



TEST REPORT

Report Number: 100934544MIN-001B

Project Number: G100934544

Testing performed on the

SALLISNODE

FCC ID: UKCNRF

Industry Canada ID: 10088A-NRF

to

47 CFR Part 15. 247:2010

RSS- 210, Issue 8, 2010

For

Salto Systems SL

Test Performed by:
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Date: March 15, 2013

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1.0 GENERAL DESCRIPTION

Model:	SALLISNODE
Type of EUT:	RF Node
Intertek Sample ID:	MIN1212210942-001
FCC ID:	UKCNRF
Industry Canada ID:	10088A-NRF
Related Submittal(s) Grants:	None
Company:	Salto Systems SL
Customer:	Mr. Julen Gutierrez
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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 7, 2013
Test Work Started:	January 7, 2013
Test Work Completed:	January 11, 2013
Test Sample Conditions:	☐ Damaged ☐ Poor (Usable) ☒ Good



1.1 Product Description; Test Facility

Product Description:	2.4GHz Sallis RF Node
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 with DSSS
Emission Designator:	1M85GXD
Antenna(s) Info:	Antenna Type: PCB Trace Gain: 3.3dBi
Antenna Installation:	☐ User ☐ Professional ☒ Factory
Transmitter power configuration:	☐ Internal battery ☒ External power source ☒ 100-240VAC from AC/DC Power Adapter ADPV500 ☐ 230VAC ☐ 400VAC ☐ 12VDC from ☐ Other: 0.3Amp. ☒ 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	RF Node was connected to Router via "Node Connector Cable". RF Node Transmitter was activated from the Router. Test was performed at low channel, middle channel, and upper channel

Cables:

No.	Type	Length	Designation	Note
1	Ethernet CAT45	6ft.	not shielded, communication cable	
2	AUX Power wires	6ft.	2-wires not shielded	
3	Node Connection Wires	6ft.	4-wires not shielded	

Support equipment/Services:

No.	Item	Description
1	Sallis Router	Router

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).

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

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

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

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

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

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

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

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	Pass
15.109 / ICES-003	Receiver/digital device radiated emissions	Pass
15.107 / ICES-003	Digital device conducted emissions	Pass

3.0 TEST CONDITIONS AND RESULTS

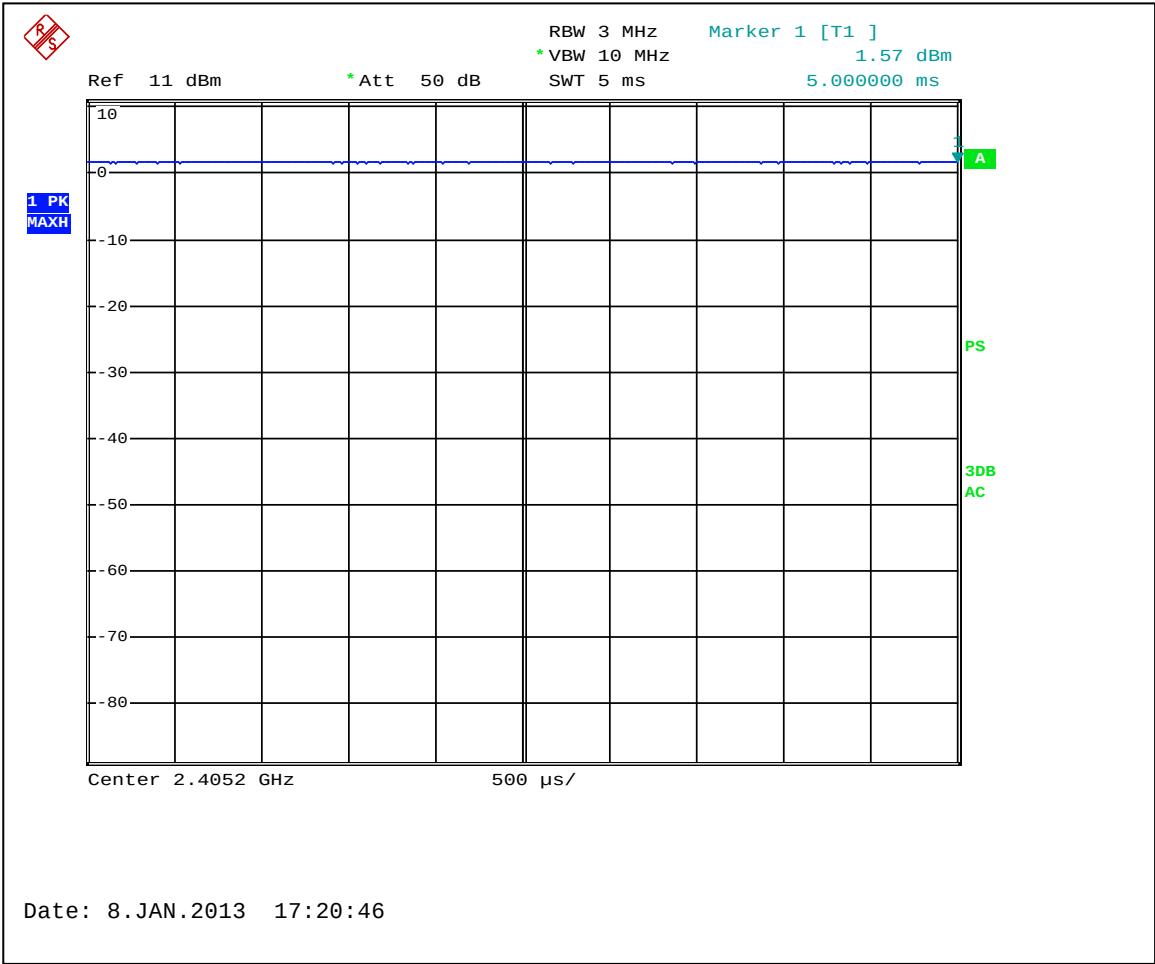
3.1 Maximum peak output power

Test result: Pass

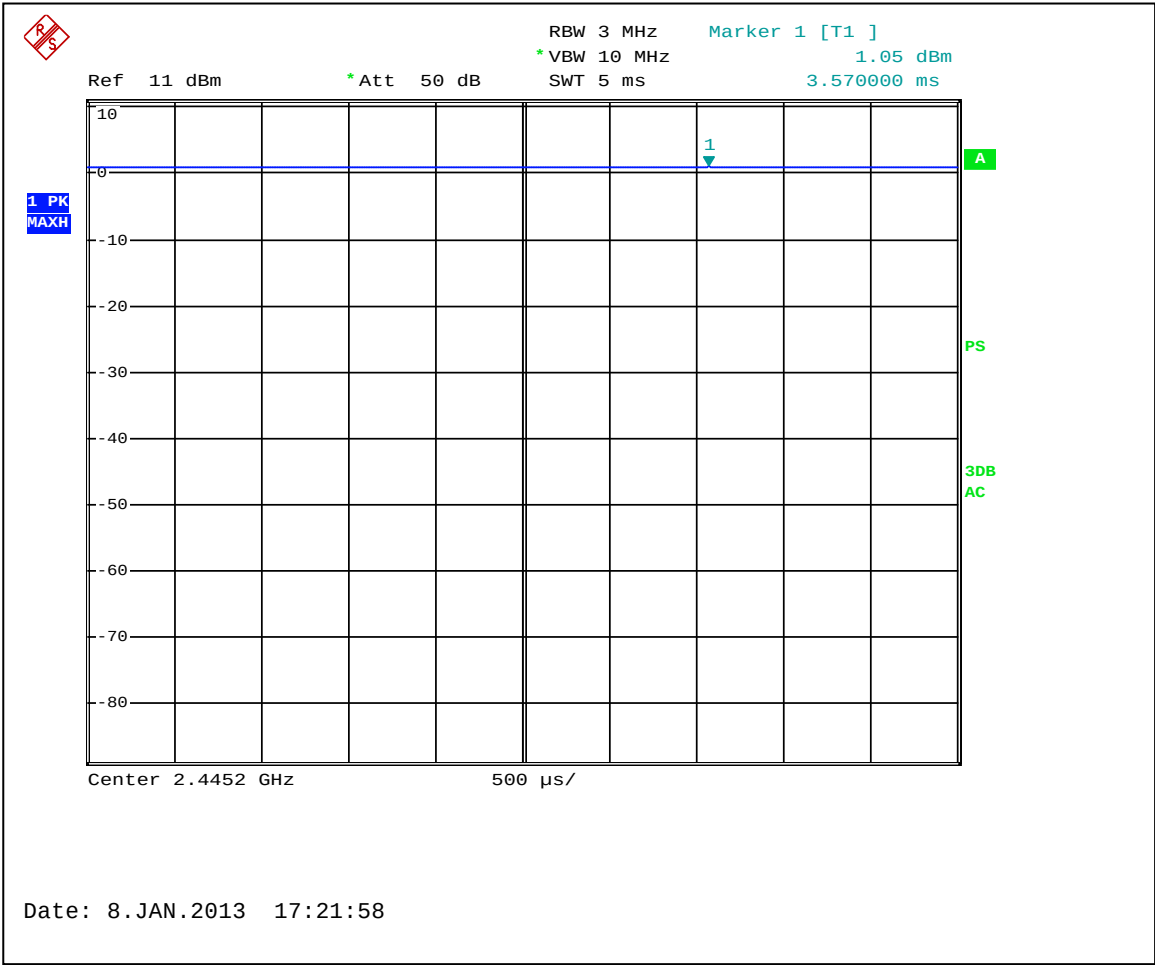
Max. Margin: 27.1dB below the limits

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	1.6	1.3	2.9	30	0	-27.1
Middle Frequency MHz						
2445.20	1.1	1.3	2.4	30	0	-27.6
Upper Frequency MHz						
2480.00	0.4	1.3	1.7	30	0	-28.3
RBW:	☐ 1MHz ☒ 3MHz ☐ 10MHz					
VBW:	☐ 1MHz ☒ 10MHz ☐ 10MHz					
Antenna Gain:	☒ < 6dBi ☐ >6dBi and = dBi, Output power reduction = dB					

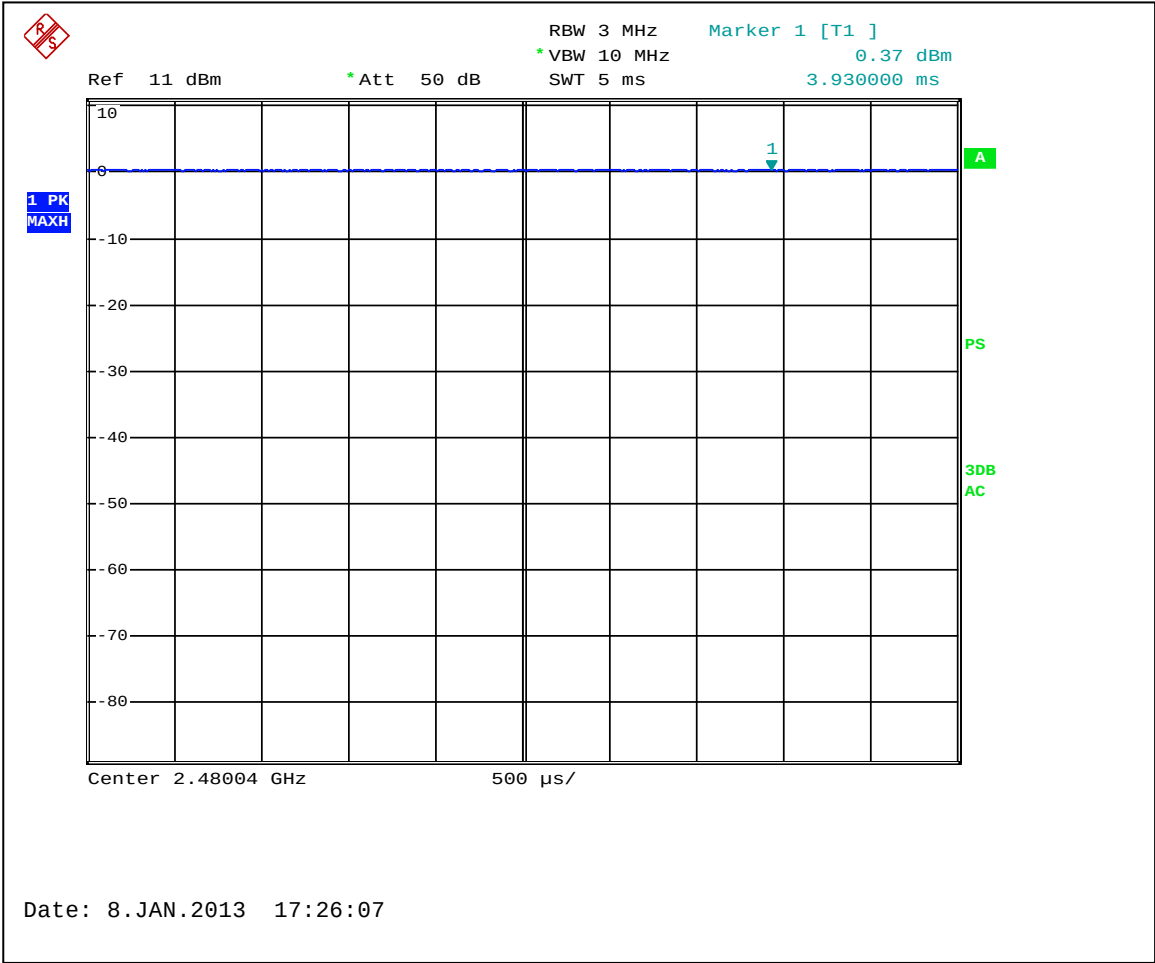
Notes: None



Graph 3.1.1



Graph 3.1.2

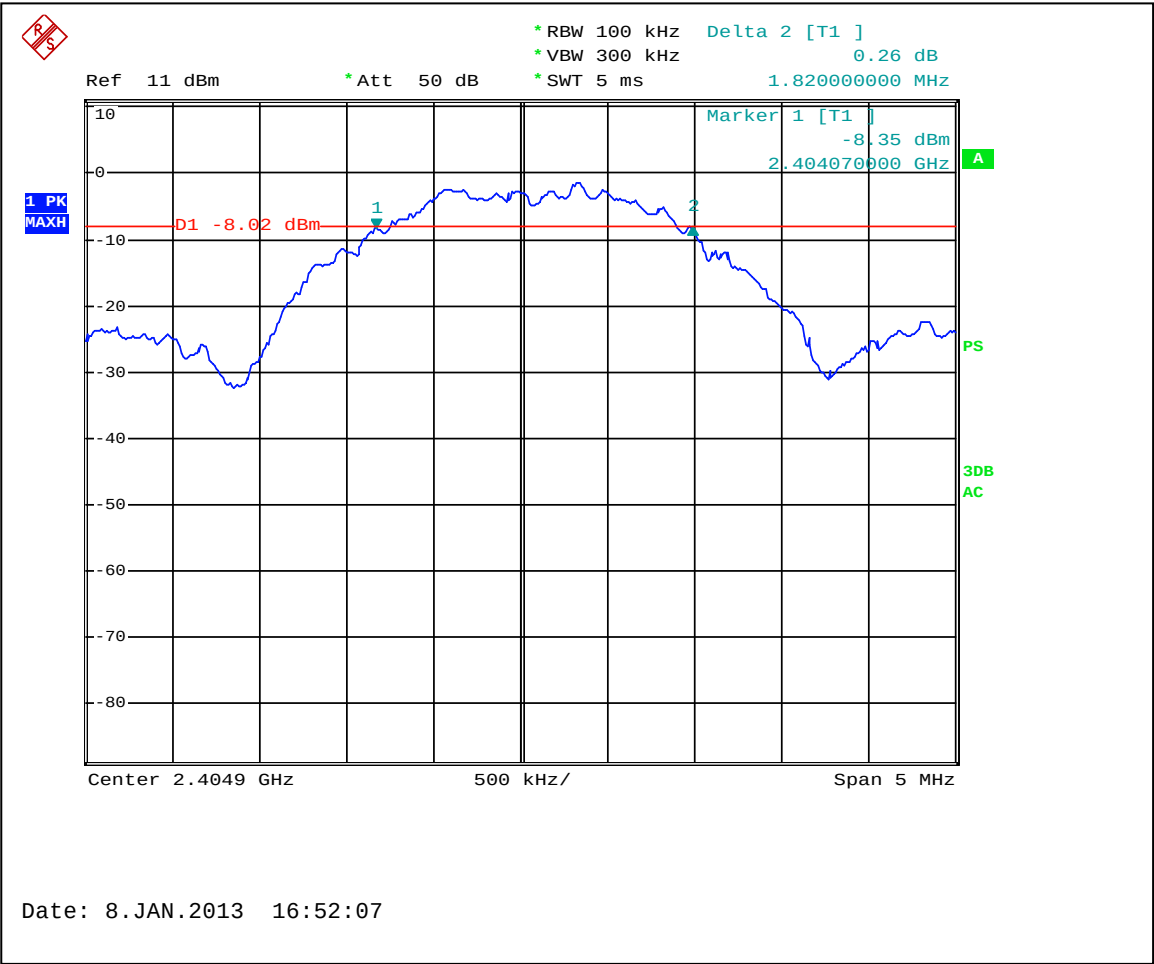


Graph 3.1.3

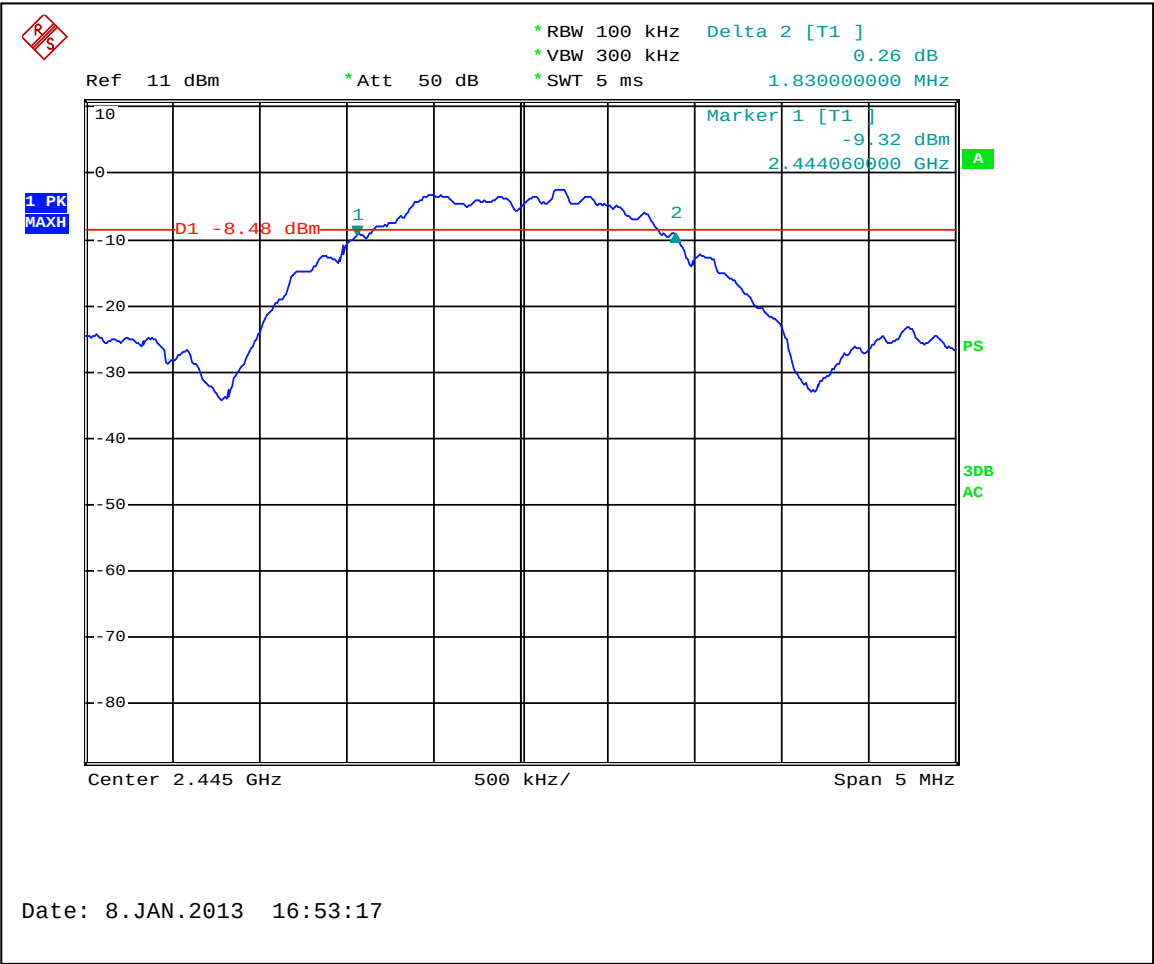
3.2 6dB bandwidth of the digital modulation

Low Frequency Channel kHz	Middle Frequency Channel kHz	Upper Frequency Channel kHz	Minimum Bandwidth kHz	Result
1820	1830	1830	500	Pass
RBW: ☒ 100kHz ☐ other kHz VBW: ☒ 300kHz ☐ 300kHz ☐ other kHz				

