**EMISSIONS TEST REPORT FOR A LOW POWER TRANSMITTER**

## I. GENERAL INFORMATION

Requirement: Federal Communications Commissions
Test Requirements: 15.205, 15.207, 15.209, 15.247

Applicant: Robertshaw Controls Company
d/b/a Invensys Home Control Systems

Product ID: FCC ID: **QI2-EMSL-200**

## II. DESCRIPTION OF EQUIPMENT UNDER TEST (EUT)

The Invensys FCC ID: **QI2-EMSL-200** is a frequency hopping spread spectrum (FHSS) transceiver. The Invensys RF Load Control Meter (LCM) is a remote switching device that receives load control OFF and ON commands from the GoodWatts system. Commands are received via an RF Communications network. The LCM is available in 120 VAC and 240 VAC versions, identical except for transformer tap selection.

The LCM operates in the U.S. ISM band between 902 and 928 MHz. The module incorporates a microcontroller and an r.f. integrated circuit that form a frequency hopping spread spectrum transceiver operating under FCC part 15.247.

### Transmitter Specification

| | |
|---|---|
| TX Power | 12dBm |
| Frequency Deviation (FSK) | +/- 20 kHz |
| Frequency of operation | 905 – 924.6 MHz |
| Data Rate | 19.2 kbps |
| Number of channels | 50 |
| Channel Separation | 400 kHz |
| Typical 20dB occupied bandwidth | 150 kHz |

## III. TEST LOCATION

All tests were performed at:

Compliance Certification Services
561F Monterey Road
Morgan Hill, CA 95037

T.N. Cokenias 27 August 2002
EMC Consultant/Agent for Invensys

## 1. Antenna connector requirement

The antenna is permanently attached to the product.

## 15.204 Antenna description

The load control module transceiver module uses a printed circuit folded dipole antenna:

| Antenna description | Gain | MFR name |
|---|---|---|
| HCST printed ckt antenna | 2.84 dBi max (z axia) | Invensys HCS |

Measured antenna data and radiation patterns are presented in a separate pdf attachment.

## 15.247(a) Frequency hopping spread spectrum definition

**Pseudorandom frequency hopping sequence:**

The transmitter cannot coordinate its hopping sequence with the hopping sequence of other transmitters, or vice versa, for the purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters

Each access unit has an individual ID number and there is no link or association between two access units so there is no simultaneous occupancy of individual hopping frequency transmission of two or more access units.

**Equal hopping frequency use:**

The EUT utilizes 50 hopping channels. Hopset is 50 channels long, then repeats. On average all channels are used equally.

**System receiver input bandwidth and receiver hopping capability:**

Receiver 26 dB bandwidth is 200 kHz, approximately equal to 26 dB bandwidth of TX. Receiver channel hops are synchronized to transmitter operating frequency.

**TEST DATA and TEST PROCEDURES - CCS Laboratory**

**Radiated Emissions**
**Test Requirement: 15.205, 15.247**

**Out of Band Measurements**
**Test Requirement: 15.247**

**Measurement Equipment Used:**

HP 8566 Spectrum Analyzer, 30-1000 MHz GHz
HP 8447D Pre-amplifier, .1 - 1300 MHz
Schaffner/Chase CBL6112B Bilog Antenna, 30 - 2000 MHz
HP 8593EM Spectrum Analyzer, 1 - 9.5 GHz
Miteq NSP2600-44 Microwave pre-amplifier, 1-26.5 GHz
EMCO 3115 Double Ridged Horn antenna, 1 - 18 GHz

Radiated emissions generated by the transmitter portion of the EUT were measured.

1. The EUT was placed on a wooden table resting on a turntable on the open air test site. The search antenna was placed 3m from the EUT. The EUT antenna was mounted vertically as per normal installation.

2. The turntable was slowly rotated to locate the direction of maximum emission at each emission falling in the restricted bands of 15.205.

3. Radiated emissions were investigated for a LOW channel, a MID channel, and HIGH channel. Emissions were investigated to the $10^{th}$ harmonic.

4. Once maximum direction was determined, the search antenna was raised and lowered in both vertical and horizontal polarizations. The maximum readings so obtained are recorded in the data listed below.

**Test Results:** Worst case results are presented. Refer to data sheets in separate attachments. Restricted band emissions meet 54 dBuV/m. Other undesired emissions from the transmitter meet the -20 dBc requirement in 15.247(c).

22-26 August 2002
Compliance Certification Services, Morgan Hill Open Field Site
Invensys Metering Systmes HCS
FCC ID: QI2-EMSL-200
Load Conrol Module

Engineer; T.Nguyen
Site A

Equipment for 1-18 GHz
HP8566B Analyzer
MITEQ NSP2600-44 Preamp
EMCO 3115 Antenna; S/N:2238
Cable: 15.0 feet
Conns: 4

Equipment for 18-26.5 GHz
HP8566B Analyzer
HP11975A Preamp (LO)
ARA MWH-1826B & HP11970K
Cable: 3.0
Conns: 4

Equipment for 26.5-40 GHz
HP8566B Analyzer
HP 11975A Amplifier (LO)
HP 11970A External mixer/antenna
Cable: IF Only (321 MHz)

Spectrum Analyzer Settings

| | Average | Peak |
|---|---|---|
| RBW | 1 Mhz | 1 MHz |
| VBW | 10 Hz | 1 MHz |

