LS RESEARCH, LLC
WIRELESS PRODUCT DEVELOPMENT
ACCREDITED
Testing Cert. 1255.01
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TEST REPORT NUMBER: 310140
LSR JOB NUMBER: C-899

Compliance Testing of:

Pentair RFD 915MHz RF transceiver module

Test Date(s):
May 6th to May 24th 2010

Prepared For:
Pentair
ATTN: Mike Lindfors
20580 Enterprise Avenue.
Brookfield, WI 53008

In accordance with:
Federal Communications Commission (FCC)
Part 15, Subpart C, Section 15.247
Industry Canada (IC) RSS 210 Annex 8
Frequency Hopping Spread Spectrum (FHSS) Operating in the Frequency Band 902 to 928 MHz

This Test Report is issued under the Authority of:

Signature:  Date: July 12th, 2010

Test Report Reviewed by:	Tested by:
Signature:  Date: 06.11.2010	Khairul Aidi Zainal, Senior EMC Engineer. Signature:  Date: 06.11.2010

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EXHIBIT 1. INTRODUCTION

1.1 - Scope

References:	FCC Part 15, Subpart C, Section 15.247 and 15.209 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: 1. 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. 2. FCC Public Notice DA 00-705 - Filing and Measurements Guidelines for Frequency Hopping Spread Spectrum Systems.
Environmental Classification:	Commercial, Industrial or Business Residential

1.2 – Normative References

Publication	Year	Title
47 CFR, Parts 0-15 (FCC)	2009	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	2009	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.
FCC Public Notice DA 00-1407	2000	Part 15 Unlicensed Modular Transmitter Approval
47 CFR Part 15 section 212	2009	Modular Transmitters.

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. Accreditation status can be verified at A2LA's web site: www.a2la2.net.

1.4 – Location of Testing

All testing was performed at the following location utilizing the facilities listed below, unless otherwise noted.

LS Research, LLC
W66 N220 Commerce Court
Cedarburg, Wisconsin, 53012 USA,

List of Facilities Located at LS Research, LLC:

Semi-Anechoic Compact Chamber
FCC Listed 3 Meter 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 at an ISO/IEC 17025 accredited calibration laboratory, traceable to the SI Standard.

EXHIBIT 2. PERFORMANCE ASSESSMENT

2.1 – Client Information

Manufacturer Name:	Pentair
Address:	20580 Enterprise Ave. Brookfield, WI 53008
Contact Name:	Mike Lindfors

2.2 - Equipment Under Test (EUT) Information

The following information has been supplied by the applicant.

Product Name:	RFD
Model Number:	BR42792U
Serial Number:	00004 Transmit low channel. 00005 Transmit middle channel. 00007 Transmit high channel. 00008 Receive low and middle channel. 00002 Receive high channel. 00006 Normal hopping.

2.3 - Associated Antenna Description

The antenna used with the module is a Johanson Technology high frequency ceramic chip antenna (part number: 0915AT43A0026). The operating frequency of the antenna is in the 902 to 928 MHz range with a peak gain of -1dBi and an average gain of -4.0dBi with a minimum return loss of 8.5 dB. Power rating is a maximum 2 watts with an input impedance of 50 Ω.

2.4 - EUT'S Technical Specifications

EUT Frequency Range (in MHz)	915 MHz to 920 MHz
Radiated RF Power in Watts	0.000533 Watts
Conducted Output Power (in dBm/in mW)	Maximum = -1.6 dBm / 0.69mW Minimum = -1.7 dBm / 0.68mW
Field Strength at 3 meters	92.5 dBuV/m at 917.5 MHz
Occupied Bandwidth (99% BW)	39.8 kHz
Type of Modulation	FSK
Emission Designator	39K8F1D
EIRP (in mW)	0.550 mW
Transmitter Spurious (worst case) at 3 meters	54.1 dBuV/m at 5490 MHz.
Receiver Spurious (worst case) at 3 meters	53.3 dBuV/m at 5518.8 MHz.
Receiver Bandwidth	58.035714 kHz
Receiver Sensitivity	-110 dBm
Stepped (Y/N)	N
Step Value:	N/A
Frequency Tolerance %, Hz, ppm	Better than 100 ppm
Microprocessor Model # (if applicable)	CC430F5137
Antenna Information	
Detachable/non-detachable	Non-detachable
Type	Ceramic chip
Gain (in dBi)	-1 dBi
EUT will be operated under FCC Rule Part(s)	15.247
EUT will be operated under RSS Rule Part(s)	210
Modular Filing	☒ Yes ☐ No
Portable or Mobile?	Mobile

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 Bulletin 65
Measurement Distance: **20 cm**
RF Value: **0.00109** ☐ V/m ☐ A/m ☒ W/m^2
☐ Measured ☐ Computed ☒ Calculated

2.5 - Product Description

End use of the RFD module is intended to be for use in a remote monitor subsystem and in an electronic valve controller for a residential use Water Softening System. The RFD modules used in this system configuration will allow the wireless transfer of data between the valve controller and the remote monitor subsystem.

EXHIBIT 3. EUT OPERATING CONDITIONS & CONFIGURATIONS DURING TESTS

3.1 - Climate Test Conditions

Temperature:	71° Fahrenheit
Humidity:	32%
Pressure:	749 mmHg

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)(1)(i) IC : RSS 210 A8.1 (a)	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 (a)(1)(i) IC: RSS 210 A8.1(b)	Carrier Frequency Separation	Yes
FCC:15.247 (a)(1)(i),(ii),(iii) IC: RSS 210 A8.1(c),(d),(e)	Number of hopping channels	Yes
FCC:15.247 (a)(1)(i),(ii),(iii) IC: RSS 210 A8.1 (c),(d),(e)	Time of occupancy (Dwell Time)	Yes
FCC : 15.247(c), 15.209 & 15.205 IC : RSS 210 A8.5, section 2.2, 2.6 and 2.7	Transmitter Radiated Emissions	Yes

3.3 - Modifications to the EUT for Compliance Purposes

☒ None ☐ Yes (explain below)

3.4 - Deviations and/or 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 A8.1) for a Frequency Hopping Spread Spectrum (FHSS) Transmitter.

Note: 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. 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 modulated transmit mode for final testing using power as provided by a bench DC supply. 3 separate units were provided for testing on 3 different channels.

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: low (915 MHz), middle (917.5 MHz) and high (920 MHz) in compliance with Title 47 CFR FCC Part 15.31(m). The channels and operating modes were set on 3 separate units.

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 for measurements between 30 MHz to 3000 MHz, and 1 meter from the EUT for measurements between 3000 MHz to 10000 MHz. A Bi-conical Antenna was used to measure emissions from 30 MHz to 300 MHz, a Log Periodic Antenna was used to measure emissions from 300 MHz to 1000 MHz, and 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 for measurements between 30 MHz to 3000 MHz, and 1 and 1.8 meters in height for measurements between 3000 MHz to 10000 MHz, using both horizontal and vertical antenna polarities.

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

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 IEC/ISO 17025 accredited calibration laboratory, traceable to the SI standard. In addition, the Connecting Cables were measured for losses using a calibrated Signal Generator and an EMI Receiver. The resulting correction factors and the cable loss factors from these calibrations were entered into the EMI Receiver database. As a result, the data taken from the 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 EMI Receiver was operated with resolution bandwidths as prescribed in ANSI C63.4.

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 FHSS transmitter. 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 902 to 928 MHz band, as specified in Title 47 CFR 15.247 and RSS 210 is 1 Watt (when channel count is > 50, applicable to this EUT). The harmonic and spurious RF emissions, as measured in any 100 kHz bandwidth, as specified in 15.247 (d) and RSS 210 A8.5, 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 30 MHz. 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 of field strength (μV/m to dBμV/m):
dBμV/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

5.6 - Radiated Emissions Test Data Chart

Frequency Range Inspected: 30 MHz to 10000 MHz

Manufacturer:	Pentair						
Date(s) of Test:	May 6th to 10th 2010						
Project Engineer:	Aidi Zainal						
Test Engineer(s):	Aidi Zainal						
Voltage:	3.0 VDC						
Operation Mode:	Continuous transmit, modulated mode						
Environmental Conditions in the Lab:	Temperature: 71° F Relative Humidity: 32 %						
EUT Power:		Single Phase ___VAC		3 Phase ___VAC			
		Battery	X	Other: Bench DC Supply			
EUT Placement:	X	80cm non-conductive table		10cm Spacers			
EUT Test Location:	X	3 Meter Semi-Anechoic FCC Listed Chamber		3/10m OATS			
Measurements:		Pre-Compliance		Preliminary	X	Final	
Detectors Used:	X	Peak	X	Quasi-Peak	X	Average	

The following table depicts the level of significant spurious radiated RF emissions found (other than the fundamentals and its harmonics):

Frequency (MHz)	Ant./EUT Polarity	Host Mode	Height (meters)	Azimuth (degrees)	Measured EFI (dBμV/m)	Limit (dBμV/m)	Margin (dB)
246.8	V/V	Note 2	1.36	288	24.0	46.0	22.0

Note:
1. H: Horizontal, V: Vertical, F: Flat.
2. Present on all channels.

The following table depicts the level of radiated Fundamental emissions seen:

Frequency (MHz)	Ant./EUT Polarity	Chan.	Height (meters)	Azimuth (degrees)	Measured EFI (dBμV/m)	Limit (dBμV/m)	Margin (dB)
915.0	H/V	Low	1.43	293	92.4	125.2	32.8
917.5	H/S	Middle	1.22	298	92.5	125.2	32.7
920.0	H/V	High	1.08	21	90.8	125.2	34.4

Note:
1. H: Horizontal, V: Vertical, F: Flat, S: Side.

RADIATED EMISSIONS DATA CHART (continued)

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

Antenna Polarization	Frequency (MHz)	Peak (dBuV/m)	Average (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (°)	EUT Orientation
	1830.0		Note 4					
	2745.0		Note 4					
Vertical	3660.0	61.7	57.1	63.5	6.4	101.6	2	V
Horizontal	4575.0	53.1	46.2	63.5	17.3	114.5	5	V
Vertical	5490.0	67.7	63.6	81.9	18.3	109.8	261	S
Horizontal	6405.0	49.1	41.9	81.9	40.0	104.6	4	S
Horizontal	7320.0	51.6	44.2	63.5	19.3	101.4	330	S
Horizontal	8235.0	49.7	38.5	63.5	25.0	106.4	9	S
Horizontal	9150.0	49.1	37.8	63.5	25.7	134.2	10	V

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

Antenna Polarization	Frequency (MHz)	Peak (dBuV/m)	Average (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (°)	EUT Orientation
	1835.0		Note 4					
	2752.5		Note 4					
Horizontal	3670.0	60.1	58.2	63.5	5.3	109.6	6	S
Horizontal	4587.5	51.7	47.5	63.5	16.0	102.5	191	F
Horizontal	5505.0	64.2	63.4	82.0	18.6	102.0	168	F
Vertical	6422.5	48.6	40.9	82.0	41.1	101.4	4	V
Vertical	7340.0	48.9	39.4	63.5	24.1	123.9	312	V
Horizontal	8257.5	49.0	37.7	63.5	25.8	114.8	318	V
Vertical	9175.0	49.3	37.5	63.5	26.0	102.2	10	F

Notes:

1. A Quasi-Peak Detector was used in measurements below 1 GHz. To ensure the peak emissions did not exceed 20 dB above the limits a peak detector (without video averaging) was used. A peak detector with video averaging was used for measurements above 1 GHz.
2. Measurements above 3 GHz were made at 1 meters of separation from the EUT. Limits have been corrected to reflect the change in measurement distance.
3. H: Horizontal, V: Vertical, F: Flat, S: Side.
4. Measurement at receiver system noise floor.

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

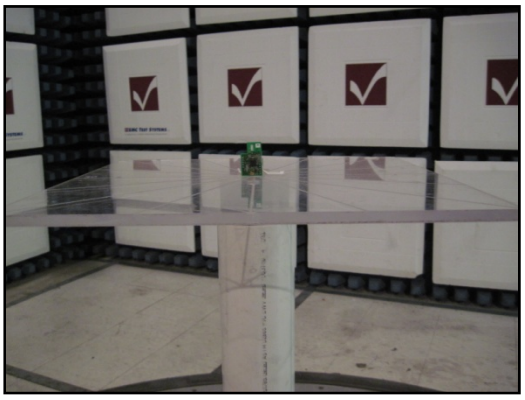
Antenna Polarization	Frequency (MHz)	Peak (dBuV/m)	Average (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (°)	EUT Orientation
	1840.0		Note 4					
	2760.0		Note 4					
Horizontal	3680.0	59.8	55.4	63.5	8.1	101.4	230	F
Horizontal	4600.0	52.3	46.3	63.5	17.2	101.8	99	F
Horizontal	5520.0	64.4	60.3	80.3	20.0	101.5	156	F
Vertical	6440.0	48.8	41.0	80.3	39.3	108.1	4	V
Vertical	7360.0	47.7	37.2	63.5	26.3	113.2	8	V
Vertical	8280.0	48.9	37.9	63.5	25.6	117.5	9	V
Horizontal	9200.0	50.8	37.8	63.5	25.7	102.2	7	V

Notes:

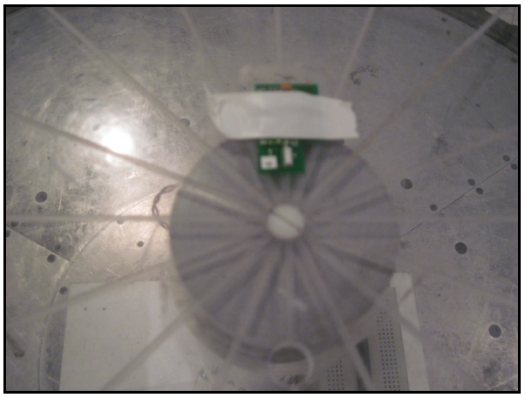
1. A Quasi-Peak Detector was used in measurements below 1 GHz. To ensure the peak emissions did not exceed 20 dB above the limits a peak detector (without video averaging) was used. A peak detector with video averaging was used for measurements above 1 GHz.
2. Measurements above 3 GHz were made at 1 meters of separation from the EUT. Limits have been corrected to reflect the change in measurement distance.
3. H: Horizontal, V: Vertical, F: Flat, S: Side.
4. Measurement at receiver system noise floor.

