Performance Certification to EMC Directive

Directive: 2014/30/EU **Normative Standards: IEC 61000-6-2 :2016**

Test Unit Description and Serial Number:

TASK FORCE TIPS MONITOR EF1

M/N: EF1 **S/N: PROTO #4**

Test Report # 3764

Dates of Test: 8-29-2017 through 9-1-2017

Industry Canada Industrie Canada

Test Laboratory:

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

IEC 61000-6-2 :2016 EMISSIONS

TEST METHOD	LIMITS
Cispr 11 :2015-06 (Radiated / Conducted Emissions)	B/B

IEC 61000-6-2 :2016 IMMUNITY

TEST METHOD		LEVEL
IEC 61000-4-2 :2008-12 Electrostatic Discharge Test	2, 4, 6 and 8 kV Air Discharge 2, 4 and 6 kV Contact Discharge	A
IEC 61000-4-3 :2010 Radiated Immunity Test	13 V/M (10 V/M minimum) 25-2700 Mhz, 1000 Hz, 80% AM modulation, 900 Mhz, 100% AM, 200 Hz, Pulsed Wave And 4.5 V/M (3 V/M Minimum), 2700-6000 MHz, 80% AM	A
IEC 61000-4-4 :2012-04 Electrical Fast Transients	.5 and 1 kV Line to Line and Line to Ground, Battery Operated	A
IEC 61000-4-5 : 2014 Electrical Surge Test	.5 and 1 kV Line to Line and Line to Ground, Battery Operated	A
IEC 61000-4-6 :2013-10 Conducted Immunity	3 & 10 V RMS Common Mode, Battery Operated	A
IEC 61000-4-8: 2009 Magneict Immunity Test	Power Frequency Magnetic Fields 3 Axis – 30 A/M minimum	A
IEC 61000-4-29 :2000 Line Voltage Dropout	3 Repetitions at 0, 40 and 70% U_T, 85% & 120% Surge, Sag Battery Operated	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 A. Brenner

Narte Certified Engineer, EMC-000738NE

BBB MEMBER CHICAGO & NORTHERN ILLINOIS

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

Industry Canada Industrie Canada

Midwest EMI Associates Test Service
Report No. 3763
Test Specifications

Cispr 11 B Conducted and Cispr 11 B Radiated Emissions
IEC 61000-4-2 Electrostatic Discharge Test
IEC 61000-4-3 Radiated Susceptibility Test
IEC 61000-4-4 Transient Susceptibility Test
IEC 61000-4-5 Surge Susceptibility Test
IEC 61000-4-6 Conducted Immunity Test
IEC 61000-4-8 Magnetic Immunity Test
EN 61000-4-29 DC Voltage Fluctuations Test

Test Device: **TASK FORCE TIPS MONITOR EF1**

M/N: EF1 S/N: PROTO #4

Conducted For: **Mr. Tim Miller**
Task Force Tips, Inc.
3701 Innovation Way
Valparaiso, Indiana 46383-6940
Ph: 1-219-462-6161
Fax: 1-219-464-7155

Dates of Test: 8-29-2017 through 9-1-2017

Technical Data
Taken by and Report
Written by:

George A. Bowman
George Bowman
Midwest EMI Associates

Approved By:
Mr. Tim Miller
Project Engineer
Task Force Tips, Inc.

BBB MEMBER CHICAGO & NORTHERN ILLINOIS

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1.0 PURPOSE:

The purpose of this test sequence is to qualify the compliance of the TASK FORCE TIPS MONITOR EF1 to the IEC 61326-1 :2013 Standard. This report covers testing to Cispr 11B Conducted and Cispr 11B Radiated Emissions, IEC 61000-4-2 electrostatic discharge test, IEC 61000-4-3 radiated susceptibility test, IEC 61000-4-4 fast transient test, IEC 61000-4-5 surge test, IEC 61000-4-6 conducted susceptibility test, IEC 61000-4-8 Magnetic Fields Test, and IEC 61000-4-29 DC Voltage Fluctuations test. This apparatus is a compact, automated directional water fire fighting apparatus which is useful for fighting fires in a forest and for general purpose fire fighting. This model includes an updated and size reduce mechanical assembly. It is exclusively powered by a 12 or 24 volt battery.

2.0 TEST FACILITY:

All susceptibility testing was performed in a 12.5 ft. wide by 16.5 ft. long by 8 ft. high, solid steel and copper semianechoic structure located at Midwest EMI Associates, 21234 W. Commercial Drive, Mundelein, Illinois 60060. 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 and 208 VAC, 3 phase, 50/60 Hz.

Referring to the room diagram, 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.

3.0 CONFIGURATION AND OPERATION OF TEST SAMPLE:

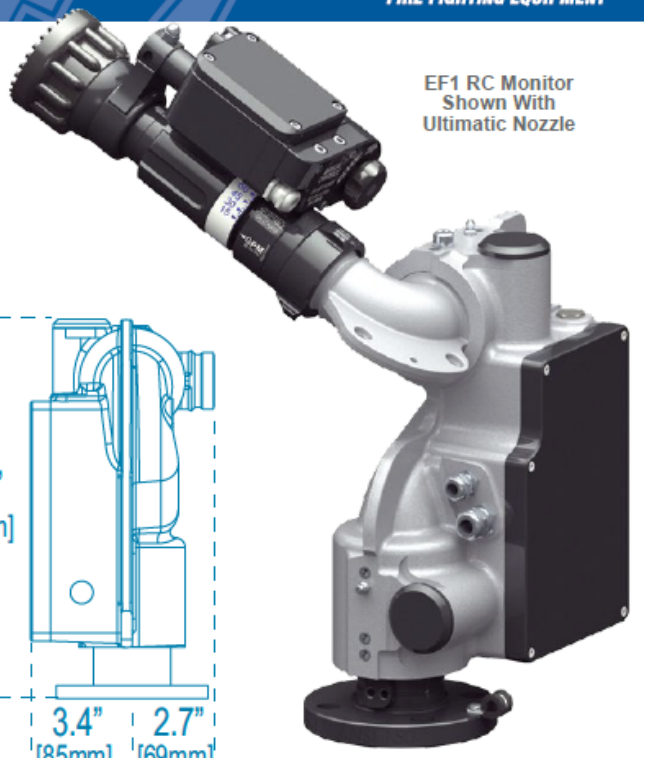
3.1 DESCRIPTION OF TASK FORCE TIPS MONITOR EF1 TEST SAMPLE:

The EF1 RC monitor is extremely compact, yet it has a large 1-½ inch waterway, capable of fl owing up to 200 gpm, making it the ideal forestry bumper turret. Waterway with turning vane has only 19 psi (1.3 bar) friction loss at 200 gpm (757 l/min). Elevation range is 90° above horizontal to 45° below. Field changeable elevation travel stops at 45 ° above and 20° below horizontal. Horizontal travel is 270° (135° either side of a center position). Field changeable horizontal travel stops to give 180° (90° either side of a center position). Designed for 12 VDC or 24 VDC operation, selection is automatic. The EF1 RC monitor comes with controls for monitor horizontal rotation, elevation, nozzle pattern, programmable PARK and Oscillate. The motor control circuits use position encoders and current limiting to protect the drive train at the ends of travel. Unit has waterproof factory installed plug on power wire for easy removal or reinstallation. Electric drives and control box are waterproof. Main waterway made from hardcoat anodized ANSI 356-T6 aluminum. Silver powder coat fi nish inside and out. Various inlets are available. Contact factory for details about wireless operation

what's new...

TASK FORCE TIPS®
FIRE FIGHTING EQUIPMENT

Our Most Compact RC Monitor

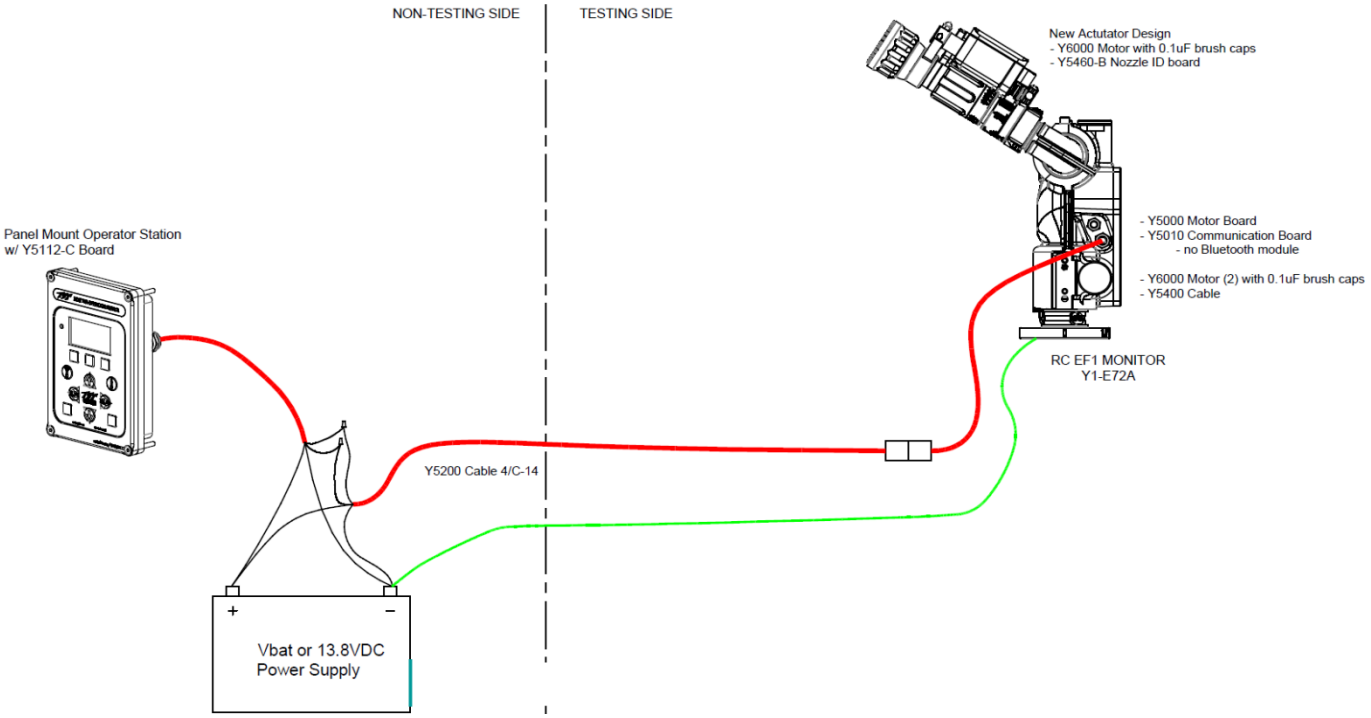


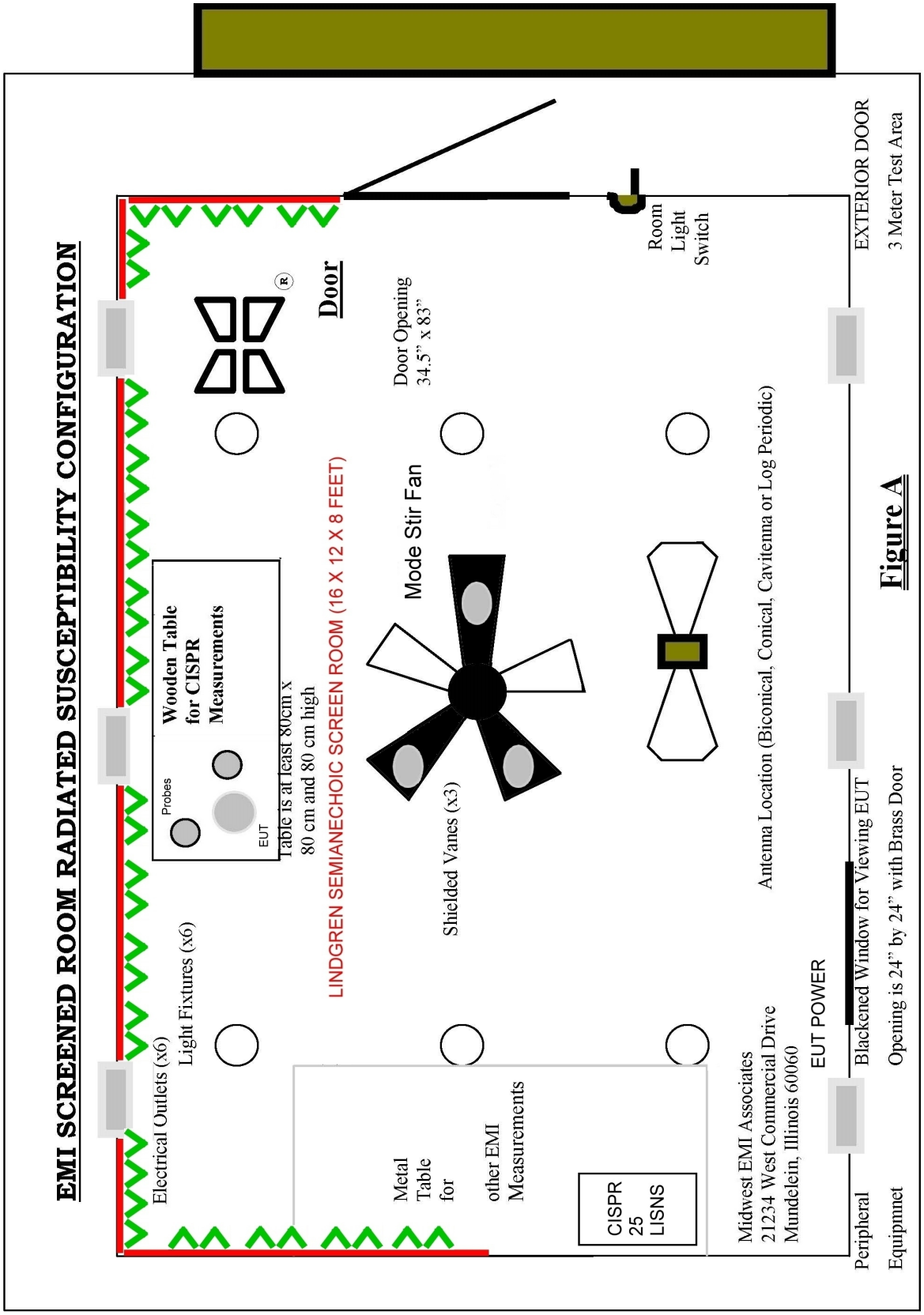
EF1 RC

Maximum Stream Performance

The EF1 remotely controlled monitor is extremely compact, yet it has a large 1-½" waterway, capable of flowing up to 200 gpm. At less than 13" tall (without nozzle) the EF1 is an ideal forestry bumper turret. The monitor is equipped with controls for monitor horizontal rotation, elevation, nozzle pattern, programmable PARK and Oscillate. The hard coat anodized aluminum alloy and powder coated monitor includes a waterproof factory installed plug on power wire for easy removal or re-installation and the electric drives and control box are waterproof.

EUT CONFIGURATION




EMI SCREENED ROOM RADIATED SUSCEPTIBILITY CONFIGURATION
Electrical Outlets (x6)
Light Fixtures (x6)
Wooden Table for CISPR Measurements
Probes
EUT
Table is at least 80cm x 80 cm and 80 cm high
LINDGREN SEMIANECHOIC SCREEN ROOM (16 X 12 X 8 FEET)
Door
Door Opening 34.5" x 83"
Mode Stir Fan
Shielded Vanes (x3)
Room Light Switch
EXTERIOR DOOR
3 Meter Test Area
Antenna Location (Biconical, Conical, Cavitenna or Log Periodic)
Metal Table for other EMI Measurements
CISPR 25 LISNS
Midwest EMI Associates
21234 West Commercial Drive
Mundelein, Illinois 60060
EUT POWER
Peripheral Equipmnet
Blackened Window for Viewing EUT
Opening is 24" by 24" with Brass Door
Figure A

3.2 POWER REQUIREMENT:

The primary power supplied to the test sample was 12 or 24 VDC capable of supplying 24 amperes (limited by fusing). The power was supplied to the test sample through a VDE style 250/50 uH, 50 ohm L.I.S.N. bonded to the floor of the room.

3.3 GROUNDING:

The grounds provided for the test sample are through the third wire in the power cord with all other grounding connections between the test sample and the ground plane being interrupted.

The EMC receiver is located outside the screen room and grounded with a low impedance strap. The EMC receiver is powered from a separate phase of power and an external Plitron extreme electrostatically shielded isolation transformer is also provided for complete isolation.

3.4 RADIATED CONFIGURATION:

The test sample was oriented so that the area exhibiting the greatest amount of radiation was facing the antenna. This was determined to be variable during testing.

3.5 TEST SAMPLE OPERATION:

The EUT was operated in its typical operational mode with pump set to the its oscillation mode of operation.

4.0 DISPOSITION OF TEST SAMPLE:

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

5.0 REFERENCES:

UL 61010-1 (2012-05-11) "Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use - Part 1: General Requirements"

IEC 61010-1:2010+AMD1:2016 CSV "Consolidated version Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 1: General requirements

ANSI 63.4 (2016), "American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 Hz to 40 GHz"

EN 55011 (2016) – "Industrial, scientific and medical equipment -Radio-frequency disturbance characteristics – Limits and methods of measurement"

EN 55024 (2016) – "Information technology equipment. Immunity characteristics·

limits and methods of measurement"

IEC 61326-1 (2013), "Electrical Measurement, Control and Laboratory Equipment, EMA requirement Part 1 -General Requirement"

CISPR 22 :2016,"Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement"

EN 61000-6-1 (2007), "Electromagnetic compatibility (EMC) - Part 6: Generic standards - Section 1: Immunity for residential, commercial and light-industrial environments"

EN 61000-6-2 (2016), "Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments"

EN 61000-6-3 (2007)/A1 (2011), "Electromagnetic compatibility (EMC) - Part 6: Generic standards - Section 3: Emission standard for residential, commercial and light-industrial environments"

EN 61000-6-4 (2007)/A1 (2011), "Electromagnetic compatibility (EMC) - Part 6: Generic standards - Section 4: Emission standard for industrial environments"

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

EN55011 2016/A1:2017, "Limits and Methods of Measurement of Radio Disturbance Characteristics of Industrial, Scientific and Medical (ISM) Radio-frequency Equipment"

CISPR Publication Number 16-1, (2003-10) Edition 1.1, "Specification for Radio Disturbance and Immunity Measuring Apparatus and Methods, Part 1, Radio Disturbance and Immunity Measuring Apparatus, 1998

6.0 GENERAL INFORMATION:

A diagram of the EMI facility and test equipment used is shown in the Appendices to this report. 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 11 & 22, Military Standard 462, and IEC 801 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 criterion 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.

- **Appendix A1 (CISPR Conducted Emissions)** - 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.*

- **Appendix B1 (CISPR Radiated Emissions)** - 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.*

- **Appendix C (EN61000-4-4 Fast Transients)** - Limits for EN 61326-1 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.*

- **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 IEC 61326-1 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.*

- **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.*

- **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.*

- **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.*

- **Appendix H (EN 61000-4-8 Magnetic Immunity Test) – The EUT is exposed to high level magnetic fields of up to 10 Gauss.** *The criterion of passing this test is no adverse malfunction during application of the fields*.

6.3 SPECTRUM ANALYZER CHARACTERISTICS

This facility uses a type TEK 2756P/TEK 2712 automated spectrum analyzer and a HP Omnibook 900 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	0.7716 dB	0 dB
0.1 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
0.1 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	932.0 kHz	0.6117 dB	0 dB
300 kHz	310 kHz	10.173 dB	10.5 dB
120 kHz	119 kHz	18.5 dB	18.5 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

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:

	Instrument	Serial No	Calibration Due
a)	Tek2756P Spectrum Analyzer	BO20224	26-Aug-18
b)	Wavetek 2520A RF Generator	222011	30-Aug-18
c)	Carver TFM-35 250 W/Ch. Audio Amp	3097104	1-Jun-01
d)	ENI RF Power Amplifier (525LA)	367	30-Aug-18
e)	ENI RF Power Amplifier (2100L)	129	30-Aug-18
f)	Eaton 15100B Power Amplifier	1529-07090	24-Aug-18
g)	Tektronix TDS 420 Oscilloscope	B021212	24-Aug-18
h)	EMCO 3109 Power Biconical (1/3/10 Meters)	9011-2504	17-Aug-18
i)	EMCO 3101 Power Conical	9007-3450	7-Nov-93 (1/3m)
j)	EMCO 6502 Active Loop	1038	18-Aug-18
k)	EMCO 3301B Active E Field	9009-3044	19-Aug-18
l)	EMCO 3147 Wide Range Log Periodic	9102-1019	23-Aug-18
m)	EMCO 3107B Power E Field	9310-2435	N/A
m)	Amplifier Research FM1000	12456	N/A
n)	Amplifier Research FP1000	60701	21-Aug-18
o)	Amplifier Research FP1000	60488	3-Aug-18
p)	IFI EFS-4 E Field Susceptibility (Holladay 3004EX with HSE405 Probe)	39883	14-Aug-18
q)	IFI LMT-B Light Modulator	1117-B	n/a
r)	IFI EFS-1 E Field Susceptibility	245738	1-Feb-99
s)	Solar 6741-1 RF Current Probe	911308	n/a
t)	Fluke 45 True RMS Voltmeter	EJ574714013	24-Aug-18
u)	Schaffner NSG 435 ESD Gun	107	15-Aug-18
v)	Solar Loop Sensor 7334-1	n/a	n/a
w)	Solar Loop Sensor 9311-1	931101	n/a
x)	Solar RF Coupler 7415-3906016	n/a	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-Aug-18
ab)	Werlatone C1795 Dir. Coupler	3442	30-Aug-18
ac)	Solar Current Injection Probe Type 9108-1N	935012	n/a
ad)	Tektronix TR 503B Tracking Generator	B011216	25-Aug-18
ae)	Acme 2KVA Isolation Transformer	T-3-53042-S	n/a
af)	Xentek Extreme Isolation Transformer Model 5410 (2 in use)	n/a	n/a
ag)	Tektronix P6202 RF Probe	n/a	n/a
ah)	Staco Power Variac Type 3PN2210 (0-140VAC) 3.1KVA	n/a	n/a
ai)	Helmholtz Coil Stepdown Xfrmr-Chicago Xfrmer Type P-6492	n/a	n/a
aj)	Goldstar Signal Generator Mod FG-2002c	201621	25-Aug-18
ak)	Holladay Magnetic Field Probe Model HI-3624	83957	15-Aug-18
al)	Tektronix 2712 Spectrum Analyzer (Quasipeak)	B022520	24-Aug-18
am)	Voltec PM100 Power Analyzer	AA04/8495	25-Aug-18
an)	EMCO 3142 Biconilog Antenna	1052	1-Aug-18
ao)	Haefely P90.1 IEC 61000-4-4 Fast Transient Tester	083 593-14	19-Aug-18
ap)	Hewlett Packard 3400A AC Voltmeter	1218A14443	24-Aug-18
aq)	Amplifier Research FP2031 Isotropic Probe	18309	5-Aug-18
ar)	Haefely 250 600/00 (61000-4-5 Surge Tester)	583 334-05	19-Aug-18

as)	Fischer CISPR 14 Absorbing Clamp type F-201	235	7-Aug-18
at)	Fischer IEC 801-6 Transducer	165	23-Aug-18
au)	Solar 9123-1N Current Clamp	956015	23-Aug-18
av	Fischer IC 801-6 CDN FCC-801-M3-25	95	7-Aug-18
aw)	Tektronix 2712 Spectrum Analyzer (Quasipeak) B022981	n/a	24-Aug-18
ax)	C. C. Moore Automated Mast Assembly Model DAPM4/6	n/a	n/a
ay)	C. C. Moore Automated Turntable Model DTT-4	n/a	n/a
az)	Antenna Research LPB2520	1152	20-Aug-18
ba)	Behlman Power Pass 50 Hz AC Source (50, 60, 400 Hz)	n/a	n/a
bb)	California Instruments WP1251 AC Source (50, 60 Hz)	n/a	n/a
bc)	Plitron Extreme Toroidal Isolation Transformers (2)	n/a	n/a
bd)	Edmund Scientific Thermometer/Hygrometer	n/a	31-Aug-18
be)	Coaxial Bird Pads (x2) 8306-030-N3DB	n/a	30-Aug-18
bf)	High Current Source, Associated Research 3030D	A140006	25-Aug-18
bg)	California Instruments 5001ix High Power Source	HK52945	25-Aug-18
bh)	Line Leakage tester, Associated Research 510L	130007	25-Aug-18
bi)	Hipot Tester, Associated Research 3570D	90595	25-Aug-18
bh)	GAASfet Preamplifier	n/a	30-Aug-18
bi)	Ametek Tachometer Model 1726	R035292	24-Aug-18
bj)	Bird Attenuator (x2), 75 Watt, 75-A-MFN-10	R035290	30-May-04
bk)	HP 8482A Power Sensor	2652A18474	24-Aug-18
bl)	HP 435B Power Meter	2702A17563	24-Aug-18
bm	Simpson Model 383 Thermometer	B001531	24-Aug-18
bn)	Wavetek 27XT Voltmeter	96120787	24-Aug-18
bo)	HP 8657A Programmable Synthesizer	365	27-Aug-18
bp)	Fluke 75	n/a	24-Aug-18
bq)	Fluke 21 Series III	n/a	24-Aug-18
br)	ENI 525LA	n/a	19-Aug-18
bs)	Tek 495P Opt 5/7	B020147	30-Aug-18
bt)	Amplifier Research FP2036 (.5-5Ghz)	n/a	4-Sep-18

7.0 CONCLUSION OF RADIO FREQUENCY INTERFERENCE EMISSIONS AND SUSCEPTIBILITY TESTS

The TASK FORCE TIPS MONITOR EF1 passed all tests in the configuration requested by the sponsor group for compliance with the CE Mark in the Directive, EN 61000-6-2: 2016. The configuration requested was that of the packaged unit in an orientation that exercised its motion capability. This also exercised the processor and control functions necessary for its proper function. A change list is supplied below.

