TEST REPORT

Report Number: 3146854MIN-002
Project Number: 3146854

Testing performed on the
Beacon
FCC ID: TPO-B01
Industry Canada ID: 6512A-B01

to
47 CFR Part 15. 249:2007
RSS- 210, Issue 7, 2007

For
Spectrum Design Solutions Inc.

Test Performed by:	Test Authorized by:
Intertek Testing Services NA, Inc.	Spectrum Design Solutions Inc.
7250 Hudson Blvd., Suite 100	420 North 5th Street, Suite 950
Oakdale, MN 55128	Minneapolis, MN 55401

Prepared by: _____ Date: March 14, 2008
Norman Shpilsher

Reviewed by: _____ Date: March 14, 2008
Uri Spector

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1.0 GENERAL DESCRIPTION

Model:	Beacon
Type of EUT:	Transmitter
Serial Number:	N/A
FCC ID:	TPO-B01
Industry Canada ID:	6512A-B01
Related Submittal(s) Grants:	None
Company:	Spectrum Design Solutions Inc.
Customer:	Mr. Chris Anderson
Address:	420 North 5th Street, Suite 950 Minneapolis, MN 55401
Phone:	612-435-0858
Fax:	
Test Standards:	☒ 47 CFR, Part 15:2007, §15.249 ☒ RSS–210, Issue 7, 2007 ☒ RSS-Gen, Issue 2, 2007 ☐ 47 CFR, Part 15:2007, §15.107 and §15.109, Class ☐ Other
Type of radio:	☒ Stand -alone ☐ Module ☐ Hybrid
Date Sample Submitted:	March 10, 2008
Test Work Started:	March 10, 2008
Test Work Completed:	March 11, 2008
Test Sample Conditions:	☐ Damaged ☐Poor (Usable) ☒ Good

1.1 Product Description; Test Facility

Product Description:	Periodic Transmitter
Operating Frequency	2400 – 2483.5 MHz
Modulation:	FSK
Emission Designator:	F1D
Antenna(s) Info:	Type: Integrated Connector Type: N/A
Antenna Installation:	☐ User ☐ Professional ☒ Factory
Transmitter Power Configuration:	☒ Internal battery ☐ External power source ☐ 120VAC ☐ 230VAC ☐ 400VAC ☒ 3 VDC ☐ Other: Amp. ☐ 50Hz ☐ 60Hz
Special Test Arrangement:	The Transmitter was programmed to transmit continuously
Test Facility Accreditation:	A2LA (Certificate No. 1427.01)
Test Methodology:	Measurements performed according to the procedures in ANSI C63.4-2003

1.2 EUT Configuration

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

☐ - Standby
☒ - Continuous (see details below)
☐ - Continuous un-modulated
☐ - Test program (customer specific)
☐ -

Operating modes of the EUT:

No.	Description
1	Transmitter was run continuously with modulated signal at 2401MHz (low channel), 2442 MHz (middle channel), and 2482.5MHz (upper channel)
2	

Cables:

No.	Type	Length	Designation	Note
1	None			
2				

Support equipment/Services:

No.	Item	Description
1	Compaq Armada M300 Laptop PC with RS232/TTL converter	Remote PC for setup RF transmitter for testing (disconnected from the EUT during testing)
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(µV/m)
RA = Receiver Amplitude in dB(µV)
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(µV) 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(µV/m).

RA = 48.1 dB(µV)
AF = 7.4 dB(m^{-1})
CF = 1.6 dB
AG = 16.0 dB
FS = RA + AF + CF - AG
FS = 48.1 + 7.4 + 1.6 – 16.0
FS = 41.1 dB(µV/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
15.249(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

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 range of measurements: 2400MHz-2483.5MHz

Test result: **Pass**

Max. Emissions margin at fundamental: 0.4 dB below the limits

Notes: None

Date:	March 11, 2008	**Result:** **Pass**
Standard:	FCC 15.249(a) / RSS-210 A2.9	
Tested by:	Norman Shpilsher	
Test Point:	Enclosure with antenna	
Operation mode:	See Page 5	
Note:		

Table 3.1.1

Frequency	Antenna		Ant. CF	Cable loss	Pre-amp	Reading	Total @ 3m	Limit	Margin	Comments
MHz	Polarity	Hts(cm); Azim	dB1/m	dB	Gain (dB)	dBµV	dBµV/m	dBµV/m	dB	
2401.00	V	126; 346	28.3	6.2	0.0	57.5	92.0	114.0	-22.0	peak
2401.00	V	126; 346	28.3	6.2	0.0	56.5	91.0	94.0	-3.0	Avg
2401.00	H	148; 96	28.3	6.2	0.0	60.2	94.7	114.0	-19.3	peak
2401.00	H	148; 96	28.3	6.2	0.0	59.1	93.6	94.0	-0.4	Avg
2442.20	V	125; 340	28.4	6.2	0.0	57.3	91.9	114.0	-22.1	peak
2442.20	V	125; 340	28.4	6.2	0.0	56.2	90.8	94.0	-3.2	Avg
2442.20	H	148; 96	28.4	6.2	0.0	57.1	91.7	114.0	-22.3	peak
2442.20	H	148; 96	28.4	6.2	0.0	56.0	90.6	94.0	-3.4	Avg
2482.50	V	130; 355	28.6	6.2	0.0	55.2	90.0	114.0	-24.0	peak
2482.50	V	130; 355	28.6	6.2	0.0	54.3	89.1	94.0	-4.9	Avg
2482.50	H	144; 107	28.6	6.2	0.0	57.0	91.8	114.0	-22.2	peak
2482.50	H	144; 107	28.6	6.2	0.0	56.0	90.8	94.0	-3.2	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: 2.5MHz-25GHz

Test result: **Pass**

Max. margin of harmonics and spurious emissions: 12.0 dB below the limits

Notes: None

Date:	March 11, 2008	**Result:** **Pass**
Standard:	FCC 15.249(a) and (d) / RSS-210 A2.9	
Tested by:	Norman Shpilsher	
Test Point:	Enclosure with antenna	
Operation mode:	See Page 5	
Note:		

