MIDWEST EMI ASSOCIATES
21234 West Commercial Drive
Mundelein, Illinois 60060

➢Design ➢Consulting ➢Compliance Testing ➢Medical Testing

February 5, 2009

Mr. Tim Miller
Task Force Tips, Inc.
2800 East Evans Ave.
Valparaiso, Indiana 46383-6940
Ph: 1-219-462-6161 Fax: 1-219-464-7155

E: tsm@tft.com

Midwest EMI Ref: EMC Test and Measurement Report for TFT RC Extend-A-Gun (EP0371)
Test Report 2902

Dear Mr. Miller,

We have forwarded the final test report on the above referenced model to your attention. The product was determined to comply with the requirements of EN 61000-6-2:2005 & 3 :2006 noted in the report.

Please review the report and direct any comments to me.

We appreciate your patronage of Midwest EMI's test services, and encourage you to contact us in the future if further test needs are necessary. This closes the current Project on the TFT RC Extend-A-Gun (EP0371).

Regards,

George A. Bowman

George A. Bowman
President
Midwest EMI
(847) - 918-9886
"Your Key to the CE Mark" sm

Performance Certification to EMC Directive

Normative Standard: **EN61000-6-2 :2005, EN 61000-6-3: 2006**

Test Unit Description and Serial Number:

TFT RC Extend-A-Gun (EP0371)

S/N: X501976

Test Report # 2902

Dates of Test: 1-21-2009 through 01-23-2009

Test Laboratory:

Midwest EMI Associates, Inc.
Electromagnetic Interference Laboratory
21234 W. Commercial Drive
Mundelein, Illinois 60060
Tel: (847)-918-9886

EN 61000-6-3 EMISSIONS

TEST METHOD	LIMITS
EN 61000-6-3 Am 1:2002-11 (Cispr 16-2-3) Radiated Emissions	B
EN 61000-6-3 Am 1:2002-11 (Cispr 16-2-1) Conducted Emissions (DC Power Supply)	B

EN 61000-6-2 IMMUNITY

TEST METHOD		LEVEL
EN 61000-4-2 Cons Ed 1.2:2001-04 Electrostatic Discharge Test	2, 4, 6 and 8 kV Air Discharge 2 and 4 kV Contact Discharge	A
EN 61000-4-3 Ed. 3.0: 2006-02 Radiated Immunity Test	10-15 V/M (10 V/M minimum) 1000 Hz, 80% AM modulation, 900 Mhz, 100% AM, 200 Hz, Square Wave, 30-1000, 1.4-2.0 GHz, 2.0-2.7 GHz (reduced level)	A
EN 61000-4-4 Ed. 2.0: 2004-07 Electrical Fast Transients	.5, 1 and 2 kV Line to Line	B
EN 61000-4-5 Ed. 2.0: 2005-11 Electrical Surge Test	.5 kV Line to Line	A
EN 61000-4-6 Ed. 2.2: 2006-05 Conducted Immunity	3 V RMS Common Mode	A
EN 61000-4-8 Ed. 1.1: 2001-03 Magnetic Immunity Test	30 A/M minimum 40-500 Hz Three Axis	A

Performance Level:

- A- During testing, normal performance occurs within the specification limits.
- B- During testing, temporary degradation, or loss of function or performance occurs that is self recovering without operator intervention.
- C- During testing, temporary degradation, or loss of function or performance occurs that requires operator intervention or system reset.
- D- Degradation or loss of function that is not recoverable occurs due to damage to equipment, components, software, or to loss or corruption of data.

Report by: George Bowman
Midwest EMI Associates
Narte Certified Engineer, EMC-000738NE

MEMBER CHICAGO & NORTHERN ILLINOIS

Nemko Accredited ELA

ACIL

Midwest EMI Associates, Inc.
Electromagnetic Interference Laboratory
21234 W. Commercial Drive
Mundelein, Il 60060

Midwest EMI Associates Test Service
Report No. 2902

Test Specifications

EN 61000-6-3 Level B Conducted Emissions
EN 61000-6-3 Level B Radiated Emissions
EN 61000-4-2 Electrostatic Discharge
EN 61000-4-3 Radiated Immunity
EN 61000-4-4 Electrical Fast Transients
EN 61000-4-5 Surge Test
EN61000-4-6 Conducted Immunity Test
EN 61000-4-8 Magnetic Immunity Test

Test Device: **TFT RC Extend-A-Gun (EP0371)**

Serial Number: **X501976**

Conducted For: **Mr. Tim Miller**
Task Force Tips, Inc.
2800 East Evans Ave.
Valparaiso, Indiana 46383-6940
Ph: 1-219-462-6161
Fax: 1-219-464-7155

Dates of Test: 01-21-2009 through 01-23-2009

Technical Data Taken by and
Report Written by:

George A. Bowman

George Bowman
Midwest EMI Associates

NARTE Certified Engineer, EMC-000738NE

Approved By:

Mr. Tim Miller
Senior Design Engineer
Task Force Tips, Inc.

1.0 PURPOSE:

The purpose of this test sequence is to qualify the compliance of the TFT RC EXTEND-A-GUN (EP0371) to the EN 61000-6-2 and 61000-6-3 commercial standards. This report covers testing to the EN 61000-6-3 Cispr 16-2-3 B level radiated and Cispr 16-2-1 conducted emissions, EN 61000-4-2 electrostatic discharge test, EN 61000-4-3 radiated immunity standards, EN 61000-4-4 electrical fast transients, EN 61000-4-5 Surge test, EN 61000-4-6 conducted immunity test and EN 61000-4-8 magnetic immunity test.

2.0 TEST FACILITY:

All susceptibility testing was performed on the indoor three-meter site located at Midwest EMI Associates, 21234 W. Commercial Drive, Mundelein, Illinois 60060. Some testing utilized the screened room facility. The personnel access door measures 36" by 82" as shown in the attached room diagram, Figure A. Each power lead is filtered by a low-pass line filter. This interference filter provides substantially more insertion loss than that required for testing. The shielded room has within it a steel table with a copper ground plane (36"W X 72"L X 1/16"D thick) that is attached to the wall of the cage and is 3 feet off the floor of the cage, and has a DC resistance of less than 2.5 milliohms, complying with Military Standards 461. It also has a movable wooden table of 80 cm. height for CISPR testing. Power, which is available, consists of 120/230 VAC, 50/60 Hz.

Referring to Figure A, the major parts of the room which are used during testing are the interference filter which provides protection against external conducted signals, the screened viewing window which allows visual access to the device under test, AC line capacitors which properly terminate the line and neutral leads, and various antennas used for radiated emissions testing. The positions at which the device under test may be placed are identified on Figure A.

3.0 DESCRIPTION OF TEST SAMPLE:

The TFT Extend-A-Gun RC lets operators lower their deck mounted master stream device used in fire trucks and pumpers to deck level for storage (or even into a well). On the fire ground, the monitor can be automatically raised to its extended position (18 extra inches or 45.7 extra cm) with a simple push of a button. This gives greater clearance of other equipment on the apparatus, greater freedom of movement, and keeps firefighters off the top of the trucks, thus providing a safer operating position.

The Extend-A-Gun RC offers a full 360 degree monitor rotation in either the raised or lowered position, large waterway, Hardcoat anodized aluminum finish. Built in sensor for connection to "monitor raised" light. Waterproof 12VDC electric drive, motor control box, and panel mount operator station for recessed mounting complete with cables and plugs for connecting the TFT RC Monitor with the RC Extend-A-Gun. Connecting RC

EMI SCREENED ROOM RADIATED SUSCEPTIBILITY CONFIGURATION

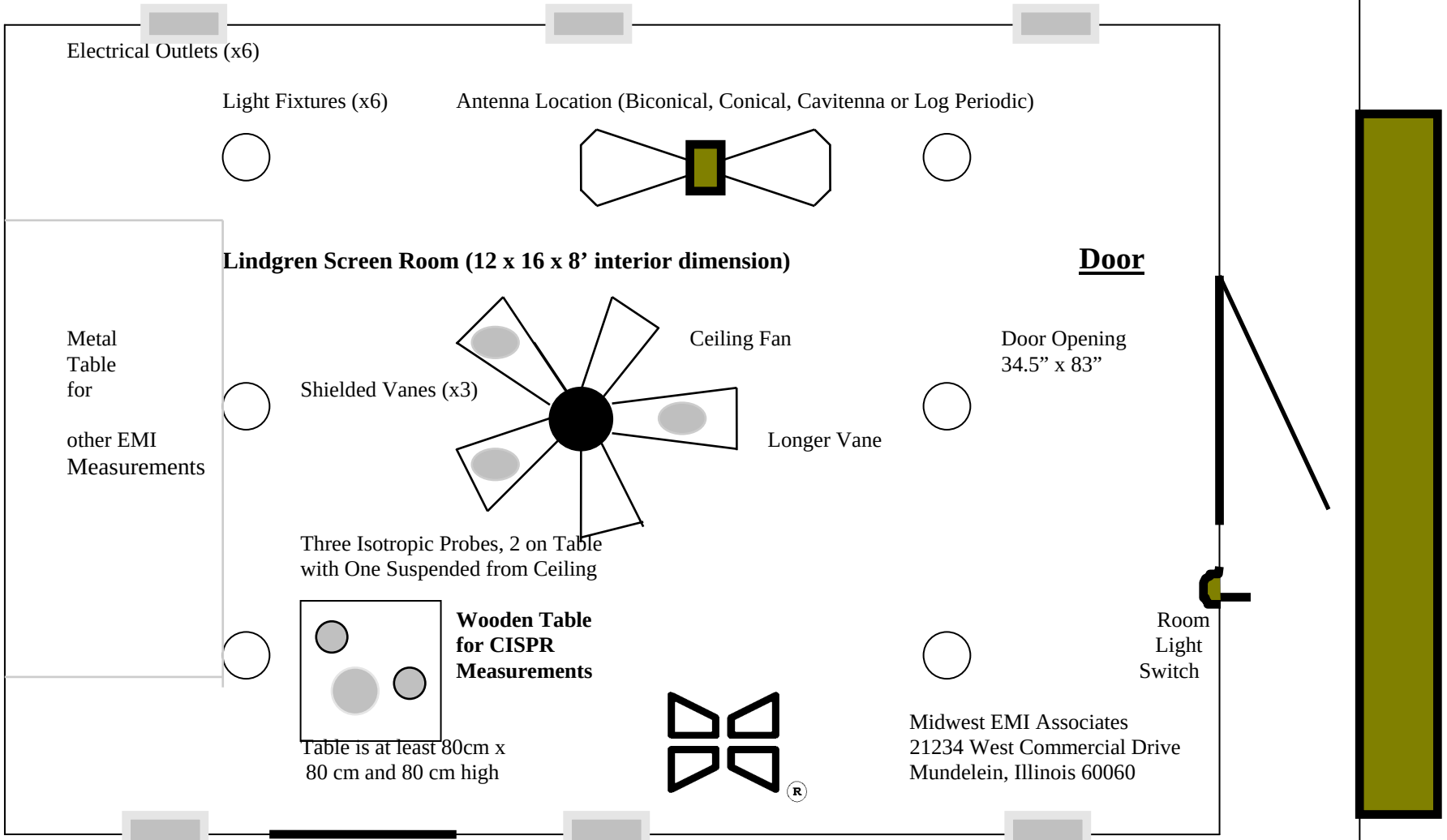


Figure A

Extend-A-Gun motor control box to RC monitor communication link (blue & white wires) allows RC Extend-A-Gun operation from any monitor operator station equipped with AUX1 button or input.

3.2 POWER REQUIREMENT:

The primary power supplied to the test sample was a 12 or 24 Volt Lead Acid Battery however the normal power is a fire engine battery.

3.3 GROUNDING:

No grounding was supplied to the test sample since it is battery operated.

3.4 RADIATED CONFIGURATION:

The test sample was oriented so that the area exhibiting the greatest amount of radiation was facing the antenna that was the front of the device.

3.5 TEST SAMPLE OPERATION:

The device was operated in its controlling or active movement mode during the test.

4.0 DISPOSITION OF TEST SAMPLE:

Upon completion of the test, the test sample was returned to the sponsor group.

5.0 REFERENCES:

EN 61000-6-1 Ed. 2.0 (2005-03), "Electromagnetic compatibility (EMC) - Part 6: Generic standards - Section 1: Immunity for residential, commercial and light-industrial environments"

EN 61000-6-2 Ed. 2.0 (2005-01), "Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments"

EN 61000-6-3 Ed. 2.0 (2006-07), "Electromagnetic compatibility (EMC) - Part 6: Generic standards - Section 3: Emission standard for residential, commercial and light-industrial environments"

EN 61000-6-4 Ed. 2.0 (2006-07), "Electromagnetic compatibility (EMC) - Part 6: Generic standards - Section 4: Emission standard for industrial environments"

EN 61326 Ed. 1 (2006-06), "Electrical equipment for measurement, control and laboratory use - EMC requirements"

EN 60601-1-2 (2005), "Medical Electrical Equipment, Part 1: General requirements for safety. 2. Collateral Standard: Electromagnetic compatibility – requirements and tests"

Cispr 16-2-3 and Cispr 16-2-1 (2006), "Methods of measurement of disturbances and immunity – Radiated (or Conducted) disturbance measurements"

Mil Std 461E, Part 4 "Electromagnetic Emission and Susceptibility Requirements for the Control of Electromagnetic Interference"

Federal Communications Commission Document MP-4 "FCC method Measurement of Radio Noise Emissions from Computing Devices"

VDE 0871 through 877 European documents

Current EN Standards 61000-4-1 through 61000-4-11 and IEC Standard "Medical Electrical Equipment Part 1, General Requirements for Safety" issued by TC62A

Cispr 22 (EN55022), Consol. Ed. 5.2, 2006-03, "Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement"

Cispr 16-2-3 (CISPR 16-2-3) Cons. Ed. 4.1, 2004-06, "Industrial, scientific and medical (ISM) radio-frequency equipment - Electromagnetic disturbance characteristics - Limits and methods of measurement"

CISPR Publication Number 16-1-1, (2006-11) Cons. Edition 1.1, "Specification for radio disturbance and immunity measuring apparatus and methods - Part 1-1: Radio disturbance and immunity measuring apparatus - Measuring apparatus", 1998

MDS-201-0004, "Electromagnetic Compatibility Standard for Medical Devices", 1979

IEC 50 (161), "International Electrotechnical Vocabulary, Chapter 161, Electromagnetic Compatibility"

6.0 GENERAL INFORMATION:

A diagram of the EMI facility and test equipment used is shown in the Appendices to this manual. The spectrum analyzer and other equipment are calibrated periodically by using their manufacturers' services.

6.1 TEST PROCEDURES:

The test limits for CISPR and IEC test configurations are located at the end of the various appendices for convenience. All test results and procedures are shown in the Appendices. Hereinafter, the equipment under test will be referred to as the E.U.T. or by its full description.

6.2 TEST DESCRIPTIONS:

All procedures below not referenced by individual protocol ("MEMI-XXX") numbers fall under the master EMI protocol, MEMI-7 "Electromagnetic Interference". Presently commercial devices are tested to 1 GHz per international convention for emissions and susceptibility.

The possible range of tests that could have application either domestically or internationally are listed below along with applicable protocol numbers. The references supplied provide information on how to perform the test. CISPR 16-2-1 and -3, Military Standard 462, and EN 61000 part 4 series are used as references for all procedures.

Midwest EMI assumes no liability for the performance of designs in the field derived from these protocols and the recommended criteria of acceptability. Midwest EMI will perform these tests as a service exclusively and will make every effort to assure the data is presented accurately and that the testing is uniformly applied per standards but we cannot guarantee to our customers that the product will gain acceptance by the market. In particular for life sustaining equipment, Midwest EMI recommends that a larger base of tests be performed to gain an accurate understanding of product performance.

6.2.1 **Appendix A1 (CISPR Conducted Emissions, Cispr 16-2-1)** - Limits are plotted for FCC or CISPR requirements for Level B emissions. *Recommended criterion of acceptability is that A or B Level emissions are passed.*

6.2.2 **Appendix B1 (CISPR Radiated Emissions, Cispr 16-2-3)** - Limits are plotted for FCC or CISPR requirements for Level B emissions. For some equipment this may include electric and VDE style magnetic emissions. *Criterion of acceptability for Europe is that A or B level emissions must be passed.*

6.2.3 **Appendix C (EN61000-4-4 Fast Transients)** - Limits for EN 60601-1-2 and FDA Reviewer's Guide compliance are 2 KV common and 1 KV differential applied to the power cables and .5 KV applied to peripheral cables. *The criterion of acceptability is that there should be no permanent degradation in performance with the stress applied that is not recoverable automatically.*

6.2.4 **Appendix D (Radiated Susceptibility-EN 61000-4-3)** - Limits are 3 - 10 V/M from 10 KHz to 1 GHz per EN 61000-4-3. For this class of product the immunity of the device must exceed the 3 V/M requirement to meet the EN 60601-1-2 requirements. *The criterion of acceptability is that there should be no degradation in performance or hardware failure when the EUT is exposed to any level lower and including the limit. In all cases the device must fail safely or it is rejected.*

6.2.5 **Appendix E (EN 61000-4-5 Surge Immunity Test) -** Recommended limits are 2 KV common mode and 1 KV differential mode at angles of 0, 90, 180, and 270 degrees. Ten repetitions at each condition are applied to the EUT. *The criterion of acceptability is no failure, serious malfunction or alarm may occur that is not self-recovered in 5 seconds.*

6.2.6 **Appendix F (EN 61000-4-6 Conducted Immunity Test)** Conducted bulk energy is applied via a voltage coupler to power leads and peripheral cables longer than 3 meters. This test is invasive in that the power line is preconditioned to allow the RF voltage to be applied to all leads of the equipment under test. It is also applied to peripheral cables using the similar coupler of the CS114 test except at a higher intensity typically. *The criterion of acceptability is that no malfunction occurs up to and including the 3 or 10 V RMS limit.*

6.2.7 **Appendix G (EN 61000-4-2 ESD Test)** – The EUT is exposed to high intensity electrostatic pulses up to 8 kV air or 4 kV contact discharge. *The criterion of passing this test is no adverse malfunction that is not self-recovering within 5 seconds of the termination of the pulse.*

6.2.8 **Appendix H (EN 61000-4-8 Magnetic Immunity Test) –** The EUT is exposed to high intensity magnetic fields of greater than 30 A/M to determine if proper operation can be maintained. *The device must not alter from its normal operation during this test.*

6.3 SPECTRUM ANALYZER CHARACTERISTICS:

This facility uses a type TEK 2756P/TEK 2712 automated spectrum analyzer and a Omnibook 900 laptop measuring system. The 6 dB impulse bandwidth settings and wideband correction factors are listed below:

TEK 2756P Analyzer

Bandwidth Setting		Wideband 6dB Bandwidth		Correction Factor		Factor Applied	
3	MHz	3.028	MHz	-9.623	dB	-10	dB
1	MHz	915.0	KHz	.7716	dB	0	dB
.1	MHz	116.4	KHz	18.68	dB	20	dB
10	KHz	9.96	KHz	40.03	dB	40	dB
1	KHz	926	Hz	60.67	dB	60	dB
.1	KHz	96	Hz	80.35	dB	80	dB
10	Hz	10	Hz	100	dB	100	dB

TEK 2712 Analyzer (Dual Analyzers in Use)

Bandwidth Setting		Wideband 6dB Bandwidth		Correction Factor		Factor Applied	
5	MHz	4.92	MHz	-13.84	dB	-14	dB
1	MHz	.932	KHz	.6117	dB	0	dB
.3	MHz	.31	KHz	10.173	dB	10.5	dB
9	KHz	8.48	KHz	41.43	dB	41	dB
3	KHz	3300	Hz	49.63	dB	50.5	dB
1	KHz	860	Hz	61.31	dB	60	dB
200	Hz	200	Hz	73.98	dB	74	dB

For test purposes, the correction factors are chosen to be at the nearest 20dB increment.

6.4 Certificates of Calibration

All certificates of calibration are maintained in a binder located at Midwest EMI Associates and are available for inspection. The present expiration dates of certified calibration by our manufacturers are:

a)	Tek2756P Spectrum Analyzer	BO20224	26 Mar 09
b)	Wavetek 2520A RF Generator	0222011	30 Mar 09
c)	Carver TFM-35 250 W/Ch. Audio Amp	3097104	N/A
d)	ENI RF Power Amplifier (525LA)	367	N/A

e)	ENI RF Power Amplifier (2100L)		129	N/A
f)	Eaton 15100B Power Amplifier		1529-07090	24 Mar 09
g)	Tektronix TDS 420 Oscilloscope		B021212	24 Mar 09
h)	EMCO 3109 Power Biconical (1/3/10 Meters)		9011-2504	17 Mar 09
i)	EMCO 3101 Power Conical		9007-3450	N/A (1/3m)
j)	EMCO 6502 Active Loop 1038		18 Mar 09	
k)	EMCO 3301B Active E Field		9009-3044	19 Mar 09
l)	EMCO 3147 Wide Range Log Periodic		9102-1019	23 Mar 09
m)	EMCO 3107B Power E Field		9310-2435	N/A
m)	Amplifier Research FM1000		12456	N/A
n)	Amplifier Research FP100060701		21 Mar 09	
o)	Amplifier Research FP100060488		3 Mar 09	
p)	IFI EFS-4 E Field Susceptibility		39883	14 Mar 09
	(Holladay 3004EX with HSE405 Probe)			
q)	IFI LMT-B Light Modulator		1117-B	N/A
r)	IFI EFS-1 E Field Susceptibility		245738	N/A
s)	Solar 6741-1 RF Current Probe		911308	N/A
t)	Fluke 45 True RMS Voltmeter	**EJ574714013**	24 Mar 09	
u)	Schaffner NSG 433 ESD Gun		107	
	and Contact Discharge Adapter		402-664/0	30 Mar 09
v)	Solar Loop Sensor 7334-1 ----------		N/A	
w)	Solar Loop Sensor 9311-1 931101		N/A	
x)	Solar RF Coupler 7415-3 906016		N/A	
y)	Solar Line Impedance Stabilization Network		8028-50-TS-24-BNC N/A	
z)	Solar VDE Filter Network 8907-250-TS-24-BP N/A			
aa)	Ohmic Instrument BET-300-ADL		522	25 Mar 09
ab)	Werlatone C1795 Dir. Coupler		3442	30 Mar 09
ac)	Solar Current Injection Probe Type 9108-1N		935012	N/A
ad)	Tektronix TR 503B Tracking Generator		B011216	25 Mar 09
ae)	Acme 2KVA Isolation Transformer		T-3-53042-S	N/A
af)	Xentek Extreme Isolation Transformer Model 5410 (2 in use)			
ag)	Tektronix P6202 RF Probe ------		N/A	
ah)	Staco Power Variac Type 3PN2210 (0-140VAC) 3.1KVA		N/A	
ai)	Helmholtz Coil Stepdown Xfrmr-Chicago Xfrmer Type P-6492		N/A	
aj)	Goldstar Signal Generator Mod FG-2002c		201621	25 Mar 09
ak)	Holladay Magnetic Field Probe Model HI-3624		83957	15 Mar 09
al)	Tektronix 2712 Spectrum Analyzer (Quasipeak)		B022520	24 Mar 09
am)	Voltec PM100 Power Analyzer		AA04/8495	25 Mar 09
an)	EMCO 3142 Biconilog Antenna		1052	1 Mar 09
ao)	Haefely P90.1 EN 61000-4-4 Fast Transient Tester		083 593-14	19 Mar 09
ap)	Hewlett Packard 3400A AC Voltmeter		1218A14443	24 Mar 09
aq)	Amplifier Research FP2031 Isotropic Probe		18309	5 Mar 09
ar)	Haefely 250 600/00 (61000-4-5 Surge Tester)		583 334-05	19 Mar 09
as)	Fischer CISPR 14 Absorbing Clamp type F-201		235	7 Mar 09
at)	Fischer IEC 801-6 Transducer		165	23 Mar 09
au)	Solar 9123-1N Current Clamp		956015	23 Mar 09
av	Fischer IC 801-6 CDN FCC-801-M3-25		95	7 Mar 09
aw)	Tektronix 2712 Spectrum Analyzer (Quasipeak) B022981		24 Mar 09	
ax)	C. C. Moore Automated Mast Assembly Model DAPM4/6			N/A
ay)	C. C. Moore Automated Turntable Model DTT-4		N/A	
z	Antenna Research LPB2520		1152	20 Mar 09
ba)	Behlman Power Pass 50 Hz AC Source (50, 60, 400 Hz) 0005		N/A	
bb)	California Instruments WP1251 AC Source (50, 60 Hz)		N/A	
bc)	Plitron Extreme Toroidal Isolation Transformers (2)			

bd) Edmund Scientific Thermometer/Hygrometer	None	31 Mar 09
be) Coaxial Bird Pads (x2) 8306-030-N3DB	None	30 Mar 09
bf) High Current Source, Associated Research 3030D	A140006	25 Mar 09
bg) California Instruments 5001ix High Power Source	HK52945	25 Mar 09
bh) Line Leakage tester, Associated Research 510L	130007	25 Mar 09
bi) Hipot Tester, Associated Research 3570D	090595	25 Mar 09
bh) GAASfet Preamplifier	None	25 Mar 09
bi) Ametek Tachometer Model 1726	R035292	24 Mar 09
bj) Bird Attenuator (x2), 75 Watt, 75-A-MFN-10	R035290	N/A
bk) HP 8482A Power Sensor	S/N: 2652A18474	24 Mar 09
bl) HP 435B Power Meter	S/N: 2702A17563	24 Mar 09
bm) Simpson Model 383 Thermometer	B001531	24 Mar 09
bn) Wavetek 27XT Voltmeter	96120787	24 Mar 09
bo) HP 8657A Programmable Synthesizer	365	17 Mar 09
bp) Fluke 75		24 Mar 09
bq) ENI 525LA		19 Mar 09
br) Tek 2755	B010135	30 Mar 09
bs) Amplifier Research FP2036 (.5-5Ghz)		04 Sep 08

7.0 CONCLUSION OF RADIO FREQUENCY INTERFERENCE EMISSIONS AND SUSCEPTIBILITY TESTS:

The TFT RC EXTEND-A-GUN (EP0371) was evaluated for all tests in the configuration requested by the sponsor group for compliance with the diagnostic instruments standards, EN 61000-6-2:2005 and EN 61000-6-3:2006. The configuration requested was that of the packaged unit system in an orientation that exercised its RC-4 extender in a continuous mode that alternatively deployed and then stowed the apparatus. Success was judged by observing the normal movement of the extender without stopping or stuttering during deployment. Success was also judged by observing the extender would not deploy when commanded into its rest mode.

The prototype required one change and was tested ungrounded in the conducted emissions test since it normally is used in an insulated truck environment. The one change involved adding a .01uF bypass capacitor across IC U3 to improve radiated immunity performance in terms of steady up and down movement of the shuttle during testing.

Most of the testing was performed using 26 V battery power. In actuality the power consisted of a 12 volt car battery and a low noise power source supplying the additional voltage for testing purposes.

Nemko Laboratory Authorisation

Aut. No.: ELA 175

EMC Laboratory: **Midwest EMI Associates**
21234 W. Commercial Drive, Unit F
Mundelein, IL 60060 USA

Scope of Authorization: **All standards for EMC and radio transmission that are listed on the accompanying page.**

Nemko has assessed the quality assurance system, the testing facilities, qualifications and testing practices of the relevant parts of the organization. The quality assurance system of the Laboratory has been validated against ISO/IEC 17025 or equivalent. The laboratory also fulfils the conditions described in Nemko Document NLA -10. During the visit by the Nemko representative it was found that the Laboratory is capable of performing tests within the Scope of the Authorisation.

Accordingly, Nemko will normally accept test results from the laboratory on a partial or complete basis, with rights of review as stated in NLA-10, for certification of the products.

In order to maintain the Authorisation, the information given in the pertinent NLA-10 must be carefully followed. Nemko is to be promptly notified about any changes in the situation at the Laboratory, which may affect the basis for this Authorisation. The Authorisation may be withdrawn at any time if the conditions are no longer considered to be fulfilled.

The Authorisation is valid through 30 June 2009.

Dallas, Texas 01 March 2006

For Nemko AS:

TB Ketterling

TB Ketterling, Nemko EMC Coordinator

Nemko AS Gaustadalléen 30 P.O Box 73 Blindern N0314 Oslo Norway T +47 22 96 03 30 F +47 22 96 05 50 Enterprise number: NO974604539

APPENDIX A1

FCC/VDE CONDUCTED EMISSIONS TEST

(CISPR 16-2-3, EN55022, EN55014)

1.0 PURPOSE:

The purpose of this test sequence is to perform compliance testing to FCC and VDE conducted emissions specifications. The test is always performed in a shielded enclosure with a Line Impedance Stabilization Network (LISN).

2.0 INTERIOR SHIELDED ROOM DESCRIPTION:

The 12.5' by 16.5' Lindgren indoor shielded room test site is situated in a 1250 sq. ft. building located at Midwest EMI Associates, 21234 W. Commercial Drive, Mundelein Illinois. This room has a solid steel exterior and copper interior with a blackened screen for visualization of the device under test. The Line Impedance Stabilization Network is bonded to a wall of the enclosure very near to the floor but in such a manner that its terminals are 40 centimeters off the floor. For both FCC and VDE tests, the LISN network has an approved low pass prefilter to permit proper measurement down to 10 kHz. In addition, if the EUT requires 220 VAC power, a Behlman Passport is provided capable of 1350 watts, 50 Hz. The LISN has applied to it a standard three terminal 120VAC IEC plug termination. If the plug style is different, then either a mating connector, a very short alligator clip network, or an equivalent length standard IEC cord is provided. In this case, the 220 VAC cord was used.

3.0 CONFIGURATION AND OPERATION OF TEST SAMPLE:

3.1 POWER REQUIREMENT:

The **TFT RC EXTEND-A-GUN (EP0371)** was operated in its normal mode using 26 VDC battery power.

3.2 GROUNDING:

Any possible alternate ground provided for the test sample was interrupted by the linoleum floor upon which the sample was placed and which situates the test sample 10 cm. above the floor of the lab area. The main ground for the test sample is established by connection of the third wire to a LISN located remotely in the screened room. The EMC receiver, a Tektronix 2712, is located outside the screen room and is grounded with a two inch copper strap at the rear of the instrument and a 2 AWG welding cable at the front of the instrument. The EMC receiver and all measurement equipment including computers are otherwise isolated from the room using a Plitron extreme isolation transformer.

3.3 CONDUCTED CONFIGURATION:

In conducted tests, the test sample was oriented on the metal floor at a 40 cm. height over the ground plane to satisfy Cispr 16-2-1 B level test criterions. The LISN was terminated directly with

a brick wall 10 kHz rolloff filter that provides 20 dB attenuation to the signal going to the spectrum analyzer. All calibration data is maintained in files inside the computer running the analyzer via the GPIB bus. Data was read and plotted in PEAK mode using the capabilities of the Tek 2756P.

3.4 TEST SAMPLE OPERATION:

All test measurements were made with the unit in its normal measuring mode after a 3-minute power up period.

3.5 LIMITS OF ACCEPTANCE:

The general procedures are dictated in the individual protocols listed such as ANSI 63.4, FCC Part 15, CISPR 16-2-3, and CISPR 22. The limits for FCC rules presently are given in Part 15.109 of 47 CFR 1 (10-9-1990) Edition of the Federal Code of Regulations. For convenience these limits are plotted on the graphs and in registered in tabulated data.