8.0 CANADIAN TESTING REQUIREMENTS (ICES-001)

A transition period ending December 1, 2006 is provided, within which compliance witheither ICES-001 Issue 3 or ICES-001 Issue 4 will be accepted. **After the above date, only compliance with ICES-001 Issue 4 will be accepted.**

In this Standard,

"ISM radio frequency generator" means any interference-causing equipment that generates and/or uses locally radio frequency energy for industrial, scientific, medical, domestic or similar purposes, excluding applications in the field of telecommunications, information technology and other applications covered by other Industry Canada standards.

Labelling Requirements

A record of the measurement method and results shall be retained by the manufacturer or importer for a period of **at least five years and made available for examination on the request of the Minister.**

The manufacturer, importer or supplier shall meet the labelling requirements set out in this section and in Notice 2014 – DRS1003 for electronic labelling for every unit:

(i) prior to marketing in Canada, for ISM RF Generators manufactured in Canada and
(ii) prior to importation into Canada, for imported ISM RF Generators.

Each unit of an ISM RF Generator model shall bear a label which represents the manufacturer's or importer's Self-Declaration of Compliance (SDoC) to Industry Canada ICES-001. This label shall be permanently affixed to the ISM RF Generator or displayed electronically and its text must be clearly legible. If the dimensions of the device are too small or if it is not practical to place the label on the ISM RF Generator and electronic labelling has not been implemented, the label shall be, upon agreement with Industry Canada, placed in a prominent location in the user manual supplied with the ISM RF Generator. The user manual may be in an electronic format and must be readily available.

Industry Canada ICES-001 Compliance Label: *CAN ICES-1/NMB-1*

9.0 FCC COMPLIANCE STATEMENT

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

FCC WARNING

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

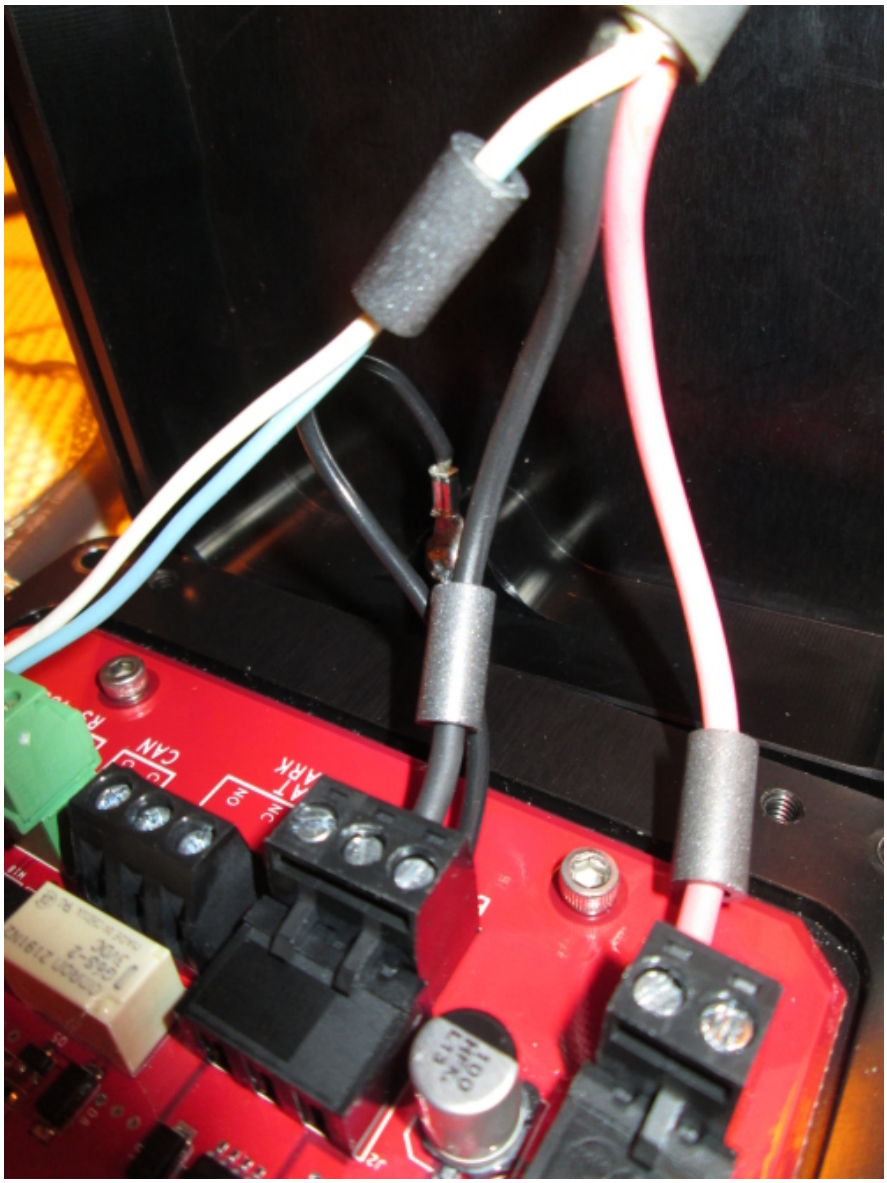
• Reorient or relocate the receiving antenna. • Increase the separation between the equipment and the receiver.
• Connect the equipment into an outlet different from that to which the receiver is connected.
• Consult the dealer or an experienced radio/TV technician for help.

Change List

The following changes were needed to meet CE Mark:

1. Add three 28B0275-0A0 to power cable wires to meet radiated emissions test.
2. Add .01 uF from motor negative lead to case ground on the PCB. Rating of capacitor should be 50 volts or higher. This was added to meet conducted emissions test.

EMI Changes for TASK FORCE TIPS MONITOR EF1



Nemko Laboratory Authorization
Authorization Number: 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 "Scope of Authorization" pages.**

Nemko has assesses 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 the Nemko Document NLA-10. During the audit by the Nemko representative it was found that the laboratory is capable of performing tests within the "Scope of Authorization".

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 tested.

In order to maintain the Authorization, 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 Authorization. The Authorization may be withdrawn by Nemko at any time if the conditions are no longer considered fulfilled.

This Authorization is valid through 23 December 2018

Nemko USA, San Diego, 23 December 2016

For Nemko AS

James E Morris

James E. Morris, Nemko USA

EMC and Wireless Divisions Manger

APPENDIX A1

FCC/VDE CONDUCTED EMISSIONS TEST

(EN55011, 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 anechoic 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 TASK FORCE TIPS MONITOR EF1 was operated in its normal mode using 12 or 24 V DC 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 40 cm. next to the screen wall 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 next to the screen room wall at 40 cm. height over the ground plane to satisfy Cispr 11 or 22 B level test criterions. The excess cord was bundled so that an 80-centimeter distance was maintained to the LISN termination point and a 40-centimeter bundle was maintained between the table and the termination point. The LISN was terminated directly with a 10 dB Bird 20 Watt pad, a 10 KHz rolloff filter to protect the spectrum analyzer, and a second 10 dB Bird pad. 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 11, 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.

CE EMC LIMITS

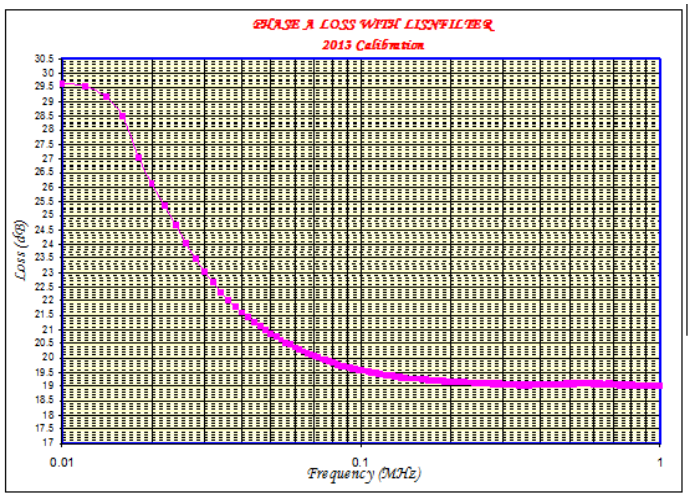
For CISPR 11 (EN55011), 22 (EN55022) or 14 (EN55014) B level conducted compliance starting at 150 KHz the allowed level is 66 dBuV and decreases at a linear rate with the log of frequency to 56 dBuV at 500 KHz. From 500 KHz to 5 MHz the allowed level is 56 dBuV, and 60 dBuV from 5 MHz to 30 MHz at the LISN mains.

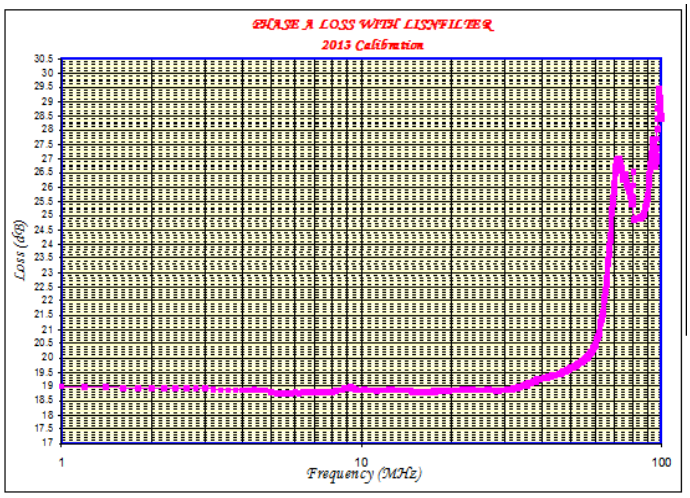
3.6 CALIBRATION DATA:

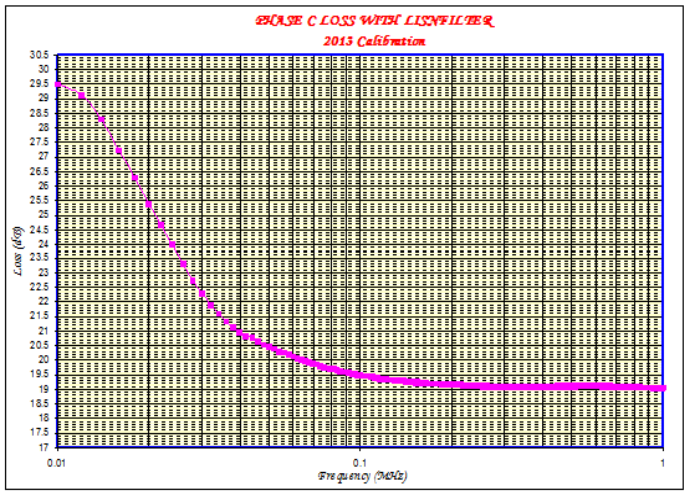
The results of the latest recalibration of the LISN's are contained on the next page over the range of 1 KHz to 1 MHz. The LISN is isolated from the spectrum analyzer by a filter network that provides 20 dB loss in the band required but rolls lower frequencies off greatly which can saturate the analyzer readings creating errors.

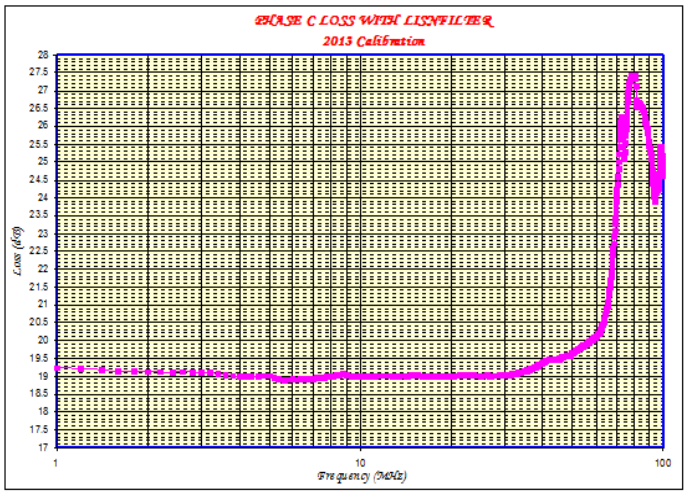
In the range higher than 1 MHz up to 70 MHz the characteristic of each LISN is flat with an insertion loss of no greater than 1.5 dB. In all cases the deviation from the perfect LISN response has been compensated for in a computer correction table file (approximately 150 points). The actual lower end of LISN response used for substantiation of customer data is 10 KHz.

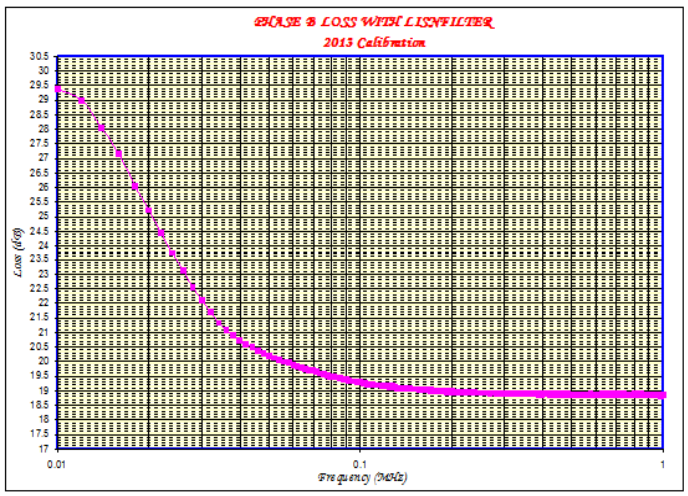
Laboratory LISN Calibration 2016 for OATS Site

