



TEST REPORT

Report Number: 3161154MIN-001

Project Number: 3161154

**Testing performed on the
ZM-24**

FCC ID: MMURTI1400

Industry Canada ID: 3166-RTI1400

to

47 CFR Part 15. 247:2007

RSS- 210, Issue 7, 2007

For

Remote Technologies Inc.

Test Performed by:
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Oakdale, MN 55128

Test Authorized by:
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Prepared by: 
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Date: December 3, 2008

Reviewed by: 
Uri Spector

Date: December 3, 2008

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1.0 GENERAL DESCRIPTION

Model:	ZM-24
Type of EUT:	RF Zigbee Transmitter
Serial Number:	N/A
FCC ID:	MMURTI1400
Industry Canada ID:	3166-RTI1400
Related Submittal(s) Grants:	N/A
Company:	Remote Technologies Inc.
Customer:	Mr. Mark Melville
Address:	5775 12 th Avenue East, Suite 180 Shakopee, MN 55379
Phone:	(952) 253-3116
Fax:	(952) 253-3131
Test Standards:	☒ 47 CFR, Part 15:2007, §15.247 ☐ 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:	November 10, 2008
Test Work Started:	November 10, 2008
Test Work Completed:	December 2, 2008
Test Sample Conditions:	☐ Damaged ☐ Poor (Usable) ☒ Good



1.1 Product Description; Test Facility

Product Description:	ZigBee RF Transceiver, with NetBit KSAC1200100W1US Adapter 100-240VAC, 50/60Hz / 12VDC
Transmitter Type:	☐ FHSS ☒ Digital Modulation ☐ WiFi ☐ Blue Tooth
Operating Frequency Range(s):	From 2400 to 2483.5 MHz
Number of Channels:	16 (from 11 to 26)
Modulation:	Offset Quadrature Phase Shift Keying
Emission Designator:	
Antenna(s) Info:	Integral Antenna Gain: 1.8 dBi
Antenna Installation:	☐ User ☐ Professional ☐ Factory
Transmitter power configuration:	☐ Internal battery ☐ External power source ☐ 120VAC ☐ 230VAC ☐ 400VAC ☒ 3.3 VDC ☐ Other: Amp. ☐ 50Hz ☐ 60Hz
Special Test Arrangement:	As a potential hand-held device the EUT was rotated through three orthogonal axes to determine and tested with the maximum emissions
Test Facility Accreditation:	A2LA (Certificate No. 1427.01)
Test Methodology:	Measurements performed according to the procedures in ANSI C63.4-2003 and FCC Public Notice DA 00-705

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	EUT was ran in specific channels using test program running on the Remote Station PC
3	

Cables:

No.	Type	Length	Designation	Note
1	CAT 5, unshielded	5m	RTI Control Port	
2				

Support equipment/Services:

No.	Item	Description
1	Station, which consists of Dell Laptop PC, 485TBLED RS232-485 converter with PS and Serial cable	Remote Station to control EUT via the RTI Control Port
2	R&S Signal Generator SMR20	RF Generator for EUT activation in receiving mode
3		

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	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



3.0 TEST CONDITIONS AND RESULTS

3.1 Maximum peak output power

Test location: ☐ OATS ☐ Anechoic Chamber ☒ Other

Test result: Pass

Max. Margin: 25.1 dB below the limits

Power Output:	Conducted					
Frequency Range:	☐ 902-928MHz ☒ 2400-2483.5MHz ☐ 5725-5850MHz					
Low Frequency	Measured power dBm	Attenuation dB	Power at Antenna dBm	Limit dBm	Limit Reduction dB	Margin dB
Channel 11	3.83	0.35	4.18	30	0	-25.8
Middle Frequency						
Channel 18	4.29	0.35	4.64	30	0	-25.4
Upper Frequency						
Channel 26	4.53	0.35	4.88	30	0	-25.1
RBW:	☐ 1MHz ☐ 3MHz ☒ 10MHz					
VBW:	☐ 1MHz ☐ 3MHz ☒ 10MHz					
Antenna Gain:	☒ < 6dBi ☐ >6dBi and = dBi, Output power reduction = 0 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
1620	1580	1420	500	Pass
RBW: ☒ 100kHz ☐ other kHz VBW: ☐ 100kHz ☒ 300kHz ☐ other kHz				

Notes: None



Graph 3.2.1



Graph 3.2.2

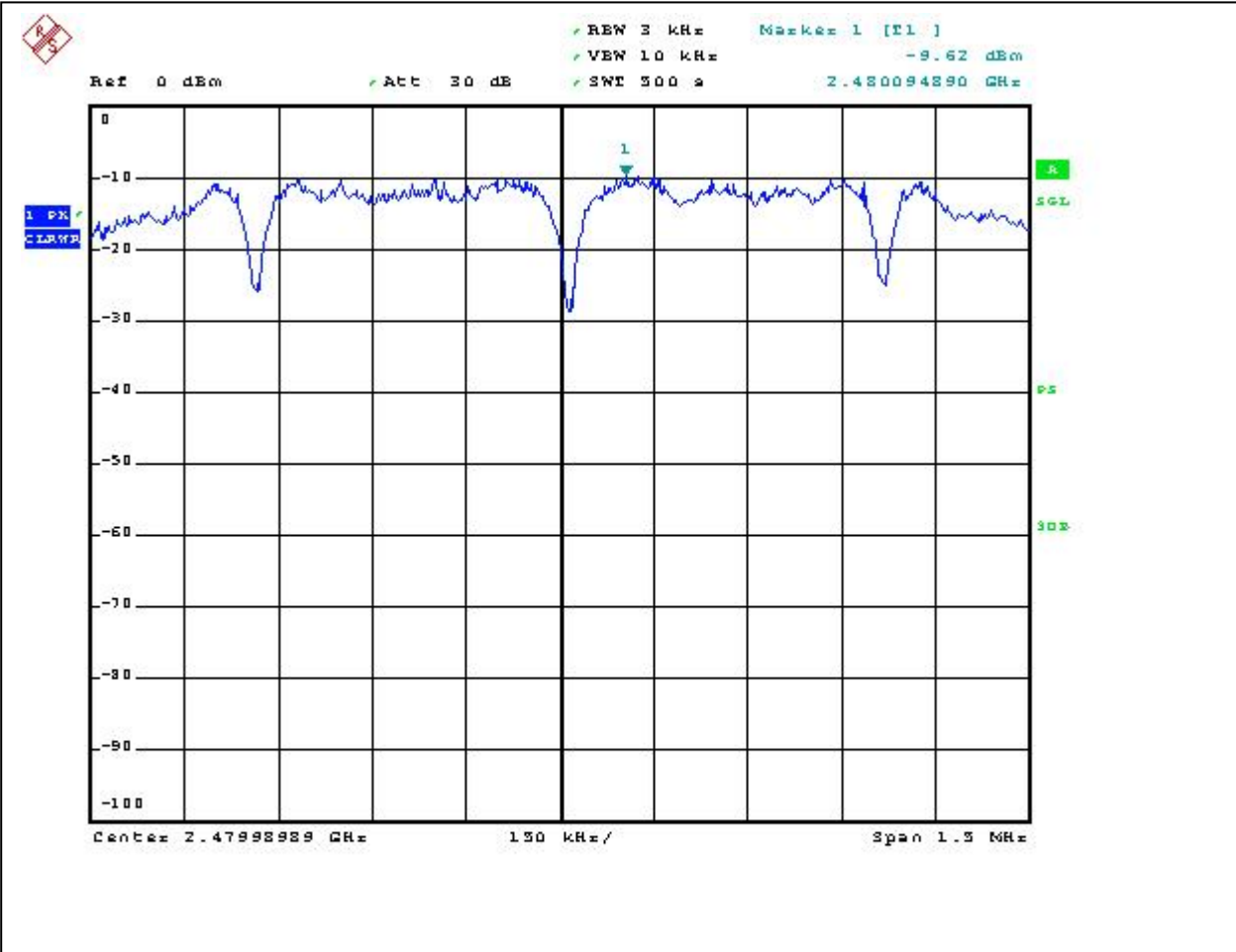


Graph 3.2.3

3.3 Power spectral density

Power Output:	☐ Conducted ☒ Radiated			
	Measured Density dBm or dBμV/m	Power Spectral Density dBm	Limit dBm	Margin dB
Low Frequency Channel 11	-9.62	-9.27	8.0	-17.3
Analyzer Settings:	☒ RBW=3KHz ☒ VBW=10KHz ☒ Span=1.5MHz ☒ Sweep=500sec			
Antenna Gain:	☒ < 6dBi and = 1.8 dBi ☐ >6dBi and = dBi, limit reduction = 0 dB			

