TEST REPORT

Report Number: 3161864MIN-003
Project Number: 3161864

Testing performed on the
4320 Wireless Position Monitor
FCC ID: W684300FT
Industry Canada ID:

to
47 CFR Part 15. 247:2007
RSS- 210, Issue 7, 2007

For
Emerson Process Management/Fisher Controls

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

Test Authorized by:
Emerson Process Management/Fisher Controls
301 South 1st Avenue
Marshalltown, IA 50158

Prepared by: _____ Date: September 26, 2008
Uri Spector

Reviewed by: _____ Date: September 26, 2008
Norman Shpilsher

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1.0 GENERAL DESCRIPTION

Model:	4320
Type of EUT:	2.4GHz Wireless Position Monitor
Serial Number:	N/A
FCC ID:	W684300FT
Industry Canada ID:	
Related Submittal(s) Grants:	None
Company:	Emerson Process Management/Fisher Controls
Customer:	Mr. Daniel Moyer
Address:	301 South 1st Avenue Marshalltown, IA 50158
Phone:	(641) 754-2096
Fax:	(641) 754-2054
Test Standards:	☒ FCC Part 15.247 ☒ RSS–210, Issue 7, 2007 ☒ RSS-Gen, Issue 2, 2005 ☒ 47 CFR, Part 15:2007, §15.107 and §15.109, Class B ☐ Other
Type of radio:	☒ Stand -alone ☐ Module ☐ Hybrid
Date Sample Submitted:	September 18, 2008
Test Work Started:	September 18, 2008
Test Work Completed:	September 26, 2008
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 ☒ 7.2 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	375 HART	Field Communicator

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(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
15.247(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

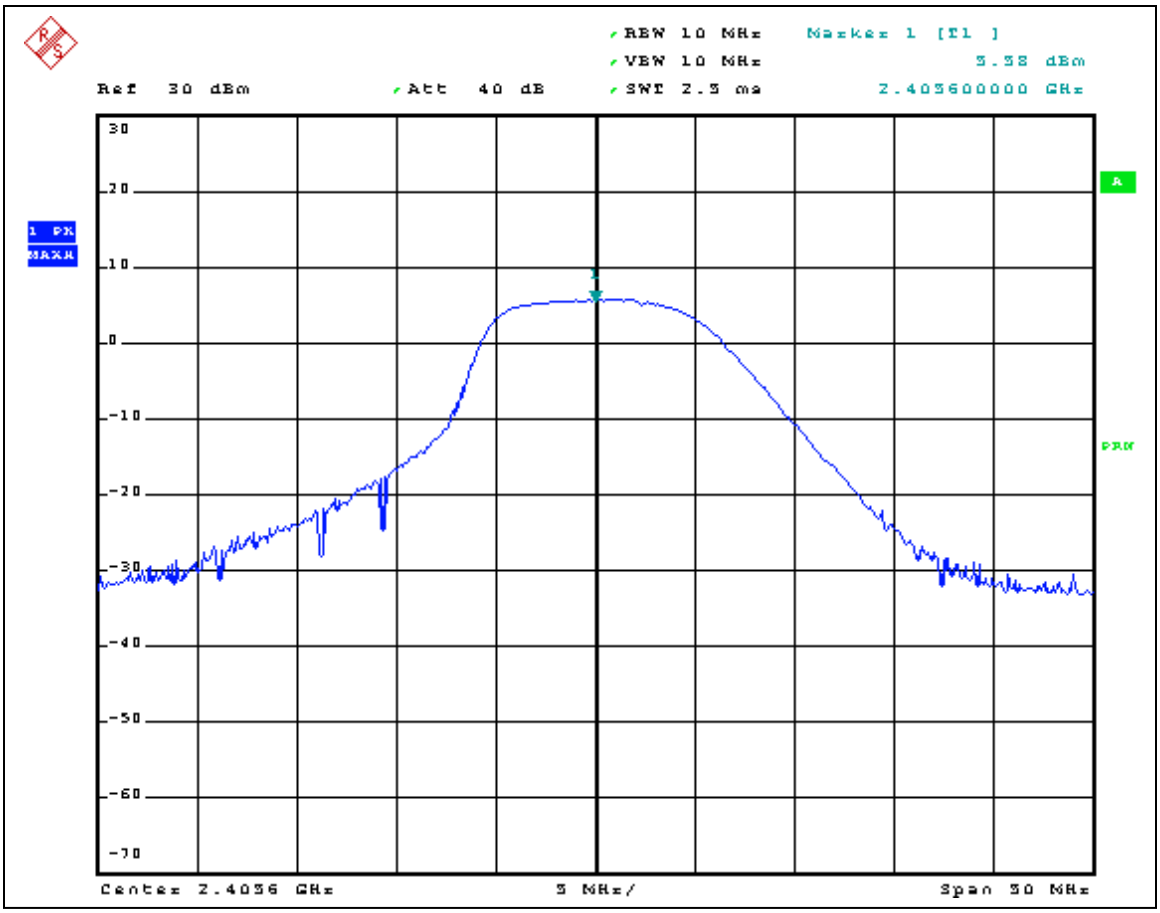
Test location: ☐ OATS ☐ Anechoic Chamber ☒ Other

Test result: **Pass**

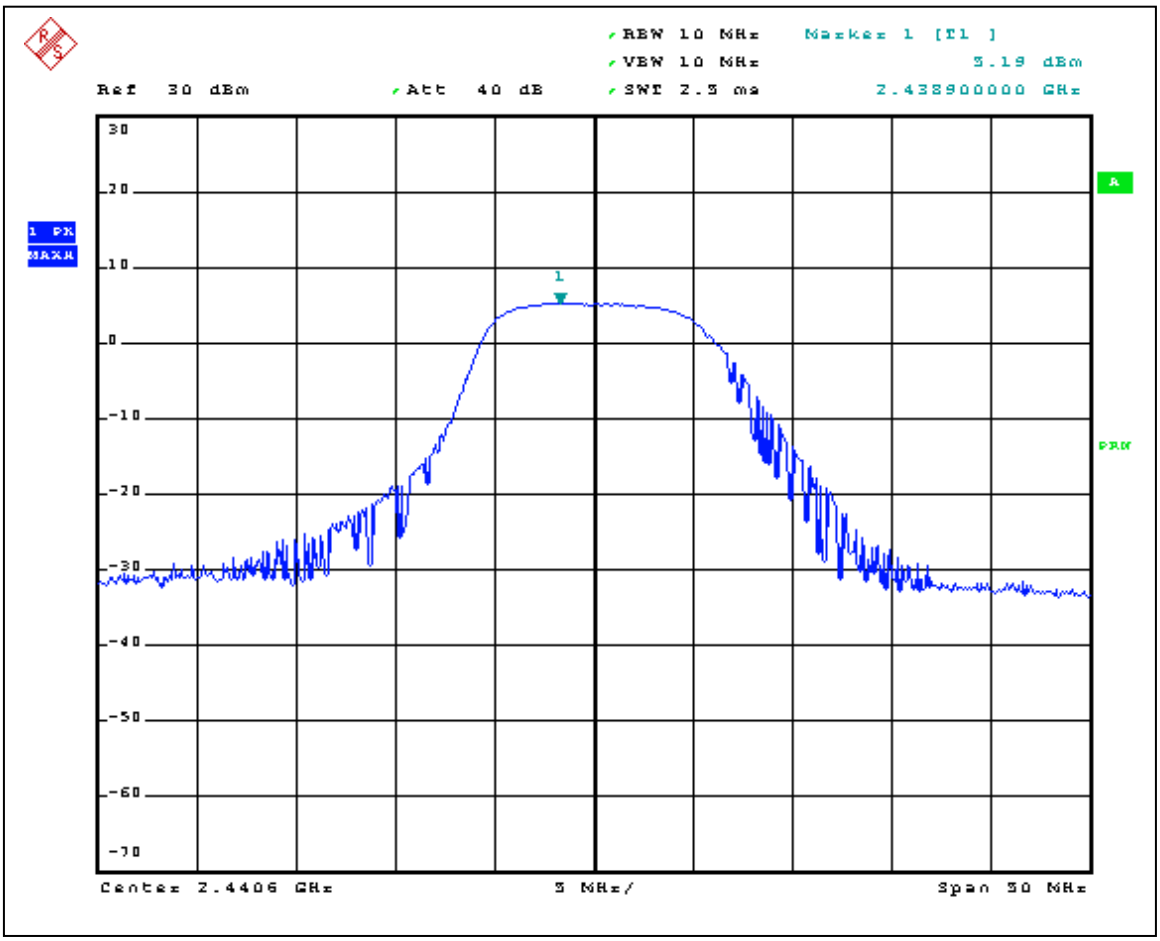
Max. Margin: 24.37 dB below the limits

Power Output:	**Conducted**					
Frequency Range:	☐ 902-928MHz		☒ 2400-2483.5MHz		☐ 5725-5850MHz	
Low Frequency MHz	**Measured power dBm**	**Attenuaton dB**	**Power at Antenna dBm**	**Limit dBm**	**Limit Reduction dB**	**Margin dB**
2405.6	5.38	0.25	5.63	30	0	-24.37
Middle Frequency MHz						
2444.06	5.19	0.25	5.44	30	0	-24.56
Upper Frequency MHz						
2475.6	5.0	0.25	5.25	30	0	-24.75
RBW:	☐ 1MHz	☐ 3MHz	☒ 10MHz			
VBW:	☐ 1MHz	☐ 3MHz	☒ 10MHz			
Antenna Gain:	☒ < 6dBi	☐ >6dBi and =	dBi, Output power reduction =	dB		

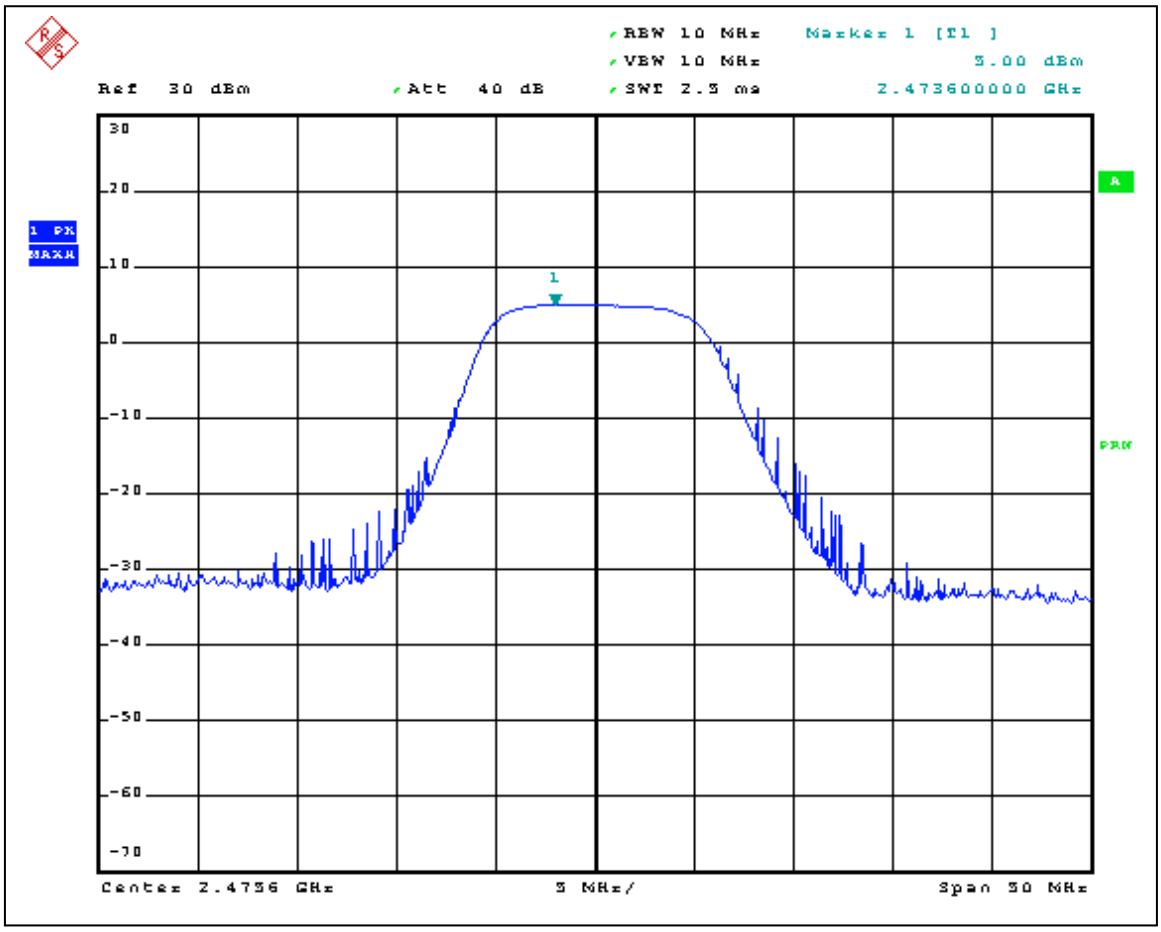
Notes: The maximum peak conducted output power limit is 1 W, or 30dBm
Graphs 3.1.1 to 3.1.3 show the conducted output power


RBW 10 MHz
VBW 10 MHz
SWT 2.5 ms
Marker 1 [T1]
5.58 dBm
2.405600000 GHz
Ref 30 dBm
Att 40 dB
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
1 PK
MAXH
A
PRN
Center 2.4056 GHz
5 MHz/
Span 50 MHz

Graph 3.1.1


RBW 10 MHz
VBW 10 MHz
SWT 2.5 ms
Marker 1 [T1]
5.19 dBm
2.438900000 GHz
Ref 30 dBm
Att 40 dB
1 PK
MAXH
A
PRN
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
Center 2.4406 GHz
5 MHz/
Span 50 MHz