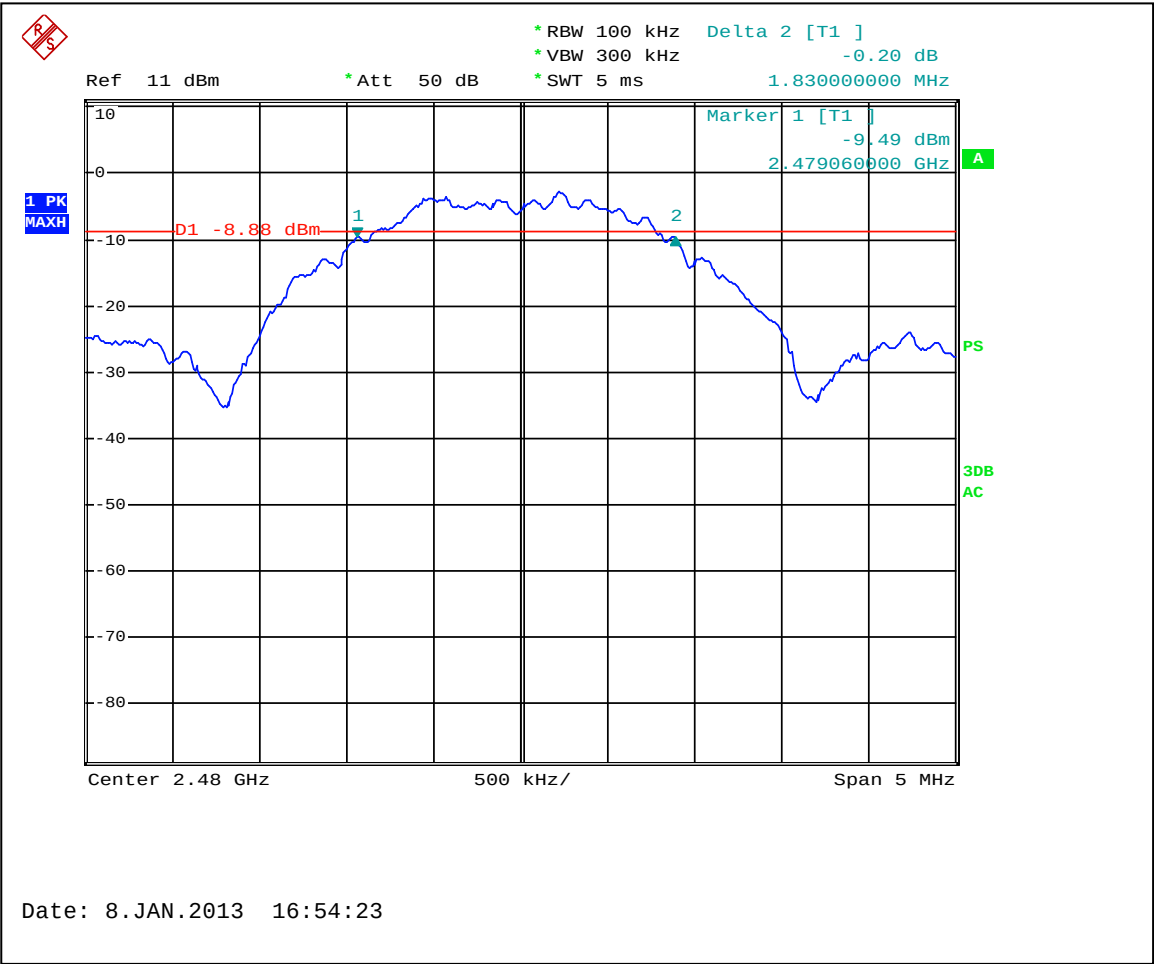
Notes: None



Graph 3.2.1



Graph 3.2.2

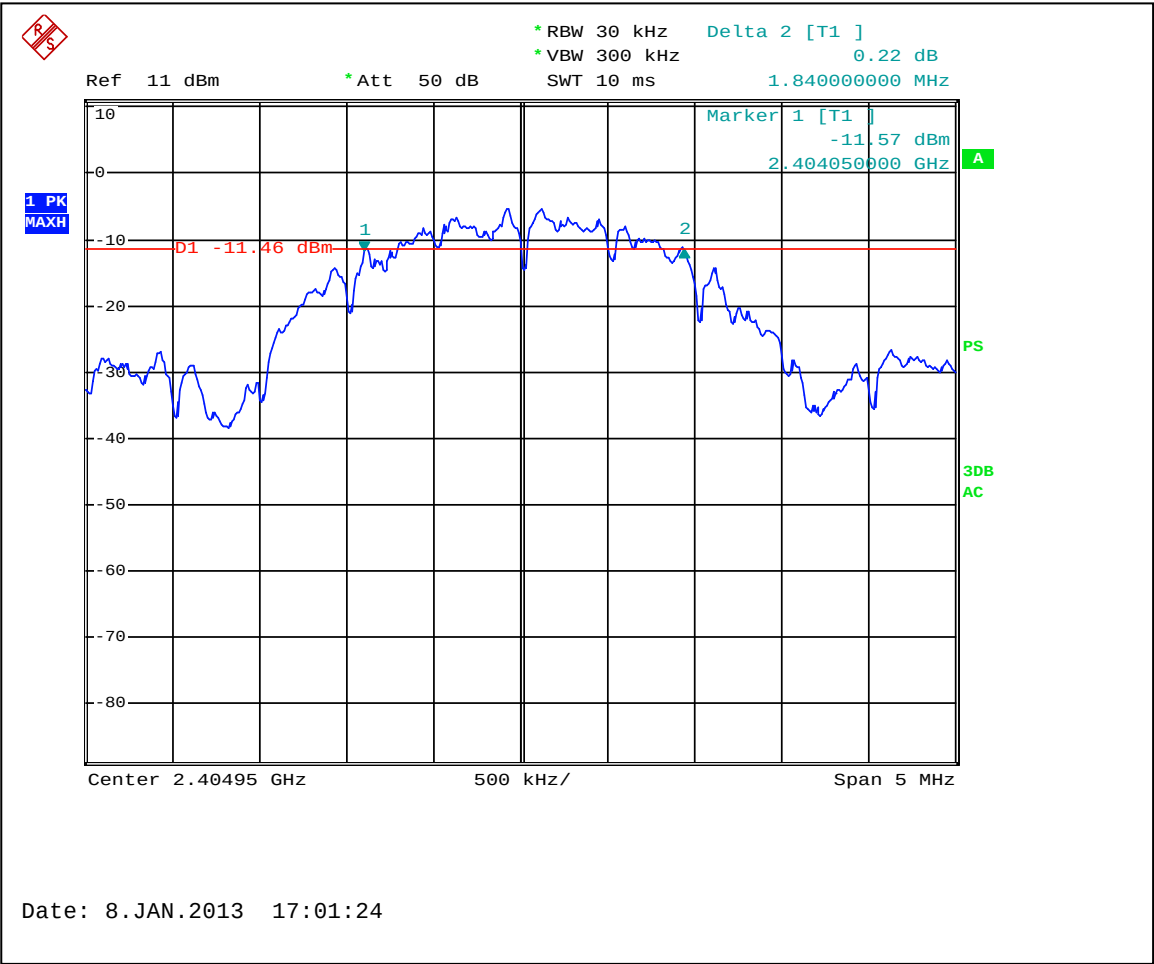


Graph 3.2.3

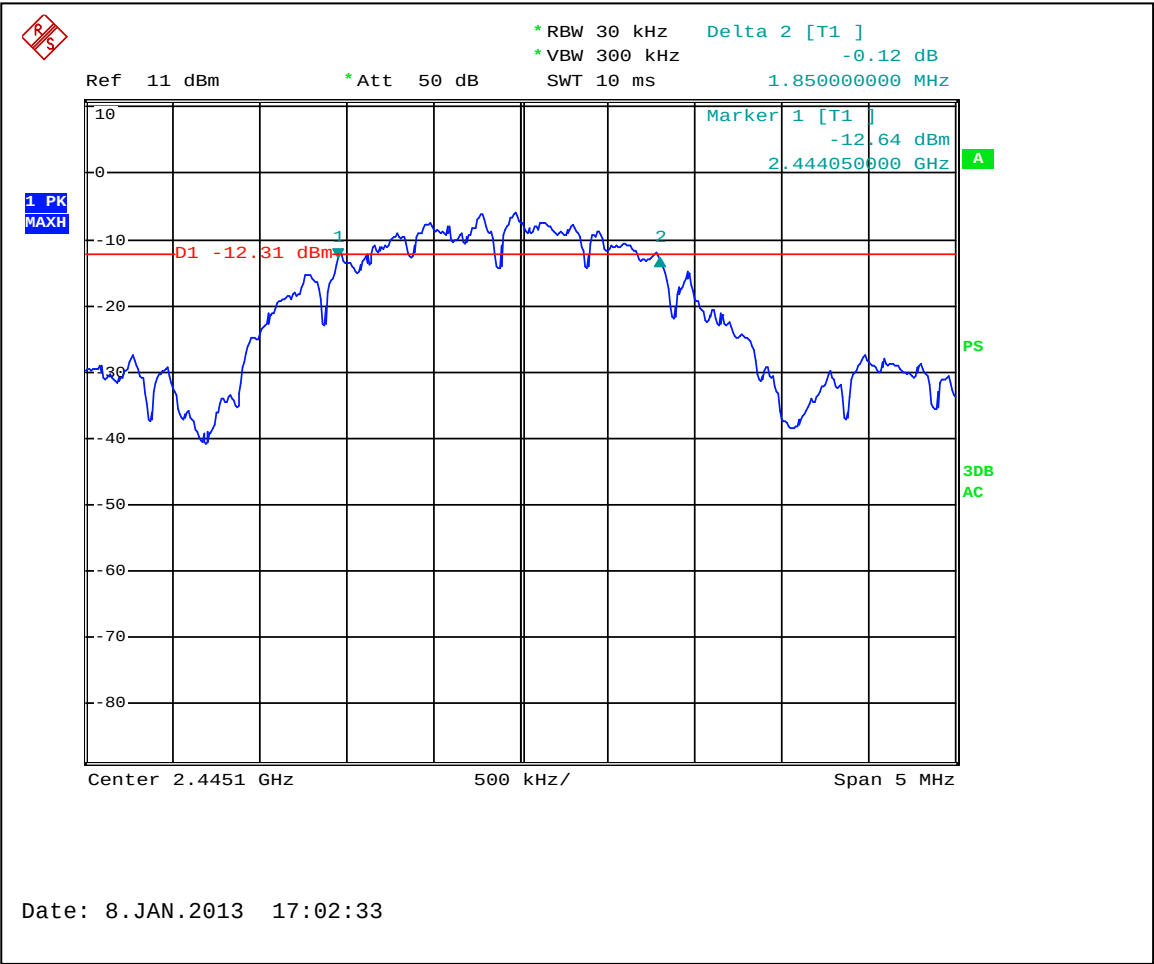
3.2.1 Emission bandwidth (EBW) of the digital modulation

Low Frequency Channel kHz	Middle Frequency Channel kHz	Upper Frequency Channel kHz	Minimum Bandwidth kHz	Result
1840	1840	1850	500	Pass
RBW: ☒ 50kHz ☐ other kHz VBW: ☒ 300kHz ☐ 300kHz ☐ other kHz				

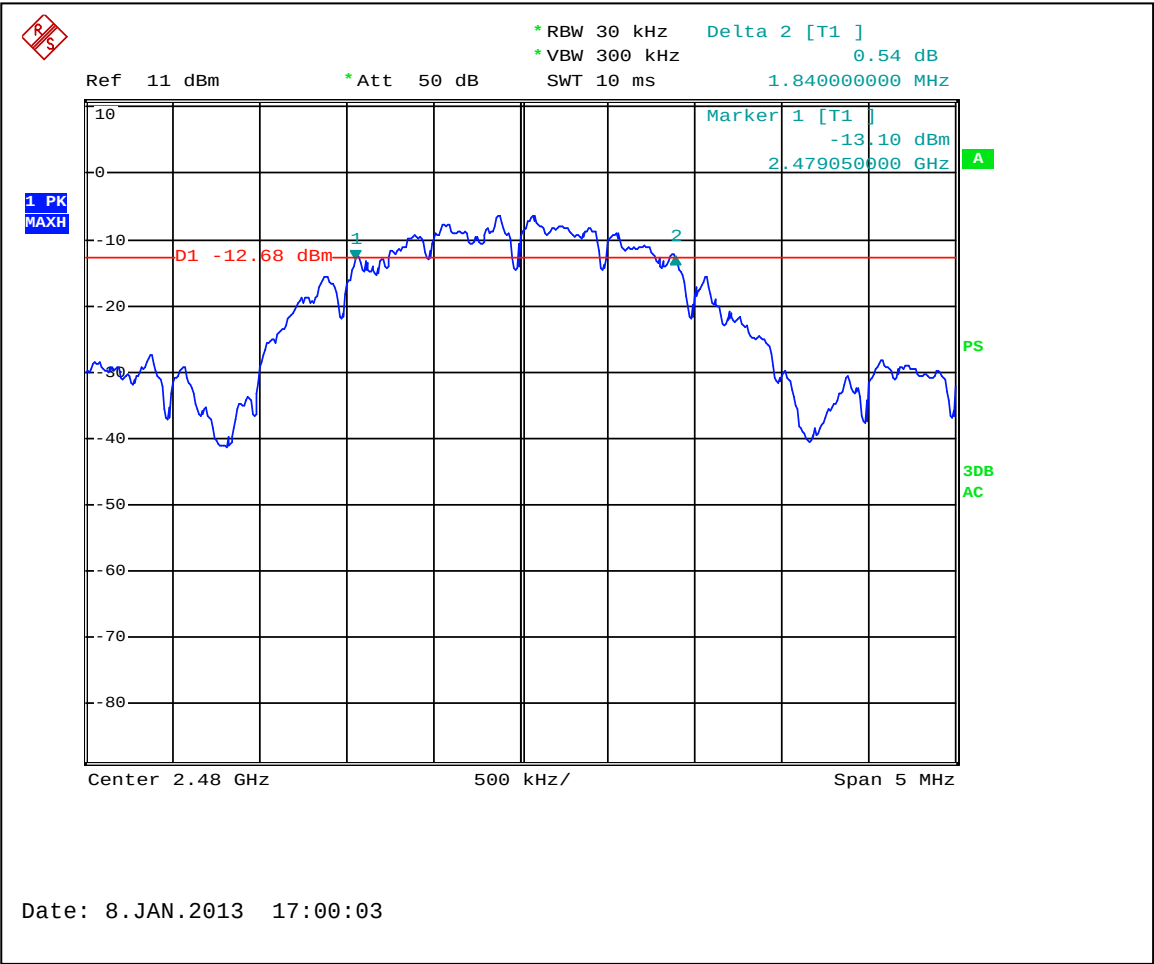
Notes: None



Graph 3.2.1.1



Graph 3.2.1.2

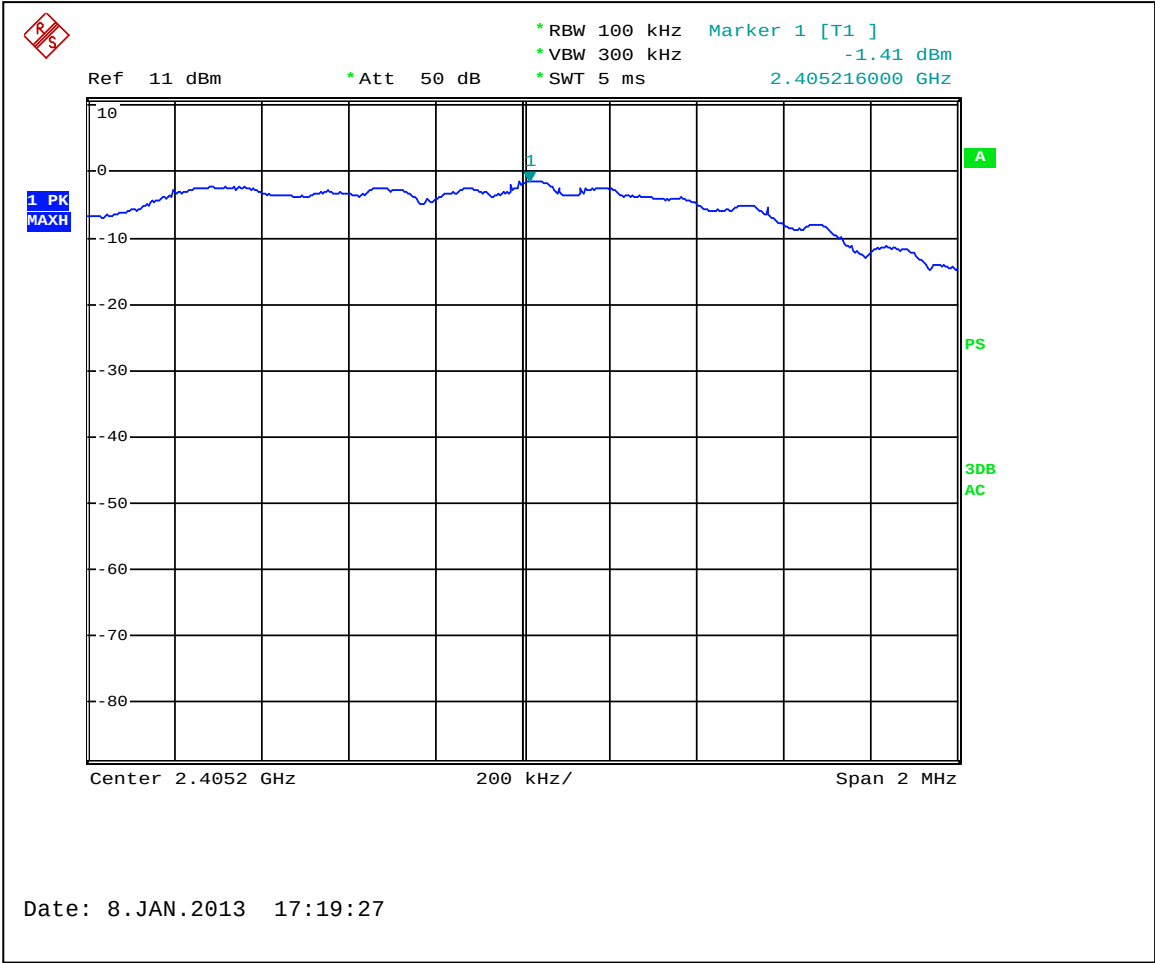


Graph 3.2.1.3

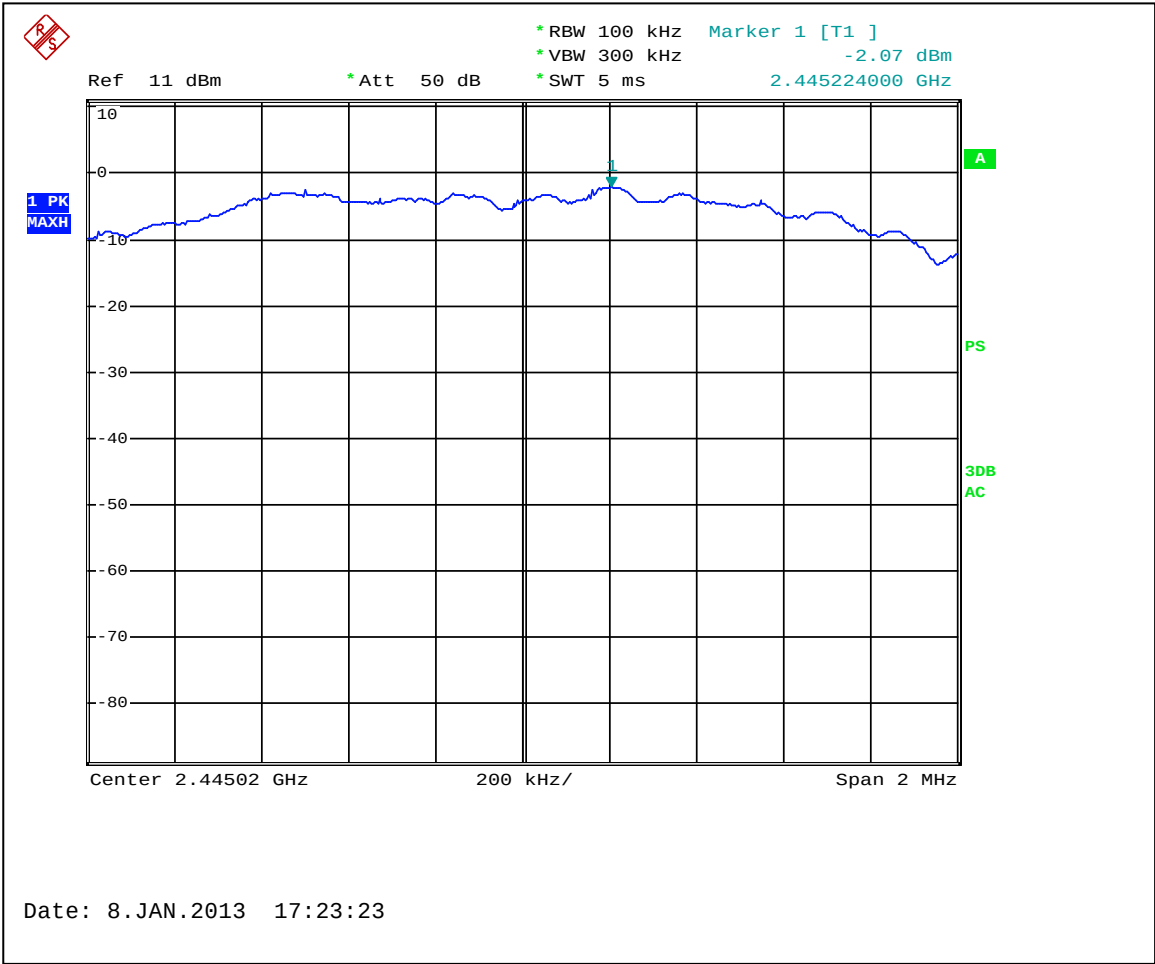
3.3 Power spectral density

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	-1.4	-0.1	-15.3	8	-23.3
Middle Frequency Channel	-2.1	-0.8	-16.0	8	-24.0
Upper Frequency Channel	-2.5	-1.2	-16.4	8	-24.4
Analyzer Settings:	☒ RBW=100KHz ☒ VBW=300KHz ☒ Span=2MHz ☒ Sweep=Auto				
Antenna Gain:	☒ < 6dBi and = dBi ☐ >6dBi and = dBi, limit reduction = dB				

