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Job Number:	1001231169
Project Number:	10CA19506
File Number:	MC16549
Date:	June 21, 2010
Model:	TC Remote

Electromagnetic Compatibility Test Report

For

Murphy Industries Inc.

Test Report Details

Tests Performed By:	**Underwriters Laboratories Inc.** **333 Pfingsten Rd.** **Northbrook, IL 60062**
Tests Performed For:	**Murphy Industries Inc.** **5311 S 122nd East Av** **Tulsa, OK 74146**
Applicant Contact: Phone: E-mail:	**Chuck Strohm** **(918) 317-4368** **CSTROHM@FWMURPHY.COM**
Test Report Date:	**June 21, 2010**
Product Type:	**Wireless Device**
Product standards	**FCC Part 15, Subpart C, 15.247** **RSS-Gen, RSS-210**
Model Number:	**TC Remote**
EUT Category:	**Frequency Hopping Spread Spectrum Transceiver**
Testing Start Date:	**June 17, 2010**
Date Testing Complete:	**June 18, 2010**
Overall Results:	**Compliant**

Report Directory

Report Revision History

Revision Date	Description	Revised By	Revision Reviewed By
None			

1.0 G E N E R A L - Product Description

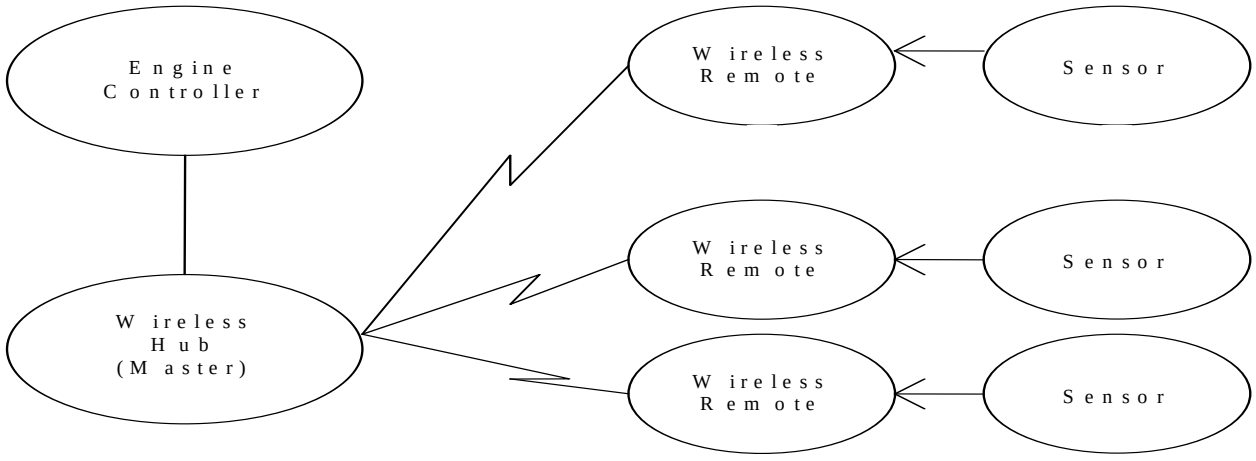
1.1 Equipment Description

The *remote* is located at the sensor location. It is low power, battery operated, and small. It sends its information to the hub, which then passes this information on to an engine controller.
The remotes spend almost all of their time in a low power sleep state and only wakes up when it needs to send a heartbeat or a sensor event occurs.

SYSTEM:
The M2Wireless system is designed to replace expensive wiring and conduit that is part of a natural gas compressor system. Typically, a natural gas compressor skid requires conduit or tubing between the sensor and the control panel which monitors the sensor. By using a low power wireless system, this conduit and wiring cost is significantly reduced or completely eliminated.

The M2Wireles will use a star type of wireless network topology as shown in Figure 1. This type of topology utilizes a single wireless master, denoted as the “Hub”, and multiple slaves, denoted as “Remotes”. This topology has been chosen because it meets the following requirements:

1. Extremely low power consumption.
2. Near real-time throughput of data from the sensor to the engine controller.



2.0 Device Configuration During Test

2.1.1 Equipment Used During Test:

Use	Product Type	Manufacturer	Model	Comments
EUT	Remote	Murphy Industries Inc.	TC Remote	The EUT may potently operate using two bandwidths – Wide Bandwidth noted in some tests as BW-W and Narrow Bandwidth noted in some tests as BW-N. See section 5.1 for bandwidth information
Note: **EUT** - Equipment Under Test, **AE** - Auxiliary/Associated Equipment, or **SIM** - Simulator (Not Subjected to Test)				

2.1.2 Input/Output Ports:

Port #	Name	Type*	Cable Max. >3m (Y/N)	Cable Shielded (Y/N)	Comments
0	Enclosure	N/E	—	—	None
1	Digital Input	I/O	-	-	Normally connected to EUT thru conduit. Not used during transmitter testing.

Note:
AC = AC Power Port DC = DC Power Port N/E = Non-Electrical
I/O = Signal Input or Output Port (Not Involved in Process Control)
TP = Telecommunication Ports

2.1.3 Power Interface:

Mode # /Rated	Voltage (V)	Current (A)	Power (W)	Frequency (DC/AC-Hz)	Phases (#)	Comments
1	3	-	-	DC	-	None

2.2 EUT Configurations

Mode #	Description
1	EUT was placed on a test bench or equivalent, temporary antenna connector was installed. The EUT was connected thru DC Block and Attenuator to SA input.
2	EUT setup in three axis in 10m semi-anechoic chamber on 80cm non-conductive support.

2.3 EUT Operation Modes

Mode #	Description
1	EUT was set to transmit on 3 channels (one channel at a time) with modulation.
2	EUT was set to transmit in hopping mode, modulated.
3	EUT was set to receive mode only.

3.0 Summary

The tests listed in the Summary of Testing section of this report have been performed and the results recorded by Underwriters Laboratories Inc. in accordance with the procedures stated in each test requirement and specification. The applicant determined the list of tests performed were applicable to the Equipment Under Test. As a result, the subject product has been verified to comply or not comply as noted in the Summary of Testing with each test specification. The test results relate only to the items tested.

3.1 Deviations from standard test methods

None

3.2 Device Modifications Necessary for Compliance

None

3.3 Reference Standards

Standard Number	Standard Name	Standard Date
FCC Part 15, Subpart C, 15.247	Code of Federal Regulations, Part 15, Radio Frequency Devices	2010
RSS-210, Issue 7	Low-Power Licence-Exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment	June 2007
RSS-Gen, Issue 2	General Requirements and Information for the Certification of Radiocommunication Equipment	June 2007
In addition to the above standards, FCC DA 00-705, Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems was used.		

3.4 Results Summary

Requirement – Test	Reference	Result (Compliant / Non-Compliant)*
AC Line Conducted Emissions	47 CFR Part 15.207 RSS-Gen 7.2.2	N/A – EUT battery operated only
20dB Bandwidth	47 CFR Part 15.247(a)(1)(i) RSS-210 A8.1(c)	Compliant
Carrier Frequency Separation	47 CFR Part 15.247(a)(1) RSS-210 A8.1(b)	Compliant
Number of Hopping Frequencies	47 CFR Part 15.247(a)(1)(i) RSS-210 A8.1(c)	Compliant
Time of Occupancy and Duty Cycle Correction	47 CFR Part 15.247(a)(1)(i) RSS-210 A8.1(c)	Compliant
Maximum Peak Output Power	47 CFR Part 15.247(b)(2) RSS-210 A8.4(1)	Compliant
Spurious Emissions (Antenna Conducted and Radiated)	47 CFR Part 15.247(d) RSS-210 A8.5 RSS-Gen 7.2.1 and 7.2.3	Compliant
Bandedge Emissions	47 CFR Part 15.247(d) RSS-210 A8.5	Compliant
Receiver Emissions	47 CFR Part 15.109	Compliant

Test Engineer:

Bartlomiej Mucha (Ext.41216)
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Reviewer:

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Senior Project Engineer
International EMC Services
Conformity Assessment Services

Any information and documentation involving UL Mark services are provided on behalf of Underwriters Laboratories Inc. (UL) or any authorized licensee of UL.

4.0 Calibration of Equipment Used for Measurement

All test equipment and test accessories are calibrated on a regular basis. The maximum time between calibrations is one year or the manufacturers' recommendation, whichever is less.

All test equipment calibrations are traceable to the National Institute of Standards and Technology (NIST); therefore, all test data recorded in this report is traceable to NIST.

5.0 EMISSIONS TEST RESULTS

The emissions tests were performed according to following regulations:

---------- United States ----------

Code of Federal Regulations Title 47	Part 15, Subpart C, Radio Frequency Devices

---------- Canada ----------

Spectrum Management and Telecommunications - Radio Standards Specification	RSS-210, Issue 7: Low-power Licence-exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment
Spectrum Management and Telecommunications - Radio Standards Specification	RSS-Gen, Issue 2: General Requirements and Information for the Certification of Radiocommunication Equipment

Unless specified otherwise in the individual Methods, the tests shall be conducted under the following ambient conditions. Confirmation of these conditions shall be verified at the time the test is conducted.

Ambient Temperature, °C	22.5 ± 2.5	Relative Humidity, %	45 ± 15	Barometric Pressure, mBar	950 ± 150

5.1 Test Conditions and Results – 20DB BANDWIDTH

Test Description	For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.
Basic Standard	47 CFR Part 15.247(a)(1)(i) RSS-210, A8.1(b)

Table 1 20dB Bandwidth Configuration Settings

Power Interface Mode #	EUT Configurations Mode #	EUT Operation Mode #
1	1	1
Supplementary information: The EUT will be operated using wide bandwidth, however the manufacturer may choose to use narrow bandwidth as well for future application. The bandwidth will not change the dwell time, channel separation or any other parameters not directly related to bandwidth of the equipment. Some measurements were repeated or spot checked at both bandwidth settings.		

Table 2 20dB Bandwidth Test Equipment

Test Equipment Used			
Description	Manufacturer	Model	Identifier
Spectrum Analyzer / Receiver	R & S	ESU	EMC4323
DC Block	JFW	50DB-037	None
Attenuator	Mini-Circuit	8W-N10W5	none

Table 3 20dB Bandwidth Results

Mode	Channel	Narrow 20dB BW	Wide 20dB BW
TX	Low	287.500kHz	366.667kHz
	Middle	291.667kHz	370.192kHz
	High	291.667kHz	376.603kHz

Test Setup Diagram for 20dB Bandwidth

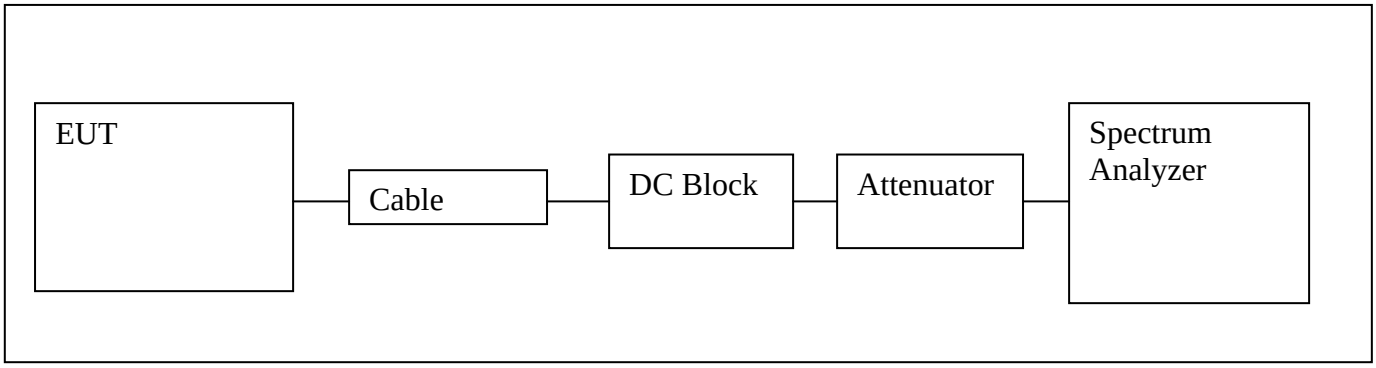
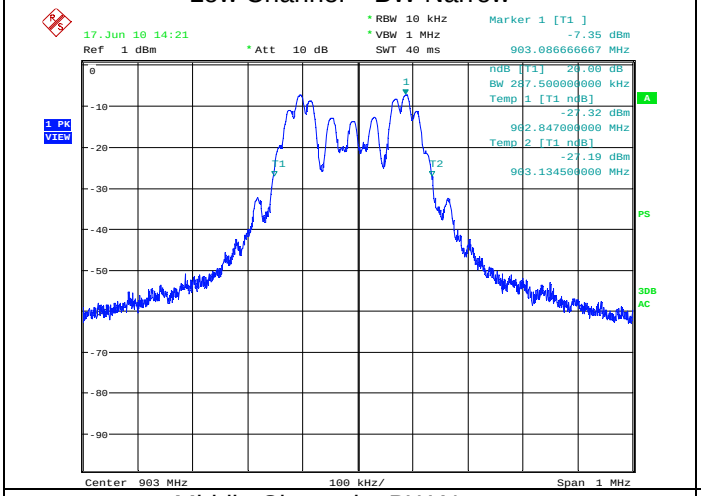
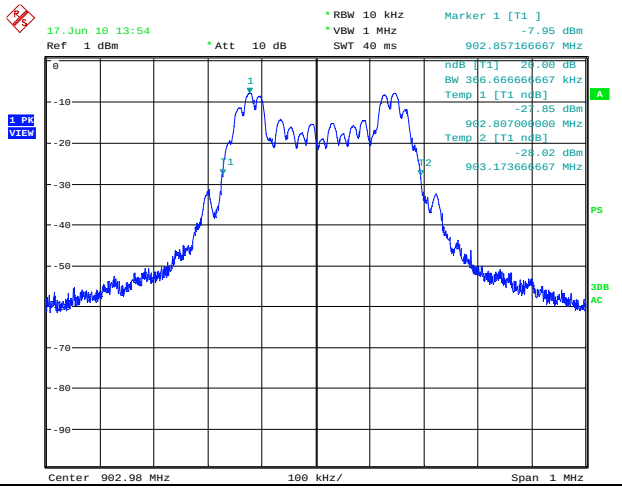


Figure 1 20dB Bandwidth Graphs

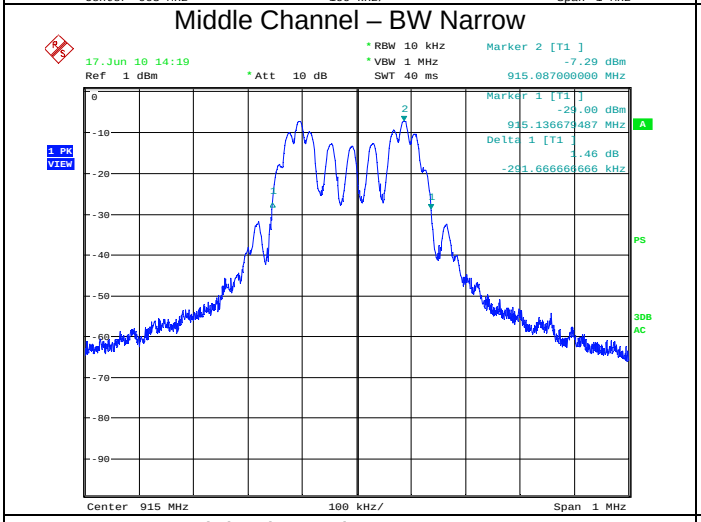
Low Channel – BW Narrow



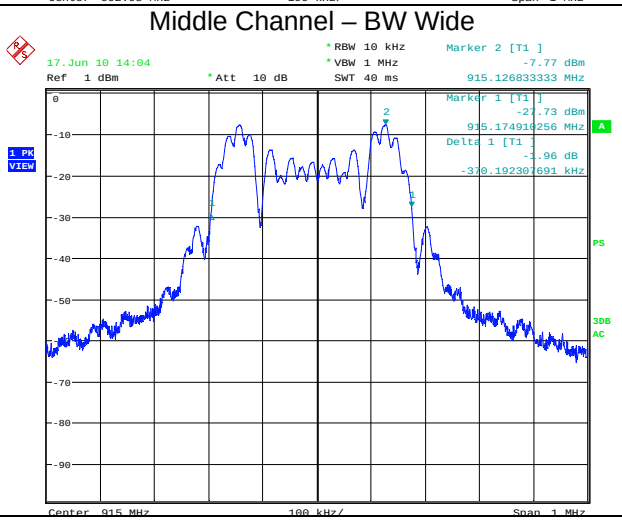
Low Channel – BW Wide



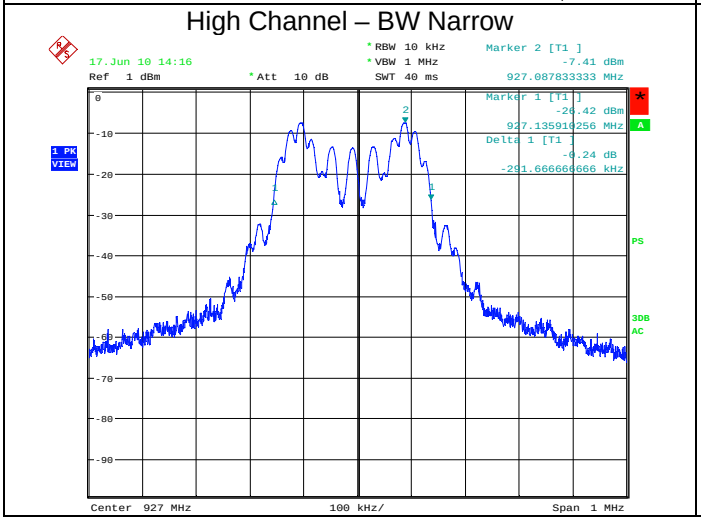
Middle Channel – BW Narrow



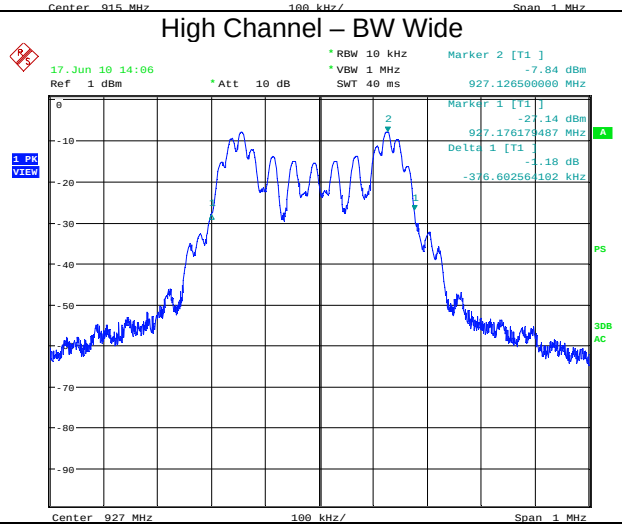
Middle Channel – BW Wide



High Channel – BW Narrow



High Channel – BW Wide



5.2 Test Conditions and Results – CARRIER FREQUENCY SEPARATION

Test Description	Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.
Basic Standard	47 CFR Part 15.247(a)(1) RSS-210, A8.1(b)

Table 4 Carrier Frequency Separation Configuration Settings

Power Interface Mode #	EUT Configurations Mode #	EUT Operation Mode #
1	1	2
Supplementary information: Separation frequencies were measured for each channel and then averaged.		

Table 5 Carrier Frequency Separation Test Equipment

Test Equipment Used			
Description	Manufacturer	Model	Identifier
Spectrum Analyzer / Receiver	R & S	ESU	EMC4323
DC Block	JFW	50DB-037	None
Attenuator	Mini-Circuit	8W-N10W5	none

Table 6 Carrier Frequency Separation Results

Mode	Channel	Carrier Frequency Separation Limit	Channel Separation
TX Hopping	Low Side	> 20dB *BW - N (aprx. 376.603kHz)	1.0617 MHz
	Middle		0.9853 MHz
	High Side		1.0107 MHz

Test Setup Diagram for Carrier Frequency Separation

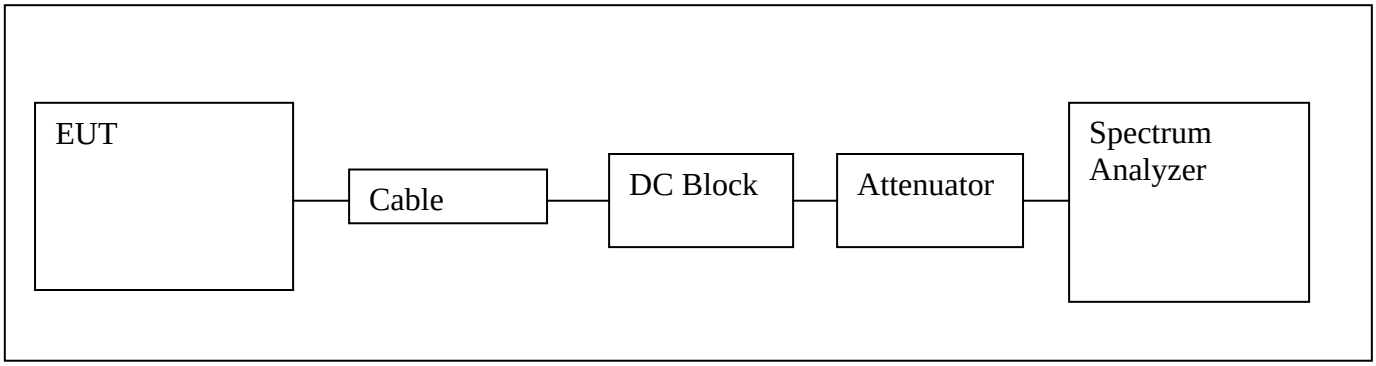


Figure 2 Carrier Frequency Separation Graph

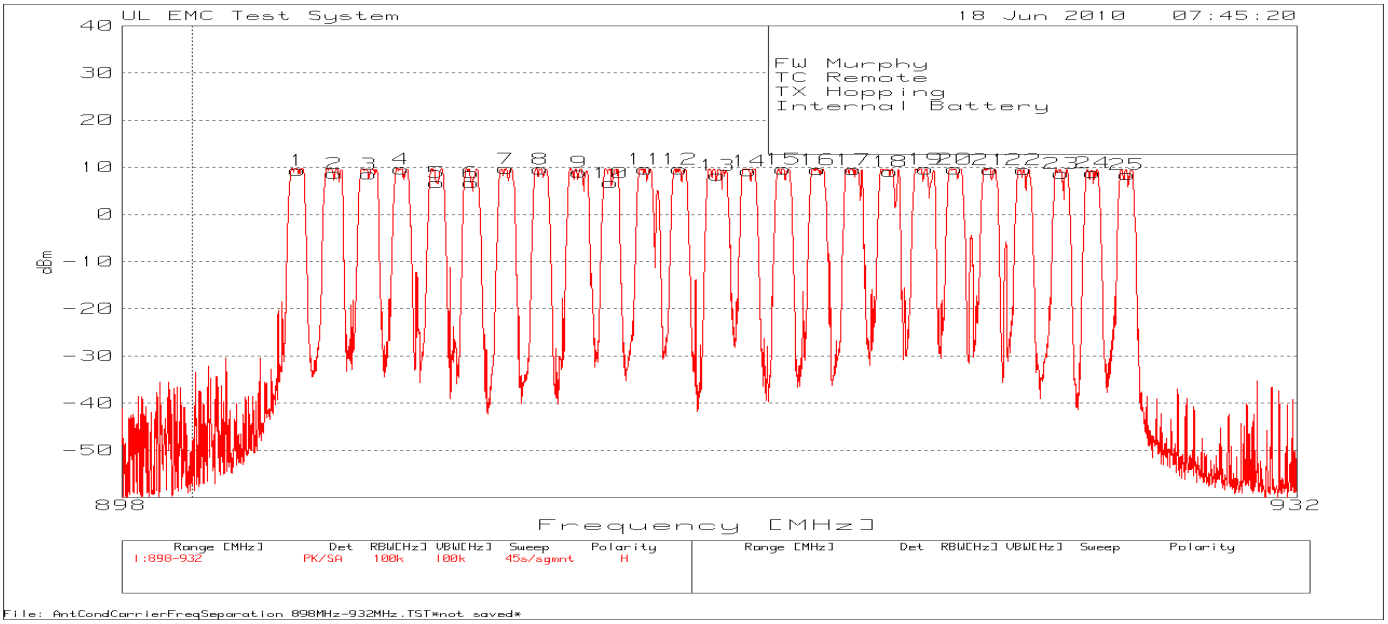


Table 7 Carrier Frequency Separation (Frequency List)

