

EMISSIONS TEST REPORT

Report Number: 3157826BOX-009b
Project Number: 3157826

Testing performed on the

Transmitter

Model: Remote Control

To

FCC Part 15, Subpart C, Section 231
FCC Part 15, Subpart B, Class B

For

Gammex

Test Performed by:
Intertek – ETL SEMKO
70 Codman Hill Road
Boxborough, MA 01719

Test Authorized by:
Gammex
7600 Discovery Drive
Middleton, WI 53562

Prepared by: Vathana Ven Date: 04/16/2009
Vathana Ven

Reviewed by: Jeff Goulet Date: 04/17/09
Jeff Goulet

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1.0 Job Description

1.1 Client Information

This EUT has been tested at the request of:

Company: GAMMEX
7600 Discovery Drive
Middleton, WI 53562

Contact: Mr. Ken Windisch
Telephone: (608) 828-7277
Fax: (608) 828-7500
Email: krw@gammex.com

1.2 Equipment Under Test

Equipment Type: Transmitter
Model Number(s): Remote Control
Serial number(s): BOX0809291118-004, BOX0904151123-005
Manufacturer: Gammex
EUT receive date: 09/29/2008, 04/15/2009
EUT received condition: Prototypes in Good Condition
Test start date: November 03, 2008
Test end date: April 16, 2009

1.3 Test Plan Reference: ANSI C63.4

1.4 Test Configuration

1.4.1 Block Diagram

Remote Control

1.4.2. Cables:

None

1.4.3. Support Equipment:

None

1.5 Mode(s) of Operation:

The EUT was activated at 7.2VDC from fresh batteries and was transmitting in a normal fashion repetitively throughout testing.

1.5a EUT Cycle Time:

CONTINOUS

2.0 Test Summary

| TEST STANDARD | RESULTS | |
|------------------------------------------------------------------------------------------|-----------------------------|---------|
| Standards from FCC Part 15, Subpart C, Section 231 FCC Part 15, Subpart B, Class B | | |
| SUB-TEST | TEST PARAMETER | COMMENT |
| FCC Part 15 Subpart C, Section 231 | Per Standard Specifications | Pass |
| FCC Part 15 Subpart B, Class B | Per Standard Specifications | Pass |

Notes:

REVISION SUMMARY – The following changes have been made to this Report:

| <u>Date</u> | <u>Project No.</u> | <u>Project Handler</u> | <u>Page(s)</u> | <u>Item</u> | <u>Description of Change</u> |
|-------------|--------------------|------------------------|----------------|-------------|----------------------------------------------------------------------------------|
| 03/24/09 | 3157826 | Vathana Ven | 2 | 1 | Added C63.4 on page 2. Changed spurious limits from 80.8 to 60.8 dBuV on page 14 |
| 04/16/09 | 3157826 | Vathana Ven | 9 | 1 | Replaced original 20 dB plot with new one |

3.0 Sample Calculations

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CF - AG$$

Where FS = Field Strength in $\text{dB}\mu\text{V}/\text{m}$

RA = Receiver Amplitude (including preamplifier) in $\text{dB}\mu\text{V}$

CF = Cable Attenuation Factor in dB

AF = Antenna Factor in dB

AG = Amplifier Gain in dB

In the following table(s), the reading shown on the data table reflects the preamplifier gain. An example for the calculations in the following table is as follows.

Assume a receiver reading of 52.0 $\text{dB}\mu\text{V}$ is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving a field strength of 32 $\text{dB}\mu\text{V}/\text{m}$. This value in $\text{dB}\mu\text{V}/\text{m}$ was converted to its corresponding level in $\mu\text{V}/\text{m}$.

