LS RESEARCH, LLC
WIRELESS PRODUCT DEVELOPMENT
ACCREDITED
TESTING CERT #1255.01
W66 N220 Commerce Court ● Cedarburg, WI 53012 ● USA
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www.lsr.com

# TEST REPORT #: 312105
# LSR Job #: C-1463

Compliance Testing of:
NGRE

Test Date(s):
August 1-3, 2012

Prepared For:
Ingersoll Rand
Attn: Frank Nardelli
11819 North Pennsylvania Street
Carmel, IN 46032

**In accordance with:**
**Federal Communications Commission (FCC)**
**Part 15, Subpart C, Section 15.249**
**Industry Canada (IC) RSS 210 Annex 2**
**Transmitters Operating in the**
**Frequency Band 902 MHz – 928 MHz**

**This Test Report is issued under the Authority of:**
Peter Feilen, EMC Engineer

Signature: Peter Feilen Date: 8/29/12

| **Test Report Reviewed by:** | **Tested by:** |
|---|---|
| Ryan Urness, Lab Manager | Peter Feilen, EMC Engineer |
| Signature: Date: 8/28/12 | Signature: Peter Feilen Date: 8/6/12 |

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# EXHIBIT 1. INTRODUCTION

## 1.1 SCOPE

| | |
|---|---|
| **References:** | Title 47 CFR FCC Part 15, Subpart C, Section 15.249<br>RSS GEN and RSS 210 Annex 2 |
| **Title:** | FCC : Telecommunication – Code of Federal Regulations, CFR 47, Part 15.<br>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:** | Radiated emissions measurements were performed 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<br>• Residential |

## 1.2 NORMATIVE REFERENCES

| Publication | Title |
|---|---|
| 47 CFR, Parts 0-15 (FCC) | Code of Federal Regulations - Telecommunications |
| RSS 210 | Low-power License-exempt Radio-communication Devices (All Frequency Bands): Category I Equipment |
| 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. |

## 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.a2la.net.

## 1.4 LOCATION OF TESTING

All testing was performed at LS Research, LLC, W66 N220 Commerce Court, Cedarburg, Wisconsin, 53012.

## 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 by a calibration laboratory accredited to the requirements of ISO 17025, and is traceable to the SI standard.

# EXHIBIT 2. PERFORMANCE ASSESSMENT

## 2.1 CLIENT INFORMATION

| | |
|---|---|
| **Manufacturer Name:** | **Ingersoll Rand** |
| **Address:** | **11819 North Pennsylvania Street** |
| **Contact Name:** | **Carmel, IN 46032** |

## 2.2 EQUIPMENT UNDER TEST (EUT) INFORMATION

*The following information has been supplied by the applicant.*

| | |
|---|---|
| **Product Name:** | Next Generation Residential Electronic (NGRE) deadbolt |
| **Model Number:** | 23685159 |
| **Serial Number:** | Engineering Sample |

## 2.3 ASSOCIATED ANTENNA DESCRIPTION

A PCB trace inverted L antenna

## 2.4 EUT'S TECHNICAL SPECIFICATIONS

| | |
|---|---|
| EUT Operating Frequency | 908.42 MHz |
| Field Strength at 3 meters | |
| Minimum: | 75.8 dBuV/m @ 3m |
| Maximum: | 86.7 dBuV/m @ 3m |
| EIRP (in mW) | |
| Minimum: | 0.111 mW |
| Maximum: | 0.141 mW |
| Type of Modulation | FSK |
| Occupied Bandwidth (99%) in kHz | 148.46 kHz |
| Emission Designator | 148KF1D |
| Transmitter Spurious (worst case) at 3 meters | 49.3 dBuV/m @ 3m @ 3633.68 MHz<br>Listed in section 5.6 |
| Receiver Spurious (worst case) at 3 meters | 44.2 @ 3m @ 1816.84 MHz<br>Listed in section 5.8 |
| Stepped (Yes/No) | No |
| Step Value: | N/A |
| Microprocessor Model # (if applicable) | Transceiver: ZW0301<br>Microcontroller: Microchip PIC18F87K22-I/PTRSL |
| Antenna Information | |
| Detachable/non-detachable | Non-detachable |
| Type | PCB trace inverted L |
| EUT will be operated under FCC Rule Part(s) | 15.249 |
| EUT will be operated under RSS Rule Part(s) | RSS 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 |
| | X | 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: %
- Standard used for evaluation: OET 65
- Measurement Distance: 20 cm
- RF Value: 0.00027 ☐ V/m ☐ A/m ☒ W/m$^2$
  ☐ Measured ☐ Computed ☒ Calculated

Since the output power of the EUT, 0.00027mW, is less than 200mW, no SAR evaluation is necessary.

## 2.5 PRODUCT DESCRIPTION

"The Next Generation Residential Electronic (NGRE) deadbolt is a deadbolt with integrated electronics for keyless access and remote control via Z-Wave radio. The Z-Wave radio operates in

the 908.4 MHz band and provides a wireless link to a Z-Wave controller for deadbolt configuration, remote access, and status reports. The NGRE deadbolt is powered by four AA batteries."