| f GHz | Dist cm | Read Pk dBuV | Read Av dBuV | AF dB/m | CL dB | Amp dB | D Corr dB | Pk E dBuV/m | Av E dBuV/m | Pk Limit dBuV/m | Margin Pk dB | Av Limit dBuV/m | Margin Av dB | Polarity | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 905 MHz | | | | | | | | **108.50** | | | | | | | |
| 1.810 | 200.0 | 41.8 | | 27.9 | 2.9 | -42.5 | -3.5 | 26.5 | | 88.5 | -62.0 | | | vertical | 15.247, -20dBc in 100 kHz |
| 2.715 | 200.0 | 60.8 | 57.8 | 30.9 | 3.4 | -42.3 | -3.5 | 49.3 | 46.3 | 74.0 | -24.7 | 54.0 | -7.7 | vertical | 15.205 restricted band |
| 3.620 | 200.0 | 48.3 | 40.8 | 32.7 | 4.1 | -42.0 | -3.5 | 39.5 | 32.0 | 74.0 | -34.5 | 54.0 | -22.0 | horizontal | 15.205 restricted band |
| 4.525 | 200.0 | 48.3 | 41 | 34.4 | 4.7 | -41.9 | -3.5 | 42.0 | 34.7 | 74.0 | -32.0 | 54.0 | -19.3 | vertical | 15.205 restricted band |
| 5.430 | 200.0 | 48.8 | 37.5 | 36.2 | 5.3 | -41.7 | -3.5 | 45.1 | 33.8 | 74.0 | -28.9 | 54.0 | -20.2 | vertical | 15.205 restricted band |
| 6.335 | 200.0 | 48.3 | 37.8 | 36.9 | 5.7 | -41.5 | -3.5 | 45.9 | | 92.0 | -46.1 | | | horizontal | 15.247, -20dBc in 100 kHz |
| 7.240 | 200.0 | 48.5 | 34.3 | 38.3 | 6.1 | -41.2 | -3.5 | 48.2 | | 92.0 | -43.8 | | | vertical | 15.247, -20dBc in 100 kHz |
| 8.145 | 200.0 | 45.2 | 34.2 | 39.1 | 6.5 | -40.3 | -3.5 | 47.0 | 36.0 | 74.0 | -27.0 | 54.0 | -18.0 | vertical | 15.205 restricted band |
| 9.050 | 200.0 | 43.5 | 33.7 | 39.8 | 6.9 | -39.4 | -3.5 | 47.3 | 37.5 | 74.0 | -26.7 | 54.0 | -16.5 | vertical | 15.205 restricted band |
| 915 MHz | | | | | | | | **108.00** | | | | | | | |
| 1.830 | 200.0 | 41.6 | | 28.0 | 2.9 | -42.5 | -3.5 | 26.5 | | 88.5 | -19.5 | | | vertical | 15.247, -20dBc in 100 kHz |
| 2.745 | 200.0 | 60.9 | 59.2 | 31.0 | 3.4 | -42.2 | -3.5 | 49.5 | 47.8 | 74.0 | -24.5 | 54.0 | -6.2 | horizontal | 15.205 restricted band |
| 3.660 | 200.0 | 49.5 | 43.2 | 32.7 | 4.1 | -42.0 | -3.5 | 40.8 | 34.5 | 54.0 | -13.2 | 54.0 | -19.5 | vertical | 15.205 restricted band |
| 4.575 | 200.0 | 48.3 | 40.7 | 34.5 | 4.8 | -41.8 | -3.5 | 42.2 | | 87.7 | -45.5 | | | horizontal | 15.247, -20dBc in 100 kHz |
| 5.490 | 200.0 | 47.7 | 39.8 | 36.3 | 5.3 | -41.7 | -3.5 | 44.1 | | 87.7 | -43.6 | | | vertical | 15.247, -20dBc in 100 kHz |
| 6.405 | 200.0 | 47 | 36 | 37.0 | 5.8 | -41.5 | -3.5 | 44.8 | | 87.7 | -42.9 | | | vertical | 15.247, -20dBc in 100 kHz |
| 7.320 | 200.0 | 46 | 35.2 | 38.4 | 6.2 | -41.1 | -3.5 | 45.9 | 35.1 | 74.0 | -28.1 | 54.0 | -18.9 | vertical | 15.205 restricted band |
| 8.235 | 200.0 | 45.2 | 34.2 | 39.2 | 6.6 | -40.2 | -3.5 | 47.2 | 36.2 | 74.0 | -26.8 | 54.0 | -17.8 | vertical | 15.205 restricted band |
| 9.150 | 200.0 | 43.5 | 33.7 | 39.8 | 7.0 | -39.4 | -3.5 | 47.4 | 37.6 | 74.0 | -26.6 | 54.0 | -16.4 | vertical | 15.205 restricted band |
| 924.6 MHz | | | | | | | | **108.50** | | | | | | | |
| 1.849 | 200.0 | 44.8 | | 28.1 | 2.9 | -42.5 | -3.5 | 29.8 | | 88.5 | -58.7 | | | horizontal | 15.247, -20dBc |
| 2.774 | 200.0 | 58.2 | 54.8 | 31.1 | 3.4 | -42.2 | -3.5 | 46.9 | 43.5 | 74.0 | -27.1 | 54.0 | -10.5 | horizontal | 15.205 restricted band |
| 3.698 | 200.0 | 47 | 38.3 | 32.8 | 4.2 | -42.0 | -3.5 | 38.4 | 29.7 | 54.0 | -15.6 | 54.0 | -24.3 | vertical | 15.205 restricted band |
| 4.623 | 200.0 | 47.3 | 37.3 | 34.6 | 4.8 | -41.8 | -3.5 | 41.3 | | 88.1 | -46.7 | | | horizontal | 15.247, -20dBc in 100 kHz |
| 5.548 | 200.0 | 46.7 | 37.8 | 36.3 | 5.3 | -41.7 | -3.5 | 43.2 | | 88.1 | -44.9 | | | vertical | 15.247, -20dBc in 100 kHz |
| 6.472 | 200.0 | 47.3 | 38.2 | 37.2 | 5.8 | -41.5 | -3.5 | 45.2 | | 88.1 | -42.9 | | | horizontal | 15.247, -20dBc in 100 kHz |
| 7.397 | 200.0 | 44.3 | 34.5 | 38.5 | 6.2 | -41.0 | -3.5 | 44.5 | 34.7 | 99.6 | -55.1 | 54.0 | -19.3 | vertical | 15.205 restricted band |
| 8.321 | 200.0 | 45.2 | 34.2 | 39.3 | 6.6 | -40.1 | -3.5 | 47.4 | 36.4 | 99.6 | -52.2 | 54.0 | -17.6 | vertical | 15.205 restricted band |
| 9.246 | 200.0 | 43.5 | 33.7 | 39.8 | 7.0 | -39.4 | -3.5 | 47.5 | | 88.1 | -40.6 | | | vertical | 15.247, -20dBc in 100 kHz |

f Measurement Frequency
Dist Distance to Antenna
Read Analyzer Reading
AF Antenna Factor
CL Cable Loss
Amp Preamp Gain
D Corr Distance Correct to 3 meters

**Radiated Emissions**
**Test Requirement: 15.109**

**Measurement Equipment Used:**

HP 8566 Spectrum Analyzer, 30-1000 MHz GHz
HP 8447D Pre-amplifier, .1 - 1300 MHz
Schaffner/Chase CBL6112B Bilog Antenna, 30 - 2000 MHz

Radiated emissions generated by the digital portion of the EUT were measured.

1. The EUT was placed on a wooden table resting on a turntable on the open air test site. The search antenna was placed 3m from the EUT. The EUT antenna was mounted vertically as per normal installation. The EUT was set to transmit continuously on the MID channel.

2. The turntable was slowly rotated to locate the direction of maximum emission at each emission falling in the restricted bands of 15.205.

3. Once maximum direction was determined, the search antenna was raised and lowered in both vertical and horizontal polarizations. The maximum readings so obtained are recorded in the data listed below.

