RHEIN TECH LABORATORIES, INC.

Engineering Solutions & Electromagnetic Compatibility Services

Certification Application Report
FCC Part 15.247 & Industry Canada RSS-210

Test Lab:	Applicant:
Rhein Tech Laboratories, Inc. Phone: 703-689-0368 360 Herndon Parkway Fax: 703-689-2056 Suite 1400 www.rheintech.com Herndon, VA 20170 E-Mail: atcbinfo@rheintech.com	Motorola, Inc. Phone: 215-323-1000 101 Tournament Drive Horsham, PA 19044 (USA) Contact: Mike Welty E-Mail: mwelty@motorola.com

FCC ID:	ACQ-DCX3600	**Test Report Date:**	October 16, 2012
IC:	109AS-DCX3600	**RTL Work Order Number:**	2012310
Model:	DCX3600	**RTL Quote Number:**	QRTL12-310D

American National Standard Institute:	ANSI C63.4-2009: Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
FCC Classification:	DTS – Part 15 Digital Transmission System
FCC Rule Part:	FCC Rules Part 15.247 (10-01-11): Operation within the bands 920-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz Direct Sequence System
IC Rule Part:	RSS-210, Issue 8 (2010) Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment
Digital Interface Information:	Digital Interface was found to be compliant

Frequency Range (MHz)	Output Power (W)*	Frequency Tolerance	Emission Designator
2425-2475	0.003	N/A	1M60G7D

**power reported is maximum peak conducted power*

I, the undersigned, hereby declare that the equipment tested and referenced in this report conforms to the identified standard(s) as described in this test report. No modifications were made to the equipment during testing in order to achieve compliance with these standards. Furthermore, there was no deviation from, additions to, or exclusions from, the applicable parts of FCC Part 2, FCC Part 15, RSS-210 and ANSI C63.4.

Signature: _____ Date: October 16, 2012

Typed/Printed Name: Desmond A. Fraser Position: President

These tests are accredited and meet the requirements of ISO/IEC 17025 as verified by ANSI-ASQ National Accreditation Board/ACLASS. Refer to certificate and scope of accreditation AT-1445.

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1 General Information

1.1 Scope

Applicable Standards:

- FCC Rules Part 15.247 (10-01-11): Frequency Hopping, Direct Spread Spectrum and Hybrid Systems that are in operation within the bands of 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz.
- IC Rules RSS-210: Frequency Hopping, Direct Spread Spectrum and Hybrid Systems that are in operation within the bands of 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz.

1.2 Description of EUT

Equipment Under Test	Set Top Box
Model	DCX3600
Power Supply	AC Adapter (12VDC 2A output)
Frequency Range	2425 – 2475 MHz
Antenna Connector Type	Internal
Antenna Types	Inverted F Trace

1.3 Test Facility

The open area test site and conducted measurement facility used to collect the radiated data is located at 360 Herndon Parkway, Suite 1400, Herndon, Virginia 20170. This site has been fully described in a report and approved by the Federal Communications Commission to perform AC line conducted and radiated emissions testing (ANSI C63.4 2003).

1.4 Related Submittal(s)/Grant(s)

This is an original FCC and IC certification application for Motorola, Inc. Model DCX3600, FCC ID: ACQ-DCX3600, IC: 109AS-DCX3600. The IC certification is a family certification that includes 24 models.

1.5 Modifications

No modifications were required.

2 Test Information

2.1 Description of Test Modes

In accordance with FCC 15.31(m), and because the EUT utilizes an operating band greater than 10 MHz, the following frequencies were tested:

Table 2-1: Frequencies Tested

Frequency (MHz)
2425
2450
2475

2.2 Exercising the EUT

The EUT was tested in all three orthogonal planes in order to determine worst-case emissions. The EUT was provided with software to continuously transmit during testing. The carrier was also checked to verify that information was being transmitted. There were no deviations from the test standard(s) and/or methods. The test results reported relate only to the item tested.

2.3 Test Results Summary

Table 2-2: Test Results Summary – FCC Part 15, Subpart C (Section 15.247); IC RSS-210

Standards	Test	Pass/Fail or N/A
FCC 15.207; IC RSS-Gen	AC Power Conducted Emissions	Pass
FCC 15.209, 15.205; IC RSS-Gen; RSS-210 2.2	Radiated Emissions	Pass
FCC 15.247(a)(2); RSS-210 A8.2(a)	6 dB Bandwidth	Pass
Peak Output Power - §15.247(b)(3); RSS-210 A8.4(4)	Maximum Peak Power Output	Pass
FCC 15.247(d); IC RSS-Gen	Antenna Conducted Spurious Emissions	Pass
FCC 15.247(e); IC RSS-210 A8.2(b)	Power Spectral Density	Pass
FCC 15.247(d); IC RSS-210 2.2	Band Edge Measurement	Pass

2.4 Test System Details

The test samples were received on October 8, 2012. The FCC identifiers for all applicable equipment, plus descriptions of all cables used in the tested system, are identified in the following tables.

Table 2-3: Equipment Under Test

Part	Manufacturer	Model	Serial Number	FCC ID	Cable Description	RTL Bar Code
Set Top Box with internal DSSS transmitter	Motorola, Inc.	DCX3600/D481/0300/1000 with RF4CE	XX0086DB010565101225542114	ACQ-DCX3600	N/A	20829
Set Top Box with internal DSSS transmitter with SMA connectors	Motorola, Inc.	DCX3600/D481/0300/1000 with RF4CE	XX0086DB010565101225542120	ACQ-DCX3600	N/A	20830
Remote Control	Motorola, Inc.	N/A	N/A	N/A	N/A	21014
12VDC/AC Adapter	Emerson	AA27130L	J587KD001A01L	N/A	1.9m unshielded DC/2m unshielded AC	20828
12VDC/AC Adapter	Emerson	AA27130L	J587KE00GYGTD1L	N/A	1.9m unshielded DC/2m unshielded AC	20827

2.5 Configuration of Tested System

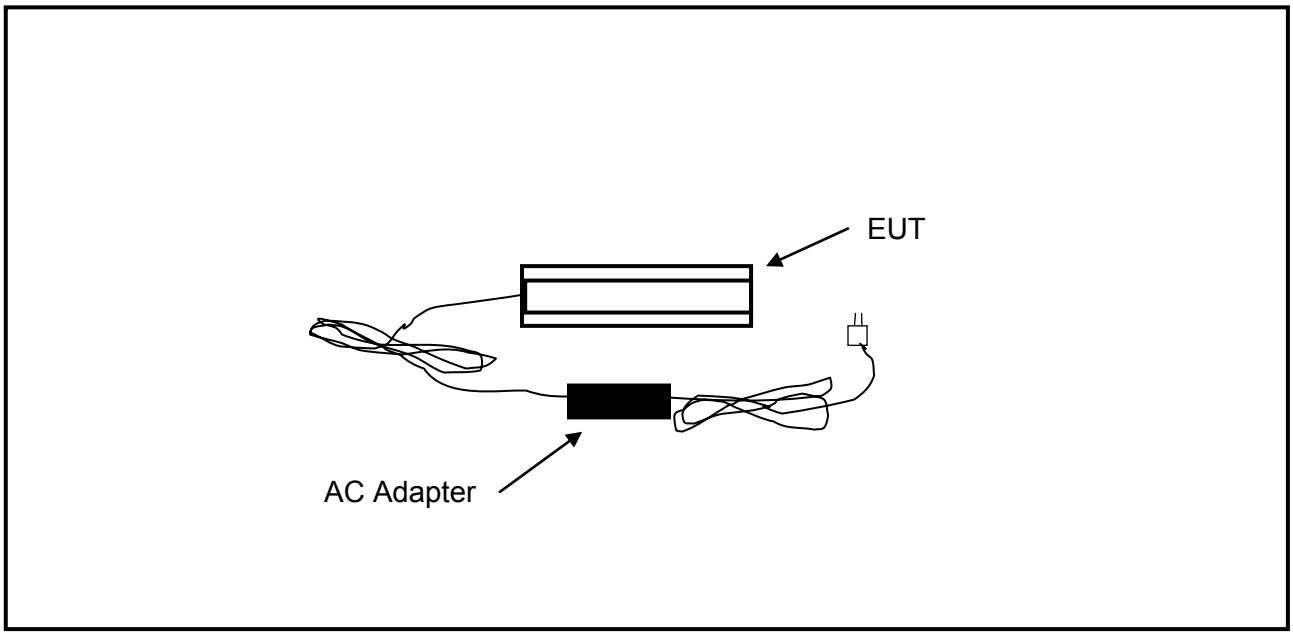


Figure 2-1: Configuration of System Under Test

3 Peak Output Power - §15.247(b)(3); RSS-210 A8.4(4)

3.1 Power Output Test Procedure

A conducted power measurement of the EUT was taken.