# EXHIBIT 3. EUT OPERATION CONDITIONS AND CONFIGURATION

## 3.1 CLIMATE TEST CONDITIONS

| | |
|---|---|
| **Temperature:** | 22 ° C |
| **Humidity:** | 44 % |
| **Pressure:** | 752 mmHg |

## 3.2 APPLICABILITY & SUMMARY OF EMC EMISSION TEST RESULTS

| FCC and IC Paragraph | Test Requirements | Compliance (yes/no) |
|---|---|---|
| FCC : 15.207<br>IC : RSS GEN sect. 7.2.2 | Power Line Conducted Emissions Measurements | N/A |
| IC : RSS GEN section 4.6.1 | 20 dB Bandwidth | YES |
| FCC : 15.249(A) & 1.1310<br>IC : RSS 210 A2.9 (a) | Maximum Output Power | YES |
| FCC : 1.1307, 1.1310, 2.1091 & 2.1093<br>IC : RSS 102 | RF Exposure Limit | YES |
| FCC : 15.249(a)<br>IC : RSS 210 A2.9(a) | Transmitter harmonics | YES |
| FCC : 15.249(d) & 15.205<br>IC : RSS 210 A2.9(b), | Transmitter Radiated Emissions | YES |
| *The digital circuit portion of the EUT has been tested and verified to comply with FCC Part 15, Subpart B, Class B Digital Devices (RSS GEN and RSS 210 of IC) and the associated Radio Receiver has also been tested and found to comply with Part 15, Subpart B – Radio Receivers (RSS GEN and RSS 210 of IC). The Receiver Test Report is available upon request.* | | |

## 3.3 MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

☒ **None** ☐ **Yes (explain below)**

## 3.4 DEVIATIONS & EXCLUSIONS FROM TEST SPECIFICATIONS

☒ **None** ☐ **Yes (explain below)**

# EXHIBIT 4. DECLARATION OF CONFORMITY

The EUT was found to MEET the requirements as described within the specification of FCC Title 47, CFR Part 15.249, and Industry Canada RSS-210, Annex 2.9.

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 continuously transmitting modulated mode using power as provided by a battery. The unit has the capability to operate on 1 channel.

The applicable limits apply at a 3 meter distance. Measurements above 5 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 the standard channel: **908.42 MHz.**

## 5.2 Test Procedure

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

In the frequency range of 30 MHz to 5 GHz, the maximum radiated RF emissions were found by raising and lowering the antenna between 1 and 4 meters in height while for the range of 5 GHz to 10 GHz the antenna was raised and lowered between 1 and 1.8 meters in height. In addition, the polarity of the antenna was switched between horizontal and vertical polarity.

The EUT was positioned in one position for the test, as it has one orientation for use.

Battery Voltage was periodically checked to ensure sufficient supply.

## 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 described in ANSI C63.4.

## 5.4 Test Results

The EUT was found to **MEET** the Radiated Emissions requirements of Title 47 CFR, FCC Part 15.249 and Canada RSS-210, Annex 2.9. 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

**Field Strength of Fundamental Frequencies:**
The fundamental emissions for an intentional radiator in the 902-928 MHz band, operating under FCC part 15.249 and RSS 210 A2.9 limits, must have electric field strength of no greater than 50 mV/m, for the fundamental frequency, when measured at 3 meters, and harmonic field strength of no greater than 500 µV/m, when measured at 3 meters. Spurious emissions outside the 902-928 MHz band shall be attenuated by at least 50 dB below the level of the fundamental, or meet the limits expressed in FCC part 15.209 under general emission limits.

**Field Strength of Fundamental Frequencies is Limited to 50,000 µV/m, or 94 dBµV/m.**
**Field Strength of Harmonic and Spurious Frequencies is Limited by FCC 15.249 a and d**

The harmonic limit of –50 dBc with respect to the fundamental limit would be:
94 dBµV/m – 50 dB = 44 dBµV/m,
*****with the exception of where FCC 15.209 allows for a higher limit to be used.

| Frequency (MHz) | 3 m Limit (µV/m) | 3 m Limit (dBµV/m) |
|---|---|---|
| 902-928 | 50,000 | 94.0 |
| 30-88 ; 88-216 | 159 | 44.0 |
| 216-902 ; 928-960 | 500 | 46.0***** |
| 960-40,000 | 500 | 54.0***** |

The following table depicts the general radiated emission limits obtained from Title 47 CFR, part 15.209a, for radiated emissions measurements, including restricted band limits as expressed in 47 CFR, part 15.205.

| Frequency (MHz) | 3 m Limit (µV/m) | 3 m Limit (dBµV/m) |
|---|---|---|
| 30-88 | 100 | 40.0 |
| 88-216 | 150 | 43.5 |
| 216-960 | 200 | 46.0 |
| 960-40,000 | 500 | 54.0 |

**Sample conversion from field strength µV/m to dBµV/m:**

$$dB\mu V/m = 20 \log_{10} (3m\ limit)$$

from 30 - 88 MHz for example: $dB\mu V/m = 20 \log_{10} (100)$

$$40.0\ dB\mu V/m = 20 \log_{10} (100)$$

**For measurements made at 1 meter, a 9.5 dB correction may be been invoked.**

960 MHz to 40,000 MHz
500 µV/m or 54.0 dBµV/m at 3 meters
54.0 + 9.5 = 63.5 dBµV/m at 1 meter

*Note: Limits are conservatively rounded to the nearest tenth of a whole number.*

## 5.6 RADIATED EMISSIONS TEST DATA CHART

Measurements of Electromagnetic Radiated Emissions
Frequency Range Inspected: 30 MHz to 10000 MHz

