

Performance Certification to EMC Directive

Normative Standard:

EN61000-6-2, EN 61000-6-3: 2007

Test Unit Description and Serial Number:

TFT EP0372 HYDRANT VALVE

S/N: EMI Prototype (Improved)

Test Report # 3131

Dates of Test: 08-16-2010 through 08-18-2010

Test Laboratory:

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

EN 61000-6-3 EMISSIONS

TEST METHOD	LIMITS
IEC 61000-6-3 Am 1:2007 (Cispr 11) Radiated Emissions	B

EN 61000-6-2 IMMUNITY

TEST METHOD	LEVEL
EN 61000-4-2 Cons Ed 1.2:2009 Electrostatic Discharge Test	A
EN 61000-4-3 Ed. 3.0: 2009 Radiated Immunity Test	A
EN 61000-4-8: 2001-03 Magnetic Immunity	A

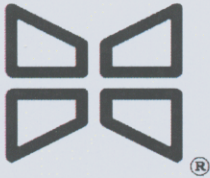
Performance Level:

- 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.

George A. Bowman

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





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

**Midwest EMI Associates Test Service
Report No. 3131**

Test Specifications

EN 61000-6-3 Level B Radiated Emissions
EN 61000-4-2 Electrostatic Discharge
EN 61000-4-3 Radiated Immunity
EN 61000-4-8 Magnetic Immunity

Test Device: **TFT EP0372 HYDRANT VALVE**

Serial Number: **EMI Prototype (Improved)**

Conducted For: **Mr. Tim Miller**
Task Force Tips
3701 Innovation Way
Valparaiso, IN 46383
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Dates of Test: 08-16-2010 through 08-18-2010

Technical Data Taken by and
Report Written by:

George Bowman
Midwest EMI Associates

NARTE Certified Engineer, EMC-000738NE

Approved By:

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

1.0 PURPOSE:

The purpose of this test sequence is to qualify the compliance of the TFT EP0372 HYDRANT VALVE to the IEC 61000-6-2 and 61000-6-3 commercial standards. This report covers testing to the IEC 61000-6-3 (Cispr 11) B level radiated emissions, IEC 61000-4-2 electrostatic discharge test, IEC 61000-4-3 radiated immunity standards, and IEC 61000-4-8 magnetic immunity test. This unit is purely battery operated from 4 1.5 volt AA lithium style batteries.

2.0 TEST FACILITY:

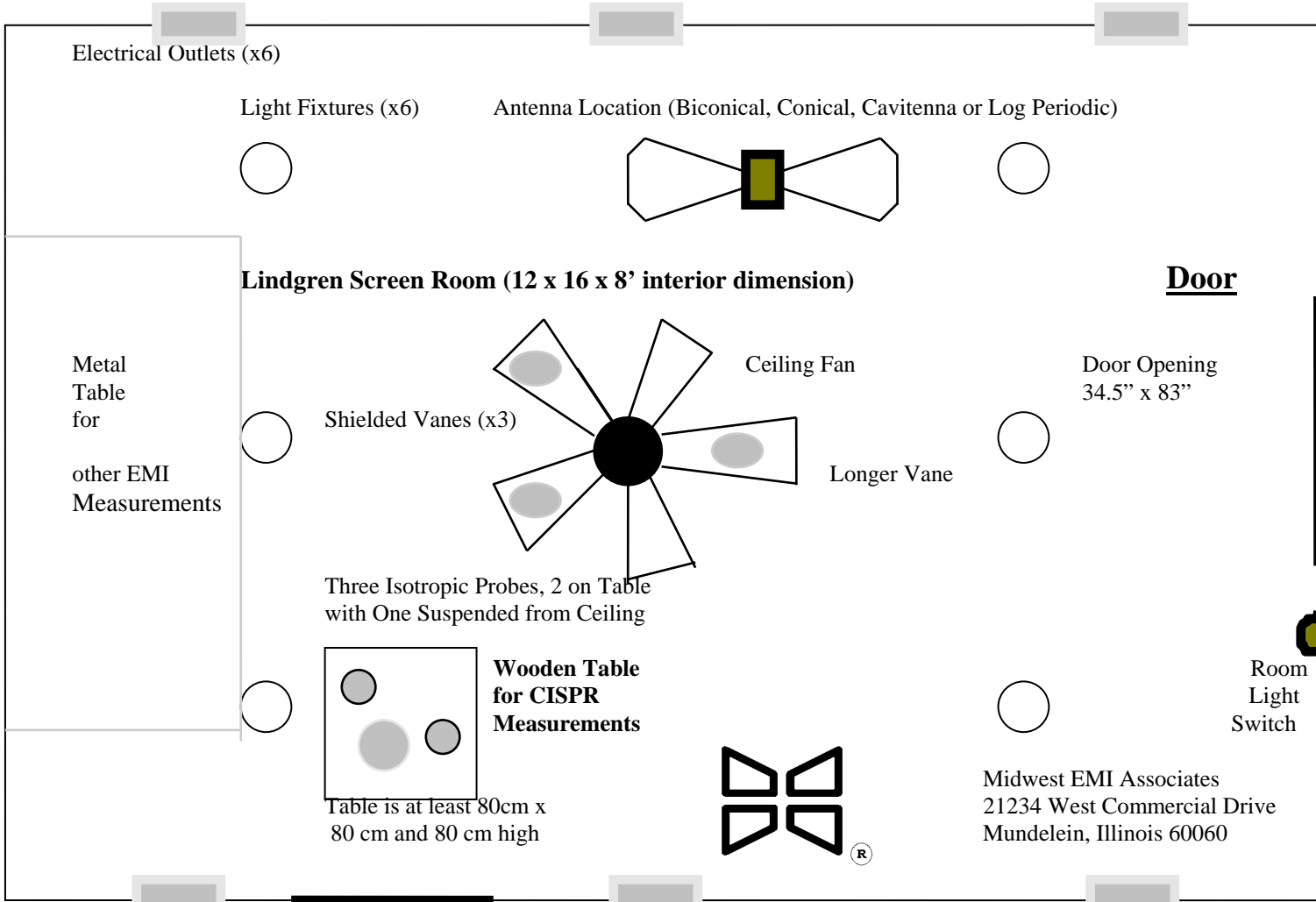
All susceptibility testing was performed on the indoor three-meter site located at Midwest EMI Associates, 21234 W. Commercial Drive, Mundelein, Illinois 60060. Some testing utilized the screened room facility. The personnel access door measures 36" by 82" as shown in the attached room diagram, Figure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

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

3.0 DESCRIPTION OF TEST SAMPLE:

The TFT EP0372 RC Hydrant Slide Valve is an electronically activated water valve that enables opening or closing a water supply from a remote location via a handheld wireless controller. The range of the system is about a quarter mile and through a proprietary mechanical linkage and low power servo uses the power from 4 AA batteries and water pressure to both turn on a major water flow as well as turn it off from anywhere in a quarter mile radius of the water hydrant. This is particularly useful in fighting fires where there are few firemen to fight a fire in multiple locations such as a large commercial building.

EMI SCREENED ROOM RADIATED SUSCEPTIBILITY CONFIGURATION



Peripheral Equipmnet

Blackened Window for Viewing EUT
Opening is 24'' by 24'' with Brass Door

Figure A

EXTERIOR DOOR
3 Meter Test Area

3.2 POWER REQUIREMENT:

The primary power supplied to the test sample was a 4 AA lithium batteries in both the RF unit and in the control module.

3.3 GROUNDING:

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

3.4 RADIATED CONFIGURATION:

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

3.5 TEST SAMPLE OPERATION:

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

4.0 DISPOSITION OF TEST SAMPLE:

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

5.0 REFERENCES:

ANSI 63.4 (2003), "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"

IEC61326-1 (2006), "Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 1: General requirements:

CISPR 22 ED. 5.2 B:2006, "Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement"

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

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

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

EN 61000-6-4 (1997-01), "Electromagnetic compatibility (EMC) - Part 6: Generic standards - Section 4: Emission standard for industrial environments"

IEC 60601-1-2 (2007-03), "Medical Electrical Equipment, Part 1: General requirements for safety. 2. Collateral Standard: Electromagnetic compatibility – requirements and tests"

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, 2004-06, "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

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

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

6.0 GENERAL INFORMATION:

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

6.1 TEST PROCEDURES:

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

6.2 TEST DESCRIPTIONS:

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

The possible range of tests that could have application either domestically or internationally are listed below along with applicable protocol numbers. The references supplied provide information on how to perform the test. CISPR 11 & 22, Military Standard 462, and EN 61000 part 4 series are used as references for all procedures.

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

particular for life sustaining equipment, Midwest EMI recommends that a larger base of tests be performed to gain an accurate understanding of product performance.

- 6.2.1 **Appendix A1 (CISPR Conducted Emissions)** - Limits are plotted for FCC or CISPR requirements for Level B emissions. *Recommended criterion of acceptability is that A or B Level emissions are passed.*
- 6.2.2 **Appendix B1 (CISPR Radiated Emissions)** - Limits are plotted for FCC or CISPR requirements for Level B emissions. For some equipment this may include electric and VDE style magnetic emissions. *Criterion of acceptability for Europe is that A or B level emissions must be passed.*
- 6.2.3 **Appendix C (EN61000-4-4 Fast Transients)** - Limits for EN 60601-1-2 and FDA Reviewer's Guide compliance are 2 KV common and 1 KV differential applied to the power cables and .5 KV applied to peripheral cables. *The criterion of acceptability is that there should be no permanent degradation in performance with the stress applied that is not recoverable automatically.*
- 6.2.4 **Appendix D (Radiated Susceptibility-EN 61000-4-3)** - Limits are 3 - 10 V/M from 10 KHz to 1 GHz per EN 61000-4-3. For this class of product the immunity of the device must exceed the 3 V/M requirement to meet the IEC 60601-1-2 requirements. *The criterion of acceptability is that there should be no degradation in performance or hardware failure when the EUT is exposed to any level lower and including the limit. In all cases the device must fail safely or it is rejected.*
- 6.2.5 **Appendix E (EN 61000-4-5 Surge Immunity Test)** - Recommended limits are 2 KV common mode and 1 KV differential mode at angles of 0, 90, 180, and 270 degrees. Ten repetitions at each condition are applied to the EUT. *The criterion of acceptability is no failure, serious malfunction or alarm may occur that is not self-recovered in 5 seconds.*
- 6.2.6 **Appendix F (EN 61000-4-6 Conducted Immunity Test)** Conducted bulk energy is applied via a voltage coupler to power leads and peripheral cables longer than 3 meters. This test is invasive in that the power line is preconditioned to allow the RF voltage to be applied to all leads of the equipment under test. It is also applied to peripheral cables using the similar coupler of the CS114 test except at a higher intensity typically. *The criterion of acceptability is that no malfunction occurs up to and including the 3 or 10 V RMS limit.*
- 6.2.7 **Appendix G (EN 61000-4-2 ESD Test)** – The EUT is exposed to high intensity electrostatic pulses up to 8 kV air or 4 kV contact discharge. *The criterion of passing this test is no adverse malfunction that is not self-recovering within 5 seconds of the termination of the pulse.*
- 6.2.8 **Appendix H (EN 61000-4-8 Magnetic Immunity Test)** – The EUT is exposed to high 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 an HP Omnibook 900 measuring system. The 6 dB impulse bandwidth settings and wideband correction factors are listed below:

TEK 2756P Analyzer

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

TEK 2712 Analyzer (Dual Analyzers in Use)

<u>Bandwidth Setting</u>	<u>Wideband 6dB Bandwidth</u>	<u>Correction Factor</u>	<u>Factor Applied</u>
5 MHz	4.92 MHz	-13.84 dB	-14 dB
1 MHz	.932 KHz	.6117 dB	0 dB
.3 MHz	.31 KHz	10.173 dB	10.5 dB
120 KHz	119 KHz	Cispr Required Bandwidth	
9 KHz	8.48 KHz	41.43 dB	41 dB
3 KHz	3300 Hz	49.63 dB	50.5 dB
1 KHz	860 Hz	61.31 dB	60 dB
200 Hz	200 Hz	73.98 dB	74 dB