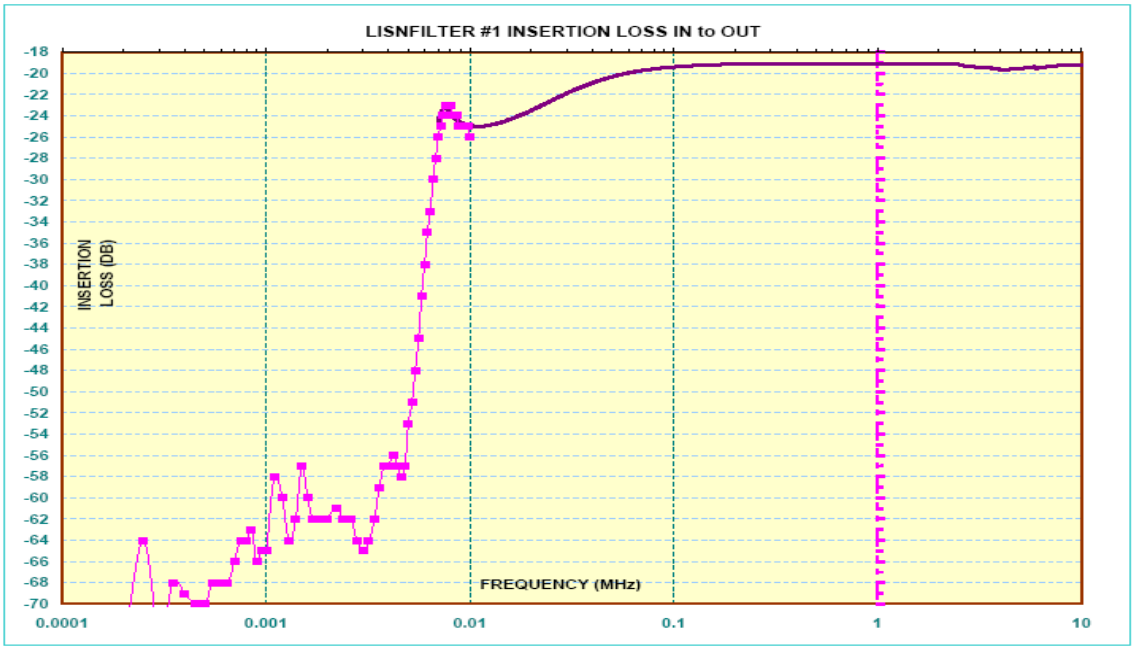
VDE LIMITS

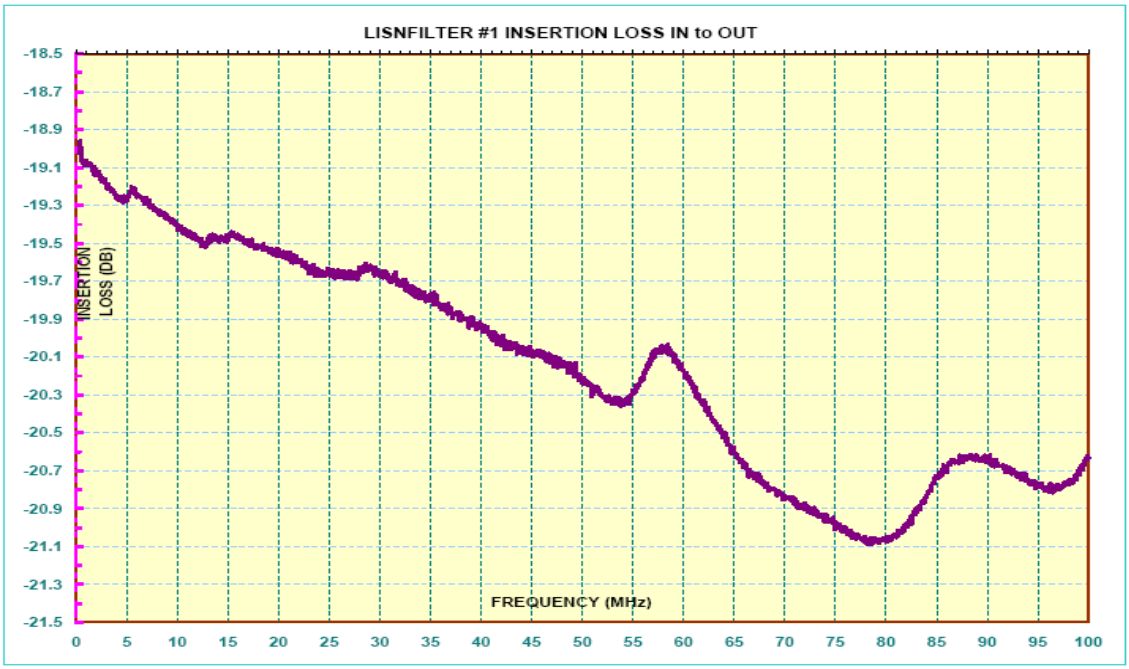
For CISPR 16-2-1 (formerly Cisp 11), 22 (EN55022) or 14 (EN55014) B level conducted compliance starting at 150 kHz the allowed level is 66 dBuV and decreases at a linear rate with the log of frequency to 56 dBuV at 500 kHz. From 500 kHz to 5 MHz the allowed level is 56 dBuV, and 60 dBuV from 5 MHz to 30 MHz at the LISN mains.

3.6 CALIBRATION DATA:

The results of the latest recalibration of the LISN's are contained on the next page over the range of 1 kHz to 1 MHz. The LISN is isolated from the spectrum analyzer by two 10-dB pads on either side of a five-pole rolloff filter. The insertion loss of each LISN has been compared and calibrated to that of a perfect LISN whose response is also shown.

In the range higher than 1 MHz up to 100 MHz the characteristic of each LISN is flat with an insertion loss of no greater than 1.5 dB. In all cases the deviation from the perfect LISN response has been compensated for in a computer correction table file (approximately 150 points). The actual lower end of LISN response used for substantiation of customer data is 10 kHz.

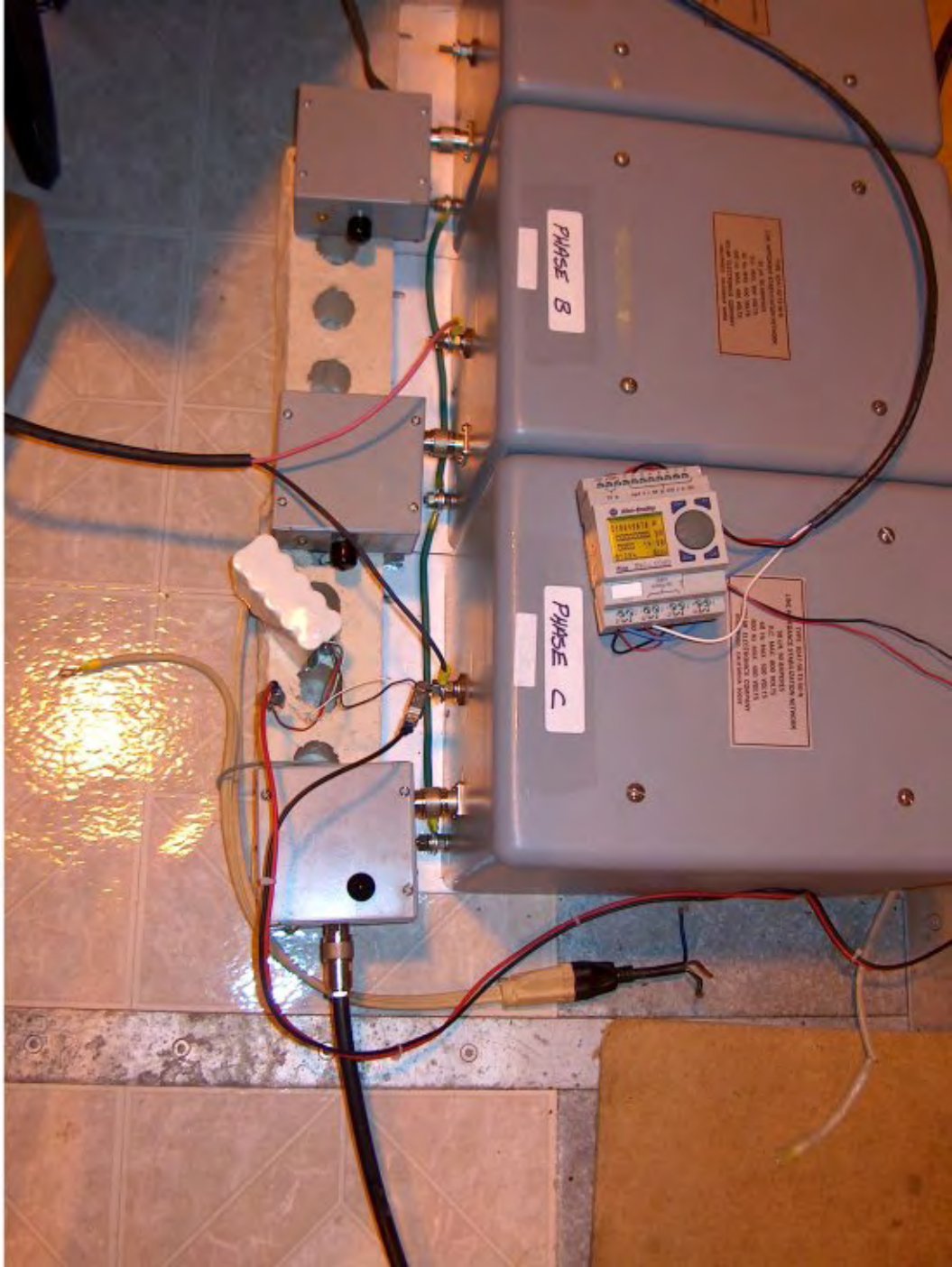

LISNFILTER #1 INSERTION LOSS IN to OUT
INSERTION LOSS (DB)
FREQUENCY (MHz)
-18
-20
-22
-24
-26
-28
-30
-32
-34
-36
-38
-40
-42
-44
-46
-48
-50
-52
-54
-56
-58
-60
-62
-64
-66
-68
-70
0.0001
0.001
0.01
0.1
1
10

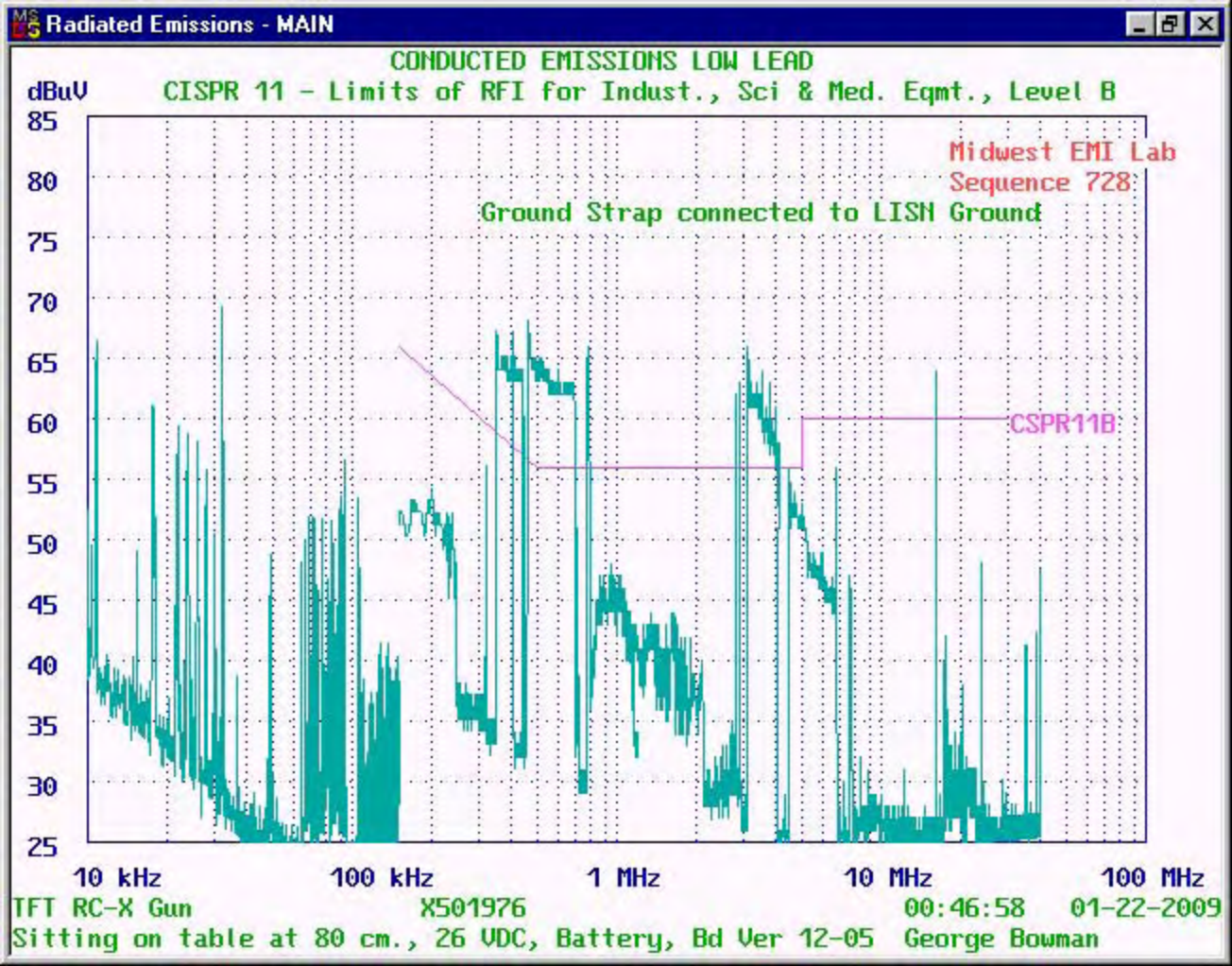

LISNFILTER #1 INSERTION LOSS IN to OUT
INSERTION LOSS (DB)
FREQUENCY (MHz)
-18.5
-18.7
-18.9
-19.1
-19.3
-19.5
-19.7
-19.9
-20.1
-20.3
-20.5
-20.7
-20.9
-21.1
-21.3
-21.5
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
95
100

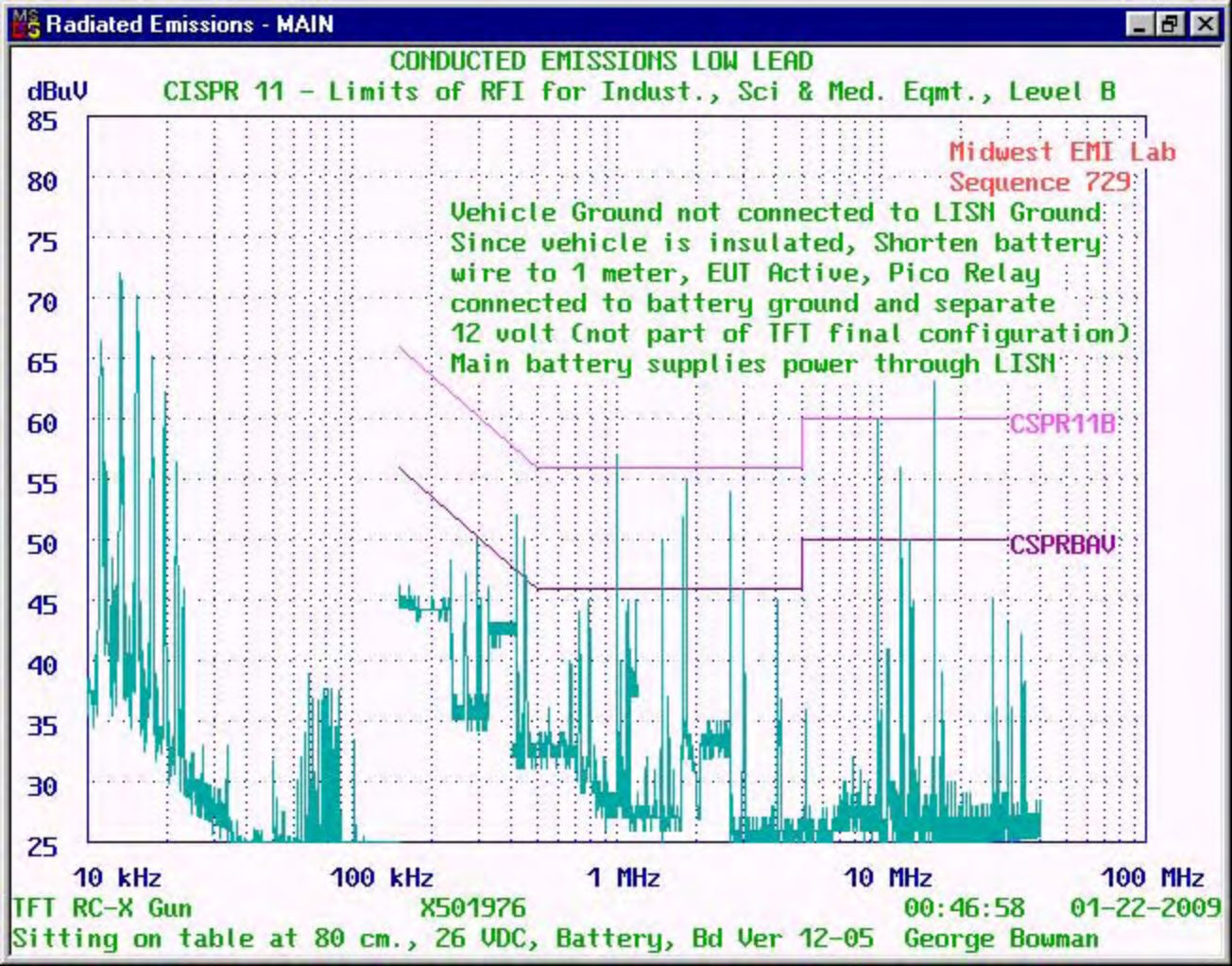
4.0 CONCLUSION OF CONDUCTED RADIO FREQENCY INTERFERENCE EMISSIONS TESTS:

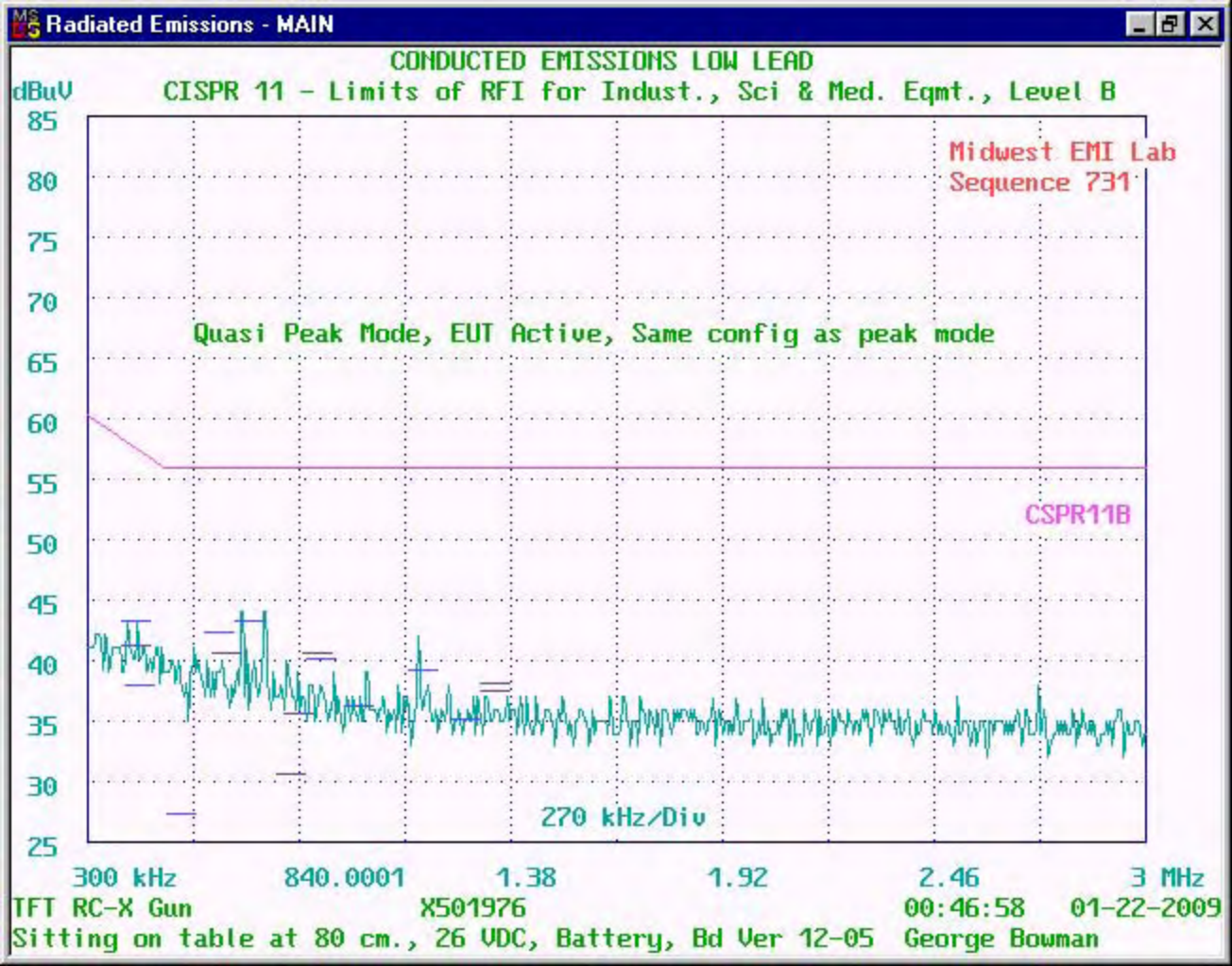
The TFT RC Extend-A-Gun (EP0371) was measured for its conducted emissions per EN61000-6-3 Cispr 16-2-1 for DC operated devices. The standard calls out for a Cispr B performance level. The device met the standard and the body of the device was not grounded since it is normally is installed in an insulated vehicle from earth ground.

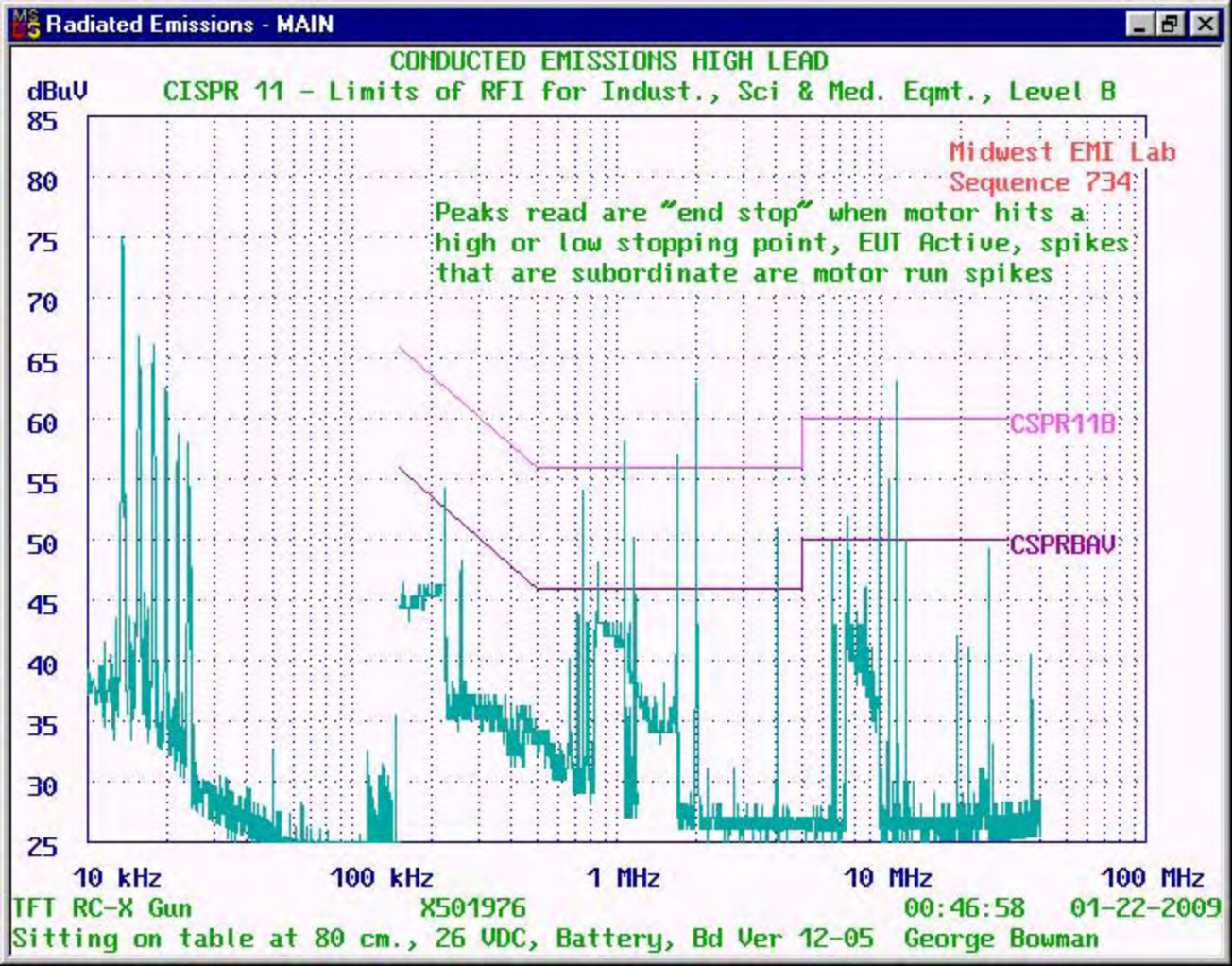
Test results include peak, quasipeak and average responding data.

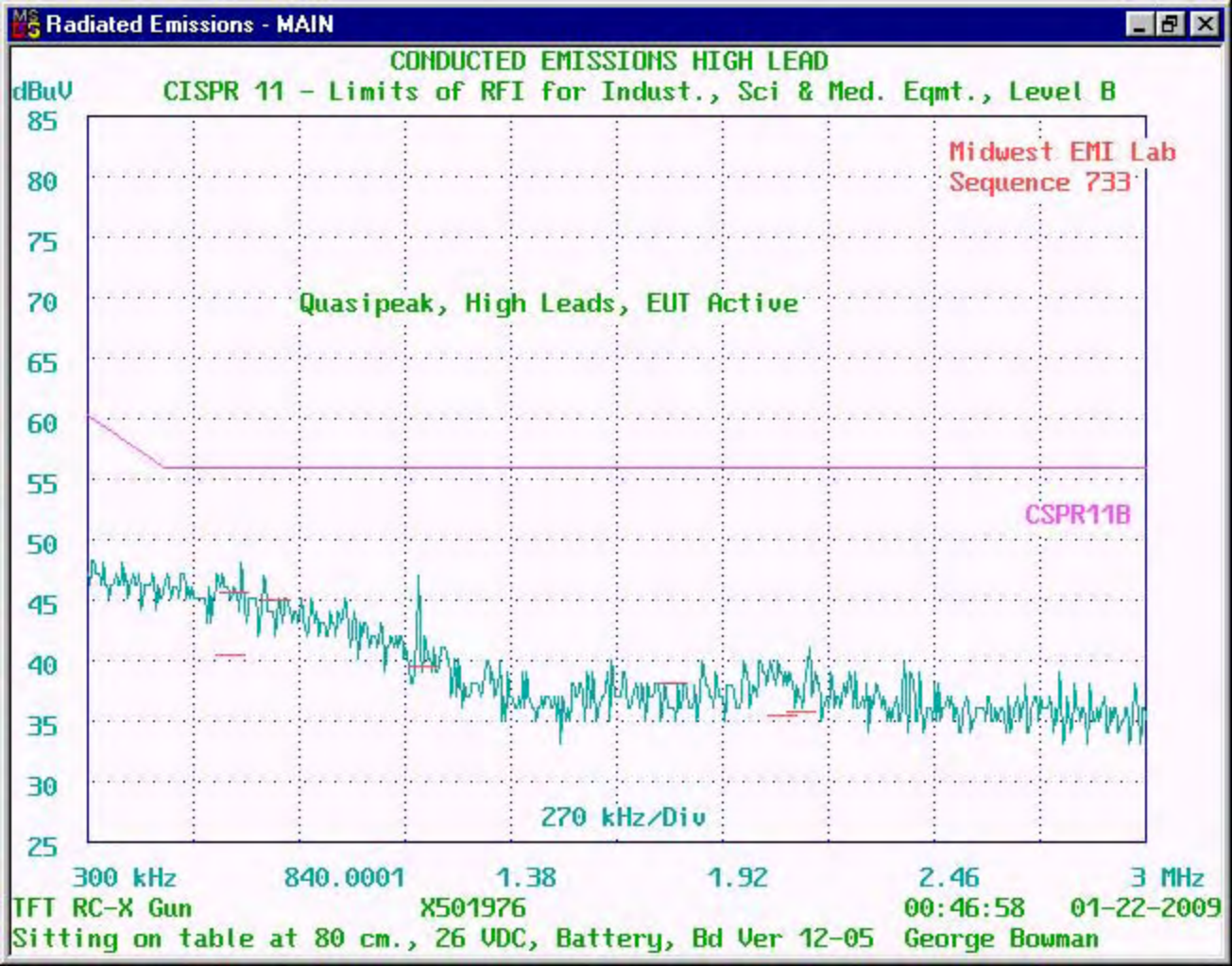

PHASE B
PHASE C


Radiated Emissions - MAIN
CONDUCTED EMISSIONS LOW LEAD
dBuV
CISPR 11 - Limits of RFI for Indust., Sci & Med. Eqmt., Level B
Midwest EMI Lab
Sequence 728
Ground Strap connected to LISN Ground
CSPR11B
85
80
75
70
65
60
55
50
45
40
35
30
25
10 kHz
100 kHz
1 MHz
10 MHz
100 MHz
TFT RC-X Gun
X501976
00:46:58
01-22-2009
Sitting on table at 80 cm., 26 VDC, Battery, Bd Ver 12-05
George Bowman


Radiated Emissions - MAIN
CONDUCTED EMISSIONS LOW LEAD
dBuV
CISPR 11 - Limits of RFI for Indust., Sci & Med. Eqmt., Level B
Midwest EMI Lab
Sequence 729
Vehicle Ground not connected to LISN Ground
Since vehicle is insulated, Shorten battery
wire to 1 meter, EUT Active, Pico Relay
connected to battery ground and separate
12 volt (not part of TFT final configuration)
Main battery supplies power through LISN
CSPR11B
CSPRBAV
85
80
75
70
65
60
55
50
45
40
35
30
25
10 kHz
100 kHz
1 MHz
10 MHz
100 MHz
TFT RC-X Gun
X501976
00:46:58
01-22-2009
Sitting on table at 80 cm., 26 VDC, Battery, Bd Ver 12-05
George Bowman


Radiated Emissions - MAIN
CONDUCTED EMISSIONS LOW LEAD
dBuV
CISPR 11 - Limits of RFI for Indust., Sci & Med. Eqmt., Level B
85
80
75
70
65
60
55
50
45
40
35
30
25
Midwest EMI Lab
Sequence 731
Quasi Peak Mode, EUT Active, Same config as peak mode
CSPR11B
270 kHz/Div
300 kHz
840.0001
1.38
1.92
2.46
3 MHz
TFT RC-X Gun
X501976
00:46:58
01-22-2009
Sitting on table at 80 cm., 26 VDC, Battery, Bd Ver 12-05
George Bowman