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Manufacturer: | Ingersoll Rand | | | | | | |
| Date(s) of Test: | August 1-3, 2012 | | | | | | |
| Project Engineer: | Peter Feilen | | | | | | |
| Test Engineer(s): | Peter Feilen | | | | | | |
| Voltage: | 6 VDC | | | | | | |
| Operation Mode: | Normal, Continuously Modulated Mode | | | | | | |
| Environmental Conditions in the Lab: | Temperature: 71˚F<br>Relative Humidity: 42 % | | | | | | |
| EUT Power: | | Single Phase 120 VAC | | 3 Phase ___VAC | | | |
| | X | Battery | | Other: | | | |
| 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 radiated fundamental:

| Frequency MHz | Antenna | EUT | Height (m) | Azimuth (0° - 360°) | Peak (dBuV/m) | Quasi-Peak (dBuV/m) | Limit (dBuV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|
| 908.4 | v | v | 1.41 | 347 | 87.0 | 86.7 | 94.0 | 7.3 |
| 908.4 | h | v | 1.25 | 300 | 82.6 | 82.2 | 94.0 | 13.3 |

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

| Frequency (MHz) | Height (m) | Azimuth (degree) | Quasi Peak Reading (dBµV/m) | Quasi Peak Limit (dBµV/m) | Margin (dB) | Antenna Polarity | EUT orientation |
|---|---|---|---|---|---|---|---|
| 900.4 | 1.49 | 343 | 29.4 | 46.0 | 16.6 | v | v |
| 544.0 | 1.00 | 0 | 27.7 | 46.0 | 18.3 | v | v |
| 528.1 | 1.00 | 346 | 27.0 | 46.0 | 19.0 | v | v |
| 265.0 | 1.05 | 5 | 25.1 | 46.0 | 20.9 | v | v |
| 279.0 | 1.06 | 348 | 25.0 | 46.0 | 21.0 | v | v |
| 72.1 | 1.00 | 188 | 14.2 | 40.0 | 25.8 | h | v |

| Frequency (GHz) | Height (m) | Azimuth (degree) | Peak Reading (dBµV/m) | Average Reading (dBµV/m) | Average Limit (dBµV/m) | Margin (dB) | Antenna Polarity | EUT orientation |
|---|---|---|---|---|---|---|---|---|
| 1445.0 | 1.00 | 0 | 59.4 | 47.7 | 54.0 | 6.3 | h | v |

Note 1.: h= horizontal, v = vertical
Note 2.: Worst case emissions reported.

## ***RADIATED EMISSIONS DATA CHARTS*** **(continued)**

The following tables depicts the level of harmonic emissions observed:

| Frequency (MHz) | Height (m) | Azimuth (degree) | Peak Reading (dBµV/m) | Avg Reading (dBµV/m) | Avg Limit (dBµV/m) | Margin (dB) | Antenna Polarity | EUT orientation |
|---|---|---|---|---|---|---|---|---|
| 1816.84 | 1.14 | 0 | 50.2 | 40.7 | 54.0 | 13.3 | Horizontal | Vertical |
| 2725.26 | 1.09 | 9 | 51.3 | 48.3 | 54.0 | 5.8 | Horizontal | Vertical |
| 3633.68 | 1.24 | 0 | 51.9 | 47.3 | 54.0 | 6.7 | Horizontal | Vertical |
| 4542.10 | 1.05 | 313 | 43.7 | 34.3 | 54.0 | 19.7 | Horizontal | Vertical |
| 5450.52 | Note 1 | | | | 63.5 | - | Horizontal | Vertical |
| 6358.94 | Note 1 | | | | 63.5 | - | Horizontal | Vertical |
| 7267.36 | Note 1 | | | | 63.5 | - | Horizontal | Vertical |
| 8175.78 | Note 1 | | | | 63.5 | - | Horizontal | Vertical |
| 9084.20 | Note 1 | | | | 63.5 | - | Horizontal | Vertical |

| Frequency (MHz) | Height (m) | Azimuth (degree) | Peak Reading (dBµV/m) | Avg Reading (dBµV/m) | Avg Limit (dBµV/m) | Margin (dB) | Antenna Polarity | EUT orientation |
|---|---|---|---|---|---|---|---|---|
| 1816.84 | 1.00 | 330 | 46.0 | 39.6 | 54.0 | 14.4 | Vertical | Vertical |
| 2725.26 | 1.00 | 312 | 48.8 | 44.6 | 54.0 | 9.5 | Vertical | Vertical |
| 3633.68 | 1.09 | 44 | 53.0 | 49.3 | 54.0 | 4.7 | Vertical | Vertical |
| 4542.10 | 1.08 | 358 | 42.3 | 31.2 | 54.0 | 22.8 | Vertical | Vertical |
| 5450.52 | Note 1 | | | | 63.5 | - | Vertical | Vertical |
| 6358.94 | Note 1 | | | | 63.5 | - | Vertical | Vertical |
| 7267.36 | Note 1 | | | | 63.5 | - | Vertical | Vertical |
| 8175.78 | Note 1 | | | | 63.5 | - | Vertical | Vertical |
| 9084.20 | Note 1 | | | | 63.5 | - | Vertical | Vertical |

Notes:

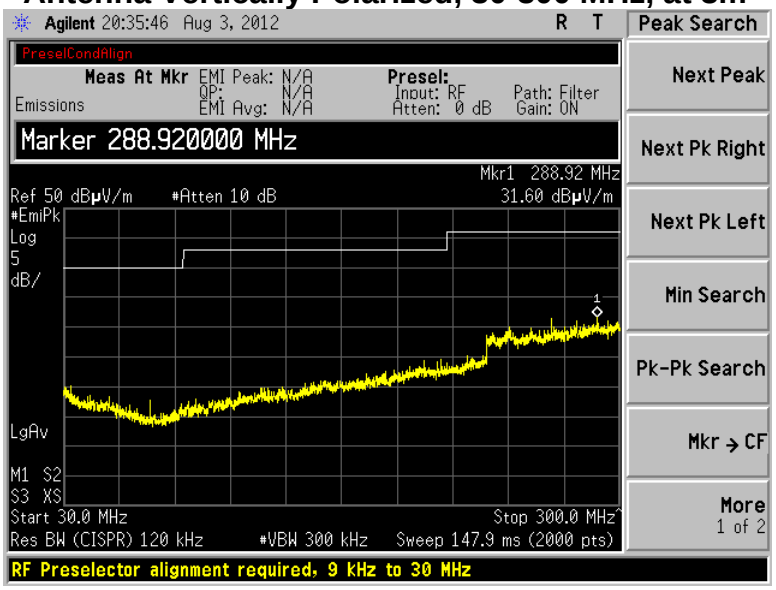
1) Measurement at receiver system noise floor.
2) A Peak Detector was used in measurements above 1 GHz, for average measurement, the peak detector was used with lower VBW. The peak detector was used to ensure the peak emissions did not exceed 20 dB above the limits.
3) Measurements above 5 GHz were made at 1 meter of separation from the EUT.

## 5.7 Screen Captures - Radiated Emissions Test - Transmitter

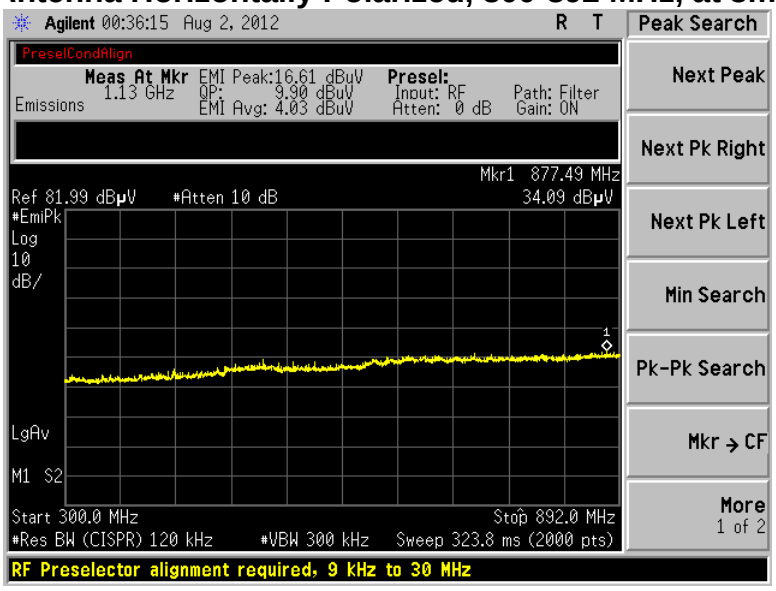
These screen captures represent Peak Emissions. For radiated emission measurements, a Quasi-Peak detector function is utilized when measuring frequencies below 1 GHz, and a peak detector with video averaging is utilized when measuring frequencies above 1 GHz.

The signature scans shown here are from worst-case emissions, as measured on one standard operating channel, 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, 300-892 MHz, at 3m**



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

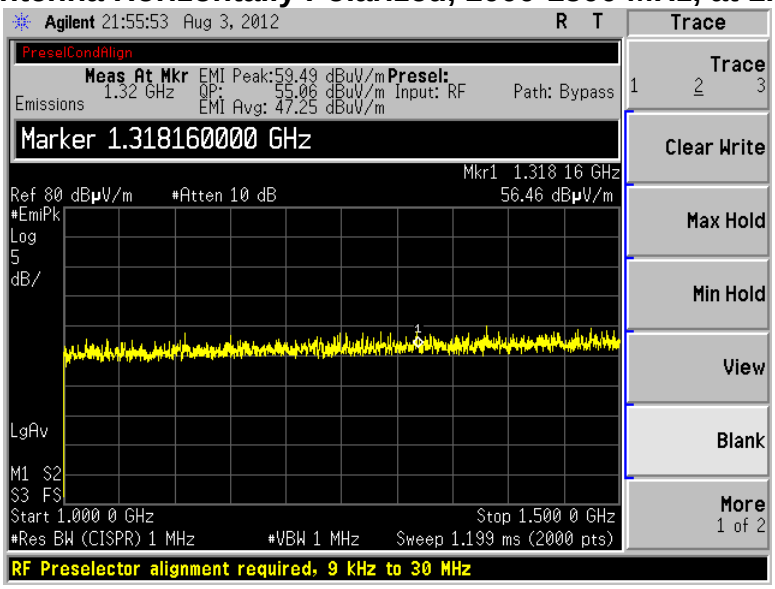
### Antenna Vertically Polarized, 892-902 MHz, at 3m