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

6.4 Certificates of Calibration

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

a)	Tek2756P Spectrum Analyzer	BO20224	26 Jun 11
b)	Wavetek 2520A RF Generator	0222011	30 Jun 11
c)	Carver TFM-35 250 W/Ch. Audio Amp	3097104	1 Jun 01
d)	ENI RF Power Amplifier (525LA)	367	30 Jun 11
e)	ENI RF Power Amplifier (2100L)	129	30 Jun 11
f)	Eaton 15100B Power Amplifier	1529-07090	24 Jun 11
g)	Tektronix TDS 420 Oscilloscope	B021212	24 Jun 11
h)	EMCO 3109 Power Biconical (1/3/10 Meters)	9011-2504	17 Jun 11
i)	EMCO 3101 Power Conical	9007-3450	7 Nov 93 (1/3m)
j)	EMCO 6502 Active Loop	1038	18 Jun 11
k)	EMCO 3301B Active E Field	9009-3044	19 Jun 11

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Ref: TPT EP0372 HYDRANT VALVE.doc

l)	EMCO 3147 Wide Range Log Periodic	9102-1019	23 Jun 11
m)	EMCO 3107B Power E Field	9310-2435	N/A
m)	Amplifier Research FM1000	12456	N/A
n)	Amplifier Research FP1000	60701	21 Jun 11
o)	Amplifier Research FP1000	60488	3 Jun 11
p)	IFI EFS-4 E Field Susceptibility (Holladay 3004EX with HSE405 Probe)	39883	14 Jun 11
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 Jun 11
u)	Schaffner NSG 433 ESD Gun and Contact Discharge Adapter	107 402-664/0	30 Jun 11
v)	Solar Loop Sensor 7334-1	-----	N/A
w)	Solar Loop Sensor 9311-1	931101	N/A
x)	Solar RF Coupler 7415-3 906016	N/A	
y)	Solar Line Impedance Stabilization Network	8028-50-TS-24-BNC	N/A
z)	Solar VDE Filter Network	8907-250-TS-24-BP	N/A
aa)	Ohmic Instrument BET-300-ADL	522	25 Jun 11
ab)	Werlatone C1795 Dir. Coupler	3442	30 Jun 11
ac)	Solar Current Injection Probe Type 9108-1N	935012	N/A
ad)	Tektronix TR 503B Tracking Generator	B011216	25 Jun 11
ae)	Acme 2KVA Isolation Transformer	T-3-53042-S	N/A
af)	Xentek Extreme Isolation Transformer Model 5410 (2 in use)		
ag)	Tektronix P6202 RF Probe	-----	N/A
ah)	Staco Power Variac Type 3PN2210 (0-140VAC) 3.1KVA	N/A	
ai)	Helmholtz Coil Stepdown Xfrmr-Chicago Xfrmer Type P-6492		N/A
aj)	Goldstar Signal Generator Mod FG-2002c	201621	25 Jun 11
ak)	Holladay Magnetic Field Probe Model HI-3624	83957	15 Jun 11
al)	Tektronix 2712 Spectrum Analyzer (Quasipeak)	B022520	24 Jun 11
am)	Voltec PM100 Power Analyzer	AA04/8495	25 Jun 11
an)	EMCO 3142 Biconilog Antenna	1052	1 Jun 11
ao)	Haefely P90.1 EN 61000-4-4 Fast Transient Tester	083 593-14	19 Jun 11
ap)	Hewlett Packard 3400A AC Voltmeter	1218A14443	24 Jun 11
aq)	Amplifier Research FP2031 Isotropic Probe	18309	5 Jun 11
ar)	Haefely 250 600/00 (61000-4-5 Surge Tester)	583 334-05	19 Jun 11
as)	Fischer CISPR 14 Absorbing Clamp type F-201	235	7 Jun 11
at)	Fischer IEC 801-6 Transducer	165	23 Jun 11
au)	Solar 9123-1N Current Clamp	956015	23 Jun 11
av)	Fischer IC 801-6 CDN FCC-801-M3-25	95	7 Jun 11
aw)	Tektronix 2712 Spectrum Analyzer (Quasipeak) B022981	24 Jun 11	
ax)	C. C. Moore Automated Mast Assembly Model DAPM4/6		N/A
ay)	C. C. Moore Automated Turntable Model DTT-4	N/A	
az)	Antenna Research LPB2520	1152	20 Jun 11
ba)	Behlman Power Pass 50 Hz AC Source (50, 60, 400 Hz) 0005	N/A	
bb)	California Instruments WP1251 AC Source (50, 60 Hz)	N/A	
bc)	Plitron Extreme Toroidal Isolation Transformers (2)		
bd)	Edmund Scientific Thermometer/Hygrometer	None	31 Jun 11
be)	Coaxial Bird Pads (x2) 8306-030-N3DB	None	30 Jun 11

Typical Test Configuration



bf)	High Current Source, Associated Research 3030D	A140006	25 Jun 11
bg)	California Instruments 5001ix High Power Source	HK52945	25 Jun 11
bh)	Line Leakage tester, Associated Research 510L	130007	25 Jun 11
bi)	Hipot Tester, Associated Research 3570D	090595	25 Jun 11
bh)	GAASfet Preamplifier	None	30 Jun 11
bi)	Ametek Tachometer Model 1726	R035292	24 Jun 11
bj)	Bird Attenuator (x2), 75 Watt, 75-A-MFN-10	R035290	30 May 04
bk)	HP 8482A Power Sensor	S/N: 2652A18474	24 Jun 11
bl)	HP 435B Power Meter	S/N: 2702A17563	24 Jun 11
bm)	Simpson Model 383 Thermometer	B001531	24 Jun 11
bn)	Wavetek 27XT Voltmeter	96120787	24 Jun 11
bo)	HP 8657A Programmable Synthesizer	365	27 Jun 11
bp)	Fluke 75		24 Jun 11
bq)	Fluke 21 Series III		24 Jun 11
br)	ENI 525LA		19 Jun 11
bs)	Tek 2755P Opt 5/7	B020147	30 Jun 11
bt)	Amplifier Research FP2036 (.5-5Ghz)		04 Sep 11

7.0 CONCLUSION OF RADIO FREQUENCY INTERFERENCE EMISSIONS AND SUSCEPTIBILITY TESTS:

The TFT EP0372 HYDRANT VALVE was evaluated for all tests in the configuration requested by the sponsor group for compliance with the diagnostic instruments standards, IEC 61326-1:2006 and IEC 61000-6-3:2007. The configuration requested was that of the packaged unit system in an orientation that exercised the remote control/hydrant activation function.

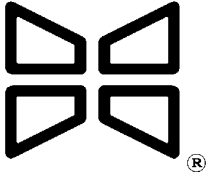
The prototype required a few changes as summarized below. After the changes were added, the device was fully functional and controlled the hydrant properly.

Changes

In the ESD test the application of ESD to the antenna mounting block caused the unit to reset. Once the block was securely grounded the resetting was eliminated. The sponsor group is evaluating alternative ways to ground the mounting block which is anodized to the housing which is not anodized on its interior.

Addendum - Week of 9/10/2010

Further testing on the ESD problem revealed that a small strap from the block to the main enclosure was successful in raising the immunity level to 8KV air and 6 KV contact. The sponsor group will apply the change and improve grounding to the retaining screw. Please see the ESD appendix for additional data.



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, VDE 0871, 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 inside a 3000 sq. ft. building located at Midwest EMI Associates, 21234 W. Commercial Drive, Mundelein Illinois. This site has flat plane above which is situated multiple 1/2" thick 4 x 8 foot wood panels with double-sided galvanized steel plates comprising an overall dimension of approximately 24 by 32 feet. The plates are interconnected by "top hat" grounding connections that is further grounded by connection to the main power ground into the earth satisfying ANSI requirements. These tests require that the antenna be raised and lowered over a 1 to 4 meter distance on an antenna mast such that the radials clear obstructions by at least 1 meter. The size of the site will accommodate three-meter Cispr measurements. All objects are clear of the ellipse defined in ANSI for a three-meter site. The antenna mast is the C.C. Moore Company automated mast assembly Model DAPM4/6 and the antenna turntable is the C.C. Moore Company automated turntable Model DTT-4.

3.0 CONFIGURATION AND OPERATION OF TEST SAMPLE:

3.1 POWER REQUIREMENT:

The TFT EP0372 HYDRANT VALVE was operated in its normal mode using a 4 lithium AA cell batteries for power.

3.2 GROUNDING:

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

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

3.3 RADIATED CONFIGURATION:

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

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

3.4 TEST SAMPLE OPERATION:

All test measurements were made with the unit in its normal measuring mode after a 3-minute power up period. The EUT was pumping at its maximum rate during this test.

3.5 TEST PROCEDURES/LIMITS OF ACCEPTANCE:

The general procedures are dictated in the individual protocols listed such as ANSI 63.4, FCC Part 15, CISPR 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 5-meter compliance tests.**

VDE LIMITS (ELECTRIC FIELDS - CISPR 11)

Above 30 MHz, the limit is written at 30 meters. From 30 MHz to 230 MHz the "A" level allowed is 30 $\mu\text{V}/\text{m}$, 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 Cisp11 B level limit is not passed then the following warning is recommended to be included in the instructions for use:

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

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

For CISPR 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 5 meters, which reflects a 6 dB increase.

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

4.0 CONCLUSION OF RADIO FREQUENCY INTERFERENCE EMISSIONS TESTS:

Preliminary Test

The device was oriented with the front of the EUT facing the antenna initially. The unit was varied in position and antenna height with a 3 meter antenna height found typically to be worst case. The orientation of the unit was typically with the control box and valve facing front at 0 degrees wrt the antenna.

Final Testing – 08-17-10

Seq. 452 shows the ambient; Seq. 458 shows the quasipeak mode in comparison in the range of 20-75 MHz. All emissions were checked with one at 72 MHz found to be from the ambient, all others found to be in compliance as confirmed by the quasipeak measurement. Tabular data is shown at the end of the graphical data.

In the 75-170 MHz range, Seq. 453 shows the ambient and Seq. 459 shows the quasipeak emissions. Ambient emissions consist of the FM band and the intentional radiators at 152-158 and 162 MHz. Emissions above the line in the mid band area were discovered to be sporadic airplane emissions. No other emissions from the EUT appeared to be above the line.

In the 160-300 MHz range, the ambient is shown on Seq. 454, and qpeak level on Seq. 460. No areas of emission from the EUT appeared to exceed the limit. Other emissions seen were from TV Channels 7 and 11, and a common carrier at about 220 MHz.

In the 300-640 MHz, the ambient is shown on Seq. 455 and the peak level emissions are shown on Seq. 461. Other high emissions are numerous UHF TV stations and they are identified. Two emissions found in this range different from the ambient were individually inspected and not found to be due to the EUT but were from limo taxi services.

In the 620-1000 MHz, the ambient is shown on Seq. 456 and peak level on Seq. 462. Other high emissions are numerous UHF TV stations and the cell telephone band around 900 MHz that is identified. When the graphs were overlaid, no excess level introduced by the EUT was seen. High emissions noticed at 924 MHz are due directly to the XBee Pro XSC radio module that is part of transmitter and receiver modules. This module has received approval from the FCC for use with the antenna specified.

