LS RESEARCH, LLC
WIRELESS PRODUCT DEVELOPMENT
ACCREDITED
Testing Cert. 1255.01
W66 N220 Commerce Court ● Cedarburg, WI 53012 ● USA
Phone: 262.375.4400 ● Fax: 262.375.4248
www.lsr.com

TEST REPORT # 309135 TCB
LSR Job #:C-626

Compliance Testing of:
Ingersoll Rand 900MHz Communications Module.

Test Date(s):
September 17th to October 5th 2009

Prepared For:
Ingersoll Rand
11819 N. Pennsylvania St.
Carmel, IN 46032

In accordance with:
Federal Communications Commission (FCC)
Part 15, Subpart C, Section 15.247
Industry Canada (IC) RSS 210 Annex 8
Digital Modulation Transmitters (DTS) Operating in the
Frequency Band 902 MHz – 2483.5 MHz

Test Report Reviewed by: Teresa A. White, Quality Manager Signature: Teresa A. White Date: October 14, 2009	**Tested by:** Khairul Aidi Zainal, Senior EMC Engineer Signature: Date: October 14, 2009

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EXHIBIT 1. INTRODUCTION

1.1 SCOPE

References:	FCC Part 15, Subpart C, Section 15.247 and 15.209 FCC Part 2, Section 2.1043 paragraph (b)1. RSS GEN and RSS 210 Annex 8
Title:	FCC : Telecommunication – Code of Federal Regulations, CFR 47, Part 15. IC : Low-power License-exempt Radio-communication Devices (All Frequency Bands): Category I Equipment
Purpose of Test:	To gain FCC and IC Certification Authorization for Low-Power License-Exempt Transmitters.
Test Procedures:	Both conducted and radiated emissions measurements were conducted in accordance with American National Standards Institute ANSI C63.4 – American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
Environmental Classification:	• Commercial, Industrial or Business • Residential

1.2 NORMATIVE REFERENCES

Publication	Year	Title
47 CFR, Parts 0-15 (FCC)	2008-10	Code of Federal Regulations - Telecommunications
RSS 210 Annex 8	2007 June	Low-power License-exempt Radio-communication Devices (All Frequency Bands): Category I Equipment
ANSI C63.4	2003	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
CISPR 16-1-1	2006-03 A1: 2006-09 A2: 2007-07	Specification for radio disturbance and immunity measuring apparatus and methods. Part 1-1: Measuring Apparatus.
CISPR 16-2-1	2003 A1: 2004-04 A2: 2007-07	Specification for radio disturbance and immunity measuring apparatus and methods. Part 201: Conducted disturbance measurement.
FCC Public Notice DA 00-1407	2000	Part 15 Unlicensed Modular Transmitter Approval
FCC ET Docket No. 99-231	2002	Amendment to FCC Part 15 of the Commission's Rules Regarding Spread Spectrum Devices.
FCC Procedures	2007	Measurement of Digital Transmission Systems operating under Section 15.247.

1.3 LS Research, LLC TEST FACILITY

LS Research, LLC is accredited by A2LA (American Association for Laboratory Accreditation) to conform to ISO/IEC 17025, 2005 “General Requirements for the Competence of Calibration and Testing Laboratories”.

LS Research, LLC’s scope of accreditation includes all test methods listed herein, unless otherwise noted. A copy of the accreditation may be accessed on our web site: www.lsr.com. Accreditation status can be verified at A2LA’s web site: www.a2la2.net.

1.4 LOCATION OF TESTING

All testing was performed at LS Research, LLC, W66 N220 Commerce Court, Cedarburg, Wisconsin, 53012 USA, utilizing the facilities listed below, unless otherwise noted.

List of Facilities Located at LS Research, LLC:

- Compact Chamber
- Semi-Anechoic Chamber
- Open Area Test Site (OATS)

1.5 TEST EQUIPMENT UTILIZED

A complete list of equipment utilized in testing is provided in Appendix A of this test report. Calibration dates are indicated in Appendix A. All test equipment is calibrated in accordance with A2LA standards.

EXHIBIT 2. PERFORMANCE ASSESSMENT

2.1 CLIENT INFORMATION

Manufacturer Name:	**LS Research**
Address:	**W66 N220 Commerce Ct. Cedarburg, WI 53012**
Contact Name:	**Dave Neperud/Bill Steineke**

2.2 EQUIPMENT UNDER TEST (EUT) INFORMATION

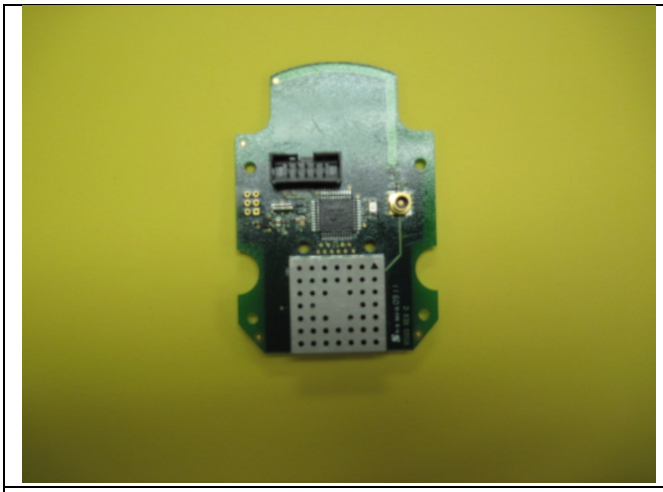
The following information has been supplied by the applicant.

Product Name:	Ingersoll Rand 900MHz Communications Module.
Model Number:	23364490 (With SMT Radial® Switch) 23520463 (Without SMT Radial® Switch)
Serial Number:	135

2.3 ASSOCIATED ANTENNA DESCRIPTION

There are 4 antennas associated with this module:

1. PCB trace inverted-L with a 5.7 dBi maximum gain (Measured).
2. Multiband panel antenna with a 9.3dBi maximum gain (Measured).
3. Dual beam GSM 'Vee' antenna with a 5dBi gain (Data Sheet) .
4. Dual beam WIFI 'Dome' antenna with a 5.7dBi maximum gain (Measured).



1. Inverted L Antenna

4. Dome Antenna (Typical antenna installation)

2. Panel Antenna (Typical antenna installation)

3. Vee Antenna (Typical antenna installation)

2.4 EUT'S TECHNICAL SPECIFICATIONS

Additional Information:

EUT Frequency Range (in MHz)	906MHz to 924MHz
RF Power in Watts	
Minimum:	0.217 Watts (module with inverted L antenna)
Maximum:	0.776 Watts (module with Panel antenna)
Conducted Output Power (in dBm)	19.6 dBm
Field Strength at 3 meters (in dBuV/m)	Inverted L antenna:120.5 dBuV/m (924MHz) Dome antenna:120.5 dBuV/m (924MHz) Panel antenna:124.1 dBuV/m (924 MHz) Vee antenna: 119.8 dBuV/m (916 MHz)
Occupied Bandwidth (99% BW)	850 kHz (0.85MHz)
Type of Modulation	BPSK
Emission Designator	850KG1D
EIRP (in mW) (Conducted power in dBm + declared antenna gain in dBi)	Inverted L antenna: 336.5mW (ERP) Panel antenna: 776.0mW Vee antenna: 288.4mW Dome antenna: 338.8mW
Transmitter Spurious (worst case) at 3 meters	Inverted L antenna: 65.9 dBuV/m (1832 MHz) Dome antenna: 86.6 dBuV/m (1848 MHz) Panel antenna: 94.5 dBuV/m (1832 MHz) Vee antenna: 81.7 dBuV/m (1812 MHz)
Receiver Spurious (worst case) at 3 meters	No spurious emissions detected above system noise floor on all combinations of antenna and on all channels.
Stepped (Y/N)	N
Frequency Tolerance %, Hz, ppm	Better than 100 ppm
Microprocessor Model # (if applicable)	ATMEGA644P-10AU
Antenna Information	
Detachable/non-detachable	Detachable and non-detachable
Type	PCB-trace inverted-L. Multiband panel antenna. Dual beam GSM 'V' antenna. Dual beam WIFI 'Dome' antenna.
Gain (in dBi)	PCB inverted-L:5.7dBi (measured over conducting ground plane). Multiband panel antenna: 9.3dBi (measured over conducting ground plane). Dual beam GSM 'V' antenna: 5dBi gain (measured over conducting ground plane). Dual beam WIFI 'Dome' antenna: 5.7dBi gain *(measured over conducting ground plane).*
EUT will be operated under FCC Rule Part(s)	CFR 47 15.247
EUT will be operated under RSS Rule Part(s)	RSS 210 and RSS GEN
Modular Filing	☒ Yes ☐ No
Portable or Mobile?	Portable

RF Technical Information:

Type of Evaluation (check one)		SAR Evaluation: Device Used in the Vicinity of the Human Head
		SAR Evaluation: Body-worn Device
	√	RF Evaluation

If RF Evaluation checked above, test engineer to complete the following:

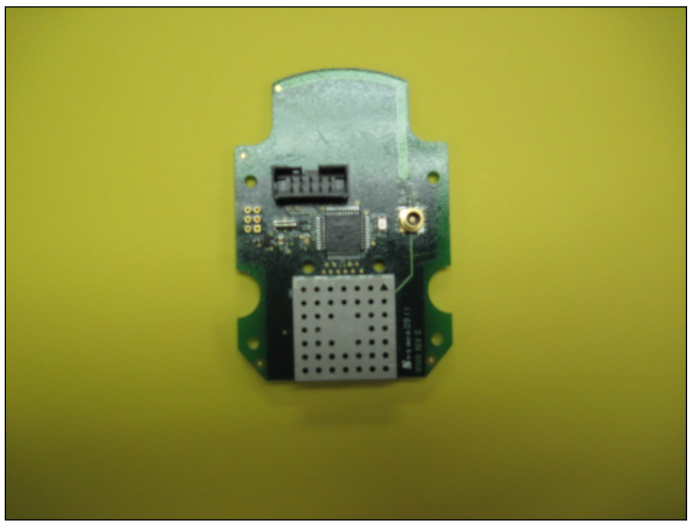
- Evaluated against exposure limits: ☒ General Public Use ☐ Controlled Use
- Duty Cycle used in evaluation: 100 %
- Standard used for evaluation: OET 65
- Measurement Distance: 20 cm
- RF Value: ☐ V/m ☐ A/m ☒ W/m^2
  ☐ Measured ☐ Computed ☒ Calculated

Inverted L antenna: 0.674 *W/m^2*
Panel antenna : 1.544 *W/m^2*
Vee antenna : 0.573 *W/m^2*
Dome antenna : 0.674 *W/m^2*

2.5 PRODUCT DESCRIPTION

The communications module is a 900 MHz transceiver for electronic locks and non-lock devices. The communications module links the access device to the Access Control Management System, with feedback control to the Access Device via a wireless means. The module contains the embedded firmware implementing the radio physical and data layers. There are 4 antennas associated with this module:

1. PCB trace inverted-L with a measured gain of 5.7dBi.
2. Multiband panel antenna with a 9.3dBi gain.
3. Dual beam GSM 'V' antenna with a 5dBi gain.
4. Dual beam WIFI 'Dome' antenna with a 5.7dBi gain.



900MHz Communication module.

EXHIBIT 3. EUT OPERATING CONDITIONS & CONFIGURATIONS DURING TESTS

3.1 CLIMATE TEST CONDITIONS

Temperature:	70° Fahrenheit
Humidity:	38%
Pressure:	738mmHg

3.2 APPLICABILITY & SUMMARY OF EMC EMISSION TEST RESULTS

FCC and IC Paragraph	Test Requirements	Compliance (yes/no)
FCC : 15.207 IC : RSS GEN sect. 7.2.2	Power Line Conducted Emissions Measurements	Yes
FCC : 15.247(a)(2) IC : RSS 210 A8.2(a)	6 dB Bandwidth of a Digital Modulation System	Yes
IC : RSS GEN section 4.6.1	20 dB Bandwidth	Yes
FCC : 15.247(b) & 1.1310 IC : RSS 210 A8.4	Maximum Output Power	Yes
FCC : 15.247(i), 1.1307, 1.1310, 2.1091 & 2.1093 IC : RSS 102	RF Exposure Limit	Yes
FCC :15.247(c) IC : RSS 210 A8.5	RF Conducted Spurious Emissions at the Transmitter Antenna Terminal	Yes
FCC : 15.247(d) IC : RSS 210 A8.2(b)	Transmitted Power Spectral Density of a Digital Modulation System	Yes
FCC : 15.247(c), 15.209 & 15.205 IC : RSS 210 A8.2(b), section 2.2, 2.6 and 2.7	Transmitter Radiated Emissions	Yes
FCC : 15.109 IC : RSS 210 and RSS GEN	Receiver Radiated Emissions	Yes

3.3 MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

☒ **None** ☐ **Yes (explain below)**

3.4 DEVIATIONS & EXCLUSIONS FROM TEST SPECIFICATIONS

☒ **None** ☐ **Yes (explain below)**

EXHIBIT 4. DECLARATION OF CONFORMITY

The EUT was found to MEET the requirements as described within the specification of FCC Title 47, CFR Part 15.247, and Industry Canada RSS-210, Issue 7 (2007), Section Annex 8 (section 8.2) for a Digital Spread Spectrum (DTS) Transmitter.

If some emissions are seen to be within 3 dB of their respective limits:
As these levels are within the tolerances of the test equipment and site employed, there is a possibility that this unit, or a similar unit selected out of production may not meet the required limit specification if tested by another agency.

LS Research, LLC certifies that the data contained herein was taken under conditions that meet or exceed the requirements of the test specifications. The results in this Test Report apply only to the item(s) tested on the above-specified dates. Any modifications made to the EUT subsequent to the indicated test date(s) will invalidate the data herein, and void this certification.

EXHIBIT 5. RADIATED EMISSIONS TEST

5.1 Test Setup

The test setup was assembled in accordance with Title 47, CFR FCC Part 15, RSS GEN and ANSI C63.4-2003. The EUT was placed on an 80cm high non-conductive pedestal, centered on a flush mounted 2-meter diameter turntable inside a 3 meter Semi-Anechoic, FCC listed Chamber. The EUT was operated in continuous transmit and receive modes, using power as provided by a bench DC supply. The unit has the capability to operate on 3 channels, controllable via a proprietary test tool installed on a laptop PC.

The applicable limits apply at a 3 meter distance. Measurements above 3 GHz were performed at a 1.0 meter separation distance. The calculations to determine these limits are detailed in the following pages. Please refer to Appendix A for a complete list of test equipment. The test sample was operated on one of three (3) standard channels: 1 (906MHz), 6 (916MHz) and 10 (924MHz) to comply with FCC Part 15.35.

5.2 Test Procedure

Radiated RF measurements were performed on the EUT in a 3 meter Semi-Anechoic, FCC listed Chamber. The frequency range from 30 MHz to 10000 MHz was scanned and investigated. The radiated RF emission levels were manually noted at the various fixed degree settings of azimuth on the turntable and antenna height. The EUT was placed on a non-conductive pedestal in the 3 meter Semi-Anechoic Chamber, with the antenna mast placed such that the antenna was 3 meters from the EUT. A Biconical Antenna was used to measure emissions from 30 MHz to 300 MHz, and a Log Periodic Antenna was used to measure emissions from 300 MHz to 1000 MHz. A Double-Ridged Waveguide Horn Antenna was used from 1 GHz to 10 GHz. The maximum radiated RF emissions were found by raising and lowering the antenna between 1 and 4 meters in height, using both horizontal and vertical antenna polarities.

The EUT was rotated along three orthogonal axes during the investigations to find the highest emission levels.

The figures of the external antennas (section 2.3) depict the typical installation orientation. However, in order to find the peak radiated emissions, the Dome and Vee antennas were also positioned facing upward. The data from the orientation with the higher emission levels were used in the report.

5.3 Test Equipment Utilized

A list of the test equipment and antennas utilized for the Radiated Emissions test can be found in Appendix A. This list includes calibration information and equipment descriptions. All equipment is calibrated and used according to the operation manuals supplied by the manufacturers. All calibrations of the antennas used were performed at an N.I.S.T. traceable site. In addition, the Connecting Cables were measured for losses using a calibrated Signal Generator and a HP 8546A EMI Receiver. The resulting correction factors and the cable loss factors from these calibrations were entered into the Agilent E4445A EMI Receiver database. As a result, the data taken from the Agilent E4445A EMI Receiver accounts for the antenna correction factor as well as cable loss or other corrections, and can therefore be entered into the database as a corrected meter reading. The Agilent E4445A EMI Receiver was operated with a resolution bandwidth of 120 kHz for measurements below 1 GHz (video bandwidth of 300 kHz), and a bandwidth of 1 MHz for measurements above 1 GHz (video bandwidth of 1 MHz). From 3 GHz to 10 GHz, an Agilent E4446A Spectrum Analyzer and an EMCO Horn Antenna were used

5.4 Test Results

The EUT was found to **MEET** the Radiated Emissions requirements of Title 47 CFR, FCC Part 15.247 and Canada RSS-210, Issue 7 (2007), Annex 8 for a DTS transmitter.

In addition, the EUT was found to **MEET** the radiated Emissions requirements of Title 47 CFR, FCC Part 15.109 and Canada RSS 210 as well as RSS-Gen Section 4.10.

The frequencies with significant RF signal strength were recorded and plotted as shown in the Data Charts and Graphs.

5.5 CALCULATION OF RADIATED EMISSIONS LIMITS

The maximum peak output power of an intentional radiator in the 2400-2483.5 MHz band, as specified in Title 47 CFR 15.247 (b)(3) and RSS 210 A8.4 is 1 Watt. The harmonic and spurious RF emissions, as measured in any 100 kHz bandwidth, as specified in 15.247 (d) and RSS 210 A8.2(b), shall be at least 20 dB below the measured power of the desired signal, and must also meet the requirements described in 15.205(c) for FCC and section 2.2,2.6 and 2.7 of RSS 210 for IC.

The following table depicts the general radiated emission limits above 30MHz. These limits are obtained from Title 47 CFR, Part 15.209, for radiated emissions measurements. These limits were applied to any signals found in the 15.205 restricted bands. The mentioned limits correspond to those limits listed in RSS 210 section 2.7.

Frequency (MHz)	3 m Limit μV/m	3 m Limit (dBμV/m)	1 m Limit (dBμV/m)
30-88	100	40.0	-
88-216	150	43.5	-
216-960	200	46.0	-
960-24,000	500	54.0	63.5

Sample conversion from field strength μV/m to dBμV/m:
$dB\mu V/m = 20 \log_{10} (100)$
= 40 dBμV/m (from 30-88 MHz)

For measurements made at 1.0 meter, a 9.5 dB correction has been invoked.