$RA = 52.0 \text{ dB}\mu\text{V}$

$AF = 7.4 \text{ dB}/\text{m}$

$CF = 1.6 \text{ dB}$

$AG = 29.0 \text{ dB}$

$FS = 32 \text{ dB}\mu\text{V}/\text{m}$

$$\text{Level in } \mu\text{V}/\text{m} = [10(32 \text{ dB}\mu\text{V}/\text{m})/20] = 39.8 \mu\text{V}/\text{m}$$

The following is how net line-conducted readings were determined:

$$NF = RF + LF + CF + AF$$

Where NF = Net Reading in $\text{dB}\mu\text{V}$

RF = Reading from receiver in $\text{dB}\mu\text{V}$

LF = LISN Correction Factor in dB

CF = Cable Correction Factor in dB

AF = Attenuator Loss Factor in dB

To convert from $\text{dB}\mu\text{V}$ to μV or mV the following was used:

$$UF = 10^{(NF/20)} \text{ where } UF = \text{Net Reading in } \mu\text{V}$$

Example:

$$NF = RF + LF + CF + AF = 28.5 + 0.2 + 0.4 + 20.0 = 49.1 \text{ dB}\mu\text{V}$$

$$UF = 10^{(49.1 \text{ dB}\mu\text{V}/20)} = 254 \mu\text{V}/\text{m}$$

3.1 Measurement Uncertainty

Compliance of the product is based on the measured value. However, the measurement uncertainty is included for informational purposes.

The expanded uncertainty ($k = 2$) for radiated emissions from 30 to 1000 MHz has been determined to be:

± 3.5 dB at 10m, ± 3.8 dB at 3m

The expanded uncertainty ($k = 2$) for mains conducted emissions from 150 kHz to 30 MHz has been determined to be:

± 2.6 dB

The expanded uncertainty ($k = 2$) for telecom port conducted emissions from 150 kHz to 30 MHz has been determined to be:

± 3.2 for ISN and voltage probe measurements

± 3.1 for current probe measurements

3.2 Site Description

Test Site(s): Site 2

Our OATS are 3m and 10m sheltered emissions measurement ranges located in a light commercial environment in Boxborough, Massachusetts. They meet the technical requirements of ANSI C63.4-2003 and CISPR 22:1993/EN 55022:1994 for radiated and conducted emission measurements. The shelter structure is entirely fiberglass and plastic, with outside dimensions of 33 ft x 57 ft. The structure resembles a quonset hut with a center ceiling height of 16.5 ft.

The testing floor is covered by a galvanized sheet metal groundplane that is earth-grounded via copper rods around the perimeter of the site. The joints between individual metal sheets are bridged with a 2 inch wide metal strips to provide low RF impedance contact throughout. The sheets are screwed in place with stainless steel, round-head screws every three inches. Site illumination and HVAC are provided from beneath the ground reference plane through flush entry ports, the port covers are electrically bonded to the ground plane.

A flush metal turntable with 12 ft. diameter and 5000 lb. load capacity (12,000 lb. in Site 3) is provided for floor-standing equipment. A wooden table 80 cm high is used for table-top equipment. The turntable is electrically connected to the ground plane with three copper straps. The straps are connected to the turntable at the center of it with ground braid. The copper strap is directly connected to the groundplane at the edges of the turntable. The turntable is located on the south end of the structure and the antennas are mounted 3 and 10 meters away to the north. The antenna mast is a non-conductive with remote control of antenna height and polarization. The antenna height is adjustable from 1 to 4 meters.

All final radiated emission measurements are performed with the testing personnel and measurement equipment located below the ground reference plane. The site has a full basement underneath the turntable where support equipment may be remotely located. Operation of the antenna, turntable and equipment under test is controlled by remote controls that manipulate the antenna height and polarization and with a turntable control. Test personnel are located below the ellipse when measurements are performed, however the site maintains the ability of having personnel manipulate cables while monitoring test equipment. Ambient radiated emissions are 6 dB or more below the relevant FCC emission limits.

AC mains power is brought to the equipment under test through a power line filter, to remove ambient conducted noise. 50 Hz (240 VAC single phase), 60 Hz power (120 VAC single phase, 208 VAC three phase), and 60 Hz (480 VAC three phase) are available. Conducted emission measurements are performed with a Line Impedance Stabilization Network (LISN) or Artificial Mains Network (AMN) bonded to the ground reference plane. A removable vertical groundplane (2 meter X 2 meter area) is used for line-conducted measurements for table top equipment. The vertical groundplane is electrically connected to the reference groundplane.