Notes: None

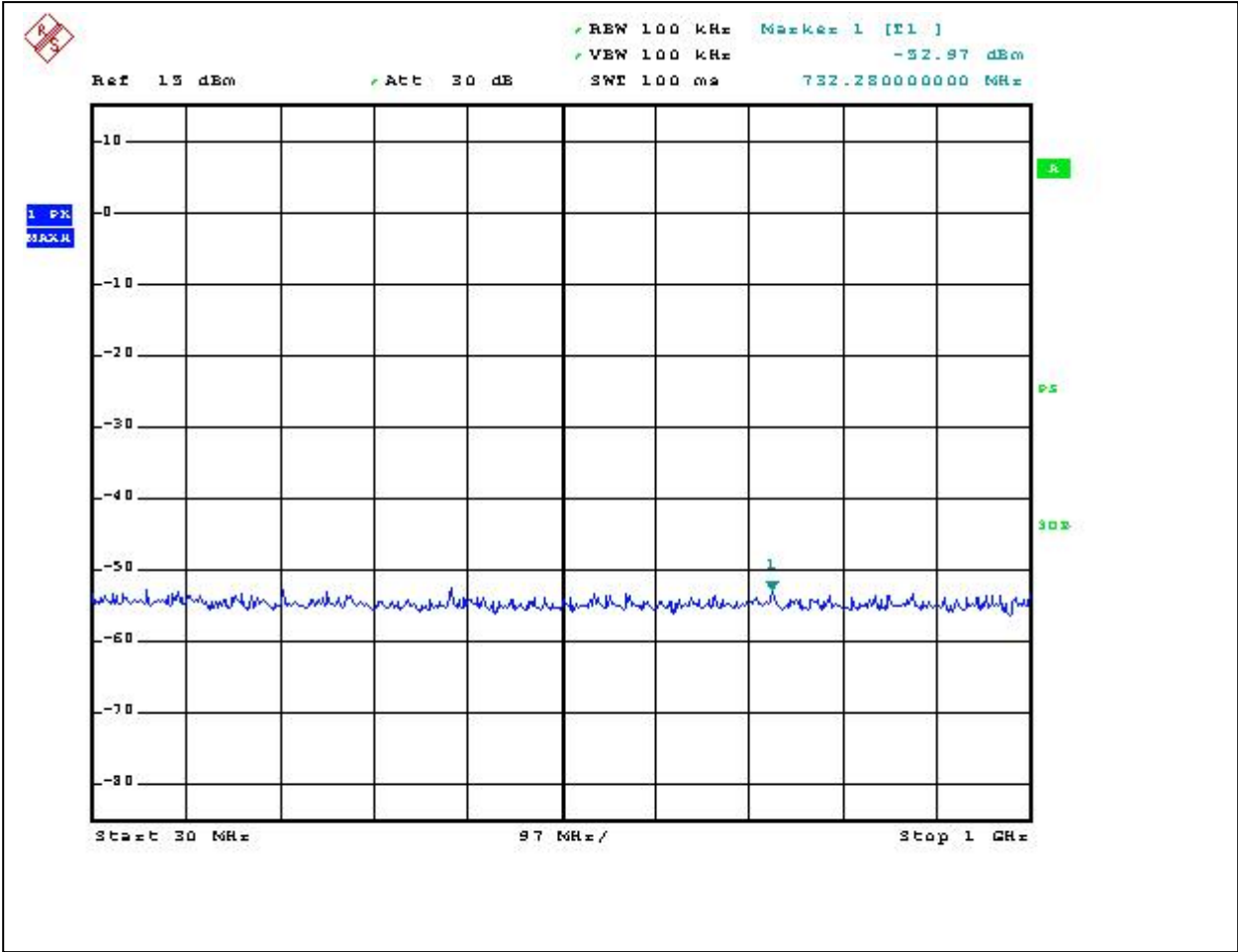


Graph 3.3.1

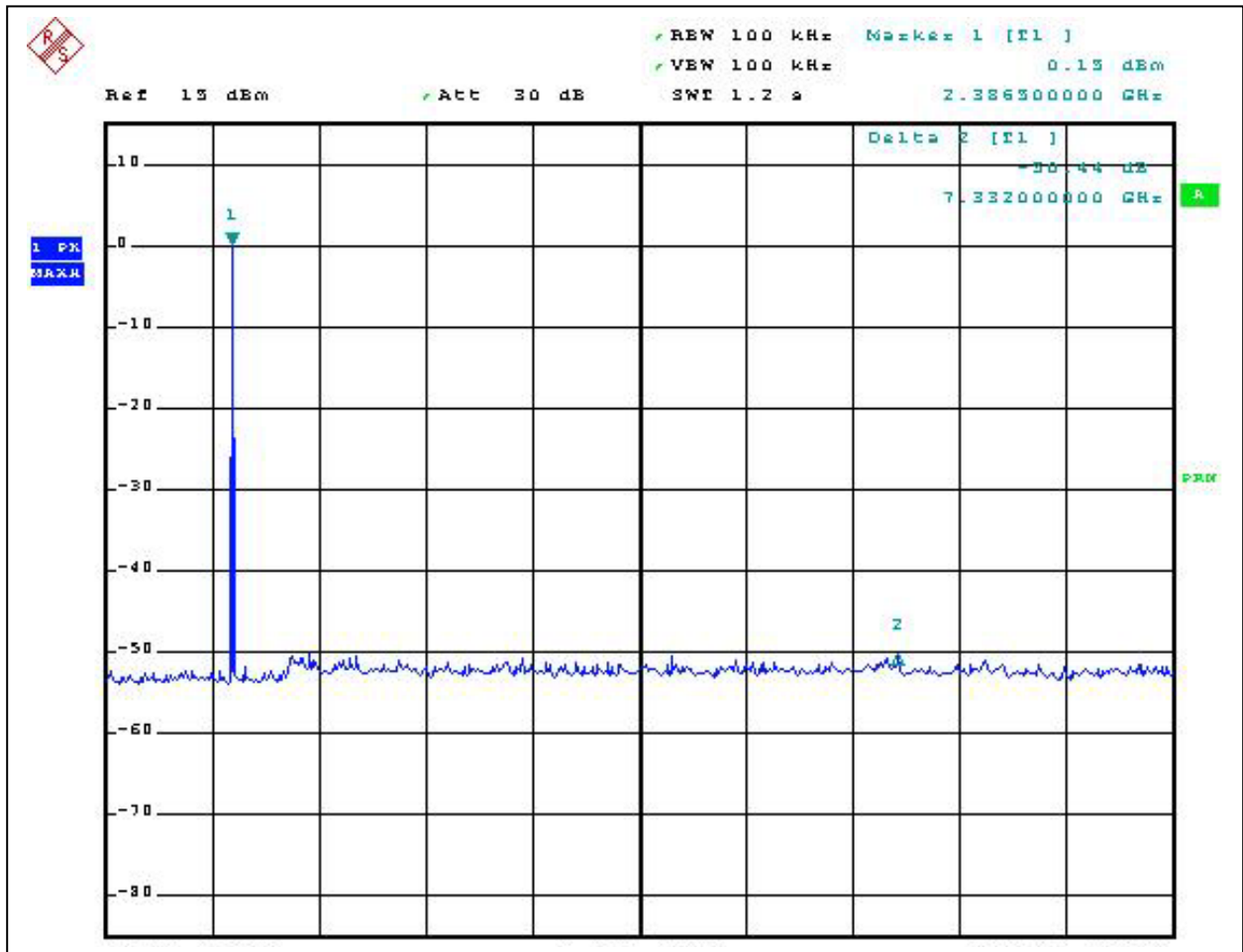
3.4 Antenna conducted spurious emissions

	Minimum Measured Attenuation dB	Minimum Allowed Attenuation dB	Margin dB
Low Frequency Channel	49.82	20	-10.8
Middle Frequency Channel		20	-8.9
Upper Frequency Channel		20	-9.9
Analyzer Settings:	☒ RBW=100KHz		
Minimum Allowed Attenuation:	☒ 20dB ☐ 30dB (for digital systems with conducted power measured using RMS averaging over a time interval)		

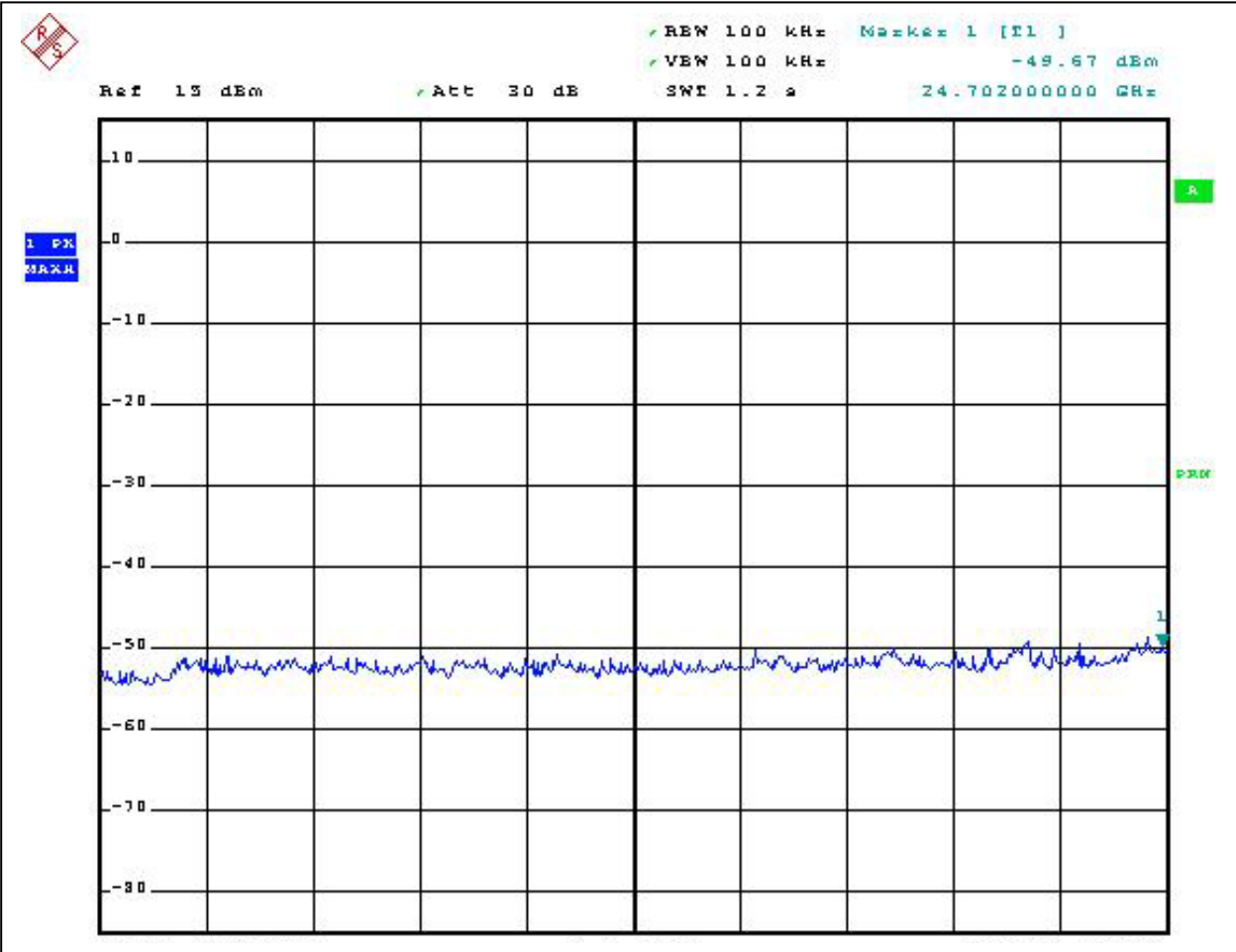
Notes: Spurious Emissions for Channel 11 are shown in Graphs 4.3.1 to 4.3.3;
 Spurious Emissions for Channel 18 are shown in Graphs 4.3.4 to 4.3.6;
 Spurious Emissions for Channel 26 are shown in Graphs 4.3.7 to 4.3.9