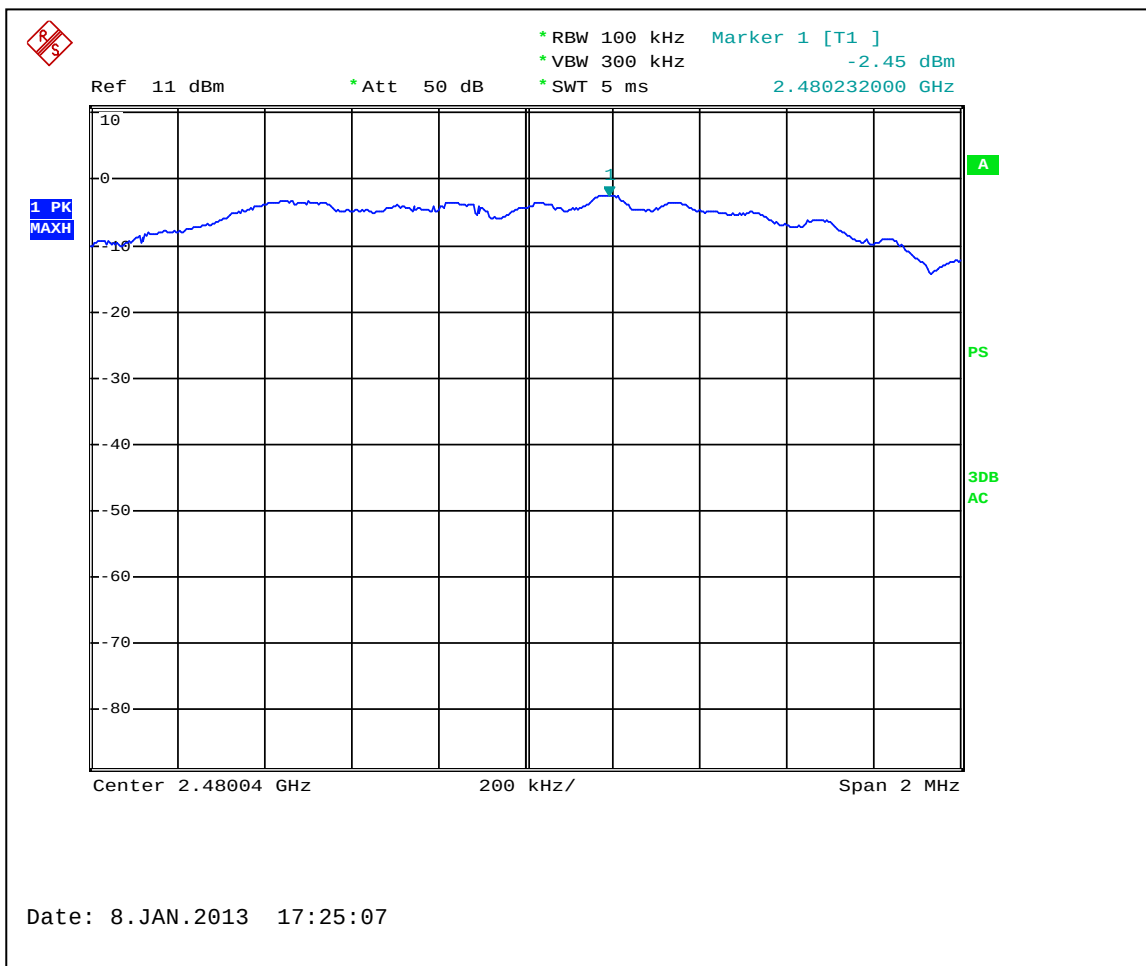
Notes: The Power Spectral Density was calculated adding the cable/attenuator loss of 1.3dB from the measured density value.
 The observed power level at RBW=100kHz was adjusted by reducing the measured power by a bandwidth correction factor (BWCF)=15.2dB



Graph 3.3.1



Graph 3.3.2

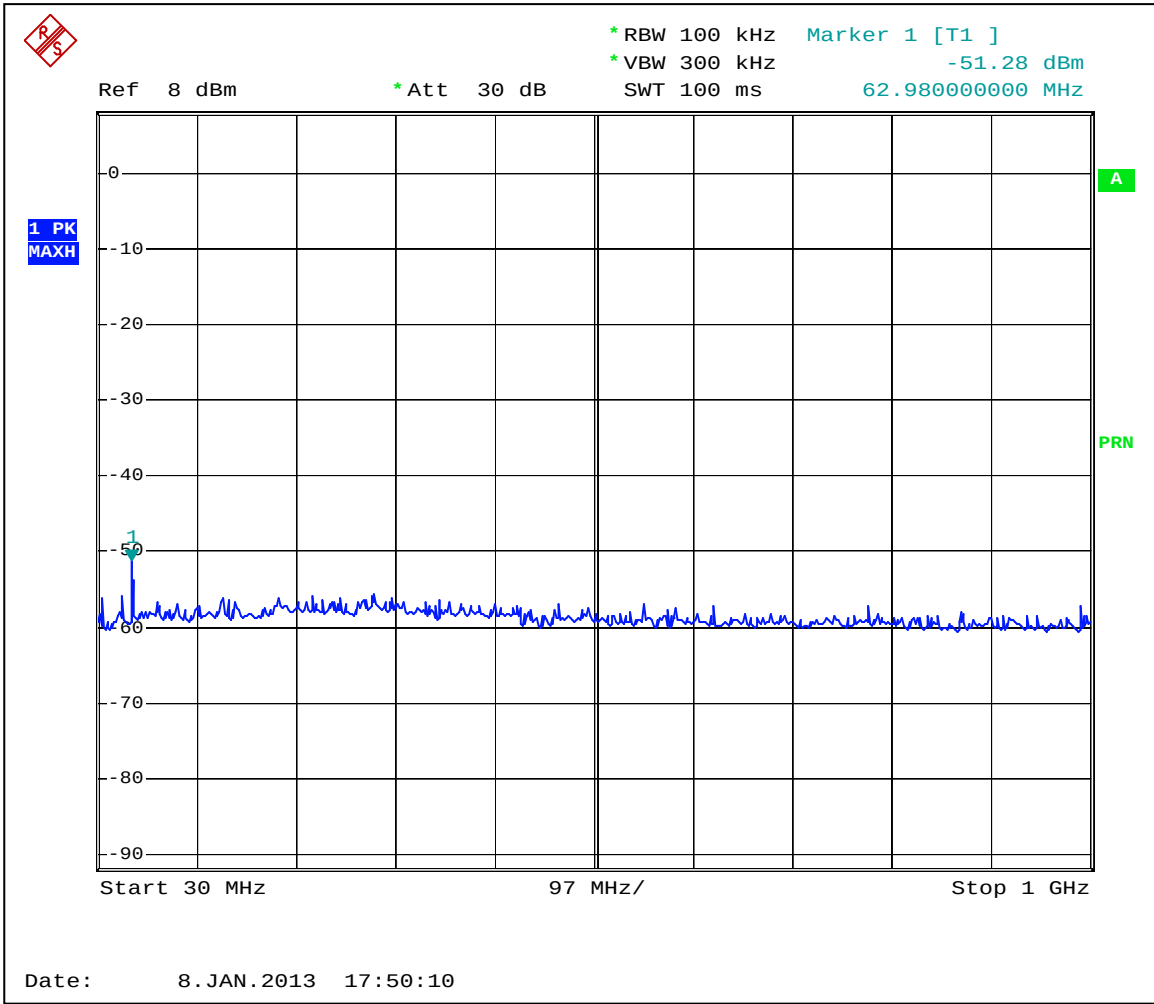


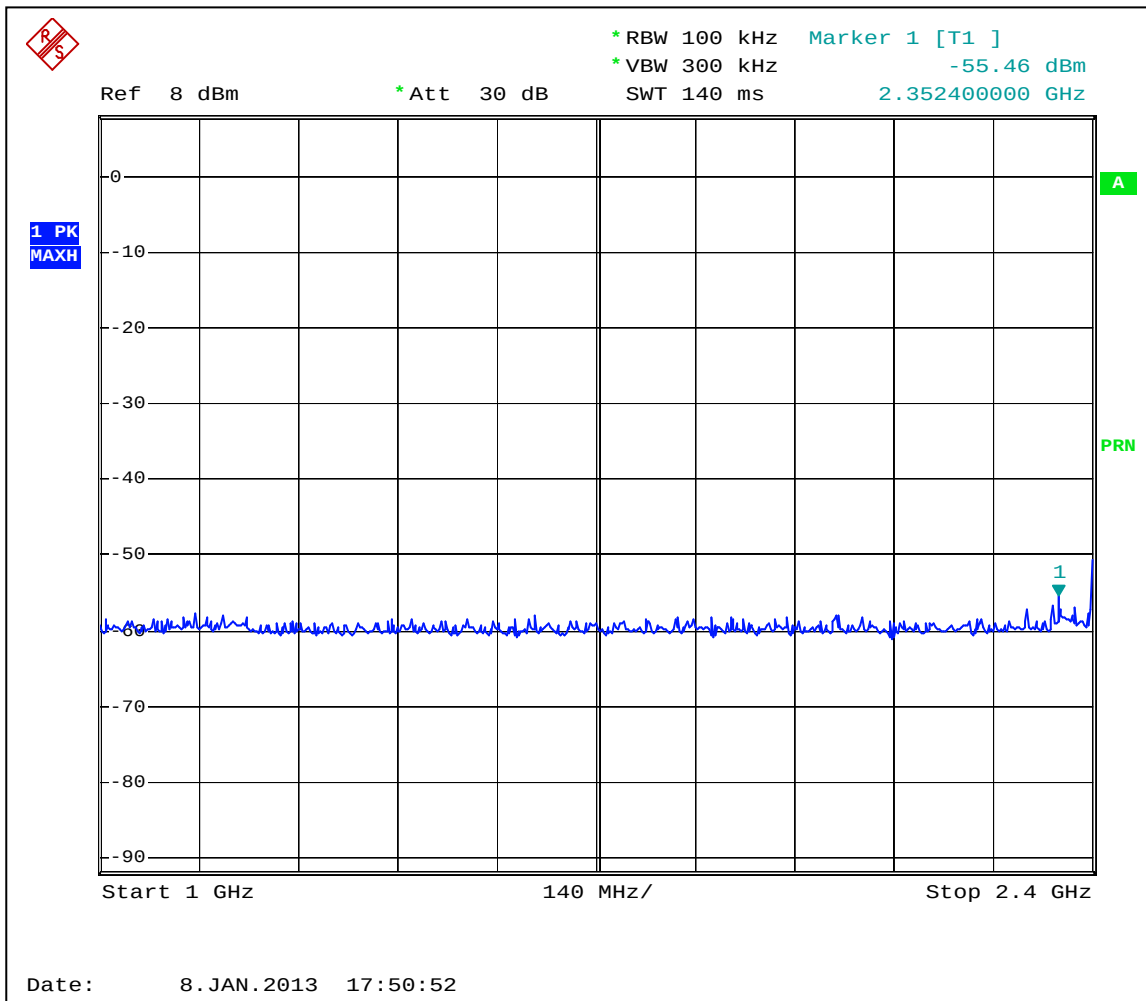
Graph 3.3.3

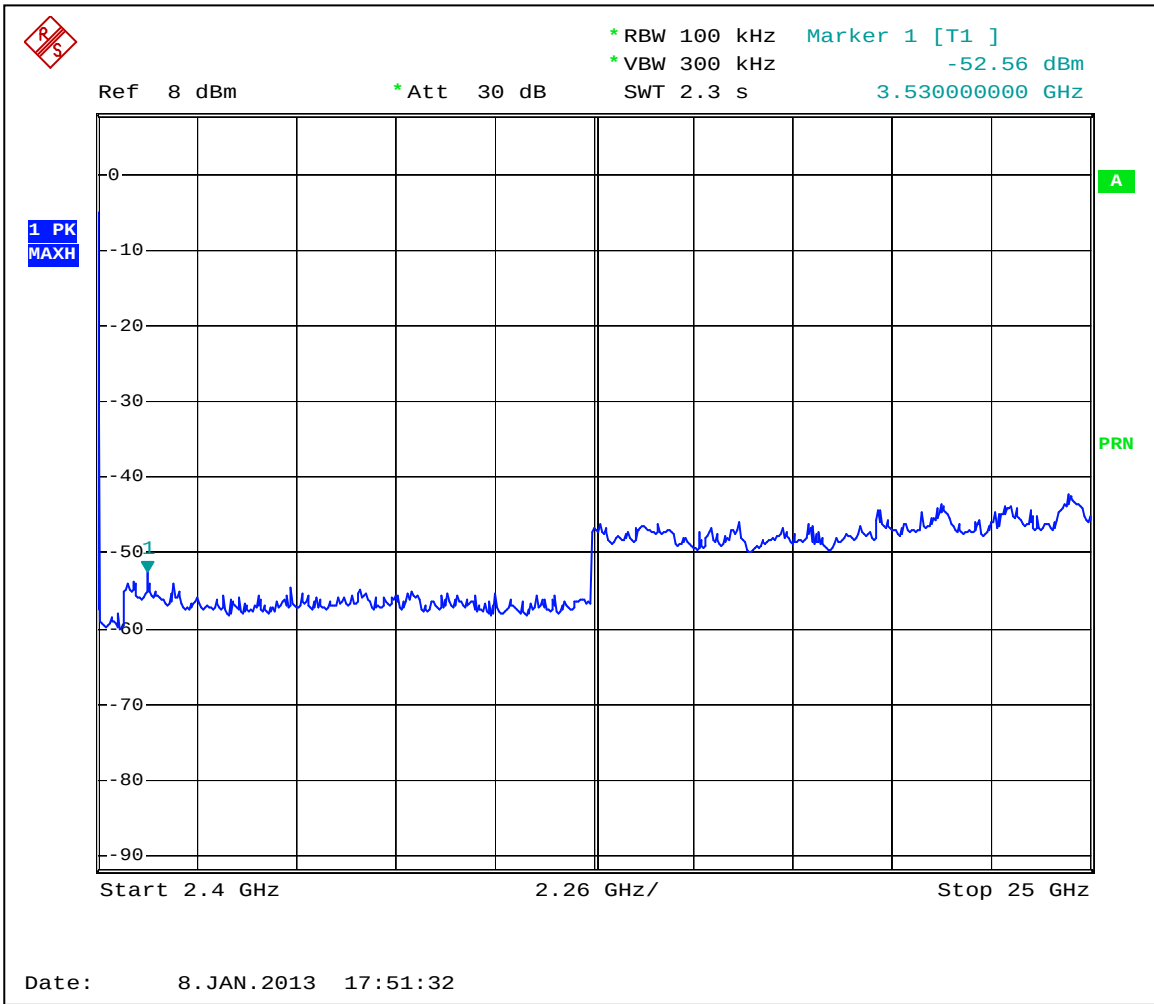
3.4 Antenna conducted spurious emissions

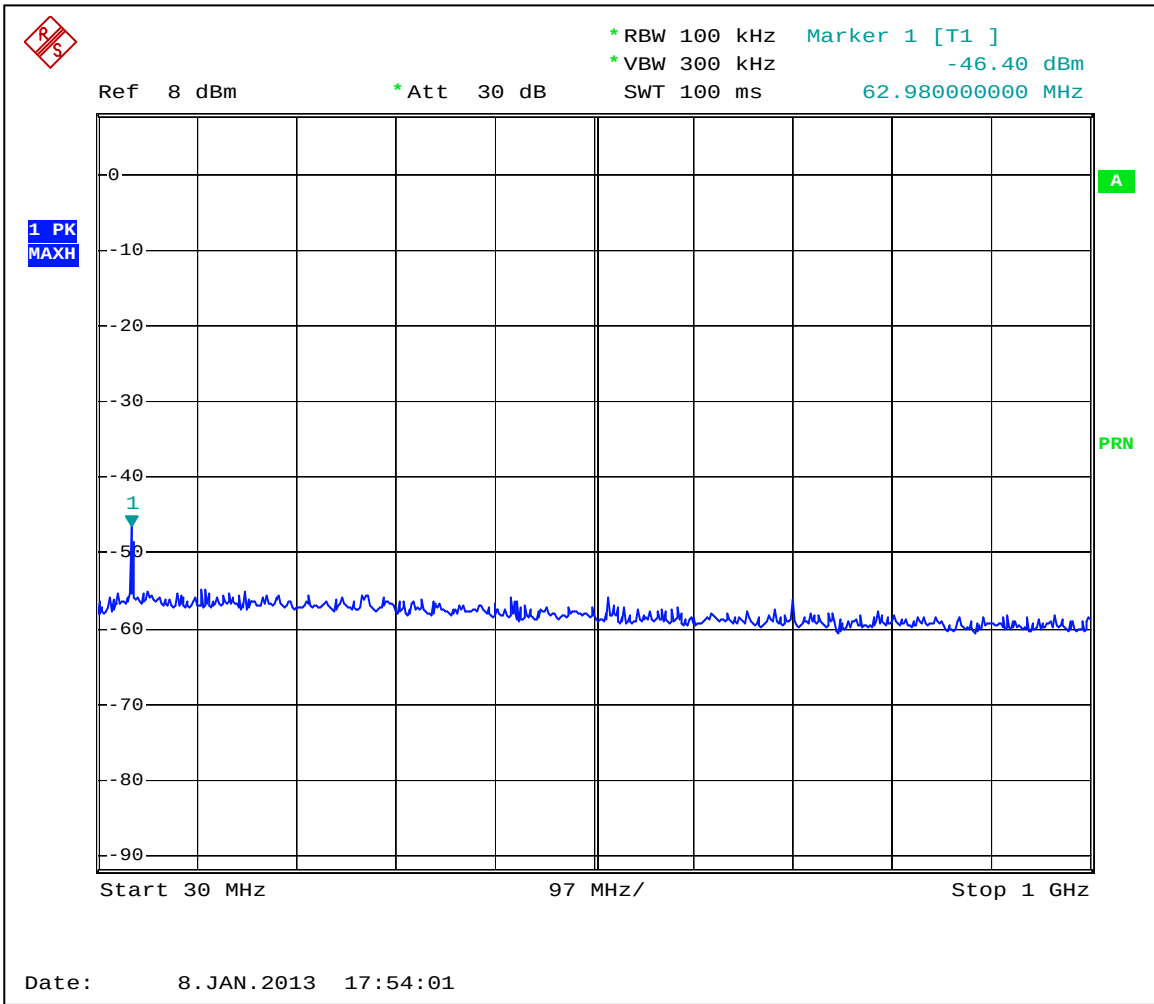
	Minimum Measured Attenuation dB	Minimum Allowed Attenuation dB	Margin dB
Low Frequency Channel	-51.3	20	-71.3
Middle Frequency Channel	-46.4	20	-66.4
Upper Frequency Channel	-45.1	20	-65.1
Analyzer Settings:	☒ RBW=100KHz		
Minimum Allowed Attenuation:	☒ 20dB ☐ 30dB (for digital systems with conducted power measured using RMS averaging over a time interval)		