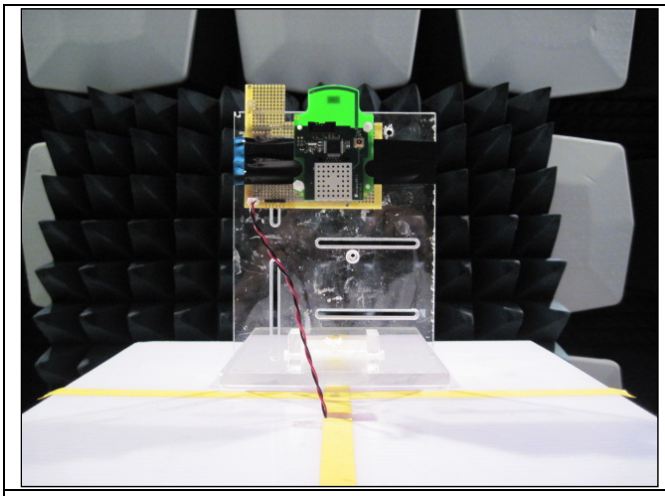
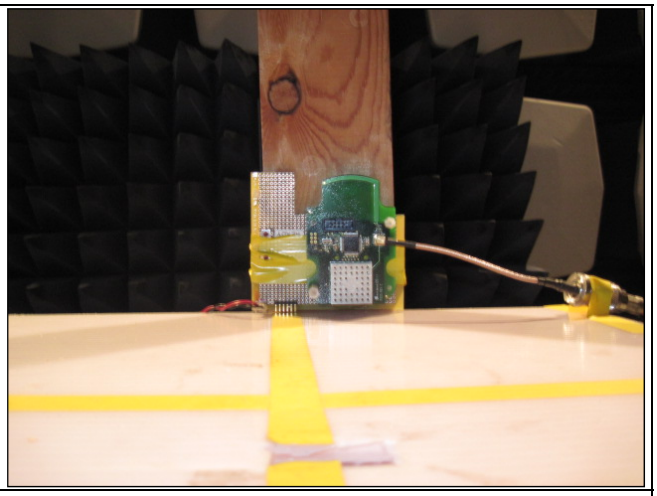
960 MHz to 10,000 MHz
500μV/m or 54.0 dB/μV/m at 3 meters
54.0 + 9.5 = 63.5 dB/μV/m at 1 meter

For measurements made at 0.3 meter, a 20 dB correction has been invoked.

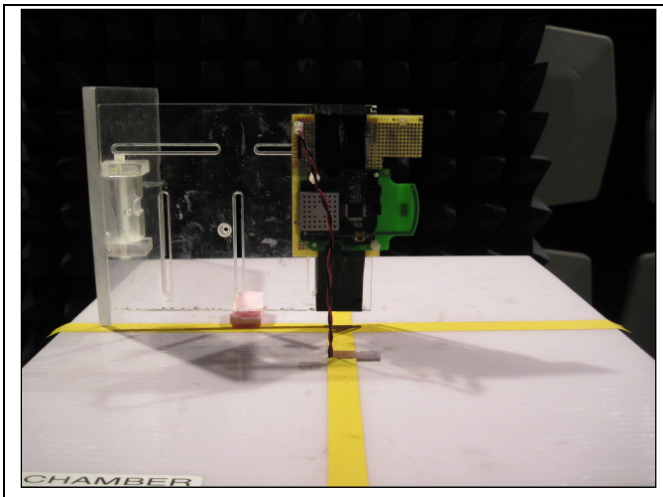
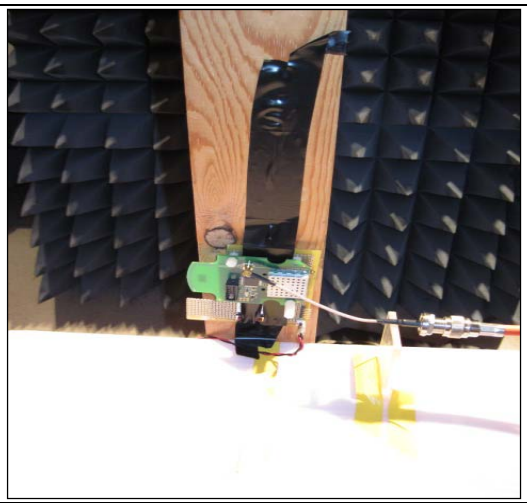
960 MHz to 10,000 MHz
500μV/m or 54.0 dB/μV/m at 3 meters
54.0 + 20 = 74 dB/μV/m at 0.3 meters

5.6 Test Setup Photo(s) – Radiated Emissions Test

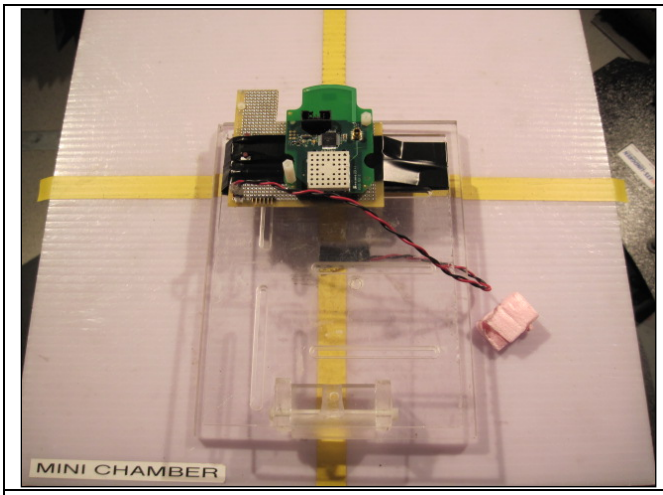
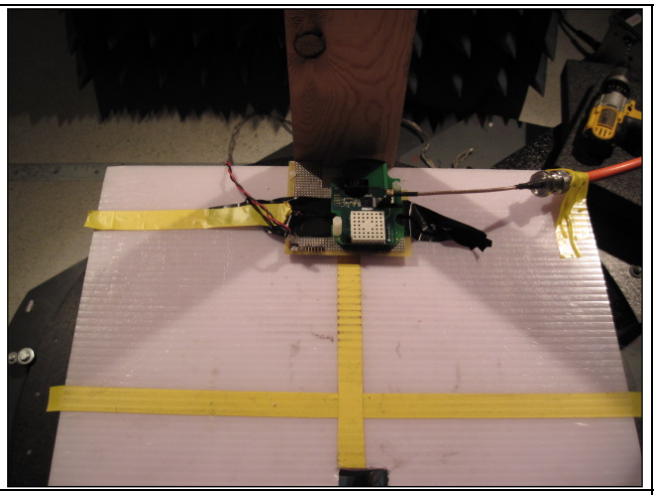
Vertical EUT Orientation (V)

	
Inverted L module	External antenna module

Side EUT Orientation (S)

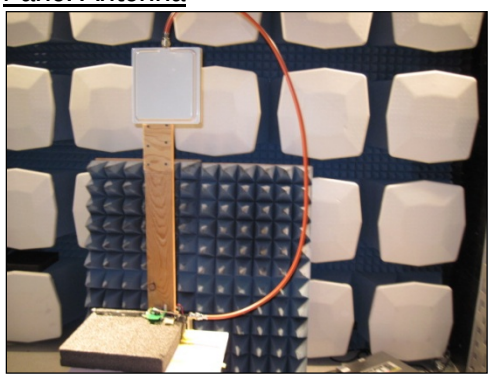
	
Inverted L module	External antenna module

Horizontal EUT Orientation (H)

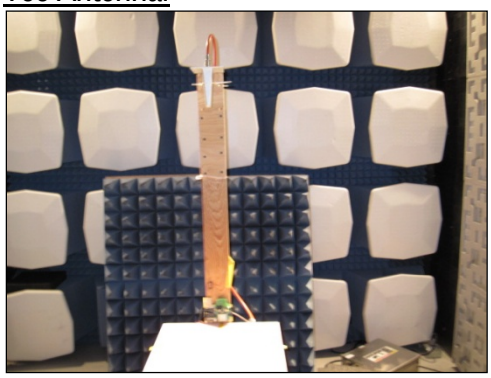
	
Inverted L module	External antenna module

External Antenna setup.

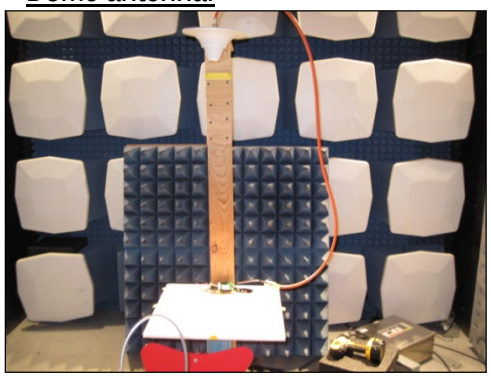
Panel Antenna



Vee Antenna.



Dome antenna.



5.6 RADIATED EMISSIONS TEST DATA CHART

3 Meter Measurements of Electromagnetic Radiated Emissions
Test Standard: 47CFR, Part 15.205, 15.247(DTS) and 15.109
RSS 210 A8, sections 2.2, 2.6, 2.7 and RSS GEN 4.10
Frequency Range Inspected: **30 MHz to 10000 MHz**

Manufacturer:	Ingersoll Rand						
Date(s) of Test:	September 17th to October 5th 2009						
Test Engineer(s):	Aidi Zainal, Peter Feilen and Laura Bott.						
Voltage:	5.0 VDC						
Operation Mode:	continuous transmit and receive						
Environmental Conditions in the Lab:	Temperature: 20 – 25˚C Relative Humidity: 30 – 60 %						
EUT Power:		Single Phase ___VAC		3 Phase ___VAC			
		Battery	√	Other: DC bench supply			
EUT Placement:	√	80cm non-conductive table		10cm Spacers			
EUT Test Location:	√	3 Meter Semi-Anechoic FCC Listed Chamber		3/10m OATS			
Measurements:		Pre-Compliance		Preliminary	√	Final	
Detectors Used:	√	Peak	√	Quasi-Peak	√	Average	

5.6.1 Radiated Fundamental.

The following table depicts the level of significant radiated RF fundamental emissions seen on:

Inverted L antenna module:

Frequency (MHz)	Ant./EUT Polarity	Channel	Height (meters)	Azimuth (0° - 360°)	Measured EFl (dBμV/m)	3m Limit (dBμV/m)	Margin (dB)
906	H/H	1	1.62	81	118.6	125.2	6.6
916	H/H	6	1.55	70	119.2	125.2	6.0
924	H/H	10	1.00	97	120.5	125.2	4.7

Panel antenna module:

Frequency (MHz)	Ant./EUT Polarity	Channel	Height (meters)	Azimuth (0° - 360°)	Measured EFl (dBμV/m)	3m Limit (dBμV/m)	Margin (dB)
906	V/S	1	1.44	9	123.1	125.2	2.1
916	V/S	6	1.40	0	123.6	125.2	1.6
924	V/S	10	1.36	0	124.1	125.2	1.1

Vee antenna module:

Frequency (MHz)	Ant./EUT Polarity	Channel	Height (meters)	Azimuth (0° - 360°)	Measured EFl (dBμV/m)	3m Limit (dBμV/m)	Margin (dB)
906	V/H	1	1.00	93	119.8	125.2	5.4
916	V/H	6	1.00	93	119.8	125.2	5.4
924	V/H	10	1.35	289	119.7	125.2	5.5

Dome antenna module:

Frequency (MHz)	Ant./EUT Polarity	Channel	Height (meters)	Azimuth (0° - 360°)	Measured EFl (dBμV/m)	3m Limit (dBμV/m)	Margin (dB)
906	V/H	1	1.00	180	120.5	125.2	4.7
916	V/H	6	1.33	186	120.1	125.2	5.1
924	V/H	10	1.35	177	120.5	125.2	4.7

Notes:

1) A Quasi-Peak Detector was used in measurements below 1 GHz.
2) For measurements of the fundamental power, because of spectral bandwidth, the receiver was set to RBW=VBW=1 MHz.
3) H = Horizontal V = Vertical S = Side.

5.6.3 Radiated RF harmonics of fundamental.

5.6.3.1: Inverted L antenna module

The following table depicts the level of significant radiated RF harmonic emissions seen on Channel 1:

Antenna Polarization	Frequency (MHz)	Peak (dBuV/m)	Average (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (°)	EUT Orientation
Horizontal	1812	69.5	65.5	98.6	33.1	115.0	138	H
	2718		Note 3					
Horizontal	3624	50.9	44.5	63.5	19.0	127.7	225	H
Vertical	4530	47.3	36.8	63.5	26.7	109.4	118	V
Vertical	5436	48.2	37.7	63.5	25.8	110.6	206	V
Horizontal	6342	62.3	55.9	108.1	52.2	104.6	43	S
Horizontal	7248	59.9	59.7	108.1	48.4	106.1	83	S
Horizontal	8154	53.5	52.5	63.5	11.0	114.6	149	H
Horizontal	9060	66.0	59.7	63.5	3.8	111.1	230	H

The following table depicts the level of significant radiated RF harmonic emissions seen on Channel 6:

Antenna Polarization	Frequency (MHz)	Peak (dBuV/m)	Average (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (°)	EUT Orientation
Vertical	1832	69.6	65.9	99.2	33.3	125.0	262	S
	2748		Note 3					
Horizontal	3664	52.2	45.7	63.5	17.8	104.9	217	H
Vertical	4580	49.1	48.2	63.5	15.3	101.3	142	V
Vertical	5496	47.6	36.8	108.7	71.9	112.3	211	V
Horizontal	6412	67.6	61.1	108.7	47.6	103.6	43	S
Vertical	7328	62.1	51.9	63.5	11.6	109.0	173	H
Horizontal	8244	53.7	45.2	63.5	18.3	106.9	217	H
Horizontal	9160	64.4	56.0	63.5	7.5	106.4	229	H

The following table depicts the level of significant radiated RF harmonic emissions seen on Channel 10:

Antenna Polarization	Frequency (MHz)	Peak (dBuV/m)	Average (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (°)	EUT Orientation
Vertical	1848	69.1	65.3	100.5	35.2	123.0	264	S
	2772		Note 3					
Horizontal	3696	51.5	44.7	63.5	18.8	103.0	219	H
Vertical	4620	48.4	46.8	63.5	16.7	103.0	219	S
Vertical	5544	47.2	36.5	110.0	73.5	104.6	204	V
Horizontal	6468	67.9	61.0	110.0	49.0	106.7	335	S
Horizontal	7392	64.0	52.5	63.5	11.0	103.3	286	S
Horizontal	8316	56.6	47.4	63.5	16.1	103.0	250	S
Horizontal	9240	60.4	52.6	110.0	57.4	113.0	235	H

Notes:

1) A Peak as well as an Average Detector was used in measurements above 1 GHz. The peak detector was used to ensure the peak emissions did not exceed 20 dB above the limits (RBW=VBW=1MHz).
2) Measurements above 3 GHz were made at 1 meter of separation from the EUT. Limits were adjusted accordingly.
3) Measurement at receiver system noise floor.
4) H = Horizontal V = Vertical S = Side.

5.6.3.2: Panel antenna module

The following table depicts the level of significant radiated RF harmonic emissions seen on Channel 1:

Antenna Polarization	Frequency (MHz)	Peak (dBuV/m)	Average (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (°)	EUT Orientation
Vertical	1812	96.5	93.8	103.1	9.3	116.0	0	V
Vertical	2718	63.1	52.3	54.0	1.7	158.0	0	H
Vertical	3624	57.3	50.3	63.5	13.2	139.5	351	V
Vertical	4530	48.6	38.7	63.5	24.8	103.1	218	V
Horizontal	5436	47.4	37.0	63.5	26.5	105.0	333	S
Vertical	6342	62.1	56.4	112.6	56.2	110.5	329	V
Vertical	7248	60.6	53.1	112.6	59.5	106.4	356	V
Horizontal	8154	54.5	45.8	63.5	17.7	103.1	33	H
Vertical	9060	65.7	59.0	63.5	4.5	143.0	49	H

The following table depicts the level of significant radiated RF harmonic emissions seen on Channel 6:

Antenna Polarization	Frequency (MHz)	Peak (dBuV/m)	Average (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (°)	EUT Orientation
Vertical	1832	97.5	94.5	103.6	9.1	116.0	0	V
Vertical	2748	62.0	51.1	54.0	2.9	150.0	0	H
Vertical	3664	61.2	54.6	63.5	8.9	148.8	7	V
Horizontal	4580	49.6	40.1	63.5	23.4	103.0	160	H
Horizontal	5496	47.7	36.9	113.1	76.2	115.9	336	S
Horizontal	6412	72.4	65.1	113.1	48.0	103.1	332	S
Horizontal	7328	63.0	54.4	63.5	9.1	103.0	340	S
Horizontal	8244	53.4	42.9	63.5	20.6	103.0	223	S
Vertical	9160	67.8	61.0	63.5	2.5	143.2	51	V

The following table depicts the level of significant radiated RF harmonic emissions seen on Channel 10:

Antenna Polarization	Frequency (MHz)	Peak (dBuV/m)	Average (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (°)	EUT Orientation
Vertical	1848	96.8	93.8	104.1	10.3	115.8	0	V
Vertical	2772	62.4	51.9	54.0	2.1	148.0	0	H
Vertical	3696	55.3	48.6	63.5	14.9	139.6	342	S
Vertical	4620	47.5	37.6	63.5	25.9	107.3	143	V
Horizontal	5544	47.2	37.0	113.6	76.6	100.0	321	H
Horizontal	6468	72.4	64.8	113.6	48.8	106.5	330	S
Horizontal	7392	64.1	54.5	63.5	9.0	103.0	341	S
Horizontal	8316	52.8	43.7	63.5	19.8	103.0	222	S
Vertical	9240	66.5	59.5	113.6	54.1	141.9	55	S

Notes:

1) A Peak as well as an Average Detector was used in measurements above 1 GHz. The peak detector was used to ensure the peak emissions did not exceed 20 dB above the limits (RBW=VBW=1MHz).
2) Measurements above 3 GHz were made at 1 meter of separation from the EUT. Limits were adjusted accordingly.
3) Measurement at receiver system noise floor.
4) H = Horizontal V = Vertical S = Side.

5.6.3.3: Vee antenna module

The following table depicts the level of significant radiated RF harmonic emissions seen on Channel 1:

Antenna Polarization	Frequency (MHz)	Peak (dBuV/m)	Average (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (°)	EUT Orientation
Vertical	1812	84.7	81.7	99.8	18.1	147.0	350	H
	2718		Note 3					
Horizontal	3624	51.0	44.0	63.5	19.5	106.4	225	H
Horizontal	4530	48.4	39.0	63.5	24.5	109.6	208	S
Horizontal	5436	48.1	38.4	63.5	25.1	116.7	3	S
Horizontal	6342	65.9	58.5	109.3	50.8	102.7	329	S
Horizontal	7248	62.1	53.8	109.3	55.5	102.6	22	S
Horizontal	8154	52.9	44.6	63.5	18.9	102.7	345	S
Vertical	9060	62.3	55.5	63.5	8.0	134.1	15	V

The following table depicts the level of significant radiated RF harmonic emissions seen on Channel 6:

Antenna Polarization	Frequency (MHz)	Peak (dBuV/m)	Average (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (°)	EUT Orientation
Vertical	1832	81.7	77.7	99.8	22.1	103.0	8	H
	2748		Note 3					
Horizontal	3664	50.9	43.7	63.5	19.8	106.5	48	H
Horizontal	4580	47.3	37.3	63.5	26.2	112.4	233	S
Horizontal	5496	46.7	35.9	109.3	73.4	115.3	326	S
Horizontal	6412	68.9	61.5	109.3	47.8	106.9	318	S
Horizontal	7328	63.9	55.7	63.5	7.8	106.4	332	S
Horizontal	8244	52.1	43.1	63.5	20.4	103.1	217	S
Horizontal	9160	63.8	55.3	63.5	8.2	109.3	323	V

The following table depicts the level of significant radiated RF harmonic emissions seen on Channel 10:

Antenna Polarization	Frequency (MHz)	Peak (dBuV/m)	Average (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (°)	EUT Orientation
Vertical	1848	83.3	80.5	99.7	19.2	160.0	16	H
	2772		Note 3					
Horizontal	3696	51.6	45.5	63.5	18.0	110.2	226	S
Horizontal	4620	49.8	39.8	63.5	23.7	107.2	229	S
Horizontal	5544	48.1	37.3	109.2	71.9	115.5	37	S
Horizontal	6468	72.2	64.7	109.2	44.5	106.1	342	S
Horizontal	7392	63.7	54.3	63.5	9.2	104.9	332	S
Horizontal	8316	54.1	44.7	63.5	18.8	106.8	290	S
Vertical	9240	62.0	54.7	109.2	54.5	149.7	318	H

Notes:

1) A Peak as well as an Average Detector was used in measurements above 1 GHz. The peak detector was used to ensure the peak emissions did not exceed 20 dB above the limits (RBW=VBW=1MHz).
2) Measurements above 3 GHz were made at 1 meter of separation from the EUT. Limits were adjusted accordingly.
3) Measurement at receiver system noise floor.
4) H = Horizontal V = Vertical S = Side.