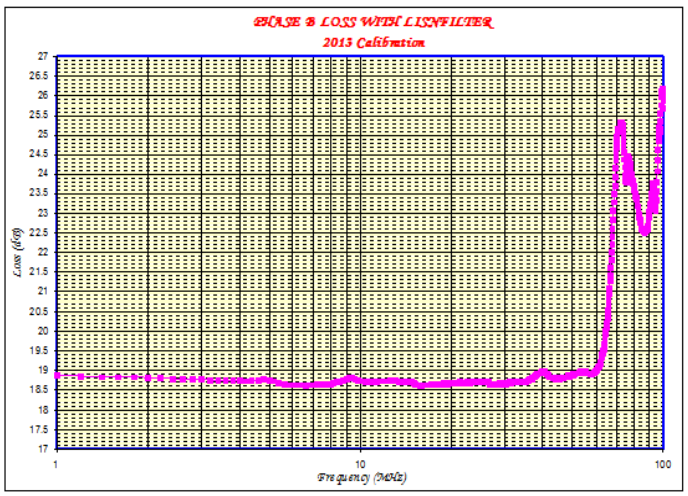






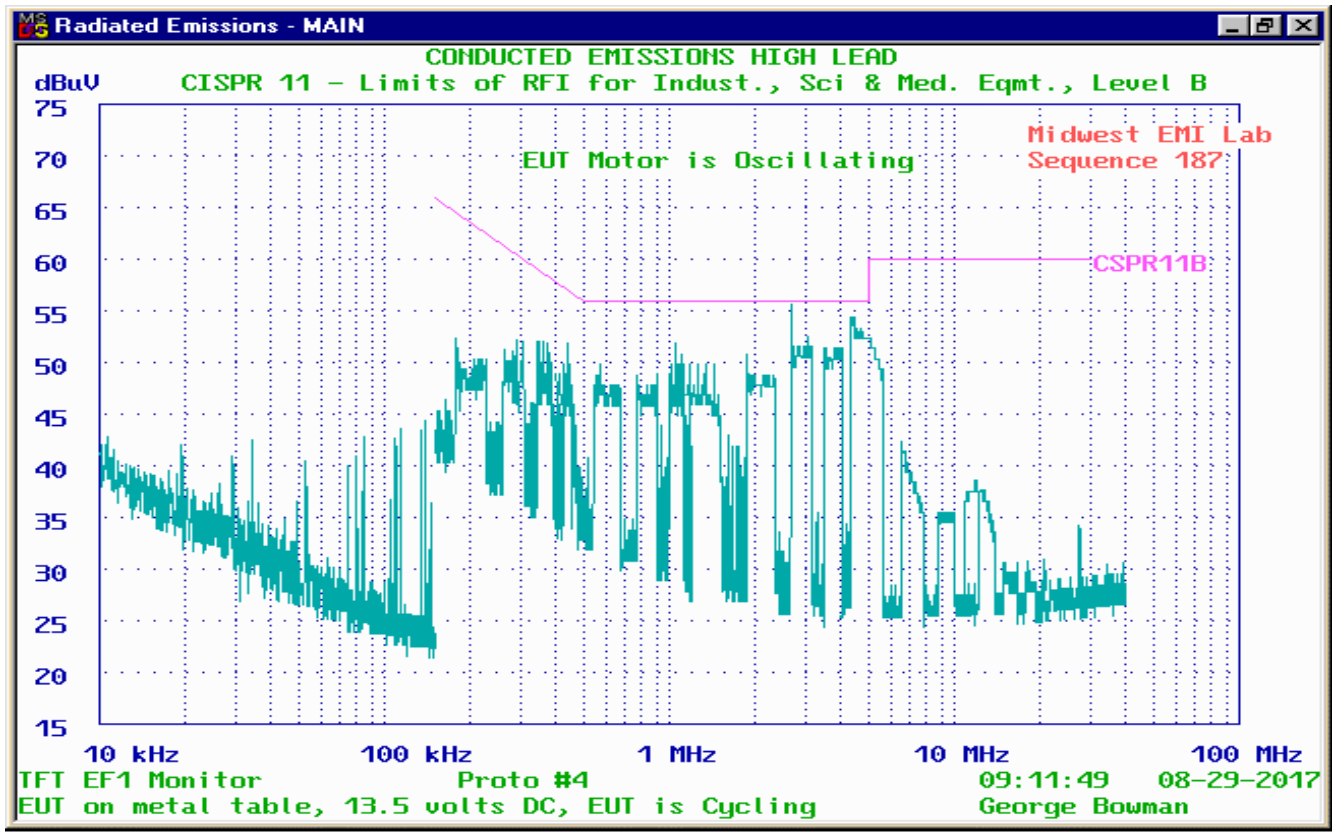


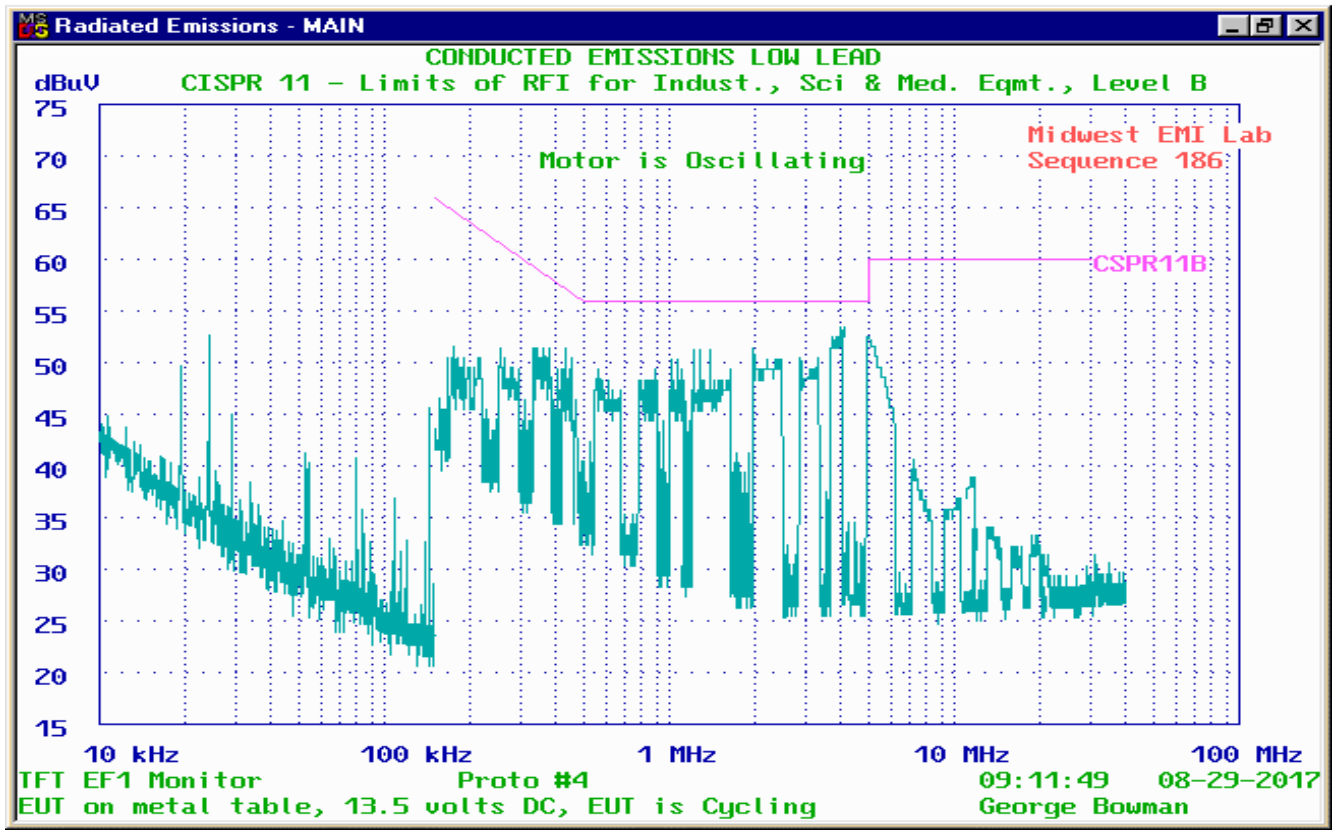


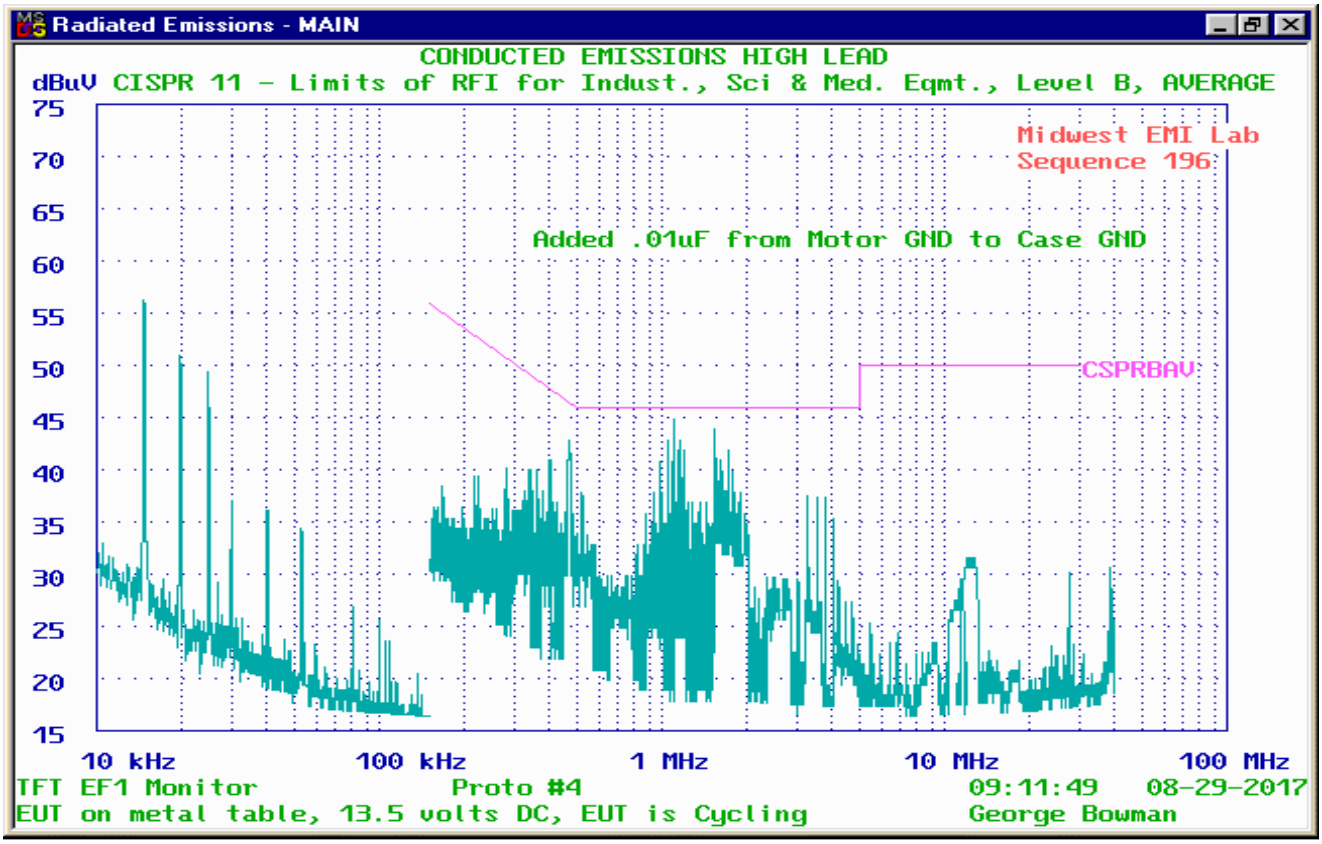


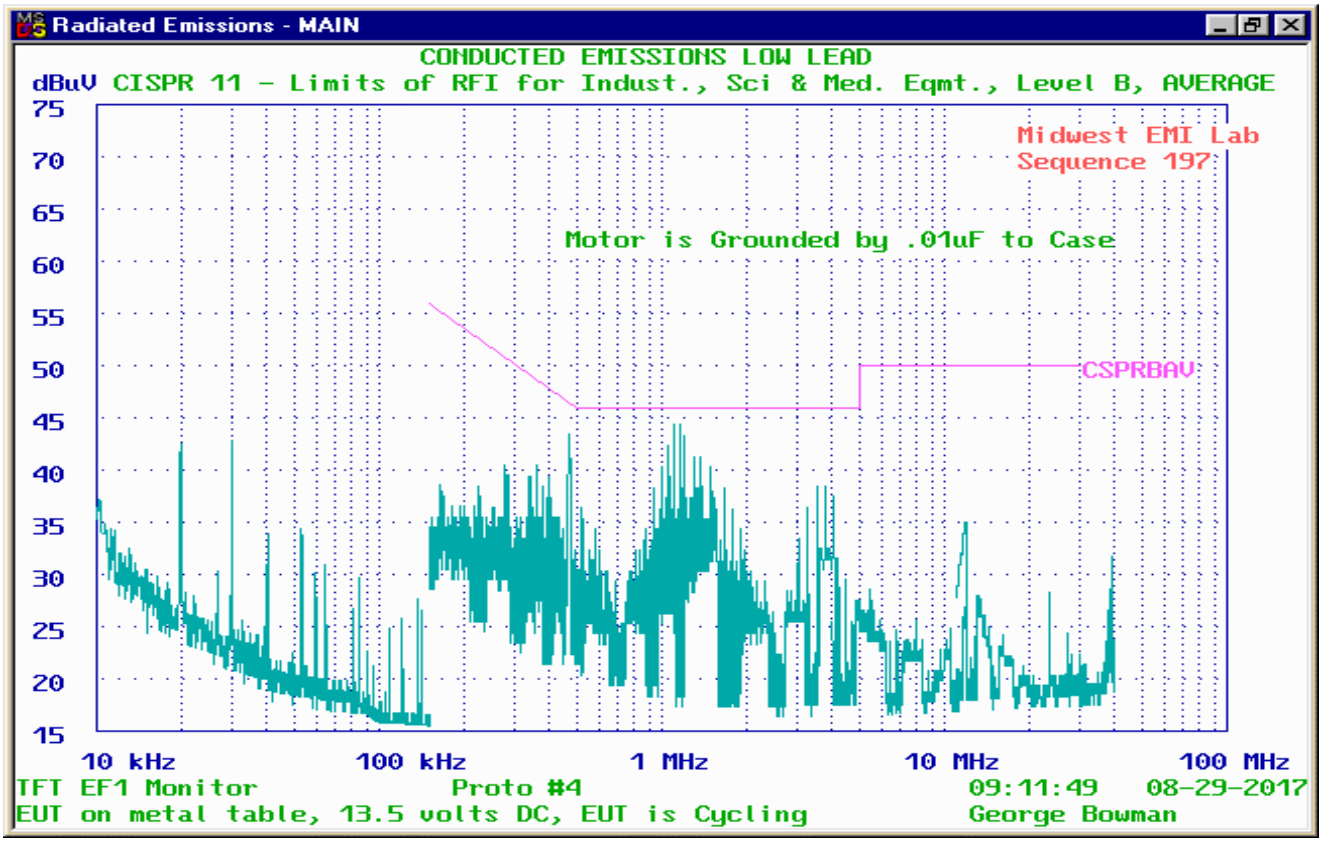
4.0 CONCLUSION OF RADIO FREQUENCY INTERFERENCE EMISSIONS TESTS:

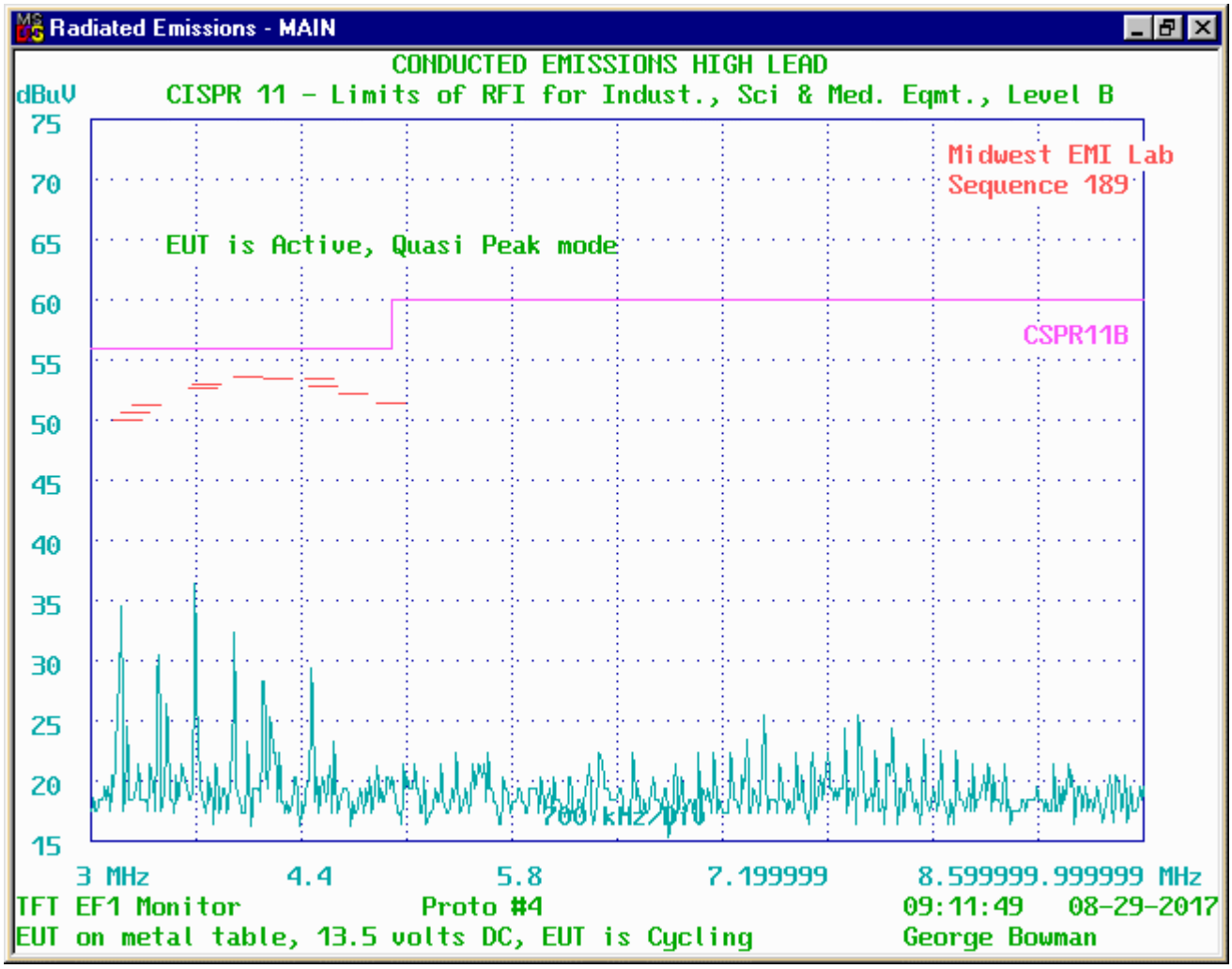
The TASK FORCE TIPS MONITOR EF1 was tested for conducted emissions and was found to pass the test to Cispr 11 B level using 12 or 24 V DC power. Peak, quasipeak and average limits are shown in successive graphs, line and neutral. The operator panel was grounded and motor negative lead was grounded by a .01 uF to case.


Radiated Emissions - MAIN
CONDUCTED EMISSIONS HIGH LEAD
dBuV
CISPR 11 - Limits of RFI for Indust., Sci & Med. Eqmt., Level B
75
70
65
60
55
50
45
40
35
30
25
20
15
EUT Motor is Oscillating
Midwest EMI Lab
Sequence 187
CSPR11B
10 kHz
100 kHz
1 MHz
10 MHz
100 MHz
TFT EF1 Monitor
Proto #4
09:11:49
08-29-2017
EUT on metal table, 13.5 volts DC, EUT is Cycling
George Bowman


Radiated Emissions - MAIN
CONDUCTED EMISSIONS LOW LEAD
dBuV
CISPR 11 - Limits of RFI for Indust., Sci & Med. Eqmt., Level B
75
70
65
60
55
50
45
40
35
30
25
20
15
Motor is Oscillating
Midwest EMI Lab
Sequence 186
CSPR11B
10 kHz
100 kHz
1 MHz
10 MHz
100 MHz
TFT EF1 Monitor
Proto #4
09:11:49
08-29-2017
EUT on metal table, 13.5 volts DC, EUT is Cycling
George Bowman


Radiated Emissions - MAIN
CONDUCTED EMISSIONS HIGH LEAD
dBuV CISPR 11 - Limits of RFI for Indust., Sci & Med. Eqmt., Level B, AVERAGE
75
70
65
60
55
50
45
40
35
30
25
20
15
Midwest EMI Lab
Sequence 196
Added .01uF from Motor GND to Case GND
CSPRBAV
10 kHz
100 kHz
1 MHz
10 MHz
100 MHz
TFT EF1 Monitor
Proto #4
09:11:49 08-29-2017
EUT on metal table, 13.5 volts DC, EUT is Cycling
George Bowman


Radiated Emissions - MAIN
CONDUCTED EMISSIONS LOW LEAD
dBuV CISPR 11 - Limits of RFI for Indust., Sci & Med. Eqmt., Level B, AVERAGE
75
70
65
60
55
50
45
40
35
30
25
20
15
Midwest EMI Lab
Sequence 197
Motor is Grounded by .01uF to Case
CSPRBAV
10 kHz
100 kHz
1 MHz
10 MHz
100 MHz
TFT EF1 Monitor
Proto #4
09:11:49 08-29-2017
EUT on metal table, 13.5 volts DC, EUT is Cycling
George Bowman


Radiated Emissions - MAIN
CONDUCTED EMISSIONS HIGH LEAD
dBuV
CISPR 11 - Limits of RFI for Indust., Sci & Med. Eqmt., Level B
75
70
65
60
55
50
45
40
35
30
25
20
15
Midwest EMI Lab
Sequence 189
EUT is Active, Quasi Peak mode
CSPR11B
3 MHz
4.4
5.8
7.199999
8.599999.999999 MHz
TFT EF1 Monitor
Proto #4
09:11:49 08-29-2017
EUT on metal table, 13.5 volts DC, EUT is Cycling
George Bowman

SHEET 1 CSPR11B CONDUCTED QUASI-PEAK REPORT
High Lead
CISPR 11 - Limits of RFI for Indust., Sci & Med. Eqmt., Level B
TIME: 09:11:49 Midwest EMI
DATE: 08-29-2017 Associates
TEST ITEM: TFT EF1 Monitor
SERIAL NUMBER: Proto #4 Sequence Number: 189
COMMENTS: EUT on metal table, 13.5 volts DC, EUT is Cycling
TEST PERFORMED BY: George Bowman

Peak Freq. (kHz)	Peak Interfer. (dBuV)	Quasi-peak Freq. (kHz)	Quasi-peak Interfer. (dBuV)	Spec. Level (dBuV)
3262.873	51.47	3260.23	50.07	56.00
3292.634	51.86	3304.87	50.76	56.00
3375.961	52.14	3364.08	51.35	56.00
3764.44	54.57	3754.54	52.77	56.00
3784.672	54.37	3784.07	52.97	56.00
4044.954	54.52	4044.89	53.72	56.00
4242.36	54.00	4250.34	53.50	56.00
4519.462	53.41	4534.34	53.51	56.00
4545.509	53.41	4550.67	52.91	56.00
4758.606	52.82	4744.57	52.32	56.00
5003.133	51.33	4989.75	51.43	60.00

APPENDIX B1

FCC/VDE RADIATED EMISSIONS TEST

(EN55011, EN55022, EN55014)

1.0 PURPOSE:

The purpose of this test sequence is to perform compliance testing to FCC Part 15, CISPR 11 and 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 in a 1250 sq. ft. building located at Midwest EMI Associates, 21234 W. Commercial Drive, Mundelein Illinois. This site has a ceiling that is approximately 6 meters high and will accommodate the full extension of appropriate antennas for three meter tests. 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 building construction is steel frame including corrugated steel walls. The room in which the product is tested also has within it a 12.5 x 16.5 ft solid steel Lindgren enclosure. All objects are clear of the ellipse defined in ANSI for a three meter site and the floor is covered with a highly reflective aluminum covering per ANSI requirements. The dimensions of the interior of the room are approximately 27 x 36 feet. The measurement antenna was raised and lowered over a 1 to 4 meter height using a C. C. Moore AUTOMATIC mast and the EUT was rotated about a central axis located three meters from the antenna using a C. C. Moore AUTOMATIC turntable.

3.0 CONFIGURATION AND OPERATION OF TEST SAMPLE:

3.1 POWER REQUIREMENT:

The TASK FORCE TIPS MONITOR EF1 was operated in its normal mode using 12 or 24 V DC 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. This was determined to be the right side of the unit (the unit faced left of center) with the power supply closest to the antenna. For test purposes the printer was also attached and active.

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 flashing on command from a remote audio generator.

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 11, 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 3 meter compliance tests. The limits for CISPR 11 and CISPR 22 have recently been updated so that testing to 6 GHz may be necessary as discussed below:**

CE EMC LIMITS (ELECTRIC FIELDS - CISPR 11/22)

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 B level limit is not passed then the following warning is recommended to be included in the instructions for use:

WARNING

This is a Class A product. In a domestic environment this product may cause radiation interference in which case the user may be required to take adequate measures.

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

For CISPR 11 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 3 meters which reflects a 10.5 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.

ADDENDUM

By the recent actions in Cispr 22 additional testing may be required for devices with clock frequencies higher than 108 MHz. Testing of up to 2 GHz is now required for any devices having clocks between 108 and 500 MHz, testing of up to 5 GHZ is required for any devices with clocks between 500 MHz and 1000 MHz, and testing of up to 6 GHZ is required for any devices with clocks over 1 GHz. The limits are suammarized below:

Condition 1. Clocks up to 108 MHz -- NO ADDITIONAL TESTING REQUIRED

Condition 2. Clocks higher than 108 MHz, CLASS A, Test Distance 3 Meters

FREQUENCY	Average Limit	Peak Limit
1 TO 3 GHZ	56	76
3 TO 6 GHZ	60	80
See Details above for frequency testing limit		

Condition 2. Clocks higher than 108 MHz, CLASS B, Test Distance 3 Meters

FREQUENCY	Average Limit	Peak Limit
1 TO 3 GHZ	50	70
3 TO 6 GHZ	54	74
See Details above for frequency testing limit		

This product has no clocks higher than 108 MHz requiring testing higher than 1000 MHz.

4.0 CONCLUSION OF RADIO FREQENCY INTERFERENCE EMISSIONS TESTS:

Preliminary Test

This EUT is battery powered from a 12 Volt lead acid battery. There was no connection to earth ground. The EUT was originally faced to the front for testing. The highest emissions were found at a 1 meter antenna height and with an angle of 150 degrees to the left in Band 3. The Monitor EF1 was oscillating in a typical pattern during this test.

Final Results of 08-31-2017

The data for this testing follows this description. In Band 1, Seq. 649 shows the ambient and Seq. 655, shows quasipeak mode all components active. There were excess emissions found due to the ambient around 35-42 MHz not coming from the EUT. The EUT passed to A level in this range.

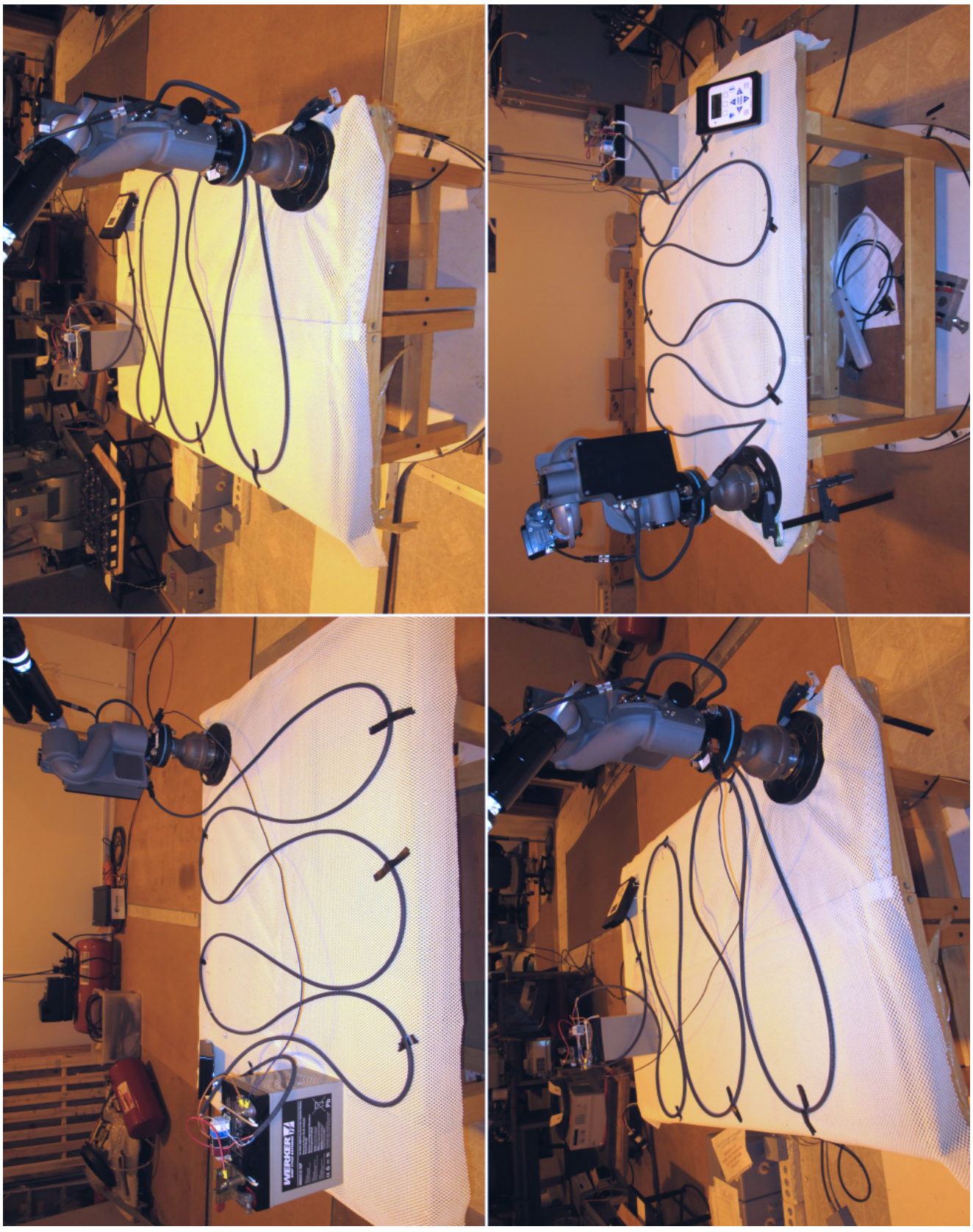
Testing in Band 2, 75-175 MHz, shows the ambient on a Seq. 650, with qpeak mode in Seq. 656. By inspection and by checking individual peaks, the EUT showed no excess emissions in this range that required further inspection. Other emissions included the FM band, weather, police and limo bands.

