Normative	e Standard: Description and Serial	Number	EN61000	-6-2, EN	61000-6-3: 2007
			ΠΟΛΝΙΤΙ	7 A T	
/N: EN	AI Prototype (Improve	d)			⊿ V ⊥≟
Dates of T Test Labor	est: 08-16-2010 through 08 ratory:	-18-2010			
M F1	idwest EMI Associate	es, Inc.	ne tom		
21	234 W. Commercial D	rive	Joratory		
M	undelein, Illinois 600)60			
Tel	: (847)-918-9886	EN 61000 6	3 EMISSIONS		
	TEST	METHOD	-5 EMISSIONS	LIM	ITS
-	IEC 61000-6-3	Am 1:2007 (Cis	pr 11)		B
	Radiate	ed Emissions			
		EN 61000-6	-2 IMMUNITY		
	Т	EST METH	OD		LEVEL
E	EN 61000-4-2 Cons Ed 1.2:2009 Electrostatic Discharge Test		2, 4, 6 and 8 kV Air Discharge 2, 4 and 6 kV Contact Discharge		Α
	EN 61000-4-3 Ed. 3.0: 2009 Radiated Immunity Test	1000 Hz, 80% Wave,	13 V/M (10 V/M minimum) 6 AM modulation, 900 Mhz, 100% AM, 200 Hz 30-1000, 1.4-2.0 GHz, 2.0-2.7 GHz (reduced lev	z, Square 7el)	Α
	EN 61000-4-8: 2001-03 Magnetic Immunity		30 A/M Min (800 A/M Applied) Three Axes		Α
-					
erformance evel:	 A- During testing, normal perf B- During testing, temporary e without operator interventie C- During testing, temporary e or system reset. D- Degradation or loss of functional system for the syst	formance occurs degradation, or le on. degradation, or le tion that is not re	within the specification limits. oss of function or performance occurs that oss of function or performance occurs that ecoverable occurs due to damage to equi	at is self reco at requires op	vering perator intervention ponents, software, or
	to loss or corruption of data George A. Bo	wman-	BBB	Nemko Accredit	R) ed ELA
Report b	George Bowman by: Midwest EMI Associates Narte Certified Engineer, EMC-(0007 3 8NE	MEMBER CHICAGO & NORTHERN ILLINO	s AC	

Midwest EMI Associates Test Services Standard Test Report 3131

Ref: TFT EP0372 HYDRANT VALVE.doc



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 Ph: 1-219-462-6161 Fax: 1-219-464-7155

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

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

Approved By:

Page 2 of 25

1.0 <u>PURPOSE:</u>

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 <u>TEST FACILITY</u>:

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.



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 <u>REFERENCES</u>:

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"

Midwest EMI Associates Test Services Standard Test Report 3131

Ref: TFT EP0372 HYDRANT VALVE.doc

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 **<u>GENERAL INFORMATION</u>**:

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

Bandw Settin	vidth g	Wideb <u>6dB Ba</u>	and Indwi	<u>dth</u>	Correct Facto	ion r	Factor	<u>r Applied</u>
3	MHz	3.	.028	MHz	-9.623	dB	-10	dB
1	MHz	9	15.0	KHz	.7716	dB	0	dB
.1	MHz	1	16.4	KHz	18.68	dB	20	dB
10	KHz	9).96	KHz	40.03	dB	40	dB
1	KHz	9	026	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)

Bandy	vidth	Wideband	Correc	tion				
Settin	g	<u>6dB Bandwid</u>	<u>dth</u>	<u>Factor</u>		<u>Facto</u>	<u>r App</u>	lied
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 Re	quirec	l Bandwie	dth	
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

Midwest EMI Associates Test Services Standard Test Report 3131

1)	EMCO 3147 Wide Range Log Periodic	9102-1019	23 Jun 11
	EMCO 3107B Power E Field	9310-2435	N/A
m)	Amplifier Research FM1000	12456	N/A
n)	Amplifier Research FP1000	60701	21 Jun 11
0)	Amplifier Research FP1000	60488	3 Jun 11
D)	IFI EFS-4 E Field Susceptibility	39883	14 Jun 11
P/	(Holladay 3004EX with HSE405 Probe)	07000	r - Jui - I -
a)	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	EI574714013	24 Jun 11
u)	Schaffner NSG 433 ESD Gun	107	J
/	and Contact Discharge Adapter	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	,
v)	Solar Line Impedance Stabilization Network	8028-50-TS-24-J	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 I	P-6492	N/A
ai)	Goldstar Signal Generator Mod FG-2002c 201621	25 Jun 11	,
ak)	Holladay Magnetic Field Probe Model HI-3624 83	957	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	5
ax)	C. C. Moore Automated Mast Assembly Model DAPM4/6	5	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	5
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



Midwest EMI Associates Test Services Standard Test Report 3131

Ref: TFT EP0372 HYDRANT VALVE.doc

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 <u>CONCLUSION OF RADIO FREQUENCY INTERFERENCE</u> <u>EMISSIONS AND SUSCEPTIBILITY TESTS</u>:

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 <u>PURPOSE</u>:

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 <u>30 meters</u>. From 30 MHz to 230 MHz the "A" level allowed is 30 uV/m, and 37 dBuV/m) from 230 MHz to 1000 MHz. Since the specification is written at 30 meters the extrapolated allowed values to 3 meters are 50 dBuV/m and 57 dBuV/m respectively. If this requirement is passed and the Cispr 11 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 <u>CONCLUSION OF RADIO FREQENCY INTERFERENCE</u> <u>EMISSIONS TESTS:</u>

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.

