Excellence in Compliance Testing

Certification Test Report

FCC ID: YTH0656A05
IC: 9174A-0656A05

FCC Rule Part: 15.247
IC Radio Standards Specification: RSS-210

ACS Report Number: 10-0140.W06.33.A

Manufacturer: Global Moisture Management Systems
Model: 0656A05

Test Begin Date: August 16, 2010
Test End Date: August 30, 2010

Report Issue Date: October 14, 2010

FOR THE SCOPE OF ACCREDITATION UNDER LAB Code 200612-0

This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.

Reviewed by:
Kirby Munroe
Director, Wireless Certifications
ACS, Inc.

This report contains 20 pages

TABLE OF CONTENTS

1 GENERAL

1.1 Purpose

The purpose of this report is to demonstrate compliance with Part 15 Subpart C of the FCC's Code of Federal Regulations and Industry Canada's Radio Standards Specification RSS-210.

1.2 Product description

The WaterSafe® Leak Management System is designed to protect a residential living space from potentially damaging water leaks that may occur in the home. If a water leak is detected, the system automatically shuts off the main water supply via a shut-off valve to the house, thus preventing large-scale water damage to the home.

Model 0656A07 is a leak detection sensor. Sensors are placed under each appliance to monitor moisture content and wirelessly communicate with a control panel monitor.

Frequency Band:	2405MHz – 2475MHz
# Channels:	15
Channel Spacing:	5MHz
Modulation:	O-QPSK (Offset-Quadrature Phase Shift Keying) 4-bit symbols
Antenna(s):	Chip Dielectric Antenna - 2.8dBi Maximum Gain
Operating Voltage:	3V Battery

Manufacturer Information:
Global Moisture Management Systems
11132 Broad River Road Suite A
Irmo, SC 29063

Test Sample Serial Number(s): ACS #27

Test Sample Condition: The test samples were provided in good working order with no visible defects.

1.3 Test Methodology and Considerations

Model 0656A07 was tested in an orientation of typical use for radiated emissions. For controlling test modes, the device was provided with an external serial connection which is not available during normal operation. Care was taken to ensure this temporary serial connection did not impact the results of testing. The device also provides an internal switch power connector for RF conducted measurements.

2 TEST FACILITIES

2.1 Location

The radiated and conducted emissions test sites are located at the following address:

Advanced Compliance Solutions
5015 B.U. Bowman Drive
Buford, GA 30518
Phone: (770) 831-8048
Fax: (770) 831-8598

2.2 Laboratory Accreditations/Recognitions/Certifications

ACS is accredited to ISO/IEC 17025 by the National Institute of Standards and Technology under their National Voluntary Laboratory Accreditation Program (NVLAP), Lab Code 200612-0. Unless otherwise specified, all tests methods described within this report are covered under the ISO/IEC 17025 scope of accreditation.

The Semi-Anechoic Chamber Test Site, Open Area Test Site (OATS) and Conducted Emissions Site have been fully described, submitted to, and accepted by the FCC, Industry Canada and the Japanese Voluntary Control Council for Interference by information technology equipment.

FCC Registration Number: 894540
Industry Canada Lab Code: IC 4175A-1
VCCI Member Number: 1831

- VCCI OATS Registration Number R-1526
- VCCI Conducted Emissions Site Registration Number: C-1608

2.3 Radiated Emissions Test Site Description

2.3.1 Semi-Anechoic Chamber Test Site

The Semi-Anechoic Chamber Test Site consists of a 20' x 30' x 18' shielded enclosure. The chamber is lined with Toyo Ferrite Grid Absorber, model number FFG-1000. The ferrite tile grid is 101 x 101 x 19mm thick and weighs approximately 550 grams. These tiles are mounted on steel panels and installed directly on the inner walls of the chamber.

The turntable is 150cm in diameter and is located 160cm from the back wall of the chamber. The chamber is grounded via 1 - 8' copper ground rod, installed at the center of the back wall, it is bound to the ground plane using 3/4" stainless steel braided cable.

The turntable is all steel, flush mounted table installed in an all steel frame. The table is remotely operated from inside the control room located 25' from the range. The turntable is electrically bonded to the surrounding ground plane via steel fingers installed on the edge of the turn table. The steel fingers make constant contact with the ground plane during operation.

Behind the turntable is a 3' x 6' x 4' deep shielded pit used for support equipment if necessary. The pit is equipped with 1 - 4" PVC chases from the turntable to the pit that allow for cabling to the EUT if necessary. The underside of the turntable can be accessed from the pit so cables can be supplied to the EUT from the pit.

A diagram of the Semi-Anechoic Chamber Test Site is shown in Figure 2.3-1 below:

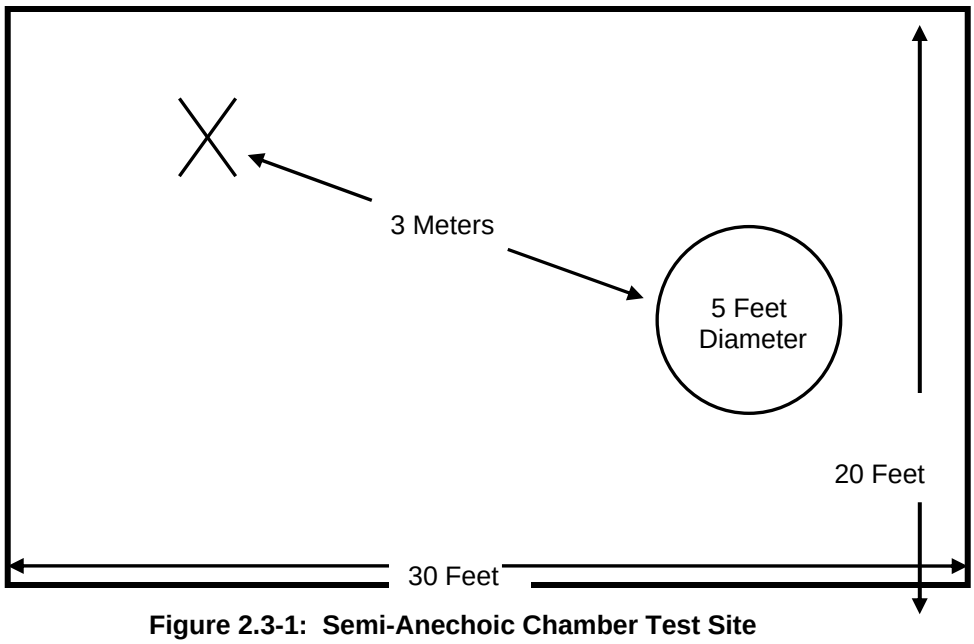


Figure 2.3-1: Semi-Anechoic Chamber Test Site

2.3.2 Open Area Tests Site (OATS)

The open area test site consists of a 40' x 66' concrete pad covered with a perforated electro-plated galvanized sheet metal. The perforations in the sheet metal are 1/8" holes that are staggered every 3/16". The individual sheets are placed to overlap each other by 1/4" and are riveted together to provide a continuous seam. Rivets are spaced every 3" in a 3 x 20 meter perimeter around the antenna mast and EUT area. Rivets in the remaining area are spaced as necessary to properly secure the ground plane and maintain the electrical continuity.

