

**LS Research, LLC**  
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**ENGINEERING TEST REPORT # 308147 TX TCB v5**  
**LSR Job #: C-333**

**Compliance Testing of:**  
Remote User Interface (RUI)  
Model # REM5000R1001

**Test Date(s):**

April 30-May 13, 2008

**Prepared For:**  
Honeywell International  
1985 Douglas Drive North  
Golden Valley, MN 55422-3992

**In accordance with:**  
**Federal Communications Commission (FCC)**  
**Part 15, Subpart C, Section 15.247 FHSS TX**  
**Frequency Hopping Spread Spectrum Operating in the**  
**Frequency Band 902 MHz – 928 MHz**

**This Test Report is issued under the Authority of:**

Kenneth L. Boston, Sr. EMC Engineer



Signature:

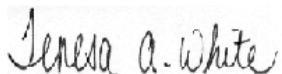
Date: August 14, 2008

**Test Report Reviewed by:**

Teresa A. White, Quality Manager

**Tested by:**

Laura Bott EMC Engineer



Signature:

Date: August 14, 2008



Signature:

Date: August 14, 2008

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## 1.1 SCOPE

<b>References:</b>	FCC Part 15, Subpart C, Section 15.247
<b>Title:</b>	Telecommunication – Code of Federal Regulations, CFR 47, Part 15
<b>Purpose of Test:</b>	To gain FCC Certification Authorization for Digital Modulation Transmitters operating in the Frequency Band of 902 MHz – 928 MHz
<b>Test Procedures:</b>	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.
<b>Environmental Classification:</b>	<ul style="list-style-type: none"><li>• Commercial, Industrial or Business</li><li>• Residential</li></ul>

## 1.2 NORMATIVE REFERENCES

<b>Publication</b>	<b>Year</b>	<b>Title</b>
47 CFR, Parts 0-15 (FCC)	2007	Code of Federal Regulations - Telecommunications
ANSI C63.4	2003	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
CISPR 16-1-1	2006 A2: 2007	Specification for radio disturbance and immunity measuring apparatus and methods. Part 1-1: Measuring Apparatus.
CISPR 16-2-1	2003	Specification for radio disturbance and immunity measuring apparatus and methods. Part 201: Conducted disturbance measurement.
FCC Public Notice DA 00-1407	2000	Part 15 Unlicensed Modular Transmitter Approval
FCC ET Docket No. 99-231	2002	Amendment to FCC Part 15 of the Commission's Rules Regarding Spread Spectrum Devices.

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### **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](http://www.lsr.com). Accreditation status can be verified at A2LA's web site: [www.a2la2.net](http://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.

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## EXHIBIT 2. PERFORMANCE ASSESSMENT

### 2.1 CLIENT INFORMATION

<b>Manufacturer Name:</b>	Honeywell
<b>Address:</b>	1985 Douglas Drive North Golden Valley, MN 55422-3992
<b>Contact Person:</b>	Robert D Juntunen
<b>Contact Phone:</b>	763.954.4839
<b>Contact Email:</b>	robert.d.juntunen@honeywell.com

### 2.2 EQUIPMENT UNDER TEST (EUT) INFORMATION

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

<b>Product Name:</b>	Remote User Interface
<b>Model Number:</b>	REM5000R1001
<b>Serial Number:</b>	974901500000196

### 2.3 ASSOCIATED ANTENNA DESCRIPTION

The Remote User Interface is a PCB strip antenna combined with a two element raised bar element. The gain, 5.14 dBi, is derived from calculations based off measurements taken from the fundamental frequency in a fully anechoic environment.

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## 2.4 EUT'S TECHNICAL SPECIFICATIONS

### Additional Information:

Frequency Range (in MHz)	902-928 MHz	
RF Power in Watts	0.0099 Watts (at 926 MHz)	
Conducted Output Power (in dBm)	9.97 dBm (at 926 MHz)	
Operating Voltage	4.5 VDC	
Field Strength (and at what distance)	115.0 dB $\mu$ V/m at 3 meters (at 903 MHz)	
Occupied Bandwidth (99% BW)	130 kHz	
Type of Modulation	FSK	
Emission Designator	F1D130k	
EIRP (in mW)	32.43 mW	
Transmitter Spurious (worst case)	63.36 dB $\mu$ V/m at 1 meter (at 9260 MHz)	
Frequency Tolerance %, Hz, ppm	n/a	
Microprocessor Model # (if applicable)	MSP 430 F2370	
Antenna Information		
Detachable/non-detachable	Non-detachable	
Type	strip	
Gain (in dBi)	5.14 dBi	
EUT will be operated under FCC Rule Part(s)	47 CFR 15.247 and 15.207 IC: RSS-GEN, 2007 and RSS-210, Issue 7, 2007	
Portable/Mobile	<input type="checkbox"/>	Portable <input checked="" type="checkbox"/> Mobile
Table-Top	<input type="checkbox"/>	Yes <input checked="" type="checkbox"/> No
Modular Filing	<input type="checkbox"/>	Yes <input checked="" type="checkbox"/> No

### 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, IC Safety Code 6
- Measurement Distance: 3 m
- RF Value: 0.06248  V/m  A/m  W/m<sup>2</sup>  
 Measured  Computed  Calculated

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## 2.5 PRODUCT DESCRIPTION

The REM5000R1001 is a battery powered, two-way RF device. The circuit card contains a partitioned radio block.

The board also contains two microcontrollers, power supply circuitry, basic sensor conditioning circuitry, LCD, and a touch screen interface.

At the core of the radio block is an integrated transceiver, CC1101 manufactured by Texas Instruments. This radio is digitally controlled relative to its mode of operation through the SPI port. The part is configured by the microcontroller to operate at frequencies as determined by a frequency-sequencing algorithm. The bandwidth, transmit power, and modulation rate and type are set identically for the all of the 50 frequencies utilized by this system. Channel spacing is defined at a minimum of 400 kHz. All frequencies are generated by the CC1101 via integral frequency synthesizer which is clocked by the 26MHz crystal, Xtal.

## PHOTO



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### **EXHIBIT 3. EUT OPERATING CONDITIONS & CONFIGURATIONS DURING TESTING**

#### **3.1 CLIMATE TEST CONDITIONS**

<b>Temperature:</b>	20-25°C
<b>Humidity:</b>	30-60%
<b>Pressure:</b>	86-106 kPa

#### **3.2 APPLICABILITY & SUMMARY OF EMC EMISSION TEST RESULTS**

<b>FCC Paragraph</b>	<b>Test Requirements</b>	<b>Compliance (yes/no)</b>
15.207	Power Line Conducted Emissions Measurements	Yes
15.247(a)(1)	Bandwidth of an FHSS System	Yes
15.247(b) & 1.1310	Maximum Output Power	Yes
15.247(i), 1.1307, 1.1310, 2.1091 & 2.1093	RF Exposure Limit	Yes
15.247(d)	RF Spurious Emissions	Yes
15.247(b), 15.209 & 15.205	Transmitter Radiated Emissions	Yes
<i>The transmit circuit portion of the EUT has been tested and verified to comply with FCC Part 15, Subpart C, and the associated Radio Receiver and digital circuitry has also been tested and found to comply with Part 15, Subpart B – Radio Receivers. The Receiver Test Report is available upon request.</i>		

#### **3.3 MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES**

None       Yes (explain below)

An RF shield is necessary to meet compliance limits, as one was used on the unit whose data is presented in this report.