Graph 3.1.2

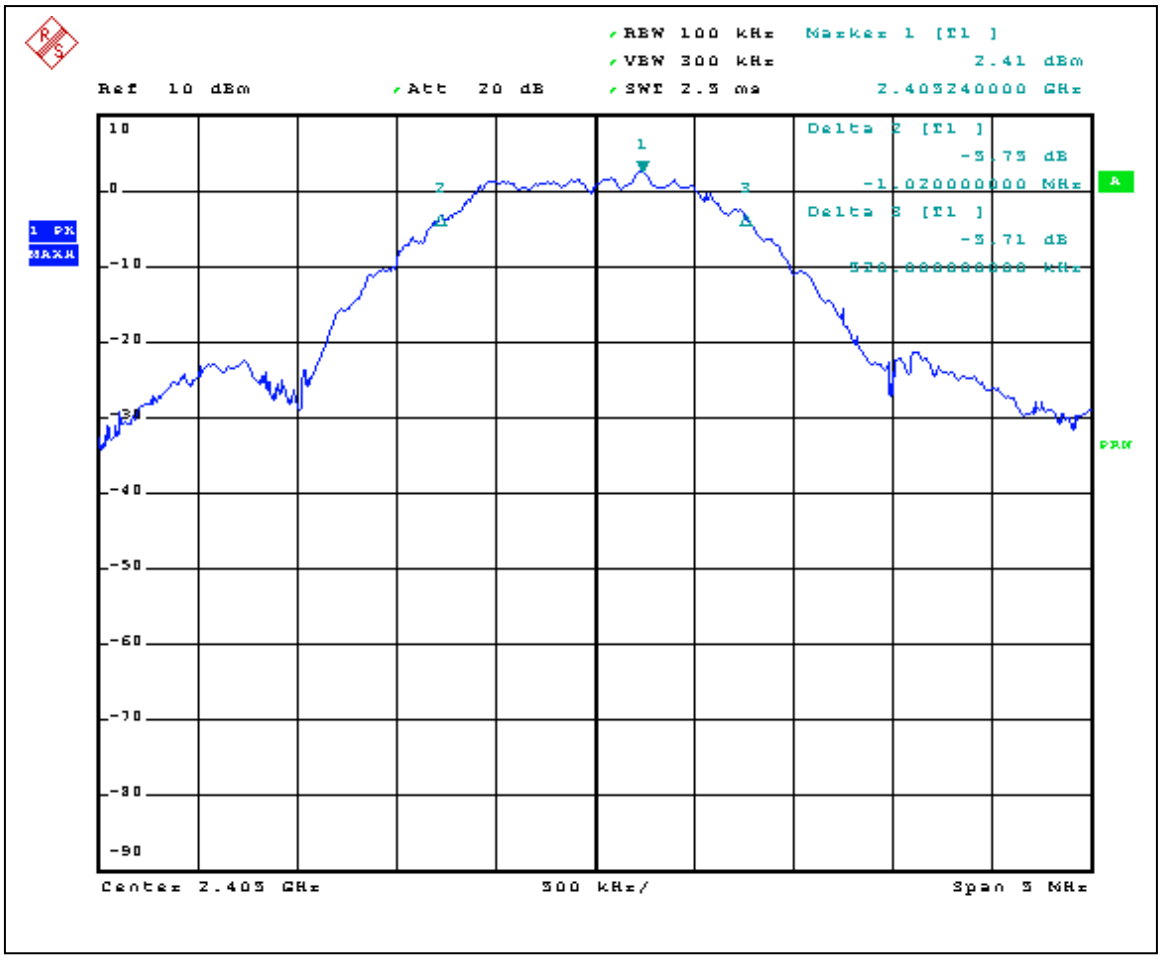

RBW 10 MHz
VBW 10 MHz
SWT 2.5 ms
Marker 1 [T1]
3.00 dBm
2.473600000 GHz
Ref 30 dBm
Att 40 dB
1 PK
MAXH
A
PRN
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
1
Center 2.4736 GHz
5 MHz/
Span 50 MHz

Graph 3.1.3

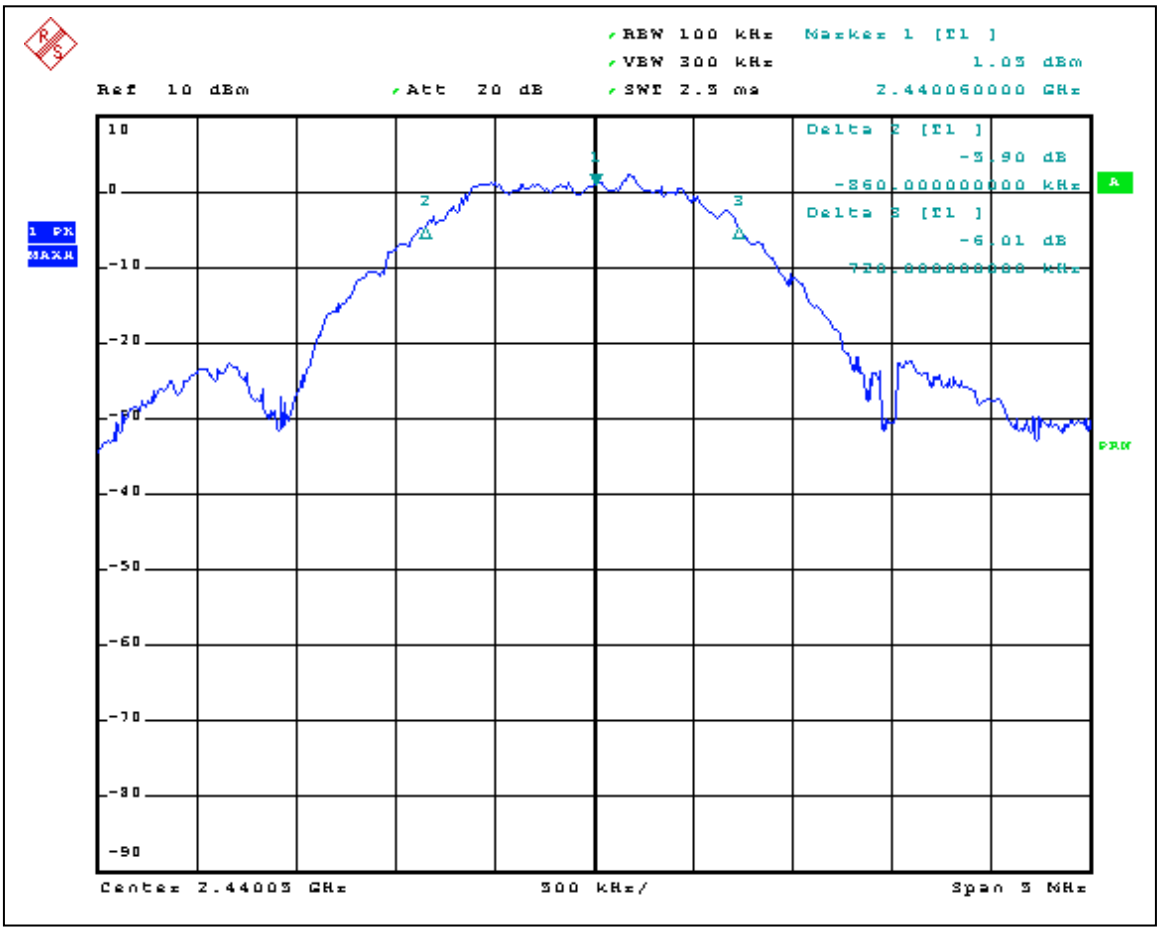
3.2 6dB bandwidth of the digital modulation

Low Frequency Channel kHz	Middle Frequency Channel kHz	Upper Frequency Channel kHz	Minimum Allowed Bandwidth kHz	Result
1540	1580	1590	500	**Pass**

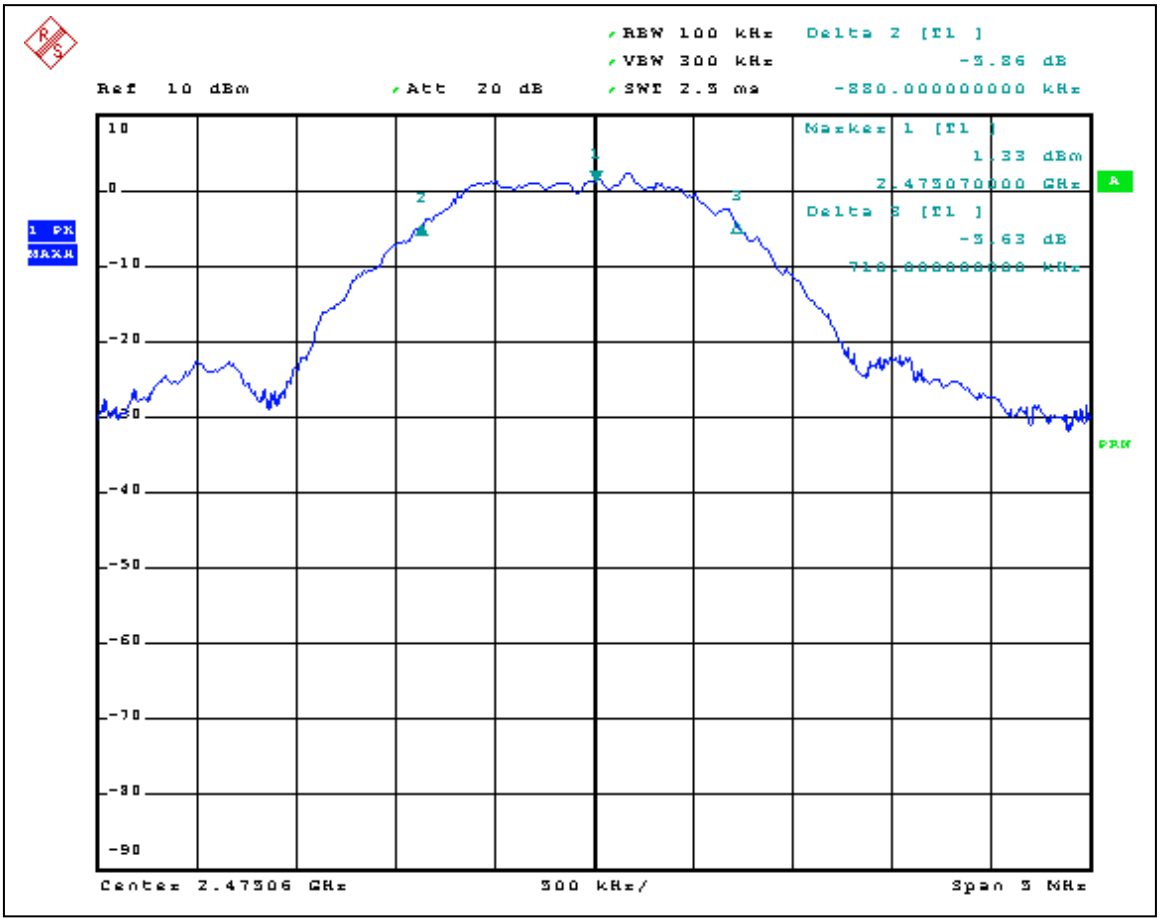
Notes: Graphs 3.2.1 to 3.2.3 show the 6dB bandwidth


RBW 100 kHz
VBW 300 kHz
SWT 2.5 ms
Marker 1 [T1]
2.41 dBm
2.405240000 GHz
Ref 10 dBm
Att 20 dB
Delta 2 [T1]
-5.75 dB
-1.020000000 MHz
Delta 3 [T1]
-5.71 dB
510.000000000 kHz
1 PK
MAXH
A
VIEW
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
Center 2.405 GHz
500 kHz/
Span 5 MHz

Graph 3.2.1


RBW 100 kHz
VBW 300 kHz
SWT 2.5 ms
Marker 1 [T1]
1.05 dBm
2.440060000 GHz
Ref 10 dBm
Att 20 dB
Delta 2 [T1]
-3.90 dB
-860.000000000 kHz
Delta 3 [T1]
-6.01 dB
720.000000000 kHz
1 PK
MAXH
A
PRN
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
Center 2.44005 GHz
500 kHz/
Span 5 MHz

Graph 3.2.2

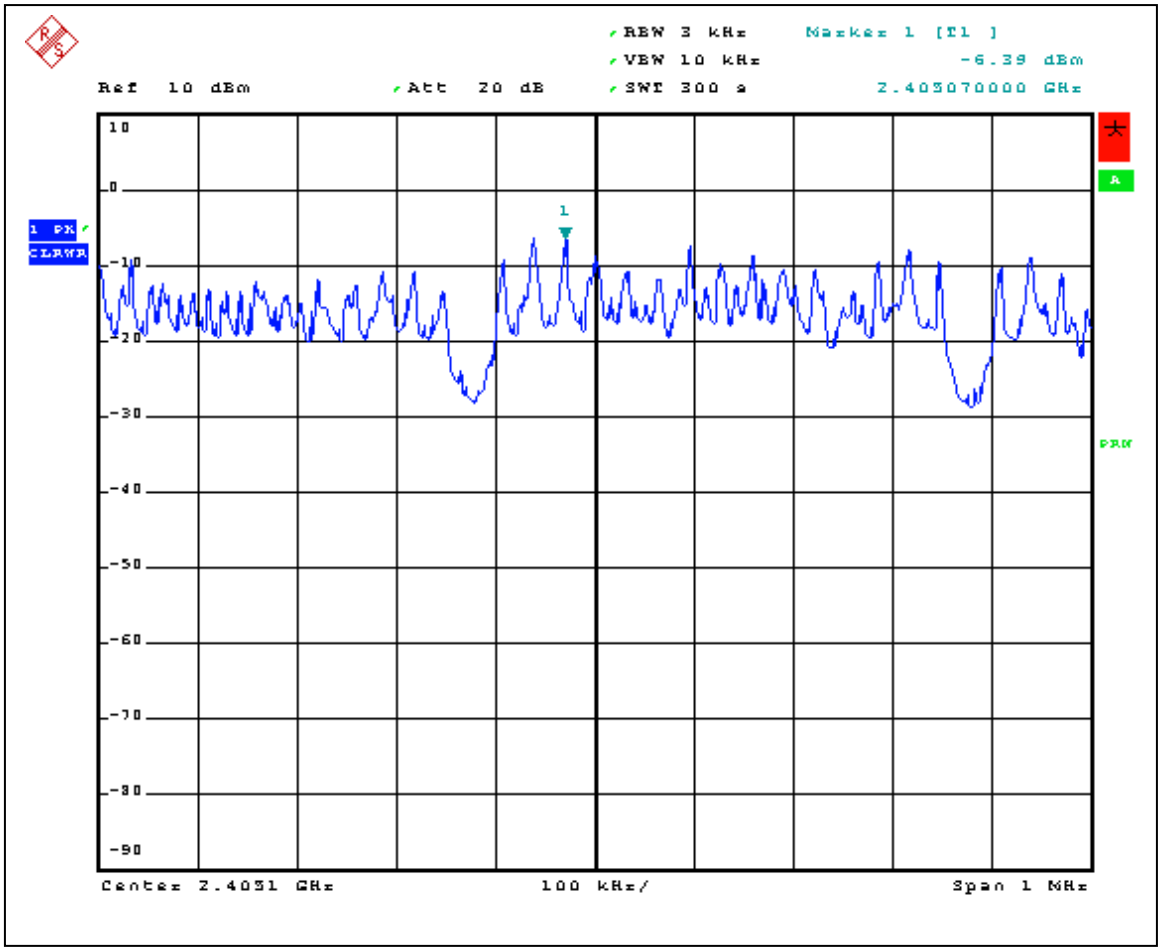

RBW 100 kHz
VBW 300 kHz
SWT 2.5 ms
Delta 2 [T1]
-5.86 dB
-880.000000000 kHz
Ref 10 dBm
Att 20 dB
Marker 1 [T1]
1.33 dBm
2.475070000 GHz
Delta 3 [T1]
-5.63 dB
718.888888888 kHz
1 PK
MAXH
A
VIEW
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
Center 2.47506 GHz
500 kHz/
Span 5 MHz