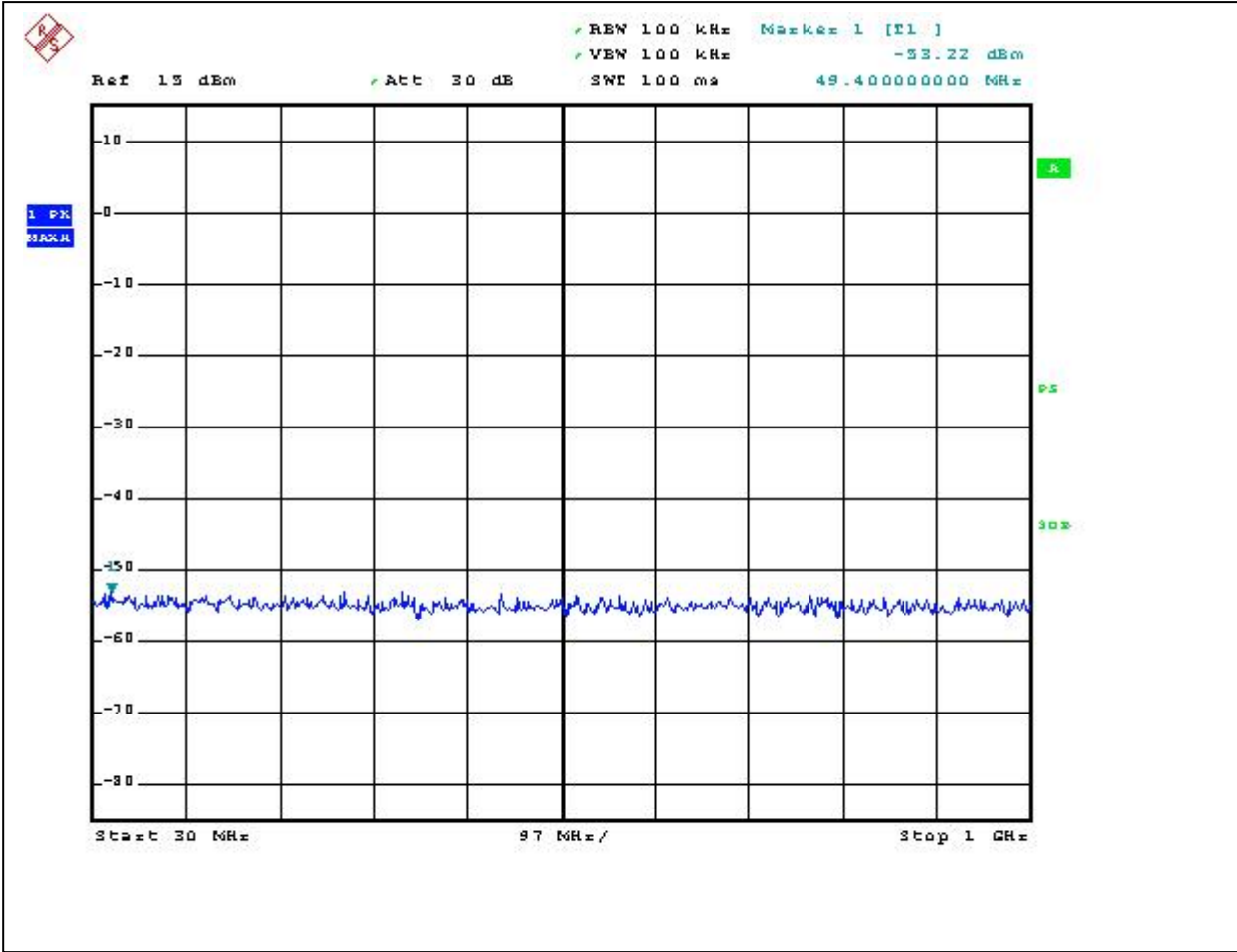
Graph 3.4.1



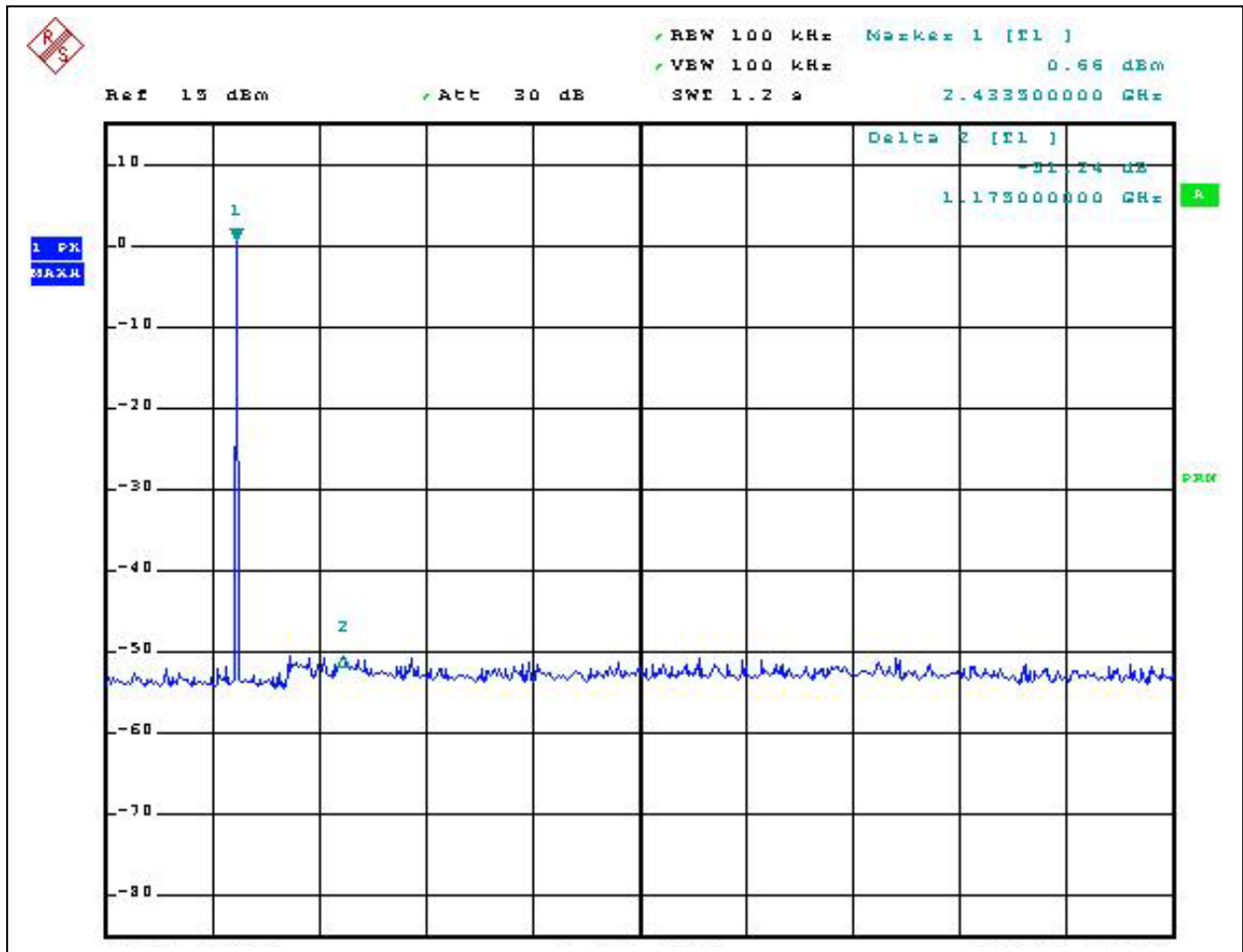
Graph 3.4.2



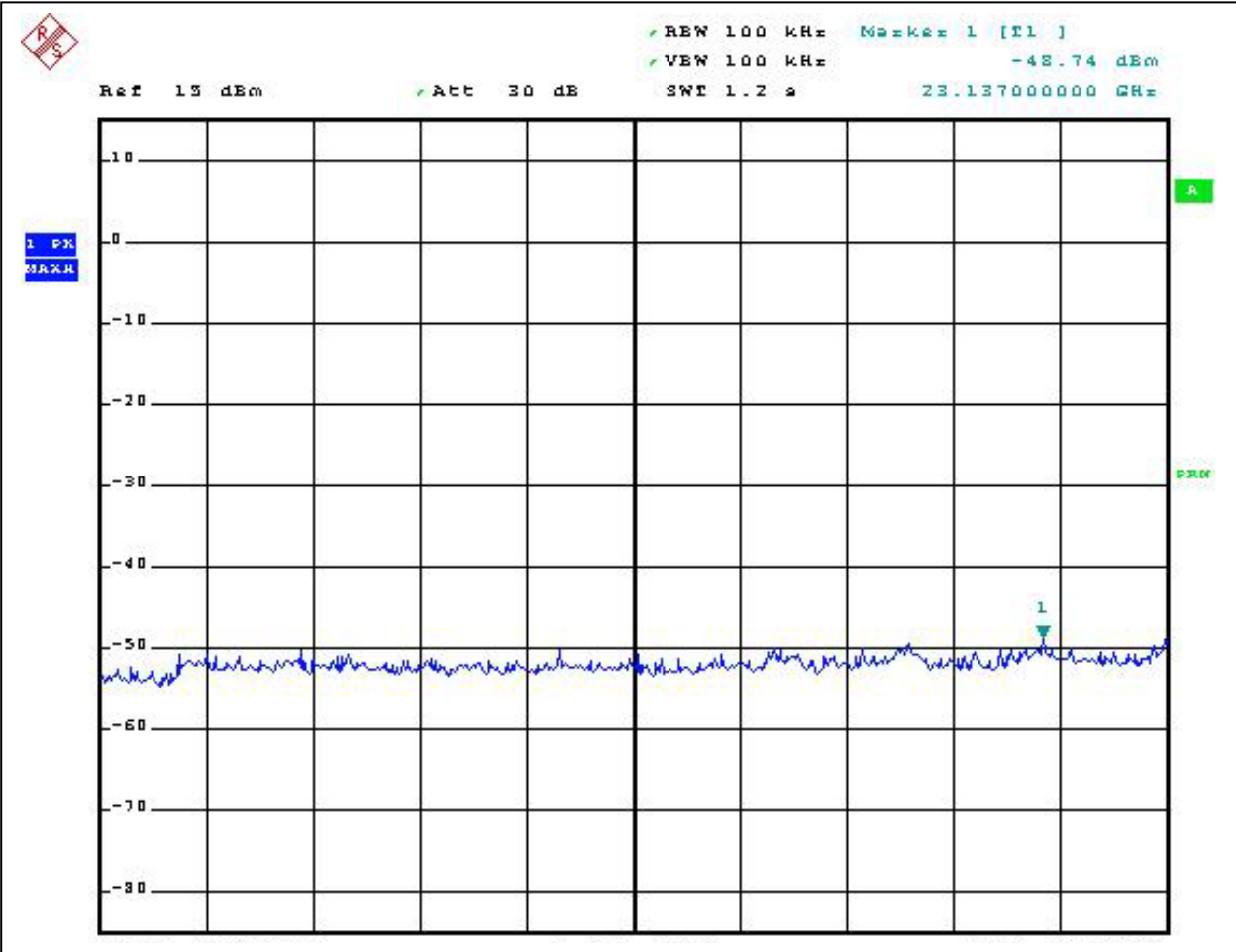
Graph 3.4.3



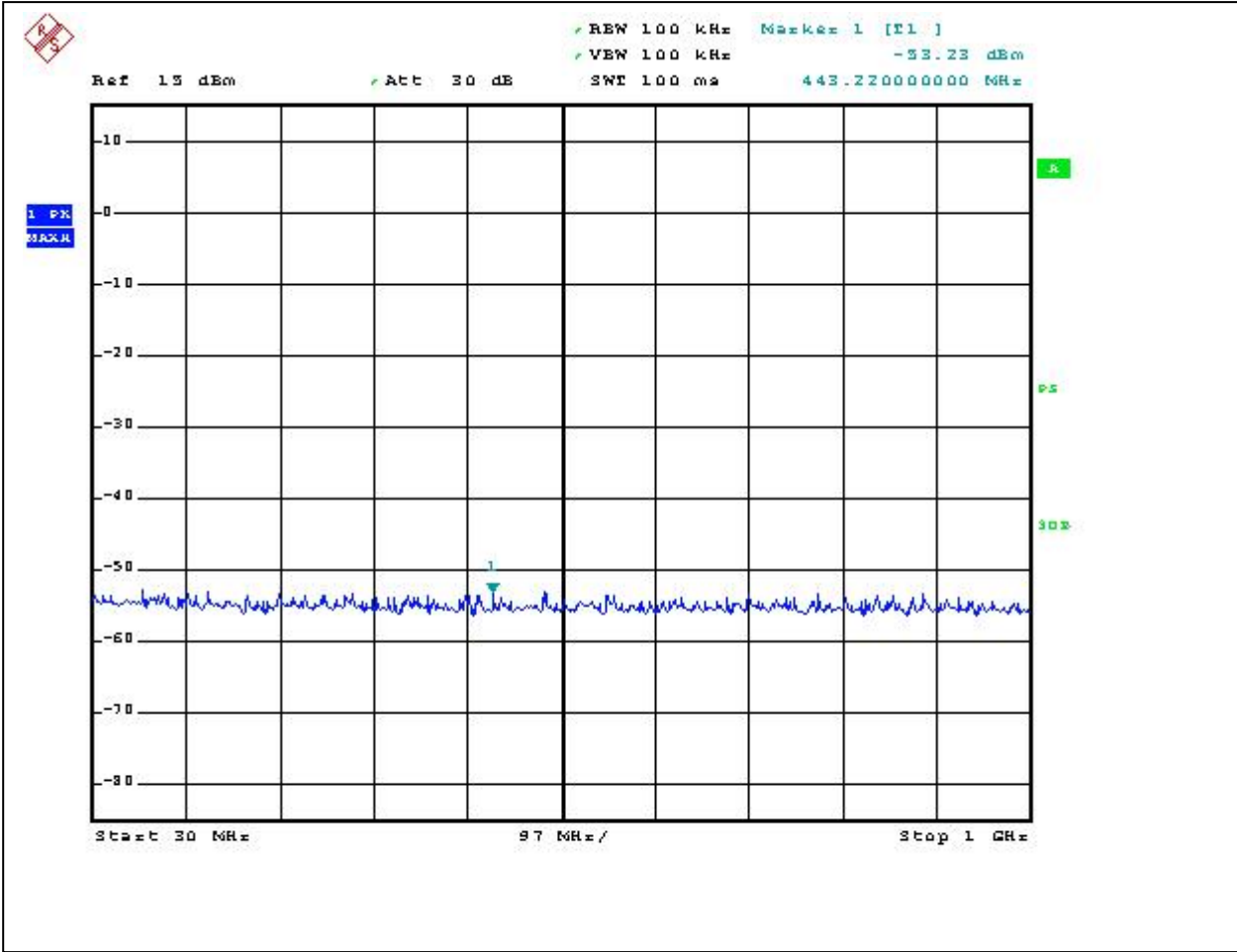
Graph 3.4.4



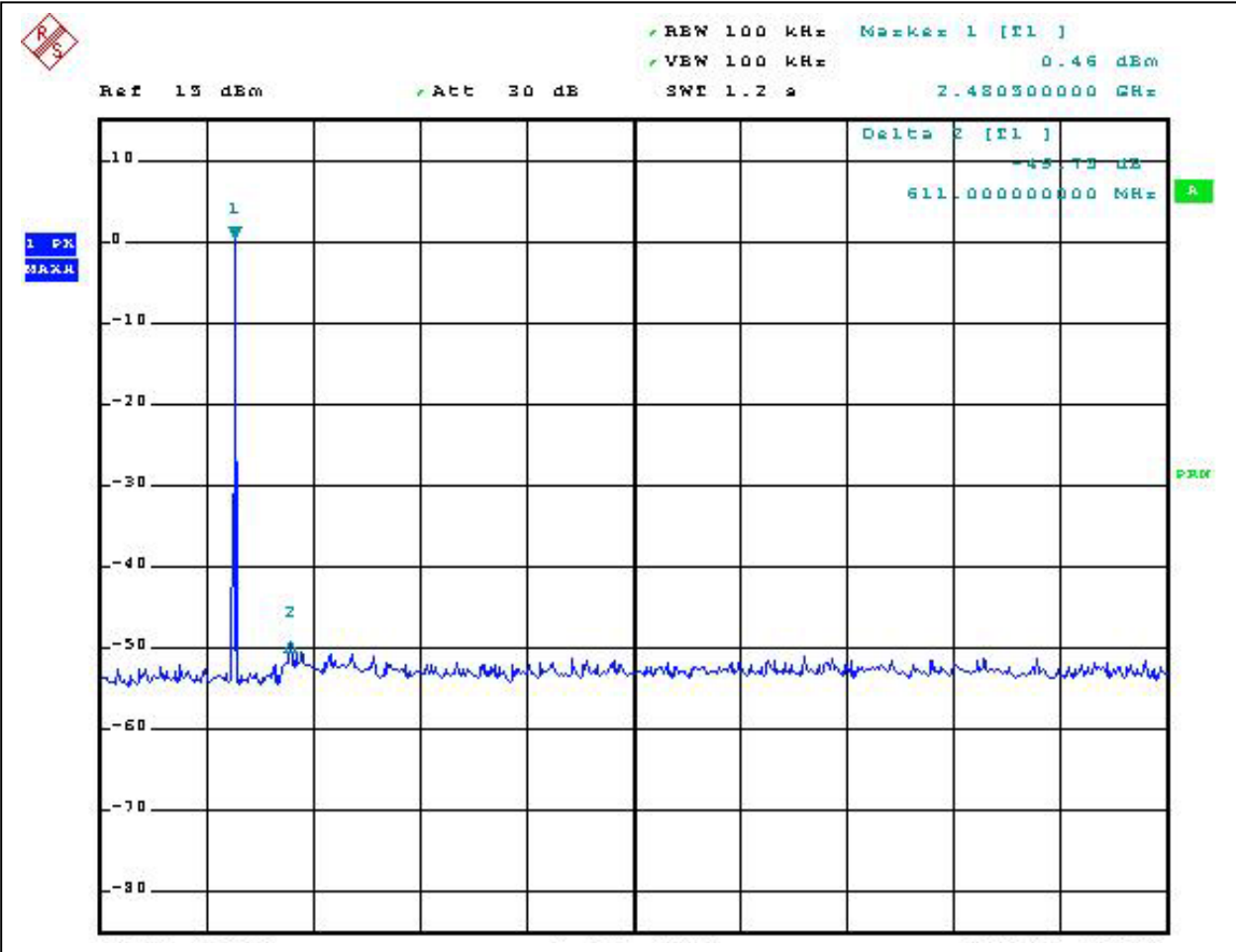
Graph 3.4.5



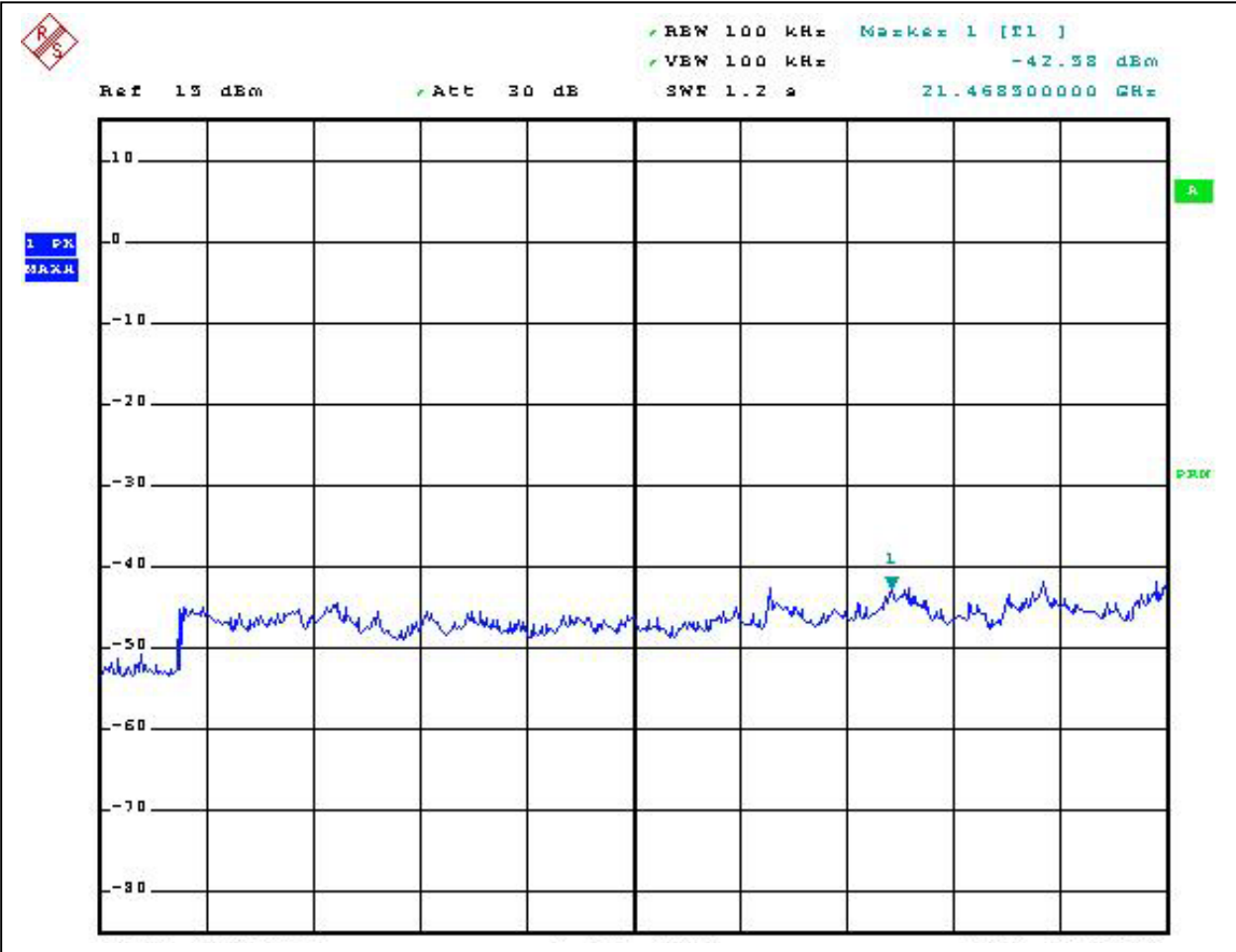
Graph 3.4.6



Graph 3.4.7



Graph 3.4.8



Graph 3.4.9



3.5 Antenna conducted band edge compliance

	Minimum Measured Attenuation dB	Minimum Allowed Attenuation dB	Margin dB
Low Frequency Channel	49.43	20	-29.4
Upper Frequency Channel	45.55	20	-25.5
