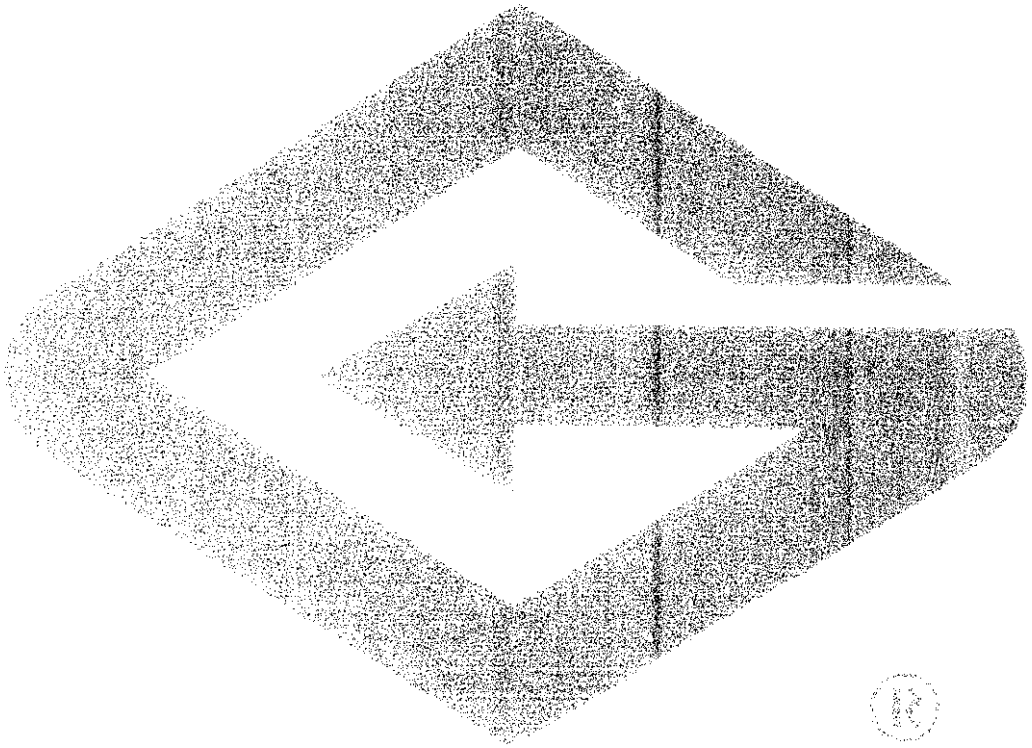


FCC TEST REPORT

for

Laser Chaser

Arena Transceiver

EMC Measurement / Technical Report

FCC Test Specification : Certification for FCC Part 15, Subpart C
Section 15.207, 15.231(c) &15.249

Manufacturer : Laser Chaser

Equipment Under Test : Arena Transceiver

Test Report No. : TR1006OC

Purchase Order No. : 64

Document History					
Revision	***Issue Date***	***Affected Pages***	***Description of Modifications***	***Revised By***	***Approved By***
0	29 December, 1998		Initial release		
1	4 June, 1999	All	Retest	E.N.	

EMC Measurement / Technical Report
Document No.TR1006OC
From
Garwood Laboratories, Inc.
World Compliance Division

Test for
Laser Chaser
Arena Transceiver

WRITTEN BY	REVIEWED BY	REVIEWED BY
Arnulfo Tapia *Sr. EMC Technician*	*Robert Lynch* *Quality Manager*	*Ed Nakauchi* *EMC Engineer* *NARTE, Certified*

Test Personnel	***Test Dates***
Arnulfo Tapia- Sr. EMC Technician	2, December 1998 & 20, May 1999

Test Facility	Garwood Laboratories, Inc.-OC
Address	565 Porter Way
City, State, Zip Code	Placentia, CA 92870
Phone	(714) 572-2027
Fax	(714) 572-2025