#### **3.4 DEVIATIONS & EXCLUSIONS FROM TEST SPECIFICATIONS**

None       Yes (explain below)

The antenna gain and EIRP calculations were derived from a fundamental measurement taken on channel 1 in a fully anechoic chamber, so the ground plane reflections would not affect the measured field strength. This E-field was measured as 110.2 dB $\mu$ V/m.

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### **3.5 TEST SPECIFICATIONS AND RELATED DOCUMENTS**

<b>Document</b>	<b>Date</b>	<b>Title</b>
FCC CFR Title 47	2007	Code of Federal Regulations Title 47, Chapter 1, Federal Communications Commission, Part 15-Radio Frequency Device
ANSI C63.4	2003	Methods of Measurement of Radio Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
IC RSS-210 Issue 7	2007	Low Power License-Exempt Radio Communication Devices (All Frequency Bands)
IC RSS-212 Issue 1		Test Methods for Radio Equipment
RSS-GEN	2007	General Requirements and Information for the Certification of Radio Communication Equipment

The test procedures used are in accordance with ANSI document C63.4-2003, "Methods of Measurement of Radio Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz". The specific procedures are described herein. Radiated testing was performed at an antenna to EUT distance of 3 meters. The antenna was raised and lowered from 1 to 4 meters.

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## 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), Annex 8 (section 8.1) for a Frequency Hopping Spread Spectrum (FHSS)Transmitter.

*If some emissions are seen to be within 3 dB of their respective limits:*

As these levels are within the tolerances of the test equipment and site employed, there is a possibility that this unit, or a similar unit selected out of production may not meet the required limit specification if tested by another agency.

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

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## EXHIBIT 5. RADIATED EMISSIONS TEST

### 5.1 Test Setup

The test setup was assembled in accordance with Title 47, CFR FCC Part 15 and ANSI C63.4-2003. The EUT was placed on an 80cm high non-conductive pedestal, centered on a flush mounted 2-meter diameter turntable inside a 3 meter Semi-Anechoic, FCC listed Chamber, where the measurement antenna is 3 meters from the EUT radiating element.

The EUT was tested in continuous modulated transmit mode. Power was supplied to the EUT by two "AA" batteries. The unit has the capability to operate on 3 channels, controllable via a button on the unit.

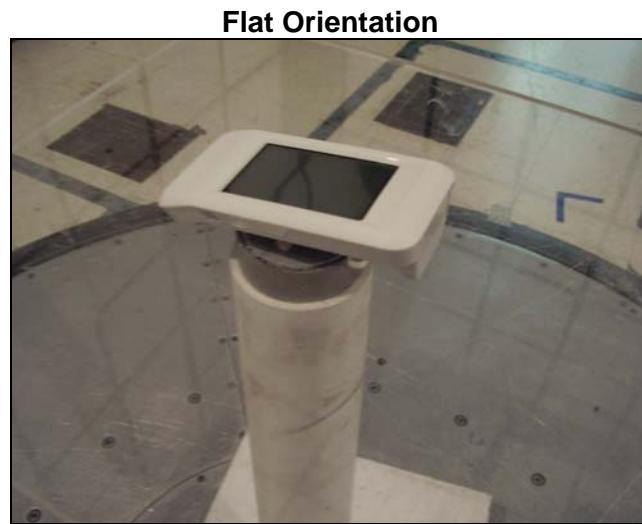
The radiated emissions limits for unintentional radiators, denoted in FCC §15.109 apply at a 3 meter distance. Measurements above 5 GHz were performed at a 1.0 meter separation distance. The calculations to determine these limits are detailed in the following pages. Please refer to Appendix A for a complete list of test equipment. The test sample was operated on one of three (3) standard channels: low (903 MHz), middle (914 MHz) and high (926 MHz) to comply with FCC § 15.35.

### 5.2 Test Setup Photo(s) – Radiated Emissions Test

Vertical Orientation



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### **5.3 Test Procedure**

Radiated Emissions measurements were performed on the EUT from 30 - 1000 MHz in a 3 meter Semi-Anechoic, FCC listed Chamber. The radiated RF emission levels were manually noted at discrete turntable azimuths and measurement antenna heights, corresponding to peak emission levels at various frequencies. A Biconical Antenna was used to measure emissions from 30 MHz to 300 MHz, and a Log Periodic Antenna was used to measure emissions from 300 MHz to 1000 MHz. A Double-Ridged Waveguide Horn Antenna was used from 1 GHz to 10 GHz. The maximum radiated RF emissions were found by rotating the EUT 360°, and raising and lowering the antenna between 1 and 4 meters, using both horizontal and vertical antenna polarities.

The battery voltage was checked frequently, and the batteries were replaced as necessary.

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

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#### **5.4 Test Equipment Utilized**

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

<b>Test Equipment</b>	<b>Manufacturer</b>	<b>Model No.</b>	<b>Serial No.</b>
EMI Receiver	HP	8546A	3617A00320
EMI Receiver Pre-Select.	HP	85460A	3448A00296
Spectrum Analyzer	Agilent	E4446A	US45300564
Spectrum Analyzer	HP	E4407B	US39160256
Log Periodic Antenna	EMCO	93146	9701-4855
Horn Antenna	EMCO	3115	6907
Bicon Antenna	EMCO	93110B	9702-2918
Pre-Amp (5-18 GHz)	Adv. Microwave	WLA612	0123101
Pre-Amp (18-25 GHz)	Adv. Microwave	WLA622-4	0123001
Horn Antenna – Std. Gain	EMCO	3160-09	9809-1120

#### **5.5 Test Results**

The EUT was found to meet the Radiated Emissions requirements of Title 47 CFR, FCC Part 15.247 for an FHSS transmitter [Canada RSS-210, Issue 7 (2007), Annex 8 (section 8.1). The frequencies with significant RF signal strength were recorded and plotted as shown in the Data Charts and Graphs.

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## **5.6 CALCULATION OF RADIATED EMISSIONS LIMITS**

The maximum peak output power of an intentional radiator in the 902-928 MHz band, as specified in Title 47 CFR 15.247 (b)(1), is 1 Watt. The harmonic and spurious RF emissions, as measured in any 100 kHz bandwidth, as specified in 15.247 (d), 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).

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.

Frequency (MHz)	3 m Limit $\mu$ V/m	3 m Limit (dB $\mu$ V/m)	1 m Limit (dB $\mu$ V/m)
30-88	100	40.0	-
88-216	150	43.5	-
216-960	200	46.0	-
960-24,000	500	54.0	63.5

Sample conversion from field strength  $\mu$ V/m to dB $\mu$ V/m:

$$\begin{aligned} \text{dB}\mu\text{V/m} &= 20 \log_{10} (100) \\ &= 40 \text{ dB}\mu\text{V/m} \text{ (from 30-88 MHz)} \end{aligned}$$

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

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

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## 5.7

**RADIATED EMISSIONS TEST DATA CHART**

3 Meter Measurements of Electromagnetic Radiated Emissions

Test Standard: 47 CFR, Part 15.205 and 15.247(FHSS)

Frequency Range Inspected: 30 MHz to 1000 MHz

Manufacturer:	Honeywell International				
Date(s) of Test:	April 30-May 13, 2008				
Test Engineer(s):	Laura Bott				
Voltage:	4.5 VDC				
Operation Mode:	Normal, continuous transmit, C.W. Mode				
Environmental Conditions in the Lab:	Temperature: 20 – 25 °C Relative Humidity: 30 – 60 %				
EUT Power:		Single Phase <u>      </u> VDC		3 Phase <u>      </u> VDC	
	√	Battery		Other:	
EUT Placement:	√	80cm non-conductive table		10cm Spacers	
EUT Test Location:	√	3 Meter Semi-Anechoic FCC Listed Chamber		3/10m OATS	
Measurements:		Pre-Compliance		Preliminary	√ Final
Detectors Used:	√	Peak	√	Quasi-Peak	√ Average

Note: There were no significant spurious radiated RF Emissions found below the fundamental frequency.

