



TEST REPORT

Report Number: 3139349MIN-003

Project Number: 3139349

Testing performed on the
RM2510

FCC ID: LW2RM2510

Industry Canada ID: 2731A-RM2510

to

47 CFR Part 15. 247:2006

RSS- 210 , Issue 7, 2007

For

Rosemount, Inc.

Test Performed by:
Intertek Testing Services NA, Inc.
7250 Hudson Blvd., Suite 100
Oakdale, MN 55128

Test Authorized by:
Rosemount, Inc.
8200 Market Blvd.
Chanhassen, MN 55317

Prepared by: Norman Shpilsher
Norman Shpilsher

Date: December 13, 2007

Reviewed by: Uri Spector
Uri Spector

Date: December 13, 2007

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1.0 GENERAL DESCRIPTION

Model:	RM2510
Type of EUT:	2.4GHz Wireless HART Radio Module
Serial Number:	N/A
FCC ID:	LW2RM2510
Industry Canada ID:	2731A-RM2510
Related Submittal(s) Grants:	None
Company:	Rosemount, Inc.
Customer:	Mr. Merritt Pulkrabek
Address:	8200 Market Blvd., Mail Stop PH03 Chanhassen, MN 55317
Phone:	(952) 949-5193
Fax:	(952) 949-7626
Test Standards:	☒ FCC Part 15.247 ☒ RSS-210, Issue 7, 2007 ☒ RSS-Gen, Issue 2, 2005 ☒ 47 CFR, Part 15:2005, §15.107 and §15.109, Class B ☐ Other
Type of radio:	☐ Stand -alone ☒ Module ☐ Hybrid
Date Sample Submitted:	December 5, 2007
Test Work Started:	December 5, 2007
Test Work Completed:	December 12, 2007
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 (DSSS) ☐ WiFi ☐ Blue Tooth
Operating Frequency Range(s):	From 2400 to 2483.5 MHz
Number of Channels:	15 (from channel 0 to 14)
Modulation:	QPSK
Antenna(s) Info:	Type: Omni directional Gain: 2 dBi Connector Type: SM
Power settings:	8 dBm
Antenna Installation:	☐ User ☐ Professional ☒ Factory
Transmitter power configuration:	☐ Internal battery ☒ External power source ☐ 120VAC ☐ 230VAC ☐ 400VAC ☒ 3 VDC ☐ Other: Amp. ☐ 50Hz ☐ 60Hz
Test Methodology:	Emission measurements were performed according to the procedures in ANSI C63.4-2003 and FCC Public Notice DA 00-705: March 30, 2000. All field strength radiated emissions measurements were performed in the semi-anechoic chamber, and for each scan, the procedure for maximizing emissions in were followed. All field strength radiated tests were performed at an antenna to EUT distance of 3 meters, unless stated otherwise in the "Justification Section" of this Application
Special Test Arrangement:	None
Test Facility:	The test site facility used to collect the radiated and conducted measurement data is located at 7250 Hudson Blvd., Suite 100, Oakdale, Minnesota. This test facility has been accredited by A2LA (Certificate No. 1427.01)
Justification:	None

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
2	

Cables:

No.	Type	Length	Designation	Note
1	RF cable, 0.25dB loss at 2.4GHz	12"	Measurements at the antenna terminal	
2				

Support equipment/Services:

No.	Item	Description
1	DUST 1107A Board	Interface PCB
2	MS Hyper Terminal	Software for control the EUT operation mode

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 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: None

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-210A8.2	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
15.207/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

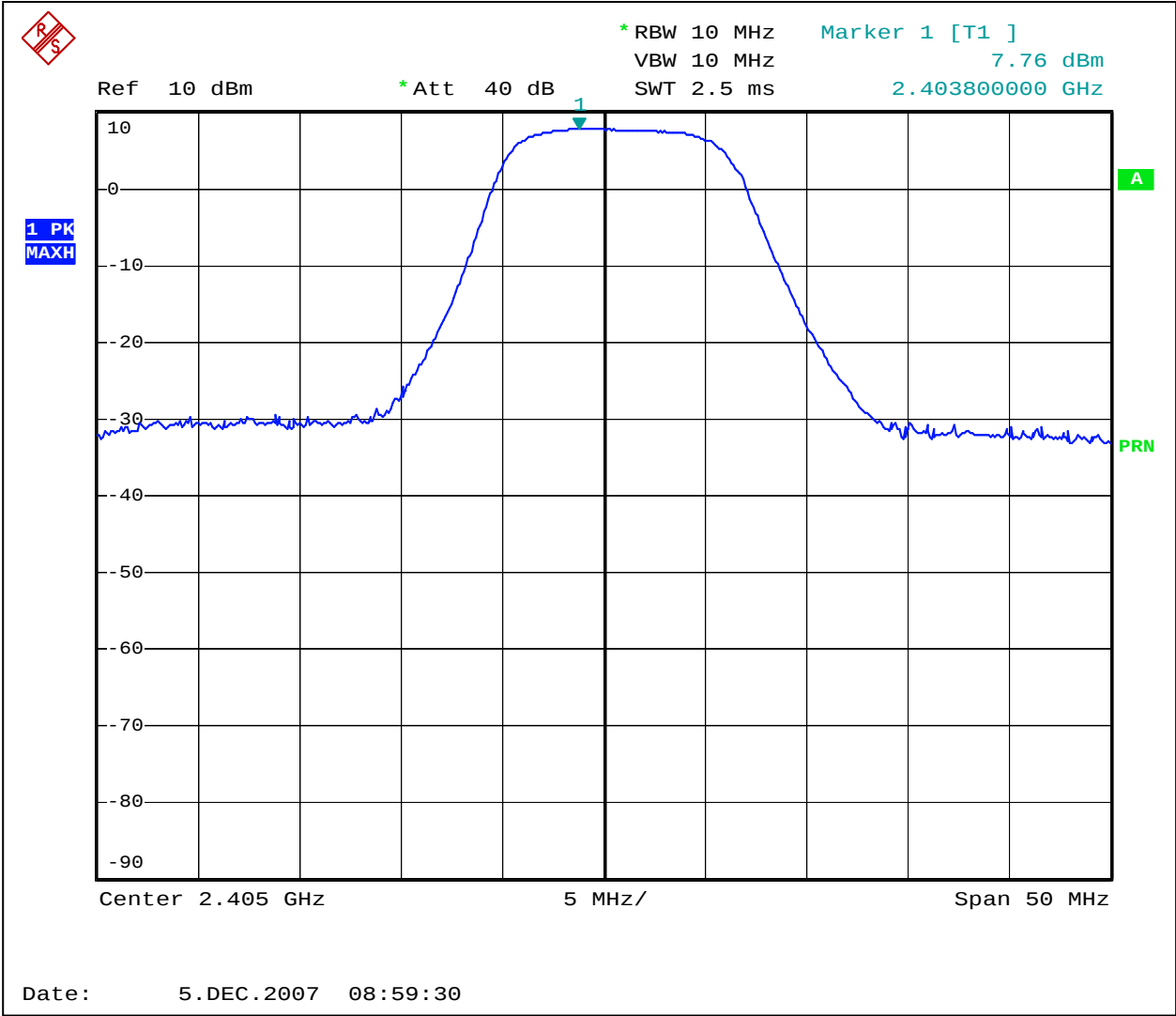
Test location: ☐ OATS ☐ Anechoic Chamber ☒ Other

Test result: **Pass**

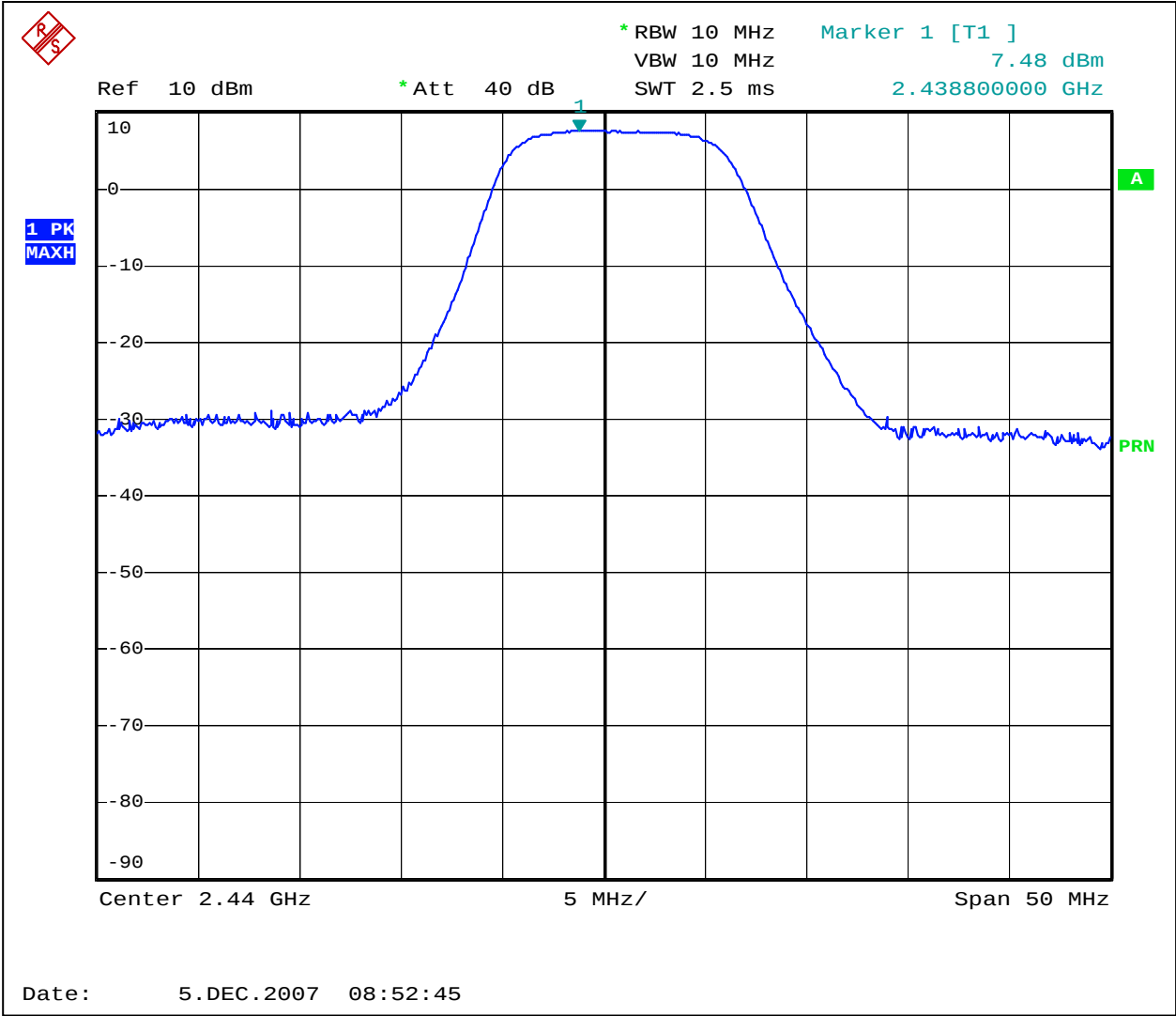
Max. Margin: 22 dB below the limits

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	7.76	0.25	8.01	30	0	-21.99
Middle Frequency MHz						
2439	7.48	0.25	7.73	30	0	-22.27
Upper Frequency MHz						
2475	7.12	0.25	7.37	30	0	-22.63
RBW:	☐ 1MHz	☐ 3MHz	☒ 10MHz			
VBW:	☐ 1MHz	☐ 3MHz	☒ 10MHz			
Antenna Gain:	☒ < 6dBi ☐ >6dBi and = dBi, Output power reduction = dB					

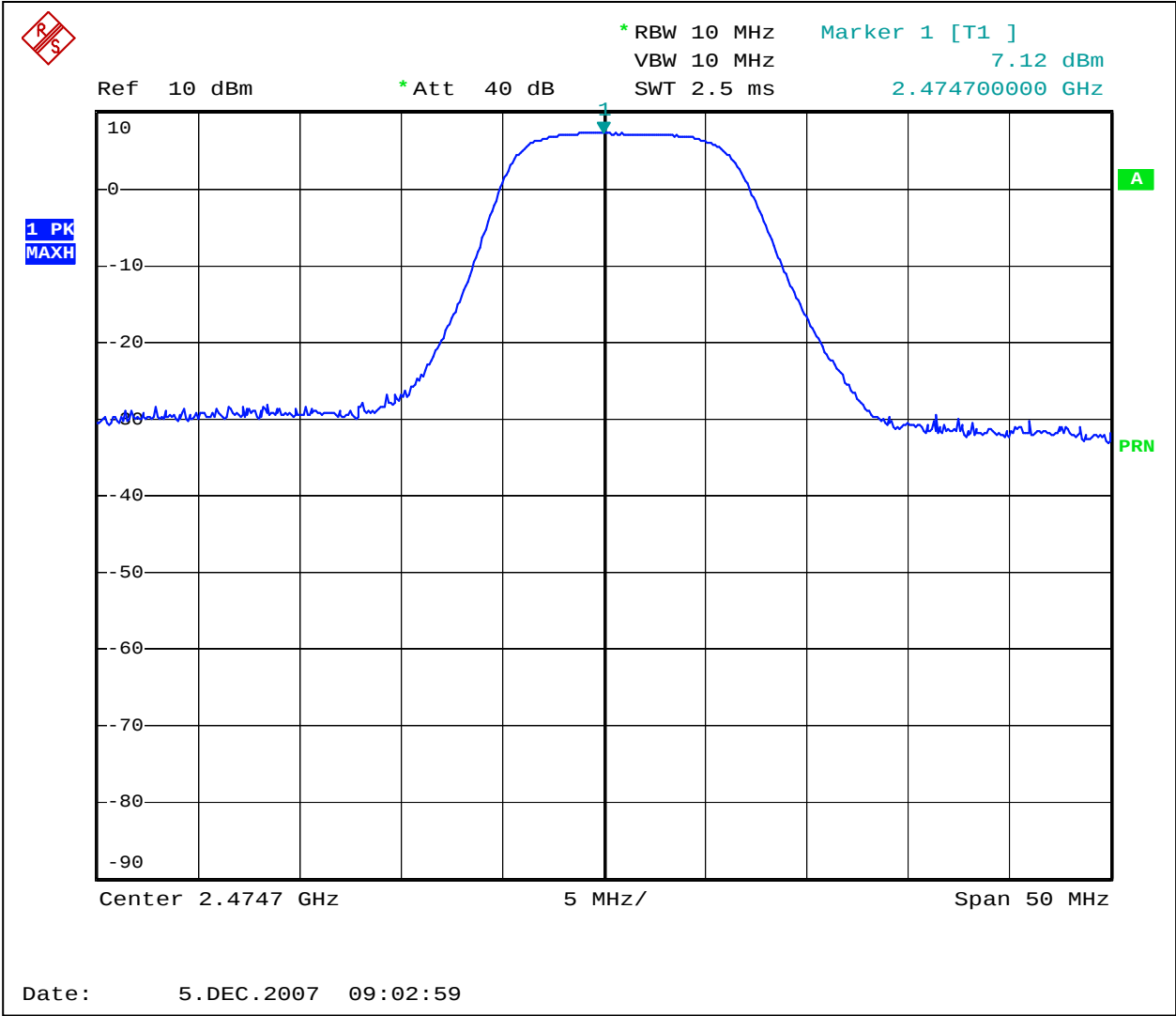
Notes: The maximum peak conducted output power limit is 1 W, or 30dBm
 Graphs 3.1.1 to 3.1.3 show the conducted output power



