LS Research, LLC
ACCREDITED
Testing Cert. # 1255.01
W66 N220 Commerce Court ● Cedarburg, WI 53012 ● USA
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ENGINEERING TEST REPORT # 310090-PROX
LSR Job #: C-864

Compliance Testing of:
PROX with WPR

Test Date(s):
May 17th, July 6th, September 21st and September 27th 2010

Prepared For:

Ingersoll-Rand Company
11819 N. Pennsylvania St.
Carmel, IN 46074.

In accordance with:
Federal Communications Commission (FCC)
Part 15, Subpart C, Section 15.209, 15.109 and 15.107
Industry Canada (IC)
RSS 210 Annex 2 and section 2.7
General Operating Requirements for Low-Power License-Exempt Transceivers

This Test Report is issued under the Authority of:
Thomas T. Smith, Manager EMC Test Services

Signature: Thomas T. Smith Date: 09/27/2010

Test Report Reviewed by:	**Test Report Reviewed by:**
Thomas T. Smith, Manager EMC Test Services Signature: Thomas T. Smith Date: 09/27/10	Thomas T. Smith, Manager EMC Test Services Signature: Thomas T. Smith Date: 09/27/10

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EXHIBIT 1. INTRODUCTION

1.1 SCOPE

References:	FCC Part 15, Subpart C, Section 15.209
Title:	Telecommunication – Code of Federal Regulations, CFR 47, Part 15
Purpose of Test:	To gain FCC Certification Authorization for Low-Power License-Exempt Transmitters.

References:	RSS 210 Annex 2
Title:	Low-power License-exempt Radiocommunication Devices (All Frequency Bands): Category I equipment.
Purpose of Test:	To gain IC Certification Authorization for Low-Power License-Exempt Transmitters.

References:	RSS GEN
Title:	General requirements and Information for the Certification of Radiocommunication Equipment.
Purpose of Test:	To gain 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)	2009	Code of Federal Regulations - Telecommunications
RSS 210 Annex 2	2007	Low-power License-exempt Radiocommunication Devices (All Frequency Bands): Category I equipment.
RSS GEN	2007	General requirements and information for the certification of Radiocommunication 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.
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.

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:	**Ingersoll-Rand Company**
Address:	**11819 N. Pennsylvania St.** **Carmel, IN 46074**
Contact Person:	**Frank Nardelli**
Contact Phone:	317-810-3191
Contact Email:	fnardelli@irco.com

2.2 EQUIPMENT UNDER TEST (EUT) INFORMATION

The following information has been supplied by the applicant.

Product Name:	PROX with WPR
Model Number:	23394059
Serial Number:	N/A

2.3 ASSOCIATED ANTENNA DESCRIPTION

The antenna for the 125 kHz transmitter in the PROX is a loop antenna made from 33 gauge wire. The coil is in series with a 1500pH tuning inductance.
The co-located 900MHz modular transceiver has a PCB trace inverted L antenna.

2.4 EUT'S TECHNICAL SPECIFICATIONS

Additional Information:

Frequency Range (in MHz)	125 kHz/0.125 MHz
RF Power in Watts (Near-field measurement at 3 meters)	0.0000114 Watts
Conducted Output Power (in dBm)	Could not be measured.
Field Strength at 3 meters	75.8 dBµV/m
Occupied Bandwidth (99% BW)	448 Hz
Type of Modulation	Un-modulated when scanning. AM when reading.
Emission Designator	448HA1D
Transmitter Spurious (worst case) at 3 meters	54.8 dBµV/m at 250 kHz
Microprocessor Model # (if applicable)	PIC24F128GB106.
EUT will be operated under FCC Rule Part(s)	CFR 47 part 15.209 and 15.109
Antenna Information:	
a) Antenna Type	Loop antenna made from 33 gauge wire.
b) Detachable/Non-Detachable	Non-detachable.
c) Antenna Gain (in dBi)	Not available.
Modular Filing	☐ Yes ☒ No
Portable or Mobile?	Mobile

2.5 PRODUCT DESCRIPTION

The PROX reader is one of IR's ACP (Access Control Point) that can be paired with any of IR's accces point modules. The PROX ACP in this case is paired with a WPR which provides a wireless link to access point modules. The WPR implements a modular RF transceiver operating in the 902 to 928 MHz ISM band. Information contained in the user credential is read by the PROX reader via a 125 kHz signal and relayed by the WPR to access point modules which control lock functions and maintains audit trails of the credential used.
The PROX gets its power from the WPR which runs on a rechargeable battery. The WPR can only supply power to the PROX reader when it is switched to the battery operated mode and not while it is in the charging mode.

	
WPR (Left) and PROX reader (Right)	PROX reader attached to WPR

WPR AC to Dc converter.

EXHIBIT 3. EUT OPERATING CONDITIONS & CONFIGURATIONS DURING TESTS

3.1 CLIMATE TEST CONDITIONS

Temperature:	71° Fahrenheit
Humidity:	44%
Pressure:	743 mmHg

3.2 APPLICABILITY & SUMMARY OF EMC EMISSION TEST RESULTS

FCC Paragraph	Test Requirements	Compliance (yes/no)
FCC : 15.107 IC : RSS GEN 7.2.2	Power Line Conducted Emissions Measurements	Yes
IC: RSS GEN 4.6	Occupied Bandwidth	Yes
FCC : 15.109 IC : RSS 210 2.6	Un-Intentional Radiated Emissions	Yes
FCC : 15.209 (a) IC : RSS 210 A2	Maximum RF Output Power	Yes
FCC : 15.209 (c) IC : RSS 210 A2	Maximum RF Spurious Emissions	Yes
FCC : 15.209 & 15.205 IC : RSS 210 A2 and 2.6	Transmitter General Radiated Emissions	Yes
FCC: 15.209 (b)	Band edge requirements	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)**

Note:
The radio was also tested for **co-location** phenomenon since there would be a case where the PROX reader is transmitting at the same time as the 900MHz modular transceiver.

EXHIBIT 4. DECLARATION OF CONFORMITY

The EUT was found to **MEET** the requirements as described within the specification of FCC Title 47, CFR Part 15.209, and Industry Canada RSS-210, Issue 7 (2007), Section 2.6 for a Low-Power License-Exempt Transmitters, as well as the specification of FCC Title 47, CFR Part 15.109, Part 15.107 and Industry Canada RSS-210, Issue 7 (2007), Section 7.