Radiated Emissions - MAIN
CONDUCTED EMISSIONS HIGH LEAD
dBuV
CISPR 11 - Limits of RFI for Indust., Sci & Med. Eqmt., Level B
Midwest EMI Lab
Sequence 734
Peaks read are "end stop" when motor hits a high or low stopping point, EUT Active, spikes that are subordinate are motor run spikes
CSPR11B
CSPRBAV
85
80
75
70
65
60
55
50
45
40
35
30
25
10 kHz
100 kHz
1 MHz
10 MHz
100 MHz
TFT RC-X Gun
X501976
00:46:58
01-22-2009
Sitting on table at 80 cm., 26 VDC, Battery, Bd Ver 12-05
George Bowman

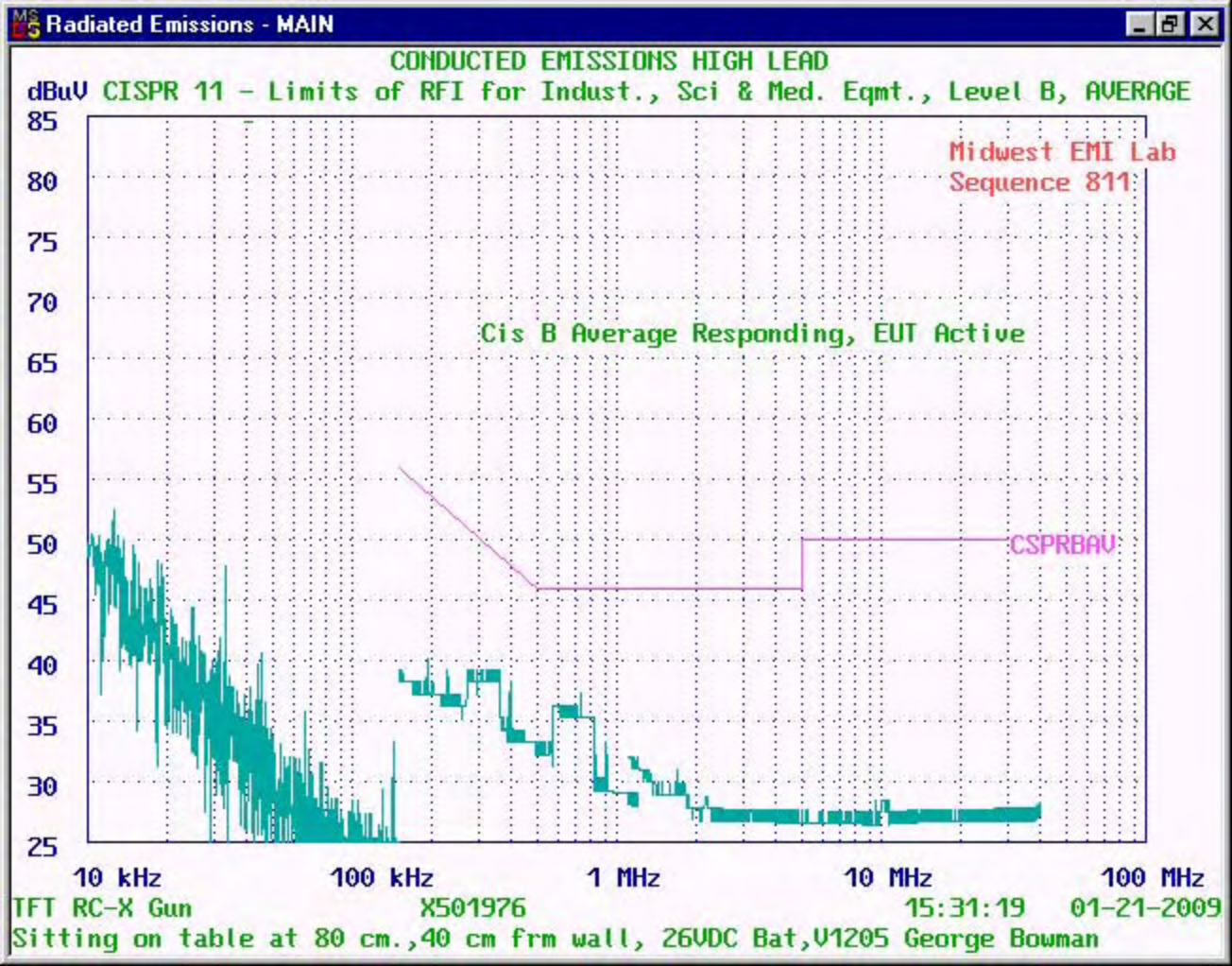

Radiated Emissions - MAIN
CONDUCTED EMISSIONS HIGH LEAD
dBuV
CISPR 11 - Limits of RFI for Indust., Sci & Med. Eqmt., Level B
85
80
75
70
65
60
55
50
45
40
35
30
25
Midwest EMI Lab
Sequence 733
Quasipeak, High Leads, EUT Active
CSPR11B
270 kHz/Div
300 kHz
840.0001
1.38
1.92
2.46
3 MHz
TFT RC-X Gun
X501976
00:46:58
01-22-2009
Sitting on table at 80 cm., 26 VDC, Battery, Bd Ver 12-05
George Bowman

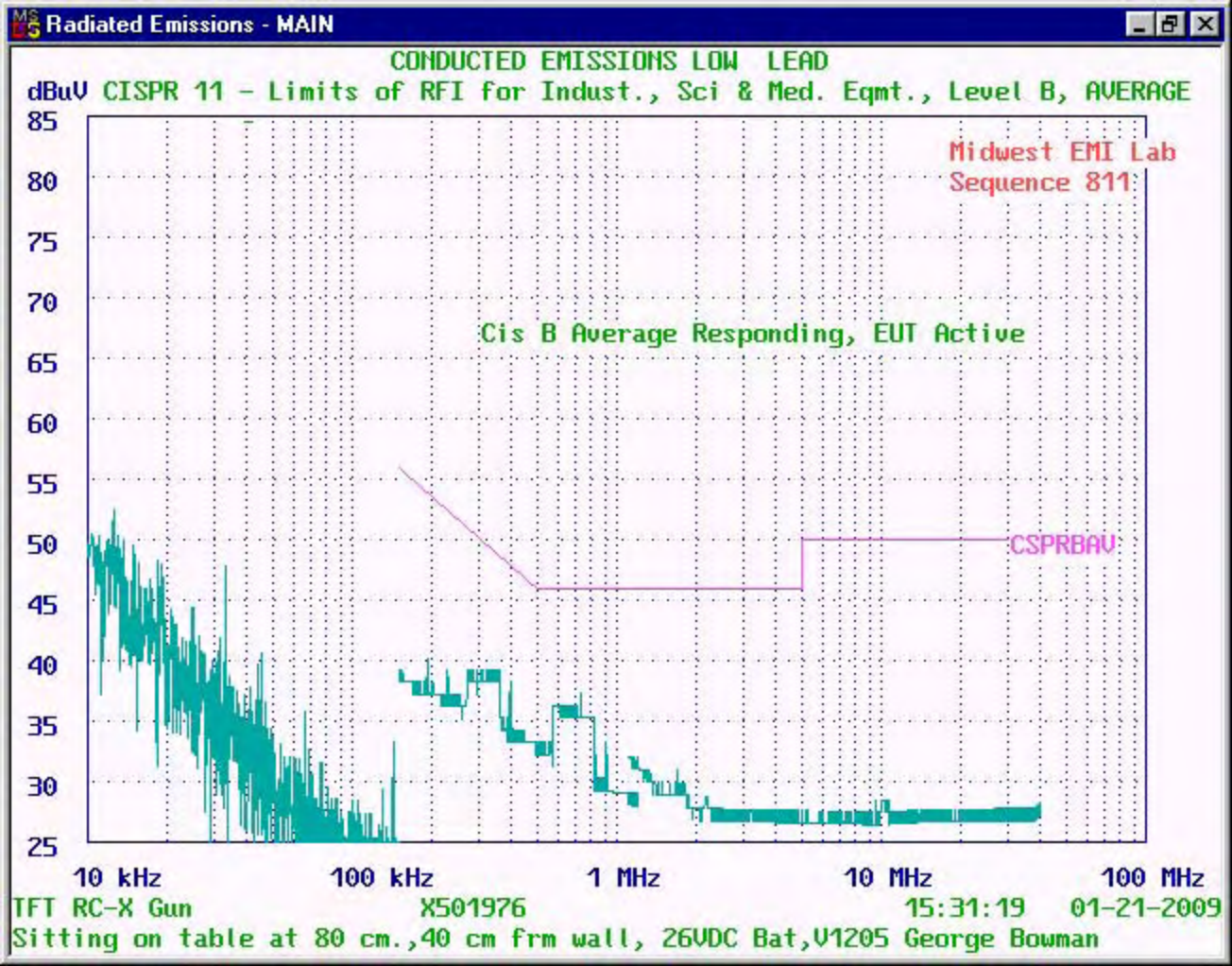
SHEET 1 **CSPR11B CONDUCTED QUASI-PEAK REPORT**
High Lead
CISPR 11 - Limits of RFI for Indust., Sci & Med. Eqmt., Level B
TIME: 00:46:58 **Midwest EMI**
DATE: 01-22-2009 **Associates**
TEST ITEM: TFT RC-X Gun
SERIAL NUMBER: X501976 **Sequence Number: 733**
COMMENTS: Sitting on table at 80 cm., 26 VDC, Battery, Bd Ver 12-05
TEST PERFORMED BY: George Bowman

Peak Freq. (kHz)	Peak Interfer. (dBuV)	Quasi-peak Freq. (kHz)	Quasi-peak Interfer. (dBuV)	Spec. Level (dBuV)
672.2054	36.33	661.71	40.52	56.00
672.2666	44.62	673.47	45.72	56.00
780.204	45.60	779.96	45.09	56.00
1161.926	41.89	1162.71	39.69	56.00
1790	52.65	1793.72	38.15	56.00
2066	58.74	2077.4	35.54	56.00
2136	52.35	2122.2	35.85	56.00

SHEET 1 **CSPR11B CONDUCTED QUASI-PEAK REPORT**
Low Lead
CISPR 11 - Limits of RFI for Indust., Sci & Med. Eqmt., Level B
TIME: 00:46:58 **Midwest EMI**
DATE: 01-22-2009 **Associates**
TEST ITEM: TFT RC-X Gun
SERIAL NUMBER: X501976 **Sequence Number: 731**
COMMENTS: Sitting on table at 80 cm., 26 VDC, Battery, Bd Ver 12-05
TEST PERFORMED BY: George Bowman

Peak Freq. (kHz)	Peak Interfer. (dBuV)	Quasi-peak Freq. (kHz)	Quasi-peak Interfer. (dBuV)	Spec. Level (dBuV)
411.1352	41.93	422.42	43.40	57.63
422.4339	41.92	425.01	41.40	57.40
427.3259	41.91	439.69	38.09	57.30
540.5878	41.57	541.37	27.46	56.00
643.429	40.94	640.3099	42.43	56.00
648.857	40.94	654.5	40.72	56.00
720.0741	40.21	718.99	43.31	56.00
826.6221	41.19	839.82	35.69	56.00
834.2755	40.19	819.28	30.69	56.00
901.0383	40.20	892.16	40.69	56.00
896.6294	39.20	902.51	40.30	56.00
1001.405	37.90	997.99	36.40	56.00
1160.886	41.19	1159.21	39.29	56.00
1283	39.48	1268.3	35.28	56.00
1346.391	37.48	1340.45	37.57	56.00
1335.139	44.08	1344.8	38.27	56.00


Radiated Emissions - MAIN
CONDUCTED EMISSIONS HIGH LEAD
dBuV CISPR 11 - Limits of RFI for Indust., Sci & Med. Eqmt., Level B, AVERAGE
Midwest EMI Lab
Sequence 811
Cis B Average Responding, EUT Active
CSPRBAV
85
80
75
70
65
60
55
50
45
40
35
30
25
10 kHz
100 kHz
1 MHz
10 MHz
100 MHz
TFT RC-X Gun
X501976
15:31:19
01-21-2009
Sitting on table at 80 cm.,40 cm frm wall, 26VDC Bat,V1205 George Bowman


Radiated Emissions - MAIN
CONDUCTED EMISSIONS LOW LEAD
dBuV CISPR 11 - Limits of RFI for Indust., Sci & Med. Eqmt., Level B, AVERAGE
Midwest EMI Lab
Sequence 811
Cis B Average Responding, EUT Active
CSPRBAV
85
80
75
70
65
60
55
50
45
40
35
30
25
10 kHz
100 kHz
1 MHz
10 MHz
100 MHz
TFT RC-X Gun
X501976
15:31:19
01-21-2009
Sitting on table at 80 cm.,40 cm frm wall, 26VDC Bat,V1205 George Bowman

APPENDIX B1

FCC/VDE RADIATED EMISSIONS TEST

(CISPR 16-2-3, EN55022, EN55014)

1.0 PURPOSE:

The purpose of this test sequence is to perform compliance testing to FCC Part 15, VDE 0871, CISPR 16-2-3 (formerly Cispr 11 or 22) and other tests that can be run on a 3 meter indoor test site or in a screen room.

2.0 INDOOR TEST FACILITY DESCRIPTION:

The indoor test site is situated inside a 3000 sq. ft. building located at Midwest EMI Associates, 21234 W. Commercial Drive, Mundelein Illinois. This site has flat plane above which is situated multiple 1/2" thick 4 x 8 foot wood panels with double-sided galvanized steel plates comprising an overall dimension of approximately 24 by 32 feet. The plates are interconnected by "top hat" grounding connections that is further grounded by connection to the main power ground into the earth satisfying ANSI requirements. These tests require that the antenna be raised and lowered over a 1 to 4 meter distance on an antenna mast such that the radials clear obstructions by at least 1 meter. The size of the site will accommodate three-meter Cispr measurements. All objects are clear of the ellipse defined in ANSI for a three-meter site. The antenna mast is the C.C. Moore Company automated mast assembly Model DAPM4/6 and the antenna turntable is the C.C. Moore Company automated turntable Model DTT-4.

3.0 CONFIGURATION AND OPERATION OF TEST SAMPLE:

3.1 POWER REQUIREMENT:

The TFT RC EXTEND-A-GUN (EP0371) was operated in its normal mode using a 26 VDC lead acid battery for power.

3.2 GROUNDING:

Any possible alternate ground provided for the test sample was interrupted by the wooden table upon which the sample was placed and which situates the test sample 80 cm. above the floor of the lab area.

The EMC receiver, a Tektronix 2712, is located outside the screen room and is grounded with a two inch copper strap at the rear of the instrument and a 2 AWG welding cable at the front of the instrument.

3.3 RADIATED CONFIGURATION:

In radiated tests, the test sample was oriented so that the area exhibiting the greatest amount of radiation was facing the antenna.

All measurements were performed using the peak and quasi peak reading capability of the Tek 2712.

3.4 TEST SAMPLE OPERATION:

All test measurements were made with the unit in its normal measuring mode after a 3-minute power up period. The EUT was extending its platform in a standard up/down sequence during this test.

3.5 TEST PROCEDURES/LIMITS OF ACCEPTANCE:

The general procedures are dictated in the individual protocols listed such as ANSI 63.4, FCC Part 15, CISPR 16-2-3, and CISPR 22. The limits for FCC rules presently are given in Part 15.109 of 47 CFR 1 (10-9-1990) Edition of the Federal Code of Regulations. **The antenna used is the Antenna Research LPB 2520 Biconilog antenna in both its horizontal and vertical modes for 5-meter compliance tests.**

VDE LIMITS (ELECTRIC FIELDS - CISPR 16-2-3)

Above 30 MHz the limit is written at 30 meters. From 30 MHz to 230 MHz the "A" level allowed is 30 uV/m, and 37 dBuV/m) from 230 MHz to 1000 MHz. Since the specification is written at 30 meters the extrapolated allowed values to 3 meters are 50 dBuV/m and 57 dBuV/m respectively. If this requirement is passed and the Cispr 16-2-3 B level limit is not passed then the following warning is recommended to be included in the instructions for use:

> **This (Equipment and/or System) is suitable for use in all establishments other than domestic and those directly connected to the low voltage power supply network that supplies buildings used for domestic purposes.**

Sale of devices is not restricted when this warning is included in the instructions.

For CISPR 16-2-3 B level, the allowed radiated emissions are measured at a 10 meters distance. The allowed levels are 30 dBuV/m from 30 to 230 MHz, and from 230 to 1000 MHz the level is 37 dBuV/m. The levels have been linearly extrapolated on the graphs to 5 meters, which reflects a 6 dB increase.

Hereinafter, the equipment under test will be referred to as the E.U.T. All radiated tests above 30 MHz are made with horizontal and vertical polarizations where applicable.

4.0 CONCLUSION OF RADIATED RADIO FREQENCY INTERFERENCE EMISSIONS TESTS:

Preliminary Test

The device was oriented with the front of the EUT facing the antenna initially. The unit was varied in position and antenna height with a 2 meter antenna height found typically to be worst case. The orientation of the unit was typically with the Monitor keypad on the control box facing front at 0 degrees wrt the antenna. Battery was set at 26 volts.

Final Testing –01-21-09

The Seq. 164 shows the ambient; Seq. 170 shows the peak mode in comparison in the range of 20-75 MHz and Seq. 171 shows the quasipeak. Several emissions in the 61-70 Mhz range were examined but were not over the limit. Spikes seen in the ambient were actually the motor hitting the top stop or bottom stop of travel (current limiting action). Several frequencies were individually searched and found not to be from the EUT. Other emissions above the line were due to TV channel 2 and the beginning of the FM band.

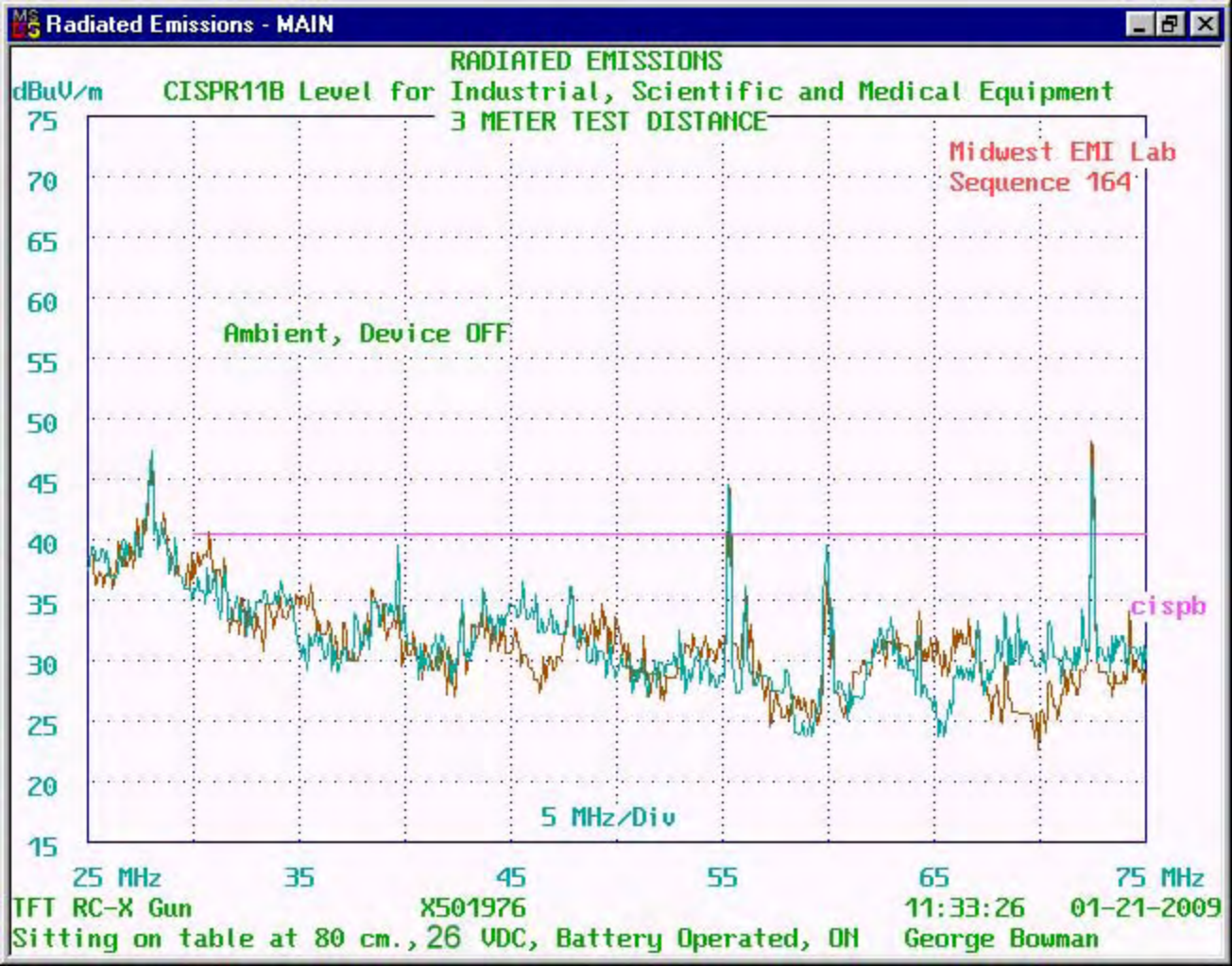
In the 75-170 MHz range, Seq. 165 shows the ambient, Seq. 173 shows the quasipeak emissions. Ambient emissions consist of TV channel 5, FM band the intentional radiators at 152-158 and 162 MHz. Emissions in the mid band area were discovered to be airplane emissions and none exceeded the limit. Other common carriers are seen at 152 and 158 MHz..

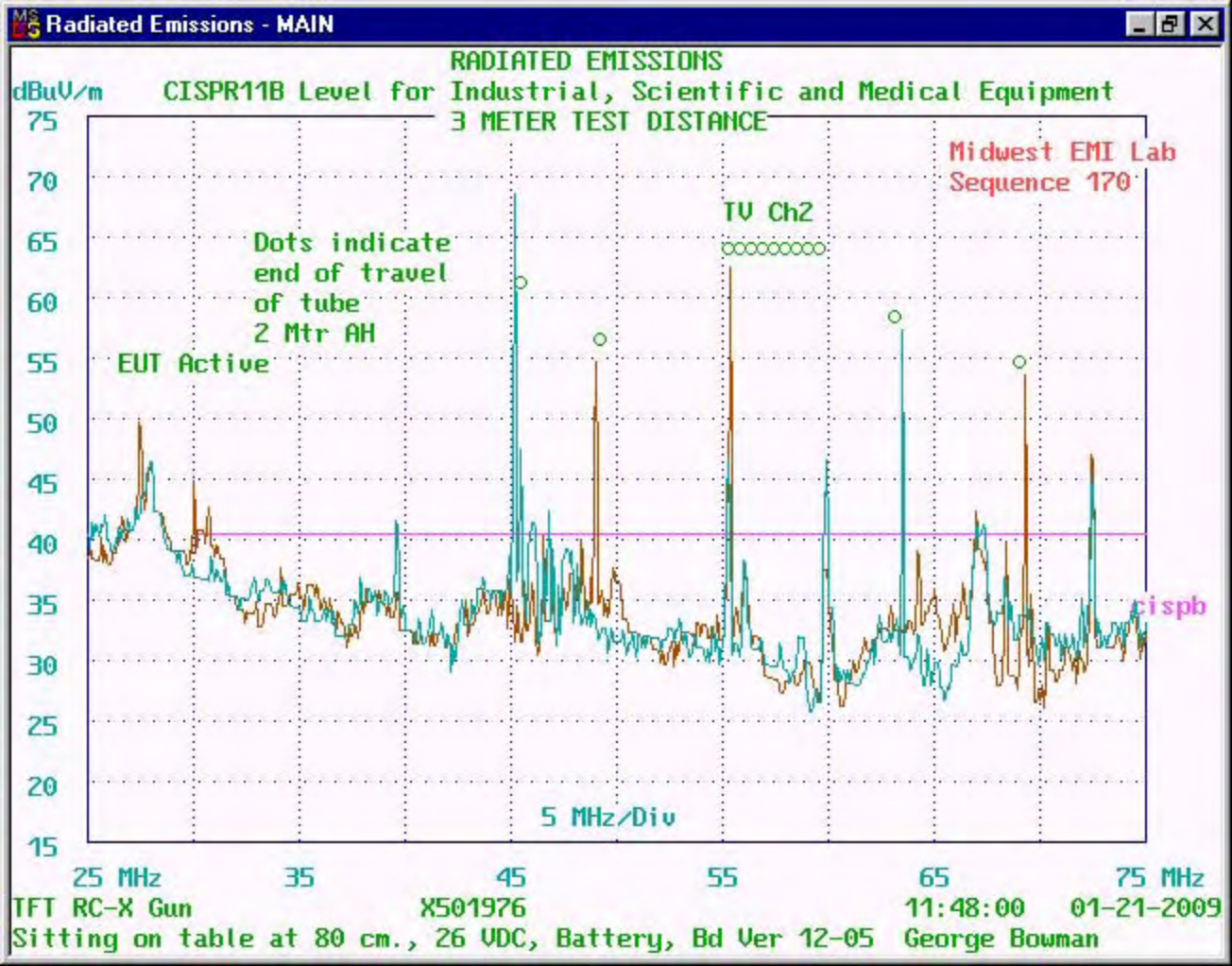
In the 160-300 MHz range, the ambient is shown on Seq. 170, and peak level on Seq. 174. No areas of emission from the EUT appeared to exceed the limit. Other emissions seen were from TV Channels 7, 9, and 11, and a common carrier at about 220 MHz.

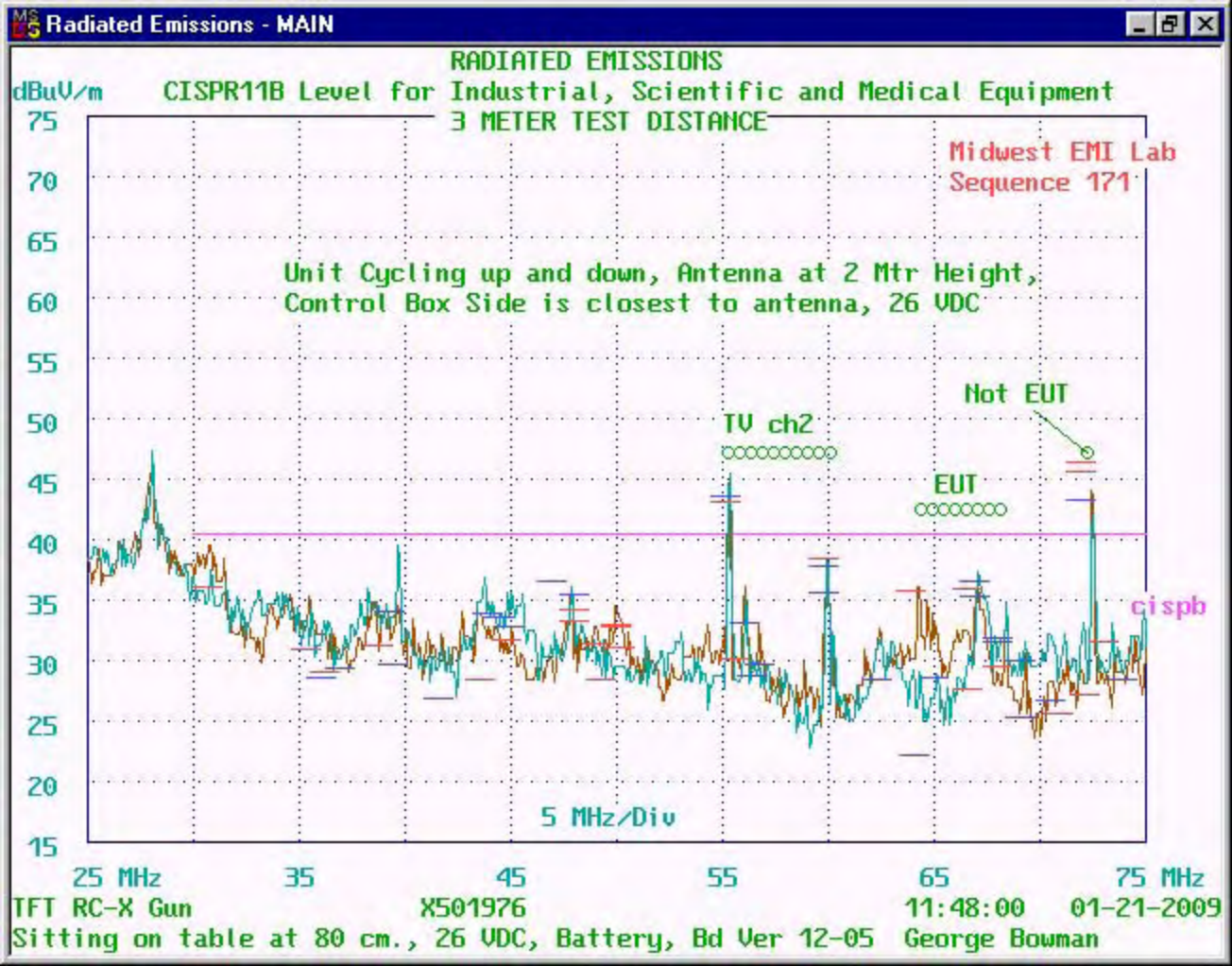
In the 300-640 MHz, the ambient is shown on Seq. 168 and the peak level emissions are shown on Seq. 175. Other high emissions are numerous UHF TV stations. Two emissions found in this range different from the ambient were individually inspected and not found to be due to the EUT but were from limo taxi services.

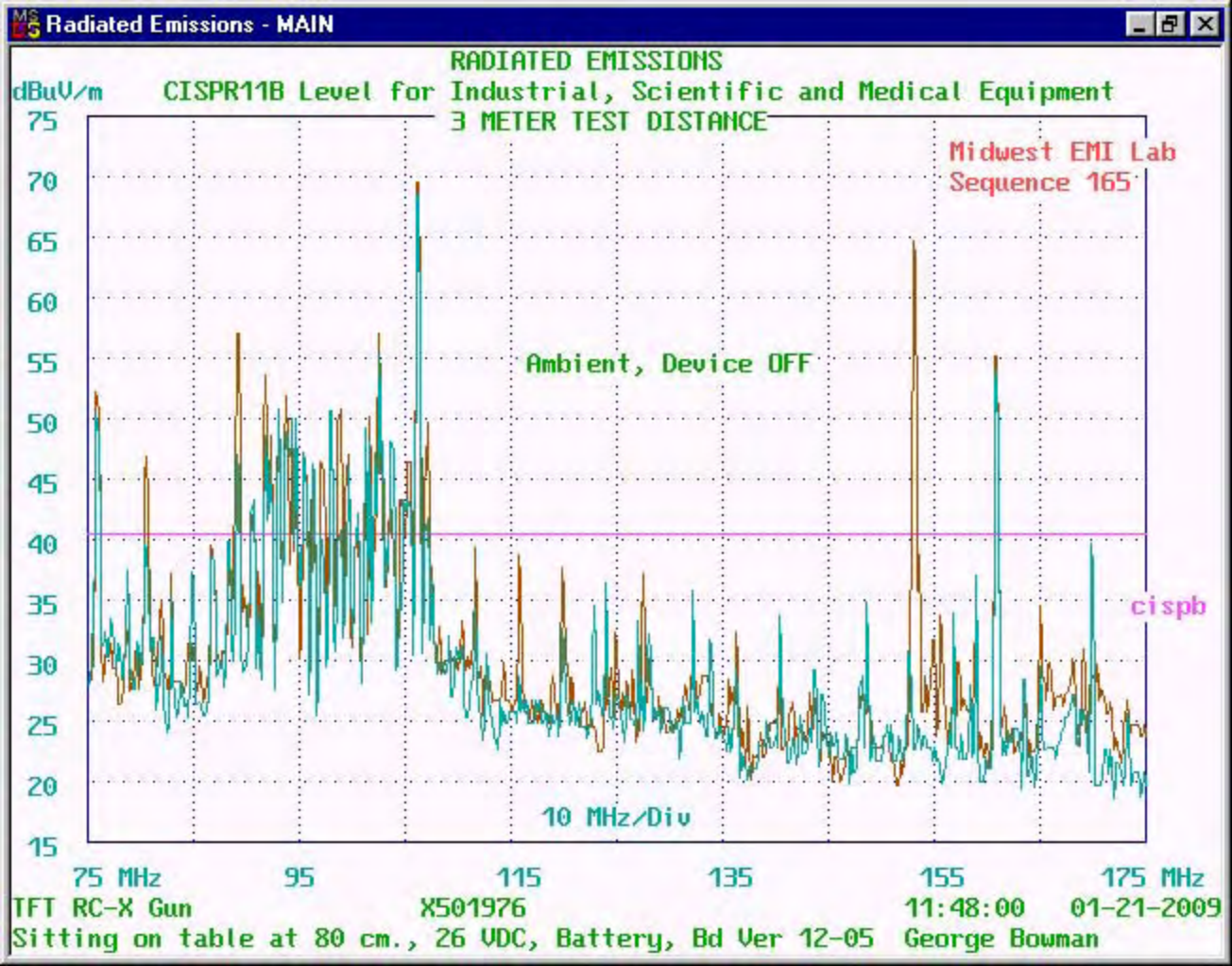
In the 620-1000 MHz, the ambient is shown on Seq. 169 and peak level on Seq. 176. Other high emissions are numerous UHF TV stations and the cell telephone band around 900 MHz. When the graphs were overlaid, no excess level introduced by the EUT was seen.