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 3.5.1



Graph 3.5.2

3.6 Radiated spurious emissions

Test location: ☐ OATS ☒ Anechoic Chamber ☐ Other

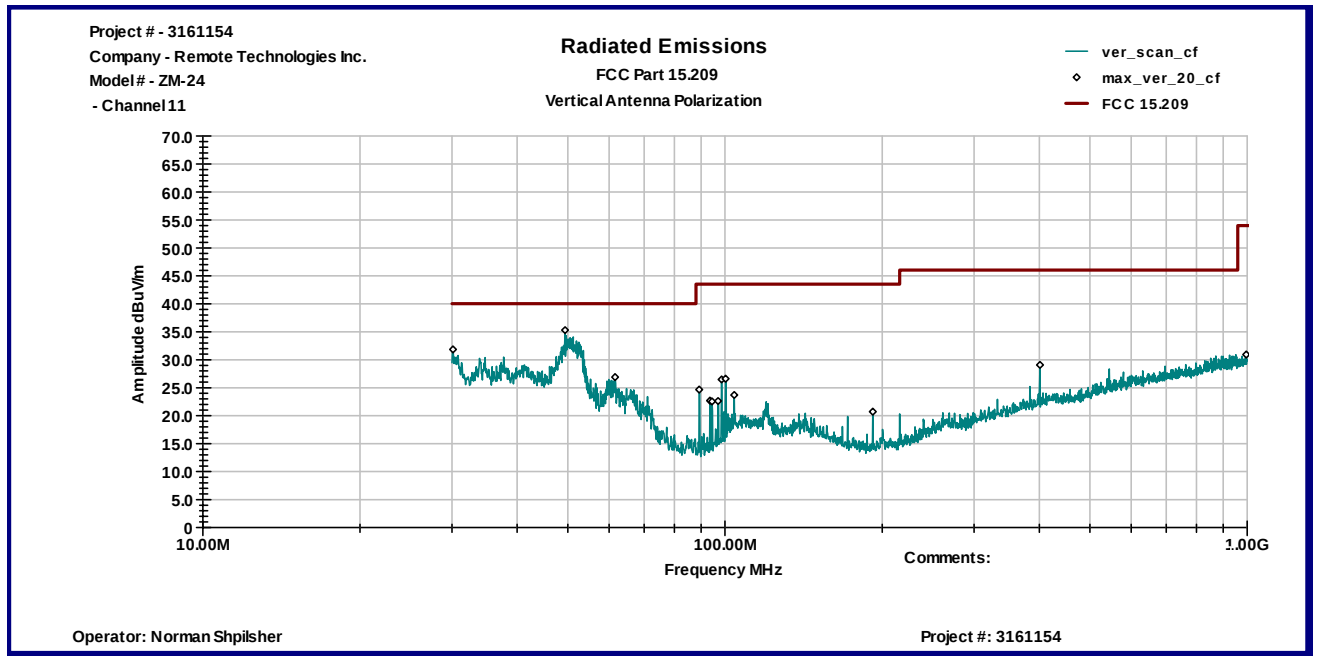
Test result: **Pass**

Max. Margin: 4.6dB below the limits

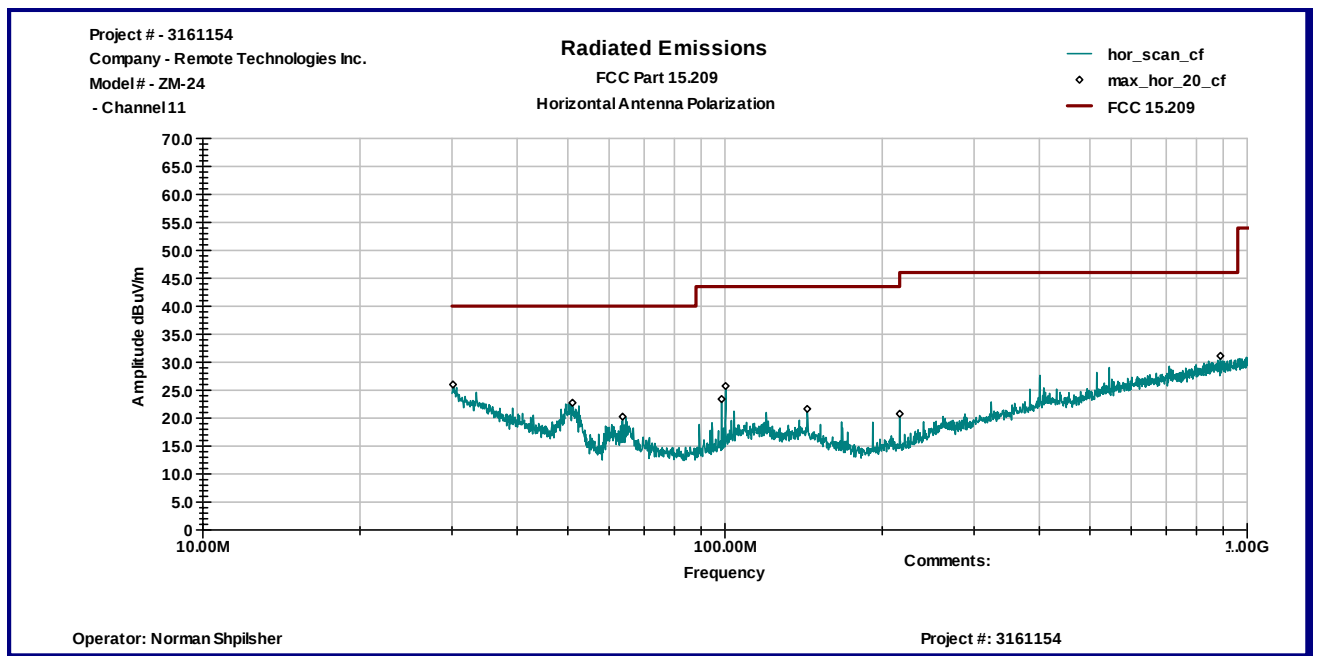
Date:	November 10 - 12, 2008	Result: Pass
Standard:	FCC part 15.247(d)	
Tested by:	Norman Shpilsher	
Test Point:	Enclosure	
Operation mode:	See Page 5	
Note:	Emissions at fundamentals were excluded from the Table. No emissions above ambient noise were detected at 2 nd and above harmonics	

