Performance Certification to EMC Directive

Normative Standard: **EN61000-6-2, EN 61000-6-3: 2007**

Test Unit Description and Serial Number:

TFT BIV/VUM VALVE CONTROLLER (EP0406)

S/N: EMI Prototype

Test Report # 2955

Dates of Test: 10-01-2009 through 10-30-2009

Test Laboratory:

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

EN 61000-6-3 EMISSIONS

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

EN 61000-6-2 IMMUNITY

TEST METHOD		LEVEL
EN 61000-4-2 Cons Ed 1.2:2009 Electrostatic Discharge Test	2, 4, 6 and 8 kV Air Discharge 2 and 4 kV Contact Discharge	A
EN 61000-4-3 Ed. 3.0: 2009 Radiated Immunity Test	10 V/M (10 V/M minimum) 1000 Hz, 80% AM modulation, 900 Mhz, 100% AM, 200 Hz, Square Wave, 30-1000, 1.4-2.0 GHz, 2.0-2.7 GHz (reduced level)	A
EN 61000-4-4 Ed. 2.0: 2004-07 Electrical Fast Transients	.5, 1 and 2 kV Line to Line	A
EN 61000-4-5 Ed. 2.0: 2006 Electrical Surge Test	.5 kV Line to Line	A
EN 61000-4-6 Ed. 2.2: 2009 Conducted Immunity	3 & 10 V RMS Common Mode	A
EN 61000-4-8: 2001-03 Magnetic Immunity	30 A/M Min (800 A/M Applied) Three Axes	A

Performance Level:

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

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

MEMBER CHICAGO & NORTHERN ILLINOIS

Nemko Accredited ELA

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

Midwest EMI Associates Test Service
Report No. 2732, 2771

Test Specifications

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

Test Device: **TFT BIV/VUM VALVE CONTROLLER (EP0406)**

Serial Number: **EMI Prototype**

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: 10-01-2009 through 10-30-2009

Technical Data Taken by and Report Written by:

George A. Bowman

George Bowman
Midwest EMI Associates

NARTE Certified Engineer, EMC-000738NE

Approved By:

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

1.0 PURPOSE:

The purpose of this test sequence is to qualify the compliance of the TFT BIV/VUM VALVE CONTROLLER (EP0406) 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 and conducted emissions, IEC 61000-4-2 electrostatic discharge test, IEC 61000-4-3 radiated immunity standards, IEC 61000-4-4 electrical fast transients, IEC 61000-4-5 Surge Test, IEC 61000-4-6 conducted immunity test and IEC 61000-4-8 magnetic immunity test. The sponsor group has made many more improvements for this second round of tests.

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 BIV/VUM Valve Controller designed under project EP0406 replaces the current A5822 valve motor control board. This re-design consists of three (3) boards, two of which are being designed and tested at this time with the results included in this report. The third board will be designed and tested at a future date. The first board is the A5825 motor control board. This board consists of microcontroller, 5 volt switching regulator, load dump TVS, encoder inputs, open/close inputs, and MOSFET h-bridge. The second board is the A5830 valve interface board, which consists of microcontroller, 5 volt switching regulator, load dump TVS, open/stop/close inputs, opened & closed feedback relays, and headers for Y5740 CANbus interface board. The third board is the valve operator station board, which again is not covered under this testing.

Communication between motor board and interface board is RS-485 serial protocol. Boards are typically powered by nominal 12 or 24 volt truck voltage system. Boards will be mounted in either anodized aluminum enclosure or painted aluminum enclosure. Appropriate cable ferrites will be used with motor control board.

The BIV/VUM valve control system will be used either to control a TFT RC Ball Intake Valve, which is used to supply water to a fire engine, or on a TFT RC Valve Under Monitor, which is used to control the water flow to a monitor typically mounted on an aerial device. Depending on the application, the customer will use the A5825 motor board either by itself or along with the A5830 interface board and/or the operator station board.

EMI SCREENED ROOM RADIATED SUSCEPTIBILITY CONFIGURATION

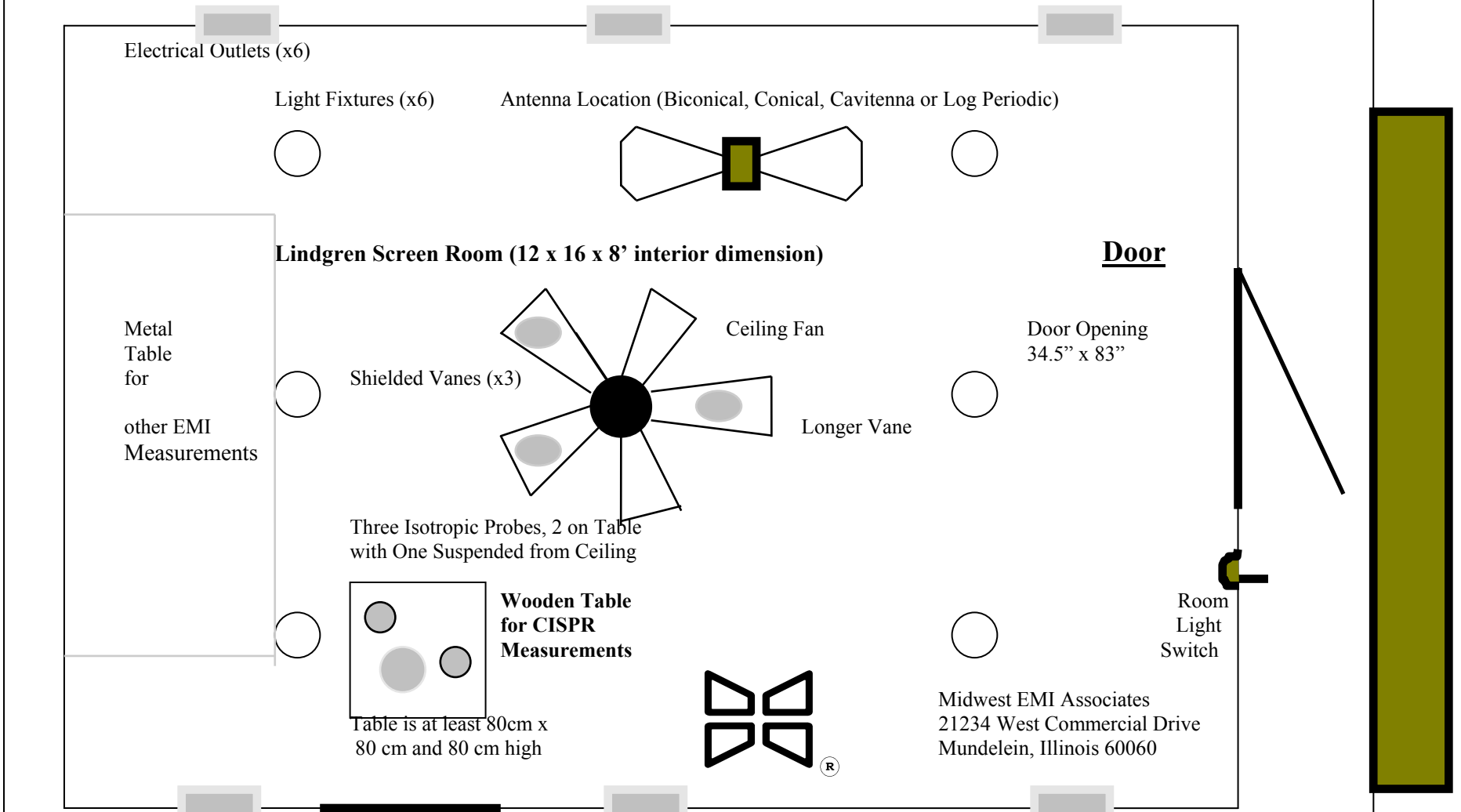


Figure A

3.2 POWER REQUIREMENT:

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

3.3 GROUNDING:

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

3.4 RADIATED CONFIGURATION:

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

3.5 TEST SAMPLE OPERATION:

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

4.0 DISPOSITION OF TEST SAMPLE:

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

5.0 REFERENCES:

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

EN 61000-6-2 Ed. 2.0 (2007), "Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments"

EN 61000-6-3 Ed. 2.0 (2007), "Electromagnetic compatibility (EMC) - Part 6: Generic standards - Section 3: Emission standard for residential, commercial and light-industrial environments"

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

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

IEC 60601-1-2 (2005), "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

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

Cispr 11 (EN55011) Cons. Ed. 4.1, 2009, "Industrial, scientific and medical (ISM) radio-frequency equipment - Electromagnetic disturbance characteristics - Limits and methods of measurement"

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

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

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

6.0 GENERAL INFORMATION:

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

6.1 TEST PROCEDURES:

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

6.2 TEST DESCRIPTIONS:

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

The possible range of tests that could have application either domestically or internationally are listed below along with applicable protocol numbers. The references supplied provide information on how to perform the test. CISPR 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 a USAFlex 486 Advanta 50 MHz measuring system. The 6 dB impulse bandwidth settings and wideband correction xaaaaaaaaaafactors are listed below:

TEK 2756P Analyzer

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

TEK 2712 Analyzer (Dual Analyzers in Use)

Bandwidth Setting		Wideband 6dB Bandwidth		Correction Factor		Factor Applied	
5	MHz	4.92	MHz	-13.84	dB	-14	dB
1	MHz	.932	KHz	.6117	dB	0	dB
.3	MHz	.31	KHz	10.173	dB	10.5	dB
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 Mar 10
b)	Wavetek 2520A RF Generator	0222011	30 Mar 10
c)	Carver TFM-35 250 W/Ch. Audio Amp	3097104	N/A
d)	ENI RF Power Amplifier (525LA)	367	N/A
e)	ENI RF Power Amplifier (2100L)	129	N/A
f)	Eaton 15100B Power Amplifier	1529-07090	24 Mar 10
g)	Tektronix TDS 420 Oscilloscope	B021212	24 Mar 10
h)	EMCO 3109 Power Biconical (1/3/10 Meters)	9011-2504	17 Mar 10
i)	EMCO 3101 Power Conical	9007-3450	N/A (1/3m)
j)	EMCO 6502 Active Loop	1038	18 Mar 10
k)	EMCO 3301B Active E Field	9009-3044	19 Mar 10
l)	EMCO 3147 Wide Range Log Periodic	9102-1019	23 Mar 10
m)	EMCO 3107B Power E Field	9310-2435	N/A

m)	Amplifier Research FM1000		12456	N/A
n)	Amplifier Research FP1000		60701	21 Mar 10
o)	Amplifier Research FP1000		60488	3 Mar 10
p)	IFI EFS-4 E Field Susceptibility		39883	14 Mar 10
	(Holladay 3004EX with HSE405 Probe)			
q)	IFI LMT-B Light Modulator		1117-B	N/A
r)	IFI EFS-1 E Field Susceptibility		245738	N/A
s)	Solar 6741-1 RF Current Probe		911308	N/A
t)	Fluke 45 True RMS Voltmeter		**EJ574714013**	24 Mar 10
u)	Schaffner NSG 433 ESD Gun		107	
	and Contact Discharge Adapter		402-664/0	30 Mar 10
v)	Solar Loop Sensor 7334-1		----------	N/A
w)	Solar Loop Sensor 9311-1		931101	N/A
x)	Solar RF Coupler 7415-3	906016	N/A	
y)	Solar Line Impedance Stabilization Network		8028-50-TS-24-BNC	N/A
z)	Solar VDE Filter Network		8907-250-TS-24-BP	N/A
aa)	Ohmic Instrument BET-300-ADL		522	25 Mar 10
ab)	Werlatone C1795 Dir. Coupler		3442	30 Mar 10
ac)	Solar Current Injection Probe Type 9108-1N		935012	N/A
ad)	Tektronix TR 503B Tracking Generator		B011216	25 Mar 10
ae)	Acme 2KVA Isolation Transformer		T-3-53042-S	N/A
af)	Xentek Extreme Isolation Transformer Model 5410 (2 in use)			
ag)	Tektronix P6202 RF Probe		------	N/A
ah)	Staco Power Variac Type 3PN2210 (0-140VAC) 3.1KVA		N/A	
ai)	Helmholtz Coil Stepdown Xfrmr-Chicago Xfrmer Type P-6492			N/A
aj)	Goldstar Signal Generator Mod FG-2002c	201621	25 Mar 10	
ak)	Holladay Magnetic Field Probe Model HI-3624	83957	15 Mar 10	
al)	Tektronix 2712 Spectrum Analyzer (Quasipeak)		B022520	24 Mar 10
am)	Voltec PM100 Power Analyzer		AA04/8495	25 Mar 10
an)	EMCO 3142 Biconilog Antenna		1052	1 Mar 10
ao)	Haefely P90.1 EN 61000-4-4 Fast Transient Tester		083 593-14	19 Mar 10
ap)	Hewlett Packard 3400A AC Voltmeter		1218A14443	24 Mar 10
aq)	Amplifier Research FP2031 Isotropic Probe		18309	5 Mar 10
ar)	Haefely 250 600/00 (61000-4-5 Surge Tester)		583 334-05	19 Mar 10
as)	Fischer CISPR 14 Absorbing Clamp type F-201		235	7 Mar 10
at)	Fischer IEC 801-6 Transducer		165	23 Mar 10
au)	Solar 9123-1N Current Clamp		956015	23 Mar 10
av	Fischer IC 801-6 CDN FCC-801-M3-25		95	7 Mar 10
aw)	Tektronix 2712 Spectrum Analyzer (Quasipeak)	B022981	24 Mar 10	
ax)	C. C. Moore Automated Mast Assembly Model DAPM4/6			N/A
ay)	C. C. Moore Automated Turntable Model DTT-4		N/A	
z	Antenna Research LPB2520		1152	20 Mar 10
ba)	Behlman Power Pass 50 Hz AC Source (50, 60, 400 Hz)	0005	N/A	
bb)	California Instruments WP1251 AC Source (50, 60 Hz)		N/A	
bc)	Plitron Extreme Toroidal Isolation Transformers (2)			
bd)	Edmund Scientific Thermometer/Hygrometer		None	31 Mar 10
be)	Coaxial Bird Pads (x2) 8306-030-N3DB			30 Mar 10
bf)	High Current Source, Associated Research 3030D		A140006	25 Mar 10
bg)	California Instruments 5001ix High Power Source		HK52945	25 Mar 10

bh)	Line Leakage tester, Associated Research 510L		130007	25 Mar 10
bi)	Hipot Tester, Associated Research 3570D		090595	25 Mar 10
bh)	GAASfet Preamplifier		None	25 Mar 10
bi)	Ametek Tachometer Model 1726		R035292	24 Mar 10
bj)	Bird Attenuator (x2), 75 Watt, 75-A-MFN-10		R035290	N/A
bk)	HP 8482A Power Sensor		S/N: 2652A18474	24 Mar 10
bl)	HP 435B Power Meter		S/N: 2702A17563	24 Mar 10
bm)	Simpson Model 383 Thermometer	B001531	24 Mar 10	
bn)	Wavetek 27XT Voltmeter		96120787	24 Mar 10
bo)	HP 8657A Programmable Synthesizer	365	17 Mar 10	
bp)	Fluke 75			24 Mar 10
bq)	ENI 525LA			19 Mar 10
br)	Tek 495P Opt 5/7		B020147	30 Mar 10
bs)	Amplifier Research FP2036 (.5-5Ghz)			04 Sep 09

7.0 CONCLUSION OF RADIO FREQUENCY INTERFERENCE EMISSIONS AND SUSCEPTIBILITY TESTS:

The TFT BIV/VUM VALVE CONTROLLER (EP0406) 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 its valve control head via a remote control connection.

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

EP0406 BIV_VUM Board Redesign
EMC Testing

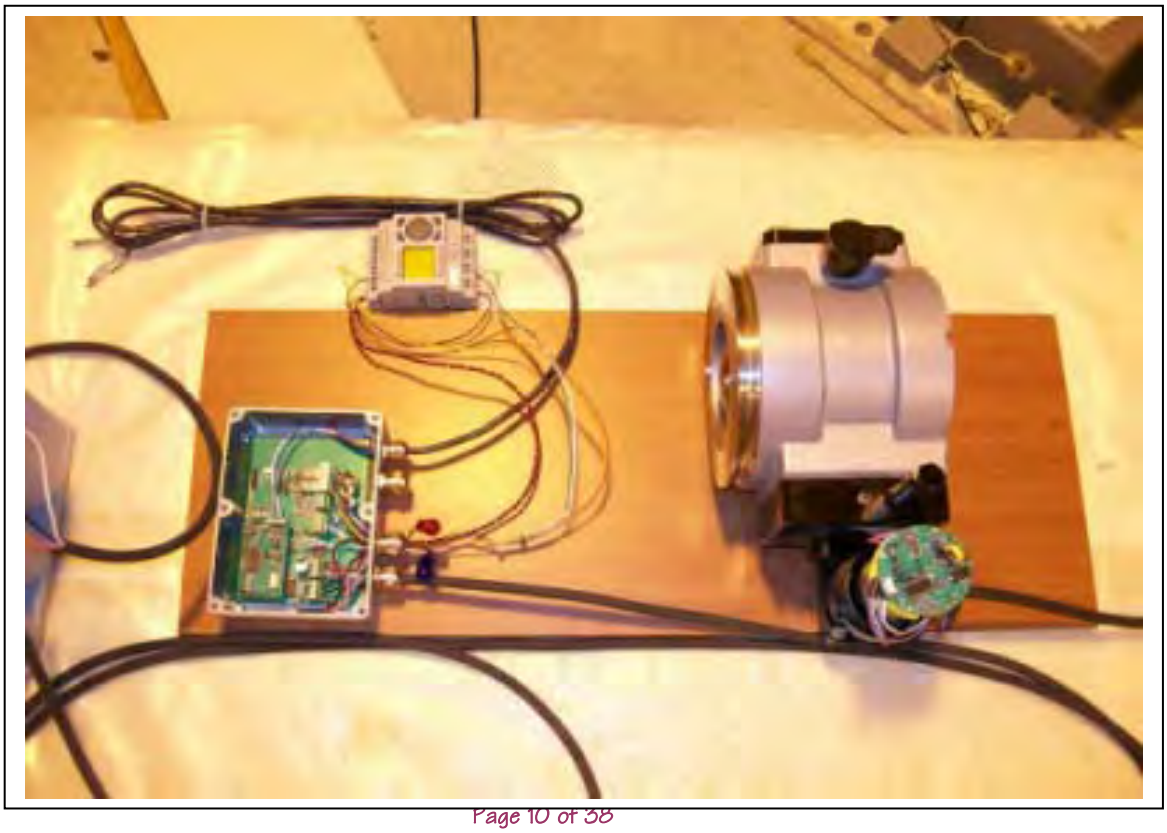
10/31/09 Testing at Midwest EMI

RC BIV

- Prototype motor board #2, 1.0.0 beta code
  - QEA encoder line - D20 schottky diode moved to after F1 (chip ferrite)
  - QEB encoder line - D21 schottky diode moved to after F2 (chip ferrite)
  - OPEN input line
    - D22 schottky diode moved to after R15 (100k ohm res)
    - Added 0.01uF, 200V ceramic cap after R18 (1 ohm res)
  - CLOSE input line
    - D23 schottky diode moved to after R17 (100k ohm res)
    - Added 0.01uF, 200V ceramic cap after R19 (1 ohm res)

- Prototype interface board #1, 1.0.0 beta code
- Prototype Y5740 CANbus board #2, 1.0.0 beta code

- AB programmable relay cycling valve open & closed thru inputs on interface board
- 10’ of 4/c cable from interface box to battery
- 10’ of 4/c cable from motor Deutsch connector to battery
- 10’ of 4/c cable from Y5740 board to nothing, 120ohm resistor across CANHI & CANLO
- 2’ of 6/c cable from motor board to Deutsch connector
- Ferrites in motor enclosure
  - One Steward 28B0275-000 ferrite on each of power & ground leads
  - One Steward 28B0275-000 ferrite on blue & white comm wires
  - One Steward 28B0275-000 ferrite on gray & purple input wires
  - One Steward 28B0275-000 ferrite on 4 encoder wires
  - One Steward 28B0275-000 ferrite on 2 motor wires
- No ferrites in interface enclosure
- Using Optima battery for power



NON-TESTING SIDE

TESTING SIDE

A5830 Board
- Discrete Switch Inputs
- RS485 Communication
- Feedback Relays
- CANbus available
- Flowmeter plug-in socket

Y5740 Board
- CANbus Communication

AB Controller
for cycling valve
open & close

Interface Box

CANbus
(not connected)

A5825 Board
- Motor Control
- RS485 Communication
- Discrete switch inputs

Y4600 Motor
- GM14632 with 220pF brush caps

RC BALL INTAKE VALVE

Blue & White

+

−

Vbat

EMC TESTING
COMPONENT SETUP
8/27/2009

Nemko Laboratory Authorisation

Aut. No.: ELA 175

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

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

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

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

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

The Authorisation is valid through 31 July 2010.

Dallas, Texas 12 Sep 2009

For Nemko AS:

TB Ketterling, Nemko EMC Coordinator

Nemko AS Gaustadalléen 30 P.O.Box 73 Blindern N-0314 Oslo Norway T +47 22 96 03 30 F +47 22 96 05 50 Enterprise number NO974404532

Nemko Laboratory Authorisation

Aut. No.: ELA 175

SCOPE OF AUTHORIZATION

BASIC TESTS AND ASSOCIATED STANDARDS

Capability to perform a basic test implies also that any product (family) standard calling up this basic test is also within the scope if mentioned below or not.