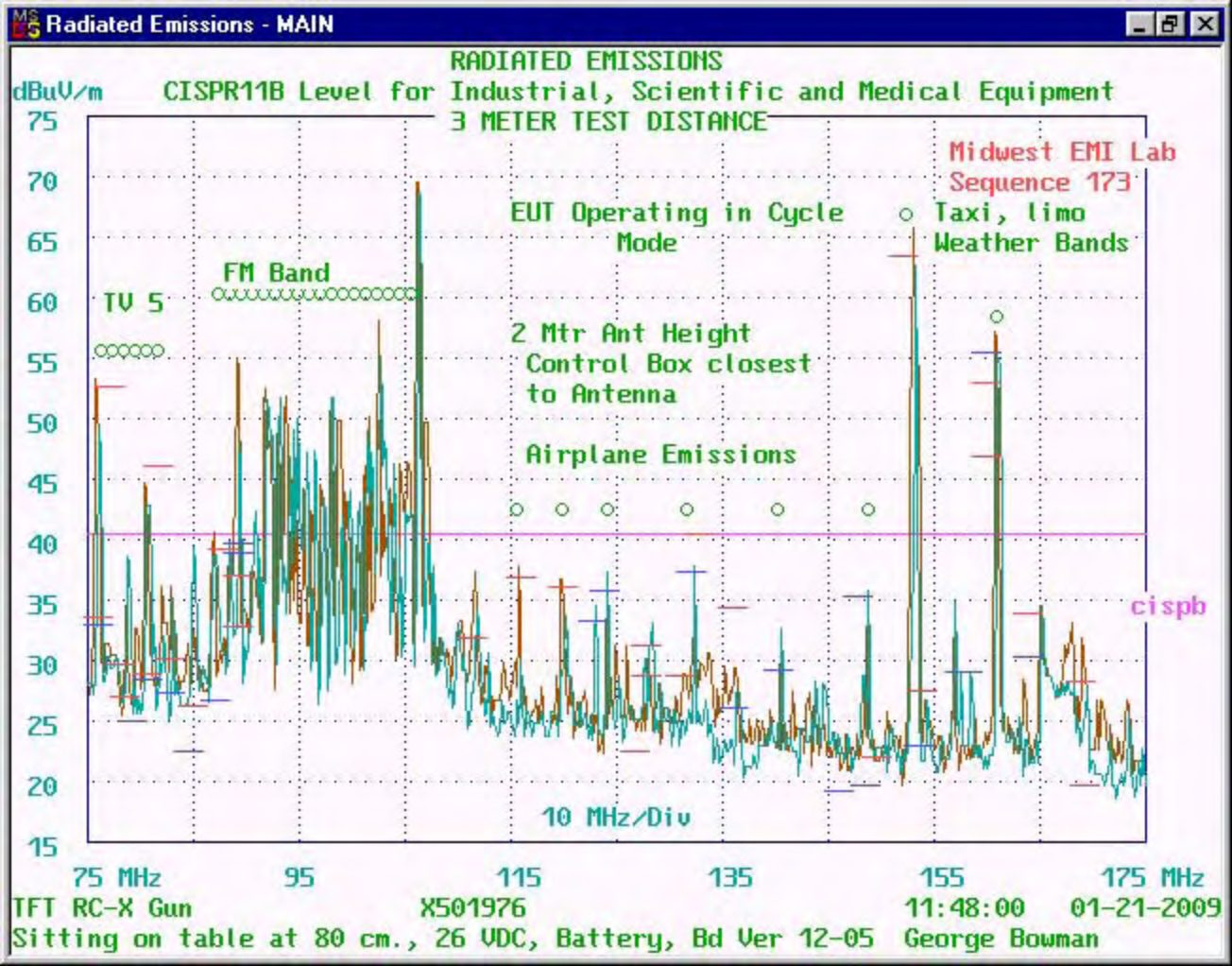
The TFT RC Extend-A-Gun(EP0371) was fully compliant with the Cispr 16-2-3 B level specification without alteration. The actual battery used for this test was a large 12 volt lead acid battery and a power supply for an additional 14 volts that was attached to the battery terminals by clip leads.

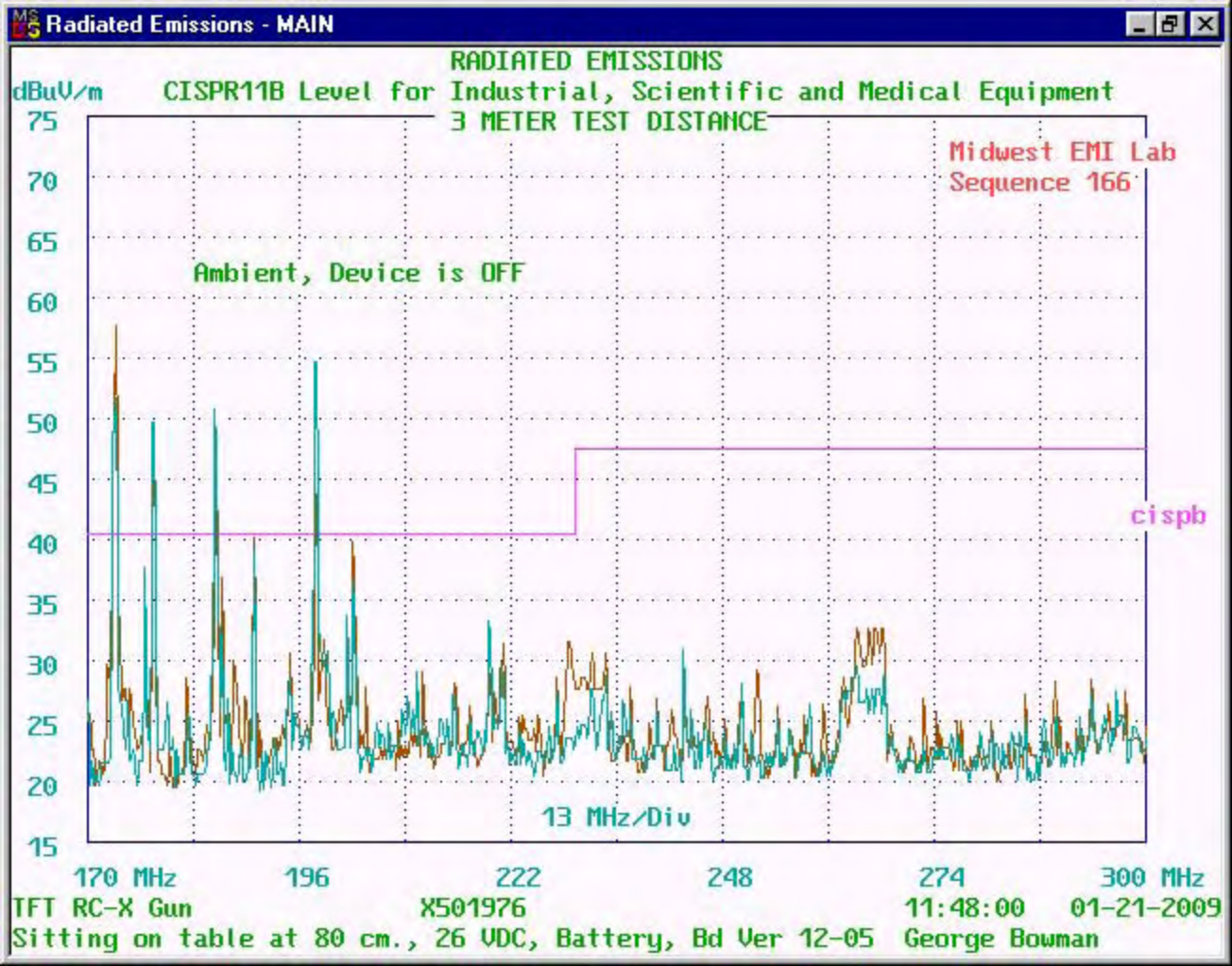

Radiated Emissions - MAIN
RADIATED EMISSIONS
dBuV/m
CISPR11B Level for Industrial, Scientific and Medical Equipment
3 METER TEST DISTANCE
Midwest EMI Lab
Sequence 164
Ambient, Device OFF
cispb
5 MHz/Div
75
70
65
60
55
50
45
40
35
30
25
20
15
25 MHz
35
45
55
65
75 MHz
TFT RC-X Gun
X501976
11:33:26
01-21-2009
Sitting on table at 80 cm., 26 VDC, Battery Operated, ON
George Bowman

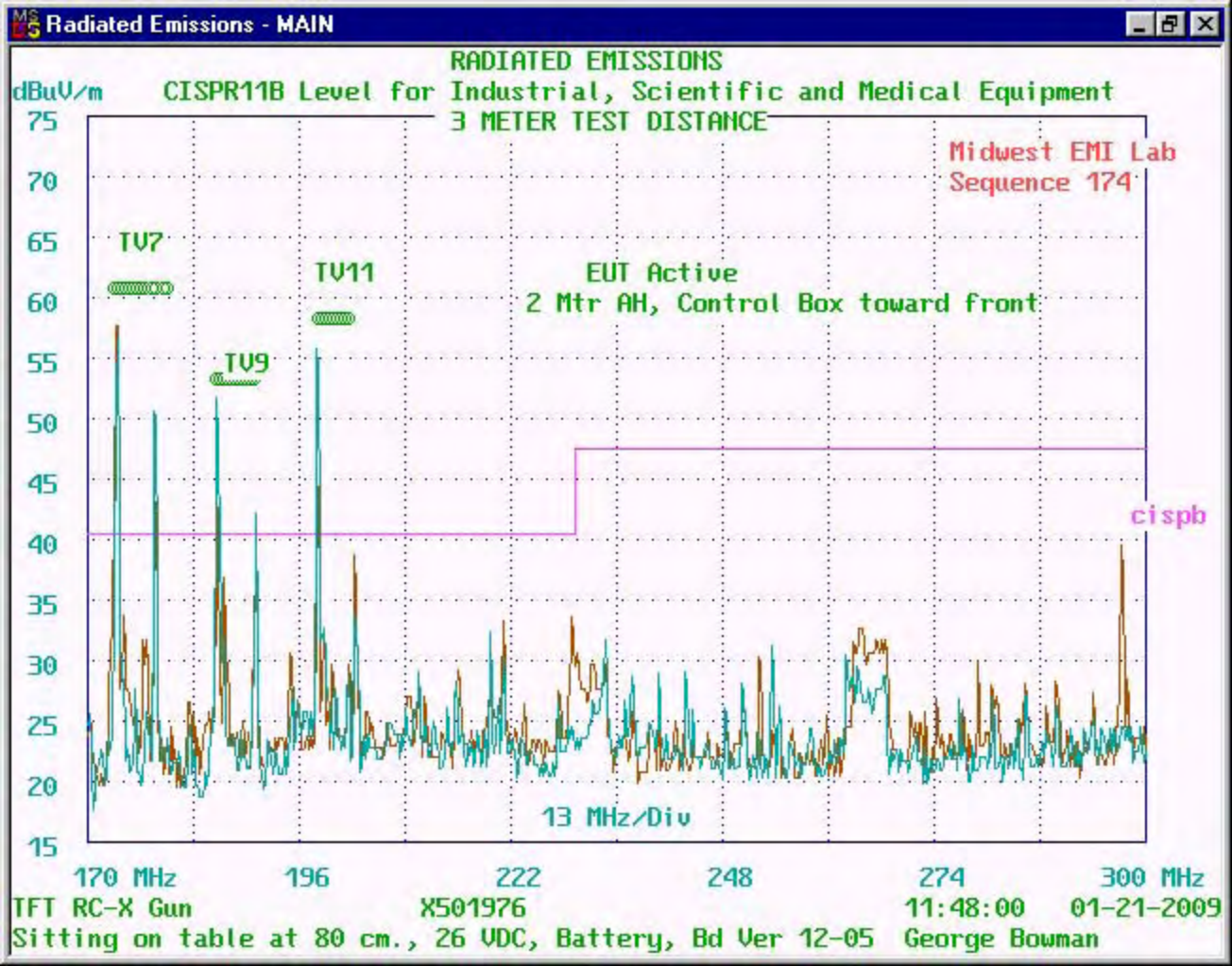

Radiated Emissions - MAIN
RADIATED EMISSIONS
dBuV/m
CISPR11B Level for Industrial, Scientific and Medical Equipment
3 METER TEST DISTANCE
Midwest EMI Lab
Sequence 170
TV Ch2
Dots indicate
end of travel
of tube
2 Mtr AH
EUT Active
cispb
5 MHz/Div
75
70
65
60
55
50
45
40
35
30
25
20
15
25 MHz
35
45
55
65
75 MHz
TFT RC-X Gun
X501976
11:48:00
01-21-2009
Sitting on table at 80 cm., 26 VDC, Battery, Bd Ver 12-05
George Bowman

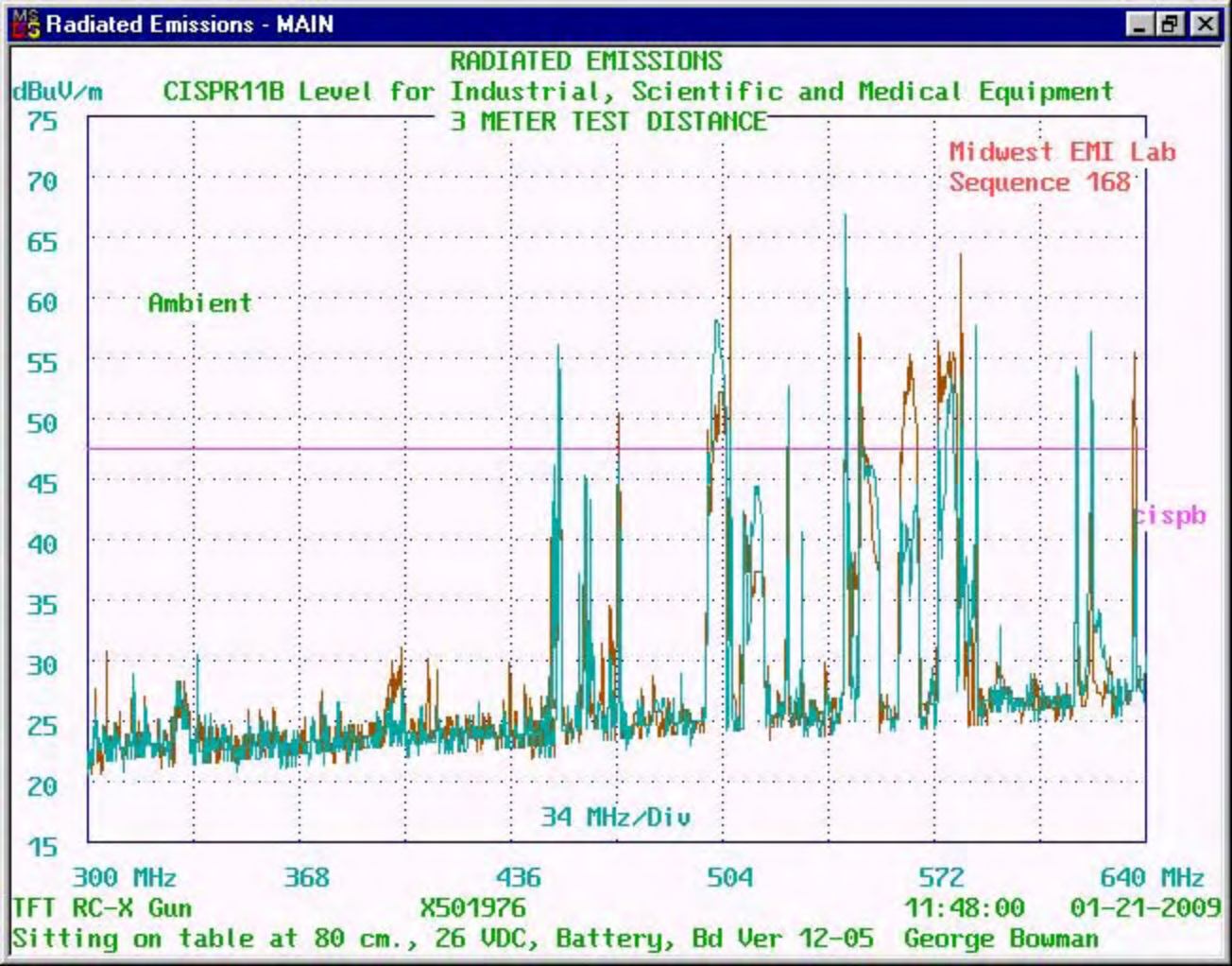

Radiated Emissions - MAIN
RADIATED EMISSIONS
dBuV/m
CISPR11B Level for Industrial, Scientific and Medical Equipment
3 METER TEST DISTANCE
Midwest EMI Lab
Sequence 171
Unit Cycling up and down, Antenna at 2 Mtr Height,
Control Box Side is closest to antenna, 26 VDC
Not EUT
TV ch2
EUT
cispb
5 MHz/Div
75
70
65
60
55
50
45
40
35
30
25
20
15
25 MHz
35
45
55
65
75 MHz
TFT RC-X Gun
X501976
11:48:00
01-21-2009
Sitting on table at 80 cm., 26 VDC, Battery, Bd Ver 12-05
George Bowman

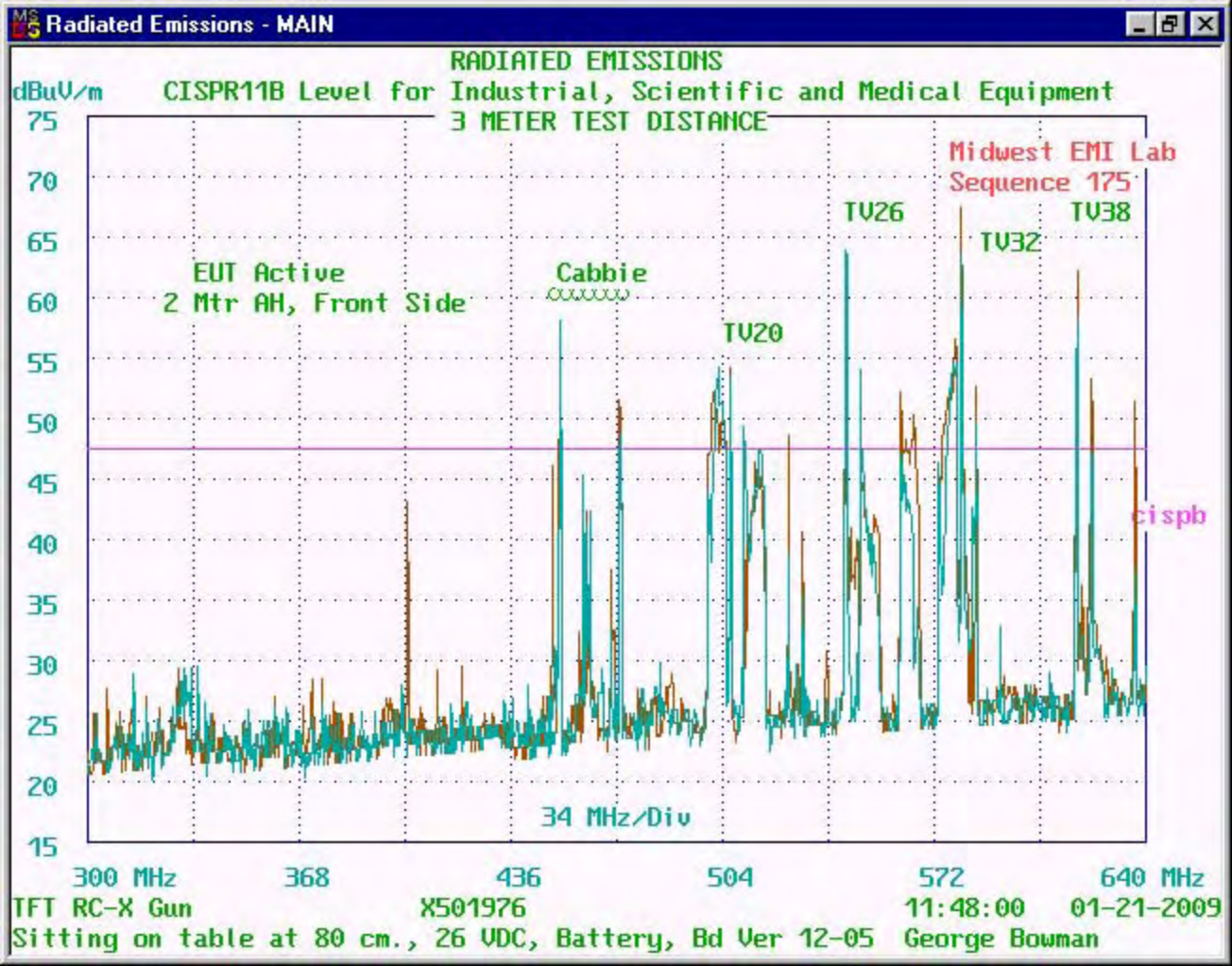

Radiated Emissions - MAIN
RADIATED EMISSIONS
dBuV/m
CISPR11B Level for Industrial, Scientific and Medical Equipment
3 METER TEST DISTANCE
Midwest EMI Lab
Sequence 165
Ambient, Device OFF
cispb
10 MHz/Div
75
70
65
60
55
50
45
40
35
30
25
20
15
75 MHz
95
115
135
155
175 MHz
TFT RC-X Gun
X501976
11:48:00
01-21-2009
Sitting on table at 80 cm., 26 VDC, Battery, Bd Ver 12-05
George Bowman

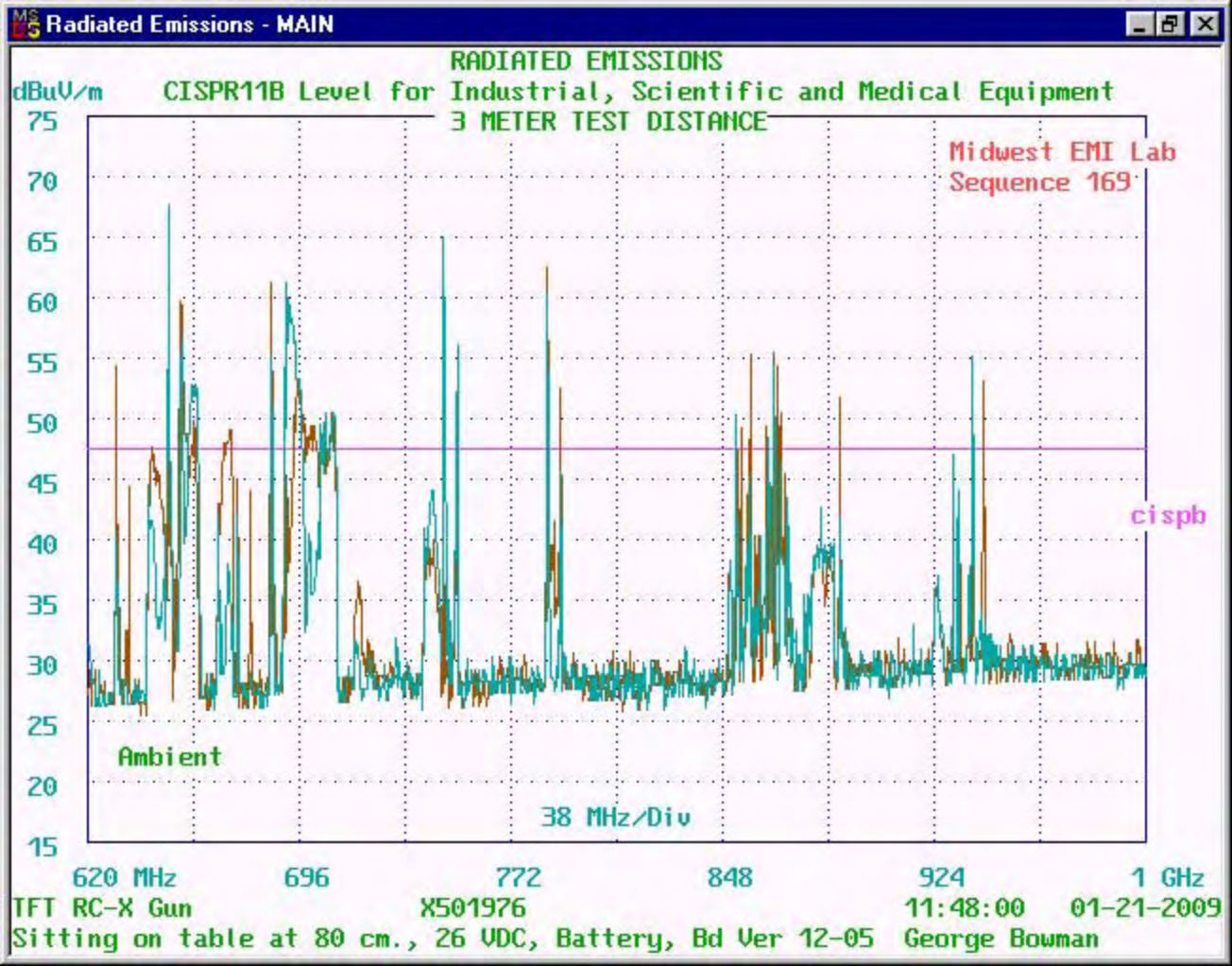

Radiated Emissions - MAIN
RADIATED EMISSIONS
dBuV/m
CISPR11B Level for Industrial, Scientific and Medical Equipment
3 METER TEST DISTANCE
Midwest EMI Lab
Sequence 173
EUT Operating in Cycle Mode
Taxi, limo
Weather Bands
FM Band
TV 5
2 Mtr Ant Height
Control Box closest to Antenna
Airplane Emissions
cispb
10 MHz/Div
75
70
65
60
55
50
45
40
35
30
25
20
15
75 MHz
95
115
135
155
175 MHz
TFT RC-X Gun
X501976
11:48:00
01-21-2009
Sitting on table at 80 cm., 26 VDC, Battery, Bd Ver 12-05
George Bowman

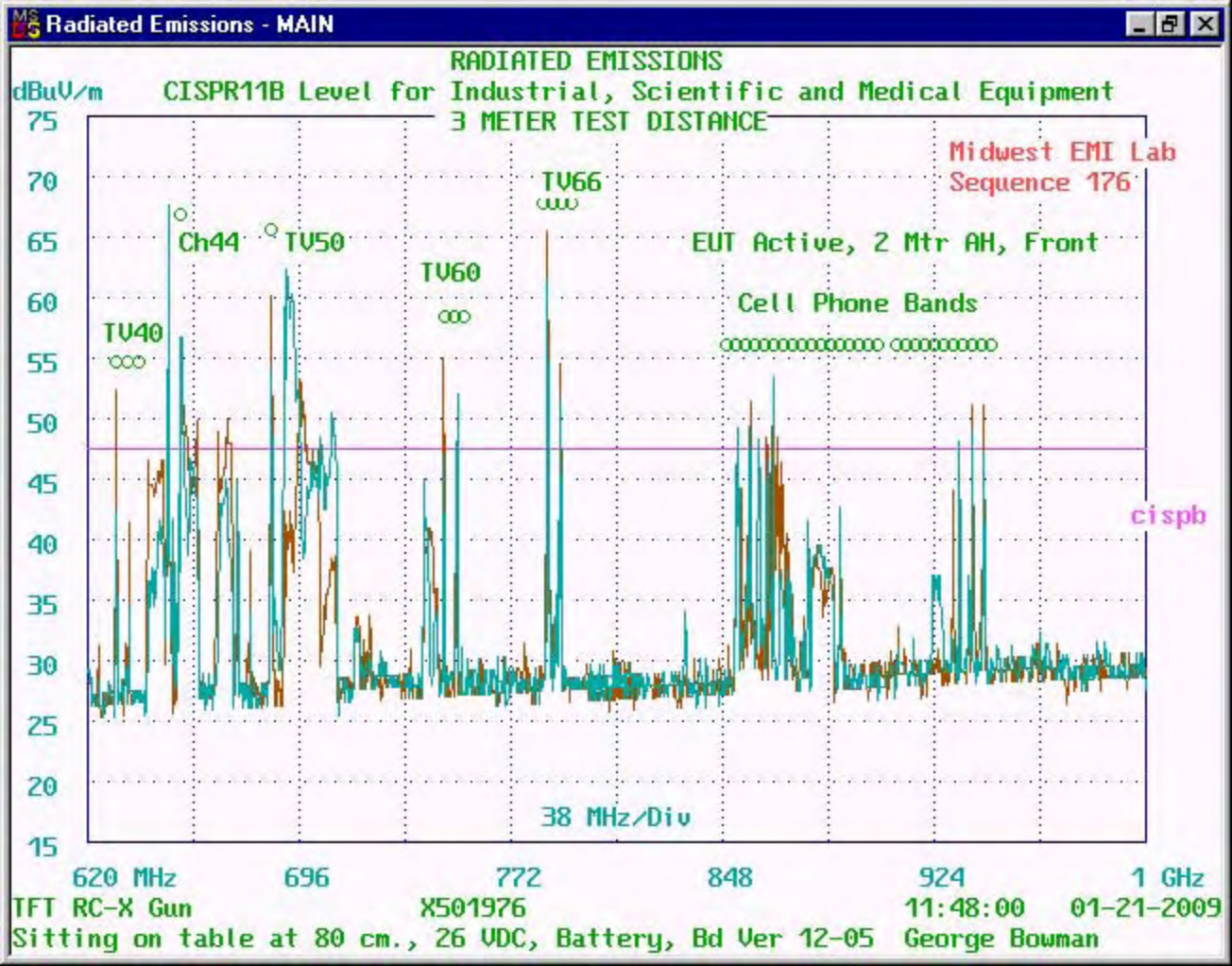

Radiated Emissions - MAIN
RADIATED EMISSIONS
dBuV/m
CISPR11B Level for Industrial, Scientific and Medical Equipment
3 METER TEST DISTANCE
Midwest EMI Lab
Sequence 166
Ambient, Device is OFF
cispb
13 MHz/Div
75
70
65
60
55
50
45
40
35
30
25
20
15
170 MHz
196
222
248
274
300 MHz
TFT RC-X Gun
X501976
11:48:00
01-21-2009
Sitting on table at 80 cm., 26 VDC, Battery, Bd Ver 12-05
George Bowman