TABLE OF CONTENTS

MEASUREMENT / TECHNICAL REPORT SUMMARY

Manufacturer Company	Laser Chaser
Address	1777 W. Arrow Route, Suite 305
City, State, Zip	Upland, CA 91786
Country	USA
Contact Name	Craig Grim
Phone	909-946-2953
Fax	909-985-8983
Type of Authorization	Certification for Intentional Radiators
Applicable FCC Rules	PART 15 - RADIO FREQUENCY DEVICES Prepared in accordance with the requirements of FCC Rules and Regulations as listed in 47 CFR Ch.1 (10-1-96 Edition). The following subparts are applicable to the results in this test report: Part 15, Subpart C – Intentional Radiators Section: 15.207 Conducted Emission Section 15.231(c) Occupied Bandwidth Section 15.249 Radiated Emission
Equipment Under Test	Arena Transceiver
Summary of Data	The EUT complies with the following sections of 47 CFR Ch.1 (10-1-96 Edition): Part 15, Subpart C – Intentional Radiators Section: 15.207, 15.231(c) & Section 15.249

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
Phone	(714) 572-2027
Fax	(714) 572-2025

1. General Information

1.1 Product Description

Equipment Under Test	Area Transceiver
Description	The Area Transceiver is one piece of an RTS System used for laser tag games. The RTS system consists of a vest with a receiver and a transmitter, a laser gun, an arena transceiver, and a smart card programmer unit. This report applies only to the arena transceiver.
Clock Frequencies	Arena transceiver 916.5MHz

Refer to the products data sheet which has been included as an Attachment to this report for additional details about the EUT.

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 maximum emissions during the test. Refer to Section 3.5 for the Test Configuration and Section 3.6 the table lists all the details for Tested System components 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 guidelines set forth in FCC Part 15, Subpart C, Section 15.207.
The Equipment Under Test (EUT) was setup in a shielded enclosure to perform conducted emissions measurements in a typical installation configuration. The EUT was powered from the 50uH/50Ω Line Impedance Stabilization Network (LISN). The LISN's unused connection were terminated with a 50Ω load. The amplitude levels (dBuV) of the emissions were maximized by varying the mode of operations of the EUT and cables. Measurements were performed from 450 kHz to 30 MHz in peak detection. The peak measurements within 5 dB of the specification limits were re-measured with the receiver in either the quasi-peak or average detection as required.

The test data presented in this report has been acquired using the guidelines set forth in FCC Part 15, Subpart C, Section 15.249.
The field strength of emissions from an intentional radiator test was performed at a receiving antenna to EUT distance of 3 meters in the Open Area Test Site. Rotating the turntable 360 degrees and varying the antenna height 1 to 4 meters maximized the emissions. The field strength of the fundamental frequency and harmonics, up to the 10th harmonic, was measured utilizing a BiLog and Horn antenna. Measurements were made in both, vertical and horizontal antenna polarizations.
The radiated emissions test 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).

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 29 January 1999 (31040/SIT 1300F2) registration #90681.

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

Acemark Europe, Ltd.	Laboratory Number: 0007 *ISO Guide 25, EN45001, and relevant parts of ISO 9002*	Dated: 03/17/97
Industry Canada	Reference: IC 3298	Dated: 03/11/99
I^2T (*Interference Tech International*)	Certificate Number: 99-051 CE Mark for European Country	Dated: 05/05/99
NVLAP (*NIST*)	NVLAP Lab Code: 200119-0 CISPR, FCC, AUSTEL	Effective Through 12/31/99
VCCI	Registration #'s C574, C575, C576, R561	Effective Through 02/04/00

(Voluntary Control Council for Interference by Information Technology Equipment)

2. Product Labeling

2.1 FCC ID Label

Refer to Attachment Page C2 for FCC ID label and its location drawing for details.

FCC ID: XXX 123...789

2.2 Location of Label on EUT

The label shall be located in a conspicuous place on the device consistent with the requirements of Section §15.19 of FCC CFR 47.

This device complies with Part 15 of the FCC rules and regulations. 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.

2.3 Information to 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.

(a) For a Class A digital device or peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the text of the manual:

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

(b) For a Class B digital device or peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the text of the manual:

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

-Reorient or relocate the receiving antenna.
-Increase the separation between the equipment and receiver.
-Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
-Consult the dealer or an experienced radio/ TV technician for help.

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

During testing, the arena transceiver was continuously transmitting. This unit transmits and receives continuously in order to keep track of the ongoing laser tag action on the game floor. The vest transmitter only transmits for a quick and short period of time when the vest is hit by a laser shot. During testing, the laser gun was used to activate the vest transmitter.