Disturbance emissions		
Electromagnetic radiation disturbance, 9 kHz to 30 MHz, re.: EN 55011 (CISPR 11), EN 60945 (IEC 60945)	***Electromagnetic radiation disturbance, 30 to 1000 MHz, re.:*** EN 55011 (CISPR 11), EN 55013 (CISPR 13), EN 55022 (CISPR 22),	***Electromagnetic radiation disturbance, above 1 GHz, re.:*** EN 55011 (CISPR 11), EN 55022 (CISPR 22)
Electromagnetic radiation disturbance, 9 kHz to 30 MHz, "Van Veen loop", re: EN 55015 (CISPR 15)	***Electromagnetic radiation disturbance, 50 Hz to 50 kHz, re:*** EN 55103-1	***Conducted common-mode disturbance power, 30-1000 MHz, re.:*** EN 55013 (CISPR 13) EN 55014-1 (CISPR 14-1)
Mains terminal disturbance voltage, re.: EN 55011 (CISPR 11), EN 55013 (CISPR 13), EN 55014-1 (CISPR 14-1), EN 55015 (CISPR 15), EN 55022 (CISPR 22), EN 60945 (IEC 60945),	***Conducted terminal disturbance, Hi-Z probe, re:*** EN 55011 (CISPR 11) EN 55014-1 (CISPR 14-1)	***Conducted discontinuous disturbance on power port, re.:*** EN 55014-1 (CISPR 14-1), section 4.2
Conducted common-mode disturbance at telecom/network ports, re.: EN 55022 (CISPR 22)	***Conducted antenna terminal disturbance, re:*** EN 55013 (CISPR 13)	***Luminaire insertion loss, re:*** EN 55015 (CISPR 15)
Mains inrush current, re: EN 55103-1	***Harmonic current emissions, re.:*** EN 61000-3-2 (IEC 61000-3-2)	***Voltage fluctuations and flicker in low-voltage supply systems, re.:*** EN 61000-3-3 (IEC 61000-3-3), EN 61000-3-11 (IEC 61000-3-11)
Immunity		
Electrostatic discharge immunity test, Re.: EN 61000-4-2 (IEC 61000-4-2)	***Radiated, radio-frequency, electromagnetic field immunity test, re.:*** EN 61000-4-3 (IEC 61000-4-3) ENV 50140:1993, ENV 50204:1995	***Power frequency magnetic field Immunity test, re.:*** EN 61000-4-8 (IEC 61000-4-8)
Radiated audio-frequency H-field, re: EN 55103-2	***Radiated E-field, 150 kHz to 150 MHz, re:*** EN 55020 (CISPR 20)	***Electrical fast transient/burst immunity test, re.:*** EN 61000-4-4 (IEC 61000-4-4)
Surge immunity test, re.: EN 61000-4-5 (IEC 61000-4-5) ENV 50142:1994	***Immunity to conducted disturbances, induced by radio-frequency fields, re.:*** EN 61000-4-6 (IEC 61000-4-6) ENV 50141:1993	***Immunity to voltage dips, short interruptions and voltage variation, re.:*** EN 61000-4-11 (IEC 61000-4-11)
Conducted antenna terminal, re: EN 55020 (CISPR 20)	***Conducted audio/video ports, re:*** EN 55020 (CISPR 20)	BLANK

Nemko Laboratory Authorisation

Aut. No.: ELA 175

SCOPE OF AUTHORIZATION

PRODUCT-FAMILY STANDARDS

Unless specifically noted, only the sections of the standards below which are covered by the capability listing above are assumed covered by this authorisation. When the capability is expanded, more parts of the product standards will be covered.

ISM equipment, emission EN 55011:1998 + A1 :99 (doc=exp) + A2:2002 (doc=1.10.05) *CISPR 11:97 + A1 :99 + A2 :02*	***ITE - emission*** EN 55022:1998 + A1:2000 (doc=1.8.03) + A2:2002 (doc=not harmonized yet) CISPR 22:1997 + A1:2000 + A2:2002 EN 55022:1994 + A1:1995 + A2:1997 (doc=exp) CISPR 22:1993 + A1:1995 + A2:1996	***ITE – immunity*** EN 55024:1998 (doc=exp) + A1 :2001 (doc=1.10.04) + A2 :2002 (doc=not harmonised yet) CISPR 24:1997 + A1 :2001 + A2 :2002
Professional AV – emission EN 55103-1:1996 (doc=exp)	***Professional AV - immunity*** EN 55103-2:1996 (doc=exp)	***Harmonics*** EN 61000-3-2 :2000 (doc=1.1.04) IEC 61000-3-2 :2000 (mod) + A1 :2001 EN 61000-3-2:1995 + A1:1998 + A2:1998 (doc=exp) + A14 :2000 (doc=1.1.04) IEC 61000-3-2:1995 + A1:1997 + A2:1998
Flicker EN 61000-3-3 :1995 (doc=exp) + A1 :2001 (doc=1.5.04) IEC 61000-3-3 :1994 + A1 :2001 EN 61000-3-11 :00 (doc=1.11.03) IEC 61000-3-11 :00	***Generic immunity - light*** EN 61000-6-1:2001 (doc=1.7.04) IEC 61000-6-1:1997 (mod) EN 50082-1 :1997 (doc=exp)	***Generic immunity – Industrial*** EN 61000-6-2:2001 (doc=1.7.04) IEC 61000-6-2:1999 (mod) EN 61000-6-2:1999 (doc=exp) IEC 61000-6-2:1999
Generic emission – light EN 61000-6-3 :2001 (doc=1.7.04) IEC 61000-6-3 :1996 (mod) EN 50081-1:1992 (doc=exp)	***Generic emission - industry*** EN 61000-6-4 :2001 (doc=1.7.04) IEC 61000-6-4:1997 (mod) EN 50081-2:1993 (doc=exp)	***SRD 25 – 1000 MHz, Art. 3.2*** EN 300 220-1:2000 EN 300 220-2:2000 EN 300 220-3 :2000 (doc=exp)
Generic Art. 3.1.b EN 300 339 :1998 (doc=exp)	***Telecom network equipment*** *EN 300 386-2 V.1.1.3 (doc=exp)* *EN 300 386 V.1.2.1 (doc=31.12.04)* *EN 300 386 V.1.3.1 (doc=31.12.04)*	***SRD 1 GHz – 40 GHz. Art 3.2*** EN 300 440-02 V.1.1.1 (doc=exp) EN 300 440-01 V.1.1.1 EN 300 440-01 V.1.3.1 (2001)
SRD 9 GHz – 40 GHz. Art 3.1.b EN 301 489-03 V.1.3.1 (2001) (doc=31.08.03) EN 301 489-03 V.1.2.1 (2000) (doc=31.10.03) EN 301 489-03 V.1.4.1 (2002) (not harmonised) EN 301 489-01:2000 V.1.2.1 (doc=exp) EN 301 489-01:2001 V.1.3.1 (doc=30.06.03) EN 301 489-01:2002 V.1.4.1 (doc=30.11.05) ETS 300 683 :1997(doc=exp)	***Wideband & Hiperlan. Art 3.1.b*** EN 301 489-17 V.1.1.1 (2000) (doc=exp) EN 301 489-17 V.1.2.1 (2002) (not harmonised) EN 301 489-01:2000 V.1.2.1 (doc=exp) EN 301 489-01:2001 V.1.3.1 (doc=30.06.03) EN 301 489-01:2002 V.1.4.1 (doc=30.11.05)	BLANK

APPENDIX A1

FCC/VDE CONDUCTED EMISSIONS TEST

(EN55011, EN55022, EN55014)

1.0 PURPOSE:

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

2.0 INTERIOR SHIELDED ROOM DESCRIPTION:

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

3.0 CONFIGURATION AND OPERATION OF TEST SAMPLE:

3.1 POWER REQUIREMENT:

The **TFT BIV/VUM VALVE CONTROLLER (EP0406)** was operated in its normal mode using 12 VDC battery power.

3.2 GROUNDING:

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

3.3 CONDUCTED CONFIGURATION:

In conducted tests, the test sample was oriented on the metal floor at a 40 cm. height over the ground plane to satisfy Cispr 11 or 22 B level test criterions. The LISN was terminated directly

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

3.4 TEST SAMPLE OPERATION:

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

3.5 LIMITS OF ACCEPTANCE:

The general procedures are dictated in the individual protocols listed such as ANSI 63.4, FCC Part 15, CISPR 11, and CISPR 22. The limits for FCC rules presently are given in Part 15.109 of 47 CFR 1 (10-9-1990) Edition of the Federal Code of Regulations. For convenience these limits are plotted on the graphs and in registered in tabulated data.

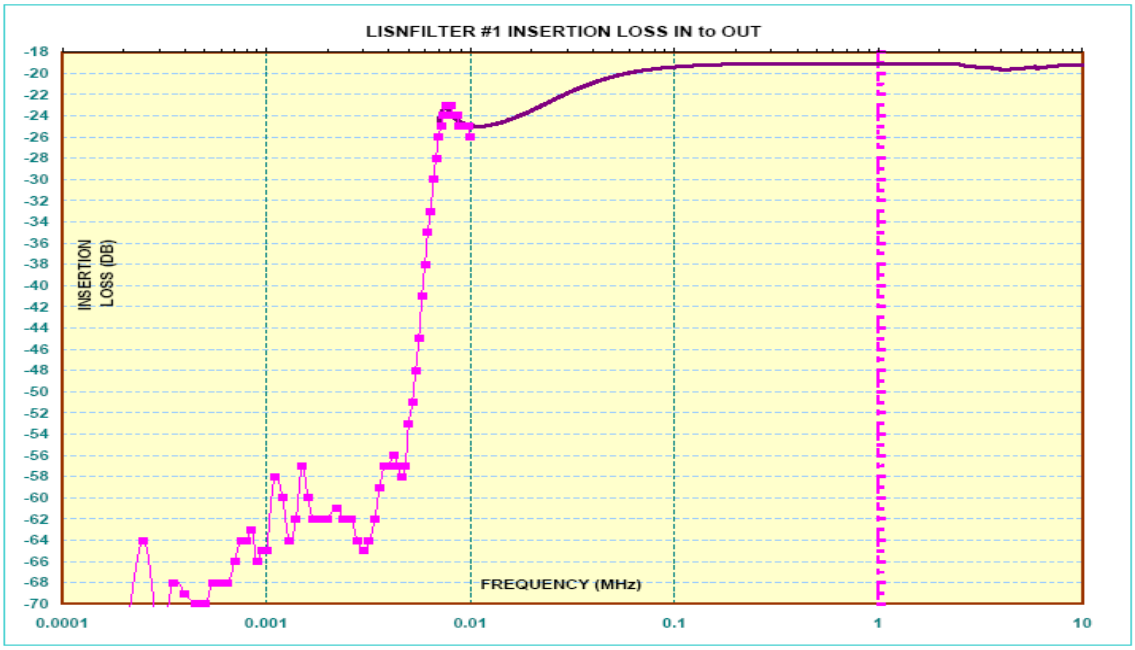
VDE LIMITS

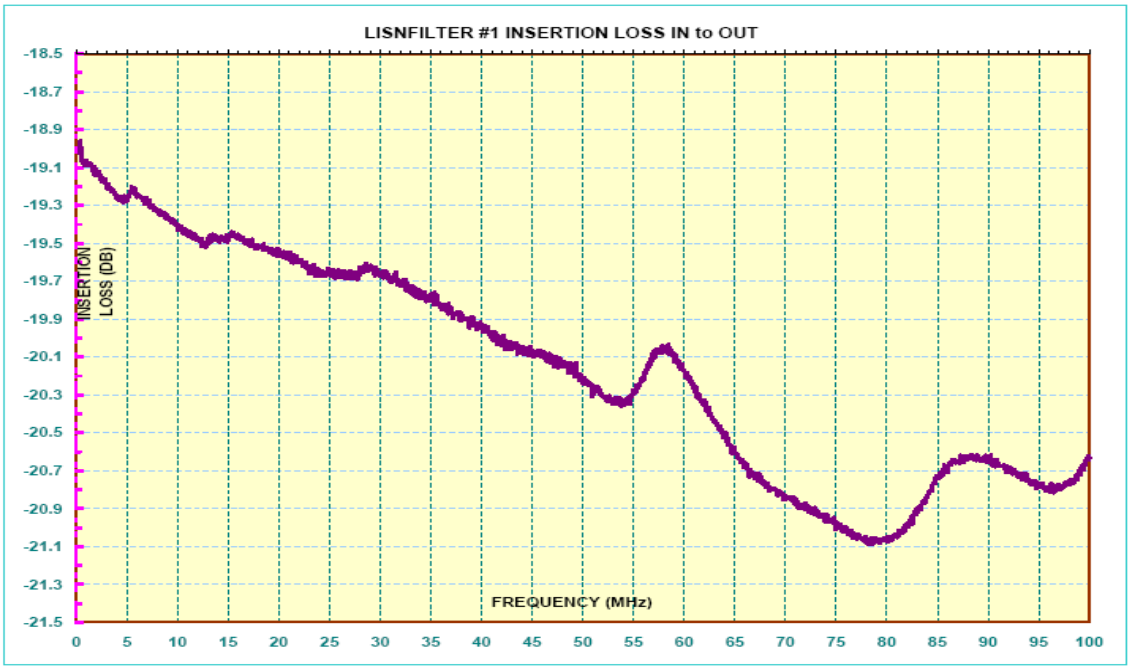
For CISPR 11 (EN55011), 22 (EN55022) or 14 (EN55014) B level conducted compliance starting at 150 kHz the allowed level is 66 dBuV and decreases at a linear rate with the log of frequency to 56 dBuV at 500 kHz. From 500 kHz to 5 MHz the allowed level is 56 dBuV, and 60 dBuV from 5 MHz to 30 MHz at the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

3.6 CALIBRATION DATA:

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

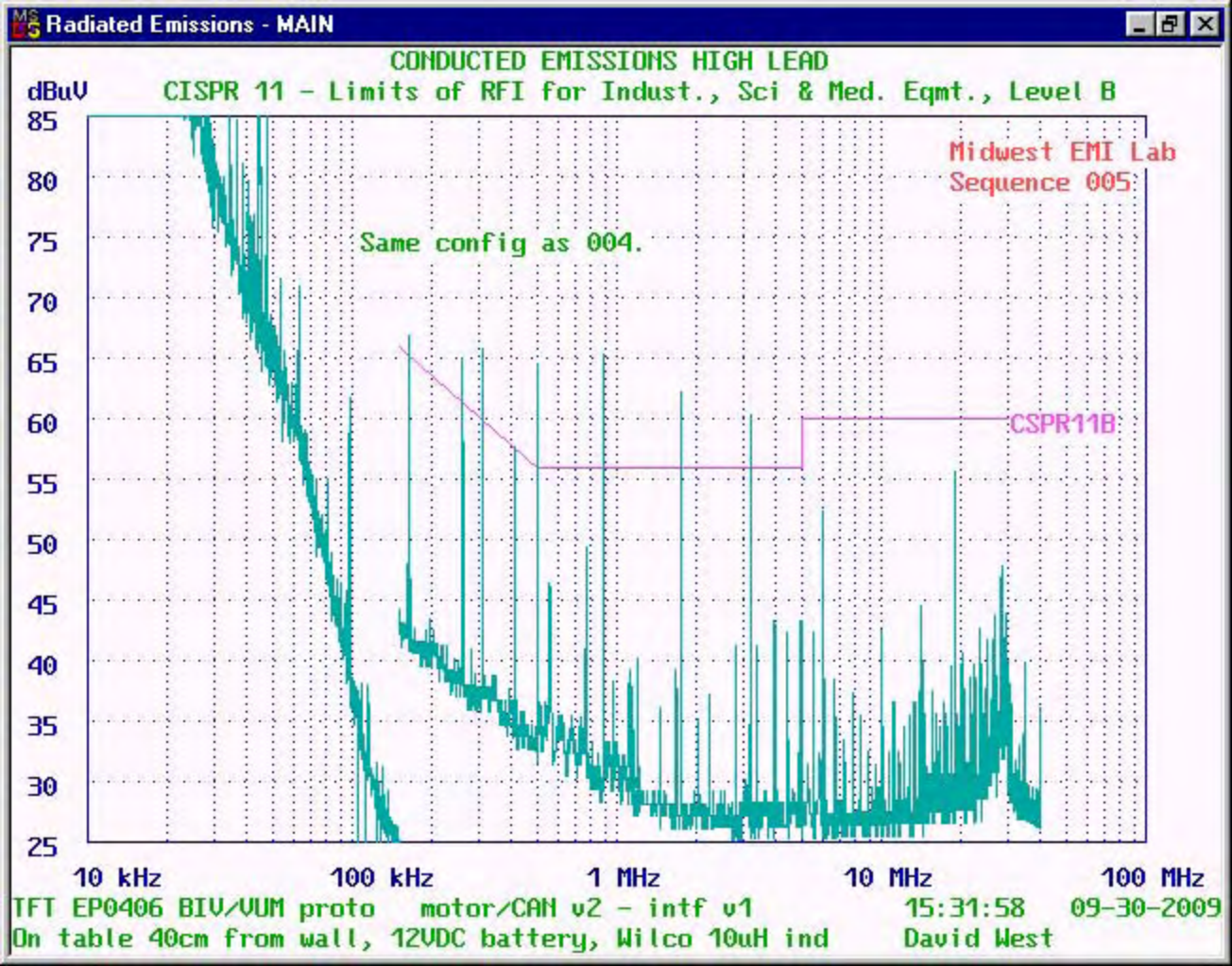
In the range higher than 1 MHz up to 100 MHz the characteristic of each LISN is flat with an insertion loss of no greater than 1.5 dB. In all cases the deviation from the perfect LISN response has been compensated for in a computer correction table file (approximately 150 points). The actual lower end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

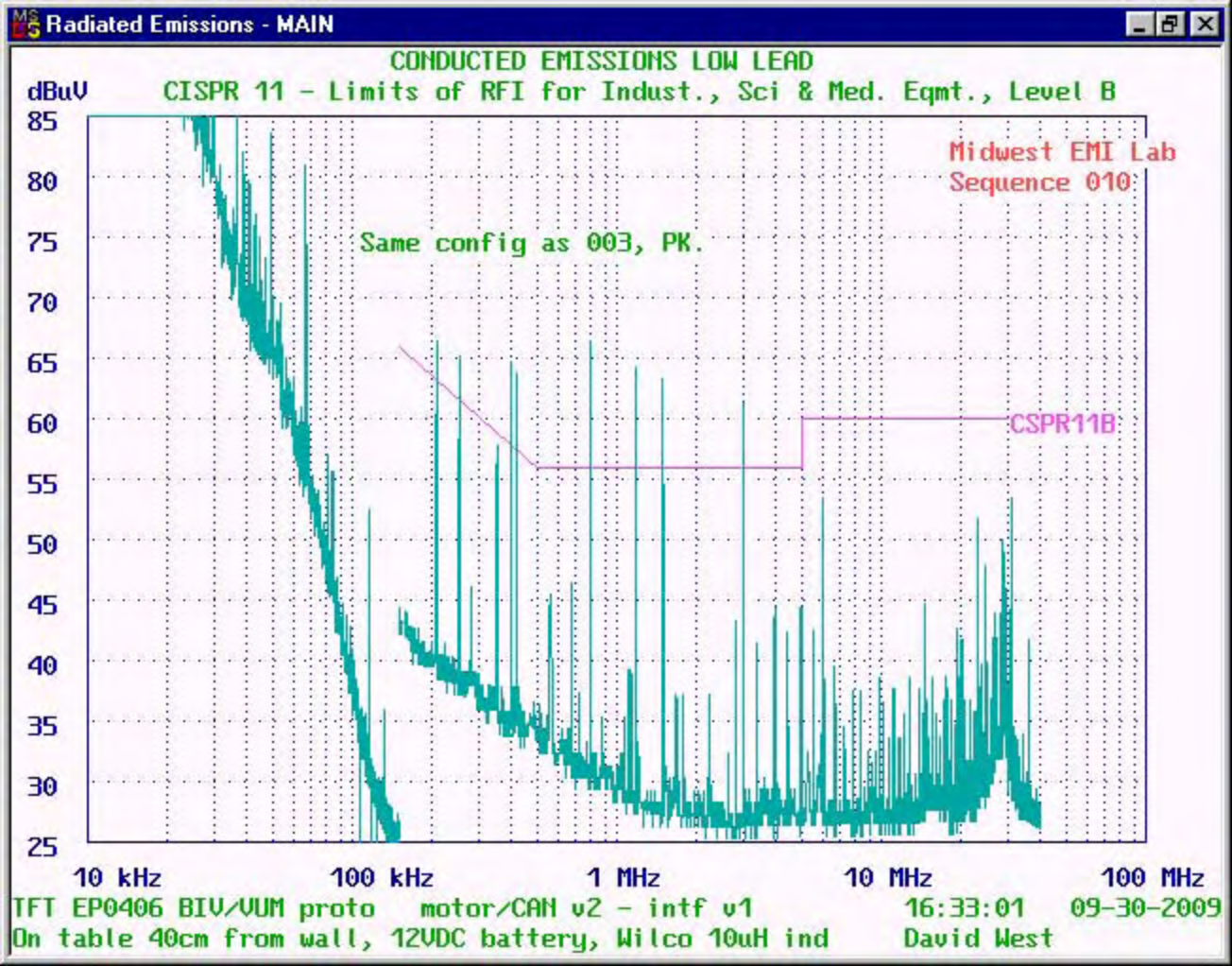

LISNFILTER #1 INSERTION LOSS IN to OUT
INSERTION LOSS (DB)
-18
-20
-22
-24
-26
-28
-30
-32
-34
-36
-38
-40
-42
-44
-46
-48
-50
-52
-54
-56
-58
-60
-62
-64
-66
-68
-70
FREQUENCY (MHz)
0.0001
0.001
0.01
0.1
1
10

