EMC Measurement / Technical Report

FCC Test Specification **:** Certification for FCC Part 15, Subpart C §15.231

Manufacturer **:** Gasguard Technologies, Inc.
Equipment Under Test **:** Maestro Transmitter
Model RFT-2000
Test Report No. **:** FR1407-2
Purchase Order No. **:** 268375

Document History					
Revision	**Issue Date**	**Affected Pages**	**Description of Modifications**	**Revised By**	**Approved By**
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EMC Measurement / Technical Report
Document No. FR1407-2
From
Garwood Laboratories, Inc.
World Compliance Division

Test for
Gasguard Technologies, Inc
Maestro Transmitter
Model RFT-2000

WRITTEN BY	REVIEWED BY	REVIEWED BY
Arnulfo Tapia *EMC Sr. Technician*	*Lisa A. Rodefeld* *Quality Manager*	*Ed Nakauchi* *EMC Chief Engineer* *NARTE, Certified*

Test Personnel	***Test Dates***
Eric Nguyen – Lead EMC Engineer	4 April, 2000

Test Facility	Garwood Laboratories, Inc.
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MEASUREMENT / TECHNICAL REPORT SUMMARY

Manufacturer Company	Gasguard Technologies, Inc
Address	2421 Canoe Avenue
City, State, Zip	Coquitlan, B.C. V3K6A9
Country	Canada
Contact Name	Ray Wood
Phone	888-397-4427
Fax	604-942-8004
Type of Authorization	Certification for an Intentional Radiator
Applicable FCC Rules	Prepared in accordance with the requirements of FCC Rules and Regulations as listed in 47 CFR Ch.1 Parts 0 to 19 (10-1-98 Edition). The following subparts are applicable to the results in this test report: Part 15, Subpart C – Intentional Radiators §15.231 Periodic Operation in the band 40.66-40.70 MHz and above 70 MHz § 15.203 Antenna requirements § 15.207 Conducted limits § 15.209 Radiated emission limits; general requirements Part 2, Subpart J – Equipment Authorization Procedures Certification sections
Equipment Under Test	Maestro Transmitter Model RFT-2000
Summary of Data	The EUT complied with all the applicable FCC rules as listed above.

EMC Test Laboratory	Garwood Laboratories Incorporated
Facility	World Compliance Division
Address	565 Porter Way
City, State, Zip Code	Placentia, CA 92870
Country	USA
Contact Name	Jason Armstrong
Title	General Manager
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1. GENERAL INFORMATION

1.1 Product Description

Equipment Under Test	Maestro Transmitter
Model Number	RFT-2000
Description	The RFT-2000 transmitter is designed to work with all Maestro sensors such as the Gas Maestro CO sensor, gas detector, tilt sensor, and the Water Maestro water sensor. A four-wire phone cable is needed to connect the transmitter with a sensor. The transmitter sends the status of a sensor to a remotely located receiver. The transmitter is powered from a 12VDC-wall adapter (GSS AC Adapter Model 1203) or a 9VDC battery. The modulation method used by the EUT is Pulse Width Modulation. The antenna for the transmitter is a ¼ " whip antenna, that is not accessible to the user. The transmitter automatically transmits a signal every 2 hours. The transmission length is for 2 seconds. The reset button on the EUT can be used to send a test signal. The transmission length of the test signal is also 2 seconds.
Transmitting Frequency	418.0 MHz
EUT Clock Frequencies	4MHz

1.2 Related Submittal(s)/ Grant(s)

Peripherals tested with the EUT, which contain FCC ID numbers can be located in the table in Section 3.6 of this report**.**

1.3 Tested System Description

The Tested System was configured with all typical peripherals (or terminations) and operated to generate the maximum emissions during the test. Refer to Section 3.5 and Section 3.6 for the configuration of the EUT during testing, support/peripheral equipment used during testing and cabling information. FCC ID numbers are included if available for a tested system component.

1.4 Test Methodology

Conducted emissions tests were performed according to the general provisions of ANSI C63.4-1992 (American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz).

