Measurement/Technical Report

Interlogix, Inc.

RCR

FCC ID: CGGAA2

May 08, 2001

This report concerns (check one):	Original Grant__	*Class II Change*__X__
Equipment Type: Part 15 Low Power Communication Device Transmitters		Rule Part: 47 CFR 15.249
Deferred grant requested per 47 CFR 0.457 (d)(1)(ii)?		Yes_____ no__X__
	If yes, defer until:	______N/A______ date
Interlogix, Inc. agrees to notify the Commission by:		______N/A______ date
of the intended date of announcement of the product so that the grant can be issued on that date.		
Transition Rules Request per 15.37:		yes_____ no__X__
If no, assumed Part 15, Subpart C for intentional radiators – new 47 CFR [10-1-92] provision.		
Report prepared by:	Northwest EMC, Inc. 22975 NW Evergreen Pkwy., Ste 400 Hillsboro, OR 97124 (503) 844-4066 fax: (503) 844-3826	

Report No. ILGX0230

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1.0 General Information

1.1 Product Description

Manufactured By .... Interlogix, Inc.

Address .... 12345 SW Leveton Dr., Tualatin, OR 97062

Test Requested By: .... Romeo Fabia

Model .... RCR

FCC ID CGGAA2

Serial Number(s) .... none

Date of Test .... May 7 & 8, 2001

Job Number ILGX0230

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1.1 Product Description con't

The Equipment Under Test (EUT) is the Interlogix, Inc. RCR. The EUT is a dual technology motion detector that plugs into the 12 vdc source of an alarm panel and utilizes both PIR (passive infrared) and microwave radar technologies to determine an alarm condition. The microwave radar technology is range gated. This allows for optimal room-size adjustments and reduces the occurrence of false alarms. The EUT operates at a single transmit frequency of 5807.8 MHz and is seeking authorization for Class II permissive changes made to the previously certified model, FCC ID: CGGAA2. The RCR includes two different models; RCR-A and RCR-C. The PCB and the transmitter are identical for both units.

1.2 Description of Class II Permissive Changes

The following is a list of the differences between the originally certified device and the EUT:

1. The original device has two microprocessors and the EUT has one. On the original device, one of the microprocessors was dedicated to generation of the transmitter pulses and to range switching. On the EUT, the transmitter pulses are generated with a free running square wave generator and the range switching is combined into the single microprocessor.
2. The original device has four amplifier channels ... one for each shell. Each channel has a different gain so the Doppler signal from each shell may be scaled to return approximately equal sensitivity. On the EUT there is only one amplifier channel. This channel has selectable gain. It doesn't work quite as well as four separate channels but the cost reduction was deemed worthwhile by the applicant. In addition, the single microwave channel reduced the processing load on the microprocessor.
3. The original device uses an EEPROM to store calibration data. On the EUT, a microprocessor with internal flash memory is used so the EEPROM was eliminated.
4. Because of the reduction in circuit complexity, the original device's two PCB solution has been reduced to a single board solution in the EUT.
5. The PIR amplifier was re-designed to yield a flat gain response with the pyro response curve included in the equation. The pyro has a non-linear response and rolls off quite severely at the higher frequencies. The PIR amplifier has been redesigned to compensate for this roll-off with some peaking at the high end.
6. The original device housing was designed with an IR transmissive cover that snaps onto the front housing. On the EUT this cover has been eliminated. The original device cover attenuated the IR signal by about 12 dB, which meant that the PIR amplifier gain had to be increased to make up for the loss. The EUT PIR amplifier gain has been reduced by 12 dB with a corresponding reduction in noise.

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1.3 Related Submittals/Grants

FCC ID: CGGAA2, Grant Date: 9/15/200

1.4 Tested System Details

EUT and Peripherals

Item	FCC ID	Description and Serial No.
EUT	CGGAA2	Interlogix RCR, S/N none
DC Power Supply	N/A	Topward TPS-2000, S/N 946425

Cables

Cable Type	Shield	Length (meters)	Ferrite	Connection Point 1	Connection Point 2
DC	No	1.4	No	DC Input on EUT	DC Power Supply

2.0 Test Methodology

Radiated testing was performed according to the procedures in ANSI C63.4 (1992). Radiated testing was performed at an antenna to EUT distance of 3 meters, from 30 MHz to 10 GHz, and at 1 meter from 10 GHz to 40 GHz.