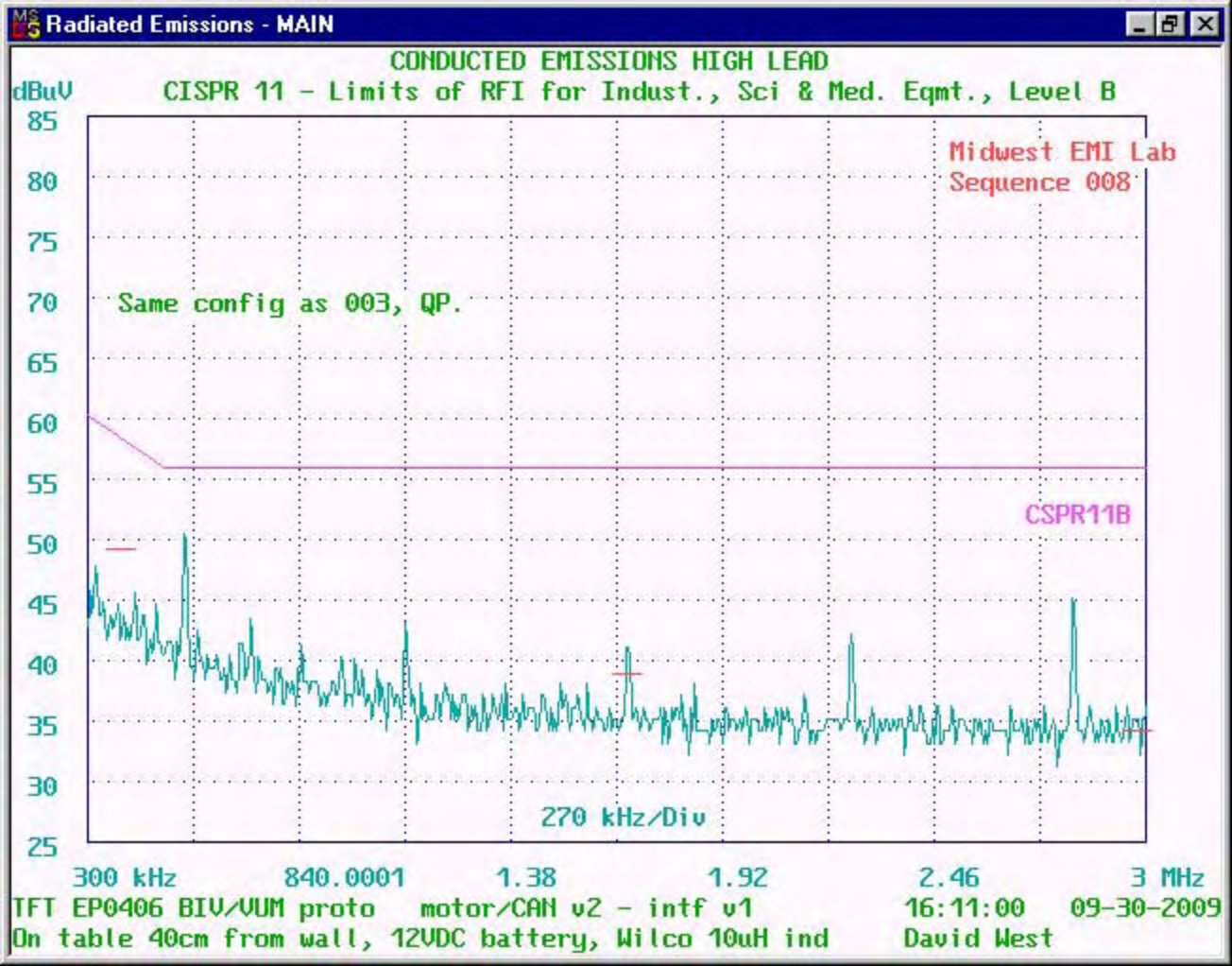

LISNFILTER #1 INSERTION LOSS IN to OUT
INSERTION LOSS (DB)
-18.5
-18.7
-18.9
-19.1
-19.3
-19.5
-19.7
-19.9
-20.1
-20.3
-20.5
-20.7
-20.9
-21.1
-21.3
-21.5
FREQUENCY (MHz)
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
95
100

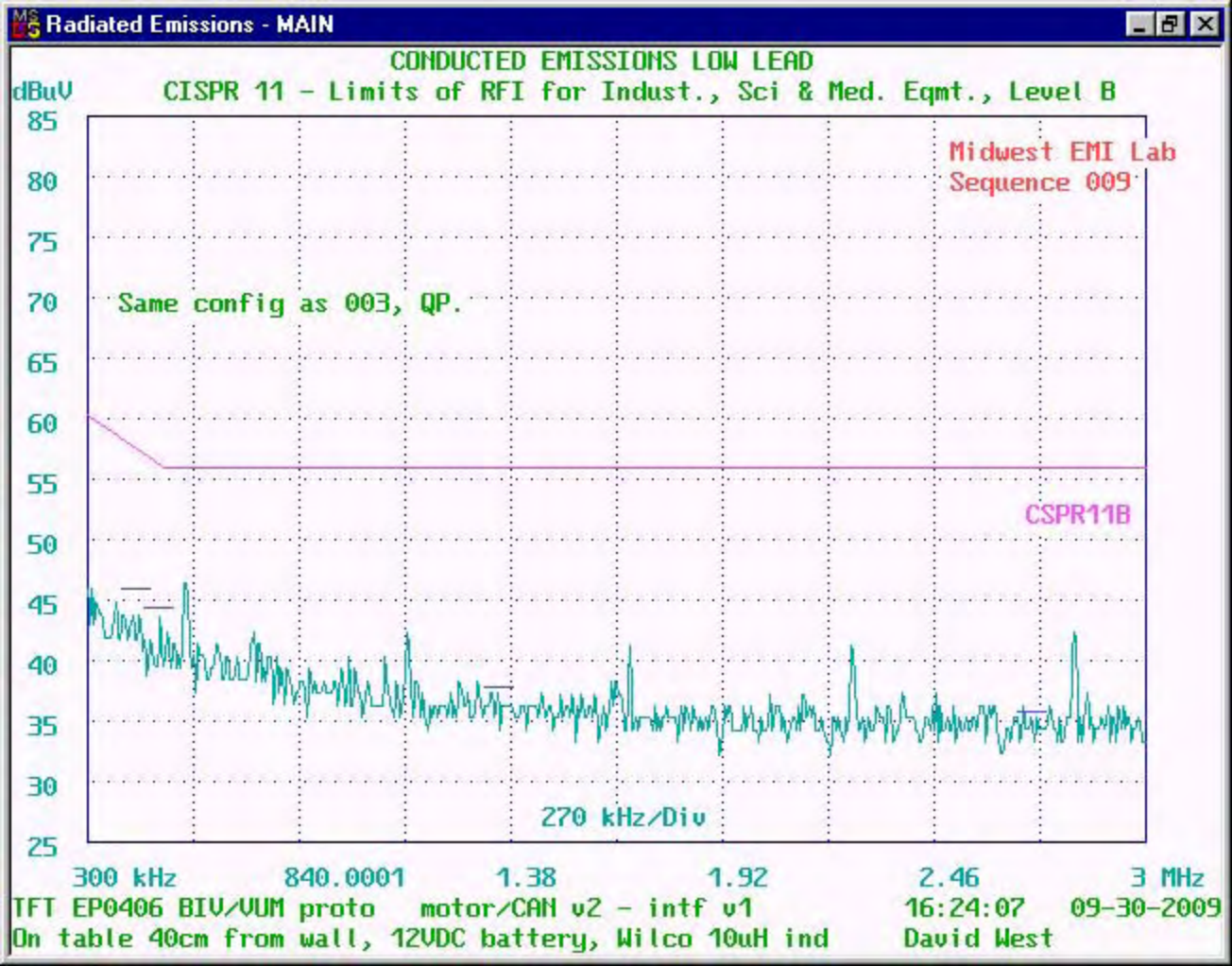
4.0 CONCLUSION OF RADIO FREQUENCY INTERFERENCE EMISSIONS TESTS:

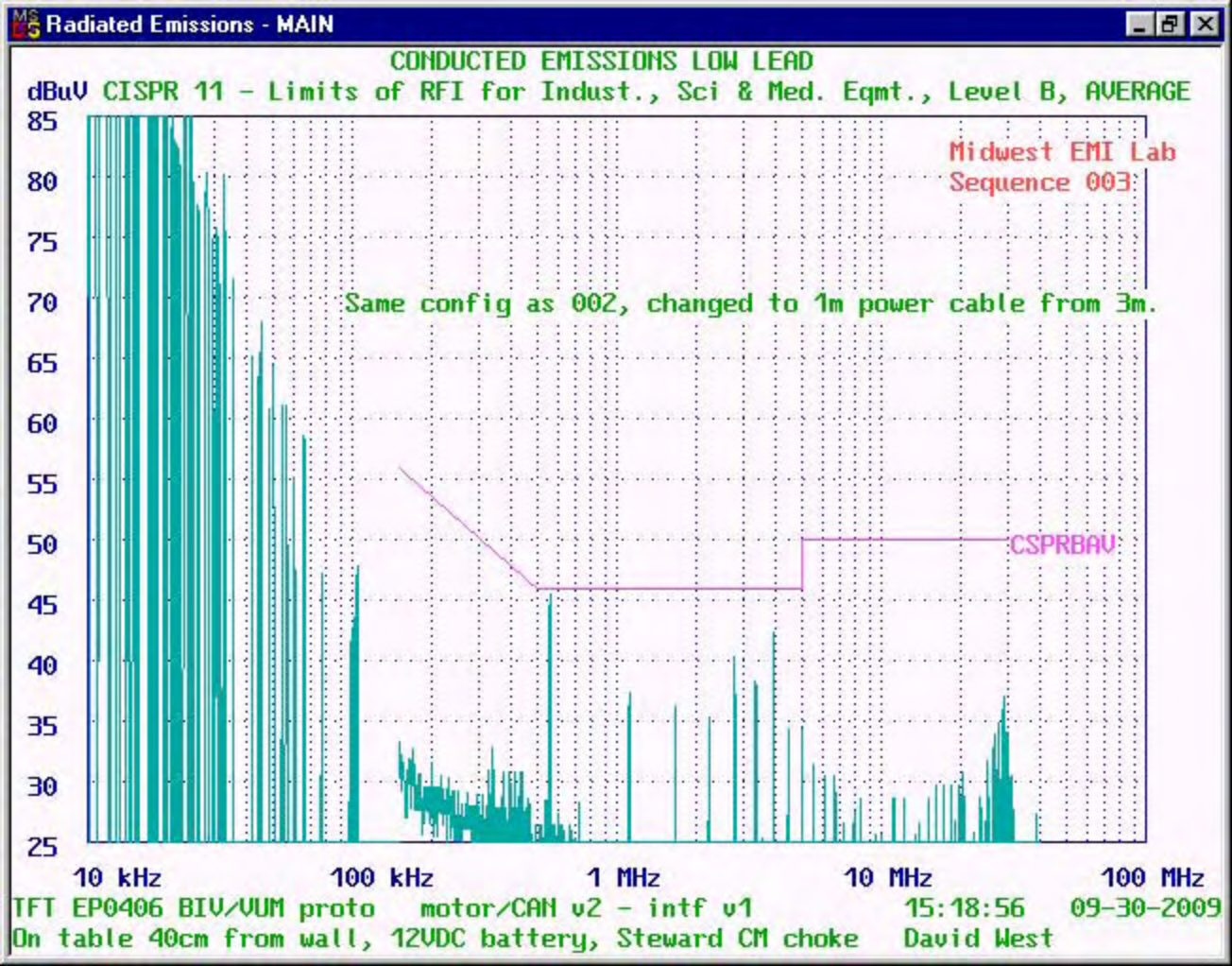
The TFT EP0406 Valve Controller was measured for its conducted emissions per EN61000-6-3 for DC operated devices. After measuring and improving the system the Cispr B objective was achieved. Spikes seen in the data are from reversal of the valve motor.


Radiated Emissions - MAIN
CONDUCTED EMISSIONS HIGH LEAD
dBuV
CISPR 11 - Limits of RFI for Indust., Sci & Med. Eqmt., Level B
Midwest EMI Lab
Sequence 005
Same config as 004.
CSPR11B
85
80
75
70
65
60
55
50
45
40
35
30
25
10 kHz
100 kHz
1 MHz
10 MHz
100 MHz
TFT EP0406 BIV/VUM proto
motor/CAN v2 - intf v1
15:31:58
09-30-2009
On table 40cm from wall, 12VDC battery, Wilco 10uH ind
David West

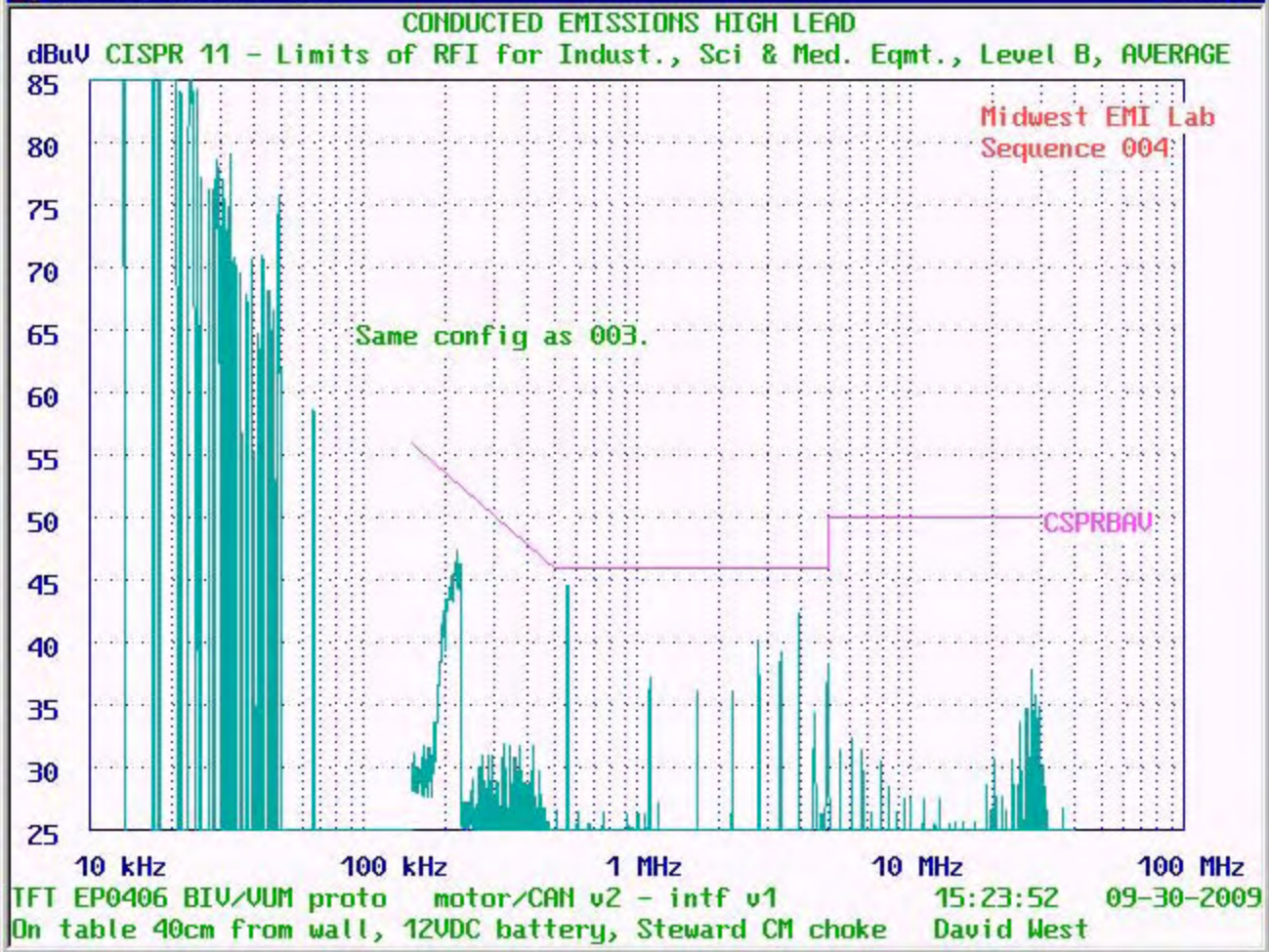

Radiated Emissions - MAIN
CONDUCTED EMISSIONS LOW LEAD
dBuV
CISPR 11 - Limits of RFI for Indust., Sci & Med. Eqmt., Level B
Midwest EMI Lab
Sequence 010
Same config as 003, PK.
CSPR11B
85
80
75
70
65
60
55
50
45
40
35
30
25
10 kHz
100 kHz
1 MHz
10 MHz
100 MHz
TFT EP0406 BIV/VUM proto
motor/CAN v2 - intf v1
16:33:01
09-30-2009
On table 40cm from wall, 12VDC battery, Wilco 10uH ind
David West


Radiated Emissions - MAIN
CONDUCTED EMISSIONS HIGH LEAD
dBuV
CISPR 11 - Limits of RFI for Indust., Sci & Med. Eqmt., Level B
85
80
75
70
65
60
55
50
45
40
35
30
25
Midwest EMI Lab
Sequence 008
Same config as 003, QP.
CSPR11B
270 kHz/Div
300 kHz
840.0001
1.38
1.92
2.46
3 MHz
TFT EP0406 BIV/VUM proto
motor/CAN v2 - intf v1
16:11:00
09-30-2009
On table 40cm from wall, 12VDC battery, Wilco 10uH ind
David West


Radiated Emissions - MAIN
CONDUCTED EMISSIONS LOW LEAD
dBuV
CISPR 11 - Limits of RFI for Indust., Sci & Med. Eqmt., Level B
85
80
75
70
65
60
55
50
45
40
35
30
25
Midwest EMI Lab
Sequence 009
Same config as 003, QP.
CSPR11B
270 kHz/Div
300 kHz
840.0001
1.38
1.92
2.46
3 MHz
TFT EP0406 BIV/VUM proto
motor/CAN v2 - intf v1
16:24:07
09-30-2009
On table 40cm from wall, 12VDC battery, Wilco 10uH ind
David West


Radiated Emissions - MAIN
CONDUCTED EMISSIONS LOW LEAD
dBuV CISPR 11 - Limits of RFI for Indust., Sci & Med. Eqmt., Level B, AVERAGE
Midwest EMI Lab
Sequence 003
Same config as 002, changed to 1m power cable from 3m.
CSPRBAV
85
80
75
70
65
60
55
50
45
40
35
30
25
10 kHz
100 kHz
1 MHz
10 MHz
100 MHz
TFT EP0406 BIV/VUM proto motor/CAN v2 - intf v1
15:18:56
09-30-2009
On table 40cm from wall, 12VDC battery, Steward CM choke
David West

Radiated Emissions - MAIN



SHEET 1 CSPR11B CONDUCTED QUASI-PEAK REPORT
High Lead
CISPR 11 - Limits of RFI for Indust., Sci & Med. Eqmt., Level B
TIME: 16:11:00 Midwest EMI
DATE: 09-30-2009 Associates
TEST ITEM: TFT EP0406 BIV/VUM proto
SERIAL NUMBER: motor/CAN v2 - intf v1
COMMENTS: On table 40cm from wall, 12VDC battery, Wilco 10uH ind
TEST PERFORMED BY: David West

Peak Freq. (kHz)	Peak Interfer. (dBuV)	Quasi-peak Freq. (kHz)	Quasi-peak Interfer. (dBuV)	Spec. Level (dBuV)
392	*61.98*	*387.08*	*49.28*	*58.02*
1677.263	*61.46*	*1682.6*	*39.05*	*56.00*
2978	*61.52*	*2985.5*	*34.32*	*56.00*

SHEET 1 CSPR11B CONDUCTED QUASI-PEAK REPORT
Low Lead
CISPR 11 - Limits of RFI for Indust., Sci & Med. Eqmt., Level B
TIME: 16:24:07 Midwest EMI
DATE: 09-30-2009 Associates
TEST ITEM: TFT EP0406 BIV/VUM proto
SERIAL NUMBER: motor/CAN v2 - intf v1 Sequence Number: 009
COMMENTS: On table 40cm from wall, 12VDC battery, Wilco 10uH ind
TEST PERFORMED BY: David West

Peak Freq. (kHz)	Peak Interfer. (dBuV)	Quasi-peak Freq. (kHz)	Quasi-peak Interfer. (dBuV)	Spec. Level (dBuV)
435	*61.060*	*427.14*	*45.960*	*57.157*
490.5762	*53.410*	*484.16*	*44.424*	*56.158*
1342	*60.575*	*1350.76*	*37.874*	*56.000*
2703	*60.602*	*2713.44*	*35.903*	*56.000*

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 BIV/VUM VALVE CONTROLLER (EP0406) was operated in its normal mode using a 12 VDC lead acid battery for power.