The Equipment Under Test (EUT) was setup in a typical configuration inside a shielded enclosure to perform the conducted emissions measurements. The EUT was powered from the 50μH/50Ω Line Impedance Stabilization Networks (LISN). The LISN's unused connections were terminated with 50-ohm loads. The amplitude level (dBμV) of the emissions was maximized by varying the modes of operation of the EUT and its cables. The frequency range of 450 kHz to 30 MHz was measured with the receiver in peak detection.

The test for unwanted emissions was performed according to the general provisions of ANSI C63.4-1992 (American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz).

The EUT was setup on a non-conductive table, 1.0 x 1.5m, in the Open Area Test Site. The test for unwanted emissions was performed at an EUT to receiving antenna distance of 3 meters. The radiated emissions were maximized by rotating the turntable 360 degrees and varying the antenna height from 1 to 4 meters. The field strength of the fundamental frequency and harmonics, up to the 10^{th} harmonic, were measured utilizing a BiLog and Double Ridge Guide Horn antenna. Measurements were made in both, vertical and horizontal antenna polarizations.

1.5 Test Facility

The Open Area Test Site (OATS) and measurement facilities used to collect the test data are located at Garwood Laboratories, Inc. World Compliance Division test facility in Placentia, CA. This facility has been fully described in a report submitted to the FCC and accepted in a letter dated 28 January 2000 (31040/SIT 1300F2) registration #90681.

The test facility is also recognized and accredited from following accreditation organizations:

NVLAP

Garwood Laboratories, Inc. is recognized under the National Voluntary Laboratory Accreditation Program (*NVLAP/NIST*) 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 Code: 200119-0, Effective through December 31, 2000.

FCC

This site has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Reference : 31040/SIT 1300F2, Registration #90681, January 28, 2000. With the above and NVLAP, Garwood Laboratories is an authorized test laboratory for the DoC process.

Technology International (I^2T)

Garwood Laboratories, Inc. has been assessed in accordance with ISO Guide *25* and with ITI's assessment criteria. Based upon this assessment, Technology International (Europe), Ltd. Has granted approval for specifications implementing the EU Directive on EMC (89/336/EEC). The scope of the approval was provided on a Schedule of Assessment supplied with a certificate and is available upon request. Certificate #99-051, Dated: May 5, 1999.

ACA

Garwood Laboratories, Inc. can also perform testing for the Australian C-Tick mark as a result of our NVLAP accreditation and the MRA (Mutual Recognition Agreement) between the US and Australia.

VCCI

Garwood Laboratories, Inc. has been accepted as a member to the VCCI. Our conducted and radiated measurement facilities have been registered in accordance with Regulations for Voluntary Control Measures.
Registration C574, C575, C576, R561 Effective through February 4, 2000 (Renewal Pending).

Industry Canada

Garwood Laboratories, Inc. is registered by Industry Canada for performance of measurements and complies with RSP 100. Reference IC 3298, Dated: March 11, 1999.

BSMI (Formerly known as BCIQ)

Garwood Laboratories, Inc. can perform testing for Taiwan to the CNS requirements. This is as a result of our NVLAP accreditation and the MRA (Mutual Recognition Agreement) between the US and Taiwan.

Nmi (Nederlands Meetinstituut)

Garwood Laboratories, Inc. has entered into a cooperative agreement with Nmi Certin B.V. of the Netherlands. Ther are a Notified Body for the RATTE Directive and Maritime Directive as well as a Competent Body for the EMC Directive.

2. PRODUCT LABELING

2.1 FCC ID Label

All devices authorized under the certification procedures are required to display an identification label showing the FCC Identifier (FCC ID) under which they are authorized.
Example:

FCC ID: XXX123

XXX = Indicates manufacturer's Grantee Code
123 = Indicates manufacturer's Equipment Product Code

In addition, the manufacturer (or importer) is responsible for having the compliance label produced, and for having it affixed to each unit that is marketed or imported.

FCC Compliance Label:

This device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference including interference that may cause undesired operation.

2.2 Location of Label on EUT

As stated in §15.19, the label shall be located in a conspicuous location on the device. When the device is so small or for such use that it is not practicable to place the compliance label on it, the information required should be placed in a prominent location in the instruction manual or pamphlet supplied to the user. Alternatively, the compliance label can be placed on the container in which the device is marketed. However, the FCC identifier must be displayed on the device.