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 WPR with the PROX, henceforth referred to as 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.

Testing of the PROX reader was performed on a reader that includes a keypad since this configuration was deemed to have worse emission characteristics compared to the PROX reader without keypad. The radio portion of PROX with keypad reader is exactly the same as that of the PROX reader with no keypad. The difference lies in the components involving the keypad itself.

Testing was also performed to investigate the effects of a co-located 900MHz modular transceiver on the RF characteristics of the PROX.

In addition, the emissions of the WPR while in charging mode was also investigated.

For the first test, the EUT was set in a configuration where it continuously transmits at 125 kHz. Its operation was then validated using a card set to work at the selected mode. In addition, the EUT was also set in a configuration where the PROX and the 900MHz modular transceiver were simultaneously transmitting. Initial measurements were performed at 3m separation to identify the emissions below 30MHz and all identified emissions were then re-measured at a 10m separation distance.

For the second test, the WPR was connected to the AC mains and the switch was positioned to the charging mode.

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 10 kHz to 1000 MHz was scanned and investigated. In cases where emissions below 30MHz were found, measurements of those emissions were repeated on the OATS at a 10m measurement distance. 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. For emissions below 30 MHz, an active loop antenna was used. This loop antenna was set at a height of 1m above the conducting ground plane and it was rotated about its vertical and horizontal axes (while utilizing the turntable to rotate the EUT) in order to measure the maximum radiated RF emissions. The maximum radiated RF emissions above 30MHz were found by raising and lowering the antenna between 1 and 4 meters in height, using both horizontal and vertical antenna polarities and rotating the EUT using the turntable.

The receiver was operated with the resolution bandwidth set at 200 Hz for measurements between 9kHz and 150kHz, 9kHz for measurements between 150kHz and 30MHz and 120kHz for measurements between 30MHz and 1000 MHz.

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 an Agilent E4445A/N9039A EMI System. 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 PROX and WPR were found to **MEET** the Radiated Emissions requirements of Title 47 CFR, FCC Part 15.209 [Canada RSS-210, Issue 7 (2007), section 2.6] and part 15.109. The frequencies with significant RF signal strength were recorded and plotted as shown in the Data Charts and Graphs.

The voltage variation test revealed that the EUT showed no variation in power and frequency. The power was then cycled On/Off to observe system response. No unusual response was observed, the emission characteristics were within compliant parameters, and the system returned to the same state of operation as before the power cycle.

The EUT also did not cause or have adverse phenomenon when the 900MHz modular transmitter was transmitting simultaneously.

5.5 CALCULATION OF RADIATED EMISSIONS LIMITS

Transmitter Limits

The maximum peak output power of an intentional radiator in the 9kH-24 GHz band, as specified in Title 47 CFR 15.209 and RSS 210 section 2.7, is calculated in a formula as described below. The harmonic and spurious RF emissions, with appropriate receiver bandwidths, as specified in 15.209 (c) and section 2.7 of RSS 210, shall be below the measured power of the desired signal, and must also meet the requirements described in 15.205(c) for FCC and table 1 of RSS 210 where applicable.

The following table depicts the general radiated emission limits. These limits are obtained from Title 47 CFR, Part 15.209, for radiated emissions measurements and are comparable to that of table 3 in RSS 210 section 2.7. These limits were applied to the fundamental emission of the intentional radiator as well as all other significant spurious signals.

Frequency (MHz)	Limit μV/m	Limit (dBμV/m)	Measurement Distance (m)
0.009-0.490	2400/F (kHz)	Note 1	300
0.490-1.705	24000/F (kHz)		30
1.705-30.0	30		30
30-88	100	40.0	3
88-216	150	43.5	3
216-960	200	46.0	3
960-24,000	500	54.0	3

Note 1: Sample calculation for the Fundamental Emission of a transmitter:

For Example:

If a transmitter operates at a fundamental frequency of 25 kHz, the emission limit may be calculated:

2400/F = 2400/25 = 96.0 μV/m if measured at 300 meters separation.

Expressed in decibels: $20 \log_{10} (96.0)$ = 39.64 dBμV/m at 300 m separation.

At 3 meters separation, the limit may be extrapolated by the addition of 40 dB/decade per 47CFR 15.31(f)(2)

Limit for the fundamental emission = 39.64 dBμV/m + 80 dB = 119.6 dB/μV/m at 3 meters

Sample conversion from 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 may be 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 may be 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 RADIATED EMISSIONS DATA CHART

Measurements of Electromagnetic Radiated Emissions
Frequency Range Inspected: 9 kHz to 1000 MHz

Manufacturer:	Ingersoll-Rand Company						
Date(s) of Test:	May 17th , July 6th and September 21st 2010						
Project Engineer:	Khairul Aidi Zainal						
Test Engineer(s):	Khairul Aidi Zainal						
Voltage:	12.0 VDC (PROX) and 120 VAC						
Operation Mode:	Continuous transmit (PROX) and charging (WPR)						
Environmental Conditions in the Lab:	Temperature: 20 – 25° C Relative Humidity: 30 – 60 %						
EUT Power:	√	Single Phase 120VAC		3 Phase ___VAC			
	√	Rechargeable Battery		Other:			
EUT Placement:	√	80cm non-conductive table		10cm Spacers			
EUT Test Location:	√	3 Meter Semi-Anechoic FCC Listed Chamber	√	10m OATS			
Measurements:		Pre-Compliance		Preliminary	√	Final	
Detectors Used:	√	Peak	√	Quasi-Peak	√	Average	

The following tables depict the level of significant fundamental and spurious radiated RF emissions found:

A. PROX emissions.

Due to the nature of the device, transmit and receive functions could not be isolated, hence the data presented below are for both transmit and receive mode:

i. 3 meter measurement

Frequency MHz	Antenna	EUT	Height (m)	Azimuth (0° - 360°)	Peak (dBuV/m)	Q.Peak (dBuV/m)	Average (dBuV/m)	Limit (dBuV/m)	Margin (dB)
0.1248	V	S	1.00	359	76.0	75.9	75.8	105.7	29.9
0.2496	V	V	1.00	173	57.2	54.8	49.8	99.7	49.9
0.3744	V	V	1.00	0	53.7	51.7	48.1	96.1	48.1
0.4992	V	V	1.00	355	50.9	48.1	43.9	73.6	25.6
0.6240	V	V	1.00	9	50.6	47.6	44.2	71.7	24.1
0.7488	V	V	1.00	191	47.6	45.4	41.5	70.1	24.7
0.8736	V	V	1.00	0	47.5	45.3	42.1	68.8	23.5
0.9984	V	V	1.00	198	45.2	43.1	39.6	67.6	24.5
1.1232	V	V	1.00	3	44.6	42.5	39.4	66.6	24.1
1.2480	V	V	1.00	0	43.3	41.4	38.3	65.7	24.3

Notes:

1) An Average and quasi peak Detector function was used in measurements below 30 MHz, a Quasi-Peak Detector was used in measurements between 30 MHz and 1 GHz.
2) H = Horizontal; V = Vertical; S = Side; F = Flat
3) Measurements below 30MHz were performed at 3m and 10m separation distance. The limits were corrected to reflect the change in measurement distance.

ii. 10 meter measurement

Frequency MHz	Antenna	EUT	Height (m)	Azimuth (0° - 360°)	Peak (dBuV/m)	Q.Peak (dBuV/m)	Average (dBuV/m)	Limit (dBuV/m)	Margin (dB)
0.1248	V	S	1.00	0	59.1	57.1	56.3	84.8	28.5
0.2496	Note 3				66.0	50.8	43.4	78.7	35.4
0.3744	Note 3				59.0	47.0	40.3	75.2	35.0
0.4992	Note 3				51.0	46.2	40.1	52.7	12.7

Notes:

1) An Average and quasi peak Detector function was used in measurements below 30 MHz, a Quasi-Peak Detector was used in measurements between 30 MHz and 1 GHz.
2) H = Horizontal; V = Vertical; S = Side; F = Flat
3) Emission buried within system noise floor. Recorded data is that of the system noise floor at the corresponding frequency.
4) Measurements below 30MHz were performed at 3m and 10m separation distance. The limits were corrected to reflect the change in measurement distance.

B. WPR charging mode emissions.

Frequency MHz	Antenna	EUT	Height (m)	Azimuth (0° - 360°)	Peak (dBuV/m)	Q.Peak (dBuV/m)	Average (dBuV/m)	Limit (dBuV/m)	Margin (dB)
994.9	Note 3				36.6	29.7	23.1	54.0	24.3
693.2	Note 3				31.8	25.5	19.0	46.0	20.5
284.7	Note 3				30.6	23.8	17.3	46.0	22.2
80.0	V	V	1.00	131	33.7	29.2	20.3	40.0	10.8
42.5	V	V	1.00	118	43.0	39.6	30.9	40.0	0.4
39.3	V	V	1.00	67	39.1	34.5	35.7	40.0	5.6

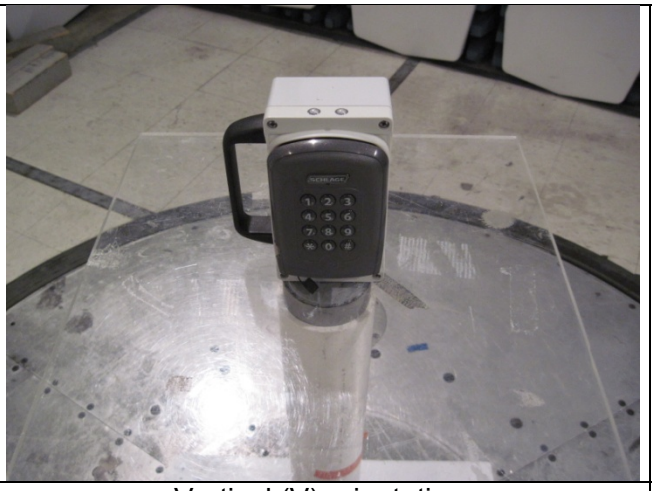
Notes:

1) An Average and quasi peak Detector function was used in measurements below 30 MHz, a Quasi-Peak Detector was used in measurements between 30 MHz and 1 GHz.
2) H = Horizontal; V = Vertical; S = Side; F = Flat
3) Recorded data is that of the system noise floor at the corresponding frequency.

5.7 Test Setup Photo(s) – Radiated Emissions Test

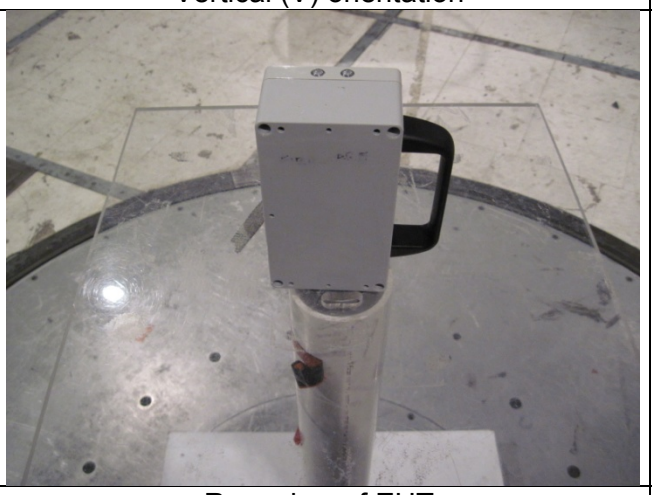
A. PROX Emissions testing setup.