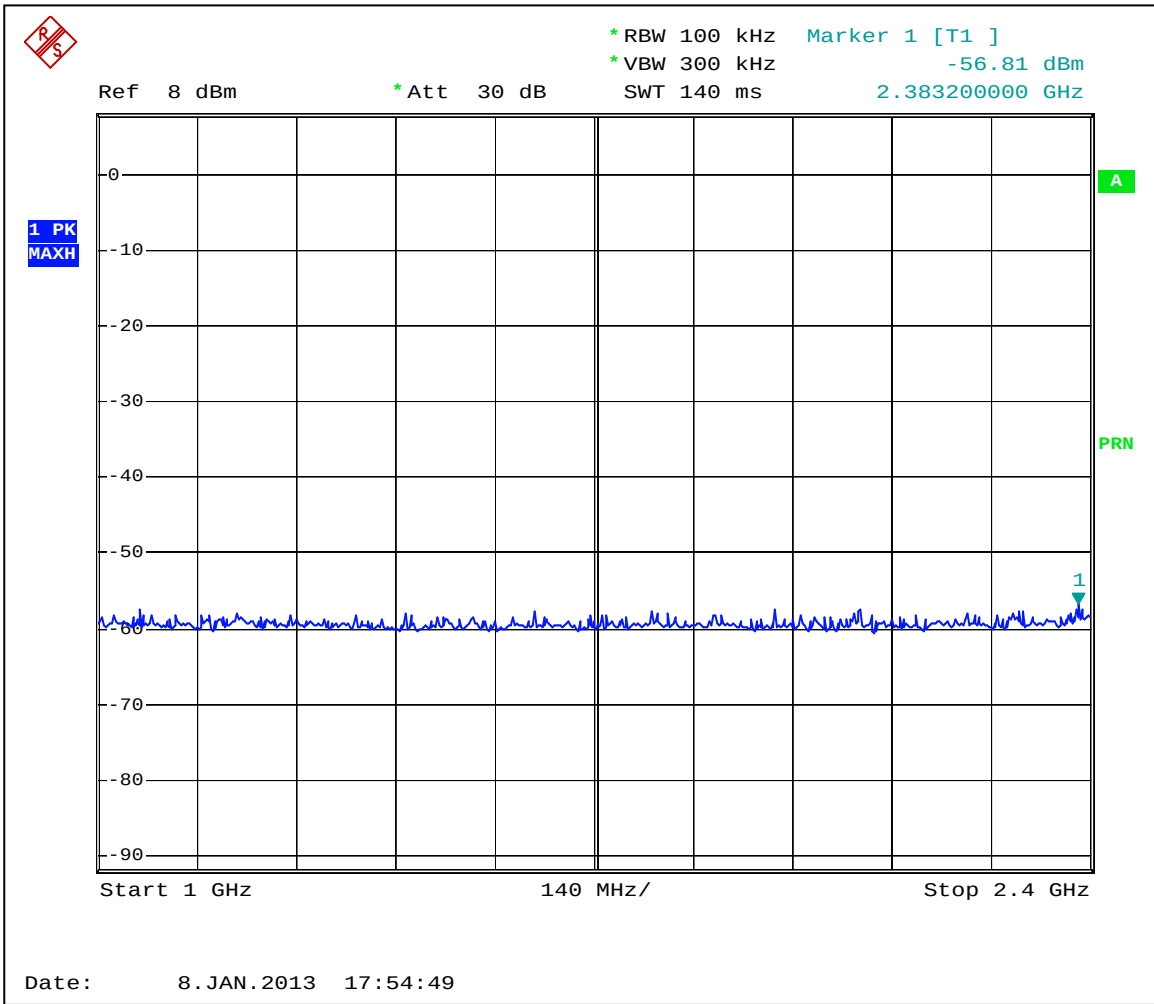
Notes: None

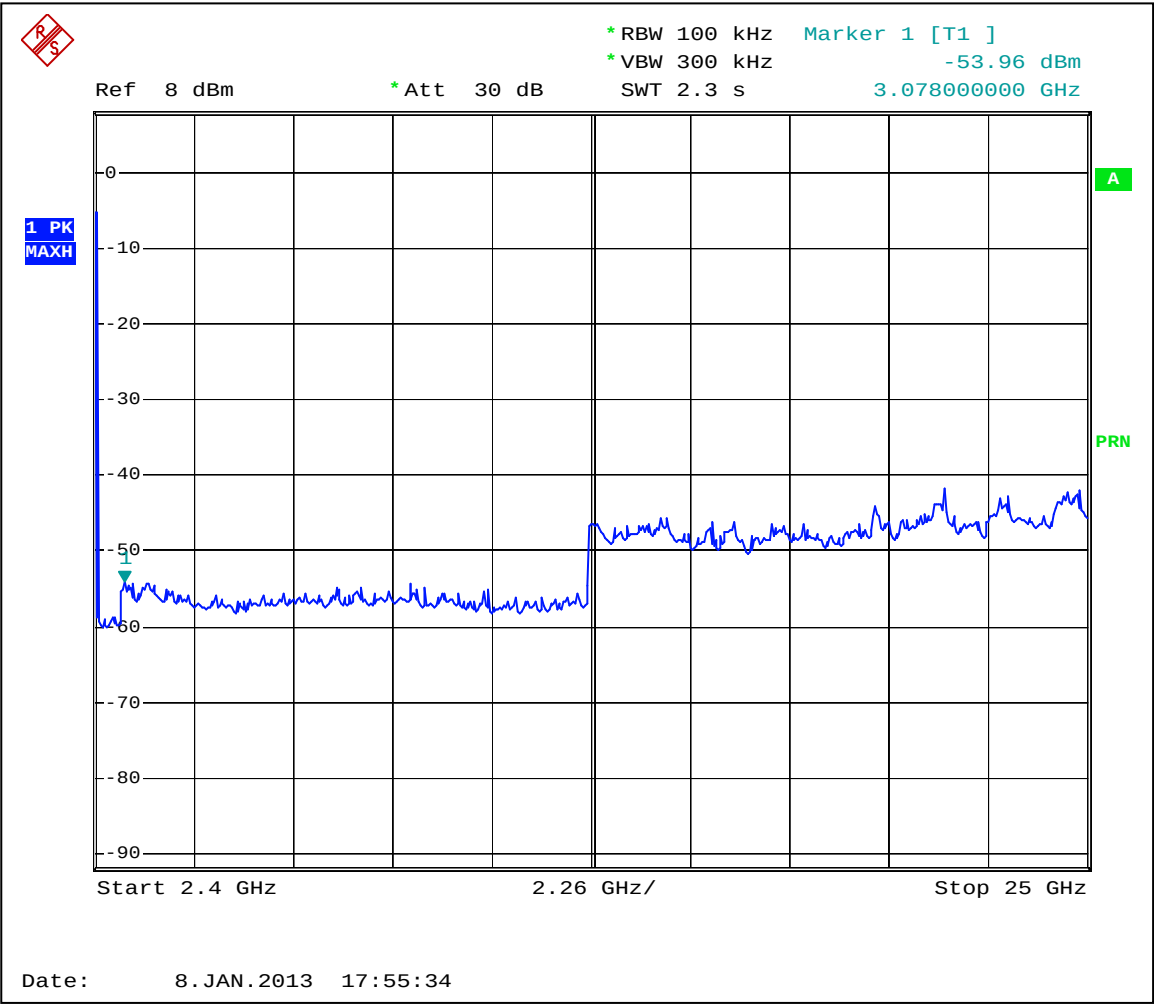


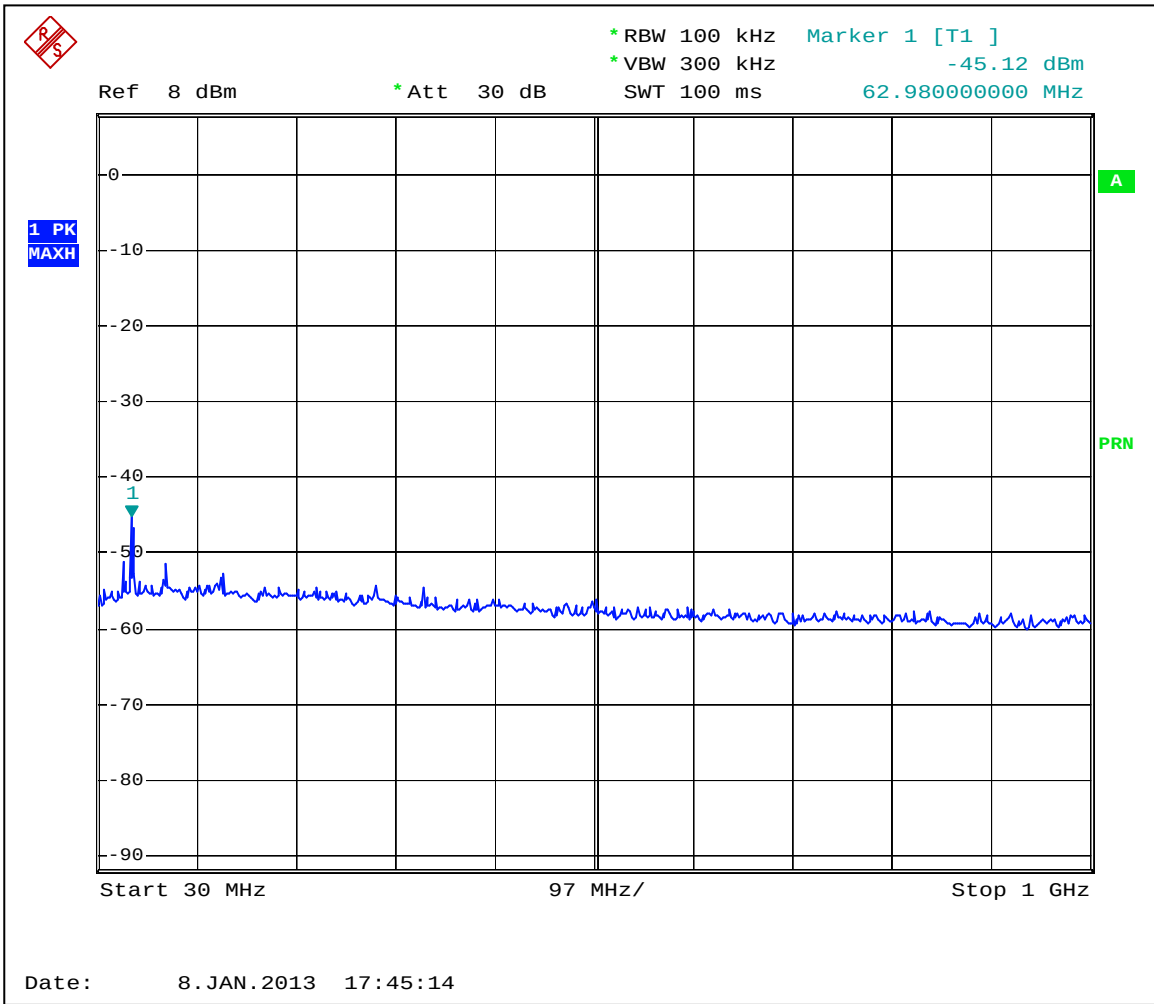


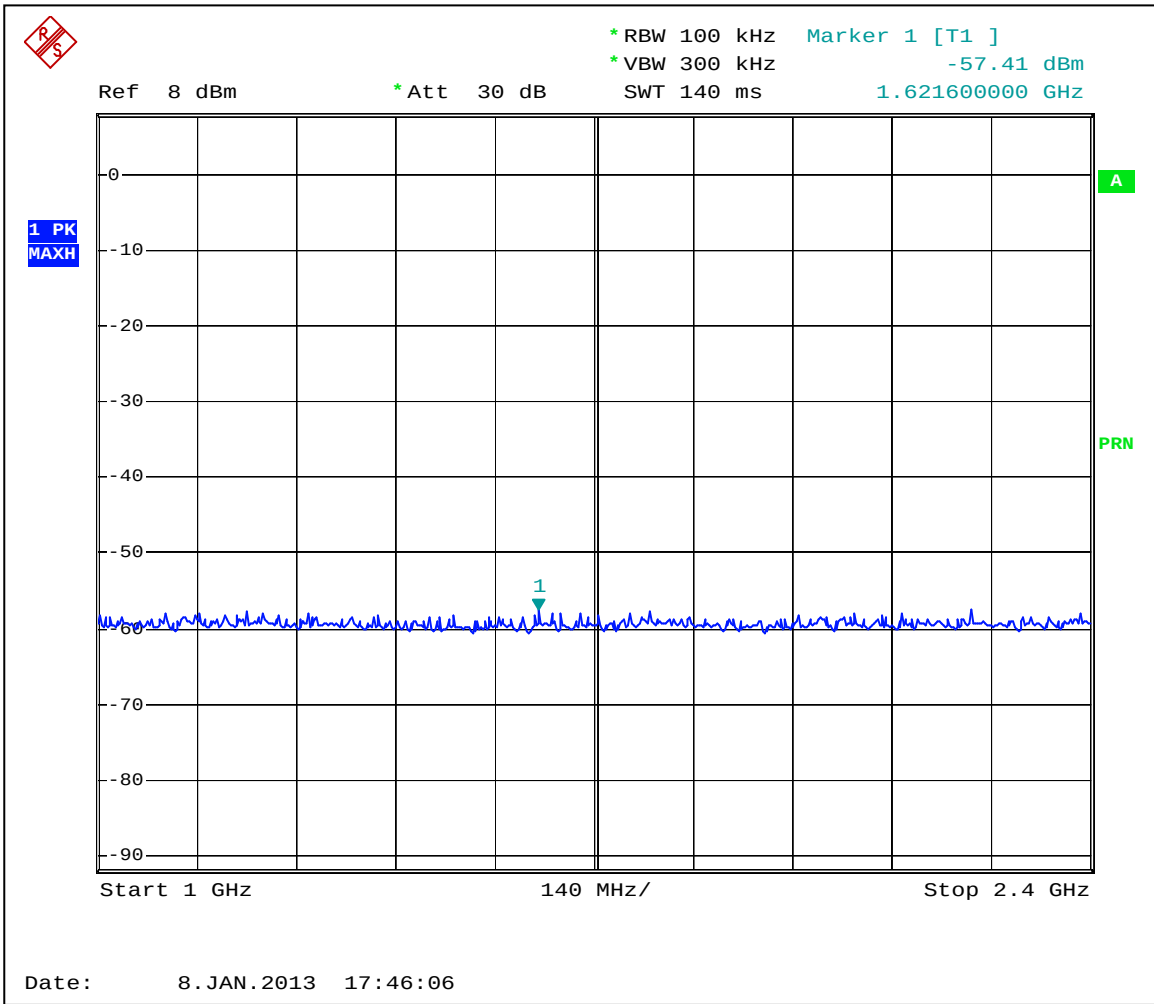


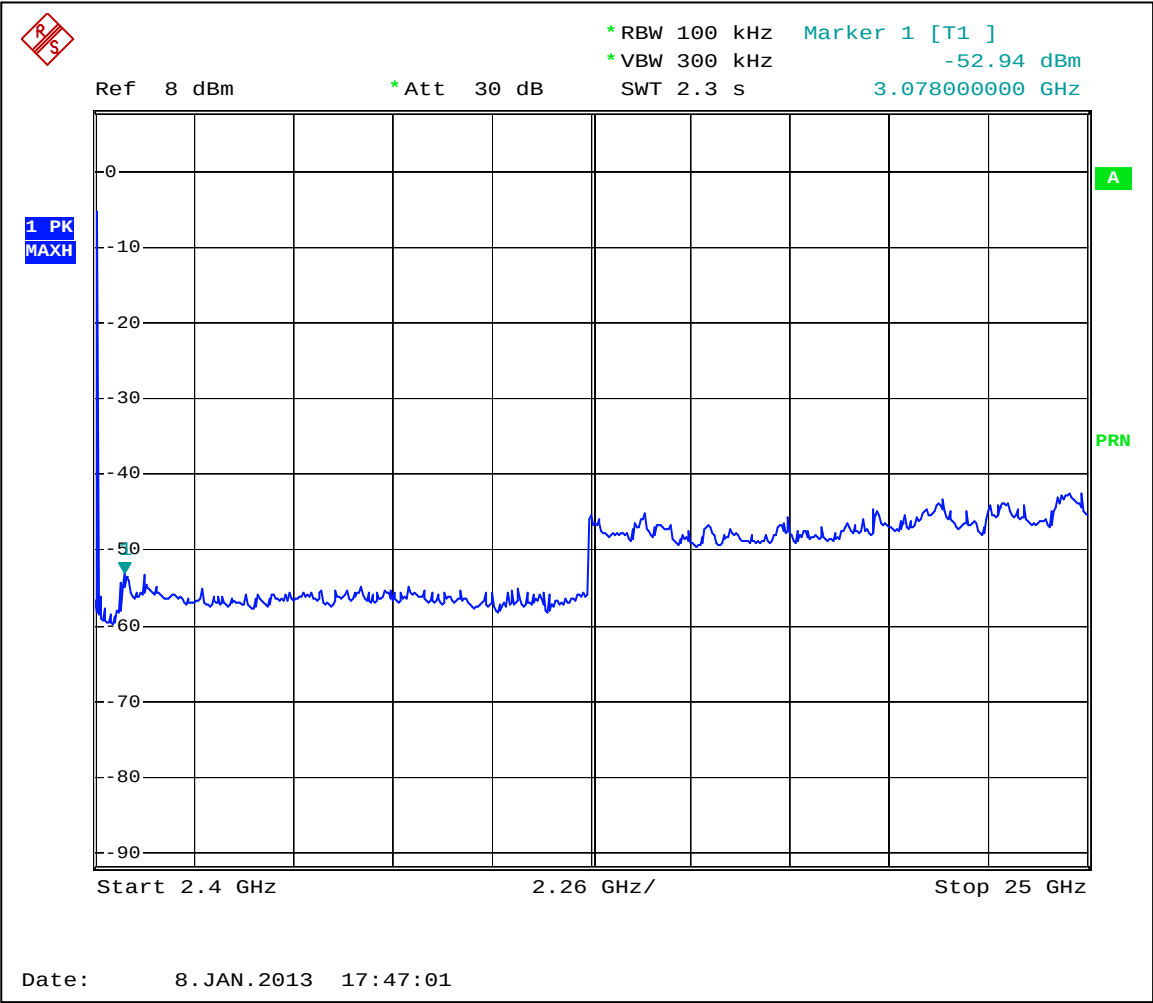








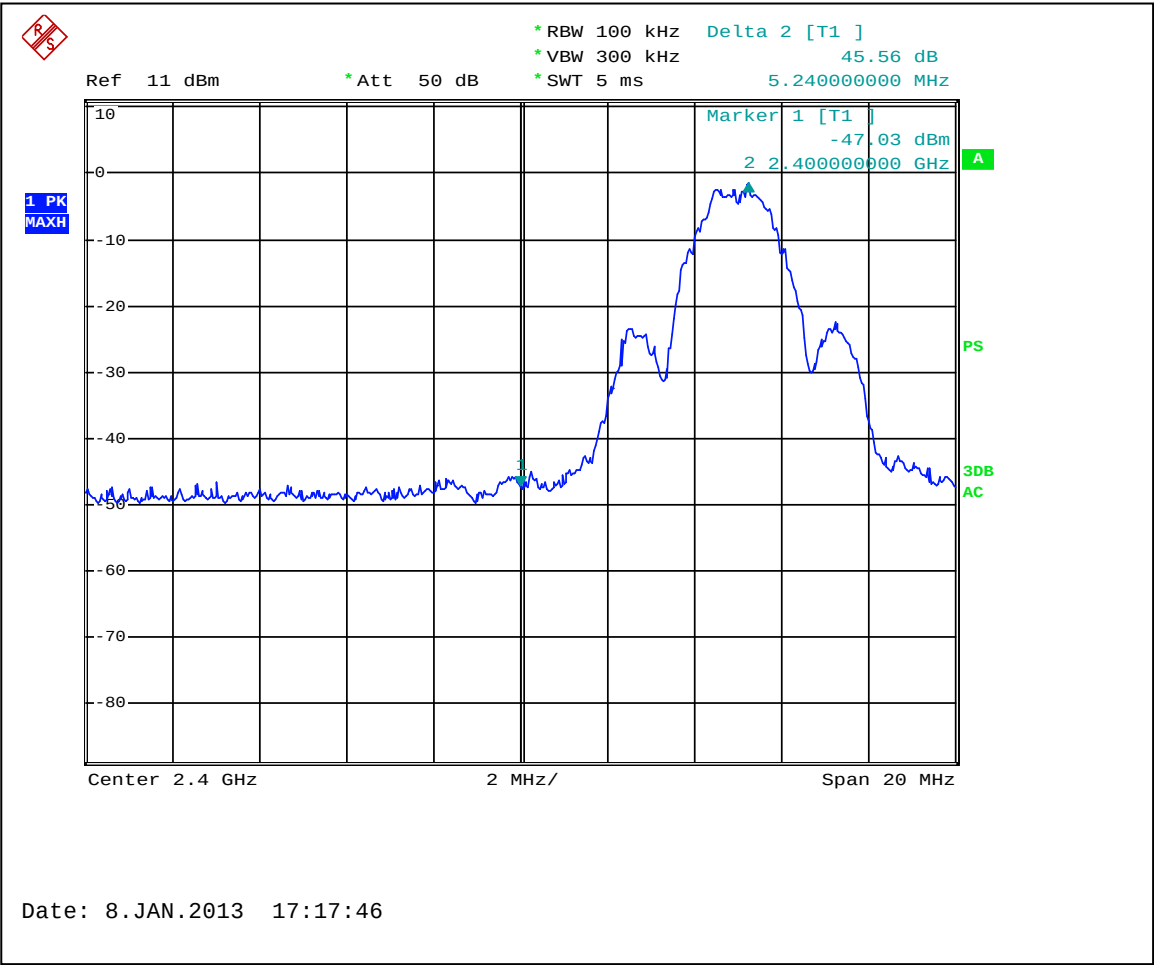




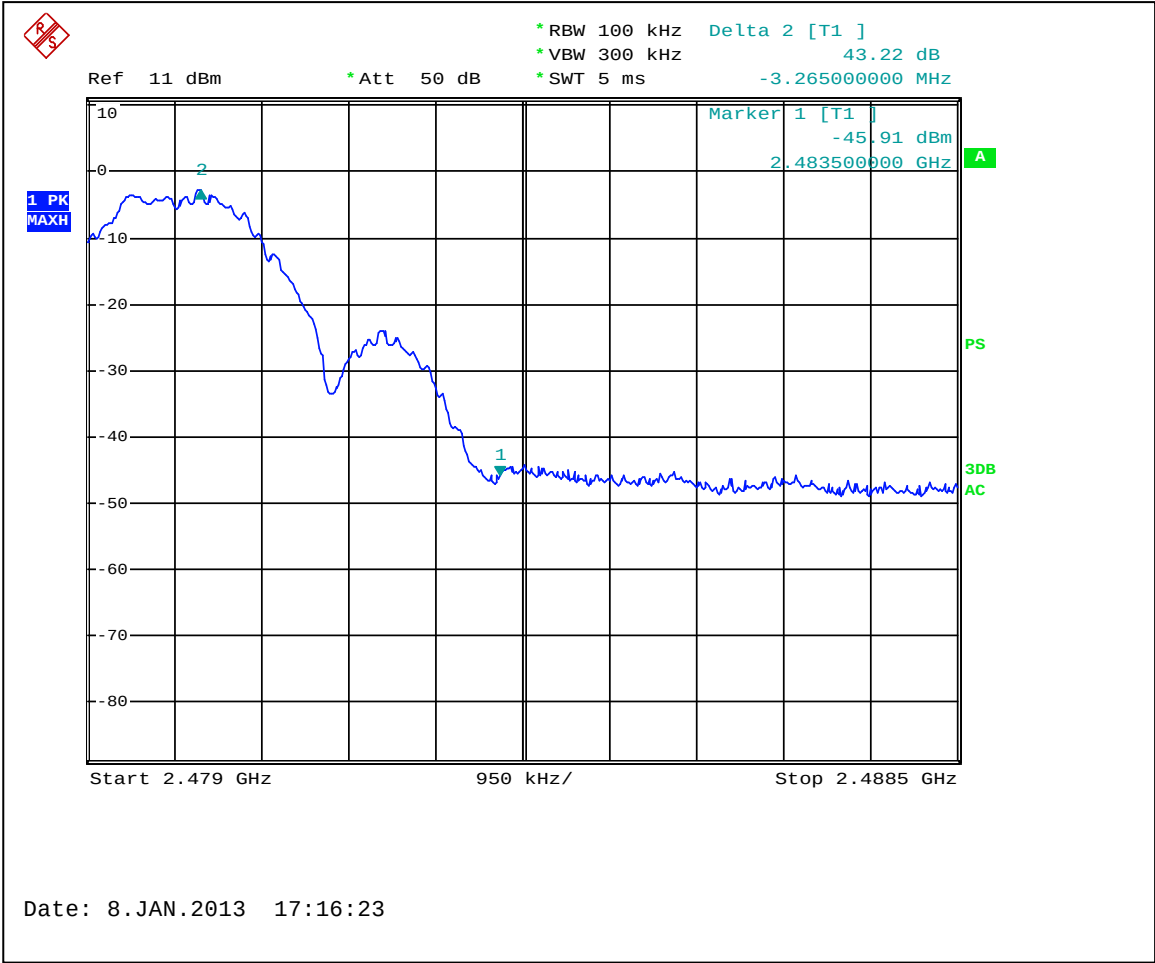
3.4.1 Antenna conducted band edge compliance