Midwest EMI Associates Test Services Standard Test Report 3131

Ref: TFT EP0372 HYDRANT VALVE.doc

























SHEET 1 cispb RADIATED QUASI-PEAK REPORT CISPR11B Level for Industrial, Scientific and Medical Equipment 3 METER TEST DISTANCE								
TIME: 18:43:3 DATE: 08-17-2	2 2010	Midwest I Associa	Mi ates					
TEST ITEM: TF	T EP0372 ER: Field	Hydrant Val Trial Numbe	ive er 8 Sec	iuence M	lumber: 458			
COMMENTS: S	Sitting on t	table, 6 V ba	attery opera	ated, 80	cm. Table			
				مممم	مممممممم			
Peak	Peak (Quasi-peak	Quasi-peak	Spec.	Antenna			
(MHz)	(dBuV/m)	(MHZ)	(dBuV/m) (dBuV/m) (H/V)			
0000000	000000		0000000		000000000			
30.54083	37.18	30.6328	33.71	40.50	Horizontal			
31.31171	40.10	31.4013	29.85	40.50	Horizontal			
32.53934	35.70	32.6097	31.29	40.50	Horizontal			
36.66539	36.76	36.8638	30.95	40.50	Horizontal			
42.77672	35.29	42.9599	32.73	40.50	Horizontal			
50.31184	36.65	50.4414	31.92	40.50	Horizontal			
50.88594	36.42	51.0499	31.35	40.50	Horizontal			
52 0622	37.39	52.0122	35.10	40.50	Horizontal			
JJ.9022 57 23817	34.00	54.155 54.1742	30.09	40.50	Horizontal			
55 80443	30 67	56 004	35.12	40.50	Horizontal			
64 10992	32.95	64 1015	30.30	40.50	Horizontal			
64.88672	36.28	64.80589	33.38	40.50	Horizontal			
65.43720	35.68	65.63639	31.56	40.50	Horizontal			
66.25878	34.01	66.2788	31.12	40.50	Horizontal			
66.6953	34.86	66.6777	29.76	40.50	Horizontal			
69.69685	32.10	69.6921	26.04	40.50	Horizontal			
72.05388	38.41	72.00830	31.10	40.50	Horizontal			
72.03946	36.00	72.0155	31.61	40.50	Horizontal			
72.27478	36.31	72.402	27.01	40.50	Horizontal			
73.82805	35.14	73.7761	31.53	40.50	Horizontal			
34.84538	35.52	34.6822	27.98	40.50	Vertical			
35.82734	35.25	36.0097	28.39	40.50	Vertical			
39.00009 42 85760	33.34	39.4833	20.15	40.50	Vertical			
42.03709	34.49	42.9009	30.13	40.50	Vertical			
46 20830	37 84	45.510	32.83	40.50	Vertical			
47.80838	35.14	47.958	29.57	40.50	Vertical			
51.80759	36.61	52.0004	32.55	40.50	Vertical			
55.90686	39.59	56.0109	35.71	40.50	Vertical			
58.59668	32.75	58.7815	28.52	40.50	Vertical			
69.34702	32.58	69.14700	24.74	40.50	Vertical			
70.58607	35.99	70.78449	29.75	40.50	Vertical			
70.99027	35.22	70.84310	31.68	40.50	Vertical			
71.59951	37.34	71.58750	29.88	40.50	Vertical			
72.00084	45.05	72.000	43.70	40.50 *	Vertical			
75.02528	55.47	73.1641	31.91	40.50	Vertical			
74.10320 74.02629	30.04 25.65	74.0055	33.84	40.50	vertical Vortical			
14.73040 77 57167	33.03 35 17	74.7419 70 2001	27.02 20 51	40.30 10 50	vertical Vertical			
70 30782	35 00	76.3761 70.7200	20.31 20.46	40.30 10 50	Vortical			
10.30104	JJ.77	10.2370	47.4U	40.30	* CI LICAI			

.

SHEET 1 cispb RADIATED QUASI-PEAK REPORT CISPR11B Level for Industrial, Scientific and Medical Equipment 3 METER TEST DISTANCE								
TIME: 18:43:3	52	Midwest I	IMI					
DATE: 08-17-2	2010	Associ	ates					
TEST ITEM: TF	T EP0372	Hydrant Val	ve		umber 450			
SERIAL NUMB	ER: Field	trial Numbe	er 8 Seq	Juence N	umber: 459 cm Table			
TEST DEPEOD	MED BY' Ce	orge Rown	illei y opeia	iteu, 80 (
Peak	Peak	Quasi-peak	Quasi-peak	Spec.	Antenna			
Frequency	interfer.	Freq.	Interfer.	Level I	Polarization			
(MHZ)	(dBuV/m)	(MHŽ)	(dBuV/m) (dBuV/m)	(H/V)			
$\bigcirc \bigcirc $	$\Delta\Delta\Delta\Delta\Delta\Delta\Delta$		$\triangle \triangle \triangle \triangle \triangle \triangle \triangle \triangle \triangle$					
75 0	24 56	7 (000	25 40	40 50	¥¥			
73.0 78 80516	34.70	70.000 70 7564	33.48	40.50	Horizontal			
20.00310 80 00013	30.32 31 75	70.7304 80.0163	23.04	40.50	Horizontal			
80 81031	34.75	80.0103 80.86060	25 34	40.30	Horizontal			
81 8	38 51	81 008 <i>1</i>	23.34	40.30	Horizontal			
82.59999	37 63	82 6712	24.03	40.50	Horizontal			
83.59999	35.37	83.4064	28.14	40.50	Horizontal			
85.06537	37.91	84.90219	30.42	40.50	Horizontal			
86.8	44.72	86.66	28.19	40.50	Horizontal			
88.8	51.88	88.84	29.39	40.50	Horizontal			
106.6	41.39	106.7112	67.61	40.50 *	Horizontal			
108	40.64	108.0072	34.84	40.50	Horizontal			
119.4	40.26	119.3768	27.77	40.50	Horizontal			
108.7904	37.96	108.7856	36.18	40.50	Horizontal			
122.4	46.62	122.5992	28.81	40.50	Horizontal			
124.6	42.85	124.4256	29.06	40.50	Horizontal			
131	36.73	130.9512	28.54	40.50	Horizontal			
132.0	35.49	132.8810	29.68	40.50	Horizontal			
134.0	41.07	134.4032	23.89	40.50	Horizontal			
138.2	35.42	138.3708	20.37	40.30	Horizontal			
139.3887	37 92	130.3400	27.37	40.50	Horizontal			
143.8	38.73	143.9952	32.61	40.50	Horizontal			
147.4	36.65	147.512	31.54	40.50	Horizontal			
152	33.00	152.0176	28.60	40.50	Horizontal			
158.4	34.35	158.2008	24.44	40.50	Horizontal			
160.2	65.32	160.0016	64.70	40.50 *	Horizontal			
162.9463	34.06	163.1375	23.19	40.50	Horizontal			
167.2	39.30	167.0008	21.74	40.50	Horizontal			
172.6	33.24	172.788	25.05	40.50	Horizontal			
78.8	42.04	78.6584	24.83	40.50	Vertical			
79.72644	39.62	79.7504	30.64	40.50	Vertical			
01.0	34.11	81.9992	25.55	40.50	Vertical			
85 000	J1.77 36 52	04.7400 81 2017	20.00 27.02	40.30 10 50	vertical Vertical			
86.30032	34 64	04.0712 86 1165	<i>41.94</i> 28 12	40.50	v ci iicai Vertical			
87.72629	43.75	87.7470	40.15	40.50 *	Vertical			
88.04967	36.71	88,0121	41.54	40.50 *	Vertical			
89.2	49.55	89.31359	31.37	40.50	Vertical			
90.000	40.40	90.1456	48.82	40.50 *	Vertical			
90.10011	44.80	90.12569	48.22	40.50 *	Vertical			