Radiated Emissions - MAIN
RADIATED EMISSIONS
dBuV/m
CISPR11B Level for Industrial, Scientific and Medical Equipment
3 METER TEST DISTANCE
Midwest EMI Lab
Sequence 174
TV7
TV11
TV9
EUT Active
2 Mtr AH, Control Box toward front
cispb
75
70
65
60
55
50
45
40
35
30
25
20
15
13 MHz/Div
170 MHz
196
222
248
274
300 MHz
TFT RC-X Gun
X501976
11:48:00
01-21-2009
Sitting on table at 80 cm., 26 VDC, Battery, Bd Ver 12-05
George Bowman


Radiated Emissions - MAIN
RADIATED EMISSIONS
dBuV/m
CISPR11B Level for Industrial, Scientific and Medical Equipment
3 METER TEST DISTANCE
Midwest EMI Lab
Sequence 168
Ambient
cispb
75
70
65
60
55
50
45
40
35
30
25
20
15
34 MHz/Div
300 MHz
368
436
504
572
640 MHz
TFT RC-X Gun
X501976
11:48:00
01-21-2009
Sitting on table at 80 cm., 26 VDC, Battery, Bd Ver 12-05
George Bowman


Radiated Emissions - MAIN
RADIATED EMISSIONS
dBuV/m
CISPR11B Level for Industrial, Scientific and Medical Equipment
3 METER TEST DISTANCE
Midwest EMI Lab
Sequence 175
TV26
TV38
TV32
EUT Active
2 Mtr AH, Front Side
Cabbie
TV20
cispb
75
70
65
60
55
50
45
40
35
30
25
20
15
34 MHz/Div
300 MHz
368
436
504
572
640 MHz
TFT RC-X Gun
X501976
11:48:00
01-21-2009
Sitting on table at 80 cm., 26 VDC, Battery, Bd Ver 12-05
George Bowman


Radiated Emissions - MAIN
RADIATED EMISSIONS
dBuV/m
CISPR11B Level for Industrial, Scientific and Medical Equipment
3 METER TEST DISTANCE
Midwest EMI Lab
Sequence 169
75
70
65
60
55
50
45
40
35
30
25
20
15
cispb
Ambient
38 MHz/Div
620 MHz
696
772
848
924
1 GHz
TFT RC-X Gun
X501976
11:48:00
01-21-2009
Sitting on table at 80 cm., 26 VDC, Battery, Bd Ver 12-05
George Bowman


Radiated Emissions - MAIN
RADIATED EMISSIONS
dBuV/m
CISPR11B Level for Industrial, Scientific and Medical Equipment
3 METER TEST DISTANCE
Midwest EMI Lab
Sequence 176
TV66
Ch44
TV50
TV60
EUT Active, 2 Mtr AH, Front
TV40
Cell Phone Bands
cispb
75
70
65
60
55
50
45
40
35
30
25
20
15
38 MHz/Div
620 MHz
696
772
848
924
1 GHz
TFT RC-X Gun
X501976
11:48:00
01-21-2009
Sitting on table at 80 cm., 26 VDC, Battery, Bd Ver 12-05
George Bowman

SHEET 1 cispb RADIATED QUASI-PEAK REPORT
CISPR11B Level for Industrial, Scientific and Medical Equipment
3 METER TEST DISTANCE
TIME: 11:48:00 Midwest EMI
DATE: 01-21-2009 Associates
TEST ITEM: TFT RC-X Gun
SERIAL NUMBER: X501976 Sequence Number: 171
COMMENTS: Sitting on table at 80 cm., 26 VDC, Battery, Bd Ver 12-05
TEST PERFORMED BY: George Bowman

Peak Frequency (MHz)	Peak Interfer. (dBuV/m)	Quasi-peak Freq. (MHz)	Quasi-peak Interfer. (dBuV/m)	Spec. Level (dBuV/m)		Antenna Polarization (H/V)
30.6	40.66	30.6656	36.12	40.50		Horizontal
35.28959	37.17	35.3	31.08	40.50		Horizontal
36.36756	38.51	36.1796	29.12	40.50		Horizontal
39.00309	33.89	38.8031	31.28	40.50		Horizontal
43.4259	34.08	43.5171	28.58	40.50		Horizontal
44.8774	35.26	44.7662	31.79	40.50		Horizontal
47.93174	37.53	48.0069	34.29	40.50		Horizontal
48.20652	33.96	48.0161	33.39	40.50		Horizontal
49.5178	33.55	49.3434	28.50	40.50		Horizontal
49.91387	36.57	49.9811	33.03	40.50		Horizontal
55.23624	44.37	55.2586	43.13	40.50	*	Horizontal
55.74678	39.08	55.6204	30.19	40.50		Horizontal
59.74205	37.44	59.7445	38.47	40.50		Horizontal
63.95816	38.60	63.9982	35.86	40.50		Horizontal
66.34276	50.07	66.5412	27.71	40.50		Horizontal
66.73335	38.22	66.6366	36.07	40.50		Horizontal
68.23815	35.38	68.039	29.67	40.50		Horizontal
70.70263	32.73	70.8826	25.65	40.50		Horizontal
71.99841	44.15	72.00239	46.44	40.50	*	Horizontal
71.99839	31.84	72.01439	45.73	40.50	*	Horizontal
72.36224	45.06	72.163	27.26	40.50		Horizontal
72.93827	55.36	73.04470	31.66	40.50		Horizontal
49.92562	36.31	50.0936	31.11	40.50		Horizontal
50.08495	34.11	50.0274	32.92	40.50		Horizontal
48.89905	35.05	49.0551	31.56	40.50		Horizontal
35.97678	46.06	36.1344	28.63	40.50		Vertical
39.68541	40.49	39.4854	29.81	40.50		Vertical
36.77358	33.20	36.8992	29.49	40.50		Vertical
39.41664	36.00	39.235	34.18	40.50		Vertical
41.50408	37.36	41.6249	26.88	40.50		Vertical
44.00488	36.29	43.9553	34.03	40.50		Vertical
44.23465	36.15	44.4155	33.63	40.50		Vertical
45.2032	36.29	45.0296	32.85	40.50		Vertical
46.91302	38.17	46.889	36.69	40.50		Vertical
47.93321	38.02	47.9972	35.50	40.50		Vertical
55.23819	46.57	55.255	43.74	40.50	*	Vertical
55.81186	36.78	56.0071	33.28	40.50		Vertical
56.65855	47.67	56.5178	28.88	40.50		Vertical
56.63894	33.15	56.7285	29.69	40.50		Vertical
59.74156	38.99	59.7392	37.88	40.50		Vertical
59.74121	33.72	59.75	35.77	40.50		Vertical

SHEET 2 cispb RADIATED QUASI-PEAK REPORT
CISPR11B Level for Industrial, Scientific and Medical Equipment
3 METER TEST DISTANCE
TIME: 11:48:00 Midwest EMI
DATE: 01-21-2009 Associates
TEST ITEM: TFT RC-X Gun
SERIAL NUMBER: X501976 Sequence Number: 171
COMMENTS: Sitting on table at 80 cm., 26 VDC, Battery, Bd Ver 12-05
TEST PERFORMED BY: George Bowman

Peak Frequency (MHz)	Peak Interfer. (dBuV/m)	Quasi-peak Freq. (MHz)	Quasi-peak Interfer. (dBuV/m)	Spec. Level (dBuV/m)		Antenna Polarization (H/V)
62.21653	31.99	62.3885	28.49	40.50		Vertical
64.37998	34.60	64.18000	22.31	40.50		Vertical
64.97675	29.89	64.9192	28.72	40.50		Vertical
66.8609	38.80	67.0145	36.59	40.50		Vertical
67.91939	37.36	68.0026	31.69	40.50		Vertical
69.25091	34.81	69.1549	25.46	40.50		Vertical
70.67952	35.03	70.5291	26.72	40.50		Vertical
72.06793	46.76	71.9855	43.35	40.50	*	Vertical
73.89351	33.97	74.0039	28.47	40.50		Vertical
67.93404	33.00	68.0116	31.98	40.50		Vertical
69.2598	32.26	69.0622	30.08	40.50		Vertical
66.81231	33.86	66.9723	35.40	40.50		Vertical

SHEET 1 cispb RADIATED QUASI-PEAK REPORT
CISPR11B Level for Industrial, Scientific and Medical Equipment
3 METER TEST DISTANCE
TIME: 11:48:00 Midwest EMI
DATE: 01-21-2009 Associates
TEST ITEM: TFT RC-X Gun
SERIAL NUMBER: X501976 Sequence Number: 173
COMMENTS: Sitting on table at 80 cm., 26 VDC, Battery, Bd Ver 12-05
TEST PERFORMED BY: George Bowman

Peak Frequency (MHz)	Peak Interfer. (dBuV/m)	Quasi-peak Freq. (MHz)	Quasi-peak Interfer. (dBuV/m)	Spec. Level (dBuV/m)		Antenna Polarization (H/V)
76.000	54.98	76.03360	33.68	40.50		Horizontal
77.24549	38.87	77.2623	52.80	40.50	*	Horizontal
77.98351	33.88	78.06270	29.77	40.50		Horizontal
78.8	36.74	78.7456	27.04	40.50		Horizontal
80.62130	44.80	80.5437	28.99	40.50		Horizontal
81.75005	38.95	81.7645	46.11	40.50	*	Horizontal
82.8	38.06	82.94799	30.28	40.50		Horizontal
85.08539	35.41	84.8862	26.32	40.50		Horizontal
87.88633	42.25	88.01909	39.24	40.50		Horizontal
89.27172	39.81	89.3189	37.17	40.50		Horizontal
89.00511	57.01	89.2003	32.95	40.50		Horizontal
111.4543	39.40	111.5551	32.00	40.50		Horizontal
115.9548	40.08	116.0028	36.88	40.50		Horizontal
119.8	39.43	119.9976	36.22	40.50		Horizontal
126.8	54.41	126.8632	22.61	40.50		Horizontal
127.7095	43.69	127.7535	28.88	40.50		Horizontal
128	36.07	127.9896	31.27	40.50		Horizontal
131.0568	45.92	130.952	28.84	40.50		Horizontal
132.6026	52.92	132.7434	40.50	40.50		Horizontal
135.999	35.67	135.9838	34.50	40.50		Horizontal
148.4	35.61	148.596	19.80	40.50		Horizontal
149.4699	38.67	149.6483	22.16	40.50		Horizontal
152.3149	64.71	152.3133	63.50	40.50	*	Horizontal
154	32.13	154.02	27.63	40.50		Horizontal
159.7405	38.59	159.9405	46.89	40.50	*	Horizontal
159.9752	59.17	160.0096	53.00	40.50	*	Horizontal
163.8579	37.54	164.0171	33.97	40.50		Horizontal
169	34.11	169.0656	28.29	40.50		Horizontal
169.2559	37.46	169.2295	19.75	40.50		Horizontal
75.77649	49.79	75.9757	32.97	40.50		Vertical
79.000	40.16	79.18000	25.08	40.50		Vertical
80.87358	43.23	80.8584	28.44	40.50		Vertical
82.8402	34.47	82.95780	27.48	40.50		Vertical
82.85498	36.79	82.95659	27.38	40.50		Vertical
84.81117	39.93	84.8128	22.51	40.50		Vertical
87.2	42.29	87.2976	26.81	40.50		Vertical
89.297	41.11	89.3386	39.78	40.50		Vertical
89.11087	49.25	89.3109	38.97	40.50		Vertical
122.9129	37.88	122.9201	33.38	40.50		Vertical
124	39.10	124.0168	35.90	40.50		Vertical
132.0262	38.84	132.0126	37.35	40.50		Vertical

SHEET 2 cispb RADIATED QUASI-PEAK REPORT
CISPR11B Level for Industrial, Scientific and Medical Equipment
3 METER TEST DISTANCE
TIME: 11:48:00 Midwest EMI
DATE: 01-21-2009 Associates
TEST ITEM: TFT RC-X Gun
SERIAL NUMBER: X501976 Sequence Number: 173
COMMENTS: Sitting on table at 80 cm., 26 VDC, Battery, Bd Ver 12-05
TEST PERFORMED BY: George Bowman

Peak Frequency (MHz)	Peak Interfer. (dBuV/m)	Quasi-peak Freq. (MHz)	Quasi-peak Interfer. (dBuV/m)	Spec. Level (dBuV/m)		Antenna Polarization (H/V)
135.8711	44.04	135.9999	26.20	40.50		Vertical
140.4	35.02	140.3368	29.23	40.50		Vertical
145.9918	38.58	145.9558	19.26	40.50		Vertical
148.2	33.32	148.0024	35.32	40.50		Vertical
148.6	37.80	148.696	19.70	40.50		Vertical
153.664	32.14	153.4648	23.01	40.50		Vertical
157.4075	35.97	157.5123	29.20	40.50		Vertical
158.4	34.95	158.2048	29.14	40.50		Vertical
159.9752	38.91	159.96	55.50	40.50	*	Vertical
163.9512	36.36	163.9872	30.47	40.50		Vertical

APPENDIX C

ELECTRICAL FAST TRANSIENT/BURST TEST

(EN 61000-4-4, First Edition, 1995 and successors)

1.0 PURPOSE:

The purpose of this test is to insure that commercial or medical devices will not be susceptible to electrical spikes or transients applied to their input AC or DC leads. This investigation evaluated the immunity of the EUT to controlled fast, low energy transients on the power or peripheral cable input lines. The burst duration is typically 15 ms and the repetition rate of the salvo of pulses is about 300 ms for commercial equipment. The applicable standard is the European EN 61000-4-4 regimen.

2.0 DESCRIPTION OF TEST APPARATUS:

The test apparatus for this test consists of the Haefely P90.1 (Article 093 204.1), S/N 083 485-32 with attendant cables and Cable Adapter 093 506.1 S/N 083 593-14. The general configuration of the test unit is described in the following test report.

3.0 TEST PROCEDURES:

3.1 POWER LEADS:

Application of the EFT generator to the EUT was performed with the power input cable routed vertically, from the EFT/B generator to the EUT. Power of 120 VAC/ 60- Hz was applied through the line and neutral leads of the EFT generator that included an internal coupler/decoupler mechanism. The power leads were less than one meter per standard. If longer ones are supplied by the manufacturer the excess is gathered into a flat coil with a .4 meter diameter and situated at a distance of .1 meter above the ground reference plane.

3.2 POLARITY and TEST LEVELS:

The electrical fast transient/burst was applied for the following modes of operation:

1) Line with respect to the GRP (Ground Reference Plane)
2) Neutral with respect to the GRP
3) Line and Neutral with respect to the GRP
4) Protective Earth with respect to the GRP
5) Line and Protective Earth with respect to the GRP
6) Neutral and Protective Earth with respect to the GRP
7) Neutral, Line and Protective Earth with respect to the GRP

Tests were performed for the following EFT/B voltage levels, repetition rates, period and duration, for asynchronous triggering with respect to the AC line input:

LEVEL	OPEN CIRCUIT OUTPUT TEST VOLTAGE	REPETITION RATE	BURST DURATION	BURST PERIOD

1	.5 KV	5.0 KHZ	15 MSEC	300 MSEC
2	1 KV	5.0 KHZ	15 MSEC	300 MSEC
3	2 KV	5.0 KHZ	15 MSEC	300 MSEC
4	4 KV	2.5 KHZ	15 MSEC	300 MSEC

The test duration of each test, at each voltage level, for each mode of operation, for positive and negative polarities was 2 minutes.

3.3 EFT GENERATOR CHARACTERISTICS:

Per standard and generator specifications the following are the EFT characteristics:

Maximum energy: 4 mJ/pulse at 2KV into 50 ohm load
Polarity: Positive/Negative
Output type: Coaxial (Cable Clamp Operation)
Dynamic source impedance: 50 ohms +/- 20% /1-100 MHz
DC blocking capacitor: 10 NF
Repetition frequency: variable
Rise time of one pulse: 5 ns +/- 30 %
Impulse Duration: 50 ns +/- 30%
Power source synchronism condition: Asynchronous
Burst Duration: 15 ms +/- 20%
Burst Period: 300 ms +/- 20%

3.4 COUPLING DECOUPLING NETWORK CHARACTERISTICS:

Frequency Range: 1 to 100 MHz
Coupling Capacitors: 33 NF
Decoupling attenuation in the non-symmetrical condition: >20dB
Cross talk attenuation in network between lines: >30 dB
Insulation withstand of coupling capacitors: 5 kV (1.2/50uS)

3.5 COUPLING CLAMP CHARACTERISTICS:

Typical coupling capacitance: 50-200 puff
Usable diameter range of round cables: 4-40 mm
Insulation withstand voltage: 5 KV

3.6 GROUND REFERENCE PLANE:

The ground reference plane is greater than 1x1 meter and allows at least 10 cm of excess dimension beyond the longest dimension of the EUT. The EUT is put on a wooden support approximately 80 cm. above the ground reference plane. A very short strap of negligible inductance (#2 AWG braided cable) and resistance couples the EFT to the GRP. All other structures that were conductive were at least .5 meter from the EUT per standard.

3.7 REFERENCE DOCUMENT:

The reference document that defines the scope of the investigation, specific details, acceptability of test methods and results, techniques and construction details, as required, may be found in:

EN 61000-4-4, Second Edition, 2004 entitled "Electromagnetic compatibility (EMC) - Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test- Section 4: Electrical fast transient/burst immunity test, Basic EMC Publication" and successors

3.8 ACCEPTABILITY CRITERION:

The following criterion was established to determine the compliance of the EUT to the test regimen:

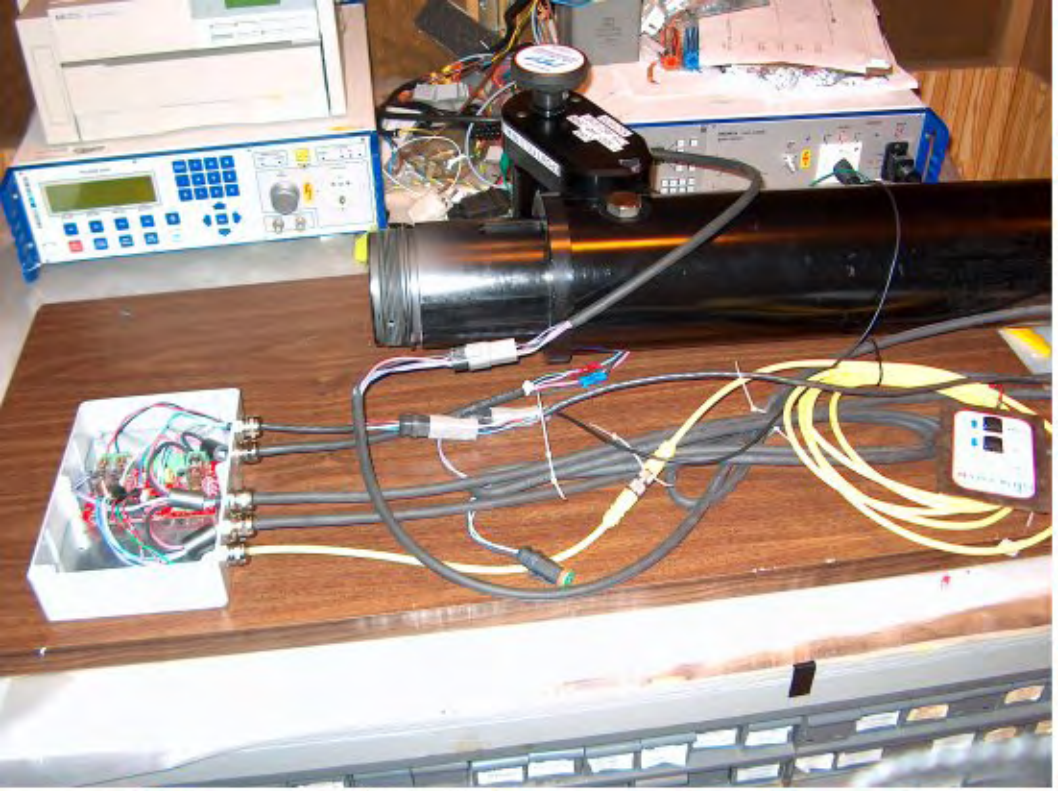
An unacceptable operating response to the stimulus was:

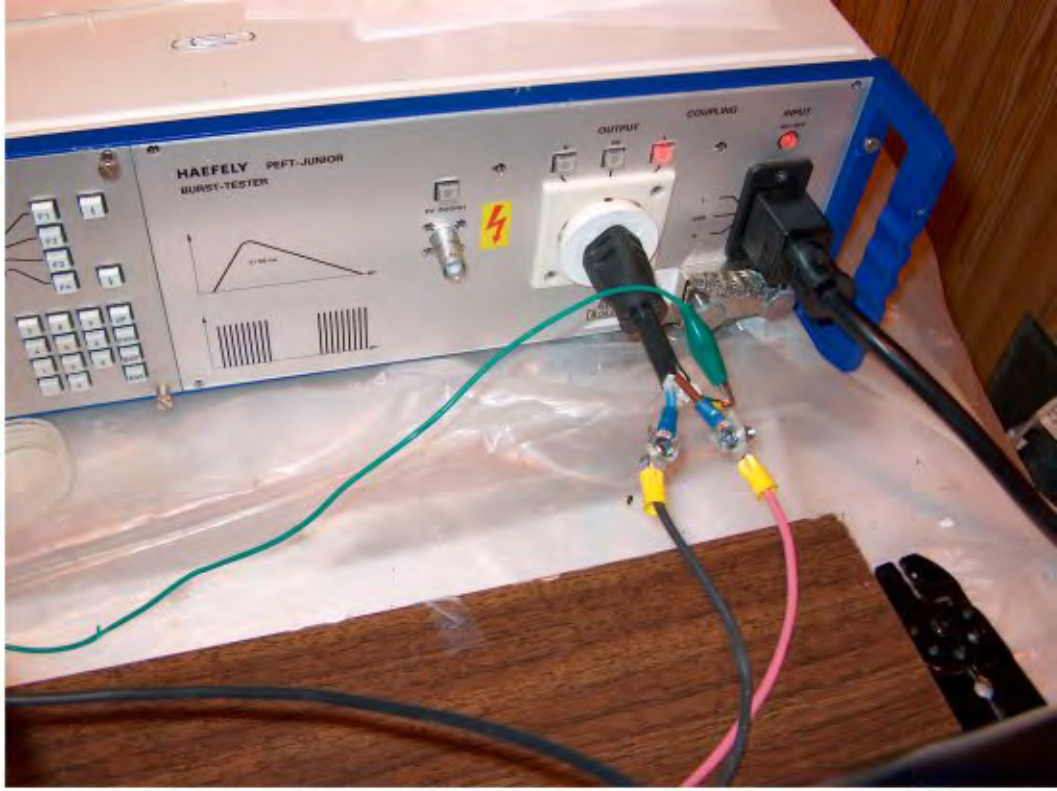
1) Any variation in a displayed character on a front panel display
2) Any permanent cessation of communication or adverse effect noticeable as a result of the application of EFT pulses
3) Any response of any kind that required an operator intervention to reset or recontrol the device to resume normal operation
4) Damage to the EUT such that it would be rendered inoperable or operate outside the manufacturer's specifications

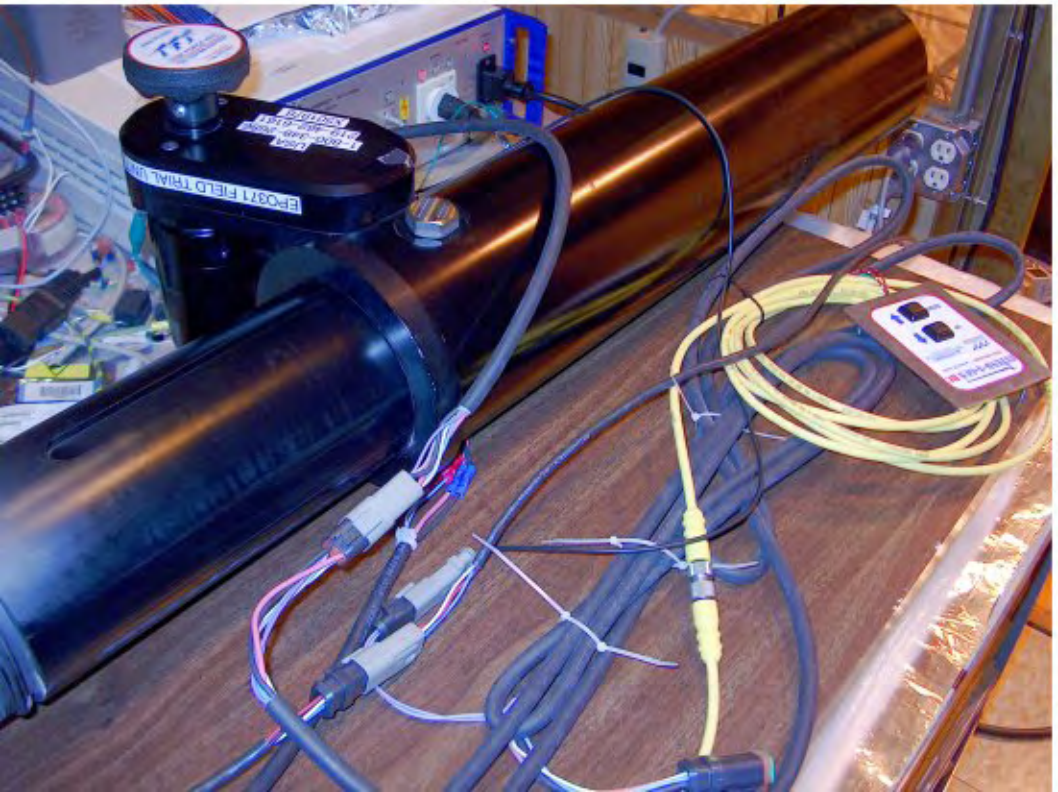
A small variation in light intensity of a display or a small variation in a displayed operating parameter in response to the applied stimulus is considered acceptable if it is within the normal operating tolerances of the instrument.

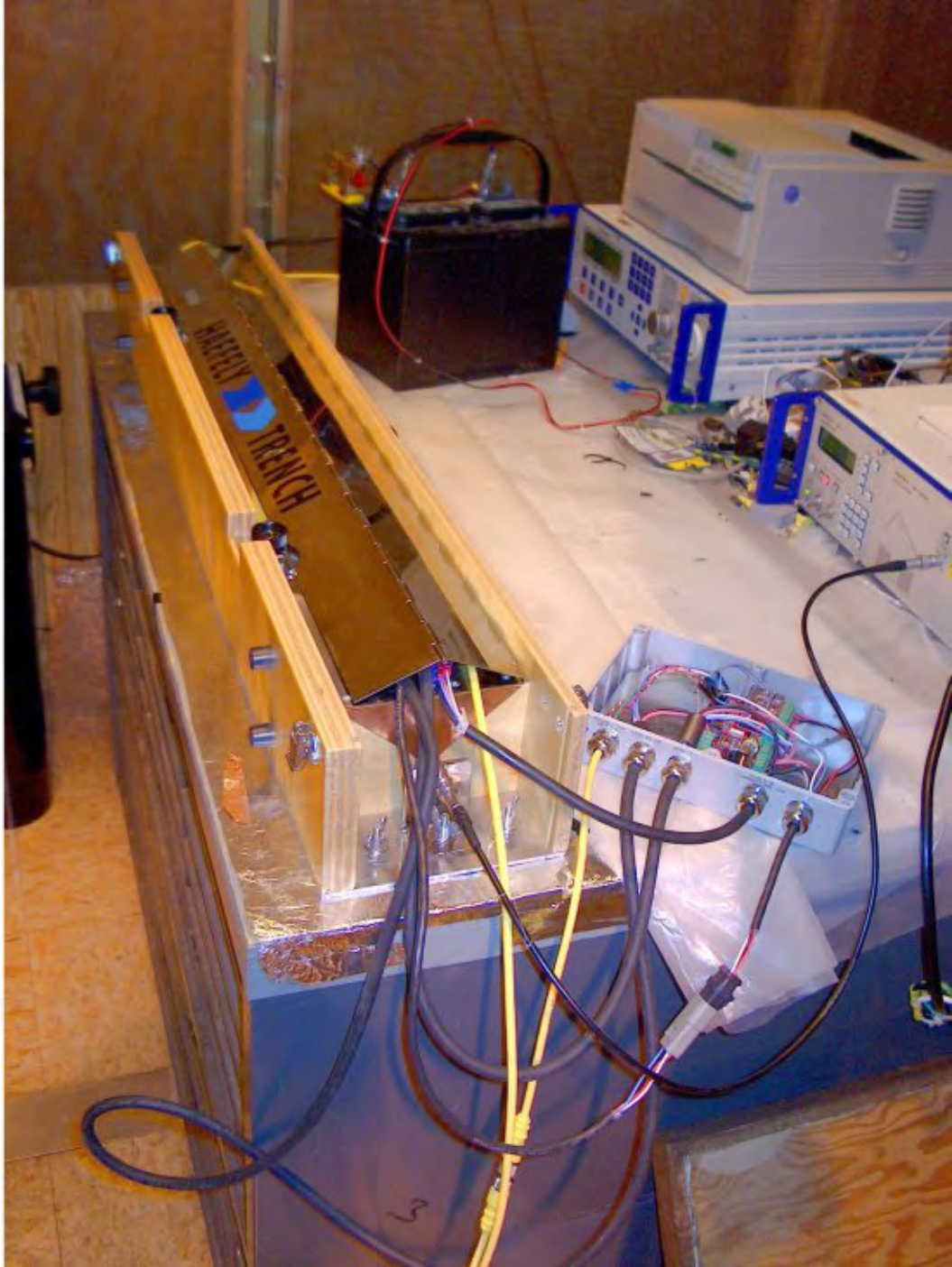
4.0 TEST RESULTS

The TFT Extend-A-Gun was tested at .5, 1 KV and 2 KV using direct injection from the EFT generator with two effects being noted while EFT was applied. The first effect was a momentarily flashing low battery light when no low battery condition existed which cleared up after the test was completed. The second effect was a motor overcurrent condition in which the shuttle momentarily stopped. Since the effect occurred during and after EFT application it was presumed the mechanical orientation needed lubrication of some kind. The sponsor group will indicate how this condition was remedied. The Extender was also tested on all peripheral lines that could be longer than 3 meters at a level of .5 KV without any noticeable adverse effects.