Graph 3.1.1



Graph 3.1.2

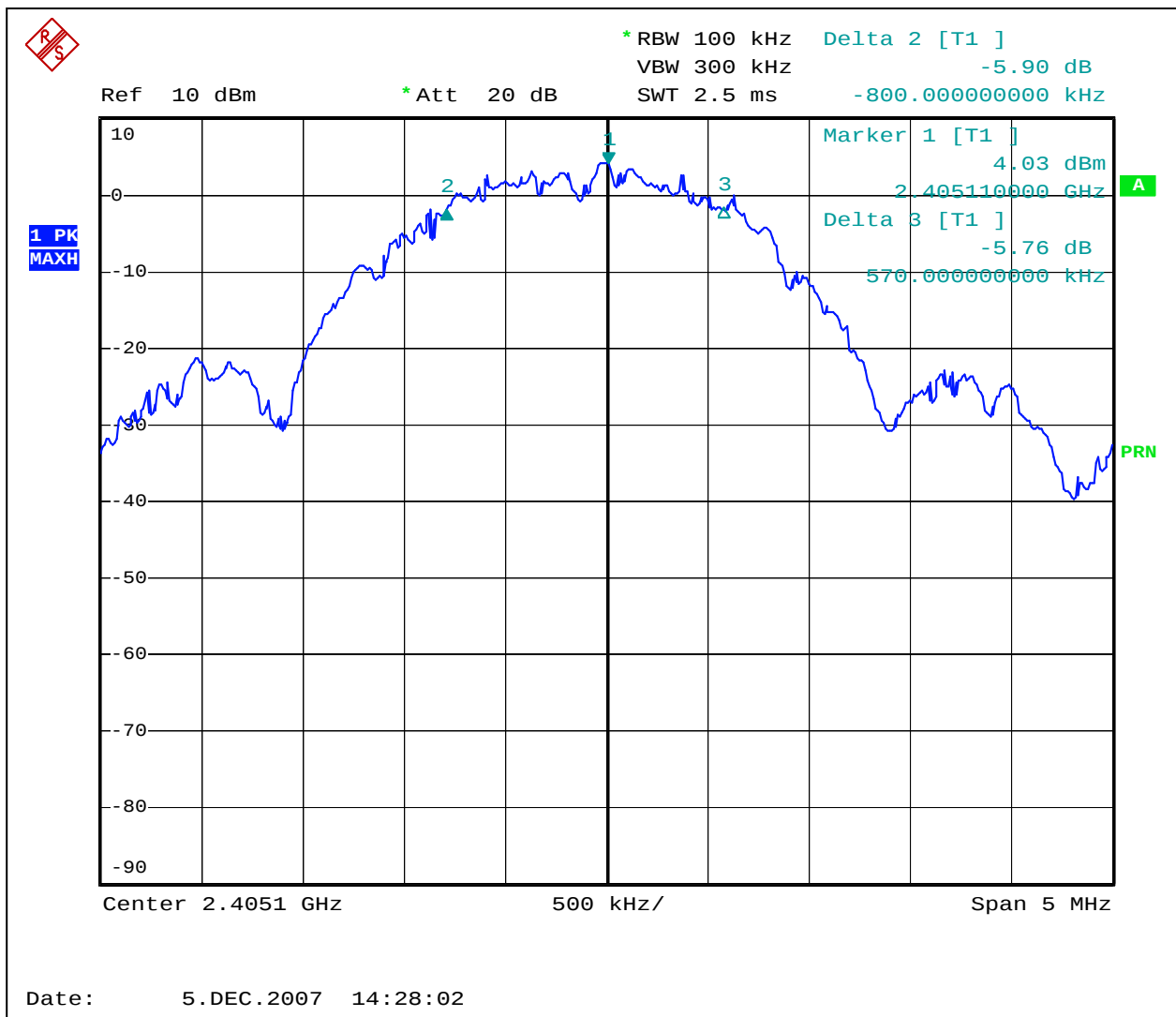


Graph 3.1.3

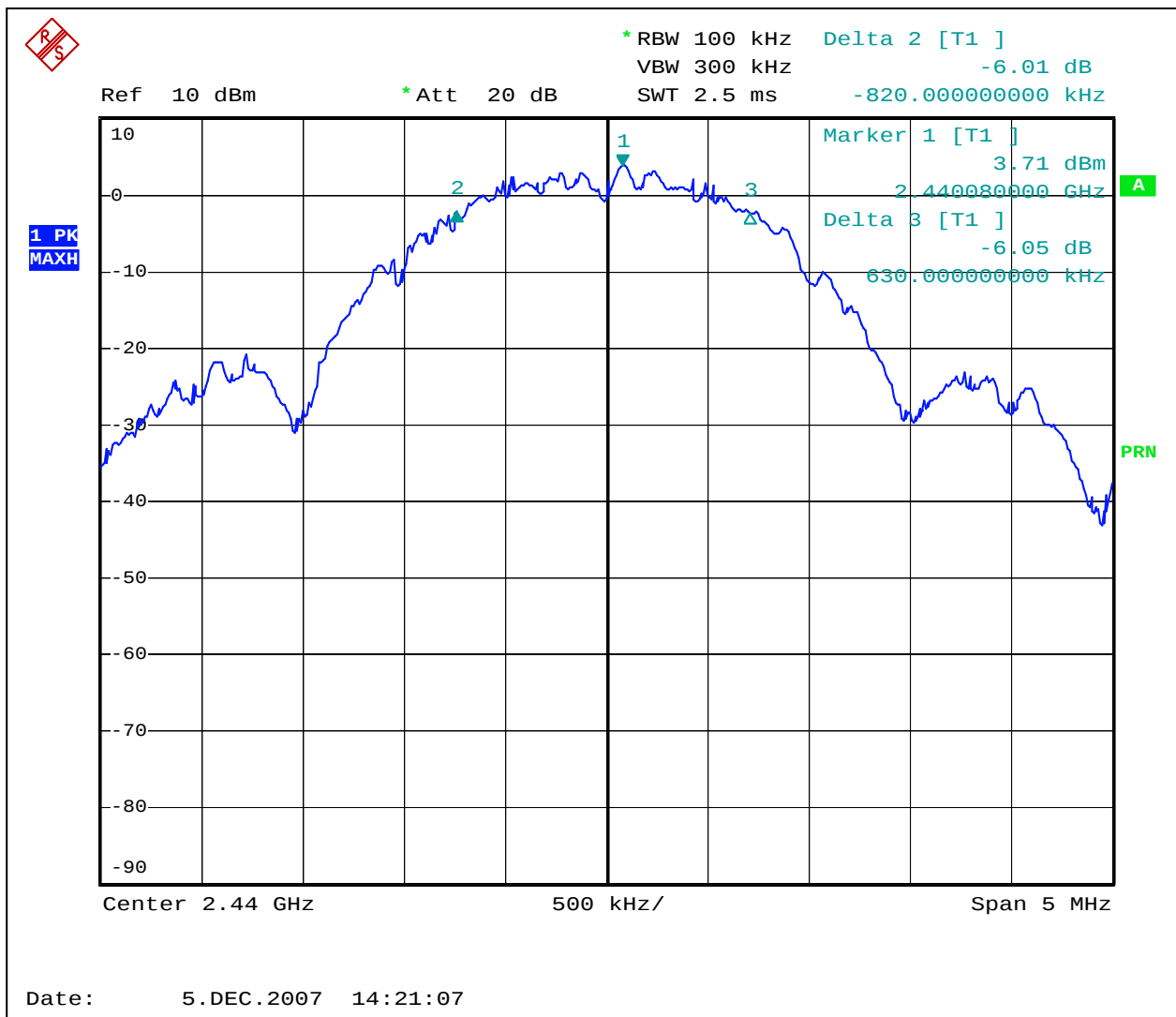
3.2 6dB bandwidth of the digital modulation

Low Frequency Channel kHz	Middle Frequency Channel kHz	Upper Frequency Channel kHz	Minimum Allowed Bandwidth kHz	Result
1370	1450	1560	500	Pass

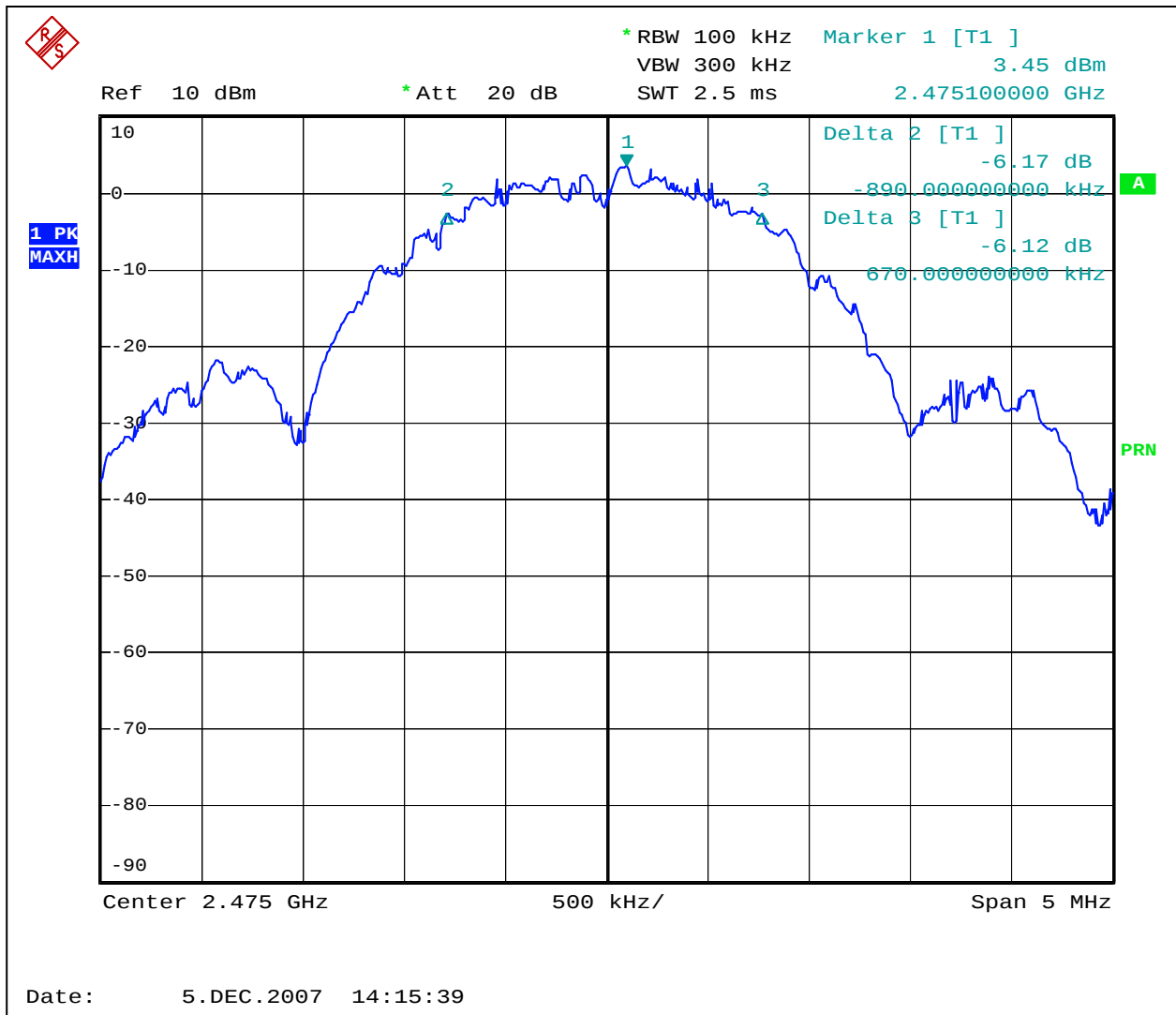
Notes: Graphs 3.2.1 to 3.2.3 show the 6dB bandwidth