5.6.3.4: Dome antenna module

The following table depicts the level of significant radiated RF harmonic emissions seen on Channel 1:

Antenna Polarization	Frequency (MHz)	Peak (dBuV/m)	Average (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (°)	EUT Orientation
Vertical	1812	88.9	86.3	100.5	14.2	205.0	16	H
	2718		Note 3					
Horizontal	3624	51.5	44.8	63.5	18.7	103.1	216	H
Horizontal	4530	48.4	38.7	63.5	24.8	103.0	153	H
Horizontal	5436	47.1	36.3	63.5	27.2	127.8	354	S
Horizontal	6342	67.1	59.8	110.0	50.2	103.2	342	S
Horizontal	7248	64.0	55.6	110	54.4	103.0	346	S
Horizontal	8154	54.3	45.6	63.5	17.9	103.0	314	S
Vertical	9060	66.3	61.8	63.5	1.7	135.1	287	S

The following table depicts the level of significant radiated RF harmonic emissions seen on Channel 6:

Antenna Polarization	Frequency (MHz)	Peak (dBuV/m)	Average (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (°)	EUT Orientation
Vertical	1832	87.9	85.4	100.1	14.7	228.0	14	H
	2748		Note 3					
Horizontal	3664	51.9	46.2	63.5	17.3	107.8	218	H
Horizontal	4580	47.9	46.6	63.5	16.9	100.6	150	H
Horizontal	5496	46.6	35.4	109.6	74.2	116.9	332	S
Horizontal	6412	67.2	59.6	109.6	50.0	110.7	324	S
Horizontal	7328	62.7	54.2	63.5	9.3	106.4	336	S
Horizontal	8244	51.5	42.3	63.5	21.2	102.7	235	S
Vertical	9160	66.6	61.7	63.5	1.8	137.7	282	H

The following table depicts the level of significant radiated RF harmonic emissions seen on Channel 10:

Antenna Polarization	Frequency (MHz)	Peak (dBuV/m)	Average (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (°)	EUT Orientation
Vertical	1848	88.1	86.6	100.5	13.9	256.0	25	H
	2772		Note 3					
Horizontal	3696	50.9	43.1	63.5	20.4	112.8	213	H
Horizontal	4620	46.8	36.8	63.5	26.7	111.2	157	H
Horizontal	5544	46.7	35.6	110.0	74.4	111.2	337	S
Horizontal	6468	69.4	61.4	110.0	48.6	106.9	288	S
Horizontal	7392	60.2	51.6	63.5	11.9	106.5	330	S
Vertical	8316	51.8	42.4	63.5	21.1	146.0	270	H
Vertical	9240	64.9	61.6	110.0	48.4	128.6	280	H

Notes:

1) A Peak as well as an Average Detector was used in measurements above 1 GHz. The peak detector was used to ensure the peak emissions did not exceed 20 dB above the limits (RBW=VBW=1MHz).
2) Measurements above 3 GHz were made at 1 meter of separation from the EUT. Limits were adjusted accordingly.
3) Measurement at receiver system noise floor.
4) H = Horizontal V = Vertical S = Side.

5.7. Radiated spurious emissions other than harmonics.

The following table depicts the level of significant spurious radiated RF emissions found:

Frequency (MHz)	Ant./EUT Polarity	Host Mode	Channel	Height (meters)	Azimuth (0° - 360°)	Measured EFI (dBµV/m)	Limit (dBµV/m)	Margin (dB)
987.9	V/S	Panel antenna	10	1.58	0	42.9	54.0	11.1
987.9	V/H	Vee antenna	10	1.28	92	43.7	54.0	10.3

Note: A quasi Peak detector was used in measurements below 1GHz.

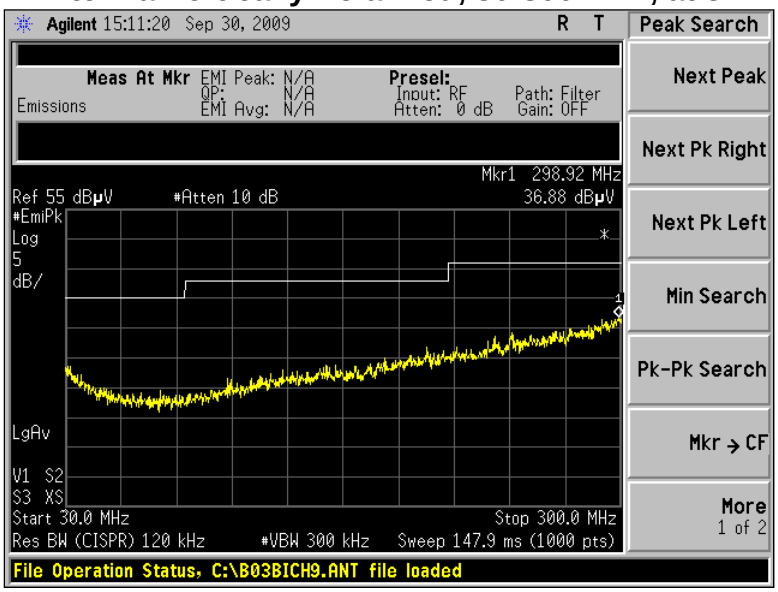
5.8 Screen Captures - Radiated Emissions Test

These screen captures represent Peak Emissions. For radiated emission measurements, a Quasi-Peak detector function is utilized when measuring frequencies below 1 GHz, and an Average detector function is utilized when measuring frequencies above 1 GHz.

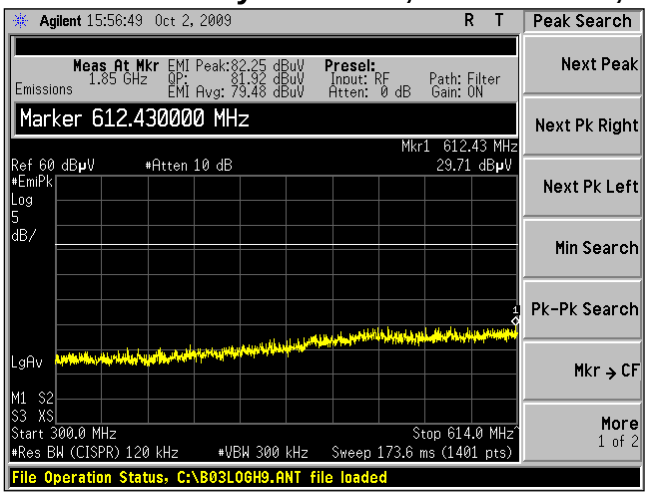
The signature scans shown here are from worst-case emissions, as measured on channels 1, 6, or 10, with the sense antenna both in vertical and horizontal polarity for worst case presentations.

Inverted L antenna module:

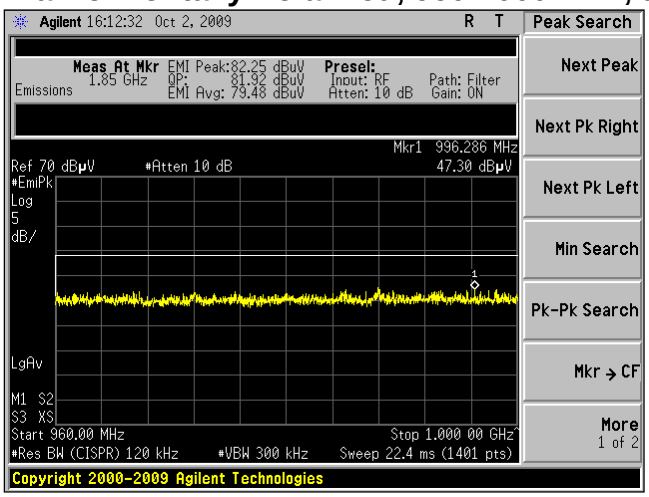
Antenna Vertically Polarized, 30-300 MHz, at 3m



Antenna Horizontally Polarized, 300-614 MHz, at 3m

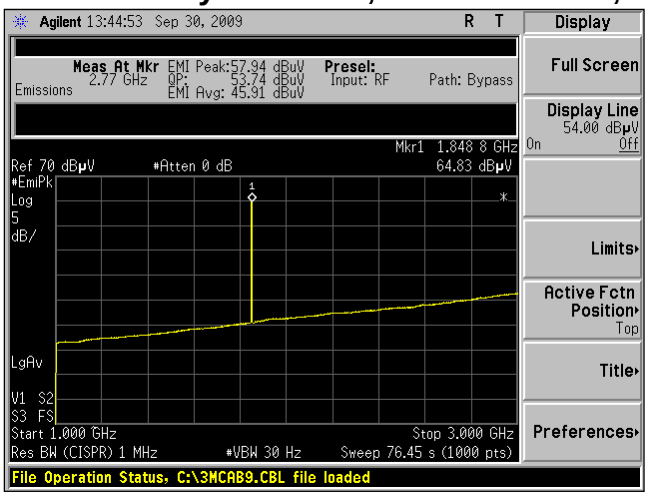


Antenna Horizontally Polarized, 960-1000 MHz, at 3m

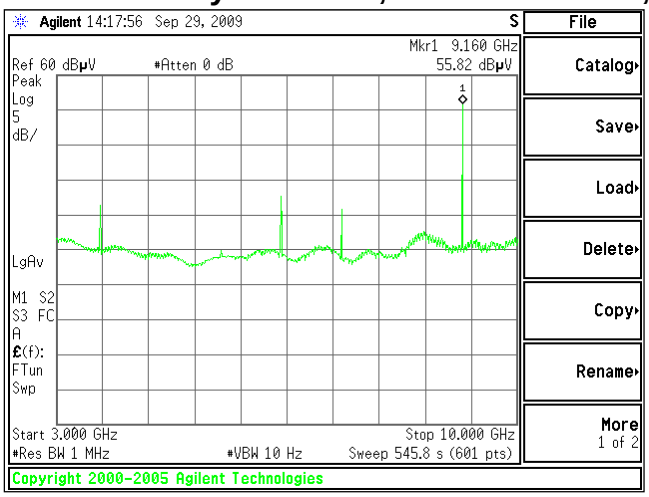


Screen Captures - Radiated Emissions Testing **(continued)**

Antenna Vertically Polarized, 1000-3000 MHz, at 3m

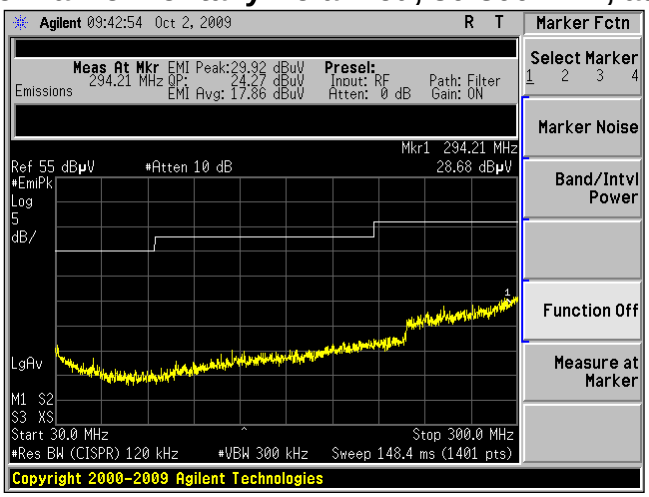


Antenna Horizontally Polarized, 3000-10000 MHz, at 1m

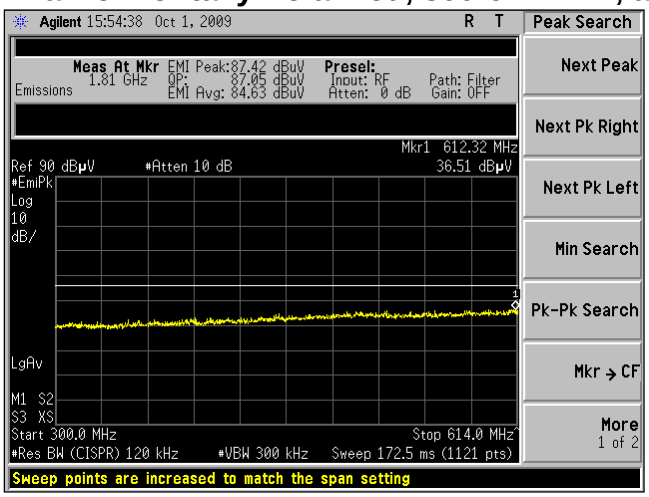


Panel antenna module:

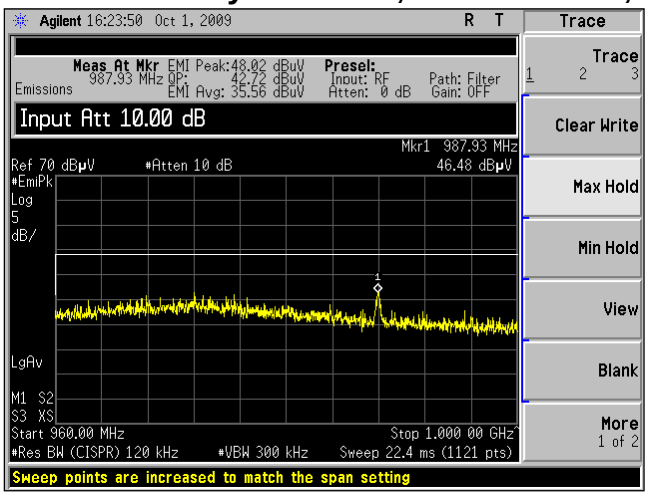
Antenna Horizontally Polarized, 30-300 MHz, at 3m



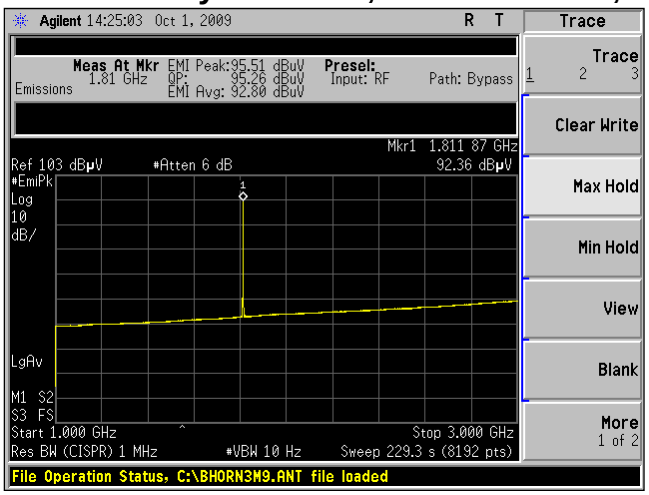
Antenna Horizontally Polarized, 300-614 MHz, at 3m



Antenna Horizontally Polarized, 960-1000 MHz, at 3m

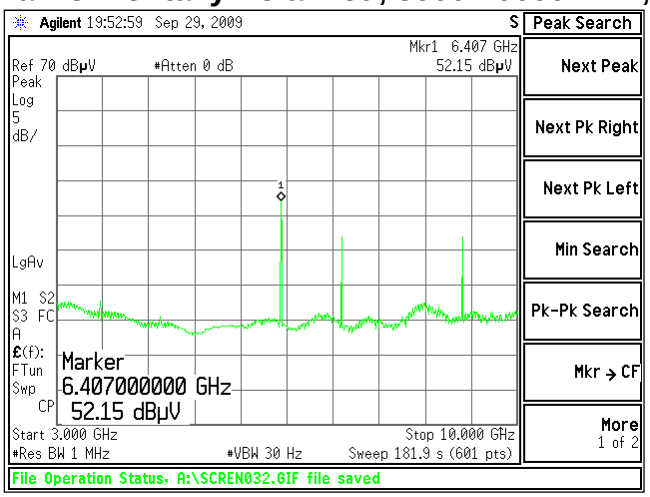


Antenna Vertically Polarized, 1000-3000 MHz, at 3m



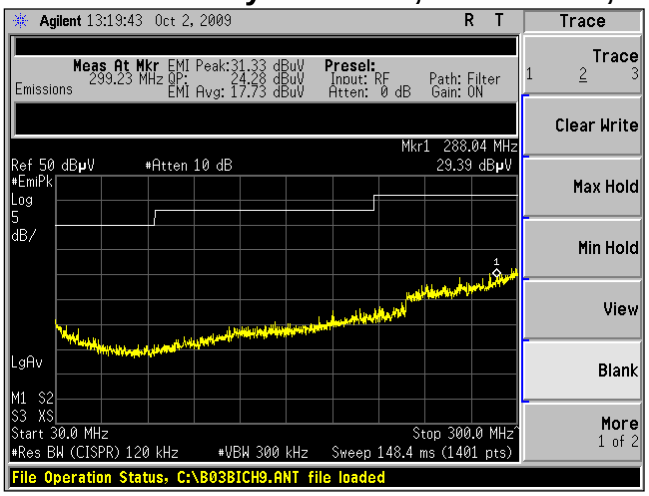
Screen Captures - Radiated Emissions Testing **(continued)**

Antenna Horizontally Polarized, 3000-10000 MHz, at 1m

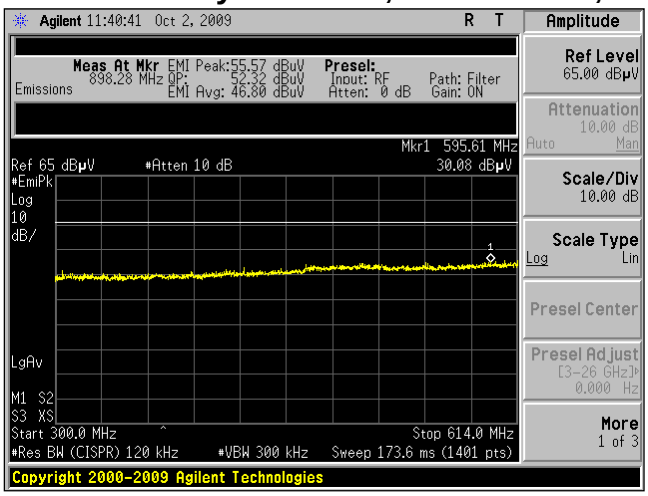


Vee antenna module:

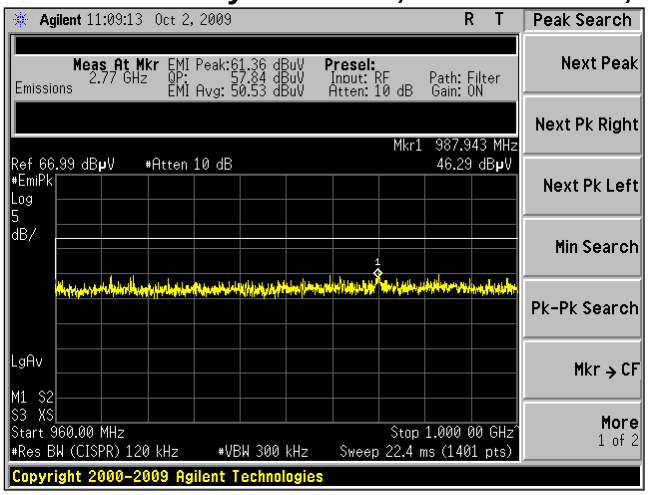
Antenna Horizontally Polarized, 30-300 MHz, at 3m



Antenna Vertically Polarized, 300-614 MHz, at 3m

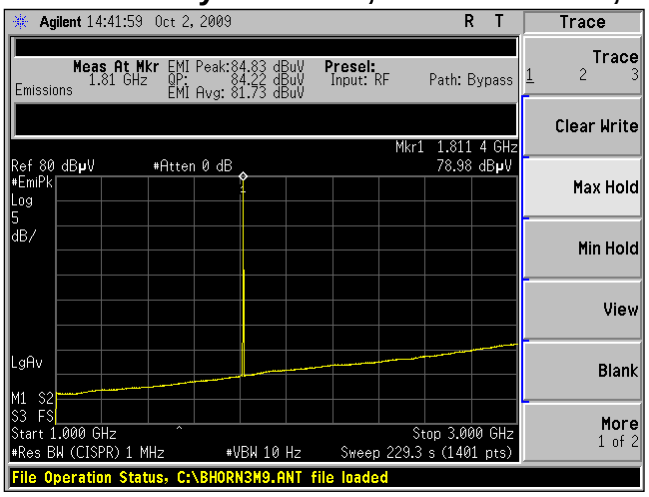


Antenna Horizontally Polarized, 960-1000 MHz, at 3m

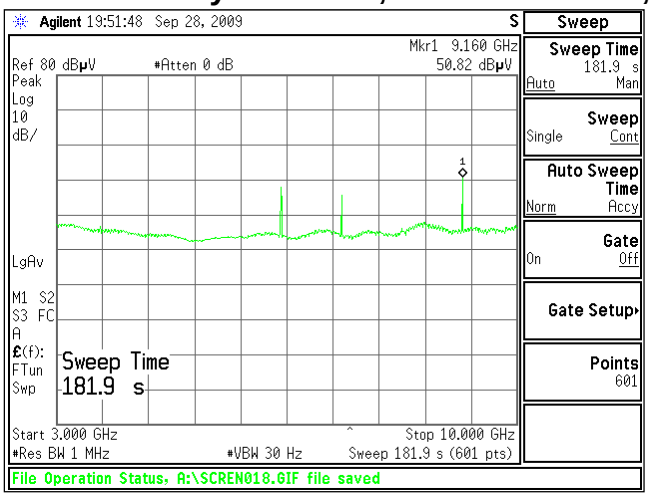


Screen Captures - Radiated Emissions Testing **(continued)**

Antenna Vertically Polarized, 1000-3000 MHz, at 3m

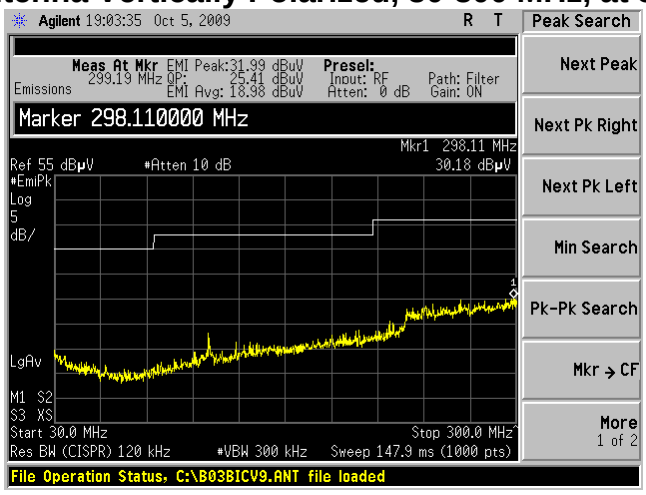


Antenna Horizontally Polarized, 3000-10000 MHz, at 1m

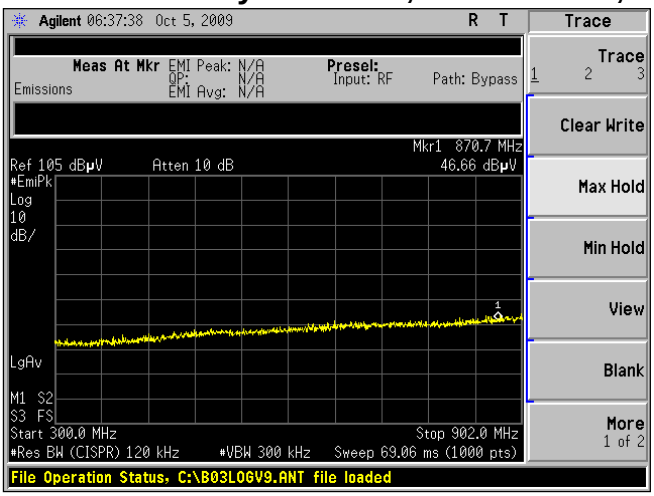


Dome antenna module:

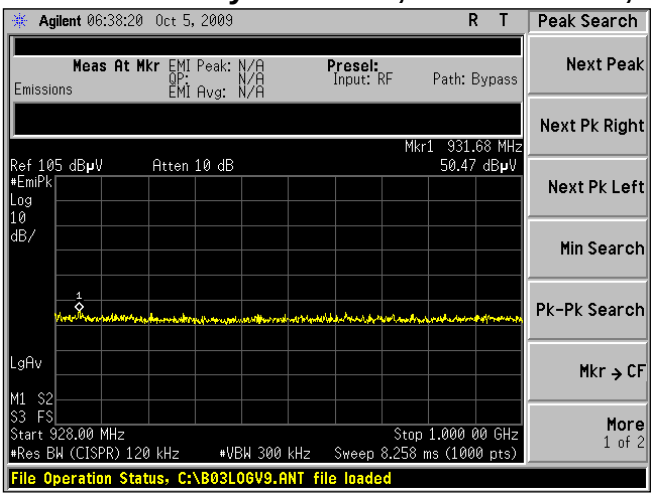
Antenna Vertically Polarized, 30-300 MHz, at 3m



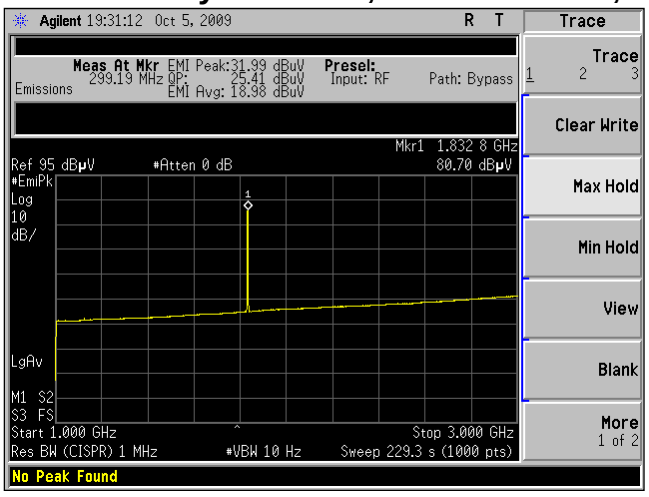
Antenna Horizontally Polarized, 300-902 MHz, at 3m



Antenna Horizontally Polarized, 928-1000 MHz, at 3m

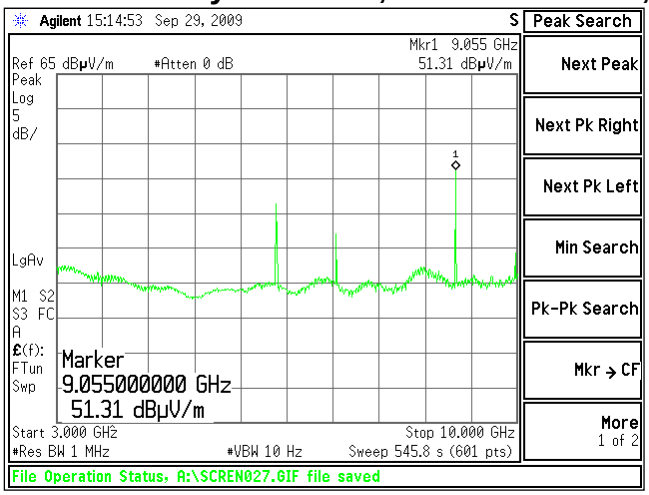


Antenna Vertically Polarized, 1000-3000 MHz, at 3m



Screen Captures - Radiated Emissions Testing **(continued)**

Antenna Horizontally Polarized, 3000-10000 MHz, at 1m



5.9 Receive Mode Testing

Per the requirements of RSS-210, the EUT was placed in continuous receive mode and the radiated spurious emissions were measured and compared to the limits stated in RSS-Gen Section 4.10.

The test setup, procedure, and equipment utilized were identical to that described in sections 5.1, 5.2, and 5.3 of this document. EUT setup was identical to that described in section 5.6.

Measurement data and screen captures from the receive tests are presented below:

There were no spurious emissions detected above the system noise floor.

Noise floor level:

30 to 300 MHz range: Maximum noise floor level = 24.3 dBuV/m (Quasi peak detector).
300 to 1000 MHz range: Maximum noise floor level = 29.9 dBuV/m (Quasi Peak detector).
1 to 3 GHz range: Maximum noise floor level = 46.9 dBuV/m (Average detector).
3 to 10 GHz range: Maximum noise floor level = 37.6 dBuV/m (Video averaged Peak detector).

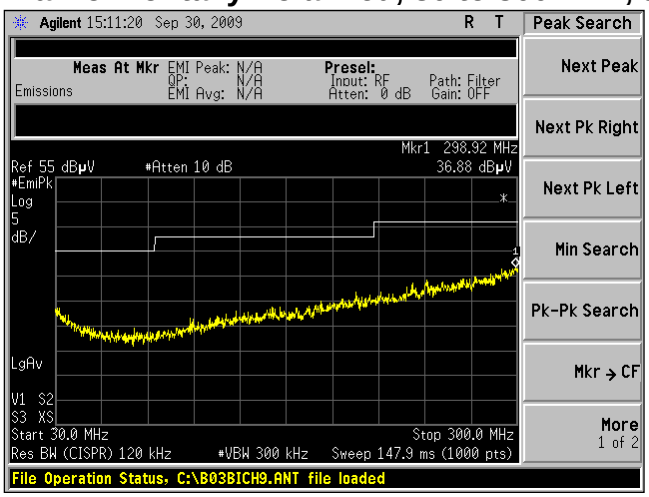
Screen Captures - Radiated Emissions Testing – Receive Mode

These screen captures represent Peak Emissions. For radiated emission measurements, a Quasi-Peak detector function is utilized when measuring frequencies below 1 GHz, and an Average detector function is utilized when measuring frequencies above 1 GHz.

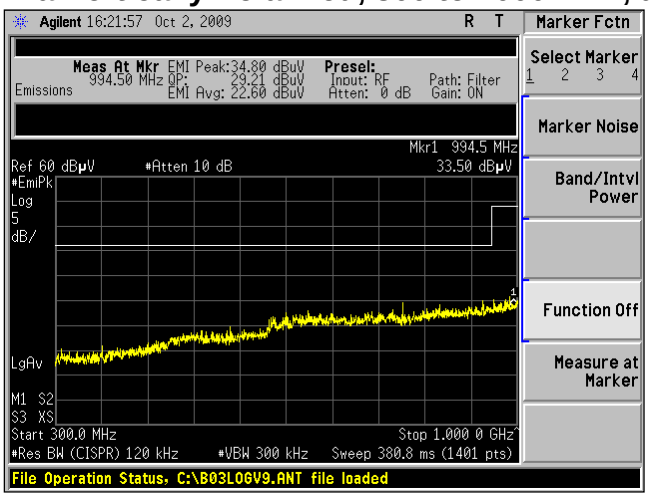
The signature scans shown here are from worst-case emissions, as measured on channels 1, 6 and 10, with the sense antenna both in vertical and horizontal polarity for worst case presentations.

Inverted L antenna module:

Antenna Horizontally Polarized, 30 to 300 MHz, at 3m

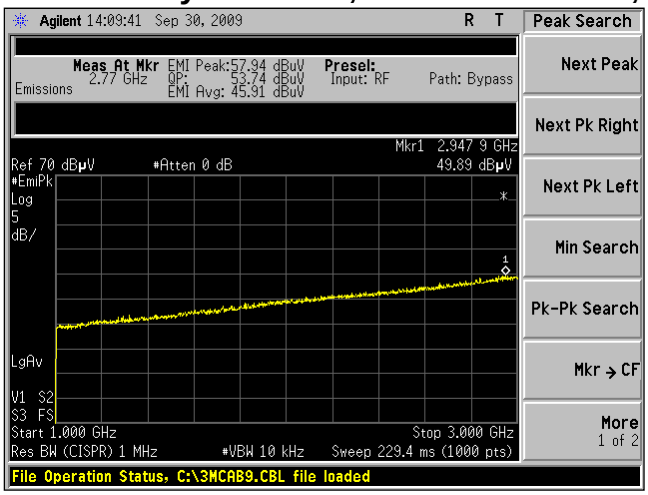


Antenna Vertically Polarized, 300 to 1000 MHz, at 3m

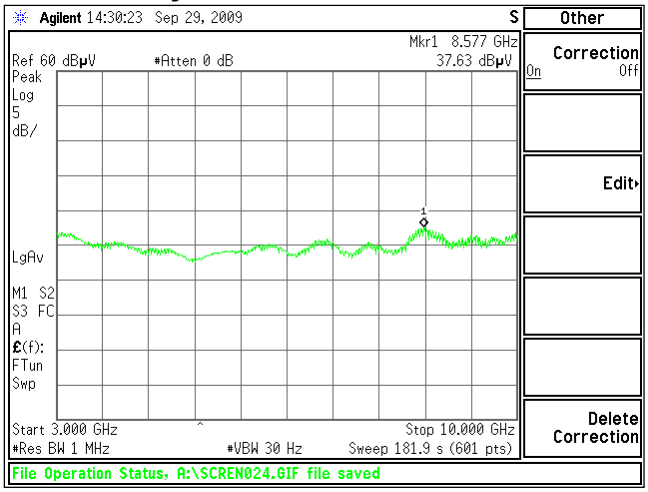


Screen Captures - Radiated Emissions Testing – Receive Mode **(continued)**

Antenna Vertically Polarized, 1000 to 3000 MHz, at 3m

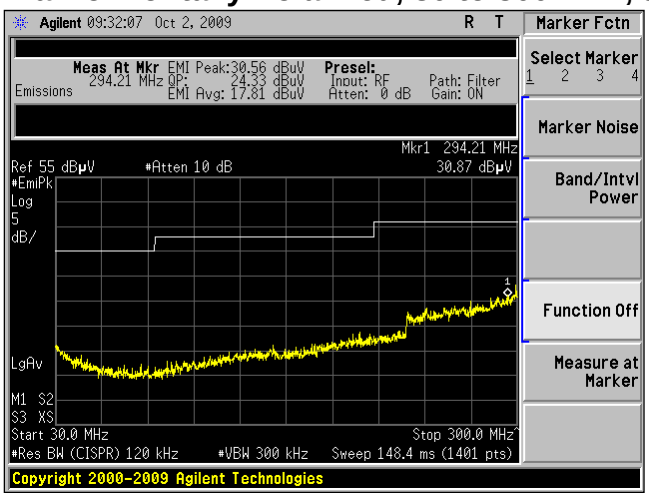


Antenna Vertically Polarized, 3000 to 10000 MHz, at 1m

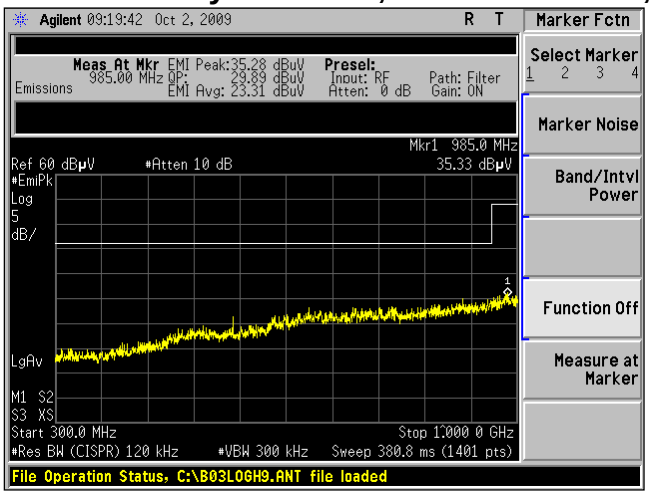


Panel antenna module:

Antenna Horizontally Polarized, 30 to 300 MHz, at 3m

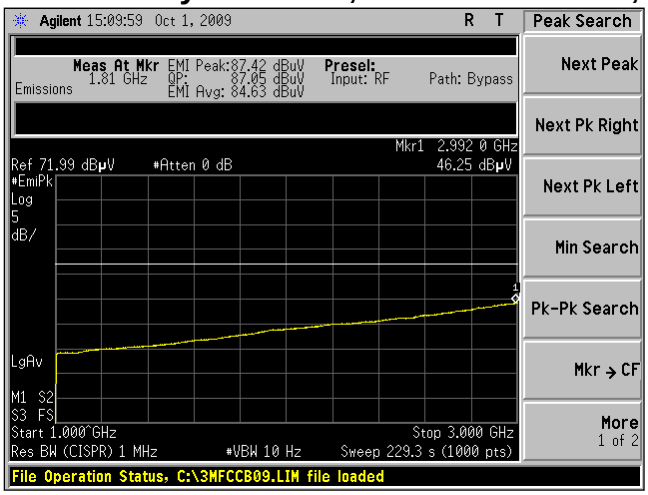


Antenna Horizontally Polarized, 300 to 1000 MHz, at 3m

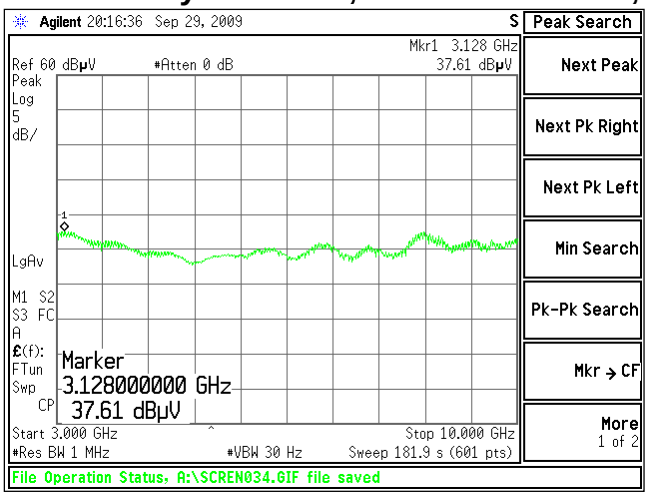


Screen Captures - Radiated Emissions Testing – Receive Mode **(continued)**

Antenna Vertically Polarized, 1000 to 3000 MHz, at 3m

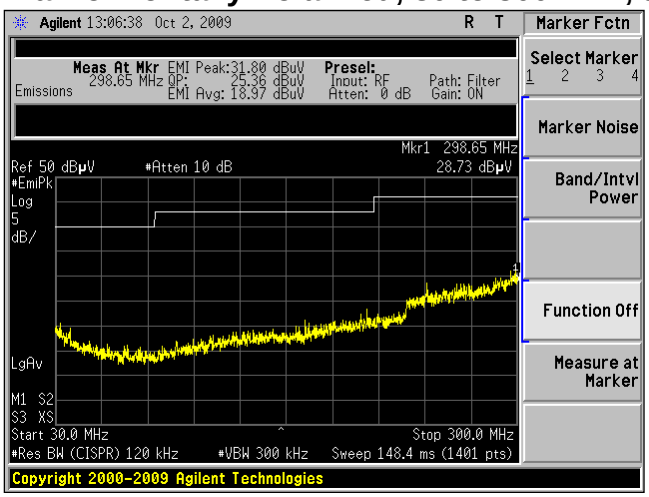


Antenna Vertically Polarized, 3000 to 1000 MHz, at 1m

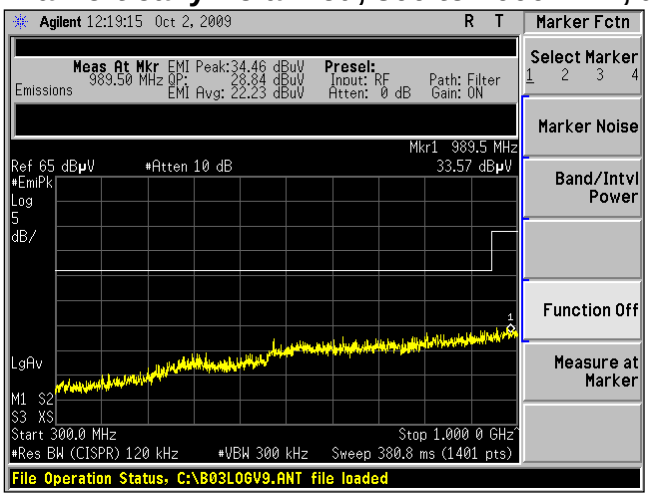


Vee antenna module:

Antenna Horizontally Polarized, 30 to 300 MHz, at 3m

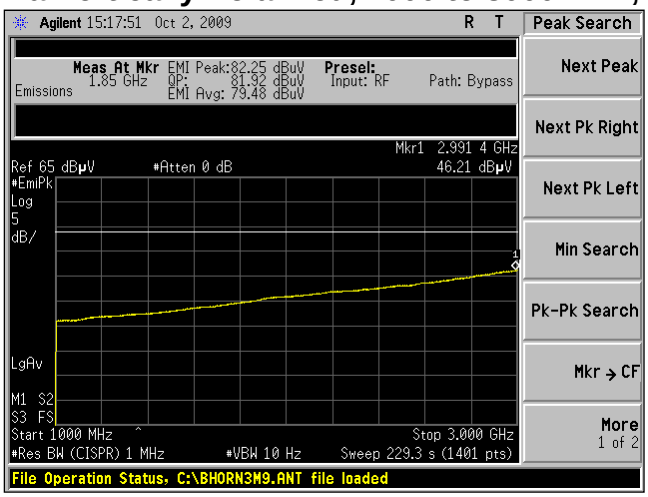


Antenna Vertically Polarized, 300 to 1000 MHz, at 3m

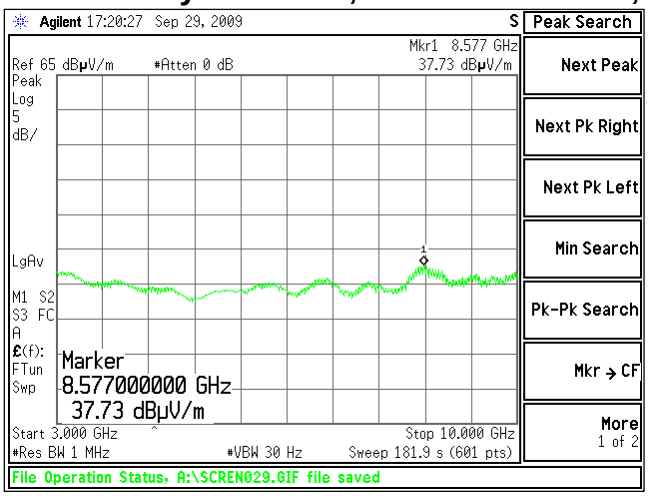


Screen Captures - Radiated Emissions Testing – Receive Mode **(continued)**

Antenna Vertically Polarized, 1000 to 3000 MHz, at 3m

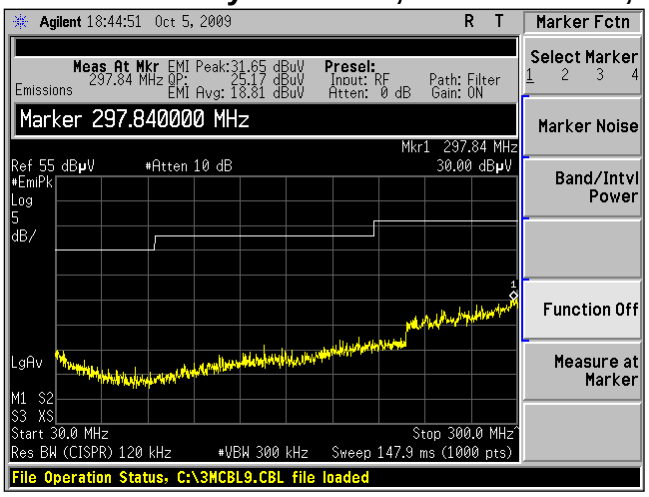


Antenna Vertically Polarized, 3000 to 1000 MHz, at 1m

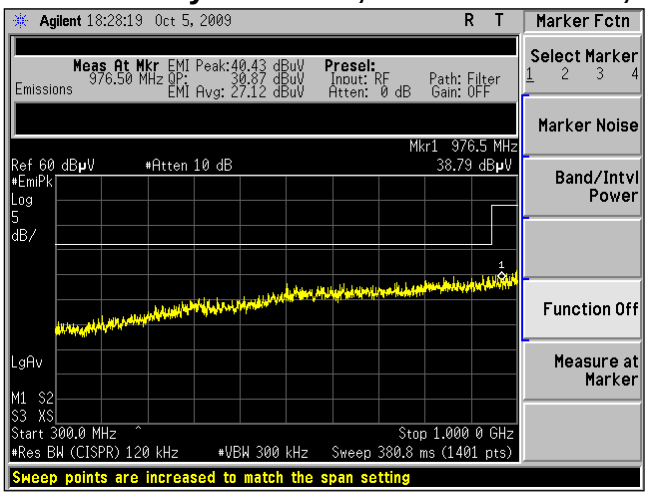


Dome antenna module:

Antenna Horizontally Polarized, 30 to 300 MHz, at 3m

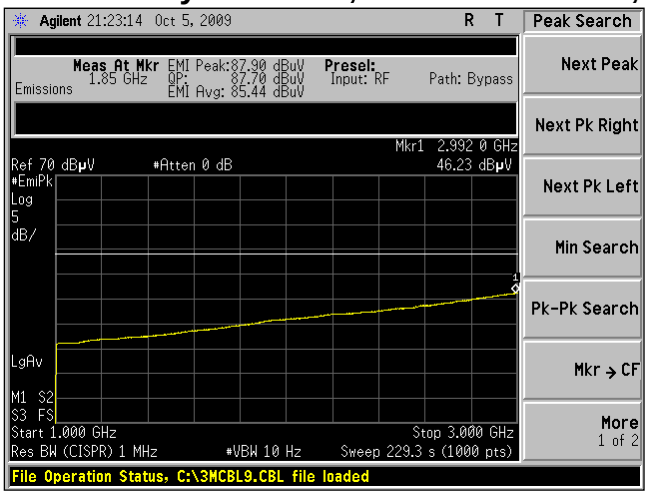


Antenna Vertically Polarized, 300 to 1000 MHz, at 3m



Screen Captures - Radiated Emissions Testing – Receive Mode **(continued)**

Antenna Vertically Polarized, 1000 to 3000 MHz, at 3m



Antenna Vertically Polarized, 3000 to 1000 MHz, at 1m

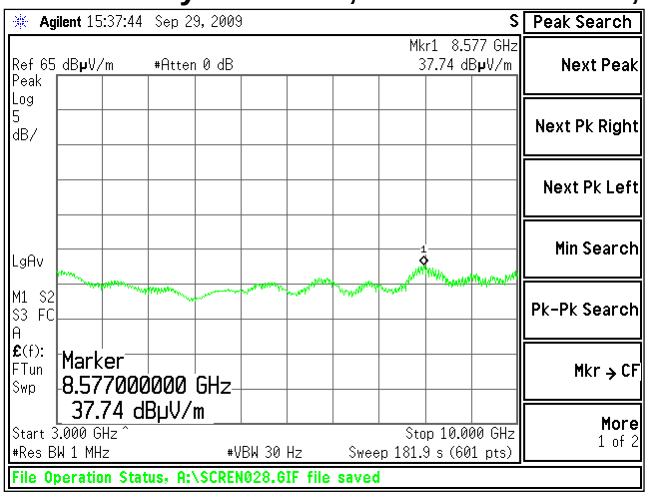


EXHIBIT 6. CONDUCTED EMISSIONS TEST, AC POWER LINE:

6.1 Test Setup

The test area and setup are in accordance with ANSI C63.4-2003 and with Title 47 CFR, FCC Part 15, Industry Canada RSS-210 and RSS GEN. The EUT was placed on a non-conductive wooden table, with a height of 80 cm above the reference ground plane. The EUT was powered using an off the shelf DC converter which was plugged into a 50Ω (ohm), 50/250 μH Line Impedance Stabilization Network (LISN). Since the DC adapter was not of the required voltage, a 5.0 VDC voltage regulator was added to supply a stable 5.0 VDC to the EUT. AC power supply of 120V was provided via an appropriate broadband EMI Filter, and then to the LISN line input. Final readings were then taken and recorded. After the EUT was setup and connected to the LISN, the RF Sampling Port of the LISN was connected to a 10 dB Attenuator-Limiter, and then to the Agilent E4445A EMI Receiver with an N9039A Pre-selector. The EMCO LISN used has the ability to terminate the unused port with a 50Ω (ohm) load when switched to either L1 (line) or L2 (neutral).

6.2 Test Procedure

The EUT was investigated in continuous modulated transmit and receive mode for this portion of the testing. The appropriate frequency range and bandwidths were selected on the EMI Receiver, and measurements were made. The bandwidth used for these measurements is 9 kHz, as specified in CISPR 16-1, Section 1, Table 1, for Quasi-Peak and Average detectors in the frequency range of 150 kHz to 30MHz. Final readings were then taken and recorded.

6.3 Test Equipment Utilized

A list of the test equipment and accessories utilized for the Conducted Emissions test is provided in Appendix A. This list includes calibration information and equipment descriptions. All equipment is calibrated and used according to the operation manuals supplied by the manufacturers. Calibrations of the LISN and Limiter are traceable to N.I.S.T. All cables are calibrated and checked periodically for conformance. The emissions are measured on the Agilent E4445A, which has automatic correction for all factors stored in memory and allows direct readings to be taken.

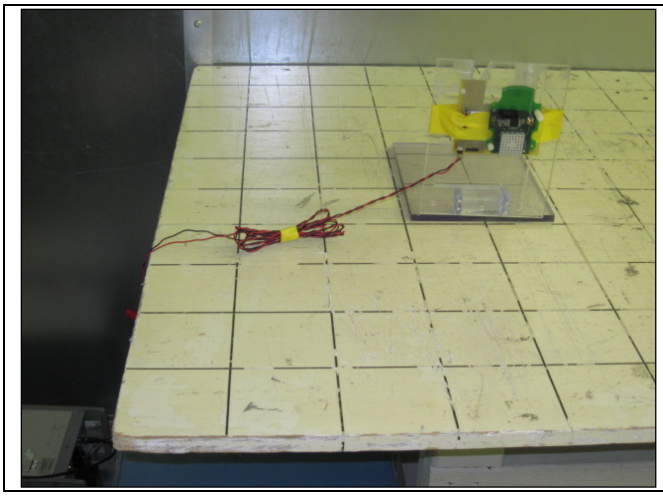
6.4 Test Results

The EUT was found to **MEET** the Conducted Emission requirements of FCC Part **15.207** and **15.107**. See the Data Charts and Graphs for more details of the test results.

6.5 FCC Limits of Conducted Emissions at the AC Mains Ports

Frequency Range (MHz)	Class B Limits (dBµV)		Measuring Bandwidth
	Quasi-Peak	Average	
0.150 -0.50 *	66-56	56-46	RBW = 9 kHz VBW ≥ 9 kHz for QP VBW = 1 Hz for Average
0.5 – 5.0	56	46	
5.0 – 30	60	50	
* The limit decreases linearly with the logarithm of the frequency in this range.			

6.6 Test Setup Photo(s) – Conducted Emissions Test



6.7.1 TRANSMITTER CONDUCTED EMISSIONS TEST DATA CHART

Frequency Range inspected: 150 KHz to 30 MHz
Test Standard: FCC 15.207 Class B
IC RSS GEN 7.2.2

Manufacturer:	LS Research					
Date(s) of Test:	October 5th 2009					
Test Engineer:	Aidi Zainal					
Voltage:	5.0 VDC					
Operation Mode:	Continuous transmit					
Environmental Conditions in the Lab:	Temperature: 20 – 25° C Relative Humidity: 30 – 60 %					
Test Location:	√	AC Mains test bench				Chamber
EUT Placed On:	√	40cm from Vertical Ground Plane			√	10cm Spacers
	√	80cm above Ground Plane				Other:
Measurements:		Pre-Compliance		Preliminary	√	Final
Detectors Used:		Peak	√	Quasi-Peak	√	Average

		QUASI-PEAK			AVERAGE		
Frequency (MHz)	Line	Q-Peak Reading (dBµV)	Q-Peak Limit (dBµ V)	Quasi-Peak Margin (dB)	Average Reading (dBµV)	Average Limit (dBµ V)	Average Margin (dB)
0.236	1.0	21.6	62.2	40.7	3.3	52.2	48.9
0.552	1.0	16.5	56.0	39.5	10.9	46.0	35.1
13.25	1.0	8.6	60.0	51.4	3.1	50.0	47.0
0.174	2.0	23.9	64.8	40.9	13.6	54.8	41.2
0.536	2.0	17.1	56.0	38.9	8.0	46.0	38.0
24.050	2.0	10.7	60.0	49.3	5.3	50.0	44.7

Notes:

1) The emissions listed are characteristic of the power supply used, and did not change by the EUT.

2) All other emissions were better than 20 dB below the limits.

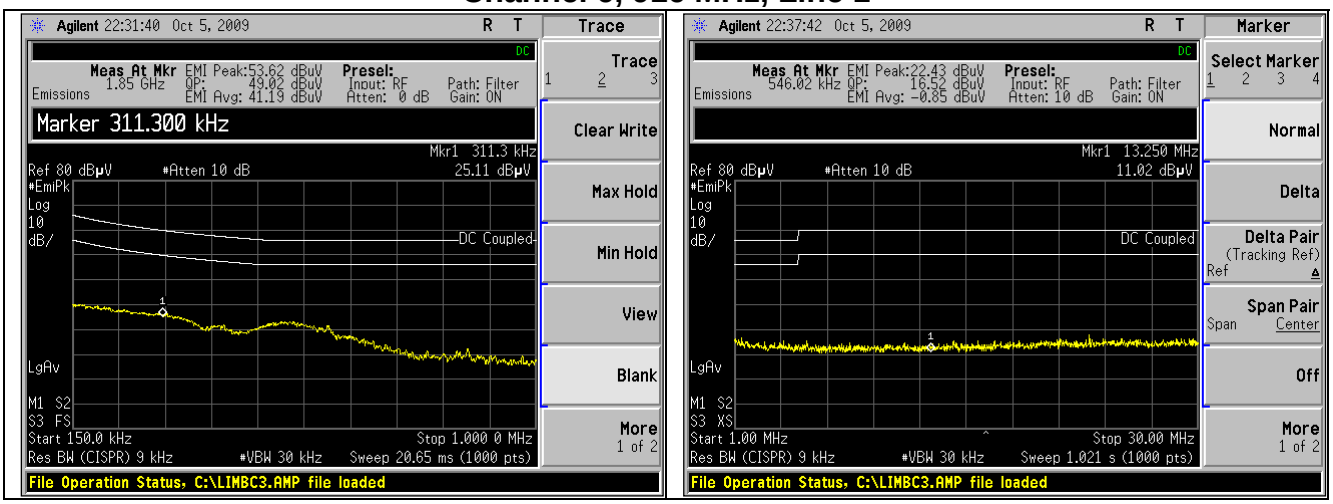
3) The EUT exhibited similar emissions across the Low, Middle and High channels tested. Similar emissions were exhibited with different antenna combination of the EUT.

Screen Captures – Conducted Emissions Test

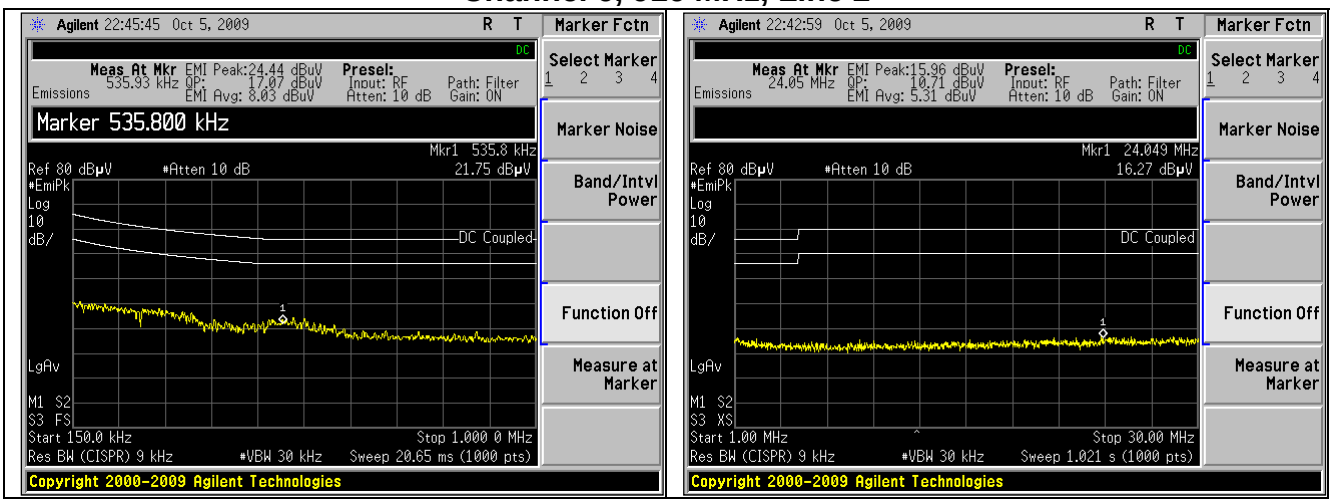
These screen captures represent Peak Emissions. For conducted emission measurements, both a Quasi-Peak detector function and an Average detector function are utilized. The emissions must meet both the Quasi-peak limit and the Average limit as described in 47 CFR 15.207 and RSS GEN 7.2.2 (Table 2).

The signature scans shown here are from channel 6 with the inverted L module, chosen as being a good representative of channels and different antenna setup.