2.1 Test Facility

The semi-anechoic chamber and conducted measurement facility used to collect the radiated and conducted data is located at

Northwest EMC, Inc.
22975 NW Evergreen Pkwy., Ste 400
Hillsboro, OR 97124
(503) 844-4066
Fax: 844-3826

The semi-anechoic chamber, and conducted measurement facility is located in Hillsboro, OR, at the address shown above. This site has been fully described in a report filed with the FCC (Federal Communications Commission), and accepted by the FCC in a letter maintained in our files.

Northwest EMC, Inc. is recognized under the United States Department of Commerce, National Institute of Standards and Technology, National Voluntary Laboratory Accreditation Program (NVLAP) for satisfactory compliance with criteria established in Title 15, Part 285 Code of Federal Regulations. These criteria encompass the requirements of ISO/IEC Guide 25 and the relevant requirements of ISO 9002 (ANSI/ASQC Q92-1987) as suppliers of calibration or test results. NVLAP Lab Code: 200059-0.

3.0 System Test Configuration

3.1 Justification

3.1.1 Operating Modes
The EUT was tested in its only operating mode – modulated at a single carrier frequency. The EUT was tested with its only antenna that is integral to the transmitter.

3.1.2 Test Configuration
During testing, the EUT was configured in a manner typical of its intended use. A 1.4 meter DC cable was attached to a laboratory DC power to provide power.

3.2 EUT Exercise Software

The EUT requires no software or firmware to operate. The operation is controlled by hardware only. The radio self generates the 5.8 GHz burst with an internal 5.8 GHz oscillator that is keyed on and off with a pair of 10 nsec pulses that are developed with a 74AC14 hex inverter (U5). Two sections of the hex inverter are wired as a 400 kHz oscillator. The output of the oscillator is differentiated into a 10 nsec pulse. The 400 kHz oscillator signal is also delayed by an integrator circuit whose time constant is controlled by the microprocessor. The delays are 18 nsec, 36 nsec, 54 nsec, and 70 nsec, which represent the four shells (9', 18', 27', 35'). The delayed square wave is differentiated into a 10 nsec pulse that is wire OR'ed with the 400 kHz oscillator differentiated pulse. This is the pulse pair that drives the 5.8 GHz oscillator. As can be seen, the only part the microprocessor plays in this scenario is selecting the range, which is done at a fairly slow rate (about 20 kHz).

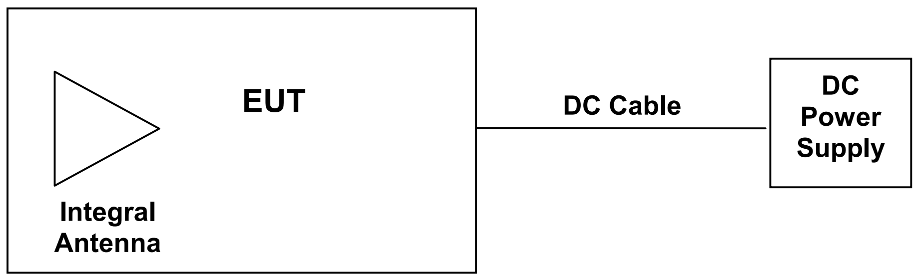
3.3 Special Accessories

None

3.4 Equipment Modifications

None.

Figure 3.1: Configuration of Tested System



4.0 Antenna Requirement

Per 47 CFR 15.203, the EUT uses an integral antenna that is designed to ensure that no other antennas other than the one supplied with the device will be used. The antenna is a dipole etched onto a PCB that is soldered to the main board.

Photos of the antenna may be referenced in exhibit "K", file name "Internal Photos"

4.1 Antenna Information

Per 47 CFR 15.204 (c), a list of antennas tested with the EUT is provided. The type, manufacturer, model number, and gain with reference to an isotropic radiator is given.