Graph 3.2.3

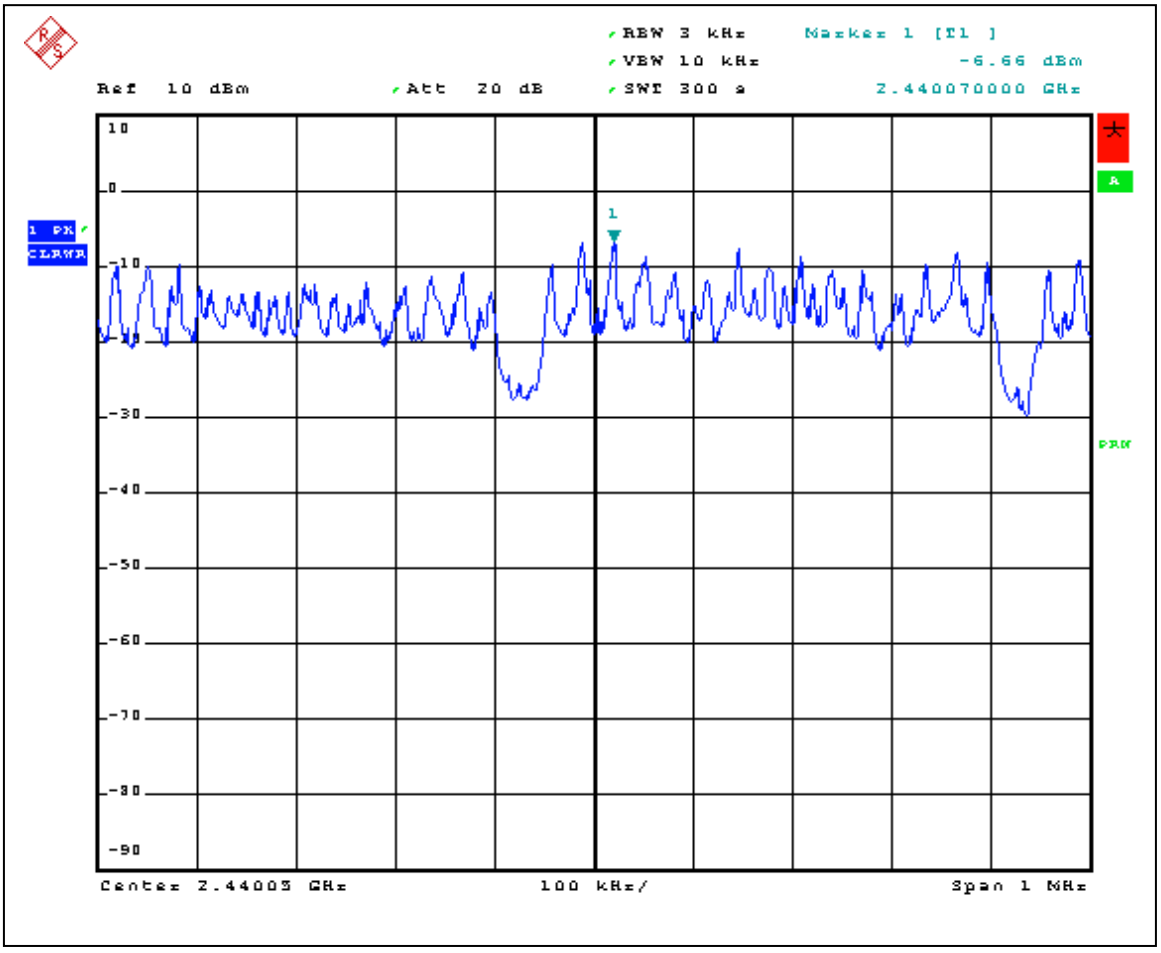
3.3 Power spectral density

Power Output:	☒ Conducted ☐ Radiated			
	Measured Density dBm	**Power Spectral Density dBm**	**Limit dBm**	**Margin dB**
Low Frequency Channel	-6.39	-6.1	8	-14.1
Middle Frequency Channel	-6.66	-6.4	8	-144
Upper Frequency Channel	-6.97	-6.7	8	-14.7
Analyzer Settings:	☒ RBW=3KHz ☒ VBW=10KHz ☒ Span=1MHz ☒ Sweep=300sec			
Antenna Gain:	☒ < 6dBi and = 2 dBi ☐ >6dBi and = dBi, limit reduction = dB			

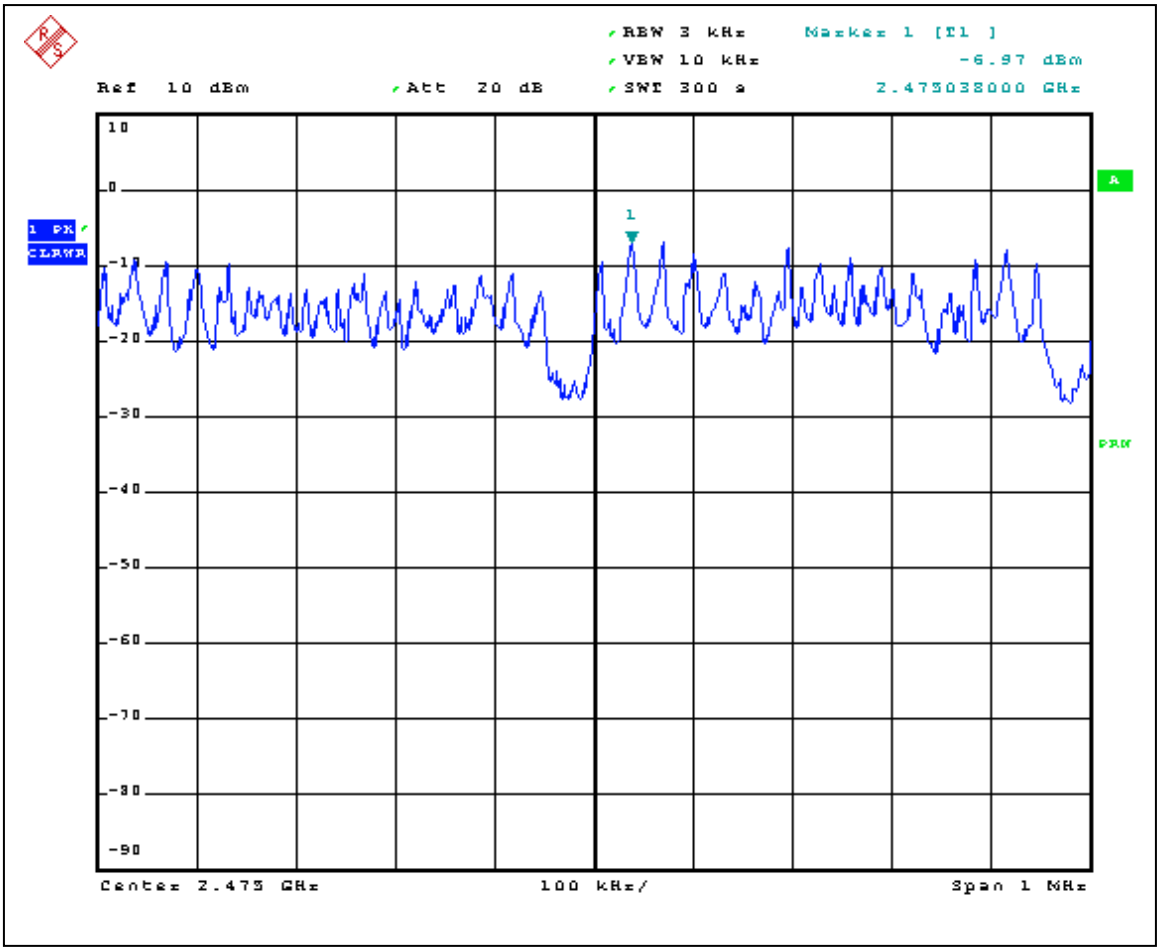
Notes: The Power Spectral Density was calculated adding the cable/attenuator loss of 0.25 dB from the measured density value.
Graphs 3.3.1 to 3.3.3 show the Power Spectral Density


RBW 3 kHz
VBW 10 kHz
SWT 300 s
Marker 1 [T1]
-6.39 dBm
2.403070000 GHz
Ref 10 dBm
Att 20 dB
1 PK
CLRWR
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
PRN
Center 2.4031 GHz
100 kHz/
Span 1 MHz

Graph 3.3.1


RBW 3 kHz
VBW 10 kHz
SWT 300 s
Marker 1 [T1]
-6.66 dBm
2.440070000 GHz
Ref 10 dBm
Att 20 dB
1 PK
CLRWR
10
0
-10
-30
-40
-50
-60
-70
-80
-90
1
A
PRN
Center 2.44005 GHz
100 kHz/
Span 1 MHz

Graph 3.3.2

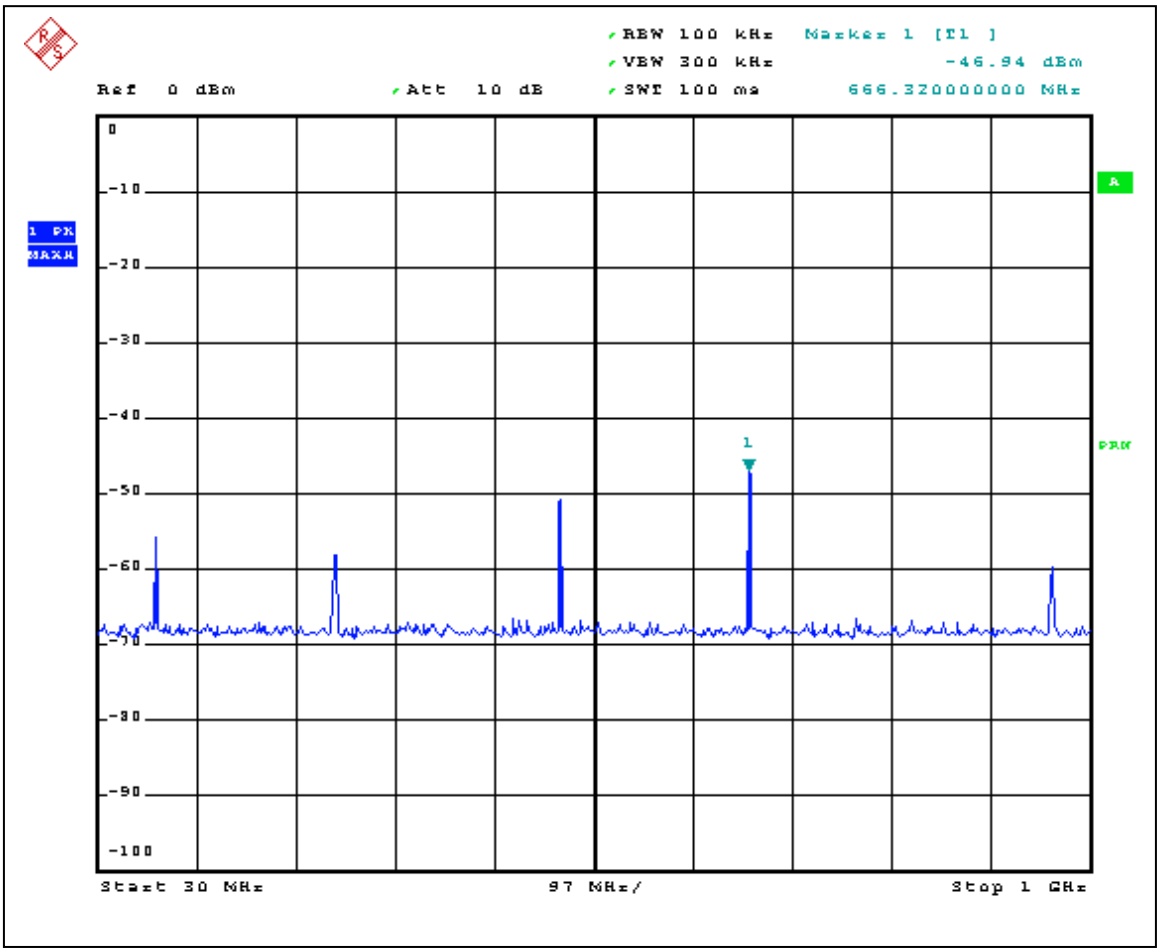

RBW 3 kHz
VBW 10 kHz
SWT 300 s
Marker 1 [T1]
-6.97 dBm
2.475038000 GHz
Ref 10 dBm
Att 20 dB
1 PK
CLRWR
A
PRN
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
Center 2.475 GHz
100 kHz/
Span 1 MHz