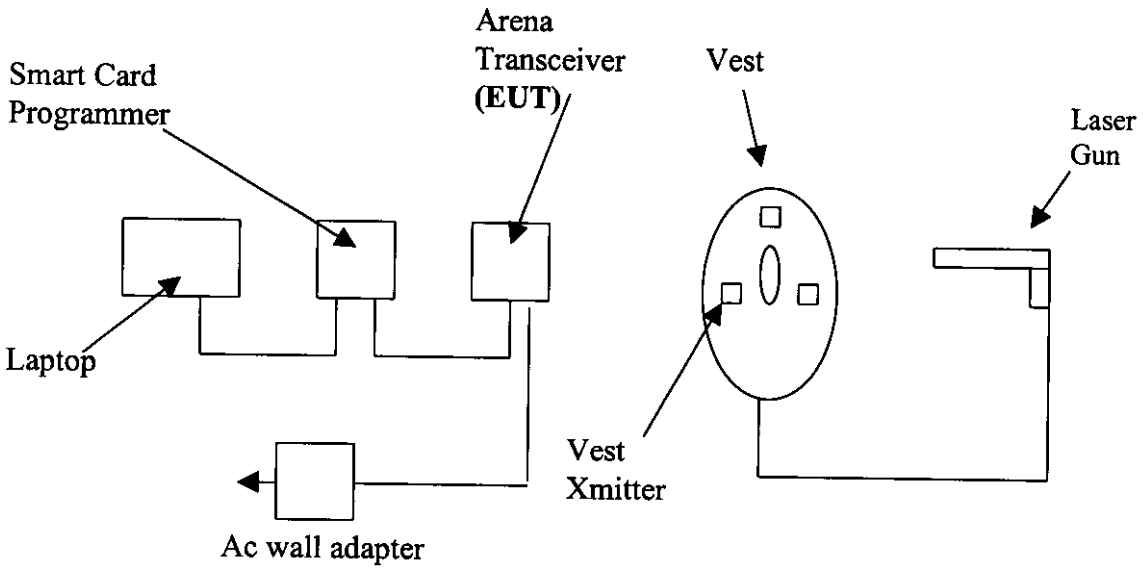
3.3 Special Accessories

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

3.4 Equipment Modifications

The following modification was made to achieve the required specification limit.
1. The antenna for the arena transceiver was changed.

3.5 Configuration of Tested System



3.6 Details of Tested System

The following table lists all of the components of the tested system. FCC ID numbers are included if available for a tested system component. Refer to the table following Tested System Details for cabling information.

Item No.	*Manufacturer*	*Description*	*Identification Numbers*
1	Laser Chaser	Vest	Model No: Refer to the Manufacture Serial No.:
2	Laser Chaser	Laser Gun	Model No: Refer to the Manufacture Serial No.:
3	Laser Chaser	Smart Card Programmer	Model No: Refer to the Manufacture Serial No.:
4	Laser Chaser	Arena Transceiver (EUT)	Model No: Refer to the Manufacture Serial No:
5	Compudyne	Laptop	Model No: N386SXE Serial No.: 3530A0R21J0279 FCC ID: IIRBC380A

The following table lists all of the cabling details for the tested system. Refer to 3.5 configuration of tested system.

Cabling of The Tested System					
Item No.	***Description***	***Length (m)***	***Type Shielded-S Unshielded-US***	***Connected From***	***Connected To***
A	DB-9 Serial Cable	2.0	Shielded	Laptop	Smart Card Programmer
B	DB-9 Serial Cable	2.0	Unshielded	Smart Card Programmer	Arena Transceiver
C	Vest to Gun Harness	1.0	Shielded	Vest	Gun

4. BLOCK DIAGRAM(S) OF EUT

Please consult the manufacturer for all block diagrams, circuit layout, and component information.

6. TEST DATA

6.1 Conducted Emissions Limits

FCC Part 15, Subpart C, Section 15.207	
Frequency Range (MHz)	***Class B Limit (dBμV)***
0.45 to 1.705	48
1.705 to 30.0	48

6.2 Conducted Emissions Results

The highest emissions are listed in the tables below.