2.3 Information to the user

The users manual or instruction manual for an intentional or unintentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

3. SYSTEM TEST CONFIGURATION

3.1 Justification

The EUT was used in a system configured for testing in a typical fashion, as a customer would normally use it.

3.2 EUT Exercise Software/Equipment

The following operating mode was used during testing to exercise the functions of the EUT.

1. Upon power up, all the functions of the EUT were enabled. The reset button on the transmitter was pressed and released. This allowed the EUT to transmit a test signal.

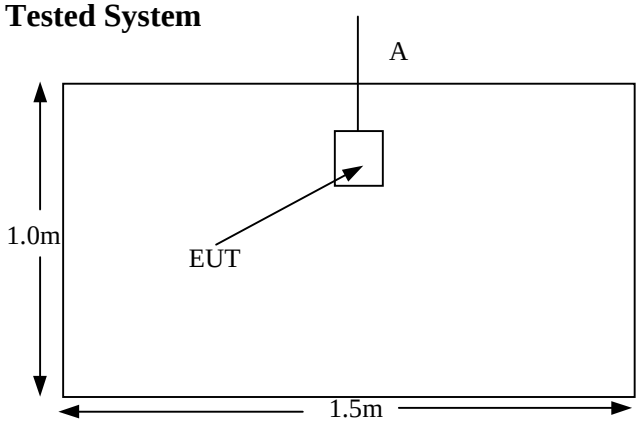
3.3 Special Accessories

The EUT requires no special accessories to comply with the limits.

3.4 Equipment Modifications

No modifications were made to achieve the required specification limit.

3.5 Configuration of Tested System



The Maestro Transmitter Model RFT-2000 was tested as a stand-alone system

3.6 Details of Tested System

The following table lists the accessory/peripheral equipment used during testing of the EUT. FCC ID numbers are included if available for a tested system component.

Accessory/Peripheral Equipment			
Item No.	***Manufacturer***	***Description***	***Identification Numbers***
1	None	None	Model No: Not applicable Serial No.: Not applicable

The EUT was tested as a stand-alone system. No accessory/peripheral equipment was used during testing.

The following table lists all of the cabling details for the tested system.

Cabling of The Tested System					
Item No.	***Description***	***Length (m)***	***Type Shielded-S Unshielded-US***	***Connected From***	***Connected To***
A	Power Adaptor Cord	2.0	Unshielded	EUT	AC Source

4. BLOCK DIAGRAM(S) OF EUT

Please refer to the Attachment Section of this report for a Block Diagram of the EUT.

5. TEST MEASUREMENT AND EUT PHOTOS

Photo: Conducted Emissions (Front View)
Photo: Conducted Emissions (Rear View)

Photo: Radiated Emissions (Front View)

Photo: Radiated Emissions (Rear View)

EUT (Top View)

EUT (Rear View)

EUT (Side View 1)

EUT (Side View 2)

EUT (Bottom cover removed)

EUT PCB (Component side)

EUT PCB (Solder Side)

6. TEST DATA

6.1 Conducted Emissions Limits

FCC Pt.15 Subpart C, §15.207		
Frequency (MHz)	***Quasi Peak Limit (dBµV)***	***Remarks***
0.45 – 30.0	48.0	None

6.2 Conducted Emissions Results

The initial step in collecting data is a spectrum analyzer peak scan of the measurement range. Significant peaks are then marked as shown on the data page, and these signals are then quasi-peaked if necessary. The following data lists the significant emission frequencies and measured levels from the EUT.

Sensor Location	***Frequency Band (MHz)***	***Measured* (dBµV)***	***Delta To Limit (dB)***
Line	0.4812	32.7	-15.3
	0.4853	32.7	-15.3
	0.4977	28.9	-19.1
	0.5740	28.6	-19.4
	0.4615	27.9	-20.1
	0.4557	27.6	-20.4
Neutral	0.5104	32.7	-15.3
	0.4673	29.6	-18.4
	0.5190	29.3	-18.7
	0.4956	29.1	-18.9
	0.5986	29.1	-18.9
	0.4595	28.9	-19.1

- All readings are peak with specified CISPR bandwidth unless stated otherwise.

Test Personnel: Eric Nguyen

Eric Nguyen – Lead EMC Engineer

6.3 General Radiated Emissions Requirements

Emissions that are radiated outside of the specified frequency bands, except for harmonics, should be attenuated by at least 50 dB below the level of the fundamental or to the general radiated limits in §15.209, whichever is the lesser attenuation.