FW Murphy
TC Remote
TX Hopping
Internal Battery

No.	Test Frequency [MHz]	Meter Reading [dB(uV)]	Gain/Loss Factor [dB]	Transducer Factor [dB]	Level dBm	Limit:1	2	3	4	5	6
1	903.0112	106.07 pk	10.3	-107	9.37	-	-	-	-	-	-
		Height:100 Horz		Margin [dB]		-	-	-	-	-	-
2	904.0729	105.38 pk	10.3	-107	8.68	-	-	-	-	-	-
		Height:100 Horz		Margin [dB]		-	-	-	-	-	-
3	905.0667	105.23 pk	10.3	-107	8.53	-	-	-	-	-	-
		Height:100 Horz		Margin [dB]		-	-	-	-	-	-
4	905.984	106.39 pk	10.3	-107	9.69	-	-	-	-	-	-
		Height:100 Horz		Margin [dB]		-	-	-	-	-	-
5	907.0117	103.49 pk	10.3	-107	6.79	-	-	-	-	-	-
		Height:100 Horz		Margin [dB]		-	-	-	-	-	-
6	907.997	103.43 pk	10.3	-107	6.73	-	-	-	-	-	-
		Height:100 Horz		Margin [dB]		-	-	-	-	-	-
7	908.9865	106.4 pk	10.3	-107	9.7	-	-	-	-	-	-
		Height:100 Horz		Margin [dB]		-	-	-	-	-	-
8	909.9888	106.39 pk	10.3	-107	9.69	-	-	-	-	-	-
		Height:100 Horz		Margin [dB]		-	-	-	-	-	-
9	911.0887	105.65 pk	10.3	-107	8.95	-	-	-	-	-	-
		Height:100 Horz		Margin [dB]		-	-	-	-	-	-
10	912.006	103.39 pk	10.3	-107	6.69	-	-	-	-	-	-
		Height:100 Horz		Margin [dB]		-	-	-	-	-	-
11	912.9913	106.35 pk	10.3	-107	9.65	-	-	-	-	-	-
		Height:100 Horz		Margin [dB]		-	-	-	-	-	-
12	913.9808	106.38 pk	10.3	-107	9.68	-	-	-	-	-	-
		Height:100 Horz		Margin [dB]		-	-	-	-	-	-
13	915.0722	105.06 pk	10.3	-107	8.36	-	-	-	-	-	-
		Height:100 Horz		Margin [dB]		-	-	-	-	-	-
14	916.0065	105.94 pk	10.3	-107	9.24	-	-	-	-	-	-
		Height:100 Horz		Margin [dB]		-	-	-	-	-	-
15	917.0003	106.29 pk	10.3	-107	9.59	-	-	-	-	-	-
		Height:100 Horz		Margin [dB]		-	-	-	-	-	-
16	918.0025	106.21 pk	10.3	-107	9.51	-	-	-	-	-	-
		Height:100 Horz		Margin [dB]		-	-	-	-	-	-
17	919.0387	106.23 pk	10.3	-107	9.53	-	-	-	-	-	-
		Height:100 Horz		Margin [dB]		-	-	-	-	-	-
18	920.1004	105.81 pk	10.3	-107	9.11	-	-	-	-	-	-
		Height:100 Horz		Margin [dB]		-	-	-	-	-	-
19	921.1366	106.3 pk	10.3	-107	9.6	-	-	-	-	-	-
		Height:100 Horz		Margin [dB]		-	-	-	-	-	-
20	921.986	106.29 pk	10.3	-107	9.59	-	-	-	-	-	-
		Height:100 Horz		Margin [dB]		-	-	-	-	-	-
21	923.0052	106.15 pk	10.3	-107	9.45	-	-	-	-	-	-
		Height:100 Horz		Margin [dB]		-	-	-	-	-	-
22	923.9905	106.25 pk	10.3	-107	9.55	-	-	-	-	-	-
		Height:100 Horz		Margin [dB]		-	-	-	-	-	-
23	925.0947	105.38 pk	10.3	-107	8.68	-	-	-	-	-	-
		Height:100 Horz		Margin [dB]		-	-	-	-	-	-
24	926.0035	105.55 pk	10.3	-107	8.85	-	-	-	-	-	-
		Height:100 Horz		Margin [dB]		-	-	-	-	-	-
25	927.0142	105.17 pk	10.3	-107	8.47	-	-	-	-	-	-
		Height:100 Horz		Margin [dB]		-	-	-	-	-	-

PK - Peak detector

5.3 Test Conditions and Results – NUMBER OF HOPPING FREQUENCIES

Test Description	For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.
Basic Standard	47 CFR Part 15.247(a)(1)(i) RSS-210, A8.1(d)

Table 8 Number of Hopping Frequencies Configuration Settings

Power Interface Mode #	EUT Configurations Mode #	EUT Operation Mode #
1	1	2
Supplementary information: None		

Table 9 Number of Hopping Frequencies Test Equipment

Test Equipment Used			
Description	Manufacturer	Model	Identifier
Spectrum Analyzer / Receiver	R & S	ESU	EMC4323
DC Block	JFW	50DB-037	None
Attenuator	Mini-Circuit	8W-N10W5	none

Table 10 Number of Hopping Frequencies Results

Mode	Number of Channels	Minimum Number Required
TX, Hopping	25	25

Test Setup for Number of Hopping Frequencies

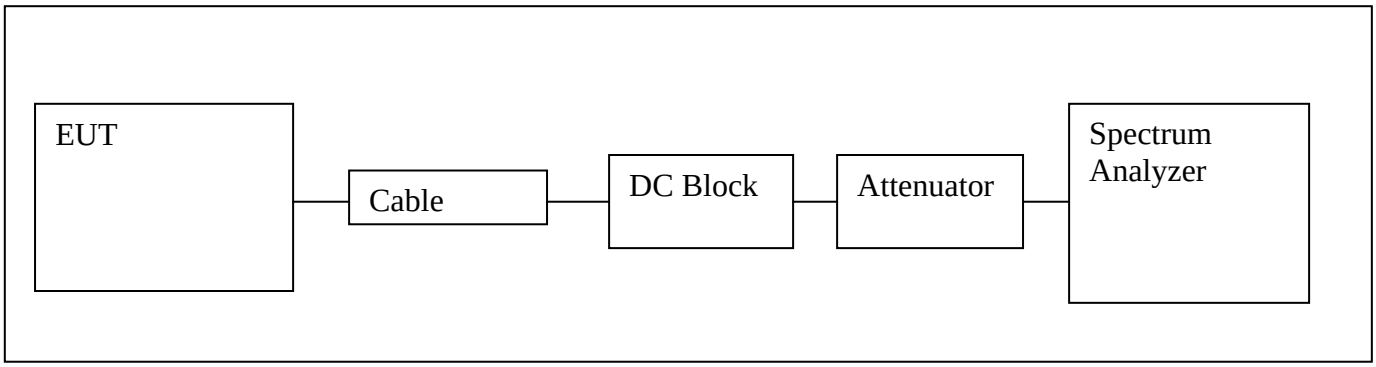


Figure 3 Number of Hopping Frequencies Graphs

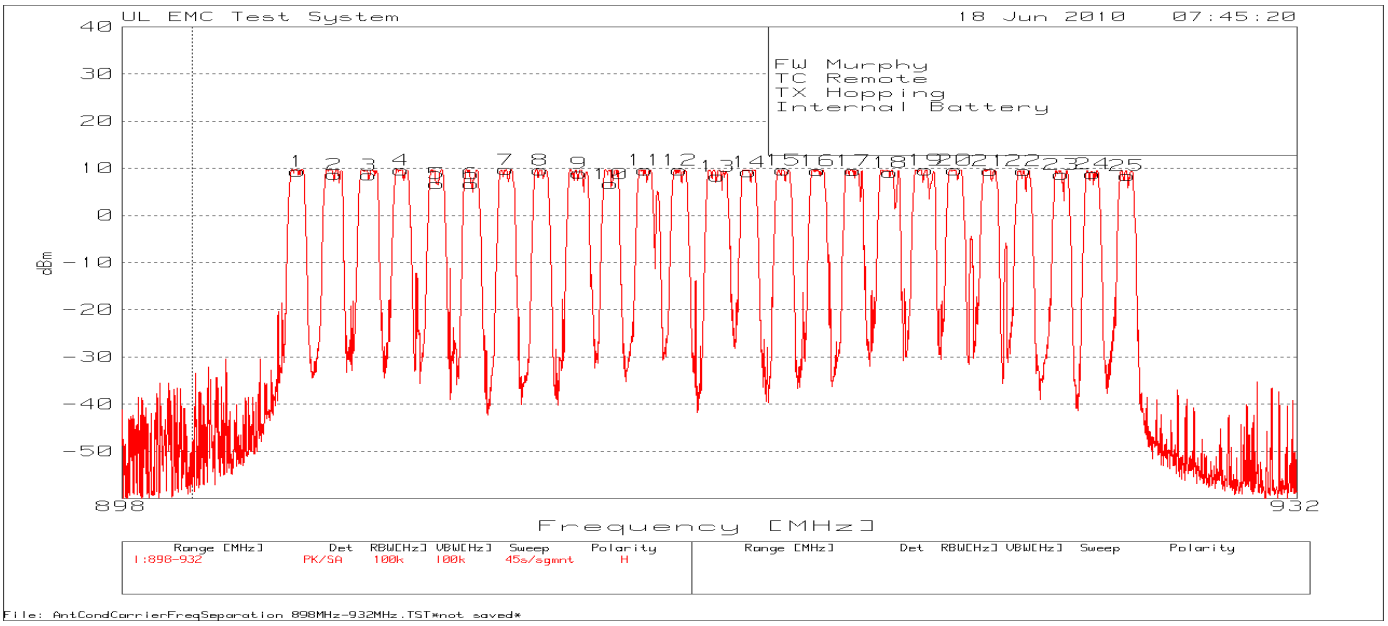


Table 11 Number of Hopping Channels (Frequency List)

FW Murphy
TC Remote
TX Hopping
Internal Battery

No.	Test Frequency [MHz]	Meter Reading [dB(uV)]	Gain/Loss Factor [dB]	Transducer Factor [dB]	Level dBm	Limit:1	2	3	4	5	6
1	903.0112	106.07 pk	10.3	-107	9.37	-	-	-	-	-	-
		Height:100 Horz		Margin [dB]		-	-	-	-	-	-
2	904.0729	105.38 pk	10.3	-107	8.68	-	-	-	-	-	-
		Height:100 Horz		Margin [dB]		-	-	-	-	-	-
3	905.0667	105.23 pk	10.3	-107	8.53	-	-	-	-	-	-
		Height:100 Horz		Margin [dB]		-	-	-	-	-	-
4	905.984	106.39 pk	10.3	-107	9.69	-	-	-	-	-	-
		Height:100 Horz		Margin [dB]		-	-	-	-	-	-
5	907.0117	103.49 pk	10.3	-107	6.79	-	-	-	-	-	-
		Height:100 Horz		Margin [dB]		-	-	-	-	-	-
6	907.997	103.43 pk	10.3	-107	6.73	-	-	-	-	-	-
		Height:100 Horz		Margin [dB]		-	-	-	-	-	-
7	908.9865	106.4 pk	10.3	-107	9.7	-	-	-	-	-	-
		Height:100 Horz		Margin [dB]		-	-	-	-	-	-
8	909.9888	106.39 pk	10.3	-107	9.69	-	-	-	-	-	-
		Height:100 Horz		Margin [dB]		-	-	-	-	-	-
9	911.0887	105.65 pk	10.3	-107	8.95	-	-	-	-	-	-
		Height:100 Horz		Margin [dB]		-	-	-	-	-	-
10	912.006	103.39 pk	10.3	-107	6.69	-	-	-	-	-	-
		Height:100 Horz		Margin [dB]		-	-	-	-	-	-
11	912.9913	106.35 pk	10.3	-107	9.65	-	-	-	-	-	-
		Height:100 Horz		Margin [dB]		-	-	-	-	-	-
12	913.9808	106.38 pk	10.3	-107	9.68	-	-	-	-	-	-
		Height:100 Horz		Margin [dB]		-	-	-	-	-	-
13	915.0722	105.06 pk	10.3	-107	8.36	-	-	-	-	-	-
		Height:100 Horz		Margin [dB]		-	-	-	-	-	-
14	916.0065	105.94 pk	10.3	-107	9.24	-	-	-	-	-	-
		Height:100 Horz		Margin [dB]		-	-	-	-	-	-
15	917.0003	106.29 pk	10.3	-107	9.59	-	-	-	-	-	-
		Height:100 Horz		Margin [dB]		-	-	-	-	-	-
16	918.0025	106.21 pk	10.3	-107	9.51	-	-	-	-	-	-
		Height:100 Horz		Margin [dB]		-	-	-	-	-	-
17	919.0387	106.23 pk	10.3	-107	9.53	-	-	-	-	-	-
		Height:100 Horz		Margin [dB]		-	-	-	-	-	-
18	920.1004	105.81 pk	10.3	-107	9.11	-	-	-	-	-	-
		Height:100 Horz		Margin [dB]		-	-	-	-	-	-
19	921.1366	106.3 pk	10.3	-107	9.6	-	-	-	-	-	-
		Height:100 Horz		Margin [dB]		-	-	-	-	-	-
20	921.986	106.29 pk	10.3	-107	9.59	-	-	-	-	-	-
		Height:100 Horz		Margin [dB]		-	-	-	-	-	-
21	923.0052	106.15 pk	10.3	-107	9.45	-	-	-	-	-	-
		Height:100 Horz		Margin [dB]		-	-	-	-	-	-
22	923.9905	106.25 pk	10.3	-107	9.55	-	-	-	-	-	-
		Height:100 Horz		Margin [dB]		-	-	-	-	-	-
23	925.0947	105.38 pk	10.3	-107	8.68	-	-	-	-	-	-
		Height:100 Horz		Margin [dB]		-	-	-	-	-	-
24	926.0035	105.55 pk	10.3	-107	8.85	-	-	-	-	-	-
		Height:100 Horz		Margin [dB]		-	-	-	-	-	-
25	927.0142	105.17 pk	10.3	-107	8.47	-	-	-	-	-	-
		Height:100 Horz		Margin [dB]		-	-	-	-	-	-

PK - Peak detector

5.4 Test Conditions and Results – TIME OF OCCUPANCY AND DUTY CYCLE CORRECTION

Test Description	For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.
Basic Standard	47 CFR Part 15.247(a)(1)(i) RSS-210, A8.1(d)

Table 12 Dwell Time Configuration Settings

Power Interface Mode #	EUT Configurations Mode #	EUT Operation Mode #
1	1	2
Supplementary information: Duty cycle also measured/calculated for use in radiated spurious measurements		

Table 13 Dwell Time Test Equipment

Test Equipment Used			
Description	Manufacturer	Model	Identifier
Spectrum Analyzer / Receiver	R & S	ESU	EMC4323
DC Block	JFW	50DB-037	None
Attenuator	Mini-Circuit	8W-N10W5	none

Table 14 Dwell Time Results

Mode	Number of Channels	Maximum Time Allowed in 10s.	Measured Dwell Time in 10s.
TX Hopping Channel	25	0.400s	300.564mS

Table 15 Duty Cycle Correction Factor

Mode	Number of TX in 100mS	TX Duration in 100mS	Duty Cycle Correction (dB) $20 \times \log(\frac{TX\,(ms)}{100\,ms})$
TX Hopping Channel	2	27.324mS	11.27dB

Test Setup for Dwell Time

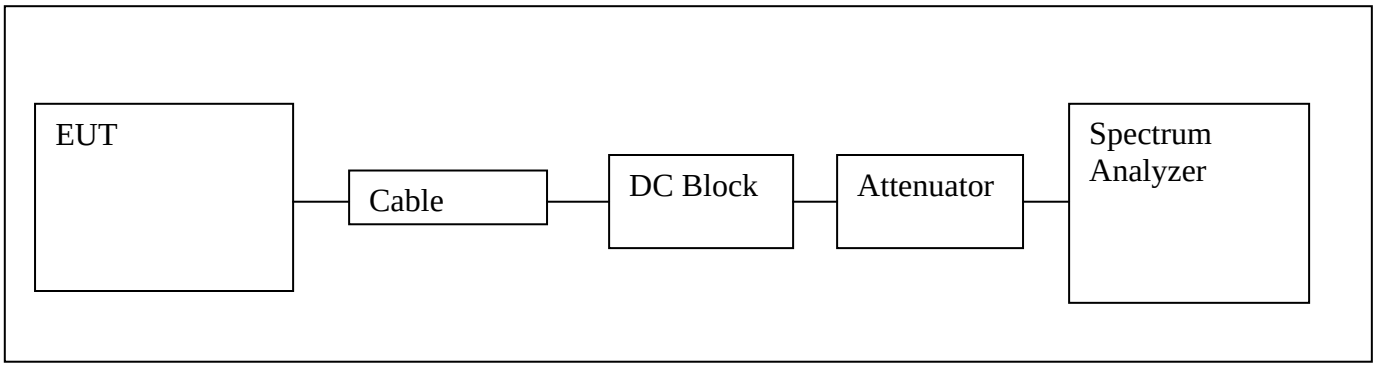
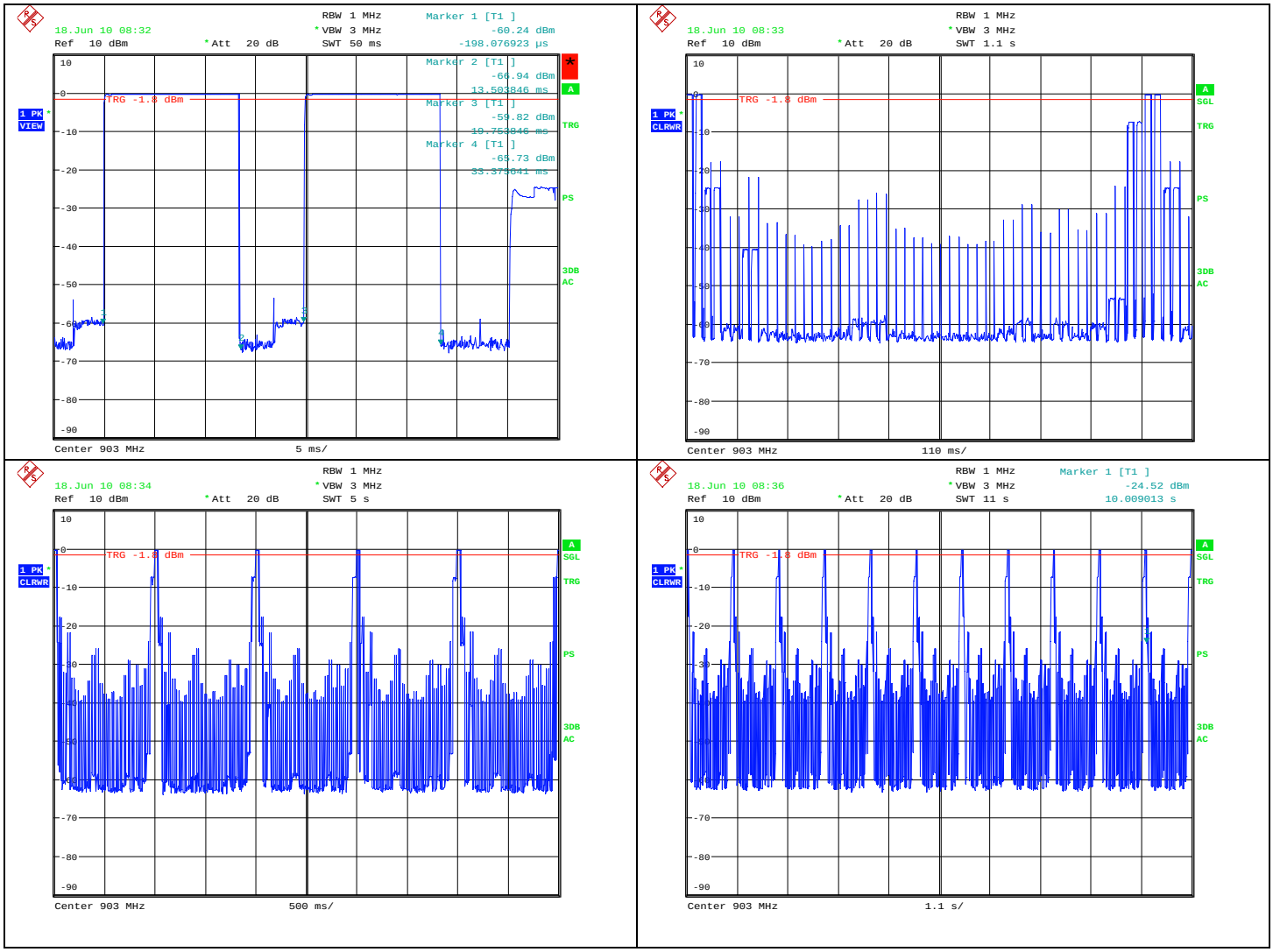


Figure 4 Dwell Time Graphs



5.5 Test Conditions and Results – MAXIMUM PEAK OUTPUT POWER

Test Description	For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels, as permitted under paragraph (a)(1)(i) of this section.	
Basic Standard	47 CFR Part 15.247(b)(2) RSS-210, A8.4(2)	
	Frequency range	Measurement Point
Fully configured sample scanned over the following frequency range	902MHz – 928MHz	Antenna Conducted
Limits		
Frequency (MHz)	Limit mW	
	Peak	
902 - 928	1000 (30dBm – gain of Antenna over 6dBi)	
Supplementary information: none		

Table 16 Maximum Peak Output Power EUT Configuration Settings

Power Interface Mode #	EUT Configurations Mode #	EUT Operation Mode #
1	1	1
Supplementary information: None		

Table 17 Maximum Peak Output Power Test Equipment

Test Equipment Used			
Description	Manufacturer	Model	Identifier
Spectrum Analyzer / Receiver	R & S	ESU	EMC4323
DC Block	JFW	50DB-037	None
Attenuator	Mini-Circuit	8W-N10W5	none

Table 18 Maximum Peak Output Power Results

Channel	Limit (dBm)	BW-N Power dBm	BW-W Power dBm
Low Channel	30	9.88	9.92
Middle Channel	30	9.83	9.85
High Channel	30	9.71	9.71