Table 3.6.1

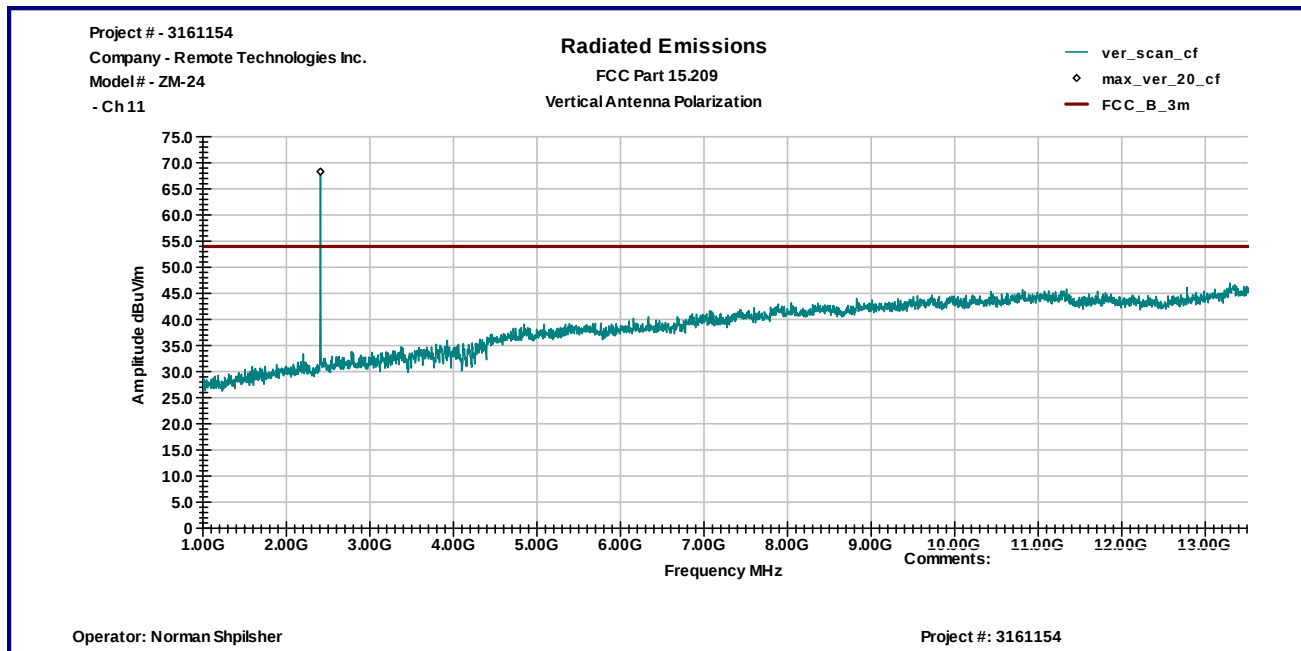
Frequency MHz	Antenna Polarity	Peak Reading dBμV	Total C.F. dB1/m	Pre-Amp. Gain (dB)	Total at 3m dBμV/m	QP Limit dBμV/m	Margin dB
Channel 11							
30.139 MHz	V	10.8	21.0	0.0	31.8	40.0	-8.2
49.395 MHz	V	24.5	10.7	0.0	35.3	40.0	-4.7
61.585 MHz	V	19.4	7.5	0.0	26.9	40.0	-13.1
				0.0			
30.139 MHz	H	5.0	21.0	0.0	26.0	40.0	-14.0
51.057 MHz	H	12.8	10.0	0.0	22.7	40.0	-17.3
888.95 MHz	H	5.8	25.3	0.0	31.1	46.0	-14.9
Channel 18							
34.849 MHz	V	12.7	18.2	0.0	30.9	40.0	-9.1
50.156 MHz	V	23.3	10.4	0.0	33.7	40.0	-6.3
57.014 MHz	V	23.3	8.1	0.0	31.4	40.0	-8.6
65.976 MHz	V	21.8	7.2	0.0	29.0	40.0	-11.0
864.19 MHz	V	8.9	25.1	0.0	34.0	46.0	-12.0
30.069 MHz	H	4.5	21.1	0.0	25.5	40.0	-14.5
52.442 MHz	H	13.6	9.3	0.0	23.0	40.0	-17.0
401.13 MHz	H	8.8	19.0	0.0	27.8	46.0	-18.3
Channel 26							
30.069 MHz	V	11.7	21.1	0.0	32.8	40.0	-7.2
49.602 MHz	V	24.7	10.7	0.0	35.4	40.0	-4.6
61.031 MHz	V	20.9	7.6	0.0	28.4	40.0	-11.6
706.45 MHz	V	8.5	23.3	0.0	31.8	46.0	-14.2
				0.0			
30.346 MHz	H	4.5	20.9	0.0	25.4	40.0	-14.7
50.849 MHz	H	12.4	10.1	0.0	22.5	40.0	-17.5
401.13 MHz	H	8.7	19.0	0.0	27.7	46.0	-18.3
1.3366 GHz	H	48.2	27.9	41.2	34.9	54.0	-19.1