Table 3-1: Power Output Test Equipment

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901581	Rohde & Schwarz	1166.1660.50	Spectrum Analyzer	2001006	6/3/13

3.2 Power Output Test Data

Table 3-2: Power Output Test Data

Frequency (MHz)	Peak Power Conducted Output (dBm)
2425	2.6
2450	3.2
2475	3.9

Test Personnel:

Daniel Baltzell		October 8, 2012
Test Engineer	Signature	Date of Test

4 Compliance with the Band Edge – FCC 15.247(d); RSS-210 2.2

4.1 Band Edge Test Procedure

The transmitter output was connected to its appropriate antenna. Peak (1 MHz RBW/VBW) and average (1 MHz RBW/10 Hz VBW) radiated measurements were taken with a suitable span to encompass the peak of the fundamental. A delta measurement was performed from the highest peak in the restricted band to the peak of the fundamental, and subtracted from the field strength; the result was compared to the limit in the restricted band (54 dBuV/m).

Table 4-1: Band Edge Test Equipment

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901242	Rhein Tech Laboratories	WRT-000-0003	Wood Rotating Table	N/A	Not Required
900772	EMCO	3161-02	Horn Antenna (2 - 4 GHz)	9804-1044	4/19/14
901581	Rohde & Schwarz	1166.1660.50	Spectrum Analyzer	2001006	6/3/13
900878	Rhein Tech Laboratories	AM3-1197-0005	3 meter antenna mast, polarizing	Outdoor Range 1	Not Required
900932	Hewlett Packard	8449B OPT H02	Preamplifier (1 - 26.5 GHz)	3008A00505	8/10/13
900878	Rhein Tech Laboratories	AM3-1197-0005	3 meter antenna mast, polarizing	Outdoor Range 1	Not Required

4.2 Restricted Band Edge Test Results

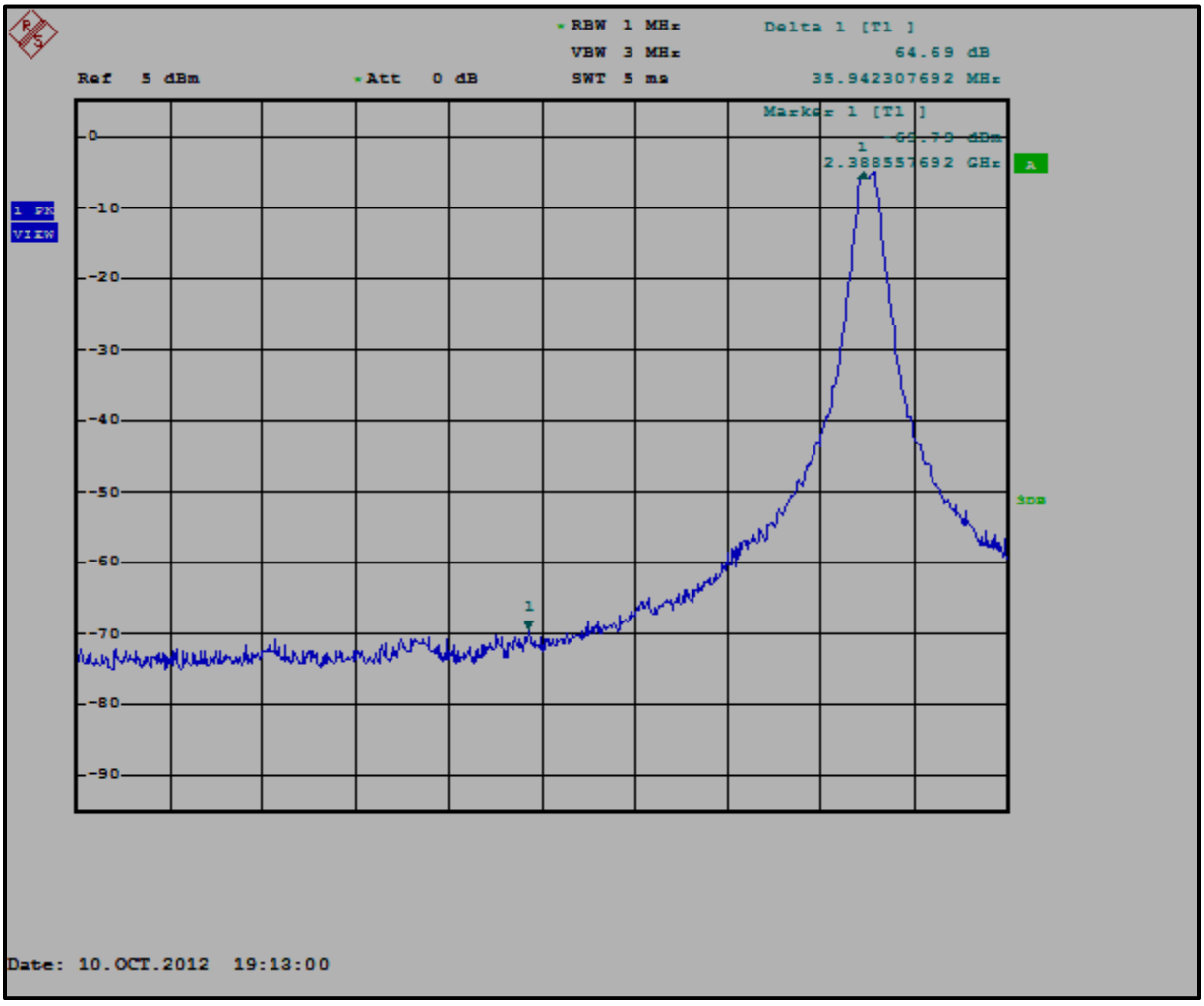
4.2.1 Calculation of Lower Band Edge

104.0 dBuV/m is the field strength measurement, from which the delta measurement of 64.7 dB is subtracted (reference plots), resulting in a level of 39.3 dB. This level has a margin of 14.7 dB below the limit of 54 dBuV/m.

Calculation: 104.0 dBuV/m – 64.7 dB – 54 dBuV/m = -14.7 dB

Peak Field Strength of Lower Band Edge (1 MHz RBW/3 MHz VBW) = 106.4 dBuV/m
Average Field Strength of Lower Band Edge (1 MHz RBW/10 Hz VBW) = 104.0 dBuV/m
Delta measurement = 64.7 dB

Plot 4-1: Lower Band Edge (2425 MHz)