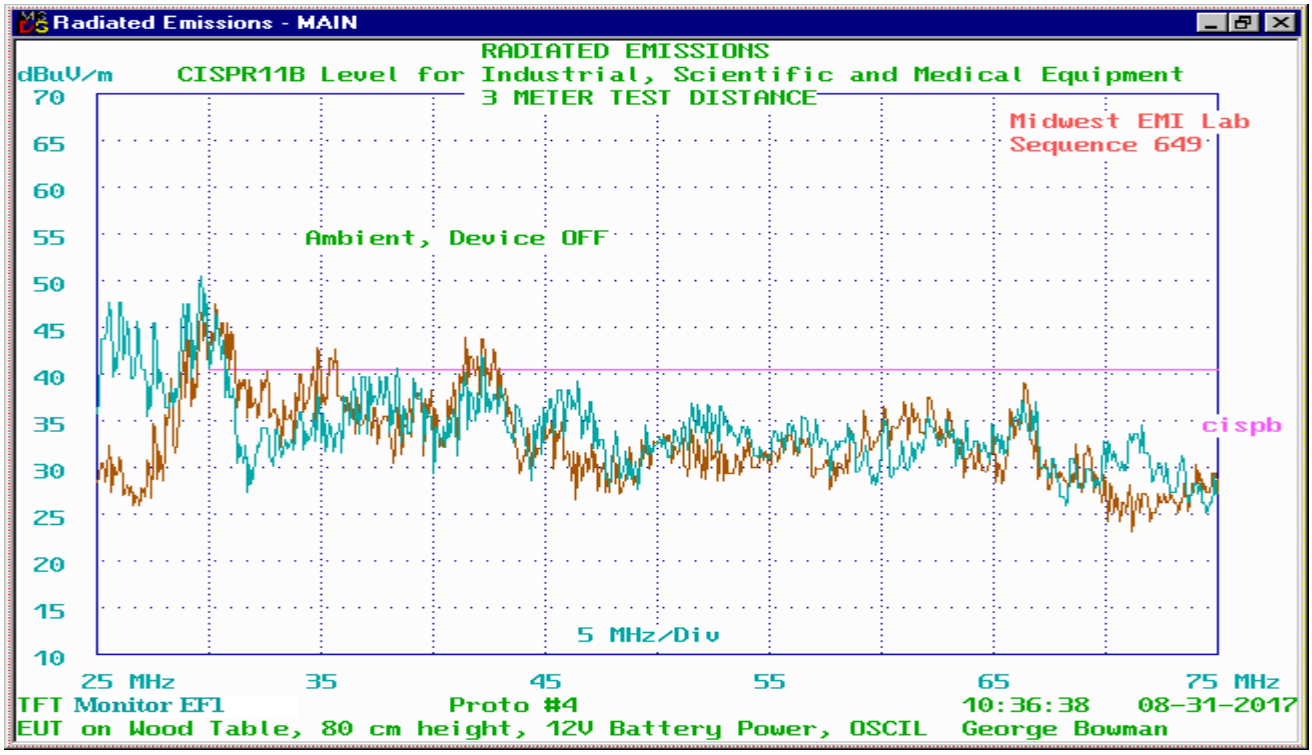
In the 170-300 MHz range, Seq. 651 shows the ambient and Seq. 657 shows the quasipeak emissions. This range required some corrections namely addition of grounding wire from the operator display console to the Battery B- Ground (which would be vehicle ground) and addition of 3x 28A0275-0A0 ferrite sleeves to the two power wires and Ethernet wires of the operator display console. The EUT was marginally compliant to B level in this range.

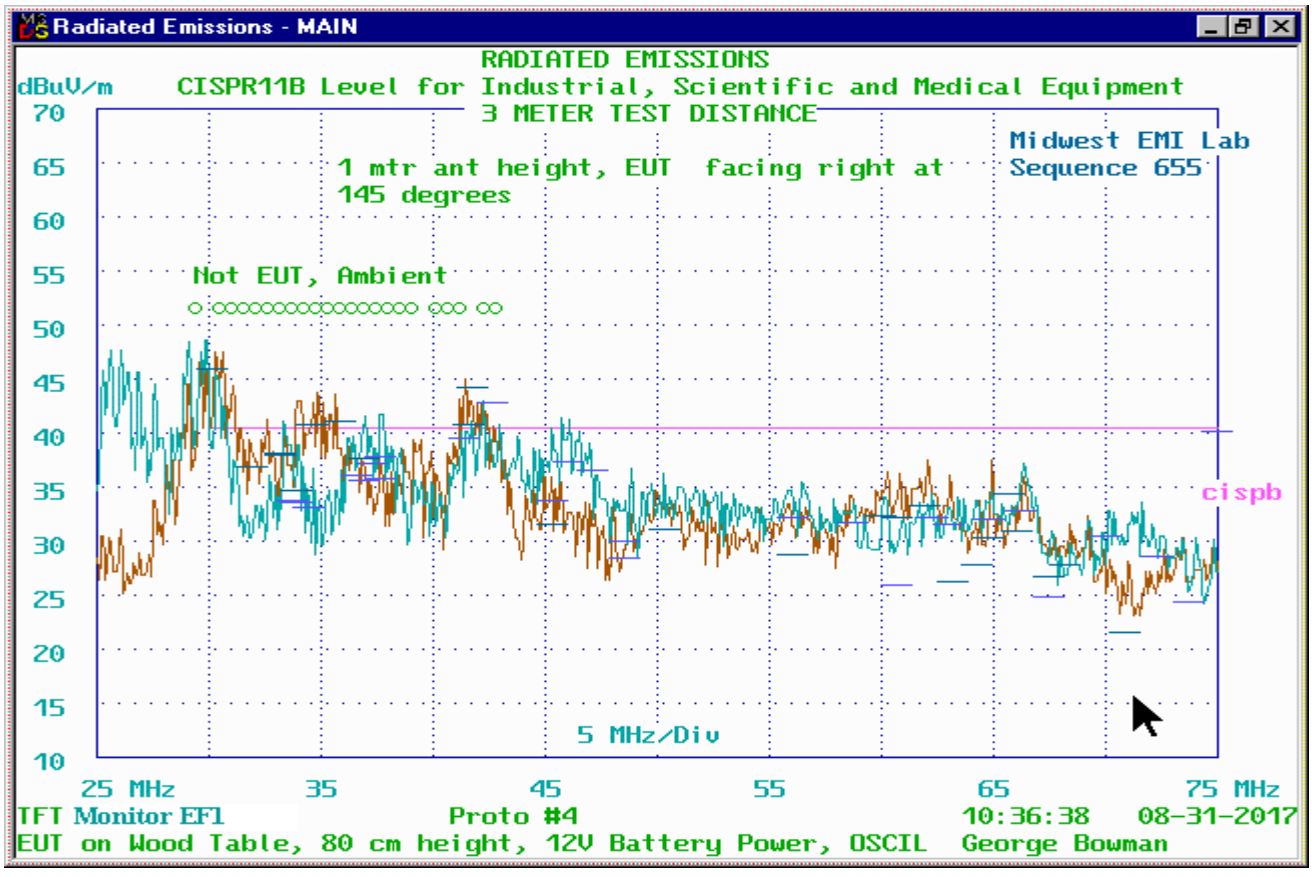
In the 300-640 MHz range, the ambient is on Seq. 652 and peak on Seq. 658. All EUT emissions were compliant with B level.

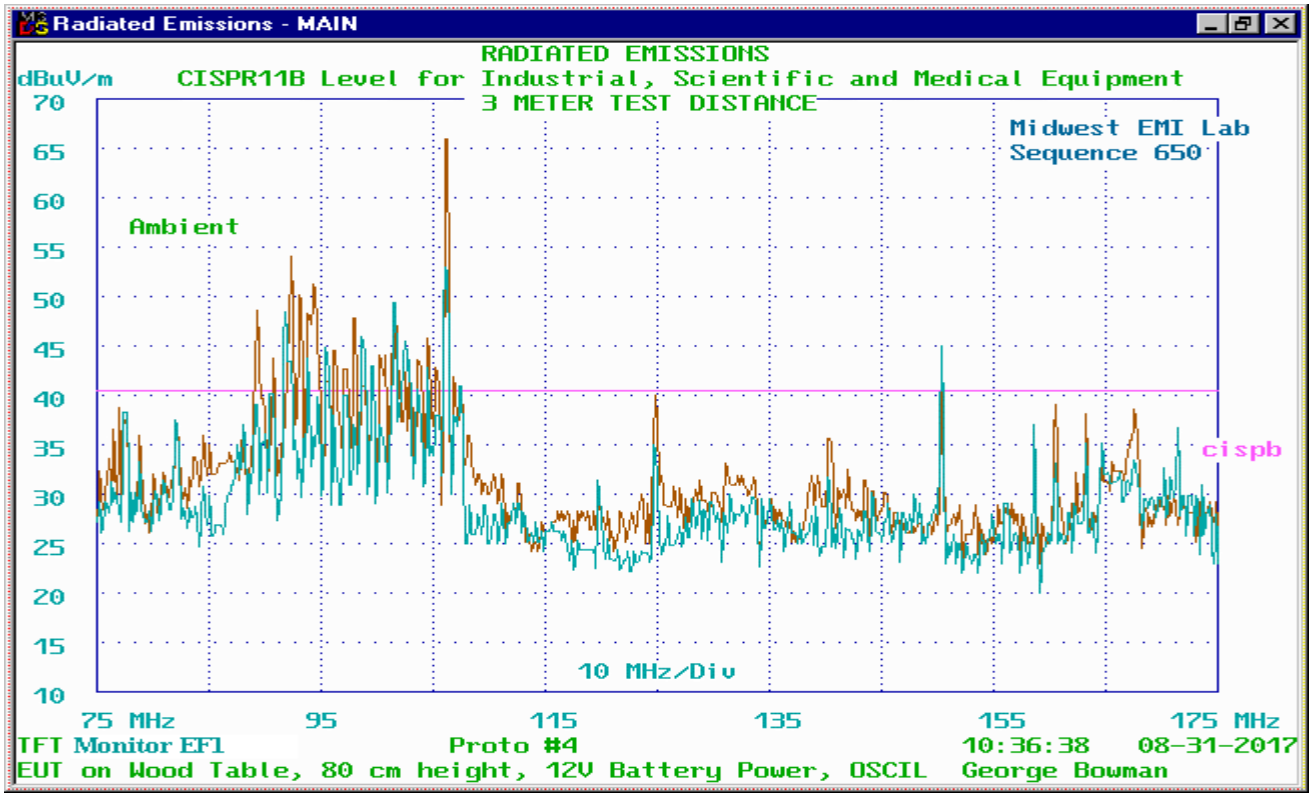
The same was true of the ambient in the 620-1000 MHz range where the ambient is shown on Seq. 653 and peak mode level shown on Seq. 659. Several UHF carriers and the cell phone band at about 900 MHz are seen. Spurious emissions were individually checked and found not to be due to the EUT.

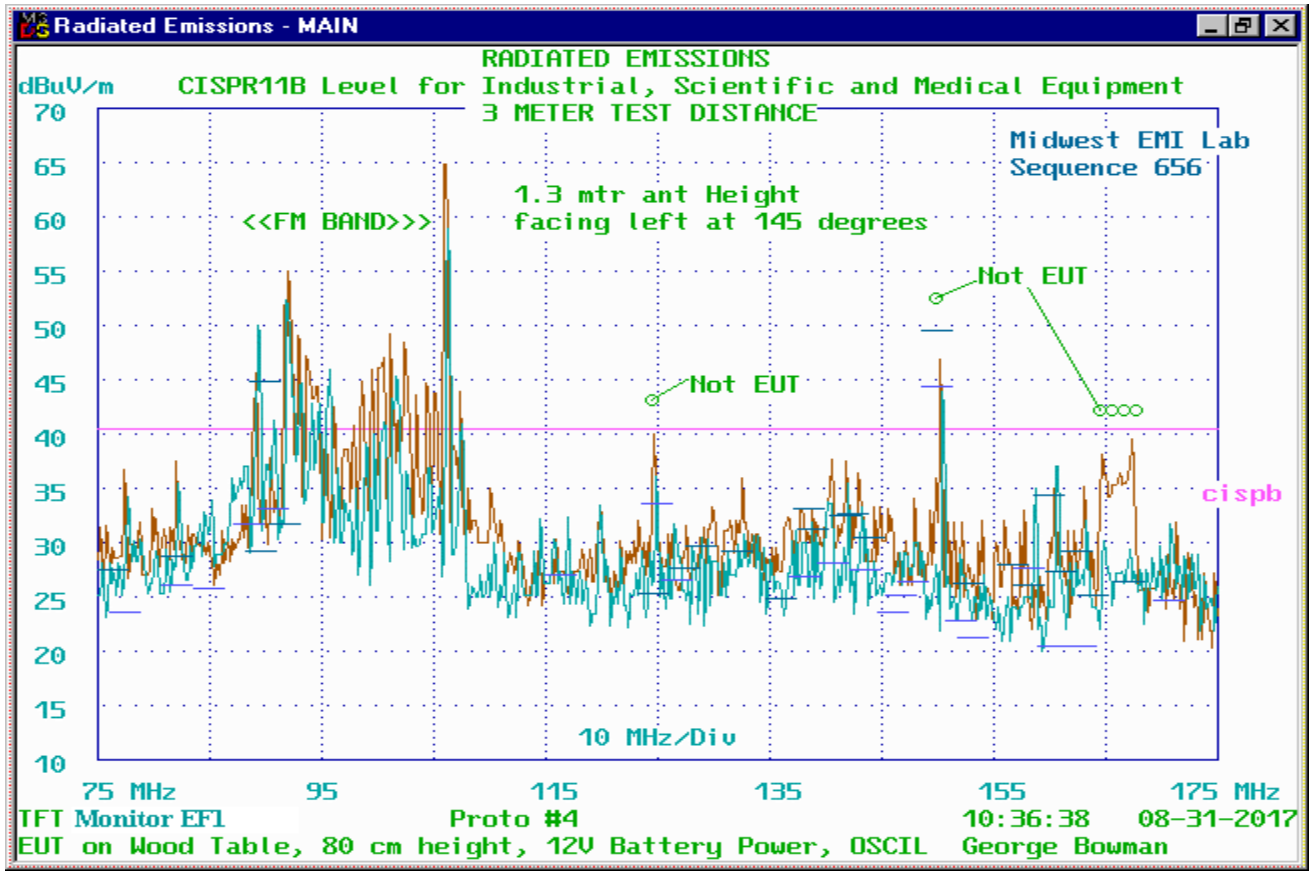
The EUT passed the Cispr 11 level B requirement.

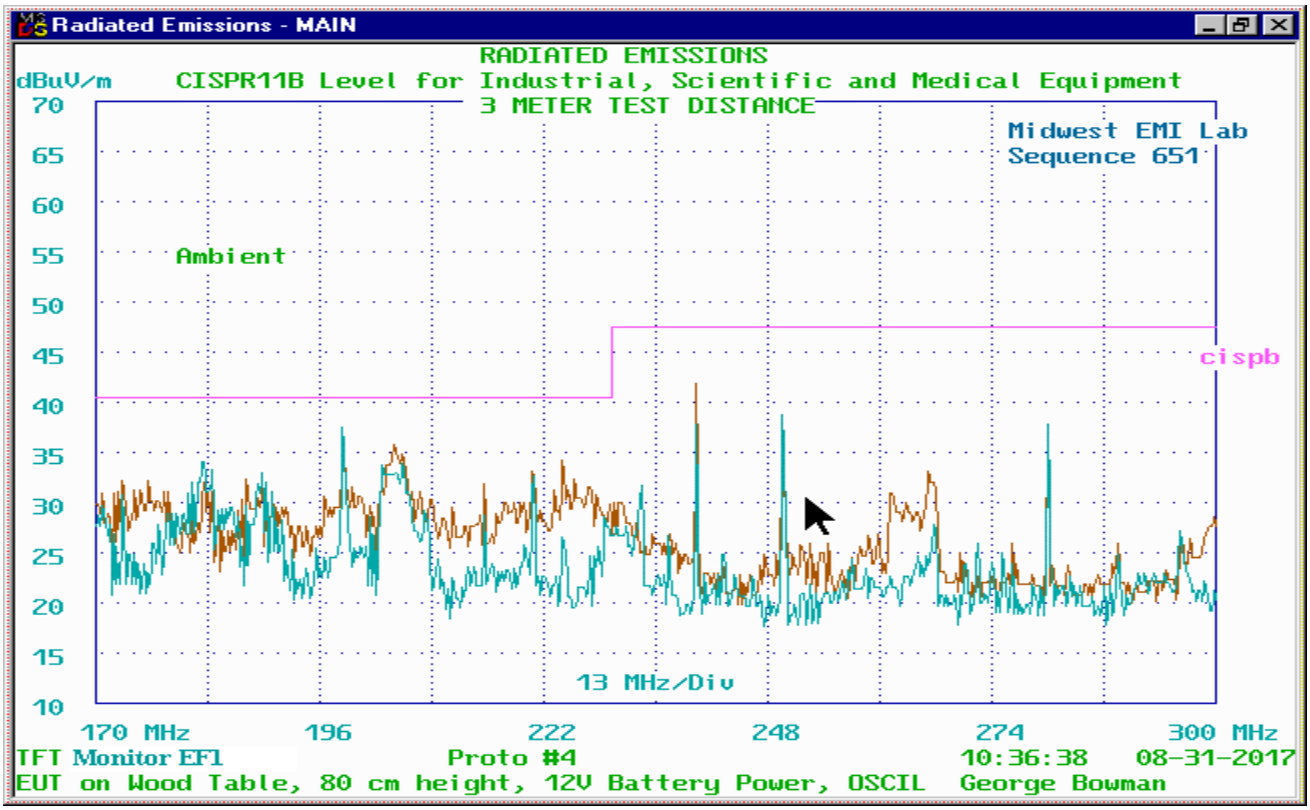

WERNER

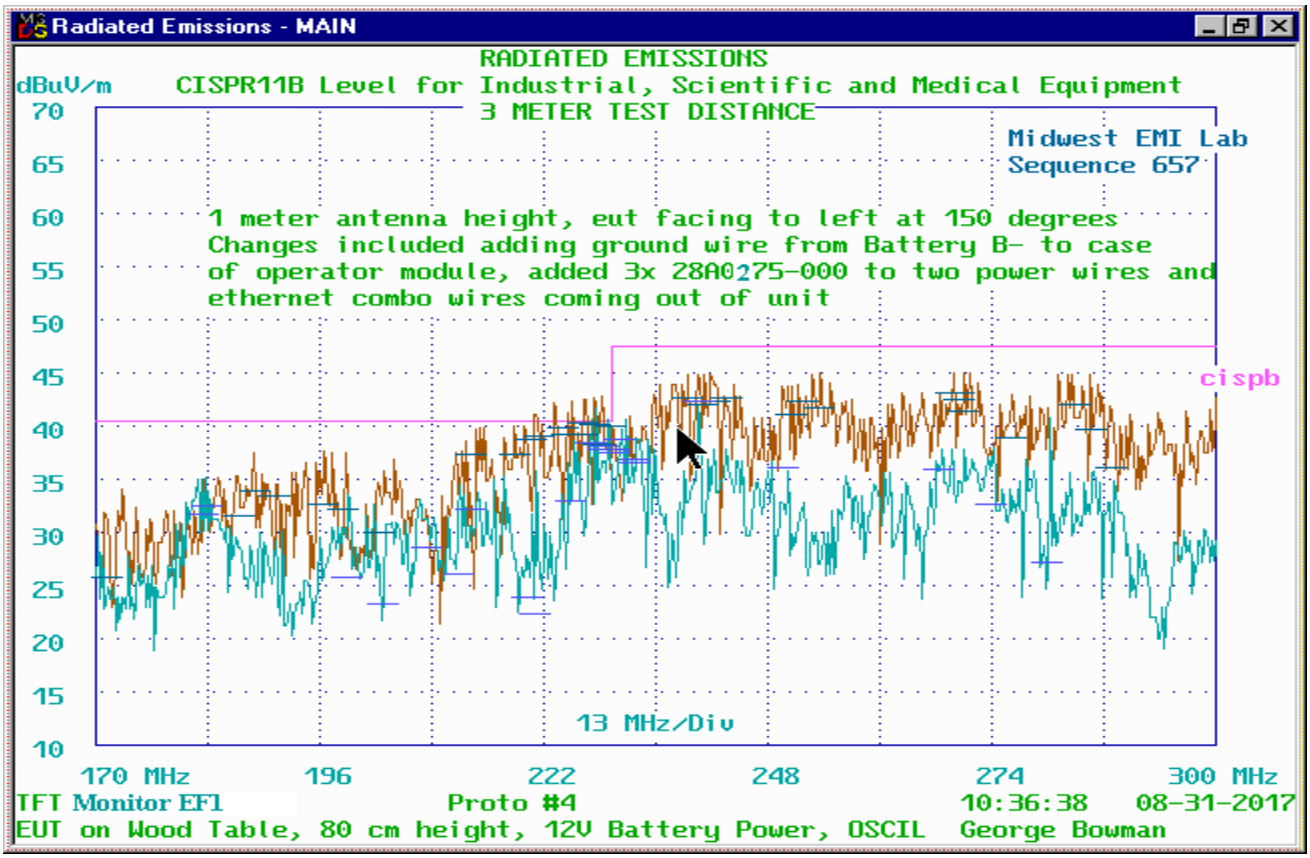

Radiated Emissions - MAIN
RADIATED EMISSIONS
dBuV/m
CISPR11B Level for Industrial, Scientific and Medical Equipment
3 METER TEST DISTANCE
Midwest EMI Lab
Sequence 649
Ambient, Device OFF
cispb
5 MHz/Div
25 MHz
35
45
55
65
75 MHz
TFT Monitor EF1
Proto #4
10:36:38
08-31-2017
EUT on Wood Table, 80 cm height, 12V Battery Power, OSCIL
George Bowman

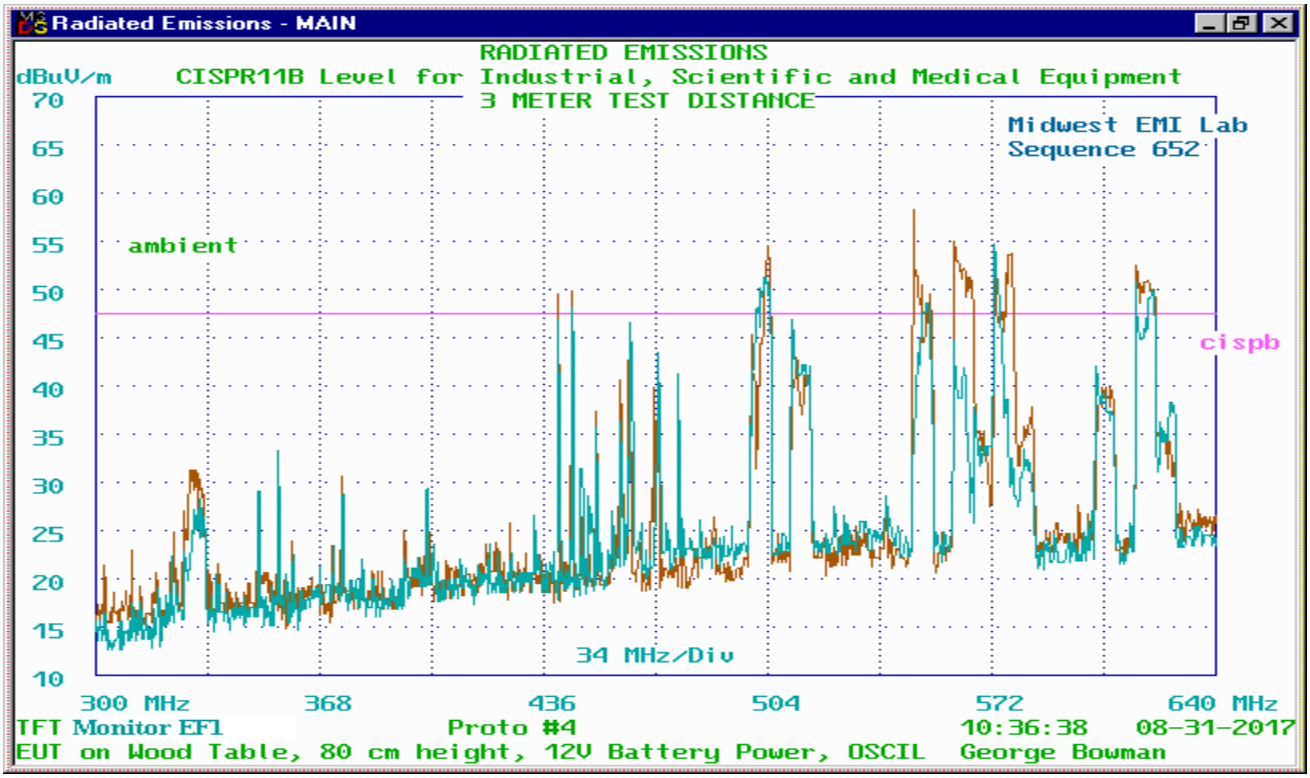

Radiated Emissions - MAIN
RADIATED EMISSIONS
dBuV/m
CISPR11B Level for Industrial, Scientific and Medical Equipment
3 METER TEST DISTANCE
Midwest EMI Lab
Sequence 655
1 mtr ant height, EUT facing right at
145 degrees
Not EUT, Ambient
cispb
5 MHz/Div
25 MHz
35
45
55
65
75 MHz
TFT Monitor EF1
Proto #4
10:36:38
08-31-2017
EUT on Wood Table, 80 cm height, 12V Battery Power, OSCIL
George Bowman