The following table depicts the level of RF fundamental emissions seen on Channels 1, 25, and 50 respectively:

Frequency (MHz)	Height (m)	Azimuth (degree)	Avg Reading (dB $\mu$ V/m)	Avg Limit (dB $\mu$ V/m)	Margin (dB)	Antenna Polarity	EUT orientation
903	1	77	115.00	125	10	Horizontal	Flat
915	1	82	114.60	125	10.4	Horizontal	Flat
926	1	94	113.80	125	11.2	Horizontal	Flat

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## RADIATED EMISSIONS DATA CHART (continued)

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

Frequency (MHz)	Height (m)	Azimuth (degree)	Avg Reading (dB $\mu$ V/m)	Avg Limit (dB $\mu$ V/m)	Margin (dB)	Antenna Polarity	EUT orientation
1806	1.15	0	44.25	95	50.75	Horizontal	Flat
2709	1	0	44.84 <sup>*Note 2</sup>	54	9.16	Vertical	Vertical
3612	1	0	48.6 <sup>*Note 2</sup>	54	5.4	Horizontal	Flat
4515	1	0	50.84 <sup>*Note 2</sup>	63.5	12.66	Vertical	Flat
5418	1.02	227	53.08	63.5	10.42	Horizontal	Vertical
6321	1	139	50.24	105	54.76	Horizontal	Vertical
7224	1.21	96	56.78	105	48.22	Vertical	Vertical
8127	1	0	49.95 <sup>*Note 2</sup>	63.5	13.55	Vertical	Side
9030	1	207	55.75	63.5	7.75	Vertical	Side

The following table depicts the level of significant radiated RF fundamental and harmonic emissions seen on Channel 25:

Frequency (MHz)	Height (m)	Azimuth (degree)	Avg Reading (dB $\mu$ V/m)	Avg Limit (dB $\mu$ V/m)	Margin (dB)	Antenna Polarity	EUT orientation
1830	1	279	43.22	94.6	51.38	Vertical	Side
2745	1	0	45.05 <sup>*Note 2</sup>	54	8.95	Vertical	Flat
3660	1	0	48.79 <sup>*Note 2</sup>	54	5.21	Vertical	Vertical
4575	1	0	46.86 <sup>*Note 2</sup>	63.5	16.64	Horizontal	Vertical
5490	1	0	49.51	104.6	55.09	Vertical	Flat
6405	1	146	55.88	104.6	48.72	Horizontal	Vertical
7320	1.24	86	59.03	63.5	4.47	Vertical	Vertical
8235	1	0	50.53 <sup>*Note 2</sup>	63.5	12.97	Horizontal	Vertical
9150	1.11	86	59.61	63.5	3.89	Vertical	Vertical

The following table depicts the level of significant radiated RF fundamental and harmonic emissions seen on Channel 50:

Frequency (MHz)	Height (m)	Azimuth (degree)	Avg Reading (dB $\mu$ V/m)	Avg Limit (dB $\mu$ V/m)	Margin (dB)	Antenna Polarity	EUT orientation
1852	1.52	180	43.42	93.8	50.38	Horizontal	Flat
2778	1	0	45.21 <sup>*Note 2</sup>	54	8.79	Vertical	Side
3704	1	0	48.1 <sup>*Note 2</sup>	54	5.9	Vertical	Flat
4630	1	0	46.79 <sup>*Note 2</sup>	63.5	16.71	Vertical	Flat
5556	1	309	51.22	103.8	52.58	Horizontal	Vertical
6482	1	0	49.2	103.8	54.6	Horizontal	Vertical
7408	1.16	90	60.28	63.5	3.22	Vertical	Vertical
8334	1	0	49.54 <sup>*Note 2</sup>	63.5	13.96	Horizontal	Flat
9260	1.18	90	63.36	103.8	40.44	Vertical	Vertical

A Quasi-Peak Detector was used in measurements below 1 GHz, and a Peak as well as an Average Detector was used in measurements above 1 GHz. Only the results from the Average detector are published in the table above.

The peak detector was used to ensure the peak emissions did not exceed 20 dB above the limits.

- 1) Measurements above 5 GHz were made at 1 meters of separation from the EUT
- 2) Measurement at receiver system noise floor.

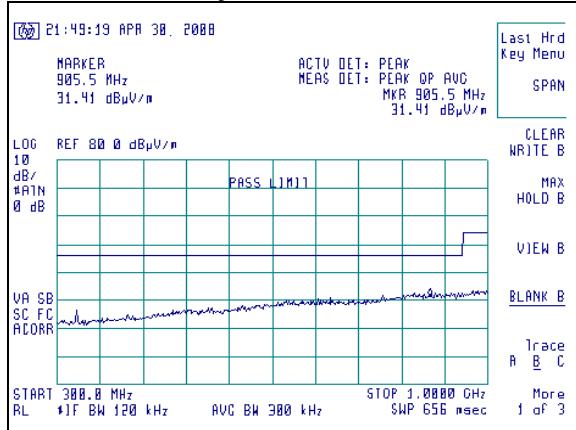
Prepared For: Honeywell	Model #: REM5000R1001	Prepared by: LS Research, LLC
EUT: Remote User Interface	IC#: 573R-REM5000R01	Template: 15.247 FHSS 900 TX (V2 8-17-06)
Report #: 308147 TX	FCC ID #: HS9-REM5000R01	Page 17 of 35

## 5.8 Screen Captures - Radiated Emissions Testing

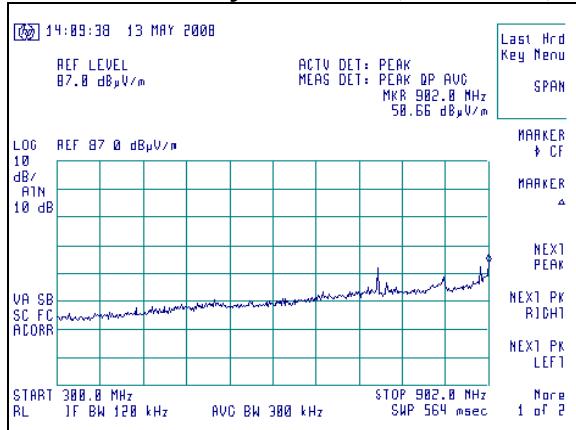
These screen captures represent Peak emissions. For radiated emission measurements, a Quasi-Peak detector function is utilized when measuring frequencies below 1 GHz, and an Average detector function is utilized when measuring frequencies above 1 GHz.

The signature scans shown here are from worst-case emissions, as measured on channels 1, 25, or 50, with the sense antenna both in vertical and horizontal polarity.