SHEET 2 cispb RADIATED QUASI-PEAK REPORT CISPR11B Level for Industrial, Scientific and Medical Equipment							
TIME: 18:43:3 DATE: 08-17-2 TEST ITEM: TE SERIAL NUMB	57 2010 FT EP0372 ER: Field	Midwest Associ Hydrant Va Trial Numb	EMI ates ive er 8 Sec	quence N	umber: 459		
COMMENTS: S	MED BY: G	table, 6 V b eorge Bown	attery oper nan	ated, 80 (m. Table		
Peak Frequency (MHz)	Peak Interfer. (dBuV/m)	Quasi-peak Freq. (MHz)	Quasi-peak Interfer. (dBuV/m)	Spec. / Level F (dBuV/m)	Antenna Polarization (H/V)		
	00000			200000			
106.6998	42.16	106.7254	75.11	40.50 *	Vertical		
107.4	38.53	107.5096	40.55	40.50 *	Vertical		
108.2	36.67	108.0048	33.14	40.50	Vertical		
111.6	39.20	111.5416	28.29	40.50	Vertical		
115.8197	39.28	116.0037	35.78	40.50	Vertical		
119.8	41.23	119.9936	35.12	40.50	Vertical		
123.8	37.81	123.9968	33.40	40.50	Vertical		
131.4	38.70	131.3344	33.31	40.50	Vertical		
133.4	38.82	133.3528	35.02	40.50	Vertical		
140	40.59	140.0048	38.69	40.50	Vertical		
152.2	36.50	152.0072	32.70	40.50	Vertical		
159.3707	44.77	159.3299	21.64	40.50	Vertical		
160.4	63.34	160.2016	30.82	40.50	Vertical		
163.9795	42.72	164.1475	40.18	40.50	Vertical		
167.4	37.76	167.38	20.55	40.50	Vertical		

SHEET 1 CISPR11B	cispb RA Level for Ind	DIATED QUASI ustrial, Scient	-PEAK RE	PORT Medical	Equipment
TIME: 18:43:2	3 ME 32	TER TEST DIST. Midwest EMI	ANCE		
DATE: 08-17-	2010	Associates			
SERIAL NUME	FT EP03/2 Hy KER: Field Tr	ial Number 8	Sear	Jence NL	umber: 460
COMMENTS: S	Sitting on ta	ble, 6 V batte	ry opera	ed, 80 c	m. Table
		rge Bowman	~~~~	ممممر	
Peak	Peak Qu	asi-peak Qua	si-peak	spec. A	Intenna
Frequency	Interfer. F	req. inte	erfer. L	evel P	olarization
172.6	30 04	172 8	20.85	40.50	Horizontal
177.3	35.12	177.4576	25.21	40.50	Horizontal
187.4106	31.74	187.2146	18.30	40.50	Horizontal
198.9	33.32	199.0992	24.11	40.50	Horizontal
203	39.49	203.04	27.99	40.50	Horizontal
206.1	37.58	206.0264	30.38	40.50	Horizontal
240.0412	42.17	240.0108	38.99	47.50	Horizontal
174.4	40.72	174.3032	37.22	40.50	Vertical
196	35.18	195.9784	23.28	40.50	Vertical
199.1	38.81	199.1392	28.61	40.50	Vertical
204.6658	37.21	204.5954	27.64	40.50	Vertical
202.2	33.67	202.216	18.87	40.50	Vertical
239.9	41.89	240.0136	34.69	47.50	Vertical

Ref: TFT EP0372 HYDRANT VALVE.doc



APPENDIX D

RADIATED RADIO FREQUENCY INTERFERENCE SUSCEPTIBILITY TEST

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

1.0 **<u>PURPOSE</u>**:

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 <u>TEST PROCEDURES:</u>

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 <u>off</u> 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:

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

4.0 LIMITS AND RESULTS OF TEST:

4.1 RADIATED LIMITS:

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

4.2 <u>RESULTS OF TEST</u>:

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:		EN 61000-4-3	3	Midwe	vest EMI Associates Form:			
Page of		Worksheet		M	lundel	ein, Illinois	EN 61000-4-3	
Device:	2372K	CHID Sponsor:	TFT	D	Date: 1/1/2010_S/W Ver: 1.00_S/N: F7_8_			
Radiated (Con	nducted)	P2031) (A/R FP2036	Ar F	P1000	Techni	cian: SB		
(magnetic) ((3114)	(Solar Injection	Clamps)	Project	No: EPOT2		
Mod Freq: 2 10 100(1	000 Hz	Modulation Depth: 50% (80%)	100%	% Other:		POWER: 230 208 12 Power Frequency: (50	$(0 VAC or _6 VDC)$	
Room of Tes	t (Scrnfm)	Antennae: B=Bicon	ical, C=	Conical		Orientation:		
(2 Mtr) (5 Mt Pos: (A) (B)	r) (Outside) (C)	L=Log Periodic BL V=Vertical, H=Hori	=Biconil zontal P	og H=Horn olarization	l	(Pole Stand) (Woode (Copper Table) (Flo	n Table) or) (Back Room)	
Frequency (M=MHz) (K=KHz)	Inc Freq (KHz) or (1%) if blank	Immunity Level (V) (V/M)	Dwell Time: (Sec)	Antenna Type	Resul	ts: Include any Failure EUT during Video Camera System	Modes Observed in the the test Used? (Yes) (No)	
30m	1%	13	7	BICH	9	ing up. AD	K, ENT 525LA	
128m	10	ic.	R	Л		¥ 7 11	00 to	
155M	.1	1	<i>i</i> (1		/(Jt /1	, and eggle to	
371M	11	13	4	1/		n)e re	11 K	
Soom	31	10	14	[]	Sug	that to EATON	ISTADE AMP	
SBOM	11	11) (BICH	An	K no effect	1	
79)M	1	10	ł	"(,			
1804m	1)() (۲)	,	1 1 11		
					len	& Phone T.	est	
900	170	13	7	BKH	20	ing no, 100	a Am, zashz	
928	11	, ·	'1	10	,	i i r	4 17	
					Pas	sed		
30M	190	/3	_7	BIL	goe	ng in HOK	·	
loom	10	11		14		rs 11		
ISOM	'/	"	"(16		16 16	un realiteres	
355M	170	41	7	ע ונ	2	ing 1p, AD	K	
410M	41	11)(4		" " "		
451m	/1	11	15	14		st XI /1		
520m	И	10	r	11		<i><i>x y y</i></i>		
873m	"	Я	7	11		Al +1 Mi		
8951AR	1					10 . 14		
100+m	10	10	7	B	9.m.	- to MICRO	WAVE AMP	
						THORN		
900	et	13	7	BV	C	le phone.	EKT OK	
928M	μ	13	2				K //	

Notes: no Faulto

Date:		EN 61000-4-3	3	Midw	est E	MI Associates	Form:
Page of	·	Worksheet		N	lundel	ein, Illinois	EN 61000-4-3
Device:	EP0372	Sponsor:	TFT	I	Date: _ 8 /	17/2010 S/W Ver:	100 S/N: FT8
Tests Perf	ormed: P	robes: (CS114) (Fis	cher CD	NLA/R			
(Magnetic) (CS114)	(Solar Injection	<u>) (A/R F</u> Clamps	P1000)	Techni	ician: <u>98</u>	
Mod Freq:		Modulation Depth:		·	Project	POWER: 230 208 12	0 VAC or VDC
2 10 100	1000 Hz	50% 80%	100%	% Other	<u> </u>	Power Frequency: (50) (60) (400) Hz 9.510
(2 Mtr) (5 Mi	tr) (Outside)	Antennae: B=Bicon L=Log Periodic, BL	ical, C≈(=Biconil	Conical og. /H=Mor i	b.	Orientation: (Pole Stand) <i>P</i> wooder	TADLE)
Pos: (A) B))(Ċ)	V=Vertical, H=Hori	zontal P	olarization	í	(Copper Table) (Flo	or) (Back Room)
(M=MHz) (K=KHz)	(KHz) or (1%) if blank	(V) (V/M)	Dwell Time: (Sec)	Antenna Type	Resul	ts: Include any Failure FUT during t Video Cam, ya System	Modes Observed in the the test Used? (Xe) (No)
Im	170	13	7	Н"	For	in no Hok	HOR
/233	10	*	۲	•	•		
2200	11	"	1.	11	~	11 11	
1000	120	3	7	H	9	in yo, ADI	lest_
1350	11	10	4	"		n in sr	
2200	10	+1	5	10	_	·· A 11	1/
2200	190	/3	7	HU	2	ing up , 1	px, Vest
2700	17	*(n	r(ic ic	11 11
						· · . · · · · · · · · · · · · · · · · ·	
2200	170	13	7	H''	Jon	ng up, Ank,	HOR
2700	N		"	1/1-	1		<i>N</i>
						<u></u>	
						······································	
			×	<u> </u>			
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						,	
					<u> </u>		

Notes:

Ref: TFT EP0372 HYDRANT VALVE.doc



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 <u>TEST PROCEDURES:</u>

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.