5.7 - Test Setup Photo(s) – Radiated Emissions Test

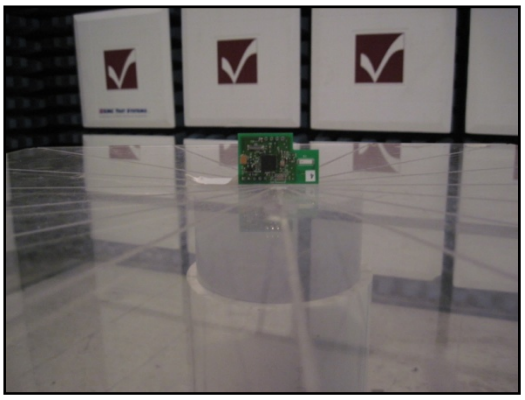
Vertical Orientation



Flat Orientation



Side Orientation

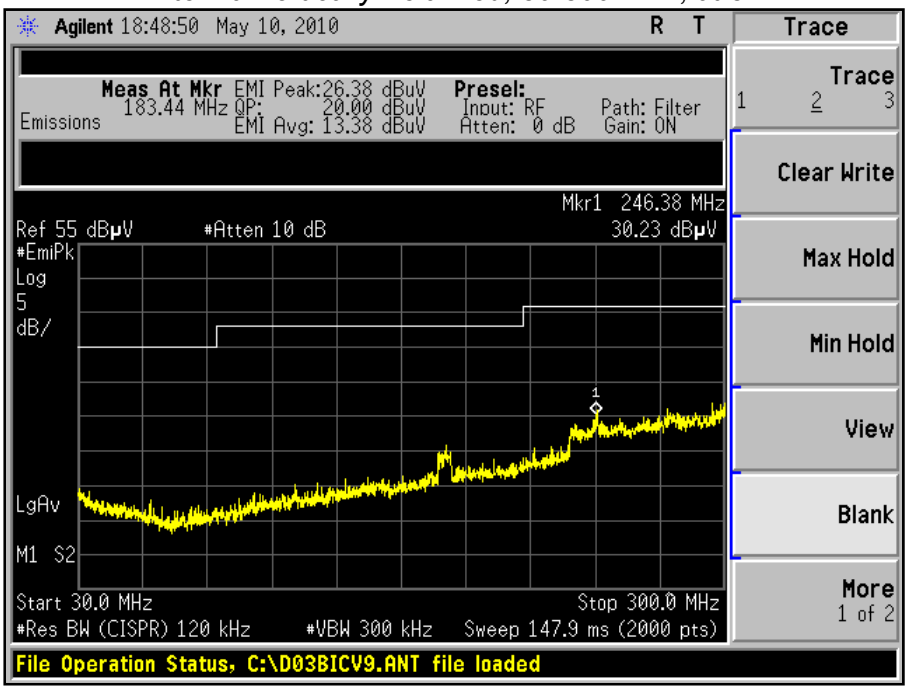


5.8 - Screen Captures - Radiated Emissions Test

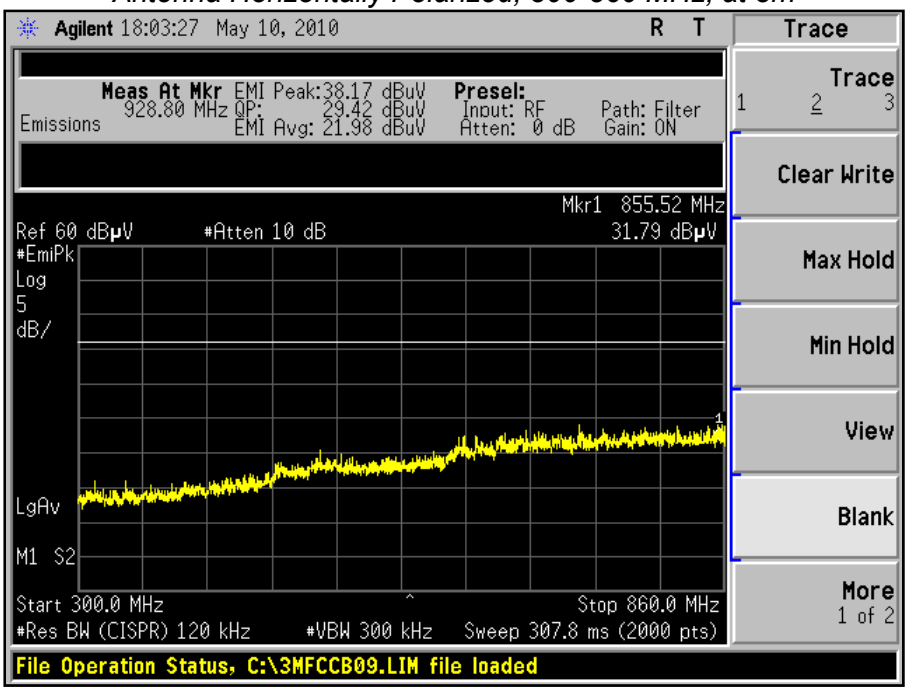
These screen captures represent Peak Emissions. For radiated emission measurements, a Quasi-Peak detector function is utilized when measuring frequencies below 1 GHz, and a video averaged Peak detector function is utilized when measuring frequencies above 1 GHz.

The signature scans shown here are from worst-case emissions, as measured on channels 915 MHz, 917.5 MHz, or 920 MHz, with the sense antenna both in vertical and horizontal polarity for worst case presentations.

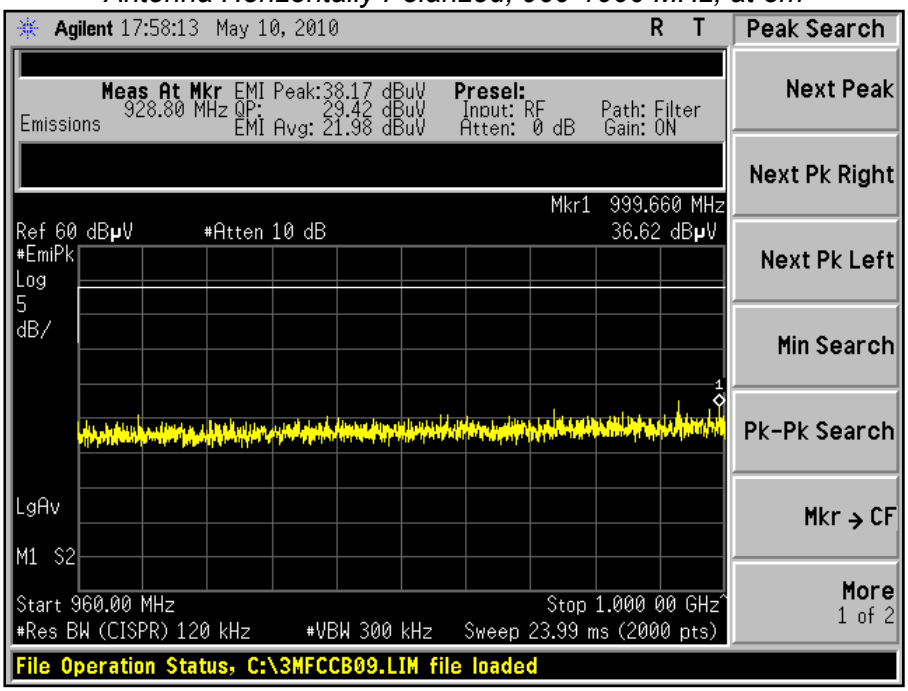
Antenna Vertically Polarized, 30-300 MHz, at 3m



Antenna Horizontally Polarized, 300-860 MHz, at 3m

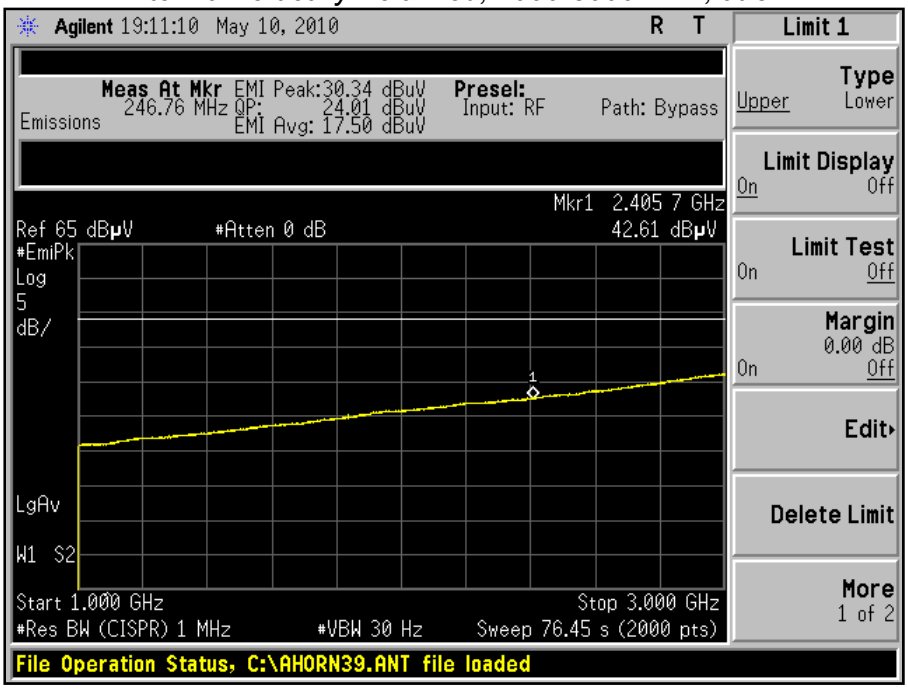


Antenna Horizontally Polarized, 960-1000 MHz, at 3m

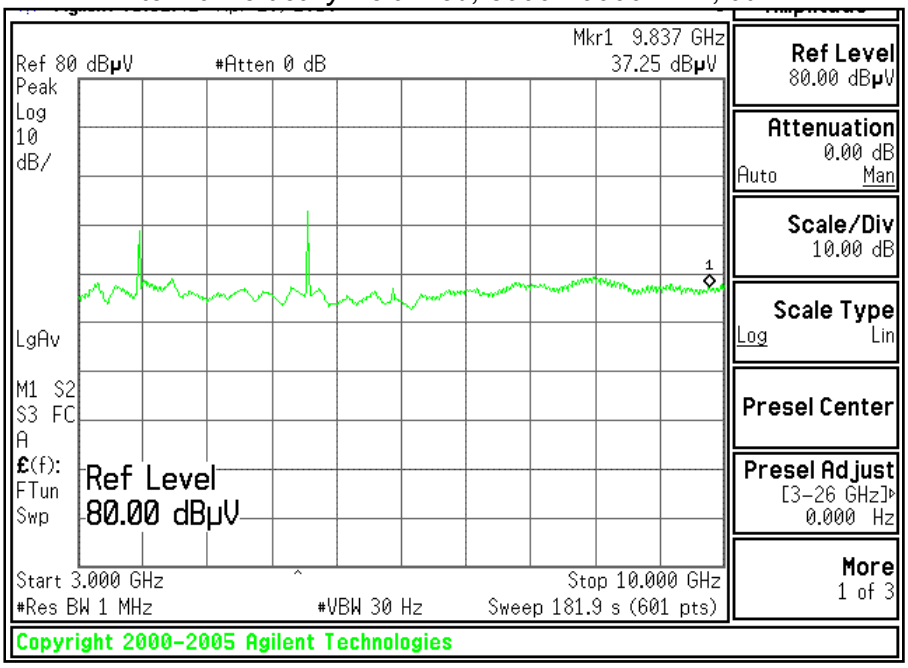


Note: The frequency range 860-902 MHz and 928-960 MHz is in the Band-edge section (Exhibit 8).

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



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



5.9 - Receive Mode Testing

Per the requirements of RSS-210 and CFR 47 part 15, 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 and CFR 47 15.109.

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

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

Frequency (MHz)	Ant./EUT Polarity	Chan.	Height/ Azimuth (m / °)	Measured Peak (dBμV/m)	Measured Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)
5488.9	V/S	Low	1.07/280	63.3	62.0	63.5	1.5
5504.5	H/F	Middle	1.00/157	63.5	62.8	63.5	0.7
5518.8	H/F	High	1.00/167	63.6	62.8	63.5	0.7

Notes:

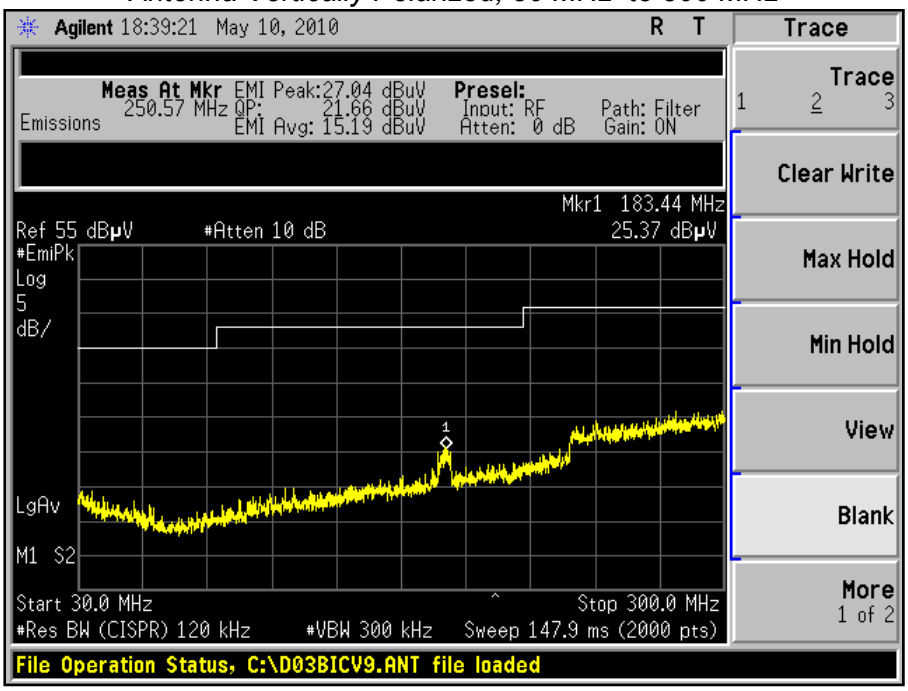
1. A Quasi-Peak Detector was used in measurements below 1 GHz. To ensure the peak emissions did not exceed 20 dB above the limits a peak detector was used. A peak detector with video averaging was used for measurements above 1 GHz.
2. Measurements above 3 GHz were made at 1 meters of separation from the EUT.
3. H: Horizontal, V: Vertical, F: Flat, S: Side.