6.4 General Radiated Emissions Results

The following data lists the significant emission frequencies, measured levels, correction factor (includes cable, preamplifier and antenna corrections), the corrected reading, plus the limit.

Worst-Case Radiated Emissions from 30 – 1000MHz				
	Frequency (MHz)	***Detection Mode***	***Corrected Reading (dBµV/m)***	***Delta to the 10m Quasi-Peak Limit(dB)***
1.	NDS	-	-	-

- All readings are peak with specified CISPR bandwidth unless stated otherwise.

NDS: There were no detectable signals from the EUT from 30 – 1000MHz.

Test Personnel: Eric Hm Nguyen

Eric Nguyen – Lead EMC Engineer

6.5 Field Strength of Emissions Requirement

FCC Part 15, Subpart C, § 15.231		
Fundamental Frequency (MHz)	Field Strength of Fundamental (µV/m)	Field Strength of Spurious Emissions (µV/m)
40.66-40.70	2,250	225
70-130	1,250	125
130-174	1,250 to 3,750*	125 to 375*
174-260	3,750	375
260-470	3,750 to 12,500*	375 to 1,250*
Above 470	12,500	1,250

*Linear Interpolations. The following formula was used to calculate the limit:

(125/3) x f (MHz) – (21250/3) µV/m = Limit,

for a test distance of 3 meters, where f (MHz) is the EUT's fundamental frequency.

The fundamental frequency of the EUT is 418.0 MHz. The applicable limits for the EUT are those listed for the fundamental frequency falling within the frequency band of 260-470 MHz.

6.6 Summary Table for Highest Field Strength Levels

The following table lists the fundamental and harmonic emission frequencies, spectrum analyzer measured levels, correction factor (includes cable loss, preamplifier gain and antenna factor), the corrected reading, and the specification limit.

EUT Name: Maestro Transmitter
EUT Model: RFT-2000
Operating Frequency: 418.0 MHz
Field Strength of Emissions from an Intentional Radiator (Reference: FCC Pt.15 Subpart C, §15.231(b))
FCC Average Limit for the Fundamental: (125/3) x f (MHz) – (21250/3) µV/m @3meters = 10,333.3µV/m
FCC Average Limit for the Harmonics: 1,033.3µV/m

Polarity (V or H)	Frequency (MHz)	S.A. Reading Peak (dBµV)	Pre-Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Peak Field Strength at 3 meters (dBµV/m)	Peak Field Strength at 3 meters (µV/m)	Average Field Strength at 3 meters (µV/m)	FCC Limit at 3 meters (µV/m)
V	418	84.5	17.65	16.25	2.65	85.75	19,386.50	7,328.10	10,333.30
H	418	81.3	17.65	16.25	2.65	82.55	13,412.20	5,069.80	10,333.30
V	836	46.3	13.15	22.75	4.3	60.2	1,023.30	386.8	1,033.30
H	836	43.5	13.15	22.75	4.3	57.4	741.3	280.2	1,033.30
V	1254	49.8	36.99	24.2	6.65	43.66	152.4	57.6	1,033.30
H	1254	45	36.99	24.2	6.65	38.86	87.7	33.2	1,033.30
V	1672	49.6	36.55	25.15	7.97	46.17	203.5	76.9	1,033.30
H	1672	44.8	36.55	25.15	7.97	41.37	117.1	44.3	1,033.30
V	2090	48	36.08	27.4	9.35	48.67	271.3	102.6	1,033.30
H	2090	43.7	36.08	27.4	9.35	44.37	165.4	62.5	1,033.30
V	2508	NDS	35.99	28.3	11	**	**	**	1,033.30
H	2508	NDS	35.99	28.3	11	**	**	**	1,033.30
V	2926	NDS	35.86	31	11.9	**	**	**	1,033.30
H	2926	NDS	35.86	31	11.9	**	**	**	1,033.30
V	3344	NDS	35.7	31.2	13.7	**	**	**	1,033.30
H	3344	NDS	35.7	31.2	13.7	**	**	**	1,033.30
V	3762	NDS	35.62	31.8	14.15	**	**	**	1,033.30
H	3762	NDS	35.62	31.8	14.15	**	**	**	1,033.30
V	4180	NDS	35.5	32.3	15.02	**	**	**	1,033.30
H	4180	NDS	35.5	32.3	15.02	**	**	**	1,033.30

Note: NDS = No Detectable Signal (Ambient level measured, 38.8 dBµV/m)
- Average emission measurements were employed and the provisions in §15.35 for averaging pulsed emissions and for limiting peak emissions were followed. The total on time for the EUT was calculated to be 37.8ms. Please refer to the Appendix B for a plot of the Duty Cycle Calculation.

