



EMC Measurement / Technical Report

FCC Test Specification : FCC Part 15, Subpart C Section 15.231
Type of Authorization : Certification
Manufacturer : Holatron Systems, LLC
Equipment Under Test : 2-Channel Digital UHF Transmitter
Model No. RFLS-1XT
Test Report No. : FR1096
Purchase Order No. : H1990015

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EMC Measurement / Technical Report

Document No. FR1096

From
Garwood Laboratories, Inc.
World Compliance Division

Test for
Holatron Systems, LLC
2-Channel Digital UHF Transmitter
Model No. RFLS-1XT

WRITTEN BY	REVIEWED BY	REVIEWED BY
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Test Personnel	Test Dates
Arnulfo Tapia- Sr. EMC Technician	19 April 1999

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

Manufacturer Company Address City, State, Zip Country Contact Name Phone Fax	Holatron Systems, LLC 7242 Alliance Court San Diego, CA 92119 USA Charlie Holdaway (619) 464-2137 (619) 4642137
Type of Authorization	Certification
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: 15.209 (Radiated Emissions Limits, general requirements) Section: 15.231 (Periodic operation in the band 40.66 - 40.70 MHz and above 70 MHz)
Equipment Under Test	2-Channel Digital UHF Transmitter Model No. RFLS-1XT
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: 15.231 The EUT is powered from a 9VDC battery therefore, Conducted Emissions limits do not apply.

EMC Test Laboratory Facility Address City, State, Zip Code Country Contact Name Title Phone Fax	Garwood Laboratories, Inc. World Compliance Division 565 Porter Way Placentia, CA 92870 USA Jason Armstrong General Manager (714) 572-2027 (714) 572-2025
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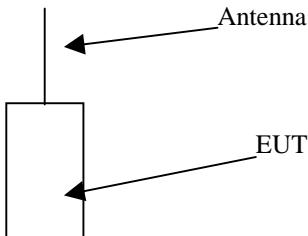


1. General Information

1.1 Product Description

Equipment Under Test	2-Channel Digital UHF Transmitter
Description	The EUT is a two-channel low power remote control transmitter operating on a single carrier frequency of 418MHz. The transmit frequency is SAW controlled. The RF output only occurs while one of the momentary transmit buttons is depressed. A digital code amplitude modulates the carrier to indicate to the receiver which of the transmit buttons is depressed. A HOLTEK HT6012 encoder IC generates the code. The modulated carrier is generated by a Linx Technologies TXM-418-LC transmitter module (see attached spec). It is coupled through 3 inches RG-174 50-ohm cable to a quarter-wave flexible whip antenna (Linx Part No. ANT-418-CW-QW). The antenna screws on to a reverse polarity SMA connector.
Clock Frequencies	418MHz

1.2 Configuration of Tested System



The Equipment Under Test (EUT) has no interface cables and was tested as a stand-alone unit. During the field strength measurements, a new battery was installed in the EUT.

1.3 Test Methodology

The field strength measurement test was performed at a receiving antenna to EUT distance of 3 meters in the Open Area Test Site (OATS). 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).

The following subpart is applicable to the results in this test report, FCC Part 15, Subpart C, Section 15.231 (Periodic operation in the band 40.66-40.70 MHz and above 70 MHz).



1.4 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 Dated: 03/17/97
ISO Guide 25, EN45001, and relevant parts of ISO 9002

Industry Canada Reference: IC 3298 Dated: 03/11/99

I²T Certificate Number: 7619 Dated: 03/11/99
(*Interference Tech International*) CE Mark for European Country

NVLAP NVLAP Lab Code: 200119-0 Effective Through
(*NIST*) CISPR, FCC, AUSTEL 12/31/99

VCCI Registration #'s C574, C575, C576, R561 Effective Through
(*Voluntary Control Council for Interference by Information Technology Equipment*) 02/04/00



2. Product Labeling

2.1 FCC ID Label

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.



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.



3. System Test Configuration

3.1 Operating Mode

The following operating mode was used to exercise the function of the EUT.