5.10 - 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 a video averaged Peak detector function is utilized when measuring frequencies above 1 GHz.

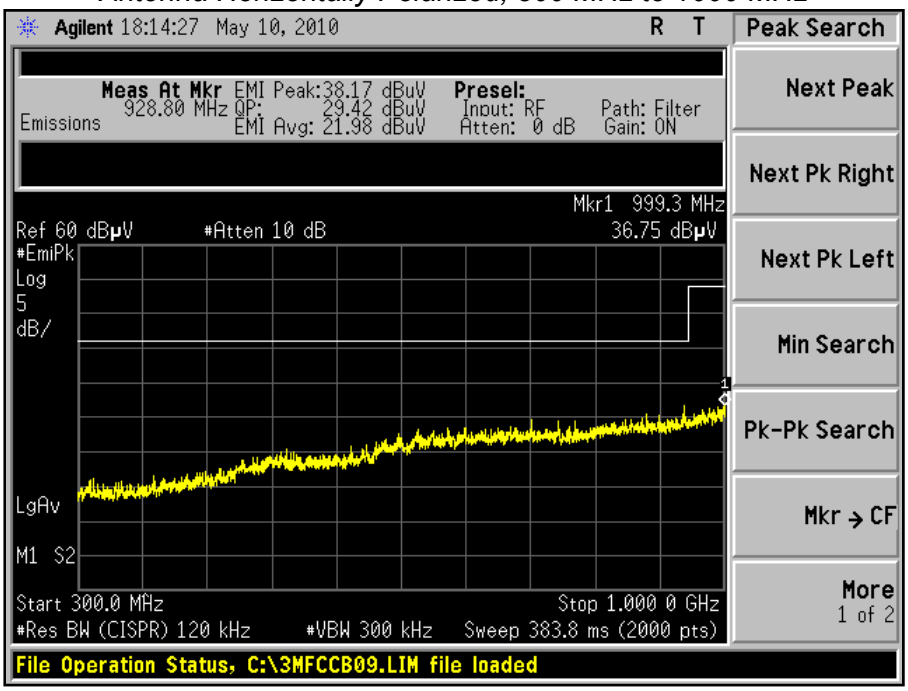
The signature scans shown here are from worst-case emissions, as measured on channels 915 MHz, 917.5 MHz, or 920 MHz, with the sense antenna both in vertical and horizontal polarity for worst case presentations.

Antenna Vertically Polarized, 30 MHz to 300 MHz

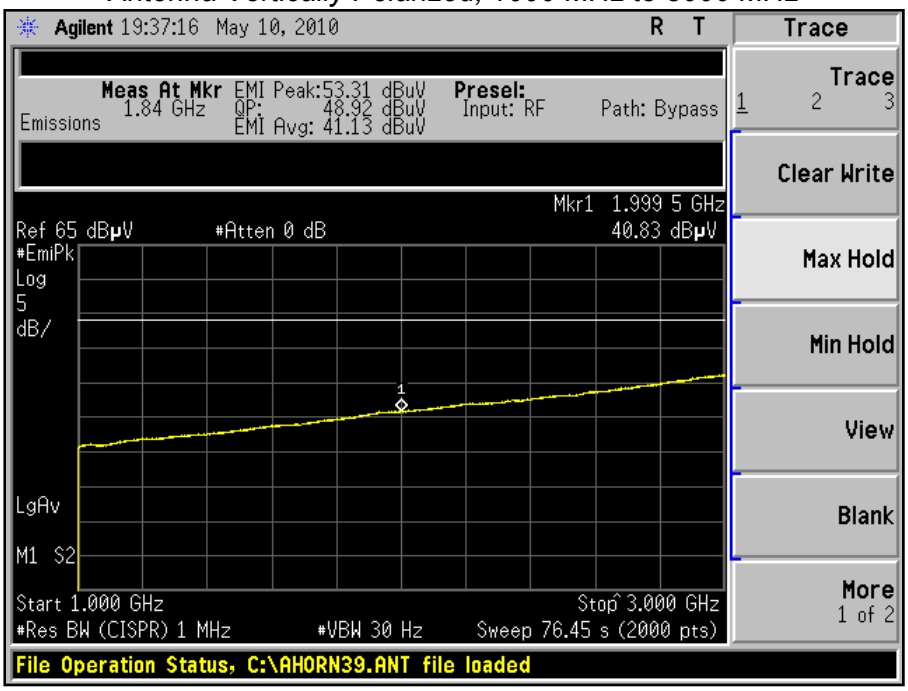


Screen Captures - Radiated Emissions Testing – Receive Mode (continued)

Antenna Horizontally Polarized, 300 MHz to 1000 MHz



Antenna Vertically Polarized, 1000 MHz to 3000 MHz



Antenna Horizontally Polarized, 3000 MHz to 10000MHz

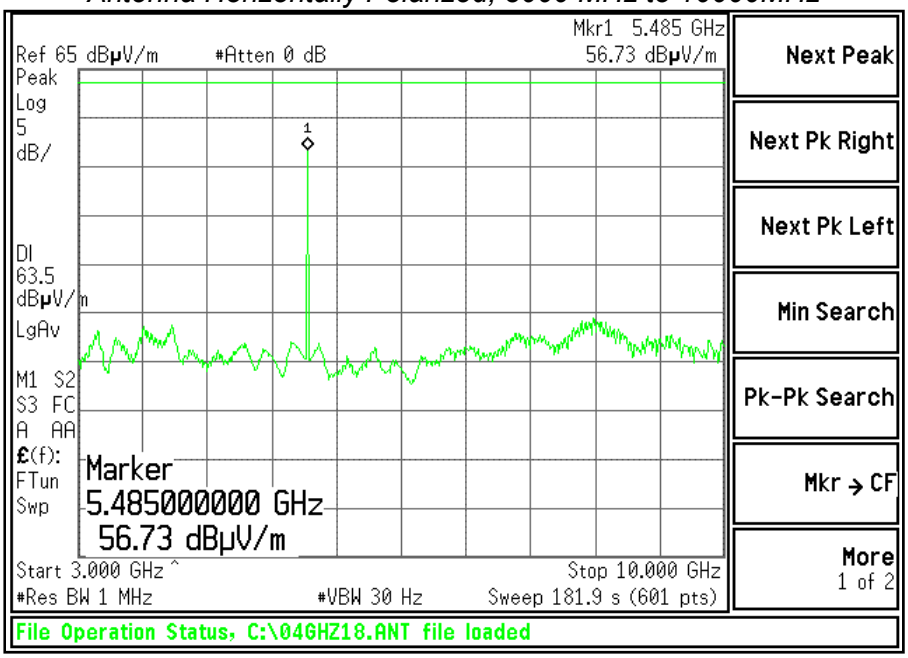


EXHIBIT 6. CONDUCTED EMISSIONS TEST, AC POWER LINE

6.1 - Test Setup

The test area and setup are in accordance with ANSI C63.4and 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's power cable was plugged into a 50Ω (ohm), 50/250 μH Line Impedance Stabilization Network (LISN). The 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 EMI Receiver. 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 mode and continuous receive mode. 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 Title 47 CFR, FCC Part 15.35, for Quasi-Peak and Average detectors in the frequency range of 150 kHz to 30 MHz. Final readings were then taken and recorded.

An off-the-shelf DC power supply was used during the test to supply the EUT with the appropriate DC voltage.

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 were performed by an ISO/IEC 17025 accredited calibration laboratory, and traceable to the SI standard. All cables are calibrated and checked periodically for conformance. The emissions are measured on the EMI Receiver, 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 CFR 47 Part 15.207 and 15.107, Conducted Emissions. See the Data Charts and Graphs for more details of the test results. By virtue of meeting the requirements of FCC, the EUT also meets the requirements of IC RSS 210 and RSS GEN.

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 – 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:	Pentair					
Date(s) of Test:	May 24th 2010					
Project Engineer:	Aidi Zainal					
Test Engineer:	Aidi Zainal					
Voltage:	120 VAC					
Operation Mode:	Continuous transmit and Continuous receive					
Environmental Conditions in the Lab:	Temperature: 20 – 25° C Relative Humidity: 30 – 60 %					
Test Location:	X	Conducted Emissions Area				Chamber
EUT Placed On:	X	40cm from Vertical Ground Plane				10cm Spacers
	X	80cm above Ground Plane				Other:
Measurements:		Pre-Compliance		Preliminary	X	Final
Detector Used:		Peak	X	Quasi-Peak	X	Average

6.6.1 Transmit mode

f (MHZ)	LINE	QP	QP LIMIT	MARGIN	AVG	AVG LIMIT	MARGIN
0.209	1.0	16.0	63.2	47.2	2.3	53.2	50.9
0.600	1.0	28.8	56.0	27.2	20.5	46.0	25.5
4.001	1.0	25.5	56.0	30.5	24.0	46.0	22.0
0.604	2.0	27.0	56.0	29.0	18.7	46.0	27.3
2.022	2.0	14.0	56.0	42.0	4.6	46.0	41.4
11.240	2.0	13.9	60.0	46.1	4.1	50.0	45.9

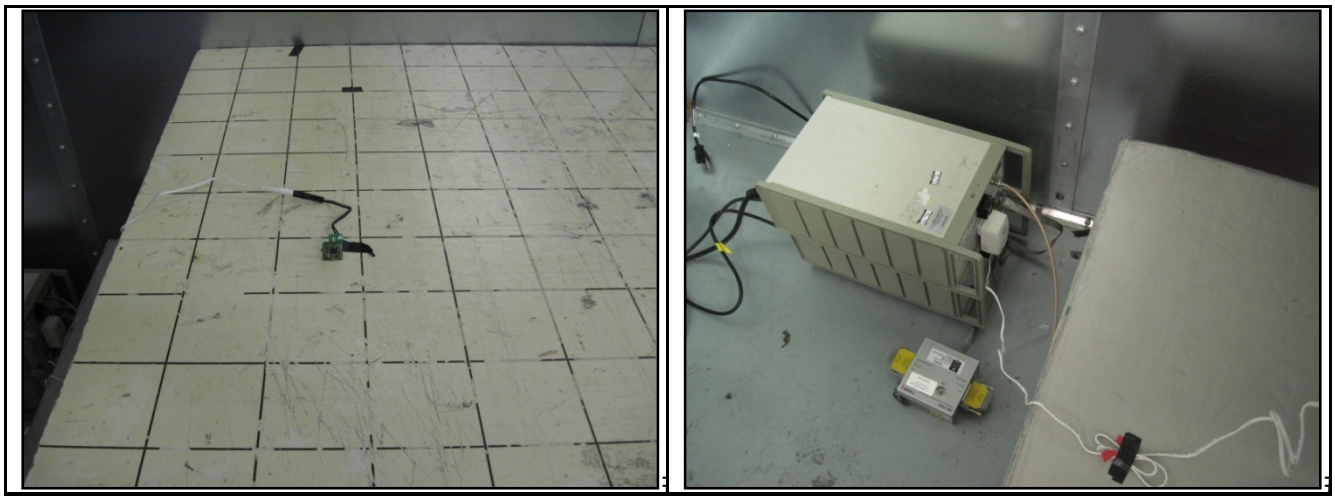
Notes:
1) The emissions listed are characteristic of the power supply used, and did not change by the EUT.
2) All other emissions were better than 20 dB below the limits.
3) The EUT exhibited similar emissions across the Low and High channels tested.
4) Measured levels and limits are in units of dBµV/m.

6.6.2 Receive mode.

f (MHZ)	LINE	QP	QP LIMIT	MARGIN	AVG	AVG LIMIT	MARGIN
0.602	1.0	29.2	56.0	26.8	25.1	46.0	20.9
3.998	1.0	25.5	56.0	30.5	23.6	46.0	22.4
27.340	1.0	18.7	60.0	41.3	16.8	50.0	33.2
0.155	2.0	18.2	65.7	47.5	4.0	55.7	51.7
0.601	2.0	27.8	56.0	28.2	23.9	46.0	22.1
26.000	2.0	18.7	60.0	41.3	16.6	50.0	33.4

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 and High channels tested.
4) Measured levels and limits are in units of dBµV/m.

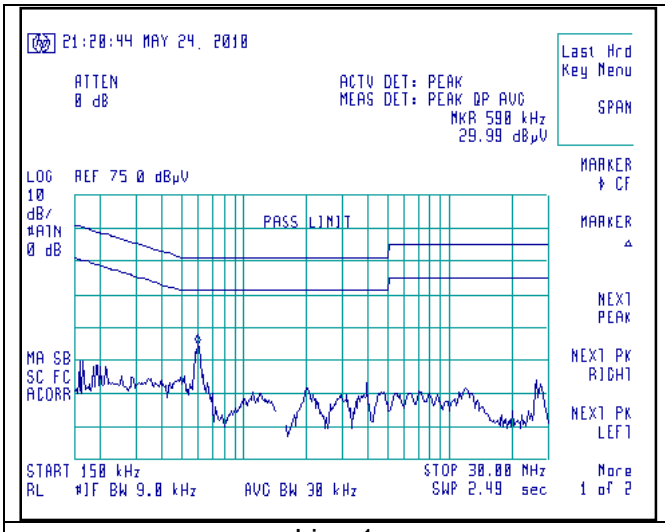
6.7 - Test Setup Photo(s) – Conducted Emissions Test



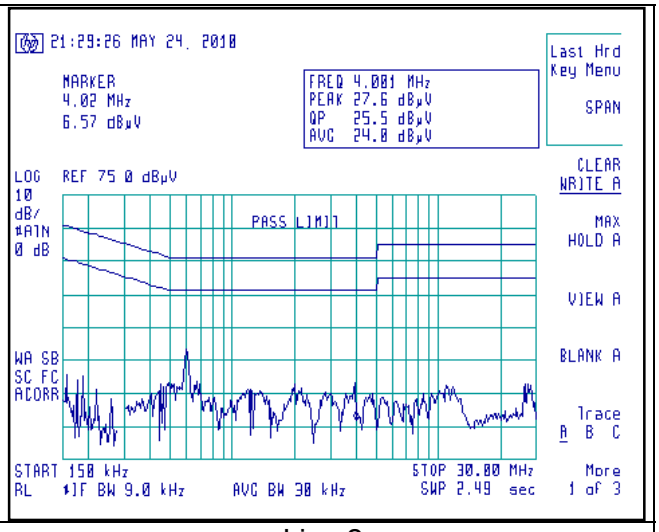
6.8 - Screen Captures – Conducted Emissions Test

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 the middle channel chosen as being a good representative of channels.