The entire ground plane extends 12' beyond the turntable edge and 16' beyond the antenna mast when set to a 10 meter measurement distance. The ground plane is grounded via 4 - 8' copper ground rods, each installed at a corner of the ground plane and bound to the ground plane using 3/4" stainless steel braided cable.

The turntable is an all aluminum 10' flush mounted table installed in an all aluminum frame. The table is remotely operated from inside the control room located 40' from the range. The turntable is electrically bonded to the surrounding ground plane via steel fingers installed on the edge of the turn table. The steel fingers make constant contact with the ground plane during operation.

Adjacent to the turntable is a 7' x 7' square and 4' deep concrete pit used for support equipment if necessary. The pit is equipped with 5 - 4" PVC chases from the pit to the control room that allow for cabling to the EUT if necessary. The underside of the turntable can be accessed from the pit so cables can be supplied to the EUT from the pit. The pit is covered with 2 sheets of 1/4" diamond style re-enforced steel sheets. The sheets are painted to match the perforated steel ground plane; however the underside edges have been masked off to maintain the electrical continuity of the ground plane. All reflecting objects are located outside of the ellipse defined in ANSI C63.4.

A diagram of the Open Area Test Site is shown in Figure 2.3-2 below:

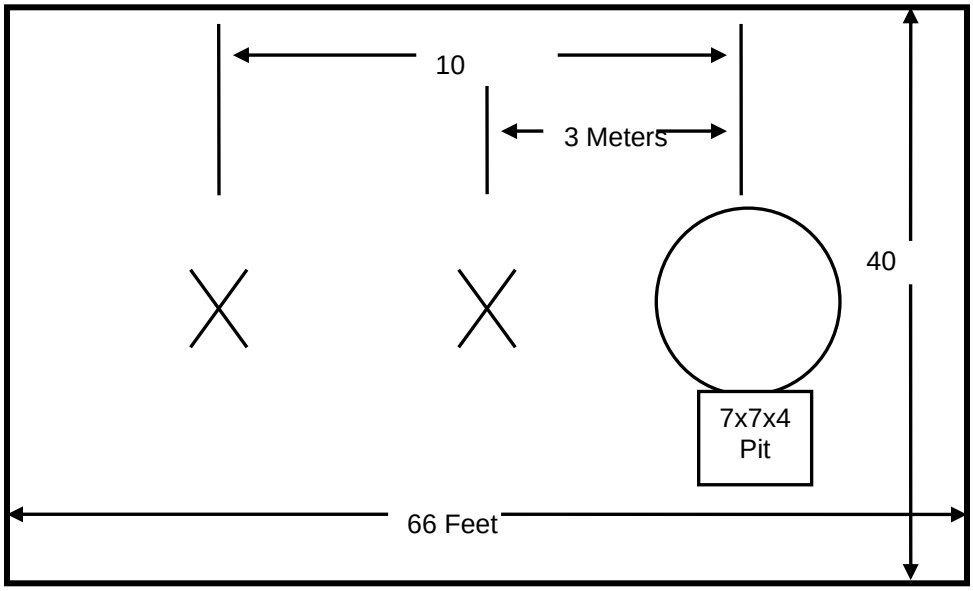


Figure 2.3-2: Open Area Test Site

2.4 Conducted Emissions Test Site Description

The AC mains conducted EMI site is located in the main EMC lab. It consists of an 8' x 8' solid aluminum horizontal group reference plane (GRP) bonded every 3" to an 8' X 8' vertical ground plane.

The site is of sufficient size to test table top and floor standing equipment in accordance with section 6.1.4 of ANSI C63.4.

A diagram of the room is shown below in figure 4.1.3-1:

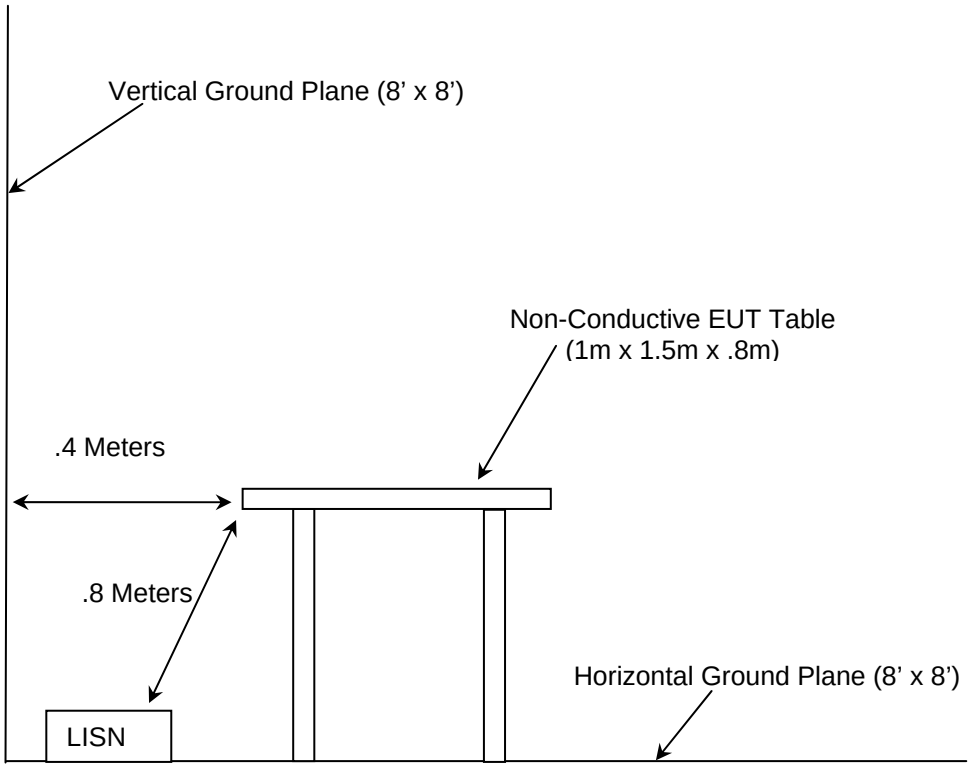


Figure 2.4-1: AC Mains Conducted EMI Site

3 APPLICABLE STANDARD REFERENCES

The following standards were used:

- ANSI C63.4-2003: Method of Measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the 9KHz to 40GHz
- US Code of Federal Regulations (CFR): Title 47, Part 2, Subpart J: Equipment Authorization Procedures, 2010
- US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2010
- FCC KDB Publication No. 558074 - Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247), March 2005
- Industry Canada Radio Standards Specification: RSS-210 - Low-power License-exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment, Issue 7 June 2007
- Industry Canada Radio Standards Specification: RSS-GEN – General Requirements and Information for the Certification of Radiocommunication Equipment, Issue 2, June 2007.