The EUT uses a single dipole antenna manufactured by Interlogix, P/N 15826, with a maximum gain of 8.67 dBi.

4.2 RF Exposure Compliance Requirements

The EUT meets the requirement that it be operated in a manner that ensures the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines (ref . 47 CFR 1.1307, 1.1310, 2.1091, and 2.1093. Also OET Bulletin 65, Supplement C).

The EUT will only be used in fixed installations. It will not be used in mobile or portable devices. The EUT supports the connection of only one antenna at a time.

The MPE estimates are as follows:

Table 1 in 47 CFR 1.1310 defines the maximum permissible exposure (MPE) for the general population as 1mW/cm^2. The distance from the EUT's transmitting antenna where the exposure level reaches the maximum permitted level is calculated using the general equation:

$$S = (PG)/4\pi R^2$$

Where:
S = power density (1mW/cm^2 maximum permitted level)
P = power input to the antenna (2.95E-3mW, see calculation below*)
G = linear power gain relative to an isotropic radiator (8.67 dBi = numeric gain of 7.36)
R = distance to the center of the radiation of the antenna

Solving for R, the 1 mW/cm^2 limit is reached 0.042 cm or closer to the transmitting antenna. Therefore, no warning labels, no RF exposure warnings in the manual, or other protection measures will be used with the EUT.

* Note: The power input to the antenna can be derived using the same general equation. The highest peak level at the transmit frequency is 78.6 dBuV/m (at a 3 meter distance). This is equal to 19.22E-9 mW/cm^2. Solving for P, the power input to the antenna is 2.95E-3 mW

5.0 AC Powerline Conducted Emissions

Per 47 15.207(d), if the EUT is connected to the AC powerline indirectly, obtaining its power from another device, which is connected, to the AC powerline, then it should be tested to demonstrate compliance with the conducted limits of 15.207. The EUT will be powered from a alarm panel that could be connected to the AC power line. Therefore, in accordance with OET laboratory policy, the measurements were made on the laboratory DC power supply used to power the EUT.

The AC powerline conducted emissions were measured with the EUT operating in a mode typical of normal operation. The spectrum was scanned from 450 kHz to 30 MHz. The test setup and procedures were in accordance with ANSI C63.4-1992.

Per 47 CFR 15.207, the radio frequency voltage that is conducted back onto the AC power line from the EUT, on any frequency within the 450 kHz to 30 MHz band, does not exceed 250 microvolts.

The AC Powerline conducted emissions data may be referenced in Exhibit "N", file name "Conducted Emissions.pdf".

6.0 Field Strength of Fundamental Frequency

The field strength of the fundamental (transmit) frequency shall meet the limits as defined in 47 CFR 15.249. If average emission measurements are employed, the provisions in 15.35 for averaging pulsed emissions and for limiting peak emissions apply. The EUT was configured for continous modulated operation at its single transmit frequency of 5807.8 MHz.

The field strength of the transmit frequency was maximized by rotating the EUT, adjusting the measurement antenna height and polarization, and manipulating the EUT in 3 orthogonal planes (per ANSI C63.4:1992).

Results

To derive average emission measurements, a pulse desensitization factor of -20 dB was utilized. This is the same factor that was used for the original application. The theoretical basis is explained in Hewlett Packard Application Note 150-2, “Spectrum Analysis…Pulsed RF”. Since no changes have been made to duty cycle of the pulse modulation used in this device, the -20 dB factor still applies.

The pulse desensitization factor of -20 dB was added to the peak readings to mathematically derive the average levels. Peak measurements were made with a resolution bandwidth of 1 MHz and a video bandwidth of 1 MHz.

The field strength of the fundamental (transmit) frequency meets the limits as defined in 47 CFR 15.249. It also meets the provisions in 15.35 for averaging pulsed emissions and for limiting peak emissions.

The final radiated data may be referenced in Exhibit “O”,
file name “ Radiated Emissions.pdf”.