6.8.1. Transmit mode.

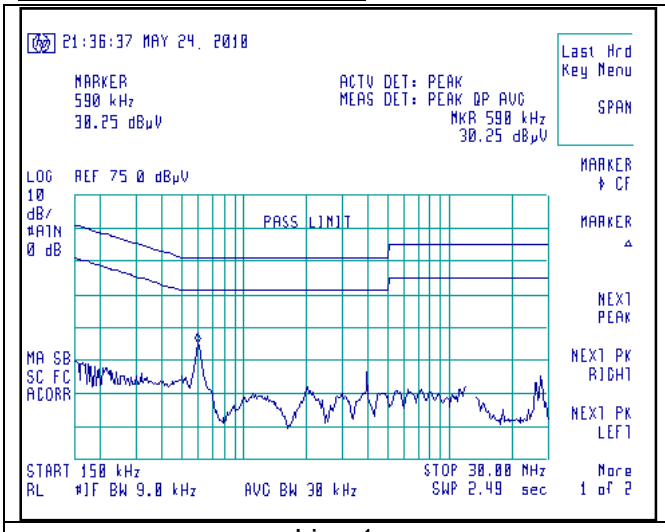


Line 1

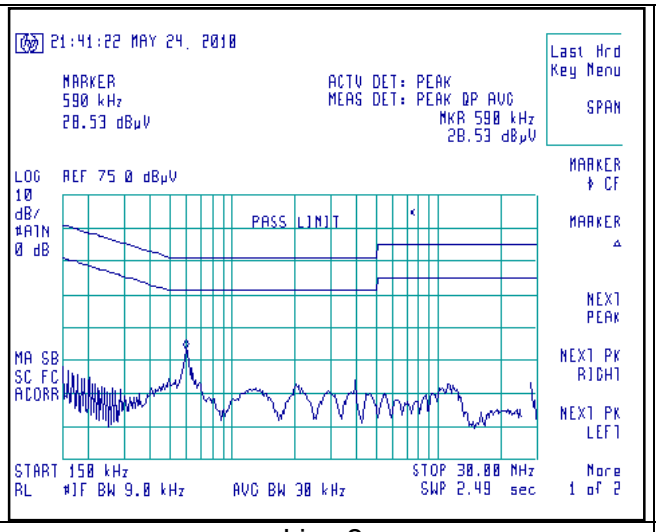


Line 2

6.8.2. Receive mode.



Line 1



Line 2

EXHIBIT 7. OCCUPIED BANDWIDTH

7.1 - Limits

For a frequency Hopping system in the 902 to 928 MHz band, the 20 dB bandwidth shall not exceed 500 kHz for FCC CFR 47 15.247 (a)(1)(i) and IC RSS 210 A8.1. (c).

7.2 - Method of Measurements

The transmitter output was connected to the Spectrum Analyzer. The bandwidth of the fundamental frequency was measured with the Spectrum Analyzer using 1 kHz RBW and VBW=3 kHz.

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 a spectrum analyzer. An attenuator was placed in series with the cable to protect the spectrum analyzer. The loss from the cable and the attenuator were added on the analyzer as gain offset settings, allowing direct measurements, without the need for any further corrections. A spectrum analyzer was used with the resolution bandwidth set to 1 kHz. 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.

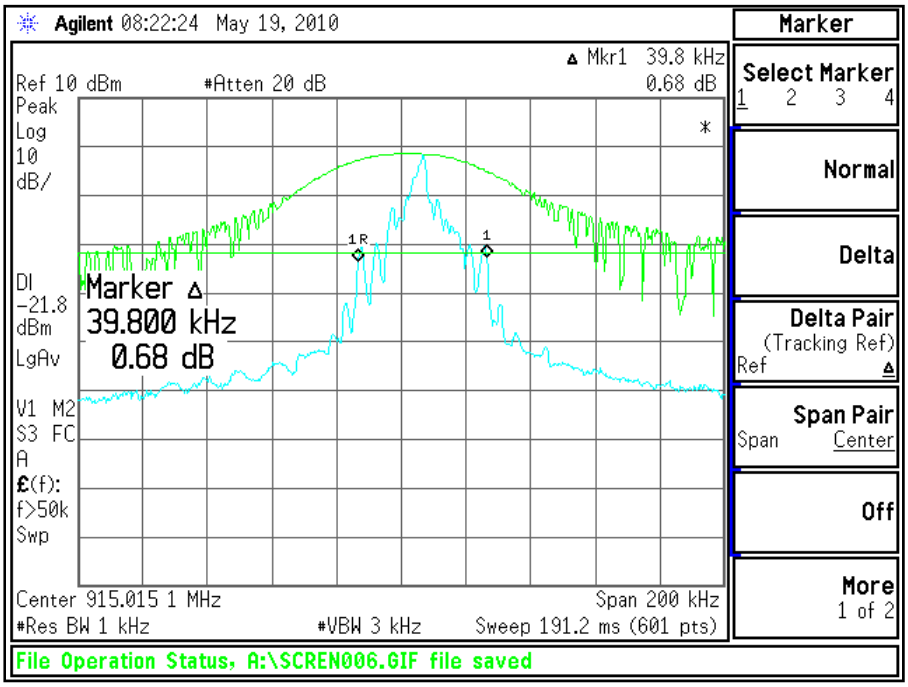
From this data, the closest measurement (20 dB bandwidth) when compared to the specified limit, is 39.8 kHz, which is below the maximum of 500 kHz.

7.3 - Test Data

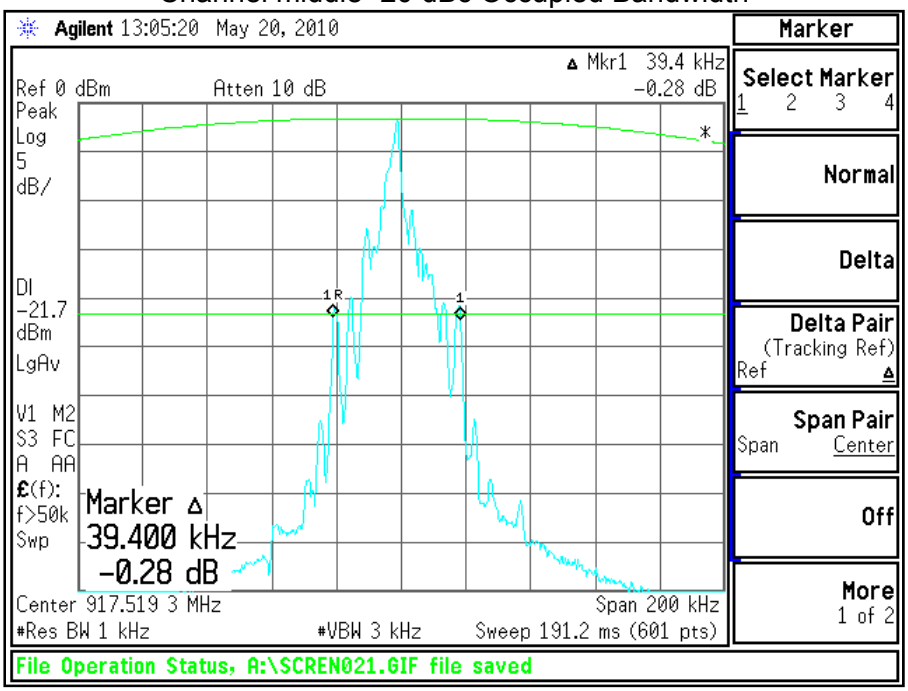
Channel	Center Frequency (MHz)	Measured -20 dBc Occ. BW (kHz)	Maximum -20 dBc Limit (kHz)	Margin (kHz)
Low	915.0	39.8	500	460.2
Middle	917.5	39.4	500	460.6
High	920.0	39.4	500	460.6

7.4 - Screen Captures - Occupied Bandwidth

Channel low -20 dBc Occupied Bandwidth



Channel middle -20 dBc Occupied Bandwidth



Channel hihg -20 dBc Occupied Bandwidth

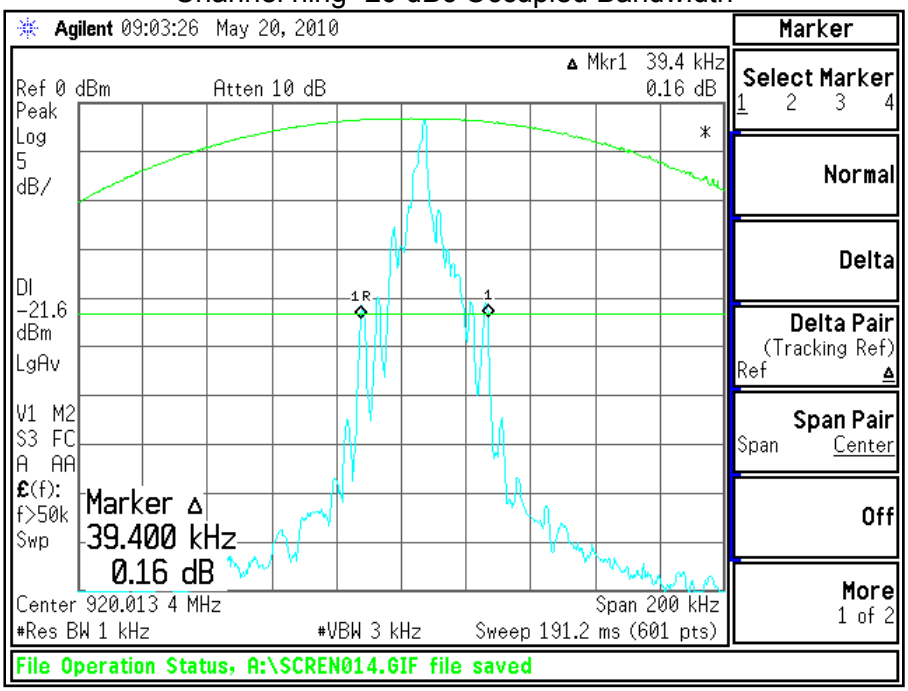
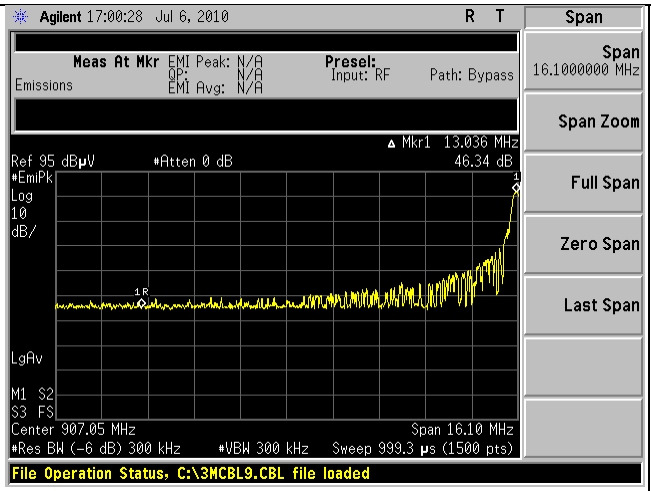


EXHIBIT 8. BAND EDGE MEASUREMENTS

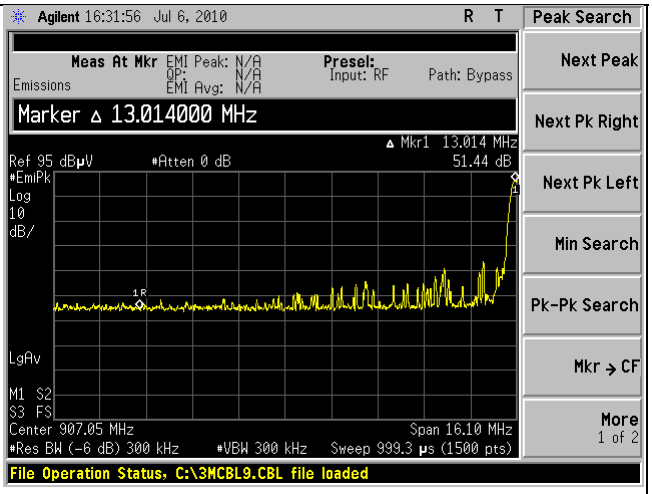
8.1 - Method of Measurements

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 MHz to 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.

Screen Capture Demonstrating Compliance at the Lower Band-Edge

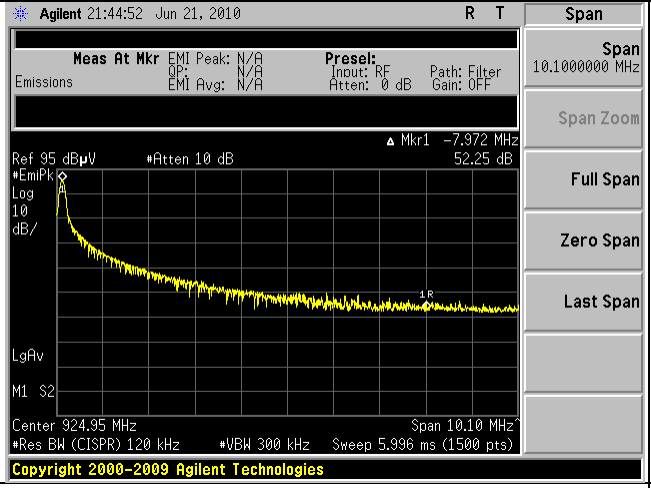


EUT continuous transmit mode

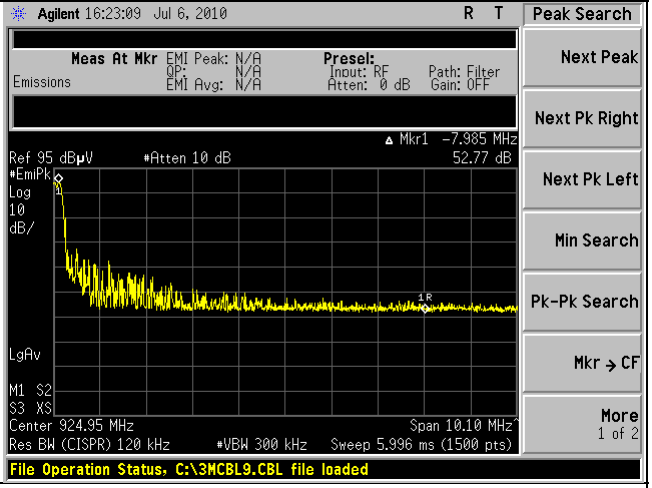


EUT hopping mode

Screen Capture Demonstrating Compliance at the Higher Band-Edge



EUT continuous transmit mode



EUT hopping mode

EXHIBIT 9. POWER OUTPUT (CONDUCTED)

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, 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 100 kHz, and a span of 500 kHz, with measurements from a peak detector presented in the chart below.

