

## 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

Reviewed by:

  
Jeff Goulet

Date: 04/17/09

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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:**

CONTINUOUS

## 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 dB $\mu$ V/m
- RA = Receiver Amplitude (including preamplifier) in dB $\mu$ 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 dB $\mu$ 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 dB $\mu$ V/m. This value in dB $\mu$ V/m was converted to its corresponding level in  $\mu$ V/m.

RA = 52.0 dB $\mu$ V  
 AF = 7.4 dB/m  
 CF = 1.6 dB  
 AG = 29.0 dB  
 FS = 32 dB $\mu$ V/m

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

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

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

Where NF = Net Reading in dB $\mu$ V

- RF = Reading from receiver in dB $\mu$ V
- LF = LISN Correction Factor in dB
- CF = Cable Correction Factor in dB
- AF = Attenuator Loss Factor in dB

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

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

#### Example:

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

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

### 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:

$\pm 3.5$  dB at 10m,  $\pm 3.8$  dB at 3m

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

$\pm 2.6$  dB

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

$\pm 3.2$  for ISN and voltage probe measurements

$\pm 3.1$  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.

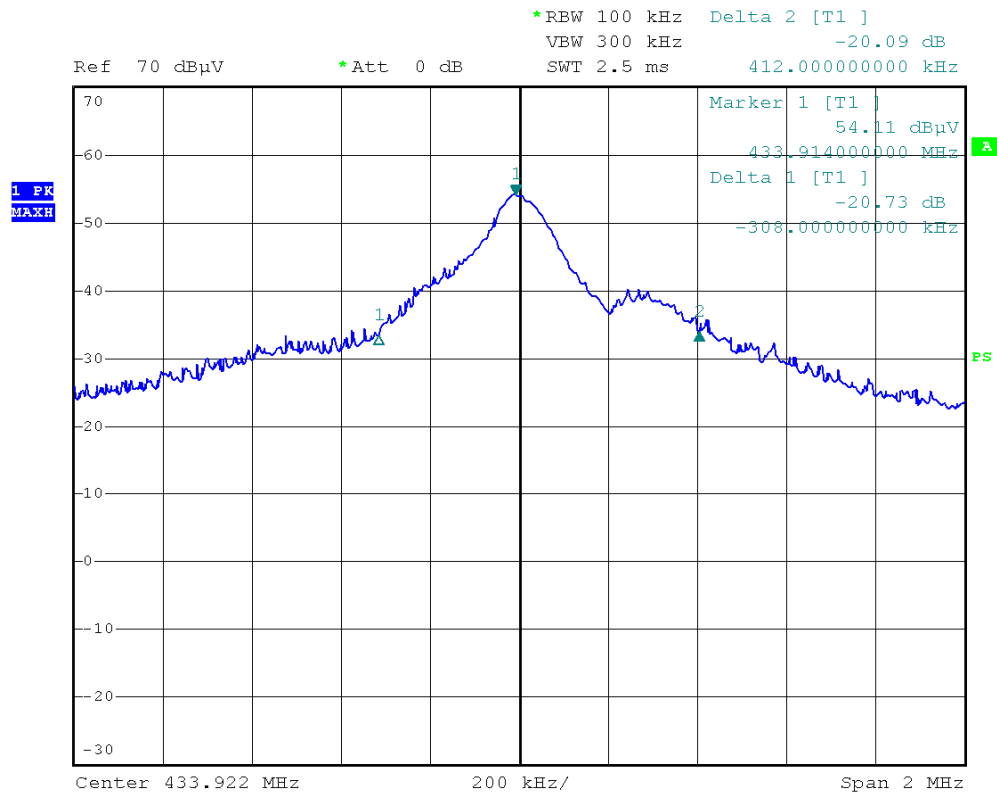
**Test Details:**

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

Notes:



## Bandwidth Plot



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

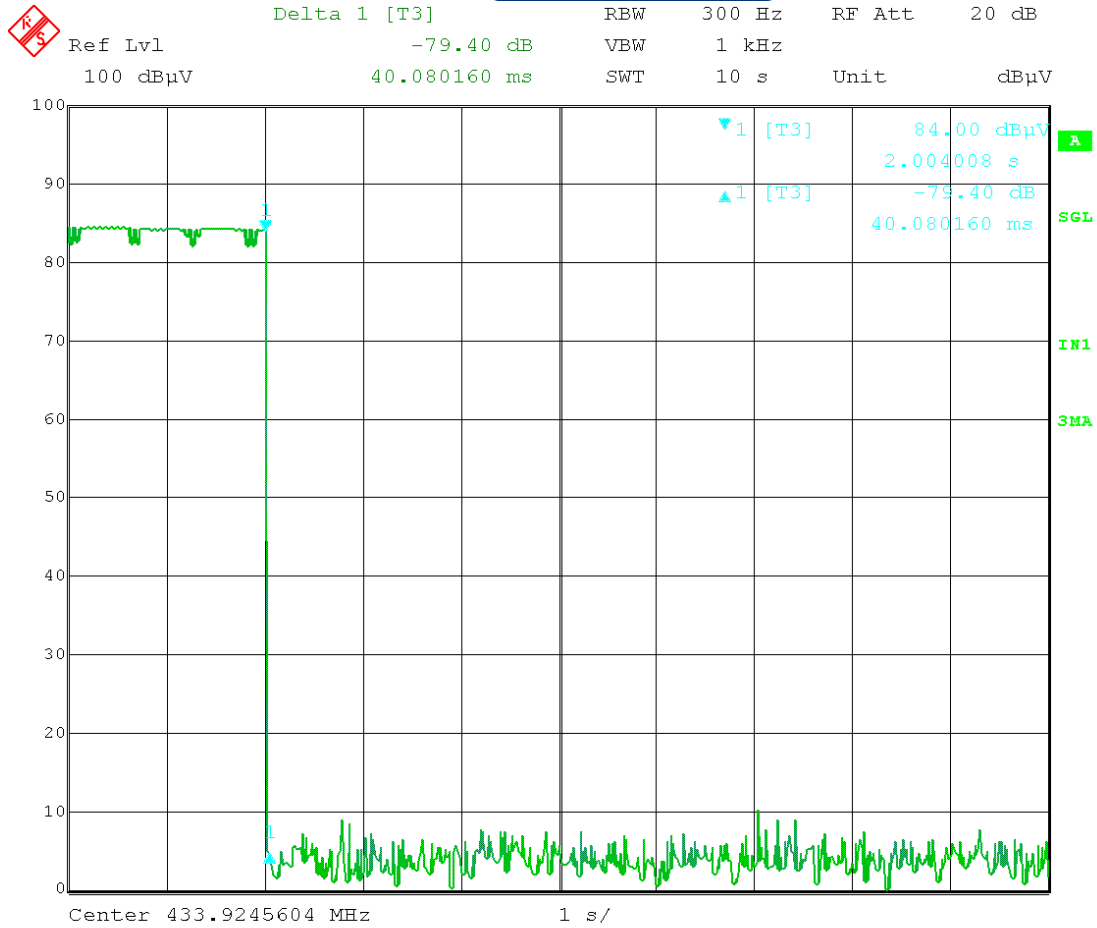
**Software Utilized:**

None.

**Test Details:**

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

Notes:



Date: 13.NOV.2008 15:16:48

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  
 Standard: 15.231 and 15.209  
 Receiver: Agilent E7405A (AGL001)  
 PreAmp: PRE9 03-27-09.txt  
 Date(s): 11/11/08  
 Location: Site 2  
 Antenna & Cables: N Bands: N, LF, HF, SHF  
 Antenna: LOG2 2-22-09 V3m.txt LOG2 2-22-09 H3m.txt  
 Cable(s): S2 3M FLR 09-23-09.txt NONE.  
 Barometer: BAR3  
 Temp/Humidity/Pressure: 18 deg. C 46% 1007 mB  
 Limit Distance (m): 3  
 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  
 Standard: 15.231 and 15.209  
 Receiver: Agilent E7405A (AGL001)  
 PreAmp: PRE9 03-27-09.txt  
 PreAmp Used? (Y or N): Y  
 Date(s): 11/11/08  
 Location: Site 2  
 Barometer: BAR3  
 Antenna & Cables: HF Bands: N, LF, HF, SHF  
 Antenna: EMC-54 V3m 4-02-09.txt EMC-54 H3m 4-02-09.txt  
 Cable(s): MEG001.txt MEG002.txt  
 Temp/Humidity/Pressure: 18 deg. C 56% 999 mB  
 Limit Distance (m): 3  
 Test Distance (m): 3  
 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		
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	RB	RB

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