### Channel 25, Antenna Vertically Polarized, EUT Flat, 30-300 MHz, at 3m



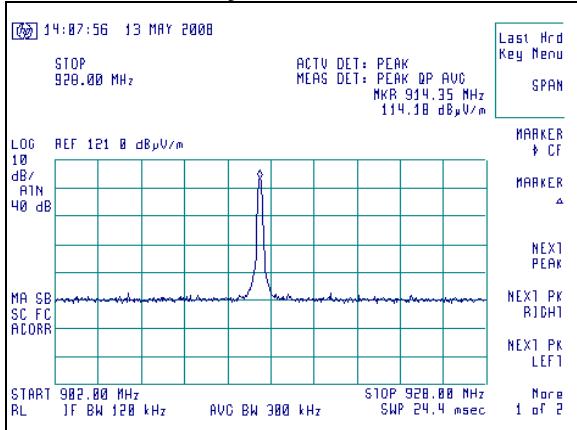
### Channel 25, Antenna Horizontally Polarized, EUT Flat, 300-902 MHz, at 3m



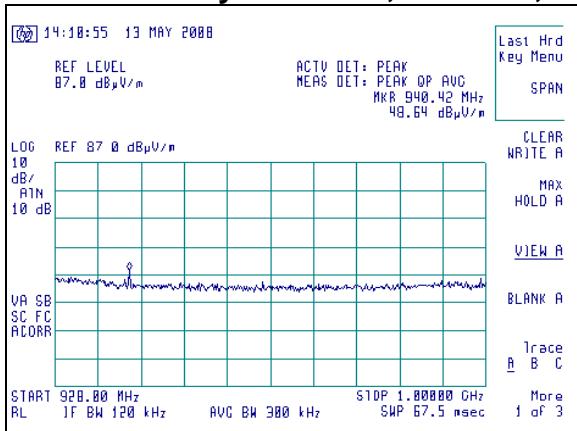
Prepared For: Honeywell	Model #: REM5000R1001	Prepared by: LS Research, LLC
EUT: Remote User Interface	IC#: 573R-REM5000R01	Template: 15.247 FHSS 900 TX (V2 8-17-06)
Report #: 308147 TX	FCC ID #: HS9-REM5000R01	Page 18 of 35

## Screen Captures - Radiated Emissions Testing (continued)

### Channel 25, Antenna Horizontally Polarized, EUT Flat, 902-928 MHz, at 3m



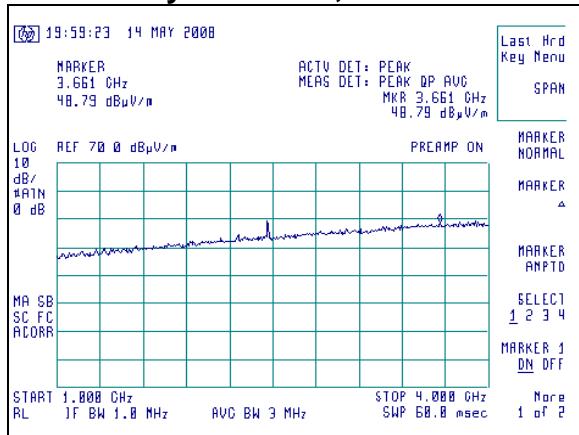
### Channel 25, Antenna Horizontally Polarized, EUT Flat, 928-1000 MHz, at 3m



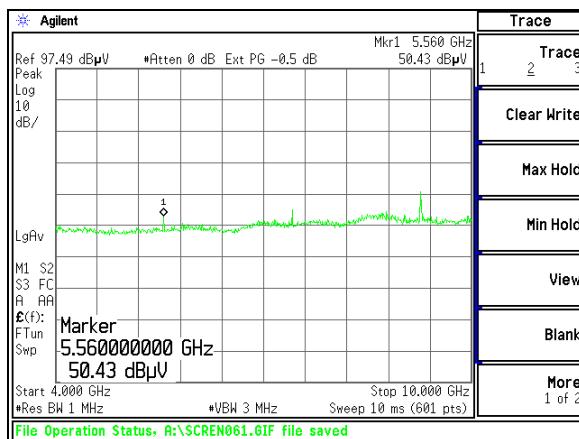
Prepared For: Honeywell	Model #: REM5000R1001	Prepared by: LS Research, LLC
EUT: Remote User Interface	IC#: 573R-REM5000R01	Template: 15.247 FHSS 900 TX (V2 8-17-06)
Report #: 308147 TX	FCC ID #: HS9-REM5000R01	Page 19 of 35

## Screen Captures - Radiated Emissions Testing (continued)

### Channel 25, Antenna Vertically Polarized, EUT Vertical 1000-4000 MHz, at 3m



### Channel 26, Antenna Horizontally Polarized, EUT on Side, 4000-10000 MHz, at 1m



Prepared For: Honeywell	Model #: REM5000R1001	Prepared by: LS Research, LLC
EUT: Remote User Interface	IC#: 573R-REM5000R01	Template: 15.247 FHSS 900 TX (V2 8-17-06)
Report #: 308147 TX	FCC ID #: HS9-REM5000R01	Page 20 of 35

## EXHIBIT 6. OCCUPIED BANDWIDTH: 15.247(a)(1)

### 6.1 Limits

For a Frequency Hopping Spread Spectrum, the -20 dBc bandwidth shall be at most 250 kHz.

### 6.2 Method of Measurements

Refer to ANSI C63.4 (2003) and FCC Procedures (2007) for FHSS Systems operating under 15.247.

The bandwidth requirement found in FCC Part 15.247(a)(1)(i) requires a maximum -20dBc occupied bandwidth of 500 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 the HP E4446A spectrum analyzer. The loss from the cable was accounted for with a correction factor file, which was loaded onto the analyzer. A Hewlett Packard model E4407B spectrum analyzer was used with the resolution bandwidth set to 30 kHz for this portion of the tests. The EUT was configured to run in a continuous modulated transmit mode. The spectrum analyzer was used in peak-hold mode while measurements were made, as presented in the chart below.

### 6.3 Test Data

Channel	Center Frequency (MHz)	Measured -6 dBc Occupied Bandwidth (kHz)	Measured -20 dBc Occupied Bandwidth (kHz)	Maximum -20 dBc Occupied Bandwidth Limit (kHz)
1	902.9	86	130	250
25	914.5	86	128	250
50	926.4	83	121.6	250