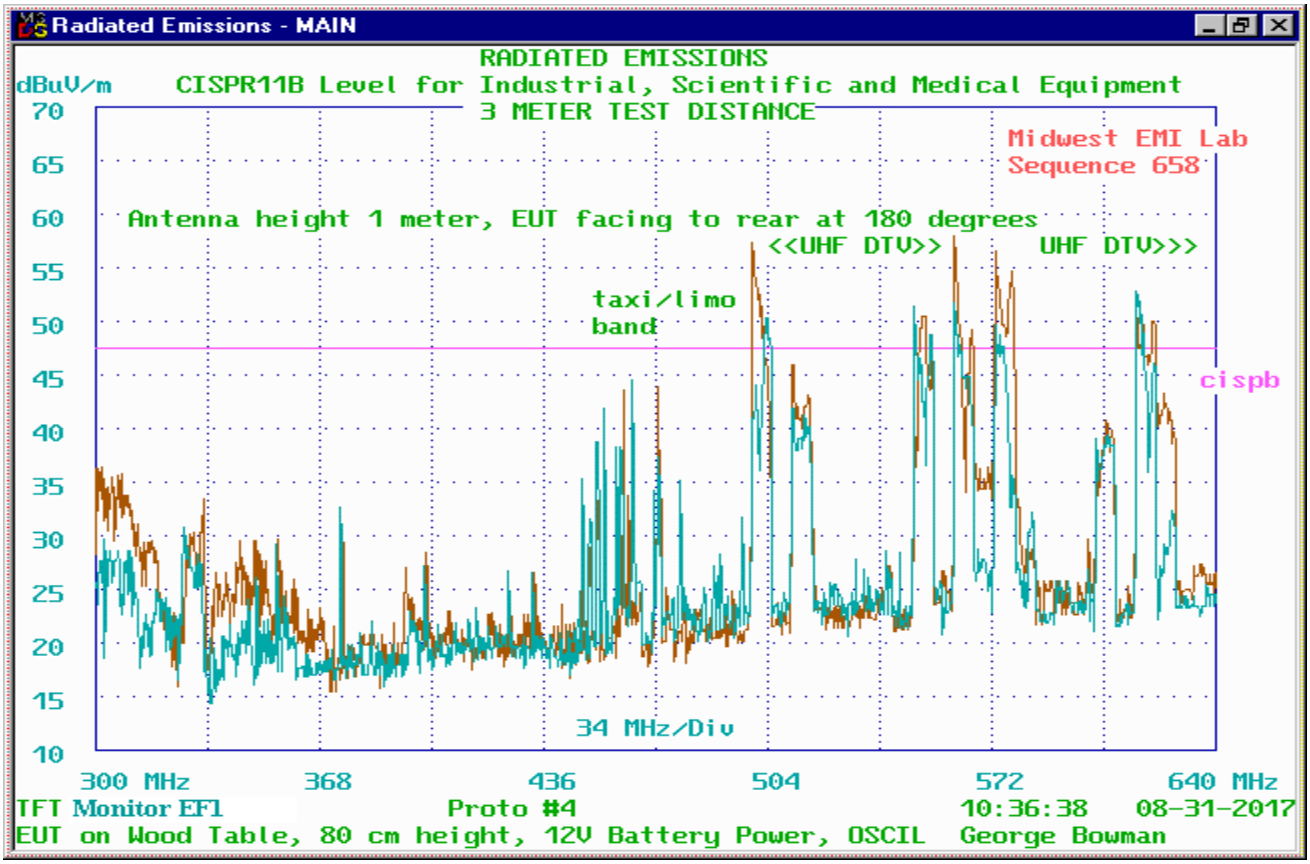

Radiated Emissions - MAIN
RADIATED EMISSIONS
dBuV/m
CISPR11B Level for Industrial, Scientific and Medical Equipment
3 METER TEST DISTANCE
Midwest EMI Lab
Sequence 650
Ambient
cispb
10 MHz/Div
75 MHz
95
115
135
155
175 MHz
TFT Monitor EF1
Proto #4
10:36:38
08-31-2017
EUT on Wood Table, 80 cm height, 12V Battery Power, OSCIL
George Bowman

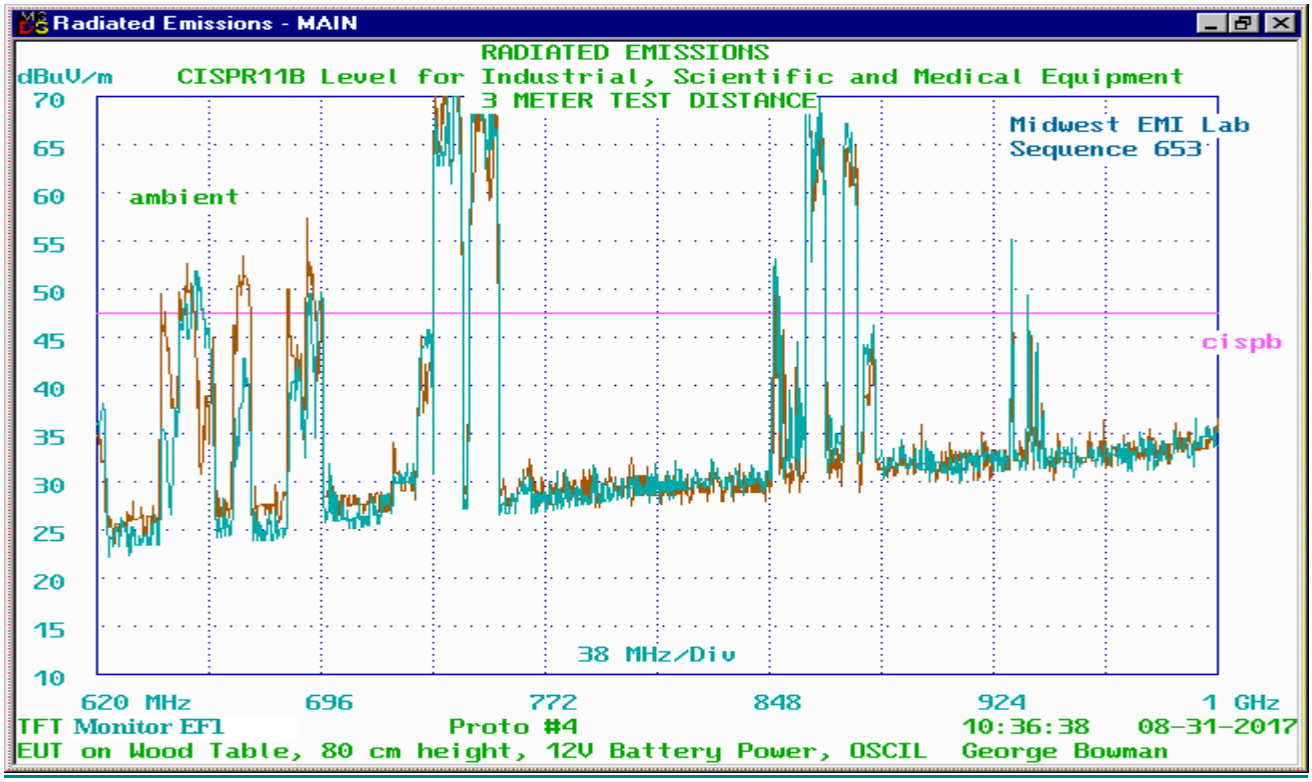

Radiated Emissions - MAIN
RADIATED EMISSIONS
dBuV/m
CISPR11B Level for Industrial, Scientific and Medical Equipment
3 METER TEST DISTANCE
Midwest EMI Lab
Sequence 656
1.3 mtr ant Height
facing left at 145 degrees
<<FM BAND>>>
Not EUT
Not EUT
cispb
10 MHz/Div
75 MHz
95
115
135
155
175 MHz
TFT Monitor EF1
Proto #4
10:36:38
08-31-2017
EUT on Wood Table, 80 cm height, 12V Battery Power, OSCIL
George Bowman

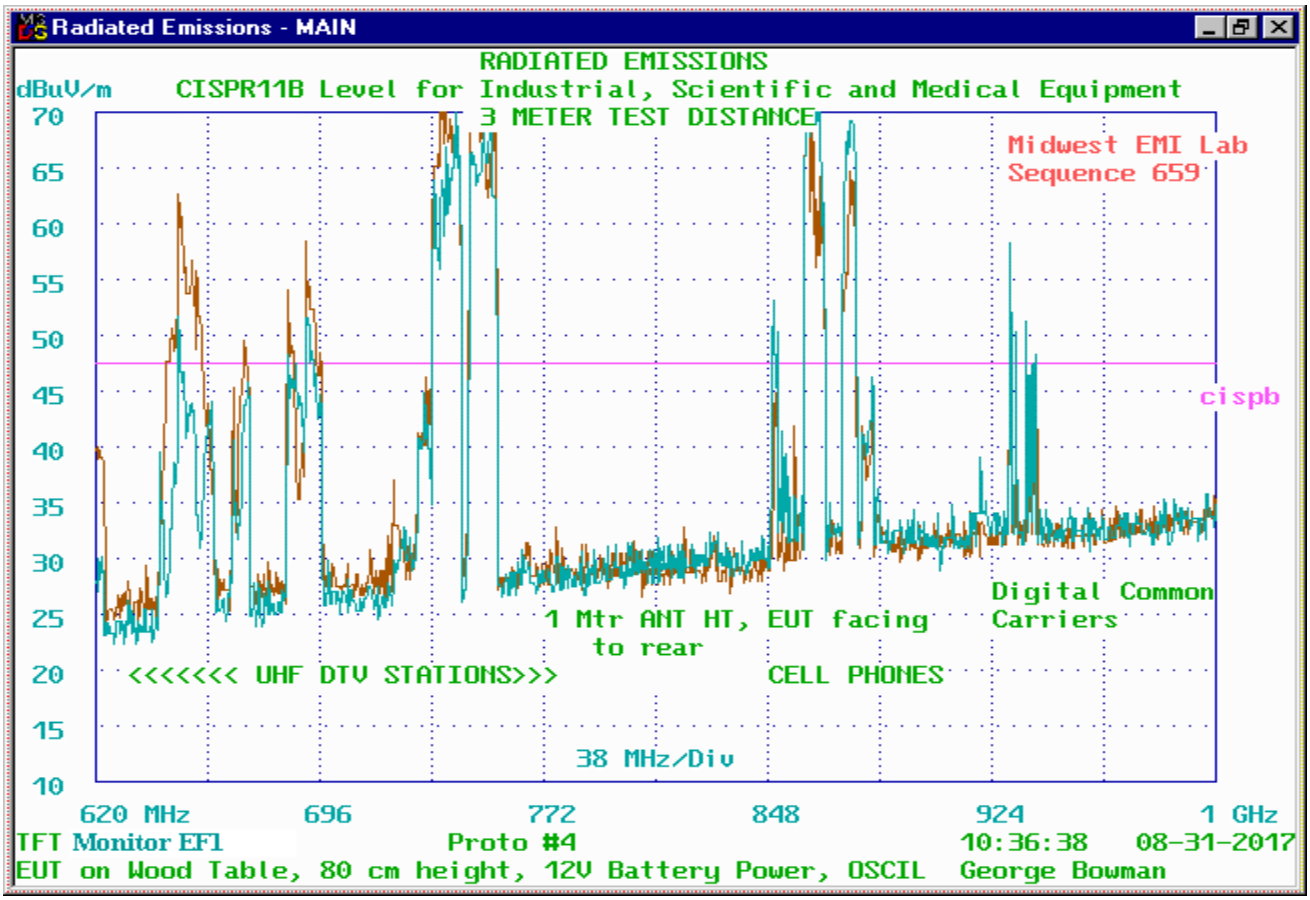

Radiated Emissions - MAIN
RADIATED EMISSIONS
dBuV/m
CISPR11B Level for Industrial, Scientific and Medical Equipment
3 METER TEST DISTANCE
Midwest EMI Lab
Sequence 651
Ambient
cispb
70
65
60
55
50
45
40
35
30
25
20
15
10
13 MHz/Div
170 MHz
196
222
248
274
300 MHz
TFT Monitor EF1
Proto #4
10:36:38
08-31-2017
EUT on Wood Table, 80 cm height, 12V Battery Power, OSCIL
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 657
1 meter antenna height, eut facing to left at 150 degrees
Changes included adding ground wire from Battery B- to case
of operator module, added 3x 28A0275-000 to two power wires and
ethernet combo wires coming out of unit
cispb
70
65
60
55
50
45
40
35
30
25
20
15
10
13 MHz/Div
170 MHz
196
222
248
274
300 MHz
TFT Monitor EF1
Proto #4
10:36:38
08-31-2017
EUT on Wood Table, 80 cm height, 12V Battery Power, OSCIL
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 652
ambient
cispb
70
65
60
55
50
45
40
35
30
25
20
15
10
34 MHz/Div
300 MHz
368
436
504
572
640 MHz
TFT Monitor EF1
Proto #4
10:36:38
08-31-2017
EUT on Wood Table, 80 cm height, 12V Battery Power, OSCIL
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 658
Antenna height 1 meter, EUT facing to rear at 180 degrees
<<UHF DTV>>
UHF DTV>>>
taxi/limo
band
cispb
70
65
60
55
50
45
40
35
30
25
20
15
10
34 MHz/Div
300 MHz
368
436
504
572
640 MHz
TFT Monitor EF1
Proto #4
10:36:38
08-31-2017
EUT on Wood Table, 80 cm height, 12V Battery Power, OSCIL
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 653
ambient
cispb
70
65
60
55
50
45
40
35
30
25
20
15
10
38 MHz/Div
620 MHz
696
772
848
924
1 GHz
TFT Monitor EF1
Proto #4
10:36:38
08-31-2017
EUT on Wood Table, 80 cm height, 12V Battery Power, OSCIL
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 659
cispb
70
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10
1 Mtr ANT HT, EUT facing
to rear
Digital Common
Carriers
<<<<<<< UHF DTV STATIONS>>>
CELL PHONES
38 MHz/Div
620 MHz
696
772
848
924
1 GHz
TFT Monitor EF1
Proto #4
10:36:38
08-31-2017
EUT on Wood Table, 80 cm height, 12V Battery Power, OSCIL
George Bowman

SHEET 1 **cispb RADIATED QUASI-PEAK REPORT**
CISPR11B Level for Industrial, Scientific and Medical Equipment
3 METER TEST DISTANCE
TIME: 10:36:38 **Midwest EMI**
DATE: 08-31-2017 **Associates**
TEST ITEM: TFT
SERIAL NUMBER: Proto #4 **Sequence Number: 655**
COMMENTS: EUT on Wood Table, 80 cm height, 12V Battery Power, OSCIL
TEST PERFORMED BY: George Bowman

Peak Frequency (MHz)	Peak Interference (dBuV/m)	Quasi-peak Freq. (MHz)	Quasi-peak Interfer (dBuV/m)	Spec. Level (dBuV/m)		Antenna Polar (H/V)
30.341	49.609	30.2234	46.014	40.500	*	Horizontal
32.17442	44.562	31.9752	36.943	40.500		Horizontal
33.03133	47.023	33.1953	38.268	40.500		Horizontal
33.33055	50.804	33.1906	37.969	40.500		Horizontal
34.06916	50.421	33.9364	34.813	40.500		Horizontal
34.79324	47.884	34.6812	40.936	40.500	*	Horizontal
35.80762	46.433	35.9132	41.168	40.500	*	Horizontal
37.05656	44.395	36.899	37.705	40.500		Horizontal
41.6014	46.808	41.6022	40.827	40.500	*	Horizontal
41.9685	45.293	41.8573	44.358	40.500	*	Horizontal
45.09665	36.709	45.2967	31.696	40.500		Horizontal
50.09426	36.397	50.2879	31.161	40.500		Horizontal
56.15714	35.919	55.9963	28.761	40.500		Horizontal
59.96199	38.810	60.0332	32.492	40.500		Horizontal
60.58635	37.138	60.788	32.192	40.500		Horizontal
61.78849	49.621	61.9813	33.379	40.500		Horizontal
63.44219	36.988	63.2478	26.308	40.500		Horizontal
64.00216	37.895	64.203	27.858	40.500		Horizontal
64.09842	38.124	64.21680	27.854	40.500		Horizontal
64.63468	37.050	64.7987	30.350	40.500		Horizontal
65.45742	35.612	65.6566	34.456	40.500		Horizontal
65.96286	38.041	65.9901	30.943	40.500		Horizontal
66.02088	38.474	66.21769	32.868	40.500		Horizontal
67.65272	32.378	67.4999	26.800	40.500		Horizontal
68.21982	33.506	68.2406	27.939	40.500		Horizontal
70.87187	38.594	70.8583	21.596	40.500		Horizontal
33.55949	50.425	33.7043	33.753	40.500		Vertical
33.84711	48.053	33.9303	33.712	40.500		Vertical
34.30161	42.214	34.432	33.126	40.500		Vertical
36.5495	41.116	36.6423	36.226	40.500		Vertical
36.76374	42.036	36.9029	35.736	40.500		Vertical
37.2625	41.445	37.3953	37.260	40.500		Vertical
37.48824	40.460	37.6514	37.873	40.500		Vertical
37.88943	41.470	37.6902	35.875	40.500		Vertical
41.30331	42.815	41.3449	39.627	40.500		Vertical
42.52138	43.948	42.607	42.862	40.500	*	Vertical
42.52012	42.005	42.6081	42.862	40.500	*	Vertical
46.03274	41.990	46.0535	37.479	40.500		Vertical
45.29637	41.510	45.3084	33.793	40.500		Vertical
46.16846	41.950	46.0693	37.476	40.500		Vertical
47.24851	37.305	47.0669	36.676	40.500		Vertical

SHEET 2 **cispb RADIATED QUASI-PEAK REPORT**
CISPR11B Level for Industrial, Scientific and Medical Equipment
3 METER TEST DISTANCE
TIME: 10:36:38 **Midwest EMI**
DATE: 08-31-2017 **Associates**
TEST ITEM: TF1
SERIAL NUMBER: Proto #4 **Sequence Number: 655**
COMMENTS: EUT on Wood Table, 80 cm height, 12V Battery Power, OSCIL
TEST PERFORMED BY: George Bowman

Peak Frequency (MHz)	Peak Interference (dBuV/m)	Quasi-peak Freq. (MHz)	Quasi-peak Interfer (dBuV/m)	Spec. Level (dBuV/m)	Antenna Polar (H/V)
48.42982	40.656	48.4874	28.562	40.500	Vertical
48.43359	35.359	48.5736	30.142	40.500	Vertical
55.79432	37.173	55.9855	32.205	40.500	Vertical
58.521	36.717	58.7114	31.776	40.500	Vertical
60.55293	38.256	60.6865	25.993	40.500	Vertical
62.0861	37.043	62.2381	32.191	40.500	Vertical
62.885	36.599	63.0346	31.660	40.500	Vertical
64.74462	37.640	64.8014	32.039	40.500	Vertical
66.09142	41.290	66.23860	32.908	40.500	Vertical
67.61556	31.632	67.5108	24.939	40.500	Vertical
70.02128	34.156	70.0133	30.568	40.500	Vertical
72.22543	33.248	72.39579	28.748	40.500	Vertical
73.67641	29.571	73.81399	24.380	40.500	Vertical
74.88248	32.272	75.0177	40.200	40.500	Vertical

SHEET 1 **cispb RADIATED QUASI-PEAK REPORT**
CISPR11B Level for Industrial, Scientific and Medical Equipment
3 METER TEST DISTANCE
TIME: 10:36:38 **Midwest EMI**
DATE: 08-31-2017 **Associates**
TEST ITEM: TFT
SERIAL NUMBER: Proto #4 **Sequence Number: 656**
COMMENTS: EUT on Wood Table, 80 cm height, 12V Battery Power, OSCIL
TEST PERFORMED BY: George Bowman

Peak Frequency (MHz)	Peak Interference (dBuV/m)	Quasi-peak Freq. (MHz)	Quasi-peak Interfer (dBuV/m)	Level (dBuV/m)	Spec.	Antenna Polar (H/V)
76.60357	38.731	76.5772	27.612	40.500		Horizontal
82.000	39.158	82.0472	28.867	40.500		Horizontal
89.56319	46.891	89.6752	29.292	40.500		Horizontal
90.10004	41.192	90.1344	44.857	40.500	*	Horizontal
92.000	55.396	91.9192	31.786	40.500		Horizontal
124.6	40.374	124.7704	25.459	40.500		Horizontal
127.2343	39.107	127.4311	27.686	40.500		Horizontal
128.8	40.790	128.8448	29.784	40.500		Horizontal
132.2	38.331	132.2368	29.226	40.500		Horizontal
135.9925	38.827	136.0725	24.879	40.500		Horizontal
138.6215	40.738	138.6527	33.224	40.500		Horizontal
139.2	41.229	139.0024	31.263	40.500		Horizontal
141.6	40.931	141.744	32.517	40.500		Horizontal
142.6	40.833	142.4024	32.752	40.500		Horizontal
143.8	39.616	143.8616	30.510	40.500		Horizontal
150	50.630	150.0024	49.630	40.500	*	Horizontal
152.9092	36.360	152.8708	26.359	40.500		Horizontal
156.5714	36.088	156.7066	27.990	40.500		Horizontal
158.4	36.100	158.22	26.099	40.500		Horizontal
160.0066	38.019	160.021	34.411	40.500		Horizontal
161.4	35.169	161.2048	27.461	40.500		Horizontal
162.8	36.928	162.6008	29.220	40.500		Horizontal
163.6862	39.895	163.8878	25.274	40.500		Horizontal
167.2	41.177	167.0016	26.554	40.500		Horizontal
77.59999	36.513	77.444	23.610	40.500		Vertical
85.03659	36.477	84.9118	25.811	40.500		Vertical
81.99151	37.216	82.0587	26.201	40.500		Vertical
88.42156	38.708	88.5176	31.726	40.500		Vertical
90.59999	44.207	90.72239	33.227	40.500		Vertical
116.6	37.095	116.4056	27.086	40.500		Vertical
124.8	36.846	125	33.630	40.500		Vertical
126.5888	34.308	126.6344	26.572	40.500		Vertical
138.2	37.660	138.2424	26.954	40.500		Vertical
140.6	37.623	140.6256	28.220	40.500		Vertical
143.5895	34.948	143.4503	27.608	40.500		Vertical
146.2	38.191	146.0664	23.597	40.500		Vertical
146.6446	41.775	146.6998	25.171	40.500		Vertical
147.6309	37.435	147.7173	26.430	40.500		Vertical
150.2	44.242	150.0072	44.440	40.500	*	Vertical
152	32.056	152.2	22.958	40.500		Vertical
153.2	36.966	153.3568	21.367	40.500		Vertical

SHEET 2 **cispb RADIATED QUASI-PEAK REPORT**
CISPR11B Level for Industrial, Scientific and Medical Equipment
3 METER TEST DISTANCE
TIME: 10:36:38 **Midwest EMI**
DATE: 08-31-2017 **Associates**
TEST ITEM: TFT
SERIAL NUMBER: Proto #4 **Sequence Number: 656**
COMMENTS: EUT on Wood Table, 80 cm height, 12V Battery Power, OSCIL
TEST PERFORMED BY: George Bowman

Peak Frequency (MHz)	Peak Interference (dBuV/m)	Quasi-peak Freq. (MHz)	Quasi-peak Interfer (dBuV/m)	Spec. Level (dBuV/m)	Antenna Polar (H/V)
158.3198	*37.445*	*158.1694*	*27.737*	*40.500*	*Vertical*
160.4	*39.172*	*160.2728*	*20.572*	*40.500*	*Vertical*
163	*34.788*	*162.8144*	*20.487*	*40.500*	*Vertical*
170.6	*34.538*	*170.6344*	*24.840*	*40.500*	*Vertical*

SHEET 1 **cispb RADIATED QUASI-PEAK REPORT**
CISPR11B Level for Industrial, Scientific and Medical Equipment
3 METER TEST DISTANCE
TIME: 10:36:38 **Midwest EMI**
DATE: 08-31-2017 **Associates**
TEST ITEM: TFT
SERIAL NUMBER: Proto #4 **Sequence Number: 657**
COMMENTS: EUT on Wood Table, 80 cm height, 12V Battery Power, OSCIL
TEST PERFORMED BY: George Bowman