Worst-Case Conducted Emissions (Compared To The Quasi-Peak Limit Line)					
	Frequency (MHz)	***Detection Mode***	***Corrected Reading (dBuV)***	***Delta To QP Limit (dBuV)***	***Sensor Location***
1.	0.4576	QP	40.9	-7.1	Line 1
2.	0.5278	QP	36.2	-11.8	Line 1
3.	0.5481	Peak	41	-7.0	Line 1
4.	0.5621	Peak	39.9	-8.1	Line 1
5.	0.5716	Peak	39.2	-8.8	Line 1
6.	0.5837	Peak	37.9	-10.1	Line 1

The highest emissions are listed in the table below.

Worst-Case Conducted Emissions (Compared To The Quasi-Peak Limit Line)					
	Frequency (MHz)	***Detection Mode***	***Corrected Reading (dBuV)***	***Delta To QP Limit (dBuV)***	***Sensor Location***
1.	0.4615	Peak	43.4	-4.6	Line 2
2.	0.4713	Peak	42.5	-5.5	Line 2
3.	0.9697	Peak	40.6	-7.4	Line 2
4.	0.9779	Peak	40.6	-7.4	Line 2
5.	0.9456	Peak	40.5	-7.5	Line 2
6.	0.9576	Peak	40.5	-7.5	Line 2

6.3 Radiated Spurious Emissions Limits

FCC Part 15, Subpart C, Section 15.249		
Fundamental frequency	***Field Strength of Fundamental (millivolts/meter)***	***Field Strength of Harmonics (microvolts/meter)***
902 – 928 MHz	50	500
2400 – 2486.5 MHz	50	500
5725 – 5875 MHz	50	500
24.0 – 24.25 MHz	250	2500

The applicable limits for the Arena Transceiver are those listed for fundamental frequencies falling within the band of 902 – 928 MHz.

6.4 Radiated Spurious 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.

EUT Name: Arena Transceiver
Test Results: Field Strength and Spurious Emissions Measurements (Reference: FCC Part 15, Subpart C, Section 15.249)
Fundamental Frequency tuned at: 916.5 MHz

Antenna Polarity (V or H)	Frequency (MHz)	S.A. Reading (dBuV)	Antenna Factor (dB)	Cable Loss (dB)	Pre-Amp Gain (dB)	QP Field Strength (dBuV/m)	QP Field Strength (uV/m)	FCC Limit 3 meters (uV/m)
V	916.5	89.0	23.4	Gain/Loss Factor 18.4		93.8	48,978	50,000.0
H	916.5	94.4	23.4	Gain/Loss Factor 18.4		89.9	31,261	50,000.0
V	1833	47.6	27.3	5.7	37.59	43.01	141.4	500.0
H	1833	48.4	27.3	5.7	37.59	43.81	155.06	500.0
V	2749.5	NDS	29.6	9.8	36.85	NDS	NDS	500.0
H	2749.5	NDS	29.6	9.8	36.85	NDS	NDS	500.0
V	3666	NDS	30.5	12.2	36.50	NDS	NDS	500.0
H	3666	NDS	30.5	12.2	36.50	NDS	NDS	500.0
V	4582.5	18.3	32.0	14.8	36.10	29.0	28.19	500.0
H	4582.5	20.7	32.0	14.8	36.10	31.4	37.2	500.0
V	5499	NDS	34.2	16.0	35.95	NDS	NDS	500.0
H	5499	NDS	34.2	16.0	35.95	NDS	NDS	500.0
V	6415.5	NDS	35.5	-	36.03	NDS	NDS	500.0
H	6415.5	NDS	35.5	-	36.03	NDS	NDS	500.0
V	7332	NDS	37.4	-	36.16	NDS	NDS	500.0
H	7332	NDS	37.4	-	36.16	NDS	NDS	500.0
V	8248.5	NDS	37.6	-	36.51	NDS	NDS	500.0
H	8248.5	NDS	37.6	-	36.51	NDS	NDS	500.0
V	9165	NDS	37.2	-	36.65	NDS	NDS	500.0
H	9165	NDS	37.2	-	36.65	NDS	NDS	500.0

Test Personnel:

Arnulfo Tapia - EMC Sr. Test Technician

6.5 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

6.6 Occupied Bandwidth

FCC Part 15, Subpart C, Section 15.231(c)	
Operating Frequency	***Bandwidth of the Emission Allowed***
Above 70 MHz & Below 900 MHz	No wider than 0.25% of the center frequency
Above 900 MHz	No wider than 0.5% of the center frequency

The Bandwidth is determined at the points 20 dB down from the modulated carrier.