Test setup for Maximum Peak Output Power

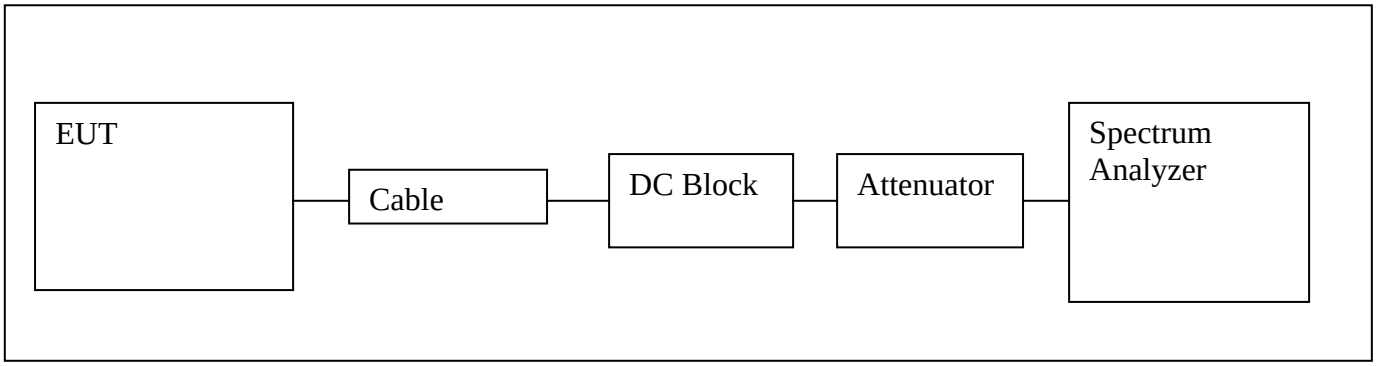


Figure 5 Maximum Peak Output Power Graph BW-N

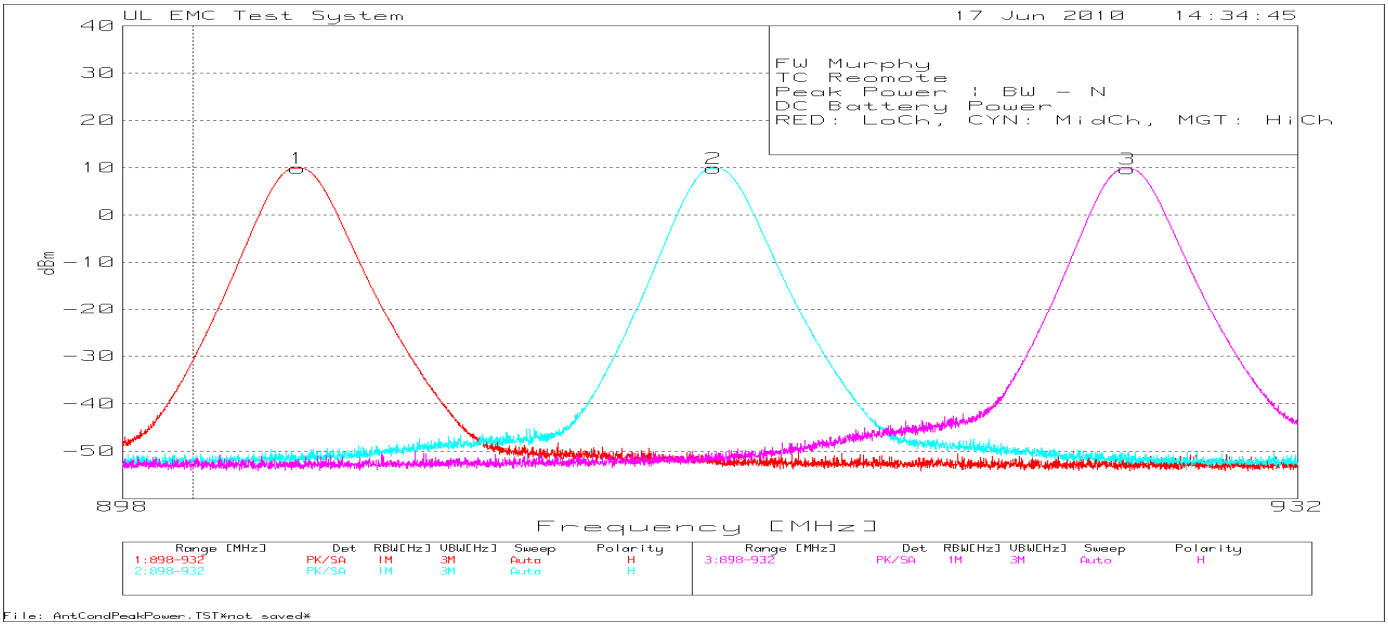


Figure 6 Maximum Peak Output Power Graph BW-W

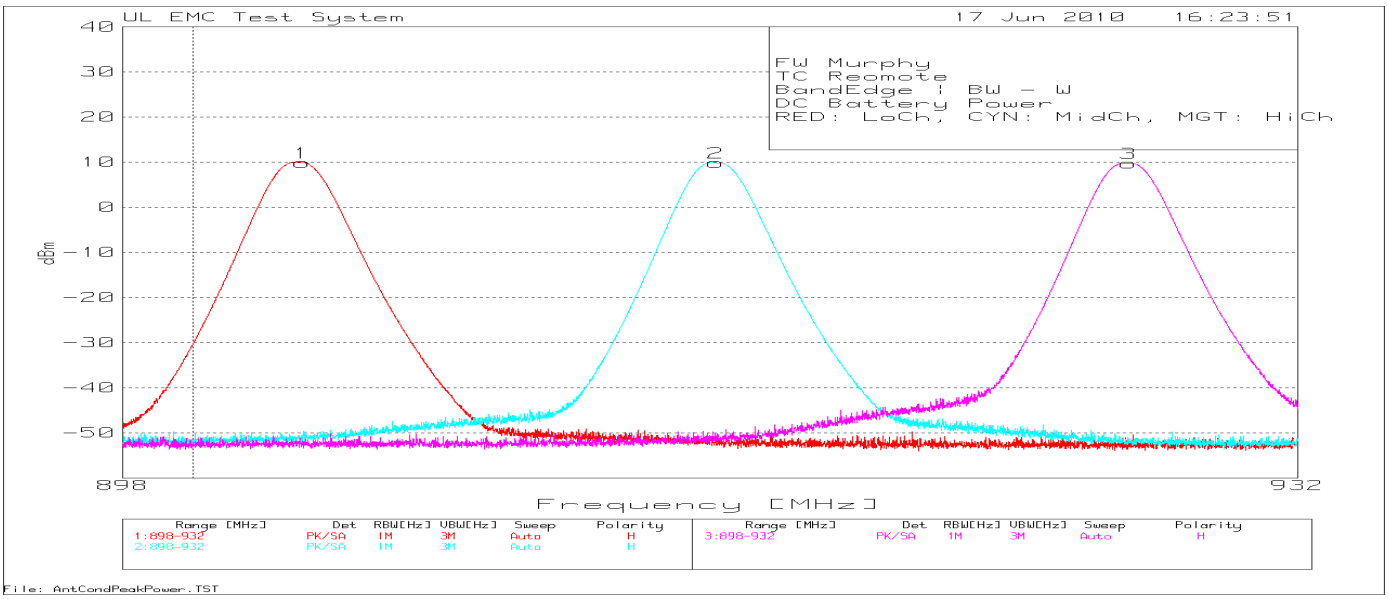


Table 19 Maximum Peak Output Power Emissions Data Points BW-N

FW Murphy
TC Reomote
Peak Power | BW - N
DC Battery Power
RED: LoCh, CYN: MidCh, MGT: HiCh

No.	Test Frequency [MHz]	Meter Reading [dB(uV)]	Gain/Loss Factor [dB]	Transducer Factor [dB]	Level dBm	Limit:1	2	3	4	5	6
Low Channel											
1	902.973	106.58 pk	10.3	-107	9.88	-	-	-	-	-	-
				Margin [dB]		-	-	-	-	-	-
Middle Channel											
2	914.9405	106.53 pk	10.3	-107	9.83	-	-	-	-	-	-
				Margin [dB]		-	-	-	-	-	-
High Channel											
3	927.0015	106.41 pk	10.3	-107	9.71	-	-	-	-	-	-
				Margin [dB]		-	-	-	-	-	-

PK - Peak detector

Table 20 Maximum Peak Output Power Emissions Data Points BW-W

FW Murphy
TC Reomote
BandEdge | BW - W
DC Battery Power
RED: LoCh, CYN: MidCh, MGT: HiCh

No.	Test Frequency [MHz]	Meter Reading [dB(uV)]	Gain/Loss Factor [dB]	Transducer Factor [dB]	Level dBm	Limit:1	2	3	4	5	6
Low Channel											
1	903.1174	106.62 pk	10.3	-107	9.92	-	-	-	-	-	-
				Margin [dB]		-	-	-	-	-	-
Middle Channel											
2	914.9958	106.55 pk	10.3	-107	9.85	-	-	-	-	-	-
				Margin [dB]		-	-	-	-	-	-
High Channel											
3	927.0227	106.41 pk	10.3	-107	9.71	-	-	-	-	-	-
				Margin [dB]		-	-	-	-	-	-

PK - Peak detector

5.6 Test Conditions and Results – SPURIOUS EMISSIONS (Antenna Conducted and Radiated)

Test Description	In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section15.205(c)).

Basic Standard	47 CFR Part 15.247(d) RSS-210, A8.5 RSS-Gen 7.2.1 and 7.2.3	
	Frequency range	Measurement Point
Fully configured sample scanned over the following frequency range	30MHz – 1GHz	10 meter distance and / or antenna port
Fully configured sample scanned over the following frequency range	1GHz – 10GHz	3 meter distance and / or antenna port

Limits (Antenna Conducted)

All emissions must be 20dB below the level of the fundamental frequency.

Limits (Radiated – Restricted Bands Only)

Frequency (MHz)	Limit (dBµV/m)		
	Quasi-Peak	Average	
	General Emissions	Fundamental	Spurious
30 – 88	29.54	-	-
88 – 216	33.06	-	-
216-960	35.56	-	-
960-1000	43.52	-	-
1,000-25,000	-	-	54

Supplementary information: Below 1GHz, spectrum was checked. All emissions related to the transmitter below 1GHz are not in the restricted band therefore only antenna conducted limits apply (20dB below the peak level of the fundamental).

All combinations were tested with BW-W setting. Some combinations were tested with BW-N setting. There was no difference in emissions between BW-W and BW-N setting.

Table 21 SPURIOUS EMISSIONS EUT Configuration Settings

Power Interface Mode #	EUT Configurations Mode #	EUT Operation Mode #
1	1 and 2	1
Supplementary information: None		

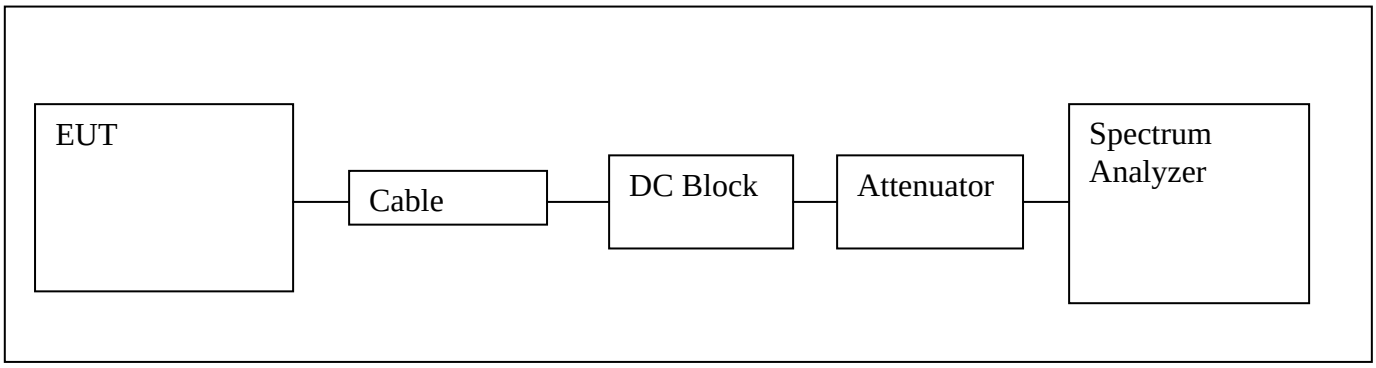
Table 22 SPURIOUS CONDUCTED EMISSIONS Test Equipment

Test Equipment Used			
Description	Manufacturer	Model	Identifier
Spectrum Analyzer / Receiver	R & S	ESU	EMC4323
DC Block	JFW	50DB-037	None
Attenuator	Mini-Circuit	8W-N10W5	none

Table 23 SPURIOUS RADIATED EMISSIONS Test Equipment

Description	Manufacturer	Model	Identifier
EMI Test Receiver	Rohde & Schwarz	ESU	EMC4323
Bicon Antenna	Chase	VBA6106A	EMC4078
Log-P Antenna	Chase	UPA6109	EMC4258
Antenna Array	UL	BOMS	EMC4276
Amplified 1GHz – 10GHz System	UL w/ EMCO Horn Antenna	3117	EMC4293

Test setup diagram for SPURIOUS EMISSIONS – Antenna conducted



Test setup for SPURIOUS EMISSIONS – Radiated

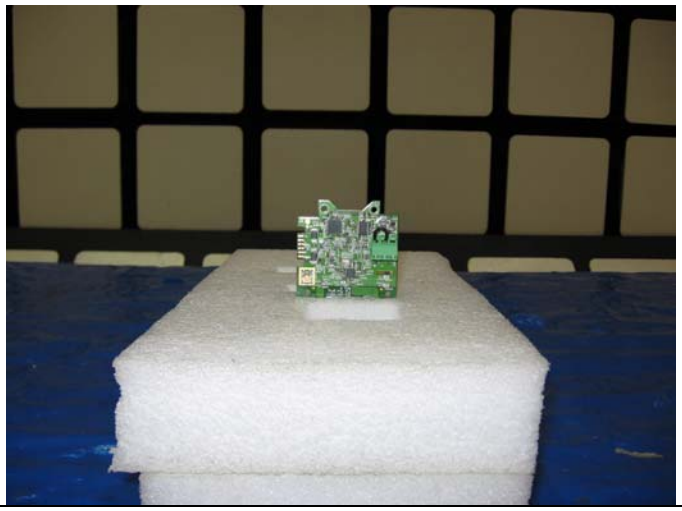
X-Axis 	Y-Axis 
Z-Axis 	Overall 10m chamber setup 

Figure 7 30MHz-10GHz Antenna Port Spurious Emissions Plot TX Mode, BW-N.

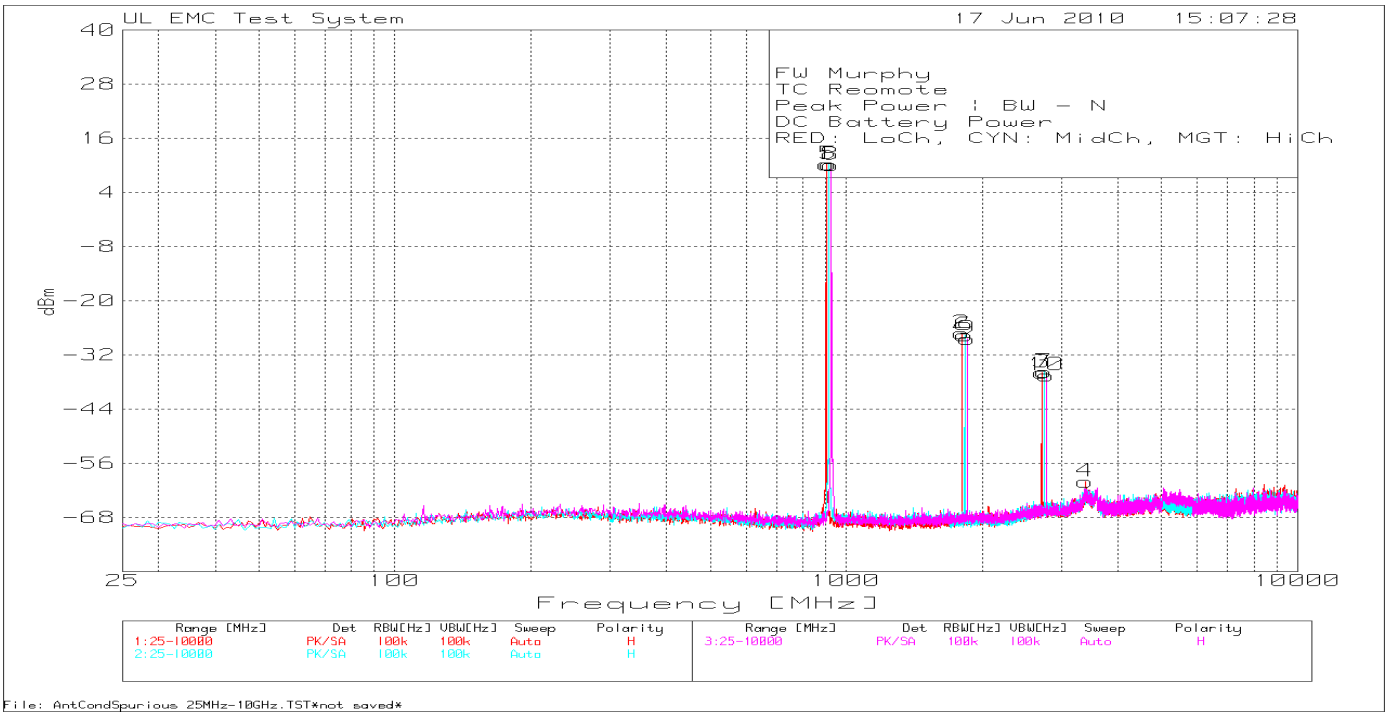


Table 24 Antenna Conducted Spurious Emissions 30MHz – 10GHz, BW-N

No.	Test Frequency [MHz]	Meter Reading [dB(uV)]	Gain/Loss Factor [dB]	Transducer Factor [dB]	Level dBm	Limit:1	2	3	4	5	6
LoCh 25 - 10000MHz											
1	902.8266	106.95 pk	10.3	-107	10.25	-	-	-	-	-	-
				Margin [dB]		-	-	-	-	-	-
2	1805.568	69 pk	10.9	-107	-27.1	-	-	-	-	-	-
				Margin [dB]		-	-	-	-	-	-
3	2709.14	59.79 pk	11.3	-107	-35.91	-	-	-	-	-	-
				Margin [dB]		-	-	-	-	-	-
4	3390.14	35.21 pk	11.8	-107	-59.99	-	-	-	-	-	-
				Margin [dB]		-	-	-	-	-	-
MidCh 25 - 10000MHz											
5	915.2839	106.93 pk	10.3	-107	10.23	-	-	-	-	-	-
				Margin [dB]		-	-	-	-	-	-
6	1829.652	68.31 pk	11	-107	-27.69	-	-	-	-	-	-
				Margin [dB]		-	-	-	-	-	-
7	2744.851	59.89 pk	11.4	-107	-35.71	-	-	-	-	-	-
				Margin [dB]		-	-	-	-	-	-
HiCh 25 - 10000MHz											
8	926.9107	106.77 pk	10.3	-107	10.07	-	-	-	-	-	-
				Margin [dB]		-	-	-	-	-	-
9	1853.736	67.64 pk	11	-107	-28.36	-	-	-	-	-	-
				Margin [dB]		-	-	-	-	-	-
10	2781.392	59.08 pk	11.4	-107	-36.52	-	-	-	-	-	-
				Margin [dB]		-	-	-	-	-	-

PK - Peak detector

Figure 8 30MHz-10GHz Antenna Port Spurious Emissions Plot TX Mode, BW-W.

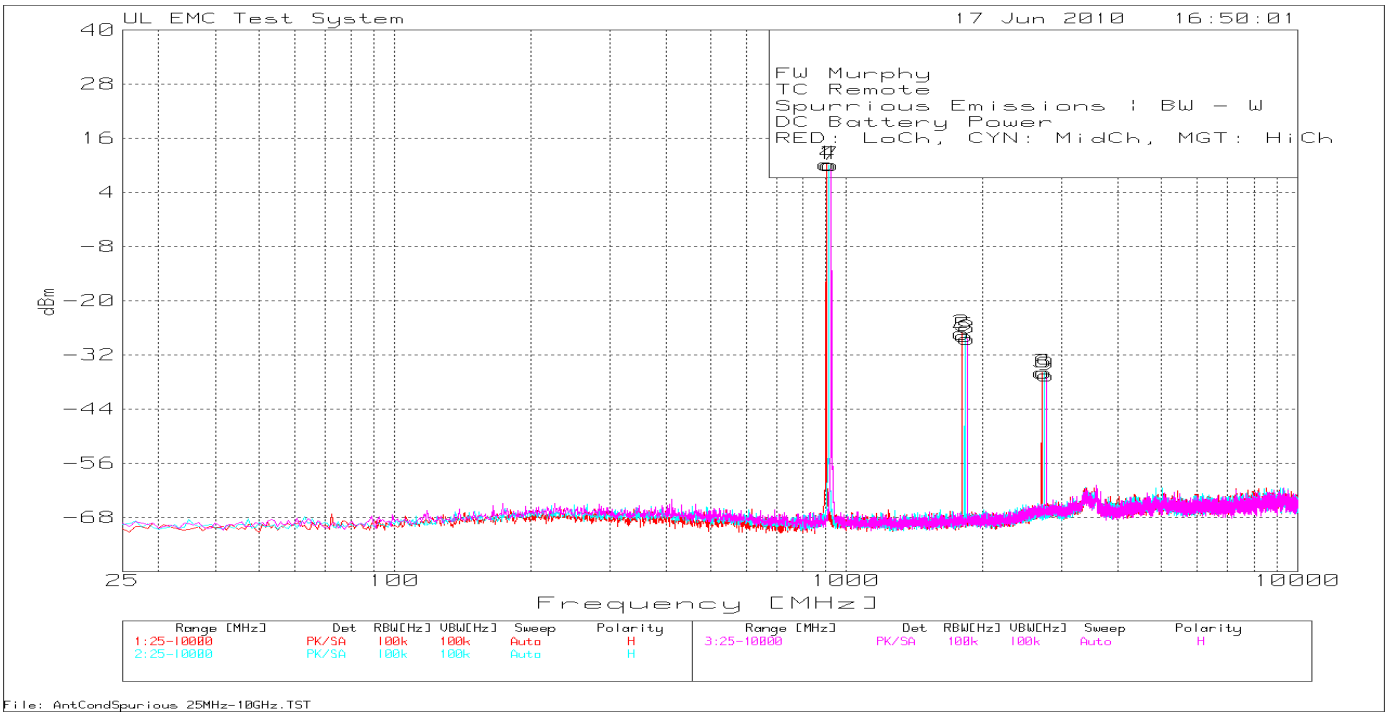


Table 25 Antenna Conducted Spurious Emissions 30MHz – 10GHz, BW-W

No.	Test Frequency [MHz]	Meter Reading [dB(uV)]	Gain/Loss Factor [dB]	Transducer Factor [dB]	Level dBm	Limit:1	2	3	4	5	6
LoCh 25 - 10000MHz											
1	902.8266	106.91 pk	10.3	-107	10.21	-	-	-	-	-	-
				Margin [dB]		-	-	-	-	-	-
2	1805.568	68.87 pk	10.9	-107	-27.23	-	-	-	-	-	-
				Margin [dB]		-	-	-	-	-	-
3	2709.14	59.78 pk	11.3	-107	-35.92	-	-	-	-	-	-
				Margin [dB]		-	-	-	-	-	-
MidCh 25 - 10000MHz											
4	914.8687	106.87 pk	10.3	-107	10.17	-	-	-	-	-	-
				Margin [dB]		-	-	-	-	-	-
5	1829.652	68.26 pk	11	-107	-27.74	-	-	-	-	-	-
				Margin [dB]		-	-	-	-	-	-
6	2744.02	59.85 pk	11.3	-107	-35.85	-	-	-	-	-	-
				Margin [dB]		-	-	-	-	-	-
HiCh 25 - 10000MHz											
7	926.9107	106.73 pk	10.3	-107	10.03	-	-	-	-	-	-
				Margin [dB]		-	-	-	-	-	-
8	1853.736	67.66 pk	11	-107	-28.34	-	-	-	-	-	-
				Margin [dB]		-	-	-	-	-	-
9	2780.562	59.05 pk	11.4	-107	-36.55	-	-	-	-	-	-
				Margin [dB]		-	-	-	-	-	-