Graph 3.2.1



Graph 3.2.2

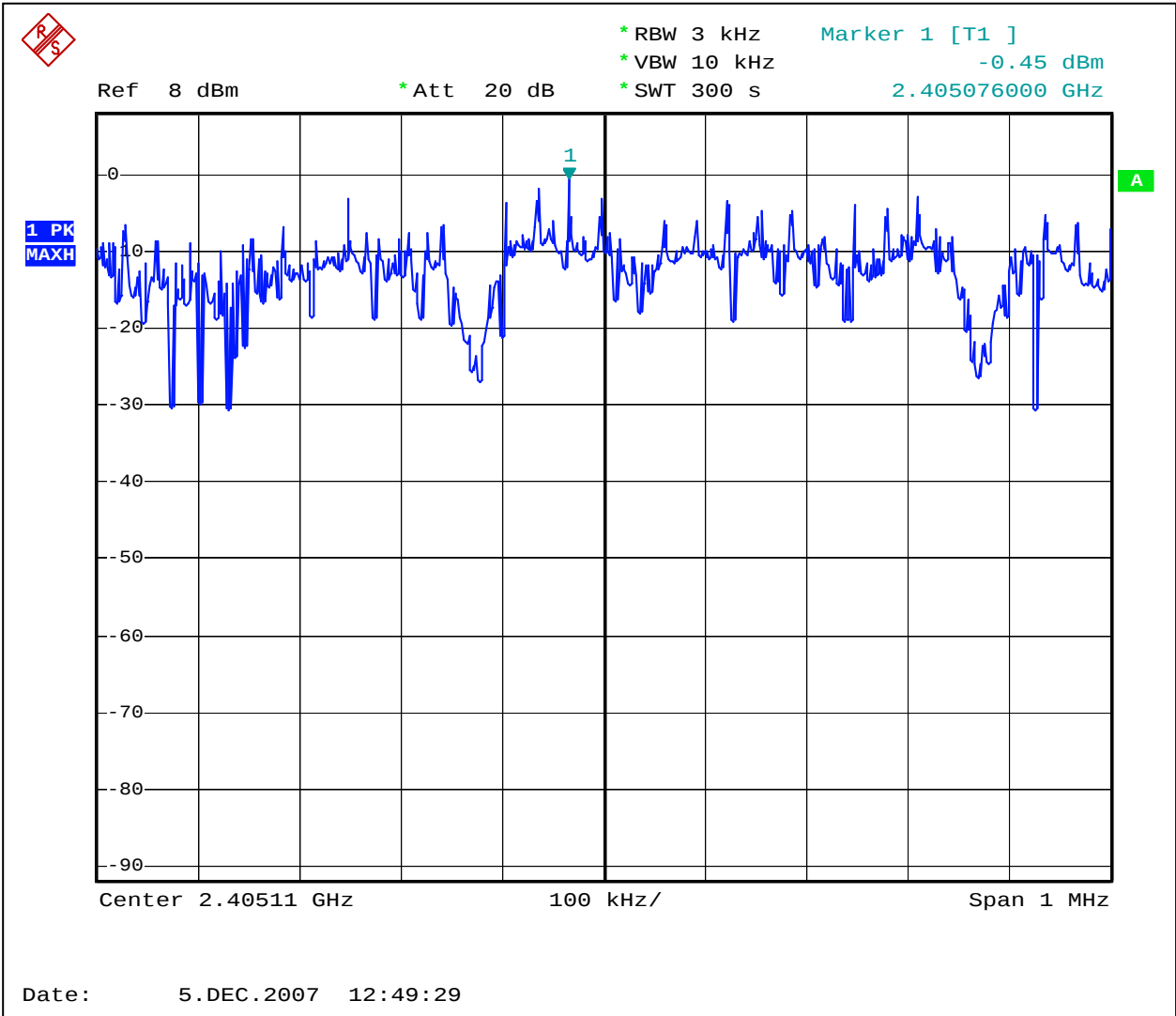


Graph 3.2.3

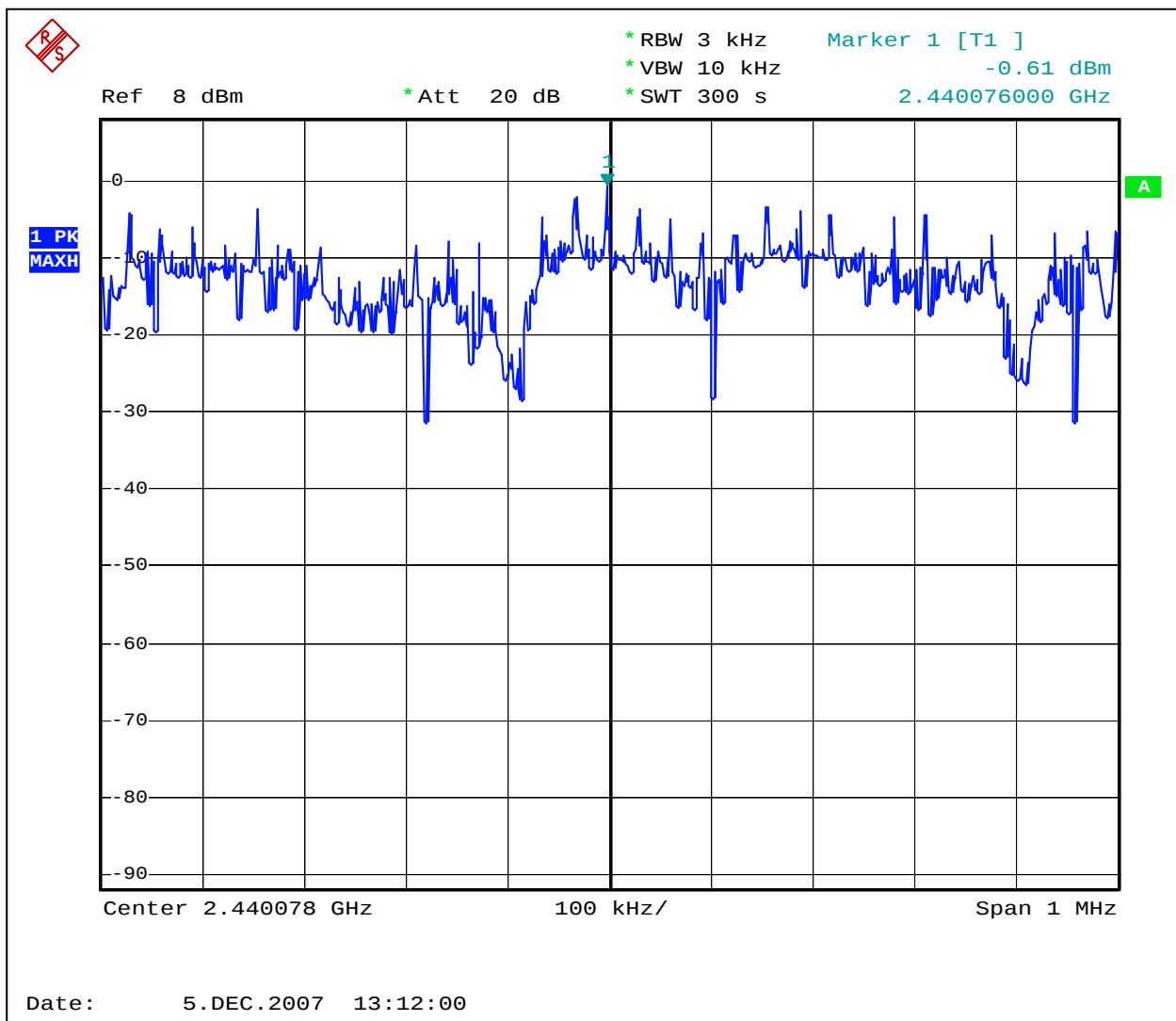
3.3 Power spectral density

Power Output:	☒ Conducted ☐ Radiated			
	Measured Density dBm	Power Spectral Density dBm	Limit dBm	Margin dB
Low Frequency Channel	-0.45	-0.2	8	-8.2
Middle Frequency Channel	-0.61	-0.4	8	-8.4
Upper Frequency Channel	-0.88	-0.6	8	-8.6
Analyzer Settings:	☒ RBW=3KHz ☒ VBW=10KHz ☒ Span=1MHz ☒ Sweep=300sec			
Antenna Gain:	☒ < 6dBi and = 2 dBi ☐ >6dBi and = dBi, limit reduction = dB			

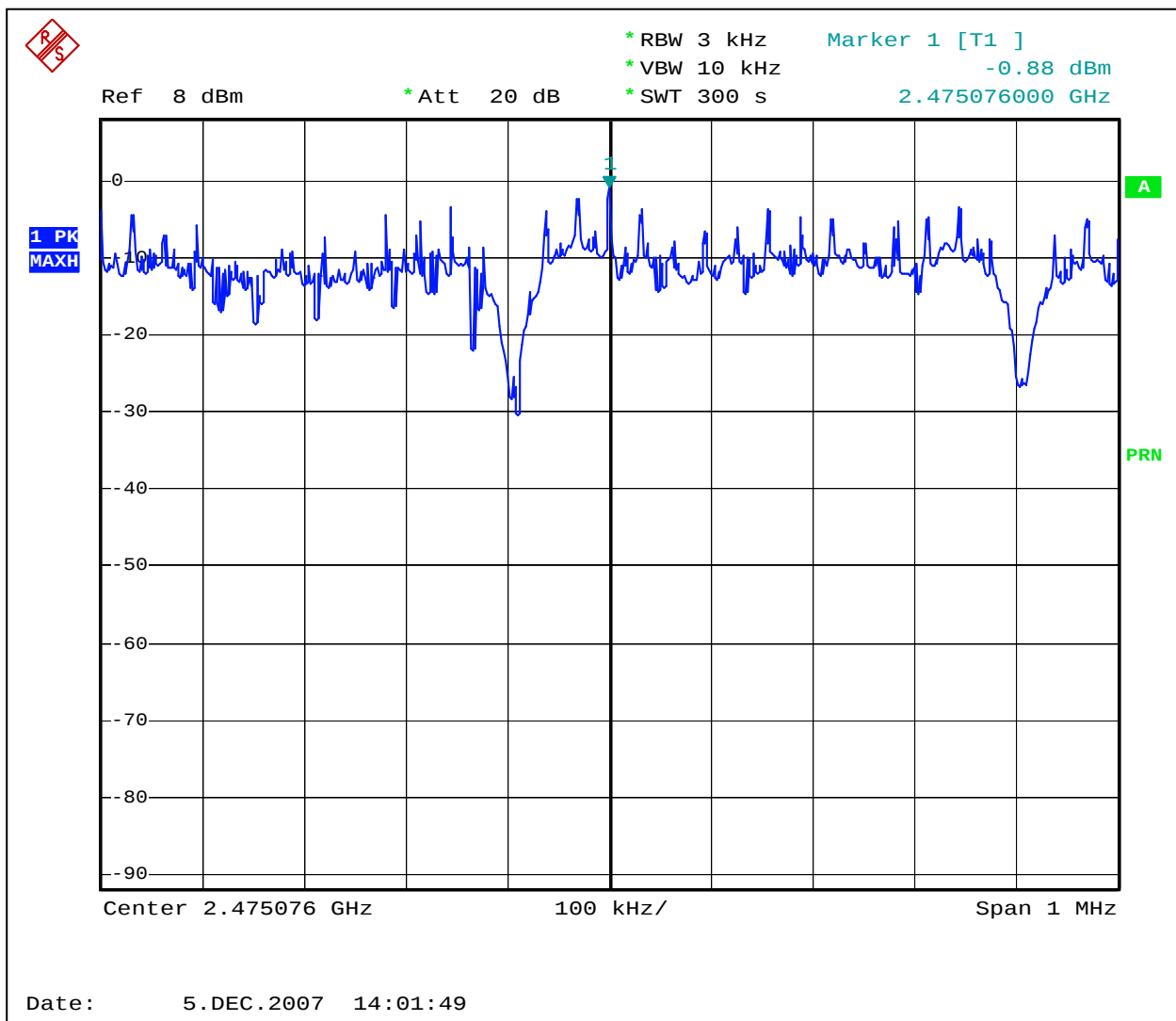
Notes: The Power Spectral Density was calculated adding the cable/attenuator loss of 0.25 dB from the measured density value.
 Graphs 3.3.1 to 3.3.3 show the Power Spectral Density