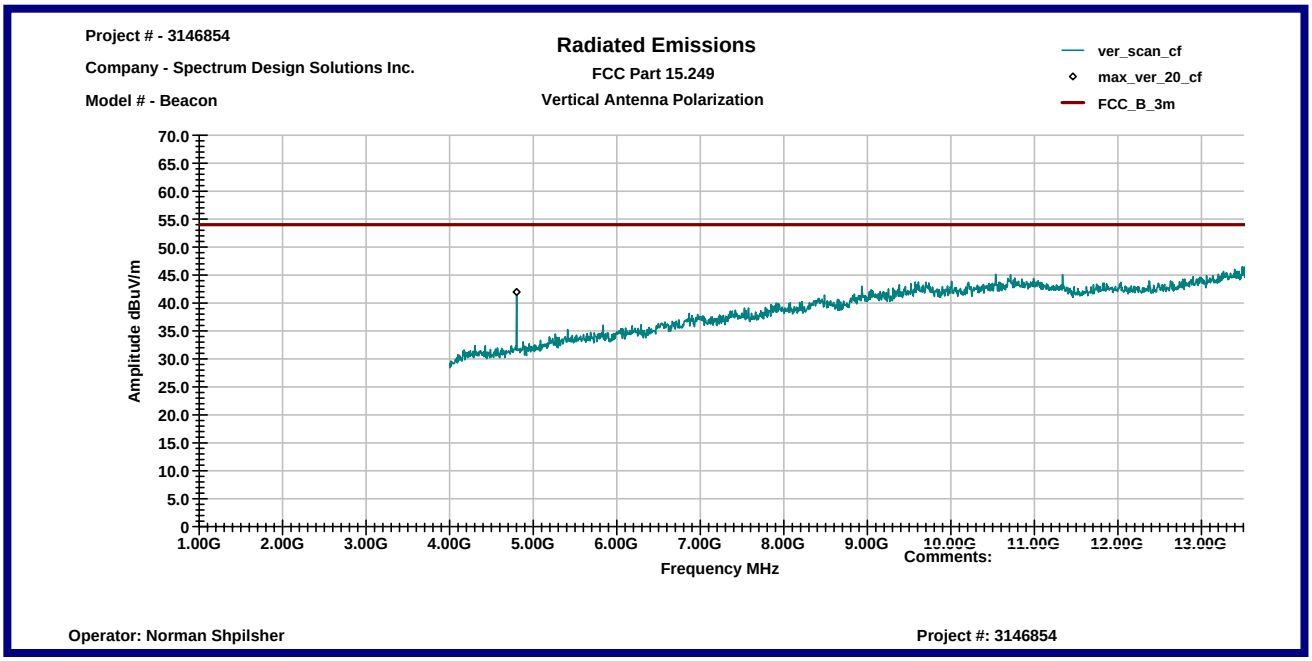
Table 3.2.1

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
		Channel 2401MHz					
4.8008 GHz	V	40.9	39.3	38.3	42.0	54.0	-12.0
4.8008 GHz	H	38.1	39.3	38.3	39.1	54.0	-14.8
		Channel 2442MHz					
4.8848 GHz	V	39.4	39.5	38.4	40.6	54.0	-13.4
4.8848 GHz	H	37.8	39.5	38.4	39.0	54.0	-15.0
		Channel 2482.5MHz					
4.9632 GHz	V	38.6	39.7	38.4	39.9	54.0	-14.1
4.9632 GHz	H	36.3	39.7	38.4	37.6	54.0	-16.4

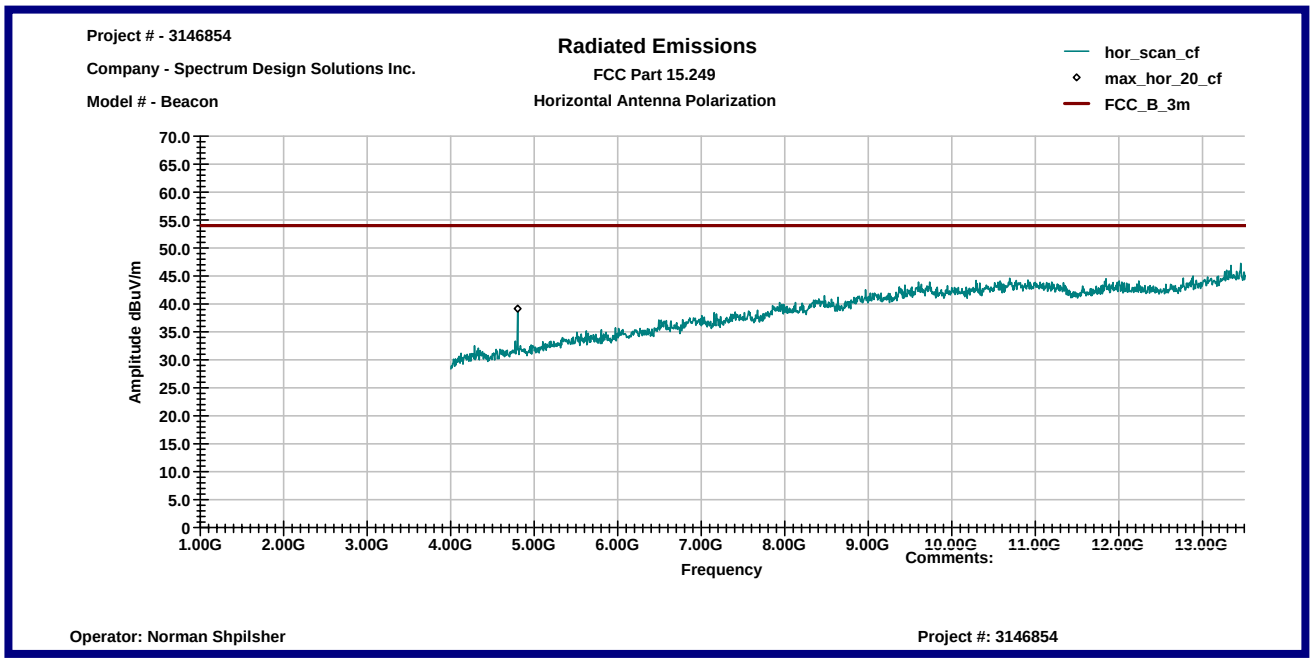
Note: No emissions above ambient was detected above the second harmonics

