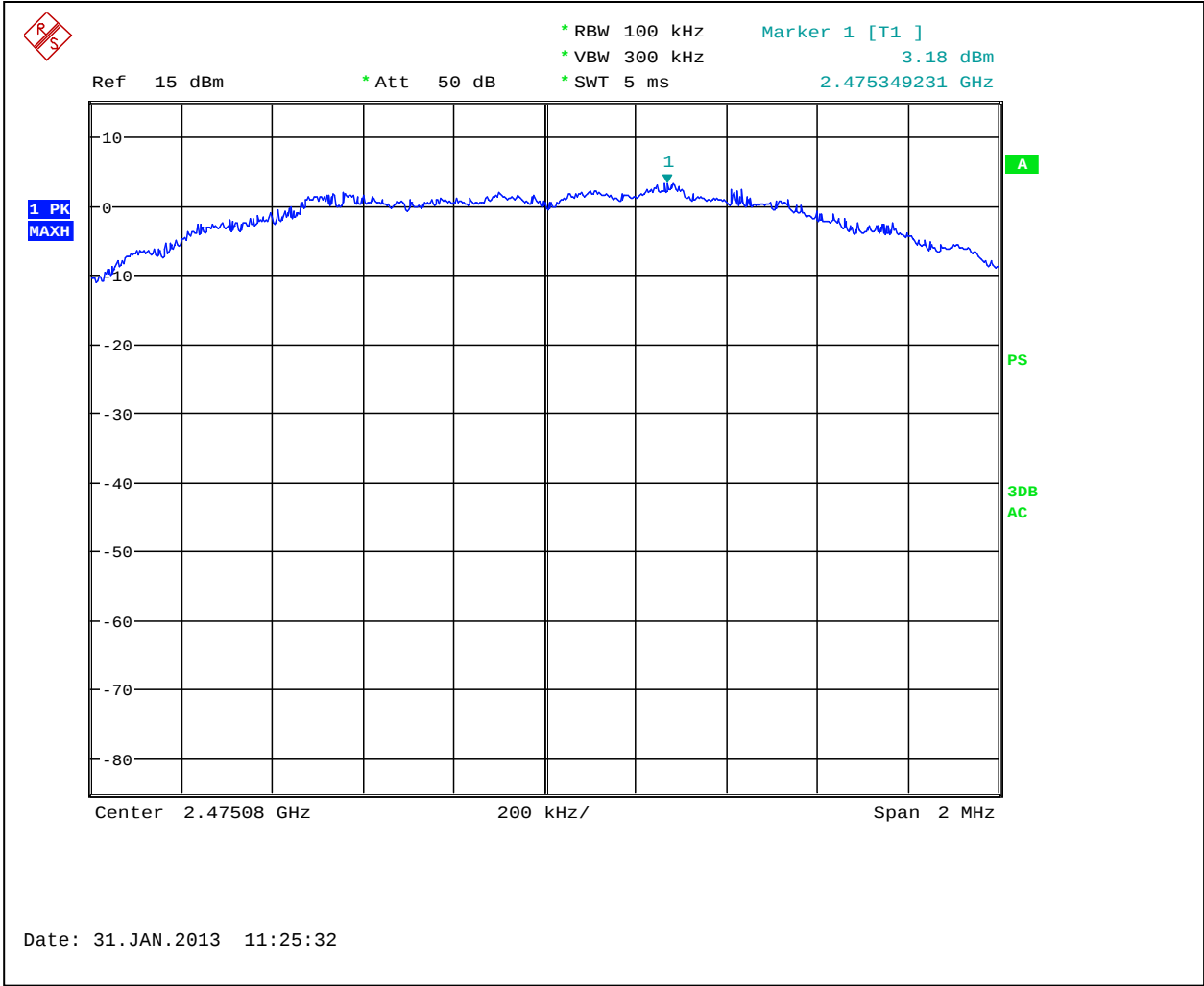
Notes: The Power Spectral Density was calculated adding the cable/attenuator loss of 1.3dB from the measured density value.
 The observed power level at RBW=100kHz was adjusted by reducing the measured power by a bandwidth correction factor (BWCF)=15.2dB



Graph 3.3.1



Graph 3.3.2



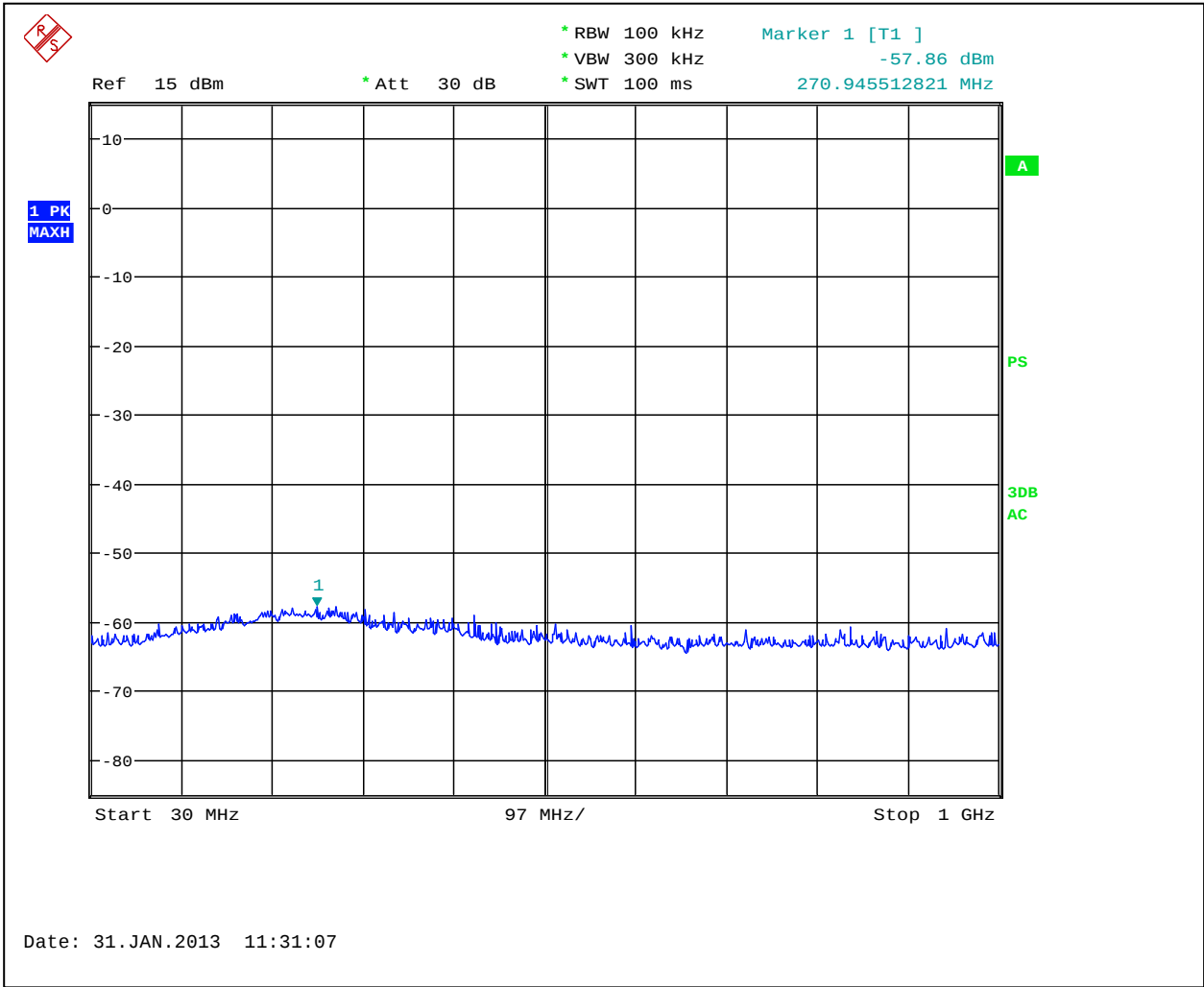
Graph 3.3.3



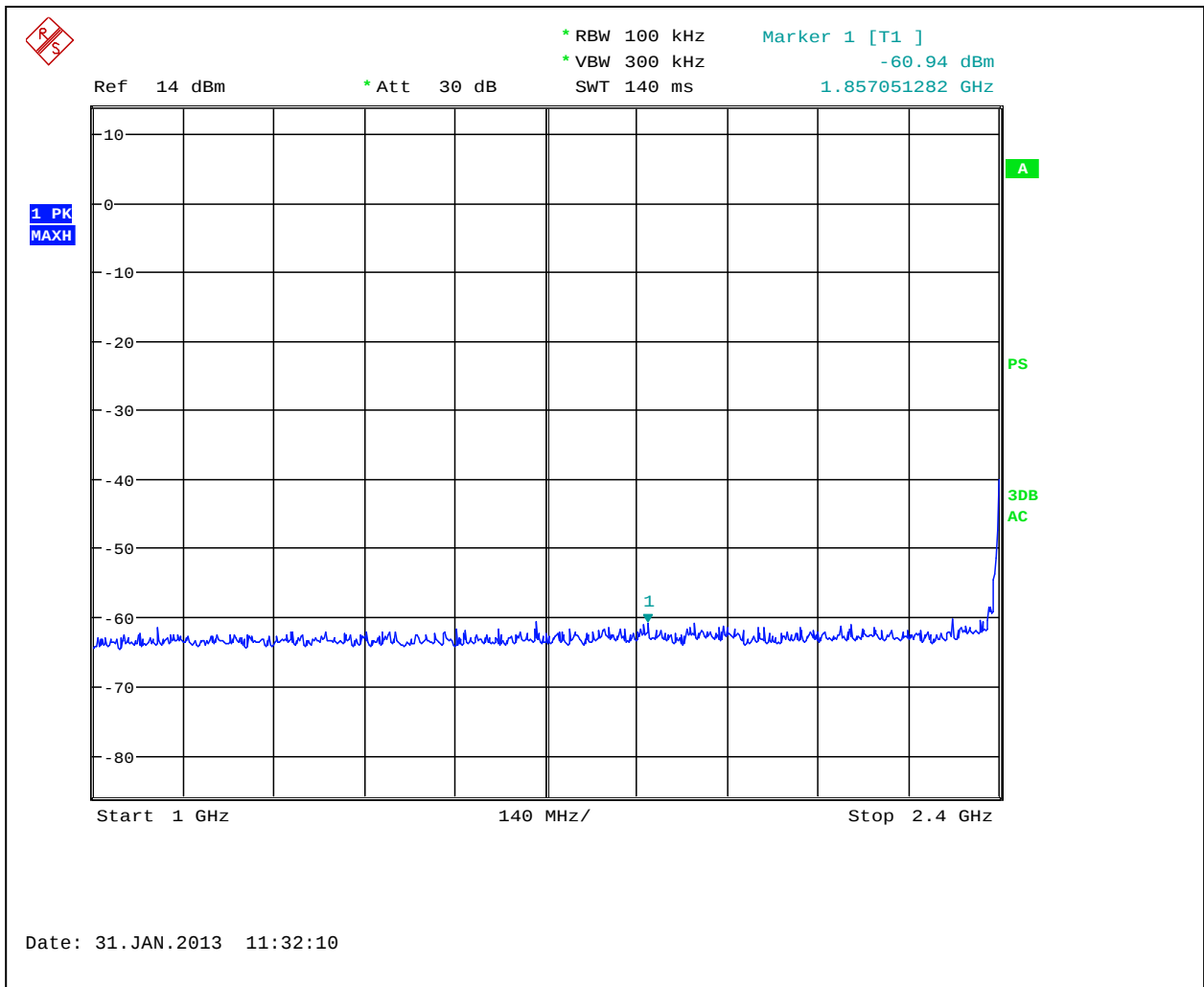
3.4 Antenna conducted spurious emissions

	Minimum Measured Attenuation dB	Minimum Allowed Attenuation dB	Margin dB
Low Frequency Channel	51.8	20	-31.8
Middle Frequency Channel	51.5	20	-31.5
Upper Frequency Channel	52.1	20	-32.1
Analyzer Settings:	☒ RBW=100KHz		
Minimum Allowed Attenuation:	☒ 20dB ☐ 30dB (for digital systems with conducted power measured using RMS averaging over a time interval)		