PK - Peak detector

Figure 9 Radiated Spurious Emissions below 1GHz, Y Axis, Low Channel, BW-N

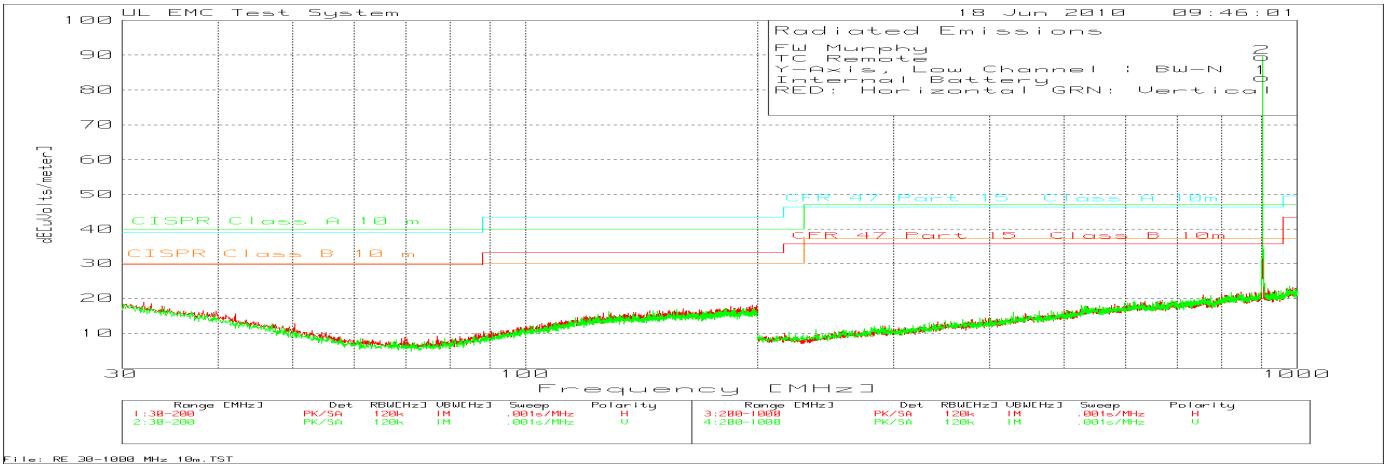


Figure 10 Radiated Spurious Emissions below 1GHz, Y Axis, Middle Channel, BW-N

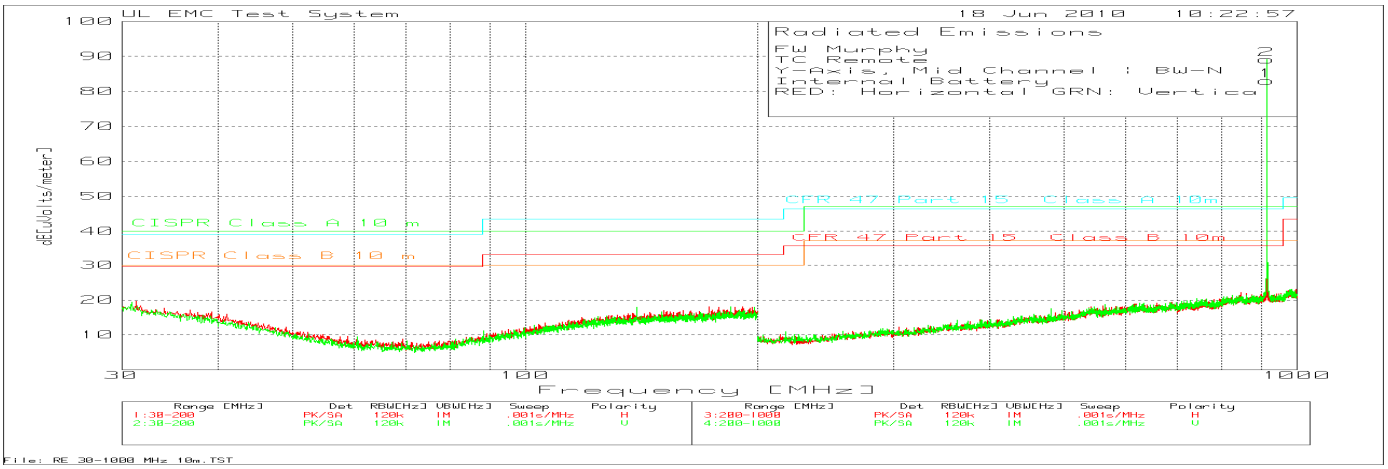
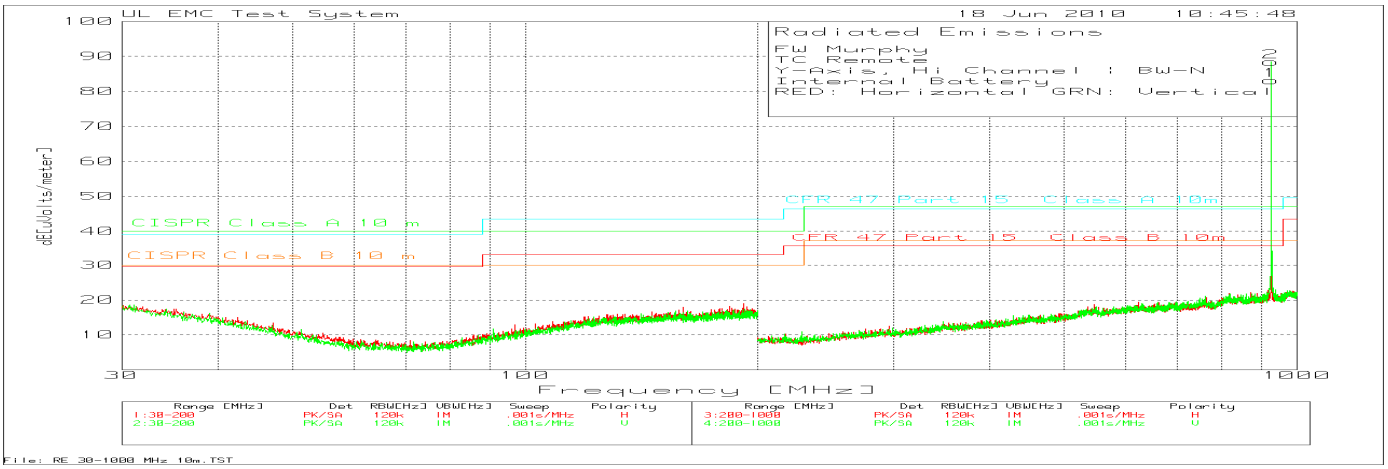
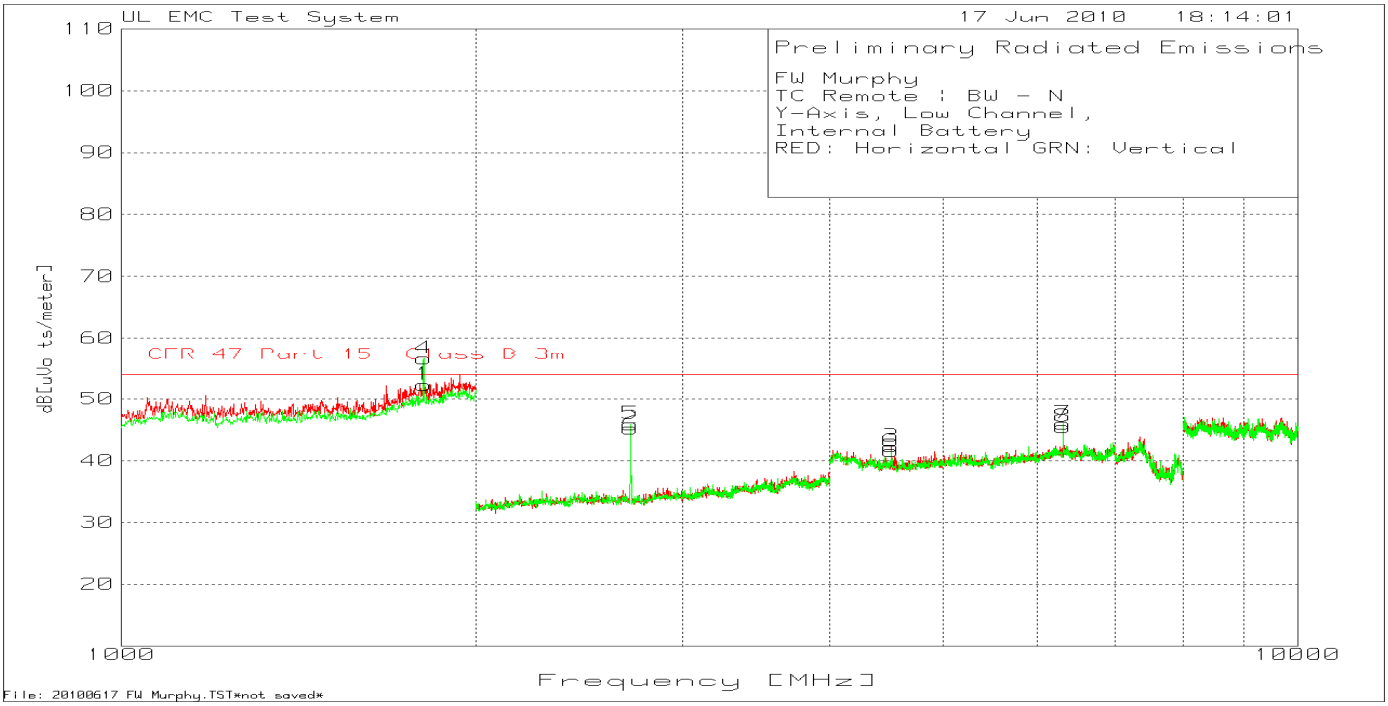


Figure 11 Radiated Spurious Emissions below 1GHz, Y Axis, High Channel, BW-N



No other emissions except the fundamental were recorded.

Figure 12 Radiated Spurious Emissions above 1GHz, Low Channel, Y-Axis, BW-N



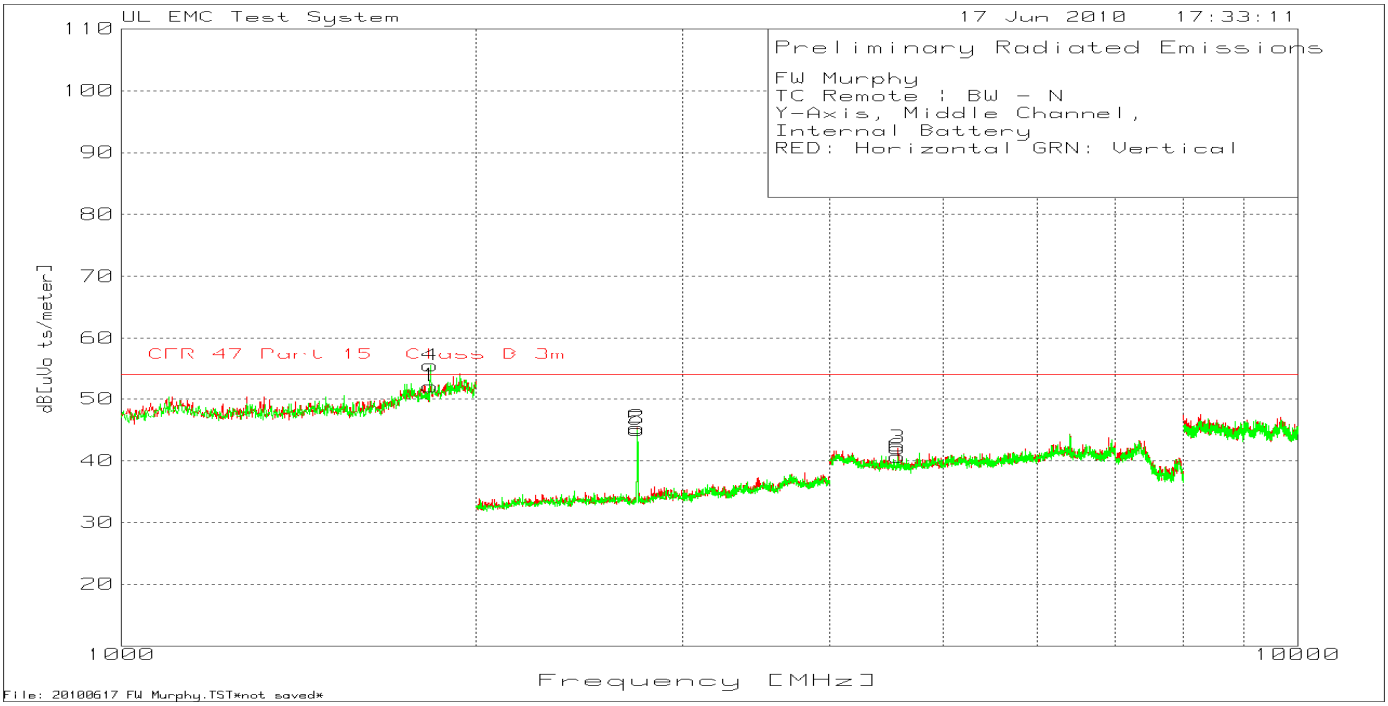
*The area between 1GHz-2GHz shows a noise floor close to the limit. It was verified that there are no emissions in this range other then the second harmonic (marked). The second harmonic is not in restricted band therefore radiated emissions limits do not apply.

Table 26 Radiated Spurious Emissions above 1GHz, Low Channel, Y-Axis, BW-N

No.	Test Frequency [MHz]	Meter Reading [dB(uV)]	Gain/Loss Factor [dB]	Transducer Factor [dB]	Level dB[uVolts/meter]	Limit:1	2	3	4	5	6
1	1807.615	21.7 pk	3.58	27	52.28	54	-	-	-	-	-
		Height:150 Horz		Margin [dB]		-1.72	-	-	-	-	-
2	2708.709	74.33 pk	-51.24	22.1	45.19	54	-	-	-	-	-
		Height:100 Horz		Margin [dB]		-8.81	-	-	-	-	-
3	4515.01	67 pk	-52.48	27.8	42.32	54	-	-	-	-	-
		Height:100 Horz		Margin [dB]		-11.68	-	-	-	-	-
8	6321.548	64.22 pk	-47.97	29.2	45.45	54	-	-	-	-	-
		Height:100 Horz		Margin [dB]		-8.55	-	-	-	-	-
4	1807.615	26.01 pk	3.58	27	56.59	54	-	-	-	-	-
		Height:150 Vert		Margin [dB]		2.59	-	-	-	-	-
5	2708.709	75.03 pk	-51.24	22.1	45.89	54	-	-	-	-	-
		Height:150 Vert		Margin [dB]		-8.11	-	-	-	-	-
6	4515.01	66.21 pk	-52.48	27.8	41.53	54	-	-	-	-	-
		Height:200 Vert		Margin [dB]		-12.47	-	-	-	-	-
7	6321.548	64.84 pk	-47.97	29.2	46.07	54	-	-	-	-	-
		Height:100 Vert		Margin [dB]		-7.93	-	-	-	-	-

LIMIT 1: CFR 47 Part 15 Class B 3m

Figure 13 Radiated Spurious Emissions above 1GHz, Middle Channel, Y-Axis, BW-N



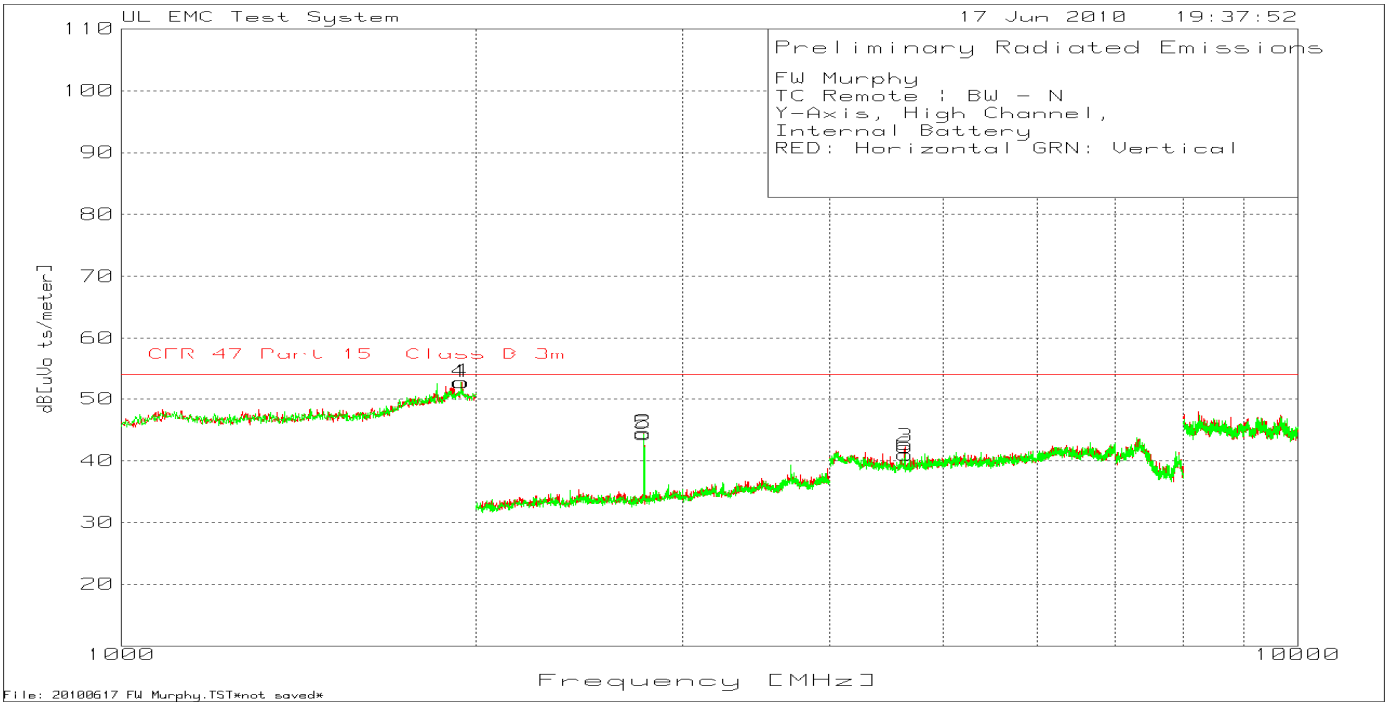
*The area between 1GHz-2GHz shows a noise floor close to the limit. It was verified that there are no emissions in this range other then the second harmonic (marked). The second harmonic is not in restricted band therefore radiated emissions limits do not apply.

Table 27 Radiated Spurious Emissions above 1GHz, Middle Channel, Y-Axis, BW-N

No.	Test Frequency [MHz]	Meter Reading [dB(uV)]	Gain/Loss Factor [dB]	Transducer Factor [dB]	Level dB[uVolts/meter]	Limit:1	2	3	4	5	6
1	1831.663	21.27 pk	3.61	27.2	52.08	54	-	-	-	-	-
		Height:150 Horz		Margin [dB]		-1.92	-	-	-	-	-
2	2744.745	74.48 pk	-51.2	22.1	45.38	54	-	-	-	-	-
		Height:200 Horz		Margin [dB]		-8.62	-	-	-	-	-
3	4573.716	66.85 pk	-52.47	27.7	42.08	54	-	-	-	-	-
		Height:100 Horz		Margin [dB]		-11.92	-	-	-	-	-
4	1829.659	24.65 pk	3.58	27.2	55.43	54	-	-	-	-	-
		Height:149 Vert		Margin [dB]		1.43	-	-	-	-	-
5	2744.745	74.14 pk	-51.2	22.1	45.04	54	-	-	-	-	-
		Height:200 Vert		Margin [dB]		-8.96	-	-	-	-	-
6	4573.716	65.42 pk	-52.47	27.7	40.65	54	-	-	-	-	-
		Height:100 Vert		Margin [dB]		-13.35	-	-	-	-	-

LIMIT 1: CFR 47 Part 15 Class B 3m

Figure 14 Radiated Spurious Emissions above 1GHz, High Channel, Y-Axis, BW-N



*The area between 1GHz-2GHz shows a noise floor close to the limit. It was verified that there are no emissions in this range other then the second harmonic (marked). The second harmonic is not in restricted band therefore radiated emissions limits do not apply.