4 LIST OF TEST EQUIPMENT

The calibration interval of test equipment is annually or the manufacturer's recommendations. Where the calibration interval deviates from the annual cycle based on the instrument manufacturer's recommendations, it shall be stated below.

Table 4-1: Test Equipment

Equipment Calibration Information					
ACS#	**Mfg.**	**Eq. type**	**Model**	**S/N**	**Cal. Due**
1	Rohde & Schwarz	Spectrum Analyzers	ESMI - Display	833771/007	09-21-2010
2	Rohde & Schwarz	Spectrum Analyzers	ESMI-Receiver	839587/003	09-21-2010
25	Chase	Antennas	CBL6111	1043	09-02-2010
30	Spectrum Technologies	Antennas	DRH-0118	970102	05-08-2011 (See Note3)
73	Agilent	Amplifiers	8447D	2727A05624	05-26-2011
167	ACS	Cable Set	Chamber EMI Cable Set	167	01-25-2011 (See Note1)
291	Florida RF Cables	Cables	SMRE-200W-12.0-SMRE	None	11-24-2010 (See Note1)
292	Florida RF Cables	Cables	SMR-290AW-480.0-SMR	None	11-24-2010 (See Note1)
324	ACS	Cables	Belden	8214	07-09-2011
329	A.H.Systems	Antennas	SAS-571	721	08-04-2011 (See Note3)
334	Rohde & Schwarz	Antennas	3160-10	00045576	No Cal Req
335	Suhner	Cables	SF-102A	882/2A	10-16-2010
338	Hewlett Packard	Amplifiers	8449B	3008A01111	10-16-2010
340	Aeroflex/Weinschel	Attenuators	AS-20	7136	10-16-2010 (See Note2)
345	Suhner	Cables	102-A	1077/2A	10-16-2010
422	Florida RF	Cables	SMS-200AW-72.0-SMR	0805	01-26-2011 (See Note2)
432	Microwave Circuits	Filter	H3G020G4	264066	07-16-2011 (See Note1)
RE39	Rohde & Schwarz	Spectrum Analyzers	FSU46	200009	07-27-2011

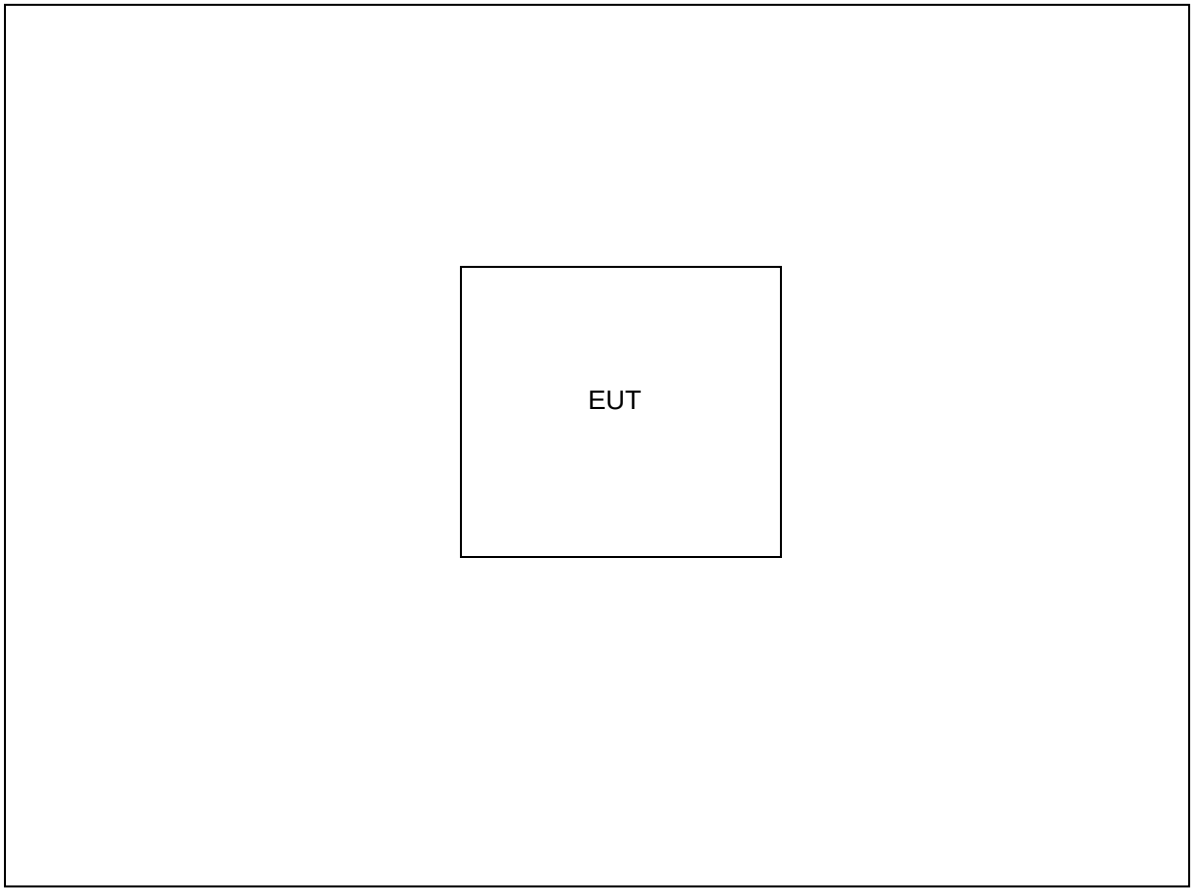
Note1: Items characterized on an annual cycle. The date shown indicates the next characterization due date.
Note2: Items verified on an annual cycle. The date shown indicates the next verification due date.
Note3: Calibration interval is based on manufacturer's recommendation and is on a 2 year cycle.