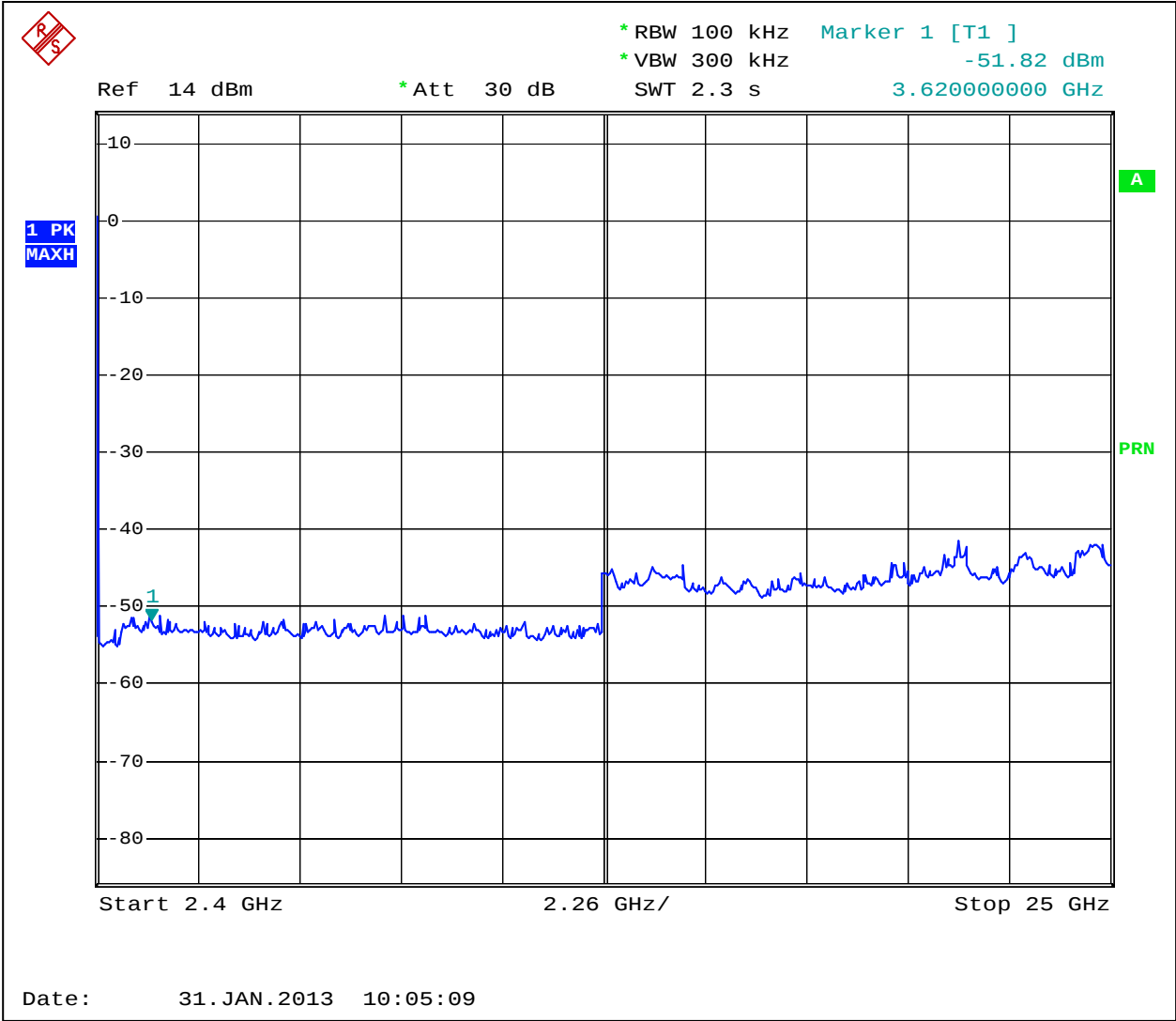
Notes: None



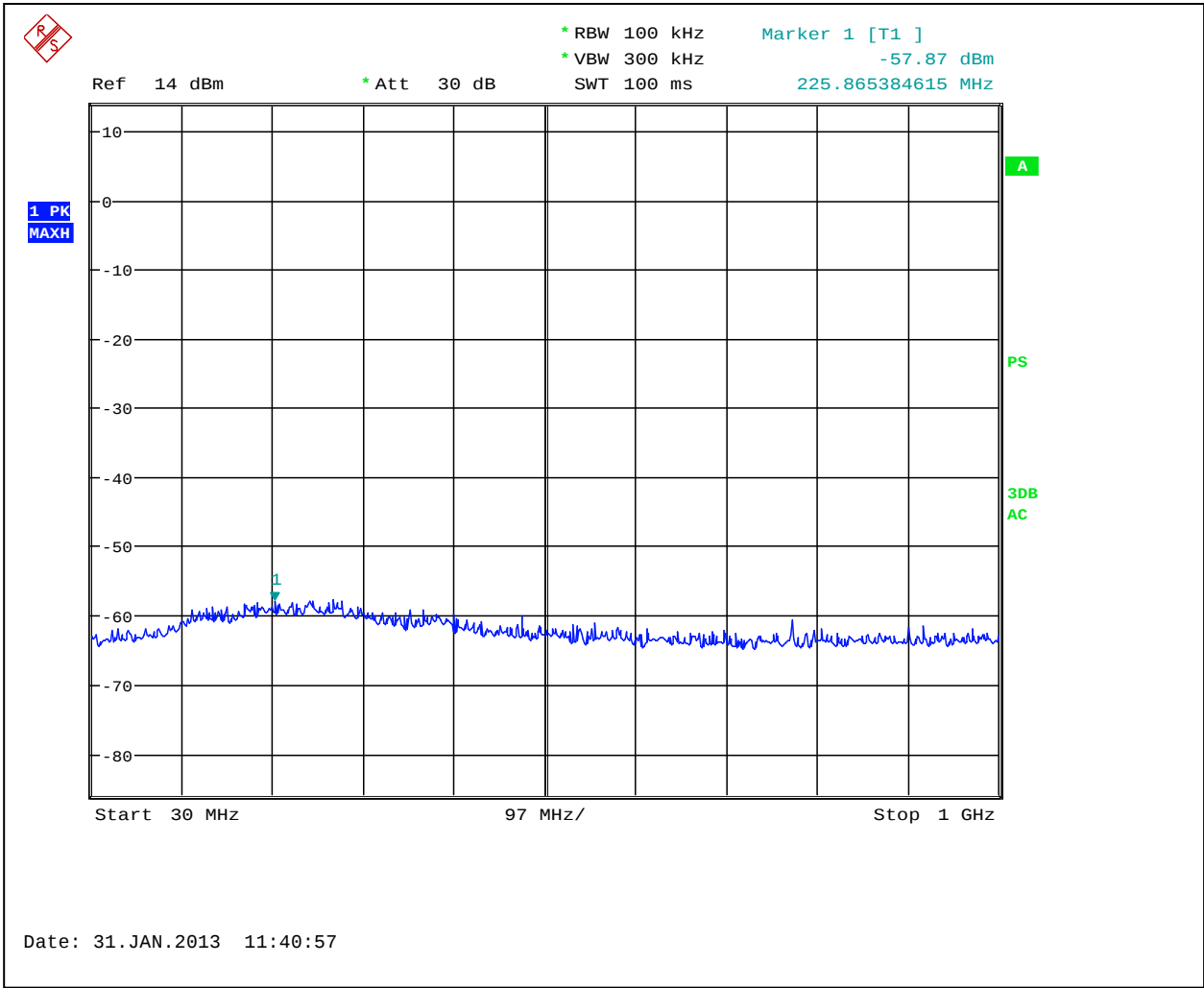
Graph 3.4.1



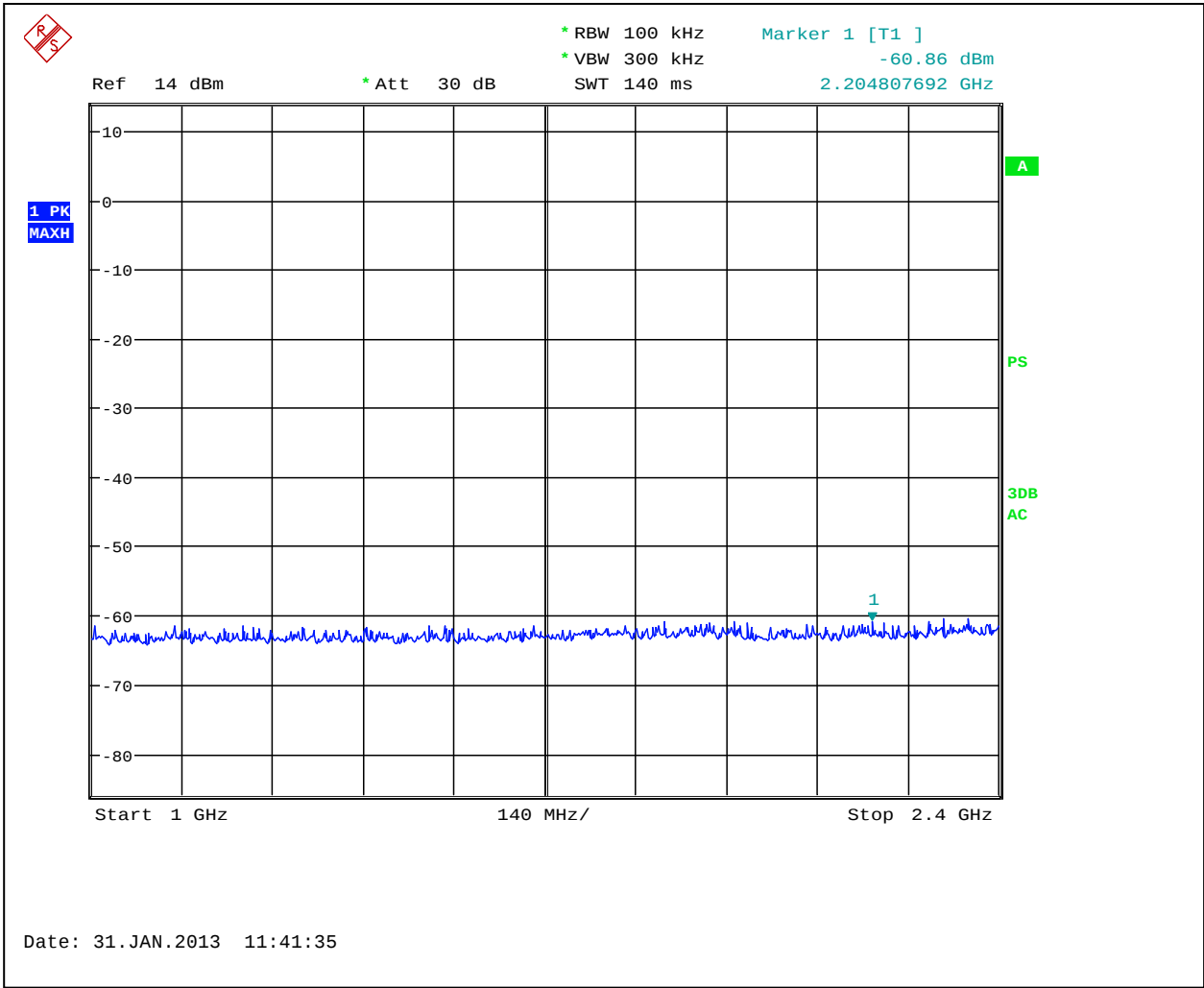
Graph 3.4.2



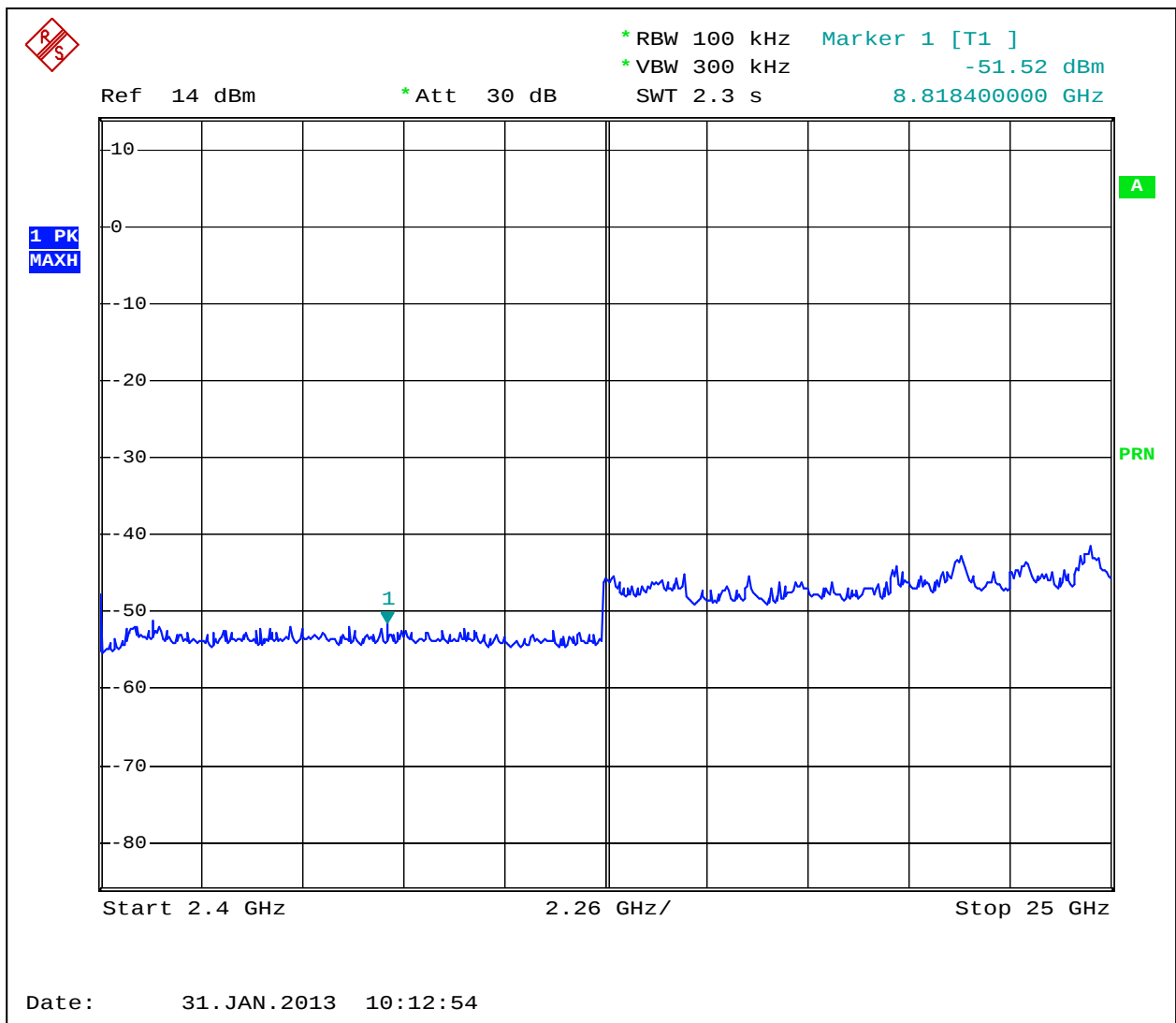
Graph 3.4.3



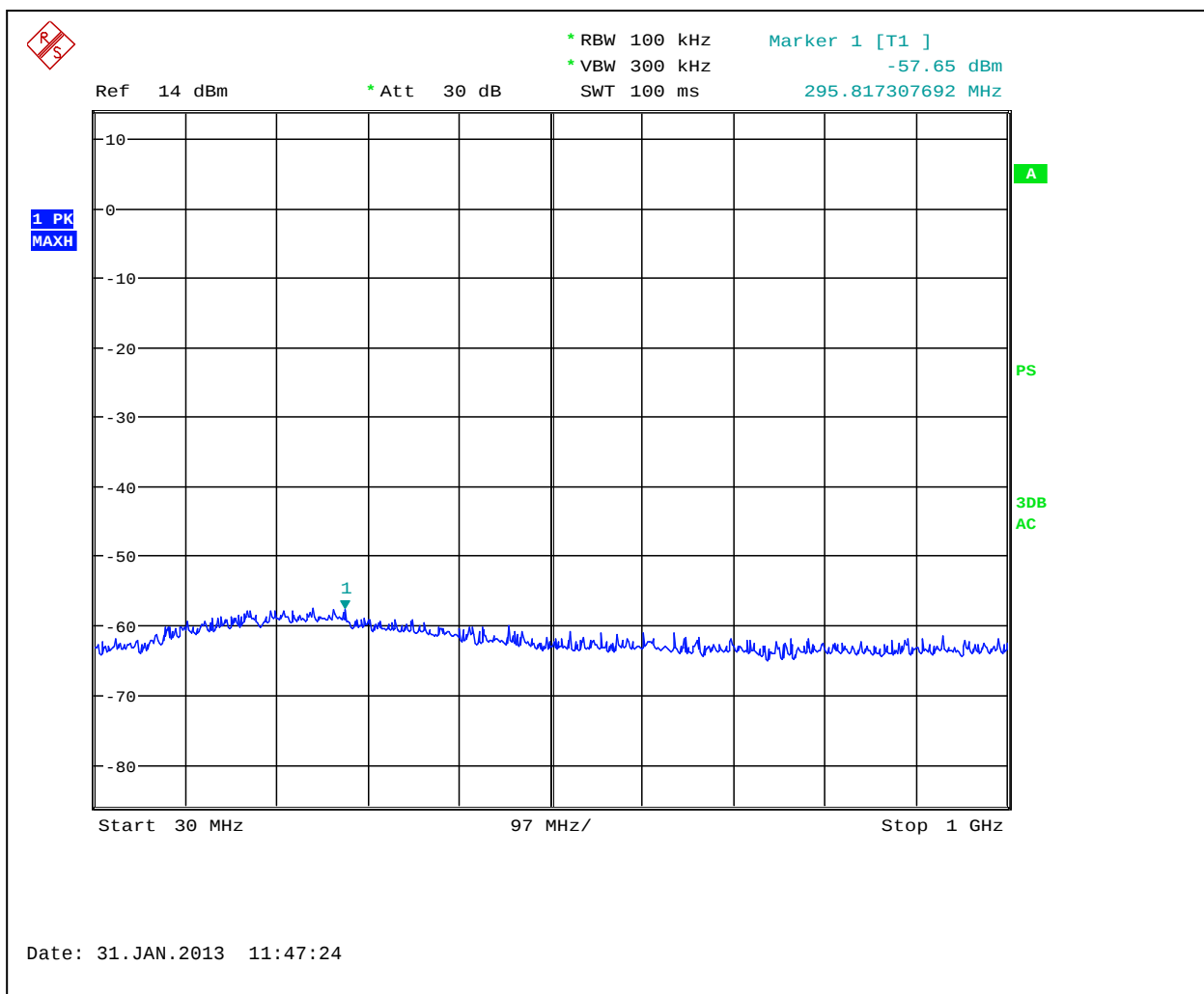
Graph 3.4.4