**Test Results:** Worst case results are presented. Refer to data sheets in separate attachment.

COMPLIANCE Certification Services

FCC, VCCI, CISPR, CE, AUSTEL, NZ
UL, CSA, TUV, BSMI, DHHS, NVLAP

561F MONTEREY ROAD, SAN JOSE, CA 95037-9001
PHONE: (408) 463-0885 FAX: (408) 463-0888

| | |
|---|---|
| ***Project #:*** | 02U1490-1 |
| ***Report #:*** | 020822B1 |
| ***Date& Time:*** | 08/22/02 1:43 PM |
| ***Test Engr:*** | Mike Heckrotte |

| | |
|---|---|
| ***Company:*** | Invensys |
| ***EUT Description:*** | Load Control Module (120V) |
| ***Test Configuration :*** | EUT with 75 Watt Load |
| ***Type of Test:*** | FCC Radiated |
| ***Mode of Operation:*** | Normal Operation |

( ) A-Site (•) B-Site ( ) C-Site ( ) F-Site [6 Worst Data] 08/22/02

| Freq. (MHz) | Reading (dBuV) | AF (dB) | Closs (dB) | Pre-amp (dB) | Level (dBuV/m) | Limit FCC_B | Margin (dB) | Pol (H/V) | Az (Deg) | Height (Meter) | Mark (P/Q/A) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.77 | 35.70 | 15.83 | 1.45 | 29.73 | 23.24 | 40.00 | -16.76 | 3mV | 360.00 | 1.00 | P |
| 163.84 | 32.70 | 9.84 | 2.70 | 29.33 | 15.91 | 43.50 | -27.59 | 3mV | 360.00 | 1.00 | P |
| 196.60 | 37.40 | 8.78 | 2.94 | 29.15 | 19.97 | 43.50 | -23.53 | 3mV | 360.00 | 1.00 | P |
| 229.37 | 35.50 | 10.75 | 3.21 | 29.01 | 20.45 | 46.00 | -25.55 | 3mV | 360.00 | 1.00 | P |
| 393.22 | 33.10 | 15.65 | 4.51 | 29.30 | 23.96 | 46.00 | -22.04 | 3mV | 360.00 | 1.00 | P |
| 425.99 | 38.00 | 16.23 | 4.74 | 29.45 | 29.52 | 46.00 | -16.48 | 3mV | 360.00 | 1.00 | P |
| 30.74 | 33.20 | 16.63 | 1.40 | 29.74 | 21.49 | 40.00 | -18.51 | 3mV | 360.00 | 1.00 | P |
| 40.98 | 38.10 | 12.75 | 1.62 | 29.69 | 22.78 | 40.00 | -17.22 | 3mV | 360.00 | 1.00 | P |
| 61.48 | 34.50 | 5.62 | 1.89 | 29.64 | 12.37 | 40.00 | -27.63 | 3mV | 360.00 | 1.00 | P |
| 122.94 | 34.20 | 11.80 | 2.38 | 29.50 | 18.88 | 43.50 | -24.62 | 3mV | 360.00 | 1.00 | P |
| 133.16 | 31.90 | 11.34 | 2.45 | 29.46 | 16.24 | 43.50 | -27.26 | 3mV | 360.00 | 1.00 | P |
| 143.43 | 35.10 | 10.81 | 2.53 | 29.42 | 19.02 | 43.50 | -24.48 | 3mV | 360.00 | 1.00 | P |
| 153.68 | 36.30 | 10.28 | 2.63 | 29.38 | 19.82 | 43.50 | -23.68 | 3mV | 360.00 | 1.00 | P |
| 163.92 | 34.30 | 9.84 | 2.70 | 29.33 | 17.51 | 43.50 | -25.99 | 3mV | 360.00 | 1.00 | P |
| 174.23 | 33.80 | 9.33 | 2.77 | 29.30 | 16.60 | 43.50 | -26.90 | 3mV | 360.00 | 1.00 | P |
| 32.22 | 34.40 | 16.05 | 1.43 | 29.74 | 22.14 | 40.00 | -17.86 | 3mV | 360.00 | 1.00 | P |
| 35.84 | 34.60 | 14.68 | 1.52 | 29.72 | 21.08 | 40.00 | -18.92 | 3mV | 360.00 | 1.00 | P |
| 39.38 | 33.70 | 13.55 | 1.60 | 29.69 | 19.15 | 40.00 | -20.85 | 3mV | 360.00 | 1.00 | P |
| 42.96 | 35.40 | 11.53 | 1.65 | 29.68 | 18.89 | 40.00 | -21.11 | 3mV | 360.00 | 1.00 | P |
| 46.54 | 37.20 | 9.40 | 1.70 | 29.68 | 18.62 | 40.00 | -21.38 | 3mV | 360.00 | 1.00 | P |

Total data #: 20
V.2b

COMPLIANCE Certification Services

FCC, VCCI, CISPR, CE, AUSTEL, NZ
UL, CSA, TUV, BSMI, DHHS, NVLAP

561F MONTEREY ROAD, SAN JOSE, CA 95037-9001
PHONE: (408) 463-0885 FAX: (408) 463-0888

**Project #:** 02U1490-1
**Report #:** 020822B2
**Date& Time:** 08/22/02 2:36 PM
**Test Engr:** Mike Heckrotte

**Company:** Invensys
**EUT Description:** Load Control Module (240V)
**Test Configuration :** EUT with 150 Watt Load
**Type of Test:** FCC Radiated
**Mode of Operation:** Normal Operation