Results:
The Bandwidth of the emission allowed for the Arena Transceiver was calculated to be 4.5 MHz (0.5% of 916.5 MHz). The emission from the Arena Transceiver was within the allowable bandwidth requirements. Detail plots are attached in appendix B.

APPENDIX A - TEST EQUIPMENT USED

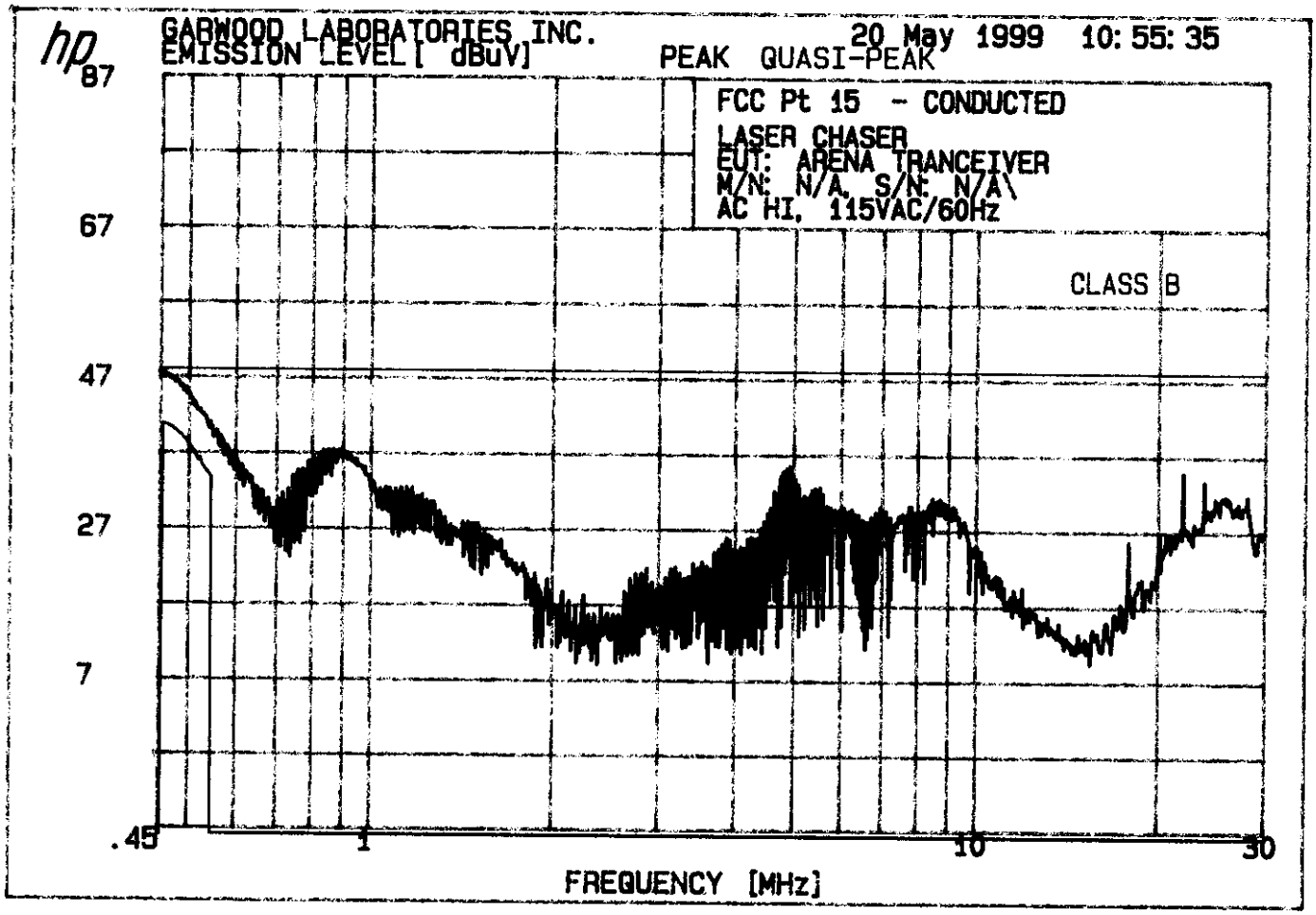
A complete list of test equipment used for each test can be found in their perspective test procedure. The absolute performance calibration, of the equipment requiring calibration, is performed on an as needed basis in accordance with MIL-STD-45662. However, calibration periods do not exceed one (1)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

