FCC TEST REPORT
FOR THE
BULLEX DIGITAL SAFETY
GAS TRAINER
TRANSCEIVER
(FCC ID: W3YGTR001)

Prepared for:

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Submitted by:

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BullEx Digital Safety, Inc.
FCC EMC Testing
At
Green Mountain Electromagnetics, Inc.

Unit: Gas Trainer Transceiver (FCCID: W3YGTR001)
Received: 1/22/09
Tested: January 22-26, 2009

I. Applicable Standards:

The unit described in this report was measured for certification with the Code of Federal Regulations Chapter 47 – "Telecommunication, Part 2 – Frequency Allocations and Radio Treaty Matters: General Rules and Regulations, Subpart J – Equipment Authorization Procedures (current as of Jan. 2009)." Measurements required were per paragraphs 2.1046 RF Power Output, 2.1047 Modulation Characteristics, 2.1049 Occupied Bandwidth, 2.1053 Field Strength of Spurious Radiation, 2.1055 Frequency Stability, and 2.1093 Radiofrequency Radiation Exposure Evaluation: Portable Devices.

The unit was also measured for verification of compliance with "CFR47, Part 15 – Radio Frequency Devices, Subpart C: Intentional Radiators, Paragraph 15.209, Radiated Emissions Limits" and Paragraph 15.249, " Operation in the Bands 902-928 MHz, 2400-2483.5 MHz, 5725-5875 MHz and 24.0-24.25 GHz."

Measurement procedures were in accordance with ANSI C63.4, "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (2003)," and FCC OET Bulletin 65, "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields (Jan. 2001)."

II. Unit Tested:

The BullEx Digital Safety, Inc. Gas Trainer consists of similar student and instructor units. The Gas Trainer uses DC battery power and has a 914.5-MHz ER900TRS transceiver module. It also consists of the multi-piece plastic enclosure with LCD display, switch hardware, and the electronics. The table below describes the unit that was subjected to measurements determining compliance with applicable EMC standards:

Product	Manufacturer	Model	Serial Number
Transceiver	BullEx Digital Safety, Inc.	Gas Trainer	ENG001

The following table describes the system physical and electrical properties:

Model	Volts/Amps/Hertz	H/W/D in cm
Gas Trainer	7.2 VDC Battery	12/7/3

No support equipment was used during testing.

Signal cables were used for testing and are supplied by the manufacturer. The following table describes the system cables:

Cable	Part Number	Description
Signal	p/o Gas Trainer	Unshielded DC multi-conductor

III. Summary of Results:

The BullEx Digital Safety, Inc. Gas Trainer complies with the requirements in CFR 47, Paragraphs 2 and 15. Section X contains the results summarized in the table below.

	Test	Mode/Port	CFR 47 Paragraph	Frequency Range/Level	Specified Values	Measured Values
1	Output Power	Transmit	**2.1046**	914.5 MHz	0 dBm	-10 dBm
3	Occupied Bandwidth	Transmit	**2.1049**	20 dB down at 0.5% of Fundamental	4.57 MHz	<0.5 MHz
4	Frequency Stability	Transmit	**2.1055**	Battery End Point	914.5 MHz	914.5 MHz
5	Radiated and Spurious Emissions	Enclosure	**15.209** **15.249** **2.1053**	1.705 - 30 MHz 30 - 88 MHz 88 - 216 MHz 216 - 960 MHz 960 - 9145 MHz 914.5 MHz (Fund) Above 915 (Spur)	49.5 dBuV/m 40 dBuV/m 43.5 dBuV/m 46 dBuV/m 54 dBuV/m 94 dBuV/m 54 dB/V/m	Within All Limits at 3 Meters
6	Exposure Evaluation	Enclosure	**2.1093**	914.5 MHz	0.08 W/kg Body 1.6 W/kg 1g Vol	Within All Limits

Table 1 – Measurement Values and Results

Testing was performed by Kyle R. Kowalczyk, president, Green Mountain Electromagnetics and requested by:

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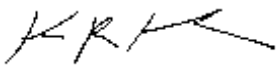

Kyle R. Kowalczyk
2/10/09

IV. Measurement Location:

The GME laboratory and Open Area Test Site (OATS) are located at 219 Blake Roy Road, Middlebury, VT. The OATS is a 3-meter site complete with antenna positioner, ground plane and motorized turntable. The OATS is constructed in accordance with ANSI C63.7-2005 and complies with the requirements for radiated emissions testing in ANSI C63.4-2003 and CISPR standards. The electromagnetic laboratory is constructed in accordance with CE immunity standards and ANSI C63.4-2003 (conducted emissions).