3.2 GROUNDING:

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

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

3.3 RADIATED CONFIGURATION:

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

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

3.4 TEST SAMPLE OPERATION:

All test measurements were made with the unit in its normal measuring mode after a 3-minute power up period. The EUT was 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 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 CONCLUSION OF RADIO FREQENCY INTERFERENCE EMISSIONS TESTS:

Preliminary Test

The device was oriented with the front of the EUT facing the antenna initially. The unit was varied in position and antenna height with a 1 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 – 10-31-09

Seq. 201 shows the ambient; Seq. 104 shows the quasipeak mode in comparison in the range of 20-75 MHz. All emissions were checked with one at 64 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.

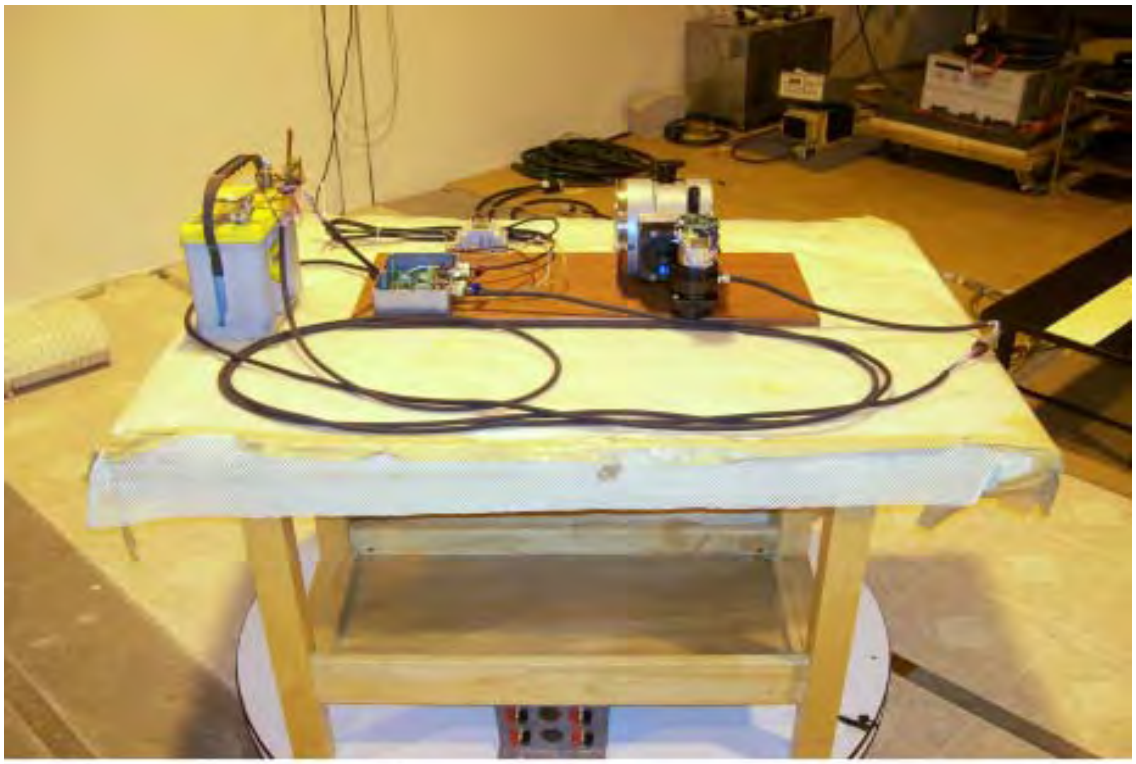
In the 75-170 MHz range, Seq. 206 shows the ambient and Seq. 205 shows the quasipeak emissions. Ambient emissions consist of the FM band and the intentional radiators at 152-158 and 162 MHz. Emissions above the line in the mid band area were discovered to be sporadic airplane emissions. No other emissions from the EUT appeared to be above the line.

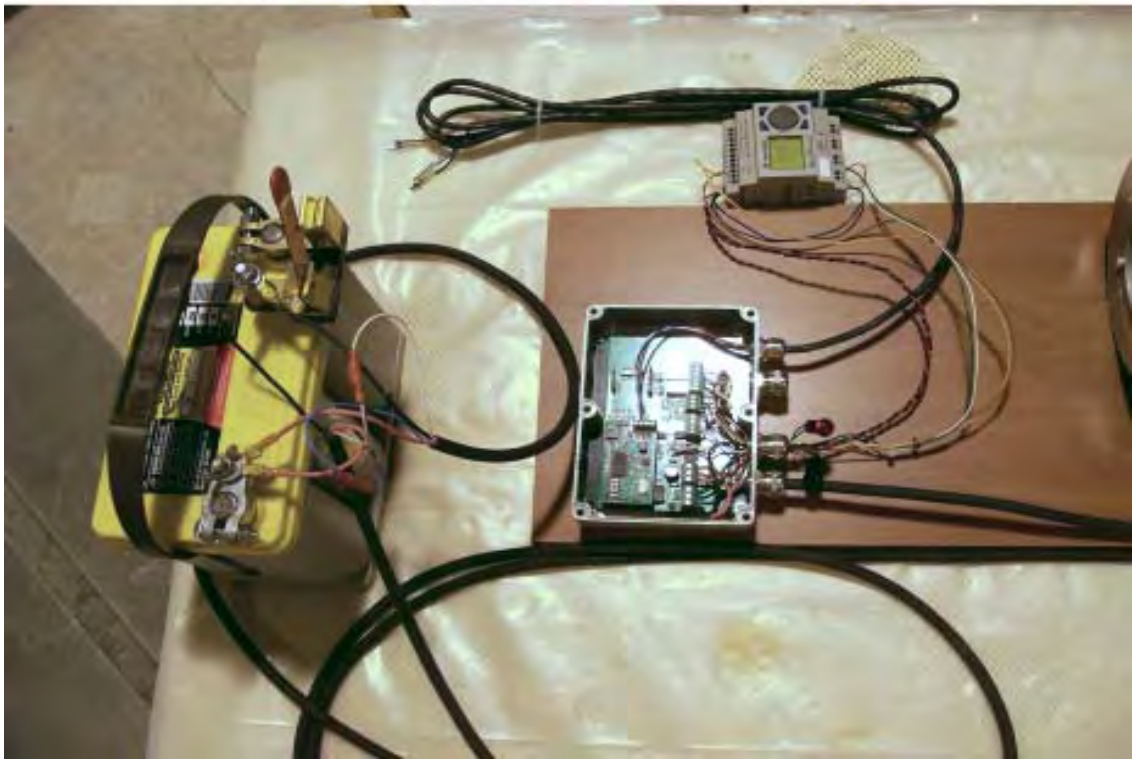
In the 160-300 MHz range, the ambient is shown on Seq. 108, and peak level on Seq. 115. No areas of emission from the EUT appeared to exceed the limit. Other emissions seen were from TV Channels 7 and 11, and a common carrier at about 220 MHz.

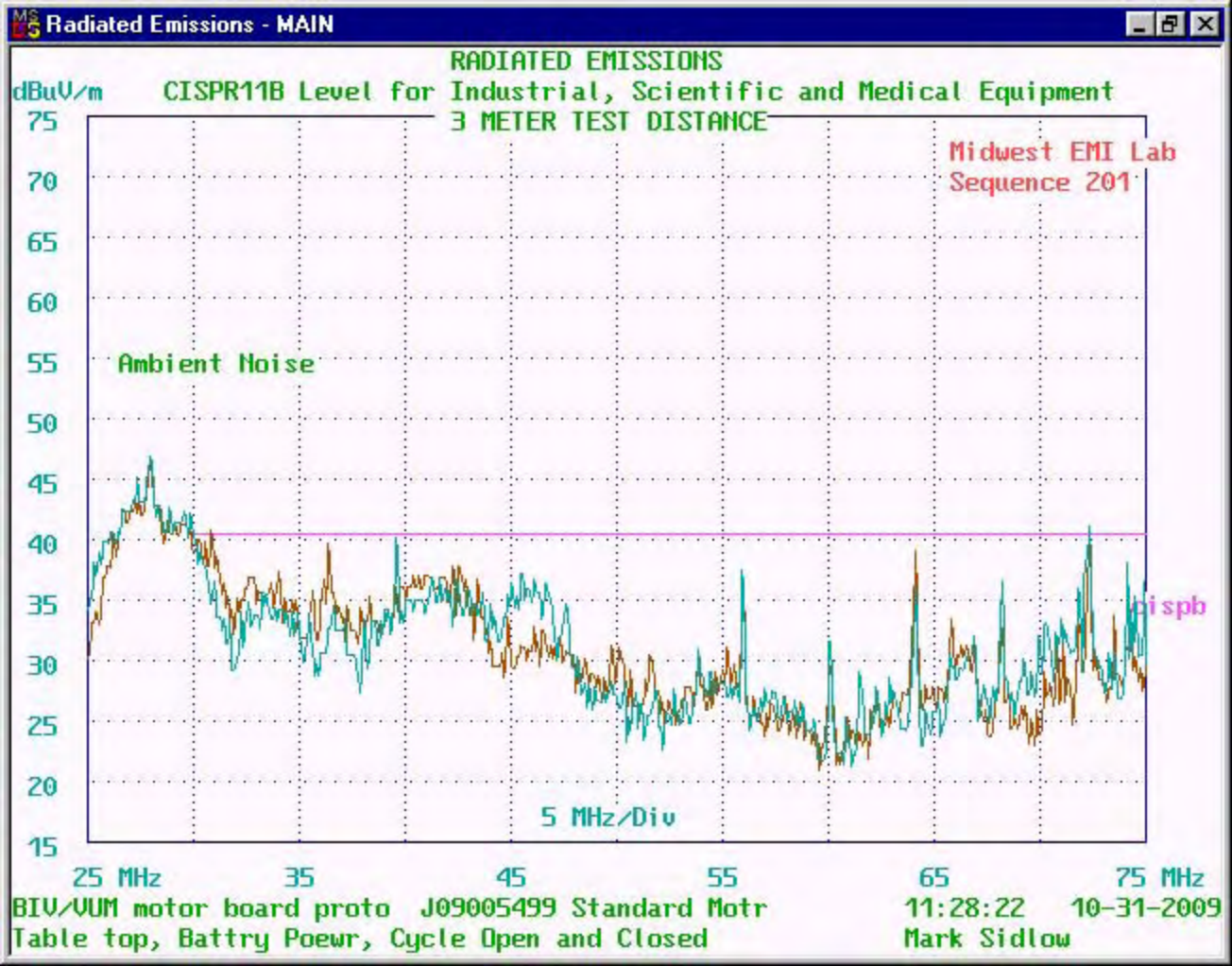
In the 300-640 MHz, the ambient is shown on Seq. 115 and the peak level emissions are shown on Seq 119. Other high emissions are numerous UHF TV stations and they are identified. Two emissions found in this range different from the ambient were individually inspected and not found to be due to the EUT but were from limo/taxi services.

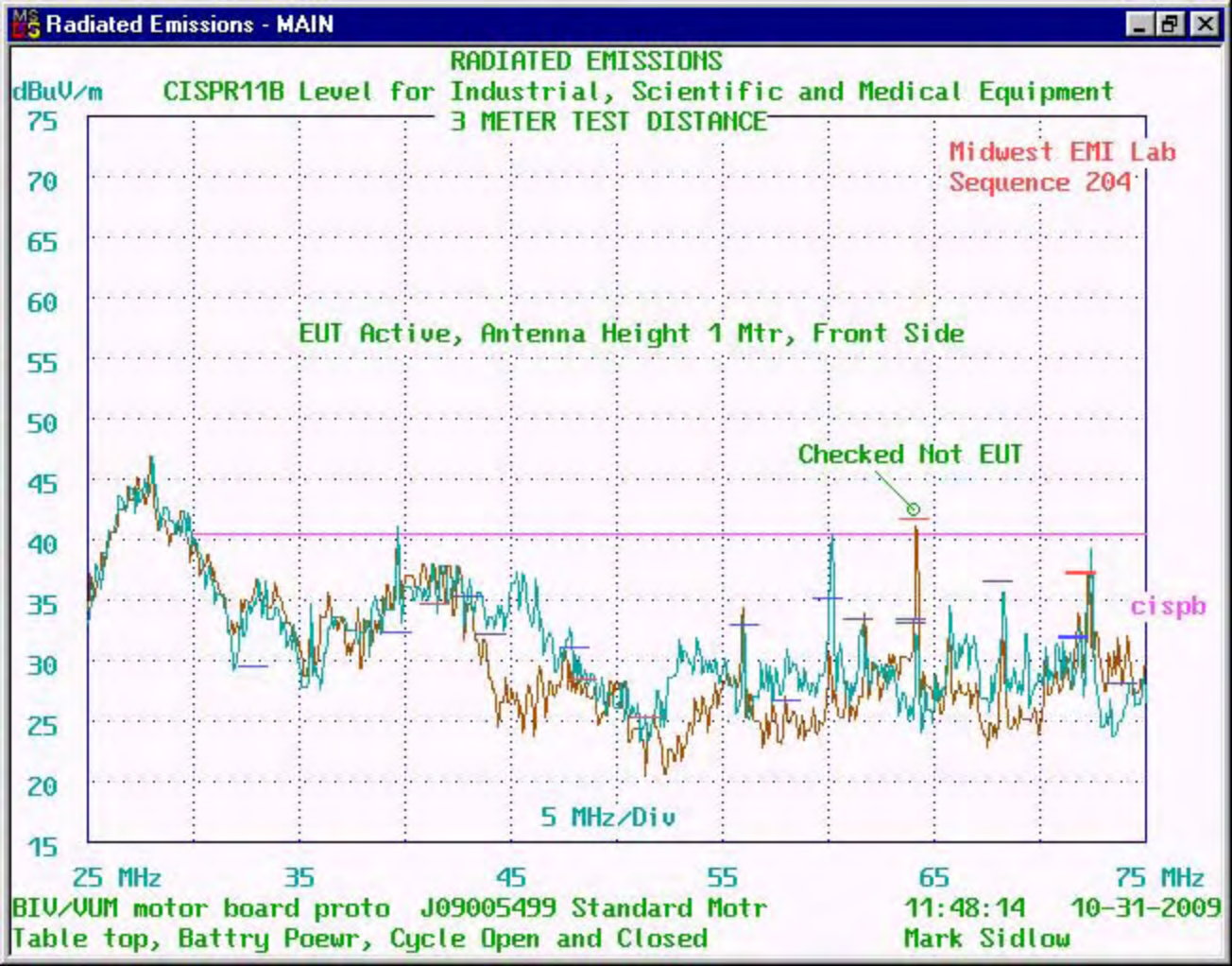
In the 620-1000 MHz, the ambient is shown on Seq. 117 and peak level on Seq. 120. Other high emissions are numerous UHF TV stations and the cell telephone band around 900 MHz that is identified. When the graphs were overlaid, no excess level introduced by the EUT was seen.

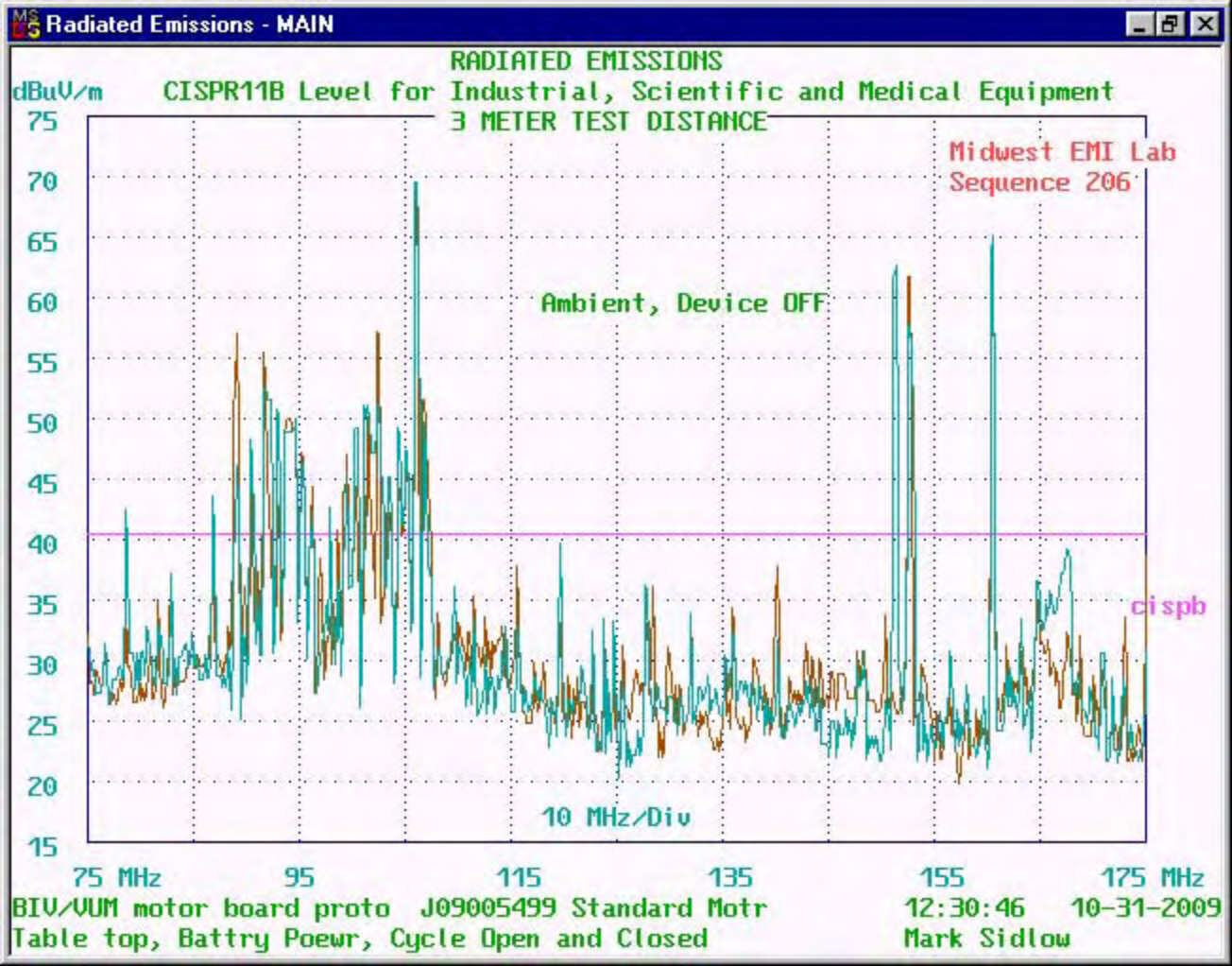
The TFT BIV_VUM Valve Controller was fully compliant with the Cispr 11 B level specification. The actual battery used for this test was a large 12 volt lead acid battery that was attached to the battery terminals by clip leads.