Graph 3.3.1



Graph 3.3.2

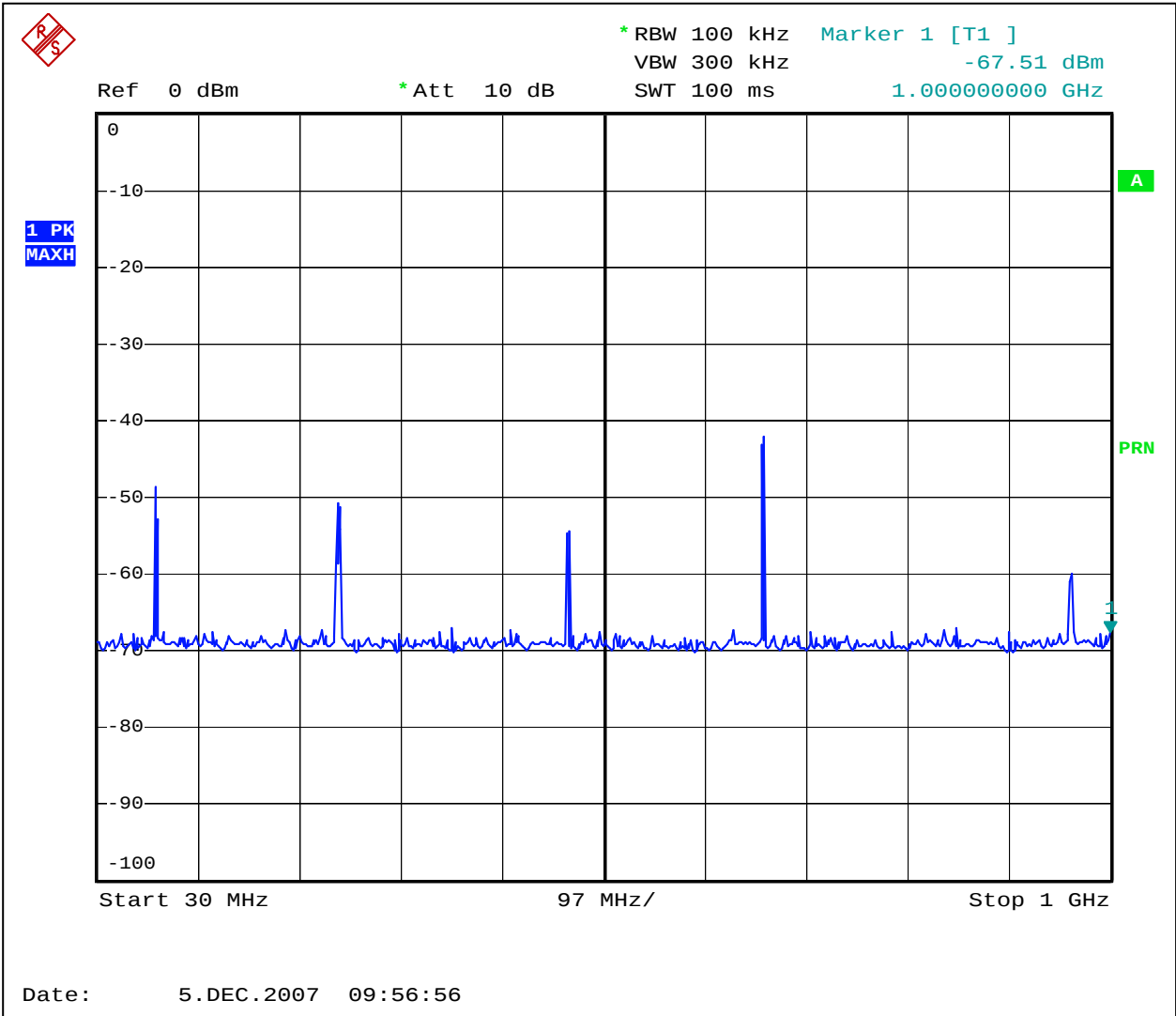


Graph 3.3.3

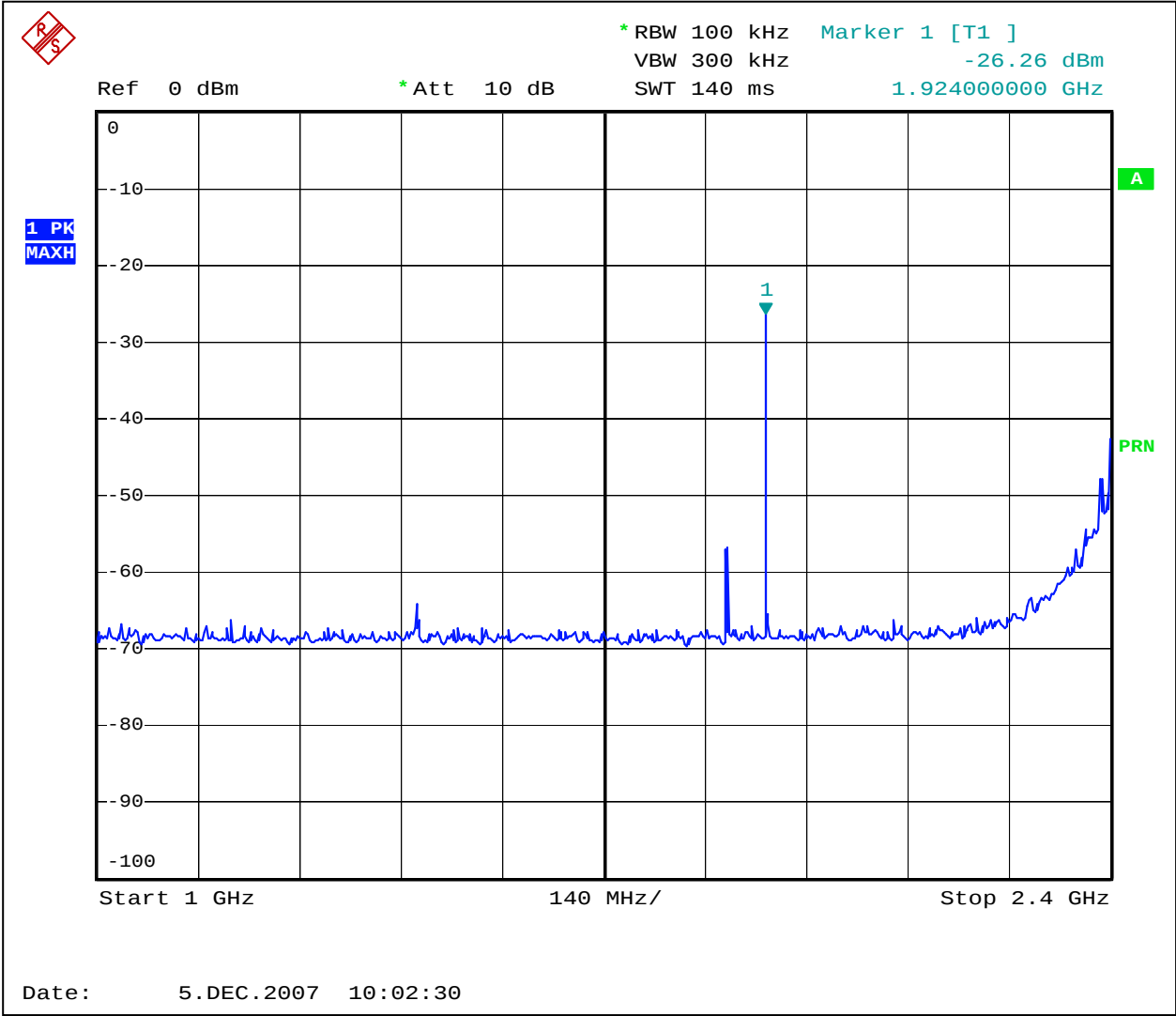
3.4 Antenna conducted spurious emissions

	Minimum Measured Attenuation dB	Minimum Allowed Attenuation dB	Margin dB
Low Frequency Channel	34.0	20	-14.0
Middle Frequency Channel	34.2	20	-14.2
Upper Frequency Channel	45.1	20	-25.1
Analyzer Settings:	☒ RBW=100KHz		
Minimum Allowed Attenuation:	☒ 20dB ☐ 30dB (for digital systems with conducted power measured using RMS averaging over a time interval)		

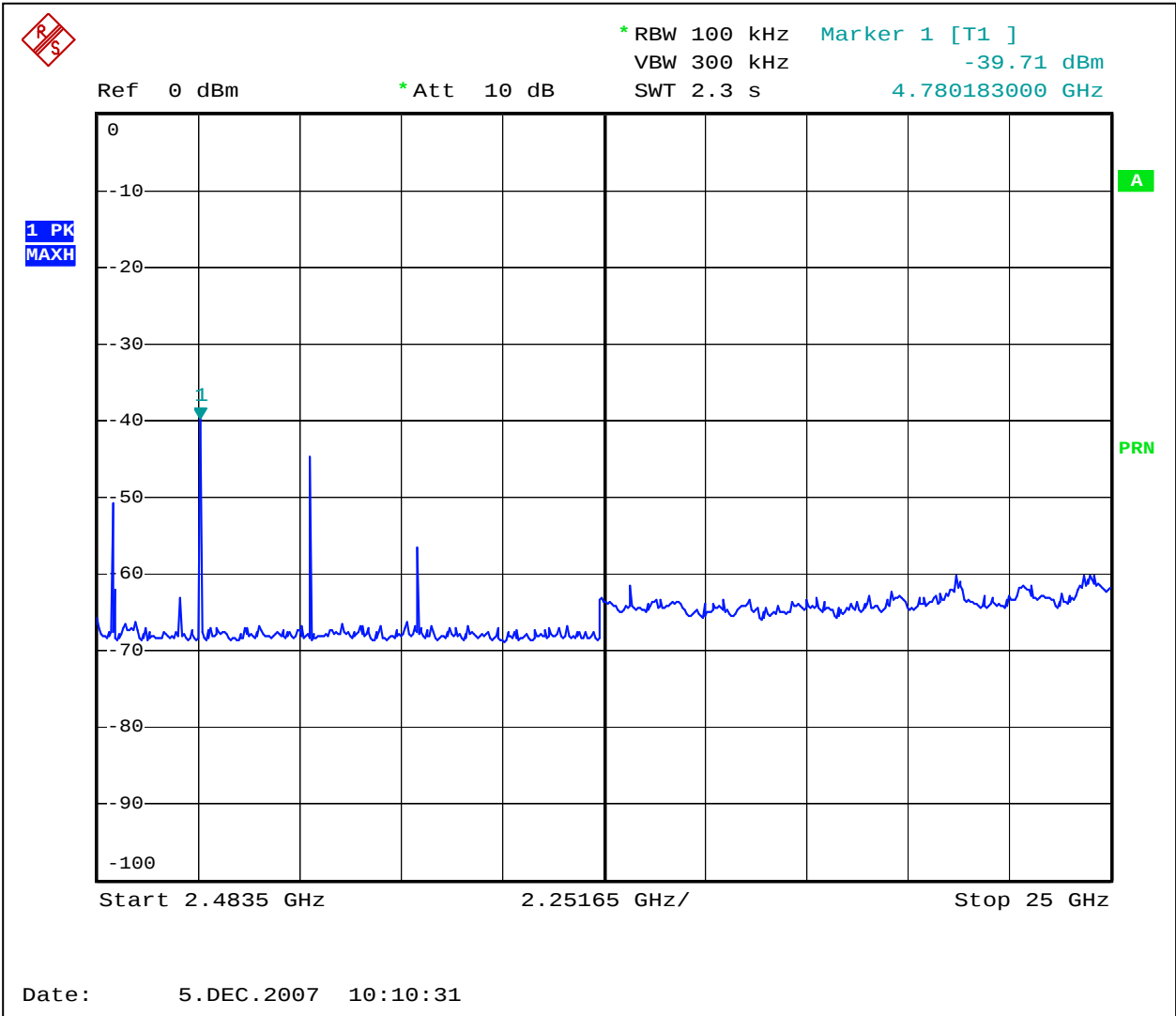
Notes: Test was performed in frequency range from 30MHz to 25GHz
 Graphs 3.4.1 to 3.4.3 show the Antenna Conducted Spurious Emissions for channel 0
 Graphs 3.4.4 to 3.4.6 show the Antenna Conducted Spurious Emissions for channel 7
 Graphs 3.4.7 to 3.4.9 show the Antenna Conducted Spurious Emissions for channel 14
 Graph 3.4.10 shows band edge compliance at 2400MHz
 Graph 3.4.11 shows band edge compliance at 2483.5MHz