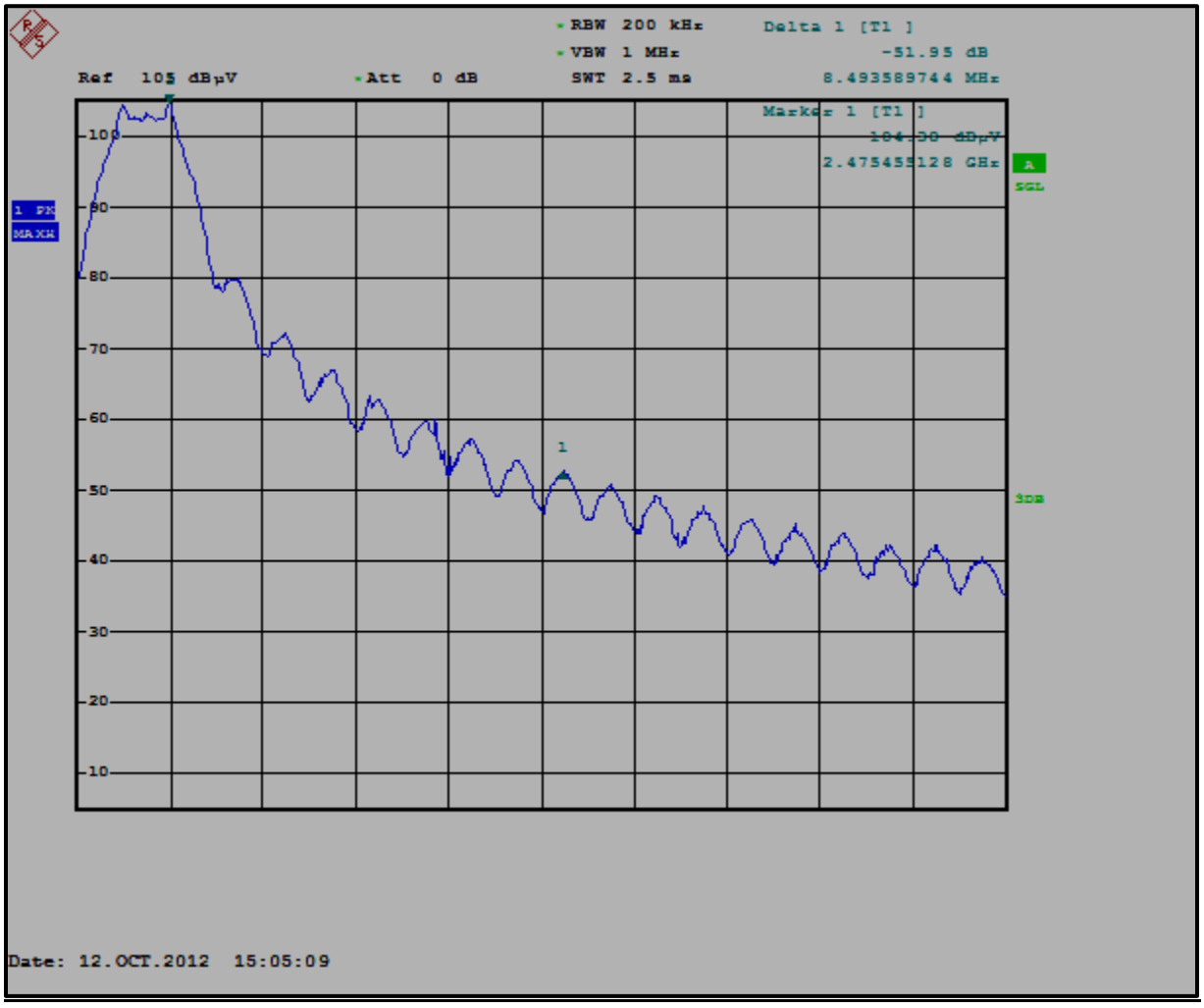
4.2.2 Calculation of Upper Band Edge

103.9 dBuV/m is the field strength measurement, from which the delta measurement of 52 dB is subtracted (reference plot), resulting in a level of 51.9 dB. This level has a margin of 2.1 dB below the limit of 54 dBuV/m.

Calculation: 103.9 dBuV/m – 52 dB – 54 dBuV/m = -2.1 dB

Peak Field Strength of Upper Band Edge (1 MHz RBW/3 MHz VBW) = 106.3 dBuV/m
Average Field Strength of Upper Band Edge (1 MHz RBW/10 Hz VBW) = 103.9 dBuV/m
Delta measurement = 52 dB

Plot 4-2: Upper Band Edge (2475 MHz)



Test Personnel:

Daniel Baltzell		October 10, 12, 2012
Test Engineer	Signature	Dates of Test

5 Antenna Conducted Spurious Emissions - §15.247(d); RSS-Gen

5.1 Antenna Conducted Spurious Emissions Test Procedures

Antenna spurious emissions per FCC 15.247(d) were measured from the EUT antenna port using a 50 ohm spectrum analyzer with the resolution bandwidth set at 100 kHz, and the video bandwidth set at 100 kHz. The modulated carrier was identified at the following frequencies: 2425 MHz, 2450 MHz and 2475 MHz.

5.2 Antenna Conducted Spurious Emissions Test Results

No harmonics or spurs were found within 20 dB (note that we are reporting power as peak) of the limit from the carrier to the 10th harmonic of the carrier frequency. Per FCC 15.31(o), no data is being reported.

Table 5-1: Antenna Conducted Spurious Test Equipment

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901581	Rohde & Schwarz	1166.1660.50	Spectrum Analyzer	2001006	6/3/13

Test Personnel:

Daniel Baltzell		October 10, 2012
Test Engineer	Signature	Date of Test

6 6 dB Bandwidth - §15.247(a)(2); RSS-210 A8.2(a)

6.1 6 dB Bandwidth Test Procedure – Minimum 6 dB Bandwidth

The minimum 6 dB bandwidths per FCC 15.247(a)(2) were measured using a 50 ohm spectrum analyzer with the resolution bandwidth set at 100 kHz, and the video bandwidth set at 300 kHz. The device was modulated. The minimum 6 dB bandwidths are presented below.

Table 6-1: 6 dB Bandwidth Test Equipment

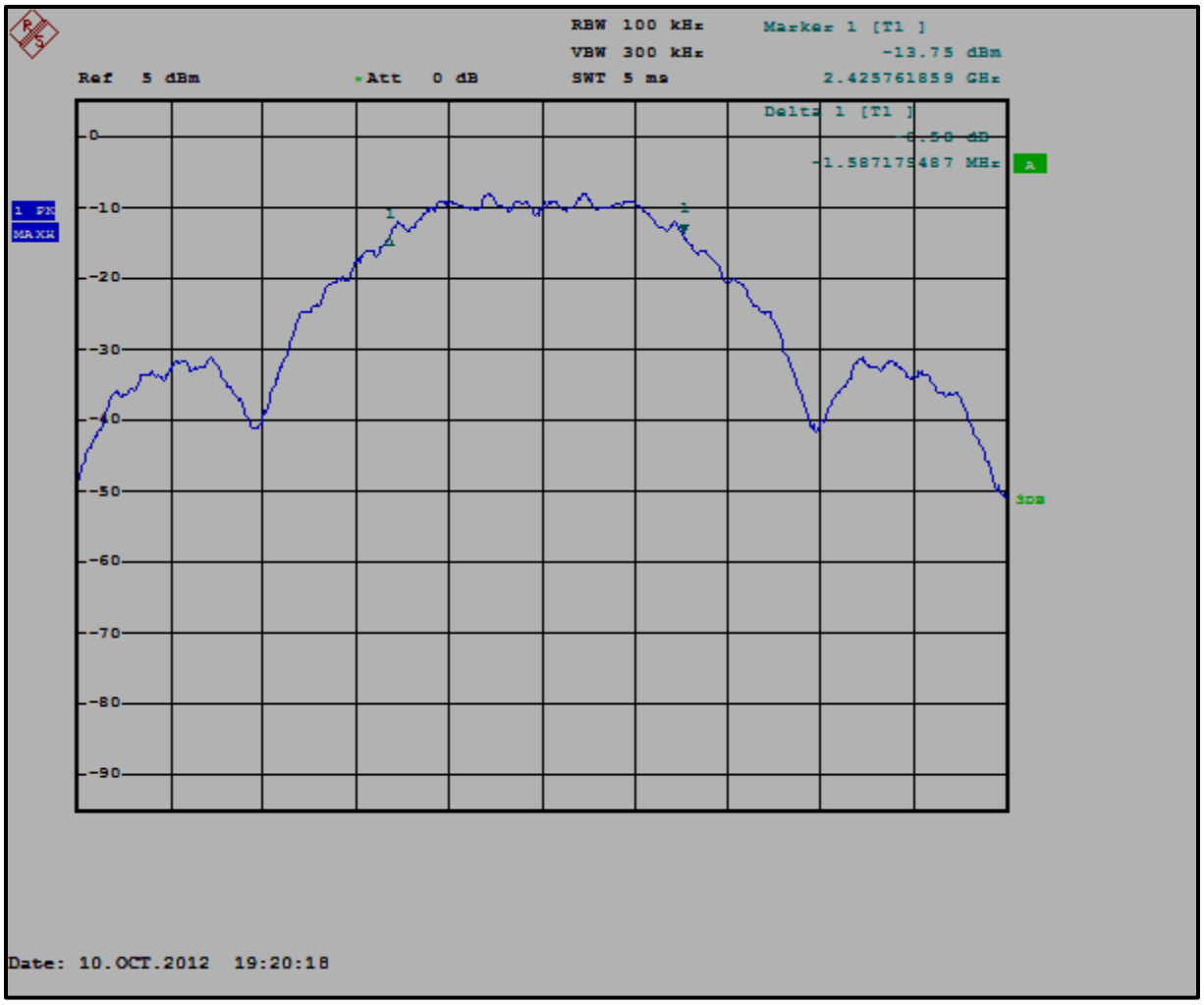
RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901581	Rohde & Schwarz	1166.1660.50	Spectrum Analyzer	2001006	6/3/13