1. During testing, the EUT was continuously transmitting. This was achieved by depressing button A on the EUT.

3.2 Special Accessories

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

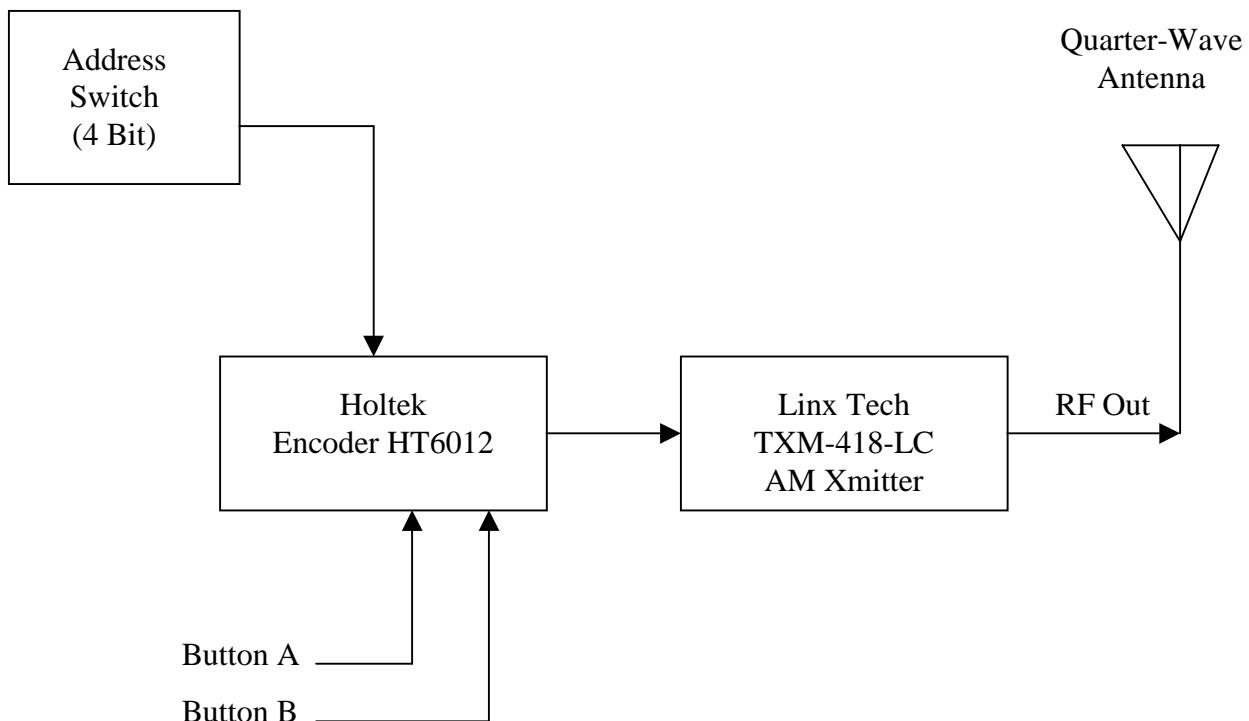
3.3 Equipment Modifications

No modifications and or adjustments were made to the EUT during testing to achieve the required specification limits.



4. BLOCK DIAGRAM OF THE EUT

2-Channel Digital UHF Transmitter Circuit Block Diagram





5 TEST RESULTS

5.1 Radiated Spurious Emissions Limits

<i>FCC Part 15, Subpart C, Section 15.231(b)</i>		
<i>Fundamental frequency (MHz)</i>	<i>Field Strength of Fundamental (microvolts/meter)</i>	<i>Field Strength of Spurious Emissions (microvolts/meter)</i>
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 operating frequency of the EUT is 418 MHz. The applicable limits for the EUT are those listed for the fundamental frequency falling within the frequency band of 260 – 470 MHz.



5.2 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: 2-Channel Digital UHF Transmitter

Test Results: Field Strength of Fundamental and Spurious Emissions

(Reference: FCC Pt. 15, Subpart C, Section 15.231b)

Fundamental Frequency: 418 MHz

Antenna Polarity (V or H)	Frequency (MHz)	S.A. Reading (dBuV)	Antenna Factor (dB)	Cable Loss (dB)	Pre-Amp Gain (dB)	Peak Field Strength (dBuV/m)	Peak Field Strength (uV/m)	Average Field Strength (uV/m)	FCC Limit 3 meters (uV/m)
V	418	98.4		Correction Factor -2.5		95.9	62,373.5	8,732.3	10,335
H	418	99.3		Correction Factor -2.5		96.8	69,183.1	9,685.6	10,335
V	836	44.2		Correction Factor 6.2		50.4	331.1	-	1,033
H	836	46.5		Correction Factor 6.2		52.7	431.5	-	1,033
V	1254	47.61	23.9	5.7	36.11	41.1	113.5	-	1,033
H	1254	46.58	23.9	5.7	36.11	40.07	100.8	-	1,033
V	1672	53.73	24.5	6.9	36.11	49.02	282.5	-	1,033
H	1672	54.73	24.5	6.9	36.11	50.02	317.0	-	1,033
V	2090	50.47	27.1	7.8	36.11	49.26	290.4	-	1,033
H	2090	52.21	27.1	7.8	36.11	51.0	354.8	-	1,033
V	2508	27.39	28.3	9.2	35.86	29.03	28.28	-	1,033
H	2508	25.78	28.3	9.2	35.86	27.42	23.50	-	1,033
V	2926	26.16	31.0	10.2	35.86	31.5	37.6	-	1,033
H	2926	25.77	31.0	10.2	35.86	31.11	35.9	-	1,033
V	3344	26.30	31.2	11.6	35.54	33.56	47.6	-	1,033
H	3344	29.31	31.2	11.6	35.54	36.57	67.4	-	1,033
V	3762	32.64	31.2	12.8	35.54	41.10	113.5	-	1,033
H	3762	34.77	31.2	12.8	35.54	43.23	145.0	-	1,033
V	4180	23.09	32.4	13.9	35.22	34.17	54.3	-	1,033
H	4180	NDS	32.4	13.9	35.22	NDS	NDS	-	1,033