Graph 3.3.3

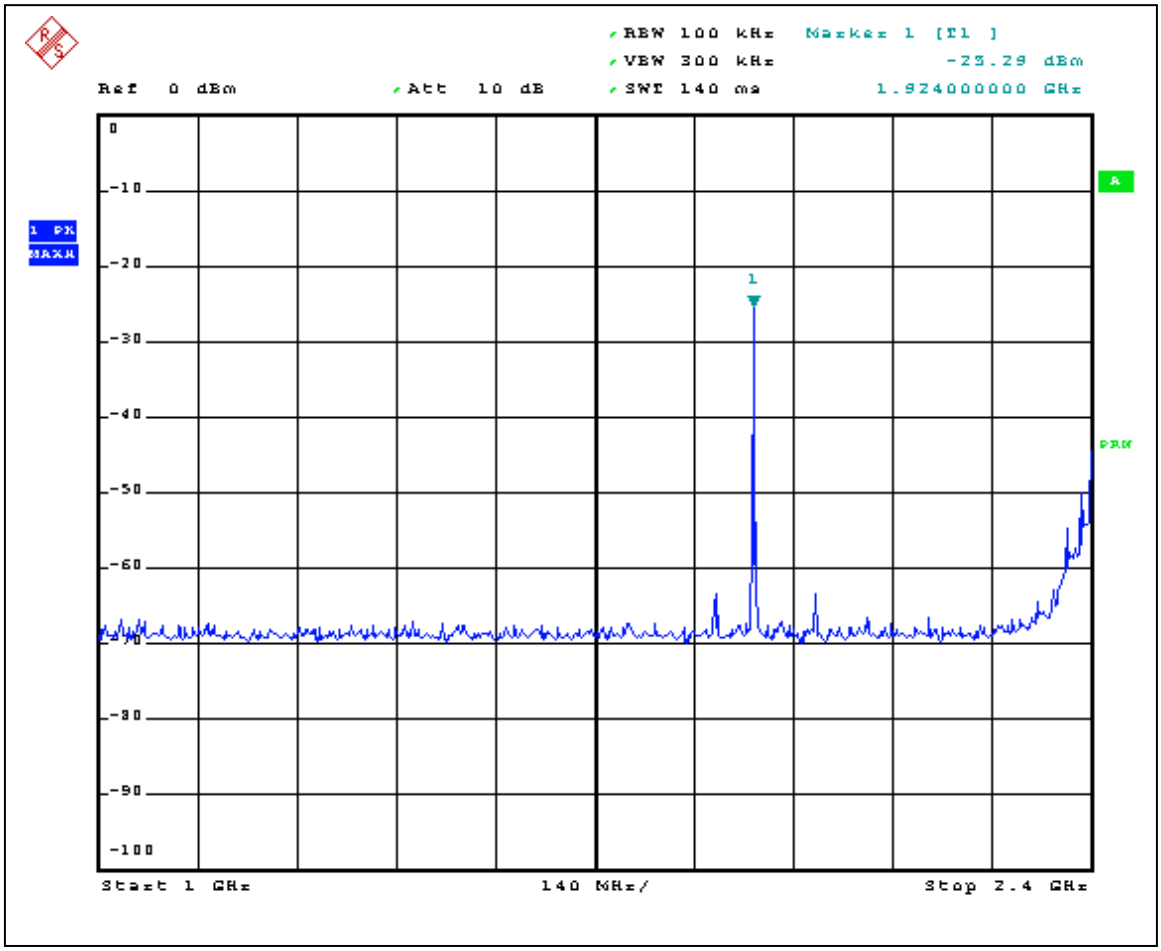
3.4 Antenna conducted spurious emissions

	Minimum Measured Attenuation dB	Minimum Allowed Attenuation dB	Margin dB
Low Frequency Channel	30.7	20	-10.7
Middle Frequency Channel	31.4	20	-11.4
Upper Frequency Channel	31.4	20	-11.4
Analyzer Settings:	☒ RBW=100KHz		
Minimum Allowed Attenuation:	☒ 20dB ☐ 30dB (for digital systems with conducted power measured using RMS averaging over a time interval)		

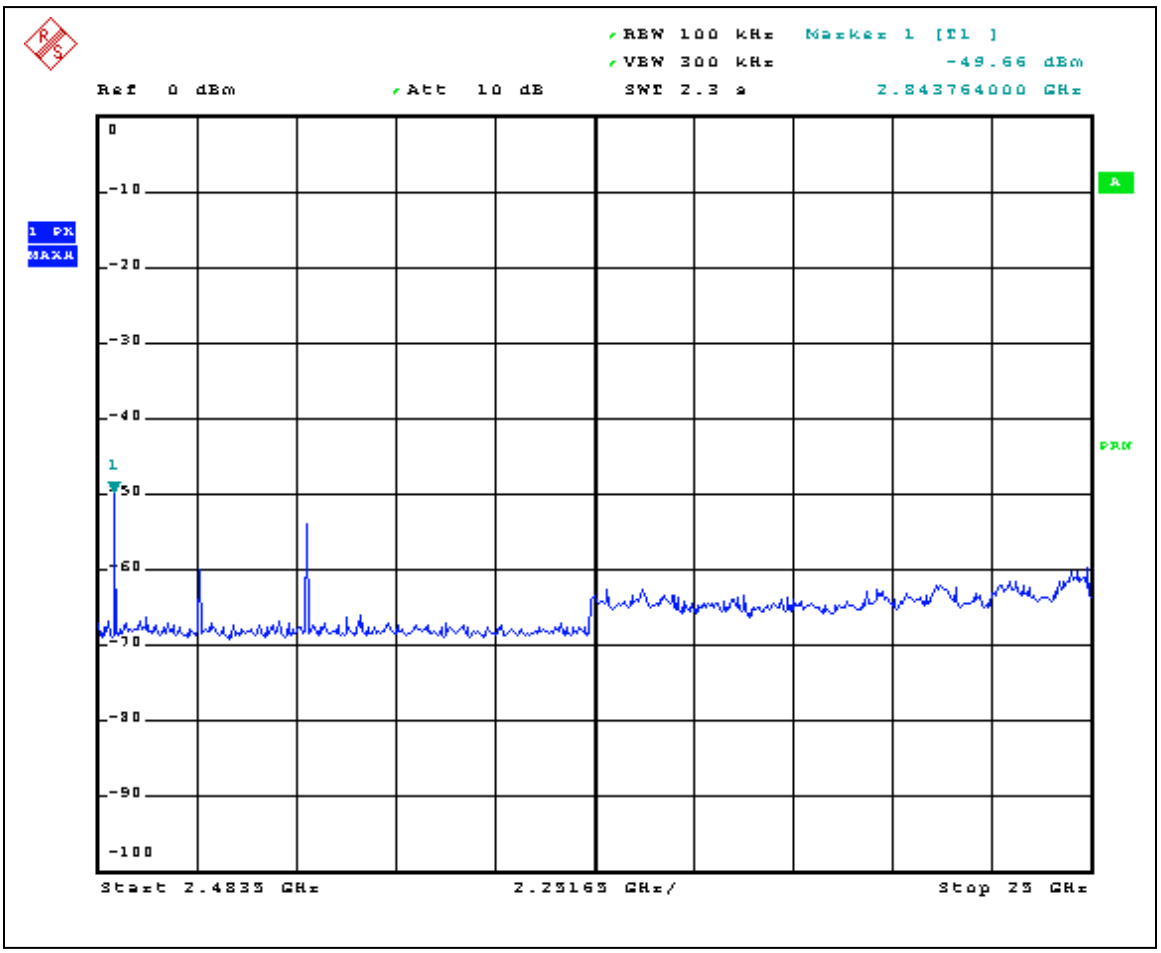
Notes: Test was performed in frequency range from 30MHz to 25GHz
Graphs 3.4.1 to 3.4.3 show the Antenna Conducted Spurious Emissions for channel 0
Graphs 3.4.4 to 3.4.6 show the Antenna Conducted Spurious Emissions for channel 7
Graphs 3.4.7 to 3.4.9 show the Antenna Conducted Spurious Emissions for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


RBW 100 kHz
VBW 300 kHz
SWT 100 ms
Marker 1 [T1]
-46.94 dBm
666.320000000 MHz
Ref 0 dBm
Att 10 dB
1 PK
MAXH
A
PRN
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
1
Start 30 MHz
97 MHz/
Stop 1 GHz

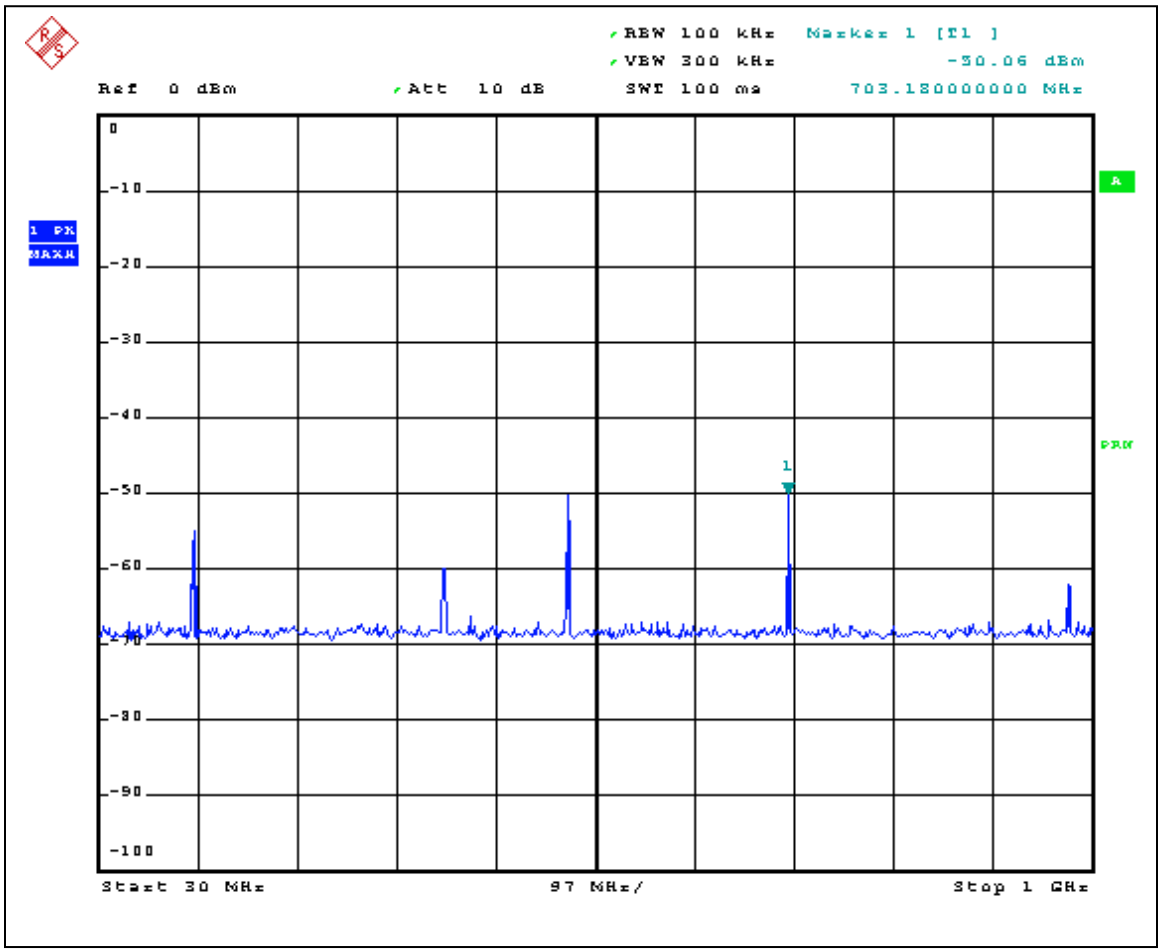
Graph 3.4.1


RBW 100 kHz
VBW 300 kHz
SWT 140 ms
Marker 1 [T1]
-25.29 dBm
1.9240000000 GHz
Ref 0 dBm
Att 10 dB
1 PK
MAXH
A
1
PRN
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
Start 1 GHz
140 MHz/
Stop 2.4 GHz

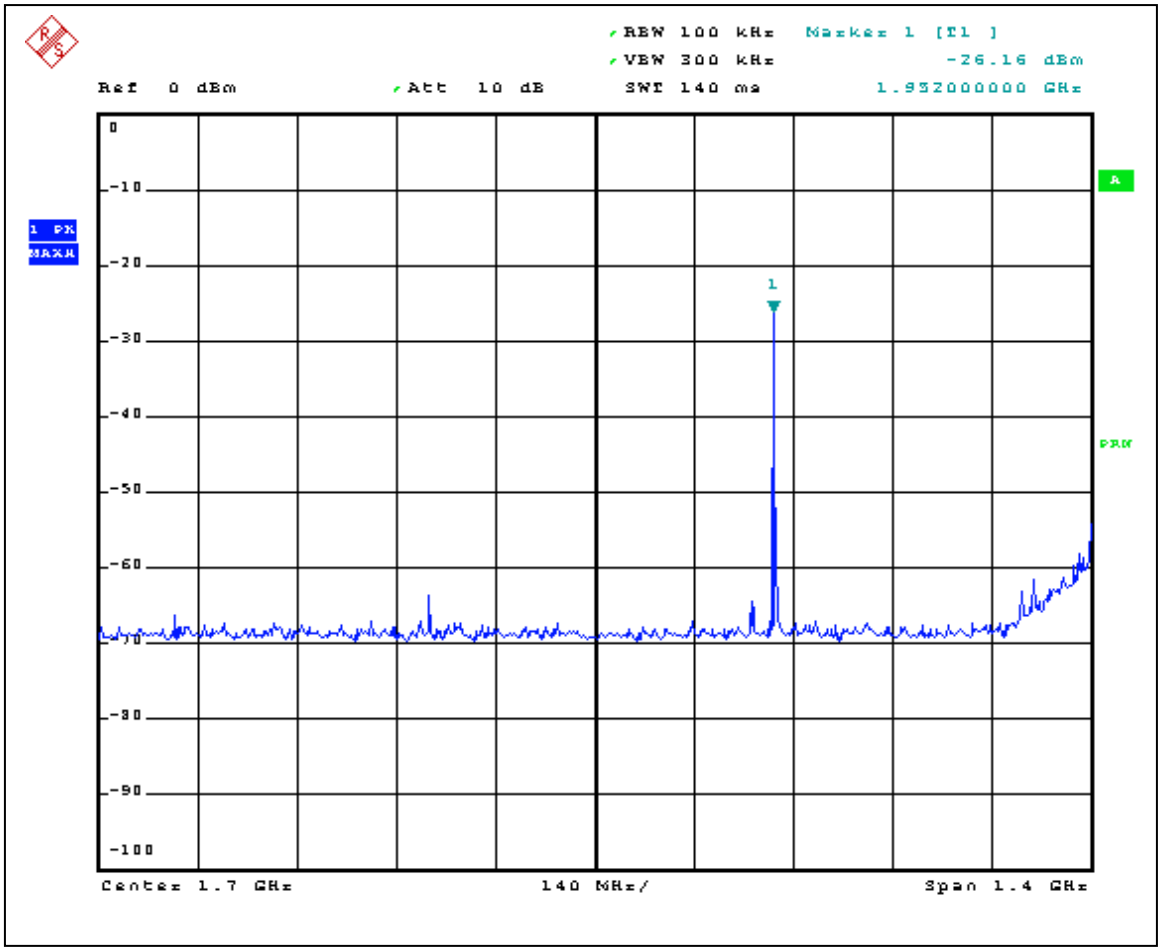
Graph 3.4.2


RBW 100 kHz
VBW 300 kHz
SWT 2.3 s
Marker 1 [T1]
-49.66 dBm
2.843764000 GHz
Ref 0 dBm
Att 10 dB
1 PK
MAXH
A
PRN
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
1
Start 2.4835 GHz
2.25165 GHz/
Stop 25 GHz