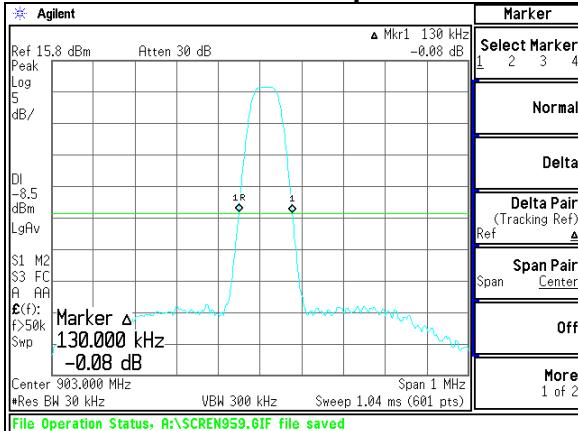
### 6.4 Test Equipment List

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

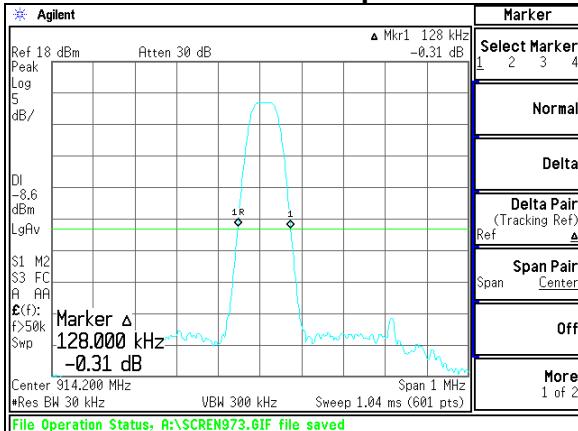
Prepared For: Honeywell	Model #: REM5000R1001	Prepared by: LS Research, LLC
EUT: Remote User Interface	IC#: 573R-REM5000R01	Template: 15.247 FHSS 900 TX (V2 8-17-06)
Report #: 308147 TX	FCC ID #: HS9-REM5000R01	Page 21 of 35

## 6.5 Screen Captures - OCCUPIED BANDWIDTH

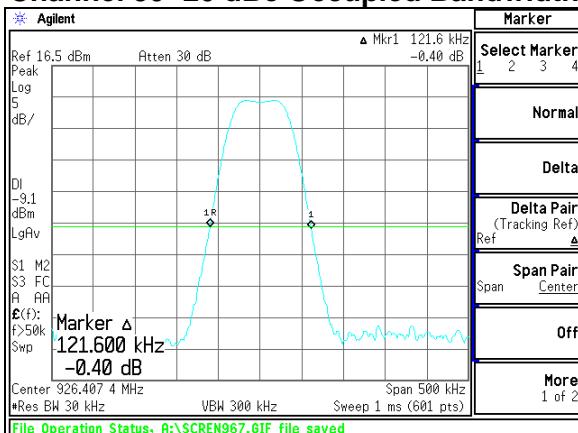
Channel 1 -20 dBc Occupied Bandwidth



Channel 25 -20 dBc Occupied Bandwidth



Channel 50 -20 dBc Occupied Bandwidth



Prepared For: Honeywell	Model #: REM5000R1001	Prepared by: LS Research, LLC
EUT: Remote User Interface	IC#: 573R-REM5000R01	Template: 15.247 FHSS 900 TX (V2 8-17-06)
Report #: 308147 TX	FCC ID #: HS9-REM5000R01	Page 22 of 35

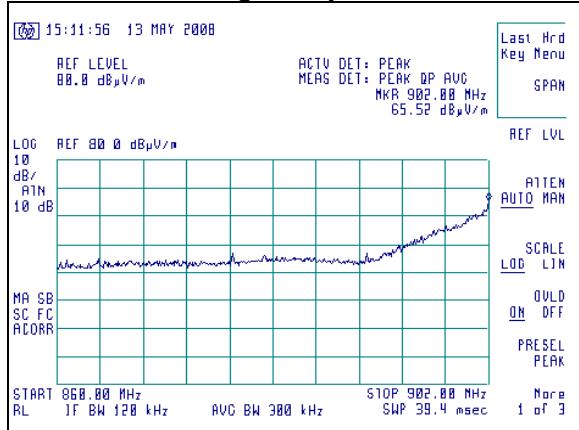
## EXHIBIT 7. BAND-EDGE MEASUREMENTS

### 7.1 Method of Measurements

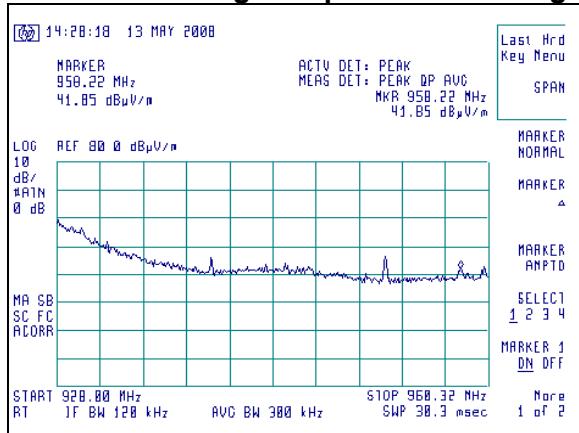
FCC 15.247(d) requires a measurement of spurious emission levels to be at least 20 dB lower than the fundamental emission level, in particular at the Band-Edges where the intentional radiator operates. The following screen captures demonstrate compliance of the intentional radiator at the 902-928 MHz 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.

*The Upper and Lower Band-Edge limit, in this case, would be  
-20 dBc with respect to the fundamental level.*

**Screen Capture Demonstrating Compliance at the Lower Band-Edge**



**Screen Capture Demonstrating Compliance at the Higher Band-Edge**



Prepared For: Honeywell	Model #: REM5000R1001	Prepared by: LS Research, LLC
EUT: Remote User Interface	IC#: 573R-REM5000R01	Template: 15.247 FHSS 900 TX (V2 8-17-06)
Report #: 308147 TX	FCC ID #: HS9-REM5000R01	Page 23 of 35

## **EXHIBIT 8. POWER OUTPUT (CONDUCTED): 15.247(b)**

### **8.1 Method of Measurements**

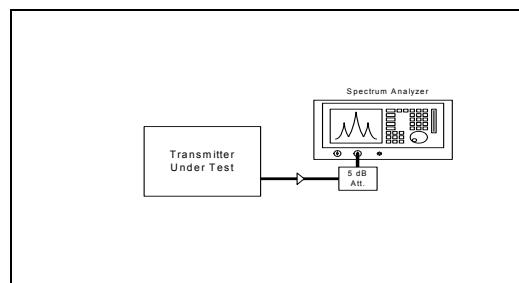
The conducted RF output power of the EUT was measured at the antenna port using a short RF cable to connect the EUT to the spectrum analyzer. The loss from the cable was accounted for via a cal factor file which was loaded onto the spectrum analyzer. The unit was configured to run in a continuous transmit mode. Measurements from the peak detector are presented in the chart below.

### **8.2 Test Data**

Channel	Center Frequency (MHz)	Measured Power (dBm)	Limit (dBm)	Margin (dB)	Calculated EIRP (dBm)	EIRP Limit (dBm)	Calculated EIRP (mw)
1	902.9	9.83	30	20.17	14.97	36.0	31.41
25	914.5	9.56	30	20.44	14.7	36.0	29.51
50	926.4	9.97	30	20.03	15.11	36.0	32.43

<sup>(1)</sup> EIRP Calculation:

$$\text{EIRP} = (\text{Peak power at antenna terminal in dBm}) + (\text{EUT Antenna gain in dBi})$$