Table 28 Radiated Spurious Emissions above 1GHz, High Channel, Y-Axis, BW-N

No.	Test Frequency [MHz]	Meter Reading [dB(uV)]	Gain/Loss Factor [dB]	Transducer Factor [dB]	Level dB[uVolts/meter]	Limit:1	2	3	4	5	6
1	1947.896	21.13 pk	3.86	27.7	52.69	54	-	-	-	-	-
		Height:100 Horz		Margin [dB]		-1.31	-	-	-	-	-
2	2780.781	73.41 pk	-51.03	22.2	44.58	54	-	-	-	-	-
		Height:200 Horz		Margin [dB]		-9.42	-	-	-	-	-
3	4635.09	66.91 pk	-52.34	27.7	42.27	54	-	-	-	-	-
		Height:200 Horz		Margin [dB]		-11.73	-	-	-	-	-
4	1943.888	21.26 pk	3.8	27.7	52.76	54	-	-	-	-	-
		Height:149 Vert		Margin [dB]		-1.24	-	-	-	-	-
5	2780.781	73.19 pk	-51.03	22.2	44.36	54	-	-	-	-	-
		Height:200 Vert		Margin [dB]		-9.64	-	-	-	-	-
6	4635.09	65.6 pk	-52.34	27.7	40.96	54	-	-	-	-	-
		Height:100 Vert		Margin [dB]		-13.04	-	-	-	-	-

LIMIT 1: CFR 47 Part 15 Class B 3m

Figure 15 Radiated Spurious Emissions below 1GHz, X Axis, Low Channel, BW-W

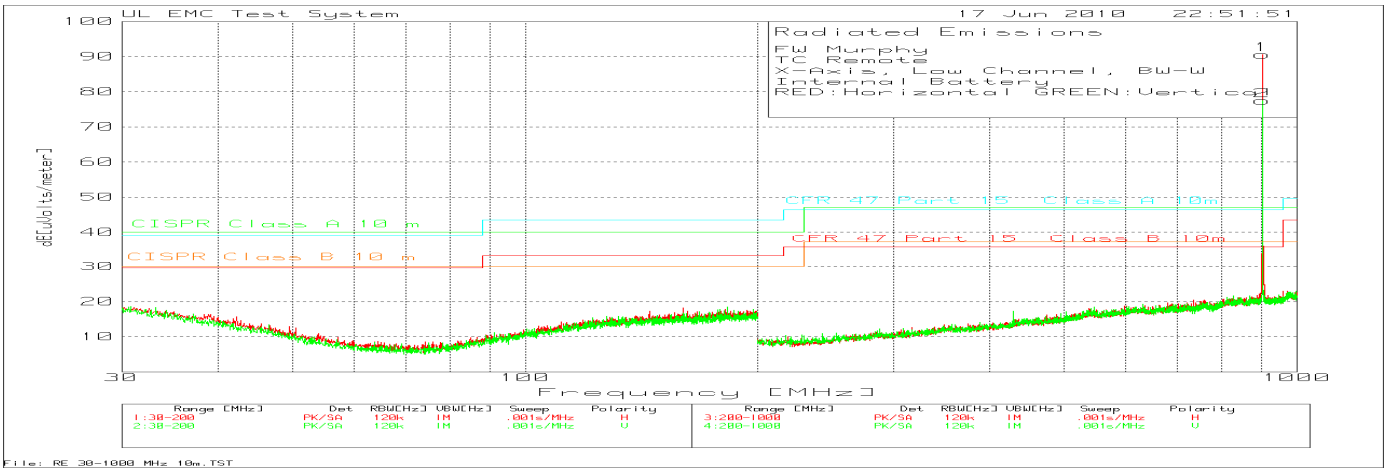


Figure 16 Radiated Spurious Emissions below 1GHz, X Axis, Middle Channel, BW-W

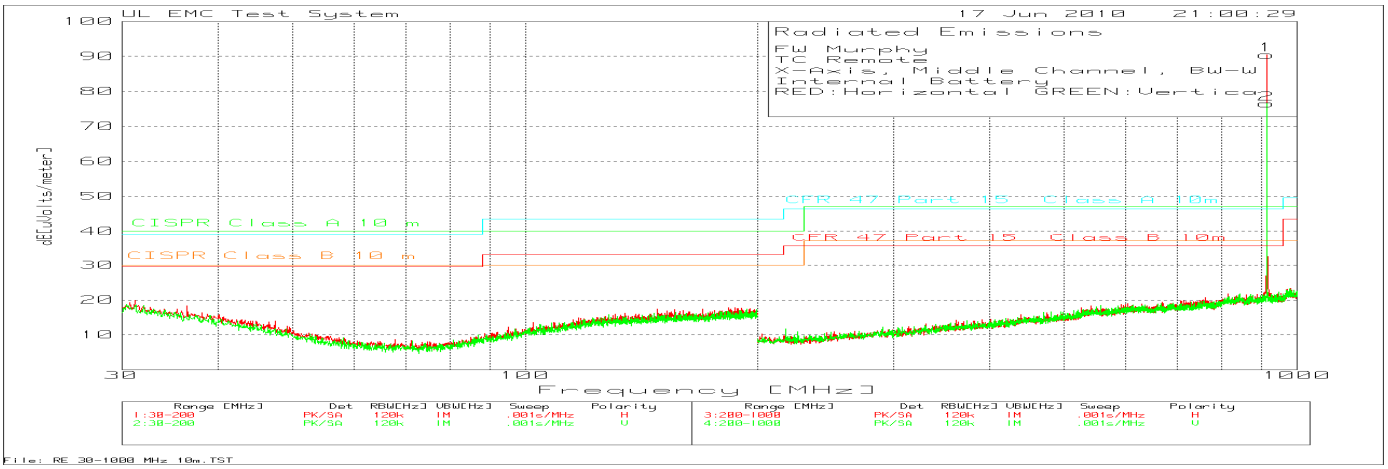
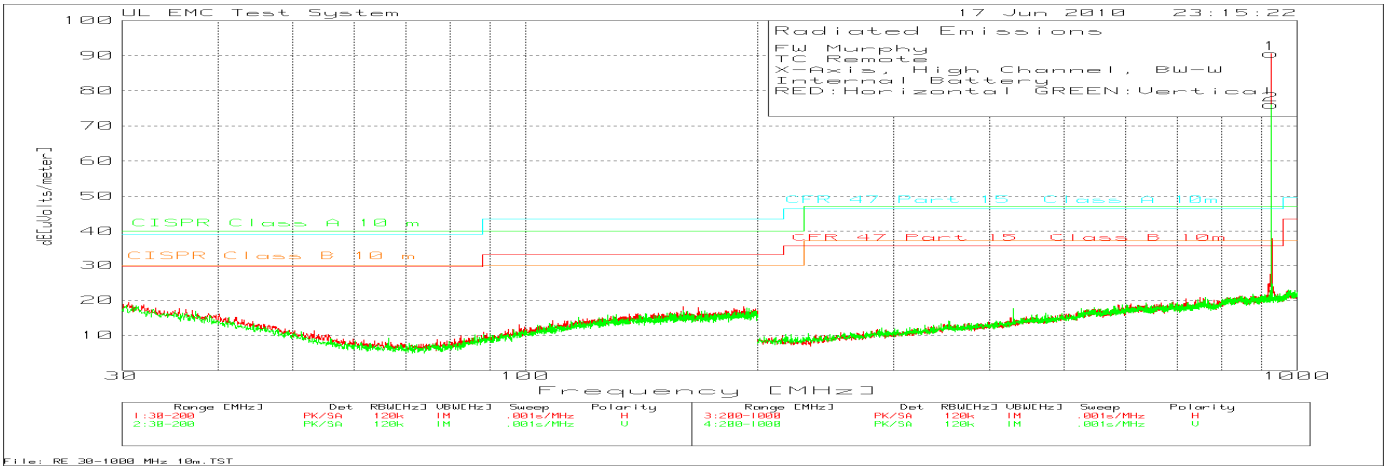


Figure 17 Radiated Spurious Emissions below 1GHz, X Axis, High Channel, BW-W



No other emissions except the fundamental were recorded.

Figure 18 Radiated Spurious Emissions below 1GHz, Y Axis, Low Channel, BW-W

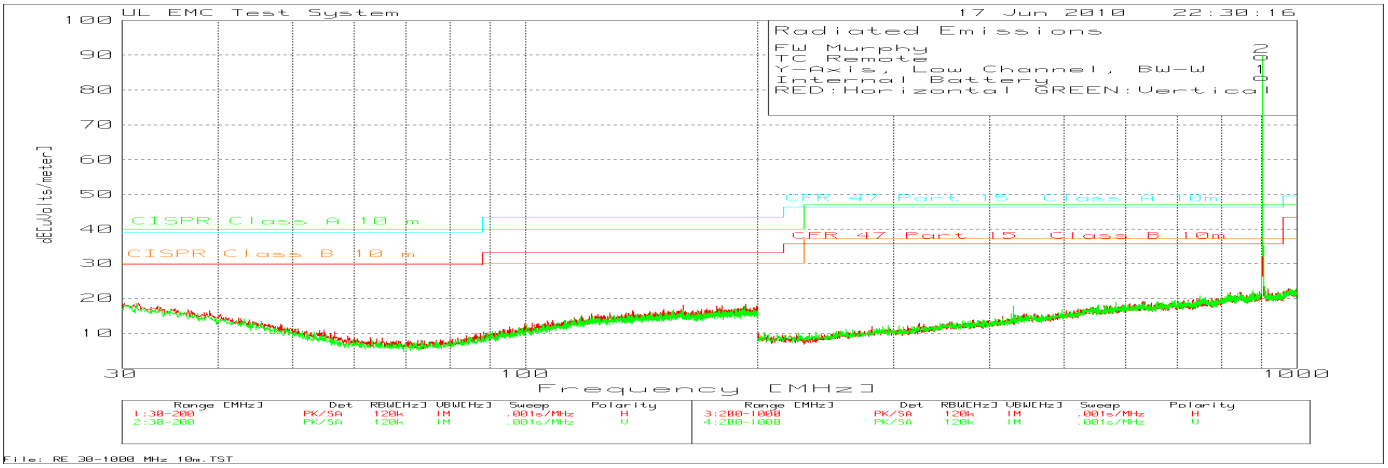


Figure 19 Radiated Spurious Emissions below 1GHz, Y Axis, Middle Channel, BW-W

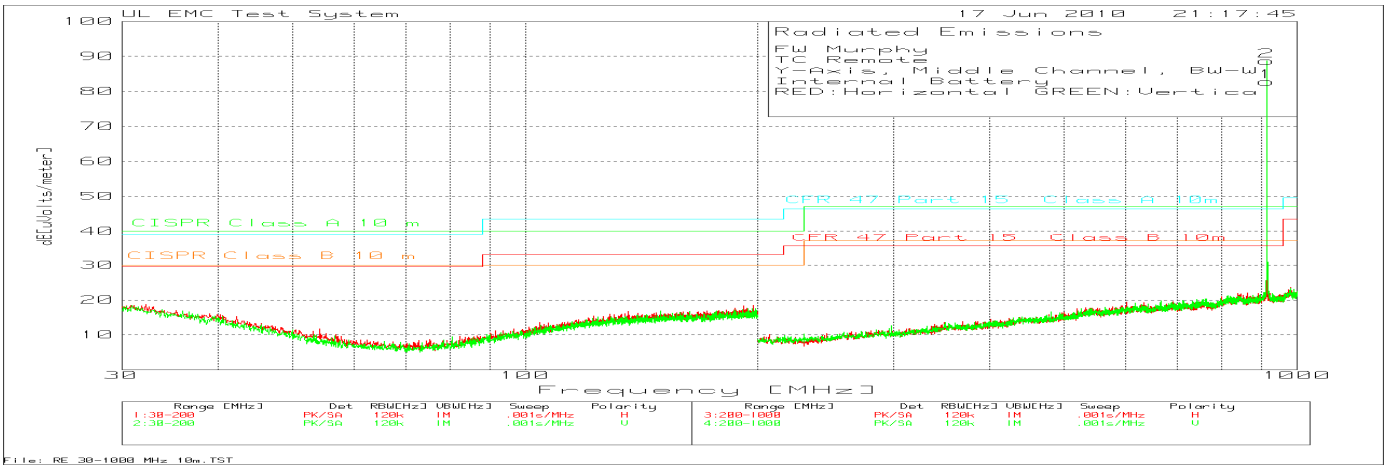
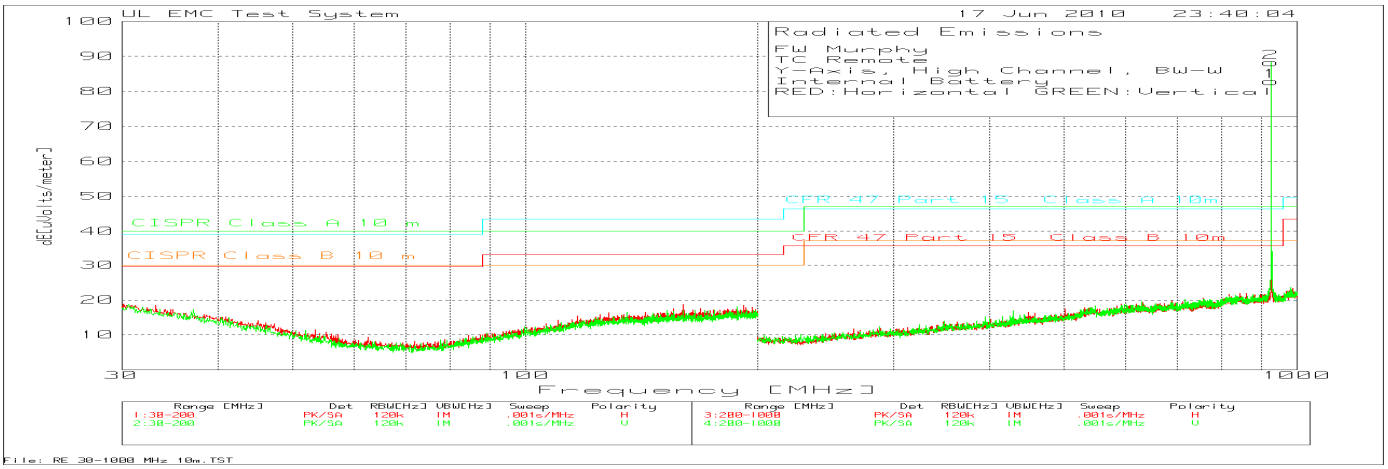


Figure 20 Radiated Spurious Emissions below 1GHz, Y Axis, High Channel, BW-W



No other emissions except the fundamental were recorded.

Figure 21 Radiated Spurious Emissions below 1GHz, Z Axis, Low Channel, BW-W

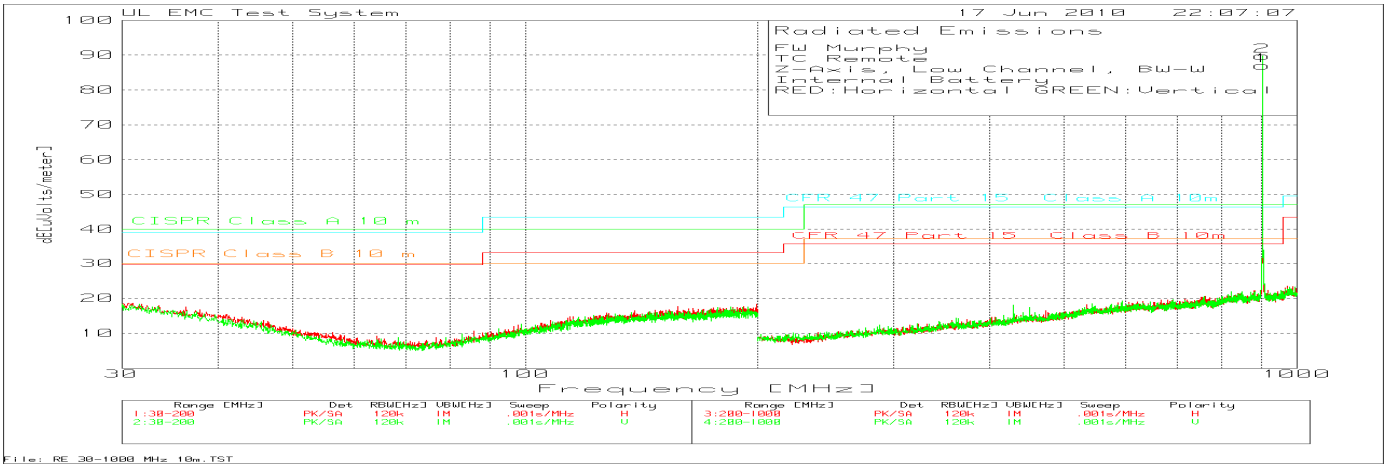


Figure 22 Radiated Spurious Emissions below 1GHz, Z Axis, Middle Channel, BW-W

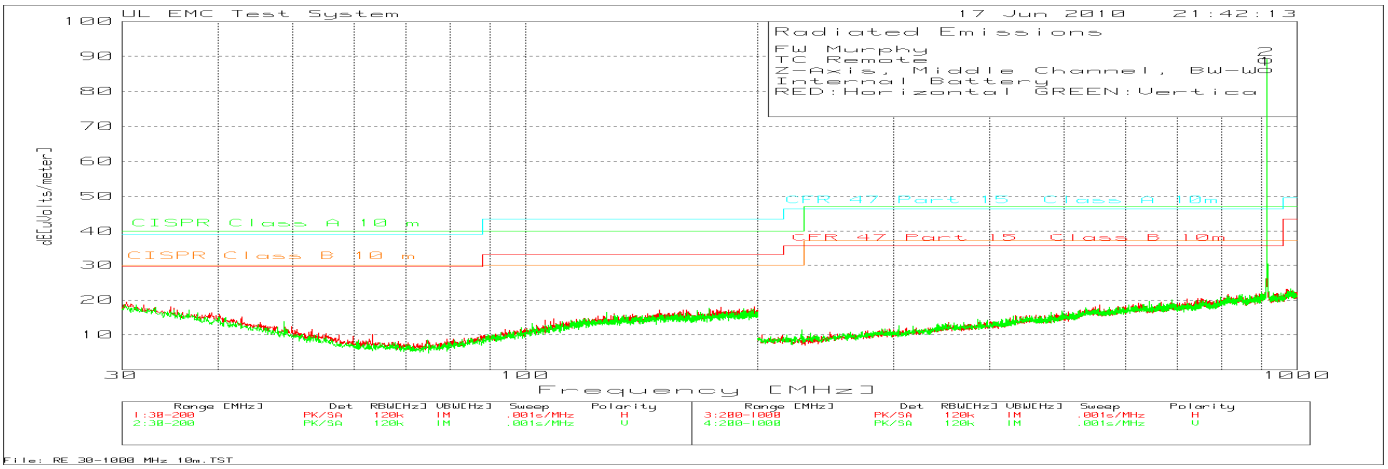
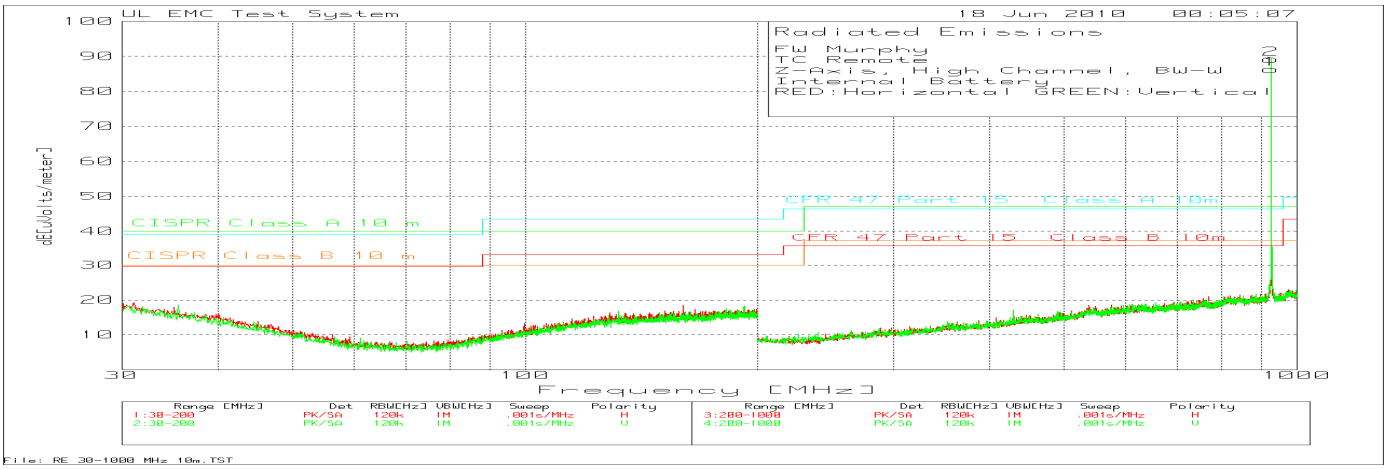
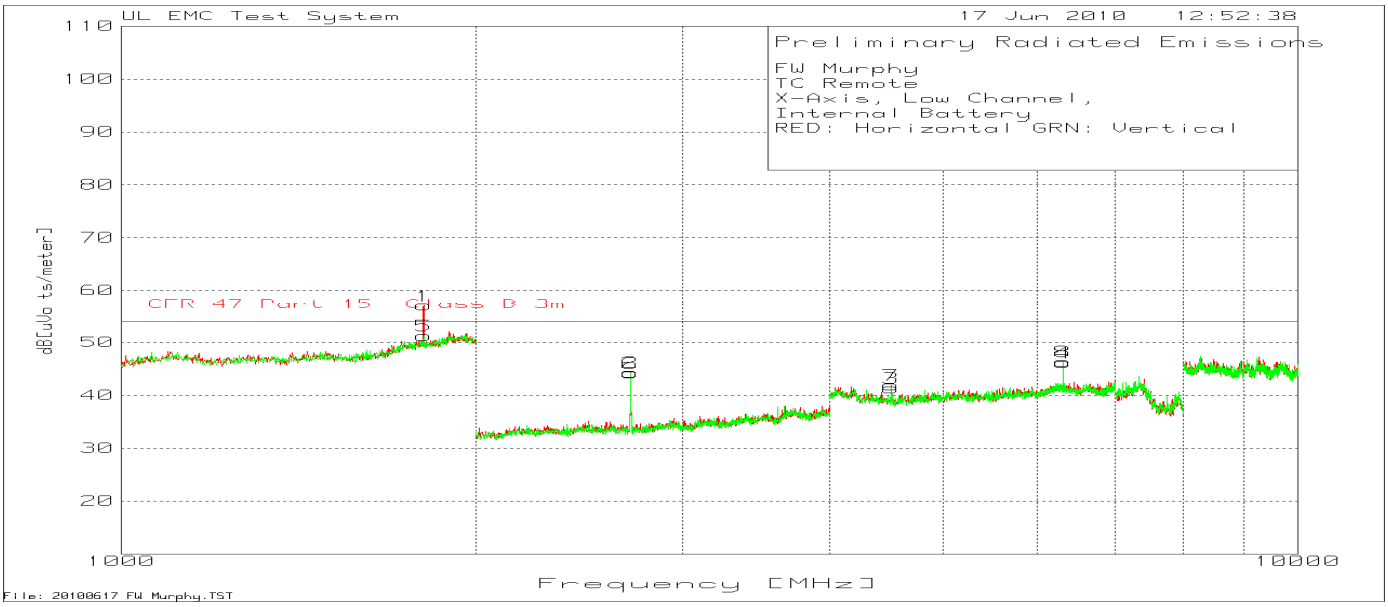


Figure 23 Radiated Spurious Emissions below 1GHz, Z Axis, High Channel, BW-W



No other emissions except the fundamental were recorded.

Figure 24 Radiated Spurious Emissions above 1GHz, Low Channel, X-Axis, BW-W



The second harmonic is not in restricted band therefore radiated emissions limits do not apply.