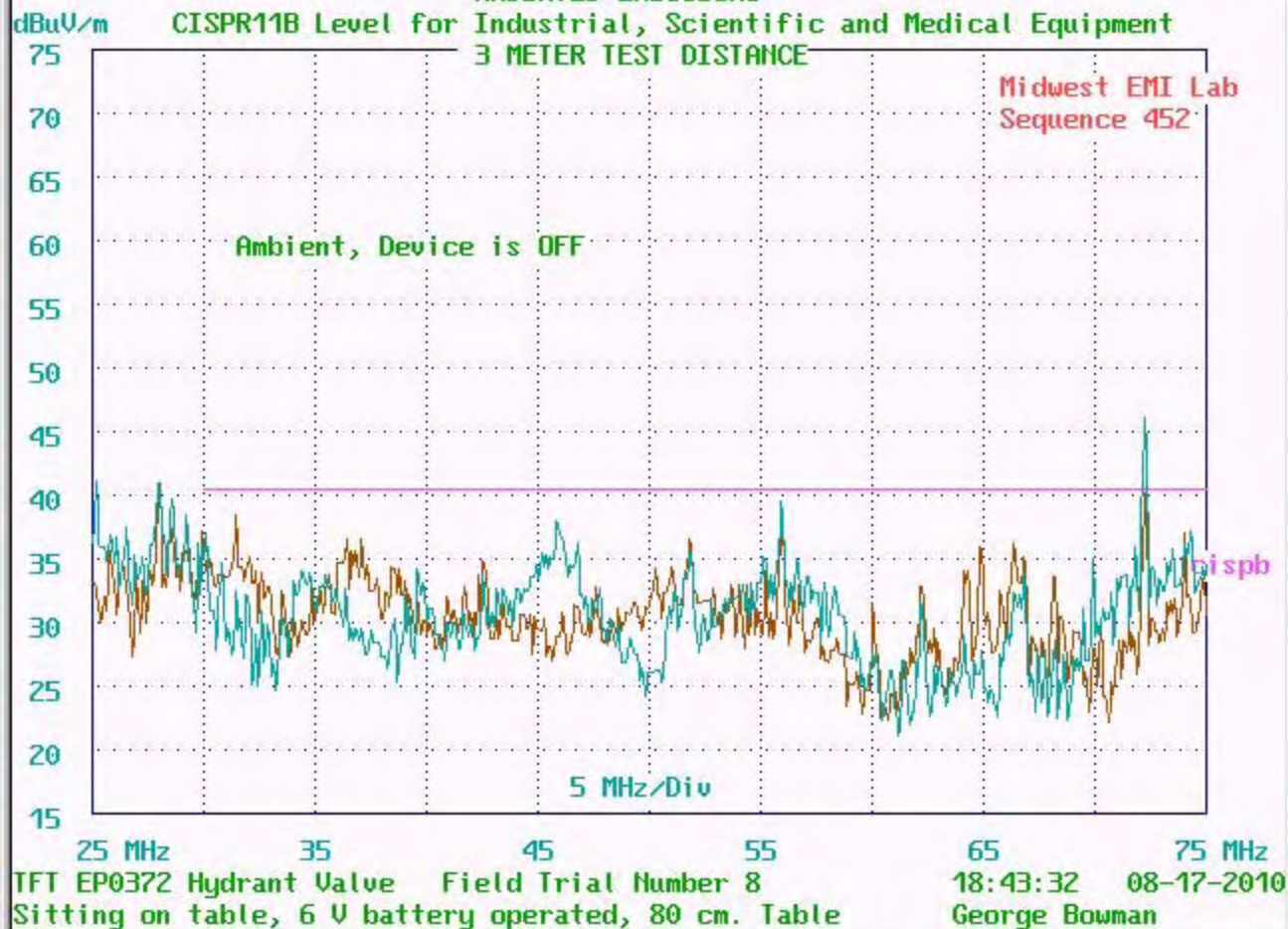
The TFT EP0372 Hydrant Valve was fully compliant with the Cispr 11 B level specification.