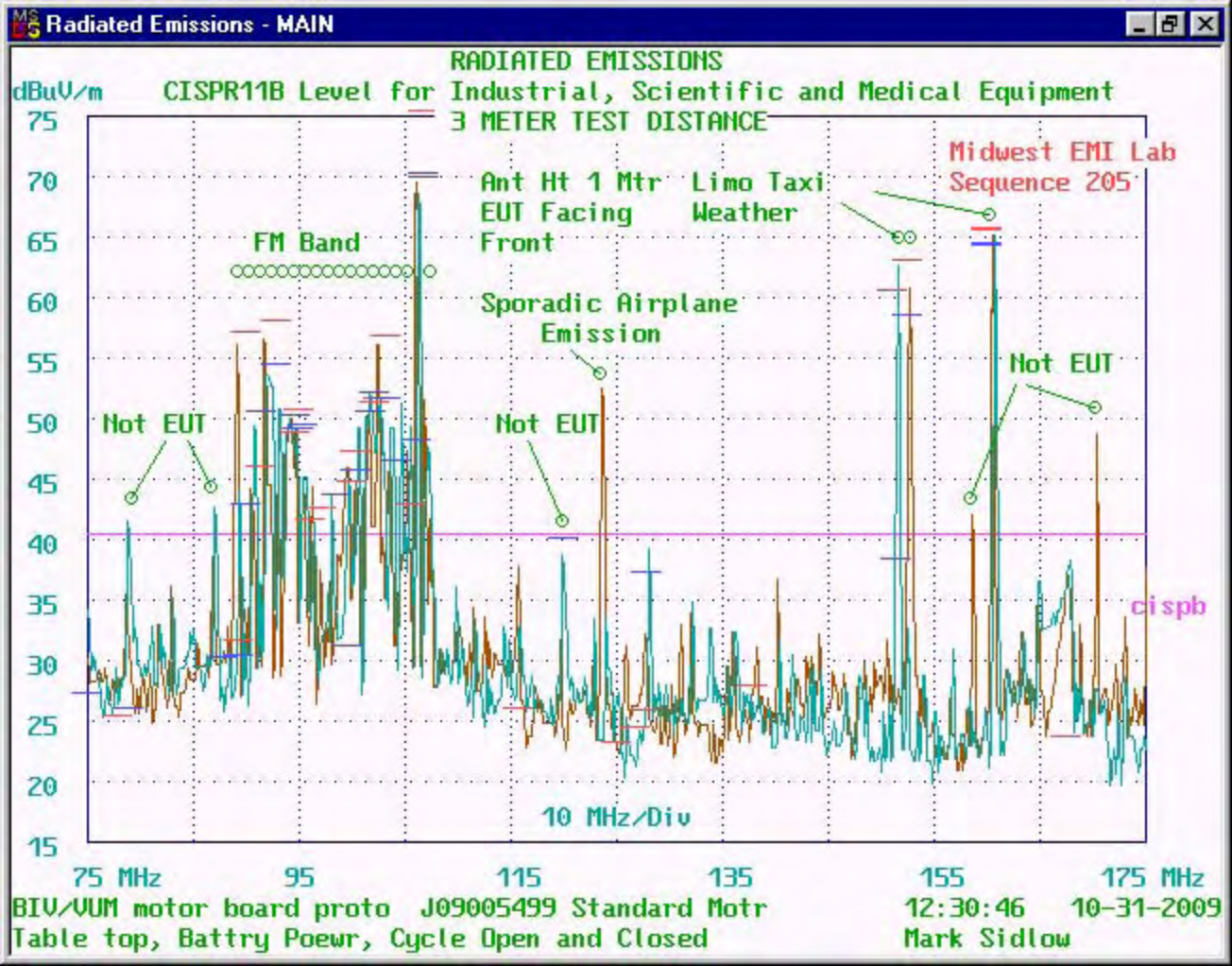


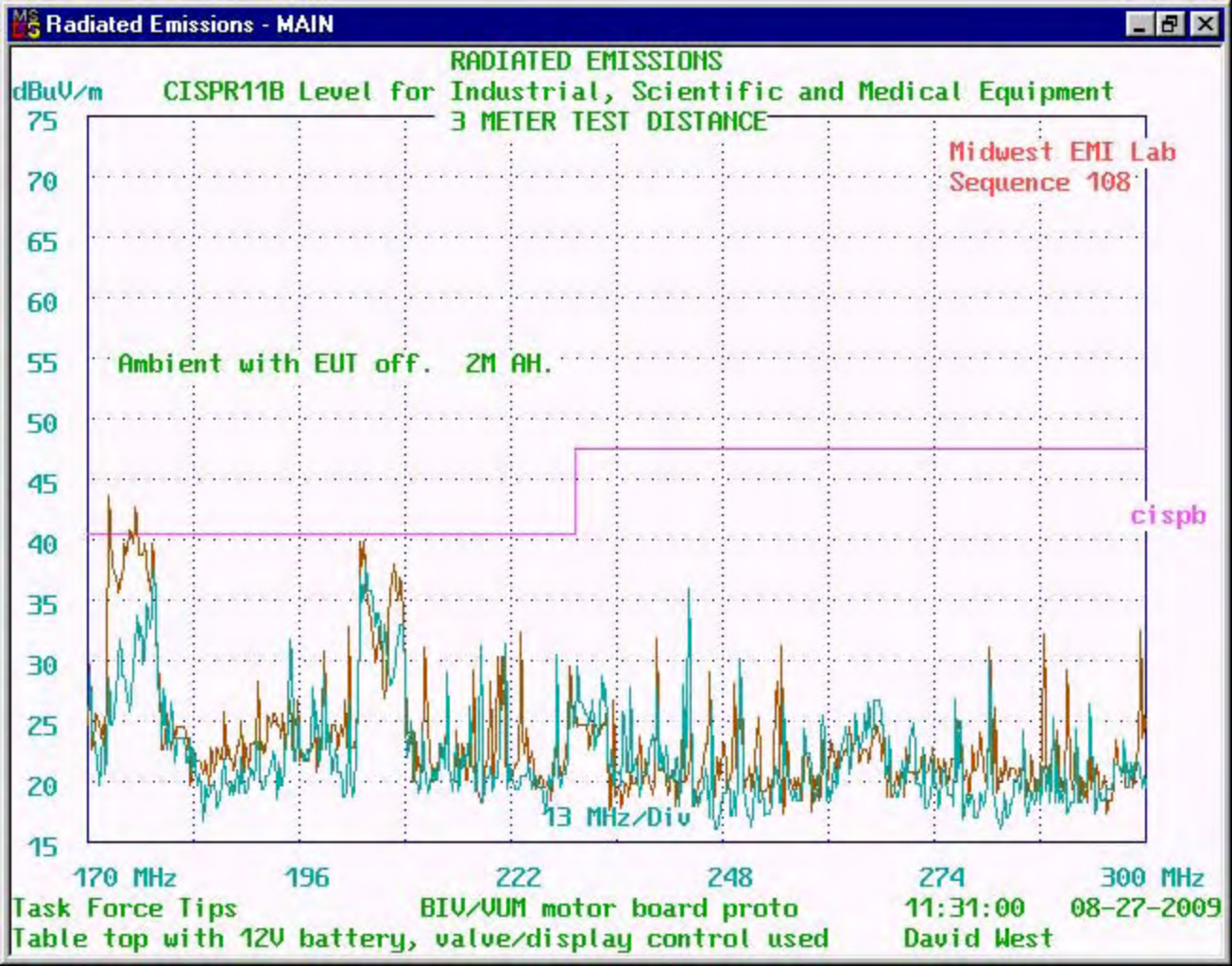


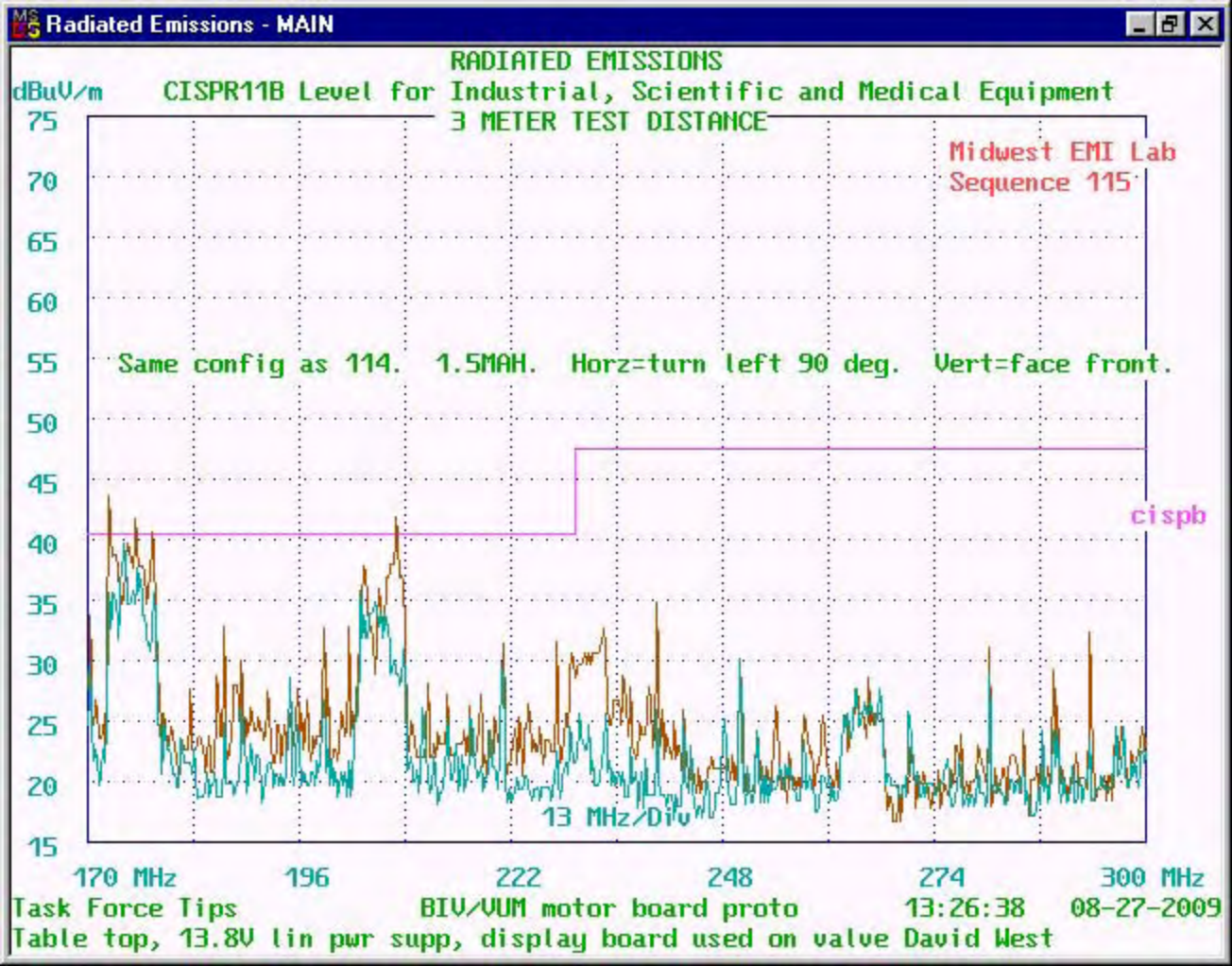

Radiated Emissions - MAIN
RADIATED EMISSIONS
dBuV/m
CISPR11B Level for Industrial, Scientific and Medical Equipment
3 METER TEST DISTANCE
Midwest EMI Lab
Sequence 201
Ambient Noise
cispb
5 MHz/Div
75
70
65
60
55
50
45
40
35
30
25
20
15
25 MHz
35
45
55
65
75 MHz
BIV/VUM motor board proto J09005499 Standard Motr
11:28:22 10-31-2009
Table top, Battry Poewr, Cycle Open and Closed
Mark Sidlow

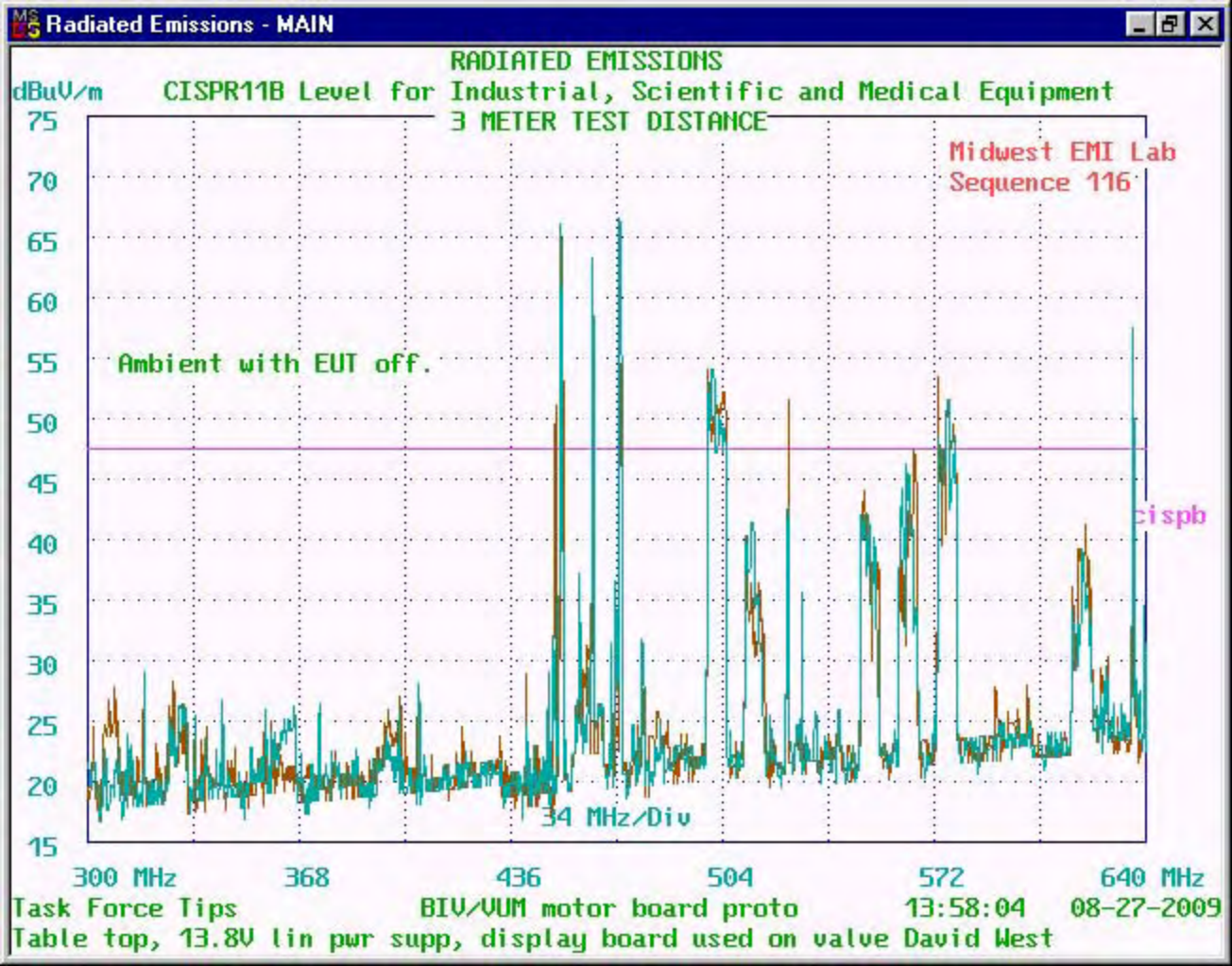

Radiated Emissions - MAIN
RADIATED EMISSIONS
dBuV/m
CISPR11B Level for Industrial, Scientific and Medical Equipment
3 METER TEST DISTANCE
Midwest EMI Lab
Sequence 204
EUT Active, Antenna Height 1 Mtr, Front Side
Checked Not EUT
cispb
75
70
65
60
55
50
45
40
35
30
25
20
15
5 MHz/Div
25 MHz
35
45
55
65
75 MHz
BIV/VUM motor board proto J09005499 Standard Motr
11:48:14 10-31-2009
Table top, Battry Poewr, Cycle Open and Closed
Mark Sidlow

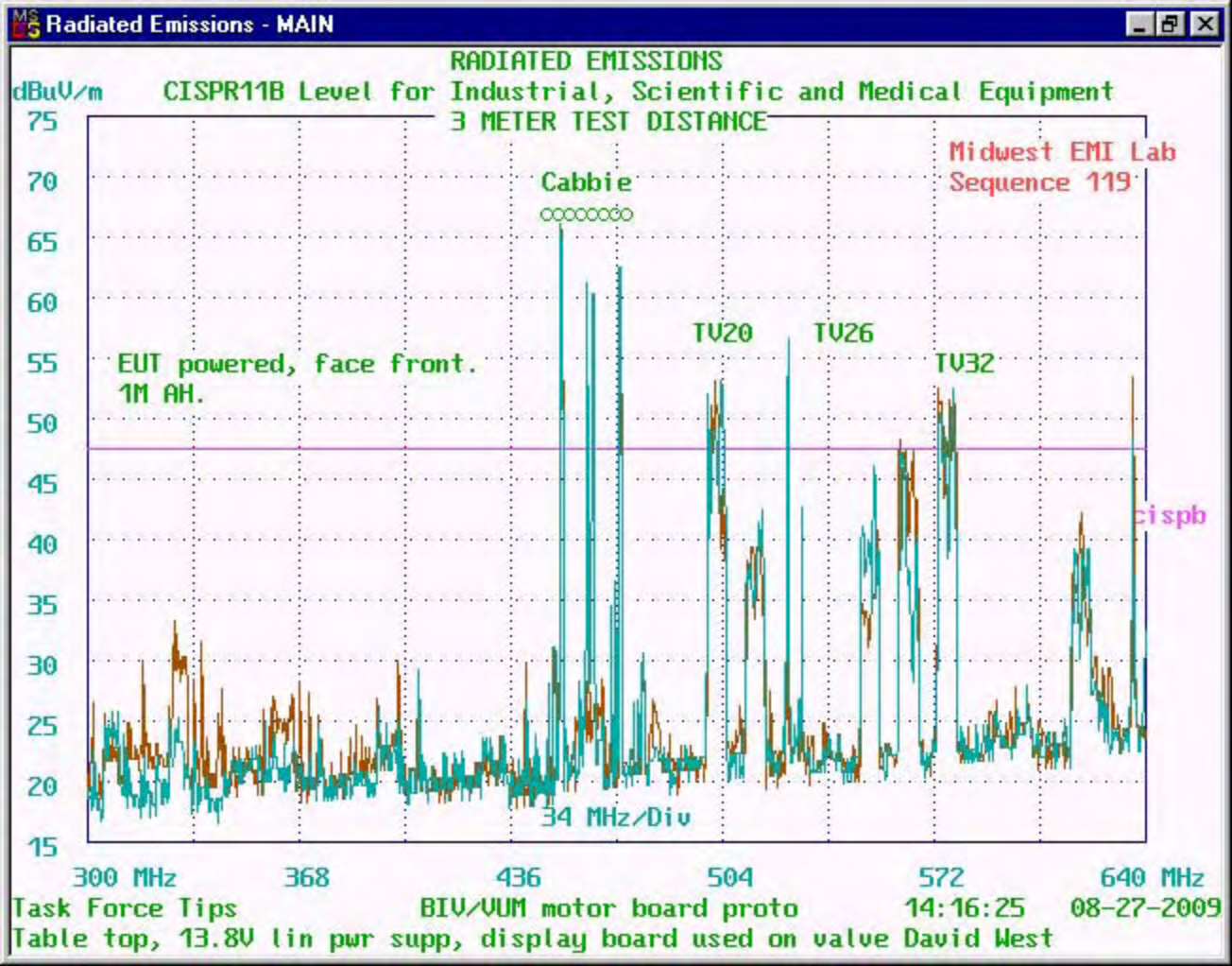

Radiated Emissions - MAIN
RADIATED EMISSIONS
dBuV/m
CISPR11B Level for Industrial, Scientific and Medical Equipment
3 METER TEST DISTANCE
Midwest EMI Lab
Sequence 206
Ambient, Device OFF
cispb
10 MHz/Div
75
70
65
60
55
50
45
40
35
30
25
20
15
75 MHz
95
115
135
155
175 MHz
BIV/VUM motor board proto J09005499 Standard Motr
12:30:46 10-31-2009
Table top, Battry Poewr, Cycle Open and Closed
Mark Sidlow

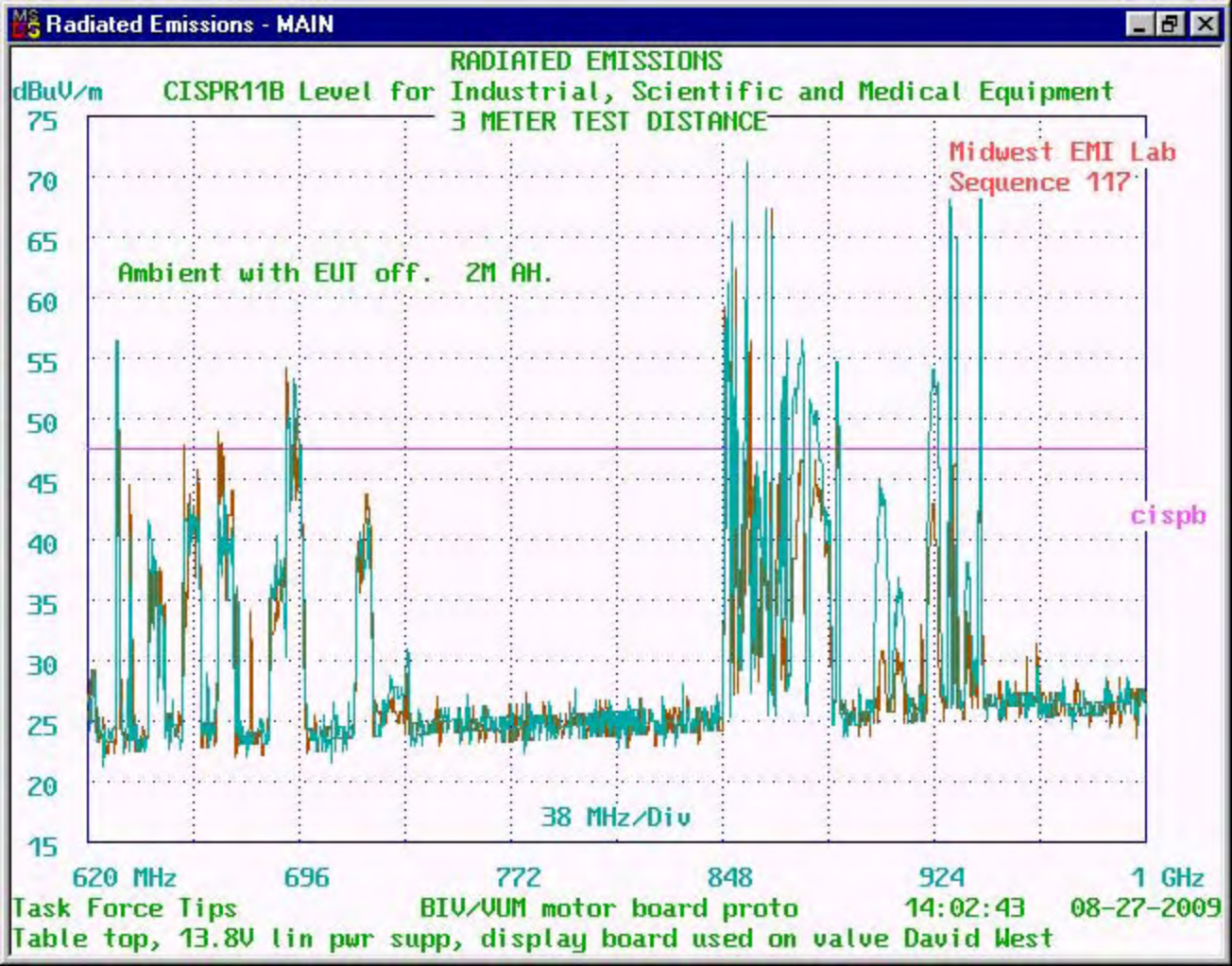

Radiated Emissions - MAIN
RADIATED EMISSIONS
dBuV/m
CISPR11B Level for Industrial, Scientific and Medical Equipment
3 METER TEST DISTANCE
Midwest EMI Lab
Sequence 205
Ant Ht 1 Mtr
EUT Facing
Front
Limo Taxi
Weather
FM Band
Sporadic Airplane
Emission
Not EUT
Not EUT
Not EUT
cispb
10 MHz/Div
75
70
65
60
55
50
45
40
35
30
25
20
15
75 MHz
95
115
135
155
175 MHz
BIV/VUM motor board proto
J09005499 Standard Motr
12:30:46
10-31-2009
Table top, Battry Poewr, Cycle Open and Closed
Mark Sidlow