Peak Frequency (MHz)	Peak Interference (dBuV/m)	Quasi-peak Freq. (MHz)	Quasi-peak Interfer (dBuV/m)	Spec. Level (dBuV/m)	Antenna Polar (H/V)
171.3	53.231	171.4992	25.851	40.500	Horizontal
186.9	39.306	186.7768	31.595	40.500	Horizontal
188.5	38.553	188.484	34.052	40.500	Horizontal
190.598	38.693	190.698	33.494	40.500	Horizontal
196.3	38.294	196.2984	32.694	40.500	Horizontal
198.9	38.242	198.9568	32.341	40.500	Horizontal
203	38.801	203.0832	30.106	40.500	Horizontal
213.8062	41.617	213.7702	37.423	40.500	Horizontal
218.9	41.625	218.9216	37.427	40.500	Horizontal
220.7687	41.399	220.5815	38.807	40.500	Horizontal
221.7	42.059	221.708	39.159	40.500	Horizontal
224.3767	42.832	224.5455	39.989	40.500	Horizontal
224.6	42.492	224.8008	39.301	40.500	Horizontal
226.6937	42.288	226.7785	39.239	40.500	Horizontal
226.9	42.755	226.8376	40.447	40.500	Horizontal
228	43.896	227.9384	40.288	40.500	Horizontal
228.8	43.998	228.6016	38.372	40.500	Horizontal
229.5	41.587	229.6672	40.008	40.500	Horizontal
238.9	45.318	238.7288	42.717	47.500	Horizontal
243.3	44.980	243.1984	42.681	47.500	Horizontal
241.8	44.998	241.9584	42.396	47.500	Horizontal
240.3103	45.014	240.3775	42.115	47.500	Horizontal
252.4	45.275	252.2576	42.368	47.500	Horizontal
251.1	42.108	250.9624	41.100	47.500	Horizontal
254	45.358	254.1496	41.766	47.500	Horizontal
269.283	44.270	269.2398	43.245	47.500	Horizontal
270.3378	45.548	270.3426	43.227	47.500	Horizontal
270.1	45.529	270.156	42.628	47.500	Horizontal
270.7318	46.421	270.7934	41.522	47.500	Horizontal
276.3	42.622	276.432	39.017	47.500	Horizontal
283.655	43.385	283.7342	42.090	47.500	Horizontal
285.8199	44.744	285.7279	39.832	47.500	Horizontal
287.9912	43.246	287.8136	36.224	47.500	Horizontal
182.2	35.668	182.3576	31.786	40.500	Vertical
182.7	36.724	182.896	32.546	40.500	Vertical
199.1	36.521	199.1448	25.822	40.500	Vertical
203.3248	34.498	203.5152	23.298	40.500	Vertical
208.6271	35.611	208.7607	28.687	40.500	Vertical
211.9	36.936	212.0992	26.249	40.500	Vertical
213.6606	36.722	213.8142	32.262	40.500	Vertical
219.9	42.140	220.0224	23.959	40.500	Vertical

SHEET 2 **cispb RADIATED QUASI-PEAK REPORT**
CISPR11B Level for Industrial, Scientific and Medical Equipment
3 METER TEST DISTANCE
TIME: 10:36:38 **Midwest EMI**
DATE: 08-31-2017 **Associates**
TEST ITEM: TFT Monitor
SERIAL NUMBER: Proto #4 **Sequence Number: 657**
COMMENTS: EUT on Wood Table, 80 cm height, 12V Battery Power, OSCIL
TEST PERFORMED BY: George Bowman

Peak Frequency (MHz)	Peak Interference (dBuV/m)	Quasi-peak Freq. (MHz)	Quasi-peak Interfer (dBuV/m)	Spec. Level (dBuV/m)	Antenna Polar (H/V)
221	39.328	221.1672	22.422	40.500	Vertical
225.4	39.806	225.2272	33.104	40.500	Vertical
229.1007	41.123	229.1231	37.966	40.500	Vertical
227.5	39.840	227.428	38.539	40.500	Vertical
229.2381	41.756	229.0773	38.165	40.500	Vertical
230.2621	42.069	230.4237	37.885	47.500	Vertical
230.1	42.481	230.2336	37.583	47.500	Vertical
230.8	42.490	230.776	38.889	47.500	Vertical
232.603	40.603	232.4998	36.710	47.500	Vertical
232.7	40.913	232.884	37.015	47.500	Vertical
240.0296	44.281	240.0336	42.389	47.500	Vertical
250.1	39.365	250.0096	36.161	47.500	Vertical
268.2711	39.148	268.1351	35.950	47.500	Vertical
274.0333	39.626	273.8341	32.687	47.500	Vertical
280.5	43.142	280.5688	27.241	47.500	Vertical

APPENDIX C

ELECTRICAL FAST TRANSIENT/BURST TEST

(IEC 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 IEC 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 13.5 VDC 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:

IEC 61000-4-4; 2012-04 and successors 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 that makes the display unreadable
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

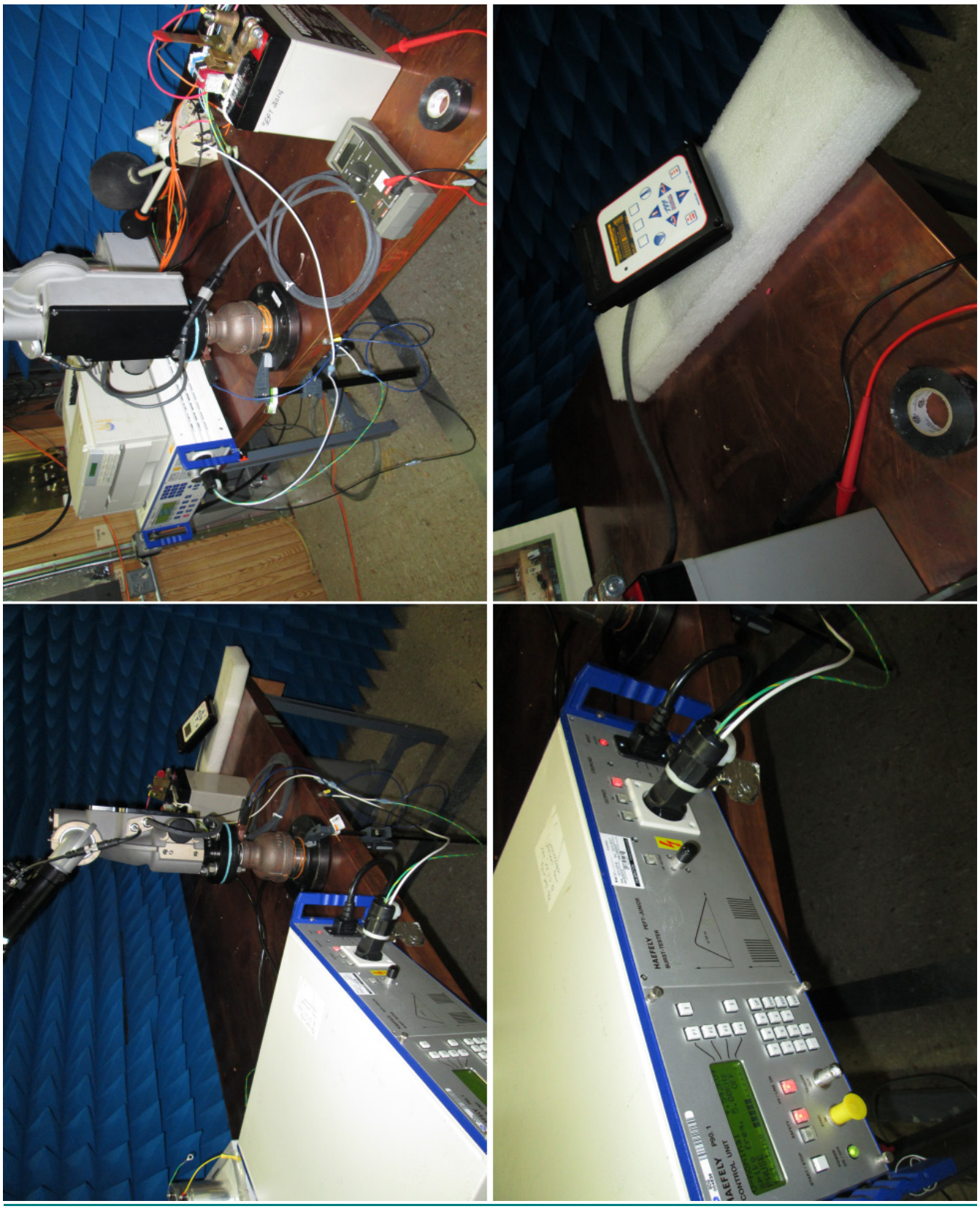
A small variation in light intensity of a display or a small variation in a displayed operating parameter in response to the applied stimulus is considered acceptable if it is within the normal operating tolerances of the instrument.

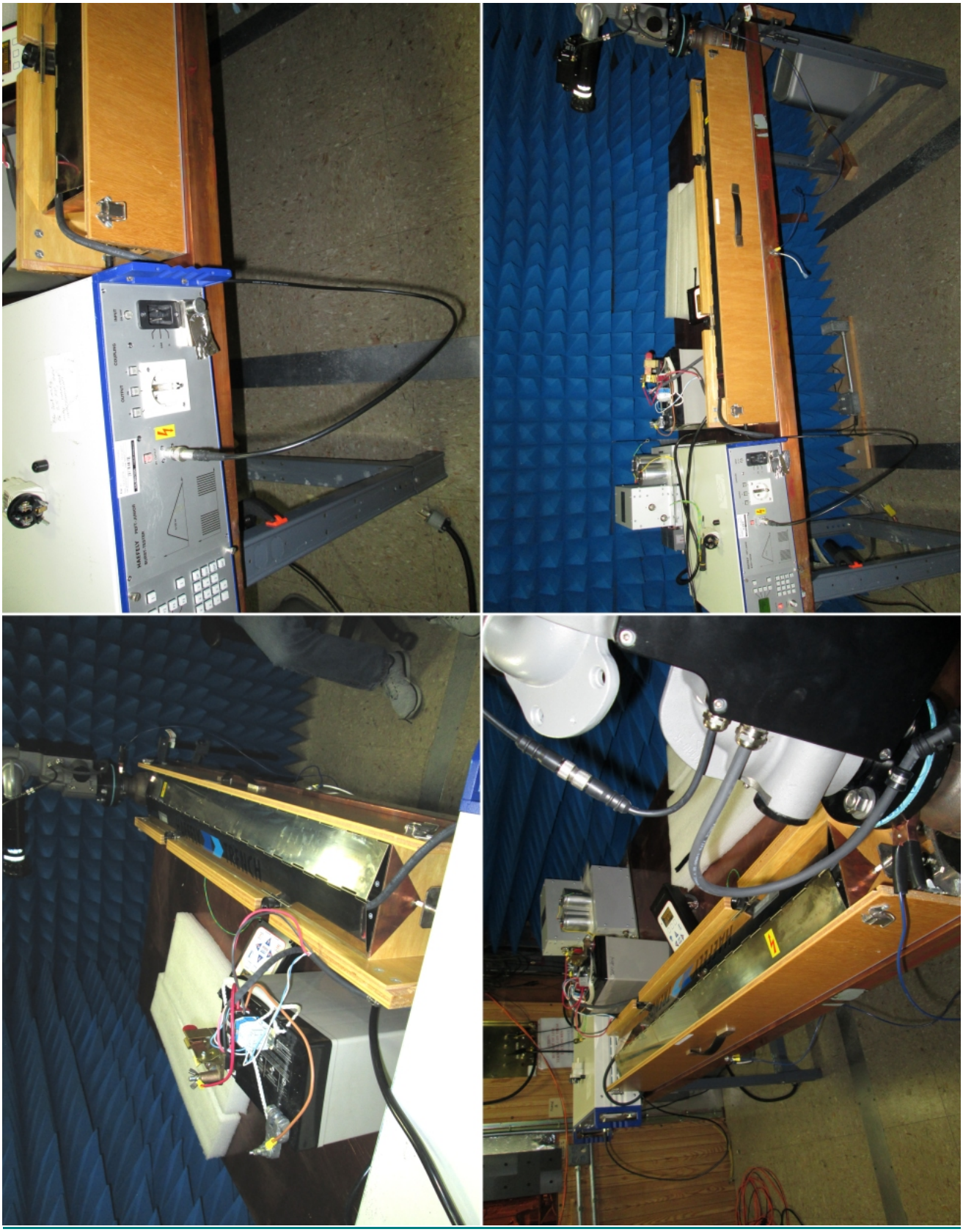
4.0 TEST RESULTS

The TASK FORCE TIPS MONITOR EF1 was tested in order to meet the .5, 1 and 2 KV EFT requirements. The test was conducted with a 13.5 V DC input to the EUT. No stoppage was experienced other than a random stop due to a software issue that was seen a few times whether or not the test was in progress. When the test was repeated the unit passed.

The RS485 lines were also tested separately using the Haefely clamp (second picture) since these line can be greater than 3 meters long. In that test no malfunction occurred at 1 or 2 KV application.

The EUT passed with an "A" acceptance level at the 2 KV level.


HAEFELY
CONTROL UNIT



Midwest EMI Associates
21234 West Commercial Drive
Mundelein, Illinois 60060

IEC Publication Number 61000-4-4 :2012

Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques – Electrical Fast Transient/Burst Immunity Test

Manufacturer: TET Test Engineer Initials: JE

Equipment Under Test: EFT MONITOR Date of Test: 29 AUG 17

Model #: 41-ETRA Serial #: PROTO #4

Temperature: 75.1 F Humidity Level: 61.5%

APPLIED BURST LEVEL: .5 **Kilovolt (Test Severity Level 1)**
REPETITION FREQUENCY: 5 Kilohertz **AC ADAPTER TYPE: (TWO) (THREE) TERMINAL**
BURST DURATION: 15 Msec BURST PERIOD: ~~300 Msec~~ 60 SEC
TEST DURATION: 60 ~~120~~ Seconds
POWER INPUT: (120 VAC / 60 Hz) (230VAC / 50 Hz) (208VAC/3PH, 50 Hz) OR **BAT VOLT:** 13.5 V

INSTRUMENT SETUP/NOMINAL CONDITIONS: MONITOR OSCILLATING

Mode of appearance	PLUS OBSERVATIONS	MINUS
Neutral with respect to the GRP	✓	✓
Line with respect to the GRP	✓	✓
Neutral and Line with respect to the GRP	✓	✓
PE 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
Checkmark Indicates no failure was observed, * Indicates Device Malfunctioned

APPLIED BURST LEVEL: 1 **Kilovolt (Test Severity Level 2)**
REPETITION FREQUENCY: ~~2.5~~ 5 Kilohertz **AC ADAPTER TYPE: (TWO) (THREE) TERMINAL**
BURST DURATION: 15 Msec BURST PERIOD: 300 Msec
TEST DURATION: 60 ~~120~~ Seconds
POWER INPUT: (120 VAC / 60 Hz) (230VAC / 50 Hz) (208VAC/3PH, 50 Hz) OR **BAT VOLT:** 13.5 V

INSTRUMENT SETUP/NOMINAL CONDITIONS: MONITOR OSCILLATING

mode of appearance PLUS	PLUS OBSERVATIONS	MINUS
Neutral with respect to the GRP	✓	✓
Line with respect to the GRP	✓	✓
Neutral and Line with respect to the GRP	✓	✓
PE 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
Checkmark Indicates no failure was observed, * Indicates Device Malfunctioned

Midwest EMI Associates
21234 West Commercial Drive
Mundelein, Illinois 60060

IEC Publication Number 61000-4-4 :2012

Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques – Electrical Fast Transient/Burst Immunity Test

Manufacturer: TFT Test Engineer Initials: GB

Equipment Under Test: EF1 MONITOR Date of Test: 3/7/2016

Model #: F1-E72A Serial #: PROTO #4

Temperature: 76.1F Humidity Level: 61.5%

APPLIED BURST LEVEL: 2 ~~3~~ **Kilovolt (Test Severity Level 1)**
REPETITION FREQUENCY: 5 Kilohertz **AC ADAPTER TYPE: (TWO) (THREE) TERMINAL**
BURST DURATION: 15 Msec BURST PERIOD: 300 Msex
TEST DURATION: 120 Seconds
POWER INPUT: (120 VAC / 60 Hz) (230VAC / 50 Hz) (208VAC/3PH, 50 Hz) OR **BAT VOLT:** 13.5 V

INSTRUMENT SETUP/NOMINAL CONDITIONS: MONITOR . . . OSCILLATING

Mode of appearance	PLUS OBSERVATIONS	MINUS
Neutral with respect to the GRP	✓	✓
Line with respect to the GRP	✓	✓
Neutral and Line with respect to the GRP	✓	✓
PE 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: SOME RANDOM STOPPAGE DUE TO SOFTWARE CODING PROBLEM
Checkmark Indicates no failure was observed, * Indicates Device Malfunctioned

APPLIED BURST LEVEL: **1 Kilovolt (Test Severity Level 2)**
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) (208VAC/3PH, 50 Hz) OR **BAT VOLT:** _____ V

INSTRUMENT SETUP/NOMINAL CONDITIONS: _____

mode of appearance PLUS	PLUS OBSERVATIONS	MINUS
Neutral with respect to the GRP		
Line with respect to the GRP		
Neutral and Line with respect to the GRP		
PE 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: _____
Checkmark 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: SB

EQUIPMENT UNDER TEST: EF1 MONITOR DATE OF TEST: 29 AUG 17

MODEL #: Y1-E72A SERIAL #: PROTO #4

TEMPERATURE: 76.1 HUMIDITY LEVEL: 61.5%

RS485 SIGNAL LINES

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 : 2 MINUTES
POWER INPUT: (120 VAC / 60 Hz) (230VAC / 50 Hz) (480VAC/50Hz/3 PHASE) OR : _____ V

INSTRUMENT SETUP/NOMINAL CONDITIONS: MONITOR OSCILLATING

VOLTAGE OF APPLICATION	MINUS OBSERVATIONS	PLUS
.5 KILOVOLT	— NT	— NT
1 KILOVOLT	✓	✓
2 KILOVOLT	✓	✓
4 KILOVOLT		
____ KILOVOLT		
____ KILOVOLT		
____ KILOVOLT		

- FAILURE MODE WAS: _____

RESULTS OF .5 kV TEST: NOT TESTED
RESULTS OF 1 kV TEST: NO EFFECT
RESULTS OF 2 kV TEST: NO EFFECT
RESULTS OF 4 kV TEST: _____

COMMENTS: _____

NUMBER "1" INDICATES NO FAILURE WAS OBSERVED, * INDICATES DEVICE MALFUNCTIONED

APPENDIX D

RADIATED RADIO FREQUENCY INTERFERENCE SUSCEPTIBILITY TEST

(IEC 61000-4-3, 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 25 MHz to 2.7 GHz. The applicable standards are IEC 61000-4-3 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 FP1000, FP2036 and 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 Ophir 4041 (lowband), ENI Model 525LA (midband), or custom Ophir 100 watt (highband). The IEC test covered was 25 MHz to 2.7 GHz.

3.0 TEST PROCEDURES:

3.1 POWER LEADS & CABLE PLACEMENT:

The TASK FORCE TIPS MONITOR EF1 was powered by **12 or 24 V DC** for this test.

3.2 TEST SETUP:

The E.U.T. was table mounted. 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 IEC 61000-4-3 as much as possible the antennas were adjusted to a 2.5 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 13 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 IEC 61000-4-3.

3.4 ANTENNAS AND AMPLIFIERS:

The radiating antennas/amplifiers that may be used during the test were:

ESD TEST LOCATIONS

TASK FORCE TIPS MONITOR EF1

TEST POINT	Description
1	Cover Mounting Screws
2	Cable Retainer
3	Stream /Fog Button
4	Grease Jet on Top of Enclosure
5	Base Bolt
6	Nozzle Cover Actuator
7	Grease Jet on Side
8	HCP
9	
10	
11	
12	
13	
14	
15	
16	

Note: Photograph of some locations is attached

Data Sheet 1 of 2	**ESD DATA SHEET** Schaffner NSG 435 Gun	**Midwest EMI Associates Mundelein, Illinois**	Form: Issued 11/22/09 **MEMI-1A**

Sponsor Group: _Task Force Tips Monitor EF1 Serial Number: Proto #4
Manager:_Tim Miller_ Temp: 77.1°F Hum: 61.3% Technician: GB S/W ver.:_____
Date of Test: 9/1/17 Time: 11:45 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: EUT power 12 VDC, EUT is oscillating under control of operator
Note: All Points are Tested with 10 Shots in Single Shot Mode each phase unless otherwise stated

Reference: EN 61000-4-2		**TEST POINT:** Cover Mounting Screws				**TEST POINT:** Cable Retainers			
		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	4	(✓)	(✓)	(✓)	(✓)	(✓)	(✓)	(✓)	(✓)
3	3								
4	4	(✓)	(✓)	(✓)	(✓)	(✓)	(✓)	(✓)	(✓)
5	5								
6	6	(✓)	(✓)	(✓)	(✓)	(✓)	(✓)	(✓)	(✓)
7	7								
8	16	(✓)		(✓)		(✓)		(✓)	
9									
10									

Reference: EN 61000-4-2		**TEST POINT:** Stream / Fog Button				**TEST POINT:** Grease Jet			
		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	16	(✓)		(✓)		(✓)		(✓)	
9									
10									

Notes: A Checkmark (✓) means the device passed the 10 shots successfully with a discharge being seen. A blank ( ) means the point was not tested. A Star sign (*) means a failure occurred that is described below
Notes:_____EUT remained Normal throughout Test_____
_____

Data Sheet 2 of 2	**ESD DATA SHEET** Schaffner NSG 435 Gun	**Midwest EMI Associates Mundelein, Illinois**	Form: Issued 11/22/09 **MEMI-1A**

Sponsor Group: _Task Force Tips Monitor EF1 Serial Number: Proto #4
Manager:_Tim Miller_ Temp: 77.1°F Hum: 61.3% Technician: GB S/W ver.:_____
Date of Test: 9/1/17 Time: 11:45 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: EUT power 12 VDC, EUT is oscillating under control of operator
Note: All Points are Tested with 10 Shots in Single Shot Mode each phase unless otherwise stated

Reference: EN 61000-4-2		**TEST POINT:** Base Bolt				**TEST POINT:** Nozzle Cover Actuator			
		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	16	(✓)		(✓)		(✓)		(✓)	
9									
10									

Reference: EN 61000-4-2		**TEST POINT:** Grease Jet on Side				**TEST POINT:** HCP			
		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	16	(✓)		(✓)		(✓)		(✓)	
9									
10									

Notes: A Checkmark (✓) means the device passed the 10 shots successfully with a discharge being seen. A blank ( ) means the point was not tested. A Star sign (*) means a failure occurred that is described below
Notes:_____(✓)_No Errors This Page_____
_____

APPENDIX I

FDA/EC MAGNETIC SUSCEPTIBILITY TEST

(EN 61000-4-8 Power Line Immunity Test, AAMI DF-39 METHOD)

1.0 PURPOSE:

The purpose of this test is to insure that medical/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 IEC 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 MDS-201-0004 is listed in paragraph 4.3.4 subparagraph a) and specifies the Helmholtz coil must be larger than the maximum dimension of the test sample. In some cases, medical 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, we use coils 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 1.5" diameter. The coils are arranged on an axis so that they are parallel to each other and are 70 cm apart.