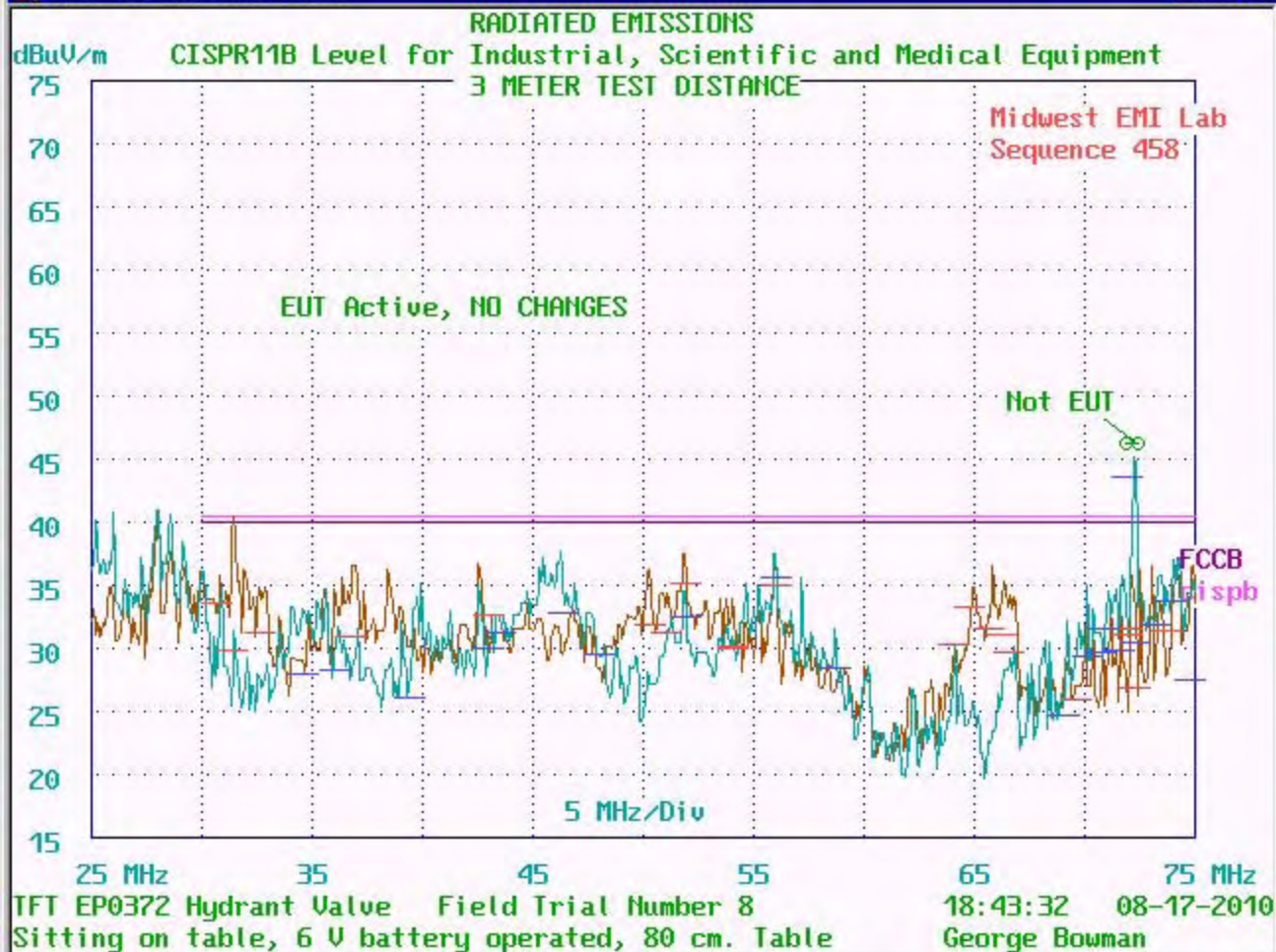


RADIATED EMISSIONS

CISPR11B Level for Industrial, Scientific and Medical Equipment

3 METER TEST DISTANCE

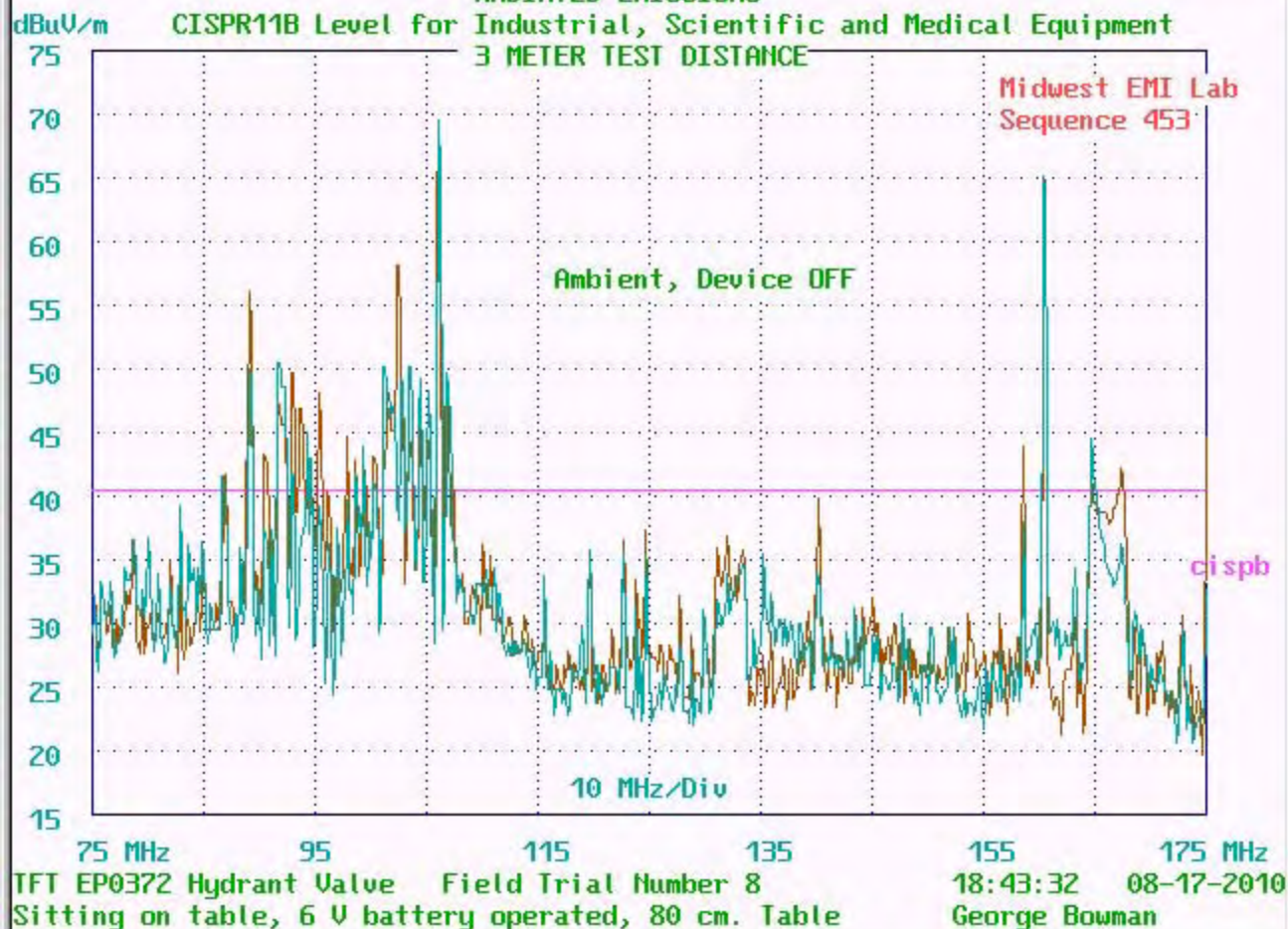




RADIATED EMISSIONS

CISPR11B Level for Industrial, Scientific and Medical Equipment

3 METER TEST DISTANCE

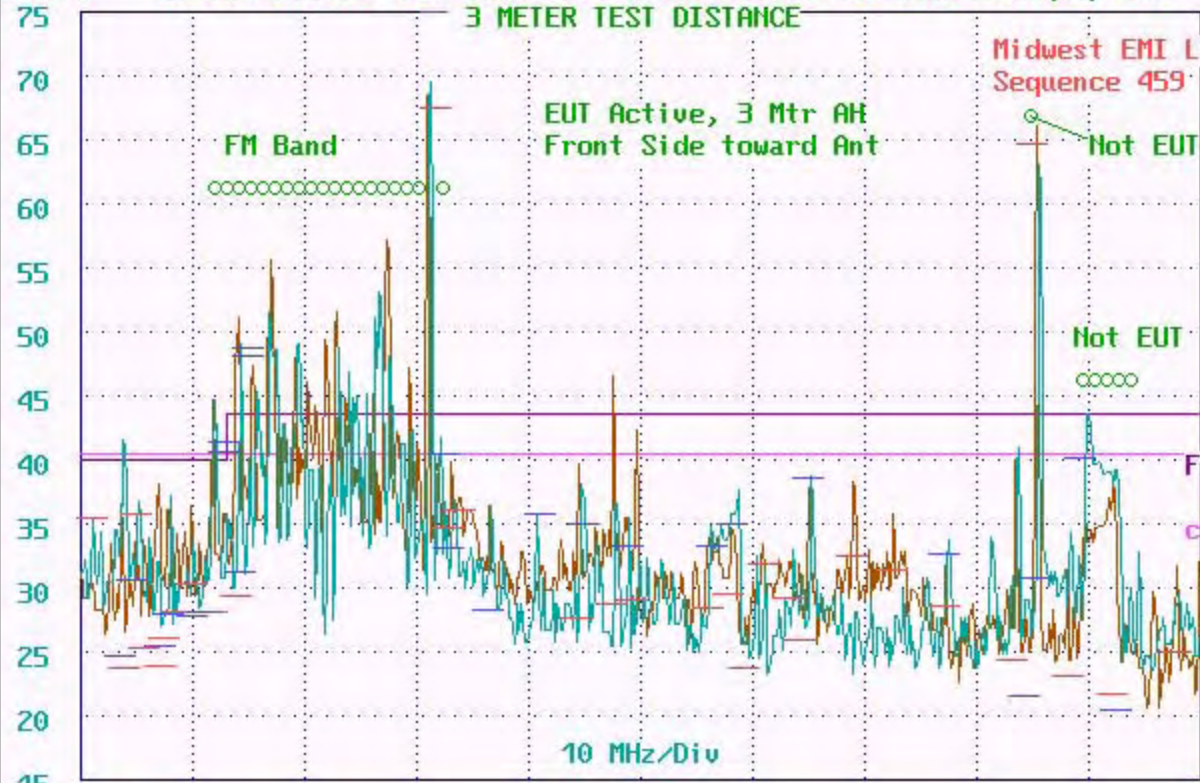


RADIATED EMISSIONS

CISPR11B Level for Industrial, Scientific and Medical Equipment

3 METER TEST DISTANCE

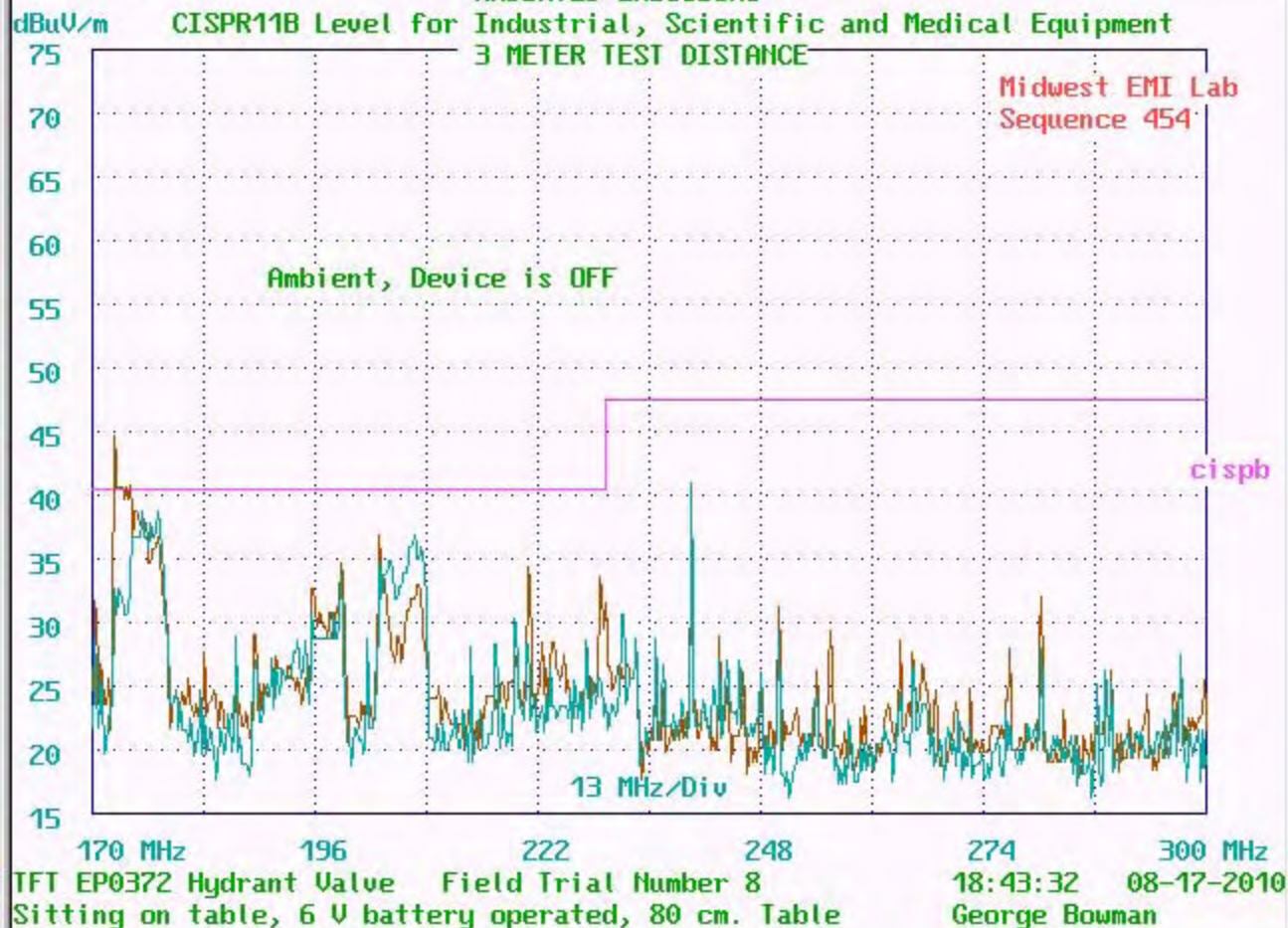
dBuV/m



RADIATED EMISSIONS

CISPR11B Level for Industrial, Scientific and Medical Equipment

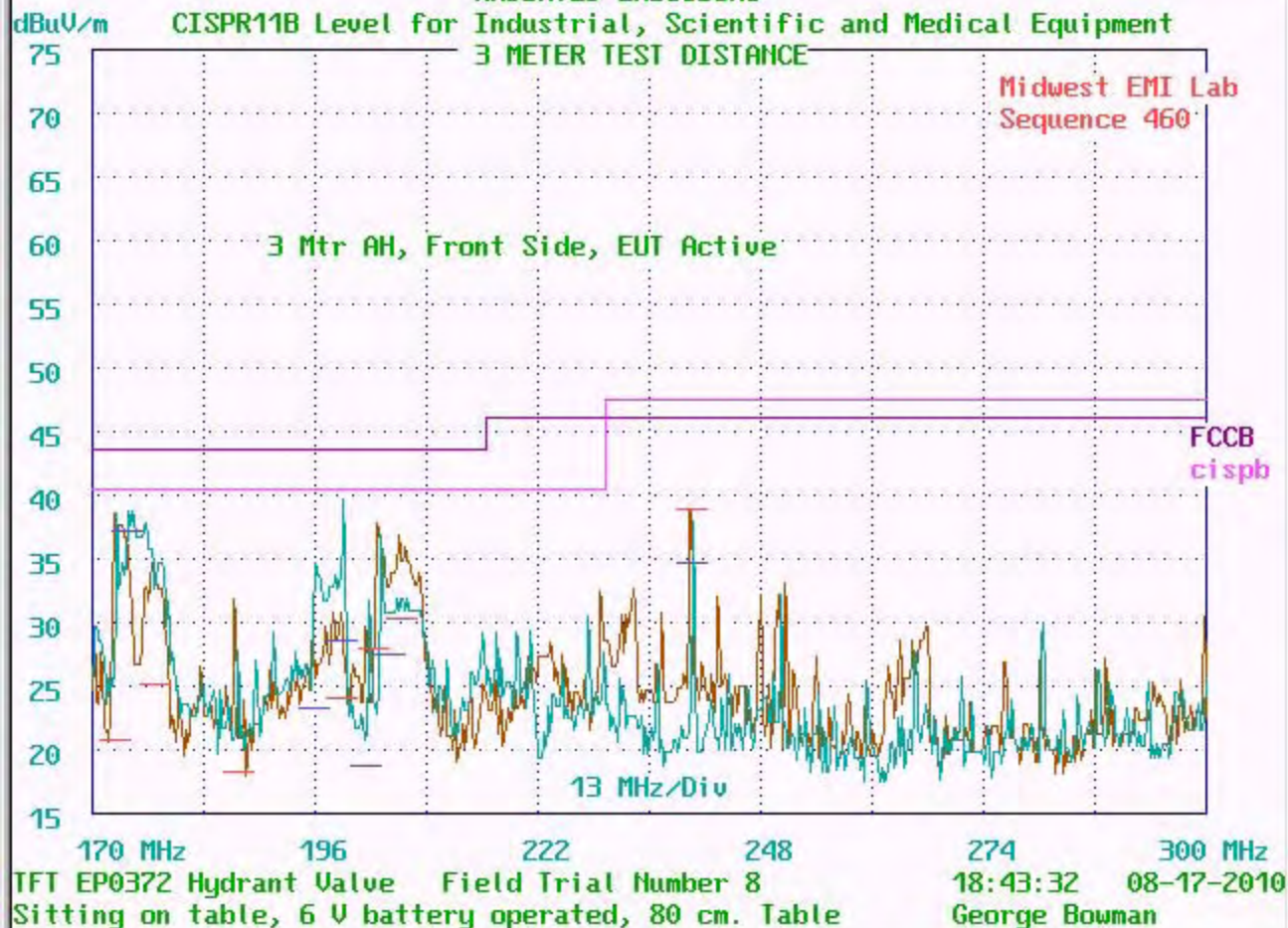
3 METER TEST DISTANCE



RADIATED EMISSIONS

CISPR11B Level for Industrial, Scientific and Medical Equipment