**Measured Radiated RF power output (in watts): 0.098 W**

**Measured Conducted RF Power Output (in Watts): 0.0099 W**

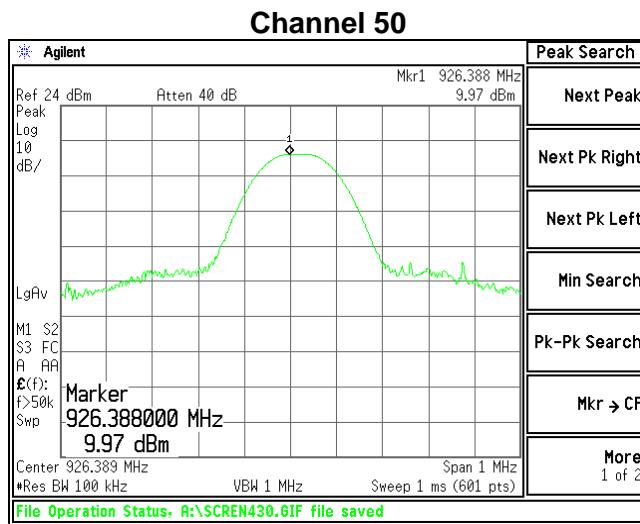
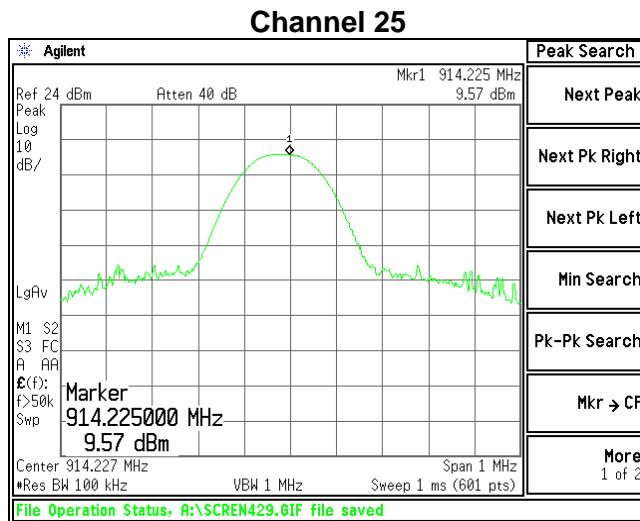
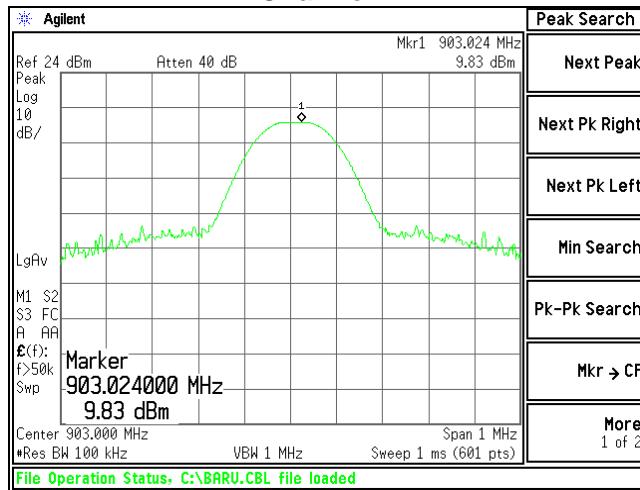
**Manufacturer Declared RF Power Output (in Watts): 0.010 Watts**

### **8.3 Test Equipment List**

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

Prepared For: Honeywell	Model #: REM5000R1001	Prepared by: LS Research, LLC
EUT: Remote User Interface	IC#: 573R-REM5000R01	Template: 15.247 FHSS 900 TX (V2 8-17-06)
Report #: 308147 TX	FCC ID #: HS9-REM5000R01	Page 24 of 35

## 8.4 Screen Captures – Power Output (Conducted)



Prepared For: Honeywell	Model #: REM5000R1001	Prepared by: LS Research, LLC
EUT: Remote User Interface	IC#: 573R-REM5000R01	Template: 15.247 FHSS 900 TX (V2 8-17-06)
Report #: 308147 TX	FCC ID #: HS9-REM5000R01	Page 25 of 35

## EXHIBIT 9. CHANNEL OCCUPANCY

Due to the nature of the transmission, testing to the standard was not possible. Below is an excerpt from the manufacturer's declaration which is in Appendix B.

*Each REM5000 has its own pseudorandom frequency sequence for transmitting and has knowledge of the central host hop sequence to receive information. The transmit sequences are derived from a 15 bit seed value chosen randomly and automatically at the time the thermostat is commissioned with a central host device, during installation. The characteristics of the pseudorandom frequency sequence are;*

- *Each possible random seed value results in a unique pseudorandom frequency sequence.*
- *Each of the 50 frequencies occurs in the sequence once and only once before the sequence repeats.*
- *There are no circumstances or special conditions that skip frequencies in the sequence.*
- *See table 1 for the frequency channel plan and table 2 for a representative hop sequence generated by the algorithm.*

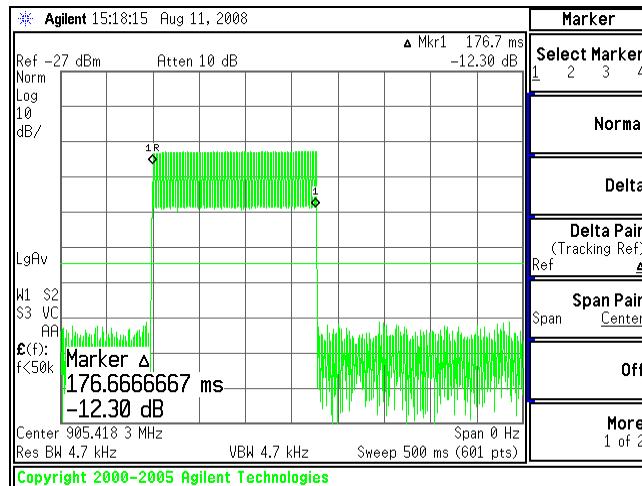
*(\*The customer sent additional information indicating that transmissions occur once every four minutes.)*

*Once chosen, the sequence does not change unless re-commissioned.*

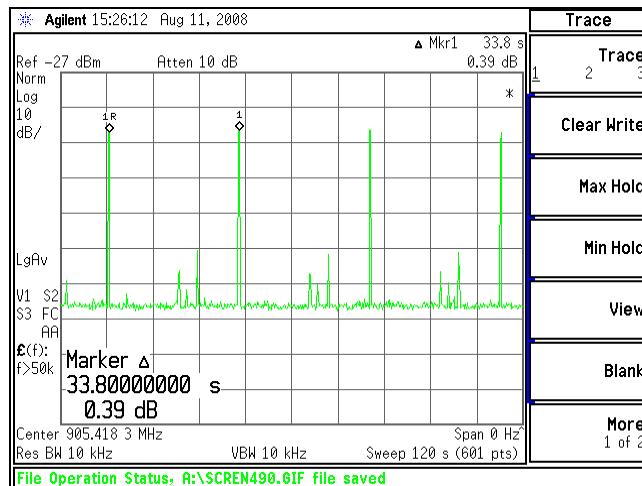
According to the customer, the unit was programmed to a condition where the packet size of the data transmission is the size it will be in the field; however, the test mode transmits more frequently than it will in practice. All the while, the test mode exhibits passing features whereas the time on each channel is less than 400 ms in a 20 second span.

Prepared For: Honeywell	Model #: REM5000R1001	Prepared by: LS Research, LLC
EUT: Remote User Interface	IC#: 573R-REM5000R01	Template: 15.247 FHSS 900 TX (V2 8-17-06)
Report #: 308147 TX	FCC ID #: HS9-REM5000R01	Page 26 of 35

The screen capture below shows the length of a single data packet transmission, which is 176.67 ms.