Table 29 Radiated Spurious Emissions above 1GHz, Low Channel, X-Axis, BW-W

FW Murphy
TC Remote
X-Axis, Low Channel,
Internal Battery
RED: Horizontal GRN: Vertical

No.	Test Frequency [MHz]	Meter Reading [dB(uV)]	Gain/Loss Factor [dB]	Transducer Factor [dB]	Level dB[uVolts/meter]	Limit:1	2	3	4	5	6
1	1807.615	26.49 pk	3.58	27	57.07	54	-	-	-	-	-
		Height:150 Horz		Margin [dB]		3.07	-	-	-	-	-
2	2708.709	73.49 pk	-51.24	22.1	44.35	54	-	-	-	-	-
		Height:200 Horz		Margin [dB]		-9.65	-	-	-	-	-
3	4515.01	66.03 pk	-52.48	27.8	41.35	54	-	-	-	-	-
		Height:149 Horz		Margin [dB]		-12.65	-	-	-	-	-
4	6321.548	64.9 pk	-47.97	29.2	46.13	54	-	-	-	-	-
		Height:200 Horz		Margin [dB]		-7.87	-	-	-	-	-
5	1807.615	20.65 pk	3.58	27	51.23	54	-	-	-	-	-
		Height:100 Vert		Margin [dB]		-2.77	-	-	-	-	-
6	2708.709	73.31 pk	-51.24	22.1	44.17	54	-	-	-	-	-
		Height:200 Vert		Margin [dB]		-9.83	-	-	-	-	-
7	4512.342	66.66 pk	-52.5	27.8	41.96	54	-	-	-	-	-
		Height:149 Vert		Margin [dB]		-12.04	-	-	-	-	-
8	6321.548	65.16 pk	-47.97	29.2	46.39	54	-	-	-	-	-
		Height:200 Vert		Margin [dB]		-7.61	-	-	-	-	-

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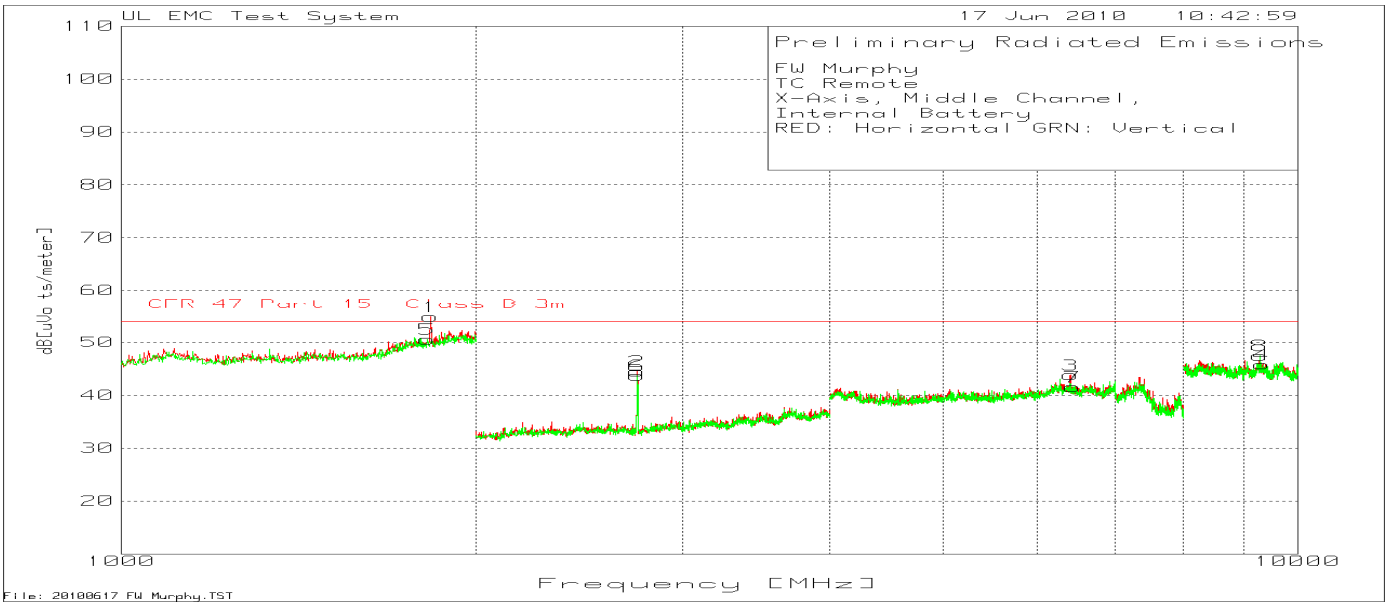
Figure 25 Radiated Spurious Emissions above 1GHz, Middle Channel, X-Axis, BW-W



The second harmonic is not in restricted band therefore radiated emissions limits do not apply.

Table 30 Radiated Spurious Emissions above 1GHz, Middle Channel, X-Axis, BW-W

FW Murphy
TC Remote
X-Axis, Middle Channel,
Internal Battery
RED: Horizontal GRN: Vertical

No.	Test Frequency [MHz]	Meter Reading [dB(uV)]	Gain/Loss Factor [dB]	Transducer Factor [dB]	Level dB[uVolts/meter]	Limit:1	2	3	4	5	6
1	1829.659	24.13 pk	3.58	27.2	54.91	54	-	-	-	-	-
		Height:150 Horz		Margin [dB]		.91	-	-	-	-	-
2	2744.745	73.69 pk	-51.2	22.1	44.59	54	-	-	-	-	-
		Height:200 Horz		Margin [dB]		-9.41	-	-	-	-	-
3	6406.938	62.62 pk	-48	29.2	43.82	54	-	-	-	-	-
		Height:100 Horz		Margin [dB]		-10.18	-	-	-	-	-
4	9327.327	59.41 pk	-49.96	36.4	45.85	54	-	-	-	-	-
		Height:200 Horz		Margin [dB]		-8.15	-	-	-	-	-
5	1819.639	19.96 pk	3.55	27.1	50.61	54	-	-	-	-	-
		Height:200 Vert		Margin [dB]		-3.39	-	-	-	-	-
6	2744.745	72.86 pk	-51.2	22.1	43.76	54	-	-	-	-	-
		Height:200 Vert		Margin [dB]		-10.24	-	-	-	-	-
7	6436.291	60.7 pk	-48.25	29.1	41.55	54	-	-	-	-	-
		Height:200 Vert		Margin [dB]		-12.45	-	-	-	-	-
8	9281.281	60.58 pk	-49.45	36.4	47.53	54	-	-	-	-	-
		Height:100 Vert		Margin [dB]		-6.47	-	-	-	-	-

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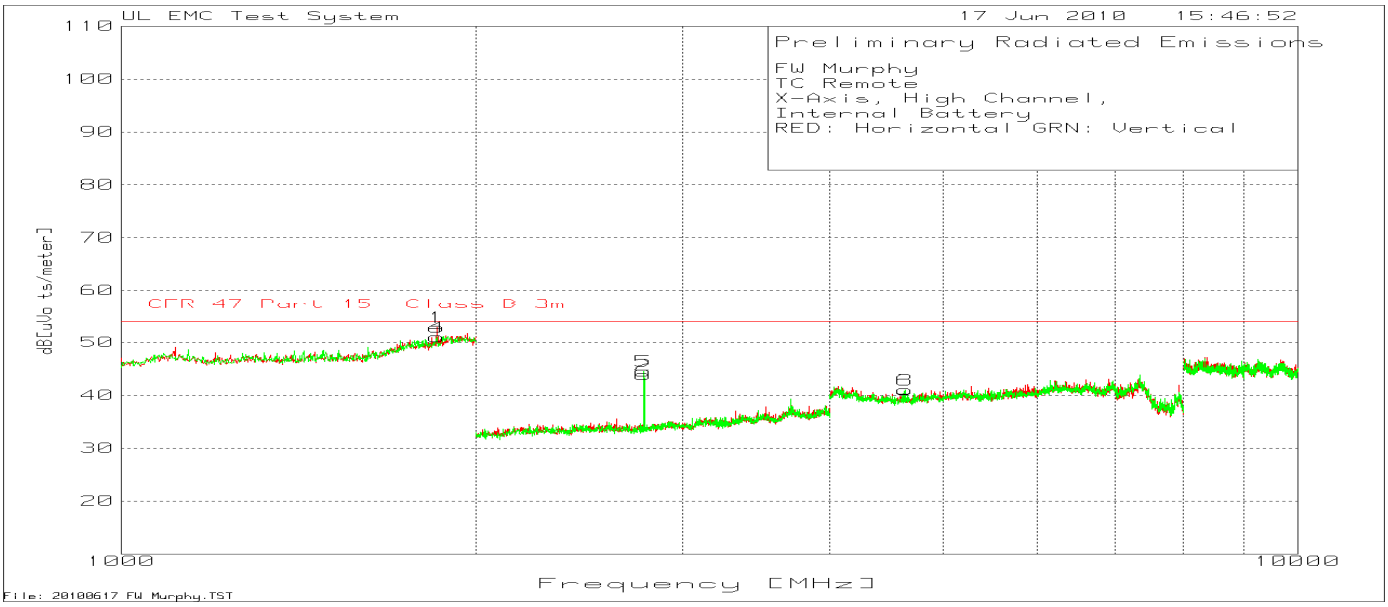
Figure 26 Radiated Spurious Emissions above 1GHz, High Channel, X-Axis, BW-W



The second harmonic is not in restricted band therefore radiated emissions limits do not apply.

Table 31 Radiated Spurious Emissions above 1GHz, High Channel, X-Axis, BW-W

FW Murphy
TC Remote
X-Axis, High Channel,
Internal Battery
RED: Horizontal GRN: Vertical

No.	Test Frequency [MHz]	Meter Reading [dB(uV)]	Gain/Loss Factor [dB]	Transducer Factor [dB]	Level dB[uVolts/meter]	Limit:1	2	3	4	5	6
1	1855.711	21.77 pk	3.72	27.4	52.89	54	-	-	-	-	-
		Height:149 Horz		Margin [dB]		-1.11	-	-	-	-	-
2	2780.781	72.72 pk	-51.03	22.2	43.89	54	-	-	-	-	-
		Height:200 Horz		Margin [dB]		-10.11	-	-	-	-	-
3	4635.09	65.71 pk	-52.34	27.7	41.07	54	-	-	-	-	-
		Height:199 Horz		Margin [dB]		-12.93	-	-	-	-	-
4	1853.707	19.85 pk	3.74	27.4	50.99	54	-	-	-	-	-
		Height:200 Vert		Margin [dB]		-3.01	-	-	-	-	-
5	2780.781	73.35 pk	-51.03	22.2	44.52	54	-	-	-	-	-
		Height:200 Vert		Margin [dB]		-9.48	-	-	-	-	-
6	4635.09	65.62 pk	-52.34	27.7	40.98	54	-	-	-	-	-
		Height:200 Vert		Margin [dB]		-13.02	-	-	-	-	-

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The second harmonic is not in restricted band therefore radiated emissions limits do not apply.

Figure 27 Radiated Spurious Emissions above 1GHz, Low Channel, Y-Axis, BW-W

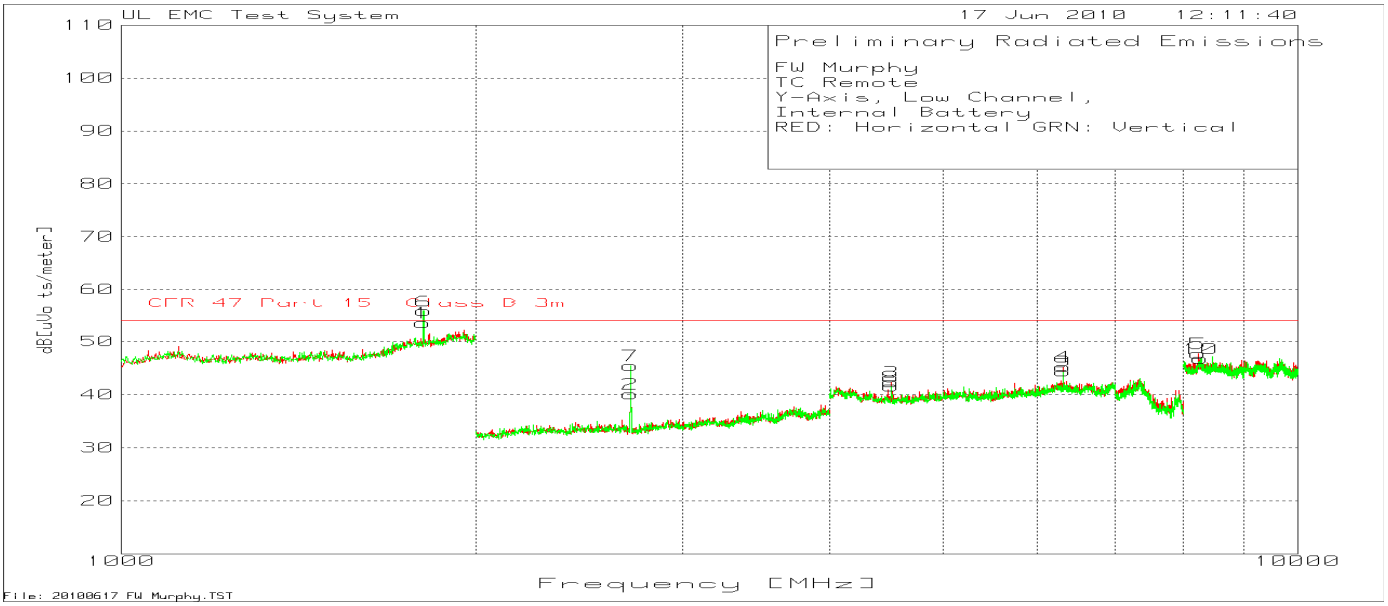
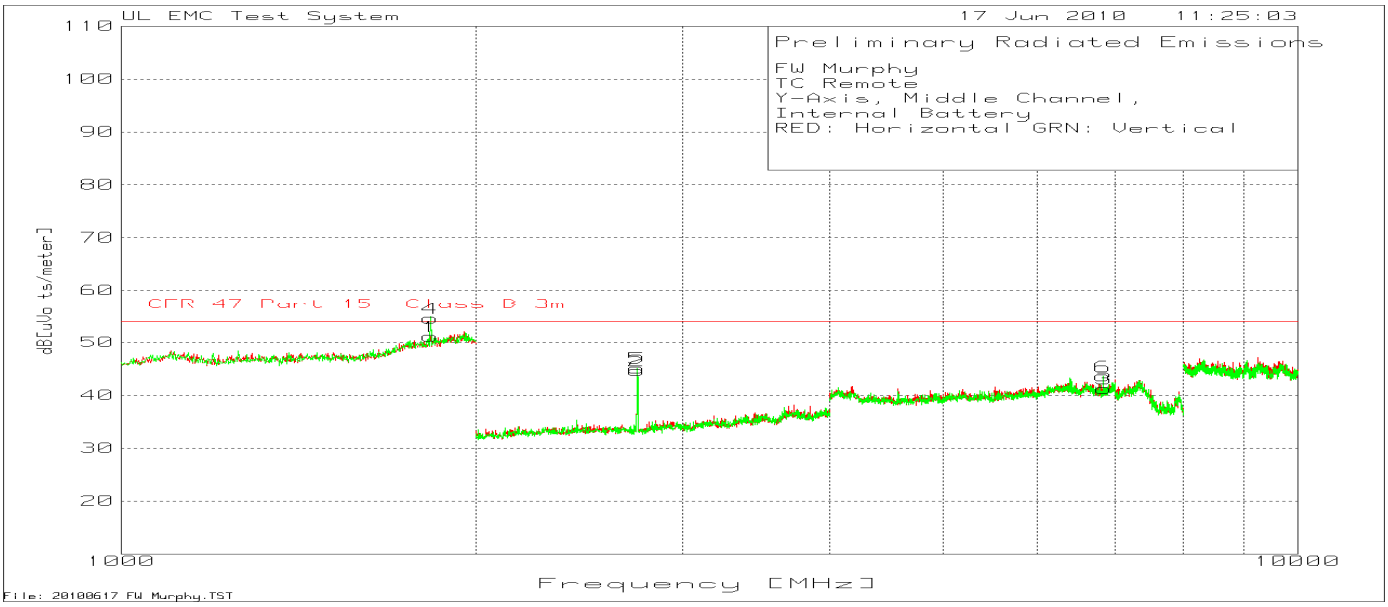


Table 32 Radiated Spurious Emissions above 1GHz, Low Channel, Y-Axis, BW-W

FW Murphy
TC Remote
Y-Axis, Low Channel,
Internal Battery
RED: Horizontal GRN: Vertical

No.	Test Frequency [MHz]	Meter Reading [dB(uV)]	Gain/Loss Factor [dB]	Transducer Factor [dB]	Level dB[uVolts/meter]	Limit:1	2	3	4	5	6
1	1805.611	22.93 pk	3.59	27	53.52	54	-	-	-	-	-
		Height:150 Horz	Margin [dB]			-.48	-	-	-	-	-
2	2706.707	69.22 pk	-51.23	22.1	40.09	54	-	-	-	-	-
		Height:200 Horz	Margin [dB]			-13.91	-	-	-	-	-
3	4515.01	67.04 pk	-52.48	27.8	42.36	54	-	-	-	-	-
		Height:100 Horz	Margin [dB]			-11.64	-	-	-	-	-
4	6321.548	64.02 pk	-47.97	29.2	45.25	54	-	-	-	-	-
		Height:149 Horz	Margin [dB]			-8.75	-	-	-	-	-
5	8240.24	59.97 pk	-48.62	36.4	47.75	54	-	-	-	-	-
		Height:150 Horz	Margin [dB]			-6.25	-	-	-	-	-
6	1806.613	25.26 pk	3.59	27	55.85	54	-	-	-	-	-
		Height:150 Vert	Margin [dB]			1.85	-	-	-	-	-
7	2708.709	74.63 pk	-51.24	22.1	45.49	54	-	-	-	-	-
		Height:200 Vert	Margin [dB]			-8.51	-	-	-	-	-
8	4515.01	66.21 pk	-52.48	27.8	41.53	54	-	-	-	-	-
		Height:100 Vert	Margin [dB]			-12.47	-	-	-	-	-
9	6321.548	63.14 pk	-47.97	29.2	44.37	54	-	-	-	-	-
		Height:100 Vert	Margin [dB]			-9.63	-	-	-	-	-
10	8262.262	58.9 pk	-48.52	36.4	46.78	54	-	-	-	-	-
		Height:100 Vert	Margin [dB]			-7.22	-	-	-	-	-

Figure 28 Radiated Spurious Emissions above 1GHz, Middle Channel, Y-Axis, BW-W



The second harmonic is not in restricted band therefore radiated emissions limits do not apply.

Table 33 Radiated Spurious Emissions above 1GHz, Middle Channel, Y-Axis, BW-W

FW Murphy
TC Remote
Y-Axis, Middle Channel,
Internal Battery
RED: Horizontal GRN: Vertical

No.	Test Frequency [MHz]	Meter Reading [dB(uV)]	Gain/Loss Factor [dB]	Transducer Factor [dB]	Level dB[uVolts/meter]	Limit:1	2	3	4	5	6
1	1831.663	20.29 pk	3.61	27.2	51.1	54	-	-	-	-	-
		Height:150 Horz		Margin [dB]		-2.9	-	-	-	-	-
2	2744.745	73.76 pk	-51.2	22.1	44.66	54	-	-	-	-	-
		Height:199 Horz		Margin [dB]		-9.34	-	-	-	-	-
3	6847.231	59.46 pk	-47.23	29	41.23	54	-	-	-	-	-
		Height:150 Horz		Margin [dB]		-12.77	-	-	-	-	-
4	1831.663	23.79 pk	3.61	27.2	54.6	54	-	-	-	-	-
		Height:150 Vert		Margin [dB]		.6	-	-	-	-	-
5	2744.745	74.21 pk	-51.2	22.1	45.11	54	-	-	-	-	-
		Height:200 Vert		Margin [dB]		-8.89	-	-	-	-	-
6	6836.558	61.84 pk	-47.26	29	43.58	54	-	-	-	-	-
		Height:100 Vert		Margin [dB]		-10.42	-	-	-	-	-

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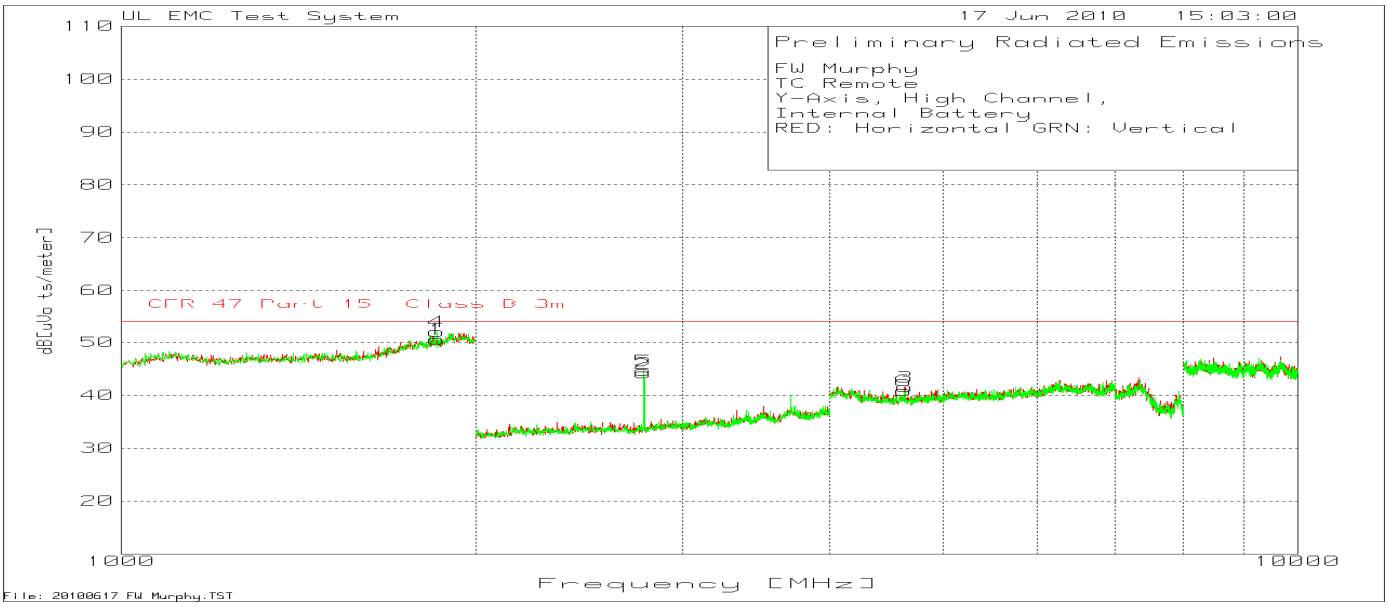
Figure 29 Radiated Spurious Emissions above 1GHz, High Channel, Y-Axis, BW-W



The second harmonic is not in restricted band therefore radiated emissions limits do not apply.

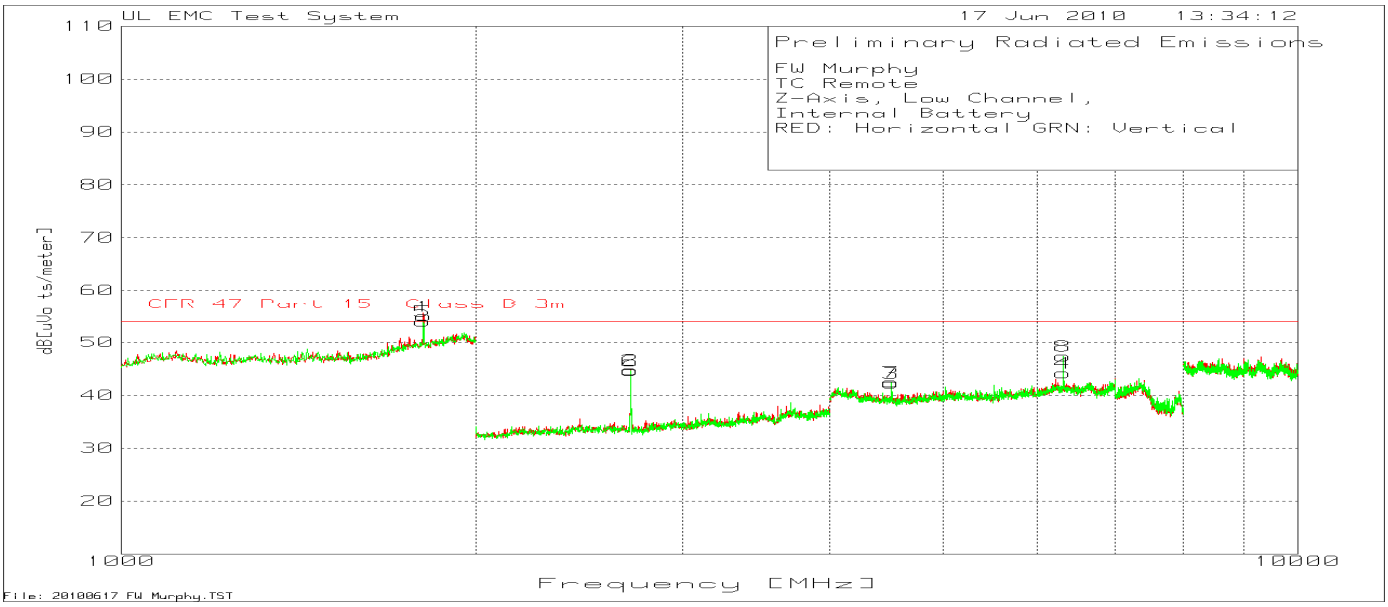
Table 34 Radiated Spurious Emissions above 1GHz, High Channel, Y-Axis, BW-W

FW Murphy
TC Remote
Y-Axis, High Channel,
Internal Battery
RED: Horizontal GRN: Vertical

No.	Test Frequency [MHz]	Meter Reading [dB(uV)]	Gain/Loss Factor [dB]	Transducer Factor [dB]	Level dB[uVolts/meter]	Limit:1	2	3	4	5	6
1	1855.711	19.49 pk	3.72	27.4	50.61	54	-	-	-	-	-
		Height:200 Horz		Margin [dB]		-3.39	-	-	-	-	-
2	2780.781	73.06 pk	-51.03	22.2	44.23	54	-	-	-	-	-
		Height:150 Horz		Margin [dB]		-9.77	-	-	-	-	-
3	4635.09	66.23 pk	-52.34	27.7	41.59	54	-	-	-	-	-
		Height:149 Horz		Margin [dB]		-12.41	-	-	-	-	-
4	1855.711	20.91 pk	3.72	27.4	52.03	54	-	-	-	-	-
		Height:150 Vert		Margin [dB]		-1.97	-	-	-	-	-
5	2780.781	73.5 pk	-51.03	22.2	44.67	54	-	-	-	-	-
		Height:200 Vert		Margin [dB]		-9.33	-	-	-	-	-
6	4632.422	65.49 pk	-52.32	27.7	40.87	54	-	-	-	-	-
		Height:150 Vert		Margin [dB]		-13.13	-	-	-	-	-

LIMIT 1: CFR 47 Part 15 Class B 3m

Figure 30 Radiated Spurious Emissions above 1GHz, Low Channel, Z-Axis, BW-W



The second harmonic is not in restricted band therefore radiated emissions limits do not apply.