9.2 - Test Data

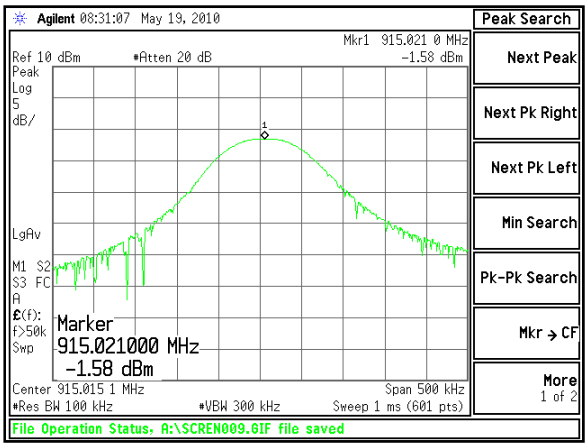
CHANNEL	CENTER FREQ (MHz)	LIMIT (dBm)	MEASURED POWER (dBm)	MARGIN (dB)
Low	915.0	+30	-1.6	31.6
Middle	917.5	+30	-1.7	31.7
High	920.0	+30	-1.6	31.6

Measured RF Power Output (in Watts): 0.000692 Watts

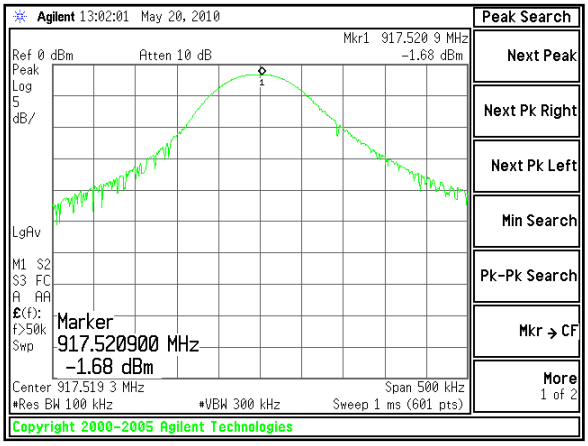
Declared RF Power Output (in Watts): 0.001 Watts

9.3 - Screen Captures – Power Output (Conducted)

Channel Low



Channel Middle



Channel High

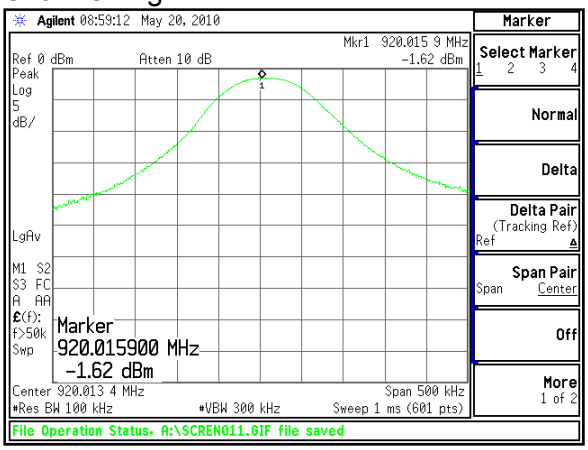


EXHIBIT 10. CONDUCTED SPURIOUS EMISSIONS: 15.247(d)

10.1 - 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 least 20 db below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.

10.2 – Conducted Harmonic And Spurious RF Measurements

FCC Part 15.247(d) and IC RSS 210 A8.5 both 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 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, thereby allowing direct readings of the measurements made without the need for any further corrections. A 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.

Conducted harmonics:

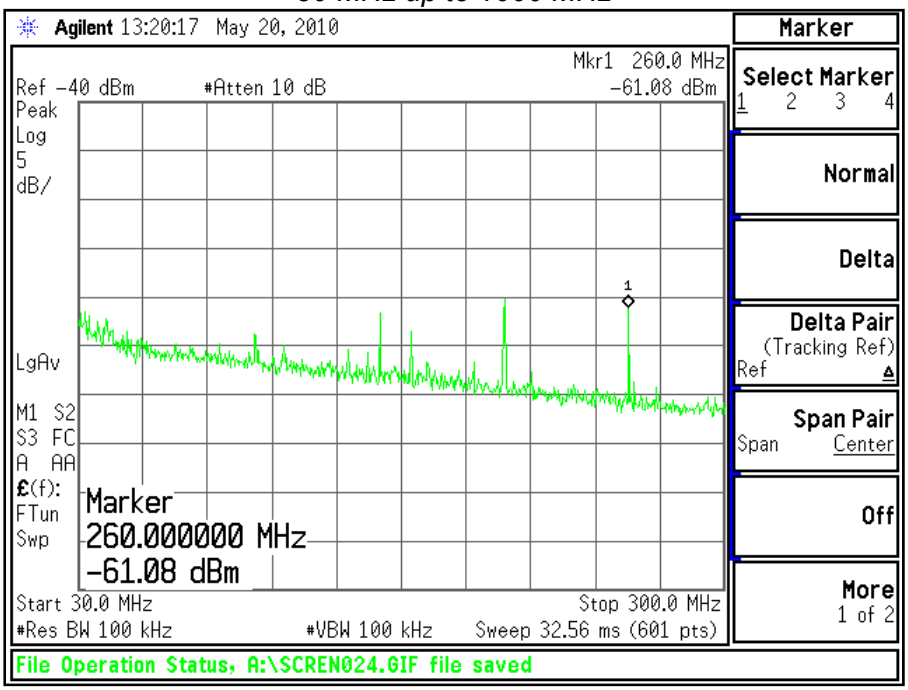
	Channel 915 MHz	**Channel 917.5 MHz**	**Channel 920.0 MHz**
Fundamental	-1.6 (dBm)	-1.7 (dBm)	-1.6 (dBm)
2nd Harmonic	-31.2 (dBm)	-32.4 (dBm)	-35.8 (dBm)
3rd Harmonic	-69.5 (dBm)	-62.2 (dBm)	-74.3 (dBm)
4th Harmonic	- 51.3 (dBm)	-52.0 (dBm)	-46.9 (dBm)
5th Harmonic	- 63.4 (dBm)	-63.4 (dBm)	-60.1 (dBm)
6th Harmonic	-60.8 (dBm)	-62.3 (dBm)	-53.0 (dBm)
7th Harmonic	-87.6 (dBm)	-87.9 (dBm)	-85.9 (dBm)
8th Harmonic	-71.8 (dBm)	-72.1 (dBm)	-75.8 (dBm)
9th Harmonic	-86.8 (dBm)	-86.7 (dBm)	-86.9 (dBm)
10th Harmonic	-84.8 (dBm)	-85.4 (dBm)	-85.5 (dBm)

Conducted spurious emissions:

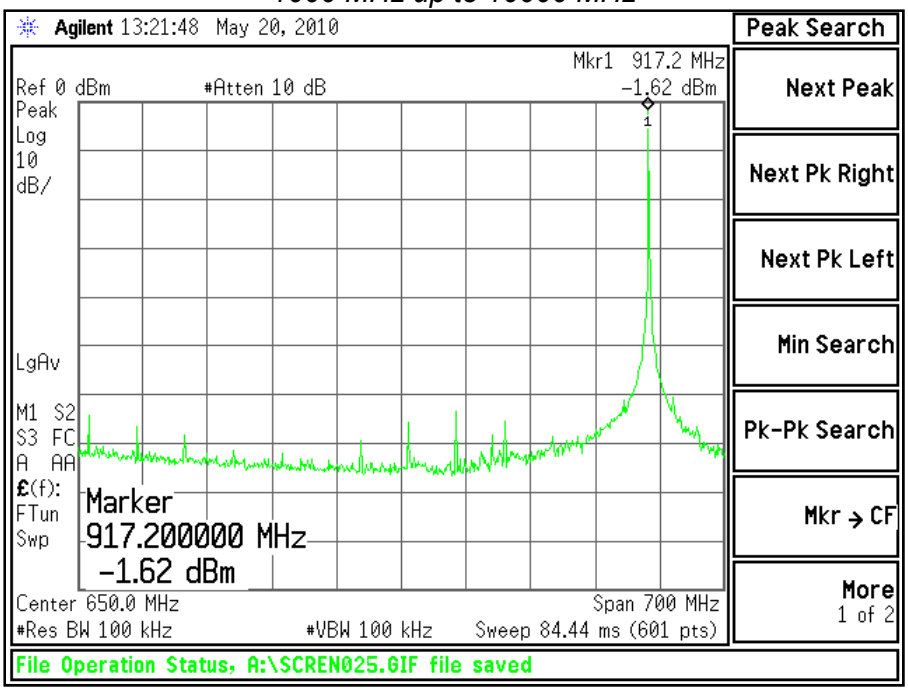
Frequency (MHz)	Host Mode	Level (dBm)
156.0	All channels	-61.5
208.2	All channels	-60.6
260.0	All channels	-61.1
709.5	Middle channel	-63.6
711.8	High channel	-65.2

10.3- Screen Captures – Spurious Radiated Emissions

30 MHz up to 1000 MHz



1000 MHz up to 10000 MHz



10000 MHz up to 10000 MHz

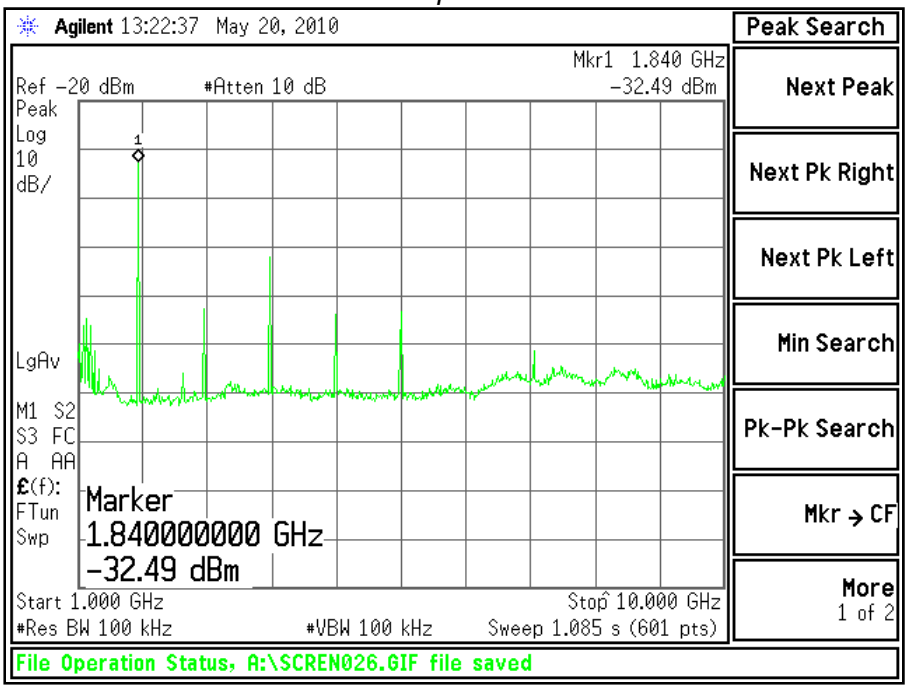


EXHIBIT 11. FREQUENCY & POWER STABILITY OVER VOLTAGE VARIATIONS

For measurements of the frequency and power stability, the transmitter was powered by an external bench-type variable power supply. A Spectrum Analyzer was used to measure the frequency at the appropriate frequency markers and also the output power at the antenna port.

2.55 VDC		3.00 VDC		3.45 VDC		
Power (dBm)	Frequency (Hz)	Power (dBm)	Frequency (Hz)	Power (dBm)	Frequency (Hz)	Channel
-1.5	915021650	-1.5	915021570	-1.5	915021650	LOW
-1.7	917517920	-1.7	917518080	-1.7	917518080	MIDDLE
-1.6	920020250	-1.6	920020330	-1.6	920020330	HIGH

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.

The maximum shift in frequency is **160 Hz** which is better than 100 ppm in the 902 MHz to 928 MHz band.

EXHIBIT 12. CHANNEL PLAN AND SEPARATION

A spectrum analyzer was used with a resolution bandwidth of 30 kHz to measure the channel separation of the EUT.

The minimum and maximum channel-separations measured for this device are 96.0 kHz and 104.0 kHz respectively. The maximum occupied bandwidth of the device, as reported in the previous section is 39.8 kHz.

The minimum channel separation limit as stated in FCC CFR 47 15.247 and IC RSS210 is 25 kHz or the 20dB bandwidth of the hopping channel, whichever is greater.

The minimum number of channels limit as stated in FCC CFR 47 15.247 and IC RSS210 is 50 channels for channel bandwidth less than 250 kHz and 25 channels for channel bandwidth greater than 250 kHz.