7.0 Field Strength of Harmonics & Spurious Radiated Emissions

The field strength of harmonics and spurious radiated emissions shall meet the limits as defined in 47 CFR 15.249; which for this transmitter are equal to the limits of 15.209. If average emission measurements are employed, the provisions in 15.35 for averaging pulsed emissions and for limiting peak emissions apply. The EUT was configured for continous modulated operation at its single transmit frequency of 5807.8 MHz. The spectrum was scanned from 30 MHz to 40 GHz.

While scanning, emissions from the EUT were maximized by rotating the EUT, adjusting the measurement antenna height and polarization, and manipulating the EUT in 3 orthogonal planes (per ANSI C63.4:1992.

Results

To derive average emission measurements, a pulse desensitization factor of -20 dB was utilized. This is the same factor that was used for the original application. The theoretical basis is explained in Hewlett Packard Application Note 150-2, "Spectrum Analysis…Pulsed RF". Since no changes have been made to duty cycle of the pulse modulation used in this device, the -20 dB factor still applies.

The pulse desensitization factor of -20 dB was added to the peak readings to mathematically derive the average levels. Above 1 GHz, peak measurements were made with a resolution bandwidth of 1 MHz and a video bandwidth of 1 MHz. Below 1 GHz, peak measurements were made with a resolution bandwidth of 120 kHz and a video bandwidth of 300 kHz.

The field strength of harmonics and spurious radiated emissions meet the limits as defined in 47 CFR 15.249. It also meets the provisions in 15.35 for averaging pulsed emissions and for limiting peak emissions.

The final radiated data may be referenced in Exhibit "O",
file name "Radiated Emissions.pdf".

8.0 Field Strength Calculations

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured level. The basic equation with a sample calculation is as follows:
FS = RA + AF + CF - AG

where : FS = Field Strength

RA = Measured Level

AF = Antenna Factor

CF = Cable Attenuation Factor

AG = Amplifier Gain

Assume a receiver reading of 52.5 dBuV is obtained. The Antenna Factor of 7.4 and a Cable Factor of 1.1 is added. The Amplifier Gain of 29 dB is subtracted, giving a field strength of 32 dBuV/meter.

FS = 52.5 + 7.4 + 1.1 - 29 = 32 dBuV/meter
Level in uV/m = Common Antilogarithm [(32 dBuV/m)/20] = 39.8 uV/m

9.0 Measurement Bandwidths

Resolution Bandwidth

Peak Data

150 kHz - 30 MHz .... 10 kHz
30 MHz - 1000 MHz .... 100 kHz
1000 MHz - 40000 MHz .... 1000 kHz

Quasi-peak Data

150 kHz - 30 MHz .... 9 kHz
30 MHz - 1000 MHz .... 120 kHz

Average Data.

1000 MHz - 40000 MHz .... 1000 kHz

Video Bandwidth

The video bandwidth was greater than or equal to the resolution bandwidth for all measurement data except average measurements:

Average Data.

Numerically derived by adding a pulse desensitization factor of –20 dB to the peak data.

10.0 Measurement Equipment

Instrument	Manufacturer	Model	Serial No	Cal Due
Spectrum Analyzer	Hewlett-Packard	8566B	2747A05213	3/23/2002
LISN	Solar	9252-50-R-24-BNC	992802	7/14/2001
Pre-Amplifier	Amplifier Research	LN1000A	25660	12/4/2001
Antenna, Biconilog	EMCO	3141	9906-1146	12/14/2001
Antenna, Horn	EMCO	3115	9710-5305	7/8/2001
Pre-Amplifier	Miteq	AMF-4D-005180-24-10P	456374	12/4/2001
Spectrum Analyzer	Tektronix	2784	B010105	3/8/2002
Pre-Amplifier	Miteq	JSD4-18002600-26-8P	577858	6/26/2002
Antenna, Horn	EMCO	3160-09	9911-1189	1/15/2003
Pre-Amplifier	Miteq	JSD4-18002600-26-8P	577858	6/26/2002
Antenna, Horn	EMCO	3160-10	9911-1111	1/15/2003