Side (S) orientation



Vertical (V) orientation

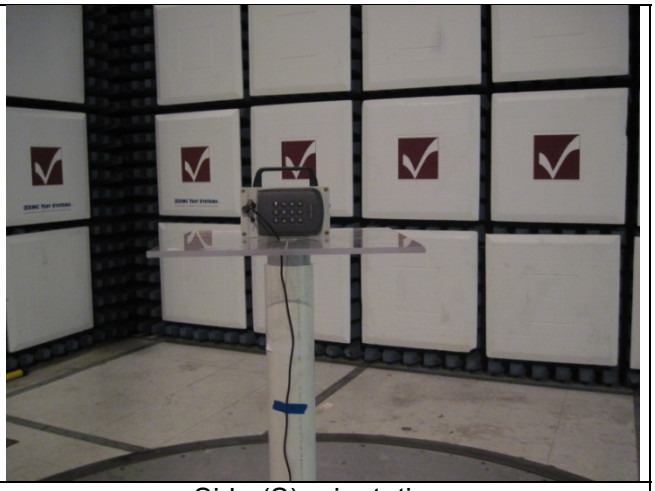
Flat (F) orientation



Rear view of EUT

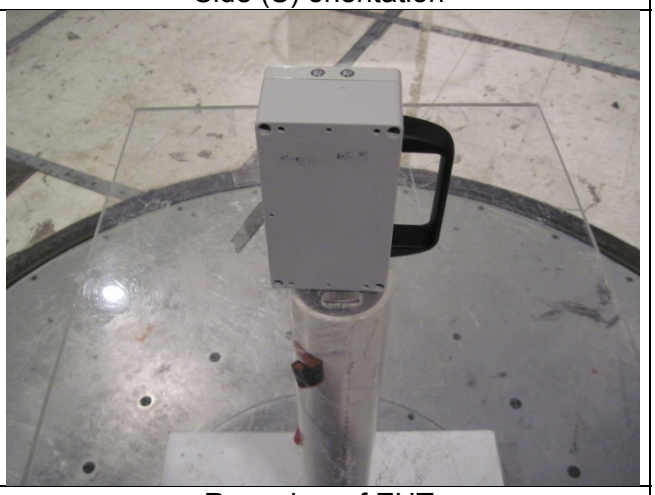
B. WPR charging mode emissions testing setup.

Vertical (V) orientation



Side (S) orientation

Flat (F) orientation



Rear view of EUT

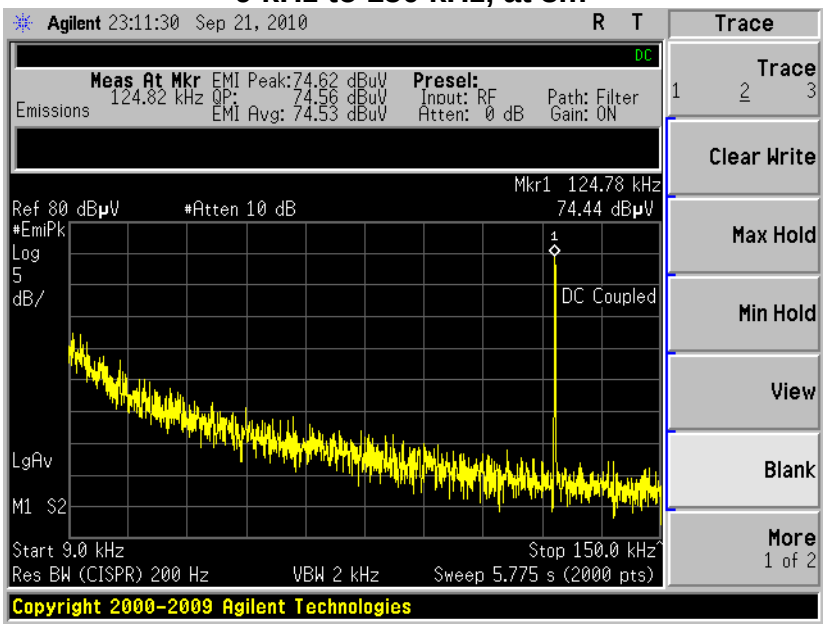
5.8 Screen Captures - Radiated Emissions Testing

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

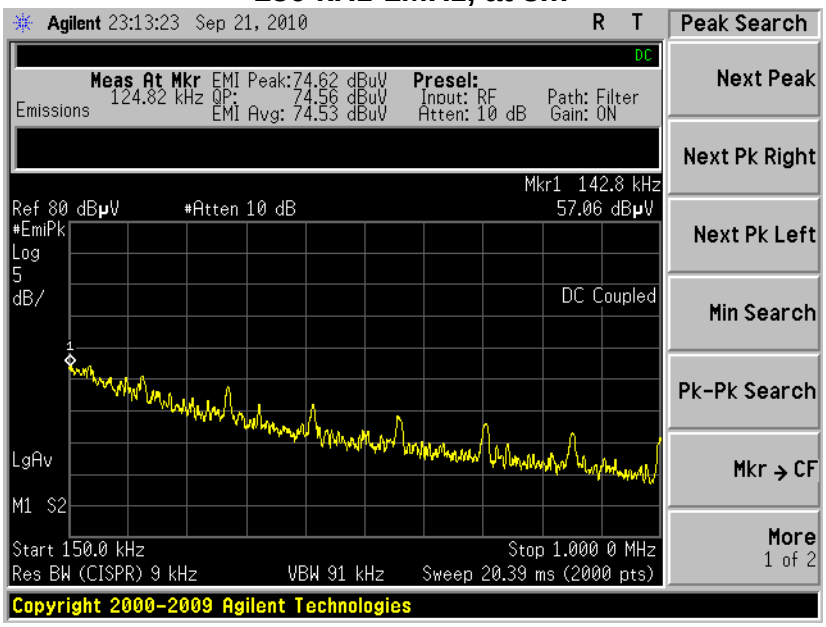
The signature scans shown here are from worst-case emissions with the sense antenna in either vertical or horizontal polarity for worst case presentations.