Channel 6, 916 MHz, Line 1



Channel 6, 916 MHz, Line 2



6.7.2 RECEIVER CONDUCTED EMISSIONS TEST DATA CHART

Frequency Range inspected: 150 KHz to 30 MHz
Test Standard: FCC 15.207 Class B
IC RSS GEN 7.2.2

Manufacturer:	LS Research					
Date(s) of Test:	October 5th 2009					
Test Engineer:	Aidi Zainal					
Voltage:	5.0 VDC					
Operation Mode:	continuous receive					
Environmental Conditions in the Lab:	Temperature: 20 – 25° C Relative Humidity: 30 – 60 %					
Test Location:	√	AC Mains test bench				Chamber
EUT Placed On:	√	40cm from Vertical Ground Plane			√	10cm Spacers
	√	80cm above Ground Plane				Other:
Measurements:		Pre-Compliance		Preliminary	√	Final
Detectors Used:		Peak	√	Quasi-Peak	√	Average

		QUASI-PEAK			AVERAGE		
Frequency (MHz)	Line	Q-Peak Reading (dBµV)	Q-Peak Limit (dBµ V)	Quasi-Peak Margin (dB)	Average Reading (dBµV)	Average Limit (dBµ V)	Average Margin (dB)
0.226	1.0	20.5	62.6	42.1	11.9	52.6	40.7
0.519	1.0	16.7	56.0	39.3	10.2	46.0	35.8
14.960	1.0	9.2	60.0	50.9	3.3	50.0	46.7
0.240	2.0	19.7	62.1	42.4	11.5	52.1	40.6
0.533	2.0	14.9	56.0	41.1	7.9	46.0	38.1
14.020	2.0	9.0	60.0	51.0	3.3	50.0	46.7

Notes:

1) The emissions listed are characteristic of the power supply used, and did not change by the EUT.

2) All other emissions were better than 20 dB below the limits.

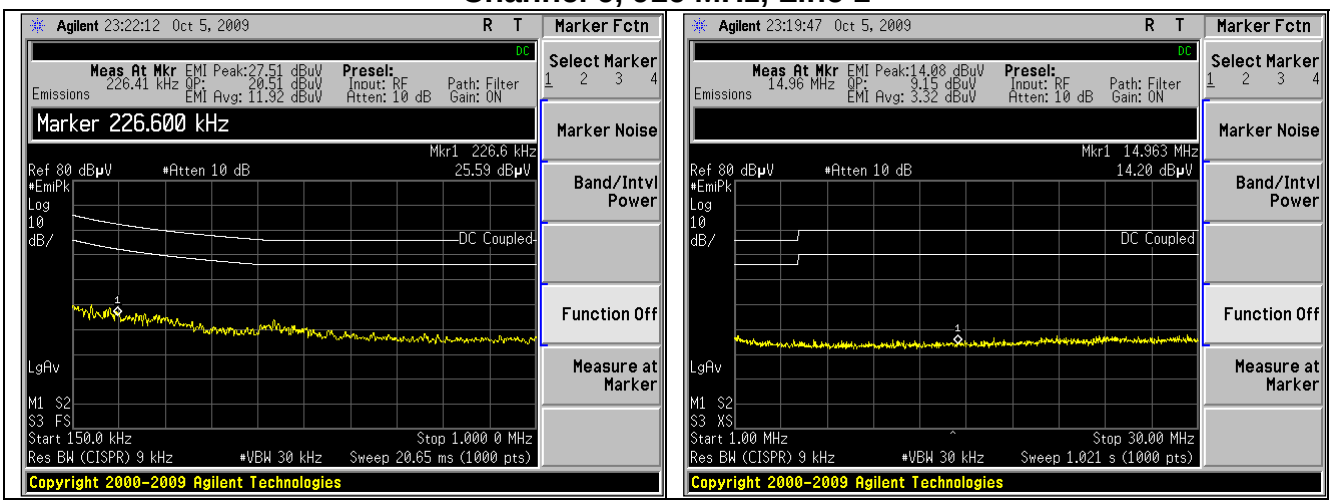
3) The EUT exhibited similar emissions across the Low, Middle and High channels tested. Similar emissions were exhibited with different antenna combination of the EUT.

Screen Captures – Conducted Emissions Test

These screen captures represent Peak Emissions. For conducted emission measurements, both a Quasi-Peak detector function and an Average detector function are utilized. The emissions must meet both the Quasi-peak limit and the Average limit as described in 47 CFR 15.107 and RSS GEN 7.2.2 (Table 2).

The signature scans shown here are from channel 6 with the inverted L module, chosen as being a good representative of channels.

Channel 6, 916 MHz, Line 1



Channel 6, 916 MHz, Line 2

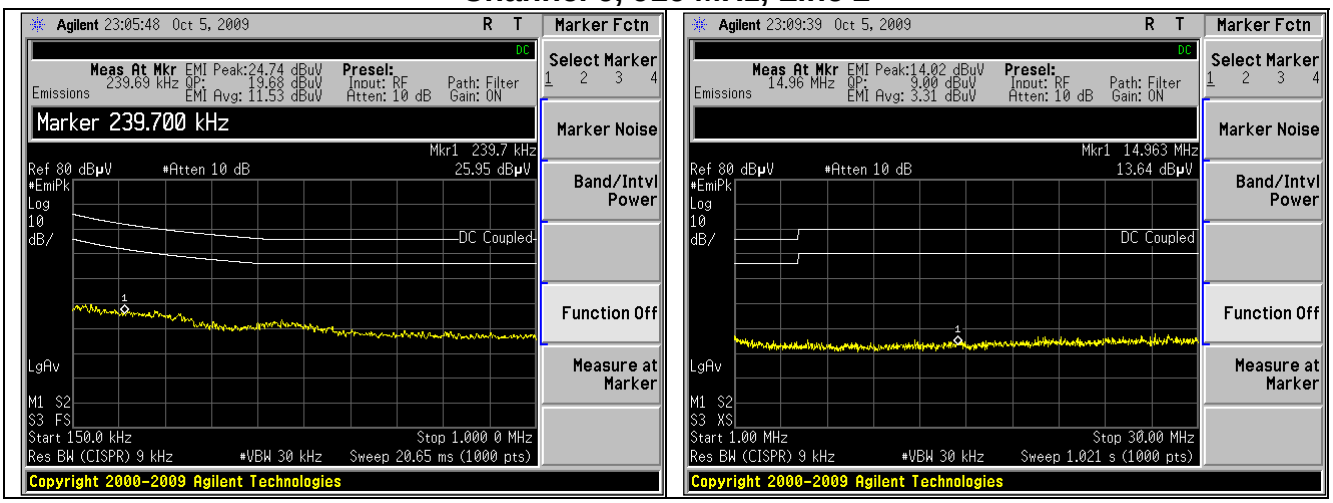


EXHIBIT 7. OCCUPIED BANDWIDTH:

7.1 Limits
For a Digital Modulation System, the 6 dB bandwidth shall be at least 500 kHz.

7.2 Method of Measurements
Refer to ANSI C63.4 (2003) and FCC Procedures (2007) for Digital Transmission Systems operating under 15.247.

The transmitter output was connected to the Spectrum Analyzer. The bandwidth of the fundamental frequency was measured with the Spectrum Analyzer using 100 kHz RBW and VBW=300 kHz.

The bandwidth requirement found in FCC Part 15.247(a)(2) and RSS 210 A8.2(a) requires a minimum -6dBc occupied bandwidth of 500 kHz. In addition, Industry Canada (IC RSS GEN 4.6.1) requires the measurement of the -20dBc occupied bandwidth. For this portion of the tests, a direct measurement of the transmitted signal was performed at the antenna port of the EUT, via a cable connection to the Agilent E4446A spectrum analyzer. The loss from the cable was added on the analyzer as gain offset settings, allowing direct measurements without the need for any further corrections. An Agilent model E4446A spectrum analyzer was used with the resolution bandwidth set to 100 kHz for this portion of the tests. The EUT was configured to run in a continuous transmit mode, while being supplied with typical data as a modulation source. The spectrum analyzer was used in peak-hold mode while measurements were made, as presented in the chart below.

From this data, the closest measurement (6 dB bandwidth) when compared to the specified limit, is 515 kHz, which is above the minimum of 500 kHz.

7.3 Test Equipment List

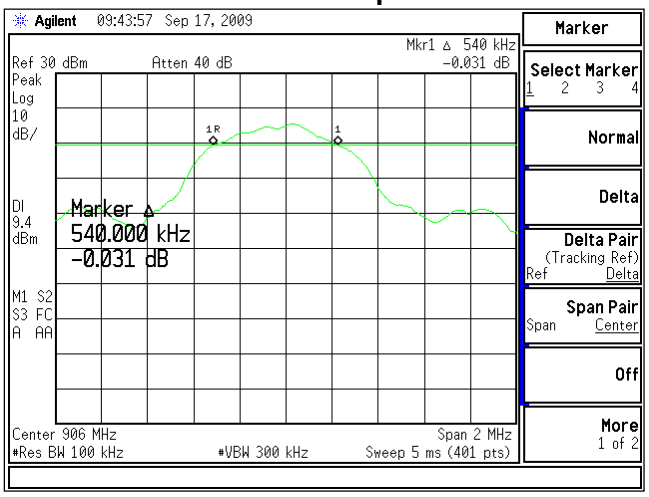
Test Equipment	Manufacturer	Model No.	Serial No.
Spectrum Analyzer	Agilent	E4446A	US45300564

7.4 Test Data

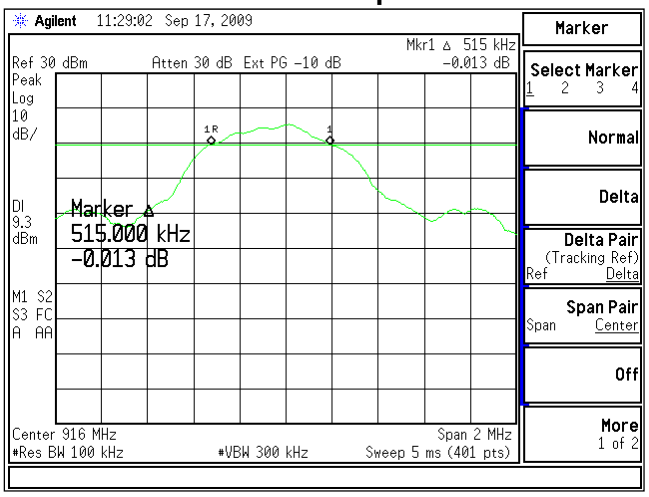
Channel	Center Frequency (MHz)	Measured -6 dBc Occ. BW (kHz)	Minimum -6 dBc Limit (kHz)	Measured -20 dBc Occ.Bw (kHz)
1	906	540	500	840
6	916	515	500	850
10	924	535	500	850

7.5 Screen Captures - OCCUPIED BANDWIDTH

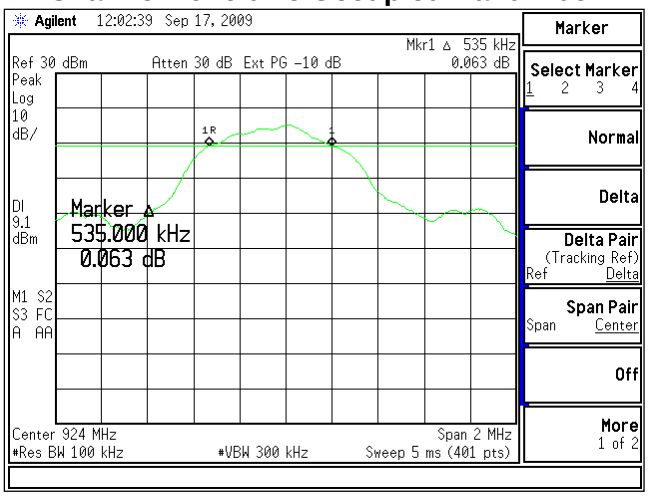
Channel 1 -6 dBc Occupied Bandwidth



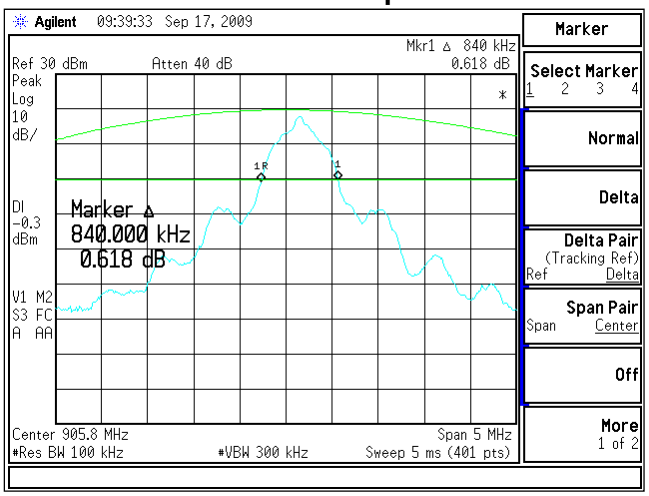
Channel 6 -6 dBc Occupied Bandwidth



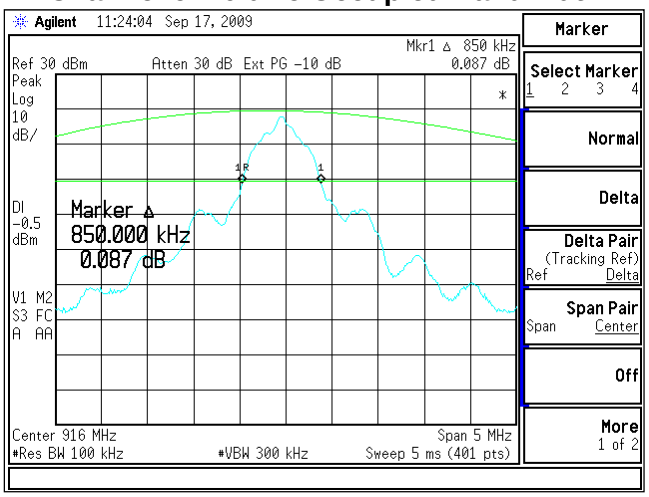
Channel 10 -6 dBc Occupied Bandwidth



Channel 1 -20 dBc Occupied Bandwidth



Channel 6 -20 dBc Occupied Bandwidth



Channel 10 -20 dBc Occupied Bandwidth

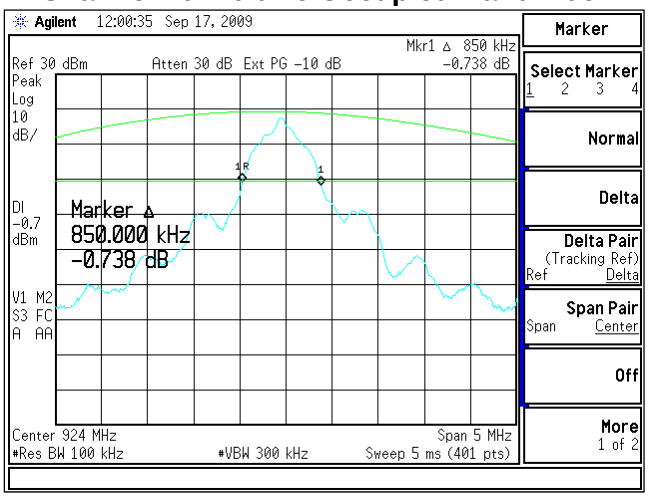


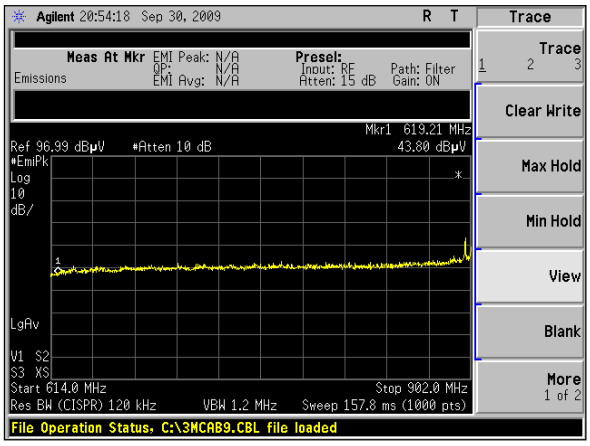
EXHIBIT 8. BAND-EDGE MEASUREMENTS

8.1 Method of Measurements

FCC 15.209(b) and 15.247(d) require a measurement of spurious emission levels to be at least 20 dB lower than the fundamental emission level, in particular at the Band-Edges where the intentional radiator operates. Also, RSS 210 Section 2.2 requires that unwanted emissions meet limits listed in tables 2 and 3 of the same standard and also to the limits in the applicable annex. The following screen captures demonstrate compliance of the intentional radiator at the 902 - 928 MHz Band-Edges. The EUT was operated in continuous transmit mode with continuous modulation, with internally generated data as the modulating source. The EUT was operated at the lowest channel for the investigation of the lower Band-Edge, and at the highest channel for the investigation of the higher Band-Edge.

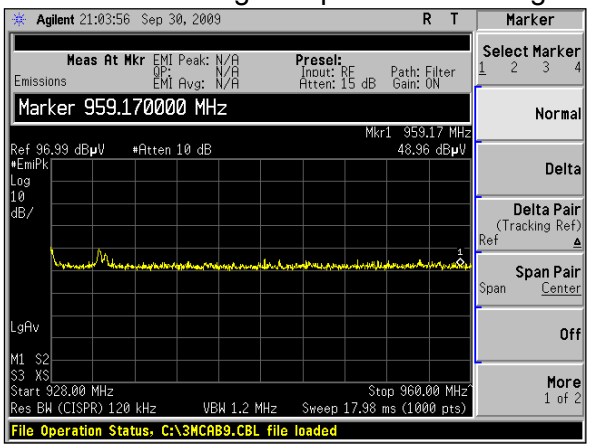
8.1.1. Module with PCB trace Inverted L antenna

Screen Capture Demonstrating Compliance at the Lower Band-Edge



The Lower Band-Edge limit, in this case, would be 98.6dBuV/m at 3m

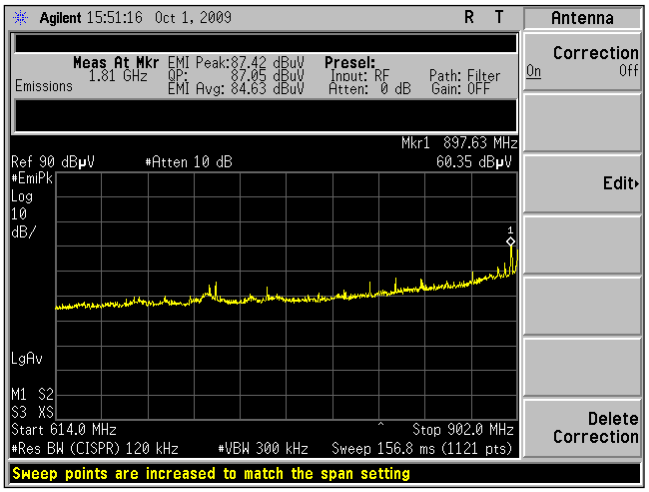
Screen Capture Demonstrating Compliance at the Higher Band-Edge



The Upper Band-Edge limit, in this case, would be 100.5dBuV/m at 3m

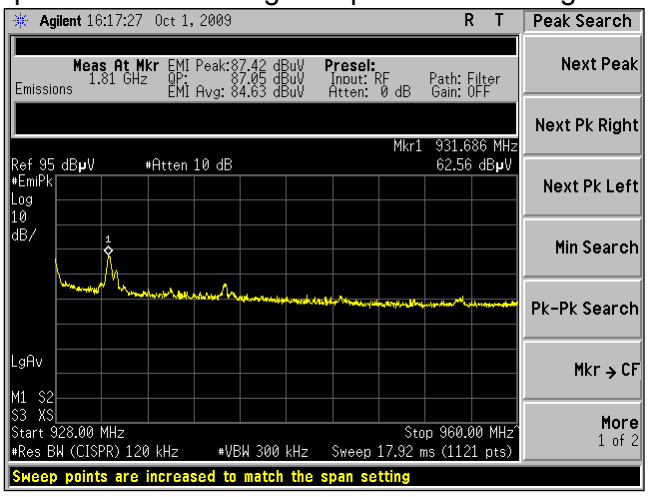
8.1.2. Module with Panel antenna.