Graph 3.2.1

Vertical antenna polarization

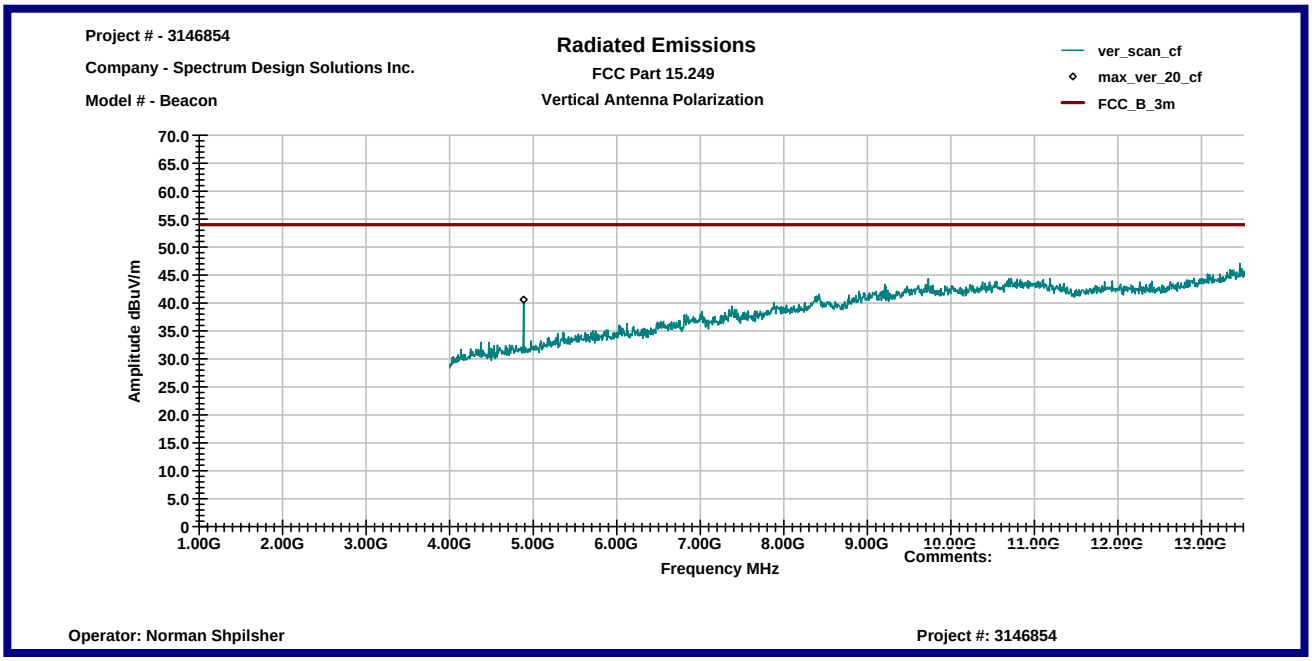


Horizontal antenna polarization

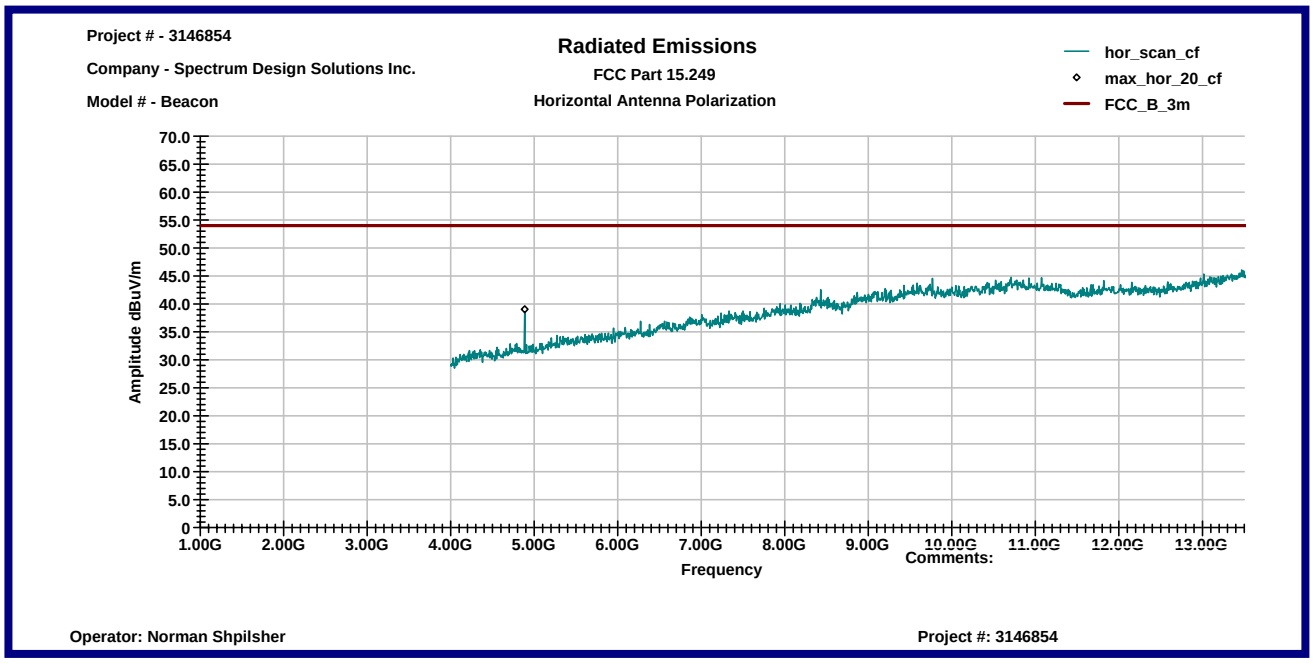


Graph 3.2.2

Vertical antenna polarization

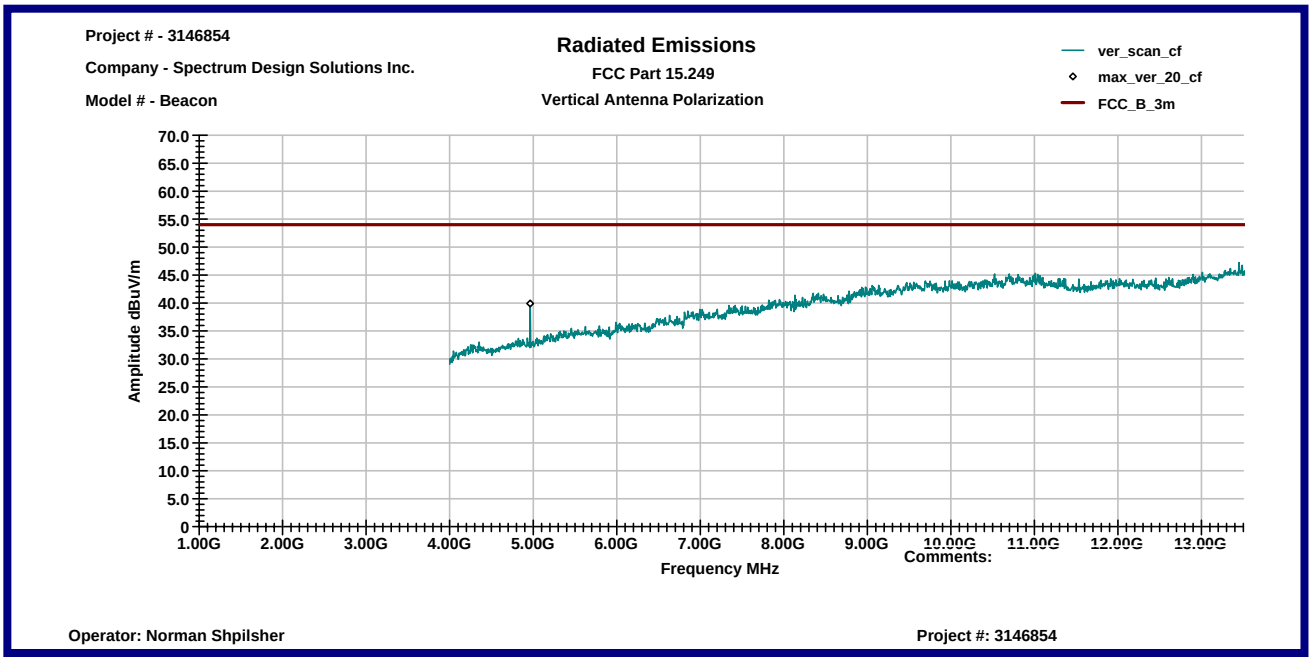


Horizontal antenna polarization

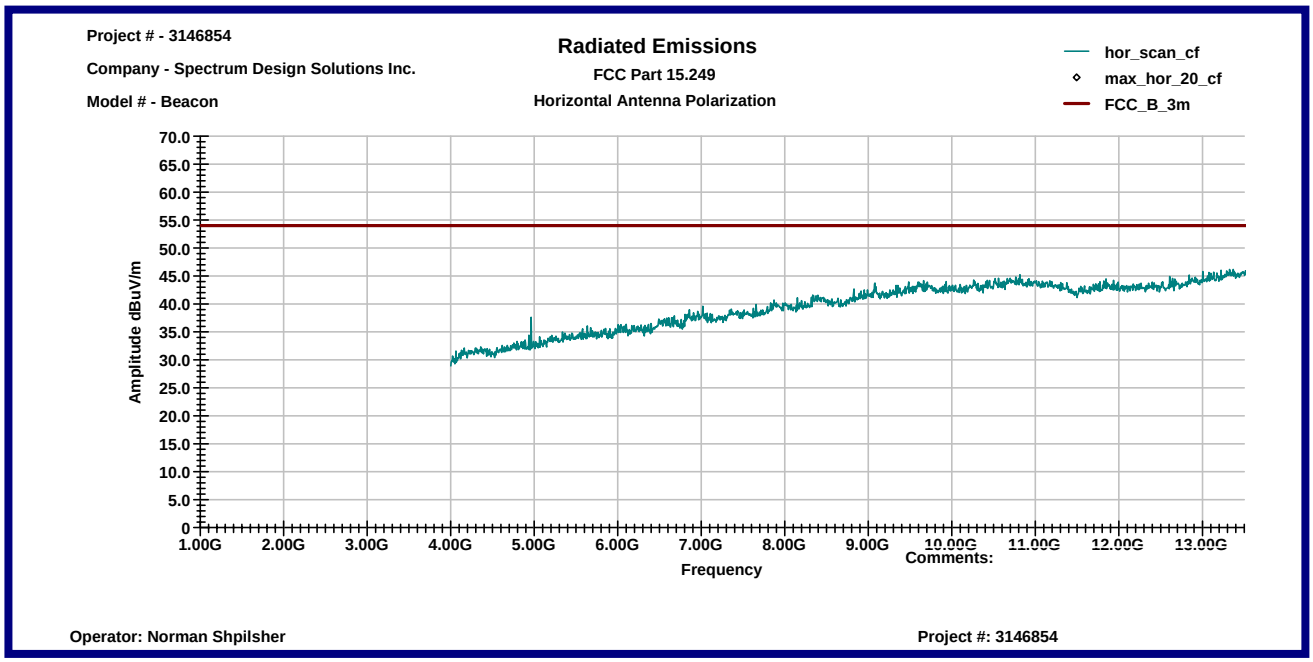


Graph 3.2.3

Vertical antenna polarization



Horizontal antenna polarization