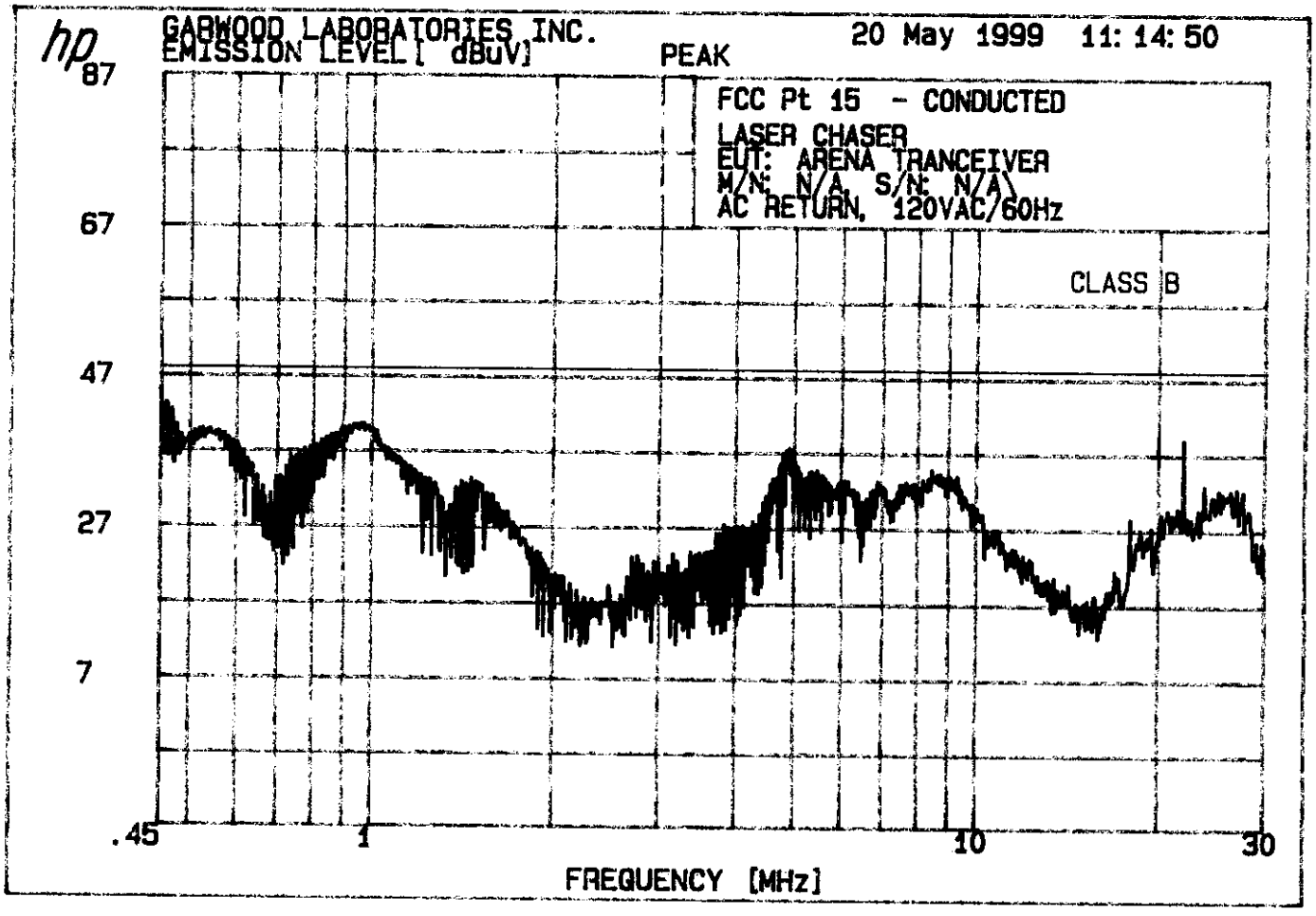
A.1 Specific Equipment Used

Test Instrument	*Mfg / Model No.*	*Serial No.*	*Cal. Due Date*
Radiated Emissions Test			
Spectrum Analyzer	Hewlett Packard / 8566B	A17517	04/22/00
BiLog Antenna	Chase / CBL6111A	1823	04/12/00
Preamplifier (30-1000MHz)	ISCI / ZFL-2000	017	03/05/00
RF Coax Cable	Times Microwave / LMR-600	030	03/05/00
Preamplifier (Above 1000MHz)	Hewlett Packard / 8449B	0357	10/14/99
Double Ridge Guide Horn Antenna	Emco / 3115	9511-4575	1/10/00
Conducted Emissions Test			
EMI Receiver System	Hewlett Packard / 8574A	23837A00824	11/25/99
Line Impedance Stabilization Network	ISCI / 3PH-20A	010	03/16/00
RF Coax Cable	Pasternack / RG223	020	12/02/99

APPENDIX B – SUPPLEMENTAL TEST DATA

Test Type	*Basic Standard*	*Details*	*Data Format*	*Page No.*
Conducted Emissions	FCC Part 15 Subpart C Section 15.207	Line 1 and Line 2, Peak and Quasi-peak	Plotted Tabulated	D1-D4


GARWOOD LABORATORIES INC.
20 May 1999 10:55:35
EMISSION LEVEL[dBuV]
PEAK QUASI-PEAK