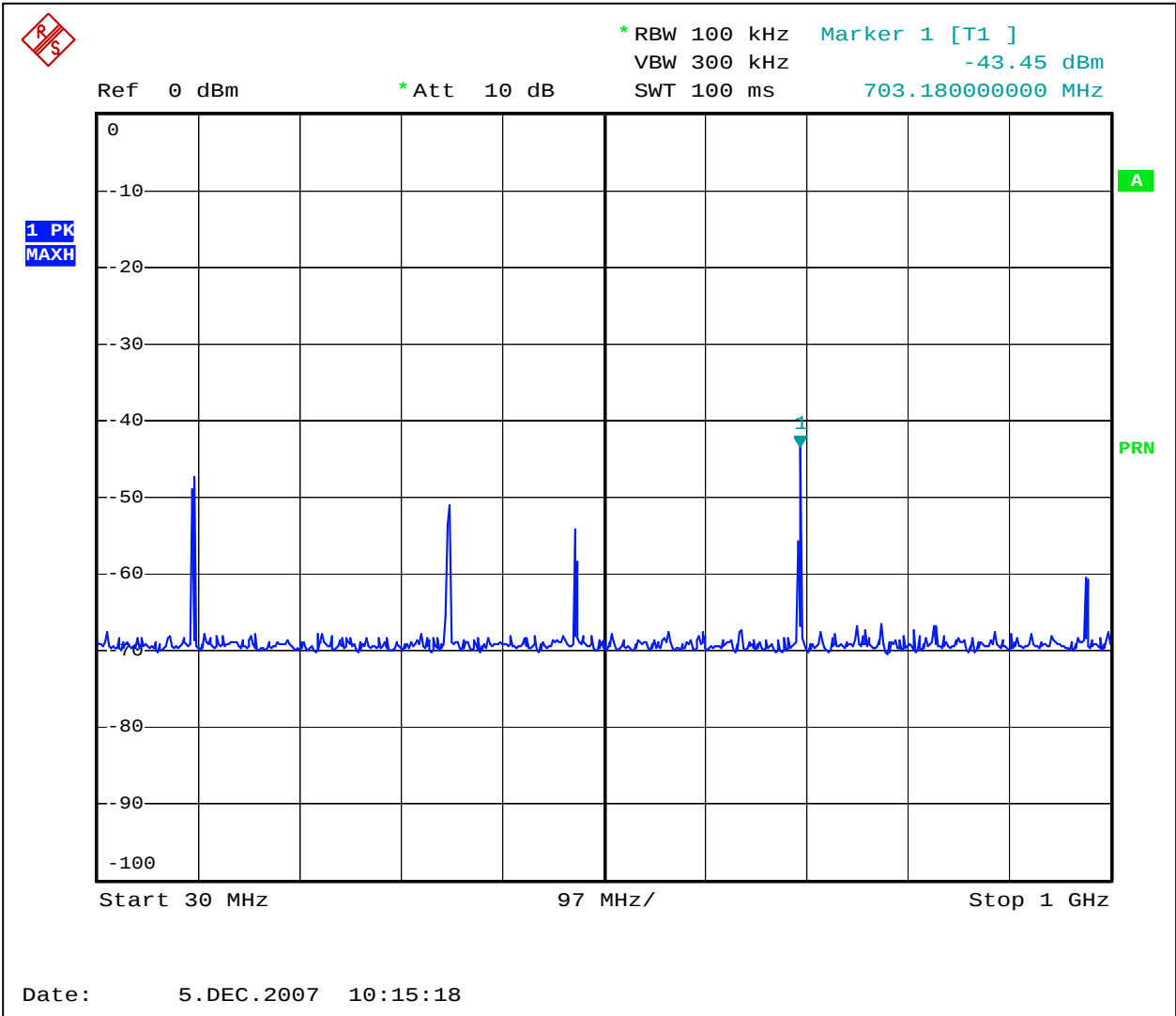
Graph 3.4.1



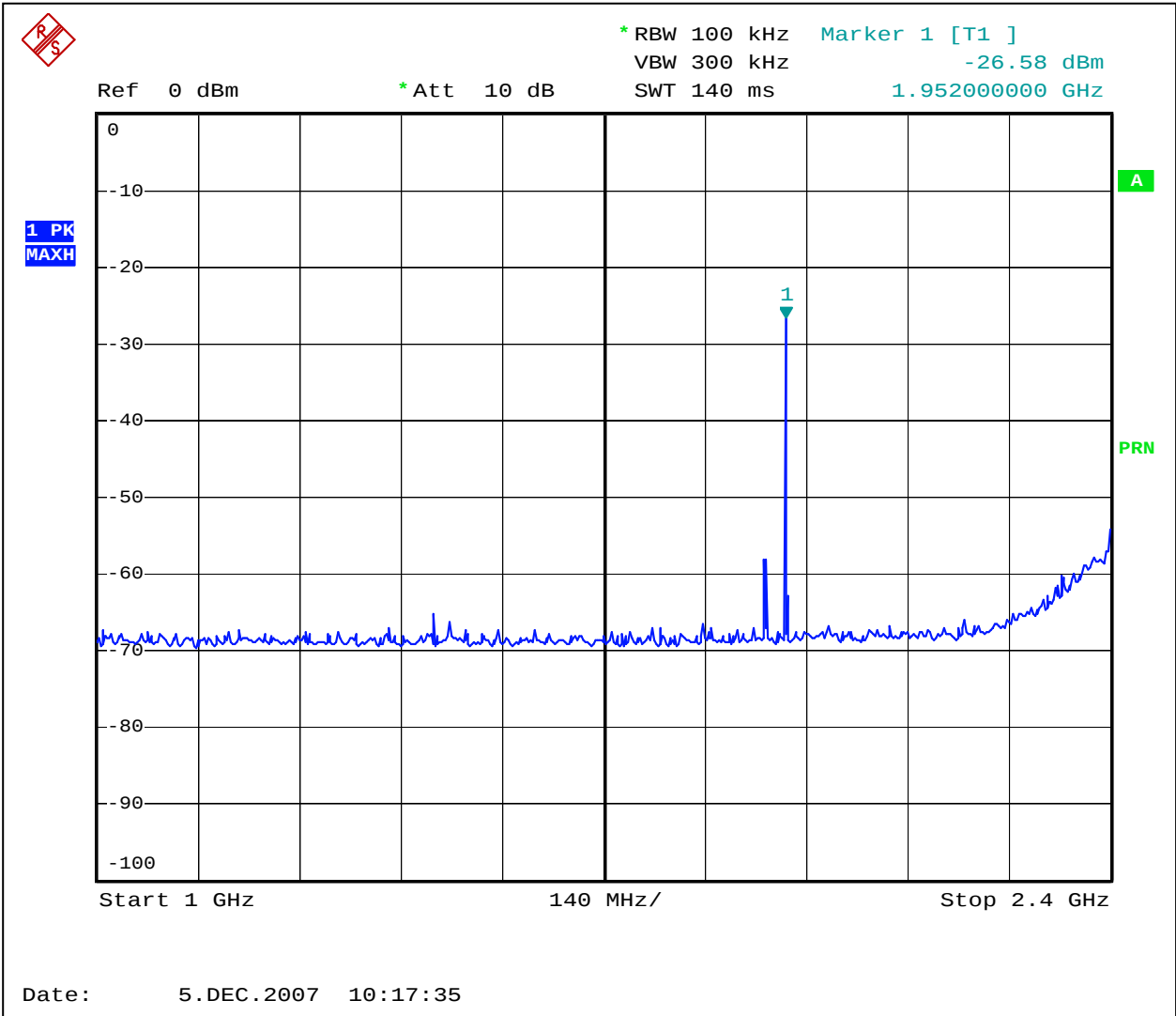
Graph 3.4.2



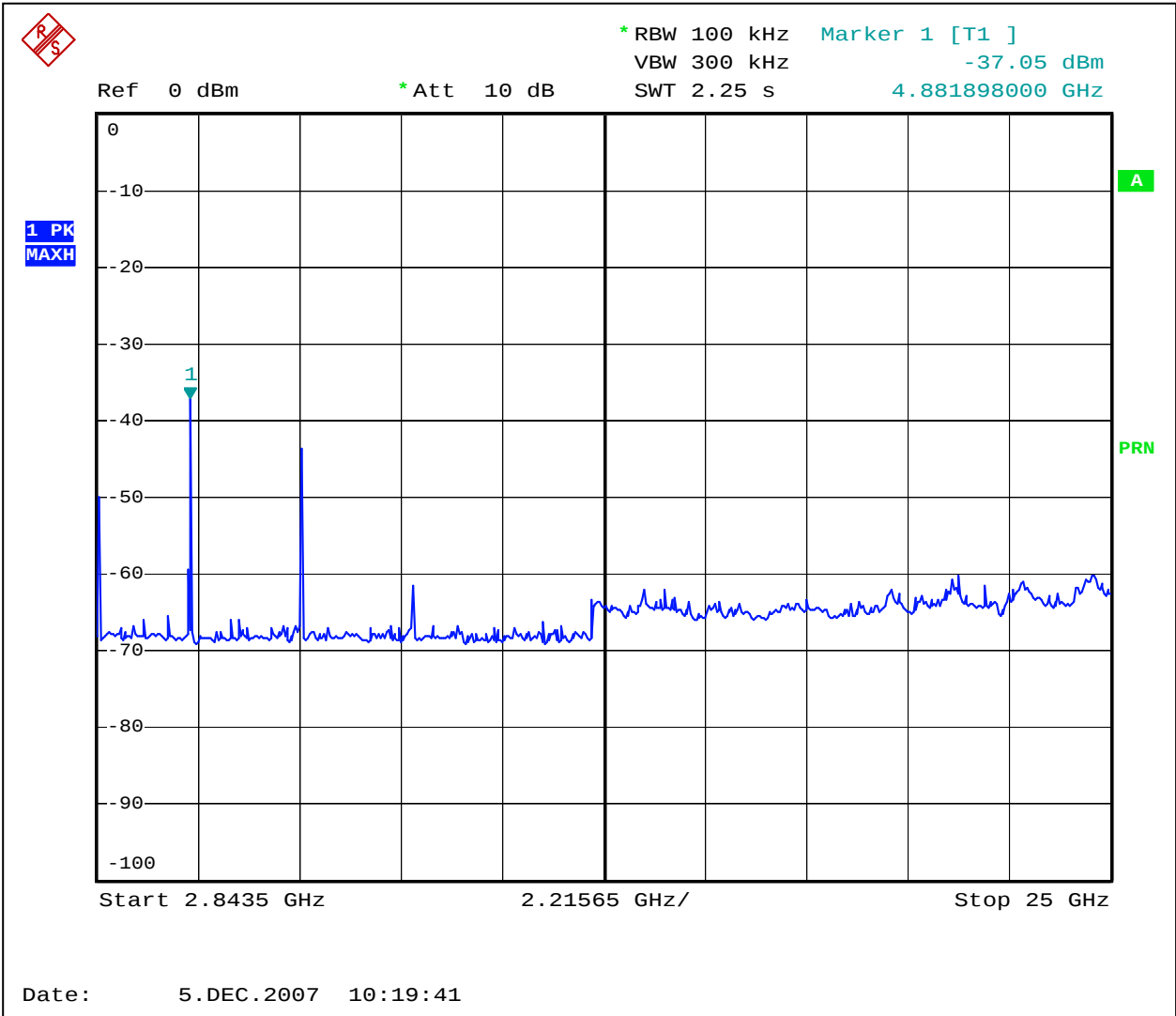
Graph 3.4.3



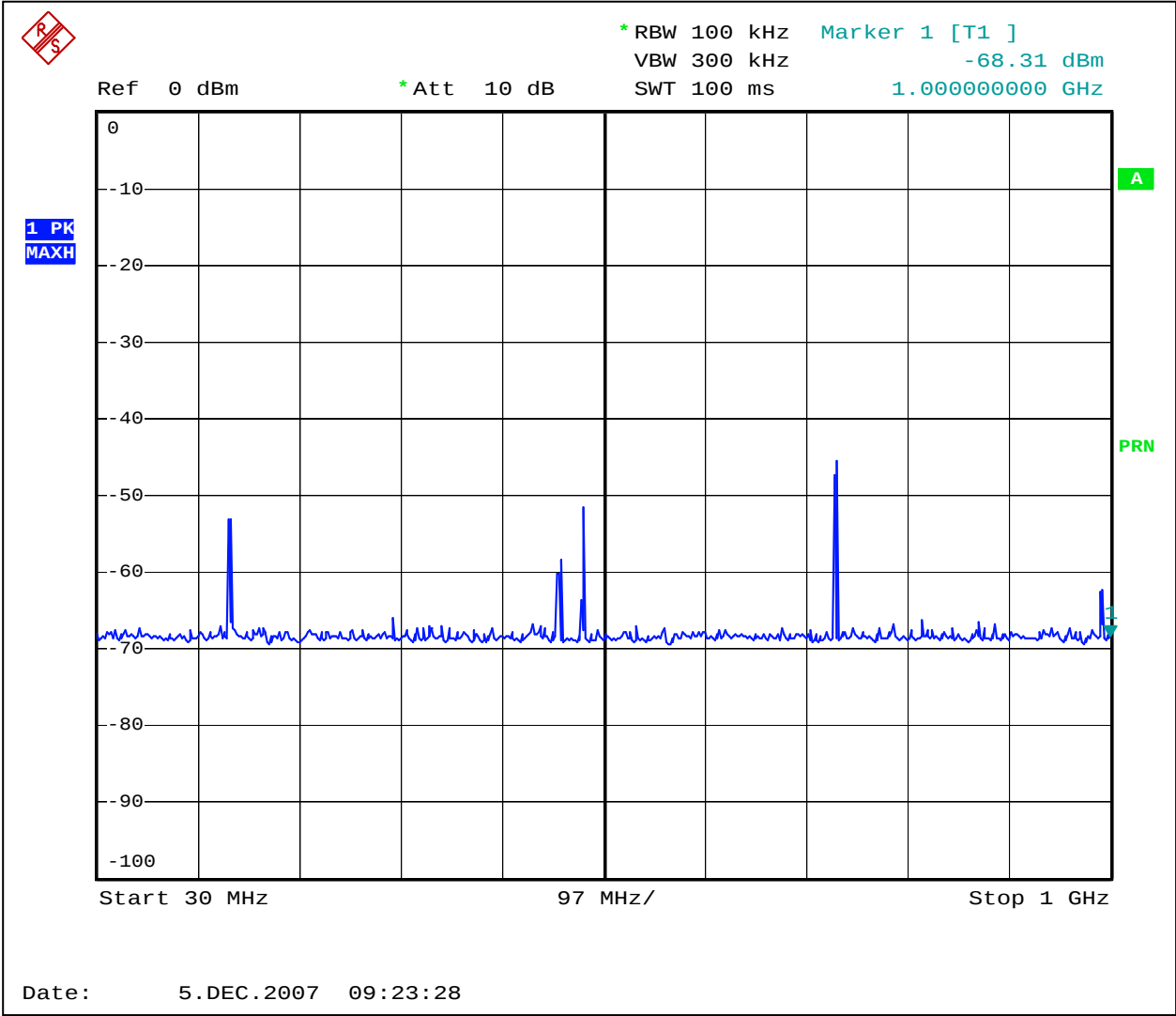
Graph 3.4.4



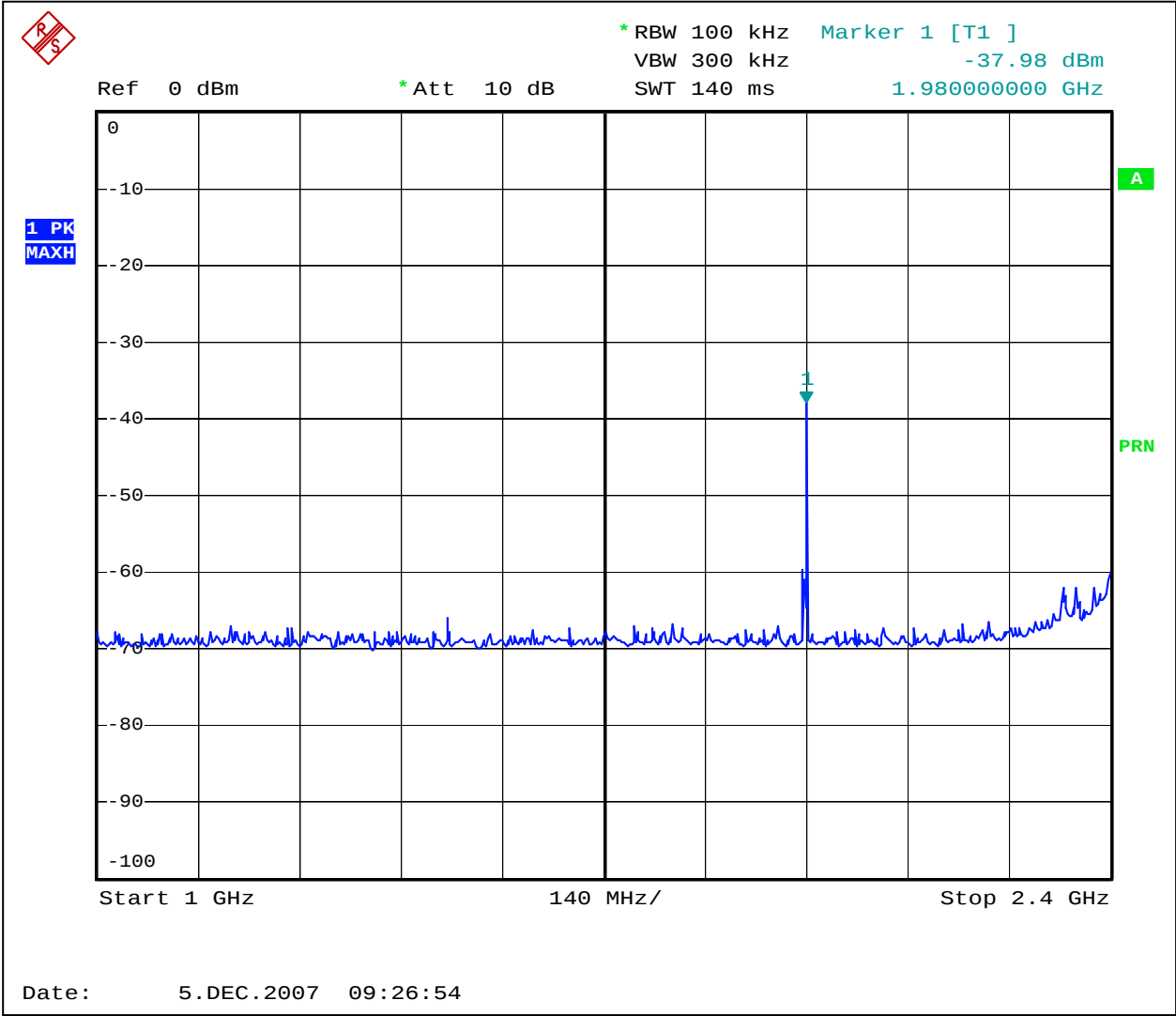
Graph 3.4.5



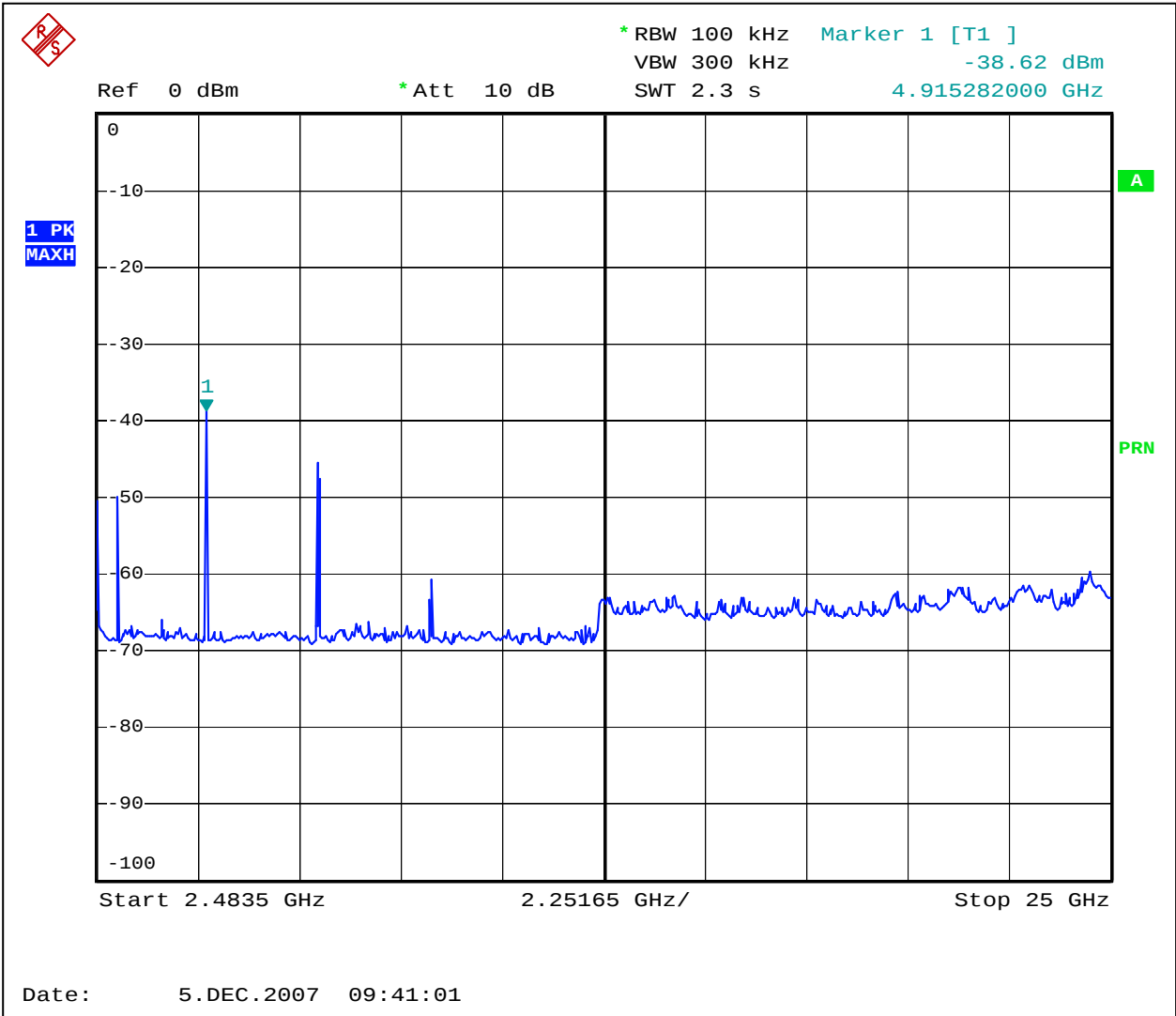
Graph 3.4.6



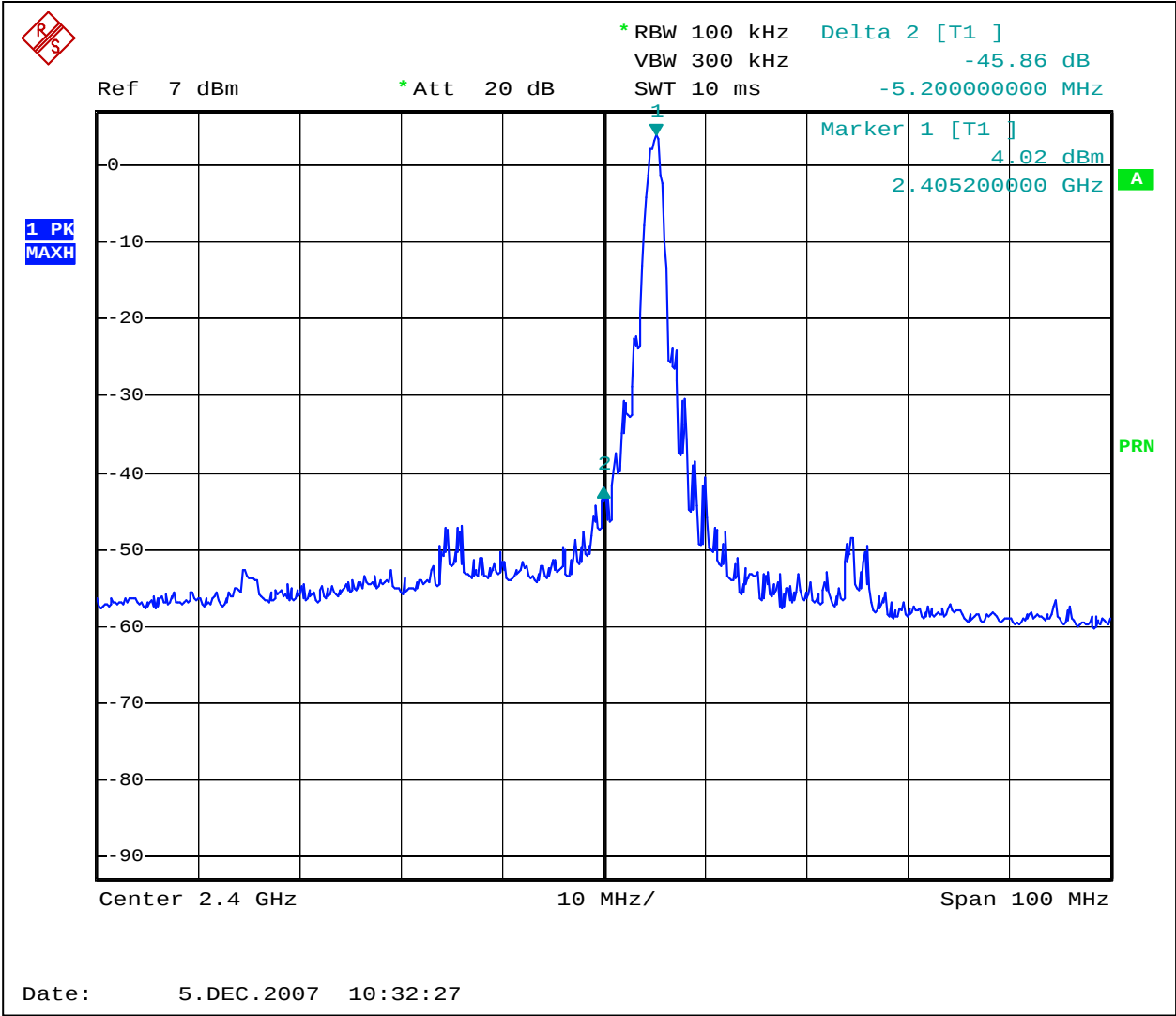
Graph 3.4.7



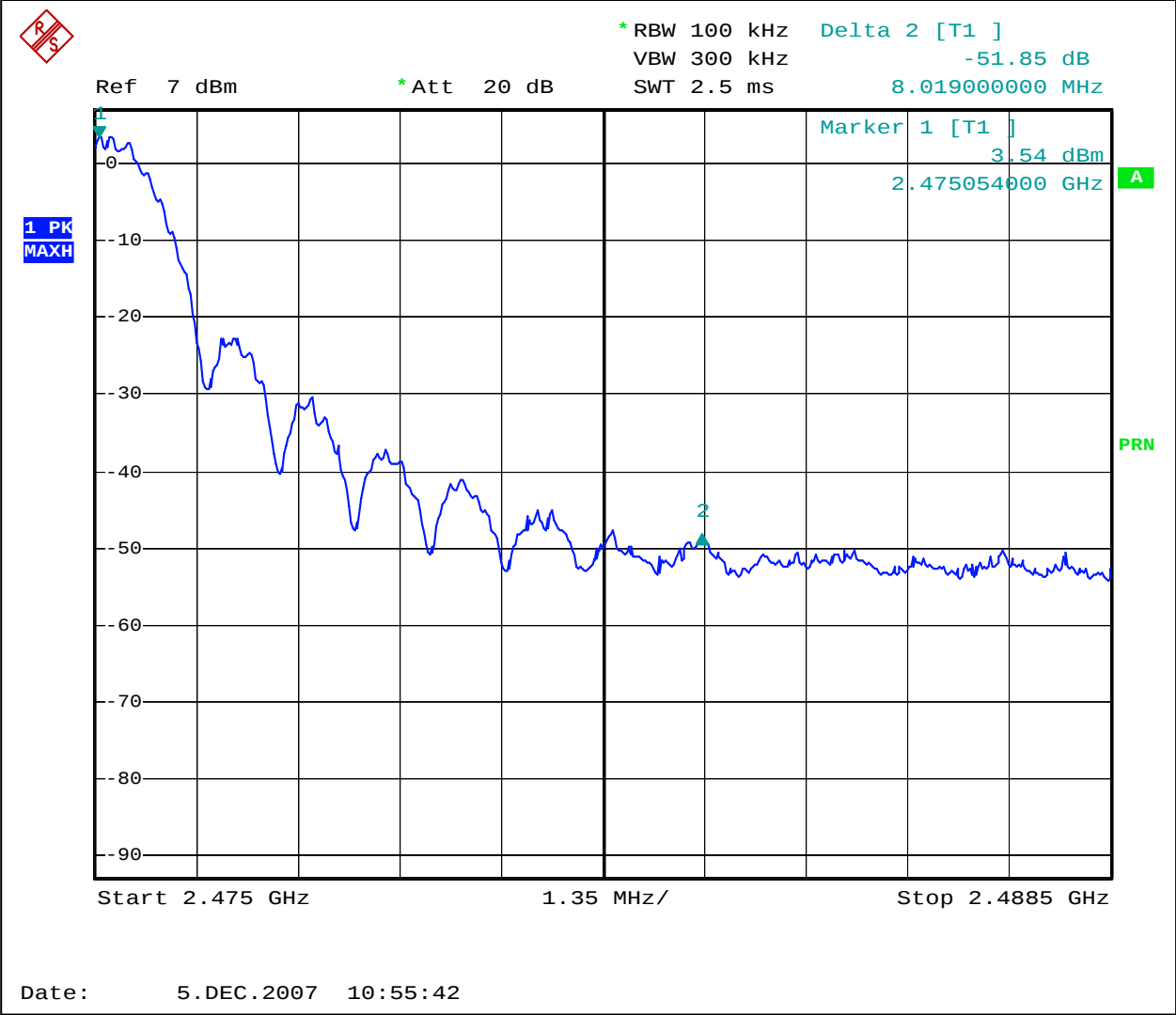
Graph 3.4.8



Graph 3.4.9



Graph 3.4.10



Graph 3.4.11



3.5 Radiated spurious emissions

Test location: ☐ OATS ☒ Anechoric Chamber

Test distance: ☐ 10 meters ☒ 3 meters

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

Test result: **Pass**

Max. Margin: 3.2 dB below the limits

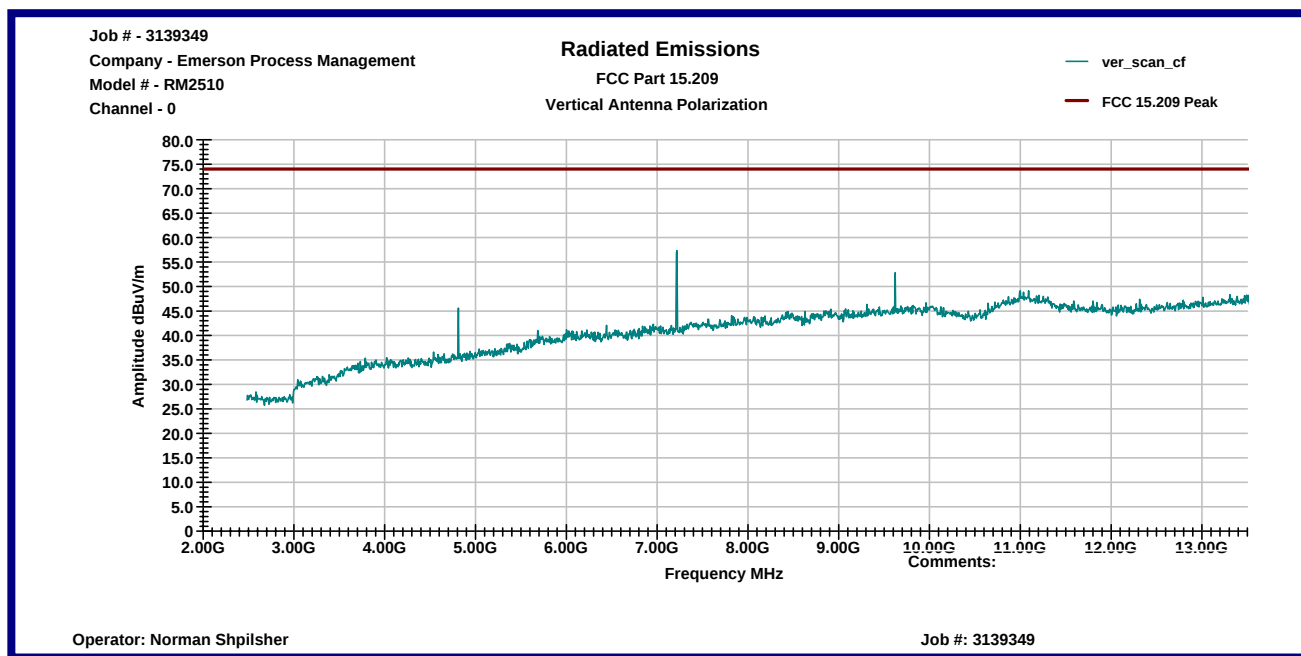
Notes: The table 3.5.1 shows the 2nd and 3rd harmonics in restricted band of operation per FCC 15.205