Screen Capture Demonstrating Compliance at the Lower Band-Edge



The Lower Band-Edge limit, in this case, would be 103.1dBuV/m at 3m

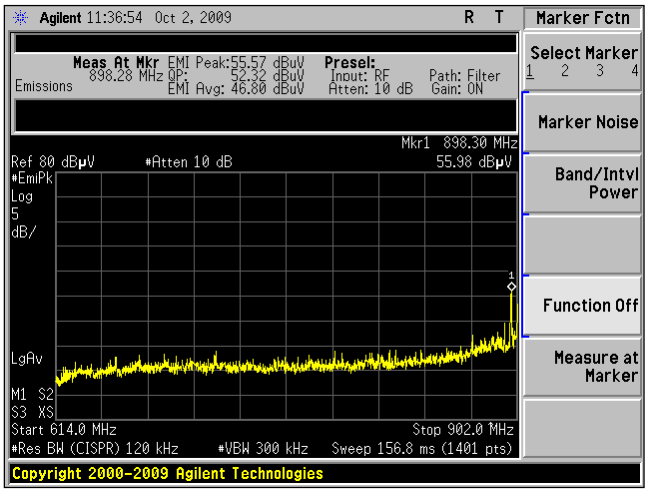
Screen Capture Demonstrating Compliance at the Higher Band-Edge



The Upper Band-Edge limit, in this case, would be 104.1dBuV/m at 3m

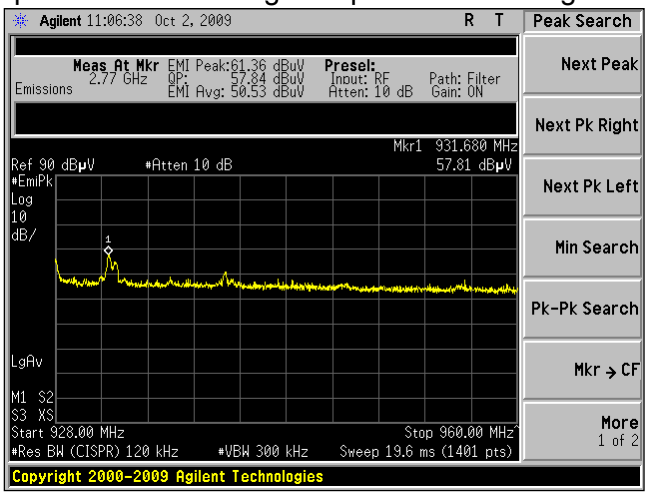
8.1.3. Module with Vee antenna.

Screen Capture Demonstrating Compliance at the Lower Band-Edge



The Lower Band-Edge limit, in this case, would be 99.8dBuV/m at 3m

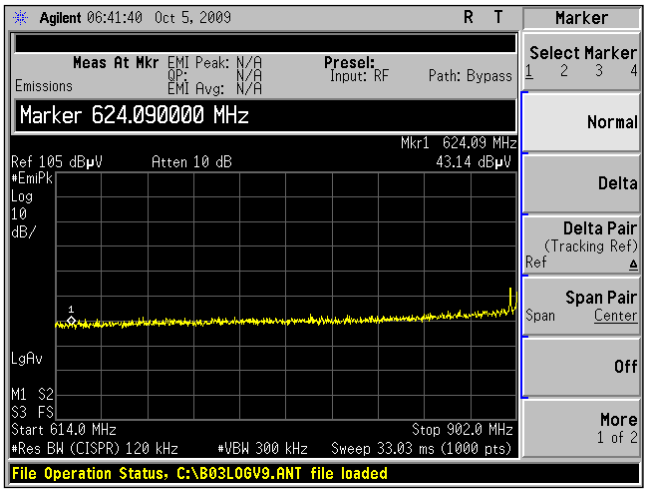
Screen Capture Demonstrating Compliance at the Higher Band-Edge



The Upper Band-Edge limit, in this case, would be 99.7dBuV/m at 3m

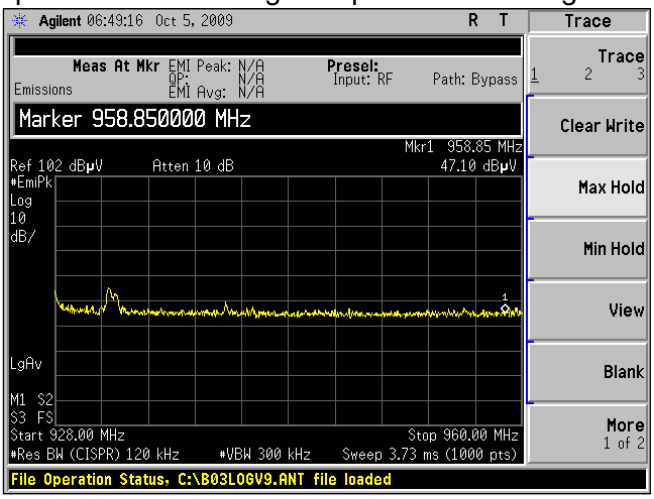
8.1.4. Module with Dome antenna.

Screen Capture Demonstrating Compliance at the Lower Band-Edge



The Lower Band-Edge limit, in this case, would be 100.5dBuV/m at 3m

Screen Capture Demonstrating Compliance at the Higher Band-Edge



The Upper Band-Edge limit, in this case, would be 100.5dBuV/m at 3m

EXHIBIT 9. POWER OUTPUT (CONDUCTED): 15.247(b)

9.1 Method of Measurements

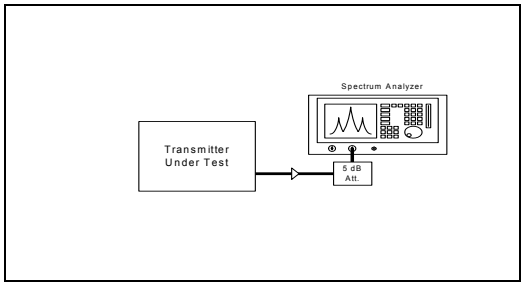
The conducted RF output power of the EUT was measured at the antenna port using a short RF cable along with an attenuator as protection for the spectrum analyzer. The loss from the cable and the attenuator were added on the analyzer as gain offset settings, there by allowing direct measurements without the need for any further corrections. The unit was configured to run in a continuous transmit mode, while being supplied with typical data as a modulation source. The spectrum analyzer was used with resolution and video bandwidths set to 1 MHz, and a span of 5 MHz, with measurements from a peak detector presented in the chart below.

9.2 Test Equipment List

Test Equipment	Manufacturer	Model No.	Serial No.
Spectrum Analyzer	Agilent	E4446A	US45300564

9.3 Test Data

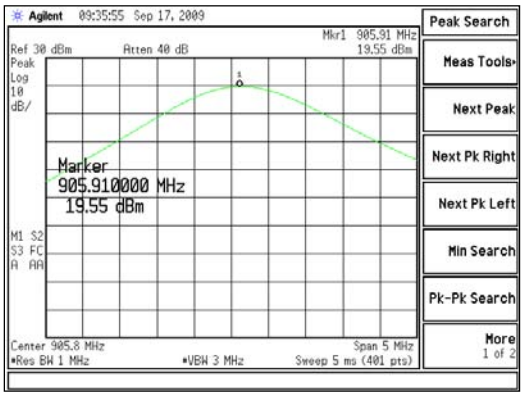
CHANNEL	CENTER FREQ (MHz)	LIMIT (dBm)	MEASURED POWER (dBm)	MARGIN (dB)
1	906	+30 dBm	19.6	10.4
6	916	+30 dBm	19.4	10.6
10	924	+30 dBm	19.3	10.8



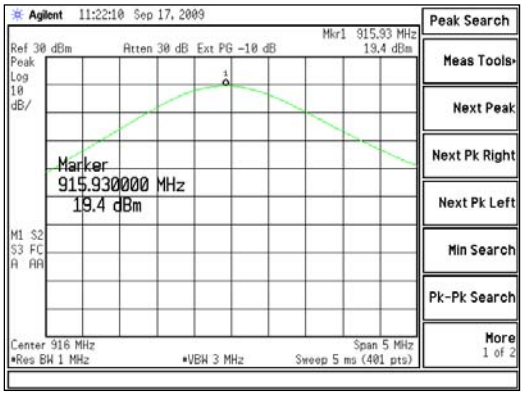
Measured RF Power Output (in Watts): 0.091
Declared RF Power Output (in Watts): 0.100

9.4 Screen Captures – Power Output (Conducted)

Channel 1



Channel 6



Channel 10

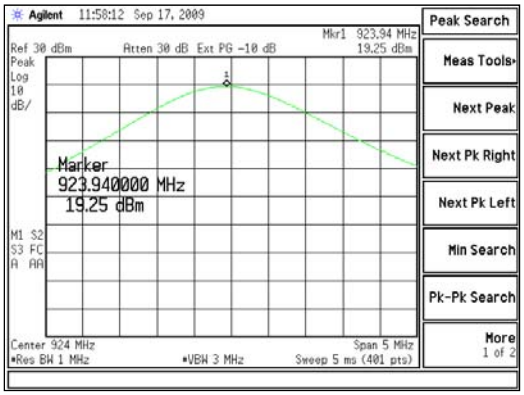


EXHIBIT 10. POWER SPECTRAL DENSITY:

10.1 Limits

For digitally modulate systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

In accordance with FCC Part 15.247(e) and RSS 210 A8.2(b), the peak power spectral density should not exceed +8 dBm in any 3 kHz band. This measurement was performed along with the conducted power output readings performed as described in previous sections. The peak output frequency for each representative frequency was scanned, with a narrow bandwidth, and reduced sweep, and a power density measurement was performed using the utility built into the Agilent Analyzer. The resultant density was then corrected to a 3 kHz bandwidth. The highest density was found to be no greater than 5.7 dBm, which is under the allowable limit by 2.3 dB.

10.2 Test Equipment List

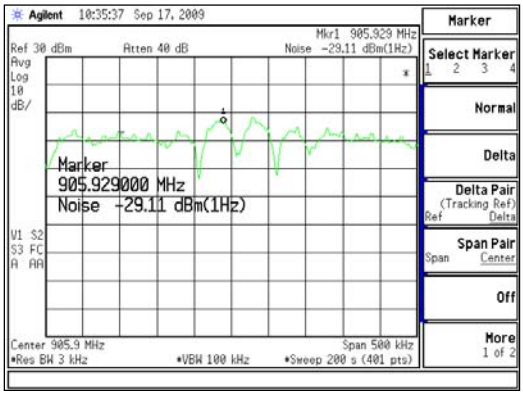
Test Equipment	Manufacturer	Model No.	Serial No.
Spectrum Analyzer	Agilent	E4446A	US45300564

10.3 Test Data

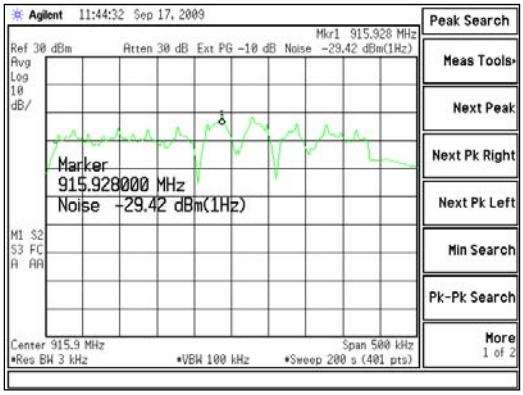
Channel	Center Frequency (MHz)	Measured Channel Power (dBm/Hz)	3 kHz Correction (dB)	Corrected Power Measurement (dBm/3kHz)	Limit (dBm)	Margin (dB)
1	906	-29.1	34.8	5.7	+8.0	2.3
6	916	-29.4	34.8	5.4	+8.0	2.6
10	924	-29.6	34.8	5.2	+8.0	2.8

10.4 Screen Captures – Power Spectral Density

Channel 1



Channel 6



Channel 10

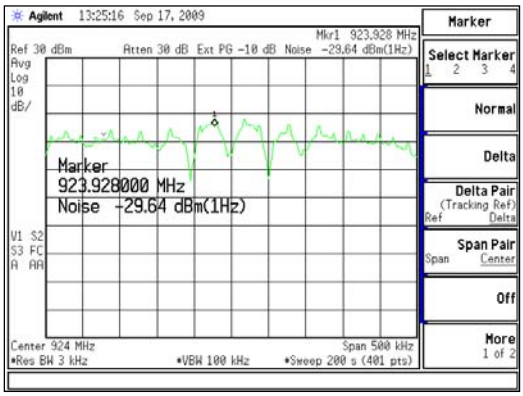


EXHIBIT 11. SPURIOUS RADIATED EMISSIONS: 15.247(d)

11.1 Limits

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 lease 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.

In addition, radiated emissions, which fall in the restricted band, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(e)

FCC Part 15.247(d) and IC RSS 210 A8.5 require a measurement of conducted harmonic and spurious RF emission levels, as reference to the carrier level when measured in a 100 kHz bandwidth. For this test, the spurious and harmonic RF emissions from the EUT were measured at the EUT antenna port using a short RF cable. The loss from the cable was added on the analyzer as gain offset settings, allowing for direct readings of the measurements made without the need for any further corrections. An Agilent model E4446A spectrum analyzer was used with the resolution bandwidth set to 100 kHz for this portion of the tests. The unit was configured to run in a continuous transmit mode, while being supplied with typical data as a modulation source. The spectrum analyzer was used with measurements from a peak detector presented in the chart below. Screen captures were acquired and any noticeable spurious and harmonic signals were identified and measured.

11.2 Test Equipment List

Test Equipment	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer	Agilent	E4446A	US45300564	To 44 GHz

11.3 Test Data

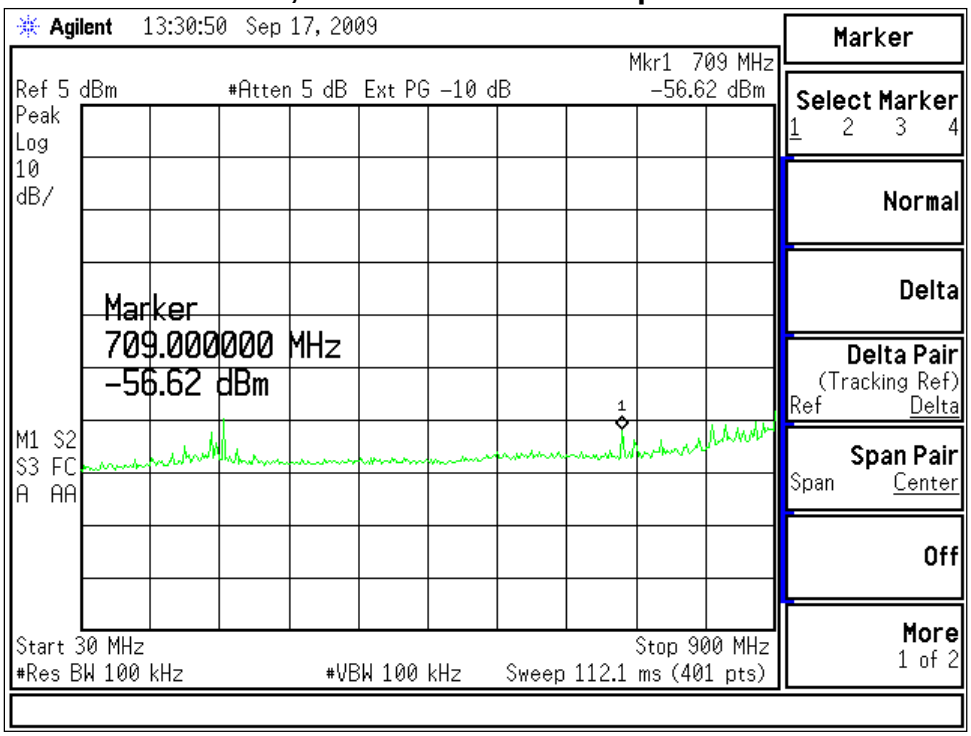
	Channel 1	Channel 6	Channel 10
Fundamental	+17.3(dBm)	+17.5(dBm)	+17.5(dBm)
2nd Harmonic	-9.8(dBm)	-9.5(dBm)	-9.4(dBm)
3rd Harmonic	-51.3(dBm)	-50.4(dBm)	-54.6(dBm)
4th Harmonic	-71.5(dBm)	-71.0(dBm)	-66.9(dBm)
5th Harmonic	-74.7(dBm)	-73.8(dBm)	-73.4(dBm)
6th Harmonic	-80.6(dBm)	-75.9(dBm)	-75.4(dBm)
7th Harmonic	-69.5(dBm)	-69.0(dBm)	-69.2(dBm)
8th Harmonic	-78.8(dBm)	-73.3(dBm)	-70.6(dBm)
9th Harmonic	-71.7(dBm)	-65.5(dBm)	-61.4(dBm)
10th Harmonic	-45.8(dBm)	-44.3(dBm)	-44.7(dBm)

Spurious emissions other than harmonics

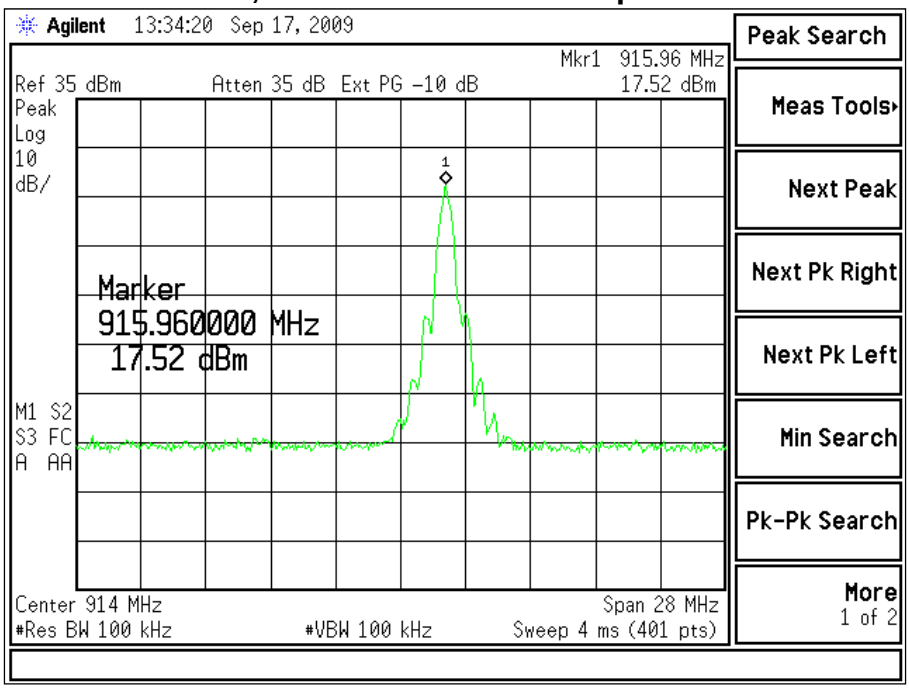
Freq(MHz)	Chan	level(dBm)
208	1	-56.0
208	6	-54.6
709	6	-56.9
208	10	-54.0

11.4 Screen Captures – Spurious Radiated Emissions

Channel 6, shown from 30 MHz up to 900 MHz



Channel 6, shown from 900 MHz up to 928 MHz



Channel 6, shown from 928 MHz up to 10000 MHz

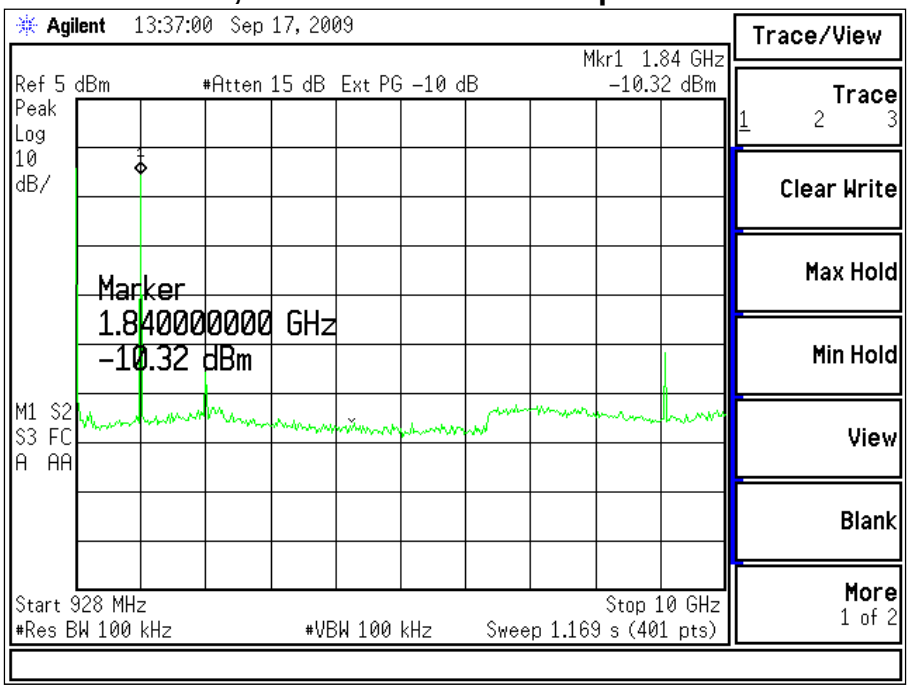


EXHIBIT 12. FREQUENCY & POWER STABILITY OVER VOLTAGE VARIATIONS

The frequency stability of the device was examined as a function of the input voltage available to the EUT. A Spectrum Analyzer was used to measure the frequency at the appropriate frequency markers. Power was supplied by an external bench-type variable power supply, and the frequency of operation was monitored using the spectrum analyzer.