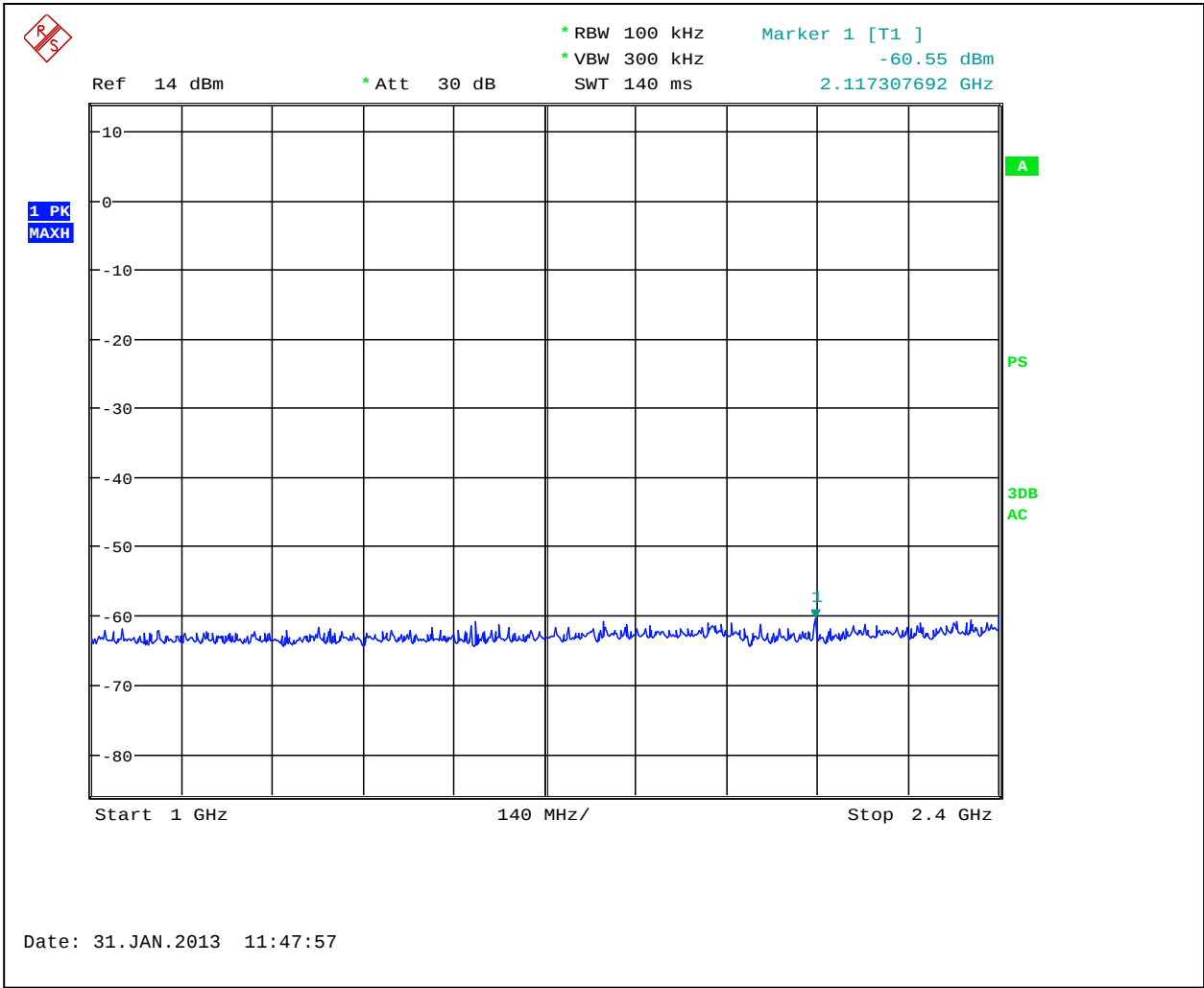
Graph 3.4.5



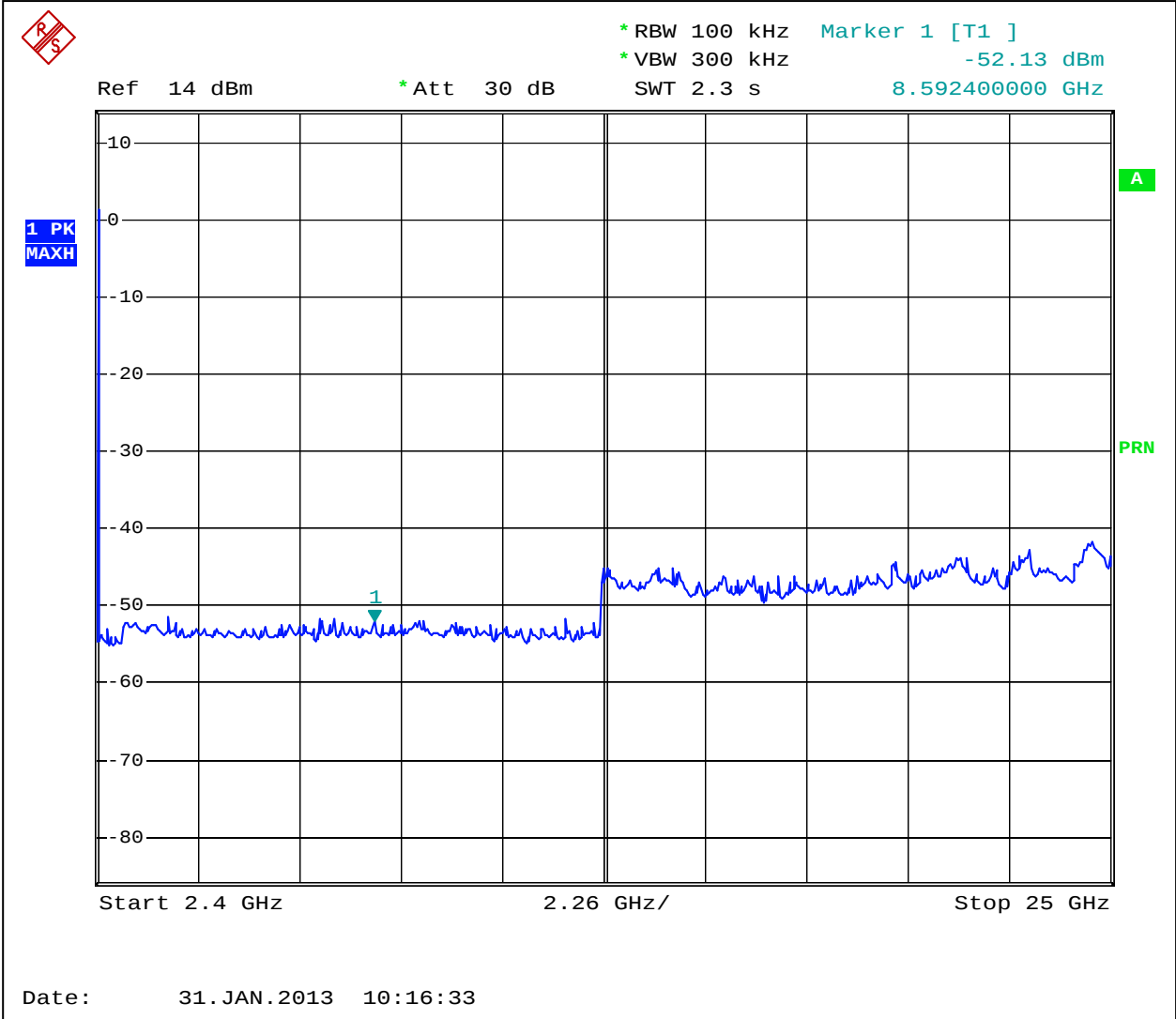
Graph 3.4.6



Graph 3.4.7



Graph 3.4.8



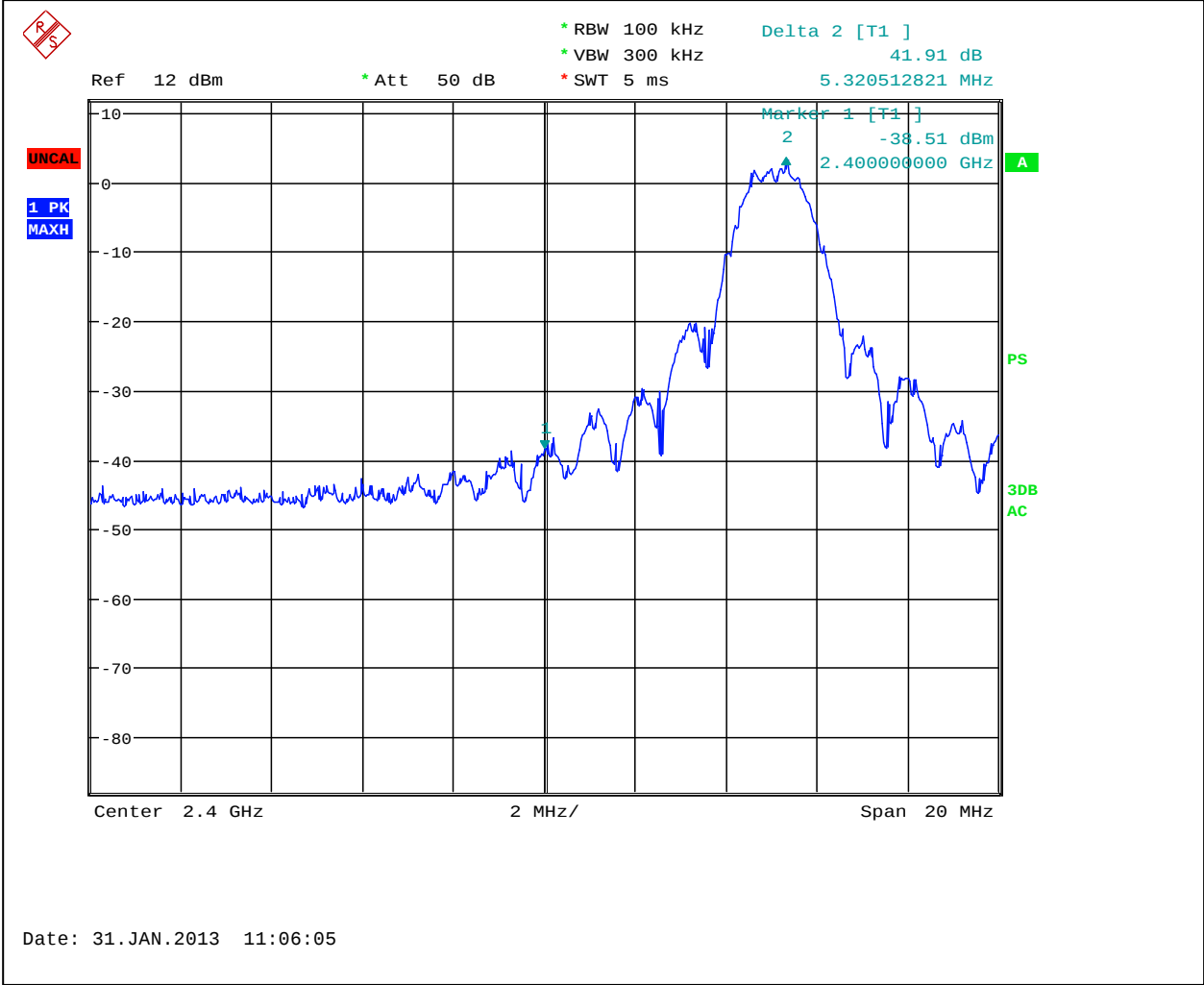
Graph 3.4.9



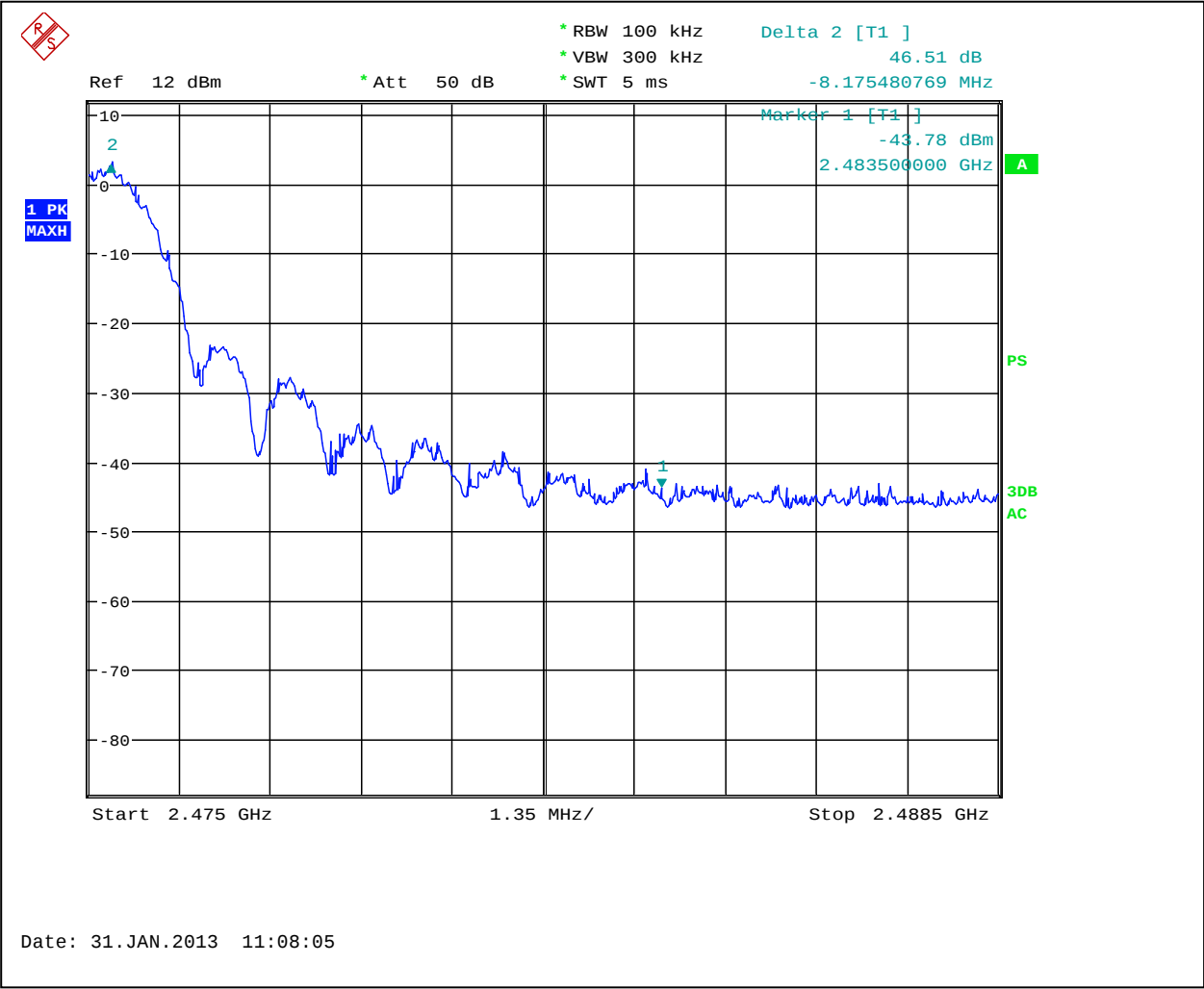
3.4.1 Antenna conducted band edge compliance