GME is internationally accredited by the American Association for Laboratory Accreditation (A2LA) and meets the quality requirements in ISO/IEC 17025 (2005), "General Requirements for the Competence of Testing and Calibration Laboratories."

V. Equipment and Cable Configuration:

GME witnessed the unit in satisfactory condition for testing, however the manufacturer is responsible for ensuring that the equipment under test (EUT) represents the product line. The manufacturer is also responsible for the EMC test plan and for assuring that this report is consistent with that plan. The EUT configuration was arranged to produce maximum radiated emissions as shown in the block diagram below. The equipment was subjected to complete emissions tests.

Figure 1 – Block Diagram of EUT on Turntable

VI. Units of Measurement:

Measurements of radiated electric fields were made in units of dB referenced to 1 microvolt per meter (dBuV/m). Limits appearing on the spectrum analyzer data were corrected for the appropriate antenna factor, cable loss, amplifier gain (when used) and measurement distance X. (See Section X.6, Radiated Emissions Measurement Results, for calculations.)

Uncertainty

The uncertainty budgets in GME EMC measurements (using the guidance of NAMAS NIS 81) are identified as follows:

1. Field strength between 30 MHz and 3 GHz on a three-meter OATS using broadband antennas:

Contribution	**Probability Distribution**	**Uncertainty (dB)**
antenna factor calibration	normal k=2	0.5
cable loss calibration	normal k=2	0.5
analyzer specification	rectangular	1.5
distance variation	rectangular	0.6
height variation	rectangular	0.5
site imperfection	rectangular	2.0
mismatch	u-shaped	1.5
repeatability	standard deviation	0.5
combined uncertainty u(y)	normal	1.946
expanded uncertainty U	normal k=2	3.892

$$u(y) = \sqrt{(\frac{0.5}{2})^2 + (\frac{0.5}{2})^2 + \frac{1.5^2 + 0.6^2 + .5^2 + 2.0^2}{3} + \frac{1.5^2}{2} + 0.5^2}$$

U = k u(y)

VII. Measuring Equipment:

The table below describes the instrumentation used by Green Mountain Electromagnetics to perform this testing:

Unit	Manufacturer	Model	Serial #	Last Cal.	Next Cal.
Spectrum Analyzer	Hewlett-Packard	8592 L	3624A00631	3/20/08	3/20/09
Amplifier	MiniCircuits	ZFL-1000G	n/a	2/11/08	2/11/09
Amplifier	MiniCircuits	ZVE-8G	n/a	2/11/08	2/11/09
Broadband E-field Antenna	Antenna Research Associates	LPB-2513/A	1125	8/9/07	8/9/09
Plotter	Hewlett-Packard	7475A	2517A05281	n/a	n/a

VIII. Measurement Procedures:

1. Output Power.

Manufacturer Specification: 0-dBm, 100% duty cycle (Not Normal Operation)

a. Set up EUT and test instrumentation in laboratory.
   i. Connect EUT to battery power and operate companion unit.
b. Verify spectrum analyzer and EUT operation.
   i. Use internal spectrum analyzer attenuator.
c. Operate EUT at high power unmodulated.
d. Record power level displayed on analyzer in dBm.

2. Occupied Bandwidth.

Specification: >20 dB at 0.5% of Fundamental (4.57 MHz at 914.5 MHz)

a. Set up EUT and test instrumentation in laboratory.
   i. Connect EUT to battery power and operate companion unit.
b. Verify spectrum analyzer and EUT operation.
   i. Use internal spectrum analyzer attenuator.
c. Operate EUT at power unmodulated.
d. Record level displayed on analyzer.

3. Frequency Stability.

Frequency: 914.5 MHz

Voltage Specification: 7.2-VDC Battery (Normal Operation)

a. Set up EUT and test instrumentation in laboratory.
   i. Connect EUT to DC power and operate companion unit.
b. Verify spectrum analyzer and EUT operation.
   i. Use internal spectrum analyzer attenuator.
c. Operate EUT at power unmodulated.
d. Record level displayed on analyzer.
   i. Sweep voltage from low to high and observe any variation in frequency.