The following graph indicates that a single channel is not used more than once in a 20 second span



Prepared For: Honeywell	Model #: REM5000R1001	Prepared by: LS Research, LLC
EUT: Remote User Interface	IC#: 573R-REM5000R01	Template: 15.247 FHSS 900 TX (V2 8-17-06)
Report #: 308147 TX	FCC ID #: HS9-REM5000R01	Page 27 of 35

## EXHIBIT 10. SPURIOUS CONDUCTED 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.

For data from the radiated measurements, please refer to section 5.6 of this report.

FCC Part 15.247(d) requires a measurement of conducted harmonic and spurious RF emission levels, as reference to the carrier level when measured in a 100 kHz bandwidth. For this test, the spurious and harmonic RF emissions from the EUT were measured at the EUT antenna port using a short RF cable. The cable calibration file was loaded into the spectrum analyzer to compensate for the loss of the cable between the antenna port of the EUT to the spectrum analyzer. A Hewlett Packard model E4446A spectrum analyzer was used with the resolution bandwidth set to 100 kHz for this portion of the tests. The unit was configured to run in a continuous transmit mode. 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.

No significant emissions could be noted within -50 dBc of the fundamental level for this product.

	Channel 1	Channel 25	Channel 50
	Power in dBm		
<b>Fundamental</b>	11.24	11.23	11.01
<b>2<sup>nd</sup> Harmonic</b>	-49.89	-49.25	-49.9
<b>3<sup>rd</sup> Harmonic</b>	-55.47	Note 1	-56.65
<b>4<sup>th</sup> Harmonic</b>	Note 1	Note 1	Note 1
<b>5<sup>th</sup> Harmonic</b>	Note 1	Note 1	Note 1
<b>6<sup>th</sup> Harmonic</b>	Note 1	-76.08	-75.02
<b>7<sup>th</sup> Harmonic</b>	-64.56	-68.13	-70.22
<b>8<sup>th</sup> Harmonic</b>	-58.74	-60.54	-61.35
<b>9<sup>th</sup> Harmonic</b>	-63.45	-66.19	-71.75
<b>10<sup>th</sup> Harmonic</b>	-55.48	-55.31	-56.52

Notes:

(1) Measurement at system noise floor.

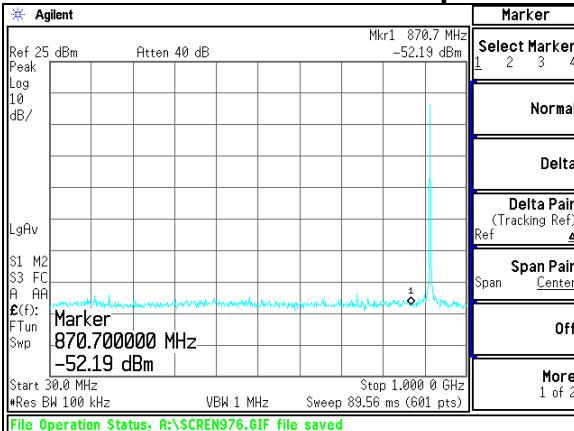
Prepared For: Honeywell	Model #: REM5000R1001	Prepared by: LS Research, LLC
EUT: Remote User Interface	IC#: 573R-REM5000R01	Template: 15.247 FHSS 900 TX (V2 8-17-06)
Report #: 308147 TX	FCC ID #: HS9-REM5000R01	Page 28 of 35

## 10.2 Test Equipment List

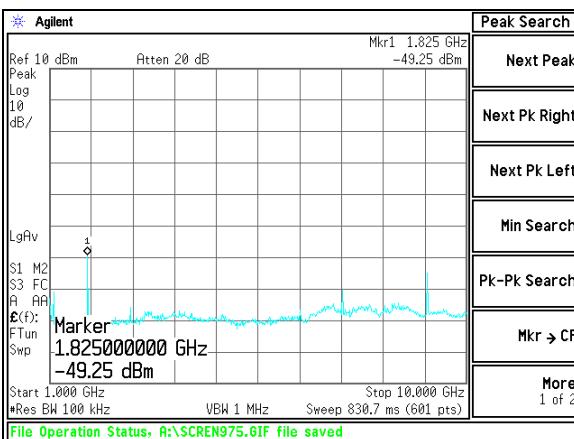
Test Equipment	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer	Agilent	E4446A	US45300564	To 44 GHz

## 10.3 Screen Captures – Spurious Emissions

Channel 25 shown from 30 MHz up to 1000 MHz



Channel 25 shown from 1000 MHz up to 10000 MHz



Prepared For: Honeywell	Model #: REM5000R1001	Prepared by: LS Research, LLC
EUT: Remote User Interface	IC#: 573R-REM5000R01	Template: 15.247 FHSS 900 TX (V2 8-17-06)
Report #: 308147 TX	FCC ID #: HS9-REM5000R01	Page 29 of 35

## EXHIBIT 11. CHANNEL PLAN AND SEPARATION

An HP E4446A 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 397 kHz and 400 kHz respectively. The maximum occupied bandwidth of the device, as reported in the previous section is 130 kHz. The following plots describe this spacing, and also establish the channel separation and plan.

### 11.1 Test Data

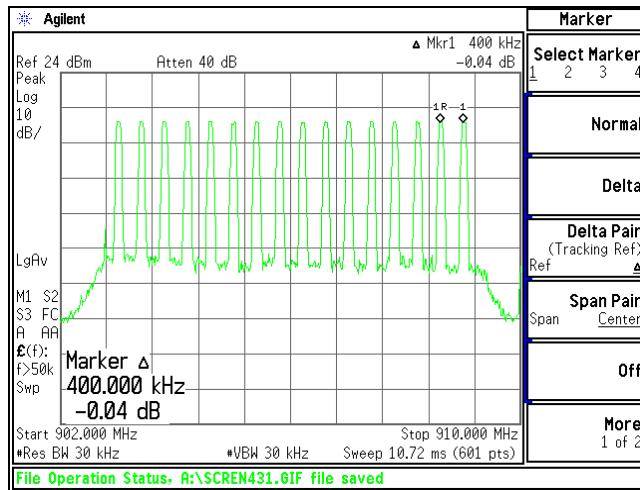
Frequency Span	Number of Channels	Minimum Separation (kHz)
902 – 910 MHz	16	400
910 – 915 MHz	10	400
915 – 922 MHz	17	397
922 – 928 MHz	7	400

The system meets the minimum requirement of utilizing the following channels, as well as maintaining a minimum channel separation of 397 kHz, which is greater than the -20 dBc occupied bandwidth BW of 130 kHz.