6.2 6 dB Bandwidth Test Results

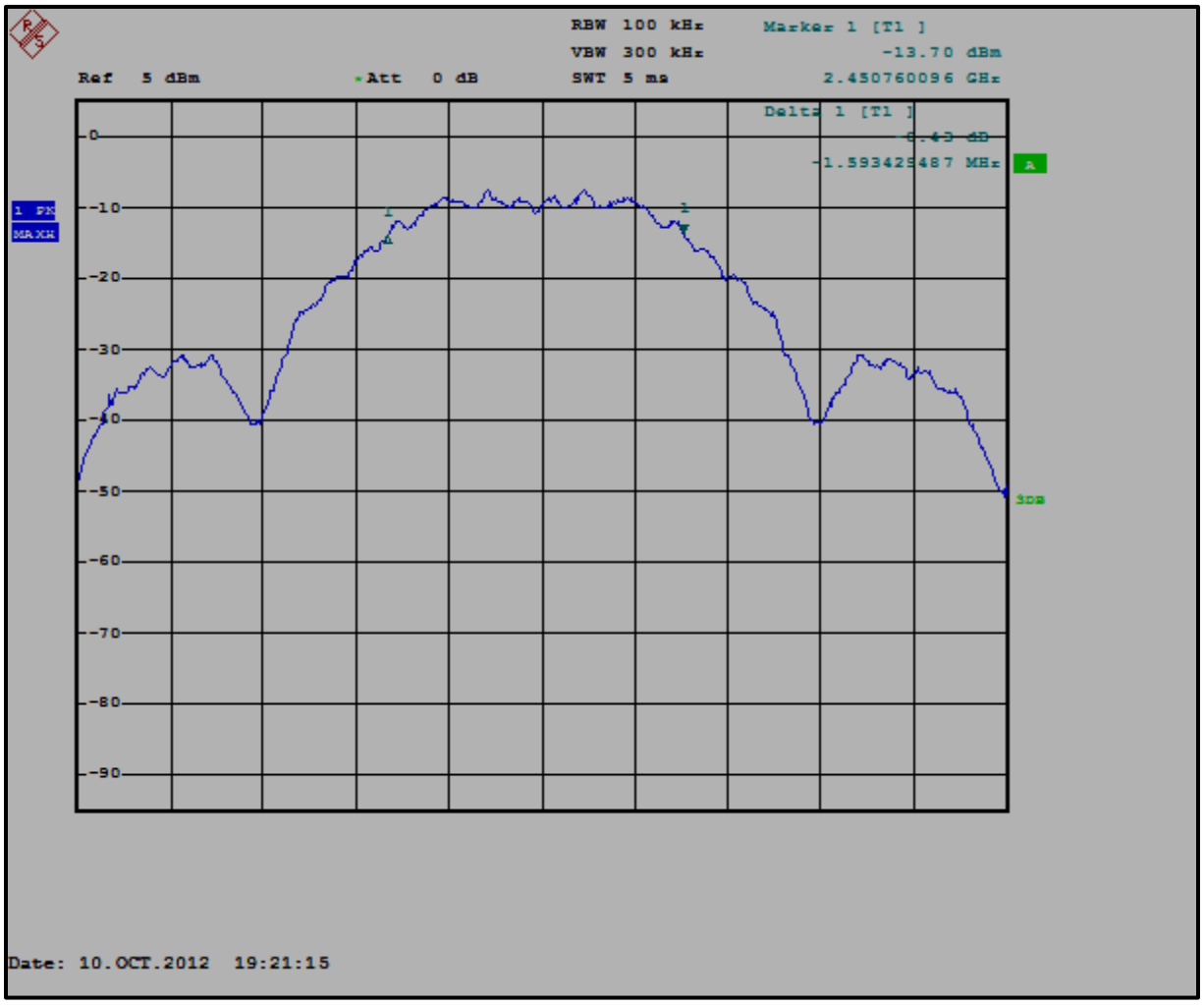
Table 6-2: 6 dB Bandwidth Test Data

Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)	Pass/Fail
2425	1.59	0.5	Pass
2450	1.59	0.5	Pass
2475	1.60	0.5	Pass

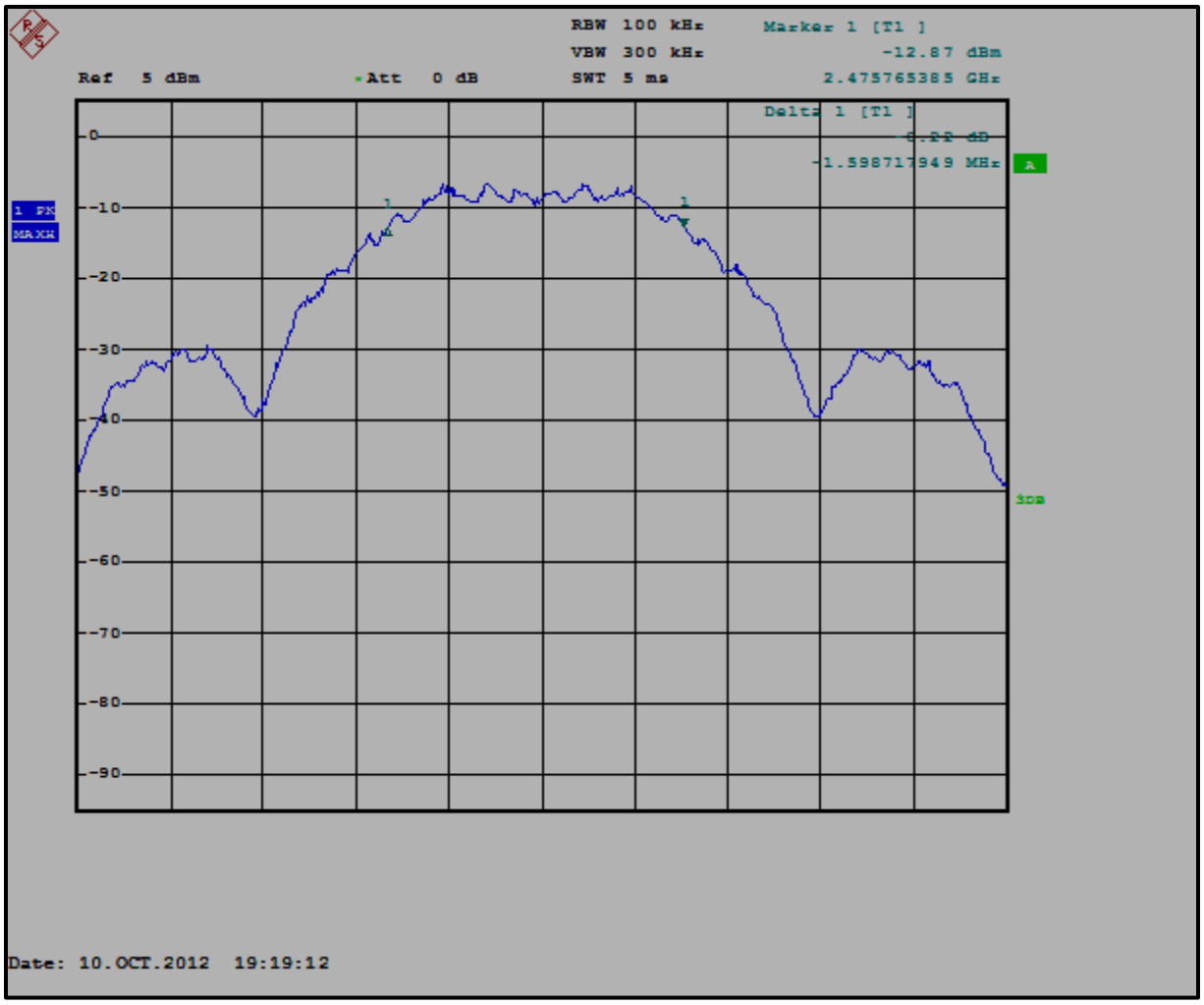
Plot 6-1: 6 dB Bandwidth (2425 MHz)



Plot 6-2: 6 dB Bandwidth (2450 MHz)



Plot 6-3: 6 dB Bandwidth (2475 MHz)



Test Personnel:

Daniel Baltzell		October 10, 2012
Test Engineer	Signature	Date of Tests

7 Power Spectral Density –FCC §15.247(e); IC RSS-210 A8.2(b)

7.1 Power Spectral Density Test Procedure

The power spectral density per FCC 15.247(e) was measured using a 50 ohm spectrum analyzer with the span set at 1.5 MHz, the resolution bandwidth set at 3 kHz, the video bandwidth set at 30 kHz, and the sweep time set at 500 seconds. The spectral lines were resolved for the modulated carriers at 2.425 GHz, 2.450 GHz, and 2.475 GHz respectively. These levels are below the +8 dBm limit. See the power spectral density table and plots that follow.