A. PROX

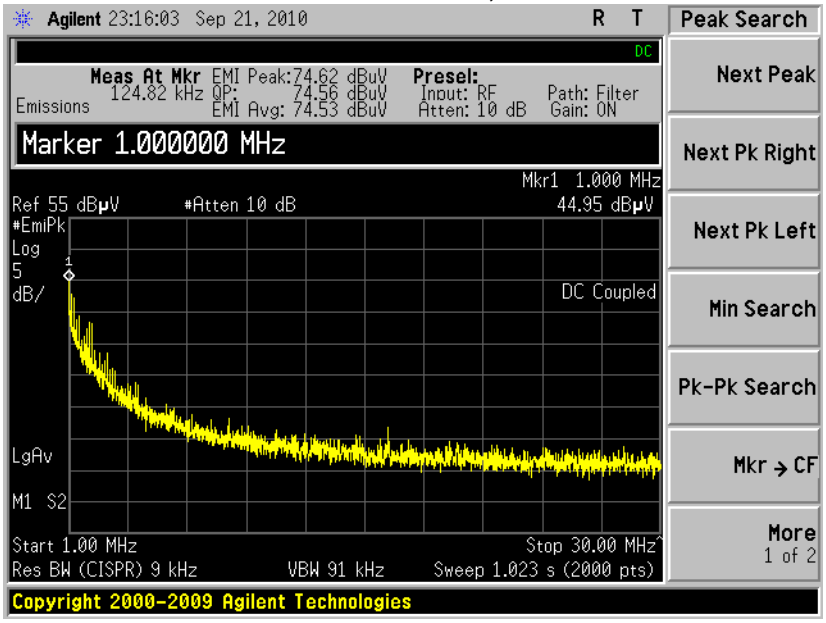
9 kHz to 150 kHz, at 3m



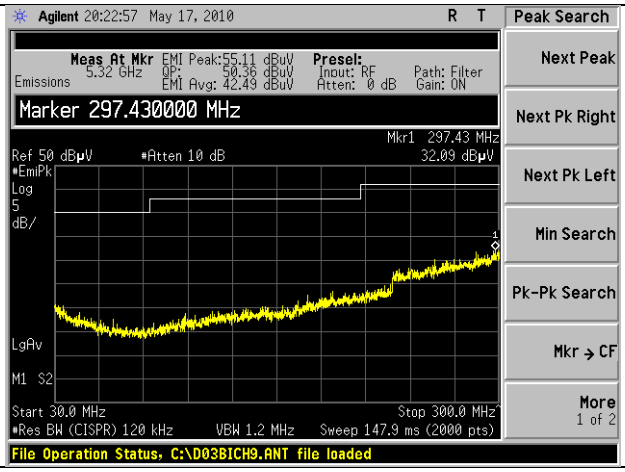
150 kHz-1MHz, at 3m



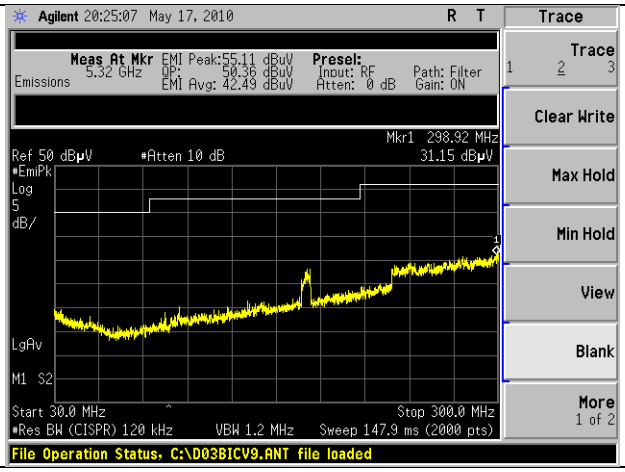
1 MHZ to 30 MHz, at 3m



30 MHz to 300 MHz, at 3m

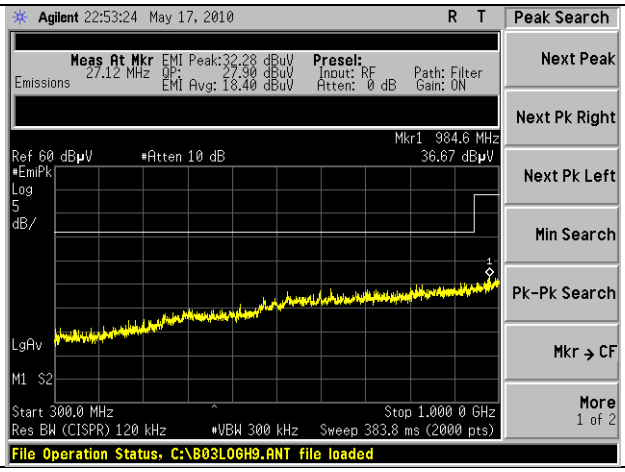


Horizontal

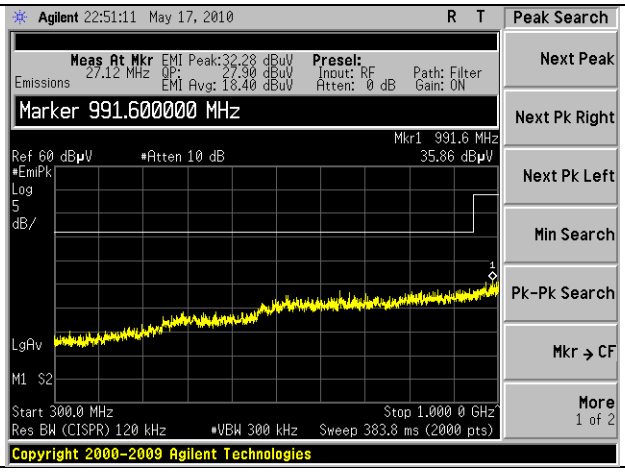


Vertical

300 MHz to 1000 MHz, at 3m



Horizontal

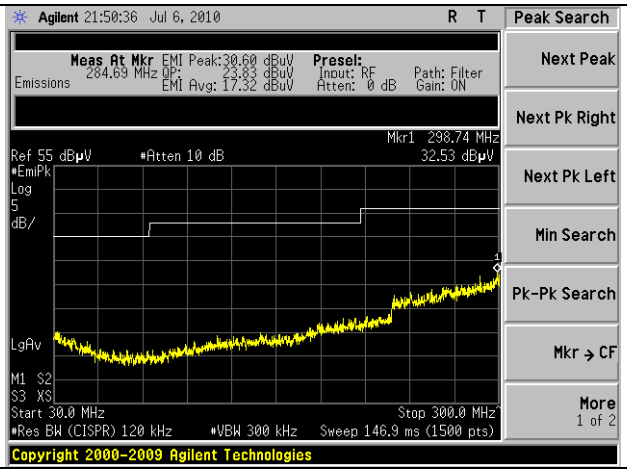


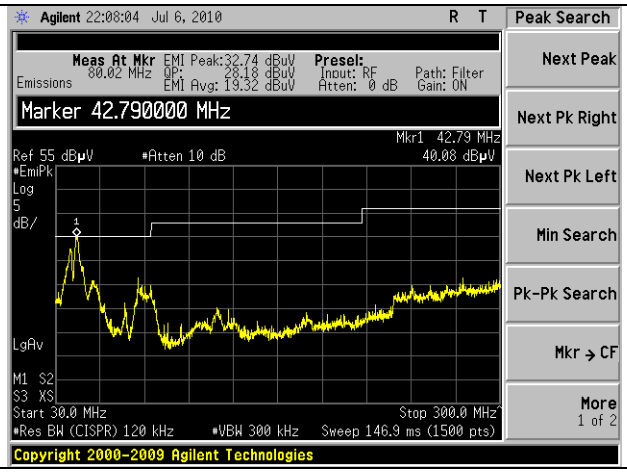
Vertical

It was also determined that while both the 900MHz modular radio and the PROX were simultaneously transmitting, there were no unexpected RF anomalies within the 30 MHz to 1000 MHz range.