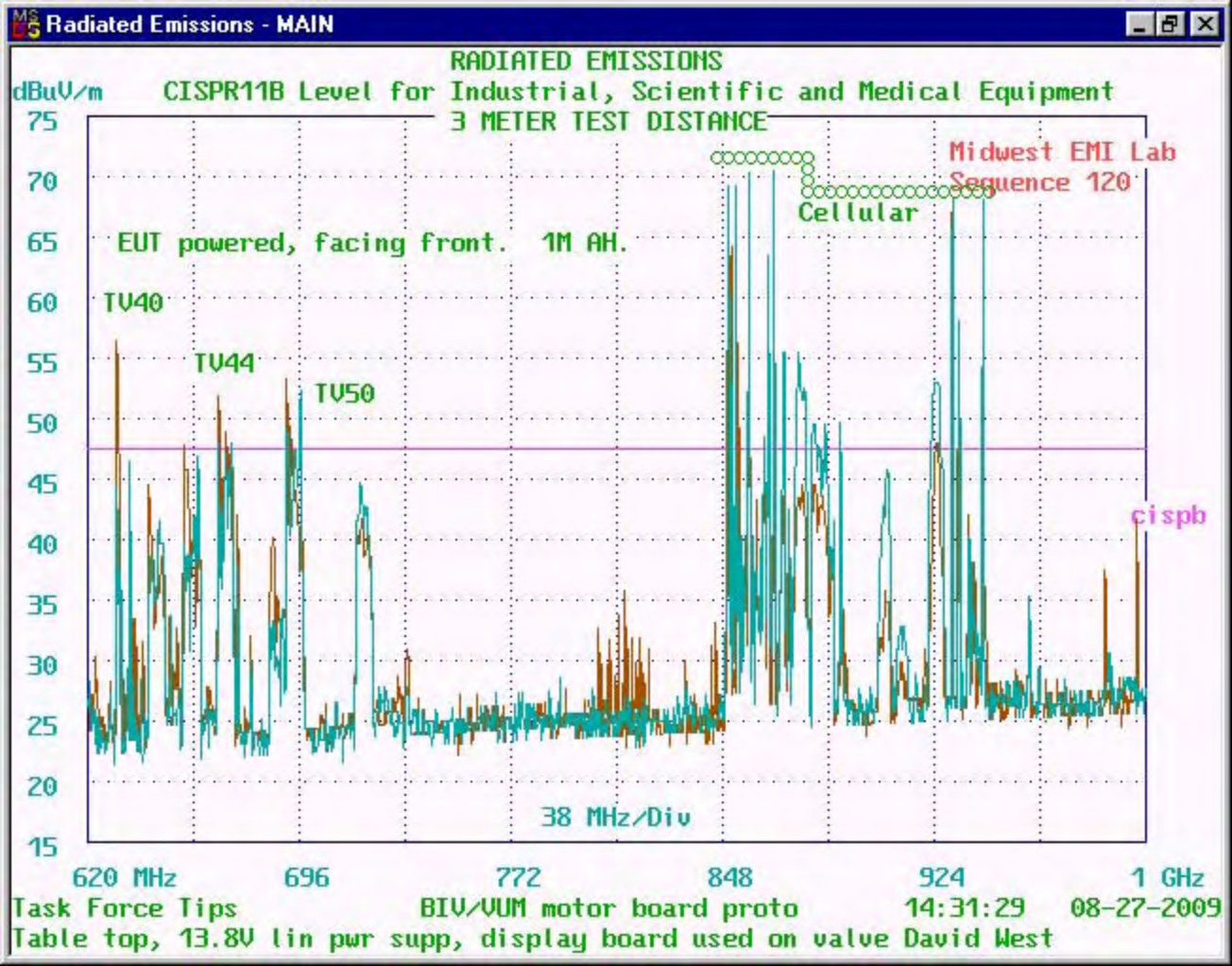

Radiated Emissions - MAIN
RADIATED EMISSIONS
dBuV/m
CISPR11B Level for Industrial, Scientific and Medical Equipment
3 METER TEST DISTANCE
Midwest EMI Lab
Sequence 108
75
70
65
60
55
50
45
40
35
30
25
20
15
Ambient with EUT off. 2M AH.
cispb
13 MHz/Div
170 MHz
196
222
248
274
300 MHz
Task Force Tips
BIV/VUM motor board proto
11:31:00
08-27-2009
Table top with 12V battery, valve/display control used
David West


Radiated Emissions - MAIN
RADIATED EMISSIONS
dBuV/m
CISPR11B Level for Industrial, Scientific and Medical Equipment
3 METER TEST DISTANCE
Midwest EMI Lab
Sequence 115
Same config as 114. 1.5MAH. Horz=turn left 90 deg. Vert=face front.
cispb
75
70
65
60
55
50
45
40
35
30
25
20
15
13 MHz/Div
170 MHz
196
222
248
274
300 MHz
Task Force Tips
BIV/VUM motor board proto
13:26:38
08-27-2009
Table top, 13.8V lin pwr supp, display board used on valve David West


Radiated Emissions - MAIN
RADIATED EMISSIONS
dBuV/m
CISPR11B Level for Industrial, Scientific and Medical Equipment
3 METER TEST DISTANCE
Midwest EMI Lab
Sequence 116
Ambient with EUT off.
cispb
75
70
65
60
55
50
45
40
35
30
25
20
15
34 MHz/Div
300 MHz
368
436
504
572
640 MHz
Task Force Tips
BIV/VUM motor board proto
13:58:04
08-27-2009
Table top, 13.8V lin pwr supp, display board used on valve David West


Radiated Emissions - MAIN
RADIATED EMISSIONS
dBuV/m
CISPR11B Level for Industrial, Scientific and Medical Equipment
3 METER TEST DISTANCE
Midwest EMI Lab
Sequence 119
Cabbie
TV20
TV26
TV32
EUT powered, face front.
1M AH.
cispb
75
70
65
60
55
50
45
40
35
30
25
20
15
34 MHz/Div
300 MHz
368
436
504
572
640 MHz
Task Force Tips
BIV/VUM motor board proto
14:16:25
08-27-2009
Table top, 13.8V lin pwr supp, display board used on valve David West


Radiated Emissions - MAIN
RADIATED EMISSIONS
dBuV/m
CISPR11B Level for Industrial, Scientific and Medical Equipment
3 METER TEST DISTANCE
Midwest EMI Lab
Sequence 117
Ambient with EUT off. 2M AH.
cispb
75
70
65
60
55
50
45
40
35
30
25
20
15
38 MHz/Div
620 MHz
696
772
848
924
1 GHz
Task Force Tips
BIV/VUM motor board proto
14:02:43
08-27-2009
Table top, 13.8V lin pwr supp, display board used on valve David West


Radiated Emissions - MAIN
RADIATED EMISSIONS
dBuV/m
CISPR11B Level for Industrial, Scientific and Medical Equipment
3 METER TEST DISTANCE
Midwest EMI Lab
Sequence 120
Cellular
EUT powered, facing front. 1M AH.
TV40
TV44
TV50
cispb
75
70
65
60
55
50
45
40
35
30
25
20
15
38 MHz/Div
620 MHz
696
772
848
924
1 GHz
Task Force Tips
BIV/VUM motor board proto
14:31:29
08-27-2009
Table top, 13.8V lin pwr supp, display board used on valve David West

SHEET 1 cispb RADIATED QUASI-PEAK REPORT
CISPR11B Level for Industrial, Scientific and Medical Equipment
3 METER TEST DISTANCE
TIME: 11:48:14 Midwest EMI
DATE: 10-31-2009 Associates
TEST ITEM: BIV/VUM motor board proto
SERIAL NUMBER: J09005499 Standard Motr Sequence Number: 204
COMMENTS: Table top, Battry Poewr, Cycle Open and Closed
TEST PERFORMED BY: Mark Sidlow

Peak Frequency (MHz)	Peak Interfer. (dBuV/m)	Quasi-peak Freq. (MHz)	Quasi-peak Interfer. (dBuV/m)	Spec. Level (dBuV/m)		Antenna Polarization (H/V)
41.34483	41.86	41.3624	34.72	40.50		Horizontal
48.2497	39.51	48.3465	28.51	40.50		Horizontal
51.66766	49.65	51.4813	25.45	40.50		Horizontal
63.97424	43.35	64.01900	41.85	40.50	*	Horizontal
71.84464	35.84	71.9958	37.20	40.50		Horizontal
72.06247	41.21	71.99850	37.40	40.50		Horizontal
32.65563	39.31	32.8508	29.58	40.50		Vertical
39.53247	42.44	39.6893	32.42	40.50		Vertical
42.79303	40.98	42.9762	35.43	40.50		Vertical
44.21691	42.76	44.0233	32.22	40.50		Vertical
48.16221	39.61	47.9998	31.24	40.50		Vertical
55.91741	35.39	56.0134	33.01	40.50		Vertical
58.18977	41.03	58.0122	26.77	40.50		Vertical
59.98219	41.78	60.011	35.28	40.50		Vertical
61.38929	36.53	61.4845	33.54	40.50		Vertical
63.94853	43.70	64.01730	33.15	40.50		Vertical
63.95504	36.45	64.0102	33.45	40.50		Vertical
68.17968	39.39	68.00449	36.66	40.50		Vertical
71.71377	35.69	71.5874	32.18	40.50		Vertical
71.73912	41.01	71.58710	31.88	40.50		Vertical
73.83638	33.24	74.0164	28.15	40.50		Vertical

SHEET 1 cispb RADIATED QUASI-PEAK REPORT
CISPR11B Level for Industrial, Scientific and Medical Equipment
3 METER TEST DISTANCE
TIME: 12:30:46 Midwest EMI
DATE: 10-31-2009 Associates
TEST ITEM: BIV/VUM motor board proto
SERIAL NUMBER: J09005499 Standard Motr Sequence Number: 205
COMMENTS: Table top, Battry Poewr, Cycle Open and Closed
TEST PERFORMED BY: Mark Sidlow

Peak Frequency (MHz)	Peak Interfer. (dBuV/m)	Quasi-peak Freq. (MHz)	Quasi-peak Interfer. (dBuV/m)	Spec. Level (dBuV/m)		Antenna Polarization (H/V)
78.000	42.37	77.9696	25.56	40.50		Horizontal
89.38638	58.21	89.32080	31.77	40.50		Horizontal
90.09998	47.47	90.0984	57.31	40.50	*	Horizontal
91.50008	58.02	91.4777	46.16	40.50	*	Horizontal
92.70005	46.44	92.7225	58.19	40.50	*	Horizontal
94.69927	50.08	94.7761	49.06	40.50	*	Horizontal
94.69878	52.55	94.7556	49.25	40.50	*	Horizontal
95.14409	47.77	95.1033	50.82	40.50	*	Horizontal
95.90066	47.31	96.0111	41.78	40.50	*	Horizontal
96.83324	43.36	97.0324	42.66	40.50	*	Horizontal
99.78773	48.85	99.9853	44.88	40.50	*	Horizontal
100.2125	47.82	100.3221	47.45	40.50	*	Horizontal
102.2954	53.03	102.3434	51.81	40.50	*	Horizontal
102.4	58.01	102.2664	51.51	40.50	*	Horizontal
103.1049	48.77	103.1225	57.03	40.50	*	Horizontal
105.5574	49.53	105.5486	43.10	40.50	*	Horizontal
106.8	53.82	106.672	75.60	40.50	*	Horizontal
115.6	42.48	115.772	26.18	40.50		Horizontal
124.7854	48.43	124.9846	23.32	40.50		Horizontal
126.6035	45.83	126.7947	24.61	40.50		Horizontal
127.6441	45.08	127.4937	25.99	40.50		Horizontal
138	44.32	138	28.02	40.50		Horizontal
150.9425	62.00	150.9609	60.71	40.50	*	Horizontal
152.3149	62.31	152.3221	63.20	40.50	*	Horizontal
159.8652	46.07	159.9868	65.80	40.50	*	Horizontal
159.9751	64.84	159.9823	65.70	40.50	*	Horizontal
167.4	42.46	167.544	23.78	40.50		Horizontal
75.000	45.68	75.0224	27.38	40.50		Vertical
78.82697	46.56	78.767	26.24	40.50		Vertical
87.66817	46.59	87.73779	30.39	40.50		Vertical
89.11162	47.25	89.31319	30.47	40.50		Vertical
90.10017	51.20	90.1122	43.12	40.50	*	Vertical
91.50001	54.86	91.47199	50.66	40.50	*	Vertical
92.70014	53.74	92.7081	54.58	40.50	*	Vertical
94.51674	51.82	94.69670	50.44	40.50	*	Vertical
95.16579	51.26	95.11060	49.32	40.50	*	Vertical
95.59999	47.81	95.468	49.58	40.50	*	Vertical
98.68868	46.44	98.7135	43.79	40.50	*	Vertical
99.59999	47.69	99.5664	31.38	40.50		Vertical
100.2859	56.12	100.3115	45.85	40.50	*	Vertical
101.8237	54.43	101.8941	50.72	40.50	*	Vertical

SHEET 2 cispb RADIATED QUASI-PEAK REPORT
CISPR11B Level for Industrial, Scientific and Medical Equipment
3 METER TEST DISTANCE
TIME: 12:30:46 Midwest EMI
DATE: 10-31-2009 Associates
TEST ITEM: BIV/VUM motor board proto
SERIAL NUMBER: J09005499 Standard Motr Sequence Number: 205
COMMENTS: Table top, Battry Poewr, Cycle Open and Closed
TEST PERFORMED BY: Mark Sidlow

Peak Frequency (MHz)	Peak Interfer. (dBuV/m)	Quasi-peak Freq. (MHz)	Quasi-peak Interfer. (dBuV/m)	Spec. Level (dBuV/m)		Antenna Polarization (H/V)
102.4	53.71	102.2704	52.21	40.50	*	Vertical
103.1067	51.67	103.0627	51.82	40.50	*	Vertical
104.6	53.17	104.4	46.65	40.50	*	Vertical
105.7103	51.27	105.8951	48.36	40.50	*	Vertical
106.7	69.81	106.7112	70.41	40.50	*	Vertical
106.6997	50.16	106.7125	70.01	40.50	*	Vertical
119.9647	43.23	120.0039	40.22	40.50		Vertical
128	42.17	128.004	37.37	40.50		Vertical
151.7427	63.30	151.5427	38.50	40.50		Vertical
152.3149	60.61	152.3565	58.60	40.50	*	Vertical
159.8667	44.57	159.9907	64.60	40.50	*	Vertical
159.9751	65.55	159.9767	64.50	40.50	*	Vertical

APPENDIX C

ELECTRICAL FAST TRANSIENT/BURST TEST

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

1.0 PURPOSE:

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

2.0 DESCRIPTION OF TEST APPARATUS:

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

3.0 TEST PROCEDURES:

3.1 POWER LEADS:

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

3.2 POLARITY and TEST LEVELS:

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

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

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

LEVEL	OPEN CIRCUIT OUTPUT TEST VOLTAGE	REPETITION RATE	BURST DURATION	BURST PERIOD
1	.5 KV	5.0 KHZ	15 MSEC	300 MSEC
2	1 KV	5.0 KHZ	15 MSEC	300 MSEC
3	2 KV	5.0 KHZ	15 MSEC	300 MSEC
4	4 KV	2.5 KHZ	15 MSEC	300 MSEC

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

3.3 EFT GENERATOR CHARACTERISTICS:

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

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

3.4 COUPLING DECOUPLING NETWORK CHARACTERISTICS:

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

3.5 COUPLING CLAMP CHARACTERISTICS:

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

3.6 GROUND REFERENCE PLANE:

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

3.7 REFERENCE DOCUMENT:

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

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

3.8 ACCEPTABILITY CRITERION:

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

An unacceptable operating response to the stimulus was:

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

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

4.0 TEST RESULTS

The TFT EP0406 was tested at .5, 1 KV and 2 KV suing the Haefely injection clamp from the battery and RS485 lines feeding the main control box. There was no noticeable change in operation during the test. The TFT EP0406 was also tested using direct injection from the EFT generator, no adverse operation was seen. A resistive termination was put on the communication line for this test.


TRENCH
HAEFELY
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TRENCH

Midwest EMI Associates
21234 West Commercial Drive
Mundelein, Illinois 60060

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

Manufacturer: TFT Test Engineer Initials: M.S

Equipment Under Test: BIV-VUM Date of Test: 10/31/09

Model #: _____ Serial #: _____

Temperature: 65.9 Humidity Level: 32.4%

Applied Burst Level: .5 Kilovolt (Test Severity Level 1)
Repetition Frequency: 5 Kilohertz AC Adapter Type: (Two) (Three) Terminal
Burst Duration: 15 Msec Burst Period: 300 Msec
Test Duration: 120 Seconds
Power Input: (120 VAC / 60 Hz) (230VAC / 50 Hz) or Battery Voltage: 12.5 V

Instrument Setup/Nominal Conditions: Coupling Open and Closed

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

* Failure Mode was: None
Number "1" indicates no failure was observed, * indicates device malfunctioned

Applied Burst Level: 1 Kilovolt (Test Severity Level 2)
Repetition Frequency: 5 Kilohertz AC Adapter Type: (Two) (Three) Terminal
Burst Duration: 15 Msec Burst Period: 300 Msec
Test Duration: 120 Seconds
Power Input: (120 VAC / 60 Hz) (230VAC / 50 Hz) or Battery Voltage: 12.5 V

Instrument Setup/Nominal Conditions: Same as above

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

* Failure Mode was: None
Number "1" indicates no failure was observed, * indicates device malfunctioned

Midwest EMI Associates
21234 West Commercial Drive
Mundelein, Illinois 60060

IEC Publication Number 1000-4-4, Part 4, First Edition, 1995
British Standard 61000-4-4, Part 4, First Edition, 2000
Section 4. Electrical Fast Transient/Burst Immunity Test

Manufacturer: TFT Test Engineer Initials: M.S

Equipment Under Test: BIV-VUM Date of Test: 10/31/09

Model #: _____ Serial #: _____

Temperature: 65.9 Humidity Level: 37.4%

Applied Burst Level: 2 Kilovolt (Test Severity Level 3)
Repetition Frequency: 5 Kilohertz AC Adapter Type: (Two) (Three) Terminal
Burst Duration: 15 Msec Burst Period: 300 Msec
Test Duration: 120 Seconds
Power Input: (120 VAC / 60 Hz) (230VAC / 50 Hz) or Battery Voltage: 12.5 V

Instrument Setup/Nominal Conditions: CYCLING ON AND CLOSED

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

* Failure Mode was: _____
Number "1" Indicates no failure was observed, * Indicates Device Malfunctioned

Applied Burst Level: 4 Kilovolt (Test Severity Level 4)
Repetition Frequency: 2.5 Kilohertz AC Adapter Type: (Two) (Three) Terminal
Burst Duration: 15 Msec Burst Period: 300 Msec
Test Duration: 120 Seconds
Power Input: (120 VAC / 60 Hz) (230VAC / 50 Hz) or Battery Voltage: _____ V

Instrument Setup/Nominal Conditions: _____

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

* Failure Mode was: _____
Number "1" Indicates no failure was observed, * Indicates Device Malfunctioned

Midwest EMI Associates
21234 West Commercial Drive
Mundelein, Illinois 60060

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

Manufacturer: TFT Test Engineer Initials: AW

Equipment Under Test: TFT; Valve motherboard Date of Test: 10-1-09

Model #: FP0406 Serial #: MB+CAN=V2; interface=V1

Temperature: 65.6 Humidity Level: 55.0

APPLIED BURST LEVEL: .5 Kilovolt (Test Severity Level 1)
REPETITION FREQUENCY: 5 Kilohertz AC ADAPTER TYPE: (TWO) (THREE) TERMINAL
BURST DURATION: 15 Msec BURST PERIOD: 300 Msec
TEST DURATION: (120 Seconds)
POWER INPUT: (120 VAC / 60 Hz) (230VAC / 50 Hz) OR BATTERY VOLTAGE: 12 V DC

INSTRUMENT SETUP/NOMINAL CONDITIONS: Running 18s open/close routine

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

* Failure Mode was: PASS
Number "1" Indicates no failure was observed, * Indicates Device Malfunctioned

APPLIED BURST LEVEL: 1 Kilovolt (Test Severity Level 2)
REPETITION FREQUENCY: 5 Kilohertz AC ADAPTER TYPE: (TWO) (THREE) TERMINAL
BURST DURATION: 15 Msec BURST PERIOD: 300 Msec
TEST DURATION: (120 Seconds)
POWER INPUT: (120 VAC / 60 Hz) (230VAC / 50 Hz) OR BATTERY VOLTAGE: 12 V DC

INSTRUMENT SETUP/NOMINAL CONDITIONS: Running 18s open/close routine

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

* Failure Mode was: PASS
Number "1" Indicates no failure was observed, * Indicates Device Malfunctioned

Heafely Trench

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 BIV/VUM VALVE CONTROLLER (EP0406) was powered by a 12 VDC lead acid battery.