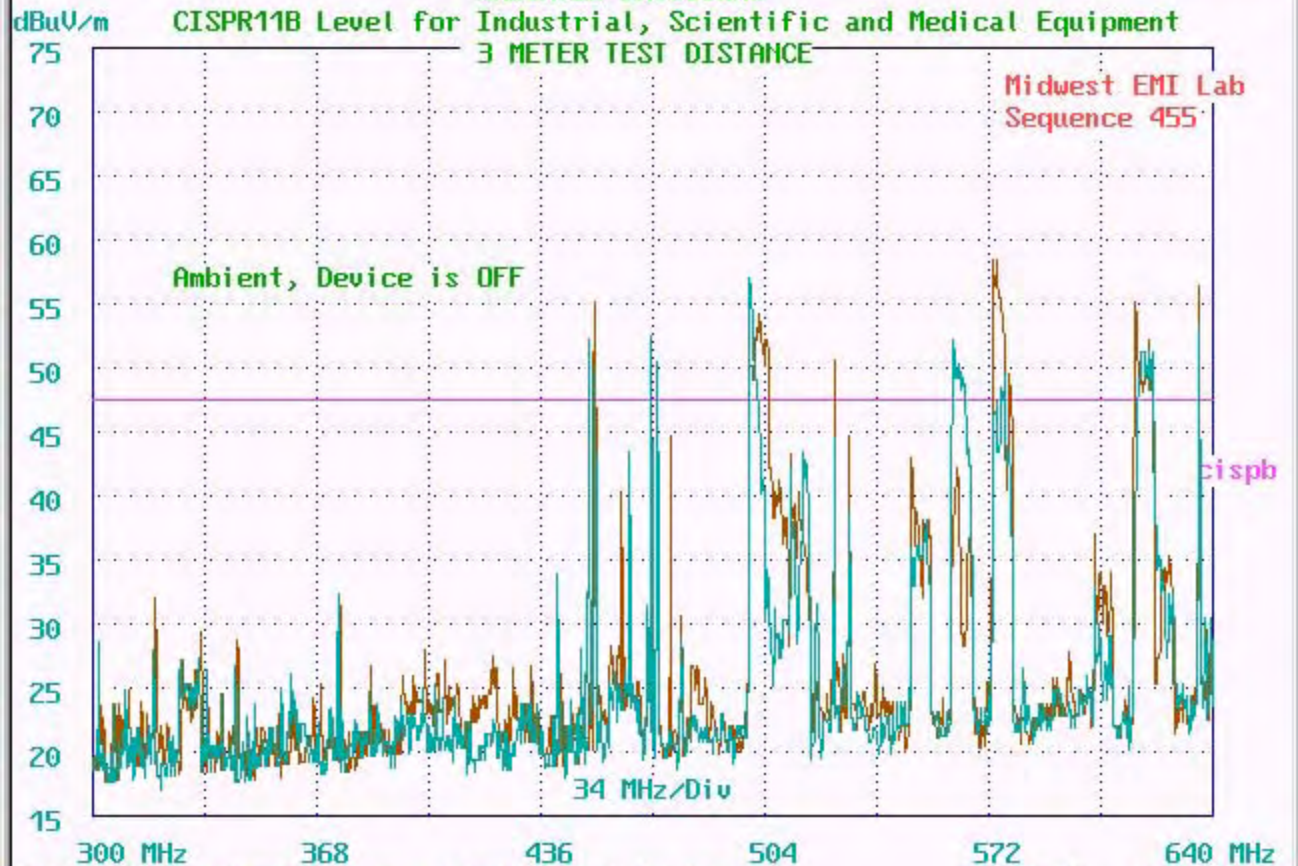
3 METER TEST DISTANCE



RADIATED EMISSIONS

CISPR11B Level for Industrial, Scientific and Medical Equipment

3 METER TEST DISTANCE



TFT EP0372 Hydrant Valve Field Trial Number 8
 Sitting on table, 6 V battery operated, 80 cm. Table

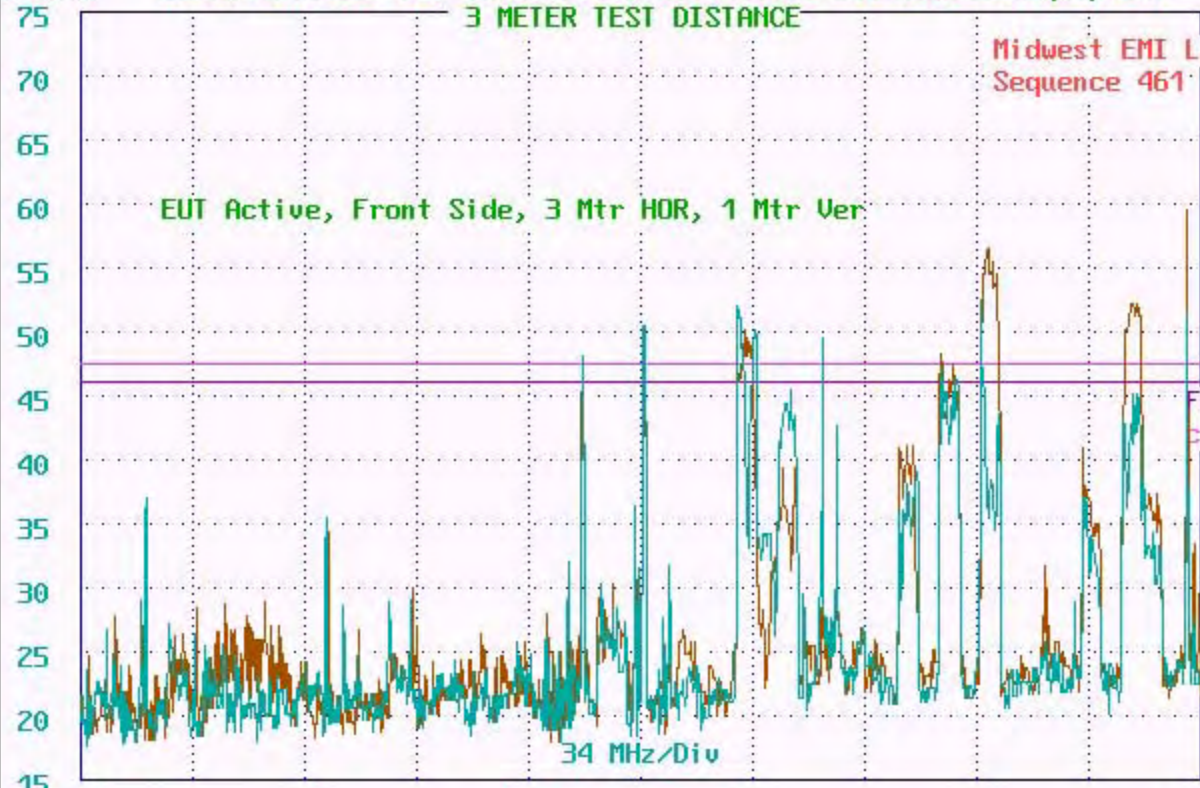
18:43:32 08-17-2010
 George Bowman

RADIATED EMISSIONS

CISPR11B Level for Industrial, Scientific and Medical Equipment

3 METER TEST DISTANCE

dBuV/m



Midwest EMI Lab
Sequence 461

EUT Active, Front Side, 3 Mtr HOR, 1 Mtr Ver

FCC
CISPR

34 MHz/Div

300 MHz

368

436

504

572

640 MHz

TFT EP0372 Hydrant Valve Field Trial Number 8

18:43:32 08-17-2010

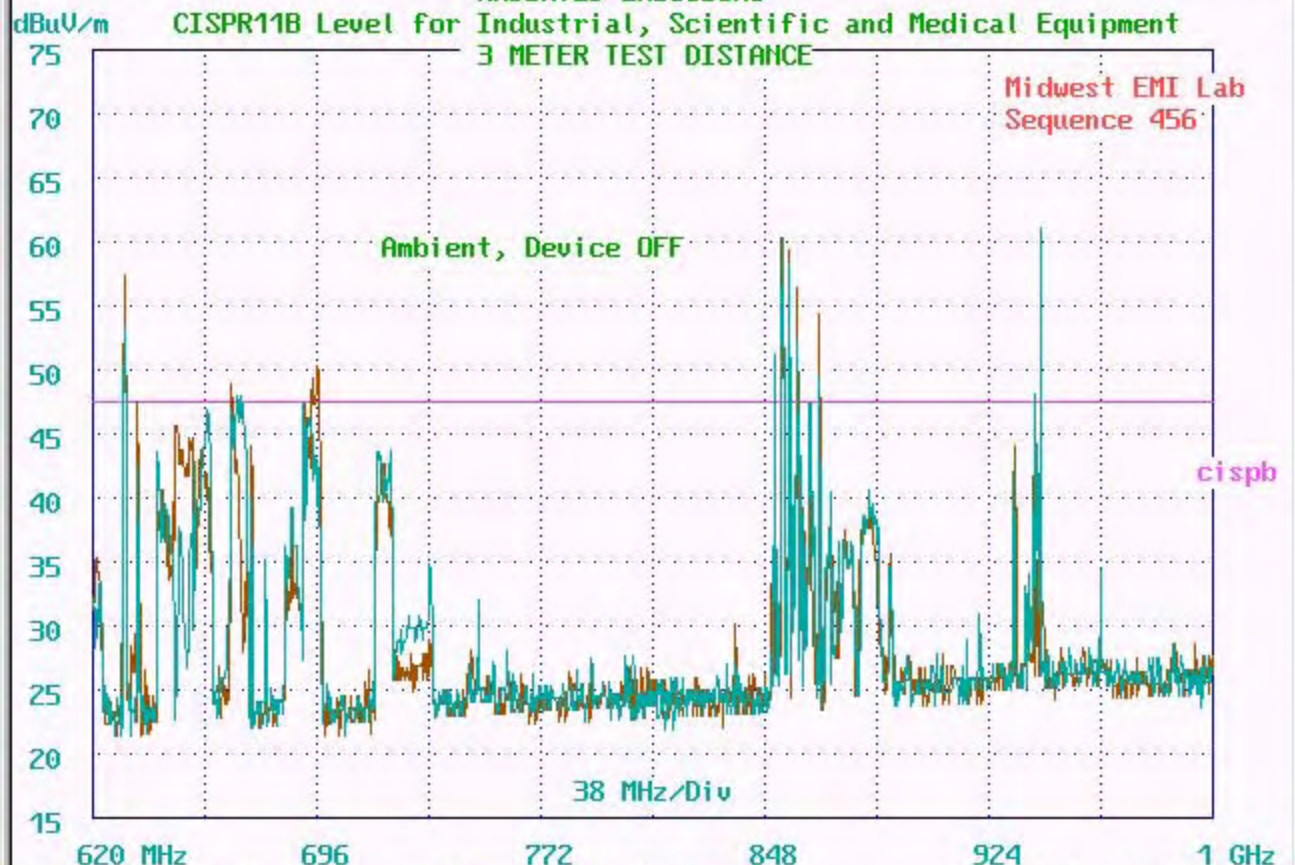
Sitting on table, 6 V battery operated, 80 cm. Table