4. Radiated Emissions.

Frequency range: 1 MHz to 30 MHz
Limit: 49.5 dBuV/m @ 3 meters
Frequency range: 30 MHz to 88 MHz
Limit: 40 dBuV/m @ 3 meters
Frequency range: 88 kHz to 216 MHz
Limit: 43.5 dBuV/m @ 3 meters
Frequency range: 216 MHz to 960 MHz
Limit: 46 dBuV/m @ 3 meters
Frequency range: 960 MHz to 9145 MHz
Limit: 54 dBuV/m @ 3 meters
Frequency range: 915 MHz to 9.145 GHz Spurious
Limit: 54 dBuV/m @ 3 meters
Frequency range: 914.5 MHz Fundamental
Limit: 94 dBuV/m @ 3 meters

a. Set up instrumentation at open area test site.
   i. Mount EUT on ground plane and broadband antenna on antenna positioner.
   ii. Observe temperature, humidity and atmospheric pressure.
   iii. Measurement distance is 3 meters and antenna scan height is 1 to 4 meters.
b. Verify spectrum analyzer and antenna operation.
   i. Spectrum analyzer is connected to antenna.
   ii. Preamplifier is inserted between antenna and analyzer to ensure analyzer noise threshold is at least 6 dB below specification limit.
c. Set up, power and operate EUT as described in Section V.
d. Perform preliminary evaluation of equipment in the near field.
   i. Vary antenna height, antenna polarization, and antenna orientation to EUT.
   ii. Repeat step d.i. while evaluating electromagnetic radiation in the 1-MHz to 9.145-GHz spectrum.
e. Determine frequencies and equipment orientations that produce maximum radiation.

i. Identify processor, clock and beat frequencies, and harmonics.

f. Perform final evaluation of unit by recording spectrum analyzer data on the plotter.
   i. Ensure the EUT is producing the maximum radiation found in step e.
   ii. Collect data over the entire frequency range.

5. Exposure Evaluation.

Frequency: 914.5 MHz

Limit: 0.8 W/kg and 1.6 W/kg

a. Set up instrumentation at open area test site.
   i. Mount EUT on table and isotropic probe or loop on antenna positioner.
   ii. Observe temperature, humidity and atmospheric pressure.
   iii. Measurement distance is 1 meter and antenna scan height is varied over human body dimensions (0.1 to 2 meters).

b. Verify spectrum analyzer and antenna operation.
   i. Spectrum analyzer is connected to antenna.
   ii. Preamplifier is inserted between antenna and analyzer to ensure analyzer noise threshold is at least 6 dB below specification limit (not normally necessary below 30 MHz).

c. Set up, power and operate EUT as described in Section V.

d. Perform preliminary evaluation of equipment in the near field.
   i. Vary antenna height, antenna polarization, and antenna orientation to EUT.
   ii. Repeat step d.i. while evaluating electromagnetic radiation at 914.5 MHz.
   iii. Ensure appropriate resolution bandwidth is set and less than or equal to VBW.
   iv. Near field measurements of unit emissions are made at ambient frequencies.

e. Determine equipment orientations that produce maximum radiation.
   i. Set peak hold on analyzer for 30 minutes while slowly varying antenna height.

f. Perform final evaluation of unit by recording spectrum analyzer data on the plotter.
   i. Ensure the EUT is producing the maximum radiation found in step e.
   ii. Collect data over the entire frequency range.
   iii. Identify all ambient signals.

IX. Photograph of Measurement Setup:

Radiated Emissions

X. Measurement Results:

1. Output Power.

Specification: 0 dBm (<1 mW)

Spectrum Analyzer (dBm) = Spectrum Analyzer (dBuV) – 107 (dB).
ERP (dBm) = Spectrum Analyzer (dBm) + Antenna Factor (dBi) + Cable Loss (dB).
ERP = 0.1 mW = -10 dBm = (81-107 = -26) dBm + 8 dBi AF + 8 dB cable loss.

X. Measurement Results Cont'd:

2. Occupied Bandwidth.

Measured 0.2 MHz, Limit < 4.57 MHz @ 20 dB down

X. Measurement Results Cont'd:

3. Frequency Stability/Tolerance Cont'd.

Frequencies: 914.5 MHz

Specification: 7.2 VDC through battery end (Normal Operation)

The table below shows no variation in frequency with selected applied voltage:

Voltage (VDC)	% Nominal	Frequency (MHz)
7.22	Nominal	914.5
7.21	Nominal	914.5
7.20	Nominal	914.5
7.19	Nominal	914.5
7.18	Nominal	914.5
7.17	Nominal	914.5
7.15	Nominal	914.5
7.13	Nominal	914.5
7.12	Nominal	914.5
7.11	Nominal	914.5
7.10	Nominal	914.5

Table 2 – Frequency Vs. Voltage

X. Measurement Results Cont'd:

4. Radiated Emissions.

The table below contains the spectrum analyzer output and the correction factors necessary to apply the limit to the data.
Field (dBuV/m) = Vmeas (dBuV) + Antenna Factor (dB/m) + Cable Loss (dB) - Amp Gain (dB).
Deviation (dB) = Field (dBuV/m) - Limit (dBuV/m) - Duty; Negative deviation is compliant.