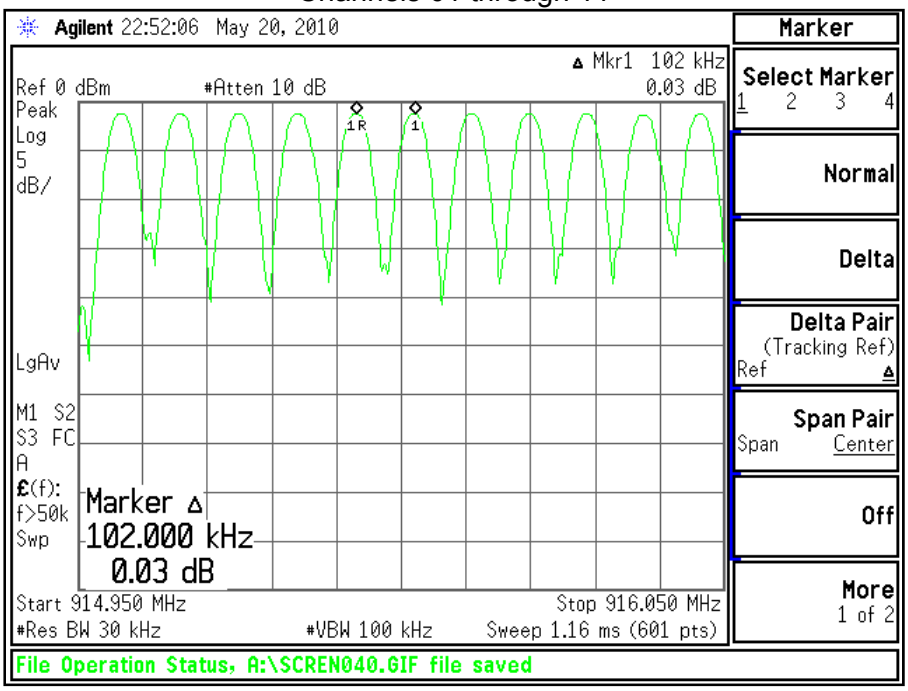
The following plots describe this spacing, and also establish the channel separation and plan.

Frequency Span (MHz)	Number of Channels	Minimum Separation (kHz)
914.95 to 916.05	11	97.0
916.05 to 917.05	10	98.0
917.05 to 918.05	10	99.0
918.05 to 919.05	10	98.0
919.05 to 920.05	10	96.0

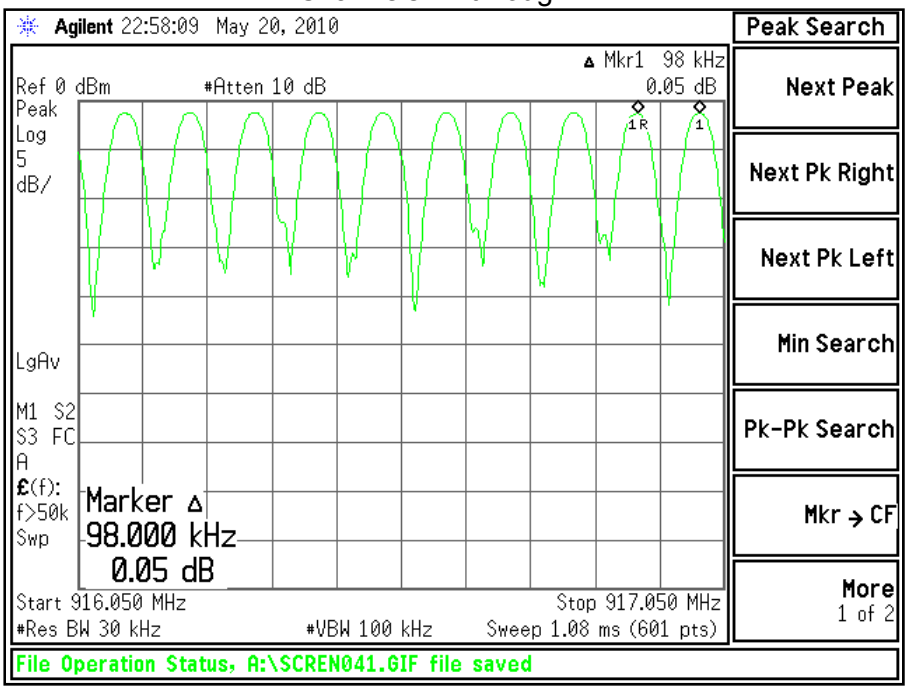
Total number of channels: 51

12.1 - Screen Captures – Channel Separation

Channels 01 through 11

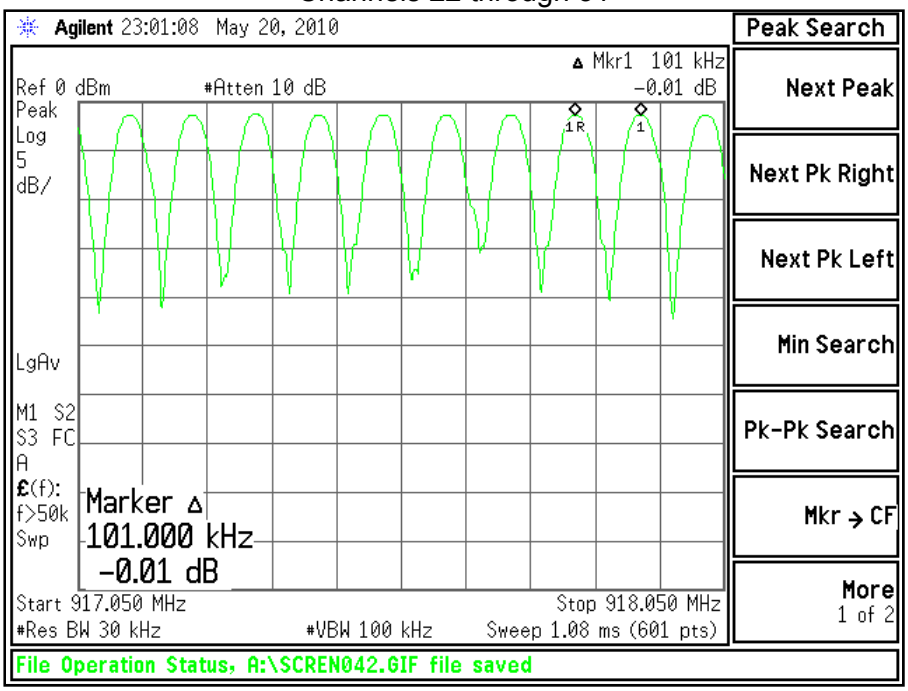


Channels 12 through 21

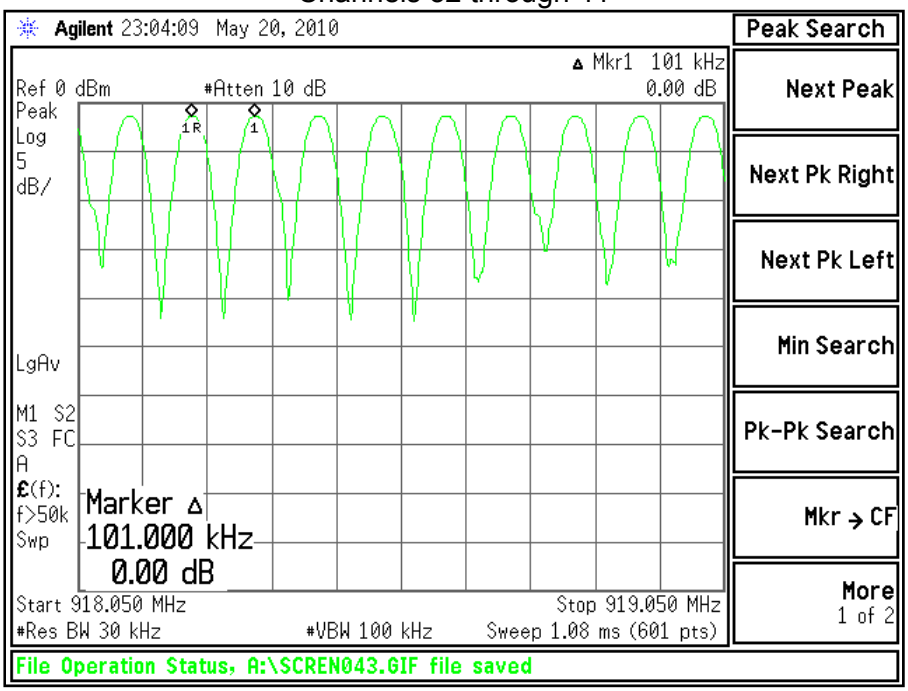


Screen Captures – Channel Separation *(continued)*

Channels 22 through 31



Channels 32 through 41



Screen Captures – Channel Separation *(continued)*

Channels 42 through 51

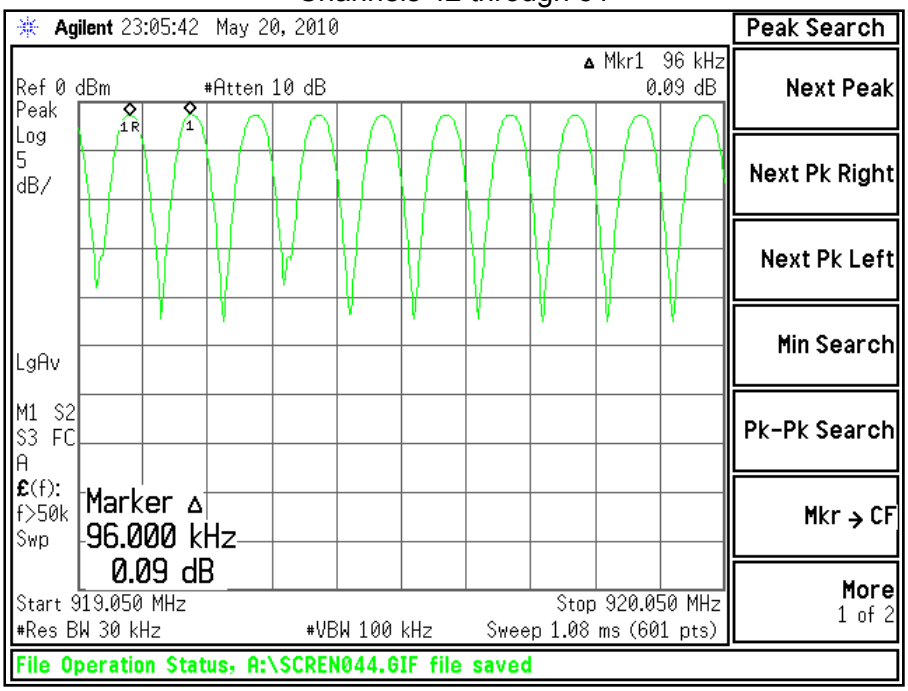


EXHIBIT 13. CHANNEL OCCUPANCY

Part 15.247(a)(1) requires a channel occupancy, for this device, of no more than 400 milliseconds in a 20 second window. The channel occupancy for this EUT was measured using a spectrum analyzer, set to zero-span at the frequency of interest. With the analyzer in peak-hold mode, the transmission lengths can be measured by adjusting the sweep rate of the analyzer. A suitable sweep rate was used to measure the channel occupancy at the low, mid and high channels.

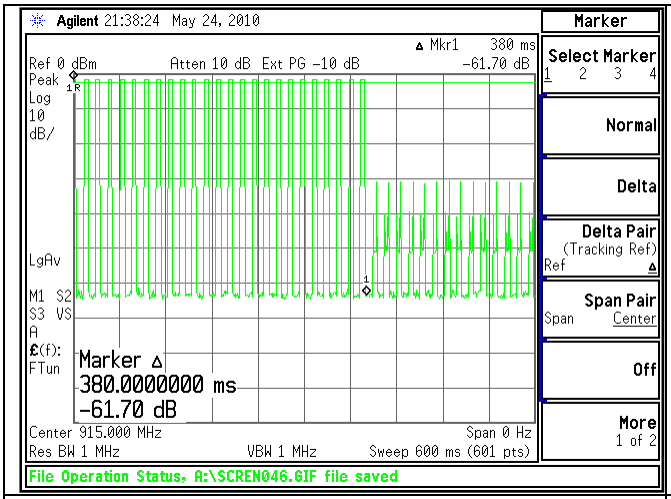
During this test, the EUT was transmitting modulated and normal hopping mode.

The longest time any transmission will occur on a single channel is 380.0 milliseconds. In a 20 second window, each channel has 1 transmission cycle. The maximum occupancy in a 20 second window is calculated by multiplying 1 transmission cycle by 380.0 milliseconds transmission duration per cycle, to arrive at 380.0 milliseconds total occupancy.