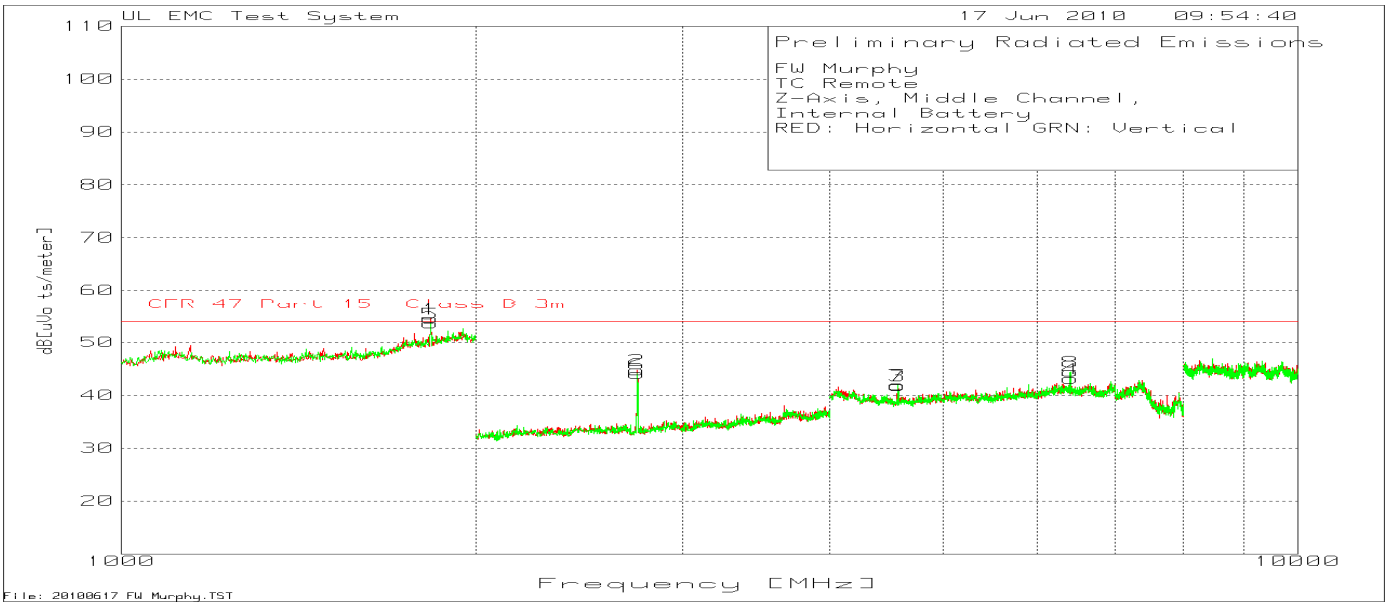
Table 35 Radiated Spurious Emissions above 1GHz, Low Channel, Z-Axis, BW-W

FW Murphy
TC Remote
Z-Axis, Low Channel,
Internal Battery
RED: Horizontal GRN: Vertical

No.	Test Frequency [MHz]	Meter Reading [dB(uV)]	Gain/Loss Factor [dB]	Transducer Factor [dB]	Level dB[uVolts/meter]	Limit:1	2	3	4	5	6
1	1807.615	24.47 pk	3.58	27	55.05	54	-	-	-	-	-
		Height:200 Horz		Margin [dB]		1.05	-	-	-	-	-
2	2708.709	73.9 pk	-51.24	22.1	44.76	54	-	-	-	-	-
		Height:200 Horz		Margin [dB]		-9.24	-	-	-	-	-
3	4515.01	66.95 pk	-52.48	27.8	42.27	54	-	-	-	-	-
		Height:200 Horz		Margin [dB]		-11.73	-	-	-	-	-
4	6321.548	62.98 pk	-47.97	29.2	44.21	54	-	-	-	-	-
		Height:200 Horz		Margin [dB]		-9.79	-	-	-	-	-
5	1805.611	23.43 pk	3.59	27	54.02	54	-	-	-	-	-
		Height:200 Vert		Margin [dB]		.02	-	-	-	-	-
6	2708.709	73.84 pk	-51.24	22.1	44.7	54	-	-	-	-	-
		Height:200 Vert		Margin [dB]		-9.3	-	-	-	-	-
7	4515.01	67.16 pk	-52.48	27.8	42.48	54	-	-	-	-	-
		Height:100 Vert		Margin [dB]		-11.52	-	-	-	-	-
8	6318.879	66.23 pk	-48.01	29.2	47.42	54	-	-	-	-	-
		Height:200 Vert		Margin [dB]		-6.58	-	-	-	-	-

LIMIT 1: CFR 47 Part 15 Class B 3m

Figure 31 Radiated Spurious Emissions above 1GHz, Middle Channel, Z-Axis, BW-W



The second harmonic is not in restricted band therefore radiated emissions limits do not apply.

Table 36 Radiated Spurious Emissions above 1GHz, Middle Channel, Z-Axis, BW-W

FW Murphy
TC Remote
Z-Axis, Middle Channel,
Internal Battery
RED: Horizontal GRN: Vertical

No.	Test Frequency [MHz]	Meter Reading [dB(uV)]	Gain/Loss Factor [dB]	Transducer Factor [dB]	Level dB[uVolts/meter]	Limit:1	2	3	4	5	6
1	1831.663	23.69 pk	3.61	27.2	54.5	54	-	-	-	-	-
		Height:150 Horz		Margin [dB]		.5	-	-	-	-	-
2	2744.745	73.85 pk	-51.2	22.1	44.75	54	-	-	-	-	-
		Height:100 Horz		Margin [dB]		-9.25	-	-	-	-	-
3	4573.716	66.59 pk	-52.47	27.7	41.82	54	-	-	-	-	-
		Height:100 Horz		Margin [dB]		-12.18	-	-	-	-	-
4	6406.938	61.93 pk	-48	29.2	43.13	54	-	-	-	-	-
		Height:100 Horz		Margin [dB]		-10.87	-	-	-	-	-
5	1831.663	22.78 pk	3.61	27.2	53.59	54	-	-	-	-	-
		Height:100 Vert		Margin [dB]		-.41	-	-	-	-	-
6	2744.745	73.14 pk	-51.2	22.1	44.04	54	-	-	-	-	-
		Height:200 Vert		Margin [dB]		-9.96	-	-	-	-	-
7	4573.716	66.69 pk	-52.47	27.7	41.92	54	-	-	-	-	-
		Height:100 Vert		Margin [dB]		-12.08	-	-	-	-	-
8	6406.938	63.28 pk	-48	29.2	44.48	54	-	-	-	-	-
		Height:200 Vert		Margin [dB]		-9.52	-	-	-	-	-

LIMIT 1: CFR 47 Part 15 Class B 3m

Figure 32 Radiated Spurious Emissions above 1GHz, High Channel, Z-Axis, BW-W

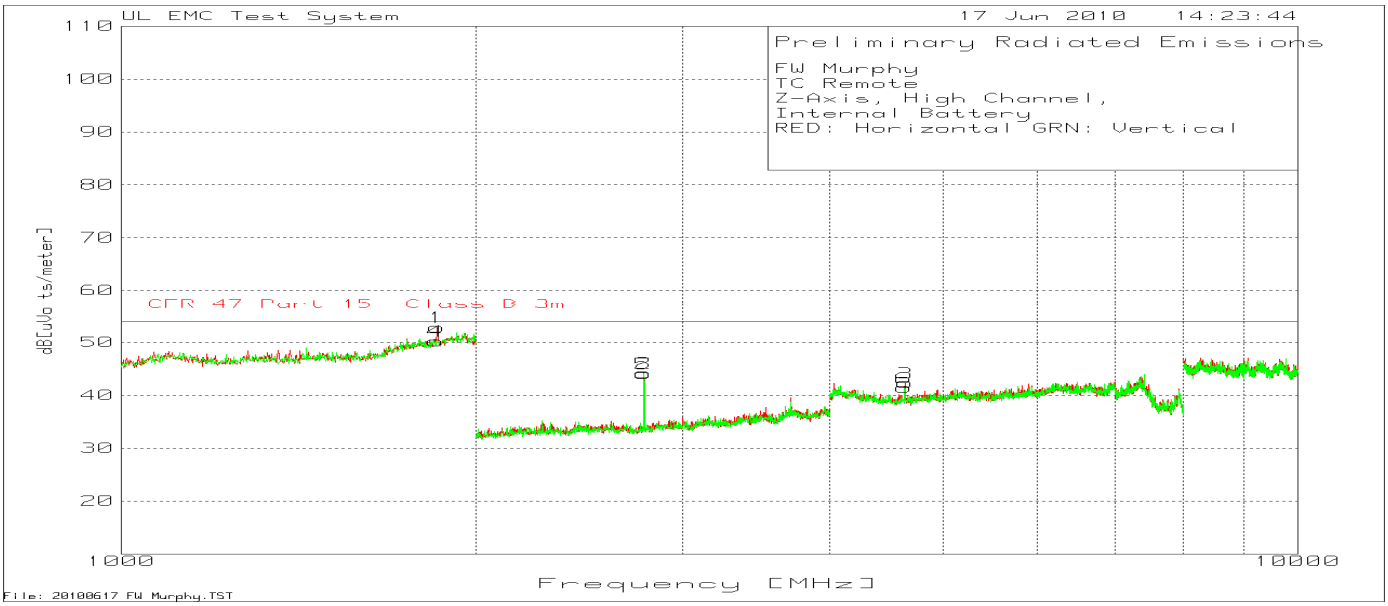


Table 37 Radiated Spurious Emissions above 1GHz, High Channel, Z-Axis, BW-W

FW Murphy
TC Remote
Z-Axis, High Channel,
Internal Battery
RED: Horizontal GRN: Vertical

No.	Test Frequency [MHz]	Meter Reading [dB(uV)]	Gain/Loss Factor [dB]	Transducer Factor [dB]	Level dB[uVolts/meter]	Limit:1	2	3	4	5	6
1	1855.711	21.72 pk	3.72	27.4	52.84	54	-	-	-	-	-
		Height:150 Horz		Margin [dB]		-1.16	-	-	-	-	-
2	2780.781	73.03 pk	-51.03	22.2	44.2	54	-	-	-	-	-
		Height:150 Horz		Margin [dB]		-9.8	-	-	-	-	-
3	4635.09	66.97 pk	-52.34	27.7	42.33	54	-	-	-	-	-
		Height:100 Horz		Margin [dB]		-11.67	-	-	-	-	-
4	1851.703	19.1 pk	3.76	27.4	50.26	54	-	-	-	-	-
		Height:200 Vert		Margin [dB]		-3.74	-	-	-	-	-
5	2780.781	72.91 pk	-51.03	22.2	44.08	54	-	-	-	-	-
		Height:200 Vert		Margin [dB]		-9.92	-	-	-	-	-
6	4632.422	66.04 pk	-52.32	27.7	41.42	54	-	-	-	-	-
		Height:200 Vert		Margin [dB]		-12.58	-	-	-	-	-

LIMIT 1: CFR 47 Part 15 Class B 3m

5.7 Test Conditions and Results – BAND EDGE COMPLIANCE

Test Description	In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section15.205(c)).

Basic Standard	47 CFR Part 15.247(d) RSS-210, A8.5	
	Frequency range	Measurement Point
Fully configured sample scanned over the following frequency range	902MHz – 928MHz	Antenna Conducted

Limits	
Measurement Type	
Conducted	Antenna Conducted – 20dB below the fundamental
Radiated	Radiated only required if emissions are in the restricted band
Supplementary information: Only Antenna Conducted Measurements required. No restricted bands close to the allocated frequency band.	

Table 38 Band Edge Compliance EUT Configuration Settings

Power Interface Mode #	EUT Configurations Mode #	EUT Operation Mode #
1	1	1 and 2
Supplementary information: None		

Table 39 Band Edge Compliance Test Equipment

Test Equipment Used			
Description	Manufacturer	Model	Identifier
Spectrum Analyzer / Receiver	R & S	ESU	EMC4323
DC Block	JFW	50DB-037	None
Attenuator	Mini-Circuit	8W-N10W5	none

Test setup for Band Edge Compliance – Conducted

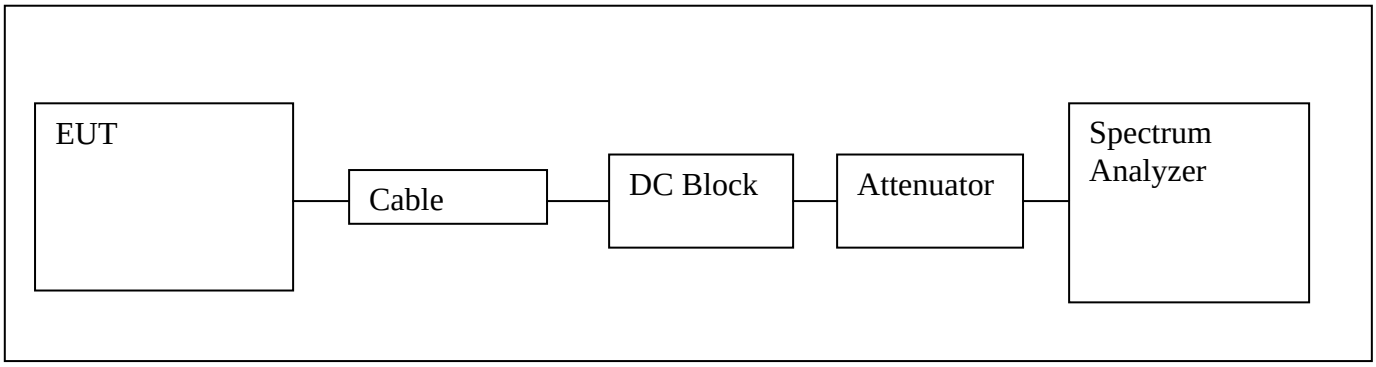


Figure 33 Conducted Band Edge Compliance Graph – Single Channel – BW-N

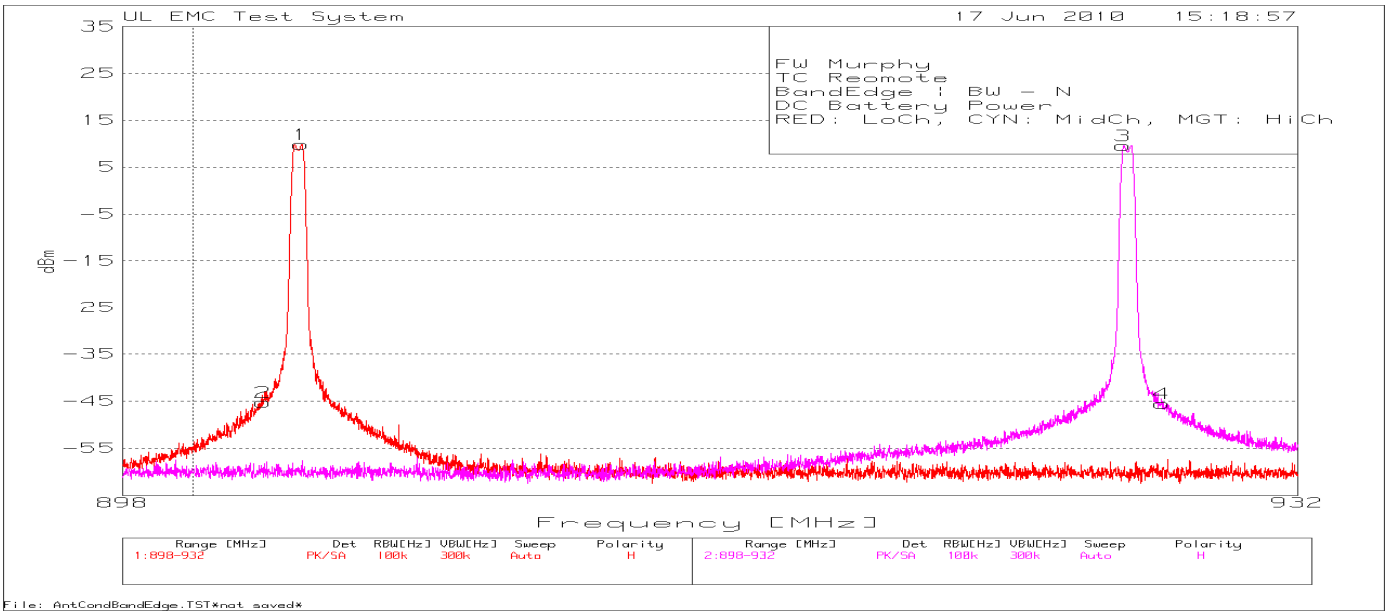


Table 40 Band Edge Compliance Data Points – Single Channel – BW-N

FW Murphy
TC Reomote
BandEdge | BW - N
DC Battery Power
RED: LoCh, CYN: MidCh, MGT: HiCh

No.	Test Frequency [MHz]	Meter Reading [dB(uV)]	Gain/Loss Factor [dB]	Transducer Factor [dB]	Level dBm	Limit:1	2	3	4	5	6
LoCh 898 - 932MHz ----------											
1	903.0919	106.49 pk	10.3	-107	9.79	-	-	-	-	-	-
				Margin [dB]		-	-	-	-	-	-
2	902.009	51.48 pk	10.3	-107	-45.22	-	-	-	-	-	-
				Margin [dB]		-	-	-	-	-	-
HiCh 898 - 932MHz ----------											
3	926.8868	106.31 pk	10.3	-107	9.61	-	-	-	-	-	-
				Margin [dB]		-	-	-	-	-	-
4	928.008	51.18 pk	10.3	-107	-45.52	-	-	-	-	-	-
				Margin [dB]		-	-	-	-	-	-

PK - Peak detector

Figure 34 Conducted Band Edge Compliance Graph – Hopping – BW-N

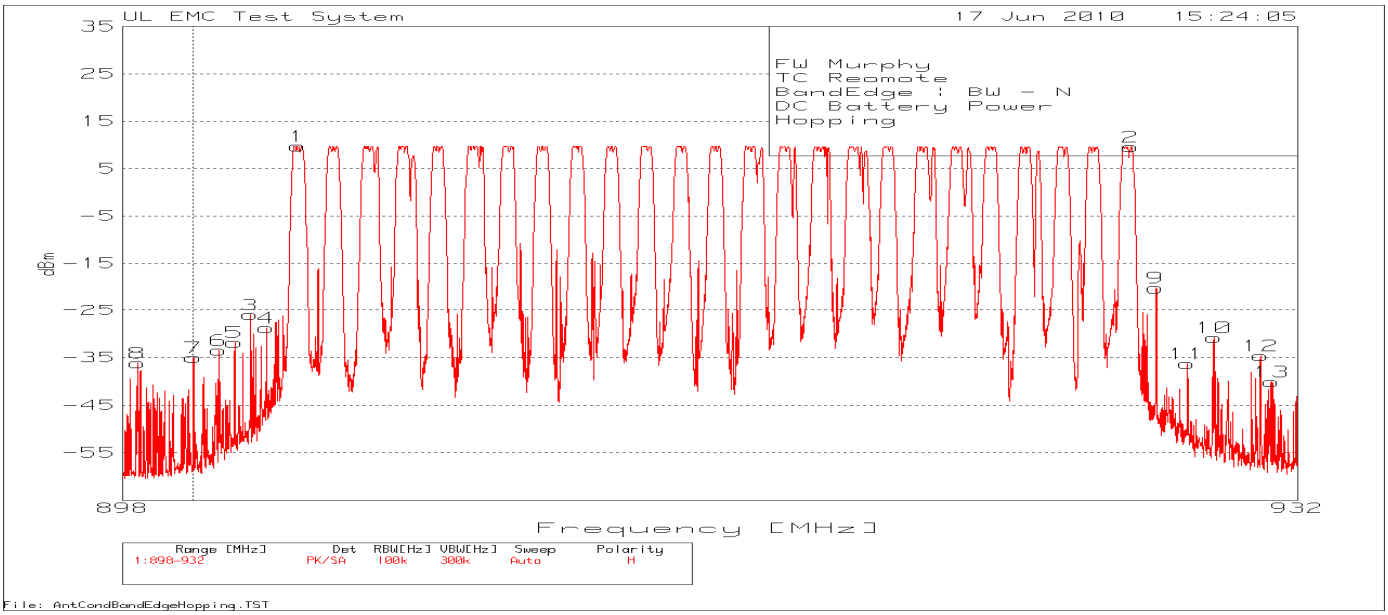


Table 41 Band Edge Compliance Data Points – Hopping – BW-N

No.	Test Frequency [MHz]	Meter Reading [dB(uV)]	Gain/Loss Factor [dB]	Transducer Factor [dB]	Level dBm	Limit:1	2	3	4	5	6
1	902.99	106.43 pk	10.3	-107	9.73	-	-	-	-	-	-
				Margin [dB]		-	-	-	-	-	-
2	927.1077	106.28 pk	10.3	-107	9.58	-	-	-	-	-	-
				Margin [dB]		-	-	-	-	-	-
3	901.6353	70.78 pk	10.3	-107	-25.92	-	-	-	-	-	-
				Margin [dB]		-	-	-	-	-	-
4	902.0854	67.97 pk	10.3	-107	-28.73	-	-	-	-	-	-
				Margin [dB]		-	-	-	-	-	-
5	901.1766	64.85 pk	10.3	-107	-31.85	-	-	-	-	-	-
				Margin [dB]		-	-	-	-	-	-
6	900.718	63.24 pk	10.3	-107	-33.46	-	-	-	-	-	-
				Margin [dB]		-	-	-	-	-	-
7	900.0045	61.66 pk	10.3	-107	-35.04	-	-	-	-	-	-
				Margin [dB]		-	-	-	-	-	-
8	898.4162	60.52 pk	10.3	-107	-36.18	-	-	-	-	-	-
				Margin [dB]		-	-	-	-	-	-
9	927.8381	76.51 pk	10.3	-107	-20.19	-	-	-	-	-	-
				Margin [dB]		-	-	-	-	-	-
10	929.5368	65.89 pk	10.3	-107	-30.81	-	-	-	-	-	-
				Margin [dB]		-	-	-	-	-	-
11	928.7639	60.46 pk	10.3	-107	-36.24	-	-	-	-	-	-
				Margin [dB]		-	-	-	-	-	-
12	930.9043	62.09 pk	10.3	-107	-34.61	-	-	-	-	-	-
				Margin [dB]		-	-	-	-	-	-
13	931.2441	56.57 pk	10.3	-107	-40.13	-	-	-	-	-	-
				Margin [dB]		-	-	-	-	-	-