Freq MHz	Pol H/V	RBW kHz	VBW kHz	Vmeas dBuV	AF dB1/m	Amp dB	Cable dB	Field dBuV/m	Duty dB	Limit dBuV/m	Dev dB
1	H	9	9	39	24.2	22	1	42.2	0	49.5	-7.3
1	V	9	9	40	24.2	22	1	43.2	0	49.5	-6.3
10	H	9	9	43	20.1	22	1	42.1	0	49.5	-7.4
10	V	9	9	44	20.1	22	1	43.1	0	49.5	-6.4
30	H	120	300	32	18.6	22	1	29.6	0	40	-10.4
30	V	120	300	33	18.6	22	1	30.6	0	40	-9.4
40	H	120	300	34	18.3	22	1	31.3	0	40	-8.7
40	V	120	300	33	18.3	22	1	30.3	0	40	-9.7
50	H	120	300	32	15.1	22	2	27.1	0	40	-12.9
50	V	120	300	31	15.1	22	2	26.1	0	40	-13.9
60	H	120	300	32	11.1	22	2	23.1	0	40	-16.9
60	V	120	300	33	11.1	22	2	24.1	0	40	-15.9
70	H	120	300	34	8.1	22	2	22.1	0	40	-17.9
70	V	120	300	35	8.1	22	2	23.1	0	40	-16.9
80	H	120	300	39	9.8	22	2	28.8	0	40	-11.2
80	V	120	300	38	9.8	22	2	27.8	0	40	-12.2
90	H	120	300	43	10.9	22	2	33.9	0	43.5	-9.6
90	V	120	300	42	10.9	22	2	32.9	0	43.5	-10.6

Table 3 – Corrected Radiated Emissions Data and FCC Limit

X. Measurement Results Cont'd:

4. Radiated Emissions Cont'd.

The table below contains the spectrum analyzer output and the correction factors necessary to apply the limit to the data.

Freq MHz	Pol H/V	RBW kHz	VBW kHz	Vmeas dBuV	AF dB1/m	Amp dB	Cable dB	Field dBuV/m	Duty dB	Limit dBuV/m	Dev dB
100	H	120	300	43	12.2	22	3	36.2	0	43.5	-7.3
100	V	120	300	44	12.2	22	3	37.2	0	43.5	-6.3
125	H	120	300	32	12.9	22	3	25.9	0	43.5	-17.6
125	V	120	300	33	12.9	22	3	26.9	0	43.5	-16.6
141	H	120	300	40	11.1	22	4	33.1	0	43.5	-10.4
141	V	120	300	38	11.1	22	4	31.1	0	43.5	-12.4
185	H	120	300	37	10.9	22	4	29.9	0	43.5	-13.6
185	V	120	300	43	10.9	22	4	35.9	0	43.5	-7.6
200	H	120	300	33	11.3	22	4	26.3	0	43.5	-17.2
200	V	120	300	34	11.3	22	4	27.3	0	43.5	-16.2
250	H	120	300	35	13.4	22	4	30.4	0	46	-15.6
250	V	120	300	34	13.4	22	4	29.4	0	46	-16.6
300	H	120	300	33	14.9	21	4	30.9	0	46	-15.1
300	H	120	300	34	14.9	21	4	31.9	0	46	-14.1
400	H	120	300	32	16.1	21	4	31.1	0	46	-14.9
400	V	120	300	31	16.1	21	4	30.1	0	46	-15.9
500	H	120	300	32	18.6	21	4	33.6	0	46	-12.4
500	V	120	300	33	18.6	21	4	34.6	0	46	-11.4
600	H	120	300	30	19.7	21	4	32.7	0	46	-13.3
600	V	120	300	31	19.7	21	4	33.7	0	46	-12.3
700	H	120	300	33	20.2	21	4	36.2	0	46	-9.8
700	V	120	300	32	20.2	21	4	35.2	0	46	-10.8

Table 3 Cont'd. – Corrected Radiated Emissions Data and FCC Limit

X. Measurement Results Cont'd:

4. Radiated Emissions Cont'd.

The table below contains the spectrum analyzer output and the correction factors necessary to apply the limit to the data.