Test Personnel:
<i>Arnulfo Tapia – Sr. EMC Technician</i>



5.3 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 dB μ V 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 dB μ V/m.

$$FS = 52.5 + 7.4 + 1.1 - 29 = 32 \text{ dB}\mu\text{V/m}$$



5.4 Occupied Bandwidth

<i>FCC Part 15, Subpart C, Section 15.231(c)</i>	
<i>Operating Frequency</i>	<i>Bandwidth of the Emission Allowed</i>
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 EUT was calculated to be 1.045 MHz (0.25% of 418MHz). The emission from EUT was within the allowable bandwidth requirements. Detail plots are attached in Appendix B.



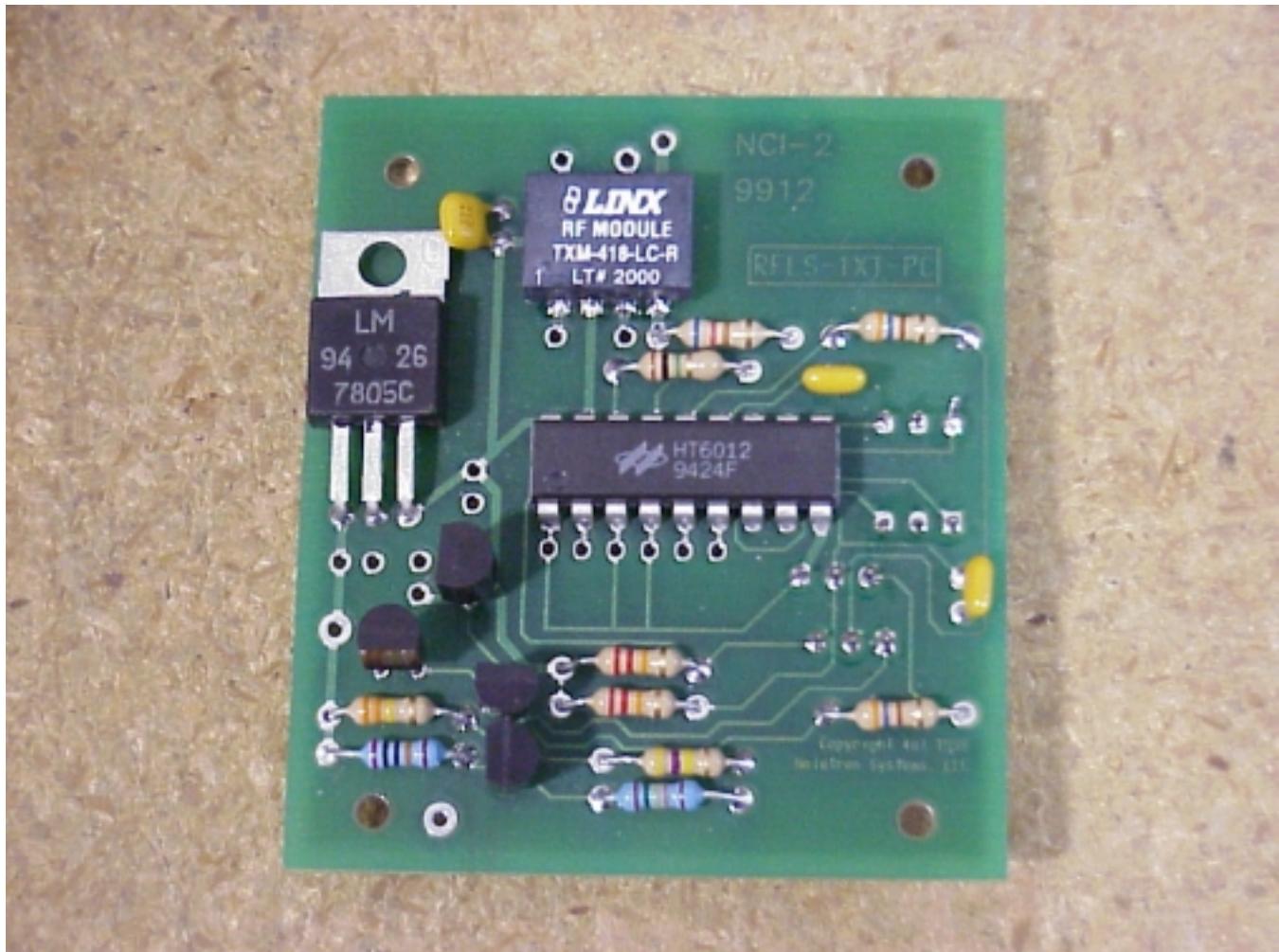
6. Photographs of Test Arrangement and EUT Construction