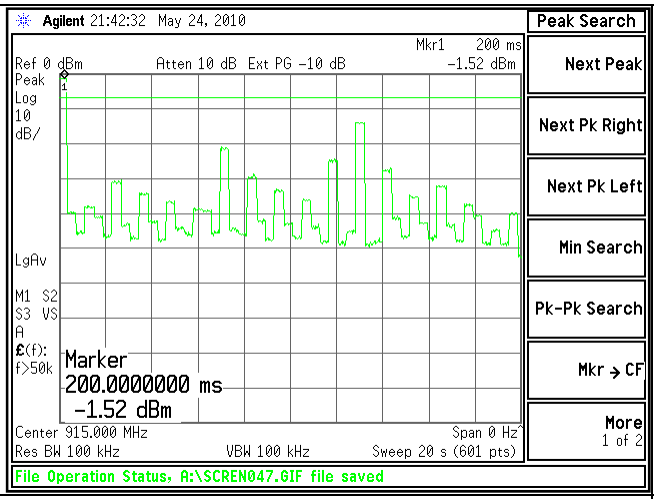
Channel	Frequency (MHz)	Total Occupancy in 20 seconds (ms)	Occupancy in 600 ms window (ms)
Low	915.0	380.0	380.0
Middle	917.5	380.0	380.0
High	920.0	380.0	380.0

Plots of Channel Occupancy

Low Channel Occupancy

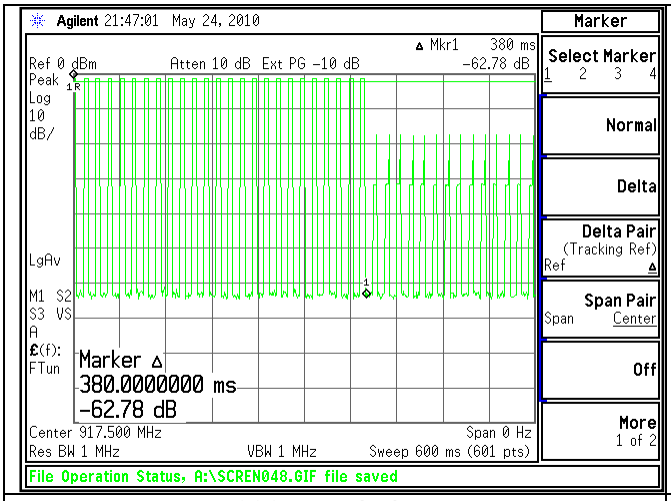


600 ms window

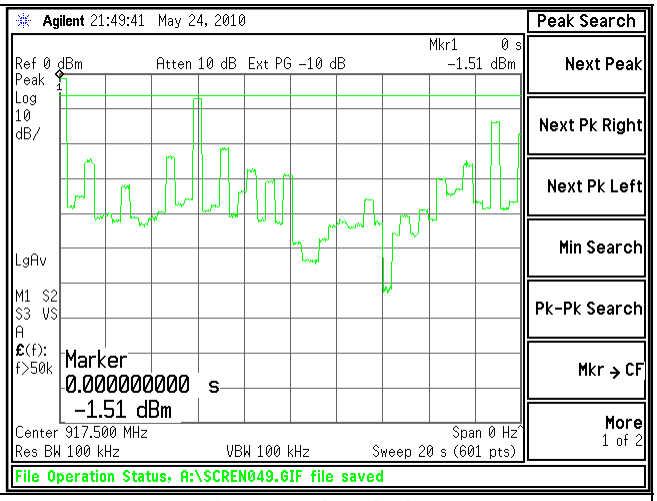


20 seconds window

Middle Channel Occupancy

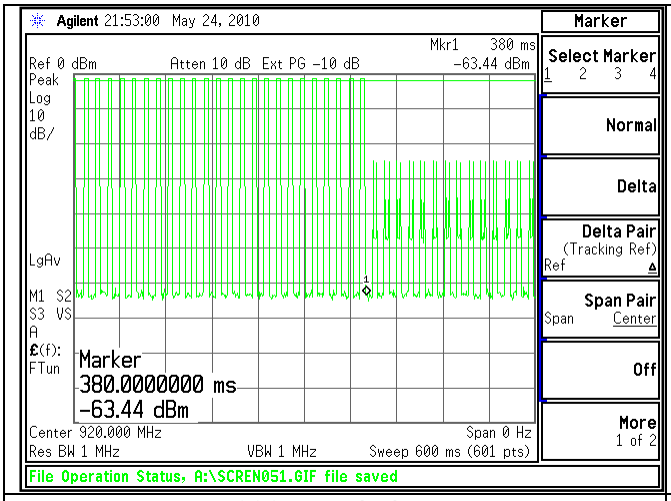


600 ms window

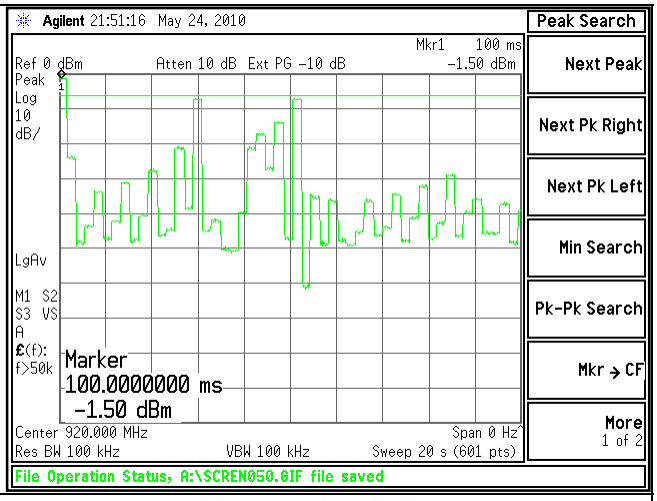


20 seconds window

Channel High Occupancy



600 ms window



20 seconds window

EXHIBIT 14. EQUAL CHANNEL USAGE AND PSEUDORANDOM HOPPING SEQUENCE.

The 51 channels generated by a pseudo random number generator are arrayed in a table which the system uses to determine the next hopping channel. The psuedo-random channel table is incorporated as a constant table of values used by the transmitter software running on board to generate the frequency offset (from 914.999969 MHz) in 100 kHz intervals as information is transmitted.

Transmission is based on data sent from an external device (asynchronous date events). The RFD will wake up periodically and transmit data if available from the external device. A separate timer on the RFD will automatically sequence through the channel table at the appropriate time interval even if no data is to be transmitted.

(HEX)	*(Decimal)*						
0x00	*0*	*0x11*	*17*	*0x22*	*34*	*0x0E*	*14*
0x14	*20*	*0x25*	*37*	*0x06*	*6*	*0x1A*	*26*
0x28	*40*	*0x09*	*9*	*0x17*	*23*	*0x2B*	*43*
0x0C	*12*	*0x1D*	*29*	*0x23*	*35*	*0x0F*	*15*
0x10	*16*	*0x21*	*33*	*0x02*	*2*	*0x1E*	*30*
0x24	*36*	*0x05*	*5*	*0x16*	*22*	*0x2A*	*42*
0x08	*8*	*0x19*	*25*	*0x27*	*39*	*0x0B*	*11*
0x1C	*28*	*0x2D*	*45*	*0x03*	*3*	*0x30*	*48*
0x20	*32*	*0x01*	*1*	*0x32*	*50*	*0x2E*	*46*
0x04	*4*	*0x15*	*21*	*0x26*	*38*	*0x0A*	*10*
0x18	*24*	*0x29*	*41*	*0x07*	*7*	*0x1B*	*27*
0x2C	*44*	*0x0D*	*13*	*0x13*	*19*	*0x2F*	*47*
0x1F	*31*	*0x31*	*49*	*0x12*	*18*		

Above is a sample of the pseudo-random channel table.

Note: The information in this section is provided by the manufacturer.

EXHIBIT 15. RECEIVER SYNCHRONIZATION AND RECEIVER INPUT BANDWIDTH.

The Rx bandwidth of the CC430F5137 Radio chip when used as a receiver is programmed to a value of 58.03574 kHz. This bandwidth setting filters out adjacent channels used in by the frequency hopping transmitter that hops on 100 kHz channels.

The receiver wakes up (using the last logical channel it received data on) and tries to detect a data transfer request from the transmitter. Typical time for the receiver to listen on a single channel will be twice the total channel hopping time for the transmitter (approximately 25 seconds). In the event that no data transfer request has been detected the receiver will switch channels (based on the channel hopping table created for transmitting) and try the next channel.

If a data transfer request is detected an “acknowledge” will be sent to the transmitter. The receiver will then hop channels at the same rate and through the same pseudo random pattern as the transmitter. This will go on as long as there is data to be transferred.

Note: The information in this section is provided by the manufacturer.

EXHIBIT 16. MPE CALCULATIONS

The following MPE calculations are based on the Johanson Technology ceramic antenna, with a measured conducted RF power of -1.6 dBm as presented to the antenna. The declared maximum gain of this antenna is -1.0 dBi.

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:	-1.60	(dBm)
Maximum peak output power at antenna input terminal:	0.692	(mW)
Antenna gain(typical):	-1	(dBi)
Maximum antenna gain:	0.794	(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:	0.000109	(mW/cm^2)
Maximum allowable antenna gain:	36.4	(dBi)
Margin of Compliance at 20 cm =	37.4	dB

APPENDIX A – TEST EQUIPMENT LIST

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date : 6-May-2010 Type Test : RF Radiation Exposure Limits Job # : C-899

Prepared By: AIDI Customer : Pentair Quote #: 310140

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	7/2/2009	7/2/2010	Active Calibration
3	AA 960078	Log Periodic Antenna	EMCO	93146	9701-4855	10/16/2009	10/16/2010	Active Calibration
4	EE 960073	Spectrum Analyzer	Agilent	E4446A	US45300564	9/17/2009	9/17/2010	Active Calibration
5	AA 960144	Phaseflex	Gore	EKD01D010720	5800373	6/25/2009	6/25/2010	Active Calibration

Project Engineer: AIDI Quality Manager:

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date : 6-May-2010 Type Test : conducted spurious Job # : C-899

Prepared By: AIDI Customer : Pentair Quote #: 310140

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

Project Engineer: AIDI Quality Manager:

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date : 6-May-2010 Type Test : AC mains Job # : C-899

Prepared By: AIDI Customer : Pentair Quote #: 310140

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960013	EMI Receiver	HP	8546A System	3617A00320;3448A	9/17/2009	9/17/2010	Active Calibration
2	EE 960014	EMI Receiver-filter section	HP	85460A	3448A00296	9/17/2009	9/17/2010	Active Calibration
3	AA 960008	LISN	EMCO	3816/2NM	9701-1057	12/15/2009	12/15/2010	Active Calibration
4	AA 960031	Transient Limiter	HP	11947A	3107A01708	9/15/2009	9/15/2010	Active Calibration

Project Engineer: AIDI Quality Manager:

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date : 6-May-2010 Type Test : Radiated Emissions (109) Job # : C-899

Prepared By: Customer : Pentair Quote #: 310140

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960157	3Hz-13.2GHz Spectrum Analyzer	Agilent	E4445A	MY48250225	7/2/2009	7/2/2010	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	10/16/2009	10/16/2010	Active Calibration
4	AA 960150	Bicon Antenna	ETS	3110B	0003-3346	11/3/2009	11/3/2010	Active Calibration
5	AA 960007	Double Ridge Horn Antenna	EMCO	3115	9311-4138	11/10/2009	11/10/2010	Active Calibration
6	EE 960073	Spectrum Analyzer	Agilent	E4446A	US45300564	9/17/2009	9/17/2010	Active Calibration

Project Engineer: AIDI Quality Manager:

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date : 6-May-2010 Type Test : Tx Spurious Emissions Job # : C-899

Prepared By: AIDI Customer : Pentair Quote #: 310140

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960157	3Hz-13.2GHz Spectrum Analyzer	Agilent	E4445A	MY48250225	7/2/2009	7/2/2010	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	10/16/2009	10/16/2010	Active Calibration
4	AA 960150	Bicon Antenna	ETS	3110B	0003-3346	11/3/2009	11/3/2010	Active Calibration
5	AA 960007	Double Ridge Horn Antenna	EMCO	3115	9311-4138	11/10/2009	11/10/2010	Active Calibration
6	EE 960073	Spectrum Analyzer	Agilent	E4446A	US45300564	9/17/2009	9/17/2010	Active Calibration

Project Engineer: AIDI Quality Manager:

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date : 6-May-2010 Type Test : channel spacing Job # : C-899

Prepared By: AIDI Customer : Pentair Quote #: 310140

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	AA 960144	Phaseflex	Gore	EKD01D010720	5800373	6/25/2009	6/25/2010	Active Calibration
2	EE 960073	Spectrum Analyzer	Agilent	E4446A	US45300564	9/17/2009	9/17/2010	Active Calibration

Project Engineer: AIDI Quality Manager:

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date : 6-May-2010 Type Test : Hopping channel Job # : C-899

Prepared By: AIDI Customer : Pentair Quote #: 310140

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	AA 960144	Phaseflex	Gore	EKD01D010720	5800373	6/25/2009	6/25/2010	Active Calibration
2	EE 960073	Spectrum Analyzer	Agilent	E4446A	US45300564	9/17/2009	9/17/2010	Active Calibration

Project Engineer: AIDI Quality Manager:

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date : 6-May-2010 Type Test : Time occupancy Job # : C-899

Prepared By: AIDI Customer : Pentair Quote #: 310140

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	AA 960144	Phaseflex	Gore	EKD01D010720	5800373	6/25/2009	6/25/2010	Active Calibration
2	EE 960073	Spectrum Analyzer	Agilent	E4446A	US45300564	9/17/2009	9/17/2010	Active Calibration

Project Engineer: AIDI Quality Manager:

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date : 6-May-2010 Type Test : Conducted Power Output Job # : C-899

Prepared By: AIDI Customer : Pentair Quote #: 310140

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	AA 960144	Phaseflex	Gore	EKD01D010720	5800373	6/25/2009	6/25/2010	Active Calibration
2	EE 960073	Spectrum Analyzer	Agilent	E4446A	US45300564	9/17/2009	9/17/2010	Active Calibration

Project Engineer: AIDI Quality Manager:

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date : 6-May-2010 Type Test : Occupied Bandwidth (6dB & 20dB) Job # : C-899

Prepared By: AIDI Customer : Pentair Quote #: 310140

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	AA 960144	Phaseflex	Gore	EKD01D010720	5800373	6/25/2009	6/25/2010	Active Calibration
2	EE 960073	Spectrum Analyzer	Agilent	E4446A	US45300564	9/17/2009	9/17/2010	Active Calibration

Project Engineer: AIDI Quality Manager:

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date : 6-May-2010 Type Test : Band-Edge Job # : C-899

Prepared By: AIDI Customer : Pentair Quote #: 310140

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960157	3Hz-13.2GHz Spectrum Analyzer	Agilent	E4445A	MY48250225	7/2/2009	7/2/2010	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	10/16/2009	10/16/2010	Active Calibration

Project Engineer: AIDI Quality Manager:

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date : 6-May-2010 Type Test : Fundamental Job # : C-899

Prepared By: AIDI Customer : Pentair Quote #: 310140

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960157	3Hz-13.2GHz Spectrum Analyzer	Agilent	E4445A	MY48250225	7/2/2009	7/2/2010	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	10/16/2009	10/16/2010	Active Calibration

Project Engineer: AIDI Quality Manager:

APPENDIX B – TEST STANDARDS: CURRENT PUBLICATION DATES

STANDARD #	DATE	Am. 1	Am. 2
ANSI C63.4	2009		
CISPR 11	2009-05	2009-12 P	
CISPR 12	2007-05	2009-01	
CISPR 14-1	2005-11	2008-11	
CISPR 14-2	2001-11	2001-11	2008-05
CISPR 16-1-1 Note 1	2010-01		
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	2009		
EN 55014-1	2006		
EN 55014-2	1997		
EN 55022	2006	2007	
EN 60601-1-2	2007		
EN 61000-3-2	2006-05		
EN 61000-3-3	2008-12		
EN 61000-4-2	2009-05		
EN 61000-4-3	2006-07	2008-05	
EN 61000-4-4	2004		
EN 61000-4-5	2006-12		
EN 61000-4-6	2009-05		
EN 61000-4-8	1994	2001	
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		
IEC 60601-1-2 Note 1	2007-03		
IEC 61000-3-2	2005-11	2008-03	2009-02
IEC 61000-3-3	2008-06		
IEC 61000-4-2	2008-12		
IEC 61000-4-3	2008-04	Incl. in 2008-04	2009-12 FD
IEC 61000-4-4	2004-07	2010-01	
IEC 61000-4-5	2005-11		
IEC 61000-4-6	2008-10		
IEC 61000-4-8	2009-09		
IEC 61000-4-11	2004-03		
IEC 61000-6-1	2005-03		
IEC 61326-1	2006-06		
ISO 14982	1998-07		
MIL Std. 461E	1999-08		

STANDARD #	DATE	Am. 1	Am. 2
ETSI EN 300 113-1 Note 1	2009-11		
ETSI EN 300 113-2	2009-11		
ETSI EN 300 220-1	2010-02		
ETSI EN 300 220-2	2010-02		
ETSI EN 300 220-3	2000-09		
ETSI EN 300 328	2006-10		
ETSI EN 300-328-1	2001-12		
ETSI EN 300-328-1	2001-12		
ETSI EN 300 330	1999-05		
ETSI EN 300 330-1	2010-02		
ETSI EN 300 330-2	2010-02		
ETSI EN 300 357 Note 1	2001-05		
ETSI EN 300 390-1	2000-09		
ETSI EN 300 390-2	2000-09		
ETSI EN 300 422	1999-07		
ETSI EN 300 422-1	2008-03		
ETSI EN 300 422-2	2008-03		
ETSI EN 300 440-1	2009-03		
ETSI EN 300 440-2	2009-03		
ETSI EN 301 357-1 Note 1	2008-11		
ETSI EN 301 357-2 Note 1	2008-11		
ETSI EN 301 489-1	2008-04		
ETSI EN 301 489-3	2002-08		
ETSI EN 301 489-5	2002-08		
ETSI EN 301 489-9	2007-11		
ETSI EN 301 489-17	2009-05		
ETSI EN 301 489-27 Note 1	2004-06		
ETSI EN 301 489-31 Note 1	2005-09		
ETSI EN 301 839-1 Note 1	2009-10		
ETSI EN 301 839-2 Note 1	2009-10		
EN 301 893 Note 1	2008-12		

Note 1: Test not on LSR Scope of Accreditation.

Updated on 03-25-10
P= Project FD= Final Draft

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)

"High Frequency Ceramic Solutions"

915 MHz Antenna — P/N 0915AT43A0026
Detail Specification: 02/20/09 — Page 1 of 3

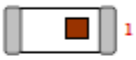
General Specifications

Part Number	0915AT43A0026
Frequency Range	902 - 928
Peak Gain	-1.0 dBi typ. (XZ-total)
Average Gain	-4.0 dBi typ. (XZ-total)
Return Loss	8.5 dB min.
Impedance	50 Ω
Input Power	2W max.

Operating Temperature	-40 to +85°C
Storage Temperature Range	+5~+35°C, Humidity 45~75%RH
Reel Quanity	1,000

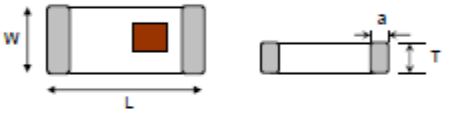
No.	Function
1	Feeding Point
2	NC

Terminal Configuration



Mechanical Dimensions

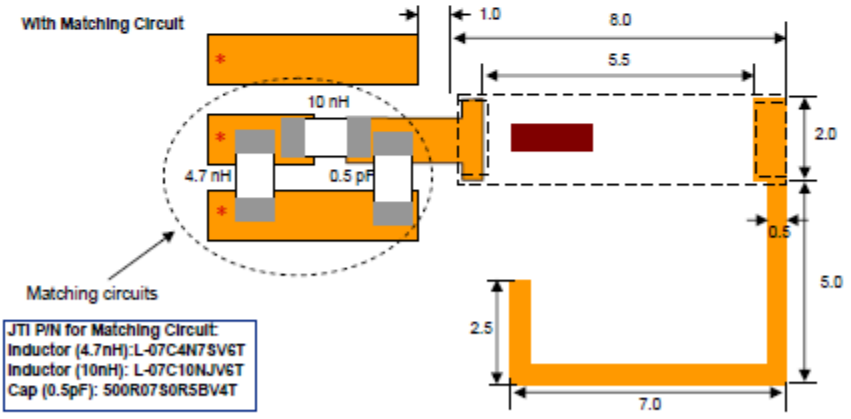
	in	mm
L	0.276 ± 0.008	7.00 ± 0.20
W	0.079 ± 0.008	2.00 ± 0.20
T	0.031 +.004/-.008	0.80 +0.1/-0.2
a	0.020 ± 0.012	0.50 ± 0.30



Mounting Considerations

Mount these devices with brown mark facing up. Units: mm

* Line width should be designed to provide 50 Ω impedance matching characteristics.



JTI P/N for Matching Circuit:
Inductor (4.7nH):L-07C4N7SV6T
Inductor (10nH): L-07C10NJV6T
Cap (0.5pF): 500R07S0R5BV4T

Johanson Technology, Inc. reserves the right to make design changes without notice.
All sales are subject to Johanson Technology, Inc. terms and conditions.

JOHANSON TECHNOLOGY

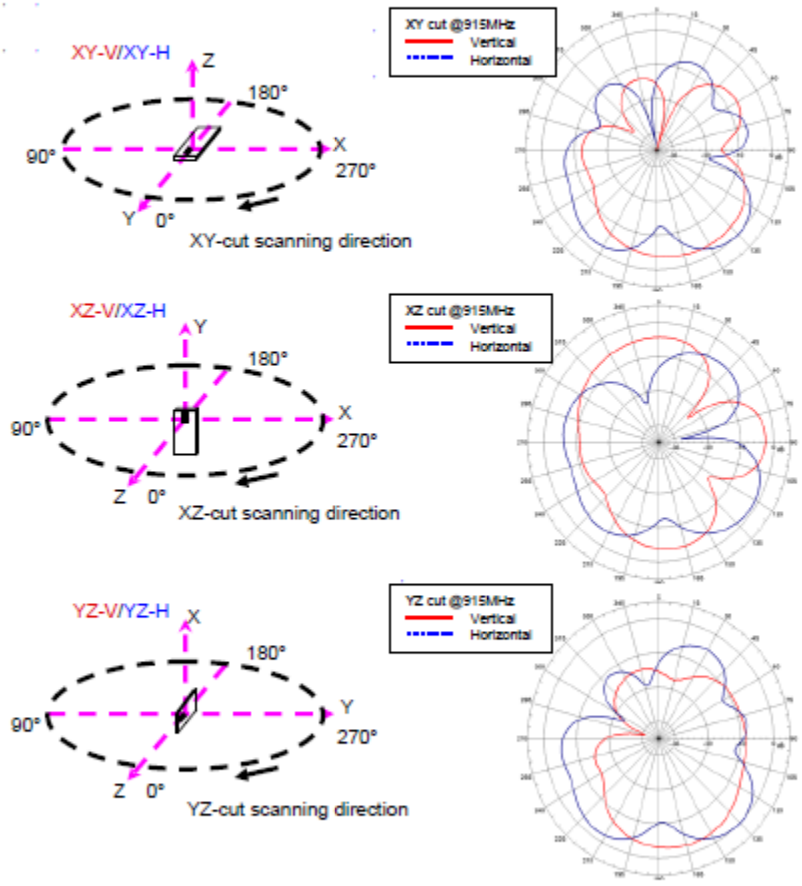
www.johansontechnology.com
4001 Calle Tecate • Camarillo, CA 93012 • TEL 805.389.1166 FAX 805.389.1821

"High Frequency Ceramic Solutions"

915 MHz Antenna — P/N 0915AT43A0026

Detail Specification: 02/20/09 — Page 3 or 3

Typical Radiation Patterns



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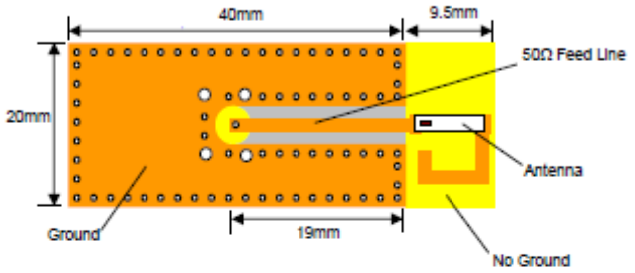
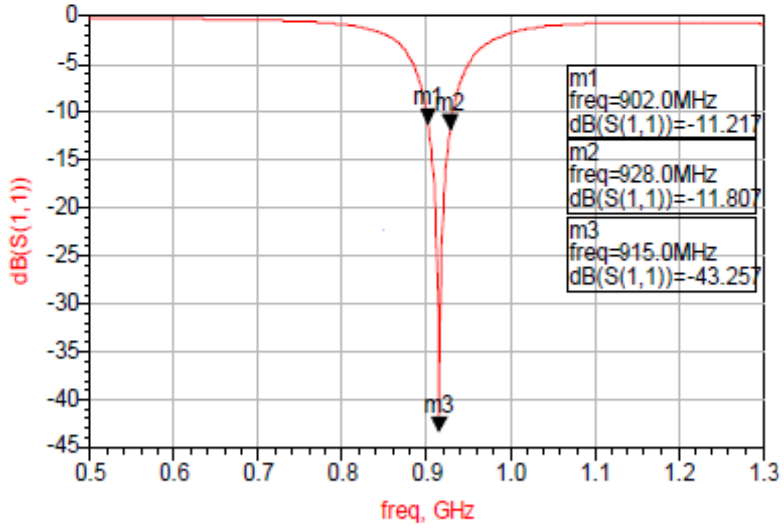
915 MHz Antenna — P/N 0915AT43A0026
Detail Specification: 02/20/09 — Page 2 of 3

Mounting Considerations

Test Board



Return Loss (with matching)



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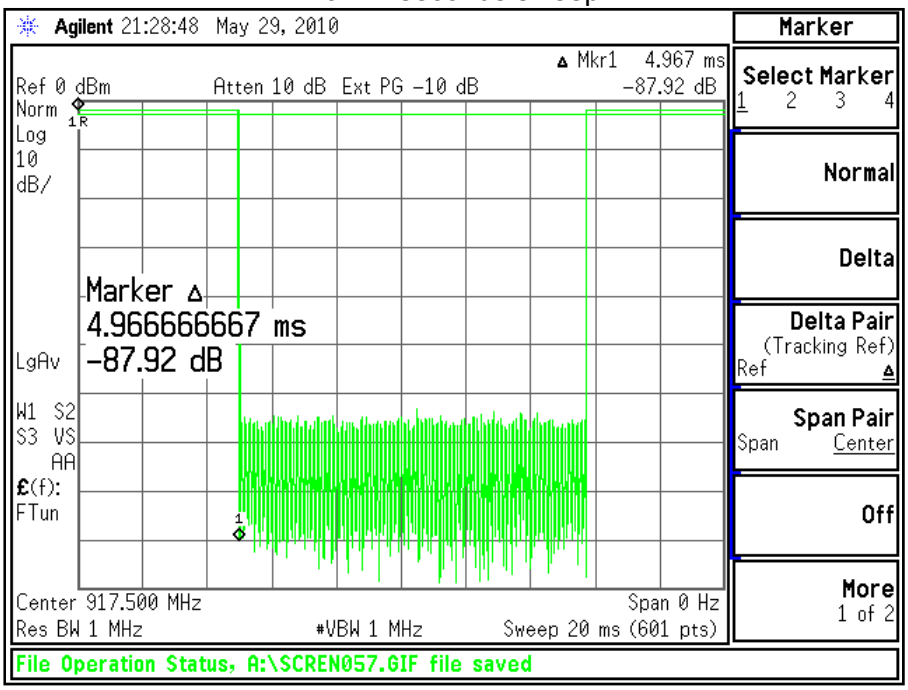
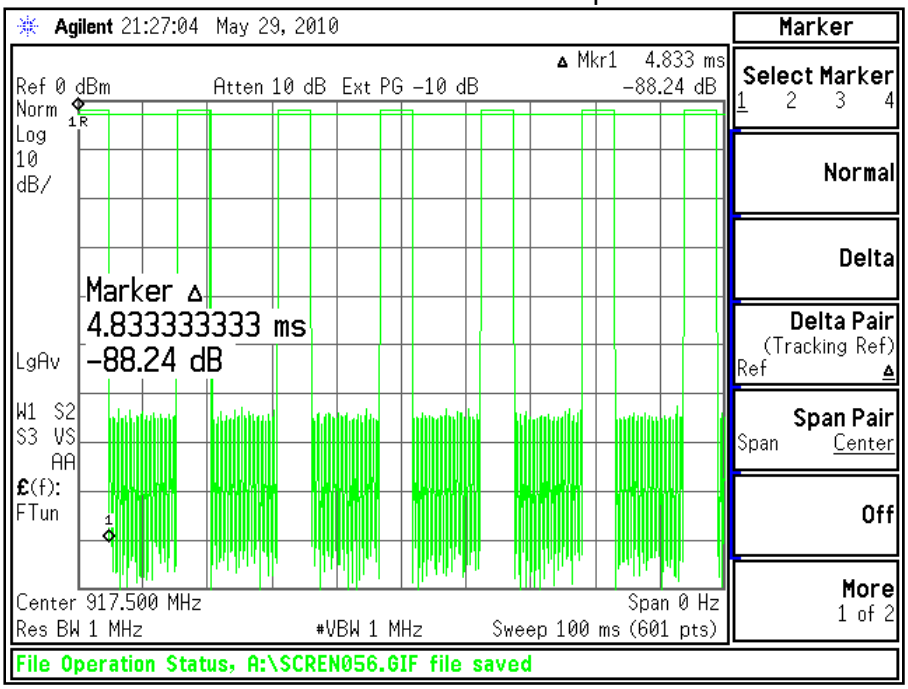
Appendix E- Pulse Repetition Plots

Plots below are from the middle channel (917.5 MHz).

20 milliseconds sweep



100 milliseconds sweep



5 seconds sweep