B. WPR charging mode.

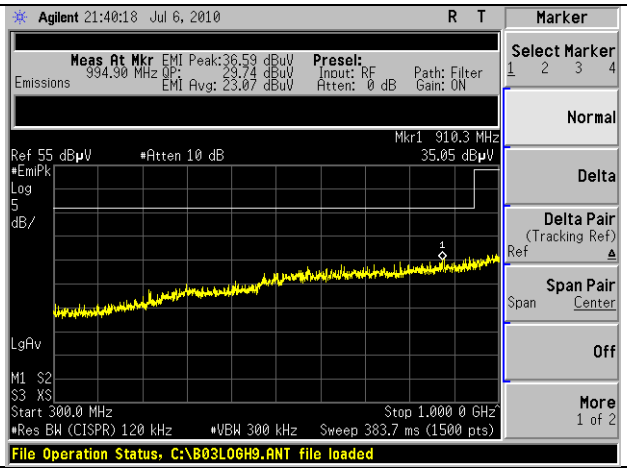
30 MHz to 300 MHz, at 3m

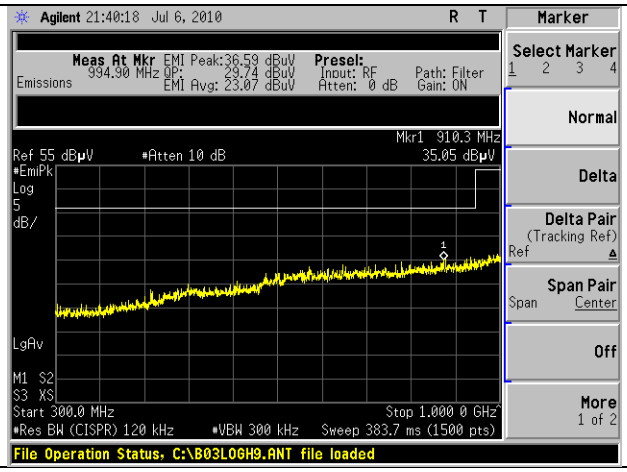




Horizontal	Vertical

300 MHz to 1000 MHz, at 3m





Horizontal	Vertical

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, Issue 7, 2007). 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 Agilent E4445A/N9039A EMI System. 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 WPR **charging mode** was investigated for this portion of the testing. The WPR was powered by the supplied 12VDC AC to DC adaptor which was connected to the Mains network via a calibrated LISN. The WPR was then switched to the **'charging mode'** via a switch on the WPR. 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/N9039A EMI System, 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 15.107 and RSS GEN 7.2.2 Conducted Emissions. 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.			

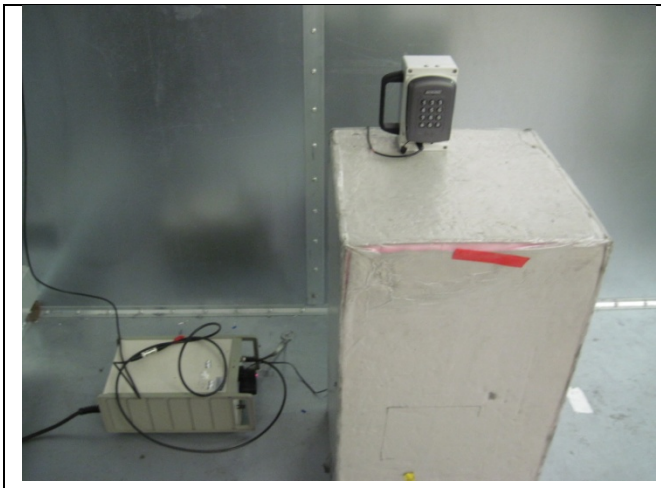
6.6 *CONDUCTED EMISSIONS – TEST DATA CHART*

Frequency Range inspected: 150 KHz to 30 MHz

Manufacturer:	Ingersoll-Rand Company					
Date(s) of Test:	September 27th					
Test Engineer:	Khairul Aidi Zainal					
Voltage:	120 VAC					
Operation Mode:	Charging					
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)
0.350	1.0	48.3	59.0	10.7	33.8	49.0	15.1
0.557	1.0	42.8	56.0	13.2	30.6	46.0	15.4
1.498	1.0	43.9	56.0	12.2	28.2	46.0	17.8
0.252	2.0	44.3	61.7	17.4	27.4	51.7	24.3
0.283	2.0	37.2	60.7	23.5	24.8	50.7	25.9
0.597	2.0	37.4	56.0	18.6	21.9	46.0	24.1

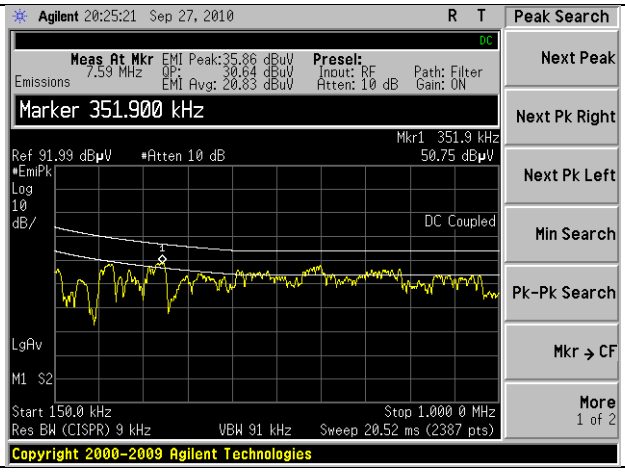
6.7 Test Setup Photo(s) – Conducted Emissions Test