Table 7-1: Power Spectral Density Test Equipment

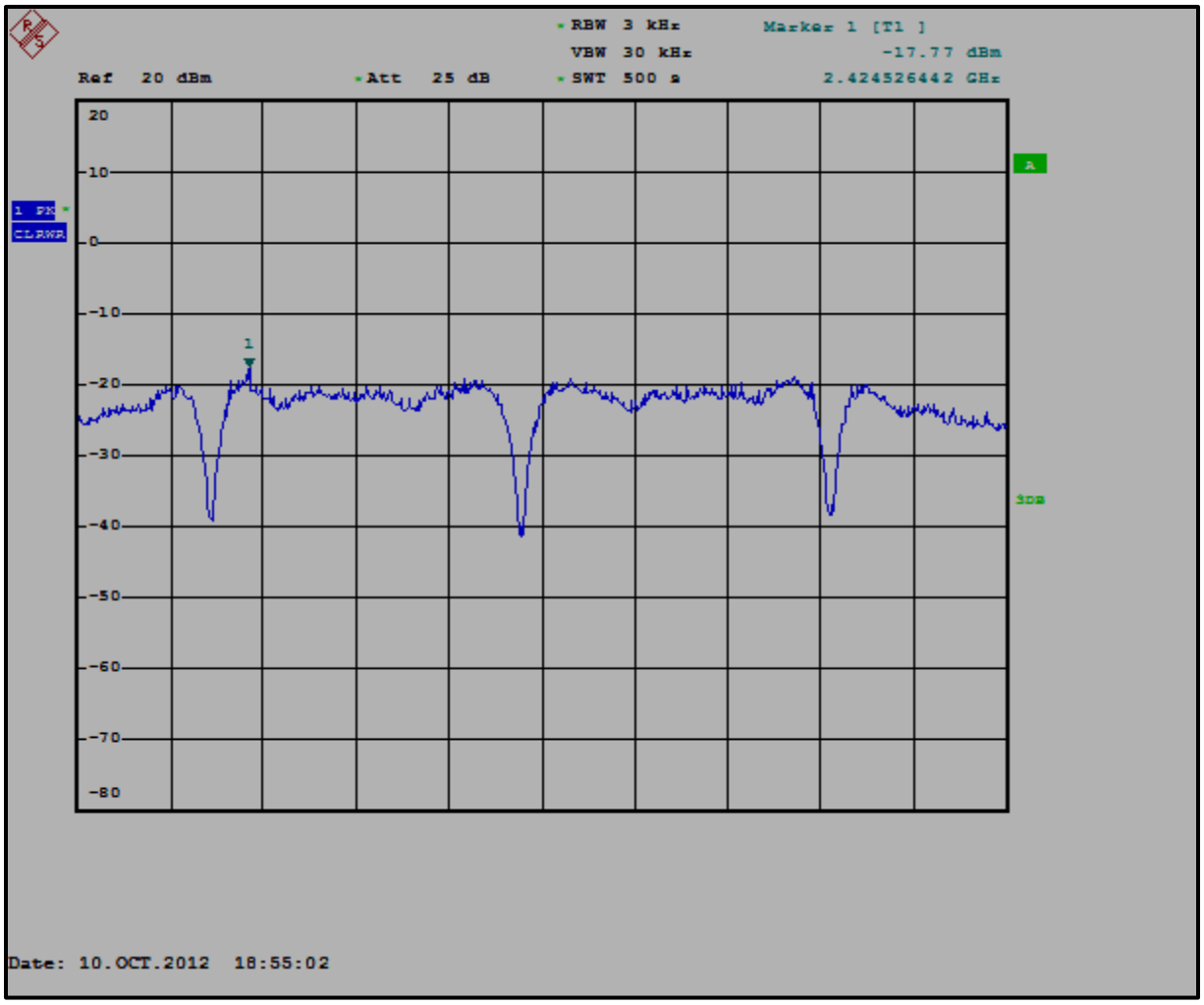
RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901581	Rohde & Schwarz	1166.1660.50	Spectrum Analyzer	2001006	6/3/13

7.2 Power Spectral Density Test Data

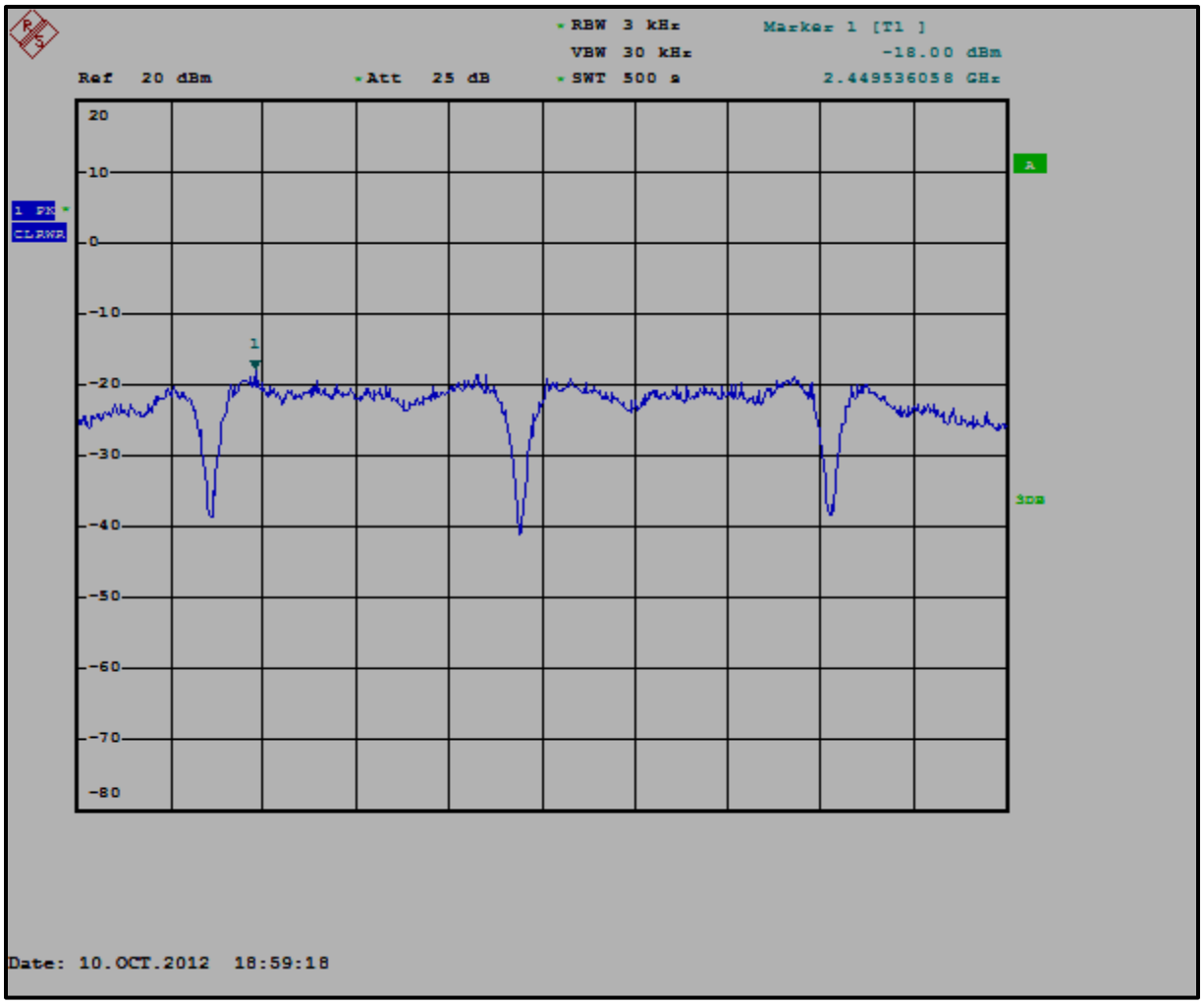
Table 7-2: Power Spectral Density Test Data

Frequency (MHz)	RF Power Level (dBm)	Maximum Limit +8dBm	Pass/Fail
2425	-17.8	8	Pass
2450	-18.0	8	Pass
2475	-18.1	8	Pass