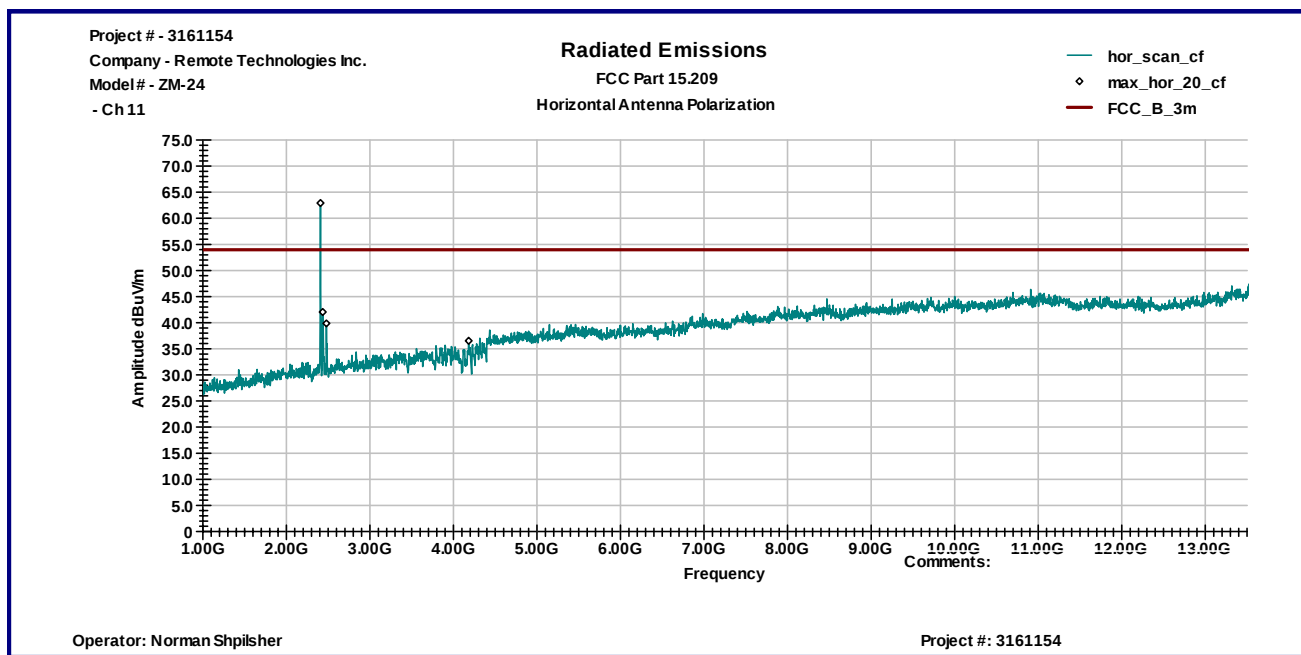
Graph 3.6.1



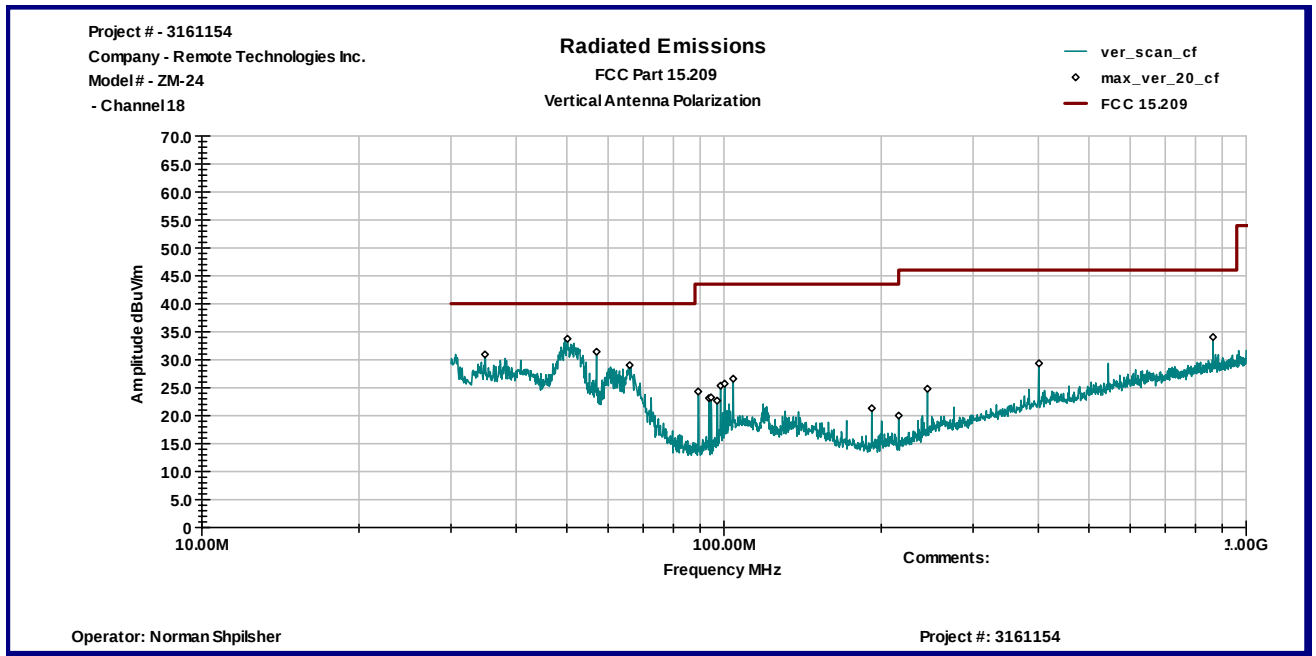
Graph 3.6.2



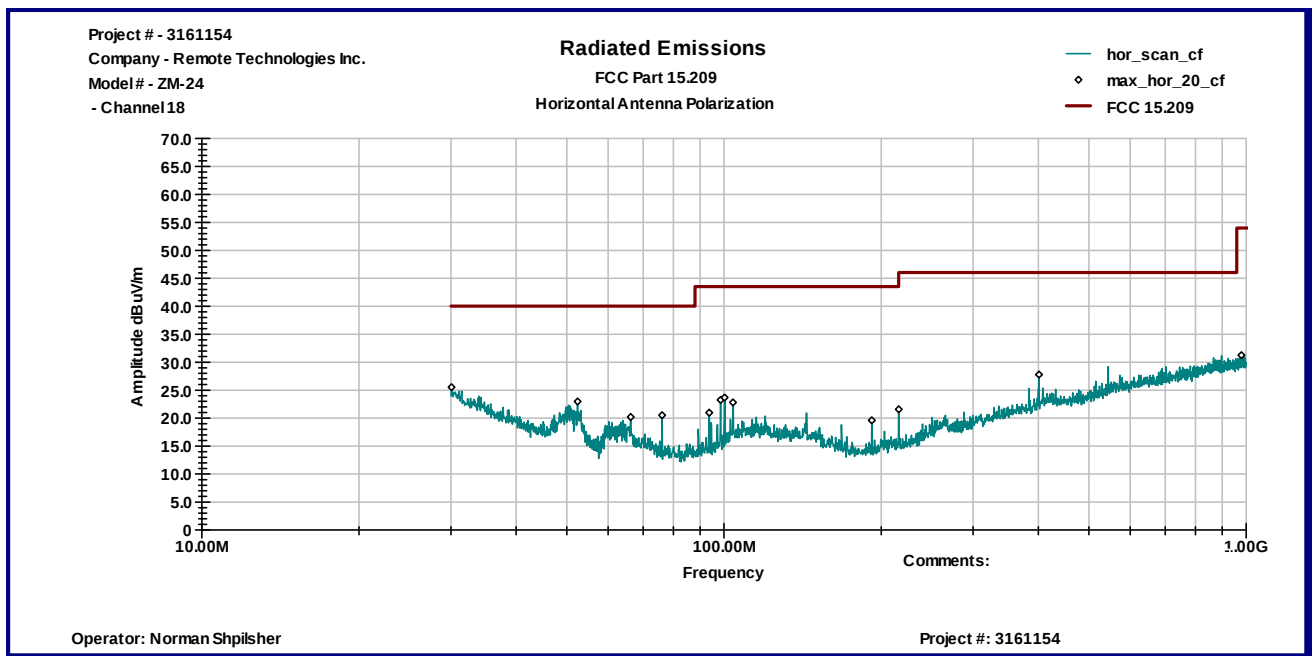
Graph 3.6.3



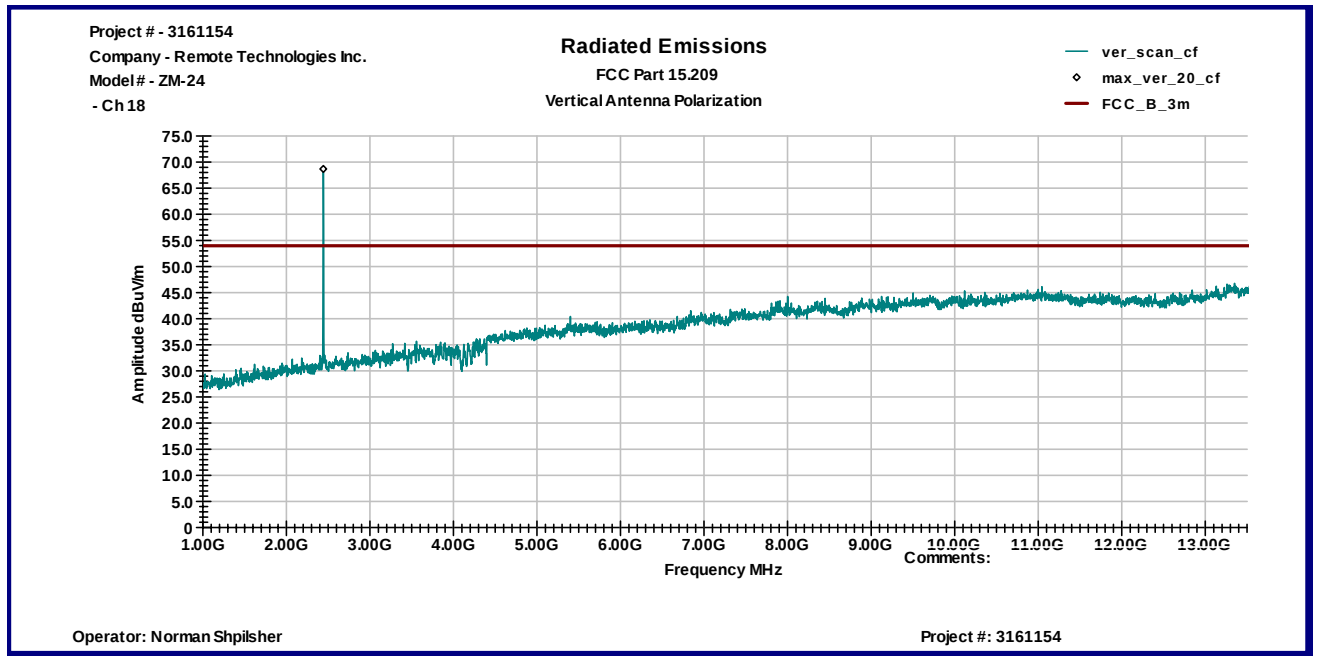
Graph 3.6.4



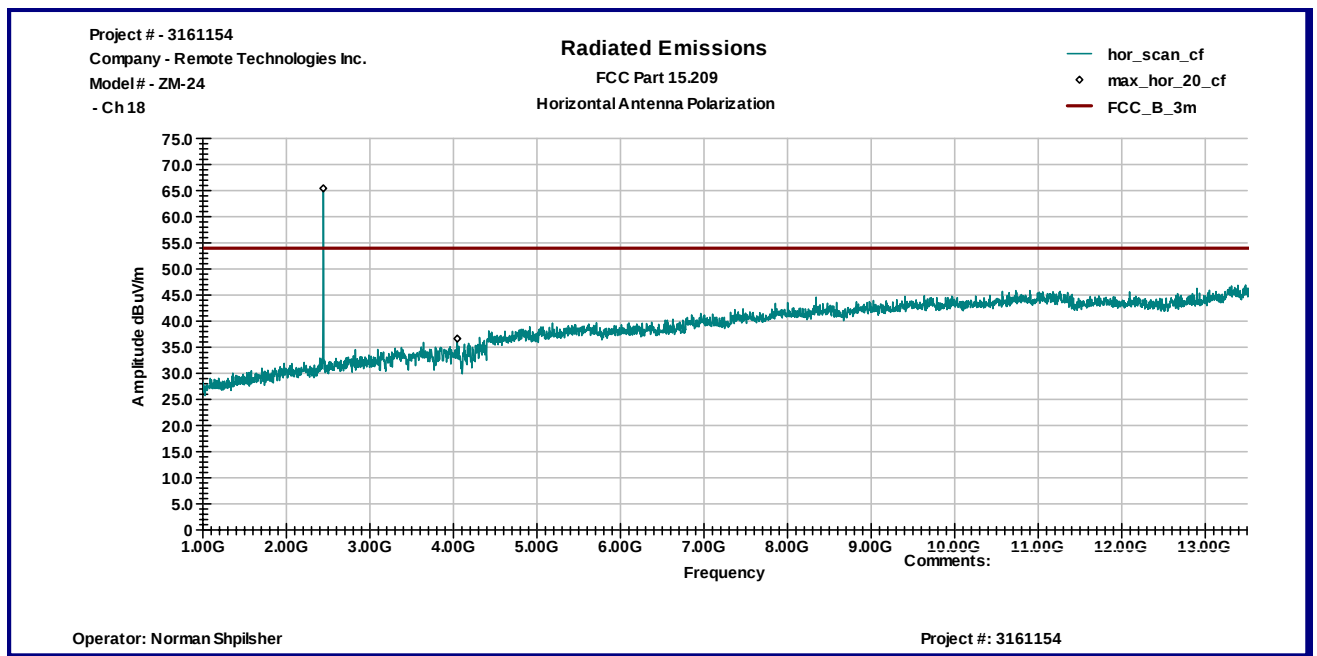
Graph 3.6.5



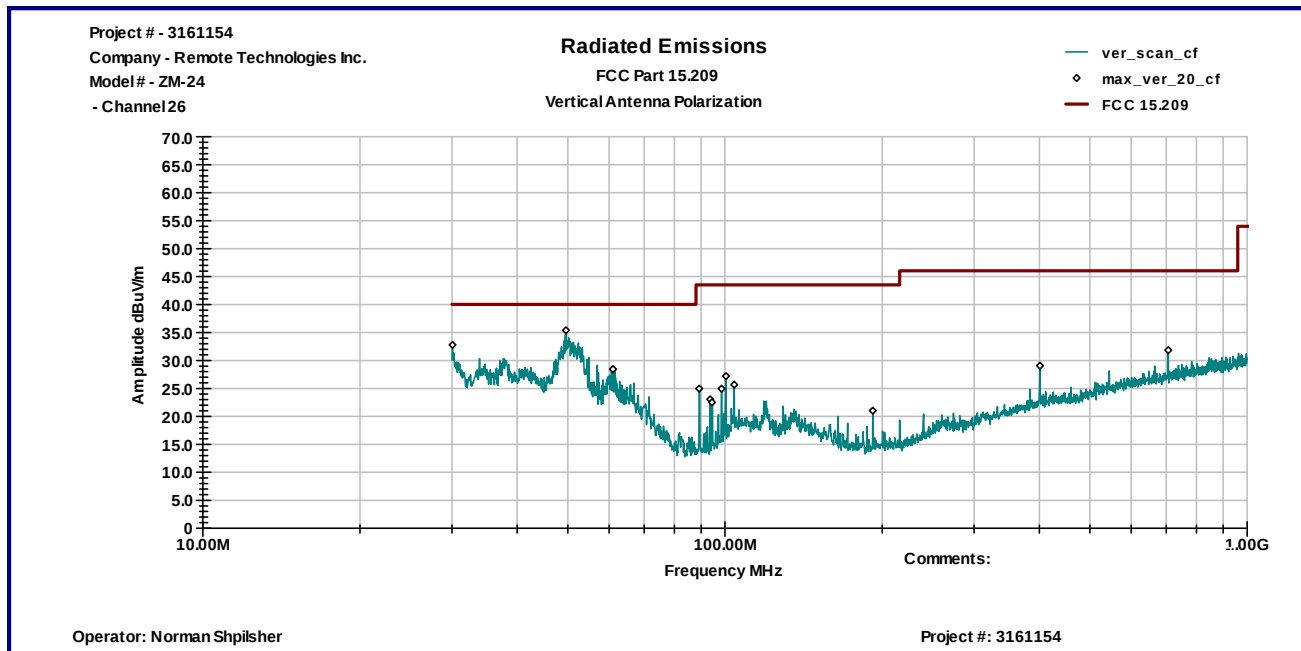
Graph 3.6.6



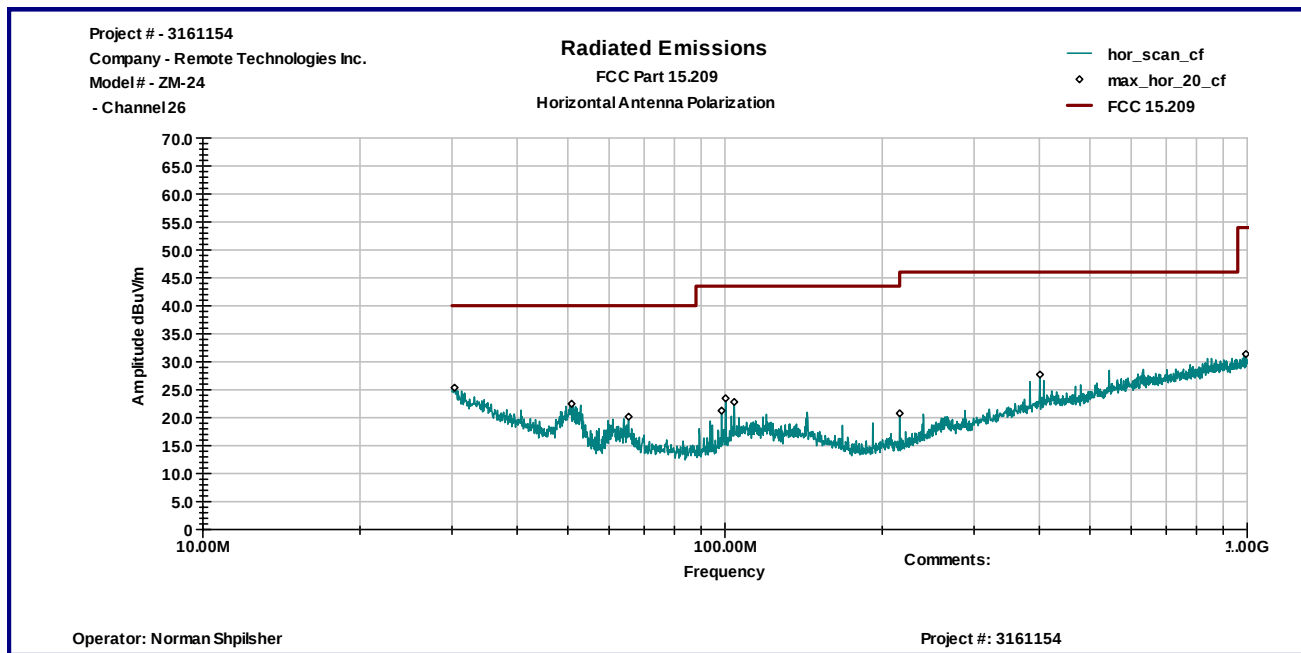
Graph 3.6.7



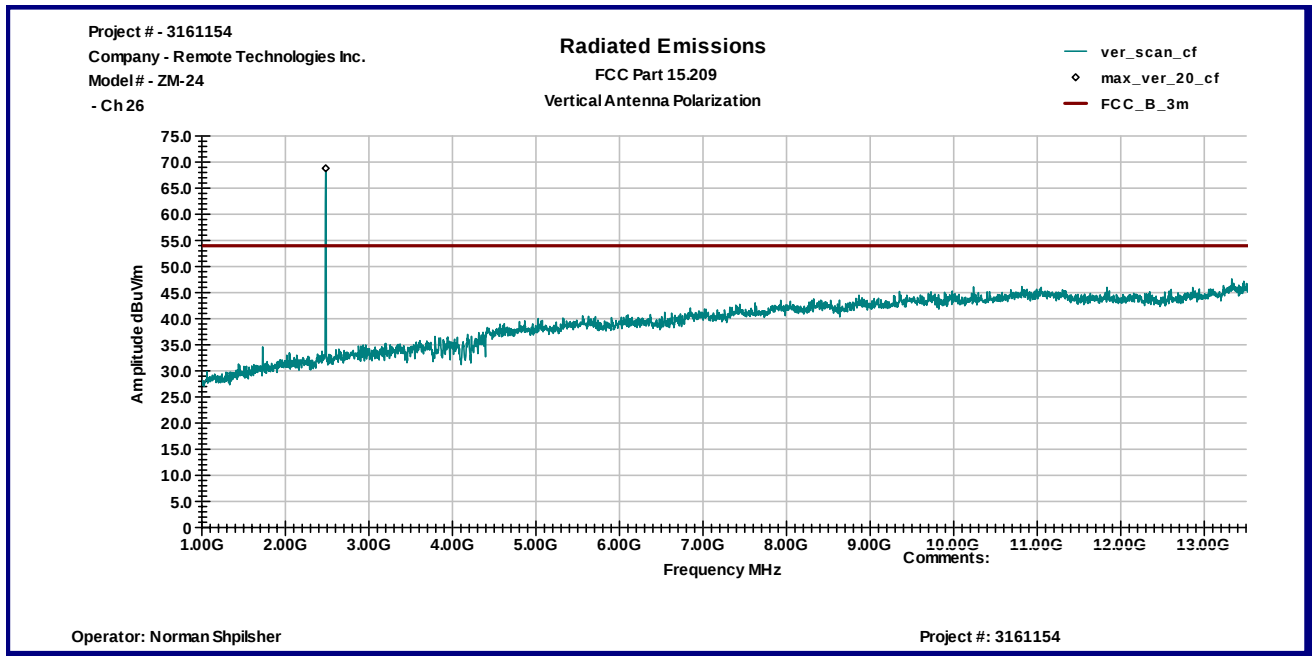
Graph 3.6.8



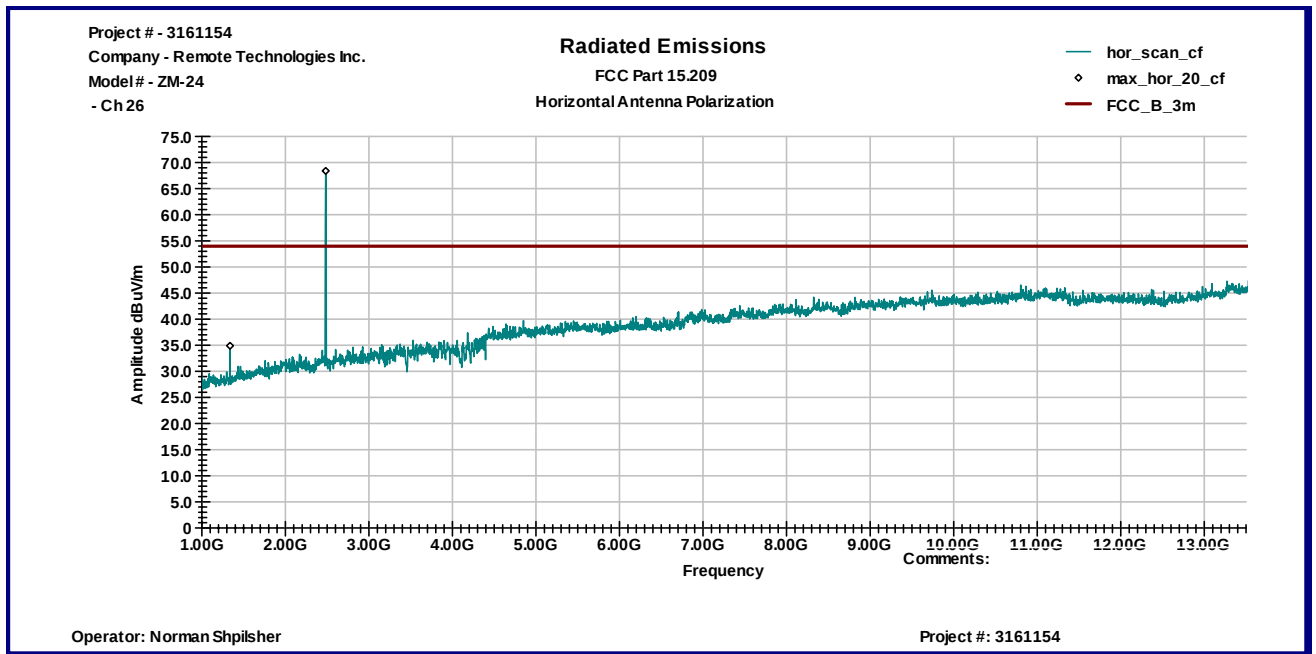
Graph 3.6.9



Graph 3.6.10



Graph 3.6.11



Graph 3.6.12

3.7 RF Exposure Compliance

The maximum measured antenna conducted power, P is 4.88dBm

The antenna gain, G is 1.8dBi

The maximum EIRP power = P + G

ERP = 4.88+ 1.8= 6.68dBm, or 0.00466W

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

The Power Density is related to ERP with the equation:

$S = \text{ERP} / 4\pi D^2$, or $10 = 0.00466 / 4\pi D^2$, where

D is a separation distance in m.

The minimum safe separation distance, D = 6.1mm, which is below 20cm



3.8 Transmitter power line conducted emissions

Test location: ☐ OATS ☒ Anechoic Chamber ☐ Other

Test result: **Pass**

Frequency range: 0.15MHz-30MHz

Max. Emissions margin: 3.5 dB below the limits

Notes: None

Date:	November 17, 2008	Result: Pass
Standard:	FCC 15.207	
Tested by:	Norman Shpilsher	