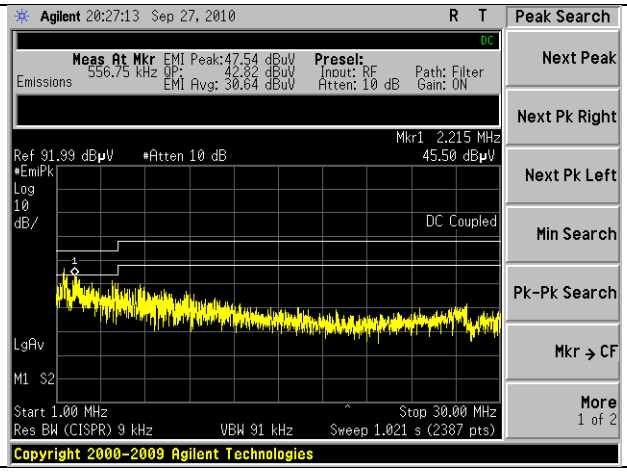
6.8 Screen Captures – Conducted Emissions Test

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 15.107 and RSS GEN 7.2.2.

Line 1

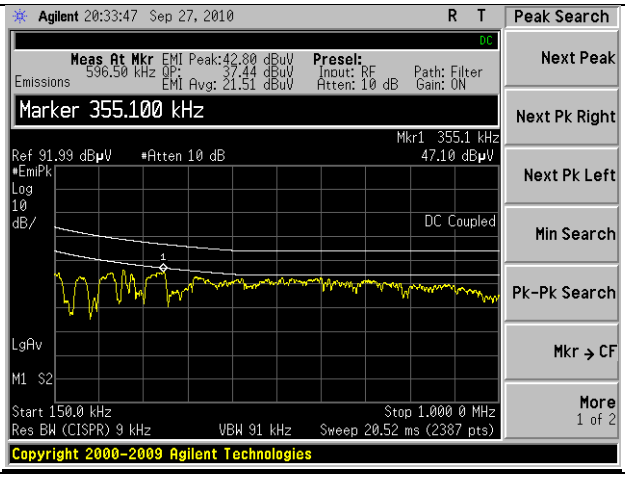


150 kHz to 1 MHz

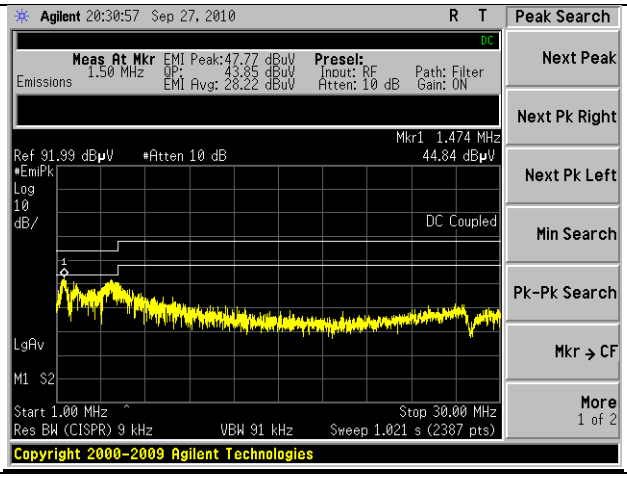


1 MHz to 30 MHz

Line 2



150 kHz to 1 MHz



1 MHz to 30 MHz

EXHIBIT 7. OCCUPIED BANDWIDTH

7.1 Limits

There are no stated limits for the occupied bandwidth for devices operating under 47CFR Part 15.209. However it is required by Industry Canada per RSS GEN 4.6

7.2 Method of Measurements

ANSI C63.4, FCC and IC standard procedures were adhered to in these measurements.

The transmitter output was placed in normal operation mode. The bandwidth of the fundamental frequency was measured via radiated measurement with the Spectrum Analyzer using RBW= 200Hz and VBW=2 kHz for the 125 kHz transmitter.

7.3 Test Data

Mode	Center Frequency (MHz)	Measured -20 dBc Occ.Bw (kHz)
PROX reader.	0.125	0.448