3.2 TEST SETUP:

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

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

3.3 MODULATION:

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

3.4 ANTENNAS AND AMPLIFIERS:

The radiating antennas/amplifiers used during the test were:

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

4.0 LIMITS AND RESULTS OF TEST:

4.1 RADIATED LIMITS:

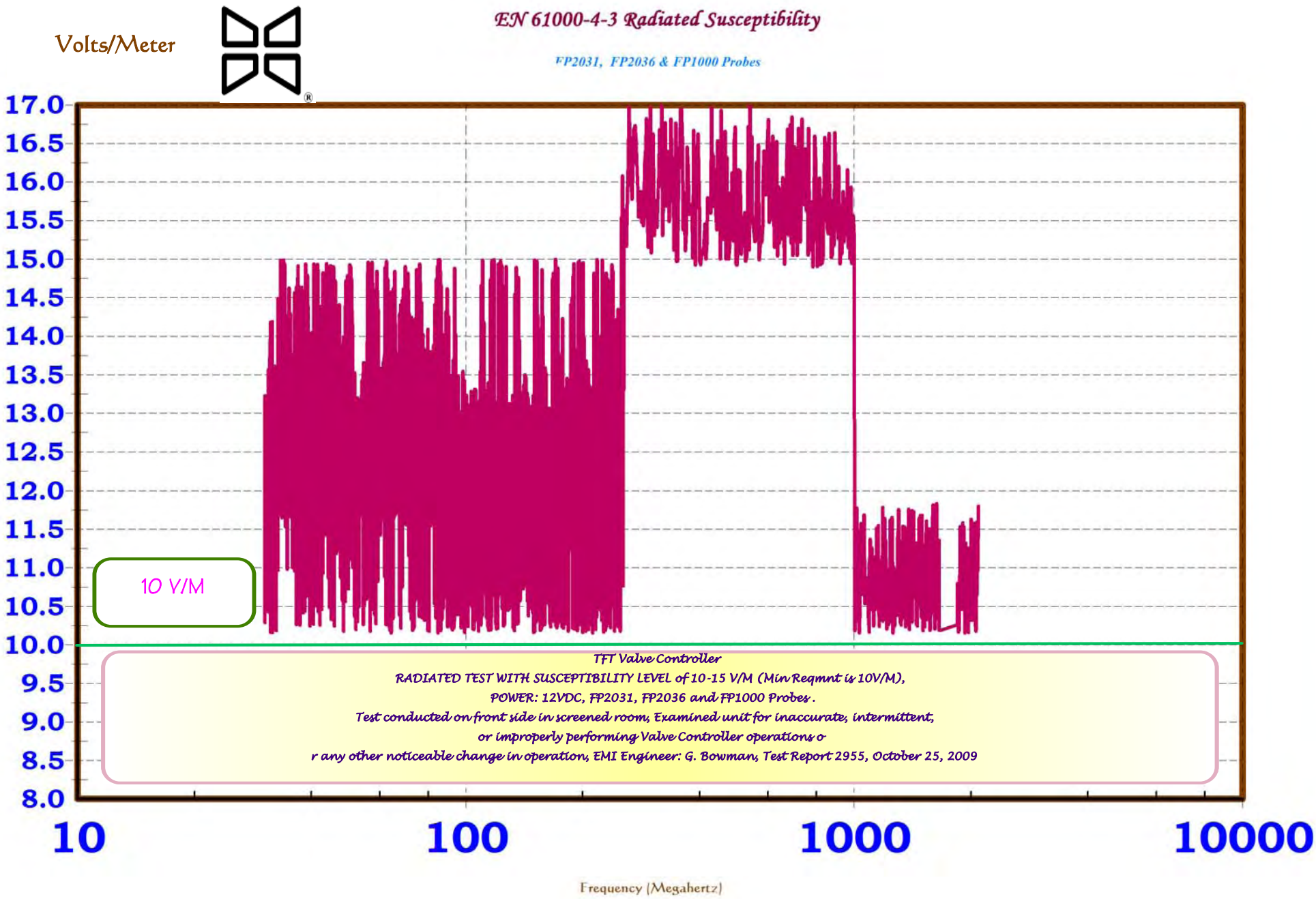
The radiated susceptibility immunity should not be lower than 3 or 10 V/M as prescribed by EN 61000-4-3. The IEC range is 80 MHz to 1000 MHz. A graph is shown of the actual averaged field strength presented to the prototype during the test.

4.2 RESULTS OF TEST:

The TFT EP0406 was exposed to a 10 V/M immunity wave from 30 to 1000 MHz with 1000 Hz, 80% modulation. It was also exposed to the same field in the 900 to 925 MHz cellular phone test using 200 Hz, 100% square wave modulation. It was also tested from 1000-2700 MHz at user selected bands without noticeable problems.

During testing the system was continuously monitored for correct functioning so that a) the valve opened and closed at the normal rate **and 2) did not stop or change** it normal operation. Around 157 MHz some changes were needed to prevent valve stoppage, the changes were successful and the EUT passed.

Radiated Immunity Test


EN 61000-4-3 Radiated Susceptibility
FP2031, FP2036 & FP1000 Probes
Volts/Meter
17.0
16.5
16.0
15.5
15.0
14.5
14.0
13.5
13.0
12.5
12.0
11.5
11.0
10.5
10.0
9.5
9.0
8.5
8.0
10 V/M
TFT Valve Controller
RADIATED TEST WITH SUSCEPTIBILITY LEVEL of 10-15 V/M (Min Reqmnt is 10V/M),
POWER: 12VDC, FP2031, FP2036 and FP1000 Probes.
Test conducted on front side in screened room, Examined unit for inaccurate, intermittent,
or improperly performing Valve Controller operations o
r any other noticeable change in operation, EMI Engineer: G. Bowman, Test Report 2955, October 25, 2009
10
100
1000
10000
Frequency (Megahertz)

Midwest EMI Associates Radiated Susceptibility Worksheet

Form: MID-RAD 2-25-2007

Date: 9-30-09	Report:	Test Engineer: DW
Item Tested:		Model: FP0406 S/N:
Project: TFT	Group:	Power: 12 V (AC) (DC) Hz
Test Performed: (Radiated) (Conducted) (Magnetic) (CS114)	Probes: (CS114) (Fischer CDN) (CLAMP) (A/R FP2031, AR FP 2036. AR FP1000) (Other:)	Modulation: (2) (10) (100) (1000) Hz, Sine Wave (Cell Phone Test, 200 Hz 100% AM Square Wave) Modulation Depth: (50%) (80%) (%)
Signal Gen.: (HP8756A) (Wavetek 2520A)	Orientation: (Pole Stand) (Other:) (Wooden Table) (Copper Table) (Floor)	Room Position: (Screenroom) (2 Mtr Site) (5 Mtr Site) (Outdoors) Flr Pos: (A) (B) (C)

Antennas: B=Biconical EMCO 3109, C=Conical EMCO 3101, E=EMCO3107B, L=EMCO 3147, CDN=Fischer FCC-801 CDN, or Solar 9108-1N & 91421-1N

Frequency (M=MHz) (K=KHz)	Increment Frequency (KHz)	Immunity Level: (V) (V/M)	Dwell Time: (Sec)	Antenna Type: B,C,L,CDN	Results: (Include any Failure Modes Observed in the EUT), Video Camera System Used: (Yes) (No)
30	1%	10	7	B	Start Horizontal 30-500MHz
500	"	"	"	"	Completed Horizontal
					*changed ANTENNA AXIX to Vert
30	1%	10	7	B	Start Vertical 30-500M
* 157.53	"	"	"	"	Valve stopped open; no end position LED
					on; reboot system
150	1%	10	7	B	restart Vertical
155.75	"	"	"	"	failure repeatable; valve open; No
					end position LED on; reboot system
150	1%	10	7	B	restart Vertical 160-500
500	"	"	"	"	Completed Vertical 30-500
					*changed Amplifier
500	1%	10	7	B	Start Vertical 500-1000M
1000	"	"	"	"	Vertical Completed
					*changed ANTENNA AXIS
500	1%	10	7	B	Start Horizontal 500-1000M
1000	"	"	"	"	Horizontal Completed
					*changed Amplifier
1000	1%	10	7	B	Start Horizontal 1G-1.4G
1400	"	"	"	"	Completed Horizontal
					*changed ANTENNA AXIS

Notes:

Midwest EMI Associates Radiated Susceptibility Worksheet

Form: MID-RAD 2-25-2007

Date: 9-30-09	Report:	Test Engineer: AW
Item Tested:	Model: FP0406	S/N:
Project: TFT	Group:	Power: 12 V (AC) (DC), Hz
Test Performed: (Radiated) (Conducted) (Magnetic) (CS114)	Probes: (CS114) (Fischer CDN) (CLAMP) (A/R FP2031, AR FP 2036. AR FP1000) (Other:)	Modulation: (2) (10) (100) (1000) Hz, Sine Wave (Cell Phone Test, 200 Hz 100% AM Square Wave) Modulation Depth: (50%) (80%) (%)
Signal Gen.: (HP8756A) (Wavetek 2520A)	Orientation: (Pole Stand) (Other:) (Wooden Table) (Copper Table) (Floor)	Room Position: (Screenroom) (2 Mtr Site) (5 Mtr Site) (Outdoors) Flr Pos: (A) (B) (C)

Antennas: B=Biconical EMCO 3109, C=Conical EMCO 3101, E=EMCO3107B, L=EMCO 3147, CDN=Fischer FCC-801 CDN, or Solar 9108-1N & 91421-1N

Frequency (M=MHz) (K=KHz)	Increment Frequency (KHz)	Immunity Level: (V) (V/M)	Dwell Time: (Sec)	Antenna Type: B,C,L,CDN	Results: (Include any Failure Modes Observed in the EUT), Video Camera System Used: (Yes) (No)
1000	1%	10	7	B	Start Vertical 1G-1.4G
1400	"	"	"	"	Completed Vertical
1400	1%	~~4~~ 4.5	7	B	Start Vertical 1.4G-2.0G
2000	"	"	"	"	Completed Vertical
					*changed antenna axis H
1400	1%	4.5	7	B	Start Horizontal 1.4G-2.0G
2000	"	"	"	"	Completed Horizontal
					*changed to Horn antenna + doubler
2000	1%	1.5	7	Horn	Start Vertical 2.0G-2.7G
2700	"	"	"	"	Completed Vertical
					*changed antenna axis
2000	1%	1.5	7	Horn	Start Horizontal 2.0G-2.7G
2700	"	"	"	"	Completed Horizontal

Notes:

Midwest EMI Associates Radiated Susceptibility Worksheet

Form: MID-RAD 2-25-2007

Date: 10-1-09	Report:	Test Engineer: DW
Item Tested:		Model: FP0406 S/N:
Project: TFT	Group:	Power: 12 V (AC) (DC) Hz
Test Performed: (Radiated) (Conducted) (Magnetic) (CS114)	Probes: (CS114) (Fischer CDN) (CLAMP) (A/R FP2031, AR FP 2036. AR FP1000) (Other:)	Modulation: (2) (10) (100) (1000) Hz, Sine Wave (Cell Phone Test, 200 Hz 100% AM Square Wave) Modulation Depth: (50%) (80%) (%)
Signal Gen.: (HP8756A) (Wavetek 2520A)	Orientation: (Pole Stand) (Other:) (Wooden Table) (Copper Table) (Floor)	Room Position: (Screenroom) (2 Mtr Site) (5 Mtr Site) (Outdoors) Flr Pos: (A) (B) (C)

Antennas: B=Biconical EMCO 3109, C=Conical EMCO 3101, E=EMCO3107B, L=EMCO 3147, CDN=Fischer FCC-801 CDN, or Solar 9108-1N & 91421-1N

Frequency (M=MHz) (K=KHz)	Increment Frequency (KHz)	Immunity Level: (V) (V/M)	Dwell Time: (Sec)	Antenna Type: B,C,L,CDN	Results: (Include any Failure Modes Observed in the EUT), Video Camera System Used: (Yes) (No)
145	1%	10	8	B	Start Vertical 145-165M
					(revisit 155M failure on 9/30)
155.43	"	"	"	"	Valve stuck open; No stop LED
					lit; same condition as on 9/30
		Deflector off 10/1 - re-run test		*	changed ISO probe positions (picture)
					between #2 and #3; re-run test
145	1%	10	8	B	Start Vertical 145-165M
165	"	"	"	"	Completed Vertical
					*re-run "deflector off" error
145	1%	10	8	B	Start Vertical 145-165M (original setup)
165	"	"	"	"	Completed Vertical - PASS
					*added "CAN" cover; re-run (pic)
145	1%	10	8	B	Start Vertical
165	"	"	"	"	Completed Vertical - PASS
					*removed cover; re-run @ 13 V/M
145	1%	13	8	B	Start Vertical 145-165M
156.41	"	"	"	"	Valve stuck open; No stop LED lit
					10 V/M right @ threshold for 155MHz?
					*replaced CAN cover on motor; re-run 13
145	1%	13	8	B	Start Vertical 145-165M
165	"	"	"	"	Completed Vertical - PASS

Notes:

Retest PASSES 10 V/M; fails 13 V/M under same condition (cover off on Motor/Valve). Possible threshold tolerance issue?

APPENDIX E

ELECTRICAL SURGE IMMUNITY TEST

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

1.0 PURPOSE:

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

2.0 DESCRIPTION OF TEST APPARATUS:

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

3.0 TEST PROCEDURES:

3.1 POWER LEADS:

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

3.2 POLARITY and TEST LEVELS:

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

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

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

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

3.3 EFT GENERATOR CHARACTERISTICS:

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

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

3.4 COUPLING DECOUPLING NETWORK CHARACTERISTICS:

Coupling Capacitors: 18 uF

3.5 QUALITY:

Meets the design and manufacturing requirements of ISO 9001

3.6 GROUND REFERENCE PLANE:

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

3.7 REFERENCE DOCUMENT:

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

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

3.8 ACCEPTABILITY CRITERION:

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

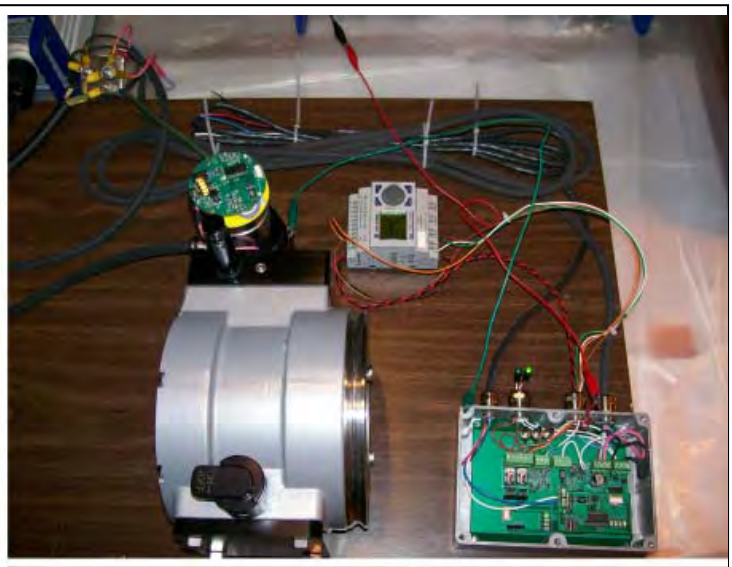
An unacceptable operating response to the stimulus was:

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

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

4.0 SURGE IMMUNITY TEST RESULTS:

The TFT EP0406 was tested on its DC leads in line to line mode at a 500 volt application in positive and negative polarities. The EUT experienced no anomalies with this application and passed the test.



Haefely Trench AG EMC Test Systems Basel/Switzerland

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

System: PSURGE 4010
Test: P5KL1NPS
Start-Date: 01.10.2009 Start-Time: 11:21

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

Coup. Path	Imp. No.	U nominal	Syncro Angle	U-peak	I-peak	Info.
L1-N	1	+0.50kV	-----	+0.16kV	+175A	
L1-N	2	+0.50kV	-----	+0.16kV	+175A	
L1-N	3	+0.50kV	-----	+0.16kV	+175A	
L1-N	4	+0.50kV	-----	+0.16kV	+175A	
L1-N	5	+0.50kV	-----	+0.16kV	+175A	
L1-N	6	+0.50kV	-----	+0.16kV	+175A	
L1-N	7	+0.50kV	-----	+0.16kV	+175A	
L1-N	8	+0.50kV	-----	+0.17kV	+176A	
L1-N	9	+0.50kV	-----	+0.16kV	+175A	
L1-N	10	+0.50kV	-----	+0.16kV	+175A	
L1-N	11	+0.50kV	-----	+0.16kV	+175A	
L1-N	12	+0.50kV	-----	+0.16kV	+175A	
L1-N	13	+0.50kV	-----	+0.16kV	+175A	
L1-N	14	+0.50kV	-----	+0.16kV	+175A	
L1-N	15	+0.50kV	-----	+0.16kV	+175A	
L1-N	16	+0.50kV	-----	+0.16kV	+175A	
L1-N	17	+0.50kV	-----	+0.16kV	+175A	
L1-N	18	+0.50kV	-----	+0.16kV	+175A	
L1-N	19	+0.50kV	-----	+0.16kV	+175A	
L1-N	20	+0.50kV	-----	+0.16kV	+175A	
L1-N	21	+0.50kV	-----	+0.16kV	+175A	
L1-N	22	+0.50kV	-----	+0.16kV	+175A	
L1-N	23	+0.50kV	-----	+0.16kV	+175A	
L1-N	24	+0.50kV	-----	+0.16kV	+175A	
L1-N	25	+0.50kV	-----	+0.16kV	+175A	
L1-N	26	+0.50kV	-----	+0.16kV	+175A	
L1-N	27	+0.50kV	-----	+0.16kV	+175A	
L1-N	28	+0.50kV	-----	+0.16kV	+175A	
L1-N	29	+0.50kV	-----	+0.16kV	+175A	
L1-N	30	+0.50kV	-----	+0.16kV	+175A	
L1-N	31	+0.50kV	-----	+0.16kV	+175A	
L1-N	32	+0.50kV	-----	+0.16kV	+175A	
L1-N	33	+0.50kV	-----	+0.16kV	+175A	
L1-N	34	+0.50kV	-----	+0.16kV	+175A	
L1-N	35	+0.50kV	-----	+0.16kV	+175A	
L1-N	36	+0.50kV	-----	+0.16kV	+175A	
L1-N	37	+0.50kV	-----	+0.16kV	+175A	
L1-N	38	+0.50kV	-----	+0.16kV	+175A	
L1-N	39	+0.50kV	-----	+0.16kV	+175A	
L1-N	40	+0.50kV	-----	+0.17kV	+175A	

>>> Test passed. <<<

Test: P5KL1NPS
Stop-Date: 01.10.2009 Stop-Time: 11:28

Haefely Trench AG EMC Test Systems Basel/Switzerland

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

System: PSURGE 4010

Test: P5KL1NNE

Start-Date: 01.10.2009 Start-Time: 11:42

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

Coup. Path	Imp. No.	U nominal	Syncro Angle	U-peak	I-peak	Info.
L1-N	1	-0.50kV	-----	-0.14kV	-216A	
L1-N	2	-0.50kV	-----	-0.14kV	-216A	
L1-N	3	-0.50kV	-----	-0.14kV	-216A	
L1-N	4	-0.50kV	-----	-0.14kV	-216A	
L1-N	5	-0.50kV	-----	-0.14kV	-216A	
L1-N	6	-0.50kV	-----	-0.14kV	-216A	
L1-N	7	-0.50kV	-----	-0.14kV	-216A	
L1-N	8	-0.50kV	-----	-0.14kV	-216A	
L1-N	9	-0.50kV	-----	-0.14kV	-216A	
L1-N	10	-0.50kV	-----	-0.14kV	-216A	
L1-N	11	-0.50kV	-----	-0.14kV	-216A	
L1-N	12	-0.50kV	-----	-0.14kV	-216A	
L1-N	13	-0.50kV	-----	-0.14kV	-216A	
L1-N	14	-0.50kV	-----	-0.14kV	-216A	
L1-N	15	-0.50kV	-----	-0.14kV	-216A	
L1-N	16	-0.50kV	-----	-0.14kV	-216A	
L1-N	17	-0.50kV	-----	-0.14kV	-216A	
L1-N	18	-0.50kV	-----	-0.14kV	-216A	
L1-N	19	-0.50kV	-----	-0.14kV	-216A	
L1-N	20	-0.50kV	-----	-0.14kV	-216A	
L1-N	21	-0.50kV	-----	-0.14kV	-216A	
L1-N	22	-0.50kV	-----	-0.14kV	-216A	
L1-N	23	-0.50kV	-----	-0.14kV	-216A	
L1-N	24	-0.50kV	-----	-0.14kV	-216A	
L1-N	25	-0.50kV	-----	-0.14kV	-216A	
L1-N	26	-0.50kV	-----	-0.14kV	-216A	
L1-N	27	-0.50kV	-----	-0.14kV	-216A	
L1-N	28	-0.50kV	-----	-0.14kV	-216A	
L1-N	29	-0.50kV	-----	-0.14kV	-217A	
L1-N	30	-0.50kV	-----	-0.14kV	-215A	
L1-N	31	-0.50kV	-----	-0.14kV	-216A	
L1-N	32	-0.50kV	-----	-0.14kV	-216A	
L1-N	33	-0.50kV	-----	-0.14kV	-216A	
L1-N	34	-0.50kV	-----	-0.14kV	-216A	
L1-N	35	-0.50kV	-----	-0.14kV	-216A	
L1-N	36	-0.50kV	-----	-0.14kV	-216A	
L1-N	37	-0.50kV	-----	-0.14kV	-216A	
L1-N	38	-0.50kV	-----	-0.14kV	-216A	
L1-N	39	-0.50kV	-----	-0.14kV	-216A	
L1-N	40	-0.50kV	-----	-0.14kV	-216A	

>>> Test passed. <<<

Test: P5KL1NNE

Stop-Date: 01.10.2009 Stop-Time: 11:49

APPENDIX F

CONDUCTED SUSCEPTIBILITY TEST

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

1.0 PURPOSE:

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

2.0 DESCRIPTION OF TEST APPARATUS:

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

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

3.0 TEST PROCEDURES:

3.1 POWER LEADS:

The device tested was plugged into a source of 120VAC, 60Hz through two Line Impedance Stabilization Networks, Solar type 8028-50-TS-24-BNC. The AC cord was made physically as short as possible to permit maximum energy into the E.U.T.