Frequency Range:	☐ 902-928MHz ☒ 2400-2483.5MHz ☐ 5725-5850MHz		
	Minimum Measured Attenuation dB	Minimum Allowed Attenuation dB	Margin dB
Low Frequency Channel	45.6	20	-25.4
Upper Frequency Channel	43.2	20	-23.2
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**

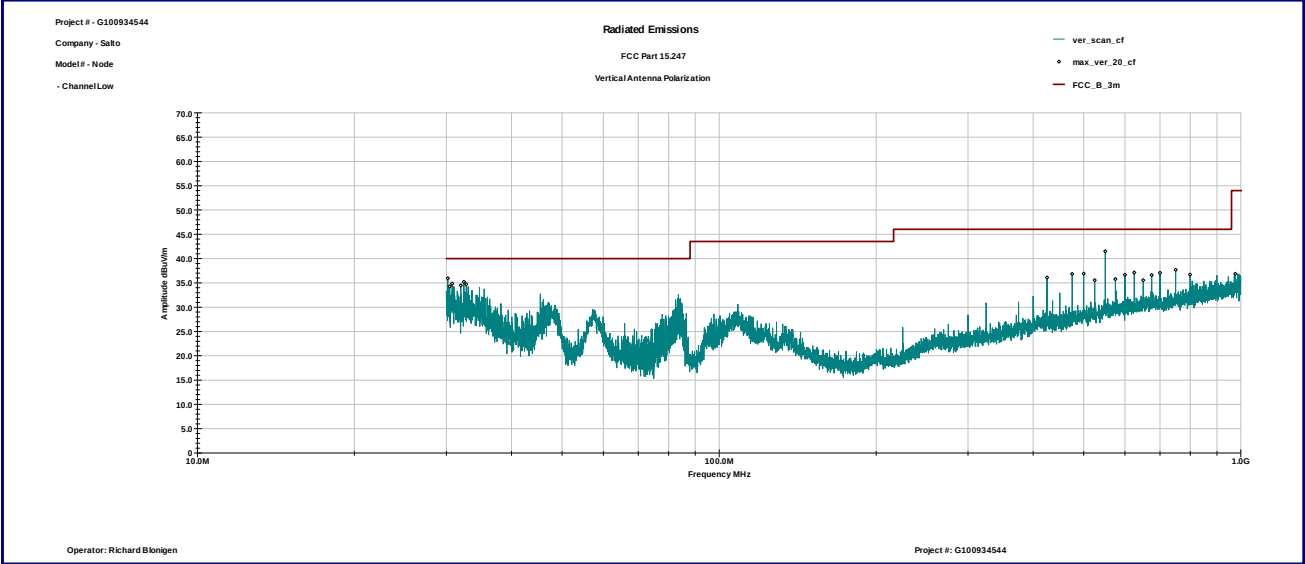
Max. Margin: 6.8dB below the limits

Date:	January 10-11, 2013	Result: Pass
Standard:	FCC part 15.247(d)	
Tested by:	Richard Blonigen	
Test Point:	Enclosure	
Operation mode:	See Page 5	
Note:	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. Testing was performed at Low, Middle and Upper channels.	

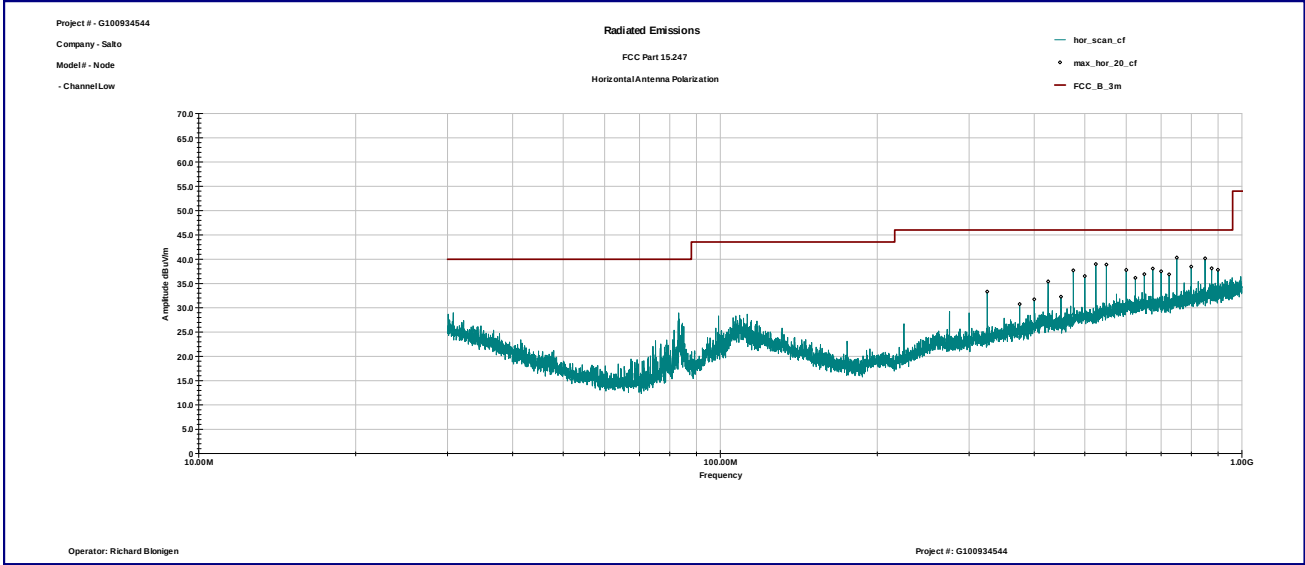
Table 3.5.1

Frequency MHz	Antenna Polarity	Peak Reading dBμV	Total C.F. dB1/m	Pre-Amp. Gain (dB)	Total at 3m dBμV/m	Limit dBμV/m	Margin dB
Channel Low							
7.2153 GHz	V	42.8	40.9	38.2	45.5	54.0	-8.5
4.8073 GHz	H	48.8	37.1	39.2	46.7	54.0	-7.3
7.2153 GHz	H	44.4	40.7	38.2	46.8	54.0	-7.2
9.6187 GHz	H	40.4	43.8	37.1	47.1	54.0	-6.9
Channel Middle							
4.8913 GHz	H	48.0	37.2	39.1	46.1	54.0	-7.9
7.332 GHz	H	42.6	41.0	38.1	45.6	54.0	-8.4
9.782 GHz	H	40.3	44.0	37.1	47.2	54.0	-6.8
Channel High							
7.444 GHz	V	41.9	41.6	38.0	45.5	54.0	-8.5
4.9613 GHz	H	47.8	37.3	39.0	46.2	54.0	-7.8
7.4393 GHz	H	43.8	41.3	38.0	47.1	54.0	-6.9

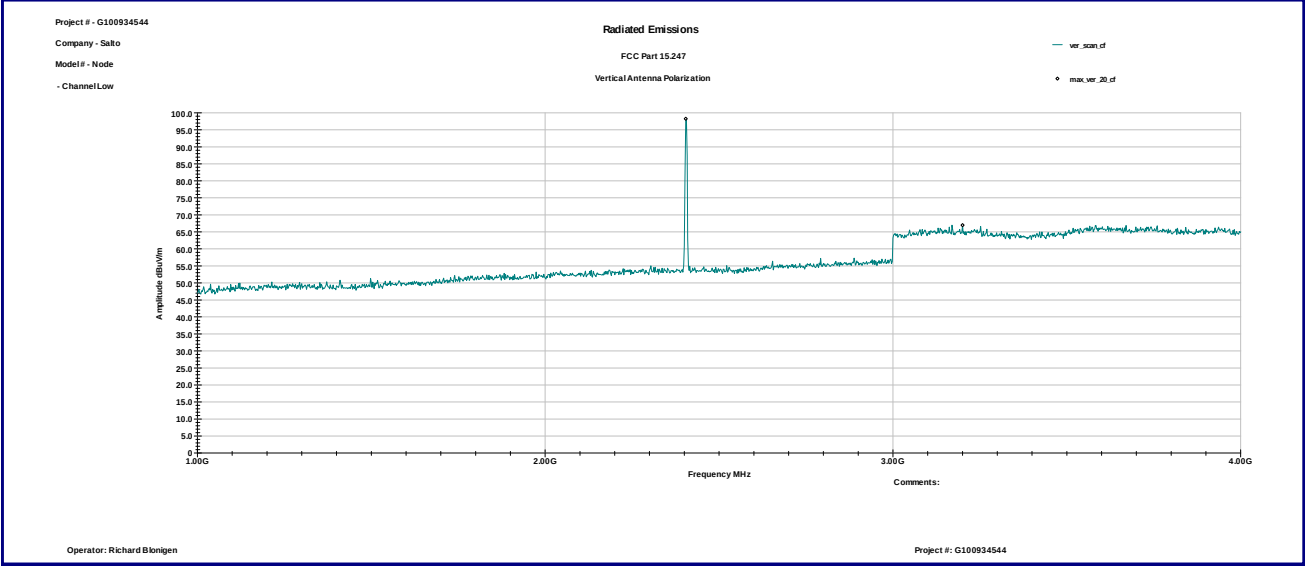
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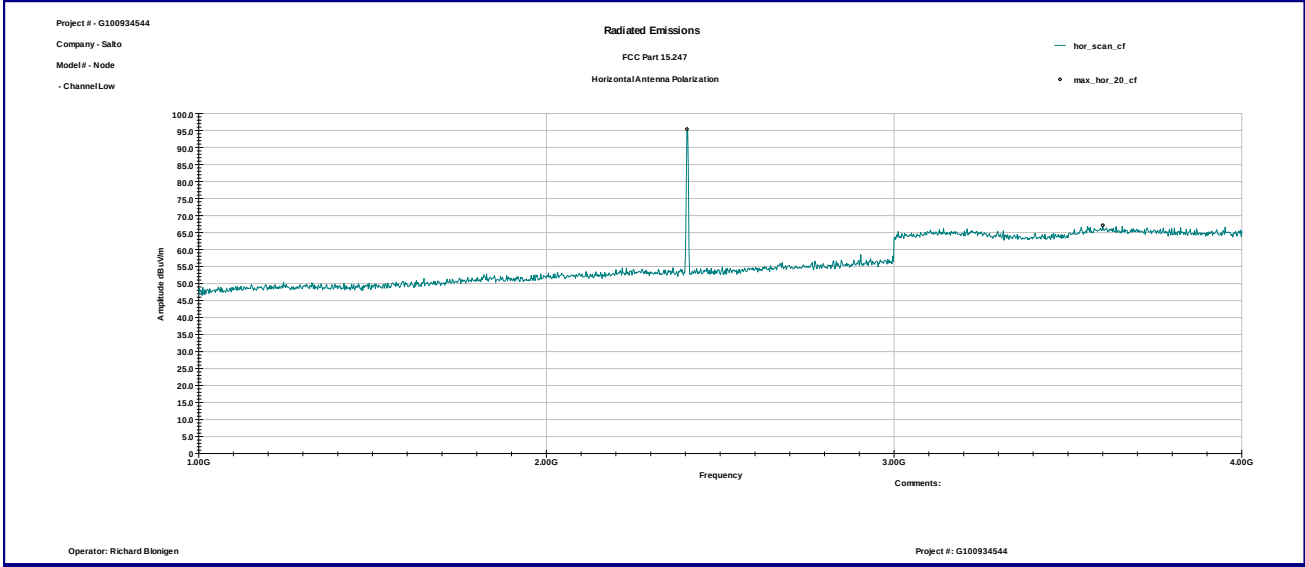
Graph 3.5.1