6.7 Field Strength Calculation

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
RA = Receiver Amplitude
AF = Antenna Factor
CF = Cable Attenuation Factor
AG = Amplifier gain

Example:

Assume a receiver reading of 52.5 dBµV 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 dBµV/m.

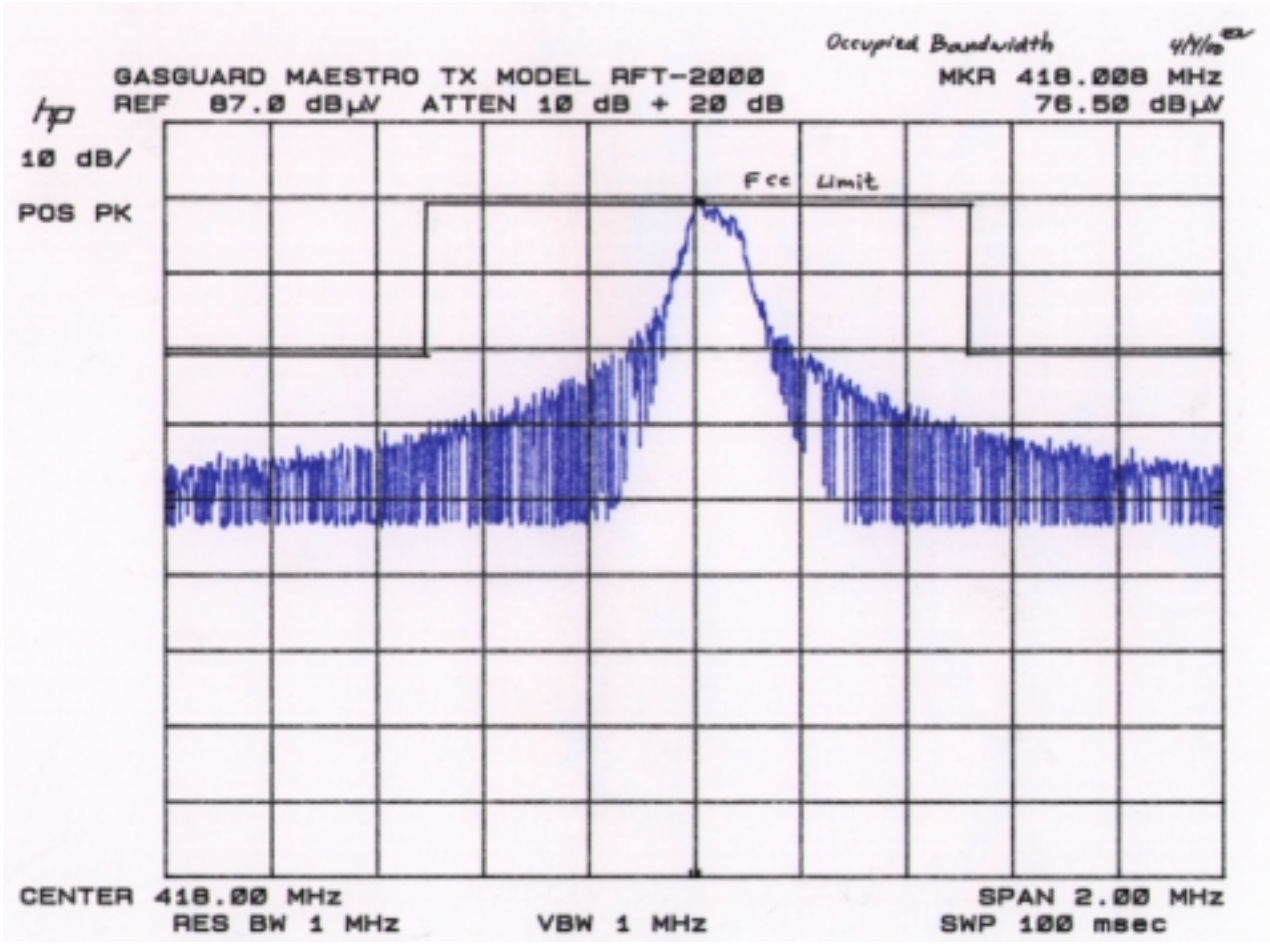
FS = 52.5 + 7.4 + 1.1 - 29 = 32 dBµV/m

6.8 Occupied Bandwidth

Requirement:
The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900MHz. The bandwidth is determined at the points 20 dB down from the modulated carrier.

Occupied Requirement for the EUT:
418 MHz x 0.0025 = 1.045 MHz (Should not exceed 1.045MHz)

Test Result:
The EUT complied with the occupied bandwidth requirement.



APPENDIX A - TEST EQUIPMENT USED

The absolute performance calibration of equipment requiring calibration is performed on an as needed basis in accordance with MIL-STD 45662A. However, calibration periods do not exceed one (1) year. The test equipment is capable of making measurements within tolerances of at least +/- 2dB amplitude and +/- 2% frequency deviation. Equipment certifications showing traceability to NIST (National Institute of Standards and Technology) are maintained on file at Garwood Laboratories, Inc. Placentia, CA. All equipment is checked and verified for proper operation before and after each series of tests.