5 SUPPORT EQUIPMENT

Table 5-1: Support Equipment

Item	Equipment Type	Manufacturer	Model Number	Serial Number
The EUT is a standalone battery operated device with no support equipment required.				

6 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM



Note: For RF conducted measurements, the EUT was connected directly to the RF input of a spectrum analyzer.

7 SUMMARY OF TESTS

Along with the tabular data shown below, plots were taken of all signals deemed important enough to document.

7.1 Antenna Requirement – FCC: Section 15.203

The antenna is an integral chip dielectric antenna (Murata Part Number ANCW12G45SAA117) with 2.8dBi maximum gain.

7.2 Radiated Emissions – FCC: Section 15.109(Unintentional Radiation) IC: RSS-210 2.6

7.2.1 Measurement Procedure

Radiated emissions tests were performed over the frequency range of 30MHz to 12.5GHz. Measurements of the radiated field strength were made at a distance of 3m from the boundary of the equipment under test (EUT) and the receiving antenna. The antenna height was varied from 1m to 4m so that the maximum radiated emissions level would be detected. Radiated measurements above 30MHz and below 1GHz were made with the Spectrum Analyzer's resolution bandwidth set to 120 KHz using a Quasi-peak detector. Above 1GHz, peak and average measurements are taken with the RBW and VBW were set to 1MHz and 3MHz respectively.

7.2.2 Measurement Results

Results of the test are given in Table 7.2.2-1:

Table 7.2.2-1: Radiated Emissions Tabulated Data

Frequency (MHz)	Level (dBuV)		Antenna Polarity	Correction Factors	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg	(H/V)	(dB)	pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
30	---------	18.23	V	-6.70	---------	11.53	--------	40.0	---------	28.50
96.82	---------	30.22	H	-14.97	---------	15.25	--------	43.5	---------	28.30
344.71	---------	19.20	H	-9.31	---------	9.89	--------	46.0	---------	36.10
491.29	---------	20.34	H	-5.67	---------	14.67	--------	46.0	---------	31.30
702.53	---------	20.59	V	-1.25	---------	19.34	--------	46.0	---------	26.70
953.66	---------	20.31	H	3.32	---------	23.63	--------	46.0	---------	22.40

* Note: All emissions above 953.66 MHz were attenuated below the permissible limit.

7.3 6dB / 99% Bandwidth – FCC: Section 15.247(a)(2) IC: RSS-210 A8.2(a)

7.3.1 Measurement Procedure

The 6dB bandwidth was measured in accordance with the FCC KDB Publication No. 558074 "Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247)". The RBW of the spectrum analyzer was set to 100 kHz and VBW 300 kHz. Span was set large enough to capture the entire emissions and >> RBW.

The 99% occupied bandwidth was measured with the spectrum analyzer span set to fully display the emission and approximately 20 dB below the peak level. The RBW was to 1% - 3% of the estimated emission bandwidth. The trace was set to max hold with a peak detector active. The occupied bandwidth measurement function of the analyzer was used for the 99% bandwidth.

7.3.2 Measurement Results

Results are shown below in table 7.3.2-1 and figure 7.3.2-1 to 7.3.2-6:

Table 7.3.2-1: 6dB / 99% Bandwidth

Frequency [MHz]	6dB Bandwidth [MHz]	99% Bandwidth [MHz]
2405	1.58	2.28
2440	1.56	2.26
2475	1.58	2.28