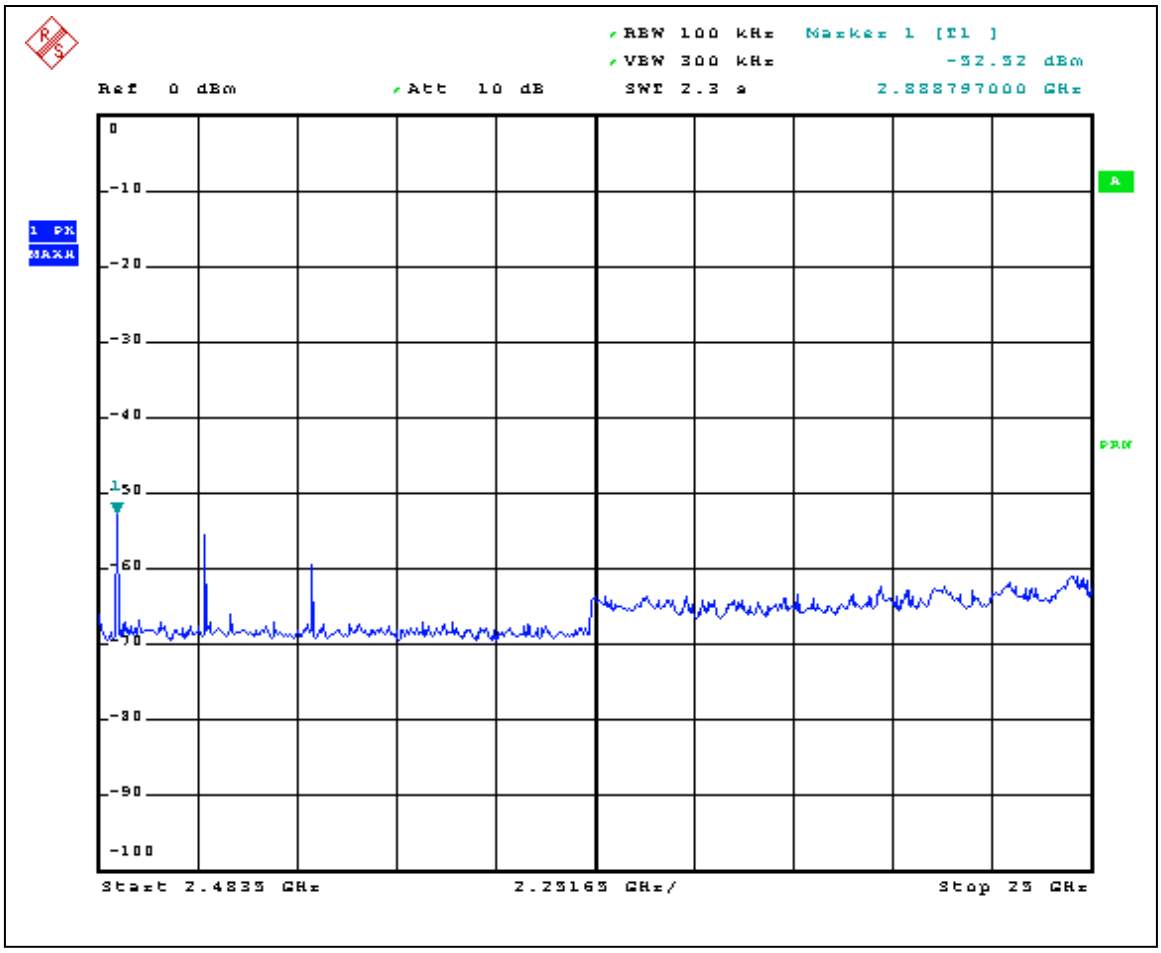
Graph 3.4.3


RBW 100 kHz
VBW 300 kHz
SWT 100 ms
Marker 1 [T1]
-50.06 dBm
703.180000000 MHz
Ref 0 dBm
Att 10 dB
1 PK
MAXH
A
PRN
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
1
Start 30 MHz
97 MHz/
Stop 1 GHz

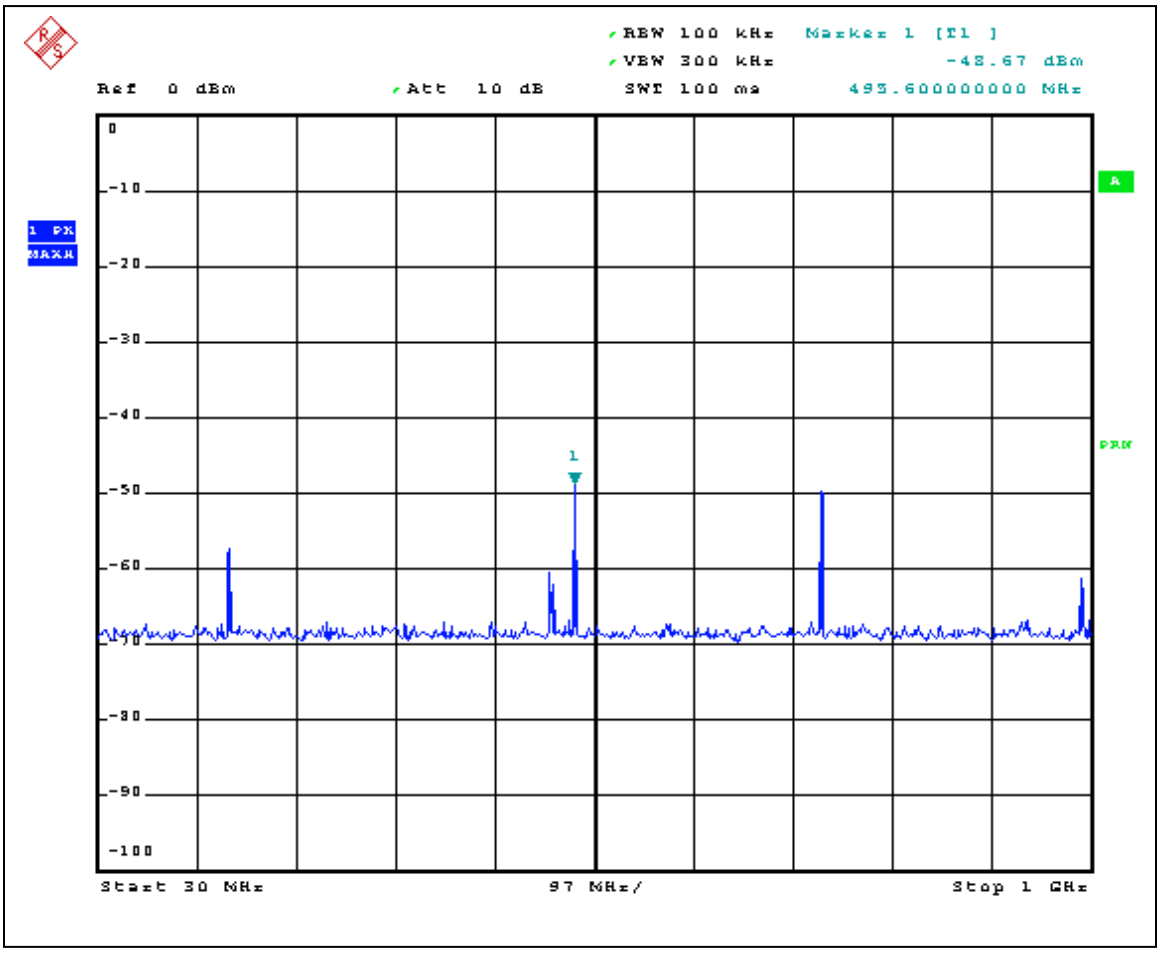
Graph 3.4.4


RBW 100 kHz
VBW 300 kHz
Marker 1 [T1]
-26.16 dBm
1.932000000 GHz
Ref 0 dBm
Att 10 dB
SWT 140 ms
1 PK
MAXH
A
PRN
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
Center 1.7 GHz
140 MHz/
Span 1.4 GHz

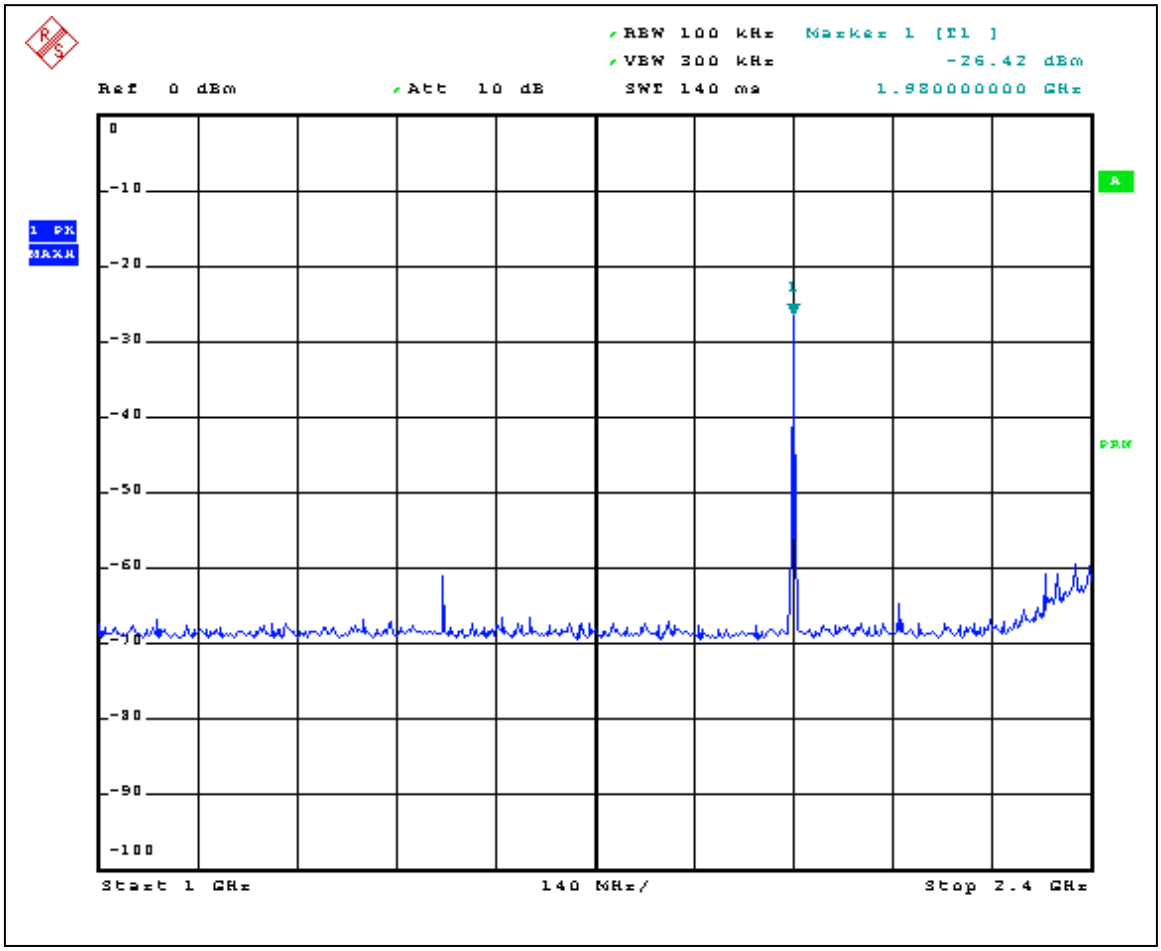
Graph 3.4.5


RBW 100 kHz
VBW 300 kHz
SWT 2.3 s
Marker 1 [T1]
-52.52 dBm
2.888797000 GHz
Ref 0 dBm
Att 10 dB
1 PK
MAXH
A
PRN
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
Start 2.4835 GHz
2.25163 GHz/
Stop 25 GHz