( ) A-Site (•) B-Site ( ) C-Site ( ) F-Site [6 Worst Data] 08/22/02

| Freq. (MHz) | Reading (dBuV) | AF (dB) | Closs (dB) | Pre-amp (dB) | Level (dBuV/m) | Limit FCC_B | Margin (dB) | Pol (H/V) | Az (Deg) | Height (Meter) | Mark (P/Q/A) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.77 | 35.10 | 15.83 | 1.45 | 29.73 | 22.64 | 40.00 | -17.36 | 3mV | 360.00 | 1.00 | P |
| 65.54 | 36.20 | 5.72 | 1.94 | 29.63 | 14.22 | 40.00 | -25.78 | 3mV | 360.00 | 1.00 | P |
| 163.84 | 33.60 | 9.84 | 2.70 | 29.33 | 16.81 | 43.50 | -26.69 | 3mV | 360.00 | 1.00 | P |
| 229.37 | 32.80 | 10.75 | 3.21 | 29.01 | 17.75 | 46.00 | -28.25 | 3mV | 360.00 | 1.00 | P |
| 393.22 | 32.00 | 15.65 | 4.51 | 29.30 | 22.86 | 46.00 | -23.14 | 3mV | 360.00 | 1.00 | P |
| 425.98 | 36.10 | 16.23 | 4.74 | 29.45 | 27.62 | 46.00 | -18.38 | 3mV | 360.00 | 1.00 | P |
| 30.74 | 35.80 | 16.63 | 1.40 | 29.74 | 24.09 | 40.00 | -15.91 | 3mV | 360.00 | 1.00 | P |
| 40.98 | 37.10 | 12.75 | 1.62 | 29.69 | 21.78 | 40.00 | -18.22 | 3mV | 360.00 | 1.00 | P |
| 61.74 | 36.00 | 5.63 | 1.90 | 29.64 | 13.88 | 40.00 | -26.12 | 3mV | 360.00 | 1.00 | P |
| 122.94 | 33.60 | 11.80 | 2.38 | 29.50 | 18.28 | 43.50 | -25.22 | 3mV | 360.00 | 1.00 | P |
| 133.19 | 36.30 | 11.34 | 2.45 | 29.46 | 20.63 | 43.50 | -22.87 | 3mV | 360.00 | 1.00 | P |
| 143.43 | 35.90 | 10.81 | 2.53 | 29.42 | 19.82 | 43.50 | -23.68 | 3mV | 360.00 | 1.00 | P |
| 153.68 | 37.00 | 10.28 | 2.63 | 29.38 | 20.52 | 43.50 | -22.98 | 3mV | 360.00 | 1.00 | P |
| 163.92 | 32.80 | 9.84 | 2.70 | 29.33 | 16.01 | 43.50 | -27.49 | 3mV | 360.00 | 1.00 | P |
| 174.17 | 38.40 | 9.33 | 2.77 | 29.30 | 21.20 | 43.50 | -22.30 | 3mV | 360.00 | 1.00 | P |
| 225.39 | 37.90 | 10.48 | 3.18 | 29.02 | 22.53 | 46.00 | -23.47 | 3mV | 360.00 | 1.00 | P |
| 235.64 | 32.00 | 11.17 | 3.26 | 28.98 | 17.45 | 46.00 | -28.55 | 3mV | 360.00 | 1.00 | P |
| 276.62 | 36.80 | 12.58 | 3.59 | 28.87 | 24.11 | 46.00 | -21.89 | 3mV | 360.00 | 1.00 | P |
| 32.22 | 34.30 | 16.05 | 1.43 | 29.74 | 22.04 | 40.00 | -17.96 | 3mV | 360.00 | 1.00 | P |
| 35.84 | 33.20 | 14.68 | 1.52 | 29.72 | 19.68 | 40.00 | -20.32 | 3mV | 360.00 | 1.00 | P |
| 39.38 | 34.40 | 13.55 | 1.60 | 29.70 | 19.85 | 40.00 | -20.15 | 3mV | 360.00 | 1.00 | P |
| 42.96 | 35.60 | 11.53 | 1.65 | 29.68 | 19.09 | 40.00 | -20.91 | 3mV | 360.00 | 1.00 | P |
| 46.54 | 36.40 | 9.40 | 1.70 | 29.68 | 17.82 | 40.00 | -22.18 | 3mV | 360.00 | 1.00 | P |
| 50.11 | 38.70 | 7.43 | 1.76 | 29.68 | 18.21 | 40.00 | -21.79 | 3mV | 360.00 | 1.00 | P |
| 53.69 | 39.20 | 6.76 | 1.80 | 29.67 | 18.10 | 40.00 | -21.90 | 3mV | 360.00 | 1.00 | P |
| 57.27 | 35.90 | 6.09 | 1.85 | 29.65 | 14.19 | 40.00 | -25.81 | 3mV | 360.00 | 1.00 | P |
| Total data #: 26 | | | | | | | | | | | |
| V.2b | | | | | | | | | | | |

**AC Line Conducted Emissions**
**Test Requirement: 15.107, 15.207**

**Measurement Equipment Used:**

Rohde & Schwarz EMI Receiver ESHS-20
Fischer Custom Communication LISN, FCC-LISN-50/250-25-2

**Test Procedure**

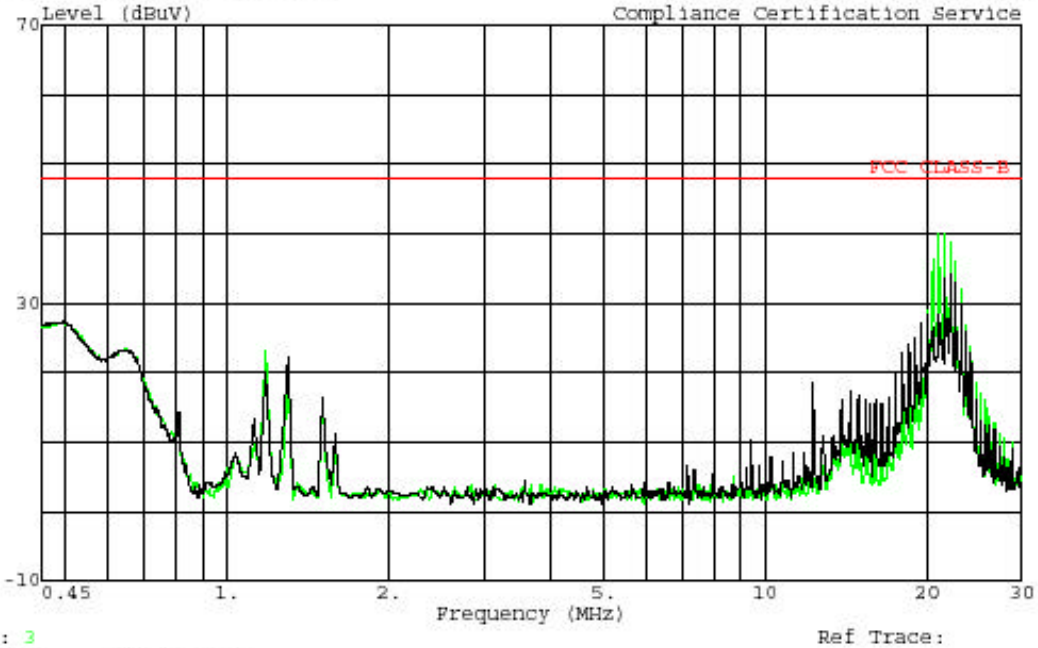
1. The EUT was placed on a wooden table 40 cm from a vertical ground plane and approximately 80 cm above the horizontal ground plane on the floor. The EUT was set to transmit in normally.
2. Line conducted data was recorded for both NEUTRAL and HOT lines.

**Test Results**

PASS. Refer to data sheets below. Data is presented for 120 VAC and 240 VAC models.