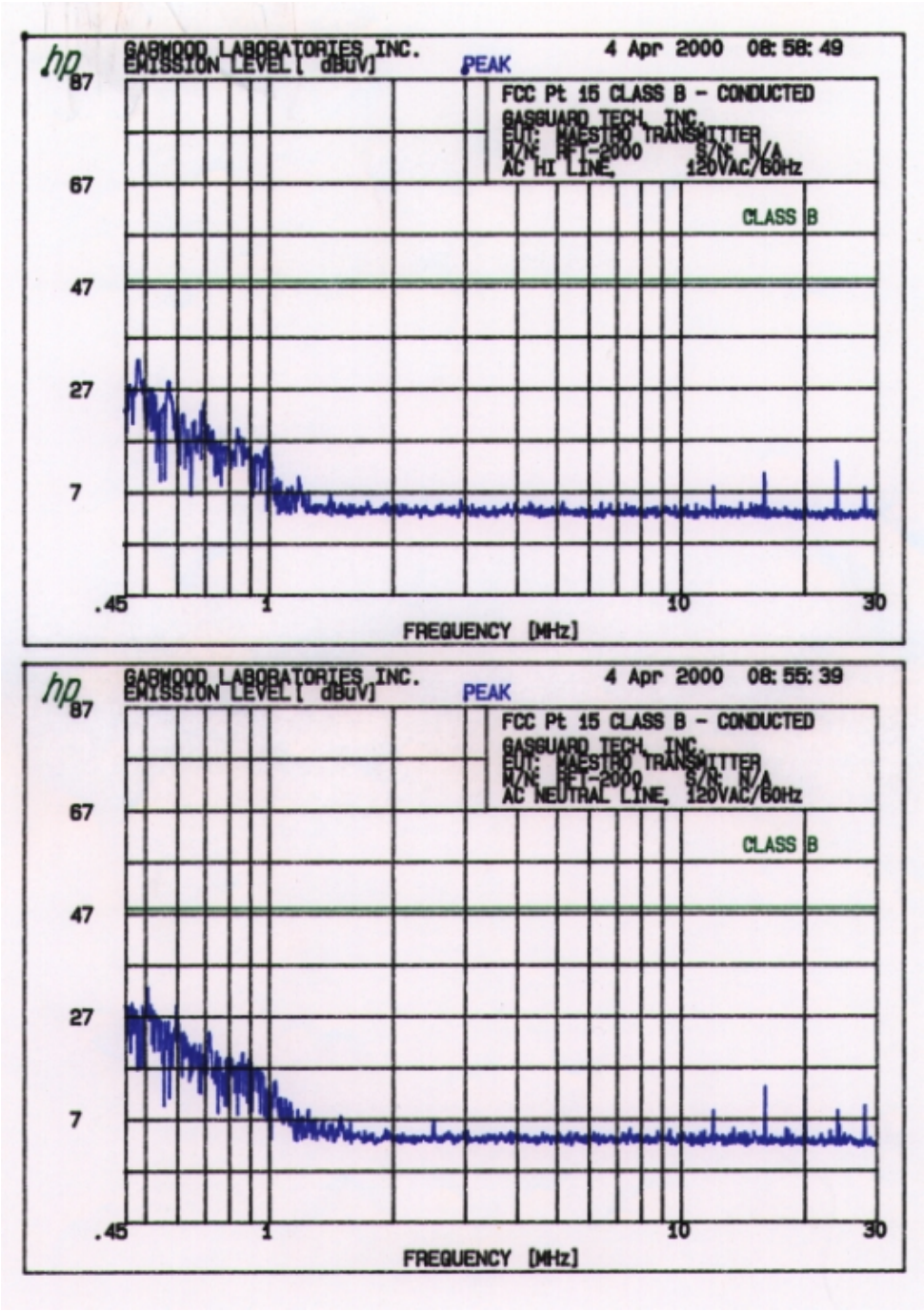
A.1 Specific Equipment Used

Test	*Instrument*	*MFG / Model No.*	*Asset No.*	*CAL. Due Date*
Conducted Emission Test				
	EMI Receiver System	Hewlett Packard	System 1	02/25/01
	RF Coax Cable	Pasternack / RG 223	20170	03/05/01
	Line Impedance Stabilization Network	FCC / LISN-50-25-2	20073	06/10/00
Radiated Emission Test				
	EMI Receiver System	Hewlett Packard	System 3	02/05/01
	RF Coax Cable	Times Microwave / LMR 600	20180	03/05/01
	BiLog Antenna	Chase / CBL6111A	20062	07/09/00
	Pre-Amplifier	ISCI / RFPA/Z FL-2000	20007	03/05/01
	Spectrum Analyzer	Hewlett Packard / 8566B	20257	02/24/01
	Preamplifier (Above 1000MHz)	Hewlett Packard / 8449B	20003	10/14/00
	Double Ridge Guide Horn Antenna	Emco / 3115	20056	01/13/01