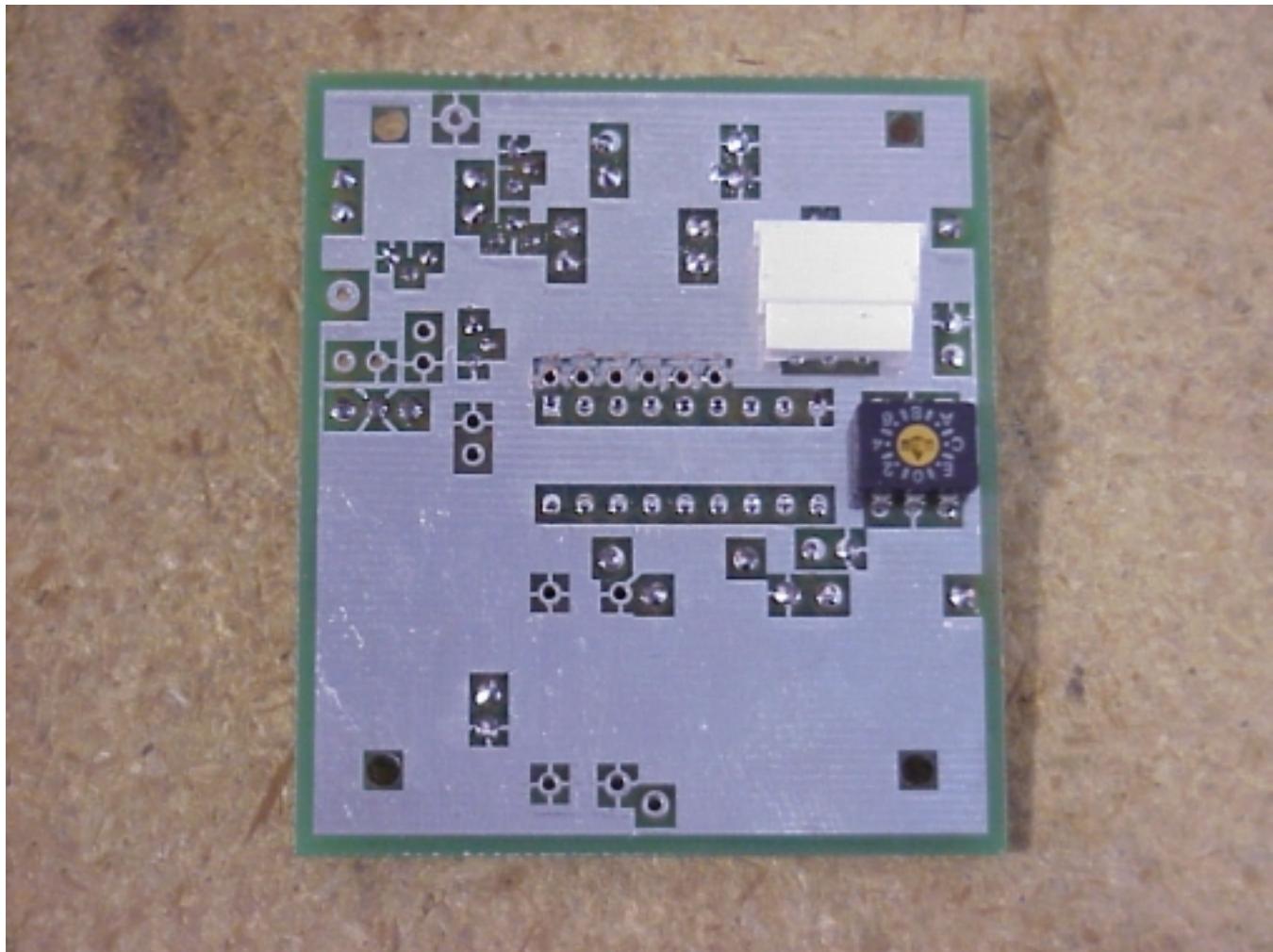
6.1 Field Strength of Spurious Radiation