Please see Exhibit 8

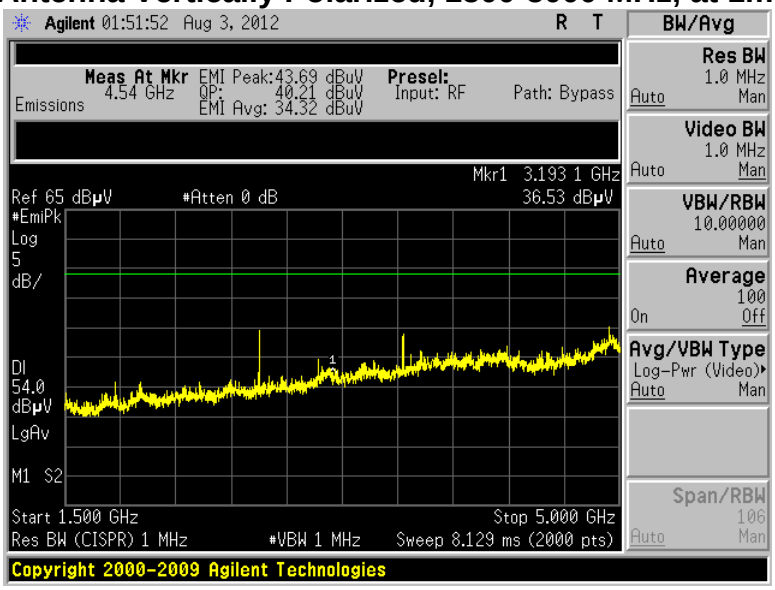
### Antenna Horizontally Polarized, 928-1000 MHz, at 3m

Please see Exhibit 8

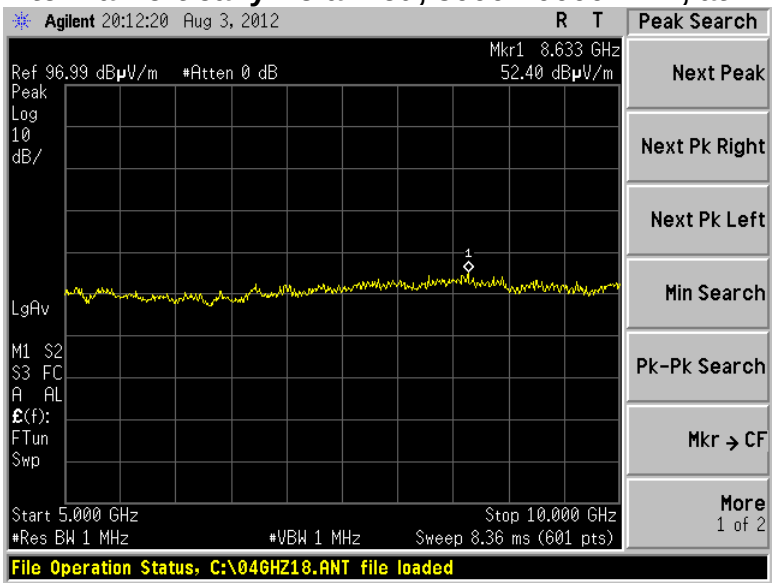
### Antenna Horizontally Polarized, 1000-1500 MHz, at 1m



## Antenna Vertically Polarized, 1500-5000 MHz, at 1m




## Antenna Vertically Polarized, 5000-10000 MHz, at 1m



## 5.8 Radiated Emissions Test - Receiver

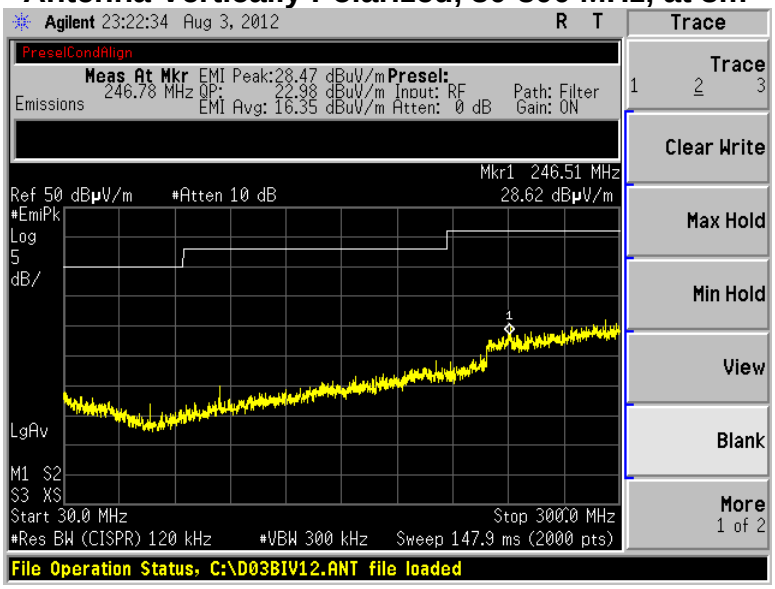
Refer to section 5.1-5.4 for test setup and details.