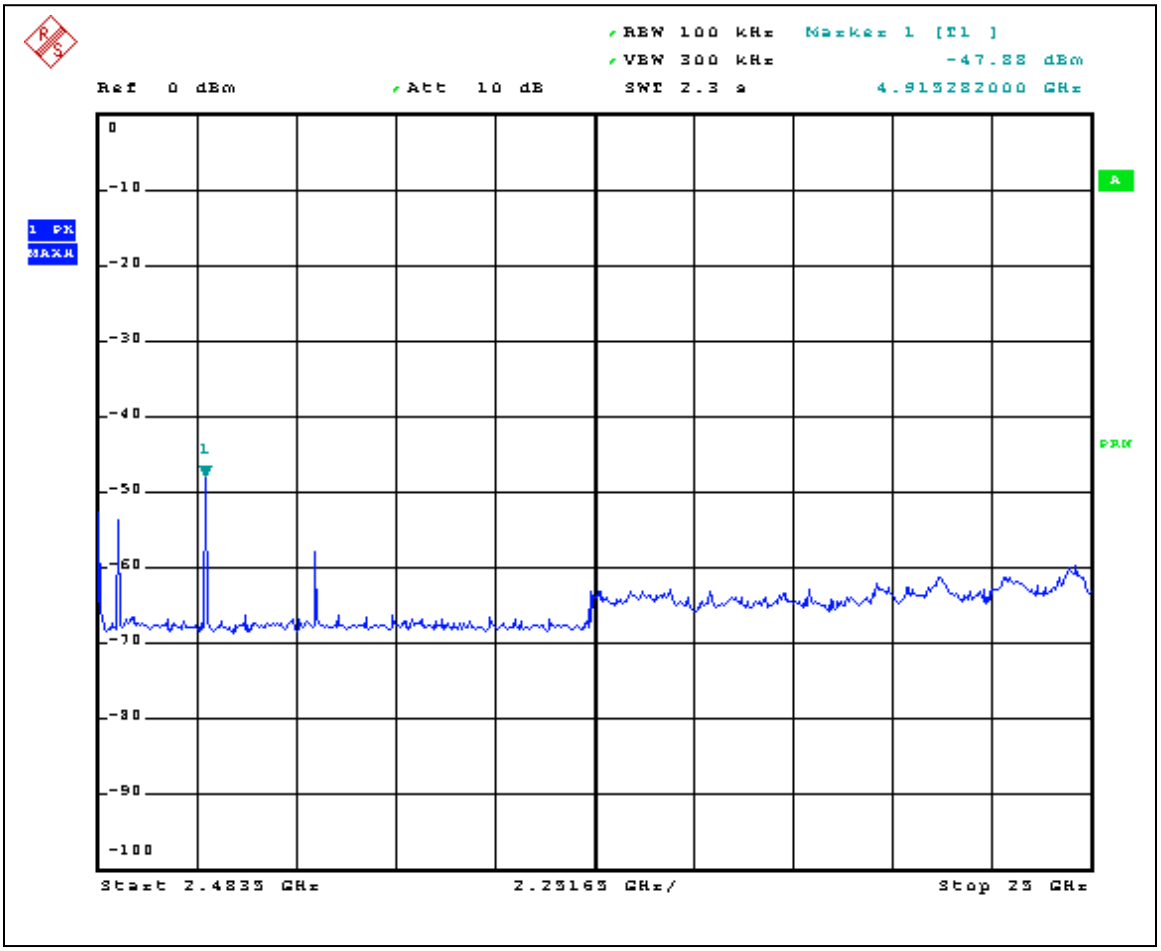
Graph 3.4.6


RBW 100 kHz
VBW 300 kHz
SWT 100 ms
Marker 1 [T1]
-48.67 dBm
495.600000000 MHz
Ref 0 dBm
Att 10 dB
1 PK
MAXH
A
PRN
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
1
Start 30 MHz
97 MHz/
Stop 1 GHz

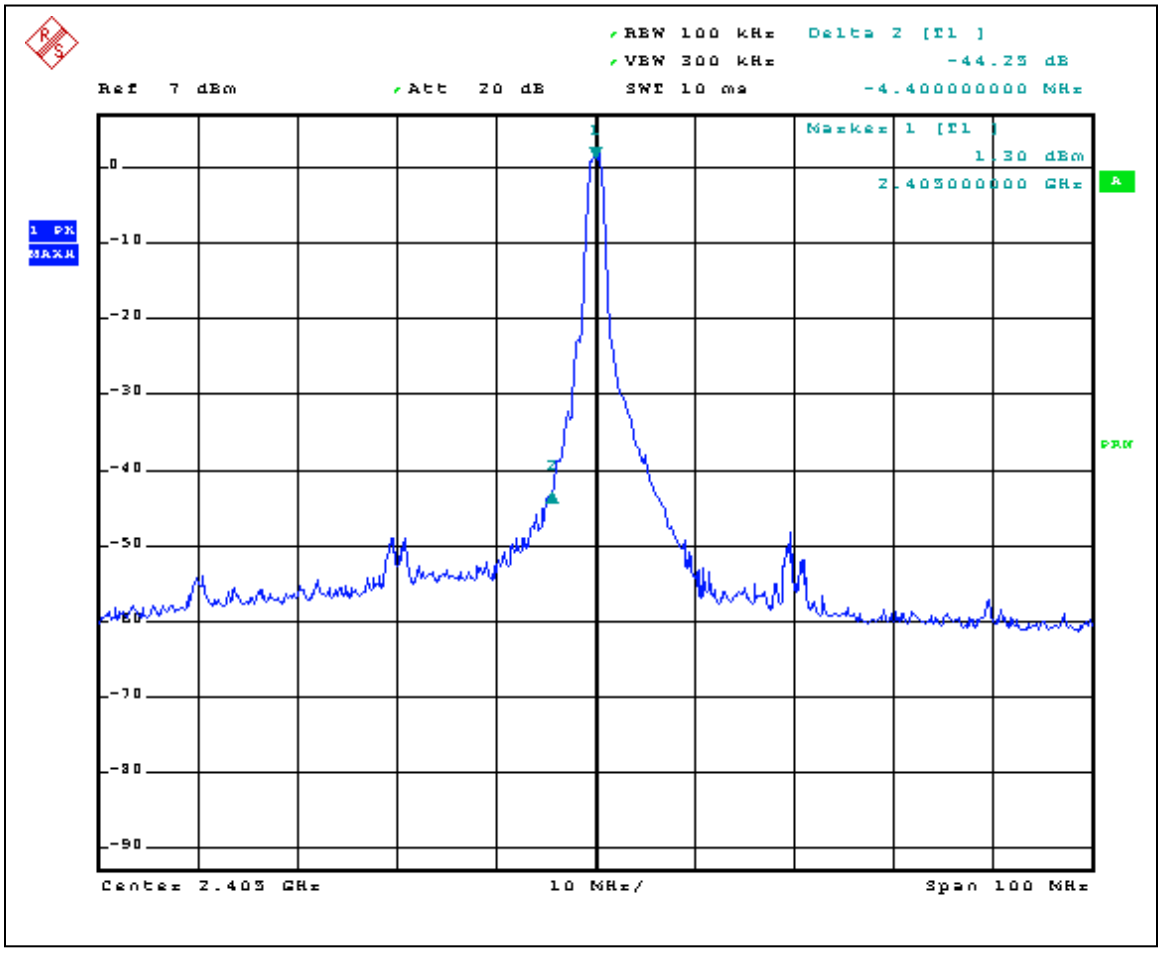
Graph 3.4.7


RBW 100 kHz
VBW 300 kHz
SWT 140 ms
Marker 1 [T1]
-26.42 dBm
1.980000000 GHz
Ref 0 dBm
Att 10 dB
1 PK
MAXH
A
PRN
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
Start 1 GHz
140 MHz/
Stop 2.4 GHz

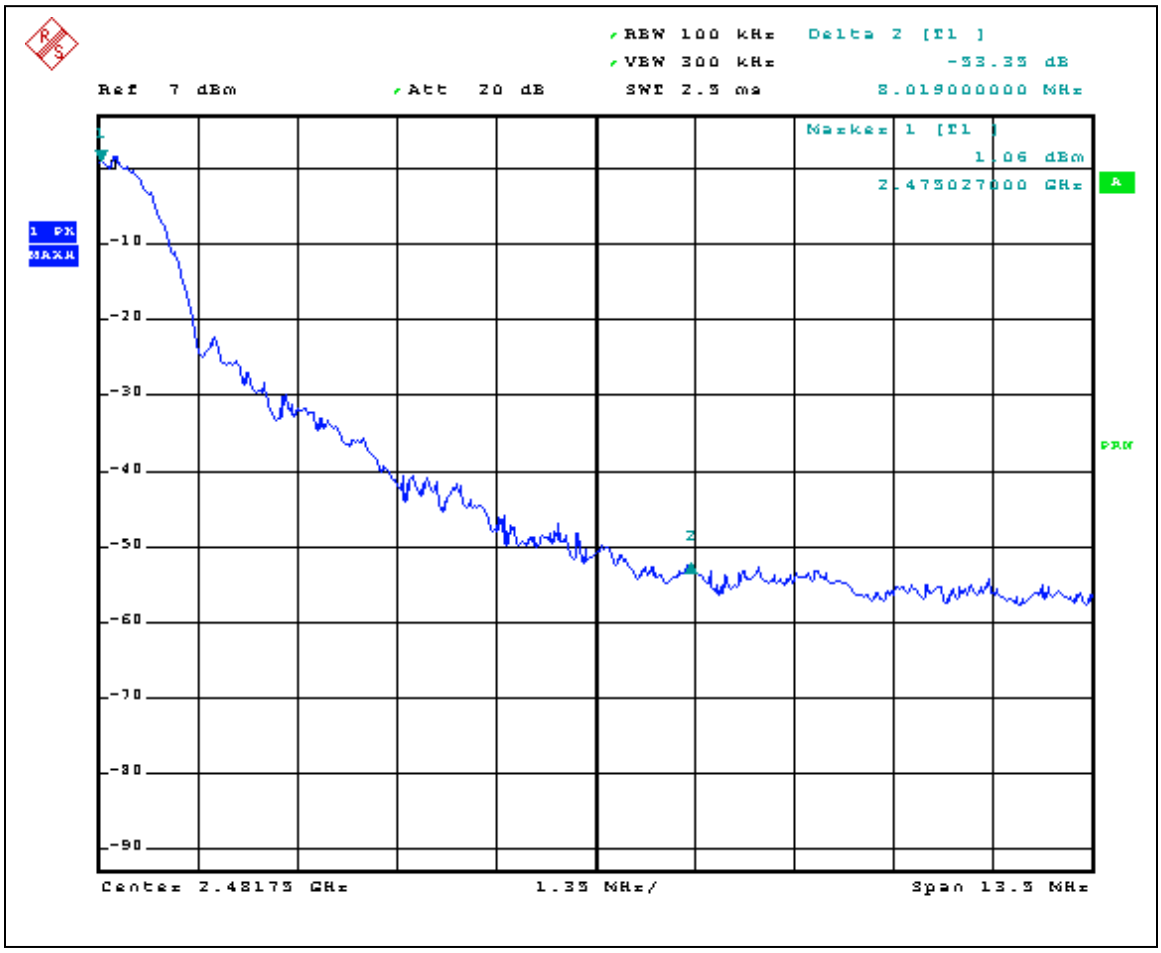
Graph 3.4.8


RBW 100 kHz
VBW 300 kHz
SWT 2.3 s
Marker 1 [T1]
-47.88 dBm
4.915282000 GHz
Ref 0 dBm
Att 10 dB
1 PK
MAXH
A
PRN
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
1
Start 2.4835 GHz
2.25165 GHz/
Stop 25 GHz

Graph 3.4.9


RBW 100 kHz
VBW 300 kHz
SWT 10 ms
Delta 2 [T1]
-44.25 dB
-4.400000000 MHz
Ref 7 dBm
Att 20 dB
Marker 1 [T1]
1.30 dBm
2.403000000 GHz
1 PK
MAXH
A
PRN
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
Center 2.403 GHz
10 MHz/
Span 100 MHz

Graph 3.4.10


RBW 100 kHz
VBW 300 kHz
SWT 2.5 ms
Delta 2 [T1]
-53.35 dB
8.019000000 MHz
Ref 7 dBm
Att 20 dB
Marker 1 [T1]
1.06 dBm
2.475027000 GHz
1 PK
MAXH
A
PRN
-10
-20
-30
-40
-50
-60
-70
-80
-90
Center 2.48175 GHz
1.35 MHz/
Span 13.5 MHz

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: 21.2 dB below the limits

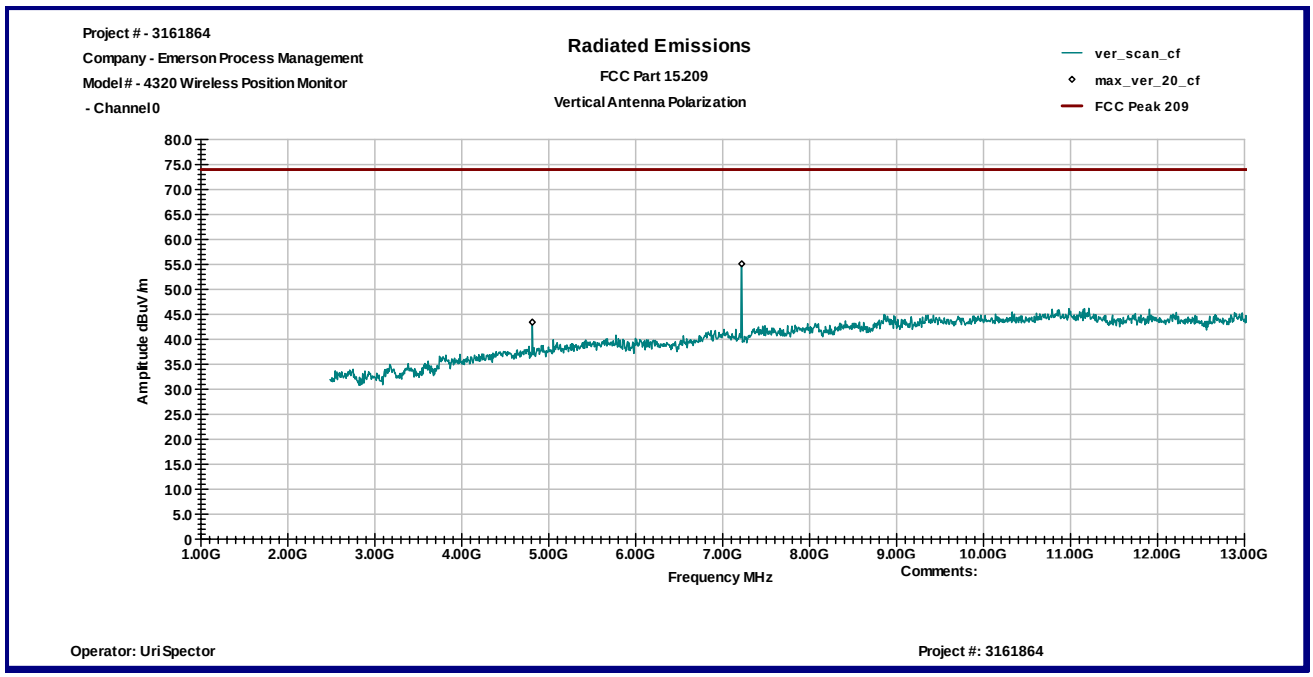
Notes: The table 3.5.1 shows the 2nd and 3rd harmonics in restricted band of operation per FCC 15.205
No emissions were detected above ambient at 4th and above harmonics

Date:	September 23, 2008	**Result:** **Pass**
Standard:	FCC part 15.247(d)	
Tested by:	Uri Spector	
Test Point:	Enclosure with Antenna	
Operation mode:	See Page 5	
Note:		