Ref: TFT EP0372 HYDRANT VALVE.doc

ESD TEST LOCATIONS TFT EP0372 HYDRANT VALVE

TEST POINT	Description
1	НСР
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

Midwest EMI Associates Test Services Standard Test Report 3131

Ref: TFT EP0372 HYDRANT VALVE.doc





Da /	ta Sheet _ of _3	- ESI Sch	D DATA affner NSC	SHEET 3 435 Gun	Mund	Midwest EMI Associates Mundelein, IllinoisForm: Issued 11/22/09 MEMI-1A							
	Sponso: Manage	r Group: _T r: Tim Mill	ask Force ' er Temp	Tips Serial 79.3°F H	l Number: _ [um: 59.2%	EMI Proto) an: GB S/V	 V ver.: 1.0.(0.FT2				
	Date of		/ <u>10_</u> Time:	<u>9:50 AM</u>	EUT: Prot	otype / Pro	duction	Unit					
	Placemo	ent of EUT:	ESD Table	:/ 1 Strin/	Pole Mo	unt		able FI					
Config	uration o	of EUT: EUT	power 12	OVAC 50Hz		I Me	s to metai	FIAME OF E					
Note:	All Point	s are Teste	d with 10 s	Shots in Sin	ngle Shot I	lode each	phase unle	ss otherwis	e stated				
Refe	rence:					ſ		.1	· · · ·				
EN 61	000 4 0	TEST PO	INT: <u>34</u>	TEST PC	DINT:	NCP							
REF.	KILO VOLTS	Air D/charge	CONTACT Mode	Air D/charge	CONTACT Mode	Air D/charge	CONTACT Mode	Air D/charge	CONTACT Mode				
1	1							<u> </u>					
2	2	(1) Ar	(/)	11)	(/)	(1) m	(1)	(\mathcal{I})					
3	3		PR	1015	DR.	102		ar ar	- IPR				
4	4	(1) pr	(1) an	(1) at	(1) ar	(1) ex	(V) av		(V) pr				
5	5		VK_		I ION	V IDA			1-1-2				
6	6	(F)ar	(1) or	(V)04	(V) OK	(V) or	(1) or	() ex	(1)="				
7	7	*											
8	8	(V)HUIT		(V)OL		(1) px		(1) pk					
9	9	A Fi	ed	D									
10	10	P	rokem										
Refe	rence:				(1000)								
ENI 6 1	000 4 0	TEST PO	INT: <u>VAL</u>	VE HANN		TEST PO	INT: VA	UE CONP	Luc BROU				
REF.	KILO	Air	CONTACT	Air	OLARITY CONTACT	Air	CONTACT	MINUS P	OLARITY CONTACT				
LINE	VOLTS	D/charge	Mode	D/charge	Mode	D/charge	Mode	D/charge	Mode				
1	1												
2	2	(1) OK	(V) or	(V) OK	(1) ar	(V) or	(V)ox	(1) ar	(1) or				
3	3				`								
4	4	(V) ex	() _{ok}	(V) ox	(1) ox	(~)	(1) or	(~)	(~)				
5	5												
6 	6	(1) ₀₁	(1) ox	(V) og	(V)ox	(~)	(V) ose	(~)	(V) sk				
(7							-+					
8	8	(/) _{0K}		(1)1K		(V) AX		(1)					

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: A data TV Sound must cap to power by the second seco

Da 2	ta Sheet _ of <u>_3</u>	Sch	D DATA affner NSC	SHEET 435 Gun	Mi A Mund	Midwest EMIForm: Issued 11/2AssociatesMEMI-1AMundelein, IllinoisIllinois							
	Sponsor Manage	Group: _T r:_Tim Mill	ask Force 7 er Temp	fips Serial : <u>79.3°F</u> H	Number: _ um: <u>59.2%</u>	EMI Proto Technici	an: <u>GB</u> S/V	W ver.: <u>1.0.(</u>	D.FT2				
Config	Date of Placeme Groundi uration o	Test: <u>8/18</u> ent of EUT: ing: Pole of EUT: EUT	/ <u>10</u> _Time: ESD Table _ Terminal power 120	9:50 AM	EUT: <u>Prote</u> Pole Mo FLOOR	otype / Pro unt 1 Meg	duction Wood Ta to Metal	Unit able FL Frame of E	OOR				
Note:	All Points	s are Teste	d with 10 s	shots in Sir	igle Shot M	lode each j	bhase unle	ss otherwis	e stated				
Reference: Index anternation TEST POINT: RILHT MANTANG FORT EN 61000-4-2 PLUS POLARITY MINUS POLARITY MINUS POLARITY DEE KILO Air CONTACT													
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	(V)ox	(1) or	(1) 0K	(V) or	(V) or	(1) ex	(V) ox	(V) or				
3	3	ſ		ſ				1					
4	4	(~)	(V) er.	(~)	(1)0x	(~)	(V) pr	(~)	(V) or				
5	5												
6	6	()	(1) BZ	(~)	(1) or	(~)	(V) pre	(1)	(V)or				
-7	7	4				•		-					
8	8	() _{ek}		(V) ak		(V) eK		(1) 0×					
9	9												
10	10												
				-									
Refe	rence:	TEST PO	INT: <u>Mer</u> e	R. RH SID	E <u>DISPLAY</u> OLARITY	TEST PO	INT: <u>Min</u>	MINIIS P	CR DISP				
REF.	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	(1) ox	(1) ok	(V)OX	(V) ~×	(1) RX	(1) px	$(\mathbf{V})_{\mathcal{O}Y}$	(1) or				
3	2					, <u> </u>							

1	1									
2	2	(1)	2X	(1) ok	(V)ox	(1) ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	(1) RK	(1) ox	(V) pr	(V) or
3	3									
4	4	(1)	5K	(1) or	(1) OK	(1) OK	(√) <i>BK</i>	(V)	(V) at	(1) or
5	5									
6	6	(X)	1	(V))01C	(1)	(V) ox	(V)ox	(V) 0K	(V) ok	(V) pr
7	7	"								
8	8	()	off		(1)		(1)*		(1)	
9	9						ANIT THEN	5		
10	10						OFF	lley		
				·			0th	TV3	P	
Notes.	A Chock	mark (acona the d	louioo nooo	od the 10 of		fully suith	die ob onno k	

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:______

Data Sheet	ESD DATA SHEE	T'
<u>3</u> of <u>3</u>	Schaffner NSG 435 Gu	ın

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Midwest EMI Associates Mundelein, Illinois