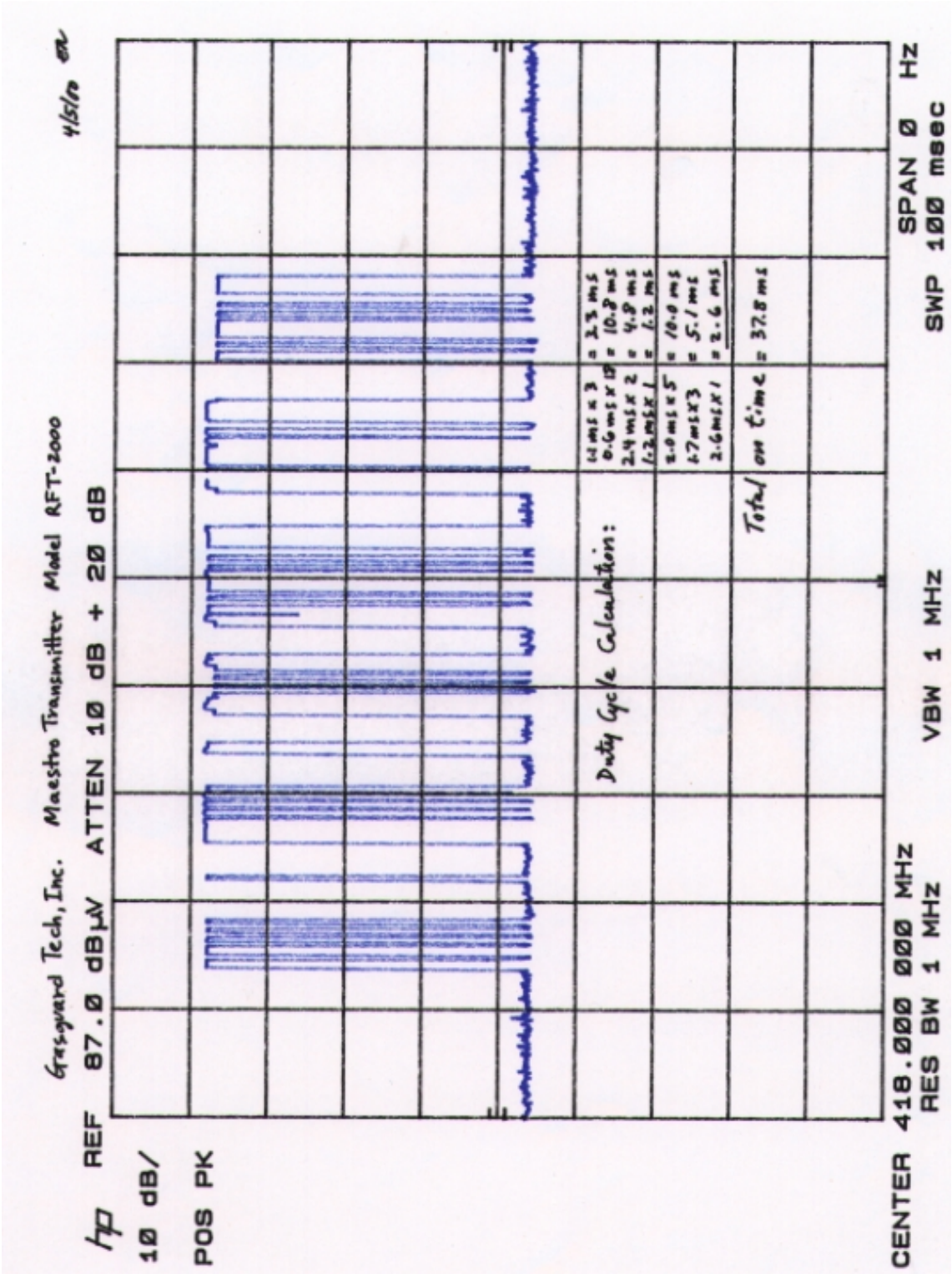
APPENDIX B – SUPPLEMENTAL TEST DATA

Test Type	*Basic Standard*	*Details*	*Data Format*	*Page No.*
Conducted Emissions	FCC Pt.15 Subpart C	Conducted Emissions Test Plot AC High Line & AC Neutral Line	Plotted	D1
Duty Cycle Calculation	FCC Pt.15 §15.35	Provisions in §15.35 for averaging pulsed emissions and limiting peak emissions were followed. Total on time of the EUT is 37.8ms	Plotted	D2

D1


GARWOOD LABORATORIES, INC.
EMISSION LEVEL [dBuV]
PEAK
4 Apr 2000 08:58:49
FCC Pt 15 CLASS B - CONDUCTED
GASGUARD TECH, INC.
EUT: MAESTRO TRANSMITTER
M/N: RFT-2000 S/N: N/A
AC HI LINE, 120VAC/60Hz
CLASS B
87
67
47
27
7
.45
1
10
30