Frequency Range:	☐ 902-928MHz ☒ 2400-2483.5MHz ☐ 5725-5850MHz		
	Minimum Measured Attenuation dB	Minimum Allowed Attenuation dB	Margin dB
Low Frequency Channel	41.9	20	-21.9
Upper Frequency Channel	46.5	20	-26.5
Analyzer Settings:	☒ RBW=100KHz		
Minimum Allowed Attenuation:	☒ 20dB ☐ 30dB (for digital systems with conducted power measured using RMS averaging over a time interval)		

Notes: None



Graph 3.4.10



Graph 3.4.11



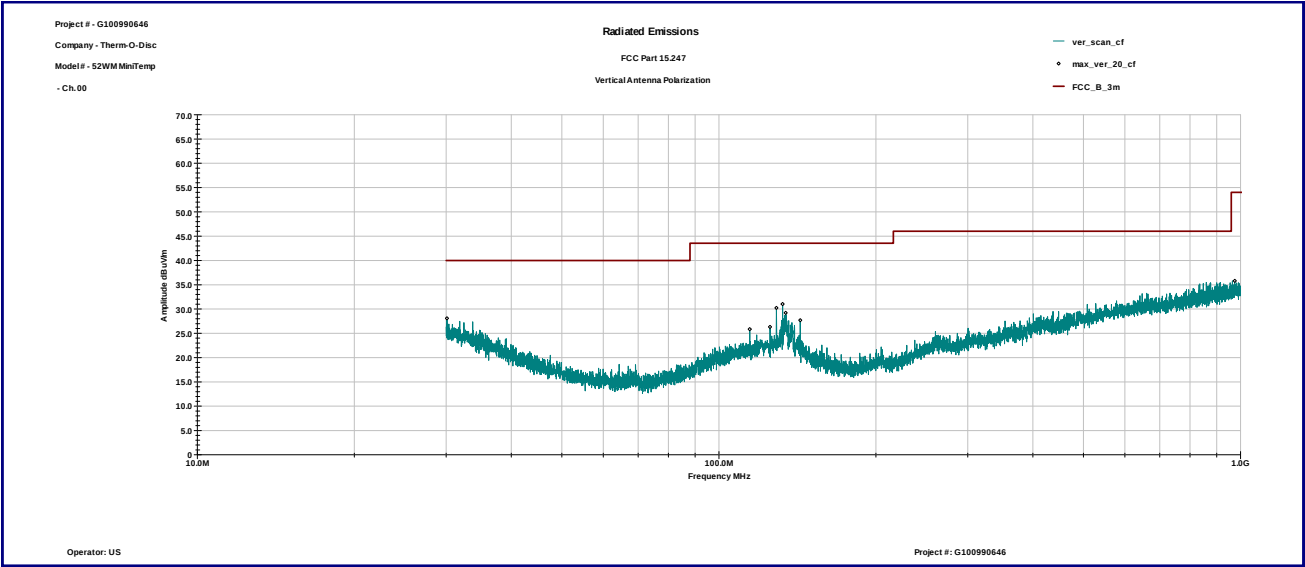
3.5 Radiated spurious emissions

Test location: ☐ OATS ☒ Anechoic Chamber ☐ Other

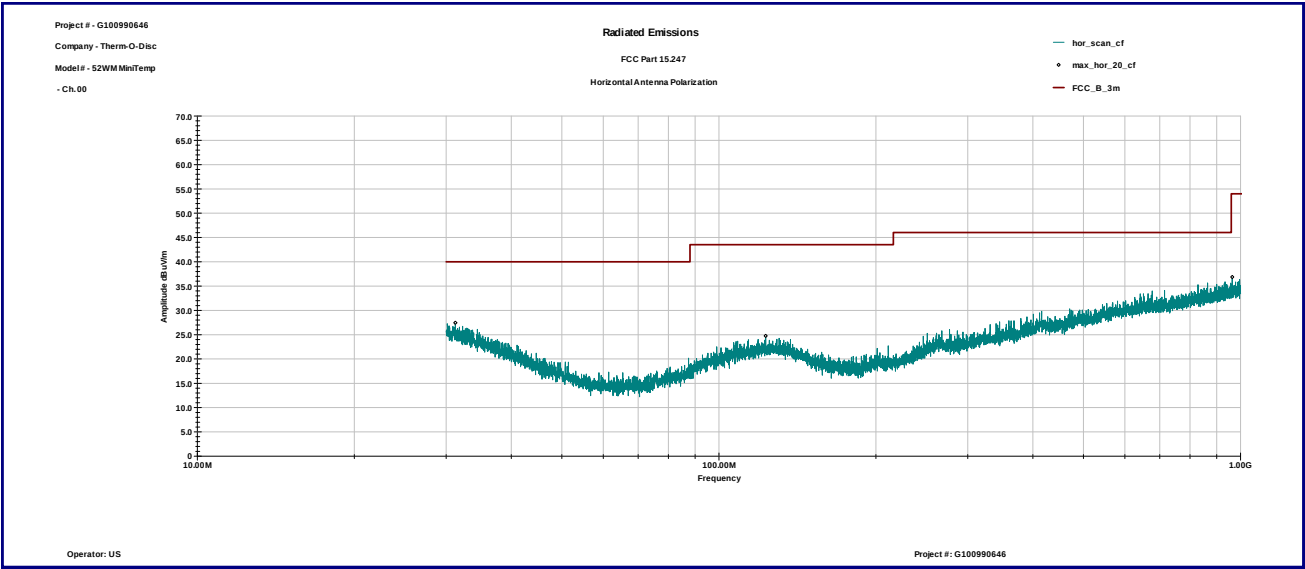
Test result: **Pass**

Max. Margin: dB below the limits

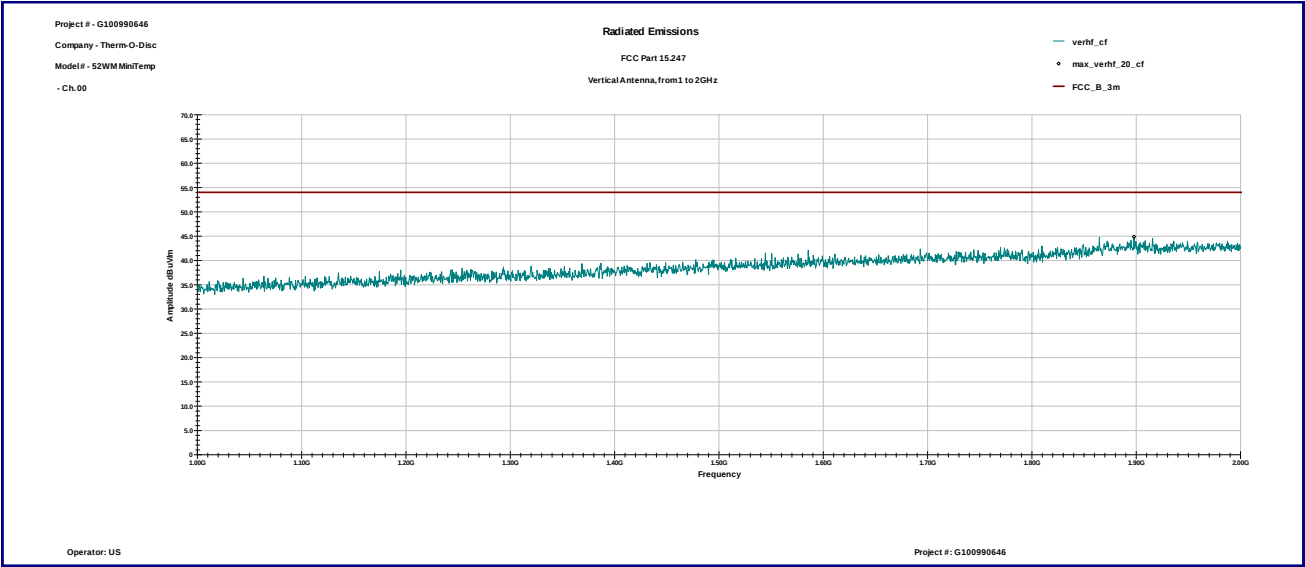
Date:	February 1-4, 2013	Result: Pass
Standard:	FCC part 15.247(d)	
Tested by:	Uri Spector	
Test Point:	Enclosure	
Operation mode:	See Page 5	
Note:	Emissions at fundamental frequency and spurious emissions not related with transmitter operations were excluded from the Table. No spurious emissions and harmonics were detected above the ambient noise (see Graphs 3.5.1 - 3.5.24) Testing was performed at Low, Middle and Upper channels.	