3.2.1 Band Edge Compliance

Test location: ☐ OATS ☒ Anechoic Chamber ☐ Other

Test distance: ☐ 10 meters ☒ 3 meters

Frequency range of measurements: 2400MHz and 2583.5MHz

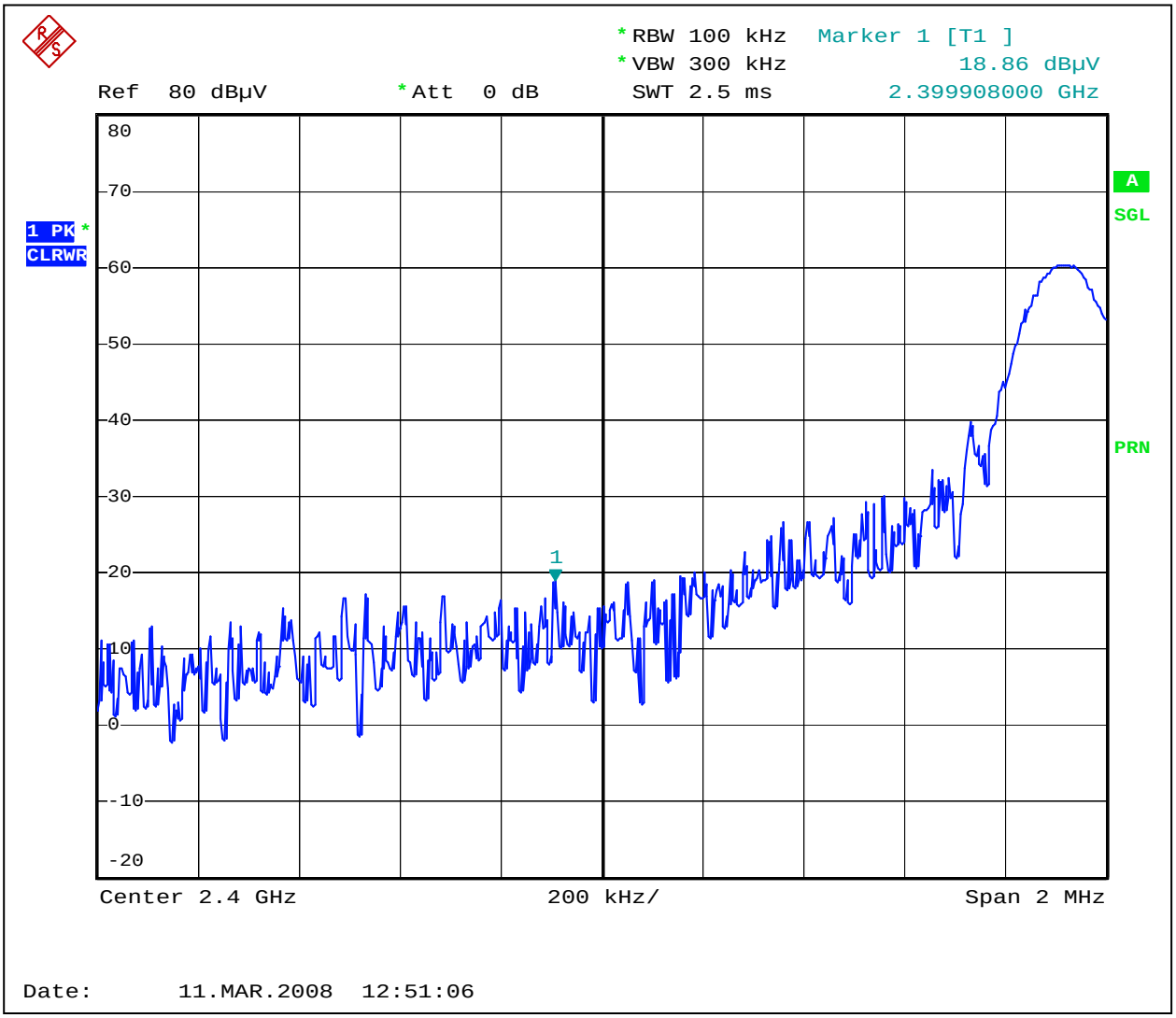
Test result: **Pass**

Notes: See Table below and Graphs 3.2.4 and 3.2.5

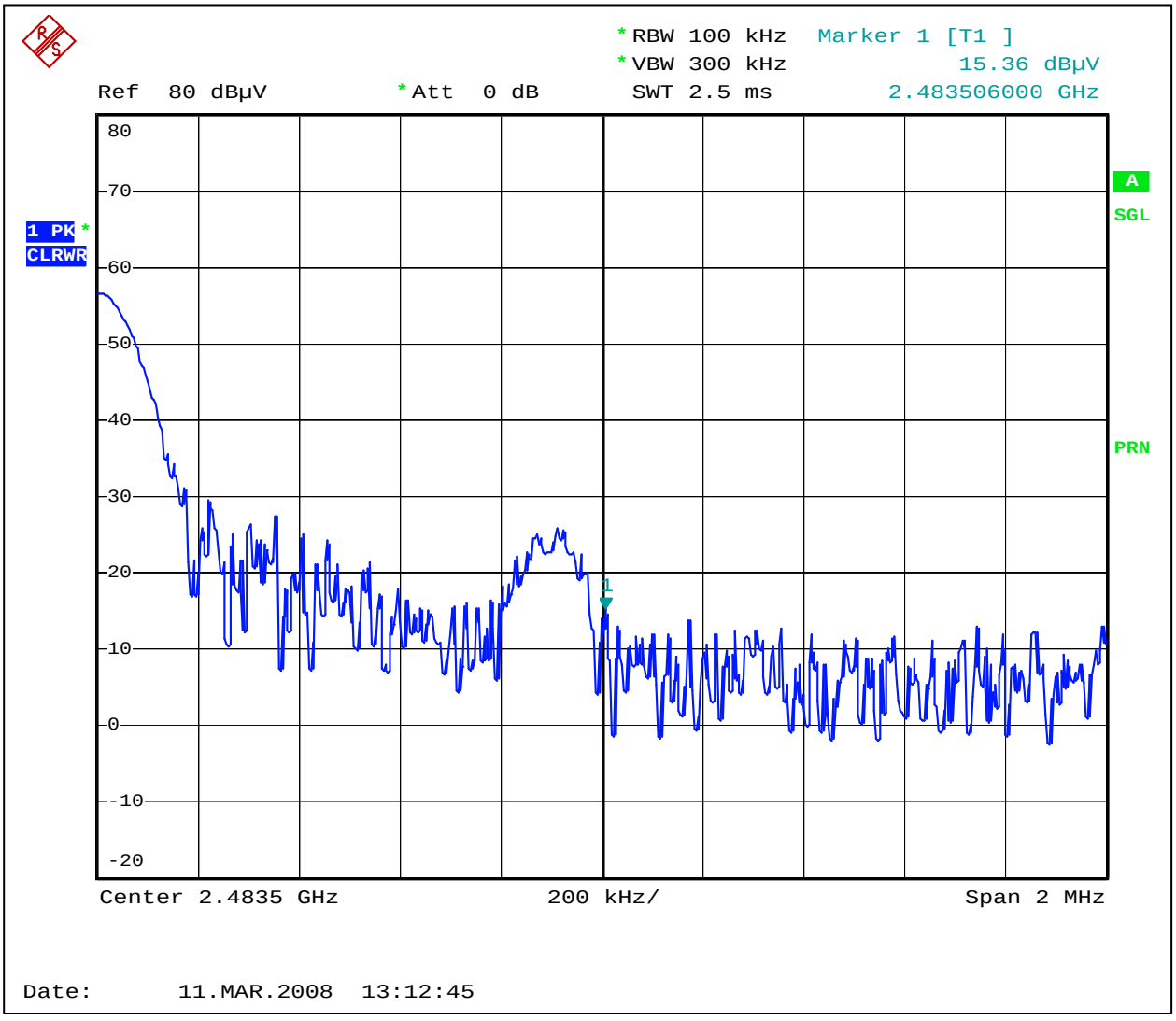
Date:	March 11, 2008	**Result:** **Pass**
Standard:	FCC 15.249(a) and (d) / RSS-210 A2.9	