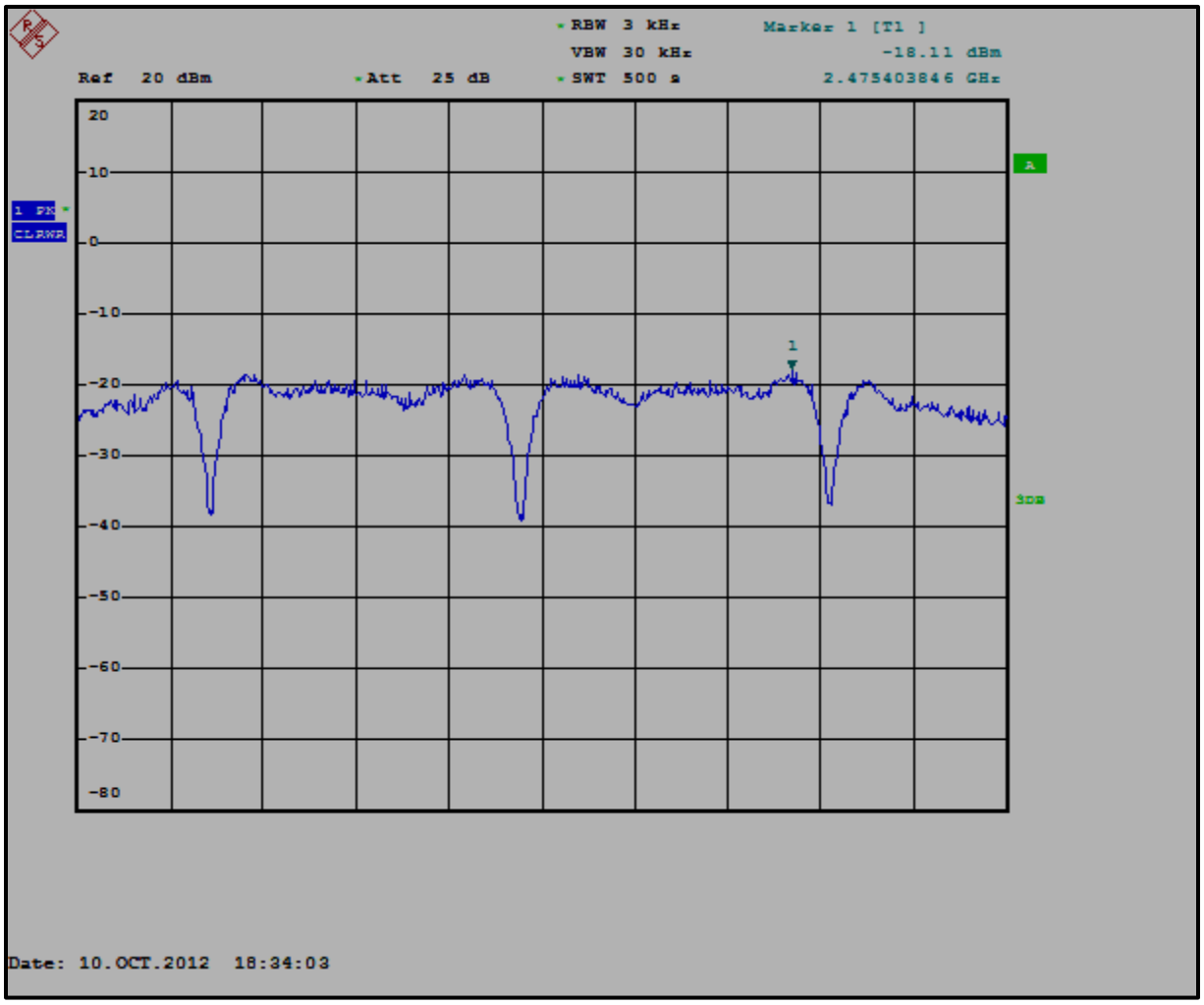
Plot 7-1: Power Spectral Density (2425 MHz)



Plot 7-2: Power Spectral Density (2450 MHz)



Plot 7-3: Power Spectral Density (2475 MHz)



Test Personnel:

Daniel Baltzell	Daniel W. Baltzell	October 10, 2012
Test Engineer	Signature	Date of Tests

8 Conducted Emissions Measurement Limits – FCC §15.207; RSS-Gen

8.1 Limits of Conducted Emissions Measurement

Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average
0.15-0.5	66-56	56-46
0.5-5.0	56	46
5.0-30.0	60	50

8.2 Site and Test Description

The power line conducted emissions measurements were performed in a Series 81 type shielded enclosure manufactured by Rayproof. The EUT was assembled on a wooden table 80 centimeters high. Power was fed to the EUT through a 50 ohm/50 microhenry Line Impedance Stabilization Network (LISN). The EUT LISN was fed power through an A.C. filter box on the outside of the shielded enclosure. The filter box and EUT LISN housing are bonded to the ground plane of the shielded enclosure. A second LISN, the peripheral LISN, provides isolation for the EUT test peripherals. This peripheral LISN was also fed A.C. power. A metal power outlet box, which is bonded to the ground plane and electrically connected to the peripheral LISN, powers the EUT host peripherals.

The spectrum analyzer was connected to the A.C. line through an isolation transformer. The 50 ohm output of the EUT LISN was connected to the spectrum analyzer input through a Solar 100 kHz high-pass filter. The filter is used to prevent overload of the spectrum analyzer from noise below 100 kHz. Conducted emission levels were measured on each current-carrying line with the spectrum analyzer operating in the CISPR quasi-peak mode (or peak mode if applicable).

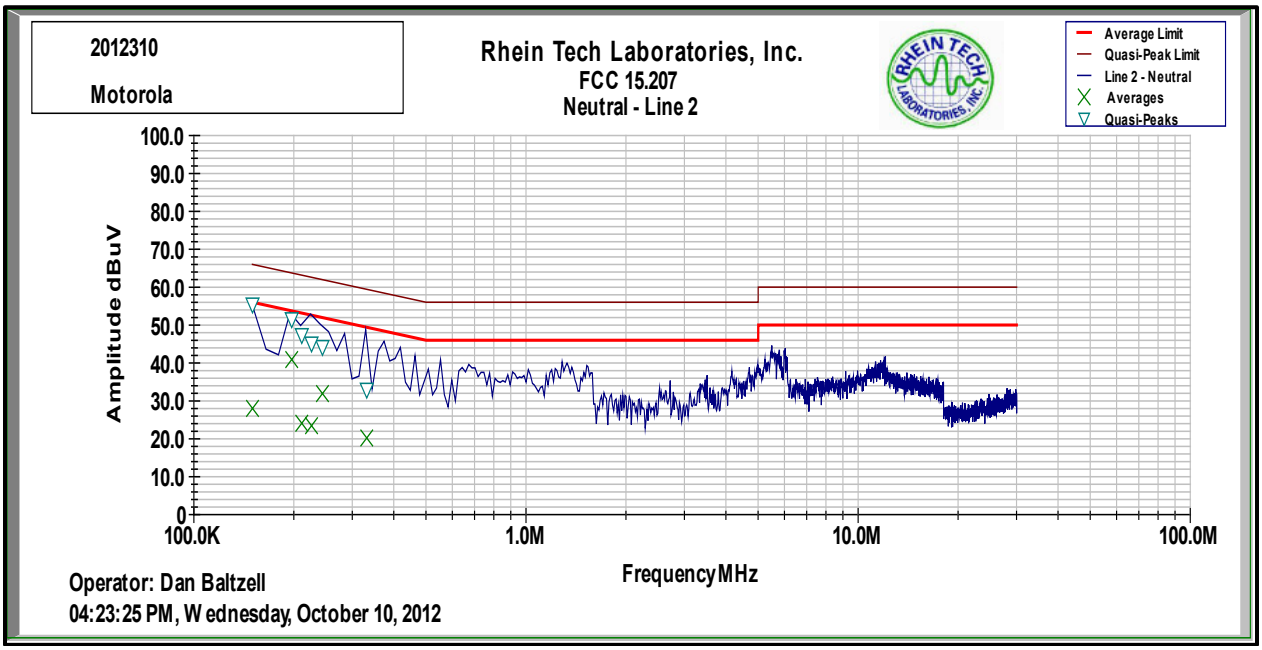
The analyzer's 6 dB bandwidth was set to 9 kHz. Video filter less than 10 times the resolution bandwidth is not used. Average measurements are performed in linear mode using a 10 kHz resolution bandwidth, a 1 Hz video bandwidth, and by increasing the sweep time in order to obtain a calibrated measurement. The emission spectrum was scanned from 150 kHz to 30 MHz. The highest emission amplitudes relative to the appropriate limits were measured and have been recorded.