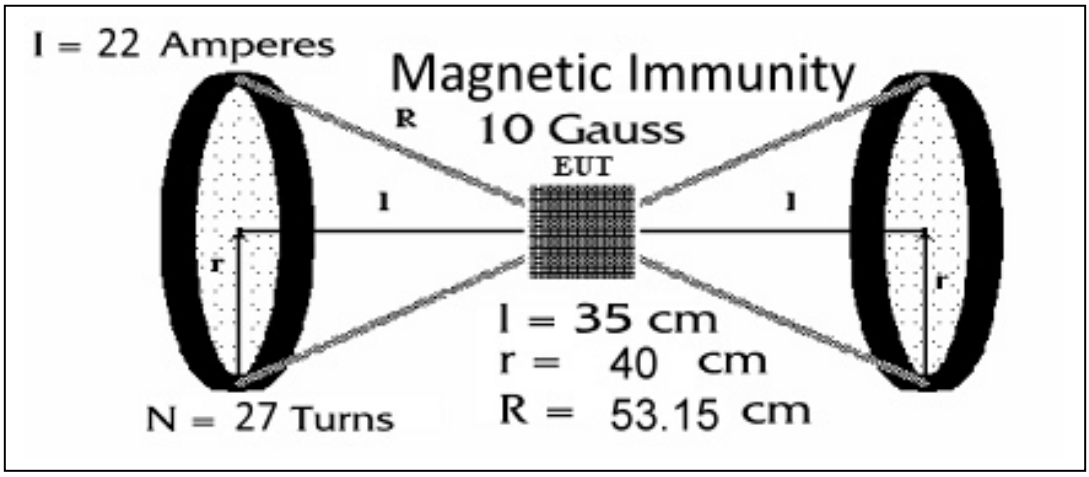
Using the "right hand" rule, the coils are phased so that the flux generated is aiding. The field generated by the coils is measured by the calibrated Holladay probe. The analysis below correlates the calculated field strength of the coils to the empirically measured field strength. The actual field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

2.3 Calculations

Given: Coil Diameter: 80 cm.

Current:	22 amperes
Coil Distance:	70 centimeters
Number of turns:	27 turns

Units: 1 Tesla = 10^4 Gauss=3 x 10^8 V/m=240 dBpT= 8 x10^5 A/M
$\mu_o = .4\pi$ x 10^{-7} T m/A, 10 Gauss = 800 A/M



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

$$R = \sqrt{l^2 + r^2} = \sqrt{35^2 + 40^2} = 53.15 \text{ cm}$$

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

I = 22 Amps RMS, 60 Hz

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

N = 27 Turns
r = .4 m, R = .5315 m

$$B \text{ (V/m)} = 188.5 * 22 * (.4)^2 / (.5315)^3 * 27 = 119318 \text{ V/m}$$

Since two coils are acting the field strength is about two times as great, or 238637 V/m, or equivalently, 227.55 dBuV/m.

Empirical Finding:

Using a calibrated Holladay probe, HI-3624, 70 cm. distance. 60 Hz and with 22 amperes applied the actual recorded strength was about 10 Gauss or 300000 V/M, 229.5 dBuV/m, 1 mT.

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.

Using a Holladay probe, HI-3624, placed midway as in the diagram, 70 cm. distance between the Helmholtz coils, 60 Hz operation and with 22 amperes applied the actual recorded strength was about 10 Gauss or 300000 V/M, 229.5 dBuV/m, 1 mT and this was the field applied to the Prototype Device.

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 22 amperes, 40-500 Hz.

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

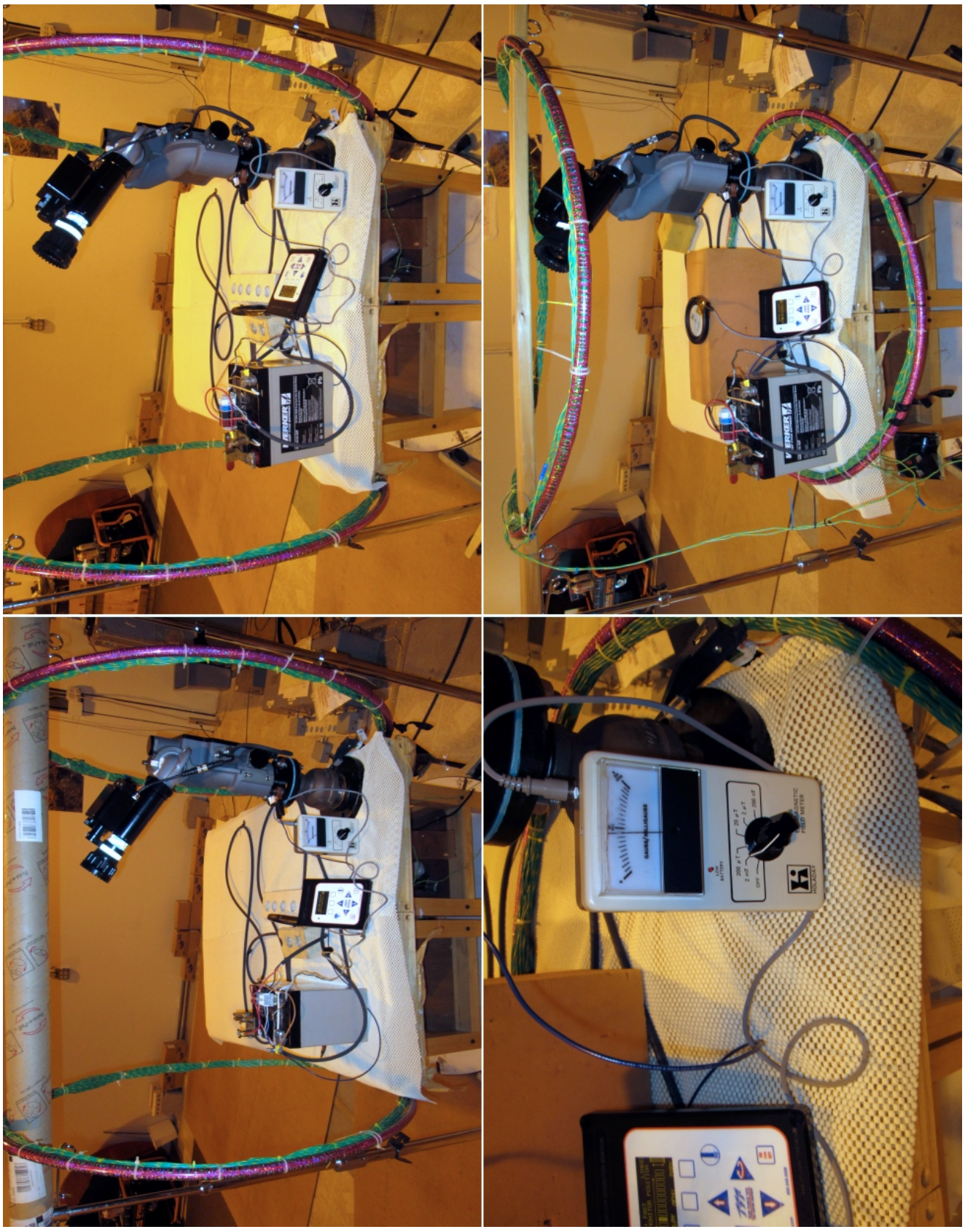
4.0 LIMITS AND TEST RESULTS

4.1 Magnetic Field Limit - IEC Recommendation

The magnetic field susceptibility of the device should not be less than the level defined in the IEC 61326-1 specification (30 A/M). Other IEC recommendations range up to 400 amperes/meter.

4.2 RESULTS

The TASK FORCE TIPS MONITOR EF1 was tested to the magnetic immunity requirement up to a level of between 6 gauss (360 A/M) to 3 Gauss (240 A/M) from 40 to 500 Hz and displayed no effects suggesting malfunction or change to its operation. No effect was seen on the display or motorized function and it achieved the "A" acceptance level.



a) The EMCO Model 3107B Power E field antenna from 10 KHz to 30 MHz, horizontal polarization only,

b) The Antenna Research LPB 2520 biconilog antenna or EMCO 3109 from 30 MHz-250 MHz, horizontal and vertical polarization, and AIINFO HORN antenna from 250-2700 MHz.

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 Ophir custom amp 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 IEC 61000-4-3. The rate was adjusted to approximately 1000-2000 KHz per step every 7 seconds and the sweep was continuous between steps. Polarization was horizontal and vertical when the biconical was used.

4.0 LIMITS AND RESULTS OF TEST:

4.1 RADIATED LIMITS:

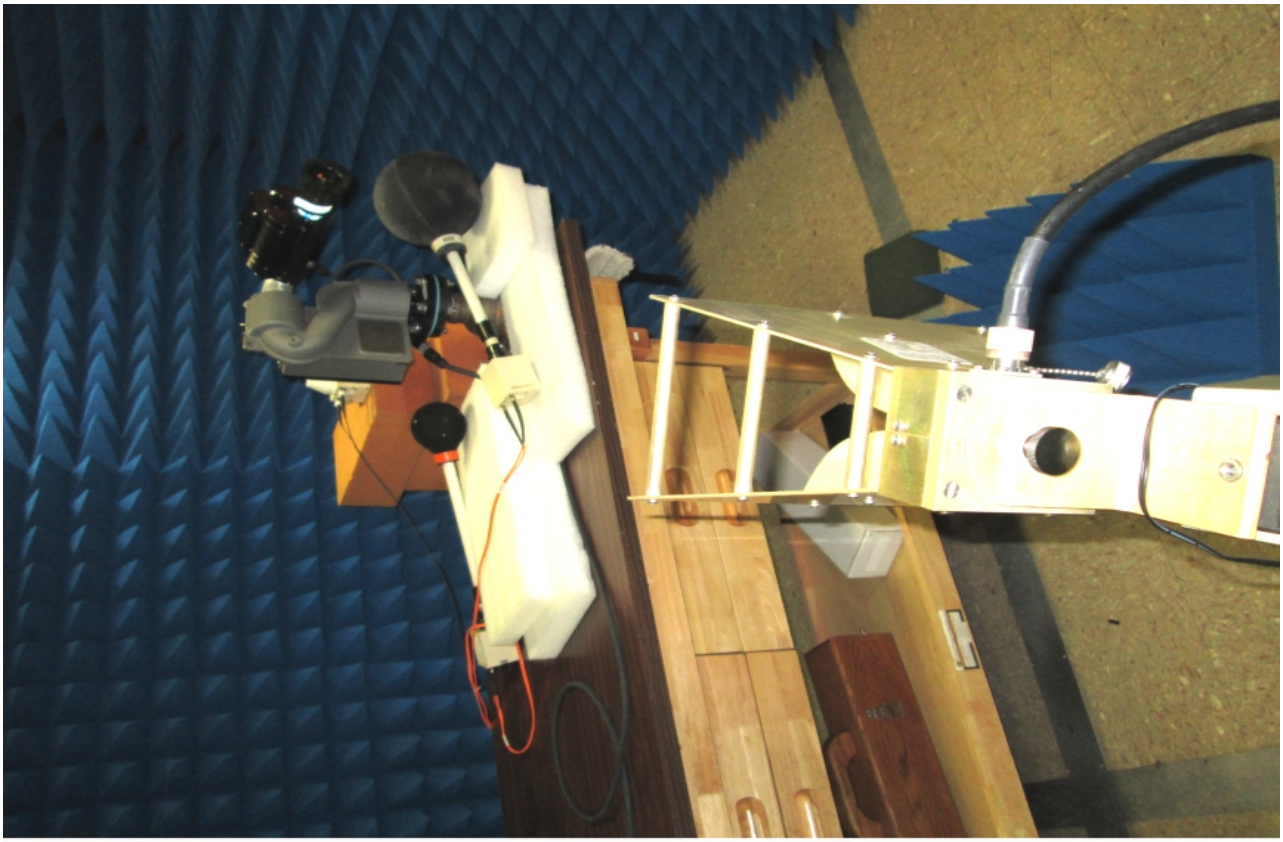
The radiated susceptibility immunity should not be lower than 3 V/M as prescribed by IEC 61000-4-3. The IEC range is 80 MHz to 1000 MHz however the more complete 25 MHz to 2700 MHz range was actually tested. A graph is shown of the actual averaged field strength presented to the prototype during the test.

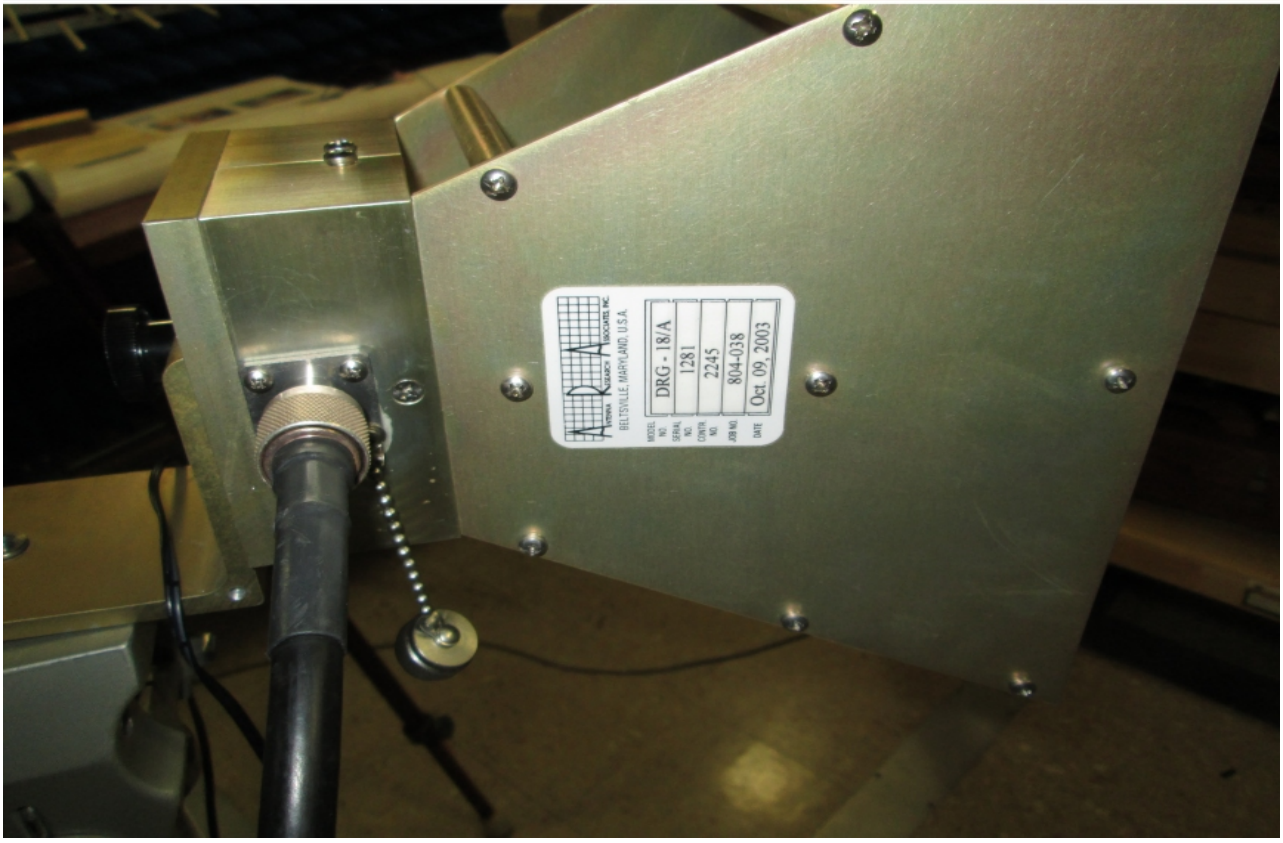
4.2 RESULTS OF TEST:

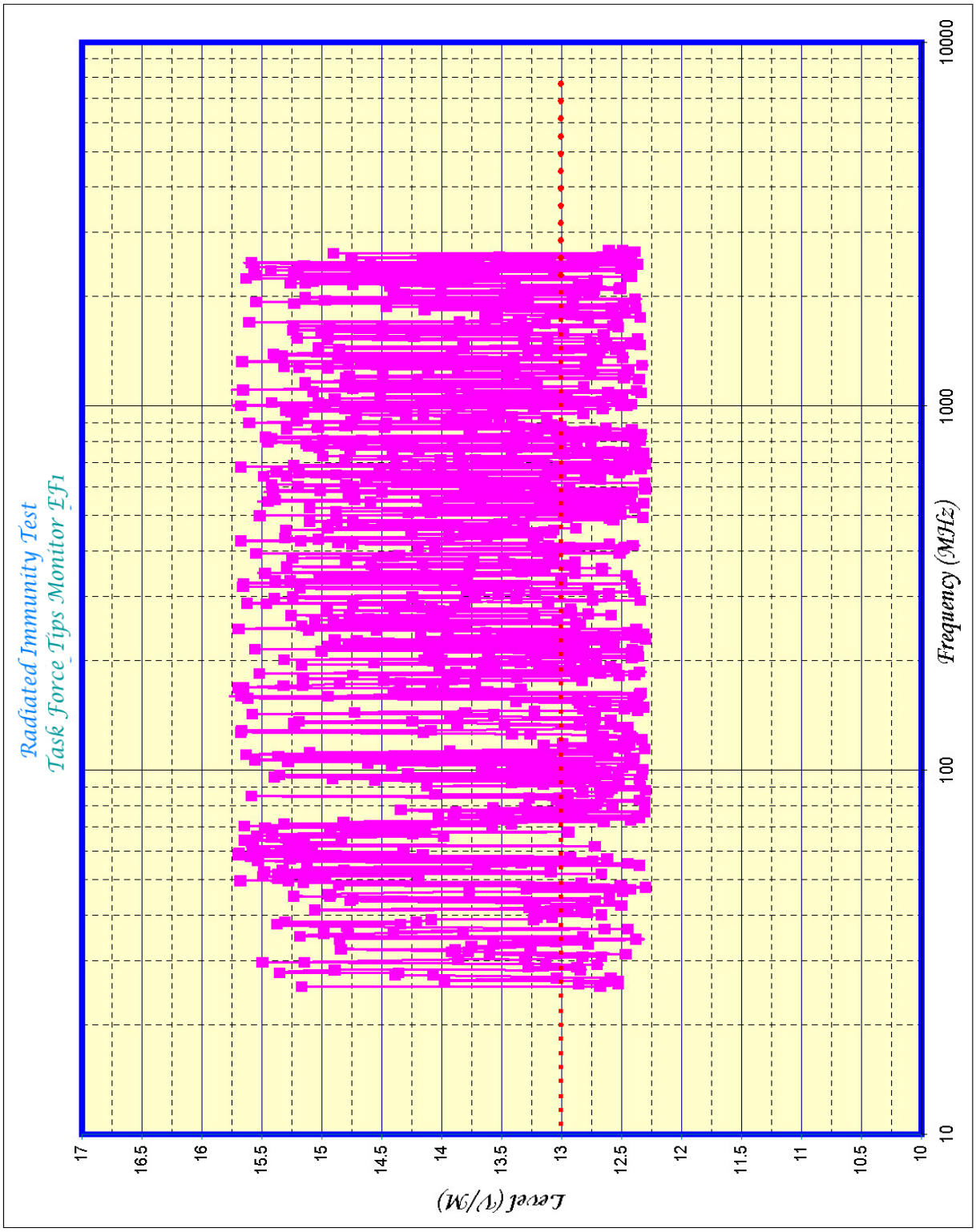
The TASK FORCE TIPS MONITOR EF1 was exposed to a 13 V/M immunity wave in the 25-2700 MHz range with 1000 Hz 80% AM modulation as well as using 200 Hz, 100 % pulse wave modulation (cellphone radio emissions). There was no noticeable change in operation to the motors or artifacts noted on the display.

The EUT was then tested from 2700 to 6000 MHz to fulfill testing required by EN 61000-6-2. See second picture using microwave horn ARA DRG-18/A. The EUT passed in this range with a 4.5 V/M or higher application. The EUT passed the requirement.

TASK FORCE TIPS MONITOR EF1 RADIATED IMMUNITY




ARA
BELTSVILLE MARYLAND, U.S.A.
MODEL NO
DRG - 18/A
SERIAL NO
1281
CONTR NO
2245
JOB NO
804-038
DATE
Oct. 09, 2003


Radiated Immunity Test
Task Force Tips Monitor EF1
Level (V/M)
17
16.5
16
15.5
15
14.5
14
13.5
13
12.5
12
11.5
11
10.5
10
Frequency (MHz)
10000
1000
100
10

Date: 3DAKL17 Page 1 of 2	IMMUNITY Worksheet	Midwest EMI Associates Mundelein, Illinois	Form: EN 61000-4-3/6

Device: TFT MONITOR EF1-1 Sponsor: TASK FORCE TIPS S/W Ver: _____ S/N: PROTO #1

Tests Performed: (Radiated) (Conducted) (Magnetic) (CS114) (SAEJ1113-21) (BCI)

Probes: (CS114) (Fischer CDN) (A/R FP2031) (A/R FP2036) (A/R FP1000) (Solar Injection Clamps)

Technician: GB

Project No: TIM MILLER

Mod Freq: 2 10 100 (1000) Hz

Modulation Depth: 50% (80%) 100% Other: AM & PULSE

POWER: 230 208 120 VAC or 13.5 VDC

Power Frequency: (50) (60) (400) Hz

Room of Test (Scrnrm) (2 Mtr) (5 Mtr) (Outside)

Pos: (A) (B) (C)

Antennae: (B=Biconical) (E=E Field, 3107) (L=Log Periodic) (BL=Biconilog) (H=Horn) V=Vertical, H=Horizontal Polarization

Orientation: (Pole Stand) (Wooden Table) (Copper Table) (Floor) (Back Room)

Frequency (M=MHz) (K=KHz)	Inc Freq (KHz) or (1%) if blank	Immunity Level (V) (V/M) (mA)	Dwell Time: (Sec)	Antenna Type	Results: Include any Failure Modes Observed in the EUT during the test. Video Camera System Used? (Yes) (No)
25M	1%	13	8	BL H	Going up, Monitor Oscillating
94M	"	"	"	"	ADK " "
224	"	"	"	"	" "
948M	"	"	"	"	" "
500M	"	"	"	"	" "
					COUPLER TYPE CS581-10
25M	1%	13	8	BL V	Going up, Monitor Oscillating
150M	"	"	"	"	ADK " "
303M	"	"	"	"	ADK " "
500M	"	"	"	"	ADK " "
500M	1%	13	8	BL V	ADK
806	1%	"	"	"	"
1000	1%	"	"	"	"
500M	1%	13	8	BL H	ADK
899M	1%	13	8	BL H	ADK
1000M	"	"	"	"	"
					Range Complete to CS161-10
1000M	1%	13	8	BL H	ADK Going up
1500M	"	"	"	"	" "
2200M	"	"	"	"	" "

Notes: No Faults this Range

Date: 3/21/17 Page 2 of 2	IMMUNITY Worksheet	Midwest EMI Associates Mundelein, Illinois	Form: EN 61000-4-3/6

Device: TFT MONITOR EF1 Sponsor: TASK FORCE TIPS S/W Ver: _____ S/N: PROTO #4

Tests Performed: (Radiated) (Conducted) (Magnetic) (CS114) (SAEJ1113-21) (BCI)

Probes: (CS114) (Fischer CDN) (A/R FP2031) (A/R FP2036) (A/R FP1000) (Solar Injection Clamps)

Technician: JB
Project No: JIM MILLER

Mod Freq: 2 10 100 (1000) Hz

Modulation Depth: 50% (80%) 100% Other:_____

POWER: 230 208 120 VAC or 13.5 VDC
Power Frequency: (50) (60) (400) Hz

Room of Test: (Screen) (2 Mtr) (5 Mtr) (Outside)
Pos: (A) (B) (C)

Antennae: (B=Biconical) (E=E Field, 3107) (L=Log Periodic) (BL=Biconilog) (H=Horn) V=Vertical, H=Horizontal Polarization

Orientation: (Pole Stand) (Wooden Table) (Copper Table) (Floor) (Back Room)

Frequency (M=MHz) (K=KHz)	Inc Freq (KHz) or (1%) if blank	Immunity Level (V) (V/M) (mA)	Dwell Time: (Sec)	Antenna Type	Results: Include any Failure Modes Observed in the EUT during the test. Video Camera System Used? (Yes) (No)
1000M	1%	13	8	BL V	Going up, MONITOR OSCILLATING
1430M	"	"	"	"	" " "
3200M	"	"	"	"	" " "
		SWITCH TO DECIBLER & ARA DRG/B-4			
2200M	1%	13	8	H H	Going up using Probe
2700M	"	"	"	HORN H	Going up ADK
2700M	1%	9.5	8	"	POWER LEVEL PER
3000	"	"	"	"	ENG1000-6-2, ADK
3500M	"	"	"	H H	EUT ADK, OPERATOR
2200M	1%	13	8	H V	Going up, ADK
2700M	"	13 TO 9.5	"	"	" " "
3000M	"	4.5	"	"	" " "
3500M	"	4.5	"	"	" " "
			SET HP MICROWAVE EQMT		
			SWEEP MODE 3.5 ⇒ 6GHz MANUAL		
3.5G	1%	>4.5	8	H V	GSM PULSED Going up, ADK, FP2036 PROBE
6G	"	"	"	H V	" " " " "
3.5G	1%	>4.5	8	H H	Going up, ADK, FP2036 PROBE
6G	1%	>4.5	8	H H	" " "

Notes: No Faults, Unit Passed

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/IEC 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:

> IEC 61000-4-5:2014, third edition, 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 TASK FORCE TIPS MONITOR EF1 was tested at phases of 0, 90, 180, and 270 degrees of the 12 or 24 V DC line. The tested values was .5 KV per EN 61000-4-5 for DC operated devices.