FREQUENCY [MHz]
GARWOOD LABORATORIES, INC.
EMISSION LEVEL [dBuV]
PEAK
4 Apr 2000 08:55:39
FCC Pt 15 CLASS B - CONDUCTED
GASGUARD TECH, INC.
EUT: MAESTRO TRANSMITTER
M/N: RFT-2000 S/N: N/A
AC NEUTRAL LINE, 120VAC/60Hz
CLASS B
87
67
47
27
7
.45
1
10
30
FREQUENCY [MHz]

D2


Garguard Tech, Inc. Maestro Transmitter Model RFT-2000
4/5/00
REF 87.0 dBµV ATTEN 10 dB + 20 dB
10 dB/
POS PK
CENTER 418.000 000 MHz
RES BW 1 MHz
VBW 1 MHz
SPAN 0 Hz
SWP 100 msec
Duty Cycle Calculation:
4 ms x 3 = 12 ms
0.6 ms x 18 = 10.8 ms
2.4 ms x 2 = 4.8 ms
1.2 ms x 1 = 1.2 ms
2.0 ms x 5 = 10.0 ms
1.7 ms x 3 = 5.1 ms
2.6 ms x 1 = 2.6 ms
Total on time = 37.8 ms

ATTACHMENTS

INDEX OF ATTACHMENTS