Λ

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 _____ ____ Wood Table __ Pole Mount 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: POSITION INDRATOR TEST POINT: ANTENNA BASE MINUS POLARITY MINUS POLARITY EN 61000-4-2 **PLUS POLARITY** PLUS POLARITY REF. KILO Air CONTACT CONTACT Air CONTACT Air CONTACT Air D/charge D/charge VOLTS Mode Mode D/charge Mode D/charge Mode LINE 1 1 2 2 (V) ox (V) or (V) or (V)OK (V)er (V)or (⁄) (√) **~**Jr 3 3 4 4 (V)or (V) ~ ~ (/) or OK 5 5 6 **(**X) 6 (⁄) (⁄) (V) OX (⁄) oz 7 um 7 NH1

1

HAPT

9H4T

			- Addam /									
10	10		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~			U U						
Refe	rence:	TEST PO PLUS PO	DINT: <u>BA</u> DLARITY	ν ε κ Τ΄ <u>C</u> ΡΜΤ MINUS Ρ	T HALE DADE POLARITY	TEST POINT: <u>Discussioned Discussion</u> 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	(V)ok	(1) ex	(V)ex	(V) es	40	AHANT	HTNIA	totur			
3	3					1		l p	1			
4	4	(1) 1×	(V) ox	(V)ox	(1)0x	t √)	HUT	14	44			
5	5											
6	6	(1)1×	(1) DK	(V)OK	(V)ox	14	HANT	14	14 15			
7	7											
8	8	(1) OK		(1)*		(4)	[A	14/1/4				
9	9											
10	10								-			

A Checkmark () means the device passed the 10 shots successfully with a discharge being seen. A Notes: blank () means the point was not tested. A Star sign (*) means a failure occurred that is described below Antema assymber had no are (plastic part) Notes:

Da _/	ita Sheet of	Sch	D DATA affner NSC	. SHEET 3 435 Gun	Mi A Mund	idwest E Issociate Ielein, Il	MI es linois	Form: Issued 11/22/09 MEMI-1A		
Config	Sponsor Manager Date of Placeme Groundi uration o	Group: _T r:_Tim Mill Test: <u>8/18</u> ent of EUT: ing: Pole f EUT: EUT	ask Force ' er Temp /10_Time: ESD Table _ Termina ; power 120	Tips Serial : <u>79.3°F</u> H <u>9:50 AM</u> :/ 1 Strip/ 0VAC 50Hz	Number: _ um: <u>59.2%</u> EUT: <u>Prote</u> Pole Mo FLOOR	EMI Proto Technici otype / Pro unt 1 Meg	an: <u>GB</u> S/ oduction Wood 1 ; to Metal	W ver.: <u>1.0.(</u> Unit Table FL Frame of E	0.FT2 00R 0UT	
Note:	All Point	s are Teste	<u>d with 10 8</u>	Shots in Sir	ngle Shot N	lode each	phase unl	ess otherwis	e stated	
Refe	rence:	INT: <u></u>	1 tomes	Seren						
REF.	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	(1) px	(1) ox	(1)	(V) er.	Vox	(1)	(V)ex	(V) OK	
3	3									
4	4	(1) ph	() ox	(V) ok	(V) ok	(1) at	(1) el	(V)ox	(1) all	
5	5									
6	6	(V) ~~	(1) x	(V) or K	(V)OF	(1) or	(1) or	(1) -55	() OK	
7	7									
8	8	(1) ox		(V)ox		(V)ok		(V) at		
9	9									
10	10									
									-	
Refe	rence: 000-4-2	TEST PO	DINT: Ky	MINUS P	Con Con Col ARITY	TEST PO PLUS POI	DINT: Z	MINUS P	Ain la OLARITY	
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									
-										

EN 61000-4-2		PLUS PC	DLARITY	MINUS P	OLARITY	PLUS POI	ARITY	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	(V)ox	(1) ON	(V)OK	(1) OK	(1) or	(V) ox	()ox	(V) ar	
3	3			-0						
4	4	$(\mathbf{V})_{\partial \mathbf{V}}$	(1) or	(1)or	(1) OC	(1)0K	(1) ox	(1) OK	() B K	
5	5									
6	6	11 Jos	(1) 0K	(1)0K	(1) BK	(V)	(V) ar	(V)8K	(V) 0 V	
7	7									
8	8	(1)		(V) or		(V)ask		(1) ar		
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:

Da 	ta Sheet _ of _Z		SD DATA	SHEET G 435 Gun	ETMidwest EMIForm: IssueJunAssociatesMEMMundelein, IllinoisImage: State										
	Sponsor Manage:	Group: _ r:_Tim M	_Task Force iller Temp	Tips Serial p: <u>79.3°F</u> Hu	Number: _ 1m: <u>59.2%</u>	EMI Proto Technici	an: <u>GB</u> S/V	W ver.: <u>1.0.(</u>	<u>).FT2</u>						
Config	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														
Note:	Note: All Points are Tested with 10 Shots in Single Shot Mode each phase unless otherwise stated														
NAMPHELD Reference: TEST POINT: <u>VC.P</u> EN 61000-4-2 PLUS POLARITY MINUS POLARITY PLUS 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	(V) on	$(\mathbf{V})_{ak}$	(1) or	(1) av	(1) or	$(1)_{\alpha}$	(1)05	(1) at						
3	3	1													
4	4	(~)	(·) p//	(1)	(1) BK	(1) or	(1) px	(1)or	(V) or						
5	5				~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~										
6	6	(1)	(1) ok	(1)	(V)OK	(V) or	(1)OK	(V)OK	(1) OK						
7	7														
8	8	(1) \$	re	(1) or		(1) ox		(1)0x							
9	9														
10	10														

Refe	rence:	mpom	DO	TRIM.	1	1+		At	0		/1	E.	+1	4.01
EN 61	000-4-2	PLUS	PC 3 PC	DLARI		MINI	JS P	OLARIT	Þ	PLUS POL	ARITY	MINUS P	OLARITY	nay
REF. LINE	KILO VOLTS	Air D/charge		CONTA Mode	CT	Air D/charg	e	CONTACT Mode		Air D/charge	CONTACT Mode	Air D/charge	CONTACT Mode	
1	1								_					
2	2	(~) _W	1A	(~)	σ	(~)	vlA	(V) NT	1	(V) OK	(1) Bic	(1) 05	(1) ox	
3	3		ř		1			1						
4	4	(~)		(~)		(1)	Γ	(1)		(1) ox	(V) OK	(1)OK	(1) BY	
5	5				4		Τ	4						
6	6	(⁄)		(⁄)	M	(~)	Γ	(~) 1	r	(V) OK	(V)oK	(V) por	(1) or	
7	7	4	ł			7	•							
8	8	(✓) _{//}	VA			(~),	AR			(1) OV		(V) DIE		
9	9		<i>,</i>											
10	10													

Notes: A Checkmark (\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: $A \oslash K$.