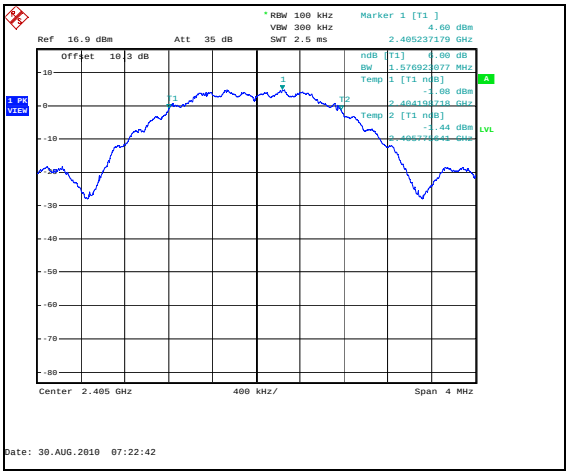


Figure 7.3.2-1: 6dB Bandwidth Plot – 2405MHz

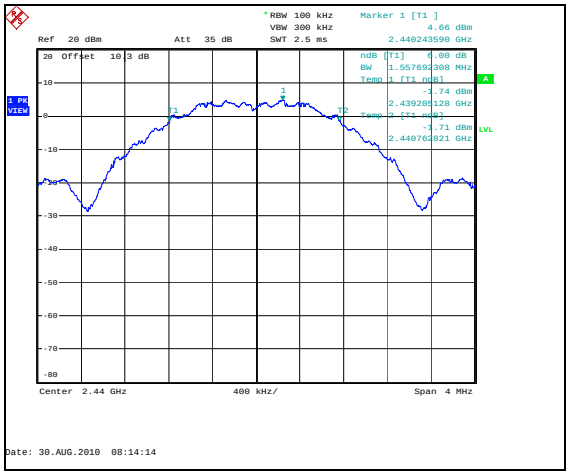


Figure 7.3.2-2: 6dB Bandwidth Plot – 2440MHz

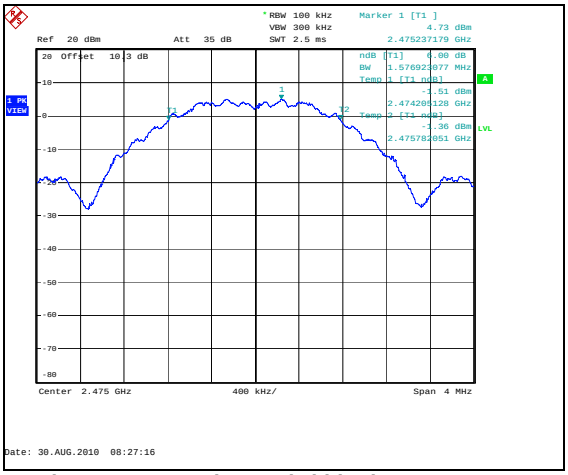


Figure 7.3.2-3: 6dB Bandwidth Plot – 2475MHz

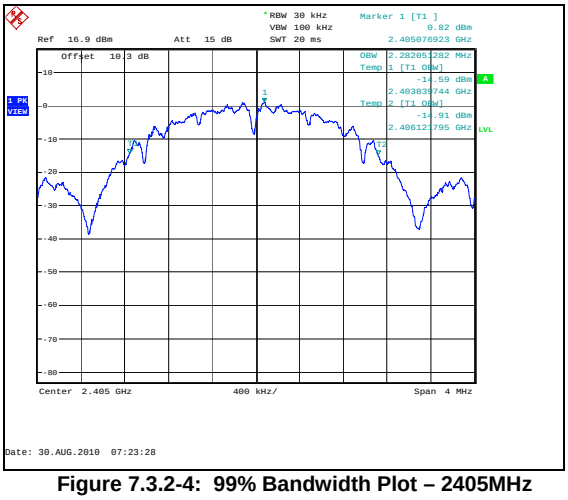


Figure 7.3.2-4: 99% Bandwidth Plot – 2405MHz

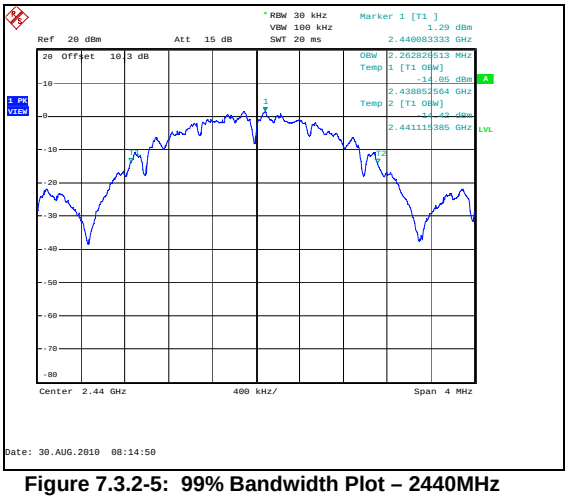


Figure 7.3.2-5: 99% Bandwidth Plot – 2440MHz

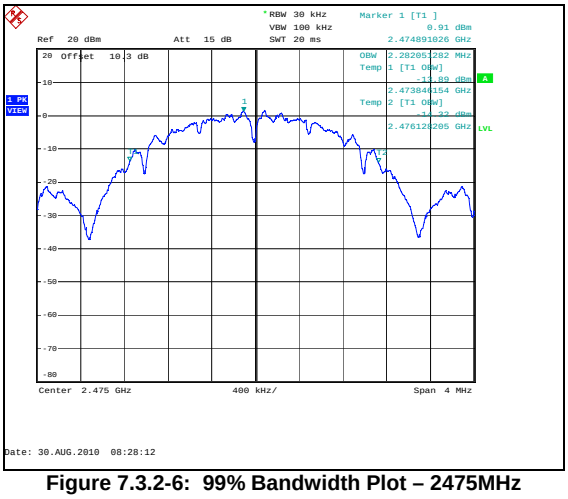


Figure 7.3.2-6: 99% Bandwidth Plot – 2475MHz

7.4 Peak Output Power Requirement - FCC Section 15.247(b)(3) IC: RSS-210 A8.4(4)

7.4.1 Measurement Procedure

The Peak Output Power was measured in accordance with the FCC KDB Publication No. 558074 "Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247)" Power Option 1. The RF output of the equipment under test was directly connected to the input of the Spectrum Analyzer. Data was collected with the EUT operating at maximum power per channelization.

7.4.2 Measurement Results

Results are shown below in Table 7.4.2-1 and Figures 7.4.2-1 to 7.4.2-3.

Table 7.4.2-1: Peak Output Power

Frequency (MHz)	Output Power (dBm)
2405	7.73
2440	8.09
2475	8.54

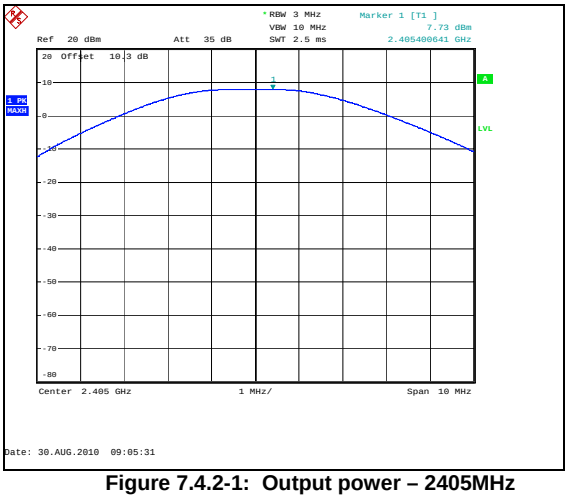


Figure 7.4.2-1: Output power – 2405MHz

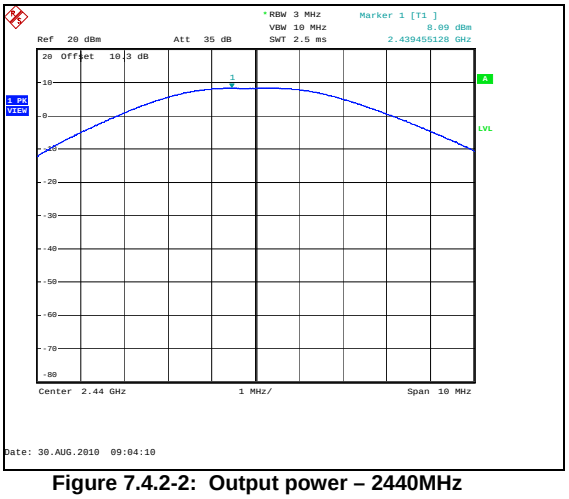


Figure 7.4.2-2: Output power – 2440MHz

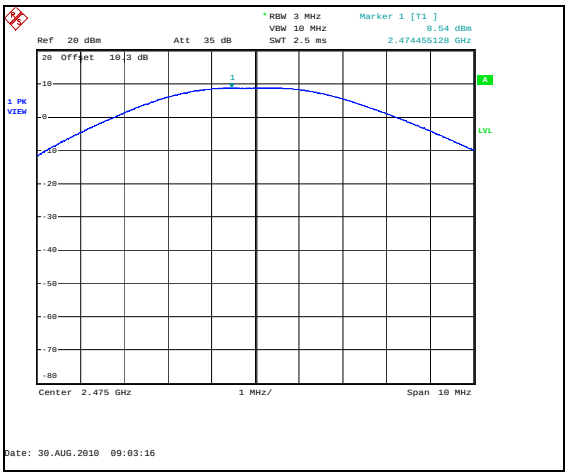


Figure 7.4.2-3: Output power – 2475MHz

7.5 Band-Edge Compliance and Spurious Emissions-FCC 15.247d IC:RSS-210 2.6, A8.5

7.5.1 Band-Edge Compliance of RF Conducted Emissions

7.5.1.1 Measurement Procedure

The EUT was investigated at the low and high channels of operation to determine band-edge compliance. All antenna types were evaluated. Because the upper band-edge coincides with a restricted band, band-edge compliance for the upper band-edge was determined based on absolute radiated field strength measurements.