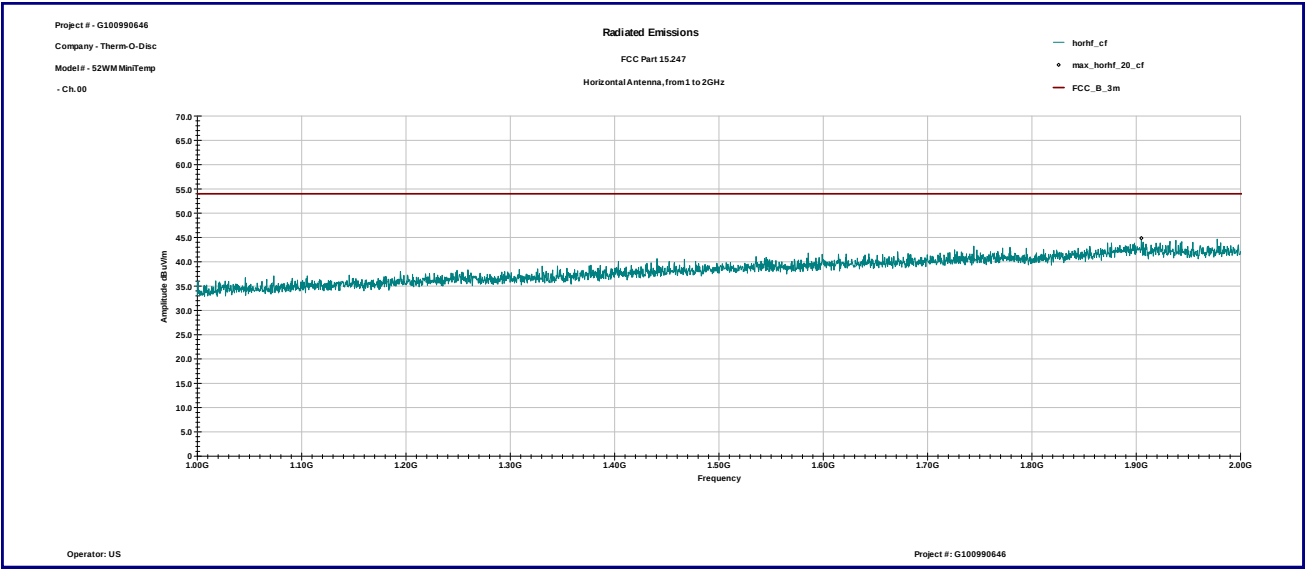
Graph 3.5.1



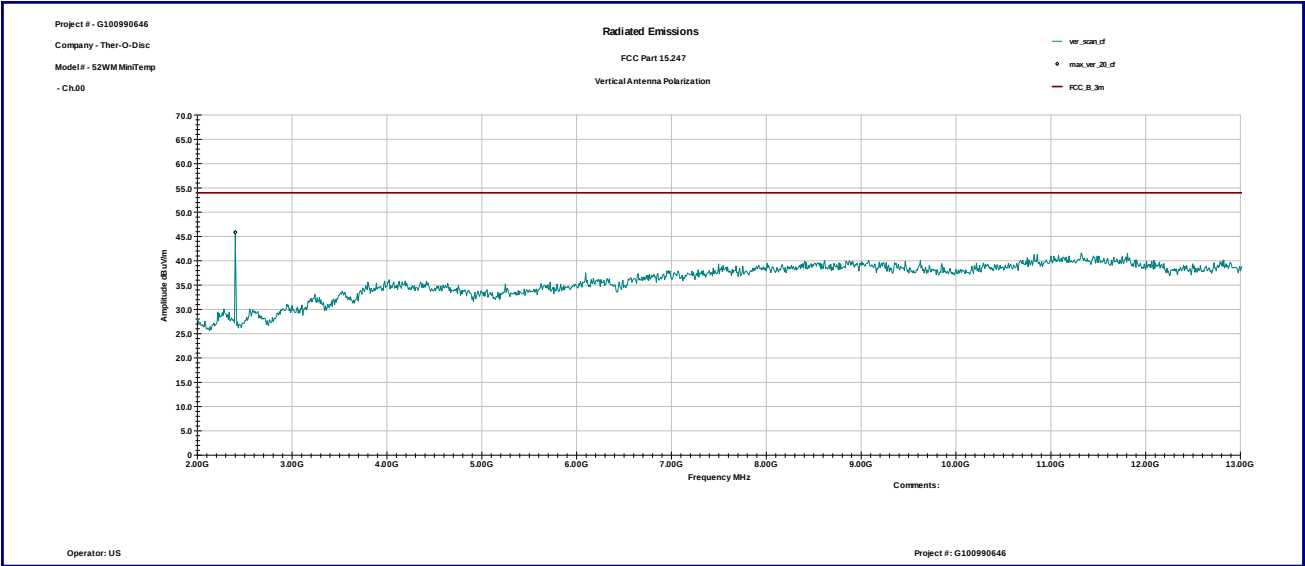
Graph 3.5.2



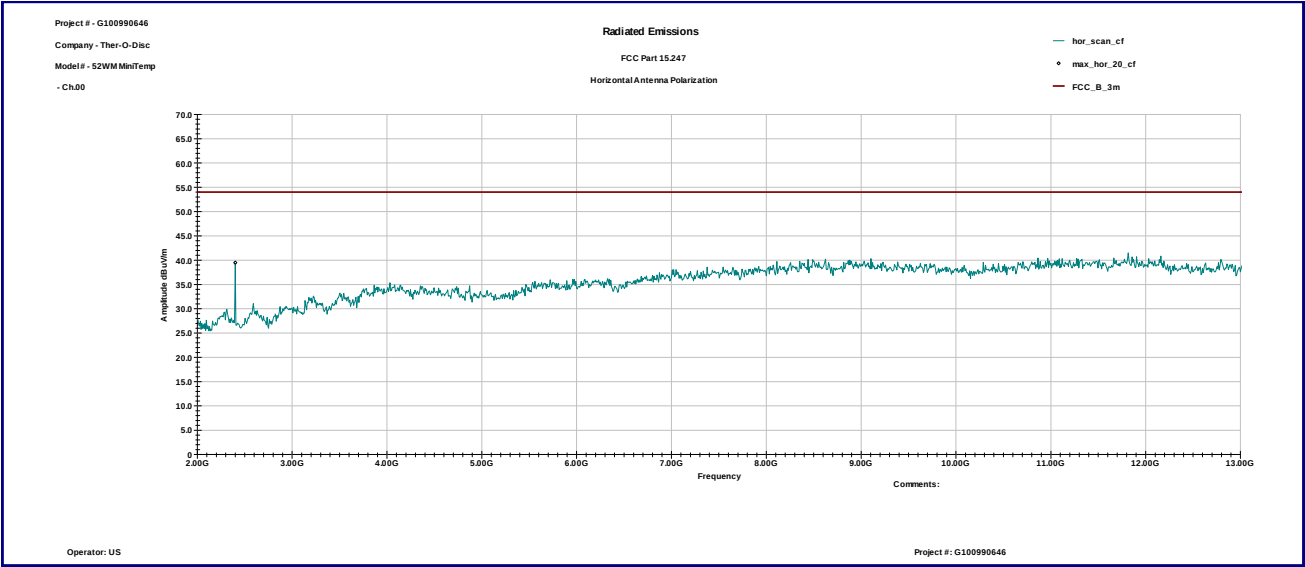
Graph 3.5.3



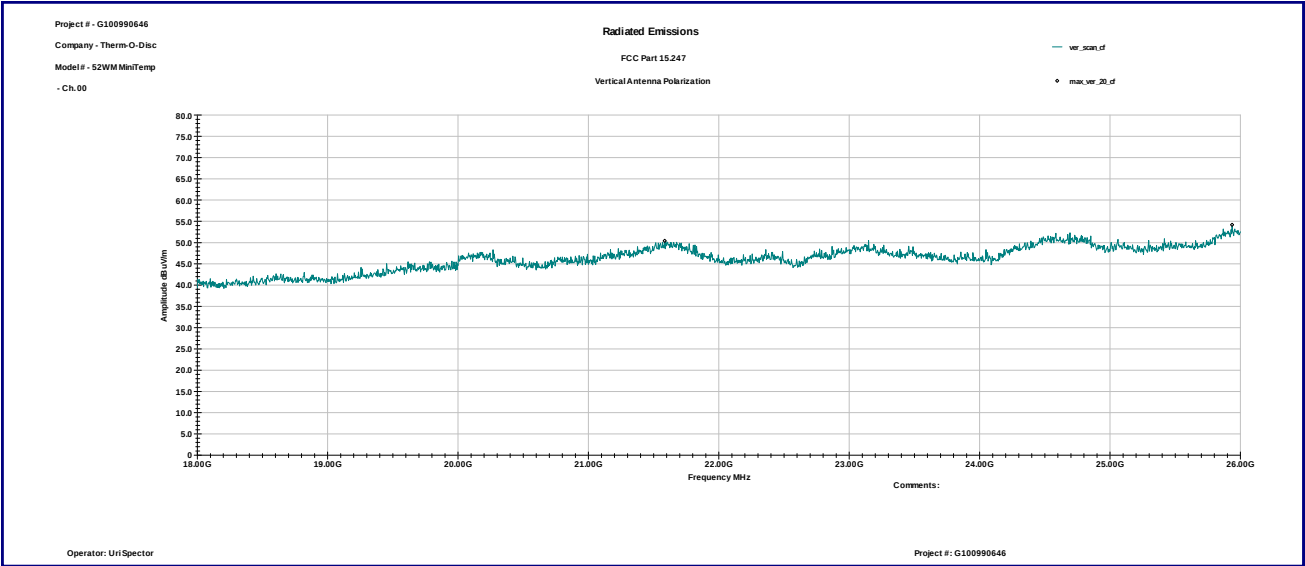
Graph 3.5.4



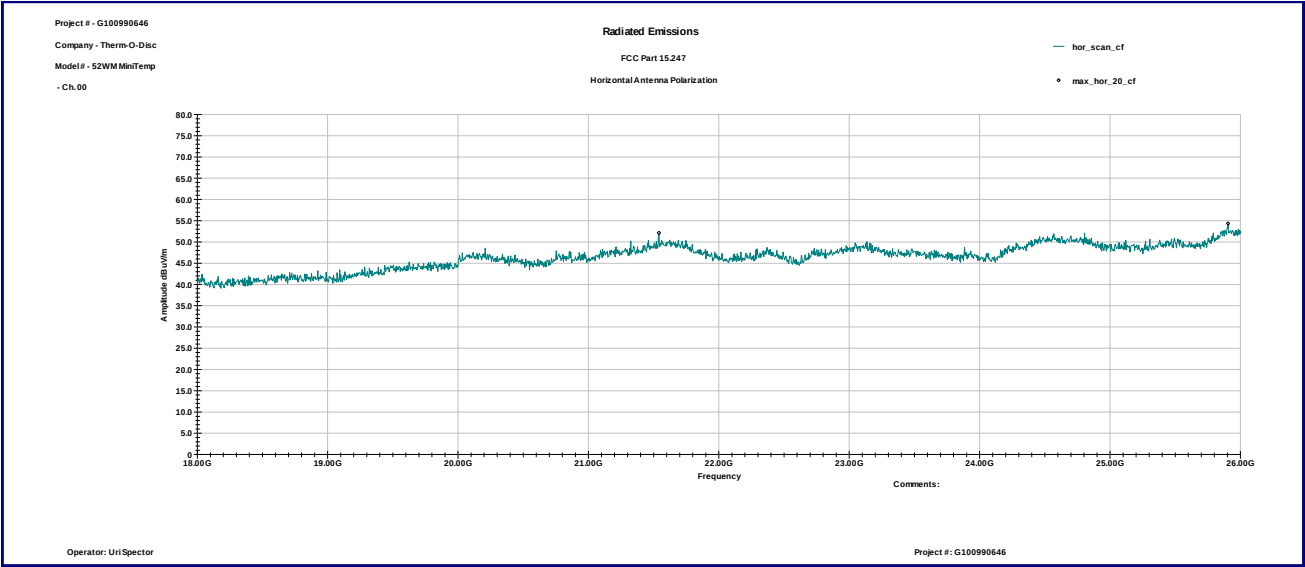
Graph 3.5.5



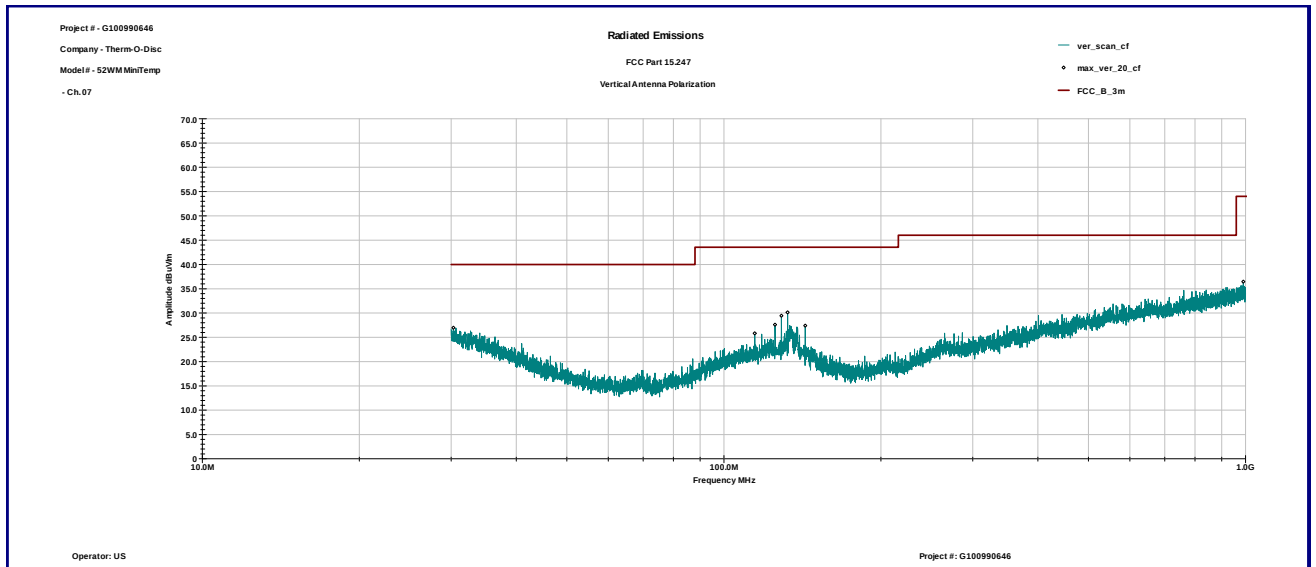
Graph 3.5.6



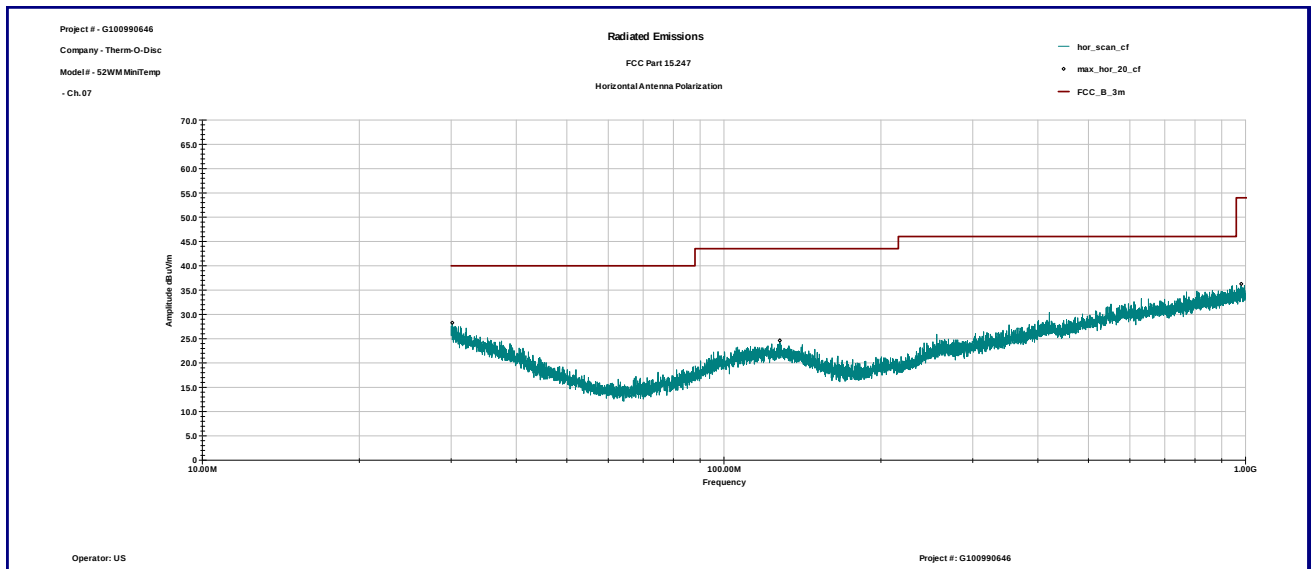
Graph 3.5.7



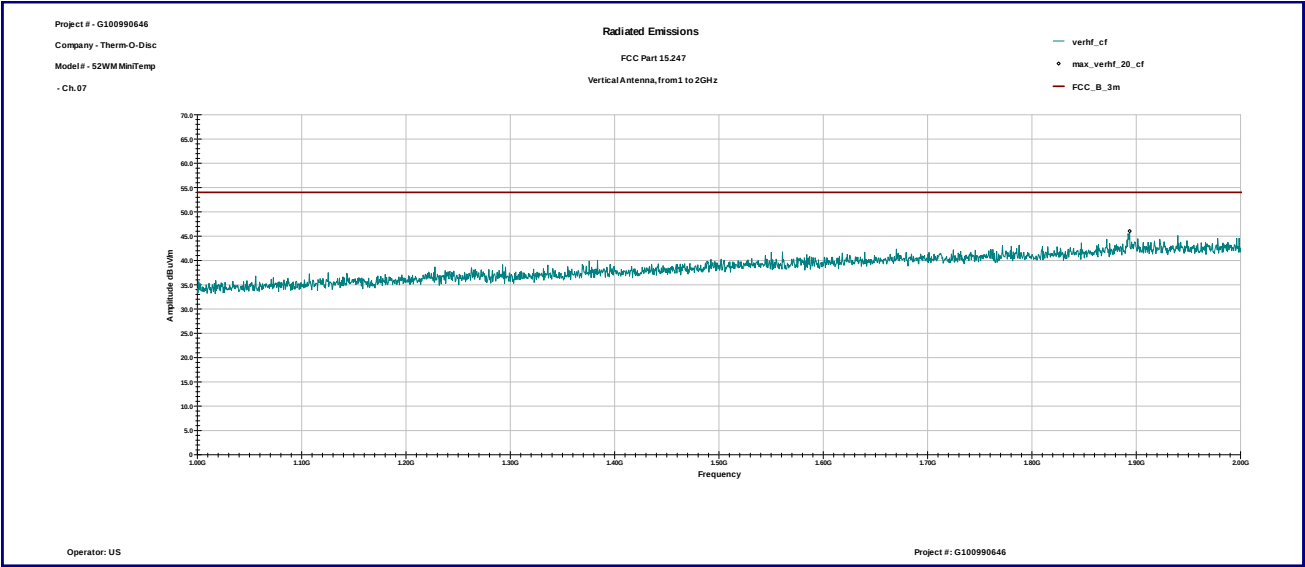
Graph 3.5.8



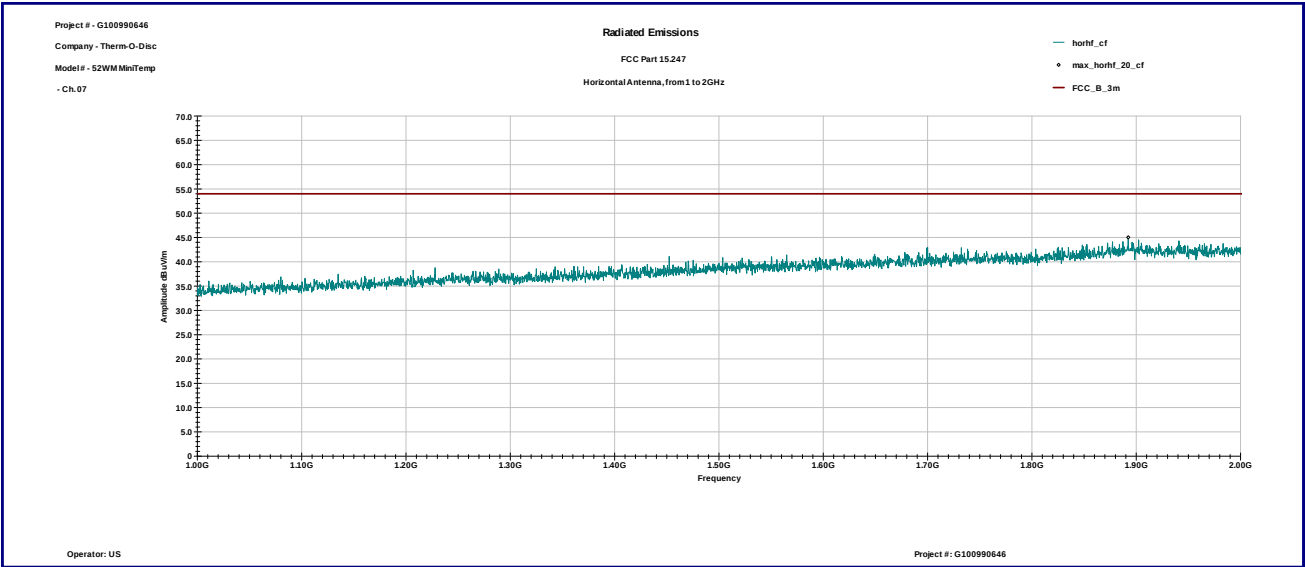
Graph 3.5.9



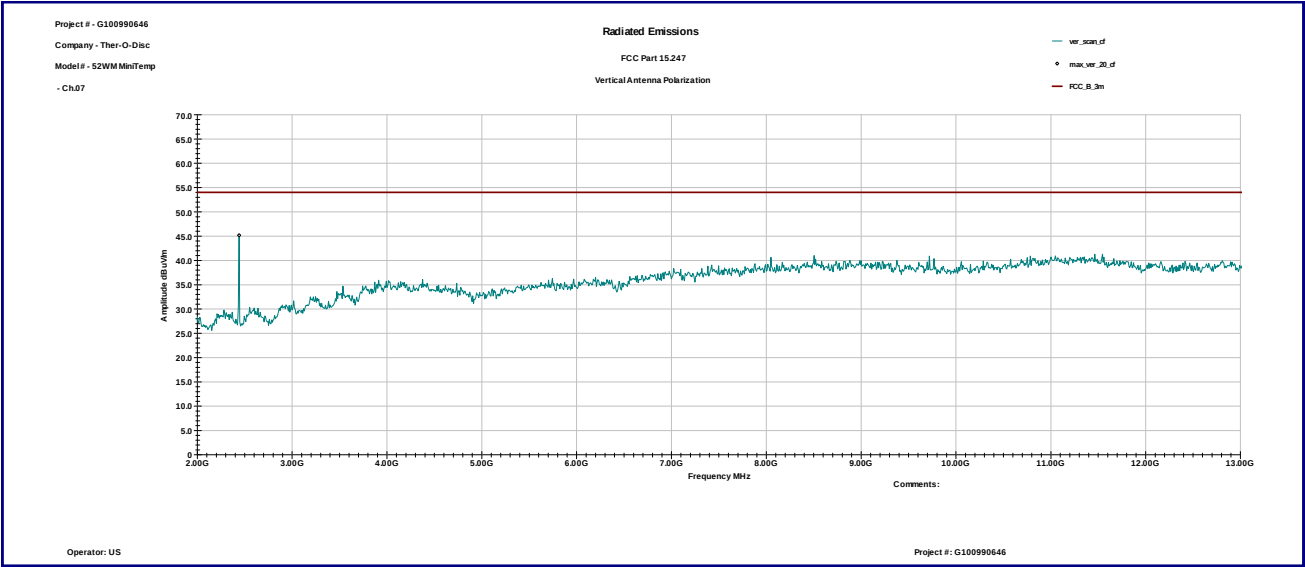
Graph 3.5.10



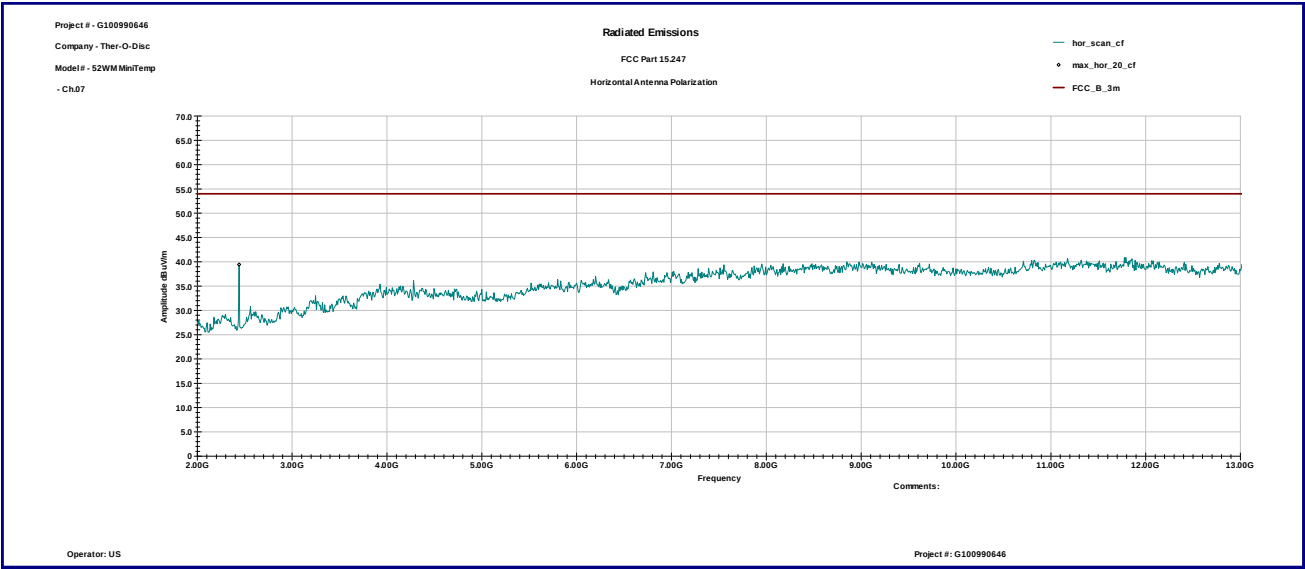
Graph 3.5.11



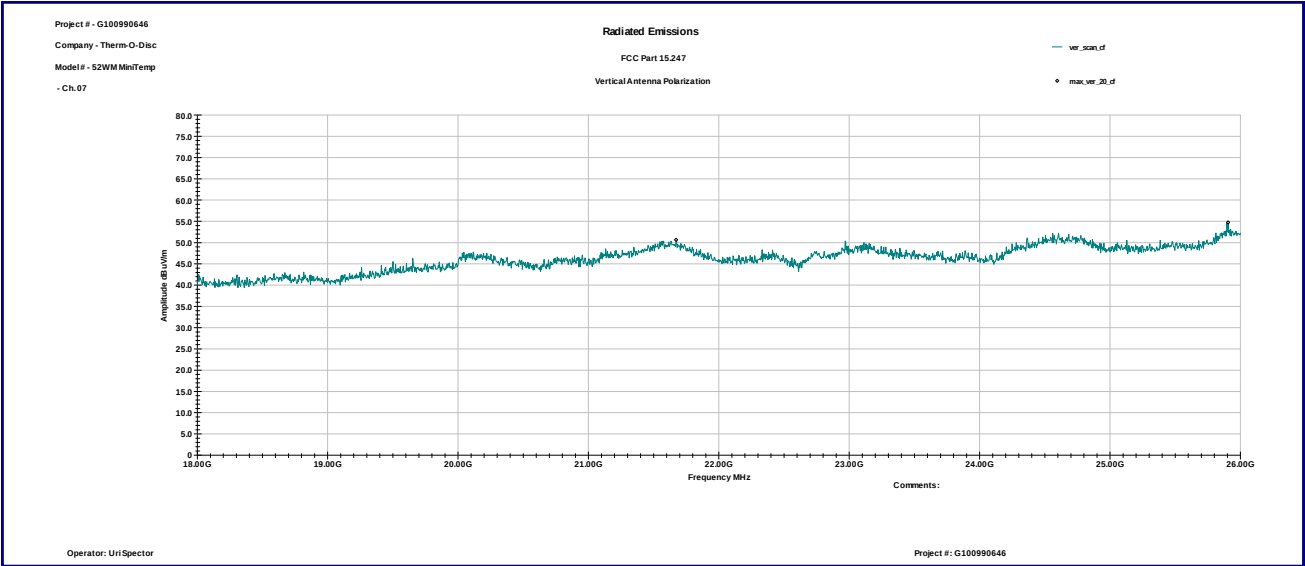
Graph 3.5.12



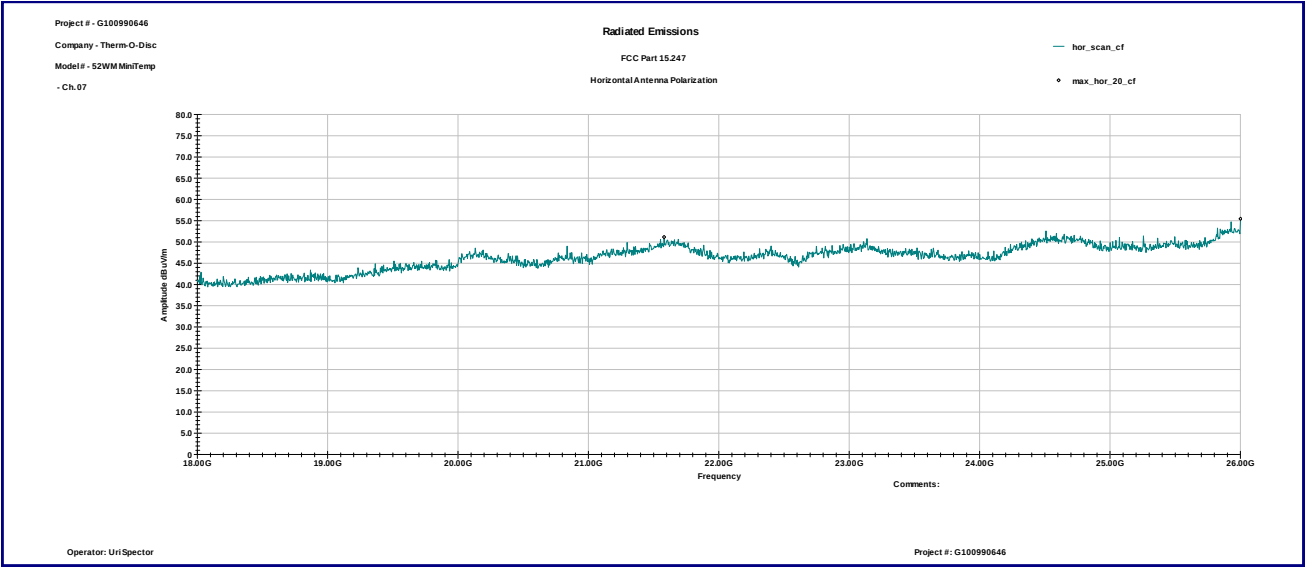
Graph 3.5.13



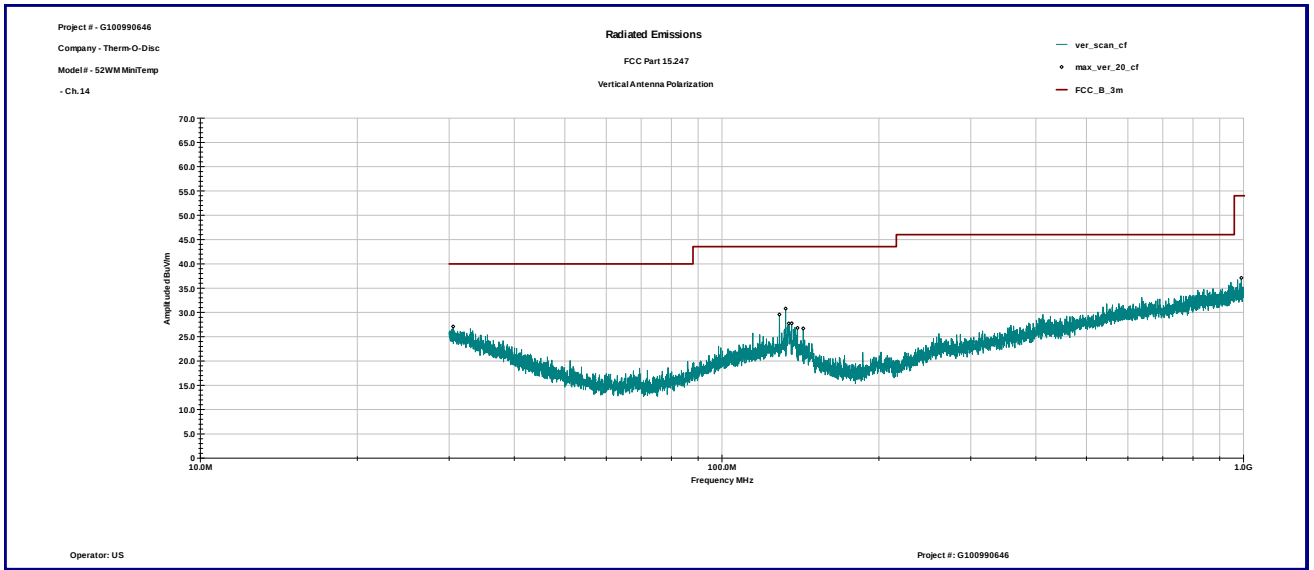
Graph 3.5.14



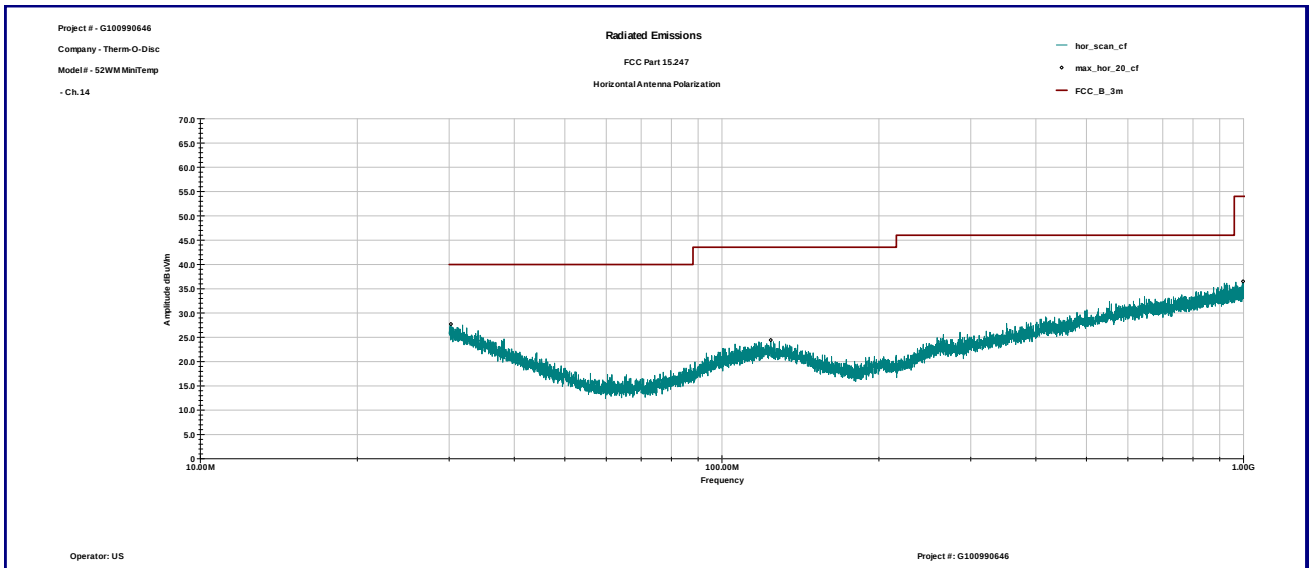
Graph 3.5.15



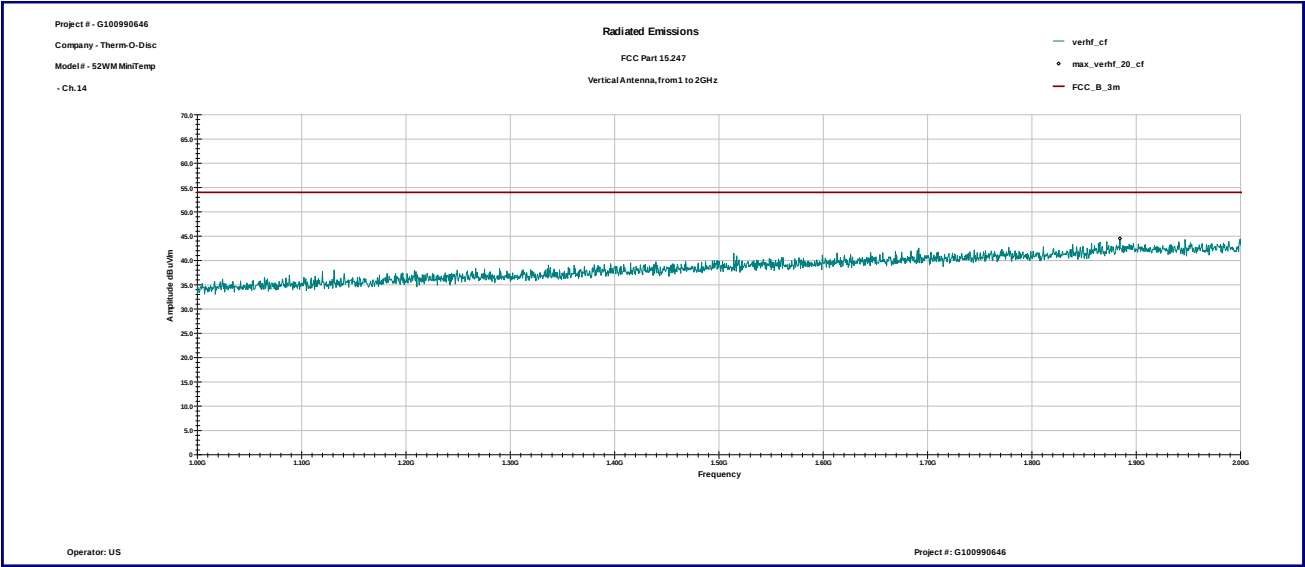