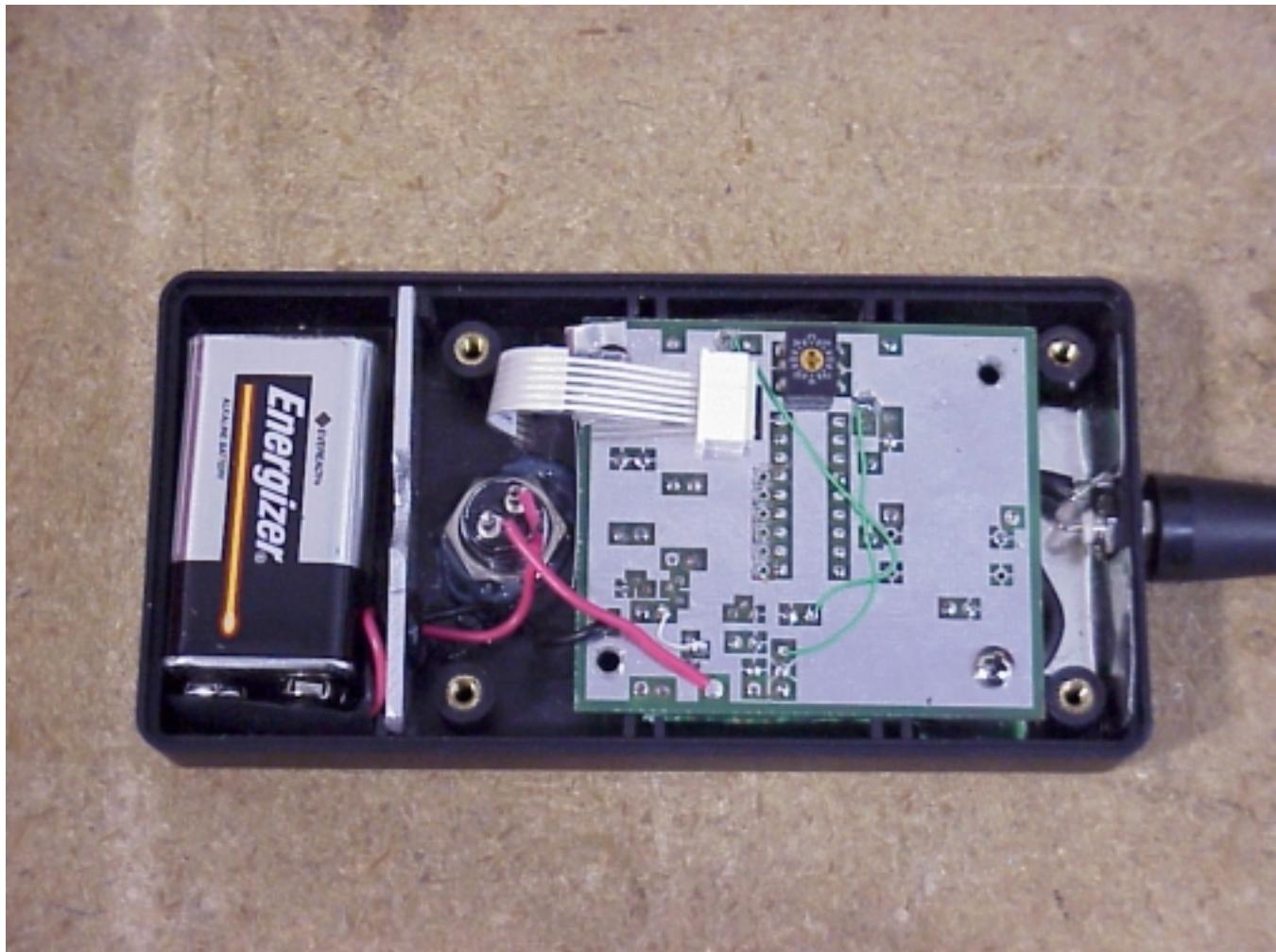
6.2 Field Strength of Spurious Radiation