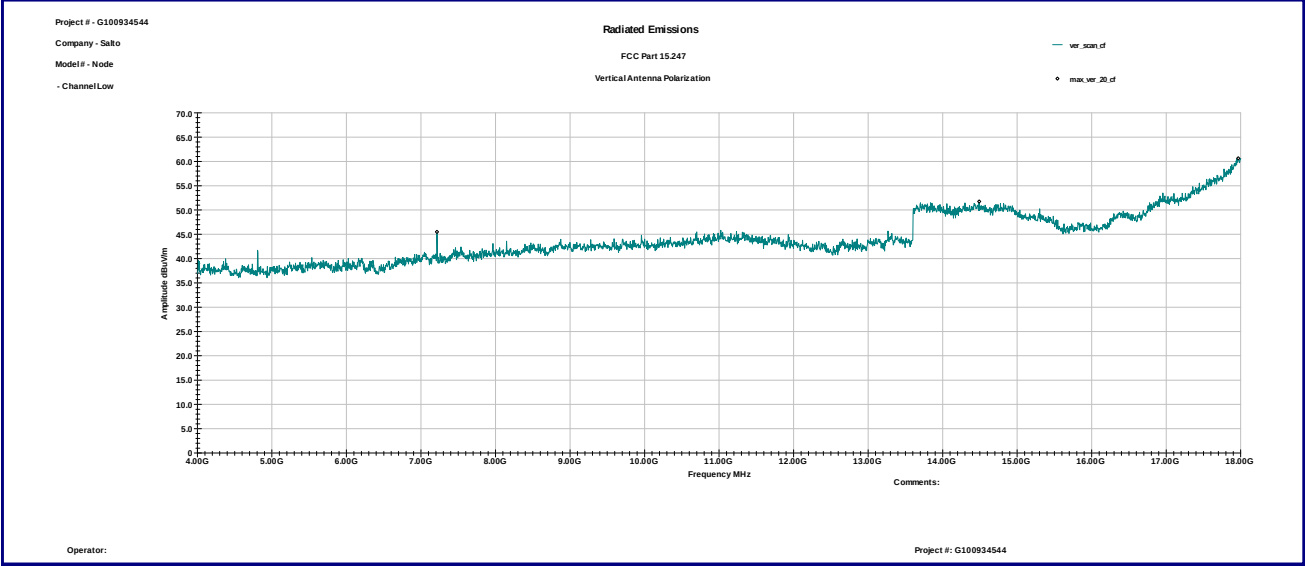
Graph 3.5.2



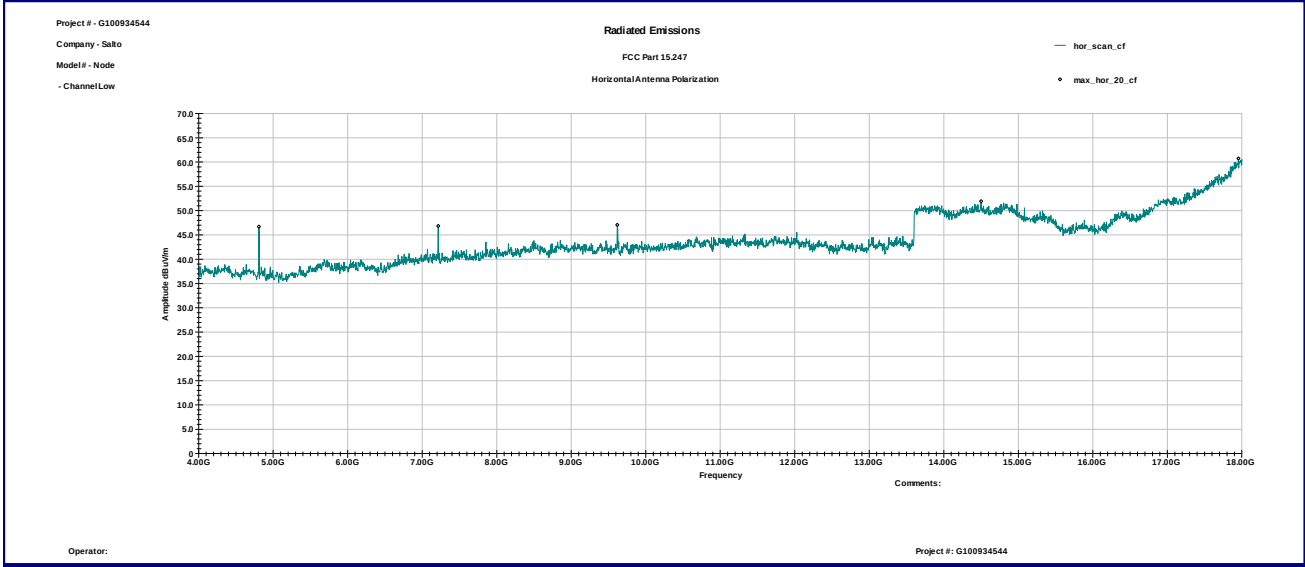
Graph 3.5.3



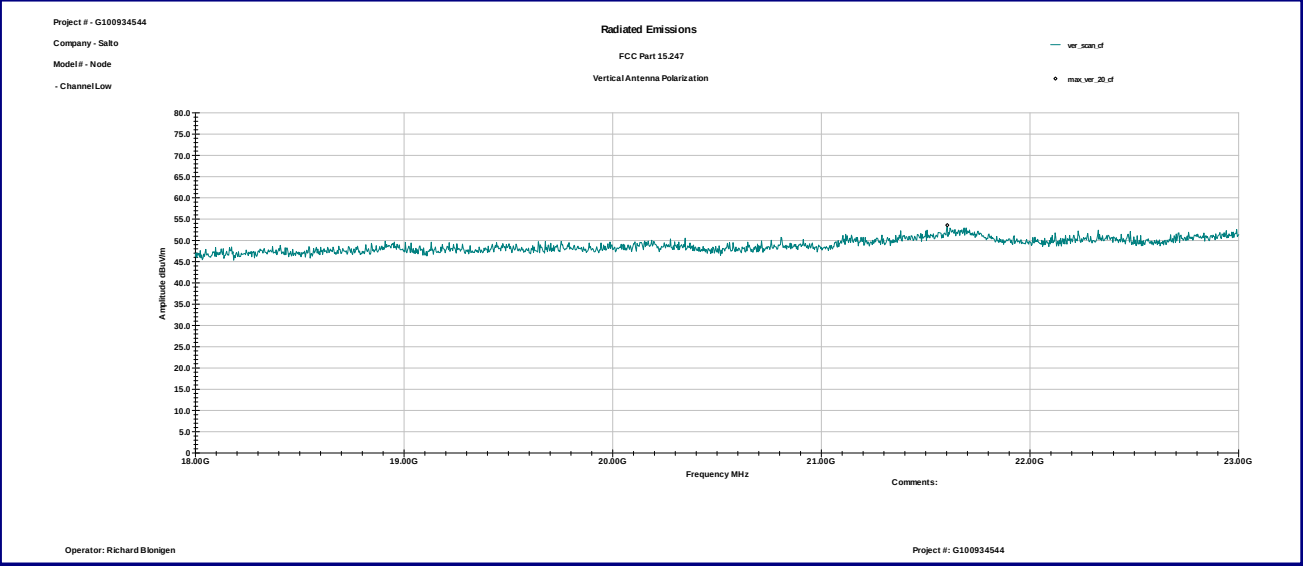
Graph 3.5.4



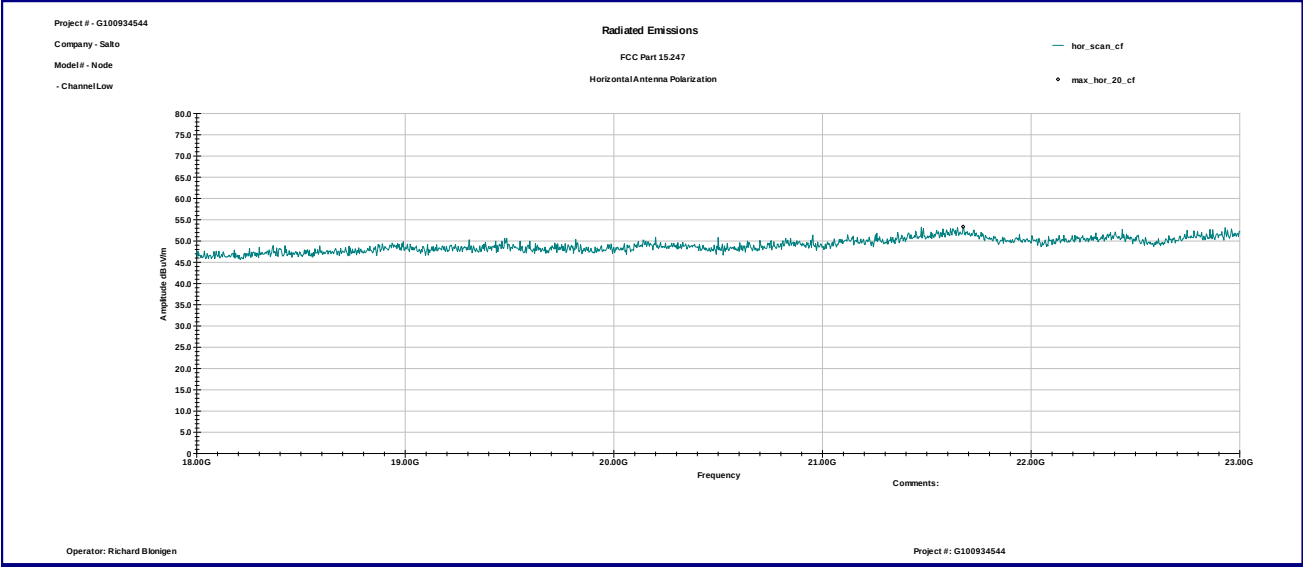
Graph 3.5.5



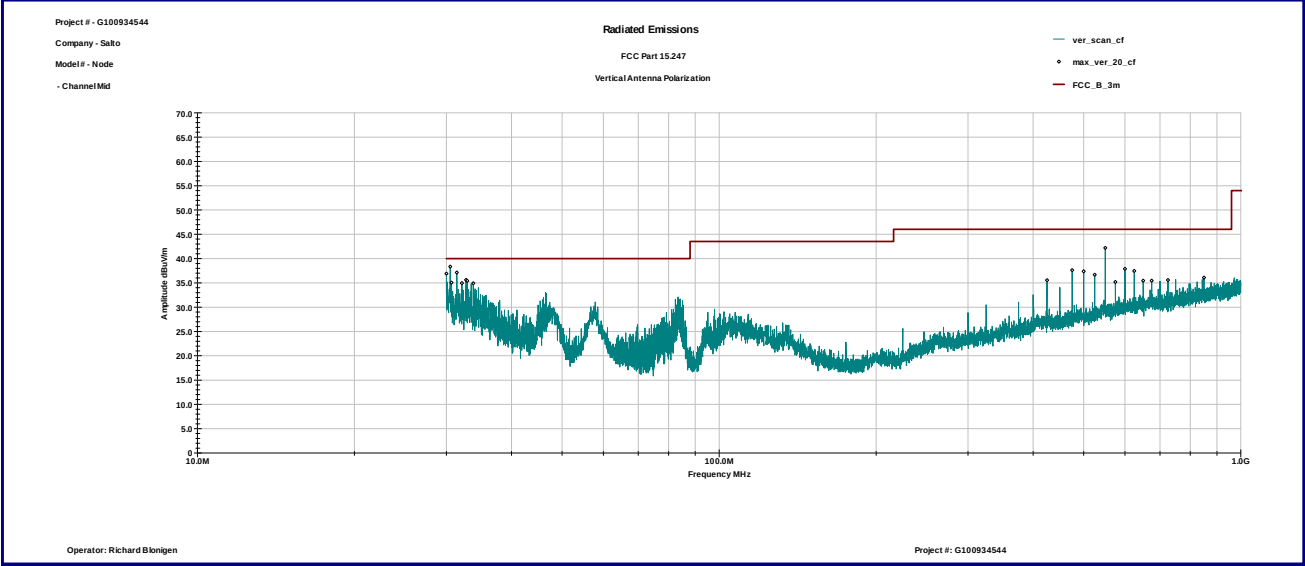
Graph 3.5.6



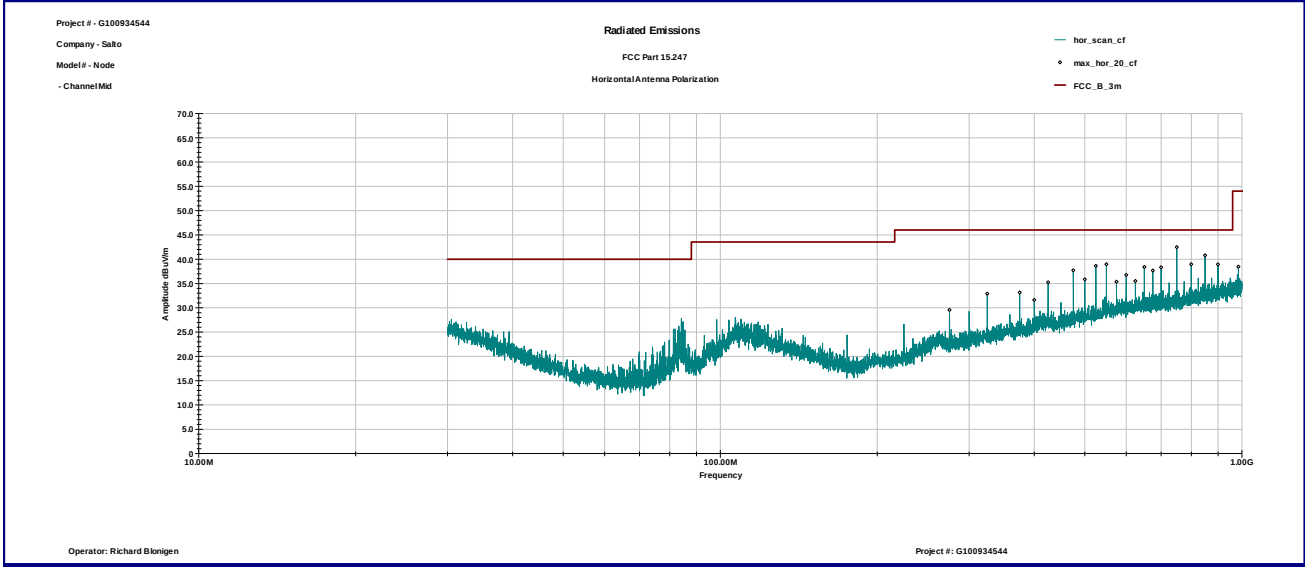
Graph 3.5.7



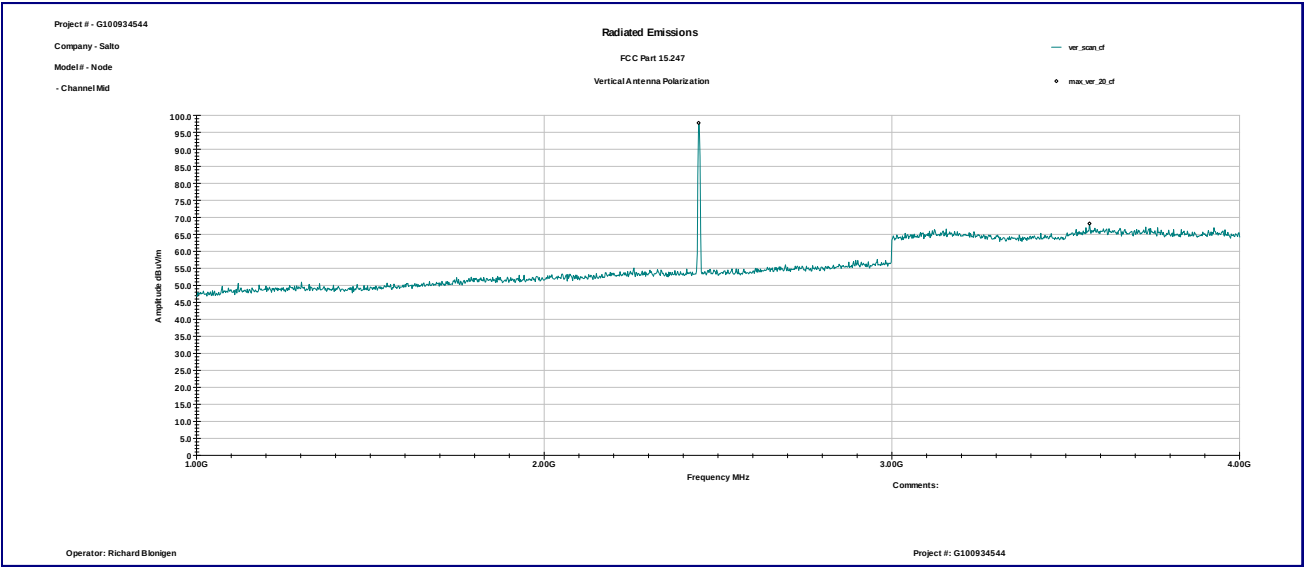
Graph 3.5.8



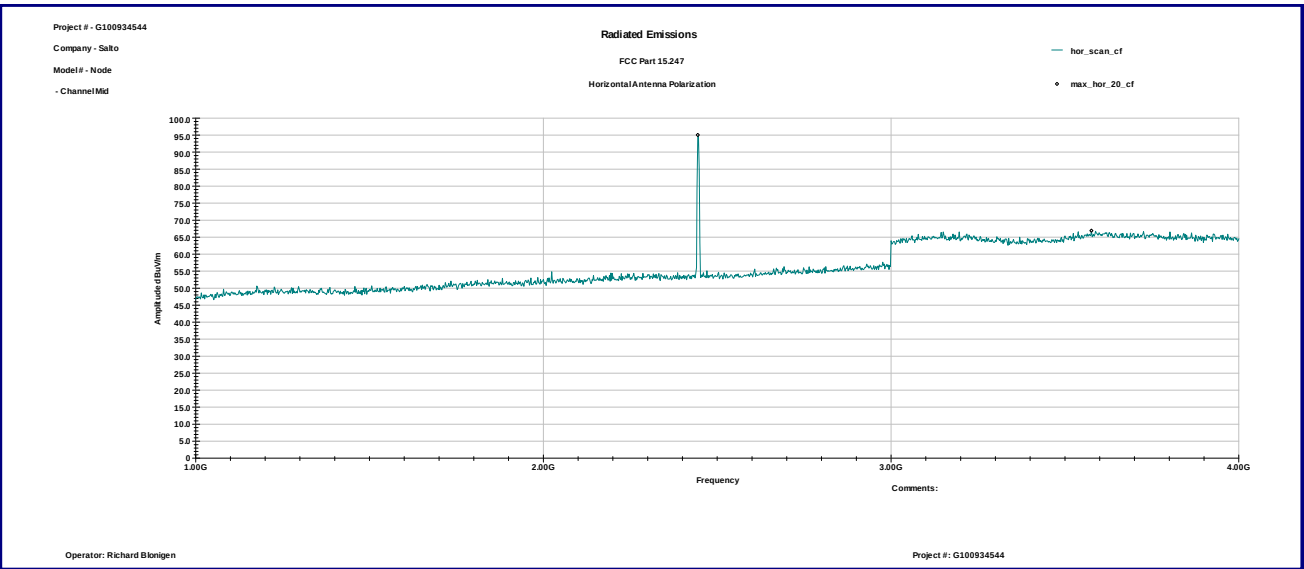
Graph 3.5.9



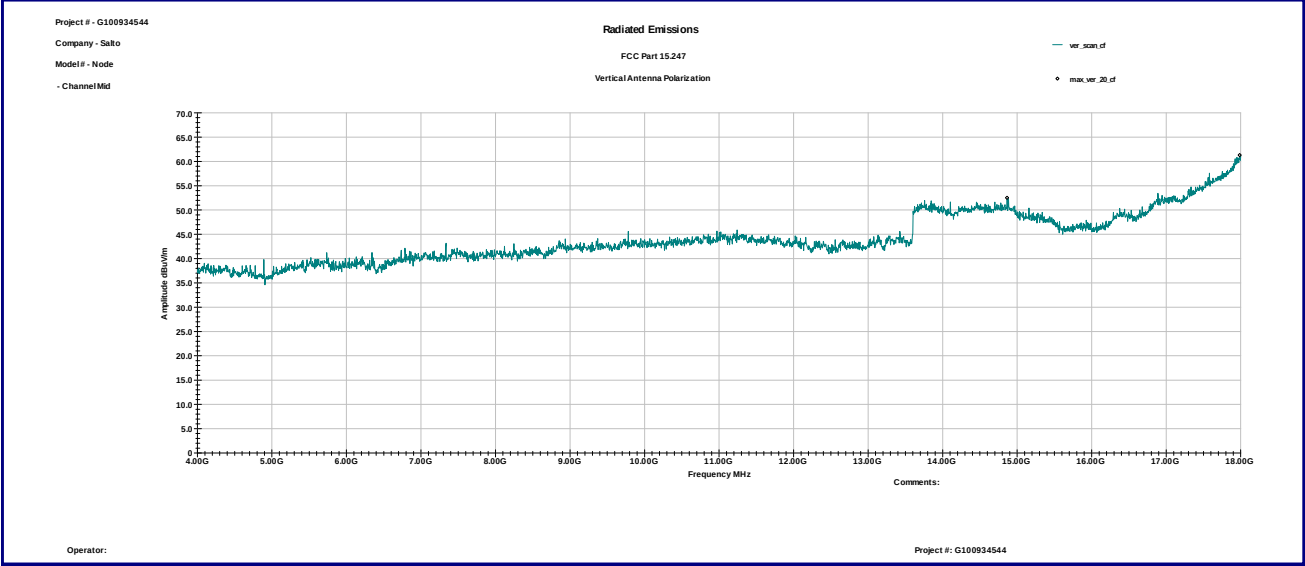
Graph 3.5.10



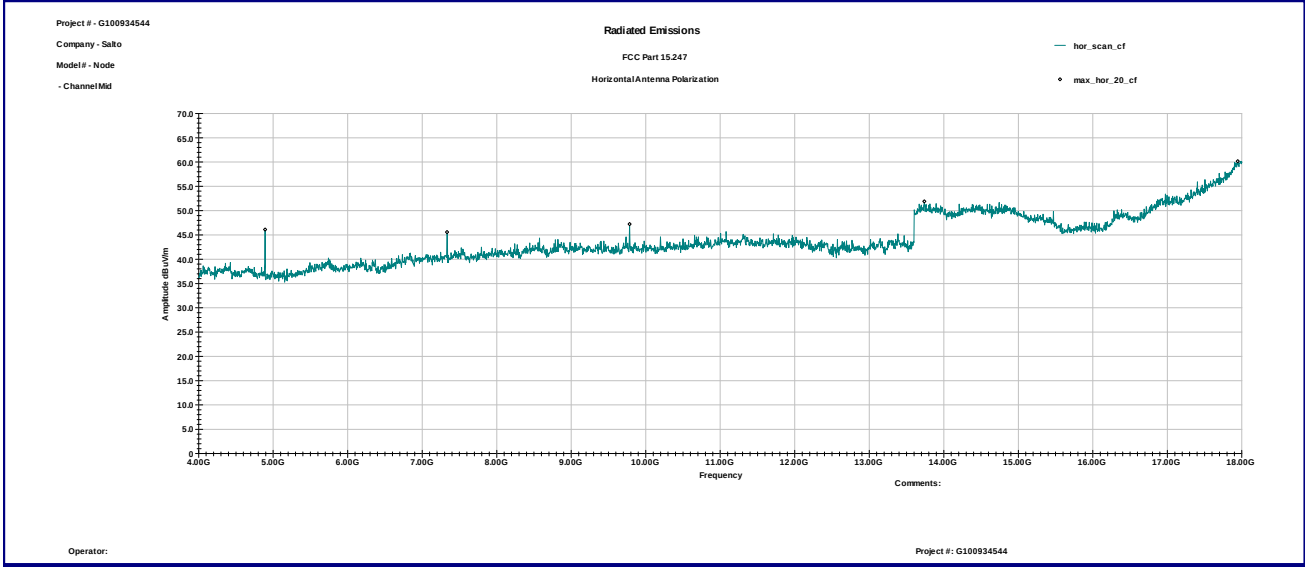
Graph 3.5.11



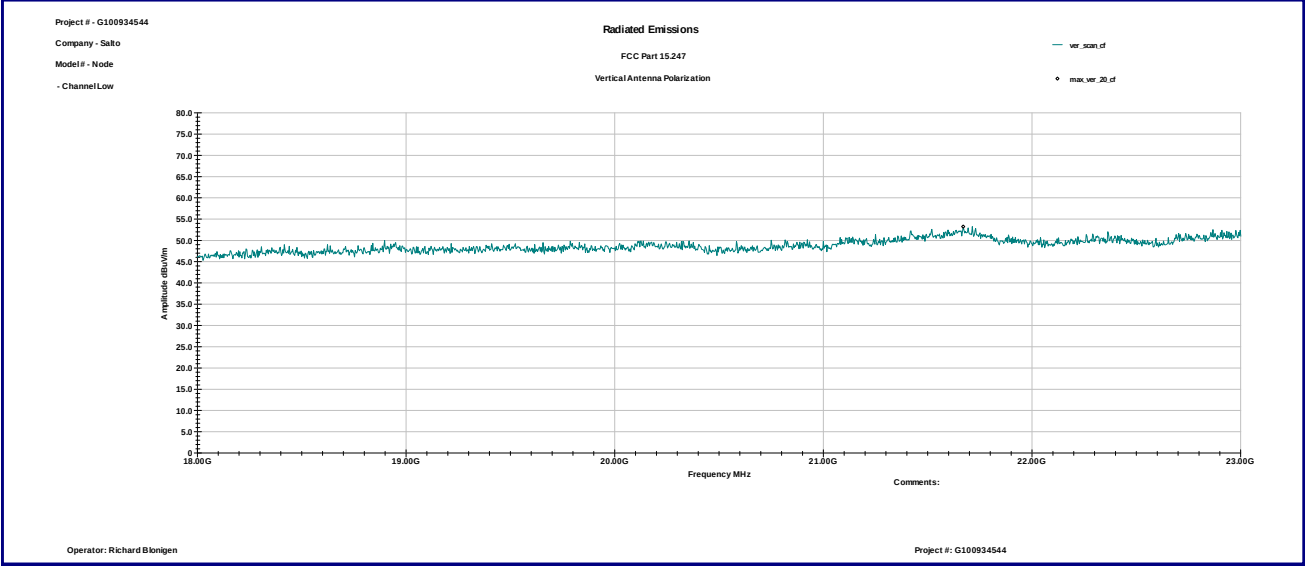
Graph 3.5.12



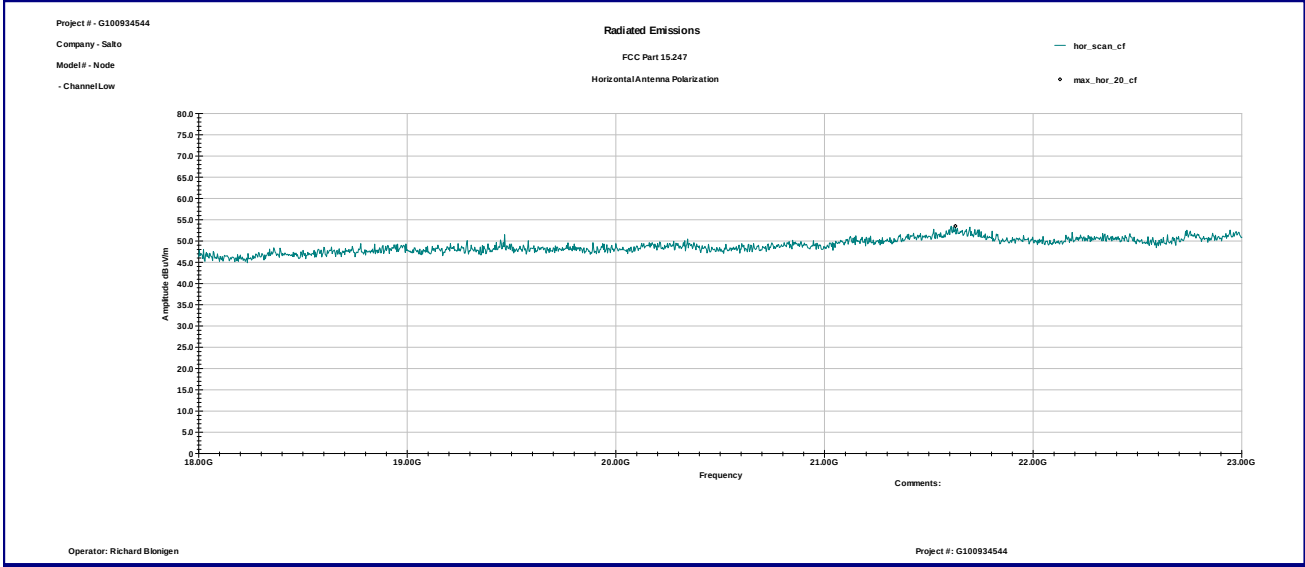
Graph 3.5.13



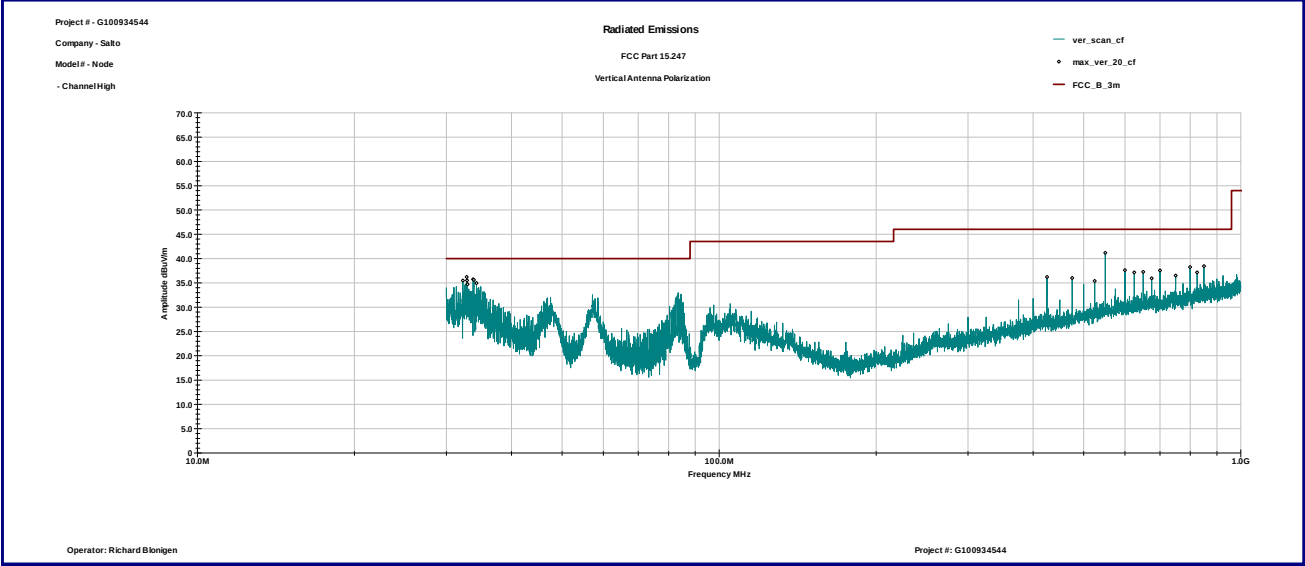
Graph 3.5.14



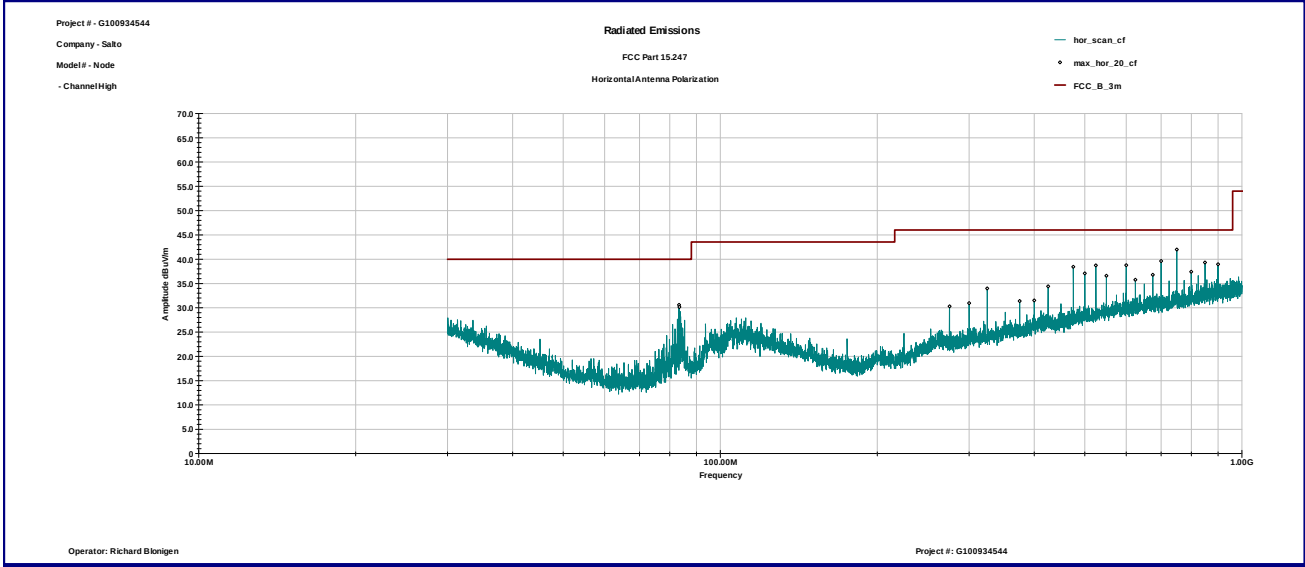
Graph 3.5.15



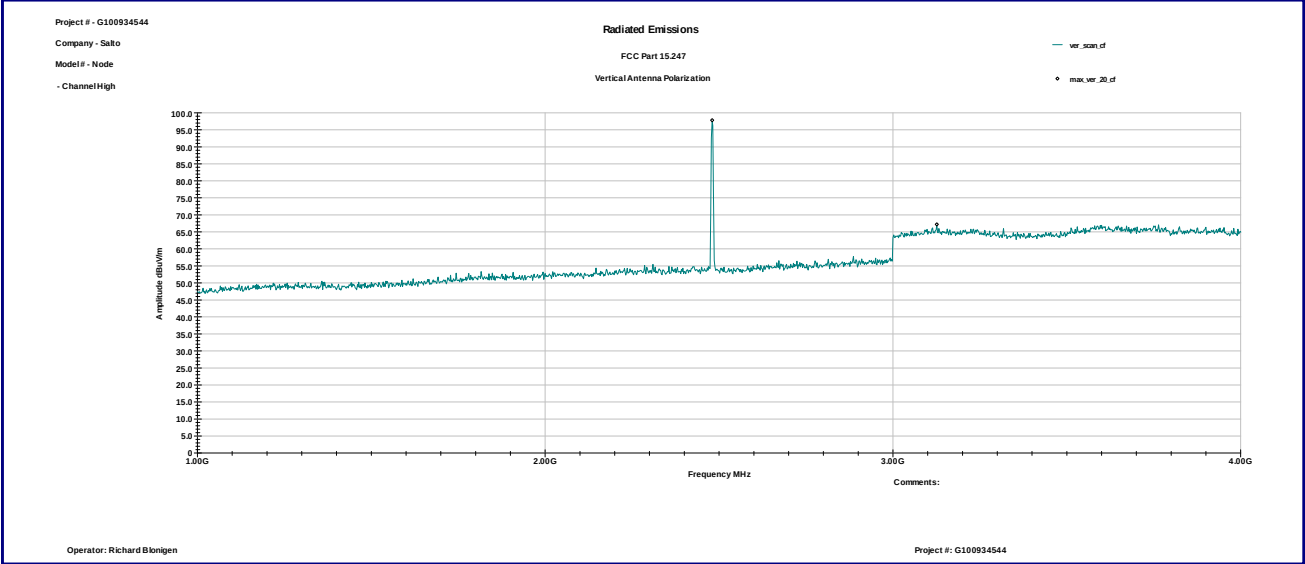
Graph 3.5.16



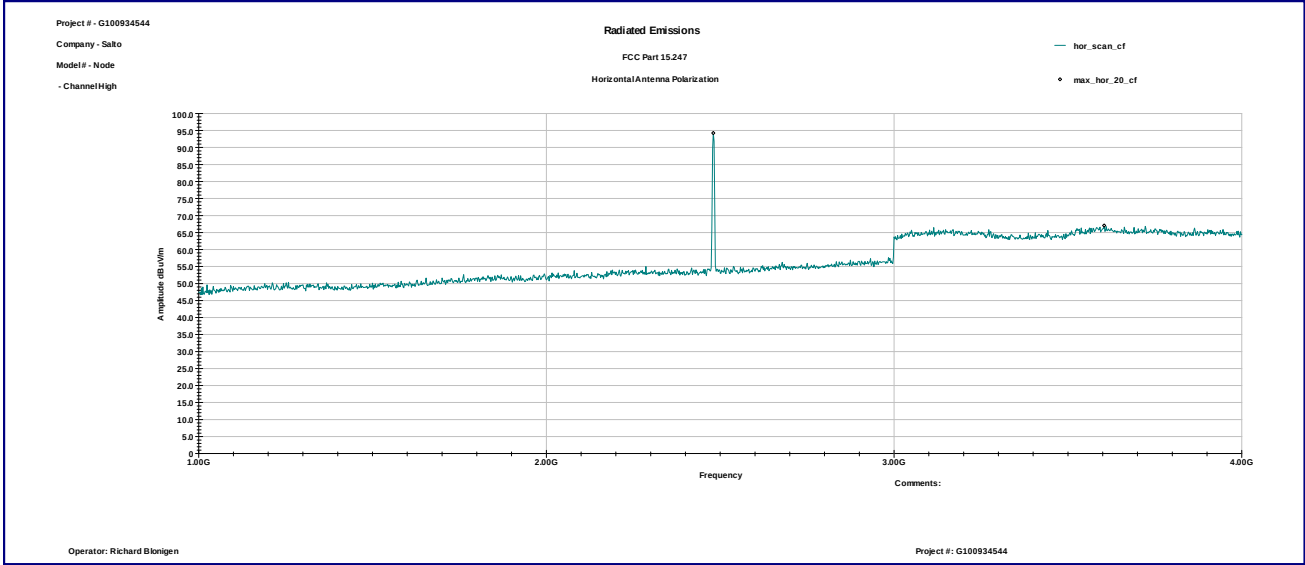
Graph 3.5.17



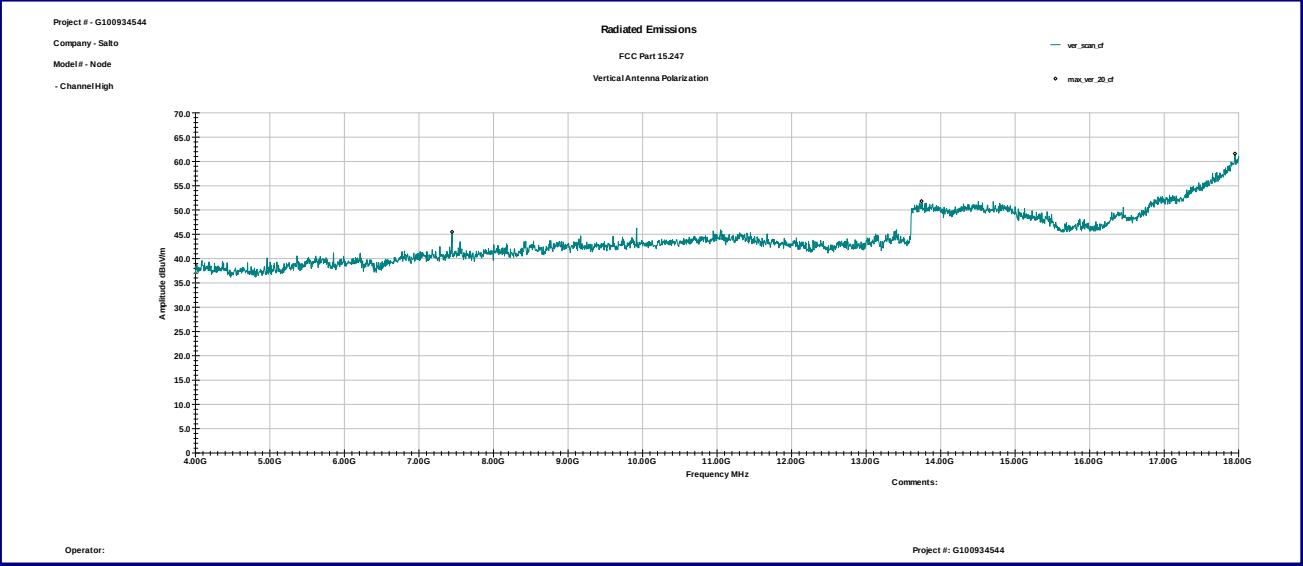
Graph 3.5.18



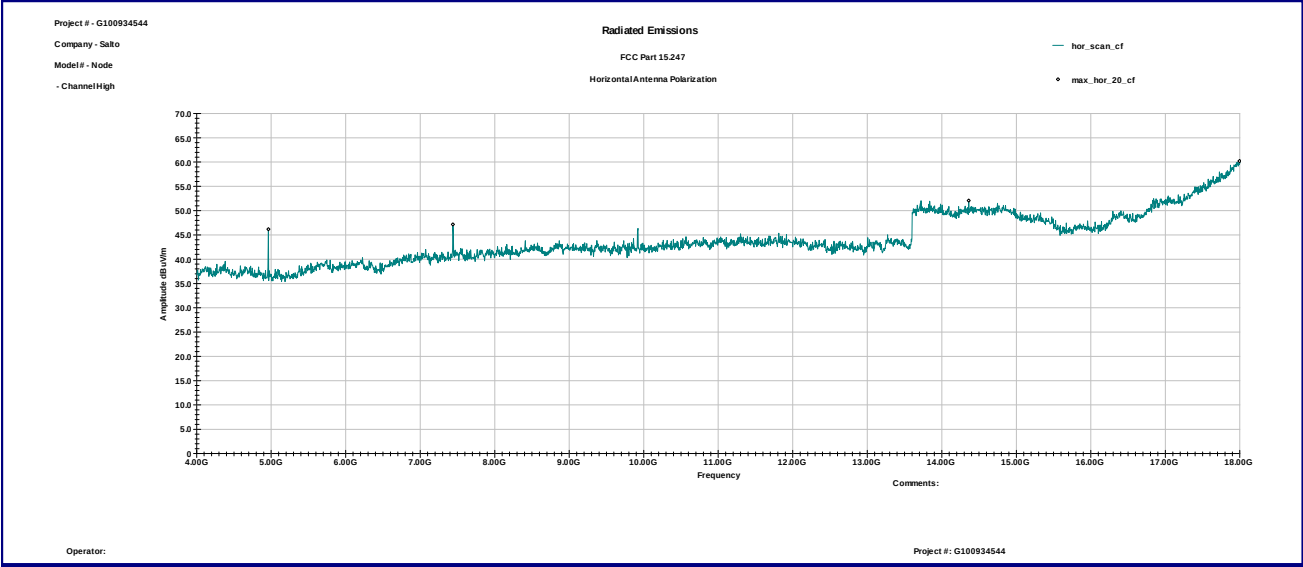
Graph 3.5.19



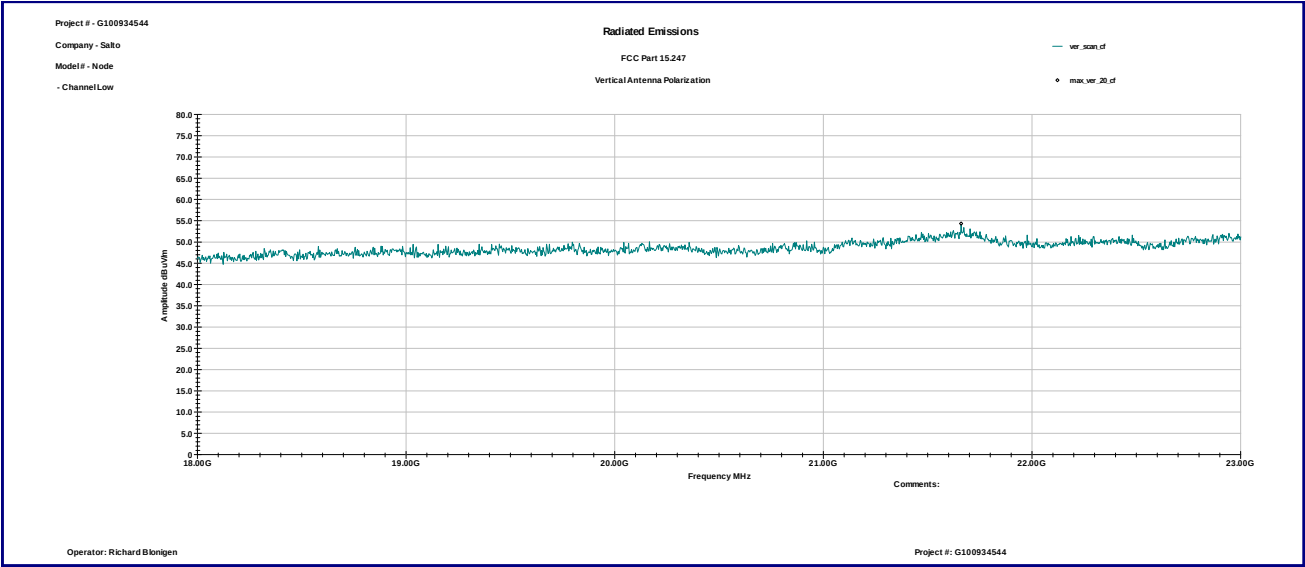
Graph 3.5.20



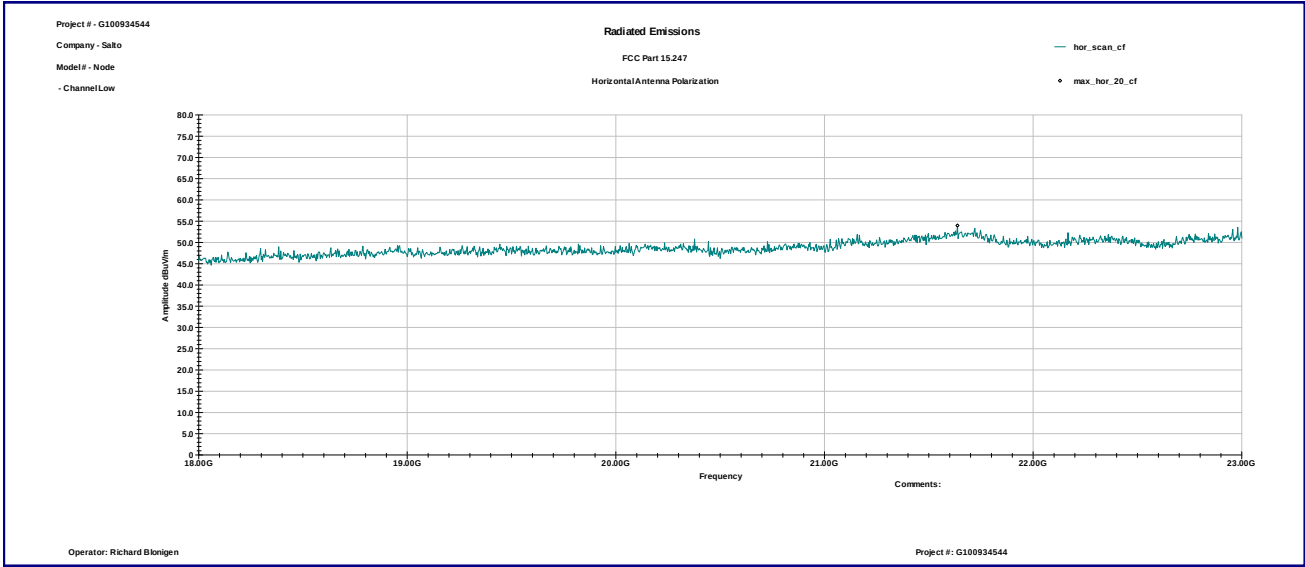
Graph 3.5.21



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 2.9dBm