FCC Pt 15 - CONDUCTED
LASER CHASER
EUT: ARENA TRANCEIVER
M/N: N/A S/N: N/A\
AC HI, 115VAC/60Hz
CLASS B
87
67
47
27
7
.45
1
10
30
FREQUENCY [MHz]


GARWOOD LABORATORIES INC.
20 May 1999 11:14:50
EMISSION LEVEL[dBuV]
PEAK
FCC Pt 15 - CONDUCTED
LASER CHASER
EUT: ARENA TRANCEIVER
M/N: N/A S/N: N/A\
AC RETURN, 120VAC/60Hz
CLASS B
87
67
47
27
7
.45
1
10
30
FREQUENCY [MHz]

GARWOOD LABORATORIES INC
EMI TEST DATA

DATE: 20 MAY, 1999 TEST NO.: 1
TITLE OF TEST: FCC PART 15 CLASS B, CONDUCTED EMISSIONS
CUSTOMER: LASER CHASER
EUT DESCRIPTION: ARENA TRANCEIVER
MODEL NO.: N/A SERIAL NO.: N/A
TEST MODE: TRANSMITTING 916.5 MHz, TYPICAL OPERATION
SENSOR LOCATION: AC HI SENSOR POL.: N/A
FREQUENCY RANGE: .450 - 30 MHz
TEST PERFORMED BY:K.VU TEMP. 71 F. HUM. 52 %
TEST RESULTS: COMPLIED
TEST CONDITIONS: 120VAC/60Hz

==========
GARWOOD LABORATORIES INC. 20 May 1999 10:55:35
==========
1. ARENA TRANCEIVER
1.1 FCC Pt 15 - CONDUCTED
==========
LASER CHASER
EUT: ARENA TRANCEIVER
M/N: N/A, S/N: N/A\
AC HI, 120VAC/60Hz