6.3 EUT Circuit Board Component Side



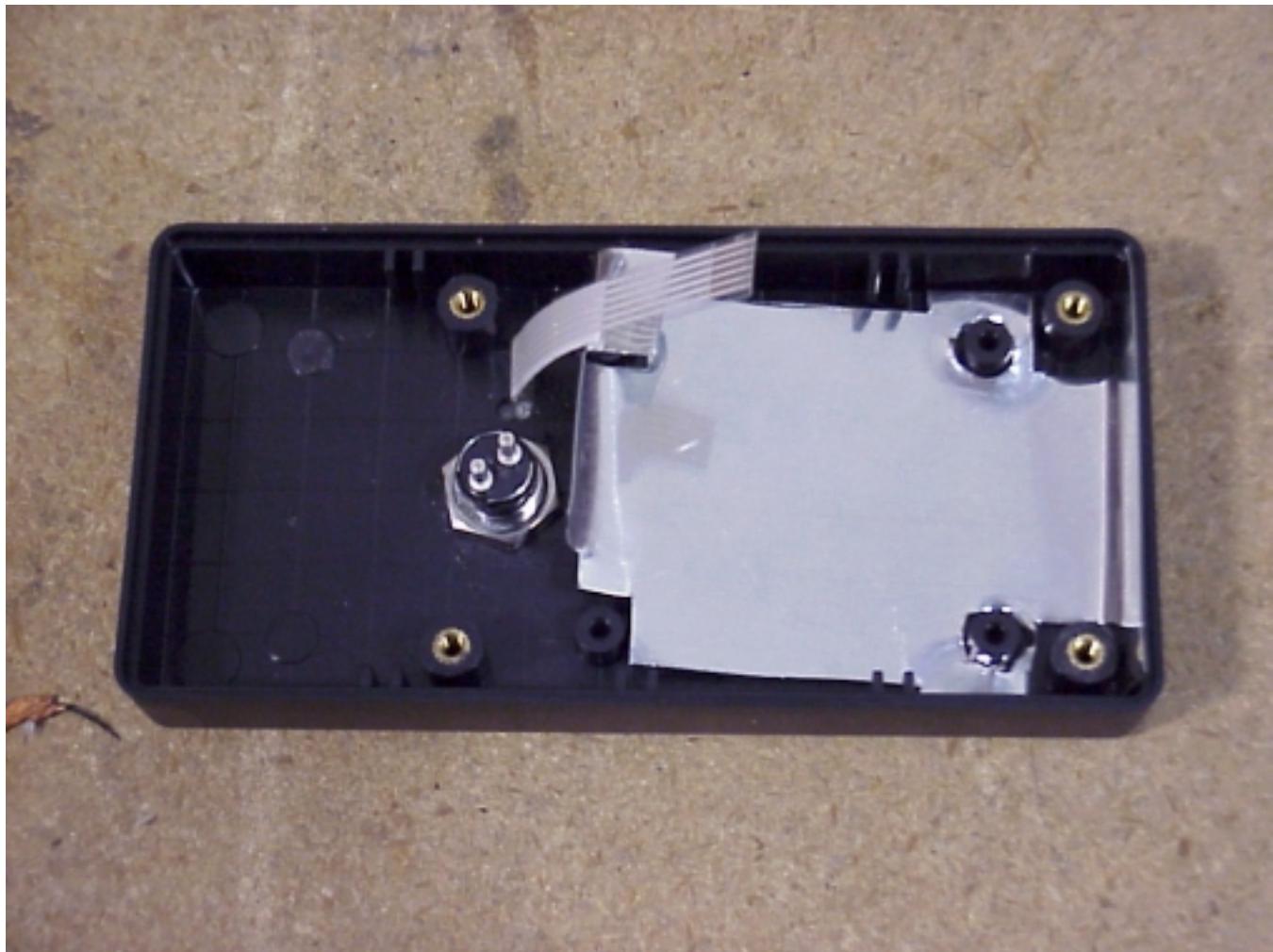
6.4 EUT Circuit Board Solder Side



6.5 EUT Construction View 1



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6.6 EUT Construction View 2



APPENDIX A - TEST EQUIPMENT USED

The absolute performance calibration, of the 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 +/- 2 dB 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.