The antenna gain, G is 3.3dBi

The maximum EIRP power = P + G

ERP = 3.9+1.7= 6.2dBm, or 0.0041W=4.1W

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:

$$S = EIRP / 4\pi D^2, \text{ or } 10 = 0.0041 / 4\pi D^2, \text{ where } D \text{ is a separation distance}$$

The minimum safe separation distance, D = 0.6cm, which is below 20cm



3.7 Transmitter power line conducted emissions

Test location: ☐ OATS ☒ Anechoic Chamber ☐ Other

Test result: **Pass**

Frequency range: 0.15MHz-30MHz

Max. Emissions margin: 7.2dB below the limits

Notes: None

Date:	January 11, 2013	Result: Pass
Standard:	FCC 15.207	
Tested by:	Richard Blonigen	
Test Point:	Power Line	
Operation mode:	See Page 5	
Note:	None	

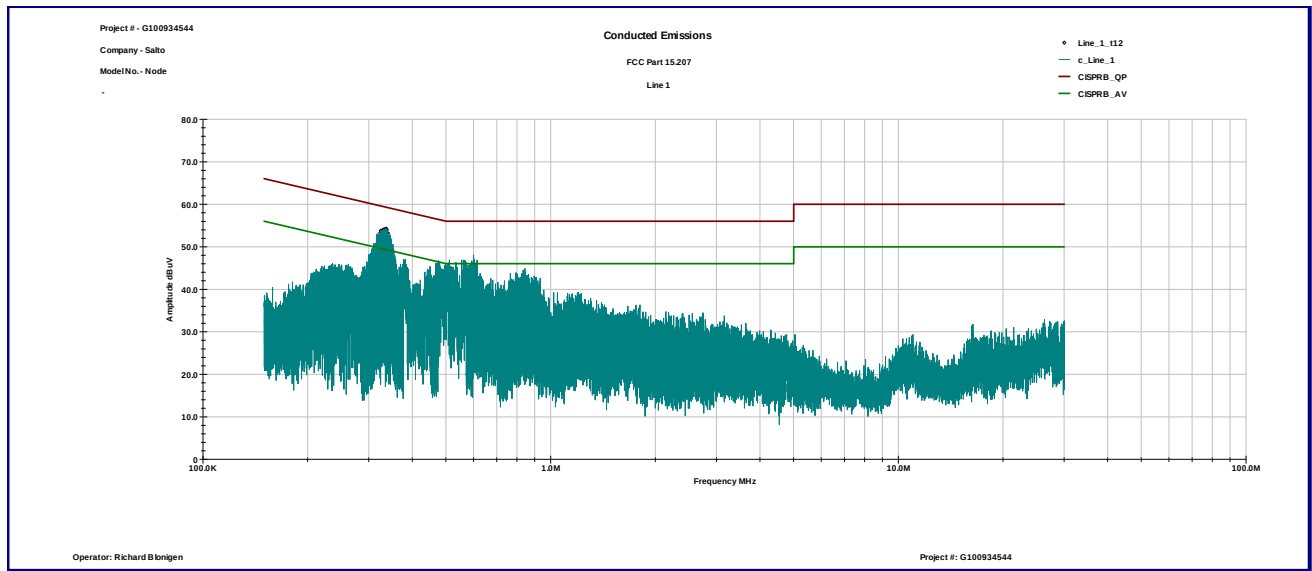
Table 3.7.1

Line 1

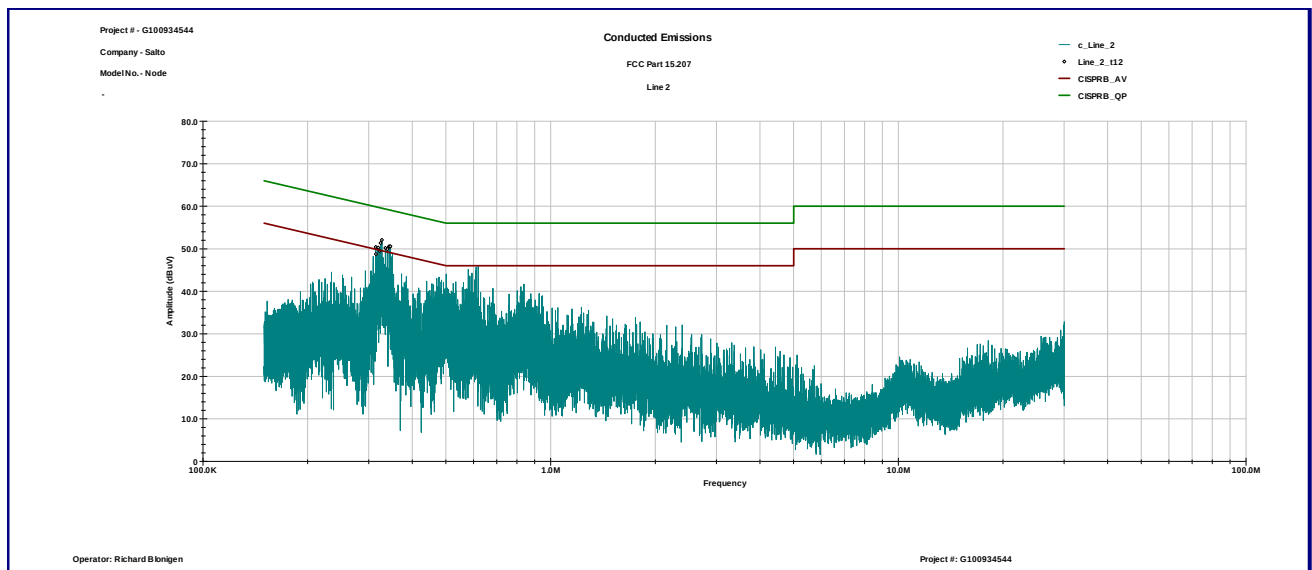
Frequency	QP dBμV	AVG dBμV	QP Limit dBμV	AVG Limit dBμV	QP Margin dB	AVG Margin dB
327.87 KHz	52.2	38.4	59.5	49.5	-7.3	-11.1
329.91 KHz	52.3	38.3	59.5	49.5	-7.2	-11.2
372.31 KHz	43.0	28.0	58.5	48.5	-15.5	-20.5
479.99 KHz	43.6	29.5	56.3	46.3	-12.7	-16.9
559.02 KHz	42.4	26.3	56.0	46.0	-13.6	-19.8
601.49 KHz	43.7	29.3	56.0	46.0	-12.3	-16.7