No emissions were detected above ambient at 5th and above harmonics

Date:	December 10-11, 2007	Result: Pass
Standard:	FCC part 15.247(d)	
Tested by:	Norman Shpilsher	
Test Point:	Enclosure with Antenna	
Operation mode:	See Page 5	
Note:		

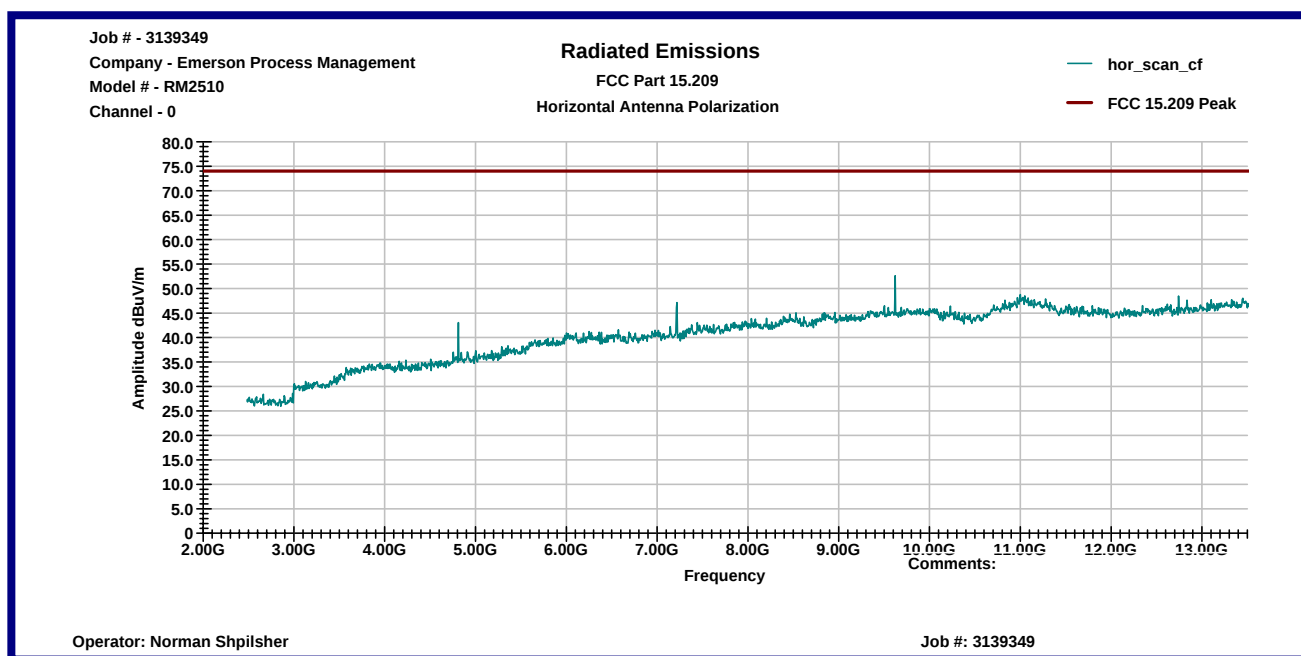
Table 3.5.1

[illegible]

Note: The table shows the 2nd and 3rd harmonics in restricted band of operation per FCC 15.205
No emissions were detected above ambient at 5th and above harmonics
All measurements were taken using an Average Value (RBW 1MHz, VBW 1Hz)



Graph 3.5.1



Graph 3.5.2

Job # - 3139349

Company - Emerson Process Management

Model # - RM2510

Channel - 7

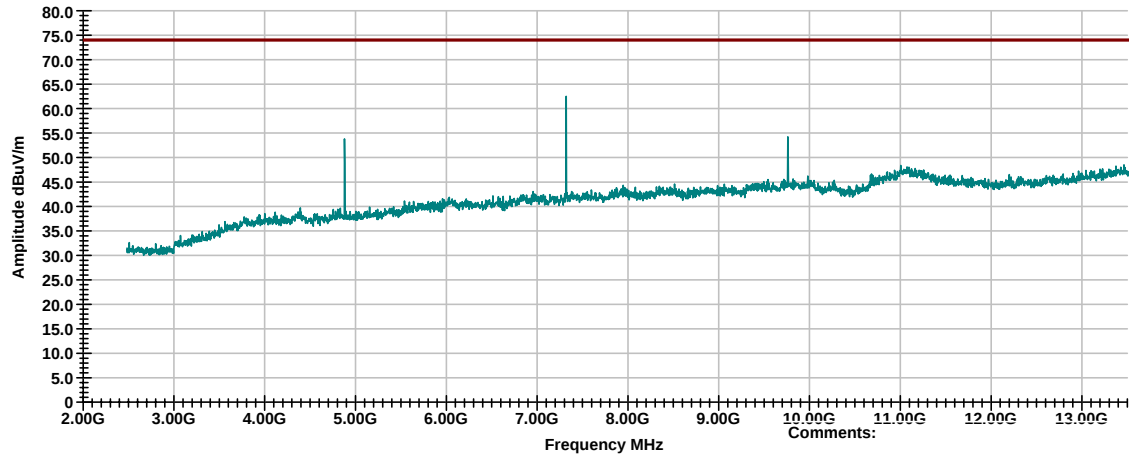
Radiated Emissions

FCC Part 15.209

Vertical Antenna Polarization

ver_scan_cf

FCC 15.209 Peak



Operator: Norman Shpilsher

Job #: 3139349

Graph 3.5.3

Job # - 3139349

Company - Emerson Process Management