	Data Sheet ESD DATA SUPET Midwast EMI Forme Landston																
Da	ta Sheet	<u>ESI</u>	<u>D DATA</u>	SHEET	<u>Mi</u>	dwest E	MI	Form: Issued 11/22/09									
- 4	_ 01	د Sch	affner NSC	3 435 Gun	A	ssociate	S	MEN	II-1A								
					Mund	lelein, Il	linois										
	Sponsor	r Group: _T r: Tim Mill	ask Force 7 er Temp	Fips Serial : 79.3°F H	Number: _ um: 59.2%	EMI Proto	an: GB S/V	ver.: 1.0.0).FT2								
	Date of Test: <u>8/18/10</u> Time: <u>9:50 AM</u> EUT: <u>Prototype</u> / Production Unit																
	Placement of EUT: ESD Table Pole Mount Wood Table FLOOR Grounding: Pole Terminal Strip / FLOOR 1 Meg to Metal Frame of FUT																
Config	Grounding: Pole Terminal Strip _/ FLOOR 1 Meg to Metal Frame of EUT Configuration of EUT: EUT power 120VAC 50Hz																
Note:	Configuration of EUT: EUT power 120VAC 50Hz Note: All Points are Tested with 10 Shots in Single Shot Mode each phase unless otherwise stated																
	Note: All Points are Tested with 10 Shots in Single Shot Mode each phase unless otherwise stated																
Refe	Reference: TEST POINT: The day To Day TEST DOINT. A. + U + Z																
EN 610	000-4-2	TEST PO	TEST POINT: <u>Minus Polarity</u> TEST POINT: <u>Mut in Hat Resc</u> <u>PLUS POLARITY MINUS POLARITY</u> <u>PLUS POLARITY</u> <u>MINUS POLARIT</u>														
REF.	KILO	Air D/shaway	CONTACT	Air	CONTACT	Air	CONTACT	Air	CONTACT								
LINE	VOLTS	D/cnarge	Mode	D/charge	Mode	D/charge	Mode	D/charge	Mode								
1	1																
2	2	(V) or	(V) or	(1) 01	(1) or	(V) OK	(V) ex	(1) or	(V) an								
3	3			,													
4	4	(1) rK	(1) ex	$(\mathbf{V})_{or}$		(1) ex	(1) ok	(V) Or	(1) 0K								
5	5																
6	6	(1)1E	(1) ok	(1) px	() or	$(\mathbf{V})_{\alpha \mathbf{X}}$	(V) or	(1)0K	(V)OK								
7	7			•													
8	8	() er		(V)OK		(V) ok		(V)ok									
9	9																
10	10																

Refe	rence:	ice:															
		TEST	PO	INT: 🖌	Isr	nakl	202	Justa	.	TEST POINT: Real Sugar Flore							
EN 61	000-4-2	PLUS	PO	LARIT	Ŷ	MINU	Ί P	OLARIA	Í <u>Y</u>	PLUS POI	ARITY	MINUS P	OLARITY				
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	<u> </u>															
2	2	(1)m/	4	(~) 1	r	(~),)A	(V) _N	1	(1) ok	(1)	(1)	(1) OK				
3	3						1	1			-						
4	4	(✓)		(√)	$\mathbf{}$	(~)		(1)		(1) Br	(1) er	(1) or	(V) or				
5	5				6												
6	6	(⁄)		(),	K	(⁄)		(1)	5	(V) or	(1) OK	(V) 0K	(V) BK				
7	7					4	,										
8	8	(1)			_	(√)¥/	14			(1) OK		(1) 0X					
9	9						•										
10	10																

Notes: A Checkmark (\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: ABK

	ta Sheet of	- ES Sch	ESD DATA SHEET Schaffner NSG 435 Gun			Midwest EMI Associates Mundelein, Illinois			Form: lssued 11/22/09 MEMI-1A			
	Sponsor Manager	r: <u>TIM Mi</u>	<u>isk Forca 7</u> <u>IIBR</u> Tem	<u>72<i>Р</i>5</u> Seria p: <u>73.2°F</u> Н	al Number: :	<u>BMI Pk</u> Technic	2 <i>070</i> ian: <u><i>M.S</i> S/</u>	W ver.:				
Config Note:	Date of Test <u>7/16/10</u> Time: <u>//:07</u> EUT: Prototype / Unit Placement of EUT: ESD Table Pole Mount Wood Table FLOOR Grounding: Pole Terminal Strip <u>//</u> 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											
WALV2												
Refe	rence:	TEST PO	DINT: <u><i>Ra</i></u>	<u>т Сот Se</u>	CRAW/	TEST P	DINT:	НСР				
EN 61	000-4-2	PLUS P	OLARITY	MINUS P	OLARITY	PLUS P	<u>OLARITY</u>	MINUS I	POLARITY			
REF.	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	V	NA	V			
3	3											
4	4	NA	NA	NA	NA	NA	V	NA	V			
5	5				<u></u>							
6	6	NA	NA	NA	NA	NA		NA	V			
7	7											
8	8	V		レ		1		V				
9	9											
10	10											
(