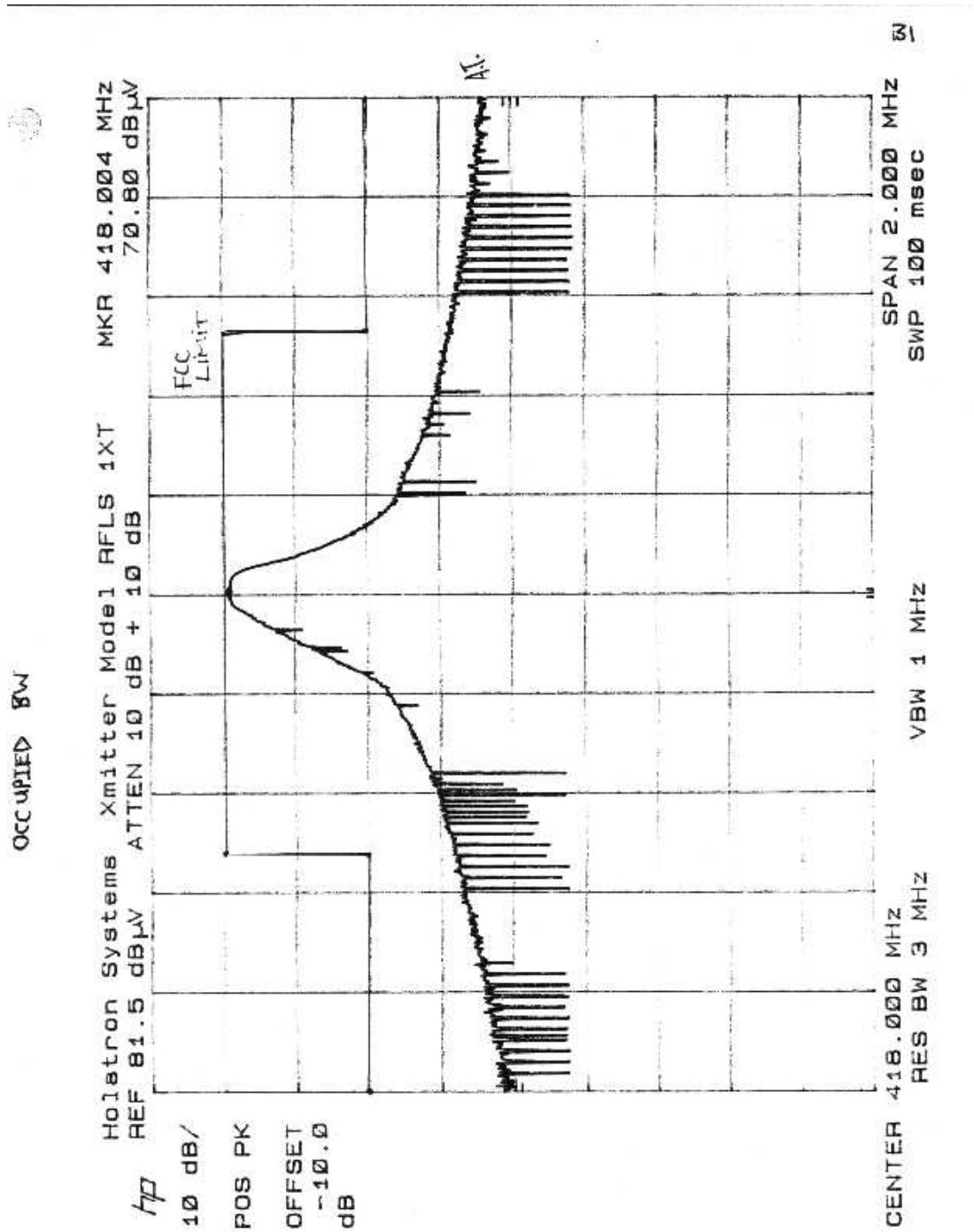
A.1 Specific Equipment Used

<i>Test Instrument</i>	<i>Mfg / Model No.</i>	<i>Serial No.</i>	<i>Cal. Due Date</i>
Radiated Emissions Test			
EMI Receiver System	Hewlett Packard / 8574A	3010A01156	10/14/99
BiLog Antenna	Chase / CBL6111A	1823	04/00/00
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	01/27/00
Spectrum Analyzer (Above 1000MHz)	Hewlett Packard / 8595E	3639AO2361	12/15/99



APPENDIX B – SUPPLEMENTAL TEST DATA

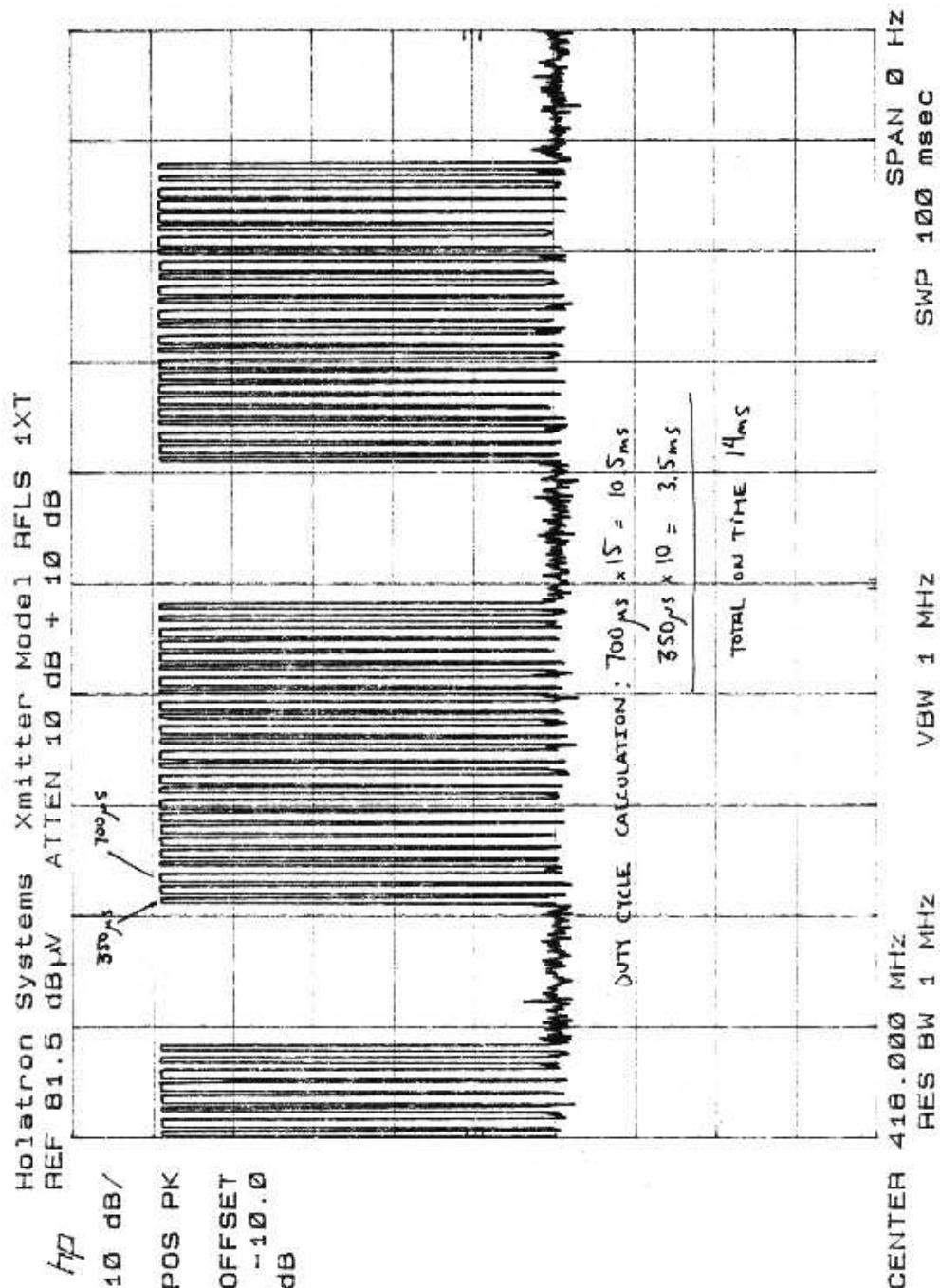
<i>Test Type</i>	<i>Basic Standard</i>	<i>Details</i>	<i>Data Format</i>	<i>Page No.</i>
Occupied Bandwidth	FCC Part 15 Subpart C §15.231 (c)	0.25% of Center Frequency (418MHz)	Plotted	B1
Average Measurement	FCC Part 15 Subpart C §15.231(b2)	Pulse Train over 100ms	Plotted	B2 B3