COMPLIANCE Engineering Services, Inc.
561F Monterey Road,
San Jose, CA 95037 USA
Tel: (408) 463-0885
Fax: (408) 463-0888

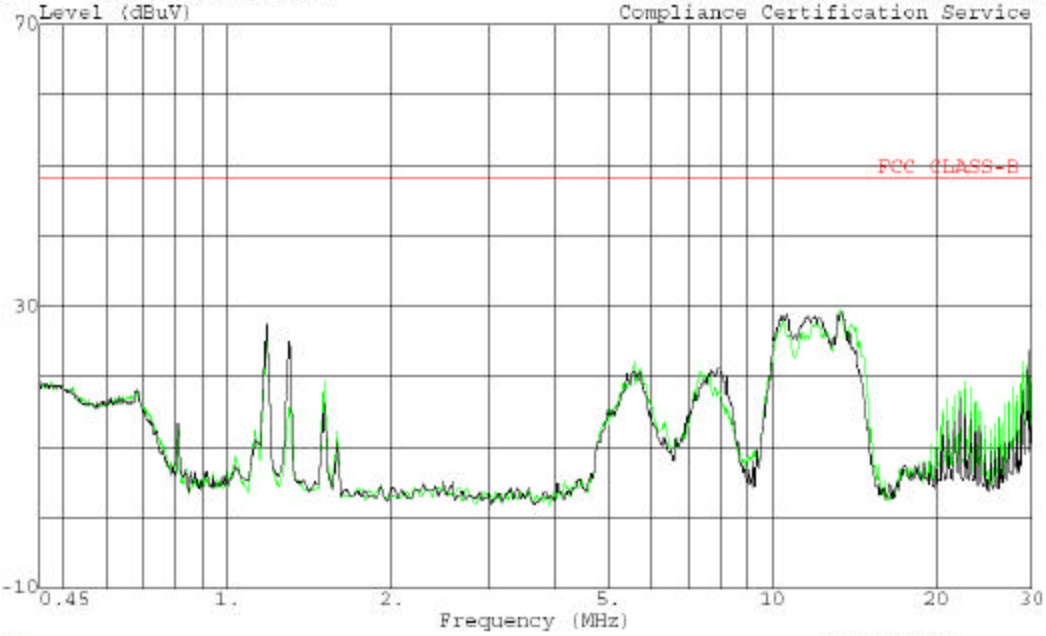
Data#: 7 File#: 0822LC1.EMI Date: 08-22-2002 Time: 11:37:59




Trace: 3 Ref Trace:
Project # : 02U1490-1
Test Engineer: Mike Heckrotte
Company : Invensys
EUT : Load Control Module
: Model: TBA (120V)
Test Config. : EUT with 75 Watt Load
Mode of Op. : Normal Operation
: Peak: L1(Black), L2(Green)
: 115Vac, 60Hz

COMPLIANCE Engineering Service, Inc.
561F Monterey Road,
San Jose, CA 95037 USA
Tel: (408) 463-0885
Fax: (408) 463-0888

Data#: 7 File#: 0822LC2.EMI Date: 08-22-2002 Time: 12:24:06




Trace: 3 Ref Trace:
Project # : 02U1490-1
Test Engineer: Mike Heckrotte
Company : Invensys
EUT : Load Control Module
: Model: TBA (240V)
Test Config. : EUT with 150 Watt Load
Mode of Op. : Normal Operation
: Peak: L1(Black), L2(Green)
: 240Vac, 60Hz

**Minimum 20 dB Bandwidth for FHSS**
**Test Requirement: 15.247**

**Measurement Equipment Used:**

HP 8593EM Spectrum Analyzer
6' length cable with loop pickup

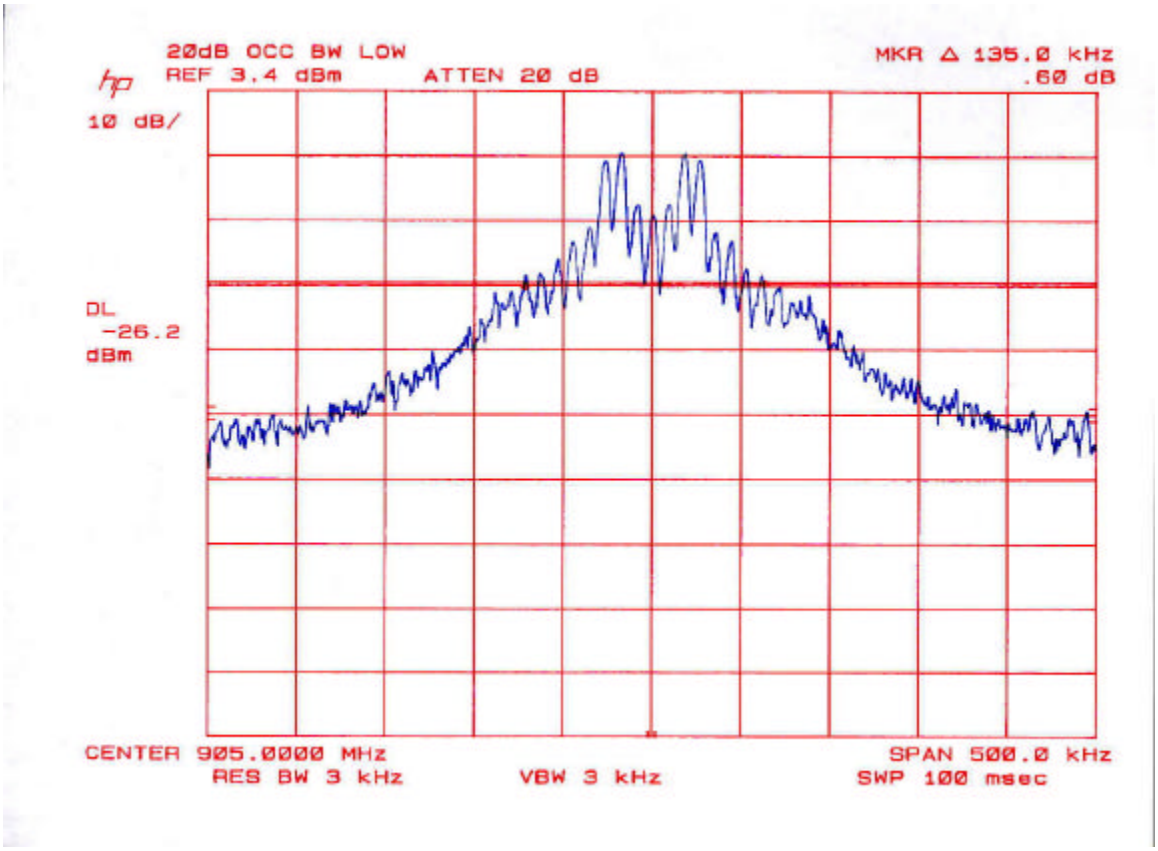
**Test Procedures**

The EUT was configured on a test bench. The EUT's hopping function was stopped, transmission was continuous at 915 MHz (LOW channel). While the transmitter broadcast a steady stream of digital data, the loop was placed around the antenna of the EUT, while the analyzer MAX HOLD function was used to capture the envelope of the transmission occupied bandwidth.