Line 2

Frequency	QP dBμV	AVG dBμV	QP Limit dBμV	AVG Limit dBμV	QP Margin dB	AVG Margin dB
317.22 KHz	43.6	28.7	59.8	49.8	-16.2	-21.1
331.48 KHz	45.1	30.4	59.4	49.4	-14.4	-19.0
338.99 KHz	43.8	28.6	59.2	49.2	-15.5	-20.7
464.19 KHz	36.7	20.9	56.6	46.6	-20.0	-25.7
580.26 KHz	36.1	21.0	56.0	46.0	-19.9	-25.0
613.8 KHz	35.7	20.1	56.0	46.0	-20.3	-25.9



Graph 3.7.1



Graph 3.7.2



3.8 Receiver/digital device radiated emissions

Test location: ☐ OATS ☒ Anechoic Chamber

Test distance: ☐ 10 meters ☒ 3 meters

Test result: **Pass**

Frequency range: 30MHz-13GHz

Max. Emissions margin: 5.1dB below the limits

Notes: None

Date:	January 10-11, 2013	Result: Pass
Standard:	FCC Part 15.109, Class B	
Tested by:	Richard Blonigen	
Test Point:	Enclosure	
Operation mode:	See page 5	
Note:	Frequency range 30MHz-1000MHz	

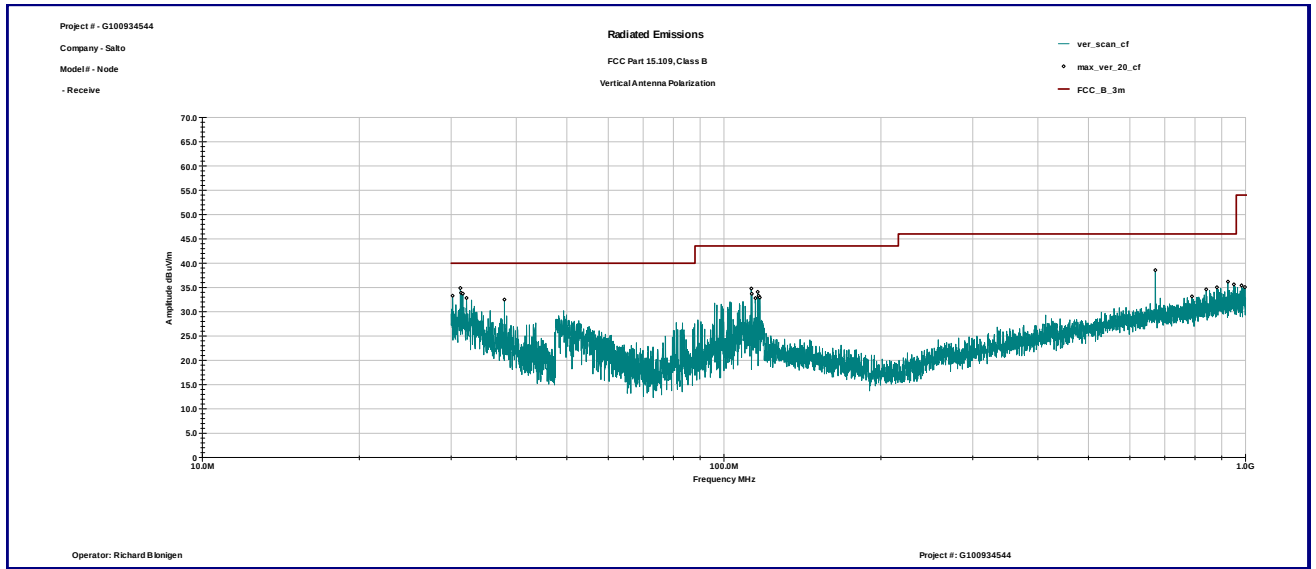
Table 3.8.1

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
30.193 MHz	V	13.2	20.1	33.3	40.0	-6.7
31.246 MHz	V	15.4	19.5	34.9	40.0	-5.1
32.106 MHz	V	13.9	18.9	32.8	40.0	-7.2
37.966 MHz	V	16.9	15.6	32.5	40.0	-7.5
112.82 MHz	V	21.1	13.7	34.8	43.5	-8.7
113.13 MHz	V	20.0	13.7	33.7	43.5	-9.8
116.08 MHz	V	20.3	13.8	34.1	43.5	-9.5
671.81 MHz	V	15.7	22.9	38.6	46.0	-7.5
840.56 MHz	V	9.9	24.7	34.6	46.0	-11.4
881.22 MHz	V	9.9	25.1	35.0	46.0	-11.0
925.08 MHz	V	10.7	25.5	36.2	46.0	-9.8
950.22 MHz	V	9.9	25.7	35.6	46.0	-10.4
30.86 MHz	H	7.1	19.7	26.8	40.0	-13.2
95.543 MHz	H	14.2	11.7	25.9	43.5	-17.6
113.61 MHz	H	13.3	13.8	27.0	43.5	-16.5
116.39 MHz	H	14.7	13.8	28.5	43.5	-15.0
116.96 MHz	H	12.8	13.8	26.6	43.5	-16.9
367.56 MHz	H	10.0	17.8	27.7	46.0	-18.3
413.0 MHz	H	8.5	19.7	28.2	46.0	-17.9
649.28 MHz	H	9.7	22.7	32.4	46.0	-13.6
671.53 MHz	H	18.0	22.9	40.9	46.0	-5.2
708.79 MHz	H	9.7	22.9	32.6	46.0	-13.4
836.86 MHz	H	9.5	24.6	34.1	46.0	-11.9
841.79 MHz	H	9.5	24.7	34.3	46.0	-11.8
924.84 MHz	H	10.6	25.5	36.0	46.0	-10.0

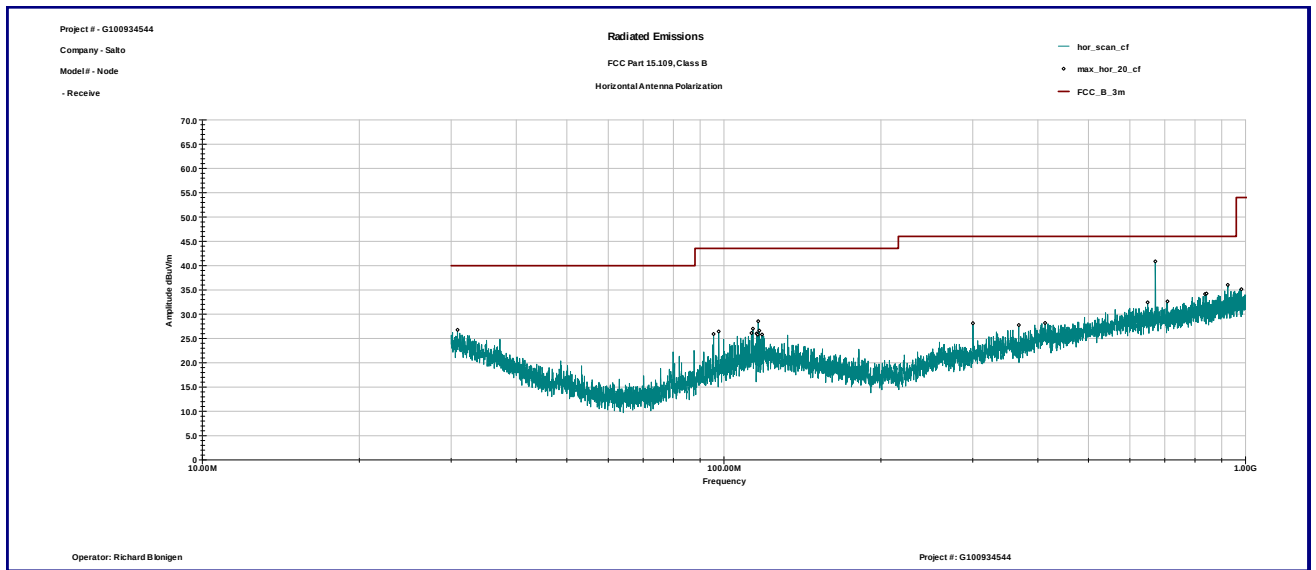
Date:	January 10-11, 2013	Result: Pass
Standard:	FCC Part 15.109, Class B	
Tested by:	Richard Blonigen	
Test Point:	Enclosure	
Operation mode:	See page 5	
Note:	Frequency range 1GHz-13GHz	

Table 3.8.2

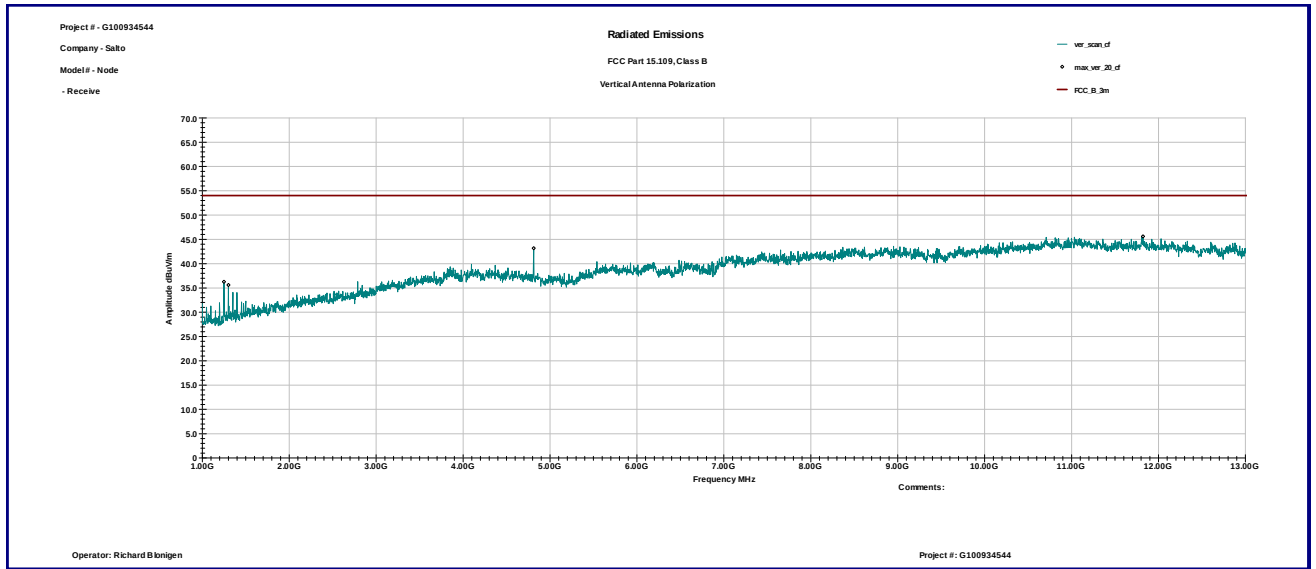
Frequency MHz	Antenna Polarity	Peak Reading dBμV	Total C.F. dB1/m	Pre-Amp. Gain (dB)	Total at 3m dBμV/m	Limit dBμV/m	Margin dB
1.249 GHz	V	51.6	26.6	42.0	36.3	54.0	-17.7
1.3 GHz	V	50.7	26.8	41.9	35.6	54.0	-18.4
4.813 GHz	V	45.1	37.2	39.2	43.2	54.0	-10.8
1.099 GHz	H	49.8	26.0	42.1	33.8	54.0	-20.2
1.198 GHz	H	50.3	26.4	42.0	34.7	54.0	-19.2
1.249 GHz	H	51.1	26.6	42.0	35.8	54.0	-18.2
1.3 GHz	H	49.8	26.8	41.9	34.6	54.0	-19.3
4.813 GHz	H	49.9	37.1	39.2	47.9	54.0	-6.1



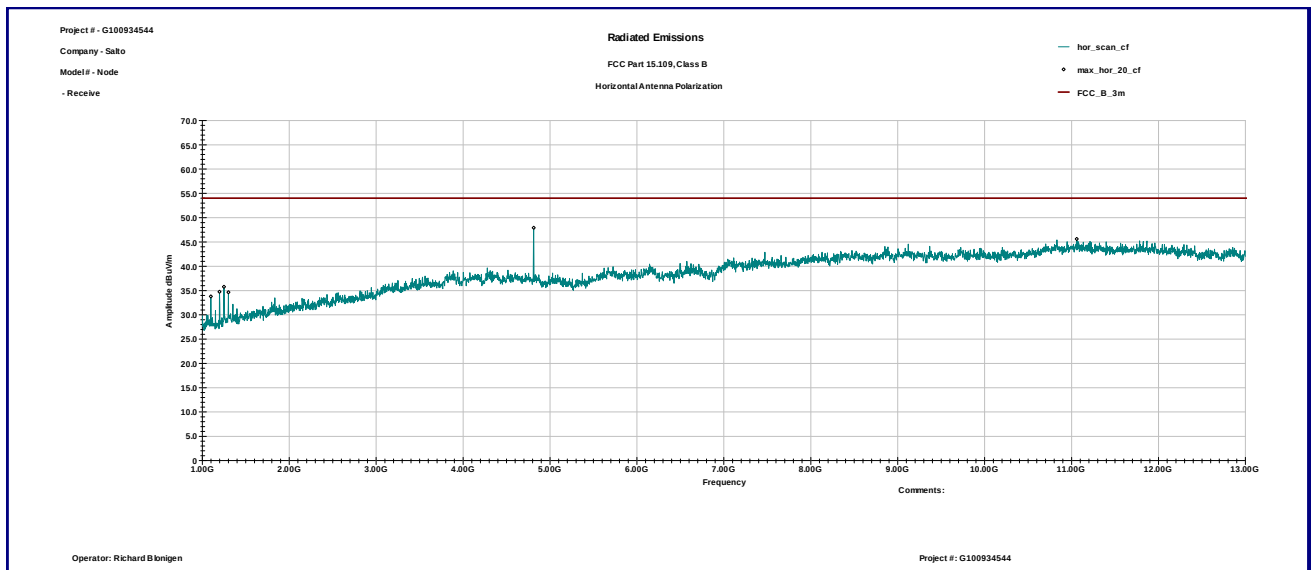
Graph 3.8.1



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: **Pass**

Frequency range: 0.15MHz-30MHz

Max. Emissions margin: 7.2dB below the limits

Notes: None

Date:	January 11, 2013	Result: Pass
Standard:	FCC 15.107, Class B	
Tested by:	Richard Blonigen	
Test Point:	Power Line	
Operation mode:	See page 5	
Note:	None	

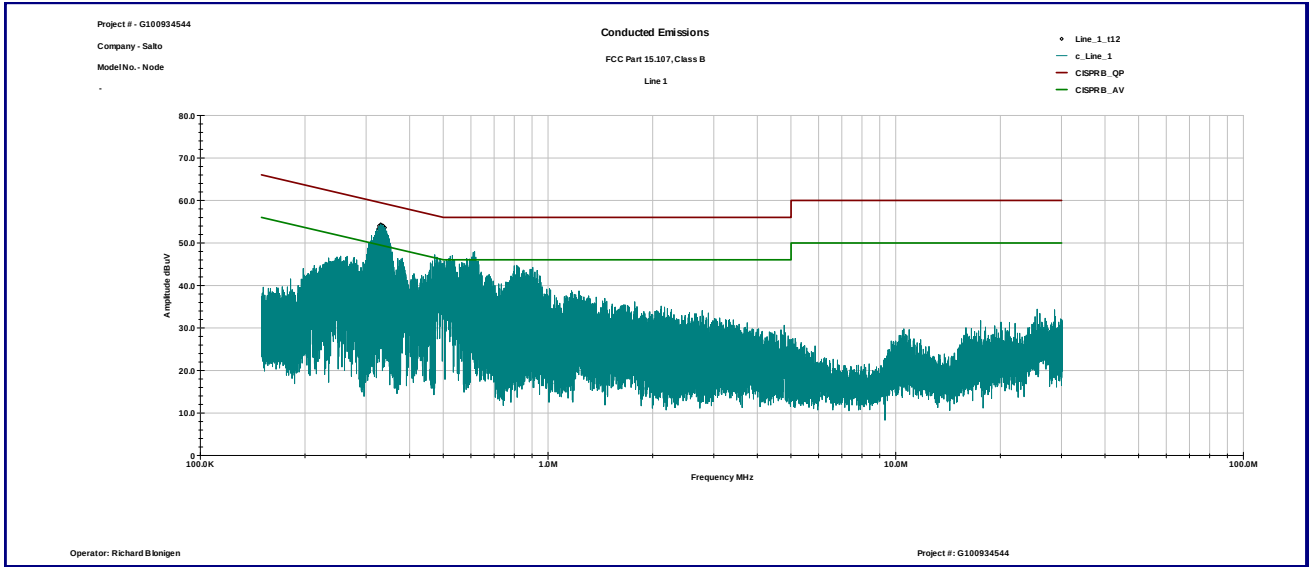
Table 3.9.1

Line 1

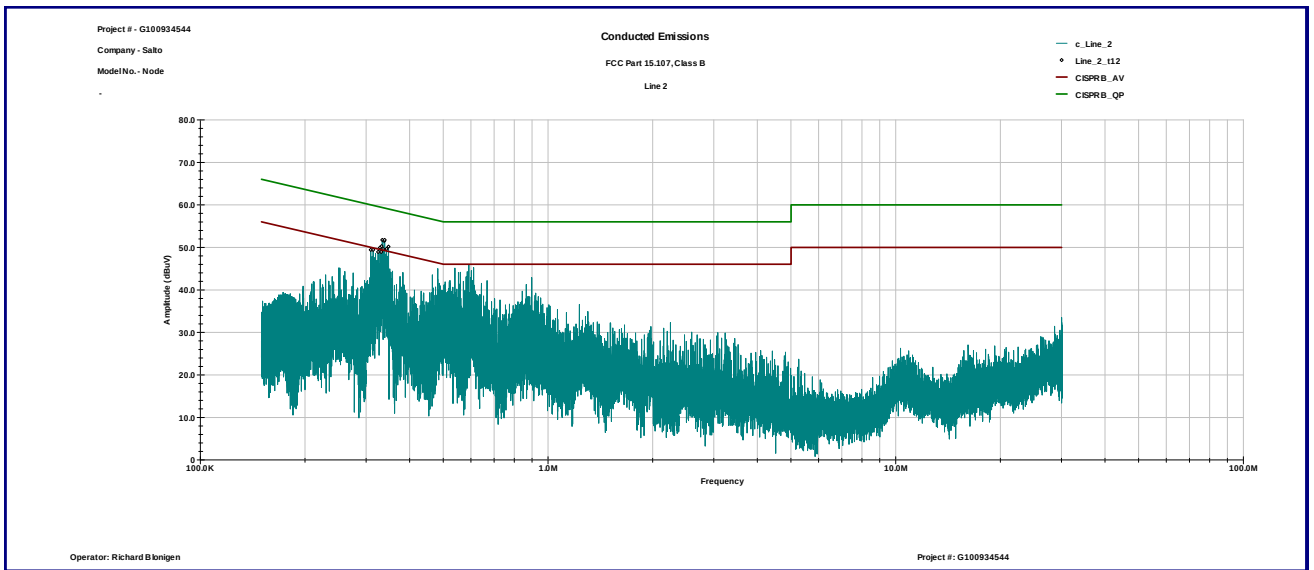
Frequency	QP dBμV	AVG dBμV	QP Limit dBμV	AVG Limit dBμV	QP Margin dB	AVG Margin dB
328.92 KHz	52.1	38.0	59.5	49.5	-7.3	-11.5
333.78 KHz	52.2	38.6	59.4	49.4	-7.2	-10.8
370.62 KHz	42.7	28.4	58.5	48.5	-15.8	-20.1
480.23 KHz	43.0	27.5	56.3	46.3	-13.4	-18.8
529.45 KHz	43.3	27.7	56.0	46.0	-12.7	-18.3
618.52 KHz	44.3	28.4	56.0	46.0	-11.7	-17.6

Line 2

Frequency	QP dBμV	AVG dBμV	QP Limit dBμV	AVG Limit dBμV	QP Margin dB	AVG Margin dB
317.43 KHz	43.1	28.4	59.8	49.8	-16.7	-21.4
332.91 KHz	44.8	31.0	59.4	49.4	-14.5	-18.4
376.9 KHz	36.7	22.0	58.4	48.4	-21.6	-26.4
475.52 KHz	37.1	19.8	56.4	46.4	-19.4	-26.6
533.71 KHz	36.9	20.0	56.0	46.0	-19.1	-26.0
613.97 KHz	37.3	22.0	56.0	46.0	-18.7	-24.0



Graph 3.9.1



Graph 3.9.2



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	ESCI	100358	12909	07/02/2013	☒
Bicono-Log Antenna	Teseq	CBL6112D	32859	25289	08/09/2013	☒
LISN	Fischer Custom Communications	FCC-LISN-2 MOD.SD	316	9945	07/17/2013	☒
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	☒