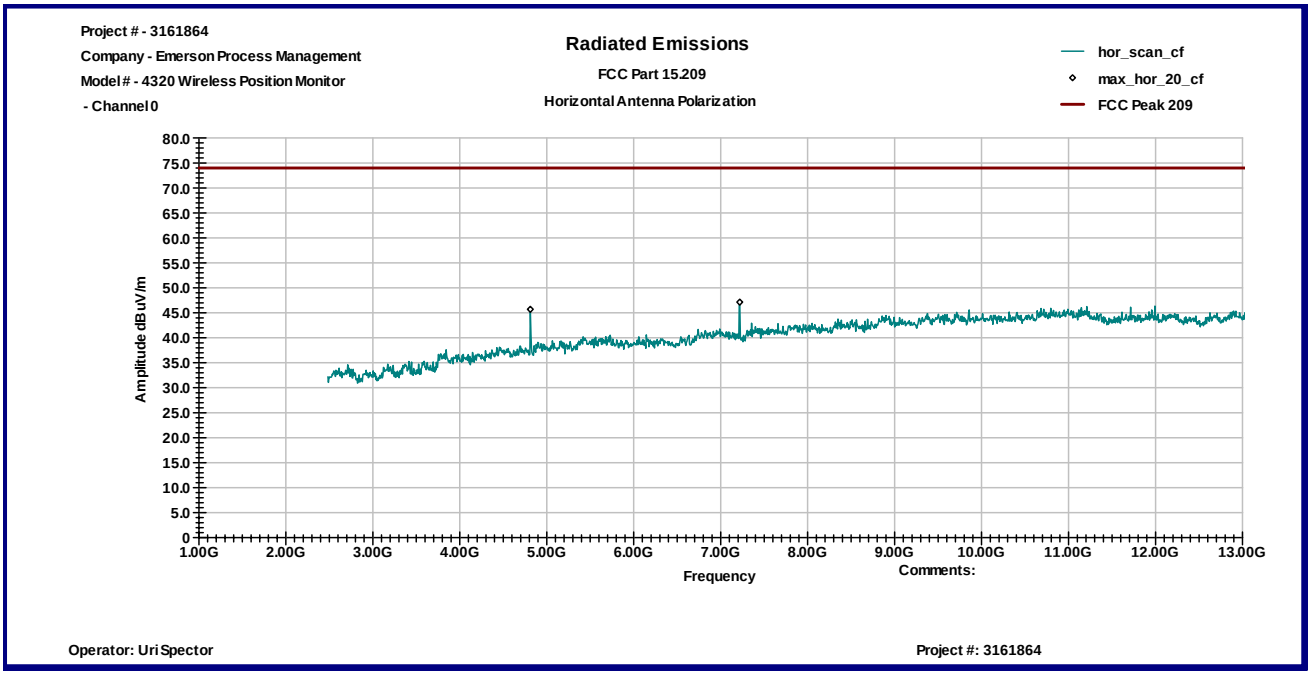
Table # 3.5.1

Frequency MHz	Antenna Polarity	Antenna Hts(cm)	Ant. CF dB1/m	Cable loss dB	Pre-amp Gain (dB)	Reading dBµV	Total @ 3m dBµV/m	Limit dBµV/m	Margin dB	Comments
				Channel 0						
4810.97	H	120	33.0	6.3	39.8	28.6	28.1	54.0	-25.8	
7219.13	V	100	35.8	7.7	40.0	28.6	32.1	54.0	-21.9	
				Channel 7						
4885.45	H	115	33.1	6.4	39.8	29.5	29.2	54.0	-24.8	
7324.64	V	100	36.1	7.7	39.9	28.9	32.8	54.0	-21.2	
				Channel 14						
4953.72	H	117	33.2	6.5	39.7	30.0	30.0	54.0	-24.0	
7423.95	V	100	36.3	7.7	44.1	28.3	28.2	54.0	-25.8	

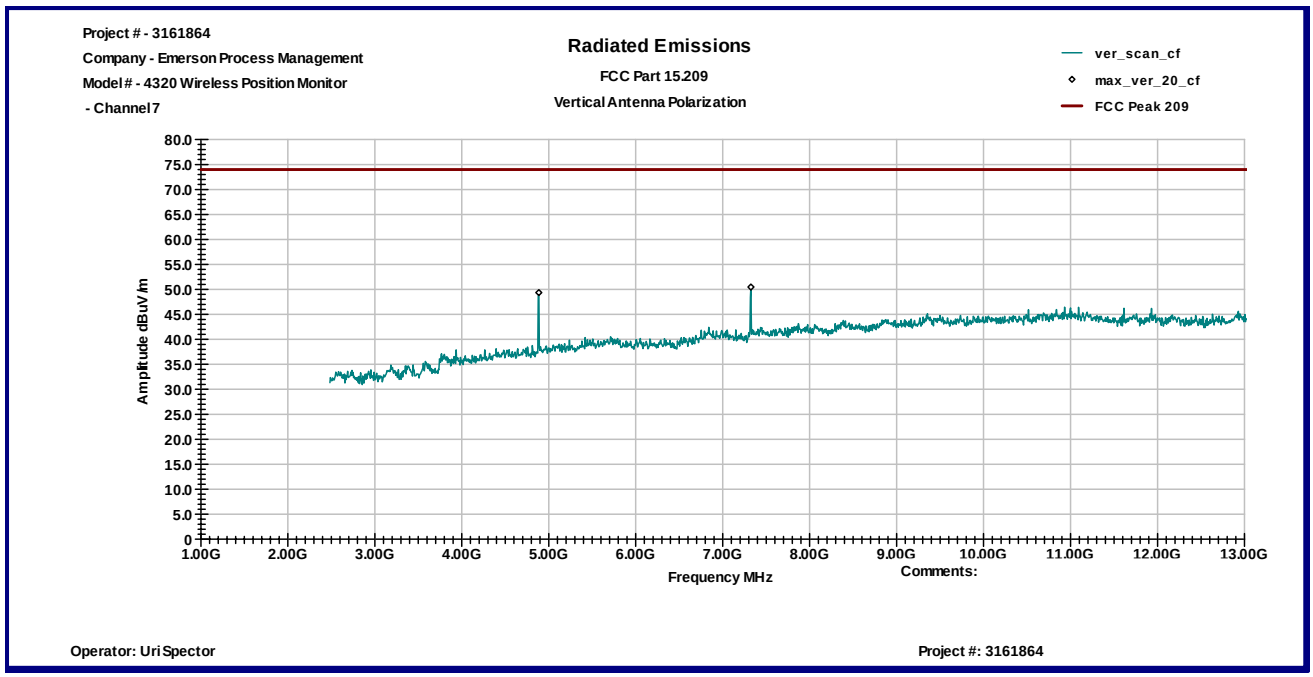
Note: The table shows the 2nd and 3rd harmonics in restricted band of operation per FCC 15.205
No emissions were detected above ambient at 4th and above harmonics
All measurements were taken using an Average Value (RBW 1MHz, VBW 10Hz)



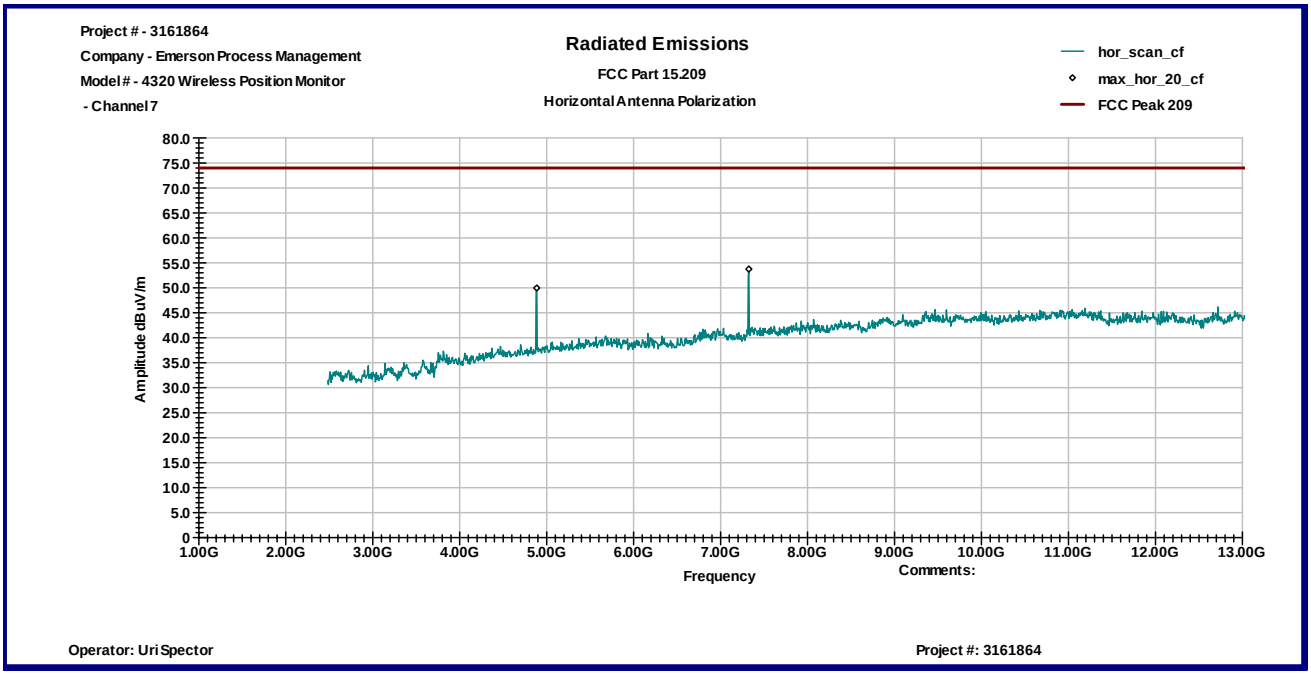
Graph 3.5.1



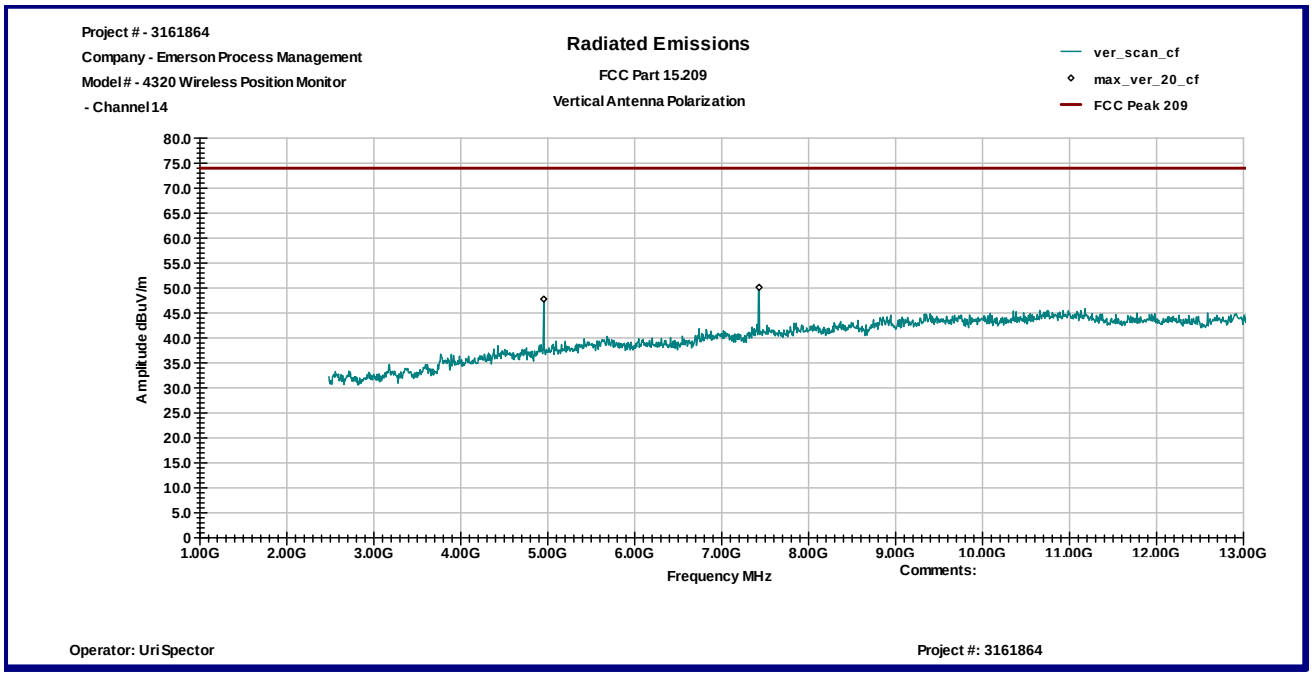
Graph 3.5.2



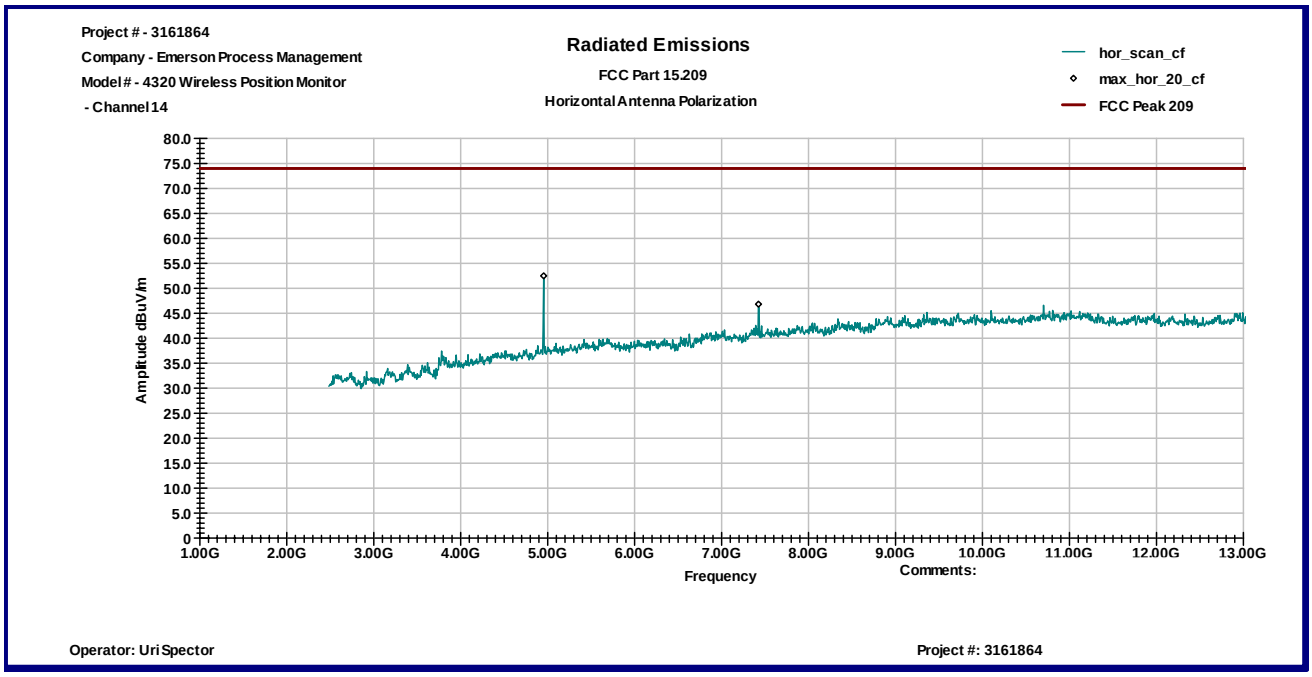
Graph 3.5.3



Graph 3.5.4



Graph 3.5.5



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)