Tested by:	Norman Shpilsher	
Test Point:	Enclosure with antenna	
Operation mode:	See Page 5	
Note:		

Frequency MHz	Antenna Polarity	Antenna Hts(cm); Azim	Ant. CF dB1/m	Cable loss dB	Pre-amp Gain (dB)	Reading dBµV	Total @ 3m dBµV/m	Limit dBµV/m	Margin dB	Comments
2400.00	H	148; 96	28.3	6.2	0.0	18.9	53.4	54.0	-0.6	
2483.50	H	144; 107	28.6	4.1	0.0	15.4	48.1	54.0	-5.9	

Graph 3.2.4


*RBW 100 kHz
*VBW 300 kHz
Marker 1 [T1]
18.86 dBµV
Ref 80 dBµV
*Att 0 dB
SWT 2.5 ms
2.399908000 GHz
1 PK *
CLRWR
A
SGL
PRN
80
70
60
50
40
30
20
10
0
-10
-20
1
Center 2.4 GHz
200 kHz/
Span 2 MHz
Date: 11.MAR.2008 12:51:06

Graph 3.2.5


*RBW 100 kHz
*VBW 300 kHz
Marker 1 [T1]
15.36 dBµV
2.483506000 GHz
Ref 80 dBµV
*Att 0 dB
SWT 2.5 ms
1 PK *
CLRWR
A
SGL
PRN
80
70
60
50
40
30
20
10
0
-10
-20
Center 2.4835 GHz
200 kHz/
Span 2 MHz
Date: 11.MAR.2008 13:12:45