Table 8-1: Conducted Emissions Test Equipment

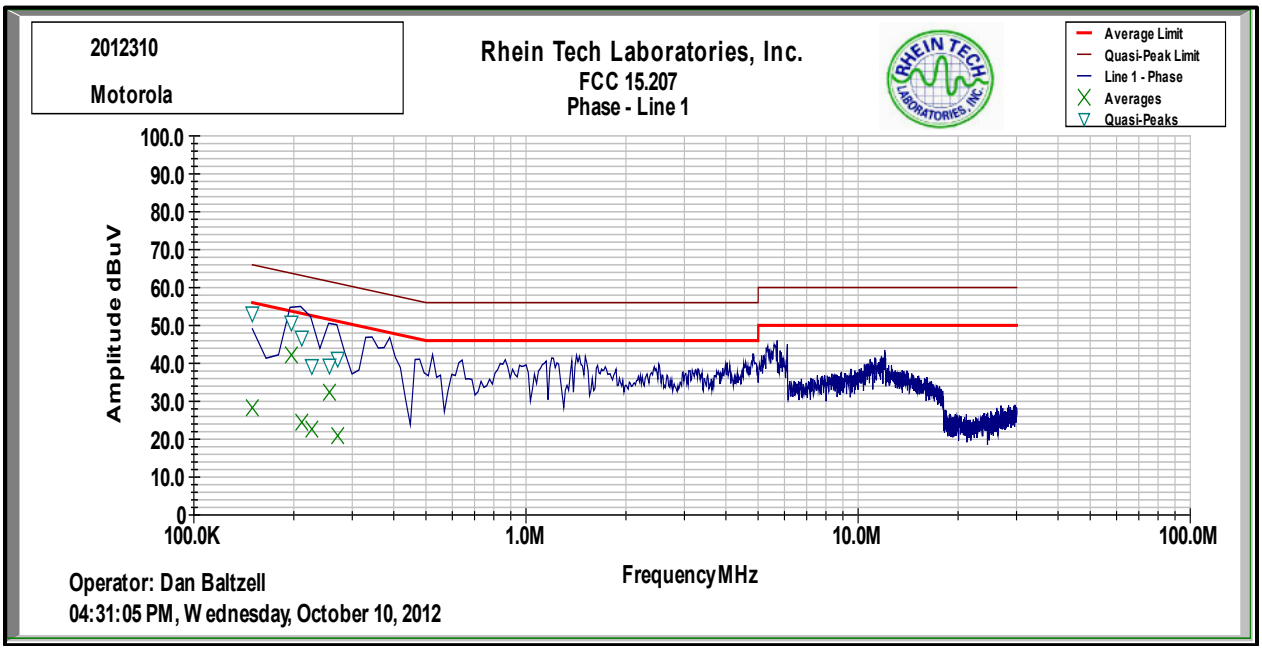
RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901215	Hewlett Packard	8596EM	Spectrum Analyzer (9 kHz - 12.8 GHz)	3826A00144	3/15/13
901083	AFJ International	LS16	16A LISN (110 V)	16010020080	4/18/13

8.3 Conducted Emissions Test Data

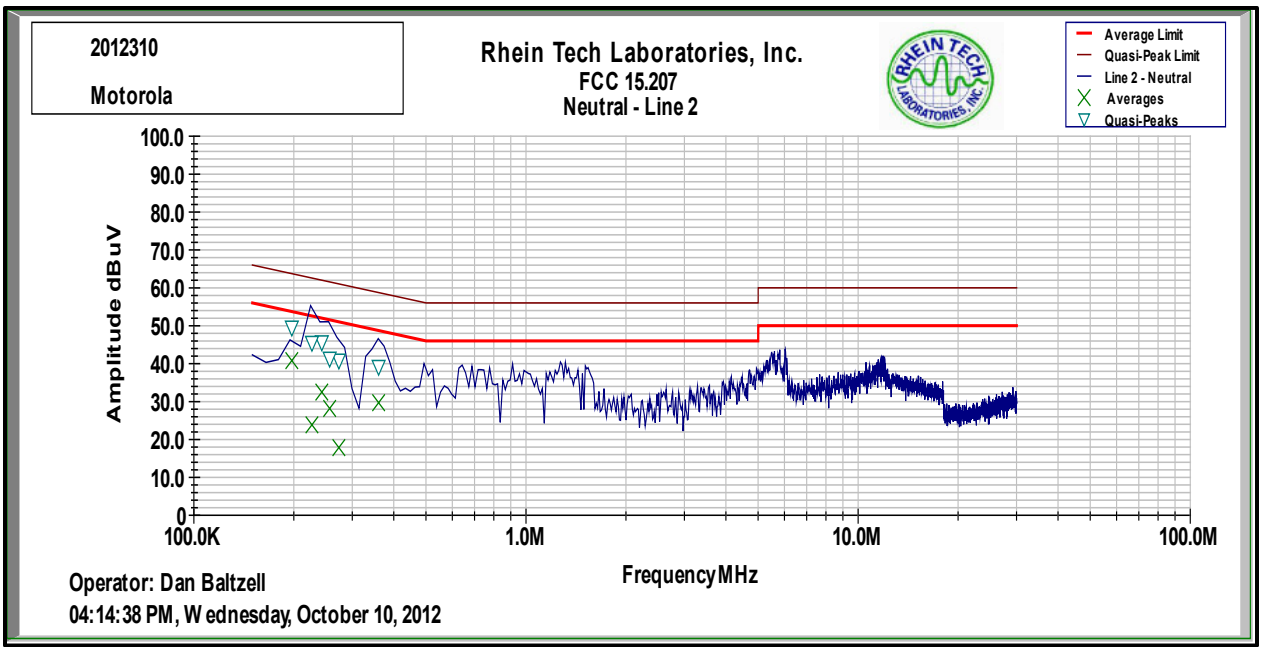
Plot 8-1: Conducted Emissions Test Data – Neutral - RX Mode



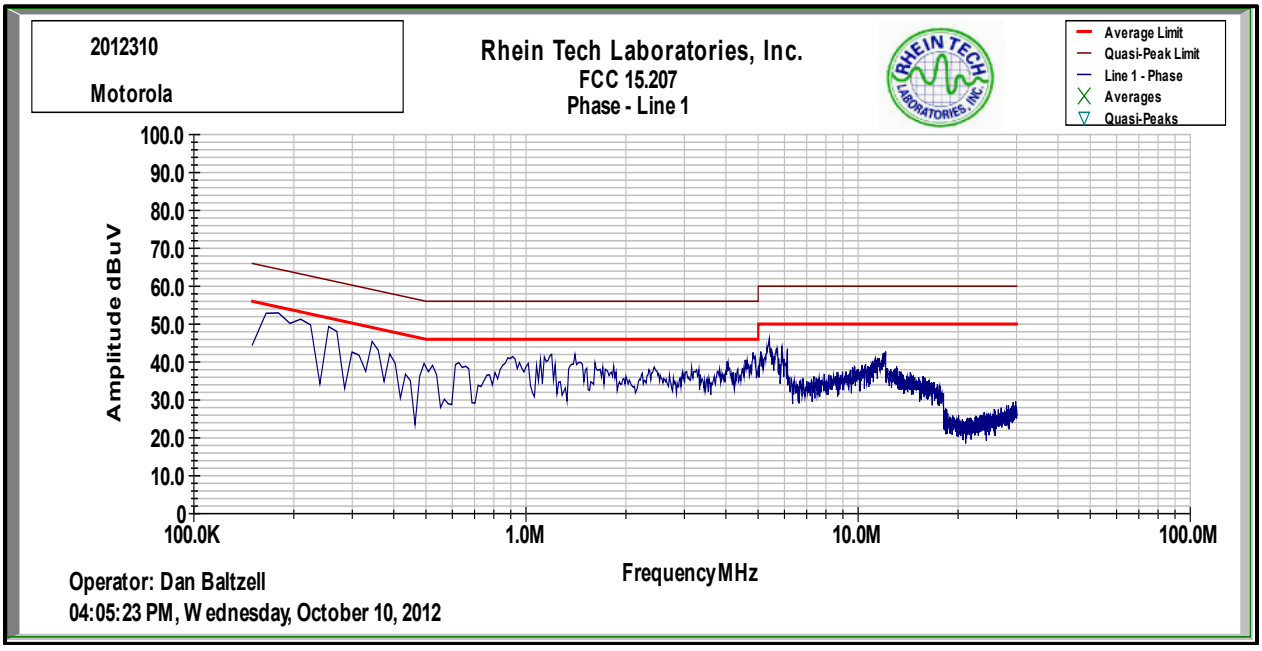
Plot 8-2: Conducted Emissions Test Data – Hot – RX Mode



Plot 8-3: Conducted Emissions Test Data – Neutral - TX Mode



Plot 8-4: Conducted Emissions Test Data – Hot – TX Mode



Test Personnel:

Daniel W. Baltzell		October 10, 2012
Test Engineer	Signature	Date of Tests

9 Radiated Emissions - FCC §15.209, 15.205; IC RSS-Gen; RSS-210 2.2

As shown in 15.35(b), for frequencies above 1000 MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20 dB under any circumstances of modulation.