Test Results: Pass

Test Standard: 15.231

Test: Bandwidth

Performance Criterion: The bandwidth of the emission shall be no wider than 0.25% of the center frequency or 1085 kHz.

Test Environment:

| | | | | | | |
|------------------------------------------|---------------|----|-----------------------|--------------------|-------------------|------|
| Environmental Conditions During Testing: | Ambient (°C): | 18 | Humidity (%): | 46 | Pressure (hPa): | 1007 |
| Pretest Verification Performed | Yes | | Equipment under Test: | Remote Control | | |
| Test Engineer(s): | Vathana Ven | | | EUT Serial Number: | BOX0904151123-005 | |

Maximum Test Disturbance Parameters: The bandwidth of the emission shall be no wider than 0.25% of the center frequency or 1085 kHz.

Test Equipment Used:

| TEST EQUIPMENT LIST | | | | | |
|---------------------|--------------------------------|------------------|-------------------|------------|---------------|
| Item | Equipment Type | Make | Model No. | Serial No. | Next Cal. Due |
| 1 | 9kHz to 3GHz EMI Test Receiver | Rohde & Schwartz | ESCI 1166.5950K03 | 100067 | 02/17/2010 |
| 2 | Digital 4 Line Barometer | Mannix | 0ABA116 | BAR3 | 06/01/2009 |

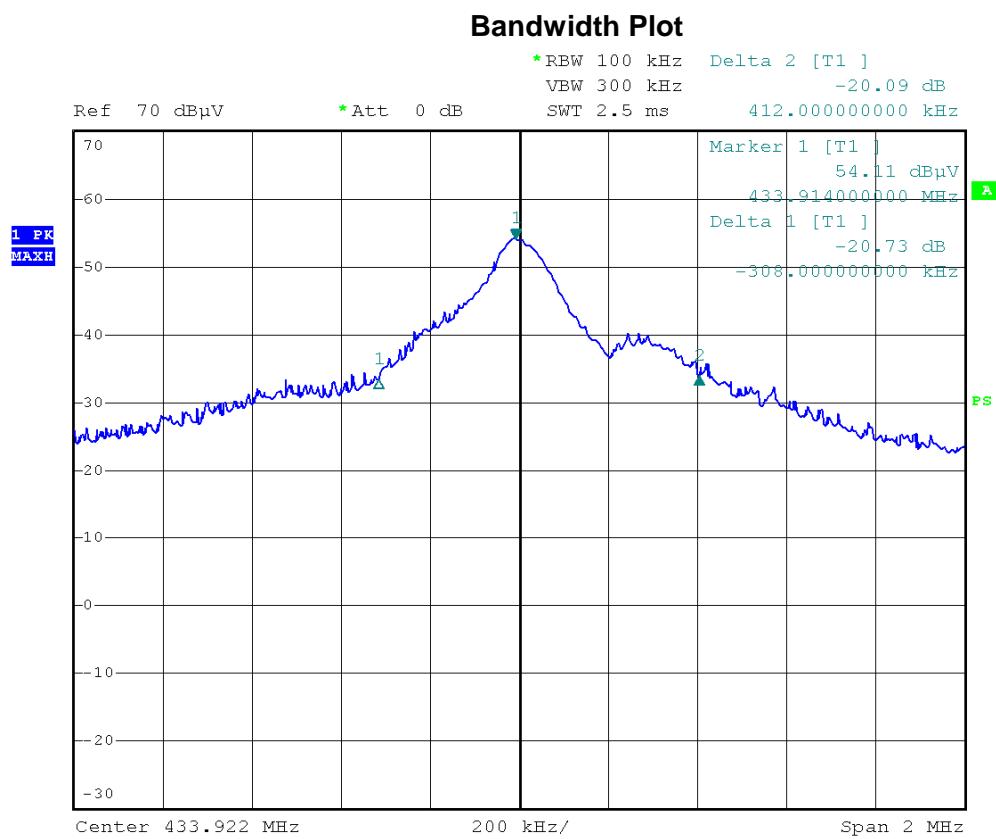
Software Utilized:

None.