The lower band-edge compliance was determined using the conducted marker-delta method in which the radio frequency power that is produced by the EUT is at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of desired power.

7.5.1.2 Measurement Results

Band-edge compliance is displayed in Table 7.5.1.2-1 and Figure 7.5.1.2-1.

Table 7.5.1.2-1: Upper Band-edge Radiated Emissions - 2475MHz

Frequency (MHz)	Level (dBuV)		Antenna Polarity	Correction Factors	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg	(H/V)	(dB)	pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
2483.5	58.04	47.32	H	-4.16	53.88	31.79	74.0	54.0	20.10	22.20
2483.5	63.83	53.39	V	-4.16	59.67	37.86	74.0	54.0	14.30	16.10

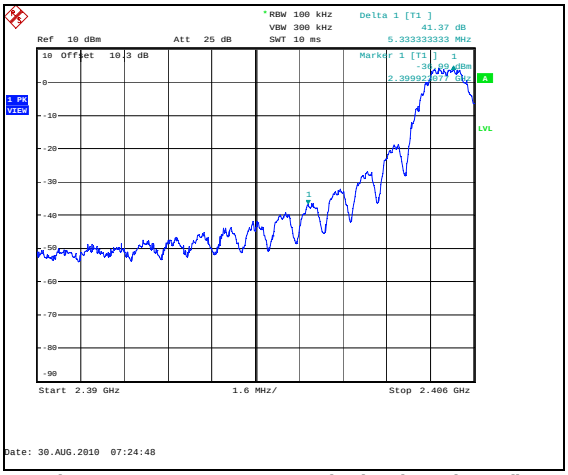


Figure 7.5.1.2-1: Lower Band-edge (Conducted)

7.5.2 RF Conducted Spurious Emissions

7.5.2.1 Measurement Procedure

The RF Conducted Spurious Emissions were measured in accordance with the FCC KDB Publication No. 558074 "Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247)". The RF output of the equipment under test was directly connected to the input of the Spectrum Analyzer. The EUT was investigated for conducted spurious emissions from 30MHz to 25GHz, 10 times the highest fundamental frequency. For each measurement, the spectrum analyzer's RBW was set to 100 kHz and the VBW was set to 300 kHz. The peak detector and Max Hold function of the analyzer were utilized.

7.5.2.2 Measurement Results

In a 100 kHz bandwidth, the radio frequency power that was produced by the EUT emissions is at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of desired power. RF Conducted Emissions are displayed in Figures 7.5.2.2-1 through 7.5.2.2-9.