George Bowman

RADIATED EMISSIONS

CISPR11B Level for Industrial, Scientific and Medical Equipment

3 METER TEST DISTANCE



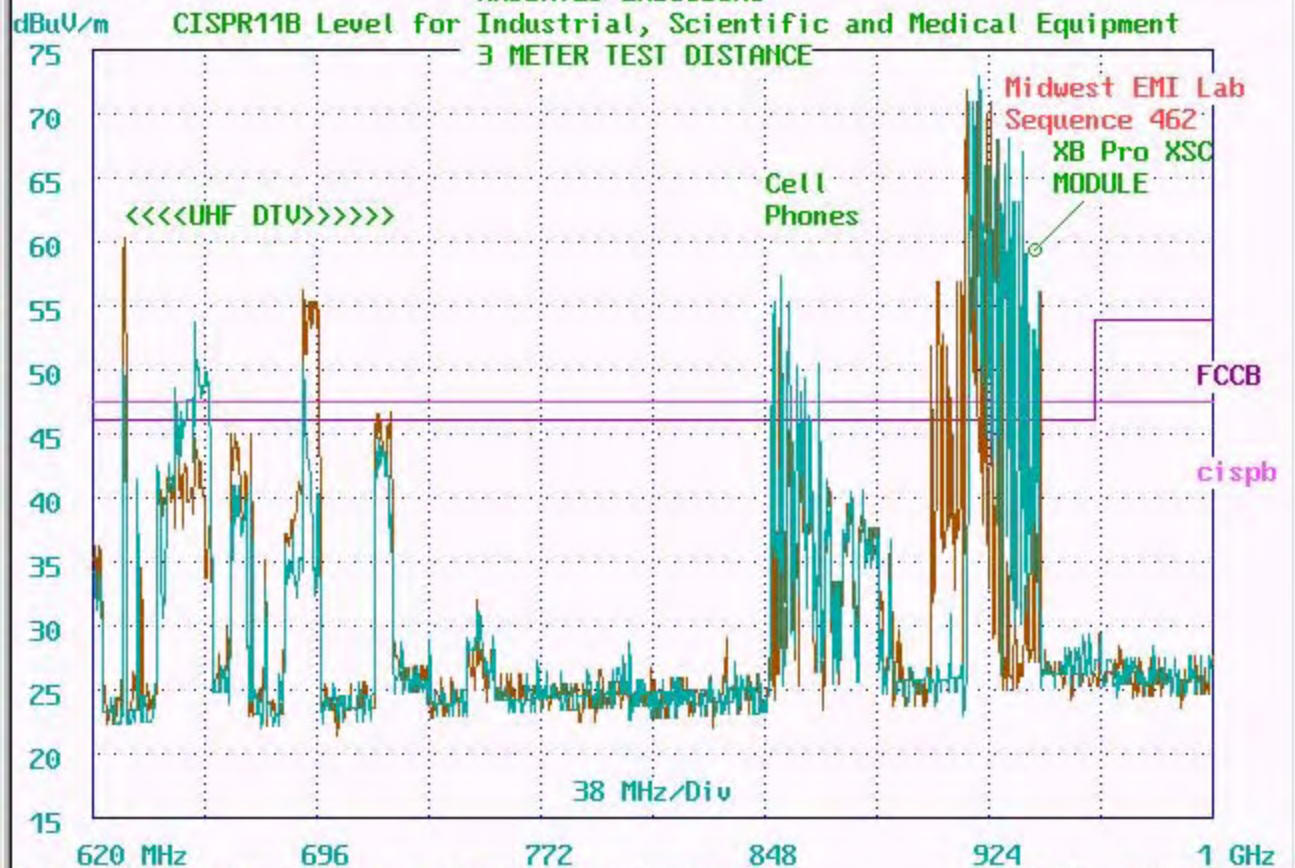
TFT EP0372 Hydrant Valve Field Trial Number 8
Sitting on table, 6 V battery operated, 80 cm. Table

18:43:32 08-17-2010
George Bowman

RADIATED EMISSIONS

CISPR11B Level for Industrial, Scientific and Medical Equipment

3 METER TEST DISTANCE



TFT EP0372 Hydrant Valve Field Trial Number 8
Sitting on table, 6 V battery operated, 80 cm. Table

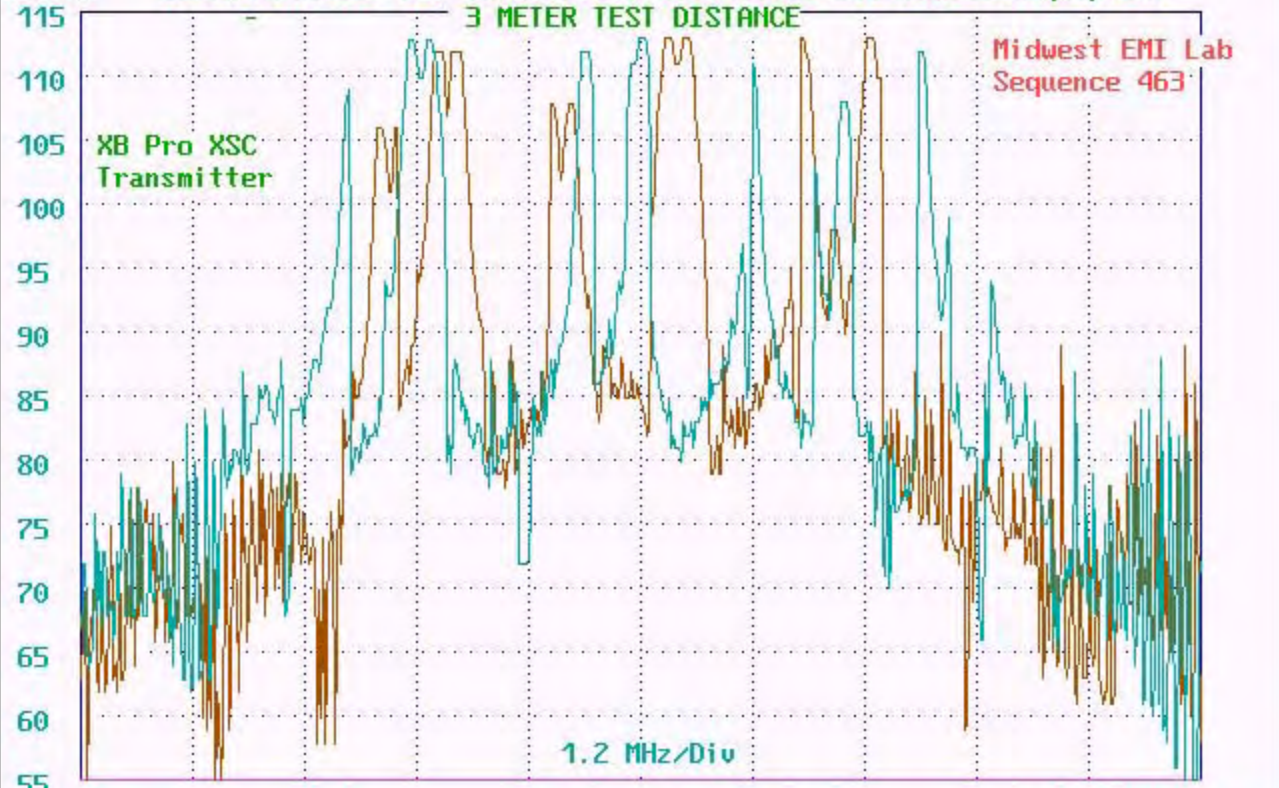
18:43:32 08-17-2010
George Bowman

RADIATED EMISSIONS

CISPR11B Level for Industrial, Scientific and Medical Equipment

3 METER TEST DISTANCE

dBuV/m



XB Pro XSC Transmitter

Midwest EMI Lab Sequence 463

1.2 MHz/Div

908 MHz

910.4

912.8

915.2001

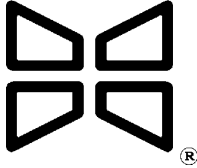
917.600920.0001 MHz

TFT EP0372 Hydrant Valve Field Trial Number 8

18:43:32 08-17-2010

Sitting on table, 6 V battery operated, 80 cm. Table

George Bowman



APPENDIX D

RADIATED RADIO FREQUENCY INTERFERENCE SUSCEPTIBILITY TEST

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

1.0 PURPOSE:

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

2.0 DESCRIPTION OF TEST APPARATUS:

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

3.0 TEST PROCEDURES:

3.1 POWER LEADS & CABLE PLACEMENT:

The TFT EP0372 HYDRANT VALVE was powered by 4 lithium AA cell batteries.

3.2 TEST SETUP:

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

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

3.3 MODULATION:

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

3.4 ANTENNAS AND AMPLIFIERS:

The radiating antennas/amplifiers used during the test were:

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

4.0 LIMITS AND RESULTS OF TEST:

4.1 RADIATED LIMITS:

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

4.2 RESULTS OF TEST:

The TFT EP0372 HYDRANT VALVE was exposed to a 13 V/M immunity wave from 30 to 1000 MHz with 1000 Hz, 80% modulation. It was also exposed to the same field in the 900 to 925 MHz cellular phone test using 200 Hz, 100% square wave modulation. It was also tested from 1000-2700 MHz without noticeable problems.

During testing the system was continuously monitored for correct functioning so that a) the remote control unit updated properly and continuously and 2) did not stop or change operational mode during testing. During the test the following adverse reactions were checked for:

- 1) The remote control unit commanded the valve to open and close
- 2) The valve unit responded to the command and activated its open and close function

No changes were necessary to keep the two units communicating properly even when the frequency of operation went through the passband (the design is frequency agile and hopping).

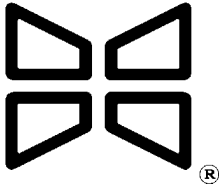
The EUT passed with an A acceptance level.

Radiated Immunity Test



Date: _____ Page ___ of ___		EN 61000-4-3 Worksheet		Midwest EMI Associates Mundelein, Illinois		Form: EN 61000-4-3	
Device: <u>EP0372</u>			Sponsor: <u>TET</u>		Date: <u>8/17/2010</u> S/W Ver: <u>1.00</u> S/N: <u>FT8</u>		
Tests Performed: Radiated (Conducted) (Magnetic) (CS114)		Probes: (CS114) (Fischer CDN) (A/R) (FP2031) (A/R FP2036) (A/R FP1000) (Solar Injection Clamps)			Technician: <u>JB</u> Project No: <u>EP0372</u>		
Mod Freq: 2 10 100 <u>1000</u> Hz		Modulation Depth: 50% <u>80%</u> 100% Other: _____			POWER: 230 208 120 VAC or _____ VDC Power Frequency: (50) (60) (400) Hz <u>9.5/00</u>		
Room of Test (Scrnrm) (2 Mtr) (5 Mtr) (Outside) Pos: (A) (B) (C)		Antennae: B=Biconical, C=Conical L=Log Periodic, BL=Biconilog, <u>H=HORN</u> V=Vertical, H=Horizontal Polarization			Orientation: (Pole Stand) (<u>Wooden Table</u>) (Copper Table) (Floor) (Back Room)		
Frequency (M=MHz) (K=KHz)	Inc Freq (KHz) or (%) if blank	Immunity Level (V) (<u>V/M</u>)	Dwell Time: (Sec)	Antenna Type	Results: Include any Failure Modes Observed in the FUT during the test Video Cam. ra System Used? (Yes) (No)		
<u>1000</u>	<u>190</u>	<u>13</u>	<u>7</u>	<u>H^H</u>	<u>Bring up, ADK, HDR</u>		
<u>1233</u>	"	"	"	"	"		
<u>2200</u>	"	"	"	"	" " "		
<u>1000</u>	<u>190</u>	<u>13</u>	<u>7</u>	<u>H^V</u>	<u>Bring up, ADK, Vest</u>		
<u>1350</u>	"	"	"	"	" " "		
<u>2200</u>	"	"	"	"	" " " "		
<u>2200</u>	<u>190</u>	<u>13</u>	<u>7</u>	<u>H^V</u>	<u>Bring up, ADK, Vest</u>		
<u>2700</u>	"	"	"	"	" " " "		
<u>2200</u>	<u>190</u>	<u>13</u>	<u>7</u>	<u>H^H</u>	<u>Bring up, ADK, HDR</u>		
<u>2700</u>	"	"	"	<u>H^H</u>	" " " "		

Notes:



APPENDIX G

ELECTROSTATIC DISCHARGE TEST

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

1.0 PURPOSE:

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

2.0 DESCRIPTION OF TEST APPARATUS:

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

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

3.0 TEST PROCEDURES:

3.1 POWER LEADS:

The **TFT EP0372 HYDRANT VALVE** was powered by 4 AA lithium batteries.

3.2 TEST SETUP:

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

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

3.3 TEST METHOD: Qualification Test (Single Shot Only)

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

4.0 RESULTS OF TEST (08-16-10) and (08-18-2010)

The ESD test was conducted on 20 surfaces in areas showing cracks in the package, switches, connectors or screws. The EUT was subjected to ESD intensity levels of 2, 4 and 6 KV in contact discharge as well as 2, 4, 6 and 8 KV in air discharge mode. The display itself was not found to allow an arc into sensitive control lines, and the periphery of the display arced into metal.

The following symptoms were noted during the test:

All areas but the antenna mounting block were immune to the ESD effects. On that surface the unit could be made to reset at 8 KV applied. The sponsor group applied a better grounding method to the block and that was effective but the final solution has not been designed in. Future testing will firm up the exact corrective method for ESD on the antenna mounting block.