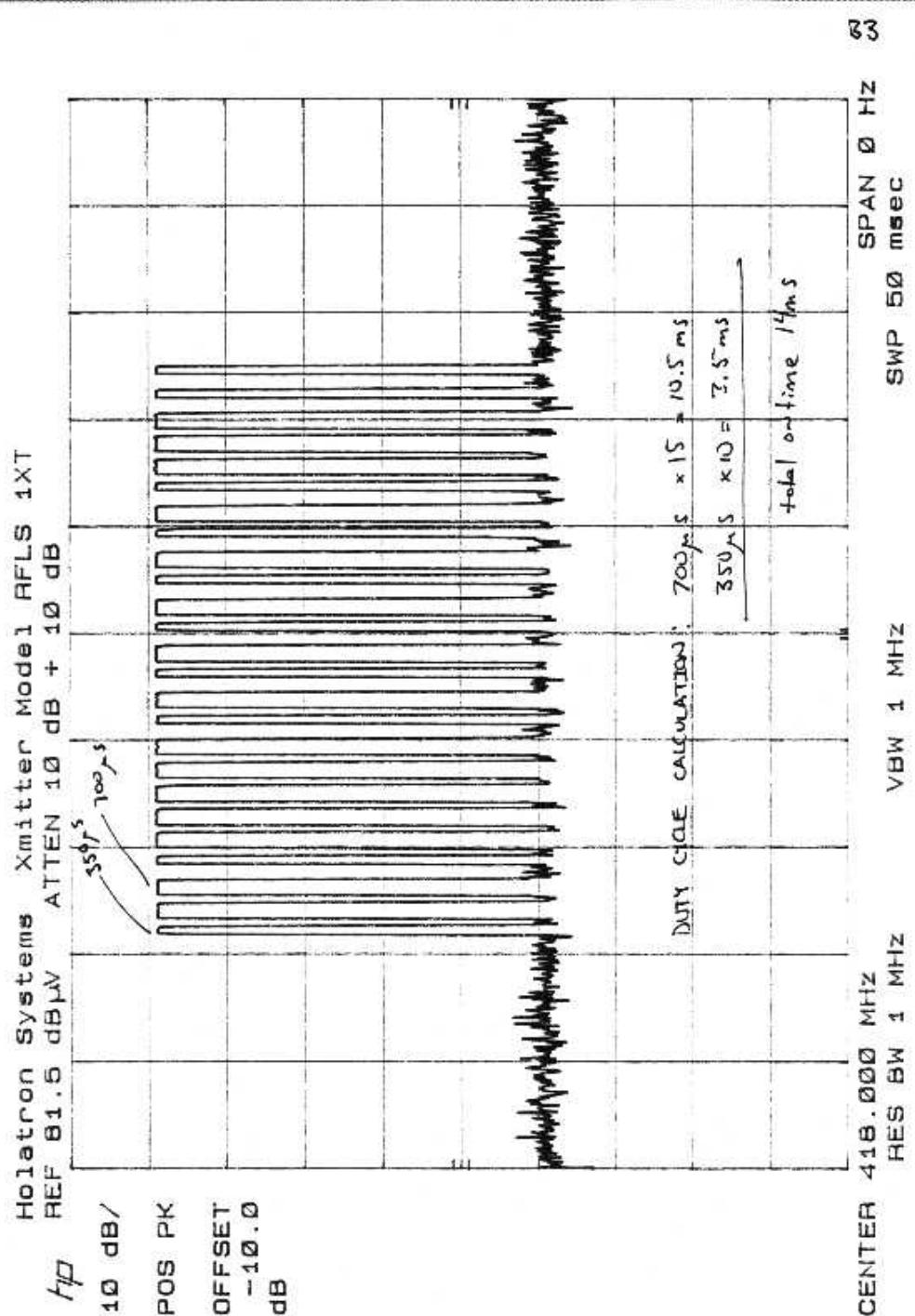
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ATTACHMENTS

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