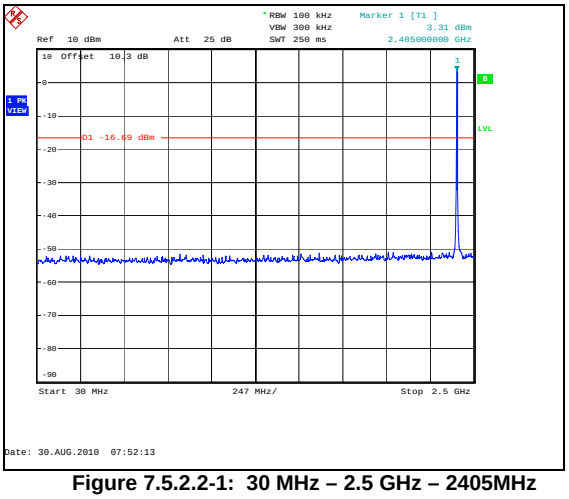


Figure 7.5.2.2-1: 30 MHz – 2.5 GHz – 2405MHz

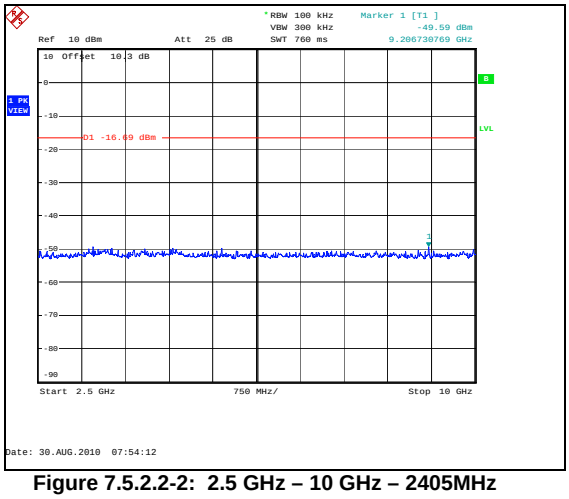


Figure 7.5.2.2-2: 2.5 GHz – 10 GHz – 2405MHz

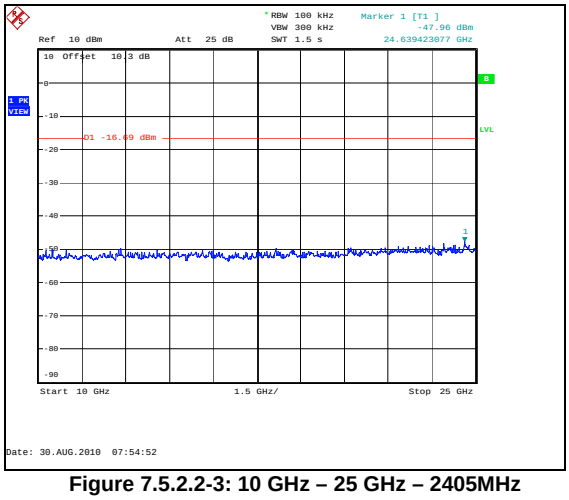


Figure 7.5.2.2-3: 10 GHz – 25 GHz – 2405MHz

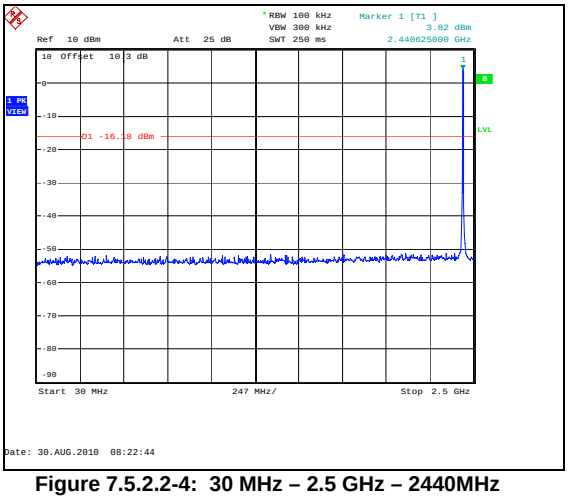


Figure 7.5.2.2-4: 30 MHz – 2.5 GHz – 2440MHz

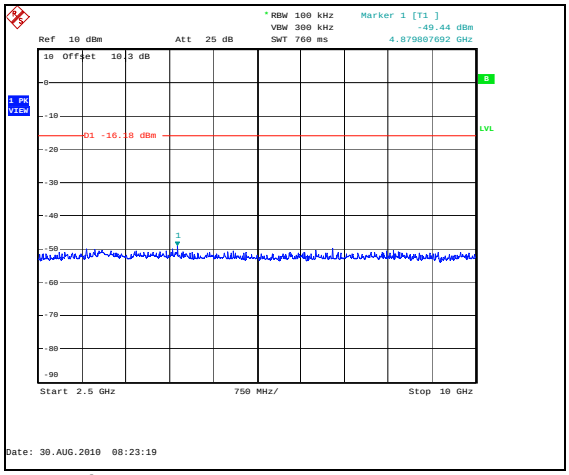


Figure 7.5.2.2-5: 2.5 GHz – 10 GHz – 2440MHz

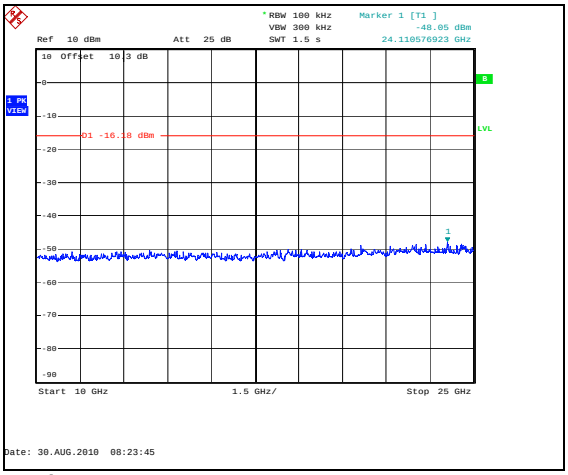


Figure 7.5.2.2-6: 10 GHz – 25 GHz – 2440MHz

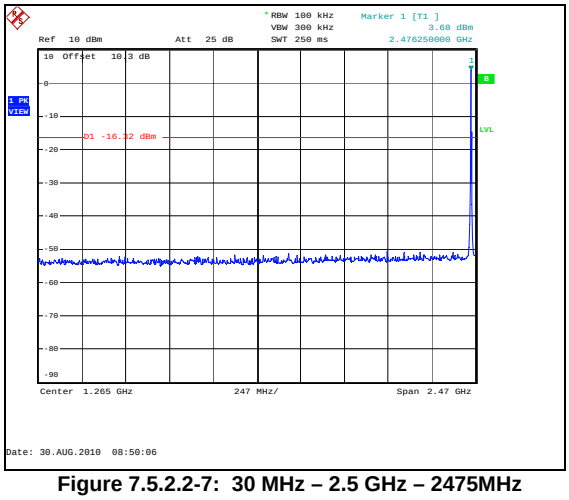


Figure 7.5.2.2-7: 30 MHz – 2.5 GHz – 2475MHz

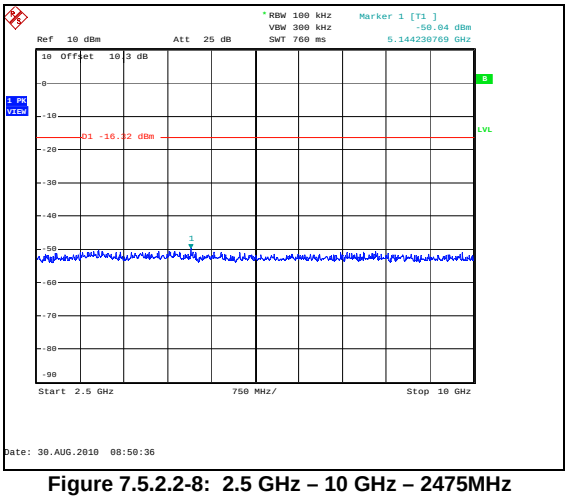


Figure 7.5.2.2-8: 2.5 GHz – 10 GHz – 2475MHz

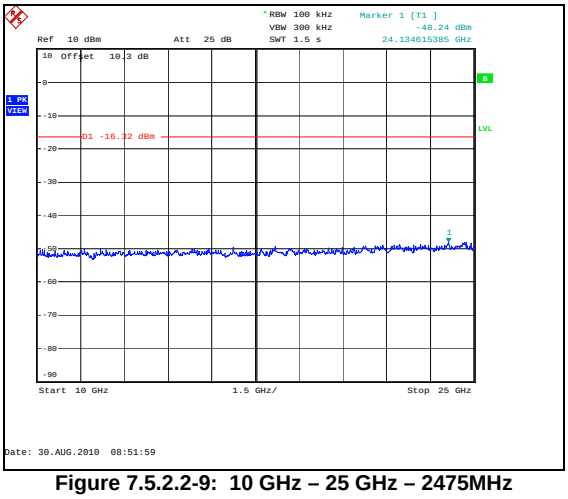


Figure 7.5.2.2-9: 10 GHz – 25 GHz – 2475MHz

7.5.3 Radiated Spurious Emissions (Restricted Bands) - FCC Sec. 15.205 IC: RSS-210 2.6

7.5.3.1 Measurement Procedure

Radiated emissions tests were made over the frequency range of 30MHz to 25 GHz, 10 times the highest fundamental frequency.

The EUT was rotated through 360° and the receive antenna height was varied from 1m to 4m so that the maximum radiated emissions level would be detected. For frequencies below 1000MHz, quasi-peak measurements were made using a resolution bandwidth RBW of 120 kHz and a video bandwidth VBW of 300 kHz. For frequencies above 1000MHz, peak and average measurements were made with RBW and VBW of 1 MHz and 3 MHz respectively. The average emissions were further corrected by applying the duty cycle correction of the EUT for comparison to the average limit.

Each emission found to be in a restricted band as defined by section 15.205 was compared to the radiated emission limits as defined in section 15.209.