Graph 3.5.16



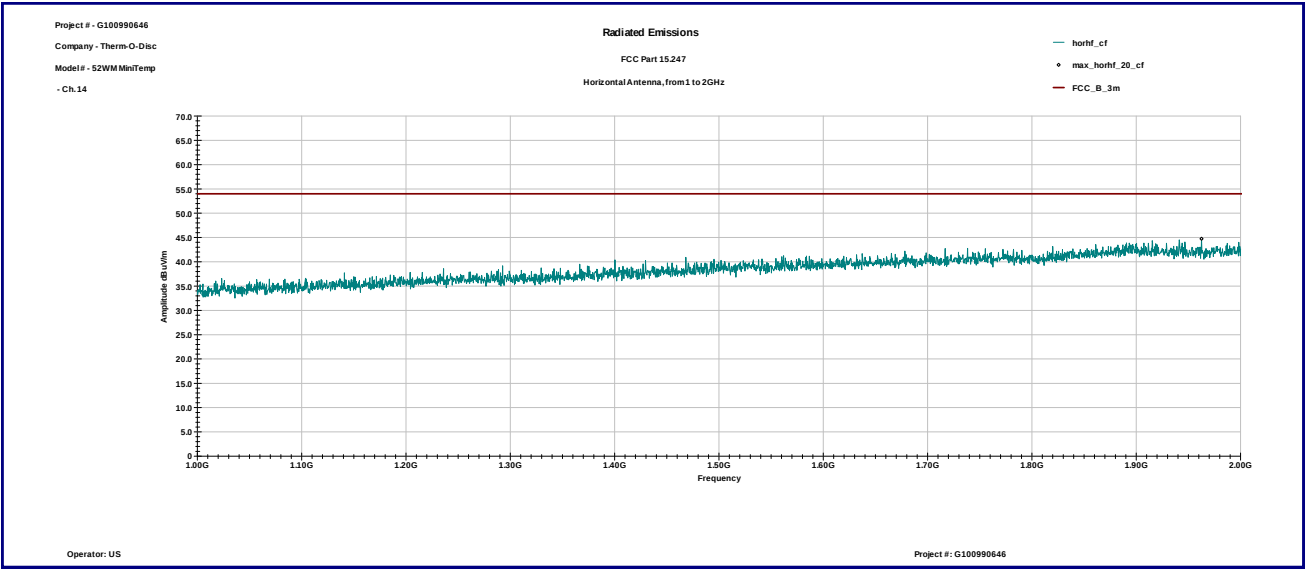
Graph 3.5.17



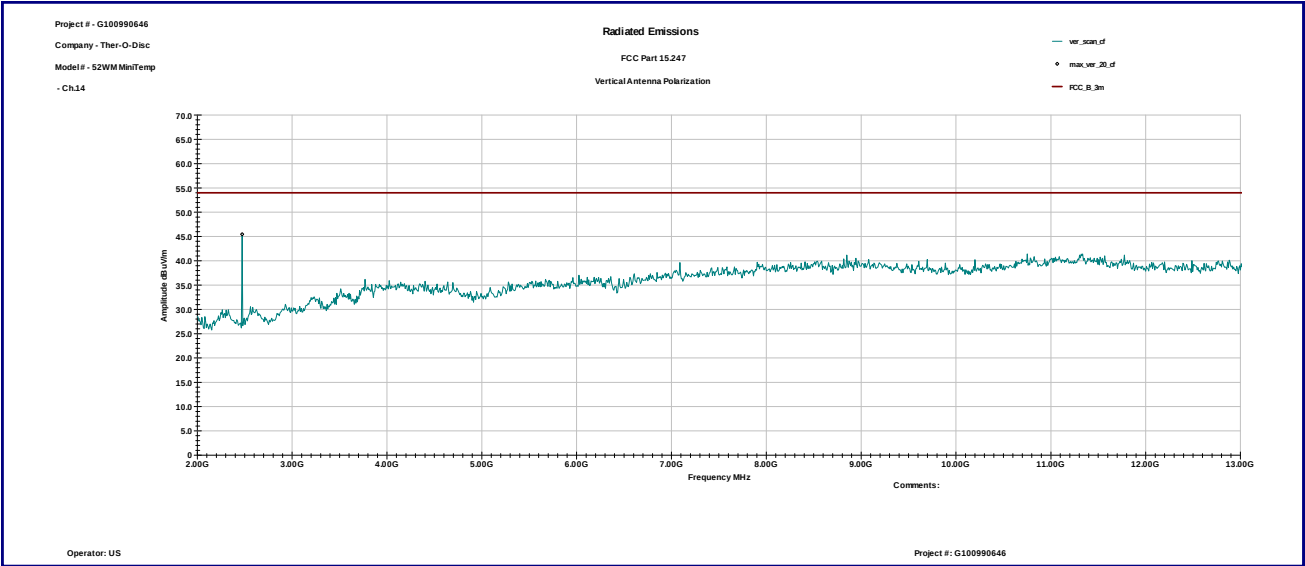
Graph 3.5.18



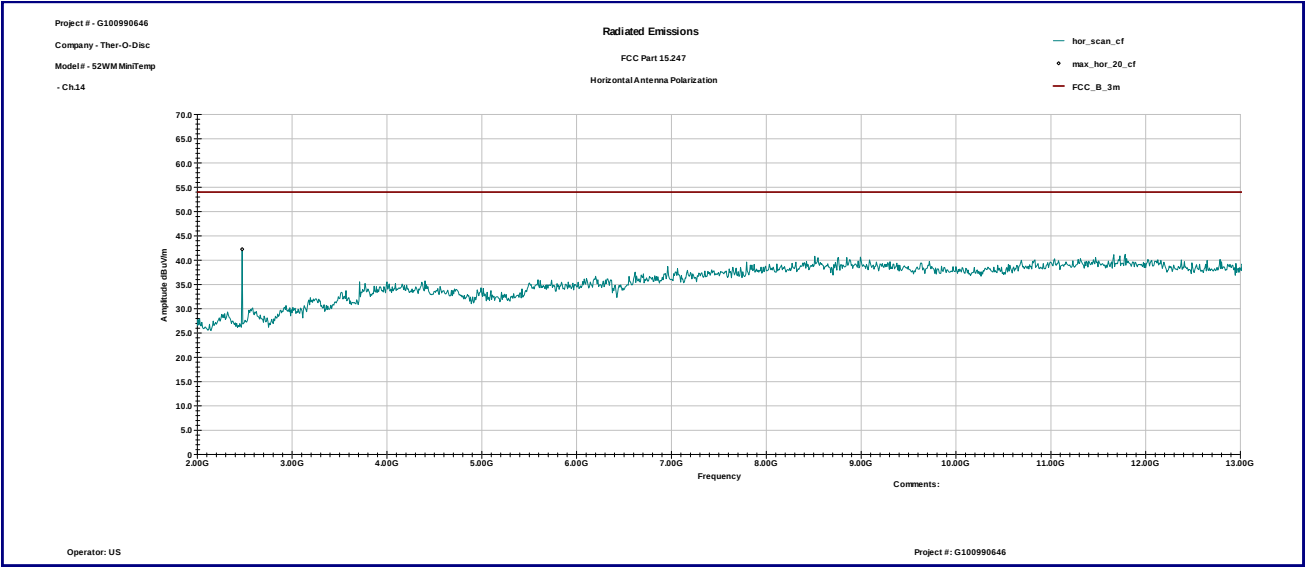
Graph 3.5.19



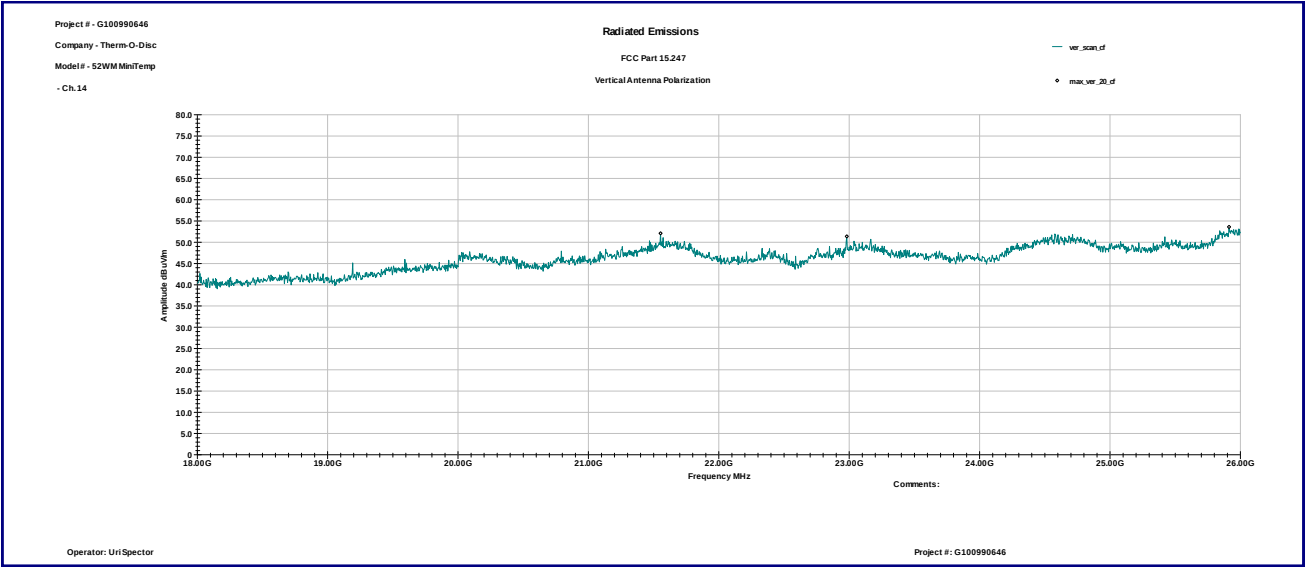
Graph 3.5.20



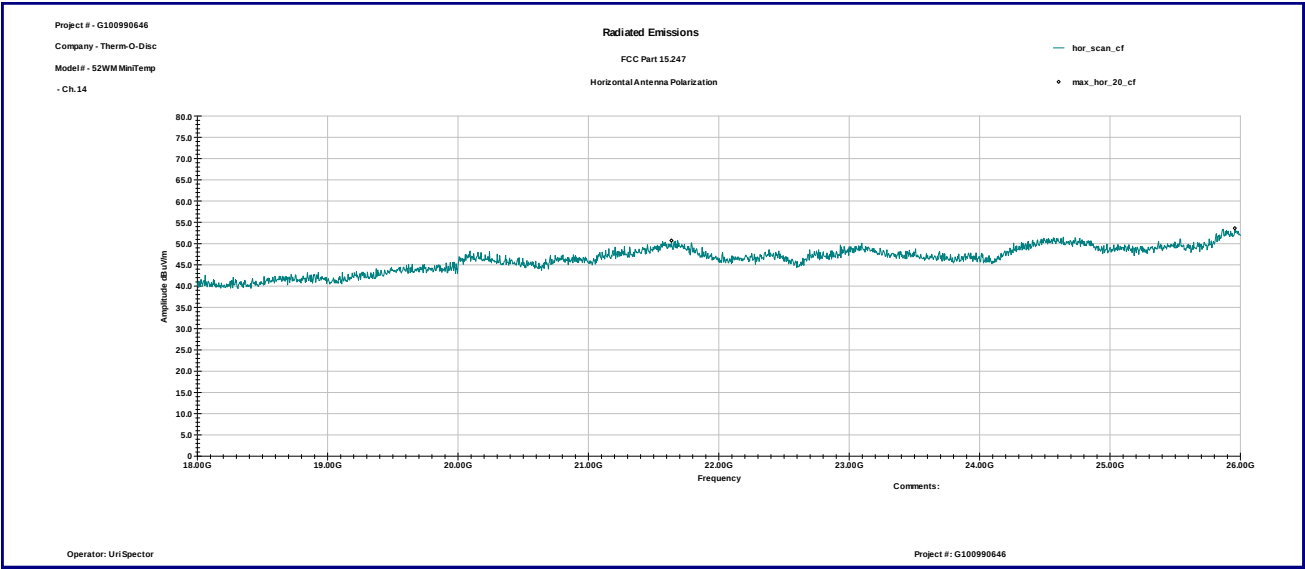
Graph 3.5.21



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 7.44dBm

The antenna gain, G is 1.7dBi

The maximum EIRP power = P + G

ERP = 7.44+1.7= 9.14dBm, or 0.0082W=8.2mW

The limits for Maximum Permissible Exposure (MPE) for transmitter operating at 2.4Hz, MPE is 1mW/cm², or 10W/m²

$$S = 10W/m^2$$

The Power Density is related to EIRP with the equation:

$$S = EIRP / 4\pi D^2, \text{ or } 10 = 0.0082 / 4\pi D^2, \text{ where } D \text{ is a separation distance}$$

The minimum safe separation distance, D = 0.8cm, 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: The EUT is DC powered from internal batteries.