Test Details:

| Test Point | Standard Limit (as published) | Compliance Level | Pass Fail N/A | COMMENT |
|------------|-------------------------------|------------------|---------------|---------|
| EUT | 1085 kHz | 1085 kHz | Pass | |

Notes:



Date: 16.APR.2009 18:04:40

The bandwidth of the emissions is 720 KHz which passed the limit of 1085 kHz.

Test Results: Pass

Test Standard: 15.231

Test: 5 Seconds Off

Performance Criterion: A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released

Test Environment:

| | | | | | | |
|------------------------------------------|-----------------|----|-----------------------|--------------------|-------------------|------|
| Environmental Conditions During Testing: | Ambient (°C): | 18 | Humidity (%): | 46 | Pressure (hPa): | 1007 |
| Pretest Verification Performed | Yes | | Equipment under Test: | Remote Control | | |
| Test Engineer(s): | Nick Abbondante | | | EUT Serial Number: | BOX0809291118-004 | |

Maximum Test Disturbance Parameters: A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released

Test Equipment Used:

| TEST EQUIPMENT LIST | | | | | |
|---------------------|--------------------------------------|-----------------|-----------|------------|---------------|
| Item | Equipment Type | Make | Model No. | Serial No. | Next Cal. Due |
| 1 | EMI Receiver 40 GHz (20 Hz - 40 Ghz) | Rohde & Schwarz | ESI | 8392831001 | 04/20/2009 |
| 2 | Digital 4 Line Barometer | Mannix | 0ABA116 | BAR3 | 06/01/2009 |

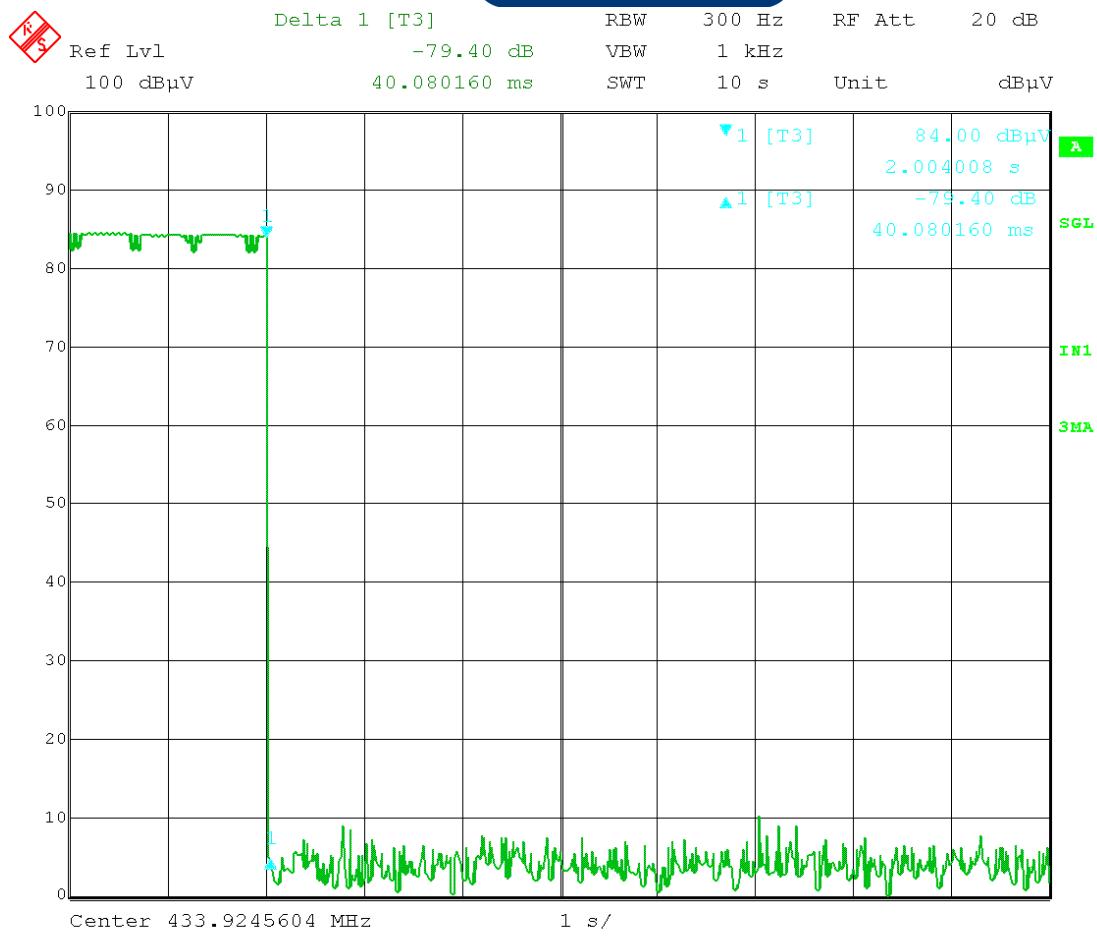
Software Utilized:

None.

Test Details:

| Test Point | Standard Limit (as published) | Compliance Level | Pass Fail N/A | COMMENT |
|------------|-------------------------------|------------------|---------------|---------|
| EUT | <5S | <5S | Pass | |

Notes:



Shut off time was 40.0816 ms

Test Results: Pass

Test Standard: 15.231 and 15.209

Test: Radiated Emissions

Performance Criterion: Emissions must be below 15.231 and 15.209 limits

Test Environment:

| | | | | | | |
|------------------------------------------|---------------|----|---------------|-----------------------|-------------------|------|
| Environmental Conditions During Testing: | Ambient (°C): | 18 | Humidity (%): | 46 | Pressure (hPa): | 1007 |
| Pretest Verification Performed | Yes | | | Equipment under Test: | Remote Control | |
| Test Engineer(s): | Vathana Ven | | | EUT Serial Number: | BOX0809291118-004 | |

Maximum Test Disturbance Parameters: Emissions must be below 15.231 and 15.209 limits

Test Equipment Used:

| TEST EQUIPMENT LIST | | | | | |
|---------------------|-----------------------------------|-----------|---------------|-------------|---------------|
| Item | Equipment Type | Make | Model No. | Serial No. | Next Cal. Due |
| 1 | Digital 4 Line Barometer | Mannix | 0ABA116 | BAR3 | 06/01/2009 |
| 2 | ANTENNA | EMCO | 3142 | 9711-1223 | 02/22/2009 |
| 3 | 3 Meter In floor cable for site 2 | ITS | RG214B/U | S2 3M FLR | 02/20/2010 |
| 4 | Spectrum Analyzer | Agilent | E7405A | US40240205 | 08/21/2009 |
| 5 | 100MHz-40GHz Preamp | MITEQ | NSP4000-NFG | 1260417 | 03/27/2009 |
| 6 | | | | EMC-54 | |
| 7 | 40GHz Cable | Megaphase | TM40-K1K1-197 | 7030801 001 | 06/05/2009 |
| 8 | 40 GHz Cable | Megaphase | TM40-K1K1-197 | 7030801 002 | 06/05/2009 |

Software Utilized:

| Name | Manufacturer | Version |
|----------------|-----------------------|------------------|
| EXCEL 2000 | Microsoft Corporation | 9.0.6926 SP-3 |
| EMI BOXBOROUGH | Intertek | 3/07/07 Revision |

Test Results:

Radiated Emissions

Company: GAMMEX
 Model #: Remote Control
 Serial #: BOX0809291118-004
 Engineers: Vathana Ven
 Project #: 3157826 Date(s): 11/11/08
 Standard: 15.231 and 15.209
 Receiver: Agilent E7405A (AGL001) Limit Distance (m): 3
 PreAmp: PRE9 03-27-09.txt Test Distance (m): 3
 PreAmp Used? (Y or N): N Voltage/Frequency: Battery Frequency Range: 30 MHz - 1 GHz
 Net = Reading (dBuV/m) + Antenna Factor (dB1/m) + Cable Loss (dB) - Preamp Factor (dB) - Distance Factor (dB)
 Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; NF = Noise Floor, RB = Restricted Band; Bandwidth denoted as RBW/VBW

| Detector Type | Ant. Pol. (V/H) | Frequency MHz | Reading dB(uV) | Antenna Factor dB(1/m) | Cable Loss dB | Pre-amp Factor dB | Average Factor dB | Net dB(uV/m) | Limit dB(uV/m) | Margin dB | Bandwidth |
|---------------|-----------------|---------------|----------------|------------------------|---------------|-------------------|-------------------|--------------|----------------|-----------|-------------|
| PK | H | 433.930 | 66.4 | 17.6 | 2.7 | 0.0 | 7.2 | 79.5 | 80.8 | -1.3 | 120/300 kHz |
| PK | H | 867.863 | 15.4 | 23.4 | 4.3 | 0.0 | 7.2 | 35.9 | 60.8 | -24.9 | 120/300 kHz |

FCC IC

Duty Cycle: given a short word length of 409.5 us, a long word length of 806.3 us, a burst interval of 62.12 ms, and a worst case burst comprised of 15 short and 26 long words, the worst case on-time is 27.1 ms in a 62.1 ms timeframe, which is a 43.6% duty cycle. and is equal to 7.2 dB average factor.

Notes:

Test Results continue:

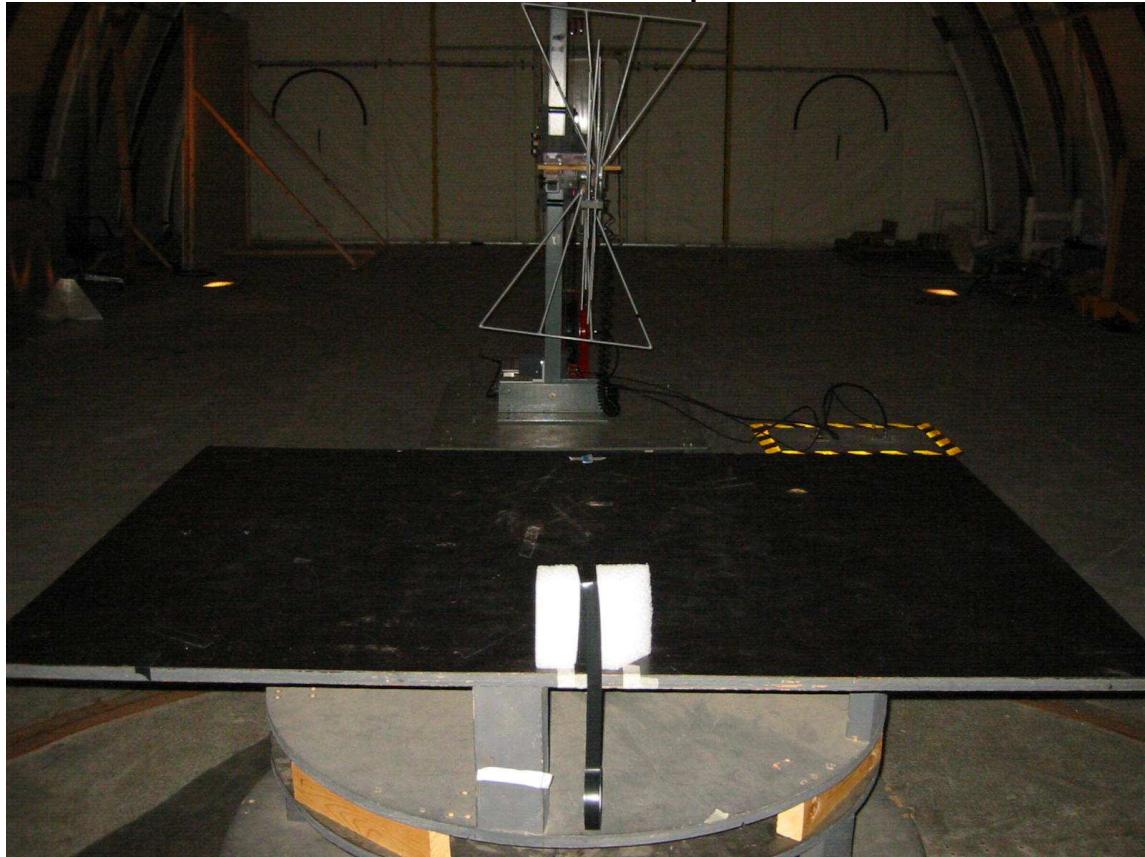
Radiated Emissions

Company: GAMMEX
 Model #: Remote Control
 Serial #: BOX0809291118-004
 Engineers: Vathana Ven
 Project #: 3157826 Date(s): 11/11/08
 Standard: 15.231 and 15.209
 Receiver: Agilent E7405A (AGL001) Limit Distance (m): 3
 PreAmp: PRE9 03-27-09.txt Test Distance (m): 3
 PreAmp Used? (Y or N): Y Voltage/Frequency: Battery Frequency Range: 1 - 5 GHz
 Net = Reading (dBuV/m) + Antenna Factor (dB1/m) + Cable Loss (dB) - Preamp Factor (dB) - Distance Factor (dB)
 Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; NF = Noise Floor, RB = Restricted Band; Bandwidth denoted as RBW/VBW

| Detector Type | Ant. Pol. (V/H) | Frequency MHz | Reading dB(uV) | Antenna Factor dB(1/m) | Cable Loss dB | Pre-amp Factor dB | Average Factor dB | Net dB(uV/m) | Limit dB(uV/m) | Margin dB | Bandwidth | FCC | IC |
|---------------|-----------------|---------------|----------------|------------------------|---------------|-------------------|-------------------|--------------|----------------|-----------|-----------|-----|----|
| PK | V | 1301.900 | 49.8 | 24.7 | 4.2 | 29.1 | 7.2 | 42.4 | 54.0 | -11.6 | 1/3 MHz | RB | RB |
| PK | H | 1735.700 | 49.9 | 26.0 | 4.9 | 29.1 | 7.2 | 44.5 | 60.8 | -16.3 | 1/3 MHz | | |
| PK | H | 2169.575 | 43.2 | 27.7 | 5.6 | 29.2 | 7.2 | 40.1 | 60.8 | -20.7 | 1/3 MHz | | |
| PK | H | 2603.600 | 44.2 | 29.3 | 6.2 | 29.2 | 7.2 | 43.3 | 60.8 | -17.5 | 1/3 MHz | | |
| PK | V | 3037.500 | 47.1 | 30.0 | 6.8 | 29.2 | 7.2 | 47.5 | 60.8 | -13.3 | 1/3 MHz | RB | RB |
| PK | V | 3471.400 | 44.4 | 31.3 | 7.3 | 29.2 | 7.2 | 46.6 | 60.8 | -14.2 | 1/3 MHz | | |
| PK | V | 3905.450 | 40.0 | 32.4 | 7.8 | 29.2 | 7.2 | 43.7 | 54.0 | -10.3 | 1/3 MHz | RB | RB |
| PK | H | 4339.300 | 43.5 | 32.2 | 8.3 | 29.3 | 7.2 | 47.6 | 54.0 | -6.4 | 1/3 MHz | | |

Duty Cycle: given a short word length of 409.5 us, a long word length of 806.3 us, a burst interval of 62.12 ms, and a worst case burst comprised of 15 short and 26 long words, the worst case on-time is 27.1 ms in a 62.1 ms timeframe, which is a 43.6% duty cycle.
 and is equal to 7.2 dB average factor.

Radiated Emissions Setup Photos



Radiated Emissions Setup Photos continue