HAEFELY PEFT-JUNIOR
BURST-TESTER
OUTPUT
COUPLING
INPUT




BARTELS TRENCH

Midwest EMI Associates
21234 West Commercial Drive
Mundelein, Illinois 60060

IEC Publication Number 61000-4-4, Part 4, 2nd Edition, 2004-07
Section 4. Electrical Fast Transient/Burst Immunity Test

Manufacturer: TET Test Engineer Initials: JB

Equipment Under Test: X-GUN Date of Test: 11/22/09

Model #: AC-4 Serial #: X501976 POWER LINES

Temperature: 67 Humidity Level: 25

Applied Burst Level: .5 Kilovolt (Test Severity Level 1) GND TO MOTOR CASE

Repetition Frequency: 5 Kilohertz AC Adapter Type: (Two) (Three) Terminal

Burst Duration: 15 Msec Burst Period: 300 Msec

Test Duration: 120 Seconds

Power Input: (120 VAC / 60 Hz) (230VAC / 50 Hz) or (Battery Voltage) 12 V

Instrument Setup/Nominal Conditions: Cycling up + down, startup current 15A travel current 6A

Mode of Appearance	Observations Plus	Observations Minus
Line with respect to the GRP	✓	✓
Neutral with respect to the GRP	✓	✓
PE with respect to the GRP	✓	✓
Neutral and Line with respect to the GRP	✓	✓
Line and PE with respect to the GRP	✓	✓
Neutral and PE with respect to the GRP	✓	✓
Neutral, Line and PE with respect to the GRP	✓	✓

* Failure Mode was: None / ~~Reset~~ Slowed Cow battery momentarily

Number "1" indicates no failure was observed, * indicates device malfunctioned

Applied Burst Level: 1 Kilovolt (Test Severity Level 2)

Repetition Frequency: 5 Kilohertz AC Adapter Type: (Two) (Three) Terminal

Burst Duration: 15 Msec Burst Period: 300 Msec

Test Duration: 120 Seconds

Power Input: (120 VAC / 60 Hz) (230VAC / 50 Hz) or (Battery Voltage) 12 V

Instrument Setup/Nominal Conditions: Cycling up + down

Mode of Appearance	Observations Plus	Observations Minus
Line with respect to the GRP	✓	✓
Neutral with respect to the GRP	✓	✓
PE with respect to the GRP	✓	✓
Neutral and Line with respect to the GRP	✓	✓
Line and PE with respect to the GRP	✓	✓
Neutral and PE with respect to the GRP	✓	✓
Neutral, Line and PE with respect to the GRP	✓	✓

* Failure Mode was: None

Number "1" indicates no failure was observed, * indicates device malfunctioned

Midwest EMI Associates
21234 West Commercial Drive
Mundelein, Illinois 60060

IEC Publication Number 61000-4-4, Part 4, 2nd Edition, 2004-07
Section 4. Electrical Fast Transient/Burst Immunity Test

Manufacturer: TET Test Engineer Initials: JB

Equipment Under Test: X-GUN Date of Test: 1/22/07

Model #: RC-4 Serial #: X501976 POWER LINES

Temperature: 67 Humidity Level: 25

Applied Burst Level: 2 Kilovolt (Test Severity Level 3) GND TO MOTOR CASE

Repetition Frequency: 5 Kilohertz AC Adapter Type: (Two) (Three) Terminal

Burst Duration: 15 Msec Burst Period: 300 Msec

Test Duration: 120 Seconds

Power Input: (120 VAC / 60 Hz) (230VAC / 50 Hz) or (Battery Voltage): 12 V

Instrument Setup/Nominal Conditions: Cycling up + down

Mode of Appearance	Plus Observations	Minus
Line with respect to the GRP	✓	✓
Neutral with respect to the GRP	✓	✓
PE with respect to the GRP	✓	✓
Neutral and Line with respect to the GRP	✓	✓
Line and PE with respect to the GRP	✓	✓
Neutral and PE with respect to the GRP	✓	✓
Neutral, Line and PE with respect to the GRP	✓	✓

* Failure Mode was: None due to EFT stopped at end due to current limit occasionally not EFT related

Number "1" indicates no failure was observed, * indicates Device Malfunctioned

Applied Burst Level: 4 Kilovolt (Test Severity Level 4)

Repetition Frequency: 2.5 Kilohertz AC Adapter Type: (Two) (Three) Terminal

Burst Duration: 15 Msec Burst Period: 300 Msec

Test Duration: 120 Seconds

Power Input: (120 VAC / 60 Hz) (230VAC / 50 Hz) or Battery Voltage: _____ V

Instrument Setup/Nominal Conditions: _____

Mode of Appearance	Plus Observations	Minus
Line with respect to the GRP		
Neutral with respect to the GRP		
PE with respect to the GRP		
Neutral and Line with respect to the GRP		
Line and PE with respect to the GRP		
Neutral and PE with respect to the GRP		
Neutral, Line and PE with respect to the GRP		

* Failure Mode was: _____

Number "1" indicates no failure was observed, * indicates Device Malfunctioned

Midwest EMI Associates
21234 West Commercial Drive
Mundelein, Illinois 60060

IEC PUBLICATION NUMBER 1000-4-4, PART 4, FIRST EDITION, 1995
BRITISH STANDARD 61000-4-4, PART 4, FIRST EDITION, 2000
SECTION 4. ELECTRICAL FAST TRANSIENT/BURST IMMUNITY TEST

MANUFACTURER: TFT TEST ENGINEER INITIALS: JB

EQUIPMENT UNDER TEST: X-GUN DATE OF TEST: 1-22-09

MODEL #: RC-4 SERIAL #: 501976

TEMPERATURE: 63.9 HUMIDITY LEVEL: 31.2

HAEFELY CLAMP TEST

THIS TEST UITILIZES AN APPLICATION CLAMP THAT IS NOT PHYSICALLY TIED TO THE POWER LINE. IN THIS TEST THE CABLE BUNDLE IS PLACED INSIDE THE HAEFELY CLAMP AND EFT IMPULSES ARE APPLIED TO THE CABLE VIA THE ACTION OF THE CAPACITIVE CLAMP. THIS TEST IS USED ON CABLE BUNDLES LONGER THAN 3 METERS OR IN SITUATIONS WHERE USE OF THE TRADITIONAL APPARATUS IS NOT FEASIBLE.

APPLIED BURST LEVEL: AS LISTED BELOW
REPETITION FREQUENCY: 5 KILOHERTZ AC ADAPTER TYPE: (TWO) (THREE) TERMINAL
BURST DURATION: 15 MSEC BURST PERIOD: 300 MSEC
TEST DURATION: 120 SECONDS OR : _____ MINUTES
POWER INPUT: (120 VAC / 60 Hz) (230VAC / 50 Hz) (480VAC/50Hz/3 PHASE) OR : 12 V

INSTRUMENT SETUP/NOMINAL CONDITIONS: Cycling up and down

VOLTAGE OF APPLICATION	MINUS OBSERVATIONS	PLUS
.5 KILOVOLT	✓	✓
1 KILOVOLT	✓	✓
2 KILOVOLT		
4 KILOVOLT		
_____ KILOVOLT		
_____ KILOVOLT		
_____ KILOVOLT		

• FAILURE MODE WAS: AOK, NONE OBSERVED, All peripheral lines tested

RESULTS OF .5 kV TEST: NONE

RESULTS OF 1 kV TEST: NONE

RESULTS OF 2 kV TEST: _____

RESULTS OF 4 kV TEST: _____

COMMENTS: _____

NUMBER "✓" INDICATES NO FAILURE WAS OBSERVED, * INDICATES DEVICE MALFUNCTIONED

APPENDIX D

RADIATED RADIO FREQUENCY INTERFERENCE SUSCEPTIBILITY TEST

(EN 61000-4-3, EN 1000-4-3, RS03 and successors)

1.0 PURPOSE:

The purpose of this test is to insure that commercial devices will not be susceptible to radiated electric fields. The frequency range tested is 10 KHz to 1 GHz nominally or higher for specific tests. The applicable standards are EN 61000-4-3, EN 1000-4-3 and Military Standard 461C Part 4, RS03 test.

2.0 DESCRIPTION OF TEST APPARATUS:

For this test, the TEK2756P Spectrum Analyzer may be used as a monitoring device with a biconical or conical antenna, and the Amplifier Research FM1000/FP1000 receiving system (optically isolated interface) is used for sensing purposes The two FP1000 and one FP2031 RF field probes are linked by an optical fiber cable outside the screen room for the purpose of closed loop control. The field is created using one of three different antennas with an amplifier such as the Model 2100L (lowband), ENI Model 525LA (midband), or Eaton Model 15100B (highband). The IEC test in two bands covers 27 MHz to 1000 MHz however the actual test range covered was 30 MHz to 1 GHz.

3.0 TEST PROCEDURES:

3.1 POWER LEADS & CABLE PLACEMENT:

The TFT RC EXTEND-A-GUN (EP0371) was powered by a 12 VDC lead acid battery.

3.2 TEST SETUP:

The E.U.T. was placed on top of a nonconducting table at a .8 meter height. A closed circuit camera was positioned in front of the pressure monitor to check for variations in speed or pressure in the tube. Three isotropic probes (See picture at end of appendices) were placed in close proximity to the sides of the unit. The EUT was exposed to an elevated RF input level on one face which was the rear face of the unit. To accommodate EN 61000-4-3 as much as possible the antennas were adjusted to a 2 meter distance from the sample.

The computer program automatically cycles the isotropic probe through X, Y and Z polarizations, takes readings from three isotropic probes, averages the probe field strengths and applies correction to maintain the field strength at the sponsor group's requested value. This is done by turning off the modulation while the probe is being measured and then turning the modulation on for a variable amount of time. This permits accurate field strength measurement even though the modulation rate is low. In this case the modulation was turned on for 6 seconds per point.

3.3 MODULATION:

The modulation applied externally to the Wavetek 2520A was a 1000 Hz sinusoid which was used to generate an 80% AM signal which is consistent with EN 61000-4-3.

3.4 ANTENNAS AND AMPLIFIERS:

The radiating antennas/amplifiers used during the test were:

a) The EMCO Model 3107B Power E field antenna from 10 KHz to 50 MHz, horizontal polarization only,
b) The Antenna Research LPB 2520 Biconilog antenna from 50 MHz-1000 MHz, horizontal and vertical polarization,
c) Power amplifiers were used to drive all antennas. In the low band test (where applicable), the 100 Watt ENI Model 2100L was used from 10 KHz- 12 MHz. In the mid-band test that can range from 1-520 MHz or 12-520 MHz, a 25 Watt linear ENI model 525LA was used. From 500 - 1000 MHz a 15 watt linear amplifier Eaton Model 15100B was used.
d) Sweep rate of amplifiers was adjusted so that the rate did not exceed 1.5 x 10^{-3} decades/second and the step size never exceeded the 1% change limit of EN 61000-4-3. The rate was adjusted to approximately 100-1000 KHz per step every 3 seconds and the sweep was continuous between steps. Polarization was horizontal and vertical when the Biconilog was used.

4.0 LIMITS AND RESULTS OF TEST:

4.1 RADIATED LIMITS:

The radiated susceptibility immunity should not be lower than 3 or 10 V/M as prescribed by EN 61000-4-3. The IEC range is 80 MHz to 1000 MHz. A graph is shown of the actual averaged field strength presented to the prototype during the test.

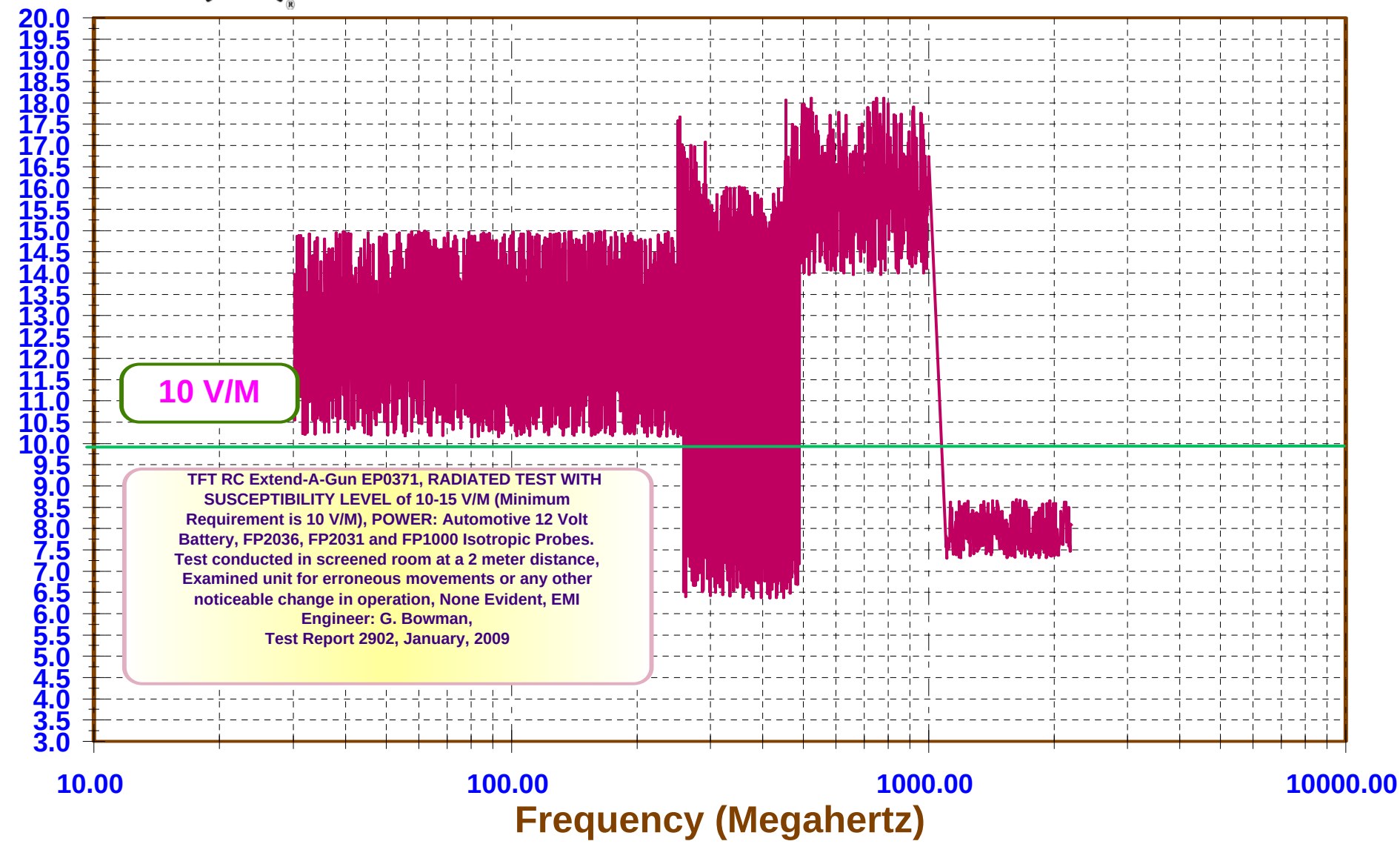
4.2 RESULTS OF TEST:

The TFT RC Extend-A-Gun was exposed to a 10 V/M immunity wave from 30 to 1000 MHz with 1000 Hz, 80% modulation. It was also exposed to the same field in the 900 to 925 MHz cellular phone test using 200 Hz, 100% square wave modulation. It was also tested from 1400-2800 MHz without any problems. The voltage applied to the test sample was 12 volts.

During testing the system was continuously monitored for correct functioning so that a) the extender went up and down in a predictable pattern that did not change over time and 2) did not stop or change operational mode during testing. The unit did show some evidence of slowing down during testing but still fulfilled its requirements of going to a fully deployed or stowed condition. The sponsor group was satisfied that the unit was meeting its operational requirements after they added a .01 uF capacitor across the U3 IC for bypassing the immunity wave signal.

EN 61000-4-3 Radiated Susceptibility

Dual FP1000 and One FP 2031 Probe



Midwest EMI Associates Radiated Susceptibility Worksheet

Date: 11/21/09	Report: 2982	Test Engineer: JB
Item Tested: TFT RC-4 EXTENDED AGAIN	Model: X-GHAI EPD371	S/N: 501976
Project:	Group: TIM MILLER	Power: 24-12 V (AC) (DC) Hz
Test Performed: (Radiated) (Conducted) (Magnetic) (CS114)	Probes: (CS114) (Fischer CDN) (A/R FP2031) (AR FP 2036) (AR FP1000) (Other:)	Modulation: (2) (10) (100) (1000) Hz, Sine Wave (Cell Phone Test, 200 Hz 100% AM Square Wave) Modulation Depth: (50%) (80%) (%)
Signal Gen. :(HP8756A) (Wavetek 2520A)	Orientation: (Pole Stand) (Other:) (Wooden Table) (Copper Table) (Floor)	Room Position: (Screenroom) (2 Mtr Site) (5 Mtr Site) Flr Pos: (A) (B) (C)

Antennas: B=Biconical EMCO 3109, C=Conical EMCO 3101, E=EMCO3107B, L=EMCO 3147, CDN=Fischer CDN

Frequency (M=MHz) (K=KHz)	Increment Frequency (KHz)	Immunity Level: (V) (V/M)	Dwell Time: (Sec)	Antenna Type: B,C,L	Results: (Include any Failure ModesObserved in the EUT), 12 Volt Battery, PSU in room Video Camera System Used: (Yes) (No) Battery in room
30m	1%	20	8	B^H	going up, AOK, cycles normally
69.5m	"	"	"	"	Low voltage light blinks
196.5	"	"	"	"	AOK
200.4	"	"	"	"	"
250m	"	"	"	"	"
30m	1%	10	8	B^V	going up
50.7m	"	"	8	B^V	" " , slightly erratic speed
52m	"	"	"	"	but still performs function
70m	"	"	"	"	AOK, no problem
85m	"	"	"	"	" " "
250m	"	"	"	"	" " "
250m	"	15	7	C	" " " going up
257m					Put cover on top for shielding
250m	"	10	7	B^V	Bicon Vert at 10V/m
→ 273	"	10	7	B^V	creeping down more slowly
300m	"	10	7	B^V	AOK, going up switch to Hor
250m	"	"	"	B^H	AOK, going up
→ 293m	"	"	"	"	creeping down more slowly
300m	"	"	"	"	AOK, switch to Conical
300m	"	14	7	C	AOK,
→ 325	"	"	"	"	creeping down more slowly
330	"	"	"	"	AOK
400	"	"	"	"	AOK

Notes:

Midwest EMI Associates Radiated Susceptibility Worksheet

Date: 1/22/09	Report: 2902	Test Engineer: JAB
Item Tested: TFT RC EXTENDER-A-GRAM	Model: X-GRAM	S/N: X501976
Project: TFT	Group: TIM MILLER	Power: 12 V (AC) (DC) — Hz
Test Performed: (Radiated) (Conducted) (Magnetic) (CS114)	Probes: (CS114) (Fischer CDN) (A/R FP2031) (AR FP 2036) (AR FP1000) (Other:)	Modulation: (2) (10) (100) (1000) Hz, Sine Wave (Cell Phone Test, 200 Hz 100% AM Square Wave) Modulation Depth: (50%) (80%) (%)
Signal Gen. :(HP8756A) (Wavetek 2520A)	Orientation: (Pole Stand) (Other:) (Wooden Table) (Copper Table) (Floor)	Room Position: (Screenroom) (2 Mtr Site) (5 Mtr Site) Flr Pos: (A) (B) (C)

Antennas: B=Biconical EMCO 3109, C=Conical EMCO 3101, E=EMCO3107B, L=EMCO 3147, CDN=Fischer CDN

Frequency (M=MHz) (K=KHz)	Increment Frequency (KHz)	Immunity Level: (V) (V/M)	Dwell Time: (Sec)	Antenna Type: B,C,L	Results: (Include any Failure ModesObserved in the EUT), Video Camera System Used: (Yes) (No)
400M	10%	14	7	C	Going up, AOK
592M	10%	14	"	"	" " "
			Suspend to	add cap across U3	
592	"	"	"	"	AOK, no problem
790.5	"	"	"	"	
1000M	"	"	"	"	" " "
1400M	10%	7	7	HORN H	Horn Horizontal, Going up
2200M	"	"	"	HORN H	" " " " AOK
400M	10%	7	7	HORN V	Vert. Horn, Going up AOK
2200M	"	7	7	HORN V	" " " " AOK
2200M	"	"	"	HORN V	Vert Horn, Going up, AOK
2500M	"	"	"	"	" " " " "
2200M	"	"	"	HORN H	HOR HORN, Going up, AOK
2500M	"	"	"	"	" " " " "
		→ Added .01uF			Bypass on chip U3 (OP AMP)
250M	"	14	"	C	Going up AOK
353M	"	"	"	"	" " "
458M	"	"	"	"	" " "
505M	"	"	"	"	" " "
					no further problems
850-900M	10%	14	7	C	Going up, cell phone test 200Hz, 100% AM, AOK, no fault

Notes:

.01uF cap bypass added on U3, EUT performed much better.

APPENDIX E

ELECTRICAL SURGE IMMUNITY TEST

(IEC 61000-4-5, First Edition, 1995 and successors)

1.0 PURPOSE:

The purpose of this test is to insure that commercial or medical devices will not be susceptible to electrical surges applied to their input AC or DC leads. This investigation evaluated the immunity of the EUT to controlled high-energy transients on the power or peripheral cable input lines. The open circuit voltage ranges from .2 to 4.2 kV with a 1.2 / 50 us waveshape and the short circuit current ranges up to 2.1 kA with an 8 / 20 uS waveshape. The surge simulates lightning pulses in the proximity of the mains supplying power to the EUT. The applicable standard is the European EN 61000-4-5 regimen.

2.0 DESCRIPTION OF TEST APPARATUS:

The test apparatus for this test consists of the Haefely Psurge 4010 with attendant cables and adapters. The general configuration of the test unit is described in the following test report.

3.0 TEST PROCEDURES:

3.1 POWER LEADS:

Application of the surge generator to the EUT was performed with the power input cable routed horizontally, from the surge generator to the EUT. Power was applied through the line and neutral leads of the surge generator that included an internal coupler/decoupler mechanism. The power leads were less than two meters as required. If longer ones are supplied by the manufacturer and are not detachable the excess is gathered into a flat coil with a .4 meter diameter and situated at a distance of .1 meter above the ground reference plane. Where an IEC connector is used a < 2 meter cable is supplied.

3.2 POLARITY and TEST LEVELS:

The surge wave was applied in the following modes of operation:

1) Line with respect to the Protective Earth
2) Neutral with respect to the Protective Earth
3) Between Line and Neutral with respect to the GRP

Tests were performed for the following surge voltage levels, repetition rates, period and duration, for synchronous triggering with respect to the AC line input:

LEVEL	OPEN CIRCUIT OUTPUT TEST VOLTAGE	REPETITION RATE of Pulse	Pulse Synchronism (Degrees)	Mode Supplied
1	.5 KV	30 Sec	0,90,180,270	1,2,3
2	1 KV	30 Sec	0,90,180,270	1,2,3
3	2 KV	45 Sec	0,90,180,270	1,2

3.3 SURGE GENERATOR CHARACTERISTICS:

Per standard and generator specifications the following are the surge characteristics:

Open Circuit Voltage: Programmable .2 to 4.2 KV, 1.2 / 50 uS
Short Circuit Current: up to 2.1 Kilo Amperes
Polarity: Positive/Negative
Repetition Rate: up to 6 impulses/Minute at Umax or 12 at 2.2 KV/Min.
Max EUT current: 16 amps
Repetition frequency: variable
Electronic Overcurrent: 0-16 Amps
Impulse Measurement Accuracy: Voltage and Current +/- 3%

3.4 COUPLING DECOUPLING NETWORK CHARACTERISTICS:

Coupling Capacitors: 18 uF

3.5 QUALITY:

Meets the design and manufacturing requirements of ISO 9001

3.6 GROUND REFERENCE PLANE:

The ground reference plane is greater than 1x1 meter and allows at least 10 cm of excess dimension beyond the longest dimension of the EUT. The EUT is put on a wooden support approximately 10 cm. above the ground reference plane. In alternate configurations the EUT may be placed on a table adjacent to the 1x1 meter plane and above a 3 meter plane of the radiated emission test site.

3.7 REFERENCE DOCUMENT:

The reference document that defines the scope of the investigation, specific details, acceptability of test methods and results, techniques and construction details, as required, may be found in:

> EN 61000-4-5, First Edition, 1995 entitled "Electromagnetic Compatibility, Part 4: Testing and Measurement Techniques - Section 4: Electrical fast transient/burst immunity test, Basic EMC Publication" and succeeding revisions.

3.8 ACCEPTABILITY CRITERION:

The following criterion was established to determine the compliance of the EUT to the test regimen:

An unacceptable operating response to the stimulus was:

1) Any permanent variation in a displayed image
2) Any permanent variation in the normal operation of the device or permanent changes to the EUT.
3) Any response of any kind that required an operator intervention to reset or recontrol the device to resume normal operation.
4) Damage to the EUT such that it would be rendered inoperable or operate outside the manufacturer's specifications.

A small variation in light intensity of a display or a small variation in a displayed operating parameter in response to the applied stimulus is considered acceptable if it is within the normal operating tolerances of the instrument.

4.0 SURGE IMMUNITY TEST RESULTS:

The TFT Extend-A-Gun was tested on its DC leads in line to line mode at a 500 volt application in positive and negative polarities. The EUT experienced no anomalies with this application and passed the test.


EP037 FIELD TRIAL UNIT

TFI XGWW POWER WIRES

Haefely Trench AG EMC Test Systems Basel/Switzerland

T E S T P R O T O C O L

System: PSURGE 4010
Test: P5KL1NPS
Start-Date: 18.07.2009 Start-Time: 16:41

******* Combination Wave 1,2/50us;8/20us *******

Coup. Path	Imp. No.	U nominal	Syncro Angle	U-peak	I-peak	Info.
>>> Test stopped by user! <<<						

Test: P5KL1NPS
Stop-Date: 18.07.2009 Stop-Time: 16:41

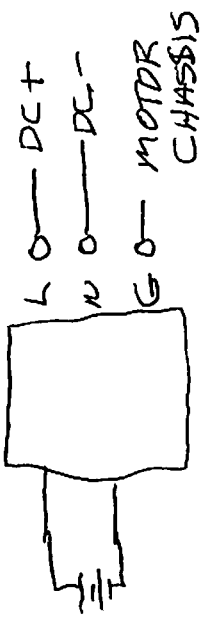
Haefely Trench AG EMC Test Systems Basel/Switzerland

T E S T P R O T O C O L

System: PSURGE 4010
Test: P5KL1NPS
Start-Date: 18.07.2009 Start-Time: 16:41

******* Combination Wave 1,2/50us;8/20us *******

Coup. Path	Imp. No.	U nominal	Syncro Angle	U-peak	I-peak	Info.
L1-N	1	+0.50kV	-----	+0.12kV	+189A	
L1-N	2	+0.50kV	-----	+0.12kV	+189A	
L1-N	3	+0.50kV	-----	+0.12kV	+190A	
L1-N	4	+0.50kV	-----	+0.12kV	+190A	
L1-N	5	+0.50kV	-----	+0.12kV	+189A	
L1-N	6	+0.50kV	-----	+0.12kV	+190A	
L1-N	7	+0.50kV	-----	+0.12kV	+189A	
L1-N	8	+0.50kV	-----	+0.12kV	+189A	
L1-N	9	+0.50kV	-----	+0.12kV	+189A	
L1-N	10	+0.50kV	-----	+0.12kV	+190A	
L1-N	11	+0.50kV	-----	+0.12kV	+190A	
L1-N	12	+0.50kV	-----	+0.12kV	+190A	
L1-N	13	+0.50kV	-----	+0.12kV	+190A	
L1-N	14	+0.50kV	-----	+0.12kV	+190A	
L1-N	15	+0.50kV	-----	+0.12kV	+190A	
L1-N	16	+0.50kV	-----	+0.12kV	+190A	
L1-N	17	+0.50kV	-----	+0.12kV	+190A	
L1-N	18	+0.50kV	-----	+0.12kV	+190A	
L1-N	19	+0.50kV	-----	+0.12kV	+190A	
L1-N	20	+0.50kV	-----	+0.12kV	+190A	
L1-N	21	+0.50kV	-----	+0.12kV	+190A	
L1-N	22	+0.50kV	-----	+0.12kV	+190A	
L1-N	23	+0.50kV	-----	+0.12kV	+189A	
L1-N	24	+0.50kV	-----	+0.12kV	+190A	
L1-N	25	+0.50kV	-----	+0.12kV	+190A	
L1-N	26	+0.50kV	-----	+0.12kV	+189A	
L1-N	27	+0.50kV	-----	+0.12kV	+190A	
L1-N	28	+0.50kV	-----	+0.12kV	+190A	
L1-N	29	+0.50kV	-----	+0.11kV	+190A	



L1-N	30	+0.50kV	-----	+0.12kV	+190A	
L1-N	31	+0.50kV	-----	+0.12kV	+189A	
L1-N	32	+0.50kV	-----	+0.12kV	+190A	
L1-N	33	+0.50kV	-----	+0.12kV	+190A	
L1-N	34	+0.50kV	-----	+0.12kV	+189A	
L1-N	35	+0.50kV	-----	+0.12kV	+190A	
L1-N	36	+0.50kV	-----	+0.12kV	+189A	
L1-N	37	+0.50kV	-----	+0.12kV	+190A	
L1-N	38	+0.50kV	-----	+0.12kV	+189A	
L1-N	39	+0.50kV	-----	+0.12kV	+189A	
L1-N	40	+0.50kV	-----	+0.12kV	+189A	

>>> Test passed. <<<

Test: P5KL1NPS

Stop-Date: 18.07.2009 Stop-Time: 16:48

Haefely Trench AG EMC Test Systems Basel/Switzerland

T E S T P R O T O C O L

System: PSURGE 4010

Test: P5KL1NPS

Start-Date: 18.07.2009 Start-Time: 16:49

Combination Wave 1,2/50us;8/20us

Coup. Path	Imp. No.	U nominal	Syncro Angle	U-peak	I-peak	Info.
L1-N	1	-0.50kV	-----	-0.09kV	-219A	
L1-N	2	-0.50kV	-----	-0.09kV	-219A	
L1-N	3	-0.50kV	-----	-0.09kV	-219A	
L1-N	4	-0.50kV	-----	-0.09kV	-221A	
L1-N	5	-0.50kV	-----	-0.09kV	-221A	
L1-N	6	-0.50kV	-----	-0.09kV	-221A	
L1-N	7	-0.50kV	-----	-0.09kV	-222A	
L1-N	8	-0.50kV	-----	-0.09kV	-221A	
L1-N	9	-0.50kV	-----	-0.09kV	-221A	
L1-N	10	-0.50kV	-----	-0.09kV	-222A	
L1-N	11	-0.50kV	-----	-0.09kV	-222A	
L1-N	12	-0.50kV	-----	-0.09kV	-221A	
L1-N	13	-0.50kV	-----	-0.09kV	-221A	
L1-N	14	-0.50kV	-----	-0.09kV	-222A	
L1-N	15	-0.50kV	-----	-0.09kV	-221A	
L1-N	16	-0.50kV	-----	-0.09kV	-221A	
L1-N	17	-0.50kV	-----	-0.09kV	-222A	
L1-N	18	-0.50kV	-----	-0.09kV	-221A	
L1-N	19	-0.50kV	-----	-0.09kV	-222A	
L1-N	20	-0.50kV	-----	-0.09kV	-221A	
L1-N	21	-0.50kV	-----	-0.09kV	-221A	
L1-N	22	-0.50kV	-----	-0.09kV	-221A	
L1-N	23	-0.50kV	-----	-0.09kV	-222A	
L1-N	24	-0.50kV	-----	-0.09kV	-221A	
L1-N	25	-0.50kV	-----	-0.09kV	-221A	
L1-N	26	-0.50kV	-----	-0.09kV	-221A	
L1-N	27	-0.50kV	-----	-0.09kV	-221A	
L1-N	28	-0.50kV	-----	-0.09kV	-221A	
L1-N	29	-0.50kV	-----	-0.09kV	-222A	
L1-N	30	-0.50kV	-----	-0.09kV	-222A	
L1-N	31	-0.50kV	-----	-0.09kV	-221A	
L1-N	32	-0.50kV	-----	-0.09kV	-222A	

L1-N	33	-0.50kV	-----	-0.09kV	-221A	
L1-N	34	-0.50kV	-----	-0.09kV	-222A	
L1-N	35	-0.50kV	-----	-0.09kV	-221A	
L1-N	36	-0.50kV	-----	-0.09kV	-222A	
L1-N	37	-0.50kV	-----	-0.09kV	-222A	
L1-N	38	-0.50kV	-----	-0.09kV	-221A	
L1-N	39	-0.50kV	-----	-0.09kV	-221A	
L1-N	40	-0.50kV	-----	-0.09kV	-221A	