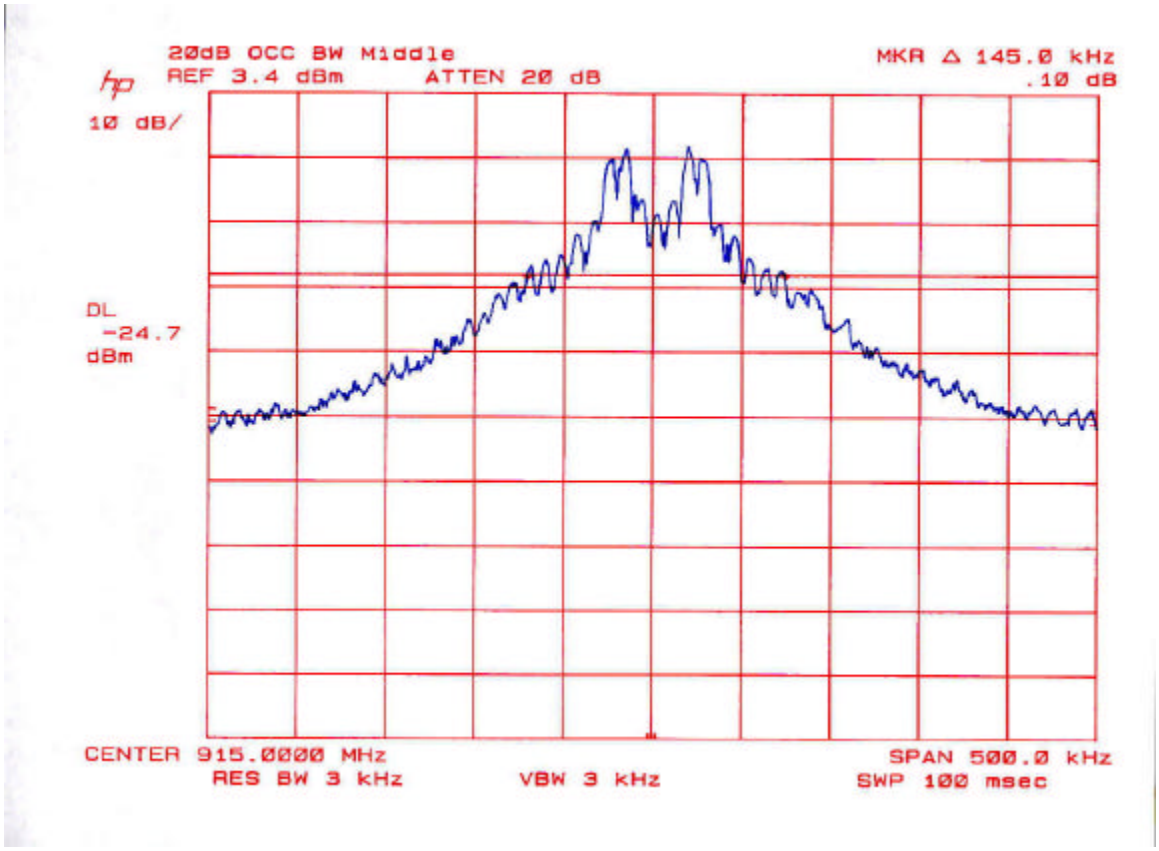
Test was repeated for MID and HIGH channels.

**Test Results:** Measured 145 kHz, design 150 kHz. Refer to data sheets below.

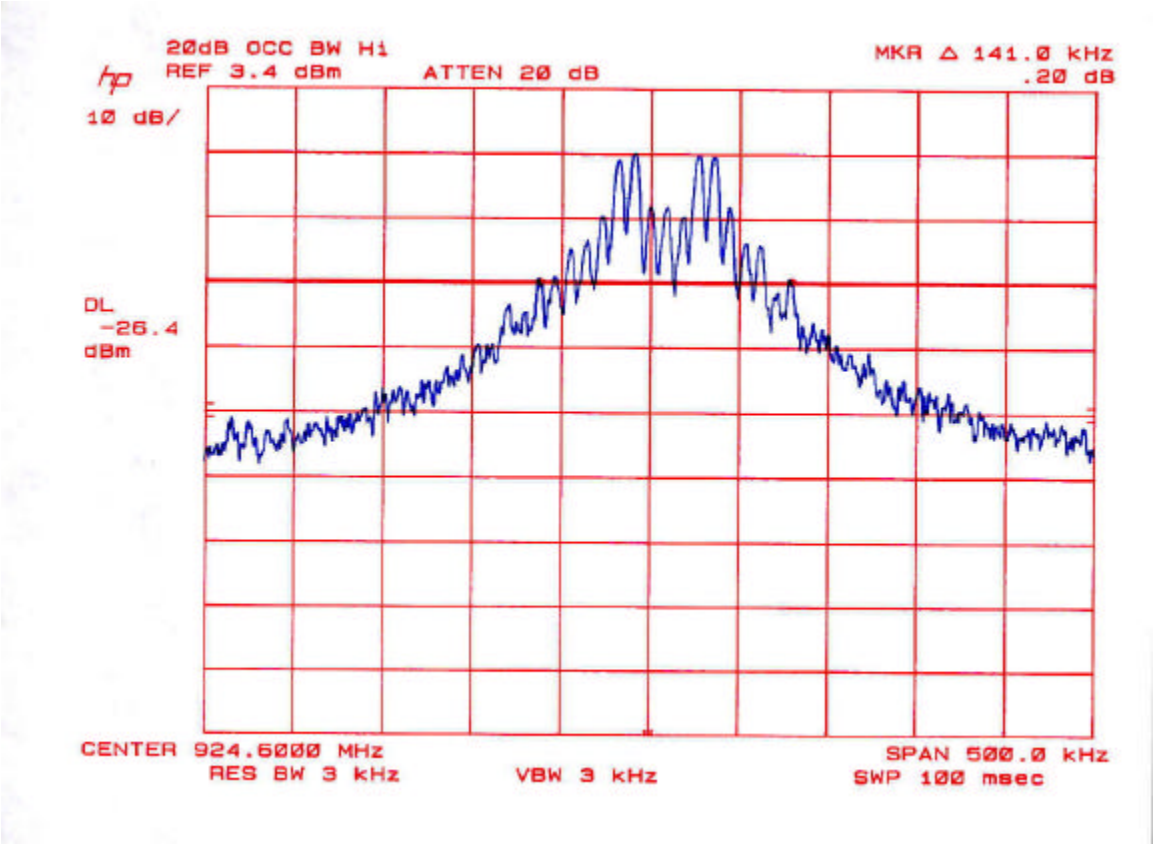
**15.247 Minimum 20 dB FHSS Channel Bandwidth LOW channel**



**15.247 Minimum 20 dB FHSS Channel Bandwidth MID channel**



**15.247 Minimum 20 dB FHSS Channel  Bandwidth HIGH channel**



**RF Power Output**
**Test Requirement: 15.247**

**Measurement Equipment Used:**

HP 8566 Spectrum Analyzer, 30-1000 MHz GHz
HP 8447D Pre-amplifier, .1 - 1300 MHz

**Test Procedures**

Because the EUT antenna is permanently attached, RF output power was calculated from radiated emissions data taken at 3m. The relationship between transmitter power, antenna gain, and field strength at 3m is

E V/m = ( (30*PW*G))/3 meters (E in volts/m, P in watts, G numeric gain over isotropic)

Converting to logarithms and combining terms,

E@3m, dBuV/m = (95.1 dB + PdBm + GdBi) dBuV/m

Re-arranging terms:

**PdBm = E@3m, dBuV/m - 95.1dB - GdBi**

1. The EUT was placed on a wooden table resting on a turntable on the open air test site. The search antenna was placed 3m from the EUT. The EUT antenna was mounted vertically as per normal installation.