	DC Voltage Source		
	4.25 VDC	5.0 VDC	5.75 VDC
Channel 1	905919500 Hz	905928500 Hz	905968500 Hz
Channel 6	915927500 Hz	915927500 Hz	915973000 Hz
Channel 10	923966500 Hz	923971500 Hz	923926500 Hz

The RF Power Output of the EUT was also monitored in a separate test, also using a Spectrum Analyzer, with RBW=VBW=1 MHz setting while the voltage was varied.

	DC Voltage Source		
	4.25 VDC	5.0 VDC	5.75 VDC
Channel 1	19.5(dBm)	19.6(dBm)	19.5(dBm)
Channel 6	19.4(dBm)	19.4(dBm)	19.4(dBm)
Channel 10	19.1(dBm)	19.3(dBm)	19.3(dBm)

The power was then cycled On/Off to observe system response. No unusual response was observed, the emission characterizes were well behaved, and the system returned to the same state of operation as before the power cycle.

EXHIBIT 13. MPE CALCULATIONS

13.1 Inverted L antenna module.

The following MPE calculations are based on an inverted-L printed circuit board trace antenna, with a measured ERP of 120.5dBµV/m, at 3 meters and conducted RF power of +19.6 dBm as presented to the antenna. The calculated gain of this antenna, based on the ERP measurements is 5.7 dB.

Prediction of MPE limit at a given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

$$S = \frac{PG}{4\pi R^2}$$

where: S = power density
P = power input to the antenna
G = power gain of the antenna in the direction of interest relative to an isotropic radiator
R = distance to the center of radiation of the antenna

Maximum peak output power at antenna input terminal:	19.60	(dBm)
Maximum peak output power at antenna input terminal:	91.201	(mW)
Antenna gain(typical):	5.7	(dBi)
Maximum antenna gain:	3.715	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	900	(MHz)
MPE limit for uncontrolled exposure at prediction frequency:	0.6	(mW/cm^2)
Power density at prediction frequency:	0.067411	(mW/cm^2)
Maximum allowable antenna gain:	15.2	(dBi)
Margin of Compliance at 20 cm =	9.5	dB

13.2 Panel antenna module.

The following MPE calculations are based on the panel antenna, with a measured ERP of 124.1dBµV/m, at 3 meters and conducted RF power of +19.6 dBm as presented to the antenna. The calculated gain of this antenna, based on the ERP measurements is 9.3 dB.

Prediction of MPE limit at a given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

$$S = \frac{PG}{4\pi R^2}$$

where: S = power density
P = power input to the antenna
G = power gain of the antenna in the direction of interest relative to an isotropic radiator
R = distance to the center of radiation of the antenna

Maximum peak output power at antenna input terminal:	19.60	(dBm)
Maximum peak output power at antenna input terminal:	91.201	(mW)
Antenna gain(typical):	9.3	(dBi)
Maximum antenna gain:	8.511	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	900	(MHz)
MPE limit for uncontrolled exposure at prediction frequency:	0.6	(mW/cm^2)
Power density at prediction frequency:	0.154429	(mW/cm^2)
Maximum allowable antenna gain:	15.2	(dBi)
Margin of Compliance at 20 cm =	5.9	dB

13.3 Vee antenna module.

The following MPE calculations are based on the Vee antenna, with a measured ERP of 119.8dBµV/m, at 3 meters and conducted RF power of +19.6 dBm as presented to the antenna. The calculated gain of this antenna, based on the ERP measurements is 5.0 dB.

Prediction of MPE limit at a given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

$$S = \frac{PG}{4\pi R^2}$$

where: S = power density
P = power input to the antenna
G = power gain of the antenna in the direction of interest relative to an isotropic radiator
R = distance to the center of radiation of the antenna

Maximum peak output power at antenna input terminal:	19.60	(dBm)
Maximum peak output power at antenna input terminal:	91.201	(mW)
Antenna gain(typical):	5	(dBi)
Maximum antenna gain:	3.162	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	900	(MHz)
MPE limit for uncontrolled exposure at prediction frequency:	0.6	(mW/cm^2)
Power density at prediction frequency:	0.057376	(mW/cm^2)
Maximum allowable antenna gain:	15.2	(dBi)
Margin of Compliance at 20 cm =	10.2	dB

13.4 Dome antenna module.

The following MPE calculations are based on the Dome antenna, with a measured ERP of 120.5dBµV/m, at 3 meters and conducted RF power of +19.6 dBm as presented to the antenna. The calculated gain of this antenna, based on the ERP measurements is 5.7 dB.

Prediction of MPE limit at a given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

$$S = \frac{PG}{4\pi R^2}$$

where: S = power density
P = power input to the antenna
G = power gain of the antenna in the direction of interest relative to an isotropic radiator
R = distance to the center of radiation of the antenna

Maximum peak output power at antenna input terminal:	19.60	(dBm)
Maximum peak output power at antenna input terminal:	91.201	(mW)
Antenna gain(typical):	5.7	(dBi)
Maximum antenna gain:	3.715	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	900	(MHz)
MPE limit for uncontrolled exposure at prediction frequency:	0.6	(mW/cm^2)
Power density at prediction frequency:	0.067411	(mW/cm^2)
Maximum allowable antenna gain:	15.2	(dBi)
Margin of Compliance at 20 cm =	9.5	dB

APPENDIX A

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date : 7-Oct-2009 Type Test : RF Radiation Exposure Limits Job # : C-626

Prepared By: Aidi Customer : Ingersoll Rand Quote #: 309135

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	ee 960157	3Hz-13.2GHz Spectrum Analyzer	Agilent	E4445A	MY48250225	3/17/2009	3/17/2010	Active Calibration
2	ee 960158	RF Preselecter	Agilent	N9039A	MY46520110	7/2/2009	7/2/2010	Active Calibration
3	aa 960078	Log Periodic Antenna	EMCO	93146	9701-4855	10/20/2008	10/20/2009	Active Calibration

Project Engineer: Aidi Quality Manager: Teresa

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date : 7-Oct-2009 Type Test : Radiated Measurements Job # : C-626

Prepared By: Aidi Customer : Ingersoll Rand Quote #: 309135

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	ee 960158	RF Preselecter	Agilent	N9039A	MY46520110	7/2/2009	7/2/2010	Active Calibration
2	ee 960157	3Hz-13.2GHz Spectrum Analyzer	Agilent	E4445A	MY48250225	3/17/2009	3/17/2010	Active Calibration
3	ee 960073	Spectrum Analyzer	Agilent	E4446A	US45300564	9/17/2009	9/17/2010	Active Calibration
4	aa 960144	Phaseflex	Gore	EkD01D010720	5800373	6/25/2009	6/25/2010	Active Calibration
5	aa 960077	Bicon Antenna	EMCO	93110B	9702-2918	11/24/2008	11/24/2009	Active Calibration
6	aa 960078	Log Periodic Antenna	EMCO	93146	9701-4855	10/20/2008	10/20/2009	Active Calibration
7	aa 960007	Double Ridge Horn Antenna	EMCO	3115	9311-4138	12/23/2008	12/23/2009	Active Calibration

Project Engineer: Aidi Quality Manager: Teresa

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date : 7-Oct-2009 Type Test : Conducted measurements Job # : C-626

Prepared By: Customer : Ingersoll Rand Quote #: 309135

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	ee 960073	Spectrum Analyzer	Agilent	E4446A	US45300564	9/17/2009	9/17/2010	Active Calibration
2	aa 960144	Phaseflex	Gore	EkD01D010720	5800373	6/25/2009	6/25/2010	Active Calibration

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date : 7-Oct-2009 Type Test : Conducted Emissions Job # : C-626

Prepared By: Aidi Customer : Ingersoll Rand Quote #: 309135

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	ee 960157	3Hz-13.2GHz Spectrum Analyzer	Agilent	E4445A	MY48250225	3/17/2009	3/17/2010	Active Calibration
2	ee 960158	RF Preselecter	Agilent	N9039A	MY46520110	7/2/2009	7/2/2010	Active Calibration
3	aa 960008	LISN	EMCO	3816/2NM	9701-1057	12/29/2008	12/29/2009	Active Calibration
4	aa 960031	Transient Limiter	HP	11947A	3107A01708	9/15/2009	9/15/2010	Active Calibration

Project Engineer: Aidi Quality Manager: Teresa

APPENDIX B
TEST STANDARDS – CURRENT PUBLICATION DATES RADIO

STANDARD #	DATE	Am. 1	Am. 2
ANSI C63.4	2003		
CISPR 11	2009-05		
CISPR 12	2007-05		
CISPR 14-1	2005-11	2008-11	
CISPR 14-2	2001-11	2001-11	2008-05
CISPR 16-1-1 Note 1	2006-03	2006-09	2007-07
CISPR 16-1-2 Note 1	2003	2004-04	2006-07
CISPR 22	2008-09		
CISPR 24	1997-09	2001-07	2002-10
EN 55011	2007-05		
EN 55014-1	2006		
EN 55014-2	1997		
EN 55022	2006	2007	
EN 60601-1-2	2007-03		
EN 61000-3-2	2006-05		
EN 61000-3-3	2008-12		
EN 61000-4-2	2001	1998	2001
EN 61000-4-3	2006-07	2008-05	
EN 61000-4-4	2004		
EN 61000-4-5	2006-12		
EN 61000-4-6	2007-08		
EN 61000-4-8	1993	1994-01	
EN 61000-4-11	2004-10		
EN 61000-6-1	2007-02		
EN 61000-6-2	2005-12		
EN 61000-6-3	2007-02		
EN 61000-6-4	2007-02		
FCC 47 CFR, Parts 0-15, 18, 90, 95	2008		
FCC Public Notice DA 00-1407	2000		
FCC ET Docket # 99-231	2002		
FCC Procedures	2007		
ICES 001	2006-06		
ICES 002	2007-02		
ICES 003	2004-02		
IEC 60601-1-2 Note 1	2007-03		
IEC 61000-3-2	2005-11	2008-03	
IEC 61000-3-3	2008-06		
IEC 61000-4-2	2008-12		
IEC 61000-4-3	2008-04	incl in 2006	
IEC 61000-4-4	2004-07		

STANDARD #	DATE	Am. 1	Am. 2
IEC 61000-4-5	2005-11		
IEC 61000-4-6	2008-06		
IEC 61000-4-8	2001-03		
IEC 61000-4-11	2004-03		
IEC 61326-1	2006-06		
ISO 14082	1998-07		
MIL Std. 461E	1999-08		
RSS GEN	2007-06		
RSS 119	2007-06		
RSS 123	1999-11		
RSS 125	2000-03		
RSS 131	2003-07		
RSS 136	2002-10		
RSS 137	2009-02		
RSS 210	2007-06		
RSS 213	2005-12		
RSS 243	2005-11		
RSS 310	2007-06		

Note 1: Test not on LSR Scope of Accreditation.

Updated on 6-26-09

APPENDIX C
Uncertainty Statement

This uncertainty represents an expanded uncertainty expressed at approximately the 95 % confidence level, using a coverage factor of k=2.

Table of Expanded Uncertainty Values, (K=2) for Specified Measurements

Measurement Type	Particular Configuration	Uncertainty Values
Radiated Emissions	3 – Meter chamber, Biconical Antenna	4.24 dB
Radiated Emissions	3-Meter Chamber, Log Periodic Antenna	4.8 dB
Radiated Emissions	10-Meter OATS, Biconical Antenna	4.18 dB
Radiated Emissions	10-Meter OATS, Log Periodic Antenna	3.92 dB
Conducted Emissions	Shielded Room/EMCO LISN	1.60 dB
Radiated Immunity	3 Volts/Meter in 3-Meter Chamber	1.128 Volts/Meter
Conducted Immunity	3 Volts level	1.0 V

Appendix D

Antenna Specification(s)

MARS ANTENNAS & RF SYSTEMS LTD.

Dual Beam GSM Antenna

MA-CC60-20

Mars Dual Beam GSM Antenna is ideal for deployment in tunnels or long building corridors. Its small and unobtrusive profile blends easily with any environment.

Additional Features:

- Wall / Ceiling mount
- DC grounded for lightning protection to meet local electrical building codes.

Application:

- Tunnel coverage
- Indoor cell extender

Specifications:

Electrical	
Frequency range	870 - 960 MHz
Gain	5 dBi (min.)
VSWR	1:1.5
Beamwidth - Azimuth	Two beams, each 60°
Beamwidth - Elevation	60°
Polarization	Vertical
Front to Back	12 dB
Power Handling	50 W
Mechanical and Environmental	
Dimensions (LxWxD)	400x185x55 mm
Weight	400 g
Connector	ending with N type (Female)
Material	Aluminum
Finish	White Epoxy paint
Temperature	-40°C to +70°C
Lightning Protection	DC grounded

Specifications subject to change without notice

Dual Beam GSM Antenna MA-CC60-20

MARS ANTENNAS & RF SYSTEMS LTD.

Multi Band Panel Antenna

MA-CL67-14

Mars Multi Band Panel Antenna covers all the bands for 2G, 2.5G and 3G cellular, as well as ISM, WLAN and Bluetooth. The antenna is aesthetic, small and has an unobtrusive profile that blends easily with any environment.

Indoor and **outdoor** versions are available, as well as different mounting options - please see 'Ordering Options' below.

Specifications:

Electrical			
Standard	SMR, AMPS, CDMA, TDMA, GSM 900	PCS, DECT, GSM 1900, UMTS	Bluetooth, ISM, WLAN
Frequency, MHz	806 - 960	1710 - 2170	2400 - 2500
Gain, typ.	8.5 dBi	7.5 - 10 dBi	5 – 6 .5 dBi
3 dB Beam Width (H-Plane), typ.	75°	60°	50°
3 dB Beam Width (E-Plane), typ.	65°	45°	25°
VSWR, max.	2.0: 1	1.7: 1	1.7: 1
Polarization	Linear Vertical		
Power	50 W		
Impedance	50 Ohm		
Lightning Protection	DC Grounded		
Mechanical and Environmental			
Dimensions (HxWxD)	230x214x31 mm		
Weight	500 gr.		
Connector	N-Type, Female		
Radome	Polycarbonate, UV Protected		
Temperature	-40°C to +65°C		
Back Plane	Aluminum protected through chemical passivation		
Mount	See below Ordering Options		

Specifications subject to change without notice

Ordering Options:

Application/Mount	Wall Mountable	Pole Mount	Az/El Adjustable Mount MNT-2
Indoor Without DC Return	MA-CL67-14	MA-CL67-14 PM	MA-CL67-14 MNT
Outdoor Without DC Return	MA-CL67-14R	MA-CL67-14R PM	MA-CL67-14R MNT
Indoor With DC Return	MA-CL67-14T	MA-CL67-14T PM	MA-CL67-14T MNT
Outdoor With DC Return	MA-CL67-14RT	MA-CL67-14RT PM	MA-CL67-14RT MNT

MARS ANTENNAS & RF SYSTEMS LTD

RoHS COMPLIANT 2002/95/EC

Multi Band Omni Antenna

MA-CM36-15

MARS Multi Band Omni Antenna covers all the bands for 2G, 2.5G and 3G cellular, as well as ISM, WLAN and Bluetooth. The antenna is aesthetic, small and has unobtrusive profile that blends easily with any environment. The antenna is easy-installed and is highly recommended as an outstanding logistic solution for In-Building Installations.

Specifications:

Electrical			
Standard	SMR, AMPS, CDMA, TDMA, GSM 900	PCS, DECT,	Bluetooth, ISM, WLAN
Frequency range	806 - 960 MHz	1.71 - 2.17 GHz	2.3 - 2.7 GHz
Gain,typ.	2 dBi	3 - 4 dBi	5 dBi
VSWR, max.	2:1	1.5:1	1.6:1
Polarization	Linear Vertical		
Input power, max	50 Watt		
Input Impedance	50 Ohm		
Lightning Protection	DC Grounded		
Mechanical			
Dimensions (HxDiameter)	Height â€“ 89 mm, Base Diameter â€“ 205 mm		
Weight	220 gr.		
Connector	N-Type, Female		
Back Plane	Aluminum; protected through chemical passivation		
Radome	UV Protected, Plastic		
Mount	Ceiling Mounting		
Environmemtal			
Operating Temperature Range	- 40°C to + 65°C		
Vibration	According to IEC 60721-3-4		
Flammability	UL94		
Humidity	ETS 300 019-1-4, EN 302 085 (annex A.1.1)		
Service Life	>10 years		

Patent Pending

Ordering Options

Antenna Indoor	MA-CM36-15
Antenna Outdoor	MA-CM36-15 R
Antenna Indoor with DC Return Option	MA-CM36-15 T

Specifications subject to change without notice