PK - Peak detector

Figure 35 Conducted Band Edge Compliance Graph – Single Channel – BW-W

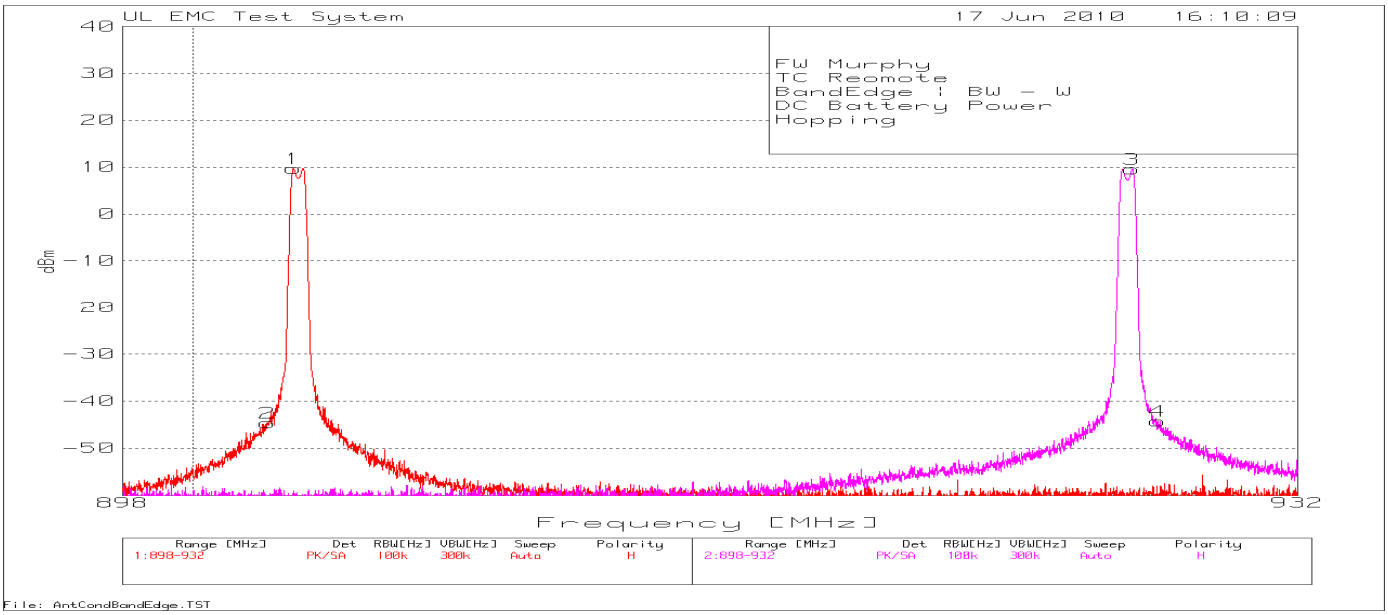


Table 42 Band Edge Compliance Data Points – Single Channel – BW-W

FW Murphy
TC Reomote
BandEdge | BW - W
DC Battery Power
Hopping

No.	Test Frequency [MHz]	Meter Reading [dB(uV)]	Gain/Loss Factor [dB]	Transducer Factor [dB]	Level dBm	Limit:1	2	3	4	5	6
LoCh 898 - 932MHz											
1	902.8541	106.41 pk	10.3	-107	9.71	-	-	-	-	-	-
				Margin [dB]		-	-	-	-	-	-
2	902.1194	52.07 pk	10.3	-107	-44.63	-	-	-	-	-	-
				Margin [dB]		-	-	-	-	-	-
HiCh 898 - 932MHz											
3	927.1416	106.26 pk	10.3	-107	9.56	-	-	-	-	-	-
				Margin [dB]		-	-	-	-	-	-
4	927.8891	52.42 pk	10.3	-107	-44.28	-	-	-	-	-	-
				Margin [dB]		-	-	-	-	-	-

PK - Peak detector

Figure 36 Conducted Band Edge Compliance Graph – Hopping – BW-W

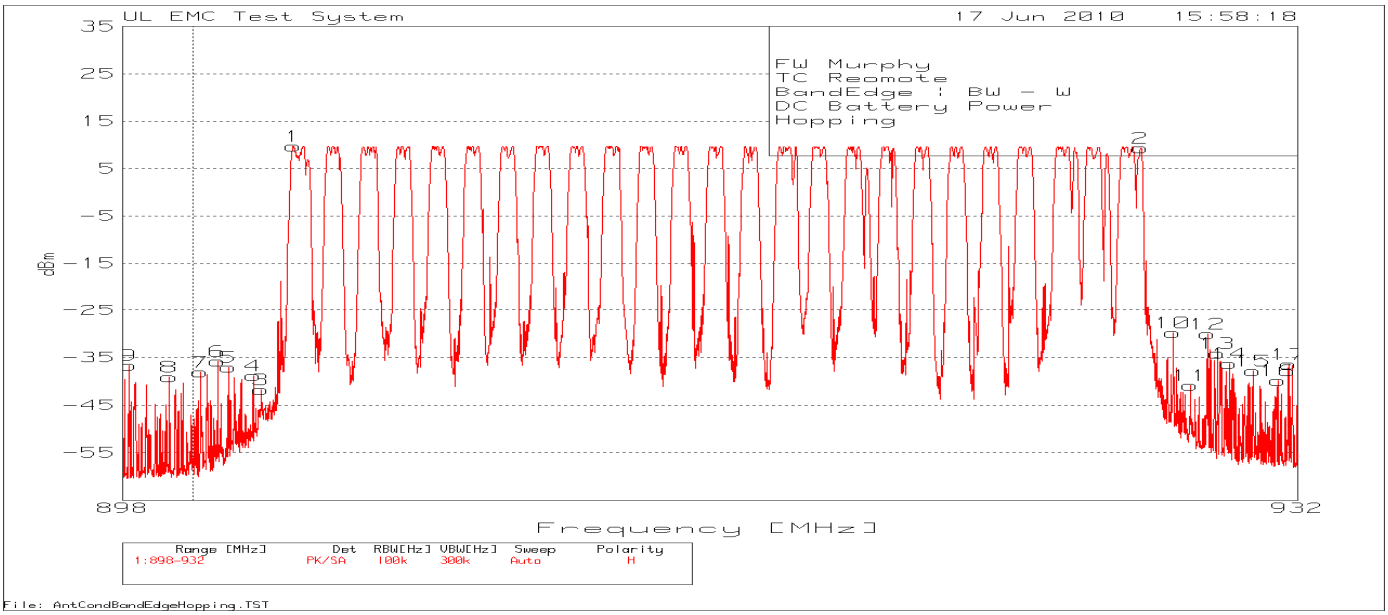


Table 43 Band Edge Compliance Data Points – Hopping – BW-W

FW Murphy
TC Reomote
BandEdge | BW - W
DC Battery Power
Hopping

No.	Test Frequency [MHz]	Meter Reading [dB(uV)]	Gain/Loss Factor [dB]	Transducer Factor [dB]	Level dBm	Limit:1	2	3	4	5	6
LoCh 898 - 932MHz											
1	902.8541	106.4 pk	10.3	-107	9.7	-	-	-	-	-	-
				Margin [dB]		-	-	-	-	-	-
2	927.388	106.07 pk	10.3	-107	9.37	-	-	-	-	-	-
				Margin [dB]		-	-	-	-	-	-
3	901.9326	54.93 pk	10.3	-107	-41.77	-	-	-	-	-	-
				Margin [dB]		-	-	-	-	-	-
4	901.7032	57.88 pk	10.3	-107	-38.82	-	-	-	-	-	-
				Margin [dB]		-	-	-	-	-	-
5	900.9983	59.69 pk	10.3	-107	-37.01	-	-	-	-	-	-
				Margin [dB]		-	-	-	-	-	-
6	900.6925	60.96 pk	10.3	-107	-35.74	-	-	-	-	-	-
				Margin [dB]		-	-	-	-	-	-
7	900.2083	58.69 pk	10.3	-107	-38.01	-	-	-	-	-	-
				Margin [dB]		-	-	-	-	-	-
8	899.325	57.58 pk	10.3	-107	-39.12	-	-	-	-	-	-
				Margin [dB]		-	-	-	-	-	-
9	898.1699	60.04 pk	10.3	-107	-36.66	-	-	-	-	-	-
				Margin [dB]		-	-	-	-	-	-
10	928.3392	66.94 pk	10.3	-107	-29.76	-	-	-	-	-	-
				Margin [dB]		-	-	-	-	-	-
11	928.8404	55.9 pk	10.3	-107	-40.8	-	-	-	-	-	-
				Margin [dB]		-	-	-	-	-	-
12	929.35	66.67 pk	10.3	-107	-30.03	-	-	-	-	-	-
				Margin [dB]		-	-	-	-	-	-
13	929.6473	62.56 pk	10.3	-107	-34.14	-	-	-	-	-	-
				Margin [dB]		-	-	-	-	-	-
14	929.987	60.38 pk	10.4	-107	-36.22	-	-	-	-	-	-
				Margin [dB]		-	-	-	-	-	-
15	930.6835	58.9 pk	10.3	-107	-37.8	-	-	-	-	-	-
				Margin [dB]		-	-	-	-	-	-
16	931.4224	56.84 pk	10.3	-107	-39.86	-	-	-	-	-	-
				Margin [dB]		-	-	-	-	-	-
17	931.7367	60.3 pk	10.3	-107	-36.4	-	-	-	-	-	-
				Margin [dB]		-	-	-	-	-	-

PK - Peak detector

5.8 Test Conditions and Results – RECEIVER RADIATED EMISSIONS

Test Description	Measurements were made in a 10-meter semi-anechoic chamber that complies to CISPR 16/ANSI C63.4. Preliminary (peak) measurements were performed at an antenna to EUT separation distance of 10-meter or 3-meter as noted. The EUT was rotated 360° about its azimuth with the receive antenna located at various heights in both horizontal and vertical polarities. Final measurements (quasi-peak or average as noted) were then performed by rotating the EUT 360° and adjusting the receive antenna height from 1 to 4-meters. All frequencies were investigated in both horizontal and vertical antenna polarity, where applicable.

Basic Standard	FCC Part 15, Subpart C, 15.109	
UL LPG	80-EM-S0029	
	Frequency range	Measurement Point
Fully configured sample scanned over the following frequency range	30MHz – 5GHz	(10m or 3m measurement distance)

Limits - Class B

Frequency (MHz)	Limit (dBµV/m)	
	Quasi-Peak	Average
30 – 88	29.54	NA
88 - 216	33.06	NA
216 - 960	35.56	NA
960 – 1,000	43.52	NA
Above 1,000 (FCC)	NA	54 (at 3-meter)

Supplementary information: None

Table 44 Radiated Emissions EUT Configuration Settings

Power Interface Mode #	EUT Configurations Mode #	EUT Operation Mode #
1	2	3

Supplementary information: None

Table 45 Radiated Emissions Test Equipment

Description	Manufacturer	Model	Identifier
EMI Test Receiver	Rohde & Schwarz	ESU	EMC4323
Bicon Antenna	Chase	VBA6106A	EMC4078
Log-P Antenna	Chase	UPA6109	EMC4258
Spectrum Analyzer	Rhode & Schwarz	FSEK	EMC4182
Antenna Array	UL	BOMS	EMC4276

Figure 37 Test setup for Radiated Emissions

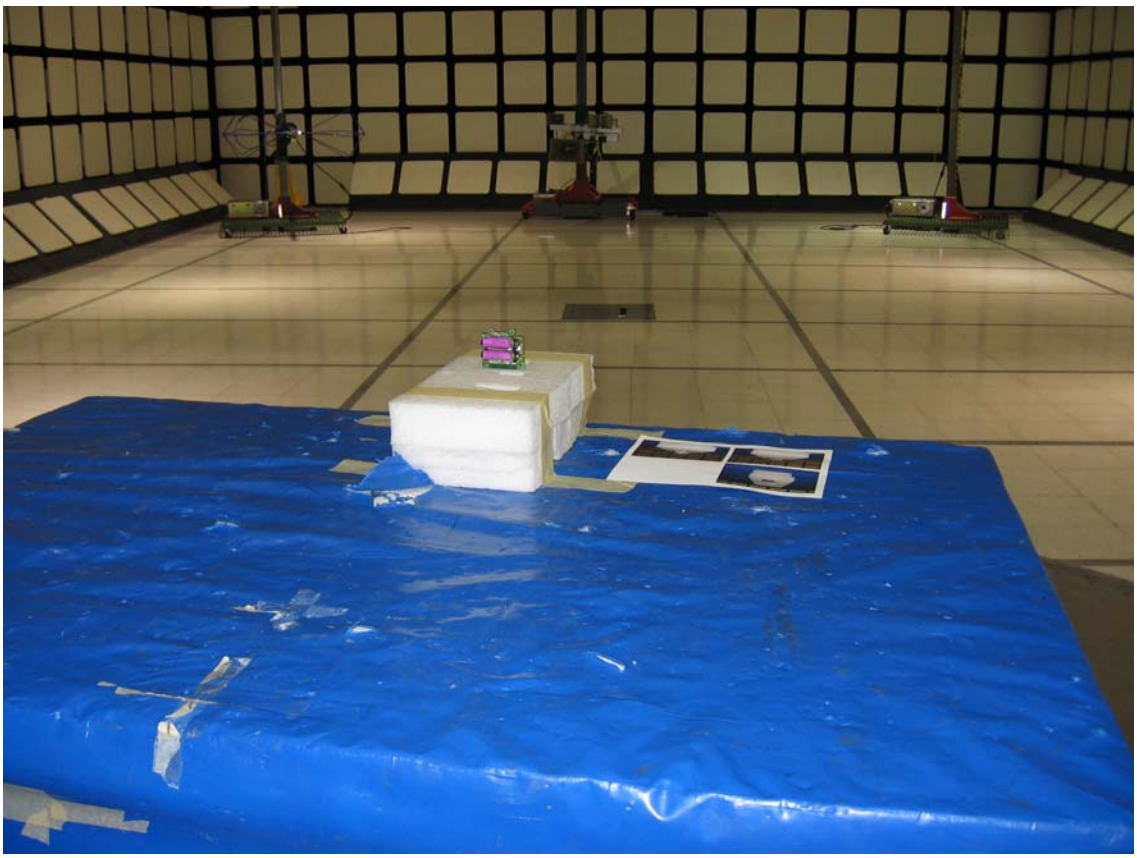


Figure 38 Radiated Emissions Graph 30MHz – 1GHz

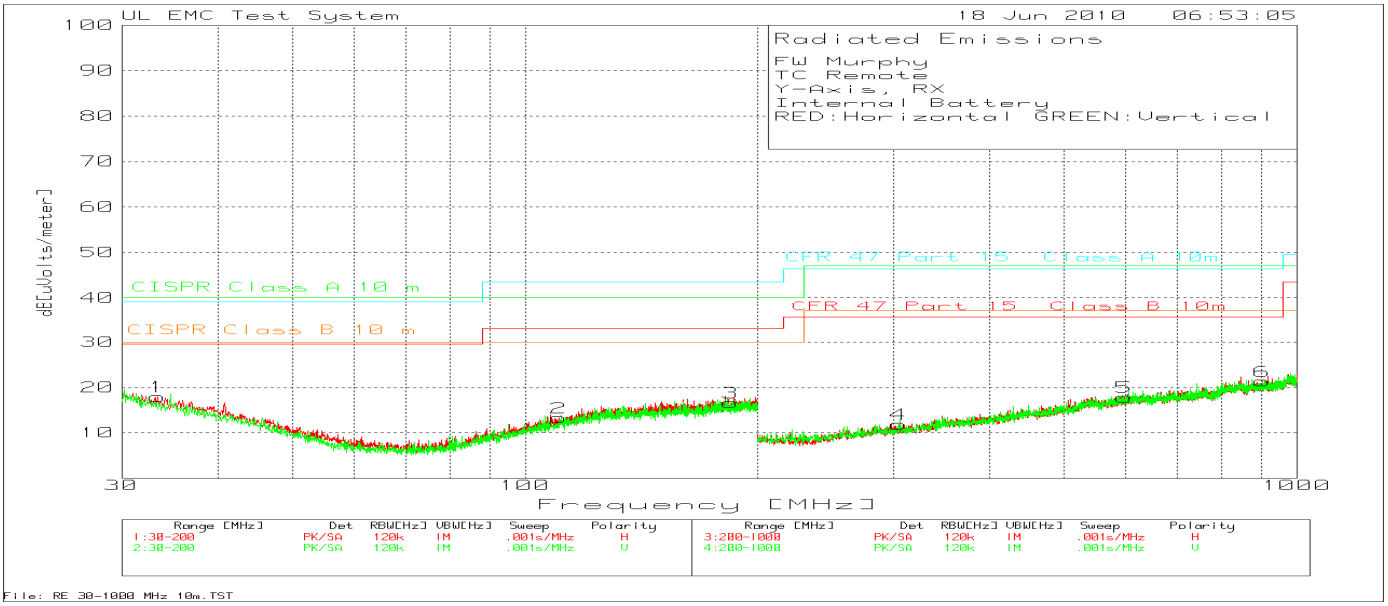
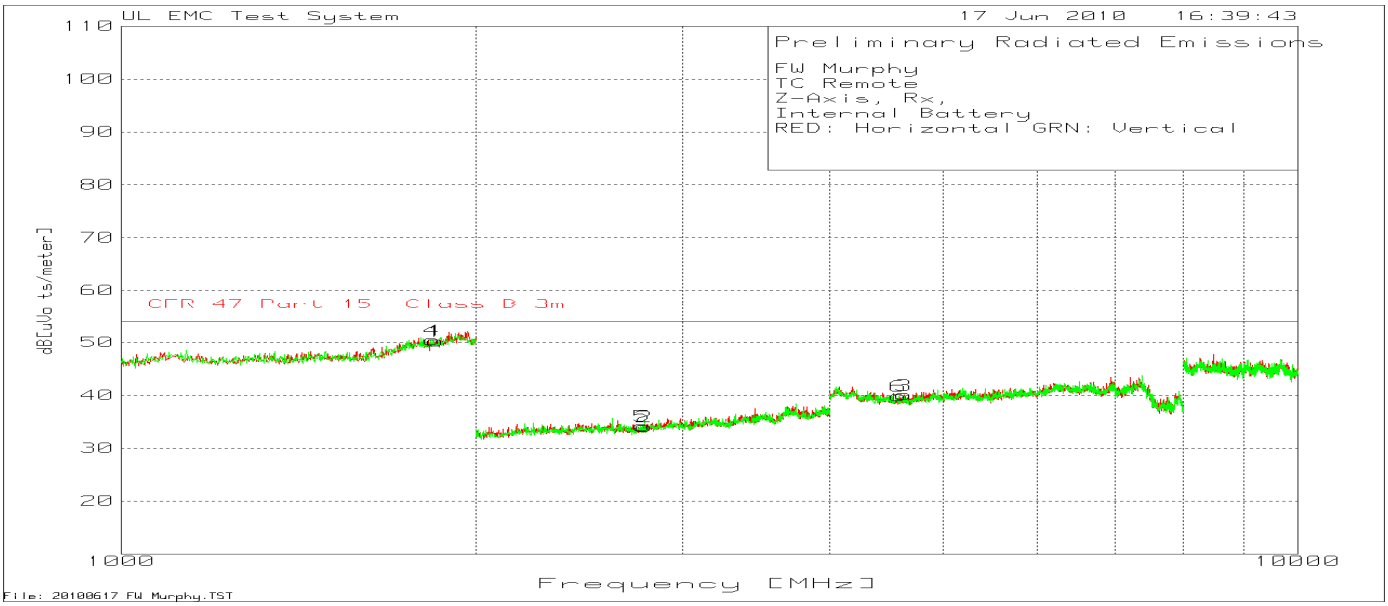


Figure 39 Radiated Emissions Graph 1GHz – 10GHz



6.0 IMMUNITY TEST RESULTS

The immunity tests were not performed nor required.

Appendix A

Accreditations and Authorizations

NVLAP Lab code: 100414-0

NVLAP: The National Institute of Standards and Technology (NIST) administers the National Voluntary Laboratory Accreditation Program (NVLAP). NVLAP is comprised of laboratory accreditation programs (LAPs) which are established on the basis of requests and demonstrated need. Each LAP includes specific calibration and/or test standards and related methods and protocols assembled to satisfy the unique needs for accreditation in a field of testing or calibration. NVLAP accredits public and private laboratories based on evaluation of their technical qualifications and competence to carry out specific calibrations or tests. Accreditation criteria are established in accordance with the U.S. Code of Federal Regulations (CFR, Title 15, Part 285), NVLAP Procedures and General Requirements, and encompass the requirements of ISO/IEC 17025. For a full scope listing see http://ts.nist.gov/ts/htdocs/210/214/scopes/1004140.htm

FCC: Details of the measurement facilities used for these tests have been filed with the Federal Communications Commission's Laboratory in Columbia, Maryland (Ref. No. 91044).

Industry Canada Industrie Canada

Industry of Canada: Accredited by Industry Canada for performance of radiated measurements. Our test site complies with RSP 100, Issue 7, Section 3.3. File #: IC 2180

VCCI: Accepted as an Associate Member to the VCCI. The measurement facilities detailed in this test report have been registered in accordance with Regulations for Voluntary Control Measures, Article 8. Registration Nos.: Radiated Emissions R-621, Conducted Emissions C-642.

ICASA: ICASA (Independent Communications Authority of South Africa) has appointed UL as a Designated Test Laboratory to test Telecommunications equipment for type approval in compliance with CISPR 22 to assist in fulfilling its mandate under section 54(1) of the Telecommunications Act, 1996 (Act 103 of 1996).

NIST/CAB: Validated by the European Commission as a U.S. Conformity Assessment Body (CAB) of the U.S.-EU Mutual Recognition Agreement (MRA) for the Electromagnetic Compatibility - Council Directive 2004/108/EC, Annex III (2-3). Also validated for the Telecommunication Equipment-Council Directive 99/5/EC, Annex III and IV, Identification Number: 0983.
NIST/CAB: Provisioned to act as a U.S. Conformity Assessment Body (CAB) under Appendix B, Phase I Procedures, of the Asia Pacific Economic Cooperation (APEC) MRA between the American Institute in Taiwan (AIT) and the United States. Our laboratory is considered qualified to test equipment subject to the applicable EMC regulations of the Chinese Taipei Bureau of Standards, Metrology and Inspection (BSMI) which require testing to CNS 13438 (CISPR 22).
NIST/CAB: Recognized by the Infocomm Development Authority of Singapore (IDA) under the Asia Pacific Economic Cooperation Mutual Recognition Agreement (APEC MRA). Our laboratory is provisionally designated to act as a Conformity Assessment Body (CAB) under Appendix B, Phase I Procedures, of the APEC MRA. Our scope of designation includes IDA TS EMC (CISPR 22), IEC 61000-4-2, -4-3, -4-4, -4-5, and -4-6