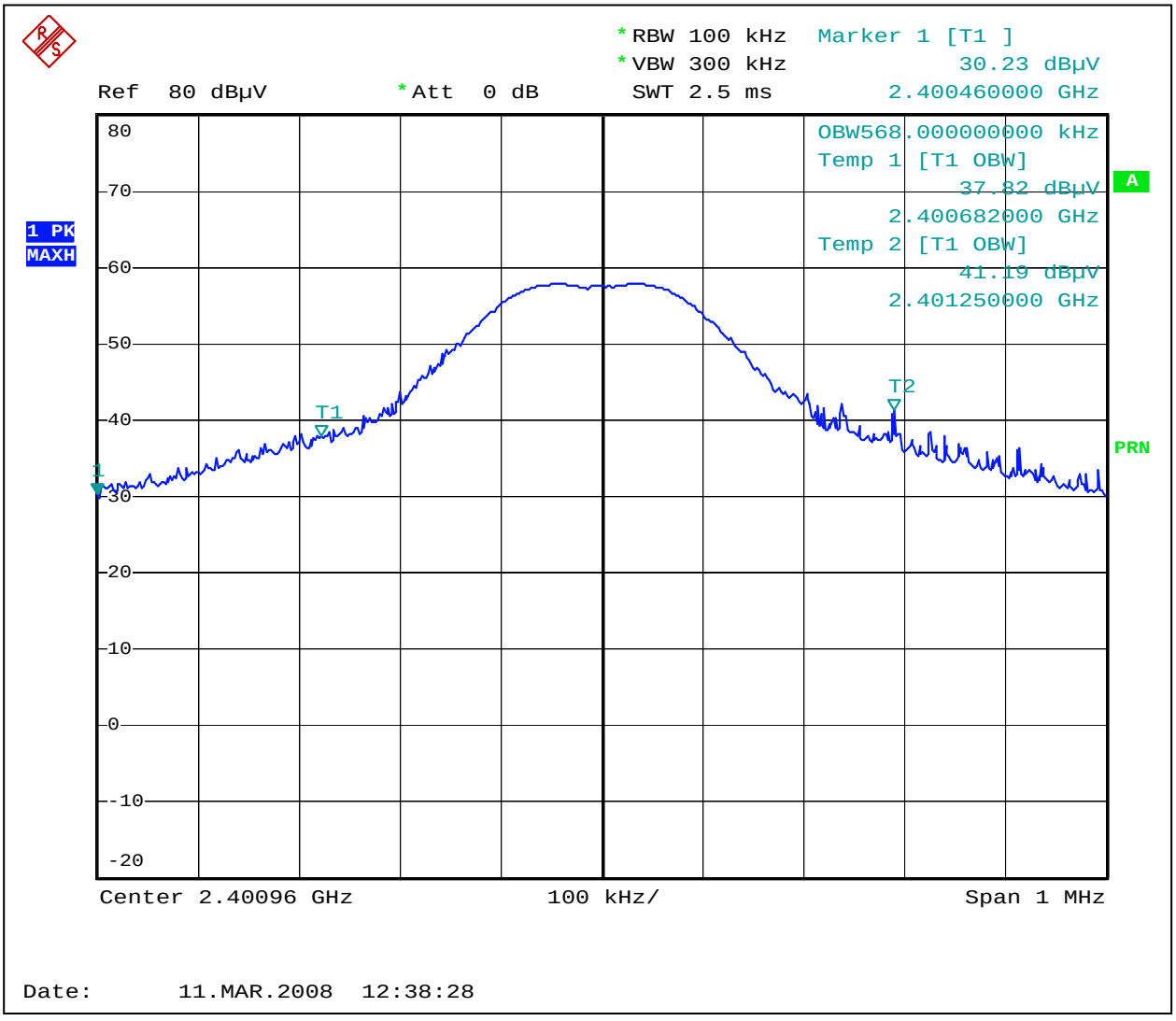
3.3 Bandwidth of Emissions

Center Frequency of operation MHz	Measured 99% bandwidth kHz
2401	568
2442	524
2482.5	404

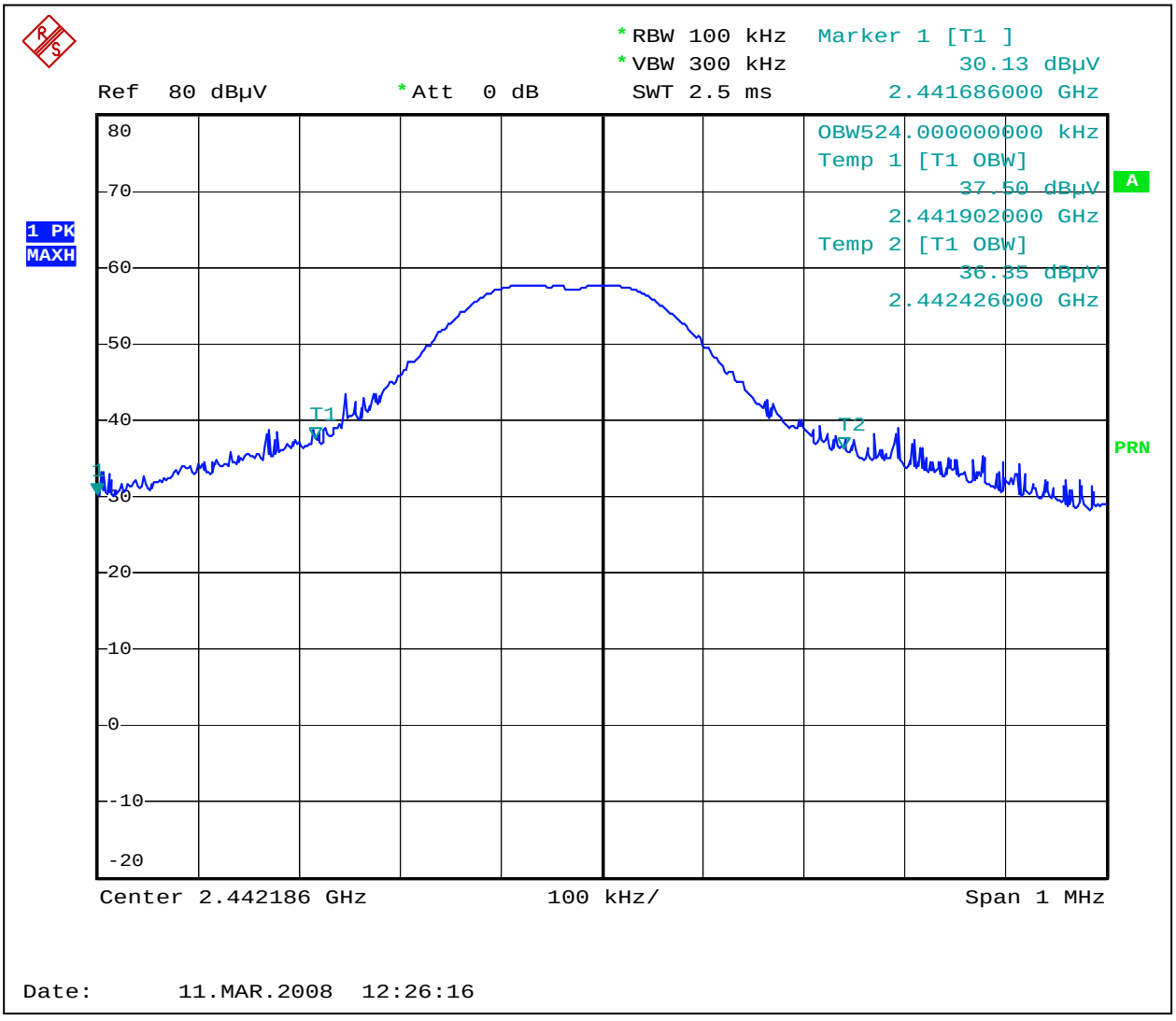
Graphs 3-3-1 to 3-3-3 are show bandwidth of emissions