7.4 Screen Captures - OCCUPIED BANDWIDTH

-20 dBc Occupied Bandwidth

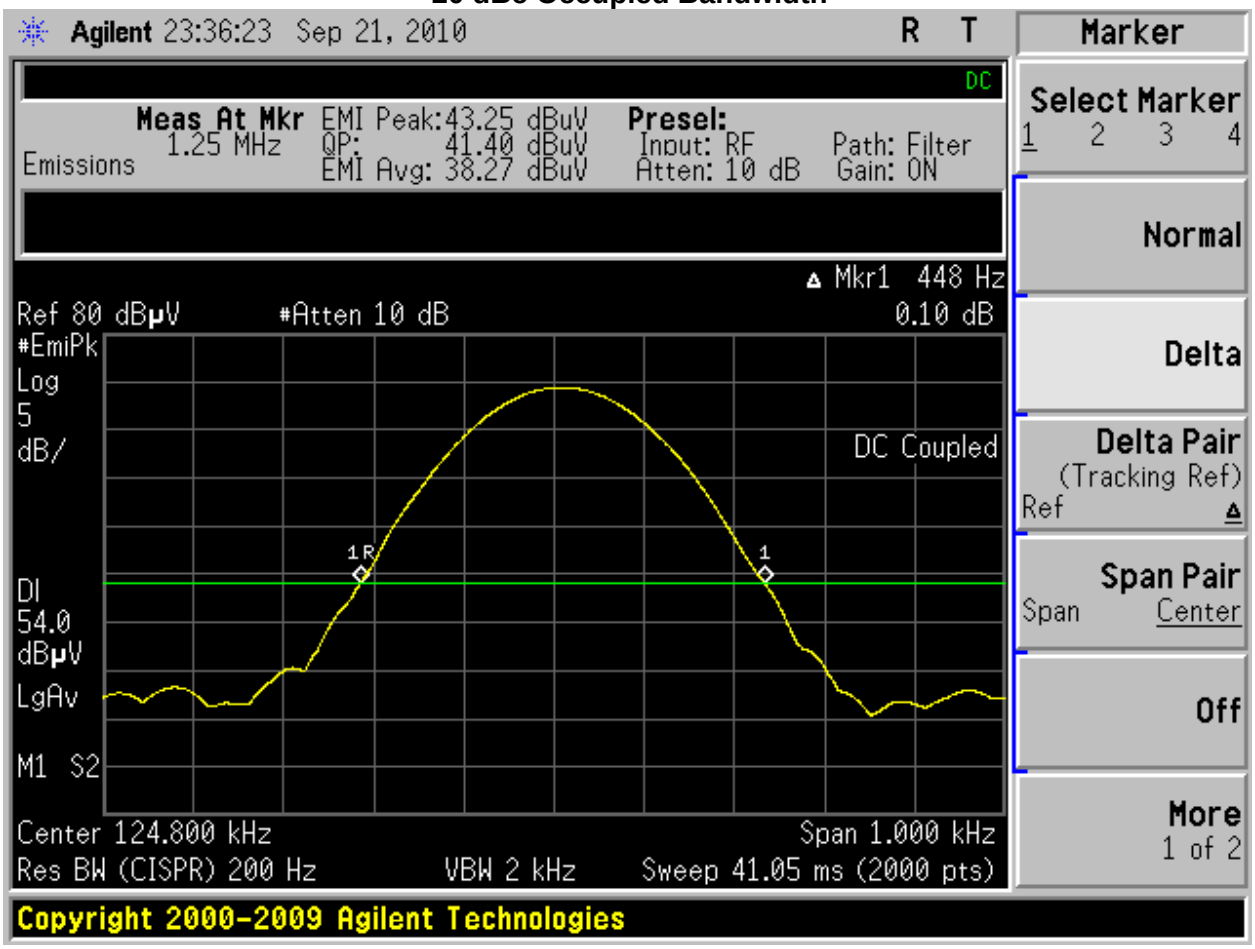
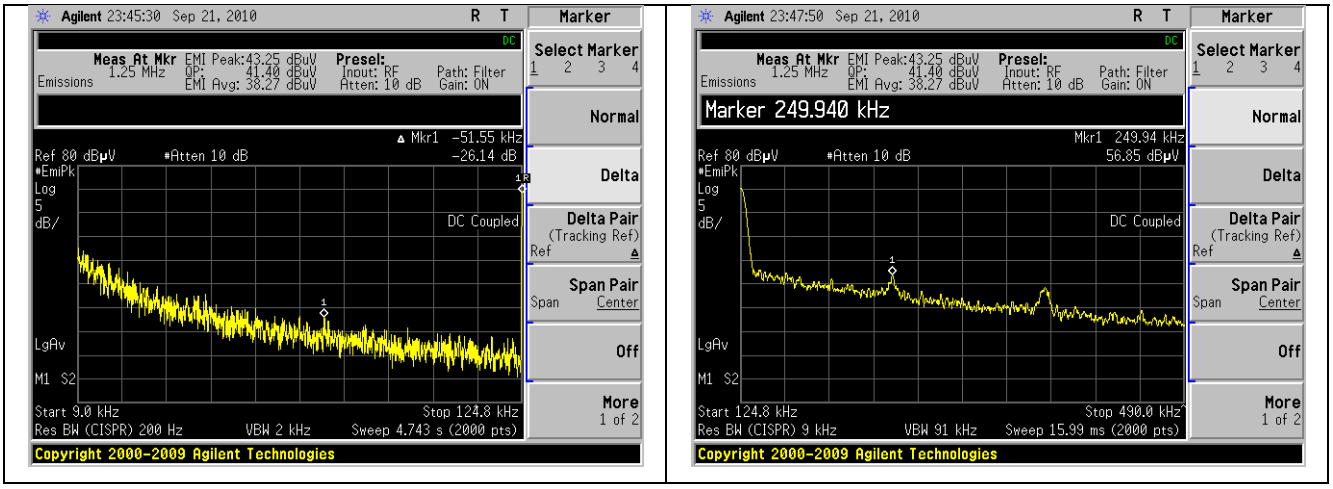


EXHIBIT 8. BAND EDGE MEASUREMENT.

8.1 Test Criterion

FCC 15.209(b) requires a measurement of spurious emission levels to be no higher than the fundamental emission level, in particular at the Band-Edges where the intentional radiator operates. The operation of this device shall also be limited to the frequency band between 110 kHz and 490 kHz for the 125 kHz transmitter. No components of the fundamental emission shall be allowed outside of this band.

8.2 Screen captures.



Screen capture shows that fundamental emissions were contained within the allowed band of operation.

APPENDIX A

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date : 6-Jul-2010 Type Test : Radiated emissions Job # : C-864

Prepared By: Aidi Customer : Ingersoll Rand Quote #: 310090

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960158	RF Preselecter	Agilent	N9039A	MY46520110	6/7/2010	6/7/2011	Active Calibration
2	EE 960157	3Hz-13.2GHz Spectrum Analyzer	Agilent	E4445A	MY48250225	6/7/2010	6/7/2011	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 960006	Active Loop Antenna	EMCO	6502	9205-2753	9/14/2009	9/14/2011	Active Calibration

Project Engineer: Aidi Quality Assurance: Tom Smith

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date : 6-Jul-2010 Type Test : Conducted Emissions Job # : C-864

Prepared By: Aidi Customer : Ingersoll Rand Quote #: 310090

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960158	RF Preselecter	Agilent	N9039A	MY46520110	6/7/2010	6/7/2011	Active Calibration
2	EE 960157	3Hz-13.2GHz Spectrum Analyzer	Agilent	E4445A	MY48250225	6/7/2010	6/7/2011	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 Assurance: Tom Smith

APPENDIX B
TEST STANDARDS – CURRENT PUBLICATION DATES RADIO

STANDARD #	DATE	Am. 1	Am. 2
ANSI C63.4	2009		
ANSI C63.10	2009		
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	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		
FCC 47 CFR, Parts 0-15, 18, 90, 95	2009		
FCC Public Notice DA 00-1407	2000		
FCC ET Docket # 99-231	2002		
FCC Procedures	2007		
ICES 001	2006-06		
ICES 002	2009-08		
ICES 003	2004-02		
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 2006	

STANDARD #	DATE	Am. 1	Am. 2
IEC 61000-4-4	2004-07		
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		
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		

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