The EUT passed the Surge criterion with an A level of acceptance.

Haefely Trench AG EMC Test Systems Basel/Switzerland

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

System: PSURGE 4010
Test: P5KNEPNE
Start-Date: 29.08.2017 Start-Time: 07:33

******* 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	-----	-0.30kV	-35A	INSULATED OPERATOR STATION
N-PE	2	-0.50kV	-----	-0.52kV	-6A	
N-PE	3	-0.50kV	-----	-0.52kV	-6A	
N-PE	4	-0.50kV	-----	-0.52kV	-6A	
N-PE	5	-0.50kV	-----	-0.52kV	-6A	
N-PE	6	-0.50kV	-----	-0.52kV	-6A	
N-PE	7	-0.50kV	-----	-0.42kV	-34A	
N-PE	8	-0.50kV	-----	-0.52kV	-6A	
>>> Pause switched ON. <<<						
>>> Pause switched OFF. <<<						
N-PE	9	-0.50kV	-----	-0.53kV	-6A	
N-PE	10	-0.50kV	-----	-0.52kV	-6A	
N-PE	11	-0.50kV	-----	-0.52kV	-6A	
N-PE	12	-0.50kV	-----	-0.52kV	-6A	
N-PE	13	-0.50kV	-----	-0.52kV	-6A	
N-PE	14	-0.50kV	-----	-0.52kV	-5A	
N-PE	15	-0.50kV	-----	-0.52kV	-5A	
N-PE	16	-0.50kV	-----	-0.52kV	-5A	
N-PE	17	-0.50kV	-----	-0.52kV	-6A	
N-PE	18	-0.50kV	-----	-0.52kV	-5A	
N-PE	19	-0.50kV	-----	-0.52kV	-5A	
N-PE	20	-0.50kV	-----	-0.52kV	-6A	
>>> Test passed. <<<						

Test: P5KNEPNE
Stop-Date: 29.08.2017 Stop-Time: 07:37

Haefely Trench AG EMC Test Systems Basel/Switzerland

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

System: PSURGE 4010
Test: P5KNEPNE
Start-Date: 29.08.2017 Start-Time: 07:37

******* 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	-----	+0.51kV	+4A	
N-PE	2	+0.50kV	-----	+0.51kV	+4A	
N-PE	3	+0.50kV	-----	+0.51kV	+4A	
N-PE	4	+0.50kV	-----	+0.51kV	+4A	
N-PE	5	+0.50kV	-----	+0.51kV	+4A	
N-PE	6	+0.50kV	-----	+0.51kV	+4A	
N-PE	7	+0.50kV	-----	+0.51kV	+4A	
N-PE	8	+0.50kV	-----	+0.51kV	+4A	
N-PE	9	+0.50kV	-----	+0.51kV	+4A	

```
*  N-PE     10     +0.50kV  -----    +0.51kV  +4A                    *
*  N-PE     11     +0.50kV  -----    +0.51kV  +4A                    *
*  N-PE     12     +0.50kV  -----    +0.51kV  +4A                    *
*  N-PE     13     +0.50kV  -----    +0.51kV  +4A                    *
*  N-PE     14     +0.50kV  -----    +0.51kV  +4A                    *
*  N-PE     15     +0.50kV  -----    +0.51kV  +4A                    *
*  N-PE     16     +0.50kV  -----    +0.51kV  +4A                    *
*  N-PE     17     +0.50kV  -----    +0.51kV  +4A                    *
*  N-PE     18     +0.50kV  -----    +0.51kV  +4A                    *
*  N-PE     19     +0.50kV  -----    +0.51kV  +4A                    *
*  N-PE     20     +0.50kV  -----    +0.51kV  +4A                    *
*    >>> Test passed. <<<                                           *
*                                                                    *
*  Test:         P5KNEPNE                                          *
*  Stop-Date:    29.08.2017                Stop-Time:     07:40    *
*                                                                    *
**********************************************************************

**********************************************************************
*                                                                    *
*  Haefely Trench AG     EMC Test Systems      Basel/Switzerland     *
*                    T E S T   P R O T O C O L                       *
*  System:       PSURGE 4010                                         *
*  Test:         P5KNEPNE                                            *
*  Start-Date:   29.08.2017                Start-Time:    07:43    *
*                                                                    *
*******    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  -----    +0.51kV  +5A                    *
*  L1-PE     2     +0.50kV  -----    +0.51kV  +4A                    *
*  L1-PE     3     +0.50kV  -----    +0.51kV  +4A                    *
*  L1-PE     4     +0.50kV  -----    +0.51kV  +4A                    *
*  L1-PE     5     +0.50kV  -----    +0.51kV  +4A                    *
*  L1-PE     6     +0.50kV  -----    +0.51kV  +4A                    *
*  L1-PE     7     +0.50kV  -----    +0.51kV  +4A                    *
*  L1-PE     8     +0.50kV  -----    +0.51kV  +4A                    *
*  L1-PE     9     +0.50kV  -----    +0.51kV  +4A                    *
*  L1-PE    10     +0.50kV  -----    +0.51kV  +4A                    *
*  L1-PE    11     +0.50kV  -----    +0.51kV  +4A                    *
*  L1-PE    12     +0.50kV  -----    +0.51kV  +4A                    *
*  L1-PE    13     +0.50kV  -----    +0.51kV  +5A                    *
*  L1-PE    14     +0.50kV  -----    +0.51kV  +4A                    *
*  L1-PE    15     +0.50kV  -----    +0.51kV  +4A                    *
*  L1-PE    16     +0.50kV  -----    +0.51kV  +4A                    *
*  L1-PE    17     +0.50kV  -----    +0.51kV  +4A                    *
*  L1-PE    18     +0.50kV  -----    +0.51kV  +4A                    *
*  L1-PE    19     +0.50kV  -----    +0.51kV  +4A                    *
*  L1-PE    20     +0.50kV  -----    +0.51kV  +4A                    *
*    >>> Test passed. <<<                                           *
*                                                                    *
*  Test:         P5KNEPNE                                          *
*  Stop-Date:    29.08.2017                Stop-Time:     07:47    *
*                                                                    *
**********************************************************************

**********************************************************************
*                                                                    *
*  Haefely Trench AG     EMC Test Systems      Basel/Switzerland     *
*                    T E S T   P R O T O C O L                       *
*  System:       PSURGE 4010                                         *
*  Test:         P5KNEPNE                                            *
```

```
*  Start-Date:  29.08.2017                    Start-Time:   07:47  *
*                                                                  *
*******   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   -----    -0.51kV   -5A                *
*  L1-PE     2     -0.50kV   -----    -0.51kV   -5A                *
*  L1-PE     3     -0.50kV   -----    -0.51kV   -5A                *
*  L1-PE     4     -0.50kV   -----    -0.51kV   -5A                *
*  L1-PE     5     -0.50kV   -----    -0.51kV   -5A                *
*  L1-PE     6     -0.50kV   -----    -0.51kV   -5A                *
*  L1-PE     7     -0.50kV   -----    -0.51kV   -5A                *
*  L1-PE     8     -0.50kV   -----    -0.51kV   -5A                *
*  L1-PE     9     -0.50kV   -----    -0.51kV   -5A                *
*  L1-PE    10     -0.50kV   -----    -0.51kV   -5A                *
*  L1-PE    11     -0.50kV   -----    -0.51kV   -5A                *
*  L1-PE    12     -0.50kV   -----    -0.51kV   -5A                *
*  L1-PE    13     -0.50kV   -----    -0.51kV   -5A                *
*  L1-PE    14     -0.50kV   -----    -0.51kV   -5A                *
*  L1-PE    15     -0.50kV   -----    -0.51kV   -5A                *
*  L1-PE    16     -0.50kV   -----    -0.51kV   -5A                *
*  L1-PE    17     -0.50kV   -----    -0.51kV   -5A                *
*  L1-PE    18     -0.50kV   -----    -0.51kV   -5A                *
*  L1-PE    19     -0.50kV   -----    -0.51kV   -5A                *
*  L1-PE    20     -0.50kV   -----    -0.51kV   -5A                *
*    >>> Test passed. <<<                                          *
*                                                                  *
*  Test:         P5KNEPNE                                          *
*  Stop-Date:    29.08.2017                 Stop-Time:    07:51  *
*                                                                  *
********************************************************************
```

```
********************************************************************
*                                                                  *
*  Haefely Trench AG    EMC Test Systems     Basel/Switzerland    *
*                    T E S T   P R O T O C O L                     *
*  System:       PSURGE 4010                                       *
*  Test:         P5KNEPNE                                          *
*  Start-Date:   29.08.2017                 Start-Time:   07:52  *
*                                                                  *
*******   Combination Wave 1,2/50us;8/20us   ********************
*                                                                  *
*  Coup.   Imp.    U nom-    Syncro                                *
*  Path    No.       inal    Angle    U-peak    I-peak    Info.    *
*  ------------------------------------------------------------    *
*  L1-N      1     -0.50kV   -----    -0.17kV   -173A              *
*  L1-N      2     -0.50kV   -----    -0.17kV   -173A              *
*  L1-N      3     -0.50kV   -----    -0.17kV   -173A              *
*  L1-N      4     -0.50kV   -----    -0.17kV   -173A              *
*  L1-N      5     -0.50kV   -----    -0.17kV   -173A              *
*  L1-N      6     -0.50kV   -----    -0.17kV   -173A              *
*  L1-N      7     -0.50kV   -----    -0.17kV   -173A              *
*  L1-N      8     -0.50kV   -----    -0.17kV   -173A              *
*  L1-N      9     -0.50kV   -----    -0.17kV   -173A              *
*  L1-N     10     -0.50kV   -----    -0.17kV   -173A              *
*  L1-N     11     -0.50kV   -----    -0.17kV   -173A              *
*  L1-N     12     -0.50kV   -----    -0.17kV   -173A              *
*  L1-N     13     -0.50kV   -----    -0.17kV   -173A              *
*  L1-N     14     -0.50kV   -----    -0.17kV   -173A              *
*  L1-N     15     -0.50kV   -----    -0.17kV   -173A              *
*  L1-N     16     -0.50kV   -----    -0.17kV   -173A              *
*  L1-N     17     -0.50kV   -----    -0.17kV   -173A              *
*  L1-N     18     -0.50kV   -----    -0.17kV   -173A              *
```

```
*  L1-N    19     -0.50kV  -----    -0.17kV  -173A                  *
*  L1-N    20     -0.50kV  -----    -0.17kV  -173A                  *
*    >>> Test passed. <<<                                           *
*                                                                   *
*  Test:         P5KNEPNE                                           *
*  Stop-Date:    29.08.2017                 Stop-Time:     07:55    *
*                                                                   *
*********************************************************************

*********************************************************************
*                                                                   *
*  Haefely Trench AG     EMC Test Systems      Basel/Switzerland    *
*                    T E S T   P R O T O C O L                      *
*  System:       PSURGE 4010                                        *
*  Test:         P5KNEPNE                                           *
*  Start-Date:   29.08.2017                 Start-Time:    07:55    *
*                                                                   *
*******   Combination Wave 1,2/50us;8/20us   ********************   *
*                                                                   *
*  Coup.   Imp.    U nom-    Syncro                                 *
*  Path    No.       inal    Angle   U-peak    I-peak    Info.      *
*  ---------------------------------------------------------------  *
*  L1-N      1     +0.50kV  -----    +0.15kV  +197A                  *
*  L1-N      2     +0.50kV  -----    +0.15kV  +197A                  *
*  L1-N      3     +0.50kV  -----    +0.15kV  +197A                  *
*  L1-N      4     +0.50kV  -----    +0.15kV  +197A                  *
*  L1-N      5     +0.50kV  -----    +0.15kV  +197A                  *
*  L1-N      6     +0.50kV  -----    +0.15kV  +197A                  *
*  L1-N      7     +0.50kV  -----    +0.15kV  +197A                  *
*  L1-N      8     +0.50kV  -----    +0.15kV  +197A                  *
*  L1-N      9     +0.50kV  -----    +0.15kV  +197A                  *
*  L1-N     10     +0.50kV  -----    +0.15kV  +197A                  *
*  L1-N     11     +0.50kV  -----    +0.15kV  +197A                  *
*  L1-N     12     +0.50kV  -----    +0.15kV  +197A                  *
*  L1-N     13     +0.50kV  -----    +0.15kV  +197A                  *
*  L1-N     14     +0.50kV  -----    +0.15kV  +197A                  *
*  L1-N     15     +0.50kV  -----    +0.15kV  +197A                  *
*  L1-N     16     +0.50kV  -----    +0.15kV  +197A                  *
*  L1-N     17     +0.50kV  -----    +0.15kV  +197A                  *
*  L1-N     18     +0.50kV  -----    +0.15kV  +197A                  *
*  L1-N     19     +0.50kV  -----    +0.15kV  +197A                  *
*  L1-N     20     +0.50kV  -----    +0.15kV  +197A                  *
*    >>> Test passed. <<<                                           *
*                                                                   *
*  Test:         P5KNEPNE                                           *
*  Stop-Date:    29.08.2017                 Stop-Time:     07:59    *
*                                                                   *
*********************************************************************
```

APPENDIX F

VOLTAGE FLUCTUATION AND HARMONIC TEST

(EN 61000-4-29)

1.0 PURPOSE:

The purpose of this test is to insure that medical or commercial devices will not be susceptible to commonly experienced brownouts and blackout syndromes (EN 61000-4-29) and will also not create conditions that could lead to localized brownouts by generating unacceptable surges or flicker in current on the power line (EN 61000-3-2, EN 61000-3-3). Since this is a DC test the flicker and harmonics test were not performed.

2.0 DESCRIPTION OF TEST APPARATUS:

Both tests require the capabilities of the California Instruments 5001ix 5-kilowatt single-phase arbitrary waveform generator and the 100-CTS/PACS-1 add on unit. The hardware devices also have validated software for sequencing the tests, which is the CIGUI 3.18 interfacing program (EN 61000-4-29). All testing is standardized however both instruments are capable of customization for a very wide range of user definable conditions.

3.0 TEST PROCEDURES:

3.1 POWER LEADS:

The TASK FORCE TIPS MONITOR EF1 was powered by a source of 12 or 24 V DC. The power leads are a standard 18 gauge three conductor with a standard domestic three terminal IEC power plug. The power leads were terminated into the California Instruments CTS/PACS-1 test unit.

3.2 TEST SETUP and TEST DESCRIPTION:

The EN 61000-4-29 directive does not require any special grounding techniques other than the normal power supply connections. In this test various brownout or blackout syndromes are applied. The unit is permitted to fail during application of the regimen but should not cause processor lockup or an unsafe mode of operation. The applied stimulus is directly called out by the standard and ranges in pulse duration and pulse depth. The sequence applied is supplied as a portion of the test report.

3.3 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)	California Instruments 5001ix	G3454	24 Mar 18
b)	California Instruments 100-CTS/PACS-1	107	24 Mar 18

4.0 RESULTS OF TEST:

TASK FORCE TIPS MONITOR EF1

This unit is powered by a battery and therefor the flicker and harmonics test do not apply. Similarly for DC operated systems the equivalent test for EN 61000-4-11 voltage fluctuations test is EN 61000-4-29 DC voltage fluctuations test. Both 12 and 24 volts were tested. The results of the test were as follows:

1) **In the 24 volt test, any dip to 0% voltage applied caused the Monitor unit to stop oscillating. The motor requires power to continue to run. All dips to 40 or 70% of nominal caused no change to operation and the Monitor continued to run normally.**

2) **In the 12 volt test, any dip to 0% voltage applied caused the Monitor unit to stop oscillating. The motor requires power to continue to run. All dips to 70% of nominal passed with no change to operation. All dips of 40% with duration of .03 seconds or more caused the Monitor to stop.**

The system was also tested for longer term fluctuations of 85% and 120% of the standard DC voltage. In this case the EUT also passed the requirement at both 12 volts and 24 volts.


California Instruments
FLICKER ON/OFF
5kVA AC POWER SOURCE

California Instruments
Compliance Test System

EN 61000-4-29 Test Report — Page 1 of 1

Program version:	AC Source GUI32; 1.28.0.0 - Nov 30, 2006
AC Source information:	Model = 5001iX, Serial no.= 52945
IEC TEST RESULT:	PASS

Time test started:	Wednesday, August 30, 2017 2:54:32 PM		
Time test completed:	Wednesday, August 30, 2017 3:07:04 PM		
Selected test file:	MASTER 61000-4-29 Dips Test.429		
Selected test type:	DC Voltage Dips and Interruptions Immunity test		
Test operator:	Midwest EMI		
Test Site:	California Room	Ambient Temperature:	80 F
Humidity:	55 %	Pressure:	
EUT description:	TFT Monitor EF1		
User Comment:	Running in Oscilation Miode		

TEST CONDITIONS:

Maximum EUT DC voltage (Vdc):	24.0 VDC, Channel A
Minimum EUT DC voltage (Vdc):	12.0 VDC, Channel A
Max. EUT Vdc =	SELECTED
Min. EUT Vdc =	SKIPPED
DC Voltage Dips and Short Interruptions	SELECTED
DC Voltage Variations	SKIPPED

DC Voltage Dips and Short Interruptions Test Sequence

Step #	Dip to % Unom	Time	Repeat	Delay (s)
1	0	0.001	2	10
2	0	0.003	2	10
3	0	0.010	2	10
4	40	0.010	2	10
5	70	0.010	2	10
6	0	0.030	2	10
7	40	0.030	2	10
8	70	0.030	2	10
9	0	0.100	2	10
10	40	0.100	2	10
11	70	0.100	2	10
12	0	0.300	2	10
13	40	0.300	2	10
14	70	0.300	2	10
15	0	1.000	2	10
16	40	1.000	2	10
17	70	1.000	2	10
18	End of list			

USER OBSERVATIONS OF EUT DURING TEST:

Observations:

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California Instruments
Compliance Test System

EN 61000-4-29 Test Report — Page 1 of 1

Program version:	AC Source CIGuiSII; 3.1.0
AC Source information:	Model = 5001iX, Serial no.= 52945
IEC TEST RESULT:	FAIL

Time test started:	Wednesday, August 30, 2017 4:21:18 PM		
Time test completed:	Wednesday, August 30, 2017 4:24:37 PM		
Selected test file:	WORKING Generic IEC 1000-4-29 Voltage Variations.429		
Selected test type:	DC Voltage Dips and Interruptions Immunity test		
Test operator:	Midwest EMI		
Test Site:	California Room	Ambient Temperature:	80 F
Humidity:	56 %	Pressure:	
EUT description:	TFT EF1 Monitor		
User Comment:	Running in Oscillate Mode		

TEST CONDITIONS:

Maximum EUT DC voltage (Vdc):	12.0 VDC, Channel A
Minimum EUT DC voltage (Vdc):	12.0 VDC, Channel A
Max. EUT Vdc =	SKIPPED
Min. EUT Vdc =	SELECTED
DC Voltage Dips and Short Interruptions	SKIPPED
DC Voltage Variations	SELECTED

DC Voltage Variations Test Sequence

Step #	Var to % Unom	Fall Time (s)	Hold Time (s)	Rise Time (s)	Repeat	Delay (s)
1	85	0.100	1.000	0.100	1	10
2	120	0.100	1.000	0.100	1	10
3	85	0.300	1.000	0.300	1	10
4	120	0.300	1.000	0.300	1	10
5	85	1.000	1.000	1.000	1	10
6	120	1.000	1.000	1.000	1	10
7	85	3.000	1.000	3.000	1	10
8	120	3.000	1.000	3.000	1	10
9	85	10.000	1.000	10.000	1	10
10	120	10.000	1.000	10.000	1	10
11	End of list					

USER OBSERVATIONS OF EUT DURING TEST:

Observations:

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APPENDIX G

CONDUCTED SUSCEPTIBILITY TEST

Common Mode Voltage Interference (Ref: IEC 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 IEC 61000-4-6 :2013

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 CDN and device tested was plugged into a source of 12 of 24 Volts through two Line Impedance Stabilization Networks, Solar type 8028-50-TS-24-BNC. The AC 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, if used in the test, 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 400 MHz range. The range required to pass for this test is only 150 KHz to 80 MHz. In the higher range of 80-400 MHz the dwell time was also 3 seconds.

4.2 RESULTS OF TEST

This test was performed using the Ophir OIP-400 Clamp from .15 to 400 MHz in a standard configuration. When the device was tested at the minimum 3 V RMS level the EUT performed normally throughout the test to 80 MHz. It also performed normally in the extended range up to 400 MHz. In the 10 V RMS test no adverse effects were noted over the entire range of .15 to 400 MHz.

Date: 29 AUG 17 Page 1 of 1	IMMUNITY Worksheet	Midwest EMI Associates Mundelein, Illinois	Form: EN 61000-4-3/6

Device: TFT MONITOR EF1 Sponsor: TASK FORCE TIPS S/W Ver: _____ S/N: PROTO #4

Tests Performed: (Radiated) (Conducted) (Magnetic) (CS114) (SAEJ1113-21) (BCI)
Probes: (CS114) (Fischer CDN) (A/R FP2031) (A/R FP2036) (A/R FP1000) (Solar Injection Clamps) CDN/IB
Technician: SB
Project No: TIM MILLER

Mod Freq: 2 10 100 1000 Hz
Modulation Depth: 50% 80% 100% Other: _____
POWER: 230 208 120 VAC or 19.5 VDC
Power Frequency: (50) (60) (400) Hz

Room of Test (Scnrm) (2 Mtr) (5 Mtr) (Outside)
Pos: (A) B) (C)
Antennae: (B=Biconical) (E=E Field, 3107) (L=Log Periodic) (BL=Biconilog) (H=Horn) V=Vertical, H=Horizontal Polarization
Orientation: (Pole Stand) (Wooden Table) (Copper Table) (Floor) (Back Room)

Frequency (M=MHz) (K=KHz)	Inc Freq (KHz) or (1%) if blank	Immunity Level (V) (V/M) (mA)	Dwell Time: (Sec)	Antenna Type	Results: Include any Failure Modes Observed in the EUT during the test Video Camera System Used? (Yes) (No)
150K	PER PGM	3	PER PGM	CLAMP	MANUALLY WATCHED, AOK
1M	"	"	"	"	"
15M	"	"	"	"	"
80M	"	"	"	"	"
115M	"	"	"	"	"
230M	"	"	"	"	"
305M	"	"	"	"	"
400M	"	"	"	"	"
					NO FAULTS DETECTED
100K	PER PGM	10	PER PGM	CLAMP	MANUALLY WATCHED, AOK
800K	"	"	"	"	NO ISSUES DETECTED
1.5M	"	"	"	"	
35M	"	"	"	"	
80M	"	"	"	"	
101M	"	"	"	"	
176M	"	"	"	"	
205M	"	"	"	"	
279M	"	"	"	"	
332M	"	"	"	"	
375M	"	"	"	"	
400M	"	"	"	"	

Notes: _____

APPENDIX I

ELECTROSTATIC DISCHARGE TEST

(IEC 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 IEC 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 **TASK FORCE TIPS MONITOR EF1** was powered by 12 or 24 V DC for this test.

3.2 TEST SETUP:

The IEC 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 (9-1-17):

The ESD test was conducted on 8 surfaces in areas showing cracks in the package, switches, connectors or screws. The EUT was subjected to ESD intensity levels of 2, 4, 6, and 8 kV in air discharge mode (insulated points) and 2, 4 and 6 kV contact discharge mode (metalized points), both polarizations required by the EN 61000-4-2 / EN 61000-6-2 standards. The EUT enclosure is mainly metal will readily accept discharge.

The following symptoms were noted during the test when the EUT was tested:

1) **None, the EUT experienced no problems during this test**