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

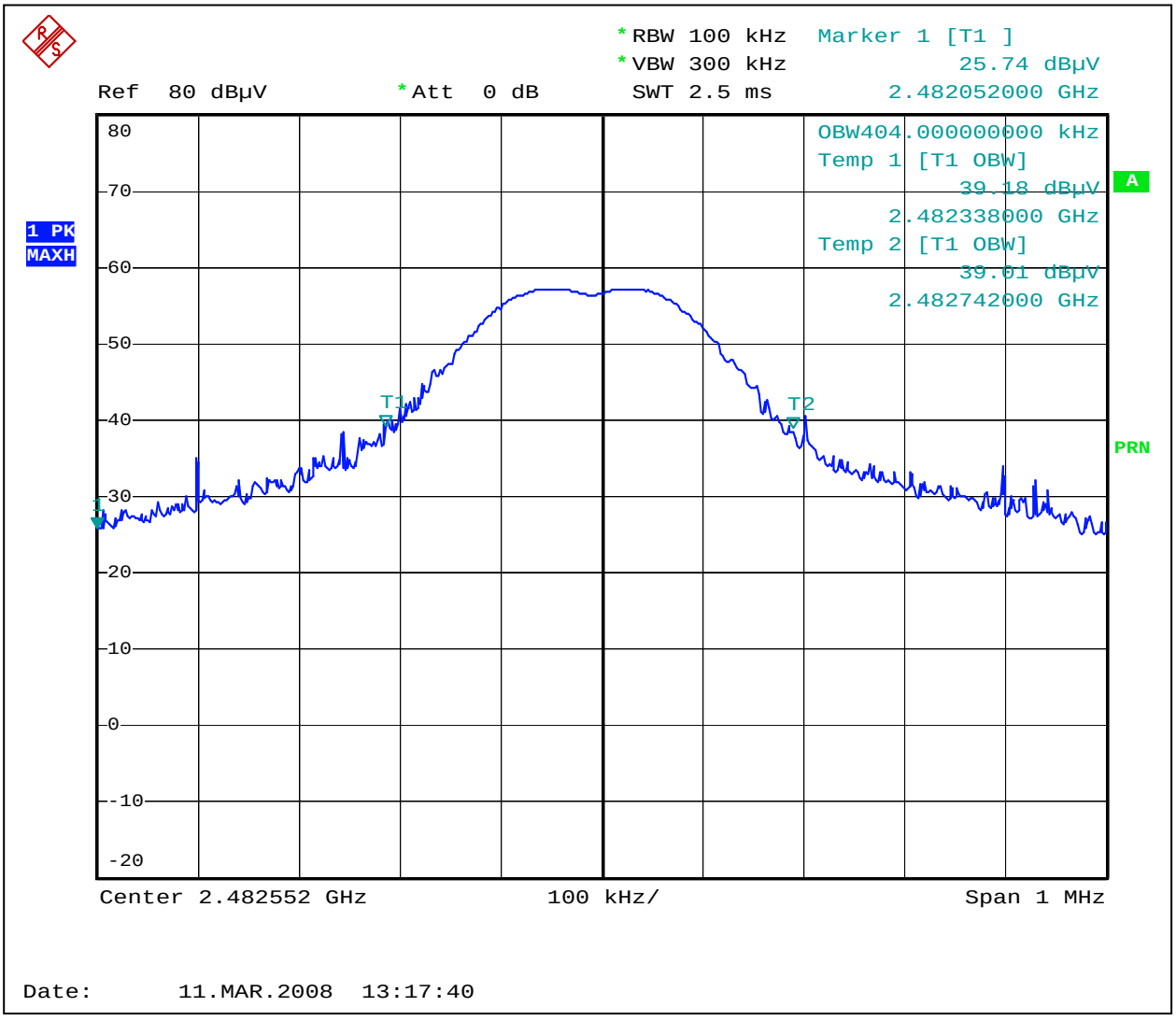
Graph 3.3.1


*RBW 100 kHz
*VBW 300 kHz
Ref 80 dBµV
*Att 0 dB
SWT 2.5 ms
Marker 1 [T1]
30.23 dBµV
2.400460000 GHz
OBW568.000000000 kHz
Temp 1 [T1 OBW]
37.82 dBµV
2.400682000 GHz
Temp 2 [T1 OBW]
41.19 dBµV
2.401250000 GHz
1 PK
MAXH
A
PRN
T1
T2
80
70
60
50
40
30
20
10
0
-10
-20
Center 2.40096 GHz
100 kHz/
Span 1 MHz
Date: 11.MAR.2008 12:38:28

Graph 3.3.2


*RBW 100 kHz
*VBW 300 kHz
Ref 80 dBµV
*Att 0 dB
SWT 2.5 ms
Marker 1 [T1]
30.13 dBµV
2.441686000 GHz
OBW524.000000000 kHz
Temp 1 [T1 OBW]
37.50 dBµV
2.441902000 GHz
Temp 2 [T1 OBW]
36.35 dBµV
2.442426000 GHz
1 PK
MAXH
A
PRN
T1
T2
80
70
60
50
40
30
20
10
0
-10
-20
Center 2.442186 GHz
100 kHz/
Span 1 MHz
Date: 11.MAR.2008 12:26:16

Graph 3.3.3


*RBW 100 kHz
*VBW 300 kHz
Ref 80 dBµV
*Att 0 dB
SWT 2.5 ms
Marker 1 [T1]
25.74 dBµV
2.482052000 GHz
OBW404.000000000 kHz
Temp 1 [T1 OBW]
39.18 dBµV
2.482338000 GHz
Temp 2 [T1 OBW]
39.61 dBµV
2.482742000 GHz
1 PK
MAXH
A
PRN
80
70
60
50
40
30
20
10
0
-10
-20
T1
T2
Center 2.482552 GHz
100 kHz/
Span 1 MHz
Date: 11.MAR.2008 13:17:40

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	☒
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	01/17/2009	☒
Pre-Amplifier	MITEQ	AMF-6F-26004000-40-8P	13224444	11/05/2008	☐
High Pass Filter	Reactel	7HS-4G-S12	0223	VBU	☒
System	TILE! Instrument Control		Ver. 3.4.K.29	VBU	☒