Model # - RM2510

Channel - 7

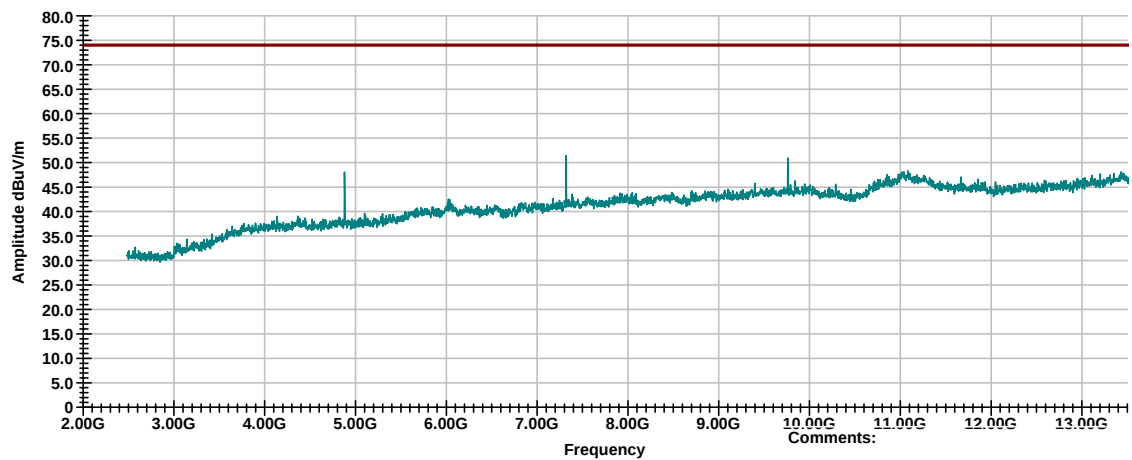
Radiated Emissions

FCC Part 15.209

Horizontal Antenna Polarization

hor_scan_cf

FCC 15.209 Peak



Operator: Norman Shpilsher

Job #: 3139349

Graph 3.5.4

Job # - 3139349

Company - Emerson Process Management

Model # - RM2510

Channel - 14

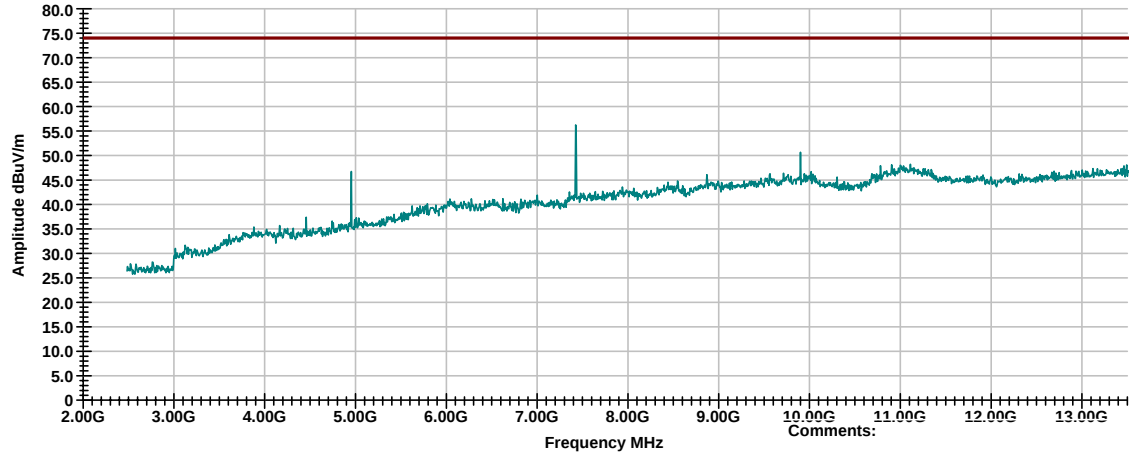
Radiated Emissions

FCC Part 15.209

Vertical Antenna Polarization

ver_scan_cf

FCC 15.209 Peak



Operator: Norman Shpilsher

Job #: 3139349

Graph 3.5.5

Job # - 3139349

Company - Emerson Process Management

Model # - RM2510

Channel - 14

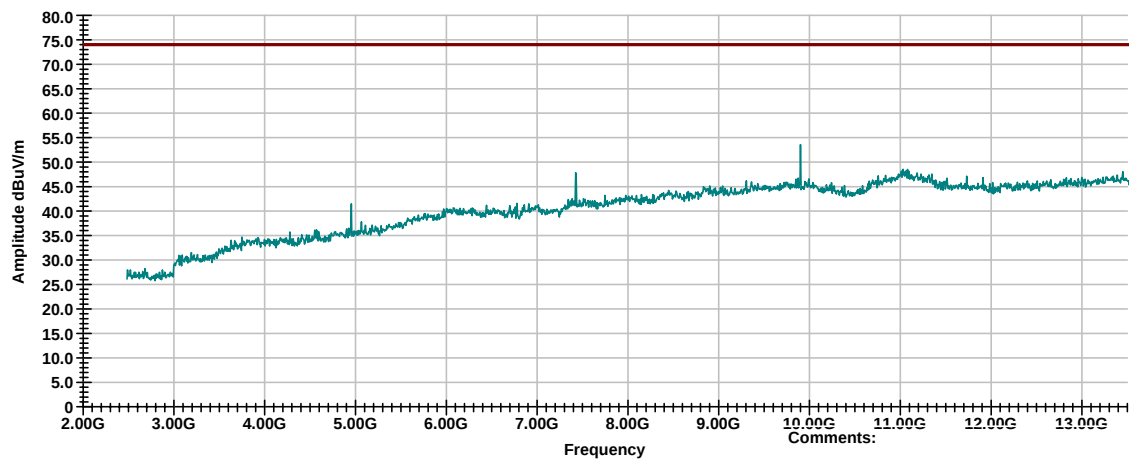
Radiated Emissions

FCC Part 15.209

Horizontal Antenna Polarization

hor_scan_cf

FCC 15.209 Peak



Operator: Norman Shpilsher

Job #: 3139349

Graph 3.5.6



3.6 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).