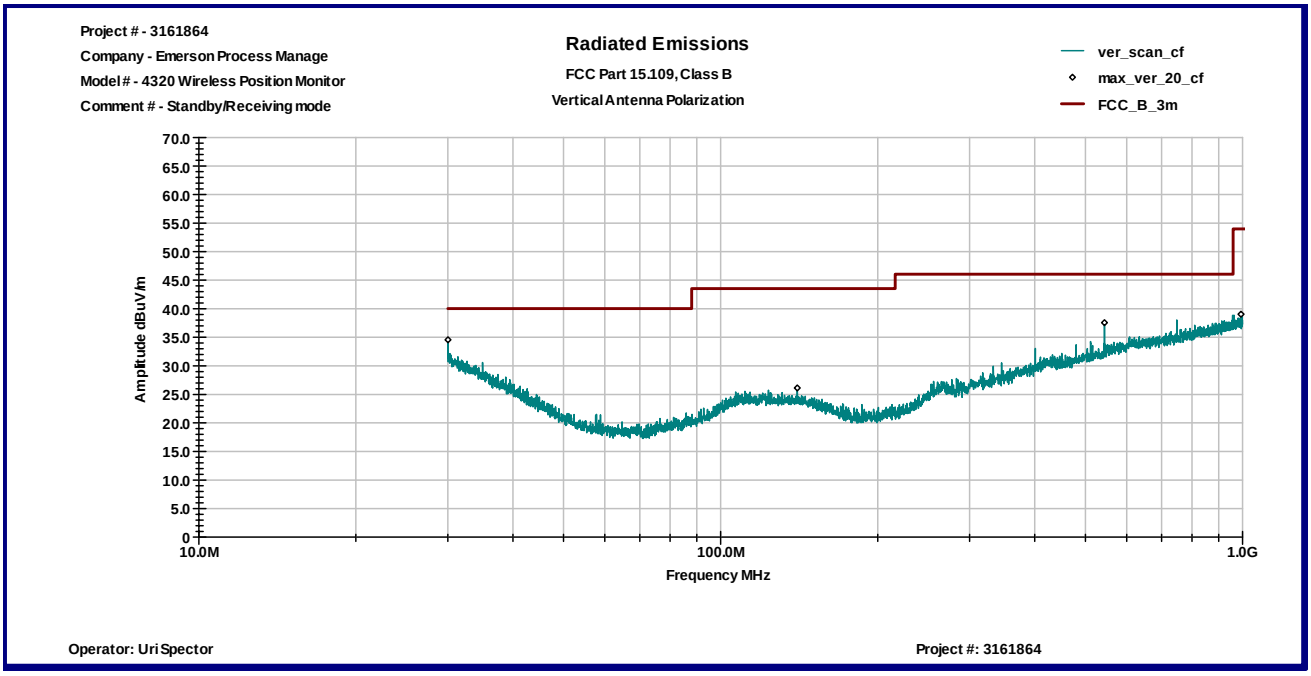
Test result: **Pass**

Frequency range: 30MHz-12.5GHz

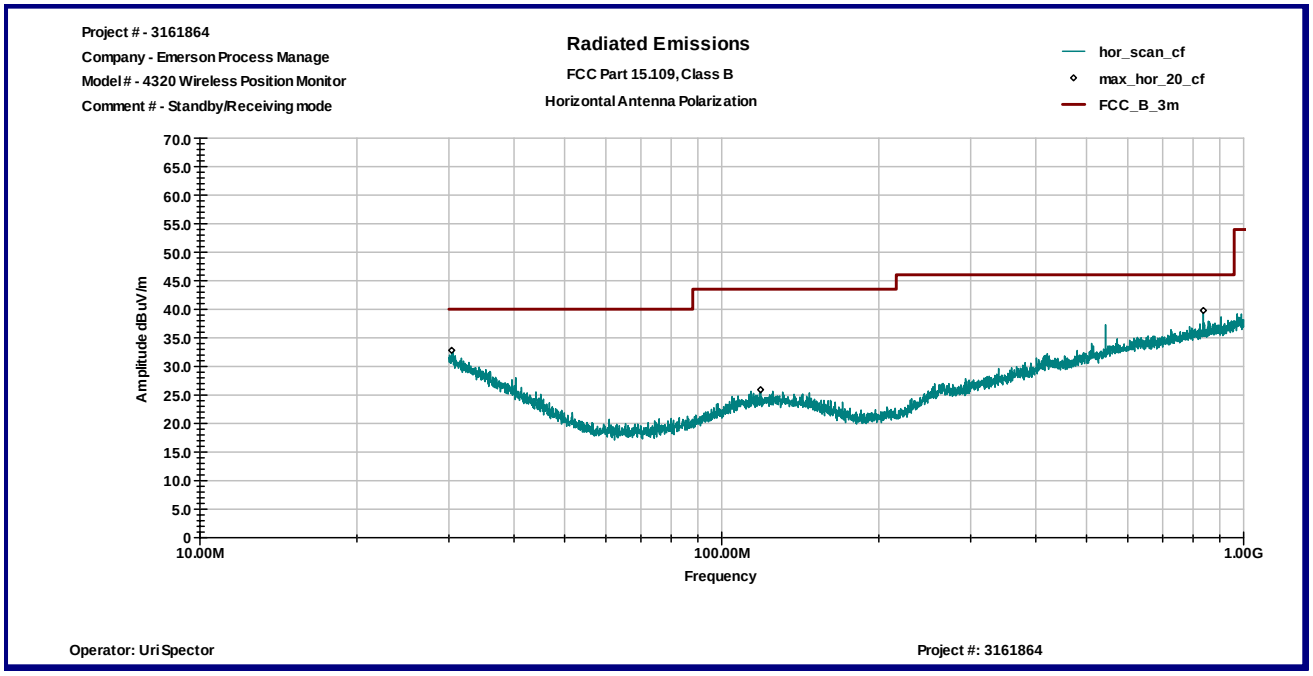
Max. Emissions margin: -13.5dB below the limits

Notes: None

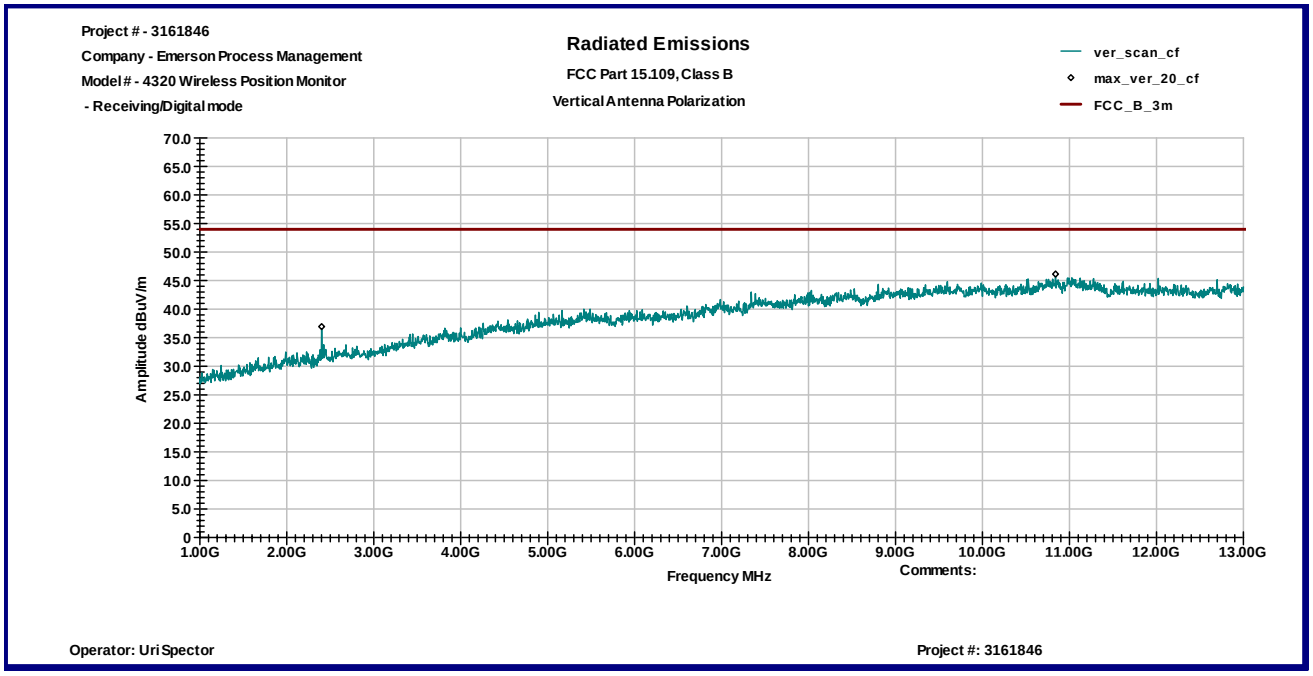
Date:	September 18-23, 2007	**Result:** **Pass**
Standard:	FCC Part 15.109, Class B	
Tested by:	Uri Spector	
Test Point:	Enclosure	
Operation mode:	Stand by / receiving	
Note:	No radiated emissions were detected at frequency range 30MHz-1GHz (see Graphs 3.7.1, 3.7.2). Maximum peak radiated emissions @ 2.4GHz was measured at 40.5dBµV.	



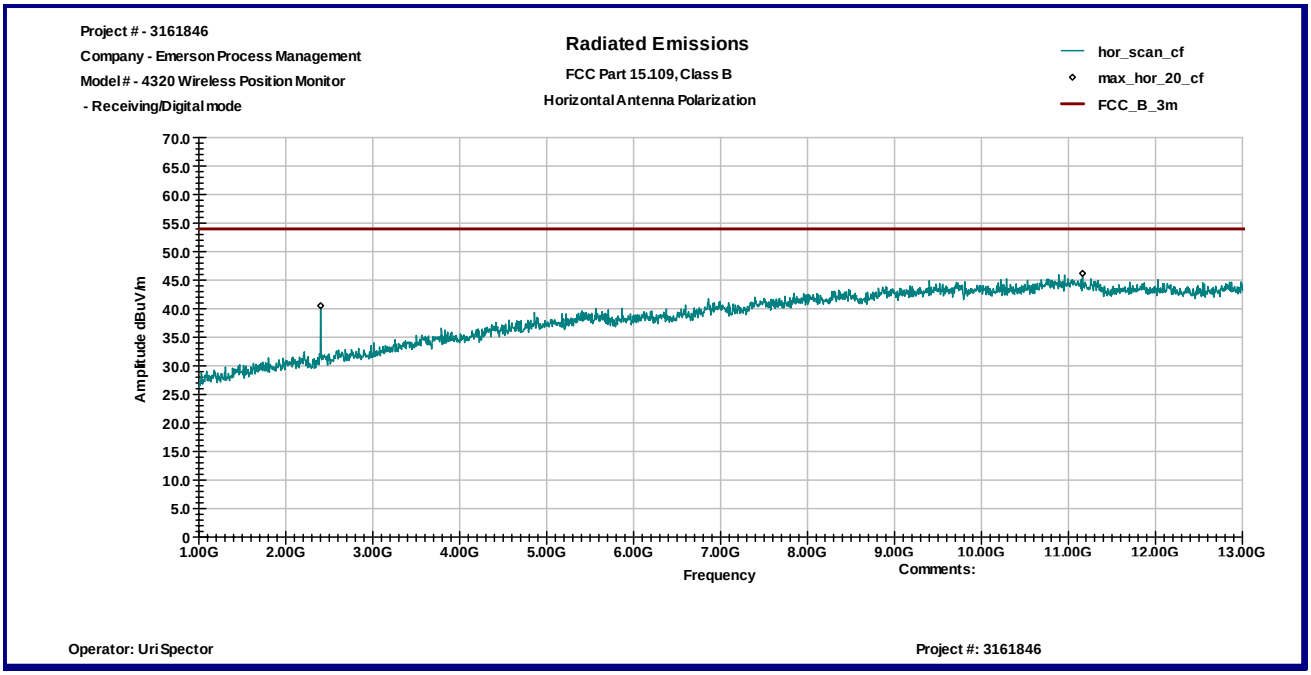
Graph 3.7.1



Graph 3.7.2



Graph 3.7.3



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	08/22/2009	☒
Spectrum Analyzer	R & S	ESCI	100358	05/07/2009	☒
Bicono-Log Antenna	Schaffner-Chase	CBL 6112 B	2468	08/27/2009	☒
Horn Antenna	EMCO	3115	9507-4513	02/13/2009	☒
Waveguide Horn Antenna	EMCO	3116	9904-2423	08/12/2009	☒
Pre-Amplifier	MITEQ	AMF-5D-00501800-28-13P	1122951	06/05/2009	☒
Pre-Amplifier	MITEQ	AMF-6F-16002600-25-10P	1222383	11/05/2008	☒
High Pass Filter	Reactel	FHS-4G-S12	0223	VBU	☒
System	TILE! Instrument Control		Ver. 3.4.K.29	VBU	☒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