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

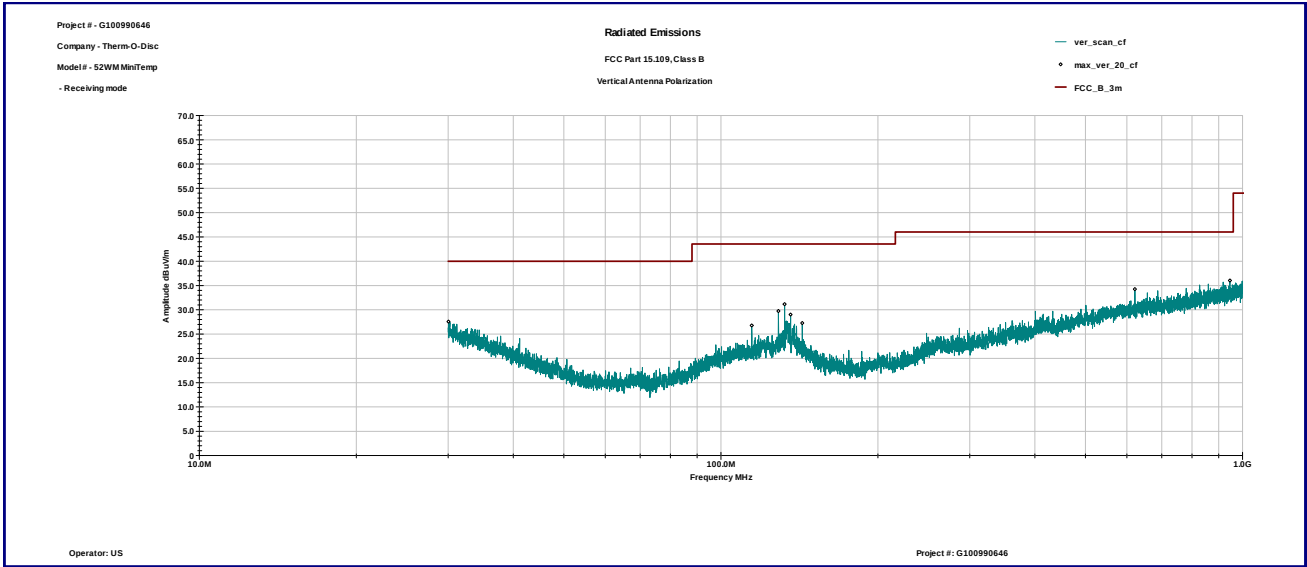
Max. Emissions margin: 11.8dB below the limits

Notes: None

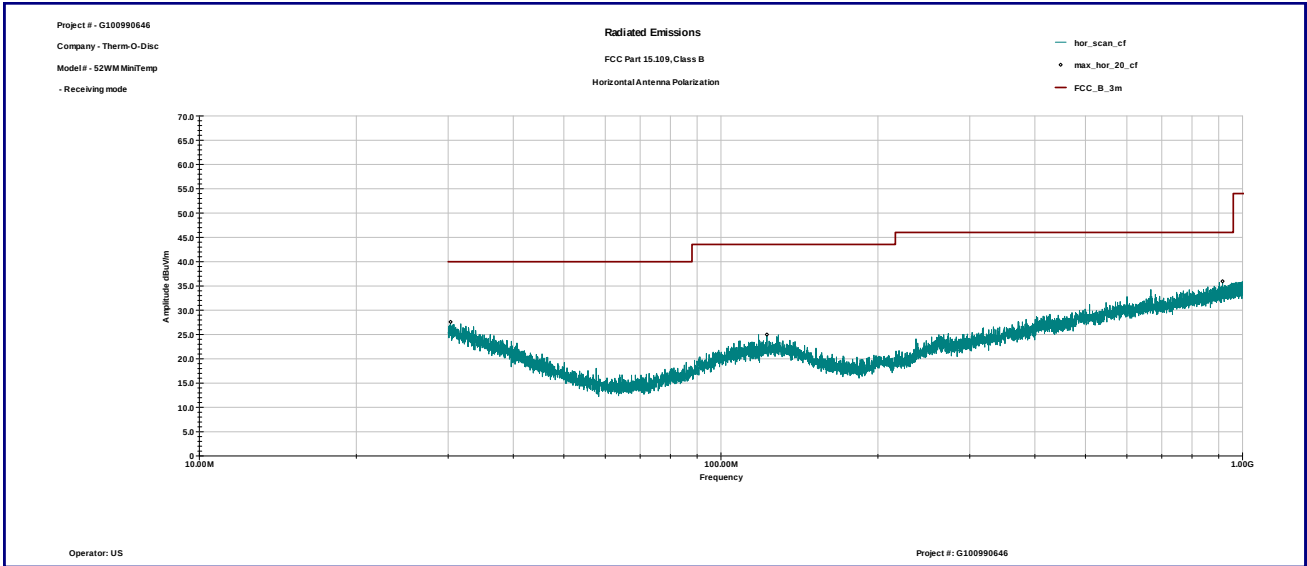
Date:	February 1, 2013	Result: Pass
Standard:	FCC Part 15.109, Class B	
Tested by:	Uri Spector	
Test Point:	Enclosure	
Operation mode:	See page 5	
Note:	Frequency range 30MHz-13GHz No Radiated Emissions were detected above 1GHz.	

Table 3.8.1

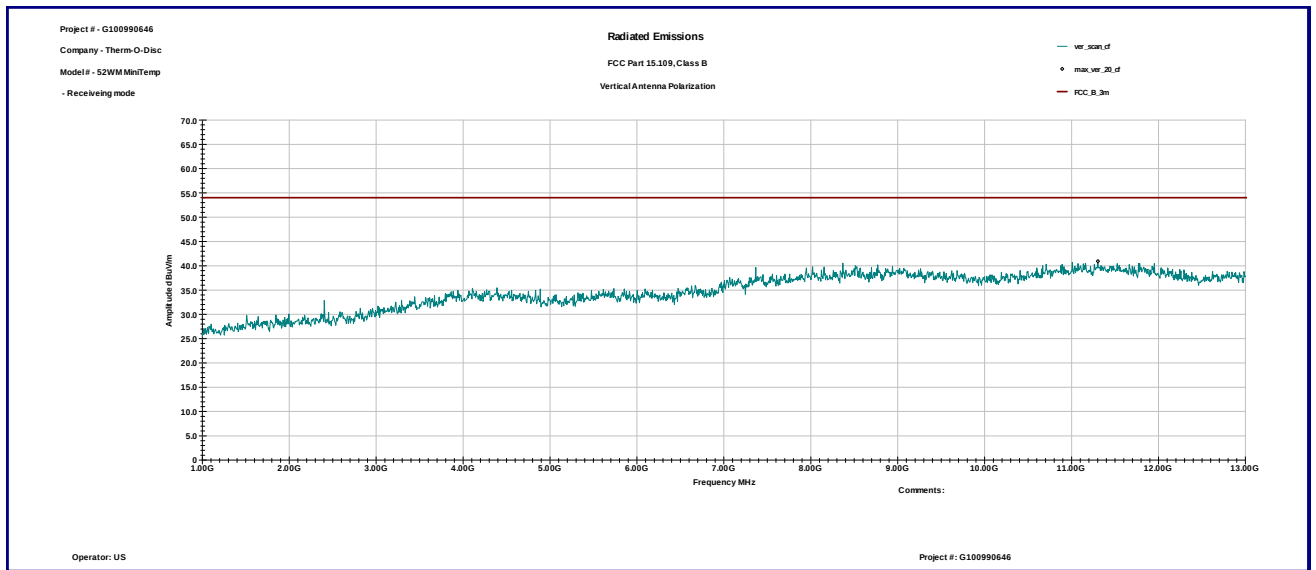
Frequency	Ant. Polarity	Peak Reading dB μ V	Total C.F. dB1/m	Total at 3m dB μ V/m	Limit dB μ V/m	Margin dB
30.053 MHz	V	7.4	20.2	27.6	40.0	-12.4
114.58 MHz	V	13.0	13.7	26.8	43.5	-16.8
128.86 MHz	V	15.8	14.0	29.7	43.5	-13.8
132.43 MHz	V	17.4	13.8	31.1	43.5	-12.4
135.99 MHz	V	15.5	13.5	29.0	43.5	-14.5
143.25 MHz	V	14.2	13.0	27.3	43.5	-16.3
622.03 MHz	V	12.0	22.3	34.2	46.0	-11.8