2. Radiated emissions at the fundamental frequency were investigated for a LOW channel, a MID channel, and HIGH channel.

3 Once maximum direction was determined, the search antenna was raised and lowered in both vertical and horizontal polarizations. The maximum readings so obtained are recorded in the data listed below.

**Test Results**

Radiated field level readings converted to power in dBm shown below:

| Channel No. | Frequency | E@3m, dBuV/m | Gain, dBi | Pcalc., dBm |
|---|---|---|---|---|
| 1 | 905 | 108.5 | 2.84(z) | 10.56 |
| 26 | 915 | 108 | 2.84(z) | 10.06 |
| 50 | 924.6 | 108.5 | 2.84(z) | 10.56 |

Maximum output power is within  2dBm of design typical maximum 12 dBm.

**Minimum Number of Hopping Channels**
**Test Requirement: 15.247(a)(1)(ii)**

**Measurement Equipment Used:**

HP 8593EM Spectrum Analyzer
6' length cable with loop pickup

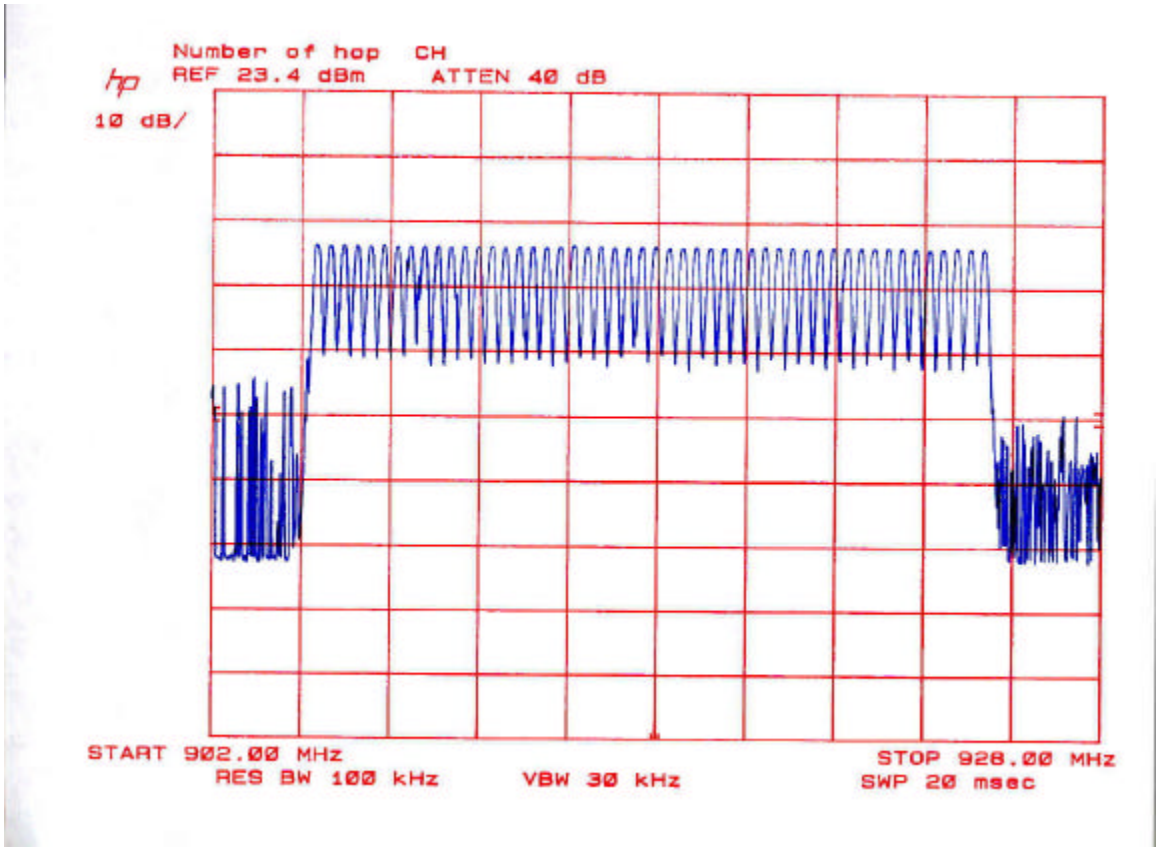
**Test Procedures**

1. The EUT was configured on a test bench. The EUT's hopping function was activated.
2. While the transmitter broadcast a steady stream of digital data, the loop was placed around the antenna of the EUT, while the analyzer MAX HOLD function was used to capture the emissions over a 3 minute period.

**Test Results**

A total of 50 hopping channels were counted. This corresponds to design. Refer to attached data sheet.

**15.247(a)(1)(ii) Minimum number of hopping channels**




**Channel separation: 400 kHz (minimum separation = 25 kHz or 20 dB BW)**

**Average Time of Channel Occupancy**
**Test Requirement: 15.247**

**Measurement Equipment Used:**

HP 8593EM Spectrum Analyzer
6' length cable with loop pickup

**Test Procedure**

1. The EUT was configured on a test bench. The EUT's hopping function was activated.
2. Spectrum analyzer center frequency was set to 915 MHz, one of the EUT hopping frequency. SWEEP TIME was adjusted until an accurate hop duration time could be displayed. VIDEO TRIGGER was used to capture the signal. The loop was placed over the EUT antenna.
3. Spectrum analyzer center frequency was set to 915 MHz, span 0 Hz, sweep time 20 sec, the loop was placed around the antenna of the EUT.
4. While the transmitter broadcast a steady stream of digital data, spectrum analyzer captured the ON time of the 905 MHz transmission during 20 seconds.
5. Step 3 was repeated 5 times. The channel occupancy time was determined as being the average of the 5 data runs.