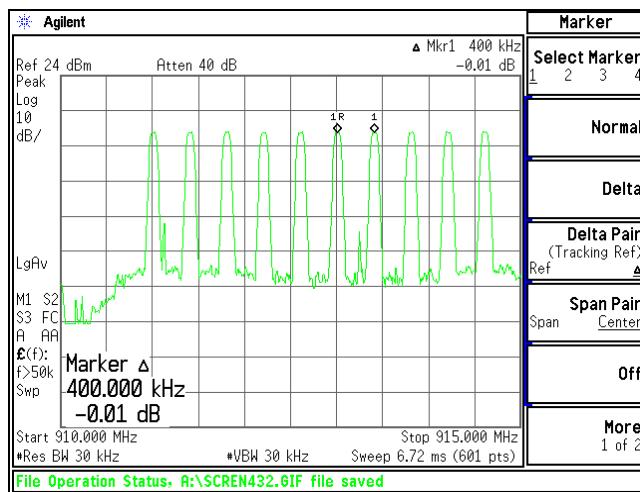
Prepared For: Honeywell	Model #: REM5000R1001	Prepared by: LS Research, LLC
EUT: Remote User Interface	IC#: 573R-REM5000R01	Template: 15.247 FHSS 900 TX (V2 8-17-06)
Report #: 308147 TX	FCC ID #: HS9-REM5000R01	Page 30 of 35

## 11.2 Screen Captures – Channel Separation

### Channels 01 through 16



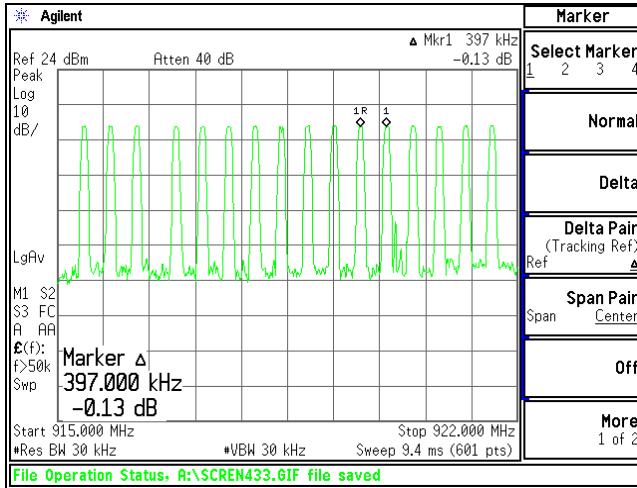
### Channels 17 through 26



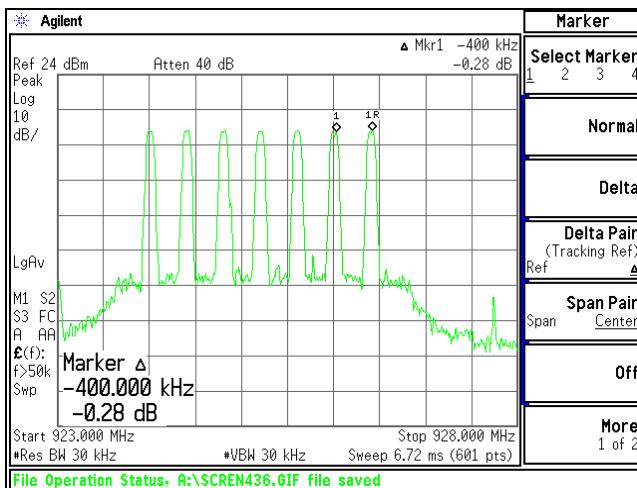
Prepared For: Honeywell	Model #: REM5000R1001	Prepared by: LS Research, LLC
EUT: Remote User Interface	IC#: 573R-REM5000R01	Template: 15.247 FHSS 900 TX (V2 8-17-06)
Report #: 308147 TX	FCC ID #: HS9-REM5000R01	Page 31 of 35

## Screen Captures – Channel Separation (continued)

### Channels 27 through 42



### Channels 43 through 50



Prepared For: Honeywell	Model #: REM5000R1001	Prepared by: LS Research, LLC
EUT: Remote User Interface	IC#: 573R-REM5000R01	Template: 15.247 FHSS 900 TX (V2 8-17-06)
Report #: 308147 TX	FCC ID #: HS9-REM5000R01	Page 32 of 35

## EXHIBIT 12. EQUAL CHANNEL USAGE

Due to the nature of the transmission, testing to the standard was not possible. Below is an excerpt from the manufacturer's declaration which is in Appendix B.

Table 2 (typical hop sequence)																Transmission #	Channel used
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
6	31	33	8	48	23	26	1	17	42	38	13	19	44	35	10		
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31		
9	34	37	12	0	25	3	28	16	41	24	49	18	43	45	20		
32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47		
21	46	30	5	7	32	47	22	29	4	40	15	14	39	27	2		
48	49	50															
11	36	repeat															

This sample hop sequence shows equal usage of all channels.

Prepared For: Honeywell	Model #: REM5000R1001	Prepared by: LS Research, LLC
EUT: Remote User Interface	IC#: 573R-REM5000R01	Template: 15.247 FHSS 900 TX (V2 8-17-06)
Report #: 308147 TX	FCC ID #: HS9-REM5000R01	Page 33 of 35

## EXHIBIT 13. PSEUDORANDOM HOPPING PATTERN

Due to the nature of the transmission, testing to the standard was not possible. Below is an excerpt from the manufacturer's declaration which is in Appendix B.

Table 2 (typical hop sequence)																Transmission #
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
6	31	33	8	48	23	26	1	17	42	38	13	19	44	35	10	Channel used
<hr/>																
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Transmission #
9	34	37	12	0	25	3	28	16	41	24	49	18	43	45	20	Channel used
<hr/>																
32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	Transmission #
21	46	30	5	7	32	47	22	29	4	40	15	14	39	27	2	Channel used
<hr/>																
48	49	50														Transmission #
11	36	repeat														Channel used
<hr/>																

This sample hop sequence shows usage of all channels and randomness of channel selections.

Prepared For: Honeywell	Model #: REM5000R1001	Prepared by: LS Research, LLC
EUT: Remote User Interface	IC#: 573R-REM5000R01	Template: 15.247 FHSS 900 TX (V2 8-17-06)
Report #: 308147 TX	FCC ID #: HS9-REM5000R01	Page 34 of 35

## APPENDIX A

### Test Equipment List

Asset #	Manufacturer	Model #	Serial #	Description	Date	Due
AA960008	EMCO	3816/2NM	9701-1057	Line Impedance Stabilization Network	12/6/07	12/6/08
AA960031	HP	119474A	3107A01708	Transient Limiter	Note 1	Note 1
AA960077	EMCO	93110B	9702-2918	Biconical Antenna	9/19/07	9/19/08
AA960078	EMCO	93146	9701-4855	Log-Periodic Antenna	9/19/07	9/19/08
AA960081	EMCO	3115	6907	Double Ridge Horn Antenna	12/04/07	12/04/08
CC00221C	Agilent	E4407B	US39160256	Spectrum Analyzer	1/11/07	1/11/08
EE960004	EMCO	2090	9607-1164	Device Controller	N/A	N/A
EE960013	HP	8546A	3617A00320	Receiver RF Section	9/20/07	9/20/08
EE960014	HP	85460A	3448A00296	Receiver Pre-Selector	9/20/07	9/20/08
EE960073	Agilent	E4446A	US45300564	Spectrum Analyzer	8/17/07	8/17/08
N/A	LSC	Cable	0011	3 Meter 1/2" Armored Cable	Note 1	Note 1
N/A	LSC	Cable	0050	10 Meter RG 214 Cable	Note 1	Note 1
N/A	Pasternack	Attenuator	N/A	10 dB Attenuator	Note 1	Note 1

*Note 1 - Equipment calibrated within a traceable system.*

### 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

Prepared For: Honeywell	Model #: REM5000R1001	Prepared by: LS Research, LLC
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