9.1 Radiated Emissions Measurement Test Procedure

Before final measurements of radiated emissions were made on the open-field three/ten meter range, the EUT was scanned indoors at one and three meter distances. This was done in order to determine its emissions spectrum signature. The physical arrangement of the test system and associated cabling was varied in order to determine the effect on the EUT's emissions in amplitude, direction and frequency. This process was repeated during final radiated emissions measurements on the open-field range, at each frequency, in order to ensure that maximum emission amplitudes were attained.

Final radiated emissions measurements were made on the three/ten-meter, open-field test site. The EUT was placed on a nonconductive turntable 0.8 meters above the ground plane. The spectrum was examined from 9 kHz to the 10^{th} harmonic of the highest fundamental transmitter frequency (24.8 GHz).

At each frequency, the EUT was rotated 360°, and the antenna was raised and lowered from 1 to 4 meters in order to determine the emission's maximum level. Measurements were taken using both horizontal and vertical antenna polarizations. For frequencies between 30 and 1000 MHz, the spectrum analyzer's 6 dB bandwidth was set to 120 kHz, and the analyzer was operated in the CISPR quasi-peak detection mode. For emissions above 1000 MHz, emissions are measured using the average detector function with a minimum resolution bandwidth of 1 MHz. No video filter less than 10 times the resolution bandwidth was used. The highest emission amplitudes relative to the appropriate limit were measured and recorded in this report.

Table 9-1: Radiated Emissions Test Equipment

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
900151	Rohde & Schwarz	HFH2-Z2	Loop Antenna	827525/019	10/1/13
901581	Rohde & Schwarz	1166.1660.50	Spectrum Analyzer	2001006	6/3/13
900878	Rhein Tech Laboratories	AM3-1197-0005	3 meter antenna mast,	OATS1	Not Required
901242	Rhein Tech Laboratories	WRT-000-0003	Wood rotating table	N/A	Not Required
900772	EMCO	3161-02	Horn Antenna (2 - 4 GHz)	9804-1044	4/19/14
900321	EMCO	3161-03	Horn Antennas (4 – 8.2 GHz)	9508-1020	4/19/14
900323	EMCO	3160-7	Horn Antennas (8.2 – 12.4 GHz)	9605-1054	4/19/14
900356	EMCO	3160-08	Horn Antenna (12.4 - 18 GHz)	9607-1044	4/19/14
900325	EMCO	3160-9	Horn Antennas (18 - 26.5 GHz)	9605-1051	4/19/14
900791	Chase	CBL6111B	Bilog Antenna (30 MHz – 2000 MHz)	N/A	1/31/13
901592	Insulated Wire Inc.	KPS-1503-3600-KPR	SMK RF Cables 20’	NA	8/16/13
901593	Insulated Wire Inc.	KPS-1503-360-KPR	SMK RF Cables 36”	NA	8/16/13
900932	Hewlett Packard	8449B OPT H02	Preamplifier (1 - 26.5 GHz)	3008A00505	8/10/13

9.2 Radiated Emissions Test Results

9.2.1 Radiated Emissions Harmonics/Spurious Test Data

Table 9-2: Radiated Emissions Harmonics/Spurious (2425 MHz) Average

Emission Frequency (MHz)	Average Analyzer Reading (dBuV) (1 MHz RBW/ 10 Hz VBW)	Site Correction Factor (dB/m)	Average Emission Level (dBuV/m)	Average Limit (dBuV/m)	Average Margin (dB)
4850	55.1	-2.1	53.0	54.0	-1.0
7275	35.2	3.2	38.4	54.0	-15.6
12125	31.4	10.3	41.7	54.0	-12.3
19400	29.6	20.4	50.0	54.0	-4.0

Table 9-3: Radiated Emissions Harmonics/Spurious (2425 MHz) Peak

Emission Frequency (MHz)	Peak Analyzer Reading (dBuV) (1 MHz RBW/ VBW)	Site Correction Factor (dB/m)	Peak Emission Level (dBuV/m)	Peak Limit (dBuV/m)	Peak Margin (dB)
4850	60.4	-2.1	58.3	74.0	-15.7
7275	47.0	3.2	50.2	74.0	-23.8
12125	43.7	10.3	54.0	74.0	-20.0
19400	43.9	20.4	64.3	74.0	-9.7

Table 9-4: Radiated Emissions Harmonics/Spurious (2450 MHz) Average

Emission Frequency (MHz)	Average Analyzer Reading (dBuV) (1 MHz RBW/ 10 Hz VBW)	Site Correction Factor (dB/m)	Average Emission Level (dBuV/m)	Average Limit (dBuV/m)	Average Margin (dB)
4900	52.0	-2.3	49.7	54.0	-4.3
7350	36.8	3.5	40.3	54.0	-13.7
12250	32.8	10.4	43.2	54.0	-10.8
19600	30.4	19.9	50.3	54.0	-3.7
22050	30.4	21.0	51.4	54.0	-2.6

Table 9-5: Radiated Emissions Harmonics/Spurious (2450 MHz) Peak

Emission Frequency (MHz)	Peak Analyzer Reading (dBuV) (1 MHz RBW/ VBW)	Site Correction Factor (dB/m)	Peak Emission Level (dBuV/m)	Peak Limit (dBuV/m)	Peak Margin (dB)
4900	60.5	-2.3	58.2	74.0	-15.8
7350	48.6	3.5	52.1	74.0	-21.9
12250	45.6	10.4	56.0	74.0	-18.0
19600	44.1	19.9	64.0	74.0	-10.0
22050	44.8	21.0	65.8	74.0	-8.2

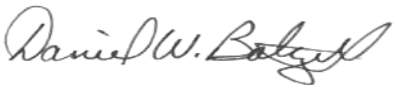
Table 9-6: Radiated Emissions Harmonics/Spurious (2475 MHz) Average

Emission Frequency (MHz)	Average Analyzer Reading (dBuV) (1 MHz RBW/ 10 Hz VBW)	Site Correction Factor (dB/m)	Average Emission Level (dBuV/m)	Average Limit (dBuV/m)	Average Margin (dB)
4950	48.7	-2.0	46.7	54.0	-7.3
7425	39.6	2.9	42.5	54.0	-11.5
12375	32.4	10.2	42.6	54.0	-11.4
19800	29.9	20.1	50.0	54.0	-4.0
22275	30.3	22.1	52.4	54.0	-1.6

Table 9-7: Radiated Emissions Harmonics/Spurious (2475 MHz) Peak

Emission Frequency (MHz)	Peak Analyzer Reading (dBuV) (1 MHz RBW/ VBW)	Site Correction Factor (dB/m)	Peak Emission Level (dBuV/m)	Peak Limit (dBuV/m)	Peak Margin (dB)
4950	57.8	-2.0	55.8	74.0	-18.2
7425	51.3	2.9	54.2	74.0	-19.8
12375	45.3	10.2	55.5	74.0	-18.5
19800	43.7	20.1	63.8	74.0	-10.2
22275	44.7	22.1	66.8	74.0	-7.2

Test Personnel:



Daniel Baltzell		October 11, 2012
Test Engineer	Signature	Date of Test

10 Conclusion

The data in this measurement report shows that the EUT as tested, Motorola, Inc. Set Top Box Model DCX3600, FCC ID: ACQ-DCX3600, IC: 109AS-DCX3600, complies with all the applicable requirements of Parts 2 and 15 of the FCC Rules and Regulations and IC RSS-210.