3.2 TEST SETUP:

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

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

3.3 MODULATION:

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

3.4 AMPLIFIERS USED:

The amplifiers used during the test were:

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

3.5 TEST PROCEDURES:

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

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

4.0 LIMITS AND RESULTS OF TEST:

4.1 CONDUCTED LIMITS:

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

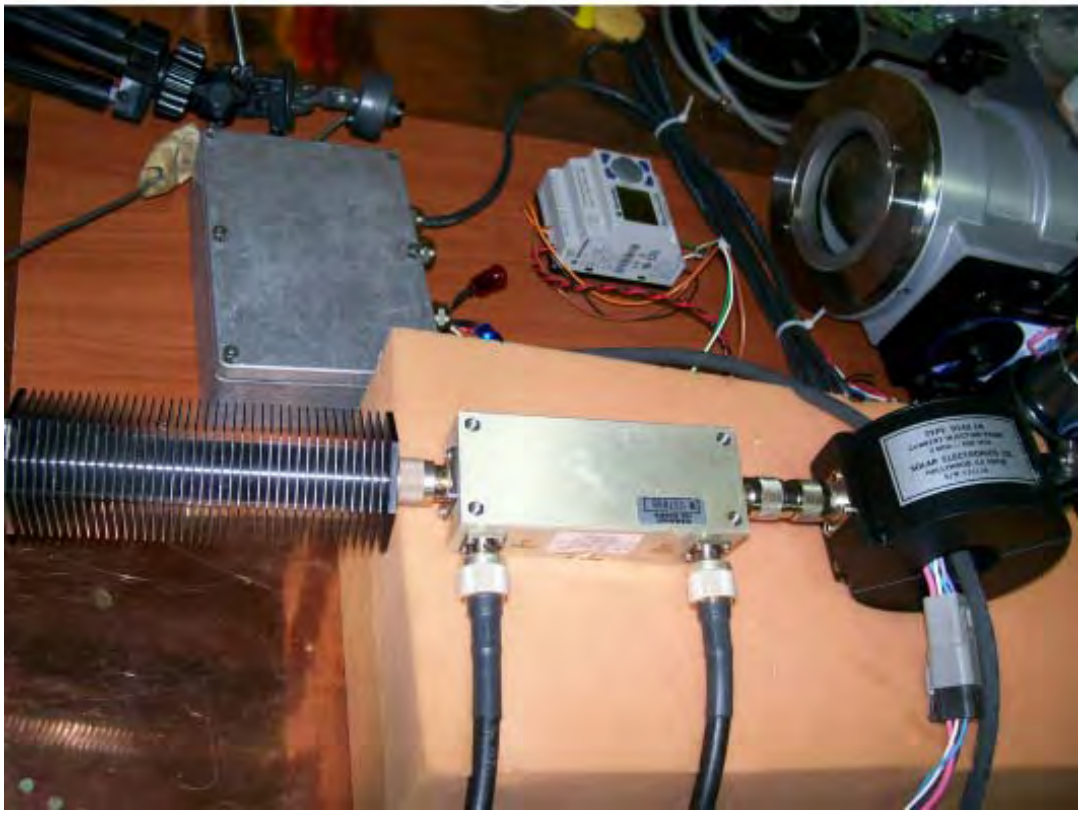
4.2 RESULTS OF TEST

Testing on the TFT EP0406 was performed on the power leads going from the battery to the circuitry using the CDN. When the device was initially tested at the minimum 3 V RMS level it performed normally throughout the entire range of frequencies of .15 to 300 MHz. Since this is the required level and just the .15 to 80 Mhz range needs to be passed the device passed the test.

In a second test a Solar clamp was used on the cable of wires going from the communications cable and wires to the motor (that can be longer that 3 meters). (See sponsor group block diagram) and the test was rerun in the .15 to 300 MHz range. Again no adverse events were noted, the device continued to exercise a normal routine throughout the test.

The device passed the EN 61000-4-6 requirement at 3 and 10V RMS in either case without noticeable failures.


TYPE 9142-1N
CURRENT INJECTION PROBE
2 MHz – 450 MHz
SOLAR ELECTRONICS CO.
HOLLYWOOD, CA 90038
S/N: 974126



Midwest EMI Associates Radiated Immunity Worksheet

Page ___ of ___

Ref: Radiated Immunity Master Sheet.doc

Date: 10-2-09	Report:	Test Engineer: (George Bowman) (Phil Rajca) (Tester:)
Item Tested: FP0406 Mother board	Model: V2	S/N:
Project: TFT	Group:	Power: 12 V (AC) (DC) Hz
Test Performed: (Radiated) (Conducted) (Magnetic) (CS114)	Probes: (CS114) (Fischer CDN) (A/R FP2031) (AR FP 2036) (AR FP1000) (Other: Inj Probe)	Modulation: (2) (10) (100) (1000) Hz, Sine Wave (Cell Phone Test, 200 Hz 100% AM Square Wave) Modulation Depth: (50%) (80%) (%)
Signal Gen.: (HP8756A) (Wavetek 2520A)	Orientation: (Pole Stand) (Other:) (Wooden Table) (Copper Table) (Floor)	Place of Test: (Screenroom) (2 Mtr Site) (5 Mtr Site) (Outdoors) Floor Position: (A) (B) (C)

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

Frequency (M=MHz) (K=KHz)	Increment Frequency (KHz)	Immunity Level: (V) (V/M)	Dwell Time: (Sec)	Antenna Type: B,C,L	Results: (Include any Failure Modes Observed in the EUT), Video Camera System Used: (Yes) (No)
.1M	Per Pgm	3	Per Pgm	CLAMP	Going up, ADK, Running normally
2.5M					Switch Amps/Loaders ADK
15.5					No issues, ADK
31M					" " " POWER
80M					" " " LINES
139M					" " "
300M	↓	↓	↓	↓	" " "
.1M	Per Pgm	10	Per Pgm	CLAMP	Going up, ADK, Running normally
2.5M	Per Pgm		Per Pgm	CLAMP	Switch Amps, " "
27M					ADK, No Issues
80M					↓ POWER
157M					LINES
300M	↓	↓	↓	↓	↓
.1M	Per Pgm	3	Per Pgm	CLAMP	Going up, ADK, Running Normally
2-5	"	"			Switch Amps, ADK CONTROL
300M	"	"	↓	↓	ADK LINES
.1M	Per Pgm	10	Per Pgm	CLAMP	Going up, ADK
2-5	"	"	"		Switch Amps CONTROL
150M	"	"	"		ADK LINES
300M	"	"	"	↓	ADK

Notes:

Unit cycled normally in all tests

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 BIV/VUM VALVE CONTROLLER (EP0406)** was powered by 12V DC battery.

3.2 TEST SETUP:

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

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

3.3 TEST METHOD: Qualification Test (Single Shot Only)

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

4.0 RESULTS OF TEST (10-01-09) and (10-02-2009)

The ESD test was conducted on 10 surfaces in areas showing cracks in the package, switches, connectors or screws. The EUT was only subjected to ESD intensity levels of 2, 4 and 6 KV in contact discharge. 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:
None
The device performed flawlessly during testing.

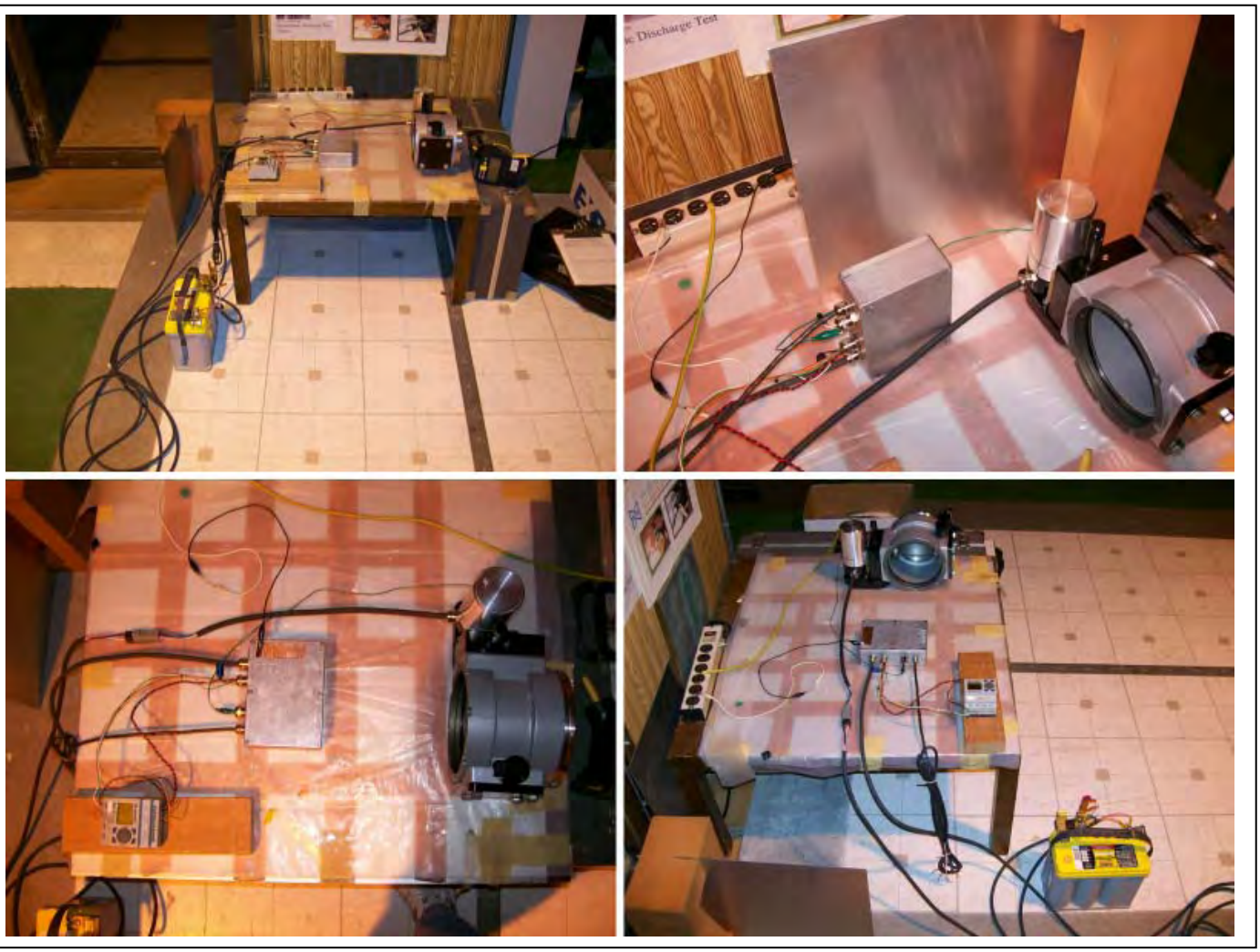
The device was given an "A" acceptance rating.

ESD TEST LOCATIONS

TFT BIV/VUM VALVE CONTROLLER (EP0406)

TEST POINT	Description
1	VCP
2	HCP
3	Valve Cable Fitting
4	Motor Housing (Valve)
5	Plastic Strip Groove (Valve)
6	Interface Case
7	CAN Bus Fitting
8	Power / Comm Fitting
9	Mounting Interface Holes
10	Case Seam (Interface)
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	
21	
22	
23	
24	
25	
26	

Note: Photograph of locations are attached



Data Sheet 1 of 3	**ESD DATA SHEET** Schaffner NSG 435 Gun	**Midwest EMI Associates Mundelein, Illinois**	Form: Issued 10/22/08 **MEMI-1A**

Sponsor Group: TFT **Model Number:** FP0406, running 18s open/close routine
Manager: Tim Miller **Temp:** 66.5F **Hum:** 55.0 **Technician:** DW **v.S/W:** test code
Date of Test: 10-01-09 **Time:** 6:00 PM **EUT:** Prototype / Production Unit
Placement of EUT: ESD Table ✔ Pole Mount ____ Wood Table ____ FLOOR ____
Grounding: Pole ____ Terminal Strip ____ FLOOR ____ 1 Meg to Metal Frame of EUT. ✔
Configuration: EUT power 12VDC battery. Copper tape w/1M res to ground on interface housing.
Note: Instrument tested with 10 discharges (min) per level/polarity, Single Shot Mode as listed below (unless otherwise stated).

Reference: EN 61000-4-2		TEST POINT: VCP PLUS POLARITY		MINUS POLARITY		TEST POINT: HCP 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)	✓	(✔) (NA)	✓
7	7								
8	8	(✔) (NA)	NT	(✔) (NA)	NT	(✔) (NA)	NT	(✔) (NA)	NT
9	9								
10	10								

Reference: EN 61000-4-2		TEST POINT: Valve Cable fitting PLUS POLARITY		MINUS POLARITY		TEST POINT: Motor Housing (Valve) 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)	✓	(✔) (NA)	✓
7	7								
8	8	(✔) (NA)	NT	(✔) (NA)	NT	(✔) (NA)	NT	(✔) (NA)	NT
9	9								
10	10								

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

Notes: ____ No Errors This Page X Note: PASS

Data Sheet 2 of 3	**ESD DATA SHEET** Schaffner NSG 435 Gun	**Midwest EMI Associates Mundelein, Illinois**	Form: Issued 10/22/08 **MEMI-1A**

Sponsor Group: TFT **Model Number:** FP0406, running 18s open/close routine
Manager: Tim Miller **Temp:** 66.5F **Hum:** 55.0 **Technician:** DW **v.S/W:** test code
Date of Test: 10-01-09 **Time:** 6:00 PM **EUT:** Prototype / Production Unit
Placement of EUT: ESD Table _✔_ **Pole Mount** _____ **Wood Table** ___ **FLOOR** ___
Grounding: Pole___ **Terminal Strip** ___ **FLOOR**___ **1 Meg to Metal Frame of EUT.** _✔_
Configuration: EUT power 12VDC battery. Copper tape w/1M res to ground on interface housing.
Note: Instrument tested with 10 discharges (min) per level/polarity, Single Shot Mode as listed below (unless otherwise stated).

Reference: EN 61000-4-2		**TEST POINT:** (VALVE) Plastic Strip Groove				**TEST POINT:** Interface Case			
		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)	✓	✔ (NA)	✓
7	7								
8	8	✔ (NA)	NT	✔ (NA)	NT	✔ (NA)	NT	✔ (NA)	NT
9	9								
10	10								

Reference: EN 61000-4-2		**TEST POINT:** CAN Fitting				**TEST POINT:** Power/Comm Fitting			
		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)	✓	✔ (NA)	✓
7	7								
8	8	✔ (NA)	NT	✔ (NA)	NT	✔ (NA)	NT	✔ (NA)	NT
9	9								
10	10								

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

Notes:_____ No Errors This Page X Note: PASS

Data Sheet 3 of 3	**ESD DATA SHEET** Schaffner NSG 435 Gun	**Midwest EMI Associates Mundelein, Illinois**	Form: Issued 10/22/08 **MEMI-1A**

Sponsor Group: TFT **Model Number: FP0406, running 18s open/close routine**
Manager: Tim Miller **Temp: 66.5F** **Hum: 55.0** **Technician: DW** **v.S/W: test code**
Date of Test: 10-01-09 **Time: 6:00 PM** **EUT: Prototype / Production Unit**
Placement of EUT: ESD Table ✔ **Pole Mount** **Wood Table** **FLOOR**
Grounding: Pole **Terminal Strip** **FLOOR** **1 Meg to Metal Frame of EUT. ✔**
Configuration: EUT power 12VDC battery. Copper tape w/1M res to ground on interface housing.
Note: Instrument tested with 10 discharges (min) per level/polarity, Single Shot Mode as listed below (unless otherwise stated).

Reference: EN 61000-4-2		TEST POINT: Mounting Holes (Interface)				TEST POINT: Case Seam (Interface)			
		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)	✓	✔ (NA)	✓
7	7								
8	8	✔ (NA)	NT	✔ (NA)	NT	✔ (NA)	NT	✔ (NA)	NT
9	9								
10	10								

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

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

Notes: No Errors This Page X Note: PASS

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

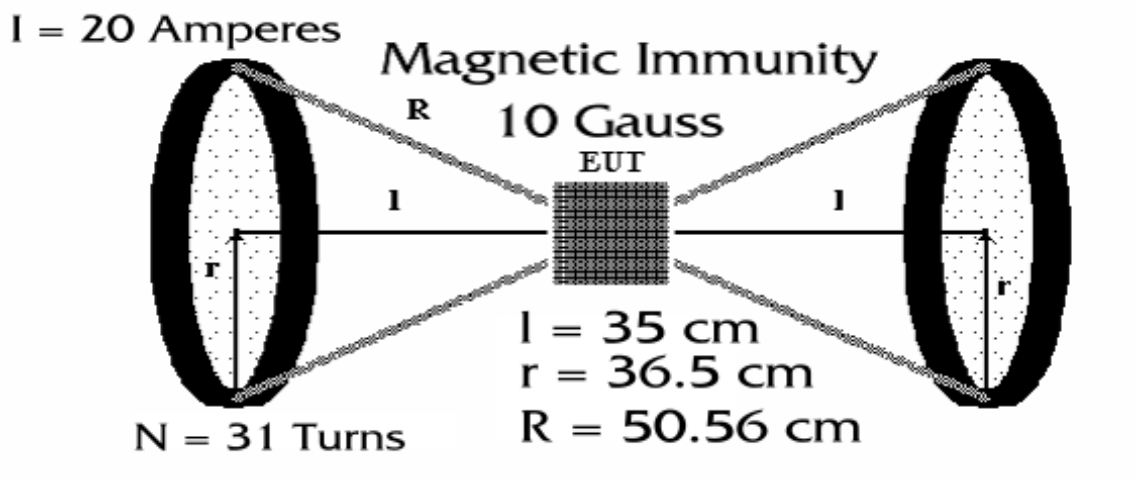
The fabricated antennas for the 50/60 Hz test consist of two bundled coils of average diameter of 73 cm. with 31 turns of #12 AWG insulated, CSA approved standard copper wire. The bundled coil dimension is a 1.5" diameter. The coils are arranged on an axis so that they are parallel to each other and 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 x 10^8 V/m=240 dBpT= 8 x10^5 A/M
μ_o = .4π x 10^{-7} T m/A, 10 Gauss = 800 A/M



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

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

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

B (Tesla) = .5 μ_o * I * $\frac{r^2}{R^3}$ * N , $\mu_o = 4\pi$ x 10^{-7} T x m/A
I = 20 Amps RMS, 60 Hz

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 RESULTS

The TFT BIV_VUM Valve Controller EP0406 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 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 TFT BIV_VUM EP0406 Controller passed the IEC 61000-4-8 recommendation.