Reference:										
FN 61000 4 2			DINT: <u>VA</u> OLARITY	<u>IVIZ HANI</u> MINUS E	DLE LEFT	TEST POINT: 1/A/VA COUPLING BAI				
REF.	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	/		×		V.		V		
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		- ES	ESD DATA SHEET Schaffner NSG 435 Gun			Midwest EMI Associates Mundelein, Illinois			Form: Issued 11/22/09 MEMI-1A		
	Sponsor Manage:	: Group: <u>77</u> r: <u>77<i>n M</i>.z.</u> /	<u>Ask Foeda</u> I <u>#R</u> Temj	<u>778</u> Seria p: <u>73.2°F</u> H	al Number: um: <u>61.8%</u>	<u>IBMI</u> Technici	<i><u>2070</u></i> ian: <i><u>M.S</u> S/1</i>	W ver.:			
Date of Test_9/16/10 Time: 11.07 EUT: Prototype / Unit Placement of EUT: ESD Table V Pole Mount Wood Table FLOOR Grounding: Pole Terminal Strip V FLOOR 1 Meg to Metal Frame of EUT Configuration of EUT:											
Reference: TEST POINT: <u>276 Hr Front</u> PLUS POLARITY MINUS POL						<u>FOOT</u> TEST POINT: <u>EIGHT LID SCERW</u> PLARITY 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	V	NA	NA	NA	\checkmark	NA		
7	7										
8	8	/				V		\checkmark			
9	9										
10	10										
									<u> </u>		

Refe	rence:									
		TEST PC	DINT: <u>UPP</u>	PAR RH SI	<u>DIZ DIS</u> PLAY	TEST POINT: MIDLE LOWRE DISPLAY				
EN 61000-4-2		PLUS POLARITY		MINUS POLARITY		PLUS POLARITY		MINUS POLARITY		
REF.	KILO	Air	CONTACT	Air	CONTACT	Air	CONTACT	Air	CONTACT	
LINE	VOLTS	D/charge	Mode	D/charge	Mode	D/charge	Mode	D/charge	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	V	NA	NA	NA	NA	
7	7									
8	8	\checkmark		~		\		V		
9	9									
10	10									

Notes: A Checkmark (\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:_____

Da	ta Sheet	t <u>ESD DATA SHEET</u>		M	Midwest EMI			Form: Issued 11/22/09				
کب	to	 Schaffner NSG 435 Gun 		A	Associates			II-1A				
					Munc	Mundelein, Illinois						
<u> </u>	Sponsor	Group 74	KE FADAR	TTP(Seri	al Number	AMT PL	DATA					
Manager: <u><i>IIM MtH2R</i></u> Temp: <u>73.2°F</u> Hum: <u>61.8%</u> Technician: <u>M.5</u> S/W ver.:												
Date of Test <u>9/6/10</u> Time: <u>11:07</u> EUT: Prototype / Unit												
	Placemo	ent of EUT:	ESD Table	t <u>V</u>	Pole Mou	nt	Wood Tal	ole FLC	HOR			
Config	uration o	f EUT:			_ FLOOR_	I meg	to metal r	rame of EU	L			
Note:	All Point	s are Teste	d with 10	Shots in Si	ngle Shot M	Aode Unles	s Otherwis	e Stated				
		1				1						
Reie	rence:	TEST PC	INT AT	a MAIA R	ncE	TEST D	INT PA	(+T+ ()A) T)	Durantal			
EN 61	000-4-2	PLUS PC	DLARITY	MINUS P	OLARITY	ARITY PLUS POLARITY MINUS POLARITY						
REF.	KILO	Air	CONTACT	Air	CONTACT	Air	CONTACT	Air	CONTACT			
LINE	VOLTS	D/charge	Mode	D/charge	Mode	D/charge	Mode	D/charge	Mode			
1	1											
2	2	NA	NA	NA	NA	NA	NA	NA	NA			
3	3											
4	4	NA	NA		V		NA	V	NA			
5	5											
6	6	V	NA	V	*	1	NA		NA			
7	7											
8	8	V		*		\checkmark		V	_			
9	9											
10	10											

Reference:					-					
		TEST PO	DINT: <u>Ba</u>	T CPMT D	DOOR	TEST POINT: <u>INTREIOR DISPLAY</u>				
EN 61	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	\checkmark	NA	NA	NA	NA	NA	
7	7									
8	8	V		\checkmark		NA		V		
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: <u>BUT INDICATOR IRD DISPLAY CORRUPTION</u>. <u>POWRE CYC/IZ</u> FOR CORRECTION. NEW ATENNA WITH CIRAN HOUSING GND 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 <u>localized</u> 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 amperesCoil Distance:70 centimetersNumber of turns:31 turns

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

Let: l = distance from each coil to midpoint, cmR = distance from midpoint to radius of coil, cmr = radius of coil, cm

 $\begin{aligned} \mathbf{R} &= /\overline{\mathbf{1}^2 + \mathbf{r}^2} = /\overline{\mathbf{35}^2 + \mathbf{36.5}^2} &= 50.56 \text{ cm} \\ \mathbf{B} \text{ (Tesla)} &= .5 \ \mu_0 * \mathrm{I} * \frac{\mathbf{r}^2}{\mathrm{R}^3} * \mathrm{N} \text{ , } \ \mu_0 &= 4 \ \pi \ \mathrm{x} \ 10^{-7} \ \mathrm{T} \ \mathrm{x} \ \mathrm{m/A} \\ \mathrm{I} &= 20 \text{ Amps RMS, } 60 \text{ Hz} \end{aligned}$

 $B (V/m) = 188.5 * I * \frac{r^2}{R^3} * N$ N = 25 Turns r = .5 m, R = .6403m

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

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 <u>RESULTS</u>

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.

Ref: TFT EP0372 HYDRANT VALVE.doc