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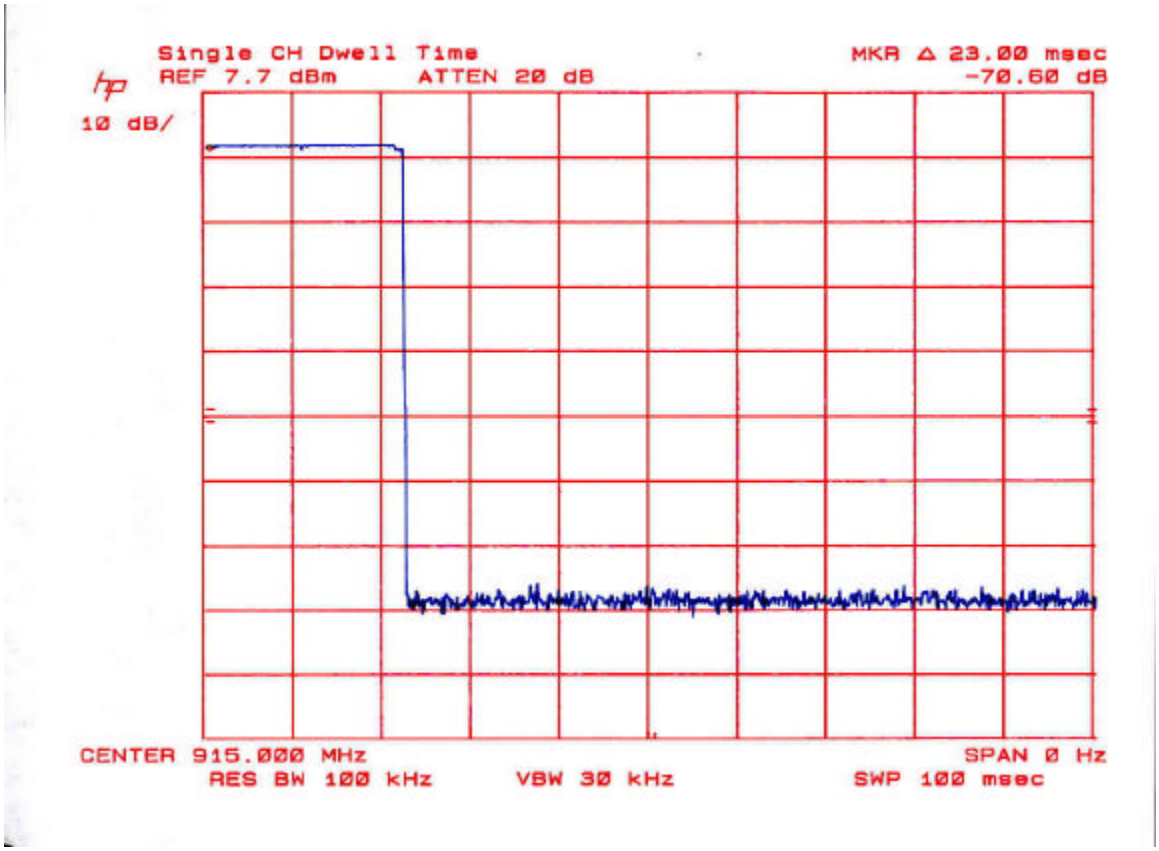
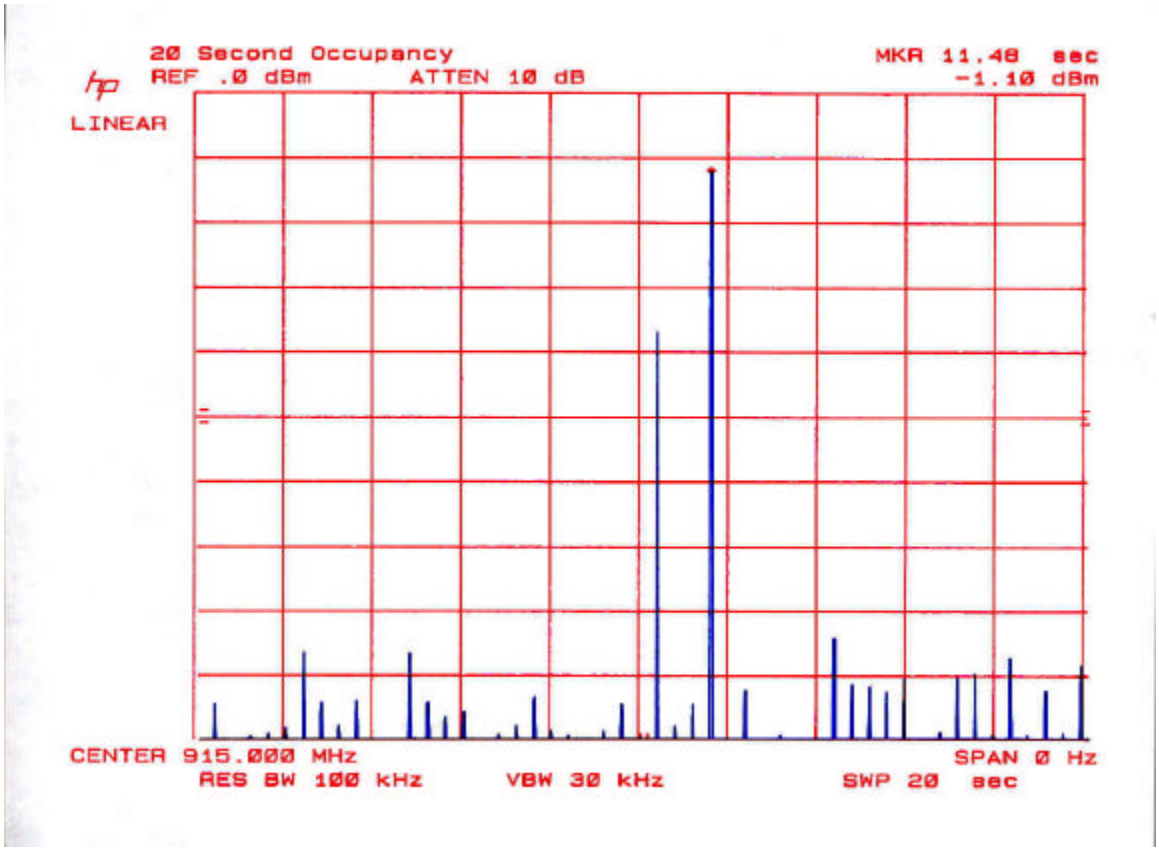
**Test Results**

Refer to graphs below.
Occupancy in 20 second period is 23 msec x 2 hits = 46 msec total.
Maximum allowed: 400 msec in 20 seconds

TX Time per Hop



TX Hops in 20 seconds



# RF Exposure (MPE) Calculations

## 905 - 924.6 MHz Frequency Hopping Spread Spectrum Radio

**Applicant:** **Robertshaw Controls Company**

**FCC ID:** **QI2-EMSL-200**

**RF Hazard Distance Calculation (worst case)**

**mW/cm2 from Table1:** **0.60**

| Max RF Power P, dBm | TX Antenna G, dBi | MPE Safe Distance, cm |
|---|---|---|
| **10.56** | **2.84** | **1.3** |

**Basis of Calculations:**

E^2/3770 = S, mW/cm2
E, V/m = (Pwatts*Ggain*30)^.5/d, meters
d = ((Pwatts*G*30)/3770*S))^0.5 Pwatts*Ggain = 10^(PdBm-30+GdBi)/10)

**NOTE: For mobile or fixed location transmitters, minimum separation distance is 20 cm, even if calculations indicate MPE distance is less**