Freq MHz	Pol H/V	RBW kHz	VBW kHz	Vmeas dBuV	AF dB1/m	Amp dB	Cable dB	Field dBuV/m	Duty dB	Limit dBuV/m	Dev dB
800	H	120	300	33	21.5	21	6	39.5	0	46	-6.5
800	V	120	300	32	21.5	21	6	38.5	0	46	-7.5
914.5	H	120	300	76	21.9	21	7	83.9	0	94	-10.1
914.5	V	120	300	81	21.9	21	7	88.9	0	94	-5.1
960	H	120	300	31	22.4	21	7	39.4	0	46	-6.6
960	V	120	300	32	22.4	21	7	40.4	0	46	-5.6
961	H	120	300	33	22.4	21	7	41.4	0	54	-12.6
961	V	120	300	34	22.4	21	7	42.4	0	54	-11.6
1000	H	1000	1000	33	24.2	21	8	44.2	0	54	-9.8
1000	V	1000	1000	32	24.2	21	8	43.2	0	54	-10.8
1829	H	1000	1000	45	26.5	30	2	43.5	0	54	-10.5
1829	V	1000	1000	44	26.5	30	2	42.5	0	54	-11.5
2743.5	H	1000	1000	44	27.4	29	2	44.4	0	54	-9.6
2743.5	V	1000	1000	45	27.4	29	2	45.4	0	54	-8.6
3658	H	1000	1000	38	28.1	29	3	40.1	0	54	-13.9
3658	V	1000	1000	39	28.1	29	3	41.1	0	54	-12.9
4572.5	H	1000	1000	37	30.3	29	3	41.3	0	54	-12.7
4572.5	V	1000	1000	38	30.3	29	3	42.3	0	54	-11.7
5487	H	1000	1000	39	30.8	29	4	44.8	0	54	-9.2
5487	V	1000	1000	40	30.8	29	4	45.8	0	54	-8.2
6401.5	H	1000	1000	40	31.2	29	4	46.2	0	54	-7.8
6401.5	V	1000	1000	38	31.3	29	4	44.3	0	54	-9.7

Table 3 Cont'd. – Corrected Radiated Emissions Data and FCC Limit

X. Measurement Results Cont'd:

4. Radiated Emissions Cont'd.

The table below contains the spectrum analyzer output and the correction factors necessary to apply the limit to the data.

Freq MHz	Pol H/V	RBW kHz	VBW kHz	Vmeas dBuV	AF dB1/m	Amp dB	Cable dB	Field dBuV/m	Duty dB	Limit dBuV/m	Dev dB
7316	H	1000	1000	39	32.4	29	5	47.4	0	54	-6.6
7316	V	1000	1000	40	32.4	29	5	48.4	0	54	-5.6
8230.5	H	1000	1000	38	32.7	28	5	47.7	0	54	-6.3
8230.5	V	1000	1000	37	32.7	28	5	46.7	0	54	-7.3
9145	H	1000	1000	36	33.1	28	6	47.1	0	54	-6.9
9145	V	1000	1000	37	33.1	28	6	48.1	0	54	-5.9

Table 3 Cont'd. – Corrected Radiated Emissions Data and FCC Limit

X. Measurement Results Cont'd:

5. Exposure Evaluation.

The analysis below compares the measured power to the maximum permissible exposure limit for general population with uncontrolled access. The unit can be used continuously; no special averaging time or limit relaxations are employed. Maximum peak available power is used in calculations.

Unit Frequency: 914.5 MHz
Unit Maximum Average Power .001 Watt available
Standard User Weight: 100 kg

Specific Absorption Rate (SAR) Limit for whole-body: 0.08 W/kg
Specific Absorption Rate (SAR) Limit for one-gram tissue volume: 1.6 W/kg

SAR Whole body = .001 W/100 kg = 0.00001 W/kg for Gas Trainer
SAR 1g tissue = .001 W/ 001 kg * = 1 W/kg for Gas Trainer

In addition per IEEE C95.1 paragraph 6.10 (2): low power devices are unlikely to expose users in excess of the criteria when power is less than or equal to:
Pmax = 1.4 * (450/f) Watts where f is in MHz.
Pmax is significantly greater than the power available at the Gas Trainer:
Pmax = 1.4 * (450/914.5) = 0.69 W.