>>> Test passed. <<<

Test: P5KL1NPS

Stop-Date: 18.07.2009 Stop-Time: 16:56

Haefely Trench AG EMC Test Systems Basel/Switzerland

T E S T P R O T O C O L

System: PSURGE 4010

Test: P5KL1NPS

Start-Date: 18.07.2009 Start-Time: 16:57

Combination Wave 1,2/50us;8/20us

Coup. Path	Imp. No.	U nominal	Syncro Angle	U-peak	I-peak	Info.
L1-PE	1	-0.50kV	-----	-0.49kV	-3A	
L1-PE	2	-0.50kV	-----	-0.49kV	-3A	
L1-PE	3	-0.50kV	-----	-0.49kV	-3A	
L1-PE	4	-0.50kV	-----	-0.52kV	-5A	
L1-PE	5	-0.50kV	-----	-0.49kV	-3A	
L1-PE	6	-0.50kV	-----	-0.52kV	-5A	
L1-PE	7	-0.50kV	-----	-0.49kV	-3A	
L1-PE	8	-0.50kV	-----	-0.52kV	-5A	
L1-PE	9	-0.50kV	-----	-0.49kV	-3A	
L1-PE	10	-0.50kV	-----	-0.52kV	-5A	
L1-PE	11	-0.50kV	-----	-0.49kV	-3A	
L1-PE	12	-0.50kV	-----	-0.52kV	-5A	
L1-PE	13	-0.50kV	-----	-0.49kV	-3A	
L1-PE	14	-0.50kV	-----	-0.49kV	-3A	
L1-PE	15	-0.50kV	-----	-0.52kV	-5A	
L1-PE	16	-0.50kV	-----	-0.49kV	-3A	
L1-PE	17	-0.50kV	-----	-0.52kV	-5A	
L1-PE	18	-0.50kV	-----	-0.49kV	-3A	
L1-PE	19	-0.50kV	-----	-0.52kV	-5A	
L1-PE	20	-0.50kV	-----	-0.49kV	-3A	
L1-PE	21	-0.50kV	-----	-0.52kV	-5A	
L1-PE	22	-0.50kV	-----	-0.49kV	-3A	
L1-PE	23	-0.50kV	-----	-0.52kV	-5A	
L1-PE	24	-0.50kV	-----	-0.49kV	-3A	
L1-PE	25	-0.50kV	-----	-0.49kV	-3A	
L1-PE	26	-0.50kV	-----	-0.49kV	-3A	
L1-PE	27	-0.50kV	-----	-0.49kV	-3A	
L1-PE	28	-0.50kV	-----	-0.49kV	-3A	
L1-PE	29	-0.50kV	-----	-0.52kV	-5A	
L1-PE	30	-0.50kV	-----	-0.49kV	-3A	
L1-PE	31	-0.50kV	-----	-0.52kV	-5A	
L1-PE	32	-0.50kV	-----	-0.49kV	-3A	
L1-PE	33	-0.50kV	-----	-0.52kV	-5A	
L1-PE	34	-0.50kV	-----	-0.49kV	-3A	
L1-PE	35	-0.50kV	-----	-0.52kV	-5A	

```
*  L1-PE   36     -0.50kV  -----    -0.49kV  -3A                    *
*  L1-PE   37     -0.50kV  -----    -0.49kV  -3A                    *
*  L1-PE   38     -0.50kV  -----    -0.49kV  -3A                    *
*  L1-PE   39     -0.50kV  -----    -0.49kV  -3A                    *
*  L1-PE   40     -0.50kV  -----    -0.49kV  -3A                    *
*    >>> Test passed. <<<                                          *
*                                                                   *
*  Test:         P5KL1NPS                                         *
*  Stop-Date:    18.07.2009                Stop-Time:    17:04    *
*                                                                   *
*********************************************************************


*********************************************************************
*                                                                   *
*  Haefely Trench AG    EMC Test Systems     Basel/Switzerland     *
*                    T E S T   P R O T O C O L                      *
*  System:       PSURGE 4010                                        *
*  Test:         P5KL1NPS                                           *
*  Start-Date:   18.07.2009                Start-Time:    17:04    *
*                                                                   *
*******   Combination Wave 1,2/50us;8/20us   ********************   *
*                                                                   *
*  Coup.   Imp.    U nom-    Syncro                                 *
*  Path    No.       inal    Angle    U-peak    I-peak    Info.     *
*  ------------------------------------------------------------     *
*  L1-PE     1     +0.50kV  -----    +0.50kV  +5A                    *
*  L1-PE     2     +0.50kV  -----    +0.49kV  +3A                    *
*  L1-PE     3     +0.50kV  -----    +0.49kV  +3A                    *
*  L1-PE     4     +0.50kV  -----    +0.49kV  +3A                    *
*  L1-PE     5     +0.50kV  -----    +0.49kV  +3A                    *
*  L1-PE     6     +0.50kV  -----    +0.49kV  +3A                    *
*  L1-PE     7     +0.50kV  -----    +0.49kV  +3A                    *
*  L1-PE     8     +0.50kV  -----    +0.49kV  +3A                    *
*  L1-PE     9     +0.50kV  -----    +0.49kV  +3A                    *
*  L1-PE    10     +0.50kV  -----    +0.49kV  +3A                    *
*  L1-PE    11     +0.50kV  -----    +0.49kV  +3A                    *
*  L1-PE    12     +0.50kV  -----    +0.49kV  +3A                    *
*  L1-PE    13     +0.50kV  -----    +0.49kV  +3A                    *
*  L1-PE    14     +0.50kV  -----    +0.49kV  +3A                    *
*  L1-PE    15     +0.50kV  -----    +0.49kV  +3A                    *
*  L1-PE    16     +0.50kV  -----    +0.49kV  +3A                    *
*  L1-PE    17     +0.50kV  -----    +0.49kV  +3A                    *
*  L1-PE    18     +0.50kV  -----    +0.49kV  +3A                    *
*  L1-PE    19     +0.50kV  -----    +0.49kV  +3A                    *
*  L1-PE    20     +0.50kV  -----    +0.49kV  +3A                    *
*  L1-PE    21     +0.50kV  -----    +0.49kV  +3A                    *
*  L1-PE    22     +0.50kV  -----    +0.49kV  +3A                    *
*  L1-PE    23     +0.50kV  -----    +0.49kV  +3A                    *
*  L1-PE    24     +0.50kV  -----    +0.49kV  +3A                    *
*  L1-PE    25     +0.50kV  -----    +0.49kV  +3A                    *
*  L1-PE    26     +0.50kV  -----    +0.49kV  +3A                    *
*  L1-PE    27     +0.50kV  -----    +0.51kV  +4A                    *
*  L1-PE    28     +0.50kV  -----    +0.49kV  +3A                    *
*  L1-PE    29     +0.50kV  -----    +0.51kV  +4A                    *
*  L1-PE    30     +0.50kV  -----    +0.49kV  +3A                    *
*  L1-PE    31     +0.50kV  -----    +0.51kV  +4A                    *
*  L1-PE    32     +0.50kV  -----    +0.49kV  +3A                    *
*  L1-PE    33     +0.50kV  -----    +0.49kV  +3A                    *
*  L1-PE    34     +0.50kV  -----    +0.49kV  +3A                    *
*  L1-PE    35     +0.50kV  -----    +0.49kV  +3A                    *
*  L1-PE    36     +0.50kV  -----    +0.49kV  +3A                    *
*  L1-PE    37     +0.50kV  -----    +0.49kV  +3A                    *
*  L1-PE    38     +0.50kV  -----    +0.49kV  +3A                    *
```

```
*  L1-PE   39    +0.50kV  -----   +0.49kV  +3A                    *
*  L1-PE   40    +0.50kV  -----   +0.49kV  +3A                    *
*    >>> Test passed. <<<                                         *
*                                                                 *
*  Test:         P5KL1NPS                                         *
*  Stop-Date:    18.07.2009                Stop-Time:    17:11    *
*                                                                 *
*******************************************************************


*******************************************************************
*                                                                 *
*  Haefely Trench AG    EMC Test Systems     Basel/Switzerland    *
*                    T E S T   P R O T O C O L                    *
*  System:       PSURGE 4010                                      *
*  Test:         P5KL1NPS                                         *
*  Start-Date:   18.07.2009                Start-Time:    17:12   *
*                                                                 *
*******   Combination Wave 1,2/50us;8/20us   ********************
*                                                                 *
*  Coup.   Imp.    U nom-    Syncro                               *
*  Path    No.       inal    Angle   U-peak   I-peak   Info.      *
*  ---------------------------------------------------------      *
*    >>> Test stopped by user! <<<                                *
*                                                                 *
*  Test:         P5KL1NPS                                         *
*  Stop-Date:    18.07.2009                Stop-Time:    17:12   *
*                                                                 *
*******************************************************************


*******************************************************************
*                                                                 *
*  Haefely Trench AG    EMC Test Systems     Basel/Switzerland    *
*                    T E S T   P R O T O C O L                    *
*  System:       PSURGE 4010                                      *
*  Test:         P5KL1NPS                                         *
*  Start-Date:   18.07.2009                Start-Time:    17:14   *
*                                                                 *
*******   Combination Wave 1,2/50us;8/20us   ********************
*                                                                 *
*  Coup.   Imp.    U nom-    Syncro                               *
*  Path    No.       inal    Angle   U-peak   I-peak   Info.      *
*  ---------------------------------------------------------      *
*  N-PE      1    +0.50kV  -----   +0.49kV  +3A                   *
*  N-PE      2    +0.50kV  -----   +0.49kV  +3A                   *
*  N-PE      3    +0.50kV  -----   +0.49kV  +3A                   *
*  N-PE      4    +0.50kV  -----   +0.49kV  +3A                   *
*  N-PE      5    +0.50kV  -----   +0.49kV  +3A                   *
*  N-PE      6    +0.50kV  -----   +0.49kV  +3A                   *
*  N-PE      7    +0.50kV  -----   +0.49kV  +3A                   *
*  N-PE      8    +0.50kV  -----   +0.49kV  +3A                   *
*  N-PE      9    +0.50kV  -----   +0.49kV  +3A                   *
*  N-PE     10    +0.50kV  -----   +0.49kV  +3A                   *
*  N-PE     11    +0.50kV  -----   +0.49kV  +3A                   *
*  N-PE     12    +0.50kV  -----   +0.49kV  +3A                   *
*  N-PE     13    +0.50kV  -----   +0.49kV  +3A                   *
*  N-PE     14    +0.50kV  -----   +0.49kV  +3A                   *
*  N-PE     15    +0.50kV  -----   +0.49kV  +3A                   *
*  N-PE     16    +0.50kV  -----   +0.49kV  +3A                   *
*  N-PE     17    +0.50kV  -----   +0.49kV  +3A                   *
*  N-PE     18    +0.50kV  -----   +0.49kV  +3A                   *
*  N-PE     19    +0.50kV  -----   +0.49kV  +3A                   *
*  N-PE     20    +0.50kV  -----   +0.49kV  +3A                   *
```

N-PE	21	+0.50kV	-----	+0.49kV	+3A	
N-PE	22	+0.50kV	-----	+0.49kV	+3A	
N-PE	23	+0.50kV	-----	+0.49kV	+3A	
N-PE	24	+0.50kV	-----	+0.49kV	+3A	
N-PE	25	+0.50kV	-----	+0.49kV	+3A	
N-PE	26	+0.50kV	-----	+0.49kV	+3A	
N-PE	27	+0.50kV	-----	+0.49kV	+2A	
N-PE	28	+0.50kV	-----	+0.49kV	+3A	
N-PE	29	+0.50kV	-----	+0.49kV	+3A	
N-PE	30	+0.50kV	-----	+0.49kV	+3A	
N-PE	31	+0.50kV	-----	+0.49kV	+3A	
N-PE	32	+0.50kV	-----	+0.49kV	+3A	
N-PE	33	+0.50kV	-----	+0.49kV	+3A	
N-PE	34	+0.50kV	-----	+0.49kV	+3A	
N-PE	35	+0.50kV	-----	+0.49kV	+3A	
N-PE	36	+0.50kV	-----	+0.49kV	+3A	
N-PE	37	+0.50kV	-----	+0.49kV	+3A	
N-PE	38	+0.50kV	-----	+0.49kV	+3A	
N-PE	39	+0.50kV	-----	+0.49kV	+3A	
N-PE	40	+0.50kV	-----	+0.49kV	+3A	

>>> Test passed. <<<

Test: P5KL1NPS

Stop-Date: 18.07.2009 Stop-Time: 17:21

Haefely Trench AG EMC Test Systems Basel/Switzerland

T E S T P R O T O C O L

System: PSURGE 4010

Test: P5KL1NPS

Start-Date: 18.07.2009 Start-Time: 17:22

******* Combination Wave 1,2/50us;8/20us ********************

Coup. Path	Imp. No.	U nominal	Syncro Angle	U-peak	I-peak	Info.
N-PE	1	-0.50kV	-----	-0.49kV	-3A	
N-PE	2	-0.50kV	-----	-0.49kV	-3A	
N-PE	3	-0.50kV	-----	-0.49kV	-3A	
N-PE	4	-0.50kV	-----	-0.49kV	-3A	
N-PE	5	-0.50kV	-----	-0.49kV	-3A	
N-PE	6	-0.50kV	-----	-0.49kV	-3A	
N-PE	7	-0.50kV	-----	-0.49kV	-3A	
N-PE	8	-0.50kV	-----	-0.49kV	-3A	
N-PE	9	-0.50kV	-----	-0.49kV	-3A	
N-PE	10	-0.50kV	-----	-0.49kV	-3A	
N-PE	11	-0.50kV	-----	-0.49kV	-3A	
N-PE	12	-0.50kV	-----	-0.47kV	-8A	
N-PE	13	-0.50kV	-----	-0.47kV	-8A	
N-PE	14	-0.50kV	-----	-0.48kV	-8A	
N-PE	15	-0.50kV	-----	-0.47kV	-7A	
N-PE	16	-0.50kV	-----	-0.48kV	-8A	
N-PE	17	-0.50kV	-----	-0.47kV	-8A	
N-PE	18	-0.50kV	-----	-0.48kV	-7A	
N-PE	19	-0.50kV	-----	-0.47kV	-7A	
N-PE	20	-0.50kV	-----	-0.47kV	-8A	
N-PE	21	-0.50kV	-----	-0.47kV	-8A	
N-PE	22	-0.50kV	-----	-0.47kV	-7A	
N-PE	23	-0.50kV	-----	-0.48kV	-8A	

```
*  N-PE     24     -0.50kV  -----    -0.48kV  -8A                    *
*  N-PE     25     -0.50kV  -----    -0.47kV  -8A                    *
*  N-PE     26     -0.50kV  -----    -0.47kV  -7A                    *
*  N-PE     27     -0.50kV  -----    -0.47kV  -8A                    *
*  N-PE     28     -0.50kV  -----    -0.47kV  -8A                    *
*  N-PE     29     -0.50kV  -----    -0.47kV  -7A                    *
*  N-PE     30     -0.50kV  -----    -0.47kV  -8A                    *
*  N-PE     31     -0.50kV  -----    -0.40kV  -25A                   *
*  N-PE     32     -0.50kV  -----    -0.47kV  -7A                    *
*  N-PE     33     -0.50kV  -----    -0.47kV  -7A                    *
*  N-PE     34     -0.50kV  -----    -0.48kV  -8A                    *
*  N-PE     35     -0.50kV  -----    -0.47kV  -8A                    *
*  N-PE     36     -0.50kV  -----    -0.48kV  -8A                    *
*  N-PE     37     -0.50kV  -----    -0.47kV  -8A                    *
*  N-PE     38     -0.50kV  -----    -0.48kV  -8A                    *
*  N-PE     39     -0.50kV  -----    -0.47kV  -8A                    *
*  N-PE     40     -0.50kV  -----    -0.48kV  -8A                    *
*     >>> Test passed. <<<                                           *
*                                                                    *
*  Test:          P5KL1NPS                                          *
*  Stop-Date:     18.07.2009                Stop-Time:     17:29    *
*                                                                    *
**********************************************************************
```

APPENDIX F

CONDUCTED SUSCEPTIBILITY TEST

Common Mode Voltage Interference (Ref: EN 61000-4-6)

1.0 PURPOSE:

The purpose of this test is to insure that commercial or medical devices will not be susceptible to conducted RF energy when induced on peripheral cabling. The frequency range possible to be tested is 150 KHz-300 MHz. The required range is 150 KHz to 80 MHz. The applicable standard and test method is described in Euronorm standard EN 61000-4-6:2001.

2.0 DESCRIPTION OF TEST APPARATUS:

The test apparatus required is described in the reference includes a signal generator, amplifier, wideband directional coupler, several attenuators, a calibration fixture, a wideband coupling probe, a coaxial load, and two spectrum analyzers. The test also can be run with one spectrum analyzer provided the test is run twice exactly the same way. The test equipment actually used was (in the order above) a Wavetek 2520 generator, one amplifier which is the ENI 525LA (mid band), a Werlatone C1795 directional coupler, Bird Model 8306-200-Nxx 20 Watt power attenuators (3,10, and 20 dB), a Fischer IEC 801-6 CDN FCC-801-M3-25, and a Tektronix 2756P spectrum analyzer.

The test also requires analysis of data using a high speed computer and graphical presentation of data. The computer used was a USA Flex Advanta 50 MHz 486 controller with Quattro Pro for Windows and Word for Windows for tabular presentation. The test requires characterization of all components and a dedicated computer program to cycle the test equipment in a precise manner that induces required common mode currents in the EUT cables.

3.0 TEST PROCEDURES:

3.1 POWER LEADS:

The device tested was plugged into a source of 26 VDC through two Line Impedance Stabilization Networks, Solar type 8028-50-TS-24-BNC. The DC cord was made physically as short as possible to permit maximum energy into the E.U.T.

3.2 TEST SETUP:

The test setup complies with the relevant portions of the reference standard. The Wavetek signal generator runs a specific pattern of signal frequencies and amplitudes to cover the range of interest in such a way that the required levels are maintained very closely. The calibration step is performed prior to the EUT portion of the test using a reference load which consists of a 150 ohm to 50 ohm pad and other apparatus to calibrate the levels to 1, 3 and 10 V RMS. The monitor probe used in the test on the EUT was a Solar type 6741-1.

The test was performed inside of the screened room with the EUT on a metal table very close to the CDN which rested on a copper tabletop to provide optimum grounding and the flattest RF level possible to the EUT. The copper table is 80 cm. off the floor of the room.

3.3 MODULATION:

The required 1000 Hz, 80% AM modulation signal was used.

3.4 AMPLIFIERS USED:

The amplifiers used during the test were:

a) The ENI 2100L from .15 to .3 MHz, 100 Watts
b) The ENI 525LA from .3 MHz - 400MHz, 25 Watts.

3.5 TEST PROCEDURES:

A calibration step is first required to set the levels to be used in the test on the EUT. The Fischer CDN is first arranged with two coupling devices that effectively short the three outputs of the CDN together and also convert the desired 150-ohm impedance to 50 ohms. These special adapters are placed on the AE port and EUT port for terminations. The EUT port was additionally fitted with a 20-dB power pad leading to the spectrum analyzer that acted as a receiver. The power for the RF input of the CDN was generated by the Wavetek signal source through the ENI 525LA power amp along with 15 feet of RG214 cable and terminated in the RF port.

The signal levels were then iteratively adjusted so that the output level would always maintain at least the 3 or 10 V RMS requirement. It is important to note that the standard requires a 3 or 10 V RMS open circuit output into the EUT. For the 10 V RMS case, if a 50 ohm termination is used the true matched level is 5 V RMS. The resistive 150 to 50 ohm matching pad further reduces the level by a factor of 3 for an overall gain reduction of 6 times. This means the output leading to the spectrum analyzer is 1.67 volts (10/6). The addition of the 20 dB pad (to avoid any reflections) further reduces the amplitude to .167 volts which is the flat level that is needed to be maintained over the frequency range.

4.0 LIMITS AND RESULTS OF TEST:

4.1 CONDUCTED LIMITS:

The conducted immunity of the EUT must not be less than the level defined in the reference standard. The possible levels are 1, 3 or 10 V RMS. The dwell time to exercise the functions of the EUT was 3 seconds per point. The total number of points taken was 750 over the 150 KHz to 300 MHz range. The range required to pass for this test is only 150 KHz to 80 MHz. In the higher range of 80-300 MHz the dwell time was also 3 seconds.

4.2 RESULTS OF TEST

Testing was performed on the power leads going from the battery to the circuitry using the CDN. It was also tested on cables that could be longer than 3 meters such as the pushbutton switch lines and the encoder lines going to the motor. When the device was initially tested at the minimum 3 V RMS level it performed normally throughout the entire range of frequencies of .15 to 300 MHz. Since this is the required level and just the .15-80 Mhz range needs to be passed the device passed the test.

In all tests an area of 8-9 MHz was found to cause the extender shuttle to speed up slightly in its up movements, the sponsor group indicated that this is not a failure condition because the unit has a mechanical override even if the encoder is affected.

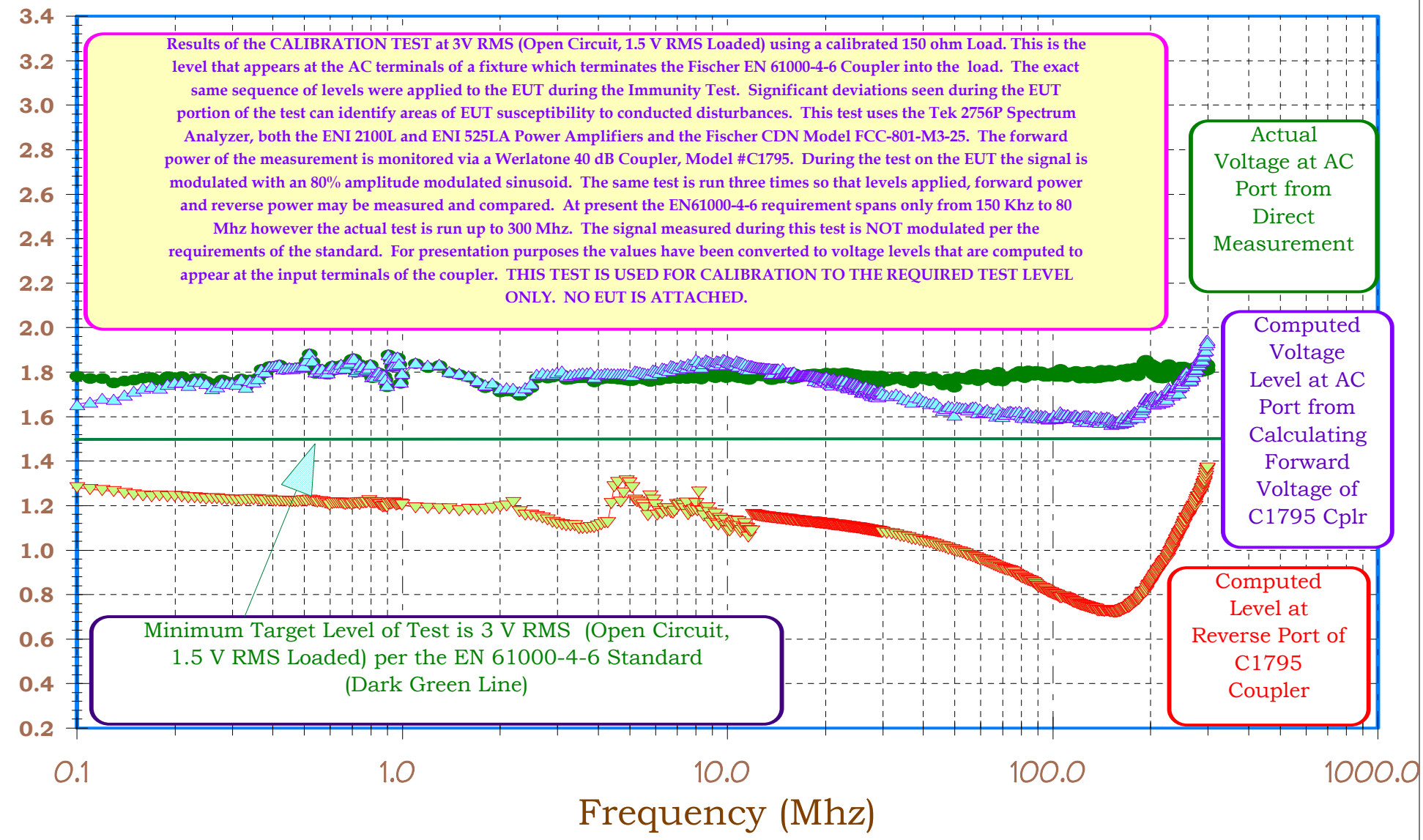
The device passed the EN 61000-4-6 requirement at 3 V and 10 RMS in all cases without signficant changes to its operation.


CAUTION
BEWARE OF LI
TERMINALS ON TH
ENCLOSURES
LINE IMPEDANCE
STABILIZATION NETWO
PHASE
B

EN 61000-4-6 Conducted Immunity Test

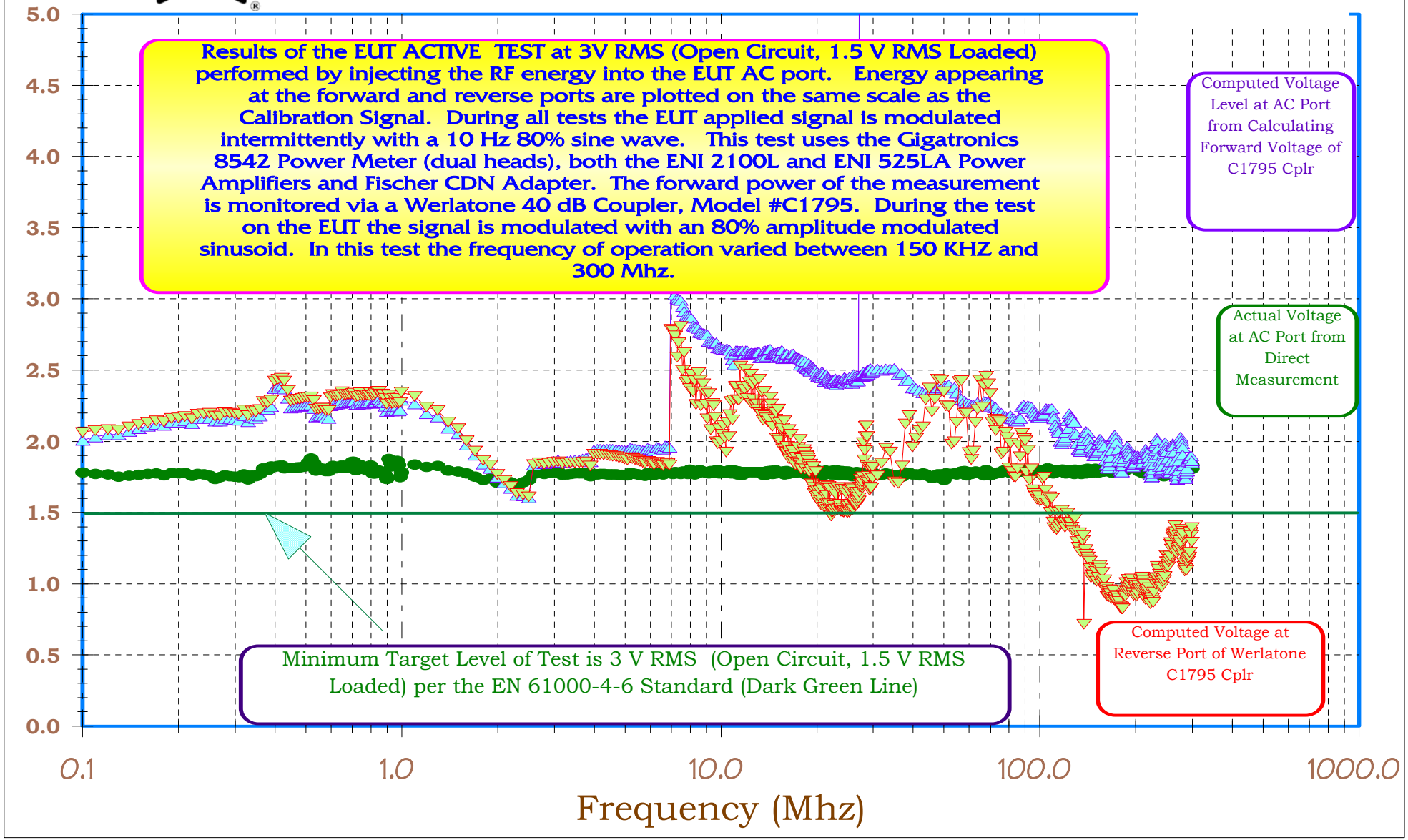
Results of 3 V RMS Probe Cal Test

15 Jan 09



EN 61000-4-6 Conducted Immunity Test

3 V RMS TFT RC Extend-A-Gun 30 Jan 09



Midwest EMI Associates Radiated Susceptibility Worksheet

POWER LINES

Date: 1/28/09	Report: 2902	Test Engineer: SAB
Item Tested: TFT SNORKEL EXTENDER	Model: X-GUN	S/N: X5D1976
Project: TFT	Group: TIM MILLER	Power: 24 V (AC) (DC) — Hz
Test Performed: (Radiated) (Conducted) (Magnetic) (CS114)	Probes: (CS114) (Fischer CDN) (A/R FP2031) (AR FP 2036) (AR FP1000) (Other:)	Modulation: (2) (10) (100) (1000) Hz, Sine Wave (Cell Phone Test, 200 Hz 100% AM Square Wave) Modulation Depth: (50%) (80%) (%)
Signal Gen. :(HP8756A) (Wavetek 2520A)	Orientation: (Pole Stand) (Other:) (Wooden Table) (Copper Table) (Floor)	Room Position: (Screenroom) (2 Mtr Site) (5 Mtr Site) Flr Pos: (A) (B) (C) ON FLOOR IN BACK

Antennas: B=Biconical EMCO 3109, C=Conical EMCO 3101, E=EMCO3107B, L=EMCO 3147, CDN=Fischer CDN

Frequency (M=MHz) (K=KHz)	Increment Frequency (KHz)	Immunity Level: (V) (V/M)	Dwell Time: (Sec)	Antenna Type: B,C,L	Results: (Include any Failure ModesObserved in the EUT), Video Camera System Used: (Yes) (No) POWER WIRES
100	Per Form	3	Per Form	CDN	Testing AC Power Wires, ADK
2.5M	" "	"	"	"	No Problems, ADK
25M	" "	"	"	"	" " , ADK
100M					no effects
200M					" "
300M	↓	↓	↓	↓	" "
100	Per Form	10	Per Form	CDN	Jerky op, ADK
2.5M	" "	"	"	"	" " "
8-9 MHz 8.0M	" "	"	"	"	ADK
8-9 MHz 8.5M	" "	"	"	"	Unit speed up slightly but still worked ADK
10M	" "	"	"	"	ADK, no issues
27.8M	" "	"	"	"	ADK, no issues
35M	" "	"	"	"	" " "
100M	" "	"	"	"	" " "
250M	" "	"	"	"	" " "
300M	" "	"	"	"	" " "
					micro not resetting, signals from encoder were being effected

Notes:

8-9 MHz at 10 V RMS showed slightly effected speed and bias (not a significant problem due to mechanical encoder) no unsafe condition, speed & travel a little higher

Midwest EMI Associates Radiated Susceptibility Worksheet

MOTOR + ENCODER + DOWN SENSOR

Date: 11/21/09	Report: 2902	Test Engineer:
Item Tested: TFT SNORKEL EXTENDER	Model: X-GUN	S/N: X5D1976
Project: TFT	Group: TIM MILLER	Power: 24 V (AC) (DC) — Hz
Test Performed: (Radiated) (Conducted) (Magnetic) (CS114)	Probes: (CS114) (Fischer CDN) (A/R FP2031) (AR FP 2036) (AR FP1000)(Other: CLAMP)	Modulation: (2) (10) (100) (1000) Hz, Sine Wave (Cell Phone Test, 200 Hz 100% AM Square Wave) Modulation Depth: (50%) (80%) (%)
Signal Gen. :(HP8756A) (Wavetek 2520A)	Orientation: (Pole Stand) (Other:) (Wooden Table) (Copper Table) (Floor)	Room Position: (Screenroom) (2 Mtr Site) (5 Mtr Site) Flr Pos: (A) (B) (C)

Antennas: B=Biconical EMCO 3109, C=Conical EMCO 3101, E=EMCO3107B, L=EMCO 3147, CDN=Fischer CDN

Frequency (M=MHz) (K=KHz)	Increment Frequency (KHz)	Immunity Level: (V) (V/M)	Dwell Time: (Sec)	Antenna Type: B,C,L	Results: (Include any Failure ModesObserved in the EUT), Video Camera System Used: (Yes) (No)
.100	Per Dec	10	Per Dec	PROBE	9108-100 CLAMP Going up, motor, encoder, down sensor
2-8M	"	"	"	"	Flashing over low battery
	"	"	"	"	Cut still working
2-5M	"	"	"	"	" " "
7M	"	"	"	"	Working quickly up + down
8M	"	"	"	"	" " " "
15M	"	"	"	"	no further problems
27.5M	"	"	"	"	Working more quickly up + down
37M	"	"	"	"	Low Voltage light blinking
100M	"	"	"	"	No Effect
200M	"	"	"	"	" "
300M	"	"	"	"	" "
		UP + DOWN			PUSHBUTTONS
.100	Per Dec	10	Per Dec	PROBE	Going up, no effects
2-5M	"	"	"	"	" " " "
8-5M	"	"	"	"	motor speeds up but continues up down cycle, no problems after 9.5M
9.5M	"	"	"	"	
102M	"	"	"	"	OK
161M	"	"	"	"	OK
300M	"	"	"	"	

Notes:

7-9M higher motor speed up + down, not a critical problem

APPENDIX G

ELECTROSTATIC DISCHARGE TEST

(EN 61000-4-2, Protocol MEMI-1)

1.0 PURPOSE:

The purpose of this test is to insure that commercial or medical devices will not be susceptible to electrostatic discharge transients applied to the case and circuitry. The device should show no degradation within 5 seconds of application. This also applies to application of charges to the horizontal and vertical coupling planes. The European directive mandates passing of the 8 kV air discharge in single shot mode and 4 kV contact discharge. The actual test was conducted at up to +/- 8KV air and 4 kV contact discharge.