Test Point:	Power Line	
Operation mode:	See Page 5	
Note:		

Table 3.8.1

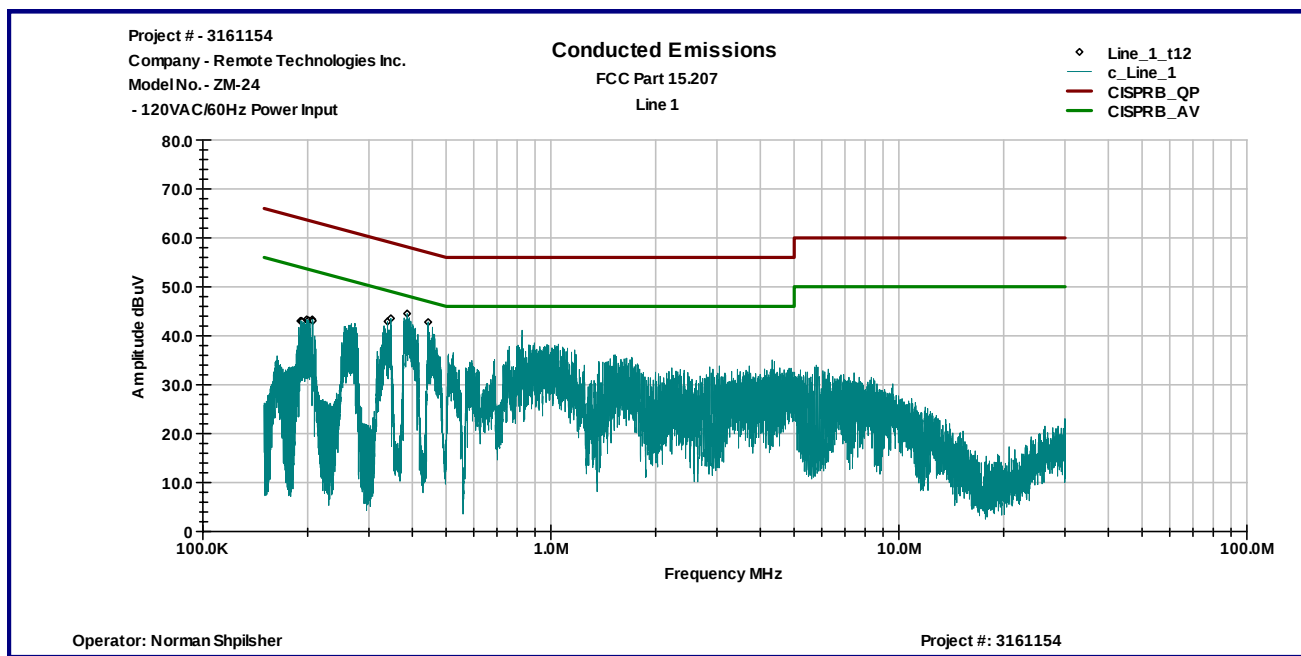
Line 1

Frequency MHz	Reading dB μ V	Cable Loss dB	QP Lim dB μ V	AVG Lim dB μ V	QP Margin dB	AVG Margin dB
0.206	43.3	0.1	63.4	53.4	-20.0	-10.0
0.273	42.5	0.1	61.0	51.0	-18.4	-8.4
0.347	43.5	0.1	59.0	49.0	-15.4	-5.4
0.386	44.5	0.1	58.1	48.1	-13.5	-3.5
0.444	42.8	0.1	57.0	47.0	-14.1	-4.1
0.826	41.1	0.1	56.0	46.0	-14.8	-4.8
1.503	38.3	0.2	56.0	46.0	-17.5	-7.5
4.320	35.0	0.4	56.0	46.0	-20.6	-10.6

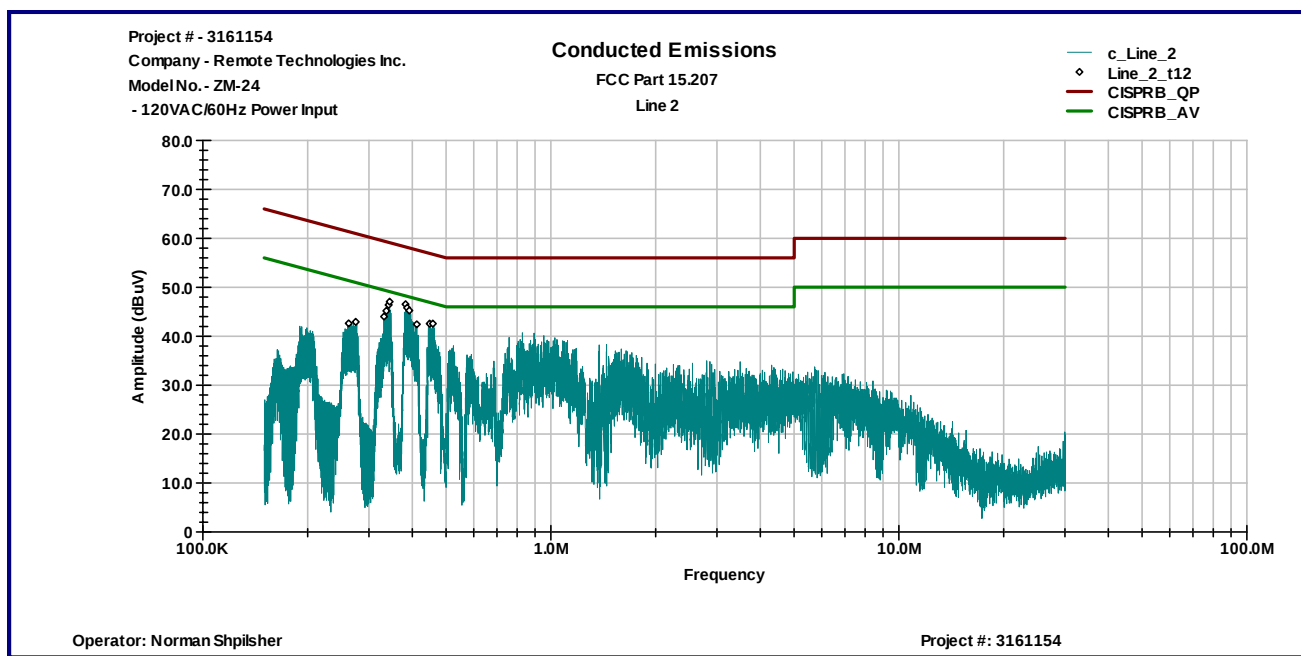
Line 2

Frequency MHz	Reading dB μ V	Cable Loss dB	QP Lim dB μ V	AVG Lim dB μ V	QP Margin dB	AVG Margin dB
0.190	42.0	0.1	64.0	54.0	-22.0	-12.0
0.275	42.9	0.1	61.0	51.0	-18.0	-8.0
* 0.344	42.1	0.1	59.1	49.1	-16.9	-6.9
* 0.382	41.5	0.1	58.2	48.2	-16.6	-6.6
* 0.461	38.3	0.1	56.7	46.7	-18.3	-8.3
0.828	40.7	0.1	56.0	46.0	-15.2	-5.2
0.954	40.1	0.1	56.0	46.0	-15.8	-5.8
1.116	39.1	0.2	56.0	46.0	-16.7	-6.7

Note: Measurements were taken using a Peak detector CISPR Quasi-peak detector (mark



Graph 3.8.1



Graph 3.8.2



3.9 Receiver/digital device radiated emissions

Test location: ☐ OATS ☒ Anechoic Chamber

Test distance: ☐ 10 meters ☒ 3 meters

Test result: **Pass**

Frequency range: 30MHz-12.75GHz

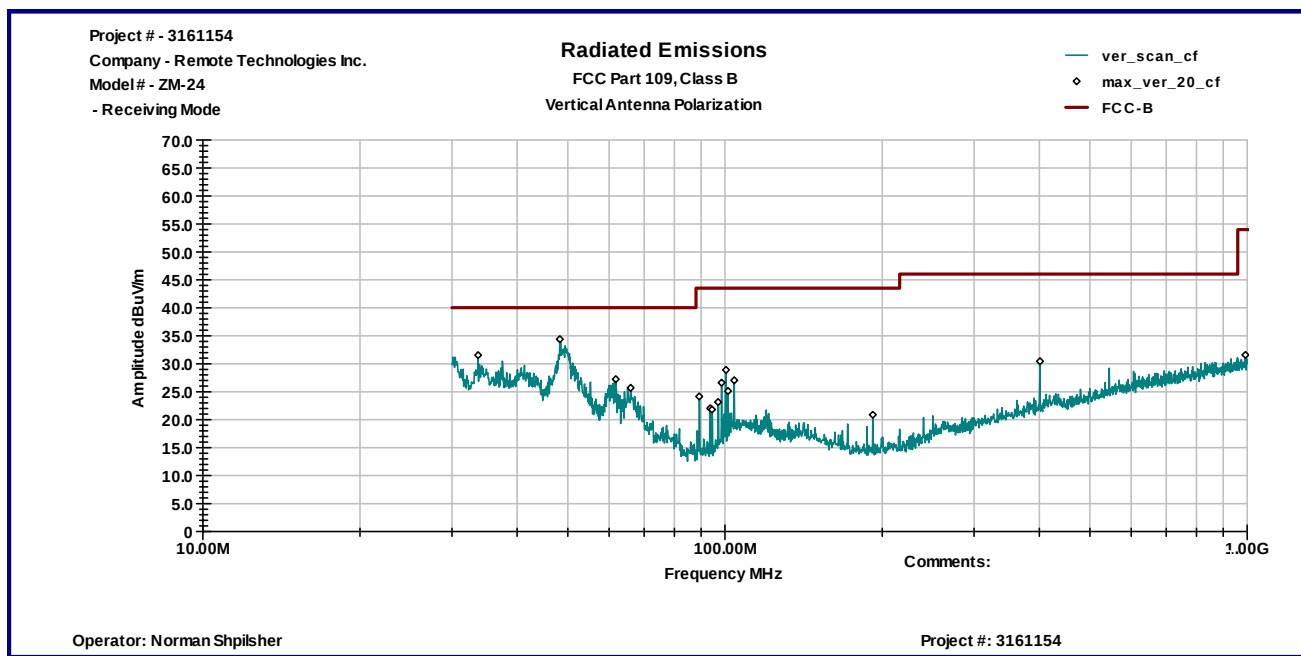
Max. Emissions margin: 5.6 dB below the limits