## Test Data

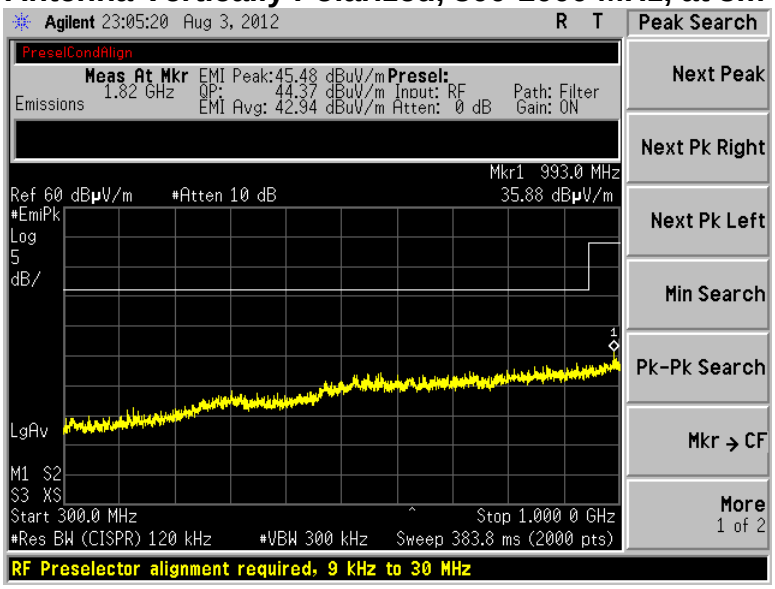
| Frequency (GHz) | Height (m) | Azimuth (degree) | Peak Reading (dBµV/m) | Average Reading (dBµV/m) | Average Limit (dBµV/m) | Margin (dB) | Antenna Polarity | EUT orientation |
|---|---|---|---|---|---|---|---|---|
| 1817.2 | 1.21 | 10 | 45.5 | 42.7 | 54.0 | 11.3 | h | v |
| 1817.2 | 1.00 | 340 | 47.0 | 44.2 | 54.0 | 9.8 | v | v |

## 5.9 Screen Captures - Radiated Emissions Test - Receiver

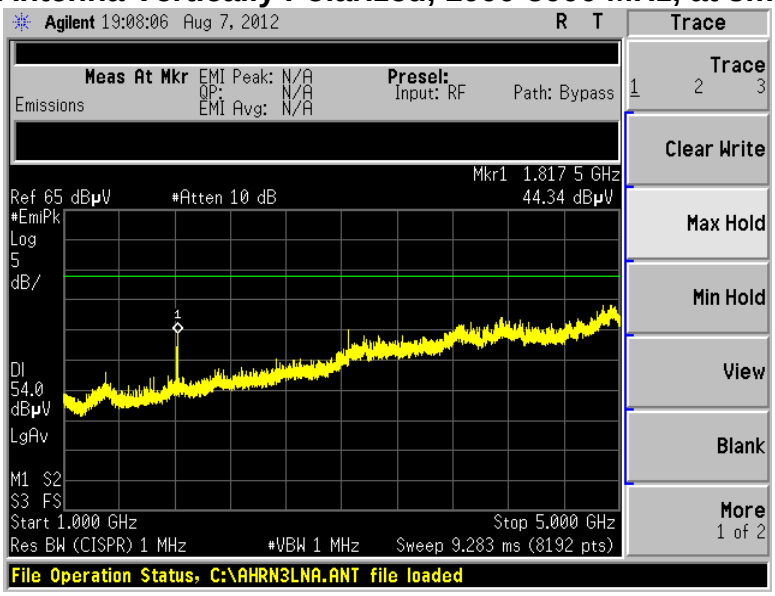
**Antenna Vertically Polarized, 30-300 MHz, at 3m**



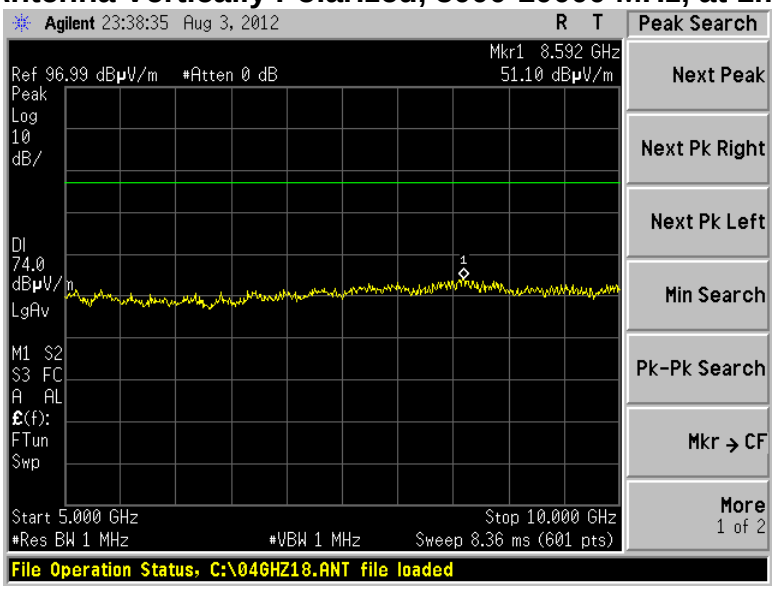
## Antenna Vertically Polarized, 300-1000 MHz, at 3m




## Antenna Vertically Polarized, 1000-5000 MHz, at 3m



## Antenna Vertically Polarized, 5000-10000 MHz, at 1m



# EXHIBIT 6. CONDUCTED EMISSIONS TEST, AC POWER LINE

**This test is not applicable for a battery-only operated device and was therefore not tested.**

# EXHIBIT 7. OCCUPIED BANDWIDTH:

## 7.1 Limits

There are no limits specified. The occupied bandwidth need only be reported.