ADDENDUM - A 3/32 inch wide 2 inch strap was added between the movable block that is attached to the antenna and to the body of the enclosure using screws and ring terminals. After this change and after additionally making sure the tie point was clean of anodization the unit was retested and passed all requirement of 8KV air and 6 KV contact discharge. The unit was completely retested to the standard and passed.

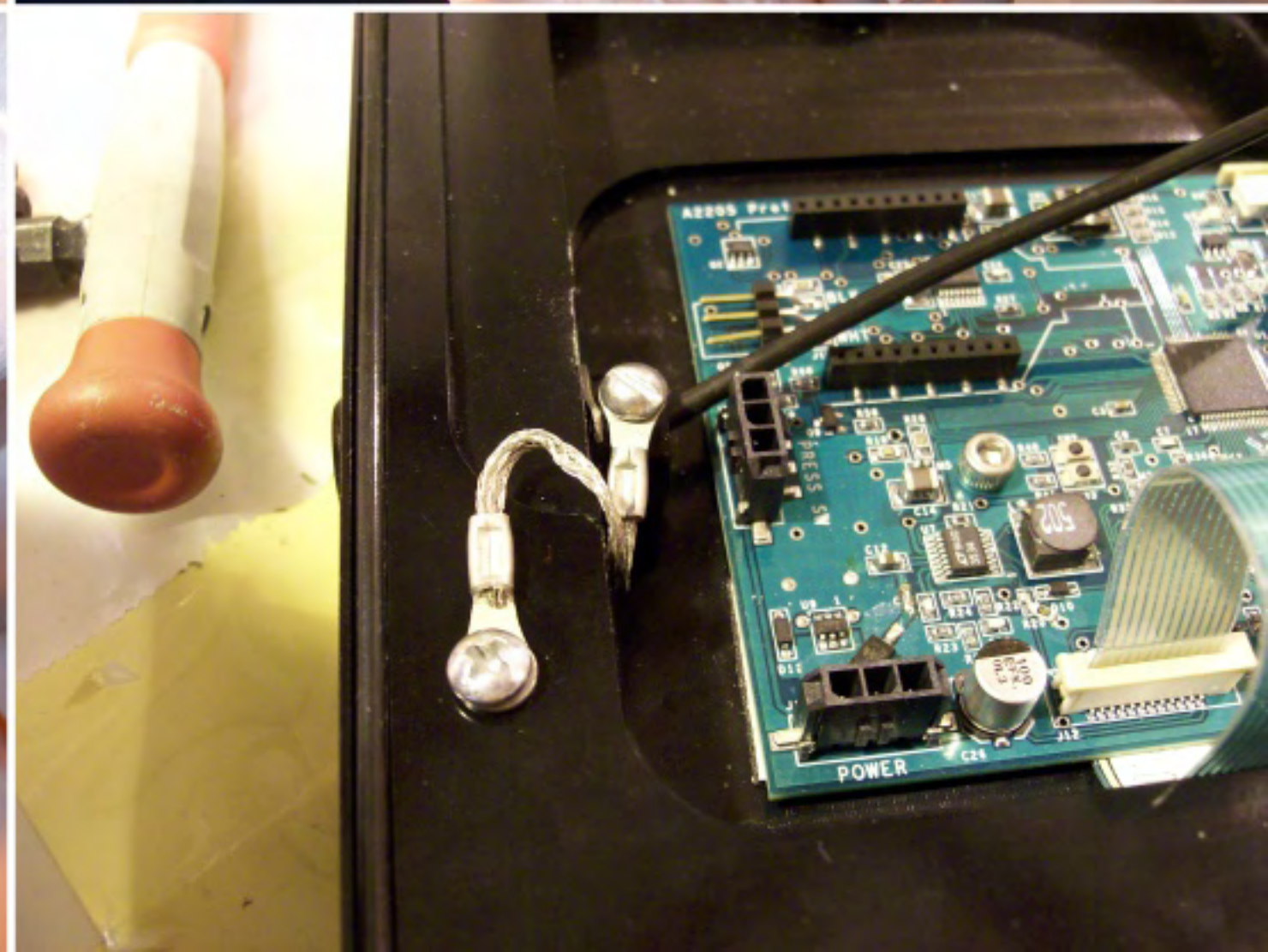
See the followup data at the end of this Appendix.

ESD TEST LOCATIONS
TFT EP0372 HYDRANT VALVE

TEST POINT	Description
1	HCP
2	Battery Com Screw
3	Valve Handle
4	Valve Coupling Ball Groove
5	Right Mounting Foot
6	Right Lid Mount Screw
7	Upper RH Side Display
8	Middle Lower Display
9	Antenna Base
10	Position Indicator
11	Battery Compartment Vent Hole
12	Interior of Display
13	Left Lower Screw Handheld
14	Upper Right Hand Cover Handheld
15	Lower Mid Display Handheld
16	Bottom of Enclosure Handheld
17	Antenna Itself Handheld
18	Upper Fron Case Half Handheld
19	VCP
20	
21	
22	
23	
24	
25	
26	

Note: Photograph of locations are attached





Sponsor Group: Task Force Tips Serial Number: EMI Proto
 Manager: Tim Miller Temp: 79.3°F Hum: 59.2% Technician: GB S/W ver.: 1.0.0.FT2

Date of Test: 8/18/10 Time: 9:50 AM 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 120VAC 50Hz
 Note: All Points are Tested with 10 Shots in Single Shot Mode each phase unless otherwise stated

VALVE

Reference:		TEST POINT: <u>BAI COM SCREW</u>				TEST POINT: <u>HCP</u>			
EN 61000-4-2		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	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK
3	3								
4	4	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK
5	5								
6	6	(*) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK
7	7								
8	8	(✓) ^{unit} _{pass}		(✓) OK		(✓) OK		(✓) OK	
9	9	① Fixed problem		①					
10	10								

Reference:		TEST POINT: <u>VALVE HANDLE (LEFT)</u>				TEST POINT: <u>VALVE COUPLING BRADUE</u> ^{BALL}			
EN 61000-4-2		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	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK
3	3								
4	4	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓)	(✓) OK	(✓)	(✓) OK
5	5								
6	6	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓)	(✓) OK	(✓)	(✓) OK
7	7								
8	8	(✓) OK		(✓) OK		(✓) OK		(✓) OK	
9	9								
10	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: ① Added 1V5 and 0.01uF cap to power button resistor (R3)
 → changed to .1uF

Sponsor Group: Task Force Tips Serial Number: EMI Proto
 Manager: Tim Miller Temp: 79.3°F Hum: 59.2% Technician: GB S/W ver.: 1.0.0.FT2

Date of Test: 8/18/10 Time: 9:50 AM 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 120VAC 50Hz
 Note: All Points are Tested with 10 Shots in Single Shot Mode each phase unless otherwise stated

Reference:		TEST POINT: <u>RIGHT MAINLINE FEET</u>				TEST POINT: <u>RIGHT LID MOUNT SCREW</u>			
EN 61000-4-2		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	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK
3	3								
4	4	(✓) ↓	(✓) OK	(✓) ↓	(✓) OK	(✓) ↓	(✓) OK	(✓) ↓	(✓) OK
5	5								
6	6	(✓) ↓	(✓) OK	(✓) ↓	(✓) OK	(✓) ↓	(✓) OK	(✓) ↓	(✓) OK
7	7								
8	8	(✓) OK		(✓) OK		(✓) OK		(✓) OK	
9	9								
10	10								

Reference:		TEST POINT: <u>UPPER RH SIDE DISPLAY</u>				TEST POINT: <u>MIDDLE LOWER DISPLAY</u>			
EN 61000-4-2		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	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK
3	3								
4	4	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK
5	5								
6	6	(*) ↓	(✓) OK	(✓)	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK
7	7								
8	8	(*) OFF		(✓)		(*) *		(✓)	
9	9								
10	10								

① Filed Log TVS +

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: _____

Sponsor Group: Task Force Tips Serial Number: EMI Proto
 Manager: Tim Miller Temp: 79.3°F Hum: 59.2% Technician: GB S/W ver.: 1.0.0.FT2

Date of Test: 8/18/10 Time: 9:50 AM 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 120VAC 50Hz
 Note: All Points are Tested with 10 Shots in Single Shot Mode each phase unless otherwise stated

PAVKE

Reference:		TEST POINT: <u>ANTENNA BASE</u>				TEST POINT: <u>POSITION INDICATOR</u>			
EN 61000-4-2		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	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK
3	3								
4	4	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK
5	5								
6	6	(*)	(*)	(✓)	(✓)	(✓) OK	(✓) OK	(✓) OK	(✓) OK
7	7								
8	8	(✓)	↓	(✓)		(✓) * WAIT		(*) x	
9	9		↓			Ⓟ Fired		Ⓟ Fired	
10	10		↓						

Reference:		TEST POINT: <u>VENT HOLE</u>				TEST POINT: <u>Antenna & Display</u>			
EN 61000-4-2		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	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(N/A)	(N/A)	(N/A)	(N/A)
3	3								
4	4	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(N/A)	(N/A)	(N/A)	(N/A)
5	5								
6	6	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(N/A)	(N/A)	(N/A)	(N/A)
7	7								
8	8	(✓) OK		(✓) *		(N/A)		(N/A)	
9	9								
10	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: Antenna anywhere had no arc (plastic part)

Sponsor Group: Task Force Tips Serial Number: EMI Proto
 Manager: Tim Miller Temp: 79.3°F Hum: 59.2% Technician: GB S/W ver.: 1.0.0.FT2
 Date of Test: 8/18/10 Time: 9:50 AM 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 120VAC 50Hz
 Note: All Points are Tested with 10 Shots in Single Shot Mode each phase unless otherwise stated
HANDHELD

Reference:		TEST POINT: <u>HCP</u>				TEST POINT: <u>Left Jones Screw</u>			
EN 61000-4-2		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	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK
3	3								
4	4	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK
5	5								
6	6	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK
7	7								
8	8	(✓) OK		(✓) OK		(✓) OK		(✓) OK	
9	9								
10	10								

Reference:		TEST POINT: <u>Upper R Hand Screw</u>				TEST POINT: <u>Lower Right Display</u>			
EN 61000-4-2		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	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK
3	3								
4	4	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK
5	5								
6	6	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK
7	7								
8	8	(✓) OK		(✓) OK		(✓) OK		(✓) OK	
9	9								
10	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: _____

Sponsor Group: Task Force Tips **Serial Number:** EMI Proto
Manager: Tim Miller **Temp:** 79.3°F **Hum:** 59.2% **Technician:** GB S/W ver.: 1.0.0.FT2

Date of Test: 8/18/10 **Time:** 9:50 AM **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 120VAC 50Hz
Note: All Points are Tested with 10 Shots in Single Shot Mode each phase unless otherwise stated

Reference:		TEST POINT: <u>Bottom of Small</u>				TEST POINT: <u>VCP</u>			
EN 61000-4-2		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	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK
3	3								
4	4	(✓)	(✓) OK	(✓)	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK
5	5								
6	6	(✓)	(✓) OK	(✓)	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK
7	7								
8	8	(✓) OK		(✓) OK		(✓) OK		(✓) OK	
9	9								
10	10								

Reference:		TEST POINT: <u>Antenna Stub</u>				TEST POINT: <u>Upper Front Case Half</u>			
EN 61000-4-2		PLUS POLARITY		MINUS POLARITY		PLUS POLARITY		MINUS POLARITY	
REF. LINE	KILO VOLTS	Air D/charge	CONTACT Mode	Air D/charge	CONTACT Mode	Air D/charge	CONTACT Mode	Air D/charge	CONTACT Mode
1	1								
2	2	(✓) N/A	(✓) NT	(✓) N/A	(✓) NT	(✓) OK	(✓) OK	(✓) OK	(✓) OK
3	3								
4	4	(✓)	(✓)	(✓)	(✓)	(✓) OK	(✓) OK	(✓) OK	(✓) OK
5	5								
6	6	(✓)	(✓) NT	(✓)	(✓) NT	(✓) OK	(✓) OK	(✓) OK	(✓) OK
7	7								
8	8	(✓) N/A		(✓) N/A		(✓) OK		(✓) OK	
9	9								
10	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: AOX