3.7 Receiver/digital device radiated emissions

Test location: ☐ OATS ☒ Anechoric Chamber

Test distance: ☐ 10 meters ☒ 3 meters

Frequency Range: 30MHz to 12.5GHz (5th Harmonic)

Test result: **Pass**

Frequency range: 30MHz-12.5GHz

Max. Emissions margin: 3.2 dB below the limits

Notes: None

Date:	December 6, 2007	Result: Pass
Standard:	FCC Part 15.109, Class B	
Tested by:	Norman Shpilsher	
Test Point:	Enclosure	
Operation mode:	Stand by / receiving	
Note:		

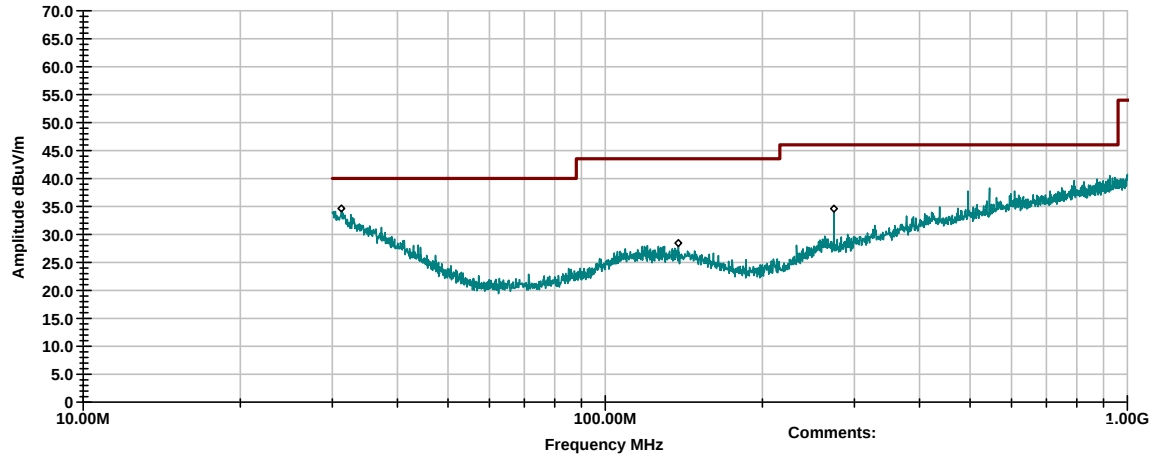
Table 3.7.1

Frequency MHz	Antenna Polarity	Peak Reading dBμV	Total C.F. dB1/m	Pre-Amp. Gain (dB)	Total at 3m dBμV/m	QP Limit dBμV/m	Margin dB
31.247 MHz	V	14.8	19.9	0.0	34.6	40.0	-5.4
138.05 MHz	V	15.2	13.3	0.0	28.4	43.5	-15.1
274.28 MHz	V	19.4	15.2	0.0	34.6	46.0	-11.4
30.208 MHz	H	15.3	20.4	0.0	35.7	40.0	-4.3
111.34 MHz	H	15.5	13.2	0.0	28.7	43.5	-14.8
495.33 MHz	H	22.7	20.1	0.0	42.9	46.0	-3.2
997.17 MHz	H	15.0	25.9	0.0	40.9	54.0	-13.1
1.3384 GHz	V	50.3	27.8	39.5	38.5	54.0	-15.5
1.8648 GHz	V	49.3	29.9	38.8	40.4	54.0	-13.6
2.1327 GHz	V	46.9	30.8	38.4	39.2	54.0	-14.7
2.4382 GHz	V	43.2	31.3	37.9	36.6	54.0	-17.4
10.875 GHz	V	34.8	47.3	35.1	47.1	54.0	-6.9
1.8601 GHz	H	44.2	29.8	38.8	35.2	54.0	-18.8
2.1327 GHz	H	38.5	30.8	38.4	30.9	54.0	-23.1
11.19 GHz	H	34.4	47.7	34.8	47.3	54.0	-6.7

Job # - 3139349
Company - Emerson Process Management
Model # - RM2510
- Stand by / receiver mode

Radiated Emissions FCC Part 15.109, Class B Vertical Antenna Polarization

ver_scan_cf
max_ver_20_cf
FCC-B



Operator: Norman Shpilsher

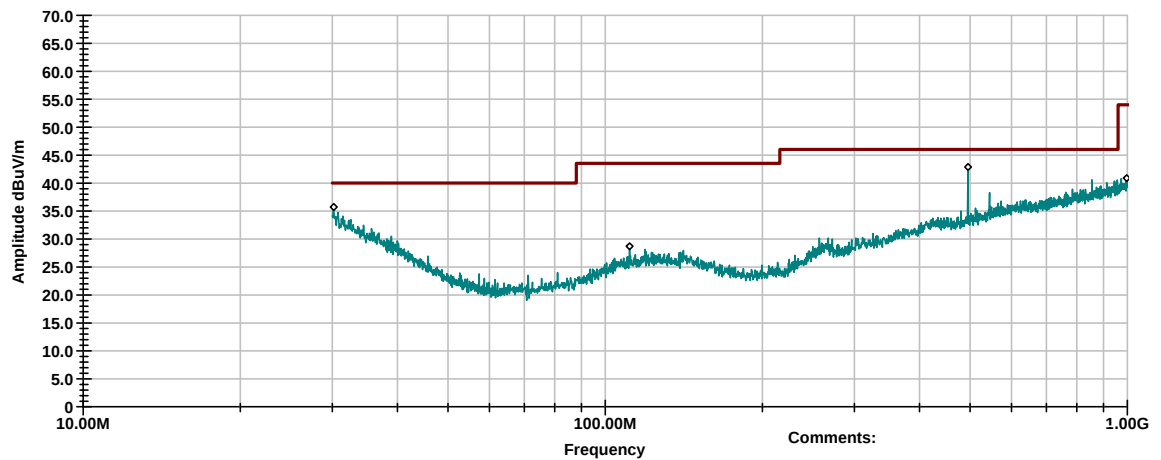
Job #: 3139349

Graph 3.7.1

Job # - 3139349
Company - Emerson Process Management
Model # - RM2510
- Stand by / receiver mode

Radiated Emissions FCC Part 15.109, Class B Horizontal Antenna Polarization

hor_scan_cf
max_hor_20_cf
FCC-B



Operator: Norman Shpilsher

Job #: 3139349

Graph 3.7.2

Job # - 3139349

Company - Emerson Process Management

Model # - RM2510

- Stand by / receiving mode

Radiated Emissions

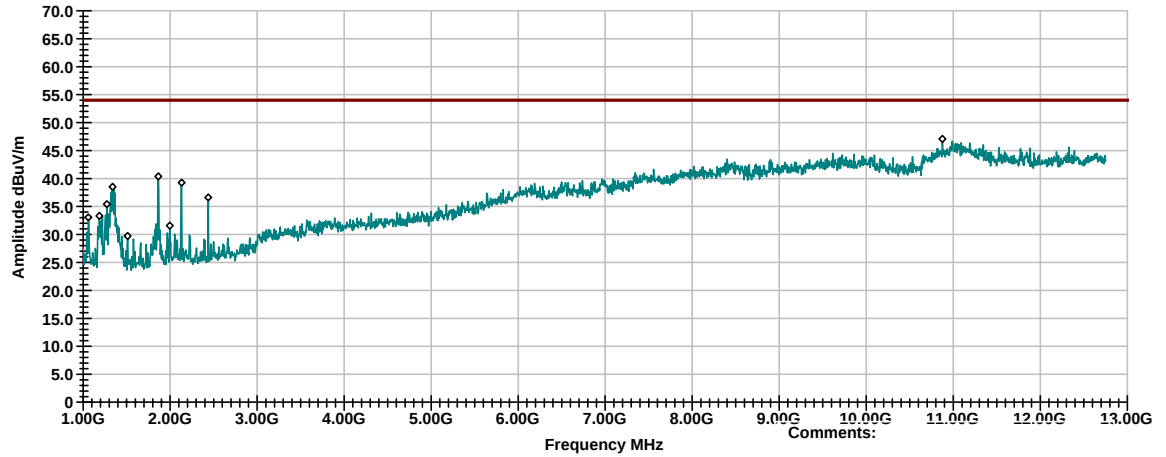
FCC Part 15.109, Class B

Vertical Antenna Polarization

ver_scan_cf

max_ver_20_cf

FCC_B_3m



Operator: Norman Shpilsher

Job #: 3139349

Graph 3.7.3

Job # - 3139349

Company - Emerson Process Management

Model # - RM2510

- Stand by / receiving mode

Radiated Emissions

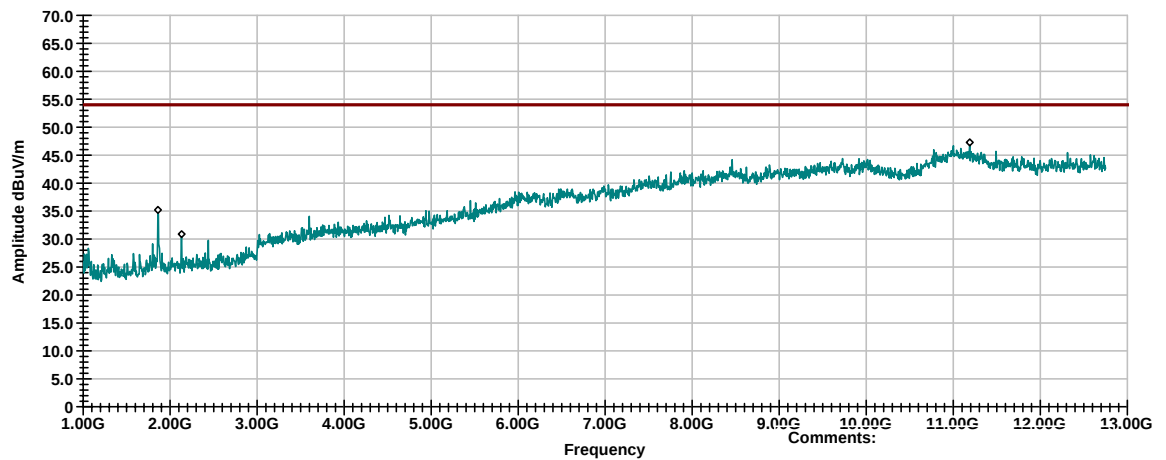
FCC Part 15.109, Class B

Horizontal Antenna Polarization

hor_scan_cf

max_hor_20_cf

FCC_B_3m



Operator: Norman Shpilsher

Job #: 3139349

Graph 3.7.4



3.8 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.	CAL DUE	USED
Spectrum Analyzer	R & S	FSP 40	100024	08/23/2008	☒
Spectrum Analyzer	R & S	ESCI	100358	04/27/2008	☒
Bicono-Log Antenna	Schaffner-Chase	CBL 6112 B	2468	07/30/2008	☒
Bicono-Log Antenna	Schaffner-Chase	CBL 6112 B	2630	09/07/2008	☐
Horn Antenna	EMCO	3115	9507-4513	01/09/2008	☒
Horn Antenna	EMCO	3115	6579	03/06/2008	☐
Waveguide Horn Antenna	EMCO	3116	9904-2423	07/20/2008	☒
Pre-Amplifier	MITEQ	AMF-5D-00501800-28-13P	1122951	04/24/2008	☒
Pre-Amplifier	MITEQ	AMF-6F-16002600-25-10P	1222383	11/05/2008	☒
Pre-Amplifier	MITEQ	AMF-6F-26004000-40-8P	13224444	11/05/2008	☐
Pre-Amplifier	HP	8447F OPT H64	3113A04974	03/07/2008	☐
System	TILE! Instrument Control		Ver. 3.4.K.29	VBU	☒