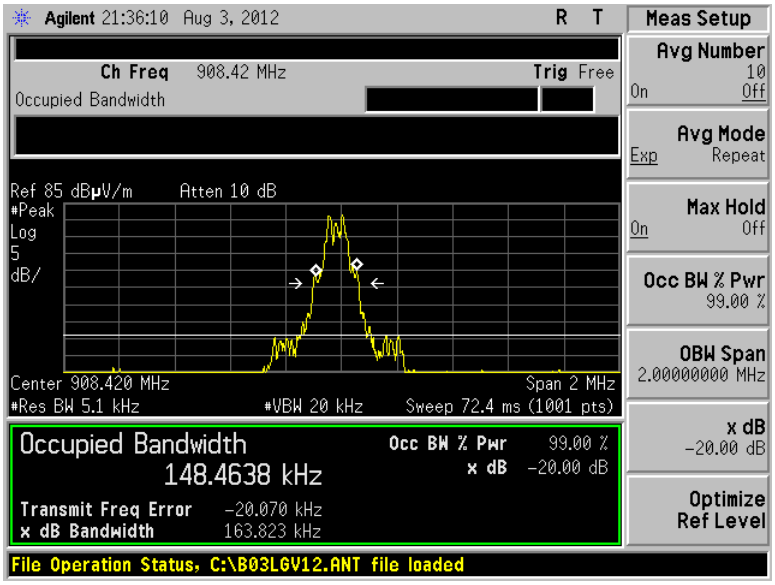
## 7.2 Method of Measurements

This test was performed radiated in a 3-meter semi-anechoic chamber. The resolution bandwidth was then set to a value that was greater than or equal to 1% of the bandwidth. Using the 20dBc and 99% Occupied Bandwidth measurement function of the spectrum analyzer, the bandwidth was measured.

## 7.3 Test Data

| Center Frequency (MHz) | Measured 99% Occ.Bw (kHz) | Measured -20 dBc Occ.Bw (kHz) |
|---|---|---|
| 908.42 | 148.46 | 163.82 |

## 7.4 Screen Captures - OCCUPIED BANDWIDTH

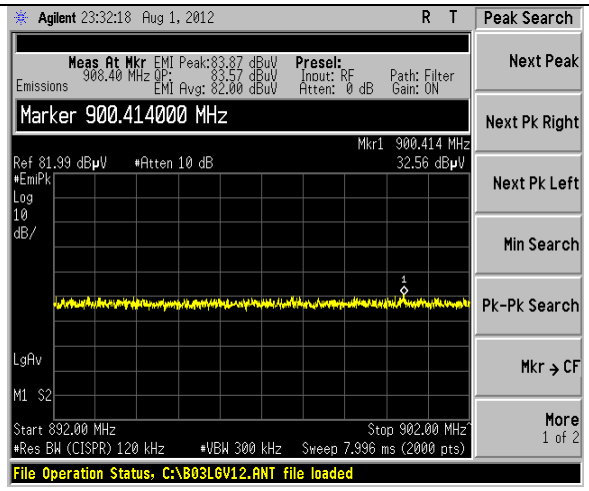


# EXHIBIT 8. BAND-EDGE MEASUREMENTS

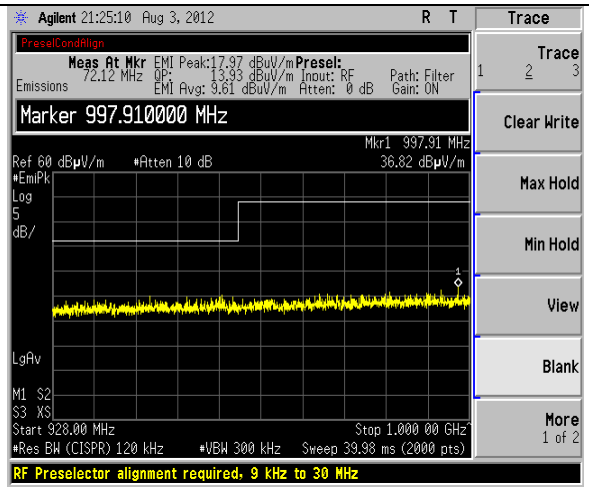
## 8.1 Method of Measurements

FCC 15.249(d) require a measurement of spurious emission levels to be at least 20 dB lower than the fundamental emission level, in particular at the Band-Edges where the intentional radiator operates. Also, RSS 210 Section 2.2 requires that unwanted emissions meet limits listed in tables 2 and 3 of the same standard and also to the limits in the applicable annex. The following screen captures demonstrate compliance of the intentional radiator at the 902-928 MHz Band-Edges. The EUT was operated in continuous transmit mode with continuous modulation, with internally generated data as the modulating source. The EUT was operated at the lowest channel for the investigation of the lower Band-Edge, and at the highest channel for the investigation of the higher Band-Edge.

Screen Capture Demonstrating Compliance at the **Band-Edges**




**Lower band edge**




**Upper band edge**

# APPENDIX A

## EQUIPMENT LIST

**LS RESEARCH LLC**
Wireless Product Development
**Equipment Calibration**

Date : 1-Aug-2012 Type Test : Radiated Output power Job # : C-1463

Prepared By: Peter Customer : Ingersoll Rand Quote #: 312105

| No. | Asset # | Description | Manufacturer | Model # | Serial # | Cal Date | Cal Due Date | Equipment Status |
|---|---|---|---|---|---|---|---|---|
| 1 | EE 960158 | RF Preselecter | Agilent | N9039A | MY46520110 | 6/29/2012 | 6/29/2013 | Active Calibration |
| 2 | EE 960157 | 100kHz-1GHz Analog Signal Generator | Agilent | N5181A | MY49060062 | 6/30/2012 | 6/30/2013 | Active Calibration |
| 3 | EE 960156 | 100kHz-1GHz Analog Signal Generator | Agilent | N5181A | MY49060062 | 6/30/2012 | 6/30/2013 | Active Calibration |
| 4 | AA 960078 | Log Periodic Antenna | EMCO | 93146 | 9701-4855 | 11/15/2011 | 11/15/2012 | Active Calibration |