Sponsor Group: Task Force Tips Serial Number: EMI Proto
 Manager: Tim Miller Temp: 79.3°F Hum: 59.2% Technician: GB S/W ver.: 1.0.0.FT2
 Date of Test: 8/18/10 Time: 9:50 AM 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 120VAC 50Hz
 Note: All Points are Tested with 10 Shots in Single Shot Mode each phase unless otherwise stated

HANDHELD

Reference:		TEST POINT: <u>Midstake Top Post</u>				TEST POINT: <u>Nut on Heat Base</u>			
EN 61000-4-2		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	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK
3	3								
4	4	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK
5	5								
6	6	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK	(✓) OK
7	7								
8	8	(✓) OK		(✓) OK		(✓) OK		(✓) OK	
9	9								
10	10								

Reference:		TEST POINT: <u>Amperage Display</u>				TEST POINT: <u>Rear Screw Hole</u>			
EN 61000-4-2		PLUS POLARITY		MINUS POLARITY		PLUS POLARITY		MINUS POLARITY	
REF. LINE	KILO VOLTS	Air D/charge	CONTACT Mode	Air D/charge	CONTACT Mode	Air D/charge	CONTACT Mode	Air D/charge	CONTACT Mode
1	1								
2	2	(✓) N/A	(✓) NT	(✓) N/A	(✓) NT	(✓) OK	(✓) OK	(✓) OK	(✓) OK
3	3								
4	4	(✓)	(✓)	(✓)	(✓)	(✓) OK	(✓) OK	(✓) OK	(✓) OK
5	5								
6	6	(✓)	(✓) NT	(✓)	(✓) NT	(✓) OK	(✓) OK	(✓) OK	(✓) OK
7	7								
8	8	(✓) N/A		(✓) N/A		(✓) OK		(✓) OK	
9	9								
10	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: ADK

Data Sheet <u>1</u> of <u>3</u>	ESD DATA SHEET Schaffner NSG 435 Gun	Midwest EMI Associates Mundelein, Illinois	Form: Issued 11/22/09 MEMI-1A
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Sponsor Group: Task Force 7EPs Serial Number: EMI PROTO
 Manager: JEM MILLER Temp: 73.2 °F Hum: 61.8% Technician: MS S/W ver.:

Date of Test 9/16/10 Time: 11:07 EUT: Prototype / Unit
 Placement of EUT: ESD Table Pole Mount Wood Table FLOOR
 Grounding: Pole Terminal Strip FLOOR 1 Meg to Metal Frame of EUT.

Configuration of EUT: _____
 Note: All Points are Tested with 10 Shots in Single Shot Mode Unless Otherwise Stated

VALVE

Reference:		TEST POINT: <u>BAT COM SCREW</u>				TEST POINT: <u>HCP</u>			
EN 61000-4-2		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	NA	NA	NA	NA	NA	✓	NA	✓
3	3								
4	4	NA	NA	NA	NA	NA	✓	NA	✓
5	5								
6	6	NA	NA	NA	NA	NA	✓	NA	✓
7	7								
8	8	✓		✓		✓		✓	
9	9								
10	10								

Reference:		TEST POINT: <u>VALVE HANDLE LEFT</u>				TEST POINT: <u>VALVE COUPLING BALL</u>			
EN 61000-4-2		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	NA	NA	NA	NA	NA	NA	NA	NA
3	3								
4	4	NA	NA	NA	NA	NA	NA	NA	NA
5	5								
6	6	NA	NA	NA	NA	NA	NA	NA	NA
7	7								
8	8	✓		✓		✓		✓	
9	9								
10	10								

Notes: A Checkmark (✓) means the device passed the 10 shots successfully with a discharge being seen. A blank (NT) means the point was not tested. (NA) means no discharge seen. A Star sign (*) means a failure occurred. Notes: _____

Data Sheet <u>2</u> of <u>3</u>	ESD DATA SHEET Schaffner NSG 435 Gun	Midwest EMI Associates Mundelein, Illinois	Form: Issued 11/22/09 MEMI-1A
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Sponsor Group: TASK FORCE 73P Serial Number: BMI PR010
 Manager: JIM MILLER Temp: 73.2°F Hum: 61.8% Technician: M.S S/W ver.: _____

Date of Test 9/16/10 Time: 11:07 EUT: Prototype / _____ Unit _____
 Placement of EUT: ESD Table Pole Mount _____ Wood Table _____ FLOOR _____
 Grounding: Pole _____ Terminal Strip FLOOR _____ 1 Meg to Metal Frame of EUT. _____

Configuration of EUT: _____

Note: All Points are Tested with 10 Shots in Single Shot Mode Unless Otherwise Stated

VALVE

Reference:		TEST POINT: <u>RIGHT FRONT FOOT</u>				TEST POINT: <u>RIGHT LID SCREW</u>			
EN 61000-4-2		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	NA	NA	NA	NA	NA	NA	NA	NA
3	3								
4	4	NA	NA	NA	NA	NA	NA	NA	NA
5	5								
6	6	NA	NA	✓	NA	NA	NA	✓	NA
7	7								
8	8	✓		✓		✓		✓	
9	9								
10	10								

Reference:		TEST POINT: <u>UPPER RH SIDE DISPLAY</u>				TEST POINT: <u>MIDDLE LOWER DISPLAY</u>			
EN 61000-4-2		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	NA	NA	NA	NA	NA	NA	NA	NA
3	3								
4	4	NA	NA	NA	NA	NA	NA	NA	NA
5	5								
6	6	NA	NA	NA	✓	NA	NA	NA	NA
7	7								
8	8	✓		✓		✓		✓	
9	9								
10	10								

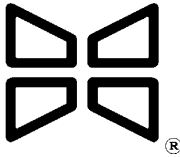
Notes: A Checkmark (✓) means the device passed the 10 shots successfully with a discharge being seen. A blank (NT) means the point was not tested. (NA) means no discharge seen. A Star sign (*) means a failure occurred. Notes: _____

Data Sheet <u>3</u> of <u>3</u>	ESD DATA SHEET Schaffner NSG 435 Gun	Midwest EMI Associates Mundelein, Illinois	Form: Issued 11/22/09 MEMI-1A
Sponsor Group: <u>TASK FORCE TIPS</u> Serial Number: <u>BMI PROTO</u> Manager: <u>Tom Miller</u> Temp: <u>73.2</u> °F Hum: <u>61.8</u> % Technician: <u>M.S</u> S/W ver.: _____			
Date of Test <u>9/6/10</u> Time: <u>11:07</u> EUT: Prototype / _____ Unit _____ Placement of EUT: ESD Table <input checked="" type="checkbox"/> Pole Mount _____ Wood Table _____ FLOOR _____ Grounding: Pole _____ Terminal Strip <input checked="" type="checkbox"/> FLOOR _____ 1 Meg to Metal Frame of EUT. _____ Configuration of EUT: _____ Note: All Points are Tested with 10 Shots in Single Shot Mode Unless Otherwise Stated			

Reference:		TEST POINT: <u>ANTENNA BASE</u>				TEST POINT: <u>POSITION INDICATOR</u>			
EN 61000-4-2		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	NA	NA	NA	NA	NA	NA	NA	NA
3	3								
4	4	NA	NA	✓	✓	✓	NA	✓	NA
5	5								
6	6	✓	NA	✓	*	✓	NA	✓	NA
7	7								
8	8	✓		*		✓		✓	
9	9								
10	10								

Reference:		TEST POINT: <u>BAT CPMT DOOR</u>				TEST POINT: <u>INTERIOR DISPLAY</u>			
EN 61000-4-2		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	NA	NA	NA	NA	NA	NA	NA	NA
3	3								
4	4	NA	NA	NA	NA	NA	NA	NA	NA
5	5								
6	6	NA	NA	✓	NA	NA	NA	NA	NA
7	7								
8	8	✓		✓		NA		✓	
9	9								
10	10								

Notes: A Checkmark (✓) means the device passed the 10 shots successfully with a discharge being seen. A blank (NT) means the point was not tested. (NA) means no discharge seen. A Star sign (*) means a failure occurred. Notes: EUT INDICATOR I/O DISPLAY CORRUPTION. POWER CYCLE FOR CORRECTION. NEW ANTENNA WITH CLEAN HOUSING AND WORKED.



APPENDIX H

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 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.

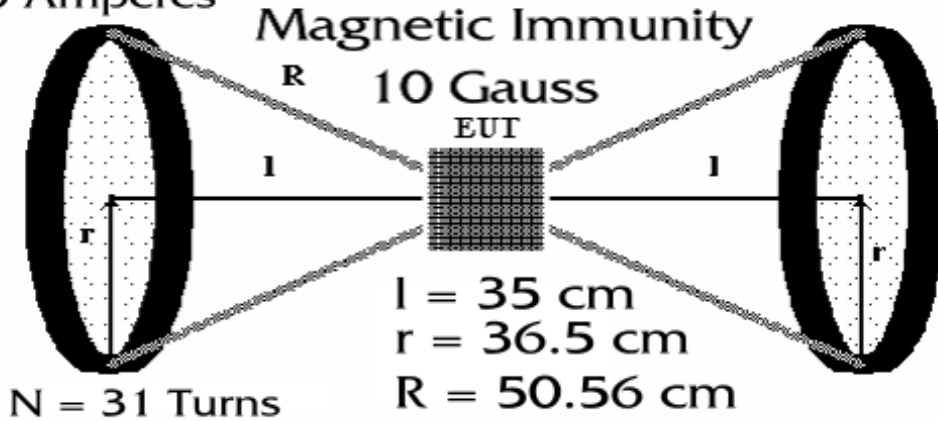
Using the "right hand" rule, the coils are phased so that the flux generated is aiding. The field generated by the coils is measured by the calibrated Holladay probe. The analysis below correlates the calculated field strength of the coils to the empirically measured field strength. The actual field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

2.3 Calculations

Given: Coil Diameter:	73 cm.
Current:	20 amperes
Coil Distance:	70 centimeters
Number of turns:	31 turns

Units: 1 Tesla = 10^4 Gauss = 3×10^8 V/m = 240 dBpT = 8×10^5 A/M
 $\mu_0 = .4\pi \times 10^{-7}$ T m/A, 10 Gauss = 800 A/M

I = 20 Amperes



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

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

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

$$B \text{ (Tesla)} = .5 \mu_0 * I * \frac{r^2}{R^3} * N, \mu_0 = 4 \pi \times 10^{-7} \text{ T x m/A}$$

I = 20 Amps RMS, 60 Hz

$$B \text{ (V/m)} = 188.5 * I * \frac{r^2}{R^3} * N \quad N = 25 \text{ Turns}$$

r = .5 m, R = .6403m

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

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

Empirical Finding:

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

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

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

2.4 Test Set Up

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

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

4.0 LIMITS AND TEST RESULTS

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

The magnetic field susceptibility of the device should not be less than the level defined in the AAMI DF-39 medical specification (1 Gauss). The IEC recommendation ranges up to 400 amperes/meter. The EN 61326 requirement is 30 A/M.

4.2 RESULTS

The TFT EP0372 Hydrant Valve was exposed in three axes to a swept field as measured by Holladay Magnetic Field Probe Model HI-3624. The current was maintained fairly constant at 22 amperes in the range of 40 to 500 Hz resulting in a 10 to 4 gauss field being applied in this range. There was no apparent effect on the device due to the 40 Hz to 500 Hz magnetic field. The EUT passed the IEC 61000-4-8 recommendation.