2.0 DESCRIPTION OF TEST APPARATUS:

The Schaffner NSG 435 electrostatic gun is used. The device under test may be mounted on a table or pole clamp for testing. The gun meets EN 61000-4-2 test standard requirements.

All tests are done with the tip which best simulates a human finger. The modes that are selectable are 1) continuous mode, or 2) single shot mode. The gun also has positive or negative polarity settings.

3.0 TEST PROCEDURES:

3.1 POWER LEADS:

The **TFT RC EXTEND-A-GUN (EP0371)** was powered by 12V DC battery.

3.2 TEST SETUP:

The EN 61000-4-2 directive specifies a horizontal and vertical coupling plane for testing packaged devices. The device was tested on the three-meter site and this formed the horizontal-coupling plane. It was placed on an 80-centimeter table above the ground plane.

The ESD gun was handheld and only one location on the ground screen was chosen for discharge that is located below the table. The ESD gun return lead was grounded to a terminal strip and the table that formed the reference earth potential.

3.3 TEST METHOD: Qualification Test (Single Shot Only)

If single shot mode is utilized for qualification tests the operating conditions are the same as shown in paragraph 3.2. At each voltage which may also include the horizontal or vertical coupling plate, the position is struck 20 times at a 1 second succession in minus and plus polarity settings. After each increment of 20 shots, the next preselected point is tested. A recording of the degradations noted is made on the data sheets and supplementary notes are made as to the response of the test sample. Special attention is given to any failure modes that appear to be unsafe.

4.0 RESULTS OF TEST (01-23-09)

The ESD test was conducted on 14 surfaces in areas showing cracks in the package, switches, connectors or screws. The unit was subjected to contact and air discharge modes of application. No errors or adverse effects were noted after a 14 AWG grounding wire was installed from the minus terminal of the PCB to the case ground of the enclosure in the main control box.

The following symptoms were noted during the test after the ground wire was added:

None

The device was given an "A" acceptance rating.

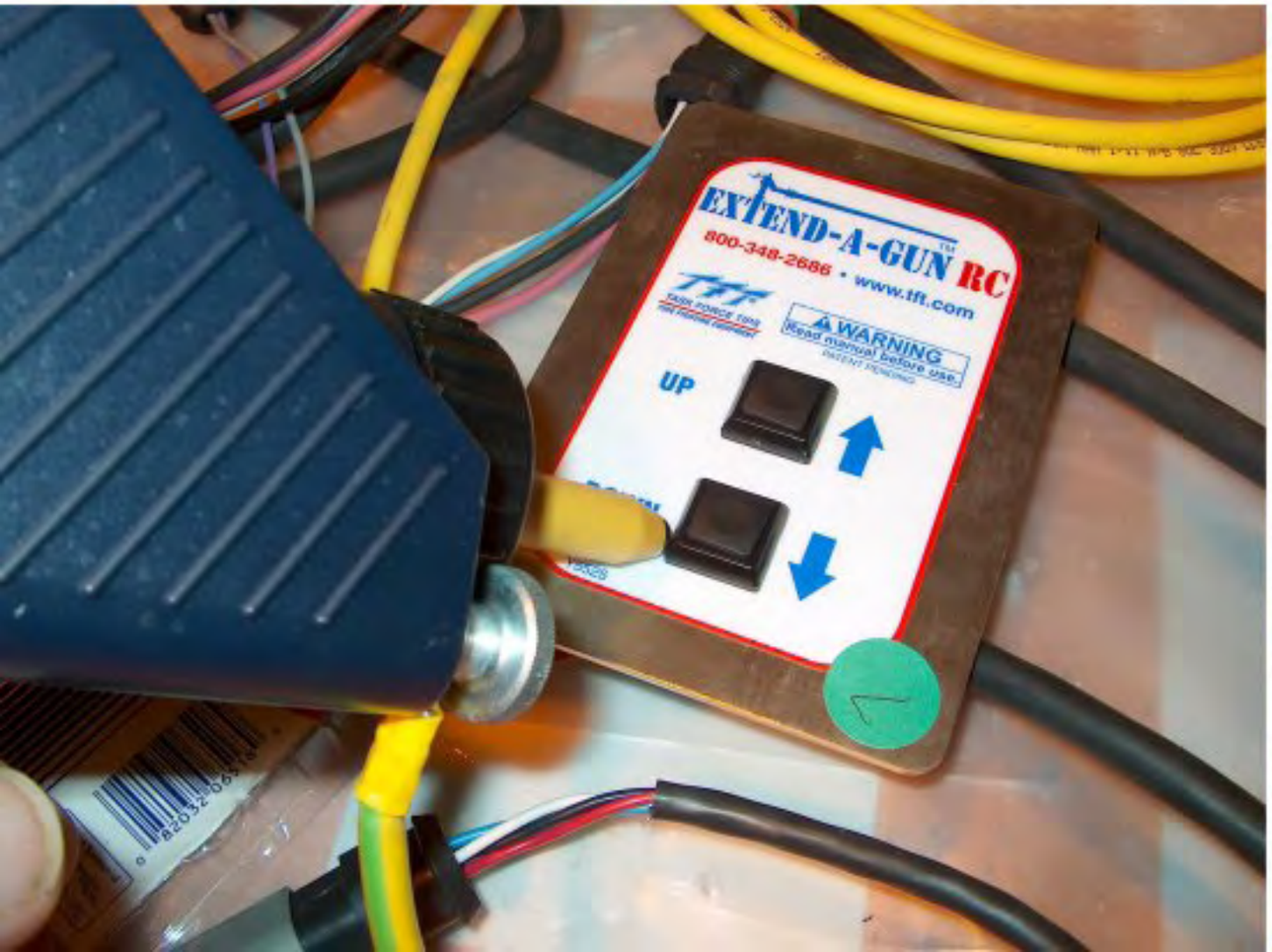
ESD TEST LOCATIONS

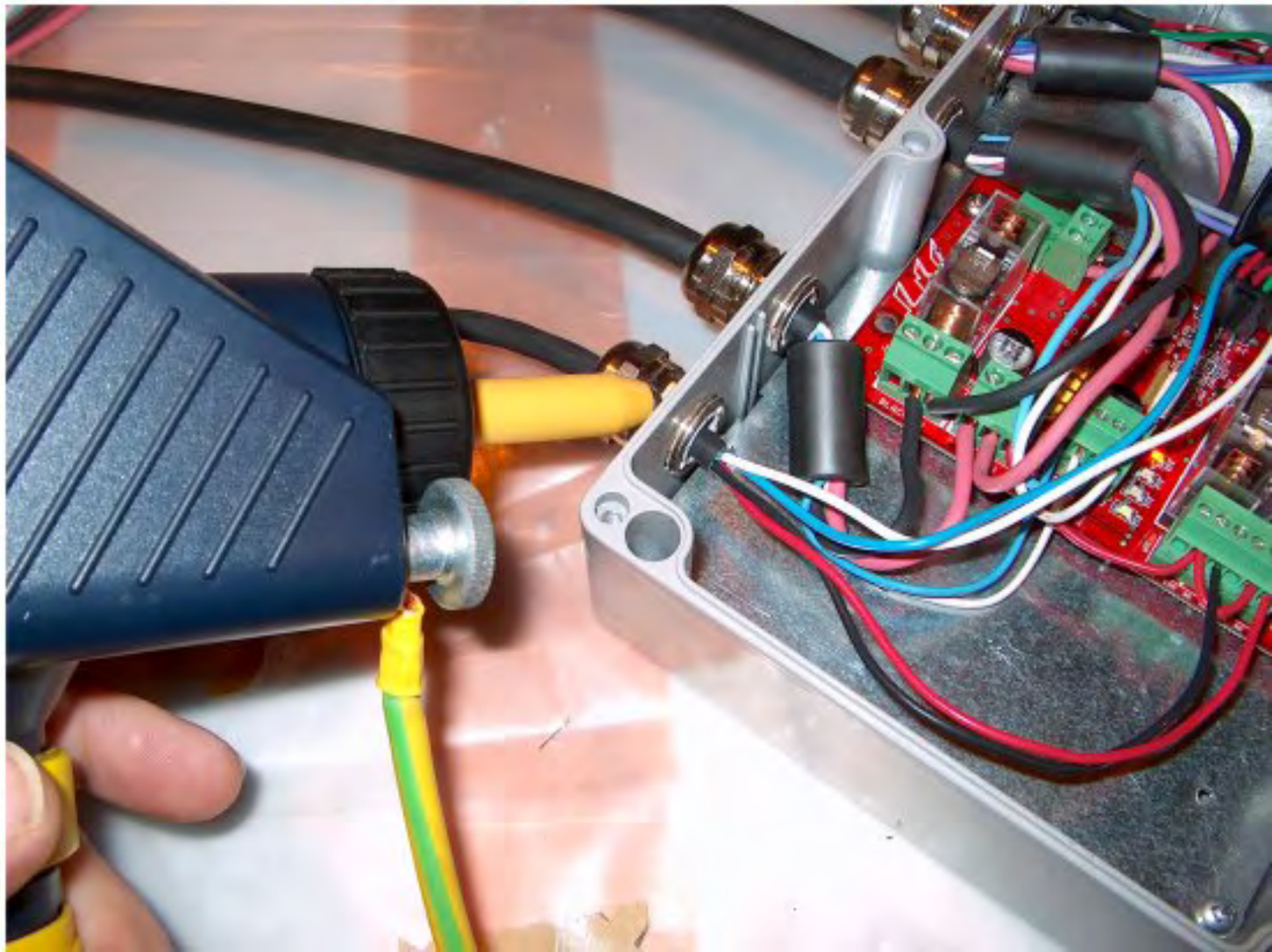
TFT RC EXTEND-A-GUN (EP0371)

TEST POINT	Description
1	Motor Bolt
2	Stop Bolt
3	Monitor Cable Entry
4	Pushbutton Entry
5	Motor Encoder
6	Down Sensor Connector
7	Pushbutton Plate
8	Main Enclosure Back
9	Power and Communications Entry
10	Motor Cable Housing
11	HCP
12	VCP
13	Up Button
14	Down Button
15	
16	
17	
18	
19	
20	
21	
22	
23	
24	
25	
26	

Note: Photograph of locations are attached


EXTEND-A-GUN RC
800-348-2686 • www.tft.com


EXTEND-A-GUN RC
800-348-2686 • www.tft.com
WARNING
Read manual before use.
UP



Data Sheet 1 of 4	**ESD DATA SHEET** Schaffner NSG 435 Gun	**Midwest EMI Associates Mundelein, Illinois**	Form: Issued 10/22/09 **MEMI-1A**

Sponsor Group: TFT RC Extend-A-Gun EP0371 **Serial Number:** _501976_
Manager: ~~Arale B~~ **Temp:** 63.1°F **Hum:** 32.9% **Technician:** GB **S/W ver.:** 2.0.0 Beta
Date of Test: 01-22-09 **Time:** 6:00 PM **EUT:** Prototype / Production **Unit**
Placement of EUT: ESD Table ✔ **Pole Mount** _____ **Wood Table** ___ **FLOOR** ___
Grounding: Pole ___ **Terminal Strip** ✔ ___ **FLOOR** ___ **1 Meg to Metal Frame of EUT.** ___
Configuration of EUT: _____
Note: All Points are Tested with 10 Shots in Single Shot Mode Unless Otherwise Stated

Reference: EN 61000-4-2		**TEST POINT:** 1-MOTOR BOLT				**TEST POINT:** 2-STOP BOLT			
		PLUS POLARITY		**MINUS POLARITY**		**PLUS POLARITY**		**MINUS POLARITY**	
REF. LINE	**KILO VOLTS**	AIR D/CHARGE	CONTACT MODE	AIR D/CHARGE	CONTACT MODE	AIR D/CHARGE	CONTACT MODE	AIR D/CHARGE	CONTACT MODE
1	1								
2	2	✔	✔	✔	✔	✔	✔	✔	✔
3	3								
4	4	✔	✔	✔	✔	✔	✔	✔	✔
5	5								
6	6	✔	✔	✔	✔	✔	✔	✔	✔
7	7								
8	8	✔		✔		✔		✔	
9	9								
10	10								

Reference: EN 61000-4-2		**TEST POINT:** 3-MOTOR CABLE ENTRY				**TEST POINT:** 4-PUSHBUTTON ENTRY			
		PLUS POLARITY		**MINUS POLARITY**		**PLUS POLARITY**		**MINUS POLARITY**	
REF. LINE	**KILO VOLTS**	AIR D/CHARGE	CONTACT MODE	AIR D/CHARGE	CONTACT MODE	AIR D/CHARGE	CONTACT MODE	AIR D/CHARGE	CONTACT MODE
1	1								
2	2	✔	✔	✔	✔	✔	✔	✔	✔
3	3								
4	4	✔	✔	✔	✔	✔	✔	✔	✔
5	5								
6	6	✔	✔	✔	✔	✔	✔	✔	✔
7	7								
8	8	✔		✔		✔		✔	
9	9								
10	10								

Notes: A Checkmark (✔) means the device passed the 10 shots successfully A Star (*) means the device failed one of the shots N/A means that the ESD gun did not discharge on the point indicated N/T means point not tested

Notes: (✔) No Errors This Page Note: **** Unit Stopped Cycling, to fix added 14 AWG Ground Strap from Case Ground to Battery Ground, Upon Retesting no failures occurred.**

Data Sheet 2 of 4	**ESD DATA SHEET** Schaffner NSG 435 Gun	**Midwest EMI Associates Mundelein, Illinois**	Form: Issued 10/22/09 **MEMI-1A**

Sponsor Group: TFT RC Extend-A-Gun EP0371 **Serial Number:** _501976_
Manager: Arnie B **Temp:** 63.1°F **Hum:** 32.9% **Technician:** GB **S/W ver.:** 2.0.0 Beta
Date of Test: 01-22-09 **Time:** 6:00 PM **EUT:** Prototype / Production **Unit**
Placement of EUT: ESD Table __✔_ Pole Mount _____ Wood Table ___ FLOOR ___
Grounding: Pole___ Terminal Strip __✔___ FLOOR___ 1 Meg to Metal Frame of EUT. ___
Configuration of EUT: _____
Note: All Points are Tested with 10 Shots in Single Shot Mode Unless Otherwise Stated

Reference: EN 61000-4-2		**TEST POINT:** 5-MOTOR ENCODER				**TEST POINT:** 6-DRIVE SENSOR COIL			
		PLUS POLARITY		**MINUS POLARITY**		**PLUS POLARITY**		**MINUS POLARITY**	
REF. LINE	**KILO VOLTS**	AIR D/CHARGE	CONTACT MODE	AIR D/CHARGE	CONTACT MODE	AIR D/CHARGE	CONTACT MODE	AIR D/CHARGE	CONTACT MODE
1	1								
2	2	✔N/A	✔N/A	✔N/A	✔N/A	✔N/A	✔N/A	✔N/A	✔N/A
3	3								
4	4	✔N/A	✔N/A	✔N/A	✔N/A	✔N/A	✔N/A	✔N/A	✔N/A
5	5								
6	6	✔N/A	✔N/A	✔N/A	✔N/A	✔N/A	✔N/A	✔N/A	✔N/A
7	7								
8	8	✔N/A		✔N/A		✔N/A		✔N/A	
9	9								
10	10								

Reference: EN 61000-4-2		**TEST POINT:** 7-PUSH BUTTON PLATE				**TEST POINT:** 8-MAIN ENCLOSURE BACK			
		PLUS POLARITY		**MINUS POLARITY**		**PLUS POLARITY**		**MINUS POLARITY**	
REF. LINE	**KILO VOLTS**	AIR D/CHARGE	CONTACT MODE	AIR D/CHARGE	CONTACT MODE	AIR D/CHARGE	CONTACT MODE	AIR D/CHARGE	CONTACT MODE
1	1								
2	2	✔	✔	✔	✔	✔	✔	✔	✔
3	3								
4	4	✔	✔	✔	✔	✔	✔	✔	✔
5	5								
6	6	✔	✔	✔	✔	✔	✔	✔	✔
7	7								
8	8	✔		✔		✔		✔	
9	9								
10	10								

Notes: A Checkmark (✔) means the device passed the 10 shots successfully A Star (*) means the device failed one of the shots N/A means that the ESD gun did not discharge on the point indicated N/T means point not tested

Notes:_____( )_No Errors This Page___Note:__** **Unit Stopped Cycling, to fix added 14 AWG Ground Strap from Case Ground to Battery Ground, Upon Retesting no failures occurred.**

Data Sheet 3 of 4	**ESD DATA SHEET** Schaffner NSG 435 Gun	**Midwest EMI Associates Mundelein, Illinois**	Form: Issued 10/22/09 **MEMI-1A**

Sponsor Group: TFT RC Extend-A-Gun EP0371 **Serial Number:** _501976_
Manager: ~~Arnie B~~ **Temp:** 63.1°F **Hum:** 32.9% **Technician:** GB **S/W ver.:** 2.0.0 Beta
Date of Test: 01-22-09 **Time:** 6:00 PM **EUT:** Prototype / Production **Unit**
Placement of EUT: ESD Table ✔ **Pole Mount** _____ **Wood Table** ___ **FLOOR** ___
Grounding: Pole___ **Terminal Strip** ✔ **FLOOR**___ **1 Meg to Metal Frame of EUT.** ___
Configuration of EUT: _____
Note: All Points are Tested with 10 Shots in Single Shot Mode Unless Otherwise Stated

Reference: EN 61000-4-2		**TEST POINT:** 9 - POWER + COMMUNITY **PLUS POLARITY**		**MINUS POLARITY**		**TEST POINT:** 10 - MOTOR CABLE NOT USED **PLUS POLARITY**		**MINUS POLARITY**	
REF. LINE	**KILO VOLTS**	AIR D/CHARGE	CONTACT MODE	AIR D/CHARGE	CONTACT MODE	AIR D/CHARGE	CONTACT MODE	AIR D/CHARGE	CONTACT MODE
1	1								
2	2	✔	✔	✔	✔	✔	✔	✔	✔
3	3								
4	4	✔	✔	✔	✔	✔	✔	✔	✔
5	5								
6	6	✔	✔	✔	✔	✔	✔	✔	✔
7	7								
8	8	✔		✔		✔		✔	
9	9								
10	10								

Reference: EN 61000-4-2		**TEST POINT:** 11 - HCP **PLUS POLARITY**		**MINUS POLARITY**		**TEST POINT:** 12 - VCP **PLUS POLARITY**		**MINUS POLARITY**	
REF. LINE	**KILO VOLTS**	AIR D/CHARGE	CONTACT MODE	AIR D/CHARGE	CONTACT MODE	AIR D/CHARGE	CONTACT MODE	AIR D/CHARGE	CONTACT MODE
1	1								
2	2	✔	✔	✔	✔	✔	✔	✔	✔
3	3								
4	4	✔	✔	✔	✔	✔	✔	✔	✔
5	5								
6	6	✔	✔	✔	✔	✔	✔	✔	✔
7	7								
8	8	✔		✔		✔		✔	
9	9								
10	10								

Notes: A Checkmark (✔) means the device passed the 10 shots successfully A Star (*) means the device failed one of the shots N/A means that the ESD gun did not discharge on the point indicated N/T means point not tested

Notes:_____( )_No Errors This Page___Note:__** **Unit Stopped Cycling, to fix added 14 AWG Ground Strap from Case Ground to Battery Ground, Upon Retesting no failures occurred.**

Data Sheet 4 of 4	**ESD DATA SHEET** Schaffner NSG 435 Gun	**Midwest EMI Associates Mundelein, Illinois**	Form: Issued 10/22/09 **MEMI-1A**

Sponsor Group: TFT RC Extend-A-Gun EP0371 **Serial Number:** _501976_
Manager: Arnie B **Temp:** 63.1°F **Hum:** 32.9% **Technician:** GB **S/W ver.:** 2.0.0 Beta
Date of Test: 01-22-09 **Time:** 6:00 PM **EUT:** Prototype / Production **Unit**
Placement of EUT: ESD Table _✔_ **Pole Mount** _____ **Wood Table** ___ **FLOOR** ___
Grounding: Pole___ **Terminal Strip** _✔_ **FLOOR**___ **1 Meg to Metal Frame of EUT.** ___
Configuration of EUT: _____
Note: All Points are Tested with 10 Shots in Single Shot Mode Unless Otherwise Stated

Reference: EN 61000-4-2		**TEST POINT:** UP BUTTON				**TEST POINT:** DOWN BUTTON			
		PLUS POLARITY		**MINUS POLARITY**		**PLUS POLARITY**		**MINUS POLARITY**	
REF. LINE	**KILO VOLTS**	AIR D/CHARGE	CONTACT MODE	AIR D/CHARGE	CONTACT MODE	AIR D/CHARGE	CONTACT MODE	AIR D/CHARGE	CONTACT MODE
1	1								
2	2	✔	✔	✔	✔	✔	✔	✔	✔
3	3								
4	4	✔**	✔	✔	✔	✔	✔	✔	✔
5	5								
6	6	✔**	✔	✔	✔	✔	✔	✔	✔
7	7								
8	8	✔		✔		✔		✔	
9	9								
10	10								

Reference: EN 61000-4-2		**TEST POINT:** _____				**TEST POINT:** _____			
		PLUS POLARITY		**MINUS POLARITY**		**PLUS POLARITY**		**MINUS POLARITY**	
REF. LINE	**KILO VOLTS**	AIR D/CHARGE	CONTACT MODE	AIR D/CHARGE	CONTACT MODE	AIR D/CHARGE	CONTACT MODE	AIR D/CHARGE	CONTACT MODE
1	1								
2	2	✔	✔	✔	✔	✔	✔	✔	✔
3	3								
4	4	✔	✔	✔	✔	✔	✔	✔	✔
5	5								
6	6	✔	✔	✔	✔	✔	✔	✔	✔
7	7								
8	8	✔		✔		✔		✔	
9	9								
10	10								

Notes: A Checkmark (✔) means the device passed the 10 shots successfully A Star (*) means the device failed one of the shots N/A means that the ESD gun did not discharge on the point indicated N/T means point not tested

Notes:_____( )_No Errors This Page___Note:__**** Unit Stopped Cycling, to fix added 14 AWG Ground Strap from Case Ground to Battery Ground, Upon Retesting no failures occurred.**

APPENDIX H

MAGNETIC SUSCEPTIBILITY TEST

(EN 61000-4-8 Power Line Immunity Test, EN 61000-4-8)

1.0 PURPOSE:

The purpose of this test is to insure that commercial devices will not be susceptible to low frequency magnetic energy. This test is normally conducted only at 50 or 60 Hertz and with very high electromagnetic fields that could be experienced with heavy machinery or MRI machines. These tests are outlined in EN EN 61000-4-8, FDA document MDS-201-0004 and Military Standard RS101. In the AAMI DF-39 method the frequency range is extended to 500 Hz encompassing all known power frequencies.

2.0 DESCRIPTION OF TEST APPARATUS:

2.1 Test Method and Exceptions

The test method for magnetic field susceptibility of EN 61000-4-8 specifies a magnetic coil that must be larger than the maximum dimension of the test sample. In some cases, commercial equipment is very large and the coils and power supply needed would be unmanageable from a floor volume and cost standpoint. Instead, as an exception, coils are used that create strong localized fields that are well in excess of the standard. The dimensions of the coils and all calculations are shown in the next section.

In performing the MDS specification at 50/ 60 Hz for large devices, the coils are held 80 cm apart and they are moved in a parallel plane up and down the device under test. The coils are properly phased with field aiding so that locally over all surfaces the field requirements are met. This is also done in all axes as specified in MDS-201-0004, paragraph 4.3.4.d.

2.2 Loop Antenna Pair

The fabricated antennas for the 50/60 Hz test consist of two bundled coils of average diameter of 73 cm. with 31 turns of #12 AWG insulated, CSA approved standard copper wire. The bundled coil dimension is a 1" diameter. The coils are arranged on an axis so that they are parallel to each other and are 70 cm apart.

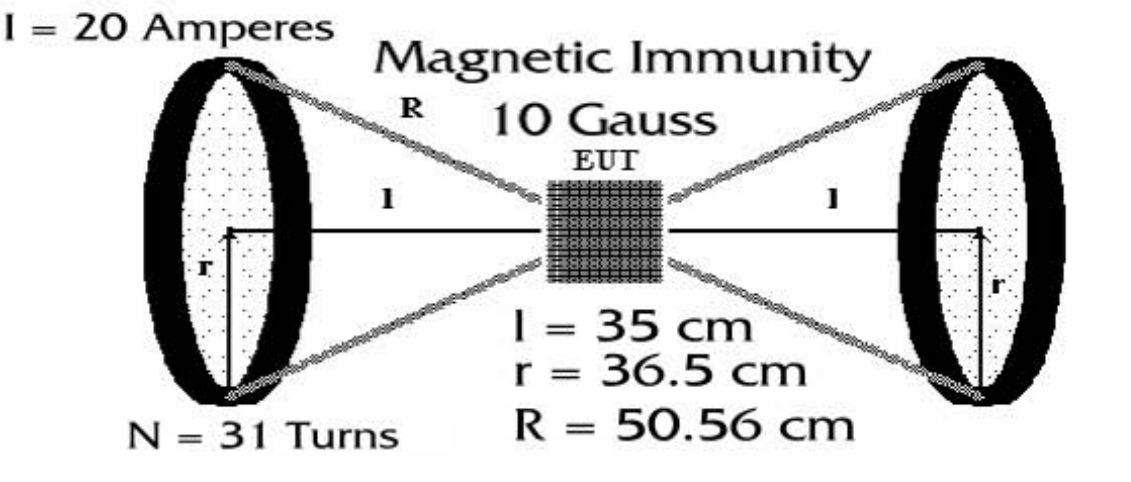
Using the "right hand" rule, the coils are phased so that the flux generated is aiding. The bundled coils are permanently affixed to two wicker disks so that they are maintained round. The field generated by the coils is measured by the calibrated Holladay probe. The analysis below correlates the calculated field strength of the coils to the empirically measured field strength. The actual field is approximately twice as great by adding the flux generated by the two coils.

2.3 Calculations

Given: Coil Diameter: 73 cm.
Current: 20 amperes
Coil Distance: 70 centimeters

Number of turns: 31 turns

Units: 1 Tesla = 10^4 Gauss=3 x 10^8 V/m=240 dBpT= 8x10^5 A/M
$\mu_o = .4\pi x\ 10^{-7}$ T m/A



Calculate: Field Strength (V/m) at point halfway between the coils.

Let: l = distance from each coil to midpoint, cm
R = distance from midpoint to radius of coil, cm
r = radius of coil, cm

$$R = \sqrt{l^2 + r^2} = \sqrt{35^2 + 36.5^2} = 50.56 \text{ cm}$$

$$B \text{ (Tesla)} = .5\ Uo * I * \frac{r^2}{R^3} * N, \quad Uo = 4\pi \times 10^{-7} \text{T x m/A}$$

I = 20 Amps RMS, 60 Hz

$$B \text{ (V/m)} = 188.5 \times I \times \frac{r^2 \times N}{R^3}$$

N = 25 Turns
r = .5 m, R = .6403m

$$B(V/m) = 188.5 * 20 * (.35)^2 / (.5056)^3 * 31 = 110769 \text{ V/m}$$

Since two coils are acting the field strength is about two times as great, or 221537 V/m, or equivalently, 227 dBuV/m.

Empirical Finding:

Using a 9311-1 loop antenna between the two coils at the 70 cm. distance and with 20 amperes applied the actual recorded strength was about 10 Gauss or 300000 V/M, 229.5 dBuV/m.

As seen the recorded strength is a few dB higher than calculated and is attributed to mutual inductive coupling between the coils that magnifies the apparent field.

The agreement is quite good and the equivalent empirical magnetic field in tesla at 20 Amps is 1 milli Tesla (10 Gauss, 800 A/M).

2.4 Test Set Up

2.4.1 The device was placed on a wood table at an 80 cm. height and the loop antenna pair was placed in all axes to assure complete exposure of the EUT. The current was adjusted to the maximum obtainable that was 20 amperes, 40-500 Hz.

3.0 MODULATION -- No modulation is specified for this test.

4.0 LIMITS AND TEST RESULTS

4.1 Magnetic Field Limit - MDS-201-0004 & IEC Recommendation

The magnetic field susceptibility of the device should not be less than the level defined in the EN 61000-4-8 standard which is 30 A/M. The IEC recommendation ranges up to 400 amperes/meter.

4.2 RESULTS

The TFT Extend-A-Gun system was exposed in three axes to a swept field as measured by Holladay Magnetic Field Probe Model HI-3624. The current was maintained fairly constant in the range of 40 to 500 Hz resulting in a 5 to 8 gauss field being applied in this range. There was no apparent effect on the device due to the 40Hz to 500 Hz magnetic field. The TFT Extend-A-Gun passed the EN 61000-4-8 recommendation.