30.316 MHz	H	7.6	20.0	27.6	40.0	-12.4
122.51 MHz	H	11.1	14.0	25.0	43.5	-18.5



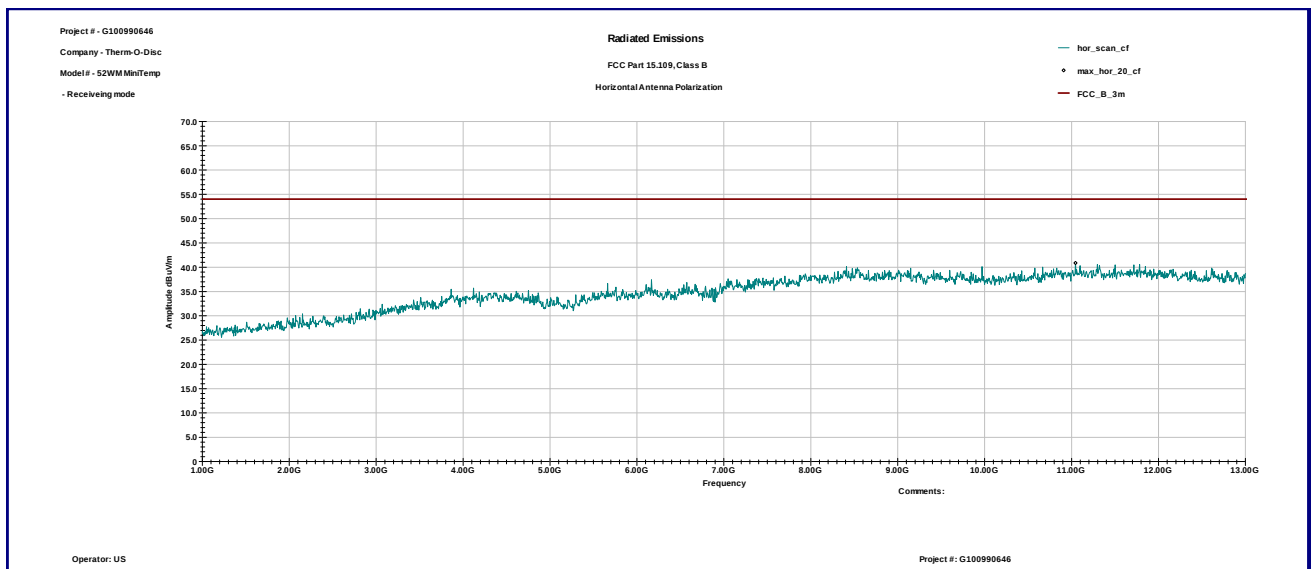
Graph 3.8.1



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 DC powered from internal batteries.



4.0 TEST EQUIPMENT

DESCRIPTION	MANUFACTURER	MODEL	SERIAL NO.	INTERTEK ID	CAL DUE	USED
Spectrum Analyzer	R & S	FSP 40	100024	12559	11/29/2013	☒
Spectrum Analyzer	R & S	ESU	100398	25283	12/19/2013	☒
Bicono-Log Antenna	Teseq	CBL6112D	32859	25289	08/09/2013	☒
Waveguide Horn Antenna	EMCO	3116	9904-2423	9705	11/07/2013	☒
Horn Antenna	EMCO	3115	9507-4513	9936	05/16/2013	☒
Pre-Amplifier	MITEQ	AMF-5D-00501800-28-13P	1122951	13475	11/01/2013	☒
Pre-Amplifier	MITEQ	AMF-6F-16002600-25-10P	1222383	MIN-0065	11/01/2013	☒
High Pass Filter	Reactel	7HS-4G-S12	0223	015274	VBV	☒
System	Quantum Change	TILE! Instrument Control	Ver. 3.4.K.29	15259	VBV	☒