25 highest Peaks above -30 dB of Limit Line #1
peak criteria = .1 dB

PEAK#	FREQ (MHz)	(dBuV)	DELTA
1	.4576	47.7	-.3
2	.4615	47.6	-.4
3	.4853	46.5	-1.5
4	.4914	45.9	-2.1
5	.4977	45.6	-2.4
6	.5168	43.6	-4.4
7	.5481	41	-7.0
8	.5621	39.9	-8.1
9	.5716	39.2	-8.8
10	.5837	37.9	-10.1
11	.9068	37.7	-10.3
12	.8768	37.5	-10.5
13	.8444	37.4	-10.6
14	.8586	37.4	-10.6
15	.8954	37.4	-10.6
16	.5961	37	-11.0
17	.9183	37	-11.0
18	.8303	36.9	-11.1
19	.9299	36.7	-11.3
20	.8131	36.5	-11.5
21	.9377	36.5	-11.5
22	.6062	36.3	-11.7
23	.9496	36.1	-11.9
24	.9576	36.1	-11.9
25	.7962	35.9	-12.1

GARWOOD LABORATORIES INC
EMI TEST DATA

DATE: 20 MAY, 1999 TEST NO.: 1
TITLE OF TEST: FCC PART 15 CLASS B, CONDUCTED EMISSIONS
CUSTOMER: LASER CHASER
EUT DESCRIPTION: ARENA TRANCEIVER
MODEL NO.: N/A SERIAL NO.: N/A
TEST MODE: TRANSMITTING 916.5 MHz, TYPICAL OPERATION
SENSOR LOCATION: AC HI SENSOR POL.: N/A
FREQUENCY RANGE: .450 - 30 MHz
TEST PERFORMED BY:K.VU TEMP. 71 F. HUM. 52 %
TEST RESULTS: COMPLIED
TEST CONDITIONS: 120VAC/60Hz

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GARWOOD LABORATORIES INC. 20 May 1999 10:55:35

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1. ARENA TRANCEIVER
   1.1 FCC Pt 15 - CONDUCTED

==========

LASER CHASER
EUT: ARENA TRANCEIVER
M/N: N/A, S/N: N/A\
AC HI, 120VAC/60Hz

25 highest Quasi-Peaks above -40 dB of Limit Line #1
peak criteria = .1 dB

PEAK#	FREQ (MHz)	(dBuV)	DELTA
1	.4576	40.9	-7.1
2	.5278	36.2	-11.8

GARWOOD LABORATORIES INC
EMI TEST DATA

DATE: 20 MAY, 1999 TEST NO.: 2
TITLE OF TEST: FCC PART 15 CLASS B, CONDUCTED EMISSIONS
CUSTOMER: LASER CHASER
EUT DESCRIPTION: ARENA TRANCEIVER
MODEL NO.: N/A SERIAL NO.: N/A
TEST MODE: TRANSMITTING 916.5 MHz, TYPICAL OPERATION
SENSOR LOCATION: AC RETURN SENSOR POL.: N/A
FREQUENCY RANGE: .450 - 30 MHz
TEST PERFORMED BY:K.VU TEMP. 71 F. HUM. 52 %
TEST RESULTS: COMPLIED
TEST CONDITIONS: 120VAC/60Hz

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GARWOOD LABORATORIES INC. 20 May 1999 11:14:50

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1. ARENA TRANCEIVER
   1.1 FCC Pt 15 - CONDUCTED

==========

LASER CHASER
EUT: ARENA TRANCEIVER
M/N: N/A, S/N: N/A\
AC RETURN, 120VAC/60Hz

25 highest Peaks above -30 dB of Limit Line #2
peak criteria = .1 dB

PEAK#	FREQ (MHz)	(dBuV)	DELTA
1	.4615	43.4	-4.6
2	.4713	42.5	-5.5
3	.9697	40.6	-7.4
4	.9779	40.6	-7.4
5	.9456	40.5	-7.5
6	.9576	40.5	-7.5
7	.4812	40.4	-7.6
8	.9945	40.3	-7.7
9	.926	40.2	-7.8
10	.903	40.1	-7.9
11	.53	39.9	-8.1
12	1.011	39.9	-8.1
13	.5234	39.8	-8.2
14	.5435	39.8	-8.2
15	.5147	39.6	-8.4
16	1.028	39.6	-8.4
17	.5367	39.5	-8.5
18	.5597	39.5	-8.5
19	.5644	39.5	-8.5
20	.8805	39.3	-8.7
21	.5764	39.2	-8.8
22	.4894	39.1	-8.9
23	.5061	39.1	-8.9
24	.5692	39.1	-8.9
25	.8659	39.1	-8.9

ATTACHMENTS

INDEX OF ATTACHMENTS