Notes: None

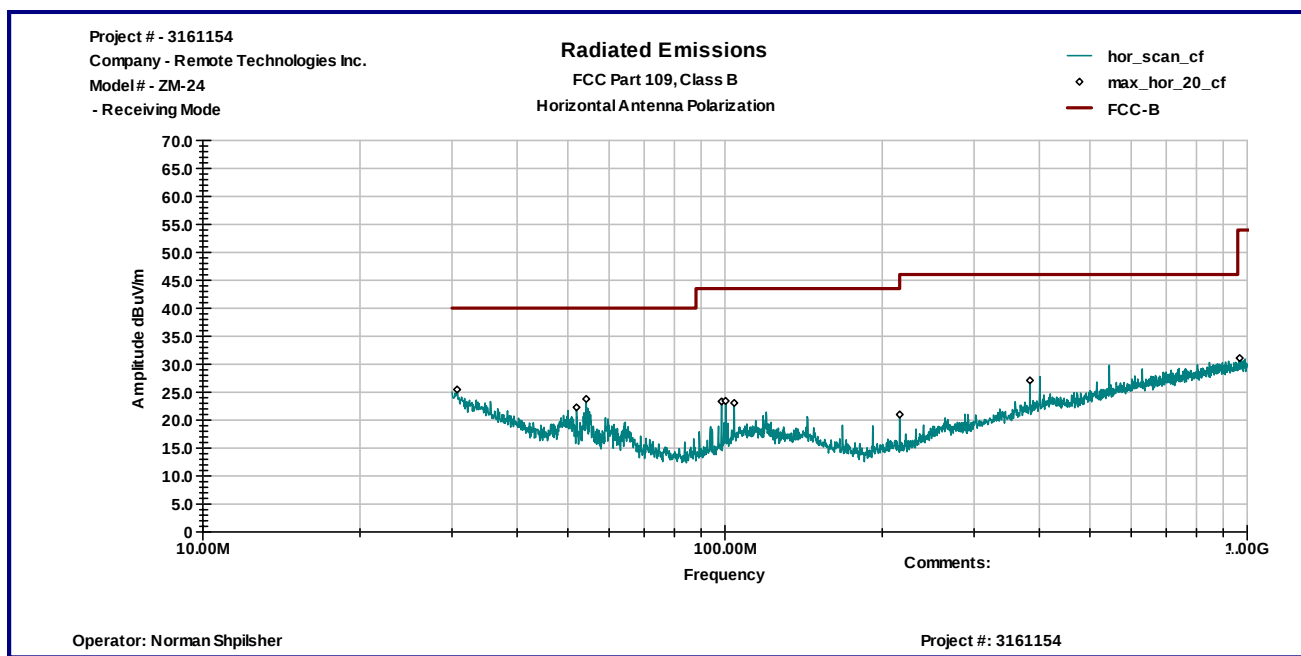
Date:	November 17, 2008	Result: Pass
Standard:	FCC Part 15.109, Class B	
Tested by:	Norman Shpilsher	
Test Point:	Enclosure	
Operation mode:	Receiving Mode, EUT was activated with External RF Generator	
Note:	Emissions at Generator Operating Frequency was removed from the Table	

Table 3.9.1

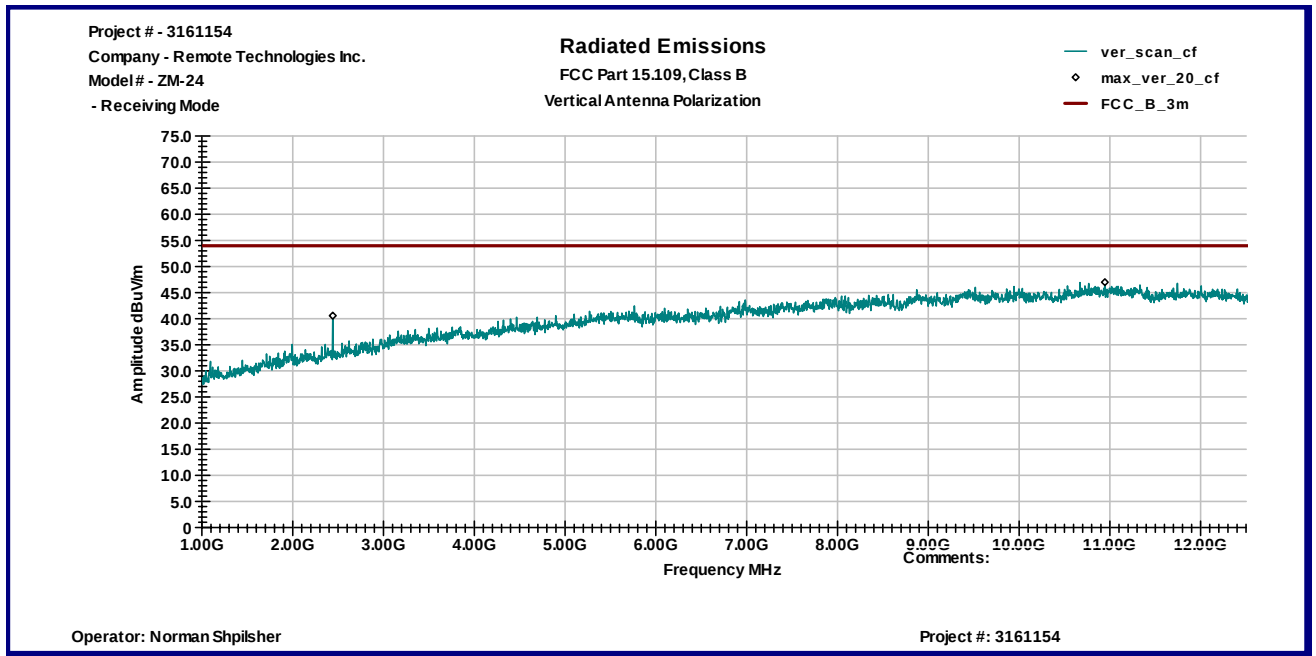
Frequency	Ant. Polarity	Peak Reading dB μ V	Ant.Factor dB1/m	Total at 3m dB μ V/m	QP Limit dB μ V/m	Margin dB
33.671 MHz	V	12.6	18.9	31.5	40.0	-8.5
48.286 MHz	V	23.1	11.3	34.4	40.0	-5.6
61.793 MHz	V	19.7	7.5	27.2	40.0	-12.8
100.45 MHz	V	16.5	12.4	28.9	43.5	-14.6
992.93 MHz	V	5.4	26.2	31.6	54.0	-22.4
30.693 MHz	H	4.8	20.7	25.5	40.0	-14.5
54.243 MHz	H	14.9	8.8	23.8	40.0	-16.2
100.3 MHz	H	11.0	12.4	23.4	43.5	-20.1
216.09 MHz	H	8.8	12.2	21.0	46.0	-25.0
383.81 MHz	H	8.6	18.5	27.1	46.0	-18.9
968.17 MHz	H	5.1	26.0	31.1	54.0	-22.9



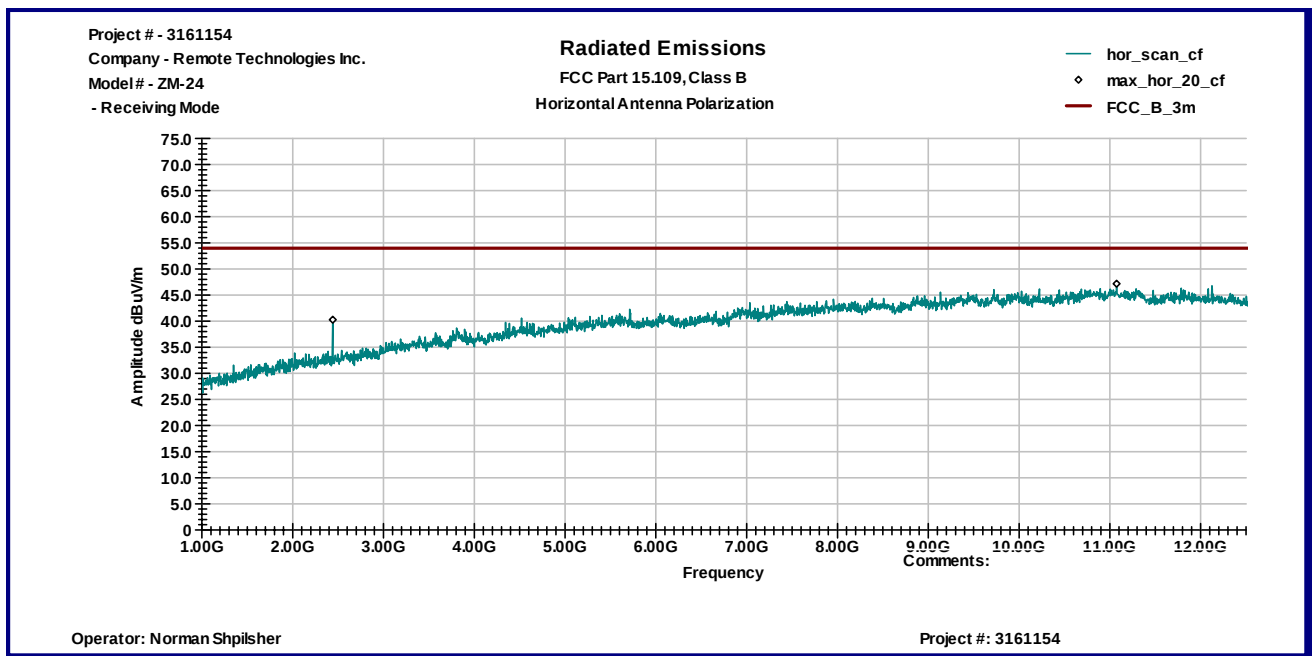
Graph 3.9.1



Graph 3.9.2



Graph 3.9.3



Graph 3.9.4

4.0 TEST EQUIPMENT

DESCRIPTION	MANUFACTURER	MODEL	SERIAL NO.	INTERTEK ID	CAL DUE	USED
Receiver RF Section	HP	85462A	3325A00106	9962	03/03/2009	☐
RF Filter Section	HP	85460A	3330A00109	9961	03/03/2009	☐
Spectrum Analyzer	R & S	FSP 40	100024	12559	08/22/2009	☒
Spectrum Analyzer	R & S	ESCI	100358	12909	05/07/2009	☒
Spectrum Analyzer	Agilent	E7402A	MY44212200	12660	11/13/2009	☐
Bicono-Log Antenna	Schaffner-Chase	CBL 6112 B	2468	14459	08/27/2009	☒
Bicono-Log Antenna	Schaffner-Chase	CBL 6112 B	2630	14459	09/26/2009	☐
Horn Antenna	EMCO	3115	9507-4513	9936	02/13/2009	☒
Horn Antenna	EMCO	3115	6579	15580	03/20/2009	☐
Waveguide Horn Antenna	EMCO	3116	9904-2423	9705	08/12/2009	☒
Loop Antenna	A.H.Systems	SAS-200/562	215	9817	05/19/2009	☐
Loop Antenna	ETS	6512	00060486	19942	08/05/2009	☐
Monopole Antenna	A.H.Systems	SAS-200/550-1	692	9986	05/10/2009	☐
Monopole Antenna	ETS-Lindgren	3310B	0071915	MIN-0054	11/14/2009	☐
LISN	Fischer Custom Communications	FCC-LISN-2 MOD.SD	316	9945	10/28/2009	☒
LISN	Fischer Custom Communications	FCC-LISN-50-25-2	2014	9665	11/06/2009	☐
LISN	Fischer Custom Communications	FCC-LISN-50-32-2-01	97-01	9835	10/06/2009	☐
Pre-Amplifier	MITEQ	AMF-5D-00501800-28-13P	1122951	13475	06/05/2009	☒
Pre-Amplifier	MITEQ	AMF-6F-16002600-25-10P	1222383	MIN-0065	01/17/2009	☒
Pre-Amplifier	MITEQ	AMF-6F-26004000-40-8P	13224444	MIN-0064	11/13/2009	☐
High Pass Filter	Reactel	7HS-4G-S12	0223	015274	VBV	☒
System	TILE! Instrument Control		Ver. 3.4.K.29	15259	VBV	☒
5001ix	California Instruments System	5001	55864, 55863, 55862, 72277	17672	11/14/2009	☐
CTS 3.0.19	California Instruments Harmonic/Flicker Software	632		12723	11/14/2009	☐