7.5.3.2 Duty Cycle Correction

For average radiated measurements, using a 27% duty cycle, the measured level was reduced by a factor 11.37dB. The duty cycle correction factor is determined using the formula: 20log (27/100) = 11.37dB.

A detailed analysis of the duty cycle timing is provided in the Theory of Operation accompanying this report.

7.5.3.3 Measurement Results

Radiated spurious emissions found in the band of 30MHz to 25GHz are reported in the tables below.

Table 7.5.3.3-1: Radiated Spurious Emissions Tabulated Data – 2405MHz

Frequency (MHz)	Level (dBuV)		Antenna Polarity	Correction Factors	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg	(H/V)	(dB)	pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
4810	61.39	54.36	H	3.17	64.56	46.16	74.0	54.0	9.40	7.80
4810	64.69	58.17	V	3.17	67.86	49.97	74.0	54.0	6.10	4.00

* Note: All emissions above 4810 MHz were attenuated below the permissible limit.

Table 7.5.3.3-2: Radiated Spurious Emissions Tabulated Data – 2440MHz

Frequency (MHz)	Level (dBuV)		Antenna Polarity	Correction Factors	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg	(H/V)	(dB)	pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
4880	61.71	54.71	H	3.38	65.09	46.72	74.0	54.0	8.90	7.30
4880	66.17	59.64	V	3.38	69.55	51.65	74.0	54.0	4.40	2.30

* Note: All emissions above 4880 MHz were attenuated below the permissible limit.

Table 7.5.3.3-3: Radiated Spurious Emissions Tabulated Data – 2475MHz

Frequency (MHz)	Level (dBuV)		Antenna Polarity	Correction Factors	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg	(H/V)	(dB)	pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
4950	64.77	58.14	H	3.60	68.37	50.36	74.0	54.0	5.60	3.60
4950	67.87	61.32	V	3.60	71.47	53.54	74.0	54.0	2.50	0.50

* Note: All emissions above 4950 MHz were attenuated below the permissible limit.

7.5.3.4 Sample Calculation:

$R_C = R_U + CF_T$

Where:

CF_T = Total Correction Factor (AF+CA+AG)-DC (Average Measurements Only)
R_U = Uncorrected Reading
R_C = Corrected Level
AF = Antenna Factor
CA = Cable Attenuation
AG = Amplifier Gain
DC = Duty Cycle Correction Factor

Example Calculation: Peak

Corrected Level: 61.39+ 3.17 = 64.56dBuV/m
Margin: 74dBuV/m – 64.56dBuV/m = 9.4dB

Example Calculation: Average

Corrected Level: 54.36 + 3.17 – 11.37 = 46.16dBuV
Margin: 54dBuV – 46.16dBuV = 7.8dB

7.6 Peak Power Spectral Density- FCC Section 15.247(e) IC: RSS-210 A8.2(b)

7.6.1 Measurement Procedure

The power spectral density was measured in accordance with the FCC KDB Publication No. 558074 "Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247)". The emission peaks within the pass band were located and zoomed in on. The spectrum analyzer RBW was set to 3 kHz and VBW 10 kHz. Span was adjusted to 200 kHz and the sweep time was calculated to be 68s ~ (Span/3 kHz).

7.6.2 Measurement Results

Results are shown below in table 7.6.2-1 and figures 7.6.2-1 – 7.6.2-3:

Table 7.6.2-1: Peak Power Spectral Density

Frequency (MHz)	PSD Level (dBm)
2405	-7.28
2440	-6.34
2475	-6.89

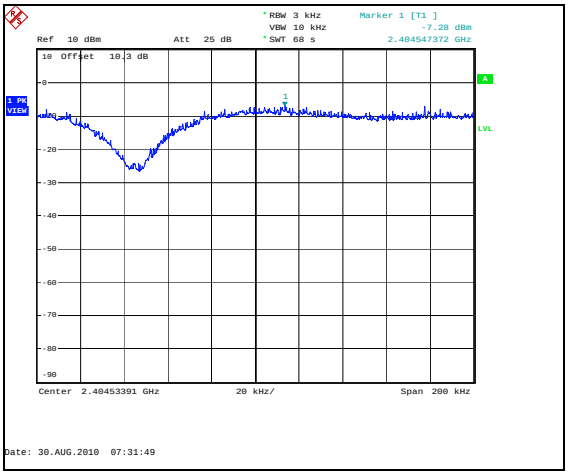


Figure 7.6.2-1: Power Spectral Density Plot – 2405MHz

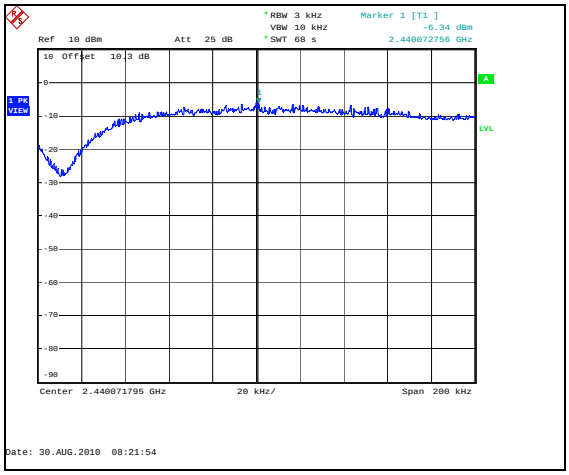


Figure 7.6.2-2: Power Spectral Density Plot – 2440MHz

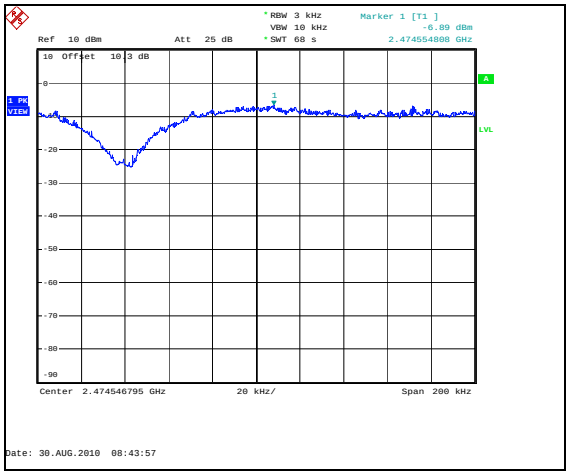


Figure 7.6.2-3: Power Spectral Density Plot – 2475MHz

8 CONCLUSION

In the opinion of ACS, Inc. the 0656A05, manufactured by Global Moisture Management Systems meets the requirements of FCC Part 15 subpart C and Industry Canada's Radio Standards Specification RSS-210.

END REPORT