Project Engineer: Peter Fiebig Quality Assurance:

**LS RESEARCH LLC**
Wireless Product Development
**Equipment Calibration**

Date : 1-Aug-2012 Type Test : Radiated Spurious Emissions Job # : C-1463

Prepared By: Peter Customer : Ingersoll Rand Quote #: 312105

| No. | Asset # | Description | Manufacturer | Model # | Serial # | Cal Date | Cal Due Date | Equipment Status |
|---|---|---|---|---|---|---|---|---|
| 1 | EE 960156 | 100kHz-1GHz Analog Signal Generator | Agilent | N5181A | MY49060062 | 6/30/2012 | 6/30/2013 | Active Calibration |
| 2 | EE 960157 | 3Hz-13.2GHz Spectrum Analyzer | Agilent | E4445A | MY48250225 | 6/29/2012 | 6/29/2013 | Active Calibration |
| 3 | EE 960158 | RF Preselecter | Agilent | N9039A | MY46520110 | 6/29/2012 | 6/29/2013 | Active Calibration |
| 4 | AA 960005 | Biconical Antenna | EMCO | 93110B | 9601-2280 | 6/26/2012 | 6/26/2013 | Active Calibration |
| 5 | AA 960078 | Log Periodic Antenna | EMCO | 93146 | 9701-4855 | 11/15/2011 | 11/15/2012 | Active Calibration |
| 6 | AA 960155 | 900MHz High Pass Filter | KWM | HPF-L-14185 | 7272-03 | 3/5/2012 | 3/5/2013 | Active Calibration |
| 7 | AA 960081 | Double Ridge Horn Antenna | EMCO | 3115 | 6907 | 1/6/2012 | 1/6/2013 | Active Calibration |
| 8 | EE 960147 | Pre-Amp | Adv. Micro | WLA612 | 123101 | 1/6/2012 | 1/6/2013 | Active Calibration |
| 9 | AA 960007 | Double Ridge Horn Antenna | EMCO | 3115 | 9311-4138 | 5/16/2012 | 5/16/2013 | Active Calibration |
| 10 | EE 960160 | 0.8-21GHz LNA | Mini-Circuits | ZVA-213X-S+ | 977711030 | 5/16/2012 | 5/16/2013 | Active Calibration |

Project Engineer: Peter Fiebig Quality Assurance:

**LS RESEARCH LLC**
Wireless Product Development
**Equipment Calibration**

Date : 1-Aug-2012 Type Test : Occupied Bandwidth (6dB & 20dB) Job # : C-1463

Prepared By: Peter Customer : Ingersoll Rand Quote #: 312105

| No. | Asset # | Description | Manufacturer | Model # | Serial # | Cal Date | Cal Due Date | Equipment Status |
|---|---|---|---|---|---|---|---|---|
| 1 | AA 960078 | Log Periodic Antenna | EMCO | 93146 | 9701-4855 | 11/15/2011 | 11/15/2012 | Active Calibration |
| 2 | EE 960156 | 100kHz-1GHz Analog Signal Generator | Agilent | N5181A | MY49060062 | 6/30/2012 | 6/30/2013 | Active Calibration |
| 3 | EE 960157 | 3Hz-13.2GHz Spectrum Analyzer | Agilent | E4445A | MY48250225 | 6/29/2012 | 6/29/2013 | Active Calibration |
| 4 | EE 960158 | RF Preselecter | Agilent | N9039A | MY46520110 | 6/29/2012 | 6/29/2013 | Active Calibration |

Project Engineer: Peter Fiebig Quality Assurance:

# APPENDIX B
# TEST STANDARDS – CURRENT PUBLICATION DATES RADIO

| STANDARD # | DATE | Am. 1 | Am. 2 |
|---|---|---|---|
| ANSI C63.4 | 2003 | | |
| RSS GEN | 2007-06 | | |
| RSS 210 | 2007-06 | | |
| FCC 47 CFR, Parts 0-15, 18, 90, 95 | 2009 | | |

# 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 | 4.82 dB |
| Radiated Emissions | 3-Meter Chamber, Log Periodic Antenna | 4.88 dB |
| Radiated Emissions | 3-Meter Chamber, Horn Antenna | 4.85 dB |
| Radiated Emissions | 10-Meter OATS, Biconical Antenna | 4.32 dB |
| Radiated Emissions | 10-Meter OATS, Log Periodic Antenna | 3.63 dB |
| Absolute Conducted Emissions | Agilent PSA/ESA Series | 1.38 dB |
| AC Line Conducted Emissions | Shielded Room/EMCO LISN | 3.20 dB |
| Radiated Immunity | 3 Volts/Meter in 3-Meter Chamber | 2.05 Volts/Meter |
| Conducted Immunity | 3 Volts level | 2.33 V |
| EFT Burst, Surge, VDI | 230 VAC | 54.4 V |
| ESD Immunity | Discharge at 15kV | 3200 V |
| Temperature/Humidity | Thermo-hygrometer | 0.64° / 2.88 %RH |